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Comparison between Manual calculation and Software calculation of G+5 Building Using Staad pro

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Abstract - *Earthquakes are known to produce one of the most destructive forces on earth. It has been seen that during past earthquakes many of the building were collapsed. Therefore, realistic method for analysis and design are required. Performance Based Design is the modern approach for earthquake resistant design. It is an attempt to predict the performance of buildings under expected seismic event. In this present study a G+5 multi-storeyed hospital building is analysed by seismic action situated at different zone. It involves the calculation of load and total Seismic weight of building from that the base shear is calculated in different zone.*

Key Words: **Analysis and comparison, Earthquake Behaviour, STAAD Pro, Base Shear**

1. INTRODUCTION

Buildings constitute a part of the definition of civilizations, a way of life advanced by the people. The construction of buildings should be looked upon as a process responded to human requirements rather than as a product to be designed and built a great expense.

It is well known fact that users of any software for structural analysis and Design do not know whether the program is having any bugs or its correctness while using. Since any program developed may contain some error or bugs it is necessary for the users to check the model and analysis and design results manually.

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure.
Earthquake-resistant structures are structures designed to withstand earthquakes. While no structure can be entirely immune to damage from earthquakes, the goal of earthquake-resistant construction is to erect structures that fare better during seismic activity than their conventional counterparts. The main objectives of earthquake engineering are:

- Forces the potential consequences of strong earthquakes on urban areas and civil infrastructure.
- Design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes

1.1 Objective

- To compare the results of base shear by manual analysis and Staad
- The input data while modelling the structures is correct.
- The assumed and the input loads on the structure are in par with the actual condition of the structure.
- The support condition considered are as per site condition.

1.2 Features of Staad pro

- Quality Assurance
- Broad Collection of design codes
- Covers all aspects of structural engineering
- Reports and Documentation

2. Methodology

Determination of design earthquake forces is computed by the following methods:

1. Equivalent static lateral method
2. Dynamic Analysis

In the first method, different partial safety factors are applied to dead, live, wind earthquake forces to arrive at the design ultimate load. In the IS: 456-2000 code, while considering earthquake effects, wind loads assuming that both severe wind and earthquake do not act simultaneously. The American and Australian code recommendations are similar but with different partial safety factors.

The dynamic analysis involves the rigorous analysis of the structural system by studying the dynamic response of the structure by considering the total response in terms of component modal responses.

3. Load Calculation

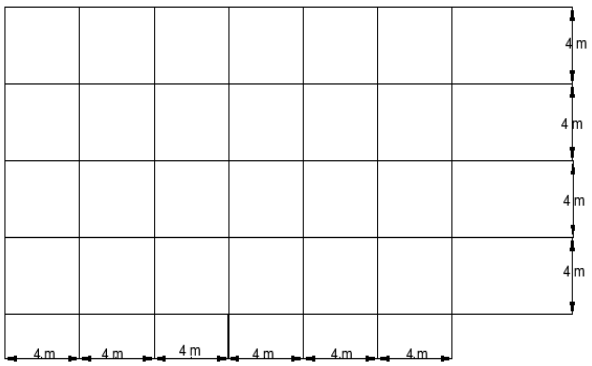

Fig -1: AutoCAD Plan

I. Dead load

a) Floor Load

Slab Load

Self-weight of slab = 3.75 kN/m^2

Floor finish = 1.5 kN/m^2

Total Load = 5.25 kN/m^2

Terrace Load

Self-weight of slab = 3.75 kN/m^2

Floor finish + Water proofing = 1.5 kN/m^2

Total Load = 6.95 kN/m^2

b) Wall Load

External Wall of 230mm thick

Floor height = 4000 mm

Beam depth = 0.75 m

Total Load

[2 (4 – 0.75 – 0.75)6 + 2(4 – 0.15- 0.15)4] ×0.23 × 20

= 274.16 kN/m

Internal Wall of 115mm thick

Floor height = 4000 mm

Beam depth = 0.75 m

Total Load

[2 (4 – 0.75 – 0.75)6 + 2(4 – 0.15- 0.15)4] ×0.115 × 20

= 273.70 kN/m

c) Beam Load

Longitudinal beam

Self-weight of beam = 25*.75*.3

Total load

(6 × 5) × (4 – 0.75 -0.75) ×5.63 = 422.25 kN/m

Transverse Beam

Self-weight of beam = 25*.75*.3

Total load

(4×7) × (4 – 0.75 -0.75) ×5.63 = 583.27 kN/m

d) Column Load

Self-weight of Column = 25*.75*.75*35

Total Load = 492.18 kN/m

e) Parapet wall

Total load

= (24×2 + 16×2)

×0.115×20

= 184 KN

II. Live Load

Load on floor =24 × 16 × 0.5 ×4

= 768 KN

- **Weight of floor**

[2016 + 422.25 +
583.27+2×445.51+2×444.76+2×984.36]+768

=7537.85 KN

- **Weight of roof**

[2668.80 + 422.25 + 583.27 + 184 ×1 + 274.16 ($\frac{4-0.75}{2}$)

