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Design and Analysis of Transfer Plate

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Abstract- *A transfer slab is essentially a beam constructed out of concrete and steel reinforcements that is created with a slab of concrete. It is used to transfer the floor loads to the support post and pillars.*

Due to uneven distribution of column location of apartment floor and podium floor's column there is a deformation in the load distribution which leads to obtaining unreasonable design straining action for the structural elements. This paper deals with the structure in which the below podium structure is used for parking/commercial purpose which leads the necessity to increase the spacing of the column and the floors above the podium level is used for the residential purpose whose column location are much closer than the podium levels and designing the transfer plate for the same structure providing a common solution as a transfer slab system between two parts of building i.e. residential and commercial parts. To remove the vertical irregularities of conventional method of column and shear wall which is replaced by transfer slab. To control the stability of high rise structure after occurrence of any events leading to inefficiency of main structural members

Keywords: Transfer plate, Transfer Structure, Transfer Beam, Transfer Girder, Shearwall.

I. INTRODUCTION

A transfer slab is essentially a slab/plate constructed out of Reinforced concrete that is created with a slab of concrete. It is used to transfer the floor loads to the support post and pillar. Building design often involves a podium structure that houses other functional spaces such as a shopping mall or a large lift lobby which require an unobstructed spatial layout in order to give a more impressive view, the upper structure, it is often used as office or residential units using more economical shorter span design, or sometimes even with the putting in of very congested core wall for lift shaft and other building services.

A transfer floor is the system which supports a vertical as well as lateral load resisting system and transfer it's loading to different below system. Transfer floor distribute the load from closely spaced columns to the columns with long span.

A high rise building with transfer floor system involves structure below transfer system that houses functional areas for a shopping mall, a large lift lobby, parking, commercial markets, multi-purpose halls, etc. And the structure above transfer floor, is used as office and residential units using more economical and shorter span design. To achieve these results, layout of podium structure use spaced columns with long span design while the upper floor implies columns with short span. Using transfer slab system between these two parts of the building has become common solution. Many buildings are constructed with these vertical irregularities (column and shear wall). As such Transfer floor is provided between these two different column arrangements. A transfer floor is the floor system which supports vertical as well as lateral load resisting system.

II. LITERATURE REVIEW

2.1 S. S. Balasuriya et al (2007) in their paper entitled "The influence of transfer plates on the lateral behavior of apartment buildings"

They presents that the land becomes a scare resource. 1So every bit of land is precious and it is used for some important purpose1. Thus, high rise apartment buildings are in demand. The current scenario is to use the whole land for the structure and provide several parking within the building in the below floors rather than providing parking outside. 1The column arrangement

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of the apartment floor will generally not match that of a parking floor, which gives rise to the issue of connecting the two sets of columns with different location together.1

To verify these the analysis was done. Changes were made to the basic model to study the effects of different meshing techniques. 1Thus, two models were created with Model A having a coarse mesh in the transfer plate with Model B having a fine mesh.1 A third model, C was created with the same building height but with apartment levels from ground floor to roof only (without the need for a transfer plate since no car parking was provided). Comparison with this model will yield the effectiveness of the thick plate. Lateral stability was measured in terms of fundamental period of vibration, wind induced acceleration and deflection for wind loads. 1The wind load analysis was carried out based on loads evaluated. The conclusion was made that the transfer plates can be used effectively as outriggers in apartment buildings. A proper finite element model will yield the required design parameters for the transfer plate itself and parameters regarding the lateral behavior of the structure1. This reduction in lateral deformation to almost zero at the transfer plate level could lead to a reduction in lateral deflection at the top of the building. The use of transfer plate can reduce the peak wind acceleration values. This could be extremely valuable in apartment buildings that are designed with a greater height due to the need for accommodating car parking needs. The provision of acceptable level of occupant comfort is one of the primary responsibilities of the structural design engineer.

