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Determination of Performance point of stability improvement of the multistoried building using different grade of concrete in beams at different levels over soft soil

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Abstract

To make sure that the structure bear, all types of loads affect the structure, such as the structure's self weight, dead loads, live load and seismic loads and its crash action on the structure such as seismic and wind force. The Grade of concrete used in the structure is one of the major parameters to guarantee strength & stability of the structure. The primary step in construction is the sub structure that rest on the subsoil beneath. The soil has diverse properties and phases in it. According to the Indian earthquake code, the soil can be soft, medium and hard soils. It can also be classified by zones. Therefore, structural requirement is to analyze the structure of the four diverse soil types, as the geography and layers of the soil surface differ according to the site conditions.

In this research the impact of Grade of concrete can be advantage to guarantee the stability of multi storey building. A G+16 Storey building having a plane area 576 m^2. The two types of grade of concrete i.e. M25 & M40 is used in the structure. A concrete up gradation or concrete belt is used in the structure on the $6^{th,}$ 7^{th} ,8^{th} 9^{th} & 10^{th} floor of the building. The collision of Concrete belt is analyzed in soft soil. The outcome are based on the maximum Displacement, base shear, bending moments, Torsional moments & Stresses. The project concluded that The Structure Models case PP2 (6^{th} floor beam M- 40 Grade of Beam) Show the most favorable Strucure with All 6^{th} floor beam M- 40 Grade of Beam. The importance of basis structure conctruction is used as M-40 grade concrete belt with 6 th floor, at plinth, all structre with M25 grade of concrete and then at the top floor(18 th floor) in decrement order.

Keywords – *Concrete Belt, M-25 & M-40, soft soil, Strength, Stability*

Introduction

Stability of a concrete structure described by authors and researchers in different ways. The Stability can be defined as the ability to restore balance or resist sudden changes, displacements, or overturns. In addition, the stable structure must remain stable with all conceivable load systems. For any structure, it is essential to have a path that passes through clearly defined structure members through which stabilizing forces and horizontal forces can be transmitted to the foundations & Sub soils exist below the structure. Soil condition is an essential area of analysis in earthquake engineering work; this soil condition (Dexter 1988) "Physical state and dynamic properties of soil that can be shared according to standards Indian code entered; hard soil (Rocky), medium soil, soft soil (loose). It is common practice in building analysis and design to assume the foundation of construction to restore the soil, whereas in reality, soil support influences the structural response as it allows some degree of movement due to its natural deformability. Lessons learned from previous earthquakes in neglecting soil effects have highlighted the importance of soil-structure interaction in seismic analysis of structures. The operation in which the reaction of the soil affects the movement of the structure and the movement of the structure influences the response of the soil.

Grades of concrete are defined the character tics strength of concrete in 28 days. The basis focus on the strength and composition of the concrete, and the minimum strength the concrete should have following 28 days of initial construction. The grade of concrete is understood in measurements of MPa, where M stands for mix and the MPa denotes the overall strength.

Table 1: Grade of Concrete

Grade of Concrete as per IS 456:2000		
Group	**Grade Designation**	**Specific charactertics Compressive strength (N/mm2)**
Ordinary Concrete	M-10	10
	M-15	15
	M-20	20
Standard Concrete	M-25	25
	M-30	30
	M-35	35
	M-40	40
	M-45	45
	M-50	50
	M-55	55
High Strength Concrete	M-60	60
	M-65	65
	M-70	70
	M-75	75
	M-80	80

As per new amendments it goes up to M-100. In this the analysis is carried out to constructed a concrete belt at plinth beam, 8th floor & 16 floor (at the top). The aim is to find the stability assessment based on the change in concrete grade in the respective storey. There are 6 different cases are consider in to it from the PP1 TO PP6

Modeling and Analysis:

The Different models are modeled by using CSI- ETABS software. The Notations of models are such that:

Soft Soil Models
PP 1: Strucure with All Beam M- 25 Grade.
PP 2: Strucure with All 6th floor beam M- 40 Grade of Beam
PP 3: Strucure with All 7th floor beam M- 40 Grade of Beam
PP 4: Strucure with All 8th floor beam M- 40 Grade of Beam
PP 5: Strucure with All 9th floor beam M- 40 Grade of Beam
PP 6: Strucure with All 10th floor beam M- 40 Grade of Beam

