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# Design of a Double storied Residential Building

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## ABSTRACT

I worked at our project on building construction of a two story residential building. Our team has worked very hard and very consciously on this project. We have tried to enumerate all the engineering aspects of a residential building. The major concerns while designing were foundation, various slabs, stair case, columns, lintel, sun shed and various other components of this building. It was most challenging task to design the foundation of this building. We as a team performed really well and every one of us contributed his utmost. It was our first experience to work in such a professional manner and we have finished our task well before timeline.

## INTRODUCTION

Our project is to build a "Double Storied Residential Building". As we have the drawing and the specification of the project provided by the owner. Before proceeding towards the project some of the minor topic which we should consider is as following:-

- Parts of a building.
- Components of a building.
- Material used in construction.

## Parts of a Building

A building can be divided into two parts: -

- **Sub structure: -** The part of a building constructed beneath the ground level is known as Sub structure.
- **Super structure: -** The part of the building constructed above ground level is known as super structure. It is second part of a building. All the activities of the building construction take place after the making of sub-structure. Flooring, wall roofing are the example of super structure of a building.

## Components of a Building

- **FOUNDATION: -** It is the lowest part of a structure below the ground level which is direct contact with ground and transmitted all the dead, live and other loads to the soil on which the structure rests.
- **PLINTH: -** The portion of a building and the top of the floor immediately above the ground is known as plinth. The level of the surrounding ground is known as formation level of the ground floor of the building is known as plinth level.
- **WALLS: -** Walls are provided to enclose or divide the floor space n desired pattern in addition wall provided privacy security and give protection against sun, rain, cold and other undesired effect of the weather.
- **COLUMN: -** A column may be defined as an isolated load bearing member, the width of which is neither less than its thickness. It carries the axially compressive load.
- **FLOORS: -** Floors are flat supporting elements of a building. They divided a building into different levels. There by creating more accommodation on a given plot of land. The basic purpose of a floor is to provide a firm and other items like stores, furniture, equipment etc.
- **DOORS, WINDOWS AND VENTILATORS: -** A door may be defined as a barrier secured in an opening left in a wall to provide usual means of access to a building, room or passage. Windows and ventilators are provided for sun light, fresh air and ventilation purposes.
- **ROOF: -** It is the uppermost component of a building and its function is to cover the space below it of a room and protect it from rain, snow, sun, wind etc.
- **BUILDING FINISHES: -** A building is considered incomplete till such time the surface of its components is given appropriate treatment.
- Building finishes include items like plastering, painting, pointing, white / color washing, varnishes and distempering etc.

## Material used in Construction

Following are the materials used for the construction of a building.

- Bricks
- Sand
- Cement
- Stone
- Coarse Aggregate
- Fine Aggregate
- Timber
- Metal
- Floor Tiles
- Roof Tiles

- Reinforcement
- Plastic Materials
- Doors & Windows
- Coloring Material
- Hardware
- White Cement
- Paints & Varnishes
- Brick Ballast
- Sanitary Materials
- Water
- Finishing Tiles. Etc.

As the civil Engineer, we have to consider all the worst condition that a site can have and be ready to overcome these conditions. There are some ideal conditions of site which every Engineer think for.

## Ideal Condition of Site

**LEVEL AT THE SITE: -** The level at the site must be higher than that of its surrounding so as to provide good drainage.

**CLIMATE CONDITION: -** The intensity of the rainfall and sub soil water level should be low as to avoid dampness in the building.

**SUB-SOIL CONDITION: -** A hard strata should be available at a reasonable depth so as to construct the foundation of the building safely and economically.

**AVAILABILITIES OF MODERN AMENITIES: -** The site must be within municipal limits so that modern amenities like water supply, electricity, drainage, road etc. can be made available inner future if there is no provision at present.

**AVAILABILITIES OF OTHER FACILITIES : -** The site should provide as easy access from the nearest road and after sufficient light and air, these should be good and cheap transport facilities available near the site, it is always better if public services like fire brigade, police station etc.

**SURROUNDINGS:-**The situation and surrounding of the site must as to suit the purpose for which the building it to be constructed.

Now coming back to our project, first of all we should have a site survey or site investigation, so that we get an idea before starting our construction part. While site investigation we should perform different test on ground explained below so we get an idea which type of foundation we will use.

## Site Investigation and Sub-Soil Exploration

Sub-soil exploration is done for the following purposes:-

- The selection of type and depth of foundation.
- The determination of bearing capacity of foundation.
- The determination of the ground water level (2.5m here).
- The provision against constructional difficulties.

Exploration should be carried out to a depth up to which the increase in pressure due to structural loading is likely to cause perceptible settlement or shear failure of foundations. Such a depth is called significant depth that depends upon the type of structure, its weight, size, shape and disposition of the loaded areas, and the soil profile and its properties. The significant depth may be assumed to be equal to one-and-a-half to two times the width of the loaded area.

Methods of soil exploration are:-

- Open excavations
- Borings
- Sub-surface soundings
- Geo-physical methods

## Soil Testing

The various soil tests for determining bearing capacity are:-

- Plate load test on soil
- Penetration test
- Presumptive bearing capacity values from codes
- Plate load test

It is a field test to determine the ultimate bearing capacity of soil, and the probable settlement under a given loading. The test essentially consists in loading a rigid plate at the foundation level, and determining the settlements corresponding to each load increment. The ultimate bearing capacity is then taken as the load at which the plate starts sinking at a rapid rate.

## Penetration Tests

This test involve the measurements of the resistance to penetration of a sampling spoon, a cone or other shaped tool under dynamic or static loadings. The resistance is empirically correlated with some of the engineering properties of soil, such as density index, bearing capacity etc.

# Drawing reading

As a civil engineer we have to built the real building on the ground just seeming the specification and drawing given by the owner, so for this drawing reading is essential for us because its gives us the rough idea for the project or for a building which we have to built. It is also essential because it gives us a idea where we have to provide doors, window, sun shed etc., that depend on the owner what he demands for.

As we have seen the drawing and read all the specification mentioned by the owner which includes types of windows, doors their location, types of brick work and so on and details are written below, now we will proceed further on ground after reading drawing.

## SPECIFICATION

- **EXCAVATION AND SPACE EARTH WORK**
- Soft soil, surplus soil, to be carried away to a distance of 50 meters the earth filling under the floor is to be well rammed and watered.
- **FOUNDATIONS:-** 1:5:10 using 40mm graded stone aggregates brick work in cm 1:6 half brick wall to be built off the ground floor sub base.
- **PLINTH:-** brick work in cm 1:6
- **DAMP PROOFING COARSE :-** 40 mm thick PCC 1:2:4 with 12 mm graded stone aggregates mixed with 3% water proofing compound, by wt. of CT mixed.
- **SUPER STRUCTURE:-** brick work in cm 1:6 half brick wall in cm 1:4 R/F with 2 No. 6mm Φ MS round bars at every $4^{th}$ course.
- **ALL ROOF FINISH:-** cement concrete 1:2:4 with 20mm graded stone aggregates.
- **FACING/EXTERNAL FINISH:-** Brick the facing in front with CT. based paint ,12mm thick CT. plaster 1:6 with cement based paint on all other external exposed surface of wall.
- **FLAT ROOF: -** average 50mm thick lime concrete terracing (1:2) laid to required slope.
- **PENT ROOF :-** 0.8mm thick corrugated black mild steel sheeting painted on outer exposed surface fixed to purling
- **GIRDER :-** black plain MS Sheet painted
- **R.W.P :-** C.I painted
- **FLOORS :-** 10mm thick terrazzo floor finish with silver gray colour with 6 to 10 mm space marble chips and using white CT. over 30 mm space TW. p.c.c. screed 1:2:4 space over 80mm TH. RCC space 1:5:10 space sub-base over rammed earth in all rooms veranda.
- 40 mm TH. pcc 1:2:4 finish over 80 mm TH pcc 1:5:10 sub-base over rammed earth.
- **STRIKING-** 150 mm high and 6mm thick terrazzo finish over 10 mm thick screed in cm 1:4 in all rooms except W.C. and kitchen in ground floor and toilet in first floor
- **DADO-** 420 mm high 8mm thick terrazzo finish over 10 mm thick screed in cm. 1:4 in ground floor W.C. 2100 mm thick dado with 5 to 6 mm glazed tiles over 10 mm thick cement screed in cm 1:4 in kitchen ad toilet.

- **WINDOWS-** deodar wood frame in glazed shutters painted 4 mm thick plane sheet glass fixed with wooden beads, fly roof shutters to be filled with wire gauge .65 mm nom. Dia. And average width of aperture 4mm.
- **DOOR-**deodar wood frame and flush shutters with commercial ply facing in both the sides.
- **CUPBOARDS-** deodar wood frame, 25 mm thick block board shutter with commercial facing ply on both the side. 19 to 20 mm thick teak wood particle board with commercial ply facing on both faces in shelves 90 mm dia.
- **PELMETS-** teak wood particle board with commercial ply facing on one side with 19 mm dia. Aluminum anodized conduit rod with external surface to be painted.
- **INTERNAL WALL FINISHES-** 12 mm thick plaster in CM 1:6 and 2 coats of dry distemper on all the room walls except kitchen, fuel store, toilet, WC, verandaand stairs. In ground and first floor 12mm thick plaster in CM 1:6 and two coats of color wash over a coat of or whitewash in kitchen, fuel store, toilet, WC, veranda and stairs.
- **CEILING FINISHES-** 6mm thick plaster 1:3 and three coats of whitewash in kitchen, fuel store, toilet, WC, veranda and stairs , in ground floor 6mm thick cement plaster 1:3 with 2 coats of dry distemper in all other rooms in ground floor.
- **SANITARY FITTINGS-** china white first quality conforming to INDIAN standard 2556.
- **MIRROR-** 5.5 mm thick sheet glass with ply wood backing
- **TOWEL RAIL-** aluminum anodized
- **PLUMBING-** waste pipe of CI medium grade, wash pipe from NAHANI trap, soil syphonage pipe to be of CI conforming to ISS 1729
- **WATER SUPPLY-** water tubing-water for supply system shall be mild steel tube medium grade galvanized conforming ISS 1239. Water storage tank- 1 no. 400 litre capacity AC tank and with removal AC cover over flow, inlet and outlet.
- **WIRING-** to be with enameled steel conduit with 5/4 mtr sq. normal area, pvc cable decorative footings, switch and socket to be of high grade packlite.
- **DRAINAGE AND SEWAGE DISPOSAL-** pipe laid, trenches jointed with lead joints. Brick construction man holes with medium duty man hole CI covers.

