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Analytical Comparison of Conventional Slab and Voided Slab Using Ansys 14.5 – A Review

Shubham Athare[1], A. U. Bhalerao[2]
[1, 2]*Department of Civil Engineering, D.VVP COE Ahmednagar, Maharashtra, India*

Abstract: ***Reinforced concrete slab with plastic voids is a new and innovative type of structural, concrete slab system developed to allow for lighter self weight of thestructure while maintaining similar load carrying capacity of a solid slab. In this study the design process for plastic voided slab is compared with reinforced concrete solid flat slab through a design comparison of typical bays with the same thickness. Also, the finite element analysis of the slab panels has been carried out byusing ANSYS Workbench 14.5 to find out the deformation. The primary objective of the work is to obtain optimum slab system with the above stated parameters.***

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Keywords: ANSYS, FINITE ELEMENT METHOD.

I. INTRODUCTION

The Bubble Deck slab is a revolutionary biaxial concrete floor system developed in Europe in 1990's by Jorgen Breuning. The traditional Bubble Deck technology uses spheres made of recycled industrial plastic to create air voids while providing strength through arch action. This results in a dramatic reduction of dead weight by as much as 35-40% allowing much longer spans and less supporting structure than traditional solutions. Hence, the Bubble Deck has many advantages as compare to traditional concrete slab such as lowered total cost, reduced material use, enhanced structural efficiency, decreased construction time and is a green technology. It gains much of attention from engineers and researchers from the world. But, while designing a reinforced concrete structure, a primary design limitation is the span of theslab between columns. Designing large spans between columns often requires the use of support beams or varies thick slabs thereby increasing the weight of the structure byrequiring the use of large amounts of concrete.

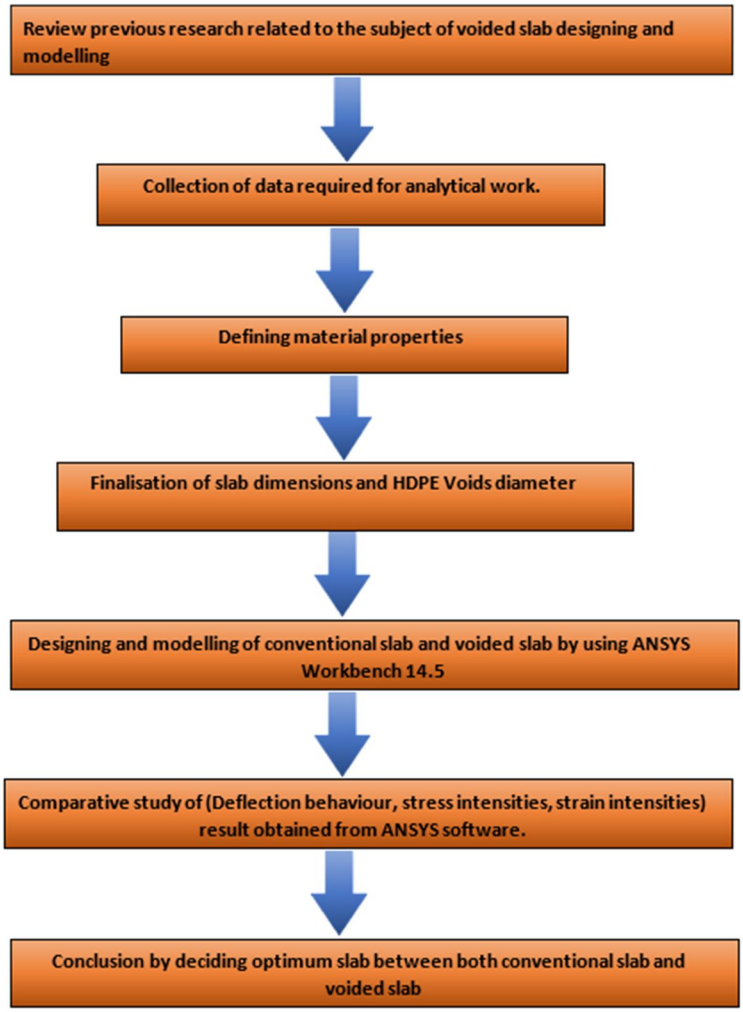
II. LITERATURE REVIEW

The some of the authors were studies on the various parameter of geopolymer concrete are as follows