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Plan

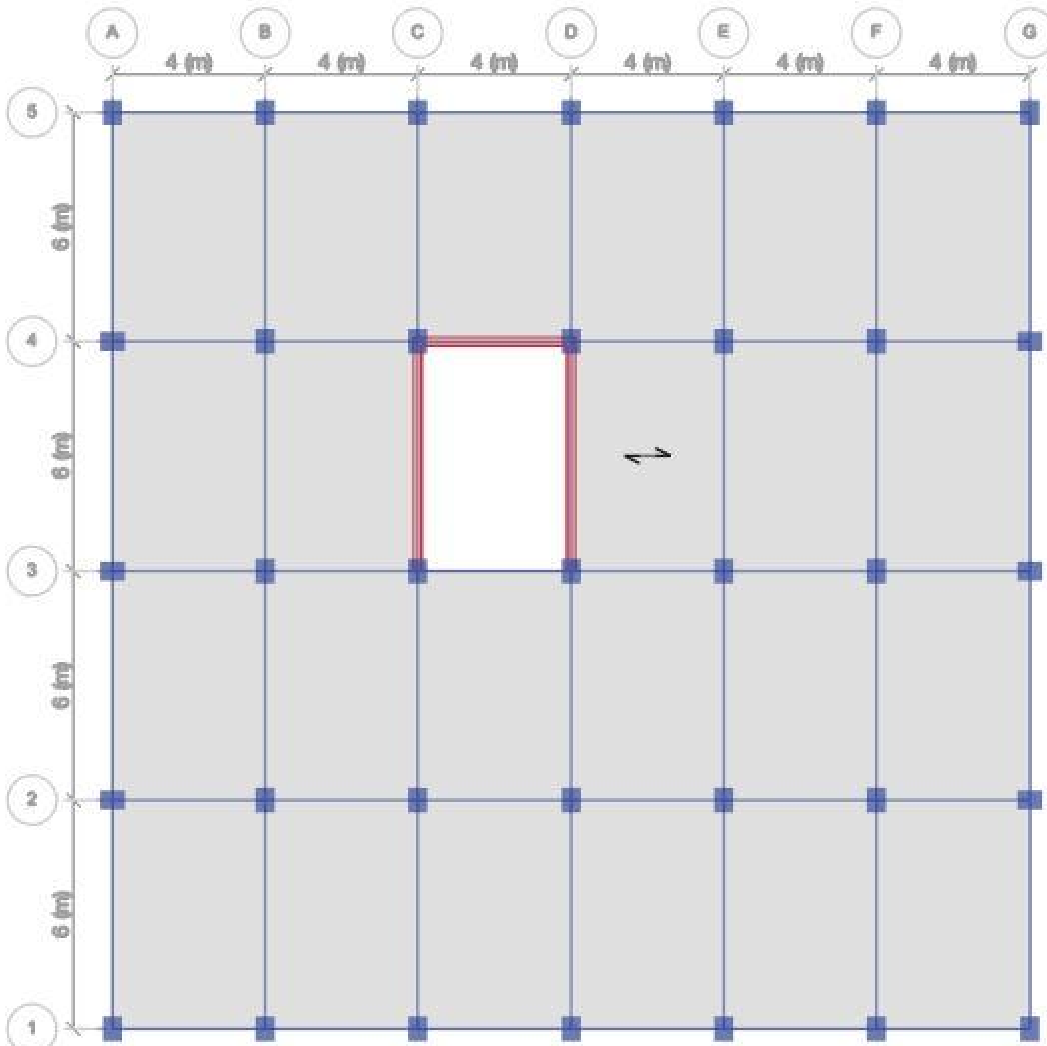

Figure 1: Plan of G+16 storey Building

Parameters Used in the Structure: Table 2 & Table 3 shows the basic parameters used in the analysis of building.

Table 2. Structural Parameters

S. No.	Element Name	Description
1	Building Types	Residential
2	No. of Storey	G+16
3	Plinth Area	576 m^2
4	Floor Height	4 m(Ground Storey) & 3.5m.(1-16 floor)
5	Dimensions of Beam	0.55 m. x 0.30 m(M25 and M40)
6	Dimensions of Column	0.50 m. x 0.55 m(M25)
7	Slab Thickness	0.130 m.
8	Shear wall	0.180 m.
10	Grade of Concrete	M-25 & M-40
11	Staircase	0.150m
12	Steel Used	Fe-415
13	Concrete Belt used at	6^{th} ,7^{th} ,8^{th} 9^{th} & 10^{th} floor
14	Grid Spacing in X- Direction	4m. each in 6 bay
15	Grid Spacing in Y- Direction	4m. each in 6 bay
16	Analysis Software used	CSI-etabs

Earthquake Analysis Parameters:

Table 3. Earthquake Parameters

S. No.	Parameters	Description
1	Earthquake Code	IS 1893(Part 1):2016
2	Earthquake Zone	III
3	Response Factor(RF)	4
4	Importance Factor(IF)	1.2
5	Soil Types	Soft
6	Damping	0.05
7	Structural Type	RCC Framed Building

Result & Discussions

The Following results are to be obtained from the modeling and analysis of Multi storey building Under the influence of soft, medium & hard soil. The results are as follows:

Maximum Displacement: It is defined as the maximum displacement or distance moved by a point on a vibrating body or wave measured from its equilibrium position. Table 4 Shows that max. value of displacement in G+16 Storey Building in soft, medium & Hard Soils.

Table 4. Maximum Displacement Results

Beam Stability Case	Maximum Displacement (mm)	
	For X Direction	For Z Direction
Case PP1	303.628	217.089
Case PP2	300.706	215.766
Case PP3	300.737	215.815
Case PP4	300.816	215.781
Case PP5	300.935	215.767
Case PP6	301.092	215.770

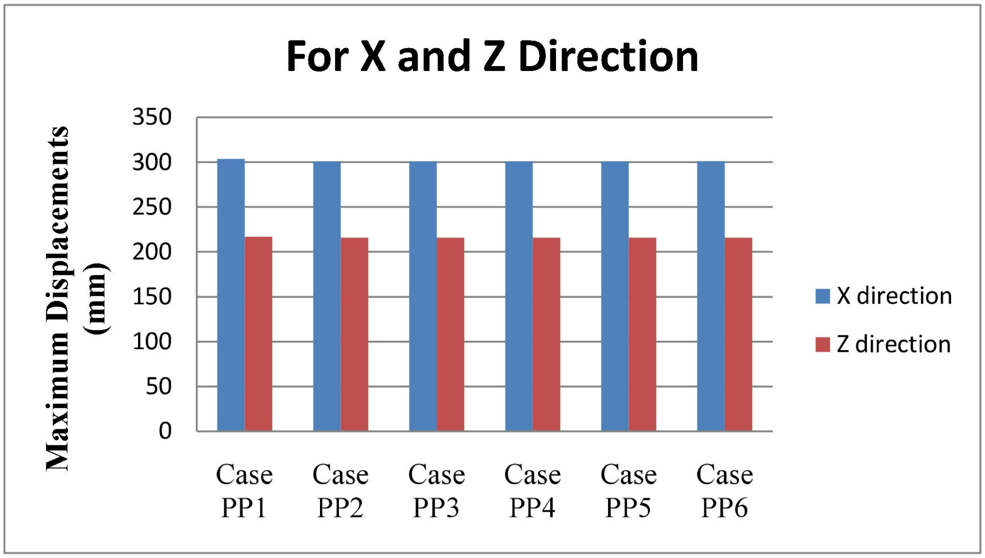

Figure 2: Max. Displacement for Soft Soil

Baser Shear*:* Base shear is an estimate of the maximum expected lateral force on the base of the structure due to seismic activity. Table 5 tabulated the obtained base shear under soft, medium & hard soil.

