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ANALYSIS AND DESIGN OF A VILLA BY USING SOFTWARES

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ABSTRACT

Structural design is an investigation method of the rigidity, strength and stability of the building. The essential aim in structural analysis and design is to construct a structure capable of overcoming all applied loads without failure during it's intended life. The process of structural design involves various stages such as computation of loads, member design, detailing and many more. The conventional method of structural design and analysis leads to lot of complications and tedious calculations which are time consuming. Nowadays to complete a design and analysis in efficient manner, fast software's are used.

The findings of this study provide valuable insights for architects, urban planners, and developers to integrate sustainable sunlight strategies into residential building projects, ultimately promoting healthier and more liable environments for inhabitants. Now a days everyone effected by deceases.by searching all the things the main issue comes from lack of sunlight. sun is the main resource to avoid deceases and to lead a healthy and happy life. Has by providing the main resource that is shelter with proper sunlight we can avoid many deceases. Building planning made with software has time and cost saving and so many benefits are there by creating the 3-D modelling using auto cad and sketch up and Staad pro.

Keywords: Auto Cad & Sketchup And Staad Pro.

1. INTRODUCTION

SketchUp is a surface modeling program used by interior designers for space planning, conceptual design, etc. Any construction project includes layout and modelling of the building for a clear picturization of the structure and to minimize the errors as we can see the 3D model of the building before head.

we can have realistic view with high efficiency**.** This project involves the layout and 3D model of a gated community. For completing the project, software's such as AutoCAD and Sketchup have been used. The planning and drafting of any structure in 2D is done by using AutoCAD. The 3D modelling of structure is done by using Autodesk Google sketchup.

The software is fully compatible with all windows operating system but is optimized for windows XP. Staad pro software is used for static or dynamic analysis for structure, etc. First step in Staad pro is to specify the geometry of the structure and then the properties of the members are mentioned. Then the supports and then generated and loadings are specified on the structure. Finally, the structure is analyzed.

2. LITERATURE REVIEW

Mr. Dhruv Patel The design communication is gradually being changed from 2D based on integrated 3D digital interface. Building information modelling (BIM) is a model-based design concept. This project analysis and planning of a building is done on both software named AUTOCAD& SKETCHUP.

Jinan 251000 China This paper mainly introduces the methods and techniques of using Auto-CAD to draw the structure design of the house. The main contents include: the preparation of interior design and mapping knowledge, Auto-CAD basic knowledge; according to the different needs of the design of the structure.

Robin de Jongh is the author of several books on professional workflows with SketchUp, BIM, and

Unity3D. He has worked for many years in the construction industry as a CAD designer and at one time ran his own architectural visualization company using SketchUp as the main presentation tool.

Nicole panorkou Dimension is a powerful mathematical construct that is rarely taught or researched explicitly. The study reported on here explored how the software Google SketchUp can facilitate students' experiences of dimension.

Safwan Ahmad (2017), have designed a residential building using SKETCHUP by applying suitable sectional details to component within the main aim of this factor was to study the extent of credibility of using SKETCHUP for analysis.

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Muhamma E-Learning based about auto cad 3D interactive multimedia on vocational education (VE) learnin.The addition 2D on of new technologies in learning process especially vocational education.

Herminarto sofyan attention and even increasing the learning speed the research focus is to develops an Elearning based interactive multimedia auto CAD. this method is used in this research and dovelopment (R&D).

Robin is the author of several books on professional workflows with SketchUp, BIM, and Unity3D. He has worked for many years in the construction industry as a CAD designer and at one time ran his own architectural visualization.

De Jongh company using SketchUp as the main presentation tool. He now works as an acquisitions editor for Manning Publications where he mentors new authors, and publishes books on Open Source technology topics.

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Guntur Zulfiqar (2014) This article offers evidence from the data on how the task setting, including Sketchup's dimensional tools identified in the software, prompted the construction of ideas about dimension. More specifically, children expressed intuitive ideas about an object/space's freedom to move within a space/object of higher dimension and its capacity to house other objects/spaces of lower dimension.

