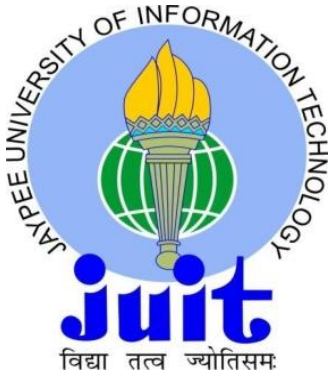
DESIGN OF EARTHQUAKE RESISTANT RESIDENTIAL BUILDING

A thesis submitted in partial fulfillment
Of the requirements for the degree of

BACHELOR OF TECHNOLOGY
IN
CIVIL ENGINEERING
Under the supervision of
Dr. Ashok Kumar Gupta
(Professor and Head)
(Department of Civil Engineering)
By
ANSHUL SHARMA (121663)
DARVESHDEEP SINGH (121713)
to



JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
WAKNAGHAT SOLAN – 173 234
HIMACHAL PRADESH INDIA (SOLAN)

CERTIFICATE

This is to certify that the work which is being presented in the project title **"Design of Earthquake Resistant residential building"** in partial fulfillment of the requirements for the award of the degree of Bachelor of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology,Waknaghat is an authentic record of work carried out by **Anshul Sharma and Darveshdeep Singh** during a period from July 2015 under the supervision of **Dr. Ashok kumar Gupta, H.O.D.**, Civil Engineering Department, Jaypee University of Information Technology,Waknaghat.

The above statement made is correct to the best of my knowledge.

Date: - ……

Dr. Ashok Kumar Gupta
Professor & Head of Civil Engineering Department
JUIT Waknaghat

ACKNOWLEDGEMENT

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

We express our ineptness and gratitude to our guide Dr. Ashok Kumar Gupta, Head of Department of Civil Engineering, JAYPEE UNIVERSITY OF INFORMATION 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. DilipTanwar, Contracter, GRID CONSULTING, Solan 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

Shimla is the hill queen of 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 peaceful surroundings the main point of view of most of the people in today's lifestyle. This project named as "**DESIGN OF EARTH-QUAKE RESISTANT RESIDENTIAL BUILDING"** involves the analysis of simple 2-D frames of varying floor heights and varying no of bays using a very popular software tool STAAD Pro. Using the analysis results various graphs were drawn between the maximum axial force, maximum shear force, maximum bending moment, maximum tensile force and maximum compressive stress being developed for the frames on plane ground and sloping ground.

CONTENTS

CHAPTER 1

1.1. AIM OF THE PROJECT:-

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

STUDY AREA

Our proposed site is located at Vijaya buildings, Rajgarh road, Solan.

The main road which is near to site leads to kamin hospital. A branch road of 10m which is near is existing W.B.M. (water bond macadam) road connected very near to the plot. The total area of the site is about 235.11sq m. the residential building consist of two storeybuilding.