+ 273.70 ($\frac{4-0.75}{2}$) + 492.18 ×$\frac{4}{2}$] + 0

=5732.05 KN

- **Total Seismic weight of building**

= Weight of roof + 4*Weight of floor

= 5732.05 + 4 × 7537.85

=35883.45 KN

3.1 Seismic Load Calculation

Table-1: Base shear results (manual)

Zone	2	3	4	5
ZONE FACTOR	0.10	0.16	0.24	0.36
I	1.5			
R	5			
SOIL TYPE	Soft			
h (m)	20			
W (KN)	35883.45			
Ta in (X) =0.075(h*0.75)	0.709			
Sa/ g =1.67 /T	2.36			
Ah =(ZI/2R) (Sa/ g)	0.035	0.05 7	0.084	0.127
Vb (X) = W *Ah (kN)	1255.9	2045	3014.2	4557.1

4. Building Modeling in Staad pro

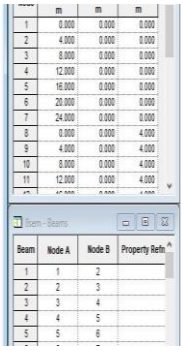

Fig-2: Staad Plan of G+5 Building

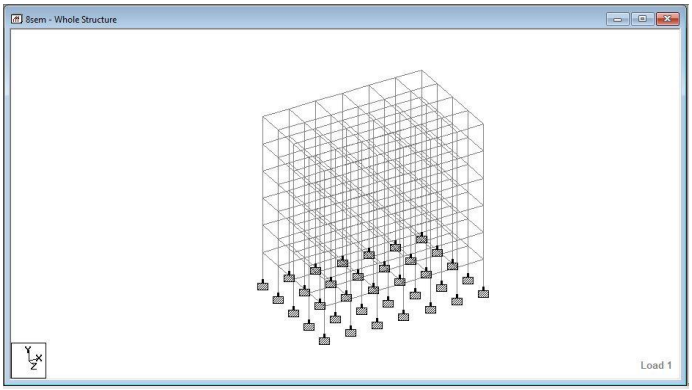

Fig-3: G+5 Building

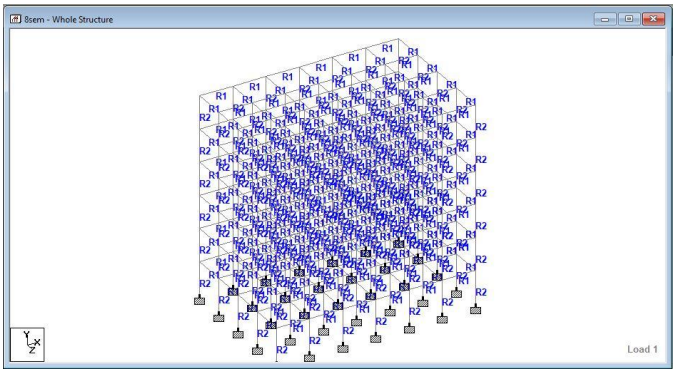

Fig-4: Assign Properties of Concrete Members

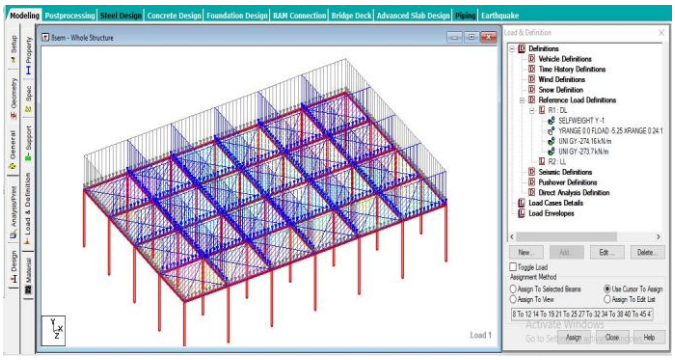

Fig-5: Assigning Loading

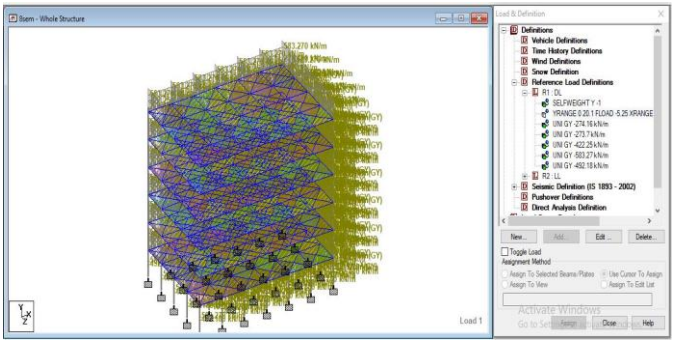

Fig-6: Magnitude of load

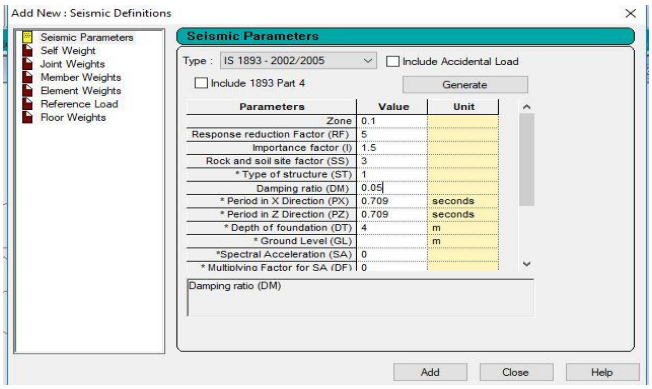

Fig-7: Generation of seismic zone

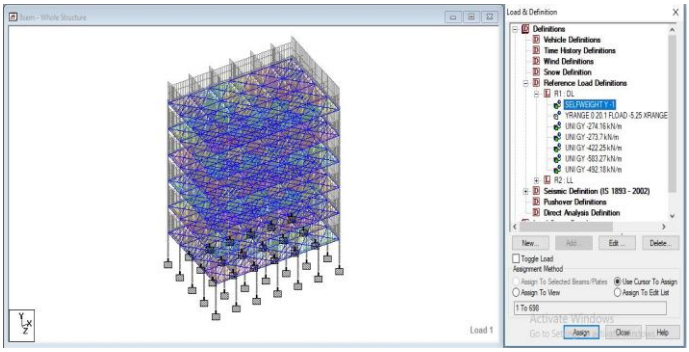

Fig-8: Load Assigning

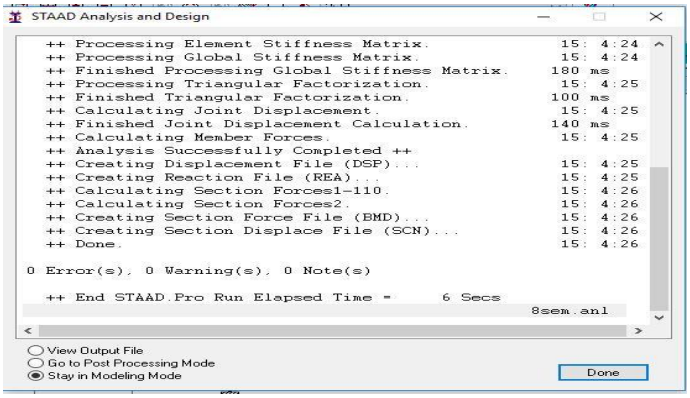

Fig-9: Performance of Analysis

4.1 Base shear by Staad pro

Table-2: Base shear by Staad pro

Ah	Actual weight of building	Lateral load	Vb=(Ah*W)
0.127	18512.314	36516.594	4637.607
0.0848	18512.314	35659.394	3023.917
