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A Comparative Study of Waffle Slab

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Abstract: — Waffle panels are often designed to assemble floors and ceilings while covering longer spaces within a building without dilemma or support. Structural engineers analyse slabs like trusses as realistically supported systems (all four corners) and derive answers based on beam or slab displacement compatibility to get approximate answers or slab girders. Refine with . Perform a comprehensive finite element analysis (FEM). A device with he one of the most generalized finite detail software available on the market. This is because there is no analytical solution or simple calculation tools except for slabs where all edges are seriously supported. Based on this observation, a comparative analysis of ribs and waffle plates is presented to determine maximum stability and distribution within the evaluation. To validate the results, selected instances are compared using finite detail analysis, and force, second, displacement, and flow results are compared for each trace.

Keywords— Bending moments, deflections, boundary conditions, Table of equations, shape function, shear stress, waffle plate, ribbed plate, ETABS.

I. INTRODUCTION

Waffle board is a kind of building material with two-way R.C.C. in the fabric, in the shape of a waffle board purse. [1] This type of R.C.C is common in concrete, wood, and metal structures. Waffle slabs provide more structural stability no any using a lot of extra material. [2] This made waffle slabs ideal for largere flat surfaces such as foundations and floors. [3] The most common material for waffle slabs is concrete. These panels have been used as inspiration for many unique styles of residential advertising systems, but are not uncommon in commercial and commercial buildings. Waffle foundations are more resist to crack and sagging than traditional concrete slabs. It can hold a lot of weight. [4] The top of the waffle slab is usually clean like a traditional building floor, but the bottom has a shape reminiscent of a waffle. Immediately, tracks run across the width

and length of the slab, usually a few inches from the surface. These ridges form rectangular pockets of the same name along the length and width of the board.[5] Waywaffleboards are made using metal or plastic pans called DOMES. To valid the final results, selected cases are compared with the finite element analysis and the results are compared with respect to forces, moments, displacements and drifts in both directions. [6] In this sense, dynamic studies measure bending stiffness ignoring diagnostic model soil sections, leading to lenient inspection errors. [7] This study completed the investigation of a productive demonstration strategy that can take into account the bending stiffness of floor panels. [8] Panel consideringresults of construction similar to G+11 with waffle panel and single rib.

II. MATERIALS AND METHODS

Create a New Model
Start your model with the included advancements.
- units to kN and metric "kN-m" using the drop down menu in the lower right edge of the ETABS screen.- Following are particular structure.
concrete- M 20
factor of zone (Z) -0.36
Fe 500 grade
Rf (R)- 5.0
height of structure -3 m
If (I) -1.0
G.f, (H) -0.750 m
Soil – II (medium soil)
D.L. - 2 kN/m2
Slab thick -200 mm
Columns - 450 × 450 mm
Beams - 350 × 450 mm
L.L. -3 kN/m2
Damping ratio- 5%

A. Model Design

There is a resurgence of construction of high rise and ultra- skyscrapers around the world. The design of these skyscrapers in seismically active areas varies greatly from region to region. Some countries, including Japan and China, require rigorous performance-based evaluation, while many others only require traditional designs based on force reduction factors. One of the goals of this modeling is to ensure that the model represents the characteristics of the apartment complex. Today's skyscrapers vary in shape, height and function. This makes each building unique. There are several standards for each type of skyscraper. B. Residential, Office, and Commercial Buildings. Seismic design of modern skyscrapers, defined as buildings over 160 feet in height, must be addressed by addressing scientific, engineering, and regulatory issues related to appropriate modelling, analysis, and modelling techniques. There are many challenges to overcome. And the acceptance criteria are certain unique structural systems. However, important factors such as grid spacing, floor geometry, floor height, and column cross section were taken into account in constructing the model. In this study two buildings with the same number of storeys of 11 (G+10)

floors and the same floor plan with dimensions of 20 m x 20 m were considered. The floor plan was divided into 4 x 4 fields with a center-to-center distance of 5 meters on each side between the two grids. The floor height of the building is 3 meters, and the foundation height is 2 meters from the foundation base.

