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Behaviour of Floating Column in RC Building at Optimum Location under Action of Seismic Load

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Abstract: ***In the last decades the trend of constructing multistorey building and competition between architectural fields has increased to construct milestone projects. For architectural purpose the aesthetic view and unique planning is more important and this requirement is the origin of floating column concept. In these articles a multistory construction for the residential, industrial and commercial has become a common feature. This multistory construction needs ample of parking or open space below or middle the building for large hall etc. And this requirement can be fulfill by introducing floating columns. Generally providing floating columns is not simple as providing regular column. Total 10 building models having regular plan are analyzed (as per Indian standards) and with variation in location of floating columns. The building models with or without floating columns is considered for the analysis. An equivalent static analysis and response spectrum analysis is performed with the help of nonlinear analysis tool (ETABS) to evaluate the response of structure against seismic forces. Storey displacement, Storey drift, storey shear and modal mass participation ratio are evaluated for each model in both horizontal directions.***

Keywords: Floating Columns, Storey Displacement, Storey Drift, Response Spectrum Analysis, Equivalent Static Analysis, Stiffness, Mass Participation Ratio.

I. INTRODUCTION

A column is vertical member in a structural system starting from foundation level to throughout overall height of the structure. Column transfers the gravity load and lateral load of the structure to the ground by mean of foundation. The concept of floating column is introduced in the structural system to fulfill the architectural requirements like open space at ground floor level for utilities like parking, reception lobby, party or assembly hall and closely spaced columns at upper floor. Sometimes aesthetic view is highly mandatory then other parameters at the time many columns have to terminate at floors and floating columns have to introduce. From literature reviews following review are discussed. Floating column buildings are trending among architects because it provides more freedom to provide good planning and good aesthetic view. Floating column is supported with the help of transfer girder which is supported by columns directly connected to ground level. The design of the floating column structure becomes critical in seismically active areas. As we know that distribution of earthquake force depend on the mass and stiffness of the structure and presence of floating columns may change the uniform distribution of earthquake force because floating column directly affect the structure's stiffness. Also structure should have shortest load path which transfer the lateral loads developed at different floor level to the earth without damaging structure but presence of floating columns discontinue the load path and make structure unstable against lateral load resistance. This instability of the structure may cause development of overturning force, column buckling and deformation failure of the beam column joint and total collapse of the structure.

II. METHODOLOGY AND MODELLING

A total number of 20 building models are selected for the thesis with number of storey G+5 and keeping the number of bays 6 in both horizontal directions for regular square and L shape building model and 6 X 8 bays in X and Y direction respectively for rectangular and irregular L shape building model. The storey height and bay width of G+5 storey frame is 3.2 m and 4 m (in both direction) respectively. The frames are assumed to be located in seismic zone IV, the soil type chosen is medium (Type II).

A. Square WOT FC Square building without floating column
B. Square WT FC at BC Square building with floating column at bottom corner
C. Square WT FC at BM Square building with floating column at bottom middle
D. Square WT FC at TC Square building with floating column at top corner
E. Square WT FC at TM Square building with floating column at top middle
F. L Shape WOT FC L Shape building without floating column
G. L Shape WT FC at BC L Shape building with floating column at bottom corner
H. L Shape WT FC at BM L Shape building with floating column at bottom middle
I. L Shape WT FC at TC L Shape building with floating column at top corner
J. L Shape WT FC at TM L Shape building with floating column at top middle

1) *Models*: Each Model Description content the three part i.e. a) Plan b) Elevation & c) 3D view for Square and L Shaped Buildings.

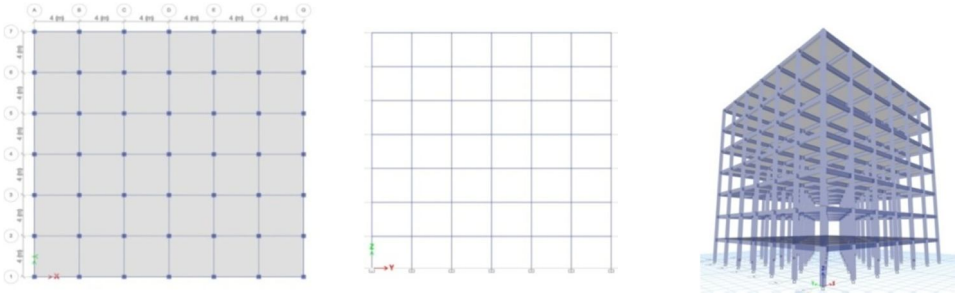

Fig 1: Square building without floating column)

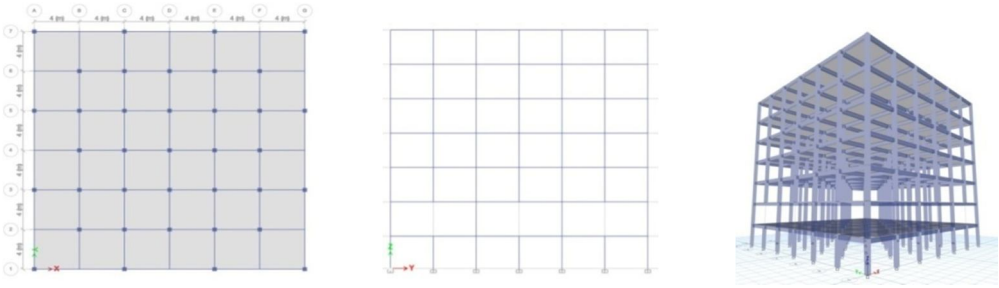

Fig2: Plan and section of square building with floating column at bottom0 corner

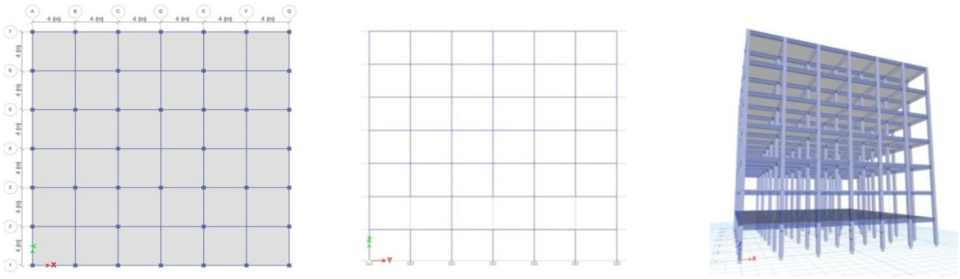

Fig.1 : Plan and section of square building with floating column at bottom middle

