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Analysis and structural performance of high rise building with core & outrigger system

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Abstract
In the type of conventional landing system, beams or exhaust farms are connected directly to the bearing frame or sliding walls near the core and to the overlaps of the columns located outside the core. Mostly, but it's not necessary, the columns are on the outer edges of the building. The strings that connect to the columns, the core suspension, and the core prevent the core from rotating and turn part of the moment into a vertical pair near the columns. In the present work different ten models are analyzed using STAAD-PRO software and the results are compared in terms of the graphical format and tabular format.

Keywords: RC frame, outrigger, STAAD

Introduction
The location of the elements for this structural system consists of a main concrete core or stewed core connected to the outer columns by relatively rigid horizontal concrete or stewed elements, commonly referred to as outriggers, having the depth of one or two-storey walls. The main structural reaction of the system is quite simple. How the outrigger acts as rigid horizontal elements connected to the outer columns when the central core tries to tilt its rotation at the level of exposure, caused tension in the side column of wind and compression in the side columns of the leeward direction and acting in front of this moment. The result is a type of recovery torque that acts on the core of the building at the autrigger level. As a result, the effective depth of the structure to resist the bending moment increases when the core bends like a vertical console due to the development of voltage in the wind columns and compression in the leeward direction of the column. In addition to those columns located at the ends of the outriggers, other peripheral columns are usually also mobilized to help curb the rotation of the outriggers.

Literature Review
Goman W M Ho has studied all the structural weight, can be reduced due to the significant lateral strength of the system. Therefore, it is the most common structural system for tall and powerful buildings built in recent years. This paper will address the different effects of reductions during the construction of the exposure system and the special connections used to address these issues.
Hemant B. Dahake *et al*., Learned from the analysis of time history, the acceleration is low for a high structure based on an outrigger, which makes it stiffer and stiffer. The location of the outrigger plays a very important role in the design of tall buildings. This study concludes that the performance of a building improves if the suspension device is located at the average height of the building.
Hi Sun Choi This article conducts a parametric study on a multi-storey building with and without systems located in Seismic Zone IV. It is designed to describe performance characteristics such as lateral displacement, time period, base shift, and more. The study is conducted on the building using various mathematical models, considering sliding walls and braces as an outrober system in different places to improve the seismic performance of the building without any exposure system. Kieran Kamat *et al*. studied the static and dynamic behavior of structural systems in the state, and an investigation was conducted to examine the behavior of various alternative 3D models using ETABS software for reinforced concrete construction with a central core wall with a hood and without exposing different relative flexibility from 0.25 to 2.0 in increments of 0.25.

The optimal position is at the average height for both static and dynamic behavior for the considered structure.
Kieran Kamat conducted analytical models representing all existing components that affect the mass, strength, rigidity and deformity of the structure. Analysis of the response spectrum is performed on the entire mathematical 3D model using the ETABS 2015 software and comparisons of these models are presented. Finally, the optimal location of the autrigger system is proposed.

Methodology
The following models are prepared using STAAD-PRO software:

i. Model-I: Outrigger at second floor with core wall (EQ-2)
ii. Model-II: Outrigger (bracings) at second floor with core wall (EQ-3)
iii. Model-III: Outrigger (bracings) at second floor with core wall (EQ-4)
iv. Model-IV: Outrigger (bracings) at second floor with core wall (EQ-5)
v. Model-V: Outrigger (bracings) at middle (fourth) floor with core wall (EQ-5)
vi. Model-VI: Outrigger (bracings) at sixth floor with core wall (EQ-5)
vii. Model-VII: Outrigger (bracings) at top (ninth) floor with core wall (EQ-5)
viii. Model-VIII: Outrigger (surface) at second floor with core wall (EQ-5)
ix. Model-IX: Outrigger (surface) at second and fourth floor with core wall (EQ-5)
x. Model-X: Outrigger (surface) at second, fourth and sixth floor with core wall (EQ-5)

