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COMPARATIVE ANALYSIS AND DESIGN DETAILING OF HIGH-RISE RC BUILDING STRUCTURE CONSIDERING CSI.DETAILING AND RCDC

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ABSTRACT:

Building planning and design are carried out according to requirement in the extremely broad area of civil engineering. As we can see, there are a lot of innovations and changes taking place in the construction industry, and new projects for commercial and residential structures are being started every day. We have known from the beginning of time that earthquakes may cause disasters. Construction is now expanding more quickly than ever before, and engineers and researchers must also bear in mind that any possible sway and resulting damage from earthquakes should be kept to a minimum. Therefore, careful planning, analysis, and design details are required before to the commencement of construction in order to finish the job efficiently, build the structures in accordance with code standards, and make the projects earthquake-resistant. The current work will be done for a high-rise RC building structure, and the analysis and modelling will be done for a G+15 structure using ETABS as a tool. This work will examine the results of the building structure on seismic variables such as base shear, lateral displacement, and lateral drifts. Csi is in charge of the structure's reinforcement details.The most effective approach for reinforcing detailing of a structure undergoing static as well as dynamic load assessment will be determined by comparing detail and the most recent software available on the market, RCDC, for the structure.

Keywords: Structural Analysis, Seismic Analysis, analysis and design detailing, static and dynamic loads, lateral displacement, lateral drift, base shear, ETABS, Csi.Detailing, RCDC.

I. INTRODUCTION

An enclosed structure meant for habitation by people might be referred to as a building. A building consists of the structure or non-structural elements, such as the ceiling, walls, and exterior and interior cladding. The excessive weight of the building is a challenge that designers are now dealing with increasingly often as a result of contemporary, sophisticated architectural demands. When constructing big structures like towering buildings and bridges, where weight is a major consideration, it is often necessary to lower the weight of the structure rather than increase its strength. The most common material used in building nowadays is reinforced cement concrete. A R.C.C. building's bare frame is made up of several horizontal and vertical components. The architects, designers, and owners choose eco-friendly or green building materials in the current construction practise.

This project uses ETABS software to analyse and design a multi-story residential structure with lateral loading effects from an earthquake. The design of this project complies with Indian Codes IS 1893-part2:2016 and IS 456:2000. Severe seismic zones are taken into account for this research, and behaviour is evaluated using Type II soil conditions. We are contemplating a strategy for each zone in our project. The Special RC moment-resisting frame for the proposed building has a Response Reduction Factor(R) of 5.0. An illustration of a G+15-story building's design The diaphragm in this project is stiff. The columns support the major beams, which prevents local eccentricity. ETABS software is used to compare the study and design of multi-story buildings with regular and irregular configurations in different seismic zones.

The singular point in the middle of a spatial distribution of mass is known as the centre of mass. The average position of a mass distribution in space is known as the centre of mass. Building with Multiple Strayeds: Seismic Analysis As this project uses the most cost-effective column approach, we had to reduce the section sizes in order to build the structure efficiently. There is no need to provide huge sizes at the top since the weight is greater at the bottom than on the upper levels. Reducing the amount of bending by orienting the column in a longer span, longer direction will save on the column by using less steel. RC This is how framed construction is described.

RC Conventional Framed Structure

A reinforced concrete (RC) framed structure is a common type of building construction that utilizes reinforced concrete members, such as columns, beams, and slabs, to provide structural support and stability. RC framed structures are widely used due to their strength, durability, and versatility. The combination of reinforced concrete and steel reinforcement provides stability and resilience, making them suitable for a variety of building types and applications. Proper design, construction, and maintenance practices are essential for ensuring the longevity and safety of RC framed structures. The combination of steel reinforcement and concrete offers strength, durability, and flexibility, making RC framed structures widely used in residential, commercial, and industrial buildings.

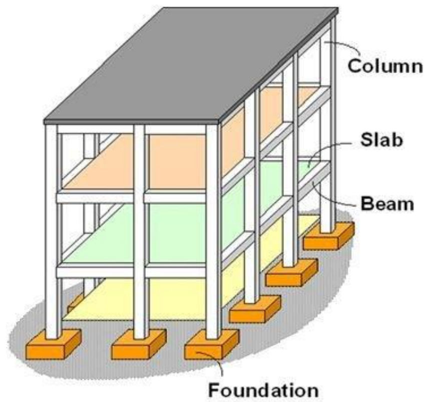


Fig.1 RC Conventional structure

Designing an RCC building using computer software like ETABS gives a precise idea to the user about the flaws of the design and also provides simulations, animations, graphs, and calculations about the different kinds of loads and conditions that the building will have to go through after the construction. The detailed views of reinforcement can be taken from CSI Detailing which is an attachment for CSIETABS. Using ETABS and Detail one can make minor to no errors in designing a building provides a clean and easy-to-use interface to visualize and draw all kinds of views of the building. All of the Standard codes are preinstalled in the design software and the structural designer can pick the codes depending upon his/her choice.

II. LITERATURE REVIEW

Dr. Sanjay K. Kulkarni and colleagues (2018): This article discusses the seismic load assessment for multistory structures in accordance with the guidelines of IS: 1893-2002 and IS: 1893-2016. the procedure for designing and analysing a multi-story (G+4) residential structure in zone III or zone IV. The purpose of providing the work is to show that appropriate Indian standard codes can be utilised to design different building components such beams, columns, slabs, foundations, and stairs using the programme E-tab while taking into account the structure's vulnerability to seismic and wind loads. To determine the values for the maximum story displacement, time period, and project base shear.[6]

Gauri G. Kakpure et al. (2017): In metropolitan India, reinforced concrete (RC) building frames are the most prevalent method of construction. Throughout their lifespan, they are exposed to a variety of forces, including static forces brought on by dead and living loads and dynamic pressures brought on by earthquakes. The equivalent static analysis technique and the response spectrum approach are used, together with the ETAB 15 software, to analyse two tall structures (a G+10 & a G+25 structure), which are presumptively located in seismic zone III. The parameters for comparison investigation, such as tale drift, story displacement, axial load, and bending moments, are determined from the analysis findings. The Response spectrum approach beat the Equivalent static analysis method, according to the results. In comparison to static analysis, the story drift between G+10 and G+25 is 22 to 25% less in dynamic analysis. According to the requirements of the code, all values are inside the ranges. The displacement values steadily rise along with the story's height. The top article has the greatest displacement quantity in both X and Y. Story displacement for the G+10 & G+25 buildings in the dynamic study is 22% & 26% smaller than the comparable values in the static analysis.[7]

B. Gireesh Babu (2017): In this research, the seismic response of the buildings is examined in terms of member forces, joint displacement, support reaction, and story drift during an earthquake. STAAD PRO design software is used to explore the reaction for g+7 building structures. It has been noted that responses in situations with an ordinary moment resistant frame are reduced. In this instance, earthquake zone 2, ordinary moment resistant frame response factor 3, and significance factor 1 have been used. We first began by creating simple 2-dimensional frames, using the findings to manually assess the software's accuracy. The structure is then analysed using the designated criteria, and the members with reinforcing details are designed for G+7 residential building RCC structures. The amount of steel used in the G+7 RC framed building's earthquake-resistant design was 1.517% more than in the conventional concrete construction. The amount of steel increases from the structure's bottom floor to its highest floor, or its G+7 level. The G+7 building's story drift condition has a base drift of 0.0 at each storey. According to this, the structure is secure even while drifting. As a result, shear walls and braced columns aren't required. So, the G+7 building's story drift state is evaluated.[8]

B. Rajesh and colleagues (2015): This essay seeks to analyse reinforced concrete structures with irregular plans both statically and dynamically. For the study, four models of a G+15-story structure were obtained, one with a normal layout and the others with an irregular plan. The FE-based programme ETABS 9.5 is used to analyse R.C.C. structures. Estimating the reaction is done using terms like lateral forces, base shear, narrative drift, and tale shear. The impact of the building design variation on the structural reaction building is another topic covered in the essay. Dynamic reactions to a significant earthquake in relation to IS 1893-2002(part1) The maximum displacement of stories in both the X and Y directions is given greater values via static analysis. At higher stories, the base shear values will be greatly enhanced as a result of RS analysis & static analysis. While the static analysis only generates story shear in the direction that of loading, the dynamic RS analysis generates story shear in both directions.[9]

E. Pavan Kumar et al. (2014): Axial force, bending moment, and displacement are the characteristics in this journal that are taken into consideration for analysis. The building's square form was the proposal under consideration. There is a necessity to study seismic analysis in order to construct earthquake-resistant structures in order to assure safety against the seismic pressures of multi-story buildings. In two situations, both the ordinary moment resisting frame & the special moment resisting frame, the response reduction in seismic analysis was taken into consideration.[10]

III. METHODOLOGY

Technique for study purpose various soil circumstances whichever is provided in IS456 in use in ETABS program. According to IS456 the Light, Medium, Rigid Strata with Variable base supports Based on movement and weight relation optimum construction were determined.

Modeling of Structural Systems: Modeling, Analysis, Design and detailing process are as follows:

- Defining materials for concrete grade, rebar grade and section properties for beam, column and slab.
- Defining mass source considering dead load factor as 1 and live load factor as 0.25 (for Seismic study) and diaphragm property as rigid frame
- Defining load patterns such as Dead, live, wind, EQ-X, EQ-Y and choosing the worst case to act on the structure.
- Defining load cases like Dead, Live, EQ, Wind, RSA and Specified load combination as per IS Standards.