Ezeli In this paper, it focuses on 2D drafting which is useful for various engineering sectors such as electrical design, mechanical design, product design, building design, and architectural rendering and design.

Nekomimi, 2016 SketchUp is a 3D modeling software that is designed for businesses in several industry segments, including architecture, construction, urban planning, woodworking and interior designing.

Automated learning programs help the teacher organize the learning process and help students master the science. They have the benefits of speeding up the learning process, making the teaching materials simpler and clearer.

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Nicole panorkou Dimension is a powerful mathematical construct that is rarely taught or researched explicitly. The study reported on here explored how the software Google SketchUp can facilitate students' experiences of dimension.

3. ANALYSIS AND MODELLING

For the drafting and design of any construction, AutoCAD is quite beneficial. The fields of architecture and construction also employ this software. The software's several built-in capabilities enable complex drafting. In addition to 2D, 3D, and other dimensions, AutoCAD is also appropriate for perspective design, which refers to a way of perceiving objects. Below are listed the many house plans.

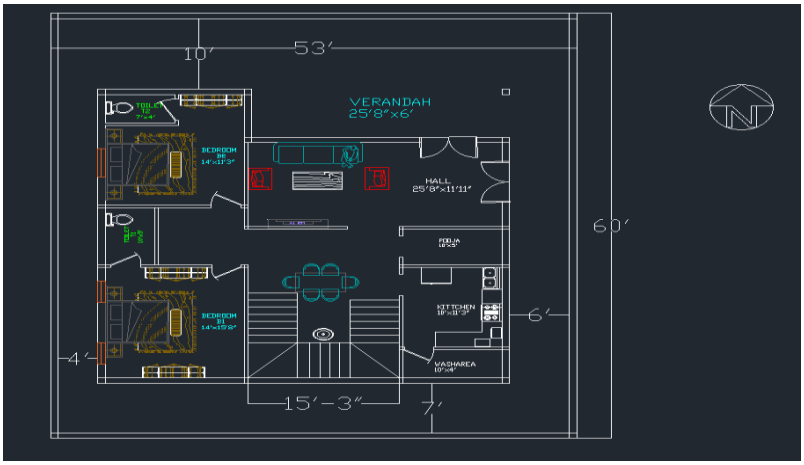

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Fig 1. Ground floor plan of villa

- SITE AREA =3180 sqft [53'X60']
- BUILT UP AREA =1730 sqft [41'6"X41'6"]
- EXTERIOR WALL THICKNESS = 9"
- INTERIOR WALL THICKNESS = 4.5"
- VERANDAH = 25'8"x6'
- BEDROOM [1] = 14'x15'8"
- BEDROOM [2] = 14'x11'3"
- HALL = 25'8"x6'
- KITCHEN = 10'x11'3"
- POOJA ROOM = 10'x5'
- TOILET [1] =10'x5'
- TOILET [2] = 7'
- WASH AREA = 10'x4'
- MINI THEATRE = 14'x18'4"
- BALCONY = 17'x9'
- GUEST ROOM = 10'x16'2"

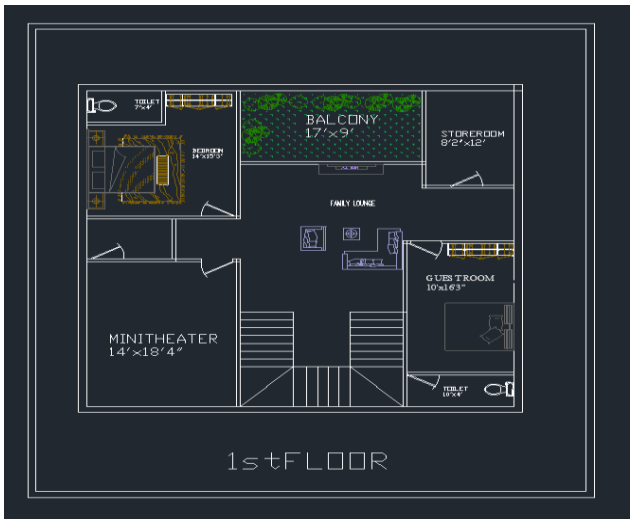

Fig 2. Dimensions of the building

4. 3D MODEL

Layout planning, 3D modeling, and realistic effects are all done with Sketch Up. Additionally, there are certain applications in the creation of movies and video games as well as in architecture, interior design, landscape architecture, civil and mechanical engineering. It is a web-based program. Trimble Inc. owes Sketch up money in August 2000.