Model 1: Building having one way Ribbed Slab.

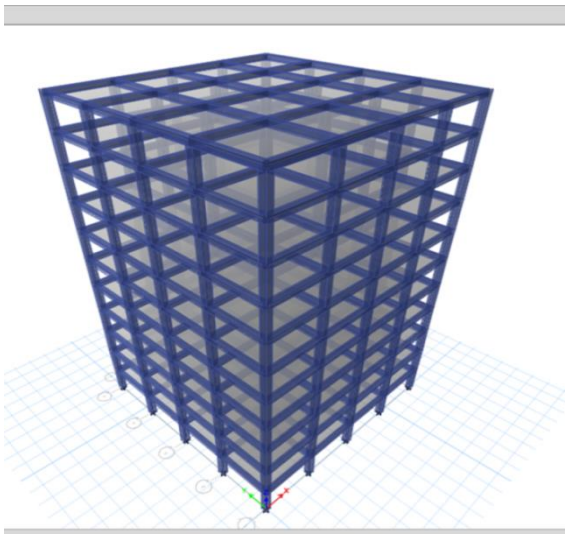


Fig 1. Building Frame with Ribbed Slab in ETABS Software.

Model 2: Building having Waffle Slab.

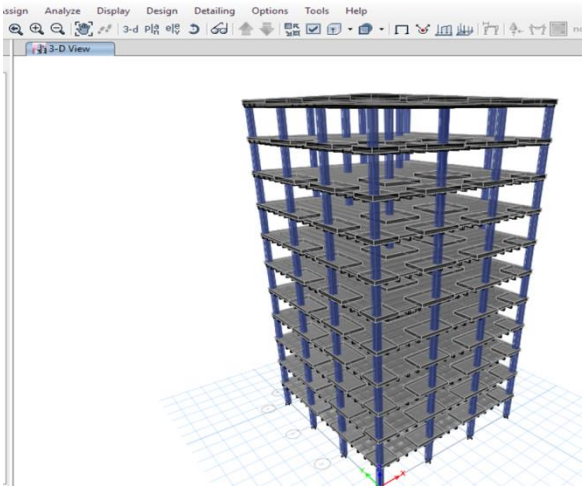


Fig 2. Building Frame with Waffle Slab in Etabs Software.

III RESULTS AND DISCUSSION

How to configure Indian regulations and unit data in ETABS.

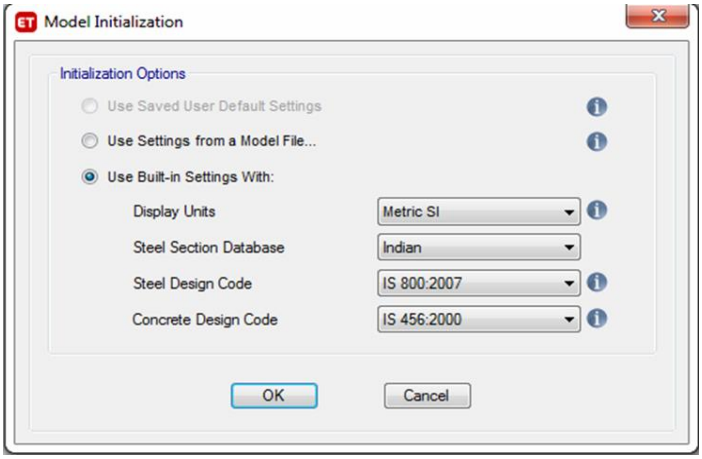


Figure 3 Choice of Indian units and code conventions

To Assign Grid data using analysis tool ETABS.

To Create materials as per Indian standards.

To Define sectional data.

