JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Seismic Analysis of RCC Building With Different Aspect Ratio and Different Soil Types with Zone Iii

Ratnakala Borkar[1], Dr. **V. D Vaidya**[2]

[1]PG scholar in structural Engineering, Department of Civil Engineering

K. D. K College of Engineering, Nagpur, Maharashtra, India

[2]Assistant Professor, Department of Civil Engineering

K. D. K College of Engineering, Nagpur, Maharashtra, India

Abstract: This study uniquely investigates the seismic resilience of reinforced concrete (RCC) buildings under seismic zone III conditions, focusing on the interplay between aspect ratios and soil types. Using the Indian seismic code IS 1893 (Part 1): 2016 as a standard, we examined RCC building models with varying aspect ratios (1:1, 1:2, and 1:3) across three soil categories: hard (Type I), medium (Type II), and soft. The analysis assessed key seismic parameters such as base shear, natural frequency, displacements, inter-story drift, and specifically axial forces and bending moments in the Y and Z directions, as well as support reactions in corner (C1), outer centre (C2), and centre (C3) columns.

Our results indicate a stabilizing effect on axial forces and bending moments as the aspect ratio increases, especially under soft soil conditions where these forces tend to vary more at lower aspect ratios. Buildings with an aspect ratio of 1:3 showed the most uniform load distribution and minimal seismic force variations, effectively reducing vulnerability. In contrast, models with 1:1 and 1:2 aspect ratios displayed higher sensitivity to soil conditions, with the centre column (C3) being the most affected in terms of bending moments and axial forces.

The findings highlight the amplifying effect of soft soils on seismic responses, resulting in greater variability in axial forces and bending moments compared to hard and medium soils. Furthermore, the support reactions—specifically force in the Y-direction and bending moments in the Mx and Mz directions—exhibited significant fluctuations in soft soils, particularly in the centre column. Hard soil conditions, while reducing force and moment variability, increased structural rigidity, potentially limiting energy dissipation during seismic activity.

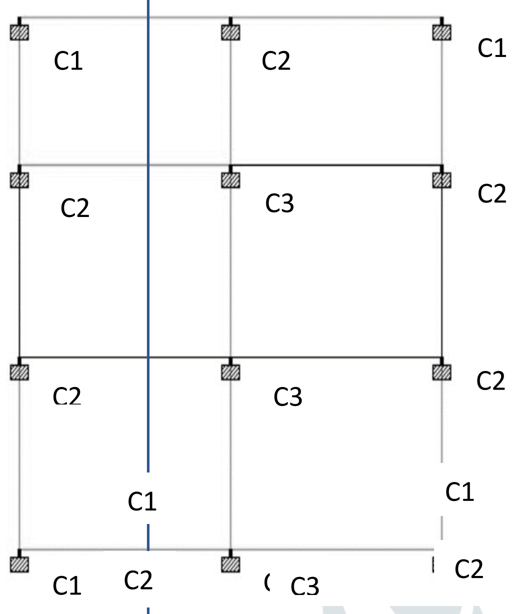
In conclusion, for seismic zone III regions, an optimized aspect ratio of 1:3 combined with a strategic approach to soil considerations—particularly soft soils—is essential for enhancing RCC building resilience against seismic forces. These findings contribute valuable guidance for structural engineers aiming to design RCC structures with improved seismic performance by carefully balancing aspect ratios, soil types, and seismic load responses.

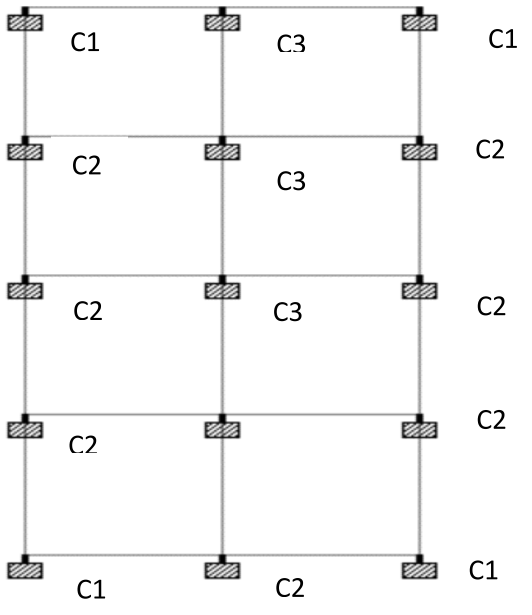
Keywords: Seismic Analysis, RCC Buildings, Aspect ratio, Soil Types, Seismic Zone III, Structural performance, Axial force, Bending Moment, Support Reaction.

Introduction: this study investigates the dynamic impact of seismic forces on reinforced concrete RCC buildings examining how variations in aspect ratios and soil types influence structural behaviour in seismic zone III earthquakes caused by tectonic plate movements produce powerful ground vibrations that can destabilize buildings especially those not designed to withstand seismic forces while earthquakes themselves may not be inherently fatal inadequate building designs can lead to significant structural failures resulting in casualties and damage multi-story buildings particularly G+10 structures as analysed here are notably complex to design due to the interplay of various forces and the increased sway at higher elevations as building height increases the effects of wind seismic activity and soil conditions become more critical to the design in seismic zone iii where moderate to high seismic activity is likely detailed structural analysis is crucial to ensure building resilience RCC buildings valued for their durability and strength require careful optimization to counteract seismic loads this study focuses on the aspect ratio which defines a buildings height-to-width proportion as a key variable in seismic performance buildings with taller slender profiles often exhibit greater susceptibility to lateral displacement which can lead to instability therefore understanding the influence of aspect ratios on seismic responses is essential for designing RCC buildings in earthquake-prone areas the type of soil beneath a building is another significant factor in its seismic resilience soil properties can either amplify or dampen seismic waves directly affecting a buildings stability during an earthquake in accordance with the Indian seismic code is 1893 part 1 2016 soils are categorized into three primary types type I rock or hard soil type ii medium soil and type iii soft soil each soil type interacts uniquely with seismic forces impacting the structural stability of buildings in different ways for instance hard soil provides a stable foundation whereas soft soil can amplify seismic effects leading to more intense structural vibrations and responses the objective of this paper is to analyse how different aspect ratios and soil types combined affect the seismic performance of RCC buildings using finite element analysis tools the study models RCC buildings subjected to seismic loads evaluating crucial parameters such as base shear natural frequency displacement and inter-story drift by drawing on existing research and empirical data the analysis provides a comprehensive understanding of how these variables impact RCC structures seismic resilience modelling approach the modelling phase of this research involves developing RCC building models with various aspect ratios and simulating their seismic responses on distinct soil types that are representative of seismic zone iii conditions this section details the methodology used for model development including parameter selection assumptions and the software tools utilized for the seismic analysis finite element models are constructed to capture the complex behaviour of RCC structures under seismic loading this approach enables an accurate assessment of how variations in aspect ratios and soil types influence seismic performance the findings from this study are intended to guide civil engineers and designers in creating more robust earthquake-resistant RCC buildings

