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Structural Analysis and Design of G+3 RCC Residential Building Using STAAD.Pro

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1. INTRODUCTION

Reinforced Cement Concrete (RCC) is one of the most widely used construction materials in civil engineering due to its high strength, durability, and versatility. RCC combines the compressive strength of concrete with the tensile strength of steel reinforcement, making it suitable for the construction of multi-storey buildings such as residential, commercial, and industrial structures.

With rapid urbanization and increasing population, the demand for safe and economical multi-storey buildings has increased significantly. Proper structural analysis and design are essential to ensure the safety, stability, and serviceability of structures under various loading conditions. A structure is generally subjected to loads such as dead load, live load, wind load, and seismic load during its service life. Accurate estimation and analysis of these loads are necessary for safe structural performance.

Traditionally, structural analysis and design were carried out using manual calculation methods. Manual design helps engineers understand the fundamental behavior of structural members and the distribution of forces within the structure. However, manual analysis becomes difficult and time-consuming for multi-storey buildings due to complex calculations and load combinations.

With advancements in computer technology, software tools such as STAAD.Pro are widely used for structural analysis and design. STAAD.Pro is based on the Finite Element Method (FEM), which provides accurate and efficient analysis of structures. The software helps engineers in structural modeling, load application, analysis, and design of RCC members with reduced calculation errors and improved efficiency.

In this project, the structural analysis and design of a G+3 RCC residential building are carried out using both manual calculations and STAAD.Pro software. The results obtained from manual analysis and software analysis are compared to study the variation in bending moment, shear force, axial force, and deflection. This comparison helps in validating the accuracy of software analysis and understanding the advantages and limitations of both methods.

The building is analyzed under different loading conditions including dead load, live load, wind load, and seismic load as per relevant Indian Standard codes such as IS 456, IS 875, and IS 1893. The design of structural members such as beams, columns, slabs, and footings is performed to ensure structural safety and economy.
The main aim of this project is to understand the behavior of RCC structures through both manual and software approaches and to evaluate the effectiveness of software-based structural analysis in modern engineering practice

CHAPTER-2

2. LITERATURE REVIEW

2.1. Design and Analysis of Residential Building(G+3)

Ibrahim, et.al (April 2019)

Design and Analysis of Residential Building(G+3): After analyzing the G+4 story residential building structure, conducted that the structure is rate in loading like dead load, live load, wind load and seismic loads. Member dimen sions (Beam, column, slab) are assigned by calculating the load type and its quantity applied on it. Auto CAD gives detailed information at the structure members length., height, depth, size and numbers, etc. STADD Pro.

2.2. Planning, Analysis and Design of Res idential Building(G+2) By using STAAD Pro:

Dunnala Lakshni Anuja, et.al (2019)

Planning, Analysis and Design of Res idential Building(G+2) By using STAAD Pro: Frame analysis was by STAAD-Pro. Slab, Beams, Footing and stair-case were design as per the S Code 456-2000 by LSM. The properties such as share defiection torsion, devel opment length is with the IS code provisions. Design of column and footing were done as per the IS 456-2000 along with the SP-16 design charts. The check like oneway shear or two-way shear within IS Code provision.

2.3. A Study on Design of Multi-Storey Residential Building:

Mr K. Prabin Kumar, et.al (2018)

A Study on Design of Multi-Storey Residential Building: They used STADD Pro. to anal ysis

and designing all structure member and calculate quantity of reinforcement needed for concrete section. Various structure action is considered as members such as axial, flexure, shear and tension.

2.4. Analysis and Design of a (G+2) MultiStorey Building Using STAAD Pro Deevi Krishna Chaitanya, et.al January, 2017

Analysis and Design of a (G+2) MultiStorey Building Using STAAD Pro:They used static indeterminacy methods to calculate numbers of unknown forces. Dis tributing known fixed and moments to satisfy the condition of compatibility by Iteration method. Kanis method was used to distribute moments at successive joints in frame and continues beam for stability of members of building structure.

2.5. Analysis and Design of Primary School building

A.V. Deepanchakaravarth (2021)

"Analysis and Design of Primary School building" This project is to design a primary school building that can hold a total strength of 500 500 students, with proper infrastructure provided. Our project is designed to be located at Othakadai village, at the foot hills of anaimalai. This primary school building is designed to benefit the children dwelling in and around Othakdai.