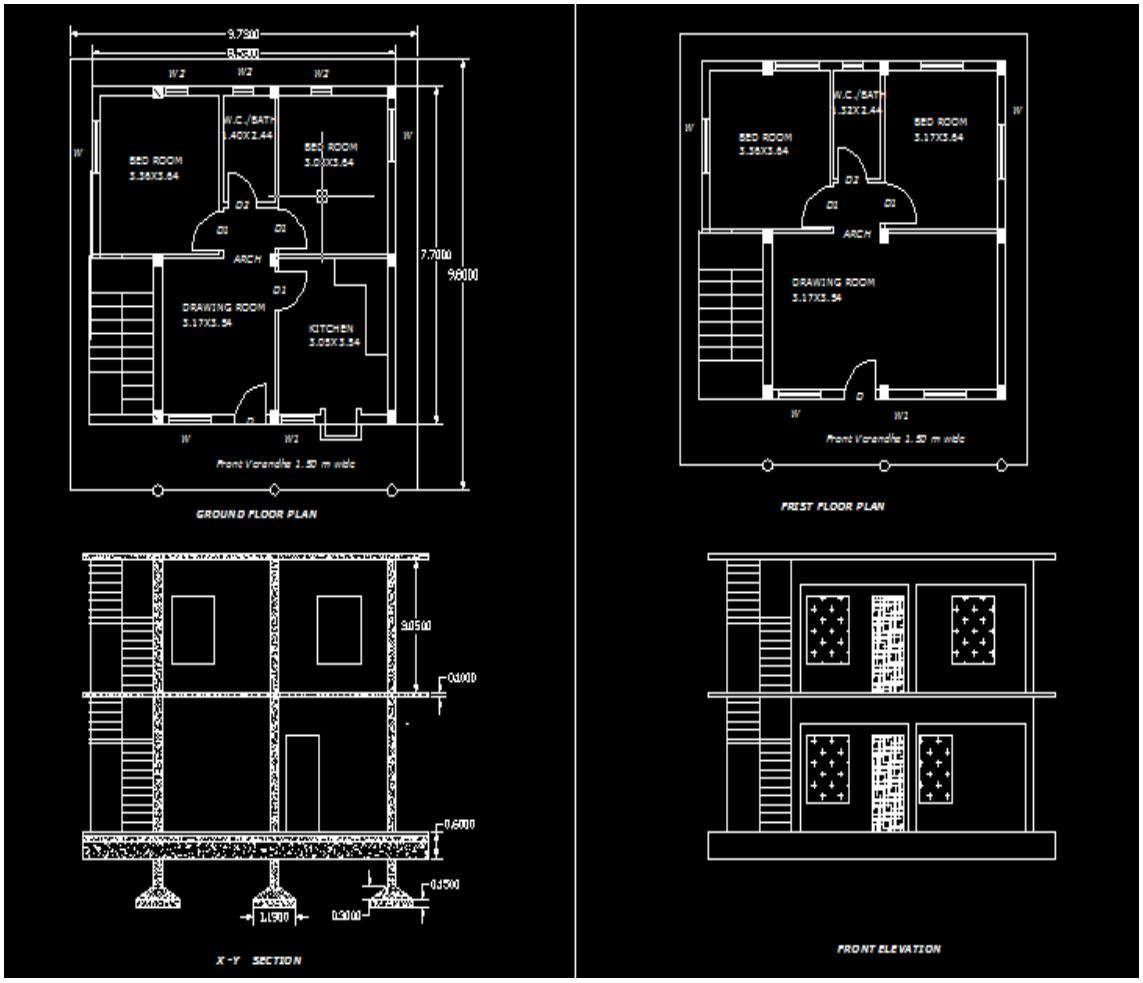


Fig 1 – Views of a building

1.2. INTRODUCTION

The basics needs of human existences are food, clothing's & 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, used, gives a feeling of security, responsibility and shown 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 considered and kept in view.

- A Peaceful environment.
- Safety from all natural source & 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 suggestion a particular type of plan to any client.

CHAPTER 2

2.1. Literature review-

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.

2.2. 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
Can be classified as –

- 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 an 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 fabrication, 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 rapidly and/or which may produce poisonous elements for storage handling, acids or other liquids or chemicals producing flames, fumes and ex plosive, 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.

2.3. 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.

2.4. 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.

CHAPTER 3

3.1. 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.

3.1.1. LIMITATION OF BUILT UP AREA

Area of plot up to 200sq.m (240sq.yd)	----	maximum permissible 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.

3.1.2. MINIMUM FLOOR AREA & HEIGHT OF ROOMS

FLOOR AREA	HIEGHT (m)	
LIVING	10sqm (100sqft)(breadth min 2.7 m or 9')	
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 (9" to13.5")	20cms to 30cms	------
DAMP PROOF COURSE (3/4" to1")	2cms to 2.5cms	thick full width of plinth wall

CHAPTER 4

4.1. 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.

4.2. 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 rainy season 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.

CHAPTER 5

Whole project was divided into different phases. They are as follows

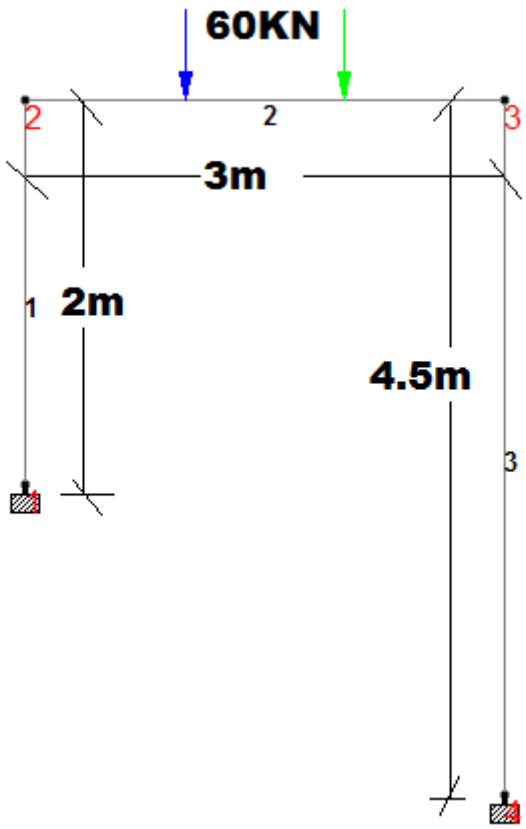
Phase-1- Comparison of design results of STAAD Pro and same problems done manually.

Phase-2- Analysis of simple 2-dimensional reinforced concrete frames and as such both static loads(dead, live and load combinations) and dynamic load (Earth quake load) are to be considered frames first on a plain ground

Phase-3- Ductility design and detailing.

