



भारत सरकार Government of India
रेल मंत्रालय Ministry of Railways
(रेलवे बोर्ड Railway Board)



International Year
of Cooperatives
2025
Cooperatives Build
a Better World

No. 2022/CE-I/IRWM/1

New Delhi, Dated 28. 11.2025

To,
As per list attached

Sub:- Indian Railway works Manual (IRWM)-2025

Railway Board constituted a committee vide Railway Board's letter No. ERB-I/2022/23/49 dated 07.07.2022 to review the existing provisions of Indian Railway Works Manual-2000.

2. The revision work was undertaken by a One-man Expert Committee constituted vide Railway Board's letter No. ERB-I/2024/23/16 dated 15.03.2024, with assistance from officers of IRICEN, RDSO, and Zonal Railways. The revised draft Manual prepared by the Committee was submitted to the Railway Board and subsequently circulated to all Zonal Railways, RDSO, and concerned Directorates of the Railway Board for comments. After due examination of the feedback and suggestions received from various Units, the final updated and revised edition was prepared. The present edition incorporates additions, deletions, and modifications to clauses pertaining to building planning and design, passenger amenities, stations and yards, water supply, and related matters.
3. The CRB & CEO as MI has approved the Indian Railway works Manual (IRWM)-2025 duly incorporating all the amendments issued earlier and the same is available on the Indian Railways website www.indianrailways.gov.in >> "About Indian Railways" >> "Railway Board Directorates" >> "Civil Engineering" >> "IR Works Manual".

DA: As above.

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAYS WORKS MANUAL

Nov'2025

FOREWORD

The procedures and practices in relation to the buildings and structures on Indian Railways were laid down in the Indian Railways Way and Works Manual of 1967, which was to be revised into three different Manuals viz. P. Way., Bridges and Works. While the P. Way and Bridge Manuals in their revised form were published from time to time, Works Manual was last published in 2000. With the modifications in the functioning related to works as well as due to introduction of new types of structures, some radical changes were inescapable. The recent shift in emphasis on customer care, passenger amenities, commercial exploitation of railway land and afforestation in the railway premises required provisions in the Works Manual. Also, new methodologies now available have been included in the Manual for the benefit of the civil engineers responsible for the construction and maintenance of railway assets.

The "Indian Railways Works Manual" provides comprehensive guidelines for the execution and maintenance of various railway infrastructure works. It covers a wide range of topics including building construction, water supply, drainage, sewerage, and landscaping. The manual ensures standardization and uniformity in practices across the Indian Railways network. The manual outlines the duties of various engineering staff in relation to different types of works. The manual provides detailed technical specifications and standards for various aspects of railway works, ensuring quality and safety.

It is hoped that procedures and practices laid down in the completely updated and revised form of Indian Railways Works Manual 2025 (IRWM 2025) will be of help to civil engineers in not only maintaining various buildings and structures with better standards, economy and safety but also in generating much needed revenue for Railways.

**New Delhi,
28-11-2025**

(Satish Kumar)
CRB cum Member Infrastructure
Railway Board

PREFACE

The Indian Railways Way & Works Manual was last published in 1967. On the recommendation of the Track Standards Committee vide Item No.678 of the 49th Report, it was decided to split the Manual into three separate parts, viz. Permanent Way, Bridges and Works. The Permanent Way Manual and the Bridge Manual in their revised form were published from time to time. Indian Railways Works Manual was last published in 2000. With the completely updated and revised form of Indian Railways Works Manual 2025 (IRWM 2025) now being published, a long standing need has been fulfilled.

The work of revision was first undertaken by a Committee constituted vide Railway Board's letter No. ERB-I/2022/23/49 dated 07.07.22, consisting of SAG officers of two Zonal Railways, IRICEN, RDSO and Dean, IRICEN.

Further, the work of revision was undertaken by a One-man expert Committee of Shri Roop Narayan Sunkar, Ex Member Infrastructure, Railway Board, constituted vide Railway Board's letter No.ERB-I/2024/23/16 dated 15.03.24, along with assistance of four officers from IRICEN, RDSO and Zonal Railways. The revised draft Manual prepared by the One-man expert Committee was submitted to the Railway Board and was circulated to all the Zonal Railways, RDSO, Concerned Directorates of Railway Board for their comments. After due consideration of the comments and suggestions received from various Units, the finally completely updated and revised edition in the present form was prepared. This includes addition/deletion/modification of various clause related to building planning and design, passenger amenities, stations and yards, water supply etc.

While revising this Manual, provisions of other Codes and Manuals of Indian Railways have been taken into account. As far as possible, provisions contained in existing Codes have not been reproduced or repeated to avoid duplication leading to differing versions. Due consideration has also been given to codes and standards published by Bureau of Indian Standards (BIS) and National Building Organization (NBO).

All efforts have been made to make the instructions comprehensive. However, the Principal Chief Engineers of Zonal Railways may supplement or elaborate the practices and procedures contained herein wherever necessary to suit local conditions on their Railways. Such instructions or orders should not contravene the extant provisions of national Codes, Rules and guidelines as applicable to Indian Railways.

Although, due care has been taken in bringing out IRWM - 2025, still there is a possibility that some errors are left inadvertently. Errors & omission may be brought to the notice of Railway Board.

Suggestions from everyone who are using this IRWM - 2025 are welcome as these have scope of further improvement.

(Ajit Kumar Jha)

Executive Director Civil Engineering (G)

Railway Board

Disclaimer

This manual is intended to serve as a general guide and reference. In case of any discrepancies between the provisions of this manual and the instructions issued by the Railway Board, the latter shall prevail. Users are advised to refer to the latest Railway Board circulars, guidelines, and amendments from time to time. Compliance with official Railway Board instructions is mandatory.

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CHAPTER 1

DUTIES OF ENGINEERING OFFICIALS

Divisional Engineer/ Sr. Divisional Engineer/ Deputy Chief Engineer who are dealing with civil Engineering assets (buildings, structures i.e. related to works) shall be generally responsible for inspection, maintenance and construction of various assets under their control.

Any specific matter related to maintenance and construction referred by Assistant Divisional Engineer or his subordinate to them shall also be scrutinized and appropriate action shall be taken by them.

A - DUTIES OF ASSISTANT DIVISIONAL ENGINEER

101 General –

The Assistant Divisional Engineer is overall responsible for the maintenance, execution, accuracy, quality and progress of all works in his charge and control over all expenditure in relation to budget allotments.

102 Essential Duties of Assistant Divisional Engineer –

The duties of the Assistant Divisional Engineer are detailed in various chapters of this Manual for works matters. The essential duties in respect of works are as under:

- 1) Inspection of all structures and their maintenance in satisfactory and safe condition;
- 2) Preparation of plans and estimates;
- 3) Execution and measurement of works;
- 4) Verification of stores held by stock-holders;
- 5) Submission of proposals for inclusion in the works programme and revenue budget.
- 6) Land Management
- 7) Regular updating of Building & Structures Information System (BSIS), Rail Bhumi Crossing Seva (RBCS) and any other portal developed by Railway Board for land and building management.

103 Knowledge of Rules and Regulations –

The Assistant Divisional Engineer shall observe the rules and procedures relating to his duties, as laid down in the General and Subsidiary Rules, various Manuals such as, the Indian Railways Permanent Way Manual and the Indian Railways Works Manual, the Indian Railways Bridge Manual, the Engineering Code and other Departmental Codes and Compendiums of Instructions.

He shall ensure that all staff under him are acquainted with the relevant rules and working methods concerning their duties and that they perform their allotted duties efficiently.

104 Co-ordination with Officials of Other Departments –

The Assistant Divisional Engineer should co-ordinate effectively with officers and staff of other Departments including non-railway department in matters that warrant joint action.

105 Inspection by Higher Officials –

When the Assistant Divisional Engineer has to accompany inspection of superior officers, he should

have with him the under-mentioned drawings and registers for reference as required:

- 1) Yard plans, colony plans showing service and residential buildings;
- 2) Index plans and sections;
- 3) Progress reports on works;
- 4) Working time table;
- 5) Inspection notes of higher officers and their compliance reports;
- 6) A laptop for ready access to online records/portals like BSIS, RBCS, etc. for scrutiny of these records by inspecting officer

106 Inspection by Assistant Divisional Engineer –

- 1) The Assistant Divisional Engineer shall conduct inspection in his jurisdiction as per the schedules laid down by the Administration. He should maintain the records of the results of his inspection and ensure compliance of the instructions. Compliance of his instructions given during his/superior officers' earlier inspection/s should invariably be an important part of his inspection note.
- 2) He shall prepare an annual plan of inspection as per laid down scale and shall submit monthly statement of inspection done.
- 3) The important inspections to be carried out by Assistant Divisional Engineer are summarized below-

a) Inspection of Buildings and Structures

The Assistant Divisional Engineer shall systematically inspect all buildings and structures periodically as prescribed in Para 301, 303 & 310 of this Manual. He shall record brief details of repair works to be carried out and plan to carry out the same.

He should also examine the Petty Repairs Book maintained by Senior Section Engineer (Works) / JE (Works-incharge) at stations and Complaint Register in their offices as prescribed in Para 305 of this Manual. He shall record his comments on the quality of inspections done by Senior Section Engineer (Works) / JE (Works-incharge) and compliance of his own inspection by Senior Section Engineer (Works) / JE (Works-incharge)

b) Inspection of Water Supply

The Assistant Divisional Engineer shall inspect various water supply installations under his control. He shall ensure cleaning of overhead / underground storage tanks and proper disinfection of drinking water supply.

c) Inspection of Sewerage and Drainage System

Assistant Divisional Engineer shall inspect sewerage and drainage systems and ensure their efficient performance in association with the concerned Officer of the Medical Department. He shall also inspect all Rain Water Harvesting structures and ensure their satisfactory functioning/periodic maintenance.

d) Inspection of Railway affecting works/Railway affecting tanks (RAW/RAT):

Assistant Divisional Engineer shall jointly inspect with civil authorities, all RAW/RAT before the monsoon every year and arrange for their safe maintenance to avoid any danger to nearby

tanks and structures. Records of these annual inspections should be kept in registers as prescribed.

- e) Assistant Divisional Engineer shall periodically inspect land and land boundaries in his Jurisdiction as detailed in Paras 813 and 814 of this Manual.
- f) Assistant Divisional Engineer should associate himself with various Committees and Groups such as the Colony Improvement Group and the Station Improvement Group as decided by the Administration and take prompt action for items pertaining to his jurisdiction.
- g) The schedule of inspection for Assistant Divisional Engineer is detailed in **Annexure 1.1**.

107 Execution and Monitoring of Works –

- 1) The Assistant Divisional Engineer should ensure works in close proximity to running lines and important works are carried out according to approved plans and specifications laid down, and duly taking all precautions for safety of running track.
- 2) Every work should be organized and so programmed that it progresses well and is completed in time. Periodical progress reports on works should be submitted to the Divisional Engineer/Sr. Divisional Engineer/Executive Engineer/Deputy Chief Engineer in IRPSM to enable proper reporting and monitoring at different levels.
- 3) Copies of all contract agreements for works should be maintained properly in the Assistant Divisional Engineer's office. Before passing measurements recorded by Sr. Section Engineer (Works) / JE (Works) in-charge, he should carry out test check as specified.
- 4) The Assistance Divisional Engineer shall ensure maintenance of registers as prescribed at work sites.

108 Control Over Expenditure –

The Assistant Divisional Engineer shall exercise due care in forwarding requisitions for materials and tools to Divisional office for the execution of new works and maintenance of works, ensuring in all cases that the expenditure is within the budget allotment and provided for in the sanctioned estimate. Where the expenditure/projected requirements indicate that the estimate is likely to be exceeded, he shall initiate timely action for revision of estimate so that the progress of works does not suffer on this account.

109 Water Supply –

Adequate water supply at each coach watering points, stations, platforms, staff colonies and service buildings should be ensured. In advance of the hot weather as well as during hot weather, when shortage of water is experienced in certain areas, the position at sources of supply should be carefully watched and timely action shall be taken.

110 Land Management –

The Assistant Divisional Engineer should take necessary action for management of land and shall prevent encroachments and protect the land from unauthorized use.

111 Training –

The Assistant Divisional Engineer should interest himself in training all probationers/ trainee officials

sent to him for training and see that the training is given according to the specified programme. He should periodically examine the notes made by them.

112 Inspection of Offices and Stores of SSE (Works)/JE (Works) –

The Assistant Divisional Engineer shall carry out inspection of each Sr. Section Engineer/Jr Engineer (Works) in charge' office and stores at least once a year. Surplus/inactive items should be identified during such inspections and action for their disposal/redistribution taken.

When checking Stores, he should pay particular attention to the Imprest stores and its distribution, engineering indicators, protection equipment and other important items of Stores.

113 Staff Matters –

The Assistant Divisional Engineer will ensure that:

- 1) Strict discipline is maintained within the framework of the rules;
- 2) Appeals and representations are dealt with promptly;
- 3) Selection of various posts like artisans are held in time and the vacant posts promptly filled up;
- 4) All the subordinates and other staff working under him receive proper training in constructions and maintenance practices, safety and protection rules at the appropriate stage.

114 Relinquishment of Charge –

Instructions regarding "Transfer-of-charge" contained in the Indian Railways Code for Engg. Dept. (1982 as amended from time to time) should be followed. The Assistant Divisional Engineer's handing over and taking over charge should carry out joint inspection of works as necessary.

Note: Where Senior Scale Officers are the lowest executive officers, their duties shall be the same as prescribed for the Assistant Divisional Engineers in this Chapter.

B - DUTIES OF SENIOR SECTION ENGINEER/JUNIOR ENGINEER (WORKS) (IN OVERALL CHARGE)

115 Duties –

While Indian Railways Permanent Way Manual and Indian Railways Bridge Manual deal with the duties and responsibilities of SSE (Works) / JE (Works) with respect to permanent Way and Bridge/Tunnel respectively, the following paras deal with their duties and responsibilities with regard to Works. The most essential being:

- 1) Inspection and maintenance of:
 - Service buildings, staff quarters and other structures
 - Approach roads
 - Water supply, drainage and sewerage systems
- 2) Execution of all new buildings/structural works
- 3) Accountal and periodical verification of stores and tools in his charge
- 4) Inspection and Maintenance of land boundaries, as specified
- 5) Removal of encroachments at his headquarters and at other places in his Jurisdiction as

specified;

- 6) Afforestation and other horticulture works.
- 7) He shall ensure proper training of the staff under him as prescribed in the training modules of the Civil Engineering Department.
- 8) Associate himself with various Committees and Groups such as the Colony Improvement Group and the Station Improvement Group as decided by the Administration and take prompt action for items pertaining to his jurisdiction.
- 9) Regular updating of Building & Structures Information System (BSIS), Rail Bhumi Crossing Seva (RBCS) and any other portal developed by Railway Board for land and building management.

116 Knowledge of Rules and Regulations –

- 1) He should be in possession of books, codes, manuals and compendium as prescribed in **Annexure 12.1.**
- 2) He shall be well acquainted with the rules, regulations and procedures contained in these books concerning his work.
- 3) He shall ensure that all staff under him are well acquainted with the relevant rules and working methods and efficiently perform their duties.

117 Co-ordination with Permanent Way, Bridge and other staff –

Senior Section Engineer (Works)/ Junior Engineer (Works) should co-ordinate effectively with the permanent way, bridge, signaling, electrical, medical, mechanical etc. where they are required to work jointly.

118 Inspections –

The important inspections to be carried out by Senior Section Engineer (Works) /Junior Engineer (Works) are summarized below:

- 1) The Senior Section Engineer (Works) / Junior Engineer (Works) shall systematically inspect all buildings and structures in his charge and record brief details of repairs to be carried out, as prescribed in Para 301, 303 & 310 of this Manual.

The Senior Section Engineer (Works) / Junior Engineer (Works) shall maintain petty repair books at all station and complaint register in his office specified in Para 305 of this Manual and shall check them during his inspections and ensure prompt action/repairs. He shall review compliance of instructions given during superior officers' earlier inspection/s.

- 2) **Inspection of water supply arrangements** - Every Senior Section Engineer (Works)/ Junior Engineer (Works) shall have details of total requirement of water, sources of water and their yield, storage capacity and shortfall etc., along with complete water supply plans of yards and staff colonies in his charge and take necessary action.

The Senior Section Engineer (Works)/Junior Engineer (Works) shall also have complete history and data of tube wells under his jurisdiction and ensure testing of yield of tube wells and other sources of water, once every year in co-ordination with Electrical staff at the time when the sub-soil water is at the lowest. According to the seasons i.e. summer or winter etc., water supply

timings and pumping hours should be decided in consultation with the Electrical Department. At wayside stations, monitoring of pumping hours should be entrusted to the Station Master for effective control. He shall carry out periodical review to assess the shortfall and plan for further augmentation. He shall control distribution of water supply at both main and wayside stations.

The Senior Section Engineer (Works) / Junior Engineer (Works) shall ensure cleaning of overhead /underground storage tanks. He shall be responsible for the disinfection of water supply, wherever required.

- 3) **Inspection of Sewerage and Drainage System-** Senior Section Engineer (Works) / Junior Engineer (Works) shall periodically inspect sewerage and drainage system and ensure their efficient performance in association with the concerned Official of the Medical Department. He shall also inspect all Rain Water Harvesting structures and ensure their satisfactory functioning. It should be inspected once in a year before monsoon.
- 4) Senior Section Engineer (Works) / Junior Engineer (Works) shall periodically inspect land and land boundaries in his jurisdiction as detailed in Para 813 and 814 of this Manual and furnish necessary certificates to the Assistant Divisional Engineer.
- 5) The schedule of inspection of Sewerage and Drainage System for Senior Section Engineer (Works) / Junior Engineer (Works) is detailed in **Annexure 1.1**.

119 Musters –

- 1) Each blank muster sheet before issue should be initialed on the top by the Assistant Divisional Engineer. The attendance of artisans, helpers and other staff under him should be checked by the Senior Section Engineer (Works) / Junior Engineer (Works).
- 2) The leave availed of by staff should be recorded in the leave register in the leave account before the musters are dispatched to the Divisional office.

120 Execution of Works –

- 1) The Senior Section Engineer (Works) / Junior Engineer (Works) shall be personally responsible for the accurate setting out and execution of all works under his charge according to approved drawings and specifications.
- 2) He should plan every work, organize labour in an efficient manner and maintain detailed accounts of materials and tools received and issued. He should exercise frequent checks on the quality and quantum of work being done in his charge and submit progress reports periodically as prescribed.
- 3) Additions and alterations to buildings and structures carried out should be carefully noted and quantities shown in the Standard Measurement Register amended as necessary with the approval of the Assistant Divisional Engineer / Divisional Engineer / Sr. Divisional Engineer.

121 Measurement of Works –

Every Senior Section Engineer (Works) / Junior Engineer (Works) shall be responsible for proper measurement of contractual works as per powers delegated to him as per the Indian Rlys. Code for Engg. Dept. (1982 as amended from time to time). He shall maintain movement register of Measurement Books and Standard Measurement Registers for works.

122 Works Affecting Moving Dimensions –

The Senior Section Engineer (Works) / Junior Engineer (Works) shall refer to the Assistant Divisional Engineer for instructions regarding works likely to affect moving dimensions.

123 Imprest of Tools and Materials –

- 1) The Senior Section Engineer (Works) / Junior Engineer (Works) shall examine all tools and plant with the artisans once a month and replace the unserviceable or defective ones or arrange repairs.
- 2) He shall ensure that the materials and tools as per scales specified for maintenance of building, water supply and drainage work etc. are available and are adequately distributed at various points according to requirement. Recoupment of shortages should be effected without delay.

124 Accompanying Important Inspections –

When the Senior Section Engineer (Works) / Junior Engineer (Works) accompanies a periodical or special inspection, he should be in possession of the following, besides the Works Manual, Schedule of Rates and the Standard Specification for Materials and Works etc.

- 1) Plans and details of all important works, recently completed, on hand or contemplated;
- 2) Progress report of works and any other papers & plans those are likely to be required for discussion;
- 3) Tape (15m & 3 m), surveying equipment and other tools required during inspection.
- 4) A laptop for ready access to online records/portals like BSIS, RBMS, etc., for scrutiny of these records by inspecting officer. Railway shall provide laptop for Senior Section Engineer (Works) / Junior Engineer (Works)

125 Journal of Daily Duties –

The Senior Section Engineer (Works) / Junior Engineer (Works) shall enter the works performed daily in the T.A. journal showing therein his movements by train, trolley or road-vehicle and submit the same to the Assistant Divisional Engineer every month.

126 Establishment –

- 1) General conditions of Railway service and rules relating to the conduct and discipline of Railway Servants are contained in the Indian Railway Establishment Codes, and Discipline and Appeal Rules. Senior Section Engineer (Works) / Junior Engineer (Works) should acquaint himself with these and meticulously follow them.
- 2) Medical Examination - The Senior Section Engineer (Works) / Junior Engineer (Works) shall ensure that all staff working under him are sent for medical examination for fitness for service. He should ensure that staff in categories A and B specified in Para 510 of Indian Railway Medical Manual (2000 as amended from time to time) are sent for periodical medical examination.
- 3) Provisions in the Payment of Wages Act, The Employees' Compensation Act and other regulations - The Senior Section Engineer (Works) / Junior Engineer (Works) shall ensure that the rules laid down in the Acts and Regulations, as modified from time to time, are strictly complied with.

127 Correspondence and Records –

The Senior Section Engineer (Works) / Junior Engineer (Works) shall keep his correspondence up to date and see that all office records, registers and stores ledgers are maintained properly and posted regularly.

128 Relinquishment of Charge –

- 1) On relinquishing charge, the Senior Section Engineers (Works) / Junior Engineer (Works) shall prepare, in quadruplicate, the specified "Transfer-of-charge" statement which will briefly contain the following-
 - a) Extent of section;
 - b) Establishment matters (service and leave records);
 - c) Works in progress;
 - d) Water sources that give trouble;
 - e) Certificate of stores check and correctness of stock;
 - f) Details of critical buildings and structures
 - g) List of Measurement Book including Standard Measurement Book
 - h) Land boundary verification register along with details of encroachment
 - i) General notes.
- 2) The statement referred in sub-Para (1) should be signed by both the relieved & relieving Senior Section Engineer (Works) / Junior Engineer (Works) and two copies submitted by the relieving subordinate to the Assistant Divisional Engineer who will forward one copy to the Divisional Engineer/Sr. Divisional Engineer/Executive Engineer for record.
- 3) The relieving Senior Section Engineer (Works)/ Junior Engineer (Works) will examine all books pertaining to rules and orders in vogue and all registers pertaining to the section to see that they are kept up to date and initial them with date.
- 4) The Senior Section Engineer (Works) / Junior Engineer (Works) handing over and taking over charge should together visit over the whole section, inspect each work in progress, check staff, all tools and plant and materials.

Errors and discrepancies, which are noticed, should be recorded in the statement and the Assistant Divisional Engineer's special attention invited to them.

C-DUTIES OF SENIOR SECTION ENGINEER (WORKS) / JUNIOR ENGINEER (WORKS) (NOT IN OVERALL CHARGE)

129 Duties –

While Indian Railways Permanent Way Manual and Indian Railways Bridge Manual deal with the duties and responsibilities of SSE (Works) / JE (Works) with respect to permanent Way and Bridge/Tunnel respectively, the following paras deal with their duties and responsibilities with regard to Works. The most essential is inspection and maintenance of:

- 1) Service buildings, staff quarters and other structures
- 2) Approach roads
- 3) Water supply, drainage and sewerage systems
- 4) Execution of works
- 5) Inspection and Maintenance of land boundaries, as specified
- 6) Inspection and Removal of encroachments at his headquarters and at other places in his jurisdiction as specified;
- 7) Inspection and Maintenance of afforestation and other horticulture works.

He should work in the SSE (Works) /JE (Works) office and assist to in-charge.

130 Knowledge of Rules and Regulations –

- 1) He shall be well acquainted with the rules, regulations and procedures concerning his work.
- 2) He shall ensure that all staff under him are well acquainted with the relevant rules and working methods and efficiently perform their duties.

131 Co-ordination with Permanent Way, Bridge and other staff –

Junior Engineer (Works) should co-ordinate effectively with the permanent way, bridge, Signaling, electrical, medical, mechanical etc. where they are required to work jointly.

132 Inspections –

The important inspections to be carried out by SSE (Works) / JE (Works) are summarized below:

- 1) He shall systematically inspect buildings and structures in his charge and record brief details of repairs to be carried out, as prescribed in this Manual. He shall maintain Petty repair book at all station and complaint register in his office as specified in this Manual and shall check them during his inspections and ensure prompt action/repairs.
- 2) **Inspection of water supply arrangements** – SSE (Works) / JE (Works) shall assist In-charge SSE (Works) / JE (Works) in keeping details of total requirement of water, sources of water and their yield, storage capacity and shortfall etc., along with complete water supply plans of yards and staff colonies in his charge. Also assist SSE (Works) / JE (Works) in-charge in disinfection/treatment of water and periodic joint quality checks with medical staff to ensure safe drinking water.
- 3) **Inspection of Sewerage and Drainage System-** Senior Section Engineer (Works) / Junior Engineer (Works) shall periodically inspect sewerage and drainage system and ensure their efficient performance in association with the concerned Official of the Medical Department. He shall also inspect all Rain Water Harvesting structures and ensure their satisfactory functioning. It should be inspected once in a year before monsoon.
- 4) He shall periodically inspect land and land boundaries in his jurisdiction and furnish necessary certificates to the SSE (Works) / JE (Works) in-charge.
- 5) The schedule of inspection for SSE (Works) / JE (Works) is detailed in per **Annexure 1.1.**

133 Execution of Works –

- 1) SSE (Works) / JE (Works) shall assist in-charge SSE (Works) / JE (Works) for the accurate setting out and execution of all works under his charge according to approved drawings and specifications.
- 2) He should plan every work, organize labour in an efficient manner and maintain detailed accounts of materials and tools received and issued.

134 Measurement of Works –

He shall be responsible for proper measurement of contractual works as per powers delegated to him as per the Indian Rlys. Code for Engg. Dept. (1982 as amended from time to time).

135 Works Affecting Moving Dimensions –

He shall refer to the SSE (Works) / JE (Works) – incharge for instructions regarding works likely to affect moving dimensions.

136 Accompanying Important Inspections –

When he accompanies a periodical or special inspection, he should be in possession of the following, besides the Works Manual, Schedule of Rates and the Standard Specification for Materials and Works etc.

- 1) Plans and details of all important works, recently completed, on hand or contemplated;
- 2) Progress report of works; and any other papers and plans those are likely to be required for discussion;
- 3) Tape (15m & 3 m), and other tools and surveying equipment as required during inspection.

137 Establishment –

General conditions of Railway service and rules relating to the conduct and discipline of Railway Servants are contained in the Indian Railway Establishment Codes, and Discipline and Appeal Rules. SSE (Works) / JE (Works) should acquaint himself with these and meticulously follow them.

138 Journal of Daily Duties –

SSE (Works)/JE (Works) shall keep record of the works performed daily showing therein his movements by train, trolley or road-vehicle and submit the same to the SSE (Works) / JE (Works) in-charge every month.

139 Correspondence and Records –

SSE (Works) / JE (Works) shall keep his correspondence up to date and see that all records, registers and other correspondence are carried out and submitted to SSE (Works) / JE (Works) in-charge.

140 Relinquishment of Charge –

- 1) On relinquishing charge, the Junior Engineer (Works) shall prepare, in 4 copies, the specified "Transfer-of-charge" statement which will briefly contain the following-

- (a) Extent of section;
- (b) Works in progress;
- (c) Water sources that give trouble;
- (d) Details of critical buildings and structures
- (e) General notes.

- 2) The statement referred in sub-Para (1) should be signed by both the relieved & relieving SSE (Works) / JE (Works) and two copies submitted by the relieving subordinate to the SSE (Works) / JE (Works) in-charge who will forward one copy to the Assistant Divisional Engineer for record.

The SSE (Works) / JE (Works) handing over and taking over charge should together visit over the whole section, inspect each work in progress, check staff, all tools and plant and materials. Errors and discrepancies, which are noticed, should be recorded in the statement and the SSE (Works) / JE (Works) special attention invited to them.

Annexure 1.1

Schedule of Inspection of ADEN, SSE (Works) and JE (Works)

SN	Item	Frequency	
		ADEN	SSE/ JE (Works)- In charge
1	Inspection and checking of office and store of SSE (Works) / JE (Works) (Para 112)	Once a year	-----
2	Inspection of Rainwater harvesting systems (Para 118(3))	-----	Once a year
3	Staff quarters & Service Buildings (Para 301(2))	10% every year.	Once in a year by rotation.
4	Inspection of complete Water supply installations. (Para 301(2))	Once in a year.	Once in three months by rotation.
5	Inspection of Sewerage & drainage system. (Para 301(2))	Once in 3 years (1/3 rd every year).	Once in a year by rotation.
6	Inspection of ORH, SRH, Running Room, Crew Booking lobby, Hospital, Officer's Club, Railway Canteen, Railway School, Railway Institute & Community Hall. (Para 301(2))	Once in a year.	Once in a six month by rotation.
7	Buildings of doubtful structural condition - till rehabilitation/ rebuilding (Para 303(1))	Once in a six months	Once in three months
8	Inspection of Petty Repair Books at stations /Complaint Register. (Para 305(1))	ADEN -During his inspection. DEN - During his inspection.	Once in a week where Headquartered Once in a month for other stations by rotation.
9	Colony Inspection Group (Para 306(2)(d))	Once in three months	
10	Inspection of Steel structures such as Workshops, Running sheds, Platform covers (Para 309 (1)(a))	Detailed inspection - Once in 5 year (20% every year). General inspection – Once in a year	Once in a year during prescribed month by rotation.
11	Cast iron, Wrought iron or Pressed Steel Plate water tanks and staging whether of steel sections or rails. (Para 309)	Detailed inspection - Once in 5 year (20% every year). General inspection – Once in a year	Once in year on a programmed basis.
12	Structure with roof trusses (Para 309)	Detailed inspection - Once in 5 year (20% every year). General inspection – Once in a year	Once a year during the prescribed month
13	Other structures in which timber, rail or steel work is	-do-	-do-

	used to support any part of the structure. (Para 309)		
14	Tie rods of arched roofs excluding jack arches (Para 309)	---	-do-
15	Wrought iron or mild steel tanks on sleeper cribs at temporary watering stations/Kilometrages (Para 309)	---	-do-
16	Foot Over Bridge (Para 309)	Once in a year	Once in a year
17	Inspection of roads. (Para 317(1))	At discretion	Once in a year by rotation.
18	Bacteriological & Chemical Test of water (Para 535)(7), 579(1)	-----	Sample to be taken jointly with Medical department as per given periodicity.
19	Physical Tests of Water (Para 535)(7), 579(1)	----	Tests shall be done by SSE/ JE (Works) once in 3 months.
20	Water purification works (Para 579 (3) & (4)) (means water treatment plant of Railways)	ADEN - Once in a year and arrange for joint inspection of SSE (Works) / JE (Works) with Mechanical and Electrical Departments DEN – Once in a Year	Once in three months by SSE (Works) / JE (Works) – in charge. SSE (Works) / JE (Works) - not in charge) as frequently as possible, but not later than 2 months.
21	Survey of surviving trees (Para 720)	--	Once in a year
22	Verifications of land boundaries. (Para 813(3))	Once in 5 year (20% every year)	Once in a year by in charge
23	Inspection of Encroachment (Para 814(5))	Once in a year	Once in three months
24	Religious structures on Railway land for prevention of encroachment. (Para 818(2))	Once in a year.	Once in six months by rotation.
25	Land verification given on license basis. (Para 823(2))	At discretion.	Once in a year by rotation.
26	Waste water treatment plant (STP, ETP, WRP, WTP etc.) (Para 301(2))	Once in a year	Once in 6 month by rotation.
27	Inspection of abandoned structures (Para 301(2))	As referred by SSE (Works)	Once in 6 month by rotation.

NOTE:

- Inspection in rotation means inspection by SSE/JE(Works) in charge & SSE/JE(Works) not in-charges alternately
- Apart from above summary of inspections, any other inspection mentioned in this manual shall be carried out by concerned officials.
- Above list is not exhaustive, Zonal Railways may supplement above inspection schedule as per specific requirement.

CHAPTER 2

PLANNING AND GENERAL INSTRUCTIONS REGARDING COLONY, BUILDINGS AND STRUCTURES

A – BUILDING PLANNING AND DESIGN

201 Siting of Buildings –

- 1) Section 11 of the Indian Railways Act of 1989 and the Government Buildings Act No. IV of 1899 read in conjunction with Sec. 358 of the Cantonments Act No. 41 of 2006 provide for the right to erect buildings on their own land by Railways without having to obtain sanction of the Municipal or Cantonment authorities in whose area the site is situated. In urban areas, the Urban Development Authority must be consulted and rules framed by them followed. Municipal or Local authorities may, however, be consulted, where appropriate, regarding water connections, sewer lines and sewage disposal and similar matters.
- 2) As approved by Union Cabinet – “Railway/RLDA shall consult urban local bodies/ other statutory authorities while approving its plans in terms of the power conferred on them by section 11 of the Railway Act’ 1989, so that the development in Railway land is harmonious with surrounding development, generally following the National Transit Oriented Development (TOD) Policy. No change in land use is required Pan India by Railways for developing Railway land for commercial use”. Thus, there is no need to obtain the approval from the local authority. However, they shall be consulted while developing Railway land.
- 3) The siting of buildings or other structures in the vicinity of tracks inside curves should be avoided. The sites should be carefully selected so as not to interfere with the visibility of drivers of trains or road vehicles at level crossings. As far as possible the siting of buildings or other structures should be at boundary of land so as to avoid encroachment as also to ensure availability of land for future tracks.
- 4) To optimize the utilization of limited and valuable land resources with the railways, all the residential accommodation shall be constructed as multi-story structures in Railway Colonies. This will maximize the utilization of Floor Space Index (FSI) as well as utilization of vacant space for public purpose/environment conservation/Commercial utilization. Any exception to above provisions shall require prior approval of General Manager. In areas where bye-laws have been notified by the Local Authorities, notwithstanding the fact that the bye-laws are not applicable for the Railway buildings, it would be in the common interest to adopt such bye-laws as being good recommended practice. Where the provision exists in such bye-laws for fire-fighting arrangements, the provisions indicated in National Building Code may be followed.
- 5) In areas where bye-laws have not been notified, it will be desirable to adopt the provisions of the National Building Code of India 2016 Part 3 & *latest version*. For quick reference, some of the provisions of National Building Code (NBC) are listed in **Annexure 2.1**.

202 Planning of Railway Colonies & Provisions of Green Building Features –

- 1) **Orientation of buildings:** The chief aim of orientation of buildings is to provide physically and psychologically comfortable living inside the building by creating conditions which suitably and successfully ward off undesirable effects of severe weather to the best possible extent. For this, the following factors should be considered for the optimum orientation of the building:
 - a) Natural light and temperature

- b) Prevailing winds
 - c) Relative humidity
 - d) Surrounding view & features
- 2) As per NBC 2016 vol. 2, five major climatic zones are mainly found in India for the purpose of design of buildings:
- a) Hot-dry
 - b) Warm-humid
 - c) Temperate
 - d) Cold
 - e) Composite
- (See **Annexure 2.2** for above zones)
- 3) Water supply and drainage: Adequate water supply and sullage and storm water drains should be provided. The water supply system should be designed on the basis of at least 150 litres/person/day (which includes 45 litres for flushing requirements) due allowance being made for gardens. Where common hydrants are provided, these may be equipped with suitable anti-waste water taps. For multi-storeyed buildings, necessary static tanks may be provided for fire fighting arrangements in accordance with the regulations laid down.
- (a) Where water-borne sewerage exists in the vicinity, open drains and soak-pits should be dispensed with and an adequate underground system provided. For colonies provided with adequate piped water supply with overhead storage facilities and where no sewerage system exists in the vicinity, an underground sewerage system with one or two septic tanks or Bio-tanks/Bio-digesters according to the layout of the ground should be provided.
- (b) Guidelines for the selection of an appropriate sanitation system for disposal of human wastes are given in **Annexure 2.3**. Groups of latrines or urinals should not be located within 15 metres of living quarters, 30 metres of any cook house or food stall, 50 metres of any well supplying drinking water and should be located away from public buildings adjoining railway colonies.
- 4) **Dust bins:** These should be conveniently located with respect to the quarters and regularly cleared by the conservancy staff. In the case of multistoried buildings garbage chutes may be provided with opening in each floor with arrangements for closing the openings. As far as possible dry and wet waste shall be segregated.
- 5) **Shady trees:** Shady trees like Gulmohur, Neem, Peepal, Banyan, Siris etc. should be provided along service roads at close intervals. Such trees should be provided along the periphery of parking areas and in the circulating areas in railway stations. Some ornamental trees like Alstonia, Kachnar, Bottlebrush, Cassia, Silver oak, Mulsari, Plumeria, Ashoka and shrubs like Chandani, Gardinia, Chinese Orange and Jatruca may also be planted. For beautification of circulating areas of stations, service of the Horticulturist may be availed of. Gardens may be maintained in circulating areas through voluntary agencies or business houses on terms and conditions to safeguard the interest and rights of the railways. For further details chapter VII may be referred.
- 6) **Play grounds for children:** An open space at an appropriate place in the colony may be left for entertainment and sports of the employees and their wards. Wherever possible children's park may be developed.
- 7) **Vendors' stalls/Shops:** These may be constructed to scale, governed by local circumstances and let out on rent to vendors for grain, meat, vegetable, fruit and general requisites. These

should be constructed in railway colonies only if shopping facilities are not available within reasonable distance. General Manager's personal approval is required for such construction.

203 General Design Requirements of Buildings –

A building should not only be functionally suitable but also aesthetically pleasing, peaceful, suitable to the inhabitants, economical to construct and easy to maintain.

While designing the building the following factors should be considered:

- 1) **Easy maintenance:** At planning stage itself, the facility of maintenance should be kept in mind. This should include cleaning of floors, windows, walls, ceiling etc. It should also take care of the periodic inspection and repair of various components of building like windows, roofs, walls, plumbing, electrical fittings and wirings etc. For this sufficient space, illumination, and service connections like plug points, master valve for whole plumbing etc. should be provided.
- 2) **Socio cultural variables:** Like privacy, family structure, recreational patterns and different cultural background of people should be kept in mind while finalizing the design of building.
- 3) **Safety:** Due care should be taken to create an environment in which user can be safe as far as possible. The following safety features should be incorporated in design & layout of building:
 - a) Use of non-flammable, non-toxic materials.
 - b) Eliminating sharp edges, corner etc. These should be rounded or chamfered properly.
 - c) Properly designed and adequately illuminated stairs, ramps and walkways.
 - d) Appropriate barriers to prevent people from walking through large glass door and windows, when they are closed.
 - e) Use of non-skid materials in area prone to becoming wet, such as in toilets, kitchen and open verandah, walk ways, stairs etc.
 - f) Emergency escape routes should also be planned. Proper fencing around special facilities like swimming pools, electric poles, high voltage wires and heaters etc.
 - g) Firefighting system and fire alarm system should be as per National Building Code - 2016 (Vol. -1, part 4) or as amended from time to time or local bye-laws wherever required.
- 4) **Natural ventilation:** Proper natural ventilation is an important factor in planning building layouts especially in warmer/humid climates and during the hot season of the year. The arrangement of ventilation will depend upon prevailing wind direction. Proper opening should be planned as per wind direction so as to get effective cross ventilation.
- 5) **Noise control:** To minimize noise pollution through ground reflection, the dwelling units/areas should be surrounded by plants and grass area. It should be broken up by areas of plants and grass to minimize noise pollution. Windows and doors should be kept away from noise side as far as possible or they should be properly designed to reduce noise pollution. Proper location and orientation of building can also contribute in controlling noise. Where there is ample space, trees can be planted to reduce noise. Multiple rows of trees and bushes are more effective in controlling the noise. Provisions of National Building Code 2016 (Vol. 2, part 8) or as amended from time to time, may be used for proper design of noise control in buildings.
- 6) **Natural lighting:** Good lighting is necessary for all buildings and has three primary aims. The first aim is to promote work and activity. The second is to promote safety and the third is to create

a pleasing environment. Additionally, it also preserves energy consumption (electricity). The natural lighting can be achieved by careful planning of brightness and colour pattern within the working area and surroundings. To improve reflectivity, light colours should be used on the walls and ceilings for better brightness in the interiors. The proper natural lighting can be provided with the help of proper orientation of building in relation to position of sun and internal open spaces. Translucent corrugated roof sheets with or without false ceiling of Perspex sheet may also be used for this purpose. The direct and reflected glare from light source should be controlled. The corridors, passage and stairways should be properly lighted to avoid accidents. The lighting throughout the building should be correlated to avoid excessive differences between adjacent areas to reduce risk of accidents. Emergency lighting system should also be provided wherever necessary.

7) **Energy efficient buildings:** 'House for all seasons' of yesteryears is now known as energy efficient or climate-conscious or energy conscious or sustainable buildings. The aim is to make a building that:

- a) Requires minimum artificial energy for providing comforts like temperature, ventilation and illumination.
- b) Effectively utilizes renewable sources of energy to power the building.
- c) Uses low energy materials (building materials that require less energy during manufacturing process) and involves minimum energy in transportation and construction methods.

Building should be designed in such a way that energy requirement for cooling, heating etc. should be the barest minimum. For this purpose, following codes shall be used.

- i) **Energy Conservation Building Code (ECBC):** This code is issued by Bureau of Energy Efficiency (BEE), Ministry of Power. Provisions of this code shall be applicable for commercial buildings and large developments. ECBC is applicable to commercial building with connected load of greater than 100 kW or a contract demand of greater than 120 kVA. The building typology includes Hospitality, Shopping Complex, Business, Educational, Healthcare and Assembly. Private residential purpose buildings are not covered by this code.

As per this code there are three levels of energy efficiency for the buildings.

- **ECBC Compliant building:** is a mandatory minimum standard for commercial buildings and is estimated to be 25% better as compared to the Business-as-usual buildings and incremental cost of 0-2%.

- **Energy Conservation Building Code Plus Building (ECBC+ Building):** is a voluntary minimum standard for commercial buildings and is estimated to be 35% better as compared to the business-as-usual buildings with incremental cost of 1-4%.

- **Super Energy Conservation Building Code Building (Super ECBC Building):** is a voluntary minimum standard for commercial buildings and is estimated to be 50% better as compared to the business-as-usual buildings with incremental cost of 3-5%.

The provisions of this code do not apply to plug loads, and equipment and parts of buildings that use energy for manufacturing processes, unless otherwise specified in the Code. For details, please refer to ECBC issued by BEE, Ministry of Power.

For Indian Railways, ECBC is applicable to all upcoming buildings with connected load of

greater than 30 kW. This stricter measure is adopted by Railways as its own policy.

- ii) **Eco-Niwas Samhita (ENS):** Eco-Niwas Samhita is a set of energy efficiency building codes and guidelines introduced by the Bureau of Energy Efficiency (BEE) in India. The primary objective of Eco-Niwas Samhita is to promote energy efficiency and sustainable building practices in residential construction.

For details, please refer to ENS issued by BEE, Ministry of Power.

- iii) **Provision of Energy Efficiency policy of Indian Railways:**

- **Compliance of all buildings to BEE Shunya/Shunya+** - All existing buildings (having connected load of more than 30 kW) to be made, as far as possible, BEE Shunya/Shunya+ label including installation of smart meters for energy monitoring.
- **Compliance of new and upcoming buildings to Super ECBC:** All new buildings having connected load of 30 kW and above shall comply to BEE Super ECBC guideline and for the new buildings having connected load of less than 30 kW, it is highly encouraged to comply with BEE Super ECBC guideline.
- **Compliance of residential buildings to Eco Niwas Samhita** - All new residential buildings built on plot area of more than 500m² shall comply with Eco Niwas Samhita.

8) **Green Building Norms:**

- a) All Railway buildings constructed with built-up area more than 2500 sqm henceforth may be green.
- b) For buildings with built-up area less than 2500 sqm SVAGRIHA (Small Versatile Affordable Green Rating for Integrated Habitat Assessment rating system from The Energy and Resources Institute (TERI) may be followed as far as possible.

- 9) **Seismic consideration:** The building should be designed for seismic forces as per seismic zone and importance of building. The general principles/Special features of earthquake resistant buildings are given in **Annexure 2.4**.

Following updated IS codes (latest version) may be used for this purpose –

- a) IS 1893-1984: Criteria for earthquake resistant design of structure.
- b) IS1893- Part I 2016: Criteria for earthquake resistant design of structure part 1. General Provisions and buildings.
- c) IS4326-2013: Code of structures for earthquake resistant design and construction of buildings
- d) IS13828-1993: Improving Earthquake resistance of low strength masonry buildings – Guidelines
- e) 13920- 2016: ductile detailing of reinforced concrete structure subject to seismic forces – code of practices
- f) 13935 2009: Criteria for repair and seismic strengthening of buildings.
- g) Any other IS codes related to earthquake issued afterwards.
- h) National Building Code.

10) Other General Design Requirements

- a) The plinth level of the building should be carefully fixed based on the level of the land and general drainage features. Plinth level should be adequately higher than road level. Buildings at the time of their construction should be adequately protected against dampness, treatment being governed by the particular type of construction, location, soil and rain-fall. Minimum height of plinth shall not be less than 45 cm from the surrounding ground.
- b) Anti-termite treatment should be done at the time of construction from the foundation stage itself. (IS: 6313 Part 2 may be referred)
- c) Floor level of bathrooms should be suitably designed keeping in view the type of sanitary fittings to be accommodated.
- d) Location of sanitary fittings, inspection holes, plumbing and other sanitary installations should be predetermined to avoid disfiguring and subsequent patching of the walls and floors. Floor level should be suitably lowered to prevent water finding its way into the living area. Floor of bathroom should be provided with a slope of minimum 1 in 60 towards water outlets.
- e) Mosquito proof shutters should be provided in all types of quarters.
- f) The position of conduits for concealed wiring and other service installations should be determined in the initial stage in consultation with Electrical, signaling and Tele-communication Departments.
- g) Designs of important buildings, like hospitals, offices, station buildings, etc. should be finalized in consultation with an Architect.
- h) The layout of the kitchen in canteens and the serving counters therein, should be such as to make the canteen functional.
- i) No addition/alterations in an existing structure should be carried out without the approval of drawings and designs by the Hqrs. Office. Particular care should be exercised to check the adequacy of the existing structure to withstand the loads further proposed to be imposed. No building drawing (including that for additions/alterations) should be approved without the relevant designs being put up to the concerned Engineer along with the Drawings. The designs should invariably include design of foundations.
- j) The General Arrangement Drawing should have the approval of an officer in Hqrs. not lower than the rank of SAG in the Office of the Principal Chief Engineer (Open Line). Further, in Station Buildings and other important structures, no additions/alterations should be carried out without approval of the general arrangement plan by the concerned SAG officer in the office of Principal Chief Engineer (Open Line).
- k) It should be ensured that cross reference of the drawing and the design calculations are endorsed on both of them and record should be maintained with equal care both for the design calculations as well as drawings.
- l) While checking the design, adequate details of physical condition of the existing structure, details of any signs of distress, settlement, etc. as well as any relevant feature having bearing on the integrity and stability of the structure including type of soil should be intimated to the Hqrs. However, continuous monitoring and reporting of observation to HQ shall be continued. Also, necessary safety measures as deemed fit shall be taken at Divisional level.

- m) The detailed construction plan which includes Sections and Elevations of building should not be approved unless following detailed plans are also available
- i) Site plan and General layout plan showing various service connections like sewerage, drainage, water & power supply, roads etc. to town services.
 - ii) Roof plan showing terracing with slopes, water proofing and water outlets. (Sample Plan at **Annexure 2.5. Fig.1**).
 - iii) Detailed larger size plans of toilets and kitchens indicating the location and type of fittings and treatment on floor and walls. (Sample Plan at **Annexure 2.5. Fig.2 & 3**)
 - iv) Plan showing layout of furniture and furnishing and their type. (Sample Plan at **Annexure 2.5 Fig.4**)
 - v) Sanitary fittings, drainage and sewage plan, plumbing details. (Sample Plan at **Annexure 2.5. Fig. 5, 6, 7**)
 - vi) Horticulture landscaping plan (optional).
 - vii) The critical dimensions and clearances for fittings and fixtures are given in **Annexure 2.5 Fig 8,9,10,11,12,13 14** which are as per IS: 2064:1993 (reaffirmed: 2022) and as per National Building Code. For more clarity and further reference may please refer these documents.
 - viii) Electrical wiring plans. (Sample Plan at **Annexure 2.5 Fig.15**)

204 High Rise and special Buildings –

1) Definition of High Rise and special Buildings:

- a) As per National Building Code 2016, clause 2.38 Part 4 Fire & life safety, a building 15 m or above in height (irrespective of its occupancy) is called as high-rise building.
- b) As per National Building Code 2016, clause 1.2 Part 4 Fire & life safety, special buildings are -
 - Hotel, educational, institutional, business, mercantile, industrial, storage, hazardous and mixed occupancies, where any of these buildings have floor area more than 500 Sqm. on any one or more floors;
 - Educational buildings having height 9 m and above;
 - Institutional buildings having height 9 m and above;
 - All assembly buildings;
 - Buildings, having area more than 300 sqm. of incidental assembly occupancy on any floor; and
 - Buildings with two basements or more, or with one basement of area more than 500 sqm. unless otherwise mentioned specifically in the provisions
- c) As per National Building Code 2016, clause 4.6 Part 3 Development control rules and general building requirements, for high rise buildings & special buildings, the following additional provisions of means of access shall be as under
 - i) The width of the main street on which the building abuts shall not be less than 12 m and one end of this street shall join another street not less than 12 m in width.

- ii) The road shall not terminate in a dead end; except in the case of residential building, up to a height of 30 m
- iii) The approach to the building and open spaces on all its sides shall be not less than 6 m in width, and a turning radius of minimum 9 m shall be provided for fire tender movement of fire tenders weighing up to 45 t. The same shall be hard surface capable of taking the mass of fire tender, weighing up to 45 t minimum. For heavier fire tenders, the minimum width, turning radius and the hard surface capable of taking the fire tender loads shall be as per the requirement laid down by the Fire Department. The layout for the open space for fire tender movement shall be done in consultation with the Chief Fire Officer of the city, which shall be kept free of obstructions and shall be motorable. The compulsory open spaces around the building shall not be used for parking.
- iv) The main entrance to the plot shall be of adequate width to allow easy access to the fire engine and in no case shall it measure less than 6 m. The entrance gate shall fold back against the compound wall of the premises, thus leaving the exterior access way within the plot free for movement of fire tender. If the main entrance at the boundary wall is built over, the minimum clearance shall be 4.5 m.

Side and Rear Open Spaces for Different Heights of Building
(As per NBC-2016 Table 4, clause 8.2.3.1 Part 3)

SN	Height of the Building (in m)	Side and Rear Open Spaces to be Left Around Building in m
(1)	(2)	(3)
1	10	3
2	15	5
3	18	6
4	21	7
5	24	8
6	27	9
7	30	10
8	35	11
9	40	12
10	45	13
11	50	14
12	55	16
13	70	17
14	120	18
15	Above 120	20

NOTES:

- For buildings above 24 m in height, there shall be a minimum front open space of 6 m.
- Where rooms do not derive light and ventilation from the exterior open space, the width of such exterior open space as given in col 3 may be reduced by 1 m subject to a minimum of 3 m and a maximum of 8 m. No further projections shall be permitted.
- If the length or depth of the building exceeds 40 m, add to col (3) ten percent of length or depth of building minus 4.0 m subject to maximum requirement of 20 m.

2) **FIRE AND LIFE SAFETY FOR HIGH RISE BUILDINGS** (Annexe E of Part -4 of NBC 2016, Fire and Life safety)

Special attention in high rise building from planning point of view fire and life safety:

High rise buildings shall receive special attention with respect to fire and life safety particularly with regard to planning, design, execution, maintenance and training. Some of the key aspects are as follows:

- Staging and evacuation requirements of occupants.
- Stack effect (It is phenomenon of airflow from bottom to top) posing challenges towards pressurization and smoke exhaust.
- Zoning of firefighting system to meet functional requirements of hydraulic pressure and flow.
- Challenges experienced by fire personnel in reaching the place of fire and towards evacuation.

i) **EGRESS AND EVACUATION STRATEGY**

One fire fighting shaft shall be planned preferably for each building/tower. The fire fighting shaft shall necessarily have connectivity directly to exit discharge or through exit passageway (having 120 min fire resistance walls) to exit discharge. It is recommended that the pressurization requirement for staircase in fire fighting shaft and for other fire exit staircases in buildings greater than 60 m in height be evaluated to limit the force required to operate the door assembly (in the direction of door opening) to not more than 133 N to set the door leaf in motion.

ii) **Horizontal Exits/Refuge Area**

A horizontal exit shall be through a fire door of 120 min rating in a fire-resistant wall. Horizontal exit require separation with the refuge area or adjoining compartment through 120 min fire barrier.

iii) **Requirements of Horizontal Exits**

It should be in confirmation with Annexe E, Part -4 of NBC 2016.

iv) **Electrical Services**

Wherever transformers are planned at higher floors, the HT cables shall be routed through a separate shaft having its own fire resistance rating of 120 min. Wherever HT generators are planned centrally at ground or first basement level, redundant transformers and HT cables shall be planned for buildings above 60 m in height.

For specific requirements for electrical installations in multi storeyed buildings Part 8 'Building Services, Section 2 Electrical and Allied Installations' of NBC 2016 and part 3, Section 22 of National Electrical Code 2023. shall be referred.

v) **Fire Protection**

a) **Sprinkler Systems:**

For residential occupancies above 120 m in height and other occupancies above 60 m in height, the sprinklers shall be fed from the main and an alternate/standby riser with suitable isolation valves.

b) **Fire Water Storage:**

Where the height of the building exceeds 150 m to 175 m, fire water static storage and pumps shall be required to be provided at 160 m to 180 m and thereafter at intermediate floors at higher levels enabling efficient and functional fire fighting installations. The static fire water storage tanks located at such levels shall have capacity at minimum half of the storage of underground static water storage tank prescribed in table 7 of NBC 2016 Part 4. Such tanks shall be supplemented with water supplies through one working and one standby pump of capacity 2850 litre/min with two risers at alternate locations feeding to such fire water static storage tanks.

c) **Seismic Bracing:**

For high rise buildings, seismic bracings shall be considered for fire fighting installations depending on seismic vulnerability of the region and the type of occupancy.

vi) **Fire and Life Safety Audit:**

- (i) Fire and life safety audit shall be carried out for all buildings having a height of more than 15 m.
- (ii) Such audits shall preferably be conducted by a third-party auditor having requisite experience in fire and life safety inspections.
- (iii) Frequency of such audits shall be once in two years.

3) **Fire Protection Requirements for Lifts in High Rise Buildings (Part 8 Section 5 Clause no. 7.1.1 of NBC 2016 Vol II)**

a) **Buildings of Height 15m and Above:**

- i) All materials of constructions in load bearing elements, stairways and corridors and facades shall be non-combustible.
- ii) The interior finishing materials shall be of very low flame spread type.
- iii) Walls of the lift bank well enclosure for a lift or group of lifts shall have a fire rating of 120 min. The lift well shall have a vent at the top, of area not less than 0.2 sqm. per lift.
- iv) Landing doors - Lift landing doors shall be imperforate. Collapsible doors shall not be permitted. Lift landing doors provided in the lift enclosure shall have a minimum fire resistance rating of 60 min.
- v) Telephone or other communication facilities shall be provided in the lift car and the lift main lobby.

Note: For detailed guidelines regarding fire protection requirement of lift in high rise buildings Part 8 Section 5 Clause no. 7.1.1 of NBC 2016 may be referred.

vi) **Fireman's Lift:**

The fireman's lift is provided in a building for the purpose of aiding fire-fighters in evacuating trapped persons in the building and to take the equipment for fighting fire to upper levels with minimum delay. The number of required fireman's lifts and their locations in a building will vary depending on the size, design, complexity of the building. For detailed guidelines regarding fireman's lift and its operation Part 8 Section 5 Clause no. 7.1.1 of NBC 2016 may be referred.

b) Buildings of Height 60m and Above:

Following additional requirements to the lifts and lift enclosures provided in buildings having height more than 60 m.

- i) The fireman's lift shall have loading capacity of not less than 1 000 kg and floor area not less than 2.35 sqm.
- ii) Electrical equipment within the fireman's lift well and on the car, located within 1.0 m of any wall containing a landing door, shall be protected from dripping and splashing water or provided with enclosures classified to at least IPX3 rating according to good practice.
- iii) The electrical switchgear placed less than 1 m above lift pit floor shall be protected to IP 67 rating as per to good practice. The socket outlet and lowest lamp shall also be located at least 0.5 m above the highest permissible water level in the pit.
- iv) There shall be Fire Command Centre (FCC) and/or Building Management System (BMS) room in the building. CCTV cameras shall be fixed in the lift lobbies and the display screen(s) shall be placed in the FCC or BMS room.

For detailed guidelines refer to clause no. 7.1.2 Section 5 Part 8 of NBC 2016.

Specifications of Automatic Evacuation Lift:

Automatic Evacuation Lift should be in confirmation with clause no. 7.2.3 Section 5 Part 8 of NBC 2016.

c) Information to be provided to the Building Owner:

Detailed instructions shall be provided to the building operator by the building designer in the form of a manual. The manual shall explain the evacuation strategies to be used, how any detection systems operate, how they shall be maintained and how the lift will operate on evacuation service. It should also provide advice on periodic checks the owner can make to ensure the system is working correctly and explain the importance of a suitable testing and maintenance system being in place. Training being very important aspect of this new concept, the manual shall include such details of training as who should be covered by training, how the training should be carried out, what should be the frequency, etc.

d) Minimum Technical and Safety Requirements for Lift:

- i) Passenger and goods lifts shall comply with the safety requirements and/or protective measures of the following clauses. In addition, the passenger and goods lifts shall be designed according to good practices.
- ii) All labels, notices, markings and operating instructions shall be permanently affixed, indelible, legible and readily understandable (if necessary aided by signs or symbols). See also clause no.13 of Part 3 'Development Control Rules and General Building Requirements' of the NBC 2016. They shall be of durable material, placed in a visible position, and written in the accepted language(s).
- iii) The minimum factor of safety for any part of the lift shall not be less than five. Higher factor of safety for various parts shall be applicable in accordance with accepted standards.
- iv) All passenger, goods, stretcher, automobile, dumbwaiter lifts shall have conformity with Lifts Acts and Rules in force, Indian Electricity Act, 2003 and Rules, all relevant and

applicable Indian Standards, applicable fire regulations, fire prevention act and rules in force.

Note: Detailed guidelines regarding minimum technical and safety requirements for lift refer to Part 8 Section 5A Clause 8 of NBC 2016 or RDSO Specification no. RDSO/2013/EM/SPEC/0016/(Rev'11)- 2019 dated 26.12.2019 or latest, whichever is stringent.

205 Water Supply to Stations and Staff Quarters –

- 1) The source, storage and distribution of water supply should be adequate and all installations maintained in a satisfactory manner.
- 2) The question of adequacy in regard to the source should be primarily considered before preparing schemes for the expansion of a colony or for new colonies.
- 3) Before deciding on a new source of supply or when there is any doubt in regard to potability of water from an existing source, suitable test may be carried out in a reputed Laboratory. Medical Department may be called upon to arrange periodical inspection of existing sources of water supply.

206 Scale of Fitment for Water Supply, Sanitation and Drainage –

- 1) At stations – As provided in Para 416 & 417 of this manual.
- 2) The requirements for fitments for drinking water drainage and sanitation in the case of buildings other than residences shall be in accordance with Table 2.1 for office buildings and Table 2.2 for factories given below.

TABLE 2.1 OFFICE BUILDINGS

SN (1)	FITMENTS (2)	FOR MALE PERSONNEL (3)	FOR FEMALE PERSONNEL (4)
i)	Water-closets*	1 for every 25 person or part thereof	1 for every 15 persons or part thereof
ii)	Ablution taps	1 in each water-closet	1 in each water-closet
		1 water tap with draining arrangement shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.	
iii)	Urinals	Nil, up to 6 persons	—
		1 for 7-20 persons	
		2 for 21-45 persons	
		3 for 46-70 persons	
		4 for 71-100 persons	
		From 101 to 200 persons, add at the rate of 3 percent. For over 200 persons add at the rate of 2.5 percent	
iv)	Wash basins	1 for every 25 persons or part there of	
v)	Drinking water Fountain	1 for every 100 persons with a minimum of one on each floor	

vi)	Cleaner's sink	1 per floor, minimum, preferably in or adjacent to sanitary rooms

* This may include adequate number of water-closets of European style, where desired.

TABLE 2.2 FACTORIES

SN (1)	FITMENTS (2)	FOR MALE PERSONNEL (3)	FOR FEMALE PERSONNEL (4)
i)	Water-closets*	1 for 1-15 persons	1 for 1-12 persons
		2 for 16-35 persons	2 for 13-25 persons
		3 for 36-65 persons	3 for 26-40 persons
		4 for 66-100 persons	4 for 41-57 persons
			5 for 58-77 persons
			6 for 78-100 persons
		From 101 to 200 persons add at the rate of 3%	From 101 to 200 persons, add at the rate of 5 %
	For over 200 persons, add at the rate of 2.5 %	For over 200 persons, add at the rate of 4 %	
ii)	Ablution taps	1 in each water-closet	1 in each water-closet
		1 water tap with draining arrangement shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.	
iii)	Urinals	Nil, up to 6 persons	
		1 for 7-20 persons	
		2 for 21-45 persons	
		3 for 46-70 persons	
		4 for 71-100 persons	
		From 101 to 200 persons, add at the rate of 3 percent. For over 200 persons add at the rate of 2.5 percent	
iv)	Washing taps with draining arrangements	1 for every 25 persons or part there of	
v)	Drinking water Fountain	1 for every 100 persons with a minimum of one on each floor	
vi)	Baths (preferably showers)	As required for particular trades or occupations.	

Note 1 - For many trades of a dirty or dangerous character, more extensive provisions are required than provided in item (iv) above.

Note 2 - Crèches, where provided, shall be fitted with water-closets (one for 10 persons or part thereof) and wash basins (one for 15 persons or part thereof) and drinking water tap with draining arrangements (one for every 50 persons or part thereof).

* Some of the water-closets may be of European style, if desired.

The above scales should be subjected to the facilities being not less than those specified in Factories Act and the rules made thereunder.

In all cases of separate latrines used by males and females, the indication boards should be conspicuously displayed.

NOTE: For other type of buildings (hospitals, hostels, and institutional buildings) IS: 1172 (updated) may please be referred.

207 Plinth Area for Various Types of Quarters –

The Plinth area to be adopted for various types of quarters is indicated in **Annexure 2.6 (a)**. The Railways may adopt their own economical type design for each category of quarters keeping in mind the economics in construction. The designs followed by Local bodies, Housing Boards, etc. will bring out the most economical local designs which could be referred for guidance.

208 Basic Amenities in Staff Quarters –

All staff quarters should be provided with the following basic amenities:

- 1) Kitchen
- 2) Individual bath room
- 3) Individual sanitised latrines.
- 4) Basic ventilation arrangements.
- 5) Mosquito proof wire mesh on outside doors and windows/ventilators.

The above amenities may be provided on a programmed basis wherever these are not available.

209 Scale of Amenities for Service/ Residential Buildings –

The Scale of Amenities for various categories of residential & service buildings/hospitals are given at **Annexure 2.6 (a) & 2.6 (b)** respectively.

The type floorings in workshops are given in **Annexure 2.6 (c)**

210 Use of New Materials –

New materials available in market may be used if found suitable from the consideration of cost, local condition and aesthetic with the approval of concerned SAG Officer/nominated officer only. Various construction materials which are available in trend over conventional construction materials and available in market are enlisted with little brief in **Annexure 2.6 (d)**. This is for only guidance however; the latest available materials may be explored.

211 Colours for Timber, Steel-Work and Walls in General –

Colours for painting of walls, timber work and steel work of buildings and structures may be directed by the Chief Engineer.

212 Rest Houses –

Officer's rest house should be separated from the subordinate rest house. Provision should be made for dormitory accommodation for group 'D' staff.

Special attention should be paid by the Assistant Divisional Engineer and staff to the cleanliness and satisfactory upkeep of all Rest Houses.

213 Railway Institute –

Railway Institute with its ancillaries should be considered as a club provided and maintained rent-free for the benefit of railway employees. The incidence of cost of maintenance and upkeep of railway institutes as between the Railway administration and the Institutes shall be in accordance with the provisions contained in the Indian Railways Code for Engg. Dept. (1982 Edition as amended from time to time).

214 Construction of R.M.S. Buildings in Railway Premises –

The R.M.S building and maintenance works will be carried out by the Railways on the following terms and conditions:

- 1) RMS building will be constructed by the Railways according to the approved design/plans to be finalised after mutual discussion between the Railway administration and the Postal authorities. Funds for this will be provided by Postal department in instalments equivalent to the anticipated outlay during the particular year.

The Railway administration will charge the usual supervision charges as per the extant rules for deposit works. The building shall be maintained by the Railway and the maintenance charges for the same will be borne by the Postal department.

- 2) Rent, depreciation and maintenance charges shall be governed in accordance with the Indian Railways Code for Engg. Dept. (1982 Edition as amended from time to time).

In the case of additions and alterations to existing buildings constructed at Railway's cost for the R.M.S. the additions and alterations to them should be carried out at Railway's cost. In case such additions and alterations are substantial or require abnormal heavy repairs of the existing portion of the building, the cost of such repairs/additions / alterations should be taken up as part of the cost of the building for purposes of reckoning its rent.

For buildings constructed at the cost of the Postal department, additions and alterations should however be carried out at the cost of the Postal department only.

In the case of lateral extension of RMS buildings to add additional plinth areas, the Railway will construct it as deposit work after ensuring that such extensions would be permissible after taking into consideration the present and future traffic needs of Railways. As regards carrying out vertical extensions to the existing RMS building constructed at the cost of land owned by the Railways, such extensions will be carried out as deposit work at the cost of Postal Department. The ownership of such vertical expansion will vest with the Postal Department. The rent for the land in such cases will be fixed on the following basis in the ratio of area added to the total area available after addition. For example, if 100 sq. metre is available in the existing railway buildings and another 50 sq. metre is added by way of vertical expansion as a deposit work, rent for the land will be charged, in the ratio of $50/150 = 1/3$ i.e. one third of the rent for land on which the existing building stands.

215 Buildings for Railway Police –

The office and residential buildings for Government Reserve Police shall be dealt in accordance with the Indian Railways Code for Engg. Dept. (1982 Edition as amended from time to time).

216 Construction of Quarters/Barracks for GRP Personnel by the Railway –

1) Provision of barracks: Railway will continue to provide barracks for GRP Personnel by including the works in their Works Programme, on need basis, subject to the usual checks as applicable to the other Works Programme proposals.

2) Provision of quarters:

a) Leasing of Railway land for quarters:

The responsibility of provision of quarters to the GRP Personnel primarily rests with the State Governments. However, with a view to encourage State Governments to provide more and more quarters to GRP, Railway land wherever sparable, may be leased to them at a concessional rate of 3% per annum of the market value of land (both for covered and open areas) for a period of 30 years for the specific purpose of construction of quarters for GRP. The lease charges for this purpose will, however, be subject to periodical revision after every 10 years based on updating of the land price. Land to be leased should be based on minimum requirement consistent with the need for quarters and should preferably be located on the periphery of the Railway boundary.

b) Construction of Quarters:

Construction of quarters for GRP on the land so leased is to be done by the State Government out of their own funds. While leasing land, it should be enjoined on State Governments that they construct the quarters within a specified time span failing which the land will revert back to the Railways.

If the State Governments are not prepared to construct the quarters themselves, Railways may take up the construction work on deposit terms. Funds for this purpose will be provided by the State Government concerned in instalments equivalent to anticipated outlay during a particular year. The Railway Administration will charge the usual supervision charges as per the extant rules for deposit works.

The quarters will be constructed according to the approved design/plans to be finalised after mutual discussion between the Railway Administration and the State Government concerned in either case, i.e., whether construction is done by State Government on their own or by the Railway Administration on deposit terms.

3) Ownership/maintenance of quarters:

The ownership of these quarters will vest with the State Government concerned.

The quarters shall be maintained by the Railway and the maintenance charges for the same will be borne by the State Government concerned.

Railway will, however, have the option to acquire the quarters at any time by payment of the depreciated cost of the building in accordance with the Railway rules, which provide for depreciation at the rate of 1/65 per year at present.

217 Additions and Alterations to Quarters –

- 1) Additions and alterations to staff quarters only of a temporary nature may be permitted to be done by the occupant under the Indian Railways Code for Engg. Dept. (1982 Edition as amended from time to time) with the prior approval of the Senior Divisional Engineer/ Dy. CE (custodian of the assets) and on the specific understanding that the occupant will dismantle the same at the time of vacation of the quarters.
- 2) Additions and alterations of a permanent nature shall not be carried out without competent sanction. When an existing building is to be enlarged or extended, the external architectural features of the old structures should be adhered to as far as possible.
- 3) Additions and alterations to standard type quarters should not be carried out, without the prior approval of the Chief Engineer.

218 Block Numbering of Buildings and Structures –

Every building or structure in a station yard, railway colony, and between stations should be numbered according to such instructions as may be issued by the Principal Chief Engineer so as to facilitate reference in correspondence, the correct number being entered in the Building Register.

219 Building Registers –

Building registers in Divisional Engineer's Offices shall be maintained up-to-date and show complete details of each structure as per Indian Railways Code for Engg. Dept. (1982 Edition as amended from time to time) Replicas of these registers will be maintained in the Accounts Offices. The Senior Divisional Engineers should advise the Accounts Officers of the construction of new structures and alterations or additions to existing structures and the costs thereof, as and when carried out.

220 Transfer of Buildings –

- (1) Each Department is responsible for the allotment of staff quarters under its control, preference being given to essential staff. The transfer of vacant staff quarters from one department to another should not be effected unless approved by the Housing or Quarters Committee.
- (2) In the case of transfer of staff quarters from one department to another, the department concerned will carry out the transfer in the presence of Sr. Section Engineer (Works)/Junior Engineer (Works) by giving due notice to the Assistant Divisional Engineer. The Sr. Section Engineer (Works)/Junior Engineer (Works) shall make out a handing over /taking over memo, listing out the details of deficiencies noticed and get it signed by the occupant. This memo will be forwarded to Divisional Engineer through Assistant Divisional Engineer after duly pricing the damages, if any, to enable the department concerned to recover the cost of damage attributable to the occupant.
- (3) In the case of occupation of quarters by a new occupant, the Sr. Section Engineer (Works)/Junior Engineer (Works) will be contacted by the allottee with the allotment order for obtaining the key of the quarters. The Sr. Section Engineer (Works)/Junior Engineer (Works) will prepare a handing over memo listing out the fittings and deficiencies and get it signed by the occupant. One copy of the Memo will be submitted to the Divisional Engineer through the Assistant Divisional Engineer. One copy will be given to the occupant; one page will be earmarked for each residential quarter in register to record details of occupancy. Signature of the occupants will be obtained on this register, whenever there is a change of occupancy. The Proforma for this register is given

Annexure 2.7.

- (4) In the case of new service buildings, the Assistant Divisional Engineer will fix a date for handing over of the building for use to the department concerned, who will arrange for their representative to be present for inspection and taking over of the building. The Sr. Section Engineer (Works)/Junior Engineer (Works) shall be deputed to represent the Engineering Department for handing over.
- (5) In the case of buildings constructed by the Construction Organization/PSU/any other organization, the Open Line will take over the same after joint inspection at the level of Assistant Divisional Engineers. The Open line Assistant Divisional Engineer will allot a number to the building and enter the details of the building in the Building Register duly intimating all concerned.

221 Responsibility of Staff Occupying Quarters –

- (1) All staff are under obligation to keep their quarters and compounds in a clean and tidy state and to obey all sanitary rules that are in force. Before occupying railway quarters, the occupant should satisfy himself of their condition and sign the prescribed form.
- (2) Cooking except in kitchens or places specially provided is forbidden.
- (3) The occupant is responsible for notifying the vacation of his quarters and for giving reasonable notice to the Works, Electrical and Telecom staff for inspecting it in his presence. The Works and Electrical Supervisor in-charge should inspect the quarter and submit an estimate of damages attributable to the occupant to enable the department concerned to recover the cost. If there is an interval of time from date of vacation of quarters to next occupation, the Sr. Section Engineer (Works)/Junior Engineer (Works) should make necessary arrangements for its safe custody. It is the responsibility of the Engineering staff or Special staff who are appointed to see that the occupants adhere to the instructions laid down. Any breach of instruction should be reported to the occupant's immediate superior.

222 Vacant Railway Buildings –

As far as possible, no railway quarters should be allowed to remain unoccupied. The Sr. Section Engineer (Works) in-charge/Junior Engineer (Works) in-charge should send a return on buildings lying vacant at the end of every month through the Assistant Divisional Engineer to the Divisional Engineer who will take necessary steps in regard to their occupation.

A return of vacant buildings should be sent by the Divisional Engineer's Office to the Accounts Department /allotment authority at the end of every month.

223 Construction and Dismantling of Building/Structures –

When constructing new structures/ buildings or making deep excavations, in addition to Building/structural plans, detailed scheme of erection of form work/ supporting arrangements should be made. When dismantling of any existing structure is involved to facilitate construction, the scheme for dismantling of the existing structure shall also be shown in plans. In contractual work, special tender conditions should be provided to cover above.

- 1) The dismantling of structure should be done under proper supervision and as per approved scheme of dismantling.
- 2) At major dismantling sites minimum level of supervision shall be Senior Section Engineer (In-charge)/Junior Engineer (in charge), who should be nominated by Dy. Chief Engineer/Sr.

DEN/DEN in writing.

- 3) The dismantling Plan should be scrutinized by the Drawing Office and approved by Sr. Divisional Engineer (Co) in case of Open Line Organization or H.O.D. in case of Construction Organization. The dismantling plan should invariably show various stages of dismantling, equipment to be used for dismantling, area likely to be affected by debris, any adjacent buildings likely to be affected and action to be taken thereof.
- 4) Proper barricading should be done to stop access of unauthorized personnel near the dismantling area. Wherever necessary, assistance of RPF should be taken to prevent people from coming close to dismantling area. Signage warning people not to enter the danger zone should also be displayed.
- 5) Proper announcement through Public Address System should be done at regular intervals to keep the onlookers away from the major dismantling affected zone.
- 6) The adjacent buildings likely to be affected by dismantling should also be evacuated.
- 7) In area where law and order is likely to be affected, assistance of local Police in addition to RPF should be taken to keep people away from dismantling area.

224. Taking Over of Building after Completion –

Buildings along with their services are designed and constructed to meet specific user requirement. In order to ensure full user satisfaction, it is necessary that the buildings and services on their completion should be subjected to intensive review before taking over of the building/structures from contractor. The Construction /Open Line Engineers should formally take over the building from the contractor.

A Proforma cum Checklist for checking the items before taking it over and giving completion certificate to the contractor shall be as per **Annexure 2.8**

B - WATER MANAGEMENT

225 Water Management –

Water is most precious resource and is essential for human life. It is essential for human, livestock, agriculture, industries etc. Today, if think the water is in abundance it is going to be a big great mistake. Over the years the water sources are depleting specifically fresh water resources.

The population on the earth is growing multi-fold and also the industrialisation is increasing at enormous space resulting in higher demand of water. To take care of the depleting resource of water the efficient "Water Management" is the need of time.

226 Water Efficiency –

Water efficiency is the practice of reducing water consumption by measuring the amount of water required for a particular purpose and is proportionate to the amount of essential water used. Water efficiency differs from water conservation in that it focuses on reducing waste, not restricting use. Solutions for water efficiency not only focus on reducing the amount of potable water used but also on reducing the use of non-potable water where appropriate (e.g. flushing toilet, watering landscape,

etc.). It also emphasizes the influence consumers can have on water efficiency by making small behavioural changes to reduce water wastage, and by choosing more water-efficient products.

227 Water Conservation –

Water conservation is all about reducing the water wastage and preventing unnecessary use of water. The key activities to conserve water include reduction in water loss, use and waste of resources, avoiding any damage to water quality; and improving water management practices that reduce the use or enhance the beneficial use of water.

228 Water Policy on Indian Railway –

Water management is an integral part of sustainability efforts. Indian Railways has formulated “Indian Railways Water Policy, 2017”. The policy envisages holistic water management through “Reduce, Recycle & Recharge”.

- 1) **Reduce:** Reduce the demand for water through technological up-gradation such as use of water efficient sanitary fixtures.
 - Identify water losses and leakages and plug the same
 - Educating consumers to economise the use of water and avoid wastage

Measures to reduce the water use-

- a) **Sub-metering:** For sustainable design of buildings individual water meters may be installed for each individual household. This meter gives exact idea to the user as how much water is used by them. This is one of the criteria in green building rating criteria.

These individual sub meters help as under

- i) Consumption of water
- ii) Detection of water leakages
- iii) Makes resident water use conscious
- iv) Saves the electrical energy – indirectly

- b) **Use of water efficient fixtures:** Water efficient fittings & fixtures play an important role in demand side management. Most of the water consumption by the end users is through valves, stop-cocks/faucets, flushing cistern, urinals etc., it is essential to choose such design of fittings and fixtures of sanitary fittings / fixtures which are efficient in water consumption. Highly – efficient or low-flow plumbing fixtures provide effective saving of water as well as energy bills. Certain water efficient fixtures are as under

- i) Water taps with sensors: helps in reducing the usage of water. Normally, for washing hands, sensor-based taps uses @ 300-400ml water as compared to 1-2 litre water in manual taps.
- ii) Dual flush toilets use up to 67% less water than conventional toilets.
- iii) Waterless urinals or urinals with sensors can be used.
- iv) Low-flow shower heads reduce the water consumption about 50-70% while bathing.
- v) Faucets like faucets, shower heads, and toilets have with low discharge can be used.
- vi) Use of washing machines and dish washers substantially saves water.
- vii) Use of sprinklers for lawns and drip irrigation for shrubs and trees.

However, maintainability of above items/fixtures shall be kept in view while choosing the design/make and specific fittings and fixtures.

2) **Reuse:** This is achieved by using the waste water for non-drinking purposes after treating the waste water.

a) **Grey water treatment:** The grey water generated from the bath, wash basins, washing machines, manual utensil cleaning, dish washers, kitchen sinks, and wash basins. This water is about 65-70% of the total water used in a household.

This waste water can be treated by-

- i) Sedimentation
- ii) Passing through grease trap
- iii) Aerobic or anaerobic digestion
- iv) Filtering
- v) UV disinfection

This water can be used for toilet flushing, washing of clothes, gardening etc.

b) **Sewage water treatment:** The sewage water generated from the water closet; urinals can be treated in sewage treatment plant (STP). Now a days, very compact STPs are available in the market.

This waste water can be treated by-

- i) Filtering
- ii) Sedimentation
- iii) Aerobic or anaerobic digestion
- iv) UV disinfection

This water can be used for toilet flushing and gardening etc.

3) **Recharge:** This is achieved by recharging the ground by rainwater.

229 Rain Water Harvesting –

Rain water harvesting and conservation is the process of collection of rain water for future productive use. Rain water so collected can be stored for direct use after disinfection or can be recharge into the ground water. Objective of RWH and conservation is to make optimum use of rain water at the place where it falls.

Rain Water harvesting (RWH) is mandatory in construction of all built-up assets e.g. new line, multitracking, gauge conversion etc.

It has been decided that RWH system shall be provided in all existing establishments (Station buildings, service buildings, residential quarters and other units) having roof top area of more than 200 sqm subject to techno-economic feasibility. Out of these, priority should be given to those areas where Ground Water Block falls in 'Semi-Critical', 'Critical' or 'Over-exploited' category as per Central Ground Water Board categorization. This is subject to the requirement for ground water recharge for a particular area as per the CGWA's guidelines.

There are two main techniques of Rain Water Harvesting viz.

- Storage of rain water on surface for future use and

- Artificial recharge to ground water.

CPWD Manual may be referred for the details, to decide about the RWH technique for given area. Knowledge of geological and hydrological feature of the area is necessary for selecting the site and type of recharge structures. Artificial recharge structures are generally pits, trenches, abandoned dug-well, hand pumps, gravity head recharge tube-wells, recharge shaft etc. The guidelines of the Central Ground Water Board and the CPWD Manual on 'Rain Water Harvesting and Conservation' (available in public domain on website) can be referred for guidance/reference.

RWH may also be done by reviving old water bodies on railway land and creating new water bodies wherever feasible.

Periodical maintenance of recharge structure is important to ensure its proper functioning.

1) **Advantages of Rain Water Harvesting:**

- Promotes adequacy of underground water.
- Mitigates the effect of drought.
- Reduces soil erosion as surface runoff is reduced.
- Decreases load on storm water disposal system.
- Reduces flood hazards.
- Improves ground quality/decreases salinity (by dilution).
- Prevents ingress of sea water in subsurface aquifers in coastal areas.
- Affects rise in ground water table. Thus, saving energy (to lift water).
- The cost of recharging subsurface aquifer is lower than surface reservoirs.
- The subsurface aquifer also serves as storage and distribution system.
- No land is wasted for storage purpose and no population displacement is involved.
- Storing water underground is environment friendly.

2) **Building Bye Laws:** Model Building Bye Laws, 2016 circulated by Ministry of Urban Development includes provision of Rainwater Harvesting. As per Model Building Bye laws, water harvesting through storing of water runoff including rainwater in all new buildings on plots of 100 Sq. m and above will be mandatory. Most of the States/Union territories have incorporated the provisions in their respective building bye laws. The plans submitted to the local bodies shall indicate the system of storm water drainage along with points of collection of rain water in surface reservoirs or in recharge wells. Further, all buildings having a minimum discharge of 10,000 litre and above per day shall incorporate waste water recycling system. The recycled water should be used for horticulture purposes.

3) **MODES AND TECHNIQUES:** Roof top water/storm runoff is harvested. The collected water can be stored directly in a storage tank or existing sump through a filter chamber or this water can be used to recharge ground water. Normally, debris, dirt and dust get deposited on the roof during non-rainy periods. When the first rains arrive, this unwanted material would be washed into the storage tank. This may cause contamination of water collected in the storage tank thereby rendering it unfit for drinking and cooking purposes. Therefore, a first flush system can be incorporated in the Roof top Rainwater Harvesting System (RRHS) to dispose off the first flush so that it does not enter the tank. There are two such simple systems. One is based on a simple manually operated arrangement whereby, the down pipe is moved away from the tank inlet and replaced again once the first flush water has been disposed. In another simple and semi-automatic system, separate vertical pipe is fixed to the down pipe with a valve provided below the

T-junction. After the first rain is washed out through the first flush pipe the valve is closed to allow the water to enter the down pipe and reach the storage tank.

Collection of roof top water –

Roofs made of corrugated iron sheet; asbestos sheet or tiles can be utilized for harvesting the rainwater. Gutter and channels can be fixed on the edges of roof all around to collect and transport the rainwater from the roof to the storage tank. Gutters can be prepared in semi-circular and rectangular shapes. Locally available materials such as plain Galvanized Iron sheets can be easily folded to required shapes to prepare semicircular and rectangular gutters. Semicircular gutters of PVC materials can be readily prepared by cutting the PV pipes into two equal semicircular channels. Bamboo poles can be used for making gutters if they are locally available in sufficient quantity. Use of such locally available materials reduces the overall cost of the system.

In flat roofs, rainwater drain pipes should be extended up to the bottom of the building. If no. of rain water drain pipes is more than one then they should be interconnected or connected separately to rainwater collection systems.

Methods of recharging subsurface aquifer:

- a) Recharge Through pit.
 - b) Recharge through abandoned hand pump.
 - c) Recharge through abandoned dug well/open well.
 - d) Through recharge trench.
 - e) Recharge through shaft.
 - f) Recharge trench with bore.
- a) **Recharge Through Pit:** This method is suitable where permeable strata is available at shallow depth. It is adopted for buildings having roof area up to 100 sq. m Recharge pit of any shape is constructed generally 1-2 m wide and 2-3 m deep. The pit is filled with boulders, gravel and sand for filtration of rain water. Water entering in to RWH structure should be silt free. Top layer of sand of filter should be cleaned periodically for better ingress of rain water in to the sub soil. Details are shown in figure **Annexure 2.9 (Fig.A)**.
 - b) **Recharge Through Abandoned Hand Pump:** In this, an abandoned hand pump is used for as recharge structure. It is suitable for building having roof top area up to 150 sq. m. Roof top rain water is fed to the hand pump through 100 mm dia pipe as shown in figure **Annexure 2.9 (fig.B)**. Water fed in the Rain Water Harvesting structure should be silt free. Water from first rain should be diverted to drain through suitable arrangement. If water is not clear then filter should be provided.
 - c) **Recharge Through Abandoned Dug Well / Open Well:** In this method, a dry / unused dug well can be used as a recharge structure. It is suitable for buildings having a roof top area more than 100 sq. m Recharge water is guided through a pipe of 100 mm to the bottom of the well as shown in figure **Annexure 2.9 (fig. C)**. Well cleaning and desilting is imperative before using it. Recharge water guided should be silt free, otherwise filter should be provided as shown in the figure. Well should be cleaned periodically and chlorinated to control bacteriological contamination.
 - d) **Recharge Through Trench:** This method is used where permeable strata is available at shallow depth. It is suitable for buildings having roof top area between 200 to 300 sq. m In

this, trench of 0.5-1.0 m wide, 1-1.5 m deep and of adequate length depending upon roof top area and soil characteristics should be constructed and filled with boulders, gravel and sand as shown in figure **Annexure 2.9 (fig. D)**. Cleaning of filter media should be done periodically.

- e) **Recharge Through Shafts:** This method is suitable where shallow aquifer is located below clayey surface. It is used for buildings having roof top area between 2000-5000 sq. m. Recharge shaft of diameter, 0.5-3 m and 10-15 m deep is excavated mechanically. The shaft should end in impermeable strata. The shaft should be filled with boulders, gravel and sand for filtration of recharge water. Top sand layer should be cleaned periodically. Recharge shaft should be constructed 10-15 m away from the buildings for the safety of the buildings. The details are given in figure **Annexure 2.9 (fig.E)**.
- f) **Recharge Trench With Bore:** This method is used where sub-soil is impervious and large quantity of roof water/ surface run off is available. In this, trench is made 1.5-3 m wide and 10- 30 m length depending upon water availability. Wells of 150-300 mm. dia meter and 3-5 m deep (below previous layer) are constructed in the trench. No. of wells to be dug are decided in accordance to water availability and rate of ingress. Trench is filled with filtration media as shown in figure **Annexure 2.9 (fig.F)**. A suitable silt chamber is also inserted with grating for water diverting arrangements as shown in the figure.

C - ENERGY MANAGEMENT

230 Energy Efficiency –

Energy efficiency: Use of less energy by adopting certain method/products to perform the same task or produce the same result which are done by conventional or routine methods/products.

The building sector in India is experiencing unprecedented growth. This sector alone accounts for over thirty per cent of India's total electricity consumption. It is estimated that India is building 3,00,000 square feet of commercial floor space every day and will see one of the largest commercial and residential building construction boom over the next two decades. India is at an inflection point where forty per cent of the building stock that will exist in the next twenty years is yet to be built. This would generate greater demand for energy and hence there is an urgent need to optimise building energy demand in upcoming as well as existing building stock.

ENERGY EFFICIENCY MEASURES: Building should be designed in such a way that energy requirement for cooling, heating etc. should be the barest minimum.

For minimizing the energy requirement in a building, the solar energy is to be made use of. This can be done in two ways. One is by passive solar design and second by active solar design.

- 1) **Passive Solar System:** Passive solar system makes use of natural energy flows as the primary means of harvesting solar energy. Passive solar design is an approach that integrates building components – exterior walls, windows, and building materials – to provide solar collection, heat storage and heat distribution. Passive solar heating systems are categorized as sun-tempered, direct-gain, sunspaces and thermal storage walls.

- a) **Passive solar heating:** Passive solar building that makes use of sunlight as a heating source should also be designed to take advantage of sunlight as a lighting source. Day-lighting benefits from the gentle diffusion of sunlight over large areas of light-coloured surface.

Integrating these two approaches requires an understanding and coordination of day-lighting of passive design, electric lighting and mechanical heating system and controls. This will require a proper orientation of building as already discussed along with proper planning of various openings. Thermal storage has added features. Thermal storage features in a passive solar building are intended to meet two needs. It should be designed to quickly absorb solar heat for use over diurnal cycle and to avoid overheating. This provides slow release of the stored heat when the sun is no longer shining. The thermal storage strategies are:

- i) Flooring of concrete, tile, brick or stone masonry.
 - ii) Trombe Wall: Trombe wall is a south facing wall covered with glass spaced a few inches away from the wall. Sunlight passes through the glass and is absorbed and stored by the wall. Heat is transferred by conduction to building some hours later. This should be used in buildings in cold climatic conditions.
 - iii) Insulated Masonry and Concrete Walls: New technologies have lowered the cost and increased the options for insulated masonry. Various foam insulations are available in panels that can be adhered directly to the masonry surface and then protected with a trowelled or sprayed on weathering skin.
 - iv) Double Gypsum Board: Thermal capacity of the building can be increased by simply increasing the thickness of the gypsum board used on interior walls of the building.
 - v) Hollow brick walls; either rat trap bond type or cavity wall as per BIS – S.P.20 titled as Hand Book of masonry design and construction, can be used on all outer walls of a buildings located in hot dry climate. It will keep the interior cool in summer months due to air pocket inside the walls.
 - vi) Autoclaved aerated concrete blocks (AAC): A low maintenance precast building material with excellent thermal insulation and durability. The heat-insulating properties of AAC blocks keep the building cooler and prevent outside heat from entering, resulting in significant savings on air conditioning costs.
 - vii) Water wall: Water walls are based on the same principle as that for Trombe walls, except that they employ water as the thermal storage material. A water wall is a thermal storage wall made up of drums of water stacked up behind glazing. It is usually painted black to increase heat absorption. Buildings that work during daytime, such as schools and offices, benefit from the rapid heat transfer in the water wall. Overheating during summer may be prevented by using suitable shading devices.
- b) Passive Solar Cooling: Passive solar cooling is designed strategies that minimize the need for mechanical cooling system. This includes proper window placement and day lighting design, selection of appropriate glazing for windows and skylights, proper shading of glass when heat gains are not desired, use of light-coloured materials for the building, careful siting and orientation decision and good landscaping design. Use of traditional full window (leaf window) stops heat and sunlight in summer months and keeps the interior cool whereas fully glazed windows admit and trap the heat in the interior rooms. Therefore, the traditional windows should be used in hot and dry climate whereas the fully glazed windows should be used in cold climate.

- 2) **Active Solar System:** Active solar energy should be integrated with a building design and systems only after passive solar and energy conserving strategies are considered. Active solar

collector systems take advantage of the sun to provide energy for domestic water heating, space heating etc.

Major components of the system include collectors, the circulation system that moves the fluid between the collectors and storage, the storage tank, a control system and a backup heating system.

- a) Solar panels may be installed on the top of the buildings which will help in creation of renewable energy and reducing the demand of electricity from State Govt.



Solar Panels on Roof Top

This also can be done by providing building Integrated Photovoltaic Cells (BIPV) in the building Roof or façade of the building.



BIPV in Roof



BIPV in Facade

- b) Solar lamps can be used in street light in colony, gardens, gate lodges etc.



Solar lamps for colony Roads



Solar lamps for Garden

231 Building Management System –

- 1) A building management system (BMS), is a computer-based control system installed in buildings to manage and monitor various mechanical and electrical systems. These systems can include HVAC (heating, ventilation, and air conditioning), lighting, security, fire alarms, elevators, and other building systems.

The primary purpose of a BMS is to optimize building performance, increase energy efficiency, and ensure the comfort, safety, and security of occupants. BMS achieves it by integrating and automating the control of various building systems, allowing for centralized monitoring, control, and management, interfacing between individual smart building applications.

2) Key components of a building management system typically include:

- a) **Sensors and Actuators:** These devices monitor various parameters such as temperature, humidity, occupancy, CO2 levels, etc., and can control equipment such as valves, dampers, motors, etc.
- b) **Controllers:** These are the brains of the system, receiving data from sensors and sending commands to actuators based on predefined algorithms and control strategies.
- c) **Human-Machine Interface (HMI):** This is the user interface through which building operators interact with the system. It can be a computer dashboard, mobile app, or physical control panel.
- d) **Software:** BMS software manages the overall operation of the system, including scheduling, alarming, data logging, and reporting.
- e) **Networking Infrastructure:** A robust networking infrastructure is necessary to connect sensors, controllers, and other devices throughout the building.

Benefits of a building management system-

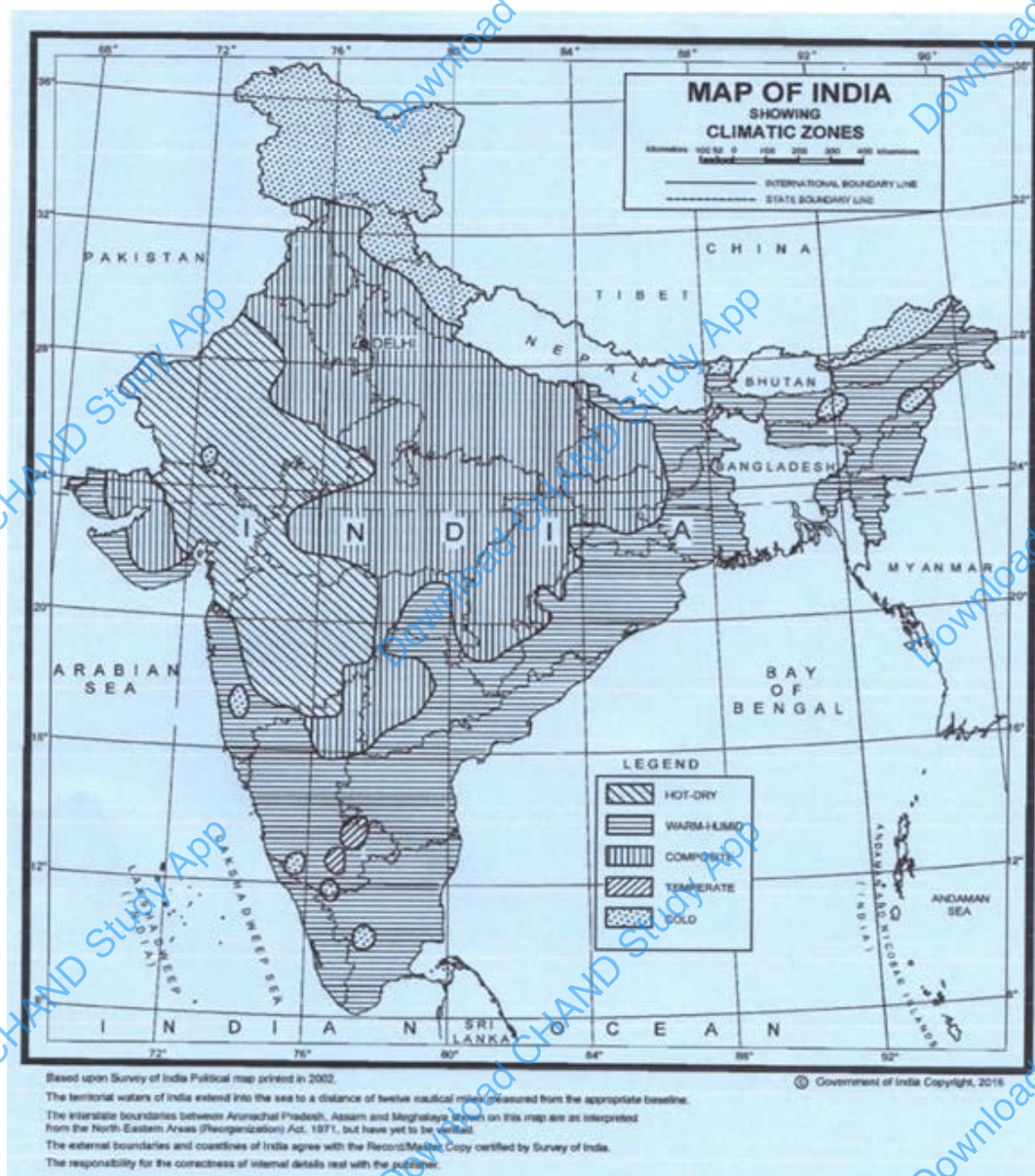
- It can help optimize the operation of a building's heating, ventilation, and air conditioning (HVAC) system, lighting, and other electrical systems, leading to reduced energy consumption and cost savings
- It can help ensure that the temperature, humidity, and other environmental conditions in a building are maintained at optimal levels for the comfort of occupants.
- It can monitor the operation of various systems in a building and alert maintenance staff to potential issues before they become problems. This can help prevent accidents and improve the overall safety of the building.
- By automating the monitoring and control of a building's systems, a BMS can help reduce the need for manual intervention and improve the reliability of those systems.
- Integration with security and fire alarm systems.
- Remote monitoring and control capabilities, allowing facility managers to access and manage building systems from anywhere.
- Predictive maintenance, which helps prevent equipment failures and reduces downtime.
- A BMS can provide real-time data on the performance of a building's systems, which can help maintenance staff identify and address potential issues before they become major problems. This can help extend the lifespan of the systems and reduce maintenance costs.

For all new major buildings, the building management system (BMS) may be adopted. Also, in existing major buildings BMS up to possible extent may be used. For implementing and monitoring an agency may be hired.

Minimum Size and Width of Different Components of Buildings

SN	Component of Building	Minimum requirement		Remarks
1	Height of Plinth	Not less than 450 mm from surrounding GL		As per NBC 2016 Provisions
2	Habitable Room	Area	9.50 sq. m.	
		Width	2.40 m.	
		Height	2.75 m.	
2 A	Educational and Industrial Building	Height	3.60m	
3	Kitchen	Area	5.00 sq. m.	If used as Dinning area also not less than 7.50 sq.m and minimum width of 2.10m
		Width	1.80 m.	
		Height	2.75 m.	
4	Bathroom	Area	1.80 sq. m.	As per NBC 2016 Provisions
		Width	1.20 m.	
		Height	2.10 m.	
5	W.C.	Area	1.10 sq. m.	
		Width	0.90 m.	
		Height	2.10 m.	
6	Combined Bath & W.C. (Toilet)	Area	2.80 sq. m.	
		Width	1.20 m.	
		Height	2.10 m.	
7	Store	Area	3.00 sq. m	
		Width	No restriction	
		Height	2.20 m.	
8	Garage	Area	3 m x 6 m	Private Garage
9	Staircase	Minimum clear width		i) Minimum width of Tread without nosing 300mm ii) Maximum height of riser shall be 150mm. iii) Number of risers shall be limited to 12 per flight. iv) Minimum head room in a passage under landing of staircase shall be 2.20m
		Residential	1.00 m	
		Assembly	2.00 m	
		Educational	1.50 m	
		Institutional	2.00 m	

The climatic classification map of India



Guidelines for Selection of Sanitation System

Following points are relevant while selecting a human waste disposal system:

1. Standard (cistern) flushing systems are meant primarily to transport human waste from the toilet to the treatment plant usually located a few kilometres away, so as to provide a self-cleansing velocity in the sewers. Therefore, this standard flushing system is, appropriate only where underground sewerage system exists. The transported waste is treated in a centralised treatment plant.

The conventional sewage treatment technologies such as Activated Sludge Process (ASP), Waste Stabilization pond (WSP), Upflow Anaerobic Sludge Blanket (UASB) Reactor etc., are commonly adopted in sewerage system to treat wastewater up to secondary level as per the effluent standards. There are a number of newer treatment technologies that have come into practice in recent times. For details para 620 of this manual may be seen.

2. Modern septic tank system is an on-site disposal method, which too uses 'standard' flushing. The septic tank acts as sedimentation-cum-digestion tank:

Anaerobic digestion of the settled sludge occurs in its bottom zone, and the supernatant has to undergo treatment ('secondary') in a soak pit/filter bed. Use of septic tanks without follow-up treatment is not permitted as the effluent from the septic tanks is hazardous from point of view of health and pollution. In built up areas or in all other areas where a soak pit/filter beds are not feasible Bio-tanks/Bio digester system would be appropriate.

3. A minimum retention of 30 days is required for anaerobic digestion, while a septic tank provides retention only for 2- 7 days and hence the effluent from the septic tank must have its main treatment in a soak pit/filter while effluent from a digester can be discharged directly in a drain system.
4. There is a general shortage of water supply in India and in some parts even drinking water is scarce. Therefore, it has to be seen that water is conserved to the maximum extent possible and that it is not polluted; and the waste disposal systems should be designed with these ends in view. This applies to both ground water and surface water.
5. For providing soak pit /filter bed with septic tanks the water table must be well below their depth and the rain water from surface also should not interfere with their functioning. Hence, these are not usually suitable where water tables are high or where ground slopes are flat.

6. Directions for selecting appropriate type of toilet systems:

- i) Where an underground sewerage system is available, toilets shall be connected with a good quality 'flush' type cistern preferably dual flush cistern as per IS 774 or 7231.
- ii) Where an underground sewerage system is not available:

In built-up areas or in all other areas where soak pits or filter beds are not feasible	Bio Tanks/Bio-digester
On roadside stations/In sparsely inhabited stations	Bio Tanks/Bio-digester or septic tank system

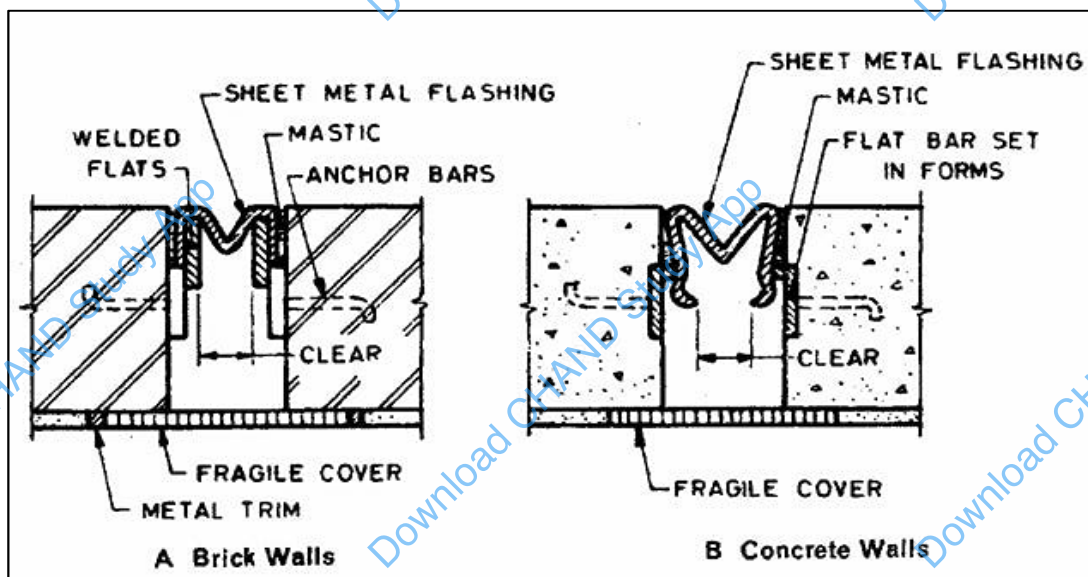
- iii) In case of urinals, waterless/sensor-based urinals may be preferred. Instead of conventional automatic flushing cisterns, dripping ferrules may be used.

