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An Earthquake Analysis of a Multi-Story Residential Building

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ABSTRACT:

In Zone-III and Zone-V, the top storey is more displaced based on the two evaluations. Compared to Zone-III, Zone-V has a greater value in terms of storey displacement.
The fifth-level EQX load case's time history approach exhibits the largest degree of storey drift.
When exposed to RSZ, Zone-6th III's and 7th floors show the most storey drift. The RSX building's fourth through ninth levels include it. In the 4th to 11th and 3rd to 12th levels for Zone-X and RSX, respectively, the maximum storey drift can be seen.
The ground receives the most shear whether employing the response spectrum or time history methods. When looking at this As a clear evidence, Zone-V outperforms Zone-III. Structural seismic analysis employs response spectrum analysis. Seismic research was performed on the G+15-story residential building situated in zone II. With the help of STAAD.PRO software, the whole structure was evaluated. we saw a decrease in the reaction time of instances of ordinary moment resistant frames and special moment resisting frames in both static and dynamic analyses. Seismic loads are well-resisted by the particular moment of the resisting frame construction.
Equivalent static analysis, response spectrum analysis, ordinary moment resisting frame, special moment resisting frame, STAAD.PRO V8i.

INTRODUCTION

People are now confronted with issues related to land shortage and rising land prices. It was unavoidable that multi-story structures would have to be built for both residential and commercial uses because of population growth and the industrial revolution. The lateral force resistance of the high elevated buildings is inadequate due to their faulty design. A structure's collapse might occur as a result of this. A number of considerations go into the construction of earthquake-resistant buildings. These include the structure's The structure should be able to resist earthquakes equal to DBE without significant structural damage though some non-structural damage may occur.
The structure should withstand an earthquake equal to MCE without collapse.

inherent frequency, damping factor, kind of base, significance of the building, and the structure's ductility and flexure. Because of their improved moment distribution, ductile structures need less lateral load design. Response reduction factor R is used to address this issue for various types of structures. The building is built as an SMRF for maximum efficiency. It simply has to be built for forces smaller than those for which an OMRF would be required.

MOMENT RESISTING FRAME:

The frame whose member and joints resist the forces primarily caused by flexure is Moment resisting frame.

Ordinary Moment Resisting Frame: The moment resisting frame which are designed without any special attention towards ductile nature of the frame are called ordinary moment resisting frames.

Special Moment Resisting Frame: The moment resisting frame which are designed to have ductile nature are called as special moment resisting frames. The design is done according to the requirements specified in IS-13920.
The earthquake resistant designs of structures are considering the following magnitudes of a earthquake.

Design Basis Earthquake (DBE): The earthquake whose probability of occurrence is at least one during the structure design life is called design basis earthquake.

Maximum Considered Earthquake (MCE): The earthquake whose expected intensity is maximum that can occur in a particular area or region is called maximum considered earthquake. The maximum values are considered as per code.

The design approach recommended by IS: 1893-2002 is based on the following principles (clause 6.1).

METHODS OF ANALYSIS

Equivalent Static Analysis:
This method is only one of several that may be used to compute seismic loads. There are no high-rise structures included in the basic static design approach.

The foundation of a structure is dependent on many different factors, many of which are not taken into consideration by this theory. The same static analysis is used to design small structures. In this approach, just one mode is employed for each compass direction. Static earthquake-resistant design is all that is needed for low-rise structures. Additional modes and the mass of each level are needed to design earthquake-resistant loads for tall structures. In the case of high-rise structures, dynamic analysis should be used instead of this method.

