ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 4, April 2018

Behavior of Transfer Girder for Different Shear Wall Locations

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***Abstract*— Today many high rise building adopted floating column for parking, assembly hall purposes. The load of floating column is a point load which is taken by transfer girder. These type of structure are danger in highly earthquake prone area because storey shear from all higher floor are not transfer to ground due to this discontinuity. This type of structure also called as stiffness irregularity. Shear wall is use in high rise structure to resist earthquake load and other lateral loads such as wind load. In particular structure floating column & shear wall used combine. For this type of structure we don't know best position of shear wall to reduce structural response of transfer girder. To find out best position of shear wall we analyze several model such as 10,15,20,25,30 storey with different shear wall locations and compare structural responses of transfer girder by conventional, construction stage analysis with EQ zone-IV and wind analysis with wind speed 47m/s in the form of bending moments, shear force and displacement with the help of ETABS V 2015.**

***Index Terms*— Construction stage analysis, ETABS, shear wall, transfer girder, floating column, risk coefficient.**

I. INTRODUCTION

Today many residential and commercial building adopted floating column to provide open space for parking, assembly hall purposes and also provide for good aesthetic view. During earthquake storey shear need to be transferred down to the ground by the shortest path; any discontinuity in the structural member results in change in the load path. Building having vertical setback cause a sudden variation in earthquake forces at the level of discontinuity. The discontinuities in the load path are formed in the buildings with floating columns at an intermediate storey or ground storey and do not continue up to foundation. Shear wall are provide for high rise building to resist lateral loads. These walls generally start from foundation level and they are continuous throughout the floor of the building. They can have minimum thickness of 150-600mm.Shear wall provide lateral stiffness to structure to resist earthquake and wind loading. For high rise structure contain floating column and transfer girder, we also provide shear wall to reduce lateral movement of structure. Shear wall also reduce the structural responses of transfer girder at different positions. Wind analysis is the behavior of building i.e. laterally for wind or air. Wind analysis is essential for high rise structure because we are going to 30 m above from plinth level wind pressure is very high. For this reason wind analysis is done for most of the building in the software.

Generally, the structures are analyzed and designed using one step using conventional analysis or seismic analysis on the assumption that the structure will be fully loaded at once. But in actual practice, the structure is constructed storey by storey hence dead load is applied storey-wise and the finishing loads are also imposed as the structure is constructed in stage wise. Conventional analysis or the seismic analysis is carried out in a one step whereas the construction stage analysis is carried out considering the actual sequence of construction of the building. To get the sequential effects, each story should be analyzed with its next stories by assigning the vertical loads as stage wise using ETABS. The effects of the sequential or stage-wise construction can be seen and understood once the construction sequential analysis is completed. This type of analysis is complex in nature but due to advancement of structural software, this is done quickly. This type of analysis gives actual behavior of structure, and we are also take this analysis result for design of structure in more precisely.

II. LITERATURE REVIEW

Meghana B.S and T.H. Sadashiva Murthy (2016) [1], reviews on RC and steel-concrete composite building with floating column in different places in plan. Different buildings such as G+3, G+10 and G+15 storey in earthquake zone II and V were analyzed using conventional analysis using ETABS software. Structural responses such as storey shear, storey drift and storey displacement were compared with the results of normal RC building.

Sri Harsha B and Vikranth J (2014) [2], investigate about the factor which is affecting limit state of serviceability of structure that is sequential construction and strength of concrete. Here two cases, conventional analysis for building subjected to whole loading construction stage analysis for the building subjected to stage loading are considered and deformation in both the cases are compared with two analysis. R.Pranay,I.Yamini Sreevalli,Er.Thota.Suneel Kumar (2014) [3], It take G+21 storey structure and analyze for conventional method and construction sequence method. Compare bending moment, displacement and shear force of transfer girder which is provide at 1st floor at two loacation by construction stage analysis and conventional analysis. Vignesh Kini K., Rajeeva S.V.(2017) [4], investigate about the behavior of composite and RCC girder and there comparison for response spectrum analysis and construction sequence analysis for zone-II in the form of bending moments, displacement and shear force of transfer girder, with the help of CSI ETABS 2016. Meghna B.S and T.H Sadashiva Murthy (2016) [5], here a RC building structure of G+ 5 storey with floating column in exterior position and RC transfer girder is replaced by composite transfer girder and the analysis of the model is carried out with the help of ETABS software. The analysis involved here are conventional analysis and construction sequence analysis and the parameter such as beam moments and deflection of both the buildings are compared.