CHAPTER-3

OBJECTIVES

- To evaluate the effect of different loads such as dead load, live load, wind load, and seismic load on the structure.
- To determine structural responses such as bending moment, shear force, axial force, and deflection under various load combinations.
- To design structural components such as beams columns, slabs, and footings as per IS 456.
- To compare the results obtained from manual calculations and STAAD.Pro analysis.

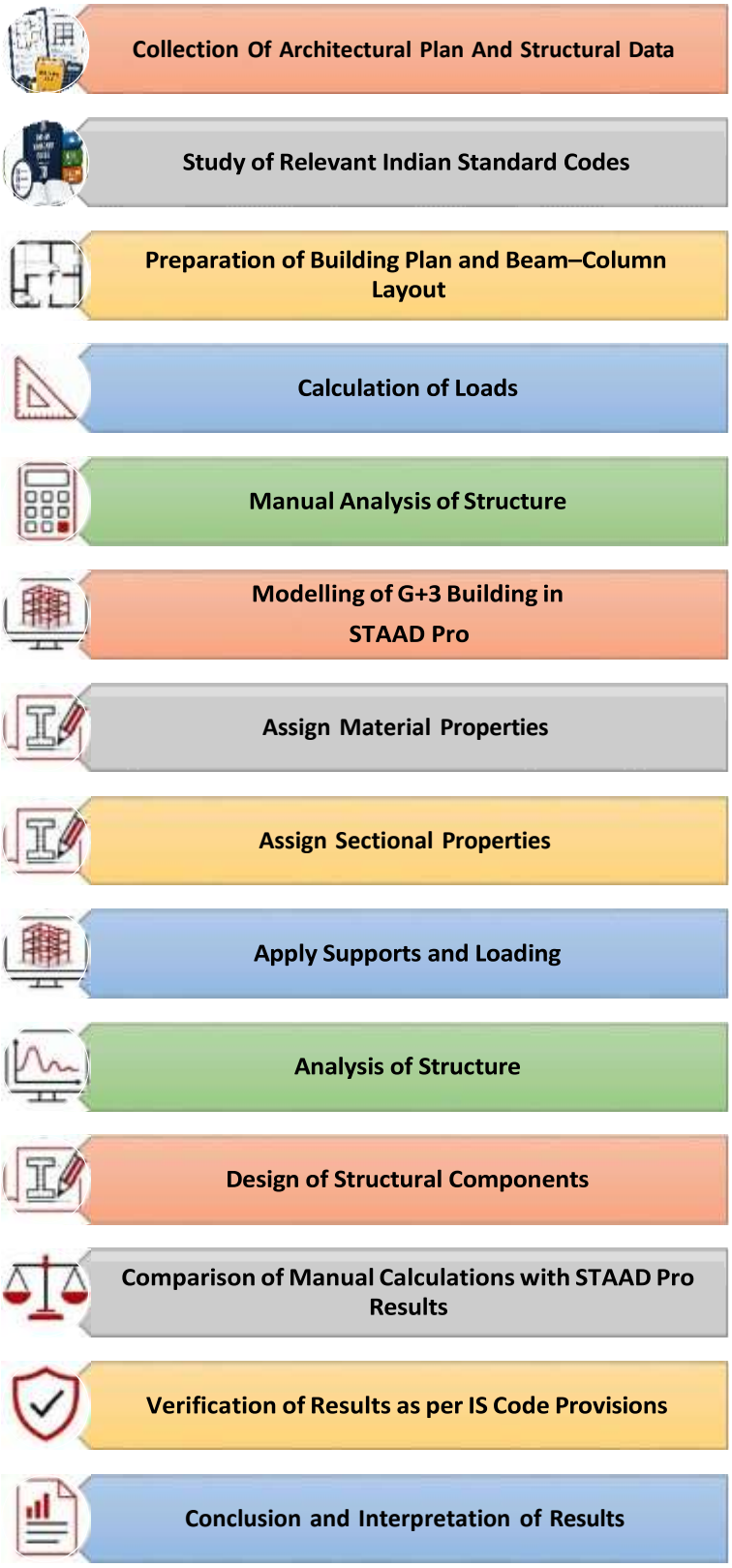
CHAPTER-4

PROPERTIES ASSIGNED

Sl. No	Purpose	Command
1	Define Material	DEFINE MATERIAL START
2	Assign Beam Property	MEMBER PROPERTY
3	Assign Column Property	MEMBER PROPERTY
4	Assign Slab Thickness	ELEMENT PROPERTY
5	Assign Supports	SUPPORTS FIXED
6	Assign Self Weight	SELFWEIGHT Y -1
7	Assign Dead Load	LOAD DEAD LOAD
8	Assign Live Load	LOAD LIVE LOAD
9	Assign Floor Load	FLOOR LOAD
10	Define Seismic Load	DEFINE 1893 LOAD
11	Assign Seismic Load	1893 LOAD X 1
12	Perform Analysis	PERFORM ANALYSIS
13	Print Results	PRINT MEMBER FORCES
14	Start Concrete Design	START CONCRETE DESIGN
15	Design Beam	DESIGN BEAM
16	Design Column	DESIGN COLUMN

CHAPTER-5

Methodology



CHAPTER-6

1. EXPECTED OUTCOME