Response Spectrum Analysis: Seismic forces will cause the foundation of a building to shift with the earth's movement. Ground motion is often smaller than structures, as seen by this data. Structure's mobility in relation to the ground is rejected as a source of dynamic amplification. Vibration frequency, dampening, the kind of foundation, and the manner of structural details are all factors to take into consideration. The spectral acceleration coefficient Sa/g is the greatest acceleration that occurs when an earthquake occurs at the foundation of a structure with a certain damping ratio. Cause and effect links may be evaluated using a modified IS 1893-2002 dynamic response spectrum. All five of a structure's most important technical elements are taken into consideration in this method. T in seconds, the natural frequency of the building (T in seconds) II. The dampening properties of the structure. There are a slew of factors to consider throughout the building process, including: In addition to the kind of foundation and importance of the building, there is a "response reduction factor" (a measure of how ductile a structure is). The ZONE FACTORS FOR

DIFFERENT

ZONES IN INDIA

Zone	Seismic coefficient of 1984	Seismic zone factor (z of 2002)
V	0.08	0.36
IV	0.05	0.24
III	0.04	0.16
II	0.02	0.1

Table.1 Seismic Zone factors

MODAL GENERATION AND ANALYSIS:

We envisioned a three-story home with G+15 floors on the y-axis. The 15 floors above the ground were all 3m in height. The base of the structure's supports were likewise stated to be fixed. Is 875 Part-1 and Part-2 requirements dictated the self-weight, dead load, and live load values for the structure. Based on the specifics of IS 875 part-3, STAAD.PRO developed the wind load estimates that were based on the specified wind intensity at various heights. IS 1893-2002 part-1 was used to calculate the seismic loads for both static and dynamic analyses.

Fig.1 column positions

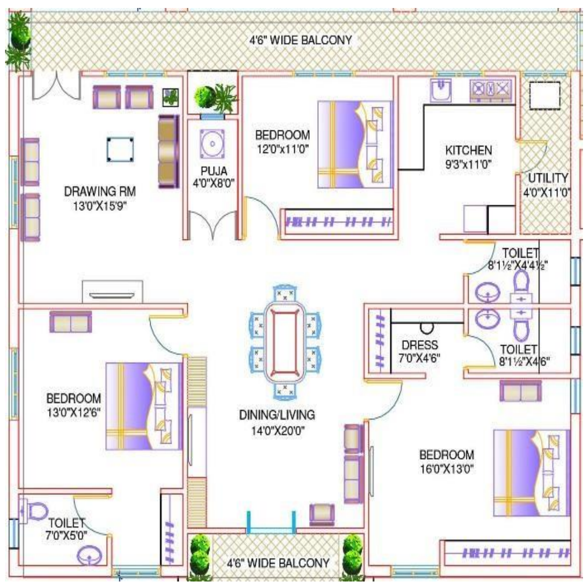

Fig.2 plan of residential building

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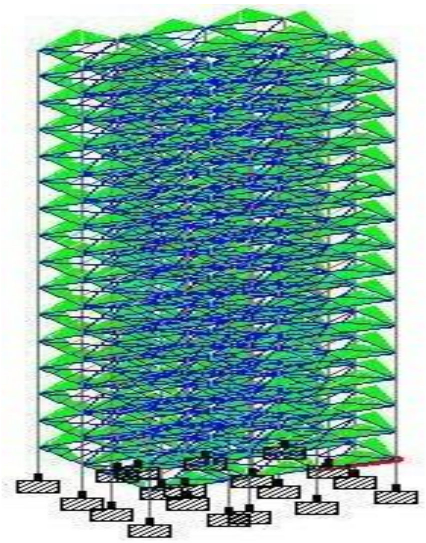

Fig.3 Live load assigned in structure

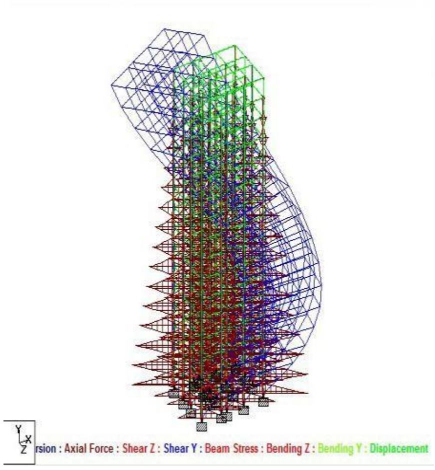

Fig.4 axial force, shear force, torsion anddiplacement

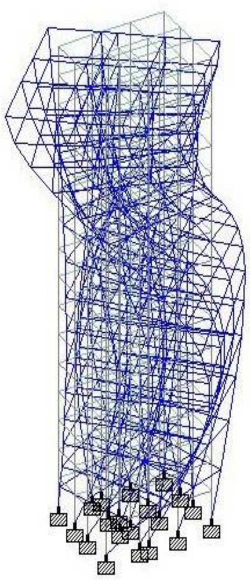

Fig.5 mode shape in dynamic analysis

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Table 2. Axial forces in Static Analysis

