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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAYS
WORKS MANUAL

Embodying all advanced correction slips
upto no. 12 dated 13.08.24

2000

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 in 1986 and 1998 respectively, Works Manual is now being published in the completely updated and revised form. 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.

It is hoped that procedures and practices laid down in the Manual 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,
02-2-2000.

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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 was published in 1986 and the Bridge Manual has been published in 1998. With this Manual 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.82/W-1/M-W/2 dated 30.3.87, consisting of Chief Planning & Design Engineers of five Zonal Railways and Director, IRICEN. The Committee, however, could do only a part of the job due to retirement of several Members. However, Railway Board nominated a Select Committee vide letter No.82/W-1/M-W/2 dated 17.9.92. The revised draft Manual prepared by the Members of this Select Committee was submitted to the Railway Board and was circulated to all the Zonal Railways and Construction Organisations for their comments. After due consideration of the comments and suggestions received from various Units, the finally revised edition in the present form was prepared by IRICEN. This includes addition of clauses related to maintenance of roads, handing over assets, felling of trees, management of land, water proofing of roofs 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. Chapters on Contracts, Engineering Stores & Accountal, Control over Expenditure and Deposit Works, which existed in the earlier Way & Works Manual, are now a part of the Indian Railways Code for Engineering Department,1993; hence not included in the present edition. Due consideration has also been given to codes and standards published by Bureau of Indian Standards (BIS) and National Building Organisation(NBO).

All efforts have been made to make the instructions comprehensive. However, the 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.

Railway Board will be glad to consider any comments and suggestions from the Railway Administrations.

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EXPLANATORY NOTES

1. Index letters for Codes - The following index letters are used for distinguishing the several Indian Railway Codes from each other -

   A - Accounts Department
   E - Engineering Department
   F - Financial Code
   G - Administration & Finance - an Introduction
   R - Establishment Code
   S - Stores Code
   T - Traffic Department (Commercial)
   M - Mechanical Department (workshops)

2. Paragraph Numbers - For convenience of indexing of reference, the paragraphs have been numbered according to 3 or 4 figures "Code", in which the last two figures give the number of the paragraph and the remaining figures the number of the Chapter. Thus paragraph 101 of any code is paragraph I of Chapter 1 of that code and paragraph 1421, paragraph 21 of Chapter XIV.

3. Reference to paragraphs - Reference to paragraphs of a code is made by putting the paragraph number, suffixed by the index letter of the code concerned. Thus 1335-R means paragraph 35 of chapter XIII of the Indian Railway Establishment Code Volume 1 and 5 Appendix VIII-RI means paragraph 5 of Appendix VIII of the Indian Railway Establishment Code Vol.I.

4. Index to Correction Slips - To facilitate reference to correction slips that have been issued to the Codes, an up-to-date index of correction slips is published from time to time showing for each Code the paragraph of rule numbers affected by correction slips and the numbers of such correction slips. This index may be pasted inside the cover of each Code.

5. Reference year quoted against various codes and references mentioned in this Manual are the latest available versions. These may be replaced by the subsequent versions whenever new versions are issued.

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CHAPTER I
DUTIES OF ENGINEERING OFFICIALS

A. DUTIES OF ASSISTANT ENGINEER

101 General:- The Assistant Engineer is responsible for the maintenance, execution and safety of all works in his charge, for the accuracy, quality and progress of new works and control over all expenditure in relation to budget allotments.

102 Essential Duties of Assistant Engineer:- The duties of the Assistant Engineer are detailed in various chapters of this Manual. The essential duties in respect of works are as under:

(i) Inspection of all structures and their maintenance in a satisfactory and safe condition;

(ii) Preparation of plans and estimates;

(iii) Execution and measurement of works;

(iv) Verification of stores held by stock-holders;

(v) Submission of proposals for inclusion in the works programme and revenue budget.

103 Knowledge of Rules and Regulations:- The Assistant 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 is 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 Engineer should co-ordinate effectively with officers and staff of other Departments in matters that warrant joint action.

105 Inspection by Higher Officials:-

a) When the Assistant Engineer has to accompany inspection of superior officers, he should have with him the under-mentioned drawings and registers for reference as required:

(i) Yard plans, colony plans showing service and residential buildings;

(ii) Index plans and sections;

(iii) Progress reports on works;

(iv) Working time table;

(v) Inspection notes of higher officers and their compliance reports;

b) All inspection notes should receive prompt attention.

106 Inspection by Assistant Engineer:-

a) The Assistant 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.

b) The important inspections to be carried out by Assistant Engineer are summarised below -

i) *Inspection of Buildings and Structures*
The Assistant Engineer shall systematically inspect all buildings and structures periodically as prescribed in para 228 and 229 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 Section Engineer (Works) at stations as prescribed in para 225(a) of this Manual.

ii) Inspection of Water Supply
The Assistant Engineer shall inspect water supply installations as prescribed in para 554 of this Manual. He shall ensure cleaning of overhead / underground storage tanks and proper disinfection of drinking water supply.

c) Inspection of Sewerage and Drainage System
Assistant Engineer shall inspect sewerage and drainage systems and ensure their efficient performance as prescribed vide para 632 of this Manual in association with the concerned Officer of the Medical Department.

d) Inspection of Railway affecting works/ Railway affecting tanks (RAW/RAT)
Assistant Engineer shall jointly inspect with civil authorities, all RAW/RAT before the monsoons every year and arrange for their safe maintenance to avoid any danger to nearby tracks and structures. Records of these annual inspections should be kept in registers as prescribed.

e) Assistant Engineer shall periodically inspect land and land boundaries in his jurisdiction as detailed in paras 813 and 814 of this Manual.

f) Assistant Engineer should associate himself with various Committees and Groups such as the Colony Committee, the Sanitation Committee and the Station Inprovement Group as decided by the Administration and take prompt action for items pertaining to his jurisdiction.

107 Execution and monitoring of Works:-

a) The Assistant Engineer should ensure that all works are carried out according to plans and specifications laid down. Important works should be set out personally by the Assistant Engineer.

b) Every work should be organised and so programmed that it progresses well and is completed in time. Periodical progress reports on works should be submitted to the Divisional Engineer/Executive Engineer/Deputy Chief Engineer on prescribed proforma as per Annexure 1.1 to enable proper reporting and monitoring at different levels as per Annexure 1.2.

c) Copies of all contract agreement for works should be maintained serially in the Assistant Engineer's Office. Before passing measurements recorded by Section Engineer (Works), he should carry out test check as specified.

108 Control Over Expenditure - The Assistant 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.

109 Water Supply : Adequate water supply at each loco & coach water 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 taken to deepen failing wells or to establish alternative sources of supply.

110 Land Management - The Assistant Engineer should take necessary action for management of land and shall prevent encroachments and protect the land from unauthorised use. He should organise tree plantation, and horticulture.

111 Training - The Assistant Engineer should interest himself in training all probationers 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 Witnessing Payments to Staff - As far as possible, payments to staff shall be made through cheques. Wherever cash payments are made, the Assistant Engineer should witness payments to workmen under one or more Section Engineers every quarter by rotation. This should be done by surprise.

113 Inspection of Offices and Stores of Inspectors - The Assistant Engineer shall carry out inspection of each Section Engineer's 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.

114 Staff Matters - The Assistant Engineer will ensure, that -

(1) strict discipline is maintained within the frame work of the rules;

(2) service and leave records are maintained correctly and upto date;

(3) appeals and representations are dealt with promptly;

(4) selections for the various posts like artisans are held in time and the vacant posts promptly filled up;

(5) all the subordinates and other staff working under him receive proper training in maintenance practices, safety and protection rules at the appropriate stage.

115 Relinquishment of Charge

a)Instructions regarding "Transfer-of-charge" contained in paras 143 & 144 of the Indian Railways Code for Engg. Deptt. (1993 Edition) should be followed. The Assistant Engineers 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 Engineers in this Chapter.*

B. DUTIES OF SECTION ENGINEER (Works)

116 Duties The duties of the Section Engineer (Works) are detailed in the various chapters of the Indian Railways Works Manual, the most essential being :-

(i) Inspection and maintenance of :

- *Service buildings, staff quarters and other structures*
- *Approach roads;*
- *Water supply, drainage and sewerage systems;*

(ii) Inspection of bridge works as assigned;

(iii) Execution of all new buildings/ structural works;

(iv) Accountal and periodical verification of stores and tools in his charge;

(v) Maintenance of land boundaries, as specified;

(vi) Removal of encroachments at his headquarters and at other places in his jurisdiction as specified;

(vii) Afforestation and other horticulture works.

(viii) He shall ensure proper training of the staff under him as prescribed in the training modules of the Civil Engineering Department.

117 Knowledge of Rules And Regulations

a) He should be in possession of books, codes, manuals and compendium as prescribed in Annexure 12.1.

b) He shall be well acquainted with the rules, regulations and procedures contained in these books concerning his work.

c) He shall ensure that all staff under him are well acquainted with the relevant rules and working methods and efficiently perform their duties.

118 Co-ordination with Permanent Way, Bridge and other staff - The Section Engineer (Works) should co-operate effectively with the permanent way, bridge, signalling, electrical staff & others. where they are required to work jointly.

119 Inspections - The important inspections to be carried out by Section Engineer (Works) are summarised below:

a) The Section 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 paras 224, 228 and 229 of this Manual.

The Section Engineer (Works) shall maintain petty repair books at all station buildings and other important buildings as specified in para 225 of this Manual and shall check them during his inspections and ensure prompt action/repairs.

b) The Section Engineer (Works) shall inspect bridge foundations and substructures.

c) Inspection of water supply arrangements - Every Section 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.

The Section Engineer (Works) shall also have complete history and data of tubewells under his jurisdiction and ensure testing of yield of tubewells 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 main stations, while on way-side stations where engineering staff is not posted, the work may be assigned to pump drivers of Electrical / Mechanical Department.

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

d) *Inspection of Sewerage and Drainage System* - Section Engineer (Works) shall periodically inspect sewerage and drainage system and ensure their efficient performance as prescribed vide para 632 of this Manual.

e) Section 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 Engineer.

120 Musters

a) Each blank muster sheet before issue should be initialled on the top by the Assistant Engineer. The attendance of artisans, helpers and other staff under him should be checked by the Section Engineer (Works).

b) The leave availed of by staff should be recorded in the leave register in the leave account before the musters are despatched to the Divisional office.

121 Execution of Works

a) The Section 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.

b) He should plan every work, organise 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.

c) 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 Engineer /Divisional Engineer.

122 Measurement of Works - Every Section Engineer (Works) shall be responsible for proper measurement of contractual works as per powers delegated to him as per paras 1315 to 1317 of the Indian Rlys. Code for Engg. Deptt. (1993 Edition). He shall maintain movement register of Measurement Books and Standard Measurement Registers for works.

123 Works Affecting Moving Dimensions - The Section Engineer (Works) shall refer to the Assistant Engineer for instructions regarding works likely to affect moving dimensions.

124 Imprest of Tools and Materials

a) The Section Engineer (Works) shall examine all tools and plant with the artisans once a month and replace the unserviceable or defective ones or arrange repairs.

b) He shall ensure that the materials and tools as per scales specified for maintenance of building, water supply and drainage works etc. are available and are adequately distributed at various points according to requirement. Recoupment of shortages should be effected without delay.

125 Accompanying Important Inspections - When the Section 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.

(i) Plans and details of all important works, recently completed, on hand or contemplated ;

(ii) Progress report of works; and any other papers and plans that are likely to be required for discussion;

(iii) Tape (15m & 2m), and other tools and surveying equipment required during inspection.

126 Witnessing Payment to Staff

a) Payment to both permanent and temporary staff will generally be made through cheque. However, in case of cash payments, they will be made by the Pay Clerk in the presence of the Section Engineer (Works) who is responsible for correct identification of the payee and to satisfy himself that the correct amount is paid.

b) The certificate at the foot of the paysheet should be filled in by the Section Engineer (Works) as payment of each batch of workmen is completed. If a person is not present, "Not paid" should be immediately written against his name; when subsequently payment is made, the kilometrage or place at which he is paid should be entered and separately certified as such on the paysheet.

c) If the witnessing official is not available, the Assistant Engineer may authorise another Subordinate to witness payment on the section.

127 Journal of Daily Duties - The Section 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 Engineer every month.

128 Establishment

a) 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. Section Engineer (Works) should acquaint himself with these and meticulously follow them.

b) *Medical Examination* - The Section Engineer (Works) shall ensure that all Group 'D' staff working under him are sent for medical examination for fitness for service. He should ensure that men in categories A and B specified in Regulation No.3 of Appendix III to the Indian Railway Establishment Code are sent for periodical medical re-examination as laid down in sub-rule 2 thereunder.

c) *Service Books* -(i) Service books for Group 'D' staff should be prepared by the Section Engineer (Works) on the prescribed form as soon as appointments in temporary/ permanent vacancies are made and submitted to the Assistant Engineer for verification and signature. These should be carefully maintained in the Assistant Engineer's or Section Engineer (Works)' office as may be prescribed.

(ii) All increments and promotions should be noted in the service books, duly attested by the Assistant Engineer.

d) Promotion to higher grades - The Section Engineer (Works) should maintain in manuscript form records of staff working under him in which he shall enter awards or penalties of each staff as and when such entries are justified.

e) *Provisions in the Payment of Wages Act, the Workmen's Compensation Act and other regulations* - The Section Engineer (Works) shall ensure that the rules laid down in the Acts and Regulations, as modified from time to time, are strictly complied with.

129 Correspondence and Records - The Section Engineer (Works) shall keep his correspondence upto date and see that all office records, registers and stores ledgers are maintained properly and posted regularly.

130 Relinquishment of Charge

a) On relinquishing charge, the Section Engineer (Works) shall prepare, in triplicate, the specified "Transfer-of-charge" statement which will briefly contain the following-

(i) Extent of section ;

(ii) Establishment matters (service and leave records);

(iii) Works in progress ;

(iv) Water sources that give trouble ;

(v) Certificate of stores check and correctness of stock;

(vi) General notes.

b) The statement referred in sub-para (a) should be signed by both the relieved & relieving Section Engineer (Works) Engineer,

and two copies submitted by the relieving subordinate to the Assistant Engineer who will forward one copy to the Divisional/Executive Engineer for record.

c) The relieving Section Engineer will examine all books pertaining to rules and orders in vogue and all registers pertaining to the section to see that they are kept upto date and initial them with date.

d) The Section Engineers (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 Engineer's special attention invited to them.

ANNEXURE 1.1
Para 107(b)

PROFORMA FOR SUBMITTING PROGRESS REPORT

Progress report of sanctioned works for the month .....

S.No.	Plan Head	Year of Sanction	Name of Work	State	Division
1	2	3	4	5	6

Original Cost	Current Cost	Expenditure upto previous year	Outlay	Target Date	Remarks including physical and financial progress in %age
7	8	9	10	11	12

ANNEXURE 1.2
Para 107(b)

PROGRESS REPORTS TO BE SUBMITTED BY VARIOUS UNITS

S.No.	Nature of Report	By whom to be sent	To whom sent
1.	Progress report on itemised works sanctioned in Works Programme	IOW	AEN
2.	Progress Report on itemised works in the Works Programme/List of approved works.	AEN	DEN/Sr.DEN
3.	Progress report on Deposit Works	Sr.DEN	CE
4.	Progress report on Passenger Amenities Works	Sr.DEN	CE
5.	Progress report of works under execution by construction units (irrespective of cost)	CAO/C	GM & PHODs Railway Board.
6.	Flash Report for works costing over Rs.100 crores	CAO/C	Ministry of Programme Implementation and to Rly.Bd.

CHAPTER II

PLANNING, INSPECTION AND MAINTENANCE OF BUILDINGS AND STRUCTURES OTHER THAN BRIDGES AND HANDING OVER COMMISSIONED ASSETS BY CONSTRUCTION ORGANISATION TO OPEN LINE

A. PLANNING AND GENERAL INSTRUCTIONS

201 Siting of Buildings

a) Section 11 of the Indian Railways Act of 1989 and the Government Buildings Act No.IV of 1899 read in conjunction with Sec.291 of the Cantonments Act No.II of 1924 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.

b) 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.

c) Multi-storeyed quarters shall only be constructed on consideration of land cost/land scarcity. For construction of independent bunglows, prior approval of General Manager shall be obtained. In areas where bye-laws have been notified by the Local Authorities, not withstanding 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.

d) In areas where bye-laws have not been notified it will be desirable to adopt the provisions of the National Building Code of India 1983 Part III. For quick reference, some of the provisions of National Building Code (NBC) are listed in Annexure 2.10".(CS No.10 Dt.17.02.2005)

e) When a large number of Type 'I' and 'II' type single storeyed quarters are to be constructed, these should be built at least in 2- unit blocks; subject to provision of adequate lighting and ventilation commensurate with optimum land use.

202 Planning of Railway Staff Colonies

a) *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.

(i) Natural light and temperature
(ii) Prevailing winds
(iii) Relative humidity

(iv) Surrounding view & features

As per IS code No.SP-41 (S&T) – 1987,Four types of climatic conditions are mainly found in India:

(i) Hot and dry
(ii)Hot and humid
(iii) Warm and humid
(iv) Cold

The list of cities falling in these climatic zones is given in annexure 2.11.

The following orientation principles with respect to various climatic condition along with building features can be used as a guideline:

i) Hot and dry climatic zones: This climatic condition generally occurs at latitude between 15 degrees to 30 degrees on both the hemispheres. Maximum day time summer temperature goes as high as 45 degree centigrade and relative humidity as low up to 20 %. Major areas falling in this climatic zone are Delhi, U.P., Bihar, Rajasthan, parts of Punjab and Madhya Pradesh. These areas are far away from coast and do not experience very heavy rainfall. The buildings should be oriented from solar point of view so that as a whole it should receive the maximum solar radiation in winter and the minimum in ummer. Desirable features of building in this zone are:

1. Orientation: Longer walls of building should face North & South. Non-habitat rooms can be located on outer faces to act as thermal barrier. Preferably the kitchen should be located on leeward side of the building to avoid circulation of hot air and smell from the kitchen.

2. Windows and fenestration: Large openings with heavy shutters should be provided on northern and western faces as light coming from north is always diffused and indirect. Also direction of breeze, which is from west at most of the places enters from opening on west side. Windows area should be 15 to 20 percent of floor area. Internal courtyard caters for cross ventilation & thermal buffer. Suitable radiation barriers in the form of canopies, Chhajjas, long verandahs etc. should be provided on the West side of the building. Sufficient number of ventilators close to the bottom of slab should be provided.

3. Walls: Thick walls are preferred to act as insulating barrier. Walls with light and shining paints on outer surface have good reflective quality and do not absorb heat. The surface of walls should be smooth and nondust catching type. Cavity walls also can be provided as they provide very good thermal insulation. Hollow bricks available in the market can also be used for making hollow - insulated walls.

4. Roofs: Should be built up with good insulating material having slope in windward direction. False ceiling can be used to improve thermal

performance of building. Terracing should be provided on the flat roof with mud phuska, lime concrete, foamed concrete or burnt clay block paving over roof slab. Top roof surface should be made reflective by providing whitewashing or any reflective paint.

5. Vegetation: Large shady trees whose roots do not strain foundation and basement should be planted near external walls to provide shade.

6. Special needs: Outdoor sleeping area for summer nights preferably be provided. Desert coolers and fans can be used during summer months. Therefore, proper space to provide coolers should be planned in the building.

ii) Hot and humid climatic zone: In these regions the climate is hot and air contains moisture. Sun's glare is more and undesirable. Relative humidity is above 40% and temperature is above 32 degree centigrade. Mostly interior peninsular region fall under this category. Interiors should be protected from hot Sun and dusty winds. The thermal characteristics are almost identical to hot & dry zone except that desert coolers are not suitable for hot & humid zone. The orientation and other features of the building would remain the same as in hot and dry climatic zone.

iii) Warm and humid climatic zone: This type of climate is normally found in the coastal areas. Mean maximum temperature during summer does not rise beyond 32 degree centigrade and relative humidity ranges between 70% and 90%. Because of less diurnal variation of temperatures along with high humidity, the emphasis should be on prevailing winds. Coastal regions of Gujrat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orrissa and West Bengal fall under this category. Desirable features of buildings in this zone are:

1. Orientation: should be preferably in North-South direction for habitable rooms i.e. longer walls should face north & south so that shorter sides are exposed to direct sunlight.

2. Windows and fenestration: Proper cross ventilation of building is of extreme importance therefore large openings should be positioned on windward and leeward direction. However, openings should be provided with suitable protection like sunshades, chhajjas etc. from Sun and rain. Windows area should be 15 to 20 percent of floor area. The sill height of windows should be at low level between 0.5 to 0.7 metre. Fixed windows should be avoided. Internal doorways between drawing & dining and dining to passage etc. may be left open without shutters/ leaves. Ventilators should be provided as near to ceiling as possible. Provision of mechanical ventilation for circulation of fresh air as well as exhaust of used air should be made.

3. Walls: Low thermal capacity material be used in construction and walls can be thinner as

temperatures are not very high. Compound wall on the windward side should be low. Bare fencing or light screen walls are preferable. RCC jalies are more advantages as they allow passage of air through them and at the same time provide privacy by obstructing the vision.

4. Roofs: should have large overhangs to avoid rainwater hitting the wall. Roof should be finished with materials of low thermal conductivity. Top roof surface should be made reflective by providing whitewashing or any reflective paint / tiles. Proper slope is essential for effective removal of rainwater.

5. Vegetation: Shrubs of medium height or coconut trees grove or casuarinas, which do not act as wind barriers are recommended.

6. Special needs: Good rain-water drainage is essential. Desert coolers are not suitable in these areas.

iv) Cold climatic zone: Cold climate occurs in mountainous regions and plateaus 800 to 1200 metres above sea level. Snowfall and rainfall is also heavy and mean daily temperatures is 6 degree or less. Minimum temperature may fall up to minus four degrees or even less at some locations. Mountainous regions of Jammu & Kashmir, Himachal Pradesh, Uttaranchal and North Eastern States and other hilly and mountainous regions of the country fall under this category. Main requirement of this region is heating during winter months and protection from chilling winds. Walls and roofs should be protected against heavy rain and snowfall.

1. Orientation: Should preferably be in North – South direction i.e longer walls should face north & south to receive more solar heat during winter months.

2. Windows and fenestration: Glazing windows upto 25% floor area may be provided. Double glazing is preferable to avoid heat losses during winter nights.

3. Walls: Thin walls with insulation from inner side (2.5cm thick insulation) are preferable. Some of the insulating materials are listed in table 2 of SP41-1987 Part 2 of BIS titled as Handbook on functional requirement of Buildings - Heat insulation. The insulation should be protected against the risk of condensation by providing sufficient vapour barrier like 2 coats of Bitumen, polythene sheet 300 to 600 gauge or aluminium foil on warm side. Hollow and light weight concrete blocks are also quite suitable.

4. Roofs: should be preferable made of asbestos cement or G.I. sheets backed by false ceiling of wood, 2.5cm wood-wool board or equivalent material. The roof should have sufficient slope for quick drainage of rainwater and snow. Vapour barrier should be used depending on location and possible

wind pressure.

5. Special needs: Provision for heating of building should be kept like fire places etc. Ceiling fans are not normally required, but may be used during summer on special occasions. Outdoor sleeping area is not required.

The services of an architect may be availed of for finalising the design and layout wherever required particularly in case of important stations, other important buildings and where new colonies/ establishments are being set up.(CS No.10 Dt.17.02.2005)

b) *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 200 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.

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 according to the layout of the ground should be provided.

Guidelines for the selection of an appropriate sanitation system are given in Annexure 2.1.

Groups of latrines or urinals should not be located within 15 metres of living quarters, 30 metres of any cook house or foodstall, 45 metres of any well supplying drinking water and should be located away from public buildings adjoining railway colonies.

c) *Dust bins* - These should be conveniently located with respect to the quarters and regularly cleared by the conservancy staff. In the case of multi-storeyed buildings garbage chutes may be provided with opening in each floor with arrangements for closing the openings.

d) *Shady trees* - Shady trees like Gulmohur, Neem, 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.

f) *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.

g) *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 Requirement 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 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 finalising 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 :-

(i) Use of non-flammable, non-toxic materials

(ii) Eliminating sharp edges, corner etc. These should be rounded or chamfered properly.

(iii) Properly designed and adequately illuminated stairs, ramps and walkways.

(iv) Appropriate barriers to prevent people from walking through large glass door and windows, when they are closed.

(v) Use of non-skid materials in area prone to becoming wet, such as in toilets, kitchen and open veranda, walk ways, stairs etc.

(vi) Emergency escape routes should also be planned.

(vii) Proper fencing around special facilities like swimming pools, electric poles, high voltage wires and heaters etc.

(viii) Fire fighting system and fire alarm system should be as per national building code or local bye-laws wherever required

4. Natural ventilation – Proper natural ventilation is an important factor in planning building layouts specially 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 minimise noise pollution through ground reflection, the dwelling units/areas should be surrounded by plants and grass area, whereas from maintenance reasons a large amount of hard paving is necessary. It should be broken up by areas of plants and grass to minimise 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 1983, (Part VIII) 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 –

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

7.1 Energy Management in building – Building should be designed in such a way that energy requirement for cooling, heating etc. should be the barest minimum. For this as already discussed in the above paras, the orientation of building along with ventilation is of prime importance. For minimising 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.

(A) 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.

(i) 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 alongwith proper planning of various openings. Thermal storage have added features. Thermal storage features in a passive solar building is 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: -

(a) flooring of concrete, tile, brick or stone masonry.

(b) 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.

(c) 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 troweled or sprayed on weathering skin.

(d) 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.

(e) 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.

(f) 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.

(ii) Passive Solar Cooling: Passive solar cooling are designed strategy 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 sitting 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.

(B) Active Solar System: Active solar energy should be integrated with a building's design and systems only after passive solar and energyconserving strategies are considered. Active solar collector systems take advantage of the sun to provide energy for domestic water heating, space heating etc. Water heating for domestic use is generally the most economical application of active solar systems.

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.

8. Seismic consideration – The building should be designed for seismic forces as per relevant IS codes as per seismic zone and importance of building. Some of the general considerations along with seismic repair and strengthening of building are given in Annexure 2.12 for ready reference. However, these should be confirmed with the latest provision of relevant IS codes.

Following updated IS codes may be used for this purpose.

i) SP22 –1982: Explanatory handbook on codes for earthquake engineering.
ii) IS 1893-1984: Criteria for earthquake resistant design of structure.
iii) IS1893 – Part I –2002: Criteria for earthquake resistant design of structure part 1 – General Provisions and buildings.
iv) IS4326-1993: Code of structures for earthquake resistant design and construction of buildings
v) IS13828 –1993: Improving Earthquake resistance of low strength masonry buildings - Guidelines
vi) 13920-1993: ductile detailing of reinforced concrete structure subject to seismic forces - code of practices
vii) 13935-1993: Criteria for repair and seismic strengthening of buildings.
viii) Any other IS codes related to earthquake issued afterwards.
ix) National Building Code.

9. Other general design requirements –
(CS No.10 Dated 17.02.2005)

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.

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.(CS No.10 Dated 17.02.2005)

e) Mosquito proof shutters should be provided in Type IV and higher type quarters and in the kitchen and toilets of 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 and Signalling and Tele-communication Departments.

g) Designs of important buildings, like hospitals, offices, station buildings, etc. should be finalised 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 alongwith the Drawings. The designs should invariable include design of foundations.

The general arrangement drawing should have the prior approval of an officers in Hqrs. not lower than the rank of SAG in the Office of the Chief Engineer(Open Line). Further, in Station Buildings and other important structures, no additions/alterations should be carried out without the prior approval of the general arrangement plan by the concerned SAG officer in the office of Chief Engineer (Open Line).

j) 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.

k) 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.

l) 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 2.13 – 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 2.13 – Fig.2, 3)

(iv) Plan showing layout of furniture and furnishing and their type. (Sample Plan at Annexure 2.13 – Fig.4)

(v) Sanitary fittings, drainage and sewage plan, plumbing details. (Sample Plan at Annexure 2.13 – Fig.5, 6, 7)

(vi) Horticulture landscaping plan (optional).

(vii) Electrical wiring plans. (Sample Plan at Annexure 2.13 – Fig.8)(CS No.10 Dated 17.02.2005)

204 Water Supply to Stations and Staff Quarters

a) The source, storage and distribution of water supply should be adequate and all installations maintained in a satisfactory manner.

b) 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.

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.

c) RAIN WATER HARVESTING (RWH)

1. Introduction:- Rain Water harvesting is the technique of collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface run-off. The augmented resource can be harvested when needed.

Thus it covers wide range of means of collecting and storing water but popularly this item is becoming synonymous to artificial recharging of ground water aquifer.

2. Necessity:- Water is one of the most essential requirement for existence of living beings. Surface water and ground water are two major sources of water. Due to over population and higher usages levels of water in urban areas, water supply agencies are unable to cope up demand with surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tubewells by house owners. Even water supply agencies have resorted to ground water sources by digging tubewells in order to augment the water supply. Replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of water table rendering many bore-wells dry. To overcome this situation bore-wells are drilled to greater depths. This further lowers the water table and in some areas which leads to higher concentration of hazardous chemicals such as fluorides, nitrates & arsenic. In coastal areas like Chennai, over exploitation of ground water resulted in sea water intrusion thereby rendering ground water bodies saline. In rural areas also Government policies on subsidized power supply for agricultural pumps and piped water supply through bore wells are resulting in to decline in ground water level. The solution to these problems is to replenish ground water bodies with rain water by man made means.

3. Basic types:- Following are three basic types:-

(a) Roof top rain water harvesting and storage in tanks.

(b) Roof top rain water harvesting and recharging subsurface aquifer.

(c) Surface run-off harvesting and recharging subsurface aquifer.

4. Advantages:-

(a) Promotes adequacy of underground water.

(b) Mitigates the effect of drought.

(c) Reduces soil erosion as surface run-off is reduced.

(d) Decreases load on storm water disposal system.

(e) Reduces flood hazards.

(f) Improves ground quality/decreases salinity (by dilution).

(g) Prevents ingress of sea water in subsurface aquifers in coastal areas.

(h) Affects rise in ground water table. Thus saving energy (to lift water).

(i) The cost of recharging subsurface aquifer is lower than surface reservoirs.

(j) The subsurface aquifer also serves as storage and distribution system.

(k) No land is wasted for storage purpose and no population displacement is involved.

(l) Storing water underground is environment friendly.

5. Legislation:- Under section 15 of Environment (Protection) Act 1986, Central ground Water Authority (Ministry of Water resources) has made it mandatory to adopt rain water harvesting system for certain types of building/institutions located in specified regions of National Capital territory.

In Chennai, rain water harvesting has been made compulsory. In Delhi, Building bye-laws have been modified making rain water harvesting mandatory for new buildings erected on plots of more than 100 sq. mtrs.

Ministry of Environment & Forest (Government of India) has circulated draft Gazette Notification regarding rain water harvesting in hilly area of entire country.

6. 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 semi-circular and rectangular gutters. Semicircular gutters of PVC materials can be readily prepared by cutting the PV pipes into two equal semi circular 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 upto the bottom of the building. If no. of rain water drain pipes are more than one then they should be interconnected or connected separately to rainwater collection systems.

Methods of recharging subsurface aquifer:

6.1 Through recharge pit.

6.2 Recharge through abandoned hand pump.

6.3 Recharge through abandoned dug well/open well.

6.4 Through recharge trench. 6.5

Recharge through shaft. 6.6

Recharge trench with bore.

6.1 THROUGH RECHARGE 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 ingression of rain water in to the sub soil. Details are shown in figure A.

6.2 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 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.

6.3 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 then 100 sq. m Recharge water is guided through a pipe of 100 mm to the bottom of the well as shown in figure 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.

6.4 THROUGH RECHARGE 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 the figure D. Cleaning of filter media should be done periodically.

6.5 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 E.

6.6 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 pervious layer) are constructed in the trench. No. of wells to be dug are decided in accordance to water availability and rate of ingression. Trench is filled with filtration media as shown in figure F. A suitable silt chamber is also inserted with grating for water diverting arrangements as shown in the figure.(CS No.10 Dated 17.02.2005)

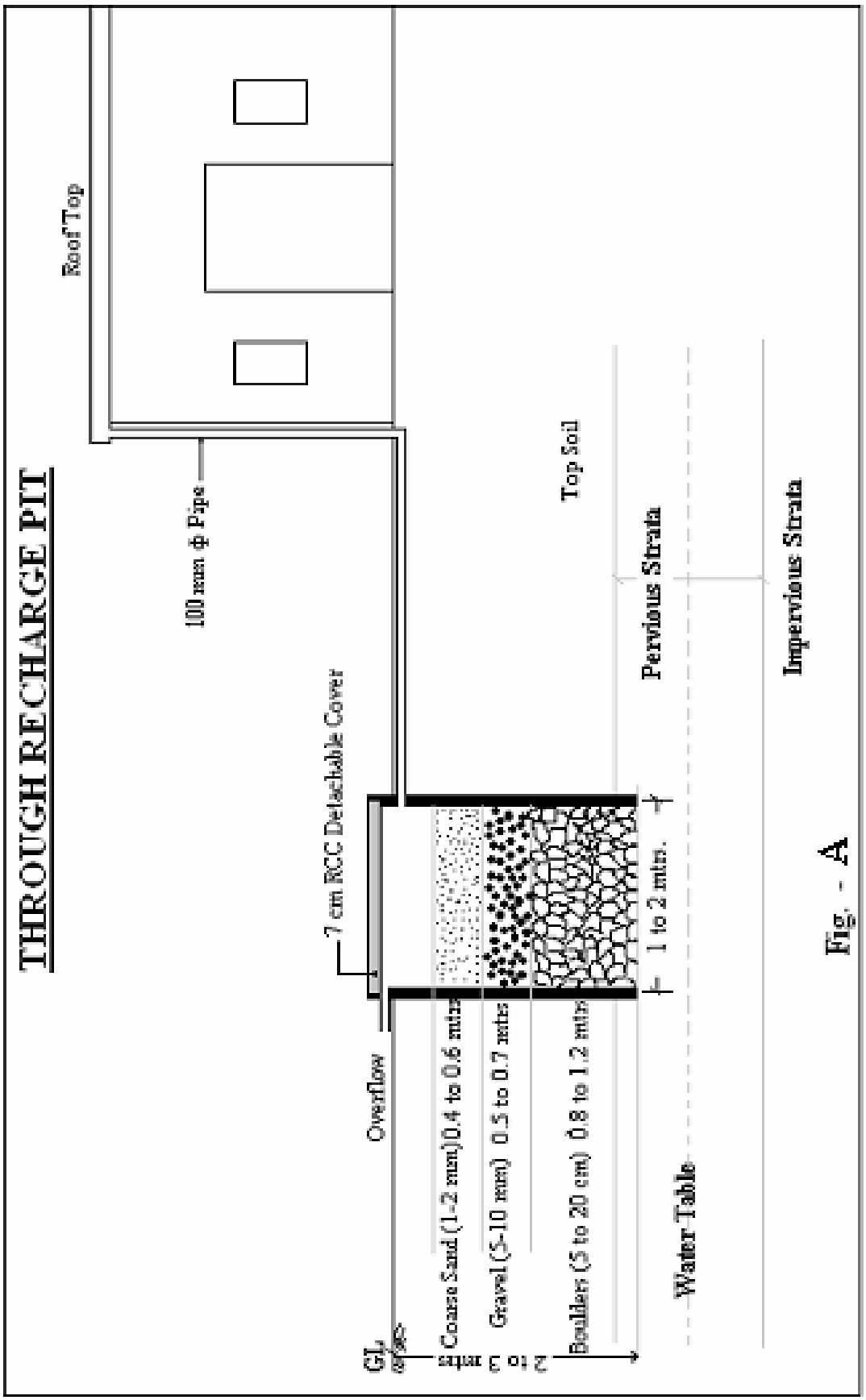

THROUGH RECHARGE PIT
Roof Top
100 mm ϕ Pipe
7 cm RCC Detachable Cover
Overflow
Top Soil
Pervious Strata
Impervious Strata
1 to 2 mtr.
Water Table
GL
Coarse Sand (1-2 mm) 0.4 to 0.6 mtrs
Gravel (5-10 mm) 0.5 to 0.7 mtrs
Boulders (5 to 20 cm) 0.8 to 1.2 mtrs

Fig. - A

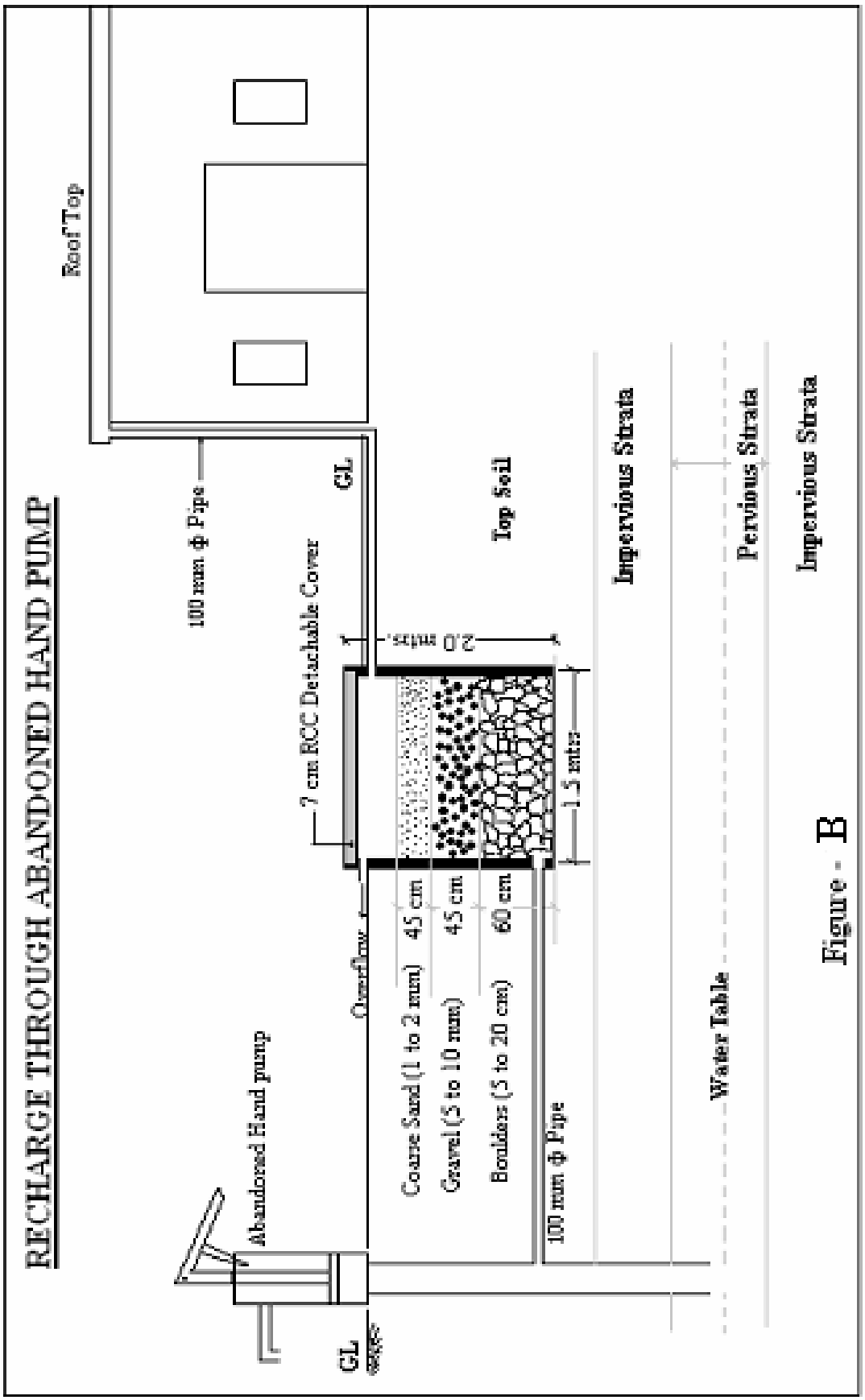

RECHARGE THROUGH ABANDONED HAND PUMP
Roof Top
100 mm ϕ Pipe
GL
7 cm RCC Detachable Cover
Top Soil
2.0 mts
Impervious Strata
Pervious Strata
Impervious Strata
1.5 mts
Overflow
Coarse Sand (1 to 2 mm) 45 cm
Gravel (5 to 10 mm) 45 cm
Boulders (5 to 20 cm) 60 cm
100 mm ϕ Pipe
Water Table
Abandoned Hand pump
GL

Figure - B

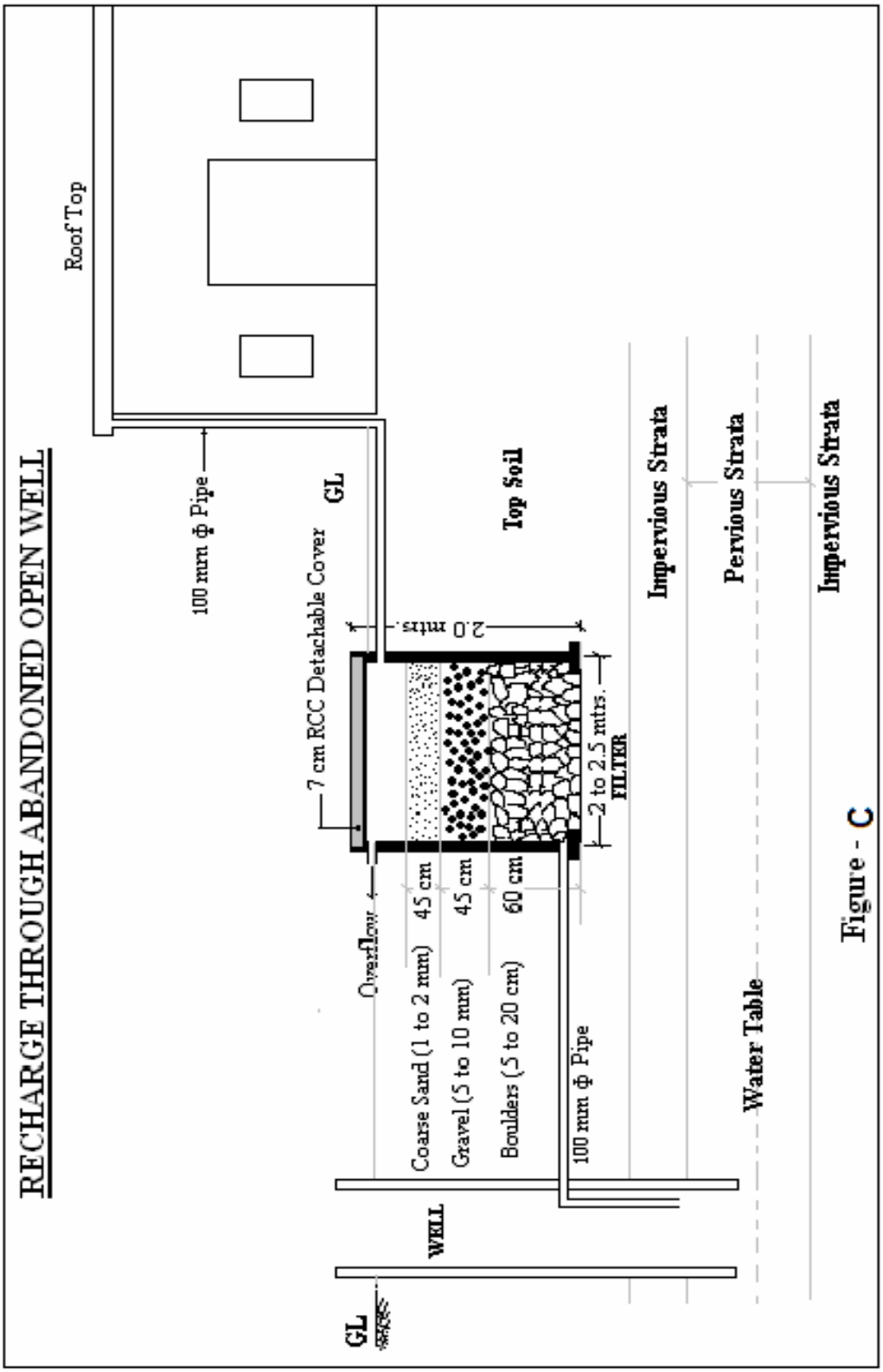

RECHARGE THROUGH ABANDONED OPEN WELL
Roof Top
100 mm ϕ Pipe
GL
7 cm RCC Detachable Cover
Top Soil
2.0 mtrs.
Impervious Strata
Pervious Strata
Impervious Strata
2 to 2.5 mtrs.
FILTER
Overflow
Coarse Sand (1 to 2 mm) 45 cm
Gravel (5 to 10 mm) 45 cm
Boulders (5 to 20 cm) 60 cm
100 mm ϕ Pipe
WELL
Water Table
GL

Figure - C

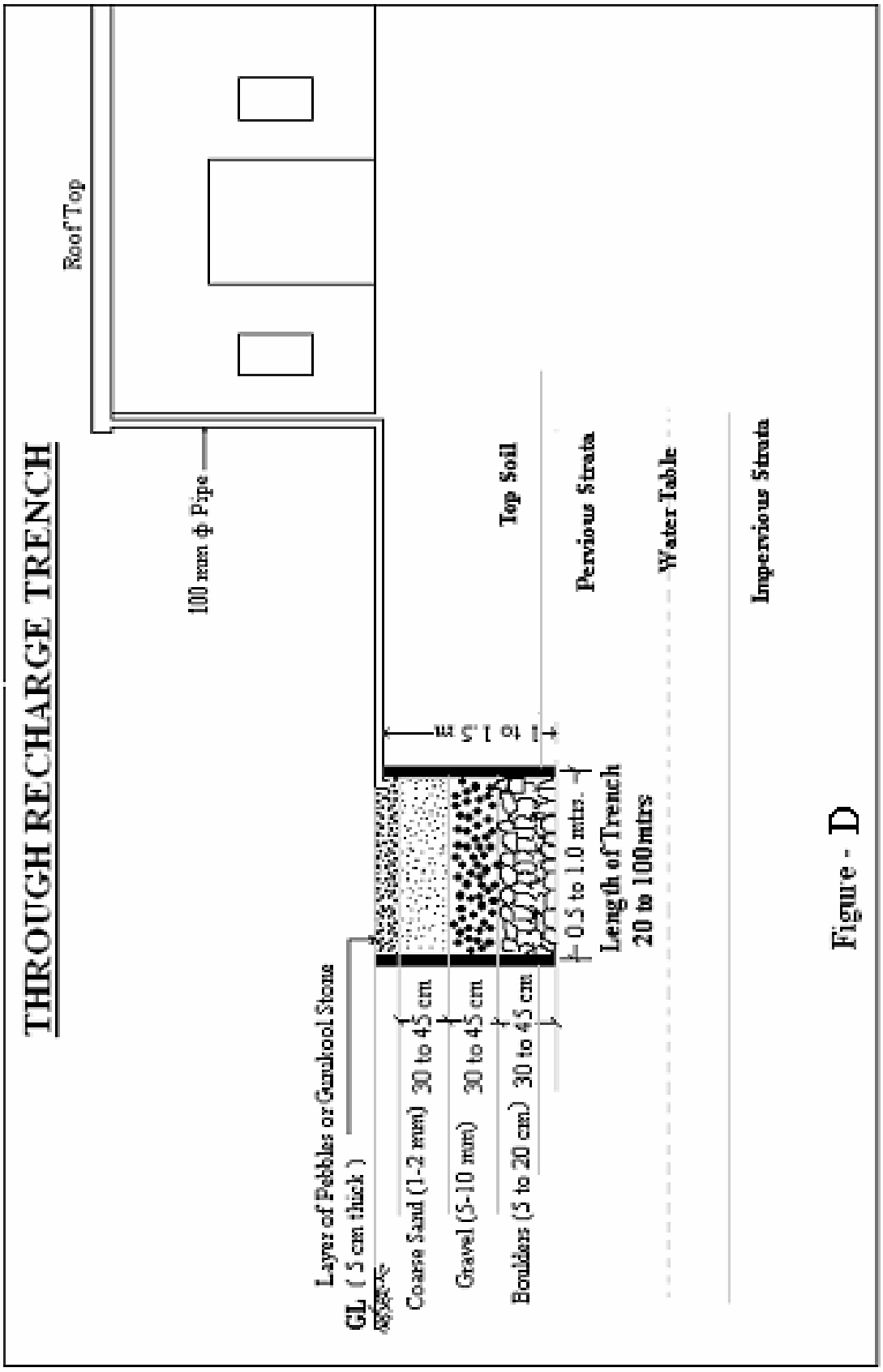

THROUGH RECHARGE TRENCH
Roof Top
100 mm ϕ Pipe
Top Soil
Pervious Strata
Water Table
Impervious Strata
1 to 1.5 m
0.5 to 1.0 mtr.
Length of Trench
20 to 100mtrs
Layer of Pebbles or Gunkool Stone
GL (5 cm thick)
Coarse Sand (1-2 mm) 30 to 45 cm
Gravel (5-10 mm) 30 to 45 cm
Boulders (5 to 20 cm) 30 to 45 cm

Figure - D

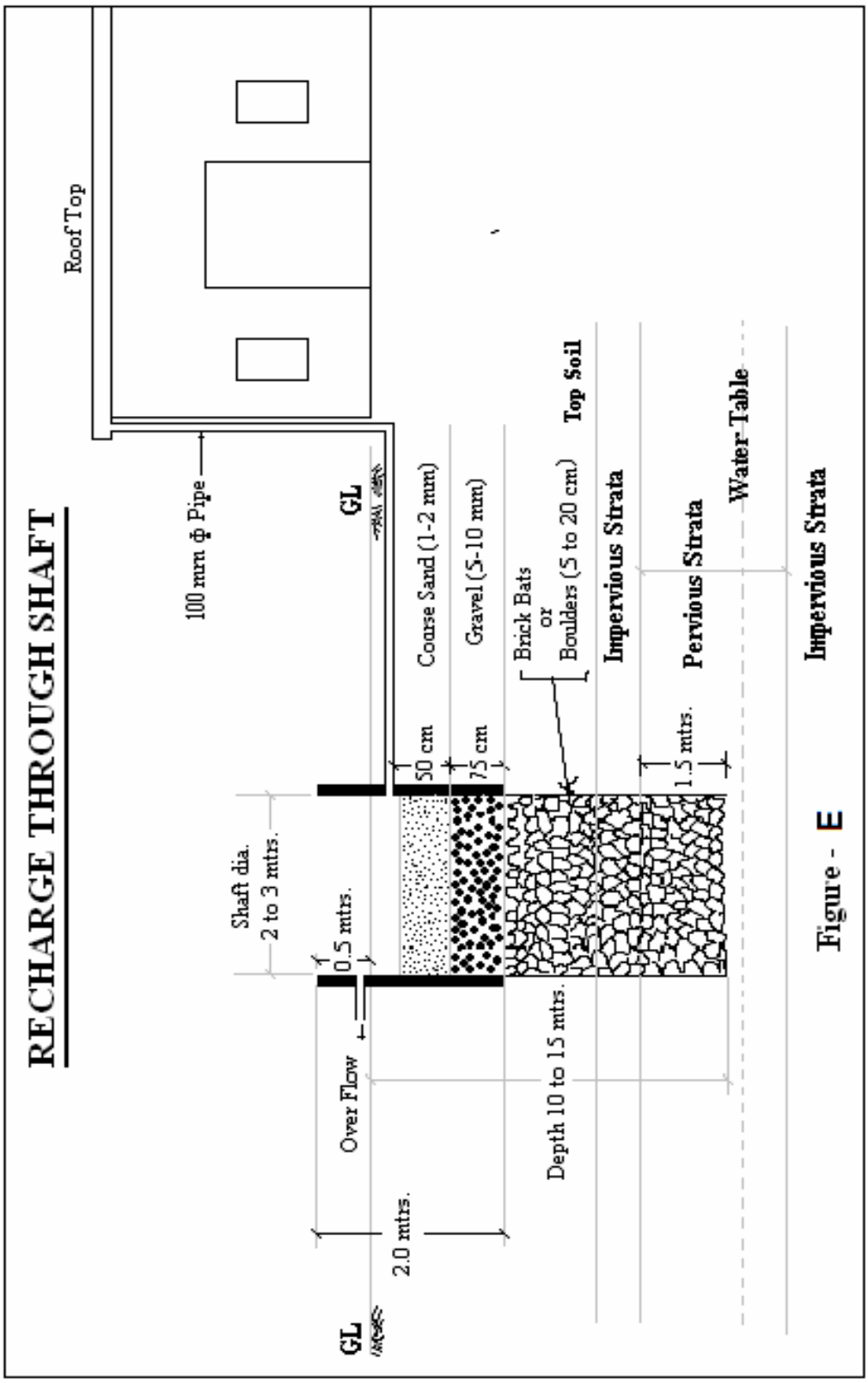

RECHARGE THROUGH SHAFT
Roof Top
100 mm ϕ Pipe
GL
Course Sand (1-2 mm)
Gravel (5-10 mm)
Brick Bats
or
Boulders (5 to 20 cm)
Top Soil
Impervious Strata
Pervious Strata
Water Table
Impervious Strata
50 cm
75 cm
1.5 mtrs.
Shaft dia.
2 to 3 mtrs.
0.5 mtrs.
Over Flow
Depth 10 to 15 mtrs.
2.0 mtrs.
GL

Figure - E

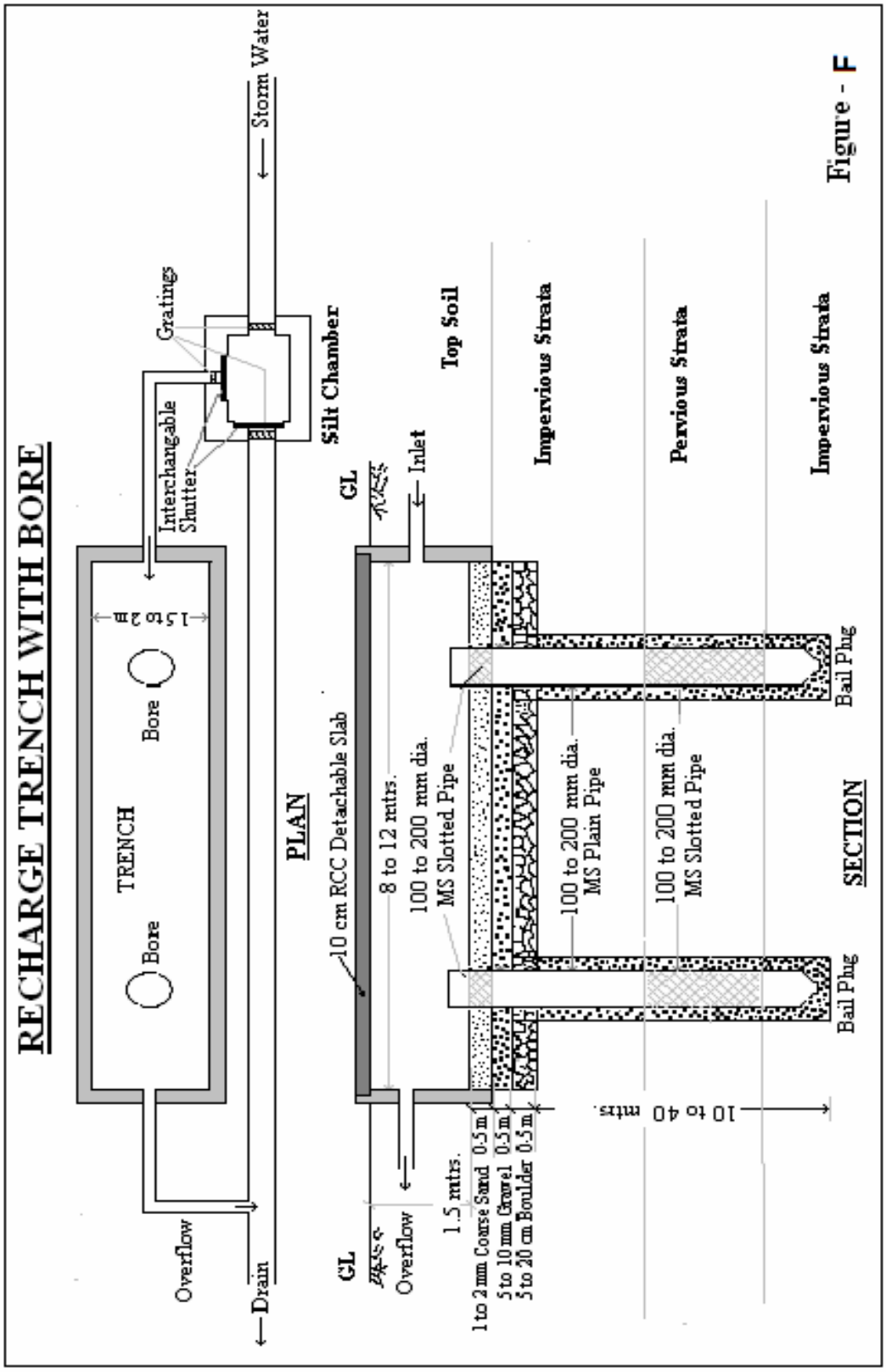

RECHARGE TRENCH WITH BORE
PLAN
SECTION
TRENCH
Bore
Bore
1.5 to 2 m
Storm Water
Gratings
Interchangable Shutter
Overflow
Drain
Silt Chamber
GL
Inlet
Top Soil
Impervious Strata
Pervious Strata
Impervious Strata
10 cm RCC Detachable Slab
8 to 12 mtrs.
100 to 200 mm dia. MS Slotted Pipe
100 to 200 mm dia. MS Plain Pipe
100 to 200 mm dia. MS Slotted Pipe
Bail Plug
Bail Plug
GL
Overflow
1.5 mtrs.
1 to 2 mm Coarse Sand 0.5 m
5 to 10 mm Gravel 0.5 m
5 to 20 cm Boulder 0.5 m
10 to 40 mtrs.