- Determination of structural responses such as bending moment, shear force, axial force, and deflection under different loading conditions.
- Analysis of the G+3 RCC building under dead load, live load, wind load, and seismic load using STAAD.Pro.
- Design of RCC structural members such as beams, columns, slabs, and footings as per IS 456.
    - Comparison of manual design results with STAAD.Pro analysis and design results.
    - Evaluation of accuracy, efficiency, and reliability of software-based structural analysis.
- Achievement of safe, stable, and economical structural design under critical load combinations.

CHAPTER-7

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3. Mr. K. Prabin Kumar et al. (2018), A Study on Design of Multi-Storey Residential Building. https://www.scribd.com/document/582530556/Plan-and-Design-of-a-Residential-Building

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6. IS 456:2000 – Plain and Reinforced Concrete Code of Practice. https://www.bis.gov.in

7. IS 875 – Design Loads for Buildings and Structures.
https://www.bis.gov.in

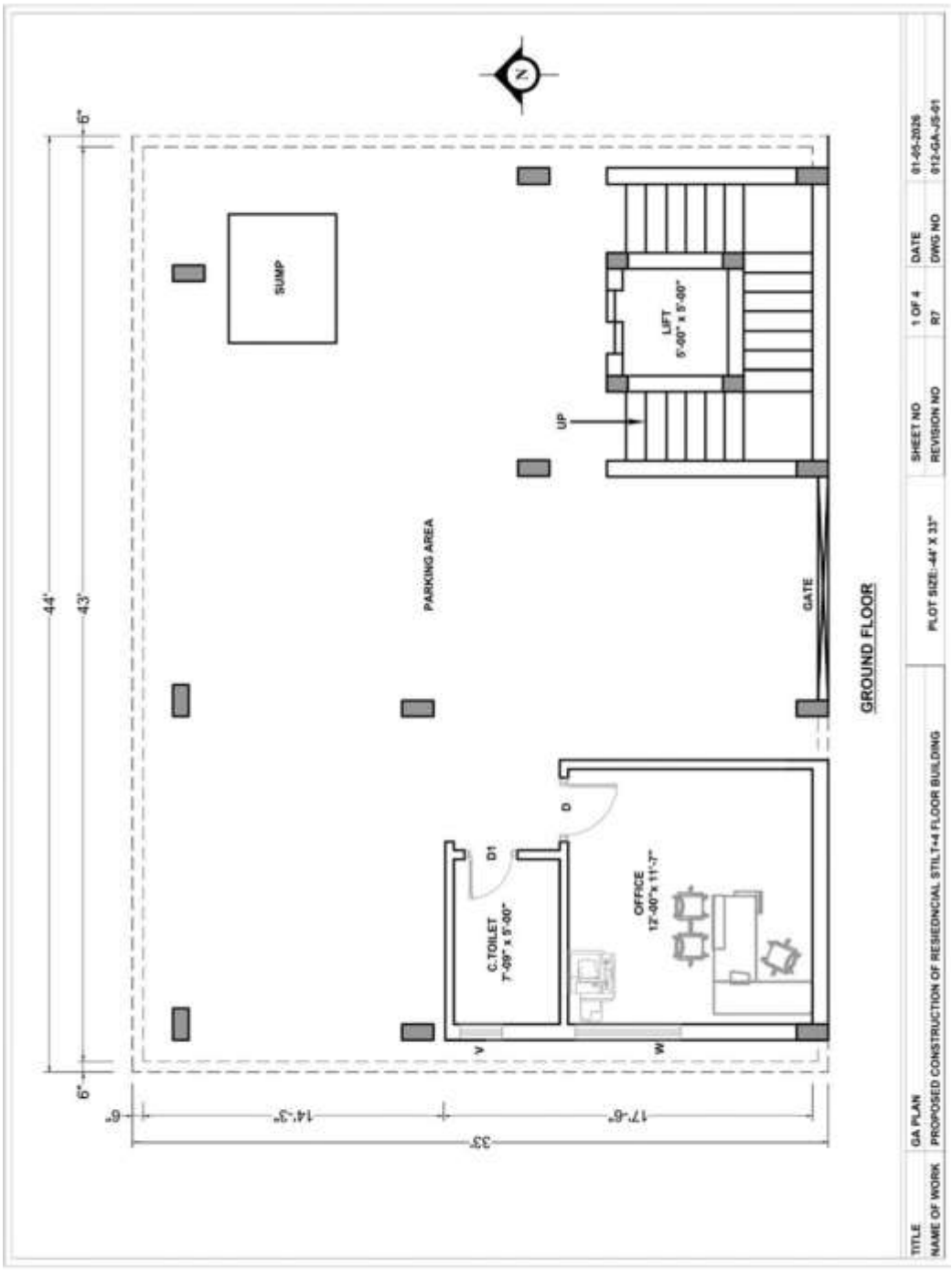
8. IS 1893:2016 – Earthquake Resistant Design of Structures.
https://www.bis.gov.in