## EXCAVATION

**EXCAVATION: -**Foundation trenches shall be dug out to the exact width of foundation concrete and the sides shall be vertical. If the soil is not good and does not permit vertical sides the side should be sloped back or protected with timber sharing excavated earth shall not be placed within 1 m. of the edge of the trench.

**FINISH OF TRENCH: -**The bottom of foundation trenches shall be perfectly leveled both longitudinally and treaverrly and sides of the trench shall be dressed perfectly vertical from bottom up to the least thickness of loose one so that concrete may be laid to the exact width as per design the bed of the trench shall be lightly watered and well lamed. Excessive digging if done trough mistake shall be filled with concrete or with stabilized soil. If rocks are found during excavation, these should be removed and the bed of trenches should be leveled and made hard by consolidation the earth. Foundation conc. And approval of the trench by the engg. In charge.

**WATER IN FOUNDATION : -**Water if any accumulated in the trenches, should be bailed or pumped out without any extra payment and necessary precautions shall be taken to prevent surface water enter the trench.

**TRENCH FILLING: -** After the conc. has been laid, masonry has been constructed the remaining portion of the trenches shall be filled up with earth in layers of 15cm and watered and well rammed. The earth filling shall be free from rubbish and refuse mater. All clouds shall be broken before filling surplus earth not required shall be removed and disposed and site shall be leveled and dressed.

## PLAIN CEMENT CONCRETING

Plain cement concrete is a mixture of cement, sand, pebbles or crushed rock and water. The mix used here in P.C.C. is M10 i.e. the compressive strength of the cube with side 150mm after 28 days is 10 N/mm2. The mix contains 1 part cement, 3 parts fine aggregates and 6 parts course aggregates.

The thickness of P.C.C. done here is 100 mm. The various purposes of laying P.C.C. are:-

- To prevent the corrosion of reinforcement
- To provide water proof bed for reinforcement
- To prevent seepage of moisture

**Laying and Compacting: -** Bed of foundation trench shall be lightly sprinkled with water before concrete is laid. Concrete shall be laid slowly and gently in layers of not more than 20 cm and thoroughly consolidated to 15 cm with 6 kg iron rammers. During consolidation concrete should be kept from earth, dust leaves and other foreign matters. The consolidation shall be checked by water test by digging a rate of about 7.5 cm diameter and 7.5 cm deep in the concrete and filling with water. The water level of should not sink more than 1.25cm in 15 minutes is concrete has been well consolidated.

**Curing: -** After about two hours laying when concrete has begun to harden, it shall be kept damp by covering with wet gunny bag or wet sand for 24 hours and then covered by flooding with water making mud walls 7.5 cam (3") high or by covering with wet sand or earth and kept damp continuously for 15 days.

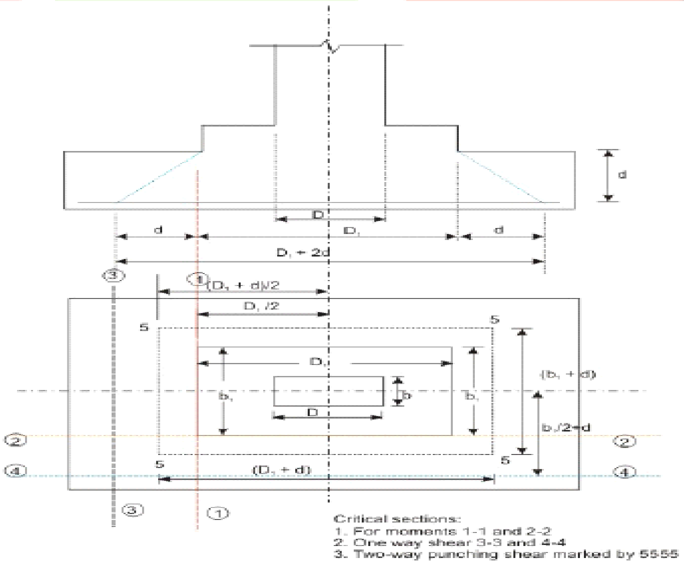
# FOUNDATION

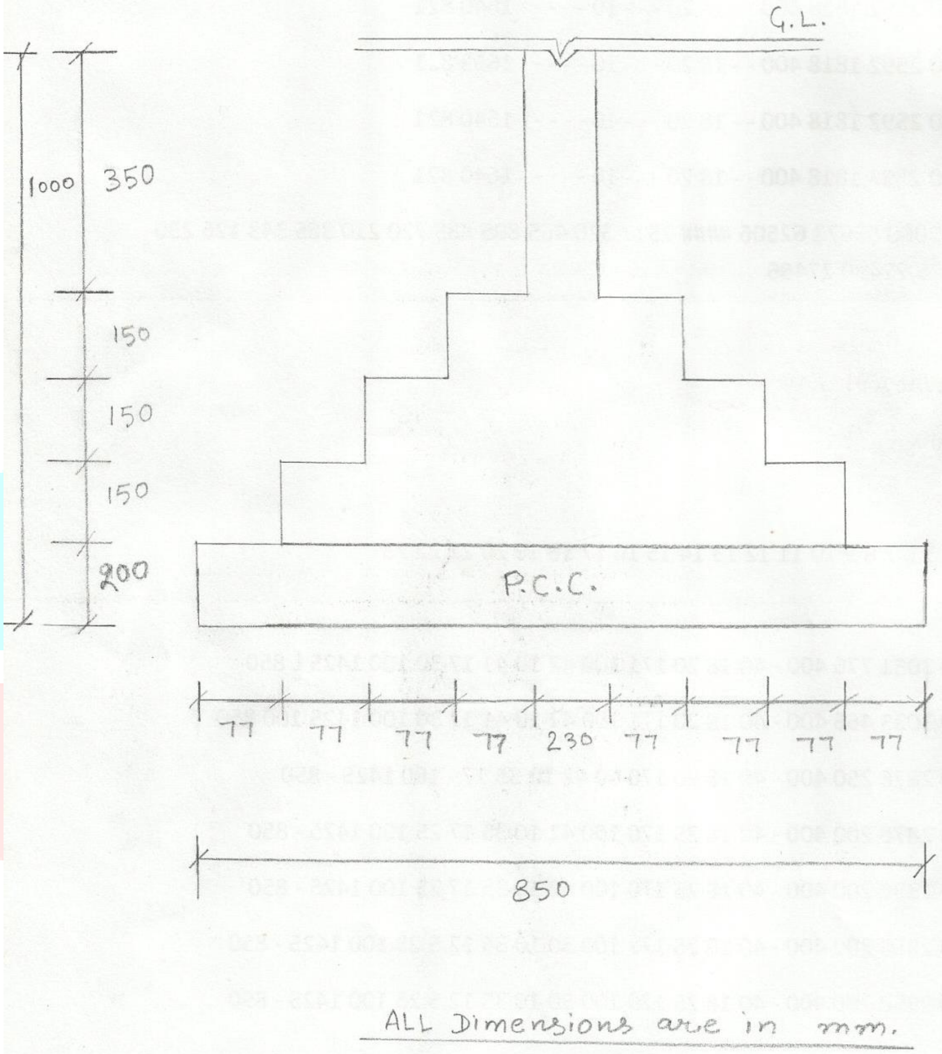
Foundation is the element of a structure that serves to support the loads super-imposed to it through the transmitting elements (such as columns). In addition, foundation also serves some other functions, such as:

- Prevent settlement (including differential settlement) of a structure.
- Prevent possible movement of structure due to periodic shrinkage and swelling of subsoil.
- Allow building over water or water-logged ground.
- Resist uplifting or overturning forces due to wind.
- Resist lateral forces due to soil movement.
- Underpin (support) existing or unstable structures.

**Shallow Foundation**

This type of foundation usually refers to those being rested on stratum with adequate bearing capacity and laid less than 3m below ground level. Shallow foundations are used when the soil has sufficient strength within a short depth below the ground level. They need sufficient plan area to transfer the heavy loads to the base soil. These heavy loads are sustained by the reinforced concrete columns or walls (either of bricks or reinforced concrete) of much less areas of cross-section due to high strength of bricks or reinforced concrete when compared to that of soil. The strength of the soil, expressed as the safe bearing capacity of the soil is normally supplied by the geotechnical experts to the structural engineer. Shallow foundations are also designated as footings.




G.L.
1000
350
150
150
150
200
P.C.C.
77 77 77 77 230 77 77 77 77
850
ALL Dimensions are in mm.

## Design of Foundation

Height of wall = 3 + 2.8

= 5.8 m

Thickness of wall = 230 mm

Wt. of wall/m = 0.23 x 5.8 x 18.54

= 24.732 KN/m

Assume superimpose load = 110 KN/m

Total load = 110+24.732

= 134.732 KN/m

Factored load = 1.5 x 134.732

= 202.10 KN/m

Width of footing = 202.1 /250

= .808m

So, provide = .85 m

Total depth of footing = 1 m

## BRICK WORK

**Materials: -** Brick shall be strictly of first class quality and selected first class brick shall be used mortar shall be fresh Portland cement. Sand shall be cause and free from foreign matter. Steel reinforcement cement shall be of standard specification as described in items.