Table 5. Base Shear Results

Beam Stability Case	Base Shear (KN)	
	X direction	Z direction
Case PP1	2115.7562	2115.7571
Case PP2	2115.7562	2115.7571
Case PP3	2115.7562	2115.7571
Case PP4	2115.7562	2115.7571
Case PP5	2115.7562	2115.7571
Case PP6	2115.7562	2115.7571

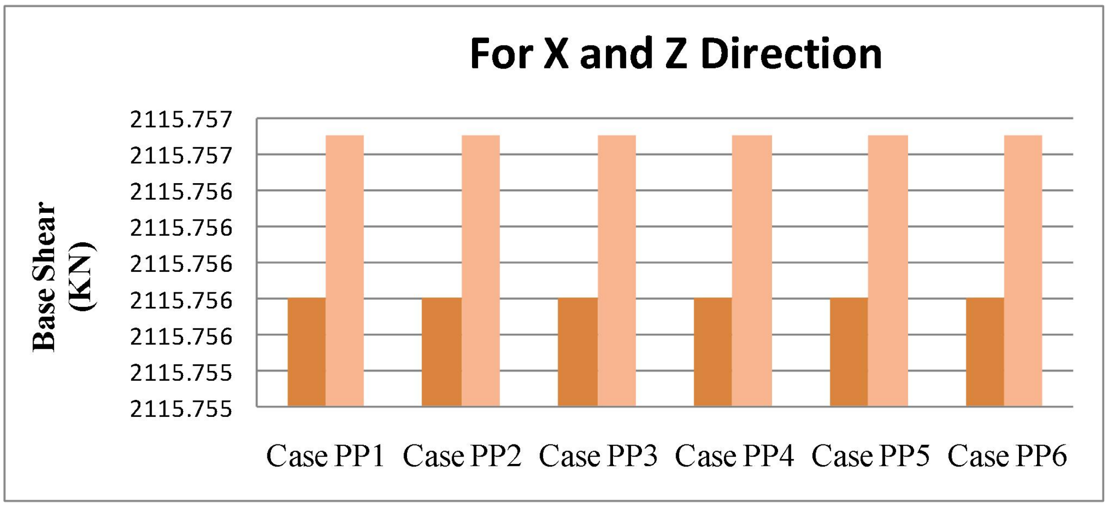

Figure 5: Base shear for soft Soil

Maximum Axial Forces: If the load on a column is applied through the center of gravity of its cross section, it is called an axial load. Axial force is the compression or tension force acting in a member. The table 6 is shown the result of maximum axial force in the three subcategory division of soil is soft, medium & hard.

Table 6. Maximum Axial Forces Results

Beam Stability Case	Column Axial Force (KN)
Case PP1	7601.1585
Case PP2	7600.1272
Case PP3	7600.3242
Case PP4	7600.2287
Case PP5	7600.4404
Case PP6	7600.1601

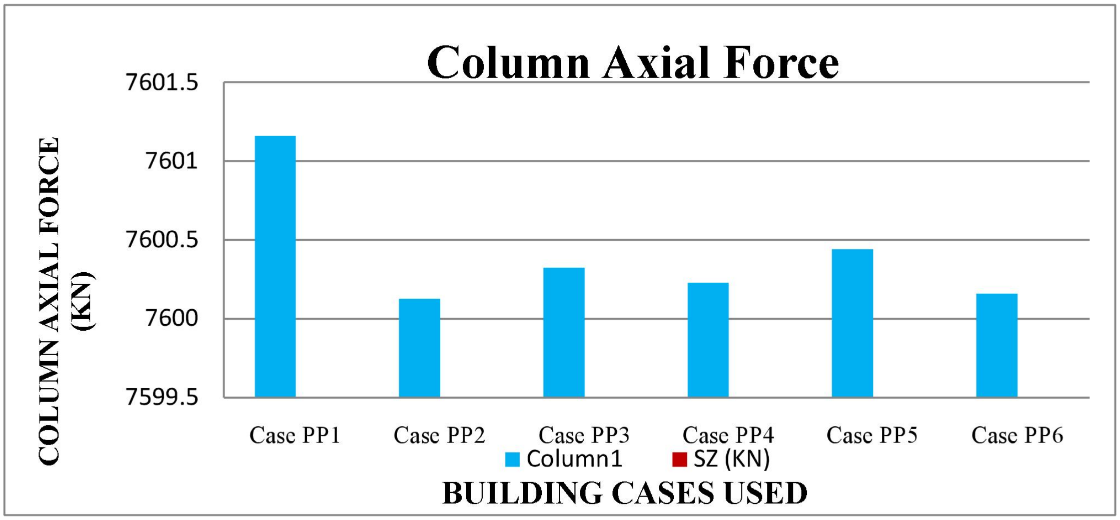

Figure 8: Axial Force in column in soft soil

Maximum Shear Force in Column: Shearing forces are unaligned forces pushing one part of a body in one specific direction, and another part of the body in the opposite direction. When the forces are aligned into each other, they are called compression forces. Table 7 shown the result of shear force of column in tabulated form.

Table 7. Maximum shear Forces Results

Beam Stability Case	Column Axial Force (KN)
Case PP1	7601.1585
Case PP2	7600.1272
Case PP3	7600.3242
Case PP4	7600.2287
Case PP5	7600.4404
Case PP6	7600.1601

