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MACHINE LEARNING-BASED INVESTIGATION ON SEISMIC ANALYSIS OF A G+12-STORY BUILDING BY USING ETABS SOFTWARE WITH A SHEAR WALL: RESPONSE SPECTRUM ANALYSIS

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ABSTRACT
Globally, nowadays the population is growing increasingly, and engineers are focusing on constructing high-rise buildings. High-rise buildings should resist the lateral loads like earthquake and wind loads. Earthquakes are commonly occurring worldwide, releasing an immense amount of energy, which shows the impact on high-rise buildings that move laterally. To avoid these, high-rise buildings are designed by providing shear walls. In the present study is analyzing a G+12 building by providing it without and with a shear wall by using response spectrum analysis in ETABS software. A shear wall is a vertical cantilever beam that resists the lateral loads like seismic load. The main objective of this study is to examine the structural vulnerable factors such as story drift and story displacement. The analysis is carried out by considering seismic zone IV, which has a zone factor of 0.24, and the soil type is medium. IS 1893:2016 guidelines are used for response spectrum analysis. The random forest regressor outperformed other models in terms of accuracy in forecasting and generalization faults for important structural characteristics. ETABS evaluation found that story height and shear wall layout and RSA were the most relevant factors, supporting standard building engineering concepts. In the present study obtained R2=1 in two cases, then this investigation concludes that the best fitting for machine learning model.

KEYWORDS: Storey displacement, Storey drift, Shear wall, Response spectrum analysis, Seismic load

1. INTRODUCTION

Earthquakes occur when enormous amount of energy is released from deep under the earth's crust, causing the surface to shake or vibrate quickly. This kind of energy transfer is mostly caused by human activity like as quarrying and reservoir-induced earthquakes, as well as the movement of continental plates and lava flows [2]. Earthquakes are one of the naturally occurring most significant hazards to life on Earth, caused by an intense release of energy under the ground. It is a natural disaster that causes shaking of the earth's surface and all living and non-living objects [4]. Vibrations triggered by the discharge of energy from a substance on the surface can cause death and structural damage. Earthquakes may differ in intensity and magnitude, so it's necessary to assess the earthquake response of RC structures for several variables, such as story displacements and story drift [4].

Nowadays, population increases rapidly and there is a scarcity of land to reduce this problem engineers are introduced high rise buildings for the purpose of residential, office works, commercial building, hotels etc. for the safety of high rise building we must design in order to withstand lateral loads, such as seismic and wind loads. Structural engineers aim to reduce lateral stresses and increase stiffness by providing earthquake resistant structures. Shear walls provide strength and rigidity to structures during earthquakes by absorbing lateral stresses. Seismic analysis of multi-storey structures is accomplished using linear and nonlinear techniques. Shaik Akhil Ahamad and K.V. Pratap (2021) studied “Dynamic analysis of a G + 20 multi-storied building by using shear walls in various locations for different seismic zones by using Etabs.” This study explores the application of shear walls in a G + 20 high-rise residential building and examines their performance during earthquakes using the response spectrum method. The multi-story building with G+20 is analyzed for story drift, base shear, the maximum permissible displacement, and torsion irregularity. They found that maximum displacements and drift between floor values are higher in seismic zone V for all three scenarios, A, B, and C, than in zones II, III, and IV, indicating that displacement can be minimized by building the structure with uniform stiffness [5].Srimurthi Saikumar and Nanditha Mandava (2022) investigated “Comparative analysis of earthquake-resistant building design by considering bracings and shear wall system in ETABS software.” Their study reveals that bracing and shear walls are often employed for developing earthquake-resistant constructions due to their simple building style and quick installation on-site. Based on considerations, both bracing systems and shear wall systems reduce building deflections. In the earlier study, a G+12 building is modeled using the ETABS model, and the analysis is carried out using the response spectrum method. Results such as story drift, story shear, story bending, time period, and frequency were investigated for building models constructed with steel bracings and shear wall systems [6].

Gourav B N et al., (2021) "Analysis of high-rise structures in different seismic zones for soil type 1" They used ETAB software and response spectrum analysis to examine the impacts of soil type I on various seismic zones in a G+29-story high-rise building. The response spectrum evaluates model behavior across four seismic zones (Zones II, III, IV, and V). It takes into account factors such as base reactions, story drift, time period, and story stiffness [8]. Mindala Rohini et al. (2019), They used ETAB's response spectrum and time history methods to determine the earthquake reaction of a (G+15)-story residential building in zones III and V. Research results indicate that zone V has a greater value of story displacement than zone III. Both the response spectrum and time history analysis indicate the highest story shear originates at the ground. Zone V has a better value than Zone 3 [9]. Vijay Kumar and Dinesh Sen (2020) investigated "Seismic Analysis of High-Rise Building (G+10) using Etabs." In today's housing industry, the structures being built have become larger, especially those that offer the most efficient and cost-effective results. These structures are supported by components such as beams and columns in multi-story reinforced concrete (R.C.) buildings. The software is primarily used for high-rise buildings and concrete and steel buildings. The objective of this research is to investigate high-rise structures with (G+10) floors by taking into account seismic, dead, and imposed loads. The main criteria for high-rise structures are strength, functionality, and stability; they are mostly concerned with identifying the effects of lateral loading on moments, shear force, base shear, axial force, maximum displacement, and tensile forces on structural systems, as well as comparing the results of earthquake zones 3, 4, and 5[10].Lingeshwaran et al., (2021)"A study on seismic analysis of high-rise building with and without floating columns and shear wall" They examined the dynamic model of G + 9 multistory buildings belonging to RCC, considering the Bhuj Earthquake on January 26, 2001, is finished by time history research with the support of ETABS. The floor displacement, base shear, and inter-story drift are determined for an overview of both structures with and without floating columns. This research emphasizes the relevance of adding a floating column as well as the usage of a shear wall in community buildings. They considered three separate examples and, in brief, compared the results produced using both the time history and response spectrum methodologies [11].
The current examine represents a G + 12 building using the ETABS software program and analyzes it using Response spectrum analysis. Earthquake resistance is an important technology for designing structures and buildings to minimize damage. Shear walls, bracings, dampers, column jacketing and base isolation appliances are all likely to lower damage rates. Shear walls are more effective than other alternatives because they are easy to design and install on construction locations [1, 7].

Objectives of the study

This study aims to examine the structure of the G+12 building regarding story drift and story displacement using ETABS. To understand the structure by using Response spectrum analysis.

2. METHODOLOGY

Earthquake analysis methods

The seismic analysis involves understanding how ground motion affects buildings and predicting their reaction [1].
The dynamic modeling of high-rise and irregular structures is conducted in accordance with the IS 1893:2016 code. Within this framework, the time history and response spectrum methods are categorized as dynamic models [1]. This study focuses on a G+12 building analyzed using response spectrum analysis in ETABS tool.

Response spectrum analysis

Response-spectrum model is a widely used method that demonstrates the maximum structural response at various times based on a ground motion record and specified damping levels. The Response Spectrum is a curve which represents the maximum displacement, velocity, and acceleration versus the natural frequency of a single-degree-of-freedom system [3,4]. This approach is essential for building structures that resist dynamic stresses. It helps engineers to pinpoint the most highly vulnerable periods that will require special attention during design. In this study considered the data and analyse the building as per IS 1893:2016 (part1) codal provisions [4].
The technique considers various types of responses; for each type, the reaction is derived from the developed spectrum using modal frequency and modal mass. The responses of a few models are combined to estimate the structure's overall response by applying modal combination techniques such as complete quadratic combination (CQC) and square root of sum of squares (SRSS). This research project used a regular plan [1].