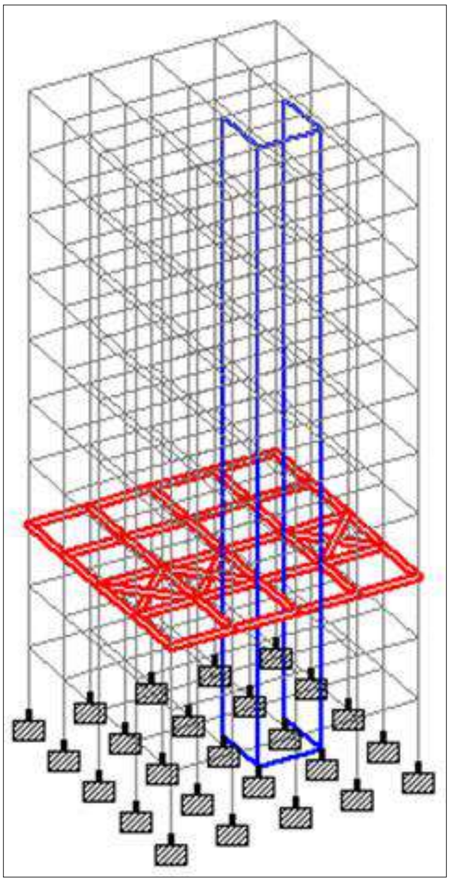

Fig 1: Model-I: Outrigger at second floor with core wall (EQ-2)

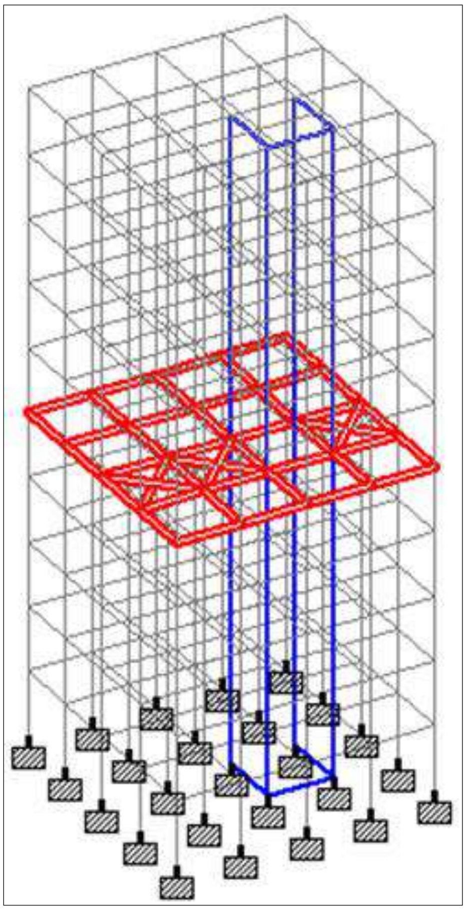

Fig 2: Model-V: Outrigger (bracings) at middle (fourth) floor with core wall (EQ-5)

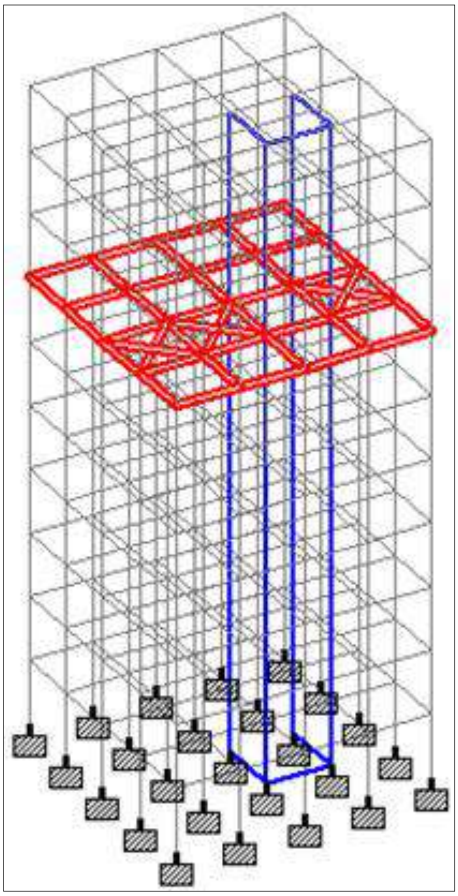

Fig 3: Model-VI: Outrigger (bracings) at sixth floor with core wall (EQ-5)