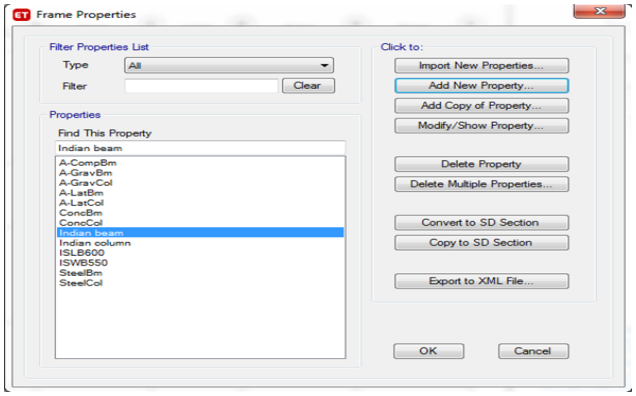


Table – 1. Storey Displacement.

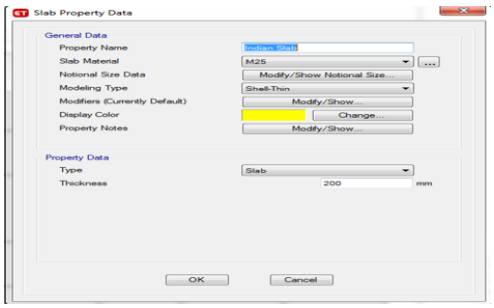
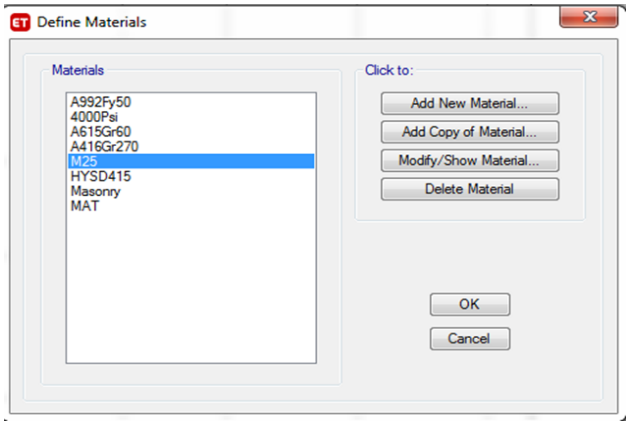


Fig 4. Sectional data

To Create building design



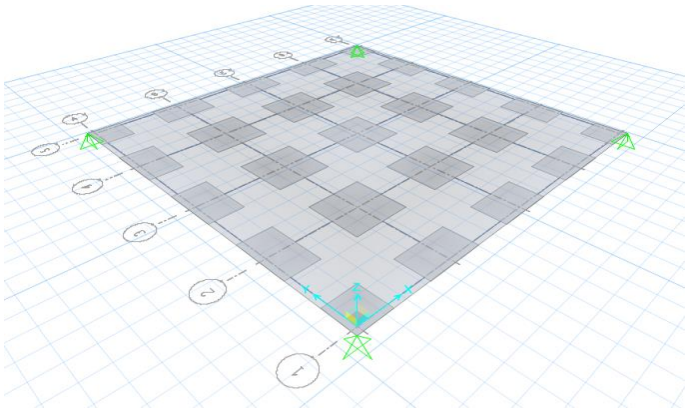
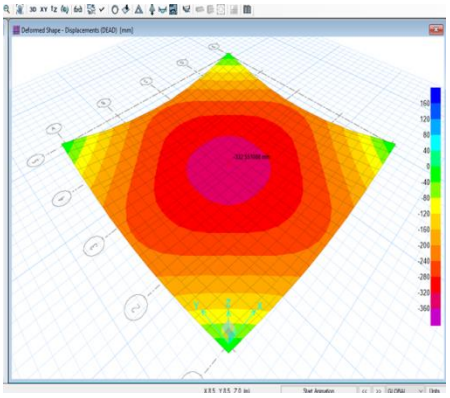


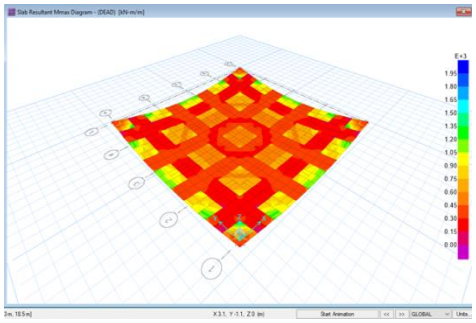
Fig 5. Unsymmetrical frame

Assign plate types. H. Waffles and ribs.