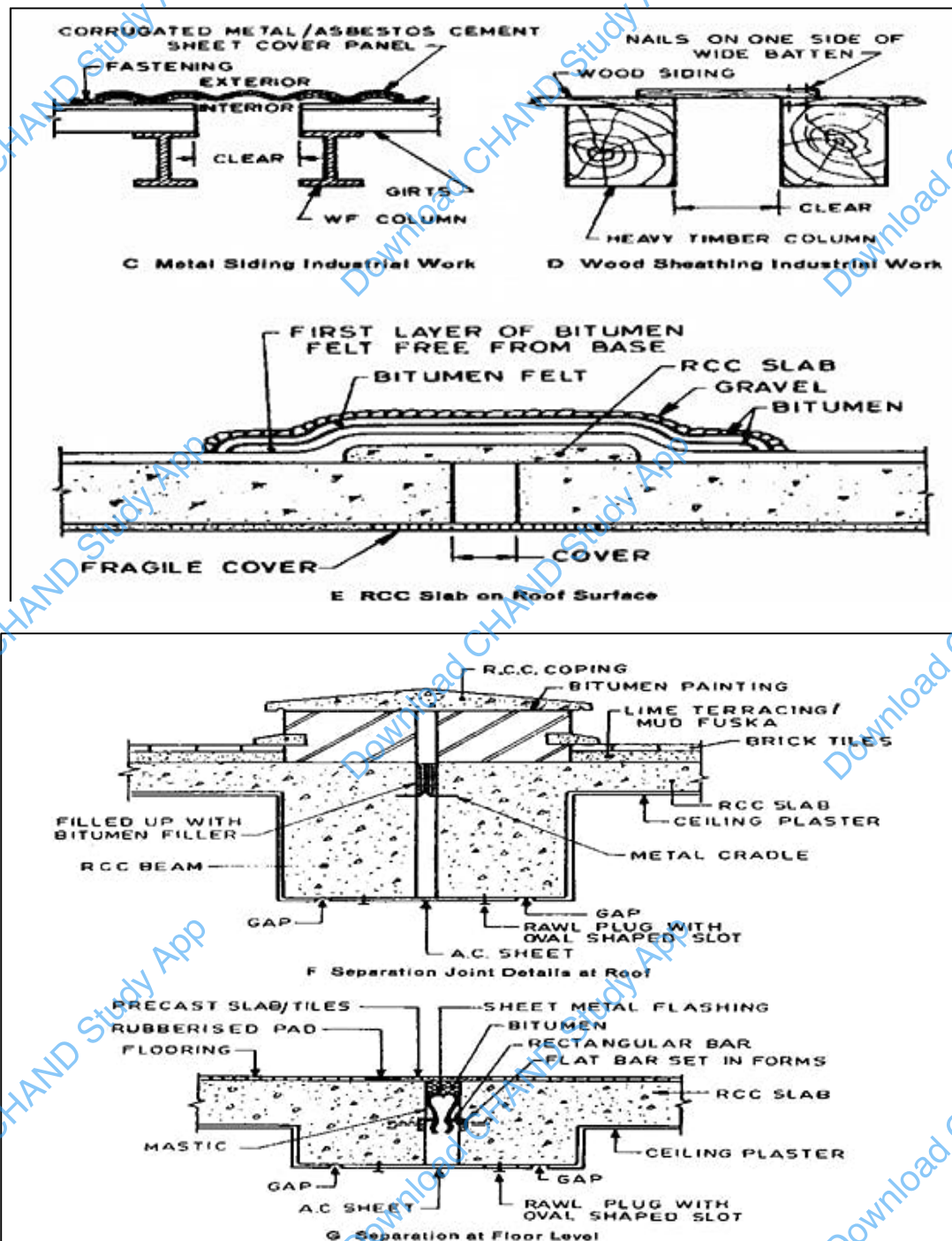
Only flush toilets with underground sewerage, flush toilets with septic tank systems (with soak pit/filter-bed for the septic tank effluent) and bio-tanks/bio digesters are sanitized toilet systems for use on the Railways.

Hence, any septic tanks, if not provided with prescribed soak pit/filter bed, must be provided with soak pit/filter bed or if possible, converted into Bio Tanks/Bio-digesters by minimizing the flushing.

General Principles/Special features of earthquake resistant buildings

1. Hospitals, control office buildings, water tanks and electrical sub-stations should be specifically designed to withstand highest probable earthquake forces with minor damages so that functioning of activities can continue unhampered.
2. **Lightness:** The building shall be as light as possible consistent with structural safety and functional requirements. Particularly, the roofs and upper storeys should be light.
3. **Continuity of Construction:**
 - a) As far as possible the parts should be tied together in such a manner that the building acts as one unit.
 - b) For parts of buildings between separation or crumple sections or expansion joints, floor slabs shall be continuous throughout as far as possible. Concrete slabs shall be rigidly connected or integrally cast with the support beams.
 - c) During addition and alteration, provision of separate crumple section between new and existing structures shall be provided as far as possible, unless possible measures are taken to establish continuity between the existing and new construction.
 - d) Typical details of few types of separation or crumple sections are shown below in fig. A to G





4. Projecting and Suspended Parts:

- Projecting parts shall be avoided as far as possible. Otherwise, they should be properly reinforced and firmly tied to main structure. Their design shall be in accordance with IS 1893:1984.
- Ceiling plaster shall preferably be avoided or shall be as thin as possible.
- Suspension ceiling shall be avoided as far as possible or they shall be light, adequately framed and secured.

5. Building Configuration:

- The building should be configured in such a manner so as to minimize torsion and stress concentration. The following provisions should be complied with to avoid such stresses.

- b) The building should have a simple rectangular plan and be symmetrical both with respect to mass and rigidity, coincide with each other and no separation section other than expansion joints are necessary IS 3414:1968 may be referred for expansion of joints.
- c) If symmetry of the structure is not possible in plan, elevation and mass, provision shall be made for torsional and other effects due to earthquake forces in the structural design. Otherwise, parts of different rigidity may be separated through crumple section. The length of such building between separation sections shall not preferably exceed three times width.
 - i) Refer IS 4326: 2013 for provision of minimum width of separation gap.
 - ii) For buildings of height greater than 40m, it will be desirable to carry out model or dynamic analysis of the structure in order to compute the drift at each storey, and the gap width between the adjoining structures shall not be less than the sum of their dynamic deflections at any level.
 - iii) Where separation is necessary, a complete separation of the parts shall be made except below the plinth level. The plinth beam, foundation beam and footings may be continuous. Where separation sections are provided in a long building, they shall take care of movement owing to temperature changes also.
- d) Building having plans with shape like L, T, E and Y shall preferably be separated into rectangular parts by providing separation sections.
- e) Any deviation or discontinuity in load transfer path results in poor performance of building. Building with vertical setbacks, having fewer columns or walls in a particular story or with unusually tall story should be avoided. Buildings on sloppy ground with unequal height of columns along slope causes ill effects like twisting and damage in shorter columns

6. **Strength in various Directions:**

The structure should be designed to have adequate strength against earthquake effects along both the horizontal axes. The design shall also be safe considering the reversible nature of earthquake forces.

7. **Foundation:**

- a) For the design of foundations, the provisions of IS1904: 2021 in conjunction with IS 1893:1984 shall generally be followed
- b) The structure shall not be founded on such loose soil which will subside or liquefy during an earthquake, resulting in large differential settlements
- c) The sub grade below the entire building shall preferably be of the same type of soil. Wherever this is not possible a suitably located separation or crumple section shall be provided.
- d) Loose fine sand, soft silt and expansive clays should be avoided. In unavoidable circumstances, the building shall rest either on a rigid raft foundation or on piles taken to a firm stratum. However, for light constructions, foundation may rest on such a soil after improving the soil by sand piling or soil stabilizing.

8. **Ductility:**

Main structural elements shall be designed to have a ductile failure. This will enable the structure to absorb energy during earthquakes to avoid sudden collapse of the structures. Reinforcing steel should be provided in masonry in critical sections, which will not only increase the strength and stability but also the ductility. IS 13920:2016 may be referred for details.

9. **Damage to non-structural parts:**

Suitable details shall be worked out to connect the non-structural parts with the structural framing so that the deformation of the structural frame leads to minimum damage of the non-structural elements.

10. **Roofs and Floors:**

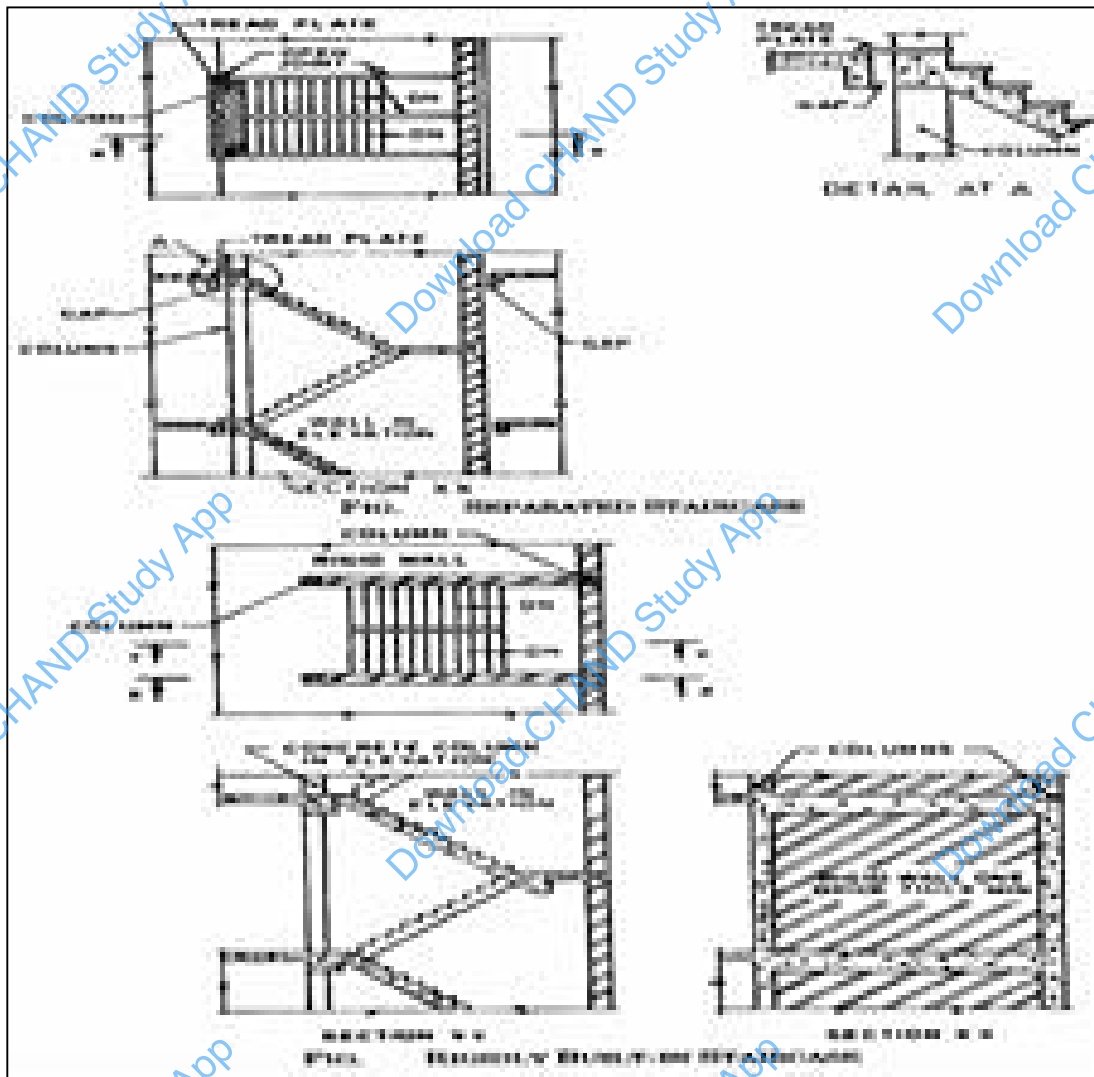
- a) Flat roof or floor shall not preferably be made of terrace of ordinary bricks supported on steel, timber or reinforced concrete joints, nor shall these be of a type which is likely to be loosened or fall during earthquake. If this type of construction cannot be avoided, the joists should be blocked at ends and bridged at intervals such that their spacing is not altered during an earthquake.
- b) For pitched roofs, corrugated iron or asbestos sheets shall be used in preference to country, Allahabad or Mangalore tiles or other loose roofing units. All roofing materials shall be tied to supporting members. Heavy roofing materials shall generally be avoided
- c) Jack arch roofs or floors where used shall be provided with mild steel ties in all spans along with diagonal braces in plan to ensure diaphragm actions.

11 **Strengthening Arrangements and Bands:**

- a) All masonry buildings are to be strengthened as per IS: 1893 -1984 Lintel Band should be provided at lintel level and in all load bearing walls, panel walls as well as partition walls also. This will improve stability during severe earthquake.
- b) R.C.C. roof bands should be provided immediately below the roofs or floors.
- c) Gable band is provided at the top of gable masonry below the purlins.
- d) Plinth band-cum-damp proof course is provided at plinth level of walls, on top of the foundation wall in cases where strip footing of masonry is used and soil is either soft or uneven in property. For details refer IS: 1893-1984.

12. **Staircases:**

- a) The interconnection of the stairs with the adjacent floor should be appropriately treated by providing sliding joints at the stairs to eliminate their bracing effects on floors. Large stairs shall preferably be separated from the rest of the building by means of separation or crumple section.
- b) Three types of stairs construction may be adopted, as below:
 - i) Separated Staircases: In this case, one end of the staircase rests on the wall and the other end is carried by columns and beams which have no connection with the floors. The opening between the floor and the staircase may be covered with some appropriate material which could crumple and fracture during an earthquake without causing structural damage. The supporting members, columns or walls are isolated from the roof by means of separation or crumple section
 - ii) Built-in Staircases: When stairs are built monolithically with floors, they can be protected against damage by providing rigid walls at the stair opening. Two walls enclosing the staircase shall extend through the entire height of the staircase and building foundation
 - iii) Staircase with sliding joints: In case it is not possible to provide rigid walls for built in stairs or to adopt separated stair case, the stair case shall have sliding joints so that they will not act as diagonal bracing. The sketches on above types of staircases are shown below:



13. **Fire safety:**

Fire frequently follows an earthquake and therefore, buildings should be constructed to make them fire resistant and in accordance with the provision of following IS code of fire safety – IS 1641:2013, IS 1642: 2013, IS 1643:2013, IS 1644:2013 and IS 1646: 2015.

Annexure 2.5 Fig. 1
Para 203(10)(m)(ii)

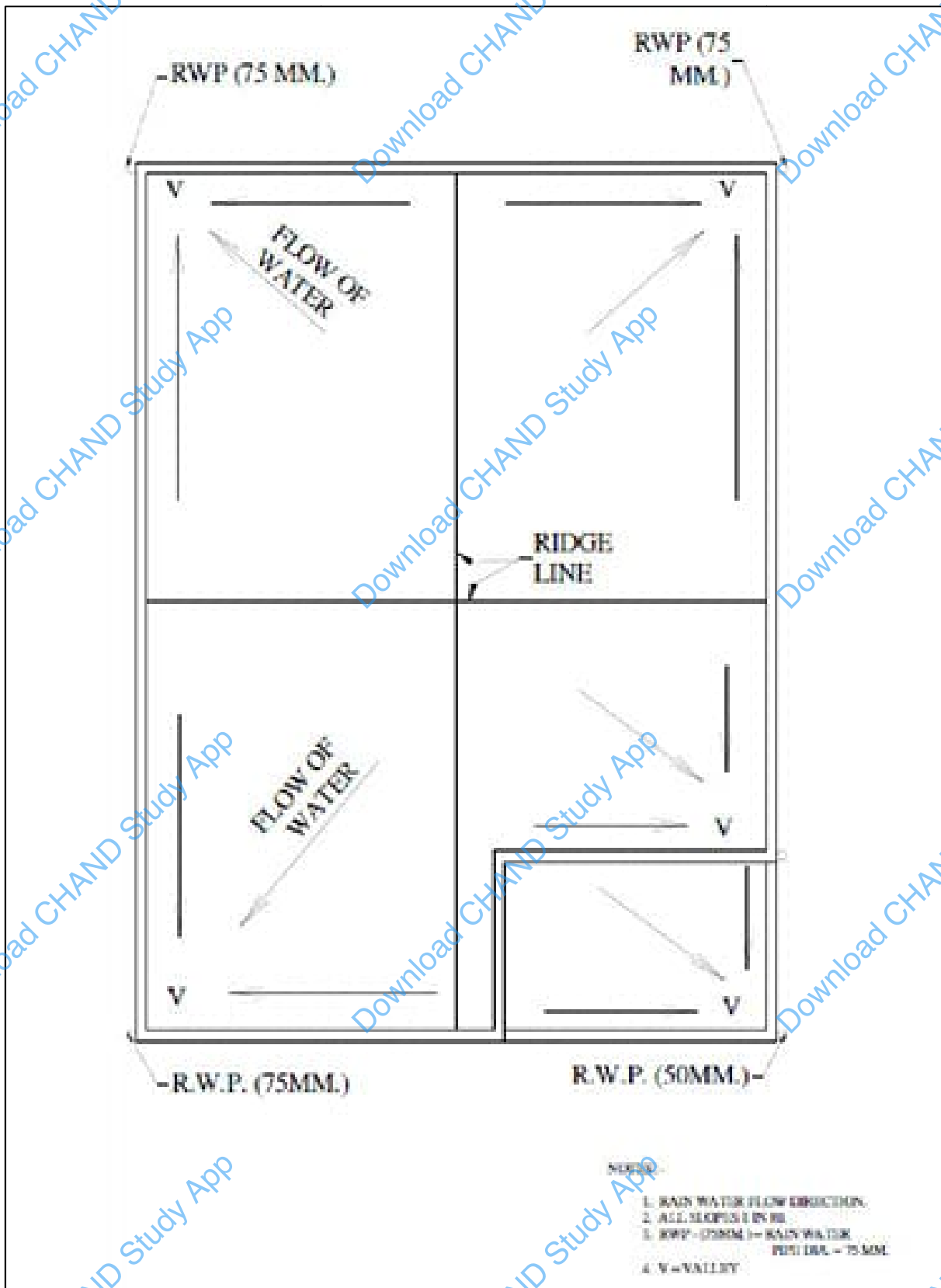


Fig. 1 – Roof Drainage Plan

Annexure 2.5 Fig. 2
Para 203(10)(m)(iii)

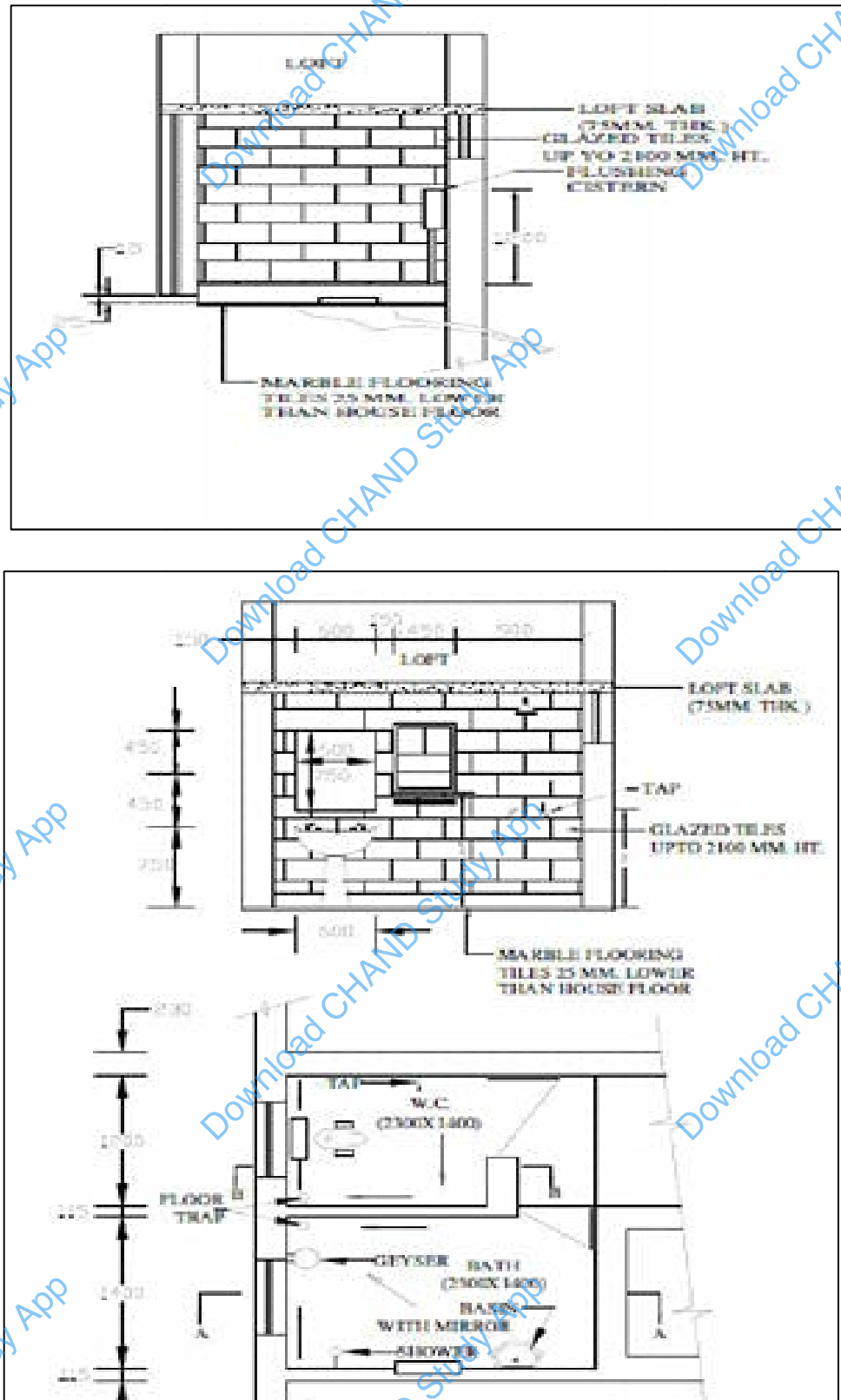
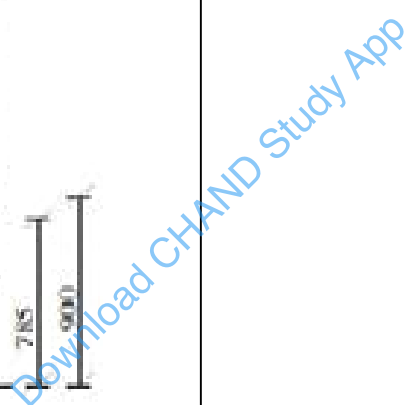


Fig. 2 Detail Plan of Toilet



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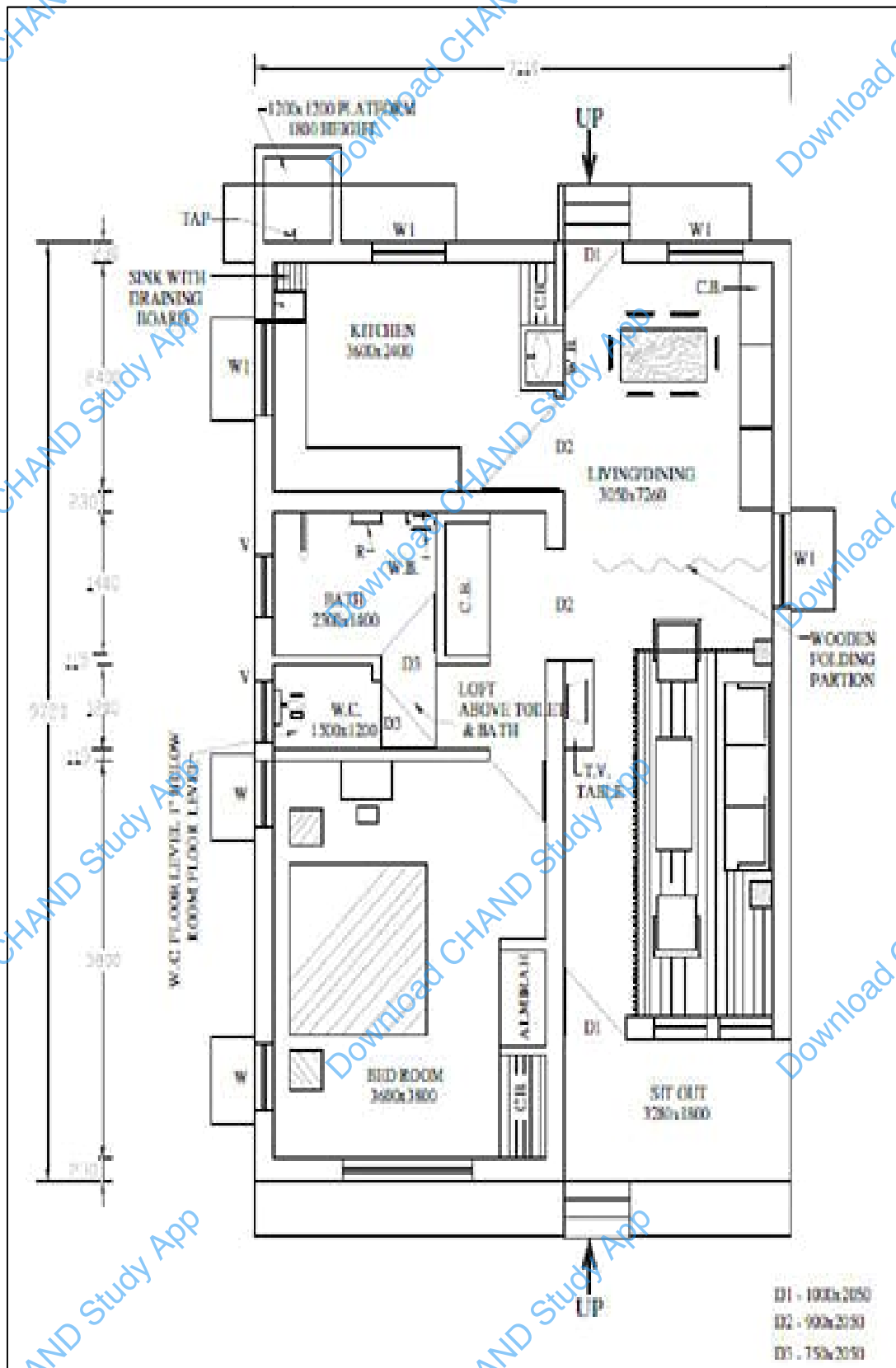


Fig. 4 Layout of Furniture & Furnishing

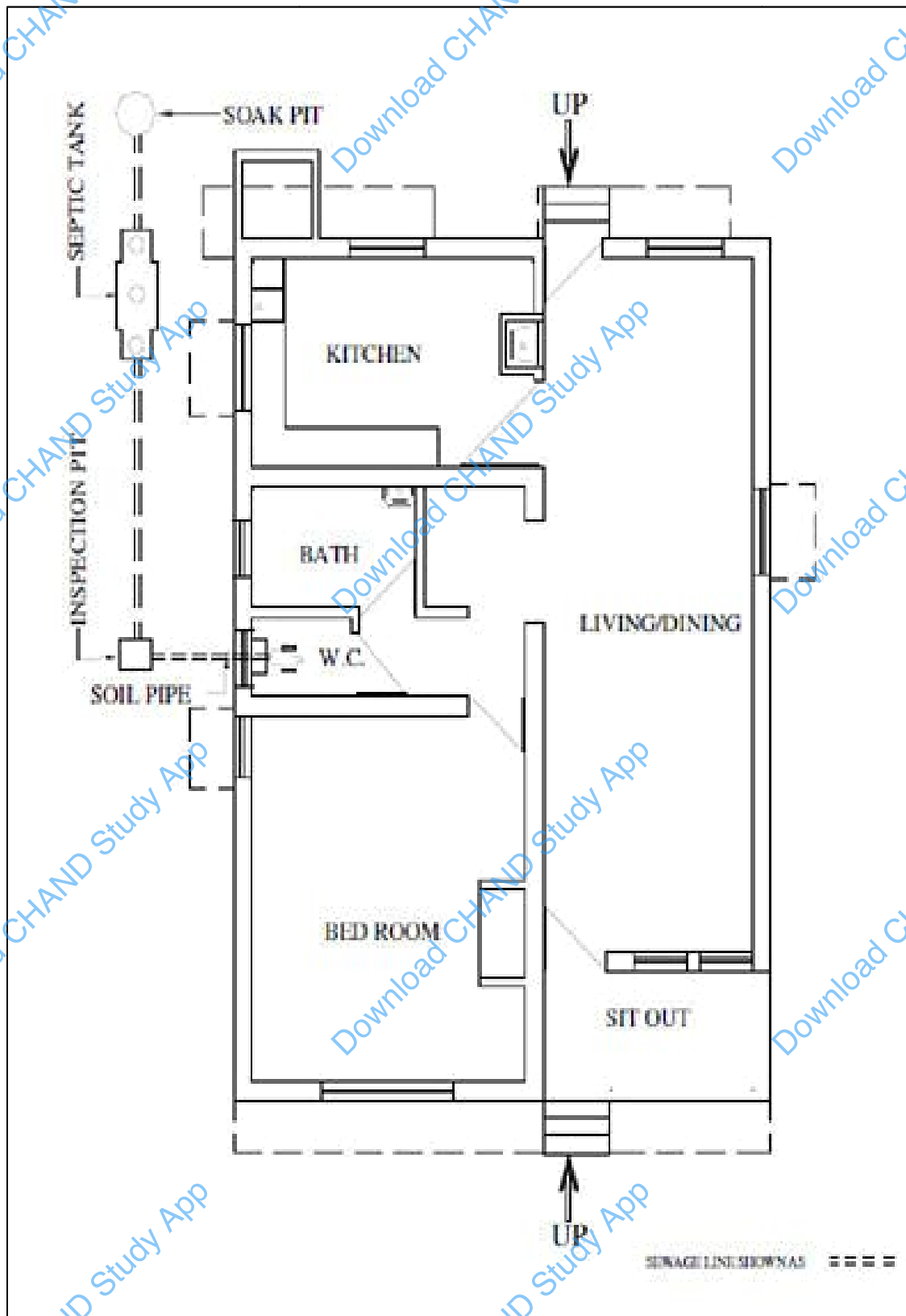


Fig. 5 Sewage Line Plan

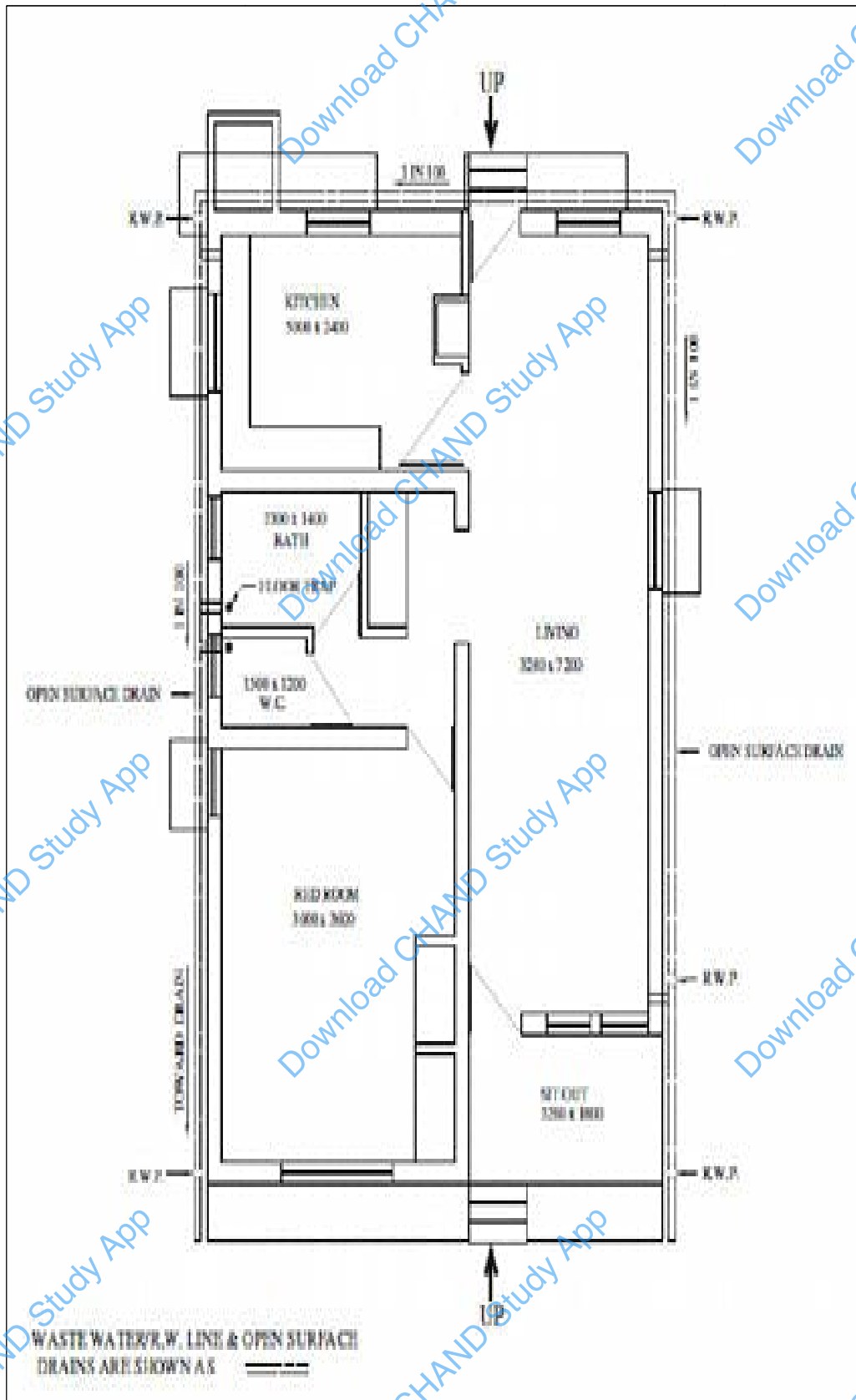


Fig. 6 Waster water / Rain Water (R.W.) Line & Open Surface Drain Plan

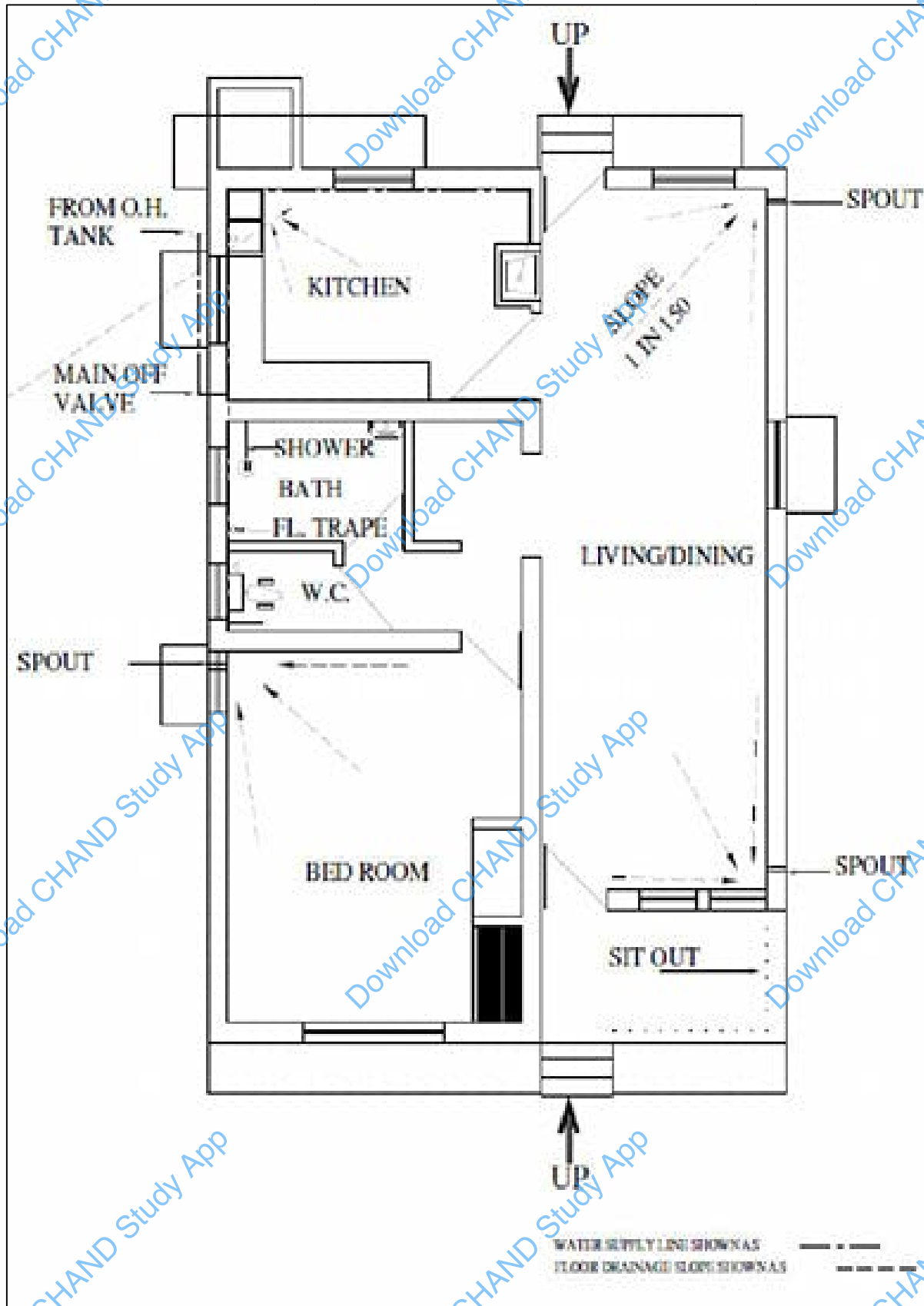


Fig. 7 Waste Supply & Floor Drainage Plumbing Plan

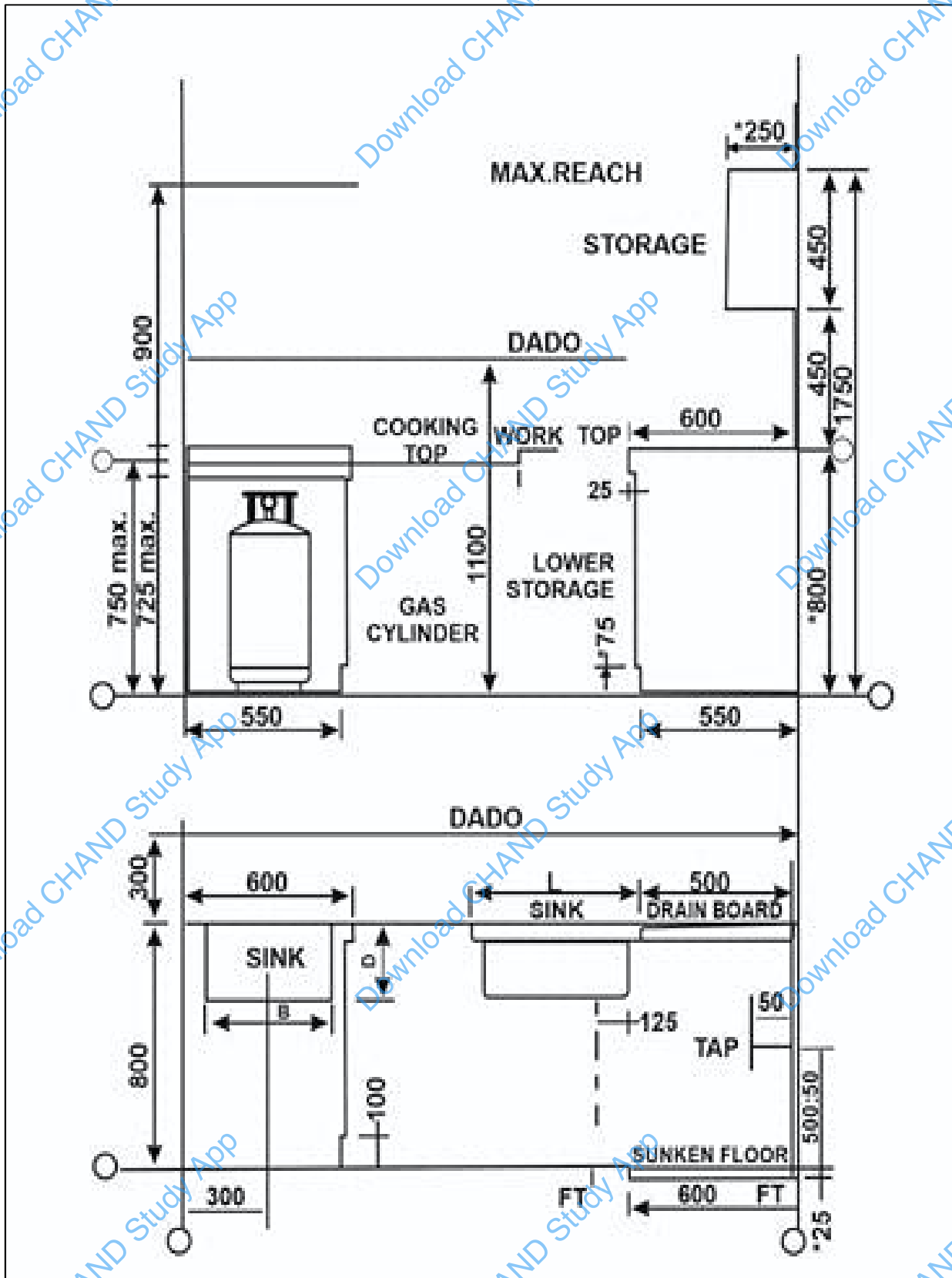


Fig. 8 Detail Dimensions of Kitchen

Annexure 2.5 Fig. 9
Para 203(10)(m)(vii)

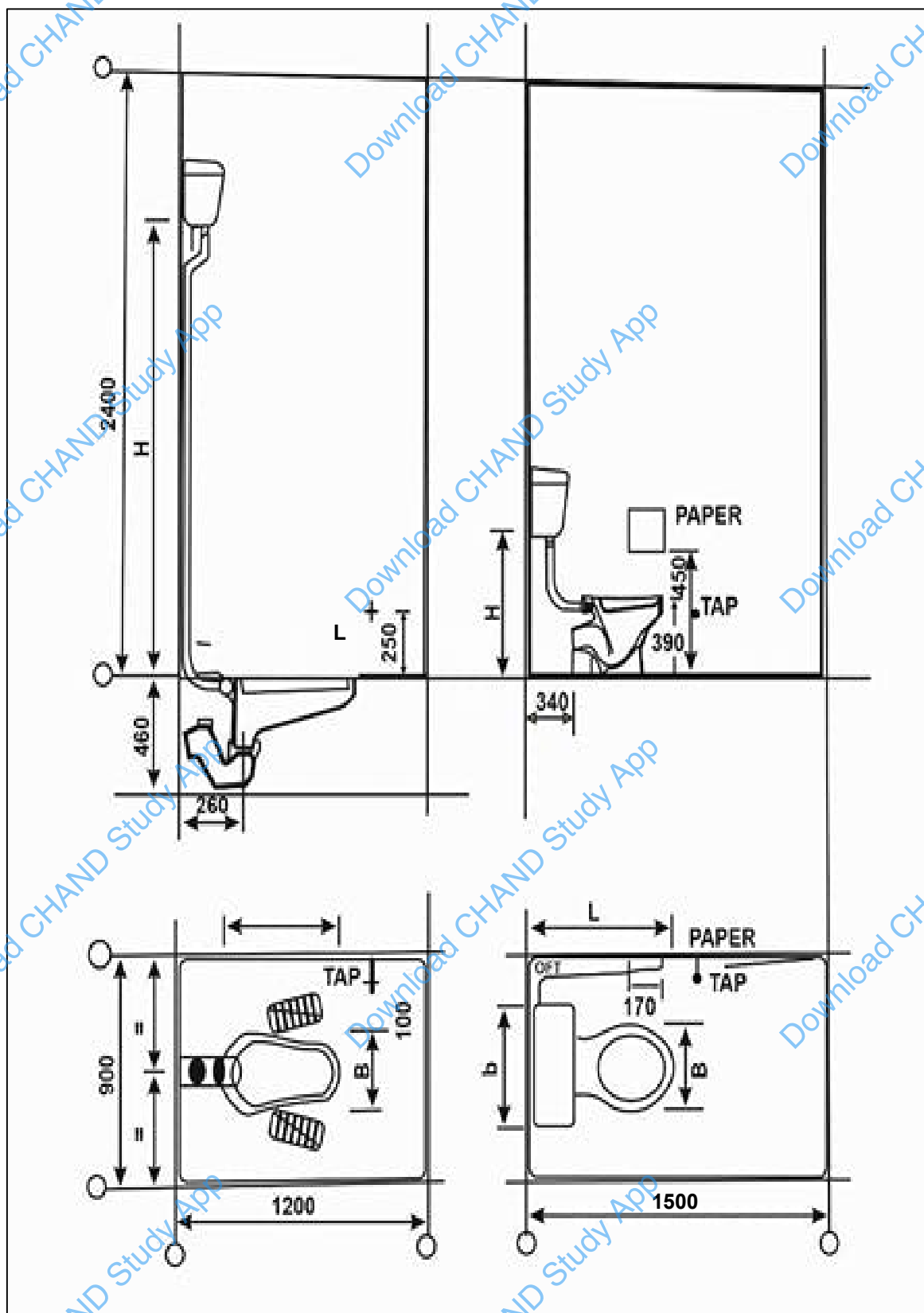


Fig. 9 Detail Dimension of Indian & Western WC

Annexure 2.5 Fig. 10
Para 203(10)(m)(vii)

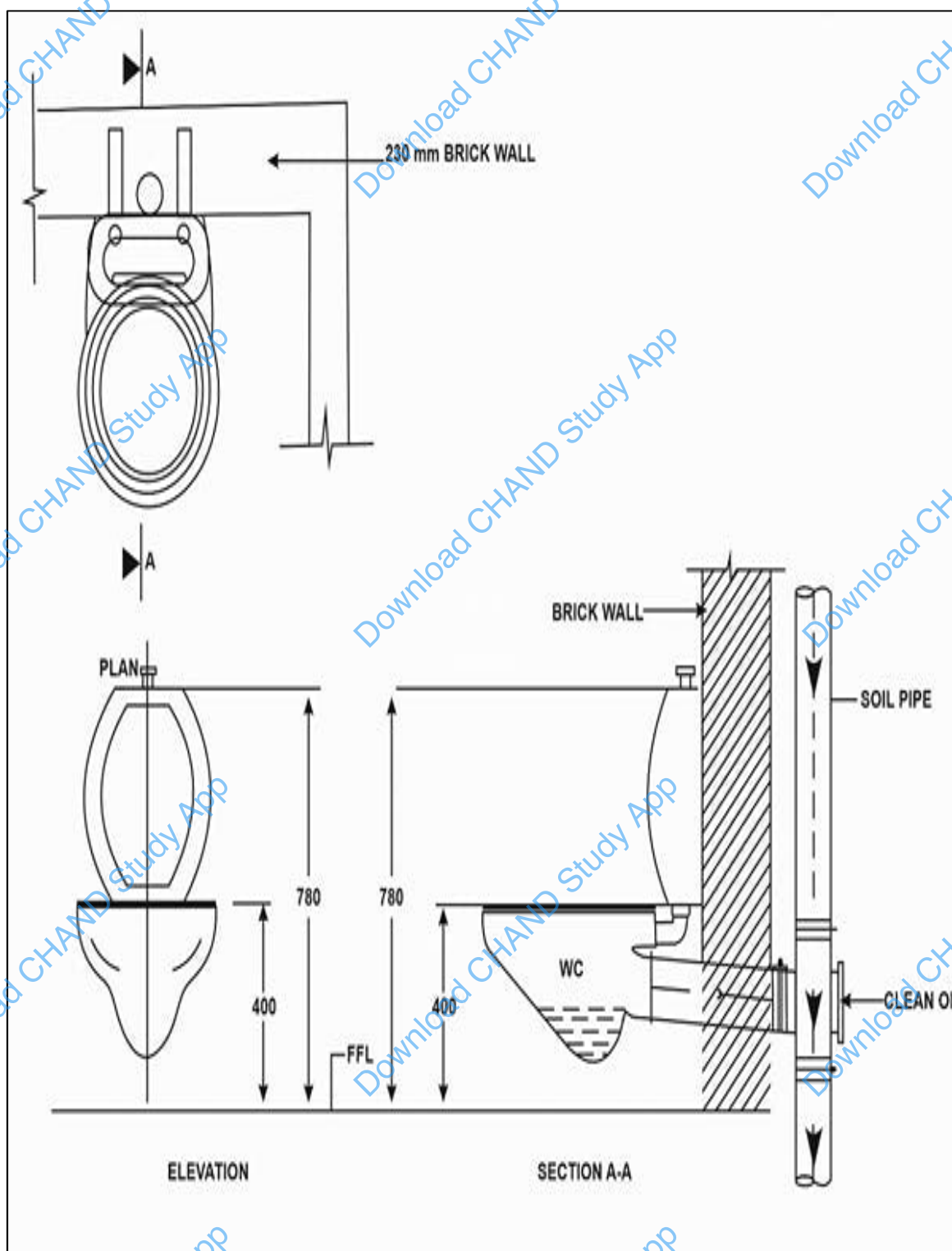


Fig. 10 Detail Dimension of European WC

Annexure 2.5 Fig. 11
Para 203(10)(m)(vii)

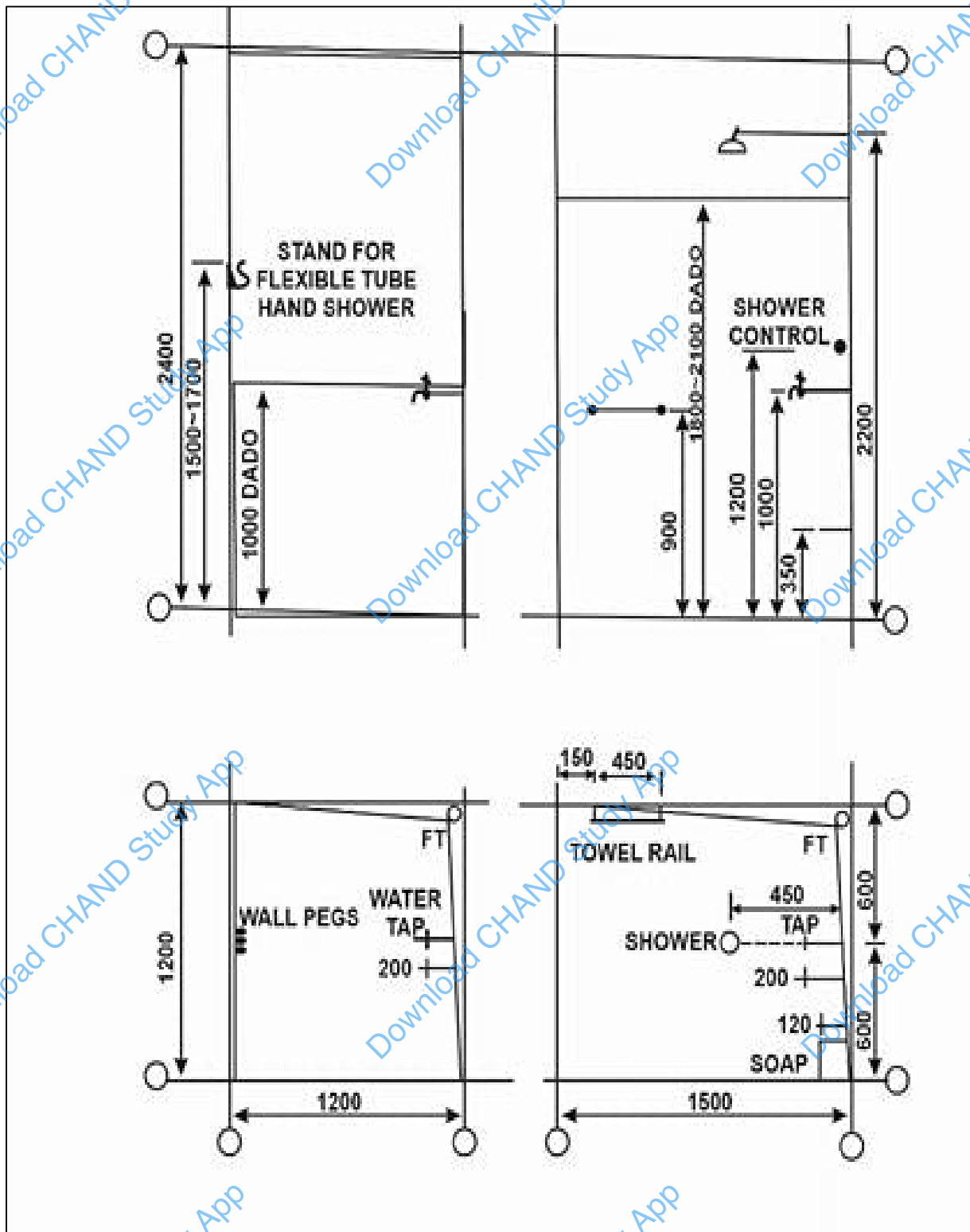


Fig. 11 Detail Dimensions of Bathrooms

Annexure 2.5 Fig. 12
Para 203(10)(m)(vii)

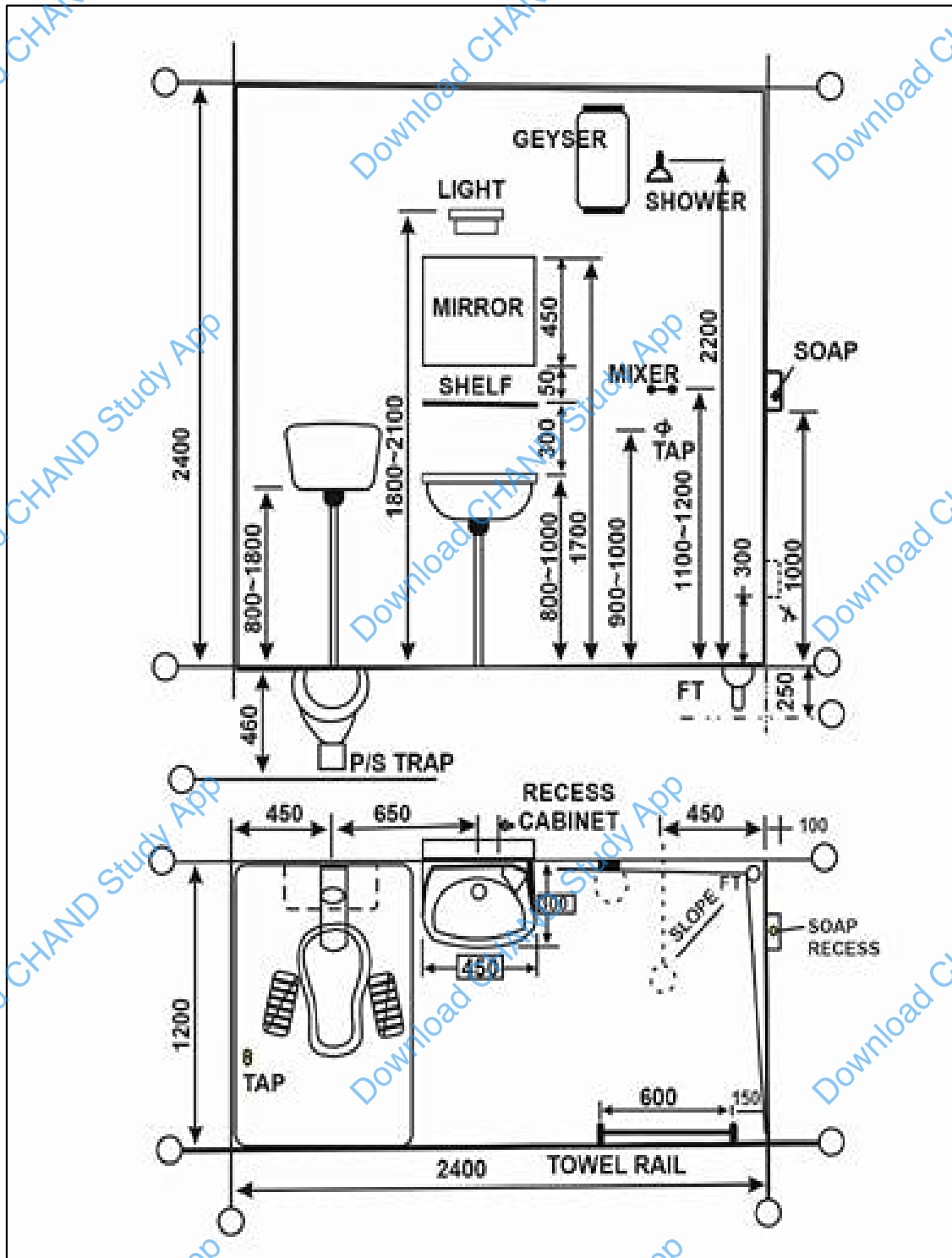


Fig. 12 Detail Dimensions of Bathroom

Annexure 2.5 Fig. 13
Para 203(10)(m)(vii)

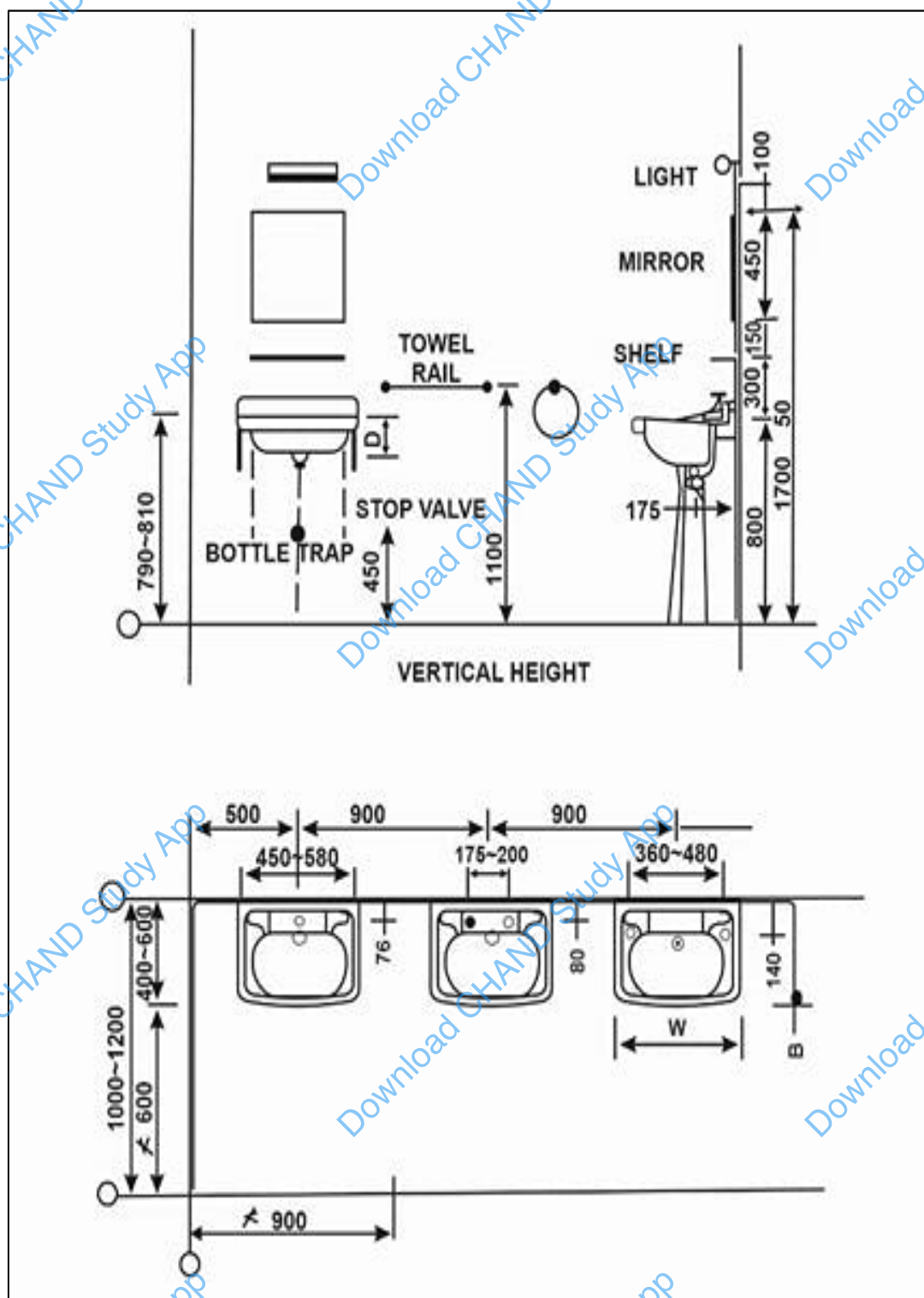


Fig. 13 Detail Dimensions of Wash Basin

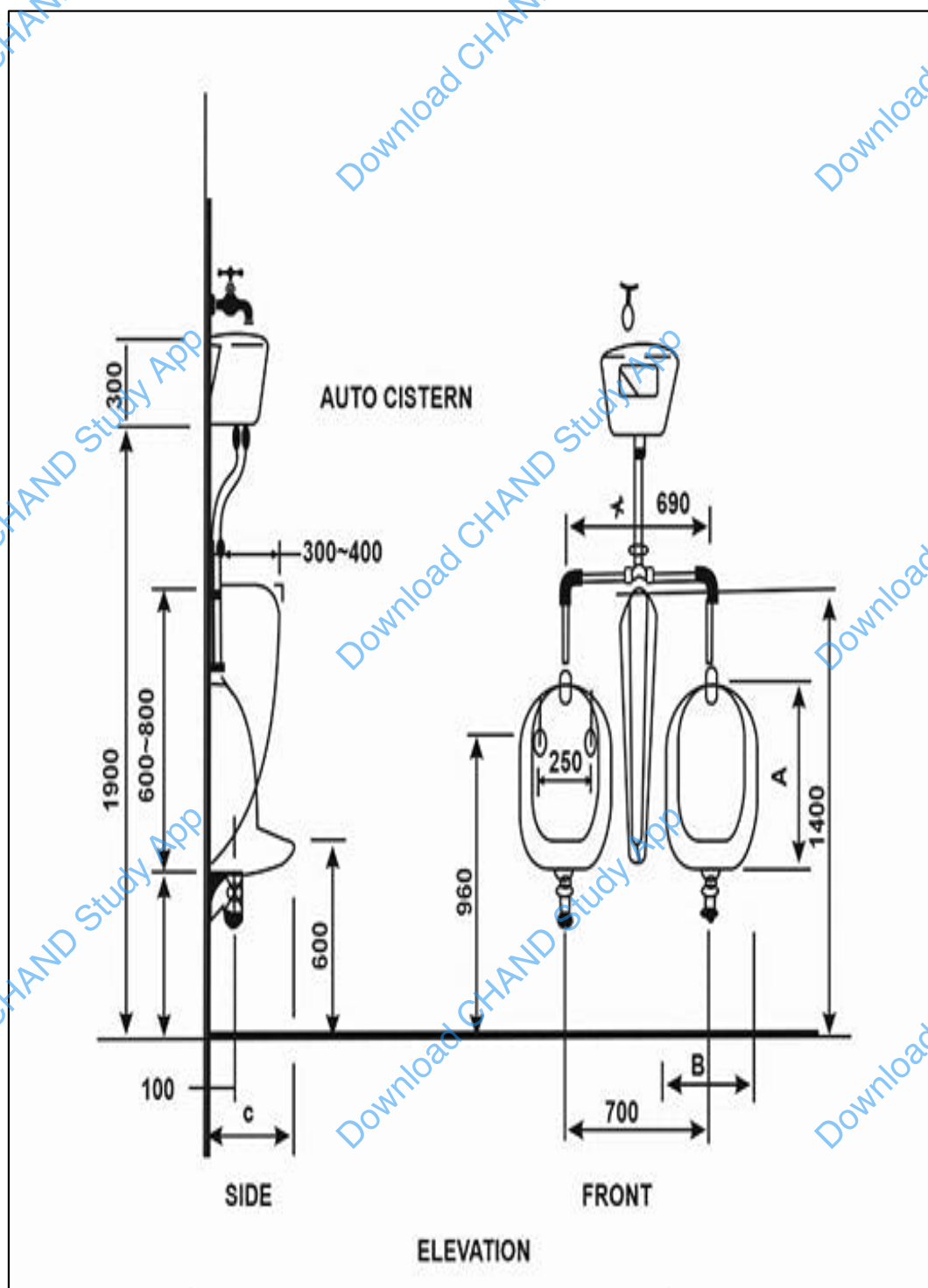


Fig. 14 Detail Dimensions of Urinals

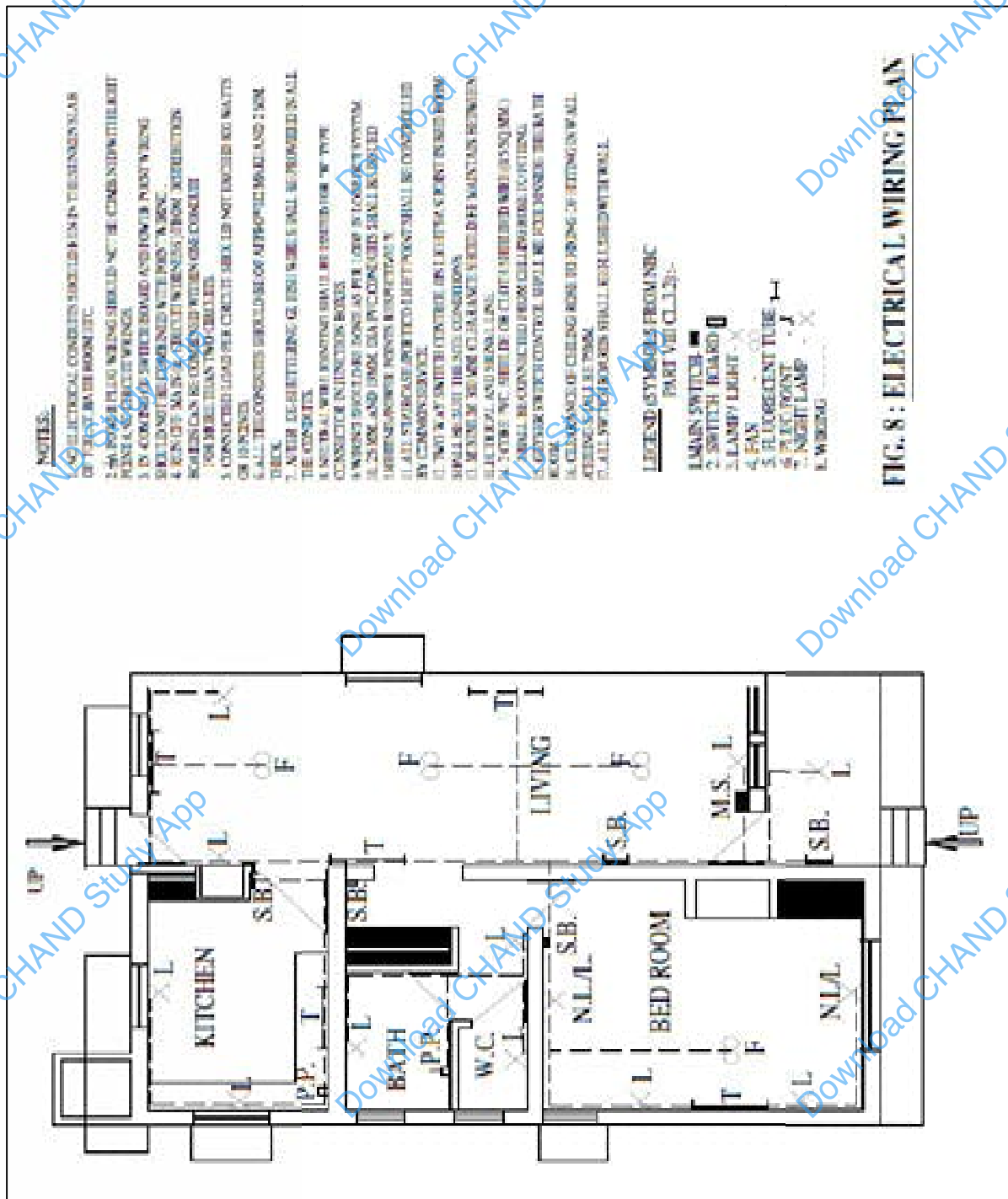


Fig. 15 Electrical Wiring Plan

Scale of Amenities for Various Residential Buildings

- A. Revised Plinth Area Norms
 B. General Design Guidelines for Railway Quarters
 C. Scale of Amenities for Architectural Services
 D. Scale of Amenities for Civil Fittings and Fixtures
 E. Scale of Amenities for Electrical Services
 F. General specifications – General specification of flooring, doors, windows, water supply, sanitary installation and other services

A. Revised Plinth Area Norms

Revised Plinth Area Norms for Dwelling Units from Type-I to Type-V and new Plinth Area Norms from Type-VI to Type VIII Quarters applicable for construction on Indian Railways for Railway Employees shall be as per Table Below in Sq. M:

Type	Unit	2013	2024
I (A)	Main Unit	49.5	No new construction
II (B)	Main Unit	63.00	75.00
III (C)	Main Unit	73.00	85.00
IV (D)	Main Unit	101.50	110.00
	Servant Unit	19.50	25.00
V (E)	Main Unit	161.50	161.50
	Servant Unit	25.00	25.00
VI (F)	Main Unit	229.00	229.00
	Servant Unit	25.00	25.00
VII (G)	Main Unit	331.00	331.00
	Servant Unit	23.5*2	25*2
VIII (H)	Main Unit	460.00	460.00
	Servant Unit	23.5*4	25*4

Note: Parking Norms: The parking norms of the local body shall be followed.

B. General Design Guidelines for Railway Quarters -

Guidelines given below may be adopted while designing Railway houses.

- Minimum floor to floor height may be kept as 3,000 mm.
- Generally, no room or space of less than 1,800 mm may be designed.
- The size of toilets may be minimum 1,500 mm x 2,100 mm, but it is desirable to design bigger toilets. All water closets must have a wash basin also.
- Generally, duplex units may be avoided. However, if designed, provision of pantry of adequate size may be made at the first-floor level.

- Utility balcony may be avoided on front side of the building. Utility Balcony to be provided in all unit types.
- Balcony must be provided in all the climatic regions of the country. These balconies may be enclosed with glaze windows only in the hilly regions. The area of balconies may vary with the design depending on the architectural & structure considerations. Minimum depth 1,200 mm
- Windows may be designed for window type ACs in all bedrooms, living and drawing rooms. Provision for power points and drainage of split/window type ACs may also be made.
- The layout of electrical points, fittings and fans shall match with furniture layout. The staircase and balcony railing may be made of SS 316 or cast iron or timber. Large size granite stone slabs may be used in common circulation areas.
- Community facilities like community hall, milk booth, vegetable shop, grocery store, dry-cleaning shop etc. may be provided, if required.
- The main entrance to the building may be designed for barrier free access. As far as possible, stilt may be avoided.
- Wherever required, additional area for staircase, circulation, porch and services like electrical sub-station, pump house, meter room, guard room etc. will be allowed over and above the norms. Staircase and circulation to be as per local bye laws/NBC.
- Shafts for services like water supply, drainage and sanitary pipes, electrical and communication lines will be allowed over and above the norms.
- Generally, no deviation from the prescribed norms should be made, but if any deviation becomes essential, proposal for such deviation should be referred to for specific approval of the owner organization on case-to-case basis.
- The proposed plinth area Norms are based on standard single brick wall of 230 mm (9") and shall be applicable to modular masonry of size 200 mm (8"). However, where the wall thickness has to be increased for technical reasons like cavity-wall for green building construction or for use of local material like stone etc. the plinth area may be suitably increased.

C. Scale of Amenities: Architectural (Main Unit)

SN	Category	Office	Drawing Room	Dining Room	Bed Rooms	Kitchen	Store	Number of Attendant's Unit	Utility Balcony	Toilets
1	Type-II	--	One	--	Two	One	--	--	One	Two
2	Type-III	--	One	--	Two plus study	One	--	--	One	Two
3	Type-IV	--	One	One	Three	One	-	One	One	Three
4	Type-V	--	One	One	Three	One	One	One	Two	Three
5	Type-VI	--	One	One	Four	One	One	One	Two	Three
6	Type-VII	One	One	One	Four	One	One	Two	Two	Four*
7	Type-VIII	One	One	One	Four	One	One	Two	Two	Four*
8	Attendant's unit	--	--	--	One	One	--	--	One	One

* One toilet (without bath) shall be provided attached with office.

D. Scale of Civil Fittings and Fixtures

SN	Item	Type- II &III		Type-IV		Type-V &VI		Type-VII & VIII		Attendant unit	
		Old	New	Old	New	Old	New	Old	New	Old	New
1	Kitchen										
(i)	Granite cooking platform	Yes	Yes	Yes	Yes	--	Yes	--	Yes	Yes	Yes
(ii)	Stainless steel 316 kitchen sink with drain Board	Yes 304 grade	Yes	Yes	Yes	--	Yes	--	Yes	Yes	Yes
(iii)	Modular cupboard with shelves and drawers	--	Yes	--	Yes	Yes	Yes	Yes	Yes	--	Yes
2	Built in wardrobe in each bedroom up to ceiling height, minimum about 900 mm wide and 600 mm deep. It may be made up of 18 mm thick blackboard or wood composite plastic or steel. The inner side of one shutter may have mirror of size 600 mm x 1200 mm approx.	Yes	Yes	Yes	Yes	Factory made wardrobe	Yes	Factory made wardrobe	Yes	Yes	Yes
3	Magic eye in front entry door	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Curtain rod with required accessories, except for kitchen and toilet doors and windows	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	18 mm thick granite window sill lining	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	Indian or European or wall hung WC pan with flushing cistern	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	Water jet spray/ Hand faucet with each IWC/EWC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
8	Wash basin with CP brass mixer tap in each toilet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Wash basin in balcony. Tap for washing machine	No	Yes	No	Yes	No	Yes	No	Yes	No	No
10	Taps in kitchen, toilets and balcony, director supply connection in kitchen	Yes Not in Balcony	Yes	Yes Not in Balcony	Yes	Yes Not in Balcony	Yes	Yes Not in Balcony	Yes	Yes Not in Balcony	Yes
11	Swan neck CP brass mixer tap in kitchen sink	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
12	Shower with CP brass mixer tap	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
13	SS 316 towel rail	Yes CP	Yes	Yes CP	Yes	Yes CP	Yes	Yes CP	Yes	Yes CP	Yes

		Brass		Brass		Brass		Brass		Brass	
14	SS 316 toilet paper holder	Yes CP Brass	Yes	Yes CP Brass	Yes	Yes CP Brass	Yes	Yes CP Brass	Yes	No	Yes
15	Mirror of size 450 x 600 mm or of bigger size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
16	Granite quadrant of 250 mm radius near shower, one at 1200 mm and second at 1500 mm height	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
17	Plumbing for water filter and geyser	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	Terrace water tank of 500 litres Capacity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19	Facility for IGL pipeline, where Applicable	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
20	PVC pipe for drainage of water from ACs	No	Yes	No	Yes	No	Yes	No	Yes	No	No
21	Provision for window A/Cs in each Room	No	Yes	No	Yes	No	Yes	No	Yes	No	No
22	Provision for split A/Cs in each room	No	Yes	No	Yes	No	Yes	No	Yes	No	No

E. Scale of Electrical Fittings and Fixtures

SN	Item	Type- II & III	Type- IV	Type- V&VI	Type-VII & VIII	Attendant unit
1	Light fittings, minimum one in each room and kitchen	Yes	Yes	Yes	Yes	Yes
2	Bracket or decorative lights, minimum one in each room balcony, each toilet and mirror light for each bathroom	Yes	Yes	Yes	Yes	Yes
3	Fans (minimum one decorative in each (room))	Yes	Yes	Yes	Yes	Yes
4	Modular switches	Yes	Yes	Yes	Yes	Yes
5	5 A sockets (minimum two in each room and kitchen)	Yes	Yes	Yes	Yes	Yes
6	15 A sockets (minimum two in each room and kitchen)	Yes	Yes	Yes	Yes	Yes
7	15 A socket with MCB for geyser in each toilet and kitchen	Yes	Yes	Yes	Yes	Yes
8	15 A socket with MCB for AC in each room	Yes	Yes	Yes	Yes	-
9	5 A and 15 A sockets, one each, in balcony, and utility area, store	Yes	Yes	Yes	Yes	Yes
10	Call bell near main door	Yes	Yes	Yes	Yes	Yes
11	Electric chimney in kitchen	-	-	Yes	Yes	-
12	Fresh air exhaust fan in kitchen and each toilet	Yes	Yes	Yes	Yes	Yes
13	25 liters geyser in each toilet	Yes	Yes	Yes	Yes	-

14	Telephone and cable TV sockets & modular mobile charging socket each room	Yes	Yes	Yes	Yes	Yes
15	Electrical points for water filter and oven	Yes	Yes	Yes	Yes	Yes
16	Electrical point for fridge and washing machine	Yes	Yes	Yes	Yes	Yes
17	Call bell point with image display system			Yes	Yes	
18	Dressing light point	Yes	Yes	Yes	Yes	Yes

F. GENERAL SPECIFICATIONS

The materials, specifications and design values given here are only illustrative. Use of local and renewable materials shall be preferred. The actual design values may vary according to type of building, bye-laws, and special requirements, if any.

SN.	Description	Specifications and design
Civil		
1	Foundation	
i	Bearing capacity	60 kN/m ² at 2500 mm below the ground level
ii	Ground water table	7 metres below ground during rainy season
iii	Type	Bored cast in situ RCC piles of M30 concrete with minimum cement content of 350 kg/m ³
iv	Masonry	Fly ash cement concrete bricks in cement mortar 1:6
2(a)	Superstructure	RCC framed structure
i	Concrete mix	M 30
ii	Rebars	Corrosion resistant Fe 550 D
iii	External walls	230 mm thick fly ash cement concrete brick masonry with cement mortar 1:6. OR 200 mm thick autoclaved aerated concrete blocks laid with adhesive.
iv	Internal Walls	115 mm thick fly ash cement concrete brick masonry with cement mortar 1:4. OR 100 mm thick autoclaved aerated concrete blocks laid with adhesive.
2b	Superstructure	Load bearing masonry in burnt clay FPS bricks.
i	Load bearing walls	230 mm thick brick masonry in cement mortar 1:6.
ii	Partition walls	115 mm thick brick masonry in cement mortar 1:4.
3	Doors	
i	Entrance Door	2 nd class teak wood frame and 2- leaf shutters. 35 mm thick decorative flush door shutter. The frames will have double rebate for wire mesh shutters.
ii	Room frames	2 nd class teak wood or UPVC.
iii	Room Shutters	35 mm thick decorative or commercial flush door.
iv	External doors	35 mm thick flush door shutters or UPVC. Exposed face of shutters in balcony or mumty will be protected with 1 mm thick PVC rigid foam sheet fixed using rubber-based adhesive.
v	Toilets	Frames and 25 mm thick shutters made of wood fibre composite board of density 650 kg/m ³ .
vi	Wire gauze shutters (for all external doors)	Wire mesh of SS 304 stainless steel.
vii	Architraves	Teak wood or wood fibre composite or UPVC.
4.	Windows	
i	Frames	2 nd class teak wood or UPVC extruded profiles having 2.3 mm thick wall.
ii	Shutters	2 nd class teak wood or UPVC extruded profiles having 2.3 mm thick wall.

iii	Fixed glazing	2 nd class teak wood or UPVC extruded profiles having 2.3 mm thick wall.
iv	Toilets	5mm glass louvers in colour anodized aluminum frame
v	Wire gauze shutters (for all external)	Wire mesh of SS 304 stainless steel.
vi	Window sill level	Rooms: 900 mm, Toilets: 1225 mm, Kitchen: 1225 mm
5	Wardrobes	Boxes and shelves of 19 mm thick commercial block board, shutters of 19 mm teak veneered or laminated or commercial block board. OR boxes, shelves and shutters of 18 mm thick wood fibre composite board of density 650 kg/m ³ . 20 mm diameter aluminum hanger rods with slotted (non screw type) brackets. Clear distance of hanger rod below the board bottom: 40 mm. Or S.S 304
6	Kitchen cupboards	Boxes shelves and shutters of teak veneered or commercial or laminated 19 mm thick block board OR 18 mm thick wood fibre composite board of density 650 kg/m ³ . Stainless steel drawers with telescopic channel.
7	Hardware fittings	SS 304 stainless steel. OR colour anodized aluminum 125 *64*1.90 mm stainless steel butt hinges
8	Curtain rods	Elliptical shaped SS 304 stainless steel with heavy duty non-screw type brackets and finials. Height 100 mm above window top.
9	Flooring and skirting	
i	Circulation areas	18 mm thick gang saw cut granite of light shade with contrast border. The skirting will not project beyond wall surface. Staircase skirting will be parallel to waist slab.
ii	Rooms	18 mm thick gang saw cut granite of light shade.
iii	Kitchen	Satin matt vitrified tiles of minimum size 600*600 mm.
iv	Kitchen platform	18 mm thick gang saw cut black granite; edges rounded. Height above finished floor level: 900 mm Granite slab will be supported over 19 mm thick block board boxes, no RCC slab is required for modular kitchen platform.
v	Kitchen dado	Above platform: 600 mm high with vitrified tiles of size 600*600 mm OR with ceramic tiles of size 600*300mm. Elsewhere full height dado of same tiles.
vi	Toilets and WC	Anti-skid ceramic tiles of size 300*300 mm. Two granite corners of 250 mm radius will be fixed in wall near shower, first at 1200 and second at 1500 mm height.
vii	Toilet dado	Vitrified tiles of size 600*600 mm OR ceramic tiles of size 600*300 mm up to ceiling. One decorative band.
viii	Wash basin counter	Counter and 100 mm high skirting with 18 mm thick gang saw cut black granite. Edges rounded. 1500 mm high dado of vitrified tiles of size 600*600 mm OR 1500 mm dado of ceramic tiles of size 600*300 mm. Only under countertop wash basins will be used.
ix	Window sill	18 mm thick gang saw cut black granite, edges rounded, and projecting 12mm from finished wall surfaces.
10	Parapet walls	1200 mm high, 230 mm thick. Top finished with black granite, sloping inwards edges rounded, projecting 12mm from finished wall surfaces.
11	Balustrade/railing	1200 mm high powder coated aluminum sections or factory-made SS 304 stainless steel. OR cast iron.
12	Terracing	Vitrified tile of size 600*600 mm with adhesive or crazy marble flooring. The RCC roof slab will be cast with a slope of 1:100.
13	Sanitary fittings	CP brass fittings Sanitary ware of reputed brands. Rigid PVC or GI waste pipe for wash basins and kitchen sinks.
14	Sanitary ware height	Wash basin top: 800 mm Urinal lip top: 600 mm Shower: 2100 mm Mirror: 1200 mm Towel rail: 1500 mm WC faucet: 300 mm
15	Internal services	

i	Rain water pipes	150 mm diameter UPVC pipes clamped over MS heavy duty brackets 50 mm away from wall surface.
ii	Soil and waste pipes	100 mm diameter centrifugally cast (spun) iron pipes and fittings. OR UPVC pipes and fittings. All pipes shall be 50 mm away from wall surface, clamped over MS heavy duty brackets. No pipe will be < 75 mm diameter.
iii	Floor traps	Long arm P-type floor traps placed at a corner of toilet Each floor trap outlet will be separate and join the vertical stack externally. No Nahani traps shall be used.
iv	Spouts	75 mm diameter UPVC OR GI spouts, projecting 150 mm beyond wall surface, sloping outwards, laid 5 mm below floor level. End of pipe shall be cut at 45°.
v	Sewer lines	HOPE pipes. Cushion of 600 mm. vi Manholes At 30 metre centres, and at bends and junctions.
vi	Manholes	At 30 metre centres, and at bends and junctions.
vii	Terrace tanks	4 PVC tanks of 1000 litres capacity each, with screw type lid. Tanks will be placed over 1200 mm wide RCC slab cantilevering from a beam spanning over two columns. The top of slab will be 900 mm above the terrace level. OR SS
16	Finishing	
i	Cement plaster	1:6 mortar with well graded coarse sand.
ii	Internal walls, ceiling	Low VOC acrylic paint over cement-based putty.
iii	External walls	Low VOC textured or smooth acrylic paint over cement-based putty.
iv	Wood and steel	Synthetic enamel paint.
v	Brick-RCC junction	200 mm wide polypropylene wire mesh with U-clip will be used at the junction before plastering.
17	Modular Kitchen	The cabinets will be made of 18 mm thick wood fibre composite board of density 650 kg/m ³ OR galvanized steel. No RCC slab is required for kitchen platform.
18	Clothes lines	Three or four rows of PVC coated steel wire 450 mm apart, tied to 75 mm long J hooks fixed with m-seal.
Electrical		
1	Wiring	FRLS PVC insulated single core copper wiring of 1.5 mm ² for light and 4 mm ² for power points. Concealed wiring in recessed medium class PVC conduits. Separate conduits from mains for wiring of essential, non-essential, and UPS distribution system.
2	Electrical fittings	Modular switches and sockets. Energy efficient LED luminaries of minimum 110 lumen per watt. 5-star, brushless direct current motor fans of 1200 mm sweep. Occupancy sensors. Master switch outside hostel and guest house rooms. Fittings will be provided as per furniture lay out. Minimum two 5A and one 15A sockets will be provided in each room. Fans and light shall be fitted symmetrically as per furniture lay out Height of fittings: Switch board centre: 1200 mm Tube light or lamps: 2400 mm, 16A sockets: 300 mm
3	Exhaust fans	125 mm inline duct booster exhaust ventilation fan
4	Escape lighting	Escape routes to get illuminated from an independent power source within 5 sec of power failure. The luminaries shall be mounted at 2400 mm height.
5	Exit signage	Green colour photo luminescent exit signs of size 450*150 mm at 2400 mm height at 30 m intervals and at all changes in direction.
6	Distribution Boards	Powder coated, prewired DBs with detachable cassette for safe removal of MCBs, RCCBs and terminal blocks.
7	Phone and TV	Only on specific requirement, telephone and coaxial TV cables will be provided in recessed PVC conduits.
8	LAN	Core switches, L2 switches, gigabit switch, SFP modules, OFC, Wi-Fi access and controller.

9	Uninterruptible power systems	Online (double conversion voltage and frequency independent) UPS shall comply with IEC 62040-3 to provide continuous power to life safety circuits and sensitive equipment. It must have both static bypass switch and manually operated bypass switch for maintenance. Battery banks shall be designed to provide at least 30 minutes back-up at full load.
10	Lifts	Two regenerative lifts of 20 persons capacity each, with speed of 1.5 m/s, microprocessor-based control, and variable voltage variable frequency drive system for AC motor. It should be equipped with automatic rescue device and maintenance free dry batteries; it should meet accessibility requirements for especially abled persons. like minimum lift size of 1500 mm x 1500 mm, minimum door width of 900 mm, call button, control panel, hand rails, and audio and visual indicators
11	Air-conditioning	Two modular air cooled variable refrigerant flow outdoor units of 20 HP capacity each with inverter type scroll compressor and R410 A refrigerant, suitable to deliver coefficient of performance (CoP) of minimum 4.7 at 50% load. High wall type indoor units of 2 TR capacity each.
12	Fire alarm system	The intelligent addressable fire alarm system (AFAS) will integrate public address, lifts, firefighting, pressurization and smoke management systems.
13	Firefighting system	The wet riser system will consist of electric pump, diesel pump, jockey pump, all suitable for automatic operation and control panel for pumps in a pump room near the underground sump, delivery pipe, terrace pump and air vessel. Powder coated MS glazed cabinet will be provided for wet riser shaft on each floor to encase one 150 mm diameter C class MS delivery pipe, fire hose box containing two reinforced rubber lined hose pipes each of 63 mm diameter and 15 m length with 20 mm diameter nozzle, powder coated MS hose reel disc with 30 m long rubber braided hose of 20 mm nominal diameter and 19 m shut off nozzle and hydrant landing valve. Four-way and three-way fire brigade inlet connection valves will also be provided in the sump and riser respectively. The landing valve, hose coupling, fire brigade inlet connection valve etc., will be of stainless steel. The yard hydrant will consist of ring main of 200 mm diameter C class MS pipe, hydrants spaced at 45 metre centres and connected to ring main with 80 mm diameter MS pipe, and fire hose box containing two reinforced rubber lined hose pipes each of 63 mm diameter and 15 m length with 20 mm diameter nozzle. The clear size of wet riser shaft will be 1200*800 mm. (This is as per Railway Board letter No. 2024/LMB-II/2/3 dated 05.04.2024)
14	Ventilation system	The basement and corridors will have supply air fans, ducts, grills, and exhaust air fans. The lift shaft, lift lobby and staircase will have pressurization system consisting of axial flow fan. Fan motor and casing shall be suitable for smoke exhaust application having thermal rating of 250 °C for 2 hours as per BS EN12101-3: 2015. The ventilation system will be designed for minimum 12 air change per hour and pressure differential of 25 to 30 Pa.
15	Lightning protection	Single prong finial with GI tape of 20 mm*3 mm suitably earthed to the ground.
Bulk services		
1	Compound wall	Low height compound wall is preferable. The maximum height may be 2100 mm, with 1500 mm high masonry and 600 mm high MS grill. The length of each wall panel may be 3600 mm centres. Expansion joint will be provided at 45 metre centres. The entrance gate, wall panels, coping, and grill will be designed aesthetically. About 1200 mm wide strip along the wall will be used for plantation, laying cables and pipes.
2	Buildings in hills	Hill slopes of up to 30° are generally stable. Therefore, building sites will be located on hillside with slope is 45°, preferably on south slope for more heat gain. Stepped terrace development and stepped storey construction will be adopted for economy and environment protection.
3	Levelling	The entire plot will be levelled to a slope of 300:1 to allow natural drainage of rain water.

4	Internal roads	6-meter-wide carriage way with 2% camber. 750 mm wide unpaved shoulders on both sides sloping outwards to drain off rain water. Paver finished bituminous road section will consist of 150 mm GSB, 150 mm WMM 50 mm BM and 40 mm thick bituminous concrete OR 150 mm thick vacuum dewatered M 30 concrete laid over 100 mm thick base of M10 concrete, in chequered bays of maximum 3*3 metre size. The grooves will be 5 mm wide, 50 mm deep and filled with suitable sealant
5	Footpath	200 mm high and 1200 mm wide footpath finished with 60 mm thick paver blocks of M30 and kerb stone
6	Tube Well	One 200 mm diameter, 100 m deep tube well with uPVC pipe. Distribution network of CPVC pipes
7	Underground Sump	RCC sump of 200 kl capacity, with 10 HP submersible pump. The floor and walls will be finished with vitrified tiles of size 600*600 mm. The first compartment of 100 kl will be used for firefighting.
8	Filtered water supply	Tube well water will be chlorinated and fed into the UG sump. Water from the sump will be pumped to terrace tanks through CPVC distribution lines.
9	Sewerage system	HOPE pipes of 300, 200, and 100 mm diameter laid to minimum slope of 300:1. Manholes at 30 m intervals. 100 kl sewage treatment plant on MBBR technology
10	Recycled water	Treated water from STP will be collected into a sump and pumped for horticulture purpose through CPVC distribution lines. The hydrants will be of ball cock type.
11	Rainwater harvesting	2 pits each of size 1.5*2*2 m with bore well of 100 mm diameter and 15 m depth
12	Sub-station	Two 1250 kVA, 5-star, 3 phase dry type 11 kV/433-250 V transformers, HT panel, LT panels, APFC panel, and surge protection device.
13	DG set	Two 250 kVA 3 phase DG set with AMF panel mounted on platform of size 7000*6000 mm. Shed of MS tubular truss and galvalume sheet.
14	Solar power	On grid, roof top solar PV plant of 250 kWp installed capacity with monocrystalline cell panels of minimum 20% efficiency. Power conditioning unit. Net metering and data monitoring system.
15	Street lights	LED fitting over 9 m high ornamental MS/CI poles
16	Horticulture works	Grassing in select areas, tree and shrub plantation
General		
1	Floor height (minimum)	Residential: 3000 mm Non-residential: 3300 mm 3600 mm with sprinklers. False ceiling height 2700 mm
2	Pantry	Pantry of minimum 1800 width may be provided on each floor of a non-residential building. It may have 600 mm wide platform and one kitchen sink
3	Toilets	Each water closet will be provided with a wash basin Wherever feasible, sanitary ware will be provided on external wall of the building. The clear depth of sunken slab for Indian WC will be 600 mm and that for EWC will be 300 mm to accommodate pipes, traps, and slope
4	Accessible terrace	All the buildings with flat roof will have accessible terrace for ease of maintenance.
5	Retaining walls	Generally, the hill slope will not be cut steeper than 60 o from the horizontal for its stability. Where unavoidable, retaining wall will be provided with weep holes of 100 mm diameter PVC pipes at 1500 mm centres in staggered manner embedded at 10 o downward slope, projecting by 150 mm beyond the wall on the valley side. Inverted filter will be provided behind the wall. About 300 mm thick silty clay layer of back-fill with grass will be provided flush with the top of retaining wall to prevent seepage of water in the back-fill. The back-fill itself will be of self-draining soil like coarse sand or gravel, free of fines. Grass turfing on toe side to prevent toe erosion

Scale of Amenities for Service buildings / Hospital and Dispensaries

SN	Description of Item	Proposed System Hospital/Service buildings excluding workshop
1	Flooring	
a)	In rooms, internal circulation area	Vitrified tiles/Terrazzo/Marble/flooring with white cement.
b)	Common circulation area, staircase	Kota/Similar stone flooring/ vitrified/ granite/ processed marble and matching skirting up to 150 mm.
c)	Toilets/Urinals	Anti-Skid Ceramic Tiles
d)	Skirting / Dado in Urinals.	Ceramic glazed tiles up to ceiling height with a decorative band of tiles.
2	Finishing	
a)	External	To be decided on the basis of importance of building & utilities.
b)	Internal Walls	To be decided on the basis of importance of building & utilities.
c)	Wood work and steel work.	To be decided on the basis of importance of building & utilities.
3	Frames	
a)	Window	Pressed steel frames /Aluminum sheets/ Wood work
b)	Door	Pressed steel frames /wood work/ factory manufactured precast RCC frames/Aluminium.
4	Shutters	
a)	Window	Steel Glazed shutters/ Aluminium window/ wood work. Shutter to match with frame. Wire mesh shutters also to be provided
b)	Doors	30mm thick flush door with paintable surface.
c)	W.C. Bath room	Solid PVC shutters 30 mm thick or wood work or equivalent
5	Fittings	Powder coated Aluminium (Anodized) / Stainless steel fittings
6	Window sill lining 18mm thick projected with Kota stone/marble	Marble /Kota Stone/ granite
7	W.C.	Indian/European type WC matching low level system with water jet as per requirement
8	Wash basin with one tap each	One in each WC/Toilets & Operation theatre etc. as per approved master plan of hospital.
9	Towel rail C.P. Brass / PTMT	One C.P. brass in all toilet attached with room.
10	Mirror with Beveled edge /P.V.C. frame with glass tray	One in each toilet/bath.

Notes:

1. The above standard shall be followed for all new works/major renovation works. The existing flooring should not be disturbed, if condition is good and life is available.
2. In case, the existing floor/finish is different from the proposed one, there is no need of immediate replacement /change unless needed to be replaced on condition basis.

Workshop Flooring

SL	Flooring Type	Type of Use	Flooring Standards
(i)	Hard surface for heavy loads	Movement of vehicles forklifts and cranes for loading/unloading	1. Consolidated & compacted subgrade with a cross slope of 1 in 60. 2. In case of poor subgrade soils i.e., black cotton, clay, silt, marshy land etc. 150 mm thick layer of coarse material i.e. granular material like sand, quarry dust etc. / moorum to be provided. 3. Overlay of 75mm thick Consolidated & compacted stone soling using 50 mm nominal graded stone aggregate. 4. Overlay of 75mm thick PCC layer of M10 Mix/1:3:6 nominal mix, well compacted, with 20mm nominal stone aggregate. 5. The top layer will consist of 150mm thick M-30 concrete with 20mm nominal size stone aggregate, vacuum de-watered (panel size not more than 3m for construction joint), smooth finish and mixing of polypropylene fibres in the top 35mm with 10mm nominal stone aggregate. Proper cross slope should be provided to ensure that there is no stagnation of water on the surface.
(ii)	Hard surface for very heavy and impact loads	Dumping scrap etc. and in other shops where impact load comes	1. Consolidated & compacted subgrade with a cross slope of 1 in 60. 2. In case of poor subgrade soils i.e., black cotton, clay, silt, marshy land etc. 150 mm thick layer of coarse material i.e. granular material like sand, quarry dust etc. / moorum to be provided. 3. Overlay of 150mm thick Consolidated & compacted stone soling using 50mm nominal graded stone aggregate. 4. Overlay of 75mm thick PCC layer of M10 Mix/1:3:6 nominal mix, well compacted, with 20mm nominal stone aggregate. 5. The top layer will consist of 150mm thick M-30 concrete with 20mm nominal size stone aggregate, vacuum de-watered (panel size not more than 3m for construction joint), smooth finish and use of Ironite/ Hardonate material in the top 15 mm with 6 mm nominal stone aggregate Or 6. Top layer to be laid with 40mm thick Mastic asphalt/ Bituminous concrete with recommended preparatory laying arrangements. Proper cross slope should be provided to ensure that there is no stagnation of water on the surface.
(iii)	Acid Proof floor and walls	Battery shop	1. Consolidated & compacted subgrade with a cross slope of 1 in 60. 2. In case of poor subgrade soils i.e., black cotton, clay, silt, marshy land etc. 100mm thick layer of coarse material i.e. granular material like sand, quarry dust etc. / moorum to be provided. 3. Overlay of 150mm thick Consolidated & compacted stone soling using 50 mm nominal graded stone aggregate. 4. Overlay of 75mm thick PCC layer of M10 Mix/1:3:6 nominal mix well compacted, with 20mm nominal stone aggregate. 5. The top layer will consist of 100mm thick M-20 concrete with 20mm nominal size stone aggregate, vacuum de-watered (panel size not more than 3m for construction joint), rough finish and Acid-resistant tiles conforming to IS 4457 in floor and dado. Proper cross slope should be provided to ensure that there is no stagnation of water on the surface.

(iv)	Epoxy coated floor finish for specific shops	Heavy duty Shops where floor gets dirty due to spill of oil/grease etc. and where cleaning arrangement is available.	1. Consolidated & compacted subgrade with a cross slope of 1 in 60. 2. In case of poor subgrade soils, 100mm thick layer of coarse material/moorum to be provided. 3. Overlay of 150 mm thick Consolidated & compacted stone soling using 50 mm nominal graded stone aggregate. 4. Overlay of 75mm thick PCC layer of M10 Mix/1:3:6 nominal mix, well compacted, with 20mm stone aggregate. 5. The top layer will consist of 150mm thick M-30 concrete with 20mm nominal size stone aggregate, vacuum de-watered (panel size not more than 3m for construction joint), smooth finish and use of Ironite/Hardonate material in the top 15mm with 6mm nominal stone aggregate over which epoxy coating be provided. Proper cross slope should be provided to ensure that there is no stagnation of water on the surface.
(v)	Approach Road	Heavy duty road for movement of loaded trucks.	1. Consolidated & compacted subgrade with a cross slope of 1 in 30 to be provided. 2. In case of poor subgrade soils, 100mm thick layer of coarse material/moorum to be provided. 3. (a) Overlaid by three layers of stone aggregate of various gradings with consolidation with roller of 8 to 10t capacity as under: (i) Bottom layer - stone aggregate of size 90mm to 45mm including stone screening of 13.2mm - 230mm thick. (ii) Middle layer - stone aggregate of size 63mm to 45mm including stone screening of 13.2mm - 100mm thick. (iii) Upper layer - WBM layer with stone aggregate of size 53mm to 22.4mm including stone screening of 11.2mm - 75mm thick. (b) Dense Bitumen Macadam (DBM) -75mm. 4. Top layer to be laid with 40mm thick Mastic asphalt / Bituminous concrete with recommended preparatory laying arrangements. 5. Edge protection by providing curb stones or by providing edges. 6. Proper drainage system should be designed and executed along with road construction.
(vi)	Heavy duty floor for machinery involving vibrations in flooring like lathes etc. in workshop.	For locations where machines need to be installed.	1. Consolidated & compacted sub-grade with a cross slope of 1 in 60. 2. In case of poor sub-grade soils, 100mm thick layer of coarse material/moorum to be provided. 3. Overlay of 150 mm thick Consolidated & compacted stone soling using 50 mm nominal graded stone aggregate. 4. Overlay of 75mm thick PCC layer of M10 Mix/1:3:6 nominal mix, well compacted, with 20mm nominal stone aggregate. 5. RCC Slab M30 grade 100mm thick for small machines with normal vibrations and for heavy and high frequency machine RCC slab should be got designed by vendor according to the static and dynamic load on the floor and size of pockets required for installation of machines. 6. A top layer of 55mm thick cement concrete flooring with "Hardcrete" concrete hardener topping may be provided.

Different types of Building Materials for guidance of Field officials

(This list is not exhaustive, latest materials can be explored and used as per provisions given in Para 210)

1.0 Roofing materials

Major railways and urban transport system prefer aesthetically planned and well-maintained roofing systems. The roof and wall cladding for railways and urban transport infrastructure are also very important from their maintenance and operations point of view, though they have high-cost implications. At the same time, it is expected that the project does not endanger public life, nor lead to ecological or environmental degradation.

Steel roofing is thus the preferable solution for various railways and urban transport system, not only because of the durability of steel but also the lower time required for steel roofing as compared to other roofing solutions. Today, unconventional design (aesthetical/concave/convex) in an infrastructure project like the Railway or Metro, is a major contributing factor in today's modern architectural transport mediums, marking its step towards a landmark project. Roofing materials in use are concrete, metal, fibre cement sheets, clay, concrete and ceramic roof tiles, shingles, tensile, RCC, metal cladding, fibre, and Zn-Al coated sheets. PEB and precast construction techniques are also gaining ground for their modular, precise, and swift completion time and good quality.

Factors to keep in mind while designing roofing system for a modern railway or urban transport system:

- **Appearance:** Aesthetics plays a major role and right material provides the correct appearance with right level of polycarbonates used for right level of diffused light transmission
- **Safety:** Imperative to meet the safety standards of the site
- **Off-site construction:** Speed of installation need to be high since disruption at busy stations needs to be kept to a minimum
- **Sustainability:** Green roofs that are compatible with solar module mounting solutions are the primary need of any modern urban transport architecture
- **Weight:** Optimum weight of the entire structure makes it easier, safer and more cost effective – to handle in the factory, in getting it to the site, and during installation
 - a) **Rainwater Gutter System:** The non-metallic 'Rainwater Gutter System' offers a highly modular, durable, and easy-to-install eaves gutter system that redefines rainwater management. With its innovative design and advanced features, it stands out a reliable solution for homes and buildings seeking long-lasting durability and efficient water drainage.
 - b) **Roofing Shingles:** Tri-laminate build and rustic sculpted profile, the shingles not only provides the desired aesthetical appeal that affirms its ability to withstand any inclement weather conditions for a long period of time.
 - c) **Rooftop solar:** Rooftop installations optimize the space for solar power energy conversion, reduce electricity costs to create long-term savings, and are aimed at encouraging buildings to

embrace clean and green solar power and help create a sustainable environment. Rooftop Solar can be used for buildings, workshops, hospitals etc.