Under the 1st phase we took up a simple 2 dimensional frame subjected to concentrated loads with un-equal supporting columns. This is for the analogy of the actual problem statement of design of a multi-storied building on a sloping ground.

Problem statement- Analysis of a portal frame as shown in the figure:



Solution: we first calculated the distribution factors as given in the table

joint	member	Relative stiffness	Total relative stiffness	Distribution factor
2	**2-1(1)** **2-3(2)**	**I/2** **2I/6**	**5I/6**	**3/5** **2/5**
3	**3-2(2)** **3-4(3)**	**3I/9** **2I/9**	**5I/9**	**3/5** **2/5**

(a) Non-Sway Analysis

Fixed end moments

M 1-2=M 2-1=M3-4=M 4-3=0

M 2-3= - $[60/3^2]$ $(1 \times 2^2 + 2 \times 1^2) = 40$ kN-m

M 3-2= +40 kN-m

		3/5	2/5		3/5		2/5
0	0 24	-40 16	40 24	0 -16	0
12	7.2	-12 4.80	8 -4.8	-3.2	-8
3.6	1.44	-2.40 0.96	2.4 -1.44	-0.96	-1.60

0.72	0.43	-0.72 0.29	0.48 -0.29	-0.19	-0.48
0.22	0.09	-0.15 0.06	0.15 -0.09	-0.06	-0.10
0.05	0.03	-0.05 0.02	0.03 -o.02	-0.01	-0.03
16.59	33.19	-33.19	+20.42	-20.42	-10.21

So horizontal reaction at 1= 16.59+33.19/2=24.98 kN.
Horizontal reaction at 4= -20.42-10.21/4.5= -6.8067 kN
Therefore net sway force = 24.89-6.8067= 18.0833 kN.

(b) sway analysis:-

Now the frame will be analysed for a sway force of 18.0833 kN
The ratio of the initial equivalent moments of the column is given by
=(I1/ l1²) : (I2/l2²) = 20.25 : 4
Now the moment distribution is performed choosing the above fixed end moments

	3/5	2/5	3/5	2/5	
-20.25	-20.25 12.15	0 8.10	0 2.4	-4 1.6	-4
6.08	-0.72	1.20 -0.48	4.05 -2.43	-1.62	0.80
-0.36	0.73	-1.22 0.49	-0.24 0.14	0.10	-0.81
+0.36	-0.04	-1.22 0.49	0.25 -0.15	-0.10	0.05
-0.02	+0.05	0.07 -0.03	-0.02 0.01	0.01	-0.05
0.02	0	0 0	0.02 -0.01	-0.01	0
A= -14.17	-8.08	8.08	4.02	-4.02	-4.01

Horizontal reaction at 1= -14.17-8.08/2= -11.125 kN
Horizontal reaction at 4= -4.02-4.01/4.5= - 1.7844 kN
Resolving we have total S=11.125+1.7844 =12.9094 kN
Now the actual sway force of 18.0833 kN , the sway moments will be
18.0833/12.904 x A as in above table.

	1	2	2	3	3	4
A	-14.17	-8.08	8.08	4.02	-4.02	-4.01
Actual sway moment	-19.85	-11.31	11.32	5.63	-5.63	-5.62
Non-sway moments	16.59	33.19	-33.19	20.42	-20.42	-10.21

Final moments	-3.26	21.87	-21.87	26.05	-26.05	-15.83

(c) Reactions
H1=9.31 kN
H4=-9.31 kN
V4=61.39 kN
V1=120-61.39=58.61 kN.

RESULTS OBTAINED FROM STAAD Pro.

