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COMPARISON BETWEEN VALUES OF BASE SHEAR OBTAINED FROM STAAD.PRO & MANUAL CALCULATONS

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ABSTRACT

An earthquake is the sudden release of strain energy in the Earth's crust, resulting in waves of shaking that radiate outwards from the earthquake source. The earthquake is a one of the most destructive natural disasters in all over the world. It has taken millions of lives and caused huge damages to infrastructures. Since the earthquake forces are random in nature and unpredictable, so it is important to analyse structures under the action seismic forces. This paper deals with comparison of base shears values obtain from manual method & STAAD. Pro software. For the study 10 Storey RC building is considered & building is situated in Zone III. The seismic analysis of building is done by Equivalent Lateral force method/Static method. This paper shows the how much variation between the software and manual method.

1. INTRODUCTION

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. Base shear is the estimation of maximum expected lateral forces that will occur at the base of structure due to ground motion during the earthquake & it is important parameter to calculate as a result of structural analysis. The objective of this study is to make a comparative study between STAAD. Pro & manual method of base shear.

2. LITERATURE REVIEW

A) **M.A. Qureshi, Nidhi Bhavsar, Pratiksha Chaudhari, Parth Panchal, Siddharth Mistry, Ankit Makadia,** discussed the behaviour of multi-storey buildings having floating columns under seismic forces (static). A G+5 multi-storey hospital is considered for seismic analysis located in different seismic zones. Variation between manual calculation & staad calculation is about 3%. The values of base shear obtain from staad pro software is greater than values obtain from manual calculations.

B) **Vaibhav Prasad K, Pradeep Karanth, K. Anil Hegde, Mahesh Halsnad**, Volume 2, Issue 3, pp: 517-520, discussed the behaviour of multi-storey buildings having floating columns under seismic forces (static). For the study G+3 building is consider & analysis is done by manual calculations & ETABS software. The aim of this study is to findout the percentage variation between the methods. Results & calculations from ETABS shows maximum values of base shear as compare to manual method.

3. OBJECTIVE

A) To check the input data in STAAD. Pro software is correct or not.
B) For maintaining accuracy of analysing & designing work.

4. MODELLING & CALCULATIONS

4.1 Modelling of building –

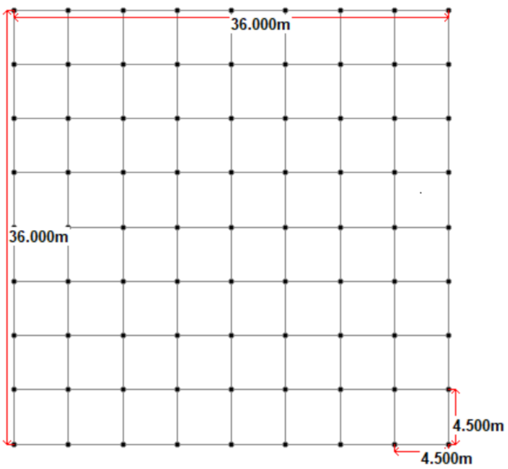

Fig. 4.1.1 Plan at Ground level

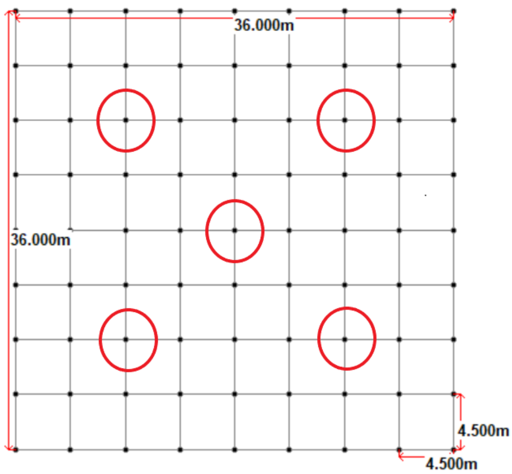

Fig. 4.1.2 Plan shows Floating columns

4.2 Building Parameters –

Table No. 4.2.1 Building Parameters

Parameters	Values
No. of Storey	10
Length of Building	36 m
Breadth of Building	36 m
Height of Building	30 m
Height of Each Storey	3.00 m
Height of Foundation Below GL	3.00 m
No. of Bays Along X-Direction	4.5 m
No. of Bays Along Z-Direction	4.5 m
Size of Beams	380 x 600 mm
Size of Beams (Under FC)	550 x 600 mm
Size of Columns	550 x 550 mm
Slab Thickness	150 mm
Material's	M25 & Fe500