Static Analysis			
		Axial Force KN	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	3537.0	3916.4
99	1 EQ+X	3339.8	3663.0
162	1 EQ+X	3127.8	3409.7
225	1 EQ+X	2908.8	3156.5
288	1 EQ+X	2685.0	2903.6

Table 3. Torsion in Static Analysis

Static Analysis			
		Torsion KNm	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	-0.617	-0.059
99	1 EQ+X	-1.520	-0.059
162	1 EQ+X	-1.587	-0.059
225	1 EQ+X	-1.643	-0.059
288	1 EQ+X	-1.658	-0.058

Table 4. Bending Moment in Static Analysis

Static Analysis			
		Bending moment-Z KNm	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	148.74	53.143
99	1 EQ+X	100.59	52.919
162	1 EQ+X	85.92	52.592
225	1 EQ+X	84.28	52.094
288	1 EQ+X	84.29	51.357

Table 5. Axial forces in Dynamic Analysis

Dynamic Analysis			
		Axial Force KN	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	3541.9	4148.1
99	1 EQ+X	3336.8	3707.3
162	1 EQ+X	3117.2	3440.5
225	1 EQ+X	2894.1	3177.1
288	1 EQ+X	2669.2	2917.4

Table 6. Torsion in Dynamic Analysis

Dynamic Analysis			
		Torsion KNm	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	1.090	2.659
99	1 EQ+X	2.484	2.660
162	1 EQ+X	2.238	2.580
225	1 EQ+X	2.535	2.473
288	1 EQ+X	2.633	2.634

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Table 7.Bending Moment in Dynamic Analysis

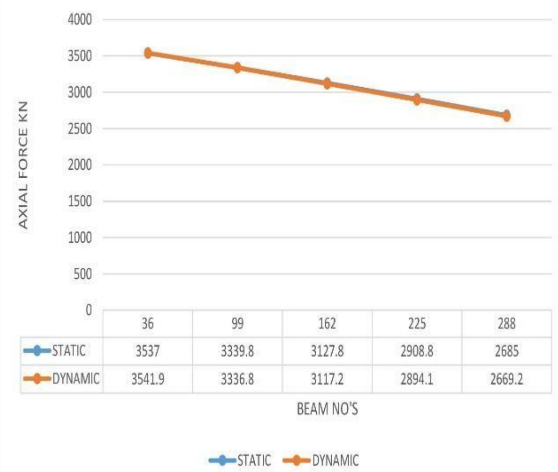
Dynamic Analysis			
		Bending moment-Z KNm	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	154.739	70.313
99	1 EQ+X	102.290	64.390
162	1 EQ+X	75.819	62.310
225	1 EQ+X	72.649	59.564
288	1 EQ+X	71.408	56.376

Table 8. Displacement X-trans in Static Analysis

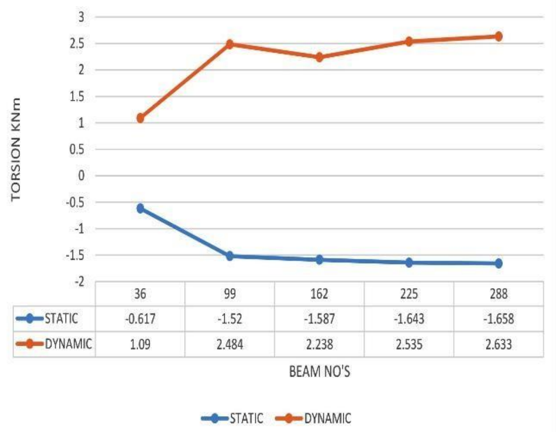
Static Analysis			
		Displacement X-Trans	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	1.849	0.456
99	1 EQ+X	13.455	2.107
162	1 EQ+X	26.684	4.433
225	1 EQ+X	39.456	7.025
288	1 EQ+X	50.163	9.624

