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COMPARATIVE STUDY ON THE STRUCTURAL BEHAVIOR OF RCC AND STEEL TWISTED BUILDING

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Abstract - *This paper presents the structural behavior of RCC & Steel twisted building subjected to dynamic loads. The comparative study between RCC & Steel twisted building is made. In a twisted tall building various rate of twist for RCC & Steel twisted building are analyzed. The different rate of twist are 1.5, 2.5 & 3.5 degree per floor for both RCC and Steel twisted building are considered. The modelling and analysis is done using SAP2000. Dead loads, live load, seismic load and wind loads are assigned for modelled structures and results obtained are plotted for parameters such as displacement, storey drift, time period and base shear. The analysis for twisted building is done for gravity loads, lateral load using Response spectrum method. The models are considered for Zone III and V & the analysis is done as per the Indian standard codal provisions. From the comparative study of RCC & Steel twisted building under Dynamic loads for various angle of twist for storey it is concluded that steel twisted building is efficient compared to RCC twisted building under seismic and wind load. 3.5 degree per floor angle of twist is efficient compared to 1.5 & 2.5 degree of angle of twist.*

***Key Words*: RCC twisted building, Steel twisted building, base shear, time period, displacement & storey drift**

1. INTRODUCTION

Employing twisted forms for tall buildings is a recent architectural phenomenon. The tall buildings emerged in the late 19th century in Chicago & New York. The international style prevailed during the mid-20th century and produced numerous prismatic Miesian style towers all over the world. Among many building types in architecture tall buildings are in sense, the accumulation of the most advanced modern building technologies due to their extreme heights and impacts of their aesthetic expressions are significant in any urban context soar because of their enormous scale. Twisted forms are often employed for today's tall buildings as are the cases with the shanghai tower in shanghai, Infinity tower in Dubai, Chicago spine project in Chicago, Lakhta Centre in saint Petersburg Russia, Diamond tower in Jeddah, Saudi Arabia, ocean heights in Dubai united Arab emirates, Cayan tower in Dubai, united Arab emirates, Evolution tower in Moscow, Russia.

Tall buildings carry very large gravity and lateral loads. Twisted tall buildings of various height, height to width aspect ratios and rates of twist are designed and their structural efficiency is investigated. Due to the unique geometric configurations of twisted forms, structural buildings is quite different from that employed for tall buildings of rectangular box forms. Twisted forms involve not only structural but also architectural and constructional challenges. The twisted buildings can make building more acro dynamic and energy efficient. For instance, those twists can lower energy consumption in a building by placing windows in such a way as to reduce and solar heat gain.

2. OBJECTIVES

Aim and Objectives of the Present Study are listed below:

- The main aim is comparative study on structural behavior of RCC & Steel twisted buildings under dynamic loads.
- To study the behavior of the RCC & Steel twisted building for 1.5, 2.5 and 3.5 degree per floor angle of twist for different storeys.
- To study the behavior of the RCC & Steel twisted building under seismic load
- To study behavior of RCC & Steel twisted building under Wind load.
- Study the response such as displacement, storey drift & base shear with respect to seismic & Wind loads.

3. MODELLING AND ANALYSIS

Modal description

For the study purpose a 50 & 25 story building model has been considered,

1) Number of stories = G+50 & G+25
2) C/C distance between columns in X- dir = 6.25m
3) C/C distance between columns in X- dir = 6.25m
4) Floor to floor height = 4.5m
5) Wall thickness = 200 mm
6) Live load on all floors = 4 kN/m^2
7) Floor Finishes= 1.5 kN/m^2
8) Material = M50 concrete grade&Fe550 for RCC structure
9) Material=M50 concrete grade &Fe345 for Steel structure
10) Depth of slab =250 mm
11) Column sizes for RCC twisted building = 1500X1500mm, 1000X1000mm,600X600mm&500X500
12) Column sizes for Steel twisted building hallow section = 1500X1500X100mm,1000X1000X100, 600X600X50mm and 500X500X50mm
13) Column sizes for RCC = 700X700mm

14) Column sizes for Steel hallow section= 700X700X50mm

4. RESULTS AND DISCUSSION

It deals with results and discussion of RCC twisted building & Steel twisted building. Discussions are made based on following parameters such as displacement, storey drift, time period & base shear

STOREY DISPLACEMENT

It is the important factor, when the structure is affected by seismic forces and wind forces.it mainly depends on the height of the structure and tall structures are more flexible for lateral loads.