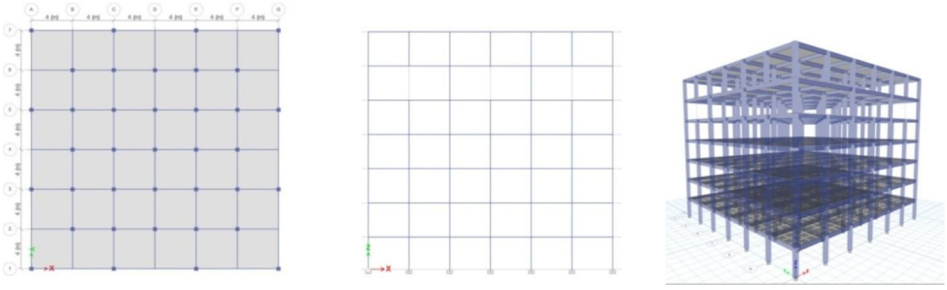

Fig.2 : Plan and section of square building with floating column at top corner

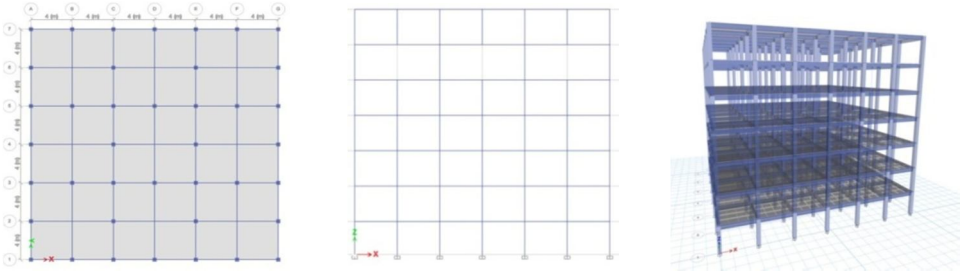

Fig.3 : Plan and section of square building with floating column at top middle

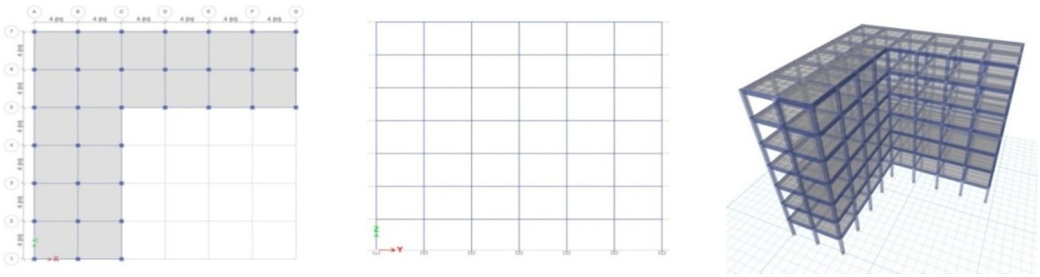

Fig.6 : Plan and section of L shape building without floating column

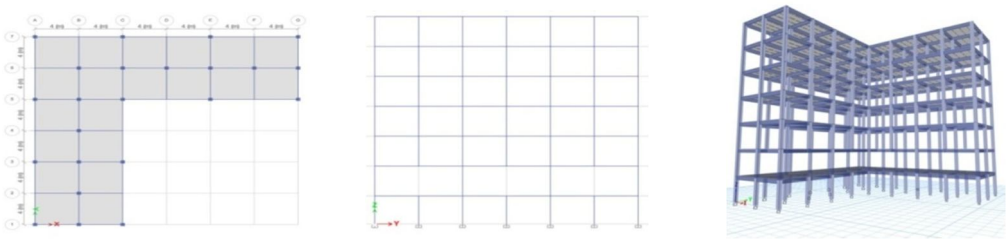

Fig.7: Plan and section of L shape building with floating column at bottom corner

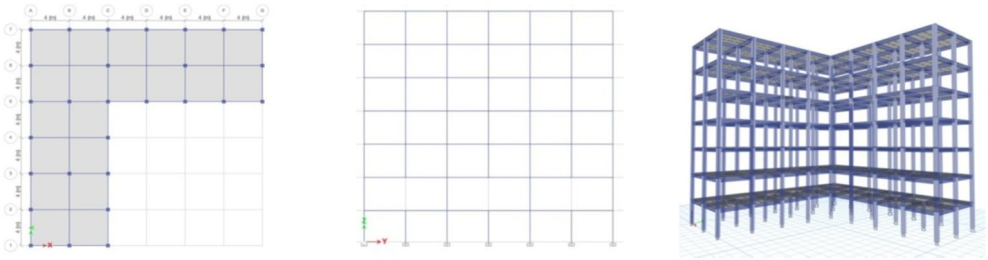

Fig.8: Plan and section of L shape building with floating column at bottom middle

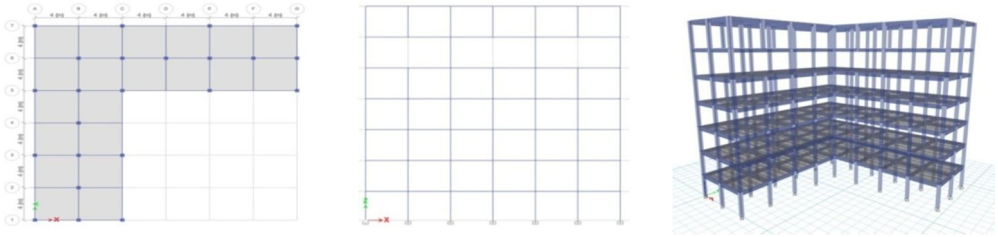

Fig.9 : Plan and section of L shape building with floating column at top corner

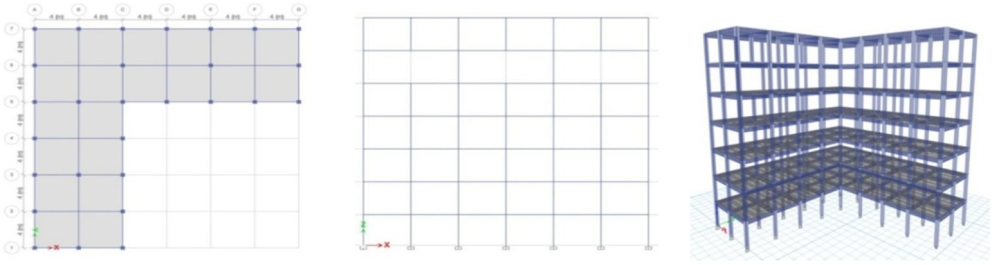

Fig.10 : Plan and section of L shape building with floating column at top middle

2) *Seismic Data:* Zone IV, R factor: 5, I factor: 1, Soil type Type II, RSA method
3) *Material Properties:* Concrete Grade: 25 MPa. The grade rebar: Fe 500 for both main and secondary rebar. The live load of 2 KN/m2 on floor and 1.5 KN/m2 on roof is taken. The unit weight of concrete and brick masonry wall is takes as 25 KN/m3 and 20 KN/m3 (including weight of plaster) respectively. The thickness of the slab is considered as 150 mm with floor finish load of 1.25 KN/m2 on all floors. The thickness of the brick masonry wall is assumed 230 mm (including plaster).