- d) **Composite membranes for tensile roofing structures:** These innovative product ranges have technological advantages and can address segments such as tensile architecture; solar protection; facade; acoustic; modular structures; visual communication; safety and security; environment and bioenergy; tarpaulins; marine; as well as furniture (sling and upholstery).

e) **Tensile Protective Roofing**

PVC Coated Membranes: PVDF (Poly Vinyl Dene Fluoride) is a fluoropolymer-based resin used for coating in many industries and applications for their brilliant weather and UV resistance and unique flexibility. These materials can be used for tension structures for screening sun, wind, insects, etc.

PVDF membranes for tensile structures:

- Translucent
- Semi-Transparent and
- Transparent

f) **Clay and the concrete tiles Roofs**

A roof tile is a very resilient material and is able to withstand some of the harshest elements such as hail, wind, and fire. The first advantage as mentioned above is the level of protection. The best illustration is that tiles roofs offer very long life. Secondly, tile roofs are also energy efficient and allowed better ventilation. This leads to an indisputable comfort for the inhabitants. Thirdly, tiles differentiated themselves by adding an aesthetic aspect which cannot be found in other solutions.

2.0 Flooring

Popular product categories include solid wood floors, laminate wood floors, engineered wood floors, vinyl floors, and carpet floors, besides indoor sports floors and outdoor flooring options.

- a) **High quality, aesthetic flooring-bacteria free pre-laminated flooring:** The top layer of flooring comes coated with high quality aluminium oxide making it resistant to stains. Plus, Deurowood chemical also protects the surface from dust. The abrasion rating of flooring is much higher than normal standard.

b) **Engineered hardwood/Linoleum flooring**

There are primarily two basic types of natural wood: Engineered & Solid. Engineered, where the base is made of birch plywood with a top layer of natural solid wood. Solid wood is natural wood; it constitutes a single piece of lumber material and can either be unfinished, lacquered or oiled, and made of red oak, white oak or maple. Engineered hardwood is the real wood floor covering and has a low vulnerability to expansion and shrinks with changes in temperatures and humidity.

- i) **Engineered hardwood flooring:** has a lower initial cost, but looks like the real solid wood. Though the flooring comprises of several layers of cheaper wood plies or layers, the topmost layer is of high-quality solid wood. The layers are amalgamated using heat and pressure and glued together.

ii) **Linoleum Flooring**

Linoleum flooring is a blend of natural and synthetic materials, it is an eco-friendly choice for commercial, industrial, and residential applications. It can imitate textures such as natural stone and wood and comes in numerous colour combinations for high quality residential and commercial resilient flooring options.

Linoleum Flooring is made of 97% natural raw materials, 70% of which are rapidly renewable, along with 43% post-industrial recycled content. The key raw materials used in production include linseed oil, wood flour, rosin, jute and limestone, which make the flooring eco-friendly and sustainable. **Linoleum** flooring is almost 100% biodegradable, anti-bacterial, fire-retardant, and water-resistant. It is used especially in the hospitals, day-care centres, and retail store

- c) **Luxury vinyl tile (LVT):** which bring life to spaces with modern colours, patterns, and textures. LVT floors are the future of commercial spaces, as these floors are resilient to heavy traffic, eco-friendly, and provide long-term functionality.

Vinyl flooring enhanced with aluminium oxide, a scratch-resistant element, and matte finish with built-in protection from mold, mildew, and discoloration, has wide range of commercial applications and vinyl sheets are predominantly used in education and healthcare.

- d) **Cork** is relatively new to the flooring as it is usually seen on the walls as murals or with wine bottles as caps. But it is great material for floors as it controls sound by absorbing footfalls and noise, besides being green or environmentally friendly. Cork is harvested from the bark of the cork oak tree which grows back every three years, making it an ideal renewable source

- e) **Mosaic Tiles: Creating Art in Bathrooms:** Mosaic today has acquired a contemporary dimension as seen in creations. The mosaic tiles are made using traditional methods. Their high percentage of minerals give the tiles long-lasting strength and brilliance, and make them resistant to temperature change.

- f) **Carpeting Solutions:** Modular Carpets Tiles are manufactured using premium Solution Dyed Nylon Pile fiber to ensure a 10-15 year wear lifespan and, most importantly, appearance retention. Additional benefits such as over twice the noise absorption for indoor acoustics, lightweight, durability, stability and comfort underfoot when compared with traditional hardback carpet tiles.

- g) **Decorative Concrete Flooring:** The perception of concrete as an aesthetic flooring material is undergoing a change as innovative use of stains, stamps, dyes, coloured pigments, textured patterns, etc., are making concrete flooring increasingly attractive. The new, improved techniques being deployed to create decorative concrete finishes have created interest in the market for these floor types, and also because they are considered hardy, long lasting, eco-friendly, and a good alternative to moisture-sensitive flooring material.

- h) **Marble:** has been the world's preferred choice when displaying strength, luxury, and good taste. It is biggest trending materials in the Architecture, Interiors and Design Industry. If the stone is used for face work, where appearance is a primary factor, its colour and ability to receive polish is an important factor. The diverse texture and colour of marble add to the elegance of space and lend it a royal touch. Marble is less porous and stronger than other stones. Depending on the limestone and the mineral combination within the marble, most marble rates from three to five on the Mohs hardness scale.

- i) **Porcelain Slabs:** can be used in walls, kitchen counters, table tops, walls of bathrooms and kitchens, or any other space where these slender slabs will look as resplendent as natural marble. They are stain-proof and fire-resistant.
- j) **Digitally printed ceramic tiles:** gives natural effects of marble, wood, and stone. These tiles are produced with advanced digital printing technology that enables high-definition reproduction of colours and objects to provide exact impression of marble or wood bringing alive even the minutest details. Besides, being ultra-charged due to vitrifying process, these tiles can withstand any moisture, scuffs, scratches, and indentation that come with everyday life. This apart, tile manufacturers are also addressing issues like health and hygiene by adding features like anti-microbial glaze, slip-retardant, and anti-abrasion.
- k) **Vitrified Flooring Tiles:** has higher durability and easier maintenance compared to both cheaper options, such as ceramic tiles and marble.
- l) The main purpose of floor tiles is protection. Vitrified tile products offer plenty of design options like digital prints, stain free or surface finishes including marble, stone, rustic, metallic, satin or matt finishes. There are some tiles that absorb heat and keeping interiors cool.
- m) **Industrial Flooring-steel fiber reinforced industrial floors (SFRC):** SFRC is defined as concrete, containing discontinuous steel fibres, which are homogeneously mixed into the concrete. Steel fibres are designed especially for the reinforcement of concrete and are made of prime quality hard-drawn steel wire to ensure high tensile strength at extremely close tolerance along with hooked ends, they deliver optimum anchorage.

3.0 FACADE

Facades are the visual gateways to buildings. Carefully crafted facades emphasize on the relationships they create with the streetscape and the spectator to create a meaningful expression. The latest trends in contemporary building facades veer towards a bold and stylish look combining a mix of materials. From the traditional stone cladding to the contemporary wooden and all-weather laminate claddings, to the on-trend glass and metal, several materials are used for elevations. Various materials which can be used are as under -

- a) **Tensile structures:** offer pleasing aesthetics, are energy efficient, recyclable, eco-friendly, sustainable, and use fewer resources, making them sustainable and cost-effective. Being lightweight and heat efficient, the spaces covered by tensile need less energy. Plus, tensile structures are easy and quick to construct or dismantle. All these factors make tensile roofing and facades a favoured material of architects and builders.
- b) **Breathing Facade-** Structures with a breathing facade are designed to breathe through countless micro apertures, helping the buildings to breathe better and improve the indoor air quality.
- c) **Green Facade:** is the most effective way to infuse life into structures and reap the advantages. Vertical gardens are working their way into urban life to protect humans from severe environmental circumstances while also preserving the planet.
- d) **Stainless Steel:** Cladding: are durable, easy to fabricate, high strength and low cost. It is an ideal material for enhancing the elevation of new-age buildings and infrastructure.
- e) **3D foam Wall Cladding:** comes with a self-adhesive; simply remove the release paper and put it up on the wall. Insta Walls provides insulation from heat and sound, is impact resistant, and completely washable.

- f) **Translucent Stones:** is engineered marble, the mosaic inspired collection with backlit surfaces, features small pearly white pieces embedded in colourful backgrounds

4.0 LAMINATES

- 1) **MDF (Medium Density Fibreboard):** MDF is an engineered product made of wood fibers bonded under high pressure using thermosetting resins and wax, forming beautiful panels by applying high temperature and pressure, for strength. Many MDF qualities make it an ideal replacement for wood, plywood, and particle boards.
- 2) **High Quality Decorative Laminates:** offer endless design options - from simple to the more complex – and designs that can be altered to resemble various textures like stone, wood, solid surfaces, etc., which can be used to enhance walls, doors, facades, floors, ceilings, and furniture pieces. The widespread adaptation of premium surface solutions like soft touch, anti-fingerprint, matte finishes, etc., especially in kitchens, in the last 5-7 years underlines their popularity.
- 3) **Wood polymer composite (WPC) Sheets for Making Long-Lasting Architectural Sculptures & Murals:** WPC boards have outstanding properties that enable their application outdoors and in all weather conditions. Besides the application of WPC sheets for heritage design preservations, architects can create unique formations from WPC boards because of the boards' precision during CNC cutting.
- 4) **Boiling Water Proof (BWP) with FR Grade HDF Boards:** are available in different grades and thicknesses, making them suitable for any kind of project. They are highly suitable for application in wet areas like Toilet Cubicles, in load bearing areas like warehouse shelves, staircases, bathroom partitions etc.
- 5) **Natural look Veneers:** come in a variety of patterns and colours. In fact, veneers go beyond shades and colours, making them a versatile and interesting medium for architects and interior designers to work with, and create uniquely imaginative themes.
 - a) **Fumed Veneer-** developed using Wood Treatment Technology (WTT), creates a regal look with its dark tone.
 - b) **Metallic Veneer-** created with a real metal formulation, gives interiors a natural metallic finish, and brings a sense of opulence to the space.
 - c) **Dyed Veneer** is bleached and pressure dyed to ensure deep colour penetration and correctness, thereby enhancing the natural beauty of the wood. Its consistency in colour makes it easy for architects and designers to visualize the outcome.
 - d) **Silver Veneer,** named after Silverwood (a visually striking tree native to Eastern USA) is an ash-coloured chromatic veneer with a silvery grey hue that adds class and beauty. What's more, its silver-grey tone gets more prominent as it ages.
 - e) **Harmony Veneer** is handcrafted to suit all décor ideas as each pattern has its own signature style. The veneers come in varied shades and are ideal for wall highlights, doors, TV cabinets, and wardrobes.
- 6) **Polyurethane (PU) products-premium Italian wood-finishes:** This is a revolutionary product that brings a range of Polyurethane (PU) products ensuring outstanding finish, appealing aesthetics and higher durability for wood surfaces that is best suited for interiors. The product gives a premium-looking finish with extra coverage and is available in both PU matt and gloss finishes.

- 7) **Glass partition walls:** are exclusive partition walls, dividers and sculptures created out of glass. These walls are highly functional, they also provide an interesting decorative element. Using a range of techniques, every design comes in a variety of effects, such as frosted, etched and carved.
- 8) **Water-resistant plasterboard:** This is a revolution in the wet area application as it provides outstanding performance in areas exposed to water such as kitchens, bathrooms and semi-exposed areas. This new-gen plasterboard has been manufactured with the GRG technology (glass reinforced gypsum) having glass fibre reinforced gypsum core and encased with specially treated hydrophobic glass mat liners. The front and back surface is reinforced with glass mats that provide an excellent water and mold resistance.
- 9) **Wall Boards:** Designer wall boards provide aesthetically appealing solutions along with strength and durability. Walls made out of these boards are fire-resistant, termite-proof and moisture-resistant making them unique walling and paneling solutions for residential, commercial and institutional use. **Heavy duty wall boards** help create both internal and external walls that are impact-resistant, load-bearing and require minimal maintenance. They are ideally suited for commercial and industrial applications. **Solid wall panels** are a revolutionary dry wall solution that maintains the solid effect of a conventional brick or block wall.

5.0 PRECAST-PREFAB

- a) **Textile Reinforced Concrete Enabling Design Flexibility:** is a lightweight, corrosion resistant material, and its potential for a range of applications from facades to modular structures, from waterways to ports, and from storm water drains to sewage water treatment plants and catch basins. Textile Reinforced Concrete can be easily installed on the top of high-rise structures where the wind load is high, and where a tower crane cannot handle heavy loads.
- b) **Invisible Grills:** Invisible Grills are fast replacing the traditional box type grills in modern high-rise buildings in metro cities, are made of superior quality stainless steel. Invisible grills provide an unblocked view unlike box-type grills and pigeon nets, owing to a gap of 2-4 inches between the cords. So, they serve a dual purpose of providing safety and allowing panoramic views of the outside. The grills can be used on casement windows, staircases, balconies, and on rooftop terrace gardens.
- c) **Dry Wall Panel:** is a system where two fibre cement boards (FCB) of 10 mm thickness are filled with insulation material namely Poly Isocyanate (PIR) in-situ and erected to produce finished walls. The system is integrated with conventional column and beam or steel for pre-engineered buildings. Insulation core provides effective insulation and strong bonding for better structural stability to facilitate higher loading and wider spans. For roof slab two PPGL (pre-painted galvanized iron) sheets of 0.5mm thickness are filled with Poly Isocyanate (PIR). This system can incorporate all types of services viz. electrical, gas and plumbing, etc.
- d) **Pre-Engineered Buildings (PEB):** PEB structures have a longer life since they are termite, insect and fire resistant, and can withstand rigors of terse environments.

For Housing Rehabilitation programs following calamities such as earthquakes, floods, etc., they can be used to create permanent or temporary housing shelters; for building an additional floor in old buildings as they are lightweight; an office in a factory shed without disturbing the factory's ongoing operations.

Annexure 2.7
Para 220(3)

Proforma for Details of Occupancy

RAILWAY: _____

Div: _____

Station: _____

Area of the building in terms of
No. of Rooms

Type: _____
With dimensions

No. of units: _____

Assessed rent per month Rs. _____

Name of Building: _____

Rent on Electric Installation per month Rs. _____
Capital Cost of each unit: _____

Registered No. _____

Assessed monthly rent: _____

Pooled cost of each unit: _____

No. of taps outside: _____
Inside: _____

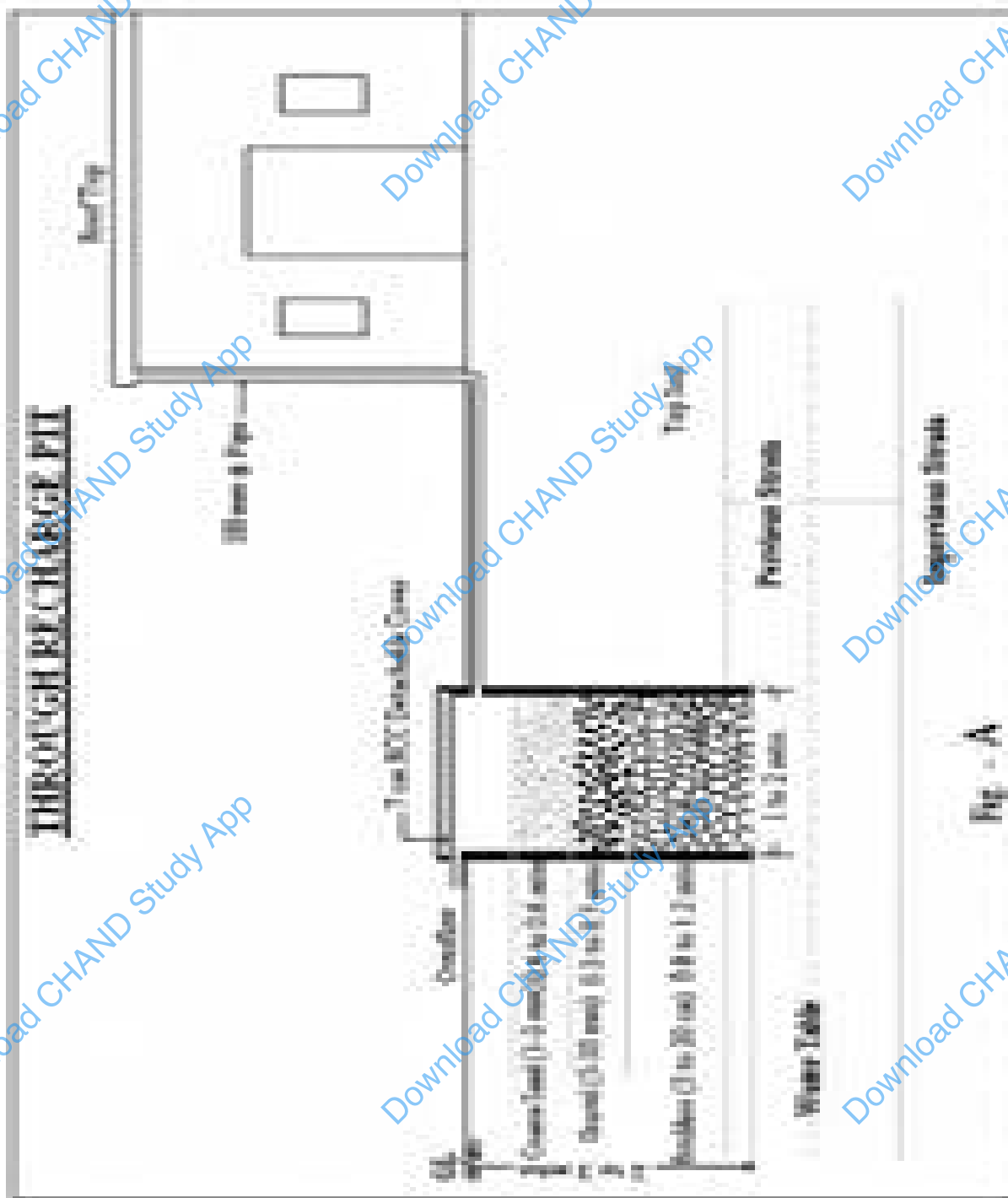
Latrine Common/Separate: _____

No. of units Occupied	Name of Occupant	Designation	Whether Married or Single	Deficiencies
(1)	(2)	(3)	(4)	(5)
Rate of pay	Date of Occupation.	Date of vacation	Remarks including date & nature of repairs executed.	Deficiencies/dam age at time of vacation
(6)	(7)	(8)	(9)	(10)

Check list while taking over building/quarter after Construction

SN.	Description of item	Remarks
GENERAL ITEMS		
1	Whether proper drains and drain pipes has been provided for the disposal of water.	
2	Whether the surrounding area cleared off, of unused materials and construction debris/waste etc.	
3	Whether plinth protection has been provided for the building?	
INSIDE BUILDING ITEMS		
WALLS		
1	Are there any cracks in walls?	
2	Are there any signs of dampness/leakage on walls?	
3	Whether finishing of wall surface is smooth and proper?	
FLOORS		
1	Are there any cracks in floors, skirting and dado?	
2	Are the floors laid to proper slopes? Is there a stagnation of water in WC, bath and verandahs?	
3	Whether finishing of floor surface is smooth and proper?	
ROOFS		
1	Are there any leakages in roofs?	
2	Whether golas are properly made?	
3	Is the slope of roof proper?	
4	Are the traps and rain water pipes proper to drain water without ponding?	
DOORS, WINDOWS AND VENTILATORS		
1	Are all the fittings viz., locking arrangement, tower bolts, pull bolts, door stoppers, hooks, stays and hinges etc. are provided & functioning properly?	
2	Whether quality of wood is as per specification?	
3	Whether surface of frame and shutter is smooth?	
FINISHING		
1	Is the plastering of walls and ceiling satisfactory, smooth and free from cracks and other defects?	
2	Is the painting of walls / doors and windows proper?	
WATER SUPPLY AND SANITATION		
1	Is there any leakage in the sewer lines, drainage pipes etc.?	
2	Are flushing cisterns, wash basins etc., correctly fitted and working properly?	
3	Are the covers of manholes, gully traps and floor traps etc. provided?	
4	Is the slope of sanitary pipes proper?	
5	Is the condition of water overhead tank proper including float valve & cleaning of tank?	
Any other deficiency noticed in the building		
Signature of the contractor		Signature of Taking over Official

Annexure 2.9 Fig. A
Para 229(3)(a)



Annexure 2.9 Fig B
Para 229(3)(b)

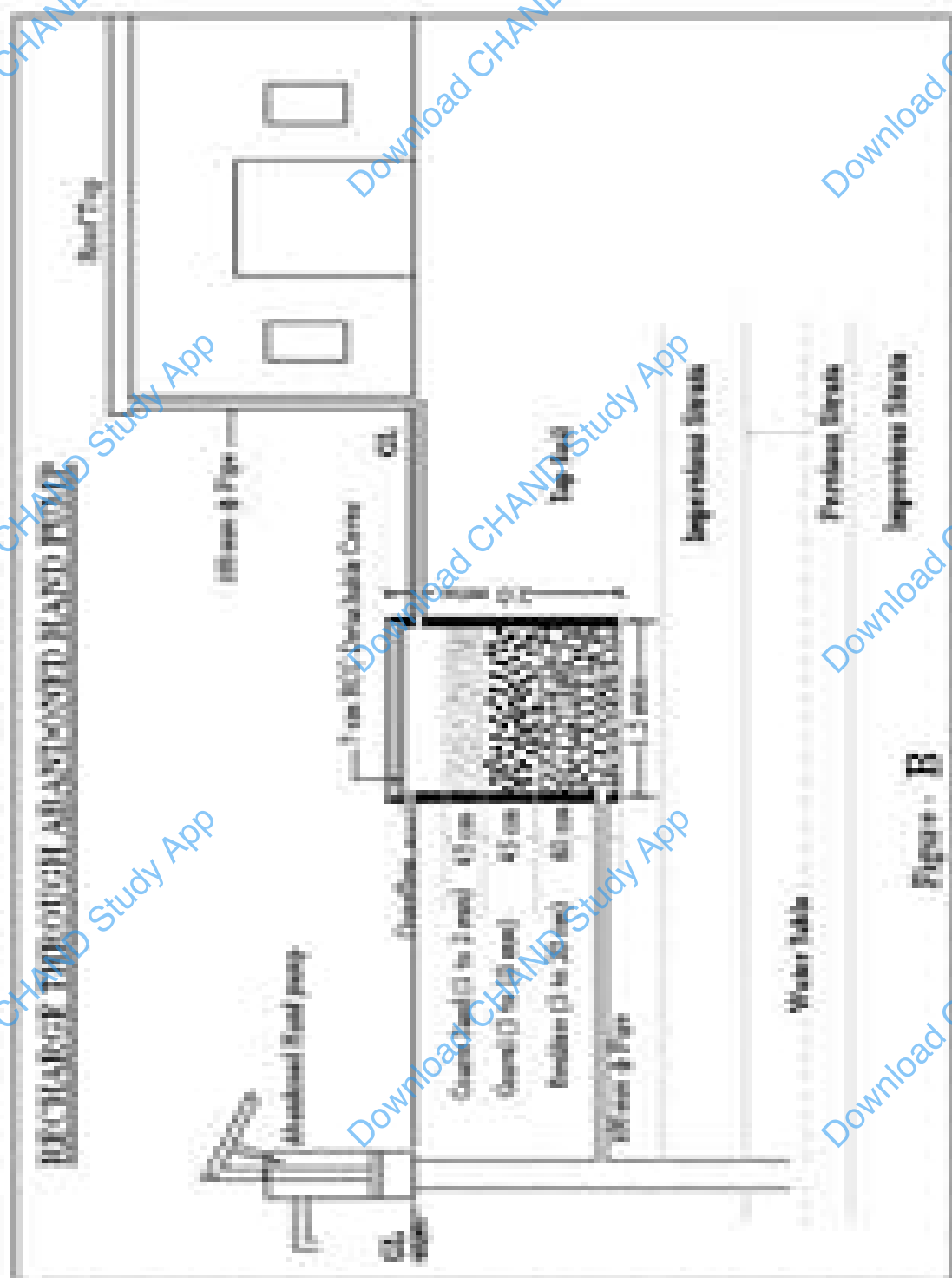


Figure - B

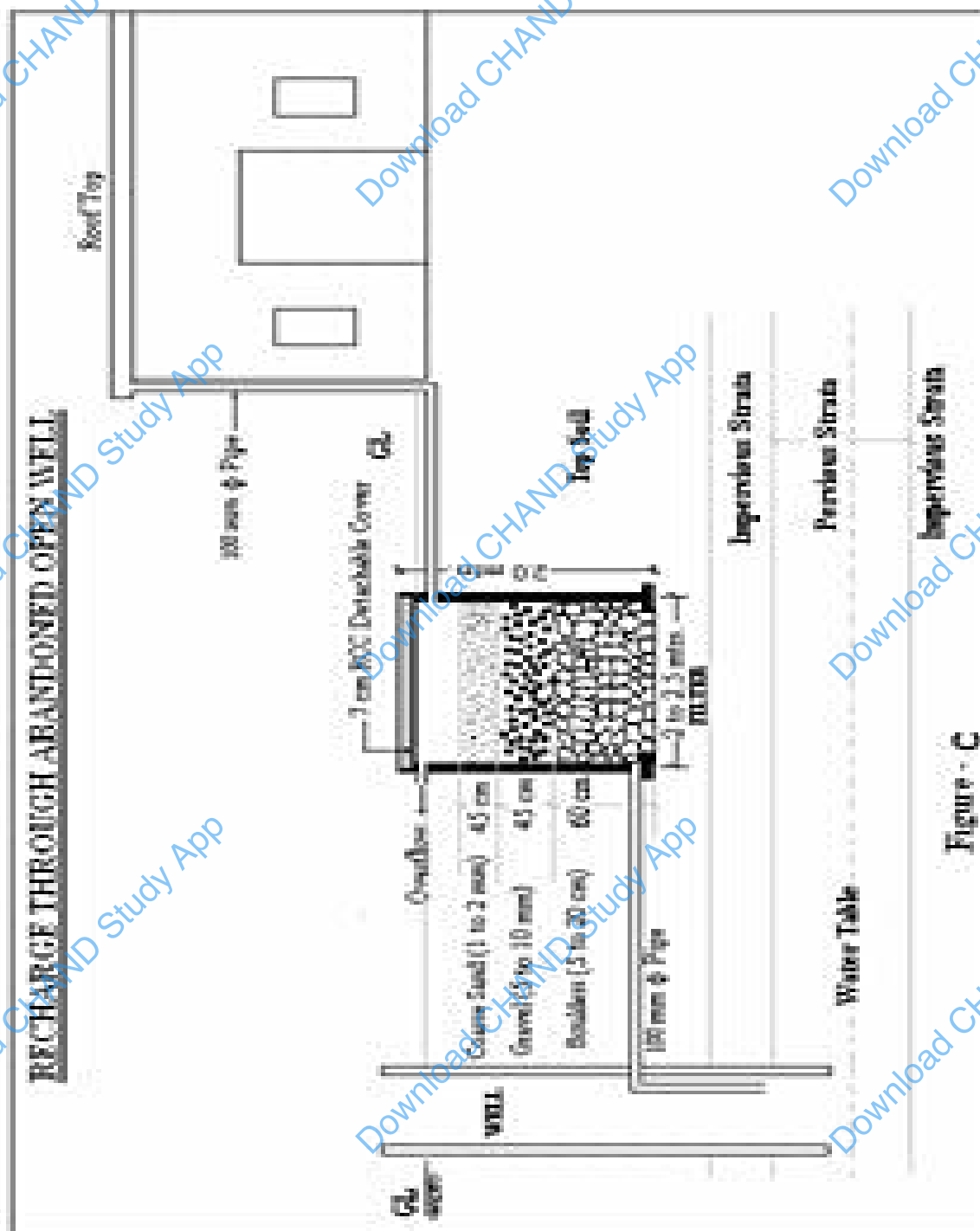
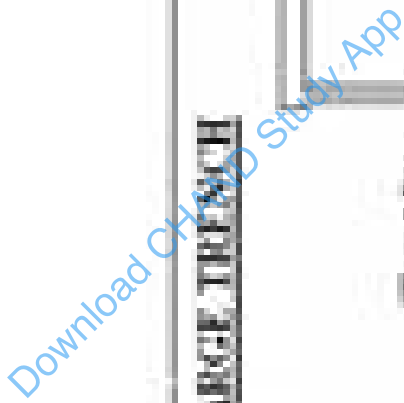


Figure - C



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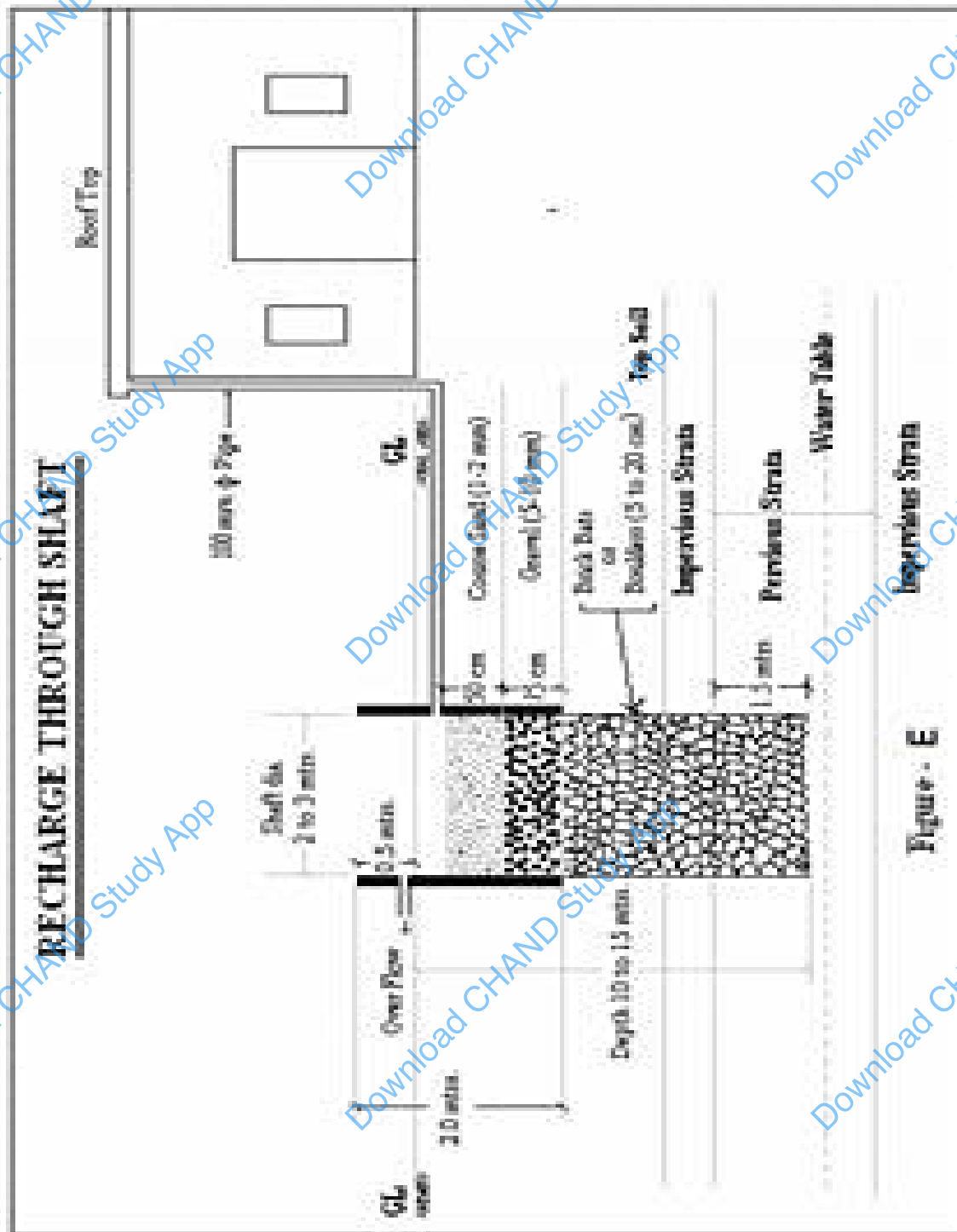
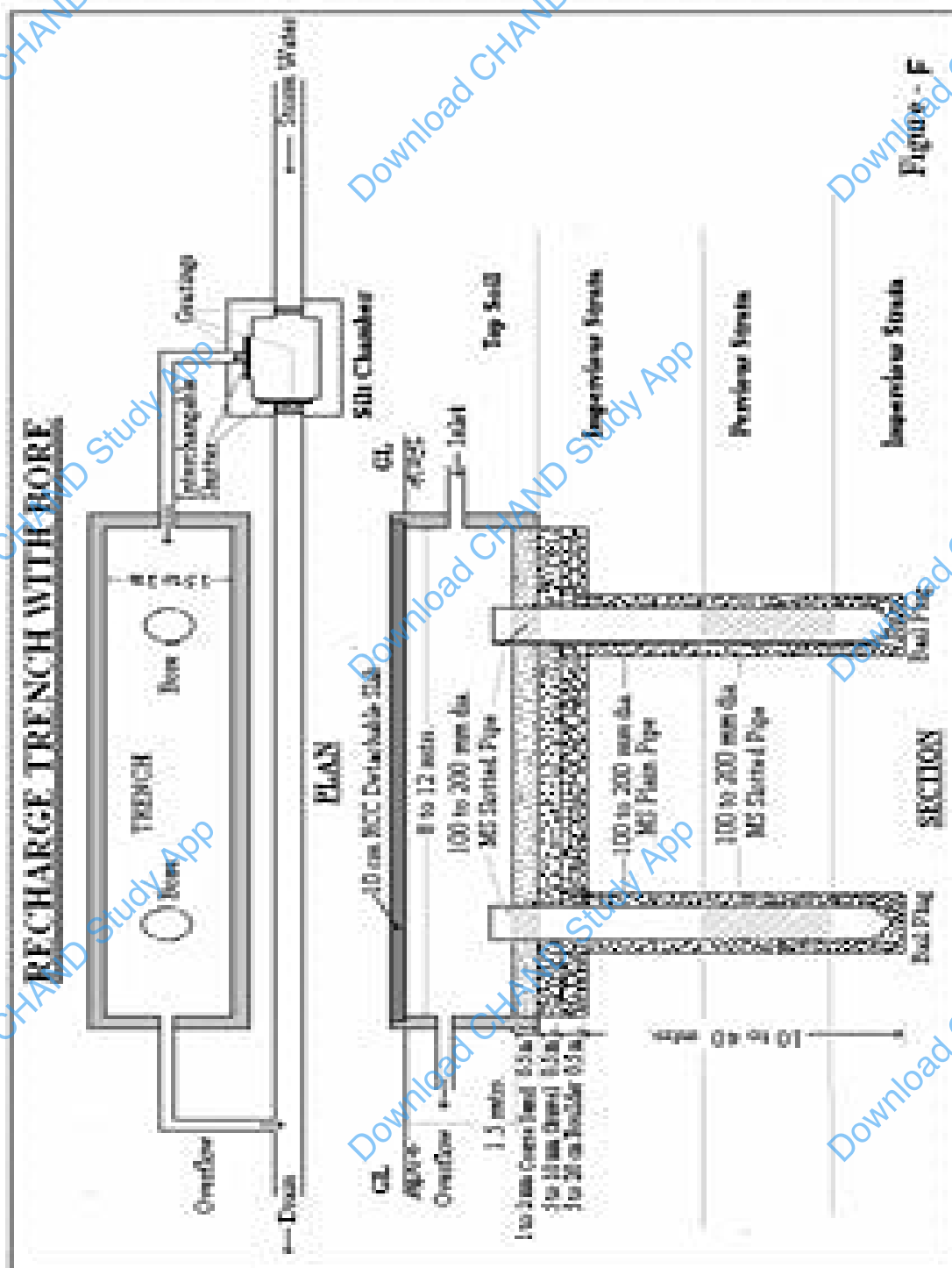


Figure - E

Annexure 2.9 Fig F
Para 229(3)(f)



CHAPTER 3

INSPECTION AND MAINTENANCE OF BUILDINGS AND STRUCTURES

301 Inspection and Records of Maintenance –

- 1) Inspections shall be carried out periodically with a view to identify the defects and need for maintenance. These inspections also help to identify the works to be undertaken under Zone works/Special works.
- 2) All assets such as buildings, water supply installations, sewerage installations, drainage arrangements etc. shall be systematically inspected by the SSE/ JE (Works) and ADEN as per schedule of inspection given in **Annexure 1.1**.
- 3) For the purpose of mobility in the field for inspection and maintenance a vehicle shall be provided to Assistant Divisional Engineer, Sr. Section Engineer (Works) /Junior Engineer (Works) in-charge.

302 Maintenance of Buildings –

- 1) Colony quarters/building maintenance is the work undertaken to keep, restore or improve every facility i.e. every part of a building, its services and operations to a currently acceptable standard and to sustain the utility and value of the facility.

The objective of maintenance is:

- a) To preserve building in good condition.
- b) To improve the facilities for the users.

2) Classification of Maintenance/Repairs

The maintenance/repair works shall be classified in under mentioned categories:

- Day to day maintenance/repair
- Periodical maintenance/repair
- Special maintenance/repair

a) Day to Day Maintenance/Repairs

Day to day maintenance/repair shall be carried out for the activities like

- i) Minor repairs of door, windows, floors etc.
- ii) Removing blockage of drainage pipes, man holes, restoration of water supply, watering of plants, lawn mowing, hedge cutting, sweeping of leaf falls etc.

b) Periodical maintenance/repair

The works of periodical nature like white washing, colour washing, distemping, painting etc. are called **Periodical Repair works** and these are generally undertaken through system of contracts.

The periodicity of maintenance/repair for a building and structures shall be as per **Annexure 3.1a** and **Annexure 3.1b**.

c) **Special Repairs**

As the building ages, there is deterioration to the various parts of the building and services. Major repairs, replacement and additions/alterations of elements become inevitable. It becomes necessary to prevent the structure from deterioration and undue wear and tear as well as to restore its functionality. The following types of works in general shall be undertaken under special repairs:

- i) Provision of water proofing treatment to the roof.
- ii) Repairs of roads and pavements.
- iii) Replacement of flooring, skirting, dado and plaster.
- iv) Replacement of doors, window frames and shutters.
- v) Replacement of water supply and sanitary installation.

303 Building Inspection Register –

The inspection of buildings and quarters shall be recorded in the Inspection Register as per Proforma given in **Annexure 3.2**.

- 1) In case there are doubts about structural soundness of a building, the same should be brought to the notice of higher authorities on a priority so as to take prompt remedial action. If the building's structural condition is not warranting immediate major rehabilitation/replacement (i.e. depending on soundness of building) but needs regular monitoring, then Sr. Divisional/Divisional Engineer shall declare these buildings as building with doubtful conditions. Such building shall be inspected by SSE/Works once in Three (3) months and by Assistant Divisional Engineer once in Six (6) months.
- 2) The insides of staff quarters should be inspected in the presence of or with prior consent of the occupants.
- 3) In monsoon period, exterior repairs or renovation works shall not be carried out except pointing and works considered to be urgent.
- 4) Requisition for repairs and renovation works should specify the dates of previous such works carried out in that building/Quarter, without which work orders should not be issued.
- 5) Planning of repairs should be based on the inspections carried out as mentioned above and should be completed well in time.

304 Standard Measurement Registers for Buildings –

- 1) Standard Measurement Registers in the format given in the **Annexure 3.3** shall be maintained in the offices of the Sr. Divisional Engineer/Divisional Engineer, Assistant Divisional Engineer and the Sr. Section Engineer (Works).
- 2) The entries made in the registers should be correctly amended when alterations or additions to structures are carried out or when new structures are built.
- 3) The block Nos. entered in the Standard Measurement Registers should correctly tally with the corresponding entries in the building registers.

- 4) The measurement books from which the entries are carried into the Standard Measurement Registers should be securely preserved in the Sr. Divisional Engineer/Divisional Engineer's Office. In case of adoption of digital form of measurement books and Standard Measurement Registers same shall be preserved in digital form.
- 5) Standard Measurement Registers may be utilized for estimating of quantities for periodical white-washing or colour washing and painting as and when required. Particulars of repair works should be carefully scrutinized by the Assistant Divisional Engineer before applying for sanction.
- 6) Date of white washing and painting done block-wise should be indicated on the building.

305 Monitoring of Maintenance and Improvement –

1) Petty repair book/Complaint Register:

Petty repair book shall be maintained at stations and complaint register shall be maintained in the office of SSE/ JE (Works). Based on the complaint, the staff actually deputed to attend a complaint shall be provided a "Task book". The "Task book" will mention the quarter number and the complaint itself. Based on the entries in "Task book", summary information regarding redressal/ closure of complaint should be entered into the petty repair book/complaint register

2) A typical format of the Petty repair book and complaint register are given in **Annexure 3.4 & Annexure 3.5**.

a) The frequency of scrutinizing the petty repair book/Complaint register shall be:

SN	Authority	Frequency
1	SSE/ JE (Works)	Once in a week for stations where he is headquartered and once in a month for other stations.
2	ADEN	During inspection should examine & initial the register and issue such instructions as considered necessary.
3	Sr. Divisional/Divisional Engineer	During inspection should examine & initial the register and issue such instructions as considered necessary.

- b) SSE/ JE (Works) shall invariably scrutinize the petty repair book/complaint register and then decide the nature of complaints. The complaints of urgent nature i.e. water supply/sanitary problem, leaky roof/walls, outside doors/windows and repairs required for ensuring the structural integrity of the quarters should be attended immediately.
- c) SSE/ JE (Works) & ADEN/DEN/Sr.DEN shall take necessary action as deemed fit based on the observations & inspections.

306 Colony Inspection Group (CIG) –

1) Colony Inspection Groups (CIG) shall be formed at different levels as under:

- a) Colonies located at Zonal/Divisional HQ with number of quarters more than 200 and any other identified colony located at zonal/divisional HQ with the approval of PCE.
- b) Colonies located at stations where ADEN is headquartered.
- c) Colonies located at road side locations.

2) The composition of various CIGs shall be as under

- a) Colonies located at Zonal/ Divisional HQ having more than 200 quarters or any other important identified colony (with approval of PCE)
- Sr. DPO/DPO (Coordinator)
 - Sr. DEN/DEN
 - Sr. DFM/DFM
 - Sr. DMO/DMO
 - Sr. DEE/DEE
 - Sr. DSTE/DSTE
 - Sr. DSC/DSC
 - Representative of Recognized Unions nominated for this purpose in staff colonies or Resident officers (2 Nos.) to be nominated by GM for officers' colonies.

b) Colonies located at stations where ADEN is headquartered

- DPO/APO (coordinator)
- ADEN
- AFA; SO where AFA is not posted
- AEE; SSE/Elect. where AEE is not posted
- ASTE; SSE/signal where ASTE is not posted
- ADMO; CHI where ADMO is not posted
- ASC; IPF where ASC is not posted
- Representative of Recognized Unions

c) Road side stations where smaller colonies are available:

- SS/SM
- SSE/Works
- Health Inspector
- SSE (Electrical/G)
- IPF

The coordinator in road side stations shall be SSE/Works where headquartered or SS/SM where SSE/Works is not headquartered.

The representative of the Unions will be residents of that colony and their nomination will be done in consultation with the concerned station branch of the union.

d) **Periodicity of Inspection:**

This CIG shall inspect and hold meeting once in every three (3) months by giving 7 days notice to the members. Other colony residents may also be co-opted to attend these meetings.

e) **Responsibilities of CIG**

Following items will fall under the purview of the colony inspection group:

- Upkeep of colony including cleanliness of quarters, their maintenance, roads, drains, water supply, sanitation, boundary wall, street lighting, etc.; priority being accorded in the following order:
 - Repairs to ensure structural integrity of building
 - Repair to leaky roof
 - Repair to outside doors & windows
 - Maintenance of proper water supply
 - Proper Sanitation and drainage arrangements

- Repair to floorings
- Maintenance of colony roads, pathways & road berms
- Fencing & others
- Proper illumination of colony

- ii) Improvement to substandard quarters.
- iii) To arrange disposal of waste from colony.
- iv) Prevention of encroachments by outsiders as well as by Railway men.
- v) Prevention/action for eviction of encroachment with the assistance of RPF staff.
- vi) Prevention of cattle nuisance in the colony.
- vii) Subletting of quarters.
- viii) Security of the Colony.
- ix) Ensure videography particularly for encroachments.
- x) Shall recommend the staff welfare works/ Maintenance works in planned manner duly prioritizing them based upon availability of resources.

The committees shall issue minutes. These minutes, particularly action for removal of encroachments, should be pursued & ensured by DRM.

307 Cash Imprest to SSEs/ JEs –

SSE/ JE (Works) in-charge shall be provided with adequate cash Imprest for petty repair works including hiring of minor equipment, plants and services of skilled artisans etc. required for maintenance.

308 Additions and Alterations to Staff Quarters –

- 1) Additions and alterations to staff quarters only of a temporary nature as mentioned in following Para may be permitted to be done by the occupant as per the Indian Railways Code for Engg. Dept. (1982 Edition) with the prior approval of Sr. DEN/Dy. CE (custodian of the assets) who shall examine the same from the point of view of availability of space and inconvenience to other occupants etc. However, the Railways reserve the right to dismantle the same if the space is required by administration. Railway shall carry out such works on actual cost basis without any departmental charges etc. as the measure is for staff welfare.
- 2) Following items of works can be executed by Railway at 100% cost of the occupant:
 - a) Provision of temporary shed for car/scooter/pets
 - b) Fencing around the individual quarter
 - c) Paving/flooring around quarter with suitable material
 - d) Provision of additional cup-board in the quarter
 - e) Changing of Indian W.C. to European W.C. & vice-versa if beyond eligibility

The above two items can also be done by the occupant
- 3) Additions and alterations of a permanent nature shall not be carried out without competent sanction. When an existing building is to be enlarged or extended, the external architectural features of the old structures should be adhered to as far as possible.

309 Inspection of Structural Steel and Timber Work –

1) Periodical Inspection:

- a) Every structure on the Section/Sub-division shall be inspected in detail by the Sr. Section Engineer (Works) /Assistant Divisional Engineer as given in **Annexure 1.1**.
- b) The Sr. Section Engineer (Works) shall record results in ink in the structural steel and timber work inspection register in the format given in **Annexure 3.6** and submit the same by the prescribed date to the Assistant Divisional Engineer who should scrutinise the entries, issue such orders as deemed necessary and return the Register. Prompt action shall be taken to carry out repairs required. The Sr. Section Engineer (Works) shall accompany the Assistant Divisional Engineer on the latter's inspection of structures carried out during the prescribed period.
- c) The Assistant Divisional Engineer shall record results of his inspection in ink in the structural steel and timber-work inspection register in form given in **Annexure 3.6**, maintained by Sr. Senior Engineer (Works) and ensure expeditious compliance of notes recorded.
- d) Structures the condition of which warrant special attention, should be inspected timely.
- e) Entries in column "Condition of structure at the time of inspection" should be in the nature of statements. A defect, once mentioned, should not be omitted in future years unless it has been eliminated through repair in which case a note should be made to that effect.
- f) When, during inspection of buildings, the Sr. Section Engineer (Works) notices the building to be unsafe for occupation he shall forthwith advise the occupant of the fact and also advise the Assistant Divisional Engineer to get a notice issued to the occupant for vacation of the premises and to apprise the controlling officer of the occupant of the premises.

2) Details of inspection of steel and timber structures –

Following steel structures to be inspected (**schedule as per Annexure 1.1**) thoroughly and requisite action shall be taken –

- Structures of Workshops, Running Sheds and Platform Covers in which Roof Trusses are fixed to built-up Stanchions
- CI/WI/Pressed Up Steel Water Tank & Staging & Flood Light Towers and other similar structures
- Foot over Bridges
- Suitable equipment, manpower and other necessary resources shall be made available to SSE/ JE (Works) for the inspection and maintenance of these structures. Railway administration shall provide specialized inspection agency for inspection of structures at height and over tracks e.g. Water tanks, high roofs, platform shelters, Air concourse etc.

In general, following points should receive attention:

- a) The condition of paint.
- b) Whether any corrosion in steel or decay in timber is taking place. In the case of steel work connected to masonry such as tie rods of arched buildings and roof trusses, whether any corrosion is apparent near the masonry. The condition of welds, rivets, bolts and tie rods particularly of water storage tanks; cast iron tank plates should be examined for any cracks.

- c) Whether any deformation of the structure has occurred.
- d) Foundations and bearings with particular reference to tightness of anchor bolts.
- e) The inspecting official shall make a thorough examination of every part of a structure in all respects, using ladders and scaffolding for examining portions beyond reach from the ground. If so, considered necessary, the assistance of the Bridge staff may be requisitioned for the purpose.

A check list for inspection of above stated items is given in **Annexure 3.7**. This checklist is for guidance of field officers, additional items to this check list may be added by Zonal Railways, if required.

310 Inspection and Maintenance of Building to Ensure Leak Proof Buildings –

- 1) A building may be a house, office or service building is an important asset involving large investment. Water is the most destructive weathering element of these structures; water continues to damage or completely destroy more buildings and structures than natural disasters. It is very costly to repair if a building structure is damaged by water. Hence, during the construction the measures shall be taken to provide adequate slopes for water drainage at required building components, water proofing treatment shall be provided as per requirement.
- 2) However, after the construction of buildings, routine inspection and maintenance shall be carried out to ensure that if any leakage is observed, then same shall be attended in time.
- 3) For the above-mentioned objective following documents may be referred –
 - a) “Guidelines on Waterproofing in New/Old Construction” published as Report no. RDSO/WKS/2015/1 Revision -2 (October -2019 or latest updated). This guideline includes general precautions during construction of building, water proofing during construction stage, water proofing of various components of building (new/old) and inspection of buildings from leakage point of view.
 - b) Also, water proofing treatment specifications as given in CPWD’s specifications Vol. II (2019 or latest update) can be referred.
 - c) Water proofing technologies/materials are changing/evolving as time is progressing. Hence, there is no binding on using guidelines given at (a) & (b) above. Suitable material and technology shall be used. The method/material used shall have approval of sectional DEN/Sr.DEN.

311 Seismic Retro Fitting and Repair/ Strengthening of Building –

- 1) Many existing buildings do not meet the seismic strength requirements as per the provisions of codes due to original inadequacy in design of structure, material degradation over time or alteration carried out during the service life of the building.
- 2) There are two aspects of strengthening:
 - a) Retrofitting: i.e. strengthening of a weak building beforehand so as to make it stronger to withstand seismic forces and,
 - b) Repairs: Architectural repairs, Structural repairs and structural restoration of a building damaged during an earthquake.

Retro fitting and Repairs Vs. Rebuilding: The decision regarding repairs or rebuilding shall be taken by Sr. Divisional Engineer/Divisional Engineer.

312 Repairs to The Earthquake Damaged Buildings –

After a severe earthquake, a detailed damage assessment shall be conducted as soon as possible to assess and decide whether the building/ structure can be repaired economically and made habitable, or whether the same should be abandoned and dismantled partly or fully. Survey should be conducted in each building by using the forms for a quick assessment of the damages. Three types of repairs viz. Architectural repairs, Structural repairs and Structural restoration, are generally adopted depending upon extent of damage.

313 Architectural Repairs –

It consists of patch repairs to superficial defects such as plastering, repairs to doors and windows, redecorations etc. as detailed below:

- Patching up of defects such as cracks and fall of plaster.
- Repairing doors, windows, replacement of glass panes.
- Checking and repairing electric conduits/wiring.
- Checking and repairing water pipes, drainage and plumbing services.
- Rebuilding non-structural wall, smoke chimneys, parapet walls etc.
- Re-plastering of wall as required
- Rearranging disturbed roof tiles;
- Rebuilding cracked flooring at ground level; and
- Redecoration – white washing, paintings etc.
- These repairs do not restore the original strength of the structure.

314 Structural Repairs –

This includes – Rebuilding cracked walls, damaged roofs, repair of pillars etc.

1) Structural repairs are generally carried out as detailed below:

- Remove only those portions of masonry walls and piers which are cracked and then rebuild that portion/stitch and grout as the case may be.
- Bolting/spiking of wire mesh on both side of a cracked wall and then cover with cement mortar/micro concrete.
- Cement/Epoxy grouting of cracks.
- Repairs of RCC by epoxy grouting, shotcrete/ jacketing.
- The structural repair work can restore the lost strength only partly. The structure remains permanently weakened.

2) **Structural Restoration:** This includes adding strength to the weakened / damaged building to restore the lost strength. Due to earthquake, a building may develop any one or more combination, the following:

- a) Minor cracks (cracks 0.50mm to 5mm): Minor cracks can be repaired by injecting low viscosity epoxy resins through ports in the cracks after the cracks are sealed by use of epoxy sealant. Cement water mixture (1:1) can also be used after the cracks are cleaned by injecting water in it.
 - b) Major cracks (cracks more than 5 mm) and crushed concrete. After removing the loose materials, the expansive cement mortar/quick setting cement can be used. Steel wire mesh nailed to the wall can be provided outside and covered with plaster (1:2).
 - c) Fractured / yielded / buckled reinforcements: The new steel should be welded to the old ones. Additional stirrup steel should be used and additional longitudinal bars can also be anchored in a hole drilled in the member.
 - d) Fractured timber members: After removing the rotten wood, splice should be nailed and preferably be covered with steel execution is done properly, then after the structural restoration, the building will be as strong as new.
- 3) Seismic Retro fitting and repair/ Strengthening of building are specialized job. Therefore, services of an architect/consultant/reputed institutes may be availed for carrying out these repairs.

315 Repairs, Retrofitting and Strengthening of High-Rise Buildings

(As per Part 7 Section 5 Clause no. 11 of NBC 2016)

- 1) **Maintenance Management:** Maintenance management of building is the art of preserving over a long period what has been constructed. Whereas construction stage lasts for a short period, maintenance continues for comparatively very large period during the useful life of building. Inadequate or improper maintenance adversely affects the environment in which people work, thus affecting the overall output. In the post construction stage, the day-to-day maintenance or upkeep of the building shall certainly delay the decay of the building structure. Though the building may be designed to be very durable it needs maintenance to keep it in good condition. The maintenance management of buildings shall be done in accordance with Part 12 Asset and Facility Management of the NBC 2016.

2) **Prevention of cracks:**

Cracks in buildings are of common occurrence. A building component develops cracks whenever stress in the component exceeds its strength. Stress in a building component could be caused by externally applied forces, such as dead, imposed, wind or seismic loads, or foundation settlement or it could be induced internally due to thermal movements, moisture changes, chemical action, etc.

Cracks in a building are broadly classified as structural and non-structural cracks.

a) **Structural Cracks:**

Structural cracks are those which are due to incorrect design, faulty construction or overloading and these may endanger the safety of a building. Extensive cracking of an RCC beam is an instance of structural cracking.

b) **Non-Structural Cracks:**

Non-structural cracks are mostly due to internally induced stresses in building materials and these generally do not directly result in structural weakening. In course of time, however,

sometime non-structural cracks may, because of penetration of moisture through cracks or weathering action, result in corrosion of reinforcement and thus may render the structure unsafe. For complete details on causes and prevention of non-structural cracks, reference shall be made to good practice SP 25:1984 'Handbook on causes and prevention of cracks in buildings'.

3) **Repairs and Seismic Strengthening of Buildings:** (Part 7 Section 5 Clause no. 13 of NBC 2016)

a) **Non-Structural repairs/restoration:**

Non-structural and architectural components get easily affected/ dislocated during the earthquake. These repairs involve one or more of the following:

- Patching up of defects such as cracks and fall of plaster;
- Repairing doors, windows, replacement of glass panes;
- Checking and repairing electric conduits/ wiring;
- Checking and repairing gas pipes, water pipes and plumbing services;
- Rebuilding non-structural walls, smoke chimneys, parapet walls, etc.,
- Re-plastering of walls, as required;
- Rearranging disturbed roofing tiles;
- Relaying cracked flooring at ground level; and
- Redecoration - white washing, painting, etc.

b) **Structural Repairs/Restoration:**

After the assessment of the damage of individual structural elements, appropriate repair methods are to be carried out component-wise depending on the extent of damage. The restoration work may consist of the following:

- i) Removal of portions of cracked masonry walls and piers and rebuilding them in richer mortar. Use of non-shrinking mortar will be preferable.
- ii) Addition of reinforcing mesh on both faces of the cracked wall, holding it to the wall through spikes or bolts and then covering it, suitably, with cement mortar or micro-concrete (maximum size of aggregate limited to 6 mm or less as suitable), and may be with use of micro-reinforcement as fibre or ferro- cement.
- iii) Injecting cement, polymer-cement mixture or epoxy materials, which are strong in tension, into the cracks in walls.
- iv) The cracked reinforced concrete elements may be repaired by epoxy grouting and could be strengthened by epoxy or polymer mortar application like concreting, jacketing, etc.

c) **Seismic Strengthening:** (Part 7 Section 5 Clause no. 13.1.3 of NBC 2016)

The main purpose of the seismic strengthening is to upgrade the seismic resistance of a damaged building while repairing so that it becomes safer under future earthquake occurrences. This work may involve some of the following actions:

- i) Increasing the lateral strength in one or both directions by increasing column and wall areas or the number of walls and columns.
- ii) Giving unity to the structure, by providing a proper connection between its resisting elements, in such a way that inertia forces generated by the vibration of the building can be transmitted to the members that have the ability to resist them. Typical important aspects are the connections between roofs or floors and walls, between intersecting walls and between walls and foundations.
- iii) Eliminating features that are sources of weakness or that produce concentration of stresses in some members. Asymmetrical plan distribution of resisting members, abrupt changes of stiffness from one floor to the other, concentration of large masses and large openings in walls without a proper peripheral reinforcement are examples of defects of this kind.
- iv) Avoiding the possibility of brittle modes of failure by proper reinforcement and connection of resisting members.

d) **Seismic Retrofitting:**

Many existing buildings do not meet the seismic strength requirements of present earthquake codes due to original structural inadequacies and material degradation due to time or alterations carried out during use over the years. Their earthquake resistance can be upgraded to the level of the present-day codes by appropriate seismic retrofitting techniques.

Note: For more details regarding to repairs, Retrofitting and strengthening of High-Rise Buildings please refer to Part 7 Section 5 of National Building Code.

316 Erection of Steel Work and Roof Trusses –

The assembly and erection of steel work for structures and roof trusses shall be carried out in accordance with approved plans and "methods of erection" as drawn up by the Engineer-in-charge and shall comply with the Indian Railway Standard Specification for "Steel structures (other than girder bridges)".

317 Maintenance of Roads –

- 1) The inspections of roads in Railway premises shall be carried out by engineering officials as per Schedule of Inspection given in **Annexure 1.1**. A separate register for inspection of road shall be maintained by each SSE/ JE in-charges as per Proforma given in **Annexure 3.8** Road Lay out plan indicating class, type, width etc. of the road shall be prepared.
- 2) Maintenance of roads needs careful planning. Thorough repairs like filling up of pot holes, resurfacing at broken patches, shall continue to be done as per the condition of the road at site. The tendency to carry out a routine resurfacing just to improve the outward look of the road should be avoided when it is noted that such resurfacing has, in the past, not been durable. Such a situation may be indicative of an inherent weakness in the design of road structure vis-à-vis the vehicular loads plying over it, or it could be due to poor drainage or a weak sub-grade. Therefore, when it is seen that the road resurfacing in general is not standing well, the adequacy of the road structure design vis-à-vis loading and other aspects like drainage, sub-grade strength, etc. need to be carefully analysed and repairs shall be planned accordingly.

318 Registers to be maintained at Site –

During execution of work proper quality control shall be exercised including quality of materials used in work. Various site registers shall be maintained as prescribed.

319 Taking over of commissioned assets –

Assets constructed by construction organisation/PSUs/any other organisation shall be taken over by open line organisation duly following procedure as under -

- 1) All structures and assets (including Electrical Assets) constructed and commissioned by Construction Organization/PSUs as per the sanctioned estimates should be taken over by Open Line within 90 days of commissioning of the said assets with the completion plans/details.

Joint inspections at the SSE/ JE' and Officers' level between the Construction/PSU and Open Line Organizations should be completed within this period. Any uncompleted work or deficiencies noticed and jointly endorsed for completion/rectification by Construction/PSU and Open Line should be listed out (along with anticipated cost wherever the works are to be tackled by Open Line) and duly signed by the officers of the two organizations not below the rank of JA Grade. The SAG Officers of Construction/PSU and Open Line concerned should jointly decide the time schedule for making good the deficiencies and providing the resources i.e. manpower, material and requisite fund, required to the Open Line by the Construction Organization/PSU. On no account, the taking over of assets by Open Line shall be delayed beyond 90 days of commissioning of the assets. On expiry of 90 days and fund made available, whichever is later, the asset will be deemed to be transferred to Open line organization.

- 2) All structures and assets constructed and commissioned by other organization as per the sanctioned estimates should be taken over by Open Line within 90 days of commissioning of the said assets with the completion plans/details.

Joint inspections at the SSE/ JE's and Officers' level between the other organisation and Open Line Organizations should be completed within this period. Any uncompleted work or deficiencies noticed and jointly endorsed for completion/rectification by other organisation should be listed out (along with anticipated cost wherever the works are to be tackled by Open Line) and duly signed by the officers of the two organizations not below the rank of JA Grade (equivalent to JA grade for other organisation).

The JAG (or JAG equivalent) officers of both should jointly decide the time schedule for making good the deficiencies and providing the resources i.e. manpower, material and requisite fund, required to the Open Line by the other Organization. Effort shall be made to get assets completed by the other organisation. On no account, the taking over of assets by Open Line shall be delayed beyond 90 days of commissioning of the assets. On expiry of 90 days and fund made available, whichever is later, the asset will be deemed to be transferred to Open Line organization.

320 Use of Training & Technology for operation and Maintenance of Assets –

- 1) Training: The existing artisan staff be given exposure to job specific training at the initial stage and through refresher course. Similarly, the works supervisors may be nominated for training in testing of materials by approved institutes.
- 2) Tools and Equipment: The use of modern tools and equipment in maintenance may be encouraged and provided to all artisan staff as a standard tool kit.

- 3) Automation & Mechanization: In order to improve the efficiency and bring down staff costs, valve operations at station, colonies should preferably be automated through the use of IT. Similarly, the cleaning of underground sewerage line, drains should be done through mechanized means. The maintenance of high-rise building should be done largely through mechanized means. The contracts entered into should, therefore, include such items to be carried through mechanized means.

Annexure 3.1a
Para 302(2)(b)

Schedule of Painting

Type of Building	Exterior			Interior		
	Colour washing	Painting external surface with water proofing cement paint	Text mat or poly mat based equivalent synthetic silicon based exterior paint	Painting with plaster Paint, Synthetic enamel paint, Oil bound distemper, Acrylic Paint, Acrylic distemper	Polishing /Painting of interior wood work and Painting of steel work	White washing of kitchen and pantry
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.Hospitals	1 year	3 years	5 years	Corridor O.T. Rooms -1 year & Other areas - 2 year	4 years	1 Year
2.(a) Refreshment rooms (b) Rest Houses for Officers and Sub-ordinates (c) Running rooms	1 year	3 years	5 years	2 years	4 years	1 Year
3.Station Buildings	1 year	3 years	5 years	2 years	4 years	-
4.(a) Offices and Service buildings (b) Institutes and clubs (c) Schools (d) Gate-lodges, cabins etc.	1 year	3 years	5 years	2 years	4 years	1 year
5. Workshops, running sheds, Goods Sheds, transshipment sheds, repacking sheds etc.	1 year	3 years	-	2 years	4 years	-
6. All type of Residential Buildings	1 year	3 years	5 years	2 years	4 years	1 year

Note:

- 1) The above periodicity can be modified with the approval of SAG officer in HQ based on local environmental/climatic condition.
- 2) White washing /distemping of interior in residential buildings shall be done on change of tenancy.

Annexure 3.1b
Para 302(2)(b)

Maintenance Norms of Sanitation Items

Item		Type of Structure/ Building		
		Hospitals	All other Service Buildings	All types of Residential Buildings
Cleaning and Disinfecting of water storage/ Distribution tanks, Water mains		Once in 6 months	Once in 6 months	Once in 6 months
Cleaning of manholes/ Gully chamber/ Inspection chambers and flushing of building sewers		Once in 6 months	Once in 6 months	Once a year before monsoon
Cleanliness of drains (underground)	Storm water drains	Once a year before monsoon	Once a year before monsoon	Once a year before monsoon
	Wet drain meant to serve as quarter drains (sullage drains)	At least once a fortnight	At least once a fortnight	At least once a fortnight
	Other small drains parallel to roads	At least once a month	At least once a month	At least once a month
Clearing of Rank Vegetation	During monsoon	At least once a month	At least once a month	At least once a month
	Rest of the period	As per requirement	As per requirement	As per requirement
Septic Tank	Once in a year			
All sullage disposal work	Once in quarter			

Annexure 3.2
Para 303

Proforma for Building Inspection Register

Division.....
Section

Sr SECTION ENGINEER (Works) /

Sub Division

Quarters No.

Type Unit

Building No.

Station

Sl. No.	Date of Inspection	Inspecting Official	Condition of roofs.	Condition of doors/windows	Condition of flooring/ Plastering	Condition of water supply/sanitary system
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Initials of Inspecting Officials	Nature of repairs to be attended	Details of repairs done with date	Initials of the Occupant	Initials of the SSE/ JE	Remarks of Inspecting officials
(8)	(9)	(10)	(11)	(12)	(13)

Separate pages should be allotted for each quarters/service building

Items to be checked during building inspection (for guidance)

SN.	Item to be Inspected
1	Roofs
	• Leakages /Damp patches
	• Tie rods of jack Arch
	• Drip course
	• Rain water pipes
	• Parapet coping
2	Doors, windows, Ventilators & Cupboards
	• Condition of glass panes
	• Condition of panels in shutters
	• Improper/missing fittings:Hinges, Handles, Tower Bolts, Aldrops, Door stopper, Knobs, Curtain Rods/Pelmets etc.
3	Floor
	• Cracks
	• Settlement
	• Skirting, Dados etc.
4	Wall
	• Cracks
	• Condition of plaster
	• Condition of masonry
	• Dampness etc.,
5	Water supply and sanitary fittings
	Leakages in pipe joints
	Functioning of washers, traps in fittings, floor trap, cistern
	Condition of overhead tank & its cleaning
	Fittings - Wash basin, Mirror, Glass shelf, Towel rail, Hangers, Sinks, Taps etc.
6	Finishing
	White wash/ colour wash/ distemper
	• When was it done last?
	• When is it due?
	• Existing conditions
	Painting
	• When was it done last?
	• When is it due?
	• Existing conditions
7	Common Areas
	Manhole covers, covers to gully traps
8	External Services
	Manhole covers, covers to gully traps
	Cleaning of manholes/ storm water drain
	Plinth protection, Approach roads, Service lanes

Annexure 3.3
Para 304(1)

Register of Standard Measurements of Buildings

Station/Kilometrage.....

Block No.	No. of units	Particulars of buildings and out-houses	Area in square meters			
			Interior Painting	Exterior painting	Painting of wood-work	Painting of steel works
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Plan No.	Sources from which the quantities are taken		Dated signature in token of correctness		Remarks	Sr. Divisional/ Divisional Engineer's initials.
	M.B No.	Page No.	Sr. Section Engineer.	ADEN		
(8)	(9)	(10)	(11)	(12)	(13)	(14)

Annexure 3.4
Para 305(2)

Proforma for Petty Repair Book

Date	Sr. No	Quarter No	Name of occupant and designation	Nature of complaint	Repairs: attended on_	Remarks for not doing repairs	Signature of SSE/ JE (Works)

Annexure 3.5
Para 305(2)

Complaint Register

Division..... ADEN..... SSE/ JE.....

SN	Time & date of Complaint	Colony, Flat /house No	Description of complaint	Classification (tick where appropriate)		Action Taken with date				Remarks of SSE/ JE regarding compliance & balance work to be done	Sign of SSE/ JE
				Urgent	Other	Given to	Date given	Date attended	Details of work done		

Annexure 3.6
Para 309(1)(b) & (c)

The Structural Steel and Timber-Work Inspection Register

Section No _____ Sub-Division _____ Division _____

1. Description of structure _____
2. Block No _____ Station or Kilometrage _____
3. Type of truss/column _____ Span/Height _____
(If timber, kind of timber _____)
4. Height of staging _____
5. Type of High-level service tank Capacity _____
6. Type of bed blocks or pedestals with details of fixture _____
7. Date painted (to be shown progressively)

Date of inspection	Condition of structure at the time of inspection	Action taken	Initials of Inspecting Officials

Annexure 3.7
Para 309(2)(e)

Checklist for Inspection of Steel Structures

SN.	Item to be Inspected	Remarks
1	Whether action has been taken in respect of earlier inspection?	
2	Whether date of painting is mentioned on the structure?	
3	Whether paint as specified is applied on all steel work?	
4	Whether the paint is in good condition?	
5	Whether all fixtures are intact in bed blocks/pedestals?	
6	Whether truss/column/trestles are in sound condition?	
7	Whether there is any corrosion of steel members?	
8	In the case of steel work built into masonry, such as tie rods of arched buildings, whether any corrosion is apparent near the masonry?	
9	Whether the condition of rivets, bolts and tie rods particularly of water storage tanks are in sound conditions?	
10	Whether any crack have developed in cast iron tank plates?	
11	Whether any deformation of the structure (supporting columns, steel girder/members of Truss) has occurred?	
12	Whether anchor-bolts are tightly fastened to foundations & bearings?	
13	Whether any crack has developed in CI/WI/Pressed steel/tank plates?	
14	Whether bed blocks or pedestals are in sound conditions?	
15	Whether any sign of leakage has been detected in water tank?	
16	Whether there is any spalling of concrete of gangway slabs?	
17	Is there any construction deficiency which is leading to accumulation of water at junction/corner locations where flooring system & columns meet or any other such location?	

Annexure 3.8
Para 317(1)

Road Inspection Register

Division:

Station/Location:

Section:

Description of Road:

Sl.	Date of inspection	Item to be inspected	Observations	Action taken with date	Remarks
		Carriage way			
		Shoulder/ footpath			
		Drains			
		Any other miscellaneous item requiring attention			

CHAPTER 4

PASSENGER AMENITIES, STATIONS AND YARDS

401 General –

As stations and their environs are the first point of contact between Railways and their customers, special importance is required to be given to the facilities provided to passengers in regard to their adequacy, quality and maintenance.

While planning for provision/ augmentation of amenities at stations, due consideration needs to be given to the importance of the station from point of view of passenger traffic.

402 Categorization of Stations –

- 1) For the purpose of categorization of stations, the basic parameter is the passenger earnings of each station, from both reserved and unreserved passengers and outward passengers handled at the station. The earnings are to be calculated on the basis of the number of passengers boarding at a particular station (both reserved & unreserved), irrespective of the location from where the ticket has been issued. The data of passenger earning should be collected from PRS, UTS, SPTM and JTBS etc.
- 2) Stations have been categorized in three categories, i.e. Suburban stations, Non-suburban stations and Halt stations based on passenger earnings and/ or outward passengers handled at the station. Suburban stations have also been segregated in three categories i.e. SG-1, SG-2 & SG-3. Non-Suburban stations have been segregated in six categories i.e. NSG-1, NSG-2, NSG-3, NSG-4, NSG-5 & NSG-6. Similarly, Halt stations have been segregated in three categories i.e. HG-1, HG-2 & HG-3. Criteria for categorization of stations is given in **Annexure 4.1**.
- 3) The categorization of stations shall be reviewed every 5 years.

403 Minimum Essential Amenities (MEA) –

When a station is constructed, certain minimum amenities are required to be provided at each category of station (on the basis of projected traffic/earnings). These are called **Minimum Essential Amenities (MEA)**. These MEA norms for non –suburban, Suburban & halt stations are shown in **Annexure 4.2 (a), 4.2(b) & 4.2(c)** respectively whereas the quantum of MEA required for non –suburban, Suburban & halt stations are shown in **Annexure 4.3(a), 4.3(b) & 4.3(c)** respectively.

404 Recommended Amenities –

The availability of amenities at station as per quantum of "Minimum Essential Amenities" (as mentioned in **Annexures 4.3(a), 4.3(b) & 4.3(c)**) may not be commensurate with the actual passenger traffic dealt at the station. Hence, the requirement of actual amenities based on traffic as per the norms laid down in **Annexure 4.4** should be worked out and any augmentation based on this, will be known as Recommended Amenities.

Powers of GM of the Railway to review -

In case quantum of amenities as worked out on the basis of norms for Recommended Amenities in **Annexure 4.4** is less than quantum prescribed for Minimum Essential Amenities in **Annexure 4.3(a), 4.3(b) & 4.3(c)**, the actual quantum of Minimum Essential Amenities to be provided could be modified,

with the approval of GM and Board should be intimated of the same. No further delegation is permitted for such approval.

Provision of recommended level of amenities at stations, which is a parameter of adequacy of the scale of amenities provided as per actual passenger volume, has not received adequate attention. Railways should review the existing facilities vis-à-vis requirements for recommended amenities and a time-bound action plan be made for augmenting shortfalls.

405 Desirable Amenities –

Desirable amenities are those amenities which are considered desirable to further improve customer satisfaction and interface process at the station. The quantum of these amenities would depend upon the category of the station. Various amenities out of the list given in **Annexure 4.5 (a), (b) & (c)** should be provided based on the need and relative importance of the station.

406 Calculation of Passenger Volume –

- 1) The method of calculation of number of passengers per day and maximum passengers at any time per day should be uniform. Zonal Railways should ensure that the number of passengers per day (originating passengers) is calculated as an average number of passengers (reserved and unreserved category) booked by PRS and UTS/other system over a period of one year (excluding the month pertaining to the period of Mela traffic). However, DRM can decide the additional facilities to be provided at stations where special melas takes place.
- 2) For the purpose of calculating Nmax (the maximum number of passengers), Zonal Railways should consider maximum number of trains dealt with in any interval of half an hour at the station and multiply the same by the average number of passengers dealt per train at that station. The average number of passengers per train at a station shall be the average number of daily passengers dealt with at the station divided by the number of trains stopping at the station during 24 hours.

407 Display of Available Amenities –

At each station, a list shall be displayed in Station Manager /Master's room showing the quantum of Minimum Essential Amenities required to be provided for that category of station, as per these guidelines, vis-a-vis the amenities actually available. The details of other amenities available at the station should also be displayed.

408 Preparation of Master Plans & Planning for Passenger Amenity Works –

- 1) The Zonal Railways shall carry out a survey of available amenities at stations in relation to those listed in the **Annexures**.
- 2) Drawing from the results of this survey, a list of the Minimum Essential Amenities, recommended and Desirable Amenities to be provided, should then be separately drawn up station-wise for each route. The Master Plan for each station should show the amenities required.
- 3) These lists shall continue to form the basis for drawing up the Divisional Action plans. Action Plans so formulated should then be amalgamated into one General Action Plan and inter-se priorities for different works assigned.
- 4) Minimum Essential Amenities should be provided first as per the scale at all categories of stations.

Thereafter, priority should be given for augmenting amenities to recommended level at Non-suburban (Excluding NSG-5 & NSG-6) & Suburban category stations.

- 5) Keeping the normal allocation of funds, under the Plan Head "Customer Amenities" in view, a time - frame be allocated to each phase of the General Action Plan. Works should be prioritized in a manner such that, gaps in minimum essential amenities, recommended amenities and desirable amenities are filled up, generally in that order.
- 6) Minimum Essential Amenities as prescribed in **Annexure 4.3(a), 4.3(b) & 4.3(c)** shall be provided as part of the concerned Plan Head at the time of construction of new stations. Elimination of shortfall in Minimum Essential Amenities at existing stations and augmentation of any facility at a station shall, however, be charged under Plan Head "Customer Amenities".
- 7) Normally, priority shall be accorded for higher category of station over lower category of station for provision of an amenity eligible to be provided at such category of stations.

409 Important Aspects –

- 1) **Platform:** Island platform should be treated as single platform for provision of Minimum Essential Amenities.

- 2) **Foot Over Bridges:**

It is an elevated structure of any span and width over/across the railway track/road, primarily used for pedestrian movement and is not directly used by motor vehicle as defined in Motor Vehicle Act, 1988.

FOB should be preferably 20 feet wide at NSG1-NSG3 & SG1 category of stations where feasible. For other category of stations Zonal Railway may decide upon the width of FOB based on the feasibility and requirement. FOB shall be provided with ramp as far as practicable. Handrails shall be provided as per design.

- 3) **Toilets:** The latest policy guidelines issued for provision of toilet & Pay & Use toilet shall be followed. Toilets/Urinals at NSG/1-3 category stations shall have auto flush after every use.

At Suburban stations:

- (a) Only urinals should be provided at the suitable location on the suburban island platforms as the major requirement of suburban passengers is a urinal. Wash basins should invariably be provided near the urinals.
- (b) The power to dispense with provision of toilets/urinals at the platforms is delegated to the General Managers.
- (c) Toilets should be provided only in concourse/ circulating areas of suburban stations. 'Pay & Use' toilets should be provided in the concourse/ circulating area of all stations. However, at stations where the provision of 'Pay & Use' toilets is not feasible, departmentally operated toilets can be provided with the approval of Divisional Railway Manager.

At non-suburban stations:

- (a) The power of provision of urinals instead of full toilets at the platforms of NSG/ 1-4 category stations is delegated to the General Managers.
- (b) Only urinals should be provided on island platforms at other than NSG / 1-4 category stations. Wash basins should invariably be provided near the urinals.

4) **Signage:**

Design principles and technical specifications for signages at stations should be adopted in terms of Railway Board's Signage Guidelines for Railway Stations issued vide Railway Board's letter no. 2023/SD-II/22/07/02 dated 15.05.2023 and 20.06.2024 or as amended from time to time. Signage Layout Plans may invariably be prepared before replacing existing Signages.

5) **Stalls & Trolleys:** The number of trolleys and catering stalls under the platform shelter should be reduced to a minimum and Automatic vending machines should be encouraged to replace existing vending stalls. The norms circulated by Tourism and Catering Directorate in this regard should be adhered to.

6) **Circulating Area:** In the circulating area, proper traffic movement flow plan should be made. Proper landscaping in the circulating area should also be developed. Wherever circulation areas are redesigned, altered, or whenever stations are congested, possibility of providing FOB landings directly into circulating area should be examined as it decongests main platforms. There should be proper segregation of incoming and outgoing passengers, wherever considered necessary.

7) **Entry & Exit:** Proper planning is essential to facilitate easy movement of passengers at stations. For suburban stations, this study shall be done in detail considering future growth. In order to decongest the entrance, separate entry/exit gates to be provided at stations, wherever feasible. All unauthorized entry points into the stations irrespective of their class should be closed excepting the specified exit and entry. Second entry with ticketing facility (booking window/ATVM) shall be a desirable amenity at SG1 and SG2 and NSG/ 1 -4 category stations.

8) **Illumination & Energy saving:** The illumination at the stations should be adopted in terms of 'Standardization of Illumination level at Railway stations & adjoining area' issued vide Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

9) **Mobile & Laptop Chargers:** 5 pin, 5 amp, 230v (Railway approved) sockets for mobile and laptop charging shall be provided in adequate numbers at refreshment rooms and Waiting Rooms.

10) **Air Cooling System:** At NSG/ 1-4 category stations where natural ventilation is not adequate, air-cooling system should be installed subject to feasibility.

11) **Floorings:** Flooring standards for platform, concourse and FOB/waiting room, etc. shall be as per **Annexure 4.6**.

12) **Booking counters:** Booking counters shall be provided based on the requirement under desirable amenity at SG/ 1-2 and NSG / 1-4 category stations.

13) **Dustbins:** Adequate number of uniformly designed standard dustbins should be provided at all categories of stations. At NSG/ 1-5, SG/1-2 & HG/1 category of stations, dustbins should be provided at regular spacing of 50m on each platform. At NSG6, SG-3 & HG/2-3 category stations, adequate number of dustbins as required should be provided. Dustbins shall be provided at locations which will not impede the free flow of passengers.

14) Railway station shall be, as far as possible, integrated for smooth transition with other modes of transport (as available/planned) e.g. metro, city bus service etc. Wherever possible last mile connectivity transportation (taxi, auto rickshaw etc) shall be segregated by providing separate drop off/pick up lanes for each of these.

410 Amenities for Persons with Disability (PwD) –

The facilities for differently abled persons (Divyangjan) and passengers with reduced mobility shall be as per Gazette Notification dated 13.11.2023 and Railway Board's letter no. 2019/LMB-I/3/2 dated 27.12.2019.

1) STATION ACCESSIBILITY

- a) **Accessible Route:** Entry and Exit of the Railway Station should be accessible. Railway stations should be planned and designed keeping in view accessibility to Divyangjans and senior citizens.
- b) **Entrance Ramps:** Entrances to the station building should have a ramp for Divyangjans. Double height handrails with rounded grips may be provided on ramps at entrance of the station. Braille signages to be provided at ramps for NSG1 category stations. The Ramps should have Tactile guiding blocks (Line/dot-type) which indicates a correct path/route to follow for a person with visual impairment.
- c) **Parking:** A minimum of two car parking lots for Divyangjan shall be earmarked as accessible car parks with direct access route to station building on NSG -1 to 4 stations as per feasibility. For other category stations, parking lots for vehicles to be provided as per availability of space, feasibility and requirement. Parking lot should be as close to the Help-Booth/Entry of station as possible. It should ideally be a step free or with ramped access.

Floor and vertical signage with blue and white pictogram of accessibility shall be provided for the parking.
- d) **Ticket Counter:** Provision of low height ticket and enquiry counters duly marked as being Divyang friendly with accessibility signage should be available at NSG-1 to 3 category stations and SG-1 category stations. For other category stations, Zonal Railway may decide provision of a low height ticket counter based on the feasibility and requirement. Priority shall be given to Divyangjans in queues at the ticket booking office. The queue segregating handrails may be provided.
- e) **Help Booths:** Facilities of wheelchairs, other assistive devices like crutches, etc. shall also be extended from the help booth. The location should be prominent and clearly marked through informational signage and directional signages at main entry of Railway Station itself to keep PwDs locate it with ease.

Accessible Help Booth(s) manned by 'Divyangjan Sahayaks' shall be provided at all NSG-1 to 3 and SG-1 category stations. An identified office shall be allocated as Help Booth at NSG-4 & NSG-5 and SG-2 category stations.

Location of Help Booth shall be near the entry/exit of the railway station and prominently identifiable by signage for ease in assistance to persons with disabilities and others. If there are separate accessible ticket counters for Divyangjan, those can serve as a Help Booth as per standards.

Where separate Help Booth cannot be provided due to any constraints, Signage to be provided or Enquiry Booth may be re-designated with a separate accessible counter for Divyangjan to function as Help Booth keeping the practical feasibility of workload of the nominated official.

2) **PLATFORM ACCESSIBILITY**

- a) **Platform Zoning & Design:** Platform design is critical to accessibility and safety of all passengers. It is therefore recommended to create and develop an unobstructed zone as part of every platform.

All the new platforms being raised to High level or during resurfacing of platform. The guiding tactile path will be ensured. The platform edges may be painted with colour strip in high contrast to the floor colour so as to ensure safety for persons with low vision and others while boarding the train or otherwise. Colouring should be such to avoid illusion to driver and also shall not result in false signal sighting.

Platforms should be well illuminated with lux levels as per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

All structural elements like columns or coach position indicator poles, etc. shall be painted in contrasting colour scheme from the bottom to 900 mm above to allow adequate visual contrast for persons with low vision/colour blindness.

Platform numbers and other signage for platform amenities shall be designed and placed/hung prominently in a uniform manner. Protruding objects, if any on the platform shall ensure a minimum head clearance of 2000 mm from finished floor level which will ensure an uninterrupted path especially with people with low vision/Blindness.

- b) **Toilet:** At least one toilet may have universal accessibility features and the facility may be used by all types of passengers

Signage at accessible toilet entrance should be clearly visible and should comply with the International Symbol of Accessibility.

Wherever, space is constrained, a unisex toilet cubicle with accessibility features to be provided

- c) **Drinking Water Booth:** Drinking water points accessible for Persons with Disabilities (PwDs) should be provided on each platform of NSG- 1 to 4 and SG-1 to 2 stations. For other category of stations, Zonal Railways may decide upon the provision of drinking water tap based on the feasibility and requirement.

Any operable part of electrical/electronic controls such as vending machines, electrical switches, wall socket, intercom buttons etc. should be designed and operable.

Faucets and other controls designated for use by Persons with Disabilities may be provided as per drawings.

Clearly visible signage shall be provided.

- d) **Foot Over Bridge:** FOBs with both stairs and Ramp facility should be provided to make them accessible for senior citizens and persons with physical disabilities (PwDs) as well as ease of self-carrying trolley bag.

FOB should be preferably 20 feet wide at NSG 1 to 3 and SG-1 category stations wherever feasible. For other category of stations, Zonal Railways may decide upon the width of FOB based on the feasibility and requirement. Handrails shall be provided as per design.

Tactile guiding and warning blocks may be provided which shall lead to the edge of staircases, lifts or escalators. (NSG 1 to 2 category stations).

Stations where there is more than one platform without any FOB/ Subway connecting them, a pathway for passengers may be provided connecting the ends of the platforms. The pathway should have a minimum width of 2 meter and notices / signages should be prominently displayed near such crossings.

Foot over bridges shall clearly indicate through signage the direction towards the various platforms and also towards the exit side of the station with proper pictograms and adequate colour contrast.

- e) **Subway:** The height of subway should be at least 2.75 metres and minimum width of subway should be 4 metres (desirable 7.5 metres).

Provision of adequate lighting and drainage system and also ensures security and safety for Subway. Power supply to subway should be made available from the feeder cable of traction line (OHE) or other means of uninterrupted power source of electric supply.

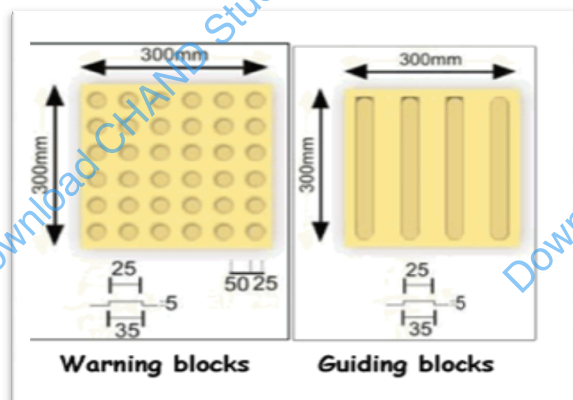
Tactile path (guiding and warning) from the platform may seamlessly lead to Subways (NSG1 to 2 & SG1 category stations).

- f) **Lifts:** Access through Lift shall be provided at platforms where FOB ramp is not available / feasible. The design aspect and specification to be followed as per RDSO Specification no. RDSO/2013/EM/SPEC/0016/(Rev'1')-2019 dated 26.12.2019 or latest.
- g) **Lighting:** Lighting is an integral part of station architecture and as such should respond to the given architectural conditions and be coordinated with other elements of the stations. In addition to providing illumination and a sense of security, the lighting system in railway stations should be durable, energy efficient and easily maintained. The lighting in office rooms, passages, stairs, open areas etc. shall be provided as per established norms and appropriately positioned.

3) **TACTILE PAVERS: GUIDING & WARNING BLOCKS**

- a) Tactile guiding blocks (Line-type) indicate a correct path/route to follow for a person with visual impairment. One/two rows of tactile guidance tiles along the entire length of the proposed accessible route shall be provided. Care must be taken to ensure that there are no obstacles, such as trees, poles or uneven surfaces, along the route traversed by the guidance blocks. Also, there should be clear headroom of at least 2.1m height above the tactile guidance blocks, free of protruding objects such as overhanging tree branches and signage, along the entire length of the walk.
- b) Tactile warning blocks (Dot-type) indicate an approaching potential hazard or a change in direction of the walkway, and serve as a warning of the approaching danger to persons with visual impairments, preparing them to tread cautiously and expect obstacles along the travel path, traffic intersections, doorways, etc. They are used to screen off obstacles, drop-offs or other hazards, to discourage movement in an incorrect direction, and to warn of a corner or junction. Two rows of tactile warning tiles should be installed across the entire width of the designated accessible pathway, before intersections, building entrances, obstacles such as trees, and each time the walkway changes direction. Warning blocks should also be placed 300mm at the beginning and end of the ramps & stairs, at landings and entrance to any door to be used by Divyang Jan.

Warning and Guiding block for reference are shown as under-



Warning blocks on platform edges

4) STANDARD DRAWINGS AND OTHER FUNCTIONAL REQUIREMENTS

Standard drawings and other functional requirements shall be as per the Railway Board's guidelines (updated from time to time).

411 Maintenance of Passenger Amenities –

- 1) It is important to maintain the amenities provided at all the stations in good working order at all times. Maintenance staff shall carry out repairs needed to restore the amenity to functional order, immediately after receipt of information from the Station Master/Station Manager. Hygiene and cleanliness should be an important activity for day-to-day monitoring.
- 2) Railway shall arrange to provide adequate Imprest with Station masters of stations where Railways maintenance staff are not headquartered, to enable them organize expeditious repairs to small items of passenger amenities such as hand pumps/ taps, water trolleys, clock, light / fans, urinal/ latrines and furniture etc. at the station.

412 Review & Updating of the Passenger Amenities Database in Division –

- 1) Complete data base of amenities available at stations in division in prescribed format to be maintained and updated every year on getting details of new amenities added from station manager from time to time. Additions / Modifications to the passenger amenities available at the stations should be incorporated in the data base & Passenger Amenities Management System (PAMS) on web based IRPSM module periodically by designated officials as per Railway Board's instructions from time to time.
- 2) The commercial department will also review the requirement of additional facilities based on passenger earnings or importance of station & will propose them for sanction in Works Programme at appropriate time.

413 General Principles of Planning –

- 1) **Booking Offices**
 - a) The Booking Windows may be distributed function wise by the Commercial Department.
 - b) The planning & layout of booking window should be as per plan provided by Commercial Department.

2) **Waiting Halls**

- a) The area of waiting hall to be decided after considering the covered area available at booking office.
- b) Waiting Halls are meant for the paid passengers and hence should have entry from the platform side only.
- c) At suburban stations, extensions of platform shelter in lieu of construction of Waiting Hall may be done.

3) **Platforms**

- a) **Length of Platforms:** The length should be adequate to accommodate the longest train received at the station.

- b) **Width of Platforms:**

- i) The width should be determined on the basis of the clearance specified in the Schedule of Dimensions (like FOB etc.). The platform widths should be adequate to permit a free unhampered movement of passengers.
- ii) The capacity of station platforms in discharging passengers per metre width of unobstructed passage for movement in both directions can be taken as:

Suburban Passengers: 60 per minute

Non-Suburban passengers: 40 per minute

- c) **Height of Platforms:** High Level Platform is considered as basic requirement hence it shall form a part of essential amenities for all category of stations on broad gauge.

- i) On all new lines, Gauge Conversion & Doubling projects, minimum level of platforms shall be of high level. No low /medium level platform shall henceforth be constructed.
- ii) All existing sanctioned works for raising the height of platform from rail/low level shall be made to high level.
- iii) Wherever platform height gets reduced on account of track works, the same should be restored.
- iv) Platform should be high level of notified minimum height wherever EMU trains are dealt with

Level	B.G.
Height above rail level for high level passenger platforms	840mm maximum 760mm minimum

- d) **Platform Surfaces:**

- i) The platform surface should be as per Guidelines issued by Railway Board from time to time.
- ii) In the case of single face platforms, the platform surface should have a slope of 1 in 60 away from the coping.
- iii) In the case of two face (island) platforms the platform surface should have a slope of 1 in 60 away from the center of the platform up to the coping on either side.
- iv) The ends of the platforms should be provided with ramps at a slope not steeper than 1 in 6. In the ramp portion, the horizontal clearance from the end of platform towards ramp shall be increased from 1670/1680 mm to 1905 mm. The clearance of 1905 mm shall be achieved at a height of not less than 305mm above rail level.

- v) A demarcation line should be drawn 1.8 m from the edge of platform. In the area so demarcated, trolleys shall not be allowed to enable free movement of passengers in that area.
- e) **Platform Fencing:** All single face platforms should be provided with a suitable fencing or hedging (preferably Bougainvillea) of a height of 1.8m with a berm of at least 600 mm beyond the fencing or the hedging. Boundary wall may also be provided.

414 Shady Trees on Platforms –

- 1) The planting will be the responsibility of the Engineering Department. Station Manager shall ensure up keep and watering of plants at stations. Suitable Imprest shall be made available to him for this purpose.
- 2) The trees should be so planted that they do not obstruct the visibility of signals or infringe Schedule of Dimensions or infringe the overhead electric wires (Traction or General Service) or obscure the platform lights or signs.
- 3) If the trees are already in existence, the positioning of the new equipment should be so adjusted as to avoid cutting of trees as distinct from trimming their branches.
- 4) It would be advantageous to provide suitable raised masonry platforms around the fully grown trees as an additional seating accommodation for the passengers.

415 Lighting –

The provision & maintenance of lighting arrangement with their associated equipment for entire station area will be responsibility of Electrical department. However, where oil lamps are used for lighting, their provision, repair & maintenance will be responsibility of Operating dept. The use of Solar Panel may be encouraged at stations where electricity is not available.

The illumination at the stations should be adopted in terms of 'Standardization of Illumination level at Railway stations & adjoining area' issued vide Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

416 Drinking Water Supply –

- 1) Where piped water supply is available, potable drinking water should be supplied on platform by providing adequate number of taps at suitable locations. At smaller stations where piped water supply is not available, minimum one hand pump should be provided.
- 2) In addition, Railway should arrange supply of potable drinking water through mobile or stationary water container wherever desirable.

417 Latrines, Urinals and Dustbins –

- 1) Latrines and Urinals shall be provided as per MEA scale laid down in **Annexure 4.3(a) & 4.3(b)**.
- 2) Out of total no. of Latrines and Urinals as determined in manner indicated above, one third may be reserved for Ladies. In case of 02 toilets existing, one each should be earmarked for ladies and gents.
- 3) All toilets should be gradually converted into Pay & Use system.

- 4) The urinals may be suitably distributed on different platforms and waiting halls.
- 5) All latrines and urinals should be sanitized.
- 6) Number of dustbins as per scale laid down in **Annexure 4.3(a), 4.3(b) & 4.3(c)**, should be provided at the suitable locations on the platforms by Commercial Department.

418 Platform Covers –

- 1) Depending on the climatic conditions, number of passengers and nature of traffic, Platform Covers should be provided as per scale laid down in **Annexure 4.3(a), 4.3(b), 4.3(c) & 4.4**.
- 2) Large-scale covering of platforms should be confined to
 - a) Junction stations.
 - b) Stations at Civil District Headquarters.
 - c) Stations at cities and towns with a population of more than 1 lakh.
 - d) Stations in heavy rainfall areas.
 - e) Suburban stations.
- 3) At important and suburban stations, the whole platform should be covered.
- 4) The Platform Covers should be provided in terms of standard bays and the area under the Platform Covers may therefore marginally exceed the area required to be provided.
- 5) Platform shelters should be extended up to the landings of the foot-over bridges. At small stations, platform shelters should be provided in front of the station building as far as possible. At locations where there is an uncovered space of platform between the shelter and the foot-over-bridge, as far as possible, a covered pathway should be provided to the foot-over-bridge.
- 6) The platform covering should be as per Guidelines issued by Railway Board from time to time.

419 Foot-Over-Bridges or Sub-ways –

- 1) Foot-over-bridges or sub-ways as convenient and techno-economically feasible should be provided at station as per laid down scale of MEA.
- 2) Foot Over Bridge is included in MEA for all category of stations on broad gauge.
- 3) New FOBs should be at least 6m wide at NSG 1-3 and SG 1-3 category stations wherever feasible. New FOBs at NSG 1-3 should be compatible for installation of travelators/escalators amenable for wheelchair users.
- 4) Foot over-bridges shall be provided at all stations of NSG -5 category with more than one platform during doubling/ gauge conversion wherever the same are not available.
- 5) The design and location of the foot-over-bridges and the sub-ways should be guided by the criterion of a rapid dispersal of the passengers through the identified exit points and keeping in view the future expansion of station building. Ramp provided for FOB or Subways should have gradient of 1 in 12 or flatter.
- 6) The design for the foot-over-bridge should provide for covering which should preferably be provided at the initial stage itself. The number of floors envisaged and their usage should be clearly mentioned in the General Arrangement Drawings of the FOB. The structural design should cater to the intended usage of the FOB.

- 7) At stations where there is more than one platform without any foot-over-bridge or sub-way connecting them, a pathway for passengers should be provided connecting the ends of the platforms. The pathways should have a minimum width of 2 m and should ensure that it is clear of all obstructions such as signalling equipment, etc. which should be suitably bridged. Notices in the prescribed languages should be prominently displayed near such pathway crossings, to warn the users to look out for trains before using the pathways
- 8) For foot-over-bridges, sub-ways and pathways, the lowest overhead clearance for the movement should be of 2.75m.
- 9) At important suburban stations, the design for the stairways should be such as to facilitate installation of escalators in future for which the standard slope required is 30°.
- 10) The width of the foot-over-bridge or the sub-way should be adequate to permit a free unhampered movement of the passengers. The capacity of the foot-over-bridges and sub-ways and their component structures in discharging passengers per metre width of unobstructed passage for movement in both directions can be taken as:

Location	Capacity (No. of Passengers/ Minute/Metre Width)	
	Suburban	Non-suburban
Level Portion	60	40
Stairway (Upward)	55	35
Stairway (Downward)	60	40
Stairway (Both Upward & Downward)	50	30
Ramp (Both Upward & Downward)	55	35

420 Waiting Rooms –

- 1) Waiting Rooms shall be provided as per MEA scale laid down in **Annexure 4.3(a), 4.3(c) & 4.4.**
- 2) At non-suburban junctions and terminal stations, the facility should be based on the volume of traffic changing over and the time the passengers have to wait as determined by the Commercial Department.
- 3) If the area to be provided for the Waiting Rooms is sufficiently large, then separate Waiting Rooms or segregated areas for female passengers and other passengers having differing requirements may be provided.

421 Vending Trolleys/Stalls –

The number of trolleys and catering stalls under the platform shelter should be reduced to minimum and automatic vending machines should be encouraged to replace existing vending stalls. Modular stalls shall be provided to save space on platforms. No cooking should be allowed on Platforms. These trolleys/stalls shall be provided in such a way that it will not obstruct the free flow of passengers.

422 Retiring Rooms –

- 1) Retiring Rooms should be provided only where a minimum of 60% occupation is expected by the Commercial Department.
- 2) Size and location of the Retiring Rooms may be decided taking into account the climatic conditions, the importance of the stations, availability of space etc. As dormitory type of Retiring Rooms offer accommodation at cheap rates to the passengers, keeping in view the demand from different types of clienteles, local conditions of the place, availability of comparable type of accommodation in the vicinity and any other factor considered relevant by the Commercial Department, preference may be given for provision of dormitory type of Retiring Rooms.

423 Station Name Boards –

The relevant provision stipulated in the guidelines on Standard Signages at railway stations issued by Board vide letter no. 2023/SD-II/22/07/02 dated 15.05.2023 (including ACS no. 1), as revised from time to time, shall be complied with accordingly.

424 Platform Sign-Boards –

The relevant provision stipulated in the guidelines on Standard Signages at railway stations issued by Board vide letter no. 2023/SD-II/22/07/02 dated 15.05.2023 (including ACS no. 1), as revised from time to time, shall be complied with accordingly.

425 Time Table Boards and Fare Lists –

Boards should be provided at suitable places, by the Commercial Department, for posting time tables and fare lists thereon, as per the extant guidelines.

426 Design of Station Complexes & Preparation of Master Plan –

The layouts for the construction of the stations including the circulating areas, station buildings, goods shed etc., should be so planned as to be functionally efficient. For important stations, the Engineering Department may engage the services of Architectural Consultants to evolve suitable plans. Apart from providing for the passenger amenities detailed here in above, the station layouts should be given special importance as detailed given in below-

1) Station Buildings

- a) The layouts for the station buildings should provide for all the passenger amenities detailed here in above and the functional requirements. The layout should also provide for future expansion and should result in an overall pleasing and functionally efficient layout. Amenities provided should be of user- friendly nature.
- b) The station buildings should incorporate in them the features of the local architectural heritage wherever possible. While extending or modifying the existing station buildings, it must be ensured that the new construction harmonizes with the architecture of the existing station buildings. The plinth level of the station buildings should provide for raising of the platform to a high-level platform.
- c) The existing facilities at the stations should be relocated to make these facilities user friendly. As far as possible maintenance free material should be used at stations to avoid frequent maintenance.

- d) For all stations, the centre of the station building acts as the reference point for the yard plans, inter-station distances, etc. The reference point shall be prominently marked with an engraved vertical arrow on the external walls of the station building with the caption "CENTRE LINE OF STATION" engraved below it. The location represents a fixed reference point and shall not be altered if the station building is subsequently extended, altered or rebuilt. The fixed reference point shall be maintained properly and in the event of removal of the part of the structure on which it is fixed, the reference point shall be re-engraved at the same location on any other permanent structural element available.
- e) A permanent Bench Mark (B.M.) linked with the Survey of India B.M. System should also be provided in the prescribed manner on a suitable part of the station building at a location least likely to be disturbed. A list of B.M.s should be maintained in the offices of SSE (Works), ADEN, & DEN with complete description of their location, level etc.

2) Approach Roads and Circulating Area

- a) The location of new stations and their facilities covering Booking offices, Goods sheds, etc. should be so chosen as to be convenient to the city, town or village served by the station. The station and goods shed approach should have an easy and unobstructed connection with the main road system serving the station.
- b) The approach roads for all the station facilities within the Railway land should be maintained by the Engineering Department. The portion of the approach road beyond the Railway Boundary linking the main road network of the city, town or village can also be maintained by the Engineering Department if the Road Authorities agree to the arrangement with the maintenance being undertaken as a Deposit work.
- c) The circulating area adjoining the station building and goods shed should be properly designed to ensure rapid dispersal of the passengers and road vehicles and avoiding conflict between pedestrian and vehicular traffic. The circulating area should provide adequate parking space, nominated space for embarking and disembarking for vehicular traffic, and loading and unloading of goods. The circulating area should facilitate a smooth unhampered flow of the road traffic in the vicinity of the station building and goods shed.
- d) While formulating the plans for new circulating area or modifying the existing circulating areas, the Engineering Department may consult the appropriate local authorities to ensure that the Railway's planning matches with the local authorities' planning for the road traffic management near the station area.
- e) Whenever circulating areas are redesigned, altered or wherever stations are congested, possibility of providing FOB landings directly into circulating areas should be examined as it decongests main platforms.
- f) No statues and plaques should be provided in the station premises.