**Centering and Shuttering:-** The cantering and shuttering shall be made with planking or sheeting of bombed pocked together at the required level supported on runner of beans and covered with a thin layer about 2.5cm thick of earth finish off with a light sprinkle of sand. The cantering shall be simple in const. so that it could be easily removed without disturbing the structure. The planting shall be kept clear of the bearing of slab. And will rest on class beams only. Planks shall not blond too closed to tender them liable to jam. Closes beam shall be carried on the walls supported intervals by bellies or temporary dry brick piles. The top surface of centering shall be given a camper of 2mm for every 30cm. of span, up to a max of 4cm of lintels.

**Mixing of Mortar: -** Mortar of cement and sand shall be thoroughly mixed in the proportion of 1:3. First by fixing dye and them and added water slowly and gradually and mixing by turning at least three to get uniform plastic mix of workable consistency so that the motor may be packed. Sound the rein for cement. Quantity of water shall not exceed 25ltr / bag of cement motor shall be mixed just before it is actually required and shall within 30 minute State mortar shall never be used.

**Laying:-** All bricks shall be thoroughly soaked with water for not less than hours immediately before use brick shall laced frogs downward over the cantering in straight line II to the direction of the rein force meant bass leaving the required. Gap for mortar joint. No vertical joint should. Come along the inner edge of the wall. The gap for mortar joint in which reinforcement has to be placed shall not be less than four times the diameter of bar so as to provide a cover of 12mm ½ an all sides of the steal bass, usually mortar joint shall be 32 mm to 40 mm (1¼ to1½) other joints where these will not be any bar be 6mm to 10mm (¼ to 3.8) thick.

**Curing: -** After about two hours laying when concrete has begun to harden it shall be kept. Damp by covering with wet gunny by or wet sand for 24 hours and thin corned by finding with water making mud walls 7.5cm 1/3 high or by covering with wet sand or earth and kept damp continuously for 15 days.

**Measurement: -** Measurement shall be taken in cu meter (as ft) for the finished work and as deduction shall be made for the volume of steel. Steel reinforcement shall be measured. Under a separate item in quintal. Plastering if any shall not include in the measurement. The rate for R.C.C. work shall be for the complete work excluding steel. But including cantering and shuttering a dell tools and plants.

**Plastering Cement Mortar: -** The joint of the brick work shall be raked out to depth of 18mm. (3/4) and the surface of the wall shall be washed. And kept wet for two days plastering. The materials of mortar, cement and sand as lime and surki or sand, or kanker lime as specified should be of standard specification. The materials or mortar shall be first dry mixed by measuring with boxes to have the required proportion and then water added slowly and gradually and mixed thoroughly. The thickness of plasters shall be as specified. Usually 12mm (½) applied in two or three Coats. To ensure uniform thickness of plaster patches of 15 × 15 (6") strip 1m (3) apart or 10 cm 4 uncle plasters shall be applied first at about 2m (6) apart. To act as a guide first mortar shall be dashed and pressed over the surface and then brought to a true smooth and uniform surface by means of float and trader. External plastering shall be started from top and worked down towards floors. Internal plastering shall be started wherever the building frame is ready and covering of the roof slabs have been removed. Cooling plastering shall be edges shall be sounded. The plastered surface shall be kept wet for 10 days. The surface should be protected from rain sun, frost etc.

**Curing** shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for at least 10 days. Any defective plaster shall be cut in rectangular shape and replace.

## DAMP PROOF COURSE

**Materials: -** Damp proof course shall consists of cement coarse sand and stone aggregate of 1:1½ :3 proportion with 2% of cam seal or ACCO proof by weight of cement or other standard water proofing compound. (1Kg. per bag of cement) . The damp proof course shall be applied at the plinth level in a horizontal layer of 2.5 cm thickness. The cement shall be fresh, Portland cement of standard specification. The sand shall be clean, coarse of 5 mm size and down and the stone aggregate shall be hard and tough of 20 mm size well glade and free from dust and dirt, compo seal, puldo, cico and other standard water proofing compound may be used, and the quantity shall be used as per instructions of the manufacturers.

**Mixing: -**Mixing shall be done in a masonry platform or in a short iron tray in the proportion of 1:1½:3 by measuring with messing boxes. The cement is first mixed thoroughly with the water proofing compound to the required quantity and then mixed dry with the sand in the proportion of 1:1.5

**Laying: -**The level of the surface of the plinth shall be checked longitudinally and transversely. The top of walls at damp proof cause should be lard with fears of the best downward. Aside from shuttering of strong wooden bottom of 2.5cm thickness shall' be fixed properly and formally a both sides to confine the concrete so that the shuttering does not get disturbed during compaction and mortal does not leak through.

## DOORS AND WINDOWS

Timber shall be of kind as specified may be of teak, shisham, Sal deodar. Timber shall be of best quality well seasoned The timber should be of best quality well seasoned angle free from shap, knot, works, cracks or any other defect .The scantling shall be sawn in direction of grains .All wood work shall be planed and neatly and truly finished to exact dimension .All joints shall be neat &strong, truly &accurately fitted and coat with white lead, before fitting together.

**Choukhats: -** The choukhats shall be properly framed and joined by mortise and tension joint with hard wooden pins and the joints shall be coated with white lead before being fitted together. The choukhats shall be of section as per drawing may be 7.5*10cm or similar shall be painted with two coats of soligum and the other faces shall be painted with a prime coat before fixing in position.

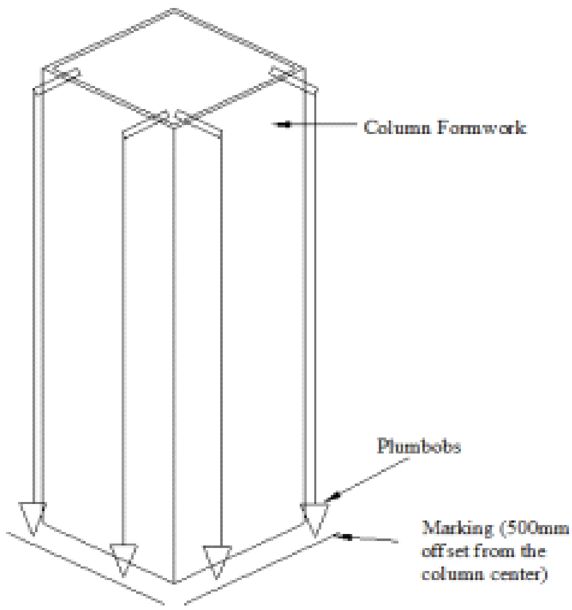
**Shutters or Leaves: -** The shutters may be paneled, glazed and palt glazed, battened, or ventilation as specified .The thickness of shutter shall be 3 to 5cm. The styles rails and panels shall be planned and neatly and truly finished to exact dimension .The styles and rails shall be framed properly and accurately with mortise and tonon joint fixed with wooden pins Panels shall be one piece without any joint and shall be fixed with 12m insertion into the rails and styles provided with moldings as per design. The thickness of panel shall be 12 to 25mm .All rail over 15cm in width shall have double tenon. No tenon shall exceed one fourth of thickness of plank for glazed windows sash bars shall not be less than 40*40 mm and glass shall be fixed with nays and putty or with wooden beddings over felt as specified .All joint shall be glued before being fitted.

**Fitting: -**All doors shall be provided with handle on both sides and all windows with handle on inner side .One of doors of each room shall be provided with sliding bolts on outer side for locking, lower bolts, hook bolts, stops for keeping the leaves open and also wooden block to prevent leaves striking the jambs of wall etc. shall be provided. The fittings may be of iron , brass or oxidizing as specified of approved quality of screws shall be of suitable length and correct diameter and shall be fixed with screw driver and not hammering.

# REINFORCED CEMENT CONCRETE

**Steel: -** Steel reinforcing bars shall be of mild steel or deformed steel of standard specifications and shall be free from corrosion, loose rust scales, oil, grease and paint etc. The steel bar shall be round, and capable of being bent accurately and placed in position as per design and drawing and bound together tight with 20 S.W.G. annealed steel wire at their point of intersection. bars shall be bent cold by applying gradual and even motion of 40 mm(11/2" ) diameter and above may be bent by heating to dull red and allowed to cool slowly without immersing in water or questing. Joints in the bar should be avoided as far as possible , when joint's have to be made an overlap of 40 times diameters of the bar shall given with proper hooks at ends and joints should be staggered.

**Centering and Shuttering: -** Centering and shuttering shall be made with timber or steel plate close and tight to prevent leakage or mortar with necessary props, bracing and wedges, sufficiently strong and stable and should not yield on laying concrete and made in such a way that they can be stacked and removed gradually without disturbing the concrete. No plastering should be made on the concrete surface. A coat of oil washing should be applied over the shuttering or paper should be spread to have a smooth and finished surface and to prevent adherence of concrete.




**Proportion of Cement Concrete: -** Cement concrete shall be 1:2:4 proportion by volume for slabs, beams and lintels and 1:1½:3 proportion for columns under otherwise specified.

**Material for Concrete: -** Cement, sand and coarse aggregate shall be same as for cement concrete. The stone aggregate shall be usually 20mm to 6mm (¾" to ¼") gauge unless otherwise specified.

**Mixing: -** Mixing shall be done one a clean water tight, masonry plot form of sufficient size bricks, Ballast shall be starched in a rectangular layer of uniform thickness usually 30 cm ( 12") high and well soaked with clean water for a w ell soaked with clean water for a period of at least three hours.

**Laying: -** Before laying the concrete, the shuttering shall be clean free from dust and other foreign matters. The concrete shall be deposited (not dropped) in its final position. If case of columns and usually it is desirable to place concrete in full height if practical so as to avoid construction joints but the progress of concreting in the vertical direction shall be restricted to one meter per hour. Care should be taken that the time between mixing and placing of concrete shall not exceed 20 minutes so that the initial setting process is not interfered with.

Concrete shall be compacted by mechanical vibrating machine until a dense concrete is obtained. The vibration shall continue during the entire period of placing concrete.

