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# SEISMIC DESIGN AND ANALYSIS OF (G+6) RESIDENTIAL BUILDING IN ZONE 3&4 USING STAAD PRO AND IT'S COST ESTIMATION

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## ABSTRACT

Planning a structure so that lessening harm during a quake makes the structure very uneconomical, as the seismic tremor may or probably won't happen in its life time and is an uncommon marvel. In this paper a G+6 existing RCC encircled structure has been broke down and planned utilizing STAAD-Pro V8i. The structure is planned according to IS 1893(Part 1):2002 for tremor powers in various seismic zones. The primary destinations of the paper are to think about the variety of steel rate, most extreme shear power, greatest bowing second, and greatest redirection in various seismic zone. Varieties are definitely higher from zone II to zone V. The steel rate, most extreme shear power, greatest bowing second, most extreme redirection is increments from zone II to zone V and cost estimation.

**KEYWORDS**: STAAD-Pro, steel percentage, Maximum Shear force, Maximum Bending Moment, Maximum Deflection, Seismic zones.

## I. INTRODUCTION

Seismic tremor has transformed into a peril to human advancement from the day of its world, destroying human lives, property and the man-made structures. Mass of a structure being planned to controls seismic diagram, despite building immovability, as tremor starts dormancy constrain that breezes up relating to the structure's mass. Sketching out structures should act deftly in the midst of the seismic shaking without mischief may render the endeavor fiscally outlandish? This paper is introduced to improve the productivity of continuous quake chance alleviation strategies and its capacity of securing structures, frameworks and individuals, to explore a multistorey RCC building (G +6 Story) for Zone 3 and 4 to take a gander at seismic lead of multistorey RCC working for explicit shaking power in regards to responses, to think about the effects of different Seismic zones on execution of multi-story filling in to the extent seismic, to know the association between different procedures for seismic examination and their seismic responses, to achieve useful learning on fundamental examination, seismic assessment, sketching out and determining of helper portions using norms of Earthquake Resistant Design. Also, we are structuring such a (G + 6) private structure. That if any zone changes zone implies that in the event that the zone changes from zone 3 to zone 4, at that point the structure planned by us will be constant. Furthermore, by computing this, we will perceive the amount it expenses to assemble such a structure.

**1.1 MOMENT RESISTING FRAMES**;- The structure whose individuals and joints oppose the powers essentially brought about by flexure is Moment Resisting Structure.

**1.2 OBJECTIVES OF PROJECT:-** Doing a total plan of the principle auxiliary components of a multi – celebrated structure including sections, pillars, segments and footing. Getting genuine involvement in the building rehearses. The structure ought to be orchestrated to the point that it can transmit dead, the breeze and forced loads in an immediate way to the establishments. The general course of action ought to guarantee a vigorous and stable structure that won't breakdown dynamically under the impacts of abuse or inadvertent harm to any one component.

## II. LITERATURE REVIEW

**Brajesh Chandra and Jai Krishna (1965),** in this investigation, decided the amount of steel fortification in the structures with the end goal of practical and effective outcomes. So as to fix the most extreme level of steel in the investigation, proposals have been given considering the vitality factor. As indicated by his investigations, the amount of steel ought to be with the end goal that the vitality consumed by the fortification amid quake does not surpass the vitality retention breaking point of workmanship, and the amount of support ought not be extremely little, so that there is an expansive twisting in support.

**Lakshmi Gayathri, J C Wason, V.Thiruvengadam (2004)** this investigation centers around expense showing of structure arranged and point by point in the various seismic zones of India. The model gives measures of solid, fortification and covering materials for the unit zone of floors. In end the creator communicates that 8 storied structure organized in zone 5 , the support rate has increase up to 69% appearing differently in relation to gravity stacking case, and it similarly communicated that for a 10 storied structure orchestrated in zones 2, 3, 4 and 5 cost extended as 5, 10, 20 and 30% independently.