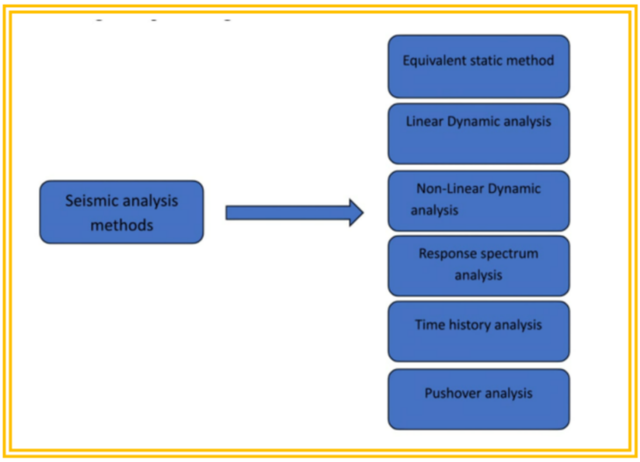


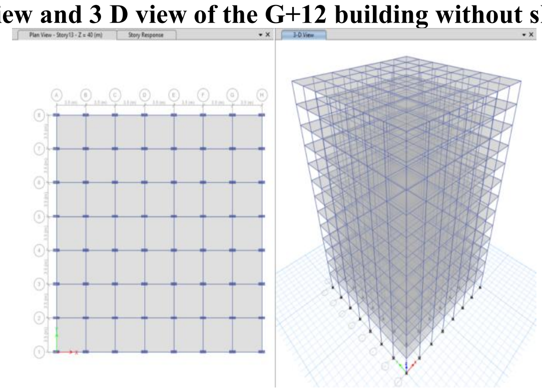
Figure 1. Earthquake analysis methods

Shear wall
Shear walls play a vital role which enhances the stability and stiffness of a building. Shear walls are vertically stiffening includes that endure the lateral stress, such as quake and wind load effects. Shear walls have already been widely implemented in medium and high-rise constructions during the last two decades, and they especially significant for tall structures, as they are prone to lateral stresses. Shear wall thickness varies from 140 to 500 mm. Shear walls commonly have various types of cross sections, includes rectangular and irregular shapes such as L, T, C, and U [2].

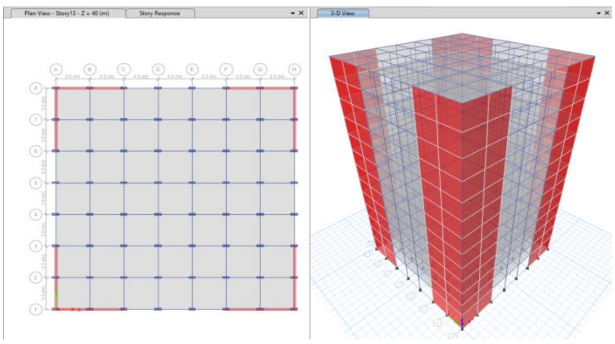
Properties of building

Building height	40 m
Type of structure	G+12 RC building
Material properties	
Concrete grade	M-35
Steel grade	Fe-500
Column size	300×750 mm
Beam size	300×450 mm
Thickness of slab	150 mm
Shear wall thickness	200 mm
Frame system	Special RC Moment resisting frame
Earthquake zone	IV
Soil type	Medium
Zone factor	0.24
Importance factor	1
Damping ratio	5%
Response reduction factor	5.0
Support condition	Fixed
Building dimensions	
Ground floor height	4 m
Floor to floor height	3 m
Loadings	
Imposed Load	3.5 kN/m2
Dead load	2 kN/m2
Floor load	1 kN/m2
Density of concrete	25 kN/m3
Response Spectrum Modal combination	CQC and SRSS

a.Plan view and 3 D view of the G+12 building without shear wall



b. Plan view and 3D view of G+12 building with shear wall



3. RESULTS AND DISCUSSION

Story Drift: It is the horizontal movement of one floor in relation to another caused by lateral forces like earthquakes or wind is known as story drift and by using ETABS software getting drift numerical values are shown in Tables 3,4,7, and 8.

Story Displacement: It is the total lateral deflection of a story in a building relative to its base or foundation, caused by lateral forces like earthquakes or wind forces and by using ETABS software getting displacement numerical values are shown in Tables 1,2,5, and 6.

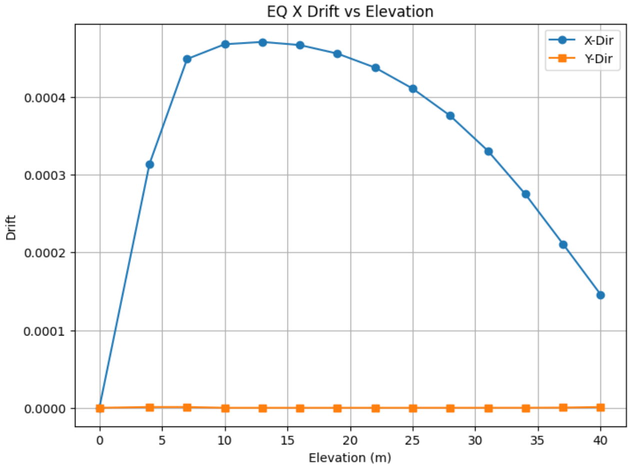


Fig.1 Story drift for EQ X.

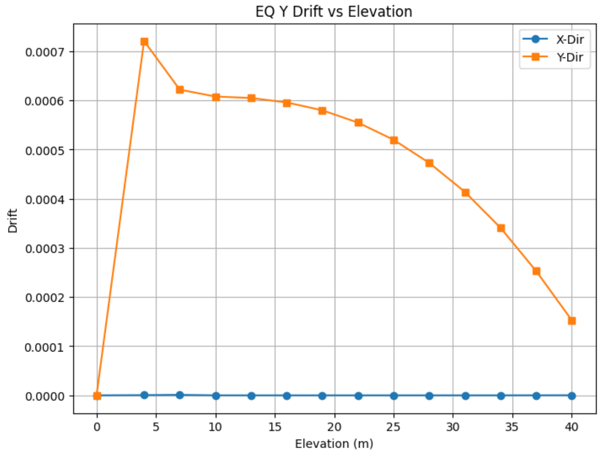


Fig.2 Story drift for EQ Y.

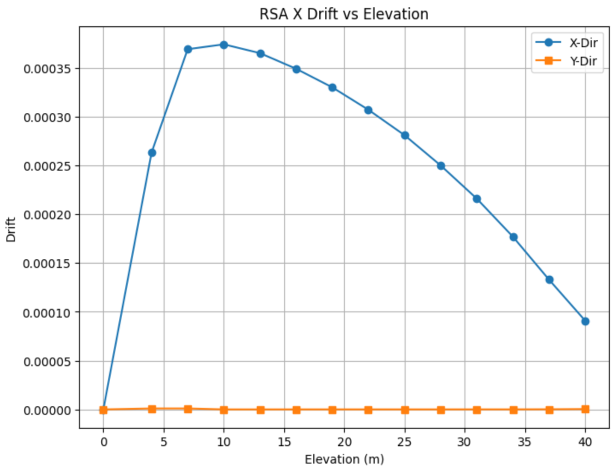


Fig.3 Story drift for RSA X.