9. STAAD.Pro Official Website.
https://www.bentley.com/software/staad/

10. AutoCAD Official Website.
https://www.autodesk.com/products/autocad/overview

Assuming Details:

Sl. No	Parameter	Data
1	Building Type	G+3 Residential Building
2	Building Size	13.19 m × 8.67 m
3	Number of Stores	Ground + 3 Floors
4	Slab Thickness	125 mm
8	Height of Each Floor	3.2 m
9	Total Height of Building	12.8 m
10	Grade of Concrete	M25
11	Grade of Steel	Fe550
12	Unit Weight of RCC	25 kN/m³
13	Unit Weight of Brick Masonry	18 kN/m³
14	Type Of Soil	Sandy silt with gravel
15	Safe Bearing Capacity (SBC)	250 kN/m²
16	Depth Of Excavation	2.1m form GL



Plan:

Fig-1: Ground floor

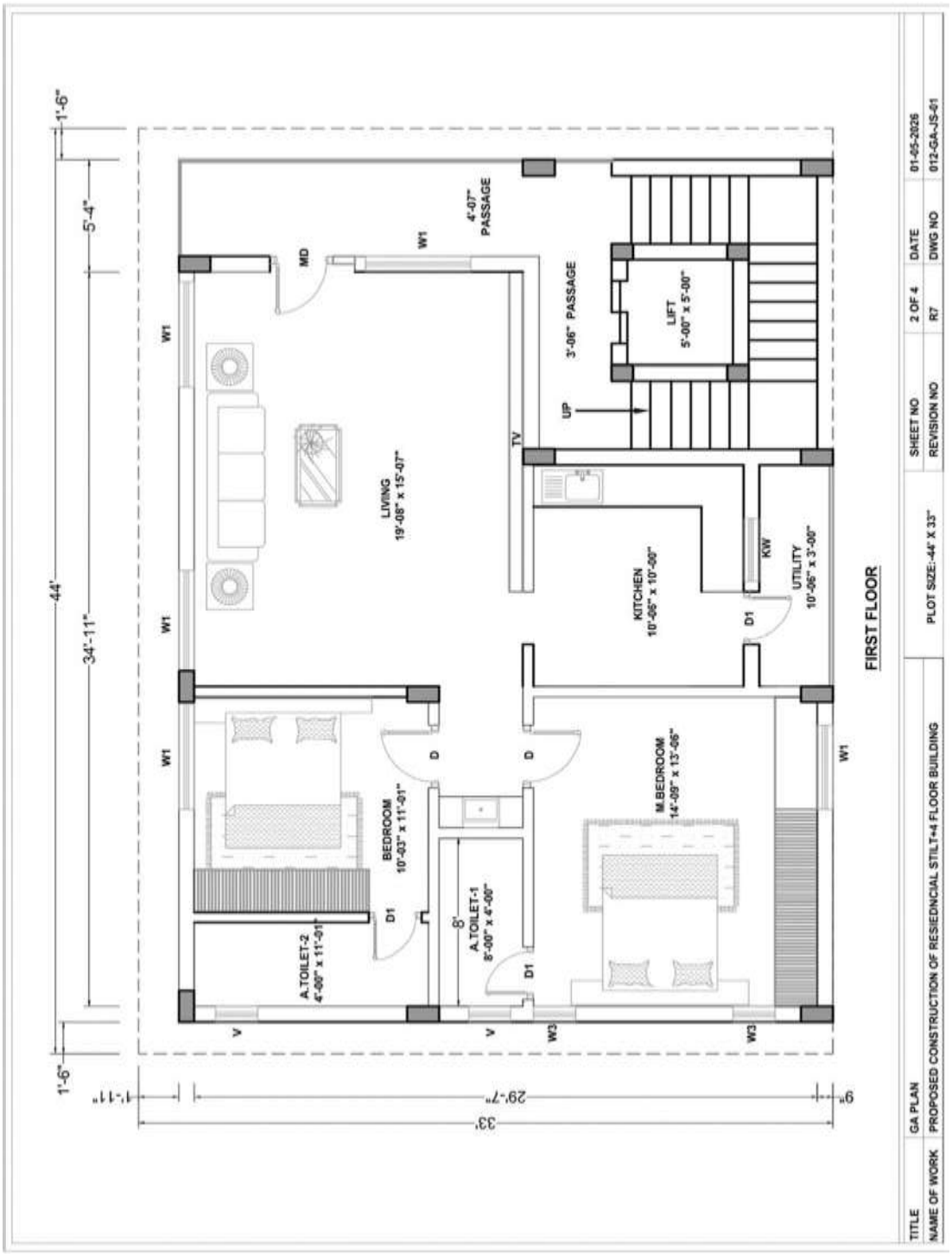


Fig-1: First floor

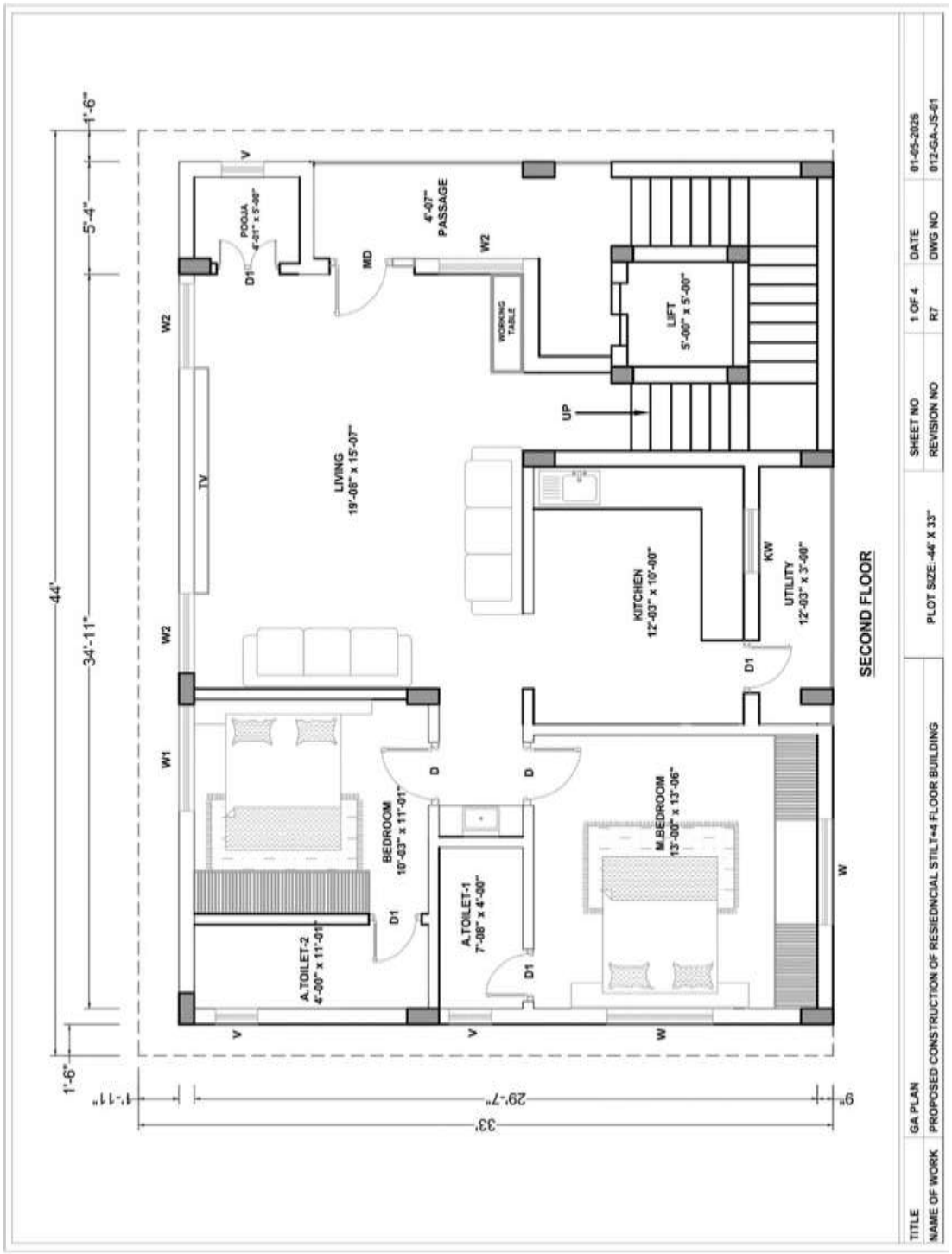


Fig-3: Second Floor

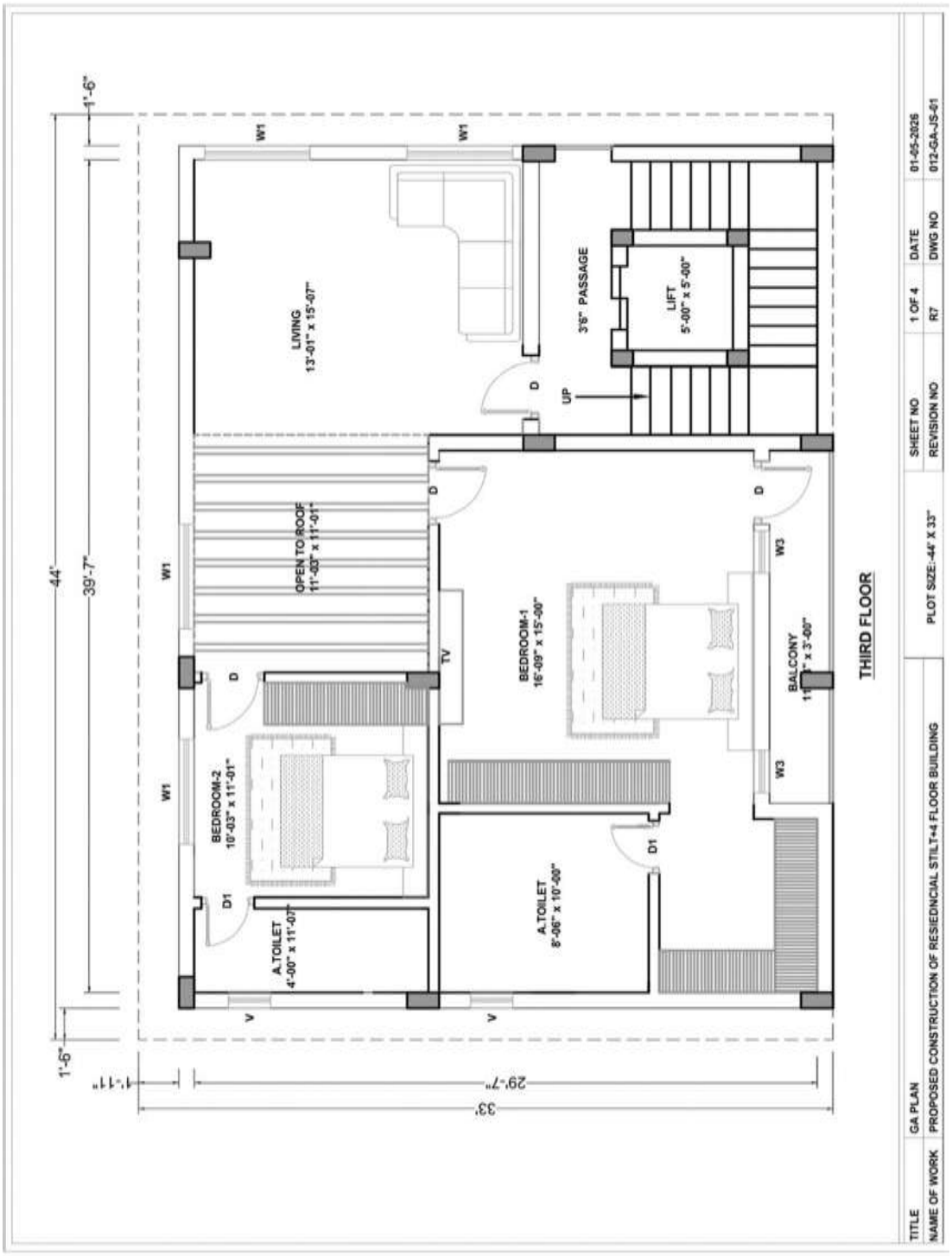


Fig-5: Third Floor

