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# A Study and Comparsion of Base Shear in Different Zones and Soil Types for (G+4),(G+9),(G+14)

Sajala, Nadiya
RVR and JC College of Engineering

***Abstract*:- In modern days the seismic design of the buildings is going for higherimportance. In this regard we are going to compare the results of the buildings of G+4,G+9,G+14 of a same dimensions for different zone values of II=0.1; III=0.16, IV=0.24 V=0.36 (low, medium, severe , very severe) and for various types of soils namely rocky , medium ,soft soils and for different fundamental natural time periods :**

**1) (G+4)**
**Ta=0.382sec**
**2) (G+9)**
**Ta=0.734sec**
**3) (G+14)**
**Ta=1.086sec**

**And for various ground accelerations**
**1) (G+4)**
**Sa/g=2.5**
**2) (G=9)**
**Sa/g = 1.361381 for rocky**
**= 1.851478 for medium**
**= 2.273506 for soft**
**3) (G+14)**
**Sa/g = 0.920193 for rocky**
**= 1.251452 for medium**
**= 1.536722 for soft**

**And we compared the base shear of the buildings at different zones and soil types.**
**For term paper we are submitting zone comparison and soil comparison results.**

## 2.NOTATION

Important letter symbols generally used are listed here for reference. Other symbols are covered in the concerned sections.

$A_h$ **:** Design horizontal seismic coefficient.

$g$ : Acceleration due to gravity.

$h$ : Height of structure, in meters

$I$ : Importance factor.

$n$ : Number of storeys.

$Q_i$ : Lateral force due to earthquake, wind at floor i.

$R$ : Response reduction factor.

$\frac{S_a}{g}$ : Average response acceleration coefficient.

$T$ : Fundamental natural period, in seconds.

$V_b$ : Design seismic base shear.

$W$ : Seismic weight of the structure.

$W_i$ : Seismic weight floor i.

$Z$ : Zone factor.

$fck$ : Characteristic compressive strength of concrete cube.

$fy$ : Yield stress of steel.

$lw$ : Horizontal length of wall.

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$tw$ : Thickness of wall web.

$dw$: Effective depth of wall section.

$\tau_v$ : Nominal shear stress.

$\tau_{c\max}$ : Maximum permissible shear stress in section.

$\tau_c$ Shear strength of concrete.

$V_u$ : Factored shear force. $xu$ : Depth of neutral axis.

## 3. INTRODUCTION

***WHAT IS EARTH QUAKE:***

An earthquake is a sudden tremor or movement of the earth's crust which originates naturally at or below the surface. The word natural is important here, since it excludes shock waves caused by nuclear tests, man-made explosions, etc., about 90% of all earthquakes result from tectonic events primarily movements on the faults. The remaining is related to volcanism, collapse of subterranean cavities or man made effects. Tectonic earthquakes are triggered when the accumulated strain exceeds the shearing strength of rocks.

***EARTHQUAKE SIZE:***

Intensity is a qualitative measure of the strength of an earthquake. It gives a graduation of strength of earthquake using observed damage to structures and or ground and reaction of humans to the earthquake shaking. An earthquake has many intensities the highest near the maximum fault displacement and progressively to lower grade at further away. Since the measure is not instrumental intensity can be assigned to historical earthquakes also. The popular intensity scale is the modified mercalli scale with twelve gradation denoted by roman numerals from I TO XII. Another intensity scale developed for central and eastern European states is kno9wn as medveddvsponheuer-karnik intensity scale. The twelve gradation MSK scale differes with MMI in details only. Like many other countries IS 1893(Part 1), the Indian standard: 2002 also refers to the MSK scale.

***MAGNITUDE:***

The magnitude is a quantitative or absolute measure of the size of an earthquake it can be correlated to the amount of wave energy released at the source of an earthquake. The elastic wave energy is that portion of total strain energy stored in lithospheric rock that is not consumed as mechanical work during an earthquake there are various magnitude scales in use. These scale differ from each other because those are derived from measuring different wave components of an earthquake.

## 4. DEFINITIONS

### TERMINOLOGY FOR EARTHQUAKE ENGINEERING OF BUILDINGS

**1. EARTHQUAKE:**

Vibrations of Earth's surface caused by waves from a source of disturbance inside the earth are known as Earthquakes.

**2. INTENSITY:**

The Severity of shaking of an Earthquake as fell or observed through damage is known as intensity. Areas having same intensities are then enclosed by contour lines such a map is called isoseismic map.

**3. MAGNITUDE:**

The magnitude of earthquake is a number, which is a measure of energy released in an earthquake .It is defined as logarithm to the base 10 of the maximum trace amplitude, expressed in microns, which the standard short period torsion seismometer would register due to the earthquake at an epicenteral distance of 100km.

**4. NATURAL PERIOD:**

Natural period of a structure is its time period of undamped free vibration.

### 5. RESPONSE SPECTRUM:

The representation of the maximum response of idealized single degree freedom systems having certain period and damping, during earthquake ground motion .The maximum response is plotted against the undamped natural period and for various damping values , and can be expressed in terms of maximum absolute acceleration, maximum relative velocity, or maximum relative displacement.

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6. SEISMIC WEIGHT:

It is the total dead load plus appropriate amounts of specified imposed load.

7. STRUCTURAL RESPONSE FACTORS (Sa/g):

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.

