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PARAMETRIC STUDY OF VARIOUS TUBE IN TUBE STRUCTURES

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***Abstract* — Tubular structures are common structural system for tall buildings in past few years. The tubular structures are different types. The tube in tube structures are more suitable for high rise buildings. A tube in tube structure is formed by outer core (external tube) tube and inner core (internal tube) tube connected by floor slab. It is act like a huge tube with a smaller tube in middle of it. The load is transfer between these two tubes. In which a strong center tube of high strength concrete is the main load carrying structure. the load is carried by long vertical tubes at perimeter of building connected by periphery walls. This structural system improves the structural stability and increases the floor space to be utilized.**

Keywords- Tube in tube, Lateral load , ETABS 2015 , Base shear, shear lag , Tall building , story drift , story displacement , Time Period.

I. INTRODUCTION

Construction of high-rise buildings used to be driven by the demand for space in densely populated land areas. Major advancements in structural engineering have been the development of different structural systems that allow for higher buildings. The height of building increase, the lateral resisting system becomes more important than the structural system that resists the gravitational loads as well. There are basically two types to satisfy these requirements in a structure. The first is to increase the size of the members beyond and above the strength requirements. The second and more graceful approach is to change the form of the structure into something more rigid and stable to confine the deformation and increase stability. There are three major factors to consider in the design of all structures: strength, rigidity, and stability. In the design of tall buildings, the structural system must also meet these requirements. Strength requirement is the dominant factor in the design of low-height structures. The height increases, the rigidity and stability requirements become more important, and they are often the dominant factors in the design.

II. OBJECTIVE

To study different Parameters like story drift, Base shear, Time period and story deflection under the effect of lateral load like wind and earthquake For 80 story And Study the Effect of different shape in tube in tube system.