III. RESULT AND DISCUSSIONS

A. *Parameter 1; Storey Displacement Result* (curve between displacement vs. storey no.)

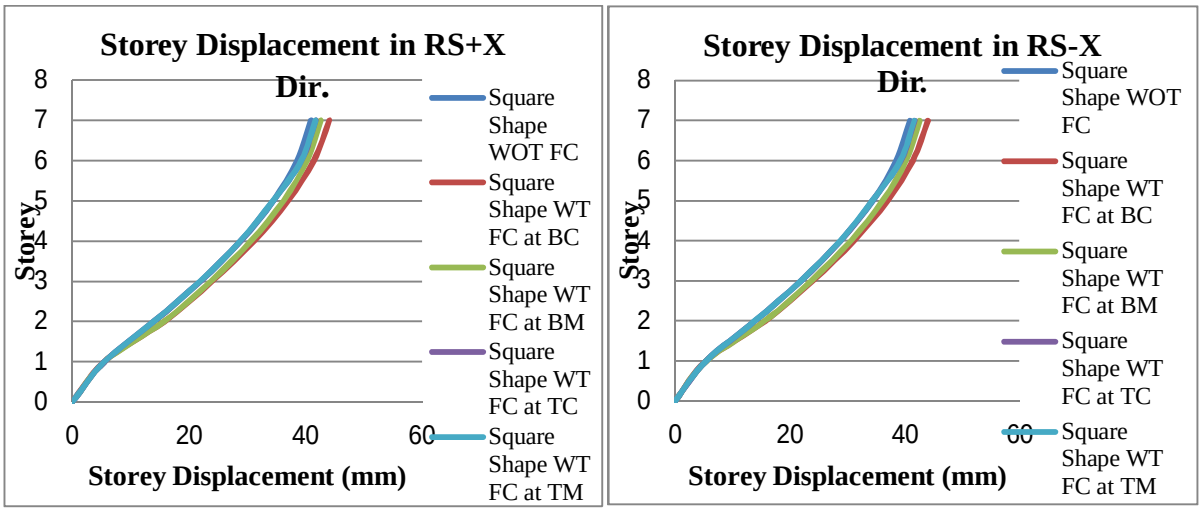

Fig.11: Square Shape Building Storey Displacement in RS + X & RS - X Direction

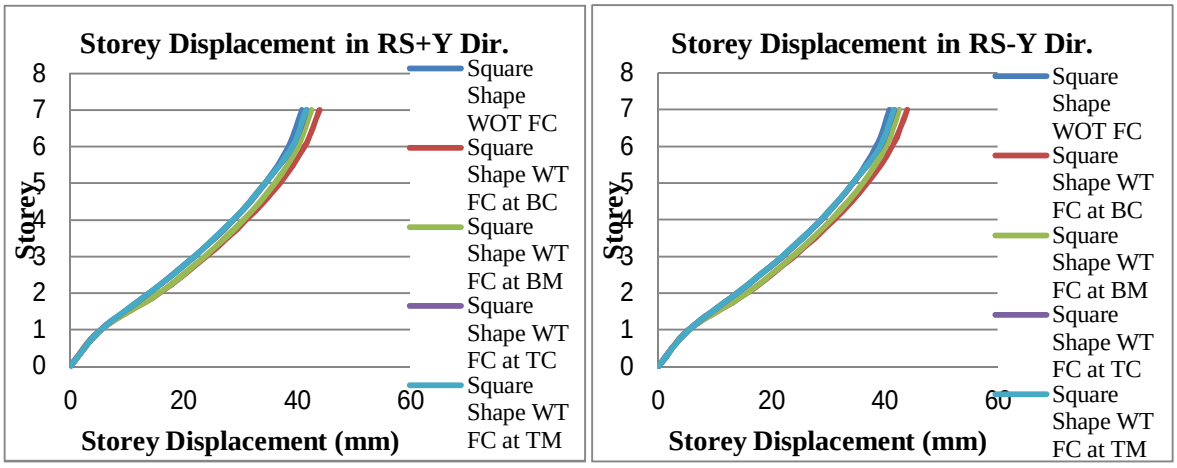

Fig.12 : Square Shape Building Storey Displacement in RS + Y & RS - Y Direction

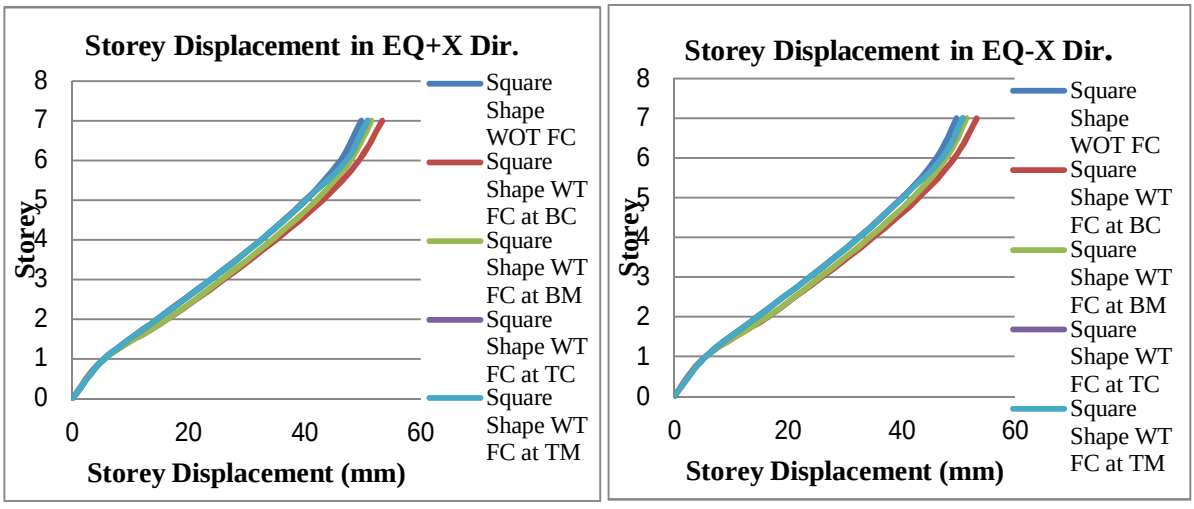

Fig.13: Square Shape Building Storey Displacement in EQ + X& EQ - X Direction

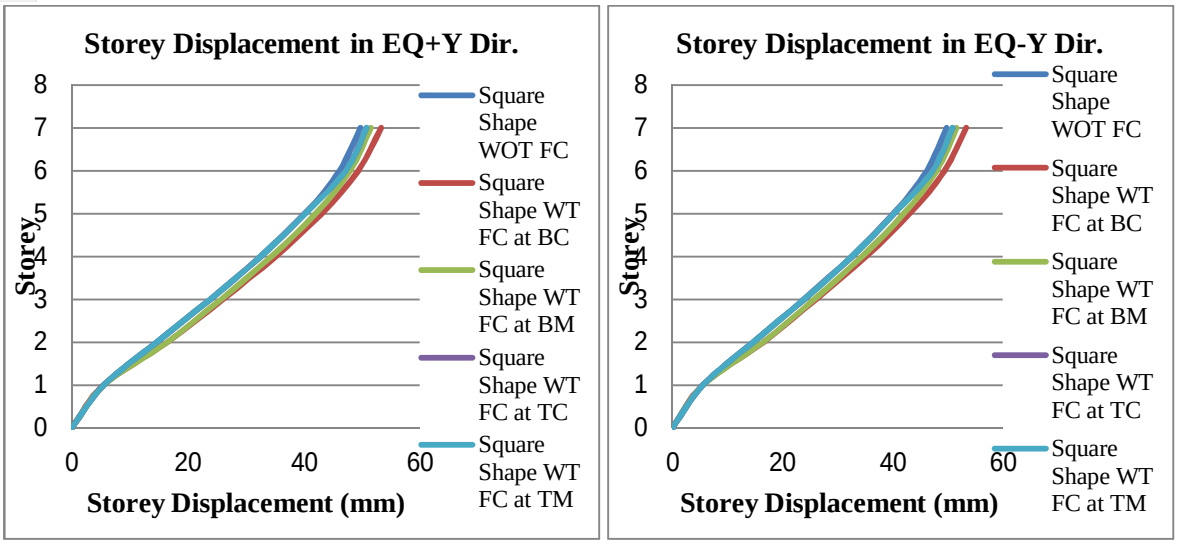

Fig. 14 Square Shape Building Storey Displacement in EQ + Y & EQ - Y Direction