**AVERAGE RESPONSE ACCELERATION COEFFICIENT (Sa/g):**

The values of Sa/g can be found either from above graph or by some empirical equations given below :-

For rocky, or hard soil sites

$$Sa/g = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50; & 0.10 \le T \le 0.40 \\ 1.36/T; & 0.55 \le T \le 4.00 \end{cases}$$

For medium soil sites

$$Sa/g = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50; & 0.10 \le T \le 0.55 \\ 1.36/T; & 0.55 \le T \le 4.00 \end{cases}$$

For soft soil sites

$$Sa/g = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50; & 0.10 \le T \le 0.67 \\ 1.36/T; & 0.67 \le T \le 4.00 \end{cases}$$

Where T is the fundamental nature period.

8. ZONE FACTOR(Z):

It is a factor to obtain 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.
The country is classified into four seismic zones as given below Zone factor,

| Seismic Zone | II | III | IV | V |
|---|---|---|---|---|
| Seismic intensity | Low | Moderate | Severe | Very severe |
| Z | 0.10 | 0.16 | 0.24 | 0.36 |

9. DESIGN SEISMIC BASE SHEAR(VB):

It is the total design lateral force or design seismic base shear(VB) along any principal direction shall be determined by the following expression.

$$VB = AhW$$

Where:

Ah = Design horizontal seismic coefficient.

W = Seismic weight of the building.

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## 10. FUNDAMENTAL NATURAL PERIOD:

The fundamental natural period of vibration (Ta), in seconds, of all other buildings , including moment resisting frame buildings with brick infill panels, may be estimated by the empirical expression .

$$Ta = 0.09h/d^{(1/2)}$$

Where:

h = Height of the building in m

d = Base dimension of the building at the plinth level in m, along the considered direction of the lateral force.

## 11 .DISTRIBUTION OF DESIGN FORCE:

The vertical distribution of base shear to different floor levels can be computed as per the following expression.

$$Qi = VB * (Wi * hi*hi) \quad /$$

where :

Qi =design lateral force at floor i

Wi =seismic weight of floor i

hi =height of floor I measured from base

n=no. of stories in the building is the no: of levels at which masses are located

## 13. BASE SHEAR:

Base shear is an estimate of the maximum lateral force that will occur due to seismic ground motion at the base of the structure.

## 14. DESIGN SEISMIC BASE SHEAR:

The total design lateral force or design seismic base shear will be along any principal direction shall be determined by the following expression:

$$VB=Ah*W$$

Where:
Ah=design horizontal acceleration spectrum value using the fundamental natural time period Tn in the considered direction of vibration.
W=Seismic weight of the building.

## 12. IMPORTANCE FACTOR:

It is the factor used to obtain the design seismic force depending on the functional use of the structure, characterized by hazardous consequences of its failure, its post earthquake functional need, historic value or economic importance.

| Sl.No | STRUCTURE | IMPORTANCE FACTOR |
|---|---|---|
| **1.** | Importance service and community buildings, such as hospitals, schools, monumental structures, emergency buildings like telephone exchange, television stations, radio stations, railway stations, fire station building; large community halls like cinemas, assembly hall stand subway stations, power stations | **1.5** |
| **2.** | All other buildings | **1.0** |

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**GENERAL:**

BHUJ earthquake occurred in 2001 and caused extensive damage to the structures and huge loss of lives also. Collapse of more than hundred reinforced buildings is due to open ground storey i.e. soft storey.
BHUJ earthquake has emphasized that such buildings are extremely vulnerable under earthquake shaking. Significant doubts have been arised in the minds of the professionals in dealing with these structures and make the structure more stiff, to resist earthquake.
The earthquake causes vibratory ground motions at the base of the structure, and the structure actively responds to these motions. For the structure responding to a moving base, there is an equivalent system. The base is fixed and the structure is acted upon by forces (called inertia forces) that cause the same distributions that occur in the moving-base system. In design system it is customary to assume the structure as a fixed- base system acted upon by inertia forces. Seismic design involves two distinct steps
1). Determining (or estimating) the earthquake forces that will acted on the structure,
and,
2). Designing the structure to provide adequate strength, stiffness, and energy dissipation capabilities to with stand these forces.

**1.2. BEHAVIOR OF STRUCTURE:**

Building and other structures are composed of horizontal and vertical structural elements that resist lateral forces. The horizontal elements, diaphragms and horizontal bracings are used to distribute the lateral forces to vertical elements. The vertical elements that are used to transfer lateral forces to the ground are shear walls, braced frames and moment resisting frames. The structure must include complete lateral and vertical force resisting systems, capable of providing adequate energy dissipation capacity to withstand the design ground motions with in the prescribed limits, deformation and strength demand.
The loads or forces that a structure sustains during an earthquake result directly from the distortions induced in the structure by motion of the ground on which it rests. Earthquake loads are inertia forces related to the mass, Stiffness and energy – absorbing. (i.e. damping and ductility) characteristics of the structure.

During the life of a structure , located in a seismically active zone, subjected to many small earthquakes, some moderate earthquakes, one or more large earthquakes and possibly a very severe earthquake. In general it is uneconomical or impractical to design buildings to resist the forces resulting from the very severe earthquake with in the elastic range of stress instead the building is designed to resist lower level of force, using ductile systems. When the earthquake motion is large to severe, some of the structural elements are expected to yield. Buildings that are properly designed and detailed can survive earthquake forces substantially greater than the forces associated with allowable stresses in the elastic range. Seismic design concepts must consider building proportions and detail for their ductility and for their reverse energy- absorbing capacity for surviving the inelastic deformations that would result from the maximum expected earthquake.