The storey versus displacement is graphs are plotted for 1.5, 2.5 & 3.5 degree per floor.

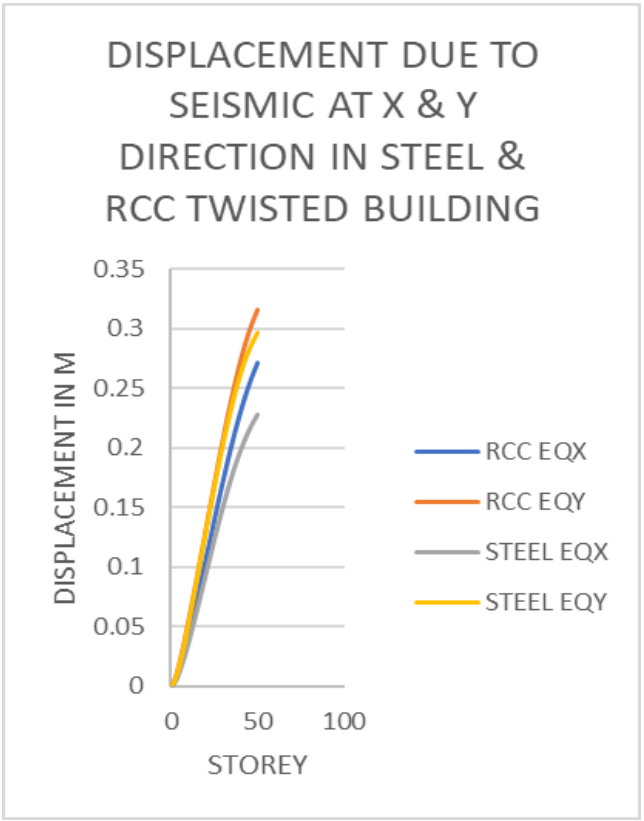

Fig1Displacement for 1.5-degree angle of twist due to seismic

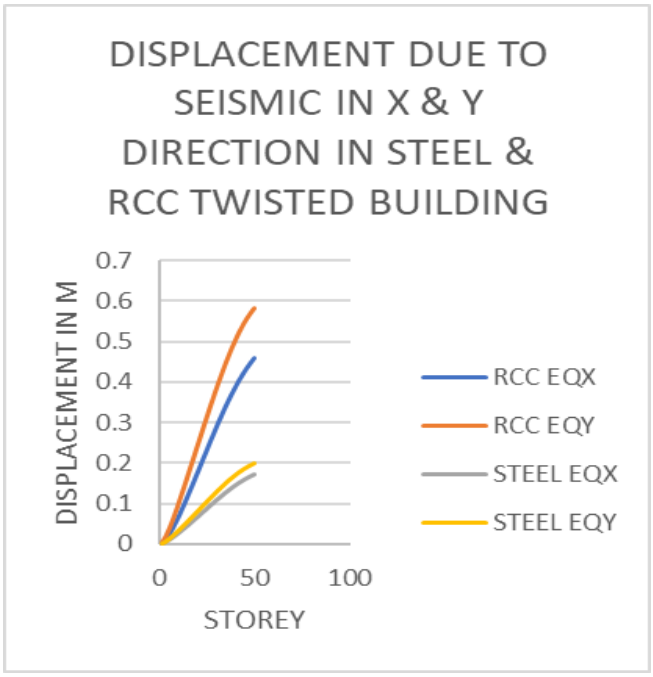

Fig2 Displacement for 2.5-degree angle of twist due to seismic

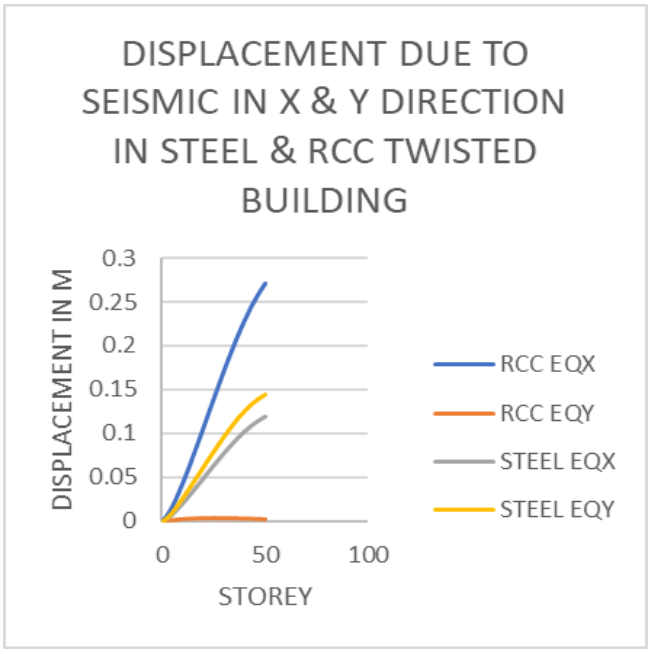

Fig3 Displacement for 3.5-degree angle of twist due to seismic

Fig 1, 2 & 3 Shows the displacement along height for 3.5 degree of angle of twist per floor. From the analysis it is observed that Steel twisted building is efficient compared to RCC twisted building. Since the