Figure - F

7. REFERENCES:

7.1 Chairman, Central Ground Water Authority, vide his DO letter No. 29-5/ CGWA/ Meetings/MOWR/2003-853 dtd. 27-05-2003, copy enclosed as Annexure 2.14 assured for giving all technical help and guidance for rain water harvesting. This also gives the addresses of offices of Central Ground Water Board which may be contacted for such help.

7.2 Mannual on Rain Water Harvesting and conservation of consultancy services organization CPWD can also be referred for more details.(CS No.10 Dt.17.02.2005)

205 Scale of Fitments for Water Supply, Sanitation and Drainage

a) At stations - as provided in para 414 and 415 of this Manual.

b) 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

SL NO. (1)	FITMENTS (2)	FOR MALE PERSONNEL (3)	FOR FEMALE PERSONNEL (4)
i)	Water-closets*	1 for every 25 persons or part thereof	1 for every 15 persons or part thereof
ii)	Ablution taps	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.	1 in each water-closet
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 thereof	
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

SL NO.	FITMENTS	FOR MALE PERSONNEL	FOR FEMALE PERSONNEL
(1)	(2)	(3)	(4)
i)	Water-closets*	1 for 1-15 persons 2 for 16-35 persons 3 for 36-65 persons 4 for 66-100 persons From 101 to 200 persons add at the rate of 3% For over 200 persons, add at the rate of 2.5 %	1 for 1-12 persons 2 for 13-25 persons 3 for 26-40 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 5 % For over 200 persons, add at the rate of 4 %
ii)	Ablution taps	1 in each water-closet 1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals.	1 in each water-closet
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 thereof	
v)	Drinking water fountains	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 - Creches, 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 subject to 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.

206 Plinth Area for Various Types of Quarters - The Plinth area to be adopted for various types of quarters by Central Government departments is indicated in the Ministry of Works and Housing memorandum dated 14.08.1975, (copy of annexure to the memorandum is given in Annexure 2.2). 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.

207 Basic amenities in Staff Quarters:

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

(i) Kitchen

(ii) Individual bath room

(iii) Individual sanitised latrines. wherever individual latrines are not feasible due to space constraints as in the case of back to back quarters, sanitised community latrines should be provided.

(iv) Basic ventilation arrangements.

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

208 Type of Flooring, Wall Surface and Colour of Wood and Steel Work in General- The following standards should be generally observed unless otherwise directed by the Chief Engineer :-

a) Hospitals and Dispensaries :

1) Important rooms and bathrooms :

(i) Flooring ..	Mosaic or terrazzo or non-slippery ceramic tiles
(ii) Wall-surface..	Mosaic or Terrazzo dado to 1200 mm in height and distemper or ceramic tiles on walls and distemper to ceiling
(iii) All wood work ..	White Paint

2) Unimportant rooms :

(i) Flooring ..	Cement concrete except for bathrooms and toilets where mosaic is to be provided.
(ii) Wall surface ..	Cement dado to 1200mm in height and white wash on sides and ceiling.
(iii) All woodwork .. and steel work	Painted buff or brown

b) Quarters-Type-IV and above:(CS No.9 Dt.19.05.03)

(i) Flooring .. Mosaic flooring.

(ii) Wall surface .. Dado in bathrooms with same material as flooring, or ceramic tiles.

c) Quarters below Type-IV :

(i) Flooring.. Cement concrete.

(ii) Wall surface .. Dado in bathrooms with same material as flooring. Skirting in other rooms.

d) Staff canteens :

(1) The kitchen, serving area, dish washing place and dining hall - marble chip flooring or anti-slippery ceramic tile flooring and mosaic or ceramic tiles dado of 1200mm in height on the walls, of light colour.

(2) The kitchen and the dining area should be white washed at close intervals to prevent accumulation of soot etc., and exhaust fans should be provided in the kitchen as per requirements.

(3) In case, the kitchen is provided in a building with high ceiling viz. roof trusses etc. a false ceiling with fire proof material, gypsum board etc., may be provided so that the problem of having to clean dust, cobwebs etc. at places not easily accessible is avoided.

(4) The following areas in the canteen may be provided with suitable finishing e.g. glazed tiles, so that cleaning is easy:

(a) Serving counters

(b) Dish washing place in the kitchen

(c) About 1.2 metres high dado on the walls above the kitchen counter slab.

(5) The slab counters provided in the kitchen for cooking purposes may be covered with locally available stone properly polished to enable easy cleaning.

209 Use of New Materials: New materials available in market may be used if found suitable from the consideration of cost, contractability and aesthetic with the approval of concerned SAG Officer.

210 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 as follows or as directed by the Chief Engineer :-

i) All wood work in offices	- Oiled/polished or varnished or painted with approved brand of paints.
ii) Doors, windows and structural wood-work of staff quarters Type-IV and above	- Frames of doors and windows and structural wood work white, cream, buff or brown; corresponding venetian and panels cream or light brown . Alternatively, doors and

		windows of may be polished or varnished. Doors and windows likely to come in contact with water may be painted with epoxy paints of appropriate colour.
iii) All woodwork of buildings and structures other than those under (i) and (ii) including station buildings and in quarters below Type-IV	-	Dark battleship grey or buff
iv) All steel work in station buildings, offices and residential quarters.	-	Aluminium or dark battleship grey
v) All steel work of platform shelters.	-	Grey, aluminium or red.
vi) All steel work in -foot over bridges, signal gantries goods sheds and small workshops		Dark battleship grey or red or aluminium
vii) All steel work in power houses and large workshops	-	Dark battleship grey or aluminium.
viii) All steel work in water tanks and stagings	-	Dark battleship grey or red or aluminium or black enamel.
ix) Water columns	-	Upper portion red, lower portion black with band about 500 mm below pivot.
x) Plastered exterior of all buildings.	-	Pale cream
xi) Plastered interior of all buildings.	-	White/Pale Cream/ Pale Green/Pale Blue.
xii) Buffer stops	-	Structural part, black; buffer beam red

All exposed steel work should be provided with a primary coat of red lead and appropriate final coats.

C.G.I. sheets should not be painted unless they are in corrosion prone areas.

211 Rest Houses - Officers 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 Engineer and staff to the cleanliness and satisfactory upkeep of all Rest Houses.

212 Allotment of Rest House.

The Rest Houses are primarily meant for Railway Officers/staff on duty. The allotment of Rest House is regulated in terms of para 1953 to 1955 of Engineering Code.

Railway Rest Houses should not be

allotted to non-officials including Members of Parliament when their visits are not connected with Railway working. Railway Rest houses can be allotted under following conditions:-

(i) The occupation of Rest House by families of railway officers accompanying him is permissible as per the following guidelines:-

(a) Earning or married children or close relatives of the Railway officers when accompanying him (either on duty or on leave) may be permitted to stay in the rest house on payment of charges to be fixed by the Railway in consultation with the FA & CAO. The officer will, however, have to accommodate them in the accommodation allotted to him. Additional accommodation may only be provided at the discretion of controlling officer when not required by other officers at the charges fixed by Railway in consultation with FA & CAO.

(b) Spouse and dependent children and dependents (as permitted in Pass Rules and close relatives) when escorting/accompanying them may be permitted to occupy the rest house if it is available for short durations not exceeding four or five days and only occasionally. The charges to be recovered from the family will be as for the officer on leave. For the other members the charges are recovered as per (a) above. In this case also no additional accommodation will be provided for the relatives. They will have to be accommodated in the accommodation allotted for.

(c) If an officer occupying a rest house on duty is recalled to the headquarters and his family has to stay in the rest house because they are unable to proceed with the officer either because of non-availability of accommodation in the train or for any other administrative reason such as the officer flying back etc., the family can continue to stay in the rest house free of charge till they are able to proceed separately on a special Pass or till the officer was due to return as per the original schedule, whichever is earlier.

In case, however, the family wants to stay on for a few more days of their own, the charges will have to be paid as at (b) above.

(d) When the officer is staying in a rest house with proper permission at his headquarters station he is being permitted to use it as residence. Therefore, whenever he proceeds on duty the rest house continues to be residence for his family.

(ii) Members of the ZRUCC and DRUCC including Members of Parliament attending meetings of respective Committees or participating in conducted tours organised by the Railways can be provided accommodation in Rest House free of charge.

(iii) Railway Rest House can be allotted to the officers and staff of CRIS on payment of normal charges applicable to railway staff on duty if rest house is not required by railway officers/staff and also the staff of CRIS are solely engaged in specific assignment in development and implementation of OIS project on production of certificate to this effect from their employer.

(iv) Railway Rest House can be allotted to the officers on transfer as per the following guidelines:-

a) In case of permanent transfers, in the first instance, occupation of the Rest House should be permitted for ten days only.

b) Use of Rest House accommodation for residential purposes beyond ten days may be permitted only on submission by the officer, of a certificate from the competent authority to the effect that "the officer has formally applied for allotment of pooled accommodation and that the same is not available."

c) These instructions shall not apply in the case of temporary transfers.

v) The Railway Rest House and Rest Room can be allotted to non-railway Government officers on tour. The Rest House should be booked not earlier than one month in advance only if not required by railway officers. The Rest House should be booked initially for a period of 4 days only. If the officer failed to occupy the Rest House, half rates for the period of booking should be charged unless the room is taken up by some other officer. Following non-Railway government officers can be permitted to occupy railway Rest House on duty:-

a) Officers of the Posts and Telegraphs Department having free duty passes in the area covered by the (Railway) pass.

b) Officers of the Special Police Establishment and Government Railway Police working on Railways.

c) All officers serving under the conciliation Officers, Railways and Supervisor Railway Labour.

d) The officers of the Audit Department (Railway Wing) and Special Railway Magistrates.

e) The Officers of the Industrial Security Inspection Team of the Intelligence Bureau (Ministry of Home Affairs).

f) The Commissioners of Departmental Enquiries or other officers of Central Vigilance Commission when on duty in respect of enquiries of Railway Officers.

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 paras 1937 and 1938 of the Indian Railways Code for Engg. Deptt. (1993 Edition).

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:-

(i) 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.

(ii) Rent, depreciation and maintenance charges shall be governed in accordance with para 1943 of the Indian Railways Code for Engg. Deptt (1993 Edition).

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 and 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 Governemnt Reserve Police shall be dealt in accordance with para 1957 to 1959 of the Indian Railways Code for Engg. Deptt. (1993 Edition).

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

(i) 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.

(ii) 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.

iii) 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 f 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 Provision of Chicks and Venetian Blinds -

Chicks or Venetian blinds as considered appropriate may, if considered necessary, be provided to the following buildings, preferably on the West and South sides:-

a) Hospitals

b) Rest Houses

c) Running Rooms

d) Offices at Railway headquarters

e) Officer's bungalows and quarters of Senior Class III staff, if of open type.

In exceptional localities where shade temperatures are high or in buildings close to a public thoroughfare, special sanction for provision of chicks or Venetian blinds may be applied for. Provision of chicks or Venetian blinds in quarters will be subject to recovery of hire charges as per provisions of the Indian Railways Code for Engg. Deptt.

218 Additions and Alterations to Quarters

a) Additions and alterations to staff quarters only of a temporary nature may be permitted to be done by the occupant under

para 1976 of the Indian Railways Code for Engg. Deptt. (1993 Edition) with the prior approval of the Senior Divisional Engineer and on the specific understanding that the occupant will dismantle the same at the time of vacation of the quarters.

b) 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.

c) Additions and alterations to standard type quarters should not be carried out, without the prior approval of the Chief Engineer.

219 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 Chief Engineer so as to facilitate reference in correspondence, the correct number being entered in the Building Register.

220 Building Registers - Building registers in Chief Engineer's Office and Divisional Engineer's Offices shall be maintained up-to-date and show complete details of each structure as per para 1977 of the Indian Railways Code for Engg. Deptt. (1993 Edition). 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.

221 Transfer of Buildings

a) 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.

b) 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 Section Engineer (Works) by giving due notice to the Assistant Engineer. The Section 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 Engineer after duly pricing the damages, if any, to enable the department concerned to recover the cost of damage attributable to the occupant.

c) In the case of occupation of quarters by a new occupant, the Section Engineer (works) will be contacted by the allottee with the allotment order for obtaining the key of the quarters. The Section 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 Engineer. One copy will be given to the occupant, one page will be earmarked for each residential quarters 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 in given Annexure 2.3.

d) In the case of new service buildings, the Assistant 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 Section Engineer (Works) shall be deputed to represent the Engineering Department for handing over.

e) In the case of buildings constructed by the Construction Department, the open line will take over the same after joint inspection at the level of Assistant Engineers. The Open line Assistant Engineer will allot a number to the building and enter the details of the building in the building register duly intimating all concerned.

222 Responsibilities of Staff Occupying Quarters

a) 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.

b) Cooking except in kitchens or places specially provided is forbidden.

c) 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 quarters 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 Section Engineer (Works) should make necessary arrangements for its safe custody.

It is the responsibility of the Engineering staff or Special staff where 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.

223 Vacant Railway Buildings

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

b) 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 A Construction and Dismantling of Building/Structures

1. 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.

2. a)The dismantling of structure

should be done under proper supervision and as per approved scheme of dismantling.

b) At major dismantling sites minimum level of supervision shall be Senior Section Engineer (In-charge), who should be nominated by Dy. Chief Engineer/Sr. DEN in writing.

c) The dismantling Plan should be scrutinised by the Drawing Office and approved by Sr. Divl. Engineer in case of Open Line Organisation or H.O.D. in case of Construction Organisation. The dismantling plan should invariably show various stages of dismantling, equipments 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.

d) Proper barricading should be done to stop access of unauthorised personnel near the dismantling area. Wherever necessary, assistance of RPF should be taken to prevent people from coming close to dismantling area. Signages warning people not to enter the danger zone, should also be displayed.

e) Proper announcement through Public Address System should be done at regular intervals to keep the onlookers away from the major dismantling affected zone.

f) The adjacent buildings likely to be affected by dismantling should also be evacuated.

g) In area where law and order is likely to be affected, assistance of local Police should be taken to keep people away from dismantling area.(CS No.3 Dt.30.08.2001)

B. INSPECTION AND MAINTENANCE OF BUILDINGS

224 Inspection and Repairs

a) All buildings shall be systematically inspected by the Section Engineer (Works) and particulars for repairs submitted to the Assistant Engineer. Repairs requiring urgent attention should be carried out expeditiously.

b) The inspection will be recorded in the Inspection Register as per proforma given in Annexure 2.4. One page will be allotted for each building.

c) The insides of staff quarters should be inspected in the presence of or with prior consent of the occupants.

d) The Assistant Engineer should inspect as many buildings as possible particularly those requiring heavy repairs and arrange for all repairs to be carried out in good time.

e) Section Engineer (Works) should inspect all the buildings, water supply installations, sewerage installations and drainage arrangements once a year.

f) All structures (including those carrying advertisement hoardings) situated alongside the running lines, particularly in the suburban sections, should be thoroughly inspected by the Section Engineer (Works)/Junior Engineer (Works) once in 6 months by rotation in order to ensure the integrity of their components with special reference to fitments like corrugated iron sheets which are likely to get loose and be impelled towards the adjacent track by gusts of wind or by the aerodynamic forces generated by the passage of fast trains in their proximity.

g) In monsoon period, repairs or renovation works should not be carried out except pointing and work considered to be urgent.

h) Requisition for repairs and renovation works should specify the dates of previous such works without which work orders should not be issued.

i) Planning of repairs should be based on the inspections carried out as mentioned above and should be completed well in time to enable the repairs being done under the annual zonal contract which commences from 1st July of each year.

225 Monitoring of Maintenance

a) Petty repair books at stations - At each station, a "Petty repair book " shall be maintained as per proforma given in Annexure 2.5. In this, the station Master will enter repairs required to service buildings and staff quarters as brought to his notice. The Section Engineer (Works) should inspect the books frequently and attend to the repairs. Action taken on the Station Master's notes should be briefly recorded in the book itself. Items of days to day maintenance only shall be recorded by the staff in the petty repair books. Any request for major additions or alterations in the buildings shall be addressed to Divisional/Asst.Engineer. The Divisional Engineer and Assistant Engineer should examine and initial the registers during their inspections and issue such instructions as considered necessary.

b)(i) In major stations and colonies where the Section Engineer (Works) is headquartered, a complaint book may

be kept in his office wherein the occupants of staff quarters can enter the complaints. This book is to be seen by the Section Engineer (Works) frequently.

(ii) Colony Committees should be formed in big colonies having more than one thousand quarters normally. Committee will be different from Station Improvement Groups and the Housing Committee already working at various stations. On certain stations there may be more than one colony committee. They should be organised in such a way that each committee has well defined functions to look after.

(iii) The following persons shall constitute the Colony Committee.

(i) Assistant Engineer will be the chairman of the Committee

(ii) Assistant Divisional Medical Officer

(iii) Health Inspector

(iv) Section Engineer (Works) in charge of the colony maintenance

(v) Foreman/chargeman incharge of the electric maintenance

(vi) One representative of each of the two recognised unions

The representatives 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.

Periodicity and agenda for the meetings : This Colony Committee will hold meeting once in every two months by giving 7 days notice to the members. Other colony residents may be co-opted also to attend these meetings. The following items will fall under the purview of the colony committee:

(i) Upkeep of the 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
- repairs to leaky roof
- repairs to outside doors & windows
- water supply
- drainage arrangement
- roads & others

(ii) Improvement to substandard quarters;

(iii) To arrange disposal of waste from colony;

(iv) Prevention of encroachments by outsiders as well as by railwaymen;

(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.

c) A list of passenger amenities provided at each station is kept with the station master. The Section Engineer (Works) inspecting the station will verify if the amenities indicated in the list are maintained properly and take action for repairs wherever required.

d) Colony Committee for maintenance:- Colony Inspection Committees shall be formed for large colonies as specified by the Railway Administration. These shall normally consist of representatives of Engineering, Medical, Operating and Electrical Departments and recognised Trade Unions. The inspection shall be once in three months and Inspection report submitted to the respective branches for attention. The Section Engineer (Works) should attend to the inspection notes pertaining to Engineering items and action taken should be briefly recorded in the Building Inspection Register.

e) Service Improvements Group's inspection of stations :

Service Improvement Groups (SIG) shall be formed at various levels for inspecting all the important stations. Representatives of Engineering, Medical, Operating and Electrical Departments shall be the members of the SIG. The Section Engineer (Works) being a member of this group, has a part to play in this scheme by attending to the following items:

(i) Checking up of the water taps provided for their working condition and water stagnation around the taps as well as on the platform;

(ii) Clearing up of platform walls if defaced by pasting of unauthorised posters;

(iii) Ensuring repairs of platform drains and washable aprons and side drains expeditiously.

(iv) Maintenance of toilet facilities in Waiting Halls, Waiting Rooms, Retiring Rooms, as well as checking up of availability of water, arresting wastage of water in the taps, and hydrants for carriage filling by plugging leaks in time;

(v) Ensuring periodical painting/ distempering/white washing of the Refreshment Rooms and kitchen, and attending to repairs expeditiously.

226 Periodical Maintenance Works

a) Exterior and interior walls : As far as possible, plastering to exterior of brick masonry should be avoided. No colour washing should be done to the outside of structures built with coursed or uncoursed rubble stone. The schedule of distempering colour washing and white washing of buildings will be as indicated in Annexure 2.6.

b) Painting of wood work and steel work: -Painting of the interior wood or steel work should normally be done once in 5 to 7 years. Doors, windows and ventilators of kitchens and pantries may be painted once every two years or more frequently at the discretion of the Assistant Engineer. Steel columns of footings when buried in ground should be encased in cement concrete well above ground level. This is to be done in the case of foot over bridges, columns of platform shelters, water tank stagings, etc.

c) Maintenance of valley gutters, vertical down take pipes of service buildings and platform covers should be attended before commencement of monsoon to ensure proper drainage.

d) Guidelines for a leak proof flat roof is indicated in Annexure 2.7 .

227 Standard Measurement Registers for Buildings

a) Standard measurement registers in the format given in the Annexure 2.8 shall be maintained in the offices of the Divisional Engineer, Assistant Engineer and the Section Engineer (Works). Authorised copies of these will be maintained in the Accounts Office for reference and checking of quantities entered in measurement books for annual repair works carried out.

b) 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. (Annexure 2.9).

c) The block Nos. entered in the standard measurement registers should correctly tally with the corresponding entries in the building registers.

d) The measurement books from which the entries are carried into the standard measurement registers should be securely preserved in the Divisional Engineer's Office.

e) Standard measurement registers may be utilised for the estimating of quantities for periodical white-washing or colour washing and painting as and when required. Particulars of repair works should be carefully scrutinised by the Assistant Engineer before applying for sanction.

f) Date of whitewashing and painting done blockwise should be indicated on the building.

C. INSPECTION OF STRUCTURAL STEEL AND TIMBER WORK BY ASSISTANT ENGINEERS AND SUPERVISORS

228 Periodical Inspection -

a) Every structure on the Section/Sub-division shall be inspected in detail by the Section Engineer (Works)/Assistant Engineer as indicated below:-

		By Sectional Engineer (Works)	By Assistant Engineer
i)	Structures such as workshops, running sheds, platform covers and foot over bridges	One a year during the prescribed months.	One fifth every year on a programme basis.
ii)	Cast iron, wrought iron or pressed steel plate water tanks and stagings whether of steel sections or rails.	Once a year on a programme basis.	As required.
iii)	Structures with roof trusses prescribed	Once a year during the month.	10% to 20% test check inspection of structures under each group.
iv)	Other structures in which timber, rail or steel work is used to support any part of the structure.	-do-	-do-
v)	Tie rods of arched roofs excluding jack arches.	-do-	------
vi)	Wrought iron or mild steel tanks on sleeper cribs at temporary watering station/kilometrages	-do-	----

b) The Section Engineer (Works) shall record results in ink in the structural steel and timber work inspection register in the form given in Annexure 2.9. and submit the same by the prescribed date to the Assistant 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 Section Engineer (Works) shall accompany the Assistant Engineer on the latter's inspection of structures carried out during the prescribed period.

c) The Assistant Engineer shall record results of his inspection in ink in the

Structural Steel and timber-work inspection register in form given in Annexure 2.9, maintained by Senior Engineer (Works) and ensure expeditious compliance of notes recorded.

d) Structures , the condition of which warrant special attention, should be inspected more frequently.

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 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 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.

229 Details of Inspection - During inspection, the 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.

Whether any deformation of the structure has occurred.

Foundations and bearings with particular reference to tightness of anchor bolts.

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.

230 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)".

231 Maintenance of Roads :

Maintenance of roads needs careful planning. Though repairs like filling up of pot holes, resurfacing atbroken 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. Costs estimated of road reconstruction vis-à-vis repairs through resurfacing etc. taking into account the respective life cycle costs should be gone into before taking up any repairs.

232 Handing over of commissioned assets by Construction Organisation to Open Line:

All structures and assets constructed and commissioned by Construction Organisation as per the sanctioned estimates should be taken over by Open Line within 90 days of commissioning of the said assets.

Joint inspections at the Inspectors' and Officers' level between the Construction and Open Line Organisations should be completed within this period. Any uncompleted work or deficiencies noticed and jointly endorsed for completion/rectification by Construction and Open Line should be listed out (alongwith anticipated cost wherever the works are to be tackled by Open Line) and duly signed by the officers of the 2 organisations not below the rank of JA Grade. The SAG Officers of Construction and Open Line concerned should jointly decide the time schedule for making good the deficiencies and providing the resources i.e. manpower and material, required to the Open Line by the Construction Organisation. On no account, the taking over of assets by Open Line shall be delayed beyond 90 days of commissioning of the assets.

ANNEXURE 2.1
Para 202(b)

GUIDELINES FOR SELECTION OF SANITATION SYSTEM

Extract of Railway Board's letter No.91/lm(l)/20/1 dated 11th July 1991.

RDSO have circulated a monogram titled "Technical Guidelines for disposal of human waste "Vide their letter NO. CBS/BMC/ W&S dated 28.2.91. The document deals with the technical aspects of various types of human waste disposal systems.

1.1. Proceeding from this monogram, other literature and the extant instructions, guidelines given in the following paras should be adopted for selecting appropriate sanitation systems.

2. RATIONALE

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

2.1 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 (off-site) treatment plant in following steps:-

(i) Sedimentation (primary' treatment) of the highly diluted waste yielding supernatant and primary sludge.

(ii) Aerobic ('secondary') treatment of the supernatant from sedimentation tank, yielding treated waste water (which is used for irrigation, or let into waste bodies) and secondary sludge.

(iii) The primary and secondary sludges, i.e the concentrated waste is treated by Anaerobic digestion, yielding digested (i.e treated) slurry and biogas.

2.2 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 soakpit/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. Since it is usually not possible to provide a soakpit/filter bed in built up urban areas, here septic tank system would not be appropriate.

2.3. The other on-site systems of sanitized toilets are:-

(i) Bio-latrines (improved aqua privies): In these a digester (anaerobic) is provided for similar treatment as used in a sewage treatment plant. Only handflushing is allowed i.e. no tap or flushing system in the toilet.

(ii) Pour flush type: In these a soakpit is provided for treatment of the waste. Here the handflush is

allowed. This would not be suitable for built-up urban areas and pit would also require care and maintenance by the users.

2.4 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 soakpit/filter while effluent from a digester can be discharged directly in a drain system.

2.5 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. In case of non-residential toilets at stations etc., and community toilets provided with 'standard flushing' arrangements, instead of flushing cisterns of 3 gallons capacity, the use of 'coach' handles should be preferred so that only the required amount of water is used. In case of urinals, instead of automatic flushing cisterns, dripping ferrules may be used to conserve water.

2.6 For providing soakpit /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.

3. Directions for selecting appropriate type of toilet systems:

Based on the above rationale, directions for selecting appropriate toilet system are summarised below:-

a) Where an underground sewerage system can be connected, use a 'flush' type toilet as under:-

(i)	Residential toilets	With no water shortage	Cistern flushing, (use good quality cisterns preferably the newer models using less than 3 gallons water/use)
(ii)	-do-	With water shortage	'Coach' handle flushing
(iii)	Non-residential toilets	-	'Coach' handle flushing. However, for toilets in retiring rooms, rest houses, same arrangement as for residential toilets

b) Where an underground sewerage system is not available:-

(i) In built-up areas or in all other areas where soakpits or filter beds are not feasible	Bio-latrines
(ii) On roadside stations	-do-
(iii) In sparsely inhabited non-roadside stations where filter beds are feasible (see para 2.6)	May provide Bio-latrines or septic tank system (with coach handle type of flushing)

c)In case of urinals at stations instead of automatic flushing cisterns dripping ferrules may be used.

4. All toilets on the Railways must be sanitised on top priority programme basis. Thus only flush toilets with underground sewerage, flush toilets with septic tank systems (with soakpit/filter-bed for the septic tank effluent and bio-latrines (also aquaprivy) are the approved sanitised toilet systems for use on the Railways. Hence -

- all 'dry' (service type) toilets must be sanitised.

- all septic tanks, if not provided with prescribed soakpit/filter-bed, they must be provided with these, if possible, or converted into digesters by minimising the flushing so that the same tank can provide clear minimum 30 days retention (in addition to the space for digestion at the bottom).

ANNEXURE 2.2
Para 206

Annexure to Ministry of works and Housing O.M.No.17020(4) /72-W.2 dt.14.8.75.

REVISED SCALE OF PLINTH AREA

Type	Area of unit SQ.M	staircase circulation SQ.M	Sleeping out balcony SQ.M	Cycle shed scooter Garage SQ.M	Remarks*
I.	34.00	5.00	7.45	2.50	Cycle shed 100%
II.	45.00	5.00	7.45	2.50	-do-
III.	55.75	5.00	7.45	4.20	Scooter shed 100%
IV.	83.60	5.50	7.80	4.20	-do-
V.	139.35	6.00	9.85	18.00	75% garage (CS No.2 Dt.3.11.2000)
Servants Qrs. attached to main units.	18.60	4.50	-	-	-

Notes:

1. These plinth areas standards shall be applicable to the construction of residential accommodation in all places in India.

2. Plinth areas proposed above are based on the wall thickness achieved by using the standard brick size 9"x 4.5" x 3"(nominal). When standard size bricks are replaced by modular bricks (20cm x 10cm x 10cm) in course of time the plinth areas specified above will not change. Where wall thickness has to be more for technical reasons, plinth areas may be suitably increased. In places where stone construction is more economical and is normally adopted, the plinth areas may be suitably increased to add for additional thickness of walls. In areas where standard size of brick is 10" increase of plinth area to the extent of 4% in case of type I, II and III quarters and 2.5% in case of type IV and V quarters will be allowed. In areas where

local specifications permit use of thinner walls such as 'accra' walling or timber construction, the plinth areas would be reduced suitably.

3(a) Sleeping out balconies shall be provided in regions of hot and dry climate and for construction which is more than two storeyed. In the case of regions, with hot and humid climates, i.e, coastal regions where it is not customary to sleep out during summer, sitting balconies with half of the areas stipulated above, shall be provided in lieu of sleeping out balconies in places other than Bombay and Calcutta (for which reduced standards as indicated at 3(b) will apply). In region of cold climate, viz. hill stations glazed verandah in lieu of sleeping out balconies may be provided with half the areas of sleeping out balconies. Where sleeping out balconies are provided, facility for use of terrace by occupants need not be provided.

(b) The area of sitting out balconies in Bombay and Calcutta will be 1.5 sq.mt (16.15 sq.ft) for Type I, 2.5 sq.mt (26.90 sq ft) for type II 3.5 sq.mt (37.65 sq.ft) for type III 4.5 sq.mt (49 sq.ft) for type IV and 5.50 sq.mt (60 sq.ft) for type V.

(c) Areas of sleeping and sitting out balconies may vary with the type design, depending on architectural and structural considerations. The areas stipulated in this statement are maximum that will be allowed.

(d) In hot and dry regions, sitting out balconies must be provided for two storeyed construction.

4 In the case of type I,II and III quarters, the standard plinth area may be exceeded upto 2% when found necessary on architectural considerations. This is to allow for some flexibility in architectural planning.

5. In type V quarters, car garages will be provided for 75% of the number of units to be constructed. Out of these 1/3rd. of the garages will be partitioned temporarily, so as to provide scooter sheds for remaining 50% of the allotees. Provision in planning and layout should be made for construction of additional garages for cars to an extent of 25% of the number of residential units.

6. In the case of double-storeyed quarters, cycle or scooter sheds shall not be provided. Also no scooter/ cycle sheds will be provided in Bombay and Calcutta.

7. In the case of main buildings, areas for staircase/ circulation area is based on a stair width of 3'-6" where bye-laws require more width than this, areas to be provided will be increased suitably, for 4' wide stair, areas for stair shall be 6.5 sq.m.

8. Where local bye-laws so require, additional area for fire escape staircase will be allowed.

9. Sanitary pipe shafts open to sky, wherever provided are not to be included within the standard plinth areas.

10. Area required for services, such as garbage chutes, electric sub-stations, pump room etc. wherever necessary will be allowed over and above the standard plinth areas.

11. In multi-storeyed flats, where lifts are

necessary additional areas over and above the standard plinth areas for the different types, will be allowed for the provision of one or more lifts and lift landing.

12. In the case of construction of four storeyed and above in places other than Bombay and Calcutta in respect of type I and IV, cycle/scooter sheds may be provided separately or one or more quarters on the ground floor may be earmarked for covered parking of cycles and scooters.

ANNEXURE 2.3
Para 220(c)

Proforma for Details of Occupancy

RAILWAY

Divn:_____ 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._____

Registered No.

Capital cost of each Unit:
Assessed monthly rent :
Pooled cost of each Unit:
No.of taps outside :
Inside :
Latrine Common/Separate

No. of Units Occupied	Name of Occupant	Designation Married or Single	Whether	Deficiencies
(1)	(2)	(3)	(4)	(5)

Rateof pay	Date of Occupa-tion.	Date of vacation	Remarks including date & nature of repairs executed.	Deficiencies/damage at time of vacation
(6)	(7)	(8)	(9)	(10)

ANNEXURE 2.4.

Para 224(b)

Proforma for Inspection Register

Division.....
SECTION ENGINEER (WORKS)/..... Section .....
Sub Division .....

Quarters No. ..... Situation .....
Type Unit .....
Building No. ..... Station .....

Sl. No.	Date of inspection	inspecting Official	Condition of roofs.	Condition of doors/windows	Condition of flooring/ plastering
(1)	(2)	(3)	(4)	(5)	(6)

Initial of Inpsecting Officials	Nature of repairs to be attended	Details of repairs done with date	Initials of the occupant	Initials of the IOW	Remarks of Inpsecting Officials
(7)	(8)	(9)	(10)	(11)	(12)

Separate pages should be allotted
for each quarters/service building.

ANNEXURE 2.5

[redacted]

Para 225 (a)

PROFORMA FOR PETTY REPAIR BOOK/COMPLAINT BOOK

Date : :	Sr. No. : :	Quarter No : :	Name of occupant and designation : :	Nature of complaint : :	Repairs attended on____ : :	Remarks for not doing repairs : :	Signature of Section Engineer (Works)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Schedule of Colour Washing and Distempering

.	**Colour washing exterior plastered surface**		**Interior white washing including ceiling**	**White washing of kitchen and pantry**	**Interior distempering**
.	**Areas with not less than 1500 mm rainfall per year**	**Areas with less than 1500 mm fall per year**	.	.	.
(1)	(2)	(3)	(4)	(5)	(6)
I. Service Building:					
1. Hospitals	Once a year	Once in 2 years	Once a year	Once in 6 months	Once in 2 years
2. Refreshment rooms	-do-	-do-	-do-	-do-	-do-
3. Rest Houses for Officers and Subordinates.	-do-	-do-	Once in 2 years	Once a year	-do-
4. Running rooms	-do-	-do-	Once a year	Once in a year	-do-
5. Station Buildings:-	.	.	.	.	.
(a) Concourse, waiting hall waiting room and bathroom	-do-	-do-	-do-	-	-do-
(b) Other rooms	-do-	-do-	Once in 2 years	-	-do-
6. Offices	-do-	-do-	-do-	-	-do-
7. Work shops and running sheds etc.	-do-	-do-	-do-	-	-
8. Goods Sheds Transhipment sheds, repacking sheds etc.	-do-	-do-	-do-	-	-
9. Gate-lodges, cabins etc.	Once a year	Once in 2 years	Once in 2 years	-	-
10. Schools	-do-	-do-	Once a year	-	-
11. Institutes and clubs	-do-	-do-	Once in 2 years	Once a year	Once in 2 years
I. Residential Buildings:-	.	.	.	.	.
1. Officers Bungalow	Once in 2 yrs.	Once in 2 yrs	Once in 2 years	Once a 2 yrs	Once in 2 years
2. Class III staff Qrs.	-do-	-do-	-do-	-do-	-do-
3. Class IV Staff Qrs.	-do-	-do-	Once a year	-do-	.

Note: (1) Polishing mosaic or wooden parquette and red ochre flooring, replacing coloured or white glazed tiles in bath room and lavatory, plastering external and internal surfaces and enamel painting, painting/varnishing wood work and painting steel work will be carried out only on condition basis.

(2) "Building/Structures such as Cinema Houses, Latrines, Canteens, dining Halls-Maintenance of which is governed by the Statutory Acts such as Factories Act, Madras Cinema (Regulations) Act, etc. should be white washed/Colour washed at the intervals as laid down in these Acts."

(3) Colour Washing or White washing may be done to the interior of residential buildings on account of disinfections. When there is a change of tenancy, white washing may be done to the kitchen and bathroom at the discretion of the Assistant Engineer.

Annexure 2.7
Para 226(d)

GUIDELINES FOR LEAK PROOF FLAT ROOF

1. Water proofing system on the roofs get deteriorated due to weathering effect and may become ineffective due to development of cracks/debonding/ disintegration of water proofing material etc. Stagnation of water due to undulation in roof surface, provision of less no. of drainage pipes or choking of same and improper detailing at junction of parapet and roof etc., are other major contributors in making the roof leaky.

2. BASIC REQUIREMENT OF ARRESTING LEAKAGE OF ROOFS:

2.1 Provision of adequate slopes:

IIt is absolutely essential that roofs are provided with adequate slope to ensure effective drainage. The slope of roof should be such that the water gets drained off quickly by achieving adequate velocity under influence of gravity. Even areas with light rainfall will require adequate slope as continuous light drizzling without dry spell also effect roof leakage problem badly. A slope of 1 in 100 or steeper depending upon the type of water proofing system, is required for effective drainage.(CS No.10 Dt.17.02.2005)

2.2 Provision of adequate openings:

Adequate openings in numbers and size, are necessary to allow the water to get drained off quickly. The number and size of openings depends upon the area of roof and intensity of rain fall of the region in which building is situated. Rain water pipes having bell mouth inlet at the roof surface, give better drainage effect. The spacings in between outlet pipes should not be more than 6 m. The size of rain water pipes, depending upon the average rate of rain fall and roof area, should be as given in Table-1. Average rainfall intensity may be obtained from local office of Indian meteorological deptt.

Table-1
Sizes of Rainwater Pipes for Roof Drainage

Dia of pipes	Average rate of Rainfall in mm/h (Roof area, m^2)					
	50 m^2	75 m^2	100 m^2	125 m^2	150 m^2	200 m^2
50	13.4	8.7	6.6	5.3	4.4	3.3
65	24.1	16.0	12.0	9.6	8.0	6.0
75	40.8	27.0	20.4	16.3	13.6	10.2
100	85.4	57.0	42.7	34.2	28.5	21.3
125	-	-	80.5	64.3	53.5	40.0
150	-	-	-	-	83.6	62.7

2.3 Proper detailing at junction of roof with parapet wall:

Junction of roof with parapet wall is a vulnerable location for leakage. It is necessary that detailing at the junction of roof and vertical face of parapet wall is done very carefully. Following should be ensured:

I) The fillet (angular or concave, not convex) of 75mm should be provided all along the junction of parapet wall with roof.

ii) Coping on top of the parapet wall should also be provided with adequate slope alongwith the provision of drip course on either side.

iii) Water proofing system should be extended from roof to parapet wall for a minimum height of 150 mm with a chase. General arrangements at junction of roof with parapet are given in fig.1.

(iv) Typical details of junction arrangement of rain water pipe with roof are indicated in Fig. 1.1. Invert level of rain water pipe should be approx. 25 mm below the level of top of adjacent tiles. Grating should be fixed at the mouth of railway water pipe to prevent entry of leaves/other waste material from roof. Unless, specified otherwise, rain water pipe and fittings should be properly secured to the walls. (CS No.4 Dt.12.09.01)

2.4 Expansion Joints:

Expansion joints in buildings/ other structures may become source of perennial seepage due to failure of expansion joint fillers and sealants. Expansion joint should be treated with suitable non-absorbent, compressible, non-brittle and water tight sealants so that no leakage occurs through joint. Joint fillers should confirm to IS: 3414 - Code of Practice for Design & Installation of Joints in Buildings or IS:1838 (Pt.I or Pt.II)- Specification for Preformed Fillers for Expansion Joint in Concrete Pavement and Structures. Sealing compound should confirm to IS: 1834 - Specification for Hot Applied Sealing Compounds for Joints in Concrete. General Arrangements for an expansion joint are shown in Fig. 2.

2.5 A water proofing system should have the following properties:

a) It should be impermeable or should have very low permeability.

b) It should have strong adhesion with substrata.

c) It should be sufficiently elastic so as to withstand expansion and contraction of substrata due to temperature fluctuations.

d) It should have high resistance to abrasion and cracking.

e) It should be resistant to ultra violet rays.

f) It should be breathable i.e. permit vapour transmission.

g) Its application should be easy..

h) It should be durable.

3. PREVALENT WATER PROOFING SYSTEM FOR ROOFS:

3.1 Various water proofing system prevalent in our country are as under:

i) Lime concrete terracing

ii) Mud-Phuska treatment.

iii) Water proofing using polyethylene films.