0.0565	18512.314	36802.537	2079.343
0.0353	18512.314	36373.863	1283.997

5. Comparison between results of Base shear

Table-3: Base shear results

ZONE	MANUAL	STAAD PRO
2	1255.92 kN	1283.99 KN
3	2045.36 kN	2079.34 kN
4	3014.21 kN	3023.92 kN
5	4557.19 kN	4637.61 kN

6. RESULTS

Table-4: Comparison of base shear results

Zone	Manual	Staad	%Increment
2	1255.92	1283.99	2.18
3	2045.36	2079.34	1.63
4	3014.21	3023.92	0.32
5	4557.19	4637.61	1.73

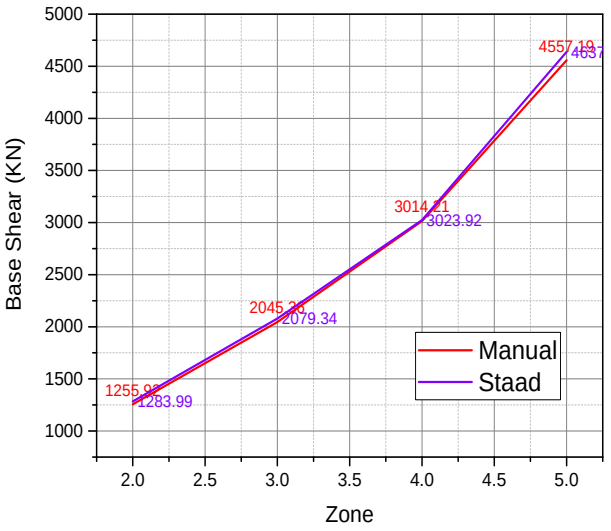

Fig-10: Zone v/s Base shear

7. CONCLUSION

The above checks can help to a greater extend and it makes sure that the user has modeled the structure with no mistake and further that there is no error in the input. After running the analysis also a simple check on the result can be made using the available formulae.

- Manual analysis results are compared with the STAAD results and identified that the variation is at max 3%.
- The value of base shear in Staad is more than the value of base shear by manual analysis.
- Always better to know two or more than a single software so that a counter check can be made especially for a large and mega projects to avoid suspicious results and to continue his design with peace of mind.

8. REFERENCES

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