International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 05 | May 2024 www.irjet.net p-ISSN: 2395-0072

A Review on SEISMIC PERFORMANCE OF SOFT STOREY BUILDING WITH DAMPERS

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Abstract - *Soft floors or open floors are a common feature in modern high-rise buildings in urban India. Such features are not very attractive in buildings built in seismically active areas; It has been confirmed in many strong shaking experiences in past earthquakes. Although open (soft) first-floor high-rise buildings are at risk of collapse due to earthquakes, their construction is still common in developing countries such as India. A soft floor may be aesthetically or commercially desirable, which means there are fewer opportunities to install an earthquake resistance system. For the current study, the symmetrical flexible story structure in the plan was modeled and analyzed using Etabs software. Static and dynamic analysis methods are adopted to analyze the structure. The structure is provided with attached dampers to control the seismic impact and increase the strength of the structure. The composite damper structure was modeled and analyzed with the same parameters using Etabs software. The results obtained in displacement, story drift and main shear are compared.*

***Key Words*: Structures, Analysis, Seismic Response, Earthquake, Viscous Damper, Wind Analysis, Etabs, Staad Pro**

1.INTRODUCTION

Parking has become an unavoidable feature of most high-rise buildings in the city. The first floor of the building is usually open without walls to facilitate parking. Soft-rise buildings are high-rise buildings with wide openings, open to commercial spaces or parking, meaning that the first-floor columns do not have partition walls (construction or RC) in between. A soft floor as per IS-1893: 2016 (Part I) is a soft floor having less than 70% of the upper layer or less than 80% of the average lateral strength of the three upper layers. In a very soft layer, the lateral stiffness is less than 60% of the upper layer or less than 70% of the average stiffness of the three layers above. The main loads that affect tall buildings are gravity (dead and live loads), dynamic loads (earthquakes, wind, explosions, collisions, etc.), snow loads. Among these dead loads, earthquake and wind loads are the most important loads that govern building design. Wind loads can be divided into static and dynamic loads depending on time. Earthquake motion causes horizontal and vertical seismic loads on structures. These horizontal forces create axial forces, bending moments, torsional moments and shear forces in structural members. The purpose of seismic analysis is to ensure that the structure behaves satisfactorily under earthquake loads. A seismic damper is a mechanical device that dissipates the kinetic energy of seismic waves traveling through a building or other structure. Seismic dampers reduce vibrations in structures during earthquakes. Damper reduces the deformation of the structure and increases the strength of the structure. Seismic dampers used in tall buildings are adhesive dampers, viscoelastic dampers, friction dampers, vibration dampers, tuned mass dampers, performance dampers, and magnetic dampers.

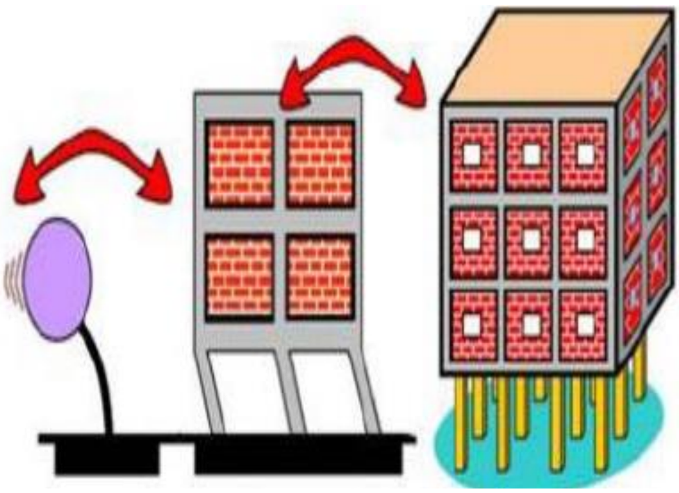

Figure 1: Behaviour of soft storey building as inverted pendulum

1.1 Objective

- Among different structural systems, dampers are the most effective for designing buildings, so the purpose of this project is to study the seismic response of buildings with dampers installed at different levels of soft layers.
- Investigate the effect of dampers to improve the seismic performance of soft-story buildings.
- Comparative study of various seismic parameters such as base shear for solid layer shear, layer shear, undamped and damper.