427. Station Development Scheme

The stations selected for development under Amrit Bharat Station Scheme shall be developed as per Railway Board's instructions in this regard from time to time.

This scheme envisages development of stations on a continuous basis with a long-term approach.

It involves preparation of Master Plans and their implementation in phases to improve the amenities at the stations like improvement of station access, circulating areas, waiting halls, toilets, lift/escalators as necessary, platform surfacing and cover over platform, cleanliness, free Wi-Fi, kiosks for local products through schemes like 'One Station One Product', better passenger information systems, Executive Lounges, nominated spaces for business meetings, landscaping, etc. keeping in view the necessity at each station.

The scheme also envisages improvement of building, integrating the station with both sides of the city, multimodal integration, amenities for Divyangjans, sustainable and environment friendly solutions, provision of ballast less tracks, etc. as per necessity, phasing and feasibility and creation of city centre at the station in the long term.

Annexure 4.1
Para 402(2)

Categorisation of Station for provision of Passenger Amenities

Category of stations	Criteria of Proposed Earnings	Number of stations on based on Earnings**		Criteria of Proposed outward Passengers handled@	Number of stations based on passengers handled**		Total number of Stations**	
		2017-18	2024-25		2017-18	2024-25	2017-18	2024-25
Non-Suburban Grade								
NSG 1	> 500 Crore	14	22	> 20 Million	7	6	21	28
NSG 2	> 100 crore ≤ 500 Crore	70	107	>10 Million ≤ 20 Million	7	6	77	113
NSG 3	> 20 Crore ≤ 100 Crore	218	303	> 05 Million ≤ 10 Million	9	4	227	307
NSG 4	> 10 Crore ≤ 20 Crore	210	312	> 02 Million ≤ 05 Million	76	23	286	335
NSG 5	> 01 Crore ≤ 10 Crore	1046	1060	> 01 Million ≤ 02 Million	10	3	1056	1063
NSG 6	≤ 01 Crore	4238	4099	≤ 01 Million	0	0	4238	4099
Suburban Grade								
SG 1	> 25 Crore	24	23	> 30 Million	11	2	35	25
SG 2	> 10 Crore ≤ 25 Crore	52	53	> 10 Million ≤ 30 Million	22	34	74	87
SG 3	≤ 10 Crore	398	466	≤ 10 Million	0	0	398	466
Halt Grade								
HG 1	> 50 lakh	18	51	> 03 lakh	12	32	30	83
HG 2	>05 lakh ≤ 50 lakh	538	673	>01 lakh ≤ 03 lakh	30	0	568	673
HG 3	≤ 05 lakh	1728	1530	≤ 01 lakh	0	0	1728	1530
	Total	8554	8699		184	110	8738	8809

NSG (Non-Suburban Grade), SG (Suburban Grade), HG (Halt Grade)

** This data is as on year 2024.

* Total NSG Category of Station = 5945

* Total SG Category of Station = 578

* Total HG Category of Station = 2286

@ Passengers handled is taken on the basis of actual outward passengers handled at the station.

* The categorization proposed is on the basis of data for originating Passengers and earning provided by Zonal Railways.

GMs shall have powers to categorize a station as NSG-4 category if it is a place of Tourist importance and/or is an important junction station.

Minimum Essential Amenities At Various Categories Of Non-Suburban Stations

SN.	Amenities	Station Category					
		NSG1	NSG2	NSG3	NSG4	NSG5	NSG6
1	Drinking water Piped / Hand Pump	Yes	Yes	Yes	Yes	Yes	Yes
2	Waiting hall	Yes	Yes	Yes	Yes	Yes	Yes
3	Seating arrangement	Yes	Yes	Yes	Yes	Yes	Yes
4	Platform shelter	Yes	Yes	Yes	Yes	Yes	Yes
5	Urinals	Yes\$	Yes\$	Yes\$	Yes	Yes	Yes
6	Latrines	Yes\$	Yes\$	Yes\$	Yes	Yes	Yes
7	Platforms High level-@	Yes	Yes	Yes	Yes	Yes	Yes
8	Lighting #	Yes	Yes	Yes	Yes	Yes	Yes
9	Fans	Yes	Yes	Yes	Yes	Yes	Yes
10	Foot over bridge @	Yes *	Yes*	Yes*	Yes	Yes	Yes
11	Time Table Display	Yes	Yes	Yes	Yes	Yes	Yes
12	Clock	Yes	Yes	Yes	Yes	Yes	Yes
13	Water cooler	Yes	Yes	Yes	Yes	Yes	-
14	Public Address system / Computer based announcement	Yes	Yes	Yes	Yes	Yes	Yes
15	Par king-cum-circulatory area, with lights	Yes	Yes	Yes	Yes	Yes	-
16	Electronic Train indicator board **	Yes	Yes	Yes	-	-	-
17	Signage(standardised)	Yes	Yes	Yes	Yes	-	-
18	Dustbins***	Yes	Yes	Yes	Yes	Yes	Yes

* With cover

As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

** At station entrance/ concourse on Foot over bridges (at landing locations) and on platforms located appropriately to guide passengers at every stage. Priority to be accorded as per category of stations subject to stations earnings and passenger footfall.

*** Adequate number of uniformly designed standard dustbins should be provided at all categories of stations at NSG1, NSG2, NSG3, NSG4 & NSG5 category of stations, dustbins should be provided at regular spacing of 50 m on each platform. At NSG6 category station, adequate number of dustbins as required should be provided. It must be ensured that provision of dustbins does not impede the free flow of passengers.

@These items are considered as basic requirement and hence they shall form a part of essential amenities for all categories of stations.

\$ Toilets/ Urinals at NSG/ 1-3 category stations shall have auto flush after every use.

Minimum Essential Amenities At Various Categories Of Suburban Stations

SN.	Amenities	Station Category		
		SG 1	SG2	SG3
1	Drinking water Piped/Hand pump	Yes	Yes	Yes
2	Seating arrangement	Yes	Yes	Yes
3	Platform shelter	Yes	Yes	Yes
4	Urinals	Yes	Yes	Yes
5	Latrines	Yes	Yes	Yes
6	Platforms - High level	Yes	Yes	Yes
7	Lighting#	Yes	Yes	Yes
8	Fans	Yes	Yes	Yes
9	Foot over bridge	Yes	Yes	Yes
10	Time Table Display	Yes	Yes	Yes
11	Clock	Yes	Yes	Yes
12	Water cooler	Yes	Yes	-
13	Dustbins***	Yes	Yes	Yes
14	Public Address system/Computer based announcement	Yes	Yes	Yes
15	Electronic Train indicator board.	Yes	Yes	Yes

As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

*** Adequate number of uniformly designed standard dustbins should be provided at all categories of stations at SG1, SG2 category of stations, dustbins should be provided at regular spacing of 50m on each platform. At SG3 category station, adequate number of dustbins as required should be provided. It must be ensured that provision of dustbins does not impede the free flow of passengers.

Minimum Essential Amenities At Various Categories of Halt Stations

SN.	Amenities	Station Category		
		HG1	HG2	HG3
1	Drinking water Piped 1 / Hand Pump 2	Yes ¹	Yes ²	Yes ²
2	Waiting hall	Yes	Yes	-
3	Platform Shelter	Yes*	--	--
	Shady trees	Yes	Yes	Yes
4	Platform s - High level	Yes	Yes	Yes
5	Lighting#	Yes	Yes ^	Yes ^
6	Foot over bridge\$	Yes	Yes	Yes
7	Time Table Display	Yes	-	-
8	Clock	Yes	-	-
9	Dustbins***	Yes	Yes	Yes
10	Fans	1	-	-

* Bus type modular shelters

\$ In double line section with two PFs provided with high level platforms.

^ At stations where the trains are scheduled to halt after sunset

As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

*** Adequate number of uniformly designed standard dustbins should be provided at all categories of stations at HG1 category of stations, dustbins should be provided at regular spacing of 50m on each platform. At HG2 & HG3 category station, adequate number of dustbins as required should be provided. It must be ensured that provision of dustbins does not impede the free flow of passengers.

Annexure 4.3(a)

Para 403, 404, 408(6), 417(1) & (6), 418(1) & 420

**Norms of Minimum Essential Amenities
At Various Categories Of Non-Suburban Stations**

SN.	Amenity	Station Category					
		NSG1	NSG2	NSG3	NSG4	NSG5	NSG6
1	Drinking water /\ (No. of taps/PF) \$ /\	20	20	20	20	8	2*
2	Waiting hall @ Sq.m	250	250	125	75	30	15
3	Seating arrangement (No. of seats / PF)	150	150	125	100	50	10
4	Platform shelter (on each PF) #	500 Sq.m	500 Sq.m	400 Sq.m	200 Sq.m	50 sqm +	50 sqm +
5	Urinals##	12	12	10	6	4	1
6	Latrines##	12	12	10	6	4	1
7	Platforms	High Level	High Level	High Level	High Level	High Level	High Level
8	Lighting++ (Lux level)	As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest					
9	Fans ©	As given below					
10	Foot over bridge®	1 with cover	1 with cover	1 with cover	1	®®	®®*
11	Time table Display	As per extant instructions.					
12	Clock	To be decided by Zonal Railways.					
13	Water cooler £	2 on each PF	2 on each PF	2 on each PF	2 on each PF	1 on main PF	-
14	Public Address system/Computer based announcement	As per extant instructions					
15	Parking-cum- circulatory area, with lights	As per extant instructions					
16	Electronic Train indicator board.	As per extant instructions					
17	Signage (standardized)	Yes	Yes	Yes	Yes	-	-
18	Dustbins***	Yes	Yes	Yes	Yes	Yes	Yes

Annexure 4.3 (b)
Para 403, 404, 408(6), 417(1) & (6), 418(1) & 420

Norms Of Minimum Essential Amenities at Various Categories of Suburban Stations

SN.	Amenity	Station category		
		SG 1	SG2	SG3
1	Drinking water ^ (No. of taps/PF) \$ ^/	6	6	6
2	Seating arrangement (No. of seats /PF)	10	10	10
3	Platform shelter (on each PF) #	200 sqm	200 sqm	200 sqm
4	Urinals##	4	4	4
5	Latrines##	2	2	2
6	Platforms	High Level	High Level	High Level
7	Lighting++ (Lux level)	As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest		
8	Fans ©	As given below		
9	Foot over bridge®	3 (20 ft. wide)	2 (20 ft. wide)	1 (20 ft. wide)
10	Time table Display	As per extant instructions.		
11	Clock	To be decided by Zonal Railways		
12	Water cooler £	2 on main PF	2	2
13	Dustbins	1 per 50 sqm area		
14	Public Address system/ Computer based announcement	As per extant instructions		
15	Electronic Train indicator board.	As per extant instructions		

Annexure 4.3 (c)
Para 403, 404, 408(6), 417 (6), 418(1) & 420

Norms of Minimum Essential Amenities At Various Categories Of Halt Stations

SN.	Amenity	Station Category		
		HG1	HG2	HG3
1	Drinking water $\wedge$ (No. of taps/PF) \$ $\wedge$	Appropriate drinking water facility **	Appropriate drinking water facility **	Appropriate drinking water facility**
2	Waiting hall @ Sqm	10 sqm booking office cum Waiting Hall	10 sqm booking office cum Waiting Hall	-
3	Platform shelter (on each PF) #	Bus type modular shelter	Shady trees	Shady trees
4	Platforms ****	High Level	High Level	High Level
5	Lighting++ (Lux level)	As per Annexure of Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.		
6	FOB	®®*	®®*	®®*
7	Time table Display	As per extant instructions		
8	Clock	1	-	-
9	Dustbin***	As per extant instructions		
10	Fans	1	-	-

% At NSG1-5 category of stations, the booking counters to operate round the clock except at stations where there is no night working.

$\wedge$ At stations falling in water scarcity zones or where water source dries up in summer, drinking water facility should be ensured at every platform by means of syntax tanks/CANS/Matkas/Piaos etc. as decided by GM of the Railways. At less important stations, particularly those falling under NSG6 and HG category stations one water supply source at a location convenient to passengers may be provided. Drinking water facility would include all necessary units whether donated by private parties or provided by the Railways themselves.

\$ There should be one drinking water tap suitable for use by disabled persons on alternate water booths at every platform.

$\wedge$ Adequate number of water taps should be suitably located to serve passengers of GS coaches, i.e. at the end of platforms.

* At 'NSG6 category stations, wherever piped water supply is not feasible due to local conditions, separate arrangement for water at each platform shall be made available with the approval of General Manager of the concerned Zonal Railway.

** Drinking water arrangements should be made at halt stations by means of water taps/hand pumps/tube wells/sintex tanks/piaos as decided by the General Manager of the concerned Zonal Railway.

*** Adequate number of uniformly designed standard dustbins should be provided at all categories of stations at NSG/ 1-5, SG/ 1-2 & HG1 category of stations, dustbins should be provided at regular spacing of 50 m on each platform. At NSG6, SG-3 & HG/2-3 category stations, adequate number of dustbins as required should be provided. It must be ensured that provision of dustbins does not impede the free flow of passengers.

@ If the variation is marginally on the lower side (upto -5 sqm), then it can be taken to be adequately provided.

#Shelter should be suitably spaced ensuring natural light and ventilation and covering areas from where passengers aboard the General Coach.

+ Preferably light weight shelters.

1. Number of latrines/urinals includes provision in waiting room/halls. 1/ 3rd of the toilet may be reserved for ladies. In case of 2 toilets existing, one each should be earmarked for ladies & gents.

2. Number of latrines / urinals can be reduced in water scarcity areas by the Railway with the approval of GM.

3. Includes pay and use toilets. The policy for setting up such toilets be referred in terms of Board's letter No. 05/TGIV/ 10/SAN/32/Pay& Use Policy Dt 7.6.06.

® New FOBs should be at least 20 feet wide at NSG 1-3 and SG 1-3 category stations wherever feasible. New FOBs at NSG 1-3 should be compatible for installation of escalators amenable for wheelchair users. (May please refer provisions of "Amrit Bharat Station Scheme" for FOB width)

®® Foot over-bridges shall be provided at all stations with more than one platform during doubling/ gauge conversion wherever the same are not available.

®®* a ramped subway shall be considered as the first and the most preferred means of accessibility followed by a second alternative of an FOB with ramp, wherever feasible, at all stations with more than one platform during doubling /gauge conversion wherever the same are not available. First preference shall be given to doglegged ramp (1 : 12 slope) on FOB. Wherever, future augmentation of platforms and number of lines or double decker operations are envisaged, the ramp subway may be explored as first preference.

£To be provided as per Board's letter No. 69/Elec(g)/730/8 Dt. 30.03.1971.

**** (a) on all New lines, Gauge Conversion & Doubling projects, minimum level of platforms shall be of high level. No low /medium level platform shall henceforth be constructed (in supersession of Board's letter No. 2003/LMB/ 14/29 Dt. 26.4.2005 and Board's letter No. 2012/LM(PA)/03/07/Policy dated 06.07.12). (b)Wherever platform height gets reduced on account of track works, the same should be restored (Board's letter No. 2003/LMB/ 14/29 Dt. 03.02.2005) (c) Platform should be high level of notified minimum height wherever EMU trains are dealt with (clarification to Board's letter No. 2006/LMB/2/ 121 Dt. 11.8.2006).

++Solar energy-based lighting needs to be introduced to provide emergency lighting at NSG1 - 5, SG1-3 and HG1 category stations, wherever feasible, in non-electric traction areas.

© For covered platforms having width of 6-9mts; one row of fans should be provided @one fan in the centre of supporting columns. For covered platforms with more than 9mts width, fans should be provided in 2 rows.

Note: (1) At stations where only one ASM is posted, only one booking window will be provided. In respect of NSG-6 category stations, where the earnings are less than Rs. 50 lakh per annum, the quantum of amenities to be provided could be decided by General Managers based on actual requirements.

(2) Scale of all the amenities prescribed above are the bare minimum to be provided at the appropriate category of stations. Amenities over and above the prescribed minimum scales will continue to be provided as per norms for provision of amenities at "Recommended Level".

Annexure 4.4
Para 404, 418(1) & 420

Norms for Recommended Level of Amenities At Various Categories of Stations

N max = Maximum number of trains dealt with in any interval of half an hour at the station multiplied by the average number of passengers dealt per train at that station. The average number of passengers per train at a station shall be the average number of daily passengers dealt with at the station divided by the number of trains stopping at the station during 24 hours.

Ndb = Design figure for number of passengers for non-suburban' stations to be calculated as $Ndb = 0.3 (N_{max})$

Nds = Design figure for number of passengers for Suburban and Halt stations to be calculated as $Nds = 0.45 (N_{max})$

SN.	Amenities	Recommended scale for provision	
		Non-Suburban	Suburban and Halt station
1.	Drinking water (No. of taps)	No. of taps = $N_{max} / 25$. Taps should be distributed so that every alternate coach gets benefit of a tap	No. of taps = $N_{max} / 25$.
2.	Waiting hall/Shed	$1.394 Ndb \text{ sqm}$	$1.394 Nds \text{ sqm}$
3.	Seating arrangement (No. of seats)	$0.4 Ndb$	$0.4 Nds$
4.	Platform shelter* (on each PF) with solar panel for lighting and fans	$0.28 N_{max}$ NSG/ 1-4 to SG/ 1-3 Category stations.	$0.28 N_{max}$ NSG / 1-4 to SG/ 1-3 category stations.
5.	Urinals#	$Ndb/200$	$Nds / 200$
6.	Latrines #	$Ndb / 200$	$Nds / 200$
7.	Lighting ®	As per Board's letter no. 95/ Elec(G) / 138 / 5 dated 19.3.96 Norms indicated in Note below.	
8.	Fans**	As per Board's letter no. 95/ Elec(G)/ 138 / 5 dated 19.3.96.	
9.	Time Table Display	To be decided by the Zonal Railways	
10.	Clock	To be decided by the Zonal Railways	
11.	Bathrooms\$	$1/400 Ndb$	$1/ 400 Ndb$ at other junction & terminal stations only
12.	Water Coolers	To be provided if total number of passengers, inward and outward is more than 1000 per day (As per Bd's letter no. 69/Elec(g)/730/8 Dt 30.3.71. To be decided by the Zonal Railways	
13.	IVRS	NSG / 1&2 - 48 lines (calls 72000) NSG/3&4 -24lines (calls 5000-20000)	A central IVRS with adequate lines should be provided to cover all suburban stations - Minimum 6 lines if IVRS is otherwise justified
14.	Public Address system/Computer based announcement	To be decided by the Zonal Railways	
15.	Parking-cum- circulatory area, with lights	To be decided by the Zonal Railways	
16.	Electronic Train indicator board.	To be decided by the Zonal Railways	
17.	Public phone booth	To be decided by the Zonal Railways	
18.	Signage (standardized)	To be decided by the Zonal Railways	
19.	Coach guidance	NSG / 1-4 to SG / 1-3 category stations.	

	system/coach indication boards	
20.	Insect catchers	NSG/1-3 category stations
21.	Infant Nursing Cubicle	NSG/1-3 category stations.
22.	Universal Mobile charging points	To be decided by the Zonal Railways

* At important category stations and suburban (SG/1-3) stations, efforts should be to cover the entire PF.

1 / 3rd of urinals/ latrines be reserved for ladies.

® (a) Emergency light: From Auxiliary Transformer (AT) connected to traction supply, 10 light points NSG/ 1-3 category stations on each platform. Emergency light from DG set/Solar supply on each platform at all stations where traction supply is not available, except NSG/ 6 and HG / 1-3 category stations. (b) Minimum One light in ASM room, Booking Window, Waiting Hall each, one light on each FOB at every 30 meter, 03 lights on each platform and one light in circulating area shall be provided as emergency light with suitable back up power source such as Solar/wind etc.

** For covered platforms having width of 6-9 m, one row of fans should be provided @one fan in the centre of supporting columns. For covered platforms with more than 9mts width, fans should be provided in 2 rows.

\$ At suburban stations, bathrooms need not be provided.

Note: Norms for recommended level of illumination at various categories of stations are as follows (Ref Railway Board's letter no. 2008/Elect(G)/172/1/Pt.I dated 26.03.2024 or latest.

Revised Norms of Illuminations as per Revised Category of Stations

S.No.	Location	Recommendation as per New Categorization of Stations		
		NSG1, NSG2, NSG3	NSG4, SG1, SG2, SG3	NSG4, NSG6
1.	Concourse	150	100	50
2.	Circulating area	50	30	20
3.	Waiting Hall	150	100	100
4.	Retiring Room	100	100	100
5.	Platform			
	Open	50	30	30
	Covered	150	100	100
6.	Enquiry cum Reservation Office			
	a. General	150	100	100
	b. Counter	150	150	100
7.	Covered Passage Way			
	a. Corridor	50	50	50
	b. FOB	50	50	50
	c. Stairs	50	50	50
8.	Parcel/Luggage Office			
	a. General	100	100	50
	b. Counter	150	150	150
9.	Time table	200	200	200
10.	Outdoor car parking	50	30	20

11.	Restaurant Area			
	a. Kitchen	200	150	150
	b. Store	150	100	100
	c. Dining hall	200	150	150
12.	Other service building at station	200	200	200
13.	Clock Room			
	a. General	150	100	100
	b. Counter	150	150	150
14.	Public utility service (Toilet/Bathroom)	100	75	50
15.	Above Escalators	150	150	150
16.	Near Lifts	100	100	100

Scale/Category (I) - Stations on Zonal Railway HQs / State capitals & all NSG1-3 category stations

Scale/Category (II) - Stations on Rlys. Divisional HQs / State Dist. HQs & all NSG4 Category stations

Scale/Category (III) - Stations in remaining Categories

Desirable Amenities At Various Categories of Non-Suburban Stations

SN.	Amenities	Station Category					
		NSG1	NSG2	NSG3	NSG4	NSG5	NSG6
1.	Retiring room	Yes	Yes	Yes	Yes1	-	-
2.	Waiting room (with bathing facilities) Upper Class	Yes	Yes	Yes1	-	-	-
	2 nd class	Yes	Yes	Yes1	Yes	Yes	-
	Separate for ladies (combined upper and 2nd Class)	Yes	Yes	Yes1			
3.	Cloak room	Yes	Yes	Yes	Yes	-	-
4.	Enquiry Counter	Yes	Yes	Yes	Yes	-	-
5.	NTES	Yes	Yes	Yes	-	-	-
6.	IVRS	Yes	Yes	Yes	Yes	-	-
7.	Public Address system / Computer based announcement	Yes	Yes	Yes	Yes	Yes	-
8.	Book stalls/other - stalls of essential goods	Yes2	Yes2	Yes	Yes	Yes	-
9.	Refreshment room	Yes	Yes	Yes	Yes	-	-
10.	Parking / circulatory area with lights ***	Yes	Yes	Yes	Yes	Yes	-
11.	Washable apron with jet cleaning	Yes	Yes	Yes	Yes	-	-
12.	Electronic Train indicator board	Yes	Yes	Yes	Yes	-	-
13.	Touch Screen Enquiry system	Yes	Yes	Yes	Yes	-	-
14.	Water vending machines	Yes	Yes	Yes**	Yes **	-	-
15.	Escalators	Yes	Yes	Yes3	-	-	-
16.	Travellator	Yes ⁴	Yes ⁴	Yes ⁴	-	-	-
17.	Signage (standardized)	Yes	Yes	Yes	Yes	Yes	-
18.	Modular Catering Stalls*	Yes	Yes	Yes	Yes	Yes	-
19.	Automatic Vending Machines	Yes	Yes	Yes**	Yes**	-	-
20.	Pay & Use Toilets on end platforms & circulating area.	Yes	Yes	Yes	Yes	Yes	Yes
21.	Provision of cyber cafes	Yes	Yes4	-	-	-	-
22.	Provision of ATMs (preferably with ticketing facility)	Yes	Yes	Yes	Yes	Yes**	Yes**
23.	Provision of at	Yes	Yes	-	-	-	-

	least one AC VIP/ Executive Lounge						
24	Food Plaza	Yes	Yes	-	-	-	-
25	Train coach indication system	Yes	Yes	-	-	-	-
26	CCTV for announcement & security purpose	Yes	Yes	-	-	-	-
27	Coin operated Ticket Vending Machines	Yes	Yes	Yes	Yes	-	-
28	Pre-paid Taxi service	Yes	Yes ⁵	-	-	-	-
29	Access Control Systems	Yes	Yes	Yes	-	-	-
30	Bio-toilets /waterless toilets/urinals	Yes	Yes	Yes	Yes	Yes	Yes
31	Bottle crushers, Vending Machines	Yes	Yes	Yes	-	-	-
32	Wi- Fi	Yes	Yes	Yes	Yes	Yes	-
33	Second entry with booking office	Yes	Yes	Yes	Yes	-	--
34	Waiting hall for senior citizens & Divyangjan	Yes	-	-	-	-	-
35	Wheelchair lifting devices/ramps	Yes	Yes	Yes	-	---	-
36	Water Fountain	Yes	Yes	Yes	-	-	-

Yes (in italics): Also prescribed as Minimum Essential Amenity under Annex 4.2.

*** Should include high mast lighting wherever feasible.

® On double line sections.

* In end platforms, all stalls should be preferably embedded in walls.

** Optional items vide Board's letter No.94 / LMB / 2 / 175 dated 16.1.05.

Numbered subscripts:

- 1 Up gradation to be taken up preferably under public-private partnership schemes. Retiring Rooms need not be provided at 'NSG / 5-6' category stations.
- 2 Should provide for minimum essential medicines.
- 3 Escalators to be provided as per Railway Board's Policy no. 2013/Elect(G)/150/13/Pt.I(Dup.) dated 06.03.2019 or latest.
- 4 Subject to availability of space & feasibility.
- 5 Subject to availability/clearance from local authorities.
- 6 Technical specification to be followed for escalators should be as per RDSO/PE/SPEC/TL/0095(Rev'3')-2019 dated 14.10.2019 or latest.

Annexure 4.5 (b)
Para 405

Desirable Amenities At Suburban Categories Stations (SG/ 1-3)

SN.	Amenities	Station Category		
		SG1	SG2	SG3
1.	Retiring room	-	-	-
2.	Waiting room (with bathing facilities) Upper-class	Yes1	Yes	---
	2ndclass	Yes1	Yes	Yes
	Separate for ladies (combined upper and 2ndClass)	Yes1	Yes	Yes
3.	Cloak room	Yes	Yes	Yes
4.	Enquiry Counter	Yes	Yes	Yes
5.	NTES	Yes	Yes	-
6.	IVRS	Yes	Yes	Yes
7.	Public Address system / Computer based announcement	Yes	Yes	Yes
8.	Book stalls / other -stalls of essential goods	Yes2	Yes	Yes
9.	Refreshment room	Yes	Yes	Yes
10.	Parking/ circulatory area with lights***	Yes	Yes	Yes
11.	Electronic Train indicator board	Yes	Yes	Yes
12.	Touch Screen Enquiry system	Yes	Yes	Yes
13.	Water vending machines	Yes	Yes **	Yes **
15.	Escalators	Yes3	Yes3	Yes3
16.	Travellator	Yes4	-	-
17.	Signage (standardized)	Yes	Yes	Yes
18.	Modular Catering Stalls*	Yes	Yes	Yes
19.	Automatic Vending Machines	Yes	Yes **	Yes **
20.	Pay & Use Toilets on end platforms & circulating area.	Yes	Yes	Yes
21.	Provision of cyber cafes	Yes4	-	-
22.	Provision of ATMs (preferably with ticketing facility)	Yes	Yes	Yes
23.	Provision of at least one AC VIP/Executive Lounge	Yes	-	-
24.	Food Plaza	Yes	-	-
25.	Train coach indication system	Yes	Yes	Yes
26.	CCTV for announcement & security purpose	Yes	Yes	Yes
27.	Coin operated Ticket Vending Machines	Yes	Yes	Yes
28.	Pre-paid Taxi service	Yes5	Yes	-
30.	Second entry with ticketing facility (booking window / ATVM)	Yes	Yes	-
31.	Water fountain	Yes	-	-

Yes (in italics): Also prescribed as Minimum Essential Amenity under Annex.4.2.

*** Should include high mast lighting wherever feasible.

® On double line sections.

* In end platforms, all stalls should be preferably embedded in walls.

**Optional items vide Board's letter No.94 / LMB / 2 / 175 dated 16.1.05.

Numbered subscripts:

1: Up gradation to be taken up preferably under public-private partnership schemes.

Retiring Rooms need not be provided at 'SG1, SG2 & SG3' category stations.

2: Should provide for minimum essential medicines.

3: Escalators to be provided as per Railway Board's Policy no. 2013/Elect(G)/150/13/Pt.I(Dup.) dated 06.03.2019 or latest.

4: Subject to availability of space & feasibility.

5: Subject to availability / clearance from local authorities.

6: Technical specification to be followed for escalators should be as per RDSO/PE/SPEC/TL/0095(Rev'3')-2019 dated 14.10.2019 or latest.

Desirable Amenities At Halt Stations (HG1, HG2 & HG3 Categories)

SN	Amenities	STATION CATEGORY		
		HG1	HG2	HG3
1	Waiting room (with bathing facilities) Upper Class	-	-	-
	2 nd class	Yes 1	Yes 1	-
	Separate for ladies (combined upper and 2 nd class	-	-	-
2	Public Address system / Computer based announcement	Yes	-	-
3	Book stalls/ other - stalls of essential goods	Yes2	-	-
4	Refreshment room	Yes	-	-
5	Par king/circulatory area with lights ***	Yes	Yes	-
6	Electronic Train indicator board	Yes	Yes	-
7	Touch Screen Enquiry system	Yes	-	-
8	Water vending machines	Yes *	-	-
9	Signage (standardized)	Yes	Yes	-
10	Modular Catering Stalls*	Yes	Yes	-
11	Automatic Vending Machines **	Yes	-	-
12	Pay & Use Toilets on end platforms & circulating area.	Yes	Yes	Yes
13	Provision of ATMs (preferably with ticketing facility)	Yes	-	-
14	CCTV for announcement & security purpose	Yes	-	-
15	Coin operated Ticket Vending Machines	Yes	-	-
16	Bus type shelter	Yes	-	-

Yes (in italics): Also prescribed as Minimum Essential Amenity under Annex. 4.2.

*** Should include high mast lighting wherever feasible.

® On double line sections.

* In end platforms, all stalls should be preferably embedded in walls.

** Optional items vide Board's letter No.94 / LMB/ 2 / 175 dated 16.1.05.

Numbered subscripts:

1: Up gradation to be taken up preferably under public-private partnership schemes. Retiring Rooms need not be provided at 'HG 1 to HG3 category stations.

2: Should provide for minimum essential medicines.

Details of Flooring / Walling / Ceiling for Various Areas in Station Premises

SN	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
1.	Platform (Covered Area)	1. ¶ Polished Granite flooring. 2. Polished Kota stone or similar stone flooring with or without stone inlays 3. *Fiber reinforced vacuum dewatered concrete flooring.	1. ¶ Polished Granite flooring. 2. Polished Kota stone or similar stone flooring with or without stone inlays 3. *Fiber reinforced vacuum dewatered concrete flooring.	1. ¶ Polished Granite flooring. 2. Polished Kota stone or similar stone flooring with or without stone inlays 3. *Fiber reinforced vacuum dewatered concrete flooring.	1. ¶ Polished Granite flooring. 2. *Fiber reinforced vacuum dewatered concrete flooring. 3. Polished Kota stone or similar stone flooring with or without stone inlays. 4. **Mastic flooring	1. *Fiber reinforced vacuum dewatered concrete flooring 2. ¶ Polished Kota stone or similar stone flooring with or without stone inlays 3. **Mastic flooring. 4. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds.	1. Rough Dressed Stones Slab flooring. 2. Brick on edge. 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds	1. Factory made Interlocking pre-cast Cement Concrete Paver hydraulically pressed. 2. Paver Blocks using plastic moulds 3. Moorum surface flooring 4. Quarry dust flooring.
		Dado upto 1500mm height or upto sill level of window whichever is lower with polished granite of matching colour with flooring.						

SN	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
2.	Platform (Uncovered Area)	1. Polished Kota stone or similar stone flooring with or without stone inlays 2. *Fiber reinforced vacuum dewatered concrete flooring.	1. Polished Kota stone or similar stone flooring with or without stone inlays 2. *Fiber reinforced vacuum dewatered concrete flooring.	1. Polished Kota stone or similar stone flooring with or without stone inlays 2. *Fiber reinforced vacuum dewatered concrete flooring.	1. Polished Kota stone or similar stone flooring with or without stone inlays 2. *Fiber reinforced vacuum dewatered concrete flooring.	1. *Fiber reinforced vacuum dewatered concrete flooring 2. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 3. Bituminous flooring.	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. Rough Dressed Stones Slab. 3. Brick on edge. 4. Moorum surface flooring	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. Brick on Edge. 3. Moorum surface flooring.

SN	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
2.	Platform (Uncovered Area)	3. Polished Kota stone or similar stone flooring with or without stone inlays 4. *Fiber reinforced vacuum dewatered concrete	3. Polished Kota stone or similar stone flooring with or without stone inlays 4. *Fiber reinforced	3. Polished Kota stone or similar stone flooring with or without stone inlays 4. *Fiber reinforced vacuum	3. Polished Kota stone or similar stone flooring with or without stone inlays 4. *Fiber reinforced vacuum dewatered concrete	4. *Fiber reinforced vacuum dewatered concrete flooring 5. Factory made Interlocking pre-cast Cement	5. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic	4. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 5. Brick on Edge. 6. Moorum

		flooring.	vacuum dewatered concrete flooring.	dewatered concrete flooring.	flooring.	Concrete hydraulically pressed Paver Blocks using plastic moulds 6. Bituminous flooring.	moulds 6. Rough Dressed Stones Slab. 7. Brick on edge. 8. Moorum surface flooring	surface flooring.

SN	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1,SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG2 & HG3
3.	# No Trolley Zone on Edges of the Platforms	1. Precast concrete studded tiles manufactured by vibro compaction process and using jointless FRP Moulds 2. Heavy duty (high strength, high abrasion resistance) precast chequered tile 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 4. Flamed Granite	1. Precast concrete studded tiles manufactured by vibro compaction process and using jointless FRP Moulds. 2. Heavy duty (high strength, high abrasion resistance) precast chequered tiles. 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 4. Flamed Granite	1. Precast concrete studded tiles manufactured by vibro compaction process and using jointless FRP Moulds 2. Heavy duty (high strength, high abrasion resistance) precast chequered tiles. 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds. 4. Flamed Granite	1. Precast concrete studded tiles manufactured by vibro compaction process and using jointless FRP Moulds 2. Heavy duty (high strength, high abrasion resistance) precast chequered tiles. 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic 4. Flamed Granite	1. Precast concrete studded tiles manufactured by vibro compaction process and using jointless FRP Moulds 2. Heavy duty (high strength, high abrasion resistance) precast chequered tiles. 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 4. Flamed Granite	1. # CC 2. Coping Slabs 3. Chequered CC Tiles 4. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds	1. #CC Coping Slabs 2. Chequered CC Tiles 3. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds

S. No	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
4.	Concourse/booking Area	1. Polished Granite Flooring 2. Polished Kota stone or similar stone flooring with or without stone inlays	1. Polished Granite Flooring 2. Polished Kota stone or similar stone flooring with or without stone inlays	1. Polished Kota stone or similar stone flooring with or without stone inlays.	1. Polished Granite Flooring 2. Polished Kota stone or similar stone flooring with or without stone inlays	1. Polished Kota stone or similar stone flooring with or without stone inlays	1. Cement Concrete flooring	-
		Dado upto 1500 mm height or upto window sill level whichever is lower with polished granite of matching colour with flooring.						
5.	Portico	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. *Fiber Reinforced Vacuum Dewatered Concrete Flooring	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. *Fiber Reinforced Vacuum Dewatered Concrete Flooring	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. *Fiber Reinforced Vacuum Dewatered Concrete Flooring. 3. Mastic	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. *Fiber Reinforced Vacuum Dewatered Concrete Flooring	1. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 2. Bituminous flooring 3. *Vacuum Dewatered Concrete flooring	-	-

S. No	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
6.	Circulating Area	1. *Fibre Reinforced Vacuum Dewatered concrete flooring 2. Mastic flooring.	1. *Fibre Reinforced Vacuum Dewatered Concrete Flooring. 2. Mastic flooring.	1. *Fibre Reinforced Vacuum Dewatered Concrete Flooring. 2. Mastic flooring.	1. *Fibre Reinforced Vacuum Dewatered Concrete Flooring. 2. Mastic flooring.	1. *Vacuum Dewatered Concrete Flooring. 2. Bituminous flooring	1. Bituminous flooring 2. Levelled surface with good quality soil/moorum	1. Levelled surface with good quality soil/moorum
7.	Parking Area	1. *Fibre Reinforced Vacuum Dewatered Concrete flooring. 2. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 3. Mastic	1. *Fibre Reinforced Vacuum Dewatered Concrete flooring 2. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 3. Mastic flooring.	1. *Fibre Reinforced Vacuum Dewatered Concrete flooring 2. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds 3. Mastic flooring.	1. *Fibre Reinforced Vacuum Dewatered Concrete flooring 2. Factory made Interlocking pre-cast Cement Concrete hydraulically pressed Paver Blocks using plastic moulds	1. *Vacuum Dewatered Concrete flooring 2. Bituminous flooring.	1. Bituminous flooring. 2. Levelled surface with good quality soil/moorum	1. Levelled surface with good quality soil/moorum

S. No	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
8.	Stairs	1. Flamed Granite Flooring 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	3. Flamed Granite Flooring. 4. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	1. Flamed Granite Flooring 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	1. Flamed Granite Flooring. 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	1. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	1. Heavy duty (high strength and high abrasion resistance) Chequered Tiles	-
9	FOB - Pathway	1. Flamed Granite Flooring. 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles.	1. Flamed Granite Flooring 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles.	1. Flamed Granite Flooring 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles.	1. Flamed Granite Flooring 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles.	1. RCC slabs 2. Heavy duty (high strength and high abrasion resistance) Chequered Tiles.	RCC slabs	

S. No	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
10.	Waiting Hall	1. Polished Vitrified Tiles as per IS : 15622 2. Granite tiles flooring.	1. Polished Vitrified Tiles as per IS : 15622 2. Granite Tiles flooring. 3. Ceramic tiles as per IS:15622.	1. Polished vitrified tiles as per IS:15622. 2. Ceramic Tiles as per IS: 15622. 3. Polished Kota stone or similar stone flooring with or without stone inlays	1. Polished Vitrified Tiles as per IS : 15622 2. Ceramic Tiles as per IS:15622. 3. Polished Kota stone or similar stone flooring with or without stone inlays	1. Terrazo Tiles in white cement 2. Ceramic Tiles as per IS:15622. 3. Polished Kota stone or similar stone flooring with or without stone inlays	1. CC Floor 2. Rough Dressed Stones Slab. 3. Polished Kota stone or similar stone flooring with or without stone inlays	1. CC Floor 2. Rough Dressed Stone Slab 3. Polished Kota stone or similar stone flooring with or without stone inlays
11	Refreshment Room	1. Polished Vitrified Tiles as per IS : 15622 2. Granite tiles flooring.	1. Polished Vitrified Tiles as per IS : 15622 2. Granite tiles flooring.	1. Polished Vitrified Tiles as per IS : 15622 2. Granite tiles flooring.	1. Polished Vitrified Tiles as per IS : 15622 2. Granite tiles flooring.	1. Ceramic floor tiles as per IS:15622 2. Polished Kota stone or similar stone flooring with or without stone inlays	-	-
12.	SS Office	1. Polished Vitrified Tiles as per IS : 15622	1. Polished Vitrified Tiles as per IS : 15622	1. Polished Vitrified Tiles as per IS : 15622	1. Polished Vitrified Tiles as per IS : 15622	1. Ceramic Tiles as per IS:15622. 2. Polished Kota stone or similar stone flooring with or without stone inlays.	1. CC Floor	-

S N	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
13.	Waiting Room and Retiring Room	1. Polished Vitrified Tiles as per IS : 15622	1. Polished Vitrified Tiles as per IS : 15622	1. Polished Vitrified tile flooring 2. Ceramic floor Tiles as per IS:15622.	-	1. Terrazo tiles flooring 2. Ceramic floor tiles as per IS:15622		-
14.	Cloak room	1. CC floor with hardened topping on concrete surface	1. CC floor with hardened topping on concrete surface	1. CC floor with hardened topping on concrete surface	1. CC floor with hardened topping on concrete surface	-	-	-
		Fiber reinforced vacuum dewatered concrete shall be provided wherever feasible.						
15.	Parcel Area	1. *Fiber reinforced vacuum dewatered concrete flooring 2. CC floor with hardened topping on concrete surface 3. Mastic flooring	1. *Fiber reinforced vacuum dewatered concrete flooring 2. CC floor with hardened topping on concrete surface 3. Mastic flooring	1. Fiber 2. reinforced vacuum dewatered concrete flooring 3. CC floor with hardened topping on concrete surface 4. Mastic flooring	1. *Fiber reinforced vacuum dewatered concrete flooring 2. CC floor with hardened topping on concrete surface 3. Mastic flooring	1. *Fiber reinforced concrete flooring 2. CC floor with hardened topping on concrete surface 3. Mastic flooring	-	-

S. No	Place	Type of flooring & Basis of station category						
		NSG 1 & NSG 2	NSG 3	NSG 4	SG 1, SG 2 & SG 3	NSG 5	NSG 6	HG 1, HG 2 & HG 3
16.	Toilet	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)	1. Anti-skid ceramic tiles in floor (Group B-II of IS-15622 and ceramic tiles on walls (Group B-III of IS-15622)
		Ceramic wall tiles upto 2100mm height of matching colour with flooring.						
17.	Wall & Ceiling Finish	Smooth finish with POP/ putty and painting with Emulsion in Concourse, Waiting hall, waiting rooms, Refreshment room, Retiring rooms & SS room. Oil bound distemper at other locations.	Smooth finish with POP/ putty and painting with Emulsion in Concourse, Waiting hall, waiting rooms, Refreshment room, Retiring rooms & SS room. Oil bound distemper at other locations.	Smooth finish with POP/ putty and painting with Emulsion in Concourse, Waiting hall, waiting rooms, Refreshment room, Retiring rooms & SS room. Oil bound distemper at other locations.	Smooth finish with POP/ putty and painting with Emulsion in Concourse, Waiting hall, waiting rooms, Refreshment room, Retiring rooms & SS room. Oil bound distemper at other locations.	Painting with oil bound distemper in Concourse, Waiting hall, Refreshment room, Retiring rooms & SS room and other locations.	Painting with oil bound distemper in Concourse, Waiting hall & SS room.	Oil bound distemper in Waiting hall.
Notes for Annexure – 4.6 content: ¶ Only on main platform. * To be provided for all new work. For existing work, it can be provided wherever traffic diversion /protection of surface during setting period is possible. ** Mastic flooring is not to be used for home platform. # The top surface of coping stone should be indented by XPM or some other method.								

CHAPTER 5

WATER SUPPLY

A - GENERAL

501 Introduction –

Reference may be made to the following for provisions not contained in this Chapter. In case of any variation, the latter shall prevail.

- 1) Manual on Water Supply and Treatment by Ministry of Urban Development, New Delhi
- 2) IS:1172 –1993(re-affirmed 2007):Code of Basic Requirements for Water Supply, Drainage and Sanitation
- 3) IS:10500 2012: Drinking Water specifications
- 4) National Building Code of India 2016, Vol. II, Part 9, Section I, Water Supply
- 5) Manuals issued by local public health departments

502 Preparation of Schemes for New Water Supply/Augmentation of Existing Water Supply –

The preparation of schemes for new water supply/augmentation of existing water supply will involve collection of following data:

- 1) Justification for an improved or additional supply or new supply - This will include number of people to be covered, estimated consumption and basis of calculation;
- 2) Nature, quality and quantity of existing supply and its source;
- 3) Possible sources of additional supply and arrangements for its filtration, purification etc.,
- 4) Future requirements.
- 5) Whether the supply will be metered, continuous or intermittent;
- 6) Details of pumping arrangement and its cost.

Ordinarily, in the summer season, sources should be able to supply in eight hours the quantity of water normally consumed in a day. For collecting this data, preliminary survey, site investigation may be necessary. The investigation will involve yield test, check on quality of water **at source** etc. Necessary checklist for framing water supply proposals is given as **Annexure 5.1**.

- 7) The objective of Water Works Management is to ensure that the water supplied is free from pathogenic organisms, clear, palatable and free from undesirable taste and odour, of reasonable temperature, neither corrosive nor scale forming and free from minerals that could produce undesirable physiological effects.
- 8) **Increasing the Water Availability, Supply & Demand Management** - The measures required to increase the water availability involve augmentation of water resources by storing rainwater on the surface or below the surface.
- 9) **Location of Water Supply System Components** - The distribution layout and the sources of supply and their development methods are important in placing the

different units like headworks, transmission mains, WTP, overhead or underground storage tank, pumping stations, pressure reducing valves, flow control valves, etc. for optimal and economical utilization.

- 10) **Automation** - Mechanization, instrumentation and automation are becoming more and more common in water works and distribution network and this should also be considered in planning the system.
- 11) **Service Building** - Considerable attention is to be given to the service building required at treatment works and pumping stations such as houses, offices and laboratories, storerooms, chemical house, pump house, etc.
- 12) **Other Utilities** - Provision needs to be made for facilities such as electricity, water supply, drainage, roadways, parking areas, walkways, fencing, telephone facilities and other welfare services such as housing for operation and maintenance personnel.
- 13) **All Season Roads** - Headworks, WTP, sumps, Balancing Reservoir and Elevated Service Reservoirs (ESRs) should be accessible in all seasons by road.
- 14) **Planning of Ground Water Schemes** - The practice of pumping water from number of tube wells directly into distribution system shall be discouraged as it has following demerits:

- There will be interruption of water supply during power failure or any breakdown.
- Direct chlorination in the pipeline will provide less contact time and high concentration.
- There will be wear and tear of pumps due to back pressure.
- There will be heavy leakage from pipes due to high pumping head.

Water quality of every tube well should meet the physical and chemical parameters stipulated in BIS IS 10500:2012.

- 15) **Planning Tool** - A Geographic Information System (GIS) is the most effective tool used in planning water supply schemes. GIS is defined as "a system designed to capture, store, manipulate, analyze, manage, and present or display spatial or geographically referenced information.
- 16) **Design Period** - The design period of the water supply scheme depends on the life of the components sharing a significant proportion of the cost as well as the difficulty in augmenting them. The projects must be designed normally to meet the requirements over a 30-year period (Handbook on Water Supply and Drainage (SP 35: 1987) of Bureau of Indian Standards) after their completion and commissioning.
- 17) **Per Capita Supply** Piped water supplies for communities should provide adequately for the following as applicable:
 - Domestic needs such as drinking, cooking, bathing, washing, flushing of toilets, gardening and individual air conditioning
 - Institutional needs
 - Industrial and commercial uses, including central air conditioning
 - Firefighting

- Requirement for livestock
- 18) In the Code of Basic Requirements of Water Supply, Drainage and Sanitation (IS: 1172-1993, Re-affirmed 2007), a minimum of 135 LPCD has been recommended for all residences provided with a flushing system for excreta disposal. However we shall consider 150 LPCD as per NBC 2016 Vol II Part 9 Sec (1). The breakup of water requirements is shown in Table.

a) **Average water uses per person per day**

SN.	Purpose	Quantity (LPCD)
1	Drinking	5
2	Cooking	5
3	Bathing	50
4	Toilet flushing	45
5	Washing utensils	15
6	Washing the house	10
7	Washing of clothes	20
	Total	150

b) **Rate of supply of water for floating population**

SN.	Facility	Litres per capita per day (LPCD)
1	Bathing facilities provided	45
2	Bathing facilities not provided	25
3	Floating population using only public facilities (such as market traders, hawkers, non-residential tourists, picnickers, religious tourists, etc.)	15

- c) **Requirement of water for institutions** - Requirement of water for different institutions is tabulated in **Annexure 5.2** of this chapter.
- d) **Fire Fighting Demand** - Prior to computation of fire requirements of all the Operational Zones (such as railway colonies, railway station area, workshops/factories, service buildings, etc.) of the railway area, it is necessary to compute the fire requirements for the railway area using following formula:

Fire requirement for railway area = $100 \sqrt{P}$ (m³ /day)

Where P is the population of the intermediate stage (15 years) of the area, in thousands. This is as per clause 2.8.2.5(iv) of Manual on Water Supply and Treatment Systems Part-A of Ministry of Urban Development (March 2024)

503 Review of Water Supply Arrangements on the Railways –

The Assistant Divisional Engineer and Sr. Section Engineer (Works) /Engineering Department officials should keep themselves posted with the information regarding rainfall, supply position from various sources and take suitable action to avoid any breakdown in supply of adequate water of proper quality.

Every year the Divisional Railway Manager should conduct a Water Review meeting with all the branch officers and Civil Public Health Department if required, to review the adequacy of existing water supply, augmentation required, any other action to be taken for avoidance of emergency during summer months etc. Minutes of the meeting should be sent to the office of the Principal Chief Engineer for information. Copy should also be endorsed to the Assistant Divisional Engineers and Sr. Section Engineers of Engineering and Electrical departments for necessary action.

After the review meeting, the Sr. Divisional/Divisional Engineer should submit necessary proposals for augmentation of water supply to concerned authorities wherever required and take further action.

504 Data for Estimating Requirements of Water –

The Scale of daily supply may be computed on the minimum basis as mentioned in **Annexure 5.2** unless otherwise justified by particular circumstances. Allowance should be made for future development.

505 Water Supply from Outside Sources –

When water is obtained for railway purposes from the Public Works Department, the Municipality or a private body, the agreement should clearly specify:

- 1) Term or duration of agreement;
- 2) Rate of payment for water;
- 3) Mode of measurement and location of meters etc.,
- 4) Maximum and minimum quantities to be supplied daily;
- 5) Minimum pressure to be maintained in the mains at points of supply;
- 6) In case of bulk supply, point or points at which water is to be supplied;
- 7) In case of distributed supply, details of the layout of distribution mains and conditions for extensions or extra connections.

Copies of such agreements should be available in the Sr. Divisional/Divisional Engineer's and Assistant Divisional Engineer's offices.

B - WELLS

506 Classification of Wells -

The wells are classified according to construction as follows:

- 1) Dug Wells: The depth and diameter of drinking wells are decided with reference to the area of seepage to be exposed for intercepting the required yield from the sub-soil layers. Unsafe quality of water may result if care is not taken in the well construction.
- 2) Sunk Wells: Sunk wells depend for their success on the water bearing formations which should be of adequate extent and porosity.
- 3) Driven Wells or shallow tube wells, are sunk in various ways depending upon its size, depth of well and nature of material encountered. The closed end of a driven well

comprises a tube of 40 to 100 mm in diameter.

- 4) Bore Wells: Bore wells are tubular wells drilled into permeable layers to facilitate abstraction of groundwater through suitable strainers inserted into the well extending over the required range or ranges of the water bearing strata.

507 Preliminary Measures for sinking of Open Well -

- 1) Samples of strata and samples of underground water for chemical and bacteriological analysis should be obtained by trial-boring or sinking a test-well. This work should normally be carried out in the dry season. The Geological Department should, whenever possible, be consulted in regard to the strata and source at the proposed site.
- 2) The yield of the test-well should be assessed by carrying out a recuperation test after pumping the water to below the "normal water-table" and plotting the results in the form of a diagram with draw down as abscissa and the inflow in litres per hour as the ordinate

508 Determination of Size of Open Well –

- 1) From the yield diagram, the diameter and depth of an open well should be arrived at on considerations of the maximum daily requirements, due allowance being made for the future demands.
- 2) For the size of the open well, the following factors should be considered:
 - a) The normal water table - This is the level at which water stands in a well which has not been pumped for 24 hours. This varies throughout the year.
 - b) The critical velocity of flow - The critical velocity of inflow is the maximum velocity of water passing through subsoil without disturbing the finer particles of the subsoil. In average conditions of subsoil, this velocity is between 750 mm and 1200 mm per hour and is obtained with a head of 2 to 3 metre.

The safe yield of open wells is limited by the critical velocity and for practical purposes the yield may be obtained by multiplying the critical velocity by the area of the floor of the well.

509 Improving Yield in Open Wells –

- 1) In sandy soil - If the yield with a "drop" of 2 meters is insufficient, then a larger diameter well is needed. Alternatively, a tube well may be sunk in the open well to supplement the yield. Any increase in the "drop" will increase the "critical velocity" and "blowing" of the sandy soil and subsidence of steining may occur.
- 2) In moorum and porous rock - If the yield is insufficient, it may be improved by deepening provided the lower strata is porous. This can only be ascertained by making a bore.

Driving adits into sides of the well and providing a greater number of "weep- holes" would increase the yield.

In porous rock the inflow may be slightly increased by holding up surface flow of the rainfall in the vicinity of the well. This may be effected by building a bund on the upstream

side of the well.

510 Shallow Tube-Wells –

Tube-wells to a depth of 7.5 to 12 meters are found useful for tapping a shallow water-table. Where only small quantities of water are required, these are cheaper than open-wells and may be constructed at wayside stations, trackmen quarters and gate-lodges between stations if the water-table could be tapped at a reasonable depth. Quality of water of these wells is not reliable and disinfection is essential.

Shallow tube well can be operated either electrically or manually depending upon the convenience.

At unimportant stations and wayside stations where water table is within about 10 metres of the ground level, hand pumps should be installed in colonies.

Hand pumps have been standardized by Bureau of Indian Standards and standard hand pumps are available for installation.

511 Construction of Bore wells –

1) **Methods:** Bored wells are constructed by following different methods:

- a) **Well Drilling Methods:** Driven wells are constructed by pushing pipe into shallow sand and gravel aquifer to a depth of 6 to 20 m. Most modern wells are drilled using cable tool or rotary drilling equipment.
- b) **With the hydraulic direct rotary method,** drilling is accomplished by rotating suitable tools that cut, chip, and abrade the rock formations into small particles. Water wells drilled by the hydraulic rotary method generally are cased after reaching the required depth, the complete string of casing being set in one continuous operation.
- c) **Percussion Method:** In the percussion method of drilling, the hole is bored by the percussion and cutting action of a drilling bit that is alternately raised and dropped.
- d) **Hydraulic Jet Method:** It is the best and most efficient method for small diameter bores in soft soils.
- e) **Reverse Rotary Method:** In this method, the water is pumped out of the bore through the pipe and fed back into the annular space between the bore and the central pipe.
- f) **Sludger Method -** In this method, the boring pipe with the cutter attached is raised and lowered by lever action and the bore filled with water from a sump nearby. This method is suitable for depths up to about 50 metres.

2) Casing and Strainers

- a) **Casing of Bore Wells:** Wells in soft soils must be cased throughout. When bored in rock, it is necessary to case the well at least through the soft upper strata to prevent caving. Casing is also desirable for the purpose of excluding surface water and it should extend well into the solid stratum below.
- b) **Well Strainer and Gravel Pack:** The openings in well strainers are constructed in

such a fashion as to keep unwanted sand out of the well while admitting water with the least possible friction. In fine uniform strata, the openings must be small enough to prevent the entrance of the constituent grains.

- c) Yield Test for wells: The wells after their construction are tested for their yield, specific capacity, and aquifer parameters as per details given in **Annexure 4.3(a), 4.3(b) & 4.3(c)** of Manual of Water Supply and Treatment systems Part-A of Ministry of Housing and Urban Affairs.

C - DEEP TUBE WELLS

512 Consultation with Geological Department –

The Geological Department or Central Ground Water Board / Public Health Engineering department of the State Government should, be consulted wherever necessary, for proposals of deep tube-wells. Where the "normal- water-table" is at greater depth, it would be economical and preferable to sink deep tube-wells instead of open-wells.

513 Stages of Work for Sinking –

- 1) Trial boring-
 - a) During sinking of pipes, samples of strata are examined for yield and samples of water taken for analysis
 - b) From the results obtained, the area of strainer necessary for the quantity of water required and the strata in which the strainers should be located are decided upon
- 2) Samples of water for analysis - For a large water supply, water should be drawn from as great a depth as possible to eliminate the danger of bacteriological contamination which can be expected in water drawn from the upper strata. Water drawn from deep ground is likely to be bacteriologically pure.

As the water obtained from deep wells may contain certain dissolved impurities, the chemical analysis of water to determine its suitability for drinking is always necessary and samples should be sent to the Sr. Divisional/Divisional Medical Officer for test.

- 3) Tube-well installation- Initially the casing pipes are sunk to required depth. Strainers and plain pipes of tube-well proper are then lowered to correct depths.

In suitable cases, pebbles or gravel is let down between the casing pipes and the tube-well as shrouding during casing-pipe extraction. This is essential when the strainers are located in fine sand.

Brass, galvanized iron, special alloy steel, high density polythene or PVC and metal combined strainers of the requisite size with gravel/sand shroud may be used. The total area of the openings in the screen should be such that the velocity of inflowing water is sufficiently low to avoid disturbance to the smaller particles of the water bearing stratum.

- 4) Testing yield of tube-wells - A tube- well should be tested for yield, IS: 2800-2019 may be referred.

514 Checking Verticality of Tube Wells –

Tube wells must be perfectly vertical. A simple method is to use plumb disk. Two disks made out of 3mm thick steel plate are connected together by a rod of 25mm diameter and 3-meter long tightened with the help of nuts at the ends. Some holes are punched in plates to facilitate immersion in water. A knob is fixed on the top nut to which a thin steel wire is attached. The disk is suspended into the tube by the wire passing over a pulley on a tripod.

When the disk is lowered into the pipe, the wire is exactly in the center of pipe when the disks are further lowered down and if the well pipe is not truly vertical, the wire will deviate from the center and that shall be indicated at the top of pipe.

Absolute verticality is ideal but a deviation of 100mm per 30 meters of boring is generally acceptable where submersible pumps are not to be installed.

515 Failure of Wells and the Remedial Measures –

The clogging of wells by sand or by corrosion or encrustation of the screen may reduce the yield substantially. The wells may be readily cleaned of sand by means of a sand pump or bucket but if the strainers are corroded, they must be pulled out, cleaned or renewed or replaced.

Method of surging, use of dry ice or chemical treatment by using acids, chlorine, polyphosphates may be used for treatment against clogging. Following table gives types of well clogging problems and recommended treatment:

WELL CLOGGING PROBLEMS AND ITS SUGGESTED TREATMENTS

SN.	Problem	Treatment recommended
1.	Clogging due to fine sand, clay and silts	Sodium hexametaphosphate 50gm/liters depending on the capacity of well bore be left therein for 24 hours. The same should be followed by surging, jetting with chemical mix or normal development till well is freed from clogging
2.	Chemical clogging	Hydrochloric acid or sulphuric acid with inhibitor are added to the well
3.	Bacterial clogging	Chlorine has been found to be effective in loosening this type of clogging Calcium hypochlorite should be used to form solution which is introduced in well in a small polythene pipe. 200 grams of hypochlorite is required at 70% concentration for 1000 liters of water

Disinfection of Wells -

Newly constructed wells as well as those after repairs have to be disinfected by heavy dosages of chlorine. Bleaching powder is generally used for this purpose.

516 Bored Well –

1) **Design of Bored Well:** The main objectives of the bore well design is as follows:

- The highest yield with minimum draw down consistent with aquifer capability
- Good quality of water with proper protection from contamination
- Water that remains sand free

- d) Well should have long life (25 years or more)
- e) Low initial cost
- (i) The well structure consists of two main elements – casing and intake zone.
 - (ii) Design Procedure Selecting the casing diameter and material Casing diameter of the well is important because it will significantly affect the cost of the structure. Therefore, following considerations should be given while selecting the casing pipe:
 - The casing must be large enough to accommodate with enough clearance for installation of pump, passage of drilling tools and development equipment.
 - The diameter of casing must be sufficient to assure that the up-hole velocity is 1.5 m/sec or less.
 - The casing diameter should be kept 50 mm larger than the pump bowls.
 - The casing should have smooth exterior to minimize resistance against the formation due to friction.
 - The casing should have sufficient wall thickness to resist the stresses from the placement and subsequent production.
 - The casing must be capable to withstand the corrosive groundwater.
 - In deep wells that have both static and high pumping water levels, the casing diameter can be reduced at a depth below the lowest pump setting to reduce material cost.

2) Groundwater Recharging Techniques

a)	Direct surface techniques • Flooding • Percolation ponds/basins • Ditch and Furrow system • Over-irrigation
b)	Direct sub-surface techniques • Injection wells • Recharge pits/shafts • Dug well recharge • Bore-hole flooding • Cavity fillings
c)	Combined surface and sub-surface techniques Basin or percolation tanks with pit-shaft or bore-wells.
d)	Indirect techniques Induced recharge from surface water sources Aquifer modification

D - IMPOUNDING RESERVOIRS

517 Governing Factors –

The catchment area, its characteristics and the rainfall decide how much water would be available for storage. A contour plan of the neighborhood of proposed dam facilitates the decision of the height of the dam and decides whether or not there is sufficient storage capacity for the amount of water needed. Losses by evaporation and absorption should be assessed. Expert agencies should be consulted where necessary.

518 Storage Capacity –

The storage capacity depends on the height of the dam and contours of catchment behind. Due allowance should be made for losses due to seepage, evaporation and silting.

519 Cracks in Reservoir Walls–

Cracks that may occur in reservoir walls should be grouted, with fine cement grout/ resins. They should be kept under observation.

520 Reservoir Management –

- 1) **Silting:** Loss of capacity due to the deposition of silt in a reservoir will occur and the usefulness of the reservoir will diminish over time. It may be minimized by proper site selection, implement erosion control like afforestation, deploy effective reservoir operation and de-silting works.

Soil erosion and control are closely related to the silting of reservoirs since without erosion there would be no silting. Erosion prevention can be done by providing check dams, afforestation. Hence it is necessary to provide for silting capacity for all impounding reservoirs, based on studies or data pertaining to similar catchments.

- 2) **Evaporation:** Evaporation is of importance in determining the storage requirements and estimating losses from impounding reservoirs, and other open reservoirs. Evaporation from water surface is influenced by temperature, barometric pressure, mean wind velocity, vapour pressure of saturated vapour and vapour pressure of saturated air and dissolved salt content of water. There are various commercially available organic compounds which when spread on the water surface forms a monomolecular film which reduces evaporation.
- 3) **Seepage:** Seepage occurs wherever the sides and bottom of the reservoir are sufficiently permeable to permit entrance of water and its discharge through the ground beneath the surrounding hills. Seepage can be reduced by making cut-off wall beneath the dam.
- 4) **Algal Problems:** Reservoir management comprises of reducing the algal problems and the growth of water hyacinth. Small inflows of water rich in organic matter should be prevented wherever possible instead of allowing them to infect the main body of the water. Algaecide treatment by using suitable algaecide may be adopted to control algae in reservoir. It is preferable to initiate the treatment in the early stage of algae growth.

E - INFILTRATION GALLERIES AND WELLS

521 Infiltration Gallery –

These are constructed in water bearing strata. The gallery obtains its water from water bearing strata by various porous drain pipes. A collecting well at the downstream end of the gallery serves as the sump from where the infiltrated supply is pumped out. The

gallery laid perpendicular to the flow of sub- surface water yields maximum quantity. Quality of water is normally reasonably good and only disinfection may be required.

522 Infiltration Wells –

Infiltration wells are usually sunk in series in the banks of river. They are generally constructed of masonry with open joints. The infiltration wells in turn are connected by porous pipes to a collecting sump (jack well).

There can be large yield of water from these wells. Quality of water varies with quality of water in river, depth, and distance of well from river bank.

523 Radial Collector Wells –

Radial collector well consists of a cylindrical well of reinforced concrete construction, 4-5 meter in diameter going into the water bearing medium to as great a depth of the substrata as possible. In the collector wells the radial pipes which are slotted steel pipes normally 200mm to 300mm diameter are driven horizontally at about 7 meters below the water table in the well. The length of the steel pipes will be determined by the requirement of water and yield of the aquifer i.e. the water bearing medium in the subsoil. The drain pipes are made of short lengths of pipes 2.4 meters each which are welded to each other. The pipes are driven horizontally by means of suitable pin jacks placed in the well.

De-sanding operation is required to be done after driving of the radial pipes. De-sanding is done by inserting another tube into the drain tubes and blast of compressed air to separate the fine particles of alluvium. The radial collector wells have higher efficiency of drawing the ground water compared to ordinary wells. This type of wells is able to obtain high yields of water depending on the strata and depth of submergence. This is normally provided in alluvial beds of major rivers.

524 Intake Arrangements –

- 1) Detailed consideration is necessary for the design of intake to prevent vortex formation to obtain uniform distribution of the inflow to all the pumps and to maintain sufficient depth of water to avoid air entry during draw down. The suction pipe should be as short and straight as possible. Any bends or elbows should be of large radius. As a general rule the sizes of the suction pipe should be of one or two sizes greater than the nominal size of the pump. Alternatively, the suction pipe should be such that the velocity is about 2m/s. Where bell mouth is used, the inlet of the bell mouth should be of such size that the velocity at the bell mouth is about 1.5 m/s. The suction strainer should have net open area equal to three times the area of the suction pipe at least.
- 2) Development of surface sources intakes. An intake is a device or structure placed in a surface water source for withdrawal of water from the source and convey the water to an intake conduit through which it will flow into the water works system. Types of intake structures consist of intake towers, intake barge or jetty, submerged intakes, intake pipes or conduits, intake wells, movable intakes, and shore intakes.
- 3) Intake towers are used for large waterworks drawing water from lakes, reservoirs, and rivers in which there is a wide fluctuation in water level and/or a desire to draw water

at a depth that will yield the best quality to avoid clogging or for other reasons.

F -PUMPS

525 Pumping Arrangements -

- 1) Site and location of pumping station: The site of the pumping station should be on dry land free from flooding risk. In case the site lies in flood prone area, the pumping station should be protected by constructing a proper embankment along with the river and pump chamber and providing adequate drainage arrangement for the pump house and its adjoining area. The pump/motor floor shall always be kept 1-2 m safety margin above high flood level (HFL) with due consideration of flood risk and should remain approachable by a vehicle even in peak Monsoon. The site should have sufficient area to locate all the components of the pumping plant as mentioned and preferably on even ground and adequately above HFL. The pumping station should have easy access for heavy vehicles carrying machines, hoisting equipment, etc. minimum of 3 m clear width.
- 2) Trash racks and Screen Chamber: A coarse screen may be installed to remove large matter, like floating wood or stones from raw water. A crane for lifting big obstacles and a lifting device for removing accumulated mud or sand from the basin will be installed. Footsteps will be provided for the descent into the basin.
- 3) Pump house: In raw water intake, either vertical turbine pump or alternatively submerged turbine pump can be selected. In case of sump, positive/flooded suction is commonly arranged for the large/medium pumping station by locating generally double suction horizontal split casing pump or end-suction centrifugal pump in adjoining dry pump room such that top of the volute of centrifugal pump is below minimum water level by magnitude of friction loss on suction piping and a small margin for drawdown level and inaccuracies in installation levels.
- 4) Water-seal arrangement: For effective operation, many pumping arrangements (like VT, horizontal centrifugal, etc.), including those with packing seals and mechanical seals, rely on seal water. Seal water serves three functions: cooling the seal and shaft, lubricating the seal, and flushing impurities from the system.

526 Types and Selection of Pumps –

1) Classes of pumps

All pumps are classified into two major classes:

- a) Kinetic energy
 - Centrifugal pumps
 - Jet pumps
 - Airlift pumps
- b) Positive displacement
 - Rotary pumps
 - Peristaltic pumps
 - Reciprocating pumps

Of these, the centrifugal pumps and the reciprocating type of positive displacement pumps are more popular. Prominently, the reciprocating pumps are good on high head (high pressure) duties and for metering/dosing requirements. Centrifugal pumps are of mechanically simpler construction and give non-pulsating continuous flow.

- 2) **Pump Types Based on Variable Frequency Drive:** A variable frequency drive (VFD) is an electronic controller that adjusts the speed of an electric motor by modulating the power being delivered. Variable frequency drives offer continuous control by matching motor speed to the specific demands of the work being done. However, for intake pumping and clear water pumping, constant speed pumps shall be preferred.
- 3) **Pump Types Based on the Method of Coupling the Drive:** Some pumps are coupled to the drives, direct through flexible couplings, or are close-coupled or are distantly driven through belt and pulley arrangement, sometimes with gearing arrangement or even with variable speed arrangement.
- 4) **Pump Types Based on the Position of the Pump Axis:** Pumps normally work with their axis horizontal. Vertical turbine pumps, borewell submersible pumps and volute type sump pumps have their axis vertical. Dry-pit pumps are often arranged to work with their axis horizontal.

- a) **Turbine pump:** In a turbine pump, the impeller is surrounded by diffuser vanes that provide gradually enlarging passages in which the velocity of water leaving the impeller is reduced, thereby, converting kinetic energy into pressure energy and thus, develops pump head.
- b) **Volute pump:** The volute pump differs from the turbine pump in that there are no diffuser vanes, and the impeller is housed in a spiral-shaped case. The velocity of water is reduced upon leaving the impeller, thus transforming velocity to pressure head.

The choice between turbine and volute pumps depends on the condition of use. Ordinarily, the volute design is preferred for large capacity, low/medium head applications whereas turbine design is desirable where high heads are involved.

Centrifugal pump is normally with volute.

- c) **Radial flow pumps:** In radial flow pumps, pressure is developed by centrifugal force. The water normally enters the impeller hub axially and flows radial to the periphery; the impellers may be single or double suction. The impeller may have either straight or double curvature and the pump shaft may be horizontal or vertical.
- d) **Mixed flow pumps:** In mixed flow pumps, the liquid/water enters axially and discharges in partly off radial direction. The head is created by centrifugal force and a lift of the vanes on the water. The casing can be volute or diffuser type.
- e) **Axial flow pumps:** Axial pumps are also known as propeller pumps and develop the head by the lifting or propelling action of the vanes on the water/liquid. They have a single inlet impeller with flow axially and discharging axially.
- f) **Vertical Turbine (VT) pumps:** The impellers are mounted on impeller shaft along

with diffusers housed in bowl assembly. The impeller shaft is connected to vertical line shaft that is housed in a column assembly which conveys the pumped water to the surface.

- g) **Solar Pumps:** The solar pump shall conform to specifications prescribed in the notification of the Ministry of New and Renewable Energy, Government of India, New Delhi vide its letter 32/5/2021 - SPV Division dated 08 June 2021 or guidelines issued by Ministry of Railways, if any.

5) Selection of Pumps

- a) The types of pumps in general use are reciprocating, centrifugal, airlift and vertical spindle deep well turbine pumps. Hydraulic rams are useful and economical in perennial streams for supply of comparatively small quantities of water.
- b) Reciprocating pumps have nearly a uniform efficiency over a large range and therefore greater flexibility in operation. Reciprocating pumps may be duplex, triplex or quadruplex accordingly to the number of water-cylinders and are suitable for pumping from open wells. They are, however, not suitable for tube-well operation as the intermittent suction has a damaging effect on the strainers.
- c) Centrifugal pumps are efficient, economical and require little attention. The suction lift is, however, limited as in the case of reciprocating pumps.

In tube-wells where centrifugal pumps cannot be installed sufficiently close to the water-table, airlift pumps may be used. Their efficiency is, however, low and should not normally be used for capacities in excess of 35000 liters per hour.

- d) Vertical spindle deep well turbine pumps are suitable for tube wells of large size; they are easy to operate and have a high efficiency. They should be used in tube wells which are free from grit and where competent supervisory staffs are available, as adjustments during repairs require skilled attention.

Submersible pump is suitable for comparatively smaller installations. It consists of an electric motor and pump both submerged in water; the vertical spinning shaft is dispensed with; the water being pumped through a vertical pipe.

- e) Pumping units should be so selected that they could be operated continuously at rated load, as the units are operated most efficiently at the rated load.
- f) Pumping capacity should not exceed the yield of the source, so as not to damage the strata through which water filtrates into the source.
- g) The requirement regarding design and selection of pumps shall be finalized by Electrical Engineering Department in consultation with Civil Engineering Departments as per good industry practice or relevant guidelines. For details regarding design and selection of pumps Chapter-5 of Manual of Water Supply and Treatment systems Part-A of Ministry of Housing and Urban Affairs may be referred to.

527 Pump Installation –

While installing a pump, the following points should be paid attention:

- 1) The foundation should be sufficiently strong to absorb vibrations and to form a permanent, rigid support for the base plate. The foundations shall be designed for the loads as per IS: 2974 Part IV - 1979.
- 2) The suction lift, which should be made as low as possible; the greatest suction-lift that may be expected at sea-level is about 7 meters.
- 3) The suction pipe should be air-tight, laid with as few bends as possible and equipped with foot-valve.
- 4) Near the pump, a non-return (reflux) valve and a delivery valve (sluice or butterfly valve) should be provided. The non-return valve should be between the pump and the delivery valve. The size of the valve should match the size of pipe.
- 5) The delivery pipe shall be of such size that the velocity of water is about 2.5 m/s.
- 6) A dismantling joint must be provided between the pump and the valves. The design of the dismantling joint should be such that no pull or push is transmitted to the pump.
- 7) Sufficient space for generating sets should be available in the pump house to locate the pump, motor, valves, pipes, control panels in a rational manner with easy access and with sufficient space around for the maintenance and repairs. The minimum space between two adjoining pumps or motors should be 0.6 m for a small or medium units and 1.0 m for large units.
- 8) Space for control panels should be planned as per the Indian Electricity Rules.

528 Driving Units –

The driving unit may be an electric motor, or an oil engine. Where power is available:

- 1) The prime mover should preferably be an electric motor, being economical;
- 2) The stand-by where provided may be an electric generator so that in case of failure of electric supply, pumping is assured.
- 3) Where power is not available, oil engines may be used.
- 4) Non-return valve at the discharge pipe, supplemented by a sluice valve shall not be closed while the pump is running.

529 Capacity of Pumping –

The pumping system should be capable of supplying:

- 1) In 12 hours or less, the normal quantity required in 24 hours;
- 2) In 16 hours or less, the present maximum quantity required in 24 hours;
- 3) In about 20 hours, the estimated maximum future requirements in 24 hours.
- 4) For small pumping systems, generally of capacity less than 15 million liters per day, two pumps (one duty and one standby of full capacity) should be provided. Alternatively, two duty and one standby, each of 50% capacity may be provided. Although this alternative would need larger space, it facilitates flexibility in regulating

the water supply. Also, in an emergency of two pumps going out of order simultaneously, the third helps to maintain at least partial supply.

- 5) In the case of medium and large pumping stations, at least two standbys should be provided. Electrical department is responsible for installation and maintenance of electrical machinery/equipment.

530 Pump Horse Power –

The equation for pump horse power- $P.H.P = \frac{L * (H+h)}{4560}$, Where

P.H.P is the pump horse power (One metric horse power = 75 kilogram- metres/sec.),

H is the vertical height in metre from suction-level to highest point of discharge,

L is the liters of water per minute and 'h' the head lost in friction in metre.

8 percent extra for incrustation in the case of cast iron pipes may be allowed while calculating PHP. The relation between the pump horse power and the indicated horse power or brake horse power of the engine working the pump depends on the type of engine and type of pump and their efficiency.

G - AQUEDUCTS AND PIPE LINES

531 Conveyance of Water from Source –

There are various types of transmission main systems.

- 1) **Gravity Main:** In cases where the source or starting point of the transmission is at a higher elevation and flow in the transmission main occurs from higher potential head to lower potential head, such systems for transmission of water, either open or closed flow is termed as Gravity System.
- 2) **Pumping Main:** When the water has to be transmitted to a higher elevation and starting point of transmission is at a lower elevation, energy/head to the flow has to be provided by an external source. Such a system for transmission of water is termed as Pumping Main.
- 3) **Combined System:** This is the combination of both gravity and pumping mains. Even though sometimes the source/starting point of transmission is at a higher elevation, the advantage of this potential head is not sufficient for the transmission of water. This may be due to friction losses or the presence of a higher elevation enroute to the transmission main. The need arises for providing energy to the system from an external source. Such a system for transmission of water is termed a combined system.

532 Different types of pipes used –

The materials used in their manufacture/fabrication are cast iron, mild steel, ductile iron, RCC, Prestressed cement concrete, polyethylene, asbestos cement (AC) pressure pipes, glass reinforced plastic (GRP), and bar wrapped steel cylinder (BWSC).

Further, all the valves such as butterfly valves, sluice valves, air valves, valves of cast steel /SG iron, selection of the diameter of air valve vs pipeline diameter, location of line valves, scour valves, air valves, spacing between air valves, air valves with vertical pipe,

valves required to be used.

Details on pipe materials, their classes and valves are described in Chapter 11, i.e., “Pipes and Pipe Appurtenances” of Manual of Water Supply and Treatment systems Part A of Ministry of Housing and Urban Affairs, this can be referred wherever necessary.

Classification of Pipe Materials Based on Material of Construction:

- 1) **Metallic pipes:** Cast Iron (CI), Ductile Iron (DI), Mild Steel (MS), Stainless Steel/Steel, and Galvanized Iron (GI) are sub-classified based on the lining:
 - a) Unlined Metallic pipes
 - b) Lined Metallic pipes with cement mortar or epoxy lining
- 2) **Non-Metallic pipes:** Reinforced Concrete (R.C.), Pre-stressed Concrete; Cylinder or non-cylinder (PSC), Bar Wrapped Steel Cylinder, Plastic Pipes: PVC (PVC-O, PVC-U), Polyethylene (PE), Glass Reinforced Plastic (GRP)/Fibre Reinforced Plastic (FRP), Asbestos Cement Pressure pipes, etc.

A broad classification of pipes used in water supply systems based on the material of construction is given in Figure below:

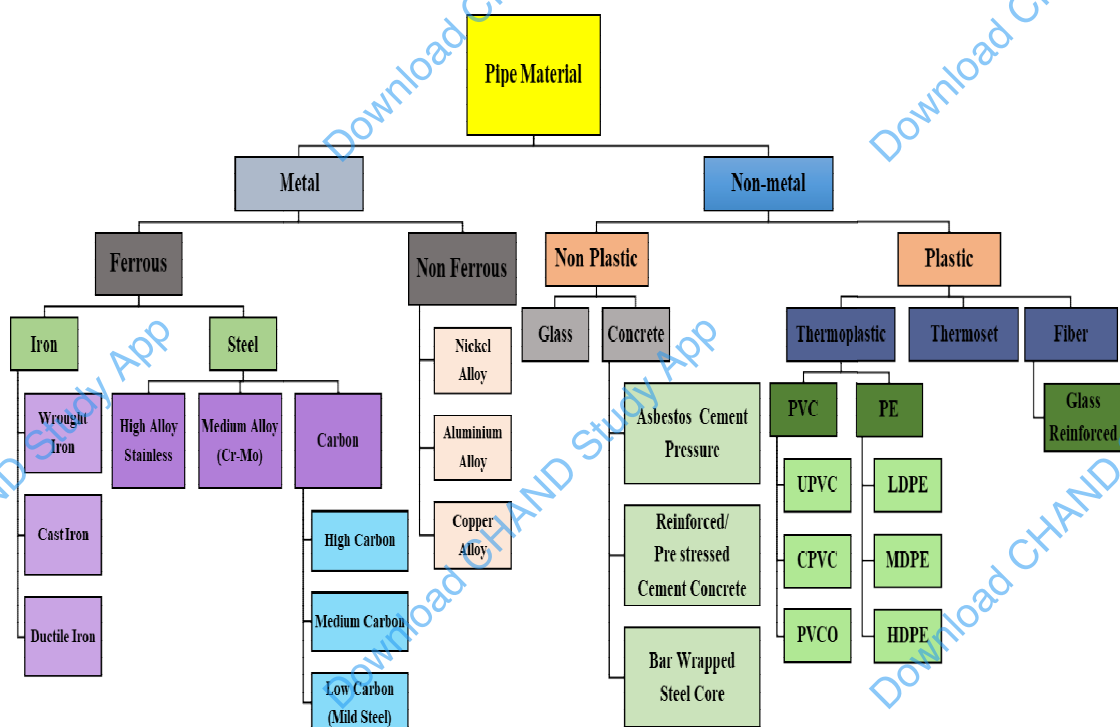


Fig 5.1 Classification of pipes based on material

- a) Gravity conduits should be accurately set out to the necessary gradient and covered to prevent contamination; they should be provided at the lowest point with a scour sluice and with manholes not farther apart than 250 meters and at all bends and changes of gradient.
- b) For pressure mains, galvanized screwed pipes up to 80 mm diameter may be used; for diameters over 80 mm, cast iron spigot and socket or reinforced concrete or suitable steel pipes should be used as per relevant BIS specification.

- c) Cast iron pipes. - First and Second-class cast-iron pipes in stock when used should be treated with a suitable solution in order to reduce corrosion and encrustation.

Owing to liability to tuberculation and encrustation, it is not economical to use cast iron pipes of 80 mm diameter or less. When arriving at the diameter of a cast iron pipe, calculations should be based on data for old pipes unless it is positively known that the pipes will not be required to serve for more than two years.

- d) Concrete pipes: Concrete pipes are best suited where pressure is low and danger of shock is small. These are not to be used for pressures above 50 meters head of water. For greater pressures, hume/steel pipes are to be used.

Reinforced concrete pipes used in water supplies are classified as P1, P2 and P3 with test pressures of 2.0, 4.0 and 6.0 kg/cm² respectively. For use on gravity mains, the working pressure should not exceed 2/3 of the test pressure. For use on pumping mains, the working pressure should not exceed half of the test pressure.

Generally concrete pipes have corrosion resistant properties similar to those of pre-stressed concrete pipes (PSC) although they have their own feature which significantly affects corrosion performance. Concrete pipes are made by centrifugal spinning or vibratory processes.

Centrifugally spun pipes are subjected to high rotational forces during manufacture with improved corrosion resistance properties.

While RCC pipes can cater to the needs where pressures are upto 3.0 kg/cm² and C.I. and steel pipes cater to the needs of higher pressures around 24 kg/cm², the PSC pipes cater to intermediate pressure range for which the metallic pipes are expensive while RCC pipes would not be suitable.

PSC competes economically with steel for pipe diameters of 600 mm and above. The PSC pipes are ideally suited for water supply mains where pressures in the range of 6 kg/cm² to 20 kg/cm² are encountered.

- e) PVC pipes have the advantages of resistance to corrosion, lightness of weight, toughness, rigidity and ease of installation. PVC pipes are cheaper and do not get pitted or corroded in service. They are resistant to a wide range of chemicals.

They have good elastic properties and resistance to deformation resulting from earth movements in buried conditions. Thermal retentivity of PVC is very low compared to metals. PVC pipes are available in various sizes ranging from 20mm to 315mm and stand working pressures varying from 2 to 10 kg/cm². The use of PVC pipes above ground is not encouraged for the reason that the decomposition of the plastic material is accelerated by the ultra violet light and frequent changes in temperature. The deterioration results in discoloration, surface cracking and ultimately rendering the pipe unfit for use.

PVC pipes are not suitable for hot water supply systems. Hitherto GI pipes have been in predominant use in water supply systems. Now pipes with specific improved characteristics are available.

- f) Steel pipes/Ductile Iron Pipes: Steel pipes can be adopted conveniently where changes in relative ground levels are there and are very suitable for laying in

grounds liable to subsidence. Where high dynamic loading is expected, pipes are joined by flexible joint.

Judicious method of laying and joining may be used i.e. either flexible joint made of white lead and spun yarn or welding the plain ended pipes (refer IS 5822-1994 and IS 12288-1987).

Note: For new materials may please refer latest specifications of CPWD/NBC.

g) **Reduction in Carrying Capacity of Pipes with Age**

The carrying capacity of the pipeline depends on the diameter and the Hazen-Williams C-value, which is proportional to the smoothness of the interior surface of the pipe. The higher the C-factor, the smoother the pipe, the greater the carrying capacity, and the smaller the friction or energy losses from water flowing in the pipe. The water carrying capacity of pipes decreases with age due to incrustations (deposition of solids).

533 Pipe Laying and Fitting of Valves and Meters –

1) The following instructions should be followed:

- a) For a gravity line, the pipe line may follow the contour of the ground so long as frequent and abrupt changes in gradient are avoided, and it is well below the hydraulic gradient under conditions of maximum discharge.
- b) Keep the top of pipe at least 0.5 meters below ground surface and where severe frost occurs, the cover is at least 1 meter. The bed of the trench shall be finished to an even gradient/level and filled with soil rammed in 150 mm layers.
- c) Provide air valves at all summits and scour valves at all sags.
- d) Lay spigot and socket pipes with sockets facing the direction from which the water will flow.
- e) Carry pipes across deep depressions or marshy places on pillars or props.
- f) On steep hill-sides, anchor the pipes to prevent sliding of pipes down slope in vertical position, use pipes with flanged ends and bolts as far as possible.
- g) Close the open end of the last pipe at the end of the day's work.
- h) Test the pipe line with water pressure in sections before the trench is filled in

2) Pipe lines should be fitted, where necessary with:

- a) Air valves of proper size and pressure rating at summits (refer SP-35 Science and technology).
- b) Reflex (non-return) valves at the foot of all ascending parts of a main.
- c) Scour valves at depressions on the main for clearing sediment and emptying the pipes.
- d) Sluices as necessary in order to divide the main into convenient sections for repairs.
- e) A ball cock at the discharge end of a gravitational main when the discharge into a

tank or reservoir is to be automatically controlled. A ball cock must only be used at the end of a pumping main if there is a safety or relief valve on the main.

- f) Meters as required.
- 3) The covers and glands of all valves should be removed, packing adjusted, spindles and gates examined and the whole assembly refitted in free and perfect order before installation.

Following fittings and appurtenances are necessary.

- a) Safety valve (to release pressure if exceeds beyond preset pressure): are used to keep the pressure in the line below a given value by causing water to flow to waste when the pressure builds up beyond the designed value.

Usually, they are spring or weight loaded and are not sufficiently responsive to rapid fluctuation of pressure to be used as surge protection devices. They are installed on the main near the pumping station and usually on the outside.

- b) Air Relief valve (to release air if quantity exceeds): These are fitted to release the air automatically when a pipeline is being filled and also to permit air to enter the pipeline when it is being emptied. Additionally, air valves have also to release any entrained air which might accumulate at high points in the pipeline during normal operations.

Location of Air relief valves are required at all peaks. Peaks are not judged solely with respect to a horizontal datum but also with respect to the maximum hydraulic gradient. The reason for this is that the hydraulic gradient is the virtual free water level along the pipeline. It may vary with changes of pipe diameter possibly with different condition of pipe surfaces and with variation of velocity caused by branch mains and local points of draw-off. Any portion of a pipeline running parallel with the hydraulic gradient above it constitutes a peak and air valves at each extremity of such a parallel stretch of main are necessary, in addition to intermediate ones for long length of main as Air valves are necessary at all points where the pipeline approaching the hydraulic gradient changes its slope to recede from this gradient, thereby forming a peak which is not necessarily a peak with respect to the horizontal as shown (Ref: SP-35 (S & T) 1987 Reaff.2014)

- c) Sluice valves: These are used for varying the flow or completely stopping the flow in a pipeline. Sluice valves are normally installed in grade conduits particularly in large ones. In the case of pressure conduits, the valves are usually placed at major summits. Summits identify the sections of line that can be drained by gravity and pressures are least at these points permitting cheaper valves and easier operation.
- d) Drain valve: are ordinary valves but used for a specific purpose of scouring or emptying the main. These are placed at the low points in the line on the scour branch from the mains and at all dead ends in a distribution system.
- e) Reflux Valves: are valves through which flow can proceed in one direction only. Any tendency for the flow to reverse causes a reflux valve to close and to remain closed until flow is re-established, in the unique direction. It should close without causing shock. They are also called non-return valves, check valves and

retaining valves.

- f) Level probes and sight glass tube (to monitor air-water interface levels)
- g) Pressure gauge

H -WATER TREATMENT

534 Water Quality Testing and Laboratory Facilities –

1) Introduction

Water quality is typically categorised into physical, chemical, microbiological, and radiological parameters. As the water comes into contact with various substances in different phases of the hydrologic cycle, such as rainfall, runoff, infiltration, impoundment, use, and evaporation, many substances are dissolved and suspended. Drinking water quality is influenced by source water, efficacy of water treatment plants, integrity, and condition of the water distribution system, and, as importantly, the condition of service lines to households.

Bacteriological and chemical tests to be done by Medical department however the samples are to be collected jointly by Engineering and medical department.

2) Health Effects of Unsafe Drinking Water

Pathogens in drinking water are likely to result in infectious diseases. In addition, chemical contaminants are increasing in the water, posing health risks when their presence is above stipulated standards and consumed without treatment.

Diseases like cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio have been linked to contaminated water and poor sanitation.

3) Standards and Guidelines

There are various standards and guidelines published by the Bureau of Indian Standards (BIS), Ministry of Environment, Forests and Climate Change (including Central Pollution Control Board) and Ministry of Jal Shakti from time to time, which form the basis of planning the Water Quality Testing requirements and laboratory facilities to be provided, to provide safe drinking water to all residents, at all times.

The Standards and Guidelines applicable are:

- IS 10500: 2012 Drinking Water - Specifications (second revision) Standards are given in **Annexure 5.3**
- IS 3025: 2019 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water.

535 Water Samples for Analysis –

Whenever the quality of water from any source of supply or from taps is to be tested and samples are required to be collected by the Engineering staff jointly with Medical Department, the following procedure should be followed:

- 1) Sterilized glass-stopper bottles available with the Sr. Divisional/Divisional Medical Officer should be obtained. Bottles separately available for bacteriological or chemical examination have to be appropriately used.

- 2) The paper cover of the stopper should be removed just before taking the sample. The stopper should be removed just before filling the bottle and replaced immediately after. The stopper should be held from the top while the bottle is being filled. Contamination while filling the bottle must be avoided. There should be no external contact with the mouth of the bottle or the part of the stopper that goes into it. The bottle should be filled to about 25mm below its neck.
- 3) When samples of water are taken from a tap, the mouth of the tap should be heated by a spirit lamp for 3 minutes. Water should then be allowed to flow for 5 minutes before the sampling bottle is filled.
- 4) If the sample is to be obtained from a tank or a reservoir or a river, the unopened bottle is to be held in water about 300 mm below the surface and away from the edge without disturbing the bed. The stopper should then be removed, the bottle withdrawn when full; a few drops of water poured out and the stopper replaced and tied down.
- 5) Well water should be collected by lowering the bottle (tied with a piece of weight) into the well by a string attached to the neck; the stopper should be removed by another string tied to it and the bottle filled in with water, not from the surface but from a point a meter or two above the bottom of the well. If collected from a tube-well with a pump, the water should be allowed to flow for about 20 minutes.
- 6) Bottles containing samples of water should be properly labeled, packed around with ice and saw-dust and sent without any delay to reach the Sr. Divisional/Divisional Medical Officer. Satisfactory packing and expeditious dispatch are essential for a proper bacteriological examination. Where proper Railway facility is not available, the testing of water samples may be undertaken at approved laboratories.
- 7) Bacteriological tests are to be conducted once in a month and Major Stations and once in Two (2) months at small stations. Chemical tests are to be conducted once in a six month. Both these tests are to be conducted by Medical Department. Sr. Divisional/Divisional Medical Officer may advise, on the appropriate dosage of the coagulant or the sterilizing agent, if deemed necessary. Reports on water analysis received from the Sr. Divisional/Divisional Medical Officer should be carefully filed, the action taken on each report being recorded. Physical test of water shall be done by Engineering department once in Three (3) months and necessary action, if any shall be taken.

536 Method of Treatment –

The aim of water treatment is to produce and maintain water that is hygienically safe, clean and potable in an economical manner. Treatment should ensure the desired quality at the end points of consumption.

The method of treatment to be employed depends on the nature of raw water and the desired standards of water quality. The unit operations in water treatment constitute aeration, flocculation (rapid and slow) and clarification, filtration, disinfection, softening, de-ferrization, de-fluoridation and water conditioning. Different combinations are possible to achieve the required quality of water. The choice of any particular sequence of treatment will depend not only on the quality of the raw water available but also on the comparative economics of alternative treatment steps to get desired quality. The

consumables like alum, chlorine etc. are to be arranged well in advance.

In the case of ground water storage which are well protected, where the water has turbidity below 10 NTU and water is free from odour and colour, plain disinfection by chlorination is adopted before supply.

Where ground water contains excessive iron, dissolved carbon dioxide and odorous gases, aeration followed by flocculation and sedimentation, rapid gravity or pressure filtration and disinfection may be necessary.

Conventional treatment including pre- chlorination, aeration, flocculation and sedimentation, rapid gravity filtration and post- chlorination are adopted for highly polluted surface waters laden with algae or other microorganisms.

Water with excessive hardness will need softening by conventional method or by ion exchange method.

537 Conventional Water Treatment–

- 1) **Introduction:** The objective of water treatment is to treat source water, in a cost-effective manner that meets drinking water standards of BIS code IS 10500 (2012) and its amendments.
- 2) **Methods of Treatment:** The method of treatment to be employed depends on the nature of raw water constituents.
- 3) **Desirable Raw Water Quality for Conventional Treatment:** As mentioned earlier, coagulation, flocculation, clarification/precipitation, filtration and disinfection are the main unit operations and processes classified as conventional treatment.
- 4) **Non-Conventional Treatment Technologies for Highly Polluted Water:** Due to excessive river pollution as a result of constituents mentioned in the earlier paragraph, the organic and microbial contaminants increase beyond the desirable limits. Conventional technologies become ineffective. For BOD and COD values consistently exceeding 10 mg/L and 30 mg/L throughout the year, the option of adopting advanced technologies needs to be analyzed. The membrane technologies (submersible or pressure) can eliminate difficult to coagulate particles with lower molecular weights.
- 5) **Groundwater with High TDS:** In many costal zones in India, the groundwater has TDS in the range of 1,000 to 5,000 mg/L (brackish to saline). In such cases, low-pressure RO membranes need to be included in the treatment process.
- 6) **Conventional Water Treatment Options:** The unit operations in water treatment include following steps:
Aeration → Coagulation and Flocculation (rapid and slow mixing) → Sedimentation (Clarification) → Filtration → Disinfection.

Various technologies for removal of emergent contaminants and Disinfection byproduct (DBP) have been given in Part A – Chapter 10 of Manual of Water Supply and Treatment systems Part-A of Ministry of Housing and Urban Affairs.

538 Aeration –

In water treatment, aeration is practiced for four purposes:

- 1) To enhance the aesthetic purpose or value of the water treatment complex as a whole for surface water as well groundwater. Aeration techniques are commonly used in pond, lake, and reservoir management to address low oxygen levels or algal blooms.
- 2) To add oxygen to water for imparting freshness, e.g., water from underground sources devoid of or deficient in oxygen so as to maintain DO level of 6-8.5 mg/L.

Types of Aerators

- Spray Aerators
- Waterfall or Multiple Tray Aerators
- Cascade Aerators
- Diffused Aerators

539 Coagulation and Flocculation –

'Coagulation' describes the effect produced by the addition of a coagulant and coagulant aids to raw water, resulting in particle destabilization and charge neutralization. This is achieved by rapid intense mixing in a unit called as a 'Flash Mixer' or 'Rapid Mixer' for obtaining uniform dispersion of the coagulant.

'Flocculation' is the second stage formation of settleable particles (or flocs) from destabilized colloidal sized particles occurs. This is achieved by gentle and prolonged mixing which ensures continuous multiple re-contacts of solids.

The IS 7090 (1985, Reaffirmed 2001): Guidelines for rapid mixing devices may be referred to for details for design considerations, guidelines for materials and methods of construction of the different types of rapid mixing devices:

Location of Coagulant Dosing Points: The primary coagulant is dosed just before the zone of maximum velocity gradient (turbulence) in the tank. For weir mixers, it is located over the 'nappe' of a free-falling weir. In the mechanical rapid agitator tank, it is near to the inlet of the tank.

Chemical Solution Feed: Preparation of the solution of the coagulant in the water of desired strength is the first step and is done in the solution tanks. This solution is fed to the raw water through controlled feeders which are of gravity or pressure type.

Solution Tanks: There should be at least two tanks for each coagulant feed. The capacity of each tank should generally be such as to hold 12 hours requirement at the maximum demand of coagulant at the design flow. Various types of Coagulant Feeders are as under:

- Pot Type Coagulant Feeders
- Pressure Solution Coagulant Feeders
- Electro-Coagulant Feeders
- Gravity Orifice Coagulant Feeders

- Reciprocating/Positive Displacement Pump Coagulant Feeders

540 Coagulants –

Coagulants/chemicals used and their properties: **Annexure 8.4** of Manual of Water Supply and Treatment systems Part-A of Ministry of Housing and Urban Affairs gives the list of coagulants and/or chemicals commonly used in water treatment and their properties. While designing, the designer must carefully consider the most effective coagulant and/or chemical that should be used for the treating water based on site-specific conditions.

541 Slow Mixing or Flocculation –

Slow mixing is the hydrodynamic process which results in the formation of large and readily settleable flocs (orthokinetic flocculation) by bringing the finely divided matter into contact with the microflocs formed during rapid mixing. Alum is a trivalent coagulant (carrying +++ charges on its surface) and it nullifies three colloidal particles (each one carrying –ve charge) and therefore, Van der Waal forces of attraction increases, which forms the microflocs and later on, these microflocs again collide together to form a settleable floc. These flocs can be subsequently removed in settling tanks and filters.

Types of Slow Mixers

- Gravitational or Hydraulic Type Flocculators
- Horizontal Flow Baffled Flocculator
- Vertical Flow Baffled Flocculator
- Mechanical Paddle Type Flocculator
- Pulsating Sludge Blanket Clarifier

542 Sedimentation (Clarification) –

Sedimentation is the separation of suspended particles from water by gravitational settling. It is one of the most commonly used unit operation of conventional water treatment. Sedimentation (settling or clarification) is used to remove coagulated impurities. The factors that influence sedimentation are:

- Size, shape, density, and nature (discrete or flocculent) of the particles;
- Viscosity, density, and temperature of water;
- Surface overflow rate;
- Velocity of flow;
- Inlet and outlet arrangements;
- Detention period; and
- Effective depth of settling zone.

Types of Sedimentation Tanks

- Horizontal Flow Tanks
- Radial Flow Circular Tank with Central Feed

- Radial Flow Circular Tanks with Peripheral Feed

Common Surface Loadings and Detention Periods

The removal of particles of varying hydraulic subsidence values is solely a function of surface overflow rate also called 'surface loading' and is independent of the depth of the basin for discrete particles and unhindered settling. However, contact opportunities among particles leading to aggregation increase with increasing depths for flocculent particles having tendency to agglomerate while settling, such as alum and iron flocs.

Sludge Removal

Sludge is normally removed under hydrostatic pressure through pipes. The size of the pipe will depend upon the flow and the quantity of suspended matter.

Tube Settlers and Plate Settlers

Tube and plate settling devices provide excellent clarification with detention times of equal to or less than 10 min. Tube configurations are steeply inclined. In inclined tubes (about 60°) based on the 'counter current' flow principal, continuous gravity drainage of the settled sludge can be achieved.

543 Combination of Technologies –

Tube – Clariflocculator (Clarissettler): Recent advances over last 10 to 15 years have resulted in development of different combinations of 'Flocculator-Tube Settlers' configurations. Essentially, these lead to saving of space (land) and are especially suited to urban area where the land availability is a prime factor. One such configuration is 'Tube-Clariflocculator' or 'Clarissettler'. This unit has similar configuration (flow path) that of a conventional clariflocculator.

Ballasted Flocculation and Settling: This technology is relatively new to India, however, in the future, it is likely to be adopted to reduce the footprint. Ballasted flocculation and settling is a clarification process that includes the use of micro-sand as ballast to increase the specific gravity of the floc particles to improve their rate of settling.

544 Filtration –

General Filtration is the process of separating suspended and colloidal impurities from water by passing it through a porous medium. Filtration, without pretreatment will not effectively remove turbidity (e.g., silt and clay), colour, microorganisms, precipitated hardness from softened waters, and precipitated iron and manganese from aerated waters. Removal of turbidity is essential not only from the requirement of aesthetic acceptability but also for efficient disinfection which is difficult in the presence of suspended and colloidal impurities that serve as hideouts for the microorganisms. Filtration of municipal water supplies normally is accomplished using:

- Slow sand filters;
- Rapid sand filters;
- High-rate filters.

a) **Slow Sand Filters:** These filters are not widely used nowadays.

b) **Rapid Sand Filters**

The rapid sand filter consists of a bed of a single or dual filter media supported on gravel overlying an under drainage system. Usually, the sand layer has a depth of 0.60 to 0.75 m. The standing depth of water over filter media top varies between 1 and 2.5 m depending on the filter control arrangement.

Filter Gravel

Gravel is placed between the sand and the under drain system to prevent sand from entering the underdrains and to aid uniform distribution of wash water. The gravel should accomplish both purposes without being displaced by the rising wash water. Sizes of gravel vary from 50 mm at the bottom to 2 mm at the top preferably with a 0.45 m–0.60 m depth. The faster the rate of application of water, the larger the gravel size required. Reference may be made to IS: 8419 Part (1)-1977 (Reaffirmed 2001) for filter gravel. The dual-parallel block underdrain does not require the gravel support.

Rapid Gravity Dual Media Filters

The rapid gravity dual media filters are filters containing two media, normally coal and sand, and water is applied in downward direction under gravity.

545 Disposal of Wastes and Sludge from Water Treatment Processes –

Disposal of wastes from the water treatment plants has become increasingly important with the availability of technology and the need for protection of the environment.

546 Layout of Water Treatment Plants –

Normally, water treatment plant complex, apart from the process units, include ancillary structures like filter annex building, chemical (coagulant, etc.) house and store, MCC/switch room, chlorination room, tonner yard, generator room, transformer yard, office, staff quarters and security cabin, etc. Many at times it includes elevated service reservoir. The entire plant complex should be planned in such a way that process and hydraulic structures are located in a sequential and logical way to reduce piping and interconnecting channels. Due consideration should be given to the convenience of operator movement. All the structures should be interconnected by walkway at the operating level. The roads and pathways should be provided on the ground, interconnecting all the units.

547 Computer-Aided Optimal Design of Water Treatment System –

The advent of computerized design systems/methodology has drastically changed the design process of water supply system including water treatment plant design.

The water treatment process involves sizing, hydraulics, electro-mechanical aspects, as well as instrumentation, and they are interlinked. It is recommended to use computer-aided optimal design to construct the plant which ultimately will be useful in effective operation and maintenance including automation and SCADA.

548 Disinfection of Water –

Water treatment processes described in paragraph above remove microorganisms to varying degrees. For utmost safety of water for drinking purposes, disinfection of water has to be done to remove disease producing organisms before it enters distribution system. Disinfection is also required to prevent contamination of water during its transit from the treatment plant to the place of its consumption. The efficiency of disinfection depends on the nature of disinfectants. For treatment on larger scale, chlorination is generally used as treatment for disinfection. Chlorine can be applied in water by using bleaching powder, chloramines, or as free chlorine gas, Chlorine Dioxide or other approved chemicals. A minimum of 30 to 60 minutes contact time must be provided before delivery of water to the consumer.

For the utmost safety of water for drinking purposes, disinfection of water has to be done in order to kill disease-causing microorganisms. Bacteria, viruses, and protozoa constitute the three main types of human enteric pathogens. Accordingly, effective disinfection with adequate detention time is aimed at the destruction or inactivation of pathogens.