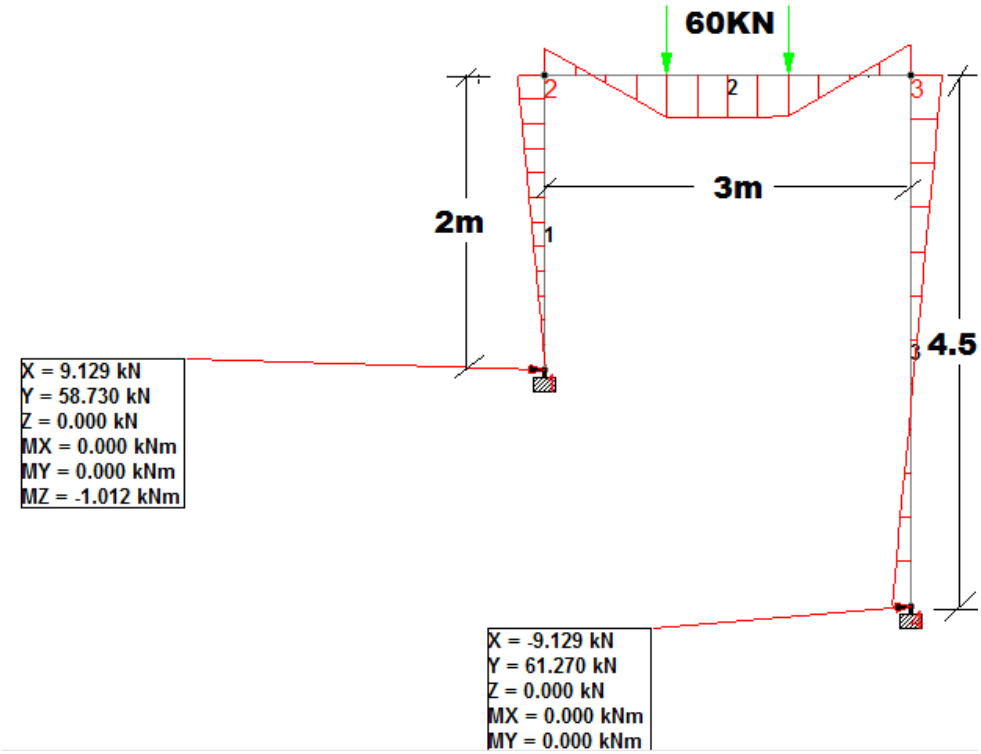
Reactions

		Horizontal	Vertical	Horizontal	Moment		
Node	L/C	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
1	1:concentrated	9.129	58.730	0.000	0.000	0.000	-1.012
4	1:concentrated	-9.129	61.270	0.000	0.000	0.000	15.462

Beam End Forces

Sign convention is as the action of the joint on the beam.

			Axial	Shear		Torsion	Bending	
Beam	Node	L/C	Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
1	1	1:CONCENTR	58.864	9.036	0.000	0.000	0.000	-3.959
	2	1:CONCENTR	-58.864	-9.036	0.000	0.000	0.000	22.031
2	2	1:CONCENTR	9.048	58.864	0.000	-100.000	0.000	22.031
	3	1:CONCENTR	-9.048	61.136	0.000	-80.000	0.000	-25.439
3	3	1:CONCENTR	61.136	-9.054	0.000	0.000	0.000	-25.439
	4	1:CONCENTR	-61.136	9.054	0.000	0.000	0.000	-15.304



Final moments (manually) (kN-m)	-3.26	21.87	-21.87	26.05	-26.05	-15.83
From STAAD Pro	-3.959	22.031	-22.031	25.439	-25.439	-15.304

PHASE 2

Under phase 2, with full confidence on the STAAD Pro. Design tool, we proceed with the analysis of simple 2 dimensional frames. The analysis was done for both the static load conditions and dynamic load conditions. The 2nd phase involves the analysis of frames on a plane ground

PROBLEM STATEMENT:-

MEMBER PROPERTIES

- All Beams : Rectangular, 400 mm width X 500 mm depth
- All Columns: Rectangular, 400 mm width X 500 mm depth

MEMBER ORIENTATION

- All members : Default

MATERIAL CONSTANTS

 Modulus of Elasticity : 22 KN/sq.mm
 Density : 25 kn/cu.m
 Poisson's Ratio : 0.17

SUPPORTS
 Base of all columns: Fixed
LOADS
Load case 1 : Earth Quake Load
 Zone- III (Z= 0.16)
 Special revisiting moment frame (RF= 5)
 Importance factor = 1
 Soil type medium
 RC frame
 Damping ratio=5
 Self weight of the structure.
 1893 load in global x direction

Load case 2 : Dead Load
 Self weight of the structure.
 Beams : 30 kN/m in global Y downward

Load case 3 : Live Load
 Beams : 200 kN/m in global Y downward

Load Case 4 : DEAD + LIVE
 L2 X 1.5 + L3 X 1.5

Load Case 5 : DEAD +LIVE+EARTH QUAKE
 L1 X 1.2 + L2 X 1.2+ L3X 1.2

Load Case 6 : DEAD +LIVE-EARTH QUAKE
 -L1 X 1.2 + L2 X 1.2+ L3X 1.2

Load Case 7 : DEAD + EARTH QUAKE
 L1 X 1.5 + L2 X 1.5

Load Case 8 : DEAD -EARTH QUAKE
 -L1 X 1.5 + L2 X 1.5

Load Case 9 : DEAD +EARTH QUAKE
 -L1 X 1.5 + L2 X 0.9

Load Case 10 : DEAD -EARTH QUAKE
 -L1 X 1.5 + L2 X 0.9

ANALYSIS TYPE: P-DELTA

CONCRETE DESIGN:

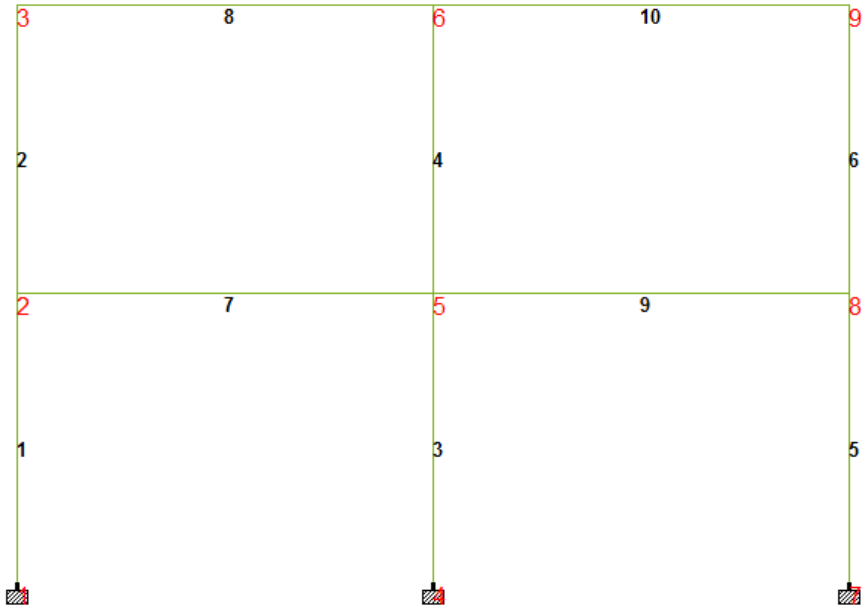
- Consider all the load cases.
- Parameters: ultimate tensile strength of steel-415 N/sq.mm
- Concrete strength: 30 N/sq.mm
- Clear cover: 30 mm.
- Centre to centre distance of each beam- 4 m
- Height of each storey

(a)First the structure is on level ground all the supporting columns being of 4 m height.
(b)For the second case the we design the frame for same loading combinations but on a sloping ground of I in 5.

- Each beam length = 5m

So for this the dimensions of the supporting column are 4m, 4.5 m,5m, 5.5m and 6m.

PLANE GROUND



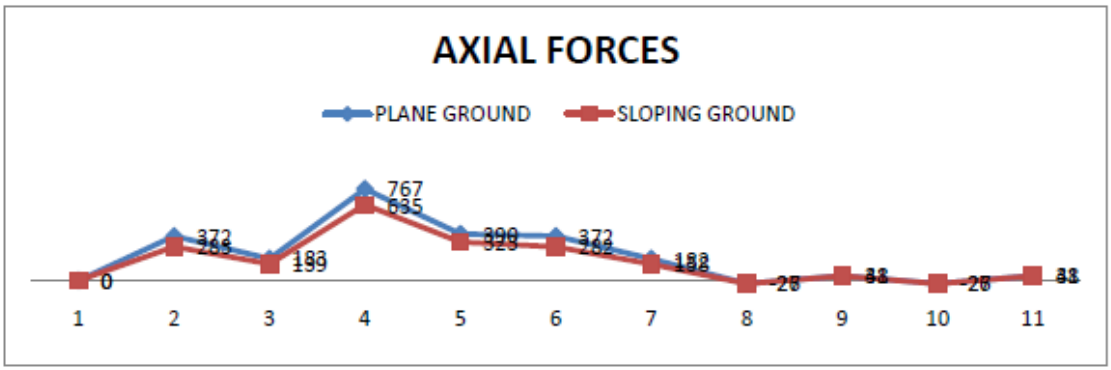
ANALYSIS RESULTS FOR 2 BAY SYSTEMS ON PLANE AND ON A SLOPING GROUND FOR TWO STORY FRAME.

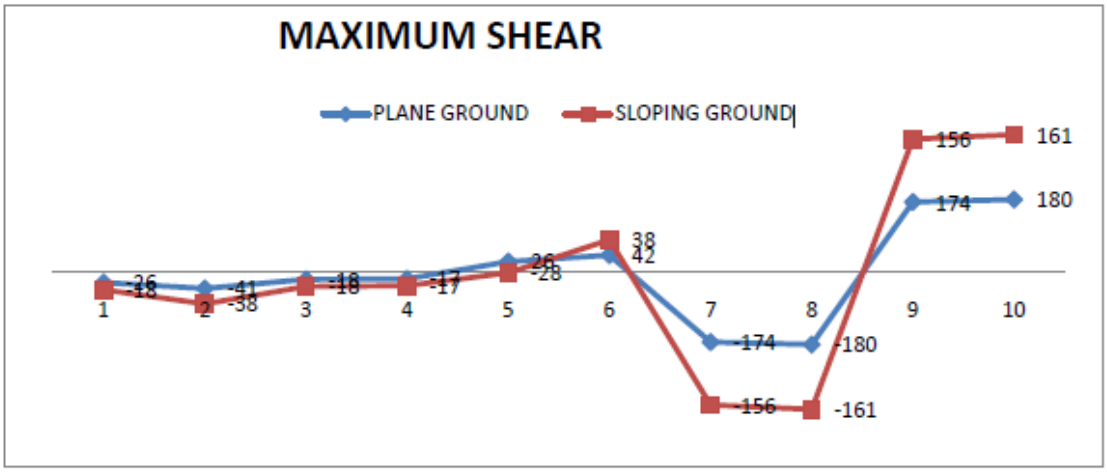
BEAM NO	MAXIMUM AXIAL FORCE	MAXIMUM SHEAR FORCE	MAXIMUM BENDING MOMENT	MAXIMUM TENSILE FORCE	MAXIMUM C