**Papa Rao and Kiran Kumar (2013):** Writer's examination on the adjustment in the measure of steel and cement for RCC encircled structure for the various seismic districts of India. They have planned the structure for gravitational burdens and the seismic powers, which can impact development. As per his exploration, he reasoned that the distinction in help reactions for outer columns expanded from 11.59% to 41.71% and on account of the shore sections, from Zone II to Zone V between 17.72% to 63.7% and on account of inside is. Section, this is exceptionally low. On account of strong amount, the measure of cement for Zone V is expanded with outer III and zone sections, in light of the fact that the expansion in help responses with the impact of the sidelong powers and the distinction in the inner segments is exceptionally low. The rate contrast of steel in the outside shaft is from 0.54% to 1.23% and inner bar is 0.78% to 1.4%. Fortification has not changed for seismic and non-seismic plan.

**Parela Karunakara (2014):** The author attempted endeavors to discover the level of steel rate and strong volume in various seismic districts and the effect on the general expense of variety and development. Be that as it may, as per his exploration, because of the expansion in help reactions, strong amounts have expanded in the external and edge sections; The variety in interior segment foot is extremely low. Reinforcement variety 12.96, 18.35, 41.39, 89.05% for the whole structure among gravity and seismic burden. Cost variety for double versus non-bendable subtleties is 4.06%.

**S. Thanmozhi, Sunyan Verma, A. Malar (2014)** the authors of this study compared the comparison between the base shear of RCC framed building located in different earthquake regions of India. They found that the software yields higher base shear results compared to Staad Pro and Manual calculation. Compared to the manual results of Zone 2, the increase in shear increased by 5.45% and 18.67%, in the case of Staad Pro, based on their research. Similarly, for Zone 3, 4, 5, it has been increased from 1.07% to 18.67%.

**(A) Basic codes for design**

The design should be carried so as to conform to the following:

1) IS 456: 2000 – Plain and reinforced concrete – code of practice (fourth revision)

2) National Building Code 2005

3) Loading Standards IS 875 (Part 1-5): 1987 – Code of practice for design loads (other than earthquake) for buildings and structures (second revision)

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• Part 1: Dead load

• Part 2: Imposed (live) loads

• Part 3: Wind loads

• Part 4: Snow loads

•Part 5: Special loads and load combinations 4) Design Handbooks

• SP 16: 1980 – Design Aids (for Reinforced Concrete) to IS 456: 1978

• SP 24: 1983 – Explanatory handbook on IS 456: 1978

• SP 34: 1987 – Handbooks on Concrete Reinforced and Detailing.

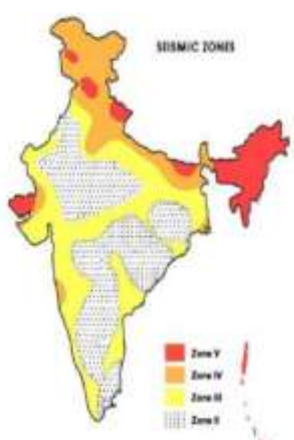
**B. Features of the STAAD Pro**

**1) The STAAD-Pro Graphical User Interface:-** It is utilized to create them model, which would then be able to be investigated utilizing the STAAD engineer. After examination and configuration is finished, the GUI can likewise be utilized to see the outcomes graphically.

**2) The STAAD-Pro analysis and design engine:-** It is a broadly useful count engineer for auxiliary examination and incorporated Steel, Concrete, Timber and Aluminum structure.

## III. SEISMIC DESIGN FORCE

Seismic tremor shaking is irregular and time variation. Be that as it may, most plan codes speak to the tremor prompted inactivity powers as the net impact of such arbitrary shaking as structure proportional static parallel power. This power is called as the Seismic Design Base Shear VB and remains the essential amount engaged with the power based quake safe structure of structures. This power relies upon the seismic danger at the site of the structure spoke to by the Seismic Zone Factor Z. Codes mirror this by the presentation of a Structural Flexibility Factor Sa/g. This way of thinking is presented with the assistance of Response Reduction Factor R, which is bigger for flexible structures and littler for weak ones Thus, the plan of seismic tremor impacts isn't named as earthquakeproof plan. Rather, the seismic tremor request is assessed just dependent on ideas of the likelihood of proof, and the plan of quake impacts is named as seismic tremor safe structure against the plausible estimation of the interest. The Design Base Shear VB is taken according to the Indian Seismic Code IS 1893 (Part 1) – 2007.




igure 2.1: Sketch of Seismic Zone Map of India: sketch based on the seismic zone of India map given in IS:1893 (Part 1) - 2007

**Fig-1**

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## IV. METHODOLOGY

In the event that the structure not appropriately planned and built with required quality they may cause enormous demolition of structures due to earthquakes. Reaction range investigation is a useful strategy for seismic assessment of structure when the structure shows linear response. Broad writing review by alluding books, particular papers did to grasp fundamental thought of subject.

