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Computer Aided Analysis & Design of Structure in Tsunami Areas

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Abstract: The Indian Ocean tsunami on December 26, 2004 led to mass destruction of coastal communities with more than 3, 00000 fatalities, as well as severe damage to buildings, bridges and other infrastructure, causing serious socio-economic problems. Such a deadly mega-event made the coastal community aware of the need for preparedness against a primary shaking of the Earth and following the aftermath of the tsunami. The accident can be minimized with the correct early warning system and network of solid shelter and roads. Experience the recent tsunami of the Indian Ocean was new to the people of India. In the present study analysis of the structure is carried out in the tsunami area and compared with the structure without tsunami prone area. The different results in terms of the base shear, storey displacement, storey shear and stiffness is presented.
Keywords: structure, tsunami, storey shear, displacement and stiffness

I. INTRODUCTION

The term tsunami comes from two Japanese words: ' tsu ', means a harbor, and ' us ', means wave. This is because these waves can create large jumps or fluctuations in coves or harbors that do not react to normal sea waves. In deep water, the tsunami is barely noticeable, but off the coast various mechanisms are causing a wave to grow over time by devastating consequences. The term tsunami was created by fishermen who returned to their ports to find the surrounding area devastated, although they were not aware of any wave in open water.

The tsunami is caused by the rapid disturbances of the sea floor or water column above it, which either raise the sea surface above its normal level (normal case) or oppress it. This Tsunami produces a number of waves, or a wave train that extends outwards from the original area, until it either is dissipated or collides with the coastline. The physics of this spreading process is considered to be later. L: Wavelength (m) G: Water height (m) Ho: wave height in deep water (m) H: Wave height (m) d: Water depth (m) HR: Launch Wave (m) η: Wave height (m) tsunami may be caused by: 1. Earthquakes 3. Volcanic eruption 2. Offsets 4. The meteorological combinations affecting these generating mechanisms often occur. As earthquakes are the most common cause of tsunamis, they will be developed in more detail.

The present work deals with the structure with and without tsunami prone zone and the different results are obtained for the structure.

II. REVIEW OF LITERATURE

Based on the assessment of the repetition of periods of large earthquakes from past seismicity, convergence and seismological results, the possible future sources of the tsunami zone generating earthquakes in the Indian Ocean are identified along the subduction zone and compression zones.

Through the movement of the Indian Plate in the northeast direction, the subduction zone is bounded on the north along the Himalayan region in conjunction with the continent-continent collision between the Indian and Eurasian plates, in the east along the Andaman-Sumatra Sunda Trench, where the Indian plate dove below the Burmese plate, as well as the subduction zone in the west along the Makran Coast, near Karachi, Pakistan. Thus, the Andaman-Sumatra and Makran subduction zone are two main sources in the Indian Ocean, where the earthquakes of magnitude 7.9 and above can occur, leading to a tsunami that can affect the east and West coast of India. (Chakha, 2006).

Besides, Bangladesh-Myanmar coast has produced some well-documented tsunamis. Karachi-Kutch Coast Region also released some possible tsunamis. (Rasstgi and Jaiswal, 2006). The draft earthquake type along a subduction zone that causes vertical oceanic movement is usually tsunami related (Jaiswal ET Al., 2008-2). A minor tsunami can be obtained through a DIP integrated error along oceanic ridges. The distant tsunami hazard in the ocean Basin is a direct feature of seismic potential for extremely large events required to create a tsunami capable of exporting death and destroying distant shores. Studies show that the seismic moment of more than 7 x 1028 dyn.cm is required in this respect (Okal and Synolakis, 2008).

III. MODELING

A. *Building Description*

Table 1: Building Description

Plane dimensions	12x18 m
Total height of building	62.5 m
Height of each storey	3.0m
Height of parapet	1m
Depth of foundation	1.5m
Size of beams	300X500 MM
size of columns	400X1200 MM
Thickness of slab	125 mm
Thickness of external walls	230 mm
Thickness of internal walls	115mm
Wind Speed	44/55 m/s
Terrain Category	1
Class of Structure	B
Importance factor	1/1.08
Floor finishes	1.0 kN/m^2
Live load at all floors	2 kN/m^2
Grade of Concrete	M30
Grade of Steel	Fe500
Density of Concrete	25 kN/m^3
Density of brick masonry	20 kN/m^3

