

PROJECT REPORT ON DESIGN OF A RESIDENTIAL BUILDING

(According to practical principals)



MINI PROJECT REPORT

Submitted in the partial fulfillment of
the Requirements for the award of the degree of

Bachelor of Technology

In Civil Engineering

By

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2011

ACKNOWLEDGEMENT

We express our sincere thanks to **Dr. VENKATARAMANA, Head of Civil Engineering department** for his support and guidance for doing the project.

We express our indebtedness and gratitude to our guide **Sri Gajendhra**, Assistant professor, Department of Civil Engineering, **GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**, for his guidance and care taken by him in helping us to complete the project work successfully.

We express our deep gratitude to **Mr. K.V.S. Appa Rao, Director, GRID CONSULTING**, Hyderabad for his valuable suggestions and guidance rendered in giving shape and coherence to this endeavor. We are also thankful to his team members for their support and guidance throughout the period of project.

ABSTRACT

Hyderabad is the fifth largest city in our country. As it is rapidly developing the construction in the city is very costly. Economic point of view if the building is constructed at a far distance from the city it will be cheaper and residents can live peaceful without any external polluted sources. Having a peaceful surroundings is the main point of view of most of the people in today's lifestyle.

STUDY AREA:

Our proposed site is located at Vijaya buildings, Bandalguda, Nagole road, Hyderabad.

The main road which is near to site leads to kamineni hospital. A branch road of 10m which is near is existing wbm road connected very near to the plot. The total area of the site is about 235.11sq m. the residential building consists of two bed room.

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AIM OF THE PROJECT

The aim of the project is to plan and design the framed structure of a residential building.

INTRODUCTION

2.INTRODUCTION

The basic needs of human existence are food, clothing & shelter. From times immemorial man has been making efforts in improving their standard of living. The point of his efforts has been to provide an economic and efficient shelter. The possession of shelter besides being a basic need, gives a feeling of security, responsibility and shows the social status of man.

Every human being has an inherent liking for a peaceful environment needed for his pleasant living, this object is achieved by having a place of living situated at the safe and convenient location, such a place for comfortable and pleasant living requires consideration and is kept in view.

- A Peaceful environment.
- Safety from all natural sources & climate conditions
- General facilities for community of his residential area.

The engineer has to keep in mind the municipal conditions, building bye laws, environment, financial capacity, water supply, sewage arrangement, provision of future, aeration, ventilation etc., in suggesting a particular type of plan to any client.

3. DEMAND OF HOUSES

The house is the first unit of the society and it is the primary unit of human habitation. The house is built to grant the protection against wind, weathers, and to give insurance against physical insecurity of all kinds.

The special features of the demand for housing consists of in its unique nature and depend on the following factors.

- Availability of cheap finance.
- Availability of skilled labours.
- Availability of transport facility.
- Cost of labours & material of construction.
- Predictions of future demand.
- Rate of interest on investment e. g., low rates of interest with facilities of long term payment may facilities investment in housing.
- Rate of population growth and urbanization.
- Supply of developed plots at reasonable prices.
- Taxation policy on real estates
- Town planning & environmental conditions.

4.CLASSIFICATION OF BUILDINGS BASED ON OCCUPANCY

GROUP-A	RESIDENSIAL BUILDINGS
GROUP-B	EDUCATIONAL BUILDINGS
GROUP-C	INSTITUTIONAL BULIDINGS
GROUP-D	ASSEMBLY BUILDINGS
GROUP-E	BUSINESS BUILDINGS
GROUP-F	MERCANTILE BUILDINGS
GROUP-G	INDUSTRIAL BUILDINGS
GROUP-H	STORAGE BUILDINGS
GROUP-I	HAZARDOUS BUILDINGS

RESIDENTIAL BUILDINGS:

These building include any building in which sleeping accommodation provide for normal residential purposes, with or without cooking and dining facilities.It includes single or multi-family dwellings, apartment houses, lodgings or rooming houses, restaurants, hostels, dormitories and residential hostels.

EDUCATIONAL BUILDINGS:

These include any building used for school, college or day-care purposes involving assembly for instruction, education or recreation and which is not covered by assembly buildings.

INSTITUTIONAL BUILDINGS:

These buildings are used for different purposes, such as medical or other treatment or care of persons suffering from physical or mental illness, diseases or infirmity, care of infants, convalescents or aged persons and for penal detention in which the liberty of the inmates is restricted. Institutional buildings ordinarily provide sleeping accommodation for the occupants.

ASSEMBLY BUILDINGS:

These are the buildings where groups of people meet or gather for amusement, recreation, social, religious, assembly halls, city halls, marriage halls, exhibition halls, museums, places of work ship, etc.

BUSINESS BUILDINGS:

These buildings are used for transaction of business, for keeping of accounts and records and for similar purposes, offices, banks, professional establishments, courts houses, libraries. The principal function of these buildings is transaction of public business and keeping of books and records.

MERCANTILE BUILDINGS:

These buildings are used as shops, stores, market, for display and sale of merchandise either wholesale or retail, office, shops, storage service facilities incidental to the sale of merchandise and located in the same building.

INDUSTRIAL BUILDINGS:

These are buildings where products or materials of all kinds and properties are fabricated, assembled, manufactured or processed, as assembly plant, laboratories, dry cleaning plants, power plants, pumping stations, smoke houses, laundries etc.

STORAGE BUILDINGS:

These buildings are used primarily for the storage or sheltering of goods, wares or merchandise vehicles and animals, as warehouses, cold storage, garages, trucks.

HAZARDOUS BUILDINGS:

These buildings are used for the storage, handling, manufacture or processing of highly combustible or explosive materials or products which are liable to burn with extreme rapidity and/or which may produce poisonous elements for storage handling, acids or other liquids or chemicals producing flames, fumes and explosive, poisonous, irritant or corrosive gases processing of any material producing explosive mixtures of dust which result in the division of matter into fine particles subjected to spontaneous ignition.

5. SELECTION OF PLOT AND STUDY

Selection of plot is very important for buildings a house. Site should be in good place where there community but service is convenient but not so closed that becomes a source of inconvenience or noisy. The conventional transportation is important not only because of present need but for retention of property value in future closely related to are transportation, shopping, facilities also necessary. One should observe the road condition whether there is indication of future development or not in case of un developed area.