Table 9. Displacement X-Trans in DynamicAnalysis

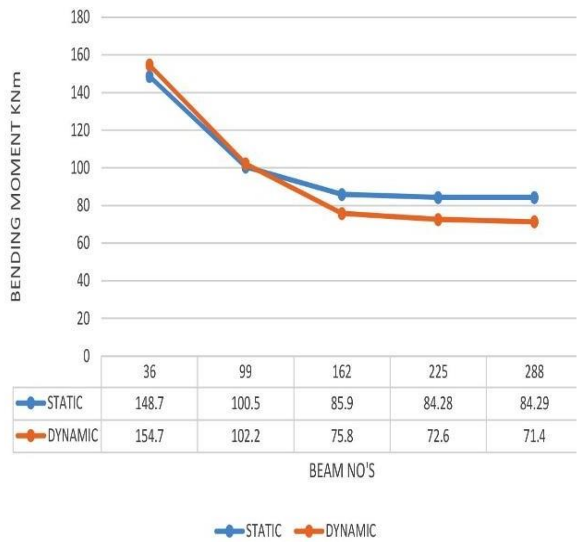
Dynamic Analysis			
		Displacement X-Trans	
BEAM	L/C	OMRF	SMRF
36	1 EQ+X	1.907	0.534
99	1 EQ+X	12.938	2.622
162	1 EQ+X	24.765	8.984
225	1 EQ+X	32.877	12.854
288	1 EQ+X	39.790	15.132



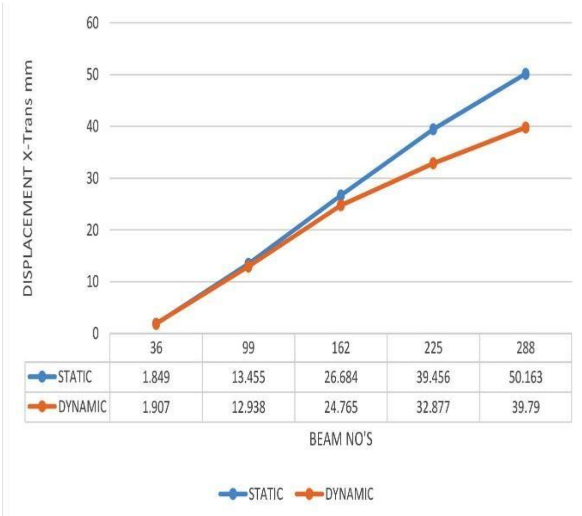
Graph 1. Static &dynamic analysis of axial forces in OMRF