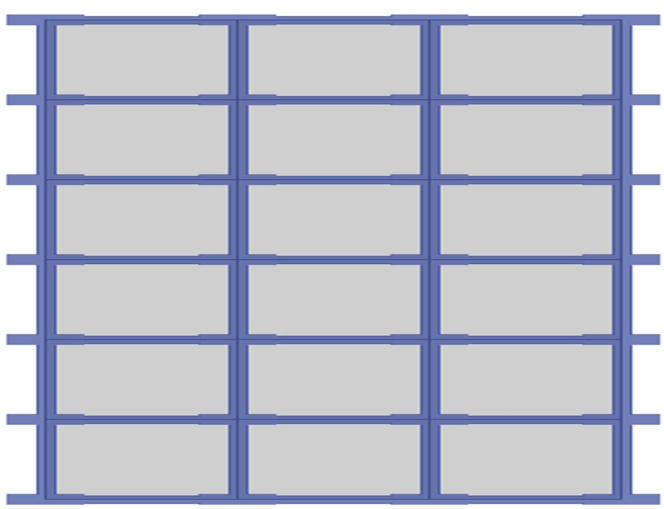

Figure 1: Plan of building

The following models are prepared in this work:

1) *Model I:* 20 Storey Building without considering tsunami factor
2) *Model II:* 20 Storey Building with considering tsunami factor
3) *Model III:* 20 Storey Building with considering tsunami factor and with X Bracings at pheriphery
4) *Model IV:* 20 Storey Building with considering tsunami factor and with X Bracings at Corners

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IV. RESULTS

A. Static Wind Analysis (X-Direction)

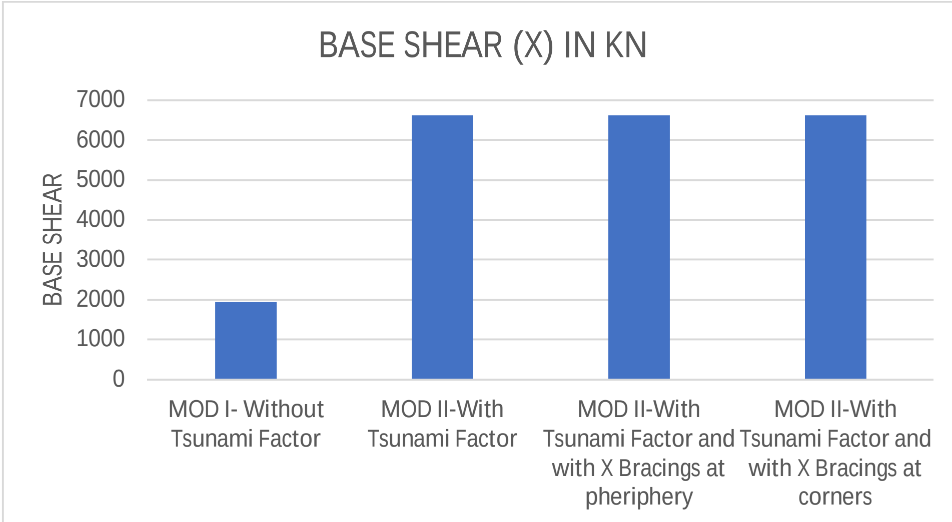

Figure 2: Base Shear (X-Direction)

