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SEISMIC ANALYSIS AND DESIGN OF G+10 MULTISTORY RESIDENTIAL BUILDING USING STAAD.PRO

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Abstract:
The paper offers with the layout & seismic evaluation of G+10 building using STAAD.pro. In this the seismic responses of a residential G+10 RCC building is analyses by the Equivalent static method & STAAD.pro Software as per IS code 1893 (Part 1): 2016. This analysis is carried out by considering seismic Zone II, III, IV, V, & hard soil type & special moment resisting frame. The frame used for study is 11 (G+10) storey, RCC structure. The typical peak of the floor is 3.0 m in total peak of the structure is 38.10 m, in the plan of 20 m by 30 m.

Index Terms **-Analysis of high rise structure, Seismic Analysis,STAAD.pro.**

I. INTRODUCTION:-

Earthquake is a natural calamity which cause huge loss of life as well as property, many people becomes homeless, children lost their parents, women become widow, affects the economy of a country very adversely. It takes many years to recover and compensate the loss caused due to earthquake. Tremors of earthquake can be realized from very far distance from its occurring place. Earthquake is one of the most devastating natural calamity in which earth surface shakes due to release of seismic energy from crust along fault. Earthquake has adverse effect on the building. Seismic waves are generated from crust and travelled toward earth surface, seismic waves are measured using Seismograph and Richter scale .When seismic waves are subjected on building the base of building starts shaking and eventually gets collapse. Seismic analysis is performed to understand response of building when subjected to earthquake. Construction of multi-storey buildings has become inevitable both for residential and as well as office purposes. The high raised structures are not properly designed for the resistance of lateral forces. It may cause to the complete failure of the structures. The earthquake resistance structures are designed based on some factors. The factors are natural frequency of the structure, damping factor, type of foundation, importance of the building and ductility of the structure. In this paper seismic analysis of G+10 BUILDING which lies in zone 2,3,4,5. Has been described and response of building is shown. The analysis has been done using STAAD Pro. According to I.S 1893:2016 CODE for Seismic parameters and designing is done using AutoCAD.

II.AIM & OBJECTIVE OF WORK:-

- To perform seismic analysis on building in different zones.
- To analyze the effect of various load imposed on the structure.
- To ensure safety of building from seismic wave in various zones.
- To observe the impact of earthquake on building.
- To compare the cost variation observed as the earthquake zone changes.
- To observe and analysis how various loads act's on the structure.
- To observe how the variation of beam and column changes as per the seismic zones.

III. METHOD OF ANALYSIS:-

a) Equivalent static analysis:-

It is one of the methods for calculating the seismic loads. In practical as it does not take into account all the factors that are the importance of the foundation condition. The equivalent static analysis is used to design only for the small structures. In this method only one mode is considered for each direction. The earthquake resistant designing for the low rise structures the equivalent static method is enough. It assumes that building acts in its fundamental mode.

b) Response spectrum analysis:-

This approach permits the multiplier modes of response of a building to be taken into account. Computer analysis can be used to determine these modes for a structure.

This method takes into account all the five important engineering properties of the structures.

i. Fundamental natural period of vibration of the building (T in seconds).
ii. The damping properties of the structure.
iii. Type of foundation provided for the building.
iv. Importance factor of the building.

IV. LIST OF SOFTWARE USED:-

- Auto CAD
- STAAD Pro
- Excel

V. ANALYSIS OF G+10 BUILDING IN DIFFERENT SEISMIC ZONES:-

Earthquake is a natural calamity which we cannot control, it's beyond our control, so to prevent the damage caused due to earthquake we should analyze the building by applying seismic load and analyze the effect caused due to it and after analyzing seismically we should take some measure or bring some changes in methods to ensure safety to the building. Seismic analysis of a building has been explained using STAAD PRO. Plan of building is drawn in auto cad then center line diagram of the structure has transported to Staad pro.
Fixed supports has been provided and various loads such as dead load, live load, wind load etc. which is vital for the analysis of the structure has been provided and some design load combinations has also been provided according to IS CODE 1893. After assigning loads we should define property of the material according to IS CODE .We have to specify column and beam size, reinforcement, grades of concrete etc.
We have to define seismic properties of particular zone according to which structure respond, in my case zone of analysis in zone 2,3,4,5.
Some of the seismic parameter are mentioned below

