A

MAJOR PROJECT REPORT

on

ESTIMATION AND DESIGN OF 1-BHK RESIDENTIAL HOME

Submitted in partial fulfillment of the requirements of the degree of

BACHELOR OF TECHNOLOGY

Submitted to
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TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

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Signatures of Students

1.

2.

3. Kartik

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For Techno India NJR Institute of Technology

पंकज पोरवाल

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DECLARATION

I hereby certify that the work which is being presented in the B.Tech. Major Project – II Report entitled **"ESTIMATION AND DESIGN OF 1-BHK RESIDENTIAL HOME"**, in partial fulfillment for the award of the **Bachelor of Technology in Civil Engineering** and submitted to the Department of Civil Engineering of Techno India NJR Institute of Technology, Udaipur, Rajasthan is an authentic record of our own carried out during a period from **March-2022 to May-2022 (8^{th} Semester)** under the supervision of **Rakesh Yadav, Civil Engineering Department.**

The matter presented in this Report has not been submitted by me /us for the award of any other degree elsewhere.

Kartik Rohit

Signature of students

This is certifying that the above statement made by the students is correct to the best of my knowledge.

Signature of Supervisors

Date 18/06/2022

Head

Civil Engineering Department

20/06/22

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CERTIFICATE

This is to certify that entitled "ESTIMATION AND DESIGN OF 1-BHK RESIDENTIAL HOME", is submitted by **Pawan Salvi, Divyanshu Purbia Kalal, Kartik Sharma, Rohit Bishnoi** in partial fulfillment of the requirements for the award of the Bachelorof Technology in Civil Engineering during a period from March-2022 to May-2022 (8th Semester) from Techno India NJR Institute of Technology affiliated to RTU Kota is approved for award of the degree.

Principal/ Director

Techno India NJR Institute of Technology

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LIST OF ABBREVIATIONS & SYMBOLS

SYMBOL	DESCRIPTION
A	Total area of section.
A_h	Equivalent area of helical reinforcement.
AS	Area of compressive steel.
Ae	Equivalent area of section.
Ak	Area of concrete core.
Am	Area of steel or iron core.
ASC	Area of longitudinal reinforcement
Ast	Area of steel (tensile)
Al	Area of longitudinal Torsional reinforcement
ASV	Total cross-sectional area of stirrup legs or bent up bars with in distances V
AΦ	Area of cross-section of one bar.
a	Lever arm.
aC	Area of concrete.
b	Width.
Br	Width of rib
C	Compressive force.
c	Compressive stress in concrete.
c'	Stress in concrete surrounding compressive steel.
cs	Permissible tensile stress in concrete.
c1	Compressive stress

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D	Depth.
d	Effective depth.
dc	Covert compressive steel.
ds	Depth of slab.
E	Eccentricity
F	Shear force
Fd	Design load
Fr	Radial shear force
f	Stress (in general).
Tu	Torsional moment (limit state design)
t	tensile stress in steel.
tc	Compressive stress in compressive steel.
vu	Shear force due to design load (limit state design)
vus	Strength of shear reinforcement (limit state design)
W	Point load; Total load.
Xu	Depth of neutral axis (limit state design)
Z	Distance.
zB,zL	Bending moment coefficients.
α	Inclination coefficient.
B	Surcharge angle
Γ	. Unit weight
γ'	Submerged unit weight

γf	Partial safety factor
σcc	Permissible stress in concrete (direct comp).
σcc	Direct compressive stress in concrete.
ch	Permissible compressive stress in concrete due to bending
σcu	Ultimate compressive stress in concrete cubes.
σsc	Permissible compressive stress in bars.
σsh	Permissible stress in helical reinforcement.
σsp	Permissible punching shear stress.
σst	Permissible tensile stress in reinforcement.
σsy	Yield point compressive stress in steel.
μ	Coefficient of friction.
Φ	Diameter of bar; angle of internal friction
θ	Angle
τb	Design bond stress
d	Shear stress in concrete
τcma	Max. Shear stress in concrete with shear reinforcement.
τv	Nominal shear stress.

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LIST OF FIGURES

ABSTRACT

Software's used in designing-

PlanninginAutoCAD2015

Structure Analysis using SAP2000

Cost estimation using MS-Excel

Building Information Modelling using Revit 2017

CHAPTER1. INTRODUCTION

1. Study area

- Our proposed site is located in hilly region, in this regions temperature is usually low and building should be located in the southern slope of hill.
- The opening should be placed as to avoid undesirable cold in winter.
- Total plot size is14.4mx15.4m
- Total plinth area is119sq.meter.

2. Selection of plot and study

Site selection is the most crucial step for building a residential home. The proposed location should not be in an isolated place where threat of crimes is substantially less; and it should be in a place with good community. However, it should not be to on be neighborhood either as it may cause inconvenience to members of the family. In addition, the location should been a place where mode of convenience is good and shopping facilities are easily available. These factors also increase the chance of future growth of property rate. One should check the future possibility of development of roads in the area.

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

- Access to park & playground.
- Agriculture polytonality of the land.
- Availability of public utility services, especially water, electricity &sewage disposal.
- Distance from places of work.
- Ease of drainage.
- Location with respect to school, collage public buildings.
- Transport facilities.
- Wind velocity and direction.