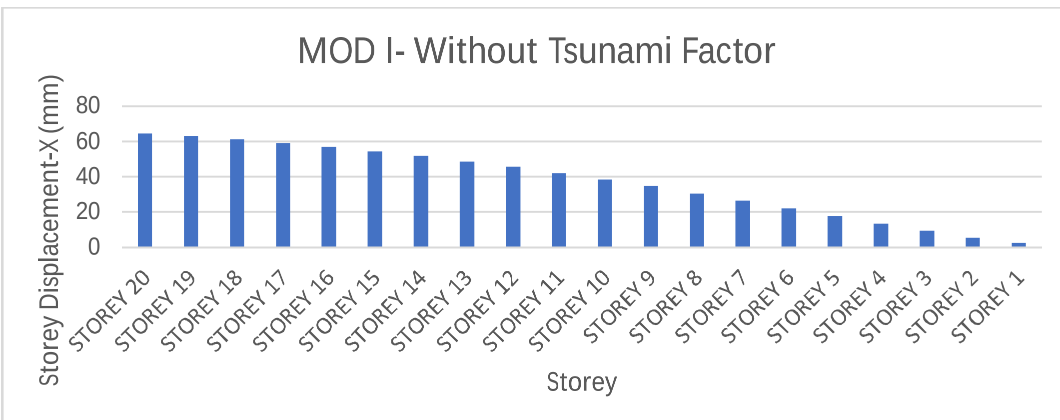

Figure 3: Storey Displacement for Model-I

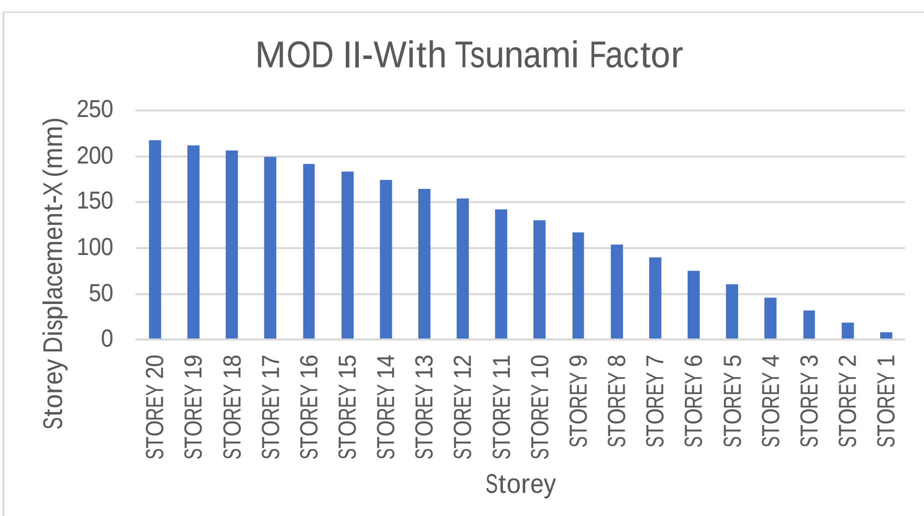

Figure 4: Storey Displacement for model-II

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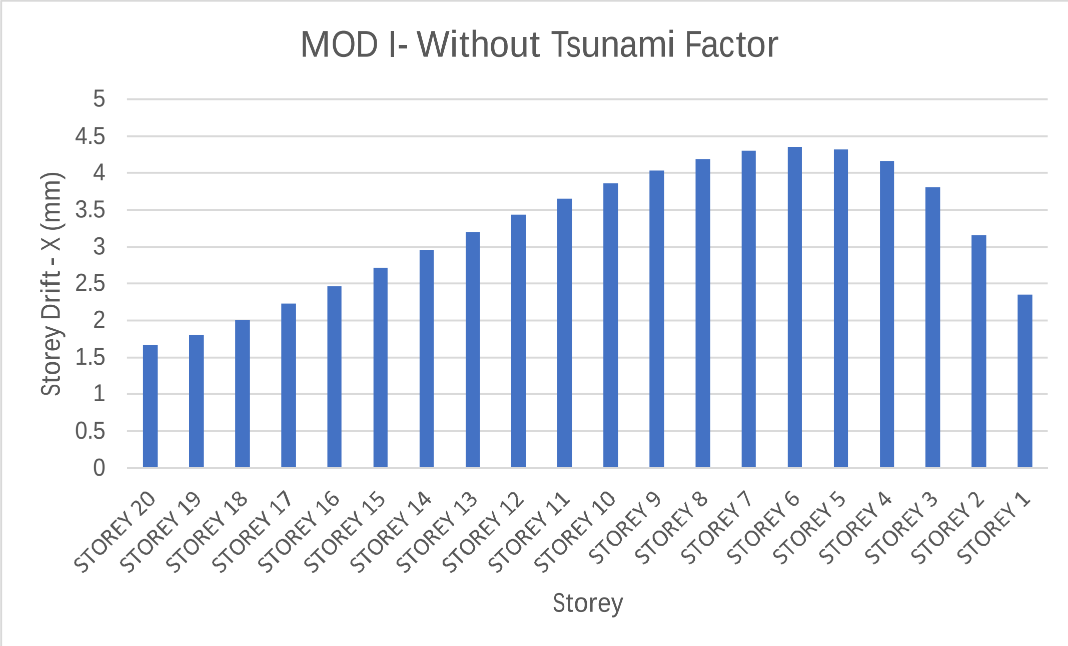