The factor to be considered while selecting the building site are as follows:-

- Access to park & play ground.
- Agriculture polytonality of the land.
- Availability of public utility services, especially water, electricity & sewage disposal.
- Contour of land in relation the building cost. Cost of land .
- Distance from places of work.
- Ease of drainage.
- Location with respect to school, collage & public buildings.
- Nature of use of adjacent area.
- Transport facilities.
- Wind velocity and direction.

6.SURVEY OF THE SITE FOR PROPOSED BUILDING

- Reconnaissance survey: the following has been observed during reconnaissance survey of the site.
- Site is located nearly.
- The site is very clear planned without ably dry grass and other throne plats over the entire area.
- No leveling is require since the land is must uniformly level.
- The ground is soft.
- Labour available near by the site.
- Houses are located near by the site.
- Detailed survey: the detailed survey has been done to determine the boundaries of the required areas of the site with the help of theodolite and compass.

7.RESIDENTIAL BUILDING

Requirement for residential accommodation are different for different classes of people & depends on the income & status of the individual a highly rich family with require a luxurious building, while a poor man we satisfied with a single room house for even poor class family.

A standard residential building of bungalow type with has drawing room, dining room office room, guest room, kitchen room, store, pantry, dressing room, bath room, front verandah, stair etc., for other house the number of rooms may be reduced according to the requirements of many available.

a)LIMITATION OF BUILT UP AREA

Area of plot up to 200sq.m (240sq.yd)	----	maximum permissable built up area
Ground and first	----	60% of site area on floor only.
201 to 500sq.m (241to 600sq.yd)	----	50% of the site area.
501 to 1000sq.m (601 to 1200sq.yd)	----	40% of the site area
More than 1000sq.m	----	33% of the site area.

b)MINIMUM FLOOR AREA & HEIGHT OF ROOMS

	FLOOR AREA	HIEGHT (m)
LIVING	10sqm (100sqft)	
	(breadth min 2.7 m or 9')	3.3 (11')
KITCHEN	6sqm (60sqft)	3.0 (10')
BATH	2sqm (20sqft)	2.7 (9')
LATTRINE	1.6sqm (16sqft)	2.7 (9')
BATH & WATER CLOSET	3.6sqm (36sqft)	2.7 (9')
SERVANT ROOM	10sqm (100sqft)	3.0 (10')
GARAGE	2.5*4.8 m (8'*16')	3.0 (10')
MIN. HIEGHT OF PLINTH		
FOR MAIN BUILDING	-----	0.6 (2')
MIN. HIEGHT OF PLINTH FOR		
SERVANT QUARTES	-----	0.3 (1')
MIN. DEPTH OF FOUNDATION	-----	0.9 (3')
THICKNESS OF WALL	20cms to 30cms	-----
	(9" to13.5")	
DAMP PROOF COURSE	2cms to 2.5cms	thick full width of
	(3/4" to1")	plinth wall

8.BUILDING BYE LAWS & REGULATIONS

- Line of building frontage and minimum plot sizes.
- Open spaces around residential building.
- Minimum standard dimensions of building elements.
- Provisions for lighting and ventilation.
- Provisions for safety from explosion.
- Provisions for means of access.
- Provisions for drainage and sanitation.
- Provisions for safety of works against hazards.
- Requirements for off-street parking spaces.
- Requirements for landscaping.
- Special requirements for low income housing.
- Size of structural elements.

9.ARRANGEMENT OF ROOMS

- LIVING ROOM
- KITCHEN
- STORE ROOM
- BED ROOM
- OFFICE ROOM
- BATH & W C
- DRESSING ROOM
- VERANDAH
- STAIR CASE

LIVING ROOMS:

This is the area is for general use. Hence the living & drawing room should be planned near the entrance south east aspects. During colder day the sun is towards the south & will receive sunshine which is a welcoming feature. During summer sunshine ti the northern side & entry of sunrays from southern or south – east aspects do not arise.

KITCHEN:

Eastern aspects to admit morning sun to refresh & purity the air.

READING ROOM/ CLASS ROOM:

North aspects this makes more suitable since there will be no sun from north side for most part of the year.

BED ROOM:

Bed may also be provided with attached toilets, there size depends upon the number of beds, they should be located so as to give privacy & should accommodate beds, chair, cupboard, etc., and they should have north or – west south – west aspect.

BATH & W.C:

Bath and w.c are usually combined in one room & attached to the bed room and should be well finished. This should be filled with bath tub, shower, wash-hand basin, w.c, shelves, towels, racks brackets, etc., all of white glazed tiles. Floor should be mosaic or white glazed files. Instead of providing all bed room with attached bath and W.C separated baths & latrines may also be provided

VERANDAH:

There should verandah in the front as well as in the rear. The front verandah serves setting place for male members & weighting place for visitors. The back verandah serve a ladies apartment for there sitting, working controlling, kitchen works etc., verandah project the room against direct sun, rain & weather effect. They used as sleeping place during the summer and rainy season & are used to keep various things verandah also give appearance to the building. The area of a building may vary from 10% to 20% of the building.

STAIR CASE:

This should be located in a easily accessible to all members of the family, when this is intended for visitors it should be in the front, may be on one side of verandah. It meant for family use only, the staircase should be placed the rear. The stairs case should be well ventilated & lighted the middle to make it easy & comfortable to climb. Rises & threads should be uniform through to keep rhythm while climbing or descending.

Some helpful points regarding the orientation of a building are as follows:-

- Long wall of the building should face north south, short wall should face.
- East and west because if the long walls are provided in east facing, the wall.
- Absorb more heat of sun which causes discomfort during night.
- A verandah or balcony can be provided to wards east & west to keep the rooms cool.
- To prevent sun's rays & rain from entering a room through external doors & windows sunshades are required in all directions.

ORIENTATION

After having selected the site, the next step is proper orientation of building. Orientation means proper placement of rooms in relation to sun, wind, rain, topography and out look and at the same time providing a convenient access both to the street and back yard.

The factors that effect orientation most are as follows.

- Solar heat
- Wind direction
- Humidity
- Rain fall
- Intensity of wind site condition
- Lightings and ventilation

SOLAR HEAT:

Solar heat means sun's heat, the building should receive maximum solar radiation in winter and minimum in summer. For evaluation of solar radiation, it is essential to know the duration of sunshine and hourly solar intensity on exposed surfaces.

WIND DIRECTION:

The winds in winter are avoided and are in summer, they are accepted in the house to the maximum extent.