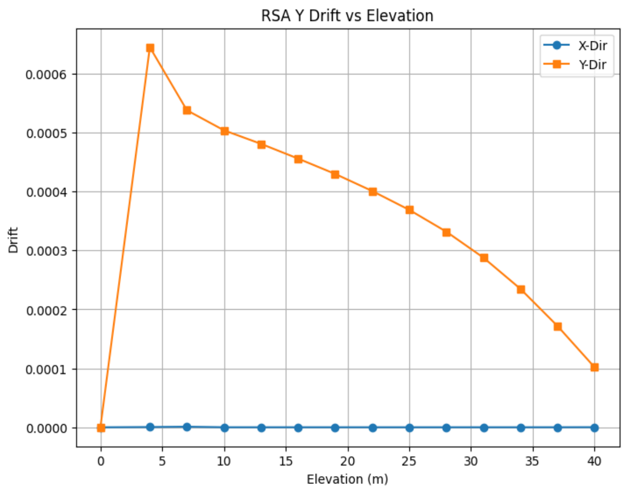


Fig.4 Story drift for RSA Y.

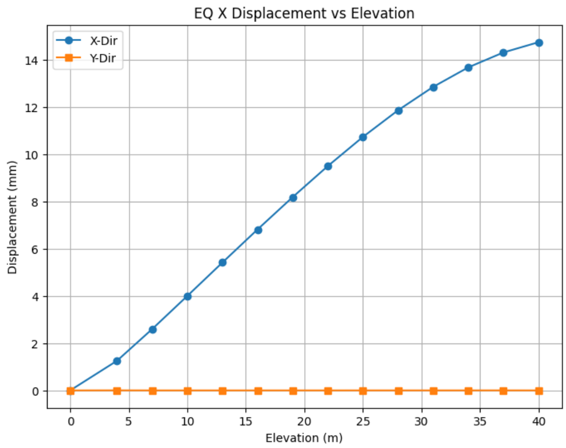


Fig.5 Story displacement for EQ X.

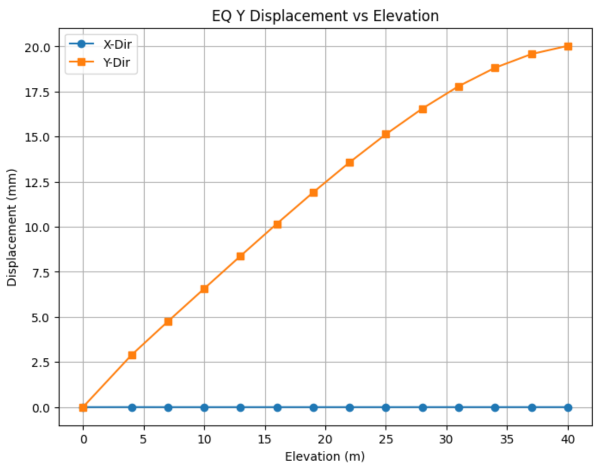


Fig.6 Story displacement for EQ Y.

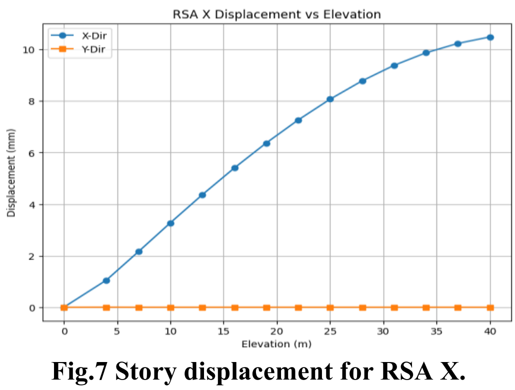


Fig.7 Story displacement for RSA X.

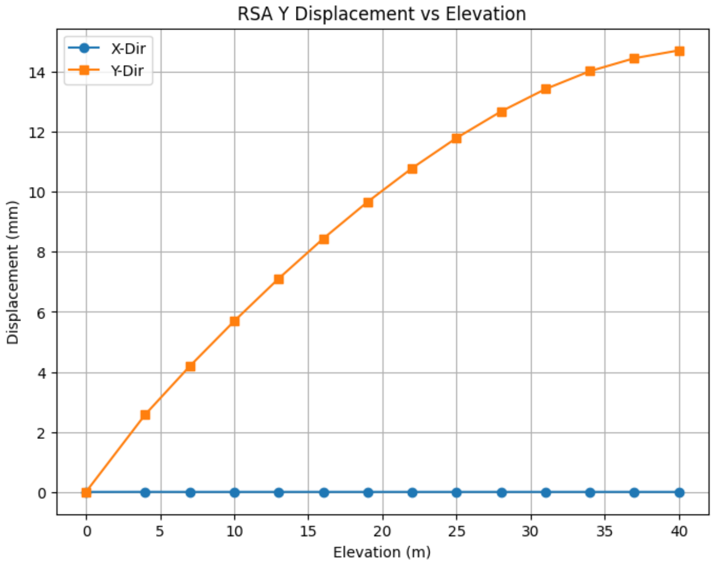


Fig.8 Story displacement for RSA Y.

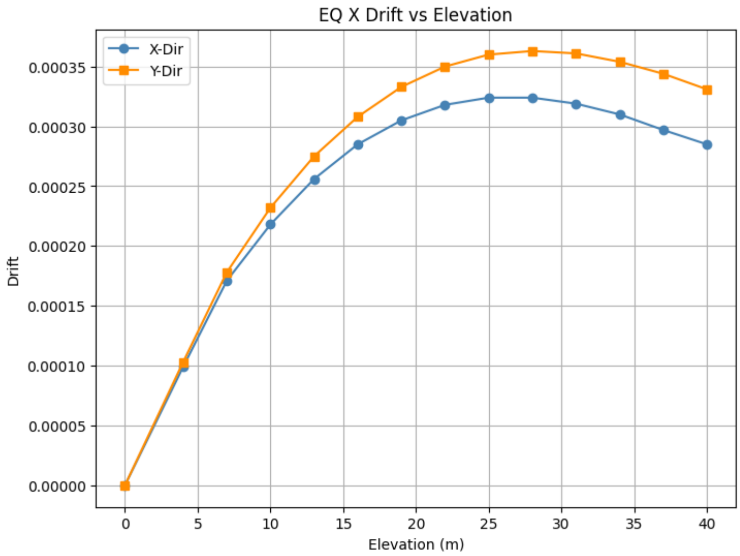


Fig.9 Story drift for EQ X.