**Curing: -** After about two hours laying when concrete begun to harden it shall be kept dump by covering with wet gummy bag or wet sand for 24 hours and then curved by flooding with water making mud walls 3.5cm (3”) high, or by covering with wet sand or earth and kept damp continuously for 15 days.

**Finishing: -** If specified the exposed surface shall be plastered with 1:3 cement mortar not exceeding 6mm thickness and the plastering shall be applied immediately after removal of concrete.

## COLUMN

**Column:-** A column or pillar in architecture and structural engineering is an structural element that transmits, through compression, the weight of the structure above to other structural elements below. For the purpose of wind or earthquake engineering, columns may be designed to resist lateral forces. Other compression members are often termed "columns" because of the similar stress conditions. Columns are frequently used to support beams or arches on which the upper parts of walls or ceilings rest. In architecture, "column" refers to such a structural element that also has certain proportional and decorative features. A column might also be a decorative element not needed for structural purposes; many columns are "engaged with", that is to say form part of a wall

Early columns were constructed of stone, some out of a single piece of stone. Monolithic columns are among the heaviest stones used in architecture. Other stone columns are created out of multiple sections of stone, mortared or dry-fit together. In many classical sites, sectioned columns were carved with a centre hole or depression so that they could be pegged together, using stone or metal pins. The design of most classical columns incorporates entasis (the inclusion of a slight outward curve in the sides) plus a reduction in diameter along the height of the column, so that the top is as little as 83% of the bottom diameter. This reduction mimics the parallax effects which the eye expects to see, and tends to make columns look taller and straighter than they are while entasis adds to that effect.

## Design of Column

Assume σst = 190 N/mm2; σcc = 5 N/mm2

Take M-20

Permissible load = 11 KN (from beam)

Least Lateral Dimension = 230 mm

Effective length of column = 3000 mm

l/b = 3000/230 = 13 > 12

It is a long column.

Reduction coefficient, Cr = 1.25 – (Leff. / 48b) = 1.25 – (13/48) = 1.23 – 0.278 = 0.9791

Permissible load, P = Cr × (σcc.Ac + σsc.Asc)

11 × 103 = 0.9791 [5 × {(230 × 230) – Asc} + 190Asc]

11234.8 = 264500 – 185Asc

Asc = 1369 mm2

Provide 4 No.s of 20mm ɸ bars

Asc = 1256.63 mm2 with 50mm cover.

Lateral Ties :-

a) Dia., greater of the following

i) ¼ th dia. of longitudinal bar i.e 22/4 = 5.5

ii) 5 mm, Adopt 8 mm ɸ ties (Min. available in market)

b) Pitch, the least of following :-

i) Least lateral dimension of compression member i.e 600 mm.

ii) 16 × dia. of main bar i.e 16 × 22 = 352 mm.

iii) 48 × dia. of tie i.e 48 × 8 = 284 mm.

Provide 8mm ɸ ties @ 380 mm c/c

Ties 8mm ɸ 380 mm

1 to 4 = 25mm ɸ

# LINTEL

**Lintel: -** A lintel can be a load-bearing building component, a decorative architectural element, or a combined ornamented structural item. It is often found over portals, doors, and windows.

In worldwide architecture of different eras and many cultures, a lintel has been an element of Post and lintel construction. Many different building materials have been used for lintels. A lintel is defined as a structural horizontal block that spans the space or opening between two vertical supports.

During Earthquake small residential houses made of conventional brick wall systems are seen to have major effect due to torsional and shear forces caused in various portions of the wall. Due to this various precautions to be taken during construction have been given by various technical institutes and government agencies from time to time. In general these should be consulted from structural consultants/ Architects but for places where a consultant is not available a few of the precautions are used.

## Design of Lintel

Given M20, Fy = 415 N/mm2

Fck = 20 N/mm2

Assume wall height from lintel to slab = 1 m

Assume over all depth of lintel(D) = 120mm

Load from slab = 7.9 KN/m

Wall = 0.23 x 1 x 20 x 1 = 4.6 KN/m

From shunshed = 0.6x (2+2.5)

= 0.6 x 4.5

=2.7 KN/m

Self weight = 0.23 x 0.12 x 25

= 0.6 KN/m

Total load = 15.89 KN/m

(Ultimate load) Wu = 1.5 x total load

=1.5 x 15.89

= 23.835 KN/m

Span of lintel = clear span + depth

= 1.2 + 0.12

= 1.32 m

(Shear force ) Vu = (Wu x clear span)/ 2

Vu = (23.835 x 1.32 / 2) = 15.7311 KN

(Bending moment) Mu = (Wu x Leff. 2 )/8

d= D – clear cover – ϕ/2

use 10 mm ϕ with 30 mm clear cover

d = 20 – 30 – 10 /2 = 85 mm

Mu = 23.835 x (1.32)2 / 8

= 5.19 KN m

Ast = (Fck x b x d)/ 2 Fy [1- (1- 4.6 Mu / Fck x b x d2)1/2]

= ( 20 x 1000 x 85/2 x 415) [1 - ( 1- 4.6 x 5.19 x 106 / 20 x 1000 x 852 )1/2 ]

Ast = 176.83 mm2

Provide 3 – 10 mm ϕ bar

So, Ast provided = 236 mm2

Min. Ast = (0.12 x 120 x 1000)/ 100

= 144 mm2

# SUN SHED/CHAJJA

## Design of Sun shed/Chajja

Assume thickness of sun shed = 80 mm

Fy = 415 N/mm2

Fck = 20 N/mm2

1) Loads :-

Self Weight = 0.08 × 25 = 2 KN/m2

Take Live Load = 2.5 KN/m2

Total load = 4.5 KN/m2

Factor Load = 1.5 × 4.5

wu = 6.75 KN/m2

Assume Clear Span = 600 mm

Effective Clear Span = Clear Span + 80÷2

Leff. = 600 + 80÷2 = 0.64 m

1) Moment :-

Mu = ( wu × Leff.2 ) ÷ 2

Mu = (6.75 × 0.642) ÷ 2 = 1.381 KN/m

Shear Force, vu = wu × Leff. = 6.75 × 0.64 = 4.32 KN

Assume 8mm ф bars

Assume Cover = 15mm

d = overall depth – clear cover – Φ÷2

= 80 – 15 – 4 = 61 mm

Ast = {fckbd [1 – (√ (1 – (4.6mu/fckbd2))]} / 2fy

Ast = {20×1000×61 [1 – (√ (1 – (4.6×1.381/ (20×1000×612)))]} / (2×415)

= 64.1 mm2 = 64 mm2

Minimum steel = (0.12÷100) × 1000 × 81 = 96 mm2

Maximum Spacing = 3 × 61 = 183 mm2

Provide 8mm ф @ 180 mm c/c

Ast = 277 mm2

# PORCH

A porch (from Old French porche, from Latin porticus ‘colonnade,’ from porta ‘passage’) is external to the walls of the main building proper, but may be enclosed by screen, latticework, broad windows, or other light frame walls extending from the main structure. There are various styles of porches, all of which depend on the architectural tradition of its location. All porches will allow for sufficient space for a person to comfortably pause before entering or after exiting the building. However, they may be larger. Verandahs, for example, are usually quite large and may encompass the entire facade as well as the sides of a structure. At the other extreme, the Grand Hotel on Mackinac Island, Michigan has the longest porch in the world at 660 feet (200 m) in length.

## Design of Columns for Porch

Assume σst = 140 N/mm2; σcc = 5 N/mm2

Take M-20

Permissible load = 2 KN (from beam)

Least Lateral Dimension = 230 mm

Effective length of column = 2100 mm

l/b = 2100/230 = 9.13 > 12

It is a long column.

P = σcc Ac + σsc Asc

7.68 x 103 = 5[(230 x230 - Asc ) + 190 x Asc

Asc = -1389 mm2

-ve area means there is no need of reinforcement so, we provide mini. Reinforcement.

Mini. 4 bars dia 8 mm and lateral ties of 6 mm dia @ 300 c/c

# FLAT SLAB

**FLAT SLAB:-** Common practice of design and construction is to support the slabs by beams and support the beams by columns. This may be called as beam-slab construction. The beams reduce the available net clear ceiling height. Hence in warehouses, offices and public halls sometimes beams are avoided and slab sare directly supported by columns. These types of construction are aesthetically appealing also. These slabs which are directly supported by columns are called Flat Slabs.

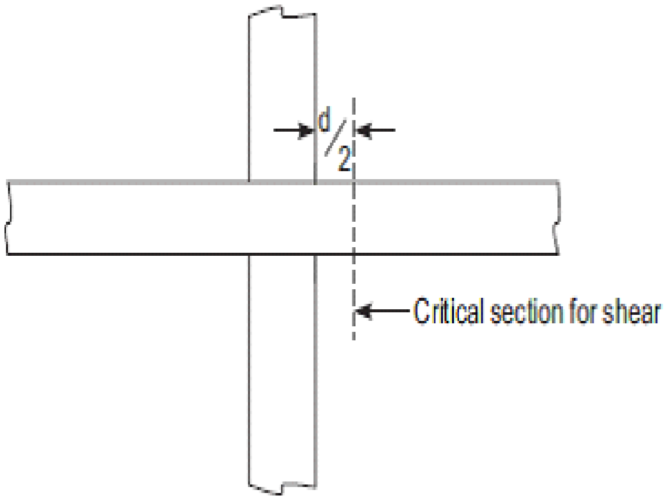



Fig. 1.1 *A typical flat slab (without drop and column head)*

## Design of Flat Slab for Porch

Given

L = 2.5 m , B = 2.5 m

Modification factor (m) = 1.6

Depth of slab

d = span / 26 x 1.6

= 60 mm

Take 20 mm cover with 10 mm dia. Bar

Take D = 125 mm

deff = D -20 -10/2

= 125 – 20 – 5

= 100 mm

Self wt. of slab = 0.125 x 1 x 25 = 3.125 KN

Live load = 2KN

Total load = 5.125 KN

Ultimate load = 5.125 x 1.5

= 7.6875 = 7.7 KN

Total design load on area (2.5 x 2.5)