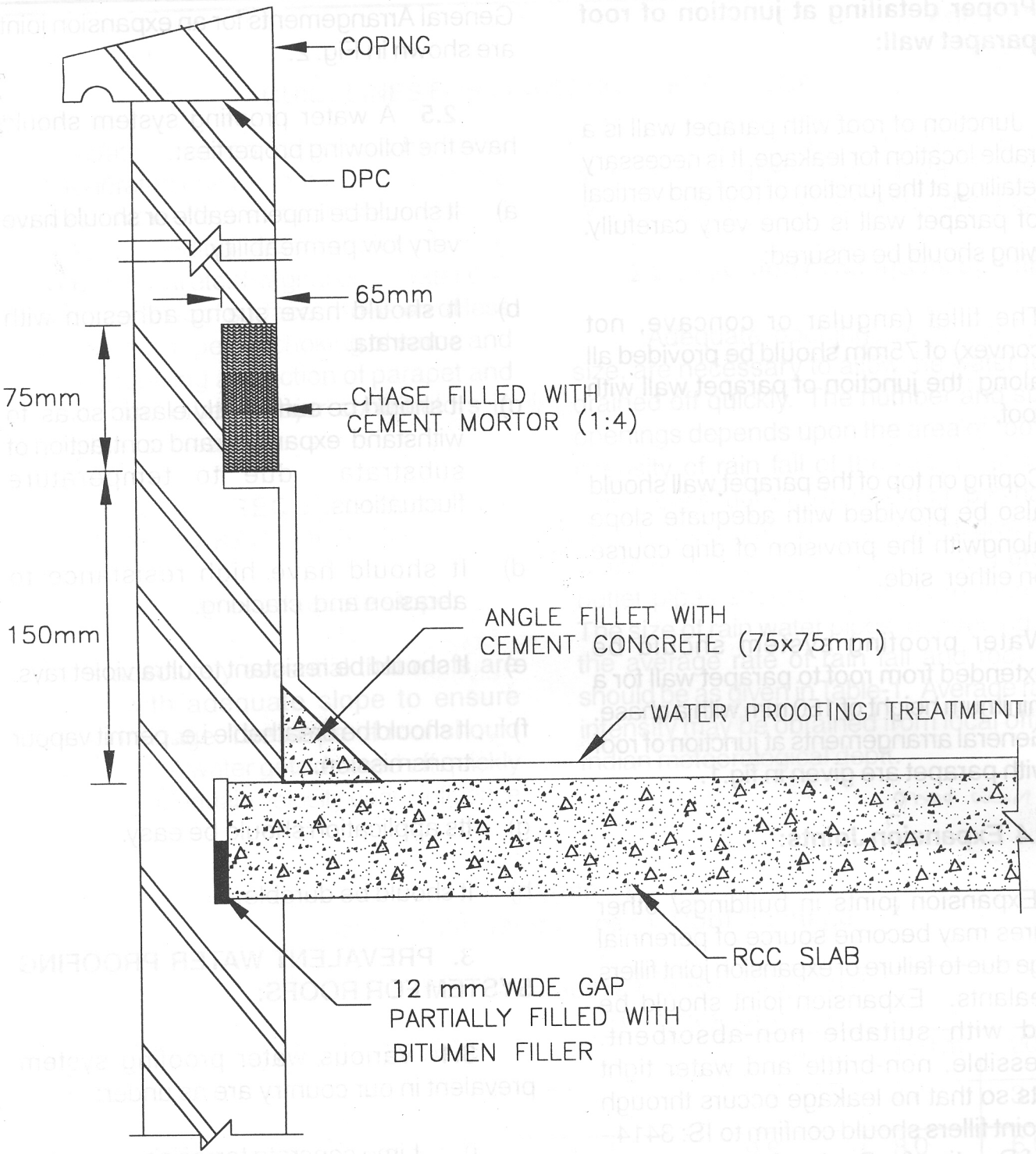
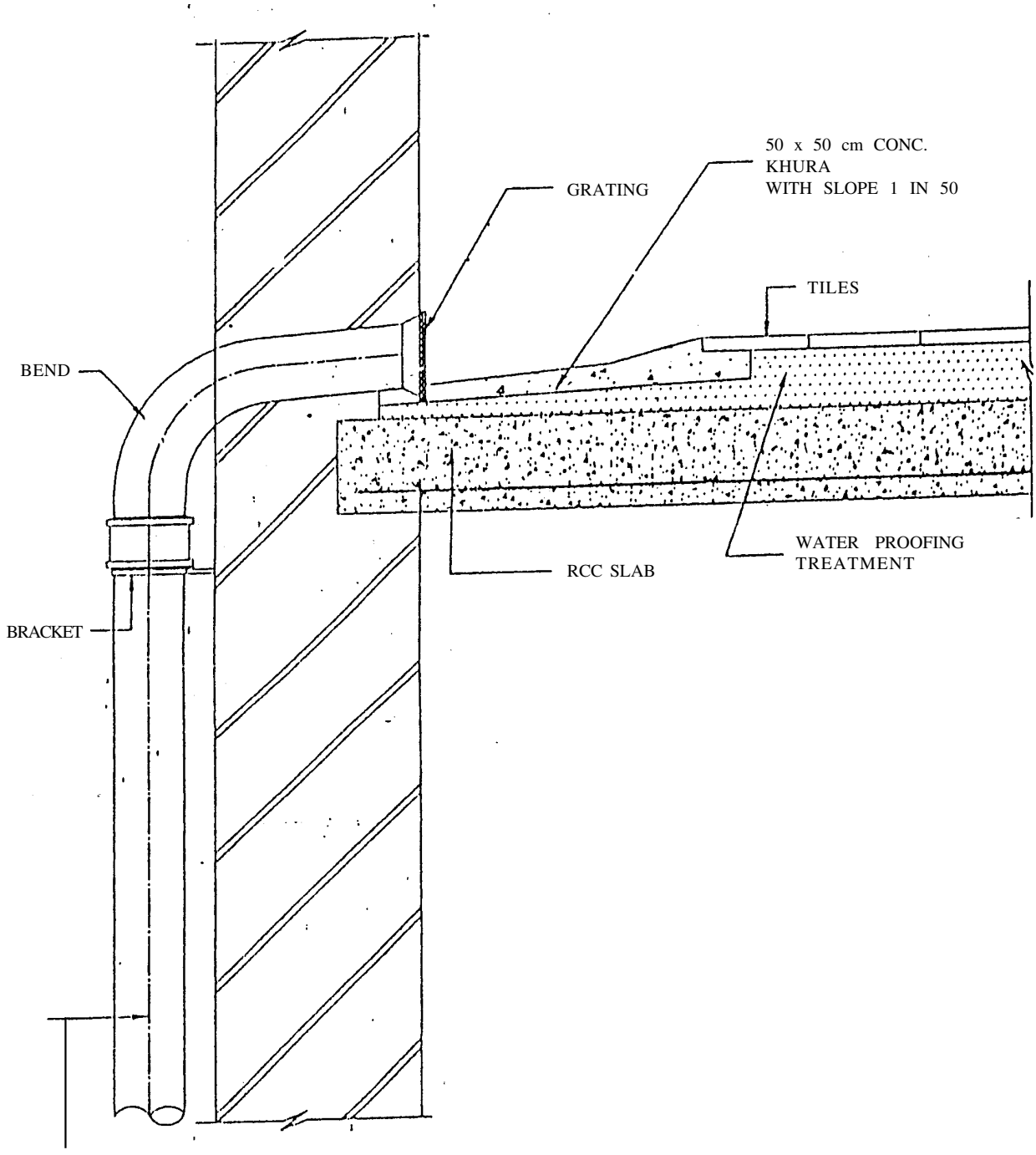


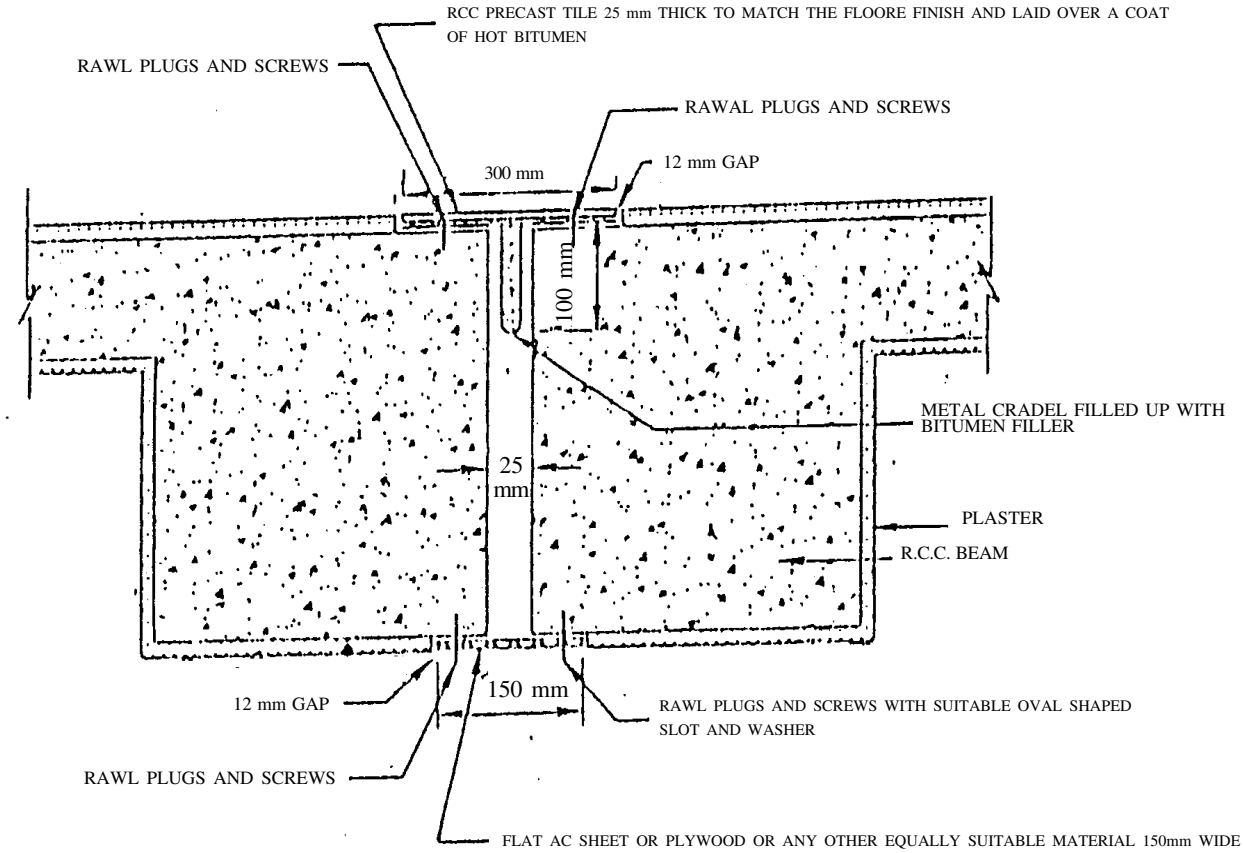
Fig.1

GENERAL ARRANGEMENT AT JUNCTION OF ROOF AND PARAPET WALL

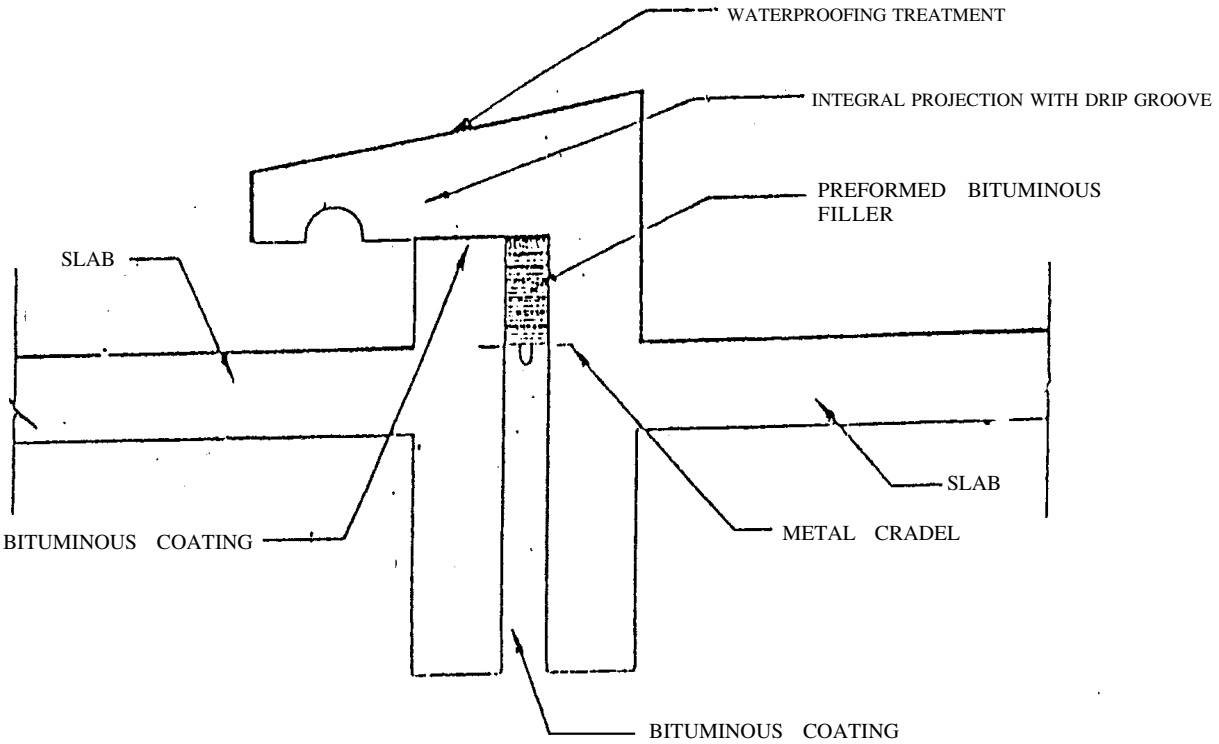


TYPICAL DETAILS OF JUNCTION ARRANGEMENT
FOR RAIN WATER PIPE WITH ROOF

Fig. 1.1 (CS No.4 Dt.12.09.01)



(a) EXPANSION JOINT AT FLOOR LEVEL



(b) EXPANSION JOINT AT ROOF LEVEL

TYPICAL DETAILS EXPANSION JOINT

Fig. 2 (CS No.4 Dt.12.09.01)

iv) Water proofing using polymer cementitious slurry coatings.

v) Water proofing using polymer modified bitumen membranes.

vi) Water proofing using bitumen felts.

3.2 Lime Concrete Terracing:

3.2.1 This system consist of laying, ramming & compaction of lime concrete to a desired slope . Lime concrete used in this system is a mixture of hydrated fat lime (conforming to IS 712) pozzolanic material (calcinated clay pozzolana conforming to IS 1344) and concrete aggregate (broken burnt clay bricks conforming to IS: 3068 or natural stone aggregate conforming to IS 383)having maximum size 25mm. This system is suitable for new as well as old roofs.

3.2.2 Application Procedure:

Various steps involved in this system are as under:

i) **Preparation of Lime Concrete:-** One part of slaked lime and two parts of burnt brick pozzolana, by volume , shall be mixed on a water tight platform. This shall then be sprinkled with required quantity of water and well ground in a mill or using mechanical grinder to obtain lime pozzolana mortar. Coarse aggregate and lime pozzolana mortar, in proportion of 21/2 :1 parts by volume, shall be used for preparation of lime concrete. In case of hand mixing, coarse aggregate shall be staked to an even surface on the platform and lime pozzolana mortar shall than be evenly spread over the aggregate and the whole thoroughly mixed in just sufficient quantity of water to obtain concrete of uniform consistency. The mixing shall be done by turning it over and over several times - until all the aggregate are covered with mortar and a concrete of uniform consistency is obtained. In case of machine mixing, two and a half parts by volume of clean saturated surface dry coarse aggregate shall first be fed into the mixer and then one part, by volume, of lime. Pozzolana mortar shall than be added to the mixer and the content mixed well. Mixing shall be continued until there is a uniform distribution of the material. Final adjustment of water, to obtain concrete of required consistency may be made by adding clear water, if necessary, and turning the ingredients in the mixer.

ii) **Laying, ramming & compaction of lime concrete:-** Before laying of lime concrete, all preparatory work described in IS 3067 i.e. cleaning of roof surface, attention to cracks by filling with cement sand slurry, provision of adequate numbers of opening and fillet at the junction of roof and parapet wall shall be completed. Roof surface should be made rough to develop sufficient bond between lime concrete and base concrete. After cleaning, roof surface shall be painted with hot bitumen 80/100 @ 1.7 kg/m2 blended with coarse sand. Subsequently, laying of lime concrete shall be started from a corner of a roof and proceed diagonally towards centre and other sides considering the slopes required for draining the rain water smoothly. The average thickness of lime concrete shall not be less than 100mm. On flat roof, slope of 1 in 60 shall be given. However, in heavy rainfall area, slope of 1 in 40 is recommended.

After laying it shall be initially rammed with a rammer weighing not more than 2 kg and then finished to the required evenness and slopes. Further consolidation shall be done using wooden 'thapies' with rounded edges. The workmen will sit close together and beat the surface lightly. The beating will normally have to be carried on for at least seven days until the 'thapi' makes no impression on the surface and rebounds readily from it when struck. In order to achieve more progress, ramming and compaction of lime concrete can be done mechanically with the help of a tamping machine developed by C.B.R.I., Roorkee.

During compaction the surface shall be sprinkled liberally with lime mortar and small proportion of sugar solution (i.e. solution prepared by mixing, 3 kg of jaggery, 11/2 kg of Bael fruit to 100 litre of water by boiling) or a solution prepared by soaking drynuts of terminalia chebula in water, for obtaining improved water proofing of concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float.

iii) **Curing:-** The lime concrete after compaction shall be cured for a minimum of 10 days or until it hardens by covering with a thin layer of grass or straw which shall be kept wet continuously.

iv) **Treatment at junction of roof and parapet:-** All along the junction of roof surface with parapet wall, a strip of lime concrete fillet shall be laid and finished smooth. Typical detail of treatment at junction between lime concrete water proofed roof finish and masonry walls are illustrated in the fig. 3.

v) **Finish:-** In case of accessible roof, one layer of burnt clay flat terracing tiles (according to IS:2690 Part-1 and Part-2) may be laid over a thin layer of lime mortar. However, in the extreme condition where there is considerable expansion and contraction, two layers of tiles may be put on the top of lime pozzolana concrete. These tiles should be joined with non-shrinking impervious cement mortar.

3.2.3 For more details, IS: 3036 - Laying Lime Concrete For Water Proofed Roof Finish, may be referred.

3.3 Mud-Phuska Treatment:

3.3.1 Mud phuska treatment is a common insulating cum water proofing treatment used in comparatively hot dry region i.e. Punjab, U.P. etc., where rainfall is not heavy. This treatment usually consist of the following courses:

I) A layer of hot bitumen 80/100 or equivalent.

ii) A coat of mud phuska of 100 mm average thickness consisting of puddled clay conforming to specification as laid down under IS: 2115.

iii) A layer of 25mm mud plaster consisting of puddled clay mixed with chopped straw 30 to 35 kg per cubic meter of soil.

iv) One or two layer of tile laid on a bed of mud mortar and pointed in 1:3 cement sand mortar.

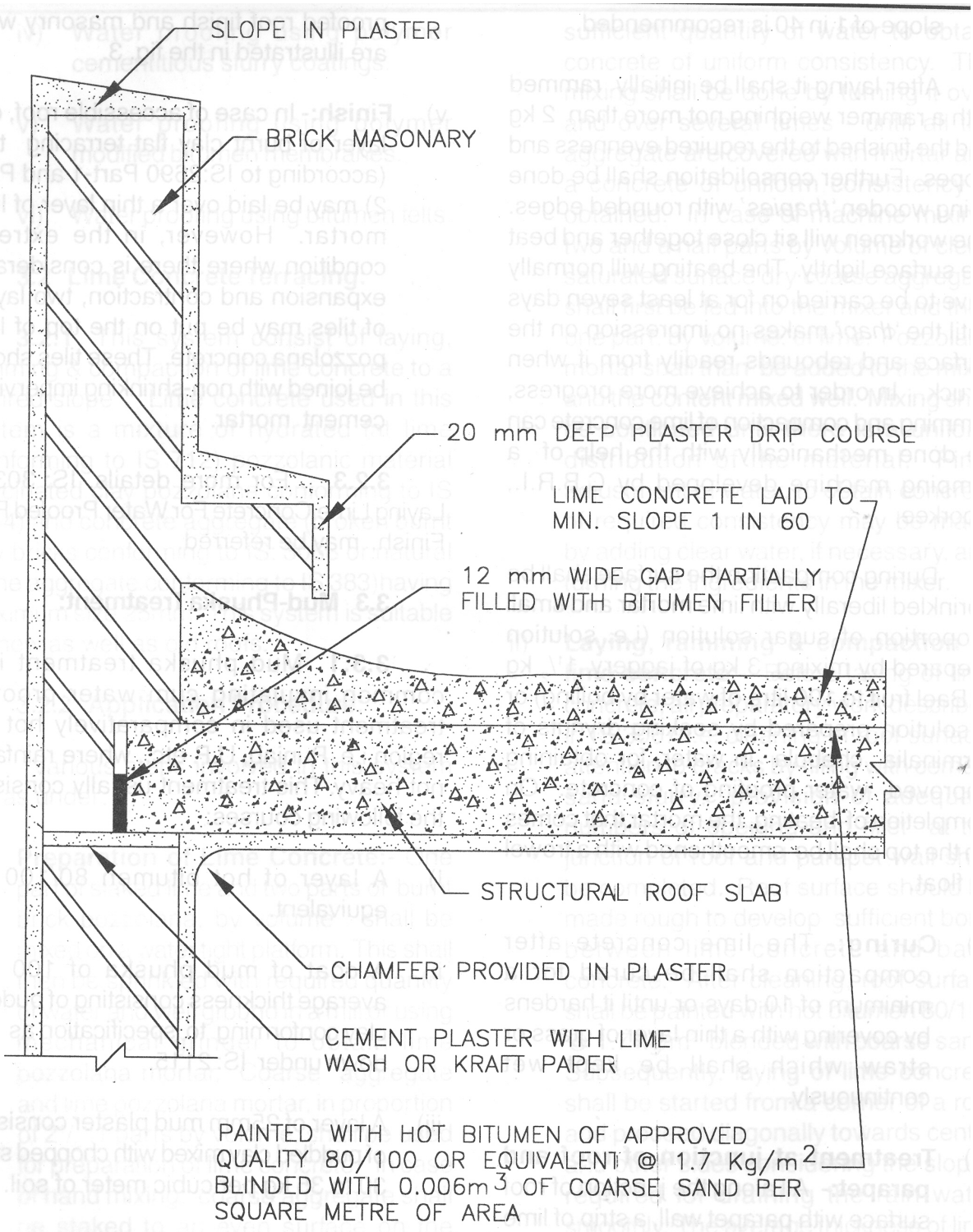


Fig. 3

DETAIL AT JUNCTION BETWEEN LIME CONCRETE WATER PROOFED ROOF FINISH AND PARAPET WALL

3.3.2 Material:

i) **Soil for Mud Phuska:** The soil for mud Phuska shall be free from gravel and coarse sand (of particle size greater than 2mm), vegetable matter and fine kankar particles. The soil shall also be free from harmful and efforescent salts. The coarse material shall not exceed 25% by mass. The plasticity index of the soil shall be between 10- 15 percent. Generally soil suitable for brick making is suitable for mud-phuska.

ii) **Soil for Mud Plaster and Mud Mortar:** The soil shall be free from vegetable roots, gravel and coarse sand of particle size greater than 2mm. The coarse material shall not exceed 10% by mass. The soil shall also be free from harmful and efforescent salts. The plasticity index of the soil shall be between 10-15 percent.

iii) **Mud Plaster:** The mud plaster shall be prepared from soil conforming to above ii). The dry soil shall be reduced to fine powder and mixed with water in a pit, adding wheat straw 6% by mass and cowdung 12% by mass. The mixture shall be allowed to rot for a period of not less than 7 days. During this period, it shall be pugged manually using spades, if necessary, to get a homogeneous mass free from lumps and clods.

The consistency of the mortar shall be adjusted by taking it in a trowel and observing how it slides off the face of trowel. The mortar shall readily slide off, but at the same time shall not be so wet as to part into large drops before falling. Alternatively, slump test may be performed in accordance with the procedure laid down in IS: 1199. The slump should be about 70mm.

iv) **Mud Mortar:** Mud mortar, used as bedding under brick tile layer, shall be prepared in the same manner as mud plaster but without any addition of fibrous reinforcing material and binding material. The mud mortar may be used immediately without any rotting period.

v) **Brick Tiles:** These shall conform to the requirements given in IS: 2690 (Part-1) or IS: 2690 (Part-II).

3.3.3 Application Procedure:

Various steps involved in this system are as under:

i) Preparatory Works: Prior to application of treatment, preparatory works like filling of cracks by cement sand slurry, provision of adequate number of drain outlets, provision of 75mm fillet at junction of roof slab with parapet wall, provision of a groove / chase in parapet wall etc. as described in IS: 3067- Code of Practice for General Design Details & Preparatory Works for Damp Proofing and Water Proofing of Buildings, shall be completed.

ii) Cleaning of Roof Surface: The surface of roof and the part of the parapet and gutters, drain mouths, etc. over which the water proofing treatment is to be applied shall be thoroughly cleaned of all foreign matter, namely fungus and dust etc. by wire brushing and dusting.

iii) **Application of Bitumen over Cleaned Roof Surface:** After cleaning of roof surface, a coat of hot bitumen (Residual type bitumens 80/100) over the roof surface shall be applied evenly over the entire surface without any gap. Bitumen coat is extended over the vertical surfaces meeting with the slab. Bitumen commonly used is residual type petroleum bitumen of grade 80/100 or hot cut back bitumen. Residual type bitumen is heated to a temp of not less than 165o C and not more than 170o C. The quantity of bitumen to be spread per 10 sqm. of the surface is approx. 17 kg.

iv) **Laying of Mud -Phuska:**

a) **Preparation:** The soil shall be stacked in required quantities in about 300mm high stacks over a level ground and the top surface divided into suitable compartments of convenient size by bunding. The estimated quantity of water corresponding to optimum moisture content shall be added about 12 hours before the use and allowed to soak. The stacks of soil shall then be worked up with spades and hands to ensure proper distribution of moisture at the time the soil is to be used.

b) **Laying:**The Mud-Phuska prepared as above shall be carried to the surface to be covered and laid in loose thickness not greater than 150mm. The surface shall then be brought to the slope of 1 in 40. It shall then be rammed manually with wooden rammers and 'thappies' so as to obtain maximum density. Normally a Mud Phuska layer, laid to a compacted thickness of not less than 100mm, is considered adequate.

The surface shall be allowed to dry for a period of not less than 24 hours. If any cracks appear, these shall be filled with a grout of the binder material.

v) **Applying Mud Plaster:** After laying the mud phuska, mud plaster shall be laid to a total thickness of not less than 25mm over the surface. The plaster may be applied in a single coat or two coats of 15mm and 10mm.

After the application, the coat of plaster shall be allowed to dry. The surface shall be checked once more for slope and evenness with a straight edge and spirit level and made up wherever necessary by application of the plaster.

vi) **Paving with Brick Tiles:** After application of mud plaster, the brick tiles shall be laid flat on a thin layer of mud mortar. The tiles shall be laid close to each other and the thickness of joints shall not be less than 6mm and not more than 15mm. It shall be ensured while laying tiles that mud mortar rises vertically in joints to a height of about 15mm. The brick tile shall be allowed to dry for a period of 24 hours before grouting the joint. After drying, the joint shall be grouted with cement sand mortar (1:3). It shall be ensured that the joints are completely filled by mortar. The mortar shall be allowed to set for a minimum of 12 hours before further pointing of the joints which need to be done only if necessary. Before pointing,

the grouted joints shall be brushed clean with a soft brush. Typical details for the treatment are given in Fig. 4.

vii) **Curing:** The surface of finished roof shall be kept wet for a period of not less than 7 days.

3.3.4 For more details IS: 2115 - Code of Practice for Flat Roof Finish: Mud- Phuska, may be referred.

3.4 Water proofing using polyethelene film:

3.4.1 It consist of laying of polyethylene film on slopped roof surface. This system is suitable for new as well as old roofs. This treatment generally consist of application of following courses:

i) A coat of bitumen primer conforming to IS: 3384 applied to the prepared surface at the rate of 0.3 to 0.5 kg/m2 .

ii) Application of hot applied bitumen (straight run bitumen conforming to IS: 73) at the rate of 0.70 kg/m2 minimum.

iii) Laying of polyethylene film conforming to IS: 2508 with cold cutback adhesive in overlaps.

iv) Laying of 100 gm brown kraft paper laminated insitu over the film with semi hot layer of straight run bitumen.

v) Application of semi hot applied bitumen at the rate of 0.7 kg/m2 dusted with fine sand.

vi) Laying of finishing layer of tiles or Indian Patent Stones i.e. 1:2:4 cement concrete with 10mm down aggregate or cement concrete.

3.4.2 Application procedure:

Various steps involved in this system are as under:

i) Provision of slope and completion of preparatory works:- Prior to application of water proofing treatment roof surface shall be provided with a minimum slope of 1 in 100 with cement concrete or cement sand mortar or lime surkhy mortar. After provision of slope all preparatory works like filling up of cracks in roof structures by cement sand slurry, provision of adequate number of drain outlets, provision of 75mm fillet at junction of roof slab with parapet wall., provision of a groove/ chase in parapet wall etc. as described in IS:3067-1988 "shall be completed.

ii) **Method of laying:**- After completion of preparatory works, a coat of primer shall be applied on the prepared roof surface by brushing and allow it to dry for 6 to 12 hours. Then a coat of hot bitumen shall be spread on the roof surface and allowed to cool to a temperature so that the film may be laid without any damage to it.

The polyethylene film shall be carefully laid and pressed on the bituminous layer. The film shall be pressed down with the help of a gunny cloth so as to prevent any damage to the film. The next length of the polythelene film shall be similarly laid down with proper longitudinal and end overlaps firmly pressed on the bituminous layer. The joints and

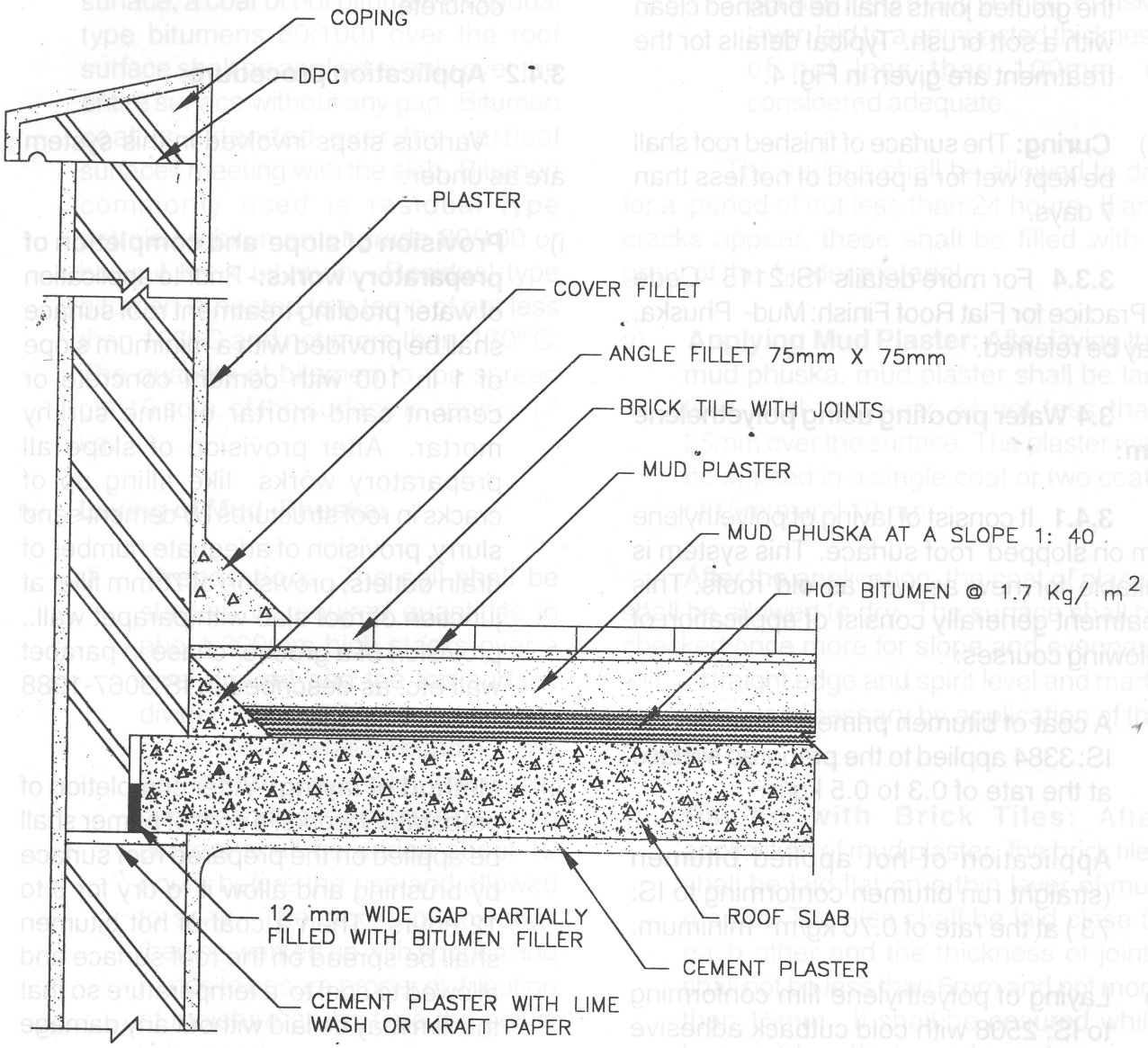


Fig.4

WATER PROOFING OF ROOFS USING MUD PHUSKA

overlaps shall be carefully sealed with the help of cutback bitumen applied over the upper surface of lower layer of polyethylene film. Minimum width of lap shall be 10 cm between adjacent films and at the ends. As far as possible for flat roof the film shall be laid at right angles to the direction of flow of water with overlap facing downwards. Width of film should be selected in such a way so that no. of laps are minimum.

On polyethelene film 100 gm brown kraft paper shall be fixed with semi hot layer of straight run bitumen. The technique of fixing kraft paper to polyethelene film is to paint semi hot bitumen on the paper, reverse it and laminate over the film.

Kraft paper shall be coated with semi hot applied bitumen at the rate of 0.7 kg/ m2 dusted with fine sand. After finishing roof surface, treatment shall be applied to parapet, gutters and drain mouth.

iii) **Treatment at the junction of roof with parapet wall:-** Typical details of treatment at junction of roof with parapet wall are shown in Fig.5. Where down water pipes are provided to drain off the rain water, extra piece of polyethylene film shall be provided in the opening covering the edge of the water pipe and covered with cement plaster 1:6.

iv) **Surface Finish:-** After completion of treatment, roof shall be provided with any one of the following:

a) Cement concrete flooring tiles conforming to IS: 1237;

b) Burnt clay flat terracing tiles conforming to IS: 2690 (Part-1) or IS: 2690 (Part-2);

c) Indian Patent Stone i.e. 1:2:4 concrete 40mm thick with 10 mm down aggregate.

Typical details for complete treatment for new roofs are shown in Fig. 5. For old roofs, details are shown in Fig. 6.

3.4.3Precautions in laying polyethelene film:

i) The roof surface should be reasonably smooth so as to avoid puncturing of film. Primer should not be applied on wet surface.

ii) Excessive bitumen should not be used for bonding the film to the prepared surface, which may otherwise result in the film sliding and wrinkling.

iii) Over stretching of the film shall be avoided at the time of laying, which otherwise leads to wrinkles when the film retracts.

iv) The laying of the film should be immediately followed by subsequent operations of covering with bituminous compositions. It is found that if the film is left, exposed, it can lead to softening of bitumen layer underneath causing wrinkles, which may possibly lead to damage. The work should not be carried out at high temperature.

v) The workman should preferably walk barefooted or with canvas shoes to prevent damage to the film.

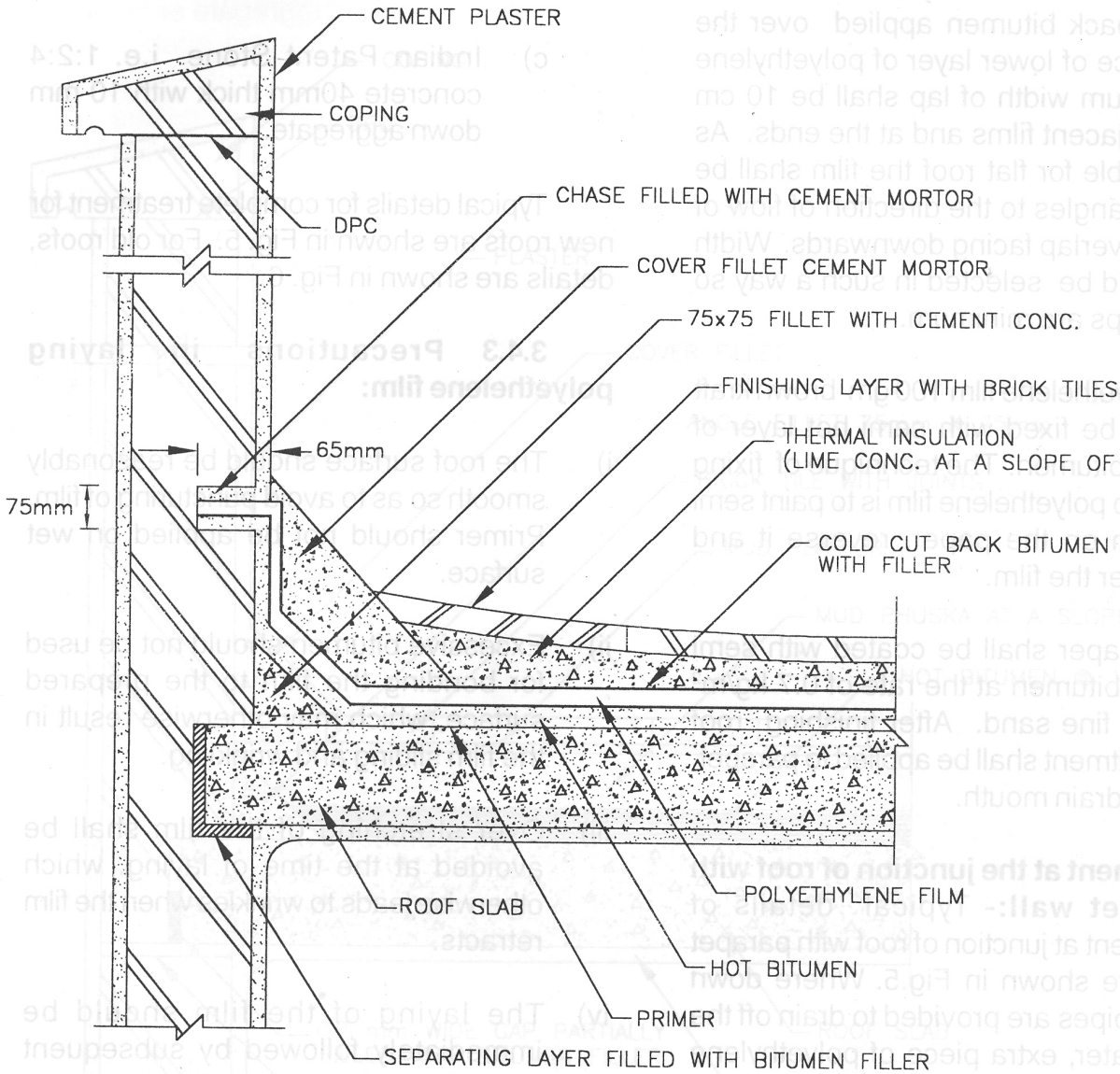


Fig.5

TYPICAL DETAIL OF WATER PROOFING TREATMENT USING POLYETHYLENE FILM (FOR NEW ROOF)

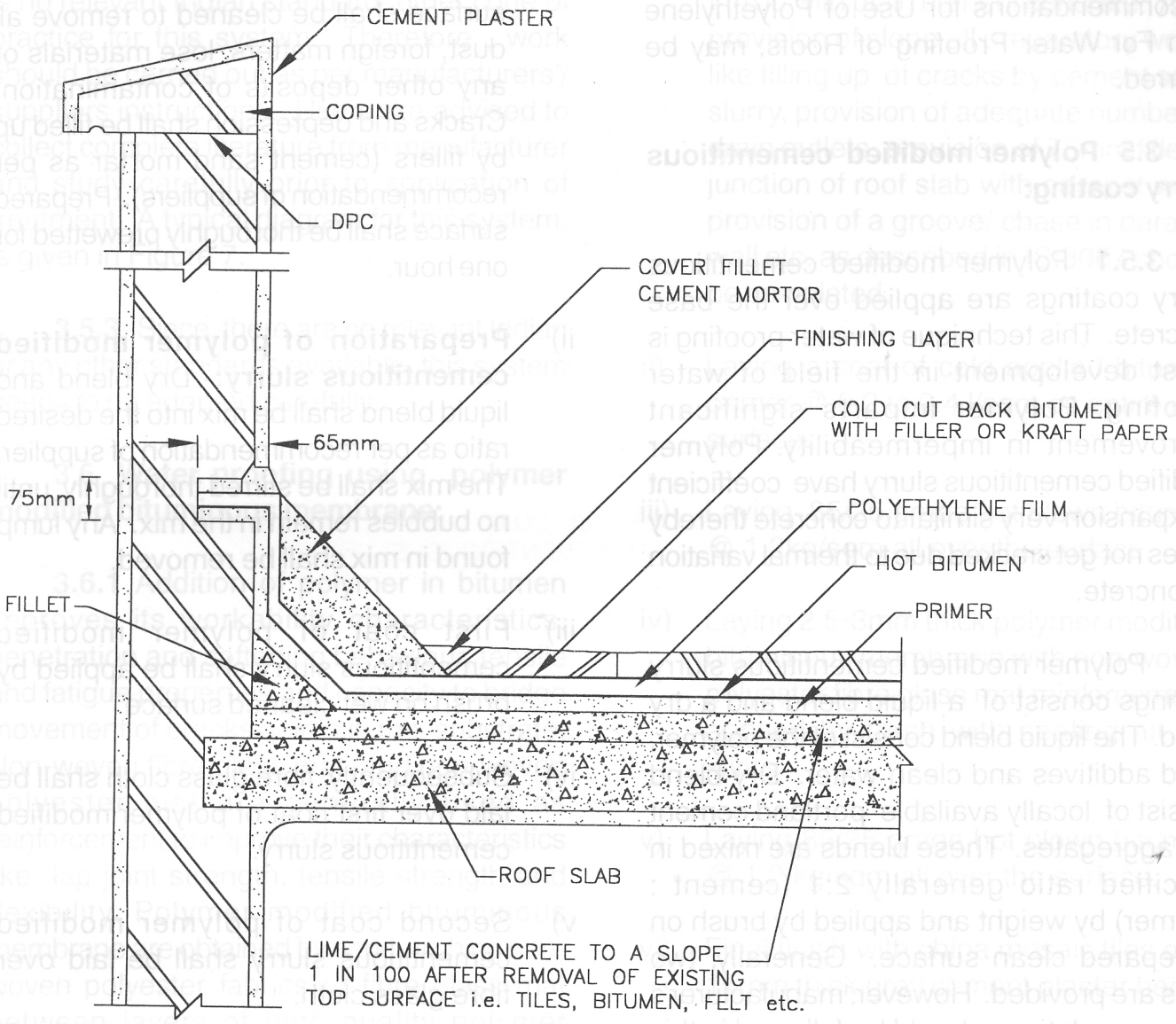


Fig.6

TYPICAL DETAIL OF WATER PROOFING TREATMENT USING POLYETHYLENE FILM (FOR OLD ROOFS)

3.4.4 For more details IS: 7290 - Recommendations for Use of Polyethylene Film For Water Proofing of Roofs, may be referred.

3.5 Polymer modified cementitious slurry coating:

3.5.1 Polymer modified cementitious slurry coatings are applied over the base concrete. This technique of water proofing is latest development in the field of water proofing. Polymer imparts significant improvement in impermeability. Polymer modified cementitious slurry have coefficient of expansion very similar to concrete thereby it does not get cracked due to thermal variation of concrete.

Polymer modified cementitious slurry coatings consist of a liquid blend and a dry blend. The liquid blend consist of the polymer, liquid additives and clean water. Dry blend consist of locally available portland cement and aggregates. These blends are mixed in specified ratio generally 2:1 (cement : polymer) by weight and applied by brush on a prepared clean surface. Generally, two coats are provided. However, manufacturer's recommendations should be followed in this regard. To impart more flexibility, it is desirable to use some reinforcement like fibre glass cloth sandwitched between two coats. This coating should be covered by screed concrete to protect it against physical damage. This system can be used over new as well as old roofs.

3.5.2 Application of polymer modified cemenetitious slurry coating :- Broadly following steps are involved in application of this system.

i) **Preparation of roof surface:-** The surface shall be cleaned to remove all dust, foreign matters, lose materials or any other deposits of contamination. Cracks and depression shall be filled up by fillers (cement sand mortar as per recommendation of suppliers). Prepared surface shall be thoroughly prewetted for one hour.

ii) **Preparation of polymer modified cementitious slurry:-** Dry blend and liquid blend shall be mix into the desired ratio as per recommendation of supplier. The mix shall be stirred thoroughly, until no bubbles remain in the mix. Any lump found in mix shall be removed.

iii) First coat of polymer modified cementitious slurry shall be applied by brush on wet cleaned surface.

iv) Subsequently, fibre glass cloth shall be laid over first coat of polymer modified cementitious slurry.

v) Second coat of polymer modified cementitious slurry shall be laid over fibre glass cloth.

vi) Polymer modified cementitious brush topping shall be applied over second coat of polymer modified coating.

vii) On brush topping, screed concrete, 1:2:4 admixed with suitable integral water proofing compound 25 to 40mm thick to a min. slope of 1 in 100 with aggregate size down 10mm with maximum water cement ratio 0.45, shall be laid.

Above system may slightly differ from case to case depending upon the instruction

of supplier of water proofing system. There is no relevant Indian standard/ other code of practice for this system. Therefore , work should be carried out as per manufacturers'/ suppliers instructions. Users are advised to collect complete literature from manufacturer and study carefully prior to application of treatment. A typical diagram for this system. is given in Figure 7.

3.5.3 Since, there are no relevant Indian or any other standards available, this system needs to be adopted carefully.

3.6 Water proofing using polymer modified bituminous membrane:

3.6.1 Addition of polymer in bitumen improves its workability characteristics, penetration and softening behaviour, tensile and fatigue properties and capacity to bridge movement of cracks/ joints in the substrate. Non-woven fibre glass mat and non-woven polyester mat are generally used as reinforcement to improve their characteristics like lap joint strength, tensile strength and flexibility. Polymer modified bituminous membrane are obtained by sand-wiching non-woven polyester fabrics or fibre glass mat between layers of high quality polymer modified bituminous membranes. These membranes have high softening point, high tensile strength, high tear & puncture resistance, high joint strength and low water vapour transmission. This system is suitable for new as well as old roofs.

3.6.2Method of application :- Steps involved in this water proofing system may be as given below:

i) **Provision of slope and cleaning of roof surface:-** Prior to application of water proofing treatment roof surface should be provided with a minimum slope of 1 in 100 with plain cement concrete. After provision of slope all preparatory works like filling up of cracks by cement sand slurry, provision of adequate number of drain outlets, provision of 75mm fillet at junction of roof slab with parapet wall., provision of a groove/ chase in parapet wall etc. as described in IS:3067 should be completed.

ii) Laying a coat of cold applied bitumen primer @ 0.2 to 0.4 l/sqm on entire roof surface.

iii) Laying 85/25 grade hot blown bitumen @ 1.2kg/sqm all over the surface.

iv) Laying 2.5-3mm thick polymer modified bituminous membrane with non-woven polyester fibre glass mat reinforcement, applied by torch with sealing all the joints.

v) Laying 85/25 grade hot blown bitumen @ 1.2 kg/sqm all over the surface.

vi) Final finish with china mosaic tiles on a 15mm thick grey cement plaster bed.

Method of application may slightly differ depending upon product and manufacturers' recommendations. As there is no relevant IS code of practice for this water proofing system, work should be carried out as per manufacturers' recommendations. Users are advised to collect complete literature from manufacturers and study completely prior to application of treatment.

A typical scheme for laying of bitumen membrane is shown in sketch 8.

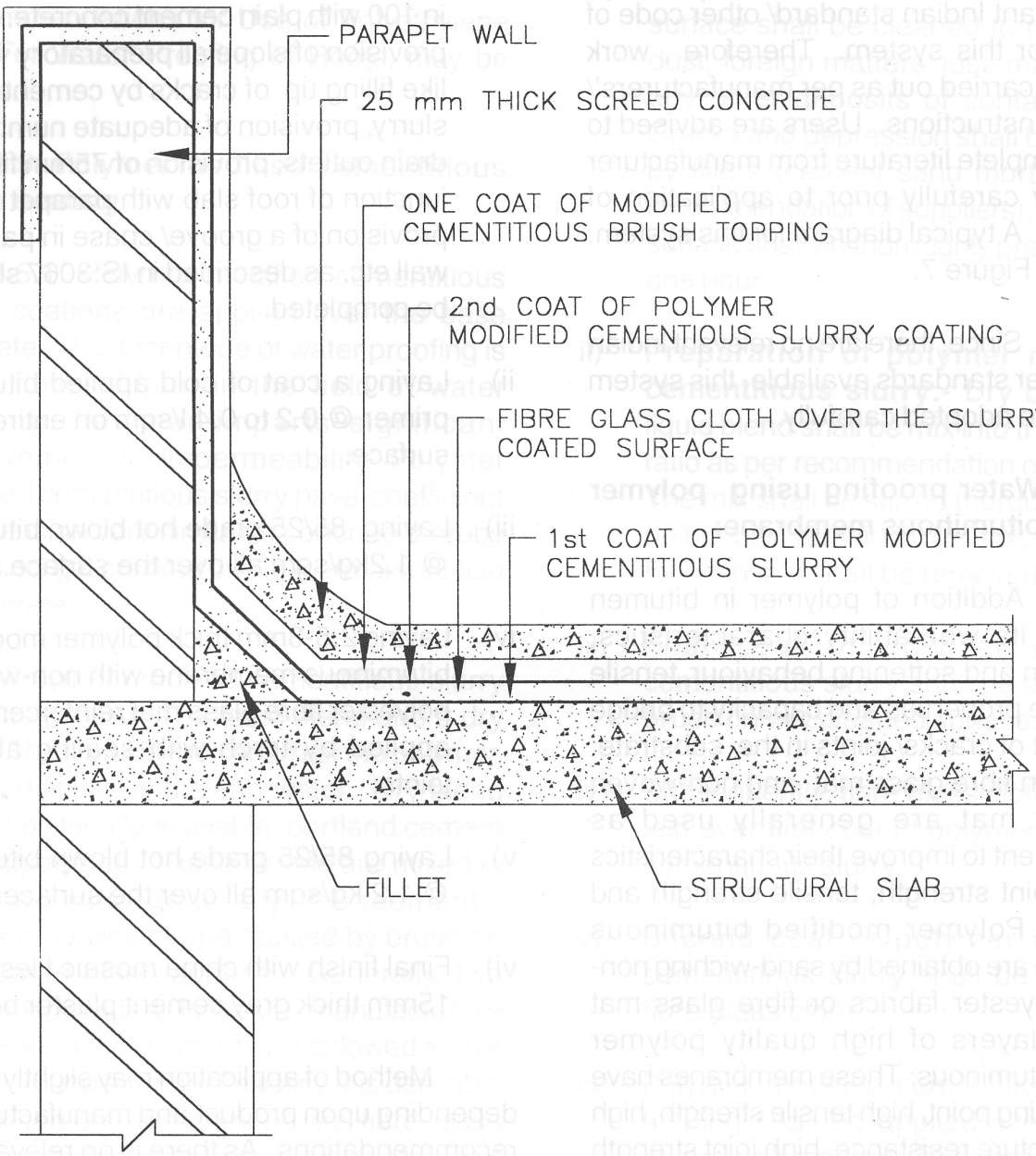


Fig.7

WATER PROOFING OF ROOF USING
POLYMER MODIFIED CEMENTITIOUS SLURRY

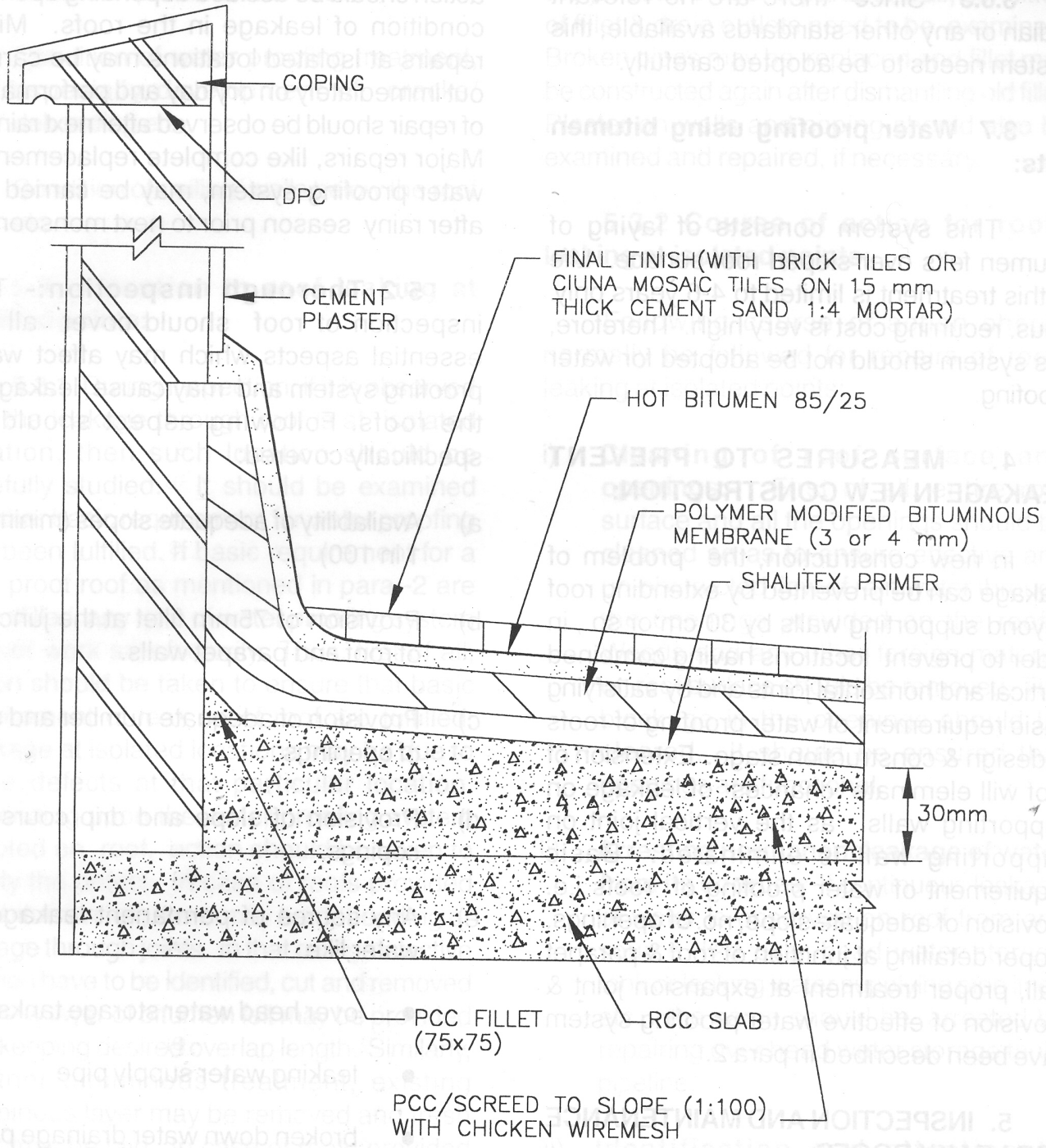


Fig.8

WATER PROOFING OF ROOFS USING POLYMER MODIFIED BITUMINOUS MEMBRANE

3.6.3 Since there are no relevant Indian or any other standards available, this system needs to be adopted carefully.

3.7 Water proofing using bitumen felts:

This system consists of laying of bitumen felts over sloped roof surface. Life of this treatment is limited to 4-6 years only. Thus, recurring cost is very high. Therefore, this system should not be adopted for water proofing.