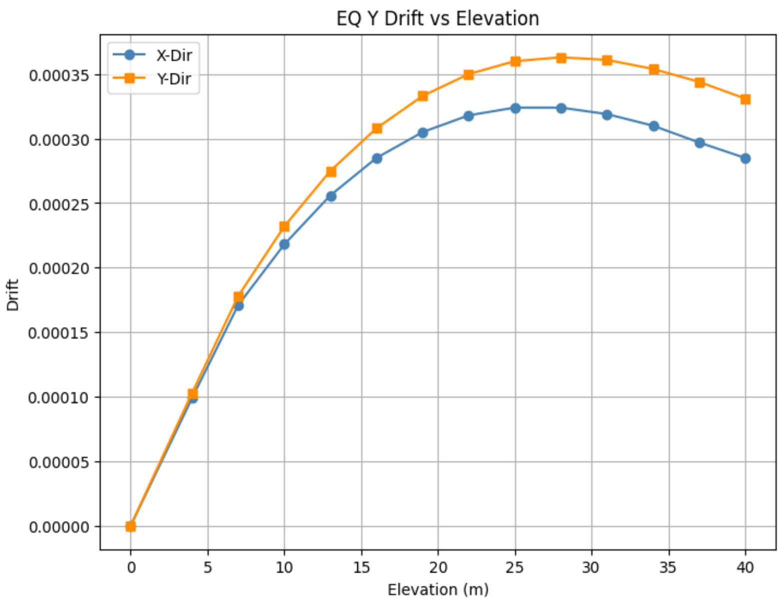


Fig.10 Story drift for EQ Y.

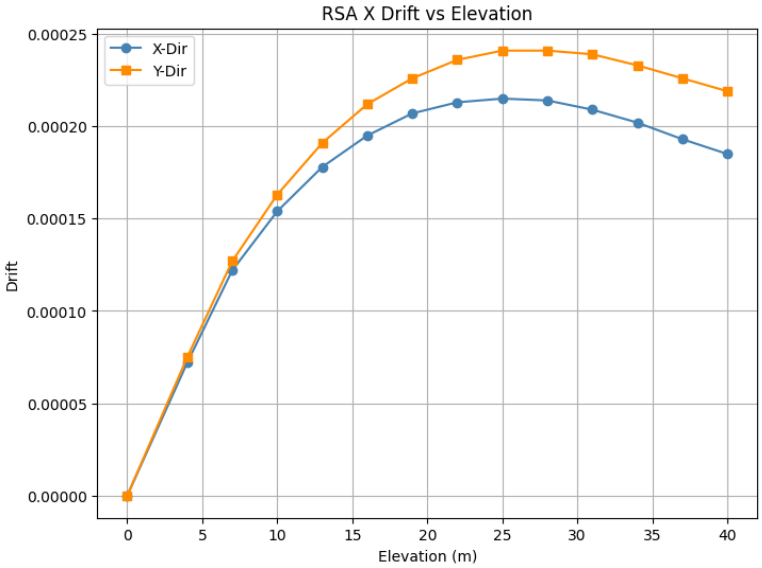


Fig.11 Story drift for RSA X.

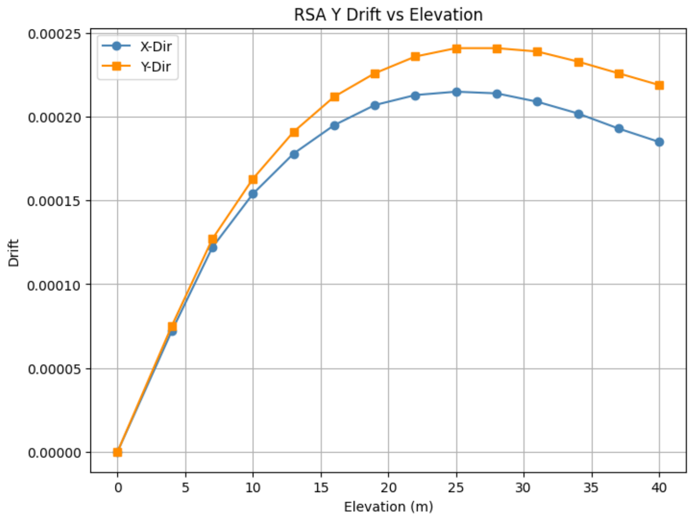


Fig.12 Story drift for RSA Y.

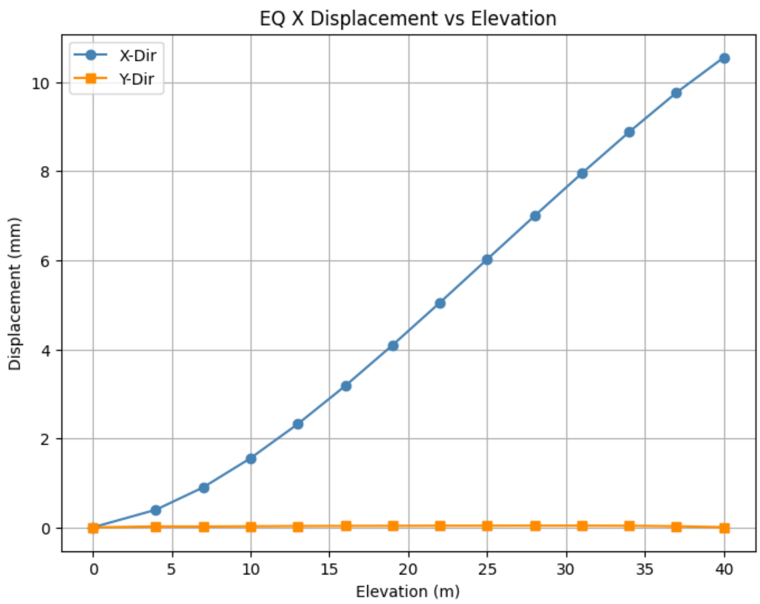


Fig.13 Story displacement for EQ X.

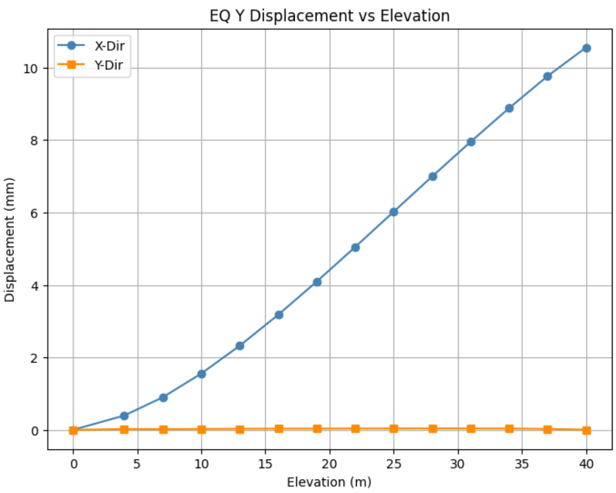


Fig.14 Story displacement in EQ Y.

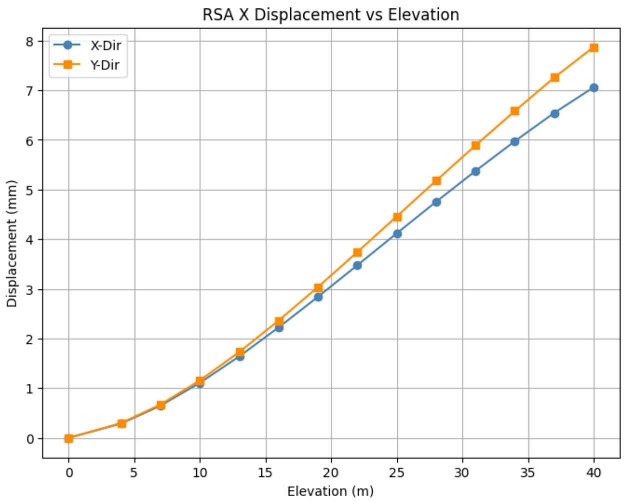


Fig.15 Story displacement for RSA X.