					COMPRESSSIVE FORCE
kN	**kN**	**kN-m**	**N/ mm2**	N/mm2	

P*	**S***	**P**	**S**	**P**	**S**	**P**	**S**	**P**	**S**
1	**372**	**283**	**-26**	**-18**	**-51**	**-45**	**-2**	**-2**	**5**	**4**
2	**183**	**139**	**-41**	**-38**	**93**	**-84**	**-5**	**-5**	**6**	**6**
3	**767**	**635**	**-18**	**-18**	**-41**	**-46**	**-1**	**-3**	**5**	**5**
4	**390**	**323**	**-17**	**-17**	**-36**	**-36**	**-1**	**-2**	**4**	**3**
5	**767**	**635**	**26**	**-28**	**51**	**59**	**-2**	**-3**	**5**	**4**
6	**182**	**138**	**42**	**38**	**-93**	**-83**	**-5**	**-4**	**6**	**6**
7	**-26**	**-27**	**-174**	**-156**	**147**	**131**	**-9**	**-8**	**9**	**8**
8	**41**	**38**	**-180**	**-161**	**157**	**140**	**-9**	**-8**	**10**	**9**
9	**-26**	**-27**	**174**	**156**	**148**	**133**	**-9**	**-8**	**9**	**8**
10	**41**	**38**	**180**	**161**	**157**	**140**	**-9**	**-8**	**10**	**9**

[P= Plane ground, S= Sloping Ground]*





5.1.

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

5.1.1. DESIGN OF COLUMN (by:Limit state method)

1. Influence area=3.17x3.54m(considered)

2. Calculation of total load=Dead loads +live load
Due to wt of slab=[7259N/m2](From calculation)
Due to wt of floor finish=[1500N/m2](from IS875)
Due to wt of Brick masonry=[49200N/m2](from IS875)
Due to self wt of column=[25000N/m^2](fromIS2000)

Due to self wt of beam=[66715N/m^2](from IS875)
Live load=2000N/m^2
Total load=9799650=P
3. Factored load (Pu)=14699475N
We know that,
$Pu=0.4Fck \times A_c+0.67Fy \times A_{sc}$
$Pu=0.4 F_{ck}[Ag-0.01Ag]+0.67 \times 415 \times 0.01Ag$
Here,[%Steel=1%of Ag,M20,Fe415]
14699475=10.71 Ag
Ag =1372500 mm^2
We know that length of column to be made from the design=3.05m
Therefore, width of the column=1372500/3050=450mm=0.45
4. Now check for long/short columns
Leff/b=3.05/0.45=4.15
Since Leff/b<12
Therefore short coloumn has to be designed for the structure
5. Eccentricity of the coloumn ,max{20mm, [0.65x3050/500 + 450/30]=19]} therefore E=20mm
Permissible eccentricity =0.05x450=22.5 –(Pe)>E----- therefore structure is valid.
6.Calculation of area of steel required
As=0.01Ag=0.01 x 1372500mm^2=13725mm^2
ASC=4 x (3.14/4 x12) +4(3.14 x 16^2)=13735mm^2
Therefore, 8 rods are required,..4 of 12mm dia and 4 of 16mm dia
Since area steel provided is more than area steel required.
Thus we have a safe design.
7.Dia of ties shall not be lesser than,
[5mm or 1\4th of smallest dia of column=12\4=3]
Therefore, spacing will be equal to 5mm.

Since we have considered largest influenced area by a column in the plan,thus the rest of 8 columns can be designed in a similar manner because they will be having lesser influence area and thus lesser load on them…,therefore designed column will be safe for all of them.

