Orientation Training to the Newly recruited Assistant Engineer's through TNPSC

Government of TamilNadu

Rural Development and Panchayat Raj Department

19.02.2024

INTRODUCTION

Rural development is the key to India's economic transformation as a majority of its population lives in the rural areas. Villages in Tamil Nadu have relatively better facilities and services in terms of road connectivity, transportation, education, drinking water supply, electrification and health infrastructure when compared to most other States.

Improving these amenities further so as to bridge the urban-rural divide has been a principal policy focus of the Government of Tamil Nadu.

The Rural Development and Panchayat Raj Department is responsible for the implementation of various Centrally sponsored and State schemes for poverty alleviation, employment generation, sanitation, capacity building apart from provision of basic amenities and services.

ADMINISTRATIVE STRUCTURE

➢ STATE LEVEL

The Principal Secretary to Government, is in charge of Rural Development and Panchayat Raj Department at Government level.

The Director of Rural Development & Panchayat Raj (DRD & PR) is the Head of the Department at State Level. Additional Directors assist the Director along with Joint Directors, Deputy Director and Assistant Directors.

➢ DISTRICT LEVEL

District Rural Development Agency has been formed for formulating and monitoring the development schemes with District Collector as Chairman.

The Additional Collector (Dev) / Project Director is looking after the functions with a team of Assistant Project Officers.

ADMINISTRATIVE STRUCTURE

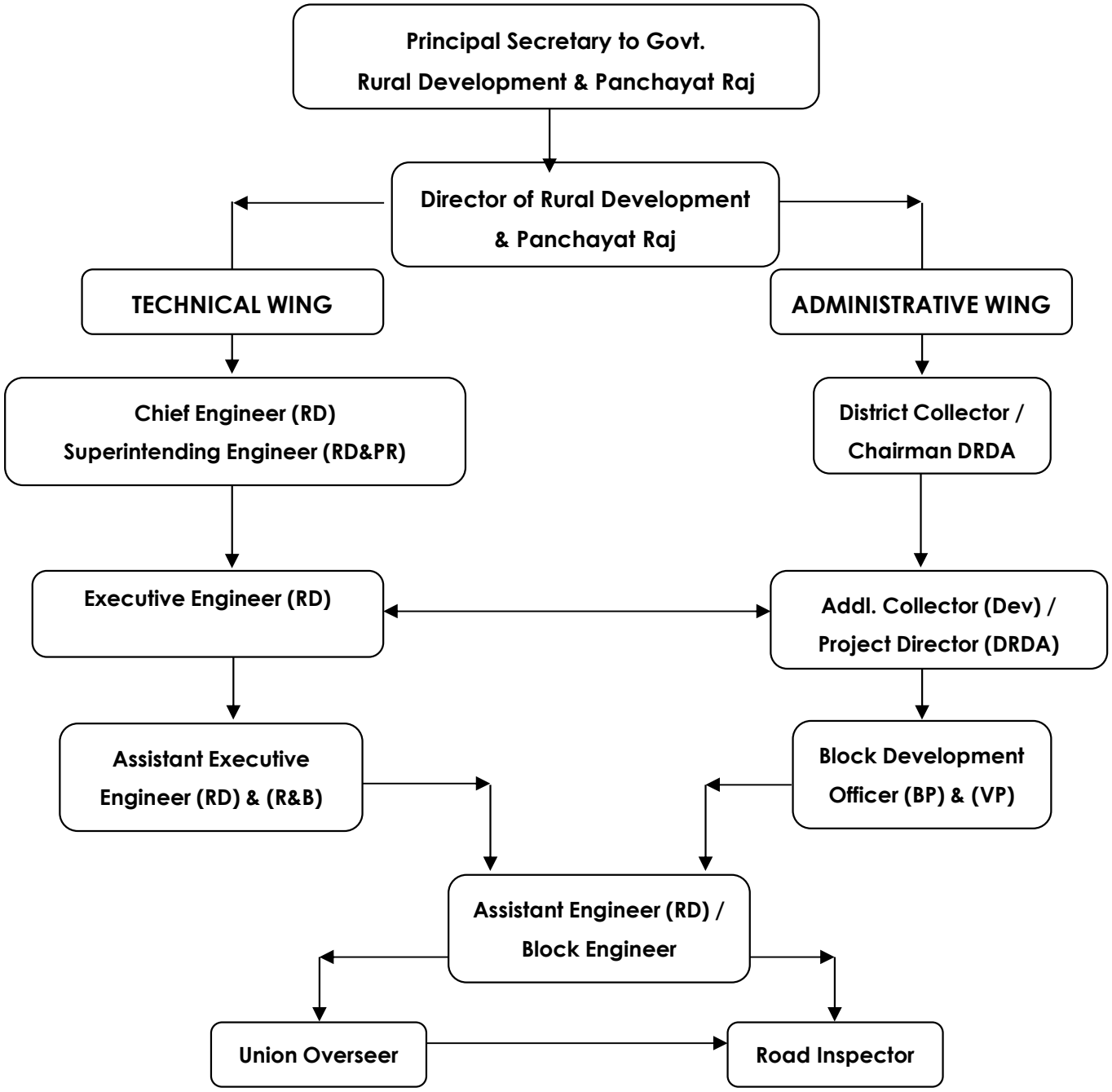
➢ BLOCK LEVEL

At Block Level, there are two Block Development Officers designated as Block Development Officer (Block Panchayat) and Block Development Officer (Village Panchayat).

All Development works and programmes are executed through Panchayat Union Councils / Village Panchayats. The Block Development officer (BP) is also the Commissioner of Panchayat Union and the Executive Authority of the Panchayat Union council.

The Block Development Officer (VP) attends to various centrally sponsored schemes. A team of Deputy Block Development Officer and Administrative Staffs assists the Block Development Officer (BP) and the Block Development Officer (VP).

ORGANIZATIONAL SETUP OF RURAL DEVELOPMENT DEPARTMENT



TYPE DESIGN DRAWINGS FOR WORKS

Standard Type Design Drawings prepared at the Directorate are adopted for the standard buildings in the blocks. For non standard buildings the type designs are prepared as per site condition.

Technical hand book may be referred for detailed Type Design Drawings

SPECIFICATION OF WORKS

Specification specifies or describes the nature and the class of the work, materials to be used in the work, workmanship, etc. and is very important for the execution of work. Specifications should be clear and there should not be any ambiguity anywhere.

For Building works, Standard Specifications as per TNBPSS / MDSSS and for Road works Standard Specifications for Rural Roads published by MoRD, GoI (IRC SP 20-2002, IRC SP 72-2015) are followed.

Various type Designs adopted in RD&PR

Sl. No	Type of Building	Area in Sq. Ft.
1	Elementary and middle school Building (Two class room GF only)	1114.2
2	Elementary and middle school Building (Two class room GF Only- With staircase)	1424.09
3	Elementary and middle school Building (3 class room GF Only - With staircase)	1971.12
4	Elementary and middle school Building (GF & FF - 4 Class room)	2848.18
5	Elementary and middle school Building (GF & FF - 6 Class room)	3942.24
6	Elementary and middle school Building (GF & FF - 8 Class room)	5036.00
7	Anganwadi Building	581.79
8	Kitchen Shed(Elementary School)	312.00
9	School Toilet	249.63
10	Rural Library Building	580.39

Various type Designs adopted in RD&PR

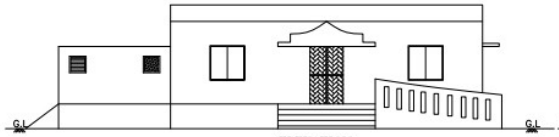
Sl. No	Type of Building	Area in Sq. Ft.
11	Community Hall - Type I	1963.55
12	Community Hall - Type II	2611.97
13	Community Hall - Type III (GF + FF)	5156.96
14	Food Grain Godown	802.45
15	Public Distribution Shop	408.88
16	Panchayat Office Building	1074.99
17	Panchayat Union Office Building	17327.47
18	Village Secretariat Option I	1568.0
19	District Panchayat Resouce Center	3136.97
20	Milk Producer's Co operative Society Building	773.86

Various type Designs adopted in RD&PR

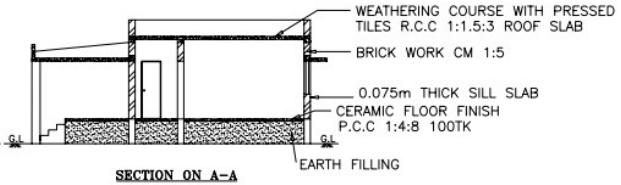
Sl. No	Type of Building	Area in Sq. Ft.
21	Integrated Women's Sanitary Complex	645.40
22	Integrated Men's Sanitary Complex	596.11
23	Cement Godown	866.07
24	Integrated Office Complex Building for Rural Development and Panchayat Raj Department	

TYPE DESIGN FOR PANCHAYAT OFFICE BUILDING

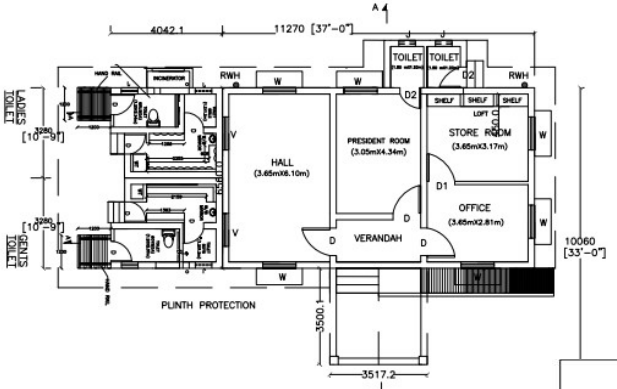
(WITH LADIES & GENTS TOILET PLINTH AREA 1200sq.ft)



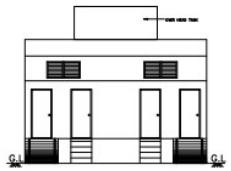
ELEVATION



SECTION ON A–A



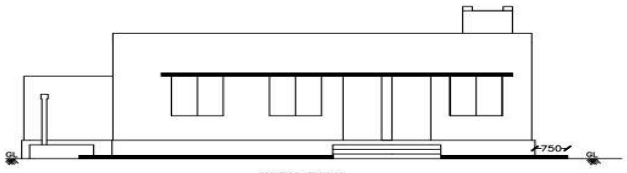
PLAN



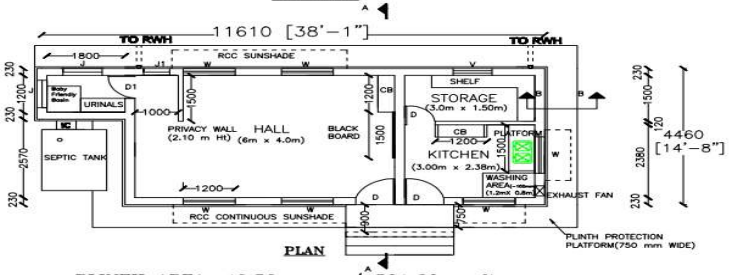
ELEVATION (FOR LEFT SIDE)

ALL DIMENSION ARE IN mm

SCALE – 1:100

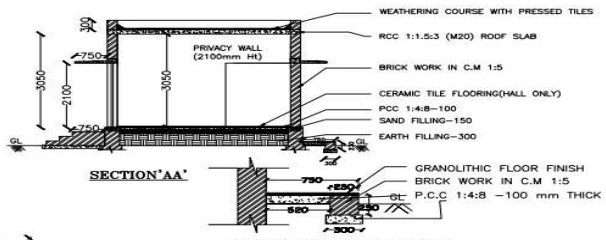


ELEVATION



PLAN

PLINTH AREA :46.59 sq.m / 501.30 sq.ft



SECTION'AA'

SECTION'BB'(PLINTH PROTECTION PLATFORM)

SCHEDULE OF JOINERY

SL. NO.	TYPE	SIZE		SILL	TOP	DESCRIPTION	REMARKS
		WIDTH	HEIGHT				
1	D	900	2100	–	2100	STEEL DOOR WITH 18GMS SHEET SHUTTER	SINGLE LEAF
2	D1	750	1200	–	–	STEEL DOOR WITH 18GMS SHEET SHUTTER	SINGLE LEAF
3	W	1200	1300	800	2100	STEEL WINDOW WITH 18GMS SHEET SHUTTER& 12MM SQ.MS.BARS	TWO LEAF
4	V	900	450	1650	2100	STEEL GLAZED VENTILATOR WITH 12MM SQ.MS.BAR	N–TYPE
5	J	900	450	1650	2100	R.C.C JOLLY	–
6	J1	600	1300	800	2100	R.C.C JOLLY	–

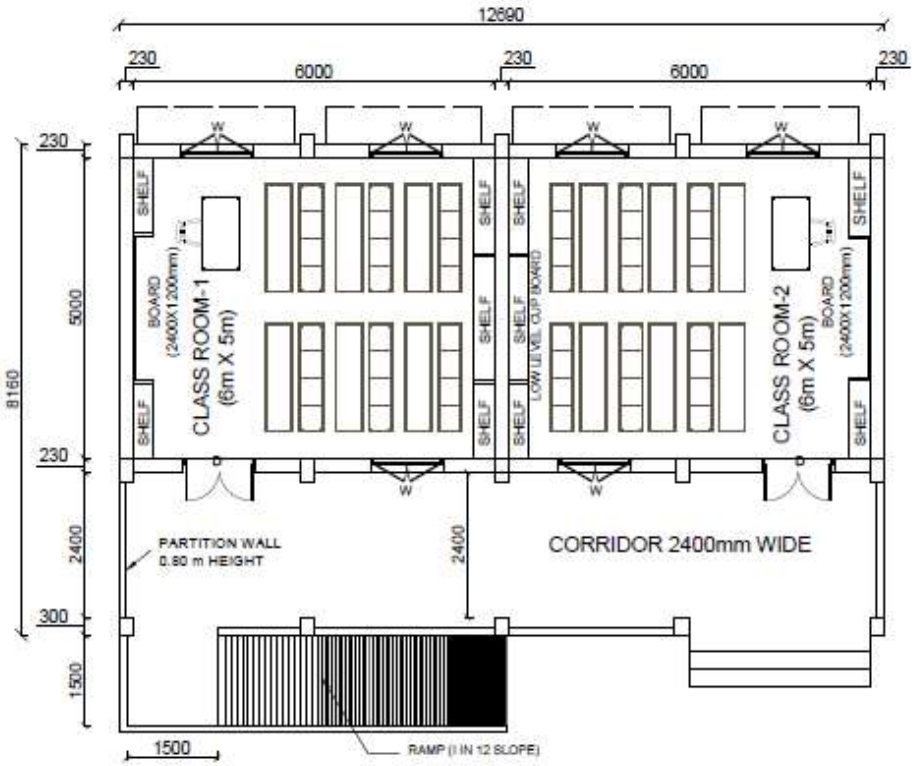
IMPORTANT NOTES:

1. ECONOMICAL FOUNDATION MAY BE ADOPTED. DEPTH OF FOUNDATION SHOULD BE BASED ON THE SOIL CONDITION AT SITE.
2. FLOORING SHOULD BE DONE USING CERAMIC TILES(FOR HALL ONLY).
3. SILL SLAB(75mm THICK) SHOULD BE PROVIDED AT BOTTOM OF ALL WINDOW OPENINGS WITH 250 mm EXTENSION ON EITHER SIDE.
4. PLINTH PROTECTION PLATFORM(750mm WIDTH) SHOULD BE PROVIDED ALROUND THE BUILDING
5. SLIGHT SLOPE SHOULD BE GIVEN FOR ROOF SLAB
6. WEATHERING COURSE SHOULD BE PROVIDED WITH REQUIRED SLOPE TO DRAIN RAIN WATER.
7. RWH STRUCTURE SHOULD BE CONSTRUCTED AWAY FROM SEPTIC TANK(IF ANY) AND IT CAN BE LINKED TO A NEAR BY WATER SOURCE.
8. 110 mm OD PVC PIPES MAY BE USED FOR RAINWATER DOWNFALL PIPES.
9. WASHING AREA SHOULD BE 100mm LOWER THAN FLOOR LEVEL.
10. CARTOONS SHOULD BE DRAWN INSIDE THE HALL AND TOILET ONLY.
11. PVC TANK OF 500 LITRES CAPACITY SHOULD BE PROVIDED.
12. CONTINOUS LINTEL SHOULD BE PROVIDED.