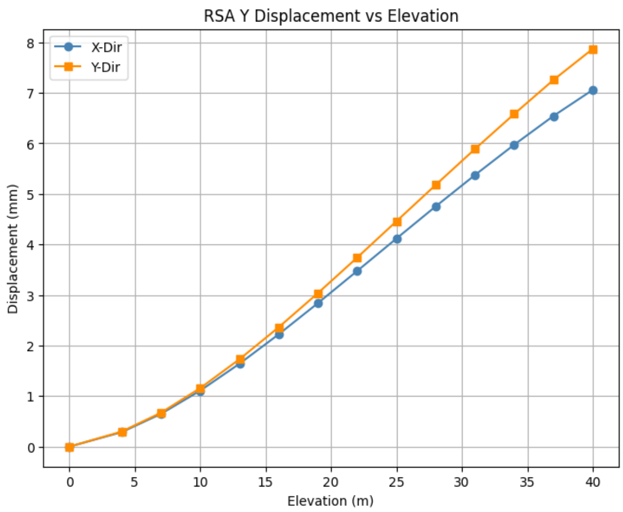


Fig.16 Story displacement for RSA Y.

Fig.1 the story drift for seismic load in X-direction observed as 0.000471 is maximum story drift occurred at story 4 and minimum at base because base is fixed for the case of G+12 building without shear wall. Fig.2, the story drift for seismic load in Y Direction the maximum story drift 0.000721 occurred at story 1 and minimum is at base. From Fig.3 the story drift for Response spectrum analysis in X (RSA X) direction the maximum story drift 0.000374 occurred between storey 2 and storey 4. Fig.4 the story drift for Response Spectrum Analysis (RSA Y) in Y Direction the maximum story drift 0.000645 located at story 1 and gradually decreases towards top story.

Fig.5, story displacement for seismic force in X direction the maximum story displacement 14.74 mm observed at story 13 and minimum is at base because mostly the building is fixed at base.Fig.6 story displacement for seismic force in Y direction the maximum story displacement 20.03 mm observed at story 13 and increases from bottom story to top story.Fig.7 story displacement for Response spectrum analysis in X-direction has slightly increased from bottom to top story and maximum story displacement 10.48 mm takes place at story 13 and minimum at base.Fig.8 story displacement for Response spectrum analysis in Y-direction the maximum story displacement 14.71 mm observed at story 13.

In case of G+12 building with shear wall the story drift and story displacements

Fig.9 the story drift for seismic force in X direction 0.000324 is the maximum story drift occurred story 9 and minimum is at base. In global Y direction the story drift is slightly varying in between story 1and story 2, story 12 and story 13. Fig.10 the story drift for seismic force in Y direction 0.000363 is the maximum story drift takes place at story 9 and in global X direction the story drift is varying between 1 and 2 story, 12 and 13 story. Fig.11 story drift for Response spectrum analysis in X direction 0.000215 is the maximum story drift occurred at story 8 in global X direction and in global Y direction the story drift is varying between story 1, 2 and story 12,13. Fig.12 story drift for Response spectrum analysis in Y direction 0.000241 is the maximum story drift located at story 9. Fig.13 story displacement for seismic force in X direction the maximum story displacement 10.55 mm observed at story 13 and minimum is at bottom is fixed. Fig.14 story displacement for seismic force in Y direction the maximum story displacement 11.70 mm is located at story 13. Fig.15 the story displacement for Response spectrum analysis in X direction 7.05 mm the maximum story displacement located at story 13 and zero at base. Fig.16 the story displacement for Response spectrum analysis in Y direction 7.86 mm is the maximum story displacement observed at story 13.

Figs. 17 and 18 represents a flow chart analysis for machine learning approach for three models and Random forest technique. Fig 19 shows that the training and testing analysis for Story Response RSA X displacement Actual vs predicted analysis for DT, RF, MLP and Story Response RSA Y displacement is presented in Fig 24. Figs. 20 and 25 represents a model comparison analysis among three models the best $R2=0.98$ DT algorithm provides best accurate than RF and MLP models. Figs. 21 and 26 shows that the representation Taylor diagram for three models. Figs. 22 and 27 demonstrates that the Analysis for Story vs Displacement. Figs. 23 and 27 shows that the curve fitting analysis in both cases were noticed that $R2=1.0$, then the study concludes that the best fit for Machine learning technique.

TABLE 1: Story Response RSA X displacement (Top=1).

Story	Elevation	Location	X-Dir	Y-Dir
	M		mm	mm
Story13	40	1	10.486	0.000349
Story12	37	1	10.235	0.001
Story11	34	1	9.87	0.001
Story10	31	1	9.383	0.001
Story9	28	1	8.78	0.001
Story8	25	1	8.07	0.001
Story7	22	1	7.263	0.001
Story6	19	1	6.37	0.001
Story5	16	1	5.399	0.001
Story4	13	1	4.363	0.001
Story3	10	1	3.274	0.001
Story2	7	1	2.154	0.000487
Story1	4	1	1.053	0.003
Base	0	1	0	0

TABLE 2: Story Response RSA Y displacement (Top=2).

Story	Elevation	Location	X-Dir	Y-Dir
	M		mm	mm
Story13	40	2	0.00045	14.711
Story12	37	2	0.001	14.451
Story11	34	2	0.001	14.02
Story10	31	2	0.001	13.423
Story9	28	2	0.001	12.676
Story8	25	2	0.001	11.793
Story7	22	2	0.001	10.786
Story6	19	2	0.001	9.664
Story5	16	2	0.001	8.436
Story4	13	2	0.001	7.109
Story3	10	2	0.001	5.69
Story2	7	2	0.000475	4.188
Story1	4	2	0.002	2.581

Base	0	2	0	0

TABLE 3: Story Response RSA X drift (Top=3).

Story	Elevation	Location	X-Dir	Y-Dir
	M			
Story13	40	3	0.000091	4.04E-07
Story12	37	3	0.000133	1.6E-07
Story11	34	3	0.000177	7.49E-08
Story10	31	3	0.000216	6.67E-08
Story9	28	3	0.00025	5.51E-08
Story8	25	3	0.000281	5.25E-08
Story7	22	3	0.000307	5.9E-08
Story6	19	3	0.00033	6.03E-08
Story5	16	3	0.000349	4.92E-08
Story4	13	3	0.000365	3.24E-08
Story3	10	3	0.000374	3.74E-08
Story2	7	3	0.000369	0.000001
Story1	4	3	0.000263	0.000001
Base	0	3	0	0

TABLE 4: Story Response RSA Y drift (Top=4).

Story	Elevation	Location	X-Dir	Y-Dir
	M			
Story13	40	4	1.96E-07	0.000102
Story12	37	4	9.27E-08	0.000172
Story11	34	4	7.35E-08	0.000235
Story10	31	4	7.07E-08	0.000288
Story9	28	4	7.18E-08	0.000332
Story8	25	4	6.61E-08	0.000369
Story7	22	4	6.74E-08	0.000401
Story6	19	4	6.58E-08	0.00043
Story5	16	4	5.99E-08	0.000456
Story4	13	4	6.9E-08	0.000481
Story3	10	4	7.94E-08	0.000504
Story2	7	4	0.000001	0.000538
Story1	4	4	4.36E-07	0.000645
Base	0	4	0	0

TABLE 5: Story Response RSA X displacement (Top=5).