Modelling:

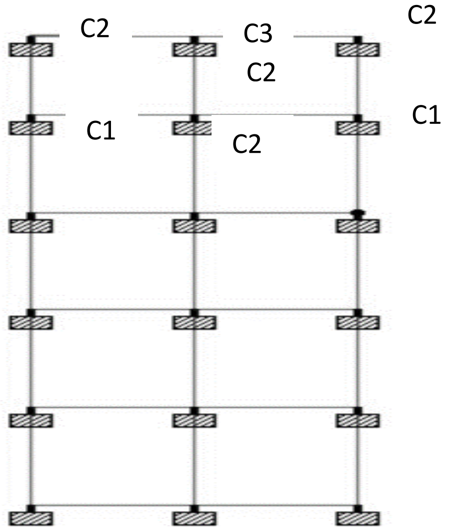
The modelling phase involves creating RCC building models with varying aspect ratios and simulating their responses on distinct soil types, reflecting seismic zone III conditions. This section provides a detailed explanation of the modelling methodology, covering the selection of key parameters, assumptions, and software tools utilized for seismic analysis. The finite element models are constructed to capture the nuanced behaviour of RCC structures under seismic loading, allowing for a precise assessment of how aspect ratios and soil types interact to affect seismic performance. The insights gained from this study are intended to aid civil engineers and designers in developing more robust, earthquake-resistant RCC buildings.

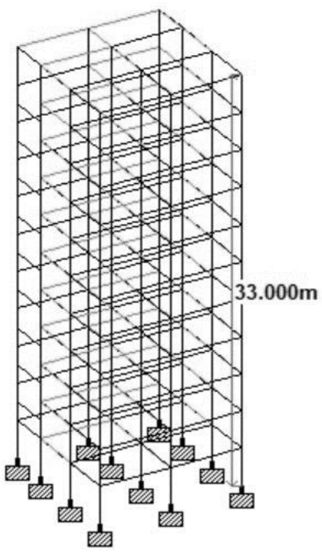




ASP RATIO C2 C3 C2 ASPECT RATIO 1:2

C2 C3 C2





MODEL 3: ASPECT RATIO 1:3 ELEVATION

1. **Building Geometry and Aspect Ratios**

   To evaluate the influence of aspect ratios on seismic performance, we modelled RCC buildings with three distinct aspect ratios: 1:1 (square plan), 1:2 (rectangular plan) and 1:3(slender structure). Each model represents a multi-story building with typical residential or commercial usage, designed in accordance with the guidelines provided in IS 456:2000 for plain and reinforced concrete structures.

   - **Model A:** Aspect ratio 1:1 (10.56m x 10.56m, 33m height)
   - **Model B:** Aspect Ratio 1:2 (7.46m x 14.92m, 33m height)
   - **Model C:** Aspect Ratio 1:3(6.1m x 18.29m, 33m height)

2. **Soil Types and Seismic Zone 3**

   The models are analysed under three different soil conditions as categorized by IS 1893 (Part 1): 2016:

   - Type I: Rock or Hard Soil (with high bearing capacity and low seismic amplification)
   - Type II: Medium Soil (intermediate properties, moderate seismic amplification)
   - Type III: Soft Soil (low bearing capacity, high seismic amplification)

Seismic zone III represents areas with moderate in e seismicity, where structures must be designed to resist significant seismic forces. The response spectrum provided in IS 1893(Part 1): 2016 is used to define the seismic loadings applied to the building's models.

1. **3. Structural Parameters**

   - Column: 0.4m x 0.75m
   - Beam: 0.23m x 0.4m
   - Floor to Floor Height: 3m
   - Foundation Depth: 3m
   - Building Types: Residential Buildings with G+10
   - Height: 33m
   - Length For (1:1 aspect ratio Building): 10.56m
   - Width For (1:1 aspect ratio Building): 10.56m
   - Length For (1:2 aspect ratio Building): 7.46m
   - Width For (1:2 aspect ratio Building):14.92m
   - Length For (1:3 aspect ratio Building): 6.1m
   - Width For (1:3 aspect ratio Building): 18.29m

4. Loading Parameters

Dead load

1. Self-weight (considering the self-weight of structures as 1)
2. Wall Load: Thickness of wall x Height of floor x Density of brick

   = 0.23m x (3-0.4) m x 20 = 11.96 KN/m^2
3. Floor Load: Thickness of Slab x Density of concrete +Floor finish

= 0.125 x 25+1= 4.125 KN/m^2

4. Floor Finish: 1 KN/m^2 (considered)
5. Load on mid landing 20.675KN
6. Load on Staircase Beam: 15.7 KN

Live Load

1. 2KN/ m^2 (for Residential Building) as per IS code 875 Part II
2. 3 KN/m^2 (for staircase Residential Building) as per IS code 874 Part II

Seismic Load

Zone = III (Z = 0.16)

Response Reduction Factor: 5(SMRF)

Importance Factor: 1

Soil Types: Hard Soil (1), Medium Soil (2), Soft Soil (3).

Damping Ratio: 5%

Wind Calculation

- ❖ Wind loads calculation as per IS: 875 Part III -2015

Basic wind speed (Vb) = 50 m/sec for zone III (Table 1 of IS: 875 2015(Part 3)

Design wind speed (Vz) = Vb x K1 x K2 x K3 x K4 (Clause 6.3)

Where, K1 Probability Factor = 1 …. (Clause 6.3.1)

K2 Terrain Roughness and Height factor = 0.67…... (Table 2 of IS: 875(Part 3)

K3 Topography Factor = 1 …. (Clause 6.3.3)

K4 Importance Factor For cyclonic Region = 1 …. (Clause 6.3.4)

For 10m Height

- ❖ Design wind speed Vz = Vb x K1 x K2 x K3 x K4…. (Clause6.3)

Vz = 50 x 1 x 0.67 x 1.0 x 1 Vz= 33.5m/sec

- ❖ Design wind Pressure Pz =0.6 Vz^2 …. (Clause7.2)

Pz = $0.6(33.5)^2$Pz = 0.673 KN/m^2

Result and discussion:

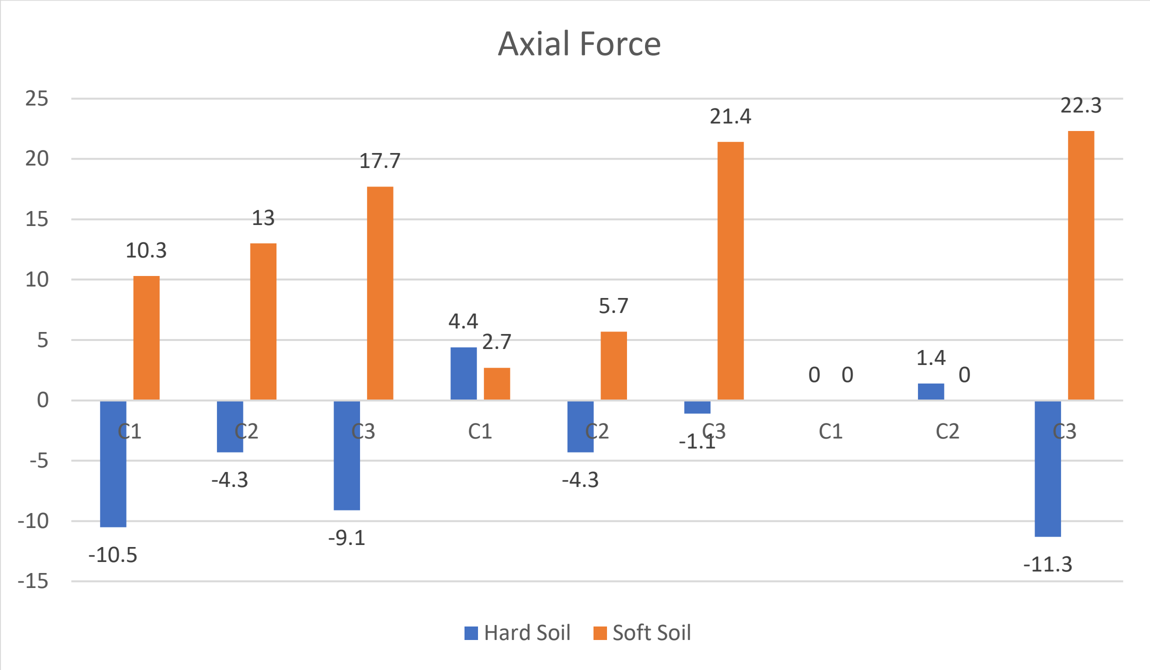


Fig 1: Percentage variation of axial force on column

1. Aspect Ratio 1:1:

- For C1 (corner column), there is a significant drop in axial force on hard soil (10.5%), while soft soil increases it by 10.3%. This suggests that corner columns are more sensitive to soil stiffness, experiencing a higher load on softer soils.

- C2 (outer center column) shows a more moderate response, with a small decrease on hard soil (4.3%) and a moderate increase on soft soil (13%). The position of C2 leads to more balanced behavior compared to C1.

- C3 (center column) experiences the largest variation on soft soil, with a 17.7% increase. The center column's load response is more sensitive to soft soil, which may reflect how load is distributed more evenly across the structure, leading to increased axial forces on softer soils.

2. Aspect Ratio 1:2:

- In this aspect ratio, C1 shows a reversal of behavior, with axial force increasing on both hard soil (4.4%) and soft soil (2.7%) compared to medium soil. The variation is smaller than in the 1:1 ratio, indicating a more stable response as the aspect ratio increases.

- C2 remains relatively consistent on hard soil (4.3%) but shows a notable increase on soft soil (5.7%). The influence of soft soil increases, although not as drastically as in the 1:1 ratio.

- C3 continues to exhibit a strong response on soft soil, with a 21.4% increase, while hard soil causes only a slight decrease (1.1%). This indicates that even at a higher aspect ratio, soft soil exerts a significant impact on center columns.

3. Aspect Ratio 1:3:

- For C1, the axial force remains stable (0%) on both hard and soft soils, indicating that at this aspect ratio, the corner column is less affected by soil conditions.

- C2 shows a slight increase on hard soil (1.4%) and stability on soft soil (0.0%), reflecting a neutral response to soil changes at this higher aspect ratio.

- C3, however, experiences the largest variations, with a substantial decrease on hard soil (11.3%) and a strong increase on soft soil (22.3%). The center column in this aspect ratio seems most influenced by soil type, especially soft soil, which significantly increases its axial load.

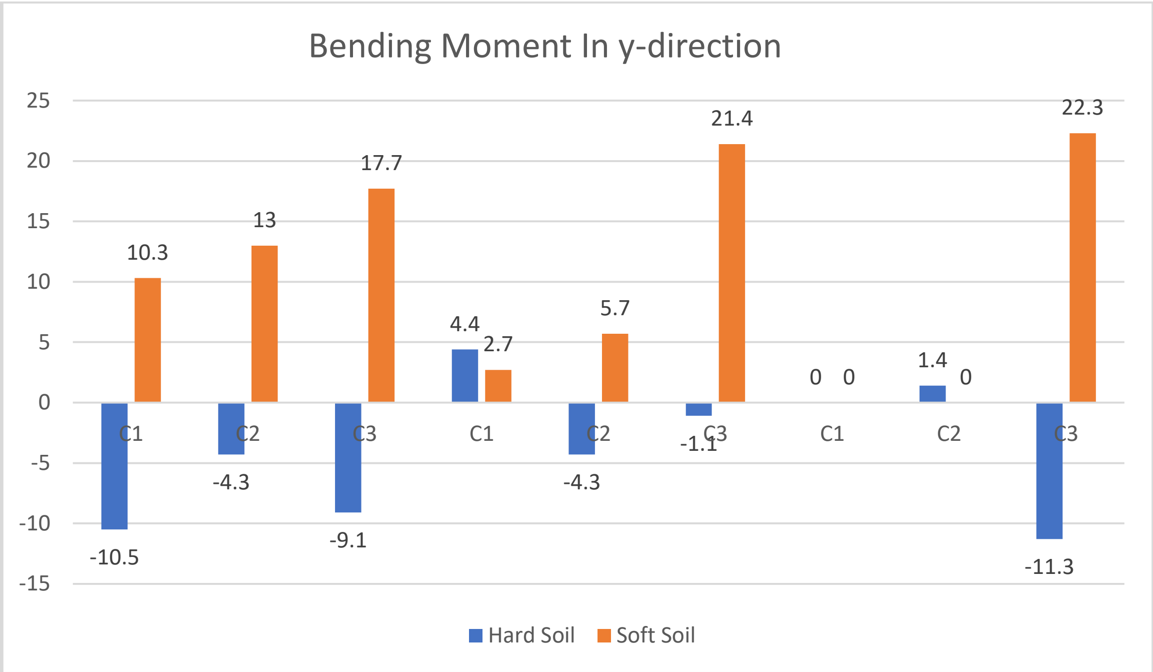


Fig 2: Percentage variation on bending moment in y-direction on column:

1. C1 (Corner Column):

- For aspect ratio 1:1, there is a 10.5% reduction in bending moments on hard soil, while soft soil leads to a 10.3% increase. This suggests that the bending moment for the corner column is significantly affected by changes in soil stiffness.