Storey Displacement mm		
Storey	Waffle	Ribbed
Story11	7.846	7.711
Story10	7.531	7.403
Story9	7.057	6.939
Story8	6.449	6.342
Story7	5.736	5.641
Story6	4.946	4.864
Story5	4.103	4.034
Story4	3.228	3.174
Story3	2.341	2.3
Story2	1.458	1.431
Story1	0.607	0.594



Ribbed Slab



Waffle Slab

Assignment of fixed exit conditions.

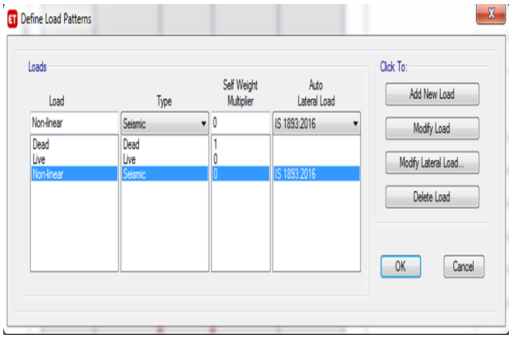


Fig 6. Loading Conditions

Assigning Load combination.
Table:-1

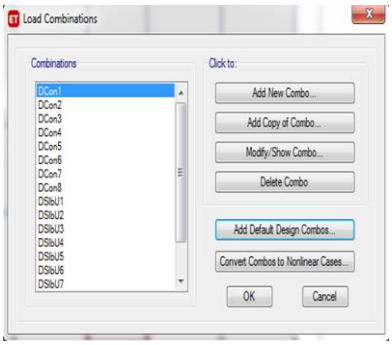


Fig 7. Load Combinations

Check the complete modeling of the structure and boundary conditions and analyze the program.Analysis considering boundary conditions and cases:

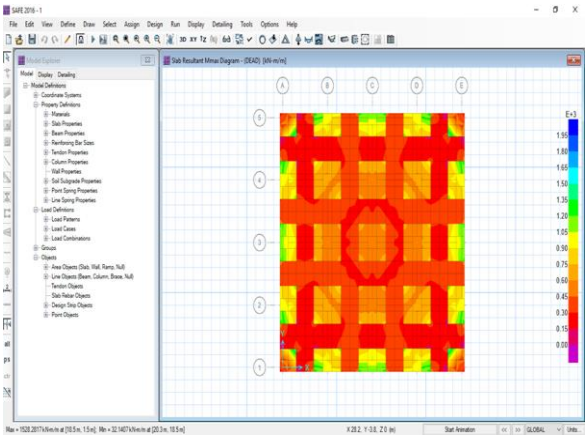


Fig 8. Analysis of Waffle Slab.

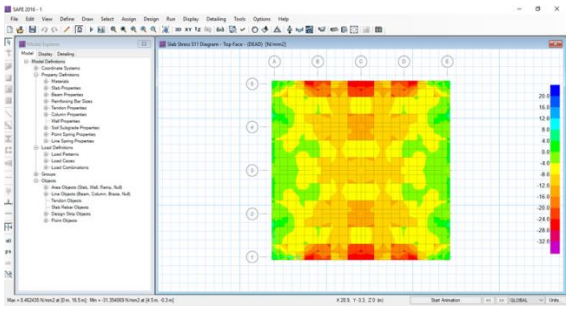


Fig 9. Analysis of Ribbed Slab

Analysis of both Cases
Comparative Results
Maximum Storey Displacement (mm).