HUMIDITY:

High humidity which is common phenomenon is in coastal areas, causes perspiration, which is very uncomfortable condition from the human body and causes more discomfort.

RAIN FALL:

Direction and intensity of rainfall effects the drainage of the site and building and hence, it is very important from orientation point of view.

INTENSITY OF WIND:

Intensity of wind in hilly regions is high and as such window openings of comparatively small size are recommended in such regions.

SITE CONDITIONS:

Location of site in rural areas, suburban areas or urban areas also effects orientation, sometimes to achieve maximum benefits, the building has to be oriented in a particular direction.

LIGHTING:

Good lighting is necessary for all buildings and three primary aims. The first is to promote the work or other activities carried on within the building.

The second is to promote the safety of people using the buildings. The third is to create, in conjunction to interest and of well beings.

VENTILATION:

Ventilation may be defined as the system of supplying or removing air by natural or mechanical mean or from any enclosed space to create and maintain comfortable conditions. Operation of building and location to windows helps in providing proper ventilation. A sensation of comfort, reduction in humidity, removal of heat, supply of oxygen are the basic requirements in ventilation apart from reduction of dust.

DESIGNS

DESIGNS

- **DESIGN OF SLABS**
- **LOADS ON BEAMS**
- **DESIGN OF BEAMS**
- **LOADS OF COLUMNS**
- **DESIGN OF COLOUMNS**
- **DESIGN OF FOOTINGS**

10. DESIGN OF SLAB

Slabs are to be designed under limit state method by reference of IS 456:2000.

- When the slab are supported in two way direction it acts as two way supported slab.
- A two way slab is economical compared to one way slab.

SLAB DESIGN:

$$f_{ck} = 15 \text{ N/mm}^2$$

$$f_y = 415 \text{ N/mm}^2$$

Span

i. Shorter span:- $L_x = 5.8\text{m}$

longer span:- $L_y = 7.62\text{m}$

ii. Check $L_x/L_y = 7.62/5.8 = 1.3 < 2$

Hence the slab has to be designed as “**two way slab**”.

iii. Providing over all depth of slab as 5”, 120mm

$$\text{eff. depth} = D - 15 - \phi/2$$

$$= 120 - 15 - 10/2 = 100\text{mm}$$

iv. Condition:- supported on four sides.

v. Load calculation:-

$$\text{Dead load} = 25 \times 0.12 \times 1 = 3.0 \text{ KN/m}$$

$$\text{Live load} = 2 \times 1 = 2.0 \text{ KN/m}$$

$$\text{Floor finish} = 1 \times 1 = \underline{1 \times 1 \text{ KN/m}}$$

$$= \underline{6.0 \text{ KN/m}}$$

vi. Bending moment calculation:- (as per IS code 456-2000)

Type of panel:- Two adjacent edges are discontinuous

$$a_x(+) = 0.049$$

$$a_x(-) = 0.065$$

$$a_y(+) = 0.035$$

$$a_y(-) = 0.047$$

(+ve) B.M at mid span in shorter directions.

$$M_x(+) = a_x(+) w l^2$$

$$= 0.049 \times 6 \times 5.8^2 = 9.9 \text{ kn-m}$$

$$\text{factored B.M} = 9.9 \times 1.5 = 14.85 \text{ kn-m}$$

Spacing and diameter:

As per sp-16.

Provide 8mmØ bars at 210mm spacing.

(-ve) B.M at continuous edge in shorter direction.

$$M_x(-) = a_x(-) w l^2$$

$$= 0.062 \times 6 \times (5.8)^2$$

$$= 13.12 \text{ kn-m}$$

$$\text{factored B.M} = 13.12 \times 1.5 = 19.67 \text{ kn-m}$$

(+ve) B.M at mid span in longer directions.

$$M_y(+) = a_y(+) w l^2$$

$$= 0.035 \times 6 \times (5.8)^2$$

$$= 7.06 \text{ kn-m}$$

$$\text{factored B.M} = 7.06 \times 1.5$$

$$= 10.69 \text{ kn-m}$$

(-ve) B.M at continuous edge in longer direction.

$$M_y(-ve) = a_y(-ve) w l^2$$

$$= 0.047 \times 6 \times (5.8)^2$$

$$= 9.48 \text{ kn-m}$$

$$\text{factored B.M} = 9.48 \times 1.5$$

$$= 14.22 \text{ kn-m.}$$

Check for depth:

Permissible depth=100mm

$$\text{Mu.lim} = 0.36 \frac{X_{u\max}}{d} (1 - 0.42 \frac{X_{u\max}}{d}) f_{ck} b d^2$$

$$14.86 \times 10^6 = 0.36 \frac{X_{u\max}}{d} (1 - 0.42 \times 0.48) 15 \times 1000 d^2$$

$$d = 84.71 < 100 \text{ mm}$$

Hence ok.

11. DESIGN OF BEAMS

- Beam is a member which transfers the loads from slab to columns and then foundation to soil.
- Beam is a tension member.
- Span of slabs, which decide the spacing of beams.
- Following are the loads which are acting on the beams.
 - Dead load
 - Live load
 - Wind load

LOADS ON BEAMS:

B1: BEAM

SPAN=5.8m (shorter span)

Assuming beam size = 9"x16" (230x405mm)

Height of the wall-10'-3m

Load calculations

- Wall load - $0.23 \times 3 \times 19 = 13.11 \text{ Kn/m}$
- Self load - $0.23 \times 0.406 \times 25 = 2.33 \text{ Kn/m}$
- Slab load -

$$W = 6 \text{ KN}$$

$$L_x = 5.8$$

$$W L_x / 3 = (6 \times 5.8) / 3 = 11.6 \text{ Kn/m}$$

$$\text{Total load} = 13.11 + 2.33 + 11.6 = 27.04 \text{ Kn/m}$$

DESIGN OF STIRRUPS:

B1: BEAM

- Calculation of shear force

$$V_a = V_b = \frac{\text{total load}}{2}$$

$$2$$

$$= \frac{27.04 \times 5.8}{2} = 78.416 \text{ KN}$$

$$2$$

- Calculation of normal shear

$$T_v = \frac{V_u}{Bd} = \frac{1.5 \times 78.416 \times 10^3}{230 \times 373} = 1.37$$

- Calculation of permissible shear stress

T_c = % of tension steel

$$P_t = \frac{A_{st}}{Bd} \times 100$$

Bd

$$A_{st} = \frac{2 \times 16^2 \times p}{4} = 402.12 \text{ mm}^2$$

4

$$P_t = \frac{402.12 \times 100}{230 \times 373} = 0.60\%$$

230×373

$$T_c = 0.50$$

$$T_c < T_v$$

$$0.05 < 0.76$$

Hence provide shear reinforcement.