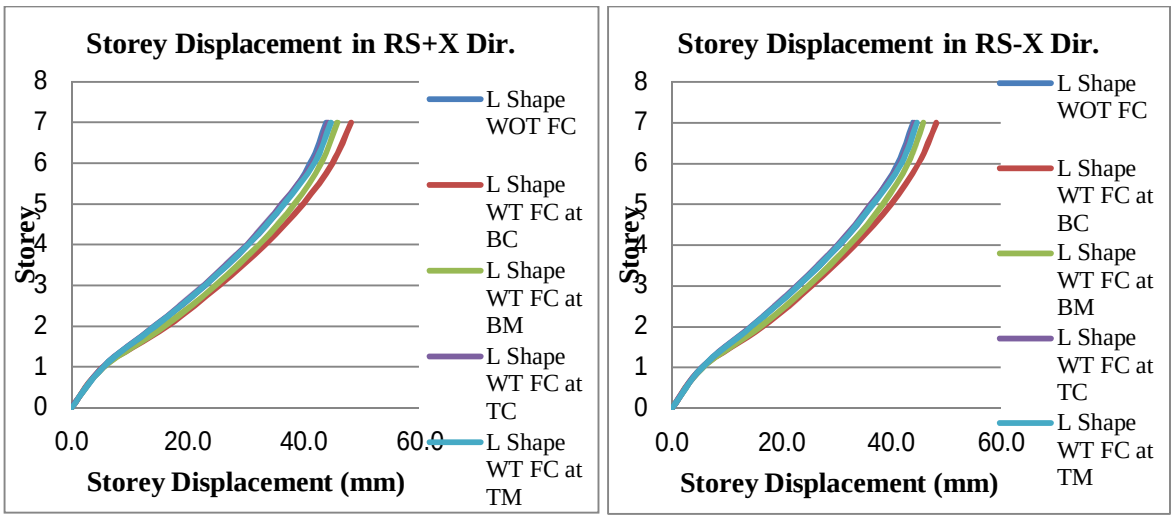

Fig. 15 : L- Shape Building Storey Displacement in RS + X & RS - X Direction

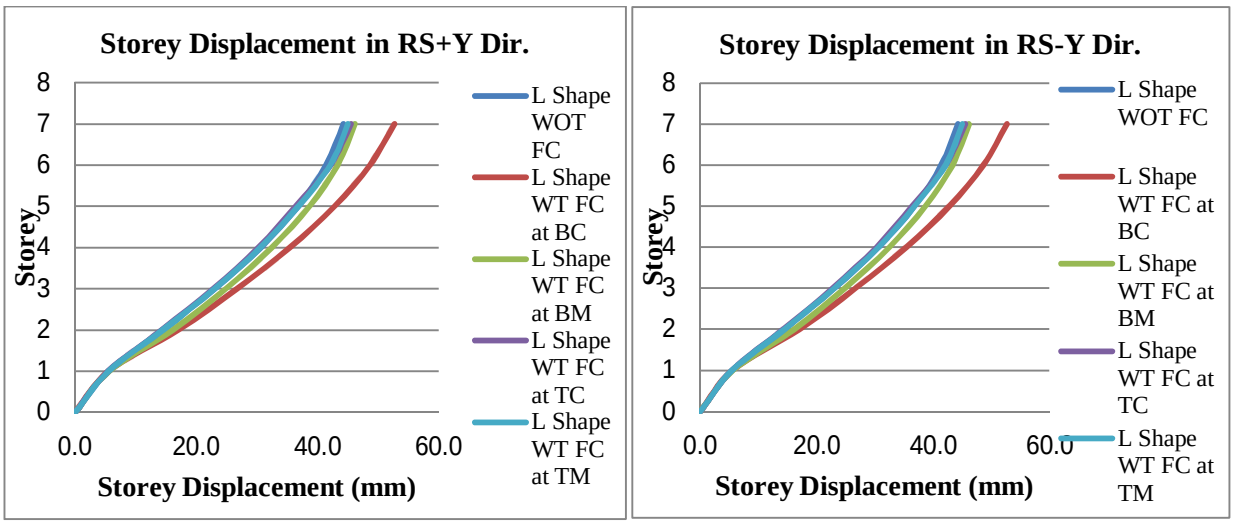

Fig.16: L- Shape Building Storey Displacement in RS + Y & RS - Y Direction

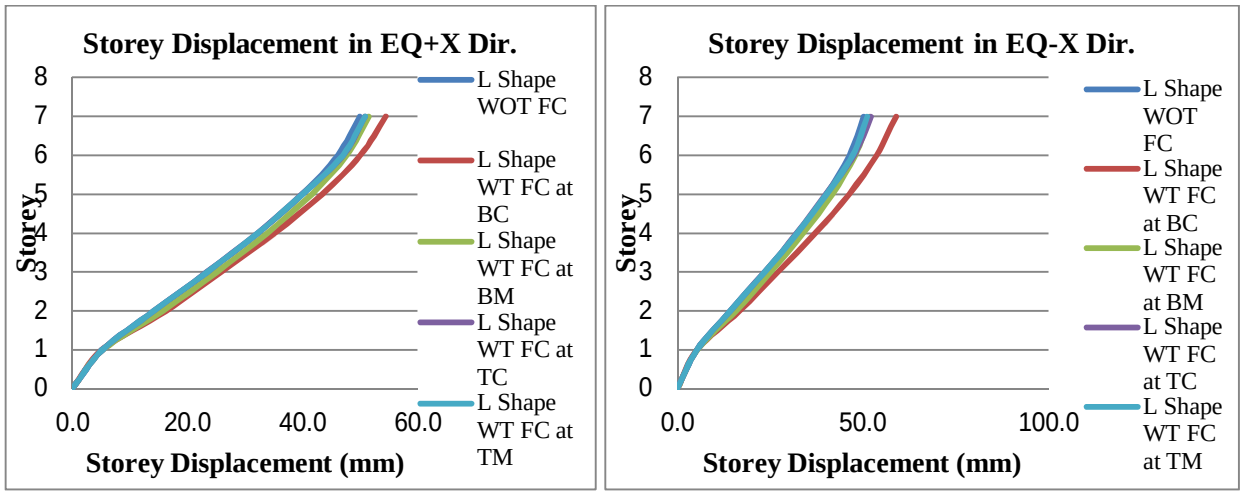

Fig. 17: L- Shape Building Storey Displacement in EQ + X & EQ - X Direction

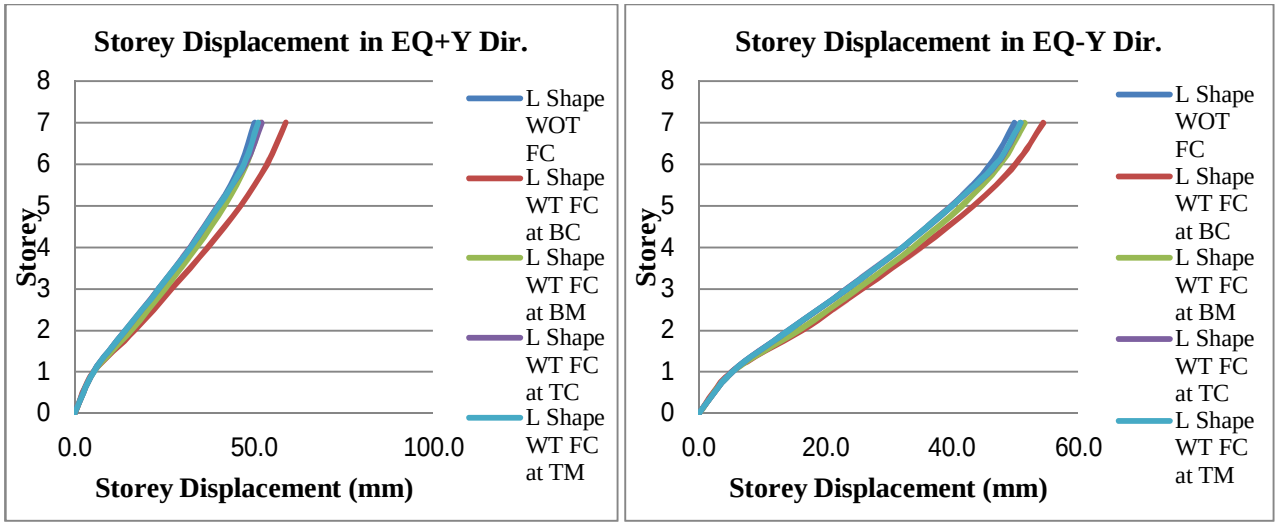

Fig.18: L- Shape Building Storey Displacement in EQ + Y & EQ - Y Direction

B. Parameter 2: Storey Drift

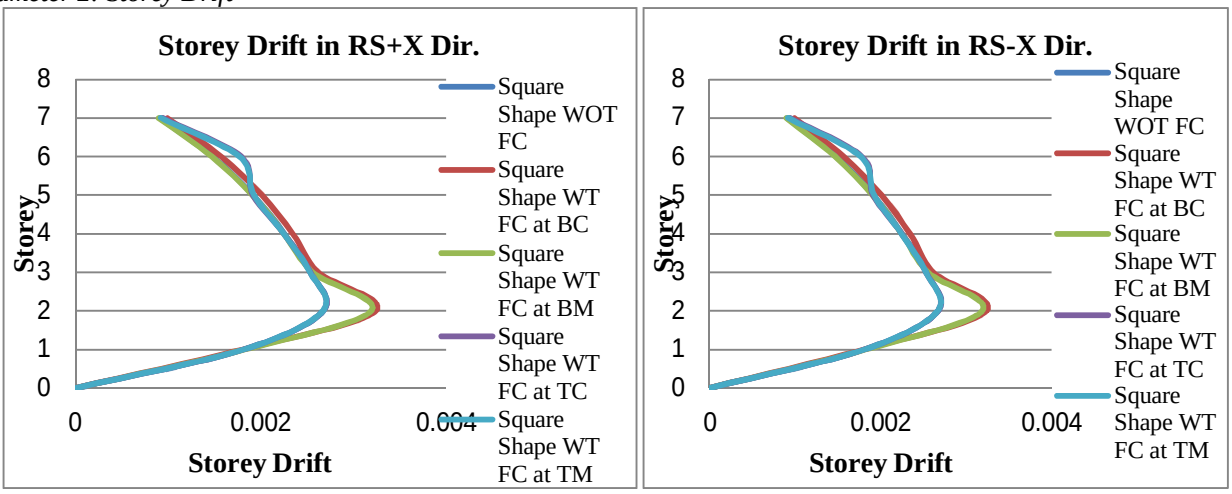

