International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

# Determination of Base Shear of RCC Structure under Different Zone

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**Abstract -** *The comparison of base shear has been done under different zone of earthquake. The calculation of static base shear for 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, Earthquake Zones...

## 1. INTRODUCTION

Dynamic actions are caused on buildings by both wind and earthquakes. But, design for wind forces and for earthquake effects are distinctly different. The intuitive philosophy of structural design uses force as the basis, which is consistent in wind design, wherein the building is subjected to a pressure on its exposed surface area; this is force-type loading. However, in earthquake design, the building is subjected to random motion of the ground at its base , which induces inertia forces in the building that in turn cause stresses; this is displacement-type loading. Another way of expressing this difference is through the load-deformation curve of the building – the demand on the building is force (i.e., vertical axis) in force-type loading imposed by wind pressure, and displacement (i.e., horizontal axis) in displacement-type loading imposed by earthquake shaking.

Wind force on the building has a non-zero mean component superposed with a relatively small oscillating component. Thus, under wind forces, the building may experience small fluctuations in the stress field, but reversal of stresses occurs only when the direction of wind reverses, which happens only over a large duration of time. On the other hand, the motion of the ground during the earthquake is cyclic about the neutral position of the structure. Thus, the stresses in the building due to seismic actions undergo many complete reversals and that took over the small duration of earthquake.

## 1.1 BASE SHEAR

Earthquake shaking is random and time variant. But, most design codes represent the earthquake-induced inertia forces as the net effect of such random shaking in the form of design equivalent static lateral force. This force is called as the Seismic Design Base Shear VB and remains the primary quantity involved in force-based earthquake-resistant design of buildings. This force depends on the seismic hazard at the site of the building represented by the Seismic Zone Factor Z. Also, in keeping with the philosophy of increasing design forces to increase the elastic range of the building and thereby reduce the damage in it, codes tend to adopt the Importance Factor I for effecting such decisions -

$$V_B = A_h \times W$$

Where -

**$V_B$ = Base Shear**

**Ah= Horizontal Seismic Coefficient**

**W = Total Weight of Structure**

**And**

**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.

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## 2. METHODOLOGY & RESULTS

### 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**

| 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**

| Sr No. | Structure | Importance Factor |
|---|---|---|
| 1 | Important service and community buildings, such as hospitals; schools; 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 Building | 1 |

### 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 un damped free vibration. The natural period of the structure is estimated for different type of structure as follows:

T = 0.075h0.75 (RCC Frame without infill)

T = (For infill frames)

h = height of building in meters

d = base dimension of the building at plinth level in meters along the considered direction of the lateral force

**Table 3: Geometric and sectional properties of plan 20mx15m.**

| Plan Area | Member Properties | Size (BxD) ,mm |
|---|---|---|
| 20mx15m | Beams | 230x300 |
| | Columns | 400x400 |
| | Slab Thickness | 150 |
| | Height of Floor | 3500 |

**Table 4 : Seismic Load Parameters for structure**

| Seismic Load Parameters | Value |
|---|---|
| Response Reduction Factor | 5.0 |
| Importance Factor | 1.0 |
| Type of Soil Strata | Medium |

**Table 5 : Base Shear**

| Zone | Z | T | $S_a/g$ | $A_h$ | Weight of structure | Base shear, $V_b = A_h x W$ |
|---|---|---|---|---|---|---|
| 3 | 0.16 | 0.506 | 2.5 | 0.03 | 25715 | 771.45 |
| 5 | 0.36 | 0.230 | 2.5 | 0.08 | 25715 | 2057.2 |

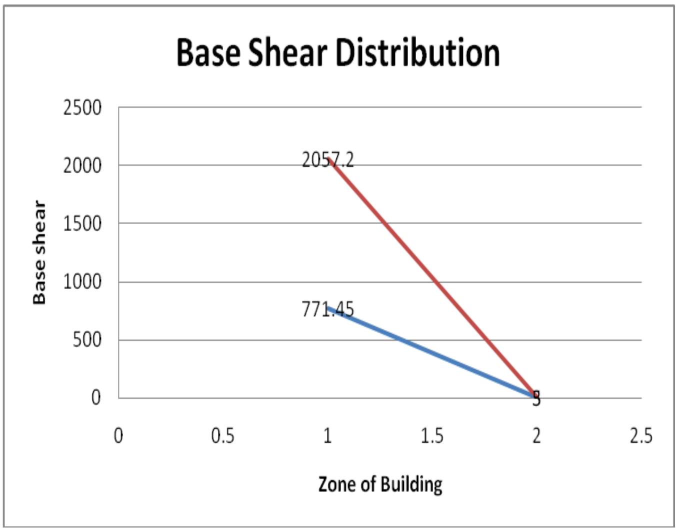


**Fig - 01 : Base Shear Distribution**

## 3. CONCLUSION

The base shear of a building will be much higher for maximum zone factor. Also, it can be concluded that building with much higher seismic weight, will be having maximum Base shear.

All calculations has been done by E-TAB software.

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