Finite Element Analysis and Design of Post-Tensioned Transfer Girder
Desai Ajaykumar J\textsuperscript{1} Nihil Sorathia\textsuperscript{2} Hiren G. Desai\textsuperscript{3}
\textsuperscript{1}PG Student \textsuperscript{2}Assistant Professor \textsuperscript{3}Structural Consultant
\textsuperscript{1,2}Parul University, Vadodara \textsuperscript{3}Sai Consultant, Surat

Abstract— A Post-Tensioned Transfer Girder is utilized to transfer point load of column from the above stories and transfer them to the supporting column. Transfer girder gives great engineering stylish view to the tall structure. Behavior and design of transfer girder is extremely unusual contrast with ordinary beam, so it is important to concentrate the behavior and design of the transfer girder in detail. To understand the same in the present review, G+10 story building is basically modeled in which the columns are float at various levels. The analysis and design of transfer girder considering dynamic loading i.e. seismic load is done in ADAPT Builder. Five unique cases are considered with the end goal of examining the behavior of transfer girder. The behavior of transfer girder is contemplated by considering the adjustment in the position of transfer girder in working in plan and the different location of shear wall. The five fundamentally unique building is displayed in ETABS and behavior of the transfer girder is examined. The entire behavior of the post-tensioned transfer girder is contemplated by doing construction stage analysis in ETABS. Additionally the construction stage analysis is done for every one of the five cases in ETABS. To the extent analysis is concerned, the column is regularly accepted pinned at the base and is consequently taken as a point load on the transfer girder. Additionally the impact of transfer girder on the above structure is concentrated under gravity and lateral load. The final design of the transfer girder will done in ADAPT Builder.

**Key words**: Post-tensioned, Floating Column, Seismic, ADAPT Builder

I. INTRODUCTION

In tall building column is stopped at ground and first floor level to encourage bigger opening at ground level to make get to agreeable to people in general zone at the base. In 1950's and 1960's, some Europe researchers proposed the soft base level to achieve the substantial openings at the base level. A frame is constructed at base level to support the upper structure in this kind of structure. It is viewed as that this kind of structure has better performance during earthquake, however as indicated by the present encounters, it has been demonstrated that the idea isn't right. In 1978, numerous this kind of building fell during the Romania quake.

A column should be a vertical part beginning from foundation level and exchanging the load to the ground. The term floating column is additionally a vertical component which closes at lower level (end level) of the building because of structural prerequisite and its lay on beam. The beams thusly exchange the load to different columns below it. Practically speaking, the genuine columns below the end level [usually the stilt level] are not constructed with care and more at risk to disappointment.

II. MODELLING

A. Problem Definition

For the purpose of understanding behaviour and design of Post-tensioned transfer girder ETABS 2016 software is utilized. In order to get correct result from the software the correct modelling of structure must be required. To validate the present work with software, following problem of book is taken in order to compare the analysis result given by software with the analytical result.

B. Different models

![Fig. 1: Configuration for case-1](image)

![Fig. 2: Configuration for case-2](image)
Grade of Concrete \( F_{ck} = 25 \) N/mm\(^2\)
Grade of Steel \( F_y = 500 \) N/mm\(^2\)
Density of Concrete \( \gamma_c = 25 \) kN/m\(^3\)
Density of Brick wall \( \gamma = 20 \) kN/m\(^3\)

Table 1: Material Specifications

<table>
<thead>
<tr>
<th>Earthquake zone</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance factor</td>
<td>1</td>
</tr>
<tr>
<td>Response reduction factor</td>
<td>5</td>
</tr>
<tr>
<td>Wall load</td>
<td>11.04 kN/m</td>
</tr>
<tr>
<td>Parapet wall load</td>
<td>4.6 kN/m</td>
</tr>
<tr>
<td>Typical floor live load</td>
<td>3 kN/m</td>
</tr>
<tr>
<td>Terrace live load</td>
<td>1.5 kN/m</td>
</tr>
</tbody>
</table>

Table 2: Loading

<table>
<thead>
<tr>
<th>Floor level</th>
<th>Typical floor Super dead</th>
<th>Floor finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>2 kN/m</td>
<td>1 kN/m</td>
</tr>
</tbody>
</table>

Table 3: Columns for the Position

All beams having size of 230 mm x 375 mm are passed in analysis result of ETABS.
- All slabs are having the depth of 150 mm in all cases.
- Thickness of Shear wall provided in the case-2, case-4 and case-5 is of 180 mm.
- Column sizes for case-1 and case-2 is same and is given in Table
- Column sizes for case-3, case-4 and case-5 are same and is given in Table
C. Results and Discussion

1) Comparison between Construction Stage & Conventional Analysis

![Bending Moment in Transfer Girder for case-1](image1)

![Shear force in transfer Girder for case-1](image2)

The maximum positive and negative bending moments are linearly increasing as construction stage increases. The maximum positive bending moment in transfer girder (case-1) is 5% more when construction stage analysis is used compare to conventional analysis. The shear forces at support and at floating column are linearly increasing as construction stage increases. The maximum shear force in transfer girder (case-1) is 3% more when construction stage analysis is used compare to conventional analysis. The maximum deflection in transfer girder (case-1) is 5% more when construction stage analysis is used compare to conventional analysis.

![Bending Moment in Transfer Girder for case-2](image3)

![Shear force in transfer Girder for case-2](image4)

The maximum positive and negative bending moments are linearly increasing as construction stage increases. The maximum positive bending moment in transfer girder (case-2) is 5% more when construction stage analysis is used compare to conventional analysis. The shear forces at support and at floating column are linearly increasing as construction stage increases. The maximum shear force in transfer girder (case-2) is 3% more when construction stage analysis is used compare to conventional analysis. The maximum deflection in transfer girder (case-2) is 5% more when construction stage analysis is used compare to conventional analysis.

![Bending Moment in Transfer Girder for case-3](image5)

![Shear force in transfer Girder for case-3](image6)

The maximum positive and negative bending moments are linearly increasing as construction stage increases. The maximum positive bending moment in transfer girder (case-3) is 5% more when construction stage analysis is used compare to conventional analysis. The shear forces at
support and at floating column are linearly increasing as construction stage increases. The maximum shear force in transfer girder (case-3) is 3% more when construction stage analysis is used compare to conventional analysis. The maximum deflection in transfer girder (case-3) is 5% more when construction stage analysis is used compare to conventional analysis.

III. CONCLUSION

1) Construction stage analysis in structure is important to improve the analysis accuracy in terms of displacement, axial force, bending moment and shear force in transfer girder and column near of it and also for structure as a whole.

2) Bending moment and shear force in transfer girder are higher in construction stage analysis which must be consider in design phase for avoiding cracking of the beam and column due to sequence effect.

3) In case of displacement, structure analyzed utilizing construction stage analysis indicates considerable larger displacement which is reality in comparison to conventional analysis in which structure is conceptualized as entire and loaded at the same time after construction which is not reality.

4) The provision of shear wall improves the behavior of transfer girder under earthquake load.

5) The maximum reduction in bending moment is about 85% due to the provision of the shear wall under earthquake load.

6) The beam above the transfer girder shows drastic change in flexural behavior as we construct the floor stage wise, it changes from hogging to ultimately sagging which should be taken care while designing the beams above the transfer girder.

7) In conventional analysis, this flexural behavior change is not getting reflected and it may result into the flexural cracking, if beams are designed considering conventional analysis only.

8) The transfer girder must be design as partially prestressed member to get acceptable depth of girder rather than fully prestressed member.
REFERENCES