- Performing analysis and checking the structure for the safety against seismic forces and design of structure.
- The results of detailing a structure using the Csi detailing and RCDC software are contrasted.

3.1. RESPONSE SPECTRUM ANALYSIS

Response spectrum analysis is a method used in structural engineering to evaluate the dynamic response of structures subjected to seismic or other dynamic loads. It involves the determination of the maximum structural response, such as displacements, velocities, or accelerations, at various frequencies. The analysis begins with the definition of a response spectrum, which is a plot representing the maximum response of a structure at each frequency. The response spectrum is typically obtained from empirical data or generated using a design code. It provides an estimate of the structural response for a given ground motion intensity.

To perform response spectrum analysis, the following steps are typically involved:

a) Define the design spectrum: The design spectrum represents the expected ground motion at the site of the structure. It is characterized by a series of spectral acceleration values at different frequencies.
b) Model the structure: Create a mathematical model of the structure using appropriate finite element or other numerical methods. The model should accurately represent the mass, stiffness, and damping characteristics of the structure.
c) Apply the input motion: Apply the design spectrum as a series of ground motion time histories at different frequencies to the model. Each time history represents the ground motion response at a specific frequency.
d) Perform dynamic analysis: Solve the equations of motion for the structure subjected to the input motion at each frequency. This involves considering the mass, stiffness, and damping properties of the structure.
e) Extract the maximum response: Identify and record the maximum structural story responses, such as story displacements, story drifts, and story shear. This is typically done for critical locations in the structure, such as the top of a building or top of the story or bottom of the story.

Response spectrum analysis is particularly useful for designing structures to resist seismic forces. Engineers can compare the response spectrum of a structure with the design spectrum to evaluate its performance and make necessary modifications to ensure structural integrity and safety. According to IS-1893:2002 the number of modes to be used in the analysis should be such that the total sum of modal masses of all modes considered is at least 90 percent of the total seismic mass.

3.2.OBJECTIVES OF STUDY

A thorough literature study is carried outside to describe the goals of the thesis. The literature survey is reviewed and quickly outlined as follows:

1. To deciding on the best, clearest, and most closely related detailing to the actual construction process for RC framed structures.
2. To analyse the framed structure's safety from dynamic loads, such as seismic effects, is done by considering the response spectrum for the IS-specified load combinations.
3. Utilization of Advanced diagnostic applications of software like Staad.Pro, Etabs for analysis, design and for the detailing software like RCDC and Csi detailing.
4. To perform dynamic investigation in the terms of maximum story displacement, story drift and story shear of the RC framed structure subjecting to IS load combinations.
5. To set up a reference study for the usage of softwares like RCDC and Csi Detailing in the design detailing of framed structures according code standards.

IV. BUILDING MODELLING AND ANALYSIS

For a analysis in ETABS firstly select the material property in define then add the required material which we use in design of G+15 structure.

By choosing define menu material properties in this case, we had first specified the material property. By providing the necessary information in the defining tab, we introduced additional material to create our structural elements (beams, columns, slabs, shear walls, steel bracing, and friction dampers). Then, by choosing the frame sections as shown below, we defined section size and added the necessary sections for beams, columns, etc.

Building type	G + 15
Plan dimensions	45 x 35 m
No. of bay in X direction	9 Bays
No. of bay in Y direction	7 Bays
Typical story height	3.3 m
Bottom story height	3.0 m
Building height	55.8 m
Soil type	Type II (Medium Soils) Combined or Isolated RCC footings with the beams
Design criteria	(As Height of building is greater than 40m up to 90m type) Analysis for all zones. Modal analysis using Response spectrum method to be performed for the mentioned zones.
Zone considering	II, III, IV & V
Importance Factor, I	1
Response Reduction Factor, R	5 (SMRF) RC Building with Special Moment Resisting Frame
Performance factor, K	1.0 (Moment resistant frame with appropriate ductility details as given in IS: 437.6-1976* in reinforced concrete or steel)
Support condition of columns	Fixed

Table 1: Geometrical properties & location factors

Column size	450 x 600 mm
Beam size	300 x 450 mm
Thickness of slab	150 mm
Grade of concrete	M-40
Grade of steel for Main Reinforcement	Fe-500
Grade of steel for Secondary Reinforcement	Fe-415

Table 2: Section & material properties

Wall load on external beams	13.11 kN/m
Wall load on internal beams	8.55 kN/m
Floor finish load	1.5 kN/m^2
Live load on floor	2 kN/m^2
Terrace finish load	1.5 kN/m^2
Dead load factor	1
Live load factor for Seismic analysis	0.25 (i.e., 25%)
Load combinations	1.2[DL + IL + WL] or 1.2[DL + IL + EL]