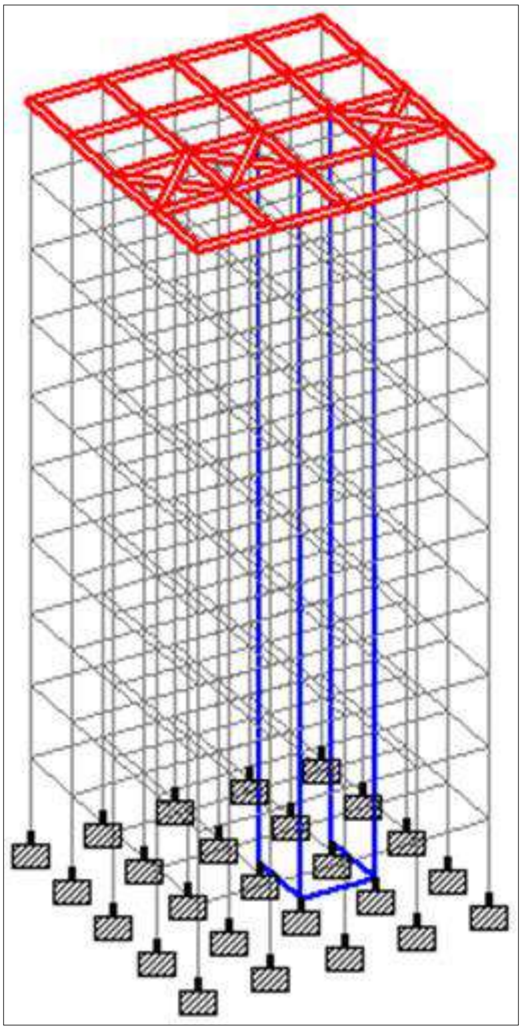

Fig 4: Model-VII: Outrigger (bracings) at top (ninth) floor with core wall (EQ-5)

Results

The results obtained in the STAAD-PRO are tabulated and shown in the graphical format as follows.

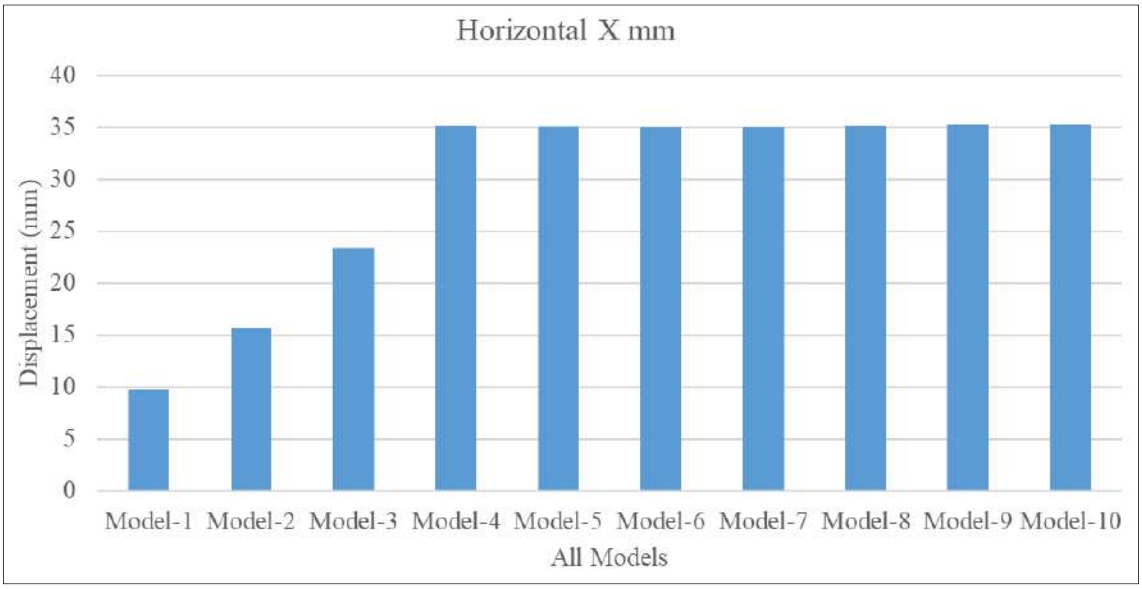

Fig 5: Horizontal Displacement (X) for all the models

The above graph is related to Horizontal Displacement (X) for all the models, this graph shows the maximum displacement of 35.282 mm for the model-9.