• Selection of a fitting arrangement of G+6, story building.

• Computation of burdens and determination of primer cross-segments of various basic individuals.

• Geometrical displaying/exhibit and basic investigation of working for different stacking conditions according to.

• IS Codal arrangements. Understanding of results consolidate base shear, story buoy and story preoccupation.

• In the current work it is proposed to finish seismic examination of multi-story RCC structures using.

•Response Spectrum Analysismethod considering mass anomaly with the assistance of STAAD PRO programming.

**STATEMENT OF THE PROJECT:-**

Analysis and Design of Residential Building (G+6)

Specifications are as:-

RCC Building

Size of beam= .7X.45

Size of column = 0.45X0.45

Slab thickness =150 mm

Height of each floor = 3 m

Material Concrete

Support Fixed

LOAD CALCULATION: Self-Weight of slab = 0.15*25=3.75

Exterior wall = 0.35*2.45*20= 17.15+2=19.15

Partition wall = 0.2*2.45*20=9.8+2=11.8 Parapet wall = 0.2*1.5*20 =6+2=8

Plaster for two face = .02*2.65*1*18*2=2

Seismic Load

Method of analysis

1. Equivalent static method

2. Lumped mass model method

3. Response spectrum method

Code used

IS 1893-2002

Vb = Ah x W

Where Vb = design seismic base shear

Ah= Average response acceleration coefficient

W= Seismic weight of the building

## V. PROCEDURE

Step - 1: Creation of nodal focuses. In view of the segment situating of plan we entered the hub focuses into the STAAD document.

Step - 2: Representation of bars and segments. By utilizing include bar order we had drawn the shafts and segments between the comparing hub focuses.

Step - 3: 3D perspective on structure here we have utilized the Transitional recurrent order in Y heading to get the 3D perspective on structure.

Step - 4: Supports and property doling out. After the formation of structure the backings at the base of structure are indicated as fixed. Likewise the Materials were determined and cross segment of shafts and segments individuals was doled out.

Step - 5: 3D rendering view. Subsequent to relegating the property the 3d rendering perspective on the structure can be appeared.

Step - 6: Assigning of seismic burdens. So as to relegate Seismic loads right off the bat we have characterized the seismic burdens as indicated by the code IS1893:2002 with appropriate floor loads. Burdens are included burden case subtleties in +X,- X, +Z,- Z headings with determined seismic factor. Step - 7: Assigning of wind loads. Wind loads are characterized according to IS 875 PART 3 dependent on power determined and introduction factor. At that point loads are included burden case subtleties in +X,- X, +Z,- Z headings. Step - 8: Assigning of dead loads. Dead loads are determined according to IS 875 PART 1 for outer dividers, inner dividers, parapet divider including self-weight of structure.

Step - 9: Assigning of live loads. Live loads are relegated for each floor as 3KN/m2 dependent on IS 875 PART 2.

Step - 10: Adding of burden blends. Subsequent to relegating all the heaps, the heap mixes are given with appropriate factor of security according to IS 875 PART 5.

Step - 11: Analysis. After the fruition of all the above advances we have played out the examination and checked for blunders.

Step - 12: Design. At last solid plan is proceeded according to IS 456: 2000 by characterizing appropriate plan orders for various basic segments. After the allocating of orders again we performed investigation for any mistakes.