- With aspect ratio 1:2, the variation is smaller, with 4.4% and 2.7%* increases for hard and soft soils, respectively, indicating that the sensitivity of bending moments decreases as the aspect ratio increases.

- For aspect ratio 1:3, the bending moment remains stable (0%) in both hard and soft soils, reflecting that the larger aspect ratio stabilizes the columns bending moment behavior regardless of soil conditions.

2. C2 (Outer Center Column):

- For aspect ratio 1:1, there is a 4.3% reduction on hard soil and a 13.0% increase on soft soil. This moderate response shows that the outer center column experiences noticeable variation, particularly on soft soil.

- For aspect ratio 1:2, the bending moment on hard soil remains unchanged at -4.3%, while it increases by 5.7% on soft soil, indicating a similar pattern but with less sensitivity compared to aspect ratio 1:1.

- For aspect ratio 1:3, the bending moment shows a slight 1.4% increase on hard soil and remains stable (0%) on soft soil, further reflecting that the higher aspect ratio reduces sensitivity to soil conditions.

3. C3 (Center Column):

- For aspect ratio 1:1, the bending moment decreases by 9.1% on hard soil, while it increases by 17.7% on soft soil, showing that the center column is highly influenced by the softness of the soil.

- For aspect ratio 1:2, the bending moment shows a slight decrease of 1.1% on hard soil but a significant 21.4% increase on soft soil, indicating that the center column remains highly sensitive to soft soil even at a higher aspect ratio.

- For aspect ratio 1:3, the bending moment experiences a substantial 11.3% reduction on hard soil and a 22.3% increase on soft soil, confirming that the center column remains the most sensitive to soil conditions, particularly soft soil, even at the largest aspect ratio.

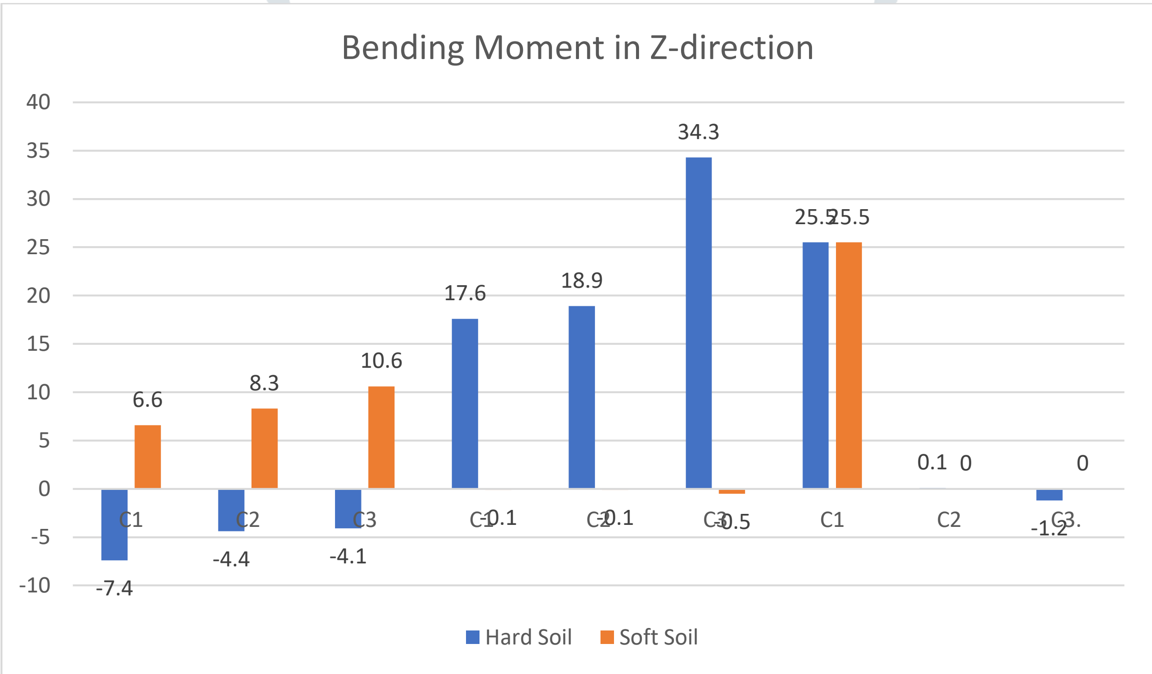


Fig 3: Percentage variation of bending moment in z–direction on column

1. C1 (Corner Column):

- For aspect ratio 1:1, bending moments decrease by 7.4% on hard soil and increase by 6.6% on soft soil. This suggests that the corner column is moderately sensitive to changes in soil stiffness, with hard soil leading to a reduction in bending moments and soft soil causing an increase.

- With aspect ratio 1:2, there is a notable 17.6% increase in bending moments on hard soil, while soft soil results in a near-neutral change (-0.1%). The increase on hard soil suggests that, at this aspect ratio, the corner column experiences more bending on stiffer soils.

- For aspect ratio 1:3, bending moments increase significantly by 25.5% on both hard and soft soils, indicating that at this higher aspect ratio, the corner column's bending moment is substantially higher in both soil conditions. This suggests that larger aspect ratios lead to increased moments in the Z-direction for corner columns.

2. C2 (Outer Center Column):

- For aspect ratio 1:1, bending moments decrease by 4.4% on hard soil and increase by 8.3% on soft soil. Similar to C1, C2 also exhibits moderate sensitivity to soil type but with a slightly smaller variation than C1.

- For aspect ratio 1:2, the bending moment increases by 18.9% on hard soil, while soft soil shows a negligible change (-0.1%). This mirrors the behavior seen in C1, where hard soil leads to a significant increase in bending moments at this aspect ratio.

- For aspect ratio 1:3, the bending moment stabilizes, with only a slight 0.1% increase on hard soil and no change (0.0%) on soft soil. This suggests that, at this higher aspect ratio, the outer center column experiences very little variation in bending moments in the Z-direction, making it more stable.

