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ijirset@gmail.com



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Analytical Approach for Determining the Most Suitable Location for Swimming Pool

P.Neeraja¹, K.Rajitha²

Assistant Professor, Department of Civil Engineering, MGIT, Hyderabad, India¹

PG Student, Department of Civil Engineering, MGIT, Hyderabad, India²

ABSTRACT: Roof top swimming pools are commonly used for storage of water for swimming, wading, diving, recreation or instruction etc. the vertical wall of such pool is subjected to hydrostatic pressure and the base is subjected to weight of water. depending upon the location of swimming pool the swimming pools can be named as roof top swimming pool, on ground swimming pool and underground swimming pool. The swimming pool was placed at the roof. The mass and frequency of the swimming pool including its water were tuned to the optimized values.

This project work on the study of behavior of swimming pool as per the considered position of pool at the terrace floor of the high -rise method of Dynamic response spectrum method using ETABS software. RCC frame building with efficiency position of swimming pool (i.e. one- side, center) were taken for the study and also seismic action on the surface plates of swimming pool due to plate stress Behavior.

The main objective of this project is to achieve most efficient swimming pool position using displacement response analysis using ETABS software. comparison between the frames with one side case & center position of swimming pool on the terrace with respective parameters i.e. displacements, Drift, lateral load, Storey Shear, Axial load.

KEYWORDS: Swimming pool, RSA, ETABS software.

I. INTRODUCTION

The trend of RCC high rise structures has increased nowadays in India. Many different amenities like swimming pool, garden etc. have been provided in high story building which is very attractive from an aesthetical point of view but it is dangerous from a structural point of view. The swimming pool is a heavy weight and the detailing is complicated, but it is not much different than other structural loads. If the pool were to break for some reason and all the water rushed out, it would destroy some interior and possibly some windows. But otherwise, it wouldn't level the building. In fact, in most cases, the extra water mass will help the building resist earthquakes by acting as a liquid mass dampener. Generally the buildings in India are being made using only static analysis, but when this type of high rise building with different amenities are made, dynamic check is also required. If the dynamic check is ignored then Most of these buildings are likely to damage or collapse and may lead to very severe disaster. It may be very difficult to cope up with such a disaster.

Along with the increasing demand of high-rise apartments and hotels, the placement of pool at the medium height of building or rooftop of the building is become more popular. Although for few buildings, roof water tank can be used to increase damping and reduce internal forces due to earthquake, for most of the buildings, it is not included in the analysis, because to get the actual response of the building needs special / advanced analysis, and roof- tank must be specially design for that purpose.

II. MODELLING

E TABS is interactive data base editing program which works over finite element method developed by Computers and Structures, Inc. (CSI), which is used for designing and analyzing 2D & 3D frames, trusses and shell elements. The program itself creates the model and also modifies it. It plays a vital role in executing the analysis and optimizes the design. The final output is accomplished in a single interface.

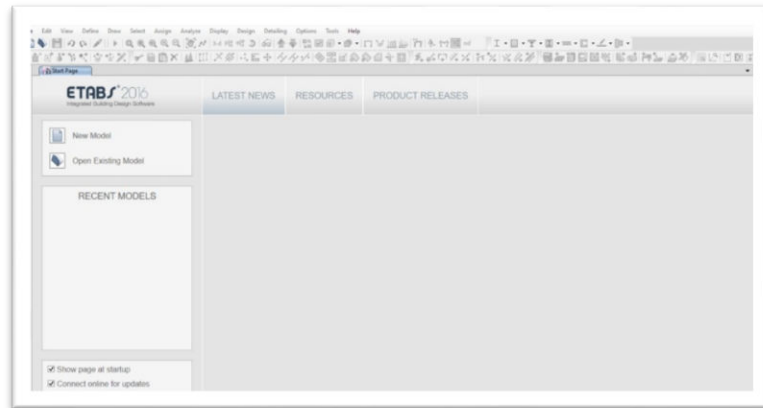


Fig 1: E TABS start up page

LOADING

Defining Load Patterns:

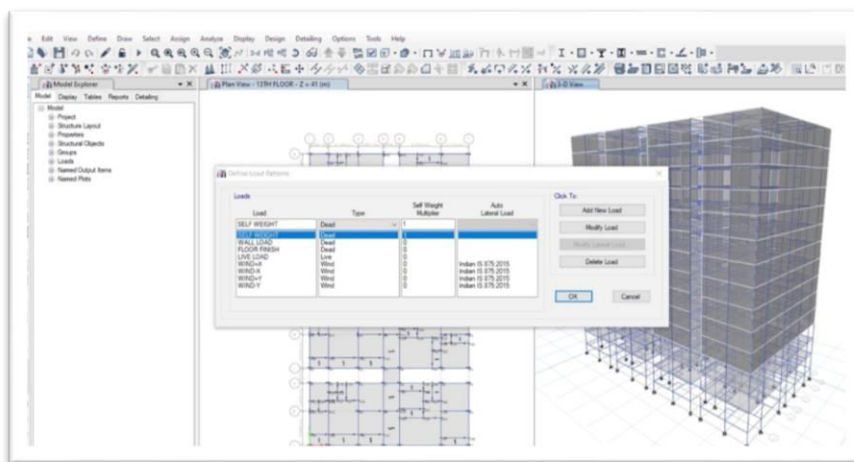


Fig 2: Assigning Load patterns to structure

SELF WEIGHT

- i. EXTERNAL WALL LOAD
- ii. INTERNAL WALL LOAD
- iii. PARAPET WALL LOAD

- i. EXTERNAL WALL LOAD Thickness of wall 9 inches = 0.23 m Height of wall = (3-0.35) = 2.65 m

External wall load = (Thickness of wall X Height of wall X Density of brick)
 = (0.23 X 2.65 X 20)
 = (12.19) kN/m
 = (3 - 0.27)
 = 2.73m

Density of Brick = 20 kN/m³ Assigning External Wall Loads:

- ii. INTERNAL WALL LOAD
 Thickness of wall 4.5 inches = 0.115 m Height of wall = (3-0.35) = 2.65 m

Internal wall load = (Thickness of wall X Height of wall X Density of brick)
= (0.115 X 2.65 X 20)

= (6.095) kN/m

Density of Brick

= 20 kN/m³

Assigning Internal Wall Loads:

iii. PARAPET WALL LOAD Thickness of wall 9 inches = 0.115 m Height of wall = 1 m

Internal wall load = (Thickness of wall X Height of wall X Density of brick)

= (0.115 X 1 X 20)

= 2.3 kN/m

Density of Brick

= 20 kN/m³ Assigning Parapet Wall Load:

SEISMIC LOADS

EARTHQUAKE DATA:

Zone	2
Medium type soil	2
Importance factor	1
Response reduction factor	3
Damping ratio	5 %

SEISMIC WEIGHT

Defining Load Patterns to Seismic Weight:

LOAD COMBINATIONS

Defining Combinations as per IS Code 456: 2000:

Defining response spectrum :

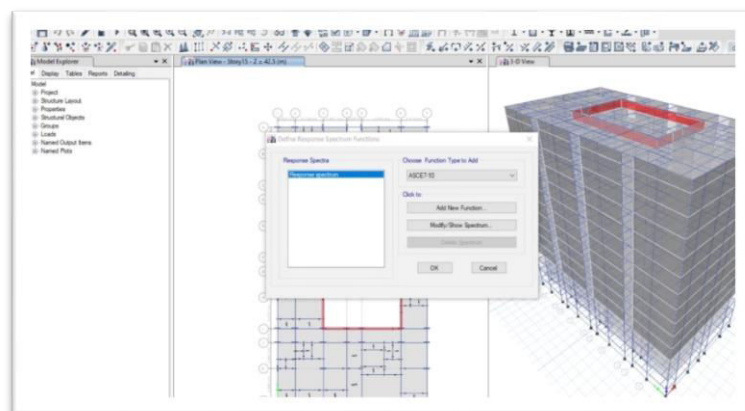


Fig 3 : Defining response spectrum

Assigning response spectrum:

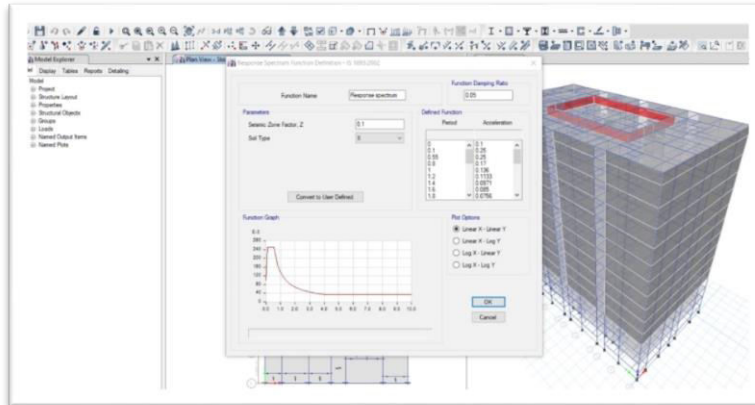


Fig 4 : Assigning response spectrum

Assigning response spectrum in X direction:

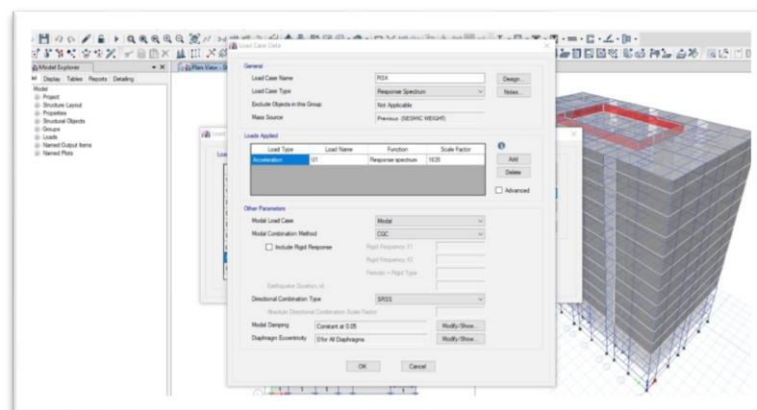


Fig 5: Assigning response spectrum in X direction

Response spectrum in Y direction:

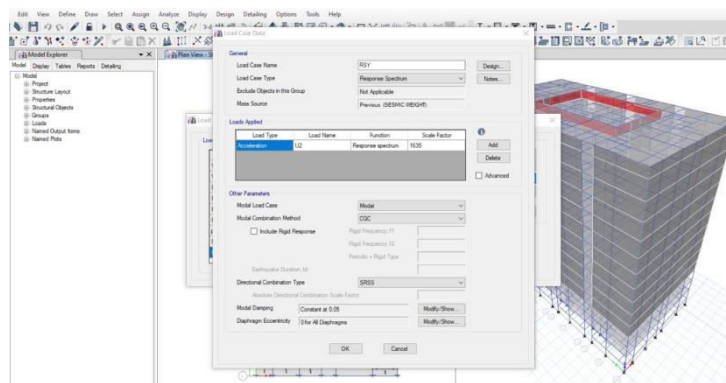
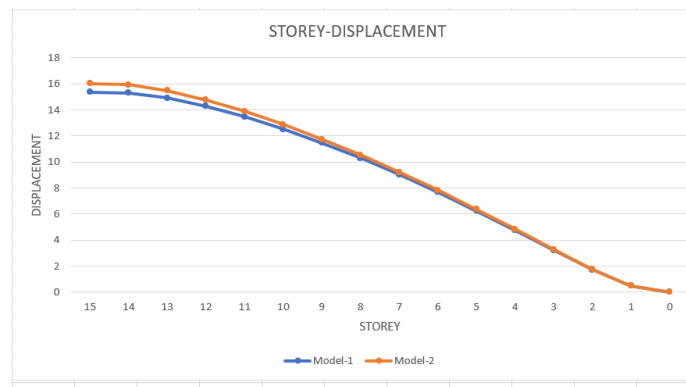