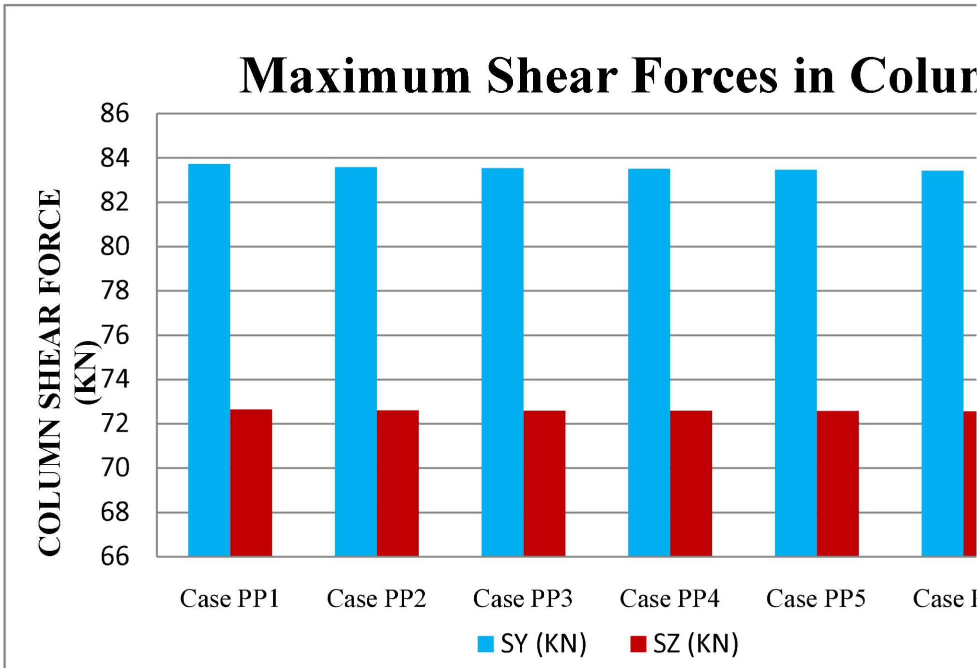

Figure 11: shear Force in column in soft soil

Maximum Bending Moment in Column: A bending moment is the reaction induced in a structural element when an external force or moment is applied to the element causing the element to bend. The most common or simplest structural element subjected to bending moments is the beam. The diagram shows a beam which is simply supported at both ends.

Table 8. Maximum Bending Moment Results

Beam Stability Case	Column Bending Moment (KNm)	
	Moment along Y	Moment along Z
Case PP1	127.5574	126.1577
Case PP2	127.4522	126.0433
Case PP3	127.4987	126.0879
Case PP4	127.5271	126.1150
Case PP5	127.5436	126.1314
Case PP6	127.5648	126.1412

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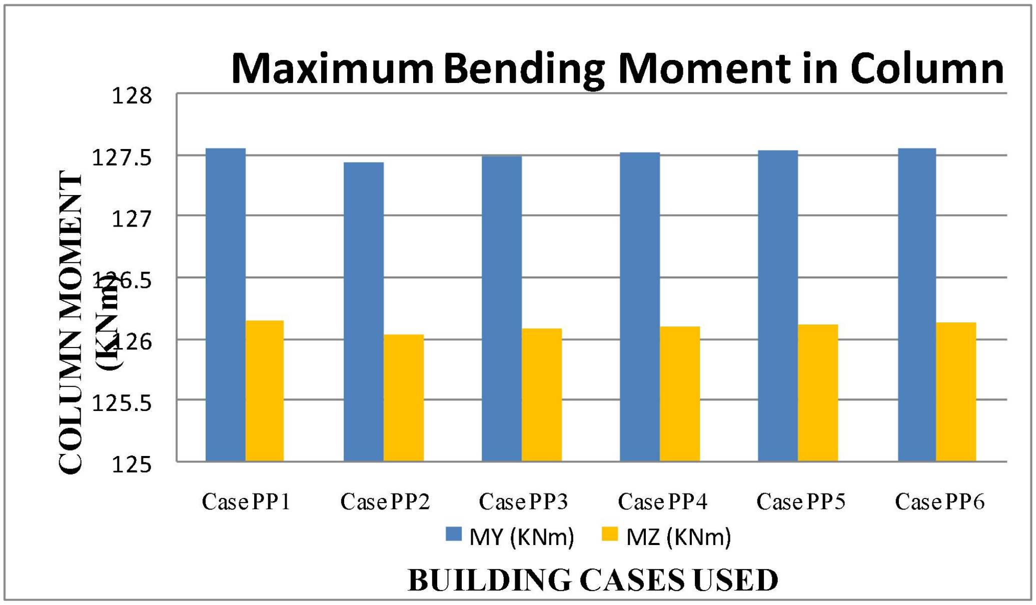

Figure 14: Bending Moment in column in soft soil

Maximum Shear Force in Beam*:* Table 9 shows the tabulated results of Maximum Bending Moment in beams and its bar chart is represented by the fig. 17-19.

Table 9. **Maximum Shear Force in Beam**

Beam Stability Case	**Beam Shear Force (KN)**	
	Shear along Y	**Shear along Z**
Case PP1	154.0092	0.936
Case PP2	154.003	0.936
Case PP3	154.0052	0.935
Case PP4	155.9032	0.0934
Case PP5	159.166	0.0932
Case PP6	161.5888	0.0939

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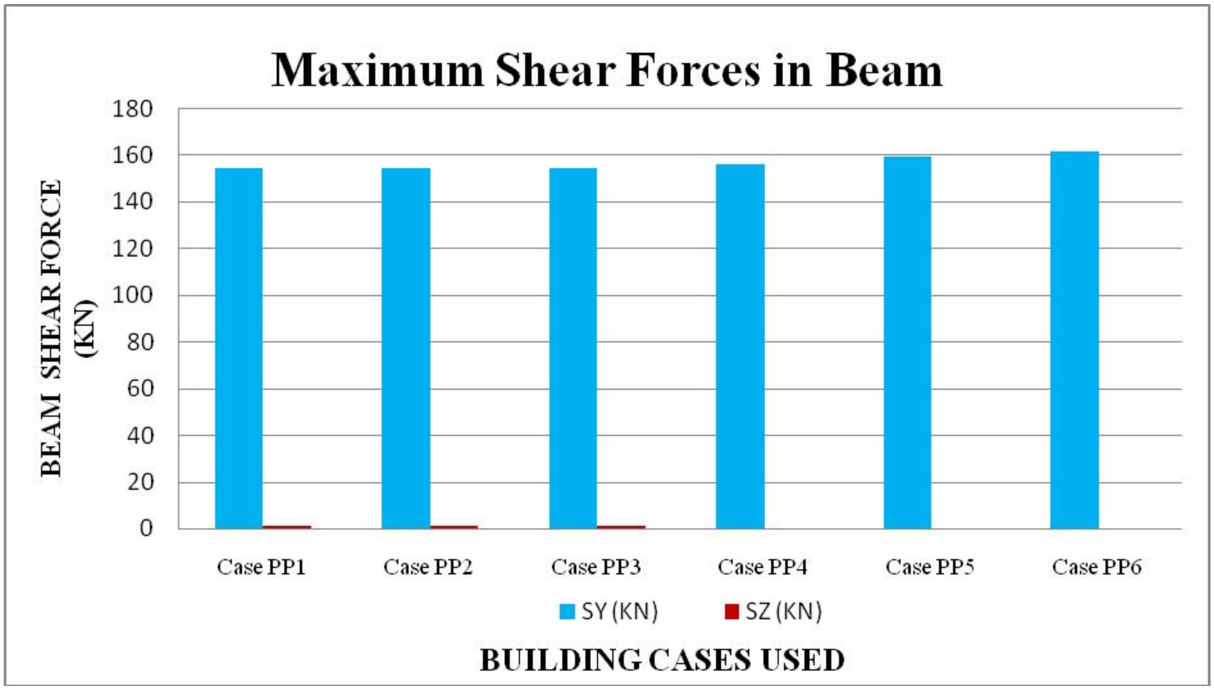