3. C3 (Center Column):

- For aspect ratio 1:1, bending moments decrease by 4.1% on hard soil and increase by 10.6% on soft soil, showing a similar trend as the other columns. The center column exhibits moderate sensitivity to soil stiffness, particularly on soft soil.

- For aspect ratio 1:2, the bending moment shows a significant 34.3% increase on hard soil, while soft soil results in a small decrease of -0.5%. The large increase on hard soil suggests that the center column is highly sensitive to soil stiffness at this aspect ratio, with a stronger response compared to C1 and C2.

- For aspect ratio 1:3, the bending moment decreases slightly by 1.2% on hard soil and remains stable (0.0%) on soft soil. This reflects a stabilizing effect similar to C2, where the bending moment becomes less affected by soil type at higher aspect ratios.

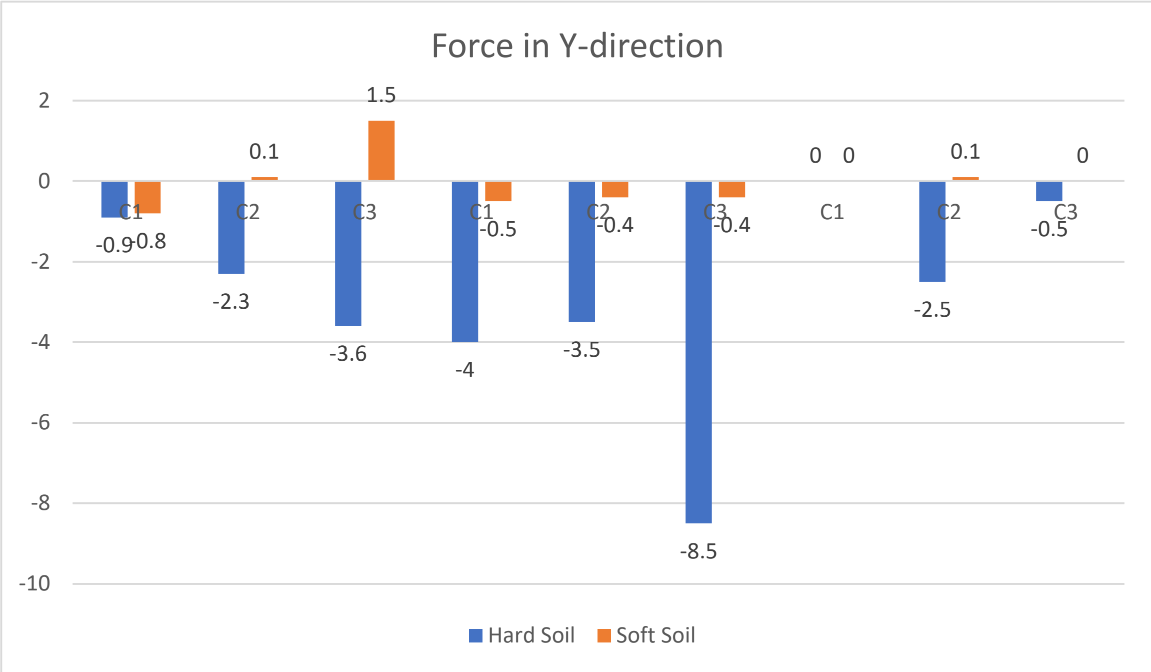


Fig 4: Percentage variation of force in y-direction on support reaction:

1. C1 (Corner Column):

- For aspect ratio 1:1, the support reaction force shows a slight decrease of 0.9% on hard soil and 0.8% on soft soil. This indicates minimal sensitivity to soil type at this aspect ratio.

- With aspect ratio 1:2, the variation becomes more pronounced, especially on hard soil, where there is a 4.0% decrease. On soft soil, the change is relatively smaller at 0.5%, indicating that the corner column experiences more of a reduction on stiffer (hard) soils.

- For aspect ratio 1:3, the support reaction force stabilizes, with no variation (0.0%) in both hard and soft soil conditions. This suggests that, at higher aspect ratios, the corner column's support reaction force in the Y-direction becomes more consistent and less affected by soil conditions.

2. C2 (Outer Center Column):

- For aspect ratio 1:1, the support reaction force decreases by 2.3% on hard soil but shows a slight increase of 0.1% on soft soil. This indicates that the outer center column is more sensitive to hard soil, where the support reaction force reduces, while soft soil has minimal impact.

- With aspect ratio 1:2, the force decreases further by 3.5% on hard soil and 0.4% on soft soil, highlighting that this column experiences more reduction in support reaction force as the aspect ratio increases, especially on hard soil.

- For aspect ratio 1:3, the variation remains somewhat similar, with a 2.5% decrease on hard soil and a negligible change (0.1% increase) on soft soil. This shows that while there is still a decrease in support reaction force on hard soil, the column’s sensitivity to soft soil remains minimal.

3. C3 (Center Column):

- For aspect ratio 1:1, the support reaction force decreases by 3.6% on hard soil and increases by 1.5% on soft soil. This suggests that the center column is more sensitive to soil type, with hard soil leading to a reduction and soft soil causing an increase.

- With aspect ratio 1:2, there is a notable 8.5% decrease in the support reaction force on hard soil, while soft soil results in a 0.4% decrease. This indicates that the center column's support reaction force is significantly reduced on hard soil as the aspect ratio increases.

- For aspect ratio 1:3, the support reaction force stabilizes, with only a 0.5% decrease on hard soil and no variation (0.0%) on soft soil, similar to C1. This suggests that the center column's force stabilizes at larger aspect ratios, becoming less influenced by soil conditions.

