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Analysis and Design of L-Shaped G+5 RCC Framed Structure using Staadpro

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Abstract

In order to compete in the ever-growing competent market, it is very important for a structural engineer to save time. As a sequel to this an attempt is made to analyze and design a multistoried building by using a software package STAAD PRO. For analyzing a multistoried building, one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. The principle objectives of this project is to create G+5 asymmetric RCC framed structure dead load, live load and seismic load and apply them to the structure for analyzing and then design beams, columns and slab for the given loads. By the end of the project, we conclude with maximum shear force, bending moment and deflections values and beam, column and slab are designs with A_{st} are provided with STAADPRO.

Keywords: *STAAD-Pro, Bending moment, Shear force, Displacement.*

1. Introduction

The enormous increase in population and scarcity of land makes the people to move from ruralareas to urban paces and construction of multi-storied buildings in small areas is being commonnow-a-days. Functional designing of the building has become very important and the requirements vary from one building to another. Every Civil Engineer should know the usage of the buildings by contacting the people and basic principles of designing of the R.C.C structures. This is project is intended at Analyzing and designing the multi-storey structure using STAAD.PRO V8i and STAAD. ETC.

Symmetric and Asymmetric Structures:

Symmetric: In architecture, symmetry is the reflection of shared forms, shapes, or angles across a central line or point called the axis. Basically, components that mirror each other across an axis are symmetrical. This is one of the oldest and most continuously used ordering principles in architecture.

Asymmetric: Asymmetry is the absence of, or a violation of, symmetry (the property of an object being invariant to a transformation, such as reflection). Symmetry is an important property of both physical and abstract systems and it may be displayed in precise terms or in more aesthetic terms.

The loads considered are Dead load, Live load, Seismic load.

Base Shear: Base shear is the maximum expected lateral force that will occur due to seismic ground acceleration at the base of the structure. The base shear, or earthquake force, is given by the symbol “VB”. The weight of the building is given as the symbol “W”.

Damping Ratio:Damping Ratio is dimensionless parameter which describes how an oscillating or vibrating body comes to rest.

2. Methodology

Planning of asymmetrical framed structure.

Material & geometric properties.

Assigning the loads & load combination on framed structure

Modeling of asymmetrical framed structure

Analysis of asymmetrical framed structure

Design of asymmetrical framed structure..

3.1. Material Properties

Material properties are assumed as 25MPa for concrete compressive strength and 415Mpa for yield strength of reinforcing steel for all the models used in the study. Elastic properties of these materials are taken as per Indian standard IS: 456- 2000.

Table 1 Material Properties and Structural components

Property / Structural component	Value
Yield strength of steel, f_y	415
Compressive strength of concrete, f_{ck}	M20
Modulus of elasticity of steel. E_s	200000MPa
Modulus of elasticity of concrete, E_c	223606.67 MPa
Slab Thickness	120mm
Unit weight of concrete	25 KN/m^3

3.2. Building Configuration Properties

Each bay size is taken as 5m x 5m.

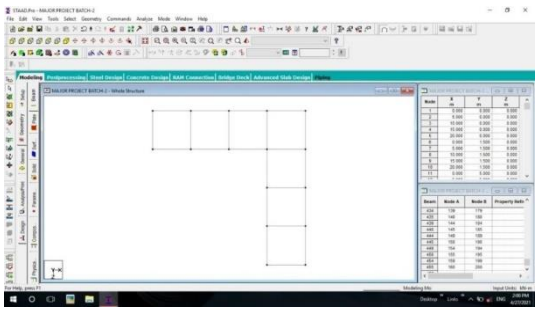


Fig.1 Plan of the Structure

3.3. Loads Considered:

1) Seismic load - Earthquake load in x – direction and (IS 1893 – 2002)Earthquake load in z- direction
2) Dead load - self weight of structure (IS 875 Part – I) it includes self weight of beam and column
3) Self weight of slab=3KN/m^2
4) External wall load=15KN/m^2
5) Internal wall load=7KN/m^2
6) Live load (IS 875 Part – II)
   a) Floor live load =4.48KN/m^2
   b) Roof live load =2.3KN/m^2
   it includes floor finishing, Roof finishing, ceiling finishing.