DRAWING NO:1–J3/SERD/Dt.03.09.11

DIRECTORATE OF RURAL DEVELOPMENT AND PANCHAYAT RAJ			
SCALE 1:100	DATE:	ALL DIMENSION ARE IN mm.	
AE	AEE	JOB NO:3	DRAWING NO:1
EE	DE		
TYPE DESIGN FOR NOON MEAL CENTRE/ANGANWADI			
PLAN, ELEVATION AND SECTION			

SCHOOL BUILDING WITH 2 CLASS ROOMS



GROUND FLOOR PLAN

SCHEDULE OF JOINERY

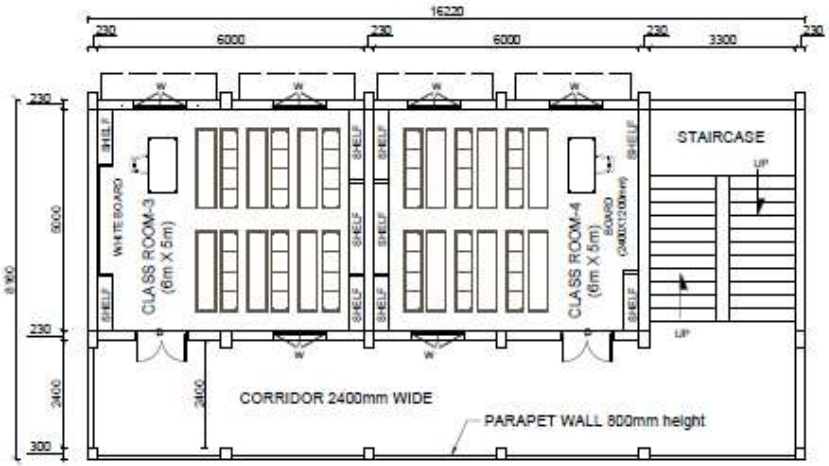
SL NO	TYPE	SIZE WIDTH	SIZE HEIGHT	SILL	TOP	DESCRIPTION	REMARKS
1	D	1200	2400	-	2400	STEEL DOOR WITH 18GMS SHEET SHUTTER	DOUBLE LEAF
#	W	1200	1600	800	2400	STEEL WINDOWS WITH 18GMS SHEET SHUTTER AND 12mm Sq.m BARS	TWO LEAVES

PLINTH AREA :

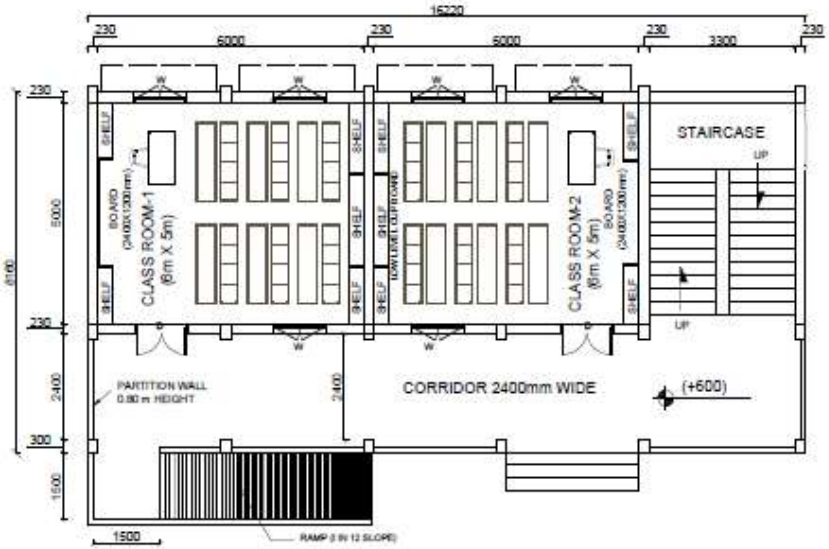
Ground floor area - 103.55 Sq.m / 1114.2 Sq.ft

DIRECTORATE OF RURAL DEVELOPMENT AND PANCHAYAT RAJ			
TITLE : TYPE DESIGN FOR SCHOOL BUILDING WITH 2 CLASS ROOMS PLAN			
AE	AEE	SCALE - 1 : 100	
EE	SE	CE	SH. No. 1 OF 2
DRAWING NO. 03		DATE -	REVISION : 0

SCHOOL BUILDING WITH 4 CLASS ROOMS



FIRST FLOOR PLAN



GROUND FLOOR PLAN

SCHEDULE OF JOINERY

SL NO	TYPE	SIZE WIDTH	SIZE HEIGHT	SILL	TOP	DESCRIPTION	REMARKS
1	D	1200	2400	-	2400	STEEL DOOR WITH 18GMS SHEET SHUTTER	DOUBLE LEAF
#	W	1200	1600	800	2400	STEEL WINDOWS WITH 18GMS SHEET SHUTTER AND 12mm Sq.m BARS	TWO LEAVES

PLINTH AREA :

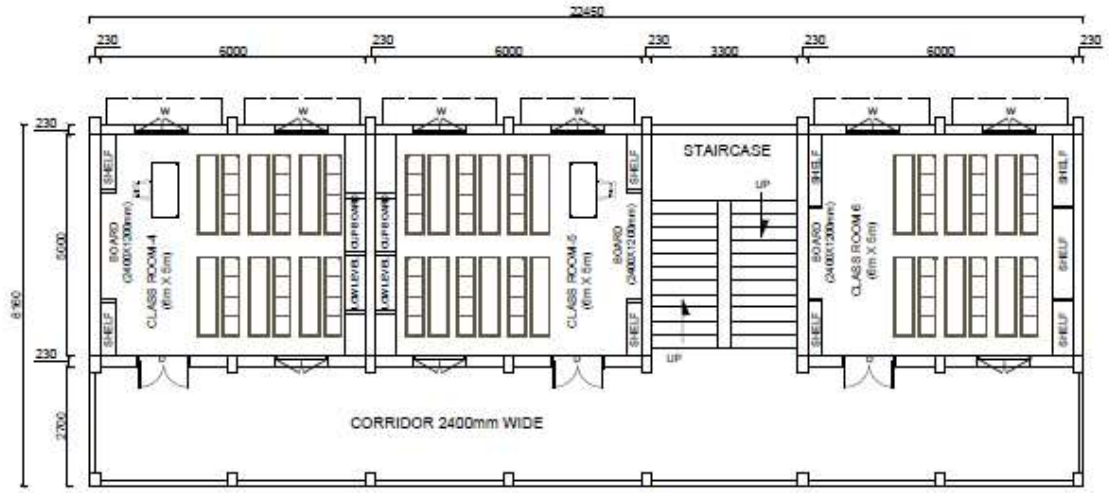
Ground floor area - 132.35 Sq.m / 1424.09 Sq.ft

First floor area - 132.35 Sq.m / 1424.09 Sq.ft

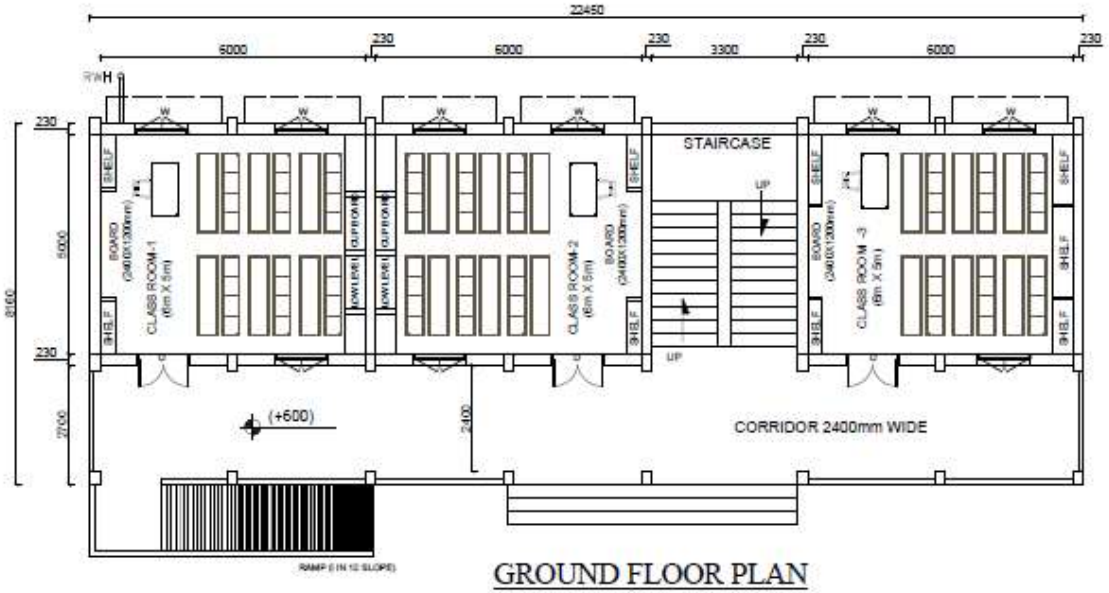
DIRECTORATE OF RURAL DEVELOPMENT AND PANCHAYAT RAJ			
TITLE : TYPE DESIGN FOR SCHOOL BUILDING WITH 4 CLASS ROOMS PLAN			
AE	AEE	SCALE - 1 ; 100	
EE	SE	CE	SH. No. 1 OF 2
DRAWING NO: 03		DATE -	REVISION : 0

297 x 420 - A3

SCHOOL BUILDING WITH 6 CLASS ROOMS



FIRST FLOOR PLAN



GROUND FLOOR PLAN

SCHEDULE OF JOINERY

SL NO	TYPE	SIZE WIDTH	SIZE HEIGHT	SILL	TOP	DESCRIPTION	REMARKS
1	D	1200	2400	-	2400	STEEL DOOR WITH 18GMS SHEET SHUTTER	DOUBLE LEAF
#	W	1200	1500	900	2400	STEEL WINDOWS WITH 18GMS SHEET SHUTTER AND 12mm Sq.m BARS	TWO LEAVES

PLINTH AREA :
Ground floor area - 183.19 Sq.m / 1971.12 Sq.ft
First floor area - 183.19 Sq.m / 1971.12 Sq.ft

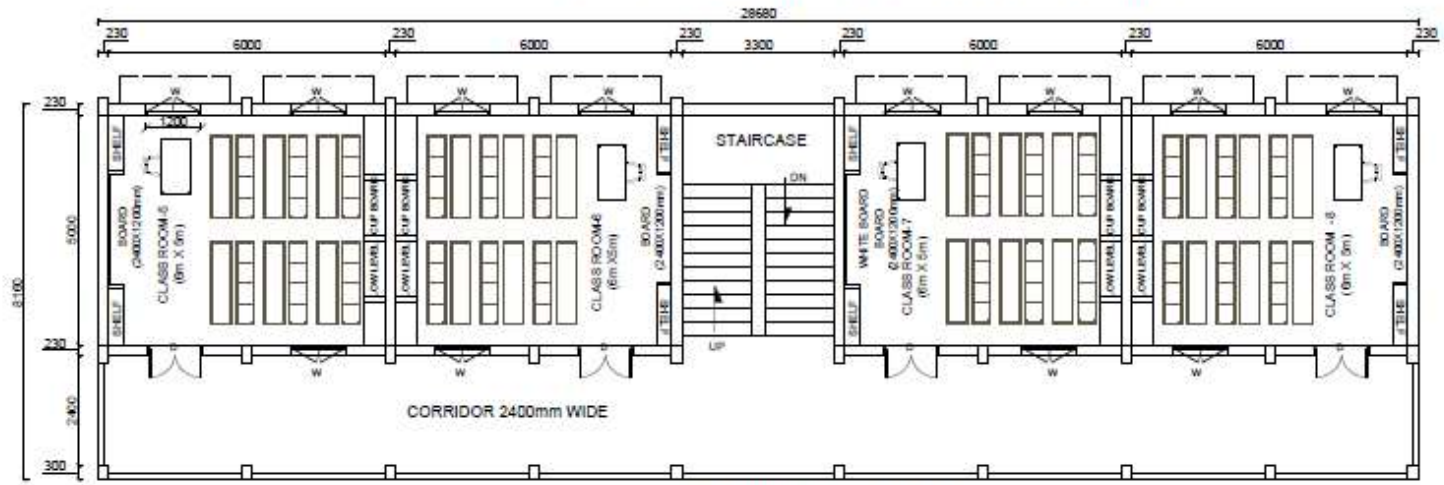
DIRECTORATE OF RURAL DEVELOPMENT AND PANCHAYAT RAJ

TITLE : TYPE DESIGN FOR SCHOOL BUILDING WITH 6 CLASS ROOMS PLAN

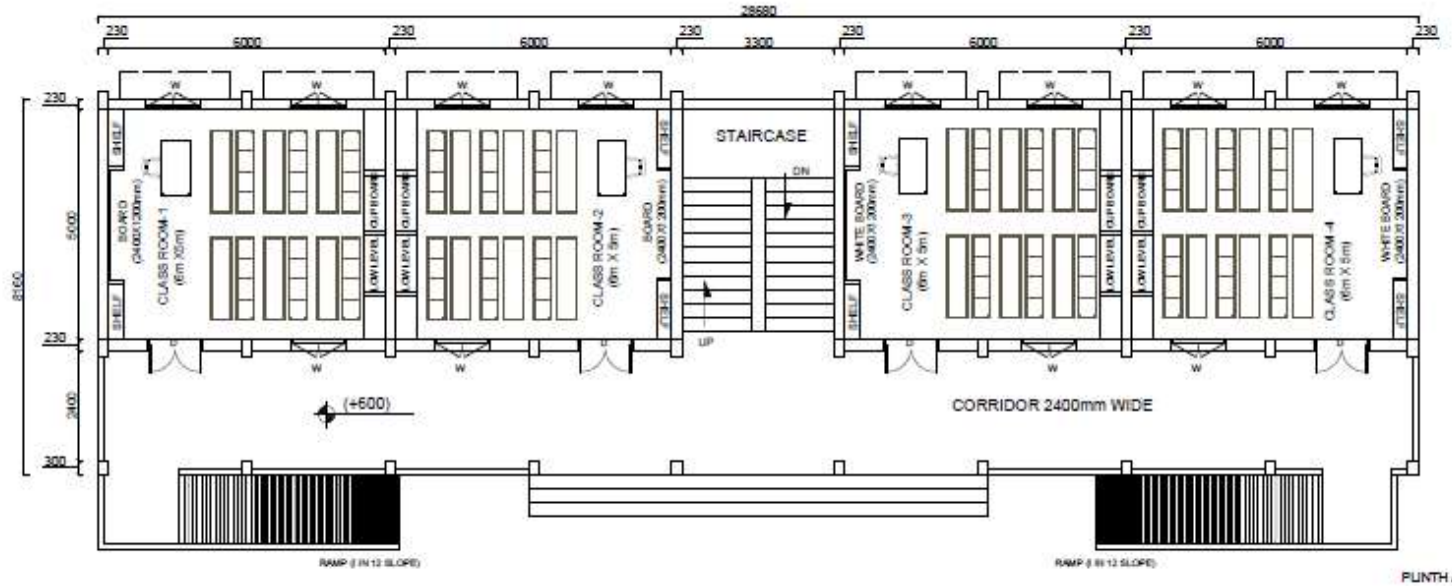
AE	AEE	SCALE - 1 : 100	
EE	SE	CE	SH. No. 1 OF 2
DRAWING NO: 03		DATE -	REVISION : 0

297 X 420 - A3

SCHOOL BUILDING WITH 8 CLASS ROOMS



FIRST FLOOR PLAN



GROUND FLOOR PLAN

SCHEDULE OF JOINERY							
SL NO	TYPE	SIZE WIDTH	SIZE HEIGHT	SILL	TOP	DESCRIPTION	REMARKS
1	D	1200	2400	-	2400	STEEL DOOR WITH 18GMS SHEET SHUTTER	DOUBLE LEAF
#	W	1200	1800	600	2400	STEEL WINDOWS WITH 18GMS SHEET SHUTTER AND 12mm Sq.m BARS	TWO LEAVES

PLINTH AREA :