Design of shear:

$$\begin{aligned} V_s &= (T_v - T_c)bd \\ &= (0.76 - 0.50) \times 230 \times 373 \\ &= 22.30 \text{ KN} \end{aligned}$$

$$\text{Calculation: } \frac{V_{us}}{D(\text{cm})} = \frac{22.30}{37.3} = 0.59 \text{ KN/cm}$$

$$D(\text{cm}) = 37.3$$

From sp-16 table no 62 we will get dia & spacing.

Hence provide 6mm dia @ 20 cm c/c spacing.

Check for spacing:

Spacing should be provided min of the following.

$$(a) 0.75d = 0.75 \times 373 = 279.75 \text{ mm}$$

$$(b) \frac{A_{sv} f_y}{0.4b} = \frac{2 \times (6^2 \times \pi / 4) \times 250}{0.4 \times 230} = 153.2 \text{ mm}$$

$$(c) \text{ design spacing } 45 \text{ cm c/c}$$

Hence provide 6mm dia stirrups @ 15 cm c/c.

LOADS ON BEAMS:

B2: BEAM

SPAN=7.62m (longer span)

Assuming beam size = 9"x16" (230x405mm)

Height of the wall-10'-3m

Load calculations

- Wall load - $0.23 \times 3 \times 19 = 13.11 \text{ Kn/m}$
- Self load - $0.23 \times 0.406 \times 25 = 2.33 \text{ Kn/m}$
- Slab load -

$$W = 6 \text{ KN}$$

$$L_y = 7.62$$

$$W L_y / 3 = (6 \times 7.62) / 3 = 15.24 \text{ Kn/m}$$

$$\text{Total load} = 13.11 + 2.33 + 15.24 = 30.68 \text{ Kn/m}$$

DESIGN OF STIRRUPS:

B2: BEAM

- Calculation of shear force

$$V_a = V_b = \frac{\text{total load}}$$

$$2$$

$$= \frac{30.68 \times 7.62}{2} = 116.89 \text{ KN}$$

$$2$$

- Calculation of normal shear

$$T_v = \frac{V_u}{B_d} = \frac{1.5 \times 116.89 \times 10^3}{230 \times 373} = 2.04$$

$$B_d = 230 \times 373$$

- Calculation of permissible shear stress

$T_c = \% \text{ of tension steel}$

$$P_t = \frac{A_{st}}{Bd} \times 100$$

Bd

$$A_{st} = \frac{2 \times 16^2 \times p}{4} = 402.12 \text{ mm}^2$$

$$P_t = \frac{402.12 \times 100}{230 \times 373} = 0.60\%$$

$$T_c = 0.50$$

$$T_c < T_v$$

$$0.05 < 0.85$$

Hence provide shear reinforcement.

Design of shear:

$$\begin{aligned} V_s &= (T_v - T_c)bd \\ &= (0.85 - 0.50) \times 230 \times 373 \\ &= 30.02 \text{ KN} \end{aligned}$$

$$\text{Calculation: } \frac{V_{us}}{D(\text{cm})} = \frac{30.02}{37.3} = 0.89 \text{ KN/cm}$$

From sp-16 table no 62 we will get dia & spacing.

Hence provide 6mm dia @ 15cm c/c spacing.

Check for spacing:

Spacing should be provided min of the following.

$$(a) 0.75d = 0.75 \times 373 = 279.75 \text{ mm}$$

$$(b) \frac{A_{sv} f_y}{0.4b} = \frac{2 \times (6^2 \times \pi / 4) \times 250}{0.4 \times 230} = 153.2 \text{ mm}$$

$$(c) \text{ design spacing } 45 \text{ cm c/c}$$

Hence provide 6mm dia stirrups @ 15 cm c/c

DESIGN OF BEAMS:

Mu at Left span = 11.577 KN-m

Mu at Mid span = 19.18 KN-m

Mu at Right span = 20.36KN-m

Check:-

Calculation limiting moment of resistances:

$$M_u = 11.577 \text{ KN-m}$$

$$M_{ulimt} = 0.138 f_{ck} b d^2$$

$$= 0.138 \times 20 \times 230 \times 305^2$$

$$= 59.05 \text{ KN-m}$$

$$M_u < M_{ulimt}$$

Hence it is designed as simply reinforcement beam using sp-16

$$\frac{M_u}{b d^2} = \frac{11.577 \times 10^6}{230 \times 305^2} = 1.39$$

$$\frac{M_u}{b d^2} = 1.39$$

Refer table no.2 at sp-16 and read out the value of percentage of reinforcement

Corresponding to $f_y = 415 \text{ N/mm}^2$ and $f_{ck} = 20 \text{ N/mm}^2$

For $\frac{M_u}{b d^2} = 1.39$ $P_t = ?$

$$\frac{M_u}{b d^2}$$

1.35	0.409
1.40	0.426
1.39	?

$$\underline{M_u} = 1.39 \quad P_t = 0.422$$

$$bd^2$$

$$P_t = 0.422 \%$$

Area of reinforcement

$$P_t = \frac{A_{st} \times 100}{Bd}$$

$$Bd$$

$$= \frac{0.422 \times 230 \times 405}{100}$$

$$100$$

$$= 393.093 \text{ mm}^2$$

$$A_{st} \text{ required} = 393.093 \text{ mm}^2$$

Ast provided:

Hence provide 3 bars & 12 mmdia

$$A_{st} \text{ provide} = 400 \text{ mm}^2$$

Reinforcement of mid span:-

Calculate limiting moment of resistances

$$M_u = 19.18 \text{ KN-m}$$

$$M_{u\text{limt}} = 0.138 f_{ck} bd^2$$

$$= 0.138 \times 20 \times 230 \times 305^2$$

$$= 59.05 \text{ KN-m}$$

$$M_u < M_{u\text{limit}}$$

Hence it is designed as singly reinforcement.

