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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Dynamic Analysis of High Rise Building with Transfer Floor

Premraj P Murodiye, Er. Pradip Ilamkar, Prof. Nidhi Jejurikar

M. Tech Student, Department of Computer Aided Structural Engineering, WCEM, Nagpur, India

Structural Engineer, RCC and Steel Structural Consultant, Nagpur, India

Assistant Professor, Department of Computer Aided Structural Engineering, WCEM, Nagpur, India

**ABSTRACT:** As the population increases, there is a corresponding rise in the need for land and associated amenities. Moreover, architectural specifications mandate adjustments in the vertical components of a building between its stories. This includes the incorporation of transfer floor structures, consolidating facilities in specific locations while simultaneously supporting both vertical and lateral load systems and transfers. The present investigation reveals the construction of three 12-story models using ETABS software, featuring transfer slabs at the 1st, 3rd, and 5th floors. A thorough analysis using response spectrum analysis was conducted, and the findings were compared to draw conclusive results.

**KEYWORDS:** Shear wall, Column, Etabs.

## I. INTRODUCTION

In emerging nations like India, China, Turkey, and Qatar, the population is steadily rising, leading to an escalating demand for versatile land usage that accommodates both residential and commercial facilities. Innovations in architectural designs further require a repositioning of vertical elements within structures across different floors. For instance, a commercial function room, malls, and parking areas can be situated below the transfer floor system, offering a space that serves both residential and office purposes. The structure with a transfer floor can be efficiently utilized for both commercial and residential functions, featuring an economical layout.

To achieve this, columns are strategically arranged for longer spans, while the top structure adopts a closer column spacing for shorter spans. This results in a spacious podium or mall structure. The incorporation of transfer floors has gained recognition in various building components. Presently, numerous structures exhibit vertical irregularities in the form of columns or shear walls. The floor transfer system acts as a bridge between two columns, and different floor systems such as the transmission dome and transfer dome are employed based on the load distribution on the structure. Figure 1.1 illustrates the irregular column arrangement on the first-floor transfer slab, while Figure 1.2 displays the shear wall above the transfer slab. This design approach showcases the versatility and adaptability of transfer floors in optimizing space and functionality in modern building structures.



Figure 1:- Transfer slab With Shear wall



Figure 2:- Transfer slab With Column

This study explores the response spectrum and wind analysis of a specified model using the E-Tabs program. The analysis takes into account references to the Indian IS 1893 and IS 875 code (PART3). The chosen floor plan measures 28m x 48m, and a 12-floor model is selected for analysis. To address the potential impact of torsion, a biaxial symmetric construction plan is adopted. The model features a transmission plate at various building levels, specifically 3.5m below and 3.0m above the transfer plate.

Three distinct models are created for analysis, focusing on the 1st, 3rd, and 5th floors on the transfer plate. This approach allows for a comprehensive examination of the structural response and wind forces at different levels of the building. The consideration of various parameters, including the placement of the transmission plate and floor levels, contributes to a thorough understanding of the model's behavior under different conditions.

#### A. Loadings:

##### Live Load:

Above and at the transfer slab level: 2 kN/m<sup>2</sup>

Below the transfer slab: 3.5 kN/m<sup>2</sup>

##### Dead Load:

##### Wall Load:

Above the transfer slab: (4.14 + 2.07) kN/m<sup>2</sup>

Below the transfer slab: (3.312 + 1.656) kN/m<sup>2</sup>

##### Floor Finish:

Above and at the transfer slab: 1 kN/m<sup>2</sup>

Below the transfer slab: 1.5 kN/m<sup>2</sup>

Response Reduction Factor: 3

#### B. Dimensions of the Building:

Storey: 12 storeys

Column Dimensions:

Above the transfer slab: 0.3 x 0.6 m

Below the transfer slab: 0.5 x 1 m

Slab Thickness:

Transfer slab: 1 m

Above and below transfer slab: 0.15 m

These specifications outline the various loadings and dimensions considered in the analysis of the 12-storey building model. The live loads, dead loads, and floor finishes are specified for both above and below the transfer slab levels. Additionally, column dimensions and slab thickness are provided for different sections of the building. The response reduction factor is also mentioned, indicating the factor by which the seismic forces are reduced for analysis purposes.