Yousuf Dinar, Munshi Md. Rasel, Muhammad Junaid Absar Chaudhary, Md. Abu Ashraf (2014)] [6], reviews about the rigid frame structures of both concrete and steel model of different configurations that have been taken for sequential analysis. The analysis result helps us to understand how the structure respond against loads of construction sequential analysis and linear static analysis. The sequential analysis results were compared with conventional analysis results. The effect of sequential construction and its effect on the overall design of the building has been evaluated using finite element modeling. In this work, multi-storey buildings of 5, 10, 15, 20, 25 and 30 storey with a floating column in exterior position is considered. The parameters like column axial load and beam maximum moment is compared with both the analysis using ETABS 9.7.2 software.

Viji R. Kumar and Binol Varghese (2017) [7],review that a G+29 RCC structure with transfer girder at four locations are analyze for construction sequence and conventional method for zone-II and compared there bending moments, shear forces and displacements for geometric nonlinearity material nonlinearity. Tabassum G Shrihatti and Vanakudre S.B (2015) [8] ,investigate the effects of conventional analysis and the construction stage analysis RC and steel buildings. Three-dimensional modeling of RCC and steel 30 storey building situated in zone IV and hard soil type is consider and the analysis results are obtained. In both the buildings the frames are consider as rigid frame. Finally, the results like shear force, bending moment and displacements were compared with both the conventional model and construction sequence model of RCC and building respectively using the ETABS-2013 software.

III. OBJECTIVE

a) To study the response and behavior of 10,15,20,25,30 storey RC building with floating column at exterior position of frame ,situated in zone-IV for different cases of each storey i.e. Without shear wall, SW at core, corner ,periphery.
b) To compare the parameter such as maximum bending moment, shear force and maximum deflection of transfer beam by three method and different cases with floating columns above the transfer girder.
c) To find most suitable position of Shear wall to reduce structural response of transfer girder during wind, construction and earthquake.

IV. METHODOLOGY

The RC structure with transfer girder and floating column in exterior position at four location are analyzed using wind analysis, conventional analysis, construction sequence analysis with the help of ETABS V-2015.
Total No. of Models:-

Table-1: Total No. of models

Storey	Without SW	SW at Core	SW at Corner	SW at periphery
10	Case-1	Case-2	Case-3	Case-4
15	Case-5	Case-6	Case-7	Case-8
20	Case-9	Case-10	Case-11	Case-12
25	Case-13	Case-14	Case-15	Case-16
30	Case-17	Case-18	Case-19	Case-20

V. BUILDING DESCRIPTION

The structure considered here is a residential building with plan dimension of 25m×25m.In the present study a

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 4, April 2018

10,15,20,25,30 storey RC structure with floating columns at exterior position in seismic zone IV is consider for analysis. The height of each storey is 3m and bay spacing in both direction is 5m.For wind load IS: 875 1987 part-3 is used and IS:1893 (part-1) 2002 is used for seismic loadings and IS: 14687 1999 is used for construction sequence analysis

Table-2: Structural data of RC framed structure

Dimension of building	25m×25m
Number of stories	10,15,20,25,30.
Height of each storey	3m
Height of ground floor	4.3m
Dimension of beam	300×450mm
Dimension of transfer girder	300×1800mm
Dimension of columns	2000×2000mm
Dimension of floating column	230×600mm
Thickness of slab	150mm
Thickness of exterior wall	230mm
Thickness of interior wall	115mm
Seismic zone	IV(Delhi)
Zone factor	0.24
Importance factor	1
Response reduction factor	3
Live load	3kN/m^2
Floor finish	1kN/m^2
Live load on roof	1.5kN/m^2
Density of masonry wall	19kN/m^3
Thickness of shear wall	300mm
Type of soil	Medium
Wind speed	47m/s
Windward coefficient	1.25
Leeward Coefficient	0.5
Risk coefficient	1
Topography Coefficient	1
Grade of steel	Fe550
Grade of concrete	M60