**Architectural planning of structures:**

The behaviour of a building during earthquake depends critically on its overall shape, size and geometry, in addition to the earthquake forces. Building with plan irregularities (e.g., those with re-entrant corners such as L-shape plans on corner plots) and those with elevation irregularities (e.g., large vertical setbacks in elevation such as a plaza – type configuration in commercial structures) are common. Building with plan asymmetry may experience significant torsional motions with even slight eccentricity between the center of mass (CM) and the center of rigidity (CR).As a result, the flexible side of the building (the edge of the building closer to CM) experiences larger than the stiff side (the edge of the building closer to CR).If not designed to accommodate these excessive deformations, the columns on the flexible side may fail and lead to collapse.

**3.5. The size of buildings:**

In tall buildings with large height to base size ratio, the horizontal movement of the floors during ground shaking is large. In short but very long buildings, the damaging effects during earthquake shaking are many. In buildings with large plan area, the horizontal forces can be excessive to be carried by columns and walls.

**3.6. Horizontal layout:**

Generally, buildings with simple geometry in plan perform well during the strong earthquakes. Building with reentrant corners like those U, V, H and + shaped in plan subjects to severe damage. Often, simple plan with columns/ walls unequally distributed in plan tend to twist during the earthquake.

**3.7. Vertical layout:**

The earthquake forces developed at different floor levels in a building need to be brought along the height to the ground by the shortest path. Any deviation or discontinuity in the load transfer path results in poor performance. Buildings with vertical

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setbacks cause a sudden jump in earthquake forces at the level of discontinuity. Building with fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Buildings with open ground storey intended for parking, building on sloppy ground having unequal height columns along the slope cause ill effects twisting and damage in short columns. Buildings with floating columns has discontinuity in the load transfer path.

### 3.8. Adjacency of buildings:

Two buildings closely spaced may pounding during strong shaking. The unequal heights in adjacent buildings cause severe damage to both the buildings due to pounding action.

### 3.9. Seismic zones of India:

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required so that buildings and other structures located in different regions can be designed to withstand different level of ground shaking. The current zone map subdivided India into five zones – I, II, III, IV and V (Fig) and subsequently in 2002 the zone I and II have minimized.

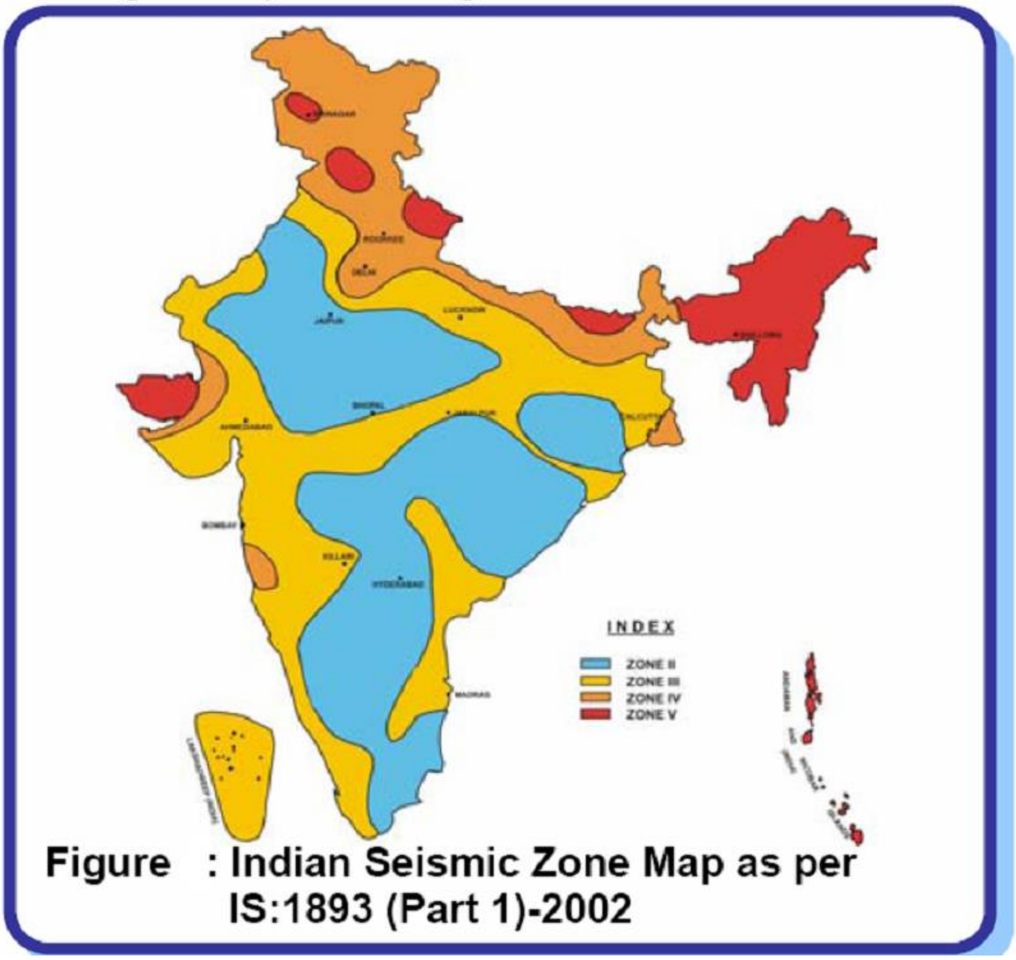


Figure : Indian Seismic Zone Map as per IS:1893 (Part 1)-2002

The maximum Modified Mercalli (MM) intensity of seismic shaking in these zones are V or less, VI, VII, VIII and IX and other, respectively. Parts of Himalayan boundary in the North and Northest, and the Kach area in the West are classified as zone V. The seismic zone maps are revised from time to time as more understanding is grained on the geology, the seismic tectonic and the seismic activity in the country.