Table1: Limitation of built up area

Aeroflot	----	Maximum permissible built up area
Upto200sq.m(240sq.yd)	----	60%ofsiteareaonflooronly.
201to500sq.m(241to 600sq.yd)	----	50%ofthesitearea.
501to1000sq.m (601to 1200sq.yd)	----	40%ofthesitearea
Morethan1000sq.m	----	33%ofthesitearea.

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1.3 Residential Building

Requirements of every individual are different according to their social status, life style and income category. A rich man may require a luxurious apartment while a lower income group guy may live in a 1BHK house.

Table2: MINIMUM FLOOR AREA & HEIGHT OF ROOMS

	FLOORAREA	HIEGHT(m)
LIVING	10sqm(100sqft)	3.3(11')
KITCHEN BATH LATTRINE	(breadthmin2.7mor9')6s	3.0(10')
BATH & WATERCLOSET	qm(60sqft)	2.7(9')
SERVANTROOM GARAGE	2sqm (20sqft)1.6sqm	2.7(9')
	(16sqft)3.6sqm	2.7(9')
MIN. HIEGHT OF PLINTH	(36sqft)10sqm(100sq ft)	3.0(10')
FOR MAIN BUILDING	2.5*4.8m(8'*16')	3.0(10')
MIN.HIEGHT OF PLINTH	-------	0.6(2')
SERVANT QUARTES	-------	0.3(1')
MIN.DEPTH OF FOUNDATION	-------	0.9(3')
THICKNESS OF WALL	20cmsto30cms (9"to13.5")	------
DAMP PRO OF COURSE	2cms to2.5cms (3/4"to1")	thick full width of plinth wall

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1.4BUILDING 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 land scarping.
- Special requirements for low-income housing.
- Size of structural elements.

5. ARRANGEMENT OF ROOMS

Living room–This is the area for general use where family spends much of their time. It is usually near the entrance of the house. During winters, this area receives much of the sunshine and in summer, the sunrays enter from southern part.

- Kitchen – this is usually made in the eastern side of the plot for morning sunshine, which refreshes and purifies the air.

- Storeroom– Generally, the storeroom is provided at the backside of the home where it is away from daily activities and proper ventilation is provided.

- Bedroom– this area should provide privacy to the members and should provide provision for table, chairs, and cupboards. Attached toilets may be provided for ease of convenience.

- Office room–Eastern aspects are preferred for office rooms to provide the morning sunrays for freshness. In addition, it should be in a spot with fewer disturbances from the surrounding areas.

- Bath & W.C. – Usually, bath and W.C. are combined in a single room and attached to bedroom for increase of convenience and privacy. The bathroom is usually made white with glazed tiles with complete showers, bathtubs etc.

- Verandah – A residential building must be provided with open verandahs at the front and rear side of the home. This verandah provides protection to the home from sunrays, wind and rain. It also provides with a place to sit and enjoy. This area varies between 10%20%ofthetotalarea.

- Stair case– The staircase should be placed in the front of the building if it is intended for visitors and should be placed at the back of the home if family members would use it more. Rises & treads should be uniform to smooth movement.

6. ORIENTATION OF ROOMS

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 outlook and at the same time providing a convenient access to both the street and backyard.

The factors that affect orientation most areas follow.

- Solar heat.
- Wind direction
- Humidity
- Rainfall
- Intensity of wind site condition
- Lighting sand ventilation

CHAPTER 2: LITERATURERE VIEW

2.1 Structural analysis of framed structure

Reinforced concrete structure mainly contains of-1) Slabs, which will be there to cover most of the areas

2)Beams are supporting the slabs and the wall

3)The columns are there for supporting the beams

4)The footing plays a vital role as they distribute the concentrated loads acting on the column to minimize the bearing capacity of the soil.

In any of the framed structure, the load is mainly conveyed from the slab to the beam, and then conveyed from beam to column and then conveyed to the foundation and at the end to the soil, which is below it.

2.2 Stages in structural design

There are different stages in designing of a structure. They are-

1) Planning of the structure

2) Direction and impact of forces and the calculations of the loads

3) Method of analysis

4) Designing of a member

5) Scheduling, detailing and preparation of drawings

2.3 Structural Planning

When once we are through our architectural plan of our residential building, then we come across our structural planning. Structural planning involves some of the following points:-

1)Orientation of the columns and their positioning

2)Positioning of the beams

3)Traversing of the slabs

4)Geometrical design of stairs

5)Selection of foundation

It is very necessary to know that the loads are transferred to the footing and that too in the shortest path from the compact members.

2.4 POSITION OF THE COLUMNS

Columns should be positioned mainly at or near the corners where there is intersection of beams and walls in a residential building. Since we know that the function of the column is to provide support to the beams which is mainly put under the walls to bear the load. Selection of the position of the columns in such a way as it will be reducing the bending moment in beams. The two columns should not be placed too near and if it is so then provide one column instead of two at a perfect position so that it reduces the bending moment. Do not take larger length of the beams. When the centre to centre distance between the intersection of walls is large or when there are no cross walls, the spacing between two columns is governed by limitations of spans of supported beams because spacing of columns decides the span of beam. As the span of the beam increases, the required depth of the beam, and hence it's self-weight, and the total load on beam increases.

We know that the moment in the beam mainly varies with the square of the span length and is directly proportional with the load. Hence if we increase the span it will considerably increase the size of the beam.