Fig 6 : Assigning response spectrum in Y direction

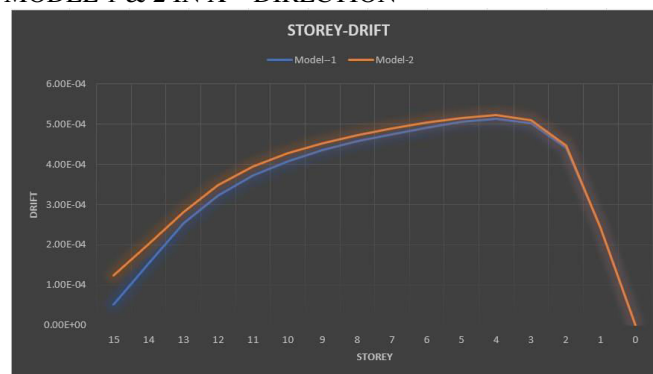
RESPONSE SPECTRUM ANALYSIS RESULTS

COMPARING STORY DISPLACEMENT FOR MODEL 1 & 2 IN X – DIRECTION



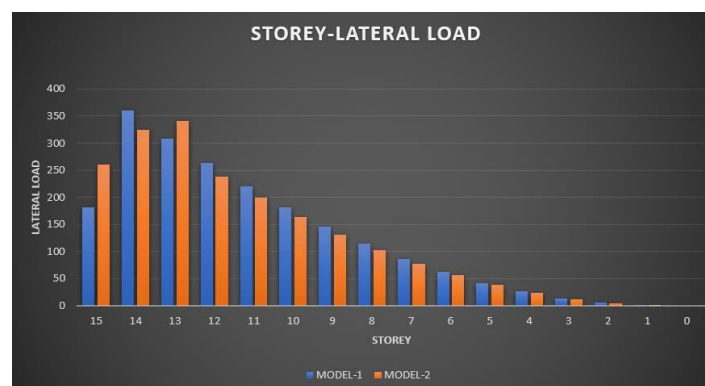
Graph 1 : Storey -displacement for model and model 2

COMPARING DRIFT FOR MODEL 1 & 2 IN X – DIRECTION



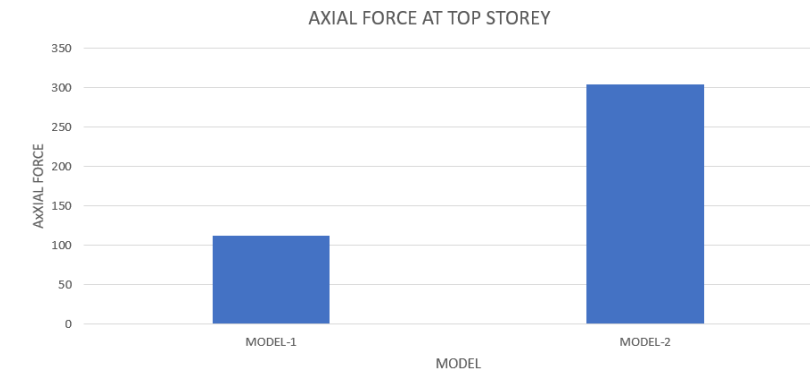
Graph 2 : storey drift for model 1 and model 2

COMPARING LATERAL LOAD FOR MODEL 1 & 2 IN X – DIRECTION



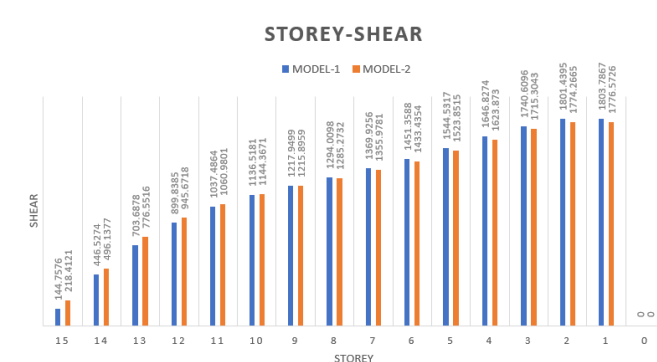
Graph 3 : Lateral load for model 1 and model 2

COMPARING AXIAL SHEAR FOR MODEL 1 & 2 IN X – DIRECTION



Graph 4 : Axial shear for model 1 and model 2

COMPARING STOREY SHEAR FOR MODEL 1 & 2 IN X – DIRECTION



Graph 5 : Storey shear for model 1 and model

III. CONCLUSIONS

THE FOLLOWING CONCLUSIONS MADE AFTER ANALYSIS OF ALL MODELFRAMES

1. It is been concluded that the displacement in center position swimming pool building (15.373 mm) is approximately 4.15 % less than one side swimming pool building (16.039mm) .it concludes that as the position of swimming pool changes there is change in displacement center position swimming pool building shows better results than model 2.
2. According to the report analysis the maximum storey shear in one side swimming pool 496.137 kN is greater than center position swimming pool 446.527 kN respectively .Thus here model 1 frame is practically safer than model 2.
3. In all the systems ,the storey drift is within the permissible limits as per IS :1893 (part1),however model 1 showed better results when compared to model 2.
4. As from the results observed the maximum shear force in model 2 (304.2110 kN) is approximately 6.043 greater than model 1 (112.426 kN) .hence the model 1 is practicallysafer than model 2.
5. SAfter all analysis we can say that there is a much variation in results as the position of swimming pool in elevation plays an important role in the designing of the building and Hence its been concluded that the center position swimming pool is the best position for theregular buildings.



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