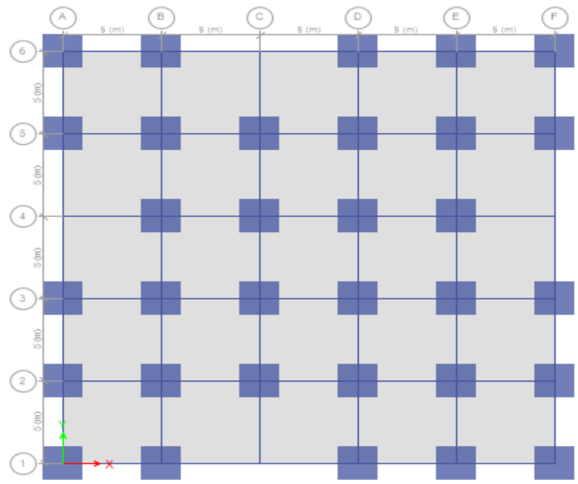

Fig.-2: Plan view with floating column at exterior side of frame

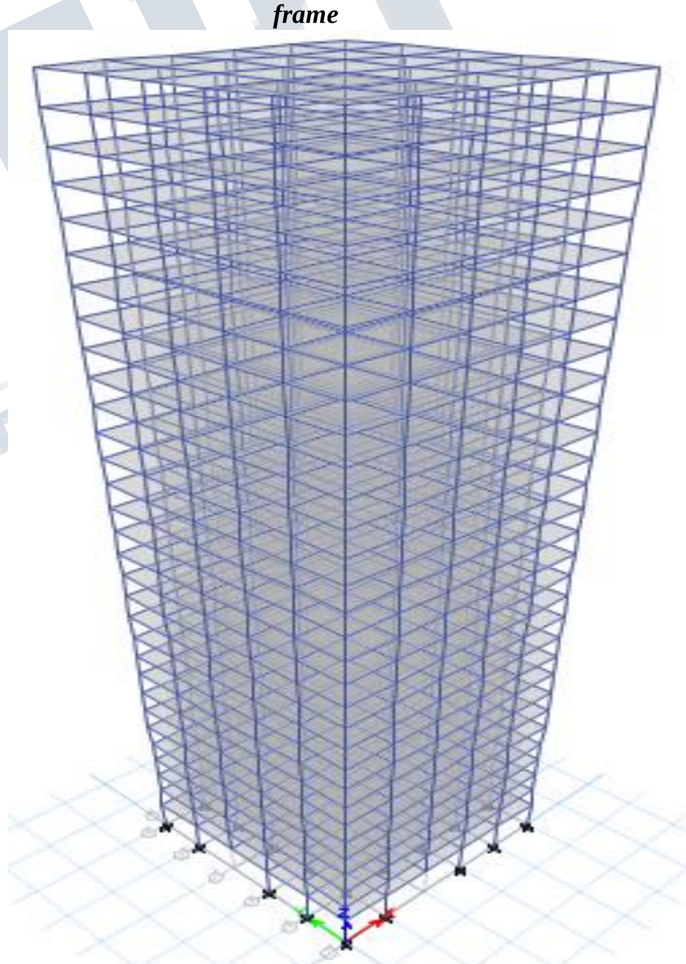

Fig.-4: 3D –View of 30 Storey building

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ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 4, April 2018

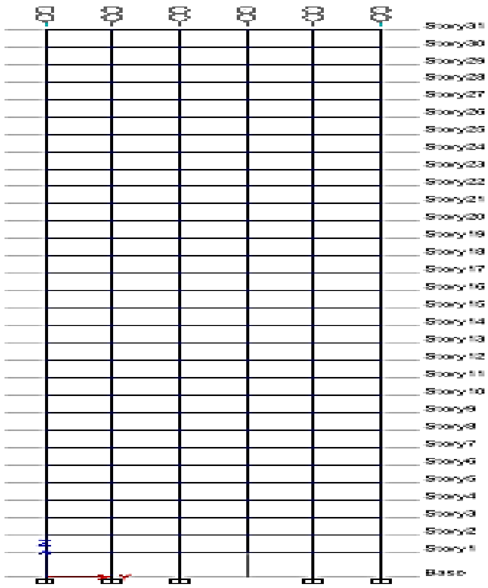
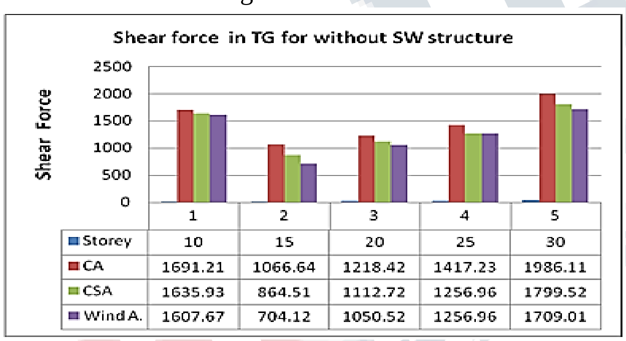