And if we see in case of columns there is negligible change in the column if we increase the total load along as the column is short. From here we came to know that the cost of the beam per unit length increases very much if we increase the span as compared to the beams. Therefore the larger span of the beams should be avoided to minimize the cost. There should be minimum center to center distance between the columns because larger spacing of columns not only increases the load on the column at each floor posing problem of stocky columns in lower storeys of multistory building.

Since column footing requires certain are a beyond the column, difficulties are encountered in providing footing for such columns. In such cases, the column may be shifted inside along across wall to make room for accommodating the footing with in the property line.

2.5 POSITION OF BEAMS

Beams should be placed under the walls or under a heavy concentrated load so that the load should not act directly on the slabs. Since beams are placed under the slabs mainly to support them, the maximum span length of slabs shall compute its spacing.

To carry a given load slab wants the maximum volume of concrete. Therefore, the thickness should be minimum in the slabs. The maximum practical thickness for residential/office/public buildings is 200mm while the minimum is 100mm.

The maximum and minimum spans of slabs, which decide the spacing of beams, are governed by loading and limiting thickness given above. However, in case of buildings, where the live load is less than $5kN/m^2$, the maximum spacing corresponds to the value of maximum span of slabs given in the table below.

Table 3: Span of slabs according to spacing provided

Support condition	*Cantilevers*		*Simply supported*		*Fixed/continuous*	
One-way Two-way	*One-way*	*Two-way*	*One-way*	*Two-way*	*One-way*	*Two-way*
Maximum Recommended span of slabs	*1.5m*	*2.0m*	*3.5m*	*4.5m*	*4.5m*	*6.0m*

Avoid larger spacing in between beams to fulfill the deflection and cracking criteria. There should be no larger span in the beams to control the deflection and cracking. That is why It is well known that deflection varies directly with the cube of span and inversely with the cube of depth*i.e.*,L^3/D^3. Consequently, increase in D is less than increase in span L that results in greater deflection for larger span.

However, for large span, normally higher L/D ratio is taken to restrict the depth from considerations of headroom, aesthetics and psychological effect. Therefore, in beams where it is required span depth to be greater than one meter should not be used.

2.6 SPANNING OF SLABS

This is calculated by supporting arrangements. If the supports are on opposite edges or pointing in the one direction, the slab behaves as a one way supported slab. If rectangular slab is supported along its four edges, it behaves as a one way slab when Ly/Lx>2 and vice versa for two way slab

If Ly/Lx<2. However, this two-way slab not only depends on the Ly/Lx ratio but also on the ratio of their reinforcement in the two directions. Therefore, it is the designer's decision whether he wants to design it as a two ways or one-way slab.

A slab is said to be one-way slab if the ratio of Ly/Lx > 2 and in this case one-way action is the main element. If there is one-way slab then the main steel will be provided in the direction of the short span and the load is transferred in the two opposite supports. The steel, which is provided along the longer span, is only a distribution steel and is not designed for transferring the loads but is designed to resist temperature stresses, shrinkage, and somewhere to distribute the load in the structure.

Whereas in case of two way slab the ratio of Ly/Lx<2 and is considered economical when compared with the one way slab because the steel provided along the span behaves like main steel and transfers the load to all the four supports. The two-way slab is very beneficial when taken in consideration in case of two slab and for live load greater than $3KN/m^2$. If there are short span and live loads, we need not to change the steel requirement for two-way slab as when compared with the one-way slab.

Spanning of the slab also depends on the continuity of the slab.

Determine the type of the slab. When determining the choice of the slab used whether a cantilever or simply supported or uniformly distributed loading it should be kept in mind that the maximum banding moment in cantilever is ($M = wL^2/2$) which is four times that of a simply supported slab with its maximum bending moment of ($M=wL^2/8$), while it is five to six times in a continuous slab or a fixed slab with their bending moment to be ($M=wL^2/10$ or $wL^2/12$) simultaneously for the same span length.

Similarly, when it comes to the case of deflection of the cantilever loaded by UDL is given by:

$\delta=wL^4/8EI=48/5*(5wL^4/38EI)$

Which is approximately ten times that of simply supported slab= ($5wL^4/384EI$).

2.7 ACTION OF FORCES AND COMPUTION OF LOADS

2.7.1 BASIC STRUCTURAL ACTIONS

There are different structural actions that an engineer should keep in mind and they are as follows:-

Axial force action:-

It occurs when we take a case of 1-D members like columns, cables, arches and any member of truss and is mainly caused by the tensile and compressive forces stresses only.

Membrane action:-It occurs when we consider 2-D structures like shells and plates. It includes forces in the longitudinal direction only.

Bending action:-The forces, which are either parallel or traverse to the membrane axis and held in the plane of bending includes tensile or compressive stresses. Mainly the bending should be about one or both the axis and perpendicular art of the member axis.

Shear action:-in-plane parallel forces mainly including shear stresses cause this action.

Twisting action:-The twisting action is caused by out plane parallel forces i.e. the forces that are not contained in the in the plane of axis of the member but in a plane perpendicular to the axis of the member producing Torsional moment and hence inducing shear stresses in the member.

Combined action:-When one or more actions combine and act then it is known as combined action. The complex stress condition is produced in the member.

2.7.2 ANALYSIS OF A STRUCTURE

The analysis of a structure can be done in different ways and they are-

1)Elastic analysis

2)Limit analysis

Elastic analysis is nothing but working stress method of design.