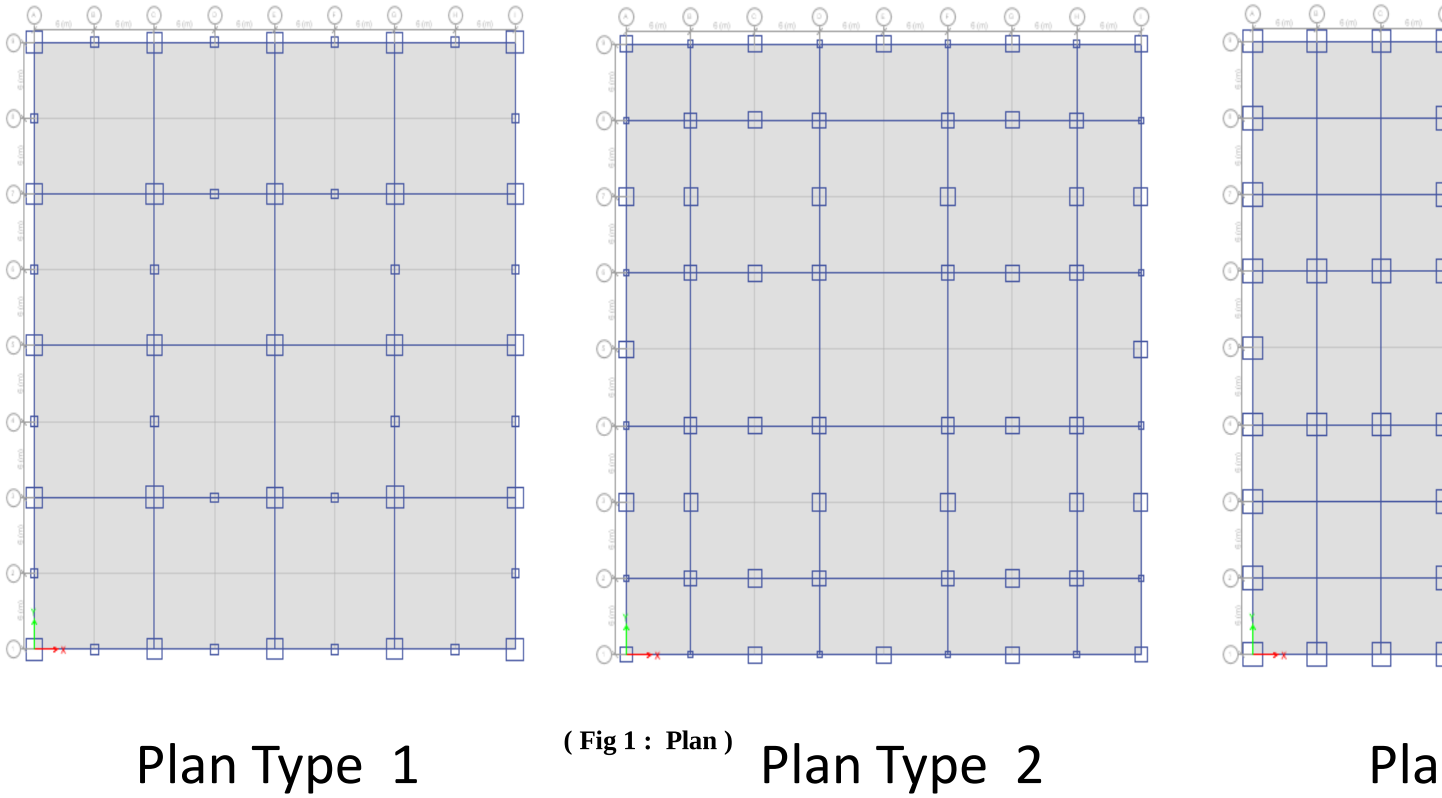
III. NUMERICAL STUDY

Building Configuration

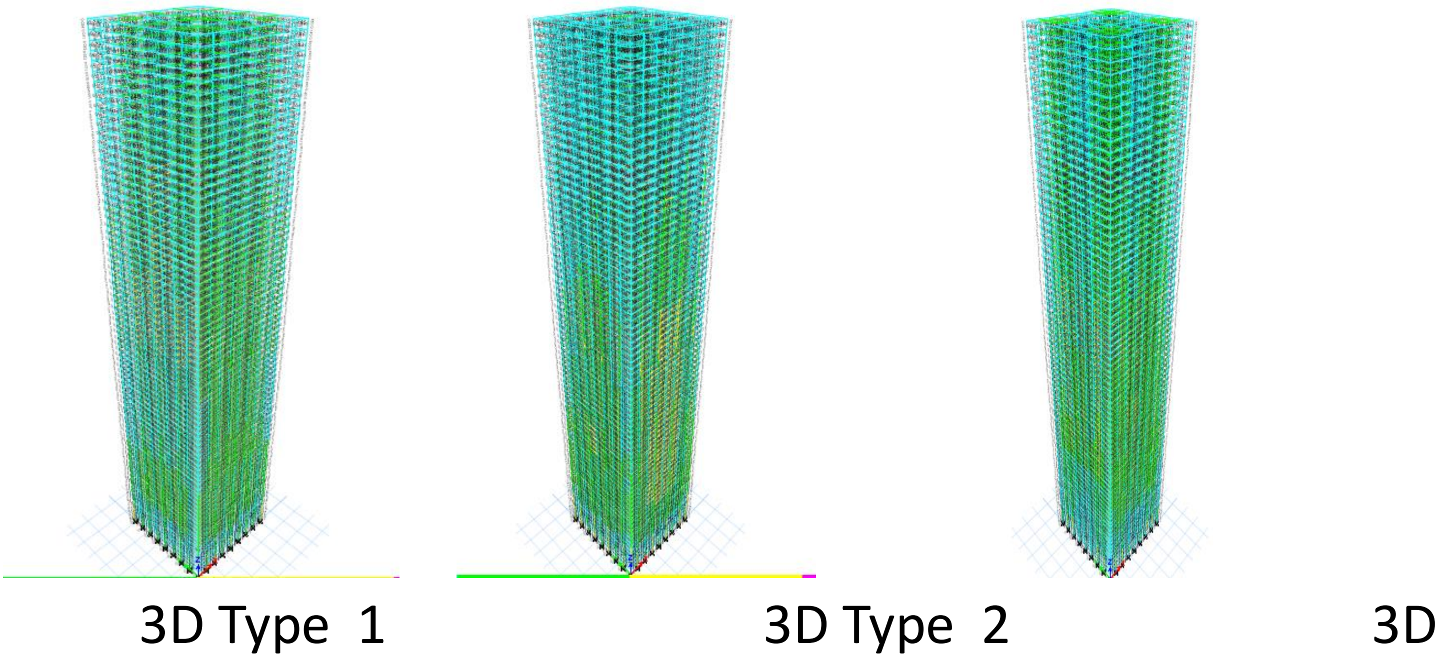
General configuration of the building is shown as below:

- All the steel member used in building is Fe250 and for concrete (slabs) use M25 grade.
- Wind and distribution in ETABS calculated according to IS: 875 (Part 3) - 1978 in both direction.
- Earthquake analysis is done using IS: 1893 (Part 1) – 2002 in both direction.
- For general steel frame design used IS: 800 -2007.
- Limiting top story displacement : H/500
- Limiting Inter story drift : 0.004h

Plan area:	**48 m × 48 m**	Story height:	**3 m**
Dead load:	**1 kN/m^2**	Story:	**All typical**
Live load:	**2.5 kN/m^2**	Slab thickness:	**120 mm**
Earthquake zone:	**V**	Location:	**Bhuj**
Importance Factor:	**1.5**	Basic Wind Speed:	**50 m/s**
Response Reduction:	**5**	Factor k_1:	**1.08**
Analysis::	**Static &Response Spectrum**	Factor k_2:	**1**
Modal Damping:	**2%**		



(Fig 1 : Plan)



(Fig 2 : 3D View)

Table 1. **Results** ***For Due To Earthquake*** **Load** ***For 80 Story Building In Tube In Tube System***

	Type 1	Type 2	Type 3
Max. Base shear (kN)	24,144	25,876	28,478
Max. Story Displacement (mm)	434	470	457
Max. Story Drift	0.0032	0.0036	0.0038
Time period (sec)	6.6	6.9	6.7

Table 2. **Results** ***For Due To Wind*** **Load** ***For 80 Story Building In Tube In Tube System***

	Type 1	Type 2	Type 3
Max. Base shear (kN)	75,526	74,462	74,462
Max. Story Displacement (mm)	468	428	448
Max. Story Drift	0.0042	0.0036	0.0024
Time period (sec)	5.3	4.8	4.9

IV. RESULTS AND COMPARISON DISCUSSIONS

After analyzing and designing all the structures, the governing loads for each building for Type 1, Type 2 and Type 3 tube in tube system are Wind load due to its large plan area.

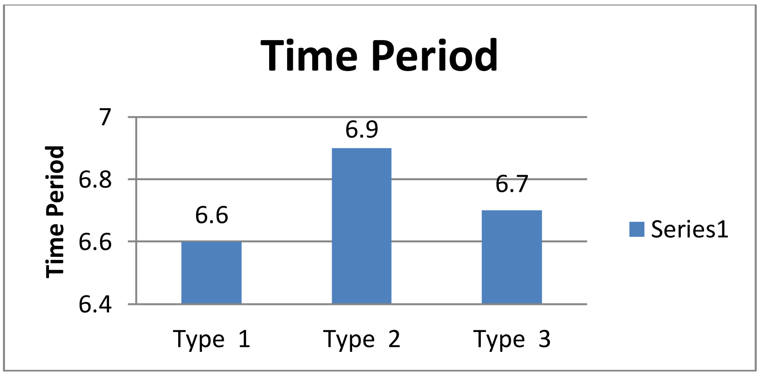
A. Parametric Study

In this study parametric comparison of two structural systems is presented.