Ground floor area - 234.03 Sq.m / 2518 Sq.ft

First floor area - 234.03 Sq.m / 2518Sq.ft

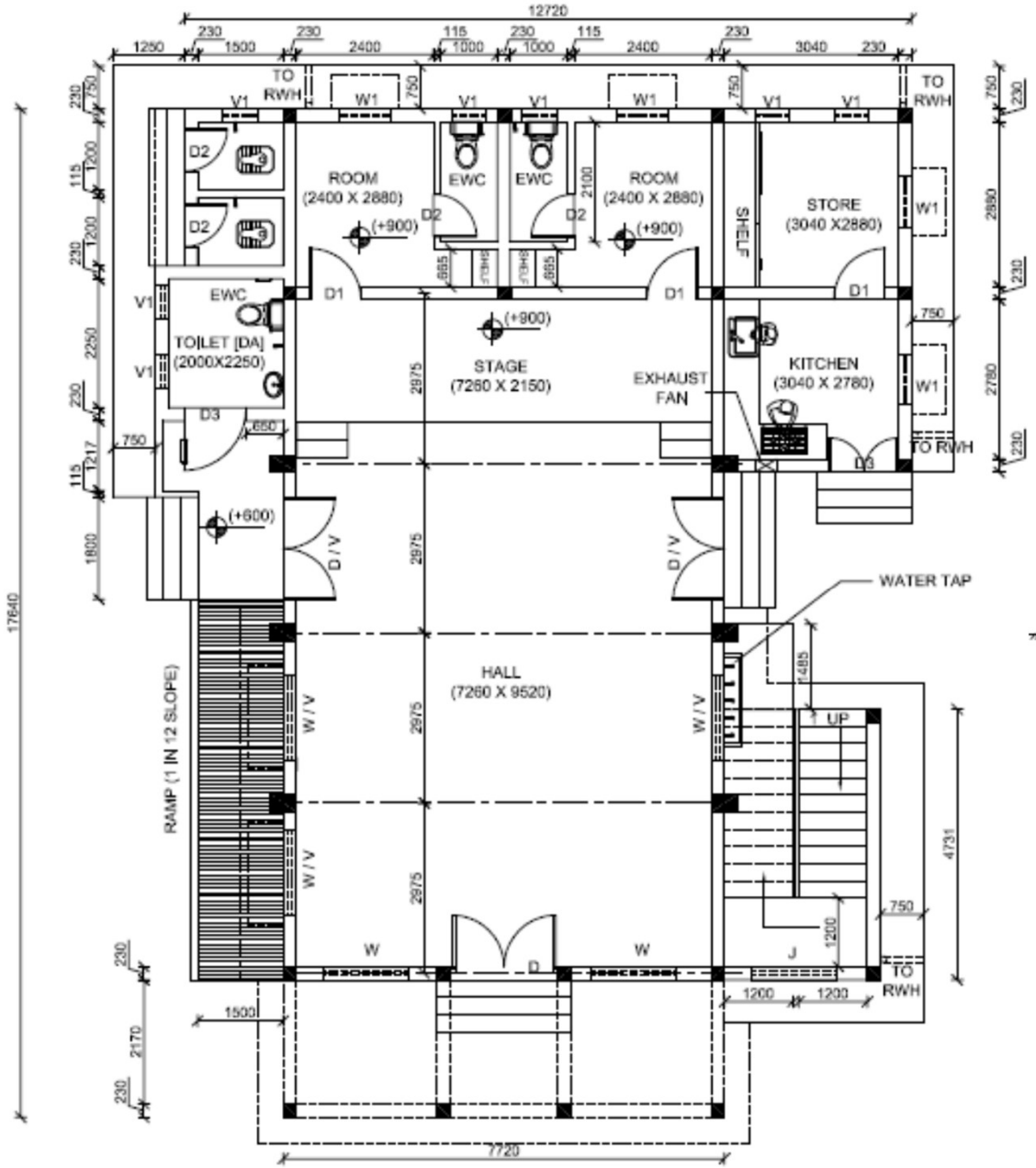
AE	AEE	SCALE - 1 : 100	
EE	SE	CE	SH. No. 1 OF 2

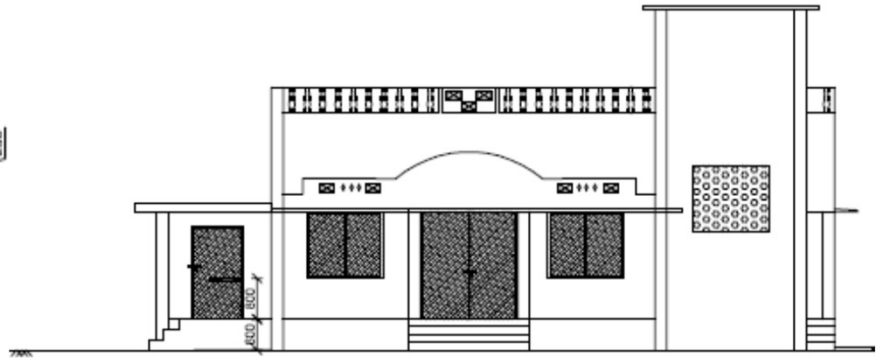
DIRECTORATE OF RURAL DEVELOPMENT AND PANCHAYAT RAJ

