Comparison of Base Shear with Height of building of RCC Structure

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Abstract - *The study includes the comparison of base shear with height of building of RCC structure. . The calculation of static base shear for a structure with masonry and without masonry in different zones are carried out and then compared. The effect of earthquake loading is also considered as per the code IS 1893:2001(Part-1).*
This study based on E-TAB software.

Key Words: Comparison, Base Shear, Earth Quake loading...

1. INTRODUCTION

An earthquake is sudden shaking of the earth surface caused by a source of disturbance inside the earth. Every year more than one lakh earthquakes occurs of magnitude higher than three. Due to earthquakes, more than 15 million human lives have been lost. In 1930, Richter developed the concept of earthquake magnitude and so it is called "Richter scale". On the basis of recordings of earthquake ground motion, seismograph displays the value of magnitude of earthquake. Magnitude 4 or lower earthquakes cause very rare damage to buildings while magnitude 6 or more earthquakes can cause severe damage to some buildings. The largest earthquake measured was 9.5 magnitude on Richter scale. The immediate cause of most shallow earthquakes is the sudden release of stress along a fault or fracture in the earth's crust, resulting in movement of the opposing blocks of rock past one another. This movement may occur rapidly in the form of an earthquake or may occur slowly in the form of creep. Great explosions, landslides, volcanic eruptions, dashing of sea waves, heavy trucks, some large engineering projects, etc. cause minor earthquakes. Shock waves from a powerful earthquake can trigger smaller earthquakes in a distant location hundreds of miles away if the geologic conditions are favorable.

1.1 BASE SHEAR

Base shear is the maximum expected lateral force that will occur due to seismic ground acceleration at the base of the structure [1]. The base shear, or earthquake force, is given by the symbol "VB". The weight of the building is given as the symbol "W"

$$V_B = A_h \times W$$

V_B = Base Shear

A_h= Horizontal Seismic Coefficient

W = Total Weight of Structure

Z = Zone Factor

I = Importance Factor

R = Response Reduction Factor

S_a/g = Average Response Acceleration Co-efficient

The adjustment factors depend on many things, like how tall the building is, what soil it is built on, how close it is to an earthquake fault, how important it is, how many people it can hold, what materials will be used to build it, and others. The weight of the building includes the structure itself plus permanent equipment and partitions, and in some cases a portion of stored items in the building or snow on the roof, or both. Calculations of base shear (VB) depend on:

- Soil conditions at the site
- Proximity to potential sources of seismic activity (such as geological faults)
- Probability of significant seismic ground motion
- The level of ductility and over strength associated with various structural configurations and the total weight of the structure.
- The fundamental (natural) period of vibration of the structure when subjected to dynamic loading.

2. METHODOLOGY & RESULTS

2.1 METHODOLOGY

Step 1: To Determine "Z"

"Z" is the zone factor for Maximum Considered Earthquake (MCE) and service life of structure in a zone. The factor 2 in the denominator of "Z" is used so as to reduce the Maximum Considered Earthquake (MCE) zone factor to the factor for Design Basis Earthquake (DBE).

Table 1 Zone Factor , Z

Seismic Zone	2	3	4	5
Z	0.10	0.16	0.24	0.36

STEP 2: To determine "I"

"I" is a factor used to obtain the design seismic force depending upon the functional use of the structure, characterized by hazardous consequences of its failure, its post-earthquake functional need, historical value, or economic importance.

Table 2 Importance Factor, I

S. N.	Structure	Importance factor
1.	Important service and community buildings,such as hospitals; chools; monumental structures; emergency buildings like telephone exchange, television stations, radio stations, railway stations, fire station buildings; large community halls like cinemas, assembly halls and subway stations, power stations.	1.5
2.	All other buildings	1.0

STEP 3: To determine "R"

"R" is the RESPONSE REDUCTION FACTOR. It is the factor by which the actual base shear force, which would be generated if the structure were to remain elastic during its response to Design Basis Earthquake shaking, shall be reduced to obtain the design lateral force.

STEP 4: To determine "S_a/g"

"S_a/g" is AVERAGE RESPONSE ACCELERATION COEFFICIENT. It is a factor denoting the acceleration response spectrum of the structure subjected to earthquake ground vibrations, and depends on natural period of vibration and damping of the structure.

Step 5: Natural Period:
Natural Period of a structure is its time period of undamped free vibration. The natural period of the structure is estimated for different type of structure as follows:

$T = 0.075\ h^{0.75}$ (RCC Frame without infill)
h = height of building in metres

Geometric and Sectional Properties of plan 36' x 30' building

Plan Area	Member Properties	Size (BxD) mm
	Beam	230x375
36' X 30'	Columns	400x400
	Slab Thickness	125
	Height of Floor	3000

2.1 RESULTS

Seismic Load Parameters for structure

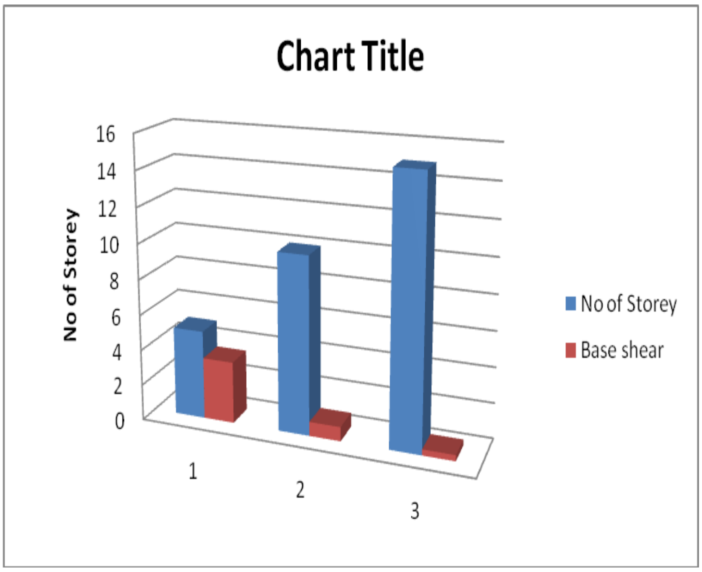
Seismic Load Parameters	Value
Response Reduction Factor (R)	5
Importance Factor (I)	1
Type of soil strata	Medium

Building Name	Height of building (m)
1	12
2	27
3	42

Building 1	
Dead Load	1724.56
Super Dead Load	4023.36
Live Load	2011.68
Total Down Load	7759.60
Earth Quake Load (EQ)	269.78
Base Shear	3.48

Building 2	
Dead Load	3449.1252
Super Dead Load	8046.72
Live Load	4023.36
Total Down Load	15519.21
Earth Quake Load (EQ)	124.4175
Base Shear	0.80

Building 3	
Dead Load	5173.6878
Super Dead Load	12070.08
Live Load	6035.04
Total Down Load	23278.81
Earth Quake Load (EQ)	78.1116
Base Shear	0.34



3. CONCLUSIONS

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, and building code lateral force equations. It is calculated that as the height of the building is increase, there is an decrease in Base shear.

Also to increase the base shear in high rise building, the shear wall accommodation can be assumed. All calculations has been done by E-TAB software.

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