5.1.2DESIGN OF SLAB-

Short span between centers of bearings—(4.15)
Long=6.15
Assume 0.3%. Steel Mf=1.43
Effective depth required= span/20×Mf)
Effective depth = (4.5×10/20×1.43)

For 8mm bars at a clear cover =15mm
Overall depth required=145+15+4=164mm
Provided overall depth=170mm

Effective depth provided=170-19=151mm
Forshortspan-
clear span+effective depth=4+0.151=4.151

for long span-

clearspan+effectivedepth=6+.151=6.15m
lx=4.15m
ly=6.15
spanratio:lx/ly=6.15/4.15=1.48
α=o.103,β=0.04
loads
D.l.=170/100×1000×2.5=4250N/m
L.l=3000×1=3000N/m

CHAPTER6

6.1. ESTIMATION

SNO	PARTICULAR ITEM OF WORK	QQTY	UNIT
1.	Providing form work with steel plates 3.15mm.thick welded with	60.79	Sqm
	angle iron in frame(30x30x5mm).	111.32	Sqm
	Vertical surface		Cum
	Flat surface	7.39	Cum
	Providing and laying cement concrete	11.13	Cum
2.	1:2:4(cement,sand,aggregates of size 2omm)	26.59	Sqm
	Flate surface	118.43	Kg
	Brick work using common burnt clay building bricks in plinth and	2222	Cum
3.	foundation	1.97	Sqm
4.	Half brick masonary bricks for complete superstructure above	35.15	Sqm
5.	plinth level upto floor level	137.87	cu
6.	Providing mild steel for rcc work including bending,binding and	288.54	
7.	floor of two level	10.14	sqm
8.	Providing wood work in frames of doors and windows	137.87	
9.	Providing and fixing glazed shutters for doors and windows	426.41	Cum
10.	6mm cement plaster to celling		
11.	15mm cement plaster in single coat on fair side of	28.21	Sqm
12.	brick/concrete/stone walls upto two floor including arrisses.		
13.	finish with under layer 10mm thick cement concrete	1132.57	Sqm
14.	Distempering with dry distemper of approved brand		
	p/f 12mm thick pre laminated board both side	512.7	Sqm