**Zone factors detailing:**

**Zone 5**

Zone 5 covers the areas with the highest risks zone that suffers earthquakes of intensity MSK IX or greater. The IS code assigns zone factor of 0.36 for Zone 5. Structural designers use this factor for earthquake resistant design of structures in Zone 5. The zone factor of 0.36 is indicative of effective (zero period) peak horizontal ground accelerations of 0.36 g (36 % of gravity) that may be generated during MCE level earthquake in this zone. It is referred to as the Very High Damage Risk Zone. The state of Kashmir, Punjab,the western and central Himalayas, the North-East Indian region and the Rann of Kutch fall in this zone.Generally, the areas having trap or basaltic rock are prone to earthquakes.

**Zone 4**

This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4. The Indo-Gangetic basin and the capital of the country (Delhi), Jammu and Kashmir fall in Zone 4. In Maharashtra Patan area(Koyananager) also in zone 4. but East Delhi is an earthquake prone area.

**Zone 3**

The Andaman and Nicobar Islands, parts of Kashmir, Western Himalayas fall under this zone. This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII. and also 7.8 The IS code assigns zone factor of 0.16 for Zone 3.

**Zone 2**

This region is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone is 10 % of gravitational acceleration) for Zone 2.

## 5.AIM OF THE PROJECT

Here the main objective of the term paper is to compare base shear values for buildings of varying heights (G+4,G+9,G+14) in different zones in India categorized as per IS code of importance factor “1”and also for different types of soils.The final conclusion for the project will be comparision of base shear values with moment values using STAAD PROGRAMING. Thus, simplifying the design calculations for construction of buildings.

**DETAILS OF MODEL PROBLEM:**

**The** RCC frames are in filled with brick masonry

| | |
|---|---|
| Thickness of slab | 0.15m |
| Load due to roof finish | 2Kn/m^2 |
| Load due to floor finish | 1Kn/m^2 |
| Thickness of outer walls | 0.25mmincluding plaster |
| Thickness of inner walls | 0.15mm including plaster |
| Imposed load | 3.5Kn/m^2 |
| Size of column at ground level | 0.25* 0.4m |
| Type of foundation | isolated footing |
| Soil condition | hard murmur available at depth of 1.5m below G.L |
| Seismic zone | III |
| Length in x-direction | 20m |
| Length in y-direction | 20m |
| No of in fills in x-direction | 3 |

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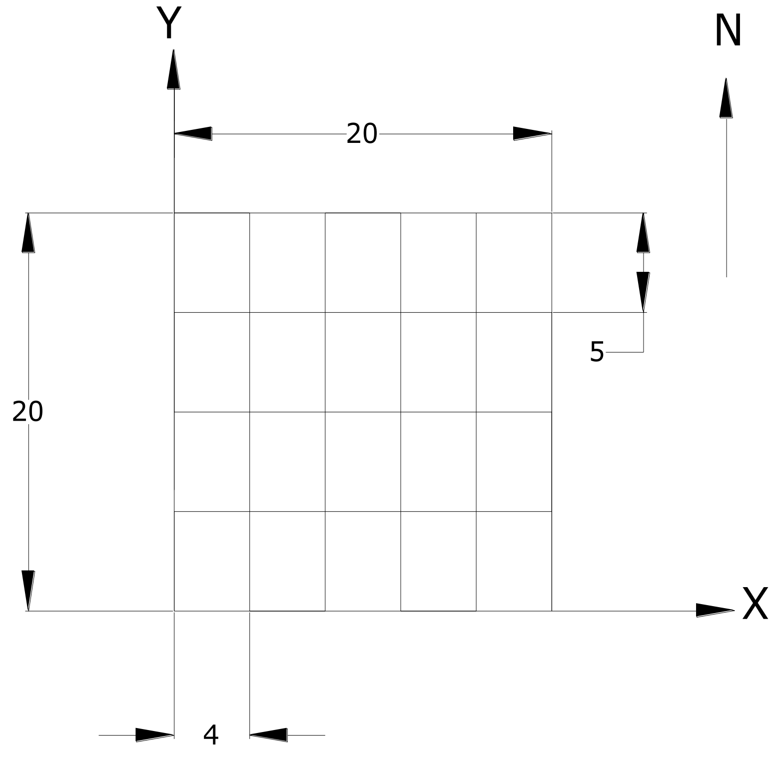
| | |
|---|---|
| No of in fills in y-direction | 4 |
| Total floor area | 400m^2 |
| Floor to floor height | 3.5m |
| Ground level | 1.5m |
| Height of ground floor | 3.5m |
| No of floors without stilt | 9 |
| Total height of the building | 36.5m |
| Unit wt of masonry | 20 |
| Unit wt of concrete | 25 |
| Self wt of slab | 3.75Kn m |
| No of floors without stilt and roof floor | 8 |