- Depth of foundation : 3m
- Structure factor : 1
- Response reduction factor : 3

VI. SEISMIC PARAMETER:-

1. For Zone II:-

- Zone factor: 0.1
- Damping ratio: 0.00
- Importance factor: 1
- Time of vibration in both and z axis: 8.57 and 7.05

2. For Zone III:-

- Zone factor: 0.16
- Damping ratio: 0.00
- Importance factor: 1
- Time of vibration in both and z axis: 8.57 and 7.05

3. For Zone IV:-

- Zone factor: 0.24
- Damping ratio: 0.00
- Importance factor: 1
- Time of vibration in both and z axis: 8.57 and 7.05

4. For Zone V:-

- Zone factor: 0.36
- Damping ratio: 0.00
- Importance factor: 1
- Time of vibration in both and z axis: 8.57 and 7.05

V. GENERAL STATEMENT OF BUILDING:-

- Ground floor: 3m
- Floor to floor height: 3m
- Height of plinth: 0.6 m
- Depth of foundation: 3 m
- Materials: Concrete

- Concrete grade: M35
- All steel grade: FE 415

VI. AUTOCAD PLAN:-

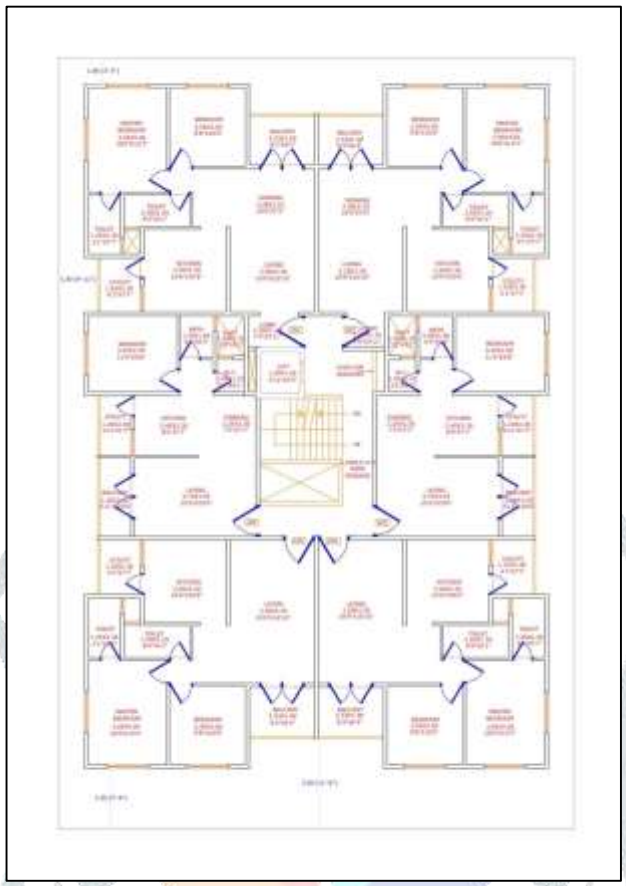

Fig 1: AutoCAD Plan

VII. Building Modeling in STAAD Pro:-

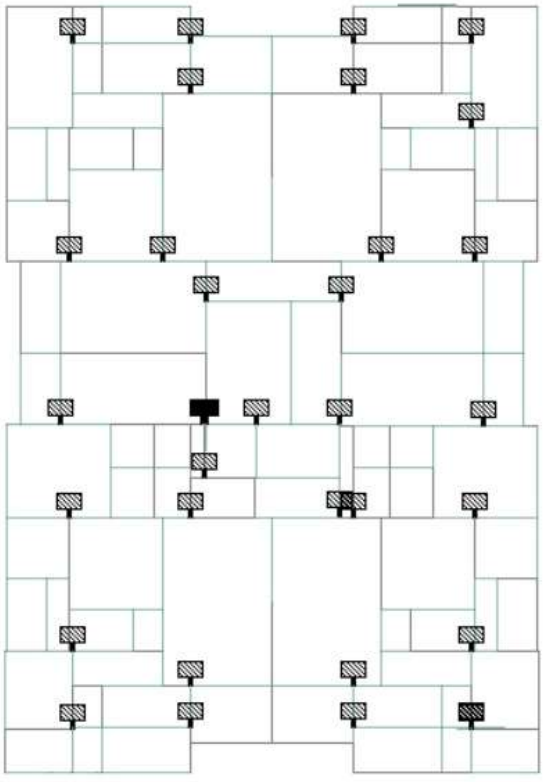

Fig 2: STAAD Plan

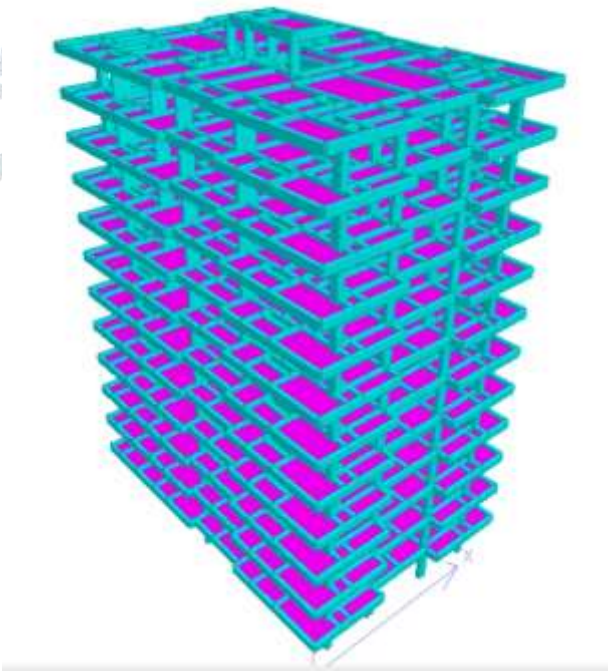

Fig 3: 3-D Rendering

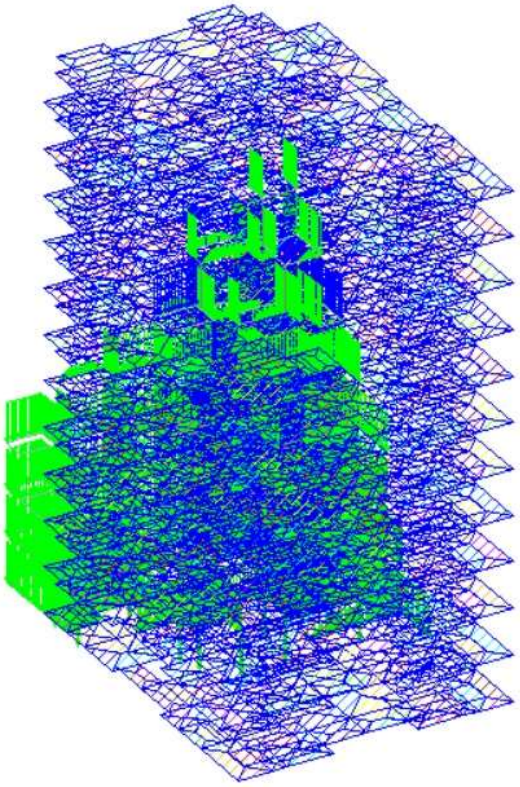

Fig 4: Dead Load on Walls

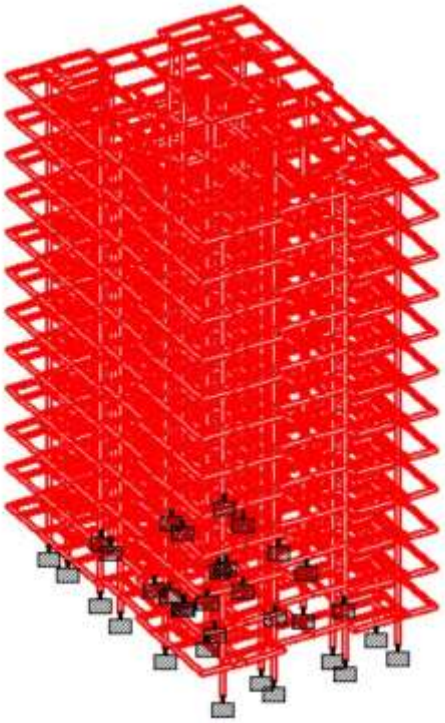

Fig 4: Live Load on Walls