Story	Elevation	Location	X-Dir	Y-Dir
	M		mm	mm
Story13	40	5	7.057	0.015
Story12	37	5	6.542	0.017
Story11	34	5	5.973	0.023
Story10	31	5	5.373	0.027
Story9	28	5	4.753	0.029
Story8	25	5	4.117	0.029
Story7	22	5	3.476	0.029
Story6	19	5	2.84	0.029
Story5	16	5	2.223	0.027
Story4	13	5	1.64	0.025
Story3	10	5	1.108	0.02
Story2	7	5	0.648	0.014

Story1	4	5	0.287	0.015
Base	0	5	0	0

TABLE 6: Story Response RSA Y displacement (Top=6).

Story	Elevation	Location	X-Dir	Y-Dir
	M		mm	mm
Story13	40	6	0.023	7.868
Story12	37	6	0.023	7.254
Story11	34	6	0.025	6.581
Story10	31	6	0.027	5.888
Story9	28	6	0.028	5.178
Story8	25	6	0.029	4.459
Story7	22	6	0.029	3.741
Story6	19	6	0.028	3.038
Story5	16	6	0.027	2.362
Story4	13	6	0.024	1.729
Story3	10	6	0.019	1.158
Story2	7	6	0.014	0.671
Story1	4	6	0.016	0.299
Base	0	6	0	0

TABLE 7: Story Response RSA X drift (Top=7).

Story	Elevation	Location	X-Dir	Y-Dir
	M			
Story13	40	7	0.000185	0.000006
Story12	37	7	0.000193	0.000003
Story11	34	7	0.000202	0.000002
Story10	31	7	0.000209	0.000001
Story9	28	7	0.000214	0.000001
Story8	25	7	0.000215	0.000001
Story7	22	7	0.000213	0.000001
Story6	19	7	0.000207	0.000001
Story5	16	7	0.000195	0.000002
Story4	13	7	0.000178	0.000002
Story3	10	7	0.000154	0.000003
Story2	7	7	0.000122	0.000003
Story1	4	7	0.000072	0.000004
Base	0	7	0	0

TABLE 8: Story Response RSA Y drift (Top=8).

Story	Elevation	Location	X-Dir	Y-Dir
	M			
Story13	40	8	0.000004	0.000219
Story12	37	8	0.000002	0.000226
Story11	34	8	0.000002	0.000233
Story10	31	8	0.000002	0.000239
Story9	28	8	0.000001	0.000241
Story8	25	8	0.000001	0.000241
Story7	22	8	0.000001	0.000236
Story6	19	8	0.000001	0.000226
Story5	16	8	0.000002	0.000212

Story4	13	8	0.000002	0.000191
Story3	10	8	0.000003	0.000163
Story2	7	8	0.000002	0.000127
Story1	4	8	0.000004	0.000075
Base	0	8	0	0

Table 9: Model estimation metrics for response spectrum analysis forecast.

S. No	Model	RMSE	MSE	MAE	R2
1	Random forest regressor	0.4219	0.1780	0.3858	0.9859
2	Decision tree regressor	0.9111	0.8301	0.8534	0.9344
3	Multi-layer perceptron	0.7699	0.5928	0.5995	0.9532

Machine learning model

Machine learning regression techniques are often employed to estimate complicated functional connections among the input factors and continuously generated outputs. Considering the several types of regression, Decision Tree Regressor (DTR), Random Forest Regressor (RFR), and Multi-Layer Perceptron Regressor (MLP-R) constitute three strong but essentially separate approaches that integrate versatility, resilience, and nonlinearity [12-14]. Table 9. Shows that model estimation metrics for response spectrum analysis forecast.

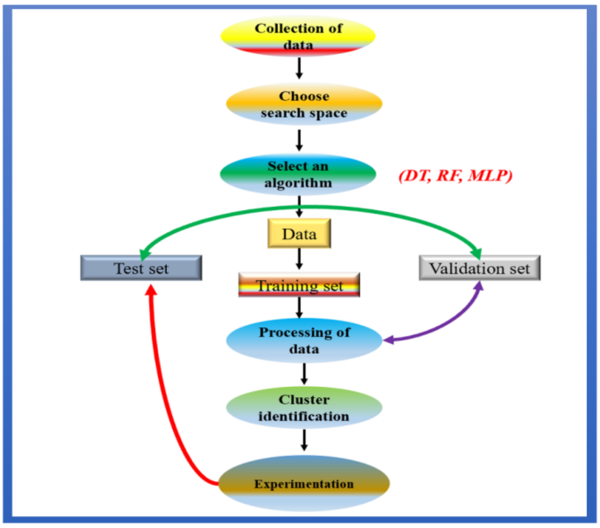


Fig 17. Flow chart for response spectrum analysis using machine learning (ML).

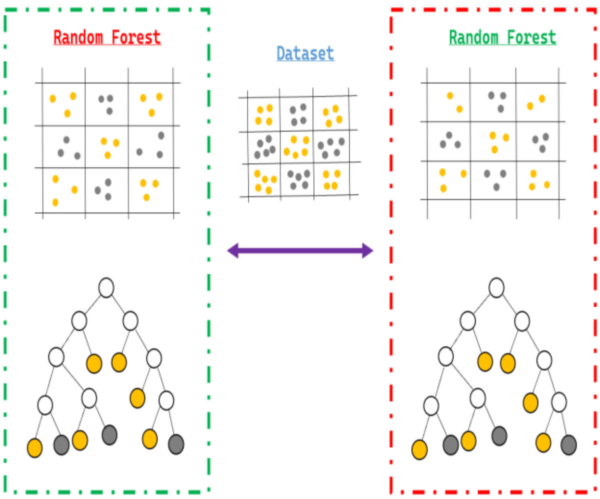


Fig 18. Flow chart of RF.

1. Random forest regression (RFR)

A Random Forest Regressor represents an integrated approach that builds numerous choice trees through bootstrapping samples and randomized choice of features. The final estimate is the mean across all trees, a feature that improves reliability and decreases excessive fitting.

2. Decision tree regression (DTR)

A DTR utilize an alternative method, iteratively splitting the data entered field based on characteristics, to decrease the MSE inside every subset that results. Decision trees, similar previous models, avoid using gradient descent. Instead, the model's variables are selected using greedy methods, which calculate the perfect division points and analysis purpose used below formulas.

$$J(\theta) = m_L MSE_L + \frac{m_r MSE_R}{Mm}$$

$$J(\theta) = \frac{\sum_{i=1}^{n}(y-\hat{y})^2}{2n} + \alpha\sum_{i=1}^{n}|\theta_i|$$

3. Multi-layer perceptron (MLR)

Neural networks capable of representing complicated, nonlinear relationships are known as multilayer perceptron's (MLPs). They have several levels of interconnected nodes, and every one of them has unique biases and weights. It is known as multilayer perceptron's (MLPs). The training was done by backpropagation, which is a kind of gradient descent changes variables by pushing mistakes backward via the network up. Cutting down on the MSE that exists between each network's results and actual values is the objective of the improvement process.