Broadly, modern disinfection processes include the use of:

- (i) Physical methods such as thermal treatment and ultrasonic waves.
- (ii) Chemicals including oxidizing agents such as chlorine and its compounds, bromine, iodine, potassium permanganate, ozone, and metals like silver.
- (iii) UV radiation.
- (iv) Chlorination

549 Chlorination –

Chlorination is the most widely used method for disinfecting water supplies across the world. The near universal adoption of this method can be attributed to its convenience and to its highly satisfactory performance as a disinfectant, which has been established by decades of use.

550 Chlorine Demand –

Chlorine and chlorine compounds, by virtue of their oxidising power, can be consumed by a variety of inorganic and organic materials present in the water before any disinfection is achieved. It is, therefore, essential to provide sufficient time and dose of chlorine to satisfy the various chemical reactions, and leave some amount of unreacted chlorine as residual, either in the form of free or combined chlorine, adequate for killing the pathogenic organisms. The difference between the amount of chlorine added to water and the amount of residual chlorine after a specified contact period is defined as the chlorine demand. The chlorine demand of any given water varies with the amount of chlorine applied, the time of contact, pH, temperature, and form of residual desired.

551 Chlorination Practices –

The type of available chlorine residual required, and the characteristics of the water being treated, determine the process of disinfection to be employed. All chlorination practices,

irrespective of the point of application, may be classified as free available residual chlorination (i.e., break point or super chlorination) or combined residual chlorination, depending on the nature of the chlorine residual formed.

552 Plain or Simple Chlorination –

This involves the application of chlorine to water as the only type of treatment to offer the necessary public health protection. Plain chlorination can be carried out in a situation where:

- 1) Turbidity and colour of the raw water are low, turbidity should not exceed 5 NTU;
- 2) Raw water is drawn from relatively unpolluted sources;
- 3) Water contains little organic matter, and iron and manganese do not exceed 0.3 mg/l; and
- 4) A contact period of a minimum of 30 minutes between the point of chlorination and the consumer end is available.

553 Super-Chlorination –

This is adopted in case of an emergency situation such as a breakdown or in case of waters that are heavily polluted or fluctuate rapidly in quality. It can give excellent results in waters where:

- 1) Plain chlorination produces taste and odour;
- 2) The water is coloured; or
- 3) Iron and manganese have to be oxidised. It may be resorted to on special occasions when available contact time is limited at the pre-chlorination stage. Super-chlorination can effectively destroy relatively resistant organisms such as viruses and amoebic cysts. The dose of chlorine may be as high as 10 to 15 mg/L with contact periods of 10 to 30 minutes. Subsequently, the undesirable excess chlorine will have to be dechlorinated.

554 Breakpoint Chlorination –

The addition of chlorine to ammonia in water produces chloramines which do not have the same efficiency as free chlorine. If the chlorine dose in this water is increased, a reduction in the residual chlorine occurs, due to the destruction of chlorine by the added chlorine.

555 Combined Available Residual Chlorination –

This method involves the application of chlorine to the water to react with natural and added ammonia, to form a predominantly combined monochloramine chlorine residual. Doing this will produce the most reliable way to maintain the residual through part or all of a water treatment plant or distribution system. Chloramines are less effective disinfectants and oxidants than free available chlorine forms. But the residual will persist much longer than free available chlorine which has a tendency to diffuse and be lost. A minimum of 30 to 60 minutes of contact time must be provided before delivery to the consumer and in long transmission mains and non-looped distribution systems,

monochloramine residual should be maintained to the furthest point in the system all the time.

556 Points of Chlorination –

The use of chlorine at various stages of the water supply system right from raw water collection to the distribution network is a common practice and terms like pre-chlorination, post-chlorination and re-chlorination have come into common usage depending upon the points at which chlorine is applied.

557 Pre-chlorination –

Pre-chlorination is the dosing of chlorine to raw water prior to any unit treatment process and is generally upstream of Parshall flume, if provided. The point of application, as well as dosage, will be determined by the objectives viz. control of biological growths in raw water conduits, promotion of improved coagulation, prevention of mud ball and slime formation in filters, reduction of taste, odour, and colour, and minimizing the post-chlorination dosage when dealing with heavily polluted water. Pre-chlorination is also required to control and prevent the growth of algae. However, in order to reduce the formation of disinfection by-products (DBPs), the practice of dosing chlorine dioxide with chlorine is increasing. For the same reason, ozone application is increasingly used in pre-oxidation. Satisfactory disinfection is obtained by Pre-chlorinating to maintain 0.10 to 0.20 mg/L free residual chlorine in the outlet of filter at normal pH values.

558 Post-chlorination –

Post-chlorination is the application of chlorine to water before it enters the distribution system to maintain the required amount of free residual chlorine. Post-chlorination dose is applied with 30 minutes of contact time in chlorine contact tank before the water enters the clear water sump. Many times, a booster chlorine dose is required at the service reservoirs in the distribution system to maintain the residual chlorine level.

559 Re-chlorination –

When the distribution system is long and complex, it may be difficult to maintain the minimum chlorine residual of 0.2 mg/L at the farthest end. To achieve this, if a very high dosage is applied at the post-chlorination stage, it would, apart from being costly, make the water unpalatable at the reaches close to the point of chlorination. The maintenance of the required residual, in such cases, can be accomplished by a stage-wise application of chlorine in the distribution system which is called re-chlorination. Re-chlorination is carried out in service reservoirs, booster pumping stations, or at points where the delivery mains supply to distribution zones. Real-time measurement for critical locations needs to be incorporated into the system.

560 Chlorine Residual –

In the post-monsoon period, the minimum residual chlorine shall be maintained as 0.20 mg/L at the end of the distribution system, and during monsoon or in epidemics, 0.50 mg/L at the end of the distribution system. Practically, the chlorine concentration at entry

point of distribution system or service reservoir and furthest point in the distribution is measured. This exercise is repeated for four to five readings and then a graph of initial chlorine concentration versus residual chlorine at end is plotted. From this graph, the required initial chlorine dose is determined. Generally, groundwater sources are naturally pure because water percolates through various layers of soil. A required chlorine dose needs to be added in the service reservoir or the outlet of the tube well for direct pumping to maintain residual chlorine of 0.20 mg/L at end of the operation zone of distribution system.

Total chlorine and free residual chlorine can be determined using BIS Standard IS 3025 (Part 26): 2004, Methods of sampling and test (physical and chemical) for water and wastewater.

Sr. Section Engineer/Junior Engineer (Works) should frequently check the concentration of residual chlorine at the consumer point by orthotolodine test. In this test 100 ml of chlorinated water sample is collected in the test tube. 1 ml of orthotolodine solution is added to it. The colour formed is noted, value of the residual chlorine is directly determined by comparing the colour so obtained with the standard chart of colours of non-chlorine residuals. Divisional Engineer should ensure that sufficient number of equipment are available with all the field units.

561 Chlorinators –

A chlorinator is a device designed for feeding chlorine to a water supply. Its functions are:

- To regulate the flow of gas from the chlorine container at the desired rate of flow.
 - To indicate the flow rate of gas feeding.
 - To provide means of properly mixing the gas either with an auxiliary supply of water or with the main body of the liquid to be disinfected.
- 1) **Types of Chlorine Feeders:** Chlorinators are used for the control and measurement of chlorine in the gaseous state and to supply chlorine as a gas or an aqueous chlorine solution. The principle of operation of this equipment depends on the regulation of flow by establishing a pressure relationship between the upstream and downstream sides of either a constant or a variable orifice in the chlorine flow gas line. Control of the feed rate is affected either by varying the pressure differential across a fixed orifice (variable differential unit) or by varying the size of the orifice (constant differential unit). The requirement for chlorination equipment should adhere to IS 10553 (Part 1) (1983, reaffirmed 2022).

These feeders are of two types, viz.

(a) Pressure Type Gravity Feed Chlorinator (IS 10553-4, 1983, Reaffirmed 2021)

(b) Vacuum Type Chlorinator (IS 10553-2, 1983, Reaffirmed 2021)

- 2) **Electrolytic Chlorinators or On-site Chlorine Generators:** Rather than storing traditional chlorine gas chemicals such as sodium or calcium hypochlorite, one can use electricity, salt, and water to generate sodium hypochlorite, safely, and on demand. This technology is commonly referred to as electro-chlorination (EC), chlorine electrolysis, or in-situ chlorine generation. EC system works on a simple

principle of electrolysis of brine solution (sodium chloride salt solution). There are two electrodes - anode and cathode, placed at a specific distance, between which the brine solution is passed. A low voltage is applied. The potential difference is responsible to create a current through the brine, which is a good conductor of electricity. In this process, dissociated salt (NaCl) breaks down into Na^+ and Cl^- ions. A small amount of hydrogen gas is also evolved.

562 Details of Chlorination Process –

Calcium hypochlorite ($\text{Ca}(\text{ClO})_2$) is often used for chlorine treatment. It is available in powder form, containing about 70% free chlorine. The quantity required is generally 20 kg to 25 kg for deep wells. Sodium hypochlorite (NaOCl) can also be used. Sometimes chlorine gas in water solution is also used, but special equipment is required for its application.

Methods of Application: Disinfection is carried out by applying chlorine or chlorine compounds. The methods of application are as follows:

- Preparing weak solution by bleaching powder, etc.
- Preparing weak solution by electrolyzing brine solution.
- By adding chlorine either in the form of gas or solution prepared from dissolving chlorine gas in small feed of water.

Safe Handling Practices as per BIS Code “IS 10553-1” (1983, Reaffirmed 2007) Requirements for Chlorination Equipment, Part I: General Guidelines for Chlorination Plants Including Handling, Storage, and Safety of Chlorine Cylinders and Drums may be referred to. This standard (Part I) covers recommendations for installation of chlorination plants including handling and storage of cylinders and drums

Storing and Shipping Containers Chlorine gas units and cylinders shall be housed in separate rooms, easily accessible, close to the point of application, and convenient for truck loading and safe container handling. The floor shall be flat and at least 150 mm above the surrounding ground and drainage shall be adequate. The height of the container room should be at least 4.0 m.

Under no circumstances such units shall be housed in the basement or below the ground level since the chlorine gas is heavy and settles into depressions. Chlorine cylinders preferably should be stored upright and secured, and in such a manner as to permit ready access and removal.

Storage areas should be clean, cool, well ventilated, and protected from corrosive vapours and continuous dampness. Cylinders and tonne containers stored indoors should be in a fire-resistant building, away from heat sources (such as radiators, steam pipes, etc.), flammable substances, and other compressed gases. Cylinders and tonne containers stored outdoors should be shielded from direct sunlight and protected from accumulations of rain, ice, and snow. All storage, handling, and use areas should be of such design that personnel can quickly escape in emergencies. It is generally desirable to provide at least two means of exit. Doors should open out and lead to outside galleries or platforms, fire escapes, or other unobstructed areas.

Employees Training It is essential to impart training to the employees who have to face

emergency. This training should include the following:

- Instructions in the action to be taken in an emergency.
- Use of emergency kit.
- Handling of containers.
- First aid.
- Use of protective equipment.
- Knowledge of chlorine hazards.
- Firefighting.
- Use of safety showers and eye fountains.
- Crash shutdown procedure for valves and switches.
- Communication system.
- Study of plant layout with diagram.
- Mock drills.

More details can be had from 'Manual on Water supply and treatment systems' issued by Ministry of Housing and Urban Affairs

I - HIGH LEVEL STORAGE

The tanks shall be constructed of reinforced concrete, brick masonry, ferro-cement precast, mild steel, stainless steel or plastic. Tanks made of steel may be of welded, riveted or pressed construction. The metal shall be galvanized, coated externally with a good quality anti-corrosive weather resistant paint. Lead based paint shall not be used in the tank.

563 Storage Capacity –

Normally, the storage capacity should be equal to the higher of the following figures:

- 1) **With efficient stand-by pump:**
 - a) One-quarter the maximum water consumption in 24 hours
 - b) One-third of the normal water consumption in 24 hours
- 2) **Without stand-by pump:**
 - a) One-third the maximum water consumption in 24 hours.
 - b) One-half the normal consumption in 24 hours.

Local conditions should however be considered when deciding on the storage capacity. Each tank may be partitioned to facilitate cleaning or repairs.

564 Maintenance and Cleaning of Storage Tanks –

- 1) For the inspection, maintenance and painting of steel-work, action should be taken as detailed in the Indian Railways Bridge Manual.
- 2) Tanks used for the storage of drinking water should be rubbed and cleaned at least once in six months. The cleaning of water tank and disinfection should be carried out as per recommended procedure (for guidance clause 4.16 of Part 9 section 1 of Vol. 2 of NBC 2016 may be referred). Tanks used for the storage of water for locomotive

and carriage washing purposes should be scrubbed and cleaned at least once in six months.

Reports on cleaning of tanks should be submitted to the Assistant Divisional Engineer by the Sr. Section Engineer (Works) who shall maintain a register with complete particulars for the purpose. The periodical reports should include information regarding the condition of external and internal painting and corrosion, if any.

The dates of cleaning both external and internal painting should be painted on one side of the staging in such a manner that these are readily visible.

565 Float Gauges and Scouring Sluices –

Every high-level storage tank should be provided on the outside with a float gauge with an appropriate water level indicator.

Every storage tank whether at high level or at ground level should be provided with a sluice at its sill level to facilitate the cleaning of the tank.

566 Protection against Pollution –

High service storage tanks, for drinking water in particular, should be covered and provided with gauze wire to obviate pollution by birds and growth of algae.

J - DISTRIBUTION OF WATER

567 Distribution System –

The distribution system is important in a water supply scheme for wholesome and adequate supply of water at required pressures in sufficient quantity. The distribution accounts for 40 to 70% of the outlay of the water supply scheme. Proper provision of configuration of pipes, pumping arrangements, and location of valves and pipe specials are very important and adequate attention should be paid to the functional and hydraulic purposes to be served by the system. For general convenience of distribution, a grid where different mains are interconnected is recommended. This system facilitates supply of water to any point from two directions. The tree system of distribution will be adequate only in small water supply.

568 Layout of Distribution Systems –

Distribution systems should be laid out in the form best suited to conditions at site. The economical diameter of a pipe-line is based on considerations of head-losses and velocities under conditions of maximum flow including fire demand.

The design of the distribution system should be based on the maximum estimated daily consumption being supplied in 10 to 16 hours as may be prescribed.

A diagram of mains, branch mains and distributaries should be prepared and on it the points of supply, the lengths of pipes and the reduced levels of all junctions noted. Starting at the end farthest from the points of supply, the supply in liters per minute that each pipe must be able to accommodate, is worked out for its length and noted on the

diagram. From the heads and longitudinal sections, the diameters are arrived at. A reserve of at least 3 metres head should be ensured at the tail- end of every service line under conditions of maximum discharge.

569 Rising Mains Not to be used for Distribution –

The tapping of a rising main for purposes of distribution shall be strictly prohibited. Where, for engineering construction purposes, such a course may be justified as a temporary expedient, e.g. in order to save long lengths of service pipe-lines, a control valve must be fitted on the connection.

570 Separate Supplies for Drinking and other Purposes –

Where there are separate mains for drinking water and water for other purposes, it should be ensured that when any junctions or branches are laid, the two supplies may not get connected. The economics of having a separate distribution system for water unfit for drinking purpose vis-a-vis the treatment cost of that water and supplying through the single distribution system has to be worked out in relevant cases and a proper choice made.

Water unfit for drinking purpose can be in many cases economically used for purposes such as carriage washing, washing aprons, platforms, fire-fighting, sanitary flushing, street cleaning, or irrigation of gardens or lawns etc.

To avoid dead ends, the main shall be arranged in a grid formation or in a network.

571 Service Pipes from Mains –

The per capita rates of water supply indicate only the average consumption of water per day. To take into account fluctuation in consumption due to season, month, day, and hour, the average demand should be multiplied by a peak factor for purpose of designing distribution system. A peak factor of 2.5 is recommended.

The number and size of service pipes that can be supplied from a properly designed distribution-main may be assumed as shown below; exceptional cases will depend, however, on actual conditions:

Distribution Main	Diameter of service pipes		
	15mm	20mm	25mm
	Number of service pipes		
40mm	12	6	3
50mm	20	10	6
65mm	39	20	10
80mm	65	32	18
90mm	88	43	24
100mm	115	56	32

To avoid dead ends, the main shall be arranged in a grid formation or in a network.

572 Residual Pressure –

Distribution system should be designed for the following minimum residual pressures at ferrule points:

Single storey building	- 7 m
Two storey building	- 12 m
Three storey building	- 17 m

Distribution system should not ordinarily be designed for residual pressures exceeding 22 m. multi-storied buildings needing higher pressure should be provided with boosters.

573 Preventive Maintenance –

Preventive Maintenance of water supply distribution pipe lines assures the twin objectives of preserving the hygienic quality of water in the distribution mains and providing conditions for adequate flow through the pipe lines without leakages. Two of the main functions in the management of preventive aspects in the maintenance of mains are assessment, detection and prevention of wastage of water from pipe lines and maintaining the capacity of pipe line and cleaning of pipe lines.

574 Protection against Pollution Near Sewer and Drains –

- 1) Horizontal Separation - A water main should be laid such that there is at least 3 m separation, horizontally from any existing or proposed drain or sewer line. If local conditions prevent this lateral separation, a water main may be laid closer to a storm or sanitary sewer, provided that the main is laid in a separate trench, or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 0.5 m above the top of the sewer.
- 2) Vertical Separation - In situations where water mains have to cross house sewer, storm drain, or sanitary sewer, it should be laid at such an elevation that the bottom of the water main is 0.5 m above the top of the drain or sewer with the joints as remote from the sewer as possible. This vertical separation should be maintained for a distance of 3 m on both sides measured normal to the sewer or drain it crosses.

575 Carriage Watering System –

On all new watering stations, carriage watering arrangement shall be by side filling. The rate of flow at delivery end on hydrant shall not be less than 100 litres per minute. The diameter of pipe, general arrangement of pipe line, spacing of wheel valve and height shall be as per standard drawing issued by RDSO.

It is preferable to have separate overhead tank of required capacity for carriage watering.

The supply of water to major consumption points such as Station buildings, Carriage watering, Hospitals, Administrative buildings etc. should be metered separately in a planned manner so as to monitor water supply and plan for remedial measures.

K - MAINTENANCE AND OPERATION OF WATER SUPPLY INSTALLATIONS

576 Responsibilities of Various Departments–

- 1) The Engineering Department will be responsible for:
 - a) The adequacy of water supply at all sources, permanent and auxiliary.
 - b) The samples of water from water supply sources, storage- tanks or taps for bacteriological and chemical tests shall be taken jointly with Medical Department.
 - c) The maintenance and operation of water purification plants.
 - d) The maintenance and periodical cleaning of all storage tanks.
 - e) The maintenance of all pipe lines and specials, water- taps in station yards and colonies, fire hydrants at stations, goods sheds and loco sheds.
 - f) The maintenance and periodical testing of all water meters wherever installed. The testing should be carried out at least once a year.
 - g) The periodical testing and joint- recording of consumption in meters at such points where supply to the railway is made by outside bodies.
 - h) Wastage and leakage detection survey should be carried out and action to be taken to reduce the losses.
- 2) The Mechanical Department will be responsible for:
 - a) The erection, maintenance and operation of diesel oil pumping plants at all pumping stations.
 - b) The operation and maintenance of carriage-watering and carriage-washing hydrants.
- 3) The Electrical Department will be responsible for:
 - a) All planning, installation maintenance and operation of electrical pumps.
 - b) All water coolers provided in offices and stations shall be cleaned once a month to prevent contamination. Water coolers shall be disinfected properly before putting into use.
 - c) Maintenance and operation of non-return valves provided near to electrical pump.
 - d) Maintenance and operation of foot valves.
- 4) The Medical Department will be responsible for:
 - a) Monitoring the quality of the water.
 - b) Health Inspector should check the presence of residual chlorine daily at various distribution points – platforms, refreshment rooms, waiting halls, hospitals, school and in the Railway colonies (preferably from farthest taps in the distribution system), randomly and record of the same should be kept in a register. Suitable remedial measures should be taken in case of deficiency.
 - c) Health Inspector should also collect water samples from taps of stations, water booths of platforms, quarters in the colonies, various service buildings, workshops, sheds & other locations and should send for Bacteriological test once in a month. The water sample for Bacteriological test should be collected jointly with SSE/ JE (Works).

- d) Action on test reports: Health Inspectors should ensure that test reports are received and followed up. Unsatisfactory results should be conveyed promptly to Engineering officials in writing. Engineering officials shall duly inform the Health Inspectors about the corrective action taken.

577 Inspections by Assistant Divisional Engineer and Staff –

The Assistant Divisional Engineer and Sr. Section Engineer (Works) should inspect as per the prescribed periodicity all water supply installations and pipelines and ensure their maintenance in efficient condition. The Sr. Section Engineer (Works) should be equipped with an adequate Imprest of materials such as pipes & specials and water taps of requisite sizes and the necessary tools to facilitate immediate attention or repairs as and when required.

578 Water-Supply Plans –

Up to date plans should be maintained in the Sr. Divisional/Divisional Engineers', Assistant Divisional Engineers' and Sr. Section Engineer (Works) Offices of every water supply system showing the source, pumps and pumping particulars, rising mains, storage tanks and capacities, the distribution mains, service pipes, hydrants and taps. The diameter, type of pipe-lines and year of laying should be clearly indicated on the plans and on the longitudinal sections.

Where there are separate supplies for drinking and other requirements, the respective systems should be shown on the plan in different colours or on separate plans.

The Assistant Divisional Engineer shall ensure that water supply plan is corrected as and when there is any addition or modification in pipeline. In case of Construction Organization implementing any water supply scheme or augmenting the existing scheme, a copy of the water supply plan shall be handed over to Open Line as and when the scheme is completed.

579 Water Purification Works –

- 1) **Periodical analysis of water** - Samples of raw, filtered and sterilized water from filter- plants should be sent for examination. Bacteriological tests are to be conducted once in a month at Major Stations and once in 2 months at small stations. Chemical tests are to be conducted once in a six month. Both these tests are to be conducted by Medical Department. Samples for these tests are to be taken jointly by Engineering & Medical Department. Sr. Divisional/Divisional Medical Officer may advise, on the appropriate dosage of the coagulant or the sterilizing agent, if deemed necessary. Reports on water analysis received from the Sr. Divisional/Divisional Medical Officer should be carefully filed, the action taken on each report being recorded. Physical test of water shall be done by Engineering department once in Three (3) months and necessary action, if any shall be taken.
- 2) **Maintenance of water works** - Detailed instructions in regard to the maintenance and operation of filtration and chlorination plants at each installation shall be issued by the Principal Chief Engineer. It should be ensured that-
 - a) The plants, in general, with their ancillaries are maintained in a perfectly sanitary and hygienic

- b) Aeration of raw water is effected by spraying through the air, cascading over obstacles.
- c) The sedimentation tanks or basins are drained at such intervals as prescribed;
- d) Coagulants, either in the form of dry powder or in aqueous solution, are added in the correct proportion according to the turbidity of raw water;
- e) The filters are cleaned and washed with pure water at such intervals as prescribed;
- f) The filtered water is sterilized either by adding liquid chlorine or bleaching powder strictly to the dosage specified.
- g) Disinfectants are stored properly and all safety precautions are taken to be available at each installation together with the duty-lists of the staff posted there.

The water works staff in-charge shall strictly adhere to the prescribed rules. A copy of the detailed instructions on the operation of plant and purification process should be available at each installation together with the duty-lists of the staff posted there.

3) **Inspection by Assistant Divisional Engineer and SSE/JE**

- a) The Assistant Divisional Engineer shall inspect each installation once in a year and record his notes in the Inspection Register maintained for the purpose. He should follow the course of water from the point of intake and through the different treatment stages to the point of delivery to the distribution mains and arrange to remedy defects noticed.

Assistant Divisional Engineer should arrange for a joint detailed inspection by Sr. Section Engineer (Works) of the pumping machinery once a year as may be prescribed along with the staff of the Mechanical/Electrical Department and ensure prompt compliance to repairs or replacements required.

- b) The Assistant Divisional Engineer should check the following:
 - Stock account showing transactions of stores
 - Log book for filtration plant
 - c) Sr. Section Engineer(Works)/Junior Engineer (Works)in-charge shall inspect such installations once in 3 months. Sr. Section Engineer (Works)/Junior Engineer (Works) not in-charge shall inspect such installations as frequently as possible, but not later than 2 months.
- 4) **Inspection by Sr. Divisional/Divisional Engineer** - The Sr. Divisional/Divisional Engineer should inspect the water works in every detail once a year and record his notes in the Inspection Register maintained for the purpose.
- 5) **Inspection Register** - An Inspection Register should be maintained at each water purification work to enable every Inspecting Officer of the Engineering and Medical Departments to record notes. Prompt action on inspection notes shall be ensured

580 Sanitary Protection of Water Supply Installations –

1) Reservoirs/Ponds:

- a) The reservoir/ponds should be fenced to prevent any outside or unauthorized use.
- b) The water in the reservoir shall not be used for any unauthorized purposes like bathing, washing clothes, cleaning of utensils etc.
- c) The water shall be periodically treated with bleaching powder or a disinfecting agent.

2) Overhead Tanks:

- a) The tanks should be cleaned and bleaching powder applied on walls as per laid down schedule.
- b) The water shall be regularly disinfected.

3) Protection of wells used for drinking:

- a) The exposed area of wells outside and inside shall be plastered to a sufficient depth to prevent percolation of water into the well through the steining at shallow depths.
- b) Parapets should be sufficiently high to prevent entry of spilled-water and water flowing at ground level. The top of steining should be edge-finished (triangular shape) to avoid buckets or vessels being kept thereon.
- c) There should be a paved platform around the parapet of the wells, with a drain to lead the spill-water sufficiently away.
- d) The ground around the well for a radius of at least 50m should be kept thoroughly clean to guard against pollution.
- e) No bathing or washing of clothes should be permitted near a well supplying drinking water. Devices for drawing water should be such as to prevent pollution.
- f) Open wells should be cleaned, when necessary, preferably during dry season. The sides should be scrapped to clear moss and other vegetation growth. Desilting of wells should be done as necessary. Quick lime should then be applied to the sides and bottom of the well (wherever dry). This work should be carried out by the SSE/ JE (Works) and a report sent to the Assistant Divisional Engineer.
- g) Disinfection of well should be carried out as often as necessary. The work is usually undertaken by the staff of the Medical Department. At trackmen quarters and gate lodges between stations, the SSE/ JE (Works) should arrange for the disinfection of staff-wells.

Check List For Framing Water Supply Scheme

Name of the Scheme:
Scheme Approval Details:

Division:

SN	Item	Yes/No
A. ASSESSMENT OF DEMAND		
1	Is this a new scheme or augmentation to the existing arrangement?	
2	Has total demand been assessed?	
3	Whether total demand includes domestic needs, Workshop, Service buildings, Hospitals, Welfare buildings, horticulture works and station requirement?	
4	Whether fire demand if any, Loss & Wastages and variation in demand has been considered?	
5	Whether demand has been calculated separately for treated and untreated water?	
6	Has the financial viability been considered for providing one distribution system with filtered water vis-à-vis separate distribution systems for treated and untreated water?	
7	Whether future requirement has been taken into account?	
B. SOURCE OF WATER		
1	Whether quantity/ yield available is sufficient to meet the requirement?	
2	Have the tests for quality of water been done?	
3	Are the test results satisfactory? (For Standards of quality of water referred in Annex. 5.3)	
4	Whether any treatment is required to bring down the various impurities within permissible range?	
5	Has the sanitary survey of area surrounding the available water source been carried out to estimate the possible pollution or contamination of water from such source?	
6	Has the line of treatment been decided consistent with quality of water required?	
7	Whether there is accessibility to the site of proposed source of water?	
8	Is there any need for development of communication system?	
9	Is the controlling device of intake located at a place which is accessible even during floods?	
10	Is there provision for pitching on the downstream and upstream portions of canal near intake?	
C. PUMPING AND STORAGE OF RAW WATER		
1	Has the selection of size and pipe material for raw water mains been done?	
2	Is direct pumping from the source feasible?	
3	Is there any need for storage of raw water?	
4	If so, is the storage capacity adequate?	
5	Has the requirement of the pumps and their capacity been calculated based on 1.5 times the average daily demand?	
6	Has the standby arrangement been made for auxiliary power unit (generally diesel type) and stand-by pumps?	

7	Is there provision for proper structure required for housing the Pumps and Pump Operator?	
8	Has the provision been made for adequate extra space for additional pump if required?	
9	Is there separate adequate space for storage of diesel and other spares?	
10	Has the arrangement been provided for lifting of pumps or stair case/staging in case the pumps are provided at lower level than the prevailing ground level?	
11	Is door of the pump house wide enough to enable pumps to be taken out for repair or replacement?	
12	Has the provision been made for firefighting equipment appropriate to hazard likely in the pump house and storage space of diesel?	
13	Has the arrangement made for measuring the quantity of water taken from the source	
D. ARRANGEMENTS FOR PURIFICATION AND TREATMENT		
1	Has the line of treatment been decided?	
2	Does the layout of the entire scheme fulfill the requirement of the line of treatment?	
3	Is aeration unit exposed to the prevailing direction of wind?	
4	Is sedimentation unit designed with coagulation? If yes, has the feasibility for supply of coagulant and cost been considered while deciding to go in for coagulation vis-a-vis only plain sedimentation with increased capacity of sedimentation unit? Is there enough space for storage of materials like - coagulants etc.	
5	Is there feasibility of regular supply of sand required for replenishing the sand of filter? (availability of all-weather road to be seen)	
6	Has the requirement of chlorination been assessed based on the quality of water and longest length of supply pipeline in the distribution system?	
7	If chlorine gas cylinders are used, then the space arrangement of loading, unloading and safety gears shall be considered for emergency situation.	
8	Is water softening required to remove the permanent hardness, if any?	
9	Is re-carbonation plant necessary (in case of Lime Soda process or softening), if so, is it provided before filtration unit?	
10	Has the method of chlorination been finalized keeping in view the availability of equipment and constant supply of chlorinating material?	
11	Is there any other impurity to be removed?	
12	Has the provision of small laboratory including equipment for testing of water required at filtration plant been made?	
13	Automation in operation of valves, water level monitoring system is considered.	
E. STORAGE AND DISTRIBUTION OF TREATED WATER		
1	Has the location of pump house been finalized taking into account the availability of power and requirement of the operator?	
2	Is it feasible to utilize the same staff for filtration unit and for operating the pumps in pump house?	
3	Has the capacity and number of pumps required been calculated based on quantity of water, pumping hours, total head and various losses?	
4	Is there provision for auxiliary power supply and stand by pumps?	
5	Has the location and staging height of the storage tank been finalized considering the topography and major areas of consumption?	

6	Are distribution mains designed for the maximum hourly demand on the day of maximum consumption? (2.5 times the average demand)]	
7	Has the layout for the pipeline for distribution system been finalized?	
8	Does the layout of pipeline take into account future expansion plans for the colony?	
9	Have the dead ends been avoided in the layout of the pipe line? If unavoidable, is there provision for hydrants to act as washouts?	
10	Has the pipeline layout been provided with the provision for controlling water supply timings for different areas if required, by operating minimum number of valves?	
11	Is there any requirement of air valves? If yes, have they been located at points which are close to or above the hydraulic gradients?	
12	In case of buried pipe line, has it been proposed min. 2m above the sewer line?	
13	Has the testing of leakage been contemplated?	
14	Are the underground/over land tank is having provision of decanting of water from water tankers?	
15	Separate pipeline distribution system for platform washing, apron washing, pit line etc. using treated waste water is planned or not?	

Computation of Requirement of Water

Particulars	Litres per day
(a) Residential area Household consumption for Officers and staff per head	150* (Includes 45 liters required for flushing.) # As per NBC 2016 Vol II Part 9 Sec (1)
(b) Office and workshop	
Offices per head.	45
Factories/ Workshops per head	30
(c) Station and platform	
Apron washing	10 per sqm
Platform washing	5 per sqm.
Passengers on railway station (intermediate stations excluding mail/express stoppage)	** 25 per passenger
Junction stations and intermediate stations where mail/express stoppage.	** 70 per passenger
Terminal stations	** 45 per passenger
Washing of carriages on washing lines	3600 per carriage for BG 2600 per carriage for MG
Cleaning of carriages on Platform	500 per carriage
Carriage watering	*** as per actual requirements.
(d) Miscellaneous	
Gardens per hectare of lawn area	6 to 8 Liters/Sqm/day # As per NBC 2016 Vol II Part 9 Sec (1)
Hospitals With number of beds not exceeding 100 With number of beds exceeding 100	340 per bed 450 per bed
Nurses' homes and medical quarters	135 per head
Hotels	180 (per bed)
Fire Service	# NBC 2016 Vol II Part 4 to be referred.
Hostels	135 per Head
Day Schools	45 per head
Boarding Schools	135 per head
Concert halls, theatres, auditorium community hall, cinema	25 per head
Restaurants	70 per seat

* The number of occupants for each residential unit may be based on a family of five.

**Number of passengers for estimating requirement at a station shall be equal to passengers entraining at the station plus half of the passengers detraining.

*** Quantity of water required for train originating station shall be equal to the full capacity of tanks for all the coaches. For trains scheduled for watering on other stations, only 75% filling capacity may be considered. (Water requirement per coach shall be considered as 1800 litres).

**** For **Terminal station** requirement can be taken from NBC 2016 vol II Part 9 section 1

Standards of Quality of Drinking Water

(Physical and Chemical Standards) as per IS 10500: 2012

SN.	Characteristics	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source
1	Turbidity (NTU scale)	1	5
2	Colour Hazen units	5	15
3	Taste and odour	Agreeable	Agreeable
4	Ph. value	6.5 to 8.5	No relaxation
5	Total dissolved solids (mg/l) max.	500	2000
6	Total hardness as CaCo ₃ (mg/l) max	200	600
7	Chlorides as Cl ₂ (mg/l)	250	1000
8	Sulphates as SO ₄ (mg/l) max.	200	400**
9	Fluorides as F (mg/l) max.	1.0	1.5
10	Nitrates as NO ₃ (mg/l) max.	45	No relaxation
11	Calcium as Ca (mg/l) max.	75	200
12	Iron as Fe (mg/l) max.	0.3	No relaxation
13	Zinc as Zn (mg/l) max.	5.0	15.0
14	Mineral Oil (mg/l)max	1.00***	No relaxation
15	Copper as Cu (mg/l) max.	0.05	1.5
16	Residual free Chlorine (mg/l) max	0.2*	1.0
	Toxic materials		
17	Arsenic as As (mg/l) max.	0.01	0.05
18	Cadmium as Cd (mg/l)max.	0.003	No relaxation
19	Lead as Pb (mg/l)max.	0.01	No relaxation

Source: Indian Standard -Drinking Water-Specification (Second Revision) IS: 10500 -2012

*When protection against viral infection is required, it should be min. 0.5 mg/l.

** Provided Magnesium (as Mg) does not exceed 30 mg/l

***Amendment No.3 of 2021

CHAPTER 6

DRAINAGE, SEWERAGE AND SANITATION

A - GENERAL

601 Objectives –

The objective of a sewage collection, treatment and disposal system is to ensure that sewage discharged from communities is properly collected, transported and treated to the required degree in short, medium and long-term planning and disposed-off/reused without causing any health or environmental problems.

Reference may be made to the following for provisions not contained in this Chapter. In case of any variation, the latter shall prevail.

- 1) National Building Code of India 2016 Volume 2 - Part 9 Plumbing Services, Section 2 Drainage and Sanitation.
- 2) Relevant BIS Codes as mentioned below:
 - IS 1172: 1993 Code of basic requirements for water supply, drainage and sanitation.
 - IS 1726: 1991 Specification for cast iron manhole covers and frames.
 - IS 1742: 1983 Code of practice for building drainage
 - IS 2470: 1985 Code of practice for installation of septic tanks
 - IS 4111 (Part I): 1986 Code of practice for ancillary structures in sewerage system.
 - IS 5329: 1983 Code of practice for sanitary pipe work above ground for buildings.
- 3) Manual on Sewerage and Sewage Treatment - Ministry of Housing and Urban Affairs, New Delhi.
- 4) Regulations issued by Municipal Corporations or local Public Health Departments should also be referred.
- 5) Standard Operating Procedure (SOP) for Cleaning of Sewer and Septic Tanks (Nov-2018 updated from time to time) issued by Ministry of Housing and Urban Affairs, New Delhi.

602 Definitions of Some Common Terms –

- 1) Drain: A conduit/channel for the carriage of storm water or other used water.
- 2) Drainage: A system for removal of any unwanted liquid.
- 3) Sewer: A pipe/conduit used generally for carrying sewage or other water borne wastes.
- 4) Sewerage: A system for the collection and conveying sewage to the point of disposal. These are separate sewers, combined sewers, pressurized sewers and vacuum sewers.
- 5) Manhole: An opening by which a man may enter or leave a drain, a sewer or other closed structure for inspection, cleaning and other maintenance operations fitted with a suitable cover.
- 6) Soil Waste: The discharge from water closets, urinals, sinks, cattle sheds, gullies etc.

7) Sewage: It includes all kinds of liquid wastes of a community or industry. It is classified as follows:

- a) Storm sewage,
- b) Sanitary sewage,
- c) Industrial waste.

8) Insanitary Latrine: "Insanitary Latrine" means a latrine which requires human excreta to be cleaned or otherwise handled manually, either in situ, or in an open drain or pit into which the excreta is discharged or flushed out, before the excreta fully decomposes in such manner as may be prescribed.

Provided that a water flush latrine in a railway passenger coach, when cleaned by an employee with the help of such devices and using such protective gear, as the Central Government may notify in this behalf, shall not be deemed to be an insanitary latrine.

9) Hazardous Cleaning: "Hazardous Cleaning" by an employee, in relation to a sewer or septic tank, means its manual cleaning by such employee without the employer fulfilling his obligations to provide protective gear and other cleaning devices and ensuring observance of safety precautions, as may be prescribed or provided in any other law, for the time being in force or rules made thereunder.

10) Faecal Sludge: The accumulated semi-solid or solid portion that settled at the bottom of the septic tank which comprising 20% - 50% of the total septic tank volume is termed as faecal sludge.

B - WATER BORNE SEWERAGE

603 Adherence to Regulations –

In the preparation of under-ground sewerage schemes, the Drainage Regulations in regard to the installations of all sanitary equipment and construction of drains and sewers shall be followed.

604 Sewerage Schemes –

Reports of sewerage schemes should include

- A historical retrospect leading to the justification of the project.
- Description of existing facilities, if any.
- Population studies, analysis and prediction based on a critical appraisal of available data.
- Location of the water supply headwork for the area and the neighboring communities.
- Availability of piped water supply in the area, present and anticipated per capita water supply.
- The nature of sewage, total sewage flow - present and prospective.
- Discussion of different possible disposal points and their comparative merits.
- Review of different possible methods of treatment.

- Engineering features and economical aspects of the sewer system, an index and a general layout plan with contours at intervals of 2m along with a schematic diagram. Sub-soil conditions including level of water table and location of other services - their positions, size etc. basis for computation of surface run-off, drainage area and silting of storm sewage and overflow, wherever necessary.
- Number and location of pumping stations with hydrostatic heads and frictional loss of heads on pumps and on mains.

A comparison of total costs (recurring and non-recurring) of the alternatives involved under major subheads.

The most satisfactory alternative scheme for the project, as recommended probable stages of construction, procurement of proprietary material for the project and any special problems relating thereto.

605 Designing of Sewers –

Sanitary sewer system and storm water drainage system should be designed separately. The size of sanitary sewer depends on quantity of sanitary sewage, variation in peak and average flows, limiting velocities of flow, topography of the area, construction material etc. The size of storm water sewer depends on storm water run-off, Self-Cleansing Velocity, construction material etc. Sanitary sewers are not expected to receive storm water. It should be ensured that proper design and construction of sewers and manholes are provided.

606 Design Basis for the Sewerage System –

- 1) **Design Period:** The recommended design period of various components shall be as follows

SN	Component	Design Period, Years (from base year)
1	Land acquisition	30 years or more
2	Conventional sewers (A)	30
3	Non-conventional sewers (B)	15
4	Pumping mains	30
5	Pumping Stations-Civil Work	30
6	Pumping Machinery	15
7	Sewage Treatment Plant	15
8	Effluent disposal	30
9	Effluent Utilization	15 or as the case may be
(A) Typical underground sewers with manholes laid in the roads.		
(B) All type such as small bore, shallow sewers, pressure sewers, vacuum sewers.		

- 2) **Per Capita Sewage Flow:** The entire spent of a community should normally contribute to the total flow in a sanitary sewer. However, the observed dry weather flow quantities usually are slightly less than the per capita water consumption, since some water is lost in evaporation, seepage into ground, leakage etc. In arid regions, mean sewage flows may be as little as 40% of water consumption and in well developed areas; flows may be as high as 90%. However, the conventional sewers shall be designed for a minimum sewage flow of 150 litres per capita per day or higher

as the case may be. Non-conventional sewers shall be designed as the case may be. For details Para 3.5 of Manual on sewerage and sewage treatment systems 2013 of Ministry of Housing and Urban Affairs (MoUHA) erstwhile Ministry of Urban Development (MoUD) may be referred. In general, 80 percent of entire spent water may be taken for design of sewer.

- 3) **Sewage from Institutions:** Institutes like railway stations, offices, factories, workshops, schools, hospitals etc. may discharged their liquid waste into the sanitary sewers. Estimate of such flows have to the made separately as for their potable water supply given in table 3.4, Part A Engineering of Manual on sewerage and sewage treatment systems 2013 of MoUHA.
- 4) **Infiltration:** Estimate of flow in sanitary sewers may include certain flows due to infiltration of groundwater through joints. Since sewers are designed for peak discharges, allowances for groundwater infiltration for the worst condition in the area should be made as given below:

Ground water infiltration

	Minimum	Maximum
Litres/hectare/day	5,000	50,000
Litres/km/day	500	5,000
Litres/day/manhole	250	500

Once the flow is estimated as per above table, the design infiltration value shall be limited to a maximum of 10% of the design value of sewage flow.

Care shall be taken that in high ground water locations and coastal locations, the sewer pipes shall not be stoneware or vitrified clay pipes and instead shall be cast iron / ductile iron pipes or other non-metallic pipes with safeguards against floatation.

- 5) **Mixing of Industrial Effluents:** The mixing of industrial effluents through discharge into public sewers is undesirable due to the possible detrimental effects of such effluent on the operation of biological sewage treatment process. This aspect has been well recognized in recent times and industrial areas having polluting industries are generally located so as to avoid mixing with sewage.

However, where polluting industries are existing in pockets of mixed land use, these industries are required to implement zero liquid discharge (ZLD) by reusing the effluents after appropriate treatment in house. For major establishments like Coach Workshop, Wagon Workshop, Locomotive Workshop etc., Effluent Treatment Plant (ETP) shall be required.

Among all the industries, this shall strictly apply to the workshops from where the spent metal plating baths and oil & grease shall be prevented from entering the sewers.

607 Alignment of Sewer –

The alignment of the sewer is determined from a survey plan which should be prepared to a scale of 100 metres to a cm. The proposed sewer-lines are shown on a plan along with the ground levels and soil conditions, necessary for establishing grades and estimating the cost of the work. In the profiles, the invert and crown gradient lines should be shown.

608 Velocity of Flow –

The limiting velocities for existing conditions should be determined and gradients decided accordingly. Normally, a minimum velocity of 1 m/s and a maximum of 3 m/s are allowed. On steep slopes, one or more drop manholes may be provided.

The minimum slopes of sanitary sewers shall be as per table given below:

Sewer Size (mm)	Minimum Slope		Sewer Size (mm)	Minimum Slope	
	As percent	As 1 in		As percent	As 1 in
150	0.6	170	375	0.15	670
200	0.40	250	450	0.12	830
250	0.28	360	≥525	0.10	1000
300	0.22	450			

- 1) **Self-Cleansing Velocity-** It is necessary to maintain a minimum velocity or self-cleansing velocity in a sewer to ensure that suspended solids do not deposit and cause blockage. Velocity required to transport material in sewers is mainly dependent on the particle size and specific gravity and slightly dependent on conduit shape and depth of flow. The specific gravity of grit is usually in the range of 2.4 to 2.65.
- 2) **Velocity at Minimum Flow** - To avoid steeper gradients which will require deeper excavations, it is the practice to design sewers for the self-cleansing velocity at ultimate peak flows. This is done on the assumption that although silting might occur at minimum flow, the silt would be flushed out during the peak flows. However, the problem of silting may have to be faced in the early years, particularly for smaller sewers which are designed to flow half- full, as the actual depth of flow then is only a fraction of the full depth. Transport of suspended solids should be achieved in such a manner that deposition and odour nuisance there from are kept to a minimum. Sewers are normally designed for flows with free water surface and self-cleansing velocities. Pressure sewers, including siphons, should be avoided as far as practicable.
- 3) **Maximum Velocity-** Erosion of sewers is caused by sand and other gritty material and is compounded by high velocities and hence the maximum velocity shall be limited to 3 m/s. In hilly areas where the slope and flows get fixed, the velocity also gets automatically fixed. If such velocities exceed 3 m/s in hilly areas - cast iron, ductile iron pipes or superior shall be used. In cast iron and ductile pipes, socket and spigot joints and O rings shall be made and sockets facing uphill. The provisions of structures like drop manholes can also be made to dissipate the energy.

609 Ventilation in Sullage –

The sewers shall not run full as otherwise the pressure will rise above or fall below the atmospheric pressure and condition of open channel flow will cease to exist. Moreover, from consideration of ventilation, sewers should not be designed to run full. Sewers up to 400 mm dia. may be designed to run at half depth, 400-900 mm diameter at two third depths and larger sewers at three fourth depth at ultimate peak flows.

610 Size of Sewer –

Minimum diameter of sewer shall be 200 mm except for hilly areas where steep slopes are available. In those areas minimum size may be 150 mm. The house sewer connection pipe to public sewer shall be (a) minimum 100 mm or higher based on the number of houses / flats connected and (b) subject to the receiving public sewer being of higher diameter.

611 Storm Water –

The storm runoff is that portion of the precipitation, which drains over the ground. Quantity of storm run-off is dependent on intensity and duration of precipitation, characteristics of tributary area and time required for such flow to reach the sewer. Storm water flow for this purpose may be determined by using rational methods, hydrograph methods, rainfall-runoff correlation studies, digital computer models, inlet method or empirical formulae.

612 Manholes –

A manhole is an opening constructed on the alignment of a sewer to facilitate a person to access the sewer for the purpose of inspection, testing, cleaning and removal of obstructions from the sewer line. Spacing of manholes is to be designed with reference to sewer diameter as given below:

Sewer dia. in mm Up to	300	301 to 500	501-900
Spacing in metres	45	75	90

The spacing of manhole will depend upon the type of equipment (mechanical devices) to be used for cleaning sewers. When silt and grit loads are heavy, catch pits may be provided at suitable intervals depending on local conditions and as approved by the Divisional Engineer.

613 Choice of Material for Sewers –

Factors influencing the selection of materials for sewers are flow characteristics, availability in the sizes required including fittings and ease of handling and installation, water tightness and simplicity of assembly, physical strength, resistance to acids, alkalis, gases, solvents, etc., resistance to scour, durability and cost. The determination of the suitability in all respects of the pipes and specials for any work is a matter of decision by the engineer concerned on the basis of requirements for the scheme and guided by **Annexure 6.1** on relative limitations on use of pipe materials in specific locations. The materials for sewers are:

- 1) **Brick** – Brickwork is used for construction of sewers, particularly in larger diameters. Many old brick sewers are still in use and the failures are mainly due to the disintegration of the bricks or the mortar joints. Because of the comparatively higher cost, larger space requirement, slower progress of work and other factors, brick is now used for sewer construction only in special cases. The advantage of brick sewers is that these could be constructed to any required shape and size. Brick sewers shall have cement concrete or stone for invert and 12.5 mm thick cement plaster with neat finish for the remaining surface. To prevent ground water infiltration, it is desirable to

plaster the outside surface. Inside plaster can be with mortar using high alumina cement conforming to IS 6452 or polyurea coating and the outer surface shall be plastered with mortar using sulphate resistant cement. Sewer bricks should conform to IS 4885.

- 2) **Salt glazed stoneware or Vitrified clay Pipes** - Salt glazed stoneware pipes are manufactured in sizes 100 to 600 mm in dia. but the maximum size usually used is 380 mm because of economic consideration. For all sewers and drains in all soils except where supports are required, glazed stoneware pipes shall be used. They are particularly suitable where acid effluents or acid sub-soil conditions are likely to be encountered. Salt glazed stoneware pipes shall conform to IS: 651 (Glazed stoneware pipes and fittings – specification) or IS: 3006 (Specification for chemically resistant glazed stoneware pipes and fittings). The lengths of vitrified clay pipes are 60, 75 and 90 cm, the preference being for the longer pipes. The resistance of vitrified clay pipes to corrosion from most acids and to erosion due to grit and high velocities gives it an advantage over other pipe materials in handling acid concentrations. The strength of vitrified clay pipes often necessitates special bedding or concrete cradling to improve field supportive strength.

3) **Concrete Pipes**

- a) **Precast Concrete Pipes** - These can be used as an alternative to glazed stoneware pipes of over 150 mm diameter. These shall not be used to carry acid effluents or sewage under conditions favorable for the production of hydrogen sulphide and shall not be laid in those sub-soils which may affect the strength of concrete. Cement concrete pipes may be used for surface water drains in all diameters. These pipes shall conform to IS: 458. Where so desired the life of cement concrete pipe may be increased by lining inside of the pipe by suitable coatings like epoxy/polyester resin, etc. Other type Pre cast section can also may be used for storm water.
- b) **Cast-in-situ Reinforced Concrete** - Cast-in-situ reinforced concrete sewers are constructed where it is more economical, or where non-standard sections are required or when a special shape is required. Concrete shall conform to IS 456.

- 4) **Cast Iron Pipes** - These shall be used in unstable or made-up grounds or where sewer is laid at insufficient depth. These are particularly useful where pipes are suspended in basements or similar situations or for crossings of water courses. These pipes are suitable where the velocity is more than 2.4 m/s. Cast iron (CI) pipes in sizes ranging from 80 to 1500 mm in dia with a variety of jointing methods are used for pressure sewers, sewers above ground surface, submerged outfalls, piping in sewage treatment plants and occasionally on gravity sewers where absolutely water-tight joints are essential. IS 1536 and IS 1537 give the specifications for spun, and vertically cast-iron pipes respectively.

- 5) **Steel Pipes** - Aqueducts, Pressure sewer mains, under- water river crossing, necessary connections for pumping stations, self-supporting spans and railway crossing are some of the situations where steel pipes are preferred. Steel pipes can withstand internal pressure, impact load and vibrations much better than CI pipe. They are more ductile and withstand water hammer better. The disadvantage of steel pipe is

that it cannot withstand high external load. Further, the main is likely to collapse when it is subjected to negative pressure. Steel pipes are susceptible to various types of corrosion. A thorough soil survey is necessary all along the alignment where steel pipes are proposed. Steel pipes shall conform to IS 3589.

- 6) **Ductile Iron Pipes** -The Indian standard IS 8329 provides specification for the centrifugally cast ductile iron. The ductile iron pipes have excellent properties of machinability, impact resistance, high wear and tear resistance, high tensile strength and ductility and corrosion resistance. Ductile Iron (DI) pipes, having same composition of CI pipe, will have same expected life as that of CI pipes. They are strong, both inner and outer surfaces are smooth, free from lumps, cracks, blisters and scars. The ductile iron fittings are manufactured conforming to IS 9523.
- 7) **Asbestos Cement Pipes** –Socketed Asbestos cement building and sanitary pipes and pipe fittings of diameter 50 to 150 mm for use as rainwater pipes, soil, waste and ventilating pipes shall confirm to IS 1626. These pipes are not recommended for underground situations. However, asbestos cement pressure pipes confirming to IS 1592 may be used in underground situation also, provided they are not subjected to heavy superimposed loads. They are not suitable to carry acid effluents or sewage under conditions favorable for the production of hydrogen sulphide. For sewerage works, asbestos cement pipes confirming to IS 6908 are usually used in sizes ranging from 100 mm to 1000 mm in diameter.
- 8) **Non-Metallic Non-Concrete Synthetic Material Pipes:** The main advantage of these pipes is their ability not to be affected by corrosion from sulphides or sulphates. Precautions are required in laying of these pipes. Following type pipes may be used:
 - a) **UPVC Pipe:** UPVC pipe are resistance to corrosion, light weight for transportation, toughness, rigidity, economical in laying, jointing, and maintenance and easy to fabricate. IS 15328 deals with non-pressure unplasticized polyvinylchloride (PVC) for use in underground sewerage system. IS 9271 deals with the unplasticized polyvinyl chloride (UPVC) single wall corrugated pipes for drainage.
 - b) **High Density Polyethylene (HDPE) Pipes:** HDPE pipes confirming to IS 14333 are offering smooth interior surfaces and relatively highest resistance to corrosion. When laid in straight gradients without humps or depressions, they can easily longer life cycle. Methods of joints are usually fusion welded or flange jointed depending on straight runs or fittings.
 - c) **Structured Wall Piping** - These pipes can be manufactured in PVC-U, PP and PE as per EN 13476-3 / IS 16098. The walls of these pipes are either double walled or ribbed wall. The BIS for pipes and fittings with PVC-U material having smooth external surface Type A is IS 16098 (Part-1) and for pipes and fittings with PE and PP material having non-smooth external surface Type B is IS 16098 (Part-2). The Type B pipes are generally known as Double Walled Corrugated (DWC) pipes. DWC pipes are produced in sizes 75 mm internal diameter (ID) to 1,200 mm ID with a standard length of 6 m for easy transportation and handling and to reduce the number of joints required.
 - d) **Glass Fibre Reinforced Plastic Pipes (GRP)** -GRP Pipes confirming to IS 14402 are suitable where corrosion resistant pipes are required. GRP can be used as a

lining material for conventional pipes which are subject to corrosion. Fibre glass can resist external and internal corrosion whether the corrosion mechanism is galvanic or chemical in nature.

- e) **Fibreglass Reinforced Plastic Pipes (FRP)** - Fibreglass reinforced plastic pipe is a matrix or composite of glass fibre, polyester resin and fillers. These pipes possess better strength, durability, high tensile strength, low density and are highly corrosion resistant. Fibreglass pressure pipes are manufactured in diameters up to 2,400 mm and length up to 18 m.
- f) **Pitch Fibre Pipes** - The pitch impregnated fibre pipes conforming to IS 11925 are light in weight and have shown their durability in service. The pipes can be easily jointed in any weather condition as internally tapered couplings join the pipes without the use of jointing compound. These are generally recommended for uses such as septic tanks and house connection to sewers, farm drainage, down pipes, storm drains, industrial waste drainage, etc.
- g) Any other suitable better material, which is time tested and available in the market, may be used.

614 Laying of Sewer Pipes –

Relevant Indian Standard Code of Practice for laying and jointing of various type of pipes shall be followed. If, relevant Indian Standard Code of practice for laying and jointing of pipe is not in existence, manufacturer's specification should be followed.

- 1) **Excavation:** The safety precautions required as per construction practices shall be ensured.
 - a) Turf, topsoil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.
 - b) Excavated material shall be stacked sufficiently away from the edge of the trench and the size of the spoil bank shall not be allowed to become such as to endanger the stability of the excavation. Spoil may be carried away and used for filling the trench behind the work.
 - c) Excavation shall proceed to within about 7.5 cm of the finished formation level. This final 7.5 cm is to be trimmed and removed as a separate operation immediately prior to the laying of the pipes or their foundations.
 - d) The sides of the trench shall be properly propped, where necessary.
 - e) Unless otherwise specified by the Authority, the width at bottom of trenches for different diameters of pipes laid at different depths shall be as given below:
 - i) For all diameters, up to an average depth of 120 cm, width of trench in cm = diameter of pipe+30 cm
 - ii) For all diameters for depths above 120 cm, width of trench in cm = diameter of pipe+40 cm.
 - iii) Notwithstanding (1) and (2), the total width of trench should not be less than the following-

- 600 mm for depths below 900 mm
 - 750 mm for depths between 900 mm to 1 200 mm
 - 900 mm for depths between 1 200 m to 1 800 mm
 - 1000 mm for depths above 1 800 mm.
- f) Where the subsoil is unstable, a foundation for the pipes shall be formed by piling and bridging, earth consolidation or other efficient means.
 - g) Excavation in roads shall be so arranged, in agreement with the proper authority, as to cause the minimum obstruction to traffic. The method to be adopted shall depend on local circumstances.
 - h) All suitable broken surface material and hard-core shall be set on one side for use in subsequent reinstatement.
 - i) Adequate warning lights/reflective signs shall be placed at night to indicate all obstructions. Red flags shall be displayed along the trenches during day time.
 - j) All pipes, ducts, cables, mains or other services exposed in the trench shall be effectively supported by timber and/or chain or rope-slings.
 - k) Excavations below water table shall be done after dewatering the trenches.
 - l) All drainage sumps shall be sunk clear of the work outside the trench or at the sides of manholes. After the completion of the work, any pipes or drains leading to such sumps or temporary sub-soil drains under permanent work shall be filled in properly with sand and consolidated.
- 2) **Laying of Pipes** - Laying of pipes shall be done in accordance with good practice i.e. unloading of pipes should be by using mechanical means to avoid damages, adjusting to proper levels, minimum thickness of lead at the face of socket not to reduce less than 6mm, alignment to be repeatedly checked and refilling of trenches etc.
 - 3) **Jointing** - All soil pipes, waste pipes, ventilating pipes and other such pipes above ground, shall be gas-tight. All sewers and drains laid below the ground shall be water tight. Jointing shall be done in accordance with specification prescribed for particular type of pipes.
 - 4) **Connection to Existing Sewers** -
 - a) The connection to an existing sewer shall, as far as possible, be done at the manholes. The work of connection with the existing sewerage system shall be carried out by the Authority owning the system or under its supervision.
 - b) Connection with the sewer shall be affected by the cautious enlargement of a small hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be formed in such a way as to constitute a projection into the sewer or to cause any diminution in its effective size.
 - 5) **Back-Filling** –
 - a) Filling of the trench shall not be commenced until the length of pipes therein has been tested and passed.
 - b) All timber which may be withdrawn with safety shall be removed as filling proceeds.

- c) Where the pipes are unprotected by concrete haunching, the first operation in filling shall be carefully done to hand pack and tamp selected fine material around the lower half of the pipes so as to buttress them to the sides of the trench.
 - d) The filling shall then be continued to 15 cm over the top of the pipe using selected fine hand-packed material, watered and rammed on both sides of the pipe with a wooden hammer. On no account shall material be tipped into the trench until the first 15cm of filling has been completed. The process of filling and tamping shall proceed evenly so as to maintain an equal pressure on both sides of the pipeline.
 - e) Filling shall be continued in layers not exceeding 15cm in thickness, each layer being watered and well rammed.
 - f) In roads, surface materials previously excavated shall be replaced as the top layer of the filling, consolidated and maintained satisfactorily till the permanent reinstatement of the surface is made.
 - g) In gardens, the top soil and turf, if any, shall be carefully replaced.
- 6) Pipes should preferably be laid with the socketed ends against the direction of flow and in straight lines.
 - 7) In manholes, no pipes should project. Pipes should be laid flush with the inside face of the manhole walls. Where a pipe passes through the manhole wall, an arch should be built round the pipe to carry the weight of the masonry above it.

615 Sewage pumping stations and sewage pumping mains–

Pumping stations handle sewage either as in-line for pumping the sewage from a deeper sewer to a shallow sewer or for conveying to the STP or outfall. They are required where sewage from low lying development areas is unable to be drained by gravity to existing sewerage infrastructure, and / or where development areas are too remote from available sewerage infrastructure to be linked by gravity means. For design and construction of sewage pumping stations chapter 4 of Part A Engineering of Manual on sewerage and sewage treatment systems 2013 of MoUHA may be referred.

616 Sewage Disposal –

Standard flushing systems are meant primarily to transport human waste from the toilet to the treatment plant located a few kilometers away or to connect the railway sewerage system to the municipal sewers. Where water-borne sewerage is not possible, septic tank system of disposal of sewage is normally adopted.

Provisions contained in “The Prohibition of Employment as Manual Scavengers and Their Rehabilitation Act 2013” should be strictly followed.

617 Septic Tanks –

Modern septic tank system is an onsite disposal method, which uses standard flushing. The septic tank acts as sedimentation-cum-digestion tank. Anaerobic digestion of the settled sludge occurs in its bottom zone and the supernatant liquid has to undergo treatment in a soak pit/filter bed. Use of septic tank without follow-up treatment is not

permitted, as the effluent from the septic tank is hazardous from the point of view of health and pollution. Since, it is usually not possible to provide soak pit/filter bed in built up urban areas, septic tank system would not be appropriate in such areas.

The capacity of the septic tank should be such as to take care of the variations in the flow. A detention period of 24 to 48 hrs. for tanks serving less than 50 persons and a period of 10 to 18 hrs. for tanks serving more than 50 persons are generally adopted.

The size and shape of the septic tank shall be generally in agreement with the minimum dimensions given in the table below:

Table 6.1

No. of Users	Length in metres	Width in metres	Liquid Depth in metres
Domestic tanks			
5	1.5	0.75	1.0
10	2.0	0.90	1.0
15	2.0	0.90	1.3
20	2.3	1.10	1.3
50	4.0	1.40	1.3
Tanks for Housing Colonies			
100	8.0	2.6	1.0
150	10.6	2.7	1.0
200	12.4	3.1	1.0
300	14.6	3.9	1.0
Tanks for Hostels and Boarding Schools			
50	5.0	1.6	1.3
100	5.7	2.1	1.4
150	7.7	2.4	1.4
200	8.9	2.7	1.4
300	10.7	3.3	1.4

The septic tank should be constructed in 2 compartments to facilitate cleaning of one while the other is in use. A bottom slope of 5 to 10% towards inlet is recommended.

Septic tanks should be cleaned when a large quantity of sludge has collected in the bottom of the tank. The interval of cleaning should not normally exceed 12 months. After cleaning 3 or 4 shovelful of surface earth containing grass roots and decaying vegetable matter should provide a good start. No disinfectants should be used in latrines attached to septic tanks as they kill the organisms, which digest sewage.

For providing any soak pit/filter bed with septic tanks the water table must be well below their depth and the rain water from surface also should not interfere with their functioning. Hence, these are not usually suitable where water tables are high or where ground slopes are flat.

618 Bio-Tanks /Bio-Digesters –

In smaller towns and way side stations where sewer lines do not exist and sewage disposal is through septic tanks with or without soak pit. Septic tank without soak pit/filter bed is not permitted as the effluent from the septic tank is hazardous from the point of view of health and pollution. In this condition, Bio tank/ Bio Digesters may be provided for making the sewage disposal system efficient as Bio tank/ Bio Digesters does not require periodical sludge cleaning.

Defence Research & Development Establishment (DRDE) has developed need based bio-digesters for different situations and climatic conditions ranging from high altitude snow bound areas to plain regions. These bio-digesters are rectangular and cylindrical shaped metal/steel or FRP tanks of assorted size (0.5-20 Cum) depending upon number of users, budget, heating requirement and site constraints. Besides these readymade bio-digesters, an alternate technology of modified septic tank (Bio-tank) can also be developed which uses a closed rectangular tank made of masonry or RCC. Bio-tank construction is done at site and it is initially charged with anaerobic microbial consortium supplied by DRDE (only once) and put to use like conventional septic tank. These bio-tanks bio degrade the solid human waste to the extent of 99% and only treated effluent comes out of the outlet. Pathogens are also inactivated during fermentation and effluent is almost free of them and safe for discharging into the drains. An outlet is also provided for discharging the end product of methane and little bit of carbon dioxide gas into the atmosphere.

619 Conservation of Water –

There is a general shortage of water supply in India and in some parts even the drinking water is scarce. Therefore, it has to be seen that water is conserved to the maximum extent possible and that it is not polluted and the waste disposal systems should be designed with these ends in view. This applies to both ground water and surface water. Water efficient fittings and fixtures play an important role in demand side management. Use of dual flushing cistern for WC and aerated water tap/sensor-based tap for wash basin conserve the water. In case of urinals, waterless urinal/ sensor-based urinal may be preferred. Instead of conventional automatic flushing cisterns, dripping ferrules may be used for urinal to conserve water.

620 Recycling of Water –

Indian railways largely consume fresh water for non-potable uses at present. Therefore, there is substantial scope for recycling the waste water after treatment for using the same for non-potable purposes like washing of platforms, aprons, coaches, gardening and flushing of toilets etc.

Waste water arising in Railways is generally from Railway tracks and platforms, pit lines, workshops/shades as also sewerage from residential/service buildings. The treatment methods and re-use potential depend upon the type of waste water.

Sewage Treatment Plant (STP)/Effluent Treatment plant (ETP)/Water Recycling Plant (WRP) may be provided at Railway Stations, colonies, workshops/sheds, hospitals etc. including other units as per the CGWA's guidelines and/or as per the recommendations of

water audit report.

The conventional sewage treatment technologies such as Activated Sludge Process (ASP), Waste Stabilization Pond (WSP), Up-flow Anaerobic Sludge Blanket (UASB) Reactor etc., are commonly adopted in sewerage system to treat wastewater up to secondary level as per the effluent standards.

There are a number of newer treatment technologies that have come into practice in recent times

- Sequencing Batch Reactor (SBR)
- Moving Bed Biofilm Reactor (MBBR) / Fluidized Aerobic Bioreactor (FAB)
- Membrane Bio Reactor (MBR)
- There are other emerging treatment technologies that have come into practice in recent times in other parts of the world
- BIOFOR Technology (Biological Filtration and Oxygenated Reactor)
- High Rate Activated Sludge BIOFOR-F Technology
- Submerged Aeration Fixed Film (SAFF) Technology
- Fixed Bed Biofilm Activated Sludge Process (FBAS)
- Rim flow Sludge Suction Clarifiers/Bio Tower
- Improved Circular Secondary Clarifier (HYDROPLUME®)
- Eco-Bio Blocks

Brief description of MBBR (Moving Bed Biofilm Reactor) Technology as under:

The MBBR process utilizes floating plastic carriers (media) within the aeration tank to increase the amount of microorganisms available to treat the wastewater. The microorganisms consume organic material. The media provides increased surface area for the biological microorganisms to attach to and grow in the aeration tanks.

The increased surface area reduces the footprint of the tanks required to treat the wastewater. The media is continuously agitated by bubbles from the aeration system that adds oxygen at the bottom of the first compartment of the aeration tank. The microorganisms consume organic material. The benefits of this system are as under -

- When compared to conventional secondary treatment it provides superior efficiency and value.
- In fact, the MBBR media or biochips utilized can have an active surface area $> 400 \text{ m}^2/\text{m}^3$. The MBBR is a complete mix, continuous flow through process which is based on the biofilms principle that combines the benefits of both the activated sludge process and conventional fixed film systems without their disadvantages.

In this system following process are involved to treat the water –

i) PRIMARY TREATMENT

The sewage generated from residential / commercial / complexes passed through Screen Chamber (SC) and Oil and Grease (O&G) trap/ tank and collected in equalization tank.

Raw sewage collected in equalization tank is pumped to Moving Bed Bioreactor (MBBR) tank.

ii) SECONDARY TREATMENT

The MBBR - consists of tank filled with special media. These media are made of specially developed material of control density such that they can be fluidized using an aeration device. A bio film develops on the media which moves along with the effluent in the reactor. The movement within the reactor is generated by providing aeration with the help of air grids placed at the bottom of the reactor. The thin bio film on the media enables the bacteria to act upon the bio degradable matter in the effluent and reduce BOD/COD content in the presence of oxygen. The aerated liquid overflow to Tube Settler tanks for separation of solids from liquid. The settled sludge is collected in sludge holding tank (SHT)/ Sludge digester having Sludge dewatering system (Filter press).

iii) TERTIARY TREATMENT

Liquid of Tube settler tank is collected in filter feed tank and pumped to Sand Filter, Activated Carbon Filter and Ultra filtration (optional). After filtration this water is sent to Chlorine contact tank/Ozonator for disinfection. Treated water is collected in treated water tank. Treated water can be used for gardening/flushing.

The filtrate from Sludge dewatering system is returned to Equalization Tank. The dewatered sludge after drying/ well digestion can be used as a manure.



Fig. 6.1 MBBR Media

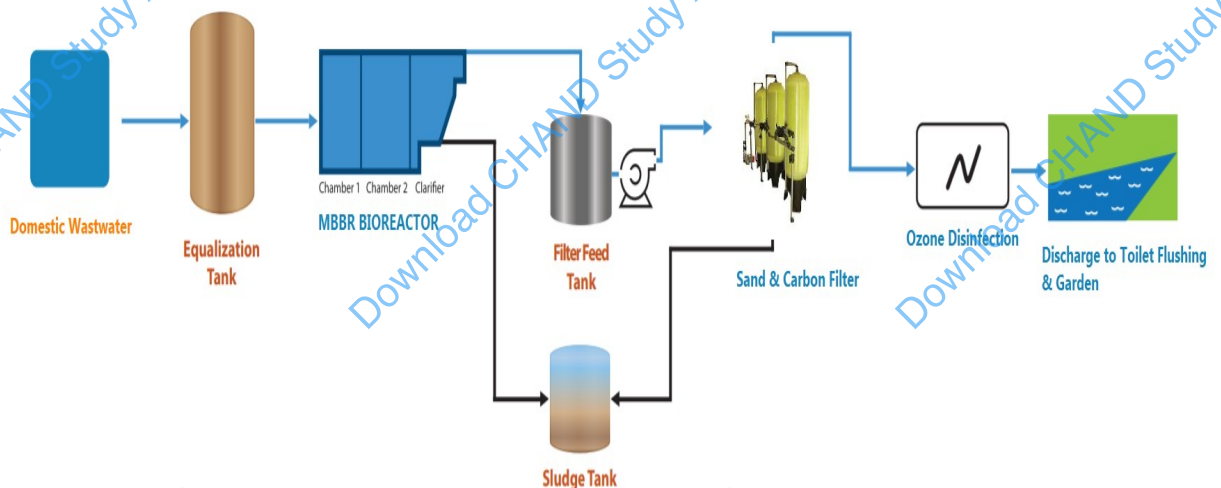


Fig. 6.2 MBBR Process Flow Chart

For details of other methods of water recycling/treatment Chapter 5 Part A, Engineering of Manual on sewerage and sewage treatment systems 2013 of MoUHA may be referred.

Technology for treatment (i.e. design & type of WRP/ETP/STP) needs to be chosen to get maximum benefits with a minimum cost. While deciding the technology, Capital cost,

operation and maintenance cost, treatment of efficiency, resource recovery, ease of operation and sustainability may be kept in view.

Coaching Depots are generally provided with manual coach washing system which consumes huge quantity of water. WRP along with the automatic coaching washing plants shall be provided at all major coaching depots to reduce fresh water consumptions.

It shall be mandatory to provide a WRP at major coach watering stations. The discharged water after treatment shall fulfill the standards for discharge of environmental pollutant mentioned in Environment (Protection) act 1986.

621 Recommended Toilet Systems –

Based on the above rationale, directions for selecting appropriate toilets system are summarized below:

- 1) Where an underground sewerage system is available, toilets shall be connected with a good quality 'flush' type cistern preferably dual flush cistern as per IS:774 or 7231.
- 2) Where an underground sewerage system is not available:

In built-up areas or in all other areas where soak pits or filter beds are not feasible	Bio-Tanks/Bio-digester
On roadside stations/In sparsely inhabited stations	Bio-Tanks/Bio-digester or septic tank system

- 3) In case of urinals, waterless/sensor-based urinals may be preferred. Instead of conventional automatic flushing cisterns dripping ferrules may be used.

Only flush toilets with underground sewerage, flush toilets with septic tank systems (with soak pit/filter-bed for the septic tank effluent) and Bio-tanks/bio-digesters are the sanitized toilet systems for use on the Railways.

Hence, any septic tanks, if not provided with prescribed soak pit/filter bed, must be provided with soak pit/filter bed or if possible, converted into Bio-Tanks/Bio-digesters by minimizing the flushing.

C - MAINTENANCE OF SEWERAGE, DRAINAGE AND SANITARY ARRANGEMENTS

622 General –

Due consideration shall be given to maintenance requirements at the time of designing sewerage system. Provision of openings, staircases and due provisions for eliminating gas hazards, should be ensured.

623 Sewer Lines –

- 1) Maintenance of sewers involves removal of stoppages and clearing out the deposits. Clogging may be due to grit deposition, penetration of roots from adjoining trees, growth of fungi or stagnation of sewage. Mechanical cleaning of sewers is the most preferred method and shall be employed to the extent possible. Manual entry for

hazardous cleaning of sewers is completely banned as per the Prohibition of Employment as Manual Scavengers and their Rehabilitation Rules, 2013. To operate and maintain a sewer collection system to function as intended, the maintenance authority should try to strive towards the objectives to minimize the number of blockages per unit length of sewer, and to minimize the number of odour complaints. For this purpose, sewer-cleaning using hydraulic or mechanical cleaning methods needs to be done on a scheduled basis to remove accumulated debris in the pipe such as sand, silt, grease, roots and rocks.

- 2) Records of the location and depth of all sewers and house connections should be kept in sufficient detail and accuracy for locating any sewer in case it becomes necessary to dig it up. Connections of house drainage to the sewer should be permitted to be done only by competent and experienced labour.
- 3) Sewer lines should be cleaned and maintained with mechanized means.

624 Open Sullage Drains –

Open sullage drains shall be avoided as far as possible. If same is available then it should be maintained in a thoroughly satisfactory condition; cleaning and flushing should be done by the medical department/station staff at least twice a month or more often, as considered necessary and maintenance of civil engineering assets should be by the engineering department.

625 Storm Water Drains –

Special examination should be made of storm water drains, particularly before the commencement of monsoon, to ensure correct grades. Out falls should be particularly examined with a view to ensure satisfactory disposal of the storm water.

626 Disposal Works –

All sullage disposal works should be examined once a quarter and their sanitary condition ensured. When an appreciable extent of silting has taken place, septic tanks should be cleaned by Medical Department either doing it on contract or departmentally.

627 House Connections –

Surface drains should be examined frequently and there should be no stagnation of sullage near the premises. Gully traps with gratings should be examined wherever installed and prompt action taken for renewal and replacements necessary.

628 Sanitation and Conservancy Arrangements –

- 1) **Sanitation** – Sanitation means maintaining a clean environment so that the beneficiaries stay in a neat and hygienic environment. Railway stations, colonies and all work places are to be maintained in a hygienic and clean manner and adequate care is to be taken at the planning stage itself. Keeping this objective in view, special emphasis is laid on the collection and disposal of refuse, sewage and sludge in a scientific manner.

- 2) **Conservancy Work** -Conservancy work is classified as - (a) indoor conservancy and (b) outdoor conservancy.

a) Indoor conservancy - This comprises the cleaning of indoor sanitary installations, the collection of refuse generated in the individual quarters/offices like floor sweeping, domestic refuse etc. and transporting it into the refuse bins. This is the responsibility of the user of quarter /office in charge.

b) Outdoor conservancy – This comprises of cleaning of Railway colonies, Railway stations, circulating area, Railway yards, office, Coaches and Track. This is a multi-disciplinary approach by various departments of the Railways viz. Medical, Traffic, Engineering and Mechanical. The medical department should maintain sanitation/outdoor conservancy at Railway colonies where Health Inspectors are posted. The Traffic Department shall maintain other colonies, stations, Goods offices, parcel offices etc. The mechanical department shall look after the sanitation and cleanliness of the coaches. The Engineering department shall take care of the track and underground sewerage areas.

629 Maintenance of Sewerage and Septic Tank System –

Latest Standard Operating Procedure for cleaning of sewers and septic tanks issued by MoUHA shall be followed, however some paras of this procedure order related to cleaning of sewers and septic tank has been modified in view of railways uses as under -

1) Cleaning of Sewers

Cleaning Frequency- The frequency of cleaning of sewers is based on the prevailing local conditions and determined through field inspections & complaints received from the residents of the area. However, it is desirable to clean the sewer at least once in every 6 months (ideally once just before monsoon season). Inspections and examinations of the sewers and septic tanks shall be made before to start the cleaning which is explained in subsequent paras.

Procedures for Cleaning of Sewers

a) Mechanical

Step 1: Reaching the site

- i) Selection of prospective employees for the sewer cleaning should take into account the duties they will be expected to perform;
- ii) The complete hazard involved in the cleaning activity should be explained clearly to the employees by the supervisor and should get their consent in written before starting cleaning activities;
- iii) A supervisor along with adequate machinery and staff shall reach the designated site, preferably during lean period of sewage flow in sewers;
- iv) The supervisor shall have the names, address and emergency contact information of the staff involved in cleaning the sewers; and
- v) Appropriate protective gears and safety devices shall be worn by the staff before beginning the work of cleaning the sewers.

Step 2: Identification and isolation of the area

- i) Identify the stretch to be cleaned and identify the manholes associated with the stretch;
- ii) Barricade the area where cleaning is to be carried out; and
- iii) A flag man shall be stationed at least 15 m ahead of the site and should be visible to incoming traffic for at least 150 m.
- iv) Cones (similar to the one used by police) shall be placed on the road.

Step 3: Verify the presence of any gases or other hindrances

- i) Ventilate the sewer line by opening 2-3 manholes on both sides of the working stretch for at least 1 hour prior to start of the work to ensure escape of toxic gases; The worker opening the manhole must not bend down into the opened manhole and this may cause his getting overcome by Hydrogen Sulphide and even tripping into the manhole.
- ii) Use gas monitor, detector lamp, wet acetate paper or gas detector masks to detect any residues of poisonous gases like hydrogen sulphide, carbon monoxide, methane and gasoline vapors;
- iii) Insert a long pole with lead acetate paper which will convert to black colour in the presence of hydrogen sulfide. The person shall not try to insert the paper by hand into the manhole.
- iv) If gases are detected, extend waiting period to allow residual gases to escape and to avoid the chance of explosion, in case. Repeat the procedure many times for checking the escape of toxic gases;
- v) Before the start of the cleaning operation, employees shall check for hindrances that may delay the cleaning process; and
- vi) Dummy covers with welded fabric or wire net shall be used to cover the manhole, if required. However, care should be taken to ensure that the cover is strong enough to hold a man's weight.

Step 4: Removal of silt/wax - Mechanical Process

- i) Appropriate machines, at least to the extent specified in this SOP issued by MoUHA are to be used to remove the silt/wax;
- ii) The operating procedures of these machines shall be strictly followed for cleaning; and
- iii) The manhole cover shall be closed tightly after cleaning.

Step 5: Leaving from the site

- i) All the equipment/machineries along with the protective gears and safety devices that had any direct contact with the sewage shall be cleaned properly as per the cleaning procedure specified by the manufacturer;
- ii) All the equipment, safety gears, barricades etc. shall be removed from the working area and the crew shall move to the base or to the next site; and

- iii) The entire operation shall be monitored and documented by the supervisor.

b) Manual

Step 1: Reaching the site

- i) Selection of prospective employees for sewer cleaning should take into account the duties they will be expected to perform;
- ii) The complete hazard involved in the cleaning activity should be explained clearly to the employees by the supervisor and should get their consent in written before to start cleaning activities;
- iii) A supervisor along with adequate machinery and staff shall reach the designated site, preferably during lean period of sewage flow in sewers;
- iv) The supervisor shall have the names, address and emergency contact information of the staff involved in cleaning the sewers; and
- v) Appropriate protective gears and safety devices shall be worn by the staff before the start of work on cleaning the sewers.

Step 2: Identification and isolation of the area

- i) Identify the stretch to be cleaned and identify the manholes associated with the stretch;
- ii) Barricade the area where cleaning is to be carried out; and
- iii) A flag man shall be stationed at least 15 m ahead of the site and should be visible to incoming traffic for at least 150 m.
- iv) Cones (similar to the one used by police) shall be placed on the road.

Step 3: Verify the presence of any gases or other hindrances

- i) Ventilate the sewer line by opening 2-3 manholes on both sides of the working stretch for at least 1 hour before to start the work to ensure escape of toxic gases;
- ii) The labour opening the manhole must not bend down into the opened manhole and this may cause his getting overcome by Hydrogen Sulphide and even tripping into the manhole.
- iii) Use gas monitor, detector lamp, wet acetate paper or gas detector masks to detect any residues of poisonous gases like hydrogen sulphide, carbon monoxide, methane and gasoline vapours;
- iv) Insert a long pole with lead acetate paper which will convert to black. The person shall not try to insert the paper by hand into the manhole.
- v) If gases are detected, extend waiting period to allow residual gases to escape and to avoid the chance of casualty, in case. Repeat the procedure many times for checking the escape of toxic gases;
- vi) Before to start the cleaning operation, employees shall check for hindrances that may delay the cleaning process; and

- vii) Dummy covers with welded fabric or wire net shall be used to cover the manhole, if required.

Step 4: Removal of silt/clogs/rocks

- i) Identify and close off or re-route the inlet sewage of the identified stretch, if possible;
- ii) Check the oxygen level in the manhole. If it is less than 19.5% or greater than 21% at any of the three levels (i.e., bottom, middle and top), the staffs (is it staffs or personnel) shall not be allowed to enter the manhole;
- iii) Air should be supplied into the manholes or to make provision of ventilation to achieve the desired oxygen level;
- iv) The staff shall wear full bodysuit if entering manholes of more than 5 ft. depth or partial fishing wade suits if entering manholes of less than 5 ft. depth;
- v) All the staffs entering the sewer shall wear helmet attached with head lamp;
- vi) The staff entering the sewer shall preferably wear full-face mask having escape breathing apparatus with at least 10-minute air supply along with other appropriate protective gears and safety devices;
- vii) Safety belt shall be fastened tightly onto their suit;
- viii) The staff shall have extra flashlights and communication devices such as two-way radios;
- ix) The staff shall check for the stability of the manhole walls visually and the strength of the rope ladder and descend into the manhole carefully after getting the permission of the supervisor;
- x) The persons entering the manhole shall be monitored by CCTV cameras or any other suitable mechanism at the ground;
- xi) Clogs/silt/rocks shall be removed by using appropriate machineries/equipment and brought up to ground level and then shall be suitably disposed off at the designated areas;
- xii) Pull the staff out of the manhole after completion of cleaning activities;
- xiii) Manhole lid shall be closed tightly after cleaning; and
- xiv) At a stretch, a duration not exceeding 90 minutes shall be taken for cleaning the sewers and a mandatory interval of 30 minute shall be given to the staff involved in cleaning between two intervals.

Step 5: Leaving from the site

- i) All the equipment/machineries along with the protective gears and safety devices that had any direct contact with the sewage shall be cleaned properly as per the cleaning procedure specified by the manufacturer;
- ii) All the equipment, safety gears, barricades etc. shall be removed from the working area and the crew shall move to the base or to the next site; and
- iii) The entire operation shall be monitored and documented by the supervisor.

2) Emptying of Septic Tanks

Emptying Frequency

Regular emptying of septic tanks through a systematic extraction and collection procedure is essential to check environmental pollution. The frequency of emptying is determined by the local conditions including loading rate and performance of septic tanks. The interval of cleaning should not normally exceed 12 months.

Procedures followed for Emptying of Septic Tanks

- i) Inform the occupant of the pending service and note any concerns or issues;
- ii) Inspect the site for possible hazards, such as clearing the area of people, or identifying high groundwater that could cause a tank to 'float', if emptied;
- iii) Park the truck as close to the septic tank as possible. The maximum distance is determined by the length of hose and elevation rise from the bottom of the pit or septic tank to the vacuum truck. This should typically be not more than 25 meters in linear distance and 4 meters in elevation gain. In case, the length and elevation are more than the specified, intermediate pumping may be required;
- iv) Break the mortar seal of the septic tank lid. Inspect the tank for cracks or damage before and after the emptying of tank;
- v) Lay out and connect the hoses from the truck to the tank or pit to be emptied and secure the truck using wheel chocks;
- vi) It is essential to ensure that the hose is in sound condition, and that the hose connections are locked into place prior to using this method;
- vii) Follow the safety instruction as prescribed in above section of mechanical cleaning of sewers;
- viii) Open the tank or pit by removing the access ports or covers over the storage system;
- ix) Engage the vacuum equipment by using a power take-off from the truck's transmission;
- x) Increase the vacuum to the proper level with the valve closed by watching the vacuum gauge, then lowering the end of the hose into the septic tank, and open the valve sufficiently such that the faecal sludge is drawn out of the tank or pit;
- xi) Break up faecal sludge that has agglomerated into a solid mass, either by making use of a long handle shovel and adding water when necessary;
- xii) Operators shall leave behind sludge not less than 25 mm in depth in the bottom of the septic tank as this will act as the seeding material.
- xiii) Identify any abnormal conditions, such as high concentration of non-biodegradable materials, oils and grease before taking to the treatment plant for final disposal;
- xiv) If the cover of the tank has been removed, it should be replaced and sealed with cement plaster. If desludging has been carried out through a desludging hatch, the cover of the hatch should be replaced and sealed with cement plaster;

- xv) Clean up any spillage using proper sorbent materials. The top of the cover and the area around the septic tank is sprayed with 1 % chlorine solution;
- xvi) Two sets of working clothes will be provided for each worker, which should be dedicated to be used only during the desludging process. Clothes worn during the desludging process should be removed before the workers return home;
- xvii) Prepare a written report indicating: how much waste was removed; the condition of the tank or pit; any recommendations for repairs or maintenance; any recommendations for proper use of the system;
- xviii) Inform the client that the work is complete, along with recommendations, if any
- xix) The final report shall also be entered in the so as to provide a database and to also know about the next emptying date, etc.
- xx) Remove the wheel chocks and drive the truck to the next site or to the nearest approved disposal Site.

3) Protective Gears and Safety Devices

All the protective gears and safety devices shall be checked once in every six months and repaired/ replaced as necessary. Proper inventory of all the protective and safety gears to be maintained. The protective gears and safety devices are listed in **Annexure 6.2**, but not limited to, as prescribed by Prohibition of Employment as Manual Scavengers and their Rehabilitation Rules, 2013 to prevent any hazardous entry of humans into the sewers.

630 Periodical Cleaning of Drainage System –

The following operations shall be carried out during periodical cleaning of a drainage system as given in **Annexure 3.1(b)**:

- 1) The covers of inspection chambers and manholes shall be removed and the side benching and channels scrubbed
- 2) The interceptive trap, if fitted, shall be adequately cleaned and flushed with clean water. Care shall be taken to see that the stopper in the rodding arm is securely replaced.
- 3) All lengths of main and branch drains shall be rodded by means of drain rods and a suitable rubber or leather plunger. After rodding, the drains shall be thoroughly flushed with clean water. Any obstruction found shall be removed with suitable drain cleaning tools and the system thereafter shall be flushed with clean water.
- 4) The covers of access plates to all gullies shall be removed and the traps plunged and flushed out thoroughly with clean water. Care shall be taken not to flush the gully deposit into the system.
- 5) Any defects revealed, as a result of inspection or tests shall be made good.
- 6) The covers or inspection chambers and gullies shall be replaced, bedding them in suitable grease or other materials; and
- 7) Painting of ladders/rings in deep manholes and external painting of manhole covers shall be done with approved paints.

631 Covered Storm water Drains and Subsoil Drains –

All storm water drains shall be periodically cleaned with suitable method.

All subsoil drains shall be periodically examined for obstruction at the open joints due to the roots of plants or other growth.

632 Responsibilities of the Assistant Divisional Engineer and Staff –

The Assistant Divisional Engineer and the Sr. Section Engineer (Works) should inspect all drainage systems in their charge as per periodicity given in **Annexure 3.1(b)** and ensure their maintenance in an efficient condition. Complaints from residents should be promptly attended to.

D - STATION YARD DRAINAGE

633 Introduction –

The drainage system for station yards is critical for satisfactory maintenance of track and proper functioning of track circuits. Water from various sources, such as rain, washable apron, carriage washing hydrant, water booths, and platform surfaces etc., or any other nearby source, must be effectively drained out.

Effective drainage systems prevent water accumulation that could potentially damage the infrastructure and cause operational delays. Therefore, designing an efficient drainage system suitable for each yard's unique layout is essential for optimal performance as well as safety of P. Way.

634 Design Concept for Yard Drainage Systems –

1) General Approach

- a) For existing yards as well as new yards being constructed, the yard layout, centre to centre distance between tracks and topography of the yard location vis-a-vis adjacent area varies from one yard to another yard. Thus, it may not be possible to exactly stipulate single yard drainage system which can be used for all the yards.
- b) However, for guidance, a typical drainage arrangement is given (Fig. 6.3A Fig.6.3B and Fig. 6.3C) for a common yard configuration with four lines (two main lines and two loop lines).
- c) The design principles are as follows:
 - i) **Longitudinal drains:** Water entering through track ballast and on top of the formation should be collected in longitudinal drains between the tracks. These drains have circular holes on the sides and with grated covers at top for water entry.
 - ii) **Chambers:** Along the longitudinal drains, chambers should be placed at suitable locations for effective collection of water from longitudinal drains.

- iii) **Cross Drains:** Water from the chambers will be drained out through suitable outfall arrangement, including cross drains, wherever needed.
- iv) **Pumping Arrangements:** Depending on the topography of the yard vis-à-vis adjacent area, pumping arrangements may also be required from the chambers or sumps, for pumping out of water to nearest outfall or waterways.

2) Providing drainage in yards

- a) In all new yards, this yard drainage can be implemented. Hence, for all new yards and during major yard re-modelling works due to Gauge Conversion, Doubling Works etc., a “Yard Drainage Plan” shall be developed and got approved. For this, the yard drainage system given in this chapter can be easily implemented.
- b) To develop “Yard Drainage Plan” in existing yards, a detailed survey should be done to examine feasibility of designing/constructing the proposed yard drainage system. In case it is not possible to construct longitudinal drains due to site conditions, site specific solutions may be implemented.

One such alternative is constructing chambers at longitudinal spacing of about 150 – 200m, based on the gradients in the yards and collecting the water flowing between the tracks (in longitudinal direction) in these chambers. The water collected in chambers can be taken to suitable outfall arrangements either by pumping out or through cross drains.

- c) The location of Signal masts, Water hydrants, OHE masts, S&T and Electrical cables in the yard shall be kept in mind while deciding the drainage layout of the existing yard. Suitable modifications, if required, divert/modify/re-fix these installations shall be done to avoid the obstructions to the free flow of drainage water.
- d) The Planning and Design of the yard drainage system should be carried out in a professional manner. The following should be kept in mind while developing Yard Drainage Plans:
 - i. Complete yard shall be covered in planning. In big yards, plan for passenger running lines may be separated from goods running lines if drainage system of both parts can work independently.
 - ii. Thorough and detailed orthographic 3D mapping of yards through drone/total station/ LiDAR or any other suitable means shall be done for planning.
 - iii. Yard Drainage Plan will have the complete Ground Level and Invert Level of each drain. It will have complete details of each drain like size, flow of direction, Qmax, covered/open etc.
 - iv. Yard drainage should be connected to city drainage network and it should be shown in Plan.
 - v. All type of drains whether open (kuchcha/pucca), covered, underground etc. for existing as well as planned/ proposed ones shall be shown in Plan.
 - vi. Plan should cover the maintenance practices to be followed for cleaning of drains.

- e) Yard Drainage Plan shall be approved by CTE of zonal railway.

3) Cross Slope of Track Formation

Top of track formations, for ballasted track as well as for concrete aprons, should have cross slope towards the longitudinal drain. In new yards, this can be ensured during the construction of new tracks. For yards being re-modelled due to gauge conversion or doubling, this can be ensured for newly constructed tracks. In existing yards or tracks not newly laid during yard re-modelling, such cross slopes can be provided during deep screening work.

635 Design Criteria of a Typical Yard Drainage System –

The longitudinal drain, chambers and cross drains should be designed as follows:

1) Type of longitudinal drain

- a) In station yards it is difficult to cast the drains in-situ with required quality. Hence, the drains should be kept as pre-cast RCC Drains only. They should be casted in casting yard, with proper control on quality and dimensions.
- b) The drains should be cast in elements of suitable lengths (with typical segment length of 1m or 0.5m), depending upon the method of handling/machinery proposed to be used, and pre-cast elements should be laid at site.
- c) For ease of casting, the drains can be rectangular shape with rounded inner corners, with rows of circular holes in the vertical walls.
- d) The joint/junction between the two pre-cast elements of longitudinal drain shall be sealed with Cement Mortar or any other suitable sealing material.

2) Bed Gradient of Longitudinal Drain

- a) The drains shall be designed using Manning's Formula. The bed gradient of longitudinal drain needed is generally 1 in 350 or steeper, to get required self-cleansing velocity of flow (about 1.0 m/s) and to ensure sub-critical flow conditions (Froude Number being within 0.8). The maximum velocity of flow shall be 3.0 m/s to avoid excessive scouring and hydraulic jumps. The drain being proposed shall be checked for these hydraulic properties.
- b) To minimize the excavation, the bed gradient of longitudinal drain shall be same as the gradient. As per Schedule of Dimensions (IRSOD), the Steepest Gradient in yards can vary from 1 in 260 to Level (generally being 1 in 1200 for new yards). Therefore, in cases where the gradient of yard/formation is 1 in 350 or steeper, the longitudinal drain should have same gradient as that of yard/formation. However, in cases where gradient of yard/formation is flatter than 1 in 350, the longitudinal drain should have gradient of 1 in 350.
- c) In cases where bed gradient of longitudinal drain is 1 in 350 and yard/formation gradient is flatter than this, the depth of drain should increase in the direction of its bed gradient.

(3) Size of longitudinal drains

- a) The width of longitudinal drains should be kept as 450mm, to facilitate their cleaning during service life.
- b) In case the longitudinal drain meets any culvert in the yard, it shall connect to and discharge in the culvert subject to invert level and discharge capacity of the culvert permitting it & can be decided as per site conditions.
- c) The location of longitudinal drains vis-a'-vis location of adjacent tracks is decided based on following three considerations:
 - i) The ballast profile side slope line should cut the drain below its top to avoid ballast rolling down on the drain cover;
 - ii) The invert level line of bottom most row of holes in the vertical wall should be at the level of top of formation level to avoid washing away of formation soil in the drain;
 - iii) Drain depth of 150mm should be provided below the invert level line of the bottom most row of holes in the vertical wall

To avoid deep excavation on the side of running track, the maximum depth of longitudinal drains should be restricted to a value of 1200mm. This may be restricted to 1000mm or any other value, depending on the site conditions and stability of excavation for placing drain elements.

- d) As per Schedule of Dimensions (IRSOD), the minimum distance between track centres in yards is 4265mm for existing yards and 5300mm for all new yards. Thus, the drain depth has to be decided for both these track centre distances, out of which the lower track centre (4265mm) will require deeper drain to ensure that the ballast profile side slope line cuts the drain below its' top. Based on consideration in Para (c) above, depth of longitudinal drain will work out to be as under:
 - i) **For Track Centres at 5300mm:** Clear depth of drain is 450mm (minimum) at the starting point and when the depth reaches the maximum decided depth, it will be terminated in a chamber/sump.
 - ii) **For Track Centres at 4265mm:** Clear depth of drain is 750mm (minimum) at the starting point and when the depth reaches the maximum decided depth, it will be terminated in a chamber/sump.
- e) The location of the longitudinal drain vis-à-vis location of adjacent tracks has been shown in Fig. 6.4 and relevant details of longitudinal drains have been shown in Fig. 6.4A and Fig. 6.4B for track centre distances of 4265mm & 5300mm respectively.
- f) The longitudinal drains should be provided with grated covers, to avoid ballast falling in the drain and at the same time facilitating their easy cleaning.

- g) For Yard gradient of 1 in 1200 and bed gradient of longitudinal drain as 1 in 350, the spacing of chambers will be as following:

Track Centre Distance	Maximum Depth of Longitudinal Drain	Spacing of Chambers	
		When bed gradient of Longitudinal Drain is in same direction as Yard Gradient	When bed gradient of Longitudinal Drain is in direction opposite to Yard Gradient
4265 mm	1200 mm	222.3 m	122.0 m
	1000 mm	123.5 m	67.7 m
5300 mm	1200 mm	370.6 m	203.2 m
	1000 mm	271.7 m	149.0 m

- h) A typical case showing direction of bed gradient of longitudinal drain vis-à-vis direction of Yard Gradient and locations of chambers for new yard (with track centre distance of 5300mm) and maximum depth of longitudinal drain as 1000mm) are given in Fig. 6.3A, Fig. 6.3B and Fig. 6.3C.
- i) If there are number of outfalls present nearby, drainage layout may accordingly be planned using the same approach. For other cases, site specific details can be worked out.
- j) Expected water flow in the longitudinal drains and its comparison with the drain capacity is indicated in **Annexure 6.3**.

4) Longitudinal drains in case of yards located in curves

In case of yards located in curves, casting longitudinal drain elements with required curvature may not be easily possible. In such cases, smaller elements lengths of 0.5m length can be used. The excavation for longitudinal drains in such cases should be done taking this aspect into account. The minor extra space on the outer side at joints of pre-cast elements, due to joining of straight elements in curved layout, may be filled up using suitable mortar or sealing product.

5) Size of chambers

The chamber size should be kept as 0.9m x 1.2m, as per the stipulations of IS:1742-1983, for Building Drainage. The arrangement at chambers, with cross drain(s) is given in Fig. 6.5. The chambers should be casted with 200mm length of longitudinal drains on either sides or one side, as per site requirement and the longitudinal should be extended further by joining the pre-cast elements.

6) Type, Size and Bed Gradient of Cross Drain

- The bed gradient of cross drains should be 1 in 350 or steeper to achieve self-cleansing velocity of flow in them.
- The cross drain(s) should be kept as perforated pipes, 300mm diameter, with wrapping of non-woven geotextiles (also known as Geo-pipes). Their numbers can be decided based on the discharge to be carried by them.
- For provision of cross-drains in yards beneath the track, Micro-tunnelling can also be a useful method for installation. It is a trenchless construction method for installing pipelines that uses a remotely controlled Micro-tunnelling Boring Machine (MTBM) combined with the pipe jack and bore method to directly install

pipes underground in a single pass. This process avoids the need to have a long stretch of open trench.

For details, “Guidelines on Pipe Pushing by Micro tunnelling Technique for Railway Bridges” (Sep’ 23), Report No. BS-134, issued by B&S Dte. Of RDSO, can be referred.





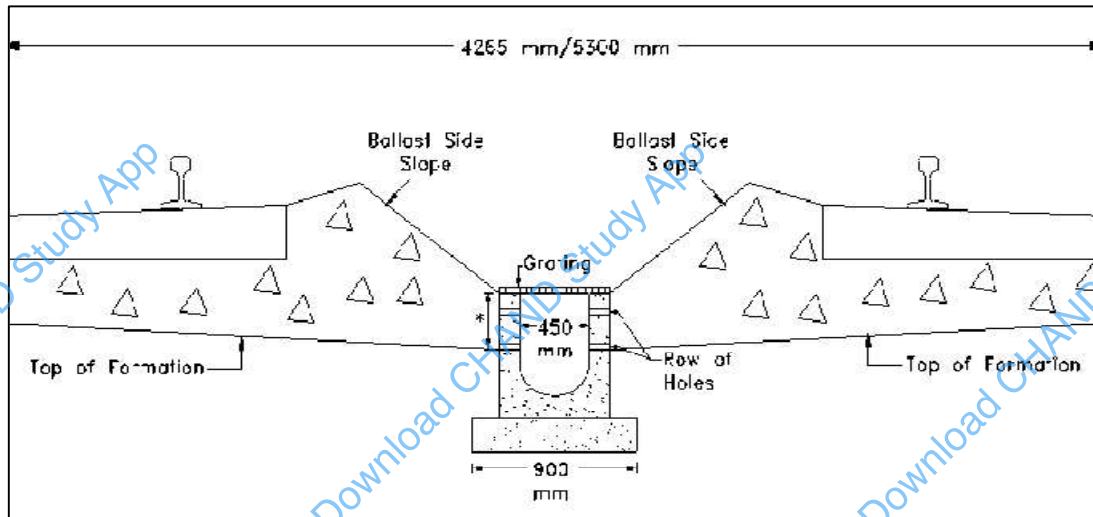


Fig. 6.4: Schematic arrangement showing Location of Longitudinal Drain Vis-a-Vis Adjacent Tracks

* 300 mm/600mm for track centres of 5300mm/4265mm.

Note: Details of Longitudinal Drain are shown in Fig. 6.4A and 6.4B.