## II. RELATED WORK

[1] Mohammed Abdul Sameer et al. (2019) led a concentrate on the seismic execution of tall structures integrating move plates. Utilizing SAP 2000 programming, they assessed structures of different levels with move floors through sucker examination. Move plates, going from 1 to 3 meters top to bottom, were intended to meet engineering necessities. They dissected attributes like base shear, dislodging, float, regular recurrence, and time span. The investigation discovered that designs with move plates showed better burden limit and firmness looked at than second opposing casings, with great results in float, dislodging, and base shear.

[2] Kong Wei-yi et al. (2018) examined the inner powers in built up substantial designs with bearing section support move floors enduring an onslaught conditions. Utilizing ABAQUS programming, they examined a four-story RCC structure with an enormous exchange brace on the principal level. Inner powers in supporting pillars expanded with warming time, with huge rearrangement saw before an hour and a half of warming. Little variety happened in twisting minutes while warming equally from the fire floor to the main level utilizing the exchange support. Be that as it may, the combined inner powers during warming might surpass configuration limits.

[3] Neelkanth D. Joshi et al. (2018) inspected the effect of move braces on the sidelong solidness of edge structures with delicate stories. Because of restricted space, elevated structures consolidate move braces to give conveniences like stopping. Utilizing STAAD-Master, they examined the sidelong firmness of casing structures with changing exchange support solidness. Results showed that while move support solidness fluctuated, the state of delicate story drifting casings stayed stable, with sections on move braces displaying more noteworthy horizontal firmness than those with discrete bases.

[4] Mehair Yacoubian et al. (2017) surveyed the seismic way of behaving of structures with move pieces in districts of low seismicity. In quake situations, they assessed underlying way of behaving considering move plate predisposition and both rotational and translational base movement.

[5] Y.M. Abdlebasset et al. (2016) explored the seismic investigation of elevated structures with move floors. Move floors oblige lopsided vertical development in multistory structures, sending loads between floors. Direct time history examination showed a 20 to 35 percent increment in sidelong and float dislodging, as well as story second and shear force, contrasted with non-straight time history examination. Direct time history investigation was considered more steady than versatile reaction range examination, and skyscraper structures with move floors can be planned with a breaking latency of 1.2 Icr.

## III. METHODOLOGY

The analysis of the response spectrum involves a linear statistical dynamic approach, which represents the highest potential earthquake impact on a structure. It entails examining the reaction of the structure under inherent elastic vibrations. The dynamics of response spectrum analysis are characterized by assessing the speed or behavior through spectral speed, measuring displacement in relation to a specific building era, time, and historical weather conditions. In this process, a scaling factor is assigned to the response range function, aiding in the comprehensive understanding of the structure's behaviour under seismic influences.

$$S.F = I \times G / R$$

Where, I = Importance factor

R= Response reduction factor

G=Gravity force

Re-scaling =  $(I \times G / R) \times (\text{Static base shear} / \text{Response spectrum base shear})$

For the analysis, a structural configuration featuring a transmission plate with columns positioned both below and above it was selected, as depicted in Fig. 6.1 and Fig. 6.2. The vertical arrangement of the model was scrutinized using E-tabs software. The analysis was conducted by employing E-tabs, considering three distinct models, each incorporating a transmission plate located at the 1st, 3rd, and 5th floors. This approach allowed for a thorough examination of the structural response at various vertical levels within the building.