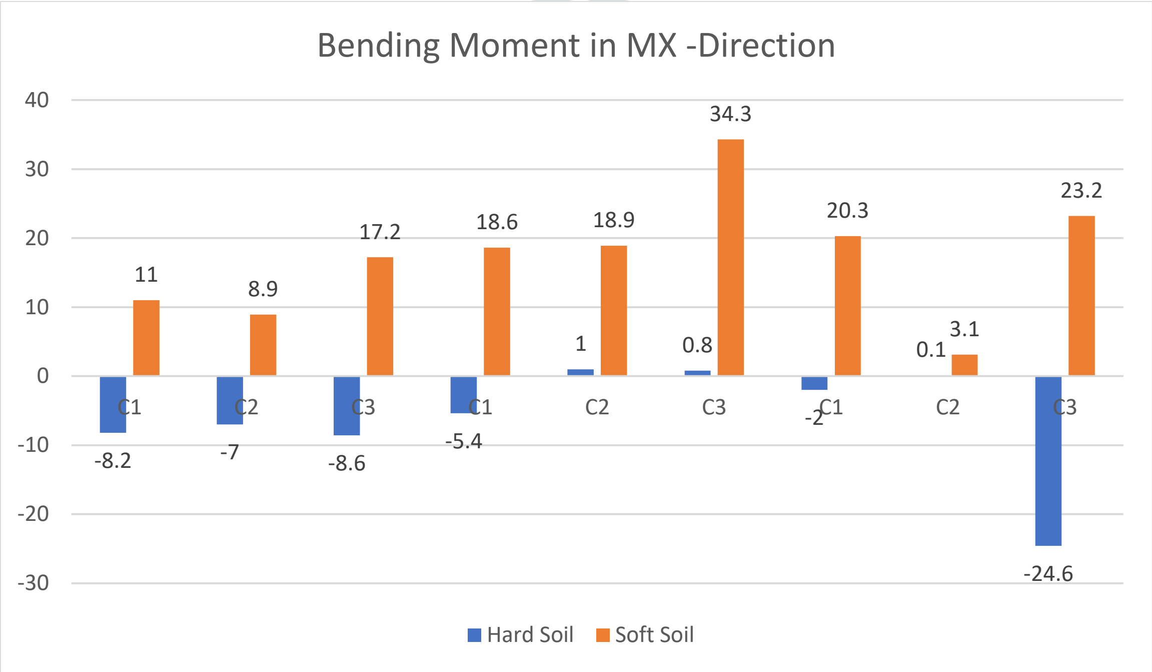


Fig 5: Percentage variation of bending moment in x-direction on support reaction:

1. C1 (Corner Column):

- For aspect ratio 1:1, the bending moment in the X-direction decreases by 8.2% on hard soil but increases by 11.0% on soft soil. This shows that the corner column experiences a more significant positive variation on soft soil, whereas it reduces on hard soil.

- With aspect ratio 1:2, the variation in bending moment becomes more moderate on hard soil with a 5.4% decrease, but it increases notably on soft soil by 18.6%. This reflects a growing sensitivity of the bending moment to soft soil as the aspect ratio increases.

- For aspect ratio 1:3, the decrease on hard soil further reduces to 2.0%, while the bending moment shows a significant increase of 20.3% on soft soil, indicating that the column becomes more sensitive to softer soils at higher aspect ratios.

2. C2 (Outer Center Column):

- For aspect ratio 1:1, the bending moment decreases by 7.0% on hard soil and increases by 8.9% on soft soil. Similar to C1, this column experiences a reduction on hard soil but a moderate increase on soft soil.

- With aspect ratio 1:2, the bending moment exhibits a 1.0% increase on hard soil, showing less sensitivity to hard soil, and a substantial 18.9% increase on soft soil, suggesting a growing influence of soft soil at this aspect ratio.

- For aspect ratio 1:3, the variation becomes minimal on hard soil with only a 0.1% increase, while on soft soil, the increase reduces to 3.1% compared to previous aspect ratios. This suggests that the outer center column stabilizes in terms of bending moment with a higher aspect ratio.

3. C3 (Center Column):

- For aspect ratio 1:1, the bending moment decreases by 8.6% on hard soil and increases by 17.2% on soft soil. This column shows similar trends to the other columns but with a slightly more significant increase in soft soil conditions.

- With aspect ratio 1:2, the bending moment shows a 0.8% increase on hard soil, while on soft soil, it surges by 34.3%, marking the highest variation in the table for soft soil. This indicates that the center column becomes highly sensitive to soft soil at this aspect ratio.

- For aspect ratio 1:3, the bending moment shows a sharp 24.6% decrease on hard soil, which is the largest reduction in the data, while soft soil still causes a significant increase of 23.2%. This suggests that at higher aspect ratios, the center column's bending moment in hard soil experiences a strong reduction, but it remains sensitive to soft soil.

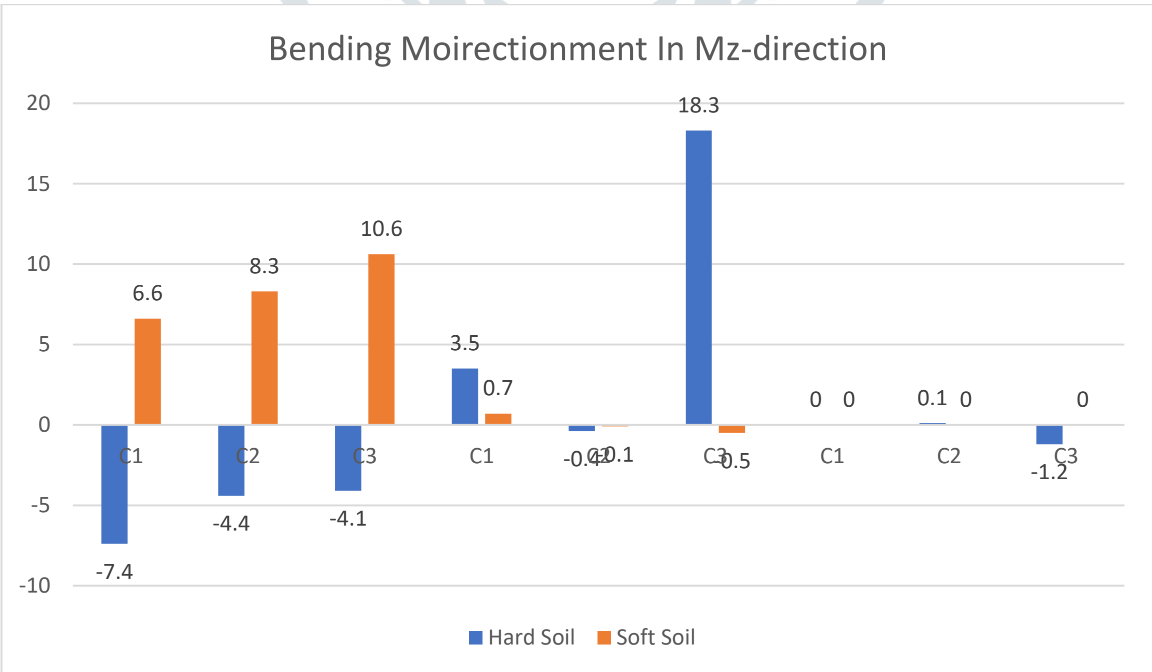


Fig 6: Percentage variation of bending moment in z-direction on support reaction:

1. C1 (Corner Column):

- For aspect ratio 1:1, the Z-direction bending moment reduces by 7.4% on hard soil but increases by 6.6% on soft soil. This indicates that on hard soil, the support reaction reduces, while on soft soil, it increases but not significantly.