1. Time Period :-

Due to earthquake:

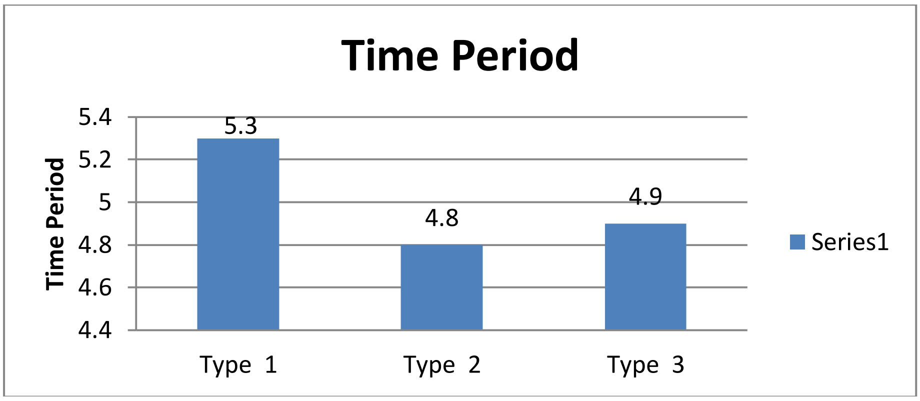
Figure 3 represents the comparison of the time period of Type 1, Type 2, Type 3 in Tube in Tube system. It is observed from the figure that as the time period of Type 1 system is lower than other type tube in tube system.



(Fig. 3 Time Period)

Due to wind:

Figure 4 represents the comparison of the time period of Type 1, Type 2, Type 3 in tube in tube system . It is observed from the figure that as the time period of Type 2 system is lower than other type tube in tube system.

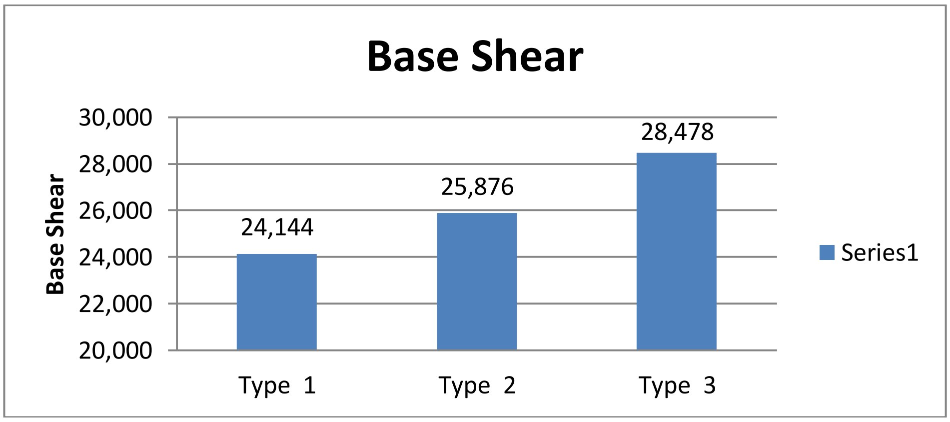


(Fig. 4 Time Period)

2. Maximum Base shear :-

Due to earthquake:

Figure 5 represents the comparison of the maximum base shear for Type 1, Type 2 and Type 3 in tube in tube system.