Limit analysis is further divided in to ultimate load method of design and plastic theory applied as steel structures, and is later modified as Limit State Method for reinforced concrete structures, which contains designing for ultimate limit state at which the ultimate load theory implies and in the service state elastic theory.

Member Design: - the member design consists of the designing of slab, beam, column, and footing which we can do by limit state method.

2.8 LOADS AND MATERIAL

Properties of material and loads are the basic parameters that affect the design of a reinforced concrete structure. The correct loading of a structure is a vital step and serviceable design of structure.

Types of loads

There are many classifications of loads and are classified as horizontal loads, longitudinal loads and vertical loads. The vertical load is further divided in dead load, live load, impact load. The horizontal load is divided in wind load and earthquake loads and lastly the longitudinal load consist of braking forces, which are considered in special case of design of bridges and design of gantry girders etc.

Dead load:-This load is permanent or stationary which the structure carries throughout their life span. Dead load is mainly due to the self-weight of the structural members, weight of different materials, permanent partition walls and fixed permanent equipment.

Live loads or Imposed loads:- Movable load or Live load is mainly without any acceleration or impact. They are mainly assumed to be due to the intended use or occupancy of the building including weights of furniture or movable partition etc.

Impact loads:-The vibrations, acceleration or impact mainly causes the impact load. For example, a person walking will only produce a live load but soldiers marching or frames supporting lifts and hoists produce impact loads. Thus we can say that the impact load is equal to the imposed incremented by some percentage that depends on the intensity of impact.

Wind load:-The wind load is mainly the horizontal load that is caused by the movement of air relative to the earth. The wind load is taken into consideration when the height of the building will exceed the two times dimensions traverse to the exposed wind surface. If the building is only having 2to3 storey's then the wind load is not critical because the moment of resistance provided by the continuity of floor system to the column connection and the walls provided between the column connection and the walls provided between the columns are sufficient to take the effec of these forces.

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Earthquake load:-These loads are horizontal loads, are caused due to earthquakes, and can be computed by the IS1893. In massive reinforced concrete structures that are located in zone 2 and zone 3 which are not, more than three storey's high and importance factor should be less than one then the seismic forces are not critical.

2.9 PROPERITIES OF CONCRETE

Compressive strength:-Same as load the strength of the concrete is also a quantity, which changes considerably for the same concrete mix. Therefore, compressive strength is a main factor in arriving at statistical probabilistic principles.

Grade of concrete:-The Concrete is mainly known by its grade and which is classified as M15, M20, M25, M30 etc. in which the M letter refers to the concrete mix and the number 15, 20, 25 defines that the compressive strength of a 150mm size cube at a time lapse of 28days which is expressed in N/mm^2. Therefore, the concrete is known by its compressive strength. We take M20 or M25 for a reinforced concrete work but for extreme environment higher grade of concrete can be taken.

Characteristic strength:-it is defined as that value of the strength below which not more than 5% of the test results are suspected to fall,(i.e., there is 95% probability of achieving this value, or only 5% probability of not achieving the same).

Characteristics strength of concrete in flexural member:-It may be noted that the strength of concrete cube does not truly represent the strength of concrete in flexural member because factors namely, the shape effect, the prism effect, state of stressing member and casting and curing conditions for concrete in the member. Taking this into consideration the characteristic strength of concrete in a flexural member is taken as 0.67 times[2.6] the strength of concrete cube.

Design strength (fd) and partial safety factor (f) for material strength:-

The strength to be taken for the purpose of design is known as design strength and is given by

Design strength (fd) = characteristic strength (fck) Partial

Safety factor (f)

The value off depends upon the type of material and upon the type of limit state. According to I.S.code,

f=1.5 for concrete and f=1.15 for steel.

Design strength of concrete in member=0.67ƒck/1.5=0.446ƒck=0.45ƒck

Tensile strength (ƒcr):-

The estimate of flexural tensile strength or the modulus of rupture or the cracking strength of concrete from cube compressive strength is obtained from the relation:

$$f_{cr}=0.7\sqrt{f_{ck}}\ N/mm^2$$

We can obtain the tensile strength of the concrete in direct tension experimentally by the split cylinder strength and it varies in the range of 1/8 to 1/12 of the 150mm cube compressive strength.

Creep:-It is defined as the plastic deformation under any sustained load.

The ultimate creep strain is calculated from the creep coefficient given by:

è=creep strain/elastic strain=$å_{cc}/å_i$

Creep strain åCC depends on the time of the sustained loading. According to the code, we take the ultimate creep coefficient to be 1.6 at a time of 28 days of loading.

Shrinkage:-The process of change in volume during the drying and hardening of concrete is termed as shrinkage.

Shrinkage depends mainly on the time for which it is exposed .There is development of cracks if the strain is prevented as it produces tensile stresses in the concrete. The shrinkage is calculated by shrinkage strain, åCC=0.0003 for design purposes.

Short-term modulus of elasticity (EC)

The short- term modulus of elasticity is obtained by testing a 150mm concrete specimen at a time-lapse of 28 days under specified rate of loading because inelastic deformations under this loading are practically zero.