- With aspect ratio 1:2, the bending moment increases by 3.5% on hard soil, while on soft soil, it increases slightly by 0.7%, showing a more stable response across soil types.

- For aspect ratio 1:3, there is no change (0.0%) in the bending moment, indicating that with a higher aspect ratio, the Z-direction bending moment becomes neutralized regardless of the soil condition.

2. C2 (Outer Center Column):

- For aspect ratio 1:1, the bending moment decreases by 4.4% on hard soil, while it increases by 8.3% on soft soil. The variation on soft soil is higher compared to hard soil, indicating a significant sensitivity to softer ground conditions.

- With aspect ratio 1:2, there is a slight 0.4% decrease on hard soil and a 0.1% decrease on soft soil, showing that the bending moment stabilizes across both soil types at this aspect ratio.

- For aspect ratio 1:3, the Z-direction bending moment shows a negligible 0.1% increase on hard soil and no change (0.0%) on soft soil, suggesting that the outer center column becomes less responsive to soil type variation with increased aspect ratio.

3. C3 (Center Column):

- For aspect ratio 1:1, the bending moment decreases by 4.1% on hard soil and increases significantly by 10.6% on soft soil, indicating that the center column reacts more to soft soil conditions.

- With aspect ratio 1:2, the bending moment experiences a notable 18.3% increase on hard soil, reflecting a significant response, while on soft soil, it decreases slightly by 0.5%, indicating some stabilization under soft soil conditions.

- For aspect ratio 1:3, the bending moment decreases by 1.2% on hard soil and shows no change (0.0%) on soft soil, suggesting a gradual normalization of the bending moment with increased aspect ratio.

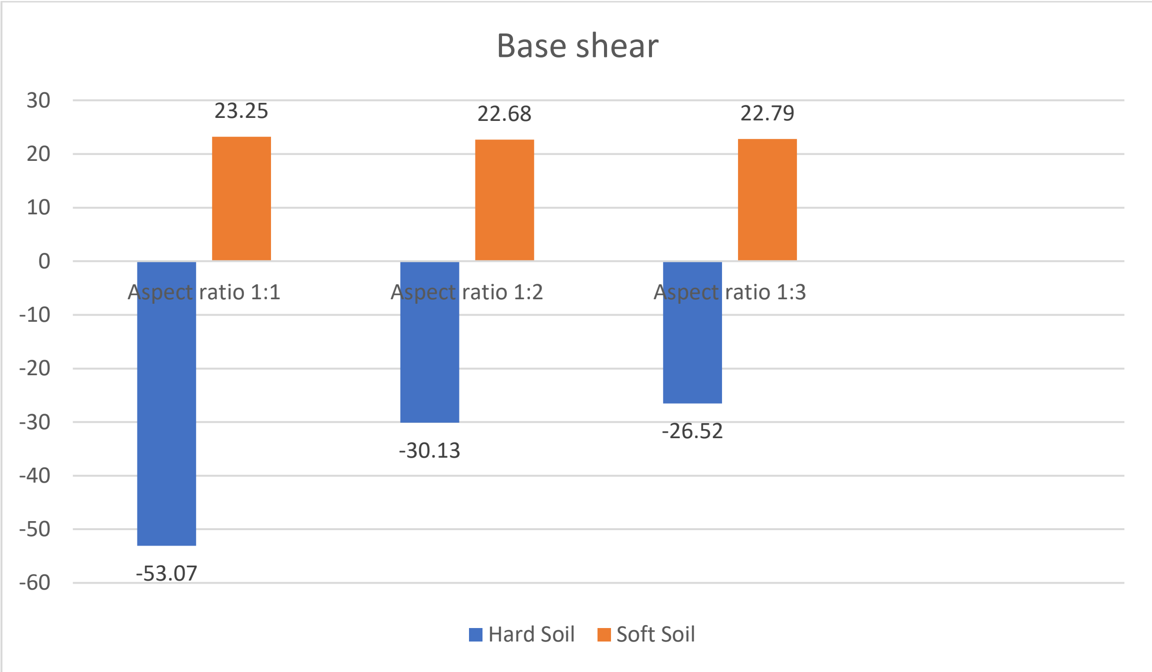


Fig 7: Percentage variation of base shear

The analysis of base shear percentage variations across different soil conditions (hard, medium, and soft) and aspect ratios (1:1, 1:2, and 1:3) reveals significant insights into how soil rigidity affects structural response.

1. Impact of Soil Rigidity on Base Shear:

- Hard soil consistently shows a reduction in base shear values compared to medium soil, while soft soil shows an increase.

- This trend is expected, as hard soil generally restricts structural movement, leading to lower seismic demands, whereas soft soil amplifies movement, resulting in higher base shear demands.

2. Aspect Ratio Influence:

- As the aspect ratio increases from 1:1 to 1:3, base shear values rise across all soil types. This trend suggests that taller structures (represented by higher aspect ratios) experience higher base shear due to increased sway and moment arm.

- The rate of base shear increase from hard to soft soil decreases with aspect ratio, indicating that taller structures may have a slightly moderated response to soil softness due to increased flexibility.

3. Percentage Variations:

- For hard soil, the percentage decrease in base shear (relative to medium soil) diminishes as the aspect ratio increases. This reduction indicates that taller structures (higher aspect ratios) are less sensitive to hard soil's restrictive effects, likely due to their inherent flexibility.

- For soft soil, the percentage increase in base shear remains fairly stable (~23%) across all aspect ratios. This consistency suggests that soil softness imposes a significant and relatively uniform impact on base shear, regardless of the structure's height or aspect ratio.

Structural Design Implications

1. Design Adjustments for Hard and Soft Soils:

- In hard soil conditions, structural designs may require less reinforcement to manage base shear compared to soft soil, due to the naturally reduced seismic forces. However, engineers must still consider potential brittle behavior in hard soils.

- For soft soil, reinforcement needs are higher, as increased base shear demands necessitate greater structural resilience. Designs on soft soils should prioritize flexibility and damping mechanisms to accommodate amplified seismic forces.

2. Consideration of Aspect Ratios:

- Structures with higher aspect ratios on soft soil face compounded seismic demands due to the combined effects of soil flexibility and structure height. These structures may benefit from advanced damping or base isolation techniques.