**PLAN AND SECTIONAL VIEWS ARE:**



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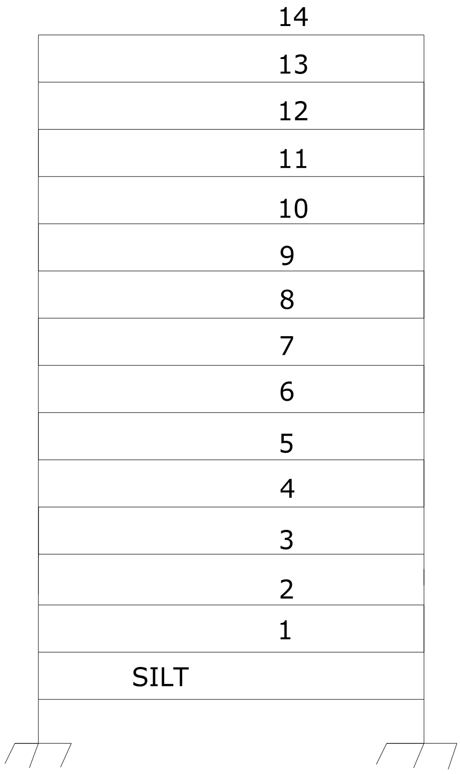
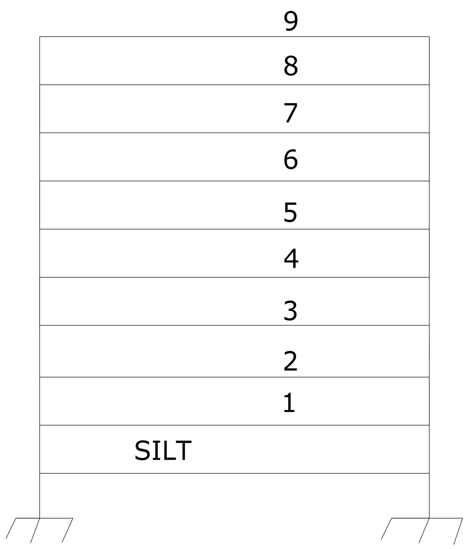
**PLAN**




**G+14**




G+9

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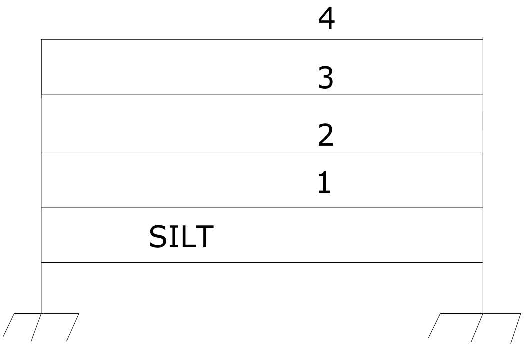


G+4

**COMPARISION RESULTS FOR ZONES:**

**BASE SHEAR VALUES FOR ROCKY SOIL, MEDIUM SOIL, SOFT SOIL (G+4):**

| ZONE /STOREY | ZONEII | ZONEIII | ZONE IV | ZONE V |
|---|---|---|---|---|
| 04 | 311.2152 | 497.9443 | 746.9165 | 1120.375 |
| 03 | 303.3289 | 485.3262 | 727.9893 | 1091.984 |
| 02 | 181.8079 | 290.8927 | 436.339 | 654.5086 |
| 01 | 91.21961 | 145.9514 | 218.9271 | 328.3906 |
| SILT | 24.02995 | 38.44792 | 57.67188 | 86.50782 |
| T-SHEAR | 911.6016 | 1458.563 | 2187.844 | 3281.766 |

| COMPARSION/ STOREY | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 04 | 360.0001 | 225.0001 | 150 | 150 | 240 | 160 |
| 03 | 360 | 225 | 150 | 150 | 240 | 160 |
| 02 | 360.0001 | 225 | 150 | 150 | 240 | 160 |
| 010 | 360 | 225 | 150 | 150 | 240 | 160 |
| SILT | 360 | 225 | 150 | 150 | 240 | 160 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

**BASE SHEAR VALUE FOR ROCKY SOIL (G+9):**

| ZONE/ STOREY | ZONEII | ZONEIII | ZONEIV | ZONEV |
|---|---|---|---|---|
| 09 | 196.3375 | 314.1401 | 471.2101 | 706.8152 |
| 08 | 235.0402 | 376.0644 | 564.0966 | 846.1449 |
| 07 | 187.8272 | 300.5234 | 450.7852 | 676.1778 |
| 06 | 145.9019 | 233.4431 | 350.1646 | 525.247 |
| 05 | 109.2646 | 174.8233 | 262.235 | 393.3525 |
| 04 | 77.91508 | 124.6641 | 186.9962 | 280.4943 |
| 03 | 51.85346 | 82.96554 | 124.4483 | 186.6725 |
| 02 | 31.0797 | 49.72752 | 74.59128 | 111.8869 |
| 01 | 15.59381 | 24.95009 | 37.42514 | 56.13771 |
| SILT | 4.107872 | 6.572595 | 9.858892 | 14.78834 |
| T-SHEAR | 1054.921 | 1687.874 | 2531.811 | 3797.717 |

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| COMPARISION/ STOREY | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 09 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160.0001 |
| 08 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 07 | 359.9999 | 225 | 150 | 150 | 240 | 159.9999 |
| 06 | 360.0001 | 225 | 150 | 150 | 240 | 160 |
| 05 | 359.9999 | 225 | 150 | 150 | 240 | 159.9999 |
| 04 | 360 | 225.0001 | 150 | 150 | 240 | 160 |
| 03 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 02 | 360 | 225 | 150 | 150 | 240 | 160 |
| 01 | 360 | 225 | 150 | 150 | 240 | 160 |
| SILT | 360 | 225 | 150 | 150 | 240 | 160 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