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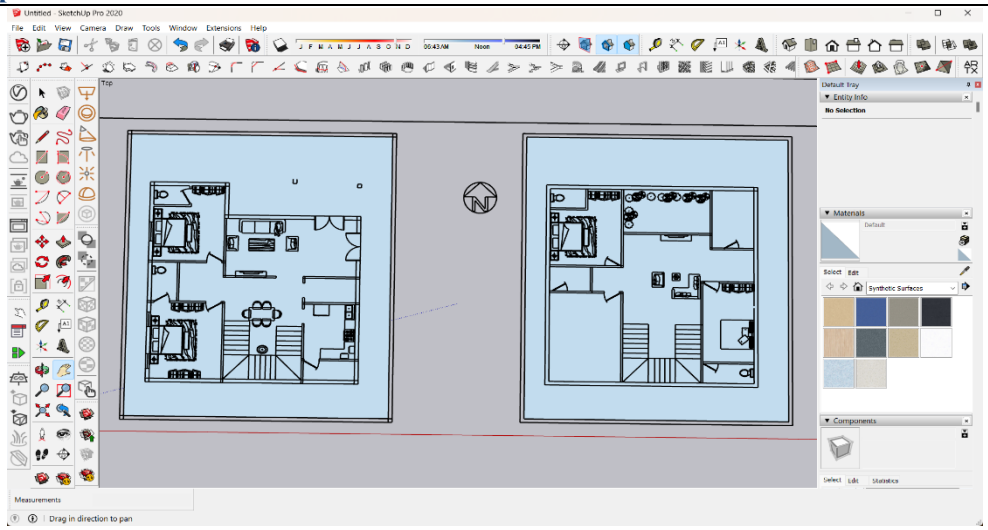

Fig 3. SketchUP plan

5. INTERIOR VIEWS

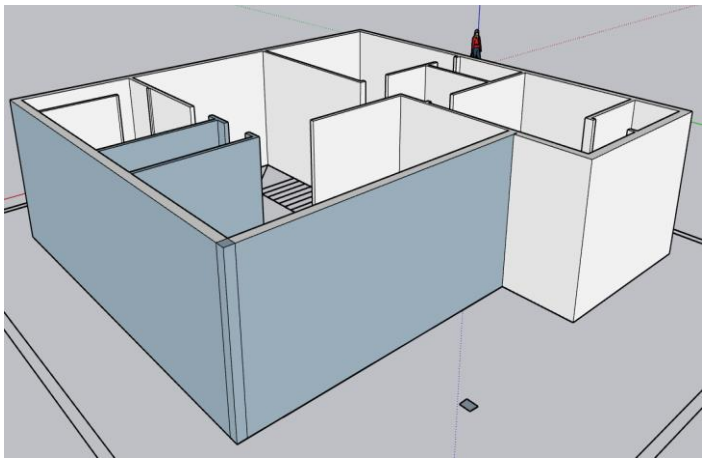

Fig 4. Raise of Walls

Fig 5. Bedroom

6. RENDERING

V-RAY is a Sketch up real – time render plugin that empowers you to create beautiful, realistic renderings in a matter of seconds, all from within your favourite modelling software.

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FIG 6. V-Ray Interface Layout

Fig 7. Hall Enscape View

FIG 8. Top View

STAAD. PRO

STAAD.PRO is user – friendly software which is used for analyzing and designing of structure by the structural engineers. Staad pro provides a lot of precise and correct results than manual techniques. It's the foremost computer code for 3D model generation and multi material design. The software is fully compatible with all windows operating system but is optimized for windows XP. Staad pro software is used for static or dynamic analysis for structure, etc. First step in Staad pro is to specify the geometry of the structure and then the properties of the members are mentioned. Then the supports and then generated and loadings are specified on the structure. Finally, the structure is analyzed.

