International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 11
July 2016

An Analytical review of Change in Steel Reinforcement of Columns for Building Frame with Infill walls and without Infill Walls .

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Abstract:

In concrete frames, masonry walls are generally provided as infills .These infills are considered as non structural members. In structural calculations, only mass of these infill walls is considered in load calculations. Structural properties such as strength and stiffness are generally neglected. It was observed that the performance of structures containing infill walls was better during earthquake as compared to those without infill walls. Behavior of infill is like a compression member between columns and beams. Compression forces are transferred from one node to another node. Infill walls resist lateral forces. Capacity of resisting lateral forces can be slightly reduced due to openings in the wall. Moment resisting capacity of the frame is appreciably affected because of infill walls. They play significant role to enhance the lateral stiffness of whole frame. Lateral deflection is significantly lowered in the case of infilled frame as compared to the frame without infill walls. In the current topic under study, we have focused on the change in column moments and thereby change in steel

Introduction

The use of a masonry infill to brace a frame combines some of the desirable structural characteristics as well some deficiencies. The high in-plane rigidity of the masonry wall significantly stiffens the otherwise relatively flexible frame, while the brittle masonry in ductile frame, after cracking, can take loads and displacements much larger than it could achieve without the frame .

The wall braces the frame partly by its in-plane shear resistant and partly by its behavior as a diagonal bracing strut in the frame. When the frame is subjected to horizontal loading, it deforms with double curvature bending of the columns and girders. The translation of the upper part of the column in each story and the shortening of the leading diagonal of the fcolumn to lean against the wall as well as to compress the wall along its diagonal.

Three potential modes of failure of the wall arise as a result of its interaction with the frame. The first is a shear failure stepping down through the joints of the masonry, and precipitated by the horizontal shear stresses in the bed joints. The second is a diagonal cracking of the wall through the masonry along a line or lines, parallel to the leading diagonal and caused by tensile stresses perpendicular to the leading diagonal. The "perpendicular" tensile stresses are caused by the divergence of the compressive stress trajectories on opposite sides of the leading diagonal as they approach the middle region of the infill. The diagonal cracking is initiated at and spreads from the middle of the infill, where the tensile stresses are a maximum, tending to stop near the

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e-ISSN: 2348-795X
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compression corners, where the tension is suppressed. In the third mode of failure, a corner of the infill at one of the ends of the diagonal strut may be crushed against the frame due to the high compressive stresses in the corner. The nature of the forces in the frame can be understood by referring to the analogous braced frame. The windward column is in tension and the leeward column is in compression. Since the infill bears on the frame not as a concentrated force exactly at the corners, but over short lengths of the beam and column adjacent to each compression corner, the frame members are subjected also to transverse shear and a small amount of bending. Consequently, the frame members or their connections are liable to fail by axial force or shear, and especially by tension at the base of the windward column.

EXPERIMENTAL PROGRAMME

An example of five storey was taken for analysis. It was analyzed for both the conditions. One with infill masonry walls and another without infill masonry walls. STAAD Pro software was used for structural analysis of these frames. Following data was used in analysis.

- Type of frame: RCC moment resisting frame
- Seismic Zone III
- Number of Storey 5
- Floor Height 3.50m
- Thickness of slab 0.10m
- Size of Columns 700mmx300mm
- Spacing between frames 3.50m
- Live Load on Floor 20kN/m^2
- Load of Floor Finish 50Kn/m^2
- Water Proofing 25Kn/m^2
- Grade of Concrete M20
- Grade of Steel Fe415
- Material of Infill Masonry Brick
- Density of Concrete 25Kn/m^2
- Density of Infill 20kN/m^2
- Type of soil Medium
- Response Spectra as per IS1893(Part-I)2002

Analysis was carried out as per IS 1893(Part-I)2002 for both the models using STAAD Pro V 8i software. Lateral load calculation and its distribution along height was done. Seismic load was calculated using full dead load and 50% live load. Wind loads were calculated as per IS875.Following load combinations were used for analysis.

1. DL(self weight)
2. DL(self weight + wall load)
3. DL(floor weight)
4. Live Load
5. WIND- X
6. WIND-Z
7. SEISMIC_X
8. SEISMIC_Z
9. 1.5(DL+LL)

10. 1.2(DL+LL+WINDX)
11. 1.2(DL+LL+WINDZ)
12. 1.2(DL+LL-WINDX)
13. 1.2(DL+LL-WINDZ)
14. 1.2(DL+LL+SEISMICX)
15. 1.2(DL+LL+SEISMICZ)
16. 1.2(DL+LL-SEISMICX)
17. 1.2(DL+LL-SEISMICZ)
18. 1.5(DL+WINDX)
19. 1.5(DL+WINDZ)
20. 1.5(DL-WINDX)
21. 1.5(DL-WINDZ)
22. 1.5(DL+SEISMICX)
23. 1.5(DL+SEISMICZ)
24. 1.5(DL-SEISMICX)
25. 1.5(DL-SEISMICZ)
26. 0.90(DL)+1.5(SEISMICX)
27. 0.90(DL)+1.5(SEISMICZ)
28. 0.90(DL)-1.5(SEISMICX)
29. 0.90(DL)-1.5(SEISMICZ)

Modeling and analysis of structure on STAAD PRO was carried out with all load combinations as per IS1893 (PART 1):2002 The maximum effect for columns and beams for all load combinations was considered for design. In our design approach the design forces of columns are not completely based on linear elastic analysis. These forces depend upon the actual flexural capacities of beams framing in to same joint, so that plastic hinges may not form at the base of column above and at the top of column below the joint(except at the base of the column of a ground storey).

CONCLUSION:

Behavior of infill is like a compression member between columns and beams. Compression forces are transferred from one node to another node. Infill walls resist lateral forces. Capacity of resisting lateral forces can be slightly reduced due to openings in the wall. Moment resisting capacity of the frame is appreciably affected because of infill walls. They play significant role to enhance the lateral stiffness of whole frame. Adverse effect can be observed for frames having partial infills. Lateral deflection is significantly lowered in the case of infilled frame as compared to the frame without infill walls.

In the current topic under study we have focused on the changes in column moments and thereby change in steel requirement in columns due to infill walls. Some of the columns were studied for steel requirement in case of infill walls and without infill walls. We observe that the requirement for steel in columns changes appreciably due to infills. This requirement increases from 11.86% to 97.07% if infills are considered in frame in comparison to bare frame.

p-ISSN: 2348-6848
e-ISSN: 2348-795X
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