- Lower aspect ratios (e.g., 1:1) show the most significant changes in base shear due to soil variation, suggesting that shorter structures are more responsive to soil rigidity. These structures require tailored design considerations based on specific soil conditions to optimize performance.

3. Overall Safety and Efficiency:

- By understanding these percentage variations, engineers can better balance safety and material efficiency. For example, structures on medium soil might serve as the baseline for material requirements, with adjustments made for the additional or reduced demands of soft or hard soils.

This analysis highlights the essential role of soil conditions and aspect ratios in determining structural response to seismic forces. It underscores the need for customized engineering solutions that consider both the foundation's soil type and the structure's height profile, ensuring safety and optimizing resource use.

Conclusion:

The seismic analysis of reinforced concrete (RCC) buildings with varying aspect ratios (1:1, 1:2, and 1:3) across different soil types (hard, medium, and soft) in seismic zone III provides critical insights into how soil rigidity and structural dimensions influence base shear, axial forces, and bending moments. The research findings emphasize the importance of adapting design strategies to address the distinct demands posed by these variables.

1. Base Shear Variation across Soil Types and Aspect Ratios:

- **Soil Rigidity Impact:** Base shear values show a clear trend, decreasing on hard soil and increasing significantly on soft soil relative to medium soil. This pattern aligns with the fact that hard soils constrain structural motion, reducing seismic demands, while soft soils amplify these demands due to increased movement.

- **Aspect Ratio Influence:** Increasing the aspect ratio from 1:1 to 1:3 leads to an overall rise in base shear across all soil types. Taller structures (higher aspect ratios) tend to exhibit greater sway and develop higher seismic forces, especially on softer soils. The rate of base shear increase, however, moderates slightly as the aspect ratio rises, indicating that taller structures may better accommodate soil-induced flexibility.

2. Percentage Variations in Axial Forces and Bending Moments:

- **Axial Forces:** A higher aspect ratio correlates with more uniform axial force distribution across soil types, particularly for soft soil conditions. This distribution suggests that taller structures offer balanced load transfer, enhancing stability in seismic zones.

- **Bending Moments in Y and Z Directions:** Bending moments fluctuate notably under soft soil, especially at lower aspect ratios. The 1:3 aspect ratio reduces these variations, underscoring that taller buildings experience stabilized bending moments across soil types, enhancing structural resilience against seismic forces.

3. Support Reaction Sensitivity:

- The support reactions, including force in the Y-direction and bending moments in the X and Z directions, demonstrate that hard soils impose fewer demands on support reinforcement, while soft soils require greater support resilience. Variability in support reactions is most pronounced in lower aspect ratios, suggesting that shorter structures are more sensitive to soil type.

4. Overall Structural Stability:

- The 1:3 aspect ratio generally provides the most stable responses across axial forces, bending moments, and support reactions, particularly in soft soils, where seismic demand is highest. This stability underscores that buildings with higher aspect ratios can better manage seismic loads, especially on softer foundations.

Design Implications

1. Soil-Dependent Reinforcement Strategies:

- Buildings on hard soils experience reduced base shear and bending moment demands, allowing for material efficiency in reinforcement. Conversely, buildings on soft soils require increased reinforcement and may benefit from advanced design solutions like damping systems or base isolation to mitigate amplified seismic forces.

2. Aspect Ratio-Specific Design:

- For taller structures with high aspect ratios, flexibility and sway must be carefully managed, particularly on soft soils, where combined effects pose compounded challenges. Lower aspect ratios are more responsive to soil conditions and require tailored reinforcement to address these dynamic variations effectively.

3. Resource Optimization and Safety:

- By establishing medium soil conditions as a baseline, engineers can adjust material and reinforcement requirements for hard and soft soils accordingly, optimizing resources while ensuring seismic safety.

Overall Conclusion

This study illustrates the critical role of soil conditions and aspect ratios in the seismic response of RCC buildings in zone III. Higher aspect ratios improve stability across different soil types, with the most pronounced benefits observed in soft soils. This understanding enables engineers to design RCC structures that are both safe and resource-efficient, providing an adaptable approach to seismic design that accommodates diverse environmental and structural variables. These findings advocate for customized engineering solutions that address both soil type and structural height, ensuring safety, efficiency, and resilience in earthquake-prone areas.

REFERENCES:

1. Abhay Guleria , "Structural Analysis of a Multi-storeyed Building using ETABS for different Plan Configurations", International Journal of Engineering Research Technology (IJERT) Vol. 3Issue5,May- 2014
2. Arnold,C., and Reitherman, R.,(1982), Building Configuration and Seismic Design, John Wiley & Sons, Inc., NY,USA
3. Murty, C.V.R.,(2005), IITK-BMTPC Earthquake Tips Learning Earthquake Design and Construction, National Information Centre of Earthquake Engineering, IIT Kanpur, India
4. Snigdha A. Sanyal, Multi-Dimensional Building Planning for Safer Tomorrow, The 14th World Conference on Earthquake Engineering Oct. 12-17, 2008, Beijing, China.
5. IS-875-1987. (Part-1) For Indian standard code of practice for structural safety loadings standards Bureau of Indian Standards, New Delhi.
6. IS: 875-1987 (part-2) for Live Loads or Imposed Loads, code of practice of Design loads (other than earthquake) for buildings and structures.

7. Sanjay Kumar Sadhu and Dr. Umesh Pendharkar [3], "Effect of Aspect Ratio & Plan Configurations on Seismic Performance of Multi-storeyed Regular R.C.C. Buildings": An Evaluation by Static Analysis. International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 6, Issue 1, January 2016).
8. Philip McKeen, Alan S. Fung, "The Effect of Building Aspect Ratio on Energy Efficiency: A Case Study for Multi-Unit Residential Building in Canada", ISSN 2075-5309.
9. W.Bourouaiah. (2019). "Influence of the soil properties on the seismic response of structures".IJASC.
10. Amar Hassan, Shilpa Pal. (2018). "Effect of soil condition on seismic response of isolated base buildings". IJASC.
11. Arun Babu M, Ajisha R. (2018). "Analysis of multi-storeyed Building in Different Seismic Zones with Different Soil Conditions".IJIRST
12. Bhalchandra p. Alone, Dr. Ganesh Awchat. (2017). "Study on seismic analysis of high-rise building by using software". IJSDR
13. Gourav Sachdeva, Vinamra Bhushan Sharma. (2017)." Impact of Different Soils and Seismic Zones on Varying Height of Framed Structures".IJIRST
14. M. Yousuf, P.M. shimpale, Dynamic analysis of reinforced concrete building with plan irregularities, Int J Emerg Techno Adv. Eng. 2013; 3(9).