1.2 Need for the Study

- Technological superiority
- Innovation in infrastructure
- Due to rapid population growth
- Increasing demand for housing and parking
- Economic development
- Desire for aesthetics in urban areas

2. Literature Review

[1] Akshay Shaji , Amrutha Binu, Dibi Divakaran, Swaraj V, "Seismic Analysis of Soft Storey Buildings", International Journal of Scientific & Engineering Research

In this study, the seismic behaviour of different models of soft-storied frame buildings reinforced with shear walls, bracing and rigid columns is compared with the soft-storied frame model. ETABS is used to perform response spectrum analysis, and parameters such as main shear, stiffness, interaxial drift, and layer drift are investigated.

When it is built with sheared walls, compared to reinforced concrete structures, its strength is increased and there is a reduction in displacement and displacement. The main shear of the shear wall model was found to be the least compared to other models.

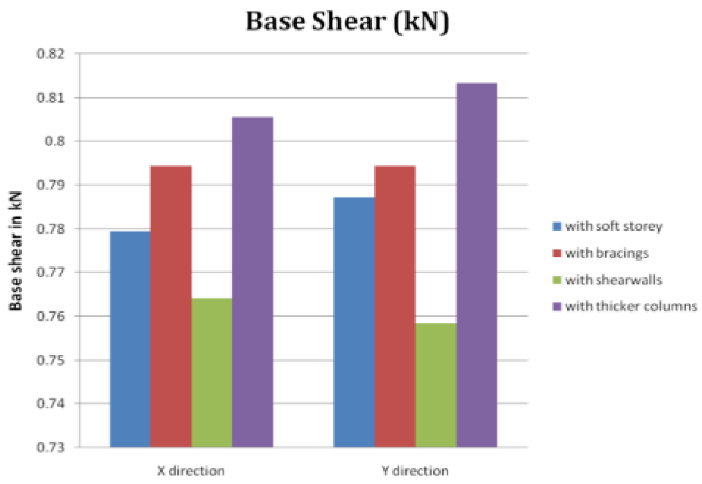

Figure 2: Base Shear

[2] Uma Devi R, Kavitha S, Sahana S Sastry, "Seismic Performance of A RC Frame with Soft Storey Criteria", International Journal of Research in Engineering & Technology

In the present study, an attempt was made to investigate the seismic behaviour of multi-story buildings with soft soil floors. When exposed to seismic loads, soft-ply frames were observed to be less resistant than infill frames.

STOREY LEVEL	*Displacement (mm)*		
	Bare	*Infill*	*Soft*
2	0.08	0.01	0.11
3	0.2	0.03	0.25
4	0.38	0.07	0.39
5	0.61	0.13	0.55

Figure 3: Response Spectrum Analysis Result

STOREY LEVEL	*Inter - storey drift (mm)*		
	Bare	*Infill*	*Soft*
1	0.68	0.14	0.56
2	0.56	0.11	0.1
3	0.38	0.08	0.07
4	0.21	0.05	0.04
5	0.08	0.02	0.02

Figure 4: Equivalent Static Analysis Result

STOREY LEVEL	*Displacement (mm)*		
	Bare	*Infill*	*Soft*
2	0.12	0.01	0.25
3	0.29	0.03	0.54
4	0.59	0.06	0.8
5	0.92	0.14	1.43

Figure 5: Time History Analysis

Filled frames should be preferred over open first floor frames in seismic areas because the first floor of an open first floor frame is larger than the top floor, which may cause the structure to collapse.

[3] S. uttamraj, K. Mythili, "Analysis of Soft Storey for Multi Storied Building in Zone-4", International Journal of Research and Innovation (IJRI)

In this thesis analysis of soft floor for high-rise buildings in zone 4, the finite element approach is used to analyse and study the behaviour of soft floor buildings at different floor levels under the action of seismic load and the action of wind load. All analyses were performed with Etabs software. base shear, layer displacement, layer drift are calculated and compared for all models.