Figure 17: shear force in beam for soft soil

Maximum Bending Moment in Beam:

Table 10. Maximum Bending Moment in beam

Beam Stability Case	Beam Bending Moment (KNm)	
	Moment along Y	Moment along Z
Case PP1	0.1675	207.1315
Case PP2	0.1660	206.1158
Case PP3	0.1675	209.8552
Case PP4	0.1671	218.181
Case PP5	0.1668	224.6865
Case PP6	0.1663	229.4687

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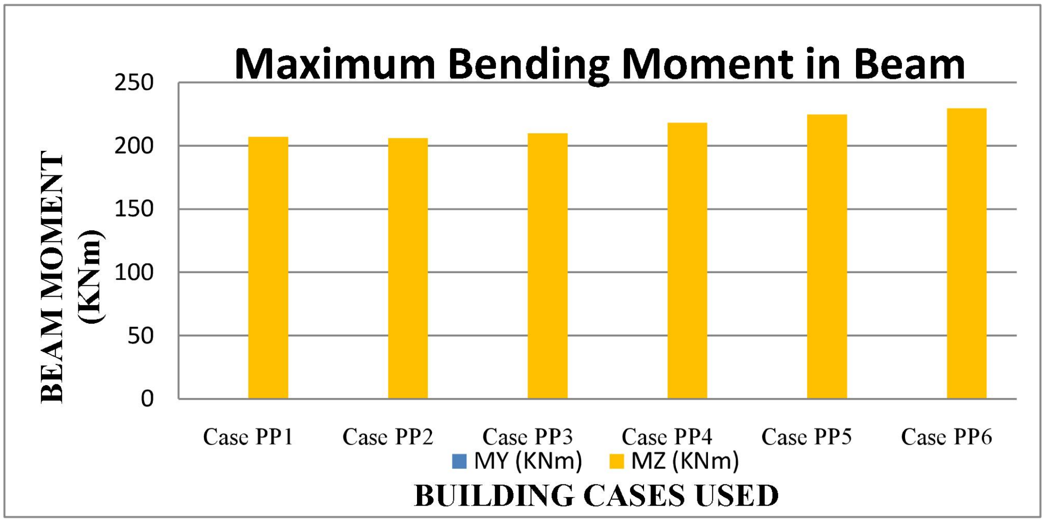
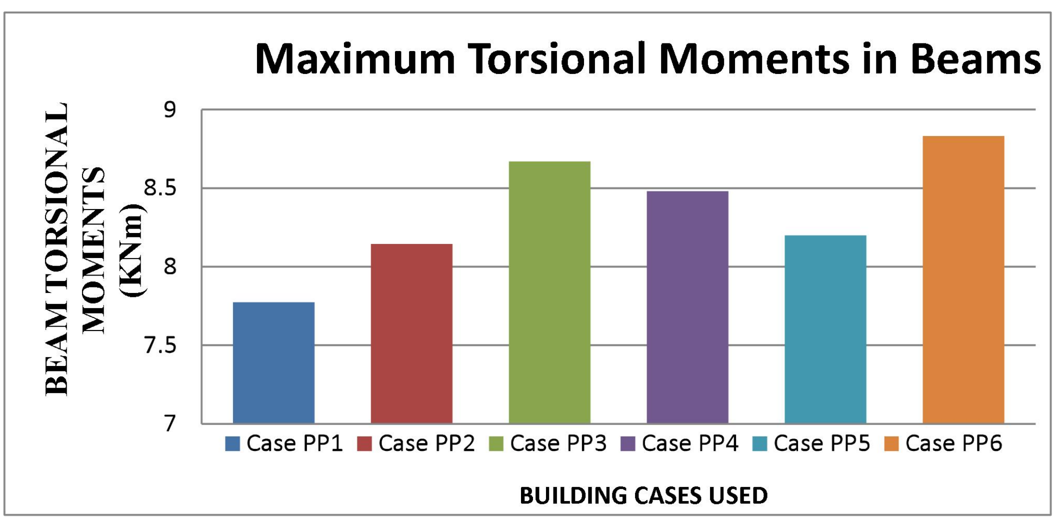


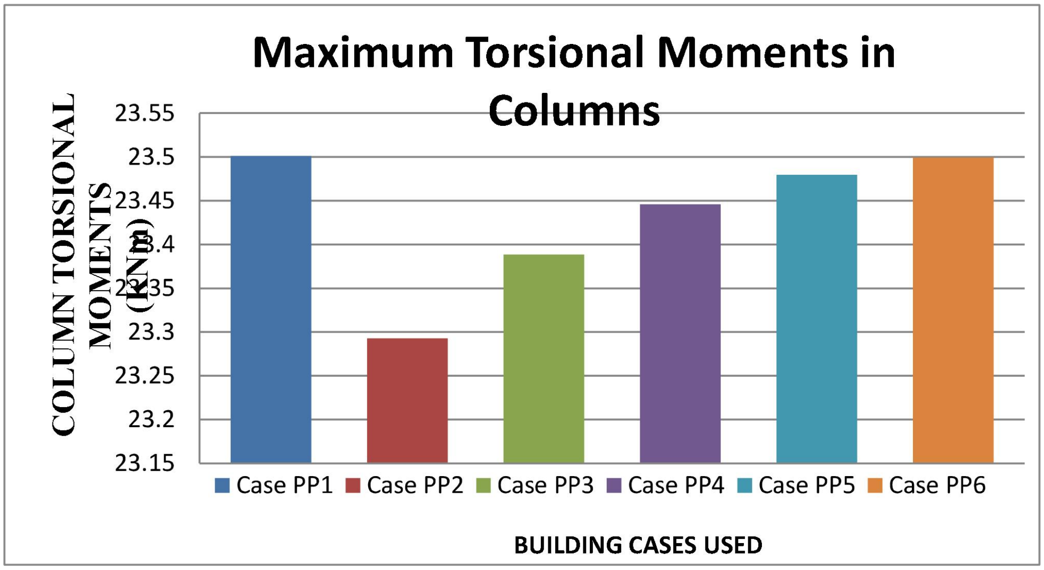
Figure 20: Bending moment in beam for soft soil

Maximum Torsional Moments in Beam & Column: Torsion, also known as torque, describes a moment that is acting upon an object around the same axis in which the object lies.

