Manual Calculation of Base Shear Force For 10-Story Building

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Abstract- *This paper highlights study of variation in base shear and lateral force for seismic zones III. In present study an earthquake load is applied on 10-storey buildings. The performance of building for base shear and lateral force has been studied. This analysis is done by referring to the code IS 1893:2002(Part-I). Base shear is an estimate of the maximum expected lateral force on the base of the structure due to seismic activity. This design lateral force shall then be distributed to the various floor levels. Base shear is an estimate of the maximum expected lateral force on the base of the structure due to seismic activity. It is calculated using the seismic zone, soil material etc. Shear force is a force acting in the lateral direction on an object. The fact is that seismic forces in the building are greatest at the base of the building. The seismic force at the base of the building is called the base shear.*

Keywords- Base shear, lateral force

I. INTRODUCTION

Over the past few years, India's infrastructure system has grown up tremendously at the same time lots of research has been done in the field of construction. With prime importance of comfort and economy safety also plays major role in the design of any structure. Now a day's earthquake resistant design got main attention in design of any type of structure. Earthquake is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves.

Base shear, storey shear and base moment are the terms associated with the earthquake. 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. It depends upon the soil conditions at the site. Storey shear factor is the ratio of the story shear force when story collapse occurs to the story shear force when total collapse occurs.

Base moment is the moment produced at the base of structure due to different loading conditions on the structure. Present study focuses on the be haviour of base shear, storey shear and base moment with respect to change in number of storey and with change in seismic zone. 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.

Zone factor is a factor obtain the design spectrum depending on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located. The basic zone factors included in this standard are reasonable estimate of effective peak ground acceleration. Based on these inputs, Bureau of Indian Standards [IS 1893 (Part I):2002], has grouped the country into four seismic zones, viz. Zone II, III, IV and V. Of these, Zone V is seismically the most active region, while zone II is the least.

II. METHODOLOGY

A 10 Storey building has plan dimension. The storey height is 3.0 m. The D.L per unit are of the floor, consisting of the floor slab, furnishes, etc is 4KN/m^2.Weight of the partitions on the floor can be assumed to be 2KN/m^2.The intensity of L.L on each floor is 3KN/m^2 and on the roof is 1.5KN/m^. The soil below the foundation is hard and the building is located in yavatmal. Determine the seismic forces and shears at different floor levels.

Specifications:

1. Size of the beam is 600 × 300 mm
2. Size of the column 300 × 600 mm
3. Size of building 24 × 24 m
4. No of storey 10
5. Height of the storey 3 m
6. D.L of the slab including finishes 4 KN/m^2
7. Weight of partition on floor 2KN/m^2
8. L.L on each floors 3KN/m^2
9. L.L on roofs 1.5KN/m^2
10. Soil below foundation is hard soil.
11. Building located in Zone III

III. MANUAL CALCULATION OF BASE SHEAR AND LATERAL FORCE

Design parameters:
For zone III zone factor is 0.16
Importance factor l= 1.0
Response reduction factor R = 3
Seismic weight :
Floor area = 24 × 24 m =576 m^2
D.L = 4 KN/m^2
Weight of partition = 2 KN/m^2, For L.L up to and including 3 KN/m^2
% of L.L to be considered = 25%
Total seismic weight on the floor W = sum of W
Effective weight at each floor and except the roof = 4 +2 +0.25 × 3 = 6.75 KN/m^2
And roof = 4.0 KN/m^2
Weight of beam at each floor and roof = 0.3 × 0.6 × 240 × 25 =1080 KN
Weight of the column at each floor = 0.3 × 0.6 × 2.4 × 25 × 25 = 270 KN
Weight of column at the roof = 0.5 × 270 = 135 KN
Total plan area of building is 24 m × 24 m = 576 m^2
Equivalent load at roof level = 4 × 576 +1080 + 135 = 3519 KN
Equivalent load at each floor = 6.75 × 576 + 1080 +270 = 5238 KN
Seismic weight of the building W= 3519 + 5238 × 9 = 50661 KN

Base shear:

Fundamental natural period of vibration of a moment resisting frame without infill
Ta = 0.075h^0.75 = 0.075 (30^0.75) = 0.96s
Average response acceleration coeff. Sa/g for 5% damping and type I soil is 1.04
Design horizontal seismic coeff.
Ah =ZI (Sa/g)/2R = 0.16 × 1 × 1.04 /2 × 3 = 0.0277
Base shear V_B = Ah × W = 0.0277× 50661 = 1404.9984 KN
Lateral load and shear force at various floor level
Design lateral forces on floor I, Qi = V_B × Wh^2/sum of Wh^2

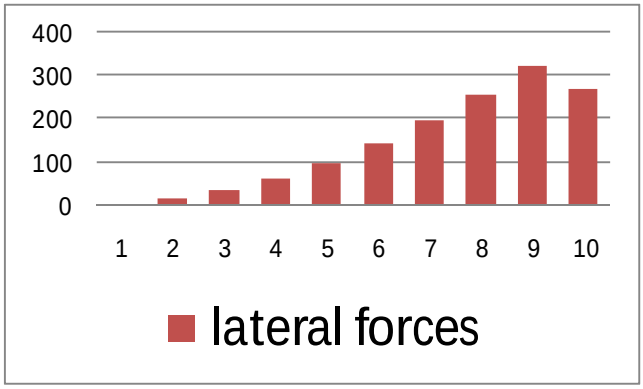
SR. NO	Wt (KN)	h	Wh^2 (KN/m^2)	Wh^2/sum of wh^2	Qi (KN)	V_B (KN)
1	3519	30	3167100	0.190	267.9	267.93
2	5238	27	3818502	0.229	323.0	590.93
3	5238	24	3017088	0.181	255.2	846.22
4	5238	21	2309958	0.139	195.4	1041.6
5	5238	18	1697112	0.102	143.5	1185.2
6	5238	15	1178550	0.070	99.61	1284.8
7	5238	12	754272	0.045	63.78	1348.6
8	5238	9	424278	0.025	35.82	1384.4
9	5238	6	188568	0.011	16.0	1400.4
10	5238	3	47142	0.002	3.933	1404.4

IV. GRAPHICAL REPRESENTATION OF LATERAL FORCE

Graphical Representation of Lateral Force:

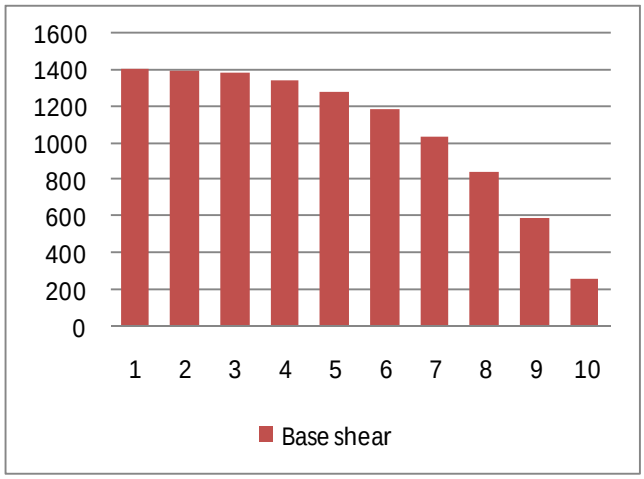
Here As per the manual analysis it is clear that lateral force increces form ground to top level for 10 story building for Zone III.

Graphical Representation of lateral force clearly show that lateral force increces form ground to top level for 10 story building.



Graphical Representation of Base shear:

As shown in above graph, the base shear value is decreses from ground to top level. At roof level the value of lateral forces and base shear are mimimum as compaired to other the blowe the roof level.



V. CONCLUSION

During an earthquakes performance of the frames structure playes an important role in point of view stability, strength and resistive power. For checking the performance of a multi-storied frame structure the effect of DL, LL and seismic load are considered. Seismic analysis for Multi-storied frame is carried out by using static analysis, manually. IS 456:2000, IS 800:2007 and IS 1893:2002 (Part 1) are used. Seismic analysis critarea are given in IS 1893:2002 (Part 1)

As per the observation and remark following result are obtained and As per the manual analysis it is clear that lateral force increces form ground to top level for 10 story building for Zone III. the base shear value is decreses from ground to top level.

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