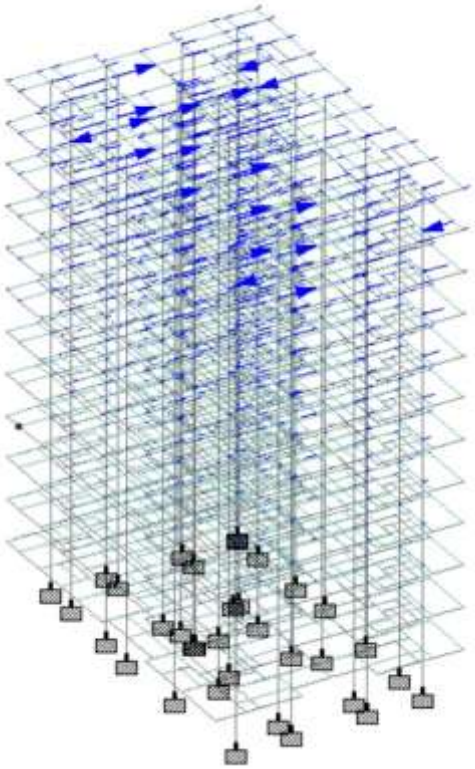

Fig 5: Seismic Load in X- Direction

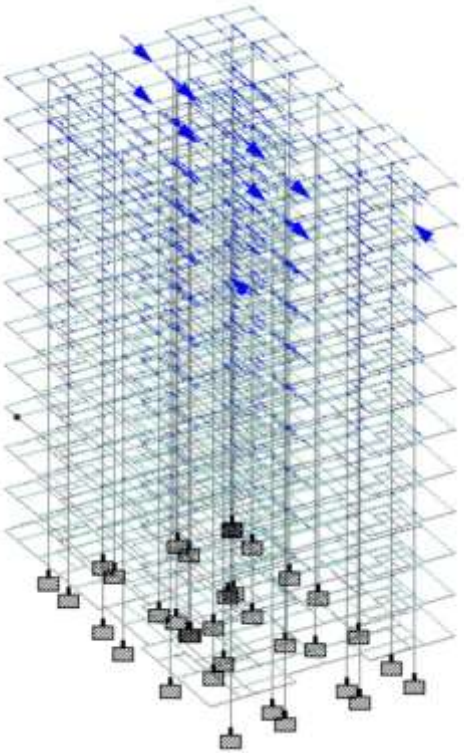

Fig 6: Seismic Load in Z- Direction

VII. VARIATION IN CONCRETE AND STEEL REINFORCEMENT IN DIFFERENT ZONE'S:-

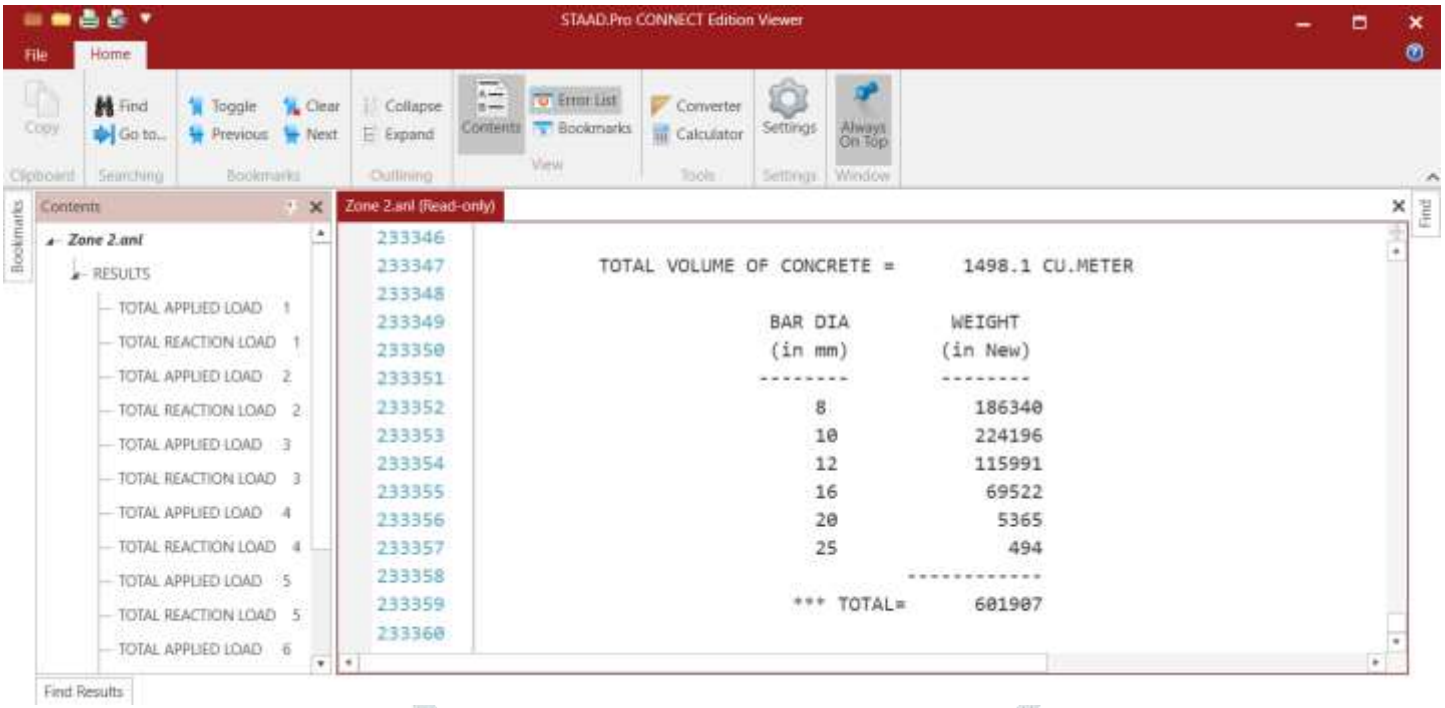

Fig 7: Zone II

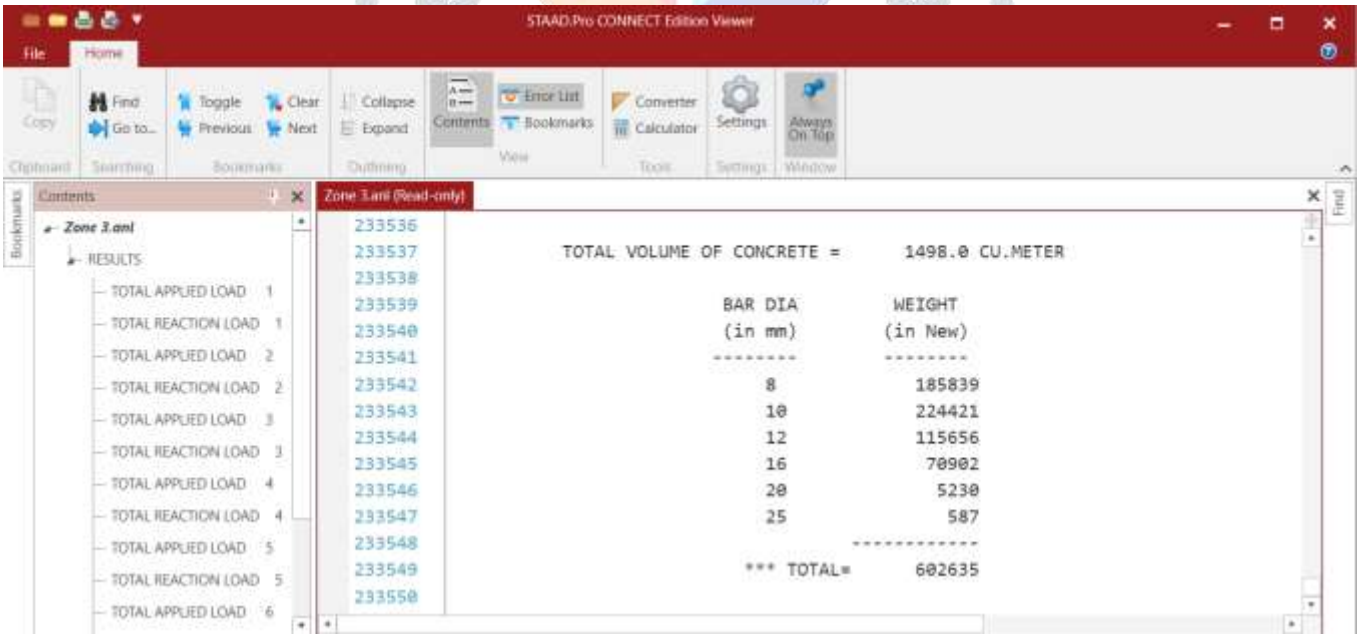

Fig 8: Zone III

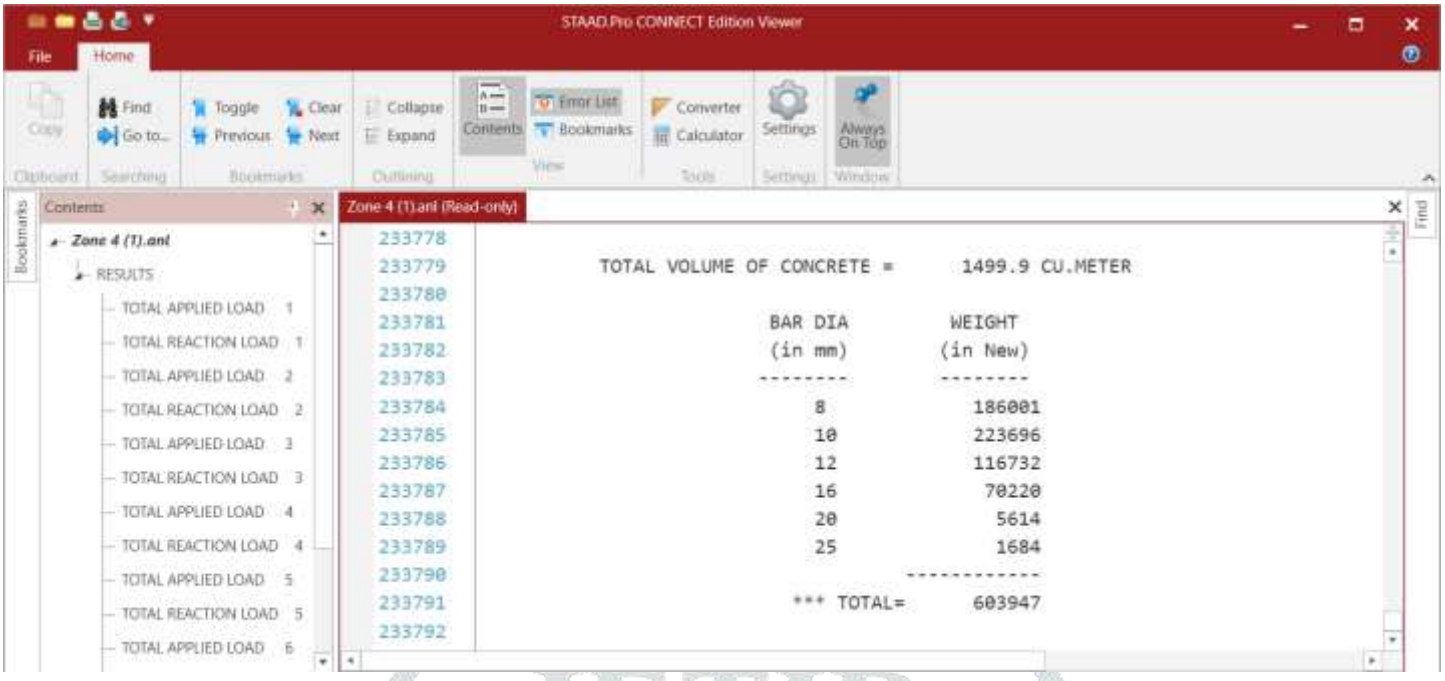

Fig 9: Zone IV

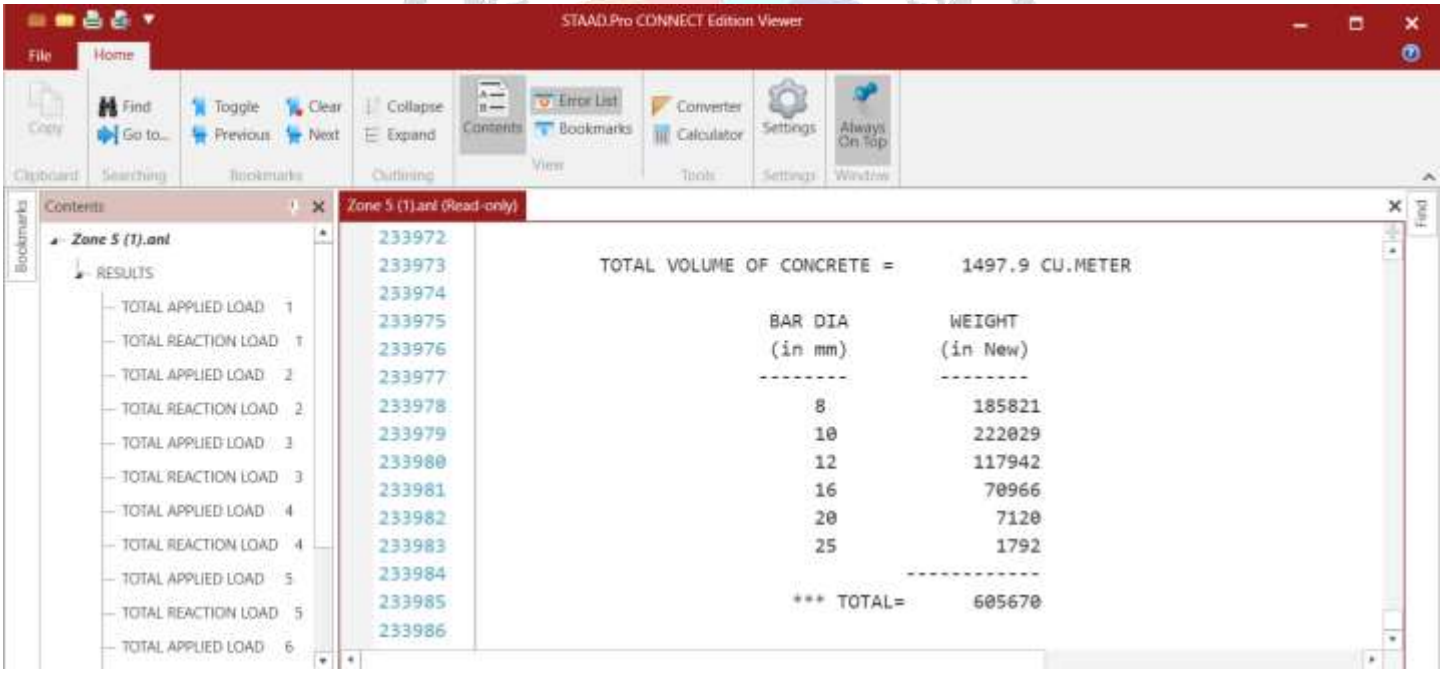

Fig 10: Zone V

VIII. RESULT:-

ZONE	VOLUME OF CONCRETE (M3)	WEIGHT OF STEEL (NEWTON)
II	1498.1	601907
III	1498.1	602635
IV	1498.1	603947
V	1498.1	605670

TABLE 1

IX. CONCLUSION:-

1. The structure is not failing in compression but failing in tension due to the earthquake load imposed on a structure in various zones.
2. The volume of concrete for all zone is 1498.1 m3 and the steel is 601907N, 602635N, 603947N, and 605670N for zone II, III, IV, V respectively.
3. Variations are drastically higher from zone II to zone V.
4. Designing using software's like STAAD.pro reduces the man power and saves time in design work.
5. Details of each and every member and component can obtained from STAAD.pro
6. Software analysis provides more accuracy within the calculations.

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