BY USING SP-16

$$\underline{M_u} = \underline{19.18 \times 10^6}$$

$$Bd^2 \quad 230 \times 305^2$$

$$= 0.66$$

Refer table no.2 at sp-16 and read out the value of percentage of reinforcement

Corresponding to $f_y = 415 \text{ N/mm}^2$ and $f_{ck} = 20 \text{ N/mm}^2$

$$\underline{M_u} \quad \text{pt}$$

$$Bd^2$$

$$0.65 \quad 0.187$$

$$0.70 \quad 0.203$$

$$0.66 \quad ?$$

$$P_t = 0.190\%$$

Reinforcement

$$P_t = \underline{A_{st} \times 100}$$

$$Bd$$

$$= \underline{0.19 \times 230 \times 305}$$

$$= \frac{\quad}{100}$$

$$= 133.285 \text{ mm}^2$$

A_{st} provided

Hence provided 2mm bars & 12mm dia

$$A_{st} \text{ provided} = 155.2 \text{ mm}^2$$

Reinforcement of right span:-

Check:

Calculate limiting moment of resistance:-

$$M_u = 20.36 \text{ KN-m}$$

$$M_{u\text{limi}} = 0.138 f_{ck} b d^2$$

$$= 0.138 \times 20 \times 230 \times 305^2$$

$$= 59.05 \text{ KN-m}$$

$$M_u < M_{u\text{limit}}$$

Hence it is designed as singly reinforcement.

BY USING SP-16

$$\frac{M_u}{b d^2} = \frac{20.36 \times 10^6}{230 \times 305^2}$$

$$= 1.39$$

$$\frac{M_u}{b d^2} \quad P_t$$

$$b d^2$$

$$1.35 \quad 0.409$$

$$0.426 \quad 0.426$$

$$1.39 \quad ?$$

$$P_t = 0.422\%$$

Reinforcement =

$$P_t = \frac{A_{st} \times 100}{b d}$$

$$b d$$

$$A_{st} = \frac{0.422 \times 230 \times 305}{100}$$

$$100$$

$$296.033 \text{ mm}^2$$

A_{st} provided

Hence provide 3 bars and 12mm dia

$$A_{st} \text{ provided} = 300 \text{ mm}^2.$$

12.DESIGN OF COLUMNS

- Columns are compression members.
- Larger spacing columns cause stocking columns in lower stores of multi storied buildings.
- Columns are transmitted loads which are coming from slabs to foundations. Larger spans of beams shall also be avoided from the consideration of controlling the deflection & cracking.

COLUMNS:

The column which takes load are:

- (a) Slab loads
- (b) Beam loads
- (c) Wall loads
- (d) Self. Wt of column

S.NO	TYPE OF LOAD	ROOF LOAD	FLOOR LOAD
1.	Wall load	$\frac{(5.8+7.62) \times 0.115 \times 0.91 \times 19}{2}$ =12.09KN	$\frac{(5.8+7.62) \times 0.23 \times 3 \times 19}{2}$ =29.32KN
2.	Slab load	$\frac{(5.8+7.62) \times 6}{2}$ = 40.26KN	$\frac{(5.8+7.62) \times 6}{2}$ =40.26KN
3.	Self wt. of beam	$\frac{0.23 \times 0.406 \times (5.5+7.62) \times 25}{2}$ =25KN	$\frac{0.23 \times 0.406 \times (5.5+7.62) \times 25}{2}$ =25KN
	Total load	77.35KN	94.58KN

Total loads on column:

$$\text{Loads from roof} = 77.35 \text{KN}$$

$$\text{Loads from floor} = 94.58 \text{KN}$$

$$\begin{aligned}\text{Self wt. of column} &= 0.23 \times 0.23 \times 3 \times 25 \\ &= 34.5 \text{KN}\end{aligned}$$

$$\text{total loads} = 167 \text{KN}$$

Column Axial load:

$$P_u = 167 \text{ KN}$$

Cross section--- 230x230mm

$$\begin{aligned}\text{calculation: } \frac{P_u}{f_{ck} \cdot b \cdot d} &= \frac{167 \times 10^3}{20 \times 230 \times 230} = 0.15\end{aligned}$$

Calculation of Eccentricity:

$$\begin{aligned}e &= \frac{l}{500} + \frac{b}{30} \\ &= \frac{4640}{500} + \frac{230}{30} = 16.94 \text{m} \\ e &\leq 20 \text{ mm}\end{aligned}$$

$$\begin{aligned}M_{ue} &= P_u \cdot e \\ &= 167 \times 0.020 \\ &= 3.34 \text{ Kn-m}\end{aligned}$$

$$\frac{M_{ue}}{f_{ck} b d^2} = \frac{3.34 \times 10^6}{20 \times 230 \times 230^2} = 0.0112$$

$$\frac{d'}{D} = 0.2$$

$$\frac{P}{f_{ck}} = 0.02$$

$$\begin{aligned}
 P &= 0.02 \cdot f_{ck} \\
 &= 0.02 \times 20 \\
 &= 0.4\% \quad \text{minimum } 0.8\% \\
 \text{area of steel} &= \frac{0.8 B d}{100} = \frac{0.8 \times 230 \times 230}{100} = 423.2 \text{ mm}^2
 \end{aligned}$$

No. of bars for 12mm dia

$$= \frac{423.2}{\frac{\pi}{4} \times 12^2} = 4 \text{ bars}$$

STIRRUPS SPACING:

LEAST OF THE FOLLOWING:

a) 16dia of main reinforcement = $16 \times 12 = 192 \text{ mm}$.

b) $48 \text{ dia} = 48 \times 12 = 576 \text{ mm}$.

Provide 6 mm dia. @ 192 mm c/c when main bars size is 12 mm

13.DESIGN OF FOOTING

Size of column (b) 230x380(a)

Load = 400.69KN

Self wt. of footing = 10%

Bearing capacity of soil = 250 Kn/m²

Area of footing

Total load = 440.76KN

Area of footing = $440.76/250 = 1.76\text{m}^2$

the side of the footing be in the same ratio of column

$$= 0.23x \times 0.38x = 1.76$$

$$= 0.0874x^2 = 1.76$$

$$x = 4.48\text{m}$$

Short side of footing = 0.23×4.48

$$= 1.0\text{ m}$$

Long side of footing = 0.38×4.48

$$= 1.70\text{ m}$$

Proved a rectangle footing 1mx1.7m

Up ward soil pressure = $\frac{440.76}{(1 \times 1.7)} = 259.27\text{ Kn/m}^2 = 260\text{ KN/m}^2$

$$(1 \times 1.7)$$

BENDING MOMENT CALCULATION:

Maximum bending moment along y- direction longer direction

$$\begin{aligned}M_{xx} &= q \times l^2 / 8 (B-b)^2 \\&= 260 \times 1.7^2 / 8 (1-0.38)^2 \\&= 32.75 \text{ KN-m}\end{aligned}$$

Maximum bending moment along x- direction shorter direction

$$\begin{aligned}M_{yy} &= q \times b^2 / 8 (B-b)^2 \\&= 260 \times 1.7^2 / 8 (1-0.38)^2 \\&= 56.62 \text{ KN-m}\end{aligned}$$

Depth of footing:

Depth of footing from moment consideration

$$d = \sqrt{M_{yy} / Q_b} = \sqrt{56.62 \times 10^6 / 0.91 \times 1000}$$

$$d = 249.43$$

say 250 mm

check for shear (two- way shear)

$$\begin{aligned}V &= q[L \times b - (a+d)(b+d)] \\&= 250[1.7 \times 1 - (0.38+250)(230+250)] \\&= 363.37 \text{ KN}\end{aligned}$$

Normal shear stress:

$$\frac{V}{[2(a+d)(b+d)d]} = \frac{363.37 \times 10^3}{[2(0.38+0.25)(0.23+0.25)0.25]} = 654.72 \text{ N/mm}^2$$

$$\tau_c = 0.65 \text{ N/mm}^2.$$

Allowable shear stress:

$$T_v = k \times T_c$$

where $k = 0.5 + \frac{0.23}{0.38}$

$$= 1.10 \quad k > 1.1$$

$$K_a = 1.0 \times 16 \times f_{ck}$$

$$K_a = 0.78 \text{ N/mm}^2$$

$T_v < T_c$ safe to compute normal shear stress due to one way action area of tensile steel required.

$$A_{st(yy)} = \frac{M_{yy}}{0.91 \times b d} = \frac{56.62 \times 10^6}{0.91 \times 250 \times 0.23}$$

$$A_{st} = 1082.08 \text{ mm}^2$$

$$\frac{A_{st} \times 100}{b d} = \frac{1082.08 \times 100}{100 \times 250 \times 0.23} = 0.43\%$$

From table 23 T_c = allowable shear stress 0.27 N/mm^2

One way shear:

The critical section along (1-1)

$$\frac{L}{2} - \frac{a}{2} - d = \frac{17200}{2} - \frac{380}{2} - 250$$
$$= 410 \text{ mm}$$

Shear force:

Upward pressure on the hatched area

$$V = 260 \times 1 \times 0.410$$
$$= 106.6$$

Normal shear:

$$T_v = \frac{V}{Bd} = \frac{106.6 \times 10^3}{1 \times 1000 \times 250}$$

$$= 0.42 \text{ N/mm}^2$$

$T_v > T_c$ in case of one way shear

The effective depth to be increase

Let the eff. Depth be 350 mm

$$T_v = \frac{V}{2[(a+d)+(b+d)]d} =$$

$$V = 260 [1.7 \times 1 - (0.38 - 0.350) + (0.23 + 0.35)]$$

$$V = 101.4 \text{ KN}$$

Normal shear $T_v = \frac{101.4 \times 10^3}{2[(0.38 + 0.35) + (0.23 + 0.35)0.35]}$

$$= 0.110 \text{ N/mm}^2$$

$T_c > T_v$

$$0.6054 > 0.110$$

Hence safe

Adopt eff depth = 350 mm

Eff cover = 50 mm

Overall depth = 400 mm

Reinforcement in longitudinal direction:

$$A_{st} = \frac{32.75 \times 10^6}{0.87 \times 230 \times 350}$$

$$= 447.08 \text{ mm}^2$$

Spacing of 12 mm mid steel leaving a clearance of 250mm on the either side

$$S = \frac{950 \times p \times 122}{447.684}$$

$$= 239.99 \text{ mm}$$

Provide 12mm bars at 230 mm c/c

Reinforcement in shorter direction:

$$A_{st} = \frac{M_{yy}}{bd} = \frac{56.62 \times 10^6}{230 \times 350 \times 0.90} = 781.50 \text{ mm}^2$$

The reinforcement in the central band width 1.7 provide in accordance with

= Reinforcement in central band width / total reinforcement in shorter direction.

$$= 1.7/1 = 1.7$$

$$\text{Reinforcement in central band} = A_{st} \times \frac{2}{B+1} = \frac{2}{1.7+1} = 578.94 \text{ mm}^2$$

Spacing of 10 mm dia bars at 190mm/c

The steel for the remaining width = $781.50 - 578.94$

$$= 202.56 \text{ mm}^2$$

Provide 4 bars of 12mm dia on either of the central band width

Developed length:

From IS 456-2000

$$L_d = \frac{\text{dia}}{4Tbd}$$

$$= \frac{0.87 \times f_y \times \text{dia}}{4 \times Tbd}$$

$$= \frac{0.87 \times 415 \times \text{dia}}{4 \times (1.6 \times 1.2)} = 47 \text{ dia} = 47 \times 12 = 528 \text{ mm}$$

Available length from face of column

$$= \frac{(1000 - 230)}{2} - 50$$

$$= 8035 \text{ mm} > 528 \text{ mm}$$

Load transfer from column to footing:

Nominal bearing stress in column concrete.

$$V_{bt} = \frac{p}{A_c} = \frac{440.76 \times 10^3}{230 \times 380} = 5.04 \text{ N/mm}^2$$

Bearing stress un M15 concrete

$$\begin{aligned} &= 0.25 \times 20 \\ &= 5 \text{ N/mm}^2 \end{aligned}$$

Allowable bearing stress

$$\begin{aligned} &= 5V \frac{A_1}{A_2} \\ &= 5 \frac{A_1}{A_2} > 2 \end{aligned}$$

$$\begin{aligned} &= 5 \times \frac{1697400}{230 \times 380} \\ &= 4.40 \text{ limited to } 2 \end{aligned}$$

Allowable bearing stress = $2 \times 5 = 10 \text{ N/mm}^2 > 6.067$

The minimum steel required for dowel bars or load transferring bar is 0.5% of column

$$\begin{aligned} A_s &= \frac{0.5}{100} \times 230 \times 380 \\ &= 437 \text{ mm}^2 \end{aligned}$$

$$\text{No. of 12mm dia} = \frac{437 \times 12^2}{\pi/4} = 3.86$$

Provide 4 nos of bars of 12mm bars

development length of dowel bars

$$L_d = \frac{v_s \times \text{dia}}{4T} = 44 \text{ dia}$$

for 12 mm dia $L_d = 528 \text{ mm}$

The dowel is to be extended by 528mm into column.