Table 11. Torsional Moment in Beam & Column

Maximum Torsional Moment in Beam & Column (KN.m)		
Soft Soil		
Beam Stability Case	Torsional Moment in Beam	Torsional Moment in Column
Case PP1	7.7742	23.5012
Case PP2	8.1446	23.2927
Case PP3	8.6695	23.3887
Case PP4	8.4804	23.446
Case PP5	8.2006	23.4796
Case PP6	8.8313	23.4991




Maximum Torsional Moments in Columns
COLUMN TORSIONAL MOMENTS (KN m)
23.55
23.5
23.45
23.4
23.35
23.3
23.25
23.2
23.15
Case PP1
Case PP2
Case PP3
Case PP4
Case PP5
Case PP6
BUILDING CASES USED

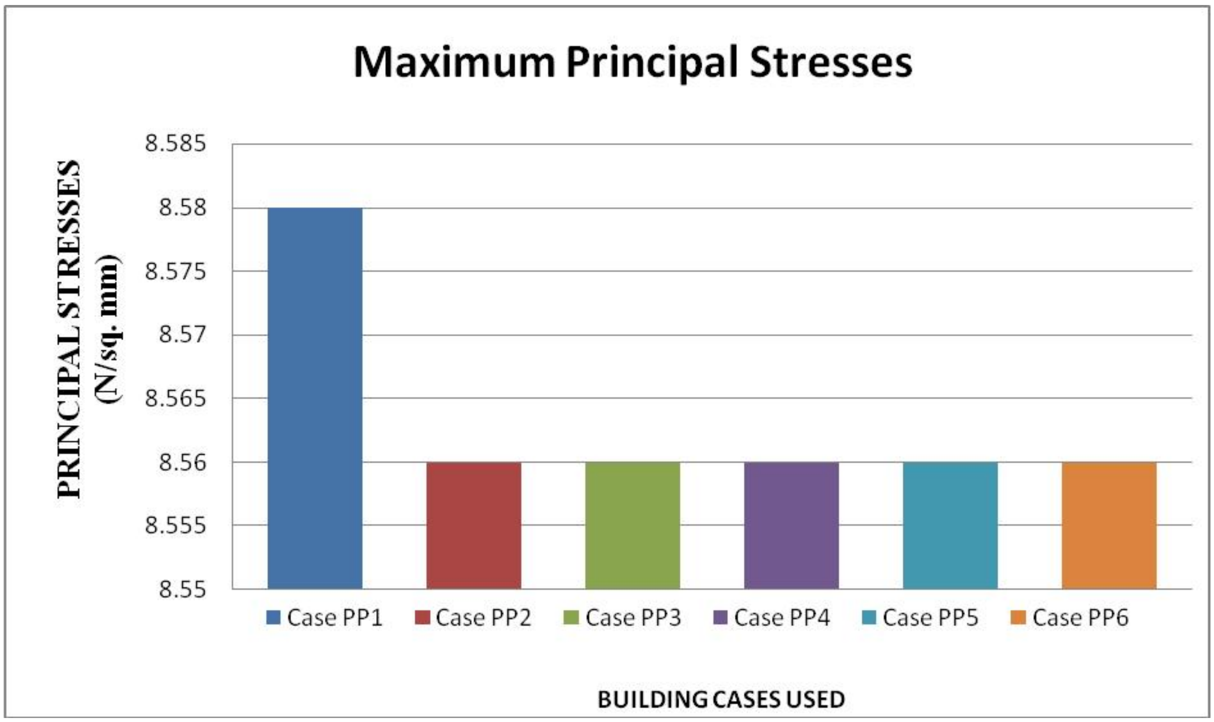
International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Figure 24: Torsional Moment in Beam & column

Maximum Stresses developed: Stress is a physical quantity that expresses the internal forces that neighboring particles of a continuous material exert on each other. In this project three types stresses are to be analyzed i.e principal stresses, Von Mises Stresses,Shearing Stresses with their maximum magnitude.

Table 12. Maximum Stresses developed

Maximum Stresses developed (N/sq. mm)			
Soft Soil			
Beam Stability Case	Maximum Principal Stresses (N/sq. mm)	Maximum Von Mises Stresses (N/sq. mm)	Maximum Shearing Stresses (N/sq. mm)
Case PP1	8.58	22.44	2.32
Case PP2	8.56	22.41	2.32
Case PP3	8.56	22.41	2.32
Case PP4	8.56	22.41	2.32
Case PP5	8.56	22.41	2.32
Case PP6	8.56	22.41	2.32