4. Performance indices

One may use a number of machine learning techniques to make predictions about shear, drift, and displacement but in the present study focused on displacement analysis only. In order to evaluate and contrast the predictive capabilities of machine learning models, four performance measures that are often used are the root mean square error (RMSE), the mean absolute error (MAE), the mean squared error (MSE), and the coefficient of determination (R2). In order to provide a comprehensive analysis of a model's functioning, each statistic offers a distinct perspective on the accuracy and efficiency provided by the model by using below formulas.

$$RSME = \sqrt{\sum_{i=1}^{n}\frac{(y-\hat{y})^2}{n}},$$

$$MAE = \sum_{i=1}^{n}\left|\frac{y-\hat{y}}{n}\right|,$$

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y-\hat{y})^2,$$

$$R^2 = 1 - \frac{\sum(y_i-\hat{y}_i)^2}{\sum(y_i-\bar{y}_i)^2}.$$

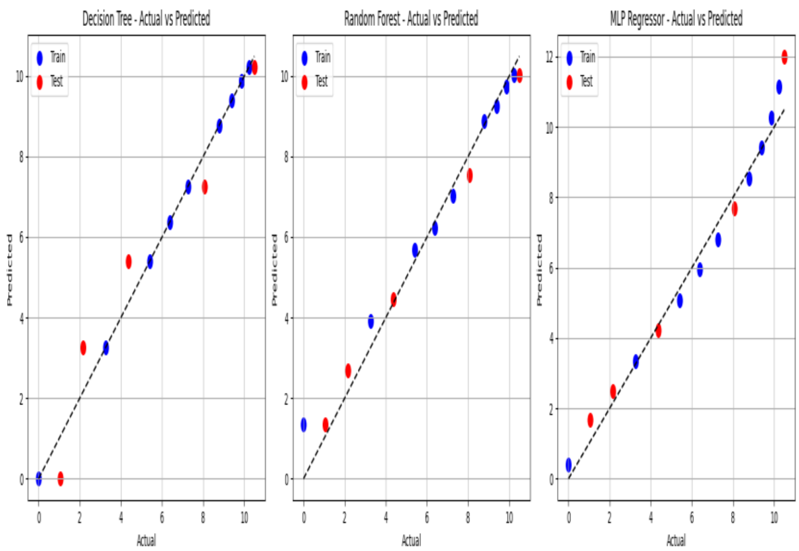


Fig 19. Actual vs predicted analysis for DT, RF, MLP.

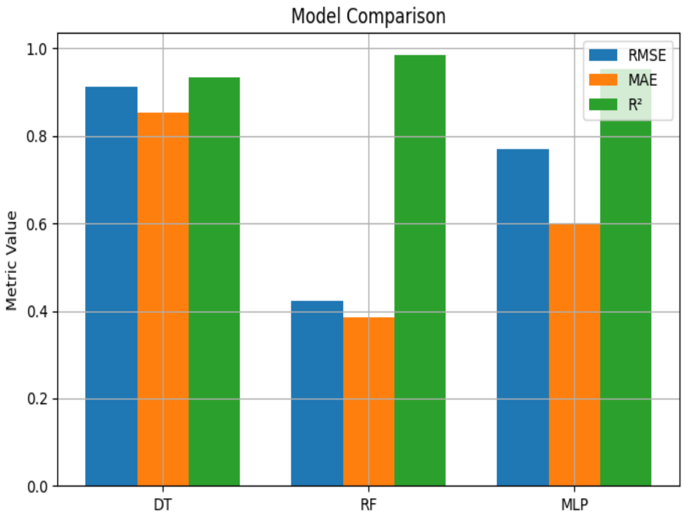


Fig 20. Model comparison analysis.

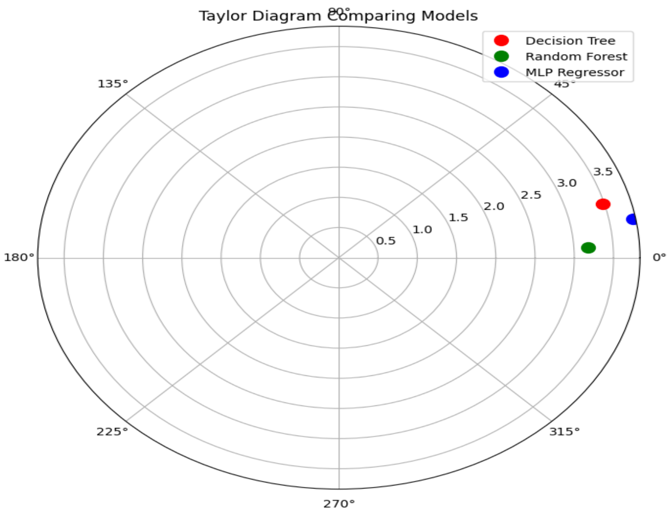


Fig 21. Representation Taylor diagram for three models.

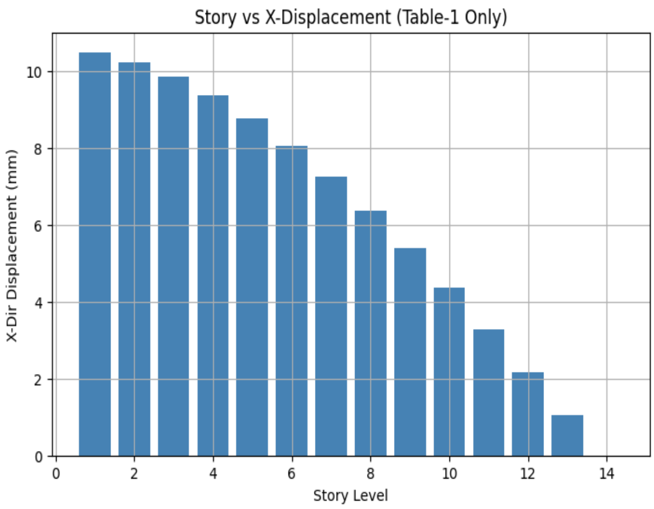


Fig 22. Analysis for Story vs Displacement.

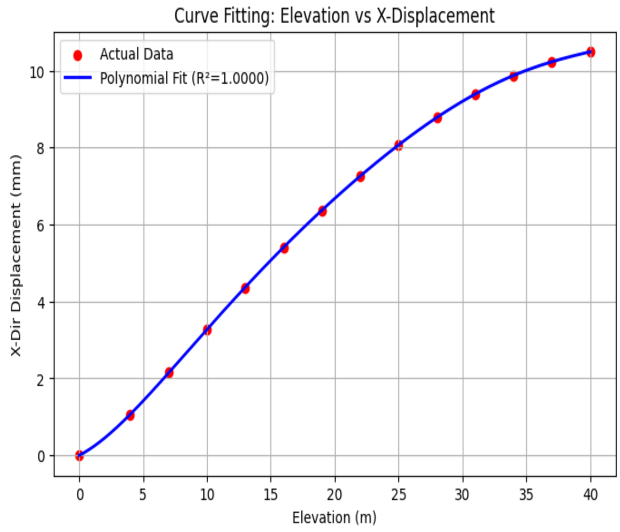


Fig 23. Curve fitting.

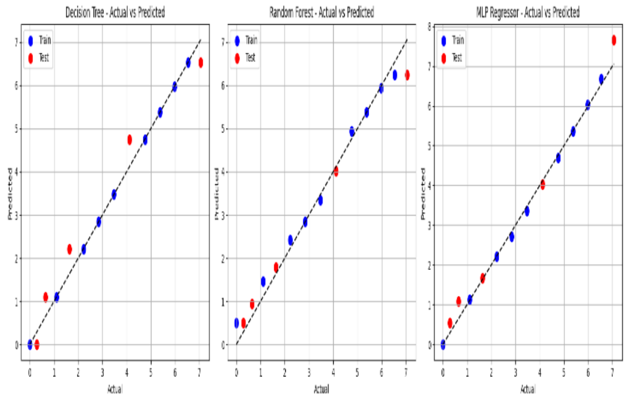


Fig 24. Actual vs predicted analysis for DT, RF, MLP.