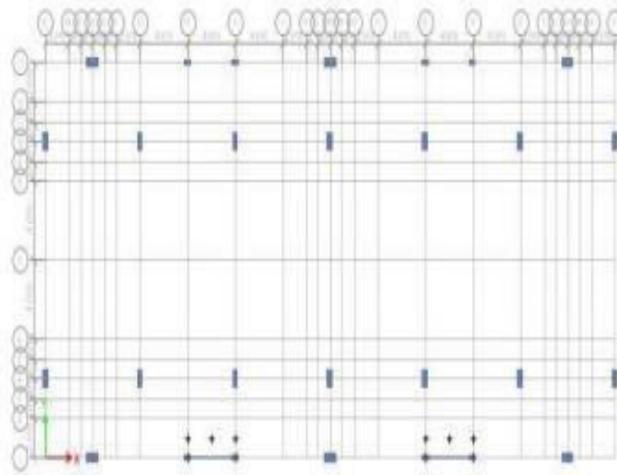


Figure 5.1

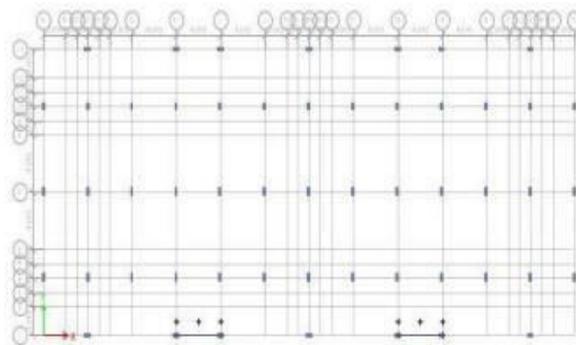


Figure 5.2

Figure 5.3, 5.4 & 5.5 shows the position of the transfer slab in the building,

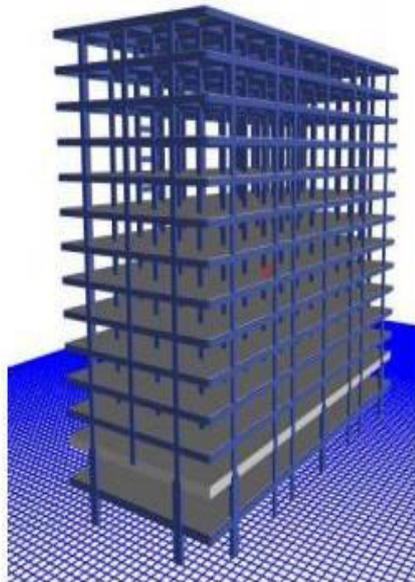


Figure 5.3

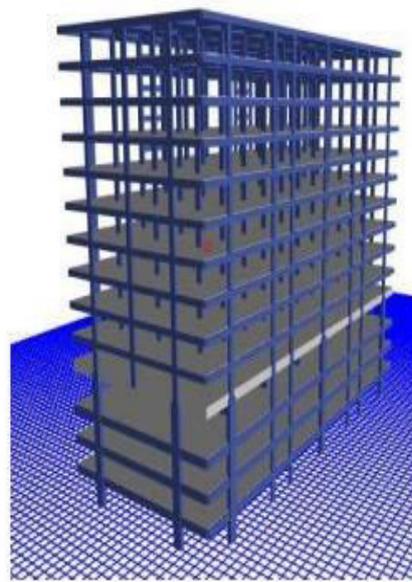


Figure 5.4

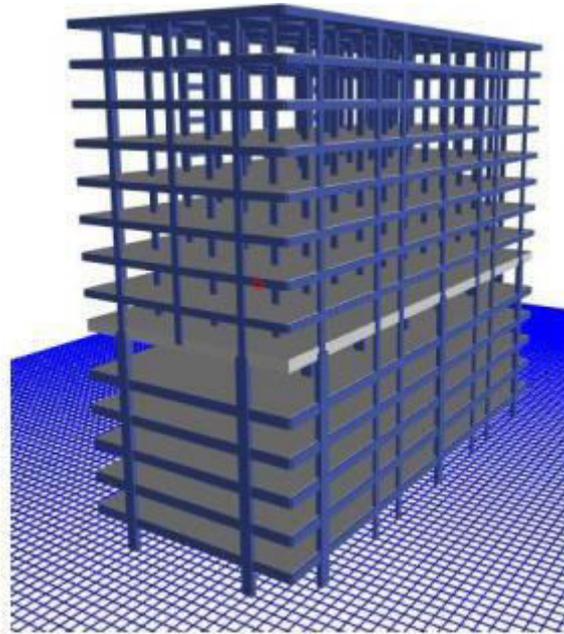


Figure 5.5

#### IV. EXPERIMENTAL RESULTS

To evaluate the structural behavior, an analysis of the vertical position of the transfer slab in the structural software, specifically E-tabs, was performed. Three distinct 12-story models were examined and analyzed. The analysis involved studying 12-floor models with transfer slabs located at the 1st floor, 3rd floor, and 5th floor. The results, presented in the form of diagrams derived from analytical displacement, provide insights into the structure's performance. The section presents the results for all models in the following manner, focusing on the position of the transmission slab:

- A. Storey Shear
- B. Lateral Displacement
- C. Storey Drift

Model 1: (Transfer slab at 1st floor level)

This structured approach allows for a comprehensive understanding of the shear forces, lateral displacements, and drift at different storeys for Model 1, where the transfer slab is positioned at the 1st floor level.