3.4 Analysis

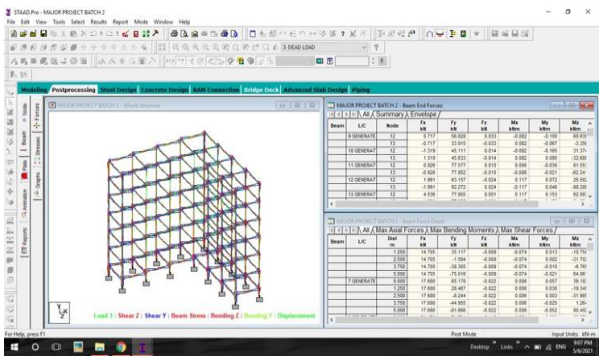


Fig:2 Shear force diagram

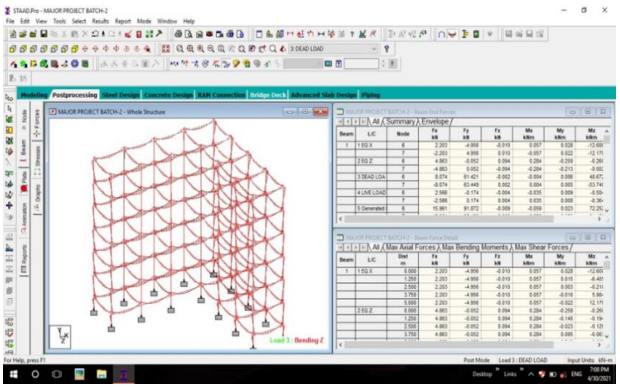


Fig:3 Bending moment diagram

3.5. Design

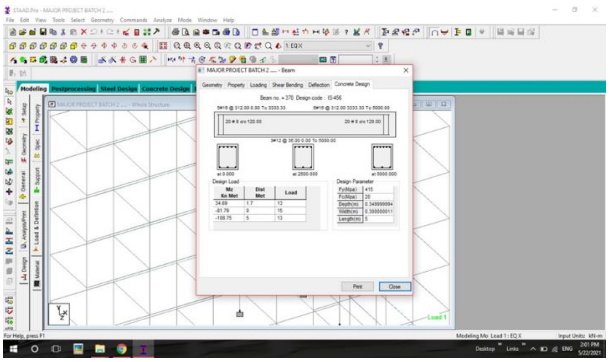


Fig: 4 Design of beam

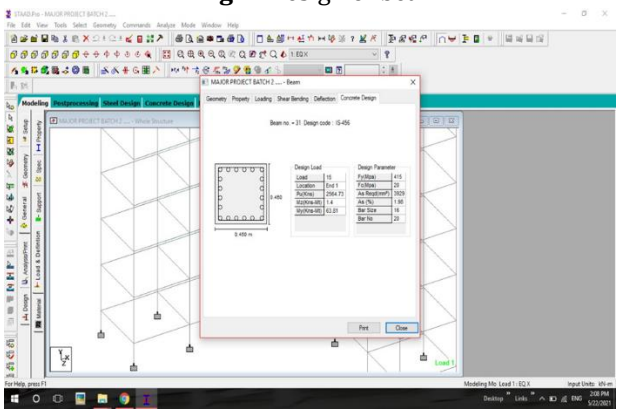


Fig:5 Design of column

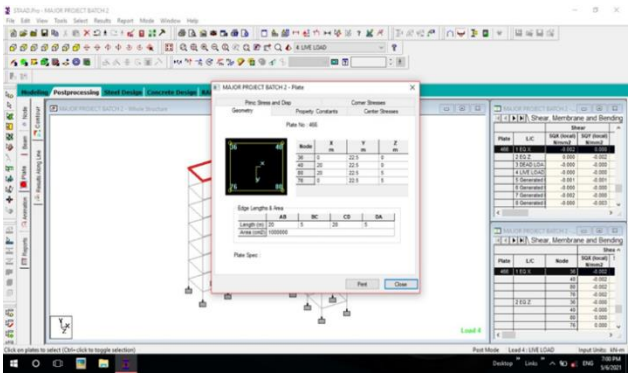


Fig:6 Design of slab

4. Results & Discussions:

4.1. Base shear Evaluation:

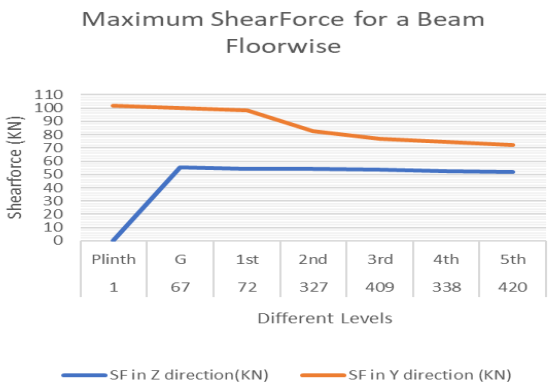
Table 2 Base shear values

Zone Z	Time(sec) T= 0.09h/ √d	S_a/g	Ah	Weight of structure (KN)	Base shear V_b=AhxW(KN)
2	0.10	0.45	2.50	0.025	W_1=410
2	0.10	0.45	2.50	0.025	W_2=2915.75
2	0.10	0.45	2.50	0.025	W_3=2864.75
2	0.10	0.45	2.50	0.025	W_4=2570.75