A) Manual Method

Step-by-step process for equivalent static analysis method -

Step 1) Design Parameters –

i) Zone Factor (Z) – As the building located in zone III
(From IS 1893 (Part I) 2002, Table No. 2, Clause No.6.4.2)
Z = 0.16

ii) Importance Factor (I)
(From IS 1893 (Part I) 2002, Table No. 6, Clause No.6.4.2)
For all other building
I = 1.0

iii) Response Reduction factor (R)
(From IS 1893 (Part I) 2002, Table No. 7, Clause No.6.4.2)
Frame system – SMRF
R = 5.0

Step 2) Calculation of time period –

(From IS 1893 (Part I) 2002, Clause No.7.6.1)

For MRF building (without any masonry infill walls)

$T_a = 0.075h^{0.75}$

$T_{ax} = T_{az} = 0.075(30)^{0.75}$

$T_{ax} = T_{az} = 0.96$ sec

For medium soil & $T_a = 0.96$

(From IS 1893 (Part I) 2002, Clause No.6.4.5)

$S_a/g = 1.36/T$ ………. $(0.4<T<4)$

$= 1.36/0.96$

$= 1.42$

Step 3) Calculation of design horizontal coefficient (A_h) –

(From IS 1893 (Part I) 2002, Clause No.6.4.2)

$A_h = (Z*I*S_a)/(R*g*2)$

$= (0.16*1.0*1.42)/ (5.0*2)$

$= 0.0227$

Step 4) Calculation of seismic weight (W) –

a) Self-weight of slab = thickness*density

= 0.125*25

= 3.125 KN/m^2

b) Self-weight of beams = area*density

= 0.380*0.600*25

= 5.70 KN/m^2

c) Self-weight of beams = area*density

(Below FC)

= 0.550*0.600*25

= 8.25 KN/m^2

d) Self-weight of columns = 0.550*0.550*25

= 7.56 KN/m^2

e) Dead load on each floor = a+b+c+d

= 3.125+5.70+7.56

= 17.01 KN/m^2

f) Dead load on roof 2nd slab = a+c+d

= 3.75+8.25+7.56

= 19.56 KN/m^2

g) Dead load on roof slab = a+b+c/2

= 3.75+5.70+7.56/2

= 13.23 KN/m^2

h) Live load on each floor = 2 KN/m^2

(From IS 1893 (Part I) 2002, Table No. 8, Clause No.7.31)

As per clause, Live Load = 0.75 KN/m^2

i) Dead load on each floor = Intensity*Plan Area

= 17.01*36*36

= 22044.96 KN

j) Dead load on 2nd slab = 19.56*36*36

= 25349.76 KN

k) Dead load on roof slab = 13.23*36*36

= 17146.08 KN

l) Live load on each floor = 0.75*36*36
= 972 KN

Seismic weight of building on each floor = i+l
= 22044.96+972
= 23016.96 KN

Seismic weight of building on 2nd slab = j+l
= 25349.76+972
= 26321.76 KN

Seismic weight of building on roof slab = 17146.08 KN

Total seismic weight of building (W) = (23016.96*8) +26321.76+17146.08
= 227603.52 KN

Step 5) Determination of design seismic base shear (V_B) –

(From IS 1893 (Part I) 2002, Clause No.7.5.3)

$V_B = A_h*W$

$= 0.0227*227603.52$

$= 5166.74$ KN

Step 6) Determination of design lateral forces (Q_i) –

(From IS 1893 (Part I) 2002, Clause No.7.7.1)

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$$

Table No. 4.2.2 Design Lateral Forces (Manual Calculations)