Fig.19: Square Shape Building Storey Drift in RS + X & RS - X Direction

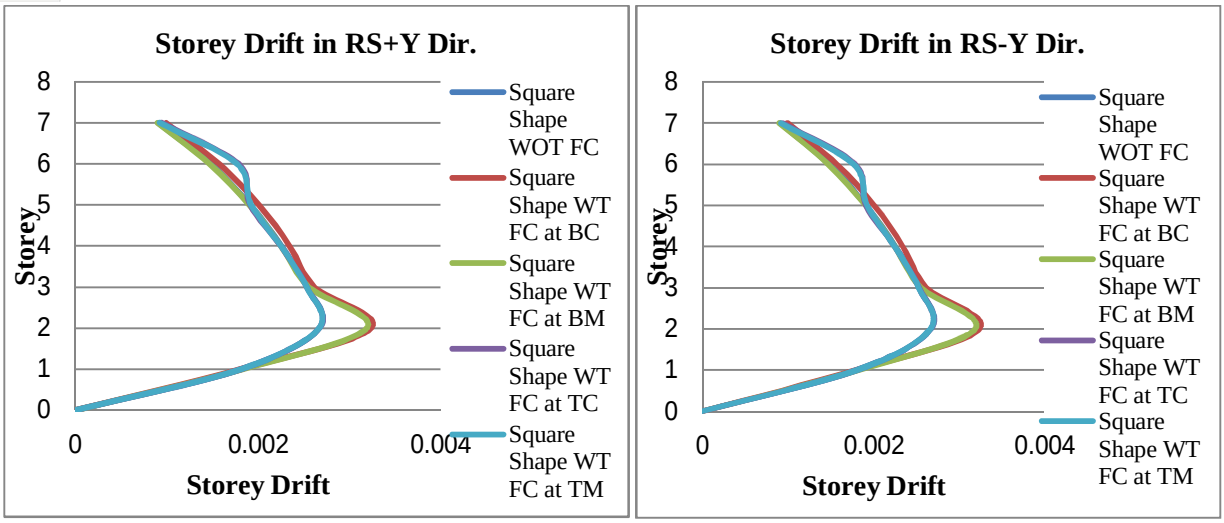

Fig.20: Square Building Storey Drift in RS + Y & RS - Y Direction

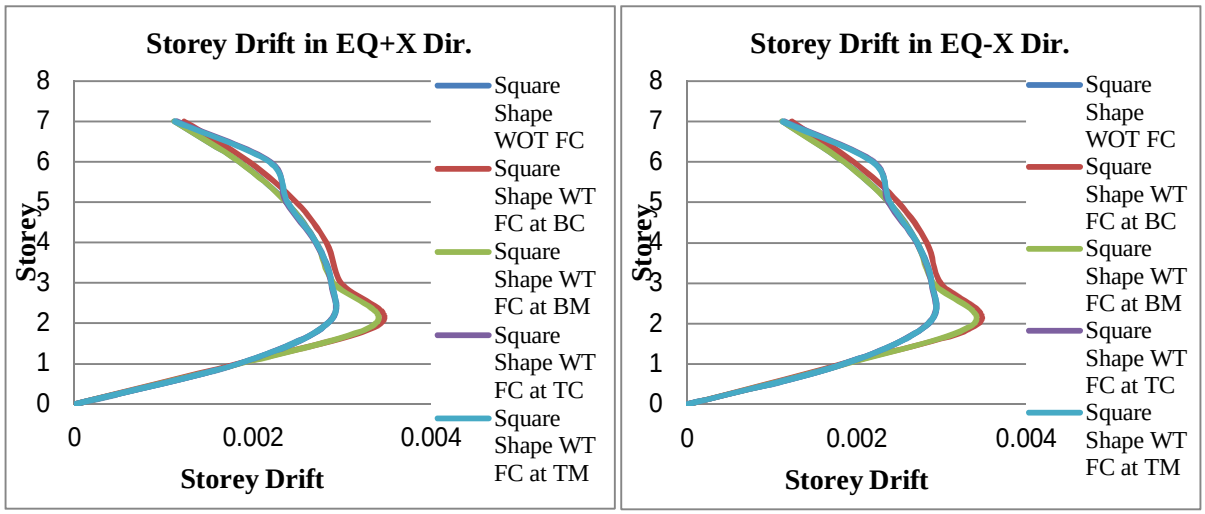

Fig.21: Square Building Storey Drift in EQ + X & EQ - X Direction

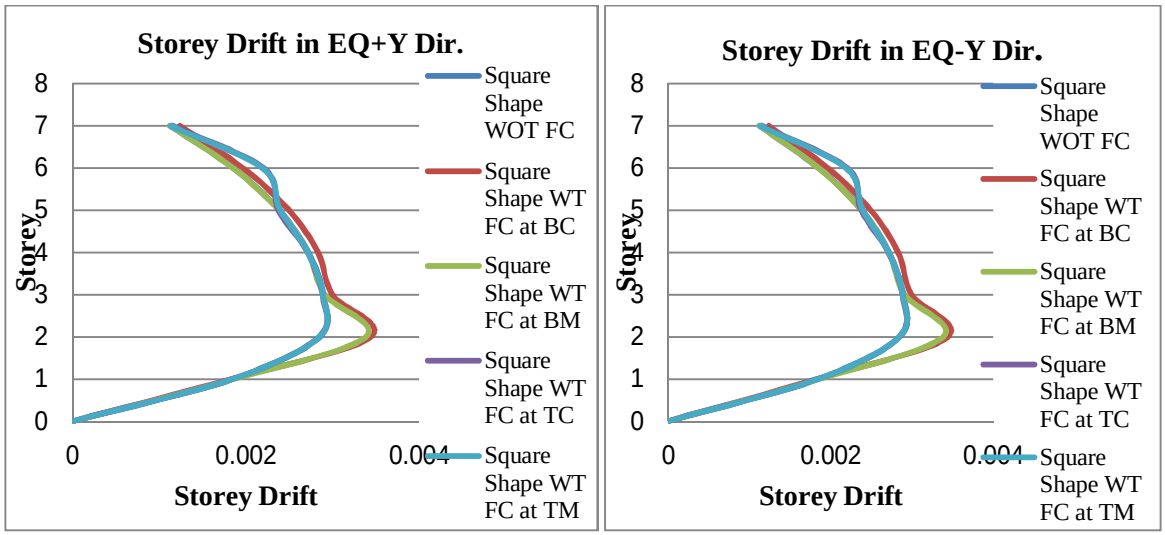

Fig.22: Square Building Storey Drift in EQ + Y & EQ - Y Direction

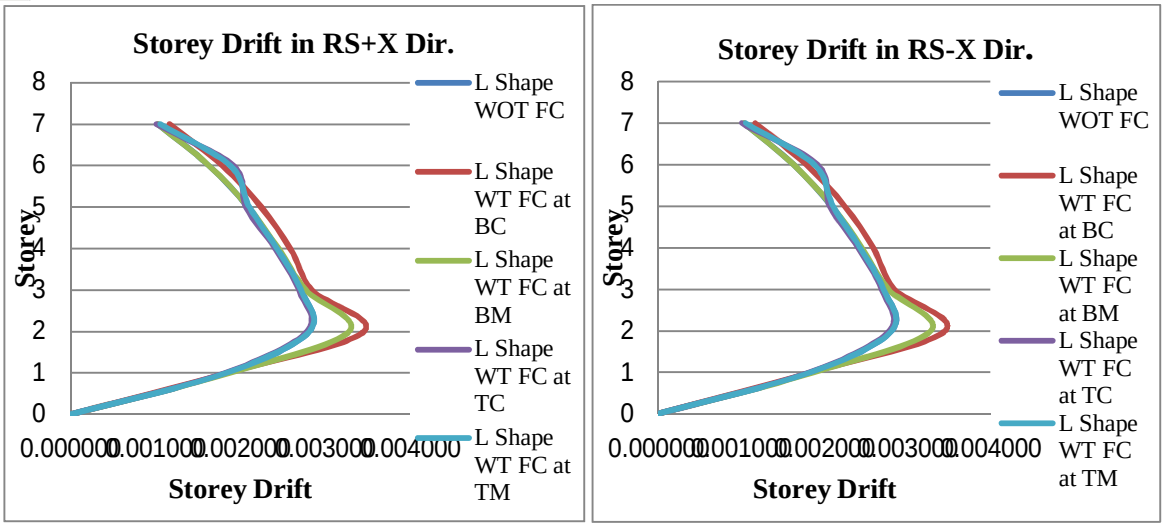

Fig.23: L Shape Building Storey Drift in RS + X & RS - X Direction

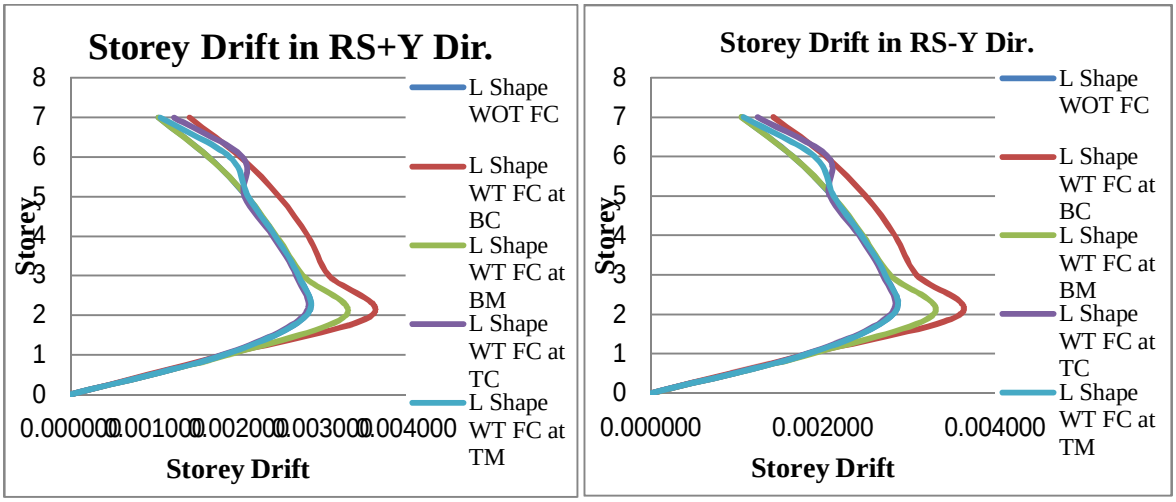

Fig.24: L Shape Building Storey Drift in RS + Y & RS - Y Direction