Table 3: Loading details

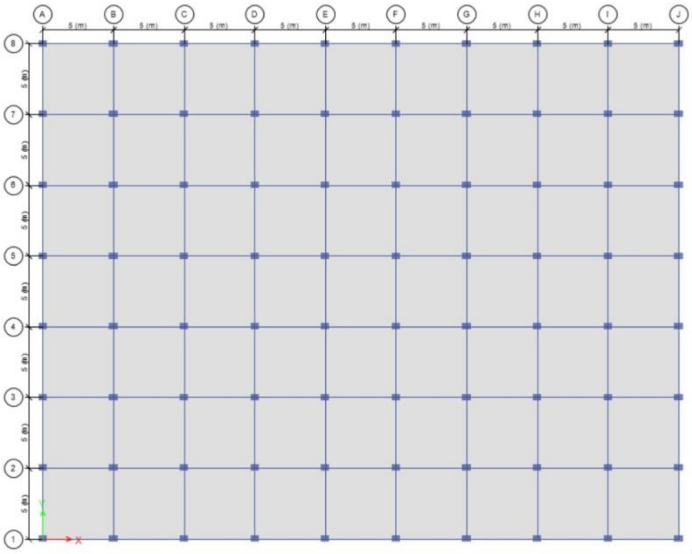


Fig 5. Plan Layout of structure

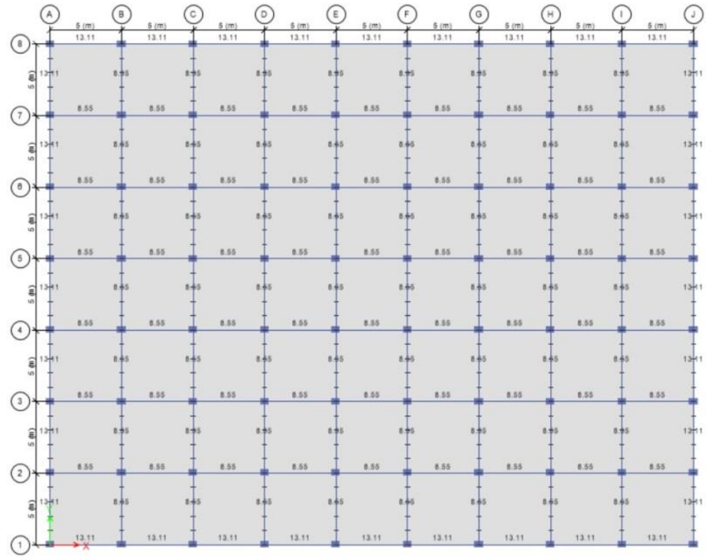


Fig 6. Dead Load on Beams

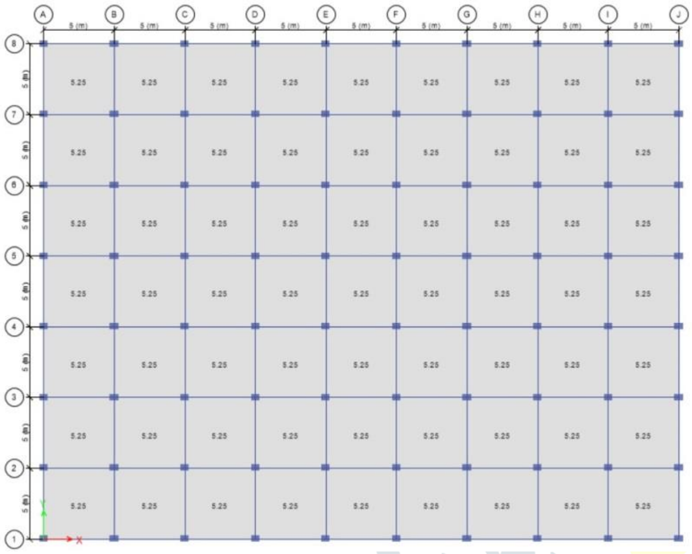


Fig 7. Dead Load on Slab

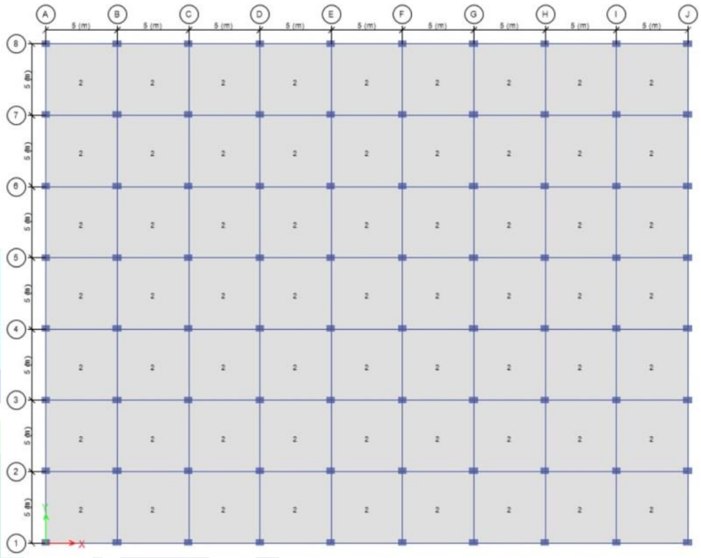


Fig 8. Live load on slab

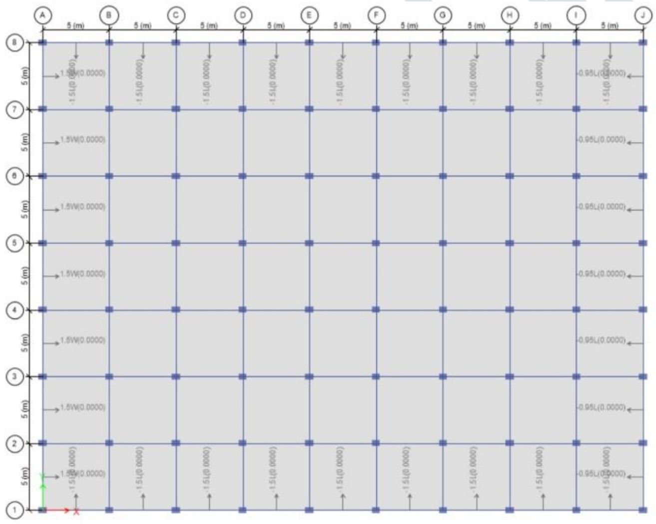


Fig 9. Wind pressure co-efficients of structure

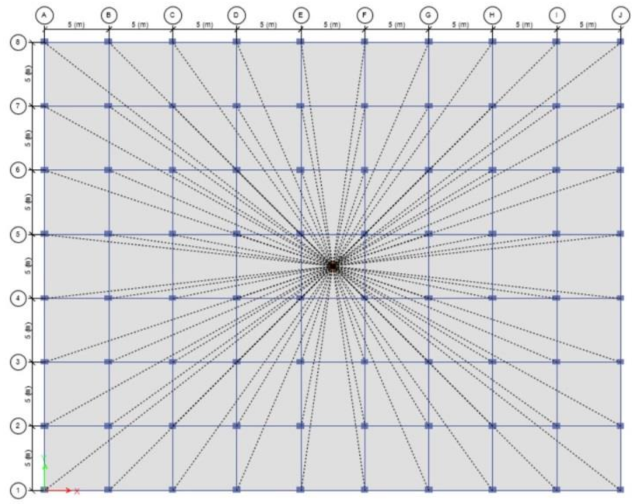


Fig 10. Diaphragm Properties

The output and display formats for moment, shear, and axial force diagrams along with deformed shapes are available after assigning all the properties of beams, columns, and slabs and applying loads. These may be arranged into specialised reports and fine-grained section cuts showing different local response measures.

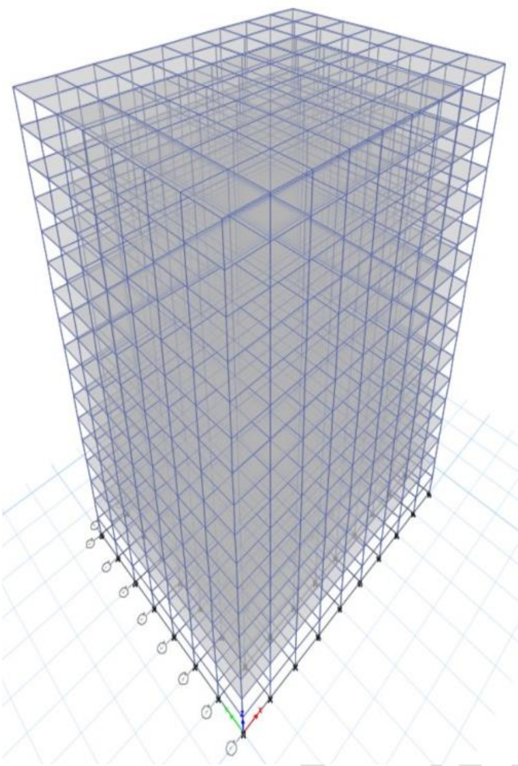


Fig 11. 3D view of Model

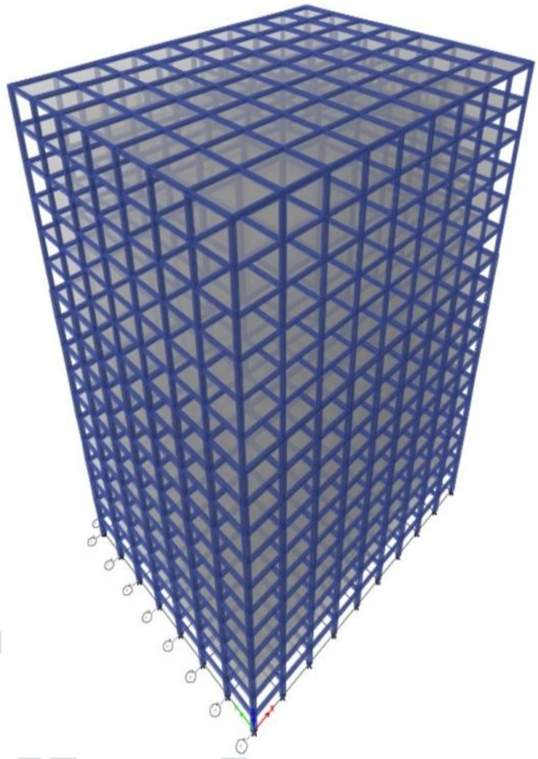


Fig 12. 3D Rendered view of Model

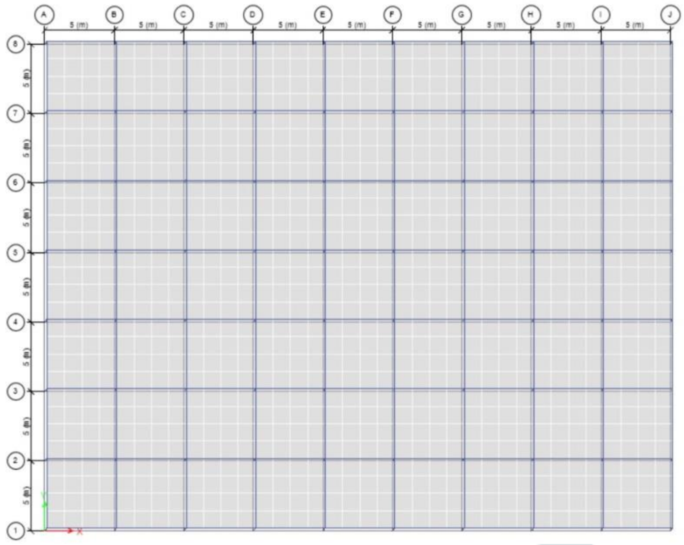


Fig 13. 3D View of Model II

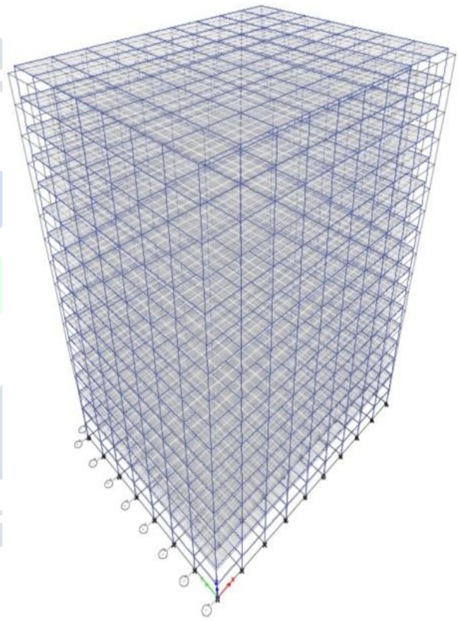


Fig 14. Deformation of Model

V. RESULTS AND DISSCUSIONS

The response spectrum analysis & load combination required by the IS standards are used to evaluate the selected building model. The terms in which the findings of the response spectrum are shown as plots for stories are as follows.

Maximum story Displacement: The tale's lateral displacement with respect to the base is referred to as story displacement. The excessive lateral movement of the building may be controlled by the lateral force-resisting system. The acceptable lateral displacement limit in the event of a wind load is H/500 (but some people may use H/400).

Maximum story Drift: Story drift is calculated by dividing the distance between two adjacent stories by the height of each storey.