4. MEASURES TO PREVENT LEAKAGE IN NEW CONSTRUCTION:

In new construction, the problem of leakage can be prevented by extending roof beyond supporting walls by 30 cm or so , in order to prevent locations having combined vertical and horizontal joints and by satisfying basic requirement of water proofing of roofs at design & construction stage. Extension of roof will eleminate chances of leakage on supporting walls, as the vertical joint on supporting wall is eliminated. Basic requirement of water proofing of roofs i.e. provision of adequate slope, no. of openings, proper detailing at junction of roof & parapet wall, proper treatment at expansion joint & provision of effective water proofing system have been described in para 2.

5. INSPECTION AND MAINTENANCE FOR LEAKY ROOFS:

5.1 Before taking any decision regarding remedial measures to be adopted for leaky roofs, it is necessary that the roofs are inspected thoroughly. The inspection should preferably be done during rainy season. Based on the observations, future course of action should be decided depending upon the condition of leakage in the roofs. Minor repairs at isolated locations may be carried out immediately on dry day and performance of repair should be observed after next rainfall. Major repairs, like complete replacement of water proofing system, may be carried out after rainy season prior to next monsoon.

5.2 Thorough inspection:- The inspection of roof should cover all the essential aspects which may affect water proofing system and may cause leakage in the roofs. Following aspect should be specifically covered:

a) Availability of adequate slopes (minimum 1 in 100)

b) Provision of 75mm fillet at the junction of roof and parapet walls.

c) Provision of adequate number and size of openings.

d) Provision of slope and drip course in copings.

e) Any source of permanent leakage of water like

- over head water storage tanks
- leaking water supply pipe
- broken down water drainage pipes
- leakage at joints of down water drainage pipes (causes wetness in walls)

f) Undulations/ minor depression in roof surface where water may stagnate.

g) Growth of plants on the roof.

h) Condition of water proofing treatment, especially development of cracks/ debonding etc.

i) Condition of ceiling/ walls below the roof etc.

5.3 Attention to roof leaking at isolated points:

5.3.1 During inspection, if it is observed that the leakage through roof is at isolated location, then such location should be carefully studied. It should be examined whether basic requirement for water proofing has been fulfilled. If basic requirement for a leak proof roof as mentioned in para -2 are not fulfilled, any type of water proofing system will not work satisfactorily. Thus, first of all, action should be taken to ensure that basic requirement of leak proof roof are fulfilled. Leakage at isolated locations may be due to some defects at that particular location. Depending upon the water proofing system adopted on roof, action should be taken to rectify the defect. In case of roofs provided with bitumen felt, there may be debonding or leakage through joints. In that case, defective location have to be identified, cut and removed and new layer of bitumen felt may be provided duly keeping desired overlap length. Similarly, in other bituminous treatment, existing bituminous layer may be removed and fresh layer may be laid. In case of roofs provided with lime terracing with tiles, there may be depression on roof surface or loss of cement mortar between tiles. Such defects may be rectified by fresh pointing/ plaster. Preferably pointing should be done with non-shrink polymer modified cement mortar. In case wetness is observed on the wall just below the junction of roof & parapet wall, condition of fillet & drain outlets need to be examined. Broken pipes may be replaced and fillet may be constructed again after dismantling old fillet. Plaster on walls and coping should also be examined and repaired, if necessary.

5.3.2 Course of action for roofs leaking at isolated points:

Following course of action should normally be followed for repairs of roofs leaking at isolated points:

i) **Cleaning of roof surface and openings:-** First of all, entire roof surface and all the openings should be cleaned so as to ensure effective and un-obstructed flow of rain water through the openings provided on the roofs. Weeds and any other foreign material on roof surface should be removed. The blockage in the openings should be cleared. It should be ensured that openings are functional.

ii) **Arresting permanent leakage of water from its sources:-**If continuous leakage of water is observed on roof from any source, like over head water storage tank or leaking water supplying pipe lines etc., the same should be arrested by repairing over head water storage tank/ pipeline.

iii) **Identification and attention to locations of stagnated water:-** Leakage of roof takes place only when water does not drain off quickly and stagnates over the roof surface. Generally, water stagnates over the depression formed in the roof surface. Thus, locations having depression in roof surface should be

attended. Subsequently, it should be ensured that there is no location on roofs where water stagnates.

iv) **Repair of filet at junction of roof on parapet wall:-** Condition of fillet at junction of roofs on parapet wall should be examined and any damage/ defective portion should be repaired.

v) **Repair to joints of tiles :**- Condition of pointing at joints in between tiles should be examined and wherever mortar has come out, fresh pointing in cement mortar 1:3 should be done. After pointing curing should also be ensured.

vi) **Repair to plaster and coping on parapet:-** Broken/ decayed plaster on parapet wall should be replaced by fresh plaster. Coping should also be attended alongwith provision of slope.

vii) After taking above steps, behaviour of roof surface should be watched and if leakage still persists, following steps have to be taken:

a) **Removal of complete top surface and repair of lime concrete:-**

Entire top surface which may be consisting of tiles and bitumen felts etc. should be removed and condition of the layer below it i.e. lime concrete/ mud plaster should be examined. Minor cracks should be sealed with cement sand slurry or bitumen compounds after making 'V' groove in case of lime concrete. Defective concrete should be replaced by fresh lime concrete. In case of mud-phuska, minor cracks may be filled up by bituminous compound. Decayed mud plaster and mud phuska should be replaced by fresh mud-phuska and mud-plaster.

b) **Provision of adequate slope:**-Many of the old roofs may not have adequate slope. For lime concrete terracing, a minimum slope of 1 in 60 is necessary. Therefore, after removal of top surface, slope of existing roof should be examined and if necessary, re-grading of roof surface should be carried out using lime concrete/ cement concrete. Prior to regrading of roof surface, level should be marked on roof and parapet . Subsequently existing lime concrete surface should be made rough. After that re-grading work should be taken up. After re-grading, top surface should be made smooth using cement plaster 1:3 and surface should be cured for 7 days. Similarly, on mud-phuska roofs a slope of 1 in 40 shall be ensured. If necessary, roof surface should be re-graded using mud-phaska and mud plaster. After re-grading, layer of mud-plaster should be allowed to dry before relaying of top surface.

c) **Re-laying of top surface:-** After completion of re-grading, a layer of burnt clay tiles should be laid. Old tiles may be used if they are in good condition. Tiles should be laid over 20 mm cement mortar 1:3. Tiles should be joined with impervious cement mortar.

5.4 Attention to roofs leaking heavily:

If heavy leakage is observed at large no. of location on the walls and on the ceiling,. it is an indication of ineffective water proofing treatment. In such cases, it will be necessary to remove entire existing water proofing material like bitumen felts/ mastic etc. After removing the existing water proofing material, fresh water proofing treatment has to be provided. In case of lime concrete terracing,

tiles needs to be removed first. After removal of tiles, condition of lime concrete should be examined. If large number of cracks are observed, it is desirable to remove complete lime concrete. If lime concrete is in good condition with few isolated cracks, these cracks should be filled up with cement slurry or bituminous caulking compound conforming to IS:1580. Subsequently, if necessary, re-grading of roof should be done as suggested under para 5.3.2 (vii). After re-grading fresh water proofing system may be provided. Water proofing treatment may be any among various systems as mentioned in para 3 except bituminous felt treatment.. While providing fresh water proofing system, care should be taken that instructions as given in relevant standard/ literature are strictly followed. Prior to provision of fresh water proofing system, provision of basic requirement of water proofing of roof should also be ensured.

6. STANDARDS & CODES OF PRACTICE DEALING WITH WATER PROOFING OF ROOFS:

Following is the list of various IS Codes which deals with water proofing of roofs:

i) IS 1322:1993 Specification for bitumen felts for water proofing and damp proofing (Fourth Revision)

ii) IS 1346:1991 Code of practice for water proofing of roofs with bitumen felt (Third Revision).

iii) IS 1580:1991 Specification for bituminous compound for water proofing and caulking purposes (First Revision)

iv) IS 2115:1980 Code of practice for Flat roof finish; Mud- Phuska.

v) IS:2527-1984 Code of practice for fixing rain water, gutters and downpipes for roof drainage.

vi) IS:2645-1975 Specification for integral water proofing cement compound.

vii) IS:3036:1992 Code of practice for laying lime concrete for a waterproofed roof finish (Second Revision).

viii) IS 3037:1986 Specification for bitumen mastic for use in water-proofing of roofs (First Revision).

ix) IS 3067:1988 Code of practice for general design details and preparatory work for damp-proofing and water proofing of buildings (First Revision).

x) IS 3384:1986 Specification for bitumen primer for use in waterproofing and damp-proofing (First Revision).

xi) IS 4365:1967 Code of practice for application of bitumen mastic for water-proofing of roofs.

xii)	IS 4911:1968	Glossary of terms relating to bituminous waterproofing and damp-proofing of buildings (First Revision)
xiii)	IS 7193:1974	Specification for glass fibre base bitumen felts.
xiv)	IS 7290:1979	Recommendations for use of polyethylene film for water-proofing of roofs (First Revision).
xv)	IS 9918:1981	Code of practice for in-situ waterproofing and damp-proofing treatments with glass fibre tissue reinforced bitumen.
xvi)	IS 13182:1991	Recommendations for waterproofing of wet areas in building.
xvii)	IS 13826 (Pt 1):1993	Bitumen based felts- Method of test Part 1 Breaking strength test.
xviii)	IS 13826 (Pt 2):1993	Bitumen based felts- Method of test Part 2 Pliability test.
xix)	IS 13826 (Pt 3):1993	Bitumen based felts- Method of test Part 3 Storage sticking test..
xx)	IS 13826 (Pt 4):1993	Bitumen based felts- Method of test Part 4 Pressure head test.
xxi)	IS 13826 (Pt 5):1993	Bitumen based felts- Method of test Part 5 Heat resistance test.
xxii)	IS 13826 (Pt 6):1993	Bitumen based felts- Method of test Part 6 Water absorption test.
xxiii)	IS 13826 (Pt 7):1993	Bitumen based felts- Method of test Part 7 Determination of binder content.

Note: Wherever IS specification has been quoted in this chapter, its latest version should be referred.

ANNEXURE 2.8
Para 227(a)

Register of Standard measurements of Buildings.

Station/Kilometrage .....

Block No.	No. of units	Particulars of buildings and out-houses	Area in square Metres			
			White washing inside	White washing outside	Painting wood-work	Distem-pering inside Officer or Senior Group C staff Qrs.
(1)	(2)	(3)	(4)	(5)	(6)	(7)

Plan No.	Sources from which the quantities are taken		Dated signature in token of correctness		Remarks	Divisional Engineer's initials.
	M.B No.	Page No.	Section Engineer.	Assistant Engineer.		
(8)	(9)	(10)	(11)	(12)	(13)	(14)

ANNEXURE 2.9.
Para 228 (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 2.10 Para 201 (d)

DIMENSIONS FOR THE RESIDENTIAL BUILDINGS (Ref: NBC 1983)

1	HABITABLE ROOMS	
	Minimum plinth	: 45 cm above road level
	Minimum height(clear)	: 3.00* m
	Minimum ventilation	: 1/12th of floor area for cold climate : 1/10th of floor area for dry hot climate : 1/8th of floor area for intermediate climate : 1/6th of floor area for wet hot climate
	Minimum size	: 9.5 sqm
	Minimum dimension	: 2.4m
2	KITCHENS	
	Minimum size	: 5.0 sqm
	Minimum width	: 1.80m
	Minimum ventilation	: 25% more than specified for item 1
3	KITCHEN & DINING	
	Minimum size	: 7.5 sqm
	Minimum width	: 2.10 m
4	BATHROOM	
	Minimum size	: 1.8 sqm
	Minimum width	: 1.2m
5	WATER CLOSET	
	Minimum size	: 1.1sqm
	Minimum width	: 0.9 m
6	TOILET	
	Minimum size	: 2.8 sqm
	Minimum width	: 1.2 m
7	Minimum height (For 4,5, & 6)	: 2.0 m
8	STAIRCASE	
	Flight Width	: 1.0 m
	Minimum tread	: 0.25m
	Maximum riser	: 0.19 m
	Maximum riser/flight	: 15 nos.
9	MINIMUM PARAPET	
	Minimum	: 1.05 m
	Maximum	: 1.20 m

*NBC specifies as 2.75 m, however for railway residential buildings it is considered that it should be 3.00m

Annexure 2.11 Para 202(a)

Representative Towns and different climatic zones

Hot & Arid Zone	Hot & Humid Zone	Warm & Humid Zone	Cold Zone
Agra Ajmer	Ahmedabad	Cochin Dwarka	Darjeeling
Akola	Asansol	Guwahati	Drass
Aligarh	Bhavnagar Bhuj	Puri	Gulmarg Leh
Allahabad	Bombay	Sibsagar Silichar	Mussoorie
Ambala	Calcutta Calicut	Tezpur	Nainital
Bareilly	Cuttack	Trivadrum	Ootacamund
Bikaner	Dohad	Veraval	Shillong
Gaya	Jamnagar		Shimla
Jabalpur	Jamshedpur		Skardu
Jaipur	Madras Madurai		Srinagar
Kanpur	Mangalore		
Khandwa	Masulipatam		
Kota	Midnapur		
Lucknow	Nellore		
Ludhiana	Patna		
Nagpur	Rajkot Ratnagiri		
Neemuch	Salem		
New Delhi	Surat		
Roorkee	Tiruchichirapalli		
Sambalpur	Vellore		
Sholapur	Vishakhapatnam		
Umaria			
Varanasi			

Annexure 2.12 Para 203

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.

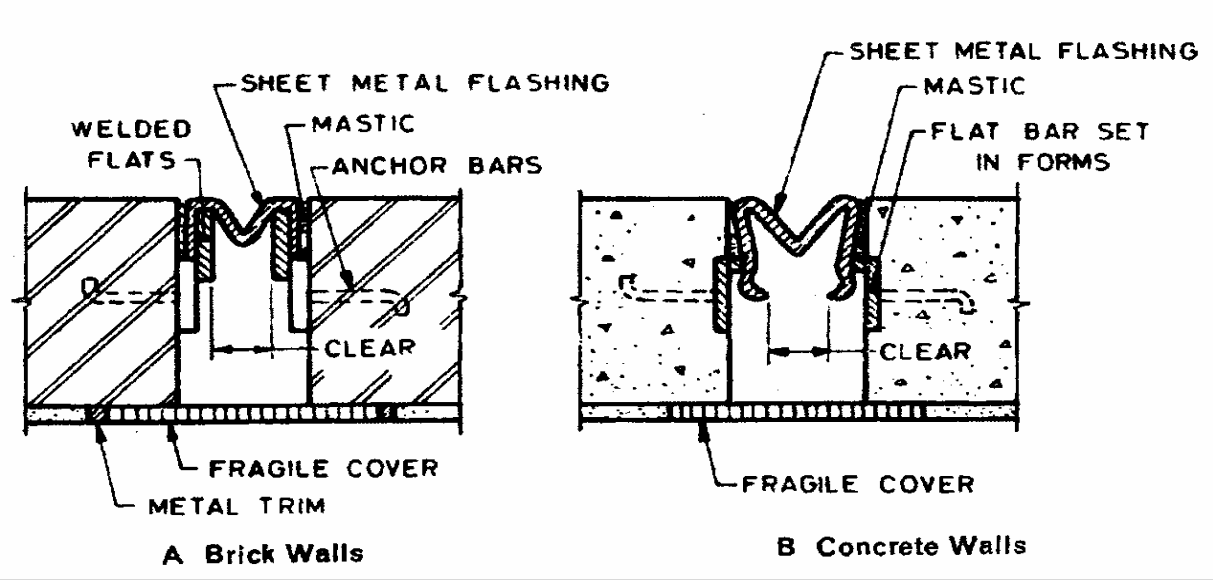
3 **Continuity of Construction:**

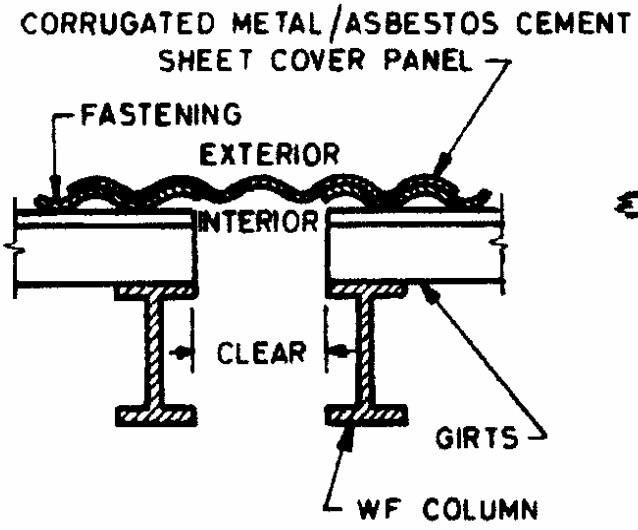
3.1 As far as possible the parts should be tied together in such a manner that the building acts as one unit.

3.2 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.

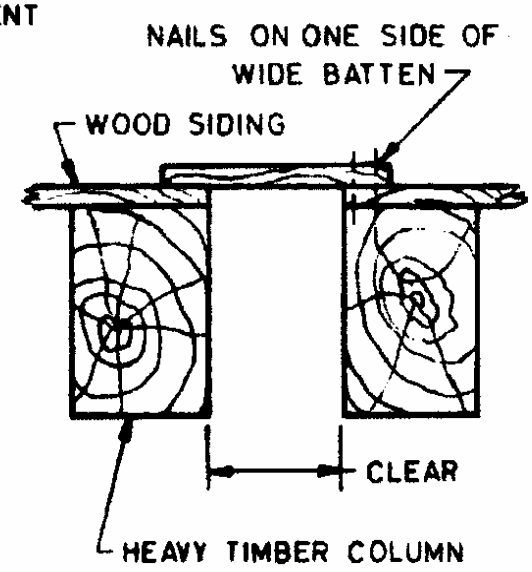
3.3 During addition and alteration, provision of separate crumple section between new and existing structures shall be provided as far as possible, unless possible measures are taken to establish continuity between the existing and new construction.

3.4 Typical details of few types of separation or crumple sections are shown below in figures A to G.

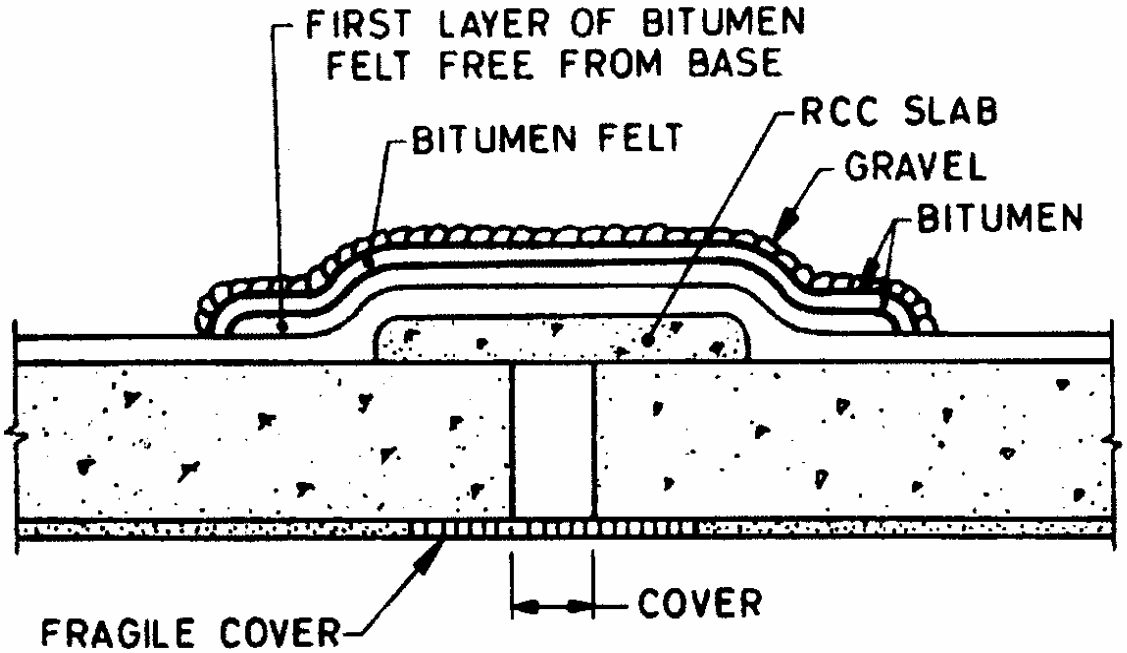




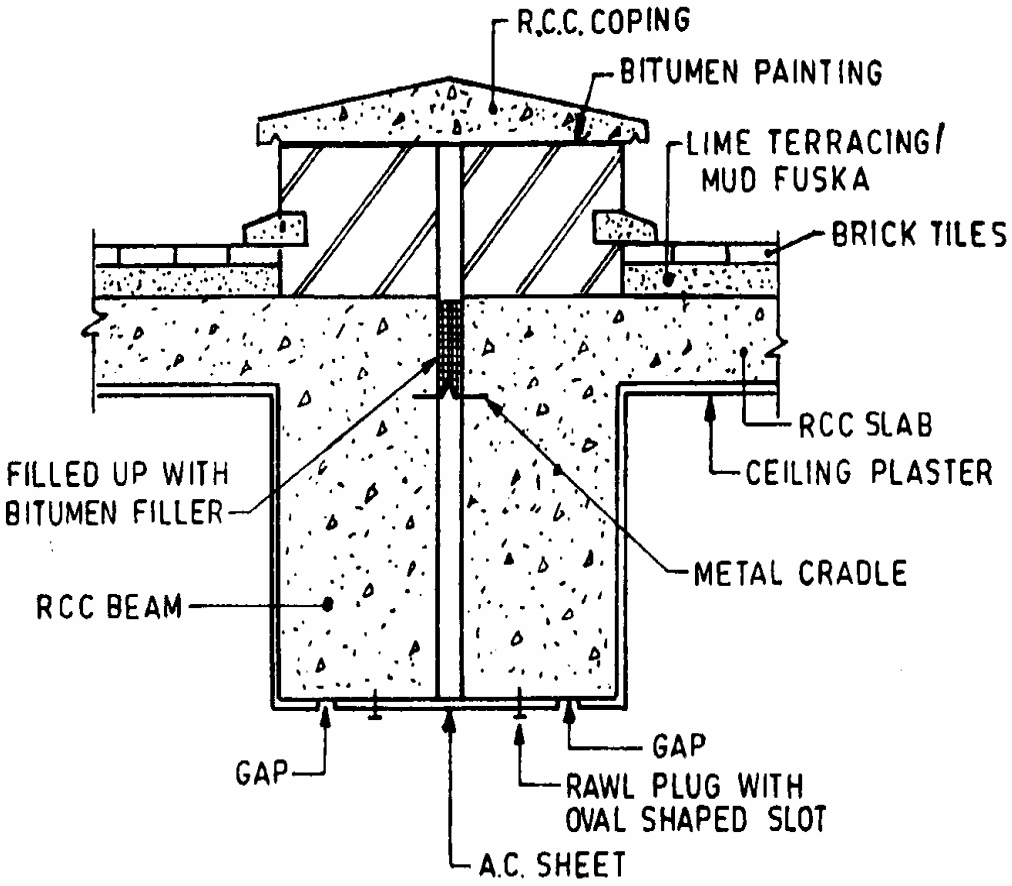
C Metal Siding Industrial Work



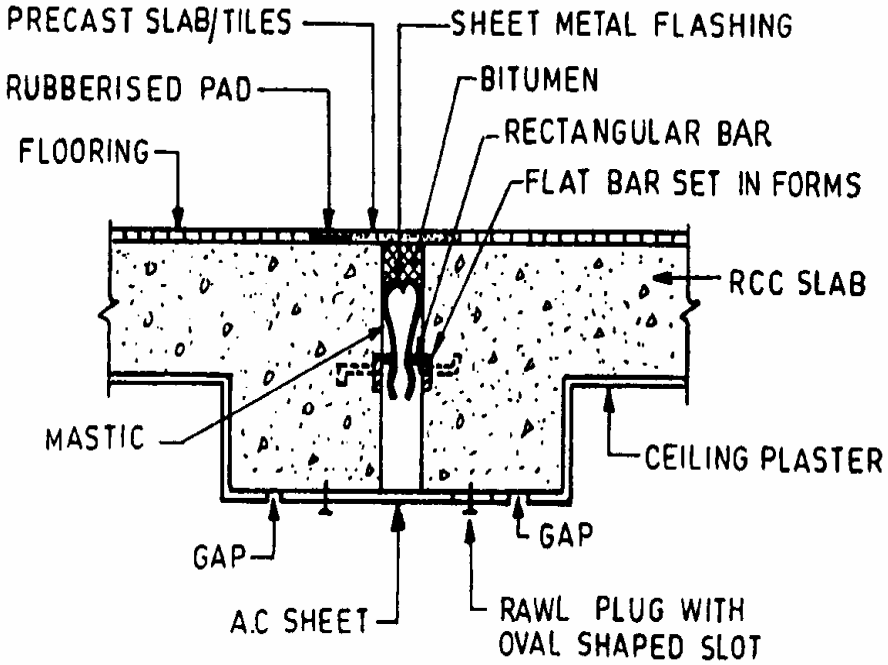
D Wood Sheathing Industrial Work



E RCC Slab on Roof Surface



F Separation Joint Details at Roof



G Separation at Floor Level

4 Projecting and Suspended Parts:

4.1 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.

4.2 Ceiling plaster shall preferably be avoided or shall be as thin as possible.

4.3 Suspension ceiling shall be avoided as far as possible or they shall be light, adequately framed and secured.

5 Building Configuration:

5.1 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.

5.2 The building should have a simple rectangular plan and be symmetrical both with respect to mass and rigidity, so that the centers of 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.

5.3 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 the width.

5.3.1 Refer IS 4326:1993 for provision of minimum width of separation gap.

5.3.2 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.

5.3.3 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.

5.4 Building having plans with shape like L, T, E and Y shall preferably be separated into rectangular parts by providing separation sections.

5.5 Any deviation or discontinuity in load transfer path results in poor performance of building. Building with vertical set backs, 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 cause ill effects like twisting and damage in shorter columns

6 Strength in various Directions:

6.1 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:

7.1 For the design of foundations, the provisions of IS 1904:1986 in

conjunctions with IS 1893:1984 shall generally be followed.

7.2 The structure shall not be founded on such loose soil which will subside or liquefy during an earthquake, resulting in large differential settlements.

7.3 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.

7.4 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:

8.1 The 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 13920:1993 may be referred for details.

9 Damage to non-structural parts:

9.1 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:

10.1 Flat roof or floor shall not preferably be made of terrace of ordinary bricks supported on steel, timber or reinforced concrete joints, nor these shall 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.

10.2 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.

10.3 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 diaphragms actions.

11 Strengthening Arrangements and Bands:

11.1 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.

11.2 R.C.C. roof bands should be provided immediately below the roofs or floors.

11.3 Gable band is provided at the top of gable masonry below the purlins.

11.4 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:

12.1 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 stair halls shall preferably be separated from the rest of the building by means of separation or crumple section.

12.2 Three types of stair construction may be adopted, as below:

12.2.1 **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.

12.2.2 **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

12.2.3 **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:

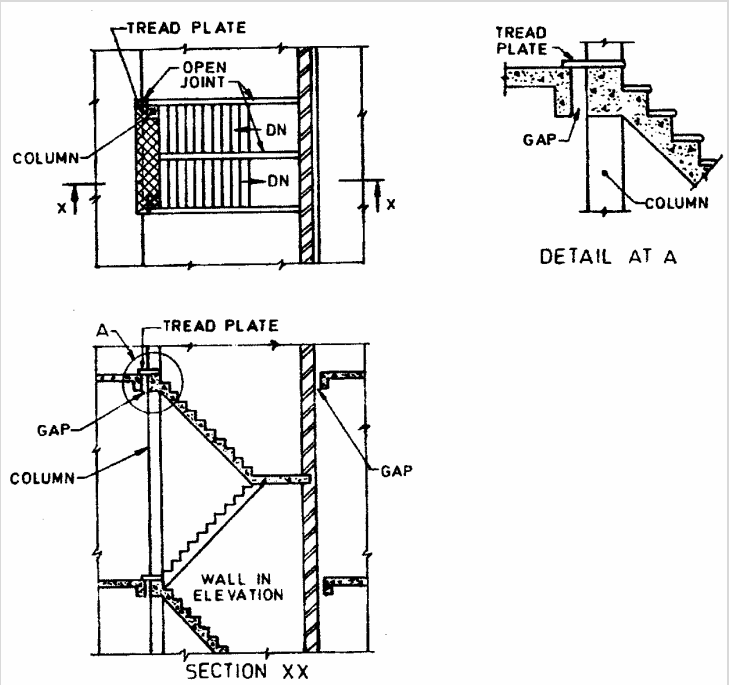


FIG. SEPARATED STAIRCASE

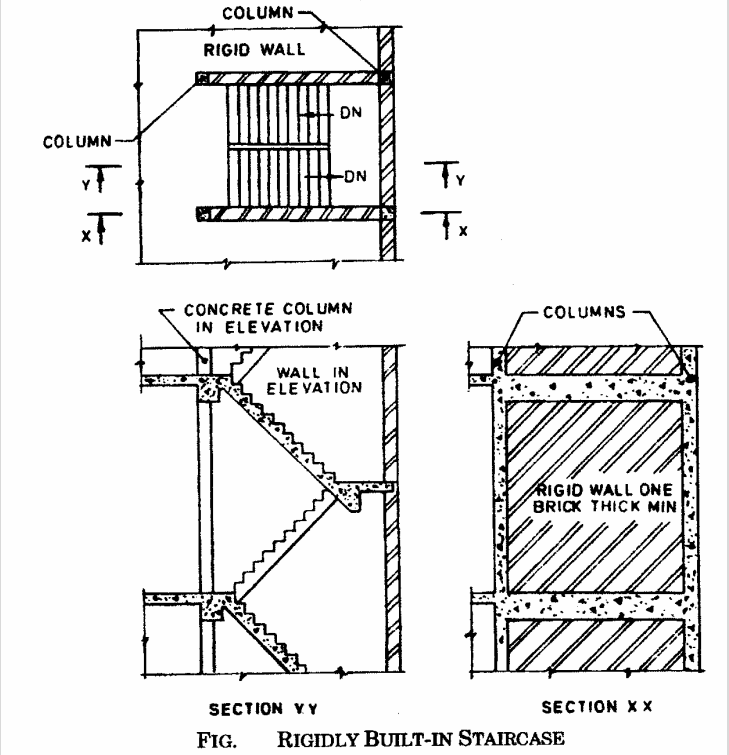


FIG. RIGIDLY BUILT-IN STAIRCASE

13 Fire Safety:

13.1 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 1641:1988, IS 1642:1989, IS 1643:1988, IS 1644:1988 and IS 1646:1986.

14 Seismic Retro fitting and Repair/ Strengthening of building:

14.1 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.

14.2 There are two aspects of strengthening:

(a) Retrofitting: i.e. strengthening of a weak building before hand so as to make it more strong 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: It is very important to know about the criteria for taking a decision whether to dismantle and rebuild a damaged structure/building or to do repairs/seismic retrofitting.

As per the IS 13935 “Repair and seismic strengthening of building – Guidelines” para 5.4.1 the thumb rule is “If the cost of repairs or seismic retrofitting is less than 50% of the rebuilding cost, only then the repair/ retrofitting is adopted”.

A flow chart has been developed, which can be used as a guide towards decision making in case of seismic repair/retrofitting.

Materials: Common materials used in repairs/retrofitting are cement, sand, coarse aggregate and steel. However, shot-crete (cement mortar/ concrete conveyed through a hose under high velocity), Epoxy Resins, Epoxy mortar (for large void space), quick setting cement mortar, mechanical anchors and welded wire mesh etc. are also used depending upon the parameters such as type of requirements, cost time etc.

15 Retrofitting of the Existing weak buildings:

15.1 **Roof:** Tiled roof can be replaced by AC/ CGI sheets. False ceilings of nonbrittle material and light materials can be provided. Roof truss should be braced by providing horizontal, vertical and inclined diagonal bracings. Diagonal angle iron can be fixed between timber post and beam to strengthen the joint. Anchors of the roof truss with the walls should be provided. Flat iron bars with bearing running through the supporting joists of jack arch roof should be used in case of jack arch roof. Diagonal bracing in plan should also be provided.

15.2 **Walls:** New walls can be provided with proper bonding with the existing walls in case of unsymmetrical buildings. The new walls should be provided with horizontal reinforcements which should be anchored to the existing walls. An existing wall can be strengthened to improve the lateral strength of the building by grouting, by using wire mesh reinforcements and by prestressing.

Large arch opening in the walls can be strengthened by steel ties at springing level or by an R.C.C. lintel above the arch.

15.3 R.C.C. beams and columns can be strengthened by casing. This can be done by encasing with additional new longitudinal and lateral (stirrup) steel bars. In case of beam and slabs system, holes may be drilled through the beam and floor.

15.4 Foundation can be strengthened by introduction of new load bearing walls, improving the drainage of the area by preventing saturation of foundation soil, provision of apron around the building and adding R.C.C. strips to the existing foundation of the building.

15.5 Seismic belts, both horizontal and vertical type can be provided at the corners, around openings and at the lintel levels by using wire mesh strip of width more than 40 cm. This is splint and bandaging technique.

16 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 various guiding factors.

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

16.1.1 Patching up of defects such as cracks and fall of plaster.

16.1.2 Repairing doors, windows, replacement of glass panes.

16.1.3 Checking and repairing electric conduits/wiring.

16.1.4 Checking and repairing water pipes, drainage and plumbing services.

16.1.5 Rebuilding non-structural wall, smoke chimneys, parapet walls etc.

16.1.6 Re-plastering of wall as required

16.1.7 Rearranging disturbed roof tiles;

16.1.8 Rebuilding cracked flooring at ground level; and

16.1.9 Redecoration – white washing, paintings etc.

16.1.10 These repair do not restore the original strength of the structure.

16.2 **Structural Repairs:** This includes – Rebuilding cracked walls, damaged roofs, repair of pillars etc. The repair is generally carried out as detailed below:

16.2.1 Remove only those portions of masonry walls and piers which are cracked and then rebuild that portion.

16.2.2 Bolting/spiking of wire mesh on both side of a cracked wall and then covering with cement mortar/micro concrete

16.2.3 Cement/Epoxy grouting of cracks.

16.2.4 Repairs of RCC by epoxy grouting, shotcrete / jacketing.

16.2.5 The structural repair work can restore

the lost strength only partly. The structure remains permanently weakened.

16.3 **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:

16.3.1 Minor cracks

16.3.2 Major cracks and crushed concrete

16.3.3 Fractured or excessive yielded or buckled reinforcements and 16.3.4 Fractured timber members.

Methods of their structural restoration are indicated as under :-

16.3.1 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.

16.3.2 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)

16.3.3 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.

16.3.4 Fractured timber members: After removing the rotten wood, splice should be nailed and preferably be covered with steel straps nailed to the member. If the execution is done properly, then after the structural restoration, the building will be as strong as new.

17 Seismic Retro fitting and Repair/ Strengthening of Building are specialized job. Therefore, services of an architect/ consultant may be availed of for carrying out these repairs.

Annexure 2.13

Para 203 (K)

Sample Plans

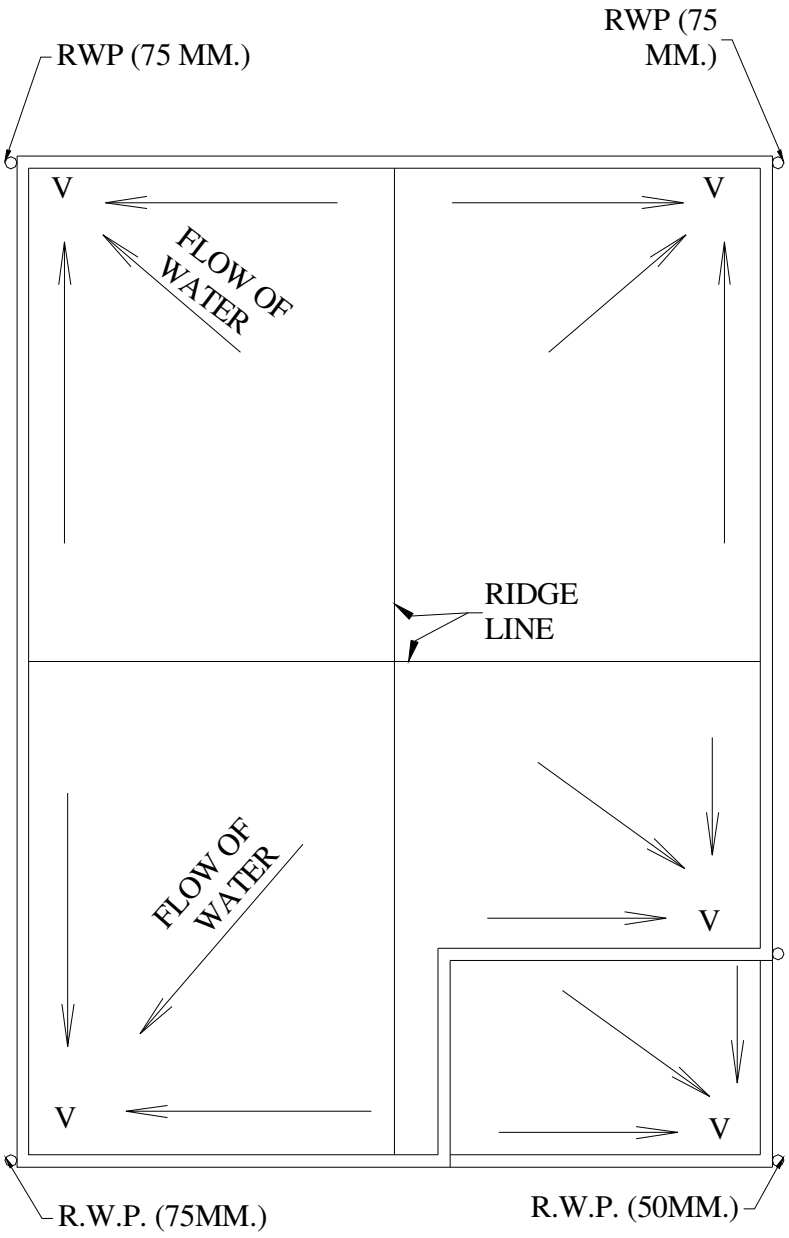
Fig. 1 -Fig. 2 & 3 - Roof plan showing terracing with slopes, water proofing and water outlets.

Detailed larger size plans of toilets and kitchens indicating the location and type of fittings and treatment on floor and walls.

Fig. 4 - Plan showing layout of furniture and furnishing and their type.

Fig. 5, 6 & 7 - Sanitary fittings, drainage and sewage plan, plumbing details.

Fig. 8 - Electrical wiring plans.(CS No.10 Dated 17.02.2005)



NOTES :-

1. RAIN WATER FLOW DIRECTION.
2. ALL SLOPES 1 IN 80.
3. RWP - (75MM.) = RAIN WATER PIPE DIA. = 75 MM.
4. V = VALLEY

Fig. 1 : ROOF DRAINAGE PLAN

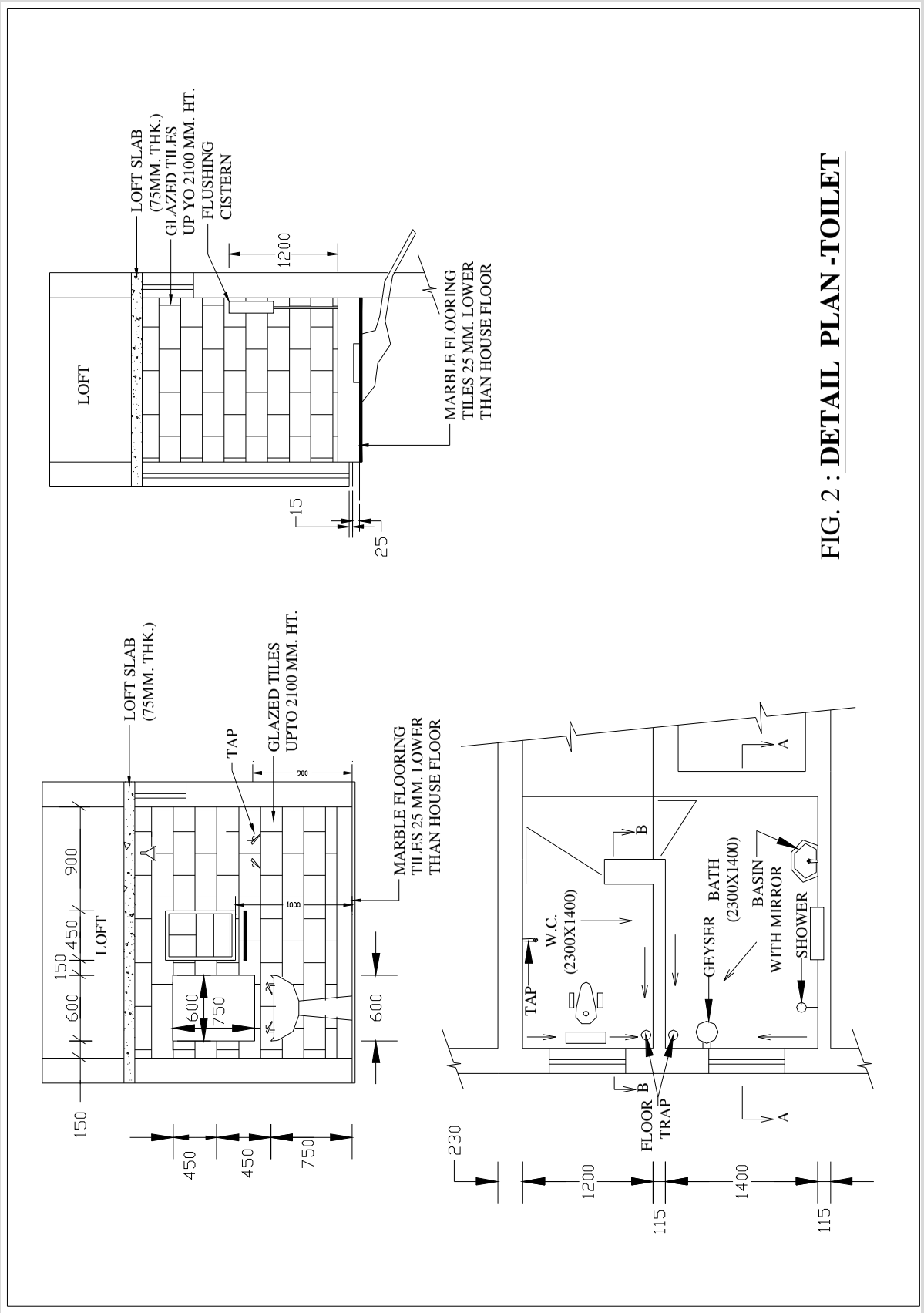
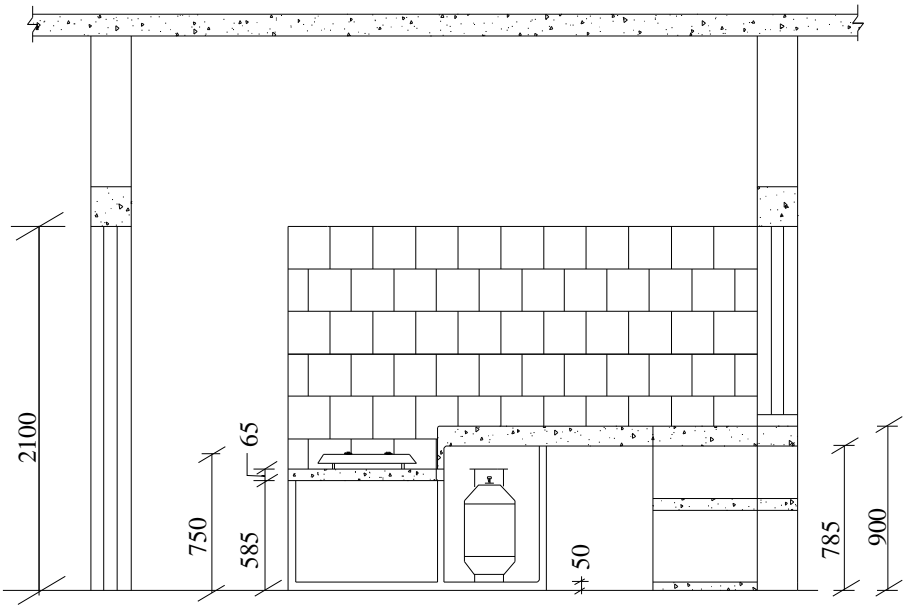


FIG. 2 : DETAIL PLAN -TOILET



SECTION AT C-C

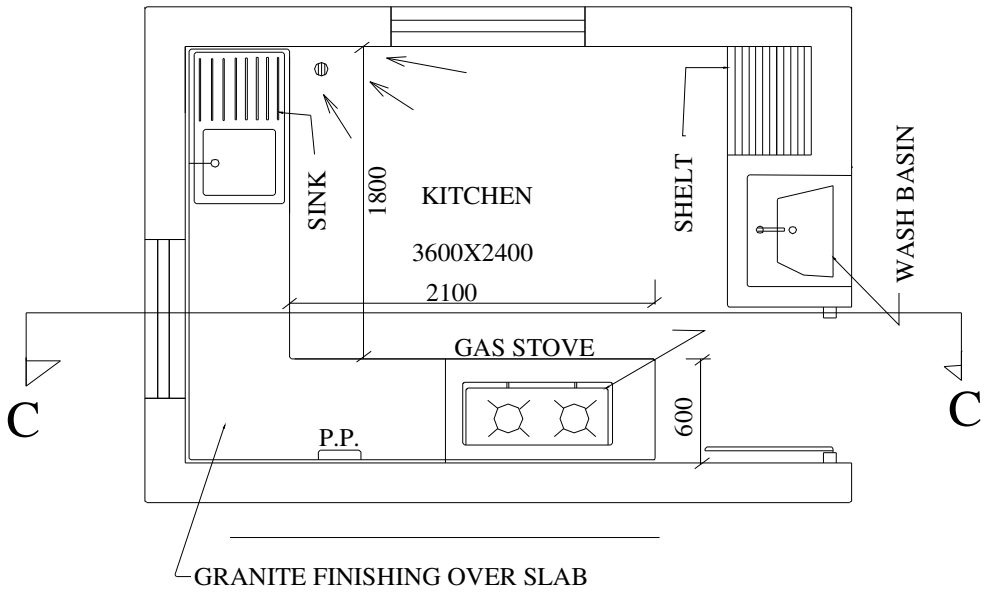


FIG. 3 : DETAIL PLAN OF KITCHEN

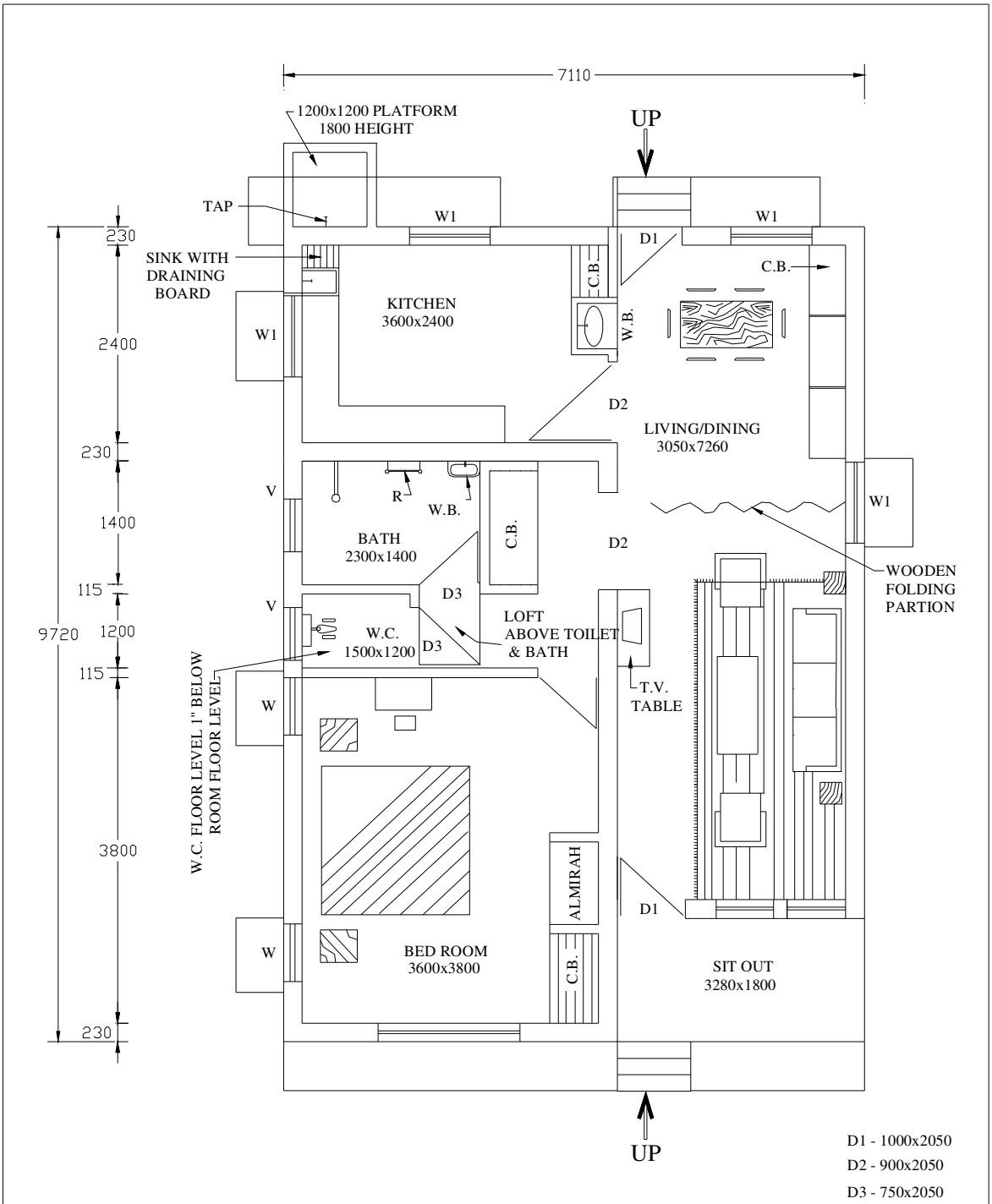


Fig. 4 : **LAYOUT OF FURNITURE & FURNISHING**

(NOT TO SCALE)