displacement for RCC twisted building is 272mm as against 119 mm for steel twisted building at top floors

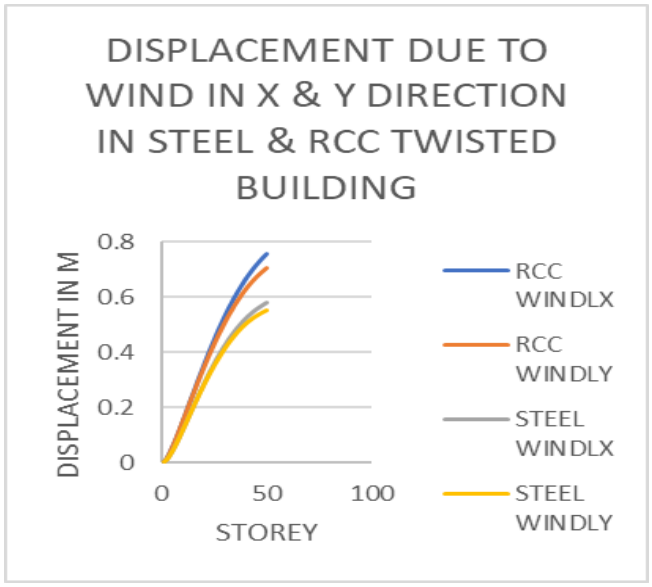

Fig4 Displacement for 1.5-degree angle of twist due to wind

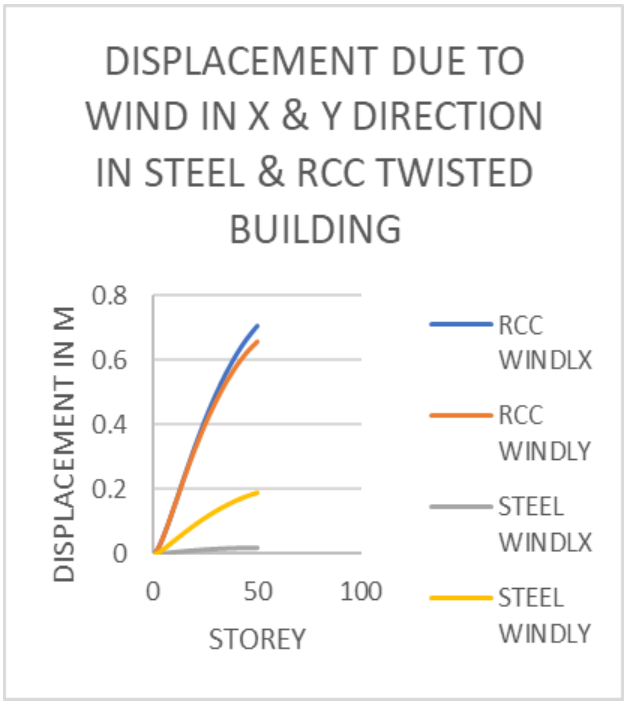

Fig5 Displacement for 2.5-degree angle of twist due to wind

Fig 4, 5 & 6 Shows the displacement along height for 3.5 degree of angle of twist per floor. From the analysis it is observed that Steel twisted building is efficient compared to RCC twisted building. Since the displacement for RCC twisted building is 663 mm as against 262 mm for steel twisted building at top floors