7. SCOPE OF THE BUILDING

BUILDING DETAILS AND SPECIFICATIONS

- Size of the building – 12.6m X 12.6m.
- Plot size – 158.76sq.m.
- Height of the floor – 3.3528m.
- Grade of concrete – M30
- Grade of steel – Fe550
- Plinth height above the ground level – 0.9m

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- Depth of the foundation – 0.305m
- External wall thickness – 0.15m
- Internal wall thickness – 0.114m

NOTE:

IS 456-2000 &

IS 875,

Part I – Dead load'

Part II – Live load,

Part III – Wind load have been applied.

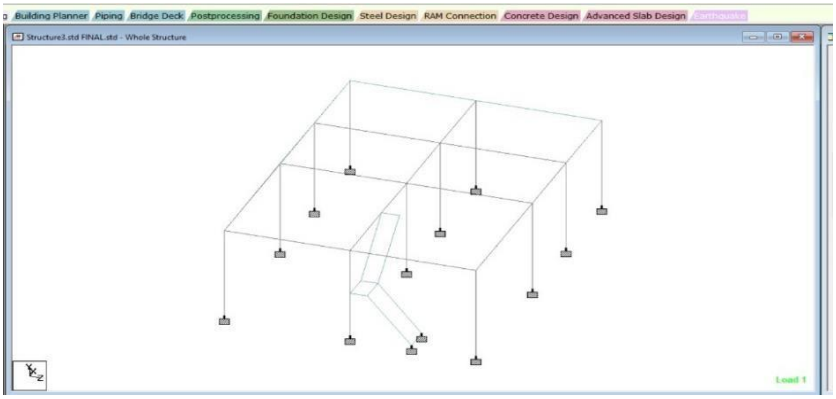

Fig 9. Skeletal Structure Of The Building

8. LOAD DISTRIBUTIONS

DEAD LOAD:

Dead loads consist of the permanent construction materials loads compressing the roof, wall, and foundation systems, including claddings, finishes and fixed equipments. Dead load is the total load of all of the components of the building that generally do not change over time, such as the steel columns, concrete floors, bricks, roofing material etc.

In staadpro assignment of dead load is automatically done by giving the property of the member. In load case we have option called self weight which automatically calculates weights using the properties of material i.e., density and after assignment of dead load the skeletal structure looks red in colour as shown in the figure.

The above example shows a sample calculations of dead load.

Dead load is calculated as per IS 875 part I

9. ANALYSIS OF THE BUILDING

COLUMN DETAILS

```
            C O L U M N   N O.      1  D E S I G N   R E S U L T S

      M30                    Fe550 (Main)               Fe550 (Sec.)

LENGTH:  4260.0 mm   CROSS SECTION:  230.0 mm X  230.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:     1 END JOINT:      5  TENSION COLUMN


REQD. STEEL AREA   :       423.20 Sq.mm.
REQD. CONCRETE AREA:     52476.81 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 12 dia. (0.86%,    452.39 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
-----------------------------------------------------------
Puz :    883.01   Muz1 :     17.06   Muy1 :     17.06

INTERACTION RATIO: 0.06 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
-----------------------------------------------------------
WORST LOAD CASE:     2
END JOINT:      6 Puz :    894.65   Muz :     17.96   Muy :     17.96   IR: 0.35
=============================================================================


=============================================================================
```