TITLE : TYPE DESIGN FOR SCHOOL BUILDING WITH 8 CLASS ROOMS PLAN

297 x 420 - A3

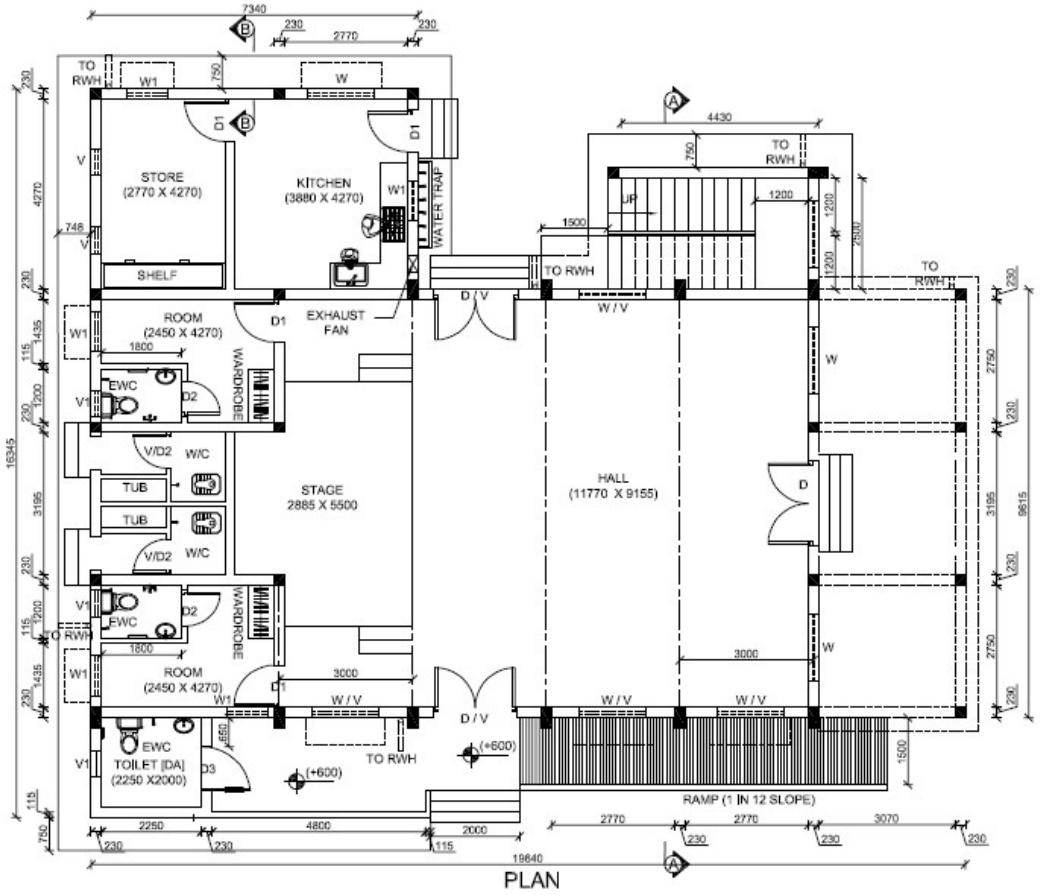
COMMUNITY HALL TYPE-I

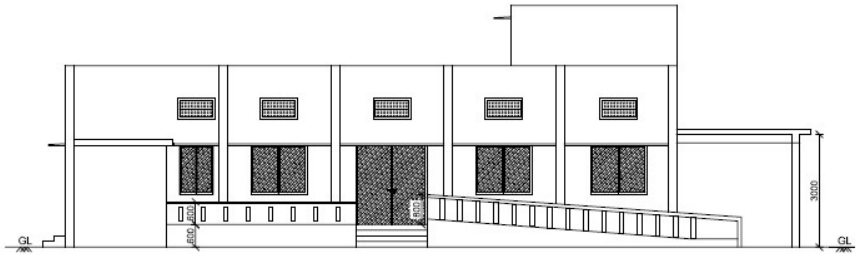




ELEVATION

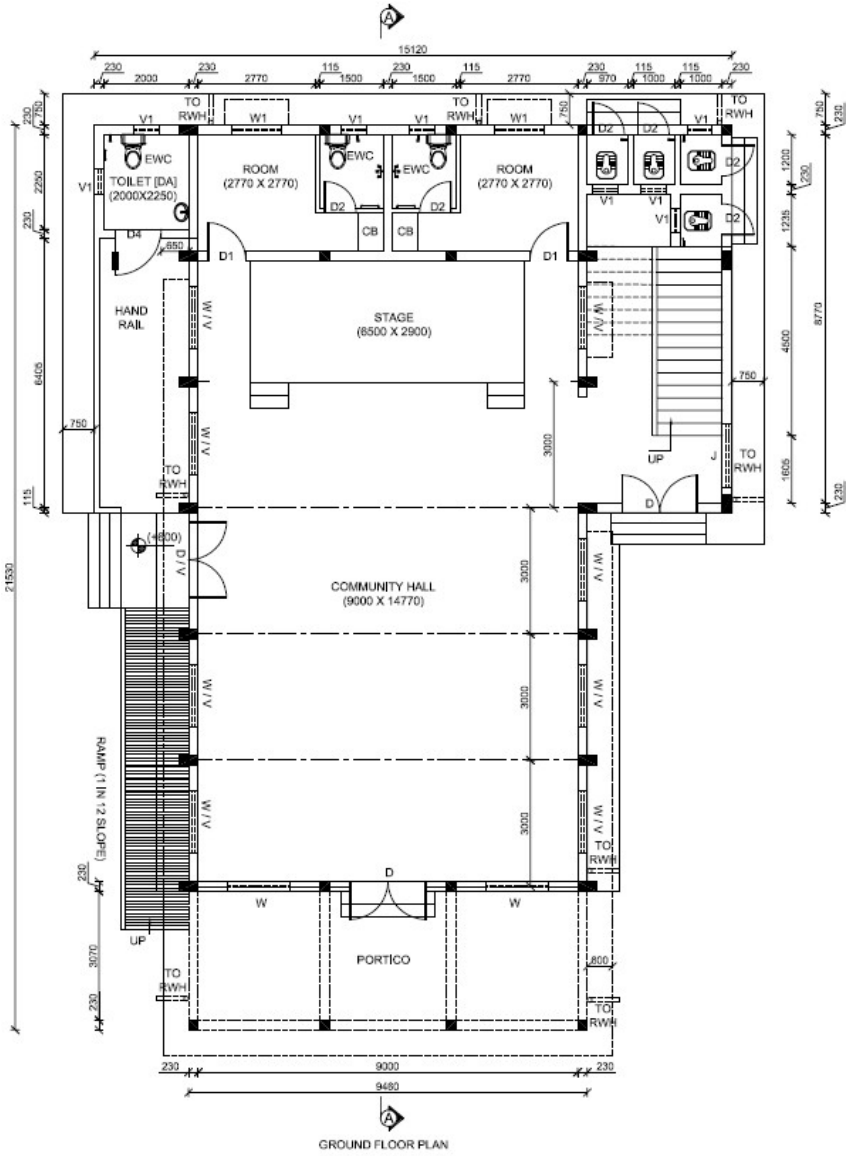
COMMUNITY HALL TYPE-II

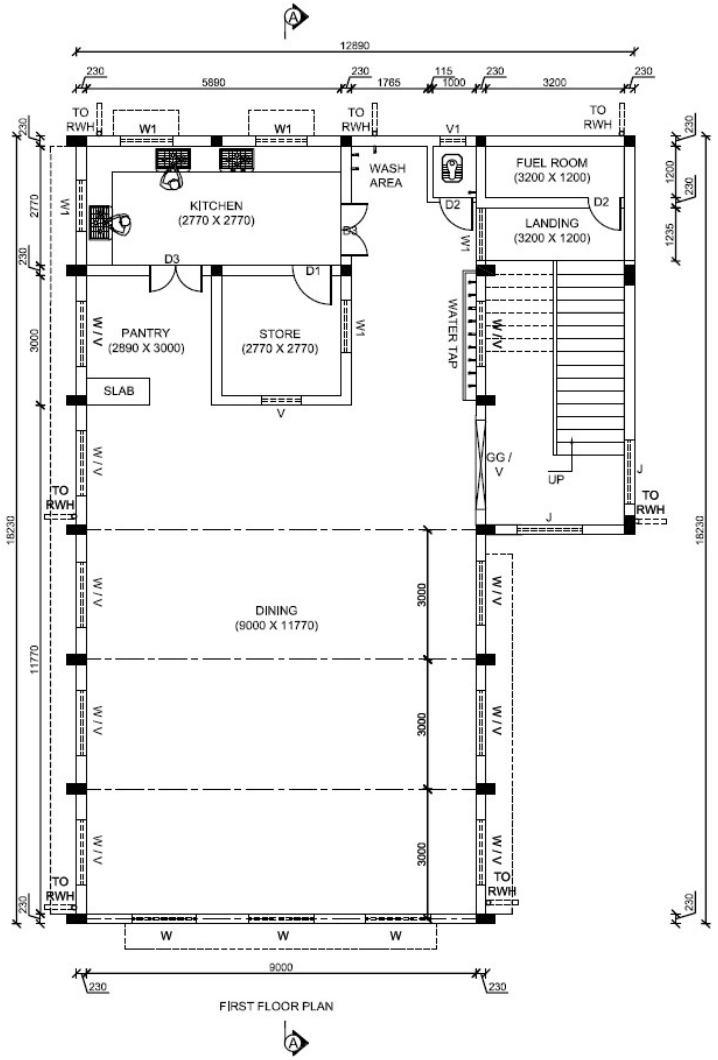


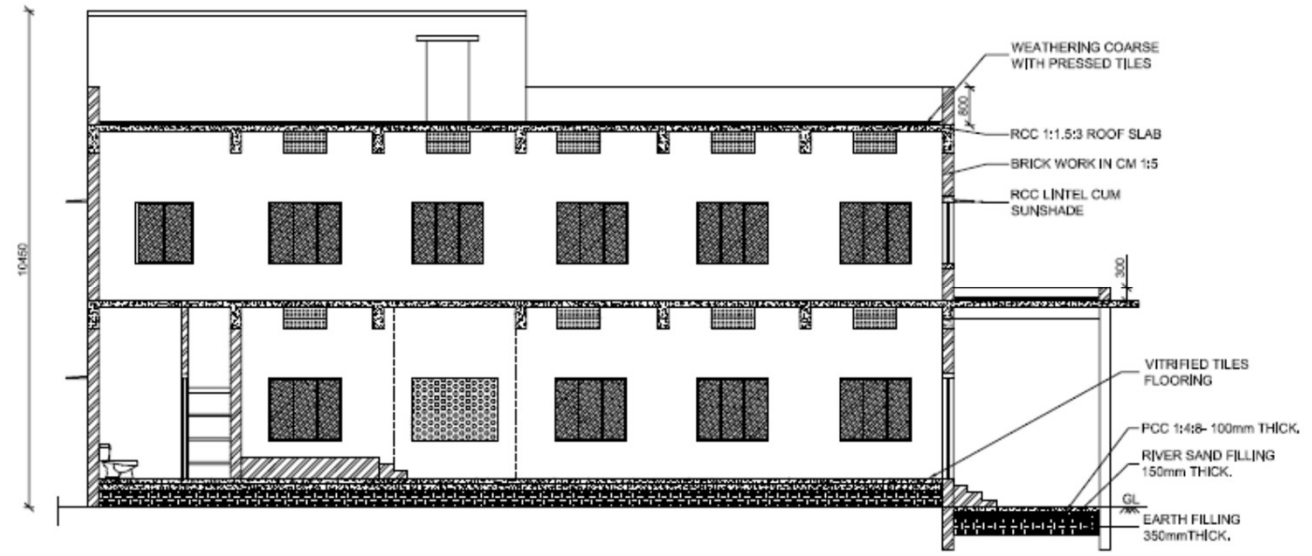


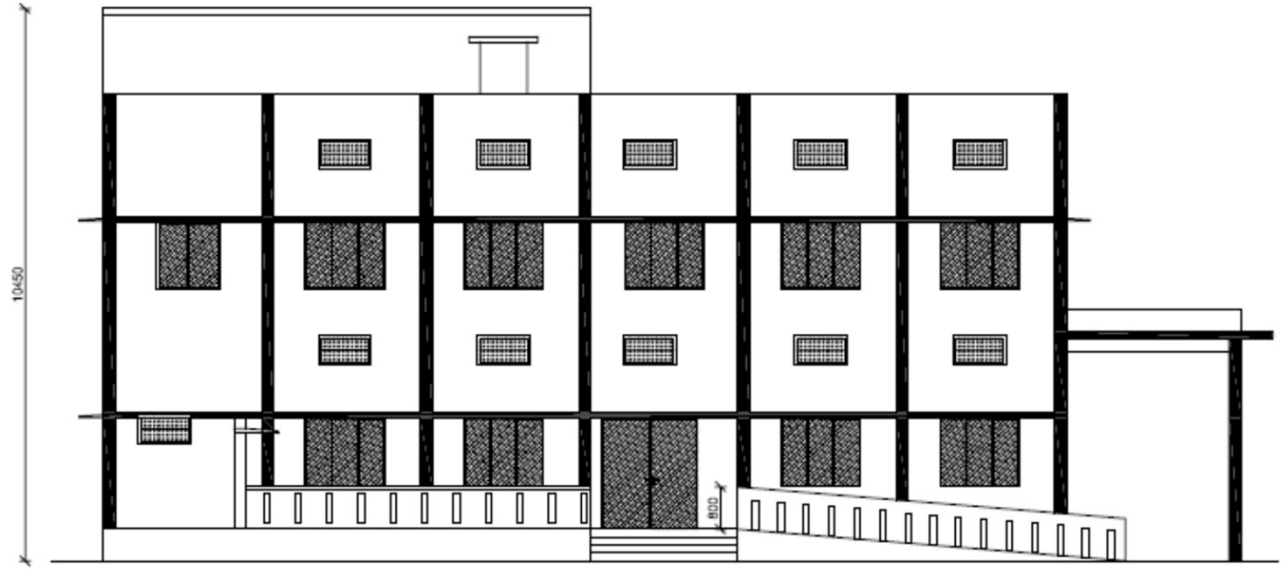
ELEVATION

COMMUNITY HALL TYPE-III

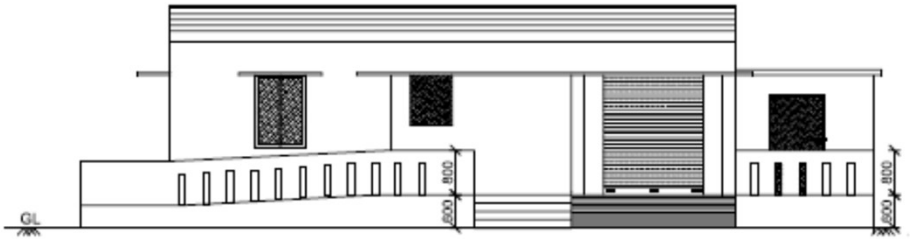




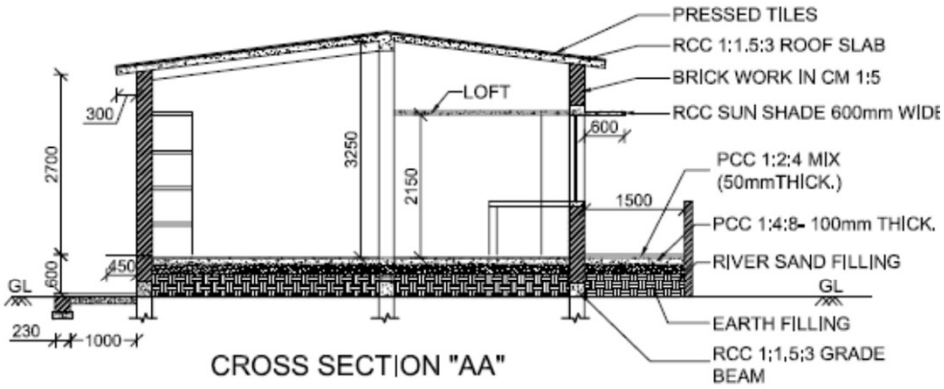

10450
WEATHERING COARSE
WITH PRESSED TILES
600
RCC 1:1.5:3 ROOF SLAB
BRICK WORK IN CM 1:5
RCC LINTEL CUM
SUNSHADE
300
VITRIFIED TILES
FLOORING
PCC 1:4:8- 100mm THICK.
RIVER SAND FILLING
150mm THICK.
GL
EARTH FILLING
350mmTHICK.


10450
600

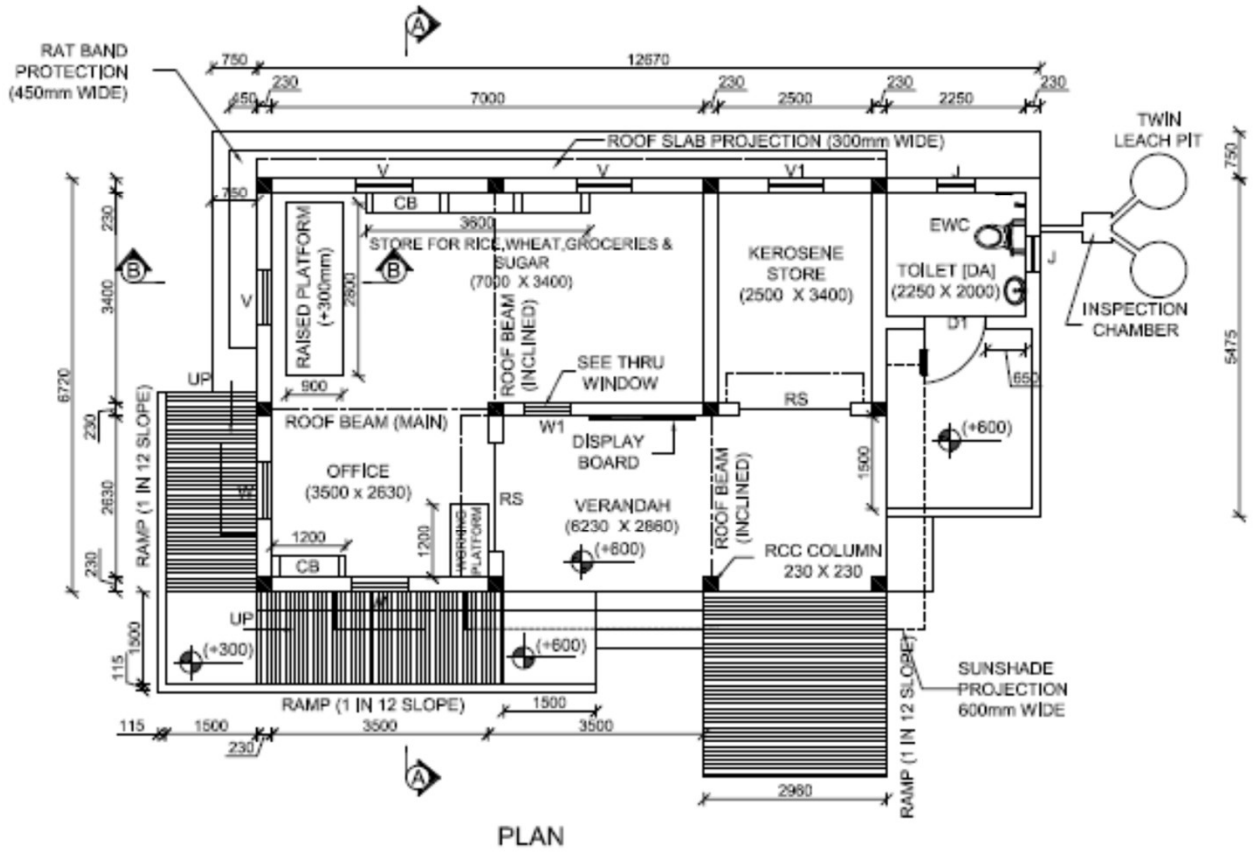
FOOD GRAIN GODOWN (PDS)



ELEVATION



CROSS SECTION "AA"



PLAN

IMPLEMENTATION OF WORKS

The implementation of a work is mainly confined to the following activities.

a. Preparation of Detailed Project Report

b. Administrative approval and technical sanction

c. Invitation of tenders and award of contract (for the schemes to be executed through tenders)

d. Execution of works

Preparation of Detailed Project Report

Prior to estimate preparation, the site should be inspected first, the preliminary survey to be conducted, the details such as topography, nature of soil and land, ground water table at site during various seasons, presence of water retaining structures and other structures / land marks nearby, etc. are to be collected. The location of culverts, drains, retaining walls etc. are to be decided as per site conditions.

Testing of soil strata before preparation of estimates

The strength of soil is to be tested prior to estimate preparation. In case of major building works such as multistoried building or bridges, the plate load test or standard penetration test should be conducted to arrive at the safe bearing capacity of the soil. Based on SBC and nature of soil below foundation level, the foundation type and size are decided.

In case of road works, undisturbed soil samples along the alignment have to be collected and should be tested in laboratory to arrive at soaked CBR value. Based on CBR value and traffic intensity, the crust thickness of road will be decided.

Preparation of Detailed Project Report

Standard Data for Preparing Rates

For building works, Standard Data Book published by Public Works Department and for road works road data prepared by Highways Department is followed.

For road works to be executed under PMGSY scheme Standard Data Book published by MoRD (Ministry of Rural Development) is followed.

Adoption of PWD Schedule of Rates & Highways approved rates

The rates of works, materials, labour, etc., vary from place to place but to have common method of working out rates, the current Schedule of Rates published by Public Works Department has been used for arriving rates of items of works in building estimates and estimates of related works such as retaining wall, compound wall, etc. In case of estimates of road works, for labour and machinery charges, current rates as approved by Highways department is being adopted.

Administrative Sanction and Technical Sanction

Administrative Sanction

Before according the Administrative Sanction, the site plan, survey number of land, ownership of the land in which the work has to be carried out is to be verified.

Administrative approval of the competent authority is a pre-requisite to take up any work. It is in effect an order to the department to execute a specified work at a stated cost.

Technical Sanction

On receipt of Administrative Sanction, detailed investigation is carried out and a detailed project estimate comprising of,

a. Report,
b. Specifications,
c. Detailed Plans and Drawings,
d. Detailed Estimate (comprising of Item of work, Measurement and Quantity) and
e. Abstract estimate comprising of Quantity to be executed, Rate, amount and Total Estimated cost.

Administrative Sanction and Technical Sanction

Technical Sanction

The Competent Authority i.e., Chief Engineer / Superintending Engineer / Executive Engineer / Assistant Executive Engineer / Assistant Engineer after satisfying himself about the efficacy and economical nature of the design accords technical sanction to the estimate.

Technical sanction powers to the different officers is given vide G.O Ms. No. 111 Rural Development and Panchayat Raj (PR-1) Dated 21.08.2018.

Methods of Execution

The methods of execution are determined mainly by the guidelines covering the schemes under which the works are being taken up

a. Departmental Execution and
b. Tendering method

Methods of Execution

Departmental Execution

Execution of works is carried out in the name of the Departmental staff i.e., the department directly engages necessary labourer and procuring the materials to execute the works by following the prescribed rules and regulation.

This method is adopted in cases where no contractor is available or where it is specified in the concerned scheme.

Tendering Method

The entire process under which the execution of works are entrusted to eligible and qualified bidders by inviting sealed tenders to execute the work within a given time frame under certain conditions is defined as tendering method. The piece worker merely agrees to execute a specified work.

After technical sanction to the detailed estimate, works are executed through contractors by way of tender system. Under tender system, Tender Transparency Act 1998 and Tamil Nadu Tender Transparency Rules 2000 are followed.

Execution of Works.

Buildings :

Planning of Building

A building should be planned to make it comfortable, economical and to meet all the requirements. The attempt of the planner should be to attain maximum convenience with the limited money available. Area, shape, size and height all influence cost apart from cost of construction and materials.

Orientation of Building

Proper orientation of buildings is an important factor, which should never be ignored. Improper orientation will result in loss of user comfort and the inmates find it miserable because of heat and absence of natural breeze. As far as possible the lengthy side of building should not face East or West, as maximum area of the outer side of the building is exposed to hot sun.

Site Clearance

The site handed over to the contractor should be taken position and it should be cleared off jungle, debris etc. Then it should be leveled.

Execution of Works.

Buildings :

Centre line marking

The centre line of building as in approved drawing, should be marked or transferred on to the ground. The corners and junction of walls also marked with reference to the baseline. After marking, the distances marked are cross verified by measuring the diagonal distances.

Excavation and deciding depth of foundation

The depth of foundation should be decided based on total load coming on the structure and on type of soil, safe bearing capacity of the soil. The soil should be excavated to the required depth and correct size vertically straight.

Sand Filling, CC for Leveling Course

In the excavated pit, sand filling should be done and compacted to a minimum depth of 150 mm. Then cement concrete in 1:4:8 should be laid to a minimum thickness of 150 mm.

Execution of Works.

Buildings :

Foundation

The lowest part of a structure which transmits the weight of the structure together with live loads, seismic and wind pressure to the material on which the structure rests, ensuring its safe bearing capacity, is called foundation.

Functions of foundation

- To transmit and distribute the total load of the structure to a larger area of underlying support.
- To prevent differential settlement of the structure. To provide stability to the structure.

Types of Foundations

- Spread Foundation.
- Pile Foundation.
- Pier Foundation.
- Well foundation.

Execution of Works.

Buildings :

Sub Structure

The components of the building below basement level are called as substructure. Stone masonry is commonly used for substructures of load bearing structures. For framed structures RCC Columns combined with footings, grade beam and plinth beam is commonly used.

Super Structure

The components of the building above basement level are called as superstructure. Brick and stone masonry are commonly used for superstructure in load bearing structures. For framed structures in addition to masonry, columns and beams are used.

Execution of Works.

Buildings :

Ceiling Height

A uniform height of 3.10m clear from the top of floor finish to the top of slab is applicable for all floors. In the case of sloping slabs the height of ceiling should be 3.25m at ridge and 2.95m at eaves, the height being measured up to top of slab.

RCC Roofing, Centering and Steel Fabrication

Grade Beams

The filling in the basement has to be retained effectively, even in case of any erosion or any scooping of earth outside the buildings by burrowing animals, the top of grade beams may be fixed at 30cm below ground level.

Plinth Beam & Plinth level

The plinth beam should be 15 cm thick and it should be laid for the full width of the wall, which it is supposed to carry above the plinth beam.

The plinth level may be fixed at a height of 60 – 90 cm above the main road level wherever necessary as per site condition to avoid intrusion of storm water.

Execution of Works.

Buildings :

Lintel & Sunshade

Continuous lintels should be laid continuously for the entire wall length. Sunshade should be provided individually for windows and no continuous sunshade is necessary in normal cases. But in expansive and black cotton soils, where continuous lintel has to be provided, then in that case, continuous sunshade can be adopted if found necessary. The cantilever reinforcement of sunshades can serve as cross reinforcement for the lintel with required anchorage.

Roof Beams & Slab

Roof beams should be constructed monolithically with roof slab. Torsion reinforcement should be provided at corners in two way slabs as per codal provisions.