5.1. ANALYSIS CHECK

5.1.1 MAXIMUM STORY DISPLACEMENT - (Response Spectrum)

STORY	ZONE II (mm)	ZONE III (mm)	ZONE IV (mm)	ZONE V (mm)
Story 15	15.284	24.455	36.682	55.023
Story 14	15.07	24.111	36.167	54.251
Story 13	14.735	23.576	35.365	53.047
Story 12	14.284	22.854	34.28	51.421
Story 11	13.725	21.959	32.939	49.409
Story 10	13.066	20.906	31.36	47.039
Story 9	12.316	19.705	29.558	44.337
Story 8	11.478	18.365	27.548	41.322
Story 7	10.56	16.896	25.344	38.017
Story 6	9.565	15.305	22.957	34.436
Story 5	8.499	13.598	20.396	30.595
Story 4	7.364	11.782	17.673	26.51
Story 3	6.164	9.863	14.794	22.191
Story 2	4.9	7.839	11.759	17.639
Story 1	3.569	5.71	8.565	12.848
Ground Floor	2.179	3.486	5.229	7.843
Plinth Level	0.769	1.23	1.846	2.768
Column Base	0	0	0	0

Table 5. Maximum Story Displacement of Structure

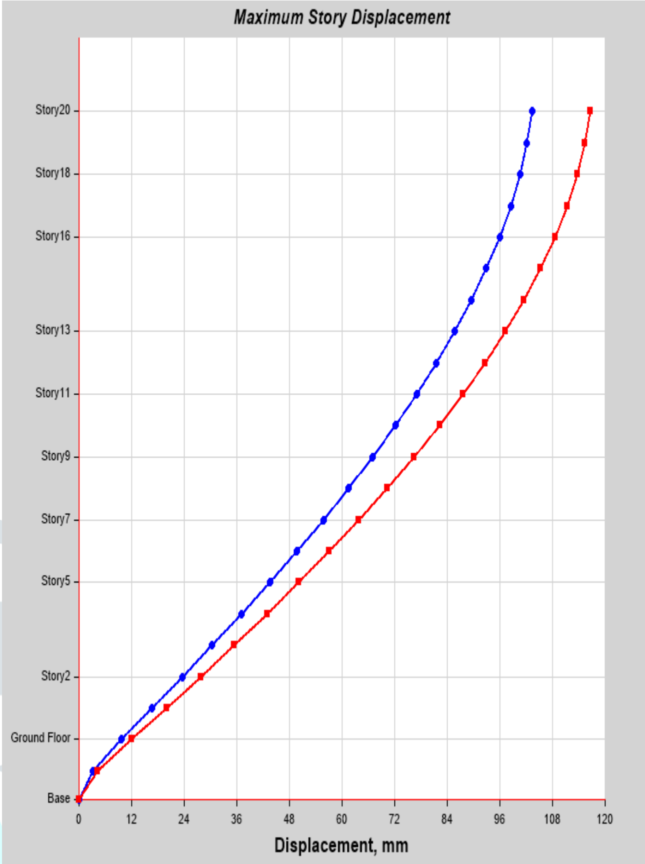


Fig 19. Maximum Story Displacement of Model I

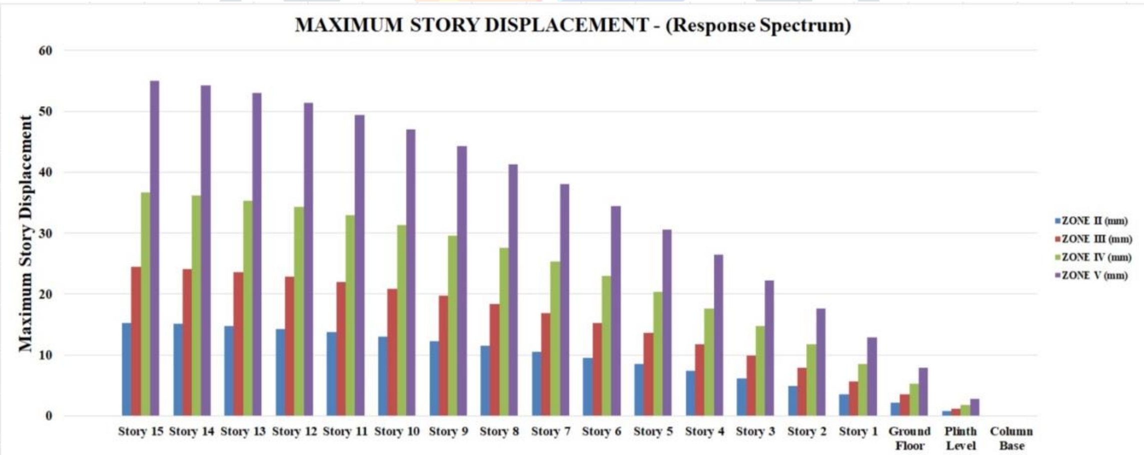


Fig 20. Comparison graph of Maximum Story Displacement

As per IS 1893:2016,

Maximum Story Displacement shall not exceed 0.004 times story height

= 0.004x55.8x1000

= 223.2 mm hence it is safe to consider.

5.1.2 MAXIMUM STORY DRIFT- (Response Spectrum)

STORY	ZONE II (Unitless)	ZONE III (Unitless)	ZONE IV (Unitless)	ZONE V (Unitless)
Story 15	0.000089	0.000142	0.000213	0.00032
Story 14	0.000142	0.000228	0.000342	0.000512
Story 13	0.000187	0.0003	0.000449	0.000674
Story 12	0.000221	0.000353	0.00053	0.000795
Story 11	0.000248	0.000397	0.000595	0.000892
Story 10	0.000272	0.000435	0.000653	0.000979
Story 9	0.000294	0.000471	0.000706	0.001059
Story 8	0.000314	0.000503	0.000754	0.001132
Story 7	0.000333	0.000532	0.000798	0.001198
Story 6	0.00035	0.00056	0.00084	0.00126
Story 5	0.000366	0.000586	0.000879	0.001319
Story 4	0.000381	0.000609	0.000913	0.00137
Story 3	0.000394	0.00063	0.000945	0.001417
Story 2	0.000408	0.000652	0.000979	0.001468
Story 1	0.000422	0.000676	0.001013	0.00152
Ground Floor	0.000433	0.000692	0.001038	0.001557
Plinth Level	0.000256	0.00041	0.000615	0.000923
Column Base	0	0	0	0

Table 6. Maximum Story Drift of Structure

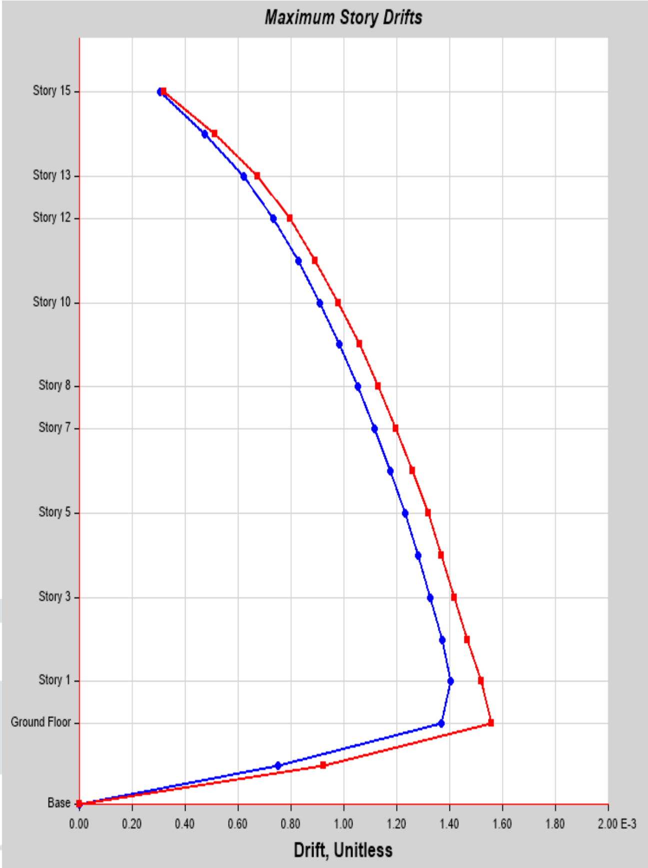


Fig 21. Maximum Story Drift of Model I

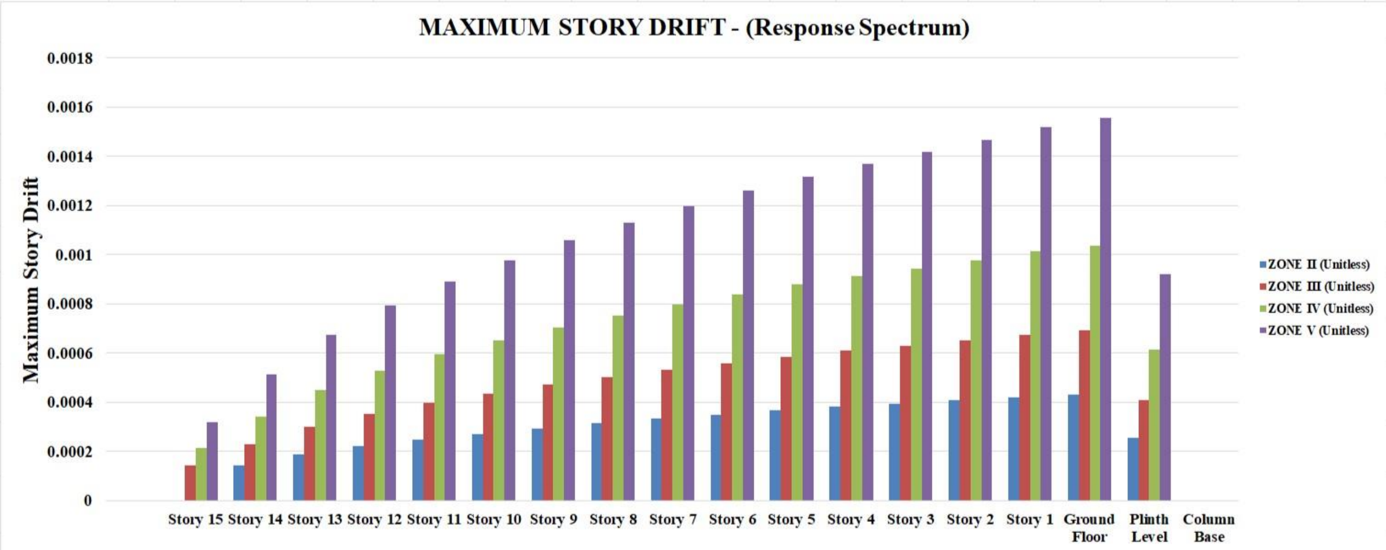


Fig 22. Comparison graph of Maximum Story Drift

As per IS 1893:2016,
Maximum Story Drift shall not exceed 0.004
Hence it is safe to consider.
Now considering the load combination from IS 456 as **1.2[DL + IL + EL]**
Performing the analysis for the selected load combination and checking the safety we got the following results