Fig.- 3: Elevation of typical 30 storey building

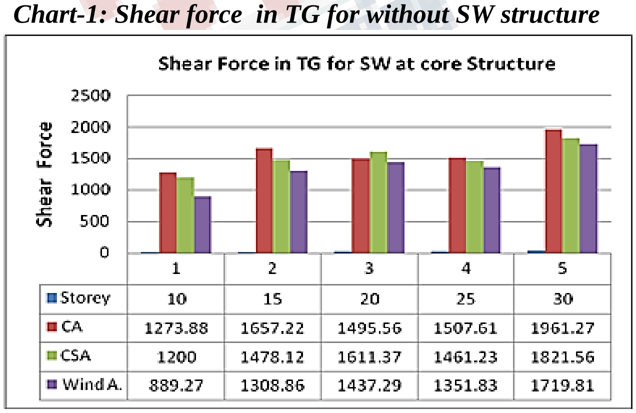
VI. RESULT AND DISCUSSION

Shear force in transfer girder for different cases:



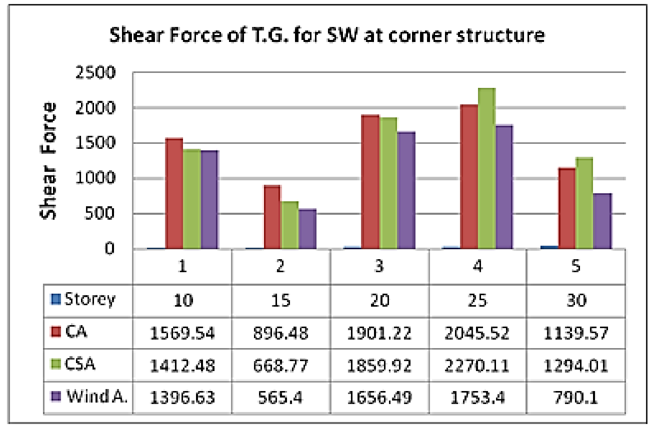
	1	2	3	4	5
Storey	10	15	20	25	30
CA	1691.21	1066.64	1218.42	1417.23	1986.11
CSA	1635.93	864.51	1112.72	1256.96	1799.52
Wind A.	1607.67	704.12	1050.52	1256.96	1709.01

Chart-1: Shear force in TG for without SW structure



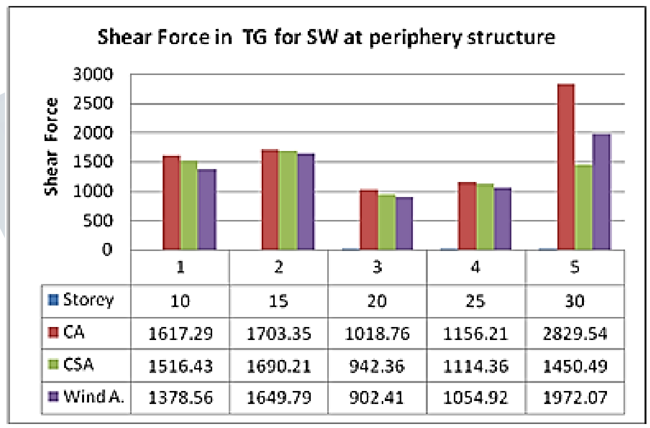
	1	2	3	4	5
Storey	10	15	20	25	30
CA	1273.88	1657.22	1495.56	1507.61	1961.27
CSA	1200	1478.12	1611.37	1461.23	1821.56
Wind A.	889.27	1308.86	1437.29	1351.83	1719.81

Chart-2: Shear Force in TG for SW at core Structure



	1	2	3	4	5
Storey	10	15	20	25	30
CA	1569.54	896.48	1901.22	2045.52	1139.57
CSA	1412.48	668.77	1859.92	2270.11	1294.01
Wind A.	1396.63	565.4	1656.49	1753.4	790.1

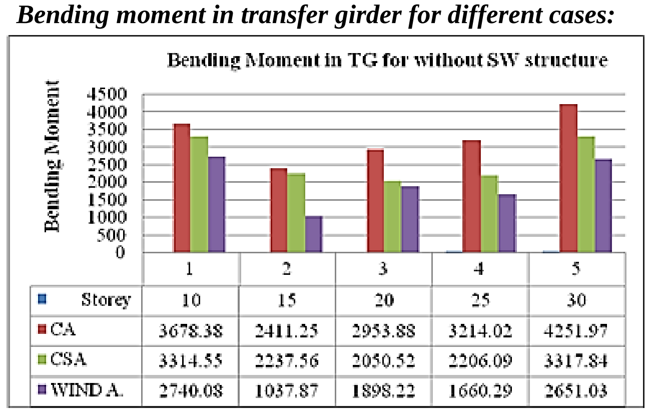
Chart-3: Shear Force of T.G. for SW at corner structure