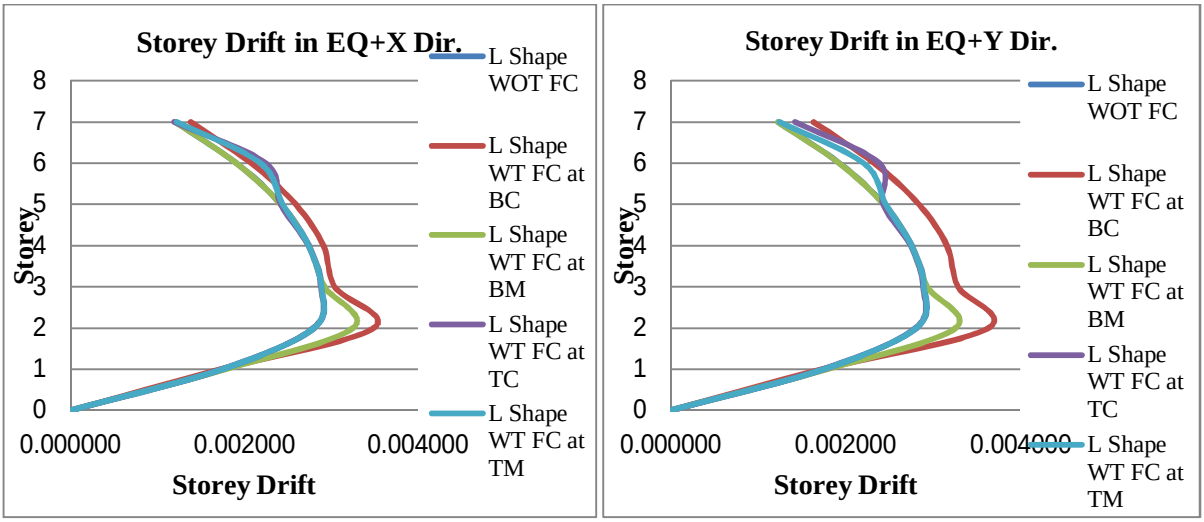

Fig.25 : L Shape Building Storey Drift in EQ + X & EQ - X Direction

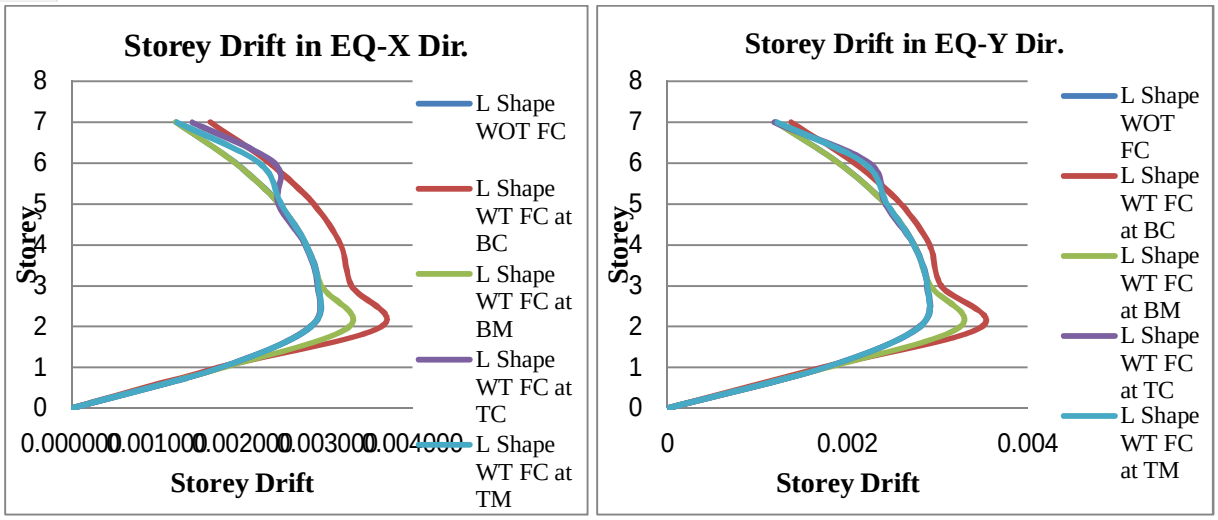

Fig.26: L Shape Building Storey Drift in EQ + Y & EQ - Y Direction

C. Parameter 3: Storey Stiffness

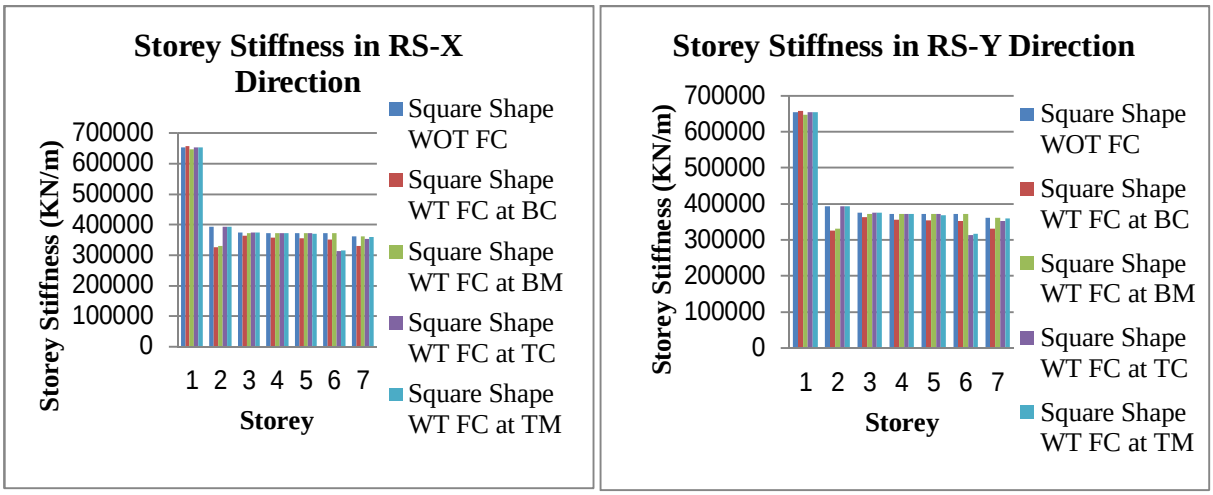

Fig.27: Square Shape Building Stiffness in RS-X & RS-Y Direction

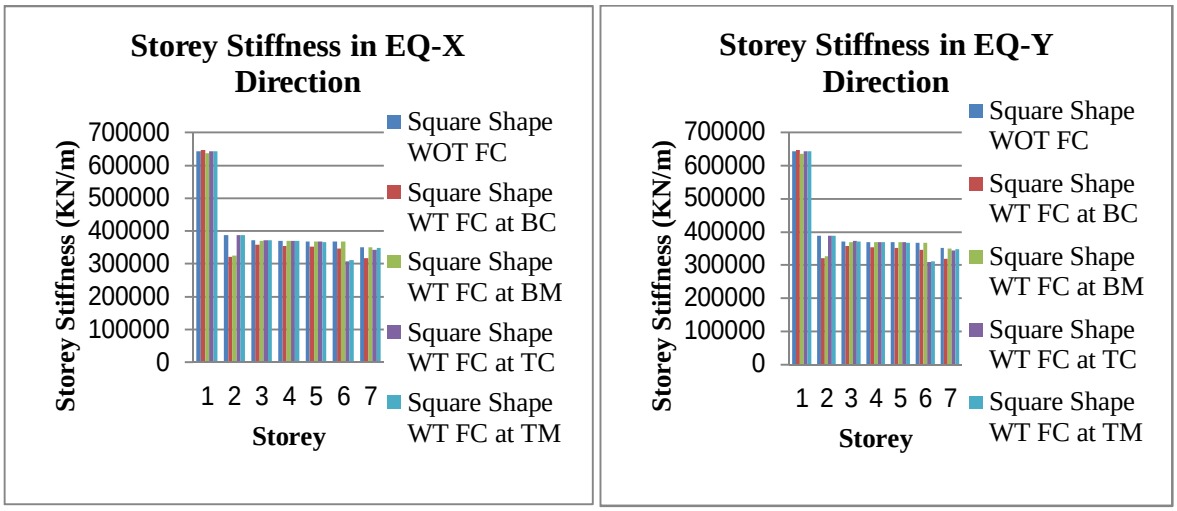

Fig.28: Square Shape Building Stiffness in EQ-X & EQ-Y Direction

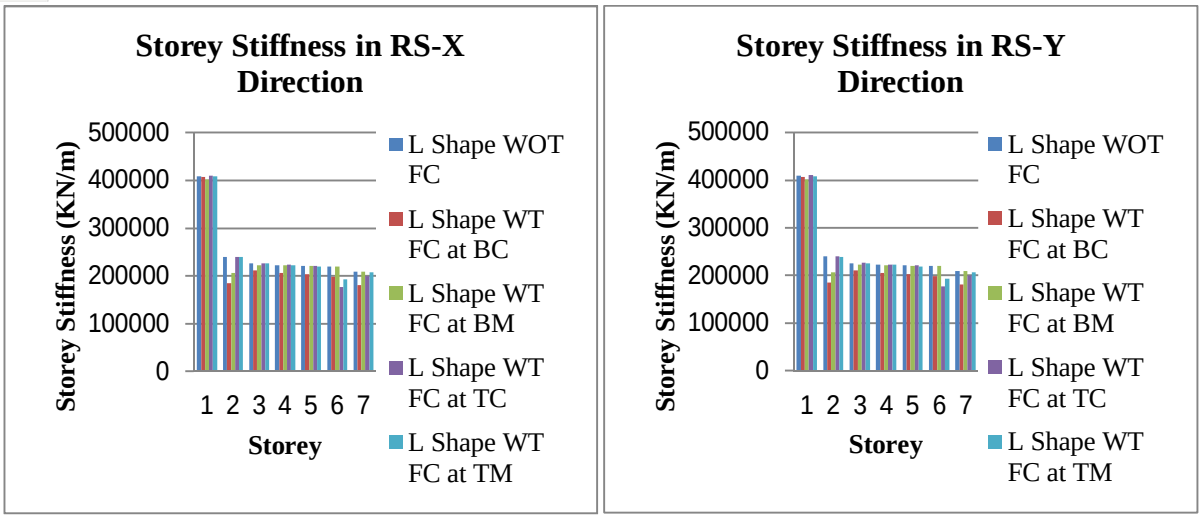

Fig29: L- Shape Building Stiffness in RS-X & RS-Y Direction