**BASE SHEAR VALUE FOR MEDIUM SOIL (G+9):**

| ZONE/ STOREY | ZONEII | ZONEIII | ZONEIV | ZONEV |
|---|---|---|---|---|
| 09 | 267.019 | 427.2305 | 640.8457 | 961.2685 |
| 08 | 319.6547 | 511.4475 | 767.1713 | 1150.757 |
| 07 | 255.4449 | 408.7119 | 913.0678 | 919.6017 |
| 06 | 198.4266 | 317.4826 | 613.0678 | 714.3358 |
| 05 | 148.5998 | 237.7597 | 356.6395 | 534.9593 |
| 04 | 105.9645 | 169.5432 | 254.3148 | 381.4722 |
| 03 | 70.5207 | 112.8331 | 169.2497 | 253.8745 |
| 02 | 42.26839 | 67.62942 | 101.4441 | 152.1662 |
| 01 | 21.20758 | 33.93212 | 50.89819 | 76.34728 |
| SILT | 5.586705 | 8.938728 | 13.40809 | 20.11214 |
| T-SHEAR4 | 1434.693 | 2295.509 | 3443.263 | 5164.895 |

| COMPARISION/ STOREY | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 09 | 360 | 225 | 150 | 150 | 240 | 160 |
| 08 | 360 | 225 | 150 | 150 | 240 | 160 |
| 07 | 360 | 225 | 150 | 150 | 240 | 160 |
| 06 | 360 | 225 | 150 | 150 | 240 | 160 |
| 05 | 360 | 225 | 150 | 150 | 240 | 160 |
| 04 | 360 | 225 | 150 | 150 | 240 | 160 |
| 03 | 360 | 225 | 150 | 150 | 240 | 160 |
| 02 | 360 | 225 | 150 | 150 | 239.9999 | 160 |
| 01 | 360 | 225 | 150 | 150 | 240 | 160 |
| SILT | 360 | 225 | 150 | 150 | 240 | 160 |

**BASE SHEAR VALUES FOR SOFT SOIL(G+9):**

| ZONE/ STOREY | ZONEII | ZONEIII | ZONEIV | ZONEV |
|---|---|---|---|---|
| 09 | 32708837 | 524.6139 | 786.9208 | 1180.381 |
| 08 | 392.5172 | 628.0275 | 942.0412 | 1413.062 |
| 07 | 313.6713 | 501.8741 | 752.8111 | 1129.217 |
| 06 | 243.6562 | 389.8499 | 584.7749 | 877.1623 |
| 05 | 182.4718 | 291.9549 | 437.9324 | 656.8985 |
| 04 | 130.1182 | 208.1891 | 312.2836 | 468.4254 |
| 03 | 86.59527 | 138.5524 | 207.8286 | 311.743 |
| 02 | 51.9031 | 83.04495 | 124.5674 | 186.8511 |
| 01 | 26.04166 | 41.66665 | 62.49998 | 93.74997 |
| SILT | 6.860145 | 10.97623 | 16.46435 | 24.69652 |
| T-SHEAR | 1761.719 | 2818.75 | 4228.124 | 6342.187 |

| COMPARISION/ STOREY | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 09 | 359.9999 | 224.9999 | 150 | 150 | 240 | 160 |
| 08 | 360 | 225 | 150 | 150 | 240 | 160 |
| 07 | 360.0001 | 225.0001 | 150 | 150 | 240 | 160 |
| 06 | 360 | 225 | 150 | 150 | 240 | 160 |
| 05 | 360 | 225 | 150 | 150 | 240 | 160 |
| 04 | 359.9999 | 225 | 150 | 150 | 239.9999 | 160 |
| 03 | 360 | 225.0001 | 150 | 150 | 239.9999 | 160 |
| 02 | 359.9999 | 225 | 150 | 150 | 239.9999 | 160 |
| 01 | 360 | 225 | 150 | 150 | 240 | 160 |
| SILT | 360 | 225 | 150 | 150 | 240 | 160 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

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BASE SHEAR VALUES FOR HARD SOIL(G+14):

| ZONE/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 01 | 139.682 | 223.4912 | 335.2367 | 502.8551 |
| 02 | 178.9091 | 286.2545 | 429.3817 | 644.0726 |
| 03 | 154.9692 | 247.9507 | 371.926 | 557.889 |
| 04 | 132.748 | 212.3968 | 318.5953 | 477.8929 |
| 05 | 112.2457 | 179.593 | 269.3896 | 404.0844 |
| 06 | 93.46205 | 149.5393 | 224.3089 | 336.4634 |
| 07 | 76.3972 | 122.2355 | 183.3533 | 275.0299 |
| 08 | 61.05111 | 97.68178 | 146.5227 | 219.784 |
| 09 | 47.42379 | 75.87806 | 113.8171 | 170.7256 |
| 10 | 35.51523 | 56.82436 | 85.23654 | 127.8548 |
| 11 | 25.32543 | 40.52068 | 60.78102 | 91.17153 |
| 12 | 16.85439 | 26.96702 | 40.45053 | 60.67579 |
| 13 | 10.10211 | 16.16337 | 24.24506 | 36.36759 |
| 14 | 5.068593 | 8.109749 | 12.16462 | 18.24693 |
| SILT | 1.347842 | 2.156548 | 3.234822 | 4.852233 |
| T-SHEAR | 1091.102 | 1745.763 | 2618.644 | 3927.966 |