2.2 Raj H Patel et al (5th may 2017) in their paper entitled "Optimized location of load transfer plate in R.C.C building under lateral load"

They states about 2the scarcity of land which leads to development of high rise building and mixed use of building as parking, commercial, residential etc.2 Transfer plate is a structure sometimes found in high-rise buildings in Hong Kong. 2Building design often includes a podium structure that houses other functional spaces such as a shopping mall, large lift lobby or Space for parking which require an unobstructed longitudinal layout in order to give a more impressive view.2 While for the upper structure, it is often used as office or residential purpose using more economical shorter span design, or sometimes even with the putting in of very close spaced core wall for lift shaft and other building services.2To achieve this result, the layout of the podium structure can use regularly spaced columns in longer span design.2 The transfer plate needs to accommodate the difference in loading is by the placing in of a transfer plate at the base of the tower structure, such that the loading of the upper floors can be taken up and transferred downward through the podium. They concluded that the providing the transfer slab to the structure gives better stability to the high rise building and during earthquake

2.3 Prof P.S Lande et al (5th may 2018) in their paper entitled "Analysis of high rise building with transfer floor"

Their Study is about seismic analysis of high rise building with transfer floor. A number of proto type models of high rise building examined using linear response spectrum analysis.3In the paper, five different models of 10 floors building has studied by providing a transfer slab at different floor location such as 1st to 5th and vertical position of transfer slab with respect to building height was explored.33They made the conclusion that base shear value and the base shear moment has been increased remarkably using transfer plate3.Vertical location of transfer floors with respect to total height of the building has a significance on buildings performance, introduction of the transfer floor in the lower part of the structure (20-30% of the total height of the building from its foundation) is better option than having it on a higher location.

2.4 MehairYacoubian et al (2017) in their paper entitled "Simplified design checks of buildings with a transfer structure in regions of lower seismicity" They states 4that the response behavior of buildings with a transfer plate when subject to earthquake vibration. The effects of load-path breaking and transfer plate flexibility are examined in the light of dynamic rotational-translational coupling. The complicated displacement response behavior of the building can be resolved into the following components: translational motion, rotational motion of the building substructure and alterations of the transfer plate.4High displacement demand and the simultaneous seismic shear demand on the building can be shown to exhibit displacement-controlled behavior, and accordingly, predictive expressions are proposed and validated for buildings with heights of up to 120m. Most important, the paper shows the extent of the effect of transfer plate flexibility on the local response behavior of the

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supporting (transferred) structural walls. 4The paper concludes that the study addresses the effects of the transfer plate interferences on the overall response behavior of the building and the local shear demands on transferred walls. A simplified design flow-chart is developed to complement existing seismic design and assessment procedures[4]

III. TRANSFER PLATE

Table no. 3.1
Difference between the High Rise Building with and without Transfer Plate

High rise building without Transfer Plate	High rise building with Transfer Plate
1. Unsuitable for varying location of column	1. Suitable for varying location of column
2. There is no sudden change in lateral stiffness.	2. There is sudden change in lateral stiffness.
3. It is exposed to more surface cracks	3. It follows conventional elastic behaviour i.e. suffers no cracks
4. It has less resistance to Earthquake	4. It is more resistant to Earthquakes
5. Structural Stability is Less	5. Structural Stability is more

Transfer plate is a structure which connects the podium floor with the above apartment floors whose column location are different which creates a deformation in the load distribution which leads to obtaining unreasonable design straining action for the structural elements.A high rise building with transfer floor system involves structure below transfer system that houses functional areas for a shopping mall, a large lift lobby, parking, commercial markets, multi-purpose halls, etc. And the structure above transfer floor, is used as office and residential units using more economical and shorter span design. To achieve these results, layout of podium structure use spaced columns with long span design while the upper floor implies columns with short span. Using transfer slab system between these two parts of the building has become common solution. Many buildings are constructed with these vertical irregularities (column and shear wall). As such Transfer floor is provided between these two different column arrangements. A transfer floor is the floor system which supports vertical as well as lateral load resisting system.

We are proposing a G+ 12 floors building with 4 podium floors with building type R.C.C frame structure, with height of podium floor 4 meters and height of Residential floor 3 meters. And we are going to analyse and design the upper apartment floors considering all the loading.Based on the loading of the upper floor we are going to design the transfer plate. Based on the loading of the transfer plate designing of the podium floors are going to be designed. And footing of the whole structure is to be designed and going tocheck the stability and the load transfer in the ETABS 2015 and SAFE. Based on the present study we have made an difference between the structure with and without transfer plate.

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