= 7.7 x 2.5 x 2.5

= 48.04 KN

Moment Mu = Wul /8

= 15.01 KN-m

Total –ve moment

Mnl = 0.65 Mu

= 9.75 KN-m

Total +ve moment

Mpl = 0.35 x 15

= 5.25 KN-m

For column strip

-ve moment M1L = 0.75 x Mnl

= 7.31 KN-m

+ve moment M2L = 0.6 x Mpl

= 0.6 x 5.25

= 3.15 KN-m

For middle strip

-ve moment

M3L = 0.25 Mnl

= 2.44 KN-m

+ve moment

M4L = 0.4 Mpl

= 2.1 KN-m

So, max. moment

Mmax = 7.31 KN-m

d = (Mu /0.1388 fck b)1/2

= 51.3 < 100

Design is OK

Ast = Mmax / σst.j.d

= (7.31 x 106 ) /(230 x 0.9 x 100)

= 350 mm2

Using 10 mm ϕ bar

Spacing = (π/4 x 102 x 1000 )/ 350

Spacing = 224 mm

So use 220 c/c spacing

Provide Ast = (π/4 x 102 x 1000) / 220

= 357 mm2

## STAIR-CASE

A Staircase provides a means of movement from one level to another in a structure. It consists of a number of steps arranged in a series of flights. Staircase flights are generally designed as slabs spanning between wall supports or landing beams or as cantilever from a longitudinal inclined beam. The staircase fulfills the function of access between the various floors in the building. Generally, the flight of steps consists of one or more landings provided between the floor levels.

The structural components of a flight of stairs comprise of the following elements:-

A) **TREAD:-**The horizontal portion of a step where the foot rests is referred to as tread. 250 to 300 mm is the typical dimension of a tread.

B) **RISER:-**Riser is the vertical distance between the adjacent treads or the vertical projection of the step with value of 150 to 190 mm depending upon the type of building. The width of stairs is generally 1 to 1.5 m and in any case not less than 850 mm. public buildings should be provided with larger widths to facilitate free passage to users and prevent overcrowding.

C) **GOING:-**Going is the horizontal projection of an inclined flight of steps between the first and last riser. A typical flight comprises two landings and one going.

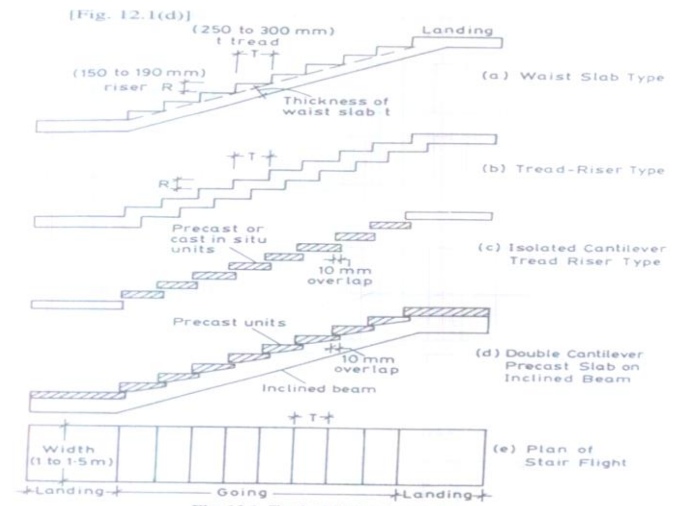


Fig. 12.1 Typical Flight in a staircase

To break the monotony of climbing, the number of steps in a flight should not generally exceed 10 to 12.

The tread-riser combination can be provided in conjunction with

- Waist slab
- Tread-riser type
- Isolated cantilever tread slab
- Double cantilever precast tread slab with a central inclined beam

**SINGLE FLIGHT STAIRCASE**

A typical single flight stairs is shown in fig. This type is used in cellars or attics where the height between the floors is small and the frequency of its use is less.

## <u>Design of Stair Case</u>

GIVEN:- Climb of a roof slab about 3 m high. These is a residential building so that rise is assume 200mm and tread is 250mm and live load is 3 kN/m2

Assume waist slab thickness = 150mm

Effective span = 4500 – 1460 + 230 + 300 = 3.57m

About 15 steps occurs in the stairs .

Width of stairs is 1200 mm.

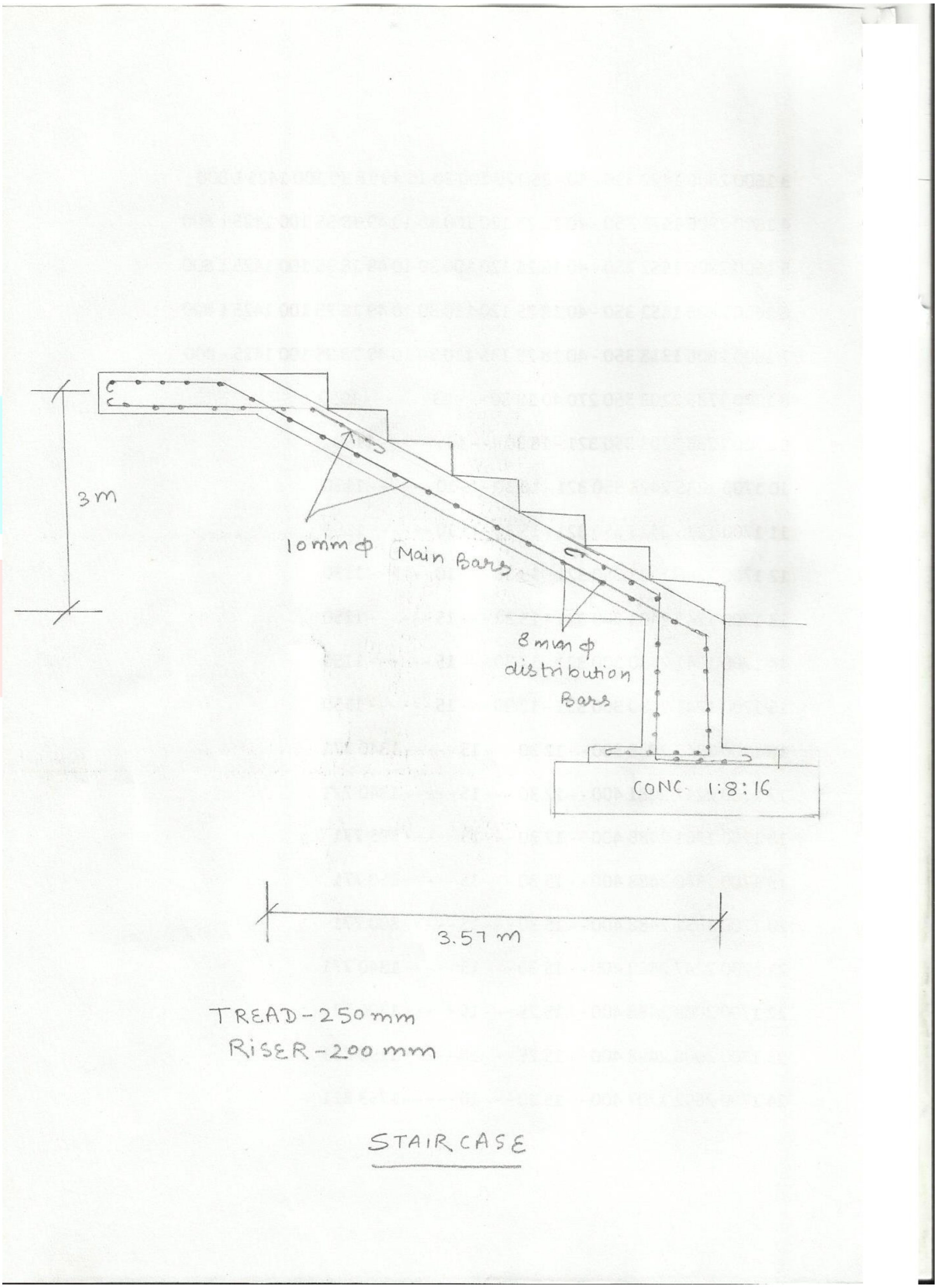
Dead load:-

Self weight of slab in horizontal direction

Fy = 415 N/mm2

Fck = 20 N/mm2

σst = 230 N/mm2



Height of Flight = 3m

Width of Stair = 1200 mm

Thickness of Slab = d = span/20 = 3570/20 = 178.5 mm

Use 10mm Φ with 20mm cover

So provide D = 200 mm

d = 200 – 20 – 5 = 175 mm

Use Rise = 200 mm

Live Load = 3 KN/m2

No. of Rise = 3000/200 = 15

No. of Tread = 15 – 1 =Self weight/Dead load of Slab, Ws = 0.15 × 1 × 25 = 3.75 KN/m2

Self weight of Slab per horizontal m = Ws × √ {(R2 + T2)/T}

= 3.75 × √ {(0.2502 + 0.2002)/0.200}

= 4802.4 N/m2

Weight of Steps per horizontal m = [1/2 × (R×T×25)/T]

= [1/2 × (0.20×0.25×25)/0.25] = 2.5 KN/m2

Live Load = 3 KN/m2

Finishes = 750 N/m2 (assumed)

Total Load = Self Weight of Slab + Weight of Step + L.L + Finishes

= 4802.4 + 2500 + 3000 + 750 = 11052.4 N/m2

Load/m of Waist Slab 1.2 m wide = 11052.4 × 1.2 = 13262.88 N/m

Ultimate Load = 1.5 × 13.262 = 19.89KN/m

Maximum Bending Moment = (19.89 × 103 × 3.572)/8

= 31692.74 N-m = 31.69 KN-m

Depth, d = √ (Mu/0.1388fck.b)