Execution of Works.

Buildings :

Cement Concrete

Concrete is a mixture of paste and aggregates. The paste, composed of Portland cement and water, coats the surface of the fine and coarse aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock – like mass known as concrete. It is plastic and malleable when newly mixed, strong and durable when hardened.

Proportion

The key to achieve a strong, durable concrete rests in the careful proportioning and mixing of the ingredients. Properly proportioned concrete has the following properties.

- While fresh, it is workable enough for economical and uniform placement but not excessively fluid.
- When hardened, it has sufficient strength and durability for its purpose.
- It involves a minimum cost for materials and labour.

Execution of Works.

Buildings :

Importance of Water Cement ratio

The ratio of the amount of water to the amount of cement is called the water – cement ratio. The greater the amount of water in a concrete mix, the more dilute the cement paste will be. This not only affects the compressive strength, it also affects the tensile and flexural strengths, porosity, shrinkage and colour of the concrete.

Disadvantages resulting from the use of too much water in mixing are

- Water occupies space in concrete and as it evaporates it leaves voids. The more the uncombined water the more voids there will be in the set concrete and the less be its density, strength and durability.
- Excess water brings a mixture of the flow part of the cement and water to the surface of the concrete and this forms a scum or thin layer of chalky material known as 'laitance' which prevents the proper bonding of the next layer of concrete and creates a plane of weakness. This is especially harmful when it occurs in tanks or dams where water tight concrete is necessary.
- Excess water leaks out of the shuttering carrying away some of the precious cement and leaving the concrete honey combed in places.

Execution of Works.

Buildings :

Stripping time for centering materials

In normal circumstances and where Ordinary Portland Cement is used, forms may generally be removed after the expiry of the following periods:

a)	Walls, columns and vertical faces of all structural members	16-24 hours as may be decided by engineer in charge
b)	Slab (Props left under)	3 days
c)	Beam soffits (props left under)	7 days
d)	Removal of props under slabs:	
	i) Spanning upto 4.5 m	7 days
	ii) Spanning over 4.5m	14 days
e)	Removal of props under Beam & Arches.	
	i) Spanning upto 6m	14 days
	ii) Spanning over 6m	21 days

Execution of Works.

Buildings :

Weathering course and Roof finish

After laying the R.C.C. roof slab the

- Brick jelly lime concrete for weathering course must be laid and tamped with wooden beaters for proper consolidation.
- Finally pressed tiles 25mm thick should be laid,
- The ceiling plastering may be done after the brick jelly lime concrete for weathering course is laid and consolidated.

Fixing & Laying of Sanitary Appliances

Sanitary fittings such as wash basin, water closet etc. should be fixed properly as per design

Plumbing including Water supply

Necessary pipe fitting and water tank for water supply should be done as per design and estimate

Plastering

The plastering for interior walls and flooring must be finished absolutely smooth with a steel trowel and the plastering for outer side of the walls and flooring exposed to sun must be finished with wooden float and must be left some what rough, but uniformly rough without variations. The corners and edges in plastering must be given sharp edge finishing with cement mortar 1:3.

Execution of Works.

Buildings :

Execution of Works.

Buildings :

Electrification to buildings

Electrification to building should be done as per electrification drawing. The light points, Fan points and other connection points should be decided previously as per requirement.

Wiring:

For concealed wiring the provisions should be given prior to roof concreting and verified at the time of checking the steel reinforcement

Fan hooks:

Fan points should be decided before the concrete for the roof is laid. The location should be decided taking into account the usable area, other than undefined passages in drawing, dining and bedrooms.


கிராம செயலகம்
புங்கஞர் ஊராட்சி.


அங்கன்வாடி மையம்
10 Ten
20 Twenty
30 Thirty
40 Forty
50 Fifty
60 Sixty
70 Seventy
80 Eighty
90 Ninety
100 Hundred


ஊராட்சி மன்ற அலுவலகம்.
மாங்காட்டுச்சேரி ஊராட்சி.


சமத்துவபுரம்
நியாயவிலை கடை


உணவுதானியக் கிடங்கு
கட்டிடம் கட்டுதல் கல்யான ஒடை.

Quality Control of Works.

Buildings :

All the Construction materials such as Cement, Steel, Bricks, M-Sand, Water are to be tested from a reputed Engineering Institute before utilizing into the work. And the results are to be entered in the Q C Register.

Periodical QC tests on work Should also be conducted,

Design mix for concrete mixes of grade M25 above should be obtained from reputed Engineering Institute

Workability of Concrete to be tested whenever concreting is done and results are to be recorded.

Concrete Cubes are to be tested for the Compressive strength of Concrete from the reputed Engineering Institute for 7 days and 28 days cube strength.


ROADS

ROADS

❖ Classification of Rural Roads:

The rural roads are commonly referred to:

1. Other District Roads (ODR)
2. Village Roads (VR)

Other District Roads are the roads serving rural area of production and providing them with outlet to market centers, Taluk head quarters, block development head quarters or major district roads, and would serve to connect village with population 1000 and above or cluster of villages.

Village roads connecting villages or cluster group of villages with each other and to the nearest road of a higher category.

❖ Terrain Classification:

The general slope of the country classifies the terrain across the area. The terrain is an important parameter governing the geometric standards.

ROADS

❖ Terrain Classification:

Terrain Classification	Cross Slope of the Country	
Plain	0-10%	More than 1 in 10
Rolling	10 – 25%	1 in 10 to 1 in 4
Mountainous	25 – 60%	1 in 4 to 1 in 1.67
Steep	Greater than 60%	Less than 1 in 1.67

❖ Design Speed:

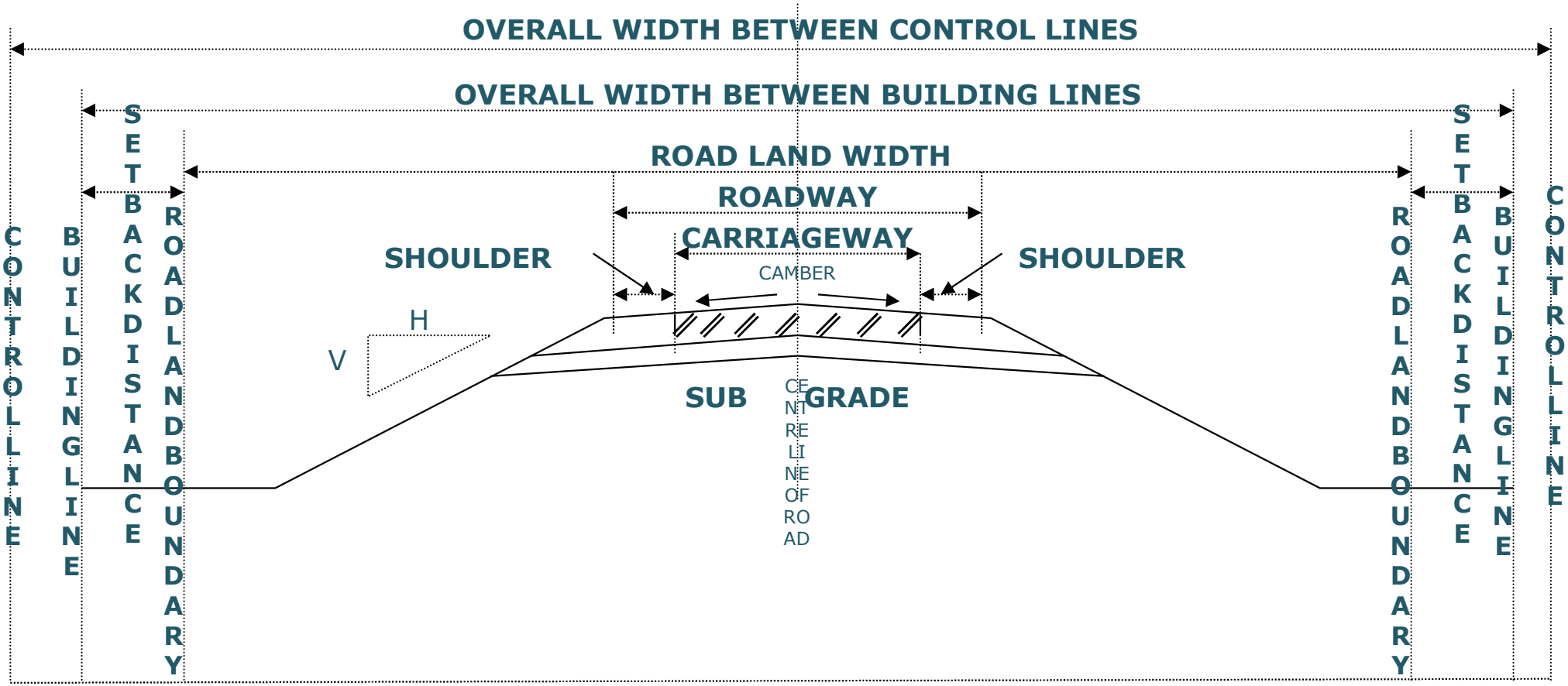
Design speed is a basic criterion for determining all geometric features of horizontal and vertical alignments.

The design speeds recommended by IRC for the rural roads.

Rural Roads (ODR and VR)		
Terrain	Design Speed (Km/h)	
	Ruling	Minimum
Plain terrain	50	40
Rolling terrain	40	35
Mountainous terrain	25	20
Steep terrain	25	20

ROADS

Cross Sectional Elements of Flexible Pavement



ROADS

Cross Sectional Elements

➢ Road Land Width:

Road land width the width of land acquired for road purposes.

Road Classification	Plain and Rolling Terrain				Mountainous and Steep Terrain			
	Open Area		Built-up Area		Open Area		Built-up Area	
	Normal	Range	Normal	Range	Normal	Range	Normal	Range
Rural roads (ODR and VR)	15	15-25	15	15-20	12	12	12	9

➢ Roadway Width:

Roadway width inclusive of parapet, side drains for rural roads.

Terrain classification	Roadway width (m)
Plain and Rolling	7.50
Mountainous and Steep	6.00

ROADS

Note:

i. For rural roads, where the traffic intensity is less than 100 motor vehicles per day, and where the traffic is not likely to increase due to situation like dead end, low habitation and difficult terrain conditions, the roadway width may be reduced to 6.00m in case of plain and rolling terrain.

ii. The roadway width given in table for mountainous and steep terrain is inclusive of parapet.

iii. The roadway width for Rural Roads is on the basis of a single lane carriageway of 3.75m.

iv. On horizontal curves the roadway width should be increased corresponding to the extra width of carriageway for curvature.

ROADS

❖ Carriageway Width:

The standard width of carriageway for plain and rolling as well as mountainous and steep terrain is given in table below.

Road classification	Carriageway width (m)
Rural roads (ODR and VR)	**3.75**

Note:

For Rural roads, the carriageway width may be restricted to 3.00m, where the traffic intensity is less than 100 motorized vehicles per day, and where the traffic is not likely to increase due to situation like dead end, low habitation and difficult terrain conditions.

ROADS

❖ Shoulder Width:

The width of shoulder for rural roads in different terrain will be one half the difference between the roadway width and carriageway width.

❖ Roadway Width at Cross Drainage Structures:

It is difficult to widen cross drainage structure at a later stage. Therefore, the roadway width should be decided very carefully at the planning stage itself.

Culvert: The roadway width at culvert (measured from outside to outside of parapet walls)

Roadway width at Culvert

Road classification	Terrain (m)	
	Plain and Rolling	Mountainous or Steep
Rural roads (ODR and VR)	7.50	6.00

ROADS

Bridge: The roadway width between kerb for minor and major bridges

Roadway width at Bridge

Road classification	Clear roadway Width (m)
Rural roads (ODR and VR)	**5.50**

For Rural Roads, where the traffic is less than 100 motorized vehicles per day and it is not likely to grow due to situation like dead end, low habitation and difficult terrain conditions, the roadway width at bridge may be reduced to 4.25m.

ROADS

Camber:

The camber on straight section of road should be as recommended on Table 2.11 of IRC: SP: 20 – 2002.

Camber for different Surface Types.

Surface Type	Camber (percent)	
	Low Rainfall (Annual rainfall < 1000mm)	High Rainfall (Annual rainfall > 1000mm)
Earthen road	4.00	5.00
WBM and Gravel road	3.50	4.00
Thin Bituminous pavement	3.00	3.50
Rigid pavement	2.00	2.50

ROADS

❖ Horizontal Curve

A Horizontal curve should consist of a circular portion flanked by transition at both ends. Design speed, super elevation and co-efficient of side friction affect the design of circular curves. Length of transition curve is determined on the basis of rate of change of centrifugal acceleration or the rate of change of super elevation.

❖ Super Elevation:

Super elevation is provided to counteract centrifugal force on moving vehicles at horizontal curves, and is calculated from the following formula:

$$e = V^2 / 225R$$

Where, e = Super elevation ratio / metre,
V = Design Speed in Km / h,
R = Radius of Curve in metre.

ROADS

Super elevation obtained from the above expression should, however be kept limited for the following values:

Plain and Rolling terrain	7 percent,
Snow bound area	7 percent and
Hilly area but not snow bound	10percent.

No super elevation is to be provided when the values falls short of the normal camber of the pavement

❖ Widening of Pavement at Curves:

At sharp horizontal curves, it is necessary to widen the carriageway to facilitate safe passage of vehicles.

Widening of Pavement at Curves

Radius of Curve (m)	Upto 20	21 – 60	Above 60
Extra Widening for 3.75 m wide Single Lane Carriageway (m)	**0.90**	**0.60**	**Nil**

ROADS

❖ Gradient:

The rate of rise or fall with respect to the horizontal along the length of road expressed as ratio or a percentage is termed as the "Gradient".

Recommended gradients for different terrain conditions.

Terrain	Ruling Gradient	Limiting Gradient	Exceptional Gradient
Plain and Rolling	3.3 percent (1in 30)	5.0 percent (1 in 20)	6.0 percent (1 in 16.7)
Mountainous terrain and Steep terrain having elevation more than 3000m above MSL.	5.0 percent (1 in 20)	6.0 percent (1 in 16.7)	7.0 percent (1 in 14.3)
Steep terrain having elevation upto 3000m above MSL.	6.0 percent (1 in 16.7)	7.0 percent (1 in 14.3)	8.0 percent (1 in 12.5)

ROADS

Road Materials

The most important pavement materials are soils, mineral aggregates, bituminous binders and stabilizers like lime, cement, water etc.

Soil and material surveys are required for various reasons as follows.

i. To determine the nature and physical characteristics of soil and soil profile for design of embankment and pavement
ii. To determine the proper methods of handling soils
iii. To classify the earthwork involved into various categories such as rock excavation, earthwork in hard soil etc.
iv. To gather information regarding subsoil water level and flooding
v. To locate for pavement construction materials and their availability and suitability for use in the different pavement courses.

ROADS

The character of material excavated from test pits should be recorded and tests conducted on it in the laboratory for properties as mentioned below:

a. **Gradation test based on wet sieve analysis** test [IS: 2720 (Part 4)-1985]
b. **Liquid Limit and Plastic Limit** [IS: 2720 (Part 5)-1985]
c. **Standard Proctor Density and Optimum Moisture Content** [IS: 2720 (Part 7)-1980]
d. **Deleterious constituents** (only in salt infested areas, where presence of salt is suspected) IS: 2720 (Part 27)-1977]
e. **Field Density and Moisture content** [IS: 2720 (Part 27)-1974]

ROADS

❖ Embankment and Subgrade materials:

The materials used in embankment, subgrade and earthen shoulder shall be soil, murrum, gravel, a mixture of these or any other material approved by the Engineer.

Specification for Embankment and Subgrade material:

The following types of materials shall be considered unsuitable for embankment / subgrade.

- Materials from swamps, marshes and bogs.
- Materials susceptible to spontaneous combustion.
- Materials in frozen conditions.
- Clay having Liquid Limit (LL) exceeding 70 and Plasticity Index (PI) exceeding 45.
- Materials with slats resulting in leaching in embankment.
- Expansive clays, "Free Swelling Index" exceeding 50 percent when tested as per IS: 2720(Part 40) – 1977, shall not be used as fill material.