5.2.1 MAXIMUM STORY DISPLACEMENT- 1.2[DL + IL + EL]

STORY	ZONE II (mm)	ZONE III (mm)	ZONE IV (mm)	ZONE V (mm)
Story 15	18.341	29.346	44.018	66.028
Story 14	18.084	28.934	43.401	65.101
Story 13	17.682	28.292	42.437	63.656
Story 12	17.14	27.424	41.137	61.705
Story 11	16.47	26.351	39.527	59.29
Story 10	15.68	25.088	37.631	56.447
Story 9	14.779	23.646	35.469	53.204
Story 8	13.774	22.039	33.058	49.587
Story 7	12.672	20.275	30.413	45.62
Story 6	11.479	18.366	27.548	41.323
Story 5	10.198	16.317	24.476	36.714
Story 4	8.837	14.139	21.208	31.812
Story 3	7.397	11.835	17.753	26.63
Story 2	5.88	9.407	14.111	21.166
Story 1	4.283	6.852	10.278	15.417
Ground Floor	2.614	4.183	6.274	9.412
Plinth Level	0.987	1.536	2.269	3.368
Column Base	0	0	0	0

Table 7. Maximum Story Displacement of Structure

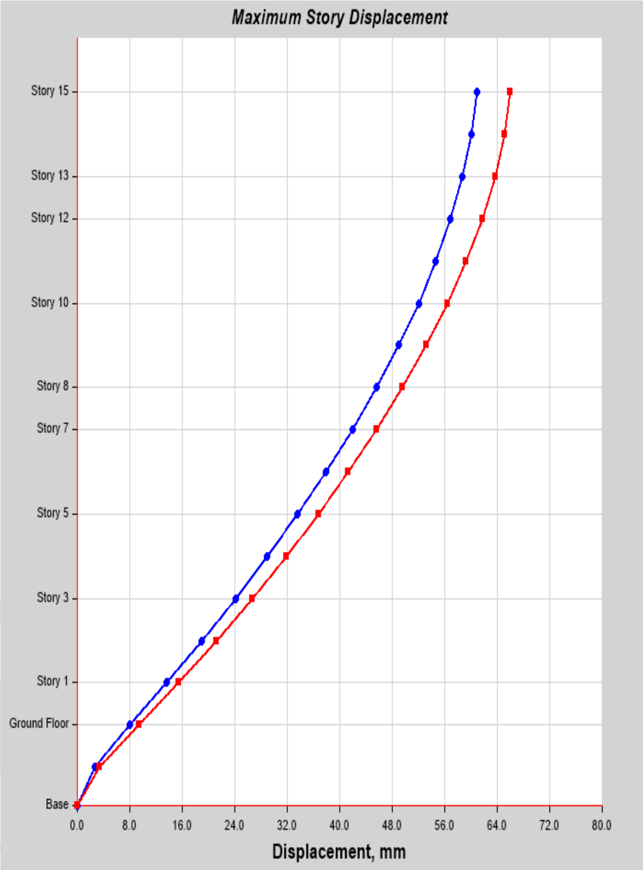


Fig 23. Maximum Story Displacement of Model I

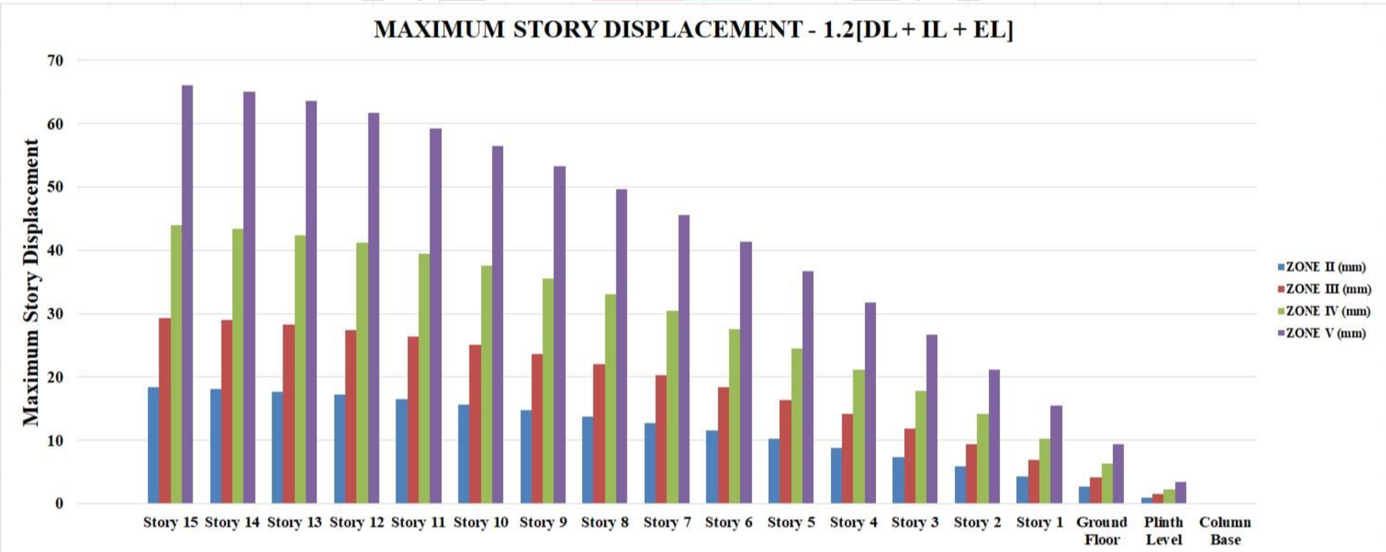


Fig 24. Comparison graph of Maximum Story Displacement

As per IS 1893:2016,

Maximum Story Displacement shall not exceed 0.004 times story height

= 0.004x55.8x1000

= 223.2 mm hence it is safe to consider.

5.2.2 MAXIMUM STORY DRIFT- 1.2[DL + IL + EL]

As per IS 1893:2016,

Maximum Story Drift shall not exceed 0.004

Hence it is safe to consider.

STORY	ZONE II (Unitless)	ZONE III (Unitless)	ZONE IV (Unitless)	ZONE V (Unitless)
Story 15	0.000107	0.000171	0.000256	0.000384
Story 14	0.000171	0.000273	0.00041	0.000615
Story 13	0.000225	0.000359	0.000539	0.000809
Story 12	0.000265	0.000424	0.000636	0.000954
Story 11	0.000297	0.000476	0.000714	0.001071
Story 10	0.000326	0.000522	0.000783	0.001175
Story 9	0.000353	0.000565	0.000848	0.001271
Story 8	0.000377	0.000603	0.000905	0.001358
Story 7	0.000399	0.000639	0.000958	0.001437
Story 6	0.00042	0.000672	0.001008	0.001512
Story 5	0.00044	0.000703	0.001055	0.001582
Story 4	0.000457	0.000731	0.001096	0.001644
Story 3	0.000472	0.000756	0.001134	0.001701
Story 2	0.000489	0.000783	0.001174	0.001761
Story 1	0.000507	0.000811	0.001216	0.001824
Ground Floor	0.000536	0.000845	0.001259	0.001882
Plinth Level	0.000329	0.000512	0.000756	0.001123
Column Base	0	0	0	0