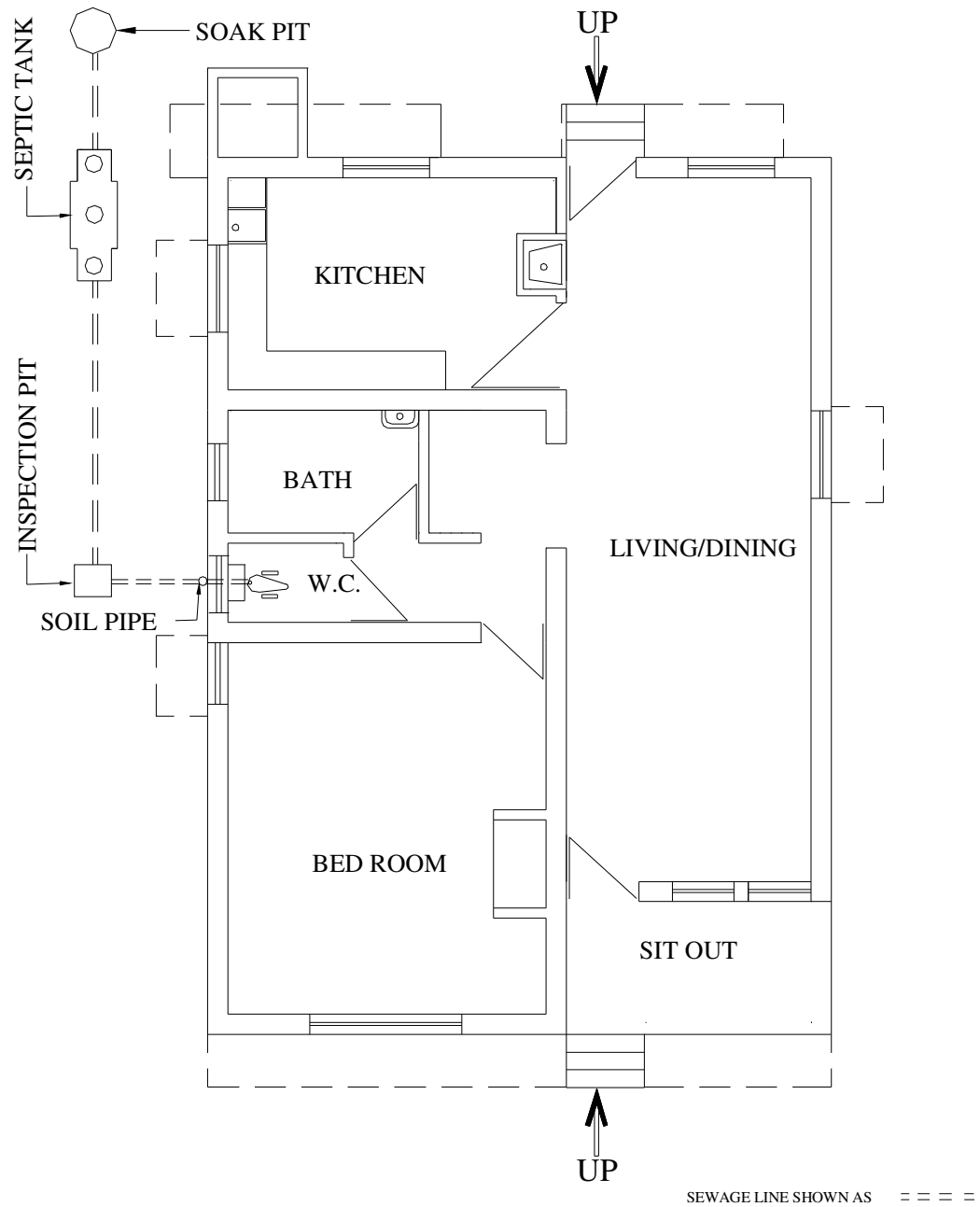
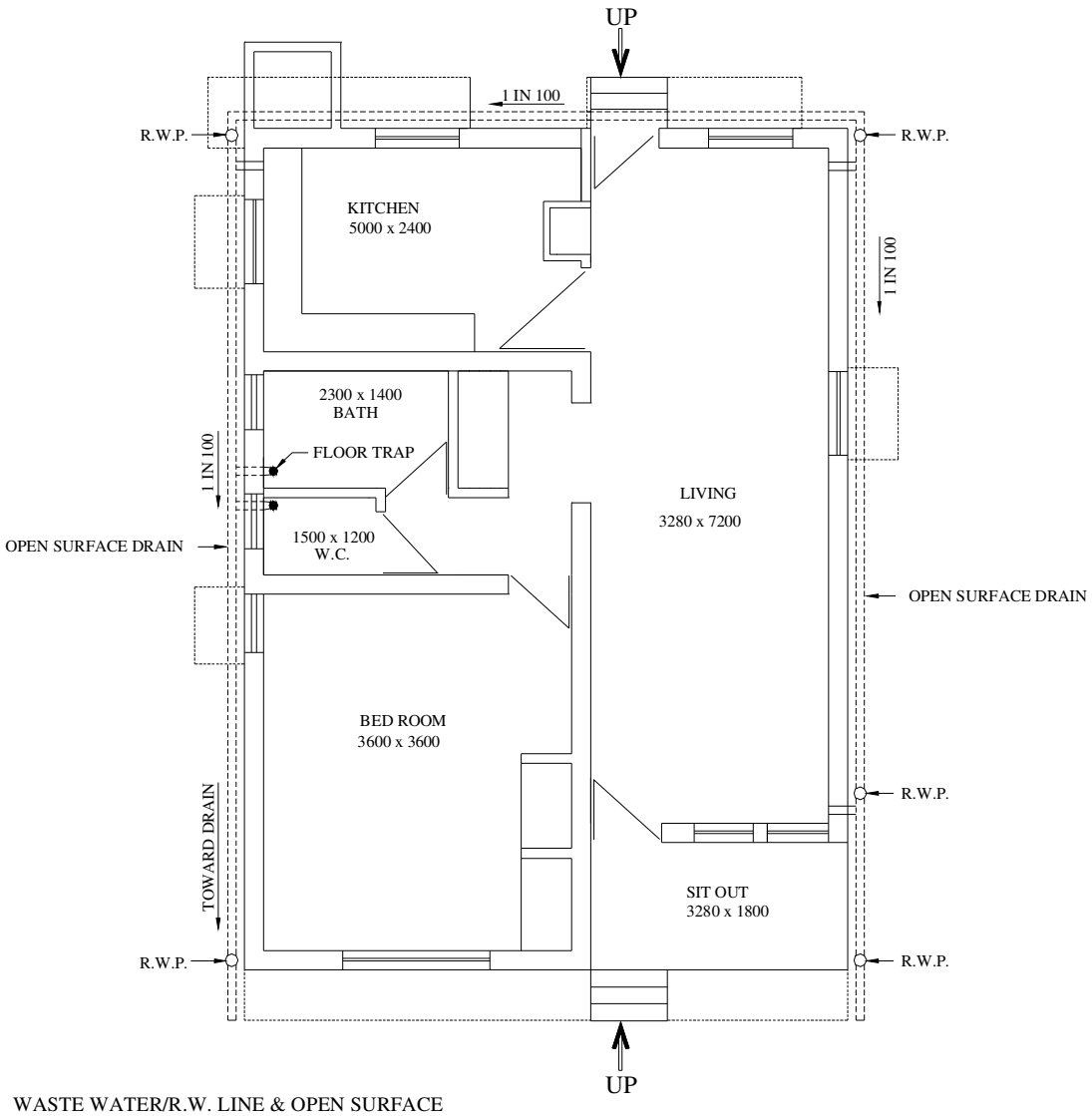


Fig. 5 : SEWAGE LINE PLAN



WASTE WATER/R.W. LINE & OPEN SURFACE DRAINS ARE SHOWN AS ----------

Fig. 6 : **WASTE WATER / R.W. LINE & OPEN SURFACE DRAIN PLAN**

(NOT TO SCALE)

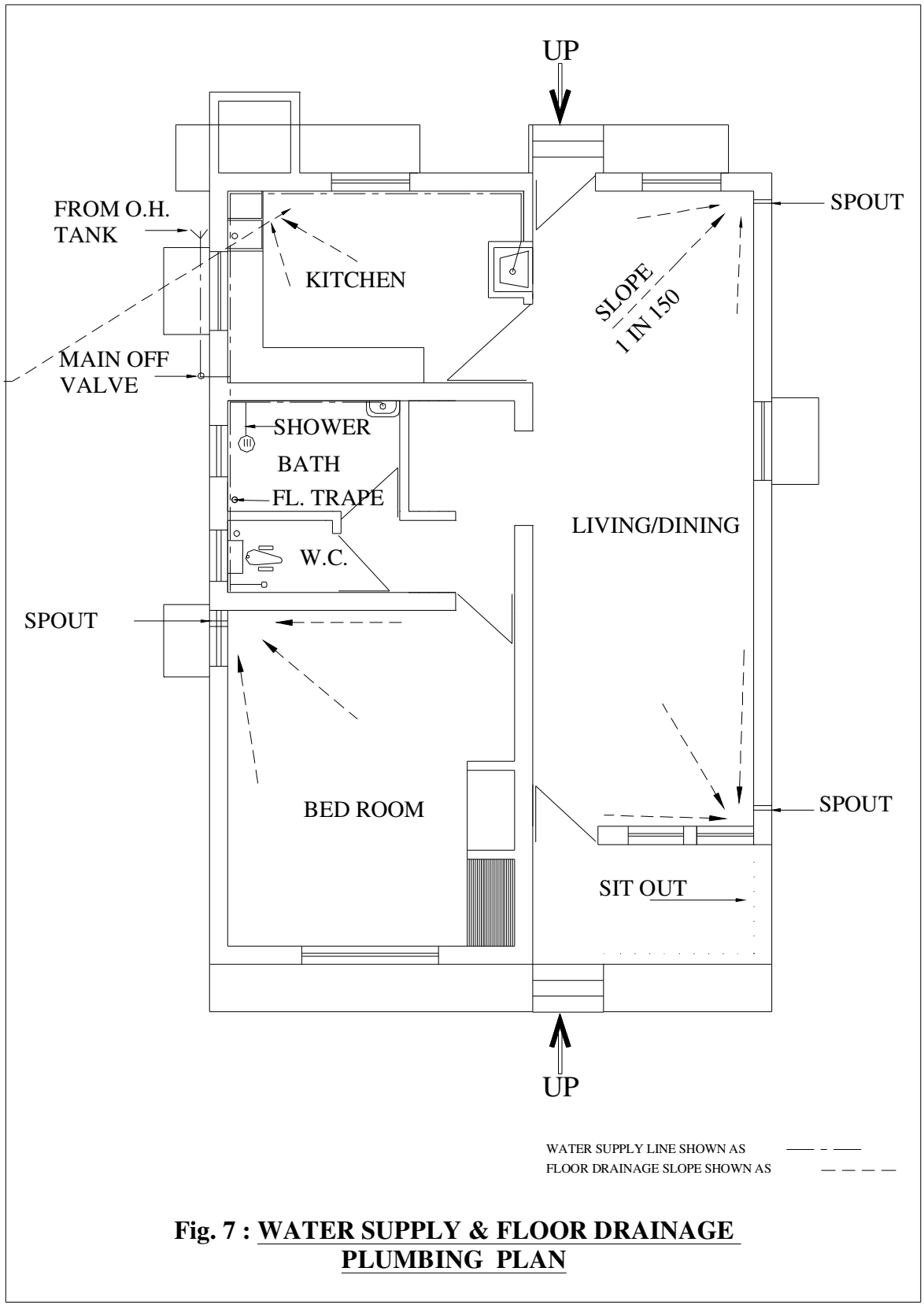


Fig. 7 : WATER SUPPLY & FLOOR DRAINAGE PLUMBING PLAN

NOTES:-

1. NO ELECTRICAL CONDUITS SHOULD RUN IN THE SUNKEN SLAB OF TOILET, BATH ROOM ETC.
2. $\frac{5}{15}$A POWER PLUG WIRING SHOULD NOT BE COMBINED WITH LIGHT POINT AND CIRCUIT WRINGS.
3. IN -COMING OF SWITCH BOARD AND POWER POINT WIRING SHOULD NOT BE COMBINED WITH POINT WIRING .
4. RUN OFF MAIN (ie. CIRCUIT WIRINESS) FROM DISTRIBUTION BOARDS CAN BE COMBINED WITHIN ONE CONDUIT FOR MORE THAN TWO CIRCUITS.
5. CONNECTED LOAD PER CIRCUIT SHOULD NOT EXCEED 800 WATTS OR 10 POINTS.
6. ALL THE CONDUITS SHOULD BE OF APPROVED MAKE AND 2 MM. THICK.
7. AFTER DE-SHUTTERING GI. FISH WIRE SHALL BE PROVIDED IN ALL THE CONDUITS.
8. NEUTRAL WIRE JOINTING SHALL BE ISSUED FOR "B" TYPE CONNECTOR IN JUNCTION BOXES.
9. WIRING SHOULD BE DONE AS PER LOOP IN LOOP OUT SYSTEM.
10. 25 MM. AND 19MM. DIA PVC.CONDUITS SHALL BE ISSUED LIGHTING /POWER POINTS RESPECTIVELY.
11. ALL STAIRCASE /PORTICO LIGHT POINT SHALL BE CONTROLLED BY COMMON SERVICE.
12. TWO WAY SWITCH CONTROL ON LIGHT/FAN POINT IN BED ROOM SHALL BE SUIT THE SITE CONDITIONS.
13. MINIMUM 300 MM. CLEARANCE SHOULD BE MAINTAIN BETWEEN ELECTRICAL AND SIGNAL LINE.
14. 2 CORE PVC. SHIELDE OR CLOTH SHIELDED WIRE (0.5 SQ.MM.) SHALL BE CONNECTED FROM CELLING ROSE TO FITTING.
15. GEYSER SWITCH CONTROL SHALL BE FIXED INSIDE THE BATH ROOM.
16. CLEARANCE OF CEILING ROSE TO FIXING OF FITTING IN WALL /CEILING SHALL BE 75MM.
17. ALL SWITCH BOARDS SHALL BE FLUSHED WITH WALL.

LEGEND (SYMBOLS FROM NBC PART VIII CL.3.2) :-

1. MAIN SWITCH-
2. SWITCH BOARD -
3. LAMP / LIGHT -
4. FAN -
5. FLUORECENT TUBE -
6. PLUG POINT -
7. NIGHT LAMP -
8. WIRING - - - - -

FIG. 8 : ELECTRICAL WIRING PLAN

Annexure 2.14
Para 204(c)

S.S. Chauhan
Chairman

Government of India
Central Ground Water Authority
Ministry of Water Resources

D.O. No.29-5/CGWA/Meetings/MOWR/2003-853 Dated 27-05-2003

Sub: **Adoption of Rain Water Harvesting System in the Railway Establishments**

Dear Shri Raina,

Ground Water has been the mainstay for meeting water supply requirements. However, growing demand for agriculture, industries and urban areas has led to over development of this resource resulting in substantial decline in ground water levels and deterioration in its quality threatening the austainability to this resource through rain water harvesting measures to utilize the surplus monsoon runoff which otherwise goes waste. Central Ground Water Board has taken up several rain water harvesting pilot projects in different hydrogeological and agro-climatic set ups and has proved the efficacy of rain water harvesting techniques to augment ground water resources.

The establishments under your control are having buildings having large roof area and open areas where these techniques can be fruitfully implemented. I shall request you to kindly advise your offices to take steps for adoption of rain water harvesting systems for sustainable management of ground water resources. Central Ground Water Board, having its offices in all the states offers to provide technical guidance in this regard. A list of offices and their addresses is enclosed for ready reference.

With regards,

Yours sincerely,

Sd/-
(S.S. Chauhan)

The Regional Director Central Ground Water Board Northern Region Bhujal Bhawan Sector-B, Sitapur Road Yojna Ram Ram Bank Chau **Lucknow**-226021 (U.P.) Ph: 2363812 Fax: 2361177	The Regional Director Central Ground Water Board West Central Region Swami Narain College Building Shah Alam Tolnaka **Ahmedabad –** 38022 (Gujarat) Ph: 25320476 Fax: 25329379	The Regional Director Central Ground Water Board North Central Chhattisgarh Region 2nd floor, Reena Apptt. NH 43, Dhamtari Road Panchpadi Naka, **Raipur**-492001 Ph: 2413687 Fax: 2413687
The Regional Director Central Ground Water Board North Eastern Region Tarun Nagar, Bye Lane-1 Near Rajiv Bhawan **Guwahati**-781005 (Assam) Ph: 2456298 Fax: 2455497	The Regional Director Central Ground Water Board Central Region N.S. Building, Civil Lines **Nagpur**-440001 (Maharashtra Ph: 2534314 Dax:2534391	The Regional Director Central Ground Water Board South Western Region 31st Cross, 11th Main Block 4, Jayanagar **Bangalore**-560011 (Karnatak) Ph: 26631336 Fax: 26348442
The Regional Director Central Ground Water Board Southern Region 3-6-291, Sadhana Building 1st floor, Hyderguda **Hyderabad**-500029(A>P.) Ph: 23222873 Fax: 23222873	The Regional Director Central Ground Water Board Kerala Region Kedaram, Kesavadasapuram **Trivendrum**-695004 (Kerala) Ph: 2442191 Fax: 2442191	The Regional Director Central Ground Water Board Northern Himalayan Region House No.3 (HIG) H.P. Housing Board Colony **Kangra** (H.P.) Ph: 227171 Fax: 223535
The Regional Director Central Ground Water Board North Western Region S.C.O. – 3, Sector 26 **Chandigarh –**160026 Ph: 790980 Fax: 790980	The Regional Director Central Ground Water Board North Central Region Block-1, 4th floor, Paryawas Bhawan Area Hills, Jail Road **Bhopal –** 162011 (M.P.) Ph: 2557639 Fax: 2760090	The Regional Director Central Ground Water Board Uttaranchal Region Ankitpuram General Mahadev Singh Road **Dehradun –** 248001 Ph: 2729533 Fax: 2722709
The Regional Director Central Ground Water Board Eastern Region 'Bhujaika', Sector-V, C.P. Block-6, Bidhan Nagar **Kolkata –** 700091 (W.B.) Ph: 23673081 Fax: 23673081	The Regional Director Central Ground Water Board North West Himalayan Ruby Shopping Complex Sanjay Nagar **Jammu**-180001 (J&K) Ph: 2451626 Fax: 2451626	The Regional Director Central Ground Water Board Western Region 6-A, Jhalna Doongri **Jaipur**-302004 (Raj.) Ph: 2706991 Fax: 2706991
The Regional Director Central Ground Water Board South Eastern Region Bhujal Bhawan Khandagri Chowk NH-IV **Bhubaneswar**, Orissa-751030 Ph: 2350332 Fax:2350332	The Regional Director Central Ground Water Board Middle East Region Lok Nayak Bhavan, 68th Floor Dak Bunglow Chowk, **Patna**-1 Ph: 2231785 Fax: 231020	The Regional Director Central Ground Water Board South East Coastal Region E-Wing, G-Block Rajaji Bhawan, CGO Complex Besant Nagar, **Chennai**-600090 Ph: 24914334 Fax: 24914334
Officer Incharge Central Ground Water Board Jamnagar House Mansingh Road, **New Delhi** Ph: 23384355 Fax: 23386743	Officer Incharge Central Ground Water Board 1 Keating Road, Opp. Assam Secretariat Building **Shillong** (Meghalaya) Ph: 2223348 Fax:	Officer Incharge Central Ground Water Board 64 Polo-I Paota **Jodhpur**-342006 (Raj.) Ph: 2747614 Fax:
Officer Incharge Central Ground Water Board North Karnataka Unit 4642-B-16, 2nd Main 2-A Cross, Sadashiv Nagar **Belgaum** 590 001 Ph: 2470959 Fax: 2473160	Officer Incharge Central Ground Water Board Dhaleshwar Road, No.11 **Agartala**-799007 (Tripura) Ph: 2325876 Fax: 2303099	Officer Incharge Central Ground Water Board 14A Sea Sanda Andhra University Campus **Vishakapatnam**-530003 Ph: 2707870 Fax: 2768018
Officer Incharge Central Ground Water Board 21711, Deccan College Road Yervada, **Pune –** 411006 (MS) Ph: 2663905 Fax: 2347651		

CHAPTER III

MAINTENANCE OF SANITARY & HYGIENIC CONDITIONS IN STATION BUILDINGS, YARDS & RAILWAY COLONIES

301 Sanitary Arrangements in Stations and Colonies -

For Sanitary arrangements in stations and colonies, the allocation of responsibilities of the Operating, Medical and Engineering departments are as laid down by the Administration and a copy of detailed instructions should be in the possession of the Assistant Engineer and concerned staff.

302 Railway Sanitation Committees

a) Railway Sanitation Committees are appointed at such important stations as decided by the General Manager to assist in the supervision and control of sanitary arrangements in station buildings, yards and residential colonies. The Committee functions not only as advisory body but as monitoring body also.

The existence of such Committees shall not however relieve any Department of the duties ordinarily devolving on that Department.

b) At less important and way-side stations where Sanitation Committees do not exist, the Station Master shall be primarily responsible for maintaining sanitary and hygienic conditions in station yards, staff colonies and their surroundings.

303 Constitution of Sanitation Committees -

The constitution of each Sanitation Committee and its functions shall be as prescribed by the General Manager. Meetings will be convened by the Chairman of the Committee at specified intervals.

304 Record of Minutes of Meetings -

Minutes should be recorded in a Minutes-Book kept at the station in the custody of the Station Manager/Station Master unless otherwise prescribed. Copies of minutes of meetings should be sent to the Chief Medical Officer, Divisional Officers, Members of the Committee, the Assistant Engineer and the supervisors concerned. The Chief Medical Officer/Chief Medical Superintendent will take up various matters at the appropriate level with the Departments.

305 Inspections by Sanitation Committees -

The Committees will carry out inspection of the premises before/after the meeting. The inspection will be directed with regard to sanitary and hygienic conditions of the following items:-

(i) *Conservancy* - The adequacy and cleanliness of latrines, receptacles, dustbins, incinerators, trenching-grounds, septic tanks, effluent disposal beds, soak pit, sumps, disposal of flood and sullage water, the adequacy and condition of conservancy equipments.

(ii) *Drinking water supply arrangements* - Reservoirs, filter beds, wells, drinking water tanks and their protection from pollution

(iii) *Quarters* - The stabling of cattle, use by occupants of any quarters leading to insanitary conditions detrimental to the health and well being of the occupants

(iv)The sanitary conditions of compounds, court-yards and surroundings of quarters, excavation of earth from any part of the surroundings of quarters whereby flood or waste water may accumulate, the growth of excessive vegetation and of creepers liable to damage the structure of buildings

(v) *Shops* - Cleanliness of licensed shops; the proper storage of meat, grain and other foodstuff; the cleanliness of chopping blocks and implements in butchers' stalls, efficient protection against flies and the prompt and proper disposal of blood, hides, offal and other refuse

(vi) Presence of stray dogs and of vicious and diseased animals

(vii) Presence of any other nuisance, such as rats or conditions detrimental to the health and well being of residents

Every subject dealt with at meetings should be recorded by the Committee and expeditious action taken by Departments concerned. In subsequent meetings compliance on items of earlier meetings should be pursued by the members.

306 Conservancy Work -Conservancy work is classified as - (i) indoor conservancy and (ii) outdoor conservancy.

(i) *Indoor conservancy* - This comprises the cleaning of indoor sanitary installations, the collection of refuse generated in the individual quarters like floor sweeping, domestic refuse etc. and transporting it into the refuse bins. This is the responsibility of the occupants of quarters.

(ii) *Outdoor conservancy* - This comprises cleaning of colony area, railway yards etc.

The responsibility for "Outdoor Conservancy" will devolve on the Medical, Engineering or Operating Department as per the Railway Board's instructions and shall include jobs like cleaning of drains, sewers, septic tanks, storm water drains, soak pits, dust bins etc.

307 Sanitary Protection of Installation

a) *Reservoirs/Ponds:*

(i) The reservoir/ponds should be fenced to prevent any outside or unauthorised use.

(ii) The water in the reservoir shall not be used for any unauthorised purposes like bathing, washing clothes, cleaning of utensils etc.

(iii) The water shall be periodically treated with bleaching powder or a disinfecting agent.

b) *Overhead Tanks:*

(i) The tanks should be cleaned and lime applied on walls as per laid down schedule.

(ii) The water shall be regularly disinfected.

c) *Protection of wells used for drinking:*

(i) 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.

(ii) 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.

(iii) There should be a paved platform around the parapet of the wells, with a drain to lead the spill-water sufficiently away.

(iv) The ground around the well for a radius of at least 50m should be kept thoroughly clean to guard against pollution.

(v) 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.

(vi) 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 Section Engineer (works) and a report sent to the Assistant Engineer.

(vii) Disinfection of well should be carried out as often as necessary. The work is usually undertaken by the staff of the Medical Department. At gang quarters and gate lodges between stations, the Section Engineer (Works) should arrange for the disinfection of staff-wells.

Para 308 of Chapter III is Deleted
Para 309 of Chapter III is Deleted
(CS No.10 Dt.17.02.2005)

CHAPTER IV

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 stations, due consideration needs to be given to the importance of the station from point of view of passenger traffic.

402 CATEGORISATION OF STATIONS

(a) Annual Passenger earnings:- This is an important parameter for deciding upon the category of a station. It consists of earnings from both reserved and unreserved passengers.

(b) Stations have been categorised in six categories, A,B,C,D,E & F depending upon the earnings, which is an indicator of the passenger traffic. Criterion for categorisation of stations are as per Annexure 4.1.

(c) The categorisation of stations shall be reviewed every five years starting from 1995-96.

(d) All suburban stations have been included in Category 'C' in order to accord a higher priority to these stations in view of a large number of passengers using them.

403 MINIMUM ESSENTIAL AMENITIES

The Minimum Essential Amenities required in each category of station shall be as per Annexure 4.2. Scale of Minimum Essential Amenities is prescribed in Annexure 4.3. Availability of these amenities at the prescribed scale will have to be ensured.

404 RECOMMENDED LEVEL OF AMENITIES:

Once the essential amenities as prescribed in Annexure 4.2 and 4.3 are available at a station to the prescribed levels, further augmentation of these amenities can be made to higher recommended norms. These norms are recommendatory and efforts shall be made to provide the amenities as per the norms given in Annexure 4.4.

405 DESIRABLE AMENTIES

(a) Desirable amenities are those 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. A comprehensive list of the Desirable Amenities is given in Annexure 4.5.

(b) The provision of Desirable Amenities need not wait for complete provision of Amenities to levels recommended in Clause 404. The amenities out of the list given in Annexure 4.5 should be provided based on the need and relative importance of the station.

405 A PASSENGER AMENITIES AT MODEL STATIONS

The scheme of Model Stations has been introduced w.e.f. June 1999 with a view to

upgrade the passenger amenities at selected stations. The facilities would be provided at Model Stations in accordance with the guidelines laid down by Railway Board from time to time, subject to availability of funds.(CS No.7 Dt.27.02.03)

406 ALLOCATION OF EXPENDITURE

Minimum Essential Amenities as prescribed in Annexure 4.2 and 4.3 shall always be provided as a part of the concerned Plan Head at the time of construction of new stations. Augmentation of any facility thereafter at station shall, however, be charged under Plan Head "Passenger And Other User Amenities".

407 MAINTENANCE OF PASSENGER AMENTITIES

Amenities provided at all the stations shall be maintained in good working order at all times. Maintenance staff shall carry out repairs needed immediately after receipt of information from the Station Master/Station Manager.

408 PASSENGER AMENITY BOOKLETS

Additions/Modification to the Passenger Amenities available at the stations should be incorporated in the database and Passenger Amenities Management System (PAMS) and printed in the form of Passenger Amenity Booklets of each division at the end of the financial year. The details of Passenger Amenities available at stations shall be updated and sent every year to Board in floppies and hard copies (sample proforma at Annexure 4.6).

409 BOOKING OFFICES

(a) The Booking Windows may be distributed function wise or destination wise by the Commercial Department.

(b) The Booking Windows should be so located that the circulation at the entrance or exit from the station or the waiting hall is not affected by the queues in front of the Booking Windows. The length of the queue can be estimated at the rate of half a meter per person waiting in the queue.

(c) A standardised layout for the Booking Windows may be formulated on the basis of the following design parameters:

(i) Size of a cubicle : 1.8m x 1.5m

(ii) Counters : Width 0.6m., Height above floor level 1 m

(iii) Ticket Tubes : On both sides of the counters

(iv) Furniture : Chairs with caned seats, revolving type with short back and facility for seat adjustment

(d) Partitions between Passenger - Booking Clerk : Toughened sheet glass or clear acrylic sheet with a hole for inter-communication at suitable height above the counter top and a suitable gap between the partition and the counter for collection of fare and issue of tickets, the partition being protected on the passenger side with steel grill.

(e) The Enquiry and Booking offices should be specially brightened up at all the stations.

410 Waiting Halls

(a) Waiting Halls should not be built detached from the main buildings. At small stations where some shelter is available for the passengers near the Booking Office, the net Waiting Hall area in the form of covered area on the Platforms may be provided. The above mentioned net area should be worked out after deducting the waiting area in front of the Booking Windows from the gross Waiting Hall area determined on the basis of Annexure 4.4.

(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.

411 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. 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 un-obstructed 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* : The level of platform shall be as mentioned as Annexure 4.2 for various categories at the stations. The heights for various levels of platforms shall be as under:

Level	B.G.	M.G.
High Level	760 mm above Rail level (840mm above Rail Level in case of Suburban stations and stations in cutting)	405mm above Rail Level
Medium Level (CS No.8 Dt.30.04.03)	455 mm above Rail Level	305mm above Rail Level
Rail Level	At Rail level	At Rail Level

d) *Platform Surfaces :*

(i) The platform surfaces should be of such material that it is dust free in dry weather and mud free in rains. At important stations, surface of main platforms should be paved with Kota stone or interlocking pavers. To keep platform surface smooth and clean, all trollies plying at the station be provided with rubber tyred wheels.

(ii) In the case of single face platforms, the platform surface should have a slope of 1 in 60 away from the coping upto the edge of the berm, with the berm and the slope of the platform filling being protected by turfing or pitching as considered adequate.

(iii) In the case of two face (island) platforms the platform surface should have a slope of 1 in 60 away from the centre of the platform upto 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.

(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 of a height of 1.8m with a berm of at least 600 mm beyond the fencing or the hedging.

f) Whenever Platforms are extended, washable aprons, if already existing, shall also be extended simultaneously.

412 Shady Trees on Platforms

a) The planting, protection and upkeep of the trees will be the responsibility of the Engineering Department. Traffic Department should associate in watering of plants at wayside stations wherever feasible.

b) The species and spacing of the trees should be properly decided.

c) 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.

d) 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.

e) It would be advantageous to provide suitable raised masonry platforms around the fully grown trees as an additional seating accommodation for the passengers.

413 Lighting

a) Where electric supply is available all the lighting arrangements with the associated equipment including the lamp posts with their fixtures for the platforms, sign-boards, buildings etc. will be provided and maintained by the Electrical Department.

b) Where electric supply is not available, the provision, repairs and maintenance of the lamp posts will be the responsibility of the Engineering Department. The provision, maintenance and repairs of the oil lamps and their lighting will be the responsibility of the Operating Department.

c) Lamp posts should ordinarily be placed along the centre line of platforms where width of platform is 18 metres and above. The lamp posts should not be less than 4.5 metres

clear from platform face and not less than 3 metres clear of the face of the station building. Where the station building is less than 7.5m from the platform face, the lamps should be supported on wall brackets. Such lamp brackets can be used upto a distance of 9 m from the platform face.

c) The heights and spacing of the lamps should be determined by the level of illumination required, the area to be illuminated, etc. apart from the obligatory locations over the station name boards, water taps and other passenger facilities required to be illuminated.

414 Drinking Water Supply

a) Where piped water supply is possible, potable drinking water should be supplied on platform by provision of taps at the rate of one tap for two coaches. On island platforms if the trains are expected to be received on both sides at the same time, number of taps should be doubled.

b) At small stations, as determined by the Commercial Department, where provision of piped water supply is technically and economically not feasible, tube-wells with hand pumps should be provided. The size, numbers and locations of such tube wells should be determined by the Engineering Department, based on the quantum of passenger traffic at the station.

c) In addition, potable drinking water should be supplied through mobile or stationary water containers. The number, size, type and deployment of such mobile containers should be determined by the Commercial Department who shall also procure & maintain them.

415 Latrines, Urinals and Dustbins

(a) Latrines and Urinals shall be provided as per scale laid down in Annexure 4.4

(b) Out of total no. of Latrines and Urinals as determined in manner indicated above, one third may be reserved for Ladies.

(c) All toilets should be gradually converted into Pay & Use system.

(d) The urinals may be suitably distributed on platforms and waiting halls.

(e) Toilet should be provided near Station Master's office for easy maintenance at D&E category stations.

(f) All latrines and urinals should be sanitised. Water-borne sanitation shall be provided as far as practicable.

(g) An adequate no.of dustbins be provided at the suitable locations on the platforms.

416 Platform Covers

a) Depending on the climatic conditions, number of passengers and nature of traffic, Platform Covers should be provided as per scale laid down in Annexure 4.4.

b) Large-scale covering of platforms should be confined to

(i) Junction stations

(ii) Stations at Civil District Headquarters

(iii) Stations at cities and towns with a population of more than 1 lakh

(iv) Stations in heavy rainfall areas

(v) Suburban stations

c) At important and suburban stations, the whole platform should be covered.

d) 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.

e) Platform shelters should be extended upto 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.

417 Foot-Over-Bridges or Sub-ways

Foot Over Bridge (FOB) 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 vehicles' as defined in Motor Vehicle Act, 1988.(ACS No.11 dt.30.09.2022)

a) Foot-over-bridges or sub-ways as convenient and techno-economically feasible should be provided keeping in view the following factors:

(i) Interconnection between high level or low level platforms;

(ii) The total number of passengers dealt with at the station;

(iii) Frequency of train services;

(iv) Blocking of the lines between platforms by freight trains.

Stations with high level platforms should normally be provided with foot- over-bridges on a programmed basis.

b) 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

c) 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 (1 in 10 Gradient : both Upward & Downward)	55	35

d) 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. (ACS 11 dt. 30.09.2022)

e) 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.

f) For foot-over-bridges, sub-ways and pathways, the lowest overhead clearance for the movement should be of 2.75m.

g) 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°. At major important stations, provision of escalators should be considered for speedy dispersal of commuters.

418 Waiting Rooms

a) Waiting Rooms need not be provided at suburban stations i.e. Category 'C' Stations.

b) At non-suburban stations other than junctions and terminal stations, Waiting Rooms should be considered only if the number of upper class passengers dealt with daily is 25 or more. If however, the bulk of the traffic is booked or received by night the provision of the Waiting Rooms could be considered even with fewer passengers.

c) 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.

d) If the area to be provided for the Waiting Rooms is sufficiently large, the Commercial Department may provide separate Waiting Rooms for the general and female passengers and passengers of different classes.

419 Signages

(a) Standard signages shall be provided at the stations.

(b) For location of signages, a plan should be made for each station.

420 Vending Trollies/Stalls

(a) Modular stalls shall be provided to save space on platforms.

(b) Efforts should be made to make the stations cooking free and reduce the number of trolleys.

(c) Minimum trolleys and catering stalls under the covered shed should be allowed.

(d) Automatic vending machines should be encouraged to replace existing vending stalls.

421 Retiring Rooms

a) Retiring Rooms should be provided only where a minimum of 60% occupation is expected by the Commercial Department.

b) 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 clientele, 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.

422 Other General Items

(i) All stations irrespective of their class should be sealed from all directions so that there is specified exit and entry and incidence of unauthorised entrants is reduced, to avoid unnecessary pressure on amenities.

(ii) For mela and fairs traffic, additional temporary facilities may be provided.

423 Facilities For Physically Handicapped

Railways are to provide convenience to the physically handicapped persons to comply with the provision of "The Persons with disabilities (Equal Opportunities; protection of rights and full participation)" Act, 1995. As per provisions of this Act, equal opportunities are to be given to handicapped persons in terms of employment, access to various places and services. The items concerning Engineering Department are as under:

(i) Section 44(b) of the Act states that "Establishments in the transport sector shall, within their limits of the economic capacity and development, for the benefit of persons with disability take special measures to adapt toilets in rail compartment, vessels, air-crafts and waiting rooms in such a way to permit the wheel chair users to use them conveniently."

(ii) Section 45(d) of the Act states that "The appropriate government and local authorities shall, within the limits of the economic capacity and development, provide for engraving edges of railway platforms for the blind or for the persons with low vision".

(iii) Section 45(e) of the Act states that the "The appropriate government and local authorities shall, within their limits of the economic capacity and development, provide for devising appropriate symbols for disability."

(iv) Section 46 of the act states that "The appropriate government and local authorities shall, within their limits of the economic capacity and development, provide for

(a) Ramps in public buildings

(b) Adaption of toilets for wheel chair users

(c) Braille signals and auditory signals in elevators/lifts

(d) Ramps in hospitals, primary health centres and other medical care and rehabilitation institutions. "

424 Station Name Boards

a) Station names should preferably be engraved and painted on the principal name boards made of stone or reinforced cement concrete. The principal name boards painted on both faces should be fixed at both the ends of the platform and generally oriented at right angle to the track without in any way infringing the Schedule of Dimensions. The actual angle at which the name boards are fixed should be determined by the site conditions ensuring the criterion that the name board is clearly visible from the approaching trains.

b) In the case of long platforms and at stations so identified by the Engineering Department, additional secondary name boards at convenient intermediate positions usually at the rate of one for two coaches may be fixed parallel to the length of the platform. Such secondary name boards can be made of framed metal, asbestos or wooden sheets and painted on the sides (one or both) facing the track.

c) The length and width of the principal and secondary name boards will be determined by the total written material to be engraved or painted on the name boards. The height of the lower edge of the principal and secondary name boards should be 2m above the platform level.

d) At large stations to be identified by the Commercial Department, tertiary name boards of sizes smaller than the principal/ secondary name boards should be provided facing the adjacent track as fixtures to the lamp posts or other fixed structures. They should be fixed in a position parallel to the track. On suburban sections, such tertiary name boards may be provided on enamel plates. Where such tertiary name boards are provided it may not be necessary to provide additional secondary name boards mentioned here in above.

e) The spacing of tertiary name boards should be such that at least one name board is visible from any compartment of a standing train. The board should preferably be square in shape and fixed with its diagonal axis in a horizontal position. The length and width of the name board will be determined by the total written material and their arrangement. The central horizontal axis of the board should be at a height of 2m above the platform surface.

f) Subject to the modifications as ordered by the Railway Board from time to time, the station names on all types of name boards should be provided in the manner indicated here in under :-

(i) The names and their spellings in different languages shall be as approved by the State Government.

(ii) The station names shall be exhibited in the following order: Regional Language, Hindi and English, except for Tamil Nadu where the use of Hindi will be restricted to important stations and pilgrim centres as determined by the Commercial Department. Where the Regional language is Hindi, the name boards will be in two languages, Hindi and English, except for provision of Urdu language as specified here in below.

(iii) Stations name boards of stations

falling under the following Districts shall also be displayed in Urdu:

Dharbanga, Purniya, Sitamari and Katihar, Bhopal, Khandwa, Morena, Gwalior, Guna, Sagar, Ratlam, Devas, Dhar, Indore, Khargone, Rajgad, Sehore, Raysen, Jabalpur, Siwni, Bareli, Bijnor, Lucknow, Meerut, Muradabad, Muzaffar Nagar, Rampur, Saharanpur, Pilibit, Baharaich, Gonda, Barabanki, Basti, Gurgaon, Balasor, Cuttack, Puri, Bardwan, Hubli, Chittor, Cuddapah, Ananthpur, Adilabad, Guntur, Kurnool, Karim Nagar, Khammam, Mehboob Nagar, Medak, Nellore, Nalgonda, Warangal, Nizambad, Prakasam, Rangareddy etc. (All the regions of Hyderabad including Hyderabad Nagar Mahapalika), North Arcot, Ambedkar, Dharamapuri, Sabarkanya, Khoda, Panchmahals and Baruch, Bellary, Bidar, Bijapur, Dharbad, Gulbarga, Kolar, Raichur, Shimoga, North Kanara, Kodgu, Dhane, Raygad, Ratnagiri, Nasik, Dhule, Jalgaon, Ahmednagar, Purne, Solapur, Aurangabad, Parbani, Bid, Nanded, Usmanabad, Buldhana, Ankola, Amarabati, Yawatmal and Nagpur.

(iv) At locations, where any other language in addition to the above is considered necessary, the Commercial Department may decide the matter in consultation and with approval of the appropriate Railway Users Consultative Committee and the concerned State Government.

(v) The script for the station names in Hindi shall be Devnagari and for other languages as adopted by the respective State Governments.

(vi) The size of the letters and their prominence for all the scripts shall be uniform and conform to the following :

Principal & Secondary Name Boards:	Height of letters 300mm thickness in proportion to the style of the script
Tertiary Name Boards:	Height of letters 75mm and thickness in proportion to the style of the script.
Colour (Non-Suburban Stations):	Letters in Black on Traffic Yellow background for Principal, Secondary and Tertiary name boards.
Colour (Suburban Stations):	Letters in Black on Traffic Yellow back-ground for Principal name boards. Tertiary name boards to have a distinguishing target of a ring bisected by one or two bands on a white background. The colours of the target ring, bands and letters should be chosen by the Engineering Department based on the tradition of the Railway and the need for proper contrasting to ensure a clear visibility from a running train.

g) All station name boards shall be properly illuminated so that they are legible at night. Special importance is to be given to the principal name-boards which may be specially illuminated with a bright electric lamp so that the whole of the board is clearly visible and legible at night.

h) Station names in the same scripts as specified here in above may also be displayed on the following structures so as to be visible from a running train, the letters being in Black on Traffic Yellow or White background :

(i) Lamp shades in letters of 75 mm height

(ii) High service tanks and other Tall Structures in letters of 300 mm to 600 mm height

(iii) Cabins in letter of 300 mm height illuminated with a bright electric lamp where the cabin is electrified.

425 Platform Sign-Boards

a) Indication sign boards - For larger stations, the following colour scheme should be adopted :-

(i) Bright red letters on white background for important offices such as Station Superintendent, Deputy Station Superintendent, Enquiry, Telegraph and Railway Mail Service etc.

(ii) Blue letters on white background for passenger amenities such as refreshment rooms, waiting rooms, retiring rooms and platform lavatories etc.

(iii) Black letters on white background for other offices.

(iv) Blue arrows should be painted at 1.5 metres above platform level or 300mm above the dado level on the walls directing passengers to Waiting, Refreshment and Retiring Rooms. Red arrows should be painted to direct passengers to Station Superintendent, Deputy Station Superintendent, Enquiry and Telegraph offices.

The lettering should be of size, suitable for the requirement.

(v) Every sign-board be painted on one side with the name of the office in Hindi and on the other in English and the regional language. The board should be erected at right angles to the building and immediately over the door of the office or room to which it refers.

(vi) The wording on sign-boards, the direction of arrows and platform numbers should be decided by Divisional Officers of the Engineering, Operating and Commercial Departments.

(vii) All notice boards shall be erected and maintained by the Engineering Department. Where notices are fastened to walls, proper fixtures should be provided.

For smaller stations, black lettering on white background may be used for all kinds of sign boards which may be painted on one

side only and fixed to the wall.

b) Platform number signs - These may be on enamel plates to the following specifications :-

Size of board	..	600 mm square
Size of letter	..	300 mm
Colour -	..	white figure on blue background.

At stations having a large number of platform signs, these should be fixed at right angles to the track and staggered horizontally so as to give a clear direction from a distance. The height of platform number signs may vary to suit local conditions.

426 Time Table Boards And Fare Lists-

Boards or cement plaques, with or without wire-netting, should be provided at suitable places, in consultation with the Commercial Department, for posting time tables and fare lists thereon.

427 Pictogram -

At major stations and places of tourist interest important pictograms, indicating the locations of various passenger amenities, as approved by Railway Board should be displayed at suitable vantage locations in the station premises.

428 Design of Station Complexes -

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 in paras 429 & 430.

429 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, chargeable 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 IOW, AEN, & DEN with complete description of their location, level etc.

430 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.

ANNEXURE 4.1
Para 402(b)

CATEGORIES OF STATIONS FOR PROVISION OF PASSENGER AMENITIES

Stations shall be classified in the following categories:

Category 'A': Non-suburban stations with an annual passenger earnings of Rs.6 crores and above.

Category 'B' : I. Non-suburban stations with an annual passenger earnings between Rs.3 crores to Rs.6 Crores.

II. Stations of Tourist importance, or an important junction station (to be decided by G.M.).

Category 'C': All Suburban Stations.

Category 'D': Non-suburban station with passenger earnings between 1 and 3 Crores.

Category 'E': Non-suburban stations with earnings less than 1 crores.

Category 'F': Halts.

Note: Earnings of the year 1995-96 can be taken as the base till next review in the year 2001.

ANNEXURE-4.2

Para 403

MINIMUM ESSENTIAL AMENITIES AT EACH CATEGORY OF STATIONS.

AMENITIES	STATION CATEGORY					
	A	B	C	D	E	F
Booking facility	Yes	Yes	Yes	Yes	Yes	Yes
Platforms - High - Low - Rail level	Yes	Yes	Yes	Yes	Yes	Yes
Drinking water -Piped Drinking water (Hand Pump)	Yes	Yes	Yes	Yes	Yes	-
Waiting Hall/Shed	Yes	Yes	Yes	Yes	Yes	-
Seating Arrangement	Yes	Yes	Yes	Yes	Yes	-
Platform Shelter Shady trees	Yes -	Yes -	Yes -	Yes -	- Yes	- Yes
Lighting #	Yes	Yes	Yes	Yes	Yes	Yes*
Fans@	Yes	Yes	Yes	Yes	Yes	-
Urinals	Yes	Yes	Yes	Yes	Yes	-
Latrines	Yes	Yes	Yes	Yes	Yes	-
Foot over bridge	Yes	Yes	Yes	-	-	-
Time Table display	Yes	Yes	Yes	Yes	Yes	Yes
Clock	Yes	Yes	Yes	Yes	-	-

(i) Regular/flag stations should be electrified if electricity is available within one Km.
(ii) If electricity is not available within one Km. and trains stop at night, electricity through solar power be considered.

* Where trains stop at night. @ To be provided at electrified stations.

ANNEXURE 4.3
Para 403

SCALE OF MINIMUM ESSENTIAL AMENITIES AT STATIONS

AMENITY	CATEGORY OF STATIONS					
	A	B	C	D	E	F
BOOKING FACILITY (No. of counters)	15	10	7	4	2	1
DRINKING WATER	12 taps on each PF	12 taps on each PF	6 taps on each PF	6 taps on each PF	1 tap /HP on each PF	1 hand pump at stations
WATING HALL	100 sqm	50 sqm	15 sqm	30 sqm	15 sqm	10 sqm Booking office cum waiting hall
URINALS	10	6	4	4	1	-
LATERINES	10	6	2	4	1	-
P.F. SHELTERS	400 sqm on each PF	200 sqm on each PF	200 sqm on each PF	50 sqm on each PF	Shady trees on each PF	Shady trees on each PF
SEATING ARRANGEMENTS (No. of seats)	100 on each P.F.	75 on each P.F.	20 on each P.F.	50 on each P.F.	10 on each P.F.	-

Note: Scale of all the amenities prescribed above are the bare minimum to be provided at the appropriate class of stations. Amenities over and above the prescribed minimum scales will continue to be provided as per stipulated norms, details in Annexure 4.4.

ANNEXURE 4.4
Para 404

RECOMMENDED AMENITITES

(Norms for provision of Passengers Amenities at the Recommended Level)

N_{max} = Maximum number of passengers at any time during peak including the inward and outward passengers (excluding mela traffic).

N_{db} = Design figure for number of passengers for 'A' & 'B' stations to be calculated as $N^{db} = 0.3\ (N_{max})$.

N_{ds} = Design figure for number of passengers for 'C', 'D' and 'E' stations to be calculated as $N^{ds} = 0.45\ (N_{max})$.

Amentities	Recommended scale for provision		Remarks
	Cat. A & B	Other stations	
Waiting hall	1.394 N_{db} sqm.	1.394 N_{ds}.Sqm.	
No. of seats	0.4 N_{db}	0.4 N_{ds}	
Drinking Water	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	
Latrines	4 x N_{db}/200	4 x N_{ds}/200	
Urinals	N_{db}/200	N_{ds}/200	1/3rd of urinals be reserved for ladies.
P.F. Covering	0.28 N_{max}	0.28 N_{max}	At important 'A' class and suburban stations efforts should be to cover the entire P.F.
Bathroom	1/400 N_{db}	1/400 N_{ds}	a)To be provided at Junctions and terminals stations only. b) At suburban stations, bathrooms need not be provided.
Coolers	To be provided if total numbers of passengers is more than 1000 per day		
Booking arrangements	1 window per 100 tickets/hour		
SPTM	One SPTM for 800 tickets for 'A', 'B' and 'C' stations		
IVRS	A-48 lines (calls 72000) B-24 lines (calls 5000-20000)	A central IVRS with adequate lines should be provided to cover all suburban stations. Other stations - Min. 6 lines if IVRS is otherwise justified.	

ANNEXURE 4.5
Para 405

DESIRABLE AMENITIES

FACILITY	STATION CATEGORY					
	A	B	C	D	E	F
Retiring room	Yes	Yes	--	Yes	--	--
Waiting Rooms						
Common	Yes	Yes	--	Yes	--	--
Separate for upper & second class	Yes	--	--	--	--	--
Separate for ladies & gents	Yes	--	--	--	--	--
Cloak room	Yes	Yes	--	--	--	--
Enquiry	Yes	Yes	Yes	Yes	--	--
NTES	Yes	--	--	--	--	--
I.V.R.S.	Yes	Yes	--	--	--	--
Public address system	Yes	Yes	Yes	--	--	--
Water vending machines / Chilling plants	Yes	Yes	--	--	--	--
Water coolers	Yes	Yes	Yes	Yes	--	--
Bathing facilities	Yes	Yes	--	Yes	--	--
Book stalls/other stalls of essential goods	Yes	Yes	Yes	--	--	--
Refreshment room	Yes	Yes	--	--	--	--
Catering/ Vending stalls	Yes	Yes	Yes	Yes	Yes	--
Parking/Circulatory area	Yes	Yes	Yes	Yes	--	--
Washable apron*	Yes	Yes	--	--	--	--
Train indicator Board	Yes	Yes	Yes	--	--	--
Public phones	Yes	Yes	Yes	--	--	--

* Washable Aprons may be provided in a planned manner to cover only stations from where trains terminate/originate or stop for longer duration in the morning hours.