4.2. Maximum Shear Fore:

Table 3 Maximum shear force values

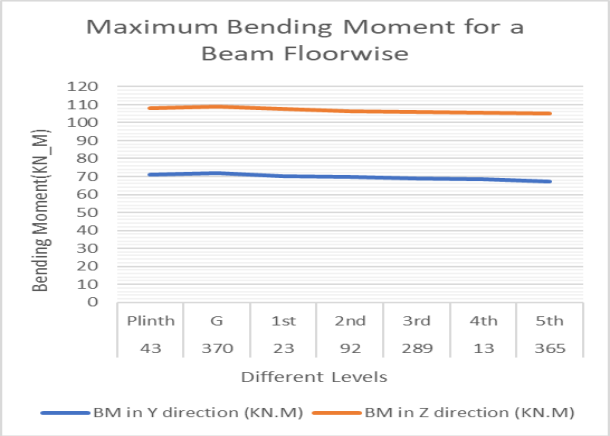
Sl. No	BEAM	Floor	SF in Z direction (KN)	SF in Y direction (KN)
1	31	Plinth	52.3	102.73
2	226	G	51.64	101.28
3	103	1st	51.17	100.56
4	109	2nd	50.50	99.35
5	115	3rd	49.06	98.07
6	123	4th	48.28	94.26
7	61	5th	48.09	89.18



4.3 Maximum Bending Moment

Table4. Maximum Bending Moment values

Sl. No	Beam No	Floor	BM in Y direction (KN.M)	BM in Z direction (KN.M)
1	43	Plinth	71.25	108.24
2	370	G	71.90	108.747
3	23	1st	70.04	107.66
4	92	2nd	69.67	106.43
5	289	3rd	69.08	105.93
6	13	4th	68.62	105.72
7	365	5th	67.33	104.88



4.4 Maximum Deflection

Table5 Maximum Deflection values

	BEAM	L/C	d(mm)	X (mm)	Y(mm)	Z(mm)
Max X	280	12:GENER-ATE	0.000	34.082	-6.724	-0.076
Max Y	344	4:LIVE LOAD	2.500	-0.093	2.394	2.396
Max Z	25	13:GENER-ATE	0.000	0.286	-7.223	33.896

4.5 Area of Steel

Table6 Area of steel provide for a Beam

BEAM NUMBER	SIZE OF CROSS SECTION OF BEAM (mm)	Ast REQUIRED	BEAM NUMBER
67	300x350	1507.78	1734.155
370	300x350	1474.38	1545.66

Table7 Area of steel provided for a column

COLUMN NUMBER	SIZE OF CROSS SECTION OF COLUMN (mm)	Ast REQUIRED	COLUMN NUMBER	SIZE OF CROSS SECTION OF COLUMN (mm)
31	450X450	3929.52	4021.24	31
289	450X450	3524.71	3619.11	289

Conclusions

Analysis:

1)The maximum shear force in z direction F_z=102.214 KN

2)The maximum shear force in Y direction F_y=55.216 KN
3)The maximum bending moment in Z direction M_z=108.747 KN-M
4)The maximum bending moment in Y direction M_y=81.545 KN-M
5)The maximum deflection in X direction is 34.739 mm
6)The maximum deflection in Y direction is 2.393 mm
7)The maximum deflection in Z direction is 34.658 mm

Design:

1) Area of steel provided for maximum design forces for a beam and the beam cross section is 300mmx350mm
   a) A_{st} provided for maximum shear force is 1734.155 sq.mm (beam no : 67)
   b) A_{st} provided for maximum bending moment is 1545.66 sq.mm (beam no:370)
2) Area of steel provided for maximum design forces for a column and the column cross section is 450mmx450mm
   a) A_{st} provided for maximum shear force is 4021.24 sq.mm (column no:31)
   b) A_{st} provided for maximum bending moment is 3619.11sq.mm(column no:289)
3) Area of steel provided for maximum design forces for a beam and the column cross section is 300mmx350mm
   a) A_{st} provided for maximum deflection in x direction is 1099.55 sq.mm (beam no :25)
   b) A_{st} provided for maximum deflection in y direction is 1218.93 sq.mm (beam no :280)
   c) A_{st} provided for maximum deflection in z direction is 1244.07 sq.mm (beam no :344)

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