Table 8. Maximum Story Drift of Structure

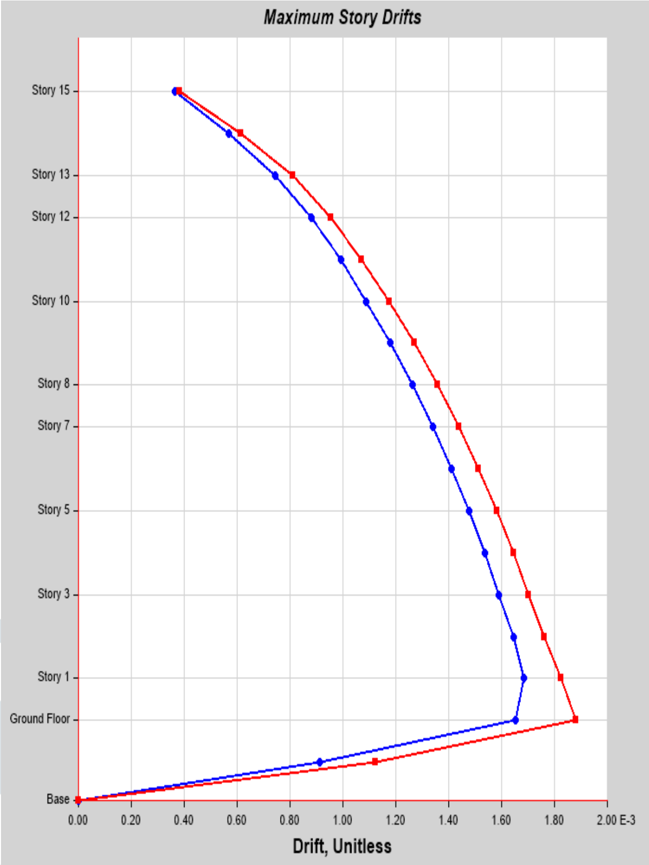


Fig 25. Maximum Story Drift of Model I

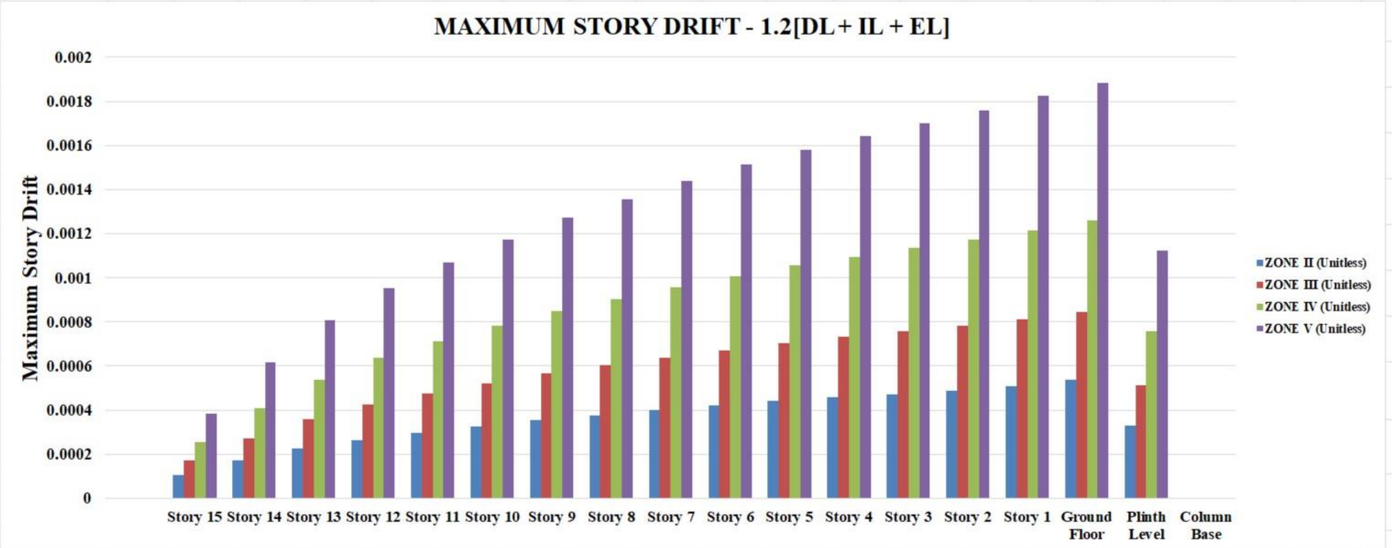


Fig 26. Comparison graph of Maximum Story Drift

From the above results it can be noted that frame structure is safe against the worst case that means the beam column dimensions which considered are stuffiest to precede for the design and detailing.

After Performing analysis here in below figure no member is in red colour i.e., all the members are passed against the design check and no member failed. We can proceed to the detailing of Rc structure.

Detailing of RC frame structure is done with two different softwares named as one Csi Detailing and other is RCDC in both the software same data file i.e., Etabs analysis-design file is imported such that there is no change of datatables change and the same set of file is used to get the reinfored detailing of structure.

Then the comparision of detailing from two different softwares is presented in results and discussions. The detailing data is actually very lengthy and includes more number of figures to get understand and execute thes structure. For this study we consider the one beam from the story 15 mid sections and ground story mid section of plan layout in the similar manner slab is compared and for the column sections at various elevation is taken from Csi detailing and RCDC software.

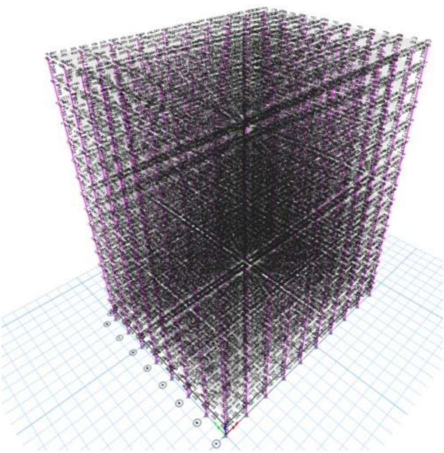


Fig 27. Design check figure

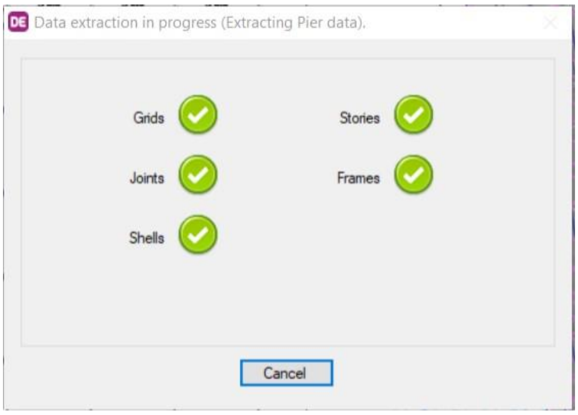


Fig 28. Data extraction

5.3. DETAILING RESLUTS OF SLAB

5.3.1. FROM CSI DETAILING

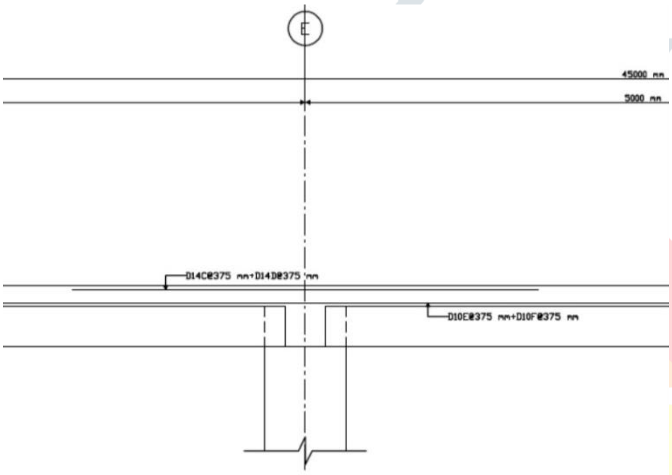


Fig 29. Cross section of Story 15 at central panel at section E

From above it can be noted that slab consists of Dia 14 and Dia 10 bars @ 375 mm c/c spacing

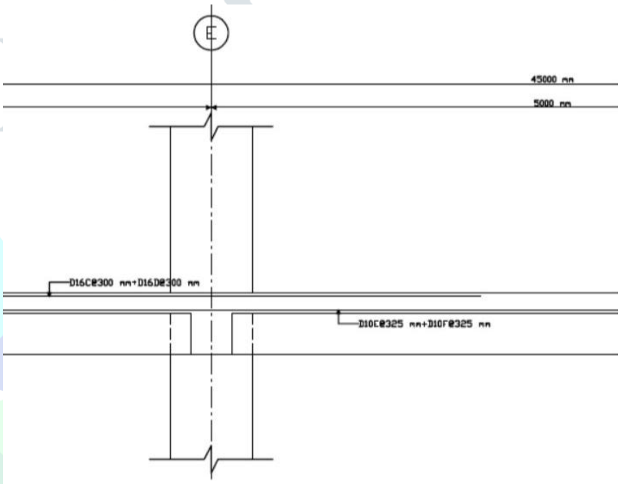


Fig 30. Cross section of Ground Story at central panel at section E

From above it can be noted that slab consists of Dia 16 and Dia 10 bars @ 325 mm c/c spacin

5.3.2. FROM RCDC

No	Slab	Thickness (mm)	Conc Grade	Steel Grade	Bottom @ Lx	Bottom @ Ly	Top @ Lx (Cont)	Top @ Lx (
1	S1	150	M40	Fe500	T12 @ 330	T12 @ 325	T12 @ 300	T12 @ 3
2	S2	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
3	S3	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
4	S4	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
5	S5	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
6	S6	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
7	S7	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
8	S8	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
9	S9	150	M40	Fe500	T12 @ 330	T12 @ 325	T12 @ 300	T12 @ 3
10	S10	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 365	T12 @ 3
11	S11	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
12	S12	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
13	S13	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
14	S14	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
15	S15	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
16	S16	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
17	S17	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
18	S18	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 365	T12 @ 3
19	S19	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 365	T12 @ 3
20	S20	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
21	S21	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
22	S22	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
23	S23	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
24	S24	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
25	S25	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–
26	S26	150	M40	Fe500	T12 @ 370	T12 @ 370	T12 @ 370	–