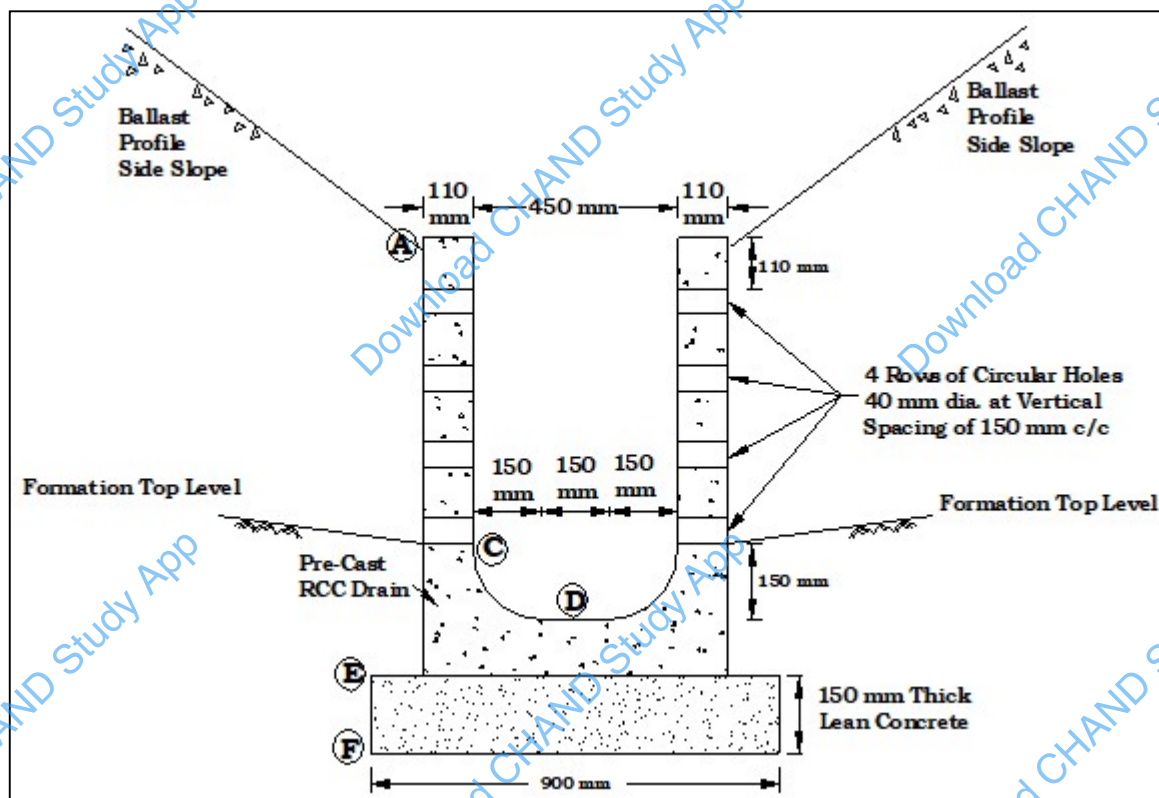


**Fig 6.4A/1: Details of Longitudinal Drain
(For Track Centre 4265mm)**

Levels Table

Location	Levels For Drain depth 750mm	Levels For Drain depth 1200mm
Rail Level	L m	L m
Platform Level	L + 840 m For High level L + 760 m For Middle level L + 455 m For Low level	L + 840 m For High level L + 760 m For Middle level L + 455 m For Low level
Top of Drain (A)	L – 0.111 m	L – 0.111 m
Formation level (C)	F = (L – 0.711 m)	F = (L – 0.711m)
Invert Level of Drain (D)	F – 0.150 m (L – 0.861 m)	F – 0.600 m (L – 1.311 m)
Bottom of Drain / top of Footing (E)	F – 0.260 m (L – 0.971 m)	F – 0.710 m (L – 1.421 m)
Bottom Of Footing (F)	F – 410 m (L – 1.121 m)	F – 0.860 m (L – 1.571 m)

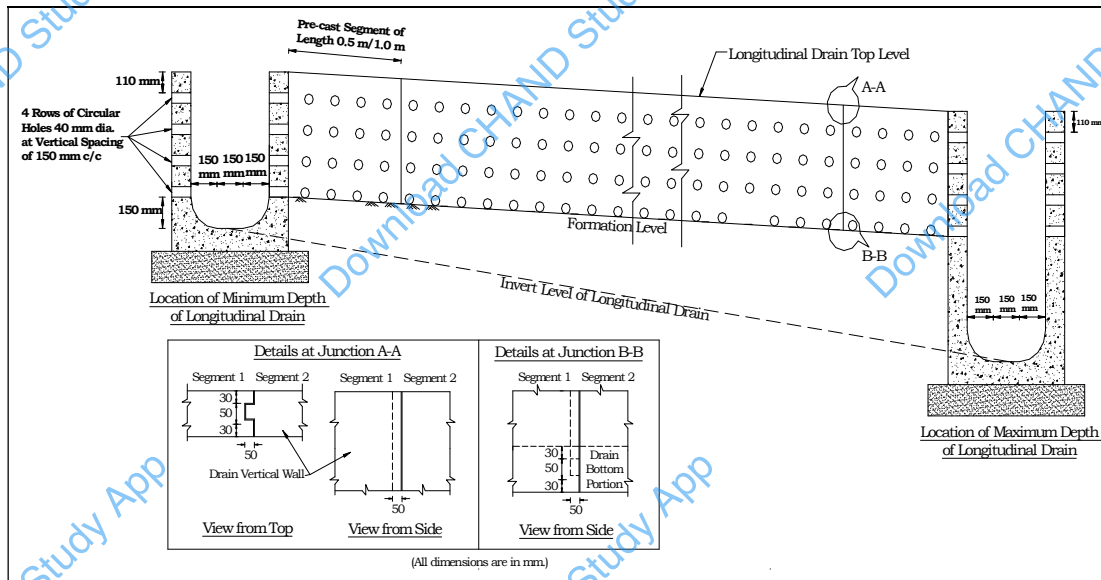


Fig. 6.4A/2: Side Schematic View of Typical Longitudinal Drain (For Track Centre 4265mm)

- Note:
- Circular holes of diameter 40mm are provided at horizontal spacing of 100mm c/c, with the centre of first hole being located at a distance of 100mm from the edge of the element. Thus, 0.5m long element will have four (4) holes in each row and 1m long element will have nine (9) holes in each row.
 - The bottom most row of holes is located in such a way that that their invert level line matches with formation level.
 - The next row of holes above is spaced at 150mm c/c vertical spacing. There will four (4) rows of holes.
 - For ensuring required line and level of the longitudinal drain and proper junction between pre-cast elements, the ends of elements shall be cast with groove in one element and projection in matching element on other side (as shown in details at A-A and B-B above).

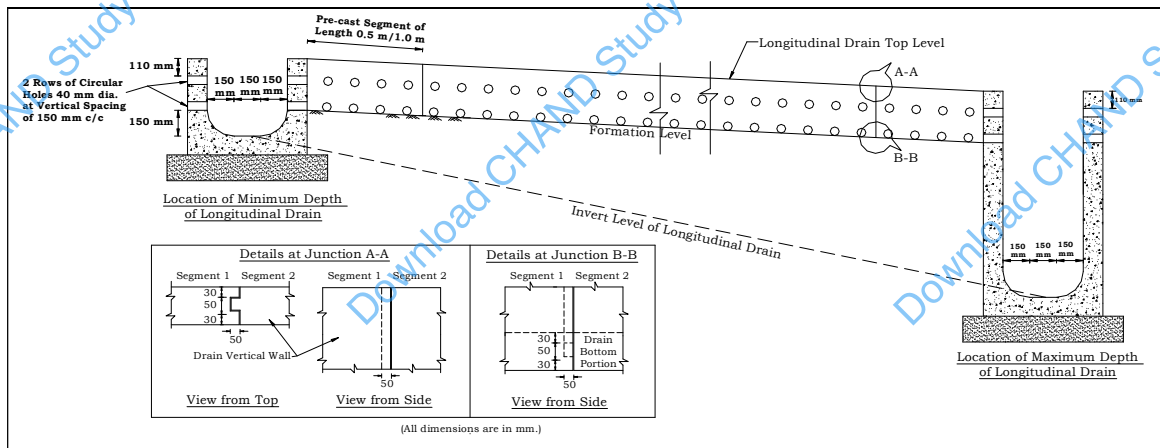


**Fig. 6.4B/2: Side Schematic View of Typical Longitudinal Drain
(For Track Centre 5300mm)**

- Note:
- (i) Circular holes of diameter 40mm are provided at horizontal spacing of 100mm c/c, with the centre of first hole being located at a distance of 100mm from the edge of the element. Thus, 0.5m long element will have four (4) holes in each row and 1m long element will have nine (9) holes in each row.
 - (ii) The bottom most row of holes is located in such a way that their invert level line matches with formation level.
 - (iii) The next row of holes above is spaced at 150mm c/c vertical spacing. There will two (2) rows of holes.
 - (iv) For ensuring required line and level of the longitudinal drain and proper junction between pre-cast elements, the ends of elements shall be cast with groove in one element and projection in matching element on other side (as shown in details at A-A and B-B above).

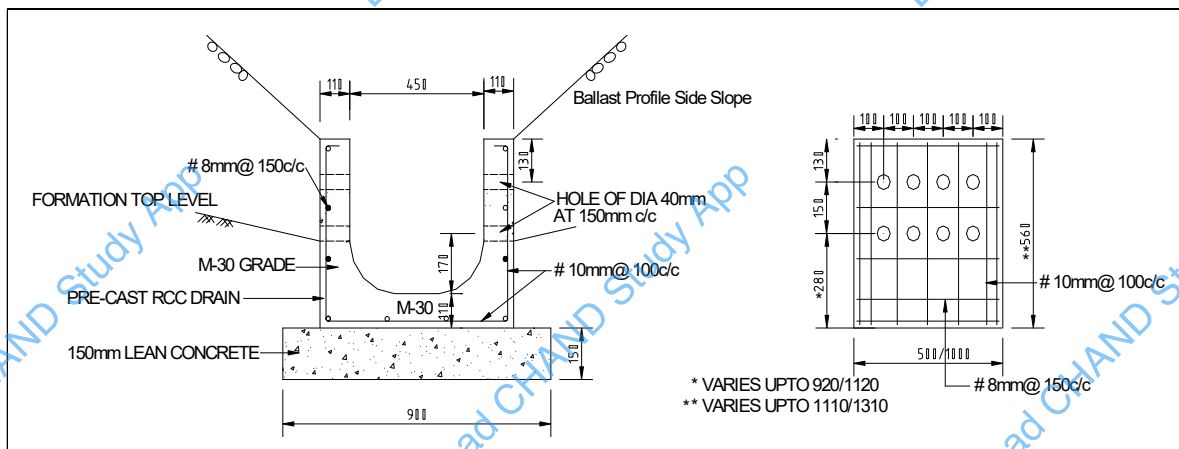


**Fig. 6.4B/3: Typical Reinforcement tentative in Longitudinal Drain elements
(For Track Centre 5300 mm)**

- Note:
- (i) Grade of Concrete is M-30.
 - (ii) Reinforcement shall be Fe-415 or higher.
 - (iii) Clear cover to reinforcement shall not be less than 25mm which may be increased as per exposure condition. (as per Clause No. 15.9.2 of IRS Concrete Bridge Code).
 - (iv) Reinforcement shall be placed in such a way that holes are covered in both the directions (i.e. at least one main bar and one distribution bar be provided in between two holes).
 - (v) For lifting of one block, slings be used in at least two holes (outer holes i.e. holes near horizontal and vertical edges shall not be used for this purpose).
 - (vi) Construction of Walls and Base Slab shall be monolithic.

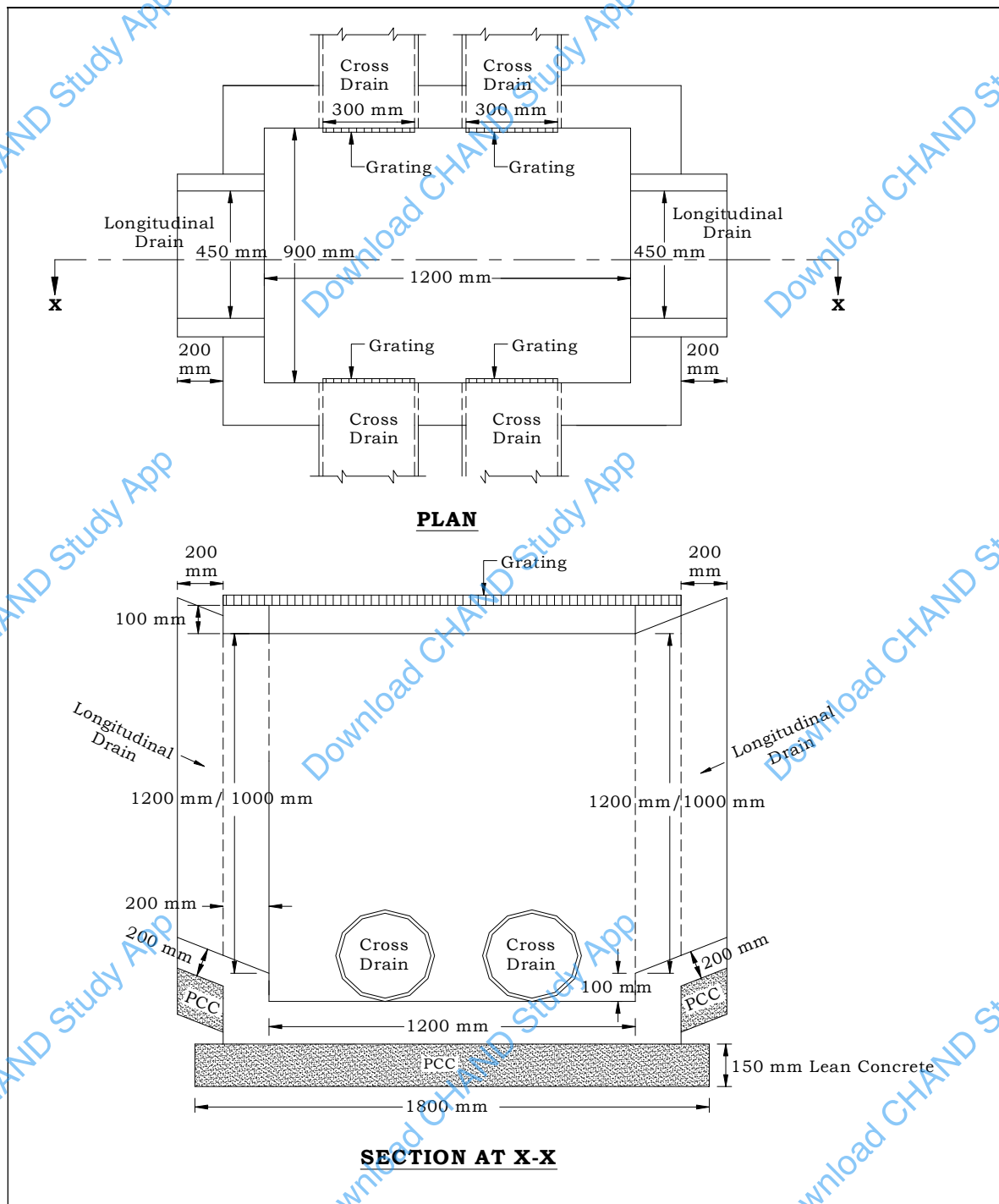


Fig. 6.5: Typical arrangement of Chamber with Cross Drain(s)

- Note: (i) For 200mm Length on each side of chamber, the Longitudinal Drain shall be cast with chambers. Further extensions of Longitudinal Drain shall be done by joining pre-cast drain elements.
- (ii) The typical arrangements are shown, actual size and design needs to be decided as per site condition.

Relative Limitations on Use of Pipe Materials In Specific Location

SN	Asbestos Cement (AC) Pipes
1	Not suitable for high sulphate levels in sewage/soil water, unless good lining such as HDPE/GRP/PVC/PE/CM with sulphate resistant cement lining is provided or pipe manufactured with sulphate resistant cement or Alumina cement. The quality of the lining shall be ensured by the competent authority.
2	Not aggressive soils/groundwater or tidal zone unless sulphate resistant cement or high alumina cement is used in manufacture.
3	Not in location where live load from vehicular traffic will occur on the laid pipeline.
Cast Iron or Ductile Iron (CIDI) Pipes	
1	Never to be used near buried electricity transmission high tension cables.
2	Wherever used above ground supports at each pipe length shall be ensured without any subsidence.
3	Pipes with external synthetic coatings not to be used marine coastal environments to prevent leaching of constituent chemicals into the environment.
Glass Fibber Reinforced (GRP) Pipes	
1	Not in area where future works may affect the pipe side support.
2	Not ground contaminated or possibly contaminated by certain chemicals in concentration deleterious to the resin of the pipe.
3	Do not use pipes/couplings with chips, cracks, crazing, layer delamination or exposed fibres or ends of pipes not sealed with resin.
4	Do not use pipe and couplings, stored unprotected from sunlight for more than 9 months.
5	Do not use in ground conditions having low stiffness, e.g. tidal zone.
6	Not in location subjected to vehicular load and has insufficient cover.
7	Not in areas subject to excavations by other service providers within 2m radial distance of pipeline.
8	Not in ground subject to differential settlement or extreme movement.
9	Not in ground offering low side support strength to the pipe.
10	Do not use when control of construction practices is not adequate to ensure quality of embedment for flexible pipes.
11	Not suitable for uncertainties in geotechnical analysis to determine if flexible pipe structurally suitable
12	Uplift precaution in locations where high groundwater table and empty pipe may be encountered.
Mild Steel (MS) Pipes	
1	Never to be used near electricity transmission cable.
2	Never to be used below ground unless proper protection against corrosion from soil and soil water is ensured.
3	Can be considered with appropriate lining and protection for gravity flow under exceptional circumstances. The quality of the lining shall be ensured by the competent authority.
4	Choice of spiral welded Vs or horizontal welded pipes shall be evaluated with respect to overburden
Reinforced Cement Concrete (RCC) Pipes	
1	Not suitable for high sulphate levels in sewage/soil water, unless good lining such as HDPE/GRP/PVC/PE/CM with sulphate resistant cement lining is provided or pipe manufactured with sulphate resistant cement or Alumina cement. The quality of the lining shall be ensured by the competent authority.
2	Not in aggressive soil/groundwater or tidal zone unless sulphate resistant cement or high

	alumina cement is used in manufacture.

Stoneware Pipes with hemp yarn and cement mortar (SWCM) packing joints	
1	Not in unstable ground, i.e. refilled ground, tidal zone.
2	Not suitable for above ground installation.
3	Not in the vicinity of trees with aggressive root systems.
4	Not to be used for crossing beneath water courses.
Stoneware Pipes with O ring (SQOR) joints	
1	Not in unstable ground, i.e. refilled ground, tidal zone.
2	Not suitable for above ground installation.
3	Not to be used for crossing beneath water courses.
Synthetic Pipes like Profile Wall, Double walled corrugated, PE, Solid Wall, HDPE, UPVC (SP) Pipes	
1	Not in location subjected to vehicular load and has insufficient cover.
2	Not in areas subjected to third party interference, e.g. excavations within 2m of pipeline by other parties.
3	Not in ground offering low side support strength to the pipe.
4	Not in ground which allows migration of pipe embedment material into it.
5	Not in ground contaminated with deleterious chemicals.
6	Not suitable for above ground installation.
7	Not suitable as reticulations systems except for special applications.

Note: Wherever special circumstances are encountered the above limitations can be overcome by appropriate precautions with the documented approval of the competent authority.

List of Protective Gears and Safety Devices

1. Air compressor for blower	23. Helmet
2. Airline breathing apparatus	24. Helmet demolishing
3. Airline respirator with manually operated air blower	25. Lead acetate paper
4. Air purifier gas mask/chin cortege	26. Life guard pad
5. Artificial respiration/reticulate	27. Modular airlines supply trolley system
6. Barrier caution tape	28. Normal face mask
7. Barrier cream	29. Nylon rope ladder – 5 m
8. Barrier cone	30. Nylon safety belt
9. Blower	31. Pocket book
10. Breath mask	32. Port oxy
11. Breathing apparatus	33. Raincoat
12. Caution board	34. Reflecting jacket
13. Chlorine mask	35. Safety belt
14. Emergency medical oxygen resuscitator kit	36. Safety body clothing
15. First aid box	37. Safety body harness
16. Face mask	38. Safety goggles
17. Gas monitor (4 gases)	39. Safety gumboots
18. Guide pipe set	40. Safety helmets
19. Full body wader suit	41. Safety showers
20. Fishing wader suit attached with boots	42. Safety torch
21. Hand gloves	43. Safety tripod set
22. Head lamps	44. Search light

Calculation of Design Discharge for the Longitudinal Drain

1. As per Rational Formula (As per RDSO Report RBF 16 for "Flood estimation Methods"):

$$Q = 0.278 \times C \times I \times A$$

Where: Q = Design Flood Discharge (in m³/s);

C = Run-off coefficient

I = Average Rainfall Intensity (in mm/h) lasting for given "time of concentration" & "return period"; and

A = Catchment Area (km²)

2. **Run-off Coefficient (C):** The runoff coefficient (C) depends on the degree and type of development within the catchment. Catchments are classified according to the expected general characteristics when fully developed. The C values are as follows:

Characteristics of catchment when fully developed	Value of C
Roads, highways, airport runways, paved up areas	1.00
Urban areas fully and closely built up	0.90
Residential/industrial areas densely built up	0.80
Residential/industrial areas not densely built up	0.65
Rural areas with fish ponds and vegetable gardens	0.45

(Ref.: PUB Singapore's "Code of Practice on Surface Drainage")

3. **Rainfall intensity (I):** Ideally, IDF Curves (intensity – duration - rainfall) curves for the given locality is required for calculating "rainfall intensity" for the given time of concentration. However, Rambabu et. Al. (1979) developed an equation for Indian region. [Ref.: Ram Babu, Tejwani K. K., Agarwal M. C. & Bhushan L. S. (1979) – Rainfall intensity duration return period equations & nomographs of India, CSWCRTI, ICAR, Dehradun, India].

$$I = (K \times T^a) / (t + b)^n$$

Where: I = rainfall intensity in cm/hour; T = return period in years; t = Time of concentration for storm duration in hours; and K, a, b and n = coefficients varying with location; values of which for some locations are as under:

Location	K	a	b	n
Agra	4.911	0.167	0.25	0.629
New Delhi	5.208	0.157	0.5	1.107
Nagpur	11.45	0.156	1.25	1.032
Bhuj	3.823	0.192	0.25	0.990
Gauhati	7.206	0.156	0.75	0.940
Bangalore	6.275	0.126	0.5	1.128
Location	K	a	b	n
Hyderabad	5.25	0.135	0.5	1.029
Chennai	6.126	0.166	0.5	0.803

4. **Return Period (T)**

Area Served by Drainage System	Return Period (T)
Catchment of less than 100 ha	10 years
Catchment of 100 to 1000 ha	25 years
Catchment of more than 1000 ha or Critical installations	50 to 100 years

(Ref.: PUB Singapore's "Code of Practice on Surface Drainage").

5. **Time of Concentration (t):** The time of concentration (t) depends on the type of catchment area and location at which the design discharge is to be measured/calculated.

Calculation of rainfall intensity for various durations of time of concentration, ranging from 0.5 hours to 6 hours or so, can be done using the formula given in Para 3 above, and the time of concentration giving maximum rainfall intensity for that city (or nearest city from the Table in Para 3 above) can be adopted.

6. Design discharge 'Q' can be calculated using parameters described above. The capacity of the longitudinal drain to be provided shall be more than the calculated Design discharge.

CHAPTER 7

GARDENS, PLANTATIONS, DISPOSAL OF GRASS AND OTHER NATURAL PRODUCES

A - GENERAL

701 Role of Engineering Department –

The Engineering Department is responsible for tree plantation, ornamental horticulture development including landscaping in common areas in stations, colonies, offices, community parks etc., gardening in premises of quarters as per specified norms and its maintenance. Engineering department is also responsible for sale of natural produces like fruit, wood etc. Staff of other departments should also be encouraged to associate in developing environment friendly area.

702 General –

Indian Railways have an important role to play in protecting the earth and its natural resources as Indian Railways have huge land across the country after various uses of railway operations. In this sequence bulk afforestation on vacant land is continuing by the railways. A facility located in a lush green environment with fresh air, natural and man-made landscape contribute to improvement in productivity, promoting wellness of individuals and help in countering pollution, noise, heat and other harmful environmental effects.

Modern infrastructure creation envisages sustainable development by synthesizing architectural designs, construction materials/technology with existing land forms and natural surroundings, duly addressing the environmental concerns. A holistic approach for landscaping and horticulture work should be adopted in planning during preparation of plans for new infrastructure / improvement of existing infrastructure as Railway Stations, Railway Platforms, Offices, Rest houses and Colonies etc. give a visitors or passerby the first impression about the Railway and Town.

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the Engineer-in-charge with good earth. Selection of tree, hedge, shrub and perennial/seasonal flower etc. for plantation depend upon the climatic condition, topographical condition of the area. For guidance purpose, name of some trees, flowers, shrubs etc. are given in **Annexure 7.1** which are not exhaustive.

Fruit bearing trees along railway track may invite stone-throwing by people living in the vicinity, thereby causing injury to railway passengers and damage to railway property. In view of this, it may be ensured that plantation of fruit-bearing trees is restricted to staff colonies and areas away from operational buildings/structures.

703 Guidelines on Planning of Landscaping and Horticulture Works –

The following aspects are to be considered in planning and design of the overall infrastructure/complex; However, these aspects are not exhaustive.

- 1) **Site Suitability, Planning and Integration.** Based on natural contours of the ground, alternatives will be studied and suitable scheme incorporated in detailed survey plan depicting all the physical features at site. The layout and scheme shall be integrated with overall layout of premises/ environment.
- 2) **Land Form and Grading.** The layout of assets and services shall generally be aligned with the existing topography, gradients, roll and terrain. The shrubs, trees etc. that can be sustained in that soil and climate will be included.
- 3) **Surface Drainage, Irrigation and Water Management.** A detailed irrigation scheme with necessary water collection and storing structures, rainwater harvesting scheme, networks for distribution of water including lines, pumps, sprinkler/ drip irrigation system and allied infrastructure will be designed taking into account water efficiency, water conservation and low-cost maintenance that involves minimum manpower. Necessary arrangement for collection, draining and disposal of surface water etc. will also be included. Use of recycled water for irrigation purposes will be explored and provided where feasible.
- 4) **Hard and Soft Landscape.** The open areas in and around the building shall be provided with paved surfaces like pathways, open courtyards, platforms, hard-standing, resting/ meditating areas, walking plazas etc. Other open spaces shall be provided with soft scape such as lawns, hedges and shrubs, ground cover, green belt, tree screens, earthen mounds, terraced soil surfaces, ponds, water bodies, rockery etc. to facilitate rain water percolation etc. Landscaped parking lots/ pathways may be provided with pervious paving, open grid pavement, grass pavers, higher solar reflectance pavers.
- 5) **Planting Plan and Plantation Design.** Thoughtful selection of the trees, shrubs, climbers, foliage plants, grass, groundcover and aquatic plants transform the barren landscape into meaningful landscape. The detailed plantation design will take into consideration the climatic conditions, soil conditions and evolve a plan consisting of combination of ornamental, flowering & evergreen trees, plants and shrubs, seasonal flowers and grass mounds representing the indigenous flora.
- 6) **Garden Furniture/ Architectural Elements.** The spaces designed for recreation, leisure, public/ community activity, sports/ athletic purposes shall include sitting/ resting facilities, shelters/ gazebo/ awning/ pergola, sculptures, miscellaneous street furniture, graphic designs, signages and other architectural features etc., enhancing the aesthetics. The area may be suitably protected with fence, railing, gates, entrance canopy etc. Provisions required for personnel with disabilities will also be provided where required.
- 7) **Illumination/ Garden Lighting.** The illumination design will be based on aspects of indirect lighting achieved with a combination of concealed lights, ground lights, bollards, post-top lights and street light fittings along with electrical networks/ control system/ external services. Focused lighting where required for highlighting facades/ elements and other features may also be provided. Use of energy efficiency devices, solar lighting, LED lights, sensor-based lighting etc. shall be encouraged and incorporated in the scheme. Suitable no. of electric points for grass cutting machine etc. shall be provided as required.

- 8) **Water Fountains/ Falls/ Screens.** Water fountains/ flowing/ running water features may be provided in common areas of main office buildings, Railway Station buildings, Officers rest house residential complexes, gardens/ parks and square of roads to enliven the areas inside and outside of buildings. All associated items including pumps, underwater lights etc. may also be provided. Recirculation shall be adopted for conservation of water.
- 9) **Green Building Parameters.** The green parameters are to be identified and incorporated at the conceptual planning stage itself by adopting an integrated approach in the design procedure. Recycled waste water for horticulture, energy efficient garden lighting, recycled material in construction, sustainable site development, solar lighting, garden furniture and accessories made of environment friendly materials, rain water harvesting structures, promoting ground water recharge etc. shall be considered and duly included as part of the scheme. Planting the right way to conserve water improving microclimate and aspects of air pollution control by plants may also be duly factored. The guidelines given in latest Green Building Rating Manual shall be referred for incorporation of mandatory and optional items of work targeting a minimum of 3-star rating.

B - PLANTATION

704 Planning for Plantation –

For systematic plantation, each Division should prepare 'tree planting plan' for every subdivision and plantation work should be carried out accordingly. On all construction projects, bulk afforestation of suitable variety should be done in vacant land as an environmental improvement measure. If the opinion of railway /forest department insists the size of the plant for planting may be suitably increased. Provision for this should be invariably made in the estimate. For new colonies/townships, assistance of specialized agencies may be taken for landscaping.

705 Nursery –

Nurseries, wherever feasible, may be maintained to cater to the requirements of the railway establishments. The resources of Forest Department, supply from contractors/agencies and nurseries in the public/ private sector may be tapped to meet the requirements of the railway. Green house also may be constructed in larger nurseries. Modern irrigation system such as drip irrigation, rain gun and pop-up sprinkler system should be planned at location like nurseries/gardens where huge quantity of water is required repeatedly for watering as it provide efficient watering to plant and save manpower. When the sapling plants are being procured through outsourcing, the plants should be as per following specifications:

- The plants should be full of fresh and healthy foliage.
- The plants should be free from insect, pest and diseases.
- Plant should be well developed and healthy.
- The height of the plants will be measured from top of the pots.
- The plants should be well settled and should not be newly shifted/Transplanted.
- The plants should be true to the variety and Variety name should be tagged.
- Moss/coir stick should be used to support the plant.

- Moss/coir stick should be straight and properly fixed in the pot.
- The rejected plants materials should be removed from the site immediately.
- Moss /coir stick should be covered with the plants in case of plants supplied with moss/coir stick.
- The Plant should be well established and should have good foliage.
- Good earth and manure used for filling the pot/poly bag should be free from any inert material
- Pot/ Poly bag used for filling the plants should be of proper size.
- There should be proper drainage in pots for plants.
- The flowering plants should also have proper flowering and should be true to the variety.
- All plant should have the tendency of growth and should not be stunted or de-shaped.
- There should be no stagnation of water in the pots.
- Plant should not have any physiological disorder.
- Tips of the Plants should be intact, there should not be any damages etc.
- In case of flowering pots flower should be on bud stage/semi bloom stage.
- In case of potted plant pots should have uniformity/same size and quality.
- Plants of bigger height should be properly supported/ staked by bamboo stick.
- Pots/Polybags soil should not be infectious and plant should have free from all kind of diseases.
- Bulbs, seeds, seedling, suckers should properly treated with fungicides before supply.
- Seasonal plants should be bought young so as to get considerable residue life.

706 Planting and Care of Young Trees –

- 1) Sites for plantation should be so selected that when the trees grow up, they do not interfere with overhead wires or obstruct the view around curves or of station signals or of level crossings.

Before planting of trees, holes shall be prepared in following manner:

- a) Pits/holes of proper shape in ordinary soil shall be excavated to the dimensions specified/required.
- b) Excavated soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole.
- c) Stones, brick bats, unsuitable earth and other rubbish, roots of other plants and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the site as directed.
- d) The tree holes shall be manured as specified/required with the excavated soil.
- e) The mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside.
- f) The refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the concerned railway officials.

When planting, it should be seen that the roots are not exposed to sun. Water should be fed to the young tree daily until it is strongly rooted, the top surface of the soil being broken up/loosened about once a week. At stations where Engineering staff/agency is not posted/available, the all activates of plantation works shall be done by station

staff/agency.

- 2) Soon after planting, the young tree should be supported firmly with a strong and straight bamboo or stake of suitable height and the trunk tied to the stake by means of a cord over sackcloth. A tree-guard or protection should be fixed around it.

The tops should be allowed to grow up to a height of 3 metres. When side shoots appear, four or five strong ones should be saved at different levels on the trunk above 3m (to prevent forking). When the top leaders have grown fully they should be pruned moderately to cause them to branch out and produce a bushy top.

The tree-guard should be removed when the tree has been firmly established and there is no risk of damage by goats or cattle.

- 3) Tree-guards may be made from bricks; mild steel etc. as specified or as per direction of concerned railway officials. Metallic Tree guards may be preferably in two halves so that it can be reused.

C - GARDENS

707 Maintenance of Gardens in Offices, Rest Houses and Colonies –

Railway premises should be kept in a neat and tidy condition. Gardens within compounds should be maintained to a satisfactory standard.

- 1) The Engineering Department is responsible for maintaining hedges, lawns, flowers/seasonal flowers, Shrubberies, murals, Fountains etc. attached to offices, rest houses, parks, stadium (where sports association is not in existence) & playgrounds and in quarters of colonies as per norms in a satisfactory condition by deploying staff/outsourcing agency. Where it feels necessary, owning departments may maintain the same with permission of engineering department.
- 2) The SSE/ JE (Works) should pay requisite attention to the cleanliness of rest house compounds and upkeep of gardens.
- 3) Yardstick for deployment of workers for horticulture maintenance is given for general guidance in **Annexure 7.2**.
- 4) Various provisions and incidences of service for different types of offices, residential bungalows, quarters, parks with regard to hedges, trees and plantation etc. are given in **Annexure 7.3**. The variations as necessitated by climatic conditions being allowed for hedge cutting, watering, lawn mowing, weeding and clearing/cutting of jungle.
- 5) Guidelines for various provisions to prepare annual maintenance estimates for horticulture works are given in **Annexure 7.4**.

708 Cultivation of Seasonal Flowers –

All most all seasonal flowers can be propagated by seeds. Marigolds can be propagated by cutting also. Their sowing time depends upon climate. It varies in different parts of India as under

Parts of India	Types of seasonal Flowers	Sowing time
Northern Plain	Winter season flowers	September – October

	Winter season flowers (late-flowering types- China aster, carnation and cineraria)	August-September
	Summer season flowers	January-February
	Rainy season flowers	May-June
Southern Plain	Winter season flowers	September-October
Northern hills	Summer season flowers	March-April
Southern hills	Summer/Rainy season flowers	March-May

The seeds of seasonal flowers are sown in nursery beds, earthen pots, seeds pan or wooden seed trays. The seeds of a few annuals like sweet pea, morning glory, lupin nasturtium and hollyhock which have bold seeds can be sown directly at permanent places.

The seed compost should consist of

- Garden soil - one part,
- Coarse sand - one part
- Farmyard manure and leaf-mould (Leaf compost) – one part.

The requirements of farmyard manure or compost and chemical fertilizers for per sqm of soil are as under:

- Farmyard manure or compost – 3 Kg
- Urea – 20 grams
- Super phosphate – 60 - 120 gram
- Muriate of potash - 30 to 60 gram

Half quantity of urea and full of superphosphate and muriate of potash should be applied at the time of bed preparation. The remaining quantity of urea must be applied one month after transplantation. Spraying plants with 2% urea twice or thrice is beneficial for good growth and flowering. Fertilizers should never come in the direct contact of the foliage since they cause scorching (leaf burning). Fertilizers should never be applied in the pot-grown annual flowers.

Seedlings are transplanted 25 days after sowing at 4 – leaf stage at suitable distance. Before transplanting, seedlings are hardened off by withholding water for 1 or 2 days or by exposing them gradually to sunlight. Transplanting is generally, done either on a cloudy day or in the evening. Light watering every day in early morning or late in the afternoon is required for about a week for proper establishment of the seedlings.

709 Provision of Lawns and Hedges in New Bungalows –

Grassing in select areas, tree and shrub plantation should be done. The following schedule of plantations may be adopted as a guideline:

Type	Officers Bungalows	Type IV
Lawn	200 sqm	75 sqm
Hedge	200 m	100 m

The cost of initial plantation should be borne by the railway against approved estimate.

D. SALE OF NATURAL PRODUCE

710 Sale of Natural Produce –

- 1) By Auction or By Tender: The natural produces on railway land should be sold by public auction or by tender and the sale proceeds credited to railway revenues. The auction of grass, dead or dying trees (with permission for cutting from Forest Department of State Government or regulatory authority of State Government), logs, rights for the collection of produce of fruit trees, tapping of date-trees for toddy (subject to Local Government's permission) and fishing in Railway tanks, shall be conducted by the Assistant Divisional Engineer about one month before the commencement of the season. The produce of fruit-bearing trees in the compound of residential quarters can be enjoyed by the residents, but the produce cannot be sold.
- 2) To State Forest Corporations etc.: The matured trees/dead or dying trees/logs can also be sold/ given for auction to State Government agencies like Forest Development Corporations on the approved rates as per their norms.
- 3) Division of lots: Schedules of lots in convenient lengths of each kind of tree logs and each kind of natural produce to be sold should be prepared by Sr. Section Engineer (Works/P.Way) and submitted to the Divisional Engineer through ADEN.

711 Fixing of Reserve Price of Lots –

Reserve price for each lot to be sold by auction should be fixed by the Divisional Engineer in consultation with the Accounts Officer. The valuation of lot for fixing of reserved price shall be obtained from the Horticulture/forest department/regulatory authority of State Government as per their jurisdiction, if applicable. If there are any special circumstances, which are likely to affect the value of the lots, these should be brought to the notice of the Divisional Engineer beforehand to enable him to fix reserve price. In fixing reserve price, the Divisional Engineer in consultation with Assistant Divisional Engineer will take into account previous year's sales and such other relevant factors as pertaining to the quality and quantity of produce of relevant year.

712 Auction or Tender Notices and Agreement –

Auction/tender notices in Hindi, English and regional language should be pasted at least a fortnight in advance, at stations and at places where they can be seen by prospective purchasers/bidders. For wide publicity the auction/tender notice may be published in local newspaper.

Auction notices should show (i) the date, time and place of auction, (ii) full particulars of the produces or rights to be sold, (iii) that the successful bidder shall deposit the full amount of sale and sign an agreement immediately after the bidding is closed and (iv) reserve prices of lots to be auctioned.

Tenders on prescribed forms for sale of natural produces may, alternatively, be invited by the Divisional Engineer and agreements entered into.

713 Recording & Finalization of Bids –

All bids made at the auction should be recorded. The highest bid should be accepted if it

is not less than the reserve price fixed by the Divisional Engineer, unless there are definite reasons for not doing so. In such a case these reasons should be recorded in the bid list before closing the auction.

- 1) At the foot of the bid list, the Assistant Divisional Engineer should certify as follows:

"I certify that I personally conducted the auction and the above is a true statement of the produces sold and the prices realized."

- 2) After closing the auction, the full amount of the bid should be collected from the successful bidder who should sign an agreement on the prescribed form. The produces or rights may then be handed over forthwith to the successful bidder.

Receipt for the amount collected should be given and the money remitted to the Railway immediately with full details.

- 3) If the successful bidder fails to pay the full amount or the highest bid is below the reserve price fixed by the Divisional Engineer, the lot should not be sold. The bidders' list should however be completed and certified by the Assistant Divisional Engineer and submitted to the Divisional Engineer with recommendations for orders. The Divisional Engineer may in consultation with the Accounts Officer approve the sale or order a fresh auction for the lot or lots not sold.

- 4) After the sale by auction is over, the bidders' list and the agreement duly executed by the party should be submitted to the Divisional Engineer for ratification. Certified copies of the agreement should then be issued by the Divisional Engineer's office to the party, the Assistant Divisional Engineer and Sr. Section Engineer.

The original agreement should be sent to the Accounts Department for record.

- 5) After the advice is given to the successful bidder regarding the acceptance, the responsibility for watching the produces or "rights" passes over to him. The Railway shall not be liable to any loss or damage from theft, fire or any other cause, whatsoever. Agreements should provide for this.
- 6) When there is a tie at an auction and a railway servant happens to be one of the bidders, his offer shall be given preference. If the bidders happen to be railway servants, the offer the employee with longer service shall be accepted. Engineer should take into account the 'locus-standi' of the bidders concerned.

714 Register of Sales of Natural Produces –

A register in manuscript form shall be maintained in the Divisional Engineer's office section-wise with complete particulars of sales affected and entries made therein, as and when necessary, and initialed by the Divisional Engineer.

715 Licensing of Tanks and Borrow Pits for Pisciculture –

Tanks/ponds which are source of water supply should not be used for pisciculture.

- 1) For licensing the borrow pits and /tanks for pisciculture, adequate publicity shall be given so that registered fisherman's Co-operative Societies formed and operative in its jurisdiction can participate. This shall be done through negotiation, subject to terms and conditions safeguarding railway's over-all financial interests and commensurate

with the prevailing market rate. For this purpose, each Division should obtain a list of fisherman's Co-operative Societies formed and operative in its jurisdiction, with well-defined 'area of operation' from the State Governments. Railway will have the unquestionable right to judge the market rate, if in its opinion the rates quoted by the fisherman's co-operative societies are not reasonable and/or other terms and conditions not favorable to Railways, the license fee in such cases should be fixed on merits in each case in consultation with FA & CAO.

- 2) If fisherman co-operative societies do not come forth, the tanks/borrow-pits may be licensed by public auction or by inviting open tenders. In such cases, where limited/open tenders are called for, all formalities of preparing briefing notes, tender committee minutes etc. are to be observed by the Railways.
- 3) The rights for fishing on the railway tanks/borrow-pits should be let out to the highest bidder on the license fee for a period of one to five years as may be convenient to the railway with specific provision for taking back tanks/borrow-pits even earlier on due notice at any stage.
- 4) While licensing tanks and borrow pits for pisciculture, suitable legal provision be made in the Agreement to protect the railway tanks/borrow pits from accrual of any permanent tenancy rights.
- 5) Plan/sketch for licensing of tanks and, borrow pits in each Section shall be prepared for approval of the Divisional Railway Manager. The plan/sketch should invariably show the sizes and number of tanks and borrow pits under the section. On the basis of plans, sketches, tender notice shall be issued by the Senior Divisional Engineer/Divisional Engineers concerned well in advance for licensing of tanks and borrow pits for the purpose of pisciculture. The notice shall also be displayed on the notice boards of the offices of the Divisional Railway Managers, Assistant Divisional Engineers, SSE (Works) & SSE (Permanent Way) and important stations. For wide publicity the auction/tender notice may be published in local newspaper.
- 6) In the tender notice,
 - a) a clear stipulation is to be made for deposit of earnest money by the tenderers along with their tender @ 10% of the anticipated sale value. The tenders unaccompanied with earnest money shall be summarily rejected.
 - b) The security money should be 10% of the total bid amount for due fulfilment of the contract. The amount of earnest money of the successful tenderer should be accounted towards 10% security money and short-fall, if any, should be deposited by the successful tenderers to make full 10% security deposit within 7 days from the date of opening of the tenders.
 - c) The successful tenderer/bidder shall be allowed 7 days' time from the date of opening of the tenders of depositing the full amount of the bid of one year failing which the amount of earnest money shall be forfeited.
 - d) In case of contract of fishing rights for more than one year, the bid amount of the subsequent years shall have to be deposited by the contractor by 31st December each year i.e. before 3 months of the commencement of the next season, failing which the contractor's security money should be forfeited and fresh tenders invited.

- 7) Suitable license agreement should be executed with the parties before handing over possession of the borrow pits/tanks.
- 8) In case of any dispute between the contractor and the Railway, the decision of the General Manager shall be final. The General Manager may delegate this power to the Divisional Railway Managers.

E - FELLING OF TREES

716 Felling of Trees Obstructing View –

- 1) Trees and bushes that interfere or tend to interfere with the view from a train, of signals or level crossings or along the insides of curves, shall be cut. When cut, it should be ensured that they do not foul the track.

When trees and bushes require to be cut in terms of Sub-Para above, on private lands, action should be taken as laid down in Section 14 of the Railways Act 1989 (24 of 1989).

It is however desirable that as many trees as possible be retained, consistent with ensuring the safety of trains. Relaxations in distance from track are left to the discretion of the Assistant Divisional Engineer who will satisfy himself that no risk of trees falling across the line is taken. The following are among the relaxations:

- a) Trees may be reduced in height by lopping the top branches to obviate danger of obstruction.
 - b) Branches on the track side may only be removed, leaving those on the side remote from the track, thus rendering it impossible for the tree to fall across the track.
- 2) When a group of trees is to be felled, each tree should be carefully marked, identified, classified and measured. Tenders may be invited for the felling and sale of timber of such lots of trees, stipulating a time limit for the felling and removal from railway land of each lot. When inviting tenders, the classification and size of trees need not be quoted, the tender being in respect of a certain number of marked trees only, at the specified Kilometrage.
 - 3) Joint Survey: Annually, joint survey of the trees should be carried out by Junior Scale Officers of Engineering, S & T, Electrical Department etc. and trees which are likely to endanger safety of track should be identified and felled/lopped as may be considered necessary. A report should be sent to the Divisional Engineer and Divisional Safety Officer.

717 Felling in Compound of Staff Quarters –

Trees in compounds of railway bungalows or staff quarters should not be felled nor any branches lopped except with the permission of the Assistant Divisional Engineer. However, horticulture/Forest department of State Government permission is to be obtained.

718 Felling Near Electrical or Other Overhead Wires –

Trees in close proximity to electrical or other overhead wires should not be cut nor the

branches lopped except in the presence of staff of the Electrical or concerned Department as the case may be. Trimming/cutting of trees in the electrified section to be done as under:

No part of the tree shall be nearer than 4 m from the nearest live conductor. Any tree or branches likely to fall on the live conductor should be cut or trimmed periodically to maintain the safety clearances. The responsibility for wholesale cutting of the trees, i.e. cutting of tree trunks, will rest with the Engineering Department. In the electrified territories, however, the cutting of the trees shall be done by the Engineering Department in the presence of authorized Traction Distribution (TRD) staff to ensure safety and satisfactory completion of the work. The day to day trimming of the tree branches, wherever required, to maintain the 4 m safety clearances from OHE shall be done by the authorized TRD staff and Supervisors.

In case of dispute, the decision whether to cut or trim a tree, shall be taken through a joint inspection of Engineering and Electrical officials.

The modalities to be adopted for cutting/ trimming of the trees i.e. contractually or departmentally, may be decided by the respective departments based on local conditions. Accountal and disposal of trees cut wholesale will be done by the Engineering Department. While the disposal of the trimmed tree branches will be the responsibility of the TRD Department. The expenditure for cutting/trimming of trees to maintain safe clearance for OHE, shall be debited to revenue grant of TRD Department.”

719 Afforestation on Railway Land by Forest Department –

- 1) No new plantation of trees by the State Forest Departments may be permitted unless they enter into a written agreement with the Railways along with a jointly signed plan indicating the areas permitted for plantation. Such plantation will only be taken up on Railway land areas which are not required for any development work/operational needs. Minor modifications to suite the situational need may be made in the model agreement prescribed by the Railway Board attached as **Annexure 7.5**, but for any important modification, the Railway Board may be referred.
- 2) The Agreement should take into account the Indian Forest Act and should have sufficient safeguards so that the Railways title on the land is not diluted and the Railwaymen are freely permitted to enter the forest and take action for safe operation of the train services.

Trees should be planted in accordance with Para 705 of this manual. In addition, other guidelines in the agreement with the Forest Department may be followed.

720 Survey of Surviving Trees –

Every year a survey of surviving trees should be made on 30 September for that year and information should be noted in the Proforma as detailed below:

Location of trees	Type of Trees	No. of trees more than 50 cm girth	No. of trees from 15cm to 50cm girth	Saplings needing protection	Total	Remarks
I	II	III	IV	V	VI	VII

The above information should be collected and entered in a tree register maintained for this purpose by Sr. Section Engineer (Works /P. Way) in-charge.

The information with regard to number of trees planted, cut and perished has to be maintained in another Register. Consolidated information is required to be sent to the Railway Board by 30th April, every year.

721 Harvesting of Matured Trees –

The Railways undertake extensive plantation of trees on their land every year. Besides increasing the green cover over the land, with all its attendant benefits, this is also a source for earning revenue when these trees reach maturity.

Planting of tree saplings and harvesting of matured trees should be a continuous process with the number of tree saplings planted on the Railway exceeding the target set by the Board for this purpose. This figure should also be at least double of the number / the number as per norms of State Forest Department of matured trees harvested on the Railway.

As per the Forest Research Institute, Dehradun, a matured tree, in commercial terms, is one which has reached an age where it gives the maximum economical outturn of timber. This shall be dependent on the specie of tree expected to be harvested.

Vigorous efforts are expected to be made to harvest the matured trees so as to earn the maximum revenue for the Railway from this source.

722 Maintenance by Private Parties –

Where the private parties are willing to maintain the gardens, the railway may accept such proposals, judiciously deciding the terms and conditions. The guidelines on beautification of railway area/premises at station approaches along the track are as under:

1) Background:

- a) It has been observed that the aesthetic appearance of open spaces along the track in the approaches of Stations can be preserved by developing green patches by planting low height plants, shrubs, creepers, aromatic plants, herbs/medicinal plants, climbers, ornamental plants, flowering plants, etc.
- b) It has, therefore, been decided that the vacant spaces/area in the station approaches along the track may be developed as green cover by planting low height plants, shrubs, creepers, bushes, herbs/medicinal plants, climbers, ornamental plants, flowering plants, flower plants, etc. Individuals, NGOs, Trusts, Horticulturists, Nursery developers, Charitable institutions, Corporates, Government Bodies and Self-Help groups, herein after referred as party/parties, can play a vital role in developing this vacant railway area into environment friendly area. All such parties will be encouraged to participate in this initiative. The implementation of this scheme will be through participation of the people (Jan Bhagidari).

2) Identification of area for the Scheme:

- a) Railway shall identify the area in the approach of stations for beautification. The

area beyond safety zone only will be marked for the purpose of beautifying/green patches.

- b) A plan of such area showing the existing tracks, railway area boundary, other railway infrastructure, road, etc. including the area already identified for railway's own purpose shall be marked. While making such plan, Railway shall ensure that access to yard/station for asset maintenance is not blocked. Moreover, the area being used for stacking railway material, GMF schemes, etc. should not be identified under this scheme.
- c) Sr. DEN/Coordination of the Division shall co-ordinate for the approval of plans and overall work. The plan shall be approved by DRM.
- d) There shall be no D&G and supervision charges on the work.

3) Scrutiny of the Proposals:

- a) Expression of interest (Eoi) from interested parties will be called through Press/online advertisement to implement this scheme with the approval of DRM.
- b) In case, there are more than one proposal in developing such green patch, the area will be divided among the interested parties. In case, it is not possible to divide the area, the selection may be done on draw of lots.

4) Execution of Memorandum of Understanding:

- a) A MOU with broad terms as under will be signed between Railway Administration (Sr. DEN) and the Party. This MOU will be initially valid for one year and may be extended after one year up to 3 years with mutual consent of both the parties. Extension of MOU will be done based on performance by the party.
- b) The responsibility for maintaining plants/green patches will lie with the party. The leaves/ branches/ roots/ bark/ gum/ flowers etc. of the plants may be collected and removed by the party to keep the area tidy and clean. Setting up of a nursery is also permitted under this policy. The developer can use potted plants or use railway land provided for this purpose to plant the saplings. These saplings/plants can also be taken away by the Horticulturists/ Nursery developer as and when required for his own use. No commercial activity will be permitted in the railway area.
- c) Party has to make arrangements for supply of water by its own means. However, Railway may provide water on best effort basis.
- d) The area will be made available only for right to use access basis. No encumbrance shall be created by the party on railway area permitted. No permanent/semi- permanent structure will be erected by party in the area. However, temporary fencing/ covering of such green patches developed may be allowed to prevent trespassing/cattle grazing.
- e) Party shall not undertake any activity which can endanger safety of track, buildings, etc. While preparing the area, special care will be taken to avoid damage to cables and other railway infrastructure, etc. Mechanized excavation shall not be permitted. Vehicles shall not be allowed to ply near the track on

railway land. In exceptional cases, if vehicles are required to ply on railway land, the same shall be under the supervision of railway staff. The party will ensure proper drainage so as not to cause any harm to railway track.

- f) The party shall not have any right on the area other than the purpose mentioned in the MOU. Upon violation of this provision railway reserve the rights to terminate the MOU. In case of doubt, decision of DRM will be final. The party shall not have any right to use the area for any commercial exploitation of asset being provided in railway premises.
- g) The height of the plants selected should not restrict the visibility of signals/interfere with electrical wires or train operations. The concerned party will ensure proper pruning/cutting of branches. Beehives shall not be permitted.
- h) Railway shall have free access to the site at all times for any purpose including but not limited to operation, maintenance, restoration works etc.
- i) The party may display its name with relevant details as per Good Industry practice. No extra space/facility for advertising/publicity shall be given to the party.
- j) The party shall indemnify Railways against any loss of life/property, injury occurring in relation to the activity/property covered under MOU. In case of any dispute, the decision of DRM will be final and binding on both the parties.
- k) The party shall comply with all applicable laws.
- l) In the event of breach of the conditions laid down in the policy, either party can terminate this Memorandum of Understanding (MOU) leaving the green patches on 'as is where is basis'.
- m) Either party can terminate MOU after serving one month notice. Upon termination of MOU, party shall not have any right to access railway premise.

5) **General**

- a) Railway will provide proper Identification Card (ID) to the person engaged in upkeep of the green medicinal green patches.
- b) Annual Review of all MOUs shall be done by the DRMs.
- c) An appropriate database of the green patches created through the above initiative should be maintained by Railway including the details of the Party. Record of all such MOUs executed over the Division shall be preserved at Division, apart from the concerned ADEN and SSEs.

723 Training of Staff –

The malis and supervisors should be trained using facilities available with state government institutions or elsewhere.

A. Shade and Ornamental Trees

SN	Common name	Scientific name
1	Neem	<i>Azadirachta indica</i>
2	Alstonia (Devils tree)	<i>Alstonia scholaris</i>
3	Mahua	<i>Bassia latifolia</i>
4	Maulsri	<i>Mimusops elengi</i>
5	Siris	<i>Albizia lebbek</i>
6	Pepal	<i>Ficus religiosa</i>
7	Banyan	<i>Ficus benghalensis</i>
8	Arjun	<i>Terminalia Arjuna</i>
9	Karanj/Papri	<i>Pongamia glabra</i>
10	Kadam	<i>Nauclea cadamba</i>
11	Rubber tree	<i>Ficus elastica</i>
12	Pakur/Pilkhan	<i>Ficus infectoria</i>
13	Silver Oak	<i>Grevillea Robusta</i>
14	Sausage (Balam Kheera)	<i>Kigelia pinnata</i>
15	Kalpvrickscha(Baobab)	<i>Adansonia digitata (kalp vricksh)</i>
16	Babool	<i>Acacia nilotica</i>
17	Bottle palm	<i>Hyophorbe lagenicaulis</i>
18	Casuarina	<i>Casuarina equisetifolia</i>
19	Seasam	<i>Dalbergia sissoo</i>
20	Mahogany	<i>Chukrassia tabularis</i>
21	Java Fig	<i>Ficus benjamina</i>
22	Fiddle Leaf Fig	<i>Ficus lyrata</i>
23	Chilkhan	<i>Ficus retusa</i>
24	Ficus shiela	<i>Ficus shiela</i>
25	Fishtail palm	<i>Caryota Mitis</i>
26	Foxtail palm	<i>Wodyetia bifurcata</i>
27	Marore fali	<i>Heterophragma adenophyllum</i>
28	Jungle Jalebi	<i>Inga dulcis, Pithecellobium dulce</i>
29	Jarul (Pride of India)	<i>Lagerstroemia flosreginae</i>
30	Daku/Drek/Bakain	<i>Melia azedarach</i>
31	Pinus	<i>Pinus longifolia</i>
32	Ashok	<i>Polyalthia longifolia</i>
33	Ashok Pendula	<i>Polyalthia pendula</i>
34	Jiaputa/Jalpiti	<i>Putranjiva roxburghii</i>
35	Teak	<i>Tectona grandis</i>
36	Washingtonia palm	<i>Washingtonia filifea</i>

B. Flowering Trees

SN	Common name	Scientific name
1	Gulmohar	<i>Delonix regia</i>
2	Amaltas	<i>Cassia fistula</i>
3	Neeli Gulmohar	<i>Jacaranda mimosaefolia</i>
4	Bottle Brush	<i>Callistemon lanceolatus</i>
5	Bauhinia	<i>Bauhinia purpurea</i>
6	Bombax ceiba (Silk cotton tree)	<i>Ceiba pentandra</i>
7	Tabebuia	<i>Tabebuia rosea</i>
8	Flame of Forest/Palas	<i>Butea monosperma</i>
9	Chorisia	<i>Chorisia speciosa</i>
10	Indian lilac	<i>Lagerstroemia indica</i>
11	Golden champa	<i>Michelia champaca</i>
12	Pagoda tree/ Plumaria	<i>Plumaria alba</i>
13	Bauhinia blakeana (Kachnar)	<i>Bauhinia blakeana (Kachnar)</i>
14	Bauhinia purpurea (Kachnar)	<i>Bauhinia purpurea (Kachnar)</i>

15	Butea frondosa (Flame Forest)	<i>Butea frondosa</i> (Flame Forest)
16	Callistemon lanceolatus	<i>Callistemon lanceolatus</i>
17	Cassia siamea	<i>Cassia siamea</i>
18	Cassia javanica	<i>Cassia javanica</i>
19	Cassia nodosa	<i>Cassia nodosa</i>
20	Chorisia	<i>Chorisia speciosa</i>
21	Erythrina (Pangri)	<i>Erythrina indica</i>
22	Lagerstroemia thorelli	<i>Lagerstroemia thorelli</i>
23	Himchampa	<i>Magnolia grandiflora</i>
24	Milletia ovalifolia	<i>Milletia ovalifolia</i>
25	Indian Cork tree	<i>Millingtonia hortensis</i>
26	Vilaiti Kikkar	<i>Parkinsonia aculeate</i>
27	Yellow Gulmohar	<i>Peltophorum enerme</i>
28	Pagoda tree	<i>Plumeria alba</i>
29	Frangipani	<i>Plumeria acutifolia</i>
30	Kanak Champa	<i>Pterospermum acerifolium</i>
31	Sita Ashok	<i>Saraca indica</i>
32	Kusum	<i>Schleichera trijuga</i>
33	Rugtoora (Fountain tree)	<i>Spathodea campanulata</i>
34	Tabebuia	<i>Tabebuia</i> sp.
35	Tecoma	<i>Tecoma argentea</i>

C. Fruits Tree

SN	Common name	Scientific name
1	Amla	<i>Phyllanthus emblica</i>
2	Mango	<i>Mangifera indica</i>
3	Jamun	<i>Syzygium cumunii</i>
4	Tamarind (Imli)	<i>Tamarindus indica</i>
5	Date palm	<i>Phoenix dactylifera</i>
6	Coconut	<i>Cocus nucifera</i>
7	Arecanut	<i>Areca catechu</i>
8	Oil palm	<i>Ealias guinensis</i>
9	Palmyra palm	<i>Borassus flaballifer</i>
10	Pincapple	<i>Ananas comosus</i>
11	Banana	<i>Musa paradisia</i>
12	Cashew.	<i>Anacardium occidentale</i>
13	Pistachio nut	<i>Pistachia vera</i>
14	Custard apple	<i>Annona squamosa</i>
15	Bullock's heart.	<i>Annona reticulata</i>
16	Karonda	<i>Carrisa carandas</i>
17	Papaya	<i>Carica papaya</i>
18	Persimmon	<i>Diospyras kaki</i>
19	Aonla	<i>Emblica officinalis</i>
20	Mangosteen	<i>Garcinia mangosteena</i>
21	Walnut	<i>Juglans regia</i>
22	Pecanut	<i>Carya illieonsis</i>
23	Avocado	<i>Persia americana</i>
24	Jack fruit	<i>Artocarpus heterophyllus</i>
25	Fig	<i>Ficus carica</i>
26	Guava	<i>Psidium guajava</i>
27	Carambola	<i>Averrhoa carambola</i>
28	Passion fruit	<i>Passiflora edulis</i>
29	Pomegranate	<i>Punica granatum</i>
30	Macadamia nut	<i>Macadamia ternifolia</i>
31	Ber	<i>Zizyphus mauritiana</i>
32	Loquat	<i>Eriobotrya japonica</i>
33	Apple	<i>Malus domestica</i>
34	Almond	<i>Prunus communis</i>

35	Apricot	<i>Prunus armeniaca</i>
36	Sweet cherry	<i>Prunus avium</i>
37	Plum	<i>Prunus domestica</i>
38	Strawberry	<i>Fragaria ananasa</i>
39	Pear	<i>Pyrus communis</i>
40	Peach	<i>Prunus persica</i>
41	Bael	<i>Aegle marmelos</i>
42	Mandarin	<i>Citrus reticulata</i>
43	Sweet orange	<i>Citrus sinensis</i>
44	Kagzi lime	<i>Citrus aurantifolia</i>
45	Grape fruit	<i>Citrus paradisi</i>
46	Wood apple	<i>Feronia limonica</i>
47	Lemon	<i>Citrus limon</i>
48	Litchi	<i>Litchi chinensis</i>
49	Sapota	<i>Achras zapota</i>
50	Grape	<i>Vitis vinifera</i>
51	Cocoa	<i>Theobroma cocoa</i>
52	Coffee	<i>Coffea robusta</i>
53	Tea	<i>Camelia sinensis</i>
54	Kiwi fruit	<i>Actinidia deliciosa</i>
55	Phalsa	<i>Grewia subinequalis</i>

D. Permanent Shrub Plant

SN	Common name	Scientific name
1	Chitra	<i>Plumbago auriculata</i>
2	Night Queen:	<i>Cestrum nocturnum</i>
3	Mussaenda	<i>Mussaenda Luteola</i>
4	Tecoma	<i>Tecoma capensis</i>
5	Tree of sadness	<i>Nyctanthus arbotristis</i>
6	Shravani	<i>Lagerstromia indica</i>
7	Peacock flower	<i>Caesalpinia pulcherrima</i>
8	Hamelia	<i>Hamelia patens</i>
9	Jatropha Abutilon	<i>Jatropha multifida</i>
10	Pili Kaner	<i>Thevetia peruviana</i>
11	Doembeya	<i>Doembeya spectabilis</i>
12	China shoe flower	<i>Hibiscus-rosa-sinensis</i>
13	Orchid tree	<i>Bauhinia acuminata</i>
14	St.Thomas tree/Bell bauhinia	<i>Bauhinia tomentosa</i>
15	Beloperone	<i>Beloperone guttata</i>
16	Calliandra	<i>Calliandra spp</i>
17	Cassia	<i>Cassia biflora</i>
18	Chandani	<i>Tabernaemontana coronaria</i>
19	Pila kaner	<i>Thevetia nerifolia</i>
20	Putranjiva	<i>Putranjiva roxburghii</i>
21	Cape Jasmine (Gandhraj)	<i>Gardenia jasminoides</i>
22	Mogra	<i>Jasminum sambac</i>
23	Weeping merry	<i>Russelia juncea</i>
24	Barleria	<i>Barleria cristata</i>
25	Galphimia	<i>Galphimia gracillis</i>
26	Daedalacanthus	<i>Daedalacanthus nervosus</i>
27	Acalypha	<i>Acalypha spp:</i>
28	Achania	<i>Achania malvaviscus</i>
29	Day king	<i>Cestrum Diurnum</i>
30	Kund	<i>Jasminum multiflorum</i>
31	Ghanari	<i>Lantana camera</i>
32	Thunbergia	<i>Thunbergia erecta</i>
33	Stachytarpheta	<i>Stachytarpheta indica</i>
34	Buddleia	<i>Buddleia asiatica</i>

35	Malti	<i>Ervatamia divaricata</i>
36	Ixora	<i>Ixora perviflora</i>
37	Kamini	<i>Murraya paniculata</i>
38	Poinsettia	<i>Poinsettia pulcherima</i>
39	Lal kaner	<i>Nerium indicum</i>
40	Azalea	<i>Azalea spp.</i>
41	Cup and saucer	<i>anguinea</i>
42	Anar	<i>Punica granatum</i>
43	Stenolobium	<i>Stenolobium stans</i>
44	Hamiltonia	<i>Hamiltonia sauveolens</i>
45	Lady of the Night	<i>Brunfelsia americana</i>
46	Ficus	<i>Ficus pandanus</i>

E. Annuals Flowering Plants

Summer & Rainy season flowers		
1	Cosmos	<i>Cosmos bipinnatus</i>
2	Vinca	<i>Vinca spp.</i>
3	Cock's comb	<i>Celosia spp.</i>
4	Gaillardia	<i>Gaillardia pulchella</i>
5	Gomphrena	<i>Gomphrena globosa</i>
6	Kochia	<i>Kochia scoparia var trichophylla</i>
7	Foliage annual Portulaca	<i>Portulaca grandiflora</i>
8	Sunflower	<i>Helianthus annus</i>
9	Zinnia	<i>Zinnia elegans</i>
10	Tithonia	<i>Tithonia speciosa</i>
11	Amaranthus	<i>Amaranthus caudatus</i>
12	Balsam	<i>Impatiens balsamina</i>
Winter season flowers		
1	Antirrhinum	<i>Antirrhinum majus</i>
2	Aster	<i>Callistephus chinensis</i>
3	Brachycome	<i>Brachycome iberidifolia</i>
4	Calendula	<i>Calendula officinalis</i>
5	California poppy	<i>Eschscholtzia californica</i>
6	Cineraria	<i>Senecio cruentus</i>
7	Clarkia	<i>Clarkia elegans</i>
8	Cliaanthus	<i>Cliaanthus dampieri</i>
9	Cosmos	<i>Cosmos bipinnatus</i>
10	Dahlia	<i>Dahlia variabilis</i>
11	Daisy	<i>Bellis perennas</i>
12	Gazania	<i>Gazania splendens</i>
13	Ice plant	<i>M. criniflorum</i>
14	Lupin	<i>Lupinus hartwegii</i>
15	Mimulus	<i>Mimulus</i>
16	Hollyhock	<i>Helichrysum bracteatum</i>
17	Nasturtium	<i>Tropaeolum majus</i>
18	Nemasia	<i>Nemasia strumosa</i>
19	Pansy	<i>Viola wittor ckiana</i>
20	Petunia	<i>Petunia hybrida</i>
21	Phlox	<i>Phlox drummondii</i>
22	Salvia	<i>Salvia splendens</i>
23	Stock	<i>Mathiola incana</i>
24	Sweet Alyssum	<i>Alyssum maritimum</i>
25	Verbena	<i>Verbena hybrida</i>
26	Carnation	<i>Dianthus caryophyllus</i>
27	Chrysanthemum	<i>Chrysanthemum Indicum</i>
28	Dianthus	<i>Dianthus barbatus</i>
29	Gerbera	<i>Gerbera jamesonii</i>
30	Marigold African	<i>Tagetes erecta</i>

31	Marigold French	<i>Tagetes patula</i>
32	Acroclium	<i>Acroclium roseum</i>
33	Ageratim	<i>Ageratum houstonianum</i>
34	Anchusa	<i>Anchusa capensis</i>
35	Annual chrysanthemum	<i>Chrysanthemum coronarium</i>
36	Arctotis	<i>Arctotis stoechadifolia</i>
37	Bells of Ireland	<i>Molucella lauvii</i>
38	Candy tuft	<i>Iberis spp.</i>
39	Coreopsis	<i>Coreopsis tinctoria</i>
40	Corn flower	<i>Centaurea cyanus</i>
41	Dimorphotheca	<i>Dimorphotheca aurantiaca</i>
42	Gamolepis	<i>Gamolepis tagetes</i>
43	Gypsophila	<i>Gypsophila elegans</i>
44	Hollyhock	<i>Althea rosea</i>
45	Lady's lace	<i>Pimphenella monoica</i>
46	Larkspur	<i>Delphinium hybridum</i>
47	Linaria	<i>Linaria bipartita</i>
48	Linum :	<i>Linum grandiflorum</i>
49	Mignonette	<i>Reseda odorata</i>
50	Nigella	<i>Nigella domascena</i>
51	Rudbeckia	<i>Rudbeckia bicolor</i>
52	Saponaria	<i>Saponaria vaccaria</i>
53	Schizanthus	<i>Schizanthus wistonensis</i>
54	Shirley puppy	<i>Papaver rhoeas</i>
55	Statice	<i>Limonium sinuatum</i>
56	Sweet pea	<i>Lathyrus odoratus</i>
57	Sweet sultan	<i>Centaurea moschata</i>
58	Sweet william	<i>Dianthus barbatus</i>
59	Venidium	<i>Venidium fastuosm l'erbena hybrida</i>
60	Wall flower	<i>Cheranthus cherii</i>
61	Godetia	<i>Godetia grandiflora</i>
62	Celosica	<i>Celosica argentia</i>

F. Rose Plants

SN	Common name	Scientific name
1	Bush Rose	<i>Rosa spp.</i>
2	Budded Rose (H.T. variety)	
3	Creeper Rose variety	
4	Standard Rose (H.T. variety)	

G. Foliage And Shade Loving Plants

SN	Common name	Scientific name
1	Aglaonema	<i>Aglaonema spp.</i>
2	Araucaria	<i>Araucaria araucana</i>
3	Areca Palm	<i>Areca catechu</i>
4	Brassia Variegated	<i>Heptapleurum actinaphyllum</i>
5	Chamaedorea elegans palm	<i>Chamaedorea elegans</i>
6	Croton	<i>Croton spp.</i>
7	Dieffenbachia	<i>Dieffenbachia spp.</i>
8	Dracaena	<i>Dracaena sp.</i>
9	Livistona Palm	<i>Livistona chinensis</i>
10	Monestaria plant	<i>Monestaria adansonii</i>
11	Money Plant	<i>Epipremnum aureum</i>
12	Philodendron	<i>Philodendron sp.</i>
13	Phoenix Palm	<i>Phoenix sp.</i>
14	Rhapis Palm	<i>Rhapis excelsa</i>
15	Rubber Plant	<i>Ficus elastica</i>

16	Seaforthia Palm	<i>Ptychosperma elegans</i>
17	Sanchezia Nobili's	<i>Sanchezia sp.</i>
18	Schefflera	<i>Schefflera sp.</i>
19	Spathiphyllum (peace Lilly)	<i>Spathiphyllum cochlerispathum</i>
20	Syngonium	<i>Syngonium sp.</i>

H. Ground Covers Plants

SN	Common name	Scientific name
1	Alpinia Variegated -in-charge.	<i>Alpinia sp.</i>
2	Alternanthera species	<i>Alternanthera sp.</i>
3	Asparagus Meyeri (Fox tail palm)	<i>Asparagus meyeri</i>
4	Asparagus sprengeri	<i>Asparagus aethiopicus</i>
5	Aspidistra	<i>Aspidistra elatior</i>
6	Clerodendrum inerme	<i>Volkameria inerme</i>
7	Chlorophytum (Green)	<i>Chlorophytum sp.</i>
8	Cuphea chinensis	<i>Cuphea hyssopifolia</i>
9	Dianella variegated	<i>Dianella tasmanica</i>
10	Duranta Golden	<i>Duranta erecta</i>
11	Euphorbia milli hybrid variety	<i>Euphorbia milli</i>
12	Iresine herbstii	<i>Iresine herbstii</i>
13	Juniperus prostrata	<i>Juniperus prostrata</i>
14	Ophiopogon, Green/Black full of leaves	<i>Ophiopogon japonicus</i>
15	Portulacaria afra (Jade)	<i>Crassula ovata</i>
16	Setcreasea purpurea	<i>Tradescantia pallida</i>
17	Syngonium (Butterfly) variegated	<i>Syngonium sp</i>
18	Tradescantia zebrina	<i>Tradescantia zebrina</i>
19	Wedelia trilobata	<i>Sphagneticola trilobata</i>

I. Creeper Plants

SN	Common name	Scientific name
1	Golden trumpet	<i>Allamanda cathartica</i>
2	Allamanda violaceus	
3	Golden shower	<i>Begonia venusta</i>
4	Bougainvillea	<i>Bougainvillea glabra</i>
5	Glory tree	<i>Clerodendrum splendens</i>
6	Bleedery Heart wine	<i>Clerodendrum thomsoniae</i>
7	Morning glory	<i>Ipomoea purpurea</i>
8	Chameli	<i>Jasmine grandiflorum</i>
9	Jasmine humile (Yellow)	<i>Chrysojasminum humile</i>
10	Passion flower (Rakhi bel)	<i>Passiflora caerulea</i>
11	Arple wreath	<i>Petra volubilis</i>
12	Rangoon creeper	<i>Quisqualis indica</i>
13	Tacoma grandiflora Chinese trumpet wine	<i>Campsis grandiflora</i>
14	Curtain creeper/iron weed	<i>Vernonia sp.</i>

J. Medicinal Plants

SN	Common name	Scientific name
1	Anjeer	<i>Ficus carica</i>
2	Ashwagandha	<i>Withania somnifera</i>
3	Kalmegh	<i>Andrographis paniculata</i>
4	Adusha	<i>Justicia adhatoda</i>
5	Satavari	<i>Asparagus racemosus</i>
6	Tulsi	<i>Ocimum tenuiflorum</i>

7	Alovera	Aloe vera
8	Bryophyllum	Kalanchoe sp.
9	Lemon grass	Cymbopogon flexuosus
10	Karonda	Carrisa carandus
11	Giloy	Tinospora cordifolia
12	Brahmi	Bacopa monuieri
13	Sarpgandha	Rauvolfia serpentina
14	Mandukparni	Centtella asiatica
15	Steviea	Stevia rebaudiana
16	Aprajita	Clitoria ternatea
17	Chitrak	Plambago zeylanica
18	Dambel	Tylophora indica
19	Hadjod	Cissus quadrangularis
20	Lajvanti	Mimosa pudica
21	Kapoor kachri	Hedychium spicatum
22	Bajradanti	Barlaria prionitis
23	Shankhpushpi	Convolvulus prostrates
24	Nirgundi	Vitex nigunda

Yardstick for Horticulture Staff

A. MALI		
SN.	Type of Area	Norms (1 Mali for)
1	Govt. Officers Bungalow	5058 Sqm or 1.25 acres
2	Office accommodation	5058 Sqm or 1.25 acres
3	Open spaces	3.00 acres
4	Play grounds	8094 Sqm or 2.00 acres
5	Public Parks	8094 Sqm or 2.00 acres
6	Hedge cutting (Normal Hedge) up to 1.2 m Height	3000m.
	Hedge cutting (Normal Hedge) above 1.2 m to 2.4 m height	2000m.
	Hedge Cutting (Designer Hedge/ Edge)	1500m.
7	Potted plants at Nursery	2000 Nos.
	Potted plants in Flats/Bungalow/Offices at ground level	750 Nos.
	Potted plants (Cement) at Nursery and display	300 Nos.
	Potted plants in Multistoried Buildings	250 Nos.
8	Topiary up to 1.2 m height	250 Nos.
	Topiary above 1.2 m height	200 Nos.
9	Kitchen garden	1000 Sqm
10	Vertical Garden	100 Sqm
11	Trees	
	Up to 3 years	250 Nos.
	3 to 8 years age	500 Nos.
	Beyond 8 years age	1200 Nos.
12	Maintenance of Shrubs Plants	500 Nos.
13	Sweeping of Public Parks	1.50 Acre per Sweeper
14	Supervisor/Chaudhary One Supervisor/ Chaudhary over 18 Malis	

Note: The above requirement is for the works to be executed with frequencies given in
Annexure 7.3.

Norms For Horticulture Maintenance

For Staff colony excluding individual gardens

SN.	Item of Works	Nos./Qty./Frequency Required
	Pruning &trimming of	
1.	Trees	Yearly/Need base with the permission of Forest department as per applicability
2.	Shrubs Creepers etc.	Yearly/Need based
3.	Hedges Cutting Summer Rains Winter	Monthly Monthly Monthly
4.	Repair & replacement of plants	As and when required
5.	Any other item (Hort., Civil, Elect., U/F water supply) required for proper maintenance	On need basis

Norms For Horticulture Maintenance

For officers Colony and officers' bungalows

SN	Item of Work	Nos./Qty./Frequency Required
1.	Irrigation	As per requirement
2.	(i) Manuring (ii) Fertilization	Once in a year in winter, in summer and rainy season - as per requirement
3.	Lawn Mowing Summer Winter Rains	Fortnightly Monthly Weekly
4.	Plant Protection	Need Based
5.	Pruning & Trimming of Trees Shrubs Creepers etc.	Yearly/Need base with the permission of Forest department as per applicability Yearly/Need base
6.	Cultivation & Weeding	As and when required
7.	Seasonal Plants Summer Winter Rains	Need Based Need Based Need Based
8.	Top dressing with soil & / or manure	Yearly
9.	Repair & replacement of plants.	As and when required
10.	Hedges Cutting Summer Winter Rains	Fortnightly Monthly Fortnightly
11.	Indoor and Outdoor potted plants	-
12.	Ground Covers	Need based
13.	Seasonal potted Plants	-

Norms For Horticulture Maintenance

For offices

SN	Item of Work	Nos./Qty./Frequency Required
1.	Irrigation	As per requirement
2.	(i) Manuring (ii) Fertilization	Seasonal in winter, in summer and rainy season- as per requirement
3.	Lawn Mowing Summer Winter Rains	Fortnightly Monthly Weekly

4.	Plant Protection	Need Based
5.	Pruning &trimming of Trees	Yearly/Need base with the permission of Forest department as per applicability
	Shrubs Creepers etc.	Yearly/Need base
6.	Cultivation & Weeding	Need based
7.	Seasonal Plants	
	Summer	Need Based
	Winter	Need Based
	Rains	Need Based
8.	Top dressing with soil & / or manure	Yearly/ Need Based
9.	Repair & replacement of plants, levelling etc.	As per requirement
10.	Hedges Cutting	
	Summer	Fortnightly
	Winter	Monthly
	Rains	Fortnightly
11.	Any other item (Hort., Civil, Elect., U/F water supply) required for proper maintenance	On need basis
12.	Indoor potted plants & planters	Need based as per requirement of site
13.	Outdoor potted plants	Need based as per requirement of site
14.	Planter Beds	Need based
15.	Ground cover	Need based
16.	Special requirements	Need based

Norms For Horticulture Maintenance
For Play Ground/Public Parks

SN	Item of Works	Nos./Qty./Frequency Required
1.	Irrigation	As per requirement
2.	(i) Manuring	Once in a year
	(ii) Fertilization	in winter, in summer and rainy season - as per requirement
3.	Lawn Mowing	
	Summer	Fortnightly
	Winter	Monthly
	Rains	Weekly
4.	Plant Protection	Need Based
5.	Pruning &trimming of Trees	Yearly/Need base with the permission of Forest department as per applicability
	Shrubs Creepers etc.	Yearly/Need base
6.	Cultivation & Weeding	As and when required
7.	Seasonal Plants	
	Summer	Need Based
	Winter	Need Based
	Rains	Need Based
8.	Top dressing with soil & / or manure	Yearly/ As and when required
9.	Repair & replacement of plants	As and when required
10.	Hedges Cutting	
	Summer	Fortnightly
	Winter	Monthly
	Rains	Fortnightly
11.	Ground cover	Need based
12.	Planter Beds	-
13.	Annual plantation under Van Mahotsav/Green Action Drive	Once in a year (in monsoon)

Annexure 7.4
Para 707(5)

Guidelines for Various Provisions To Prepare Annual Maintenance Estimates for Horticulture Works

SN	Item Description	Quantity
1.	Sludge Manure/ Cattle Manure For HORs, GOBs, Type I to VI flats, Samadhis, Offices, Hospitals, Prestigious works, playground etc.	0.003 Cum per sqm. Over the surface i.e. 4000x0.003 per cum=12 cum per acre.
2.	Good Earth: For HORs, GOBs, Type I to VI flats, Samadhis, Offices, hospitals, Prestigious works, playground etc.	0.003 Cum per sqm over the surface i.e. 4000x0.003 per cum=12 cum per acre.
3.	Fertilizer: For HORs, GOBs, Type I to VIII flats, Samadhis, Offices, hospitals, Prestigious works, playground etc.	A) N.P.K. @ 100kgs per acre/year B) Organic Manure, (mixture of manure, Oil cakes, Bone meal, Vermi Compost, Organic Compost, etc. as per specified proportion based on soil test report to be done annually)
4.	Guidelines for Road/Track side plantation Materials required Manure/Sludge/Cow dung Concentrated Organic Manure (Two applications)	@ 5 cum for 100 trees @ 5 cum for 1200 shrubs @ 2 Quintal for 100 trees @ 2 quintals for 200 shrubs
5.	Trees & Shrubs required for mortality replacement 1 st 3 Years of plantation Beyond 3 years of plantation	25% of the total plantation 10% of the total plantation
6.	Replacement of Cement pots	20% of the total pots

Agreement between Railway Administration and State Forest Department for plantation on railway lands

This Agreement made this..... Day of month..... & year..... between the President of Union of India acting through the General Manager (Engineering) of the..... Railway (hereinafter called the Railway Administration which term shall include his successors) of the one part and the Principal Chief Conservator of Forests, (Name of State) (hereinafter called the Forest Department, (Name of State) which term shall include his successors) of the other part.

Whereas the Railway Administration is the absolute owner of the lands situated along the Railway Track and station yards as described in the schedule attached here to as **Annexure A.** (hereinafter called the said land). And whereas on the request of the Railway Administration, the Forest Department, ... has agreed to take over the management of the said land for plantation purposes on the terms and conditions specified hereunder.

Now this agreement witnesses and the parties hereby agree as follows:

1. The Forest Department shall from the day of month & year..... take over the management of the said lands for the purpose of plantations of suitable trees of native as well as commercial species. The said lands shall not be deemed to be or declared as "Protected Forest" or "Reserved Forests" or any other 'Forest' category under Indian Forest Act 1927. However, the said land will be managed in accordance with this agreement as per terms and conditions agreed upon by both the Forest Department and Railway Administration.
2. The cost of plantation including its maintenance and protection will either be borne by the State Forest Department or Railway administration.
3. In case, the entire cost of plantation including maintenance and protection on the said land is borne by the Forest Department, the sharing of proceeds will be as below:
 - (i) 75% of the sale proceeds of timber, firewood, grass and other forest produce on the said lands will be credited to the account of Forest Department and
 - (ii) 25% of all proceeds of sale of harvested timber from the said lands will be credited to the account of Railway Administration.
4. In cases where the entire cost of plantation including its initial maintenance and protection is borne by the Railway Administration, the sale proceeds will be shared as below:
 - i) 75% of the sale proceeds on the said lands will be credited to the account of concerned Railway Administration and.
 - ii) 25% of all sale proceeds will be credited to the account of Forest Department towards their technical support, long term maintenance and for disposal of matured trees i.e. cutting, selling/auctioning, etc.
5. In case where the cost of plantation, maintenance and protection is shared by both the Railway Administration and State Forest Department, the sharing of sale proceeds will be accordance with mutually agreed terms and conditions.
6. Railway Administration through their local authorities and workers will also take care for protection of the plantations and trees, fencing, boundary pillars etc.
7. The Railway Administration may resume the said lands or any part thereof at any time, without payment of any compensation to the Forest Department. A written request for such resumption with justification shall be submitted to the Forest

- Department by the Railway administration. The Forest Department will remove trees from such land or part of land on Railway's request, or will give permission to Railway Administration to remove trees. However, all the proceeds received from such premature removal of trees if any will be retained by the Forest Department to recover the initial cost where the plantations have not attained maturity.
8. All instructions issued by the Railway administration and advisories issued in this matter by the authorities of the Railway Administration regarding track visibility, planting along inside of curves, minimum distance of planting line from the railway track, measure for the safety of track and communication lines shall be strictly followed by the Forest Department while planning the plantation program but choice of species of plant, models of plantation, cultural operations employed in management and protection of plantation and imposition of reasonable restriction of inter cropping on plantation area, grazing, burning of grass etc. will be determined by the Forest Department.
 9. Railway Administration shall hand over the said land to Forest Department free from all encumbrances and encroachments. An inventory of trees already growing on said land shall be jointly taken by Railway and Forest Department at the time of handing over land to Forest Department and these trees will continue to be Railway property. Felling of such trees can be done by Railway in accordance with relevant Rules/Acts applicable if any, in respect of that area. Revenue from same will accrue to Railway only.
 10. Forest Department will adhere to the Indian Railway Act for trespassing of track, entering over Railway platform etc. until mutually agreed between both the Departments.
 11. Forest Department will use the said land made over only for plantation or for a purpose ancillary there to. However, plant nurseries may be developed for developing seedlings for plantations on said land undertaken by the Forest Department. No permanent structure shall, however, be built on such land. Railway reserves the right to their inspection from time to time.
 12. The ownership of the land shall remain vested in the Railway Administration as here to, and only management thereof will be handed over to the Forest Department for plantation purpose. The Forest Department shall exercise its powers in such a way that there is no interference with the management of the Railways.
 13. After raising the plantation, the State Forest Department shall maintain an inventory of all trees on the said land above 30 cm diameter at breast height (DBH) at its own cost according to procedure prescribed in Technical Note and practice followed in the Forest Department. The abstract of the enumerated trees will be supplied to the Railway Administration, on demand, for information and record.
 14. The Railway Administration shall be entitled and permitted to utilize earth for repairs to formation, cut branches of trees and also to execute works required for normal functioning of the Railway in consultation with the concerned Divisional Forest Officer/Forest Ranger from or authority designated to do so by the Forest Department on the said land. The Railway authority shall decide the nature of such works and no compensation shall be paid by the Railway Administration. Any substantial cut/felled material will be handed over to forest department.
 15. The Railway staff would be free to carry out their normal work in connection with maintenance of track and signaling works and they shall not be prevented challenged or arrested while moving above in the performance of their duties on such lands.
 16. The Railway representative i.e. Assistant Divisional Engineer of concerned section (ADEN) shall be empowered to cut/fell/prune any tree/branch perceived to be threat to safety of railway traffic, utilize earth for repairs & execute works required for safe

restoration & safe running of Rail traffic, in consultation with the local authorities of the Forest Department. In case of emergency the Railway representative may undertake emergent work without prior consultation of the local authorities of the Forest Department, however, such action will be intimated within 48 hours by Railway representative, to local authorities of the Forest Department not below the rank of Range Forest Officer for record and collection of cut material.

17. Permits for grazing of cattle on the said land will not be issued but there will be no objection if rights to cut and remove grass and other NTFP are given to persons approved by Forest Department.
18. Forest Department will be competent to deal any damage or loss of plantation/trees by other than railway officials, according to the provision of the Indian Forest Act, 1927, the Bhartiya Nyaya Sanhita (BNS), Bhartiya Nagarik Suraksha Sanhita (BNSS) as applicable and procedure in this regard in the court of law.
19. The Railway Administration or its authorized person, however, may direct and permit and specified area to be included with the scope of plantation under this agreement. All such area shall be demarcated on jointly signed plans, which will be included in the agreement.
20. The agreement will generally be valid for 25 years from the date of handing over the land with review after every ten years. After the expiry of the agreement the same may be renewed with or without amendment in terms and conditions for another 25 years with mutual agreement. If agreement is not renewed and agreement is terminated or terminated before the expiry of agreement period, a joint inventory of trees shall be made at the time of termination of agreement and the sale proceeds will be shared by the Forest Department and the Railway authorities as per the clause 3 & 4 aforesaid. In case of emergency/urgent requirement of the land by Railway Administration, provisions of para-7 shall apply.
21. The parties here to agree that if any dispute and or difference arises between the parties in relation to this Agreement, the same shall be settled as per the extant practice for dispute resolution between two government departments.
22. Forest Department will be given possession of land free from all encumbrances, in case of encroachment on such land, the Railway authorities shall get it vacated and fix boundary pillars before handing over.
23. Co-ordination meeting between Railway and Forest Officers shall be held regularly and periodically at least twice in a year.
24. Forest Department will not be responsible for any damage caused to life and property by the trees on the said land due to an act of God for events outside human control, such as sudden natural disasters, for which no one can be held responsible.
25. This Agreement will be applicable with effect from the date it is signed by both parties.

This agreement signed on by the Authorized Officer of concerned State Government and Concerned Zonal Railway on the day of..... year.....

State Government

Zonal Railway

CHAPTER 8

ACQUISITION, RECORD KEEPING & DISPOSAL OF LAND

A – ACQUISITION & DISPOSAL OF LAND

801 General –

Earlier, land acquisition was being done through “The Land Acquisition Act, 1894”. Later, “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013” was introduced duly repealing “The Land Acquisition Act, 1894”. For expediting land acquisition for Railway Projects, Chapter IVA – “Land Acquisition for a Special Railway Project” is inserted in “The Railways Act, 1989” with effect from 31st day of January, 2008.

- 1) The law regarding acquisition of land is embodied in “The Railways Act, 1989, Chapter-IVA” and “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR Act 2013)”.
- 2) The rules and procedures for acquisition, custody and management of Railway land and disposal of surplus land are contained in the following chapters of the Indian Rlys. Code for the Engg. Dept. (1982 Edition as amended from time to time):
 - Chapter VIII - Rules for the Acquisition of Land
 - Chapter IX - Procedure for the Acquisition of Land
 - Chapter X - The Custody, Management and Disposal of Land
- 3) Acquisition or relinquishment of land proceedings are subject to such special rules and regulations as are issued by the State Governments or Local Bodies from time to time.

802 Ownership of Railway Land –

- 1) The ownership of all land held by the Railway vests in the Central Government. Hence it is the duty of every Railway Administration to preserve unimpaired, the title to all land in its occupation and to keep it free from encroachment. With a view to avoid any litigation, accurate and certified land plans of all railway land should be maintained after carrying out necessary consolidation and mutation, and boundaries adequately demarcated and verified therewith at regular intervals.
- 2) In making land use special care should be taken to see that remains of archaeological and historical interest on Railway land are not affected. Interference with religious edifices, burial grounds and other places or objects which may be considered as sacred should be avoided, unless they come in alignment of line/yard or any new project.
- 3) The rights for quarrying and mining in railway land shall be governed by the provisions contained in the Indian Rlys. Code for the Engg. Dept. (1982 Edition as amended from time to time).

803 Acquisition of Land –

The State Governments frame rules in respect of their States consistent with the Act. The procedure of land acquisition may differ from State to State. The actual practice in vogue in the State may be verified before processing the papers for land acquisition.

Some of the important aspects/principles to be observed while acquiring land are as under-

- 1) While acquiring land for major projects, alignment should be fixed in such a way that minimum extent of agricultural land and dislocation of land owner are involved. Acquisition of private land may be done only when very essential & unavoidable.
- 2) In case of urgency, the application should be made to the Collector for acquisition of land under Section 40 of RFCTLARR Act. As per this Section the land can be occupied on expiry of 30 days after publication of notice under Section 21 of RFCTLARR Act 2013.
- 3) When land is acquired on the bank of a river with the intention of obtaining the rights to the foreshore, it should be made clear, subject to the concurrence of the State Government that the boundary on the river side as indicated in the acquisition plan is the low water line for the time being and that, should the river at any time recede from the bank, accretion to the foreshore shall form part of the land acquired and no additional payment or compensation for such accretion shall be made.

Cases, in which difficulties arise in consequence of a sudden change in the course of a river as distinguished from a gradual process of erosion and accretion, should be dealt with on their merits.

- 4) In the case of any slip or other accident happening or being apprehended to any cutting, embankment or other works, section 14 of the Railways Act 1989 (as amended from time to time) empowers Railway to enter upon any lands adjoining the Railway for the purpose of repairing or preventing the accident and to do all such works as may be necessary for the purpose. Adjoining land should be entered upon only in cases of absolute necessity and to the minimum extent required.

In such cases, a report must be made to the Central Government (Railway Board) within 72 hours of such entry, specifying the reasons which necessitated entry on the land without having obtained previous permission. The compensation shall be as per Section 15 of "The Railways Act 1989" (as amended from time to time).

- 5) It will be in the interest of the Administration if the Assistant Divisional Engineer or Senior Section Engineer / Junior Engineer (Works / P. Way) concerned is deputed to attend award inquiries and also settlement operations in Civil Districts with a view to have proper records of settlement pertaining to the Railway land.
- 6) In special cases, if the State Government so desires, the Railway should deposit in advance an amount determined on the advice of the State Government for the expeditious payment of compensation to the land owners. This amount should be kept as low as possible and should not normally exceed the amount that can be disbursed by the State Government within the financial year in which the deposit is made.
- 7) As the financial justification for a project and its location in a particular place, takes also into consideration the value of the land to be acquired for the project, it is essential to obtain a realistic estimate of the cost of the land from the land revenue authorities at the time of preparation of the estimate.
- 8) For acquisition of forest land, the procedure laid down in Paras 857 and 858 of the

- Indian Railways Code for the Engg. Dept. (1982 Edition as amended from time to time) should be followed.
- 9) While acquiring land for quarrying purposes, it should be ensured that the State Government does not insert such declaration as could deny quarrying rights to the Railway.
 - 10) Wherever the portion of land required for linear connectivity of Gati Shakti Multi-Modal Cargo Terminal (GCT) with the serving Railway station for GCTs being developed on non-railway land, such land may be acquired by Railway Administration on the specific request of applicant / GCTO (Gati Shakti Multi-Modal Cargo Terminal Operator) and at the cost of the applicant / GCTO, under 'The Right to Fair Compensation And Transparency In Land Acquisition, Rehabilitation And Resettlement Act, 2013 (RFCTLARR Act 2013)' / 'The Railways Act 1989'.
 - 11) Provisions regarding land acquisition as described in Para 816 to 850 of Indian Railways Code for the Engg. Dept. (1982 Edition as amended from time to time) to be followed.
 - 12) To enable the revenue authorities to take action for the acquisition of land required for railway purposes, it is necessary that proper plans should be made for reference.
 - 13) Railway Administration should ensure for certification of land plans by the Revenue Authorities for the land acquired.
 - 14) Railways have to scrupulously complete all the formalities related to land acquisition i.e. mutation of land and completion of land records for the acquired land for railway projects in favour of Railways so as to ascertain the ownership of the land vests with Railways.

804 Relinquishment and Exchange of Railway Land –

1) Relinquishment of Railway Land

- a) When it has been decided that a certain area of land is no longer required for Railway purposes and is eligible for relinquishment, action should be taken as detailed in Para 1035 to 1044 of Indian Railways Code for the Engg. Dept. (1982 Edition as amended from time to time). The Powers of relinquishment of railway land shall vests with Railway Board only.
- b) When Railway land is relinquished, possession of the land should not be given until the price for the land has been paid. Possession should be handed over jointly by the representatives of the Railway and the State Government to the purchaser if the purchaser is not a Government Department / Public Sector Undertaking.
- c) When State Governments, in arranging disposal of surplus Railway land, decide to sell it by public auction, a minimum upset or reserve-price should be fixed along with such other terms, as will be beneficial to the Railway Administration with their consultation. The auction should take place in the presence of a responsible railway representative. All papers and plans prepared by the civil authorities before the auction should be carefully scrutinized to ensure that the description of the land being sold is correct and that no easements are allowed

over adjoining land remaining in the possession of the Railway.

- d) The amount payable by the Central Government or the State Government for lands relinquished by the Railway will in all cases be their market value at the time of transfer and not the original value paid on their acquisition by the Railway.
- e) Vide Para 1042 of the Indian Rlys. Code for Engg. Dept. (1982 Edition as amended from time to time) in cases where Railway land is transferred to a State Government and where the capitalized value of the land revenue had been paid to the Local Government on acquisition, the amount payable by the State Government for the land should include the refund of the capitalized value. In the case of land disposed of to private parties, the refund of the capitalized value of land revenue by the State Government will not however be necessary.
- f) In all other cases, land will be disposed off at the highest offer and also if that is considered reasonable.

2) Exchange of Railway land -

- a) A Railway Administration may exchange railway land with equitable value of land of Govt Departments / State Govts / Public Sector Undertakings / Local Bodies. The sale value of the land on exchange basis should be market value prevailing at the time of actual exchange of land.
- b) General Managers have been delegated powers for approval of exchange of Railway land with land of Government departments / State Govts / Local bodies / PSUs having value up to Rs.25 Lakhs (amended from time to time), with the concurrence of PFA.

In case of land value being exchanged is more than Rs. 25 Lakhs (amended from time to time), Railway Board's approval is to be obtained.

- c) Railway Administration has to make following certifications while obtaining approval of any land exchange proposals:
 - i) "Railway land being exchanged with Govt department / State Govt / PSUs / Local Bodies is not required for Railways developmental purpose".
 - ii) The land being taken over by Railways from Govt department / State Govt / PSUs / Local Bodies is required for Railway's own purposes and is free from encumbrance.

805 Outstanding Cases of Acquisition and Relinquishment / Exchange of Land-

Half yearly lists of outstanding cases of acquisition and relinquishment / exchange of land should be prepared by the Division, district wise and state wise. These should be sent to concerned collectors for necessary action with copies sent to the Principal Chief Engineer for information and record.

B - LAND RECORDS, DEMARCATION AND VERIFICATION OF RAILWAY BOUNDARIES

806 Land Records in Principal C.E.'s Office –

- 1) As per Para 850 of Indian Railways Code for the Engg. Dept. (1982 Edition, as amended from time to time) a complete series of land plans for the entire Railway should be maintained in the Principal Chief Engineer's office. The original tracings that are duly certified by the State Governments should be kept as permanent records in the Principal C.E.'s office. Sufficient copies of certified plans after carrying out necessary consolidation and mutation should be made out and supplied to the Division for reference, a copy being kept in the cover of each relevant file.

No noting should be made on certified plans and declarations nor on important letters from the State Governments in connection with acquisition / relinquishment / exchange of land as these may, at times, be required in a Court of Law to prove the Railway's title.

- 2) Land Records Registers should be maintained in the Principal Chief Engineer's office as per the following Proforma (Table 8.1.) in which all details of transactions both acquisition and relinquishment/exchange should be noted.

Table 8.1.

LAND RECORDS REGISTER				
Division	Railway		Section	
Engg.Divn	Land Plan No.	Station or Kilometrage	Description	Area (in hectares)
(1)	(2)	(3)	(4)	(5)
Cost of Land Acquisition / relinquishment / Exchange	Reference to correspondence	Govt. Resolutions & date of sanctioning the transfer of land	Date of consolidation / mutation with Revenue authorities	Remarks
(6)	(7)	(8)	(9)	(10)

- 3) During consolidation and settlement operations that take place after certain intervals, re-survey of all the villages is carried out by concerned Revenue authorities. During these operations, the shape of the Railway land plans and the total land area available with the Railways may get obliterated in Revenue records. It would, therefore, be necessary that whenever such operations take place, the concerned SSEs / JEs (Works/P. Way) keep a track of such operations to ensure that Railway's land is kept intact in Revenue records. In fulfilling this responsibility, the Divisions may take suitable assistance from the Land Cell of the Principal Chief Engineer's office.

4) **Preservation of Land Records -**

- a) **Micro-filming** - All certified land plans shall be transferred as micro-films, and also other advance techniques may be used for preservation. Requisite sets of which can be kept in safe custody both in Headquarters Office and also in the Divisional Offices. These micro-films, however cannot replace or reduce the need for original tracings signed by Railway administration and Civil authorities but would help in taking prints of land plans in case original tracings are

lost/mutilated and in keeping copies with SSEs/ ADENs / DENs.

- b) **Digitization** – All the Land plans along with relevant records should be converted to non-editable digitized form or other advance techniques and shall be uploaded in TMS Portal.

807 Land Records in Divisional/Executive Engineer's Office –

- 1) Divisional/Executive Engineer shall be responsible to ensure that records of title are carefully preserved and kept up to date by noting all changes on the copies of authorized land plans in their possession. All land plans should show complete dimensions preferably with boundary stones and their numbers.
- 2) Land Records Registers as per Para 806(2) should be continued to be maintained in the Divisional/Executive Engineer's office in addition to digital land records.

Entries in the Land Register should be duly initialed by the Divisional/ Executive Engineer's, as and when any transaction takes place.

- 3) After land acquisition proceedings are completed, the original papers viz. the notifications, awards, certificates of handing over and taking over of land, final land plan and schedule signed by the Revenue Authorities should be separately bound together and carefully preserved. These documents should be kept in the custody of the SSE/ JE (Drawing) of the Drawing office and these records should be properly handed over whenever there is a change in the incumbent of the post.
- 4) The last stage in the process of land acquisition is the mutation entry in the Revenue records. It is, therefore, necessary that such mutation entries are completed as early as possible in a sustained follow-up of the land acquisition process. Unless and until the mutation of the land, which has been acquired, has been done, a quarterly report thereon should continue to be sent to the Principal Chief Engineer's office. This point should also be checked by the Open line Engineers while taking over complete stretches of new construction, involving land acquisition, from the Construction Branch.
- 5) Final land plans, after mutation entries are carried out, should be sent to the Principal Chief Engineer's office for safe custody and record. Copies of final land plans should be made and kept in the Divisional and field offices for use of DENs, ADENs, and SSEs / JEs (Works/P.Way).
- 6) In case of Construction Projects involving land acquisition, it will be the responsibility of the Construction Engineers to hand over the land acquired, free of all encroachments and along with all records specified below to the Open Line Engineers:
 - a) Land Records Register (Table 8.1) duly filled in; and
 - b) In case of land acquired by Construction Organization, after land acquisition proceedings are completed, following records should be handed over to Open Line in original in bound registers:

- i) Indent for acquisition of land for Railways as submitted to Revenue authority
- ii) Land plan duly certified by the Revenue authorities showing details of Mutation
- iii) Notification
- iv) Declaration
- v) Attested copy of Mutation
- vi) Shajra duly verified
- vii) Copy of Awards
- viii) Taking / handing over note for land possession (between Railways & State Govt Revenue officials)

In addition to above, corresponding additional documents as per "Railway Act 1989" or as per "The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR Act, 2013)" also to be included.

These documents must be handed over duly pasted in machine numbered registers. Each register should have index in beginning, showing the details of documents pasted in the register. The first register containing land documents for a project should be numbered as land - 1/x and subsequent registers may be numbered as land - 2/x land - 3/x etc. where x is the total number of registers.

Above documents should be prepared in five copies (1 original + 4 copies), to be distributed as under-

- i) Original to Open Line HQ
 - ii) One copy to Divisional HQ
 - iii) One copy to SSE / JE (Works) Open Line
 - iv) One copy to Construction HQ
 - v) One copy to be retained by Construction Field Unit.
- 7) In case of land acquired by Open line or Gati Shakti Unit (GSU) also, the above-mentioned provisions shall be ensured.
- 8) Digitization -All the Land plans along with relevant records should be converted to non-editable digitized form or other advance form and shall be uploaded in IR-TMS portal.

808 Demarcation of Land Boundaries –

For proper demarcation of land boundaries, Para 1047 of the Indian Rlys. Code for the Engg. Dept. (1982 Edition, as amended from time to time) provides as under:

- 1) All land permanently occupied for the purposes of Railway, shall have its boundaries defined on the ground in such a manner as to enable such boundaries to be readily ascertained and identified.
- 2) For this purpose, the boundary of the railway land may be defined by a continuous wall, fence or ditch or by detached marks, posts or pillars.
- 3) Where the boundary mark is continuous, the boundary of the Railway land is to be on the outer edge of the wall, fence or ditch, that is to say, the wall, fence or ditch will be

situated wholly on Railway land.

- 4) Where detached marks, such as isolated posts or pillars are used the boundary of the Railway land will pass along the outside of such posts and pillars. Between marks, the boundary shall in each case be taken in a straight line from the outside of one mark to the outside of the next mark.
- 5) Detached marks should, in no case be at a greater distance apart (centre to centre) than 50 (fifty) meters. They should be of a substantial character, not easily destroyed or moved by accident or mischief, and of such size and form as can be readily found and recognized.
- 6) Where there is a change in land boundary line or possibility of displacement of boundary post by mischief, additional boundary posts may be installed.
- 7) Each detached boundary mark should bear a number. The position and number of each detached boundary mark should be shown on the land plan.
- 8) Where a fence, wall or ditch is situated at some distance within the boundary and does not mark the actual limit of the railway land, it will be necessary (in addition to such fence, wall or ditch) to have the actual boundary of the Railway land properly marked and defined in accordance with these rules.

809 Boundary Stones –

- 1) The boundary stones may be of suitable size and section, projecting about 500 mm above ground and inscribed with letters e.g. “IR” for Indian Railways (IR) and the number in black below, the stones being colour washed white, red or yellow to suit local conditions. The stones should be fixed squarely, the outside face representing the boundary with the letters and number facing the railway line. The boundary stone may be serially numbered 1,3,5 and so on in ascending order of Kilometrage on one side, on the opposite side being numbered 2,4,6 and so on, the number starting from a kilometer post and ending at the next kilometer post where the numbers should begin afresh. The boundary stones should be kept clear from jungle growth or shrubs for at least 1 metre all round within the Railway limits.
- 2) Boundary stones should be fixed at every point of change of alignment. In hilly areas and for sharp curves, each stone should be so placed that it can be observed from the adjoining stone on either side.

810 Boundary Pillars on Banks of Rivers –

High boundary pillars on each bank of rivers or important waterways crossed by Railway bridges should be erected so as to prevent and control encroachments. Land within this boundary should never be surrendered.