The results of this study show that the soft floor will have a very decisive effect on the structural behaviour of the building and the structural capacity under the lateral load. Changes and relative story drifts are influenced by structural irregularities.

[4] Eben C. Thomas, "Seismic Response of Soft Storey Buildings with Viscoelastic Dampers", International Journal of Engineering Research & Technology

In the current study, the seismic performance of soft-story buildings equipped with VED was investigated. Dynamic analysis is performed using ETABS software, considering different time history analyses. The results obtained from the software for models with and without dampers were analyzed in terms of upper story displacement, interstory drift, and roof acceleration.

Viscoelastic damper offers a significant seismic reduction of the building. VEDs are maintenance free and easy to install compared to other dampers. The main advantage of VEDs is that they absorb even small vibrations, while friction dampers, producing dampers, absorb seismic energy only after a certain threshold.

[5] S. Zubair Ahmed, K.V. Ramana, Ramancharla Pradeep Kumar, "SEISMIC RESPONSE OF RC FRAME STRUCTURE WITH SOFT STOREY", International Journal of Research in Engineering and Technology

In this case R.C.C. This building was modelled and analysed in three cases. I) Model without walls (bare model). II) open model with bottom layer. III) Structural steel model on the ground floor. Dynamic analysis of the building model is done in ETABS. Building performance is evaluated in terms of store drifts, lateral displacements, lateral force, layer stiffness, base shear, time period, torque.

It was found that the steel bracing system in the exposed sub-floor significantly contributes to the structural strength and reduces the displacement of the maximum story span of the R.C.C building. It was found that the X-type torsional effect of the sub-floor steel frame is low.

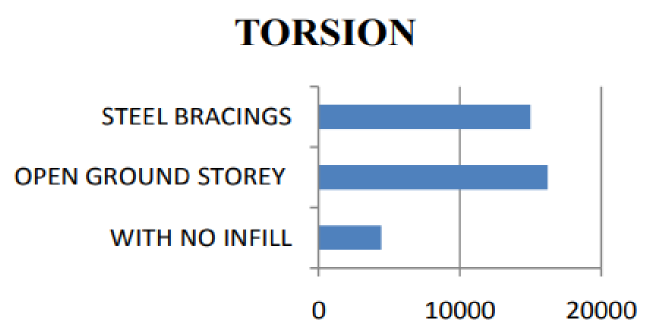

Figure 6: Comparisons of Torsion (KN-m)

[6] Pravesh Gairola, Mrs. Sangeeta Dhyani, "Seismic Analysis of Open Soft Storey Building for Different Models", International Journal of Engineering Research & Technology

In this paper, a study was conducted to investigate the seismic behaviour of soft floor buildings with different models (bare frame, infill frame, span frame, shear wall frame) under earthquake loads. If provided with a different model, it increases the durable movement of the structure compared to the soft layer provided.

The single-layer shear strength was the highest for the first layer and decreased to a minimum in the top layer in all cases. It is observed that the solid drift is higher in the bare frame model. As a result of the comparison, the stiffness is the highest for the shear wall model. These results show that the shear wall system provides stronger retention and performance against seismic changes and is a good model among all.

3. CONCLUSIONS

The effects of the model are compared in a series of results, comparing various parameters such as displacements, layer drifts and basic shear. From the obtained results, the following conclusions are drawn,

1) Hard floor and floor displacement of soft-story buildings increase respectively by 7.8% and 10.3% compared to conventional buildings.
2) It is observed that the drift is higher in the bare frame model.
3) The drift floor for all stories is within the limits allowed by the code.
4) With the use of dampers attached to the structure, the soft layer story drift and layer drift are reduced by 53.7% and 47.89%, respectively, without the damper model.
5) RC frame buildings with an open lower floor are known malfunction in a strong earthquake. That's it is clear that such buildings will show poor performance during a strong shock.
6) The average displacement value in the soft layer with the smallest damper model (47.53%).
7) The drift layer increases slightly in the second layer because there is an effect of a less smooth layer in the upper layer.
8) From the comparative study, construction with angle damper has better performance when seismic force is considered.

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