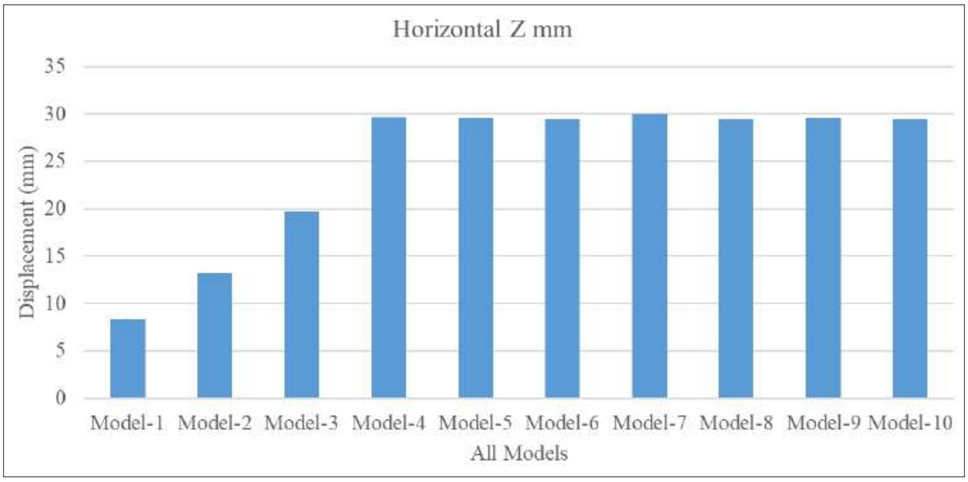

Fig 6: Horizontal Displacement (Z) for all the models

The above graph is related to Horizontal Displacement (Z) for all the models, this graph shows the maximum displacement of 30.013 mm for the model-7.

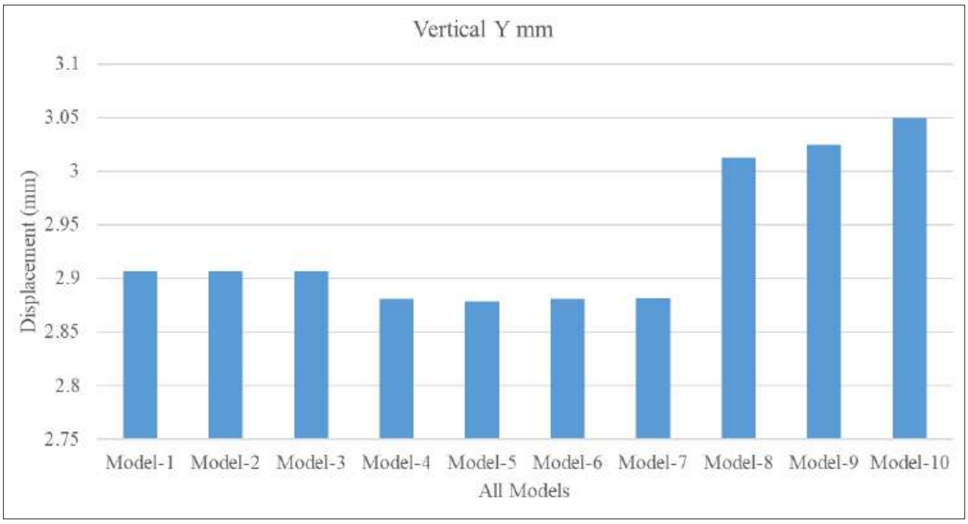

Fig 7: Vertical Displacement (Y) for all the models

The above graph is related to Vertical Displacement (Y) for all the models, this graph shows the maximum displacement of 3.05 mm for the model-10.