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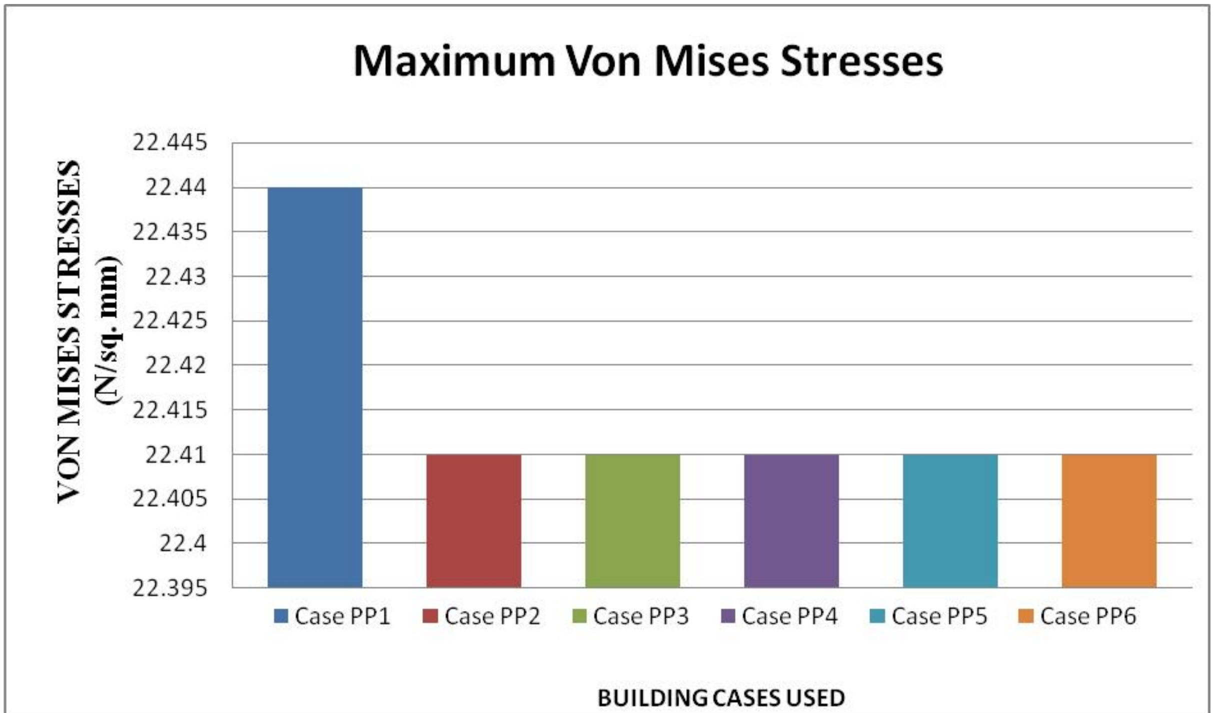

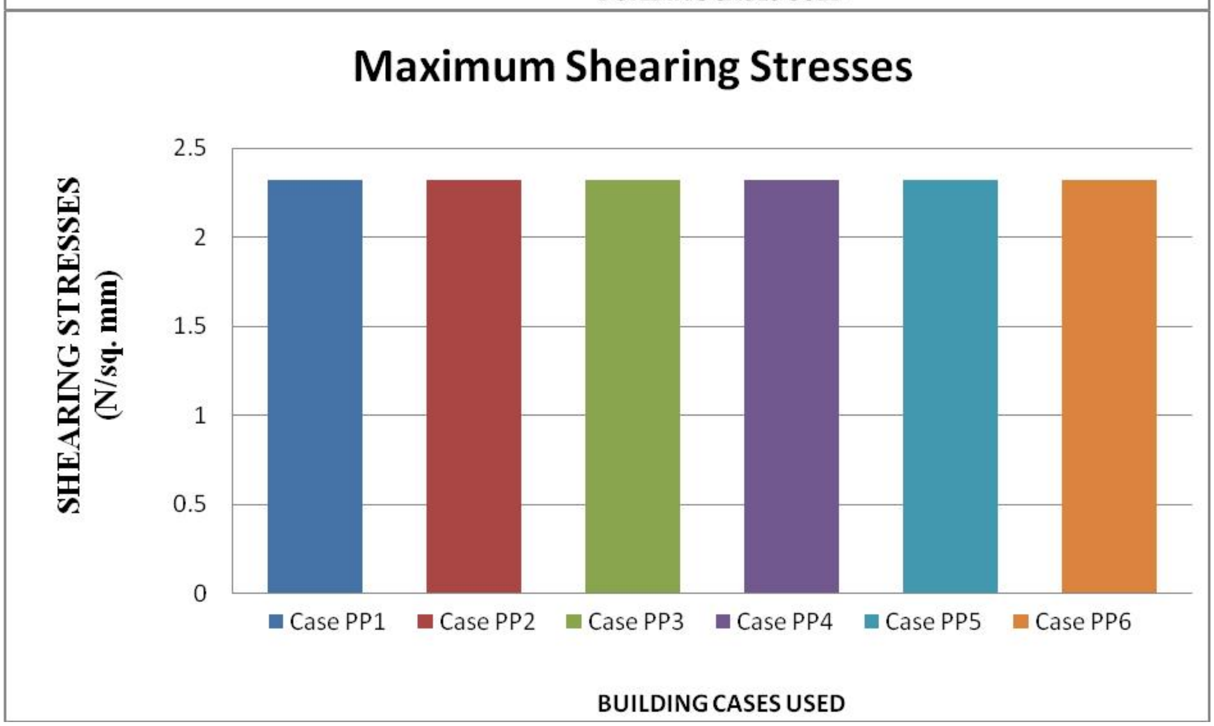

Figure 25: Maximum Stresses developed- Principal Stresses (a,b,c) ,Maximum Von Mises Stresses (d,e,f) Maximum Shearing Stresses (g, h,i)

Conclusions

We studied about different grade of concrete in different level of building and there are 6 cases in soft soil grade. In this research work we study about which floor is suitable for Determination of Performance point of stability improvement of the multistoried building using different grade of concrete in beams at different levels over soft soil. On the basis of above parameters following results are obtained from this comparative study.

1. On comparing it has been concluded that the maximum displacement in X direction obtained for case PP2 with a minimum value respectively again as well as Z direction.
2. Displacement may changed because of shear core are not in center of structure that's why displacement value may be fluctuating in both direction.
3. As per comparative results, Case 4 for base shear forces in X direction values are efficient among all cases.
4. As per comparative results, Case 4 for base shear forces in Z direction values are efficient among all cases..
5. As per comparative results in axial force, Case PP2 is very effective than other cases.
6. Comparing the column shear force for all cases shape PP6 is the optimum than other cases.
7. As per comparative results in column bending moment, Case PP2 is very effective than other cases.
8. Comparing the beam shear force in X and Z direction for all cases, case PP2 is the optimum than other cases.
9. As per comparative results in beam in X and Z direction bending moment, Case PP2 is very effective than other cases.
10. On analyzing the Torsional Moment in beams Case PP6 is very efficient and Torsional Moment in column case PP6 is very efficient
11. As per comparative results in Smax stress , SVM stress and S12 stress values are shows no minor changes has been observed in the different type of stresses when there is concrete grade change from M25 to M40 in different levels of multi-story building under seismic loading.
12. Comparing all the parameter of building in various aspect, in soft soil Case PP2 is find out the best among all cases.