	1	2	3	4	5
Storey	10	15	20	25	30
CA	1617.29	1703.35	1018.76	1156.21	2829.54
CSA	1516.43	1690.21	942.36	1114.36	1450.49
Wind A.	1378.56	1649.79	902.41	1054.92	1972.07

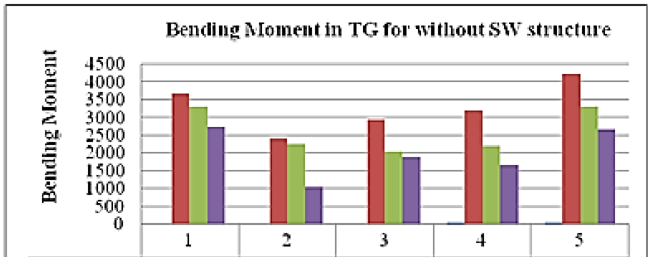
Chart-4: Shear Force in TG for SW at periphery structure

Bending moment in transfer girder for different cases:



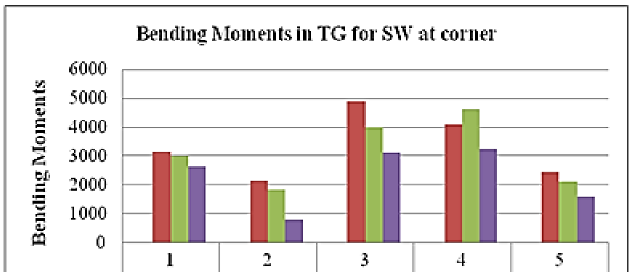
	1	2	3	4	5
Storey	10	15	20	25	30
CA	3678.38	2411.25	2953.88	3214.02	4251.97
CSA	3314.55	2237.56	2050.52	2206.09	3317.84
WIND A.	2740.08	1037.87	1898.22	1660.29	2651.03

Chart-5: Bending Moment in TG for without SW structure



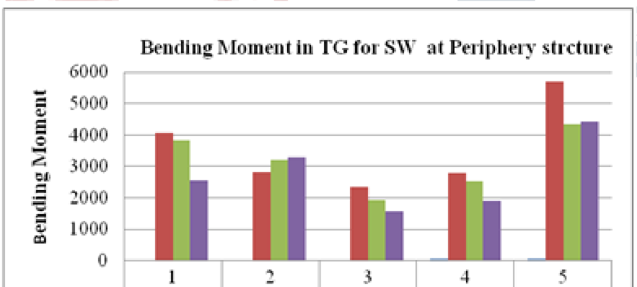
	1	2	3	4	5
Storey	10	15	20	25	30
CA	3678.38	2411.25	2953.88	3214.02	4251.97
CSA	3314.55	2237.56	2050.52	2206.09	3317.84
WIND A.	2740.08	1037.87	1898.22	1660.29	2651.03

Chart-6: Bending moments in TG for SW at core structure



	1	2	3	4	5
Storey	10	15	20	25	30
CA	3167.75	2172.55	4911.99	4100.34	2460.09
CSA	3012.78	1836.78	4000.8	4628.95	2128.78
Wind A.	2659.35	796.51	3113.82	3263.86	1609.9

Chart-7: Bending Moments in TG for SW at corner structure



	1	2	3	4	5
Storey	10	15	20	25	30
CA	4067.93	2816.63	2341.14	2779.25	5699.02
CSA	3842.56	3203.61	1938.42	2517.78	4333.24
Wind A.	2561.11	3308.87	1573.78	1901.94	4429.84

Chart-8: Bending Moment in TG for SW at Periphery structure

From above chart, its clear that bending moment and shear force is maximum for conventional analysis and then for wind analysis. for safety of structure ,building is design for conventional analysis considering earthquake forces.

In previous all research work on transfer girder and floating column, structural responses of girder is critical in construction stage analysis, but in our work conventional analysis method give more critical result than wind and construction stage analysis.

VII. CONCLUSION

a) Transfer girder give less bending moment at 10 and 20 storey cases, when shear wall provided at core.

b) Transfer girder give less bending moment at 15 and 30 storey cases, When shear wall provide at corner.

c) Transfer girder give less bending moment at 25 storey case, for without shear wall.

d) Transfer girder give less shear force at 15 and 30 storey cases, when shear wall provide at corner.

e) Transfer girder give less shear force at 20 and 25 storey cases, when shear wall provide at periphery.

f) Transfer girder give less shear force at 10 storey case, when shear wall provide at core.

g) In most of storey cases, result of conventional analysis is critical and which is adopted for further procedure.

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