Fig 31. Slab panel details After the run

analysis for Ground story

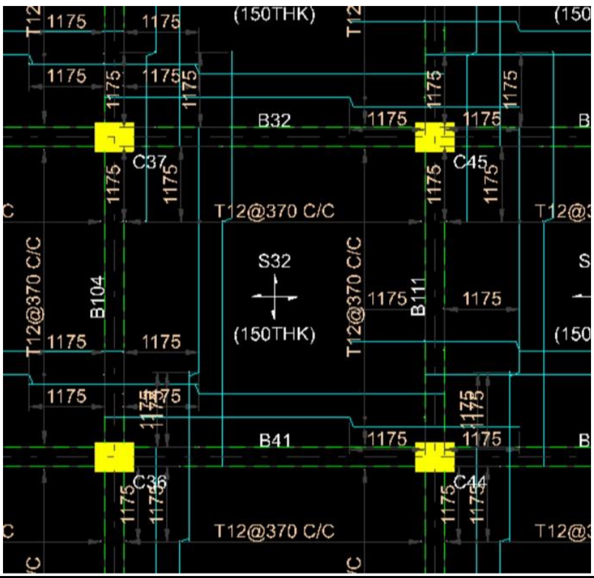


Fig 32. Cross section of slab

From the above it can be noted that slab consists of Dia 12 @ 370 c/c spacing (for maximum panels)

5.4. DETAILING RESLUTS OF BEAMS

5.4.1. FROM CSI DETAILING

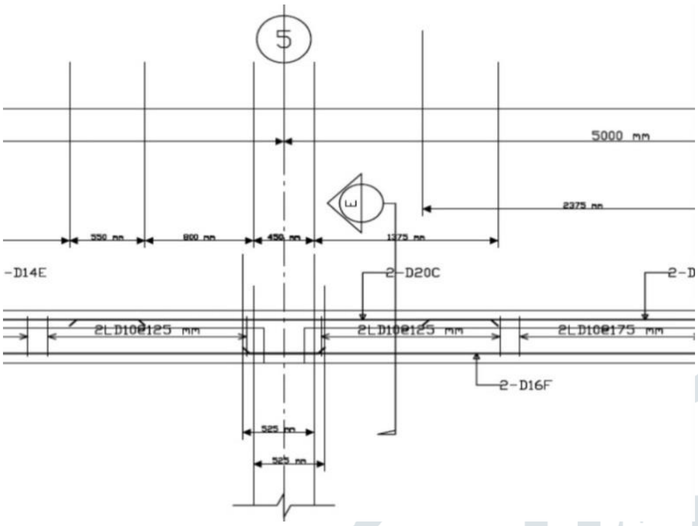


Fig 33. Beam longitudinal Section at the central span

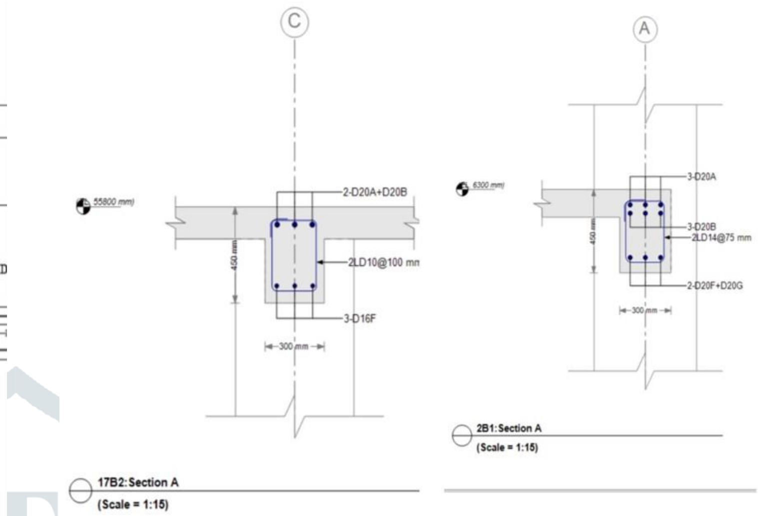


Fig 34. Cross section of Story 15 and Ground story

5.4.2. FROM RCDC

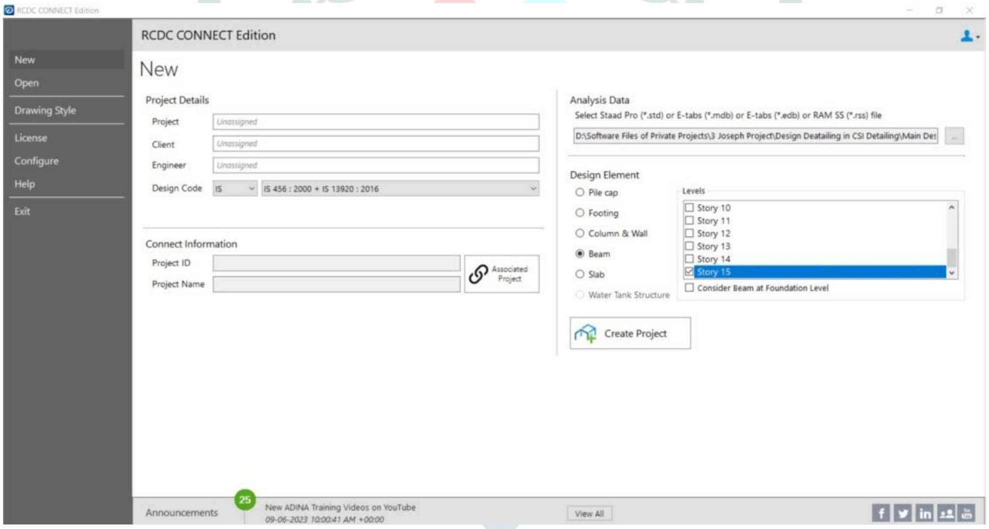


Fig 35. Importing of file for Beam Detailing

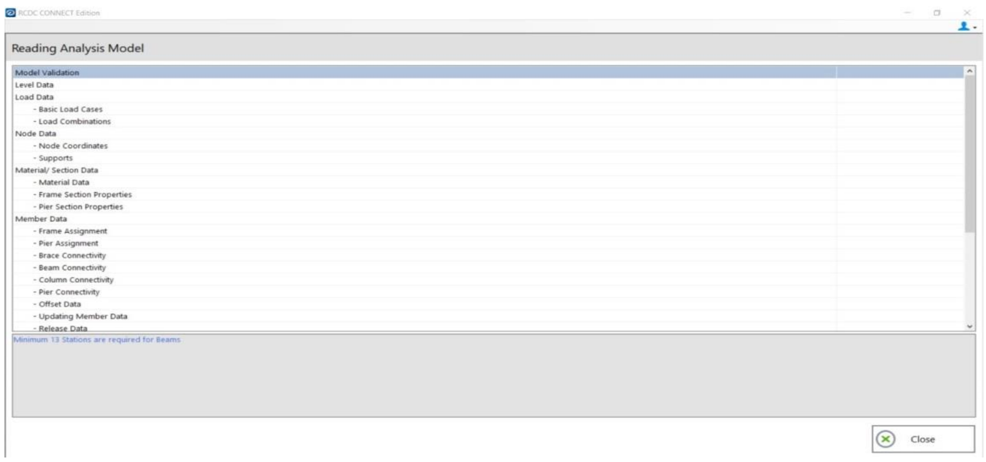


Fig 36. Additional data required for the Detailing from RCDC

From above it can be noted that The same set of file which concludes the detailing from Csi Detailing software is not performing the detailing for the beams in RCDC.

5.5. DETAILING RESLUTS OF COLUMN

In this we will take the data of top and bottom from the structure as the top story will expose less and the bottom story will expose more to the structural loads. From Top and Bottom story also the section of the frame which effected more is considered i.e., central span members wich is at the centre of RC Structure.