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BEAM DETAILS

```
--------------------------------------------------------------------------------
                B E A M  N O.       1   D E S I G N  R E S U L T S

      M30                    Fe550 (Main)                Fe550 (Sec.)

     LENGTH:  4260.0 mm      SIZE:   230.0 mm X  230.0 mm   COVER: 25.0 mm

                        SUMMARY OF REINF. AREA (Sq.mm)
--------------------------------------------------------------------------------
SECTION       0.0 mm      1065.0 mm      2130.0 mm      3195.0 mm      4260.0 mm
--------------------------------------------------------------------------------
 TOP           81.75          0.00           0.00          71.09          81.75
REINF.       (Sq. mm)       (Sq. mm)       (Sq. mm)       (Sq. mm)       (Sq. mm)

BOTTOM          0.00         71.09          71.09          71.09           0.00
REINF.       (Sq. mm)       (Sq. mm)       (Sq. mm)       (Sq. mm)       (Sq. mm)
--------------------------------------------------------------------------------

                        SUMMARY OF PROVIDED REINF. AREA
--------------------------------------------------------------------------------
SECTION       0.0 mm      1065.0 mm      2130.0 mm      3195.0 mm      4260.0 mm
--------------------------------------------------------------------------------
 TOP         6-10i          2-10i          2-10i          6-10i          6-10i
REINF.    1 layer(s)     1 layer(s)     1 layer(s)     1 layer(s)     1 layer(s)

BOTTOM      2-10i          6-10i          6-10i          6-10i          2-10i
REINF.    1 layer(s)     1 layer(s)     1 layer(s)     1 layer(s)     1 layer(s)

SHEAR    2 legged  8i  2 legged  8i  2 legged  8i  2 legged  8i  2 legged  8i
REINF.   @  90 mm c/c  @  90 mm c/c  @  90 mm c/c  @  90 mm c/c  @  90 mm c/c
--------------------------------------------------------------------------------

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT
--------------------------------------------------------------------------------

SHEAR DESIGN RESULTS AT    315.0 mm AWAY FROM START SUPPORT
  VY =      6.57 MX =     -0.12 LD=     2
  Provide 2 Legged  8i  @  90 mm c/c

SHEAR DESIGN RESULTS AT    315.0 mm AWAY FROM END SUPPORT
  VY =      6.14 MX =     -0.12 LD=     2
  Provide 2 Legged  8i  @  90 mm c/c

================================================================================
```

10. FOOTING

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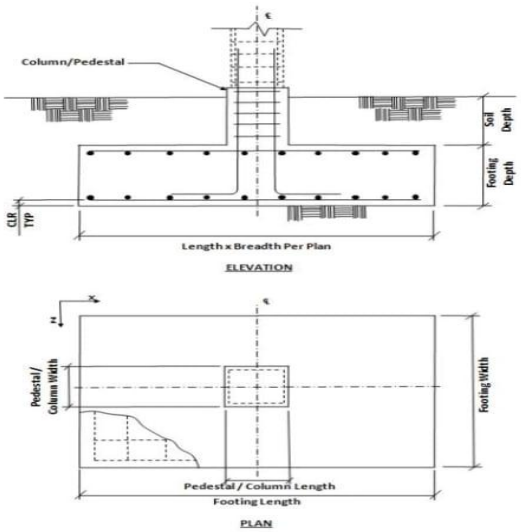
Isolated Footing Design (IS 456-2000)

Design For Isolated Footing 49

Footing No.	Group ID	Foundation Geometry		
-		Length	Width	Thickness
49	1	1.750 m	1.750 m	0.305 m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
49	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	Ø6 @ 70 mm c/c	N/A	N/A

Isolated Footing 49



Input Values

Footing Geomtery

Design Type : Calculate Dimension
Footing Thickness (Ft) : 305.000 mm
Footing Length - X (Fl) : 1000.000 mm

Footing Width - Z (Fw) : 1000.000 mm
Eccentricity along X (Oxd) : 0.000 mm
Eccentricity along Z (Ozd) : 0.000 mm

Column Dimensions

Column Shape : Rectangular
Column Length - X (Pl) : 0.230 m
Column Width - Z (Pw) : 0.300 m