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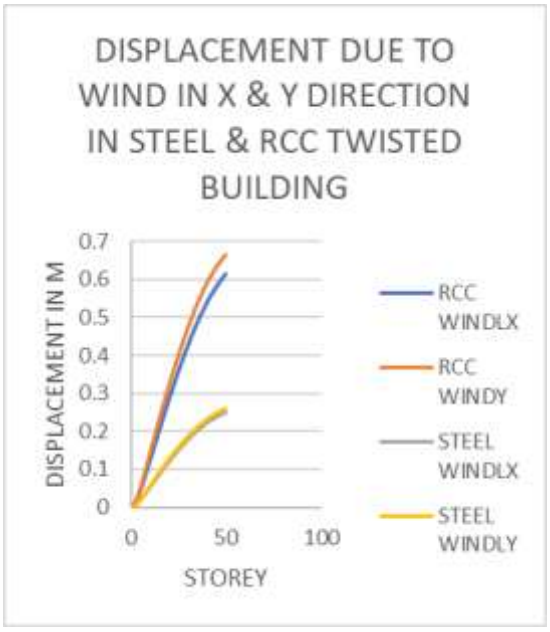

Fig6 Displacement for 3.5-degree angle of twist due to wind

STOREY DRIFT

The storey versus Storey drift is graphs are plotted in X & y direction for 1.5, 2.5 & 3.5 degree per floor.

