Comparative study on post-tensioned and composite trasfer girder for multi story building

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Abstract - **Engineers and others experts in this field have been trying to implement new and innovative technologies which can provide design economy and structural capacity while performing the same role in architectural terms. The principal design objectives for structural engineers are safety, functionally, economy and now days legality of design. Transfer girder plays a very important role for mega as well as small structures. A transfer girder is used to transfer the loads of the column to the surrounding columns. Transfer girder is used to transfer the load from the above story to the column which is support the transfer girder. It is important for the engineers and architects to understand the appropriate application of post-tensioned and composite concrete and the effects that may result. The structural behavior and analysis of multi-storey building component and supporting transfer girders have received added emphasis due to its importance in connection with building. For avoiding progressive collapse, control deflection and load path discontinuity provide transfer girders. In this study, R.C.C., Post-tensioned and composite transfer girder can be analyzed. These three transfer girder was analyzed with 5 to 10 number of story. all these girder are analyzed for span range from 5 to 10m for buildings. The models were prepared in ETABS software. To check the behavior of three transfer girder and compare parameter such as bending moment, shear force and Deflection. Transfer girder system takes more bending moments with less deflection.**

keywords - **Transfer girder, Post-tensioned transfer girder, Composite transfer girder, Seismic forces, ETABS**

I. INTRODUCTION

For the successful construction of new buildings, the more importance is given to the successful planning. Successful planning includes the good communication and close co-operation between all parties involved in the project, in particular the owner, the architect, the engineer and the contractor. One of the key aspects of successful planning is the constructability of the building. The principal design objectives for structural engineers are safety, functionally, economy and now a day's legality of design. With increase in demand for space, construction of multi-storeyed buildings is becoming a necessary part of our living style. The dearth of space is forcing us to raise the height of buildings as much as possible to accommodate maximum number of people and also in harmony with the architectural necessities. These multi-storeyed buildings can be constructed using various structural systems. The earthquake force are developed at various floor level in the building need to be carried down along the height to ground by shortest path, but due to the floating columns discontinuity in the load transfer path which results poor performance of the structure. If we take a building, the transfer girder plays an important role to transfer the loads of columns from above story of the buildings. Transfer girder gives great engineering stylish view to the structures. Transfer girder affects the overall cost of the structure**.** Transfer girder system takes more bending moments with less deflection.

In such situation, the load bearing vertical element cannot be allowed to continue downwards through the lower floors and then the foundation. This problem is solved by the construction of transfer girder. The transfer girder is very heavy beam whose depth can extend over one full story**.** The columns in the upper story will be terminated in the transfer girder. The loads from the above columns are transferred to the girder. By beam action, the load is transferred to the main columns that are supporting the girder from below. Transfer girder plays a very significant role in the design of mega as well as small structures.

Some times for architectural purpose buildings are designed without using any columns for a very large span, in such case if ordinary beams are provided they can cause failure such as flexural failure. To avoid this problems transfer girder is very effective and durable. Transfer girder transfer heavy and concentrated loads through shear. In order to avoid progressive collapse, the transfer girder should be cast monolithically and continuously while spanning over several supports. The structural system should also provide an alternative load path for load path redundancy. Moreover, for transfer girder, deflection controls. If the transfer girder deflects, all the floors above the transfer girder will deflect with it. Transfer girder design is different from that of a main or secondary reinforced concrete beam design**.**

II. ETABS 2016

The structural analysis software play important role to carry out the seismic calculation for the infrastructure. ETABS is a program that can deeply improve an engineer's analysis and design capabilities for structure. The user can set up grid lines, places structural objects relative to the grid line using joints, frames, links, tendons, shell and assigns load, and structural properties. By using this program, anyone can manage the file, edit the model, change the view, define properties or load patterns and cases, Draw something new in the model, select that something, Assign properties or loads, analyse the model. It display analysis results for checking, gives the design of structure, generate detailing construction document. For the editing, there are some commands such as copy, delete, edit tower and grid, replicate, extrude, edit frames, edit shell and edit links.

III. LITERATURE REVIEW

Meghana B. S. And T. H. Sadashiva murthy[1] (2016) Investigate that in recent time many buildings are constructed with various irregularities such as floating column at various location and level. This floating column creates discontinuity in the load transfer path which result poor performance of buildings. They can focus on composite structure with floating columns at different location in buildings of various heights such as G+3, G+10 and G+15 in lower and higher earthquake prone zones and compare various parameters such as shear force, displacement and story drift. They can model these structures in ETABS software and they can study the behavior of the composite multi story structure with various height.

Parth danani and Mr umang parekh[21] (2016) review that the evaluation of structural systems and technological developments are driving force behind the growth of tall buildings around the world. In the framed tube system columns and deep beams are closely spaced so that the shear log phenomenon, capacity of structural member is not fully utilized. For that the composite constructions system has brought new era for high rise buildings with advantages of good economy, structural efficiency, light weight and better performance under gravity and lateral loading. From this evaluation they can gives that the composite mega frame structure is more efficient as compare to the RC and Steel structure. Composite structure give the better economy based on cost analysis.