ANNEXURE4.6
Para 408

PASSENGER AMENITIES DETAILS

Station Name	Secunderabad Jn.	Category	A	Adv.Res.Windows	35 (Nos.) with:	No.of passengers dealt	
Station Code	SC	Section	VIKARABAD-KZT	Curr.Booking Win.	27 (nos.)	(a) Per Day	5000
Railway	SC	Km.	194.36	Enquiry Offices	1 (nos.)	(b) Max.at any time:	8000
Division	Secunderabad	Route	B	Public Address Sys.	Yes	Pass.Earnings/Year(Rs.):	60,000,000
State	Andhra Pradesh	Electrified	Yes	Clock	No	Length of longest stoppingtrain(m)	539
District	Hyderabad	FOB	3	Wheel Chairs	0		
		Subway	0	Other Items			

PF No.	Is land Y/N	Length (m)	Brea -dth (m)	Height (cm)	Surface	Shelter Sq.m.	Trees Nos.	Taps Nos	Hand Pumps Nos.	Water Huts/ Trollies Nos.	Water Coolers Nos.	Wash -able Apron (m)	Carr. Wate -ring (m)	Seats Nos.	Lav. Nos.	Urinals Nos.	Fans Nos	V. Stall Nos.	CC TV Nos.	Gauge
1	N	516	0	83	Pucca	5372	0	27	0	0	9	0	0	209	4	0	0	0	1	BG
2&3	N	498	0	83	Pucca	2928	0	14	0	0	3	0	0	156	0	0	0	0	1	BG
4&5	Y	490/490	0	84	Pucca	5496	0	16	0	0	0	0	0	60	0	0	0	0	1	BG
6&7	Y	639/639	0	84	Pucca	3294	0	12	0	0	0	0	0	21	0	0	0	0	1	BG

WAITING HALL		WAITING ROOM		
(a) Area:	637.89		Gents	Ladies
(b) Seats:	638	Area(sqm)	257	0
(c) Lav.(Nos.)	4	Lav.(Nos.)	4	0
(d) Urinals	4	Urinals(Nos.)	0	0

UC Waiting Room Area (sqm):	0	Bathing Cubicals:	6	Open Wells (Nos.):	0
Refreshment Room (sqm)	340	Circulating Area (Sqm)	0	Bore Wells (Nos.)	0
Retiring Room(Nos.)	20	Circulating Area (Type)		OH Tank Cap. in litres	0
Beds in Retiring Room (Nos.)	20	Approach Road (Type)			
Beds in Dormitory (Nos.)	0			**Remarks for water:**	
Tourist facility	No			Drinking water taps available on all platforms	
Cloak Room:	No				

Remarks for Station:

SUMMARY

Item	Waiting Hall (Sqm)	Shelter (Sqm)	Tap/HP	Lavatories (Nos.)	Urinals (Nos.)	Seats (Nos.)	Height of Platforms
As per norms	3346	2240	320	48	12	960	HL
Actual	637.89	17090	69	12	4	1084	See platform details
Shortage, if any	2608.11		251	36	8		

CHAPTER V

A. WATER SUPPLY

501 General - 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 - 1983

(3) IS:10500 - 1991

(4) National Building Code of India

(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:-

a) 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;

b) Nature, quality and quantity of existing supply and its source;

c) Possible sources of additional supply and arrangements for its filtration, purification etc;

d) Future requirements if known;

e) Whether the supply will be metered, continuous or intermittent;

f) Details of pumping arrangement and its cost.

For collecting this data, preliminary survey, site investigation may be necessary. The investigation will involve yield test, check on quality of water etc. Necessary checklist for framing water supply proposals is given as Annexure 5.1.

503 Review of Water Supply Arrangements on the Railways: 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 Chief Engineer for information. Copy should also be endorsed to the Assistant Engineers and Section Engineers (Works) for necessary action.

After the review meeting, the 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 following minimum basis unless otherwise justified by particular circumstances. Allowance should be made for future development:-

Particulars		Litres per day
(a) Residential area		
Household consumption for Officers and staff per head	.. ..	200 (Includes 45 litres required for flushing).
(b) Office and workshop		
Offices per head	..	45
Workshops per head	..	30
(c) Station and platform		
Apron washing	..	10 per sqm
Platform washing	..	5 per sqm.
Passengers on railway station	..	* 25 per passenger
Washing of carriages on	..	3600 per carriage for BG
washing lines	..	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	..	22500 approx.
Hospital	..	450 per bed
Fire Service	..	Occasional Sumps and hydrants to be adequate for emergencies.

** 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.*

505 Capacity of Source -

Ordinarily, in the summer season, sources should be able to supply in eight hours the quantity of water normally consumed in a day.

B. OPEN WELLS

506 Preliminary Measures for Sinking

a) 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.

b) 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.

507 Determination of Size:

(a) 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.

b) For the size of the open well, the following factors should be considered:-

(i) *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; and

(ii) *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 metre 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.

508 Improving Yield in Open Wells

b) *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 staining may occur.

c) *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.

509 Shallow Tube-Wells -

Tube-wells to a depth of 7.5 meters 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, gang 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. Sufficient number of spare parts for repair of hand pumps should be kept with the Section Engineer (Works) to attend to emergencies.

C. DEEP TUBE WELLS

510 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.

511 Stages of Work for Sinking

a) Trial boring-

(i) During sinking of pipes, samples of strata are examined for yield and samples of water taken for analysis

(ii) 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

b) *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 Divisional Medical Officer for test.

c) *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.

d) *Testing yield of tube-wells.*- A tube-well should be tested for yield by experienced staff of the tube well organization of the Railway. IS:2800-1979 may be referred where necessary.

512 Checking Verticality of Tube Wells-

Tubewells 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 metre 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 centre of pipe . When the disks are further lowered down and if the well pipe is not truly vertical, the wire will deviate from the centre and that shall be indicated at the top of pipe.

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

513 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

Problem	Treatment recommended
1. Clogging due to fine sand, clay and silts	Sodium hexametaphosphate50gm/litres 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 hypochloride should be used to form solution which is introduced in well in a small polythene pipe. 200 gms. of hypochloride is required at 70% concentration for 1000 litres of water

514 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.

D. IMPOUNDING RESERVOIRS

515. 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.

516 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.

517 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.

518 Reservoir Management -

Problem of silting, evaporation losses, seepage and algae troubles are some of the areas requiring attention. Loss of capacity due to the deposition of silt in reservoir may impair the usefulness of the reservoir within a few years. It may be minimized by erosion control, reservoir operation and desilting works. There are various commercially available organic compounds which when spread on the water surface form a monomolecular film, which reduces evaporation. Seepage can be reduced by making cut off wall beneath the dam. The water weeds in the reservoir should be controlled by suitable methods such as dragging and underwater cutting. Algicidal treatment by using suitable Algicide may be adopted to control algae in reservoir. It is preferable to initiate the treatment in the early stages of algae growth.

E. INFILTRATION GALLERIES AND WELLS

519 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.

520 Infiltration Well -

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.

521 Radial Collector Wells -

Radial collector well consists of a cylindrical well of reinforced concrete construction, 4-5 metre 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 metres each which are welded to each other. The pipes are driven horizontally by means of suitable pin jacks placed in the well.

Desanding operation is required to be done after driving of the radial pipes. Desanding 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 are 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.

522 Intake Arrangements -

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.

523 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:-

(a) term or duration of agreement;

(b) rate of payment for water;

(c) mode of measurement and location of meters etc,

(d) maximum and minimum quantities to be supplied daily;

(e) minimum pressure to be maintained in the mains at points of supply;

(f) in case of bulk supply, point or points at which water is to be supplied;

(g) 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 Divisional Engineer's and Assistant Engineer's offices.

F. PUMPS

524 Types and 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 litres 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 staff 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.

525 Pump Installation -

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

a) 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.

b) 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 metres.

c) the suction pipe should be air-tight, laid with as few bends as possible and equipped with foot-valve.

d) 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.

e) the delivery pipe shall be of such size that the velocity of water is about 2.5 m/s.

f) 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.

g) 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.

Space for control panels should be planned as per the Indian Electricity Rules.

526 Driving Units -

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

(i) the prime mover should preferably be an electric motor, being economical;

(ii) the stand-by where provided may be an electric generator so that in case of failure of electric supply, pumping is assured.

(iii) Where power is not available, oil engines may be used.

(iv) Non-return valve at the discharge pipe, supplemented by a sluice valve shall not be closed while the pump is running.

527 Capacity of Pumping -

The pumping system should be capable of supplying:-

(a) In 12 hours or less, the normal quantity required in 24 hours;

(b) In 16 hours or less, the present maximum quantity required in 24 hours;

(c) In about 20 hours, the estimated maximum future requirements in 24 hours.

For small pumping systems, generally of capacity less than 15 million litres 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.

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/equipments.

528 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 (metric): (One metric horse power = 75 kilogram metres/Sec.), H is the vertical height in metres from suction-level to highest point of discharge; L is the litres of water per minute and 'h' the head lost in friction in metres.

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

529 Conveyance of Water from Source

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 upto 80 mm diameter may be used; for diameters over 80 mm, cast iron spigot and socket or reinforced concrete or suitable asbestos 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 metres 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 prestressed concrete pipes (PSC) although they have their own feature which significantly affect 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 per cm square. 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: 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 5822-1986).

530 Pipe Laying and Fitting of Valves and Meters

a) The following instructions should be followed : -

(i) 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.

(ii) Keep the top of pipe at least 0.5 metres below ground surface and where severe frost occurs, the cover is at least 1 metre. The bed of the trench shall be finished to an even gradient/level and filled with soil rammed in 150 mm layers.

(iii) Provide air valves at all summits and scour valves at all sags.

(iv) Lay spigot and socket pipes with sockets facing the direction from which the water will flow.

(v) Carry pipes across deep depressions or marshy places on pillars or props.

(vi) On steep hill-sides, anchor the pipes to prevent sliding of pipes downslope In vertical position, use pipes with flanged ends and bolts as far as possible.

(vii) Close the open end of the last pipe at the end of the day's work.

(viii) Test the pipe line with water pressure in sections before the trench is filled in.

b) Pipe lines should be fitted, where necessary with:-

(i) Air valves of proper size and pressure rating at summits.

(ii) Reflex (non-return) valves at the foot of all ascending parts of a main.

(iii) Scour valves at depressions on the main for clearing sediment and emptying the pipes.

(iv) Sluices as necessary in order to divide the main into convenient sections for repairs.

(v) 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.

(vi) Meters as required.

c) 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.

H. WATER TREATMENT

531 Quality of Water -

It should be ensured that the water supplied is clear, potable, free from pathogenic organisms and odour. Water should be of reasonable temperature and free from minerals which could produce undesirable physiological effects.

The physical and chemical Standards as per Annexure 5.2 may be adhered for drinking water supply.

532 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, the following procedure should be followed:-

a) Sterilized glass-stoppered bottles available with the Divisional Medical Officer should be obtained. Bottles separately available for bacteriological or chemical

examination have to be appropriately used.

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.

b) 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.

c) 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.

d) 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 metre 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.

e) Bottles containing samples of water should be properly labeled, packed around with ice and saw-dust and sent without any delay to reach the Divisional Medical Officer. Satisfactory packing and expeditious dispatch are essential for a proper bacteriological examination.

533 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, deferrization,defluoridation 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.

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 micro organisms.

Water with excessive hardness will need softening by conventional method or by ion exchange method.

534 Disinfection of Water - Water treatment processes described in paragraph above remove micro organisms 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. A minimum of 30 to 60 minutes contact time must be provided before delivery of water to the consumer.

Utmost care shall be taken for storage and use of disinfectants. All safety precautions as laid down in relevant codes shall be taken.

Sufficient number of chlorinators in working conditions should be available with the Inspectors of works. To decide the quantity of chlorine to be added,Inspector of works should find out breakpoint chlorination and accordingly chlorinate the supply.

535 Residual Chlorine -

Minimum residual chlorine available at the farthest end shall be 0.2 mg per litre. However, where distribution is long and complex it may be difficult to maintain the minimum residual value and in such cases re-chlorination may be carried out in the distribution system.

During monsoon months or if specific complaints are there, super-chlorination more than 2 ppm of chlorine may be resorted to effectively get rid of bacteria.

The Section 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 sufficient number of equipment with all the field units.

I. HIGH-LEVEL STORAGE

536 Storage Capacity -

Normally, the storage capacity should be equal to the higher of the following figures:-

a) With efficient stand-by pump:-

(i) One-quarter the maximum water consumption in 24 hours

(ii) One-third the normal water consumption in 24 hours

b) *Without stand-by pump:-*

(i) One-third the maximum water consumption in 24 hours.

(ii) 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.

537 Maintenance and Cleaning of Storage Tanks

a) For the inspection, maintenance and painting of steel-work, action should be taken as detailed in the Indian Railways Bridge Manual.

b) Tanks used for the storage of drinking water should be rubbed and cleaned at such intervals as specified by the Divisional Engineer. The cleaning of water tank and disinfection should be carried out as per recommended procedure. 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 Engineer by the 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 and of both external and internal painting should be painted on one side of the staging in such a manner that these are readily visible.

538 Float Gauges and Scouring Sluices-

Every high level storage tank should be provided on the outside with a float gauge with a scale marked in metres divided into 5 parts to indicate the water level in the tank.

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.

539 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

540 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

distribution system on wayside stations.

541 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 litres 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.

542 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.

543 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 etc.

544 Service Pipes from Mains -

The per capita rate 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.

545 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-storeyed buildings needing higher pressure should be provided with boosters.

546 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.

547 Protection Against Pollution Near Sewer and Drains

a) *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.

b) *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.

548 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.

K. MAINTENANCE AND OPERATION OF WATER SUPPLY INSTALLATIONS

549 Engineering Department's Responsibilities-

The Engineering Department shall be responsible for:-

a) The adequacy of water supply at all sources, permanent and auxiliary.

b) The despatch of samples of water if so required to be done, from water supply sources, storage-tanks or taps for chemical and bacteriological analysis to the 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, hydrants and 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 taken to reduce the losses.

550 Mechanical Department's Responsibilities

a) The Mechanical Department will be responsible for the erection, maintenance and operation of diesel oil pumping plants at all pumping stations.

b) The Mechanical Department will be responsible for the operation and maintenance of carriage-watering and carriage-washing hydrants.

551 Electrical Department's Responsibility

a) All planning,installation maintenance and operation of electrical pumps shall be done by electrical department.

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.

552 Inspections by Assistant Engineer and Staff

a) The Assistant Engineer and Section Engineer (Works) should frequently inspect all water supply installations and pipelines and ensure their maintenance in efficient condition. The Section Engineer (Works) should be equipped with an adequate imprest of materials such as pipes and specials and water taps of requisite sizes and the necessary tools to facilitate immediate attention on repairs as and when required.

b) Storage-tanks for drinking water and for flushing purposes over offices, bungalows and quarters should be inspected frequently by the Section Engineer (Works) and their cleanliness ensured. Complaints from residents should be promptly attended to.

553 Water-Supply Plans -

Up to date plans should be maintained in the Chief Engineer's, Divisional Engineers', Assistant Engineers' and 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 and type of pipe-lines 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 Engineer shall ensure that water supply plan is corrected as and when there is any addition or modification in pipeline. Wherever the laying/modification to the existing pipe line is done through contractual agency, a certificate in the measurement book shall be recorded while entering the final measurements to the effect that necessary changes in the plans have been incorporated. 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.

554 Water Purification Works

a) *Periodical analysis of water* - Samples of raw, filtered and sterilized water from filter-plants should be sent for examination and certification once a month or as may be prescribed to the Divisional Medical Officer who will advise, if deemed necessary, on the appropriate dosage of the coagulant or the sterilizing agent. Reports on water analysis received from the Divisional Medical Officer should be carefully filed, the action taken on each report being recorded. Samples for chemical examination should be sent for testing once in six months or once before monsoon and once after monsoon.

b) *Maintenance of water works* - Detailed instructions in regard to the maintenance and operation of filtration and chlorinaton plants at each installation shall be issued by the Chief Engineer. It should be ensured that-

(i) the plants, in general, with their ancillaries are maintained in a perfectly sanitary and hygienic

condition;

(ii) aeration of raw water is effected by spraying through the air, cascading over obstacles.

(iii) the sedimentation tanks or basins are drained at such intervals as prescribed;

(iv) 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;

(v) the filters are cleaned and washed with pure water at such intervals as prescribed;

(vi) the filtered water is sterilized either by adding liquid chlorine or bleaching powder strictly to the dosage specified.

(vii) disinfectants are stored properly and all safety precautions are taken

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.

c) *Supervision by Assistant Engineer*

(i) The Assistant Engineer shall inspect each installation once in three months 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.

AEN should arrange for a joint detailed inspection by Section Engineer (Works) of the pumping machinery once a year as may be prescribed alongwith the staff of the Mechanical/Electrical Department and ensure prompt compliance to repairs or replacements required.

(ii) The Assistant Engineer should check the following:-

- Stock account showing transactions of stores

- Log book for filtration plant

d) *Inspection by Divisional Engineer* - The 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.

e) *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.

ANNEXURE 5.1
Para 502

CHECK LIST FOR WATER SUPPLY SCHEME

NAME OF THE SCHEME :

DIVISION :

SCHEME APPROVAL DETAILS :

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, offices 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-a-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 Stds. of quality of water refer Annexure 5.2)
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 down stream 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 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 fire fighting equipment appropriate to hazard likely in the pump house and storage space of diesel?

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 ?

5. Is there feasibility of regular supply of sand required for replenishing the sand of filter ?

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. Is water softening required to remove the permanent hardness, if any ?

8. Is recarbonation plant necessary (in case

of Lime Soda process or softening), if so, is it provided before filtration unit ?

9. Has the method of chlorination been finalised keeping in view the availability of equipment and constant supply of chlorinating material ?

10. Is there any other impurity to be removed ?

11. Has the provision of small laboratory including equipment for testing of water required at filtration plant been made ?

E. STORAGE AND DISTRIBUTION OF TREATED WATER

1. Has the location of pump house been finalised taking into account the availability of power and requirement of the operator ?

2. Is it feasible to utilise 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 of the storage tank been finalised 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 finalised ?

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?

ANNEXURE 5.2
Para 531

STANDARDS OF QUALITY OF DRINKING WATER

PHYSICAL AND CHEMICAL STANDARDS

S.No.	Characteristics	Requirement (Desirable limit)	Permissible limit in the absence of alternate source
(1)	(2)	3	4
1.	Turbidity (NTU scale)5.0	10	
2.	Colour Haten units 5.0	25	
3.	Taste and odour	Unobjectionable	---
4.	Ph value	6.5 to 8.5	No relaxation
5.	Total dissolved solids(mg/l) max.	500	2000
6.	Total hardness as CaCo3(mg/l) max.	300	600
7.	Chlorides as Cl2(mg/l)	250	1000
8.	Sulphates as SO4 (mg/l) max.	200	400
9.	Fluorides as F (mg/l)max.	1.0	1.5
10.	Nitrates as No3 (mg/l)max.	45	100
11.	Calcium as Ca (mg/l)max.	75	200
12.	Iron as Fe (mg/l)max.	0.3	1.0
13.	Zinc as Zn (mg/l)max.	5.0	15.0
14.	Mineral Oil (mg/l)max.	0.01	0.03
15.	Copper as Cu (mg/l)max.	0.05	1.5
	Toxic materials		
16.	Arsenic as As (mg/l)max.	0.05	No relaxation
17.	Cadmium as Cd (mg/l)max.	0.01	-do-
18.	Lead as Pb (mg/l)max.	0.05	-do-
19.	Residual free chlorine (mg/l)max.	0.2*	---

Source :Indian Standard - Drinking water - specification (First Revision)
IS:10500 - 1991 by BIS

*When protection against viral infection is required, it should be min. 0.5 mg/l.

CHAPTER VI

A. DRAINAGE & SEWERAGE

601 General

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

(i) National Building Code of India 1983 - Part IX Plumbing Services, Drainage and Sanitation.

(ii) Relevant BIS Codes as mentioned below :-

IS 1172: 1983 Code of basic requirements for water supply drainage and sanitation.

IS 1726: 1974 Specifications 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: 1986 Code of practice for ancillary structures in sewerage system.

IS 5329: 1983 Code of practice for sanitary pipeworks above ground for buildings.

(iii) Manual on Sewerage and Sewage Treatment - Ministry of Urban Development, New Delhi.

(iv) Regulations issued by Municipal Corporations or local Public Health Departments should also be referred.

602 Preparation of Schemes of Sewerage-

Definitions of some common terms are given below:-

(i) *Drain :* A conduit/channel for the carriage of storm water or other used water

(ii) *Drainage :* A system for removal of any unwanted liquid

(iii) *Sewer* : A pipe/conduit used generally for carrying sewage or other water-borne wastes

(iv) Sewerage : A system for the collection and conveying sewage to the point of disposal

(v) *Manhole* : An opening by which a man may enter and leave a drain, a sewer or other closed structure for inspection, cleaning and other maintenance operations fitted with a suitable cover

(vi) *Soil Waste* : The discharge from water closets, urinals, sinks, cattle sheds, gullies etc.

(vii) 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.

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 equipments and construction of drains and sewers shall be followed.

604 Sewerage Schemes -

Reports of sewerage schemes should include-

a) a historical retrospect leading to the justification of the project

b) description of existing facilities, if any

c) population studies, analysis and prediction based on a critical appraisal of available data

d) location of the water supply headwork for the area and the neighbouring communities

e) availability of piped water supply in the area, present and anticipated per capita water supply

f) the nature of sewage, total sewage flow - present and prospective

g) discussion of different possible disposal points and their comparative merits

h) review of different possible methods of treatment

i) engineering features and economical aspects of the sewer system, an index and a general layout plan with contours at intervals of 2m alongwith 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

j) number and location of pumping stations with hydrostatic heads and frictional loss of heads on pumps and on mains

k) a comparison of total costs (recurring and non-recurring)of the alternatives involved under major subheads

l) the most satisfactory alternative scheme for the project, as recommendedprobable 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 Quantity of Sewage -

The factors which influence the quantity of sewage are population and per capita sewage. Population estimates should cater for future requirements.

a) Generally 80% of the water supplied may be considered to reach the sewers.

b) The lean and peak flows of sewage will be about 50 and 150 percent of the average respectively. The sewer should be designed for the maximum flow rate, after allowing for seasonal fluctuations. For design purposes standard tables are available which may be referred.

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 alongwith 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 metre per second and a maximum of 2 metres per second, are allowed. On steep slopes, one or more drop manholes may be provided.

a) *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. Self cleansing velocity is determined by considering the particle size and specific weight of the suspended solids in sewage. A minimum velocity of 0.8 mps at design peak flow in the sanitary sewers is recommended subject to a minimum velocity of 0.6 mps for present peak flow.

b) *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 therefrom 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.

c) *Maximum Velocity* - Erosion of sewers is caused by sand and other gritty material in the sewer at excessive velocity. Velocity of flow in a sewer is recommended not to exceed 2.0 mps.

609 Ventilation in Sullage -

From consideration of ventilation in wastewater flow, sewer should not be designed to run full. Sewers upto 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 100 mm.

611 Storm Water

Quantity of storm run-off is dependent on intensity and duration of rainfall, characteristics of catchment 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 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.

According to IS:4111 - spacing of manholes is designed with reference to sewer diameter as given below:

Sewer dia in mm	Upto 300	301 to 500	501-900
Spacing in metres	45	75	90

When silt and grit loads are heavy, catchpits may be provided at suitable intervals depending on local conditions and as approved by the Divisional Engineer.

613 Choice of Material for Sewers

a) *Salt glazed stoneware pipes* - 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.

b) *Cement 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 favourable for the production of hydrogen sulphide and shall not be laid in those sub-soils which may affect the strength of concrete.

c) *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.

d) *Asbestos Cement Pipes* - These pipes are commonly used for house drainage systems and are not recommended for underground situations. They are not suitable to carry acid effluents or sewage under conditions favourable for the production of hydrogen sulphide.

e) *PVC Pipes* - Unplasticised PVC pipes may be used for drainage purpose.

614 Laying of Sewer Pipes

a) *Excavation* - The safety precautions required as per construction practices shall be ensured.

(i) 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.

(ii) Unless specified otherwise by the Authority, the width at bottom of trenches for pipes of different diameters laid at different depths shall be as given below:

1) For all diameters, upto an average depth of 120 cm, width of trench in cm = diameter of pipe+30 cm

2) For all diameters for depths above 120 cm, width of trench in cm = diameter of pipe+40 cm.

3) Not withstanding (1) and (2), the total width of trench at top should not be less than 75 cm for depth exceeding 90 cm.

iii) All pipes, ducts, cables, mains or other services exposed in the trench shall be effectively supported by timber and/or chain or rope-slings.

iv) 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.

b) *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.

c) *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.

d) *Connection to Existing Sewers* -

(i) 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.

ii) 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.

e) *Back-Filling* -

(i) Filling of the trench shall not be commenced until the length of pipes therein has been tested and passed

(ii) All timber may be withdrawn safely as filling proceeds.

(iii) 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.

(iv) 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 15-cm of fil-ling 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.

(v) Filling shall be continued in layers not exceeding 15cm in thickness, each layer being watered and well rammed.

(vi) 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.

(vii) In gardens, the top soil and turf, if any, shall be carefully replaced.

f) Pipes should preferably be laid with the socketted ends against the direction of flow and in straight lines.

g) 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 Disposal -

Standard flushing systems are meant primarily to transport human waste from the toilet to the treatment plant located a few kilometres away or to connect the railway sewerage system to the municipal sewers. Therefore, this standard sewerage system is appropriate only where underground sewerage

system exists. A comparative estimate of cost should be prepared for the connection with the municipal sewerage system vis-a-vis an independent sewage disposal plant.

Where water-borne sewerage is not possible, septic tank system of disposal of sewage is normally adopted.

616 Septic Tanks -

Modern septic tank system is an on a site 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	Width	Liquid Depth
	metres	metres	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		
	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 soakpit/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.

617 Aqua Privy Latrines -

The latrine will usually consist of an under ground masonry tank on top of which are fixed the latrine pans. The outlet of the pans are dipped 7.5 to 10 cm below the flow line in the tank. The pans may be fixed with or without traps to the outlet pipe. The excreta will get digested in the masonry tank below and will be cleared at intervals through manhole left for this purpose. The effluent may be then absorbed by sub-surface irrigation process or by other alternative means.

618 Bio-Latrines -

These are improved aqua privies used for sewage ranging from very small quantities to comparatively larger quantities. They need 1.5 to 2 litres/capita of water for flushing. Standard drawings are available from RDSO. The following points should be taken care of in bio-latrines.

1. No water tap should be provided in the water closet to prevent flooding of digesters, which will prevent efficient anaerobic action.

2. Excessive water should not be used in the water closet.

3. The pan in the bio-latrines should have a slope not less than 40 degrees with horizontal.

4. No foreign matter e.g. garbage, soap water etc. should be thrown into the water closet pan.

5. The digesters should be linked directly to the toilet with least possible inter distance.

6. The flow from the toilet to digesters is to be by gravity.

7. When combined digesters are used, the sewage will first get collected in a chamber attached to each water closet and then flow to a combined digester. The slope of the pipe lines from the collection chamber to the digester should not be flatter than 1 in 20 so as to allow for easy flow.

8. A water seal of 50mm above the crown level of the inlet pipe at the inner face of the digestion tank wall, shall always be maintained in the digestion tank.

9. The plinth level of the latrines should be decided working backwards from the invert level of the outlet pipe of the digestion tank.

10. The sludge settled at the bottom of the digestion tank may be cleared once in two years.

11. Satisfactory working of the anaerobic digesters in the tank, is indicated

    i) if the effluent is odourless
    ii) if the effluent does not attract flies and mosquitoes; and

    iii) if the pH value of the effluent is not less than 7.0.

12. Outlet drains should have proper slope and rounded corner.

13. Adequate ventilation should be provided in bio-latrines.

14. In case of public or community type of toilets, users are likely to throw rags, stones etc. into the toilets. In such cases an inspection chamber with 25-50mm spaced grating should be provided just before the entry of water into the digesters to arrest any such material.

15. 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 soakpit/filter while effluent from a digester can be discharged directly in a drain system.

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. In case of non-residential toilets at stations etc., and community toilets provided with 'standard flushing' arrangements, instead of flushing cisterns of 13.5 litres capacity, the use of 'coach' handles should be preferred so that only the required amount of water is used. In case of urinals, instead of automatic flushing cisterns, dripping ferrules may be used to conserve water.

620 Recommended Toilet Systems

Based on the above rationale, directions for selecting appropriate toilets system are summarised below:-

(i) Where an underground sewerage system can be connected, use a 'flush' type toilet as under:-

Residential Toilets	With no water shortage	Cistern flushing, (use good qualitycisterns, preferably the newer Models using less than 3 gallons Water).
Residential toilets	With water shortage	'Coach' handle flushing
Non-residential toilets	-	'Coach' handle flushing. However,for toilets in retiring rooms, rest houses same type as for residential toilets.

(ii) Where an underground sewerage system is not available:

In built-up areas or in all other areas where soakpits or filter beds are not feasible	Bio-latrines
On roadside stations-do-	
In sparsely inhabitedstations	Bio-latrines or septic tank system (coach handle type flushing should be used)

(iii) In case of urinals, automatic flushing cisterns should not be used and only dripping ferrules may be used.

All toilets on the Railways must be sanitised on top priority program basis. Thus only flush toilets with underground sewerage, flush toilets with septic tank systems (with soakpit/filter-bed for the septic tank effluent) and bio-latrines (also acquaprivy) are the approved sanitised toilet systems for use on the Railways. Hence -

- all 'dry' (Service type) toilets must be sanitised.

- all septic tanks, if not provided with prescribed soakpit/filterbed, must be provided with these or if possible, converted into digesters by minimising the flushing so that the same tank can provide clear minimum 30 days retention (in addition to the space for digestion at the bottom).

C. MAINTENANCE OF SEWERAGE AND DRAINAGE

621 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.

622 Sewer Lines

a) 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.

Sewers may be flushed by firehose from the nearest fire hydrant if conveniently located if the stoppage is too stubborn to respond to flushing, it may be removed by rodding from the next manhole or it may be necessary to dig down to the point where the trouble exists.

(b) 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.

(c) Sewer line gangs, if under the Engineering Department, should attend to the cleaning and flushing of all sewers at least twice every month. Manholes should be left open for few hours for gases to escape, before any man enters into it.

623 Open Sullage Drains

Open sullage drains should be maintained in a thoroughly satisfactory condition; cleaning and flushing should be done at least twice a month or more often, as considered necessary. Soak-pit should be dug up and cleaned at least once a month or as required and fresh broken stones, broken bricks or cinder filled in.

624 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.

625 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 in co-ordination with the Medical Department whose responsibility lies in either doing it on contract or departmentally.

626 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.

627 Conservancy and Sanitary Arrangements

Conservancy arrangements will be in the charge of either the Medical, or Operating or Engineering Department. Any irregularity noticed in their working should be promptly reported to the officials concerned.

628 Maintenance of Sewerage System

While assisting sewer maintenance crews entering a deep manhole or sewer where dangerous gas or oxygen deficiencies may be present, the following precautions should be taken:

a) allow no smoking or open flames and guard against sparks

b) erect warning signs

c) use only safe gas-proof electric lighting equipment

d) test for noxious gases and oxygen deficiencies (presence of hydrogen sulphide is detected using lead acetate paper and that of oxygen by safety lamps)

e) If the atmosphere is normal, workmen may enter with a safety belt attached and with two men available at the top. For extended jobs, the gas tests shall be repeated at frequent intervals depending on circumstances

f) If oxygen deficiency or noxious gas is found, the structure shall be ventilated with pure air by keeping open at least one manhole cover each on upstream and downstream side for quick exit of toxic gases or by artificial means. The gas tests shall be repeated and the atmosphere cleared before entering. Adequate ventilation shall be maintained during the work and the test repeated frequently

g) If the gas or oxygen deficiency is present and it is not practicable to ventilate adequately before workers enter a manhole, mask shall be worn and extreme care shall be taken to avoid all sources of ignition. Workers should be taught how to use the oxygen hose equipment. In these cases, they shall always use permissible safety lights (not ordinary flashlights), rubber boots or non-sparking shoes and non-sparking tools

h) Workmen descending a manhole shaft to inspect or clean sewers, shall try each ladder step or rung carefully before putting the full weight on it to guard against insecure fastening due to corrosion of the rung at the manhole wall. When work is going on in deep sewers,

at least two men shall be available for lifting workers from the manhole in the event of serious injury

i) Portable air blowers, for ventilating sewer manhole are recommended for all tank, pit or manhole work where there is a question of the presence of noxious gases, vapours or oxygen deficiency. The motors for these shall be of weather proof and flame-proof types; compression ignition-diesel type (without sparking plug). When used, these shall be placed not less than 2m away from the opening and on the leeward side protected from wind, so that they will not serve as a source of ignition for any inflammable gas which might be present. Provision should be made for ventilation and it should be of the forced type which can be provided by a blower located at ground level with suitable flexible ducting to displace out air from the manhole

629 Periodical Cleaning of Drainage System - The following operations shall be carried out during periodical cleaning of a drainage system:-

a) The covers of inspection chambers and manholes shall be removed and the side benchings and channels scrubbed

b) 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.

c) 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.

d) 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.

e) Any defects revealed, as a result of inspection or tests shall be made good.

f) The covers or inspection chambers and gullies shall be replaced, bedding them in suitable grease or other materials; and

g) Painting of ladders/rings in deep manholes and external painting of manhole covers shall be done with approved paints.

630 Covered Stormwater Drains - All stormwater drains shall be periodically rodded by means of drain rods and a suitable rubber or leather plunger. After rodding, they shall be thoroughly flushed with clean water. Any obstruction found shall be removed with suitable drain cleaning tools.

631 Subsoil Drains - 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 Engineer and Staff - The Assistant Engineer and the Section Engineer (Works) should inspect all drainage systems in their charge and ensure their maintenance in an efficient condition. Complaints from residents should be promptly attended to.

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, 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

A. General Approach

1 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.

2 However for guidance, a typical drainage arrangement is given (Fig. 1A, Fig.1B and Fig. 1C) for a common yard configuration with four lines (two main lines and two loop lines).

3 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 arrangement may also be required from the chambers or sumps, for pumping out of water nearest outfall or waterways.

B.Providing drainage in yards

1. 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 “Drainage Plan” shall be developed and got approved. For this, the given in this chapter can be easily implemented.

2.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.

3.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, to divert/modify/re-fix these installations shall be done to avoid the obstructions to the free flow of drainage water.

4.The Planning and Design of the yard drainage system should be carried out in a professional manner.

C. Cross Slope of Track Formation

Top of track formations, for ballasted track as well 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:

635 (i) 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 inners 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.

635 (ii) 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 will increase in the direction of its' bed gradient.

635 (iii) Size and other features 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-à-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. 2 and relevant details of longitudinal drains have been shown in Fig. 2A and Fig. 2B 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 shown in Fig. 1A, Fig. 1B and Fig. 1C

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-1.

635 (iv) 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.

635 (v) 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. 3. 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.

635 (vi) Type, Size and Bed Gradient of Cross Drain

a) The bed gradient of cross drains should be 1 in 350 or steeper to achieve self-cleansing velocity of flow in them also.

b) The cross drain(s) should be 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.

c) For provision of cross-drains in yards beneath the track, Micro-tunneling can also be a useful method for installation. It is a trenchless construction method for installing pipelines that uses a remotely controlled Micro-tunneling 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 Microtunneling Technique for Railway Bridges” (Sep’ 23), Report No. BS-134, issued by B&S Directorate of RDSO, can be referred.(Ref : RB Lr No.2024/CE-I/ACS-12/IRWM dt.13.08.2024)

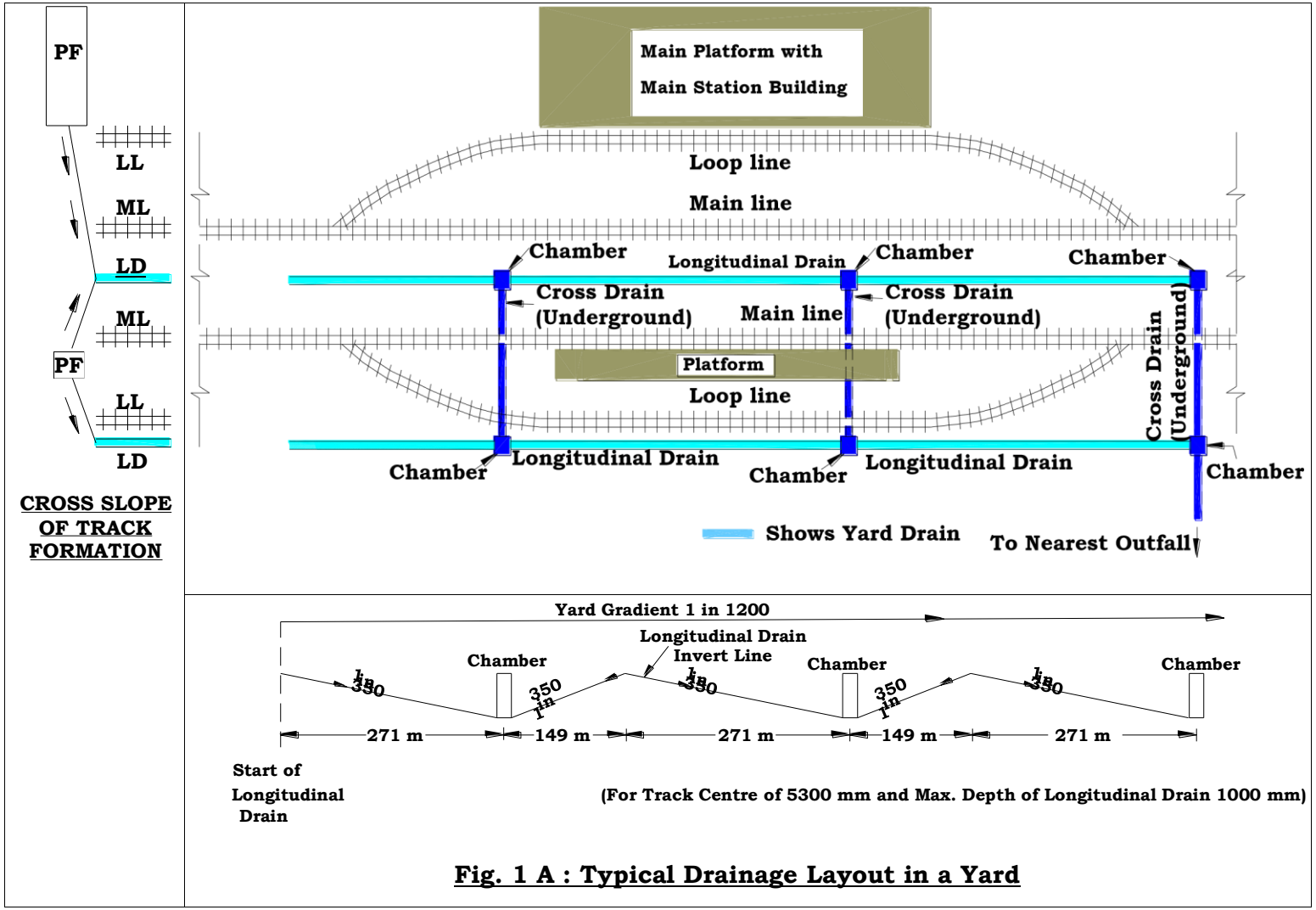


Fig. 1 A : Typical Drainage Layout in a Yard

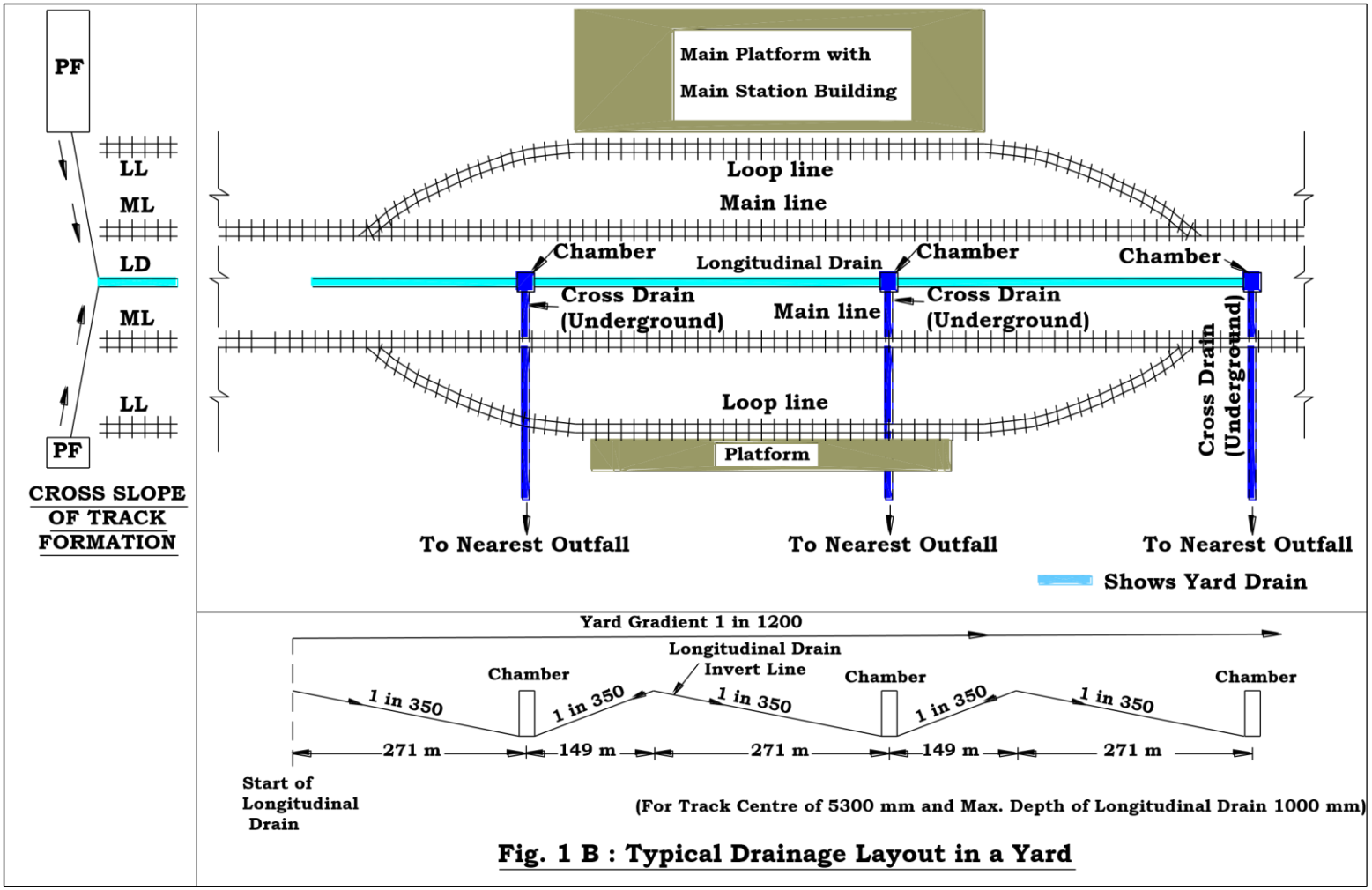


Fig. 1 B : Typical Drainage Layout in a Yard

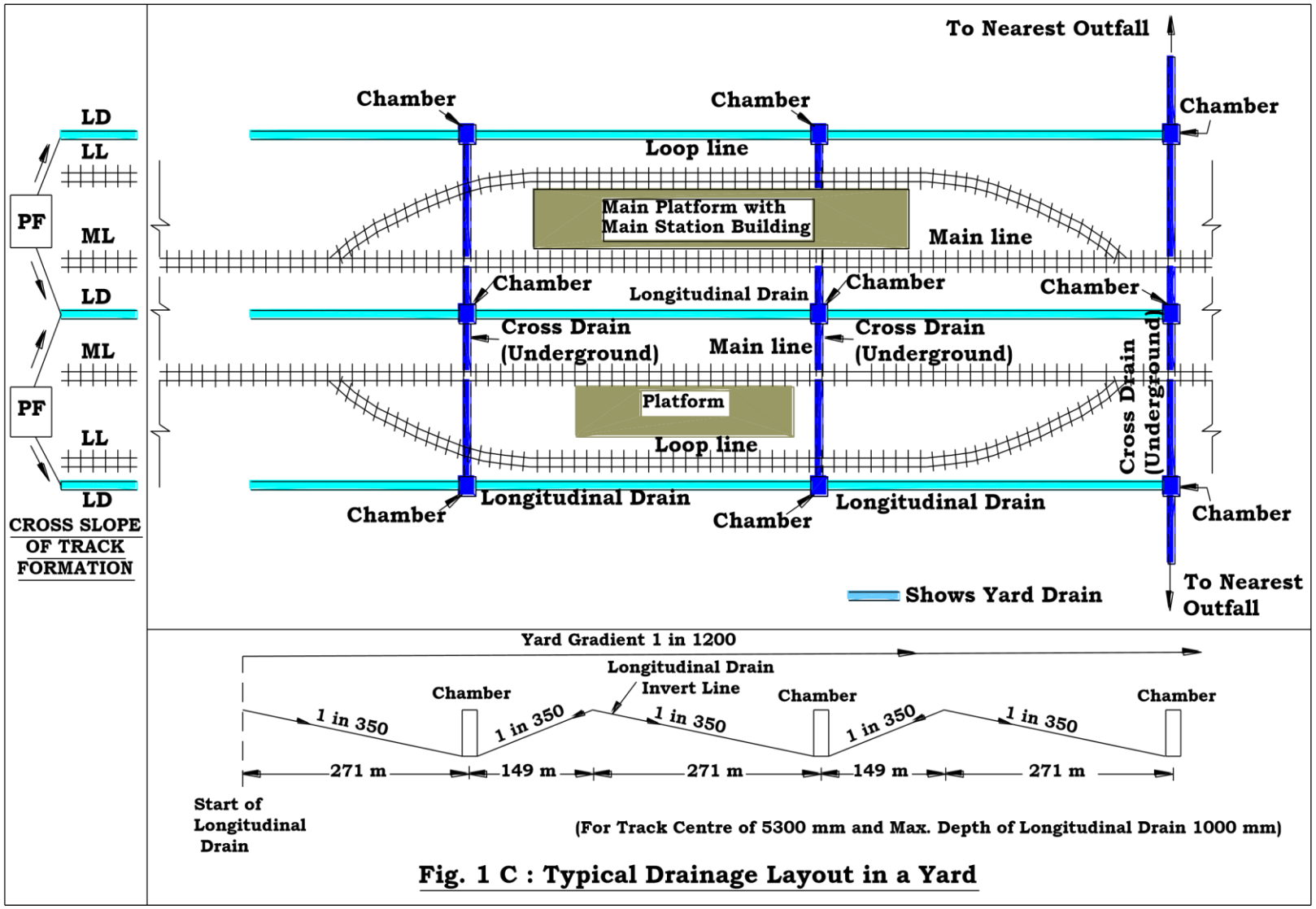
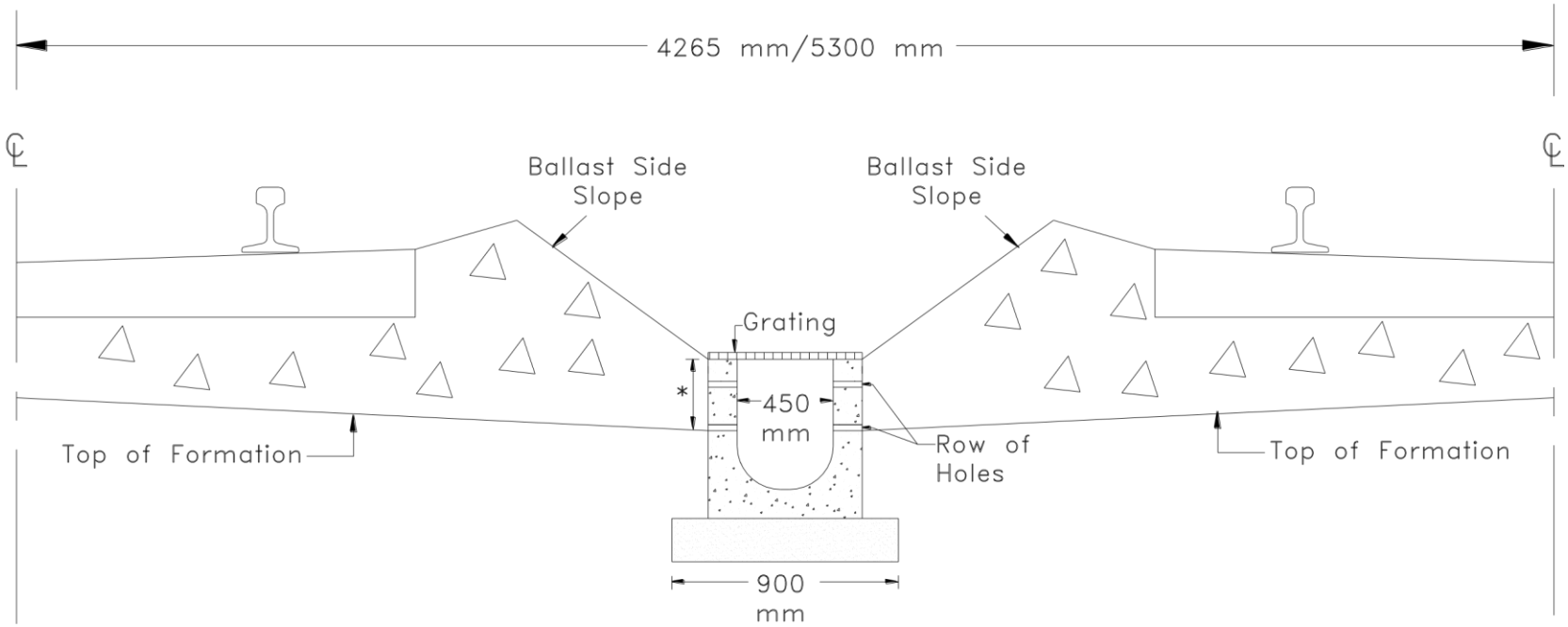


Fig. 1 C : Typical Drainage Layout in a Yard



*** 300 mm/600mm for track centres of 5300mm/4265mm.**

Note: Details of Longitudinal Drain are shown in Fig. 2A and 2B.