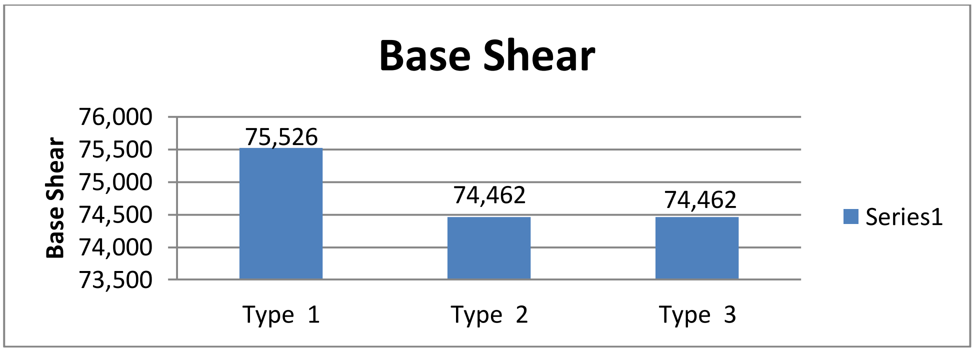


(Fig. 5 Base Shear)

As the building is symmetric, the base shear will be the same in both the directions. As we show in chart that the Type 3 is more base shear. So it is more stiffer than other type tube in tube system.

Due to wind:

Figure 6 represents the comparison of the maximum base shear for Type 1 , Type 2 and Type 3 in tube in tube system.



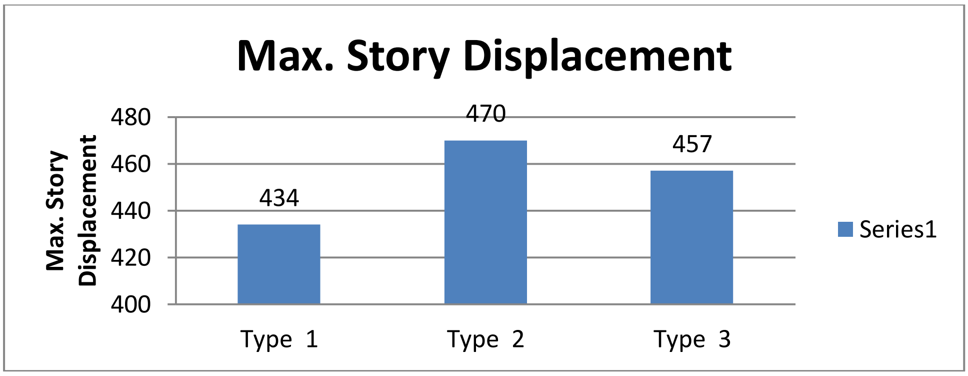
(Fig. 6 Base Shear)

As the building is symmetric, the base shear will be the same in both the directions. As we show in chart that the Type 1 is more base shear. So it is stiffer than other type tube in tube system. In the wind model base shear depend on the wind force.

3. *Maximum Story Displacement :-*

Due to earthquake:

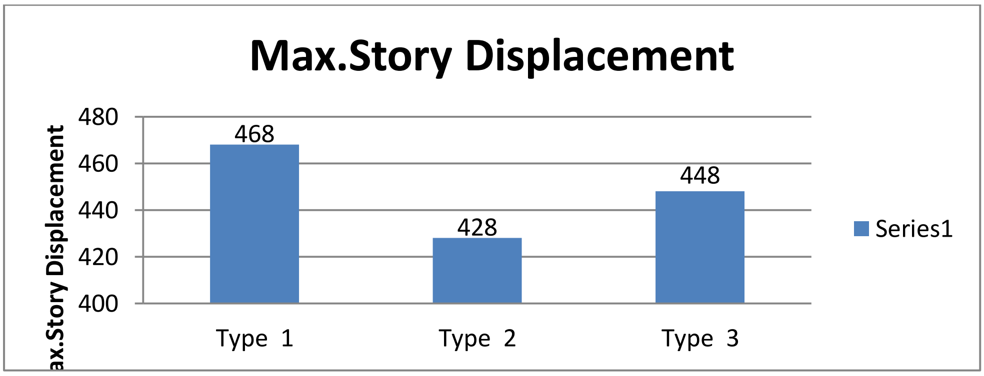
Maximum story displacement for the Type 1 is 434 mm , Type 2 is 470 mm and Type 3 is 457 mm in tube in tube system. So the maximum story displacement of Type 2 system is higher than the other system. All Types tube in tube system values are permissible.