811 Measures to prevent Trespassing –

1) Construction of boundary wall in areas having habitation

- a) In areas having habitation bordering railway land and also where habitation is likely in near future, boundary walls should be provided, so that potential encroachments

are prevented and outsiders do not develop any right of entry on railway land. Boundary walls are an operational necessity in such situations, so as to prevent trespassing, cattle being run over by trains, use of railway tracks for easing etc. and theft of P. Way fittings and other railway materials. It is also necessary for boundary walls to be extended right from the Station outwards along the tracks of vulnerable locations within towns so that outsiders do not find an easy access to the Stations.

- b) Boundary wall and fencing should invariably be erected in places where land is vulnerable to encroachment or costly. Chief Engineer will be the authority for deciding the nature of boundary structure (fencing or tree row or continuous wall or ditch etc.) for each area based on cost and vulnerability of land.

2) Fencing as a rule, should be provided at the following locations

- a) For specified lengths on either side of level crossings, so as to prevent trespassing when the gates are closed;
- b) Around busy station yards for 30m width on either side;
- c) In municipal limits and notified-area limits and in proximity to villages or such localities where huts or houses are close to railway line.
- d) For protection of railway land from encroachments. Pucca boundary walls may be constructed in urban areas to prevent encroachment. In metros/major cities, RCC boundary walls may be provided.

3) Other preventive steps as

- a) Land boundary verification in vulnerable areas.
- b) Plantation such as bamboo /Juli Flora or similarly effective bushes in the area.
- c) Provision of boundary pillars and ensuring proper maintenance of boundary pillar.
- d) Preventing unauthorized entry of road vehicles into railway land threatening side collision with trains, through Plantation/fencing should be done. At the vulnerable location pedestrian subway should be provided if possible.
- e) Construction of structures and unauthorized hutments obstructing the visibility to road users at the unmanned level crossings should not be permitted.
- f) Seeking assistance of RPF / GRP / local authorities for prevention of encroachments in these areas.
- g) Regular / Joint inspections of the vulnerable locations shall be done by representatives of concerned departments along with civil authorities (wherever required) in preventing encroachments.

4) Safety fencing along the track with speed more than 110 Kmph -

- a) Need based fencing to be provided along the track for the speed above 110 Kmph and upto 130 Kmph.
- b) Safety fencing along the track for high-speed routes and sectional speed >130 Kmph is the mandatory minimum requirement. This safety fencing need not necessarily be at the land boundary as the purpose of these fencing is to stop

cattle crossing and unauthorized trespass of motorcycles etc.

The following options available for providing safety fencing:

- i) NHAI anti crash barrier type
- ii) Fencing made of seasoned and Creosote oil treated bamboos coated with HDPE.
- iii) Fixed Knots Fence made from high tensile steel wire coated with Bezinal 2000.
- iv) Fencing using weld mesh
- v) Composite reinforced UPVC fencing.

The above options are not exhaustive, as many new products and technologies are evolving. Hence, Zonal Railways should select suitable type of fencing based on the requirements of the particular section. However, it should be ensured that the fencing provided should prevent cattle and vehicle entry on the track.

812 Land Plans –

- 1) Up to date land plans should be available in the Zonal Railway H.Q. office, Divisional Offices and copies should be made available to the Field Engineers.
- 2) In case of acquisition of Railway land is involved in addition to the existing railway land, for doubling / tripling / quadrupling, gauge conversion, etc., land plan should be prepared duly indicating the following:
 - a) Existing railway land boundary details with land schedule (as per the existing land plan certified by Revenue Authorities).
 - b) New railway boundary details with land schedule of the additional land acquired.

This avoids confusion of correlating land boundary details, in case of more number of land plans available at a particular stretch and having only one land for a particular stretch.

- 3) All land plans should be properly mapped duly indicating railway boundaries and certified by the Revenue Authorities. All certified land plans in digitalized forms and also AUTO-CAD copies of plans uploaded on IR-TMS. This portal should be accessible to concerned SSEs / JEs.
- 4) Copies of certified land plans pertaining to their jurisdictions showing complete dimensions, should be in the possession of the Assistant Divisional Engineers, SSE / JE (Works / P. Way).

Every SSE / JE (Works / P. Way) will maintain a land record as per Para 806(2) for their jurisdiction. From time to time all entries in the Register shall be made up-to-date. Land holding details should also be updated in Indian Railways – Land Asset Management System (IR-LAMS) portal. Land Records Register should be checked annually by ADEN/DEN/Sr.DEN and observations recorded on them should be followed by SSE / JE (Works/P. Way). During inspections of higher officers, the register will be kept by the ADEN with him.

- 5) Provisions regarding land plans, as described in Para 837 to 850 of Indian Railways Code for the Engg. Dept. (1982 Edition as amended from time to time) to be followed.

813 Verification of Land Boundaries and Encroachments –

- 1) As per Para 1048 of the Indian Railway Code for the Engg. Dept. (1982 Edition as amended from time to time), every Zonal Railway Administration is responsible for the demarcation and periodical verification of the boundaries and maintenance of proper records in connection with land in the possession of that Railway.
- 2) The SSE / JE (Works/P. Way) is responsible for maintaining railway land within the jurisdictions defined in paras hereinafter, without any encroachments or development of easement rights. He should prevent and remove encroachments, as and when these arise and where removal of encroachment is possible without taking recourse to PPE act. Particular care is required to prevent encroachment on railway land situated above tunnels and below bridges especially Road over/Under bridges.

In cases where the SSE / JE (Works/P. Way), Station Master, Chief Goods Clerk, Carriage & Wagon Inspector, RPF Inspector, and other concerned Inspectors are not able to remove the encroachments on railway land within their respective areas of responsibility as defined in Para 815 hereinafter, they should report the case to the Assistant Divisional Engineer / Divisional Engineer / Divisional Commercial Manager / Senior Divisional Engineer / Senior Divisional Commercial Manager and concerned Departmental officer in charge (in case of workshop/sheds) / Divisional Security Commissioner as well as the Superintendent of Police / Divisional Commissioner, and other Civil authorities verbally as well as in writing for further action.

- 3) SSE/JE (P. Way) shall inspect and maintain the Railway Land boundaries including way side stations in his entire jurisdiction. SSE/JE (Works) shall inspect and maintain the land boundaries in his entire jurisdiction viz. staff colonies and locations of all other Railway Installations including land boundaries within station limits for all major and important stations. Inspection schedule shall be as per **Annexure 1.1**.

Regarding demarcation/jurisdiction in approaches of Major & Important stations, decision of Divisional Engineer shall be final.

4) **Maintenance of land boundaries verification Register-**

Railways should maintain printed registers on the lines of Bridge Registers as at **Annexure 8.1 (a) & (b)** in the attached format showing “Details of Encroachments” and “Details of the Missing Boundary Stones” and action taken thereon. The entries in the register should be certified by the SSE/ JE/ (Works/P. Way) of the respective sections and verified/inspected by the Asst. Divisional Engineer/DEN/Sr.DEN or other higher officers from time to time. The registers should have adequate pages so that record of inspection and verification of land boundaries for a period of 15 years can be accommodated in the register. Separate registers should be maintained for each SSE / JE (Works/P. Way)’s jurisdiction.

A certificate on the following Proforma should be given by the SSE/ JE once a year which is to be verified and counter-signed by ADEN with regard to correct demarcation of land boundaries.

Land Boundaries Verification Certificate

Year ----- Section----- Kms. --- to-----

SSE/ JE (P. way/Works) ----- SubDivision----- Division-----

I, -----SSE / JE (P. Way/Works) certify that I have inspected the railway land fencings and boundary stones on my section during the year ending -----and that they are in accordance with certified the/land plans. There have been no encroachments except at the following Kilometrages that have been reported upon vide reference given against each.

Details of encroachments

Station premises/ colony/ mid-section	Location		Rly employee/ Outside persons/ others	Soft/ hard	Area in sqm
	KM/ Station (from-to)	Reference to encroachment plan			
1	2	3	4	5	6

Value of land approx.		Approx. Period since encroachment existing	Purpose: Personal/ Commercial/ Religious/ Social/ other	Action taken to remove	Remarks
Value	Basic market rate/ notified rate/ Rough assessment				
7	8	9	10	11	12

I further certify that wire fencing and/or boundary stones are available at all locations except at the Kilometrages shown below for which action to replace the same is indicated against each location.

Details of missing boundary stones

Date of inspection	Location	Description of missing boundary stones		Action taken	Initials of inspecting Officers	Remarks
		Km	Boundary stone No.			
1	2	3	4	5	6	7

1. I certify that railway boundaries are demarcated correctly and that there are no encroachments, except those listed above.

2. Certified that land plans pertaining to the above mentioned SSE/ JE (P. Way/Works) -----are available with him except the following.

Asst. Divisional Engineer/

DEN/Sr. DEN/

Chief Engineer/General

5) During his inspections, the Assistant Divisional Engineer should ensure that Railway boundaries are demarcated correctly and that there are no encroachments. In cases where he cannot prevail on the parties to remove the encroachments, he must report the facts with particulars to the Divisional Engineer who will take up the matter with local authorities.

814 Prevention and Removal of Encroachments –

- 1) New encroachments shall be got removed promptly under provisions of section 147 of Railway Act 1989. For old encroachments where party is not amenable to persuasion for removal of such encroachments, action should be taken under the provisions of Public Premises (Eviction of Unauthorized Occupants) Act 1971. Encroachment of railway land by railway staff also constitutes grave misconduct on their part and is 'good and sufficient reason' for imposition of major penalty after following the procedure laid down in the Discipline and Appeal Rules.
- 2) When an encroachment is in the process of building up, it should be removed by concerned supervisor (Station Master, Chief Goods Clerk, RPF Inspector, and other Section Engineers/Jr. Engineers as per Para 815 of the Manual) then and there without / with the help of RPF as the case may be.

If required, help of Civil and Police officers of the district(directly or through ADEN/DEN) in writing as well as by personal contacts without loss of time to ensure that the new encroachment is not allowed to come.

Headquarters Office should also be contacted without loss of time if necessary.

The SSE/JE(P. Way/Works)/SSEs /JEs of Workshop concerned/Station Master/Chief Goods Clerk will call on the gangmen, khalasis or outsourced labor & machinery to dismantle and remove the encroachment as soon as noticed. If during such process of removal of the encroachment the official(s) as stated above is (are) threatened, an FIR should be lodged with the RPF and simultaneously assistance of RPF Inspector be sought. The RPF Inspector will provide the manpower and other required assistance to the officials for immediate removal of the encroachments, and simultaneously lodge FIR with GRP, Civil Police as the case may be.

Senior officers of the Divisions as mentioned above should guide the subordinate officials in doing their best to deal with the situation. Simultaneously, if the ground situation so requires the senior officers should contact their counterparts of similar rank/authority in the Civil and Police Departments of the State Govt. and seek their help to deal with the situation. The senior officers of the Division should also contact the concerned officers in the Headquarters and seek their intervention in the matter as necessary.

The officers in the Headquarters should contact their counterparts in the Civil and Police Depts. of the State Govt. and request that required civil assistance be made available by them to the Railway officials.

As specified above, a well-coordinated effort should be made by officers/officials of different capacities and jurisdiction to achieve the ultimate objective that the encroachments are removed / dismantled within the shortest possible time.

- 3) Where the encroachments are of a temporary nature in the shape of jhuggies, jhopries and squatters and where it may be difficult to take action under PPE Act the same may be got removed in consultation and with the assistance of local civil authorities.
- 4) Every year, at the close of financial year, detailed survey of encroachments must be made under the following categories:

- a) CATEGORY - A) Encroachments by outsiders removal of which requires action under Public Premises Eviction (PPE) Act.
- b) CATEGORY - B) Encroachments by outsiders which do not require action under PPE Act (e.g. temporary occupation of land by hawkers, using Railway land for cattle, cow dung, refuse etc.)
- c) CATEGORY- C) Encroachment by Railway staff in the form of temporary huts etc.
- d) CATEGORY - D) Encroachment by Railway staff who have been allotted railway accommodation, by way of additions to the structures, unauthorized use of land for cultivation etc.

Note: Category "A" encroachment is of the hard type and Category "B", "C" & "D" encroachments are of the soft types.

- 5) The SSE / JE (Works/P. Way) should maintain details of encroachments in a register showing their incidence and removal with necessary details as given in **Annexure 8.2** (Encroachment Inspection Register).

One page of this register shall be allotted to each encroachment. A scale plan of the encroachment shall be provided on the facing side.

Once a case is opened the entries should not be discontinued unless and until the encroachment is removed. A note to that effect should be made in the register.

The frequency of inspection of encroachment shall be as per Annexure 1.1.

SSE / JE (Works/P. Way) shall give a certificate in the following Proforma, once in three months which shall be verified and countersigned by the ADEN.

"I....., SSE / JE (Works/P. Way) certify that I have inspected the Railway land in my section during the quarter ending and there have been no encroachments except at the locations shown in this register, that have been reported upon vide references given against each."

sd/-

SSE / JE (Works/P. Way)

ADEN should submit every month the summary of the status of removal of encroachments to the Divisional Engineer.

Monthly progress regarding additions and removal of encroachments, filing eviction cases and their progress in court of Estate Officer, in Civil Courts etc. should be submitted by Divisions to Head Quarter.

Modules on "Encroachment Master" and "Encroachment Inspection Register" in IR-LAMS (Indian Railways – Land Asset Management System) portal are developed for online updating and monitoring of the encroachment details.

Custodians of railway land i.e SSE/ JE (Works/P. way) have to upload the complete details of all encroachments in their jurisdiction, in IR-LAMS portal and

quarterly inspections of the encroachment by the concerned custodians i.e. SSE/ JE (Works/P. way) should be carried out through “Encroachment Inspection Module” of IR-LAMS portal so that online details of encroachments and their removal is readily available to Railway Administration.

Encroachment plans to scale shall be made for every encroachment. These encroachment plans along with details of encroachment as per **Annexure 8.2** should be checked and signed by SSE/ JE (Works/P. way)/ ADEN. Records of such encroachment plans should be kept in the Divisional office and these encroachment plans should be handed over and taken over by SSE / JE (Works/P. way)/ADENs at the time of change of charge.

A copy of encroachment plan should be available with SSE/ JE (Works/P. way) / ADEN / DEN / Sr. DEN. Any encroachment added or removed should be reflected in the encroachment plan.

A copy of encroachment plan should be handed over by the SSE / JE (Works/P. Way) to SMs/ RPF Inspectors/Workshops Supervisors in charge etc.

6) Steps to control the unauthorized use of Railway land.

Following further steps should be adopted to control the unauthorized use of railway land:

- i) For any addition/alteration of a pucca structure, written sanction of the Divisional Engineer should be necessary. Any structure in which cement / Stone / Bricks / Steel / Timber / any other material which cannot be broken into easily is used may be classified as pucca structure.
- ii) For alteration /addition of any temporary structure, written sanction of ADEN should be necessary.
- iii) Plans for commercial plots at various stations should be approved jointly by Divisional Engineering and Commercial Officers and at site demarcation of the plots should be done with rail posts by Engineering Department. Whenever any commercial plot is licensed, the Commercial Department should give a copy of the allotment letter to the Engineering Dept. so that SSE / JE (Works) can ensure against any unauthorized use. The Station Master should also have a copy of the approved plan of commercial plots at the Station. Station staff, including Commercial staff posted in Goods Sheds should firstly ensure that commercial plots are not misused and secondly, in case of any misuse and/or encroachment should immediately report it to the Engineering Dept. for eviction and other action that may be necessary. This will also apply to the cases of any licensing for shops, tehbazari etc. in the circulating area and goods shed premises.
- iv) To prevent imminent encroachments on vacant railway land, planting of suitable trees/ shrubs including quick growing thorny trees like Prosopis Juliflora (Vilayati Babul) should be adopted.

If the place is affected by recurring encroachment, plantation may be done immediately after removal of encroachments, and the area shall be fenced by barbed wire.

- v) Proper maintenance of land boundary is the first and effective step towards prevention of encroachment.
- 7) Eviction process shall include inter alia:
 - i) Identification of the existing encroachments.
 - ii) Ensuring that all the cases under the PPE Act have been filed.
 - iii) Estate Officers should expedite finalization of the cases pending with them.
 - iv) Action for possession in accordance with the extant orders where eviction orders are received.
 - v) Mobilization of help of Civil Authorities by formal/informal requests at different levels till the required assistance is forthcoming.
 - vi) Cases directed to the courts to be pursued for early finalization with the help of the Railway Advocates.

815 Division of Responsibility –

The following division of responsibility between the station staff and the engineering staff should be observed in regard to encroachments within the station areas:

- 1) At stations, the Station Master, jointly with nominated/senior RPF Inspector, will be responsible for preventing encroachments and for driving out trespassers by obtaining help also from RPF, Police and SSE / JE (Works/P. Way) as necessary.
- 2) In the goods shed, the Chief Goods Clerk wherever available and at other places the Station Master, jointly with RPF inspector, will be responsible for preventing encroachments and for driving out trespassers also with the help of RPF/Police and SSE / JE (Works/P. way) as necessary.
- 3) The responsibility for preventing encroachments and for driving out trespassers in circulating areas of the stations and goods sheds will rest with the 'Station Manager/Station Master/SS/CGC for their respective areas. They can take the assistance from Engineering and RPF staff / Police, as may be found necessary.
- 4) At station, where SSE / JE (Works) is not posted, but Inspector/RPF is there, then the Inspector/RPF is responsible for checking fresh encroachments.
- 5) In / around loco sheds / workshops, concerned (nominated) departmental SSEs / JEs (e.g. SSE / JE (C&W) for coach manufacture depots etc.) of loco shed / of the Department to which the workshop belongs, along with RPF Inspector shall be jointly responsible.
- 6) The responsibility of preventing encroachments within / around the colony premises lies with the concerned SSE / JE (Works) jointly with concerned RPF Inspector and Senior most RPF official at that Station where no RPF Inspector is posted.
- 7) The responsibility of preventing encroachments in between Stations lies with the concerned SSE / JE (Works / P. Way) and RPF official.
- 8) The responsibility of preventing encroachments in / around carriage & wagon

depots lies with nominated SSE / JE of the depot and RPF official.

- 9) While instructions contained in this Para (a) to (g) would generally apply, it would be desirable to nominate Traffic, Commercial, Engineering officials as in-charges of specified areas at medium and large sized stations to keep a watch on encroachments and take appropriate action for immediate removal.
- 10) Whenever encroachments are taken up under PPE Act, the concerned officials from Engineering (including workshops Supervisors), Commercial, Traffic or Security departments, as the case may be, would act as the Presenting Officer, and proactively help in expeditious finalization of the proceedings. Adequate training may be provided by IRICEN/Pune and in National Academy of Indian Railways (NAIR), Vadodara to the Estate Officers to make them well conversant with the provisions of the PPE Act, 1971 and also various avenues available to them while dealing with cases of encroachments. Course contents may include case histories and various relevant court judgments on the appeals against the orders of Estate Officers.
- 11) RPF should play a proactive role in removal of soft encroachments as and when existence of such encroachments is brought to their notice. They should also provide assistance in co-operation with State Police/GRP where cases have been decided by the Estate Officers.

A) Action to be taken while handing/taking over of charge by SSEs / JEs –

- a) A joint field check on the existing encroachments will be mandatory part of the Handing over/Taking over of the SSE / JE (Works/P. Way) s' charge. This should be followed by a joint signing at the end of the Encroachments Register on the number of encroachments in the jurisdiction. The fact that these steps have been completed should be an item required to be specifically mentioned in the Handing over Note of the outgoing SSE/ JE. Similar procedure should be followed by the concerned officials from Commercial, Traffic, Mechanical, Electrical, and Security departments.
- b) In the event of fresh encroachments having taken place being noticed at the stage of handing over of charge, and which were not specifically brought out in writing to the notice of the officers/authorities as specified in paragraph 814 (2) suitable adverse entries shall be made in the Confidential Records of the official(s) concerned, and he(they) will also be liable for DAR action.

B) Liability for D&AR action –

It is imperative on the part of concerned Branch officer that for any new encroachments that come up on railway land, officials responsible for safeguarding the railway land are taken up under Railway Servants(D&A) Rules.

816 Railway Land in Important Metropolitan & Commercial Cities –

In all such cities where the cost of land is very high, special staff including RPF should be deputed to deal with the encroachments and its removal. This batch of staff will be jointly responsible to ensure that no further encroachment of Railway land takes place. They will immediately remove the encroachments to avoid any development of the same. In case

of non-removal, due to certain unavoidable reasons, they will lodge FIR with GRP/Civil police and report the encroachments with copy of encroachment plan, FIR etc. to the Divisional Engineer/Sr. Divisional Engineer who will initiate action for removal of encroachment and keep headquarters informed. Assistance of RPF should be enlisted when dealing with the Civil Police.

817 Maintenance of Right of Way –

- 1) The Assistant Divisional Engineers and SSEs / JEs (Works) shall see that the rights of way across Railway land are not allowed to be infringed upon.

Prompt action should be taken to prevent any person obtaining squatter's rights on railway property.

- 2) So as to assert the right of ownership as against any public claim of way, roads and authorized passage across Railway land over which the public have no right of way, should be closed for one day of 24 hours every year. This should be done during the date or dates approved, if necessary, by the local authorities. Necessary reports should be sent by the SSEs / JEs to their Assistant Divisional Engineers after the procedure is observed, with details of station yards and Kilometrages. A notice of at least a fortnight should be given to the public of such closure. These notices may be fixed in some conspicuous place in the villages or towns where such passages exist, for the information of the public. In case of important roads such notices should be published in the local newspapers.

818 Religious Structures –

- 1) There is a total ban on licensing land for religious purposes. The Zonal Railways will ensure that no requests for further licensing of Railway land for religious purposes are entertained by them.
- 2) In regard to existing licenses for prayer platforms, shrines, temples, mosques, graves and tombs etc. on Railway land, the Assistant Divisional Engineers should maintain registers showing therein full particulars of the extent of each structure. The Religious Structures Registers should contain details of the locations, description of construction, extent of land on which the structures are located, history of the structure, reference to plans, community by which it is regarded as sacred and with whom dealings should be made. The principles enunciated in Para (1) should be complied and suitable control of Railways should be ensured through Agreement and Plans. The management should be by a committee consisting of railway employees.

The SSEs/ JEs should keep a constant look-out for un-authorized extension of existing structures or construction of new structures and report such occurrences at once to the Assistant Divisional Engineer. Inspection schedule of such structures shall be as per **Annexure- 1.1**.

- 3) In case unauthorized extensions or new constructions are noticed, it should be possible for the Assistant Divisional Engineer and Staff to persuade those concerned, to desist from further construction. If required the Assistant Divisional Engineer should report immediately to the Divisional Engineer who will then ask the Department concerned to take requisite measures. When this stage is reached, the matter should

be reported by the Divisional Engineer to the Principal Chief Engineer. It would be desirable to inform District authorities about such instances promptly and impress upon them the need for removal of such additions to old structures or new constructions. In unavoidable circumstances, only individual cases may be referred to the Railway Board for regularization of the encroachments.

- 4) Licensing of the area or regularization of the religious structures may be limited to maximum of 500 sq. metre in each individual case.
- 5) Nominal license fee fixed for the purpose will be charged in respect of religious and welfare organizations, as decided by railway administration from time to time.

C - MANAGEMENT OF LAND

819 Basic Principles –

The basic principles of management of Railway land are contained in paras 1008 to 1034 of the Indian Railways Code for the Engg. Dept. (1982 Edition-as amended from time to time).

All leases, licenses and way leave permissions should be covered by agreements in the approved form.

Railway land is given out on lease as well as license basis for activities connected with Railway working and activities which promote Railway's cargo service. Railway land also given on lease for infrastructure activities of Government bodies/Departments for their own use.

- 1) To enable integrated development of infrastructure aligned with PM Gati Shakti framework and to attract more cargo to rail, "Master Circular on Policy for Management of Railway land" has been issued by Railway Board vide Letter No. 2021/LML/25/5 dt. 04.10.2022. This policy shall be applicable for grant of lease / license / way leave permissions.
- 2) **Permitted uses of Railway land under this Master Circular -**
 - a) **General:** All activities connected with railway working and activities which will promote Railway's cargo service shall be permitted.
 - b) **Cargo Terminals:** Cargo Terminals shall be permitted in accordance with the extant Gati Shakti Cargo Terminal Policy issued by Ministry of Railways vide Letter No. 2021/TC(FM)/18/23 dt. 15.12.2021 as amended from time to time.
 - c) **Cargo related facilities:** All activities which use railways as a mode of transport for at least one direction of movement, e.g. warehouses, storage facilities, silos, tanks, conveyer belt, decanting facilities, and other enabling facilities for cargo like rail/road weigh bridges, truck parking, etc. shall be permitted.
 - d) **Passenger facilities:** Railway land shall be permitted for passenger facilities as per the policies issued by Railway Board from time to time.
 - e) **Renewable Energy and other Activities required for railway's:** Sewage Treatment Plants (STPs), Water Recycling Plants (WRPs)/Water Treatment Plants, Renewable Energy any other such facility, etc. shall be permitted.

- f) **Infrastructure for public service utilities:** Infrastructure for all public service utilities viz. electricity, gas, water supply, telecom cable, sewage disposal, drains, optical fiber cables (OFC), pipelines, roads, flyovers, bus terminals, regional rail transport, urban transport and any other such infrastructure shall be permitted.
- g) **Staff amenities:** Legacy scheme like Grow More Food Scheme to Railway employees to prevent encroachment of railway land shall be permitted.
- h) **Cultural, Social and Sports Activities:** Activities for cultural, social and sports will-be permitted for short term period not exceeding four months.
- i) **Government Bodies/Department:** Railway land shall be permitted for infrastructure activities of Government Bodies/Department for their own use.
- j) **Social Infrastructure:** Hospitals selected through a transparent policy and Kendriya Vidyalaya through Kendriya Vidyalaya Sangathan.
- k) **Land entrusted to RLDA:** Commercial development of surplus railway land entrusted to RLDA, in accordance with the Rules of RLDA, and the policies of the Ministry of Railway, shall be permitted.
- l) **Rail Tel Corporation of India (RCIL):** For towers and other telecom infrastructure as per arrangement between Ministry of Railway and RCIL.

3) Application & Approval process -

- a) Transparent methods of competitive bidding as per instructions issued from time to time shall be followed for allocating land to new cargo related projects/facilities and renewable energy, water treatment, water recycling, sewage treatment plants, etc. for exclusive use of the railways. For critical infrastructure/public service utilities projects, railway land and right of way permission shall be accorded on the specific requirement of concerned Ministries/Department/agencies.
- b) IR has developed an online approval system i.e. IR-LSPS (Indian Railways Lease License Processing System) for granting leasing/licensing of railway land. Similarly, IR has developed IR-RBCS (Indian Railways- Rail Bhoomi Crossing Seva), an on-line system, for way leave permissions on railway land. Application for grant of land leasing/licensing and way leave permissions shall be submitted on respective online portals only. Approval in all cases shall be granted online.
- c) **Competent Authority:** Divisional Railway Manager (DRM) shall be the competent authority to allot railway land on lease/license, way leave permissions, and subsequent renewal of lease/license/way leave agreements. For renewal cases, aspects like regular maintenance of assets connected with railway working, adherence to the commitments made in the lease/ license agreement, payment of dues on time etc. shall be examined.
- d) **Time frame for approval:**
Railway shall ensure to accord permission for way leave for
 - (i) Public utilities like electricity cables, telecom cables, optic fibre cables and water/sewage pipelines upto diameter of 300 mm within 15 days from date of registration on the online portal.

- (ii) Activities other than stipulated above, within 60 days from date of registration on the online portal.

Railway shall ensure to accord grant of land lease/license of cases within 90 days from date of registration on the online portal.

4) Market value of land -

- a) Market Value of railway land (MVL) shall be the prevalent circle rate/ready reckoner rate/ guidance value of the railway land at the time of execution of the lease agreement, if available, otherwise prevalent circle rate/ready reckoner rate/ guidance value of surrounding land for similar classifications/activities shall be considered. For example, if surrounding land is classified as industrial use, then industrial rate shall be used.

Note: In case the notified circle rates of the current year are not available then last available circle rates/ ready reckoner rate/guidance value as notified by revenue authority or as decided by District Revenue Authorities shall be considered.

- b) For cargo terminals, industrial rates, if specified in that State shall be considered. If not specified, then any other rate depending upon use of surrounding land as specified by State/ Revenue office shall only be considered.
- c) In case of cargo terminals, if logistics industry is given a special status and discount is given in a state, then railways shall also give same discount in that state.

5) General Conditions -

- a) Cargo related activities can be taken up by any entity including railways, PSUs, existing container terminal operators, new container terminal operators, multi-modal logistics operators, industries, ports, mines and any other entity interested in carrying cargo on railway network.
- b) Land ownership will continue to remain with Railways. No sub-lease/sub-license/ mortgage / transfer / relinquishment of railway land shall be permitted under this policy.
- c) The lease/license of railway land shall not be granted to religious and political institutions, private individuals/entities (not connected with railway working) for setting up shops, commercial offices, vending stalls, clinics, schools (other than Kendriya Vidyalaya) and tehbazari.
- d) The execution of work for providing way leave facilities/ permission to cross railway track in railway area shall normally be done by the party except for the cases affecting safety of railway track for which execution work may be done by railway administration. The execution scheme shall be approved by DRM in all cases.
- e) The cost on account of stamp duty charges, documentation, registration of agreements, GST, property taxes etc., as the case may be, shall be borne by the party for the facility permitted by the railway under this policy. The party shall be responsible for registration of agreement in terms of applicable laws.

6) **Tenure and Charges of grant of lease/license and way leave permissions -**

Tenure and rates for

- a) Lease / License of railway land are detailed in Para-820 below.
- b) Way leave permissions (ROW) are detailed in Para-821 below.
- c) Metro/other Rail Systems are detailed in Para-822 below.

7) **Agreement -**

- a) Before giving actual possession of the land or permission to start the work, lease / license / way leave agreement shall be executed between the Senior Divisional Engineer (authorized representative) of concerned railway division and the party seeking such rights without any exception.
- b) Model standard agreement issued by Railway Board shall be used
 - (i) Way leave agreement – Railway Board's Letter No. 2022/LML-I/25/5-(Pt-2) dated 16.12.2022.
 - (ii) Lease agreement for Cargo related purposes – Railway Board's Letter No. 2021/LML/25/5 dated 02.06.2023.
- c) Records of all lease/license/way leave agreements shall be maintained by railway and will be uploaded on online portal of IR-LSPS & IR-RBCS. Original copy of executed lease/license agreements shall be kept with division with one copy of agreement to be maintained in zonal headquarters.
- d) **Renewal of Lease/License/Way leave agreement:** On expiry of lease / license / way leave agreement, further renewal up to 35 years or for period as stipulated in the agreement can be done based on mutual agreement between railway and party. Market value of the land prevalent at the time of renewal shall be considered for deciding the lease/ license/way leave charges.

8) **Migration of existing lease/licenses/way leave permissions -**

Existing lease/license holders of Terminals/ Private Sidings/ Private Freight Terminals (PFTs): All entities currently using railway land for cargo activities will continue to be governed by railway's extant policies, i.e. annual lease/license charges @ 6% of Market Value of Land (MVL) with annual escalation of 7% for the remaining lease/license period or 35 years or period as mutually decided whichever is earlier. The existing entities shall be given option to migrate to the new policy regime on transparent competitive bidding process as applicable for new cargo terminals provided there are no outstanding dues. In such cases, the right of first refusal shall be with the existing licensee/ lessee. For Terminals/Private Sidings/PFTs dedicated to one customer and where competition is not possible or existing entities who do not want to avail the option as above, the annual lease charges shall remain unchanged i.e. annual lease/license charges @ 6% of MVL with annual escalation of 7%.

Existing users of way leave: All existing way leave facility users shall be able to migrate to this policy regime only after expiry of period of existing way leave agreement and payment of all dues.

- 9) **Dispute Resolution:** In case of any dispute arising in interpretation of the policy, land rates, land area, etc., a standing committee of three JAS/SG officers of Engineering, Finance and user department of concerned railway division shall examine all the issues and submit recommendations to the DRM whose decision shall be final and binding on all the parties.
- 10) **Termination of Agreement** -In the event of any serious irregularity, grave breach of the terms & conditions of the agreement, any default, violation of the Railway Act, 1989, commission of any unlawful act which is not in line with good industry practices, railway administration may terminate the lease/license/ way leave agreement subject to the provisions in the agreement.

820 Lease / License Tenure and Charges –

1) Lease/License Tenure and charges shall be as under -

SN	Activity	Tenure up to	Charges#
1(a)	New Cargo Terminals/ sidings/Goods shed and other cargo related facilities etc.	35 years	Lease charges @1.5 % of market value of land per annum with annual escalation of 6%
1(b)	Existing Cargo Terminals/ sidings/ Goods shed etc.	35 years	Lease charges @6 % of market value of land per annum with annual escalation of 7%*
2	Renewable power plants, Sewage Treatment/Water Treatment Plants/ Water Recycling Plants and any such activity for exclusive Railway's use	35 years	Lease charges @ ₹ 1/- per sqm per annum
3	Social infrastructure such as hospitals through PPP and Kendriya Vidyalaya through Kendriya Vidyalaya Sangathan	60 years	Lease charges @ ₹ 1/- per sqm per annum
4	Infrastructure works for public service utilities like electricity, gas, water supply, telecom cable, sewage disposal, optical fiber cable, pipelines, urban transport and any such infrastructure under PM Gati Shakti programme, if leasing of railway land is involved	35 years	Lease charges @1.5 % of market value of land per annum with annual escalation of 6%
5	BOOT Laundry	15 years	Lease charges @ ₹ 1/- per sqm per annum
6	Other activities related with railway working not covered under 1 to 4 above	35 years	Lease charges @6 % of market value of land per annum with annual escalation of 6%

7	Passenger amenities related activities as amended from time to time	As specified in the Commercial policy circulars/ guidelines	Activity Specific policy issued by Railway Board.
8	State Govt/ Other Govt. Departments / PSUs for activities for their own use	35 years	Lease charges of Upfront payment @ 99% of market value of land with nominal charges of @ 1000/- per Annum further extendable for 35 years on nominal charges.
9	Legacy scheme Grow More Food (up to 2 Hectare per employee)	2 years	License charges @ 1/4 th of the expected revenue
10	Cultural and sports activities (Temporary licensing)	4 months	License charges @ 6.0 % of market value of land per annum

Charges shall be as amended from time to time.

Note:

1. Payment of land use can be done either annually or entire payable amount can be paid in advance on present value basis with discounting of future cash flows at rate of 7% per annum for the activities listed from SN (1) to (4) & (6) of above table.
2. * If existing entities operating Cargo Terminals/ sidings/ Goods shed etc. do not want to avail option for shifting to new cargo terminal policy under transparent competitive bidding process, then these existing entities will be permitted to enter into new lease agreement at 6% annual lease charges with annual escalation of 7%.
3. No fresh licensing of railway land for new establishment of shops, religious structures, private schools, etc. will be granted.
 - a) (i) **For existing shops on railway land where license has expired or not yet renewed:** These shops will be auctioned for grant of license at reserve price of 10 % of market value of land per annum, provided land is not required for railways' own infrastructural and development need. However, existing licensee/owner will have the right of first refusal. The rent shall be increased @ 6 % per year. The license will be given for maximum tenure of 5 years.
 - (ii) **For existing shop with valid license agreement:** These shops, on expiry of license tenure, will be given on license by auctioning at reserve price of 10 % of market value of land per annum, provided land is not required for railways' own infrastructural and development need. However, existing licensee/owner will have the right of first refusal. The rent shall be increased @ 6 % per year. The license will be given for maximum tenure of 5 years.
 - b) The license fee of existing religious institutions will be @ ₹2,000/- per annum. Further, the area of existing religious structure shall not be permitted to increase in any case.
 - c) The license fee for existing Govt./Govt. aided schools shall be levied @ ₹10,000/- per annum. However, license charges for existing private schools on railway land shall continue to be @ 6% of market value of land at 7 % annual increment.

4. For Staff Welfare organization including Handicraft centers, Railways social welfare organizations, Bharat Scouts and Guides license charges will be @ 2,000/- per annum.
5. Licensing of railway land including railway buildings (cost of building is to be suitably incorporated) for Rail Mail Service (RMS) shall be governed by Railway board' instruction 2014/LML-II/18/6 dated 03.12.2014 & 73/ W2/3/8 dated 02.02.1979 and 1943 of Engineering Code.
6. The usage of railway land related to Passenger amenities shall be activity specific policy issued by Railway Board (commercial directorate.) as amended from time to time.
7. For the purpose of calculation of the cost of the land, area of land shall be calculated as followed:
 - a) The minimum width of land shall be taken as 1m, thereafter in multiple of 1 m.
 - b) The length of crossing shall be as actual, if less than 50 m, otherwise in multiple of 50 m.
8. The minimum lease/license charges under activity at SN. 4 of above table shall be 10,000/-.

2) Rent for Buildings -

- a) For assessment / reassessment of rent to be charged from other Government departments except P&T where the whole railway building or part of the building is given on rent, procedure given in the Railway board's letter no. 2010/LML/18/64 Dt. 11.07.2018 to be followed.
- b) The office and residential buildings for Government Reserve Police shall be dealt in accordance with Para 1957 to 1959 of Indian Railways Code for Engg. Dept. (1982 edition, as amended from time to time).
- c) "Building rent" to levied for utilization of Railway Building by P&T dept. in terms of Para-1943 of Engg. Code. (1982 Edition as amended from time to time).

821 Way Leave (Right of Way) Facilities –

- (1) Way leave provisions as defined in Engineering Code 1982 Edition, as amended from time to time, shall be followed. The guidelines and instructions issued by RDSO and Railway Board such as "Guidelines on Pipeline Crossings under Railway Track – Report No. BS-105" shall be followed from time to time.

(2) Way leave facilities Tenure and Charges:

SN	Activity	Tenure upto	way leave charges #
1(a)	For underground public utilities like electricity cable, telecom cable, optical fibre cable and water/sewage pipeline up to diameter 300mm for railway land which includes track crossing (ROW)	35 years	Onetime fee of ₹1000/-
1 (b)	Public utility provider/any organization that provides and maintain the infrastructure for a public service like electricity, gas, waters supply, telecom cable, sewage disposal, irrigation channels/canals subject to applicable regulations, etc.	35 years	1.5 % of market value of land per annum with annual escalation of 6%
2	Passages up to one metre wide for individual households or agriculturists adjoining Railway line.	35 Years	Onetime fee of ₹6400/-

3	Water pipe line crossing for cultivation by individual farmer, electrical line crossing, water/sewage pipe lines and other crossings up to 300 mm dia. for individual house, shops.	35 Years	Onetime fee of ₹1000/-
4	Passage/road for vehicles, scooters etc. (i.e.: between 1m to 3m wide) by individuals, housing societies, private firms, organizations	35 Years	1.5 % of market value of land per annum with annual escalation of 6%
5	Public road by local bodies/state Govt/ Govt/ Charitable institutions, welfare organizations up to 3 m width.	35 Years	1.5 % of market value of land per annum with annual escalation of 6%
6	Pipe conveyor/open conveyor system over RCC/PSC/Steel/ composite structure	35 Years	1.5 % of market value of land per annum with annual escalation of 6%
7	ROB/RUB in lieu of level crossings	N.A.	Nil
8	Flyovers/ ROB/Road Under bridges	35 Years	1.5 % of market value of land per annum with annual escalation of 6%
9	Metros/RRTS/NHSRCL	As per Para-822 below	

Charges shall be as amended from time to time.

Note:

1. Payment of land use and ROW charges can be done either annually or entire payable amount can be paid in advance on present value basis with discounting of future cash flows at rate of 7% per annum.
2. In case of State Govt/Govt projects of public utilities having wider social implication or in some way advantageous to railways, the Divisional Railway Manager of concerned division may decide for way leave charges on case-to-case basis "as deemed fit" by relaxing laid down standards or reducing way leave charges on reciprocal basis with finance concurrence.
3. Any proposal for passage /roads for width more than 3 m shall be treated under lease.
4. Supervision charges in case of deposit work being undertaken by party himself for the way leave cases shall be 6.25 % of cost of work. No other charges except way leave charges will be applicable.
5. For request of way leave permission (ROW) having tenure less than a year, the way leave charges on prorated basis shall be levied.
6. In case of annual payment option, a security deposit (refundable after tenure) of two-year annual payment shall be deposited by the party.
7. The minimum way leave charges for activities specified at SN 1(b), 4,5,6,8 and 9 shall be 10,000/-.
8. The land width to be considered for working out way leave charges for laying of OFC / telecom cables shall be 300mm or actual width of trenching or total area becoming unsuitable for monetization / way leave due to cable laying, whichever is more.
9. The OFC / telecom cables shall normally be laid by HDD (Horizontal Directional Drilling) method.
10. In case of way leave charges for Flyovers/ROB/RUB with Ministry of Road Transport and Highways / National Highways Authority of India, the charges shall be payable as

per the existing Memorandum of Understanding (MoU) between Ministry of Railways and MoRTH executed on 10.11.2014. The charge of way leave in these cases shall be for 35 years.

11. The way leave facilities / easement charges / land leasing charges for construction of ROB/RUB across railway tracks financed through NREGA, MPLADS, PMGSY, MMGSY etc. shall remain waived in accordance with the instructions contained in Railway Board's letter No. 2006/CE-IV/BRO/82/MPLADS (Policy) dated 16.07.2012. The other conditions as stipulated in the aforesaid letter shall also remain same.
12. The provisions of SN 1(b) of above table shall also be applicable for crossing of telecom cables and fixing of installations including antenna, equipment, etc. for telecommunication in railway tunnel.
13. In case of OFC crossings (SN.1a of above table) other than OFC proposals under "Bharatnet Project" & "Smart City Mission", Lumpsum charges towards supervision charges ₹20,000/- per crossing for length of crossing up to 50m and ₹24,000/- per crossing for length of crossing more than 50m. No other charges shall be levied for granting approval.
14. In case of water / sewage pipeline crossings up to 300mm diameter (S.No.1a of above table), Lumpsum charges towards supervision charges at ₹45,000/- per crossing for length of crossing up to 50m and ₹90,000/- per crossing for length of crossing more than 50m. No other charges shall be levied for granting approval.
15. Proposals for laying OFC / Telecom cables received under "Bharatnet Project" and "Smart City Mission" being implemented by "Department of Telecom" and "Ministry of Housing & Urban Affairs" respectively will continue to be governed by the instructions issued vide Railway Board's Letter No. 2017/LML-I/24/13 dated 05.01.2018, 16.02.2018 & 07.06.2018 and Railway Board's Letter No. 2022/LML-I/24/38 dated 04.08.2022 & 05.09.2022.
16. Right of Way charges including supervision charges for OFC cables under "Bharatnet Project" and "Smart City Mission" are as under:
 - (i) For laying underground telegraph infrastructure - ₹1,000 per Km.
 - (ii) for laying over ground telegraph infrastructure - ₹10,000 per case.

822 Metro/RRTS/NHSRCL Crossings Tenure and Charges -

SN	Activity/ Location	Tenure up to	New crossing Charges#
1	On Ground	35 years	A. Within track portion- (not permitted) B. Beyond track portion - At 1.5% of market value of land with annual escalation at 6%
2	Overhead	35 years	1.5 % of market value of land per annum with annual escalation of 6%
3	Underground		
3.1	For depth up to 10 metres	Not permitted	
3.2	For depth from 10 m to 30 metres	35 years	1.5 % of market value of land per annum with annual escalation of 6%
3.3	for depth exceeding 30 metres	35 years	At Rs. 10,000/- per annum
3.4	For station building or entry/ exit or circulating	35 years	1.5 % of market value of land per annum with annual escalation of 6%

	area		

Charges shall be as amended from time to time.

Note:

1. For the purpose of calculation of the cost of the land, area of land shall be calculated based on the width of land as below:
 - 1.1 Elevated Crossings: Width of land should be taken as superimposed width of overhead Metro structure plus 500 mm margin on either side.
 - 1.2 Underground Crossings: Width of land: D1 plus D2 plus 10m plus 1 m where D1 & D2 are diameters (in metre) of tunnels passing beneath the Railway track considering 10 metre minimum clear spacing between tunnels and 500 mm margin on either side of the tunnel.
2. For all above cases, the charges shall be payable either annually or entire payable amount can be paid in advance on present value basis with discounting of future cash flows at rate of 7 % per annum.
3. However, in case of annual payment option, a security deposit of two-year annual payment (refundable after tenure) shall be deposited by the party.
4. In no case, Metro crossing shall be permitted at a depth less than 10metre from ground level to top of tunnel/underground structure.
5. Irrespective of the permission granted for underground, on ground or over ground structures for crossing of Metro Networks, all air/space rights shall rest with the Railways.

823 Utilization and Development of Available Land -

- 1) All railway land should be managed on commercial lines, and each Railway Administration should endeavor to develop the resources of, and put to profitable use, any areas in its occupation which, though not eligible for disposal are lying idle and can be put to profitable use. Such land is referred as "available land" as per Para 1008 of Engg Code 1982 Edition (as amended from time to time).

2) Demarcation of land for Licensing to Traders at Stations -

Land may be licensed to traders at stations where there is a demand for this facility. Licensing of land is done by the Commercial or Engineering Department. Where land is licensed for stacking materials received or dispatched by train, the licensing will be done by the Commercial Department. In all other cases and also where temporary structures are to be erected on the licensed land, licensing will be done by the Engineering Department.

Plans showing plots of land which could be licensed should be prepared in consultation with the Commercial department. The area of the plots should be decided with reference to local conditions. In case of plots licensed for stacking materials received or to be dispatched by Railway, the dimension of the plot along the siding should be restricted to 10m so that maximum number of plots are served by the siding.

Plots should be demarcated at site by fixing unserviceable sleepers or concrete / steel posts at each of the four corners and plot numbers painted on them. Four copies of plans

should be made out, one for the Divisional Commercial Manager, one for record in the Divisional Engineer's office, one for the SSE / JE Works and one for the Station Master.

The SSE / JE (Works/P. Way) should ensure that in all cases where railway land is licensed, the land beyond allotted area is not infringed by the licensees. He should report to the Assistant Divisional Engineer regarding such cases where he cannot successfully get the licensees to adhere to the limits of the plots allotted to them. The Assistant Divisional Engineer should then take up the matter at a higher level. The schedule of land verification shall be as given in **Annexure 1.1**

3) Each ADEN/ SSE / JE will be fully aware of the available land (including commercial plots) under his jurisdiction and will submit suitable development plans for the most economical utilization of the available land, in accordance with the recent circulars and instructions.

824 Use of Surplus Land –

Plantation of suitable trees on vacant land should be done on program basis. Strip plantations should be developed on big chunks of land available. No surplus Railway land should be licensed for cultivation purpose except for Grow More Food scheme as per Railway Board latest guidelines.

Land between stations should, preferably be placed at the disposal of the State Government for afforestation by Forest Department, only after entering into proper agreement ensuring safety of train operation at all times and without diluting Railway's title on the land.

The vacant spaces/area in the station approaches along the track may be developed as green cover by planting low height plants, shrubs, creepers, bushes, herbs/medicinal plants, climbers, ornamental plants, flower plants etc. Individuals, NGOs, Trusts, Charitable institutions, Corporates, Government bodies and Self-Help Groups can play vital role in developing this vacant Railway area into environment friendly area. All such parties will be encouraged to participate in this initiative. The implementation of this scheme will be through participation of the people (Jan Bhagidari).

The area for beautification shall be identified in the approaches of stations and beyond the safety zone only. For details para 722 of this manual may be referred.

Commercial Development of railway land by RLDA:

Rail Land Development Authority (RLDA) is a statutory Authority, under the Ministry of Railways, set-up by an Amendment to the Railways Act, 1989, for development of vacant Railway Land for commercial use for the purpose of generating revenue by non-tariff measures.

Railway land which is not required for operational purposes in the foreseeable future would be identified by the Zonal Railways and the details thereof would be advised to Railway Board. Such plots of land would thereafter be entrusted to RLDA by Railway Board in phases for commercial development. RLDA may also suggest sites to Zonal Railways for this purpose.

The land entrusted to RLDA shall continue to be in possession of the Zonal Railways till the time the developer is selected by RLDA and the land is handed over to the developer

by RLDA on lease for commercial development.

It shall be the duty of Zonal Railways to keep the land free from encroachments and all encumbrances.

A joint demarcation of the site will be carried out by RLDA and the Zonal Railways, if necessary, along with the local revenue authorities, and a proper "Land Plan with Schedule" will be prepared by and signed jointly between Zonal Railway and RLDA showing the exact boundaries and important structures / land marks in each direction, along with area and any other details that may be considered relevant.

A "Joint Handing Over Note" (as per format prescribed by Railway Board) shall be prepared by the Zonal Railways and the RLDA duly annexing "Land Plan with Schedule" as mentioned above. This Joint Handing Over Note shall be signed and physical handing over of the land will be effected, along with the signing of the Development Agreement (to which it will form **Annexure**) between the RLDA and the Developer.

For achieving the purposes of commercial development of railway land, active cooperation of Zonal Railways who are the land owners, is very important at all stages, including project implementation, especially in the case of "Redevelopment Projects" i.e. those involving rebuilding of Railway structures

825 Bulk Oil Installation on Railway Land –

- 1) The terms and conditions for license of railway land to oil companies at stations, for erection of mineral oil tanks, godowns and depots and for laying pipe lines, are governed by special agreements between the Railway Administration and the licensees. Each document is accompanied by a detailed site plan and drawings showing structural details. Such agreements are usually long-term agreements and are executed by the commercial department on behalf of the Railway administration.
- 2) In dealing with bulk oil installations, reference should be made to the Petroleum Act of 1934 and the Petroleum Rules of 2002, as amended to date. Care should be taken to distinguish between the various classes of petroleum products, based on their flash points, as given in the rules referred to.
- 3) The Petroleum Rules of 2002 lay down that plan or plans relating to all new petroleum storage works or alterations in those existing, must be signed by the licensing authority in token of approval. No work on a storage installation or a storage shed should be permitted on or close to Railway land unless plan or plans for work duly signed by the licensing authority are received in the Divisional Commercial Manager's and Divisional Engineer's offices.
- 4) Bulk oil storage should be located so that:
 - a) they are as far away as possible from goods-sheds and station buildings;
 - b) they could be conveniently served by a road and siding from which the oil wagons can be unloaded;
 - c) they do not interfere with any future extension of the station yard;
 - d) they are sufficiently far apart from each other or are so protected as to avoid any possibility of danger, should any installation catch fire.

As regards condition (b), installation may be permitted near a traffic dead-end siding, the use of which for stabling oil wagons while being unloaded will not interfere with the general working of the station. If such a siding is not available, the provision of a special siding will be necessary.

- 5) It is not essential for an oil installation to be close to a siding as it can be served by a pipe line from the point of discharge from the wagon and the storage tank.
- 6) The approach road to a Bulk Oil Installation should be made and maintained at the cost of the licensee who will pay license fee for the land occupied.
- 7) Around every Bulk Oil Installation, a safety area must be kept clear of buildings of any description and the safety distances should conform to the requirements of Petroleum Rules.
- 8) The following distances shall be kept clear at all the times between storage shed to protected works. *(Vide Schedule II, Form XVI of Petroleum Rules 2002)

Licensed capacity of storage shed of all classes of petroleum stored in the shed	Total Distances to be observed from storage shed for		
	Petroleum Class A	Petroleum Class B	Petroleum Class C
Not exceeding 2,500 litres	6m	Not applicable	Not applicable
Exceeding 2,500 litres but not exceeding 2,5000 litres	7.5m	Not applicable	Not applicable
Exceeding 2,5000 litres but not exceeding 50,000 litres	9m	3m	Not applicable
Exceeding 50,000 litres but not exceeding 1,00,000 litres	12m	4.5m	3m
Exceeding 1,00,000 litres	15m	6m	3m

Note:

1. "Protected Works" include –
 - a) Buildings in which persons dwell or assemble, docks wharves, timber and coal yards, furnace, kiln or chimney and buildings or places used for storing petroleum or for any other purpose but does not include buildings or places forming part of an installation;
 - b) Any public road or a Railway line which is not used exclusively as an oil siding; and
 - c) Overhead high-tension power lines.
2. In the case of underground storage tanks, it is not necessary to maintain any safety distances around the storage tank.
3. a) Petroleum class A means Petroleum having its flashing point below 23-degree C.
 b) Petroleum class B means petroleum having a flash point of 23 degree C and above but below 65-degree C.
 c) Petroleum class C means petroleum having a flash point of 65 degree C and above but below 93-degree C. Flashing point of any petroleum means the lowest temperature at which it yields a vapour which gives a momentary flash when ignited. It is determined in accordance with the provisions of the Petroleum Act.
4. The area of land which is licensed for the purpose of an oil installation on which rent is to be paid should be the whole area including the safety areas prescribed in para 825(7).

826 Laying of Oil / Gas / Petroleum / other inflammable Pipelines –

1) Laying of oil pipe lines for installation other than those for bulk oil installations:

- a) No oil / gas / petroleum / other inflammable pipe lines are permitted on railway land without the approval of the Chief Engineer.

The powers for granting land lease / license / way leave has been granted to DRM. However, GADs for Oil / gas / Petroleum / other inflammable substances shall be got approved from Headquarters office of Engineering Department.

- b) Where the sanction to the project has been obtained, a set of rules for the laying, construction and maintenance of pipe line from the point of view of safety of the travelling public and railway property shall be drawn up by the Railway administration in consultation with the Commissioner of Railway Safety before the work on the project is permitted.

The pipe line shall comply with all the relevant provisions of the petroleum rules relating to transport of petroleum by pipe lines vide para-V of Chapter III of the Petroleum Rules 2002.

827 Construction of Government and Private Buildings Near Railway Land –

- 1) a) While it may be realized that Railways have a prior right of acquisition and utilization of land adjacent to Railway boundaries, the Railway Administration can only insist on previous intimation being given by the revenue authorities or the local Govt. when such lands are assigned for specific purposes. For the prevention of encroachments on railway land such as by the erection of buildings and platforms and the gradual accrual of easements such as right of way and a right to discharge sullage or storm water over Railway land, it is desirable that sufficient open space be provided between the railway boundary and the nearest face of any structure erected on adjoining land.

- b) The interest of the Railways will be suitably safeguarded by providing for:

- i) An open space of approximately 30m being left between the railway boundary and the nearest edge of a building constructed on adjacent land, the exact space to be left being governed by local conditions; and Railway's NOC is required for construction of buildings / structures within 30 metres from Railway boundary. The procedure for granting NOC shall be as per extant guidelines (amended from time to time)
- ii) Intimation regarding proposed construction on lands adjacent to the railway boundary being given to the railway authorities at least 90 days before the commencement of erection work.

- c) The lands adjoining the railway boundary will be either privately owned or nazul and will be either included in a municipal area or not. Regarding private lands not included in a municipal area, there appears to be no method of enforcing the provisions mentioned above. As regards private lands included in a municipal area, the provisions can be made applicable by incorporating them in the municipal bye-laws and if the state governments have no objection, the municipal committees of the state may be asked to frame bye-laws to this effect. As regards nazul lands, both inside and outside municipal areas, it is suggested that if the state

governments have no objection, suitable provision may be made in the conditions governing transfer, at the time of making grants.

- 2) In cities and towns where land is valuable and the cost high, it is not expected of the owner of a plot to leave a large vacant space between his building and the Railway boundary. The Interests of the Railway would be adequately safeguarded if sufficient vacant space is left so as to facilitate future road and drainage developments outside the railway land to avoid requests for surrender of railway land for access at a future date. Railways should insist on barest minimum distance. Barest minimum distance shall be ascertained by examining building plans and ensuring that the layout of the building shall not result into accrual of various easement rights as mentioned above.
- 3) It is necessary that the Principal Chief Engineer should arrange with each State Authority to frame rules in connection with the following:
 - i) The procedure to be adopted for obtaining the Railway Administration's opinion before consenting to the assignment of land adjacent to railway limits for any specific purposes.
 - ii) The extent of open space to be left outside the railway boundaries for Government owned and privately-owned lands. Such orders may be issued by the State Governments in the form of government circulars or government orders, copies of which should be carefully recorded in the offices of the Principal Chief Engineer, Divisional Engineer and Assistant Divisional Engineer.
- 4) Construction of a building or other structure near a station yard or between stations adjacent to the railway limits and within the zone specified in the said government circulars or orders, should be intimated at its commencement by the SSE/ JE (P. Way/Works) to the Divisional Engineer and Assistant Divisional Engineer by fax / e-mail and copies to the local authority, furnishing brief particulars with Kilometrage and the distance of the structure from the railway boundary. This action should be immediately followed by a brief report and a sketch of the construction. On receipt of the report, the Divisional Engineer should address the local authority to arrange stoppage of the construction.

828 Earning From Railway Land and Its Monitoring –

Once a year each ADEN will arrange a detailed survey of existing sources of earnings like grass, fruit trees, fish ponds etc., from Railway land including outstanding dues to be recovered.

Immediate action for issue of auction notice etc., will be taken to have the maximum earnings out of these sources. Targets will be set and the same will be advised to Headquarters for the corresponding year, based on the survey of existing resources and outstanding dues (including those of commercial department) to be recovered.

SSE / JE (P. Way/Works) and ADENs during routine trolley inspection will make entries of such sources in their diaries which will also be checked by higher officers during inspection.

Monthly progress of earnings under above sources shall be reported by SSE / JE (P. Way/Works) and ADEN to Divisional Office who shall report the same to headquarters.

Annexure 8.1(a)
Para 813(4)(Left Side of Register)

Proforma for 'Land Boundary Verification Register'

DETAILS OF BOUNDARY STONES BETWEEN KILOMETRES..... AND

Date of Inspection	Details of missing boundary stones		Action Taken	Initials of Inspecting officials.
	L	R		

Annexure 8.1(b)
Para 813(4) Right side of Register)

Plan Showing Railway Boundary Stones Between Km..... To.....

Rly Land Boundary Stones Shown Thus -

L and R indicate Boundary Stones on the Left & Right while facing in the direction of increasing Kilometrage.

Note: Dimensions of Railway Land boundary may be given from Centre Line of Track.

Annexure 8.2
Para 814(5)

Encroachment Inspection Register

(left page)

1. Location.....
2. Name of Encroacher.....
3. Father's Name & Address.....
4. Area Occupied.....
5. Use of Land..... (Commercial/Residential/Cultivation)
6. Date of Commencement of Unauthorized Occupation.....
7. Date on which the Encroachment came to notice for first time.....
8. Reference of File No.....

Date of Inspection/review	Action taken	Date of Removal	Initials of Inspecting Official

Note: Encroachment plan (to the scale) shall be pasted on the right-hand side.

CHAPTER 9

PREPARATION OF PLANS

901 General –

- 1) Various types of drawings are prepared for the execution of work by Civil, Electrical and S&T Engineering departments. Some of the important drawings which are prepared by the Civil Engineering department are as follows:

a) General Arrangement Drawings (Buildings, Railway bridges, FOB/ ROB/ RUB/RFO):

The drawings and plans for building structures, bridges, water supply & sanitation works etc. shall be as per commonly accepted definition and terms. The General Arrangement Drawing (GAD) shows the overall shape and size of the structure, detailing the specific dimensions and specifications of materials and work. This will normally include the following:

- Key plan of the work site in a box.
- Chainages of the center line of structure and its elements and elevations as Reduced Levels.
- Overall dimensions of structure, distances of structure from outer reference points or outer boundaries. The plan and elevation along with sections at specific locations should be drawn wherever required to leave no ambiguity in the arrangement of the structure.
- Ground level, Rail level, High Flood Level (HFL), bed level in case of bridges, formation level of the embankment or plinth level with reference to the bench mark.
- Plinth area of building, total height of building, type of structure.
- Scale to which drawing is drawn.
- Place/Box of all required signatures of officers of concerned departments, alteration box for future amendments to be issued.
- Authority for the approval/sanction of work.
- The codes, manuals and specifications on which the work has to be executed.
- Soil bore log details and the bearing capacity of soil at founding levels.
- In case of a building, a floor plan of the building with the roof removed at various floors.
- If there are more than one distinct structure in the work, separate sets of GAD's and detail drawings should be prepared for each, e.g., there might be a residential complex, a power substation, and a gymnasium constituting the work. Then three sets of GADs and corresponding detail drawings should be made.
- Checklist for preparation of General Arrangement Drawing (GAD) is given in **Annexure 9.1**.
- Check list for preparation of GAD of ROB is given in **Annexure 9.2**

- Check list for preparation of GAD of RUB is given in **Annexure 9.3**.

i) **Engineering Scale plan for yard, junction arrangements:**

An Engineering drawing made to scale is basically an Engineering Scale Plan (e.g. yard plans, LC plans). However, the terminology- Engineering Scale Plan is primarily used for yard plans. Yard Plan for a station shall be defined as "A single line latest updated scaled drawing of a station yard indicating location and dimensional details of all the running lines, sidings, platforms, bridges in yard, buildings, wells, tanks, weigh bridges, Level crossings (LCs), Road Over Bridges(ROB)/ Road Under Bridges(RUBs), Foot Over Bridges (FOBs), gradients, turnouts, curves, dead end etc. along with railway land boundary and other important relevant structures up to the station limits". The definition is indicative and additional information as considered necessary shall be incorporated in the Engineering Scale Plan (ESP). ESP shall be prepared on a scale of 10m to 1 cm. The plan shall show all lines, sidings, platforms, buildings, wells, tanks, water cranes, ash pits, turntables, traversers, weighbridges, signals, etc. within the boundary of the station yard; also any roads, buildings, etc., lying outside the station yard but immediately adjacent thereto. The name of each work or structure should be entered against it on the plan, with such notes and dimensions as may be necessary to define its size, position and purpose for which intended.

ESP shall be prepared as per Engineering code Para 468 to 472. The checklist for preparation of Engineering Scale Plan is given in **Annexure 9.4, 9.4A & 9.4B**. The yard plans of stations to be updated time to time with completion details of newly completed work.

ii) **Index plan and Index section:** shall be prepared as per Engineering code Para 449 to 451.

iii) **Detailed plan and section (L-section) or project sheets:** shall be prepared as per Engineering code Para 452 to 466.

iv) **Completion Drawings** - The completion drawing should be submitted by Assistant Divisional Engineer to the Divisional/Dy. Chief Engineer for works completed as per the approved drawings digitally as well as physically. The drawing should indicate the work as actually carried out. Details is given in Para 913.

v) **Temporary Arrangement Drawing (TAD)** - The Temporary Arrangement Drawing shows the scope of temporary works required to be done for the completion of work as proposed in GAD. In bridge works, separate temporary arrangement drawing is prepared to show the methodology of temporary work along with phase working with details of minute-to-minute activities to be completed in block hours. Details of cranes working in a phased manner with pictorial diagrams are also to be included in the case of launching of girders, slabs, R-H girders, etc. A temporary supporting arrangement to support the span by C.C. Crib or Trestles as per standard RDSO drawings/approved working drawings is also to be shown in TAD. The TAD along with launching scheme for bridge works, is approved by Chief Bridge Engineer (CBE), and this becomes part of the documents to be submitted to Commissioner of Railway Safety(CRS).

vi) All new assets should be planned with provision of requisite path for providing services. A combined services drawing (CSD) shall be prepared for the purpose and provisions shall be made in other drawings accordingly. It shall be ensured that services are provided as per the CSD and any deviation be marked in the completion CSD."

- 2) All plans such as Index plans, Index sections, yard plans etc. shall be prepared in accordance with the provisions in the following chapters of the Indian Railways Code for the Engineering Department (1982 as amended from time to time).

Chapter II	"Modes of Investigations of Railway Projects".
Chapter IV	"Engineering Surveys - Reconnaissance, Preliminary and Final Location Surveys".
Chapter V	"Engineering Survey – Project Report, Techno Economic Survey Report and Feasibility Report."

Drawings other than Index Plans, Index Section and Yard Plans shall generally consist of building drawings, station platform drawings, bridge drawings, water supply and sanitation drawings, etc. For preparing detailed drawings including the drawings prepared according to the provisions in Chapter II, IV and V above, reference may be made to IS: 11669-1986 (ISO 129 -1985) 'General Principles of Dimensioning on Technical Drawings' and to special publication SP 46-2003 issued by Bureau of Indian Standards for engineering drawing practice.

- 3) All drawings and plans should be registered in the offices of origin and should be referred to not only by their titles but also by their registration numbers. For the purpose of registering drawings and plans a manuscript register should be kept in each Drawing Office, Indian Railway Standard (IRS) drawing should be referred to by their standard numbers.
- 4) Drawings shall be prepared in computer compatible media; adequate care shall be exercised in maintaining back-up copies and installing security systems. Each Zonal Railway shall develop computerized system of preparing and preserving drawings.

902 Plans for Other Departments –

- 1) The Divisional Engineer may, at his discretion, prepare sketch plans for other Departments or other Government Departments, or for private parties. Detailed plans should be prepared when there is a likelihood of the schemes proposed being sanctioned or when the charges for preparation of plans and estimates have been deposited.
- 2) When preparing plans, the Divisional Engineer should obtain complete details from other departments. He should arrange for the plans to be signed by the representatives of the department concerned or the private party in token of approval and acceptance.

903 Sizes of Drawings –

- 1) Sizes of the trimmed sheets of all drawings, except yard plans, should be as given in

Table 9.1. All plans required to be of longer length will be in the form of a roll, keeping the width as specified. The size to be used would depend on the extent of details required; broad guidelines are indicated in **Table 9.1**.

TABLE 9.1 – SIZES OF DRAWING SHEET			
SN.	Sheet Designation	Trimmed size (mm) (W x L)	Description
1	A0	841 x 1189	Index Plan and Section, General arrangement and detailed drawings for road over bridges, major/ important bridge works & important structures, building (steel and concrete) etc.
2	A1	594 x 841	General arrangement,
3	A2	420 x 594	Temporary arrangement & detailed drawings for bridge works, steel structures, building and temporary arrangement drawings for SN .1 above.
4	A3	297 x 420	Site plans for road over/road under bridges, passenger platform coverings, buildings etc. and drawings for minor detailing.
5	A4	210 x 297	Plans for inclusion in Works Programme booklets for handy reference, PERT charts of works of limited activities etc.
6	-	-	Yard plans shall be as per Para 903 (2).

- 2) Depending on the size of a yard, yard plans should be prepared in the trimmed widths of 841 mm or 420 mm or 210 mm. If the length of the yard plans is more than 1189 mm then same shall be preserved in the form of a roll.
- 3) Borders enclosed by the edges of the trimmed sheet and the frame limiting the drawing space shall be as detailed in BIS: SP – 46-2003 and shown in **Annexure 9.5**.
- 4) A standard arrangement of drawing layout will ensure that all necessary information is included and its essential part is located easily. The title block should be placed at the bottom right-hand corner. Folding marks must be made on the drawing sheet as shown in **Annexure 9.6**.

904 Titles and Numbering of Drawings –

- 1) Title block should be of minimum size 170 mm x 65 mm as shown in **Annexure 9.5**. In case of drawings prepared by other organization, the block size can be suitably increased. Following basic information should be given in the title block.

1)	Name of the railway
2)	Name of Divn/Constrn. Organization/ other organization
3)	Name of work
4)	Intended purpose of drawing: e.g. General Arrangement Drawing, temporary arrangement drawing, layout plan, structural detail drawing, architectural plan, concept plan, demolition plan, bridge plan, yard plan etc.
5)	Reference to sanction particulars
6)	Scale of drawing and reference to standard drawing, if any
7)	Drawing number
8)	Completion drawing number

9)	Dated initials of the concerned officials
10)	Alterations, if any, with full particulars

- 2) Multiple drawing sheets marked with the same number should be indicated by means of a sequential sheet number on the total number of sheets in the following manner:

Sheet No. = n/p

Where n = sheet number and

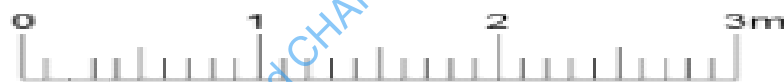
p = total number of sheets

- 3) If a drawing cancels or supersedes a previous one, a note to this effect and the number of cancelled drawing or superseded drawing should be recorded on the drawing. Correspondingly, the cancelled drawing should have an appropriate endorsement, including on its original digital copy.
- 4) In the case of land plans or plans where other Railways or Organizations are concerned, additional space should be provided for their signatures. In cases involving organizations other than the Railways, the designations should be written in full.
- 5) All signatures on tracings should be in indelible ink and dated.
- 6) Every plan should bear the name and initials of the JE/SSE Drawing who prepared or and checked the plan at the appropriate place beside the title block.

905 Scale of Drawings –

- 1) All drawings except sketch plans should be drawn to scale. The scale or scales of a drawing should be indicated at the appropriate place in the title block. Where different scales are used for details, the corresponding scales should be shown under each relevant detail.

In case of computer drawings, the Graphical scale should be shown on the drawing as shown in the figure below. The Graphical scale stands applicable in any size of computer printouts.



- 2) Plans should be prepared to scales as specified in Chapter IV of the Indian Railways Code for Engineering Department (1982 as amended from time to time).
- 3) Details that are too small for complete dimensioning in the main representation, shall be shown adjacent to the main representation in a separate detail view or section which is drawn to a larger scale. Recommended scales for details are 1:2, 1:5, 1:10, 1:20 and 1:50.

906 Details on Different Types of Drawing –

The drawing should be accompanied with following details/ information wherever applicable-

- 1) **For Building / Bridge Works:**

Following type of drawings shall be prepared -

- a) Concept plan
 - b) Demolition Plan.
 - c) Site plan and/or General layout plan.
 - d) Architectural and/or detailed execution plan.
 - e) Structural design drawing.
- a) **Concept Plan:** For major works, at the proposal finalization stage, Railway may decide preparation of Concept plan. The concept plan may include different possible alternatives with brief noting of their pros and cons. The concept plan shall consist features like land utilization, air space utilization, earmarking space for future development, functional and architectural aspects, perspective drawings, 3 dimensional sketches along with charts/notes regarding financial and technical aspects and other relevant details as shown by Consultant/Architect or other executing agency. These drawings shall also be processed similar to Engineering Scale Plans and shall form the basis for development of other technical drawings.
- b) **Demolition Plan:** For major demolition works involving safety, demolition plan indicating sequence, method and safety precaution should be prepared. In case of rebuilding of bridges or wherever structure near running line is involved, demolition drawing must be approved before actual demolition.
- c) **Site plan and/or General layout plan:** The site plan can be separate or part of an existing general plan. Site plans for new quarters should include the type drawing numbers and show the north line.
- d) **Architectural and/or detailed execution plan:** The Architectural drawing/detailed building drawing should normally include ground plan, section through the building in such directions as are necessary to exhibit the intended form and dimensions of the various parts, and elevation of one or more faces. It should invariably indicate the number of floors for which the foundation of the building is designed. It should also include roof drainage arrangement, sanitary details, layout of bathrooms and layout of kitchen. Details of finishing items and specification should also be indicated in the drawing in the form of a note. Landscaping and developmental work involved must also be shown. This drawing shall be self-contained i.e. physical construction of a structure should be possible with this drawing except structural design detail.
- e) **Structural design drawing:** The structural drawing will indicate foundation plan, details of R.C.C./Steel members and a bar bending schedule as per standard I.S. bar bending specification. It should also contain notes on method of execution references to codes and specification, fabrication details, etc. A separate note bringing out safety aspect in the design should also be given (e.g. precaution for lifting Prestressed girder while lifting by crane.)
- f) For all building and station related works, preparation of drawings listed in above paragraphs c, d and e are mandatory. However, in case of small buildings, these parts can be included in one sheet but placed distinctly.

The following common information wherever applicable shall be given in the above drawings:

- i) The north direction.
- ii) Any known bench mark with the datum from which its value has been reckoned.
- iii) Wherever applicable details of all borrow pits, rivers and pipelines, streams, sullage and sewer drains together with their direction of flow. Further location indicating temples, mosques and graves, roads and footpaths with the names of towns or villages they lead to, etc. should also be given.
- iv) The position and block numbers of buildings. Where a building consists of two or more storey, the number of floors shall be mentioned. Where outhouses exist, these shall be marked "O.H. to Block No.".
- v) In the case of foundations, the nature of the soil as determined from trial pit, and bore log details.
- vi) Wherever relevant in the drawing details of capacity of high-level tanks and of ground tanks; diameter and depth of all wells whether for drinking or for loco use; diameter of water columns, hydrants, taps, main and subsidiary pipe lines; the clear lengths and sizes of drains and sewers and storm-water drains; location of septic tanks and other such details should also be indicated.
- vii) Plans of water supply, pumping, storage and distribution systems should show complete dimensions and details including reduced level of salient points. The lines should be drawn in thicker lines than the rest of the plan and only sufficient buildings (with their designations) and tracks shown as are necessary to make the purpose and location of pipe-lines understood.
- viii) Plans of drains and sewerage should show complete dimensions and details with sufficient features of the site including gradient and reduced level of salient points.
- ix) The set of drawings should be complete so as to enable the work being executed as per the specifications and standards desired.

2) For Bridge (Bridge Plans) -

In addition to the relevant details as given in (1) above, the bridge and related works plan shall also include General Arrangement Drawing (GAD), Temporary Arrangement Drawing (TAD) in case of Rehabilitation, Rebuilding and Regirdering works, the site plan, plan and longitudinal section of the river or nala above and below the proposed site in the case of large bridges being rebuilt on account of insufficient waterway or being built at a new site and a sufficient number of cross sections showing highest flood level. If a correct survey of an important river does not exist, the river should be surveyed for a distance of 8 km upstream and 2 km downstream, all spill channels upstream being shown on the plan; these distances of 8 km and 2km are to be taken as measured at right angles to the centre line of the Railway and not along the course of the river.

The standard of loading for which the bridge is designed should be recorded in the Title Block of the plan and reference to the type drawing of the particular girder should also be recorded.

3) For Yard (Yard Plans) -

In addition to the relevant details as given in (1) and (2) above, Yard Plan and plans related with platform and station structures shall also include the following details wherever applicable:

- a) The names of the nearest junctions or terminal stations, that on the left hand being the one from which the Kilometrage starts.
- b) The Kilometrage of all junction points, the zero of all branch lines, the centre of a station, junction point and zero of any line, when once adopted for any 'yard' or portion of the line, shall be a permanent mark for all future references and shall not vary with additions, alterations, or remodeling of yards.
- c) The original centre line of the railway station together with its chainages.
- d) The boundaries of land according to the land plans. Where it does not unduly interfere with important details of the plan, side widths from the centre line and boundary posts (and desirably their numbers) should be shown. However, the land boundary shown in yard plans should be rechecked and confirmed with approved & certified land plans when land related issues are dealt with.
- e) The degree, radius, total angle of deflection and the tangent points of all curves on the line, both on the plan and in the longitudinal section, Beginning and end of transitions together with their lengths should also be shown.
- f) All gradients, together with the distance from which the level or gradient extends out of station. If required, in case of steeper gradient, L' section of existing and proposed track shall be prepared separately with reference to the original yard plan. A reference to the L' section drawing can be recorded on the original yard plan.
- g) The length of sidings; position of fouling marks and buffer stops; distance, centre to centre of tracks; distance of all the facing points on the main line from the centre of station; the serial numbers of the turnouts; the angles of crossings; inclination of gathering lines; lengths of passenger and goods platforms and their heights above rail level
- h) Road crossings with their class and location; road over bridges and under bridges;
- i) Infringements of schedule of dimensions, if any, note regarding the condonation, if obtained for the infringement should be incorporated in the drawing. In case it is yet to be obtained, remark for processing condonation should be recorded.

907 Symbols and Colours on Drawings –

- 1) Symbols to be used on site plans and plans of station yards should conform to BIS code SP 46 -2003. For other commonly accepted abbreviations, table 20.1 of BIS code SP 46 -2003 may be referred to. (Table 20.1 reproduced in **Annexure 9.7** for ready reference).
- 2) For clarification of drawings it is sometimes necessary to shade some members/parts of members for which sections are drawn. In such cases, colouring/ shading in broad(thick) line may be done on the back of the tracing for the affected area.

- 3) In regard to black and coloured lines on tracings and prints, the following conventions should be observed:
 - a) Existing work that is to remain should be in full line of black;
 - b) Work that is to be dismantled should be in thin black dotted lines;
 - c) New additional work should be in full red lines. This does not apply to a drawing in which all the work is new. In case of phase working red lines shall indicate Phase-I. Dismantling of temporary work in phase – I shall be in red dotted.
 - d) Future phase working, if any, shall be shown in blue (Phase-II) and all other future works shown in green.
 - e) Work to be re-laid or rebuilt elsewhere on the same plan should be in full yellow lines.
- 4) When desirable to do so, coloured lines may also be used to distinguish tracks of different railways at junctions, M.G. or N.G. from B.G. tracks and buildings of different railways. If this is done, the colour used should be distinctly different from those mentioned above.

908 Standard Drawings –

Standard drawings issued by the RDSO and the Track Manual Drawings, shall not be traced. Copies as required should be obtained or Standard drawings should be carefully filed in each office separately from other drawings and a record thereof maintained.

909 Plans Issued By The Principal Chief Engineer's Office –

Copies/Prints of plans issued by the Principal Chief Engineer's office should be carefully maintained and recorded; copies as required may be obtained.

910 Plans in Divisions/Dy. Chief Engineer's, Assistant Divisional Engineer's and Sr. Section Engineer's offices –

- 1) The Divisional/Executive Engineers and Assistant Divisional Engineers should be in possession of a set of each of the Standard Drawings, type plans, and station yard plans, land plans, plans and longitudinal sections of the line, track diagrams, plans of bridges and other structures and plans of water supply and drainage as pertain to their jurisdiction. Plans in their custody should be carefully stored.

They shall ensure that the SSE (In charge) of Permanent Way, Works & Bridge are in possession of necessary plans as pertain to their jurisdiction and to works.

- 2) Plans need revision as and when renewals are carried out and additions or alterations are made. Every endeavor should be made to keep the track diagrams and plans, particularly of station yards and colonies, up-to-date. When alterations are extensive and cannot be shown on an existing plan, a fresh plan should be prepared.

911 Procedure For Preparation of Plans –

- 1) In general, all plans will be initiated at the Divisional level [open line or construction, as appropriate]. Principal Chief Engineer (Open line) will issue instructions as to which category of drawings will be approved at the Divisional level and which are to be sent to the Principal Chief Engineer (Open line or Construction) for approval.

Original tracings of drawings approved by a division will be retained at the Divisional office with sufficient number of copies sent to the Principal Chief Engineer's office for record and for correction of Master Plans.

In respect of drawings to be approved by the Principal Chief Engineer's office, the Divisional Engineer will prepare the tracing and send it to the Principal Chief Engineer with copies marked "preliminary", after giving 'R' number (Rough Number). When the Principal Chief Engineer has approved the tracing, 'P' Number (Pucca Number) will be given and required number of copies will be taken and sent to the Division. Original tracing in such cases will be kept in the Principal Chief Engineer's office.

- 2) Additions and alterations to an existing plan should be shown in red. After additions and alterations are approved, the original tracings will be corrected by the office where they are preserved.
- 3) However, approval of all yard plans including modification shall be dealt at Zonal HQ level only and the nominated Chief Engineer shall be the authority for approval of these plans. The system of 'R' number and 'P' number shall be followed. A detailed procedure for processing Yard Plan including modification is given in subsequent Para.
- 4) All drawings should be quoted by their number along with their alteration no.(e.g.P-8321/ALT.1 or (Zonal Railway). H.Q.E. PLAN No.(Division Name)10/09-93/R1) in the estimates and in the covering, letters accompanying the estimates and tenders etc. in all correspondence relating thereto.
- 5) Reference of sanction particulars such as Works Programme item number and work ID as per IRPSM should be shown in the plan. In case work is yet to be sanctioned reference of the proposal shall be given e.g. "Proposal for inclusion in WP 2013-14".

912 Standard procedure order for ESP & GAD approval –

- 1) All GADs, except drawings involving construction/modification of yards, and bridges (including ROB, RUB, FOB, ROR flyover etc.) shall be approved at the level of division. The structural design and drawing shall be carried out by open line or construction organisation who is the executing agency for the work.
- 2) In case of new lines/doublings/gauge conversions, General Arrangement Drawing (GADs) for Railway bridges where linear waterway is being reduced or vertical clearances are inadequate and where construction is likely to affect any of the existing bridges (during construction or during service), after clearance of concerned divisional branch officers and Divisional Railway Manager (DRM), shall be approved by Chief Bridge Engineer (CBE) of the concerned Zonal Railway. GADs of all other Railway bridges shall be approved by concerned Chief Engineer/Construction.
- 3) For Dedicated Freight Corridor Lines, GADs for railway bridges where linear waterway is being reduced or vertical clearances are inadequate and where new bridge (during construction or during service) is likely to affect any of existing bridges, shall be approved by CBE of concerned Zonal Railway. GADs of all other bridges shall be approved by the officer nominated to works as CBE by Dedicated Freight Corridor Corporation of India Ltd(DFCCIL).

- 4) GADs for all Railway bridges on open line shall require approval of Chief Bridge Engineer of the concerned Zonal Railway.
- 5) GADs and Launching schemes of all ROB/RUB/FOB/Rail Flyovers, which shall affect the existing lines, after clearance of concerned divisional branch officers and DRM, shall require approval of CBE of the concerned Zonal Railway. GADs and launching schemes of all other ROB/RUB/FOB/Rail flyovers shall be approved by concerned Chief Engineer/Construction.
- 6) For Dedicated Freight Corridor lines, GADs and Launching schemes of all ROB/RUB/FOB/Rail Flyovers shall require approval of CBE of concerned Zonal Railway.
- 7) The structural design and drawing work for the bridge works (Railway bridges/ ROB/RUB/FOB/Rail flyovers etc.) being executed by Open line organisation shall be carried out by Bridge branch at HQ level of the concerned Zonal Railway.
- 8) The structural design and drawing work for the bridge works (Railway bridges/ ROB/RUB/FOB/Rail flyovers etc.) being executed by Construction organisation shall be carried out and approved by Construction organisation.
- 9) For Dedicated Freight Corridor lines, the structural design and drawing work for the bridge works (Railway bridges/ ROB/RUB/FOB/Rail flyovers etc.) shall be prepared and approved by the officer nominated to work as CBE by DFCCIL. However, in case of Rail flyovers, proof checking of the designs by IIT is mandatory.
- 10) DRM shall be responsible to ensure that GADs are approved/ cleared by all concerned branch officers in division within a period not exceeding 15 days. DRM shall get GADs signed at Divisional level in a meeting to be conducted for this purpose.
- 11) Similarly, AGM shall be responsible in HQ. to ensure that GADs are approved/cleared by concerned HOD within a period not exceeding 7 days. AGM shall personally ensure adherence of time limit by CTPM, CPDE (or nominated SAG officer) & CBE (For Bridge GADs). There shall be no other signatures on the GADs in the HQ.
- 12) ESP approval, grade condonation, Project sheet (L-sections) etc. shall be dealt as under -
 - (a) Approval of ESP:
 - (i) ESP should be signed by JAG officers of Originating Department, DRM of Division and HQ officers (CE/Con, CEE/Con, CSTE/Plg, CSTE/Con, CTPM & CE/Planning (or nominated SAG officer) for ESPs of Construction Organisation & CTPM, and CSTE/Plg & CE/Planning (or nominated SAG officer) for ESPs of Open Line/RVNL/RITES/IRCON/Other Units). ESP signed by JAG/SG/Equivalent officers of Originating Department should be circulated by concerned JAG/SG/Equivalent officer to divisional branch officers (Sr DOM, Sr DEN, Sr DEN Co, Sr DSTE, Sr DCM & Sr DEE TRD) and ADRM. DRM/ADRM should resolve conflicting observations, if any in consultation with Originating Department and ESP should be cleared within 15 days from Division.

(ii) ESP should be prepared as per the concept plans given in the DPRs in the normal course unless the extra facilities which are minor in nature are approved by DRM and major modifications/additions are approved by GM.

(iii) While finalizing Concept Plan during DPR/DE, standard layout & instructions mentioned in (1) to (12) above and Railway Board's letter 2015/Sig/WG/Standardize layout, dated 12.07.2017, may be followed to the extent possible.

(iv) Concept plan for remodelling of yard included in the DPR should be revalidated by CTPM, CE Planning (or nominated SAG officer), CSTE/Planning & concerned SAG Officers of Originating Department before initiation of approval of ESP to avoid changes in ESP at approval stage and written minutes to be issued. Revision of ESP should be divided into following two broad categories:

- **Major Revision:** resulting into changes of yard layout. Provision of additional line, additional cross over, addition/deletion of slip/catch siding etc. shall qualify for major yard remodelling. ESP once approved should not be taken up for major revision without approval of General Manager. If revision of ESP is inescapable due to any reason, the onus taking the approval of GM within 15 days shall lie with the Department asking for revision of the ESP. Phasing of work to be indicated department wise.
- **Minor Revision:** this does not result in change of layout of the yard but is required to rectify the minor defects or deficiency detected after approval of ESP/at the time of preparation of SIP or due to any other reason. In case of minor alteration in ESP, the approval of ESP should be only by Concerned JAG/SG & SAG Officers of Originating Department & CSTE/Planning. Change of turnout from 1 in 12 to 1 in 8 ½ or vice versa, classification of line, change in location of gradient post, change in chainage, closure of LC gate, change in classification of LC gates & updating to match actuals at site shall be treated as minor alteration.

Categorization of Planning/alteration into minor or major apart from above defined categories may be done jointly by CE /planning (or nominated SAG officer) and CSTE /Planning or CSTE/Project.

In case of any difference of opinion regarding categorization of alteration into minor and major, decision of AGM shall be final.

Note: Concerned branch officers of open line and construction officials shall inspect the site, if possible, as joint inspection, before finalization of ESP.

- (b) **Sanction of grade condonation:** Proposal for grade condonation is based on approved ESP and infringement table in the approved ESP should be made. Once ESP along with infringement table is approved, there is no need to involve Divisional officers in approval of grade condonation proposal. Grade condonation proposal signed by the concerned JAG/SG & SAG officers of Originating Department should be submitted to CE Planning (or nominated SAG officers) for

further processing for approval and signature of concerned PHODs (PCOM, PCSTE, PCEE and PCE) and GM and submission to CRS for sanction.

- (c) **Approval of project sheet (L-section and Plan)** - Project sheet shall continue to be approved by Planning Cell of HQ. Planning Cell should broadly check the project sheet for violation of Terms of References to the project, if any. Executing agency should furnish the certificate that level of bridges as shown in approved GAD has been adopted in Project Sheet. Any discrepancy in the levels shown in ESP, GAD of projects and Project sheet shall be reconciled by Executing Agency and will be rectified in completion drawing.
- (d) **Approval of ESP** should not be linked with the correction of the project sheet.
- (e) **Checklist for approval** of ESP, GAD of major and minor bridges, project sheet and other drawings should be signed by JAG/SG officer of the concerned Department.
- (f) DRM shall ensure that GADs are approved/cleared by all concerned branch officers in division within a period not exceeding 15 days. DRM shall get GADs signed at Divisional level in a meeting to be conducted for this purpose.
- (g) Similarly, AGM shall monitor in HQ to ensure that GADs are approved/cleared by concerned HOD within a period not exceeding 7 days and time limit is adhered by CTPM, CE Planning (or nominated SAG officer) & CBE (for bridge GADs). There shall be no other signatures on the GADs in the HQ.
- (h) Timelines in working days for comments / approval shall be as under:

	DRM & Divisional Officers	CAO/C	CTPM	CSTE/Plg / CSTE(Proj) / CSTE(Con)	CE(P&D) / CBE	Total
ESPs						
Up to 5 lines	15	7	3	3 (Parallel)	7	32
More than 5 lines & major junctions	18	10	5	5 (Parallel to CTPM)	10	43
GADs						
Minor Bridges	7	7	--	--	7	21
Major Bridges	10	10	--	--	10	30

- (13) Bridge designs and drawings for works being executed by RVNL –

GADs of all important, major, minor railway bridges affecting existing bridges during doubling/tripling/quadrupling works, all important bridges on NL/GC works, and all ROBs/RUBs/FOBs/RORs shall be prepared by RVNL and approved by CBE.

- a) GADs of all minor and major railway bridges not affecting existing bridges during doubling/tripling/quadrupling works and on NL/GC works shall be prepared by RVNL and approved by the Chief Engineer/Construction.
- b) To the extent possible and wherever applicable, standard RDSO drawings shall be used. Existing instructions in this regard need to be followed in letter and spirit.
- c) A centralized design cell shall be created in corporate office of RVNL, headed by ED/ GGM and assisted by an experienced design team to scrutinize and

approve structural designs prepared by field units of RVNL. This design cell shall also assist field units in the preparation of GADs for important bridges and other typical bridges, the preparing design basis reports, and launching schemes for various structures. The structural design of important, major, and other typical bridges approved by this design cell shall be submitted to Zonal Railways and may be suitably considered for approval by CBE and Chief Engineer/Construction for further certifications during the submission of opening documents to the Commissioner of Railway Safety (CRS).

- d) The completion plans of various bridges/structures shall be approved by the Chief Project Managers (CPMs) of RVNL. A countersignature of the concerned Executive Engineer or Divisional Engineer (not below the level of DEN) shall be done on the completion plan.
- e) The design of launching schemes for all ROB/RUBs/FOBs/RORs and Railway bridge girders affecting running lines shall be checked by the ED/GGM in charge of the design cell of corporate office, RVNL, and approved by CBE before submission of documents for CRS sanction through the nodal Chief Engineer/Construction.
- f) CRS sanction for construction of bridges by RVNL adjacent to existing bridges and affecting the structural safety of existing bridges shall be processed by nodal Chief Engineer/Construction as per the approved GAD.

Note 1: A brief on competent authority for approval of Railway bridges, ROB/RUB etc. for Zonal Railways and other than Zonal Railway is given in **Annexure 9.8**.

Note 2: As per the Gazette notification for the Railways (opening for public carriage of passengers) Amendment Rule, 2023, following matters shall be referred to the Principal Chief Engineer or the Principal Chief Electrical Engineer or the Principal Chief Signal and Telecommunication Engineer:

- Construction, rebuilding, modification and strengthening of foot over bridges and road over bridges;
- Construction, rebuilding, re-girding and strengthening of minor bridges;
- Re-girding and strengthening of all existing bridges, other than minor bridges;
- Elimination of manned level crossing;
- Up-gradation of level crossing including interlocking outside station limits;
- Introduction to electric traction
- Work related to the Dedicated Freight Corridor

14) GAD's and Drawings for works in connection with construction of project lines by Special Purpose Vehicles (SPVs)/Joint Ventures (JVs) companies under (Public Private Partnership (PPP) model -

Railway lines being developed by SPVs/JVs, GAD/Drawings of Structures/ESP/SIP/L-Section etc. shall be approved by an SAG level (minimum) officer of the concerned Railway PSU (e.g. IRCON, RVNL etc.) except in cases where the Structure/Yards/Installations of SPV lines are involved with Indian Railway network.

913 Procedure for processing for approval of Plans –

- 1) **Approval at divisional/field unit level:** For plans to be finalized at divisional level, DRM shall be the final approving authority. Approval of all concerned branch officers shall be obtained before obtaining DRM's approval. In case of field units other than division, PCE/CAO(C) may decide the approving authority.
- 2) **Approval at Zonal level:** An ESP (Engineering Scale Plan) once prepared by division/field unit will have approval of concerned branch officers and DRM (or appropriate authority) which shall then be submitted to CPDE (or nominated SAG officer). The CPDE's office (or nominated SAG officer) shall then process for approval of all concerned HOD's in HQ before obtaining final approval of CPDE (or nominated SAG officer). An ESP shall be considered "approved" when signed by CPDE (or nominated SAG officer) of Open Line.

In case of ESP's developed by Construction Organization, after obtaining approval of DRM, the approval of different departments at headquarters level shall be processed by Construction Organization. However, the same shall be finally approved by the CPDE (or nominated SAG officer). The original tracing of these ESP's shall also be in the custody of CPDE (or nominated SAG officer) Open Line.

- 3) **Modification in plans other than yard plans:** Modification in an approved plan shall be approved by the plan approving authority. The modification shall be initiated by division & approval of concerned divisional officers shall be obtained before DRM's approval. In Zonal headquarter, the plan approved by DRM shall then be submitted to CPDE (or nominated SAG officer) for processing approval in headquarters.

For minor modifications, the approval of all officers may not be necessary. At divisional level, DRM may decide the officers whose approval is considered necessary for modification. In Zonal headquarter, CPDE (or nominated SAG officer) may decide the HOD's whose approval, he considers necessary for modification in the drawing.

However, it should be ensured that the modified plan is circulated to all concerned.

- 4) **Modification in Yard Plan:** No modification shall be carried out in Yard Plan without the approval of HQ, CPDE (or nominated SAG officer). All sanctioned works requiring modification in Yard Plan shall be commenced only after approval of modified Yard Plan and other necessary statutory sanctions. The process of modification in Yard Plan is given in para 912 above.
 - a) After approval of modification the number shall remain same, but will be added with suffix ALT -1 or ALT-2 etc.; as the case may be. The corrected Yard Plan shall then be circulated to all the signatories of the original Yard Plan for their record.
 - b) **Preparation of fresh Yard Plan:** When modifications are extensive and cannot be shown on an existing plan, new Yard Plan shall be prepared and processed for approval. A fresh number shall be accorded to the new Yard Plan.
 - c) **Periodicity of updating of Yard Plan:** A Yard Plan shall be known not only by the station name but also, it's Month and Year of updating. e.g. Yard Plan of Pune

station shall be known as "Yard Plan of Pune as on March 2010". The month of approval by CPDE (or nominated SAG officer) of Open Line shall be taken as the Month and Year of updating.

All the Yard Plans shall be updated at least once in 10 years incorporating all the details afresh. A fresh drawing number shall be allotted to the updated drawing. The updated Yard Plan shall invariably contain a note stipulating the supersession of previous Yard Plan. The following certification shall be given in all the approved Yard Plans.

"This Yard Plan supersedes the previous Yard Plan No. _____ approved in _____". Similar certification indicating the new drawing number shall also be recorded on the superseded drawing.

In stations where no modifications have been carried out in last 10 years, updating shall be indicated by certification of updating and recording the date of updating. This certification shall be treated as Alteration and old Drawing number shall be allowed to continue on the drawing by suffixing ALT-1/2, etc.

- d) Electronic Drawing Approval System (e-DAS) is to be utilized over all Indian Railways using cloud environment.
- f) For approval, modifications of plans mentioned above, the latest instructions issued by Railway Board shall be observed.

914 Completion Drawings –

1) Structures other than yards -

- a) Signed copies should be submitted by Assistant Divisional Engineer or the Engineer responsible to the Divisional/Dy. Chief Engineer for works completed to the approved drawings. These should indicate the work as actually carried out, special care being taken that the work below ground is correctly shown and nature of soils met with recorded. Alterations or modifications which may have been made from the working plans should be marked on the prints/ fresh paper tracing in red ink. When several structures are erected at the same time in the same locality and to the same drawings, one completion drawing may be submitted. If the structures or buildings differ only in foundations, the completion drawing should show the superstructure common to all, and separately the foundations of each building, designated in such a way that the separate foundation drawings can be identified with the different buildings.
- b) The Divisional/Dy. Chief Engineers should prepare fresh tracings if the alterations are numerous, showing the works as actually built. Such tracings will have "completion drawing number" stenciled in red letters in the space provided in Title Block and Divisional Engineer's signature appended thereto.

If minor alterations have been made, the original tracing may be amended in the Divisional/Executive Engineer's office and marked "completion drawing".

- c) In case of drawings approved at the divisional level, the original tracing of completion drawing will be kept at the divisional office with sufficient number of copies endorsed to Principal Chief Engineer for record and incorporation in

master plan.

In case of drawings approved by the Principal Chief Engineer office, the "Completion drawing" prepared by the division will be sent to the Chief Engineer for incorporating in the original tracing marking the same as "completion drawing".

- d) The completion drawing of a bridge should show, in addition to all dimensions, the following -
 - i) Reduced level of rails.
 - ii) Reduced level of bed blocks or crown and springing level of arch or underside of slabs.
 - iii) Reduced levels of top and bottom of foundations. If on piles or wells, reduced level of bottom should be given and complete drawings showing the strata passed through with details of any tests made.
 - iv) Nature of soil/details of bore log/details of soil strata actually encountered during execution.
 - v) Date of commencement of Work, date of completion of work.

2) Yard Plans -

In case of Yard Plans immediately after completion of a work, the executing agency (Construction/Open Line) shall submit a completion drawing on the original Yard Plan by converting red lines into black lines. Changes, if any, during the execution shall also be incorporated. New number shall be given to the drawing which shall be treated as the new Yard Plan of the station yard. In all such cases where the completion drawing is to be converted into new Yard Plan, CPDE's or nominated SAG officer's office shall accord a new number after obtaining approval of only CPDE (or nominated SAG officer). A certificate to the following effect shall be recorded on the drawing.

"The proposed work of _____ sanctioned vide _____ No. has been completed and the Yard Plan is updated which supersedes earlier drawing No. _____.

A copy of such new Yard plan with revised No. shall be circulated to all concerned.

915 Processing of ESP Developed by PSU's Govt. and Semi Govt. Organization –

These organizations shall submit the drawings to Sr. DEN (CO) of concerned division. In division, Sr. DEN (CO) shall be the nodal officer for processing expeditious approval. The drawings received from these organizations shall be processed in a time bound manner.

Essentially the procedure for processing the approval of drawing shall be same as described for all railway drawings. After processing by division, the same shall be submitted to CPDE (or nominated SAG officer) who will be the nodal officer in HQ.

In case of any modification/rectification desired by HQ, the same shall be referred to the concerned organization directly by CPDE (or nominated SAG officer) for rectification/modification. Thus, the drawings approved earlier by division need not be referred back to division for the changes decided by Hqrs. unless so decided by the CPDE

(or nominated SAG officer).

The number shall then be accorded to the drawings and a copy shall be circulated to all concerned.

916 Care and Filing of Print/Tracing –

- 1) Tracing shall not be used for reference as they are likely to get lost or damaged. Required number of prints should be supplied to concerned Engineering officers and SSEs; each particular project file should contain a print of the works relating to it.
- 2) Tracing should not be folded. Should it be necessary to send a tracing from one office to another, it shall be rolled and inserted in a cardboard cylinder.
- 3) Prints should be folded as indicated in Para 903(4) above. Two methods of folding are shown in **Annexure 9.6**. When prints are rolled for dispatch, they should be rolled with the title head outwards.
- 4) The Records Section of each Drawing Branch may file every tracing and original drawing on the basis of the subjects' classification and the index-card-filing system. Each drawer of the index-card-cabinet should be distinguished by a classification number, the system of classification being determined by C.E. Each card should be complete as regards title of the drawing, other connected drawings, file-reference and the drawer number in which the original is stored.

Storage drawers should have placards on the outside indicating the contents in each. The plans should be stored flat in shallow drawers of convenient dimensions. Probability of damage by moths or white ants should be guarded against.

- 5) All Zonal Railways shall digitize original records/ drawings in a time bound manner.