As we study in this research and also which is shown in the above result that Case PP2 are the best suited case in soft soil. The major outcome is that grading of concrete in determination of Performance point of stability improvement of the multistoried building using different grade of concrete in beams at different levels over soft soil in 6th floor consider the best suited for soft soil.

REFERENCES

1. B. Fatahi, B. F. Harry & et, al. (2014) "Soil-structure interaction vs Site effect for seismic design of tall buildings on soft soil" *Geomechanics and Engineering* 6(3):293-320.

2. Ahamad Abrar, Ankit Pal & et.al. (2019) “Determine the Best Location of Porch in Multistory Building with Seismic Loading” *International Journal of Current Engineering and Technology* E-ISSN 2277 – 4106, P-ISSN 2347 – 5161 pp 72-77 .
3. Ahamad Abrar, Pal Ankit & et. al. (2020) “Review Analysis on Determine the Best Location of Porch in Multistory Building with and without Seismic Loading” *International Journal of Advanced Engineering Research and Science (IJAERS)*, Vol-7, Issue-1, https://dx.doi.org/10.22161/ijaers.71.25 ISSN: 2349-6495(P) .2456-1908(O), pp 182-184.
4. Aasif Khan, Ankit Pal(2020) “Reduction of Base Shear Using Different Size of Columns with Same Concrete Grade in Multistoried Building under Seismic Loading” *Journal of Xi'an University of Architecture & Technology*, Volume XII, Issue IV, 2020 ISSN No : 1006-7930, pp 5060-5069.
5. B. R. Jayalekshmi & H. K. Chinmayi (2014) “Effect of Soil Flexibility on Seismic Force E valuation of RC Framed Buildings with Shear Wall: A Comparative Study of IS 1893 and E UROCODE8 *Hindawi Publishing Corporation Journal of Structures* Volume 2014, Article ID 493745, pp 1-15
6. Amer Hassan & Shilpa Pal(2018) “Efect of soil condition on seismic response of isolated base buildings*”* *International Journal of Advanced Structural Engineering* (2018) 10:249–261
7. S.V. Jitesh T Chavda PG Student & et. al. (2013) Proceedings of Indian Geotechnical Conference December 22-24, Roorkee Seismic Behaviour Of Buildings On Different Types of Soil Ketan Bajaj, S.V. Jitesh T Chavda PG Student, Bhavik M Vyas
8. Qudsia Bhavikatti , Swapnil B. Cholekar,(2017) Soil structure interaction effect for a building resting on sloping ground including infiill subjected to seismic analysis. Qudsia Bhavikatti 1, Swapnil B. Cholekar International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 04 Issue: 07 p-ISSN: 2395-0072
9. Vishwakarma A.(2020) Optimum Use Dismantle Concrete As A Recycled Aggregate In Concrete” International Journal of Engineering Applied Sciences and Technology, Vol. 4, Issue 12, ISSN No. 2455-2143, may 2020.pp 159-162, DOI: 10.33564/IJEAST.2020.v04i12.022
10. Upadhyay D. K. and S. Jamle (2020) “A Review on Stability Improvement with Wall Belt Supported Dual Structural System Using Different Grades of Concrete” *International Journal of Advanced Engineering Research and Science (IJAERS),* Vol-7, Issue-3.
11. Upadhyay D. K. and S. Jamle (2020), Vol.10, No.2 (March/April 2020) pp 237-242. *International Journal of Current Engineering and Technology* E-ISSN 2277 – 4106, P-ISSN 2347 – 5161.
12. Vishwakarma A. (2020) Optimum Use of Fly Ash (FA) and Glass Powder (GP) as a Partial Replacement for Cement in Concrete, Page No. : 1182-1186, http://doi.org/10.22214/ijraset.2020.4192
13. Mahajan B , S. Jamle , Analytical Approach in Stability Enhancement Techniques by Altering Beam Members at Different Levels *International Journal of Advanced Engineering Research and Science (IJAERS)* [Vol-7, Issue-6, Jun- 2020] ISSN: 2349-6495(P) | 2456-1908(O), pp 301-308.
14. “Assessment of Human Comfort Criteria of Tall Building Under Dynamic wind Loading”, *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* ISSN: 2321-9653; UGC Grade A, Scopus Index Journal, Impact Factor:5.54(2018), Volume-9 Issue-2, Retrieval Number:B6688129219/2019©BEIESP,DOI:10.35940/ijitee. B6688.129219, pp 2265-2273.
15. Malviya R. and Jamle s. (2020) Increasing Stability of Multistoried Building using Different Grades of Concrete in Column Member Sets at Different Locations Received 01 Jan 2020, Accepted 02 March 2020, Available online 03 March 2020, Vol.10, No.2 (March/April 2020) , pp 208-217.
16. Patidar M., Jamle S.(2020) Optimization of Stability of Multistoried Structure by Changing Grades of Concrete in Shear Wall Member *Journal of Xi'an University of Architecture & Technology* Volume XII, Issue IV, 2020 ISSN No : 1006-7930 , pp 2479-2797.
17. Jajoriya M., Vishwakarma A & et. al (2020), Arvind Vishwakarma “Assessment on Different Arrangement of Grouping of Piles by Response Spectrum Method” *Journal of Xi'an University of Architecture & Technology* Volume XII, Issue V, 2020 ISSN No : 1006-7930 https://doi.org/10.37896/JXAT12.05/1446, pp 469-480.

18. Jajoriya M., Vishwakarma A & et. al. (2020) "A Review: Earthquake Analysis of Pile Group with Different Variations in Dimensions & Parameters" *International Journal for Research in Applied Science & Engineering Technology (IJRASET)* ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429 Volume 8 Issue V , http://doi.org/10.22214/ijraset.2020.5440 pp 2639-2642