6.2 PHOTOS

Fig 2 –footing of column

Ground floor –

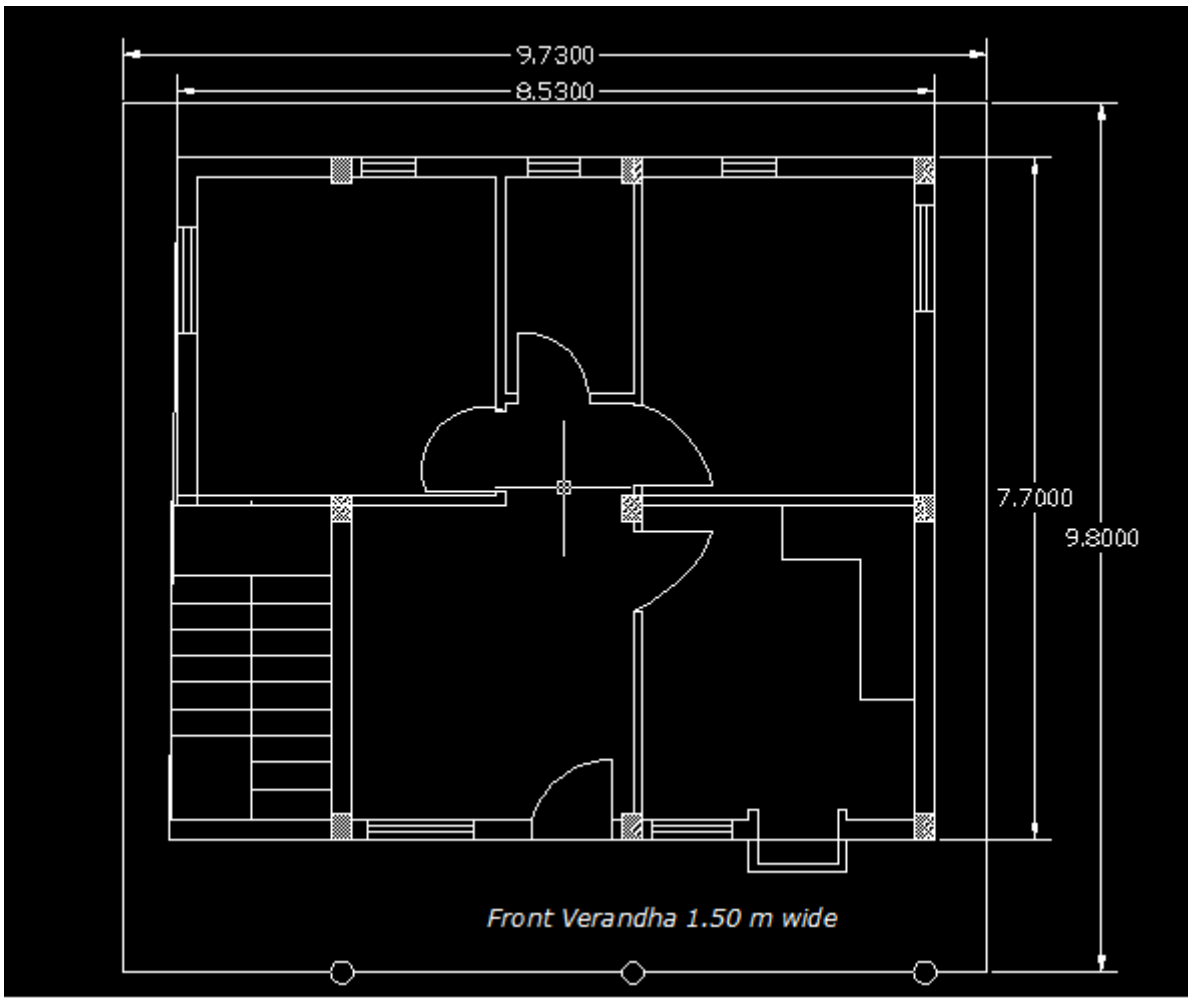


Fig 3 – ground floor plan

First Floor –

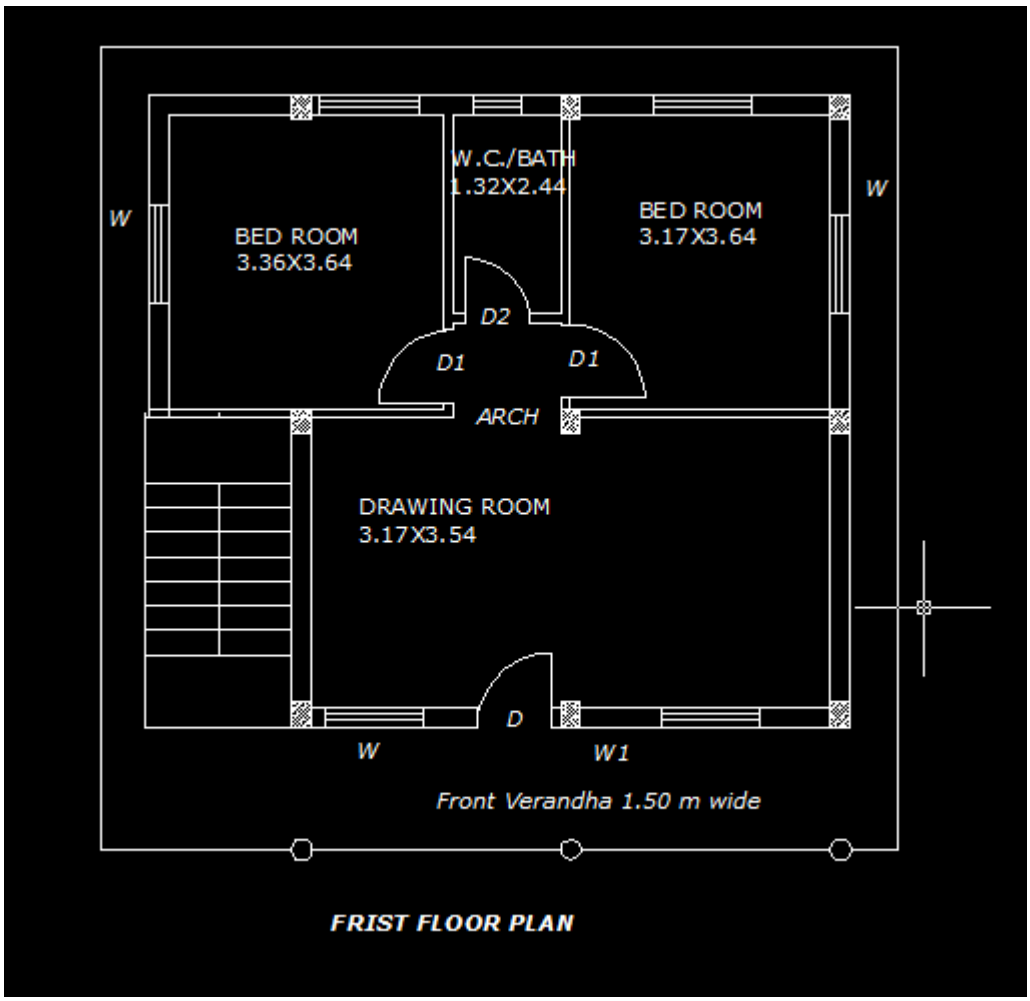


Fig 4 – first floor plan

CHAPTER 7

7.1 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 lx/ly 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.

REFRENCES

- **IS456 (2000)-** Plain and Reinforced Concrete - Code of Practice is an Indian Standard code of practice for general structural use of plain and reinforced concrete
- **IS875 part-`1** - code of practice of design loads (other than earthquake load)
- **IS875 part-2** - code of practice of design loads (other than earthquake load)
- Agrawal, Shrikhande Mansih, earth quake resistant design of structures
- Murthy C.V.R, Learning earthquake design
- *Ramamurtham,Theory of structures*