According to the code, short-term modulus of elasticity of concrete is given by:

$E_c = 5000\sqrt{f_{ck}}\ N/mm^2$

Long-term modulus of elasticity (ECe):-

The creep and shrinkage mainly affect the long-term elasticity as it reduces it with time. Therefore, the long- term modulus of elasticity of concrete takes into account the effect of creep and shrinkage and is given by-

$E_{ce} = E_c / (1+\theta)$

Where,

Ece=long-term modulus of elasticity

EC = short term modulus of elasticityè=creep coefficient.

There should be reduction in Ece with time to increase the deflection and cracking with tim That is why it plays a very important role in serviceability and in the calculation of deflecti and cracking . It is said that in IS modular ratio is defined as Es/Ec

Where Es= modulus of elasticity of steel = $2 \times 10^5\ N/mm^2$. $E_c = 5000\sqrt{f_{ck}}\ N/mm^2$.

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Table 4: Modular Ratio for different grades of concrete

Modular ratio for different grades of concrete Grade of concrete modular ratio 'm' Short term long term

M20	[illegible]	[illegible]
M25	8.0	11.0

CHAPTER 3: 2-D DESIGNING IN AUTO-CAD

Introduction

ıtoCAD is mainly a computer aided drafting software which is used mainly by the drafters gineers surveyors to create the design of buildings, bridges etc. it has many benefits like shorter ne span in preparation of drawings, reduces man power, very much efficient in drafting etc.

ıas many advantages over manual methods as if it is faster as it takes very less time. Repetition of work not there as one can start from where one had left, as it is stored in the computer memory. e previous drawings can be combined to make the newer drawings. It increases the accuracy of the work.

ıce the drawing is drawn on a screen, it can be easily drawn on paper with a plotter and this will result in ıt, clean and accurate drawings with sharp and consistent lettering. It is very economical and ordable to drafting design officers.

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Table 5: Building specifications (acc.toNBC2015)

	Norm (m)	Applied in project (m)
Living Room	4.2 X 4.8 – 5.4 x 7.2	4 x 5.2
Dining Room	4.2 x 4.8 – 4.8 x 6	4.2 x 4.8
Bed Room	4.2 x 4.8	4.2 x 4.3
Kitchen	3 x 3 (min)	3.5 x 4
Dressing Room	1.5 x 3 (min).	3.5 x 1.5
Bathroom + W.C.	1.8 x 2.5 (min)	3 x 2.5
Verandah	10% -20% of total plot area	3.3 x 1.5
Garage	3 x 6	3 x 6
Staircase	Width- 0.9 (min.) Clear Railing- 1.5 (max.) Clear headway-2.1 (max.) R=18-T, or R=66/T, or R=(24-T)/2	Width- 1 Clear Railing – 1.2 Clear headway – 2.1 Rise= 0.2 Tread=0.3 No of steps= 19 (9+1+9)