5.5.1. FROM CSI DETAILING

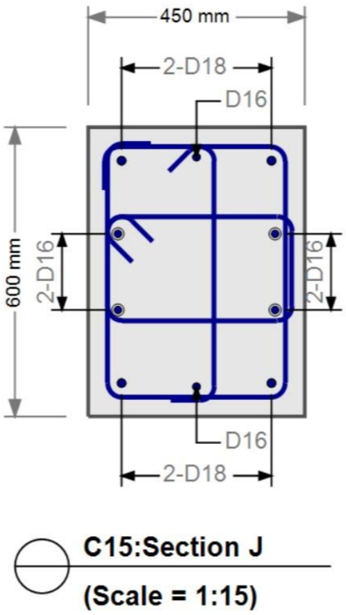


Fig 37. Column c/s at Story 15 of cental column

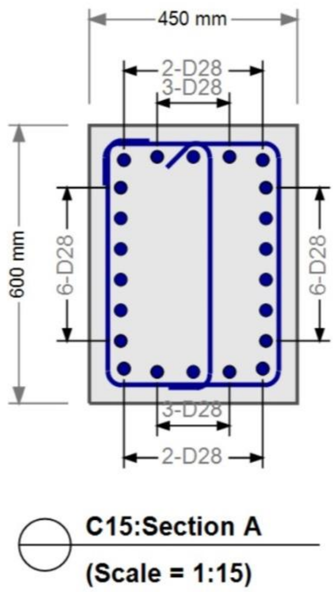
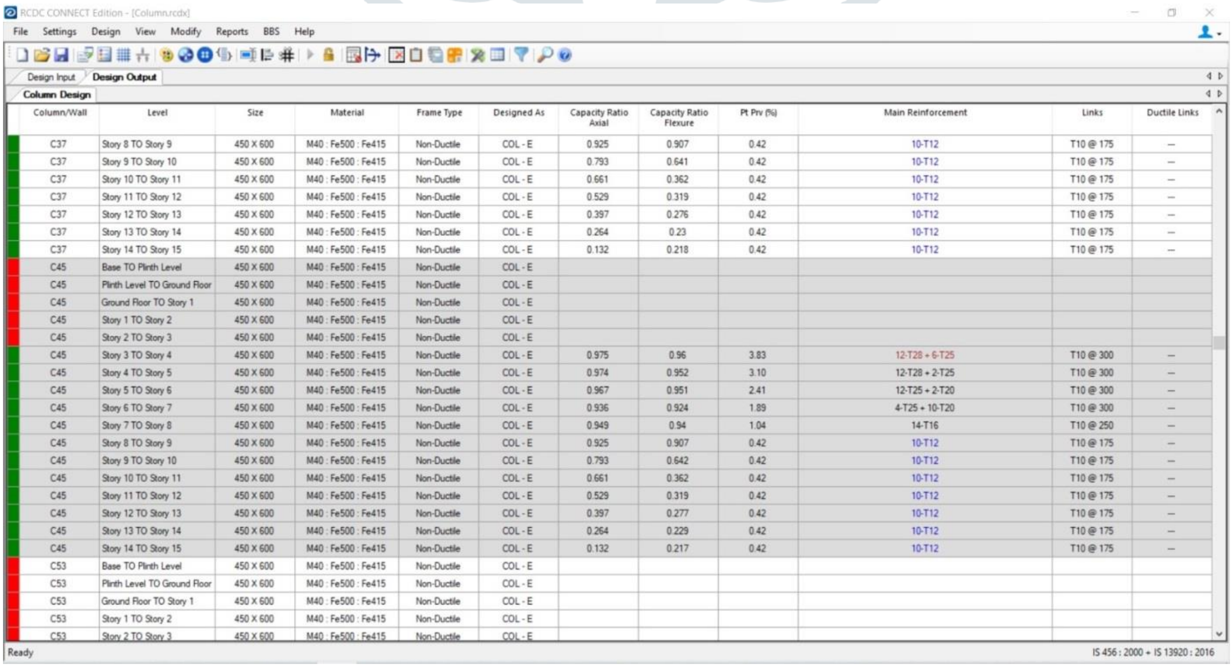


Fig 38. Column c/s at Ground Story of cental column

From the above we can note that at Ground Story column consists of 12 Nos Dia 28 and 10 Nos Dia 28 with Dia 12 Ties @ 275 mm c/c spacing

At the Story 15 column consists of 6 Nos Dia 16 bars and 4 Nos Dia 18 bars with Dia 10 ties @ 275 mm c/c spacing.

5.5.2. FROM RCDC



Column/Wall	Level	Size	Material	Frame Type	Designed As	Capacity Ratio Axial	Capacity Ratio Flexure	Pt Prv (%)	Main Reinforcement	Links	Ductile Links
C37	Story 8 TO Story 9	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.925	0.907	0.42	10-T12	T10 @ 175	—
C37	Story 9 TO Story 10	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.793	0.641	0.42	10-T12	T10 @ 175	—
C37	Story 10 TO Story 11	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.661	0.362	0.42	10-T12	T10 @ 175	—
C37	Story 11 TO Story 12	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.529	0.319	0.42	10-T12	T10 @ 175	—
C37	Story 12 TO Story 13	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.397	0.276	0.42	10-T12	T10 @ 175	—
C37	Story 13 TO Story 14	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.264	0.23	0.42	10-T12	T10 @ 175	—
C37	Story 14 TO Story 15	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.132	0.218	0.42	10-T12	T10 @ 175	—
C45	Base TO Plinth Level	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C45	Plinth Level TO Ground Floor	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C45	Ground Floor TO Story 1	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C45	Story 1 TO Story 2	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C45	Story 2 TO Story 3	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C45	Story 3 TO Story 4	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.975	0.96	3.83	12-T28 + 6-T25	T10 @ 300	—
C45	Story 4 TO Story 5	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.974	0.952	3.10	12-T28 + 2-T25	T10 @ 300	—
C45	Story 5 TO Story 6	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.967	0.951	2.41	12-T25 + 2-T20	T10 @ 300	—
C45	Story 6 TO Story 7	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.936	0.924	1.89	4-T25 + 10-T20	T10 @ 300	—
C45	Story 7 TO Story 8	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.949	0.94	1.04	14-T16	T10 @ 250	—
C45	Story 8 TO Story 9	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.925	0.907	0.42	10-T12	T10 @ 175	—
C45	Story 9 TO Story 10	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.793	0.642	0.42	10-T12	T10 @ 175	—
C45	Story 10 TO Story 11	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.661	0.362	0.42	10-T12	T10 @ 175	—
C45	Story 11 TO Story 12	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.529	0.319	0.42	10-T12	T10 @ 175	—
C45	Story 12 TO Story 13	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.397	0.277	0.42	10-T12	T10 @ 175	—
C45	Story 13 TO Story 14	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.264	0.229	0.42	10-T12	T10 @ 175	—
C45	Story 14 TO Story 15	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E	0.132	0.217	0.42	10-T12	T10 @ 175	—
C53	Base TO Plinth Level	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C53	Plinth Level TO Ground Floor	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C53	Ground Floor TO Story 1	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C53	Story 1 TO Story 2	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						
C53	Story 2 TO Story 3	450 X 600	M40 : Fe500 : Fe415	Non-Ductile	COL - E						

Fig 39. Reinforcement Data of Column in RCDC

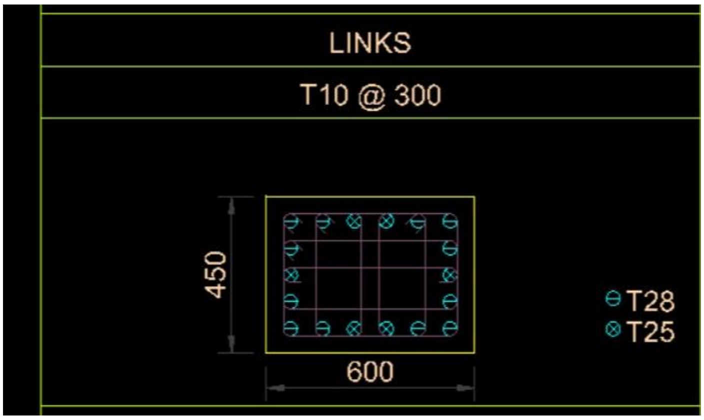


Fig 41. **Cross section details at Ground Story of central column**

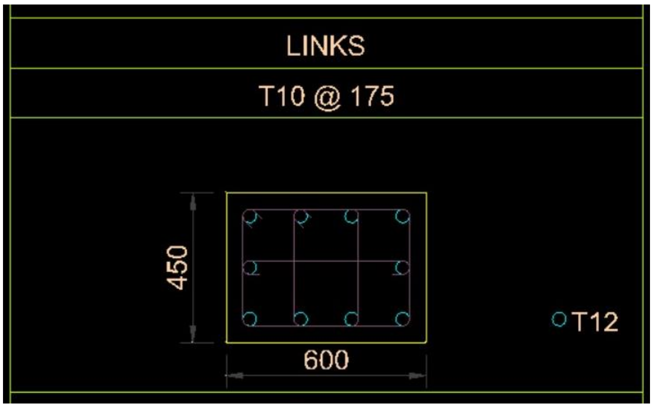


Fig 42. **Cross section details at Story 15 of central column**

From the above we can note that at Ground Story column consists of 12 Nos Dia 28 and 8 Nos Dia 25 with Dia 10 Ties @ 300 mm c/c spacing

At the Story 15 column consists of 10 Nos Dia 10 bars with Dia 10 ties @ 175 mm c/c spacing.

BILL OF MATERIALS: FLOOR SLAB

SR. NO.	ITEM	QUANTITY	UNIT
1	TOTAL AREA, A	25,200.00	SQ M
2	TOTAL VOLUME, V	3,780.000	CU M
3	AVERAGE THICKNESS, T=V/A	150	MM
4	TOTAL REBARS WEIGHT, W	2,50,870	KG
5	REBARS PER AREA, W/A	9.955	KG/SQ M
6	REBARS RATIO, W/V	66.3678	KG/CU M

Fig 43. Bill of Materials for slab from Csi Detailing

BOQ SUMMARY

Project Name: Unassigned

Element : Slab

No.	Material	Unit	Quantity
1	Concrete M40	(cum)	208.33
	Sub Total		208.33
2	Rebar T12 (Fe500)	(kg)	15122.82
	Sub Total		15122.82
3	Shuttering	(sqm)	1388.84
	Sub Total		

Fig 43. Bill of Materials for slab from RCDC

From above we can see the bill of quantities for the total slabs from Csi Detailing and from RCDC

VI. CONCLUSIONS

1. From this study we can conclude that, the Csi detailing software is widely useful when the analysis and design of framed structure is done in Etabs.
2. The RCDC software creates difficulty while importing the same Etabs file in RCDC for reinforcement detailing and for each detail of slab beam at different floor we have to do it separate for each time.
3. The influence of worst case on structure on the seismic response of multi-storied buildings played a major role in getting the Maximum story displacement and story drift the RC structure to verify against the collapse deformation.
4. This study indicates that Detailing of reinforcement is much sorted interms of size of bar and the centre to centre spacing for stirupps and ties and for the slab reinforcement bars.
5. From this study we noted that along with the reinforcement detailing we can get the quantity estimation of materials used in the structure from both the softwares, but we can say Csi Detailing gives the sheets and the schedules along with the estimation with much clearer than RCDC.

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