(Fig. 7 Maximum story displacement)

Due to wind:

Maximum story displacement for the Type 1 is 468 mm , Type 2 is 428 mm and Type 3 is 448 mm in tube in tube system. So the maximum story displacement of Type 1 system is higher than the other system. All Types tube in tube system values are permissible.

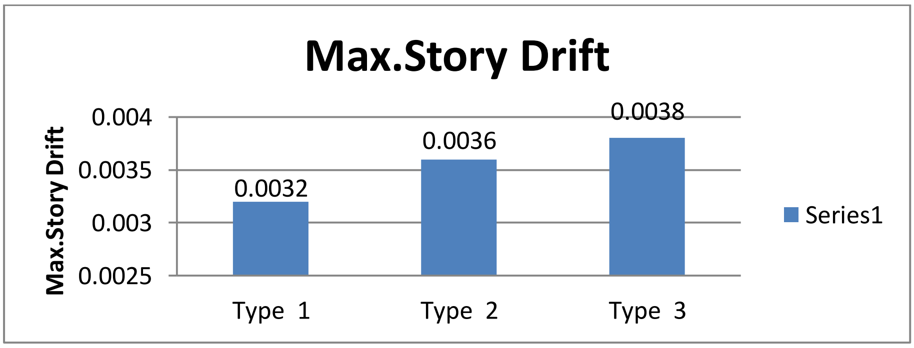


(Fig. 8 Maximum story displacement)

4. Maximum Story Drift :-

Due to earthquake:

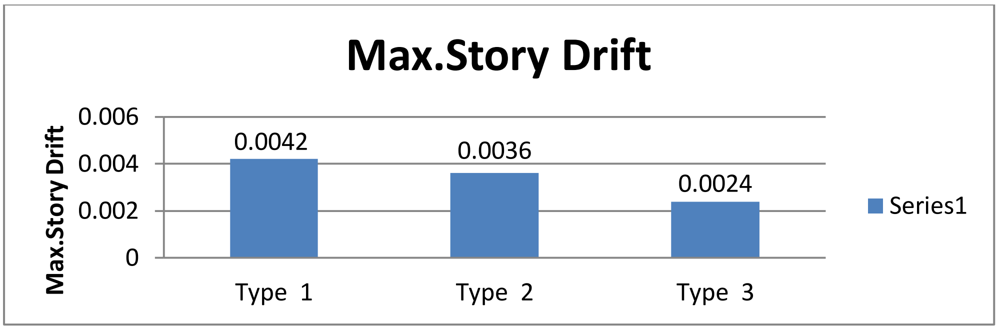
Maximum story drift for the Type 1 is 0.0032 , Type 2 is 0.0036 and Type 3 is 0.0038 in tube in tube system . So the maximum story drift of Type 3 system is higher than the other system. All Types tube in tube system building maximum drift is within permissible limit.



(Fig. 9 Maximum story drift)

Due to wind:

Maximum story drift for the Type 1 is 0.0042, Type 2 is 0.0036 and Type 3 is 0.0024 in tube in tube system . So the maximum story drift of Type 1 system is higher than the other system. All Types tube in tube system building maximum drift is within permissible limit.



(Fig. 10 Maximum story drift)

V. CONCLUSION

The following conclusions have been made based on the present study:

1. The main purpose of the tubular structure is to resist the horizontal lateral load by external tube and the internal core to resist gravity load.
2. To decrease the story displacement , story drift , shear lag effect and base shear by use of the tubular system.
3. To increase the building height by using the tubular system.
4. Tubular system is economic from 60 to more than 100 story.
5. Tube in tube structural system has emerged as a better solution for lateral load resisting system in terms of lateral displacements, story drift, base shear and stiffness. It's stiff enough to resist wind forces up to higher heights.

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