Fig. 2: Location of Longitudinal Drain vis-à-vis Adjacent Tracks

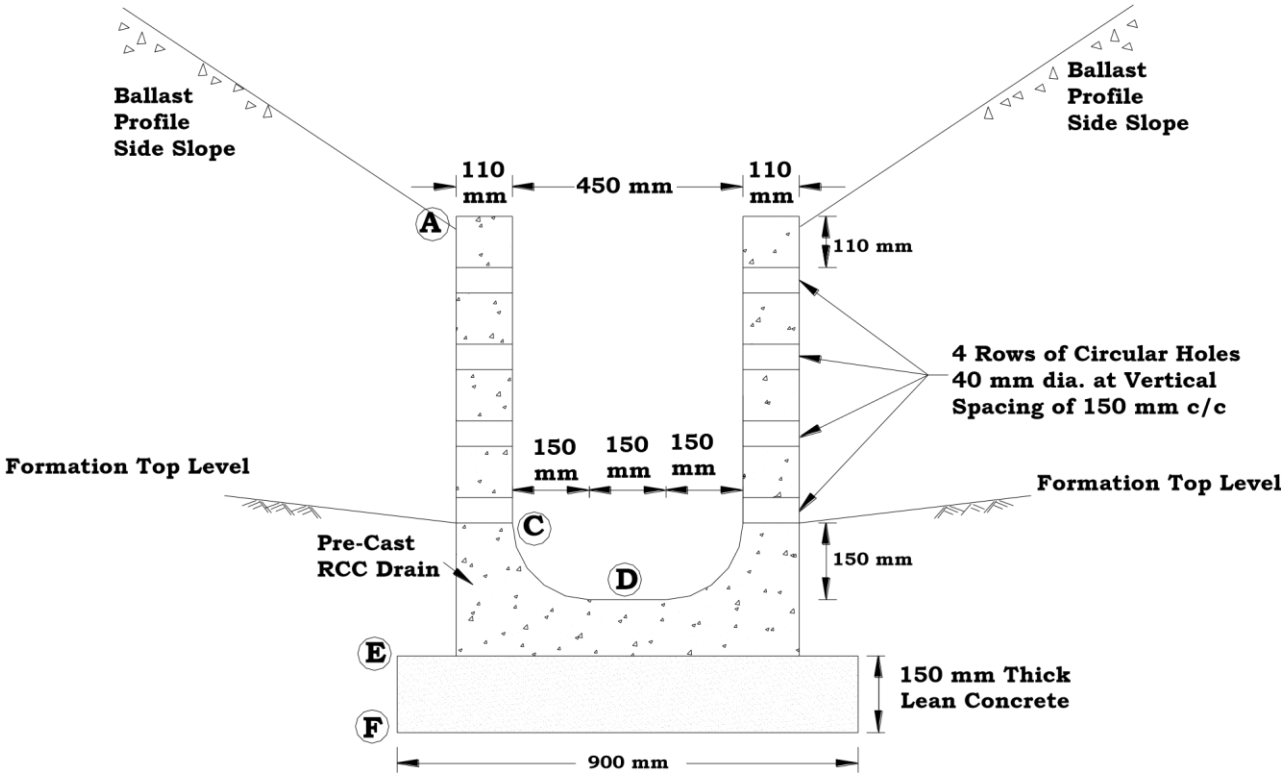
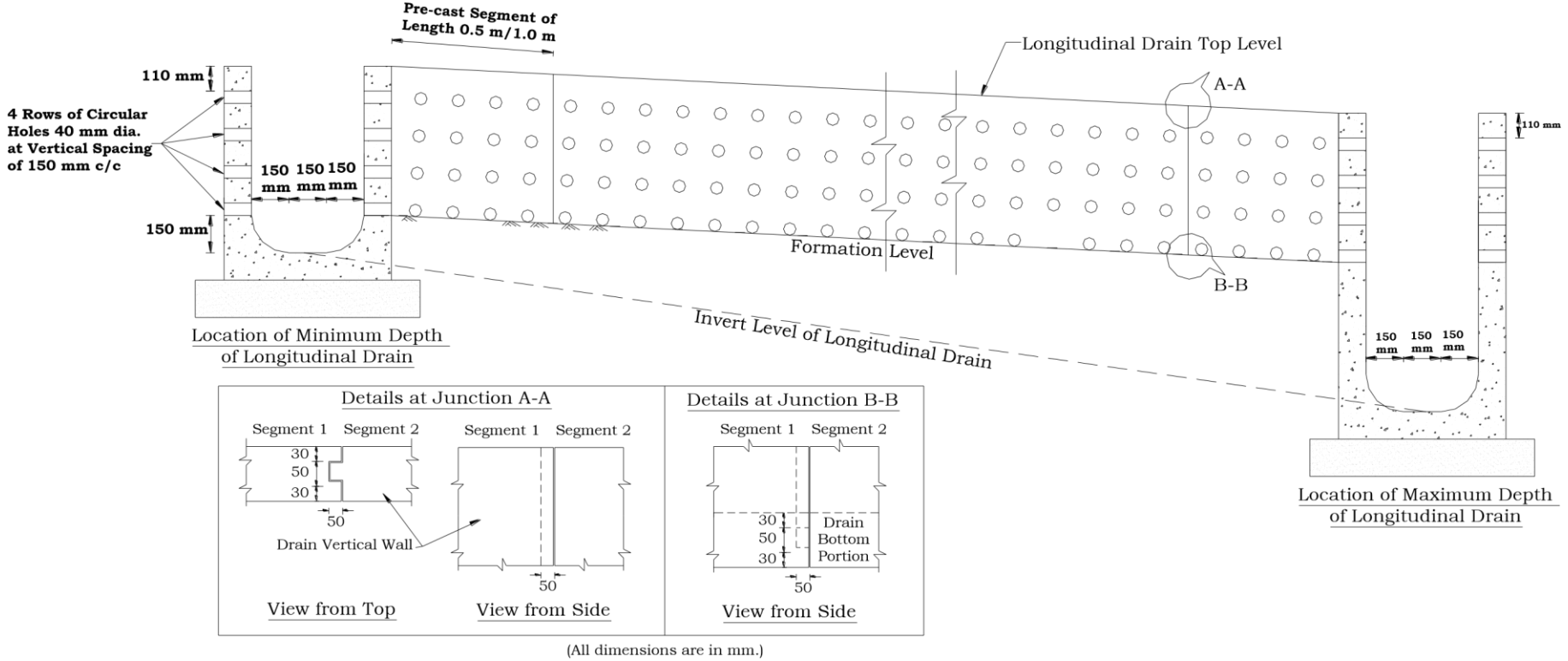


Fig. 2A/1 : Details of Longitudinal Drain (For Track Centre 4265mm)

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)

Levels Table



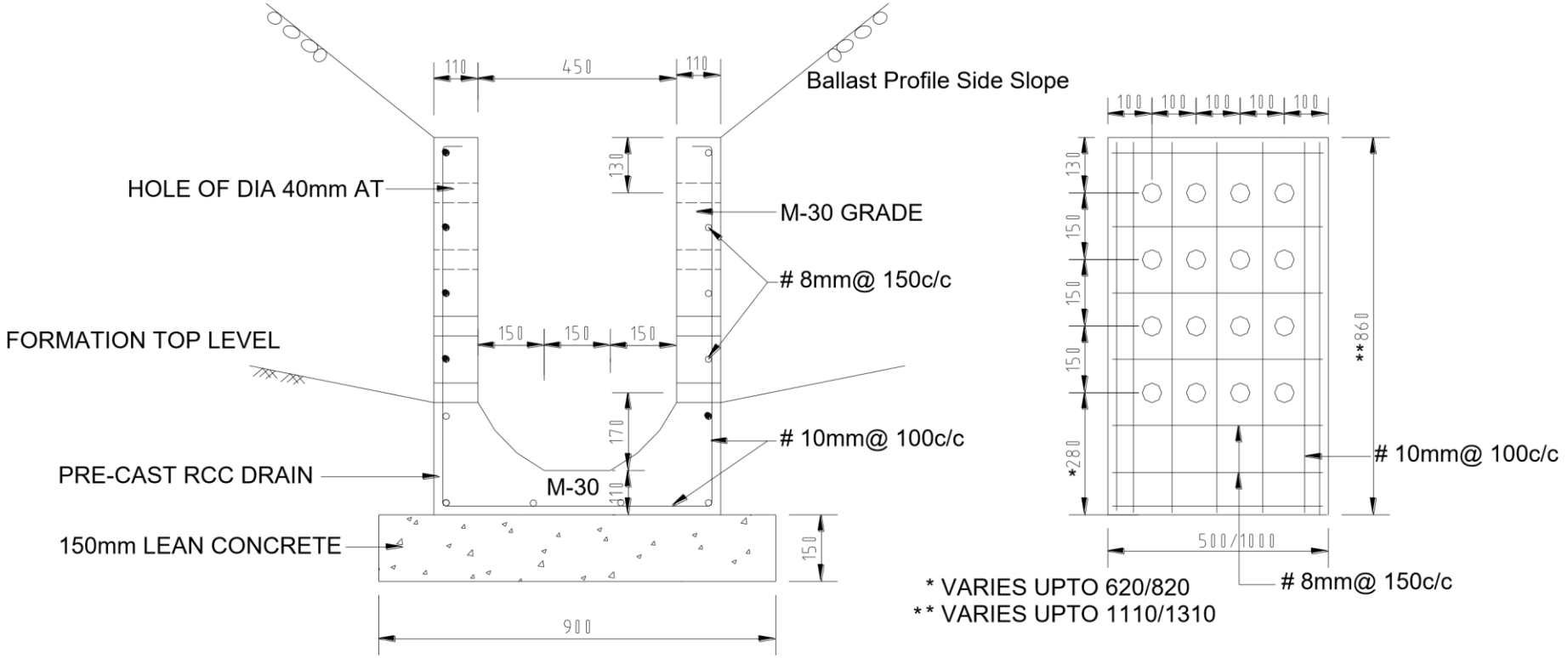
Note: (i) Circular holes of diameter 40mm are provided at horizontal spacing of 100mm c/c, with the centre of first hole being located at a distance of 100mm from the edge of the element. Thus, 0.5m long element will have four (4) holes in each row and 1m long element will have nine (9) holes in each row.

(ii) The bottom most row of holes is located in such a way that 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 four (4) 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 grove in one element and projection in matching element on other side (as shown in details at A-A and B-B above).

Fig. 2A/2 : Side Schematic View of Longitudinal Drain (For Track Centre 4265mm)



150mm c/c

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. 2A/3 : <u>Design / Reinforcement of Longitudinal Drain elements (For Track Centre 4265 mm</u>)

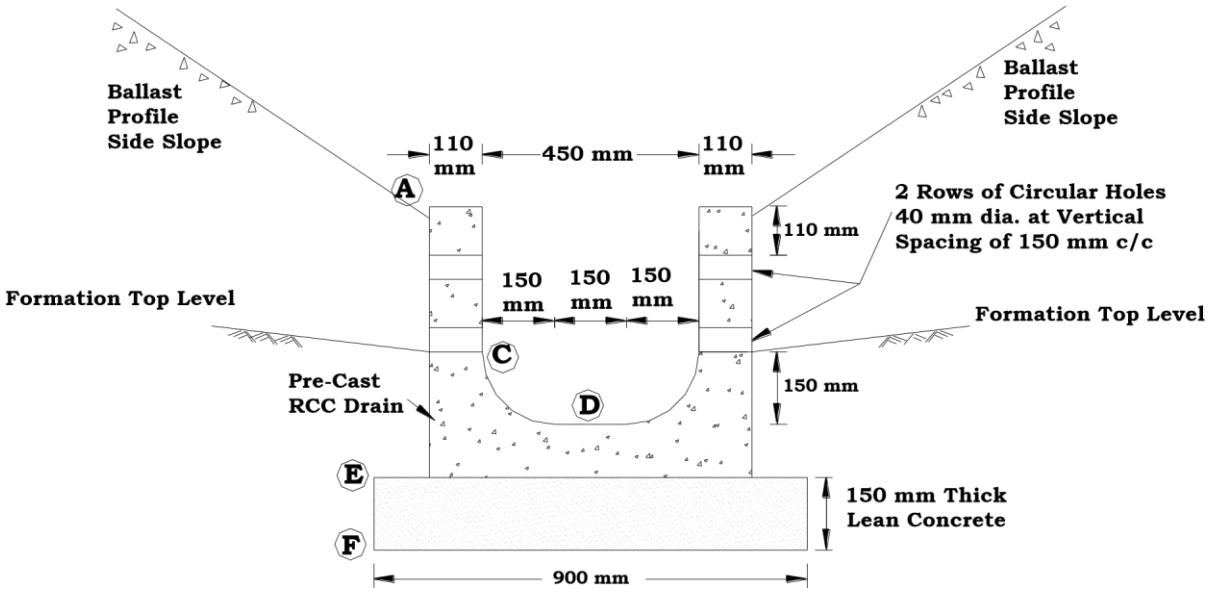
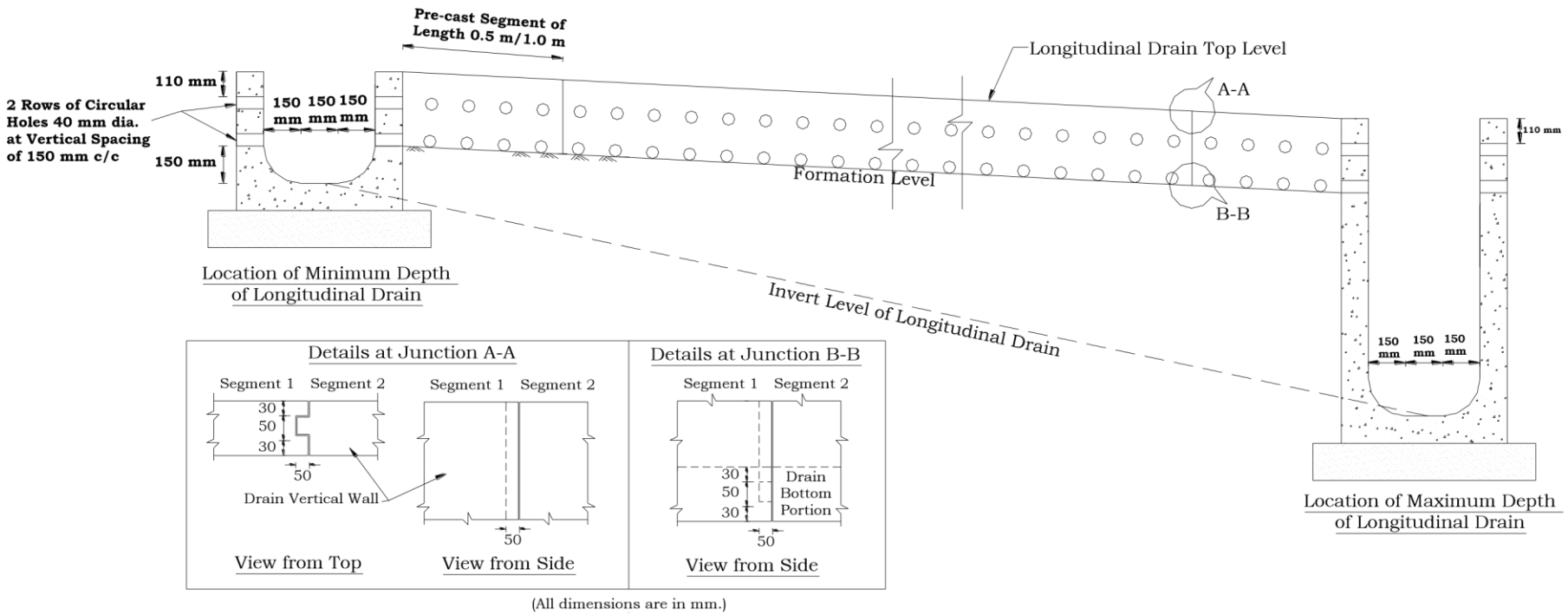


Fig. 2B/1 : Details of Longitudinal Drain (For Track Centre 5300mm)

Location		Levels For drain depth 450mm	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 – 0.424 m	L – 0.424 m
Formation Level	(C)	F = (L – 0.724 m)	F = (L – 0.724 m)
Invert Level of Drain	(D)	F – 0.150 m (L – 0.874 m)	F – 0.900 m (L – 1.624 m)
Bottom of Drain / Top of Footing	(E)	F – 0.260 m (L – 0.984 m)	F – 1.010 m (L – 1.734 m)
Bottom Of Footing	(F)	F – 0.410 m (L – 1.134 m)	F – 1.160 m (L – 1.884 m)

Levels Table



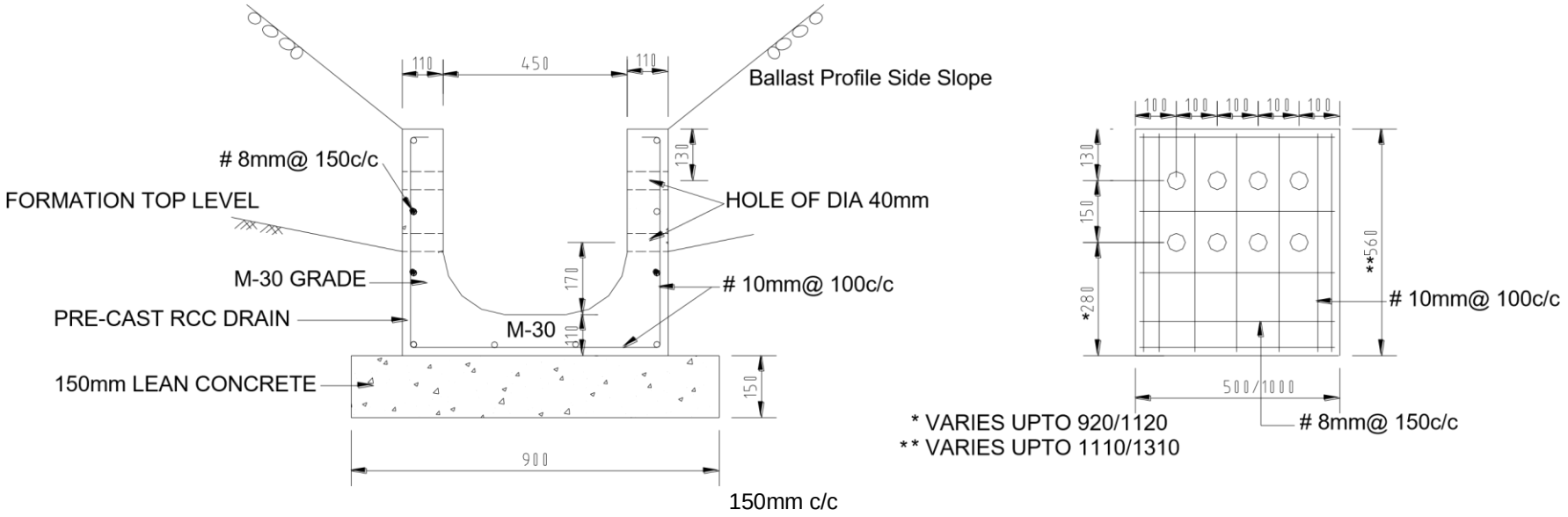
Note: (i) Circular holes of diameter 40mm are provided at horizontal spacing of 100mm c/c, with the centre of first hole being located at a distance of 100mm from the edge of the element. Thus, 0.5m long element will have four (4) holes in each row and 1m long element will have nine (9) holes in each row.

(ii) The bottom most row of holes is located in such a way that 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 grove in one element and projection in matching element on other side (as shown in details at A-A and B-B above).

Fig. 2B/2 : Side Schematic View of Longitudinal Drain (For Track Centre 5300mm)



Note: **(i) Grade of Concrete is M-30.**

(ii) Reinforcement shall be Fe-415 or higher.

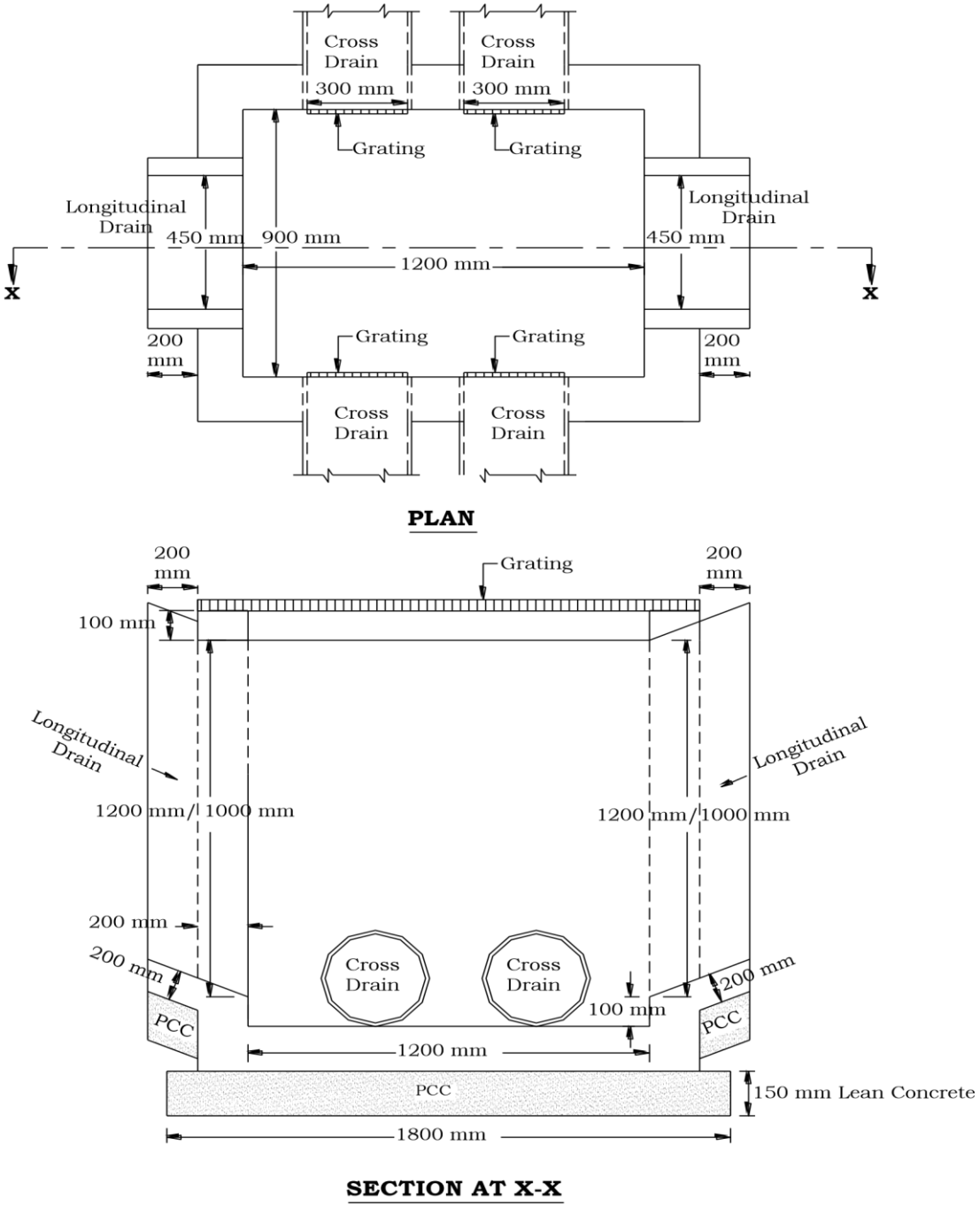
(iii) Clear cover to reinforcement shall not be less than 25mm which may be increased as per exposure condition. (as per Clause No. 15.9.2 of IRS Concrete Bridge Code).

(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. 2B/3 : <u>Design / Reinforcement of Longitudinal Drain elements (For Track Centre 5300 mm</u>)



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.

Fig. 3: Details of Chamber with Cross Drain(s)

ANNEXURE - 1

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 m^3/s);
C = Run-off coefficient
I = Average Rainfall Intensity (in mm/h) lasting for given "time of concentration" & "return period"; and A = Catchment Area (m^2)

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. & Bhusan 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
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 VII

GARDENS & PLANTATIONS, DISPOSAL OF GRASS AND OTHER NATURAL PRODUCTS

A. GARDENS AND PLANTATIONS

701 Role of Engineering Staff -

The Engineering Department is responsible for tree plantation and maintenance of horticulture in common areas in stations, colonies, offices, community parks etc. Staff of other departments should also be encouraged to associate in these activities.

702 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. Provision for this should be invariably made in the estimate. For new colonies/townships, assistance of specialised agencies may be taken for landscaping.

703 Nursery

Nurseries wherever feasible may be maintained to cater to the requirements of the railway establishments. The resources of Forest Department and nurseries in the public/ private sector may be tapped to meet the requirements of the railway.

704 Planting and Care of Young Trees

a) Sites for plantation should be so selected that when the trees grow up they do not interfere with telegraph wires or obstruct the view around curves or of station signals or of level crossings.

Before planting, a pit normally of size ½ sq.m and 1 metre deep should be dug, the soil broken up and the pit well watered. The earth removed from the pit should then be mixed with a mortar-panfull of manure and the mixture replaced in the pit and "flooded" with water.

When planting, it should be seen that the roots are not exposed to sun more than necessary. Water should be fed to the young tree daily until it is strongly rooted, the top surface of the soil being broken up about once a week. At way side stations where Engineering staff is not posted, daily watering may be entrusted to station staff.

b) Soon after planting, the young tree should be supported firmly with a strong and straight bamboo or stake about 3 metres in 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 the 3m stake (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 molestation by goats or cattle.

c) Tree-guards may be made economically from thorns or bricks; old bitumen drums with holes punched in them could be used with advantage where the hot weather is not too intense, otherwise they retain heat and shrivel up the young plants.

705 Maintenance of Gardens in Offices, Rest Houses and Colonies

(a) The responsibility of maintaining hedges, lawns and shrubberies attached to offices, rest houses and playgrounds and in colonies in a satisfactory condition devolves on the garden staff attached to the division/ district. Where such gardens are small, the watchman should maintain them in a satisfactory state.

b) The Section Engineer (Works) should pay requisite attention to the cleanliness of rest house compounds and upkeep of gardens. Shrubs and seedlings should be obtained when required from the divisional/district nursery.

B.GARDENS IN OFFICERS' BUNGALOWSAND SENIOR SUPERVISORS' QUARTERS

706 Maintenance

Railway premises occupied by Officers and Senior Supervisors should be kept in a neat and tidy condition. Gardens within compounds should be maintained to a satisfactory standard.

707 Incidence of Service

Where hedges and lawns in bungalows are maintained by the railway, the incidence of service should generally be as follows, with variations as necessitated by climatic conditions being allowed for:-

(i) Hedges:

Hedge cutting	..	Once in 2 months
Watering	..	Once a week till the hedges are fully grown and then once in 2 months

(ii) Lawns:

Mowing	..	Once a month
Watering	..	Once a fortnight and once a week in summer
Weeding	..	Once a month

708 Provision of Lawns and Hedges In New Bungalows

The following schedule of plantations may be adopted as a guideline:-

	Officers' Bungalows	Type IV Quarters
Lawn	200 sq.m	75 sq.m
Hedge	200 m	100 m

The cost of initial plantation should be borne by the railway against approved estimates.

C. SALE OF NATURAL PRODUCTS

709 (a) By Auction or By Tender

The natural products 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, 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 Engineer about one month before the commencement of the season. The products of fruit-bearing trees in the compound of residential quarters can be enjoyed by the residents, but the products cannot be sold.

(b) To State Forest Corporations etc.

The matured trees can also be sold to State Government agencies like Forest Development Corporations on the approved rates.

(c) Division of lots

Schedules of lots in convenient lengths for each kind of natural product to be sold, should be prepared by Section Engineer (Works/P.Way) and submitted to the Divisional Engineer through AEN.

710 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. 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 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.

711 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.

Auction notices should show (i) the date, time and place of auction, (ii) full particulars of the products 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.

Sealed tenders on prescribed forms for sale of natural products may, alternatively, be invited by the Divisional Engineer and agreements entered into.

712 Recording & Finalisation 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.

a) At the foot of the bid list, the Assistant Engineer should certify as follows:-

"I certify that I personally conducted the auction and the above is a true statement of the products sold and the prices realised."

b) 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 products 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.

c) 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 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.

d) 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 Engineer and the Inspector. The original agreement should be sent to the Accounts Department for record.

e) After the advice is given to the successful bidder regarding the acceptance, the responsibility for watching the products 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.

f) 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 of the employee with longer service shall be accepted. Engineer should take into account the 'locus-standi' of the bidders concerned.

In case of lease of right of fishing by public auction or tender, the first preference should be given to Fishermen's Co-operative Societies formed by Railwaymen. If no such society exists, the second preference should be given to other Fishermen's Co-operative Societies. If no such Society exists, it may be let out to others by open public auction or open tender.

713 Register of Sales of Natural Products

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, initialled by the Divisional Engineer.

714 Licensing of Tanks and Borrow Pits for Pisiculture

For licensing the borrow pits and tanks for pisiculture, preferences shall be given to

co-operative societies formed by railway employees. The period of such licensing can be from 1 to 5 years and the licence fee is to be fixed on merits in consultation with FA & CAO.

D. FELLING OF TREES

715 Felling of trees obstructing view

(a) 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.

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 Engineer who will satisfy himself that no risk of trees falling across the line is taken. The following are among the relaxations:

(i) Trees may be reduced in height by lopping the top branches to obviate danger of obstruction.

(ii) 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.

(b) 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 purchase 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.

(c) 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.

716 Felling Outside Railway Limits

When trees and bushes which interfere with the view of signals or level crossings are on private land, steps to clear the obstructions should be taken as laid down in section 14 of the Indian Railways Act 1989.

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 Engineer.

718 Felling Near Electrical or Telegraph Wires

Trees in close proximity to electrical or communication lines should not be cut nor the branches lopped except in the presence of staff of the Electrical or Telegraph Department as the case may be.

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. Minor modifications to suite the situational need may be made in the proforma prescribed by the Railway Board, 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 704 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 for that year and information should be furnished in the proforma as detailed below:

Location of trees	Type of Trees	No.of trees more than 50 cm girth	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 Section Engineer (Works /P.Way) in-charge.

The information with regard to number of trees planted, cut and perished have to be maintained in another Register.

A 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 atleast double of the number 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.

723 Training of Staff

The malis and supervisors should be trained using facilities available with state government institutions or elsewhere.

CHAPTER VIII

A. ACQUISITION, MANAGEMENT & DISPOSAL OF LAND

801 General

a) The law regarding acquisition of land is embodied in the Land Acquisition Act of 1894 (as amended by the Land Acquisition Amendment Act No.68 of 1984). The important sections of this Act are reproduced as Appendix II in the Indian Rlys. Code for the Engg. Deptt.(1993 Edition).

b) 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. Deptt.(1993 Edition):-

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

c) 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

a) 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.

b) 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.(CS No.6 Dt.21.12.01)

c) The rights for quarrying and mining in railway land shall be governed by the provisions contained in paras 814 & 856 of the Indian Rlys.Code for the Engg.Deptt.(1993 Edition).

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,

a) While acquiring land for major projects, alignment should be fixed in such a way that minimum extent of agricultural land is involved.

b) In case of urgency, the application should be made to the Collector under Section

17 of the Act. As per this Section the land can be occupied on expiry of 15 days after publication of notice under Section 9(i) of the act.

c) 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.

d) 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 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. As the Collector of the District will be called upon under section 15 of the same Act, to assess damage and compensation, he should be advised of the entry within 24 hours.

e) It will be in the interest of the Administration if the Assistant Engineer or Section Engineer (Works) 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.

f) 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.

g) 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.

h) For acquisition of forest land, the procedure laid down in paras 857 and 858 of the Indian Railways Code for the Engg. Deptt. (1993 Edition) should be followed.

a) 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.

804 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. Deptt. (1993 Edition).

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.(CS No.6 Dt.21.12.01)

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 scrutinised 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 f or 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. Deptt (1993 Edition) in cases where Railway land is transferred to a State Government and where the capitalised 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 capitalised value. In the case of land disposed of to private parties, the refund of the capitalised value of land revenue by the State Government will not however be necessary.

f) In all other cases, land will be disposed of at the highest offer and also if that is considered reasonable.(CS No.6 Dt.21.12.01)

g) In respect of relinquishment of railway land in favour of the State Government or outsiders for the approaches of ROBs/RUBs, specific approval of the Railway Board should be obtained irrespective of the value of land involved.

h) Railways should include contingency charges @ 3% in all the relinquishment estimates to cover incidental charges incurred during the process.

i) Powers of sanction - In all cases of disposals, conditions of restriction of uses agreed upon if any by both the parties may be embodied in the transfer or sale deeds. When the estimated value exceeds Rs. 5 lacs, a prior reference should be made to the Railway Board.(CS No.6 Dt.21.12.01)

805 Outstanding Cases of Acquisition and Relinquishment of Land

Half yearly lists of outstanding cases of acquisition and relinquishment of land should be prepared by theDivisional Engineer, district wise and state wise. These should be sent to concerned collectors for necessary action with copies sent to the Chief Engineer for information and record.

B. LAND RECORDS, DEMARCATION AND VERIFICATION OF RAILWAY BOUNDARIES

806 Land Records in C.E.'s Office

a) Vide para 850 of the Indian Railways Code for the Engg. Deptt. (1993 Edition) a complete series of land plans for the entire Railway should be maintained in the Chief Engineer's office. The original tracings that are duly certified by the State Governments should be kept as permanent records in the C.E.'s office. Sufficient copies of certified plans after carrying out necessary consolidation and mutation should be made out and supplied to the Divisional Engineers for reference, a copy being kept in the cover of each relevant file.(CS No.6 Dt.21.12.01)

No notings should be made on certified plans and declarations nor on important letters from the State Governments in connection with acquisition or relinquishment of land as these may, at times, be required in a Court of Law to prove the Railway's title.

b) Land Records Registers should be maintained in the Chief Engineer's office as per the following proforma (Table 8.1.) in which all details of transactions, both acquisition and relinquishment should be noted.

Table 8.1.

LAND RECORDS REGISTER (CS No.6 Dt.21.12.01)

Division ..... Railway ..... Section .....

Engg. Divn.	Land Plan No.	Stn. or Kilometrage	Description	Area (in hectares)
(1)	(2)	(3)	(4)	(5)
Cost of land acquisition/ relinquish-ment	Reference to corres pondence	Govt. Resolutions & date of sanctioning the transfer of land	Date of consolidation/ mutation with Revenue authorities	Remarks
(6)	(7)	(8)	(9)	(10)

c) 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 Section Engineers (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 Chief Engineer's office.

d) **Micro-filming** - All certified land plans shall be transferred as micro-films, 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 Supervisors/AENs/DENs. (CS No.6 Dt. 21.12.01)

807 Land Records in Divisional/ Executive Engineer's Office

a) Divisional/Executive Engineer's shall be responsible to ensure that records of title are carefully preserved and kept upto date by noting all changes on the copies of authorised land plans in their possession. All land plans should show complete dimensions preferably with boundary stones and their numbers.

b) Land Records Registers as per para 806(b) should be maintained in the Divisional/ Executive Engineer's office.

Entries in the Land Register should be duly initialled by the Divisional/ Executive Engineer's, as and when any transaction takes place.

c) After land acquisition proceedings are completed, the original papers viz. the notifications, awards, certificates of handing over and taking over of land and final land plan and schedule signed by the Collector should be separately bound together and carefully preserved. These documents should be kept in the custody of the head or Chief Draftsman of the Drawing office and these records should be properly handed over whenever there is a change in the incumbent of the post.

d) 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 (CS No.6 Dt.21.12.01)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 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.

e) Final land plans, after mutation entries are carried out, should be sent to the 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, AENs, and Section Engineers (Works/P. Way).(CS No.6 Dt.21.12.01)

f) 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 :-

(i) Land Records Register (Table 8.1) duly filled in; and

(ii) The original papers viz. the notifications, awards, certificates of handing over and taking over of land and final land plan and schedule signed by the Collector, separately bound together.(CS No.6 Dt.21.12.01)

808 Demarcation of Land Boundaries

For proper demarcation of land boundaries para 1047 of the Indian Rlys. Code for the Engg. Deptt. (1993 Edition) provides as under:

i) 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.

ii) 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.

iii) 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.

iv) 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.

v) Detached marks should, in no case be at a greater distance apart (centre to centre) than 50 (fifty) meters.(CS No.6 Dt.21.12.01). 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 recognised.

vi) Each detached boundary mark should bear a number. The position and number of each detached boundary mark should be shown on the land plan.

vii) 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

a) The boundary stones may be of suitable size and section, projecting about 500 mm above ground and inscribed with appropriate letters e.g. NR for Northern Railway 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. On the telegraph post side preferably, the boundary stone may be serially numbered 1,3,5 and so on in ascending order of kilometrage, those

on the opposite side being numbered 2,4,6 and so on, the number starting from a kilometre post and ending at the next kilometre post where the numbers should begin afresh. The stones should be kept clear from jungle growth or shrubs for at least 1 metre all round within the Railway limits.

b) Boundary stones should be fixed at every point of change of alignment. In hilly country 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 (i) 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 (Letter No. 80/W2/14/0/APT dt. 2.9.93)

(b) In other areas instructions as per para 3715 of Way and Works Manual should be strictly followed.

811 (ii) 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.

811 (iii) Other preventive steps as:-

(a) Identification of vulnerable areas.

(b) Plantation of Juli Flora or similar effective bushes in the area.(CS No.6 Dt.21.12.01)

(c) Ensuring proper maintenance of boundary pillar.

(d) Preventing unauthorised entry of road vehicles into railway land threatening side collision with trains, through Plantation/fencing should be done.

(e) Construction of structures and unauthorised hutments obstructing the

visibility to road users at the unmanned level crossings should not be permitted.

(f) Interaction with local authorities for assistance in preventing encroachments in these areas.

(g) Joint visits of the vulnerable locations by representatives of concerned departments along with civil authorities (wherever required) with a view to create adequate impression in the locality that Railways are serious in preventing encroachments in the areas.

812 Land Plans.

(a) Up to date land plans should be available in the Divisional Offices and copies should be made available to the Field Inspectors whenever required in connection with any work. Non-availability of land plans should not be a ground for wrong demarcations of land boundaries while dealing with outsiders.

(b) Copies of certified land plans pertaining to their jurisdictions showing complete dimensions, should be in the possession of the Assistant Engineers, Section Engineer (Works /P.Way)

Every Section Engineer (Works /P.Way) will maintain a land record as per para 806(b). From time to time all entries in the Register be made up-to-date. During important inspections of higher officers from the Headquarters and Railway Board, the register will be kept by the AEN with him. Land Records Register should be checked annually by AEN/ DEN/Sr.DEN and observations recorded on them should be followed by Section Engineer (Works/P.Way)

813 Verification of Land Boundaries and Encroachments (CS No.6 Dt.21.12.01)

a) Vide para 1048 of the Indian Railway Code for the Engg. Deptt. (1993 Edidtion) 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.

b) "The Section Engineer (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 Section Engineer (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 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".(CS No.6 Dt.21.12.01)

c) The Section Engineer (P.Way) shall inspect and maintain the Railway land boundaries between stations and at unimportant stations. The Section Engineer (Works) shall inspect and maintain the land boundaries at important stations and staff colonies.

(d) 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 Section Engineer/(Works/P.Way) of the respective sections and verified / inspected by the Asstt. 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 Section Engineer (Works/ P.Way)'s jurisdiction. A certificate on the following proforma should be given by the Section Engineer once a year which is to be verified and counter-signed by AEN with regard to correct demarcation of land boundaries.

Certificate for Land Boundaries verification is given below:

LAND BOUNDARIES VERIFICATION CERTIFICATE

Year _____ Section_____ Kms._____ to_____

Section Engineer (P. Way/Works)_____Sub Division_____

Division_____(CS No.6 Dt.21.12.01)

I,_____Section Engineer (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 kilometerages that have been reported upon vide reference given against each.

Details of encroachments (CS No.6 Dt.21.12.01)

Station pre-mises/ colony /mid sec tion	Location		Rly emplo yee/ outsiders persons /others	Soft /hard	Area in Sq.m.	Value of land approx.		Approx. period since encroa chment existing	Purpose: Personal /Com-mercial /religious /Social/ other	Action taken to remove	Remarks
	KM/ EM Station (from -to)	Reference to encroach ment plan				Value	Basic market rate/ notified rate/ Rough assess -ment				
1	2	3	4	5	6	7	8	9	10	11	12

I further certify that wire fencing and/or boundary stones are available at all locations except at the Kilometerages shown below for which action to replace the same is indicated against each location.

Details of missing boundary stones (CS No.6 Dt.21.12.01)

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 land plans pertaining to the above mentioned Section Engineer (P. Way/ Works)_____are available with him except the following.

_____
Asstt. Engineer/

_____
DEM/Sr. DEN/

_____
Chief Engineer/General

e) During his inspections, the Assistant 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 - a) 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 Unauthorised 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.

b) When an encroachment is in the process of building up, it should be removed then and there. In case the new encroachment is sought to be built by force, the Section Engineer will immediately contact his AEN and DEN, the Security Officers (RPF) of the Railway, the Civil and Police officers of the District (directly or through AEN/DEN) in writing as well as by personal contacts without loss of time to ensure that the new encroachment is not allowed to come. The Station Master, Chief Goods Clerk, RPF Inspector, and other Section Engineers also will be equally responsible for taking similar action in their areas of responsibility as per para 815 of the Manual. Headquarters Office should also be contacted without loss of time if necessary.

The Section Engineer/Section Engineer of workshop concerned/Station Master/Chief Goods Clerk will call on the gangmen, khalasis 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 efforts 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.(CS No.6 Dt.21.12.01)

c) 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.

d) Every year, at the close of financial year, detailed survey of encroachments must be made under the following categories :-

i) CATEGORY - A Encroachments by outsiders removal of which requires actionunder Public Premises Eviction (PPE) Act.

ii) 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, cowdung, refuse etc.)

iii)CATEGORY- C) Encroachment by Railway staff in the form of temporary huts etc.

iv)CATEGORY - D) Encroachment by Railway staff who have been allotted railway accommodation, by way of additions to the structures, unauthorised 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.

e) The Section Engineer (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 at least once in 3 months.

Section Engineer (Works/P. Way)(CS No.6 Dt.21.12.01) shall give a certificate in the following proforma, once in three months which shall be verified and countersigned by the AEN.

"I....., Section Engineer (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/-
Section Engineer (Works/P. Way)

AEN 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.

Encroachment plans to scale shall be made for every encroachment. These encroachment plans alongwith details of encroachment as per Annexure 8.2 should be checked and signed by Section Engineer (Works/P. Way)/AEN. Records of such encroachment plans should be kept in the Divisional office and these encroachment plans should be handed over and taken over by Section Engineer (Works/P. Way)/AENs at the time of change of charge.

A copy of encroachment plan should be available with Section Engineer (Works/ P. Way) /AEN/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 Section Engineer (Works/ P. Way) to SMs/RPF inspectors/Workshops Supervisors in charge etc.

(f) Steps to control the unauthorised use of Railway land.

Following further steps should be adopted to control the unauthorised 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 is used may be classified as pucca structure.

(ii) For alteration /addition of any temporary structure, written sanction of AEN should be necessary.

(iii) Plans for commercial plots at various stations should be approved jointly by Divl. Engineering and Commercial Officers and at site demarcation of the plots should be done with rail posts by Engineering Deptt. Whenever any commercial plot is licensed the Commercial Department should give a copy of the allotment letter to the Engineering Deptt. so that Section Engineer (Works) can ensure against any unauthorised 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 Deptt. 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/ shurbs including quick growing thorny trees like Prosopis Juliflora (Vilayati Babul) should be adopted.

(g) Eviction process shall include inter alia:- (CS No.6 Dt.21.12.01)

(i) Identification of the existing encroachments.

(ii) Ensuring that all the cases under the PPE Act have been filed.

(iii) Estate Officers should expedite finalisation of the cases pending with them.

(iv) Action for possession in accordance with the extant orders where eviction orders are received.

(v) Mobilisation 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 finalisation 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 :

a) At stations, the Station Master, jointly with nominated/senior RPF Inspector, will be reponsible for preventing encroachments and for driving out trespassers by obtaining help also from RPF, Police and Section Engineer (Works/P.Way) as necessary

b) 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 Section Engineer (Works) as necessary.(CS No.6 Dt.21.12.01)

c) 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, as may be found necessary.

d) Whenever an encroachment incipient or otherwise is noticed in the station area, the Station Master/Chief Goods Clerk should take immediate action to have it removed. Assistance from the RPF and Engineering staff should be taken as necessary.(CS No.6 Dt.21.12.01)

e) At station, where Section Engg. (Works) is not posted, but Inspector/RPF is there, then the Inspector/RPF is responsible for checking fresh encroachments.

f) In case of locosheds/workshops, concerned (nominated) departmental supervisor (e.g. Section Engineer (C&W) for coach manufacture depots etc.) along with RPF Inspector shall be jointly responsible.

g) While instructions contained in this para (a) to (d) 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.

h) 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 finalisation of the proceedings. Adequate training may be provided by IRICEN/ Pune to the Estate Officers to make them

well conversant with the provsions 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 judgements on the appeals against the orders of Estate Officers

i) 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.

815-A Action to be taken while handing/taking over of charge by Supervisors.

(a) A joint field check on the existing encroachments will be mandatory part of the Handing over/Taking over of the Section Engineer(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 Supervisor.

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 (b) 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.

815-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.(CS No.6 Dt.21.12.01)

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 Rights of Way

a) The Assistant Engineers and Section Engineers (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.

b) So as to assert the right of ownership as against any public claim of way, roads and authorised 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 Senior Supervisors to their Assistant 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 lie, for the information of the public. In case of important roads such notices should be published in the local newspapers.

818 Religious Structures

a) 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.

b) In regard to existing licenses for prayer platforms, shrines, temples, mosques, graves and tombs etc. on Railway land, the Assistant 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 (a) 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 Senior Supervisors should keep a constant look-out for un-authorised extension of existing structures or construction of new structures and report such occurrences at once to the Assistant Engineer.

c) In case unauthorised extensions or new constructions are noticed, it should be possible for the Assistant Engineer and Staff to persuade those concerned, to desist from further construction. If required the Assistant 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 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 regularisation of the encroachments.

d) Licensing of the area or regularisation of the religious structures may be limited to maximum of 500 sq. metre in each individual case.

e) Nominal license fee fixed for the purpose will be charged in respect of religious and welfare organisations, as decided by railway administration from time to time.

C. MANAGEMENT OF LAND

819 Basic Principles

a) The basic principles of management of Railway land are contained in paras 1008 to 1034 of the Indian Railways Code for the Engg. Deptt. (1993 Edition).

b) All leases and licenses should be covered by agreements in the approved form.

820 Lease And License

Railway land is given out on license only. Request of Government Departments for lease may be considered on merit. Leasing of land is not permitted except in cases where it is approved by the Railway Board.

821 Utilisation And Development Of Available Land

a) Licensing of land by the Railways is permitted only for purposes connected with the railway working.

b) In all cases, the license fee shall be fixed by the General Manager keeping in view recommendations of the committee of Heads of Departments {see part (d) of this para}.

c) Licence fee of plots should be fixed as a percentage of the land value determined as per the procedure detailed below. The percentage applicable to various types of plots will be as under :

	Type of Plots	Annual licence fee as a % of land value *
(1)	Commercial plots - for city booking agencies, out agencies etc.	6%
(2)	Ordinary commercial plots without structures.	6%
(3)	Ordinary commercial plots - with temporary structures for stacking/ storing.	7.5% for the whole area allocated including covered area.
(4)	Steel yards/coal dumps, bulk oil installation etc.	10%
(5)	Land used to lay private sidings	6%
(6)	Shops, Retail oil depots etc.	20%

▪ Fixing of land value :

As the end use of the land licenced for the above purposes is generally directly related to traffic movement, it does not bear any direct relation to the land value advised by the Revenue authorities etc, which is for a different end use. A market value would however be required to be taken to serve as a base value for working out rental fee payable. This shall be fixed on the basis of the land value of the surrounding area as on 1.1.1985, as determined from the Revenue authorities and/or from the following :

(i) Evaluation of Town Planning Department

(ii) Actuals as per PWD and CPWD transactions

(iii) Actual transactions, as per documents filed in the office of the Sub-Registrar

(iv) Value of land as assessed by professional evaluators of the State and Central Governments.

In case it is not possible to obtain land value as on 1.1.1985 and in case where the land rates are readily available as on 1.4.1986 the cut-off date of 1.4.1986 may be adopted.

The value so fixed shall be increased notionally every year on the 1st of April, starting from 1.4.1986, at the rate of 10% over the previous year's value to arrive at the land value for the following year based on which the licence fee to be paid shall be fixed. Once the notional value has been so obtained it shall apply to all plots at that station.

However, for the Metropolitan towns of Mumbai, Calcutta, Delhi and Madras if the Standing Committee of Head of Department (see part (d) below) feel that the land rates are widely varying within the city, two or more rates can be utilised for that city.

d) *Standing Committee of Head of Departments*

A Standing Committee of three HODs will be set up at the Head quarters of each zonal railway and other railway units. The Standing Committee shall normally consist of CE, CCM and FA&CAO. The broad functions of the Committee, inter alia will be as follows :

(i) To fix the rental value using the procedure detailed above; and

(ii) To review annually whether the traffic commitments by the licensees of the commercial plots have actually materialsed or not and in case of any deviation, initiate suitable corrective action including de-licensing and vacation as necessary.

e) *Minimum licence fee*

The minimum licence fee in respect of plots covered above should be Rs.1000/- per annum.

f) *Revision of licence fee*

As the national land value will increase by 10% over the previous year's land value as mentioned above, the licence fee will automatically go up by 10% over the previous year's fee from the first of April every year. Suitable provisions, with the schedule of payment due should, therefore, be incorporated in the Agreement.

The termination/renewal date of the agreement should always be the end of the financial year so that there is no confusion and a better watch is kept on renewals.

g) *Powers of licensing and renewals*

Fresh cases of licensing of plots connected with Railway working and mentioned at (5) of part (c) above will be approved by the GM, on recommendation of the HODs Committee. As regards plots mentioned at (6), viz., shops, retail oil depots etc., as already stated, the railway administration has no powers to enter into fresh licensing for purposes unconnected with Railway working.

h) The licence agreement shall provide for Security Deposit and Liquidated Damages in terms of instructions contained in para 1025, 1026 and 1027 of the Indian Railways Code for Engg. Deptt.(1993 Edition).

i) No permanent structure is allowed to be put up on land licensed for commercial purpose.

j) *Licensing of Land 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 despatched 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 despatched 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 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 works inspector and one for the station master.

The Section Engineer (Works/P.Way) should ensure that in all cases where railway land is licensed, the allotted area is not infringed by the licensees. He should report to the Assistant Engineer regarding such cases where he cannot successfully get the licensees to adhere to the limits of the plots allotted to them. The Assistant Engineer should then take up the matter at a higher level.

k) *Licensing Of Land For Short Duration*

Temporary licensing of land for conducting exhibitions, melas, carnivals, circus shows and such other cultural activities including temporary shops on such festive occasions, should be permitted subject to a maximum of three months with the personal approval of the General Manager. The power is not to be delegated to the lower authorities. The usual safeguards in regard to recovery of license fee and taking back the railway land after the period of license in original condition as also the licensees abiding by the terms and conditions of the local authorities, should be kept in view while licensing the Railway land. The rate of license fee should be fixed at 20% of the market value of land for shopping etc. However, when more than one party is involved, open auction may be done to fetch better value.

l) *Renewal Of Licenses For Shopping/ Teh Bazari.*

Licensing of fresh and additional land for shopping/Teh Bazari has been banned. However, in old cases of shopping/Tehbazari, where licenses are renewed periodically, such licenses should not be treated as new cases

of licensing but renewals even where fresh licenses have to be given to new parties on open tender/auction basis. No new plots may however, be added for Teh Bazari/licensing. However, specific cases for licensing of land, for purposes not connected with railway working but concerning welfare of staff, such as, providing shops in areas where adequate shopping facilities do not exist, may be accepted on merits, with the concurrence of the FA & CAO and personal approval of the General Manager. The rate of license fee charged should be fixed at 20% of the market value of land. Where, however, auction is feasible and is likely to give better return, the same may be adopted. The licensing of plots should be for a specific period and also conform to the rules and regulations of the local bodies, Municipalities etc. The agreement entered with the parties should also specifically indicate the temporary removable structure to be put up and must guard against the licensees indulging in encroachment of Railway land. In the case of death/ medical unfitness of a licensee of a plot of land, renewal of license may be done to his/her legal heirs on the merits of the case. The medical unfitness shall be certified from a Govt. Hospital.

m) In each case of licensing, proper agreement must be executed before giving possession of land. It is the responsibility of the official handing over the land to verify whether the agreement has been executed.

n) Each AEN/Section Engineer 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.

822 Use of Surplus Land

No surplus Railway land should be licensed for cultivation purpose. Plantation of suitable trees on such vacant land should be done on programme basis. Strip plantations should be developed on big chunks of land available.

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.

823 Licensing/ Leasing of Railway Land to other Government Departments

a) For railway land licensed/leased to other Government departments, the rent should be 6% of the market value of land, as assessed by local revenue authorities at the time of licensing/leasing. However, where structures are raised by departments, the rate of license fee for actual covered area should be enhanced to 12% of the market value. In the case of long term leases, provisions should be made for periodical revision of rent with retrospective effect. In case of Department of defence, licence fee of 6% of the market value of land with revision at every 10 years interval may be accepted.

b) In case of land leased to Government owned undertakings, payment of security deposit may not be insisted upon provided the concerned ministry gives a guarantee to the Railway against payment of dues by the undertakings.