= √ (31.69 × 106/0.1388 ×20 ×100) = 114 mm < 125 mm

So design is O.K

D = 150 mm & d = 125 mm

Ast = Mu/ (σst×j×d)

= 31.69 × 106/(230×0.91×125) = 1211.2 mm2

Provide 10mm Φ @ 100 mm c/c, 15bars

Distribution Steel = (0.12/100) × 1200 × 150

= 216 mm2

Provide 8mm ф @ 230 mm c/c

# BEAM

## Design of Beam

1) Clear span = 2.54 m

Width of support = 230 mm

Fy = 415 , Fck = 20

Width of beam = 230 mm

2) Depth of beam

Span / depth = 15

Depth of beam = 2540/15 = 169.33 mm

Use 20mm ф bar with 30mm cover

So, take D = 210 mm

Deff. = 210 - 30 -20/2 = 170 mm

Eff. Span = 2.54 + 0.17 = 2.71 m

= 2.54 + 0.23 = 2.77 m

Take mini. Value

Loads = self wt. of beam

= 0.21 x 0.23 x 25 = 1.21 KN/m

Assume live load + wall load

D = 10 KN/m

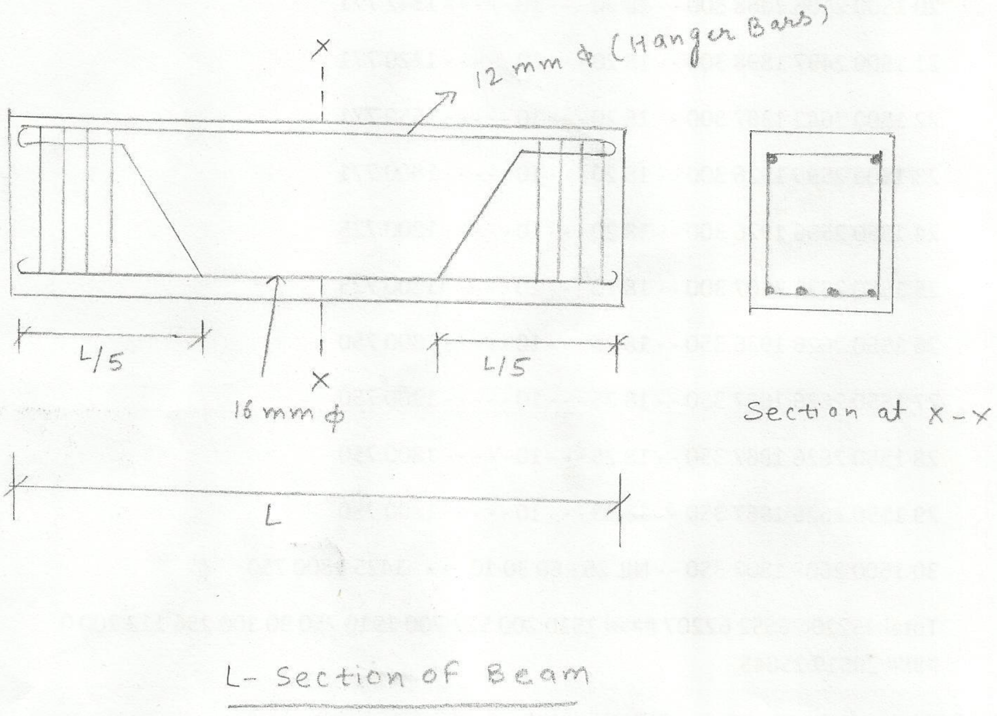
Therefore total working load = 11.21 KN/m

Ultimate design load = 1.5 x 11.21 = 16.815 KN/m

Max. Bending Moment

Mmax = (Wu x leff 2)/8 = (16.815 x 2.712)/8 = 15.436 KN-m

3) Check Depth




Mu = 0.1388 fck bd2

d = (Mu/0.1388 fck b)1/2

= [(15.436 x 106)/(0.1388 x 20 x 1000)]1/2

= 74.63 < 170

So, design is OK

Now, Ast = Mu/ σst x j x d

= (15.436 x 106) /( 230 x 0.9 x 170)

= 438.64 mm2

Ast mini. = (0.12 x 210 x 1000 )/ (100)

= 252 mm2 < 438.64 mm2

Provide 3 bars of 16 mm ф

Ast provide = π/4 x d2 x 3 = 603.1 mm2

Area of anchor bar = 0.2 x 603.1

= 120.6 mm2

Provide 2 – 10 mm ф bar

So, provide Ast = 157mm2

# SLAB

**SLAB: -** Slabs are plane structural members whose thickness is quite small as compared to its other dimensions. Slabs are most frequently used as roof covering and floors in various shapes such as square, rectangles, circular and triangular in buildings, tanks, etc.the slabs are designed just like beams keeping the breadth of such a beam as unity depending upon systems of units.

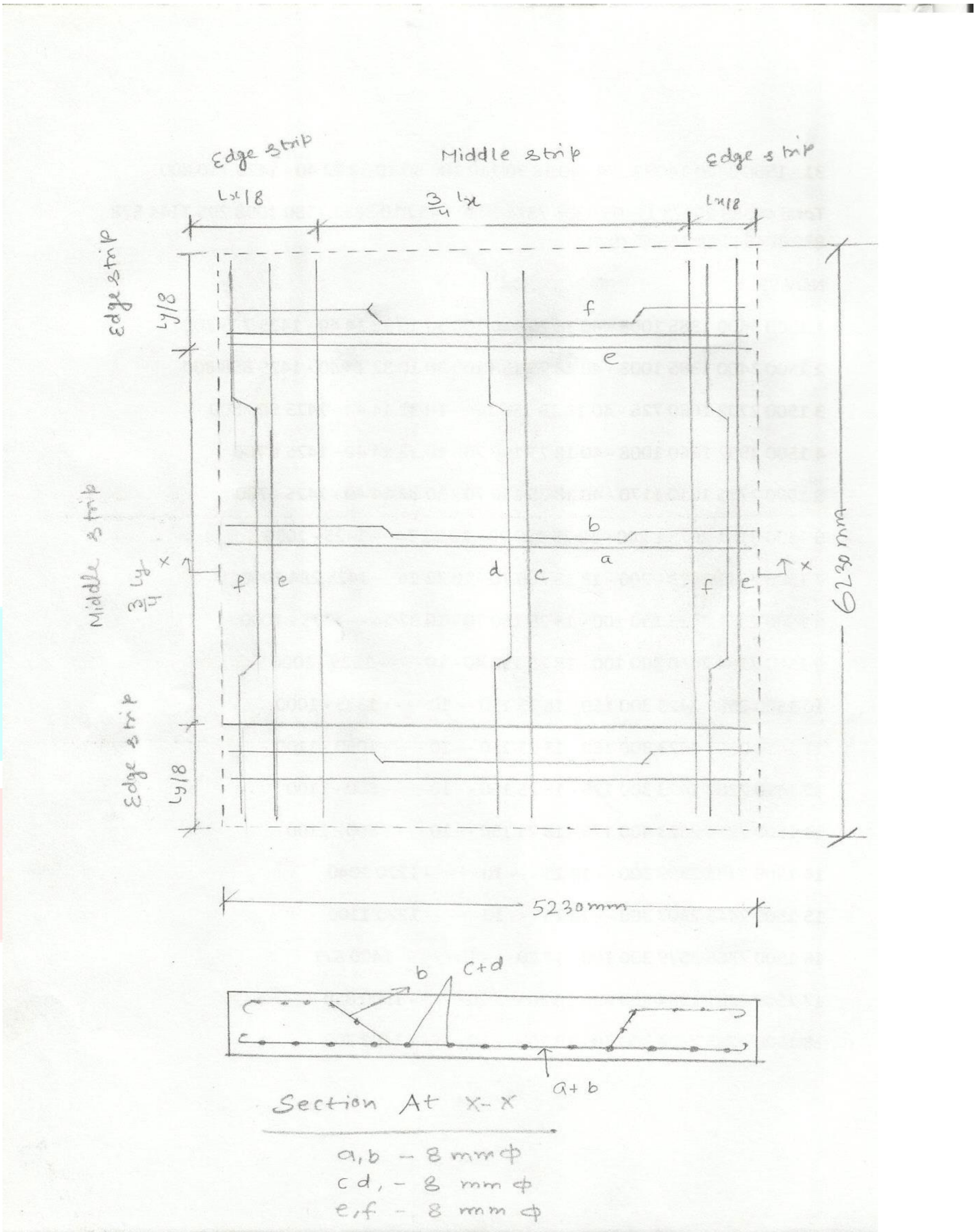
Slabs are in general, divided into two categories depending upon the ratio of long span to short span. when this ratio is greater than or equal to 2, the slab is to be designed as slab spanning in one-direction(one-way slab) but if its ratio is less than 2, the slab is to be designed as slab spanning in two direction(two-way slab),provided in both the cases the slab is supported on all four sides. However, if the slab is supported over two opposite edges only as in case of verandahs, corridors, foyers in cinema houses etc., such slabs are designed as one-way slab. Whether the slab is to be considered as one-way or two-way slab, depending upon the supporting conditions of the slab.

A beam is a horizontal structural element that is capable of withstanding load primarily by resisting bending. The bending force induced into the material of the beam as a result of the external loads, own weight, span and external reactions to these loads is called a bending moment.

Beams are traditionally descriptions of building or civil engineering structural elements, but smaller structures such as truck or automobile frames, machine frames, and other mechanical or structural systems contain beam structures that are designed and analyzed in a similar fashion.

Beams are characterized by their profile (the shape of their cross-section), their length, and their material. In contemporary construction, beams are typically made of steel, reinforced concrete, or wood. One of the most common types of steel beam is the I-beam or wide-flange beam (also known as a "universal beam" or, for stouter sections, a "universal column"). This is commonly used in steel-frame buildings and bridges. Other common beam profiles are the C-channel, the hollow structural section beam, the pipe, and the angle.