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3.2 Design Plans

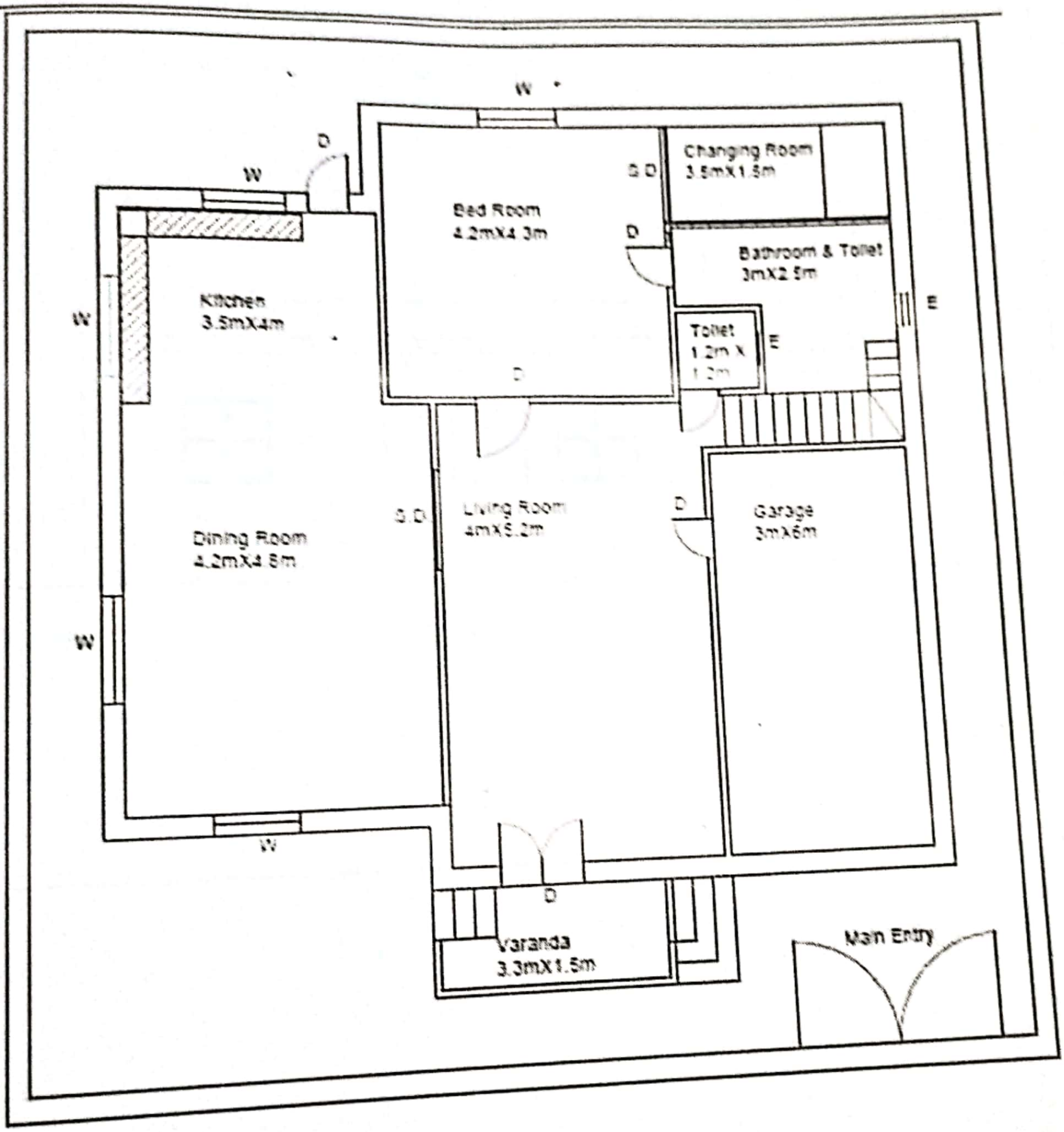

Figure 1: Architectural Plan

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CHAPTER 4: 3D MODELLING IN REVIT

1. Introduction

It is modeling software used by the designers, structural engineers, architects and contractors. When we use revit it designs a building and structure in 3D and gives explanation of the model with 2D drafting elements. Revit is mainly a tool to plan and track various stages in building construction till its demolition.

The revit work allows users to operate whole buildings or assemblies or individual 3D shapes. An experience user can make any realistic and accurate design by the use of Autodesk revit. It can create parametric models with its dimensions and properties. It can modify a given component such as changing its height, width and number in case of an array.

Rendered models

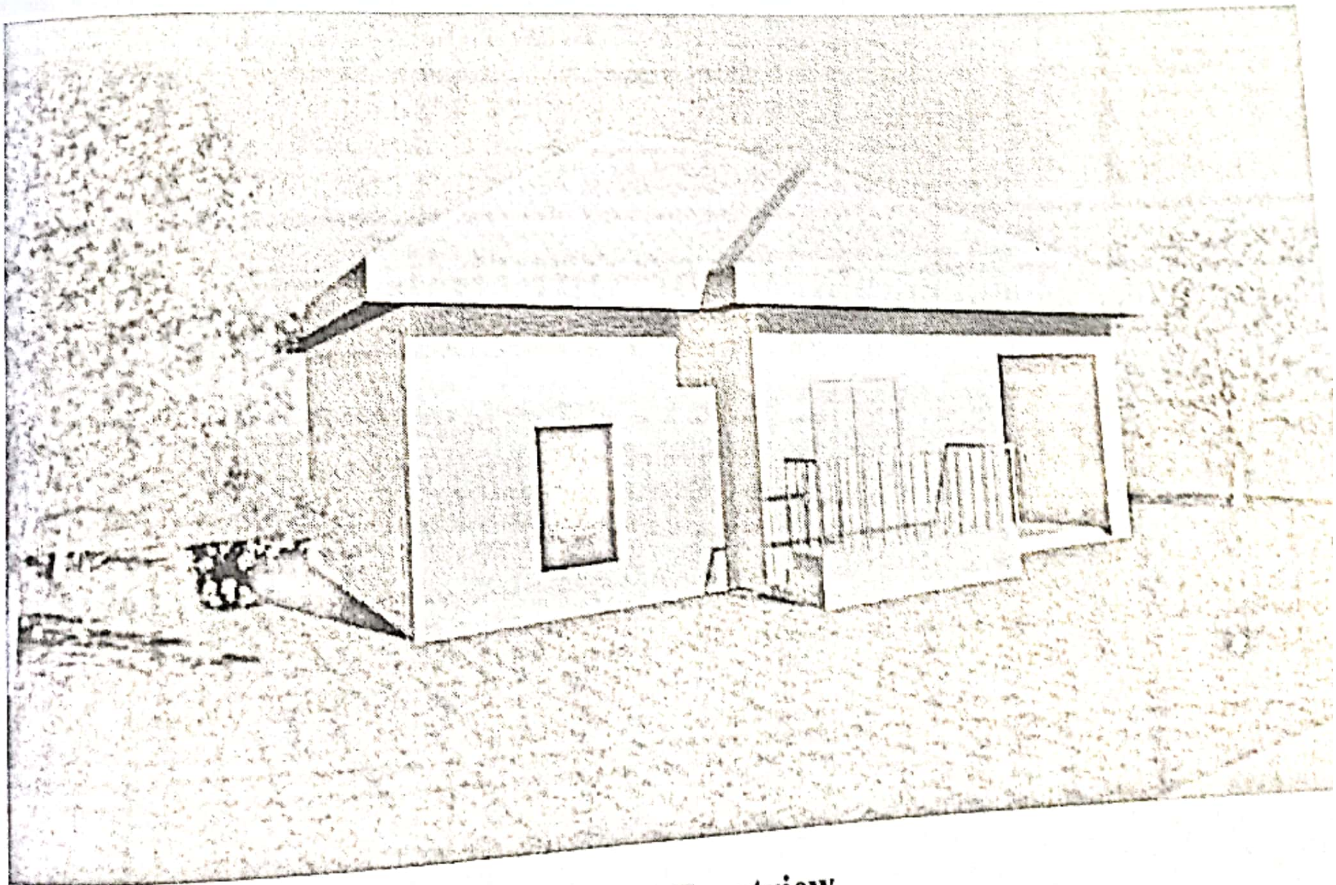

Figure8:Frontview

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CHAPTER 5: DESIGN CALCULATIONS