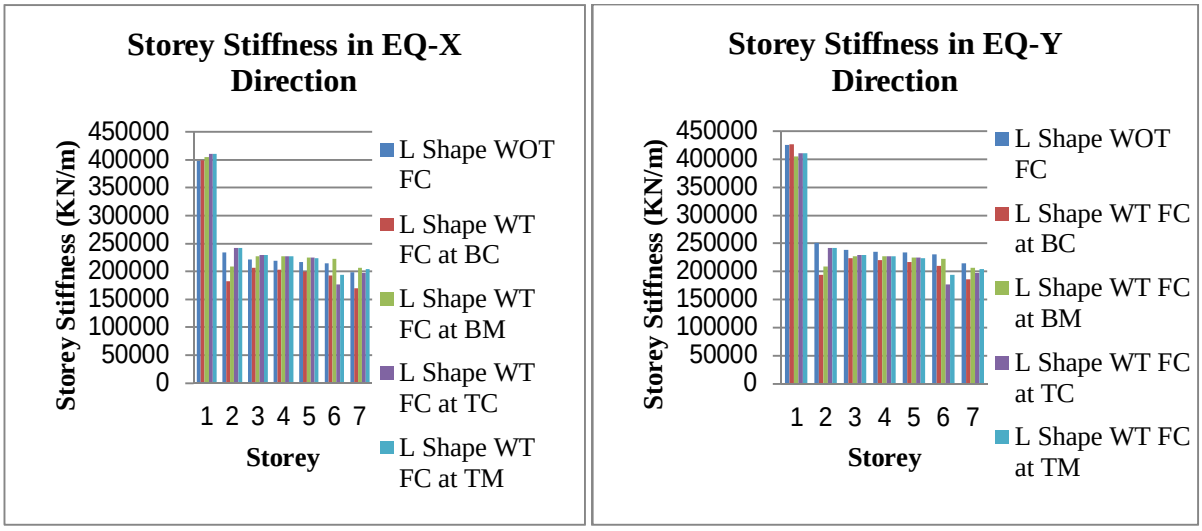

Fig.30: L- Shape Building Stiffness in EQ-X & EQ-Y Direction

IV. CONCLUSIONS

A. The displacement is more for floating column buildings because as the columns are removed the stiffness gets reduced and hence displacement also increases. From the above discussion it has been concluded that providing floating columns at corner location is critical in terms of storey displacement.

B. The displacement is more for floating column buildings because as the columns are removed the stiffness gets reduced and hence drift also