Beams are also described by how they are supported. Supports restrict lateral and/or rotational movements so as to satisfy stability conditions as well as to limit the deformations to a certain allowance. A simple beam is supported by a pin support at one end and a roller support at the other end. A beam with a laterally and rotationally fixed support at one end with no support at the other end is called a cantilever beam. A beam simply supported at two points and having one end or both ends extended beyond the supports is called an overhanging beam.




## DESIGN of Slab

STEPS :-

1) Effective Depth :-

Effective Depth = span for continuous slab/40 = 5000/40 = 125 mm

d = 125 mm

overall depth (D) = d + cover + ½ bar

Take 10 mm of Df bar with 20 mm cover ( not less than 15 mm )

D = 125 + 20 + 10/2 = 150 mm

So, take D = 150 mm

Effective Depth = 125 mm

2) Fck = 20 N/mm2 , Fy = 415

Long span = Lx = 5m + 0.125m

Short span = Ly = 6.23m + 0.125m

Ly/Lx = (6.23 + 0.125)/(5 + 0.125) $\leq$ 2

= 1.240 $\leq$ 2

This is two-way slab.

3) Effective Span :-

From c/c support = clear span + width of wall

= 5 + 0.230 = 5.23m

From effective depth = clear span + effective depth

5 + 0.125 = 5.125m

Take whichever is less

So, effective span = 5.125m

4) Loads :-

Self wt. of slab = overall depth + unit wt. x 1

= 0.15 x 25 x 1 = 3.75 KN/m2

Live load = 3 KN/m2 or ( 2.5 or 2 ) KN/m2

Floor finish = 1.15 KN/m2 ( assumed )

Total = L.L + self wt. + F.F

= 3 + 3.75 + 1.15 = 7.9 KN/m2

Working / Ultimate load = load factor + total load

= 1.5 x 7.9 = 11.95 KN/m2

K = Ly/Lx = 1.24

5) Moment & shear force :-

From table by Ly/Lx ratio

Ax = 0.0885

Ay = 0.057

Mux = Ax Wu Lx2 & Ay Wu Lx2

= 0.0885 x 11.95 x 5.1252

= 17.89 KN-m

6) Shear forces :-

Vux = 0.5 Wu LX

= 0.5 x 11.95 x 5.125

= 30.621 KN

7) Check Depth = Mmax = 0.1388 fck bd2

d = Mmax / 0.1388 fck b

= [( 27.78 x 106 )/( 0.1388 x 20 x 1000 )]1/2

d = 100.32 < 125

Design is safe and OK

So provide overall depth 150 mm & d = 125 mm

Reinforcement of Slab :-

Reinforcement along the shorter span in middle strip

Ast = Mx/σst.j.d

= 27.78 × 106 / 230×0.9×0.125

= 1073.62 mm2

Take Ast = 1074 mm2

Provide 10mm ϕ bars

Spacing = (Area of one bar × 1000) / Ast

= (Π/4 × 102 × 1000)/1074 = 73.12 mm

Provide 10mm ϕ bars @ 100 mm c/c

Thus provide spacing Ast = (Π/4 × d2 × 1000)/100

Ast = 785 mm2

Maximum Spacing = 3d or 300 mm

= 3 × 125 = 375 mm or 300 mm

Bend half bars at 0.15 of Span from end.

Reinforcement along the longer span in middle strip :-

Ast = Mu/σst.j.(d – d′)

= 17.89 × 106 / 230×0.9× (125 – 10)

= 75 mm2

Provide 10mm ϕ bars @ 150 mm c/c

Thus provide spacing Ast = (Π/4 × 102 × 1000)/150

Ast = 523 mm2

Bend half bars at 0.15 of Span from both ends.

Reinforcement in edge strip :-

Area of Steel = (0.12/100)b.d

= (0.12/100) × 1000 × 150 = 180 mm2

Provide 10mm ϕ bars @ 250 mm c/c

## <u>DESIGN of Slab</u>

1) Effective Depth :-

Effective Depth = span for continuous slab/40 = 4500/40 = 112.5 mm

d = 115 mm

overall depth (D) = d + cover + ½ bar

Take 10 mm of Df bar with 20 mm cover ( not less than 15 mm )

D = 115 + 20 + 10/2 = 140 mm

So, take D = 140 mm

Effective Depth = 115 mm

2) Fck = 20 N/mm2 , Fy = 415

Long span = Lx = 4.5m + 0.115m = 4.615 m

Short span = Ly = 4.8m + 0.115m = 4.915 m

K = Ly/Lx = (4.8 + 0.115)/(4.5 + 0.115) ≤ 2

= 1.065 ≤ 2

This is two-way slab.

3) Effective Span :-

From c/c support = clear span + width of wall

= 4.5 + 0.115 = 4.615m

4) Loads :-

Self wt. of slab = overall depth + unit wt. x 1

= 0.140 x 25 x 1 = 3.5 KN/m2

Live load = 2 KN/m2

Floor finish = 1.15 KN/m2 ( assumed )

Total = L.L + self wt. + F.F

= 5.5 + 1.15 = 6.65 KN/m2

Working / Ultimate load = load factor + total load

= 1.5 x 6.65 = 9.975 KN/m2

Wb = Wr4 /(1+r4) =( 9.97 x 1.0654) /(1+1.0654 )

= 5.65

Wl = W/(1+r4) = 9.975/(1+1.0654 )

= 4.39

Mb max. = wb Le2 /8 = 5.65 x 4.6152 /8

= 15.04 KN-m

Ml max. = wl Le2 /8 = 4.39 x 4.6152 /8

= 11.69 KN-m

d = [(15.04 x 106) /( 0.1388 x 20 x 1000)]1/2

= 73.61 m < 115m

So, acceptable

Reinforcement of Slab :-

Ast = Mu/σst.j.d

= 15.04 × 106 / 230×0.9×0.115

= 624 mm2

Provide 12 mm ф bars

Spacing = (Area of one bar × 1000) / Ast

= (Π/4 × 122 × 1000)/624 = 181.09 mm

Provide 12mm ф bars @ 180 mm c/c

Thus provide spacing Ast = (Π/4 × d2 × 1000)/180

Ast = 628 mm2

Reinforcement along the longer span in middle strip :-

Ast = Mu/σst.j.(d – d′)

= 11.69 × 106 / 230×0.9× (125 – 10)

= 491 mm2

Provide 12mm ϕ bars @ 220 mm c/c

Thus provide spacing Ast = (Π/4 × 122 × 1000)/220

Ast = 514 mm2

Distribution steel = .12 * 1000 * 150/100

= 180mm2

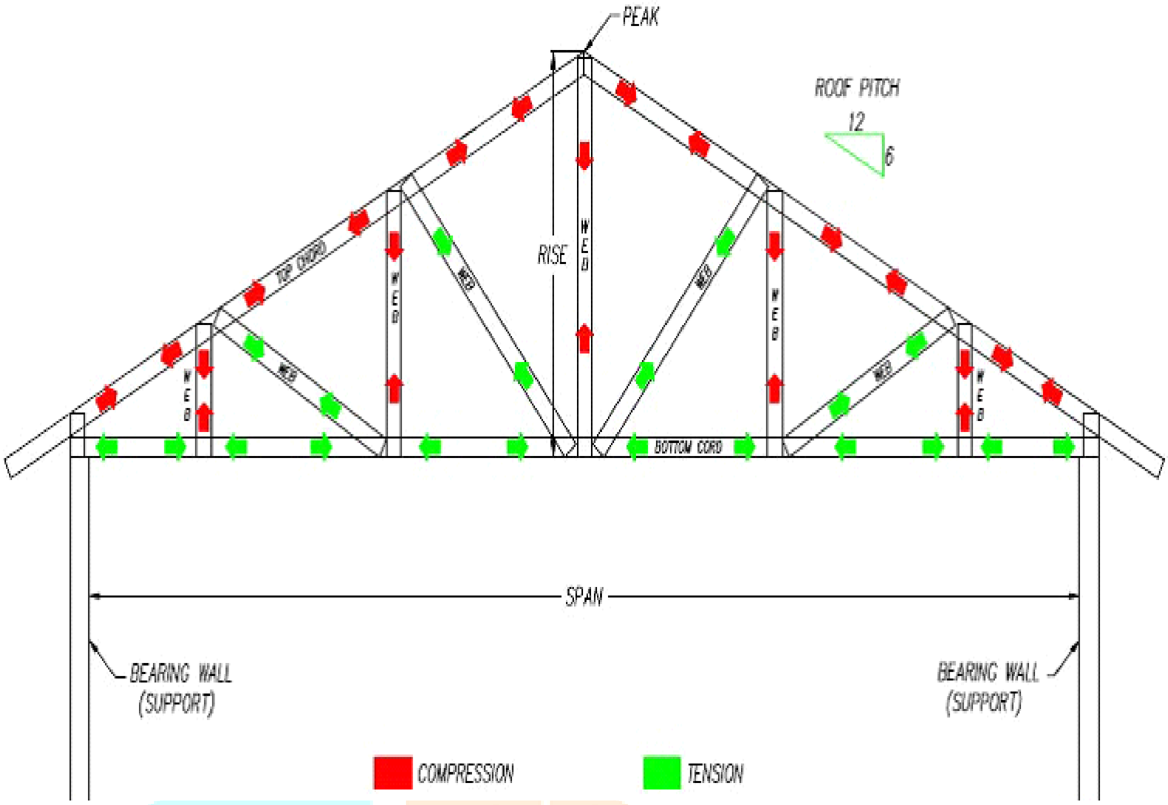
Provide 8mm ϕ bars @ 200 mm c/c

## ROOF TRUSS

**Roof trusses:-** A standard truss is a series of triangles - a stable geometric shape that is difficult to distort under load. Regardless of its overall size and shape, all the chords and webs of a truss form triangles. These triangles combine to distribute the load across each of the other members, resulting in a light structure that is stronger than the sum of the strength of its individual components.