Graph 2.static & dynamic analysis of Torsion in OMRF



Graph 3. Static & dynamic analysis of Bending Moment in OMRF



Graph 4. static&dynamic analysis of Displacement in OMRF

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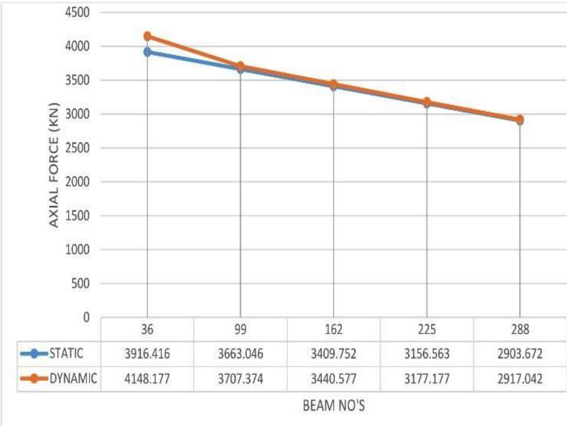
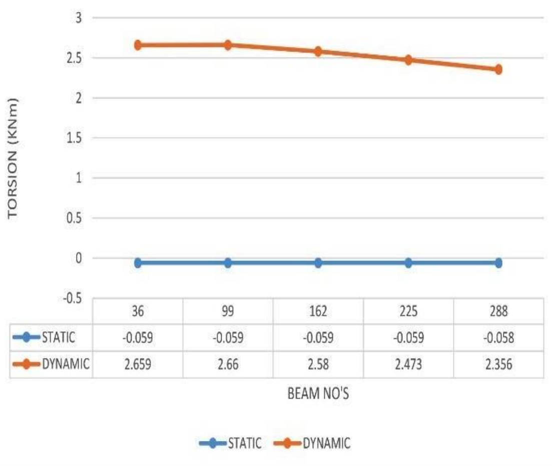
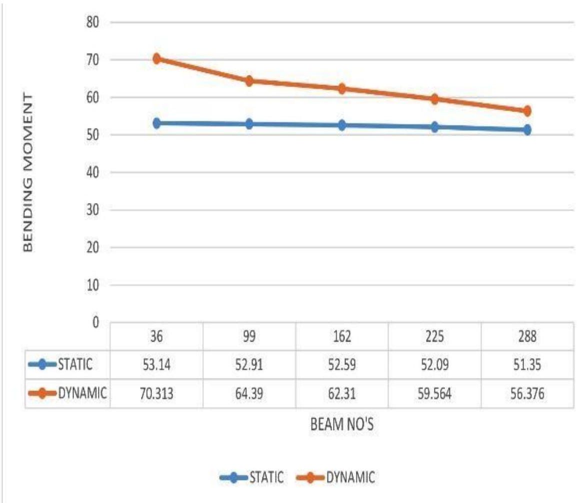


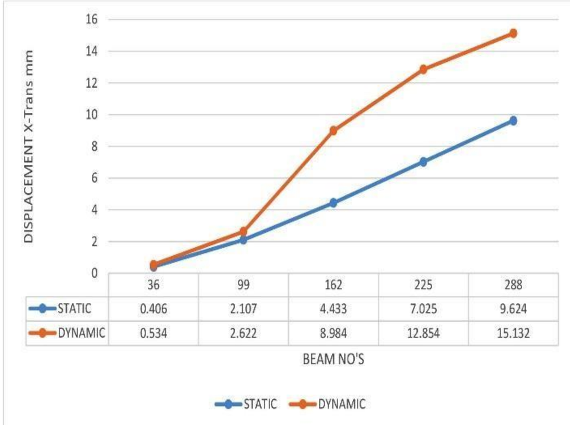
Graph 5. Static & dynamic analysis of Axial forces in SMRF



Graph 6. Static & dynamic analysis of Torsion in SMRF



Graph 7. Static & dynamic anlysis of Bending Moment in SMRF



Graph 8. Static & dynamic analysis of Displacement in SMRF

CONCLUSION:

The OMRF and SMRF results for several columns under axial, torsion, bending moment, and displacement forces are compared. According to graph-1, both static and dynamic examinations of the OMRF structure yielded similar results. For example, a graph-2 shows that static torsion values are negative, but dynamic torsion values are positive. Dynamic analysis yields more bending moments than static analysis does in this case, as seen in graph 3. However, this reduces with time for other columns. According to graph-4, OMRF values in static analysis indicate more displacement than in dynamic analysis.
The results of graph-5 reveal that dynamic analysis of the SMRF structure provides larger axial force values than static analysis. It is clear from graph 6 that dynamic analysis generates positive torsion values rather of negative values, but static analysis provides negative torsion values. Dynamic SMRF structures have larger bending moment values than static SMRF structures, according to Graph 7. In graph-8, the displacement values for SMRF values in dynamic analysis are shown to expand with time, compared to static analysis values of the same columns.
When it comes time to analyse data, both static and dynamic methods are used. Using static and dynamic analysis, the static analysis results are much lower than the dynamic analysis results. To put it another way, SMRF buildings designed using dynamic analysis can survive earthquakes far better than those designed using static analysis.

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