Figure 5: Storey Drift for model-I

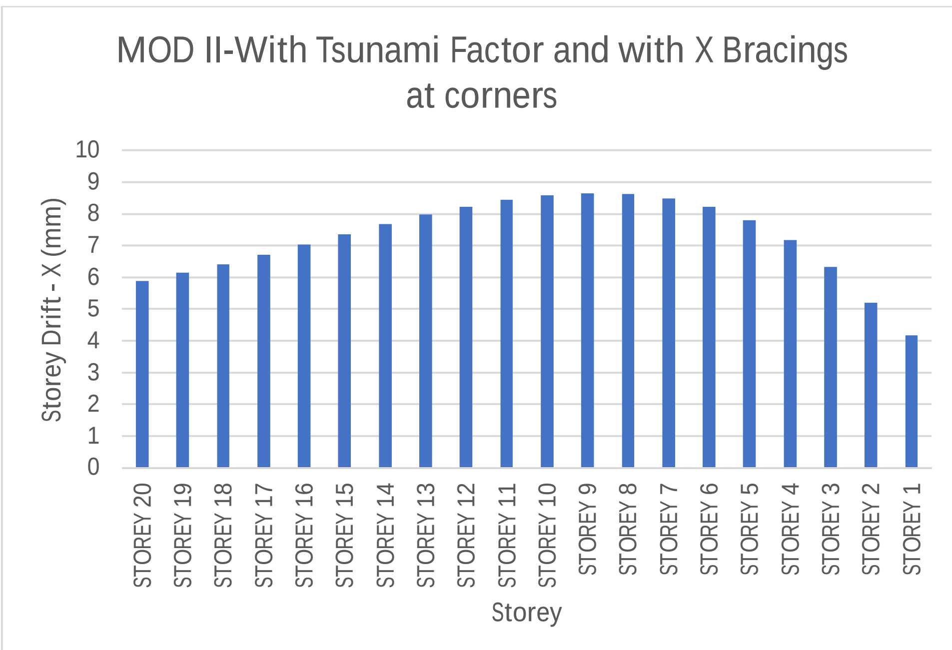

Figure 6: Storey Drift for model-IV

Table 2: Steel consumption in columns

	MOD I- Without Tsunami Factor	MOD II-With Tsunami Factor	MOD II-With Tsunami Factor and with X Bracings at pheriphery	MOD II-With Tsunami Factor and with X Bracings at corners
REINF. IN MM2	2194876	3613956	2580832	2480054