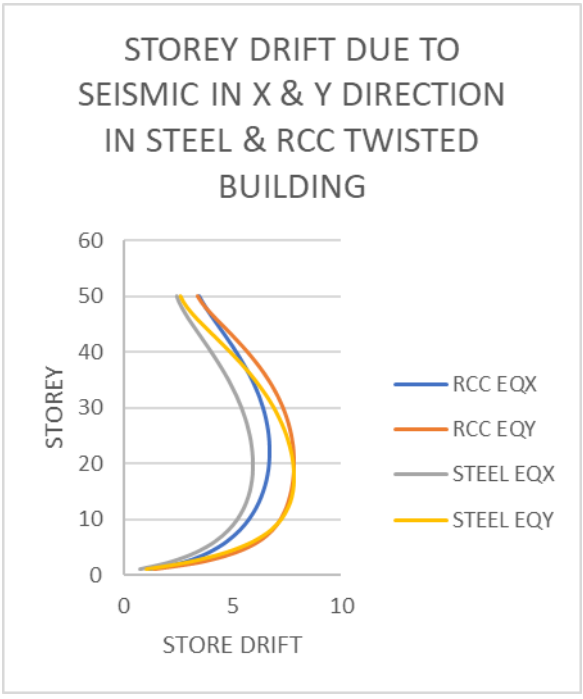

Fig7 Storey drift for 1.5-degree angle of twist due seismic

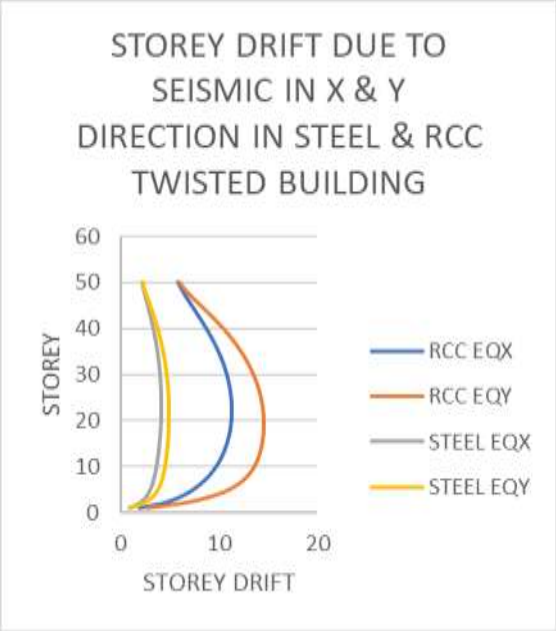

Fig8 Storey drift for 2.5-degree angle of twist due to seismic

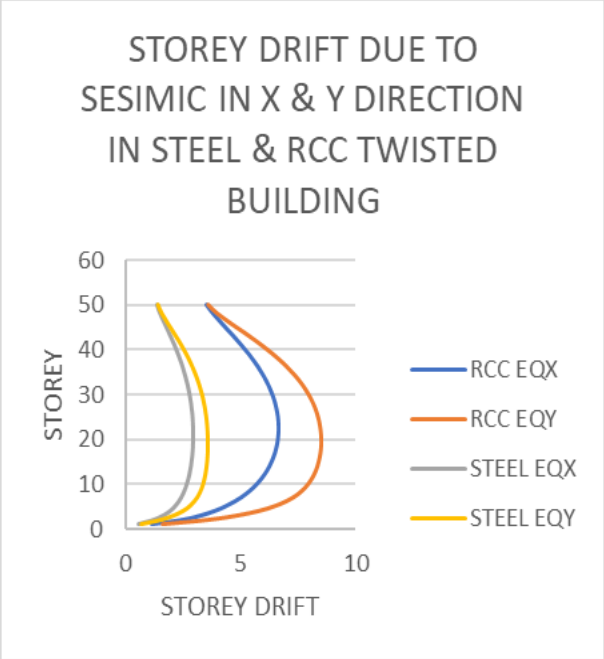

Fig9 Storey drift for 3.5-degree angle of twist due to seismic

Fig 7, 8 & 9 Shows the storey drift along height for 3.5 degree of angle of twist per floor. From the analysis it is observed that Steel twisted building is efficient compared to RCC twisted building. Since the storey drift for RCC twisted building is 8.50 as against 3.585mm for steel twisted building at top floors

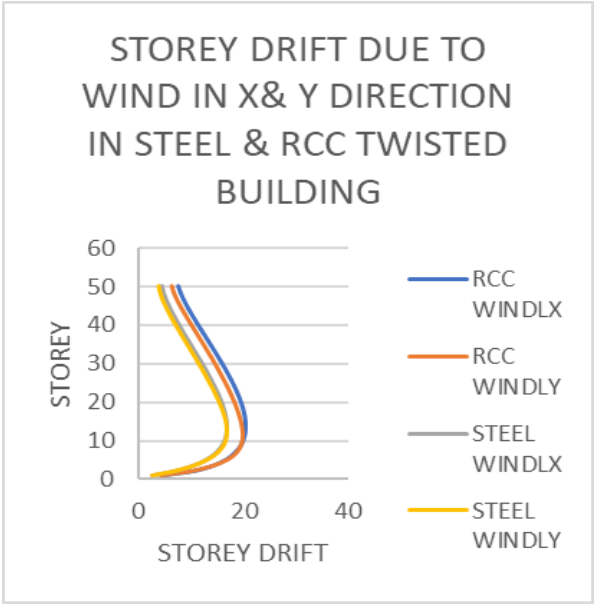

Fig10 Storey drift for 1.5-degree angle of twist for due to wind

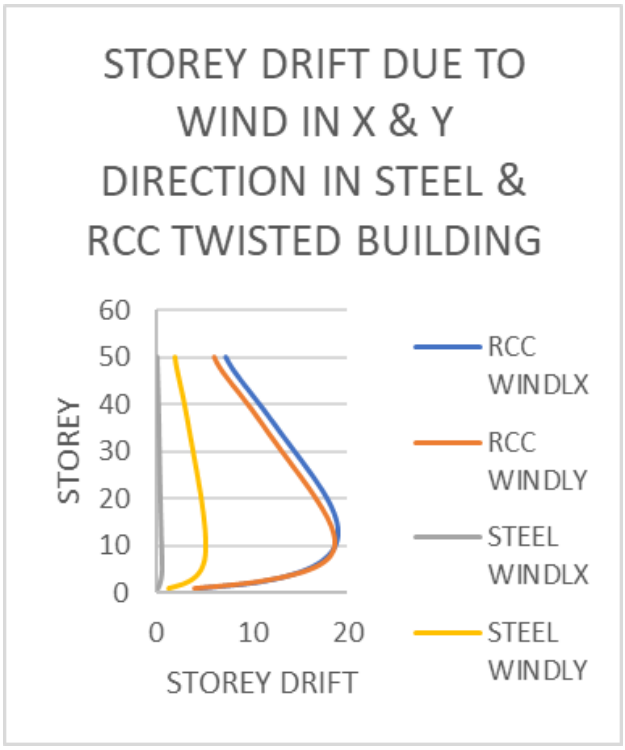

Fig11 Storey drift for 2.5-degree angle of twist due to wind

Fig 10, 11 & 12 Shows the storey drift along height for 3.5 degree of angle of twist per floor. From the analysis it is observed that Steel twisted building is efficient compared to RCC twisted building. Since the storey drift for RCC twisted building is 18.450 as against 7.4 for steel twisted building at top floors