STAAD EDTIOR

1. STAAD SPACE
   INPUT FILE: D:\STAAD FILE\Structure3.std FINAL [1].STD
2. START JOB INFORMATION
3. ENGINEER DATE 05-MAR-24
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 5.3 0 0; 3 8.5 0 0; 4 11.87 0 0; 5 0 3.65 0; 6 5.3 3.65 0
9. 7 8.5 3.65 0; 8 11.87 3.65 0; 9 0 0 4.325; 10 5.3 0 4.325; 11 8.5 0 4.325
10. 12 11.87 0 4.325; 13 0 3.65 4.325; 14 5.3 3.65 4.325; 15 8.5 3.65 4.325
11. 16 11.87 3.65 4.325; 17 0 0 8.65; 18 5.3 0 8.65; 19 8.5 0 8.65
12. 20 11.87 0 8.65; 21 0 3.65 8.65; 22 5.3 3.65 8.65; 23 8.5 3.65 8.65
13. 24 11.87 3.65 8.65; 25 0 1.825 4.325; 26 1 1.825 4.325; 27 0 1.825 4.925
14. 28 1 1.825 4.925; 29 0 0 6.425; 32 1 0 6.425; 33 3 3.65 4.325; 34 3 3.65 4.925

15. MEMBER INCIDENCES
16. 1 5 6; 2 6 7; 3 7 8; 4 1 5; 5 2 6; 6 3 7; 7 4 8; 9 14 15; 10 15 16; 11 9 25
17. 12 10 14; 13 11 15; 14 12 16; 15 21 22; 16 22 23; 17 23 24; 18 17 21; 19 18 22
18. 20 19 23; 21 20 24; 22 5 13; 23 6 14; 24 7 15; 25 8 16; 26 13 21; 27 14 22
19. 28 15 23; 29 16 24; 30 25 13; 34 13 33; 35 33 14
20. ELEMENT INCIDENCES SHELL
21. 32 29 27 28 32; 33 27 25 26 28; 36 26 33 34 28; 37 5 8 24 21
22. ELEMENT PROPERTY
23. 32 33 36 37 THICKNESS 0.12
24. DEFINE MATERIAL START
25. ISOTROPIC CONCRETE
26. E 2.17185E+007
27. POISSON 0.17
28. DENSITY 25
29. ALPHA 1E-005
30. DAMP 0.05
31. TYPE CONCRETE
32. STRENGTH FCU 27579
33. END DEFINE MATERIAL
34. MEMBER PROPERTY AMERICAN
35. 1 TO 3 9 10 15 TO 17 22 TO 29 34 35 PRIS YD 0.3 ZD 0.23
36. 4 TO 7 11 TO 14 18 TO 21 30 PRIS YD 0.3 ZD 0.3
37. CONSTANTS
38. MATERIAL CONCRETE ALL STAAD SPACE
39. SUPPORTS
40. 1 TO 4 9 TO 12 17 TO 20 29 32 FIXED
41. LOAD 1 LOADTYPE DEAD TITLE DL
42. SELFWEIGHT Y -1
43. MEMBER LOAD
44. 1 TO 3 9 10 15 TO 17 22 TO 29 34 35 UNI GY -15
45. FLOOR LOAD
46. YRANGE 0 3.65 FLOAD -2.5 GY

NOTE about Floor/OneWay Loads/Weights.

Please note that depending on the shape of the floor you may have to break up the FLOOR/ONEWAY LOAD into multiple commands.

For details please refer to Technical Reference Manual

Section 5.32.4.2 Note d and/or "5.32.4.3 Note f.

47. LOAD 2 LOADTYPE LIVE REDUCIBLE TITLE LL
48. FLOOR LOAD
49. YRANGE 0 3.65 FLOAD -2 GY
50. LOAD COMB 3 1.5(DL+LL)
51. 1 1.5 2 1.5
52. PERFORM ANALYSIS PRINT ALL

11. CONCLUSION

We can conclude that there is difference between the theoretical and practical work done. As the scope of understanding will be much practical work is done. As we get more knowledge in such a situation where we have great experience doing the practical work. The sunlight effects on house is depends on aspect, material used for doors and windows and the projection's view makes the viewers effective towards building and they come to know how the

building looks like after construction. All the structural components were designed manually and detailed using AutoCAD. The analysis and design were done according to standard 8 specifications using STAAD.PRO for static and dynamic loads. The dimensions of structural members are specified and the loads such as dead load, live load, floor load and earthquake load are applied. Deflection and shear tests are checked for beams, column and slabs. The tests provide to be safe. Theoretical work has been done. Hence, I conclude that we can gain more knowledge in practical work when compared to theoretical work.

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