| ZONES/ COMPARISION | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 01 | 359.9999 | 225 | 150 | 150 | 239.9999 | 160 |
| 02 | 359.9999 | 225 | 150 | 150 | 239.9999 | 160 |
| 03 | 359.9999 | 225 | 150 | 150 | 239.9999 | 160 |
| 04 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 05 | 359.9999 | 225.0001 | 150 | 150.0001 | 239.9999 | 159.9999 |
| 06 | 360 | 225 | 150 | 150 | 240 | 160 |
| 07 | 360 | 225 | 150 | 150 | 240 | 160 |
| 08 | 360 | 225 | 150 | 150 | 240.0001 | 160 |
| 09 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 10 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 11 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 12 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 13 | 359.9999 | 225 | 150 | 150 | 240 | 159.9999 |
| 14 | 359.9999 | 224.9999 | 150 | 150 | 239.9999 | 160 |
| SILT | 360.0001 | 225 | 150 | 150 | 240.0001 | 160.0001 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

**BASE SHEAR VALUES FOR MEDIUM SOIL(G+14):**

| ZONES/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 14 | 189.9674 | 303.9479 | 455.9218 | 683.8827 |
| 13 | 243.3162 | 389.3059 | 583.9589 | 875.9384 |
| 12 | 210.758 | 337.2128 | 505.8191 | 758.7287 |
| 11 | 180.5372 | 288.8596 | 433.2894 | 649.9341 |
| 10 | 152.654 | 244.2465 | 366.3697 | 549.5545 |
| 9 | 127.1083 | 203.3733 | 305.06 | 457.59 |
| 8 | 103.9002 | 166.2402 | 249.3604 | 374.0405 |
| 7 | 83.02948 | 132.8472 | 199.2708 | 298.9061 |
| 6 | 64.49633 | 103.1941 | 154.7912 | 232.1868 |
| 5 | 48.30069 | 77.2811 | 115.9217 | 173.8825 |
| 4 | 34.44257 | 55.10811 | 82.66216 | 123.9932 |
| 3 | 22.92196 | 36.67513 | 55.0127 | 82.51905 |

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| | | | | |
|---|---|---|---|---|
| 2 | 13.73886 | 21.98218 | 32.97327 | 49.45991 |
| 1 | 6.893284 | 11.02925 | 16.54388 | 24.81582 |
| SILT | 1.833065 | 2.932904 | 4.399356 | 6.599034 |
| T.SHEAR | 1483.898 | 2374.236 | 3561.354 | 5342.031 |

| ZONES/ COMPARISION | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 01 | 360 | 225 | 150 | 150 | 240 | 160 |
| 02 | 360 | 225 | 150 | 150 | 240 | 160 |
| 03 | 360 | 225 | 150 | 150 | 240 | 160 |
| 04 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 05 | 360.0001 | 224.9999 | 150 | 150 | 240.0001 | 160.0001 |
| 06 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 07 | 359.9998 | 225 | 150 | 150.0001 | 239.9999 | 159.9999 |
| 08 | 360 | 224.9999 | 149.9999 | 150 | 240.0001 | 160 |
| 09 | 360 | 225.0001 | 150 | 150 | 240 | 160 |
| 10 | 360 | 225 | 150 | 150.0001 | 240.0001 | 160 |
| 11 | 359.9998 | 224.9999 | 150 | 150 | 240 | 160 |
| 12 | 360 | 225 | 150 | 150 | 240 | 160 |
| 13 | 360.0001 | 225 | 150 | 150 | 240 | 160 |
| 14 | 360 | 225.0001 | 150 | 150 | 240 | 159.9999 |
| SILT | 360 | 225 | 150 | 150 | 240 | 160 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

## BASE SHEAR VALUES FOR SOFT SOIL (G+14):

| ZONES/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 14 | 233.2688 | 373.2302 | 559.8452 | 839.7678 |
| 13 | 298.7781 | 478.0449 | 717.0673 | 1075.601 |
| 12 | 258.7984 | 414.0775 | 621.1163 | 931.6744 |
| 11 | 221.6892 | 354.7027 | 532.054 | 798.081 |
| 10 | 187.4502 | 299.9203 | 449.8805 | 674.8207 |
| 9 | 156.0816 | 249.7305 | 374.5958 | 561.8937 |
| 8 | 127.5833 | 204.1333 | 306.1999 | 459.2999 |
| 7 | 101.9553 | 163.1285 | 244.6928 | 367.0392 |
| 6 | 79.19771 | 126.7163 | 190.0745 | 285.1118 |
| 5 | 59.31042 | 94.89667 | 142.345 | 213.5175 |
| 4 | 42.29345 | 67.66952 | 101.5043 | 152.2564 |
| 3 | 28.14682 | 45.03491 | 67.55237 | 101.3286 |
| 2 | 16.87052 | 26.99283 | 40.48924 | 60.73387 |
| 1 | 8.464548 | 13.54328 | 20.31492 | 30.47237 |
| SILT | 2.250896 | 3.601434 | 5.402151 | 8.103227 |
| T.SHEAR | 1822.139 | 2915.423 | 4373.134 | 6559.701 |

| ZONES/ COMPARISION | V/II | V/III | V/IV | IV/III | IV/II | III/II |
|---|---|---|---|---|---|---|
| 01 | 360.0001 | 225 | 150 | 150 | 240 | 160.0001 |
| 02 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 03 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 04 | 359.9999 | 225 | 150 | 150 | 240 | 160 |
| 05 | 360 | 225 | 150 | 150 | 240 | 160 |