ROADS

Density requirements of Embankment and subgrade Materials

Type of work	Maximum laboratory dry unit weight when tested as per IS: 2720 (Part 7) - 1980
Embankments upto 3 metres height, not subject to extensive flooding	Not less than 1.44 gm/cc
Embankments exceeding 3 metres height or embankments of any height subject to long periods of submergence	Not less than 1.52 gm/cc
Subgrade and Earthen shoulders	Not less than 1.65 gm/cc

Specifications for Granular Sub-base (GSB):

The material to be used for the work shall be natural sand, murrum, gravel, crushed stone, crushed slag, granulated slag, brick metal and kankar etc. the material shall be free from organic or other deleterious material. The CBR requirement for sub-base layer should be atleast 15 percent when tested in soaked condition. The material shall be preferably non-plastic.

ROADS

❖ Stabilized Soils:

Sometimes soil / soil-gravel / aggregates and waste materials such as fly ash, iron and steel slag and other such materials, available in the near vicinity of the construction sites do not conform to the grading, PI and strength requirements.

The methods of stabilization can be broadly grouped as:

- ✓ Mechanical stabilization
- ✓ Lime stabilization
- ✓ Cement stabilization
- ✓ Chemical Stabilization
- ✓ Bituminous stabilization

Mechanical Stabilisation:

This work consists of improving the inferior soils / low grade aggregates like kankar, laterite, brick aggregates, murrum etc., by blending them with locally available suitable materials. Correctly proportioned material (aggregate and soil) can be adequately compacted to form a mechanically stable pavement layer.

ROADS

Lime Stabilization:

When the local soil, murrum cannot be economically and effectively stabilized by mechanical methods, the chemical stabilization of these materials are resorted to.

Lime stabilization is normally adopted for silty clays and clayey soils including black cotton soil. The development of strength in soil lime mixes depends on the type of clay and its quantity in soils.

Cement Stabilization:

Gravelly, sandy, clayey type of soils can be stabilized using cement, when comparatively higher and faster development of strength and durability characteristics are needed especially for waterlogged and high rainfall areas.

The material used for stabilization by cement shall be gravelly or sandy type of soil. Marginal materials like kankar, laterite, brick aggregate, crushed rock or slag or any combination of these can be stabilized using cement.

For use in sub-base and base course the material shall have uniformity co-efficient not less than 5, so that it can produce a well closed surface finish.

ROADS

Road Aggregates:

Aggregates form the major portion of pavement structure and they are the most voluminous ingredient used in pavement construction.

Waste Materials:

There are large variety of waste materials, which can be used effectively for road construction. The following waste materials have been successfully tested in the lab and also used in field trials:

- ✓ Fly ash
- ✓ Iron and Steel slag
- ✓ Processed municipal wastes
- ✓ Rice husk ash
- ✓ Marble slurry dust wastes
- ✓ Recycled concrete
- ✓ Quarry waste / mine waste.

ROADS

❖ Aggregate for Base course

WBM is one of the commonly used pavement layers. It can be used for construction of sub-base or base course.

Physical requirements for WBM

Layer	AIV (%) not less than [IS: 2386 (part 4)-1963]	Flakiness Index [IS: 2386 (part 1)-1963]	Moisture or Water absorption (%) [IS: 2386 (part 3)-1963]
Sub-base course	**50**	**40**	**6**
Base course	**40**	**30**	**3**

Grading of Coarse Aggregates for WBM Gr. II

Grading No.	Size range	IS Sieve (IS: 460)	Percent by weight passing the sieve
II	63 mm – 45 mm	**90 mm**	**100**
		63 mm	**90 – 100**
		53 mm	**25 -75**
		45 mm	**0 - 15**
		22.4 mm	**0 - 5**

ROADS

Grading of Coarse Aggregates for WBM Gr. III

Grading No.	Size range	IS Sieve (IS: 460)	Percent by weight passing the sieve
III	53 mm – 22.4 mm	63 mm	100
		53 mm	95 – 100
		45 mm	65 - 90
		22.4 mm	0 - 10
		11.2 mm	0 - 5

Grading requirements for screening material:

The materials used for screening includes Stone grit, coarse sand, hard murrum, etc., The quality of screening material shall conform to MoRT&H Specifications / IRC 19. The binding material shall have PI value between 4 to 6 percent. Non plastic binding material may also be used.

ROADS

Grading Requirements of Aggregates for Wet Mix Macadam		
IS Sieve Designation		**Percent by Weight Passing the IS Sieve**
53.0 mm		**100**
45.0 mm		**95 – 100**
22.4 mm		**60 – 80**
11.2 mm		**40 – 60**
4.75 mm		**25 – 40**
2.36 mm		**15 – 30**
600 mic		**8 – 22**
75 mic		**0 - 5**

ROADS

Material for Bituminous construction:

Bitumen is a viscous liquid, semi-solid or solid material, colour varying from black to dark brown, having adhesive properties, consisting essentially of hydrocarbons derived from distillation of petroleum crude or natural asphalt and soluble in carbon disulphide.

Bitumen:

The bituminous binder should possess the following qualities as per IS: 73 – 1992:

- Adequate viscosity at the time of mixing and compaction
- Not highly temperature susceptible
- Should not strip off from aggregate in presence of water

Bitumen Emulsion:

Bitumen Emulsion is a liquid product in which a substantial amount of suspended in a finely divided condition in an aqueous medium and stabilized by means of one or more suitable materials.

ROADS

The bitumen content in emulsion is around 60 percent and the remaining is water. When emulsion is applied on the road, it breaks down resulting in release of water and the mix starts to set. The setting time depends on grade of emulsion.

The various types of bituminous emulsions available are:

i. Rapid Setting (RS)

ii. Medium Setting (MS) and

iii. Slow Setting (SS).

- **Prime coat over Granular base:**

This work shall consist of application of single coat of low viscosity liquid bituminous material to any superimposed bituminous construction. The choice of the primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16.

ROADS

a. Surface of low porosity; such as Wet mix macadam and Water bound macadam,

b. Surface of medium porosity; such as cement stabilized soil base,

c. Surface of high porosity; such as gravel base.

The different ranges of viscosity requirements for the primer to be used for different types of surfaces to be primed are given below.

Type of surface	Kinetic Viscosity of Primer at 60°C (Centistokes)	Quantity per 10Sqm (Kg)
Low Porosity	**30 – 60**	**6 to 9**
Medium porosity	**70 – 140**	**9 to 12**
High Porosity	**250 – 500**	**12 to 15**

ROADS

❖ **Tack Coat:**

Tack coat application consists of a single coat of low viscosity bituminous material to an existing road surface preparatory to another bituminous construction over it.

❖ **Premix Carpet:**

The binder shall be bitumen of a suitable grade appropriate to region, traffic, rainfall and other environmental conditions satisfying the requirements of IS: 73 – 1992, 217 – 1988, 454 – 1994 or other approved emulsion and cut back as applicable.

The selection of appropriate grade of paving bitumen under different climatic conditions as follows:

- For Traffic intensity of less than 50 CVPD (Commercial Vehicles per Day) and temperature variation throughout the year is less than 25^{o}C, paving bitumen 60/70 maybe preferred.

ROADS

- ✓ In areas where the difference between maximum and minimum atmospheric temperature is more than 25oC and traffic intensity is less than 500 CVPD, paving bitumen 80/100 may be used.
- ✓ Paving bitumen 80/100 may be used in high altitude and snow-bound regions irrespective of traffic intensity.

❖ **Seal Coat:**

This work consist of the application of Seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall.

Seal coat may be either liquid seal coat (Type A) or

sand seal coat (Type B).

Type-A seal coat shall be used for high rainfall areas (over 1000mm rainfall per annum) and Type-B seal coat for other climatic conditions.

ROADS

❖ Mix Seal Surfacing

Close-Graded Premix surfacing material of 25 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

The fine aggregates shall consist of crushed rock, quarry sands, natural gravel/sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

The binder shall be a viscocity grade bitumen of a suitable grade as specified in the Contract and satisfying the requirements of IS:73.

ROADS

❖ Pavement Design:

The road structure may be divided into four major components, viz., land, earthwork, pavement and cross drainage works.

The factors which govern the selection of the type of the pavement are:

- ✓ Construction cost
- ✓ Availability of good materials locally
- ✓ Cost of maintenance
- ✓ Construction technology required and its availability.

The potions available are:

a. Flexible Pavement,
b. Cement concrete pavement,
c. Composite pavement with semi-rigid base with suitable bituminous surfacing,
d. Semi-rigid base with surfacing of inter connected concrete paving blocks and
e. Roller compacted Concrete.

ROADS

The choice of pavement further guided by several other factors such as:

a) Rainfall and temperature
b) Type and strength of soil along the alignment
c) Availability of good aggregates
d) Availability of industrial wastes (like Fly ash, Slag etc.,) in the proximity.

Any design using conventional, marginal or waste material must follow standard procedure based on material property, traffic and design life.

❖ **Design parameters:**

The principal criterion for determining the thickness of a flexible pavement with a thin bituminous surfacing is the vertical compressive strain on top of the subgrade imposed by a standard axle load of magnitude 8.17KN (8160 Kg)

ROADS

For rigid and semi rigid pavements tensile stress is taken as the design criteria to prevent fracture of the concrete layer within the design period.

- **Traffic:**

For the purpose of structural design, only the number of commercial vehicles of laden weight 3 Tonnes or more should be considered.

- **Design Life:**

Design life is usually as the number of years until first major reconstruction is anticipated. It is necessary that sufficient thickness is provided to prevent rutting failure during the design life due to high vertical subgrade pressure. It is considered appropriate that roads in rural areas should be designed for a design life of 10years. The thin bituminous surfacing that is commonly provided on low volume roads has a life of about 5 years.

ROADS

❖ Computation of Design traffic:

The design traffic is considered in terms of the future traffic to be carried during the design life of the road.

The traffic for the design life is computed as

$$A = P(1 + r)^{n+x}$$

Where; A = Number of commercial vehicles per day for the design

P = Number of commercial vehicles per day at last count

r = Annual growth rate of commercial traffic

n = Number of years between the last count and the year of completion of construction

x = Design life in years.

ROADS

❖ Pavement Components

Subgrade:

In rural roads, the top 30 cm of the cutting or embankment at the formation level shall be considered as a subgrade. The subgrade, whether in cut or fill, should be compacted to utilize its inherent strength and prevent permanent deformation. A minimum of 100 percent of Standard Proctor compaction should be attained in the top 30 cm of the subgrade.

Sub-base:

Sub-base is a layer of selected material placed on the subgrade compacted to 98 percent of the IS heavy compaction. It consists of locally available, relatively low strength inexpensive material. The principal function of the sub-base is to distribute the stress over a wide area of the subgrade imposed by traffic and to ensure that no subgrade material intrude into the base course.

ROADS

Base:

The base course materials should be of good quality so as to withstand high stress concentrations which develop immediately under the wearing surface. The upper surface of the base must be sufficiently smooth and true to profile to provide a good riding surface. The different types of base course which are commonly used are:

a) Water Bound Macadam (WBM)

b) Wet Mix Macadam (WMM)

c) Crusher-Run Macadam

d) Dry Lean Concrete

e) Soft Aggregate Base Course

f) Lime Fly Ash Concrete

ROADS

Pavement surface:

Pavement can be with a sealed or unsealed surface. The unsealed surface means a granular surface where percolation of water into the pavement layers is possible, whereas in sealed surface it is prevented by appropriate surfacing layer.

Drainage and Shoulders:

The performance of a pavement can be seriously affected if, internal drainage measures (sub-surface drainage) to prevent accumulation of moisture in the pavement structure are not provided. Earthen shoulder shall be compacted to density not less than 100 percent of laboratory density.

Roadside Drains:

The function of roadside drain is to collect surface water from the roadway and lead it to an outlet. Another function of roadside ditches is to drain out the base course of the roadway structure so as to prevent its saturation and consequent loss in load bearing capacity.

BRIDGES & CULVERTS

Bridges & Culverts

GENERAL :

Bridges and Culvert serves as road drainage in almost every location, where road intersects in location where water in a roadside ditch must cross the road to reach natural drainage or stream crossing.

Bridge is a structure providing passage over an obstacle without closing the way beneath.

Culvert separates the water and traffic streams to permit continuous flow of both.

Bridges & Culverts

DEFINITIONS :

- **Sill level :**

The bed level at site is fixed as sill level.

- **Linear waterway :**

It is the width of the waterway between extreme edges of water surface at the highest flood level measured at right angles to the abutment faces.

- **Ordinary Flood Level :**

It is the level of flood expected to occur every year.

- **Highest Flood Level (HFL) :**

It is the level of the highest flood ever recorded or the calculated level for the design discharge.

Bridges & Culverts

- **Span :**

The distance between two bridge supports, whether they are columns, towers or the wall of a canyon.

- **Clear Span :**

Clear distance between the adjacent faces of Piers or the face of the abutment and the adjacent Pier.

- **Length of a Bridge :**

The length of a bridge structure will be taken as the overall length measured along the Centre line of the bridge between inner faces of Dirt walls.

- **Vertical Clearance :**

It is the height from design highest flood level to the lowest point of the bridge Super structure (Deck Slab / Girder)

Bridges & Culverts

- **Abutment :**

It is end support structure of a bridge / Culvert, which supports the Deck slab / Girder and transfers the load to Foundation and also retains the earth fill at the approach.

- **Pier :**

It is the middle support, which supports the Deck slab / Girder and transfers the load to Foundation.

- **Wing wall :**

It is an earth retaining structure constructed monolithically with abutment, which retains the Approach.

- **Bed Block :**

It is the cap which protects the Abutment and Pier and receives the load from Super structure and transfers it into the Abutment / pier.

Bridges & Culverts

❖**Culvert :**

Culvert is a **small bridge having 6 m or less** between the faces of abutments or extreme vent way boundaries and measured at right angles thereto.

❖**Minor Bridge**:

The Bridge having **length between 6 m to 60 m** between the faces of abutments or extreme vent way boundaries and measured at right angles thereto are called as Minor Bridges.

❖**Submersible Bridge**:

The Submersible Bridge is a **structure designed to be overtopped during floods**, having its formation level fixed in such a way that ***not to cause interruption to traffic during flood for more than three days at a time nor for more than six times in a year***.

Bridges & Culverts

- **Foot Bridge cum Cart Track Foot Bridge**:

A footbridge is a bridge exclusively used for carrying pedestrians, cycles and animals. The cart - cum footbridge is a bridge exclusively used for Bullock cart, pedestrians, cycles and animals. Since most of the cart – cum footbridges are not designed for motorized vehicles, a caution board in this regard should be erected at both ends of the bridge well in advance of the entrance of the bridge.