a) Storey Shear: The accompanying graph illustrates the maximum floor shear for each storey, as depicted in Fig. 6.1 for the first model featuring a 1st-floor transfer plate. In a linear fashion, the shear force in the x-direction decreases on the upper floor levels. The maximum floor shear, initially at 1398.507 kN, decreases to a minimum level of 241.97 kN. Fig. 6.2 provides a visualization of the shear forces in the Y-direction at the lower and upper levels of the models.



Figure 6.1 Maximum storey shear in direction of X



Figure 6.2 Maximum storey shear in direction of Y

b) Displacement: The joint displacements in the X-direction and Y-direction are illustrated in Fig. 6.3 and 6.4, respectively. The top floor exhibits the maximum displacement in the 1st model with a transfer plate, with values of 24.374 mm in the X-direction and 21.906 mm in the Y-direction. These displacement values provide insights into the structural response and deformation under the given model and loading conditions.

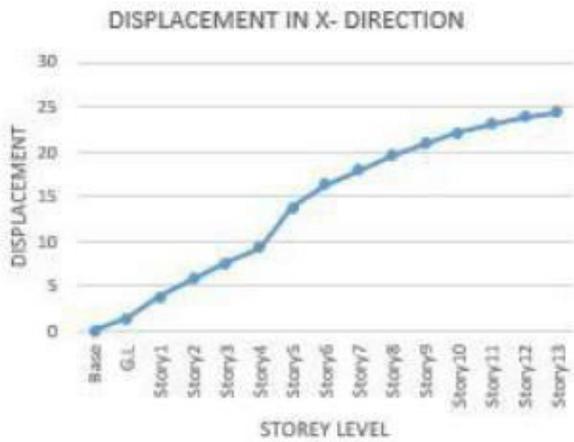


Figure 6.3 Joint displacement in direction of X

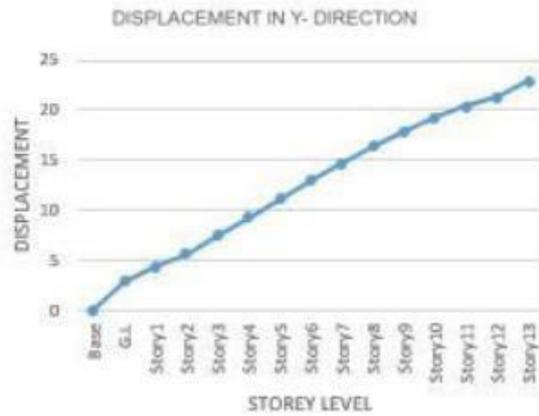


Figure 6.4 Joint displacement in direction of Y

c) Storey drift: The largest value of storey drift is at first level and thereafter declines to the top level in Figure 6.5



Figure 6.5 Joint Drift.

## V. COMPARATIVE RESULTS

All the models are compared in order to understand the behaviour of all structures with respect to the position of the transmission plate. The result shaving, joint shift and maximum shielding drift given in this section are compared.