824 Licensing of Railway Land to Welfare Organisations, Private Schools etc.

(a) For railway land licensed to temple committees, Railway Co-operative stores/ Cooperative societies, handicrafts centres and other welfare organisations, a nominal fee as per extant rules should be recovered. Such proposals duly concurred by F.A. & C.A.O. and recommended by the General Manager would require the prior sanction of Railway Board.

(b) The licensing of railway land to all schools (Govt./Private) will require prior sanction of the Railway Board.

(i) Kendriya Vidaylayas can be provided surplus land/accommodation purely as a welfare measure at nominal licence fee decided by Railway Board from time to time. Slimilarly, surplus land can be licensed to State Govts. for opening new school by the State Govts. for benefit of children of railway employees at nominal licence fee.

(ii) In areas, where educational institutions are not available or existing school facilities are not adequate to cater to the needs of wards of railway employees, railway land if it is sparable, may also be licensed to privately run schools on payment of annual licence fee @ 6% of the present market value of land. In such cases, licence agreements entered into with these organisations should provide for some direct control of the Railway over the functioning of such organisations including their financial affairs. Railways should also insist that the managing committees of such organisations comprise of some members of railway staff, or railway's nominated representatives. The school should obtain railway's approval to any charges/fees/ membership fees etc. proposed to be levied by them. Likewise, Railway may stipulate preference in admission of children/wards of railway staff in such institutions to the extent of 75% of their intake. No compensation shall be payable for any structures on railway land, in case Railway decides to terminate agreement for violations of conditions or for any other reason whatsover. Such proposals should be duly approved by CPO (with regard to need, capacity of school required for railway children after taking account of the existing facilities etc.) and concurred by F.A. & C.A.O. and recommended by the General Manager.

(c) The period of lease for Railway land in such cases should not exceed 30 years. In the case of railway land leased to Kendriya Vidyalaya, the lease period may be 99 years. (CS No.5 Dt.05.11.01)

825 Bulk Oil Installation On Railway Land

a) 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.

b) In dealing with bulk oil installations, reference should be made to the Petroleum Act of 1934 and the Petroleum Rules of 1976, 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.

c) The Petroleum Rules of 1976 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.

d) Bulk oil storage should be located so that :

i) they are as far away as possible from goods-sheds and station buildings;

ii) they could be conveniently served by a road and siding from which the oil wagons can be unloaded;

iii) they do not interfere with any future extension of the station yard;

iv) 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 (ii), 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.

e) 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.

f) 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.

g) 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.

h) The following distances shall be kept clear between storage tank or its enclosure and protected works.*

(Vide Schedule II of Petroleum Rules 1976)

Licensed capacity (Total of all classes of petroleum stored in the shed)		Distance to be observed from storage shed for		
		Petroleum Class A	Petroleum Class B	Petroleum Class C
(1)		(2)	(3)	(4)
Not exceeding	2500 litres	6m	Not applicable	Not applicable
Exceeding but not exceeding	2500 litres 25000 litres	7.5m	Not applicable	Not applicable
Exceeding but not exceeding	25000 litres 50000 litres	9.0m	3.0 m	Not applicable
Exceeding but not exceeding	50000 litres 100000 litres	12.0m	4.5 m	3.0m
Exceeding	100000 litres	15.0m	6.0m	3.0m

Note:(i) "Protected Works" include -

1) 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;

2) Any public road or a Railway line which is not used exclusively as an oil siding; and

3) Overhead high tension power lines.

(ii) In the case of underground storage tanks, it is not necessary to maintain any safety distances around the storage tank.

(iii) 1) Petroleum class A means Petroleum having its flashing point below 23 degree C.

2) Petroleum class B means petroleum having a flash point of 23 degree C and above but below 65 degree C.

3) 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.

(iv) 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 sub-para (g).

826 Laying Of Oil Pipelines

a) Laying of oil pipe lines for installation other than those for bulk oil installations :-

i) No oil pipe line for conveyance of petrol or other oil is permitted on railway land without the special sanction of the Chief Engineer/ Chief General Engineer.

ii) 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 1976.

b) Licensing of land for laying of pipe line, sewer line etc. to State Government and local bodies can be approved by G.M. with FA&CAO's concurrence. However, for other agencies, permission of Railway Board would be required.

827 Construction of Government and private buildings near Railway land

a) 1. While it may be realised that Railways have a prior right of acquisition and utilisation 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.

2. 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

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.

3. 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".

b) 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 lay out of the building shall not result into accrual of various easement rights as mentioned above.

c) It is necessary that the 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 Chief Engineer, Divisional Engineer and Assistant Engineer.

d) 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 Section Engineer (P.Way/Works) to the Divisional Engineer and Assistant Engineer by telegram 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 AEN 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 under the following heads 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.

i) Licensing of land for grow more food

ii) Sale of grass rights

iii) Sale of fruits of trees

iv) Sale of fishing rights

v) Sale of dry and matured trees

vi) Licensing of land for Teh Bazari and for shopping purposes.

vii) Licensing of land for other purposes.

viii) Licensing of land to oil companies.

ix) Way leave facilities and easement rights along road and rail approaches.

Section Engineer (P.Way/Works) and AENs 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 heads shall be reported by Section Engineer (P.Way/Works) and AEN to Divisional Office who shall report the same to headquarters.

ANNEXURE 8.1(a)
(Para 813(d))
(Left Side of Register)

Proforma for 'Land Boundary Verification Register'

DETAILS OF BOUNDARY STONES BETWEEN KILOMETRE.....AND.....

Date of Inspection	DETAILS OF MISSING BOUNDARY STONES		Action Taken	Initials of Inspecting officials
	L	R		

ANNEXURE 8.1(b)
Para 813(d)
(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 (e)

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 Unauthorised 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 IX

PREPARATION OF PLANS

901 General Procedure

a) 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 (1993).

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."

Reference may be made to IS:696-1972 'Code of Practice for General Engineering and to special publication SP46-1988 issued by Bureau of Indian Standards for engineering drawing practice.

b) Wherever drawings are prepared in computer compatible media, adequate care shall be exercised in maintaining back-up copies and installing security systems.

c) Standard drawings shall not be departed from without the specific permission of the Chief Engineer.

d) When part of the work has to be done to a standard plan or to an existing drawing, the fact should be so stated; such drawings need not be reproduced. If part of the information necessary has to be supplied by the Chief Engineer's office or by an officer of another Department, the Divisional Engineer should obtain and incorporate the details on the drawings.

e) In general, all plans will be initiated at the Divisional level [open line or construction, as appropriate]. 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 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 Chief Engineer's office for record and for correction of master plans.

In respect of drawings to be approved by the Chief Engineer's office, the Divisional Engineer will prepare the tracing and send it to the Chief Engineer with copies marked "preliminary ". When the Chief Engineer has approved the tracing, the required number of copies will be taken and sent to the Division. Original tracing in such cases will be kept in the Chief Engineer's office.

f) Additions and alterations to an existing plan should be shown in red. Such additions and alterations will be approved by the authority who approved the original plan. When the additions and alterations are approved by the Division, copies will be sent to the Chief Engineer's office.

After additions and alterations are approved, the original tracings will be

corrected by the office where they are preserved.

g) All drawings should be quoted by their number along with their alteration no.(e.g.NR. H.Q.E.PLAN No.LKO/10/09-93/R1) in the estimates and in the covering letters accompanying the estimates and in all correspondence relating thereto.

h) Reference of sanction particulars such as Works Programme item number should be shown in the plan.

902 Plans for Other Departments

a) 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.

d) When preparing plans, the Divisional Engineer should obtain complete details from other departments. He should arrange for the plans to be signed by the representative of the department concerned or the private party in token of approval and acceptance.

The terms "tracing" includes drawings/ documents which are capable of being reproduced.

903 Sizes of Drawings

a) 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 SHEETS

No	Sheet Designation	Trimmed size (mm) (W x L)	
1.	AO	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 drgs.for bridge works, steel structures, building and temporary arrangement drgs. for Sr. No .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.

b) 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. The length of the yard plans should not be more than 1189 mm when they are not intended to be kept as a roll. Yard plans can be in parts, if necessary, maintaining the scale for the drawing.

c) Borders enclosed by the edges of the trimmed sheet and the frame limiting the drawing space shall be as detailed in BIS : SP - 46- 1988 and shown in Annexure 9.1.

d) 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 figures 1(a) to 1(d) of Annexures 9.2A & 9.2B.

904 Titles and Numbering of Drawings-

a) Title block should be of size 170 mm x 65 mm as shown in Annexure 9.1. Following basic information should be given in the title block.

1) NAME OF THE RAILWAY

2) NAME OF DIVN/CONSTN. ORGANIZATION

3) NAME OF WORK

4) REFERENCE TO SANCTION PARTICULARS

5) SCALE OF DRAWING AND REFERENCE TO STANDARD DRAWING, IF ANY

6) DRAWING NUMBER

7) COMPLETION DRAWING NUMBER

8) DATED INITIALS OF THE CONCERNED OFFICIALS

9) ALTERATIONS, IF ANY, WITH FULL PARTICULARS

b) 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

c) If a drawing cancels a previous one, a note to this effect and the number of cancelled drawing should be recorded on the drawing. Correspondingly, the cancelled drawing should have an appropriate endorsement.

d) In the case of land plans or plans where other Railways or Organisations are concerned, additional space should be provided for their signatures. In cases involving organisations other than the Railways, the designations should be written in full.

e) All signatures on tracings should be in indelible ink and dated.

f) Every plan should bear in small letters at the lower left hand corner the name and initials of the Draftsman and Tracer who prepared and checked the plan. The Head Draftsman should initial below the space provided for the Divisional/District Engineer's signature.

905 Scale of Drawings

a) 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.

b) Plans should be prepared to scales as specified in Chapter IV of the Indian Railways Code for Engineering Department (1993Edition).

c) 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 Drawing

a) The following information should, when applicable, be shown

i) The magnetic north point and true north with magnetic variation, if known and where buildings are designed to suit a particular orientation, an indication to that effect.

ii) The names of the nearest junctions or terminal stations, that on the left hand being the one from which the kilometrage starts.

iii) The kilometrage from headquarters of the railway to the centre of the station, 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 remodelling of yards.

iv) The original centre line of the railway together with its chainages.

v) 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.

vi) Any known bench mark with the datum from which its value has been reckoned.

vii) 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.

viii) All gradients, together with the distance from which the level or gradient extends out of station.

ix) All borrow pits, rivers and pipelines, streams, sullage and sewer drains together with their direction of flow. For rivers their names and the highest known flood levels must be given.

x) Temples, mosques and graves, roads and footpaths with the names of towns or villages they lead to.

xi) The position and block numbers of buildings. Where a building consists of two or more storeys, the number of floors shall be mentioned. Where outhouses exist, these shall be marked "O.H. to Block No. ....".

xii) In the case of foundations, the nature of the soil as determined from trial pit, and bore log details.

xiii) The clear length of all inspection pits, capacity of weigh-bridges in tonnes; diameter of turntables; 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.

xiv) The length and capacity in terms of vehicles 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; the distance from the centre of station of all signals, signal cabins with their distinguishing feature, signals being shown as viewed by the Driver and with their bases at the sites they occupy; lengths of passenger and goods platforms and their heights above rail level; telegraph posts and crossings of tele-communication and power lines over head or underground.

xv) Road crossings with their class and location; road over bridges and underbridges;

xvi) Infringements of standard dimensions, if any.

b) Drawing for a structure including building should be prepared in three parts :

i) Site plan

ii) Architectural and/or General Layout drawing

iii) Structural and/or execution drawing.

In case of small buildings, all these parts can be included in one sheet but placed distinctly.

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 and direction of prevailing wind.

The Architectural 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 Architectural drawing in the form of a note. Landscaping and developmental work involved must also be shown.

The structural drawing will indicate foundation plan, details of R.C.C. members and a bar bending schedule as per standard I.S. bar bending specification.

c) 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. 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 down stream, 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. On these drawings, notes should be made of area of flood sections and hydraulic mean depths for each case, catchment area, velocity obtained by calculation and by experiments (preferably at high flood), waterway through bridge proposed to be allowed with a note on increase in velocity and probable highest flood level due to afflux, 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 standardised.

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.

d) 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.

e) 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.

f) The set of drawings should be complete so as to enable the work being executed as per the specifications and standards desired.

907 Symbols and Colours on Drawings

a) Symbols to be used on site plans and plans of station yards should conform to BIS code SP46-1988. For other com-monly accepted abbreviations and symbols, table 19.1 of BIS code SP46-1988 may be referred to. (reproduced in Annexure 9.3 for ready reference).

b) For clarification of drawings it is sometimes necessary to shade some members/parts of members for which sections are drawn. In such cases, colour washing/ shading in broad line may be done on the back of the tracing for the affected area.

c) In regard to black and coloured lines on tracings and prints, the following conventions should be observed :

i) Existing work that is to remain should be in full line;

ii) Work that is to be dismantled should be in thin dotted lines;

iii) New additional work should be in full red lines. This does not apply to a drawing in which all the work is new;

iv) New additional work that is not to be done at the same time as the bulk of the work shown on the drawing should be in broken red lines. This does not apply to a drawing in which all the work is new;

v) Work to be relaid or rebuilt elsewhere on the same plan should be in full yellow lines.

d) 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.

e) The following colours will print clearly on ferro-paper :

Black	..	Indian ink
Red	..	Vermilion red or scarlet lake
Yellow	..	Chrome yellow
Green	..	Emerald green
Blue	..	Prussian blue Cobalt blue mixed with a little Chinese white.

908 Standard Drawings

Standard drawings issued by the RDSO such as for track and bridges 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 Chief Engineer's Office

Copies/Prints of plans issued by the 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 Engineer's and Section Engineer's offices:

a) The Divisional/Executive Engineers and Assistant 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 Section Engineer of Permanent Way, Works & Bridge are in possession of necessary plans as pertain to their jurisdiction and to works.

b) Plans need revision as and when renewals are carried out and additions or alterations are made. Every endeavour should be made to keep the track diagrams and plans, particularly of station yards and colonies, up-to-date and the Chief Engineer's office kept advised with details. When alterations are extensive and cannot be shown on an existing plan, a fresh plan should be prepared.

911 Completion Drawings

a) Signed copies should be submitted by Assistant 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 na-ture of soils met with recorded. Alterations or modifications which may have been made from the working plans should be marked on the prints 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 struc-tures 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" stencilled 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 Chief Engineer for record and incorporation in master plan.

In case of drawings approved by the Chief Engineer, 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 of arch or underside of slabs.

iii) Reduced levels of top and bottom of founds. 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.

When possible without undue labour and expense, these levels should be connected to a permanent bench mark, but where this is not readily available, the reduced level as given in the longitudinal section should be taken as correct. In all cases, a note must be added stating from where the datum level has been obtained.

912 Care and Filing of Tracing

a) Tracing shall not be used for reference as they are likely to get lost or damaged. Required number of prints should be supplied to Engineers and Inspectors; each particular project file should contain a print of the works relating to it.

b) 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.

c) Prints should be folded as indicated in para 903(d) above. Two methods of folding are shown in Annexure 9.2. When prints are rolled for despatch, they should be rolled with the title head outwards.

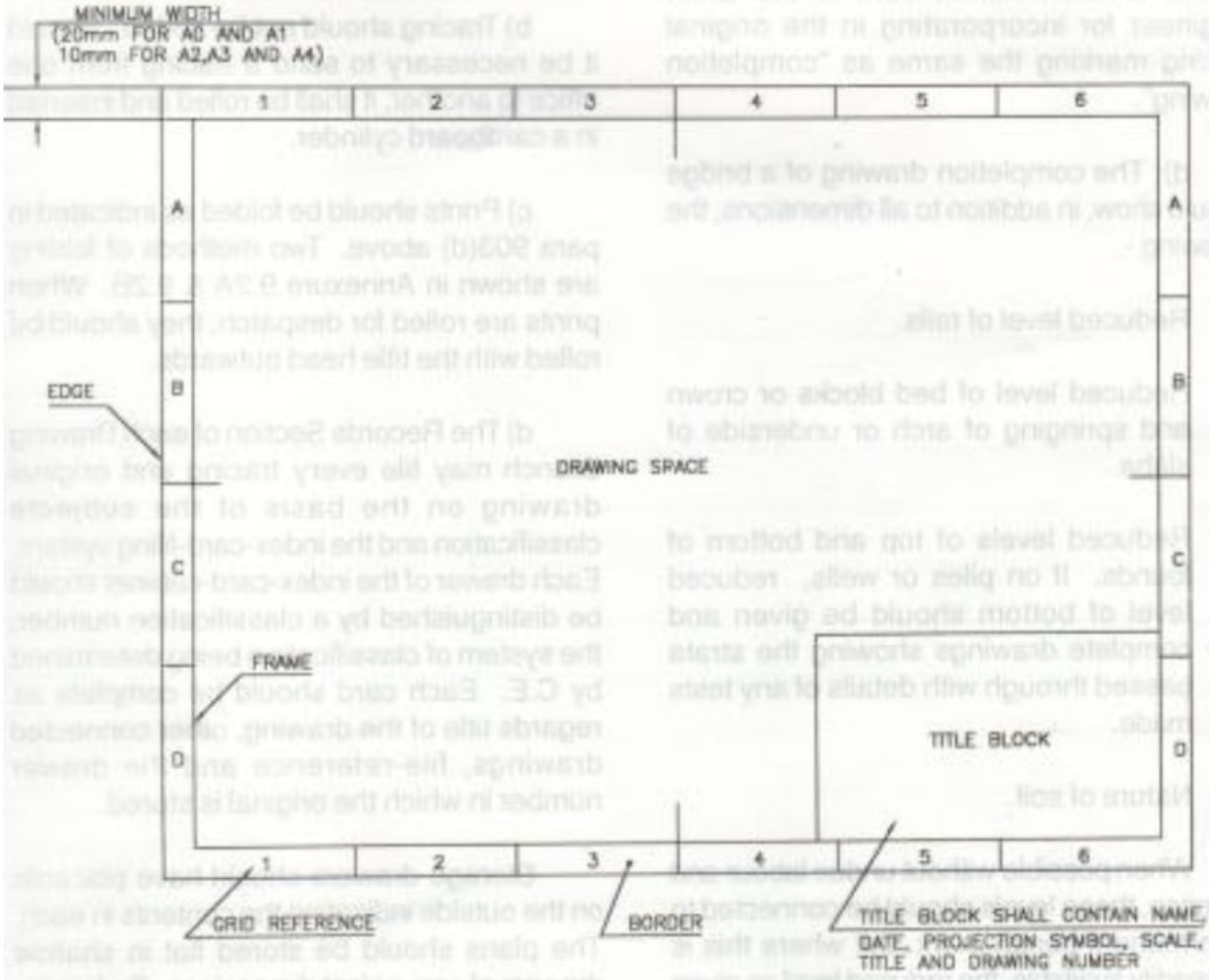
d) The Records Section of each Drawing Branch may file every tracing and original drawing on the basis of the subjects classification and the index-card-filing system. Each drawer of the index-card-cabinet should be distinguished by a classification number, the system of classification being determined 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.

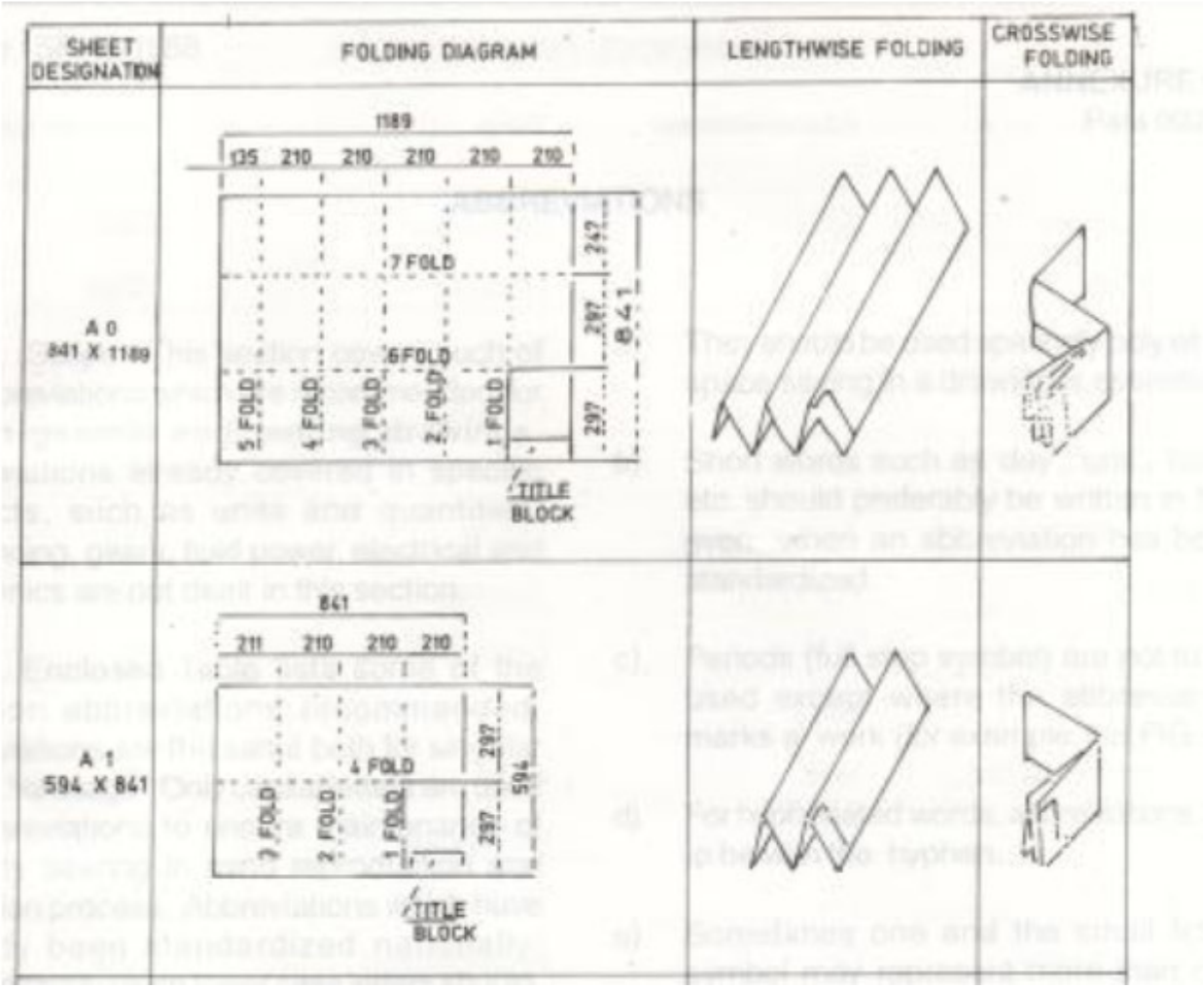
e) Wherever found convenient The Chief Engineer can put the original records/drawings on microfilm or they may be computerised for future records.

ANNEXURE 9.1

ANNEXURE 9.1
Para 903 (c)
& 904 (a)



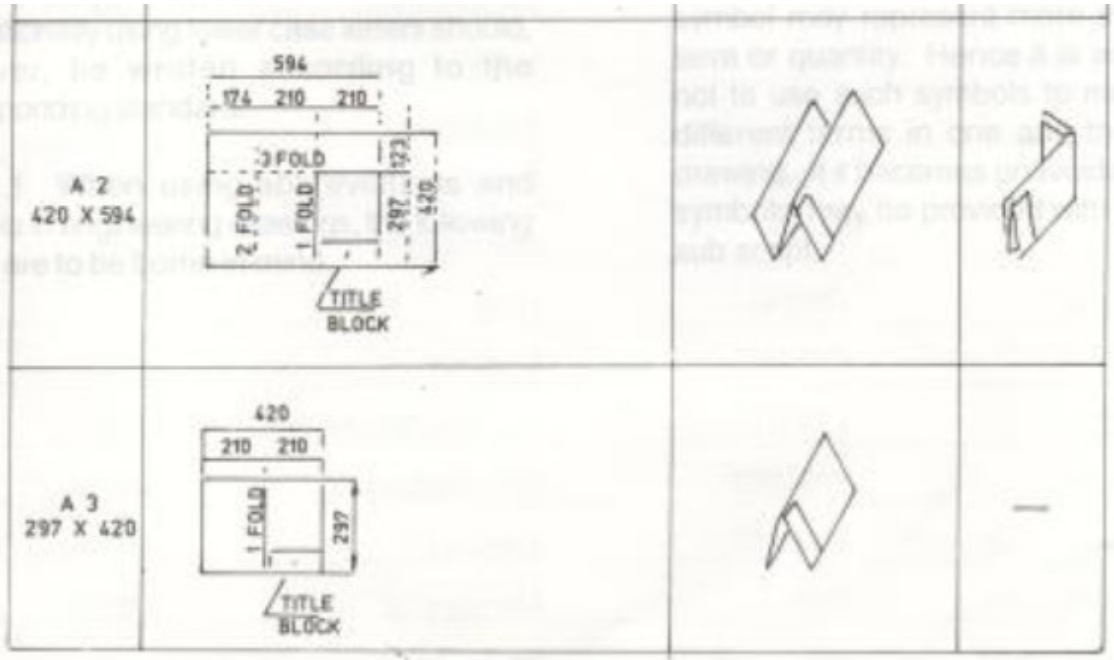
ANNEXURE 9.2 Para 903 (d)



All dimensions in millimetres

FOLDING OF PRINTS STORING IN FILING CABINET

ANNEXURE 9.2 Para 903 (d)



All dimensions in millimetres

FOLDING OF PRINTS STORING IN FILING CABINET

Source : SP 46-1988

ANNEXURE 9.3
Para 907(a)

ABBREVIATIONS

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, tolerancing, 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 small 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 subscript.

RECOMMENDED ABBREVIATIONS

Term	Abbreviations
Across corners	A/C
Across flats	A/F
Alteration	ALT
Approved	APPD
Approximate	APPRO
Arrangement	ARRGTX
Assembly	ASSY
Auxiliary	AUX
Bearing	BRG
Bureau of Indian Std.	BIS
Cast Iron	CI
Centre Line	CL
Centre of gravity	CG
Centre to Centre	C/C
Centres	CRS
Chamfered	CHMED
Checked	CHKD
Cheese head	CH HD
Constant	CONST
Continued	CONTD
Counterbore	C'BORE
Countersunk head	CSK HD
Countersunk	CSK
Cylinder/Cylindrical	CYL
Diameter (in a note)	DIA
Dimension	DIM
Drawing	DRG
East	E
Etcetera	Etc.
External	EXT
Figure	FIG.
General	GEN
Ground Level	GL
Haxagon/Hexagonal	HEX
Head	HD
Horizontal	HORZ
Hydraulic	HYD
Inspection/ed	INSP
Inside diameter	ID
Insulation	INSUL
Internal	INT
Left Hand	LH
Long	LG
Material	MATL
Machine/Machinery	M/C
Manufacture/ing	MFG
Maximum	MAX
Mechanical	MECH.
Minimum	MIN

Miscellaneous **Term**	MISC **Abbreviations**
Modification	MOD
Nominal	NOM
North	N
Number	NO.
Opposite	OPP
Outside diameter	OD
Pitch circle diameter	PCD
Quantity	QTY
Radius(in a note)	RAD
Required	REQD
Right Hand	RH
Round	RD
Reference	REF
Screw/Screwed	SCR
Serial Number	SL.No.
Sheet	SH

South **Term**	S **Abbreviations**
Sketch	SK
Specification	SPEC
Standard	STD
Spotface	SF
Symmetrical (in a note)	SYM
Temperature(" ")	TEMP
Thick	THK
Thread (in a note)	THD
Through(in a note)	THRU
Tolerance	TOL
Typical	TYP
Undercut (in a note)	U/C
Weight	WT
West	W
With reference to/ With respect to (in a note)	WRT

CHAPTER X

STORAGE AND USE OF EXPLOSIVES

1001 General

Reference may be made to the following for detailed provisions:

a) Indian Explosive Act 1884

b) BIS Codes

IS: 4081-1986 : Safety code for blasting and related drilling operations.

IS: 4756-1978 : Safety code for tunnelling work.

c) 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

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.

The Railway Administration shall prescribe the type and quantity of explosives to be kept with inspectors for removing boulders falling on running lines. The Administration shall also prescribe the locations for stocking these explosives magazines in the sub-division.

Blasting works may be carried out departmentally or by contract; in either case it should be ensured that competent qualified staff are engaged and safe working practices are employed. If the work is done through contract, 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 authorised by the appropriate Department.

For major works, the Railway Administration will draw up special instructions which should cover every aspect of each operation and be illustrated with sketches where necessary; the instructions should include:-

(i) Duties of Blasting Mates and other staff.

(ii) Description of materials used for blasting, such as explosives, detonators, safety-fuses, blasting cables, joint adapters, fuse lighters, exploders and crimpers.

(iii) Collection and transport of materials.

(iv) Testing of materials used for blasting.

(v) Procedure and methods of boring and charging of holes and blasting for each type of explosive.

(vi) Imposition and removal of traffic and/or

power blocks.

(vii) Safety-distances.

(viii) Protection of track and structures during blasting operations.

(ix) Precautions before, during and after blasting.

(x) Danger and all clear signals before and after a blasting operation.

(xi) Submission of periodical progress reports.

(xii) Custody and storage of explosives in magazines and their accountal.

1003 Observance of Rules

a) Possession of explosives shall be covered by a license as required by the extant Explosive Rules.

b) The Divisional/Dy. Chief Engineer, Assistant Engineer and the 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 Engineer should, by frequent check, personally satisfy themselves that all staff handling explosives are in possession of and understand the rules and any subsequent modifications thereto.

c) The Assistant Engineers and 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 Carriage of Explosives

Assistant Engineers and Inspectors should make themselves acquainted with the instructions contained in the I.R.C.A. Red Tariff No.16 "Rules and rates for the conveyance by rail of explosives and other dangerous goods". If carried by a road vehicle, the vehicle should have the necessary licence issued for the purpose.

1005 Protection to Trains and Railway Property

a) 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 old sleepers 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 Permanent Way Inspector 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.

b) In vicinity of buildings.- When any blasting operation is carried out within 100 metres of a building, the Works Inspector shall be present to ensure that special precautions, as may be prescribed by the Divisional/ Dy.Chief Engineer or the Assistant Engineer or as stipulated by the licensing authority, are taken and that the necessary warning is given to the inhabitants.

1006 Precautions to be Observed During Blasting

The Blasting Mate shall be responsible:-

a) 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 workspot, of the commencement and cessation of blasting operations:

b) 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;

c) To see that, in order to avoid damage to structures (such as girder bridges and telegraph wires) 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;

d) To select and instruct carriers of the explosives, detonators and safety fuse after they have been drawn from the magazine;

e) To ensure that no one interferes in his absence with any explosive, detonators or caps already drawn by him from the magazine;

f) To see that neither himself nor any person within 10 metres of himself smokes while he is conveying, handling or using explosives;

g) 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.

h) 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.

j)To see that the safety fuses of the charged holes are lighted in his presence and have properly ignited;

j)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;

k) 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.

l) 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.

1007 Misfires with Electrical Method of Firing

a) If after complying with para 21 of the Indian Metalliferous Mines Regulations, the Official in-charge of the blasting operations at a site ascertains that a misfire has occurred, he will immediately prevent any one from approaching the site whose presence is not absolutely essential. He will 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.

b) Should he be unable to fire the unexploded charge(s) by electrical means, he will then comply with paras 82-84 of the above Regulations, which are reproduced below, using the means considered the most suitable:-

"82. No person shall bore out a hole that has once been charged or attempt to withdraw a charge either before firing or after a misfire or deepen or tamper with empty holes or sockets left after blasting.

"83. When a misfire occurs, a portion of the tamping may be sludged out with compressed air or water under pressure, but no kind of metal tool shall be used for this purpose. The hole shall thereafter be reprimed and fired.

"84. No person shall drill or cause or permit to be drilled any hole within 300 mm of a misfired hole, and care shall be taken to drill the new hole in such a direction that there is no danger of touching the unexploded charge. The new holes shall be bored in the presence of an authorised shot-firer and he shall be present during operation undertaken for the removal of debris lying within 2 metres of the misfired hole. A careful search amongst the debris shall be made for cartridges and detonators, if any.

c) 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.

1008 Explosives Disposal

a) No explosive shall be abandoned. These shall be disposed off or destroyed strictly in accordance with the approved methods and in doing so the manufacturers or the appropriate authority shall be consulted.

b) Explosives, caps, boxes liners or material used in packing of explosives shall not be left lying around in places to which children or unauthorised persons or livestock can have access.

c) 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.

1009 Destruction of Explosives

The destruction of explosives should, in all cases, be supervised by the Assistant Engineer.

When destroying explosives, the following instructions should be strictly adhered to:-

a) Black powder- Black powder should be thrown into water, preferably hot water, which dissolves out the saltpetre and renders the explosive harmless. An alternative method is to lay it out in a train and fire this from one end by means of a piece of safety fuse, but if more than one train is laid, care should be taken to lay the second at such a distance from the other as to run no risk of one being fired by the heated ground of another.

b) Dynamite and other similar explosives - Not more than 2.5 Kg. of the explosive should be destroyed at a time. A clear space of ground, free from dry grass, about 100 square metres should be selected at least 800 metres away from buildings and dwelling places. A line of shavings or dry grass, about 450 mm wide and at least 100 mm thick, should then be laid down. The direction of the line should be at an angle of about 45 degrees to the direction of the wind. The work should not be undertaken on a day when the wind would be strong enough to disturb or blow away the shavings. This line of shavings or dry grass should then be adequately sprinkled with kerosene oil to ensure its burning continuously. The cartridges with the wrappers opened and unrolled should then be placed in a continuous line not more than 2 abreast with an interval of 25 mm between each line of cartridges and with the cartridge wrappers or other paper lightly placed below them. The cartridges should be placed at about 6 metres from the weather end of the line of shavings, at the extreme weather end of which will be placed an adequate length of safety fuse. To ensure the ignition of the shavings, it may be found necessary to place a small quantity of cotton waste soaked in petrol adjacent to the end of the safety fuse and on the shavings. The safety fuse should then be lighted and the operator should retire quickly to a

safe distance when after a short time the dynamite will burn steadily without exploding.

c) Detonators -Surplus detonators should be disposed of by throwing them, one at a time, into a deep pool of a river or the sea. An alternative method is to soak them thoroughly in light mineral oil for 48 hours and then destroy them by throwing them one at a time into a fire with due precautions.

d) Safety fuse - Safety fuse should be destroyed by burning in lengths in the open.

CHAPTER XI

POLICE JURISDICTION AND SECURITY OF RAILWAY MATERIALS.

1101 General

The officers and supervisors 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. 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.

a) 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.

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 generally to be 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.*

b) *Local Police:*

Local Police is responsible for Law and Order in the areas other than those coming under the jurisdiction of the Railway Police.

c) *Railway Protection Force*

(i) Railway Protection Force has been created as an Armed Force of the Union under the R.P.F.Act 1957 (as modified by Act No.60 of 1985). 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.

1103 Lodging of Complaints

a) The procedure for lodging complaints with the Government Railway Police varies as per orders issued by Local Governments. Engineers and supervisors should acquaint themselves with the procedure in force over their jurisdictions.

b) Officers and senior subordinates should prefer complaints to the Government Railway Police whenever a cognizable offence comes to their notice or when a non-cognizable offence may lead to danger to railway property, trains or passengers.

The complaint should be made to the Government Railway Police Station Officer or in his absence, to the Platform Constable or to the next passing Travelling Constable and acknowledgment obtained. Copies of complaints preferred by Supervisors should be sent to the Assistant Engineer and Divisional Engineer for information.

c) In serious cases, the Divisional Engineer or Assistant Engineer should follow up with a complaint or report made to the Superintendent Railway Police or District Superintendent of Police, as the case may be. In ordinary cases the Engineering Supervisor should pursue the matter with the local police officials.

d) Whenever Engineering officials lodge a FIR for theft with the Government Railway Police, it should be clearly indicated that the same is for "stolen property". FIR empowers the Government Railway Police to start investigations in cases of cognizable offences.

e) A sample proforma for lodging 'FIR' is given as Annexure 11.1.

1104 Co-operation with Government Railway Police

a) Engineering staff should co-operate with the Government Railway Police (GRP) for the prevention and detection of crime. Promptness in reporting an offence is essential; telegraphic, FAX advice should be sent, when so required, of any occurrence forming the subject of a complaint and the formal complaint should follow as soon as possible.

b) When the GRP require information from the records of the office of Engineering Supervisor, they will apply to the latter with particulars of requirements. The supervisor may allow GRP staff to verify the information given. No records should however be handed over without the authority of the Assistant Engineer or Divisional/ Dy. Chief Engineer. In each case, the memo received from the Police Officer must be sent to the Divisional/Dy. Chief Engineer through the Assistant Engineer for information.

c) Any railway staff having information in connection with a crime under enquiry should at once communicate it to the Police Officer in charge of the case.

d) All railway staff should answer questions put by the Police in the course of their investigations.

1105 Cognizable Offences

Some of the offenses listed below demand immediate intimation to the GRP by Engineering Staff; they are termed as 'cognizable by the Police', meaning that the

Police are authorised to commence enquiries and effect arrests without direction from a Magistrate :-

Sr.No	Sections of the Railway Act	Nature of offence.
1.	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
2.	Sec. 146 ..	Obstructing Railway Servant in his duty.
3.	Sec. 147 ..	Trespass and refusal to desist from trespass.
4.	Sec. 150 ..	Maliciously wrecking or attempting to wreck a train
5.	Sec. 151 ..	Damage to or destruction of Railway Property
6.	Sec. 166 ..	Defacing public notices.
7.	Sec. 175 ..	Endangering safety of any person travelling upon the railway by disobeying any rule negligent act. (This applies to Railway Servants only).

When a complaint has been made to the GRP in respect of any cognizable offence, the working up of the case rests with the Police. This does not affect the action necessary for departmental purposes, such as making preliminary enquiries which are in some cases necessary to establish the fact that any crime has been committed or to fix the departmental liability for neglect of error.

1106 Non-Cognizable Offences

a) 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.

Sr.No	Sections of the Rail way 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.

b) 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

a)Section 179 of the Indian Railways Act of 1989, empowers a Railway Official to effect the arrest of any person who has committed a cognizable offence.

Section 180 of the Indian Railways Act, 1989, empowers a Railway Official to effect the arrest of any person for an offence "non-cognizable by the Police" provided there are valid reasons to believe that the offender will abscond or that he/she is giving a false name and address. In cases where the person refuses to give his proper name and address, or there is reason to believe that the name and address given are false or that such person will abscond, the GRP may arrest him (or her) under Section 180 of The Railway Act.

b) 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 superior grade, who shall, if he finds on proceeding to execute the warrant that the immediate arrest of the railway servant would occasion risk or inconvenience, make all arrangements necessary to prevent escape and apply to the proper quarter to have the accused relieved, deferring arrest until he is relieved.

Wherever possible, the Divisional Engineer or Assistant 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 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 made to the appropriate authorities.

1110 Answering of Court Summons -

Court summons served on the staff shall be promptly obeyed. Section 66 of the Civil Procedure Code 1974 provides that :-

"Where the person summoned is in the active service of the Railways, the Court issuing the summons shall ordinarily send it in duplicate to the Head of the Office in which such person is employed; and the Head of the office shall thereupon cause the summons to be served in the manner provided by Section 62 and shall return it to the Court with the endorsement required by the Section".

The Divisional Engineer or Assistant Engineer shall make necessary relief arrangements timely in such cases.

1111 Prevention of Trespass

a) Trespass Notice Boards should be erected and maintained properly at necessary

locations. The Boards should indicate the consequences of trespass.

b) Stray cattle found grazing in the railway limits may be sent to the cattle pound.

c) 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:-

a) 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 -

(i) Position of body on the line.

(ii) Blood stains on track, ballast or engine, extent of injuries and whether seemingly inflicted by a train or otherwise.

(iii) Position of any clothing, found on or near the rails.

b) 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.

c) A report shall be made by the Section Engineer to the nearest Station Master and to the Assistant Engineer in every such case.

In the case of such accidents occurring in station yards the Station Master will take 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.

a) Whenever an Engineering personnel is involved in a charge of commission of an offence under RP(UP) Act, a report should be sent to the Assistant/ 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:

Whoever is found, or is proved to have been in possession of any Railway property reasonably suspected of having been stolen or unlawfully obtained shall be punishable, unless he proves that the Railway property came into his possession lawfully.

SECTION 4:

Any owner or occupier of a land or building, or any agent of such owner or occupier incharge of the management of that land or building, who connives with an offence against the provisions of this Act, shall be punishable with imprisonment for a term, which

may extend to five years or with fine or with both.

b) Encroachments shall be got removed promptly as per 814 of this manual. Necessary help should be sought from GRP as well as R.P.F.

c) Whenever unauthorised occupation or subletting of quarters is noticed by the Section Engineer (Works) he will take immediate action to report this to the allottment authority for taking action at that authority's end.

d) 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, Railway Challans etc.

ANNEXURE 11.1
Para 1103

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
Date: official who received the Report.

CHAPTER XII

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 Works Inspectors of each Division.

The offices of 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.

1202 Circulation of Technical Papers - The 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 Engineers:-

(i) Technical papers pertaining to Civil Engineering published by the Railway Board from time to time.

(iii) Engineering Bulletins issued by Zontal Railways.

(iii) Monograms issued by RDSO.

Annexure 12.1
Para 1201

LIST OF BOOKS OF REFERENCE.

		Office which should be equipped with a copy of the publication		
Item No.	Publications	Divl./ Dy. Chief Engineer	AEN	Sr.Section Engineer (Works)
1	Act, Indian Railway	1	1	1
2	Act, Land Acquisition and State Govt. Publications.	1	1	-
3	Act, Payment of wages, with notification as issued	1	1	1
4	Act. Forest, Center and State Government	1	-	-
5	Act, Workmen's Compensation	1	1	1
6	Alphabetical list of Railway			
7 a) b)	Circulars - Statement Government Re: Construction near railway limits Sales Tax on Works Contracts, Royalty on minerals	1	1	1
8	Circulars, State Government or Joint, re: Tanks affecting railway line.	1	1	1
9	Code, Indian Railways, for the Engineering Department	1	1	1
10	Code, Indian Railways, for the StoresDeptt.	1	-	-
11	Code, Indian Railway for the Mechanical Department.	1	-	-
12	Code, Indian Railways for the Accounts Department	1	-	-
13	Code, Indian Railways Establishment	1	1	1
14	Codes, Indian Railway General	1	-	-
15	Codes, Indian Railways Standard, for Bridges, Structures and other subjects	1	-	-
16	Engineering Formulae Pocket Book	1	1	-
17	Engineering Standing Orders	1	-	-

		Office which should be quipped with a copy of the publication		
Item No.	Publications	Divl./ Dy. Chief Engineer	AEN	Sr.Section Engineer (Works)
18	Manual, Permanent Way	1	1	1
19	Manual, Signalling and Interlocking	1	1	-
20				
21	Manual , Bridge	1	1	1
22	Manual, Works	1	1	1
23	Manual, Accident or circulars pertaining to accidents.	1	1	1
24	Price lists of Stores and Stores nomen-clature and circulars as applicable.	1	1	1
25	Regulations, Hours of Employment, with notifications as issued	1	1	1
26	Regulations, Income Tax (where applicable)	1	1	1
27	Regulations government the placing of electric transmission lines across and underground cables under railway track	1	1	1
28	Rules, General and Subsidiary Parts I and II	1	1	1
29	Rules, re.Leave, Passes & PTOs	1	1	1
30	"Safety First", Rules	1	1	1
31	Schedule of Dimensions	1	1	1
32	Schedule of Powers in Estt. and other than establishment matters.	1	1	1
33	Chief Engineer's circular-Engineering Department	1	1	1
34	General conditions of Contract	1	1	-
35	Water supply for Railway Emgomeers - IRICEN Publication.	1	1	1
36	Works Hand Book of specifications for materials and works	1	1	1
37	Working Time Table and Appendix thereto	1	1	1
38	Working of Cranes and Hoists as issued - Technical Monograms issued by Rly. Board/RDSO	1	-	-

		Office which should be quipped with a copy of the publication		
Item No.	Publications	Divl./ Dy. Chief Engineer	AEN	Sr.Section Engineer (Works)
39	Biolatrines	1	1	1
40	Economy in Water Supply	1	1	1
42	Prestressed Concrete Manual	1	1	1
43	Guidelines for Earthwork Compaction	1	-	-
44	* Technical Monograms	1	-	*

* Copies may be supplied to AEN/Sr.Section Engineer (Works) as required).

LIST OF ANNEXURES

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CONCORDANCE

Concordance showing the paragraphs in the IRWM, 2000 and the corresponding paragraphs in the IRWWM, 1967 Edition.

Paragraph in IRWM, 2000	Paragraph in the IRWWM, 1967 Edition	Remarks
(1)	(2)	(3)
101	101A	Modified
102	101D	Modified
103	101B	---
104	102	---
105	110	Modified
106	--	New para
107	106	Modified
108	107	---
109	109(a)	---
110	---	New para
111	112	---
112	104	Modified
113	105	Modified
114	111	Modified
115	113	Modified
116	303	Modified
117	301	Modified
118	302	Modified
119	304	Modified & Amplified
120	305	Modified
121	306	Modified
122	---	New para

(1)	(2)	(3)
123	307	---
124	308	Modified
125	309	Modified
126	310	Modified
127	311	---
128	312	Modified
129	313	---
130	314	Modified
201	2301	Modified & Amplified
202	2313	Modified & Amplified
203	---	New Para
204	2307	Modified
205	2309	Modified & Amplified
206	---	New Para
207	---	New Para
208	2317	Modified & Amplified
209	---	New Para
210	2316	Modified
211	2311	Modified
212	---	New Para
213	2310	Modified
214	---	New Para
215	---	New Para
216	---	New Para
217	2312	Modified
218	2302	Modified
219	2303	---
220	2305	---
221	2304	Modified & Amplified

(1)	(2)	(3)
222	2306	---
223	2318	---
224	2319	Modified & Amplified
225	2320	Modified & Amplified
226	2321	Modified
227	2322	Modified
228	2323	Modified
229	2324	Modified
230	2325	---
231	---	New Para
232	---	New Para
301	2308 2201	Modified
302	2401	Modified
303	2402	-----
304	2403	Modified
305	2404	Modified
306	2405	Modified
307	2406 2407 2408	Modified & Amplified
308	2409	Modified
309	2412	Modified
401	----	New Para
402	----	New Para
403	----	New Para
404	----	New Para
405	----	New Para
406	----	New Para

(1)	(2)	(3)
407	----	New Para
408	----	New Para
409	2218	Amplified
410	2219	Amplified
411	2203	Amplified
412	2224	Amplified
413	2209 2214	Amplified
414	2206	Amplified
415	2207	Amplified
416	2213	Amplified
417	2215	Amplified
418	2219	Amplified
419	----	New Para
420	----	New Para
421	----	New Para
422	----	New Para
423	----	New Para
424	2208	Amplified
425	2212	Amplified
426	2217	----
427	----	New Para
428	----	New Para
429	2225	Modified & Amplified
430	2222	Amplified
501	----	New Para
502	----	New Para
503	----	New Para
504	2531	Modified

(1)	(2)	(3)
505	----	New Para
506	2503	----
507	2504	----
508	2506	----
509	2507	Amplified
510	2508	----
511	2509	Amplified
512	----	New Para
513	----	New Para
514	----	New Para
515	2510	Modified
516	2511	Modified
517	2513	Modified
518	----	New Para
519 to 522	----	New Para
523	2534	----
524	2505 2521	Modified
525	2522	Amplified
526	2523	Amplified
527	2514B	Modified
528	2527	Modified
529	2524	
2526	Amplified	
530	2525	----
531	----	New Para
532	2502	Modified

(1)	(2)	(3)
533 to 535	---	New Para
536	2517	----
537	2518	----
538	2519	----
539	2520	----
540	----	New Para
541	2532	----
542	2528	----
543	2529	Amplified
544	2530	Amplified
545	----	New Para
546	----	New Para
547	----	New Para
548	----	New Para
549	2535	Modified
550	2536	Modified
551	----	New Para
552	2537	----
553	2533	Amplified
554	2538	Modified
601	----	New Para
602	----	New Para
603	2602	Modified
604	----	New Para
605	----	New Para
606	2603	Modified
607	2607	Modified

(1)	(2)	(3)
608	2608(d)	Modified
609	---	New Para
610	2603	Modified
611	----	New Para
612	2604	Amplified
613	----	New Para
614	2605	Amplified
615	2606	Modified
616	2613(c)	Amplified
617	----	New Para
618	---	New Para
619	----	New Para
620	----	New Para
621	----	New Para
622	2615	Modified
623	2616	-----
624	2617	----
625	2618	Modified
626	2619	----
627	2620	Modified
628	-----	New Para
629	2615	Modified
630	---	New Para
631	----	New Para
632	2621	Modified
701	3801	Modified
702	----	New Para
703	3802	Modified
704	3804	----

(1)	(2)	(3)
705	3805	Modified
706	3806	Modified
707	3807	Modified
708	3809	Modified
709	3810	Modified
710	3812	Modified
711	3813	Modified
712	3814	Modified
713	3815	----
714	----	New Para
715	3816	Modified
716	3817	Modified
717	3818	----
718	3819	----
719	----	New Para
720	----	New Para
721	----	New Para
722	----	New Para
723	---	New Para
801	3701	Modified
802	3702	Modified
803	3706	Amplified
804	3706	Amplified
805	3712	Modified
806	3713	Amplified
807	3714	Amplified
808	3715	Modified
809	3716	Modified
810	3717	----
811	3718	Amplified

(1)	(2)	(3)
812	3719	Amplified
813	3720	Modified
814	----	New Para
815	----	New Para
816	----	New Para
817	3721	Modified
818	3722	Modified
819	3723(a)	Modified
820	3723	Modified
821	----	New Para
822	----	New Para
823	----	New Para
824	----	New Para
825	3725	Modified & Amplified
826	3727	Modified
827	3728	Modified
828	----	New Para
829	----	New Para
901	2801	Modified
902	2802	Modified
903	2803	Modified
904	2804	Modified
905	2805	Modified
906	2806	Modified
907	2807	Modified
908	2808	Modified
909	2809	Modified
910	2810	Modified
911	2811	Modified
912	2812	Modified

(1)	(2)	(3)
1001	----	New Para
1002	3601	Modified
1003	3602	Modified
1004	3603	Modified
1005	3616	Modified
1006	3617	----
1007	3618	----
1008	----	New Para
1009	3619	----
1101	---	New Para
1102	----	New Para
1103	3902	Modified & Amplified
1104	3903	Modified
1105	3904	Modified
1106	3905	Modified
1107	3906	Modified
1108	3907	Modified
1109	3908	Modified
1110	3909	Modified
1111	3910	Modified
1112	3911	----
1113	3912	----
1114	----	New Para

'ERRATA'

INDIAN RAILWAYS WORKS MANUAL 2000

Page No.	Para / Line	Existing	Read as
(1)	(2)	(3)	(4)

CORRECTION SLIPS (C.S.)

S. No.	C. S. No. & Date	Reference

NOTES