Table 2. Storey Displacement

Storey Drift mm		
Storey	Waffle	Ribbed
Story11	0.379	0.371
Story10	0.57	0.559
Story9	0.732	0.726
Story8	0.858	0.844
Story7	0.952	0.936
Story6	1.015	0.999
Story5	1.053	1.037
Story4	1.069	1.053
Story3	1.024	1.048
Story2	0.729	1.008
Story1	0.82	0.713

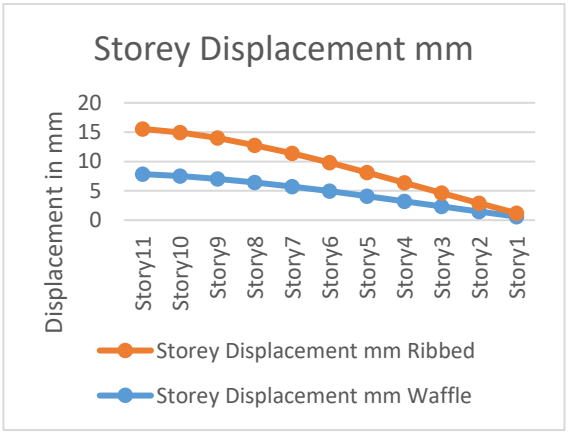


Fig 10. Storey Displacement.

As observed in fig 6.1, it can be said that displacement in waffle slab is comparatively more in comparison. Ribbed slab is in permissible limit as per I.S. 1893-I: 2016.
Storey Drift:

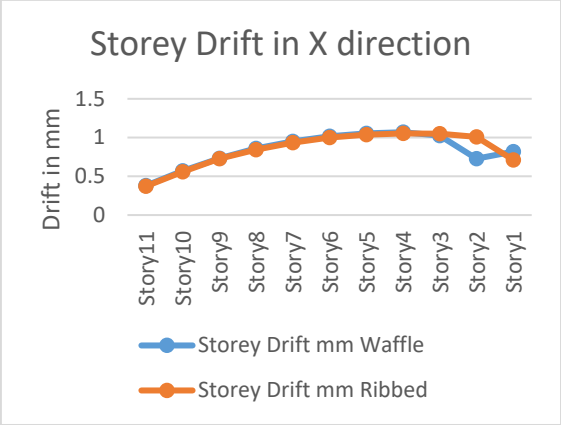


Fig 11. Storey drift in X direction.

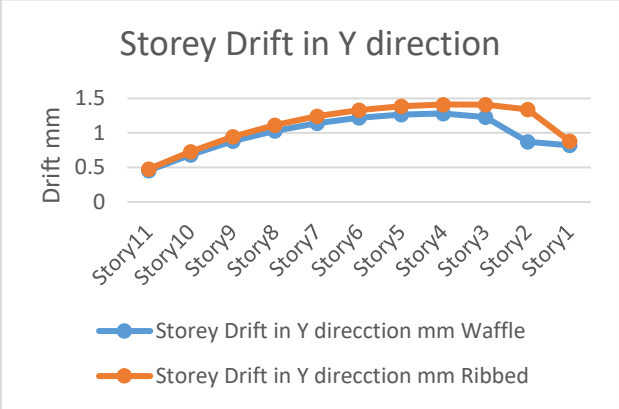


Fig 12. Drift in Y direction.

Drift can be defined as two relative continuous displacements. storey, in this study it can be said that upto 6 storey waffle slab has less drift increment but after 6th storey ribbed slab is observed as more stable.

IV Conclusion

In conclusion of this study it can be said that on the basis of results observed in comparison in above chapter this can be said that Ribbed slab structure is capable of maintaining the structure stable and more resistible in earthquake load.

i) In the proposed work ribbed and waffle slab is considered whereas in future other types of slab can be consider for comparison.

ii) In this study seismic analysis is considered whereas in future study wind load can be consider.

In this study analysis is done using etabs and Safe whereas in future SAP2000 can be prefer for P-delta analysis to determine the displacement force graph.

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