### A. Storey Shear

Figure 7.1 and 7.2 below illustrates the shop shears for the 12-story models with transfer slabs at different positions in the building in Both X & Y direction. When observing the figures, it shows that the level of shear is reduced in x and y direction, as the location of the transfer plate is in the lowest position compared to the entire building height, the shear is decreased gradually.

When the position of the transfer shear is higher and lower, the storey shear value is more.



Figure 7.1 Maximum storey shear in direction of X Figure 7.2 Maximum storey shear in direction of Y

**B. Displacement**

Below figures 8.3 & 8.4 show the results of analyses in the building from which joint displacement in X & Y directions observation was explored, for the 12-story model with a transfer plate in different locations. By looking at the figure, it shows that the position of the transferring lab increases more and the displacement increases as the height of the structure increases, i.e. the displacement over the transferring label increases and the displacement under the transfer layer decreases.

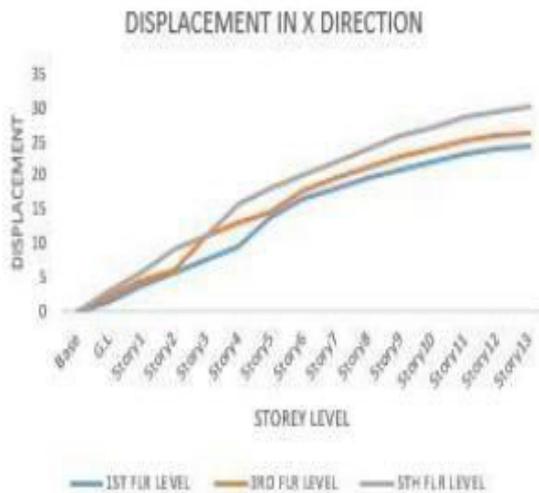


Figure 8.3 Joint displacement in direction of X

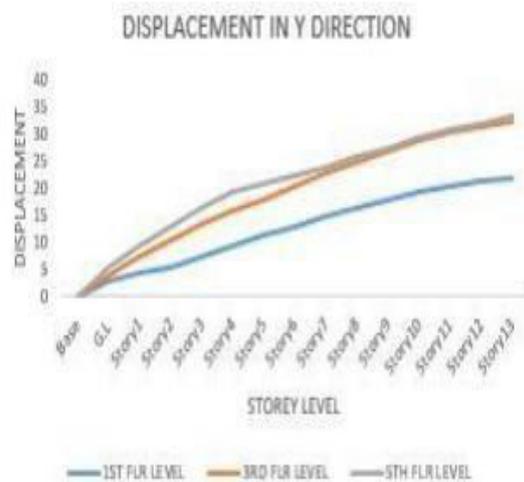


Figure 8.4 Joint displacement in direction of Y

**C. Storey Drift**

The drift of structure from several transfer plate sites is illustrated in figure 8.5, below, and the drift across the transfer plate is seen to reduce and rapid increase at the transfer plate level. Figure 8.5 below



Figure 8.5 Storey Drift.

## VI. CONCLUSION

- To prevent significant structural damage, it is crucial to consider imperfections in the construction of a building with a transfer floor. Columns with separate footings exhibit better lateral stiffness compared to floating columns on a transfer floor, contributing to enhanced structural stability. In minor earthquakes, the absence of cracks and the pliability of the structure are maintained.
- To observe the vertical position of the transfer slab in the structure, a comprehensive study was conducted, exploring various locations of the transfer slab with respect to the building's height. The study yielded several conclusions:
- There is an increase in storey shear when the transfer floor system is positioned at the lowest level in the building compared to the total height of the structure.
- Story shear consistently decreases above the transfer slab position in every case due to unusual mass devaluation.
- Displacement decreases when the transfer slab is located at the lowest level and increases when it is at the upper level in both X and Y directions.
- The drift value increases up to the transfer slab level and then suddenly decreases.
- The maximum base shear value increases when the position of the transfer slab is at a higher level and decreases when the location of the transfer slab is at a lower level.

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