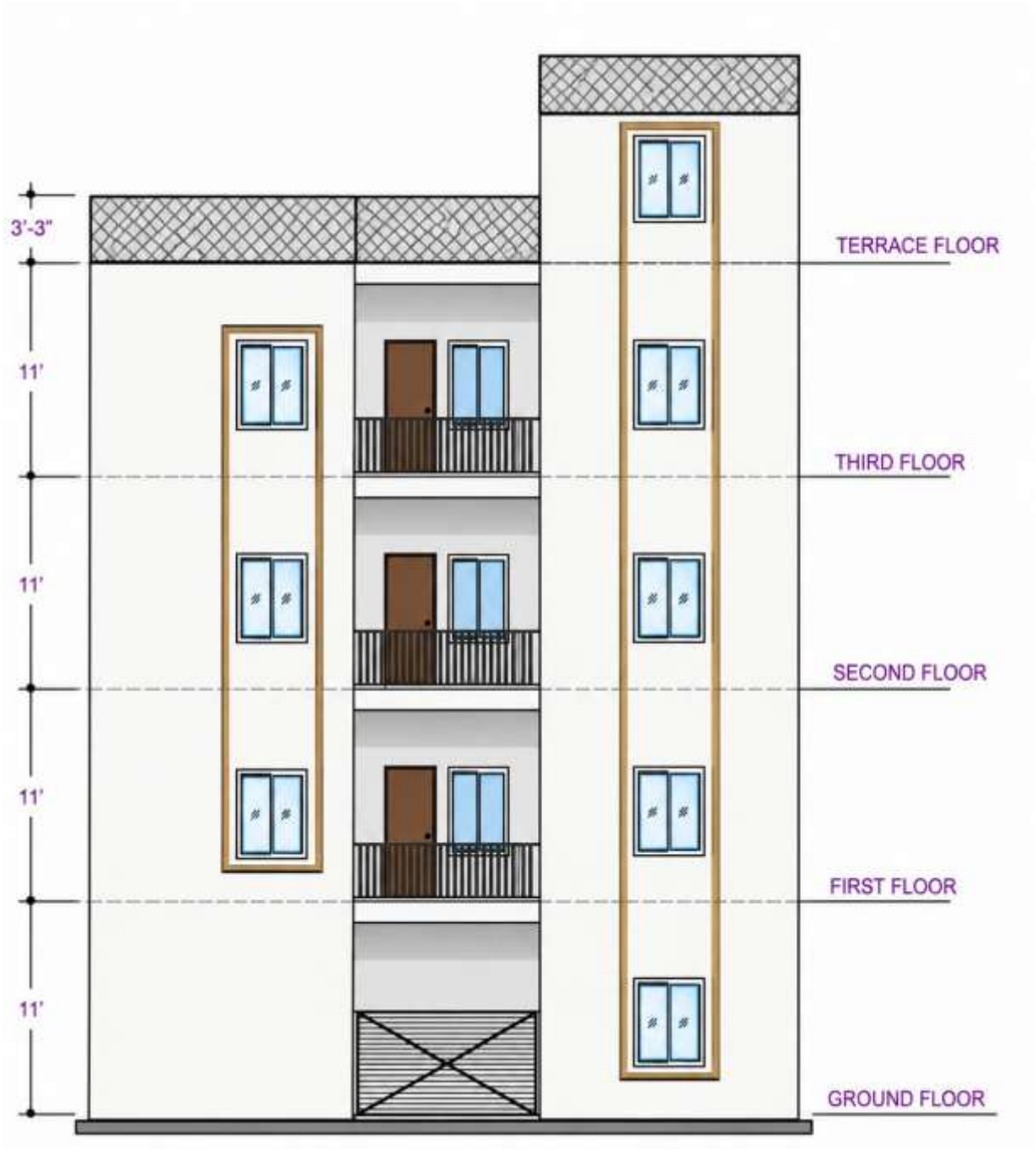


Fig-5: Elevation

Fig-6: Cross Section

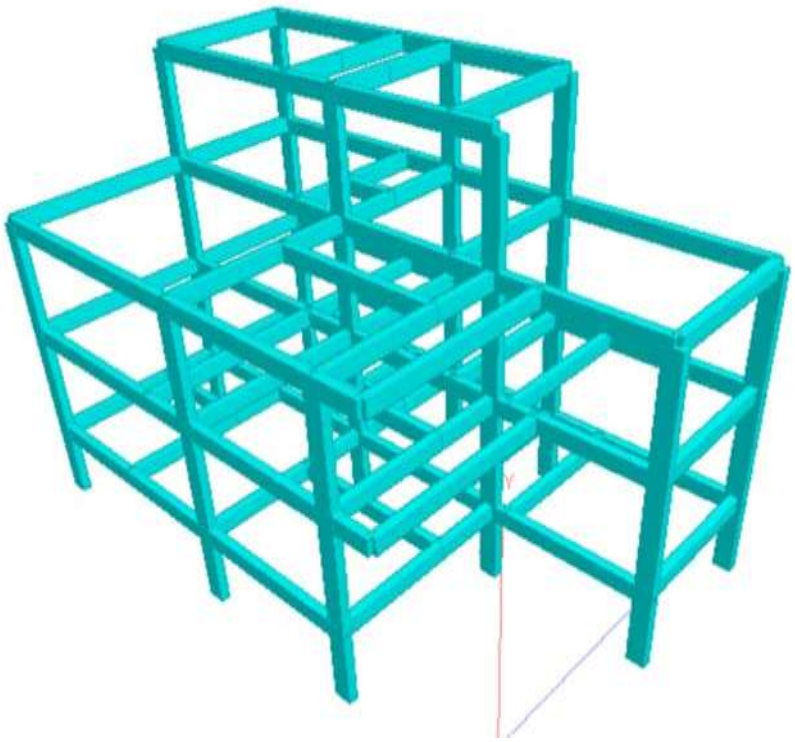


Fig-7: 3D Modelling

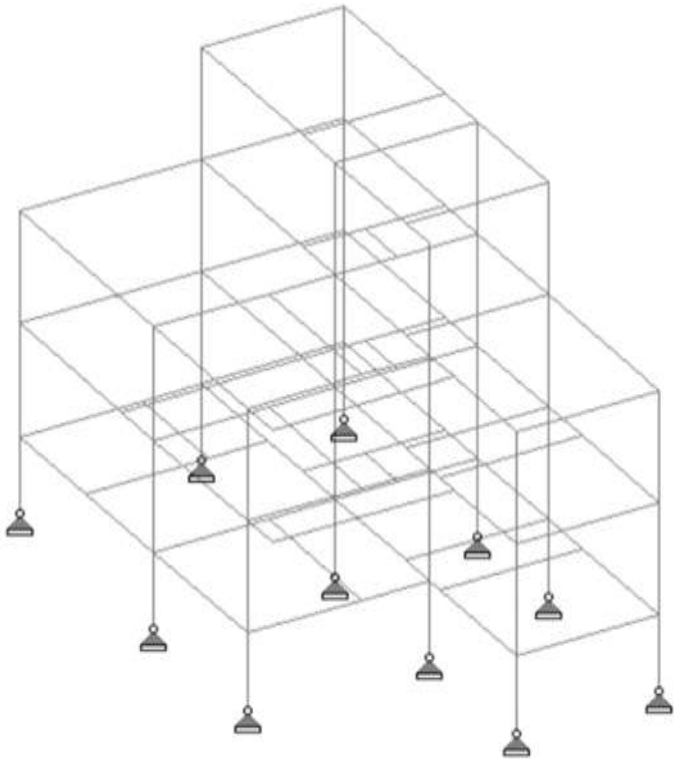


Fig-8: 2D Modelling