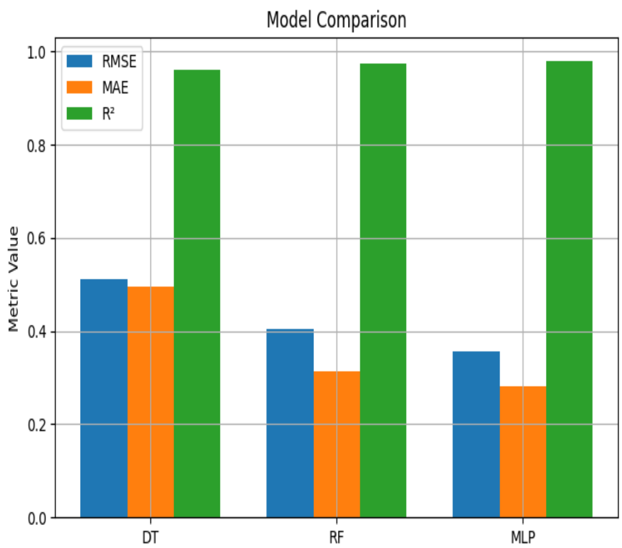


Fig 25. Model comparison analysis.

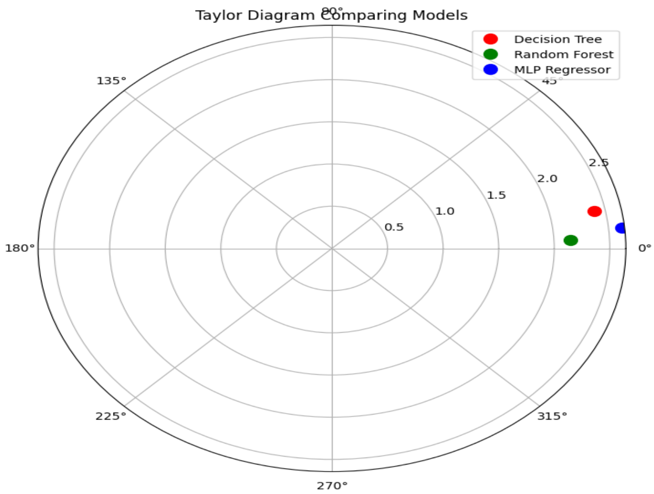


Fig 26. Representation Taylor diagram for three models.

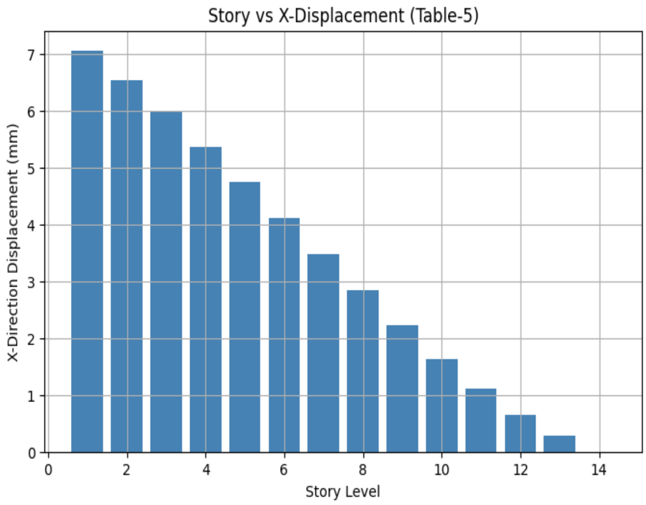


Fig 27. Analysis for Story vs Displacement.

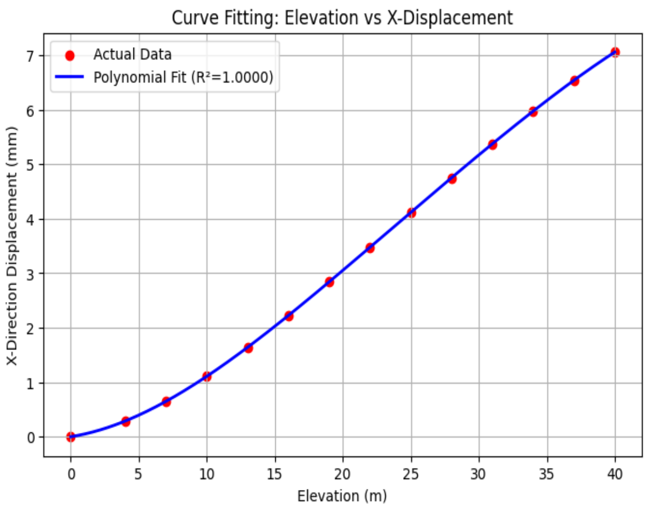


Fig 28. Curve fitting.

4. CONCLUSION

The current research presents a complete study on the seismic analysis of a G+12 building utilizing ETABS software, both without and with shear walls, and analyzed using response spectrum analysis. Story drift and displacement are critical elements in the seismic design of the building.

From this study the following conclusions are:

It is studied that the G+12 building without shear walls, by using ETABS software, maximum story drifts of EQ X and EQ Y of 0.000471 and 0.000721, located at stories 4 and 1, respectively.

The study used response spectrum analysis for this study, which gives accurate results, i.e., the maximum story drifts of RSA X and RSA Y are 0.000374 and 0.000645 and are located between stories 2 and 4 and story 1, respectively.
The maximum story displacements of EQ X and EQ Y are 14.74 mm and 20.03 mm, respectively, at story 13. For RSA X and RSA Y, the maximum story displacements are 10.48 mm and 14.71 mm, respectively. This tells us that the response spectrum analysis gives better results than others.
The maximum story drifts of EQ X and EQ Y are 0.000324 and 0.000363 and are located at story 9, respectively.
Maximum story drifts of RSA X and RSA Y are 0.000215 and 0.000241 at story 8 and story 9, respectively.
The maximum story displacements of EQ X and EQ Y are 10.55 mm and 11.70 mm, located at story 13, respectively.
The maximum story displacements of RSA X and RSA Y are 7.05 mm and 7.86 mm, located at story 13, respectively.
The story displacement is reduced from the top to the bottom story of the building in both cases.
Finally, this investigation concludes that by using shear walls, the story drift and story displacement are reduced for the design of the seismic force of the building, and also shear walls are significant in the design of the seismic response of the building and also the cost.
In the future, the shear wall position may affect the behavior of the building in case of seismic design, and the cost parameter is also included. Further, the study can use bracings, base isolations, and retrofitting techniques.
The random forest regressor outperformed other models in terms of accuracy in forecasting and generalization faults for important structural characteristics. ETABS evaluation found that story height and shear wall layout and RSA were the most relevant factors, supporting standard building engineering concepts.
This work assesses the structural durability of various wall designs against lateral loads and introduces accessible machine learning algorithms in the present setting. This study uses extensive architectural computational machine learning, ETABS values, and significance factor evaluation to give practical advice for building design, above only predicted accuracy.
This technique may be applied to various building components, considerably advancing artificial intelligence in building engineering.

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Ethical Approval: Not Applicable.

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