Mahesh suresh kumavat and L G kalurkar[10] (2014) present the work of steel concrete composite with RCC options are considered for the comparative study of G+9 story commercial building which is situated in earthquake zone III and for earthquake loading. For earthquake loading the provision IS 1893 (part-1): 2002 should be considered for design. They can prepare three dimensional models and analyze this model in SAP 2000 software. This 3D model was analyzed with equivalent static and response spectrum method for both composite and RCC structure. They can conclude that the cost comparison of the both structure, composite structure gives better economy than RCC structure. Composite structures have ductile characteristics so that structures perform better than RCC structure.

Vikas V. Mehetre and V. T. More[6] (2018) can analyze seismic analysis, wind analysis and sequential analysis to check the behavior of the floating column and transfer girder in high rise building. For that they can study the 10, 15, 20, 25, and 30 story RCC building with zone IV and wind speed 47 m/s. The floating column at four places of the frame and each story case can analyze for different position of shear wall by using ETABS V-2015 and then show the effect of this different position of shear wall for each model is observed in the form of bending moment and displacement. From this study they can observed that, when shear wall is located at core the bending moment and displacement will be less for 10 and 20 story cases.

Jainam S. Shah, K. Karthikeyan and bhautik R. Shah[20] (2017) gives the behavior and analysis of the structural component and supporting transfer girder received added emphasis due to its importance in connection with building. They can study G+8 multi-story transfer girder system concrete building was analyzed using ETABS to predict the behavior of the structure to progressive collapse. The can adopt load combination as per GSA (General services administration) guidelines. From this study they can conclude that, storey above the transfer girder gives maximum value of DCR as compare to other storey.

Desai Ajay kumar J., Nihil Sorathia and Hiren G. Desai[15] (2017) reviewed that Behavior and design of the transfer girder is particularly unusual with regular beam. To understand the behavior and design of transfer girder in detail G+10 story building should be model in ETABS. For analysis of transfer girder they can adopt dynamic loading and seismic load is done in ADAPT builder. They can consider five unique cases to examine the behavior and design of transfer girder. They can change the position of transfer girder for every case and also change the position of shear wall with it. This all five cases can examine in ETABS software. From this analysis, the bending moment and shear force in the transfer girder is much higher in construction analysis which is use to avoid cracking of the beam and column. The maximum reduction in the bending moment is about 85% due to provision of shear wall.

Meghana B. S. And T. H. Sadashiva murthy[7] (2016) have analyzed the building structure in a single step using linear static analysis (LSA) on the assumption that the structure are subjected to total load at once the whole structure is constructed completely. They can study the 3D analysis of the building structure using ETABS and they model 30m X 30m plan dimensions with G+5 storey building considering floating column. The size of transfer girder is 300 x 450mm and size of composite transfer girder is 300 x 450mm of ISMB 350. From this study they can conclude that, moment is taken by composite girder is more than the RC transfer girder with less deflection.

Sungchul Hwang, Housyu Kyou and Yasuhisa Tagawa[19] (2004) are given that, when the framed structure are subjected to lateral load and sustained load, the elastic rigidity of composite girder varies with the change of moment and rotation of angle. They can explain the approximate equation on the elastic rigidity of composite girder is described by the constant value of rigidity. Analytical assumption is that the both ends rotation angle of composite girder are equal. The elastic rigidity of composite girder varies with section of steel girder, thickness of slab and width of column. . From this study they can say that, the elastic rigidity of the composite girder will more as compare to steel girder and composite girder take more bending moment.

IV. SUMMARY

This study investigates the use of alternative approach to the transfer girder, which involved the post-tensioned transfer girder and composite transfer girder for the multi-storey building. The composite transfer girder gives another alternative system for the structure. In such situation, the load bearing vertical element cannot be allowed to continue downwards through the lower floors and then the foundation. This problem is solved by the construction of transfer girder. The transfer girder is very heavy beam whose depth can extend over one full story. The columns in the upper story will be terminated in the transfer girder. The loads from the above columns are transferred to the girder. By beam action, the load is transferred to the main columns that are supporting the girder from below. Transfer girder plays a very significant role in the design of mega as well as small structures.

The overall effort included concept development, component fabrication and practical practice and the location of the provision of the post-tensioned transfer girder and composite transfer girder depends upon the worst load condition on the

structure. In this investigation instead of beam transfer girder will be provided in the structure to give better performance of the structure and give better bending moment capacity with low deflection.

V. CONCLUSION

This review paper provides an outline of a research and development effort to demonstrate the merits of new structural system for multi-storey buildings. In this study, to achieve the longer span with less deflection transfer girder will be adopted for the structure. From this literature survey, transfer girder gives maximum bending moment as compared with ordinary building. For avoiding progressive collapse the transfer girder will be provided in the structure. In regards to the structural capacity the RC transfer girder showed a slight better performance in the moment resistance. Post-tensioned transfer girder give better saving in size due to post-tensioned the girder and it gives good performance of moment resistance. PT and composite transfer girder give maximum bending resistance with less deflection.

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