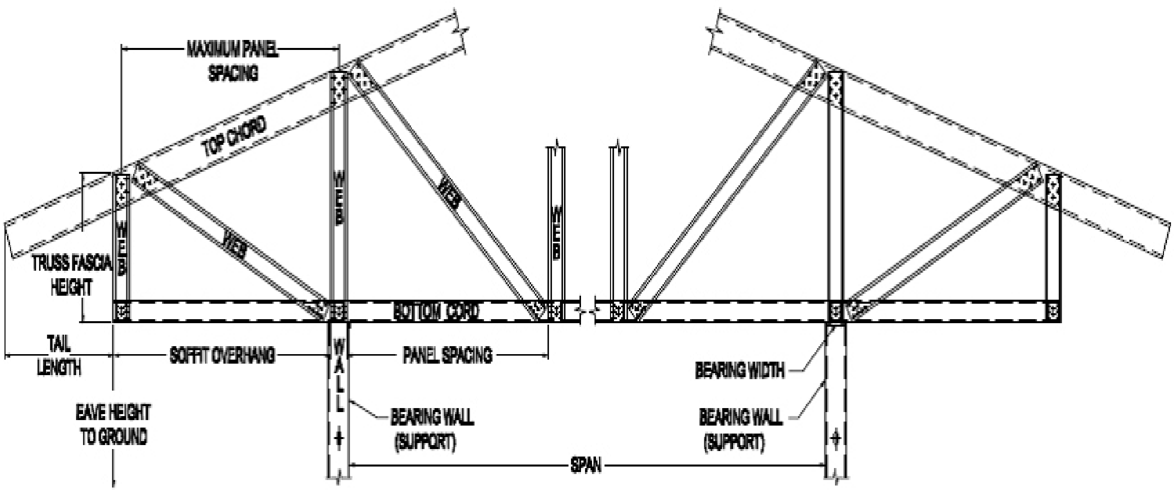
However, for all the advantages, proper installation techniques and bracing are critical. Additionally, trusses should not be modified in the field without consulting the truss manufacturer. Cutting a web member, for example will radically alter its strength.

However, for all the advantages, proper installation techniques and bracing are critical. Additionally, trusses should not be modified in the field without consulting the truss manufacturer. Cutting a web member, for example will radically alter its strength.




## Inputs Required to Truss Manufacturer

- **Truss Type-** Determines whether there will be storage or living space. Also defines architectural details such as soffit, overhang, fascia heights and tail length.
- **Location-**Determines the building codes and loads that apply. For example, in western California, seismic requirements may drive the design and cost of the truss. In coastal Florida, its wind that drives the design.
- **Open Category-** Determines the proportion of openings (doors, windows, etc) to the overall wall area. Door and window openings can increase the pressure inside a structure during wind loading conditions.
- **Wind Exposure Category-** Determines the amount of wind the structure will be susceptible to.
- **Building Category-** Determines the type of structure such as a hospital, school, residential, etc.
- **Span(s)-** Determined by the building plans. If special requirements are needed, they need to be noted on the plans.
- **Desired Roof Slope (Pitch)** Pitch influences many of the design parameters and consequently has an impact on the overall truss weight.
- **Building Plans-** Building plans provide the truss designer/manufacturer valuable information on the wall types, thicknesses, spans, chord slopes, etc.




# WHITE WASHING AND DISTEMPERING

Fresh white lime slacked as the site of work should be act as the marking of the quality required with the help of clean water screened through a coarse clothes cloth and gun in the proportion are in the dry type of the work and they shall applied of flushing the four few days which are in clear water shall be dictated and the cream like a paste of lime shall be taken from leaving reduce of the bottom for the places application. Those should be cleaned in the applied coarse soda send lime and prepped lime paste of the proper triply the viewed in the uniform to 30mm thickness by wood. This should be handle with the help of cement and rubbing with the steel trawl to ahead the surface of thru smoothness of the kept mist for seven days

**Cloud washing: -** cloud are shall be propped with fresh started in the cloud pigment with the required quantity with day of wash shall be applied for one or specified the method of the applications are for white washing The materials or mortar shall be first dry mixed by measuring with boxes to have the required proportion and then water added slowly and gradually and mixed thoroughly.

The distempering shall be of best quantity and closured the distemper should be mixed and wat6er added as laid power and shirred through and the part past is allowed to sand for a new minute. The past is then turn with water too have a thin cream if the surface is rough it should be smooth with sand paper. The surface must be perfectly dry before distempering is command. In the new cement plaster the surface shall be washed over with the selection of zinc sulphate one 1kg in 10ltr of water and then closed today in old surface shall be prepared with water. Plaster of Paris where required & then whole surface sand prepared & washed &allowed to dry.

The number of coats shall be two or as specified. The distemper shall be kept well slurred in containers & shall be applied with broad brushes. First horizontally & immediately crossed vertically. Brushing should not be continued too long to avoid brush marks .The second shall be applied after the first coats is dried up. After each day’s work the brushes will be washed kept dry distempering should be done during dry weather but not during the hot weather

Nor wet weather.

# PROJECT-SPECIFICATION AND ESTIMATING

## MATERIAL SPECIFICATION

No. of door on ground floor = 9

No. of window on ground floor = 6

No. of door on 1st floor = 7

No. of window on 1st floor = 6

Total No. of pendant point = 17

Total No. of Light plug = 9

Total No. of Power plug = 14

Total No. of fan = 8

Total No. of light point = 8

## ESTIMATING

### Calculation of Number of Bricks for Foundation

Use the step foundation

For external wall (below ground level)

Volume of 1st layer = 5183982cm$^3$

Volume of 2nd layer = 4036951.5cm$^3$

Volume of 3rd layer = 2889921cm$^3$

Volume of 4th layer = 3997227.5cm$^3$

Total volume = 16108082cm$^3$

Volume of bricks with mortar = 2000cm$^3$

No. of bricks = 16108082/2000 = 8055

## Foundation for Stair Wall

Volume of 1st layer = 1173978cm$^3$

Volume of 2nd layer = 9142185cm$^3$

Volume of 3rd layer = 654469cm$^3$

Volume of 4th layer = 905222cm$^3$

Total volume = 11875884cm$^3$

Volume of bricks with mortar = 2000cm$^3$

No. of bricks=11875884/2000 = 6000

## Stair side Foundation

Volume of 1st layer = 501120cm$^3$

Volume of 2nd layer = 390240cm$^3$

Volume of 3rd layer = 279360cm$^3$

Volume of 4th layer = 386400cm$^3$

Total volume = 1557120cm$^3$

Volume of bricks with mortar = 2000cm$^3$

No. of bricks = 1557120/2000 = 800

## Foundation for Fuel Store

Volume of 1st layer = 139896cm$^3$

Volume of 2nd layer = 108942cm$^3$

Volume of 3rd layer = 77988cm$^3$

Volume of 4th layer = 107870cm$^3$

Total volume = 434696cm$^3$

Volume of bricks with mortar = 2000cm$^3$

No. of bricks = 434696/2000 = 250

## Half Brick Foundation

Volume of layer = 207000cm$^3$

Volume of bricks with mortar = 2000cm$^3$

No. of bricks = 207000/2000 = 150

## Fuel Store Half Bricks Work

Volume of layer = 90000$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 90000/2000 = 45

## Bricks in External Wall (upto 1$^{st}$ Floor)

Volume of layer = 3426195$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 3426195/2000 = 17120

## Bricks for Internal Wall of Stair

Volume of layer = 7759050$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 7759050/2000 = 3880

## Bricks for Fuel Store

Volume of layer = 3312000$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 3312000/2000 = 1660

## Half Bricks Work for Kitchen

Volume of layer = 1552500$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 1552500/2000 = 738

## Bricks Calculation for 1$^{st}$ Floor

Volume of layer = 27440840$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 27440840/2000 = 13720

Half bricks work

Volume of layer = 2303910$cm^3$

Volume of bricks with mortar = 2000$cm^3$

No. of bricks = 2303910/2000 = 1150

**Total no. of bricks used(appx.) = 53600**

| S. No. | Particulars | Rates<br>Rs. P. |
|---|---|---|
| 1. | Cement bags | 5800.00/quintal |
| 2. | Sand | 400.0/ $m^3$ |
| 3. | Aggregate | 800.0/ $m^3$ |
| 4. | Bricks | 4500/ 1000brick |
| 5. | Lime for washing | 2250/ quintal |
| 6. | White washing | 110.0/ $m^2$ |
| 7. | Tiles | 3.5/ Tile |
| 8. | Wood works<br>Door<br>Window<br>Ventilator | <br>3000.00/ piece<br>2500.00/ piece<br>1000.00/ piece |
| 9. | Steel bars<br>Bar 18 mm Ø<br>Bar 16 mm Ø<br>Bar 14 mm Ø<br>Bar 12 mm Ø<br>Bar 10 mm Ø<br>Bar 08 mm Ø | <br>4200.0/ quintal<br>4250.0/ quintal<br>4300.0/ quintal<br>4350.0/ quintal<br>4400.0/ quintal<br>4700.0/ quintal |

| | | |
|---|---|---|
| | Bar 06 mm Ø | 4800.0/ quintal |

# REFERENCES


## BOOKS:-

- **Reinforced concrete structure by Dr. I.C.Syal**
- **Design of steel structure by S.K. Duggal**
- **Building material by B.C.Punmia**

## IS CODE

- **IS 456-2000 code of practice for plain and reinforced concrete**
- **IS 1983-2002 (part 1) Indian standard criteria for earthquake resistant design of structure**
- **IS 1904-1966 CODE OF PRACTICE FOR STRUCTURAL SAFETY OF BUILDING ;FOUNDATION**
- **DESIGN OF REINFORCED CONCRETE DESIGN 1976**
- **NATIONAL BUILDING CODE OF INDIA 1970**