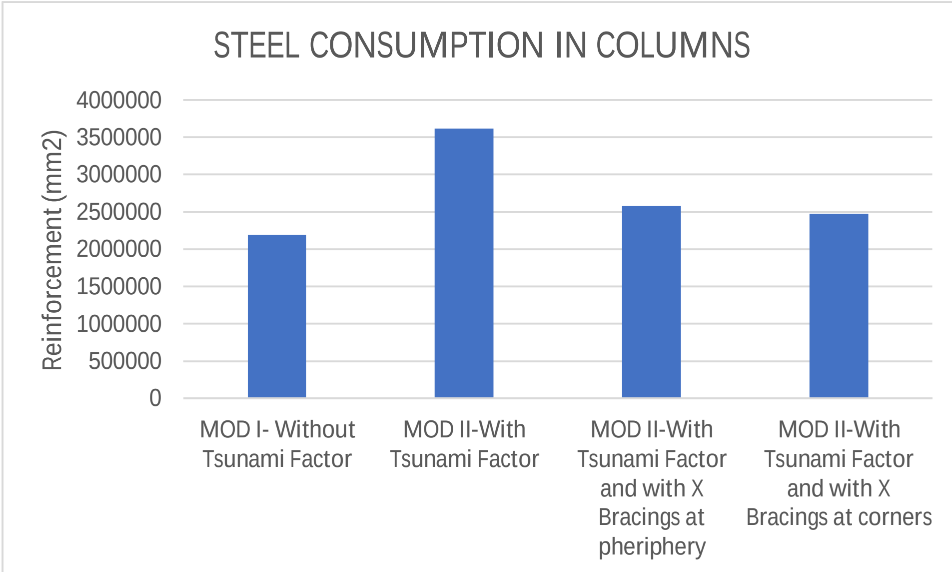

Figure 7: Steel consumption in columns for all models

B. *Static Wind Analysis (Y-Direction)*

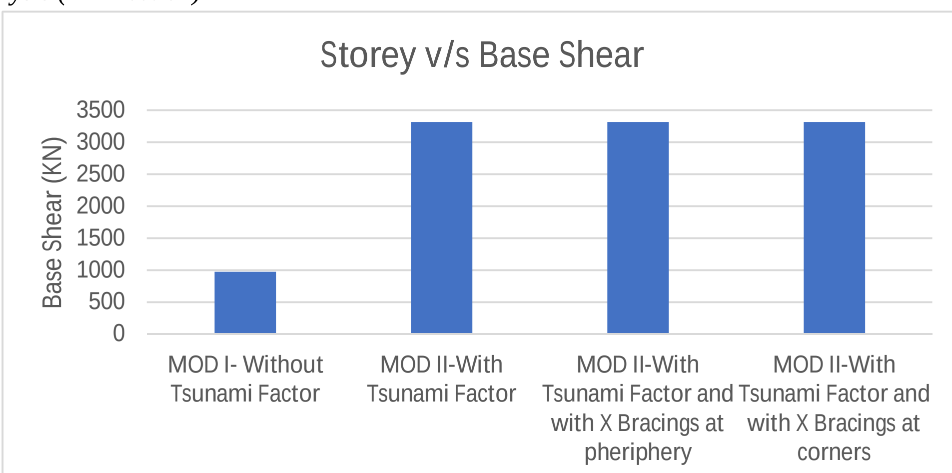

Figure 8: Base Shear (KN) for all storey

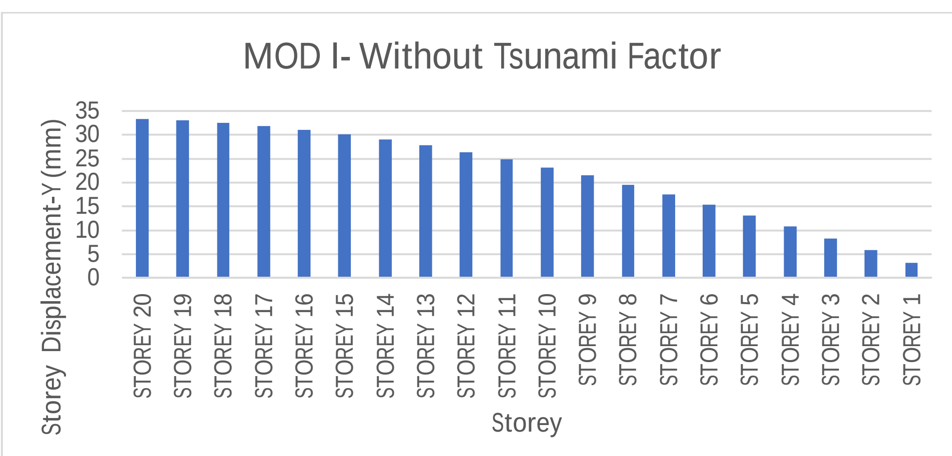