Available depth in footing

Effective to the centre of 20 mm dia 350mm

Deduct $\frac{1}{2} \times 20 = 10 \text{ mm}$

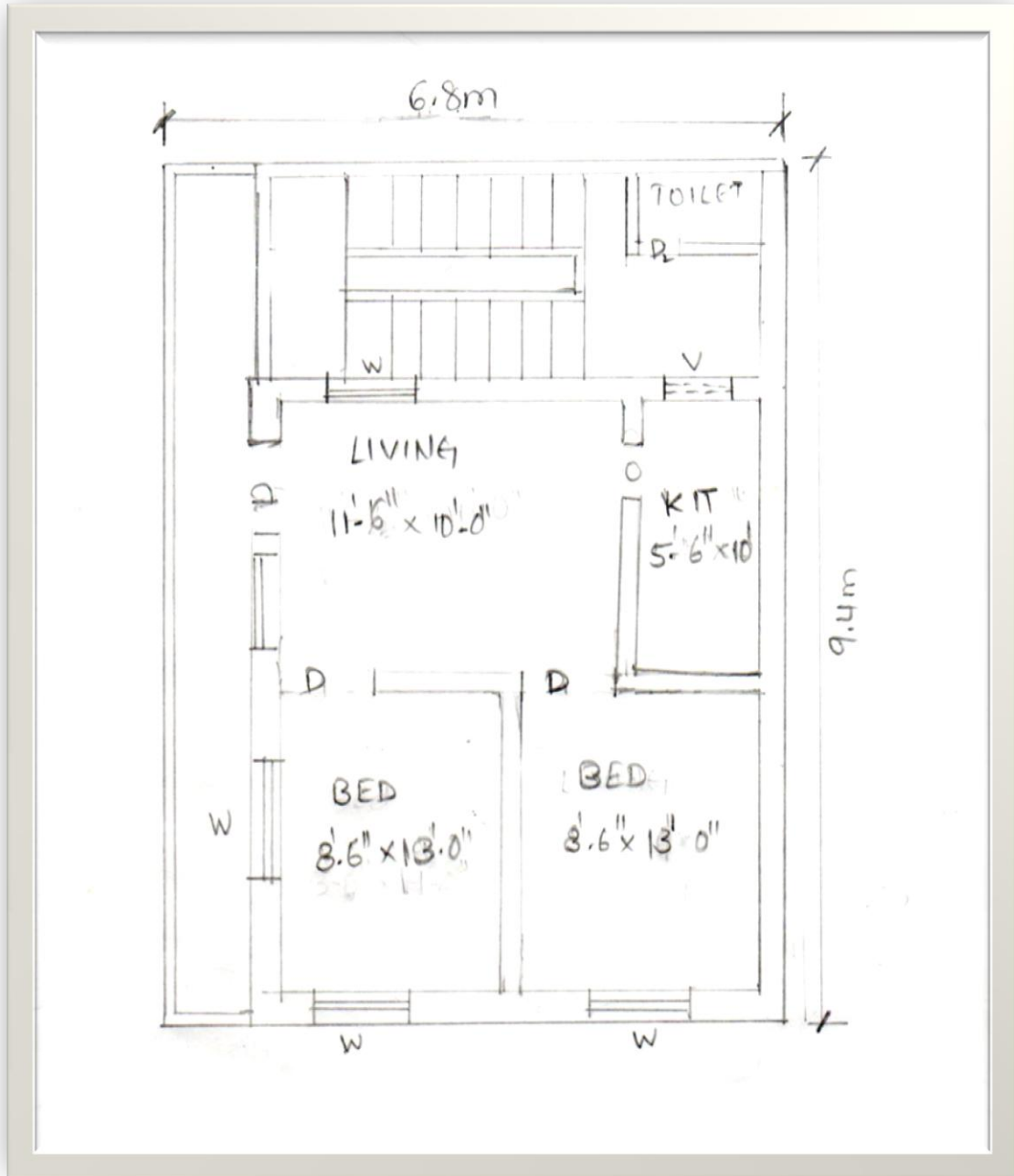
Deduct 12 mm dia

$$\begin{aligned} \text{Net available distance} &= [350 - 10 - 12] \\ &= 328 \end{aligned}$$

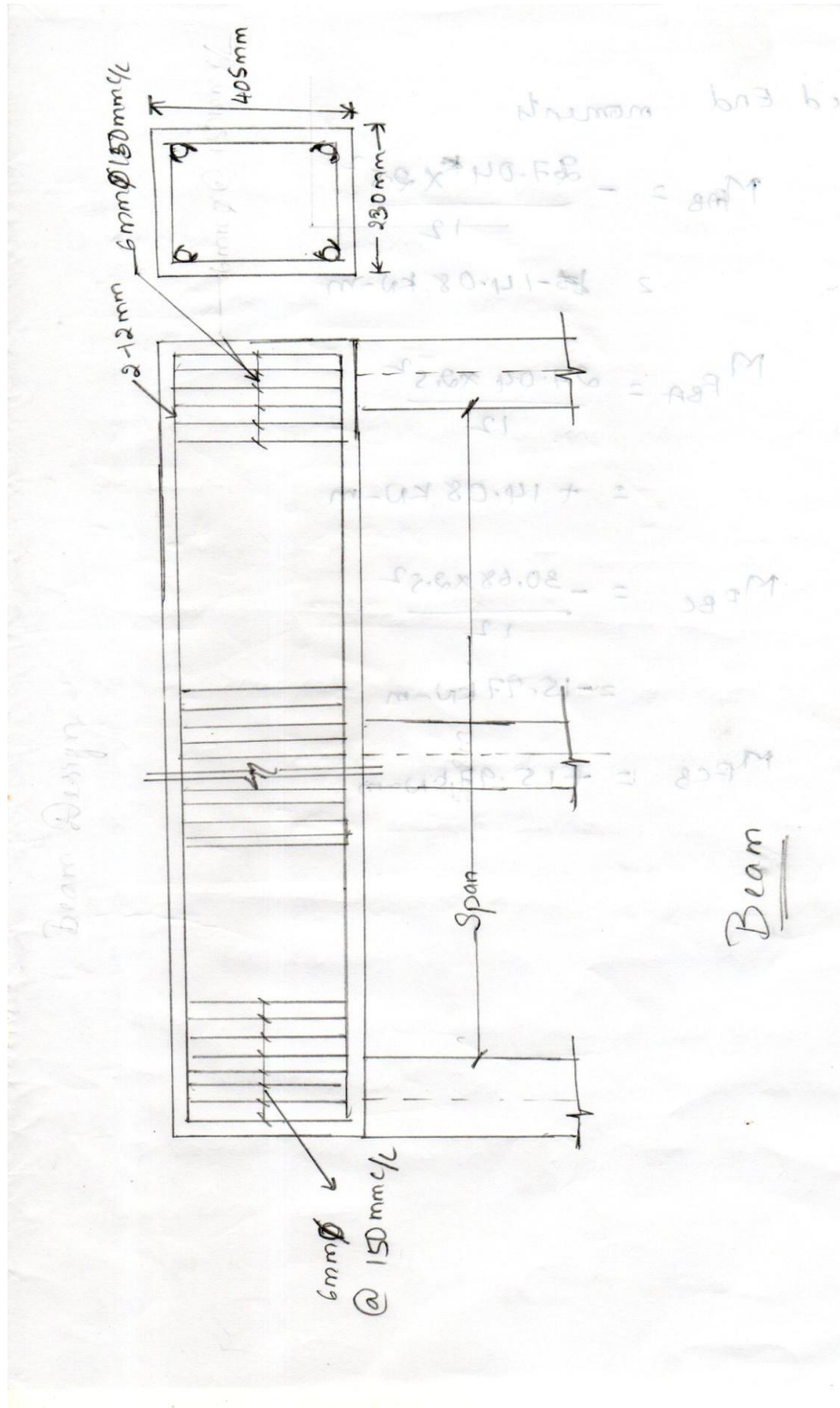
Provide bent of bars to $[528 - 328] = 200 \text{ mm}$.