- **High level Bridge:**

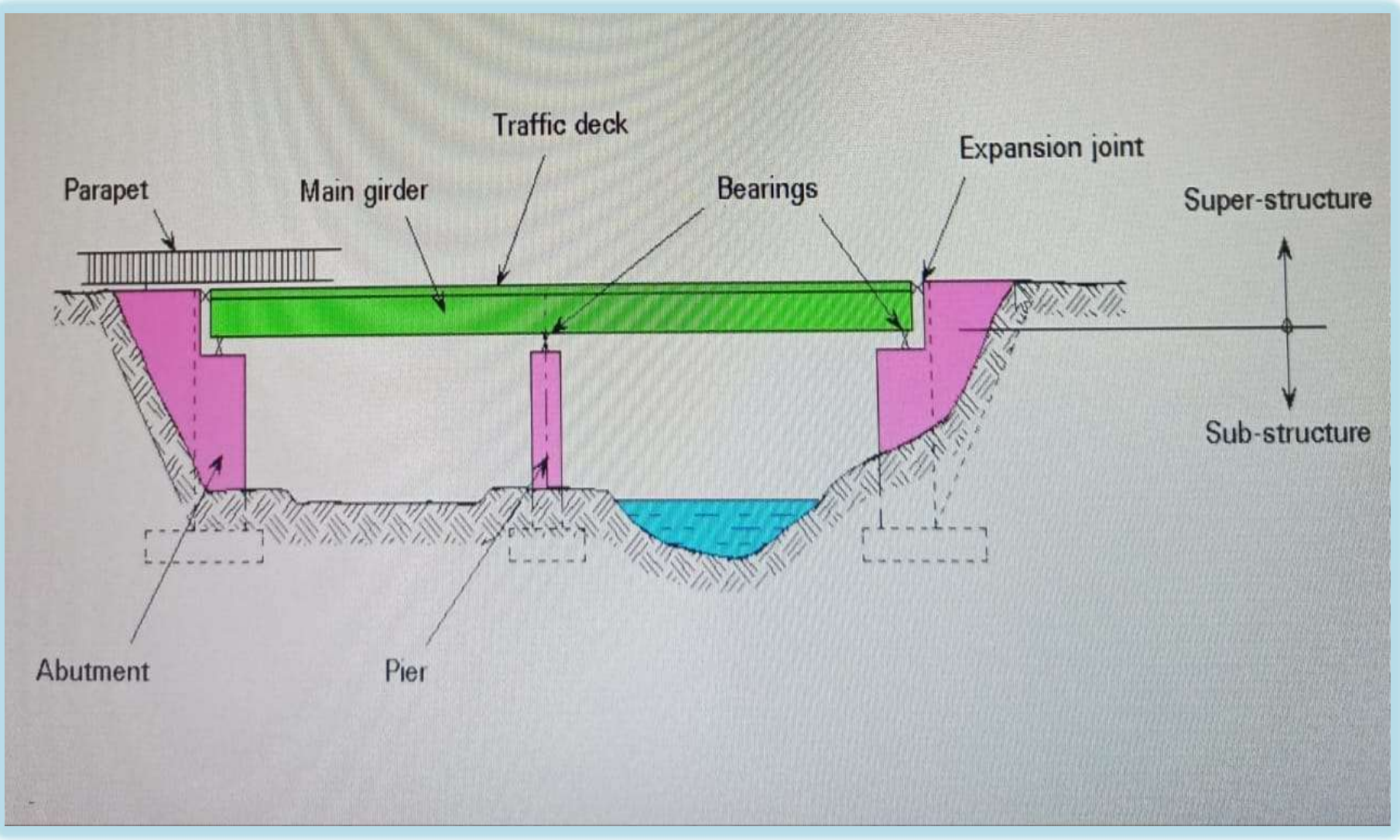
A high-level bridge is a bridge which caries the roadway above the highest flood level.

Bridges & Culverts

COMPONENTS OF BRIDGE STRUCTURE

- **Super structure**
  - Deck
  - Bearings
  - Kerb & Hand railing
  - Expansion joints
  - Drainage spouts
  - Ornamental pilasters, Parapet wall & Guide posts
- **Sub structure**
  - Abutments
  - Piers
  - Wing & Return walls
  - Approach slab

Bridges & Culverts



Bridges & Culverts

SELECTION OF SITE :

- Straight reach of stream
- Away from the confluence of large tributaries
- Well defined Banks
- To make approach road straight

Bridges & Culverts

Following Points to be ascertained from the site of Bridge:

- **HFL ascertained from watermarks, if any.**
- **Information about velocity of flow and presence of floating debris etc. from local enquiry.**
- **In case a causeway or the existing bridge is of insufficient waterway resulting in afflux, the extent of such afflux be ascertained for arriving at the rough assessment of discharge.**
- **Skew angle of crossing, if any should be ascertained correctly.**
- **Approximate depth of the deep scour hole below HFL mentioning its location.**
- **The width and depth of the channel during dry weather flow, OFL and HFL should be noted.**

Bridges & Culverts

CULVERTS

TYPES OF CULVERTS :

- RCC Pipe Culvert
- RCC Slab Culvert
- Causeway
  - Bed level causeway
  - Vented Causeway

Bridges & Culverts

Points to be kept in mind while Constructing Pipe Culvert :

- ✓ Placing of pipes below bed level (max. 150 mm).
- ✓ Proper **gradient of pipes** between Inlet and outlet should be maintained.
- ✓ **Clear spacing (half the dia.)** between rows of pipes should be maintained
- ✓ **Cushion over pipes (minimum to a depth of 50% dia.)** should be maintained
- ✓ Plumb of **verticality of Body wall** should be maintained.
- ✓ **Catch pits on upstream side** should be provided to avoid silting.

Bridges & Culverts

RCC Slab Culvert

Catchment area (Hectares)	Clear Span (Meters)
Upto 15	1.5
16 to 25	2.0
26 to 50	3.0
51 to 75	4.0
76 to 100	5.0
101 to 125	6.0

Bridges & Culverts

Inspection Aspects

- Check for vent height / Span.
- Wing wall length shall be provided as 1.5 times the height of abutment.
- Check for weep holes in abutment and wing walls.
- Check for verticality in Wing wall/ Return walls.
- Check for Honey combing in concrete.

Bridges & Culverts

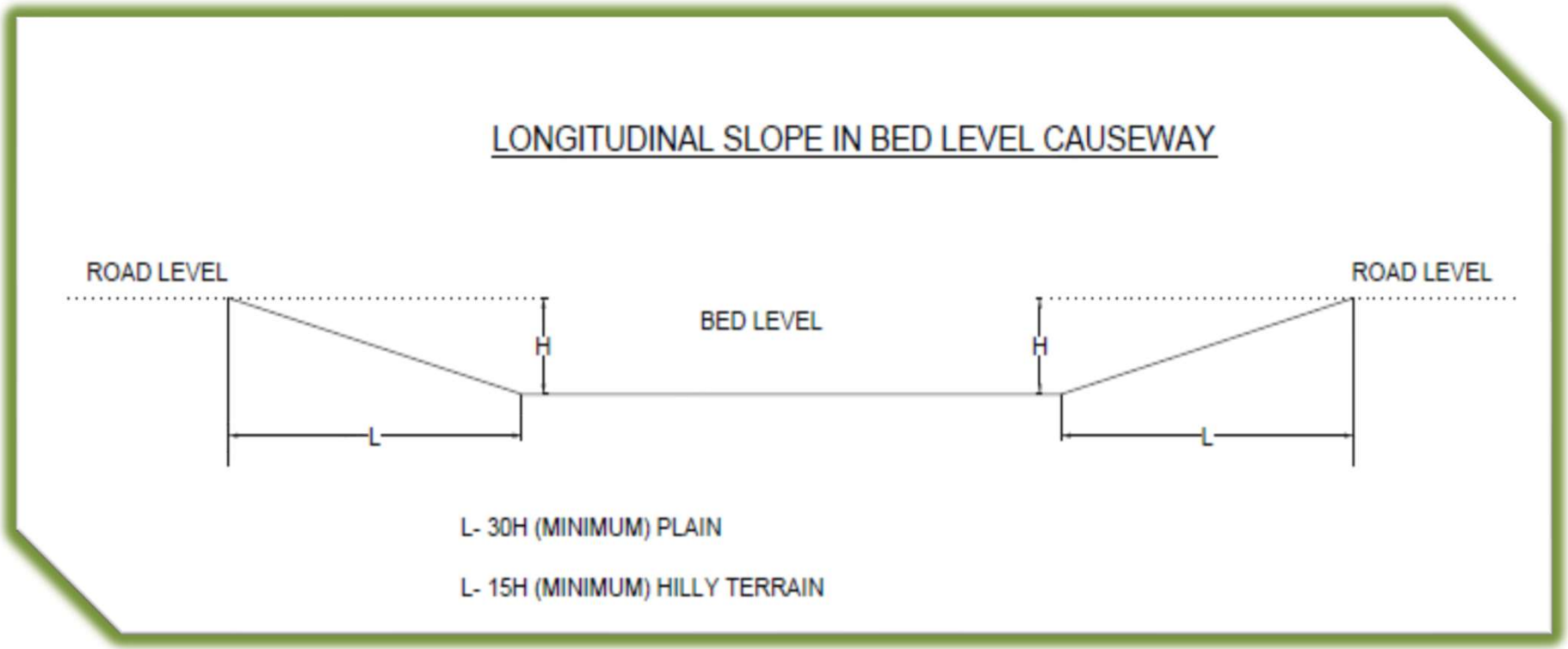
Causeways :

- A causeway is a small submersible structure with or without openings, which allows flood to pass over it.
- The causeway may have vents for low water flow, is called as Vented Causeway.
- Depending on the type of construction and the road level above the bed of the watercourse, these structures can be classified under,
  - ✓ Flush,
  - ✓ Low level and
  - ✓ High-level causeways.

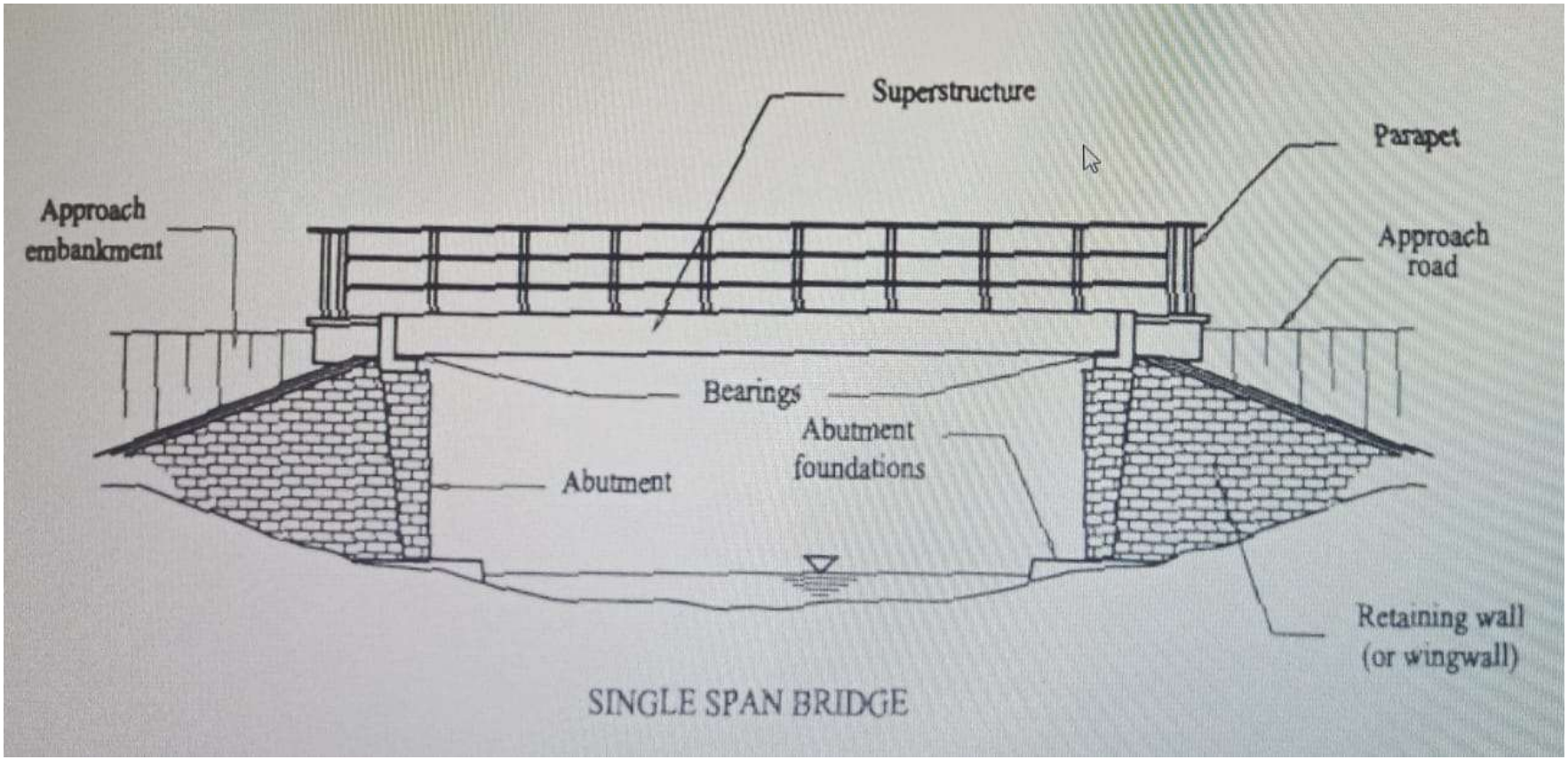
Bridges & Culverts

General considerations

- Area of Vents Should be not be less than 30% for areas having rainfall more than 750 mm
- For scanty rainfall area it can be reduced upto 15%
- Head wall / trapezoidal blending with natural cross section , desirable grade 1:30
- Apron for down stream protection if required



BRIDGES



Typical Single Span Bridge Basic Components of a Bridge

Bridges & Culverts

BRIDGE COMPONENTS

Foundation:

- Open Foundation- Individual Footing / Raft Foundation
- Deep Foundation – Pile Foundation

Sub structure:

- Abutment , Pier (Wall Type Or Circular), Bed block, pedestal
- Bearing - Elastomeric Bearing is used in Girder Bridge.

Super structure:

- Deck Slab / Girder, Handrails or Crash Barrier

Bridges & Culverts

Pile foundation :

- Preferred when soil available to a depth of 10 m or more is in poor state.
- Suitable to carry heavy loads from long span bridge (10 to 25m) and vent height of the bridges are high.
- In General, Pile foundation is suitable for bridges across major river and hard stratum is not available at shallow depth.
- Minimum diameter of the pile in river bridges : 1 m
- Bored cast in situ piles are preferred.
- Depth of pile varies from 10m to 50m depends upon hard strata available at site.
- Pile carrying capacity will be verified at site by conducting pile load test.

Bridges & Culverts

Substructure:

Substructure include those portions of a bridge which are above the foundation, which include Piers, Abutments, Abutments and Pier caps, Dirt walls, Returns, Wing walls etc.

Type of substructure depends upon the span and type of superstructure, the height of substructure, availability of construction materials and construction equipments, period and time of construction and above all an overall economy. ***The shape of piers and abutments in general, should be such as to cause minimum obstruction to flow of water.***

Normally wall type Pier and Abutment are used for minor bridges.

Circular pier are preferable for long span bridges (10 to 25m) and also for skew river / road crossing i.e., flow of river has no effect in circular shape.

Diameter of Pier varies from 1.2m to 1.8m

Depth of Pier cap varies from 1m to 1.5m.

Bridges & Culverts

Super Structure :

Super structure of a bridge that directly supports the traffic and facilitates its smooth uninterrupted passage over natural / man made barriers like rivers, creeks, railways, roads etc., by transmitting the loads and forces coming over it to the foundation through sub structure.

Components of Super structure are

- Girder / Deck
- Bearings
- Kerb & Hand railing
- Expansion joints
- Drainage spouts

Bridges & Culverts

Components of Super structure

Deck :

The principal function of a bridge deck is to provide support to local vertical loads (from highway traffic, railway or pedestrians) and transmit these loads to the primary superstructure of the bridge.

Bearings :

The connection between the substructure and the superstructure is usually made through bearings.

Bearings are vital components of a bridge which while allowing of longitudinal and / or transverse rotations and / or movements of the superstructure with respect to the substructure, effectively transfer loads and forces from superstructure to substructure.

In slab bridges bearings are not required. Kraft Paper may be provided.

Bridges & Culverts

Components of Super structure

Kerb :

Kerbs is a barrier or boundary. It indicates the boundary between the pavement and shoulder or sometimes island or footpath or car parking space. Kerbs are generally constructed of cut stone or cement concrete.

A kerb serves one or more of the following purposes:

- ✓ Drainage control,
- ✓ Access control,
- ✓ Pavement edge delineation and support,
- ✓ Right-of-way reduction,
- ✓ Aesthetics,
- ✓ Delineation of pedestrian walkways,

Drainage spouts :

Bridge drainage spout is a pipe that carries rainwater down from Deck slab.

Bridges & Culverts

Components of Super structure

Hand railing :

It is a system designed to keep people or vehicles from falling off the bridge. They may be a handrail for pedestrians, a heavier guard for vehicles, or a common railing for both.

Expansion joints :

Expansion joints are provided at the end of deck and cater for movement of deck due to temperature, shrinkage, creep etc. Expansion joints make the deck joint leak proof, protect the edges of slab / girder and also allow smooth passage of loads from one span to other by bridging the gap.

They stop the bridge from bending out of place in extreme conditions, and also allow enough vertical movement to permit bearing replacement without the need to dismantle the bridge expansion joint.