**Fig-2:** 3D Rendered View

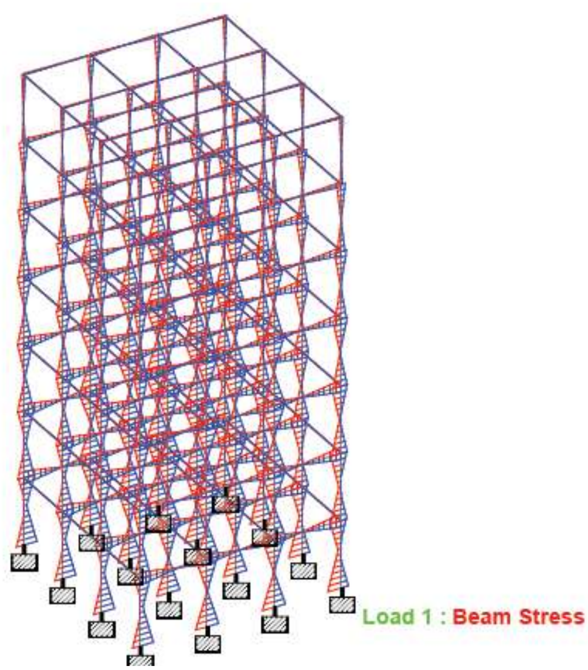


**Fig-3:** Beam Stress

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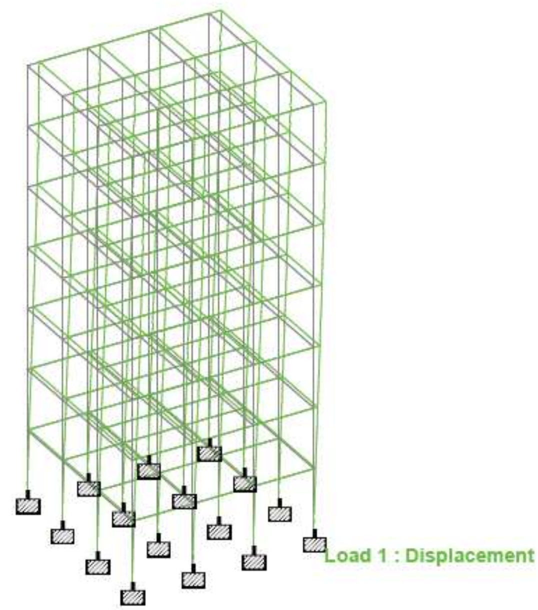