Figure 9: Storey Displacement for model-I

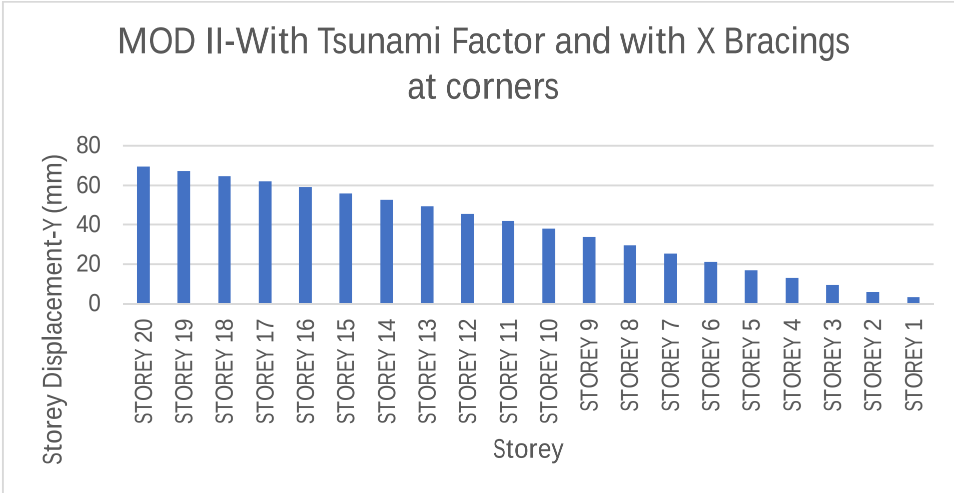

Figure 10: Storey Displacement for model-IV

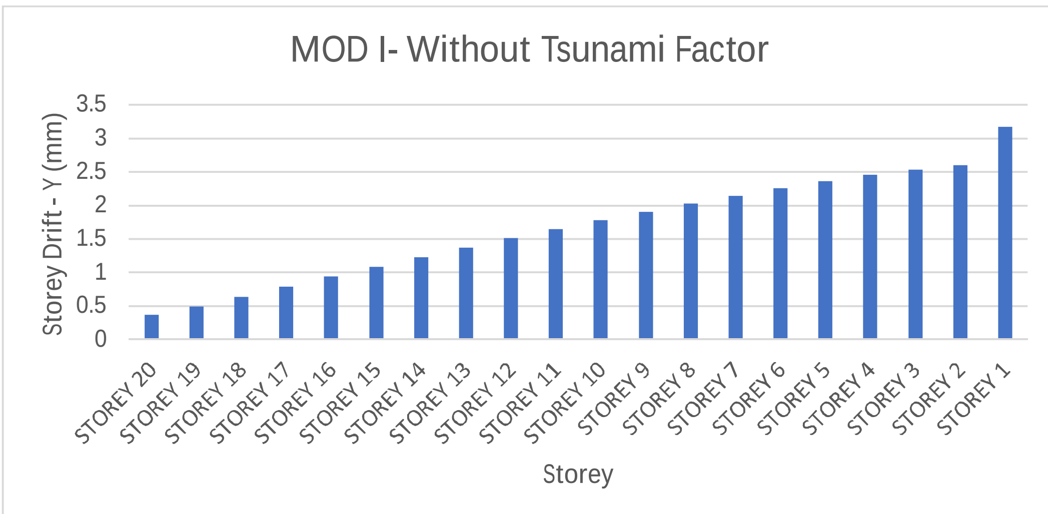

Figure 11: Storey Drift for model-I

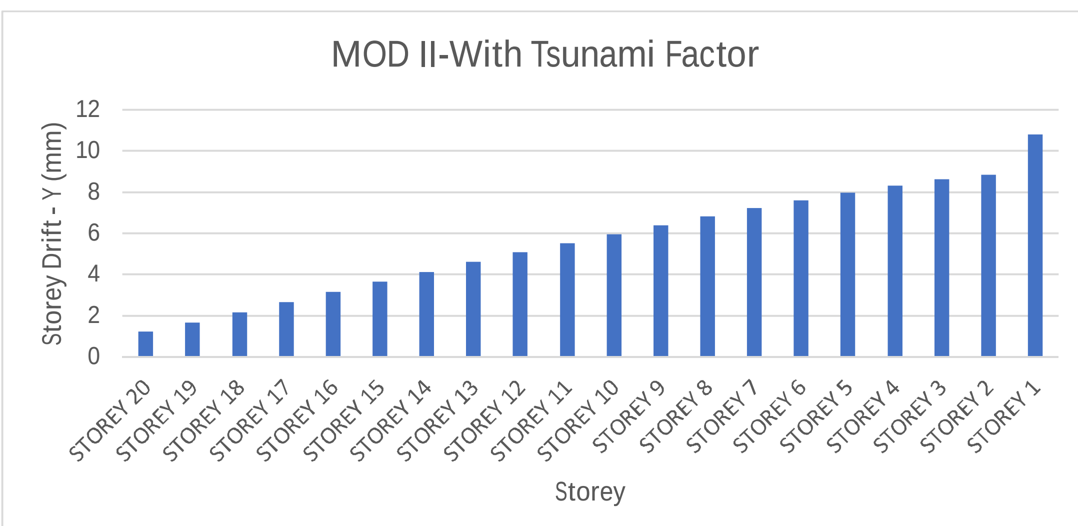

Figure 12: Storey Drift for model-II