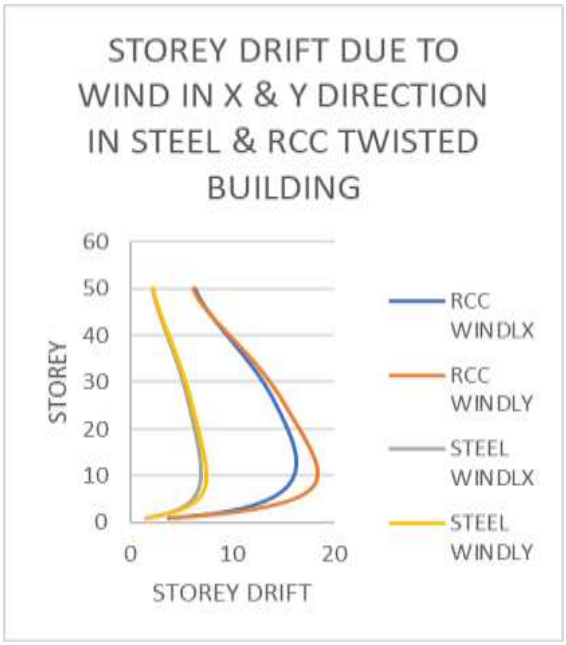

Fig12 Storey drift for 3.5-degree angle of twist due to wind

BASE SHEAR

The Shear force at the base of the structure so obtained is been plotted for all models in X and Y direction

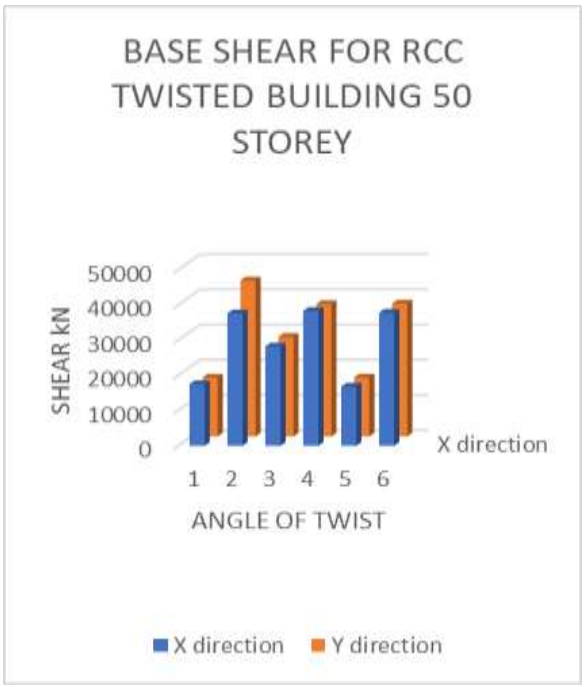

Fig13 Base shear for RCC 50 storey

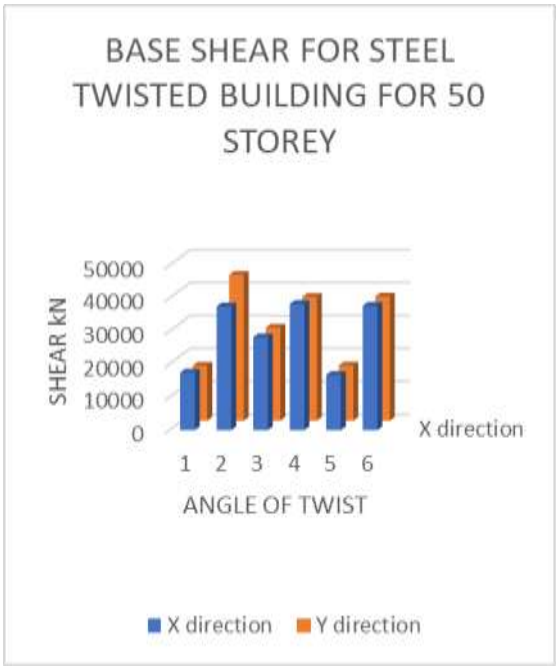

Fig14 Base shear for Steel 50 storey

Fig13 & Fig 14 shows the base shear is more for steel twisted building as compared to RCC twisted building in 2.5 degree per floor angle of twist and the base shear is more in Y direction