DRAWINGS

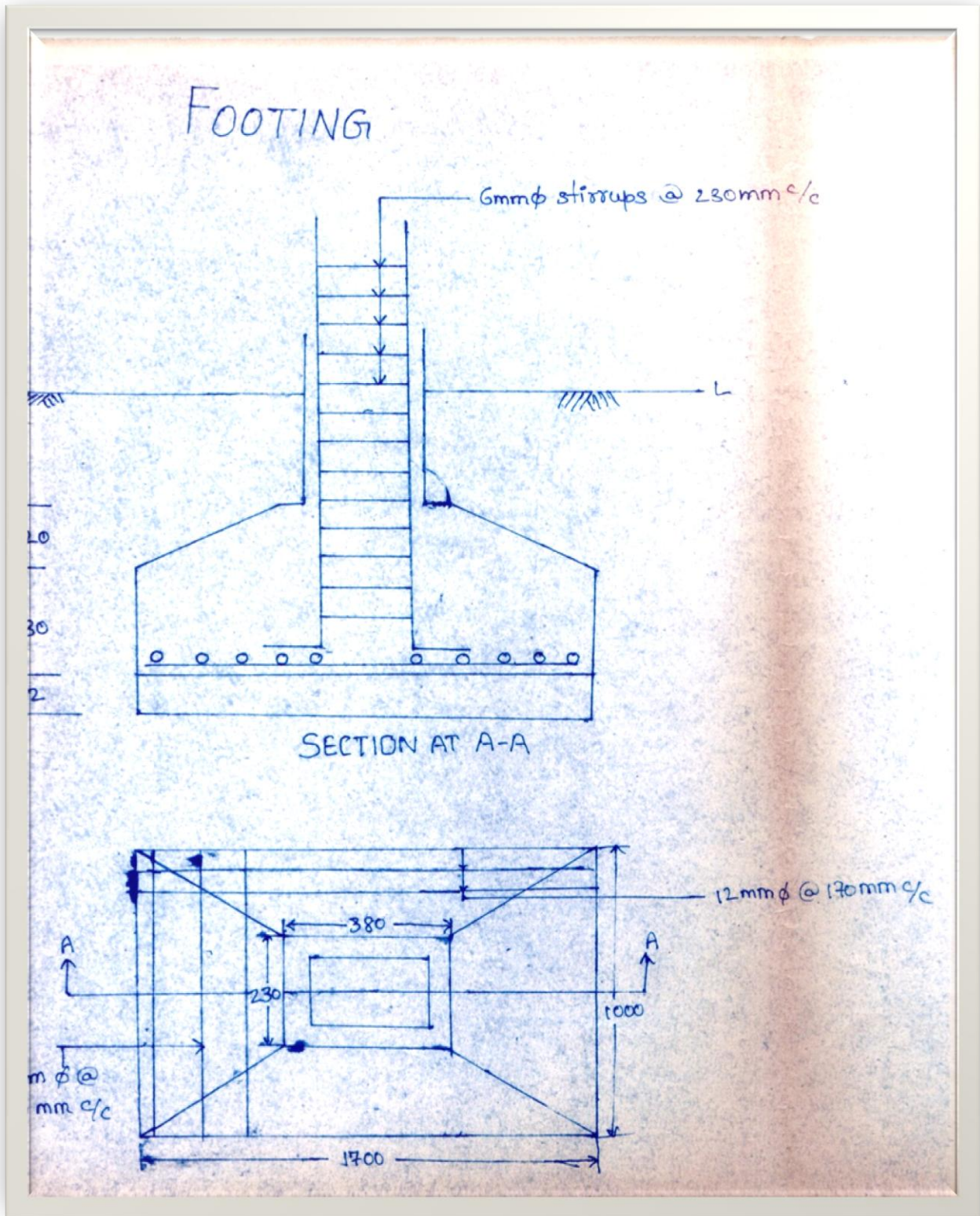
PLAN



BEAM



FOOTING



PHOTOS







CONCLUSION

We can conclude that there is difference between the theoretical and practical work done. As the scope of understanding will be much more when practical work is done. As we get more knowledge in such a situation where we have great experience doing the practical work.

Knowing the loads we have designed the slabs depending upon the ratio of longer to shorter span of panel. In this project we have designed slabs as two way slabs depending upon the end condition, corresponding bending moment. The coefficients have been calculated as per I.S. code methods for corresponding l_x/l_y ratio. The calculations have been done for loads on beams and columns and designed frame analysis by moment distribution method. Here we have a very low bearing capacity, hard soil and isolated footing done.