Storey	W_i	h_i	$W_i*h_i^2$	$W_i*h_i^2/ \sum W_i*h_i^2$	$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$
10	17146.08	30	$15.43x10^6$	0.2063	1065.87
9	23016.96	27	$16.80x10^6$	0.2247	1160.94
8	23016.96	24	$13.26x10^6$	0.1173	916.04
7	23016.96	21	$10.15x10^6$	0.1357	701.11
6	23016.96	18	$7.46x10^6$	0.0997	515.11
5	23016.96	15	$5.18x10^6$	0.0692	357.53
4	23016.96	12	$3.31x10^6$	0.0442	228.36
3	26321.76	9	$2.13x10^6$	0.0284	146.73
2	23016.96	6	$828.61x10^3$	0.011	56.83
1	23016.96	3	$207.15x10^3$	0.0027	13.95
			$= 74.76x10^6$		

The values of base shear from manual calculation is 5166.74 KN

B) STAAD. Pro Method

Following table shows values of base shear obtain after analysis

Table No. 4.2.3 Design Lateral Forces (STAAD. Pro)

Storey	$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$
10	1065.20
9	1158.25
8	915.16
7	700.67
6	514.80
5	357.49
4	228.80
3	147.17
2	57.20
1	14.30

The values of base shear from STAAD. Pro calculation is 5159.01 KN

5. RESULTS

Base shear value from manual method = 5166.60 KN

Base shear Value from STAAD. Pro = 5159.01 KN

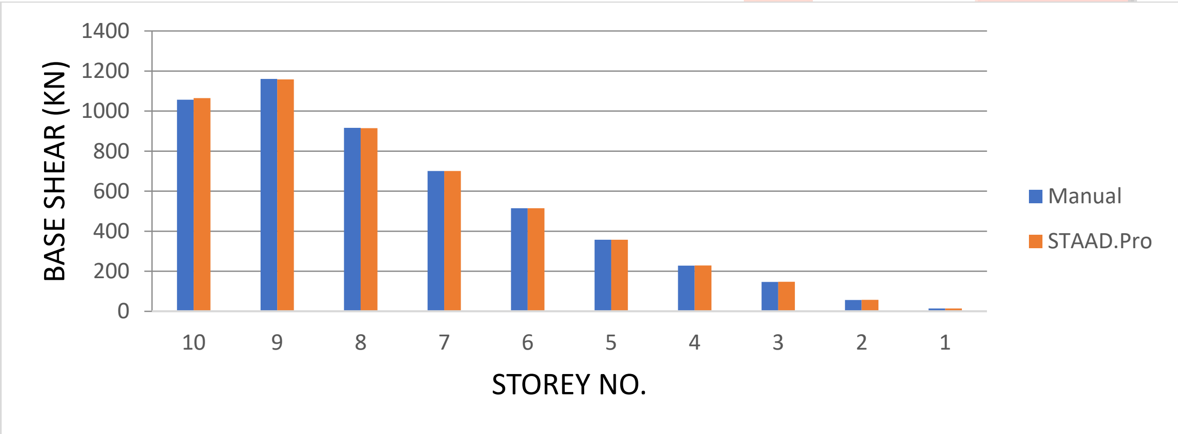

Fig. 5.1 Base shear comparison between manual method & STAAD. Pro software

6. CONCLUSION

1) The values obtain from manual method & STAAD. Pro software is almost same.
2) Difference between manual method & STAAD. Pro software is 7.59 KN.

7. REFERENCE

1) IS 1893 (Part 1) 2002 (Criteria for Earthquake Resistant Design of Structures)
2) STAAD.Pro Manual
3) M.A. Qureshi, Nidhi Bhavsar, Pratiksha Chaudhari, Parth Panchal, Siddharth Mistry, Ankit Makadia 'Comparison between Manual calculation and Software calculation of G+5 Building Using Staad pro.' Volume: 05 Issue: 05 | May-2018.
4) Prof. Komal S. Meshram, Samiksha Kumbhare,Sagar Thakur,Diksha Mate, Amit Moundekar, Raksha Waghmare '"Seismic Analysis of Building Using Staad-Pro' National Conference on "Emerging Trends In Engineering & Technology" Organized by Manoharbhai PatelInstitute Of Engineering& Technology Shahapur, Bhandara International Journal of Innovations in Engineering and Science, Vol. 4, No. 5, 2019.