increases. From the above discussion it has been concluded that providing floating columns at corner location is critical in terms of storey drift.

C. Presence of floating columns at bottom corner location affect the stiffness at all floor level.

D. Presence of floating columns at bottom middle location affects the storey level stiffness.

E. Presence of floating columns at top corner and top middle affects the storey level stiffness.

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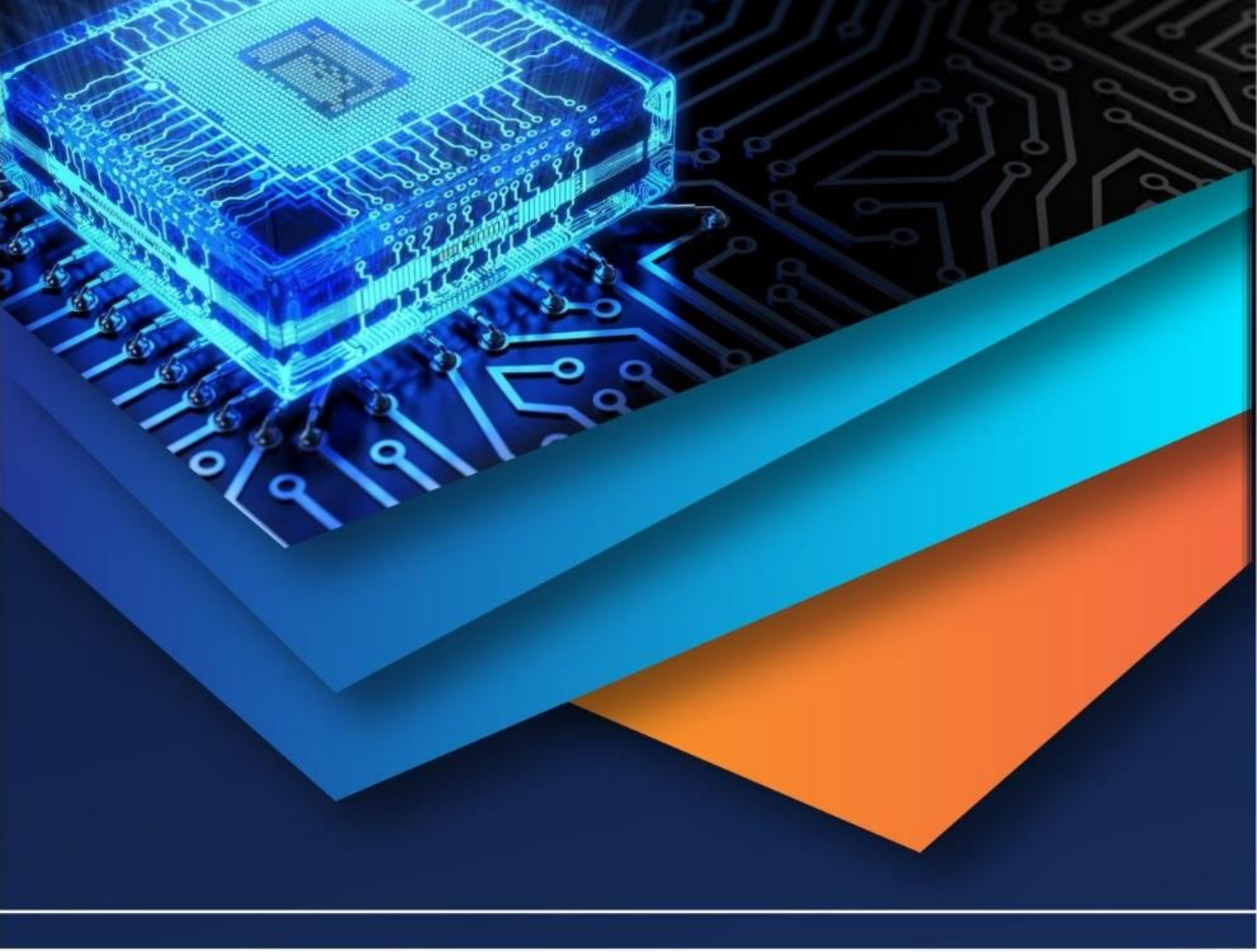

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