**Fig-4:** Displacement of Load 1

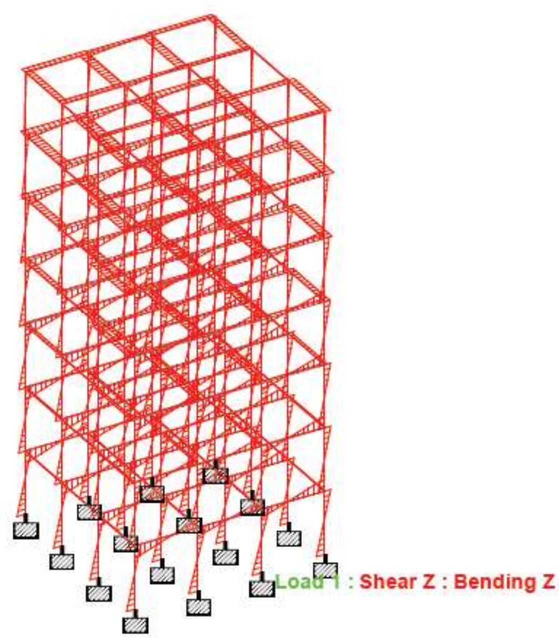


**Fig-5:** Shear and Bending in Z direction

**DEFLECTION:-**

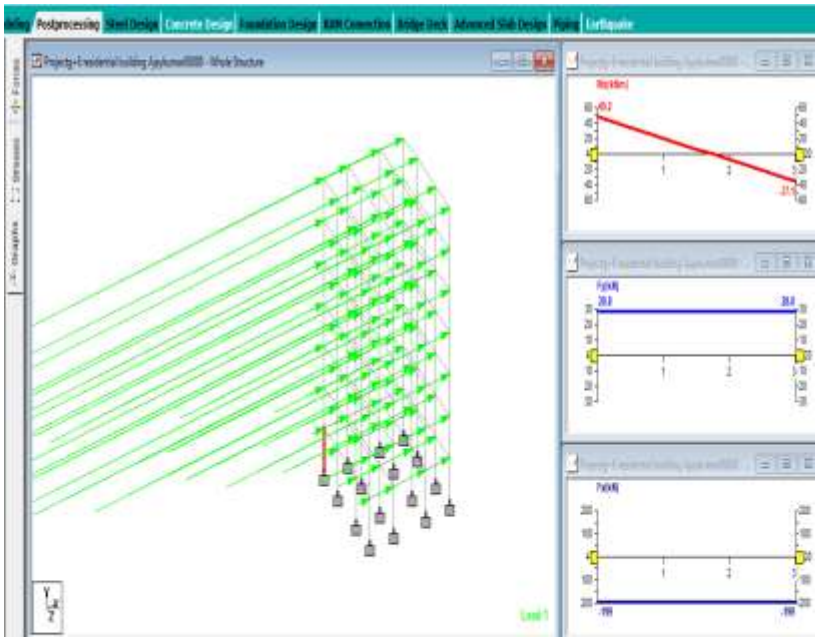

Fig-6

**FLOOR LOAD:-**

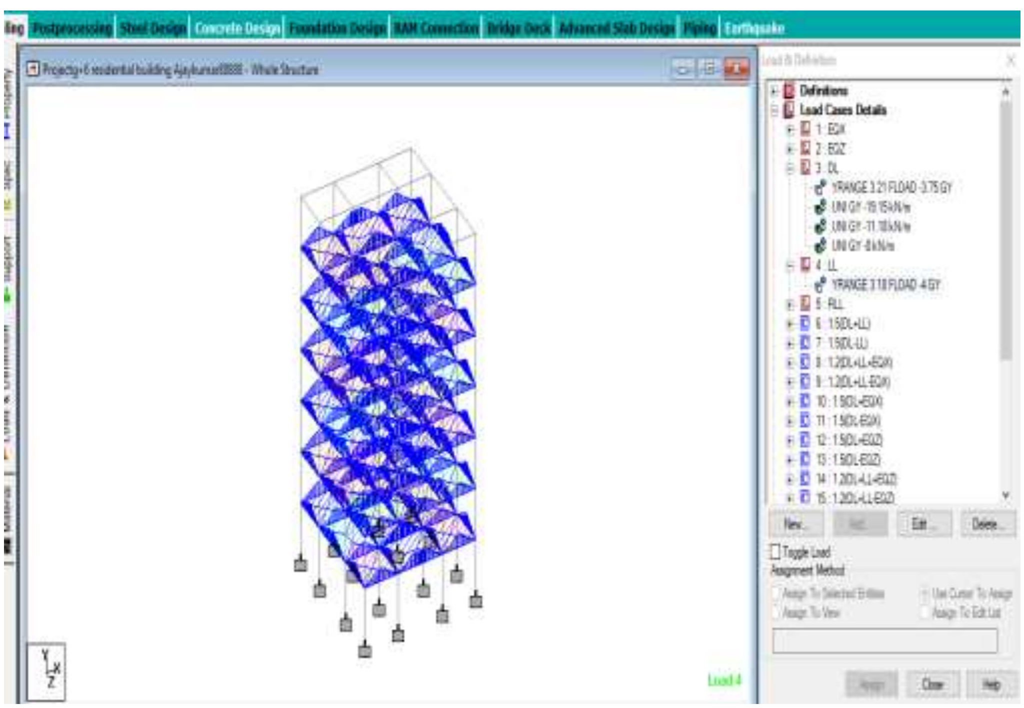


Fig-7

**BEAM STRESS:-**

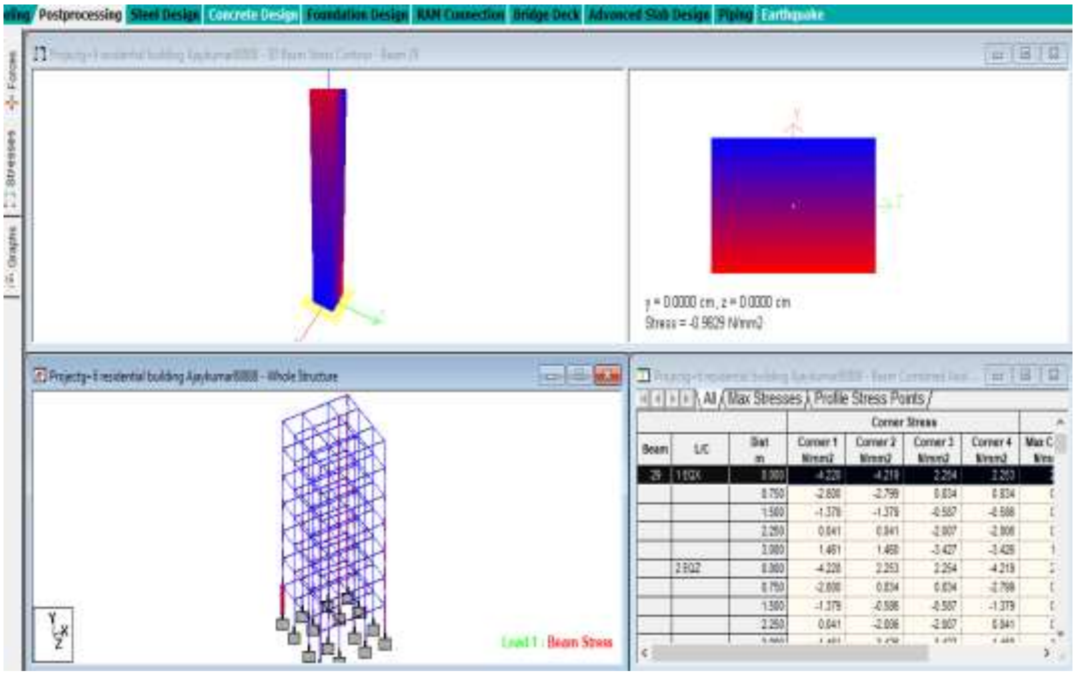


**Fig-8**

**CONCRETE DESIGN:-**

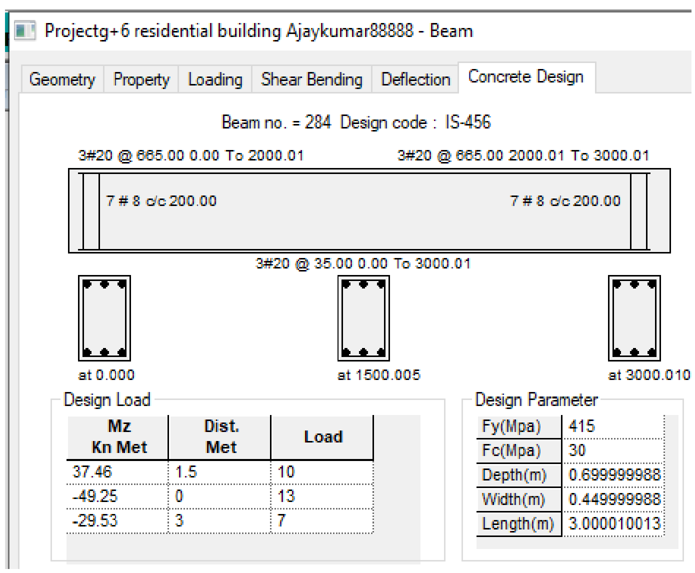


**Fig-9**

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## VI. RESULT

| Parameters | Zone III | Zone IV |
|---|---|---|
| Steel Percentage of column | 2.36 | 3.54 |
| Beam Displacement | 14.60 mm | 17.30 mm |
| Maximum Bending Moment | 123 kN-m | 132 kN-m |
| Maximum Shear Force | 1.90 kN | 2.10 kN |
| Node Displacement | 10 mm | 11.2 mm |

So we see that when we design the building for zone 3 and zone 4, then steel percentage for zone 3 is 2.36 and zone 4 is 3.54. It becomes 1.14% more steel is required.

**Cost Estimation:-**

Total valume of concrete= 661.74 CU Meter

| BAR DIA (in mm) | WEIGHT (in staad) (kg) |
|---|---|
| 8 | 142796.00 |
| 10 | 340.00 |
| 12 | 289856.00 |
| 16 | 172675.47 |
| TOTAL = | 605667.50 kg |

**Quantity of steel:-**

605667.50 kg (zone 3)

6813750938 kg (zone 4)

**Total cost of building:-**

3600 x 1800 x 6 = 38,880,000/- (zone 3)

3600 x 2090 x 6 = 45,144,000/- (zone 4)

## VII. CONCLUSION

- After analysis the G+6 storey building structure, concluded that structure is safe in loading like dead load , wind load and seismic load.

- Member dimensions (Beam, Column, Slab, Footing) are changed by calculating the load type and it's quantity applied on it.
- We found that if a building is converting from zone 3 to zone 4, then if we take12.5% more steel, the building will also be maintained in zone 4.
- We found that there is a 13.875% variation in cost due to change in the quantity of steel.

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