Checklist for Preparation of General Arrangement Drawing (GAD)
for Railway Bridges

SN	Item	Yes/ No
(A)	GENERAL (To be written on the right bottom corner) Chap. IX of IRWM	
1	Drawing is prepared on standard paper size i.e. A0= 841 x 1189 mm (Important/Major Bridge works) A1= 594 x 841mm (Other Bridge works) A2= 420 x 594mm Temporary arrangement & detailed drawings for bridge works. (Ref. Table 9.1 of IRWM Para 903)	
2	Drawing is prepared on AutoCAD or any other similar software	
3	Borders provided as per BIS: SP-46	
4	Title block placed at right bottom corner as per Para 903(4) of IRWM and the following basic details should be given in it:	
5	Name of the work - to be mentioned correctly i.e. Name of Railway, Division/ Construction organization, Project Work with location, name of the consultant, etc.	
6	Drawing number- to be mentioned correctly. (Ref. Para 904 of IRWM)	
7	Scale- to be mentioned in the title block correctly, size of drawing shall not be less than that mentioned in SN 1 of (A) above.	
8	Name & Signatures – The name and signature of all officials involved in preparation of GAD to be written clearly and to be signed with date. For works by construction organization name and signature of Divisional Officers also to be ensured. Provision to be made for signature of Headquarter officials. (Ref: Para 904 of IRWM)	
9	Reference – Reference of Pink Book/others Item No. with the name of sanctioned work to be mentioned clearly. (Ref. Para 904 of IRWM)	
10	Alterations – Alterations should be clearly mentioned with the name and signature with date of the officials concerned.	
(B)	NOTES (To be written on the right side of plan) The following items to be covered in the Notes on the GAD Plan	
1	Dimensions – To be written clearly (preferably in mm and levels in meter). The font size should be reasonably big and easily readable)	
2	Colour- The colour of existing work, proposed work, proposed dismantling, and future work to be indicated. (Ref. Para 907(3)) of IRWM)	
3	Scaling and Direction- No scaling of dimensions from the GAD should be permitted, all relevant dimensions to be written, North direction to be shown.	
4	Shown to scale- plan, section and elevation to be as per scale and scale to be mentioned.	
5	Directions to Field Engineers- Directions to Field Engineers before execution should be mentioned clearly, i.e. verification of various levels, including rail level, formation level, HFL, maximum observed scour level on upstream, foundation level, bore log data, type of soil, bearing capacity, etc. Clear directions in case there is apprehension of damage to nearby structures, etc.	
6	Co-ordination – Clear direction to the executive department to consult/intimate other concerned departments.	
7	Traffic diversion- In case of traffic diversion during execution, the same is to be mentioned with details like the chainage of take-off points on both ends, etc.	
8	Speed restriction- A clear mention of speed restrictions to be followed before/ during/after the execution.	
9	Reference Drawings- The drawings referred for detailing to be mentioned	

	clearly.	
10	Miscellaneous details- Miscellaneous details like skin reinforcement, no plastering/cement wash, dry stone pitching, weep holes, backfill, inspection platform, pedestal, trolley refuges, OHE mast, safety measures, service cables, launching scheme, protective coating to reinforcement and concrete, station names with their MSL, railway boundary, modus operandi, etc. to be mentioned in the notes itself.	
11	Codes and Specifications- Reference of Railway Codes/Manuals (Bridge Rules, IRBM, etc.), IS Codes, IRC Codes with their order of preference and specifications to be followed, should be clearly mentioned.	
12	Technical details- All technical data used for preparation of GAD such as latitude/ longitude, track on single/double line, bridge on UP line or DN line, grade, rail level, formation level on approaches, HFL, LWL, bed level, free board & vertical clearance provided vis-à-vis the codal requirements, linear water-way, standard of loading, type of super- structure, type of bearing, type of sub-structure, type of foundation, design discharge, catchment area, seismic zone, wind zone, hydro- meteorological sub- zone for water-way calculation, exposure condition, clear cover to reinforcement, provision of guard rails, track on straight or on curve, any RAT/RAW within 50km on upstream, cross slope, name of river/stream etc. to be summarized in a tabular form. All reduced levels to be mentioned w.r.t. MSL.	
13	Details of existing bridge- Details of existing rail bridge/road bridge to be written in a tabular form i.e. existing bridge no., location, span, type of sub- structure/ foundation, distance from new bridge, rail level, formation level & foundation level, water-way and critical levels, any major incidents that happened to these bridges in the past, etc.	
14	Details of trial pit/bore log- Nature of the soil as determined from trial pit & bore log details, the details of location with chainage, reduced level at the top of the trial pit/bore log; SBC value for each stratum to be shown in tabular form and pictorial form. (Ref. Para 906(1)(f)(v) of IRWM)	
(C)	INSTRUCTIONS TO BE FOLLOWED IN THE PREPARATION OF GAD	
1	Whether the proposed work is as per sanction or is there any deviation from sanction. In case of deviation, the details thereof. (Pink Book/Other Sanction)	
2	Whether GAD satisfies the latest approved SOD. Infringements of standard dimensions, if any, should be shown. (Ref: a. IRSOD b. Para 906-(3)(i) of IRWM)	
3	Relevant & up to date IRS and IRC Codes, etc. with their order of preference to be decided. (Ref. Various Codes, Manuals, Specifications, etc.)	
4	L-Section:	
	(i) Whether L-Section of Gauge Conversion Projects and Doubling Projects has been approved by open line?	
	(ii) In case of New Line Projects being executed by construction organization, whether L-Section has been approved by construction organization? In case of New Line Projects being executed by PSUs, whether L-Section has been approved by open line? (Ref: Board's letter No. 98/W- 1/General/ O /30 dated 10.06.2008)	
5	In case of construction of new bridge during doubling, whether Railway has considered the condition of existing single line bridge also for replacement in the near future? (Ref. Board's letter No. 2021/ED(Proj)/Misc./ Committee dated 12.11.2021)	
6	Whether provision of IRBM has been considered for site selection of bridge? (Ref. Para 308 of IRBM)	
7	Whether hydrological investigation has been carried out? A report to be submitted. If not, the reasons thereof. (Ref: a. Clause 4.1 of IRS Sub-structure Code b. Chapter 3 of IRBM)	
8	Whether design discharge has been calculated/ provided as per the Sub-structure Code? (Ref. Clause 4.2 to 4.4 of IRS Sub-structure Code)	

9	Whether discharge due to RAT/RAW in upstream has also been taken into account? (Ref. IRC: 5- 2015 - Clause 106.3.5)	
10	Waterway:	
	(i) Whether proposed waterway has been provided as per the Sub-structure Code? (Ref: Clause 4.5 of IRS Sub- structure Code)	
	(ii) In case of gauge conversion and doubling works, where there is no history of past incidents of over-flow/washout/excessive scour, etc. during last 50 years, whether waterway of existing bridge has been retained after taking measures for safety as considered necessary? (Ref: Clause 4.5.7 of IRS Sub- structure Code).	
	(iii) Whether waterway has been re-assessed based on the freshly estimated design discharge, where such history is there? (Ref: Clause 4.5.7 of IRS Sub-structure Code)	
	(iv) Whether clearance from Inland Waterways Authority of India/concerned Authority for navigational requirement for proposed bridge is taken, wherever required? (Ref: Para 302 (f) of IRBM)	
11	Whether vertical clearance and free board have been provided as per the Sub-structure Code? If not, a note should be added that condonation should be taken from the competent authority before starting the work. (Ref: Clause 4.8 and 4.9 of IRS Sub- structure Code)	
12	Whether maximum scour depth below HFL at pier and abutment has been considered as per the Sub- structure Code? (Ref: Clause 4.6 of IRS Sub-structure Code)	
13	Foundation:	
	(i) Whether safe bearing capacity has been calculated by suitable method? (Ref: Clause 6.3.1 of IRS Sub- structure Code)	
	(ii) Whether open foundation has been adopted? If not, whether approval of CBE/SAG officer has been obtained? (Ref: Board's letter No. 2014/CE- III/BR/ Bridge Policy dated 15.11.2016)	
	(iii) Key details such as HFL, LWL, Bed Level, Scoured Bed Level, Founding Level, Grip Lengths, Diameter of Pile/Well, Well/Pile cap Level, etc. are shown in the GAD.	
	(iv) Whether distance between existing and proposed bridge has been adequately provided? (Ref: RDSO letter No. CBS/DWF dated 15.07.2019)	
	(v) Whether the location of proposed piers and abutments are in line with those of the existing bridge? If not, the reasons thereof. (Ref: Board's letter No. 2017/29/C E- III/BR/ Br. 588/ECOR dated 03.08.2017)	
	(vi) In case of doubling, whether new bridge is provided in downstream side? (It is preferable to provide a new bridge in downstream of an existing bridge)	
14	Selection of span:	
	(i) Whether most economical option has been considered? Proper and adequate justification for selection of span to be mentioned.	
	(ii) Whether overall length is more than existing bridge/water course? If so, the reasons thereof.	
	(iii) Whether overall length is less than existing bridge/water course? If so, the reasons thereof.	
	(iv) In case of doubling, the span arrangement should preferably be the same. Board's letters No. 2014/CE- III/BR/Bridge Policy dated 04.02.2015 & 21.04.2015	
15	Super-structure:	
	(i) Whether Board's guidelines followed for selecting the type of super-structure? If not, whether Board's approval has been taken? (Ref: Board's letter No. 2005/CE- I/BR-II/8 dated 28.05.2009)	
	(ii) Whether RDSO standard drawing/standard span is followed? If so, whether all the dimensions are as per RDSO standard drawing? If not, approval from	

	PCE/ CAO obtained with proper justification should be obtained. (Ref: Board's letter No. 2013/C- III/BR/RDSO/Misc. dated 11.08.2014)	
16	Size of pier/abutment cap	
	(i) Whether size of pier/abutment cap has been provided based on the provisions of the Sub- structure Code, Seismic Code & IRBM including inspection arrangements?	
	(ii) While deciding the size of pier/abutment cap, whether the following key aspects have been considered:	
	• Space for inspection and maintenance of bearings including the space for jacks to lift the superstructure for repair/ replacement of bearings, etc. • Placement of seismic-restrainer. • Placement of the bearings, leaving an offset of 150 mm beyond them, • Space for the ballast wall. • Space for the equipment for pre-stressing operations where necessary, over and above space for end block in cast in-situ cases. • The drainage arrangement for the water on the cap. • To accommodate inspection ladders • Placement of OHE mast • Dimensions of girder as given in superstructure drawing. • Minimum seating width should be provided as per IRS Seismic Code. (Ref: a. Clause 7.1.1 & 7.2.1 of IRS Sub-structure Code b. Clause 14 of IRS Seismic Code C. Para 604(1) of IRBM)	
17	Whether bearings have been provided as per requirement and details shown correctly? (Ref. a. BS-102 (Rev.1) b. BS-131)	
18	Whether bridge is located in seismic zone III, IV & V? If yes, ductile detailing is mandatory for piers/portals as per the IRS Seismic Code. (Ref: Clause 5.3 of IRS Seismic Code First Revision – 2020)	
19	Whether RCC Boxes are provided?	
	If yes, whether the instructions latest Railway Board instructions are followed?	
20	RUB/Subways alongside ROB:	
	(i) Whether the instruction given in Railway Board letter dated 18.02.2021 has been followed for water logging and drainage problem in RUB/Subways? (Ref: Board's Letter No.2017/C E- IV/RUB/88 dated 18.02.2021)	
	a. Whether Height Gauges have been provided? (ref: a. Para 1107 (14)-b(i) of IRBM b. Railway Board Letter No.2017/CE-IV/LX/ Misc./244(L C) dated 15.10.2020)	
21	Safety provisions:	
	(i) Whether trolley refuges have been provided a. Para 646 & 834 of IRPWM-2020 b. IRSOD	
	(ii) Provision of Side Pathways on Girder Bridge (Ref: a. RDSO letter No. CBS/DP G1 dated 24.04.2019 b. Para 229 of IRPWM-2020)	
	(iii) Provision of Guard rails on Bridges (Para 220 of IRPWM 2020)	
22	Whether backfill material behind abutments, wing walls, RCC boxes, etc. has been shown? (Ref: Clause 7.5 of IRS Sub- structure Code)	
23	Whether weep holes have been provided adequately? (Ref: Clause 7.6 of IRS Sub- structure Code)	
24	Whether flooring details with curtain wall/drop wall/apron have been shown with cross- section? (ref: a. IRC SP: 13-2004 b. Para 818 of IRBM)	
25	Whether wing walls with cross-section, with dotted lines in elevation have been shown?	
26	Whether proper facilities for inspection like inspection ladder, steps, inspection platform have been provided? If not, the reasons thereof. (Ref. a. Para 6 of BS-102 (rev. 1) b. Para 6.3 of BS -113 c. RDSO drawing no. CBS- 0016)	

27	Whether reference of separate drawings like protection work, pitching etc. has been mentioned at appropriate place?	
28	Whether direction of flow has been confirmed from site and shown correctly in the plan?	
29	Whether river-training and protection works are required? If so, these have been provided as per IR Bridge Manual. (Ref: Chapter 8 of IRBM)	
30	Whether following information is shown on the drawing:	
	(i) The names of the nearest junctions or terminals stations, that on the left hand being the one from which the Kilometrage starts). (Ref: Para 906(3)(a) of IRWM)	
	(ii) The boundaries of land according to the land plans. (Ref: Para 906(3)(d) of IRWM)	
	(iii) Any known bench mark with the datum from which its value has been reckoned.(Ref: Para 906 (1)(f)(ii) of IRWM)	
	(iv) The degree, radius, beginning and end of transitions, total angle of deflection and the tangent points of all curves on the bridges and its approaches. (Ref: Para 906(3)(e) of IRWM)	
	(v) All gradients, points of change of gradient on the bridges and its approaches (Ref: Para 906(3)(f) of IRWM)	
	(vi) In the case of foundations, the nature of the soil as determined from trial pit, and bore log details. (Ref: Para 906(1)(f)(v) of IRWM)	
31	The drawings for a bridge should include the site plan, plan and longitudinal section of the river or nala above and below the proposed site in the case of large bridges being rebuilt on account of insufficient waterway or being built at a new site and a sufficient number of cross sections showing highest flood level, ground plan of foundations, sections through the bridge in such directions as are necessary to show the intended form and dimensions of the various parts, front and side elevation of abutments and piers, and drawings of such details as have not been standardized. The standard of loading for which the bridge is designed should be recorded in the plan and reference to the type drawing of the particular girder should also be recorded. (Ref: Para 906(2) of IRWM)	
32	Whether GAD has been prepared with half plan at top and half plan at bottom with longitudinal section, sectional elevation and key plan?	
33	Whether the dimensions of plan, elevation, cross section, longitudinal section have been cross checked for inconsistency/ errors. The dimensions should match?	
34.	In case of Important Bridge, whether preparation & approval of Design Basis Report is required in terms of extant policy of Railway Board? (Ref: a. Board's Letter No. 2013/C E-III/BR/RDSO/ Misc. dated 04.06.2014 b. Board's Letters No. 2014/C. E-III/ BR/Bridge policy dated 11.11.2019 & 09.03.2017)	
35.	Whether inspection and maintenance of bridge can be ensured as per the extant instructions, methodology and techniques or preparation of a bridge-specific inspection and maintenance manual is considered necessary in view of use of special type of span/use of new technology/peculiar features of bridge?	

Note: Latest version of Codes & Manuals, Special Publications and RDSO BS Reports should be referred to.

Check List for Preparation of GAD of ROB

SN	General	Yes/ No
1	Whether the GAD has been prepared with a key plan, showing existing alignment with all features like ROB, bridges, curves etc., up to the curve/stations on both sides of ROB?	
2	Description of spans: Whether Overall length & effective length of span which are within railway boundary, is mentioned? Width of ROB: Whether the width of ROB at deck level has been mentioned?	
3	Skew angle: Whether Skew angle with existing track and proposed ROB is mentioned in the key plan? All square and skew dimensions shall be shown in the plan and elevation	
4	General: Whether the following has been written on Right Bottom Corner?	
	Name of work - Mention proposed ROB type, Division, Name of Road and Type, LC No., Railway KM, between Stations and block section etc., name of consultant etc.	
	Drawing number- to be mentioned correctly.	
	Scale - to be mentioned correctly, Size of drawing to be not less than A1, on tracing paper (to be converted to tracing cloth after execution). 1) Scale 1 :100 as a rule 2) Key Plan also to be drawn on a scale up to curves, or station yard, or 1000 m at least on either side in the case of ROB.	
	Name and Signature- The name and signature of all officials involved in preparation of GAD to be written clearly and to be signed with date. For construction organization works, name and signature of divisional officer also. Provision to be made for signature of Head Quarter officials.	
	LC No. & TVU: Whether LC No. and TVU with year is mentioned above title block?	
	Name of Road authority: Whether the name of road authority with address of concerned Engineer of road authority is mentioned?	
	Reference- Reference of PB/others, item no. with name of sanctioned work to be mentioned clearly.	
5	Dimensions & Levels - To be Written Clearly (Preferably in mm and levels in meter).	
	Colour- The colour of existing work, proposed work, proposed dismantling and future work to be indicated. (Ref. Para 907(3)) of IRWM)	
	Directions- Whether North directions has been shown in the Key Plan? To be shown on Top Right Corner 'ONLY'.	
	Whether Plan section and elevation are to be as per scale? Scale to be Mentioned.	
	Whether Direction to Field Engineers has been Incorporated (Direction to field Engineers, before execution should be mentioned clearly i.e. verification of various levels including rail level, Formation level, foundation level, bore Log data, type of Soil, Bearing capacity, etc. (Clear directions in case there is apprehension of damage to nearby Structure etc.)	
	Co-ordination- Clear direction to executive department to consult /intimate to other concerned departments. Clear responsibility of other executive departments to be defined for Consultation /intimation to other departments.	
	Traffic diversion- In case of traffic diversion during execution, the same to be mentioned with details like chainage of take-off points on both ends, etc. Division should show and ensure.	

	Speed restriction- Clear mention of speed restriction to be followed before/ during and after the execution.	
	Reference Drawings - The drawings to be referred for detailing to be mentioned clearly. e.g. Inspection Arrangements, Structural Drawings, Type plans such as rain water harvesting, RCC Hume pipe, Height gauge, etc.	
	Miscellaneous details- Miscellaneous details like inspection platforms on pier/ abutments, service cables, launching scheme, railway boundaries, Modus operandi, etc. to be mentioned in the notes itself.	
	Codes and specification - Reference of IRS codes, IS Codes, IRC Codes with their preferential order and specification to be followed and should be clearly mentioned.	
	Technical Details - Whether GAD contains all technical details?	
	(all technical data used for reference in preparation of GAD to be written in a tabular form, like type of IRC loading, latitude/longitude, grade of road at approaches, rail level, formation level on approaches, , ground level, vertical clearance, standard of loading, type of superstructure, type of bearings, type of substructure, type of foundation, seismic Zone, wind zone, exposure Condition, Clear Cover to reinforcement and all reduced levels to be mentioned w.r.t rail level.	
	Details of existing ROB- Whether details of existing ROB if any, have been incorporated? (Details of existing road level/FRL to be written in a tabular form, i.e. existing ROB no, location, span, type of substructure/foundation, distance from existing ROB, rail level, road level, etc.)	
	Details of Trial pit/ Bore log- Whether details of trial pit/bore log have been incorporated? - (the details of location with chainage, reduced level at top of trial pit/bore log, SBC value for each stratum to be shown in a tabular form).	
	Alteration- Alteration should be clearly mentioned with the name and signature with date of official concerned.	
6	Whether the stipulations regarding speed restriction, traffic and power block etc. Have been firmed up and indicated in GAD? The traffic block and caution order requirement to be shown in tabular form.	
7	Consent of competent authority for closing of LC: The GAD should specifically contain a note regarding the status of Level crossing, whether (a) It would be closed during the construction of ROB or (b) It would be closed after the commissioning of ROB or In case LC is to be closed after construction of ROB, the consent of competent authority (collector) to be obtained, and copy of letter shall be enclosed along with check list. The same shall also to be mentioned in the note.	
8	In case of electrified sections, whether OHE protection arrangements like protection screen, etc. on the superstructure of ROB has been planned as per the RDSO standard arrangement? If a non-standard arrangement has been proposed, whether the same has been checked and certified? Sr. DEE/TRD and Sr. DEN should examine this aspect while signing the GAD.	
9	For ROB, whether a Copy of approved alignment plans up to Adjacent stations/ Curve on both sides has been Submitted for better appreciation? The approved project sheet should be sent along with and the reference of the same should be in the notes.	
10	Whether term of work i.e. Deposit basis or cost sharing basis, has been shown? If the work is on a deposit basis, enclose the detail of paid P&E charges and mention DEPOSIT WORK at the right corner of GAD. If the work is on a cost sharing basis, mention PB No./LB No. at right corner of GAD.	
11	Whether Road authority /NHAI have submitted Detailed Project Report (DPR) along with proposed GAD duly signed by concerned official of NHAI/Road authority through their consultant?	
	MISCELLANEOUS	

12	Whether the foundation of ROB has been finalized on the basis of detailed soil exploration and with due consideration of requirement of speed restrictions/traffic blocks? RL of bottom of foundation should be indicated in GAD.	
13	Whether detail of at least one span laying outside but adjacent to Railway boundary has been shown for considering their load coming on the pier under consideration.	
14	Whether the gradient of the road of approaches has been mentioned on either side. It should be min. 1 in 40 as per IRC.	
15	Whether the top of the pile cap is sufficiently below formation level? Whether the pile cap is sufficiently away from railway track so that the excavation of pile cap should not come in the line of load dispersion below sleeper, assuming a slope of 1V:1H.	
16	Whether provisions have been made for stairs located outside railway area at both ends of ROB for the passage of pedestrian? This is essential for the closure of the level crossing after the construction of ROB.	
17	Whether the horizontal and vertical clearances as applicable to electrified territory (25 kV AC) have been adopted in GAD even on routes having diesel traction to cater for future electrification?	
18	Whether the Head Room clearance under ROB in electrified section has been provided as minimum 6525mm as per Railway Board's letter No. 2007/RE/161/5- FTS-774 dt. 12.10.2011. If the proposed ROB comes on Electrified DFCC/Double stack container route, the minimum clearance shall be as per DFC SOD.	
19	Whether RDSO standard composite steel girders/Bow string girder has been adopted for ROB? PSC girders can be adopted for spans less than 24.4 m only.	
20	(i) Whether steel structures have anti-corrosive protection of long durability? Whether adequate arrangements for the drainage of the deck have been made?	
21	Whether Inspection ladders from road to pier top, inspection steps from track level to road level and inspection platforms in the piers/Abutments have been incorporated in the structural drawings to ensure proper inspection accessibility?	
22	Whether the shoring arrangement is required during foundation work? If yes, details shall be submitted.	
23	Whether the existing utilities are shown in the GAD? The signature of utility owner shall be obtained.	
24	Whether future tracks have been incorporated into key plan?	
25	Sanction of PCE is required for all cases where there is passenger carrying train traffic.	
26	Whether staircases have been provided at outside Railway land boundary in case of ROB is in lieu of any LC?	
27	Whether road width has been provided as per RDSO and IRC standard configuration?	
28	Whether road level of ROB is uniform within the Railway land limit?	

Check list for preparation of GAD for RUB

SN	General	(Yes/ No)
1	Whether the GAD has been prepared with a key plan showing existing alignment with all features like bridges, curves etc., up to the curve/stations on both sides of RUB/Subway?	
2	Internal size of Box: Whether the span and height of the RCC box have been decided based on the type of road, nature of traffic, and TVU? The consent of road authority shall be obtained on the GAD.	
3	Total length of RCC Box: Whether the total length of the Box is mentioned? The minimum length of RCC BOX should be the distance between points where a slope of 1.5:1 drawn from the ends of sleeper to cut the bottom face of the slab of BOX. However, in no case, the minimum length of RCC BOX shall be less than 7850mm for a single line and 13150mm (7850+5300) for double lines.	
4	Standard of loading: Whether the loading is mentioned? It should be mentioned in GAD above the title block. Mention 25T loading for all BG routes. Mention DFC loading (32.5t) if the LC is coming in the feeder route or in the nominated route of the double stack container. Whether RDSO standard drawing no. of RCC box, according to loading, type of construction, depth of fill, & nos. of track crossings, has been mentioned?	
5	Method of Execution: Whether execution method is mentioned? a. Pushing through embankment b. Pushing method with Reliving girder or c. Cast in situ method	
6	Skew angle: Whether the skew angle of the existing road and proposed RUB/Subway is mentioned in key plan? Skew angle of existing Road and Skew angle of proposed subway should be mentioned in the key plan. All possibilities shall be explored to avoid skew. All square and skew dimensions shall be shown in the plan and elevation.	
7	General: Whether the following has been written on Right Bottom Corner? Name of work - Mention proposed RUB/Subway type, Division, Name of Road and Type, LC No., Railway KM, between Stations and block section etc., name of consultant etc. Drawing number- to be mentioned correctly. Scale - to be mentioned correctly, Size of drawing to be not less than A1, on tracing paper (to be converted to tracing cloth after execution). 1) Scale 1 :100 as a rule. 2) Key Plan also to be drawn on a scale up to curves or station yard or 500m or less than 500 in case of RUB.	
8	Name and Signature- The name and signature of all officials involved in the preparation of GAD to be written clearly and to be signed with a date. Provision to be made for the signature of Head Quarter officers also. LC No. & TVU: Whether LC No. and TVU with year is mentioned above in the title block? Name of Road authority: Whether the name of the road authority with the address of concerned Engineer of road authority is mentioned? Reference- Reference of PB/others, item no., with the name of sanctioned work to be mentioned clearly.	
9	Dimensions & Levels -To be Written Clearly (Preferably in mm and levels in meter). The font size Should be reasonably big and easily readable. The Reduced level of the existing rail level shall consider as 100m. All levels such as Road level, Ground level, formation level, Top of Box, Bottom of Box, top of	

	wing and return wall, founding levels etc. shall be indicated accordingly.	
	Colour- The colour of existing work, proposed work, proposed dismantling and future work to be indicated. (Ref. Para 907(3)) of IRWM)	
	Directions- Whether North directions have been shown in the Plan? To be shown on Top Right Corner 'ONLY'.	
	Whether Plan, section and elevation to be as per scale? Scale to be Mentioned.	
	Whether Direction to Field Engineers has been Incorporated (Direction to field Engineers before execution should be mentioned clearly i.e. verification of various levels including rail level, Formation level, foundation level, bore Log data, type of Soil, Bearing capacity etc. Clear directions in case there is apprehension of damage to nearby Structure etc.).	
	Co-ordination- Clear direction to executive department to consult /intimate to other concerned departments. Clear responsibility of other executive departments to be defined for Consultation /intimation to other departments.	
	Traffic diversion- In case of traffic diversion during execution, the same to be mentioned with details like chain age of take-off points on both the ends etc. Division should show and ensure.	
	Speed restriction- Clear mention of Speed restriction to be followed before/ during and after the execution.	
	Reference Drawings - The drawings to be referred for detailing to be mentioned clearly. e.g. Inspection facilities, structural drawings, Height gauge etc.	
	Miscellaneous details- Miscellaneous details like weep holes, backfill, railway boundary, Modus-operandi etc. to be mentioned in the notes itself.	
	Codes and specification - Reference of Railway codes, IS Codes, IRC Codes with their preferential order and specification to be followed and should be clearly mentioned.	
	Technical Details - Whether GAD contains all technical details? (All technical data used for reference in preparation of GAD to be written in a tabular form like latitude/longitude, RCC Box of single/Double, subway on UP line /DN line/yard lines, grade on approaches, rail level, road level on approaches, bed level, standard of loading, type of foundation, exposure Condition, Clear Cover to reinforcement, track on Straight or on Curve, etc. All reduced levels to be mentioned w.r.t rail level).	
	Details of existing LC- Whether details of existing LC, if any, have been incorporated?	
	Details of Trial pit/ Bore log- Whether details of trial pit/bore log have been incorporated? - (the details of location with chainage, reduced level at the top of the trial pit/bore log, SBC value for each stratum to be shown in a tabular form).	
	• The classification of soil shall be as per IS-1498, IRS substructure code & IRC-78. • The depth of soil exploration shall be as per IS 1892. • The location of trial pit should be near to the proposed subway and may be indicated on the plan. • Depth of bore should be at least 5m below the bed of BOX to estimate a feasible drainage scheme. It should also be sufficiently below the proposed deepest foundation level of BOX/wing or return wall.	
	Alteration- The alteration should be clearly mentioned with the name, date and the signature of official concerned.	
10	Whether the stipulations regarding speed restriction, traffic, power block, etc. have been firmed up and indicated in GAD?	
11	Consent of competent authority for the closing of LC: The GAD should specifically contain a note regarding the status of level crossing, whether • It would be closed during the construction of RUB or • It would be closed after the commissioning of RUB	
12	Drainage arrangement: Whether following details has been incorporated? (a) The drainage arrangement shall be adopted as per recommendations for water logging and drainage problems for RUB/Subways issued vide Rly Board's letter No.2017/CE-IV/RUB/88 dated 22.04.2020 or latest instructions of Railway	

	Board & as per Rly. Board's Letter No.2017/C E- IV/RUB/88 dated 18.02.2021) RUB or the latest instructions of Railway Board. (b) The drainage scheme should be shown in GAD, and its functional feasibility at the site should be carefully verified. (c) All arrangements for storm water outlay shall be clearly shown in the drawing, such as sump detail, soak pit, bore hole, outfalls in the river, Nalla, or open area etc. and their reduced levels.	
	Approach: Whether following details incorporated? a. Mention Type of approach and earth-retaining structures according to site condition: Open cutting by providing a suitable cross slope: Open cutting with soil protection with turf: Open cutting with soil protection with pitching: Earth retaining wall (RCC or CC retaining wall/RCC U wall) b. Gradient of road at approaches on either side should be as per IRC:73 -2023 Table 7.1 & 7.2 i.e. Ruling gradient: 1 in 30 & Limiting gradient: 1 in 20 (for low volume rural road)	
13	• Suitable railings (1.2m high from GL for RCC wall) or spoil bank (0.6m high from GL for open cut) on both of approaches should be provided. • Detail of approach on either side should be shown in key plan.	
MISCELLANEOUS		
14	Whether term of work, i.e., deposit basis or cost sharing basis, has been shown? • If the work is on a deposit basis, enclose the details of paid P&E charges and mention DEPOSIT WORK at the right corner of GAD. • If the work is a on cost sharing basis, mention PB No./LB No. at right corner of GAD.	
15	Whether Road authority /NHAI have submitted Detailed Project Report (DPR) along with a proposed GAD duly signed by concerned official of NHAI/Road authority through their consultant?	
16	Whether the foundation of Subway has been finalized on the basis of detailed soil exploration and with due consideration of requirement of speed restrictions/ traffic blocks?	
17	Whether the subway has been proposed at the same location of LC to avoid wastage of railway land? If subway is not feasible at the existing location of LC, detail justification should be brought out.	
18	Whether the longitudinal grade of road surface of Subway has been shown in L-section on either side. The slope should not less than 1:40.	
19	Whether height gauge as per RDSO drawing No. M-0001 at either side of box has been shown or note regarding the same to be incorporated?	
20	Whether the type of wing and return wall (CC or RCC) proposed is mentioned in the drawing?	
21	Whether shoring is required while box pushing/ cast-in- situ construction? If yes, details shall be submitted.	
22	Whether speed restriction/traffic block is required?	
23	Whether the existing utilities are shown in the GAD? The signature of utility owner shall be obtained.	
24	Whether future tracks have been incorporated in the key plan?	
25	Whether the details of either end of the bridges along with the distance from the proposed subway to be shown in key plan?	
26	Whether the details of OHE mast, TP, gate, hut, canal, pipe crossings, or any other structure have been mentioned in the Key plan/ plan?	
27	Whether the Standard RDSO relieving girders have been provided for LHS work, if applicable?	
28	Sanction of PCE is required for all cases where there is passenger carrying train traffic.	

Annexure 9.4
Para 901(1) (a)(i)

Checklist for ESP Approval

SN	Items	Yard Sticks/Requirements
1	Title / Signature Block and Numbering	Title Block: Following information to be incorporated in the title block. i. Bilingual ii. Name of Railway iii. Name of Division/Construction Organization iv. Name of work v. Reference to sanction particulars. (PB/LB item number) vi. Scale of drawing should be 1: 1000 vii. Drawing number of DRM or CAO/C or Zonal HQ viii. Dated initials of the concerned officials. ix. Signature box for 'Drawn by' and 'Checked by' with concerned officials' digital sign to be added in block. x. Reference drawing number like approved plan being superseded, the standard drawing, etc.
2	Key Plan	Key plan (not to scale) should be shown in ESP on Top Right or Left Corner.
3	Scale of Drawing	i. Scale 1 cm to 10 m (1:1000) ii. Details too small for complete dimensioning in the main representation shall be shown adjacently in separate detail view of recommended scale 1:2, 1:5, 1:10, 1:20 and 1:50 [Ref: Engg. Code Para 468 and IRWM Para 905(3)]
4	North Direction	The north direction should be shown at top right corner of plan. [Ref: IRWM 906(1)(i)]
5	Color Scheme & Line Weight	i. Existing details (track, PF, bridge etc.) in black. ii. Work to be dismantled in black dotted line. iii. Proposed work in Red. For Phase work, Phase-I in Red, Phase- II in Blue, dismantling of temporary work in Phase-I in Red- dotted. All other future works in green. iv. Mention executing agency of each phase work / works proposed in the ESP such as Open line/Const./RVNL, etc. v. Cancellation/Modification/Alteration proposed shall be strictly as per colour scheme as detailed above. vi. Existing Railway land boundary Black chain dotted and proposed Railway Boundary in Red chain dotted. vii. Proposed land acquisition to be shown hatched in Red. viii. Other details which need to be required should be shown in faded colour.
6	Chainage	i. All chainages should be in meter and reckoned from centre line of the station building, which shall be at zero (0.0 m) chainage. However, proper chainage in Kilometer/meter may also be mentioned, and mathematically, the figures should be consistent. ii. Chainages of turnouts, dead end, FM, LC gate, Bridge, Gradient post, Curve chainages (T1, J1 J2, T2), trap point and other important fixtures should be mentioned with respect to centre line of station building. Chainages should be marked positive in increasing kilometers and negative in decreasing kilometers. iii. Notation line mentioning chainage value of each relevant point/ structure on the track should be shown with adequate offset for clarity of drawing.
7	Gradient	i. Chainage and gradient values should be the same as those of approved L-section/ESP unless proposed for change with specific justification. ii. Grade post should be marked at the exact location with a rise and

		fall. Indicate the line no. to which it belongs to under the grade post chainage. iii. Yard gradient post with their chainages should be shown up to 2.5 km on both sides of the station. iv. Remarks for departure from recommended gradient 1:1200 for new yard should be marked as per Para 2 of chapter 2 of IRSOD 2022. v. Maximum gradient in station yards shall be as per Para 2(i) of chapter 2 of IRSOD 2022. vi. No change of gradient within 30 meters of SRJ of any points and crossings or between crossovers, per Para 2(f) of chapter 2 of IRSOD 2022. vii. In new lines, preferably no level grade in yards, (from drainage point of view). viii. If gradient is 1 in 80 or 1 in 100 and steeper towards/away from yard limits, proper catch siding in former case or slip siding in latter case is provided. [Ref: Para 232 of Engg. Code] ix. Re-grading profile should be shown (if applicable) x. Gradient rounded off in whole no. (If not) Note should be added that 'The gradient in fraction should be rounded off in the completion drawing, and the adjustment should be done in formation in level suitably.'
8	Curve	i. Transition curve shall be for 160 KMPH speed potential, if not, then reason thereof. {Ref: Rly. Board letter no. 2013/W-I/Genl./0 / 30 Pt. II, Dated:12.05.2017} ii. Curve Length with Tangent & Circular Curve Points (TP1/J1 & TP2/J2) chainages with nomenclature etc. shall be shown. Representation of Curve to be shown Annexure 9.4A. iii. Other Curve details (Radius, Degree, Deflection angle, Tangent length, Transition length (in case of unequal transition, length of both transition curve to be shown), Super elevation, Speed potential). iv. If Permanent speed restriction (PSR) is imposed due to certain reasons, note regarding the same should be added with explanation and supporting calculations. v. For high speeds, in group 'A' and 'B' routes, a straight with a minimum length of 50 m shall be kept between two transitions of reverse curves. vi. Lead radius of Turnout taking off from curved track (similar flexure) should not be less than 350 m. [REF IRPWM 408(2)(e)(i)] Note: On groups 'A' and 'B' routes on straights less than 50 m between reverse curves should be eliminated by suitably extending the transition lengths. In doing so, it should be ensured that the rate of change of cant and versine along the two transitions so extended is kept the same. Whenever such straights between reverse curves can neither be eliminated nor the straight length increased to over 50m, speed in excess of 130 Kmph should not be permitted. [Ref: Para 405, 9(b) of IRPWM 2020]
9	Track & related items	i. Minimum track centre should be 5.3m for doubling & 7.8 m for 3rd & 4th line. [Ref: Railway Board's letter no. 2013/W-1/Genl./0/30Pt.II dt. 28.05.2018] ii. Designation and Nomenclature of each existing and proposed line. iii. Direction of Traffic in UP and DN main line to be marked. iv. CSR of each line from FM to FM with chainages. Minimum CSR provided to be 750m.

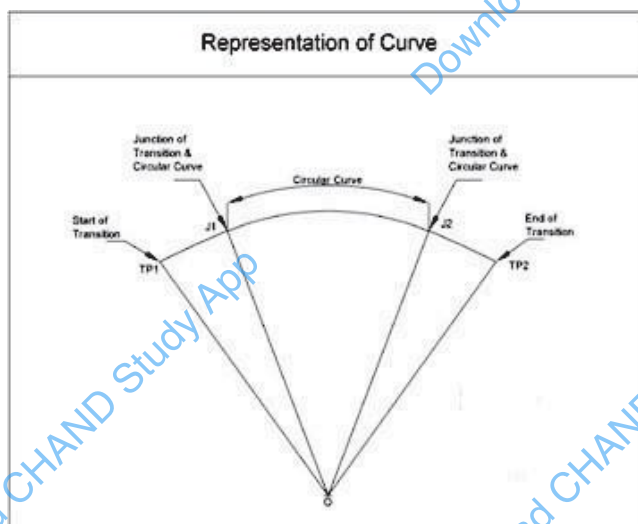
		v. FM should be provided at location where distance between track centres starts reducing from 5.3 m. vi. Centre to centre of track distance, especially at crossover location. vii. Next station to be marked with their Kilometer at both ends of yard. viii. Provision of Track machine siding in projects for newlines, doubling, GC and yard remodeling should not less than 300m. [Ref: RB letter no. 2007/track- III/TK/24 vol II dt 14.03.2012]
10	Isolation	i. Isolation to be provided for each sidings/Loop lines. ii. Trap points with isolation as required, opening away from the important running lines. [Ref: Railway opening for public carriage passenger rule 2005 Para 36, 8(c)(ii)] iii. Dead end /over run for Isolation (signal overlap) and simultaneous reception provided. (Minimum length 120 m) iv. Sand hump details with proper connection with 1:12 CS or 1: 8 ½ SS to be shown & mention RDSO specifications / RDSO drawing no. alongside the location of sand hump.
11	Turnouts	Turnouts in running lines over which passenger trains are received or dispatched laid with 1 in 12 curved switch or flatter. [Ref: Para 408 (2)(a) of IRPWM]. 1 in 8.5 turn out with curved switches can be laid in exceptional circumstances taking off from straight track with the approval of PCE [Ref: Para 408 (2)(b) of IRPWM]. i. Marked Cross-over length should be equal to calculated length to avoid kink and wearing of Track. ii. Turnout & crossover should be drawn with proper curvature and details mentioned alongside the specific location. iii. There should not be any turnout on LC Gate. iv. No turnout should be taking off from transition length, if it is unavoidable, CTE approval must be taken. [Ref 410-IRPWM- 2020]
12	Bridges	i. Bridge type and number with span. ii. Direction of Flow of Stream, River to be marked & to be shown in light blue color. iii. There should not be any point & crossing on Major Bridge. iv. Major Bridge with approaches up to 50 m on either side should be in Level.
13	L.C. Gate	i. TVU with Month/Year, Km. of L.C. Gate, LC no., Class of LC and whether manned or unmanned. [Ref IRPWM Para 902] ii. Gate lodge for LC to be shown. iii. Planning of Elimination of LC to be indicated with status. [Ref.: Railway Board's Letter no. 2013/W-I/ Genl./0 / 30 pt-II Dated:18.06.2013]
14	Clearance and Infringement	i. Clearance from center of track to any structure on platform should be as per IRSOD ii. Clearance of any new structure keeping margin for one additional line in future. iii. Infringement should be shown in tabular form. iv. In case of no infringement, Table of infringement should be drawn and written as "NIL" in table. [Ref: Para -906(3)(i) of IRWM] (Format of same is as per Annexure 9.4B) v. All existing infringements need to be tabulated with status/details of CRS condonation.
15	FOBs	i. FOB should be provided with provision of ramp, lift or pathway at the end of platform. ii. Width of FOB and Staircase to be shown.

		iii. Long term facilities for Divyangs (Engraving on the edge of platform and facility for Inter- platform transfer either by lift/ ramp at FOB or subway/ pathway at the end of PF) should be provided. [Ref: RB's letter no. 2012 / LM / (PA) / 3 / 5 dated:11.09.12]
16	Platforms	i. Type of Platform, Passenger/Goods. ii. Level of Platform - All new platforms shall be high-level. [Ref as per Railway Board's letter 2012/LM(PA)/03/05 dated 18.08.2017] iii. Length & Width of platform should be marked at ends, at middle and at any offset points. iv. Horizontal distance from center of track to face of passengers or goods PF coping shall be as per SOD. Radius of curve, if platform is located on curved track (Do not permit platform on a curve having radius less than 875 m.) [Ref: Para 6/g & h of chapter II of IRSOD]. v. FOB should be provided with provision of ramp / lift or pathway at the end of platform. vi. Segregation of goods PF/Lines with passenger platform and lines.
17	Service Building	i. Mention approved GAD no. of existing/proposed Station building in Note. ii. It is to be confirmed that proposed changes will be accommodated in existing RRI buildings & no further RRI building should be required. iii. If new work over traction facility is proposed, clarify whether existing RRI building is sufficient to accommodate the proposed work. In case new RRI building is proposed mention approved GAD no. from HQ
18	Alteration	i. In case of Alteration in already approved plan, give complete details in Alteration table with serial numbering. The specific alteration should also be clearly indicated at the specific location. (Colour scheme to be followed as above)
19	Miscellaneous	• Terms of Reference attached • Approved Concept Plan attached • Speed of route. • Note should be added: • Authentic Land plans should be referred for proper verification of Land boundary indicated on this plan. • Comprehensive instructions of Railway Board for provision of passenger amenities should be complied according to Rly. Bd. letter no. 2018/LM/ (PA)/03/06 dt. 09.04.2018. • The levels in ESP, Project Sheet and GAD of Bridges must be verified before execution. • The proposed layout should be checked in the field for the feasibility of execution. • The gradient, Track center and alignment should be as per corresponding project sheet no. (Mention drawing no.)

Annexure 9.4A
Para 901(1)(a)(i)

Curve Nomenclature

Item No 8(ii) Of Checklist



CURVENO.(R/L)	
LineNo./MainlineUPorDN	
DeflectionAngle(Δ)	
Degree(D)	
Radius(R)	
LengthofCurve(CL)	
TangentLength(TL)	
LengthofTransitioncurve(LTC)	
Shifts(S)	
CantActual(Ca)	
CantDeficiency(Cd)	
SpeedPotential	

Annexure 9.4B
Para 901(1)(a)(i)

Infringement Table

Item No 14(iii) of Checklist

SN	Type of Infringement	Amount of Infringement	From Chainage (Km)	To Chainage (Km)	Total length in M	Standard Dimension & IRSOD Para
1	2	3	4	5	6	7

If there is no infringement, this table should be shown as "NIL"



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Method Of Folding Of Drawing Sheets

SHEET DESIGNATION	FOLDING DIAGRAM	LENGTHWISE FOLDING	CROSSWISE FOLDING
A0 841 x 1189			
A1 594 x 841			
A2 420 x 594			
A3 297 x 420			—

All dimensions are in mm

ABBREVIATIONS As Per SP 46 - 2003

1. Scope - This section covers such of the abbreviations which are recommended for use in general engineering drawings. Abbreviations already covered in specific subjects, such as units and quantities, tolerances, gears, fluid power, electrical and electronics are not dealt in this section.
2. Enclosed table lists some of the common abbreviations recommended. Abbreviations are the same both for singular and plural usage. Only capital letters are used for abbreviations to ensure maintenance of legibility bearing in mind reproduction and reduction process. Abbreviations which have already been standardized nationally/internationally using lower case letters should, however, be written according to the corresponding standard.
- 2.1 When using abbreviations and symbols in engineering drawings, the following points are to be borne in mind.
 - a) They should be used sparingly only when space saving in a drawing is essential.
 - b) short words such as 'day', 'unit', 'time', etc. should preferably be written in full, even when an abbreviation has been standardized.
 - c) Periods (full stop symbol) are not to be used except where the abbreviation marks a work (for example, No; FIG.)
 - d) For hyphenated words, abbreviations are to be with the hyphen.
 - e) Sometimes one and the same letter symbol may represent more than one term or quantity. Hence it is advisable not to use such symbols to mean two different terms in one and the same drawing. If it becomes unavoidable, the symbols may be provided with suitable sub script.

RECOMMENDED ABBREVIATIONS

Term	Abbreviations	Term	Abbreviations
Across flats	AF	Maximum	MAX
Alteration	ALT	Maximum material condition	MMC
Approved	APPD	Mechanical	MECH
Approximate	APPROX	Minimum	MIN
Arrangement	ARRGT	Miscellaneous	MISC
Assembly	ASSY	Nominal	NOM
Auxiliary	AUX	North	N
Cast Iron	CI	Not to scale	NTS
Centre Line on a view in a note	⌄	Number	NO
Centre of gravity	CG	Opposite	OPP
Centres	CRS	Outside diameter	OD
Chamfered, chamfer (in a note)	CHAM	Pitch circle diameter	PCD
Checked	CHKD	Quality	QLY
Cheese head	CH HD	Quantity	QTY
Constant	CONST	Radius (in a note)	RAD
Continued	CONTD	Radius (preceding a dimension)	R
Counterbore	CBORE	Reference	REF
Countersunk	CSK	Required	REQD
Countersunk head	CSK HD	Right Hand	RH
Countersunk	CSK	Round Head	RD HD
Cylinder or Cylindrical	CYL	Screw (or screwed)	SCR
Diameter (in a note)	DIA	Serial Number	SL NO

Diameter (preceding a dimension)	∅	Sheet (referring to drawing sheet)	SH
Dimension	DIM	Sketch (prefix to a drawing No.)	SK
Drawing	DRG	South	S
East	E	Specification	SPEC
Equi-spaced or equally spaced	EQUI SP	Spherical	SPHERE
Etcetera	etc.	Spherical diameter (only preceding a dimension)	S∅
External	EXT	Spherical radius (only preceding a dimension)	SR
Figure	FIG.	Spotface	SF
Full indicated movement	FIM	Square (in a note)	SQ
General	GEN	Square (preceding a dimension)	□ or ▣
Head	HD	Standard	STD
Hexagon head	HEX HD	Symmetrical (in a note)	SYM
Hexagon/Hexagonal	HEX	Taper on diameter or, width	
Horizontal	HORZ	Temperature (in a note)	TEMP
Hydraulic	HYD	Thick	THK
Indian Standard	IS	Thread (in a note)	THD
Inside diameter	ID	Through (in a note)	THRU
Inspection/ed	INSP	Tolerance	Tol
Insulation or insulated	INSUL	Typical/Typically	TYP
Internal	INT	Undercut	UCUT
Least material condition	LMC	Volume	VOL
Left Hand	LH	Weight	WT
Long	LG	West	W
Machine	MC	With reference to or with respect to	WRT
Material	MATL		

Approval of GAD and Structural Drawings of Railway Bridges and ROBs

S N.	Executing Agency	Railway Bridges		ROB Composite I Girder		ROB Bow string Girder	
		GAD	Structural Drawings	GAD	Structural Drawings	GAD	Structural Drawings
1.	DFCCIL (Para 318 of IRBM modified by A&C Slip No. 36 dated 27.03.2018)	Where linear waterway is being reduced or vertical clearance are inadequate and where new bridge (during construction or during service) is likely to affect any of existing bridges- By CBE of Zonal Railway All other bridges- CBE of DFCCIL	By CBE of DFCCIL	CBE of Zonal Railway	CBE of DFCCIL	CBE of Zonal Railway	CBE of DFCCIL
2.	RVNL (Railway Board's letter No. 2021/2/CE - III/BR/1/Bridge Policy dated 28.10.2021)	i) All important, major, minor railway bridges affecting existing bridges during Doubling/Tripling/Quadrupling works, all important bridges on NL/GC works- By of Zonal Railway. ii) All major and minor bridges not affecting existing bridges-By Nodal CE/C.	By centralized design cell of RVNL headed by ED/CGM except for important, major and other typical bridges which shall be further submitted to Zonal Railways for approvals by CBE and CE/C for further Certifications during submission of opening documents to CRS.	CBE of Zonal Railway	CBE or CE/Const. (Nodal)	CBE of Zonal Railway	CBE or CE/Const. (Nodal)
3.	PSU (Para 317 of IRBM modified by A&C Slip No. 38 of IRBM dated	Where linear waterway is being reduced or vertical clearances are inadequate and where construction is likely to affect any of the existing Bridges (during construction or during	For railway bridges being executed by open line -By bridge	Affecting the existing lines after clearance of concern	Bridge works executed by open line- By Bridge Branch at HQ Level	Affecting the existing lines after clearance of concern	Bridge works executed by open line- By Bridge Branch at HQ Level

S N.	Executing Agency	Railway Bridges		ROB Composite I Girder		ROB Bow string Girder	
		GAD	Structural Drawings	GAD	Structural Drawings	GAD	Structural Drawings
	14.01.2020 , Ref. No. 2021/2/CE III/BR/1/Bridge Policy dated 19.07.2021 & 17.05.2021)	service), after clearance of concerned divisional branch officers and DRM-By CBE of Zonal Railway For all other railway bridges- By concerned CE/C All railway bridges on open line- By CBE of Zonal Railway.	branch at HQ level of Zonal Railway For railway bridges being executed by construction Organization- By construction organization.	ed divisional branch officers and DRM-By CBE of Zonal Railway Other ROB-By concerned CE/Construction.	of Zonal Railways. Bridge works executed by Construction Organization- By Construction Organization.	ed divisional branch officers and DRM-By CBE of Zonal Railway Other ROB-By concerned CE/Construction.	of Zonal Railways. Bridge works executed by Construction Organization- By Construction Organization.
4.	Zonal Railway (Para 317 of IRBM modified by A&C Slip No. 38 of IRBM dated 14.01.2020)	Where linear waterway is being reduced or vertical clearances are inadequate and where construction is likely to affect any of the existing Bridges (during construction or during service), after clearance of concerned divisional branch officers and DRM-By CBE of Zonal Railway For all other railway bridges- By concerned CE/C All railway bridges on open line- By CBE of Zonal Railway.	For railway bridges being executed by open line -By bridge branch at HQ level of Zonal Railway For railway bridges being executed by construction Organization- By construction organization.	Affecting the existing lines after clearance of concerned divisional branch officers and DRM-By CBE of Zonal Railway Other ROB-By concerned CE/Construction.	Bridge works executed by open line- By bridge Branch at HQ Level of Zonal Railways. Bridge works executed by Construction Organization- By Construction Organization.	Affecting the existing lines after clearance of concerned divisional branch officers and DRM-By CBE of Zonal Railway Other ROB-By concerned CE/Construction.	Bridge works executed by open line- By bridge Branch at HQ Level of Zonal Railway. Bridge works executed by Construction Organization- By Construction Organization.

CHAPTER 10

STORAGE AND USE OF EXPLOSIVES

1001 General –

Reference may be made to the following for detailed provisions:

- 1) Indian Explosive Act 1884
- 2) The explosive Rules-2008
- 3) BIS Codes
IS 4081: 2013 Blasting and related drilling operations – code of safety (2nd revision)
IS: 4756-1978: Safety code for tunnelling work.
- 4) Other rules and special instructions issued by Railway Administration or by State Government from time to time.

1002 Issue of Instructions on Use of Explosives –

- 1) Explosives are used in the following cases:
 - a) For clearing boulders which fall on the railway line, as in ghat sections;
 - b) For quarrying rock;
 - c) For widening rock cuttings;
 - d) For deepening wells;
 - e) For cuttings in rock,
 - f) Excavation of foundations in rock; and
 - g) Construction of tunnels.
- 2) Blasting works shall be carried out by competent qualified staff engaged and safe working practices are employed. The Contractor shall be in possession of a license to purchase, store and use explosives. Blasting operation can be carried out only through persons (Blasting Mates) who are authorized by the appropriate Department.
- 3) For major works, the Railway Administration shall obtain the method statement from contractor with special instructions which should cover every aspect of each operation and be illustrated with sketches where necessary; & approve the same prior to start of the work. The instructions should include:
 - a) Duties of Blasting Mates and other staff
 - b) Description of materials used for blasting, such as explosives, detonators, safety-fuses, blasting cables, joint adapters, fuse lighters, exploders and crimpers
 - c) Collection and transport of materials
 - d) Testing of materials used for blasting
 - e) Procedure and methods of boring and charging of holes and blasting for each type of explosive
 - f) Imposition and removal of traffic and/or power blocks
 - g) Safety-distances
 - h) Protection of track and structures during blasting operations
 - i) Precautions before, during and after blasting
 - j) Danger and all clear signals before and after a blasting operation
 - k) Submission of periodical progress reports

- l) Custody and storage of explosives

1003 Observance of Rules –

- 1) Possession of explosives shall be covered by a license as required by the extant Explosive Rules.
- 2) The Divisional/Dy. Chief Engineer, Assistant Divisional/Assistant Executive Engineer and the Sr. Section Engineer (Works) shall be responsible to ensure that rules issued by the Government and the Administration in regard to the storage and use of explosives on works are strictly obeyed. The Inspector of Explosives and the District Magistrate have powers to inspect all magazines. All staff should willingly assist in such inspections.

The Divisional/Dy. Chief Engineer and Assistant Divisional/Assistant Executive Engineer should, by frequent check, personally satisfy themselves that all contractors' staff handling explosives are in possession of and understand the rules and any subsequent modifications thereto.

- 3) The Assistant Divisional/Assistant Executive Engineers and Sr. Section Engineer (Works) within whose jurisdiction magazines are situated should make a special mention of these in their handing over notes and ensure that their relievers understand the orders relating to these magazines. Mention should also be made in the handing over notes of any modifications which may have been suggested by the Inspector of Explosives or District Magistrate on his last inspection and whether these have been carried out.

1004 Protection to Trains and Railway Property –

- 1) **In vicinity of railway line:** Blasting operations within 100 metres of a running line should normally be carried out under block protection. Tracks, within 60 metres of the rock to be blasted, should be protected by covering with rubber tyre mats/sand bags which should be removed after the blasting is over and before removal of the block.

When the blasting operation is carried out without imposition of the block, the SSE/ JE (P.Way or Works) shall ensure protection to trains in such a case, no blasting should be done within half-an-hour of the time when any train is expected to pass.

- 2) **In vicinity of buildings:** When any blasting operation is carried out within 100 metres of a building, the SSE/ JE (Works) shall be present to ensure that special precautions, as may be prescribed by the Divisional/Dy. Chief Engineer or the Assistant Divisional Engineer or as stipulated by the licensing authority, are taken and that the necessary warning is given to the inhabitants.

1005 Precautions to be observed during Blasting –

Preference shall be given to controlled blasting so as to avoid damage to surrounding area. In case of blasting, the blasting Mate/ shot firer shall be responsible:

- 1) To see that when blasting is conducted in the neighbourhood of a public or private road or building, or of any place where there may be people who would be endangered, experienced Watchmen are sent, with red flags, to stop traffic or warn persons. These Watchmen would be warned from the work spot, of the commencement and cessation of blasting operations.
- 2) To see that, before blasting commences, all persons except those who are actually to light the fuses, are warned by the repeated striking of an empty tin or blowing of a siren and are at a distance of not less than 150 metres and that, in special cases, suitable extra precautions are taken.
- 3) To see that, in order to avoid damage to structures (such as girder bridges and OHE & wires etc.) which may be in close proximity to the blasting spot, only shallow bore-holes are drilled and light charge used or vary the angle of bores to control the blast. The OHE staff shall be present during blasting operation to take care of any damage to OHE.
- 4) To select and instruct carriers of the explosives, detonators and safety fuse after they have been drawn from the magazine.
- 5) To ensure that no one interferes in his absence with any explosive, detonators or caps already drawn by him from the magazine.
- 6) To see that neither he nor any person within 10 metres of himself smokes while he is conveying, handling or using explosives.
- 7) To see that bore holes are of such a size that cartridges can easily pass down them; that bore holes are clear of all debris before a cartridge is inserted, that charging is done by himself and the position of the charged holes are noted carefully.
- 8) To drop several centimetres of tamping of sand or clay on top of the primer cartridge before beginning to stem or press and that this tamping is gently pressed down on top of the primer without the use of force.

Note: The primer-cartridge is the cartridge in which the detonator or cap and fuse are attached and is usually fixed as the last cartridge of the charge.

- 9) To see that the safety fuses of the charged holes are lighted in his presence and have properly ignited.
- 10) To compare the number of shots actually heard with shots intended to be fired and to carefully inspect the work after blast and satisfy himself that all holes have exploded and the broken rock does not contain any unexploded cartridge or pieces of cartridges;
- 11) To take precautions as given below in cases of mis-fires
 - i) if a charge has apparently missed fire, to immediately warn all present and see that no person is allowed to go near it for an hour,
 - ii) if a charge misses fire, to examine the hole and mark a red cross over it,
 - iii) to see that a shot that has missed fire is not bored or picked out; that no further charge is introduced into the hole;

- iv) to determine the direction of the hole for which purpose a few centimetres (inches) of tamping may, if necessary, be picked out and a stick placed in the mis-fired hole and to drill, after 60 minutes have passed, a fresh hole near the charge which has missed fire and that this is done at a safe distance from the former hole and in such position and direction that the boring tool cannot come in contact with the explosive which has missed fire. The Blasting Mate must not leave the spot on any account whatsoever until the second hole (which should explode the old charge) has been fired. He must carefully examine the result and continue the operation, if necessary, until the original charge has exploded.
- 12) To make sure that there is only one key to the exploder and that this is in his pocket when he has to leave the exploder. This is necessary for his own protection.
 - 13) The electric power at the blasting site shall be discontinued as far as practicable before charging the explosives.
 - 14) No work other than that associated with the charging operations shall be carried out within fifteen metres of the holes unless otherwise specified to the contrary by the licensing authority.
 - 15) When charging is completed, any surplus explosives, detonators or fuses shall be removed from the vicinity of the hole and stored at a distance which would prevent sympathetic detonation in the event of a charge detonating in any hole.
 - 16) The holes, which have been charged with explosives, shall not be left unattended till the blasting is completed.
 - 17) Care shall be taken to ensure that fuse or wires connected to the detonators are not damaged during the placing of stemming material and tamping.

1006 Misfires with Electrical Method of Firing –

- 1) As per the Indian Metalliferous Mines Regulations, 1961 in the event of misfire, the Official in-charge of the blasting operations at a site shall immediately prevent anyone from approaching the site whose presence is not absolutely essential. He shall re-examine the connections, check the wiring or re-wire as he thinks fit and will try again to fire the charge by electrical means.
- 2) If he is unable to fire the unexploded charge(s) by electrical means, the official in charge at site shall follow the instructions provided under Para 167 & 168 of the Indian Metalliferous Mines Regulations, 1961 and use the means considered the most suitable.
- 3) Since with the electrical method of firing, it is possible for one shot to explode and blast out the rock in which an adjacent charge has been placed but which has not exploded, the Official-in-charge is responsible, at the end of each blast, for examining the working face minutely to detect whether any charges have misfired in this manner. If he considers that this may have been possible, a careful search must be made in the debris for the unexploded detonator.

1007 Explosives Disposal –

- 1) No explosive shall be abandoned. These shall be disposed of or destroyed strictly in accordance with the approved methods and in doing so the manufacturers or the appropriate authority shall be consulted.
- 2) Explosives, caps, boxes liners or material used in packing of explosives shall not be left lying around in places to which children or unauthorized persons or livestock can have access.
- 3) Paper or fibrous material employed in packing explosives shall not be put to any subsequent use. Such material shall be destroyed by burning in the presence of a responsible person.

CHAPTER 11

POLICE JURISDICTION AND SECURITY OF RAILWAY MATERIALS

1101 General –

The officers and SSEs/ JEs of the Engineering Department are required to coordinate and take assistance from Police including Railway Police and the Railway Protection Force for ensuring safety of railway men and security of railway property.

1102 Police Jurisdiction –

The jurisdiction between the Railway Police and the Local Police varies according to the orders issued by the concerned State Governments. The jurisdiction of the Local Police and the Railway Police is given in the Police Manual of concerned State Governments. However, the procedure for lodging FIR / complaint is the same. Officials of the Engineering Department will have to acquaint themselves with the procedure in force over their jurisdiction.

1) Government Railway Police -

Railway Police forms a part of the State Police and is responsible for the maintenance of law and order and policing on the railways including running trains.

Role of Government Railway Police (GRP):

The Government Railway Police (GRP) is responsible for the prevention and detection of passenger crime on railways.

The duties of the Government Railway Police (GRP) as regards the areas in their jurisdiction correspond to those of the District Police (Local police) in the areas under their charge.

The Government Railway Police (GRP) has in addition the following special duties:

- a) to maintain law and order at railway stations and in trains. The term "Order" comprises: –
 - i) controlling passenger traffic within station premises, especially on platforms, in booking offices, waiting halls, at entrance and exit gates and wherever specially required in emergencies by the station officials
 - ii) control of vehicular and other traffic in station precincts
 - iii) maintain Law and order in passenger trains halted at stations and prevention of overcrowding
 - iv) arrest of persons guilty of committing nuisance, removal of persons suffering from infectious diseases and keeping station premises clear of beggars
 - v) examination of empty coaches on arrival at terminating stations for property left behind by passengers, dead bodies and tampering of coach fittings
 - vi) removal of bodies of persons who die in trains or in station premises and admitting sick passengers in nearby hospitals

- b) submit report to concerned authorities railway or civil, about the commission of offences under the Railways Act, and cases of fraud or suppression on the part of railway personnel
- c) to enquire into accidents on railways
- d) to render assistance to railway officers and travelling public as the compatible with their own duties as Police officers.

NOTE:

- i) "Railway limits" may be defined as the area owned or legally occupied by a Railway Administration for the purposes of carriage of goods and passengers, and covers every place or building used for such purposes. A road over or across a Railway line is not usually used for railway transportation unless specified. Police duties arising on it are discharged by the Local Police.
- ii) "Station limits" includes all traffic lines, platform surfaces, circulating area and the length of tracks within the outermost signals.
- iii) In case of any ambiguity regarding the jurisdiction of the Local Police and the Railway Police, the Police Manual of the State concerned may be referred to.

2) Local Police -

Local Police is responsible for Law and Order in the areas other than those coming under the jurisdiction of the Railway Police.

3) Railway Protection Force (RPF) -

- i) Railway Protection Force has been created as an Armed Force of the Union under the RPF Act 1957 (as modified by Act No.60 of 1985 and as amended from time to time). It is placed under the Ministry of Railways and its members are deemed to be Railway Servants within the meaning of the Indian Railways Act 1989 and shall exercise the powers conferred on Railway Servants by or under that Act.
- ii) RPF has been conferred with powers under the Railway Property (Unlawful Possession) Act 1966 to arrest, search, inquire and prosecute offenders of unlawful possession of Railway property.
- iii) Being an Armed Force of the Union, RPF can also exercise the powers conferred on the Armed Forces of the Union.

ROLE OF RPF:

The Railway Protection Force (RPF) is entrusted with following duties:

- to protect and safeguard Railway property, passenger area and passengers.
- to remove any obstruction in the movement of Railway property or passenger area.
- to do any other act conducive to better protection and security of Railway property, passenger area and passengers.

1103 Lodging of Complaints –

- 1) With Government Railway Police (GRP) –
 - a) The procedure for lodging complaints with the Government Railway Police (GRP) varies as per orders issued by Local Governments. Engineers and SSEs/ JEs should acquaint themselves with the procedure in force over their jurisdictions.
 - b) Officers and SSEs / JEs should make complaint to Government Railway Police (GRP) whenever an offence, as defined in sections 150, 151 & 152 of “The Railways Act”, comes to their notice.
- 2) With Railway Protection Force (RPF) -

Officers and SSEs / JEs should make complaint to Railway Protection Force (RPF) whenever an offence, as defined in sections 137 to 139, 141 to 147, 153 to 157, 159 to 167, 172 to 176 of “The Railways Act”, comes to their notice.
- 3) The complaint should be made to the Government Railway Police Station Officer or concerned RPF personnel, as the case may be, or in his/her absence, to the Constable available on station platform in train or at the next station and acknowledgment obtained. Copies of complaints preferred by SSEs/ JEs should be sent to the Assistant Divisional Engineer and Divisional/Sr. Divisional Engineer for information.
- 4) In serious cases, the Divisional Engineer or Assistant Divisional Engineer should follow up with a complaint or report made to the Superintendent Railway Police or District Superintendent of Police or concerned RPF personnel, as the case may be. In ordinary cases the SSEs/ JEs should pursue the matter with the local police officials.
- 5) Whenever Engineering officials lodge a FIR with the Government Railway Police (GRP) or concerned RPF personnel, it should be clearly indicated the nature of offence. The FIR empowers the Government Railway Police (GRP) / Railway Protection Force (RPF) to start investigations in cases of cognizable offences.
- 6) A sample Proforma for lodging 'FIR' is given as **Annexure 11.1**.

1104 Co-operation with Government Railway Police (GRP) & Railway Protection Force (RPF) –

- 1) Engineering staff should co-operate with the Government Railway Police (GRP) & Railway Protection Force (RPF) for the prevention and detection of crime. Promptness in reporting an offence is essential; advice should be sent through telephonic, FAX, electronic means, whenever required, of any occurrence as subject of a complaint followed by a formal complaint as soon as possible.
- 2) When the GRP/ RPF require information from the records of the office of SSEs/ JEs, they will apply to the later with particulars of requirements. The SSEs/ JEs, may allow GRP/ RPF staff to verify the information given. No records should however be handed over without the authority of the Assistant Divisional Engineer or Divisional/Sr Divisional Engineer/ Dy. Chief Engineer. In each case, the memo received from the GRP / RPF Officer, a copy of the same must be marked to the

Divisional/r Divisional/Sr Divisional Engineer / Dy. Chief Engineer through the Assistant Divisional Engineer for information.

- 3) Any railway staff having information in connection with a crime under enquiry should at once communicate it to the in-charge of GRP / RPF of the concerned case.
- 4) All railway staff should answer questions put forth by GRP / RPF in the course of their investigations.

1105 Cognizable Offences –

The list of offences defined in sections 150, 151 & 152 (3 sections) of “The Railways Act 1989” will be dealt by GRP.

The list of offences defined in sections 137 to 139, 141 to 147, 153 to 157, 159 to 167, 172 to 176 (29 sections) of “The Railways Act 1989” will be dealt by RPF.

The offences demand immediate intimation to the GRP/ RPF by Engineering Staff; they are termed as 'cognizable by the Police', means, GRP / RPF are authorized to initiate enquiries and effect arrests without direction from a Magistrate:

SN	Sections of the Railway Act 1989	Nature of offence.
1	Sec. 137	Fraudulently travelling or attempting to travel without proper pass or ticket
2	Sec. 138	Levy of excess charge and fare for travelling without proper pass or ticket or beyond authorized distance
3	Sec. 139	Power to remove persons.
4	Sec. 141	Needlessly interfering with means of communication in a train
5	Sec. 142	Penalty for transfer of tickets
6	Sec. 143	Penalty for unauthorized carrying on of business of procuring and supplying of railway tickets
7	Sec. 144	Prohibition on hawking, etc., and begging
8	Sec. 145	Drunkenness or nuisance-being in a state of intoxication committing act of nuisance, using obscene language, interfering with amenities so as to affect comfort of passengers.
9	Sec. 146	Obstructing Railway Servant in his duty.
10	Sec. 147	Trespass and refusal to desist from trespass
11	Sec. 150	Maliciously wrecking or attempting to wreck a train
12	Sec. 151	Damage to or destruction of Railway Property
13	Sec. 152	Maliciously hurting or attempting to hurt persons travelling by railway
14	Sec. 153	Endangering safety of persons travelling by railway by willful act or omission
15	Sec. 154	Endangering safety of persons travelling by railway by rash or negligent act or omission
16	Sec. 155	Entering into a compartment reserved or resisting entry into a compartment not reserved
17	Sec. 156	Travelling on roof, step or engine of a train
18	Sec. 157	Altering or defacing pass or ticket
19	Sec. 159	Disobedience of drivers or conductors of vehicles to directions of railway servant, etc.

20	Sec. 160	Opening or breaking a level crossing gate
21	Sec. 161	Negligently crossing unmanned level crossing
22	Sec. 162	Entering carriage or other place reserved for females
23	Sec. 163	Giving false account of goods
24	Sec. 164	Unlawfully bringing dangerous goods on a railway
25	Sec. 165	Unlawfully bringing offensive goods on a railway
26	Sec. 166	Defacing public notices
27	Sec. 167	Smoking
28	Sec. 172	Penalty for intoxication
29	Sec. 173	Abandoning train, etc., without authority
30	Sec. 174	Obstructing running of train, etc.
31	Sec. 175	Endangering safety of any person travelling upon the railway by disobeying any rule negligent act (This applies to Railway Servants only).
32	Sec. 176	Obstructing level crossing

Whenever a complaint has been made to the GRP in respect of any cognizable offence, the complete investigation of the case rests with the Police. This does not affect the action necessary for departmental purposes, such as making preliminary enquiries which in some cases is necessary to establish the fact about any crime that has been committed or to fix responsibility for dereliction of duty.

1106 Non-Cognizable Offences –

- 1) Some of the offences listed below are termed "non-cognizable by the Police", meaning that the Police are not liable to take action, including effecting arrests, without specific orders from a Magistrate.

SN.	Sections of the Railway Act 1989	Nature of offence.
1	Sec. 158	Contravention of regulations of hours of work and period of rest by any Railway Servant
2	Sec. 177	Furnishing false returns.

- 2) In the case of non-cognizable offenses, the Railway Police will record the complaint and take further action as per the procedure in force.

1107 Powers of Arrest by Railway Staff –

- 1) Provisions of sections 179 & 180 of Railway Act 1989 (amended from time to time):

Section 179: Arrest for offences under certain sections:

- a) If any person commits any offence mentioned in sections 150 to 152, he may be arrested without warrant or other written authority by any railway servant or police officer not below the rank of a head constable.
- b) If any person commits any offence mentioned in sections 137 to 139, 141 to 147, 153 to 157, 159 to 167 and 172 to 176, he may be arrested, without warrant or other written authority, by the officer authorized by a notified order of the Central Government.

- c) The railway servant or the police officer or the officer authorized, as the case may be, may call to his aid any other person to effect the arrest under sub-section (1) or sub-section (2), as the case may be.
- d) Any person so arrested under this section shall be produced before the nearest Magistrate within a period of twenty-four hours of such arrest excluding the time necessary for the journey from the place of arrest to the court of the Magistrate.

Section 180: Arrest of persons likely to abscond, etc.:

- 1) If any person who commits any offence under this Act, other than an offence mentioned in sub-section (2) of section 179, or is liable to pay any excess charge or other sum demanded under section 138, fails or refuses to give his name and address or there is reason to believe that the name and address given by him are fictitious or that he will abscond, the officer authorized may arrest him without warrant or written authority.
- 2) The officer authorized may call to his aid any other person to effect the arrest under sub-section (1).
- 3) Any person arrested under this section shall be produced before the nearest Magistrate within a period of twenty-four hours of such arrest excluding the time necessary for the journey from the place of arrest to the court of the Magistrate unless he is released earlier on giving bail or if his true name and address are ascertained on executing a bond without sureties for his appearance before the Magistrate having jurisdiction to try him for the offence.
- 4) The provisions of Chapter XXXV of the The Bharatiya Nagrik Suraksha Sanhita (BNSS), 2023, shall, so far as may be, apply to the giving of bail and the execution of bonds under this section.
- 5) The power to arrest conferred by Sections 179 and 180 of the Indian Railways Act, 1989, shall be exercised with the greatest caution.

1108 Warrants against Railway Staff –

Warrants issued against railway servants will be entrusted for execution to a Police Officer of (GRP/RPF), who shall, if he finds on proceeding to execute the warrant finds that the immediate arrest of the railway servant would involve risk or inconvenience, make all necessary arrangements to prevent escape and apply to the proper authority to have the accused relieved, thereby deferring arrest until he / she is relieved.

Wherever possible, the Sr Divisional/ Divisional Engineer or Assistant Divisional Engineer should arrange relief and report any case of arrest to the higher authority.

1109 Action by Railway Staff in Cases of Attempted Sabotage –

Whenever any offence under Sections 150 or 151 of the Indian Railways Act, 1989 is detected, the senior most Railway Official present may direct the Police Officer (GRP) or Policemen present or, Railway servant (if there be no Policeman present), to arrest the offender at once.

In every case, a detailed report should be submitted to the appropriate authorities.

1110 Answering Court Summons –

Court summons served on the staff shall be promptly acknowledged. Section 68 of The Bharatiya Nagrik Suraksha Sanhita (BNSS), 2023 provides that:

68(1) Where the person summoned is in the active service of the Government, the Court issuing the summons shall ordinarily send it in duplicate to the head of the office in which such person is employed; and such head shall thereupon cause the summons to be served in the manner provided by section 64 of BNSS, and shall return it to the Court under his signature with the endorsement required by that section

68(2) Such signature shall be evidence of due service

The Sr Divisional/Divisional Engineer or Assistant Divisional Engineer shall make necessary relief arrangements timely in such cases.

1111 Prevention of Trespass –

- 1) Trespass Notice Boards should be erected and maintained properly at necessary locations. The Boards should indicate the consequences of trespass.
- 2) Stray cattle found grazing in the railway limits may be sent to the cattle pond.
- 3) Whenever dead bodies of the cattle etc. are found in the railway colony, station limits, Medical Department may be promptly advised for their removal.

1112 Disposal of Human Bodies Found Run Over –

When the body of a person run over is found between stations, the following procedure shall be adopted:

- 1) If life is extinct, the body shall not be moved more than is necessary to clear the line, until the arrival of the Police. The body may be left in charge of a Gangman, Gateman or a villager. In all cases, a written memo with the following particulars shall be prepared by the Guard or if, there be no Guard, by the Driver of the train or other person finding the body and be made over to the man placed in charge of the same to be given by him to the Police Official -
 - a) Position of body on the line.
 - b) Blood stains on track, ballast or engine, extent of injuries and whether seemingly inflicted by a train or otherwise.
 - c) Position of any clothing, found on or near the rails.
- 2) If life is not extinct, the person shall be conveyed to the next station as promptly as practicable where medical aid shall be arranged by the Station Master.
- 3) A report shall be made by the SSE / JE to the nearest Station Master and to the Assistant Divisional Engineer in every such case.

In the case of such accidents occurring in station yards the Station Master will initiate requisite action.

1113 Disposal of Cattle Found Dead on The Line –

When cattle are run over on the line, the carcasses should be cleared sufficiently away from the line.

1114 Miscellaneous –

- 1) Whenever Engineering personnel is involved in commission of an offence under RP(UP) Act, a report should be sent to the Assistant Divisional / Sr Divisional/Divisional Engineer immediately for necessary action at the appropriate level. In this connection the provisions of section 3 and 4 of RP (UP) Act are reproduced below:

SECTION 3 - Penalty for theft, dishonest misappropriation or unlawful possession of railway property:

Whoever commits theft, or dishonestly misappropriates or is found, or is proved] to have been, in possession of any railway property reasonably suspected of having been stolen or unlawfully obtained shall, unless he proves that the railway property came into his possession lawfully, be punishable

- i) for the first offence, with imprisonment for a term which may extend to five years, or with fine, or with both and in the absence of special and adequate reasons to be mentioned in the judgment of the court, such imprisonment shall not be less than one year and such fine shall not be less than one thousand rupees;
- ii) for the second or a subsequent offence, with imprisonment for a term which may extend to five years and also with fine and in the absence of special and adequate reasons to be mentioned in the judgment of the court, such imprisonment shall not be less than two years and such fine shall not be less than two thousand rupees.

[Explanation. —For the purposes of this section, “theft” and “dishonest misappropriation” shall have the same meanings as assigned to them respectively in section 303 and section 314 of the The Bharatiya Nyaya Sanhita 2023]

SECTION 4- Punishment for abetment, conspiracy or connivance at offences:

Whoever abets or conspires in the commission of an offence punishable under this Act, or any owner] or occupier of land or building, or any agent of such owner or occupier in charge of the management of that land or building, who willfully connives at an offence against the provisions of this Act, shall be punishable with imprisonment for a term which may imprisonment for 7 years and fine.

[Explanation. — For the purposes of this section, the words “abet” and “conspire” shall have the same meanings as assigned to them respectively in sections Section 48 and 61 of The Bharatiya Nyaya Sanhita, 2023

- 2) Encroachments shall be removed promptly in terms of Para 814 of this manual. Necessary help should be sought from GRP as well as R.P.F.
- 3) Whenever unauthorized occupation or subletting of quarters is noticed by the SSE / JE(Works) he will take immediate action and submit report to the concerned allotment authority for taking action at their end.
- 4) Engineering Supervisors should take necessary care to ensure that issue of materials is covered under a proper authority to avoid attracting of RP (UP) Act. Such authority could be Issue Notes, Gate Passes, and Railway Challans etc.

Proforma for Lodging FIR

1. Name of Complainant _____
 - a) Permanent address in full _____
 - b) Nearest railway station to the permanent residence. _____
 - c) Telephone No. _____
2. Date of Occurrence _____
3. Time of Occurrence _____
4. Place of Occurrence _____

Place where the complainant detected the occurrence

 - a) Train No. and name _____
 - b) Bogie No. _____
 - c) Class in which travelling _____
(AC I class/AC 2 Tier sleeper/Sleeper Class/II Class/AC 3-Tier sleeper/
/General/ II class (Ladies)
5. Ticket No. _____
6. Names of Stations in between which occurrence took place _____
7. Particulars of Property Looted or Stolen and Estimated cost thereof.
 - a) Full description of identifiable property, if any. _____
8. Brief particulars of the incident (Theft/Robbery / Dacoity) _____
9. Name of person or persons suspected with descriptive role and name and address, if known
 - a) The station where the suspect entrained _____
 - b) The station where the suspect detrained _____
 - c) The station where such suspect wanted to go. _____
10. Did the suspect show sympathy towards you by providing seat or place to sleep or advise to put the Box / attaches at a certain place. _____

Report No. _____ Received On _____ at _____ Hrs. _____

Signature with name and designation of the official who received the Report.
Date: _____

CHAPTER 12

BOOKS OF REFERENCE

1201 Books of Reference –

Books of reference listed in **Annexure 12.1** and other publications from R.D.S.O. and IRICEN/PUNE including Technical monograms considered essential should be supplied to the officers and the SSEs/ JEs (Works) of each Division.

The offices of Principal Chief Engineers and Divisional Engineers should be equipped with adequate number of copies of each publication. The publications should be accounted in the Dead Stock Register. Officials for whose personal use publications are supplied shall be responsible for their custody and handing them over prior to retirement from service to the office from where they retire. The book of references listed in **Annexure 12.1** may also be downloaded from the concerned official website.

1202 Circulation of Technical Papers –

The Principal Chief Engineer may arrange to circulate sufficient number of copies of the following publications and such other journals relating to, Works as deemed necessary to the Headquarters Officers and Divisional Engineers who in turn should circulate them to their Assistant Divisional Engineers:

- (i) Technical papers pertaining to Civil Engineering published by the Railway Board from time to time.
- (ii) Engineering Bulletins issued by Zonal Railways.
- (iii) Monograms issued by RDSO.
- iv) Policy Guidelines /Circulars issued by RDSO and Railway Board.

To avoid wastage of paper and manpower, the distribution of hard copy of policy circulars/orders/instructions etc. in Board's office and to Zonal Railways/PUs and other Units may be kept to bare minimum. Different electronics forms of communication like e-copies (scanned copies in PDF format) may be forwarded to all concerns through NIC mail and through e-Office platform or as e-Receipt through e-Office. Subsequently, the Orders/Instructions be uploaded on IR website in Directorate section under the concerned branch.

LIST OF BOOKS OF REFERENCE.

SN.	Publications	Office which should be equipped with a copy of the publication		
		Sr. Divisional/ Divisional Engineer/ Dy. Chief Engineer	ADEN	Sr. Section Engineer (Works)
1	Act, Indian Railway	1	1	1
2	Act, The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement and State Govt. Publications.	1	1	-
3	Act, Payment of wages, Minimum wages, with notification as issued	1	1	1
4	Act, Forest, Center and State Government	1	-	-
5	Act, Apprentices	1	1	
6	Act, Contract Labour (Regulation & Abolition) and Contract Labour (Regulation & Abolition) Central Rules, 1971	1	1	-
7	Act, Employees' Provident Funds and Miscellaneous Provisions	1	1	-
8	Provisions of "The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996" and "The Building and Other Construction Workers' Welfare Cess Act, 1996"	1	-	-
9	Act, Mines	1	-	-
10	Act, Workmen's Compensation	1	1	1
11	Act, The Prohibition of Employment as Manual Scavengers and their Rehabilitation 2013	1	-	-
12	Circulars – State Government Ref: Construction near railway limits	1	1	1
13	Circulars, State Government or Joint, ref: Tanks affecting railway line.	1	1	1
14	Code, Indian Railways, for the Engineering Department	1	1	1
15	Code, Indian Railways, for the Stores Dept.	1	1	1
16	Code, Indian Railway for the Mechanical Department.	1	1	1
17	Code, Indian Railways for the Accounts Department	1	1	1
18	Code, Indian Railways	1	1	1

	Establishment			
19	Codes, Indian Railways Standard, for Bridges, Structures and other subjects	1	1	1
21	Comprehensive guidelines and specifications for Railway Formation (GE: IRS-0004)	1	1	1
23	CPWD DSR	1	1	1
24	Engineering Formulae Pocket Book	1	1	-
27	General conditions of Contract	1	1	1
28	Guidelines on accessibility of Indian railway stations and facilities at stations for differently abled persons (Divyangjan) and passengers with reduced mobility	1	1	1
29	National Building Code 2016 (Vol I & II)	1	1	1
30	Manual, Permanent Way	1	1	1
31	Manual, Signaling and Interlocking	1	1	1
32	Manual, Bridge	1	1	1
33	Manual, Works	1	1	1
34	Manual, Accident or circulars pertaining to accidents.	1	1	1
35	Manual on Water supply and Treatment Systems (Drink from Tap) of Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Housing and Urban Affairs, New Delhi	1	-	-
36	Manual on Sewerage and Sewage Treatment Systems, Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Housing and Urban Affairs (erstwhile Ministry of Urban Development), New Delhi	1	-	-
37	Price lists of Stores and Stores nomenclature and circulars as applicable.	1	1	1
38	Principal Chief Engineer's Circular-Engineering Department	1	1	1
	Concrete Technology – IRICEN Publication.	1	1	1
	Fundamental of Building Orientation & Layout – IRICEN Publication.	1	1	1
39	Rain Water Harvesting – IRICEN Publication.	1	1	1
	Water supply for Railway Engineers – IRICEN Publication.	1	1	1

40	Regulations, Hours of Employment, with notifications as issued	1	1	1
41	Regulations, Income Tax (where applicable)	1	1	1
42	Regulations government the placing of electric transmission lines across and underground cables under railway track	1	1	1
43	Rules, General and Subsidiary Parts I and II	1	1	1
44	Rules, reg. Leave, Passes & PTOs	1	1	1
46	Schedule of Dimensions	1	1	1
47	Schedule of Powers in Estt. and other than establishment matters.	1	1	1
48	Standard signages at Stations on Indian Railways	1	1	1
50	Works Hand Book of specifications for materials and works	1	1	1
51	Working Time Table and Appendix thereto	1	1	1

* Copies may be supplied to ADEN/Sr. Section Engineer (Works) as required.

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CONCORDANCE

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	Chapter 1	
---	Duties of Engineering officials	New Para
A.	A.	Modified
101	101	Modified
102 (i) to (v)	102 (1) to (5)	No Change
---	102 (6) to (7)	New Para
103	103	Modified
104	104	Modified
105 (a)	105	Modified
105 (a) (i) to (v)	105 (1) to (5)	No Change
---	105 (6)	New Para
105 (b)	---	Deleted
106 (a)	106 (1)	Modified
---	106 (2)	New Para
106 (b)	106 (3)	Modified
106 (b) (i)	106 (3) (a)	Modified
106 (b) (ii)	106 (3) (b)	Modified
106 (c)	106 (3) (c)	Modified
106 (d)	106 (3) (d)	Modified
106 (e)	106 (3) (e)	Modified
106 (f)	106 (3) (f)	Modified
---	106 (3) (g)	New Para
107 (a) to (c)	107 (1) to (3)	Modified
---	107 (4)	New Para
108	108	Modified
109	109	Modified
110	110	Modified
111	111	Modified
112	---	Deleted

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
113	112	Modified
114 (1)	113 (1)	No Change
114 (2)	---	Deleted
114 (3)	113 (2)	No Change
114 (4) to (5)	113 (3) to (4)	Modified
115 (a)	114	Modified
B.	B.	Modified
116	115	Modified
116 (i)	115 (1)	No Change
116 (ii)	---	Deleted (Content merged in Para 115)
116 (iii) to (iv)	115 (2) to (3)	No Change
116 (v)	115 (4)	Modified
116 (vi) to (viii)	115 (5) to (7)	No Change
---	115 (8) to (9)	New Para
117 (a) to (c)	116 (1) to (3)	No Change
118	117	Modified
119 (a)	118 (1)	Modified
119 (b)	---	Deleted
119 (c) to (e)	118 (2) to (5)	Modified
---	118 (5)	New Para
120 (a)	119 (1)	Modified
120 (b)	119 (2)	No Change
121 (a)	120 (1)	Modified
121 (b)	120 (2)	No Change
121 (c)	120 (3)	Modified
122	121	Modified
123	122	Modified
124 (a)	123 (1)	Modified
124 (b)	123 (2)	No Change
125	124	Modified

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
125 (i) to (ii)	124 (1) to (2)	No Change
125 (iii)	124 (3)	Modified
---	124 (4)	New Para
126	---	Deleted
127	125	Modified
128 (a) to (b)	126 (1) to (2)	Modified
128 (c) to (d)	---	Deleted
128 (e)	126 (3)	Modified
129	127	Modified
130	128	Modified
.	C.	New Para
---	129 to 140	New Para
Chapter 2		
Chapter II (Name)	Chapter II (Name)	Modified
A.	PART A	Modified
201 (a)	201 (1)	No Change
—	201 (2)	New Para
201 (b&c)	201 (3&4)	Modified
201 (d)	201 (5)	No Change
201 (e)	---	Deleted
202 (a)	202 (1) to (2)	Modified
202 (b)	202 (3)	Modified
202 (c) to (d)	202 (4) to (5)	Modified
202 (f)	202 (6)	Modified
202 (g)	202 (7)	No Change
203 (1) to (2)	203 (1) to (2)	No Change
203 (3) (i) to (vi)	203 (3) (a) to (f)	No Change
203 (3) (vii)	---	Deleted (merged in 203(3)(f))
203 (3) (viii)	203 (g)	Modified
203 (4)	203 (4)	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
203 (5)	203 (5)	Modified
203 (6)	203 (6)	Modified
	203 (7) (c)	New Para
203 (7.1)	---	Deleted and modified as New Para 230
---	203 (8)	New Para
203 (8)	203(9)	Modified
203(9) (a)	203(10) (a)	Modified
203(9) (b)	203(10) (b)	Modified
203(9) (c) to (d)	203(10) (c) to (d)	No Change
203(9) (e)	203(10) (e)	Modified
203(9) (f) to (h)	203(10) (f) to (h)	No Change
203(9) (i)	203(10) (i) to (j)	Modified
203(9) (j)	203(10) (k)	No Change
203(9) (k) to (l)	203(10) (l) to (m)	Modified
---	204	New Para
204 (a) to (b)	205 (1), (2) & (3)	Modified
C	---	Deleted and modified as New Para 229
205	206	Modified
206	207	Modified
207	208	Modified
208	---	Deleted (Content covered under Para 209)
---	209	New Para
209	210	Modified
210	211	Modified
211	212	Modified
212	—	Deleted
212 (i) (a)	-	Deleted
212 (i) (b)	---	Deleted
212 (i) (c)		Deleted

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
212 (i) (d)	---	Deleted
212 (ii)	---	Deleted
212 (iii)	---	Deleted
212 (iv) (a) to (c)	---	Deleted
212 (v)	---	Deleted
213	213	Modified
214 (i)	214 (1)	No Change
214 (ii)	214 (2)	Modified
215	215	Modified
216 (i) to (iii)	216 (1) to (3)	No Change
217	---	Deleted
218 (a)	217 (1)	Modified
218 (b) to (c)	217 (2) to (3)	No Change
219	218	Modified
220	219	Modified
221 (a)	220 (1)	No Change
221 (b) to (e)	220 (2) to (5)	Modified
222 (a) to (b)	221 (1) to (2)	No Change
222 (c)	221 (3)	Modified
223 (a) to (b)	222	Modified
223A (1)	223	Modified
223A (2) (a)	223 (1)	No Change
223A (2) (b) to (c)	223 (2) to (3)	Modified
223A (2) (d) to (f)	223 (4) to (6)	No Change
223A (2) (g)	223 (7)	Modified
B.	---	Deleted
224 (a)	---	Deleted (Content covered under Para 301)
224 (b)	---	Deleted (Content covered under Para 303)
224 (c)	---	Deleted {Content covered under Para 303(2)}

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
224 (d) to (e)	---	Deleted (Content covered under Para 301)
224 (f)	---	Deleted
224 (g) to (i)	---	Deleted {Content covered under Para 303 (3, 4 & 5)}
225 (a) to 225 (b) (i)	---	Deleted (Content covered under Para 305)
225 (b) (ii) to 225 (e)	---	Deleted (content covered in 306)
---	224	New Para
226 (a) to (c)	---	Deleted (Content covered under Para 302)
226 (d)	---	Deleted (Content covered under Para 310)
227	---	Deleted (Content covered under Para 304)
C.	---	Deleted
228	---	Deleted (Content covered under Para 309)
229	---	Deleted (Content covered under Para 309)
230	---	Deleted (Content covered under Para 316)
231	---	Deleted (Content covered under Para 317)
232	---	Deleted (Content covered under Para 319)
---	PART B	New Para
---	225	New Para
---	226	New Para
---	227	New Para
---	228	New Para
---	229	New Para {With content of Para 106(3) (c)}
---	PART C	New Para
---	230	New Para
---	231	New Para
Chapter 3		

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
Chapter III (Name)	Chapter III (Name)	Modified
301	---	Deleted
---	301	New Para
302	---	Deleted
---	302	New Para
303	---	Deleted
---	303	New Para
304	---	Deleted
---	304	New Para
305	---	Deleted
---	305	New Para
306	---	Deleted {Content covered under Para 628(2)}
---	306	New Para
---	307	New Para
307(a)	580(1)	Deleted {Content covered under Para 580(1)}
307(b)(i)	580(2)	Deleted {Content covered under Para 580(2)}
307(b)(ii)	580(2)(b)	Deleted {Content covered under Para 580(2)(b)}
307(c)(i) to (c)(v)	580(3)(a to e)	Deleted {Content covered under Para 580(3)(a to e)}
307(c)(vi)	580 (3) (f)	Deleted {Content covered under Para 580(3)(f)}
307(c)(vii)	580 (3) (g)	Deleted {Content covered under Para 580(3)(g)}
—	308	New Para
--	309	New Para
---	310	New Para
---	311	New Para
---	312	New Para
---	313	New Para
---	314	New Para
---	315	New Para

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
---	316	New Para
---	317	New Para
---	318	New Para
---	319	New Para
---	320	New Para
Chapter 4		
401	401	No Change
402 (a) to (c)	402 (1) to (3)	Modified
402(d)	---	Deleted (Content covered in 402 (1 to 3))
403 to 404	403 to 404	Modified
405	405	Modified
405 A	--	Deleted
406	--	Deleted
---	406	New Para
---	407	New Para
---	408	New Para
---	409	New Para
---	410	New Para
407	411(1)	Modified
---	411(2)	New Para
408	412(1)	Modified
---	412(2)	New Para
409 (a) to (b)	413 (1) (a) to (b)	Modified
409 (c) to (e)	---	Deleted
410(a)	413 (2)(a)	Modified
410(b) to (c)	413 (2)(b) to (c)	No Change
411(a)	413 (3)(a)	No Change
411(b)(i)	413 (3)(b)(i)	Modified
411(b)(ii)	413 (3)(b)(ii)	No change
411(c)	413 (3)(c)	Modified

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
411(d)(i) to (ii)	413 (3)(d)(i) to (ii)	Modified
411(d)(iii)	413 (3)(d)(iii)	No Change
411(d)(iv)	413 (3)(d)(iv)	Modified
411(d)(v)	413 (3)(d)(v)	No Change
411(e) to (f)	413 (3)(e)	Modified
412(a)	414 (1)	Modified
412(b)	---	Deleted
412(c) to (e)	414 (2) to (4)	No Change
413	415	Modified
414(a) to (b)	416 (1)	Modified
414(c)	416(2)	Modified
415(a) to (b)	417 (1) to (2)	Modified
415(c)	417 (3)	No Change
415(d)	417 (4)	Modified
415(e)	---	Deleted
415(f)	417 (5)	Modified
415(g)	417 (6)	Modified
416(a) to (e)	418 (1) to (5)	Modified
—	418 (6)	New Para
417(a)	419 (1)	Modified
---	419 (2) to (3)	New Para
417(b)	419 (4)	Modified
417(c)	419 (10)	Covered in Para 419 (10)
417(d)	419 (6)	Modified
417(e) to (f)	419 (7) & (8)	No Change
417(g)	419 (9)	Modified
418(a)	420(1)	Modified
418(b)	---	Deleted
418 (c)	420 (2)	No Change
418(d)	420 (3)	Modified
419	---	Deleted

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
420	421	Modified
421	422	No Change
422	---	Deleted
423	---	Deleted (Content covered under Para 410)
424	423	Modified
425	424	Modified
426	425	Modified
427	---	Deleted
428	426	Modified
429(a) to (c)	426 (1) (a) to (c)	No Change
429(d) to (e)	426 (1) (d) to (e)	Modified
430	426 (2)	No Change
—	427	New Para
Chapter 5		
A.	A.	Modified
501(1) to (4)	501(1) to (4)	Modified
501(5)	501(5)	No Change
502	502	No Change
502(a) to (c)	502(1) to (3)	No Change
502(d)	502(4)	Modified
502(e)	502(5)	No Change
502(f)	502(6)	Modified
---	502(7) to (18)	New Para
503 to 504	503 to 504	Modified
505	---	Deleted (Content merged in Para 502(6))
---	505	New Para
B.	B.	Modified
---	506	New Para
506	507	Modified
507(a)	508(1)	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
507(b)(i)	508(2)(a)	No Change
507(b)(ii)	508(2)(b)	No Change
508	509	No Change
509	510	Modified
---	511	New para
C	C	No Change
510	512	No Change
511(a) to (c)	513(1) to (3)	No Change
511(d)	513(4)	Modified
512	514	No Change
513 to 514	515	No Change
---	516	New Para
D	D	No Change
515 to 517	517 to 519	No Change
518	520	Modified
E	E	No Change
519 to 521	521 to 523	No Change
522	524(1)	Modified
---	524(2) to (3)	New Para
523	---	Deleted (Content modified as Para 505)
F.	F.	No Change
---	525 (1) to (4)	New Para
524	526	Modified
525 (a) to (g)	527 (1) to (8)	No Change
526 (i) to (iv)	528 (1) to (4)	No Change
527 (a) to (c)	529 (1) to (5)	No Change
528	530	No change
G	G	No Change
529(a) to (f)	531	Modified
—	532	New Para

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
530(a)(i) to (vii)	533(1)(a) to (h)	No Change
530(b)(i) to (b)(vi)	533(2)(a) to (f)	No Change
530(c)	533(3)	Modified
H	H	No Change
531	534	Modified
532(a) to (d)	535(1) to (5)	Modified
532(e)	535(6)	Modified
--	535(7)	New Para
533	536	No change
---	537 to 547	New Para
534	548	Modified
---	549 to 559	New Para
535	560	Modified
---	561 to 562	New Para
I.	I.	Modified
536	563	No Change
537(a)	564(1)	No Change
537(b)	564(2)	Modified
538	565	Modified
539	566	No Change
J.	J.	No Change
540	567	Modified
541	568	No Change
542	569	No Change
543	570	Modified
544	571	No Change
545	572	No Change
546	573	No Change
547	574	No Change
548	575	Modified
K.	K.	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
549(a)	576 (1)(a)	No Change
549(b)	576 (1)(b)	Modified
549(c) to (d)	576 (1)(c) to (d)	No Change
549(e)	576 (1)(e)	Modified
549(f) to (h)	576 (1)(f) to (h)	No Change
550	576 (2)	Modified
551(a)	576 (3)(a)	Modified
551(b)	576 (3)(b)	No Change
---	576 (3)(c) to (d)	New Para
---	576(4)	New Para
552	577	Modified
553	578	Modified
554(a)	579(1)	Modified
554(b)	579(2)	Modified
554(b)(i) to (b)(vi)	579(2) (a) to (f)	No Change
554(b)(vii)	579(2)(g)	Modified
554(c) to (d)	579(3) to (4)	Modified
554(e)	579 (5)	No Change
---	580	New Para
Chapter 6		
Chapter VI (Name)	Chapter VI (Name)	Modified
A.	A.	Modified
601	601 (1) to (4)	Modified
---	601(5)	New Para
602	602	Modified
602(i) to (iii)	602 (1) to (3)	No Change
602 (iv)	602 (4)	Modified
602 (v) to (vii)	602 (5) to (7)	No Change
---	602 (8) to (10)	New Para
B.	B.	No Change
603	603	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
604 (a) to (l)	604	No Change
605	605	No Change
606	606	Modified
607	607	No Change
608	608	Modified
608 (a)	608(1)	Modified
608 (b)	608 (2)	No Change
608 (c)	608(3)	Modified
609	609	Modified
610	610	Modified
611	611	Modified
612	612	Modified
613	613	Modified
614	614	Modified
---	614 (1)(a)to(b)	New Para
614 (a)(i)	614 (1)(c)	No Change
---	614(1)d)	New Para
614(a)(ii)(1) to (2)	614(1)(e)(i) to (ii)	No Change
614(a)(ii)(3)	614(1)(e)(iii)	Modified
—	614(1)(f) to (i)	New Paras
614 (a) (iii)	614(1) (j)	No Change
—	614(1)(k)	New Para
614(a) (iv)	614(1) (l)	No change
614 (b) to (g)	614 (2) to (7)	No Change
---	615	New Para
615	616	Modified
616	617	Modified
617	---	Deleted
618	---	Deleted
---	618	New Para
619	619	Modified

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
---	620	New Para
620	621	Modified
C.	C.	Modified
621	622	No Change
622(a)	623(1)	Modified
622(b)	623(2)	No Change
622(c)	623(3)	Modified
623	624	Modified
624 to 626	625 to 627	No Change
627	628	Modified
628	629	Modified
629	630	Modified
629(a) to (g)	630(1) to (7)	No Change
630 to 631	631	Modified
632	632	Modified
D.	D.	No Change
633	633	No Change
634 (2)	634 (2)	Modified
635	635	No Change
Chapter 7		
Chapter VII (Name)	Chapter VII (Name)	Modified
A.	A.	Modified
701	701	Modified
---	702	New Para
---	703	New Para
---	B.	New Para
702	704	Modified
703	705	Modified
704	706	Modified
---	C.	New Para

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
705	707	Modified
706 to 707	---	Deleted (Content covered under Para 707)
---	708	New Para
708	709	Modified
C.	D.	Modified
709(a) to (c)	710 (1) to (3)	Modified
710	711	Modified
711	712	Modified
712	713	No Change
712 (a) to (f)	713 (1) to (6)	Modified
713	714	Modified
714	715	Modified
D.	E.	No Change
715	716	No Change
715(a)	716(1)	Modified
715(b)	716(2)	Modified
715(c)	716(3)	No Change
716	-	Deleted (Content covered under Para 716(1))
717	717	Modified
718	718	Modified
719	719	Modified
720	720	Modified
721	721	Modified
722	722	Modified
723	723	No Change
Chapter 8		
Chapter VIII (Name)	Chapter VIII (Name)	Modified
A.	A.	Modified
801(a) to (c)	801(1) to (3)	Modified
802(a)	802(1)	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
802(b)	802(2)	No Change
802(c)	802(3)	Modified
803(a)	803(1)	Modified
803(b)	803(2)	Modified
803(c)	803(3)	No Change
803(d)	803(4)	Modified
803(e)	803(5)	Modified
803(f) to (g)	803(6) to (7)	No Change
803(h)	803(8)	Modified
803(i)	803(9)	No Change
---	803 (10 to 14)	New Para
804(a)	804(1)(a)	Modified
804(b) to (d)	804(1)(b) to (d)	No Change
804(e)	804(1)(e)	Modified
804 (f)	804(1)(f)	No Change
804 (g) to (h)	---	Deleted
804 (i)	804 (2)	Modified.
805	805	Modified
B.	B.	No Change
806 (a) to (c)	806 (1) to (3)	Modified
806 (d)	806(4) (a)	Modified
---	806(4) (b)	New Para
807(a)	807(1)	No Change
807(b) to (f)	807(2) to (6)	Modified
---	807 (7) to (8)	New Para
808 (i) to (iv)	808 (1) to (4)	No Change
808 (v)	808 (5)	No Change
806 (vi)	808 (7)	No Change
808 (vii)	808 (8)	No Change
809 (a)	809 (1)	Modified
809 (b)	809 (2)	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
810	810	No Change
811(i) (a)	811(1) (a)	Modified
811(i) (b)	811(1) (b)	Modified
811(ii)	811(2)	Modified
811(iii) (a) to (d)	811(3) (a) to (d)	Modified
811(iii)(e)	811(3)(e)	No Change
811(iii) (f) to (g)	811(3) (f) to (g)	Modified
---	811(4)	New Para
812 (a)	812 (1)	Modified
---	812 (2) to (3)	New Para
812 (b)	812 (4)	Modified
---	812 (5)	New Para
813(a) to (d)	813 (1) to (4)	Modified
814 (a)	814 (1)	No Change
814 (b)	814 (2)	Modified
814(c) to (d)	814 (3) to (4)	No Change
814(e)	814 (5)	Modified
814 (f) (i) to (iv)	814 (6) (i) to (iv)	Modified
---	814 (6) (v)	New Para
814 (g)	814 (7)	No Change
815 (a) to (c)	815 (1) to (3)	Modified
815 (d)	---	Deleted
815 (e) to (f)	815 (4) to (5)	Modified
---	815 (6) to (8)	New Para
815 (g) to (h)	815 (9) to (10)	Modified
815 (i)	815 (11)	No Change
815-A	815(A)	Modified
815-B	815(B)	No Change
816	816	No Change
817(a) to (b)	817(1) to (2)	Modified
818 (a)	818 (1)	No Change

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
818 (b) to (c)	818 (2) to (3)	Modified
818 (d) to (e)	818 (4) to (5)	No Change
C.	C.	No Change
819	819	Modified
820	---	Deleted
---	820, 821 & 822	New Para
821	823	Modified
822	824	Modified
823, 824	---	Deleted (Content covered under Para 820)
825 (a)	825 (1)	No Change
825 (b) to (c)	825 (2) to (3)	Modified
825 (d) to (g)	825 (4) to (7)	No Change
825 (h)	825 (8)	Modified
826 (a) (i) & (ii)	826 (1) (a) & (b)	Modified
826 (b)	---	Deleted
827 (a) (1)	827 (1) (a)	No Change
827(a) (2) (i)	827 (1) (b) (i)	Modified
827(a) (2) (ii)	827 (1) (b) (ii)	No Change
827(a) (3)	827 (1) (c)	No Change
827(b)	827 (2)	No Change
827(c) to (d)	827 (2) (3) to (4)	Modified
828	828	Modified
Chapter 9		
-	901 (1)	New Para
901(a)	901(2)	Modified
-	901 (3)	New Para
901(b)	901(4)	Modified
901(c) to (h)	---	Deleted and content covered in 911
902	902	Modified
903	903	Modified

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
904(a)	904(1)	Modified
904(b)	904(2)	No Change
904(c)	904(3)	Modified
904(d) to (e)	904(4) to (5)	No Change
904(f)	904(6)	Modified
905(a) to (b)	905(1) to (2)	Modified
905(c)	905(3)	No Change
906	906	Modified
907(a) to (c)	907(1) to (3)	Modified
907(d)	907(4)	No Change
907(e)	-	Deleted
908	908	No Change
909 to 910	909 to 910	Modified
-	911	New para
---	912	New Para
---	913	New Para
911	914	Modified
---	915	New Para
912 (a)	916 (1)	Modified
912 (b)	916 (2)	No Change
912 (c)	916 (3)	Modified
912 (d)	916 (4)	No Change
912 (e)	916 (5)	Modified
Chapter 10		
1001(a)	1001 (1)	No Change
---	1001(2)	New Para
1001(b)	1001 (3)	Modified
1001(c)	1001 (4)	No Change
1002	1002	Modified
1003(a)	1003(1)	No Change
1003 (b) to (c)	1003 (2) to (3)	Modified
1004	---	Deleted

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
1005	1004	Modified
1006	1005	Modified
1006(a) to (b)	1005 (1) to (2)	No Change
1006(c)	1005 (3)	Modified
1006(d) to (h)	1005 (4) to (8)	No Change
1006(i) to (l)	1005 (9) to (12)	No Change
---	1005 (13) to (17)	New Para
1007(a) to (b)	1006 (1) to (2)	Modified
1007(c)	1006 (3)	No Change
1008	1007	No Change
1009	---	Deleted
Chapter 11		
1101	1101	Modified
1102 (a)	1102 (1)	Modified
1102 (b)	1102 (2)	No Change
1102 (c)(i)	1102 (3)(i)	Modified
1102 (c)(ii)	1102 (3)(ii)	No Change
1102 (c)(iii)	1102 (3)(iii)	Modified
1103 (a)	1103 (1)(a)	Modified
1103 (b)	---	Deleted(Content covered under Para 1103(1)(b) and 1103(3)
---	1103 (1)(b)	New Para
---	1103 (2) to (3)	New Para
1103 (c) to (d)	1103 (4) to (5)	Modified
1103(e)	1103(6)	No Change
1104	1104	Modified
1104(a) to (d)	1104 (1) to (4)	Modified
1105	1105	Modified
1106	1106	No Change
1107	1107	Modified
1108	1108	Modified

Paragraph in IRWM 2000	Paragraph in IRWM 2025	Remarks
1109	1109	Modified
1110	1110	Modified
1111	1111	No Change
1112(a) to (b)	1112 (1) & (2)	No Change
1112(c)	1112(c)	Modified
1114(a) to (c)	1114 (1) to (3)	Modified
1114(d)	1114(4)	Modified
Chapter 12		
1201	1201	Modified
1202	1202	Modified

***** **END** *****