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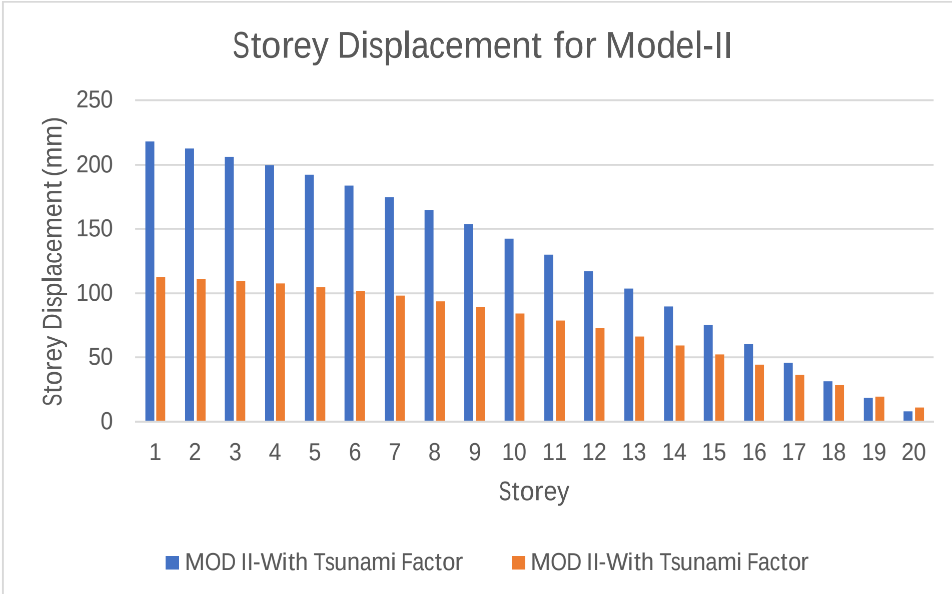

Figure 13: Storey Displacement for model-II

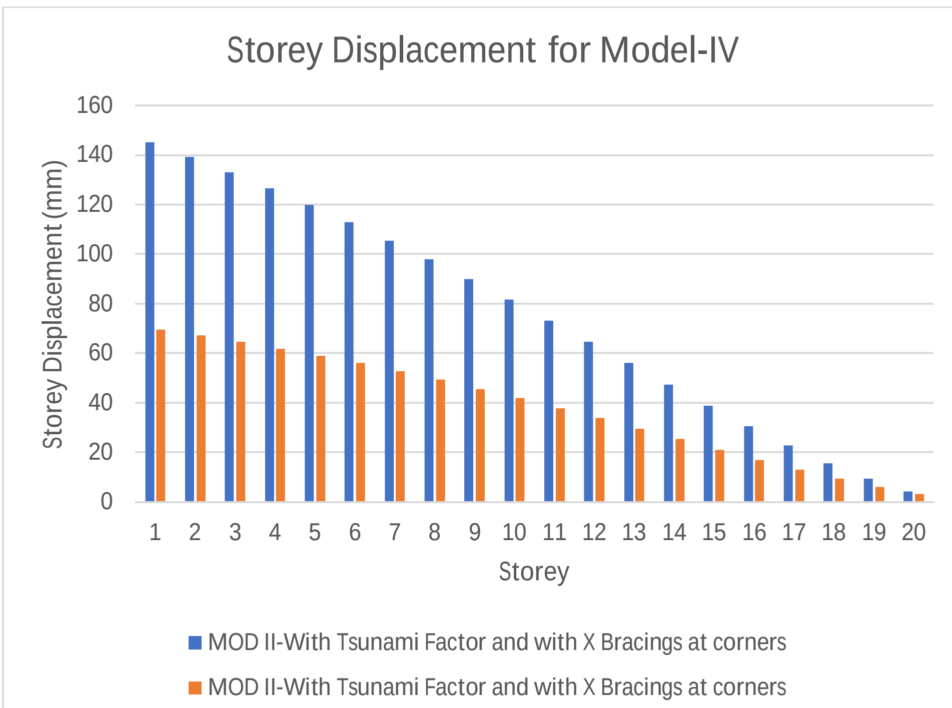

Figure 14: Storey Displacement for model-IV

V. CONCLUSION

From the above study following conclusions can be drawn:

A. Base shear is maximum for model-II as compared to other models
B. Storey displacement is maximum in model II while it is minimum for model-I
C. Storey drift is maximum in case of model-IV
D. The maximum storey drift is found in storey 6
E. Steel consumption is minimum in model I when compared with other models

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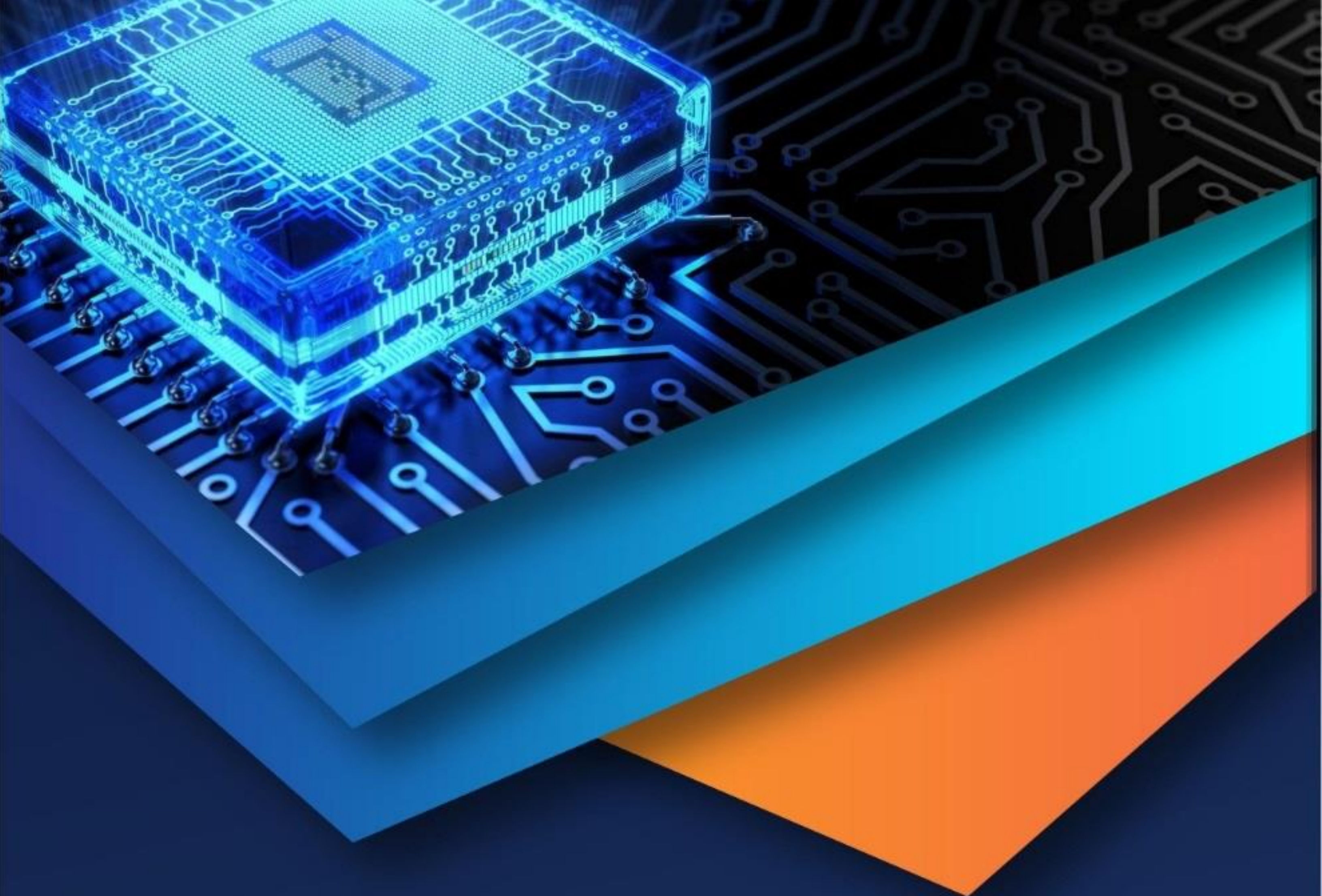

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