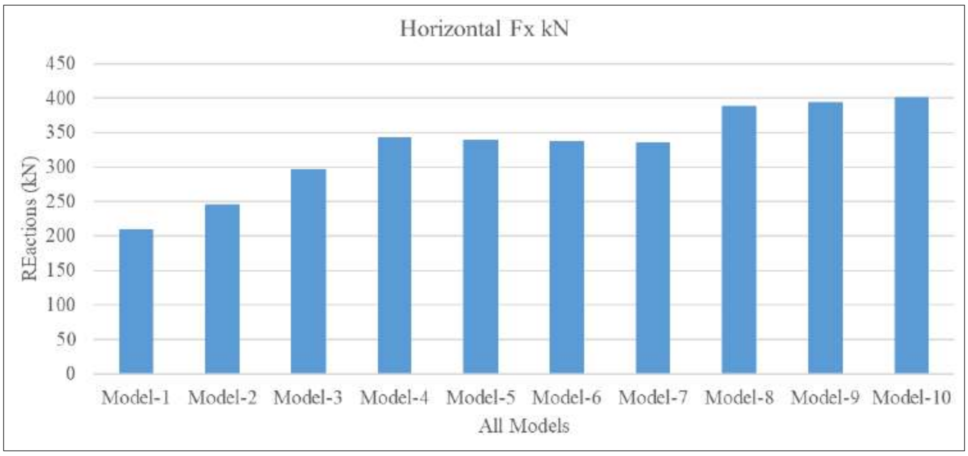

Fig 8: Horizontal Reactions (Fx) for all the models

The above graph is related to Horizontal Reactions (Fx) for all the models, this graph shows the maximum reaction of 400.977 kN for the model-10.

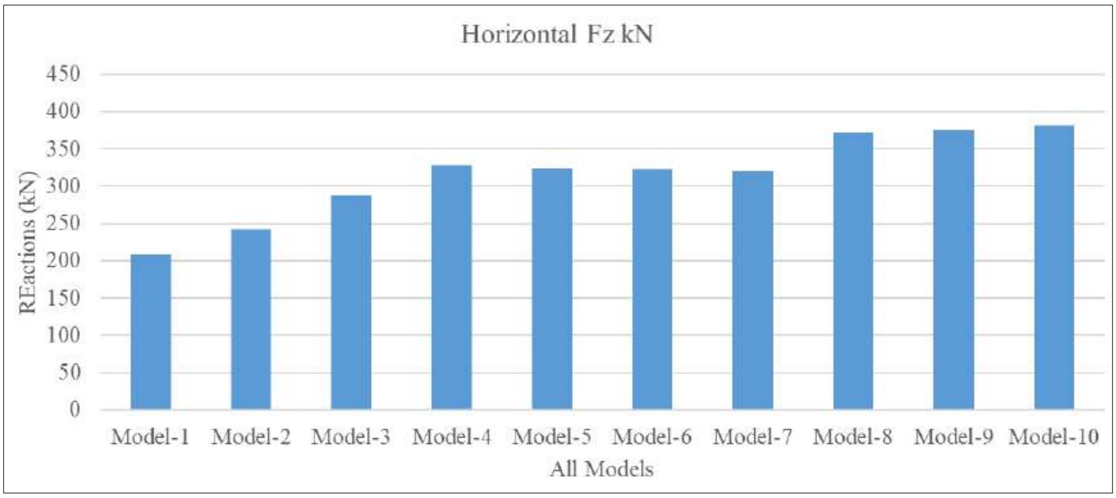

Fig 9: Horizontal Reactions (Fz) for all the models

The above graph is related to Horizontal Reactions (Fz) for all the models, this graph shows the maximum reaction of 381.502 kN for the model-10.