Bridges & Culverts

Components of sub-structure

Weep holes :

Weep Holes are placed in the abutment back walls of bridges to provide drainage of the pervious backfill material. They may be ***spaced at 1.50m in horizontal and Vertical (staggered).***

Bridges & Culverts

Components of sub-structure

Back fill:

The type of materials to be used for filling behind abutments and other earth retaining structures should be selected with care.

The filter material shall be well packed to a thickness of not less than 600mm provided over the entire surface behind abutment, wings or return walls to the full height. Densities to be aimed at in compaction, Each layer shall be tested in the field for density.

Bridges & Culverts

Planning for Construction

Requirements of Good Planning:

- Design decisions effect:
  - Buildability
  - Cost
  - Time
- Modern Methods of Construction to save time & cost of construction.

✓ Knowledge of Construction process

✓ Knowledge of Equipment & construction Techniques

✓ Knowledge of Interface issues

✓ Planning should also address Health & Safety aspects

Bridges & Culverts

Planning for Construction

Benefits of Good Planning

- ✓ Considerable saving in time and cost is feasible with proper planning
- ✓ Significant improvement in Quality is feasible due to controlled environment
- ✓ Unnecessary traffic closures and traffic diversions for prolonged durations can be avoided due to reduced on-site construction time

Bridges & Culverts

Planning for Construction

Actions in Planning :

Carryout ***thorough investigation***

- Levels,
- Utilities,
- Adjacent structures,
- Access,
- Geo-tech

Plan for essential ***site production requirements***

- Site access requirement,
- Material handling,
- Construction programme

Plan for a ***practical sequence***

- ✓ Construction sequence to maintain stability of structure at all stages.
- ✓ Assumed Method of erection to be indicated in Design basis.

Bridges & Culverts

Planning for River Bridges

- Linear Waterway
- Span arrangement
- Type of foundation
- Type of Superstructure
- Bearings
- River Protection –Guide bunds, toe walls, etc.

Bridges & Culverts

Planning for River Bridges

Linear Waterway depends on

- Estimated flood discharge,
- Bed profile,
- Presence / Absence of rigid banks, etc.,

Estimating Flood Discharge

- Improved Rational Method (C.A < 25 Sqkm)
- Suh Method (C.A > 25 Sqkm And < 2500 Sqkm)
- Velocity Area Method
- Empirical formulae

Bridges & Culverts

Wearing Coat :

Concrete wearing coats have been provided extensively. It is desirable to provide 20mm Premix Carpet with Seal coat as wearing coat on culverts. If the road is not black topped, concrete wearing coat can be adopted. For submersible structures, Cement concrete wearing coat 75mm thick must be provided.

Approach road :

Proper approach road should be constructed, ensuring easy approach on both ends. Approach road should be well compacted and surfaced.

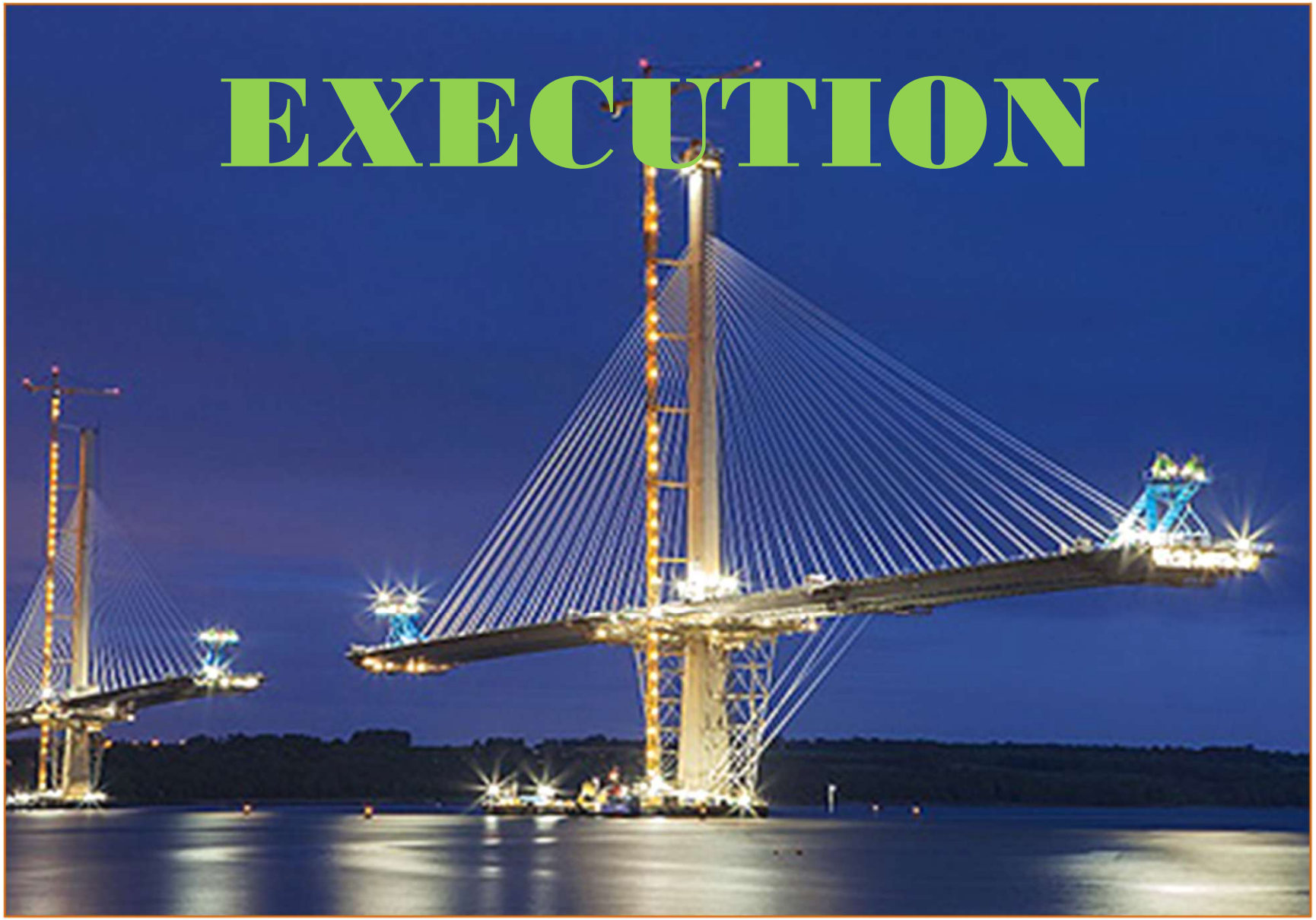
Bridges & Culverts

River training and protective works :

River training and protective works is required for ensuring the safety of bridges and their approaches on either side. The selection of the type of river training or protective work will depend upon terrain, overall behavior of the river.

- **Bed protection** should be provided over erodible bed to prevent scouring action i.e., provided over loose sandy / silty soil .
- **Rigid Apron:** Concrete flooring to be provided over a base course for 300m thick.
- **Flexible Apron:** Stone boulders are provided with boulders weighing 40kg(min) for 750mm thick (average).

EXECUTION



Bridges & Culverts

- Once the design of bridge has been completed then comes to the **execution part**.
- During execution, various **quality tests** are being conducted to ensure the quality of work. The details are as follows:

Details of tests to be conducted for Concrete structures – Prior to construction

Sl. No	Material / Work	Test / Check	Frequency
1	Cement	a) Setting Time (IS:4031 Part 5) b) Soundness (IS:4031 Part 3) c) Compressive strength of mortar cube	One test for 10 Tonnes of cement (same brand & grade) 3 specimens for each lot
2	Coarse Aggregates	a) Gradation for PCC or RCC works (Table 800.4) b) Flakiness index (IS:2386 part 1) c) Deleterious constituents (IS:2386 part 2) d) Water absorption/content (IS:2386 part 3) e) Aggregate Impact Value (IS:2386 part 4)	3 samples for each quarry source If in doubt, Once for each source of supply One test per source of supply
3	Fine Aggregates	a) Gradation (IS:2386 part 1) (Table 800.5) b) Deleterious Constituents (IS:2386 part 2) c) Alkali silicate reactivity (IS:2386 part 7)	3 samples for each source of supply If in doubt, one test per source of supply

Details of tests to be conducted for Concrete structures – Prior to construction

Sl. No	Material / Work	Test / Check	Frequency
4	Water	a) Normally potable water is good enough for making concrete Determination of Impurities b) Suspended matter IS:3025 (Part 17) c) Organic IS:3025 (Part 16) d) Inorganic IS:3025 (Part 19)	For large works If the quality is in doubt Samples taken from each source and tested at an approved test house
5	Concrete	Mix Design (for each work)	To be approved by EE for cement content, W/C ratio and use of plasticizers, if any.

Details of tests to be conducted for Concrete structures – During construction

Sl. No	Material / Work	Test / Check	Frequency
1	Cement	Moisture content (IS:2386 part 3)	Once before commencement of work each day
2	Cement (consumption)	Minimum quantity (kg/m^3)	Daily
3	Concrete	a) Workability slump cone test (IS:1199) b) Cube Strength (IS:516)	2 tests / day (Minimum of 6 cubes) (3 each to determine 7 days and 28 days strength) to be cast every day
4	Construction Joints	Fixing location before concreting and resumption of work	As and when work demands
5	Form work	For stability, leakage of slurry, bulging etc.	Throughout Concreting
6	Concreting	Fine and coarse aggregate	Random check in each member, Once check before commencement of work Regularly
7	Curing Concrete	Regular (till 28 days after casting) inspection	Daily

Tests to be conducted at site

For Concrete :

- **Cube test has to be conducted to ensure the strength of concrete.**
- **Normally, 7 days compressive strength and 28 days compressive strength will be verified.**

For Steel:

- **At site, grade of steel has to be verified.**
- **Steel should be properly stacked so that it could not be get rusted.**

Frequency of Samples for Cube test(Concrete) and Tensile test(Steel)

Concrete: Cube test (To determine compressive strength of Concrete i.e., M10, M15, M20 etc.,

Quantity of concrete in the work (m^3)	Number of Samples
1-5	**1**
6-15	**2**
16-30	**3**
31-50	**4**
51 and above	**4 plus one additional** sample for each additional 50 m^3 or part thereof.

Steel: Tensile test (To determine tensile strength (i.e., Fe 500, Fe 550 etc.,) and percentage of elongation test (Fe 550 D).

Quantity of Steel	No. of samples to be tested
Upto 50 tonnes	2
50 to 150 tonnes	3
150 to 500 tonnes	5

Field Testing:

Plate load test:

Plate load test should be conducted on raft foundation (Compacted Sand filling) to determine the Safe Bearing Capacity (SBC) of the Compacted Sand.

Pile load test:

The pile load test should be carried out to determine the load carrying capacity of Pile and settlement of pile on loading.

INITIAL PILE LOAD TEST

Recording Measurements in M-Book

- *The Assistant Engineer should furnish Part/Final bills as soon as the works are over, without any lapse of time.*
- *The Assistant Engineer should ensure that the materials issued to the works by the Department are recovered in the bills of the concerned contractors.*

Recording Measurements in M-Book

- *The first entries to be made are,*

  (1) Name of Work.

  (2) Scheme of Work.

  (3) Agency by which executed.

  (4) Name of the contractor.

  (5) Date of Measurement

Recording Measurements in M-Book

- *The M-Book must be looked upon as the most important record since it is basis of all accounts of quantities whether of work done by daily labour or contract of materials received which have been measured.*

- *The description of work must be clear and sufficiently full to admit of easy identification and check.*

Recording Measurements in M-Book

- *The pages of book being machine numbered, the page should not be on any account be torn-out or erased.*
- *If any mistake is made, it should be corrected by scoring through and re-writing the words of figures and correction thus made should be initialled.*
- *The entries made in M-book should be made in ink and when not possible shall be made using Copying Pencil.*

Recording Measurements in M-Book

- *The pencil entries should never be over-written by pen.*
- *Every measurement should be recorded by the officer by whom it was actually made and bear his signature.*
- *From M-Book, all quantities should be clearly traceable into bills and a reference to the bill in which the quantities are entered for payment as well as date of entry should be given by writing in red ink across the original entries.*

Recording Measurements in M-Book

P.U.Form No. 52

The quanfity and value of all work done upto date as well as prvious payment made can be obtained from the following entries to made after to talling the abstract of payment now made :-

Deduct previous payments as per certificate

No ..... Date ..... 20 -Rs.
Payments now made :

Cheque ..... No .....Dated ..... -Rs.
Cash - Rs.

Recoveries (Cash or Stores) -Rs .....

Total -Rs .....

Balance due -Rs .....

2. The first entries to be made on the occasion of each measurement are

i) Name of work
ii) Situation of work
iii) Agency by which executed, i.e. contract etc
iv) Name of measurement
v) Date of measurement

Recording Measurements in M-Book

3. The measurement book must be looked upon as most important record. Since it is the basis of all account of quantities, whether of work done by daily labour or contract or of materials, recevied which have to be measured. The description of the work must clear and sufficiently fully to admit of cost identification and checked for instance in the case of road materials the name of the quarry the distance to road side from quarry the size and description of materials etc., should be given.

4. A Separate book be kept for each biog road or work and if found convenient two or three work or more may be recorded in a single book provided separate pages are set a part for each work this instruction should be carefily attended to by each subordinate or officer who writes up the measurements

Recording Measurements in M-Book

5. This page of the book being machine numbered the pages should on no account be turn out should an entry be erased or effased as to illegible. If a mistake be should be correction by scoring through and rewritten the words to figure and the correction this made should be intialled. A reliable record is the objects to be aimed at. as if may have to be produced as evidence in courts of law.

6. The entries in the measurement book should is possible be made in ink. But when that is not possible and entries have to made in pencil. The Pencil entries should not be inked over but let untouched Good pencil should used for making pencil entries and found if convenient copying pencil may be supplied. The entries in the first column should however be made in ink in the first instance and not linked over. Every measurements should be record by the officer by whom it was actually made and bear his signature.

Recording Measurements in M-Book

7. Form the measuring book all quantities should be clearly traceable into the bills and a reference to the bill in which quantites are entered for payments as well as date of entry should be given by writting in red ink across the original entries. No contract certificated or bill should be signed without crossing off the connected entries in the measurement book and the document on which payment is made should be invariable contain reference to be number and page of the book which the detailed measurement are recorded.

8. When the check measurement officer happens to measure a work prior to its being measured by the executive subordinate concerned, the former should record his measurement in as separate book kept for that purpose.

Recording Measurements in M-Book

9. The engineer is require to make it a special duty to see that measurement book are carefully kept and measurement properly recorded and they are complete records of each kind of work done. He should also see that the books are regularly returned to his office.

10. The practice of entering measurement in note books or on slips of paper and afterwards copying them into measurement book is prohibited.

Check Measurement Powers

Gazette Notification: G.O. Ms.No.111 , Rural Development and Panchayat Raj(PR.1) Department dated 21.08.2018

Value of Work	Measuring Officer	Check-Measuring Officer
Not more than Rupees Two Lakhs **	Overseer	Block Engineer/ Assistant Engineer
More Than Rupees Two Lakhs	Block Engineer/ Assistant Engineer	Assistant Executive Engineer

** All Housing works constructed by the beneficiaries under any Central or State Government sponsored schemes irrespective of the value of works, the overseer shall be the measuring officer and the Block engineer/Assistant Engineer shall be the Check measuring officer

Check Measurement Powers

- *In case of National Rural Employment Guarantee Scheme (NREGS) works, if five successive bills for a work in a given Village Panchayat are each less than rupees one lakh, the Block Development Officer (Village Panchayats) shall stop payment on the fifth bill until and unless the work is super-checked by the Assistant Executive Engineer (Rural Development and Panchayat Raj) concerned.*

Check Measurement Powers

- *The Block Development Officer (Village Panchayats) shall not pass the final bill for a National Rural Employment Guarantee Scheme (NREGS) work in a Village Panchayat until and unless it is check-measured or super-checked, as the case may be, by the Assistant Executive Engineer (Rural Development and Panchayat Raj) concerned.*
- *The Assistant Executive Engineer (Rural Development and Panchayat Raj) shall also super-check not less than five percent of the works costing not more than rupees fifty thousand.*
- *The Executive Engineer (Rural Development and Panchayat Raj) shall also super-check atleast ten works check-measured by Assistant Executive Engineer (Rural Development) in each Block every year.*

THANK YOU