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|---|---|---|---|---|---|---|
| 06 | 360 | 225 | 150 | 150 | 240 | 160 |
| 07 | 360 | 225 | 150 | 150 | 240 | 160 |
| 08 | 360.0001 | 225 | 150 | 150 | 240.0001 | 160 |
| 09 | 360.0001 | 225.0001 | 150 | 150 | 240 | 160 |
| 10 | 360 | 225 | 150 | 150 | 240 | 160 |
| 11 | 360 | 225 | 150 | 150 | 240 | 160 |
| 12 | 360.0002 | 225.0001 | 150.0001 | 150 | 240 | 160 |
| 13 | 360 | 225 | 150 | 150 | 240 | 160 |
| 14 | 360 | 224.9999 | 150 | 150 | 240.0001 | 160 |
| SILT | 360.0001 | 225 | 150 | 150 | 240 | 160 |
| T-SHEAR | 360 | 225 | 150 | 150 | 240 | 160 |

## COMPARISION OF BASE SHEAR VALUES BY TYPE OF SOIL:

### HARD AND MEDIUM SOIL:

| ZONES/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 14 | 135.9999 | 135.9999 | 136 | 136 |
| 13 | 135.9999 | 135.9999 | 136 | 135.9999 |
| 12 | 135.9999 | 135.9999 | 135.9999 | 135.9999 |
| 11 | 135.9999 | 136 | 135.9999 | 135.9999 |
| 10 | 135.9999 | 136 | 135.9999 | 135.9999 |
| 9 | 135.9999 | 135.9999 | 136 | 135.9999 |
| 8 | 136 | 135.9999 | 136 | 135.9999 |
| 7 | 136 | 136 | 136 | 135.9999 |
| 6 | 135.9999 | 135.9999 | 136 | 136 |
| 5 | 135.9999 | 135.9999 | 136 | 136 |
| 4 | 135.9999 | 136 | 136 | 135.9999 |
| 3 | 135.9999 | 135.9999 | 135.9999 | 136 |
| 2 | 135.9999 | 136 | 136 | 136 |
| 1 | 136 | 135.9999 | 136 | 136 |
| SILT | 136 | 135.9999 | 135.9999 | 135.9999 |
| T.SHEAR | 135.9999 | 135.9999 | 135.9999 | 135.9999 |

### FOR HARD AND SOFT SOIL:

| ZONES/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 14 | 166.9999 | 167 | 167 | 167 |
| 13 | 166.9999 | 167 | 167 | 167 |
| 12 | 166.9999 | 166.9999 | 167 | 167 |
| 11 | 167 | 167 | 167 | 167 |
| 10 | 166.9999 | 167 | 167 | 166.9999 |
| 9 | 167 | 166.9999 | 167 | 166.9999 |
| 8 | 167 | 167 | 166.9999 | 167 |
| 7 | 166.9999 | 166.9999 | 166.9999 | 167 |
| 6 | 167 | 166.9999 | 166.9999 | 167 |
| 5 | 167 | 167 | 167 | 167 |
| 4 | 166.9999 | 167 | 167 | 166.9999 |
| 3 | 166.9999 | 167 | 167 | 167.0001 |
| 2 | 167 | 167 | 167 | 167 |
| 1 | 167 | 167 | 167 | 167 |
| SILT | 167 | 166.9999 | 166.9999 | 167 |
| T.SHEAR | 166.9999 | 167 | 167 | 167 |

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**FOR MEDIUM AND SOFT SOILS:**

| ZONES/ STOREY | ZONE II | ZONE III | ZONE IV | ZONE V |
|---|---|---|---|---|
| 14 | 122.7941 | 122.7941 | 122.7941 | 122.7941 |
| 13 | 122.7942 | 122.7942 | 122.7941 | 122.7941 |
| 12 | 122.7941 | 122.7941 | 122.7942 | 122.7941 |
| 11 | 122.7942 | 122.7942 | 122.7941 | 122.7941 |
| 10 | 122.7942 | 122.7941 | 122.7941 | 122.7941 |
| 9 | 122.7942 | 122.7941 | 122.7941 | 122.7941 |
| 8 | 122.7941 | 122.7942 | 122.7941 | 122.7942 |
| 7 | 122.7941 | 122.7941 | 122.7941 | 122.7941 |
| 6 | 122.7941 | 122.7941 | 122.7941 | 122.7941 |
| 5 | 122.7941 | 122.7942 | 122.7941 | 122.7941 |
| 4 | 122.7941 | 122.7941 | 122.7942 | 122.7942 |
| 3 | 122.7941 | 122.7941 | 122.7941 | 122.7942 |
| 2 | 122.7942 | 122.7941 | 122.7941 | 122.7941 |
| 1 | 122.7941 | 122.7942 | 122.7942 | 122.7941 |
| SILT | 122.7941 | 122.7941 | 122.7941 | 122.7941 |
| T.SHEAR | 122.7941 | 122.7941 | 122.7941 | 122.7941 |

**COMPARISION RESULTS FOR SOILS:**

1. Comparision of base shear value for hard and medium soils for all zones is 136.
2. Comparision of base shear value for hard and soft soils for all zones is 167
3. Comparision of base shear value for medium and soft soils for all zones is 122.7941.

## CONCLUSION:

In this contest we are going to develop the graphs with respect to :

| X | Y |
|---|---|
| Height | base shear |
| Base shear | moment |

And observe the relation between base shear and moment with respect to height for wind load of terrace conditions 1(10 m) of building area.

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