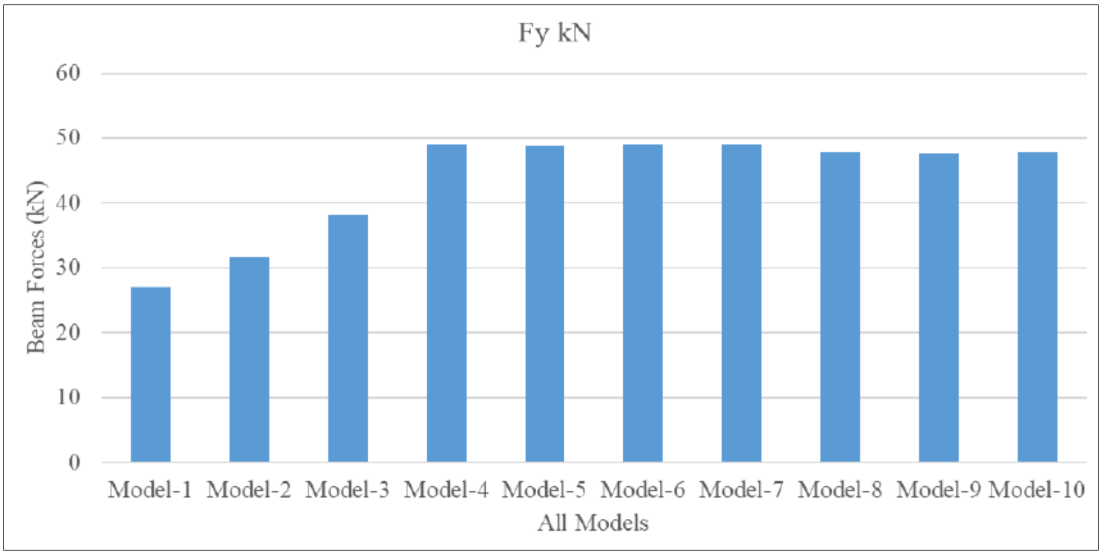

Fig 10: Beam Forces (Fy) for all the models

The above graph is related to Beam Forces (Fy) for all the models, this graph shows the maximum Beam Forces of 49.019 kN for the model-6.

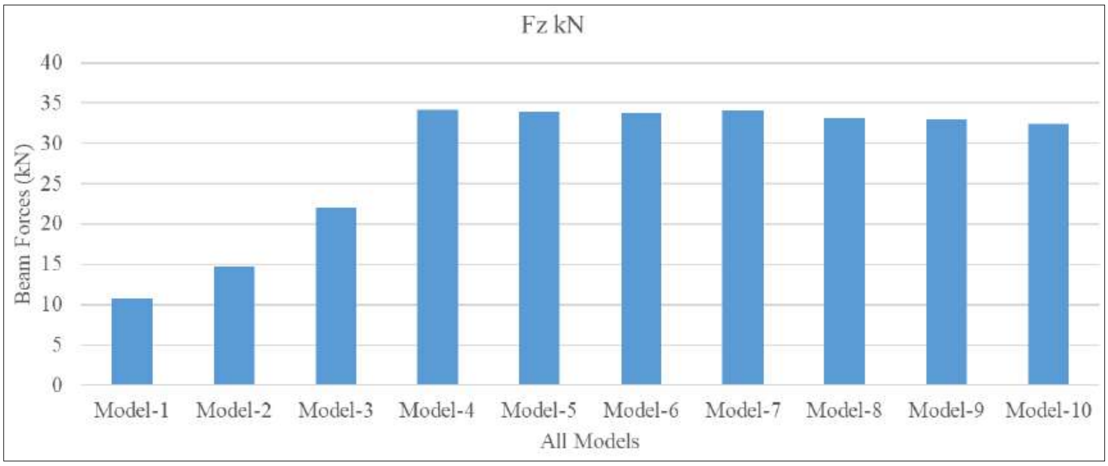

Fig 11: Beam Forces (Fz) for all the models

The above graph is related to Beam Forces (Fz) for all the models, this graph shows the maximum Beam Forces of 34.039 kN for the model-6.

Conclusions

The different ten models are analyzed using STAAD-PRO software and the following conclusions can be drawn:

i. The maximum displacement of 35.282 mm for the model-9 (Outrigger (surface) at second and fourth floor with core wall (EQ-5)).
ii. The maximum Horizontal Displacement (Z) of 30.013 mm for the model-7 (Outrigger (bracings) at top (ninth) floor with core wall (EQ-5)).
iii. The maximum Vertical Displacement (Y) of 3.05 mm for the model-10 (Outrigger (surface) at second, fourth and sixth floor with core wall (EQ-5)).
iv. Maximum displacement Vertical Displacement (Y) of 36.648 mm for the model-9 (Outrigger (surface) at second and fourth floor with core wall (EQ-5)).
v. The maximum Horizontal Reactions (Fx) of 400.977 kN for the model-10 (Outrigger (surface) at second, fourth and sixth floor with core wall (EQ-5)).

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