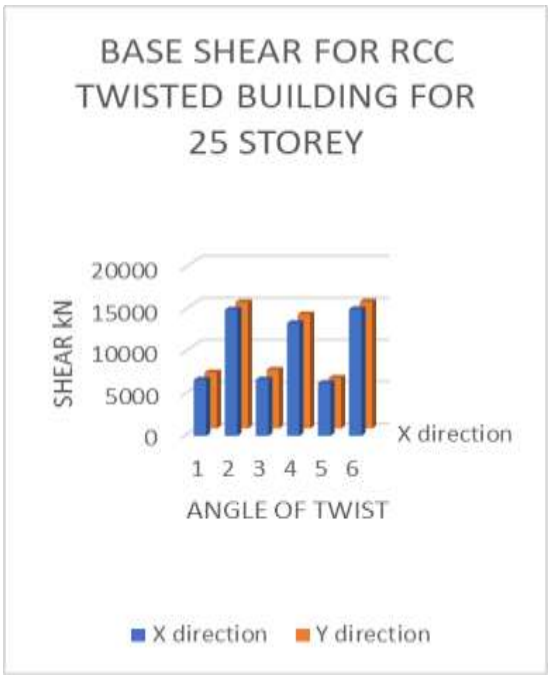

Fig15 Base shear for RCC 25 storey

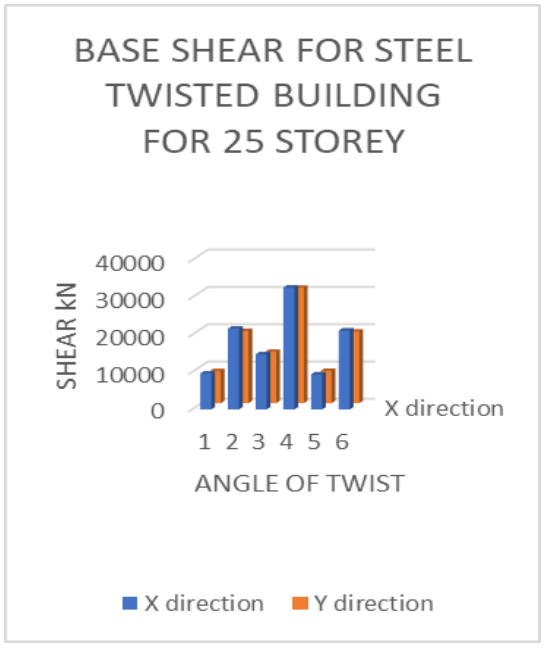

Fig16 Base shear for Steel 25 storey

Fig15 & Fig 16 shows the base shear is more for steel twisted building as compared to RCC twisted building in 2.5 degree per floor angle of twist and the base shear is more in Y direction

5. CONCLUSIONS

From above comparative study between RCC twisted building & Steel twisted building of various angle of twist, for different storeys and for different zones it is concluded that:

Results of effect of angle of twist variation demonstrated for two different storey of building for both RCC twisted building & Steel twisted building considerably influence on the structure

From result analysis it is observed that for different angle of twist, for RCC & Steel, for different storey under seismic & wind load.

As height of storey increases the displacement, storey drift and base shear increases for various angle of twist for both RCC & Steel twisted building.

From above results for all angle of twist, different storey height and for different seismic Zones and wind load the Steel twisted building gives less displacement, storey drift & more base shear compared to RCC twisted building.

From above results the 3.5 degree of angle of twist for each floor gives the less displacement, storey drift and base shear.

It is observed that the result analysis the displacement due to wind is more compared to the seismic loads for different angle of twist, different zones and different storey for both RCC & Steel buildings.

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