5.1 Design of Rectangular Slab:

Design of a rectangular slab of size 13.8mX13.2m superimposed load for the slab is 3KN/m^2usingM20andFe415

Solution: Design constant for: kc=0.284, ju=0.404 and c=0.414Length of panel (L)=13.8mWidth of panel

(B) =13.2m Along length$l1$=L=13.8mand$l2$=B=13.2m

Width of Column Strip=0.25B=0.25X13.2=3.3m with upper limit of 0.25L = 0.25 X 13.8 = 3.45m Width of middle strip=13.8- 6.9=6.9m

Along length$l1$=L=13.2 mand$l2$B=13.8m

Width of Strip=0.25B=0.25X13.8=3.45m

with an 0.25L=0.25X13.2=3.3m width of

middle strip=13.2-6.6=6.6m

We provided dorsal so the drops should be rectangular in plan having a length in each direction not less than one third the panel lengths in that direction. This is direction in length along length:-

Min length of drop=$l1$/3=13.2/3=4.4m

(However keep it equal to the total width of column strip ($l2$=6.6m)

Along with B:-

Min length of drop=$l1$/3=13.8/3=4.6m

(However keep it equal to the total width of column strip (l_2=6.6m)

Let the column have a column load of side of square column one fifth of average span.

$L = \frac{L+B}{2} = \frac{13.8+13.2}{2} = 13.5m$

Hence D=2.7m

Loading:-The thickness of flat slab is generally controlled by consideration of span of effected depth ratio: $\frac{span}{d} \leq 2.6$

Assuming balanced section percentage reinforced for M20 concrete=0.72% and modification factor for mild steel=1.6

$\frac{span}{d} = 26X1.6$

$\frac{13.2}{26X1.6}$

d=0.317m

Assuming an on in all over of 15 mm and using 12mm diameter bars total thickness

=317+15+12+6=350mm

The thickness of drops is normally 25% more than thickness of slab we assumed thickness of 400mm for the calculation of dead load. $m^3 = \frac{400X1X25000}{100}$

Weight of Slab/ = 10000N= 10KN/m^3Super imposed load=3kN/m^2

Snow load: $\mu_2 = 0.8+0.4\frac{\beta-15}{15} = 0.8+0.4\frac{30-15}{15} = 1.2$

S=μS0

$\beta = 30^0$

$15 \leq \beta \leq 30$

$S = \mu S_0 = 1$

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Ground snow load p_g =20psf

1 psf= 0.96kPa=0.96kN/m^2 Total W=13.96kN/m^2 **Moment along shorter span:** For the shorter span length l_1=L=13.2m and l_2B=13.8m the column head is circular of Diameter 2.7m

Size of equivalent square support= $\sqrt[2]{\frac{\pi}{4}2.7^2}$ =2.39m

l_{nl}=l_1-2.39= 10.8mw$l$= total design load on l_2xl_{nl}=(13.8X13.2)13960=2082542.88N

14.011kN.m

Moment along Longer span: For the longer span length l_1=B=13.8mandl_2=L=13.2m the column head is circle are of diameter 2.7m.

$$M_{ol}=\frac{w_l+L_{nl}}{8}=28$$

$$\sqrt[2]{\frac{\pi}{4}2.7^2}$$

Size of equivalent square support=

l_{nB}=l_2-2.39=11.4/m.

w_B=total design load onl_2xl_n =(13.2X11.4)13960

=2104543.52N

$$M_{oB}=\frac{w_B+L_{nB}}{8}$$ =2998.752km

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Thickness of Slab and Drop

Width of column strip on longer span L=6.6m=335mm

Provide total thickness=400mm we will provide 12mm diameter bars and nominal cover of 20mm.

Available d= 400-12-20 =378 mm for Shorter Span=368mm

$$d = \sqrt{\frac{M_{2L}}{R_c.b}} = \sqrt{\frac{680746.68}{0.914X6600}}$$

5.2 Design of Isolated Rectangular Footing of Uniform Thickness

For R.C.C. column

Base size=300mm X 500mm Load=650kN

Assuming q0 = 120kN/m^2

Design Contrast M20 Fe415

RU=2.761 $\frac{x_{u\ max}}{d} = .479$

Size of the Footing

w=650kN

W= $\frac{B}{L}$=2:3

1.1w=715kN

A=715/120=5.95m^2

So, B= 1.93m and L= 2.9m

Footing size we take will 3mX2m

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5.3 Design of Section:

Based on Bending Moment: About section X-X

$M = \frac{P_0 B}{8}(L-a)^2 = 144X\ 10^6\ N-mm$

$M_{1u} = 216X10^6\ N-mm$

About Section Y-

$YM = \frac{P_0 L}{8}(B-b)^2 = 96X10^6\ N-mm$

$M_{2u} = 144X10^6\ N-mm$

$$d = \sqrt{\frac{M_{1u}}{R_u B}} = 198mm = 200mm$$

D=260mm

Based on one way shear

$$V = P_0 B \frac{L}{2} - \frac{a}{2} - d$$

$=2X10^5(1.2-0.001d)$

$V_u = 1.5V = 3X10^5(1.2-0.001d)$

$$\tau_v = \frac{V_u}{Bd} = \frac{150}{d}(1.2-0.001d)$$

P= 0.3%

$\tau_v = 0.384\ N/mm^2$

D≥300mm

Permissible Shear Stress=1X0.384=0.38

Equating it with V_u

d=337mm=340mm

5.4 Reinforcement Design:

$$A_{st} = \frac{0.5 f_{ck}}{f_y}\left[1 - \sqrt{1 - \frac{4.6 M_{u}}{f_{ck} B d_1^2}}\right] B d_1$$

m^2 =1752m

No. Of Bars having 12mm diameter =1752/113= 16

Effective depth $d_2$48mm

A_{st} short bars

$A_{st2} = 1175 mm^2$

No of 12mm Diameter $\frac{117.5}{113} = 1.04$

Min 3 bars in each end band width = $\frac{(L-B)}{2}$ = 0.5m

5.5 Design for Column:

Unsupported length=3m

other) Axial Load=600kN (restrained from one side, unrestrained from

Using M20 and Fe415

Effective Length=.65X3000=1950mm

Assuming 1% steel b= $\frac{D}{2}$

$e_{min} \leq 0.5D$

$P_u = 0.4 f_{ck} A_c + 0.67 f_y A_{sc}$

1.5X600X10^3=0.4X20($A_g - 0.01A_g$)+0.67 X415X0.01

$A_g = 112144.2$

bd= d=473.59mmD=500mmb=250mm

A_g=250X 473.59=1121.44 mm^2

Area of each bar =1121.44/8=140.18mm^2 Bar Diameter=13.35mm

So 6 Bars of 12mm

diameter Aø=173.04 $\frac{6 X 113.04 X 100}{250 X 275}$

mm^2

$\frac{L_e}{b} = \frac{1950}{250} = 7.8$

Percentage Steel= =0.98%>0.8 % $\frac{L_e}{b} = 7.8$

$\frac{L_e}{b} = 9.4$

Hence Column is short in both directions in one direction

Emin= $\frac{L}{500} + \frac{D}{30}$=26mme

=.06D=30mm>emin

So column is preferable to be rectangular with **a=300mm** and **b=500mm** in the presence of 6 number of bars of diameter 12mm.

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CHAPTER 6: STRUCTURAL ANALYSIS ON SAP 2000

Introduction

In designing of the bridges, residential buildings SAP2000 can do the moving load analysis that none of the other software can do. This program can do torque and other reaction even in case of curved and inclined system. SAP2000 is very simple as it can easily apply loads and assign supports and restraints in the skewed direction. It is very efficient in case of braced or sloped beams.

SAP2000analysismakesiteasytointerpretthedirectionorforceswithoutmuchtimeconsuming.The user to define the selected list of sections can compute steel member sizes. It minimizes the error as analyze one section at a time. The forces and moments can be summed using SAP2000's force sum option in order to obtain useful results of shear force and bending moment.

2. Structural analysis on SAP 2000

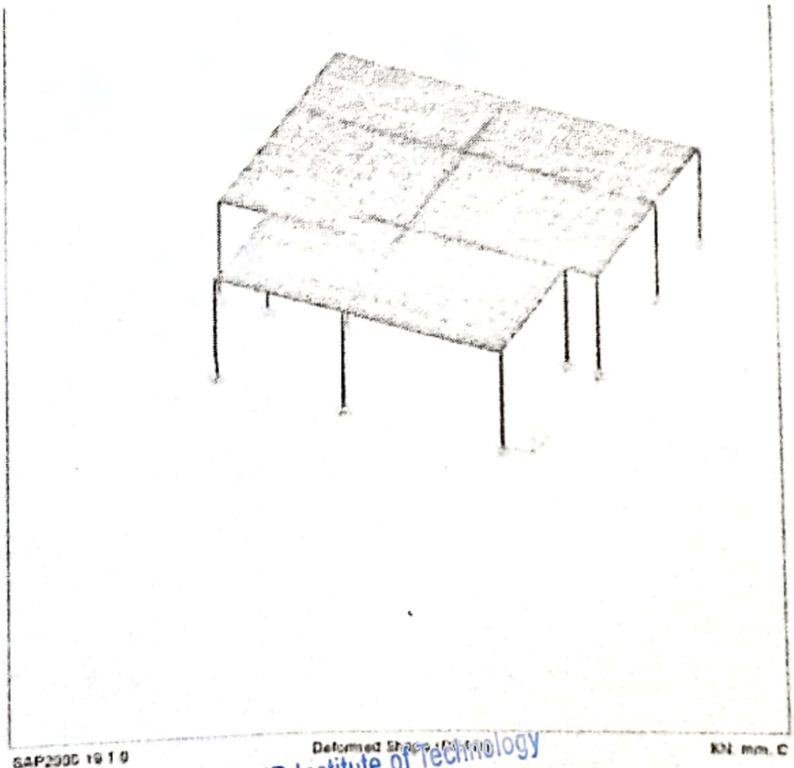

Figure 11: Deformed shape

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"sp-16" Design aids for reinforced concrete.

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