Roberto Grade(2001): He developed and patented a new system of hollow formers, in order to decrease the transportation costs (and CO2 production). The U-Boot formwork is a modular element made of re-cycled plastic for use in building lighter structures in reinforced concrete cast at the work-site. A truck of U-boot means approximately 5000m² of slab, once hollow formersare laid down at building site. The second innovation is the shape: U-boot creates a grid of orthogonal "I" beams, so the calculation of the reinforcement can be effected by any static engineer according to Eurocode, British standard or any local standard.The biggest advantage of U-boot is that it is stackable. Schnellenbach-Held M., Ehmann S., P feffer K.(2009) : They wrote that Bubble deck slab is the slab in which some amount of the concrete is replaced by the plastic hollow bubbles which are made by the waste plastic material, which reduces the self-weight of the structure. The main effect of the plastic sphere is to reduce the dead load of the deck by1/3 in compare to solid slab having same thickness without effecting its deflection behaviour & bending.By applying the knowledge gathered during the behavioural analysis. Modular deck components for pedestrian bridges that is notably lighter but comparable in strength to typical reinforcement concrete section will be designed. Jorgen Bruening (1990): He studied that locks ellipsoids between the top and bottom reinforcement meshes, thereby creating a natural cell structure, acting like a solid slab. For the first time a hollow biaxial slab is created with the same capabilities as a solid slab, but with considerably less weight due to the elimination of superfluous concrete. Design of this type of the slab is based on the euro and the British codes. Neeraj Tiwari zafar (2013): He had presented a paper. This presented a study on the Bubble Deck slab is a newly designed slab made by reinforcement mesh,hollow HDPE void, reinforcement mesh again at bottom. It is based on the patented integration technique there is the connection of steel and air. It is a hollow deck in which HDPE sphere void serve the purpose of reducing concrete that has no carrying effect. S.N.

Bhagat et al. (2014) states that, the use of flat plate slab is gaining much popularity amongst architects because the flat plate slab system provides a way for the architect to achieve the concept of high and completely flat ceiling with no beam. As we know that, slab is one of the largest members consuming concrete, when the load acting on the slab is large or clear span between columns is more, the slab thickness is on increasing. It leads to consume more material such as concrete and steel due to that self-weight of slab is increase. To avoid these disadvantages various studies carriedout and researchers suggest voided flat plate slab system to reduce the self-weight of the slab. In this study various parameters of the voided and solid flat plate slabs is calculated to compare the both systems. To evaluate the performance of the R.C.C voided and solid flat plate slabs, modeling of slabs is carried out using SAP 2000 having span ranging from 6x6 m to 14x14 m of 4x4 bay in both direction with thickness of the slabs 280 to 600 mm. The results drawn from the SAP 2000 are Reaction, Deflection, Moment and Reinforcement required for the voided and solidflat plate slabs.

III. METHODOLOGY



IV. CONCLUSION

In this project, comparative study of voided slab and solid slab is performed with respect to FEA analysis, % weight reduction and cost analysis. And we got variousresults with conclusions as follows.

1) In this study, nonlinear finite element analysis of reinforced concrete slabs with HDPE Spheres is performed. Based on the results, the various conclusions are carried out such as the general behaviour of the finite element models representedby the total deformation show good agreement.

2) The deformation in voided slab is approximately similar to solid slab. Becausediameter used for analysis is very small as

60mm.

3) By inserting the HDPE balls, unnecessary concrete is removed and self-weight ofslab is also reduced, which results in the longer spans in voided slab system.
4) From the above study average % weight reduction is 0.73%. Reducing weight ofslabs can lead to a large reduction in overall seismic force, as weight is a leadingfactor in determining the seismic force.
5) From the cost analysis of Solid slab and voided slab, voided slab has reduced cost. So, we can conclude that overall structural cost of construction reduces.

HDPE balls are made up of recycled polypropylene and also its ability to save materialallows building to have smaller impact on the environment, all these aspects lead to a high degree of sustainability and an environment friendly design.

Conclusions Based on Finite Element Analysis in ANSYS Workbench 14.5

In this study, nonlinear finite element analyses of reinforced concrete slabswith HDPE spheres are performed. Based on the results, the various conclusions are carried out such as the general behavior of the finite element models represented bythe total deformation show good agreement. The deformation in voided slab is maximum therefore load carrying capacity of the voided slab predicted by the finite element analysis is lesser than that of the solid slab.

Effect of Thickness: As the reinforcement and void diameter was kept constant andthe thickness of slab increases the values of deformation decreases. Also, for all loading conditions stress intensity and elastic strain intensity decreases. The decrementof 22% is observed for every 20mm increment of slab thickness.

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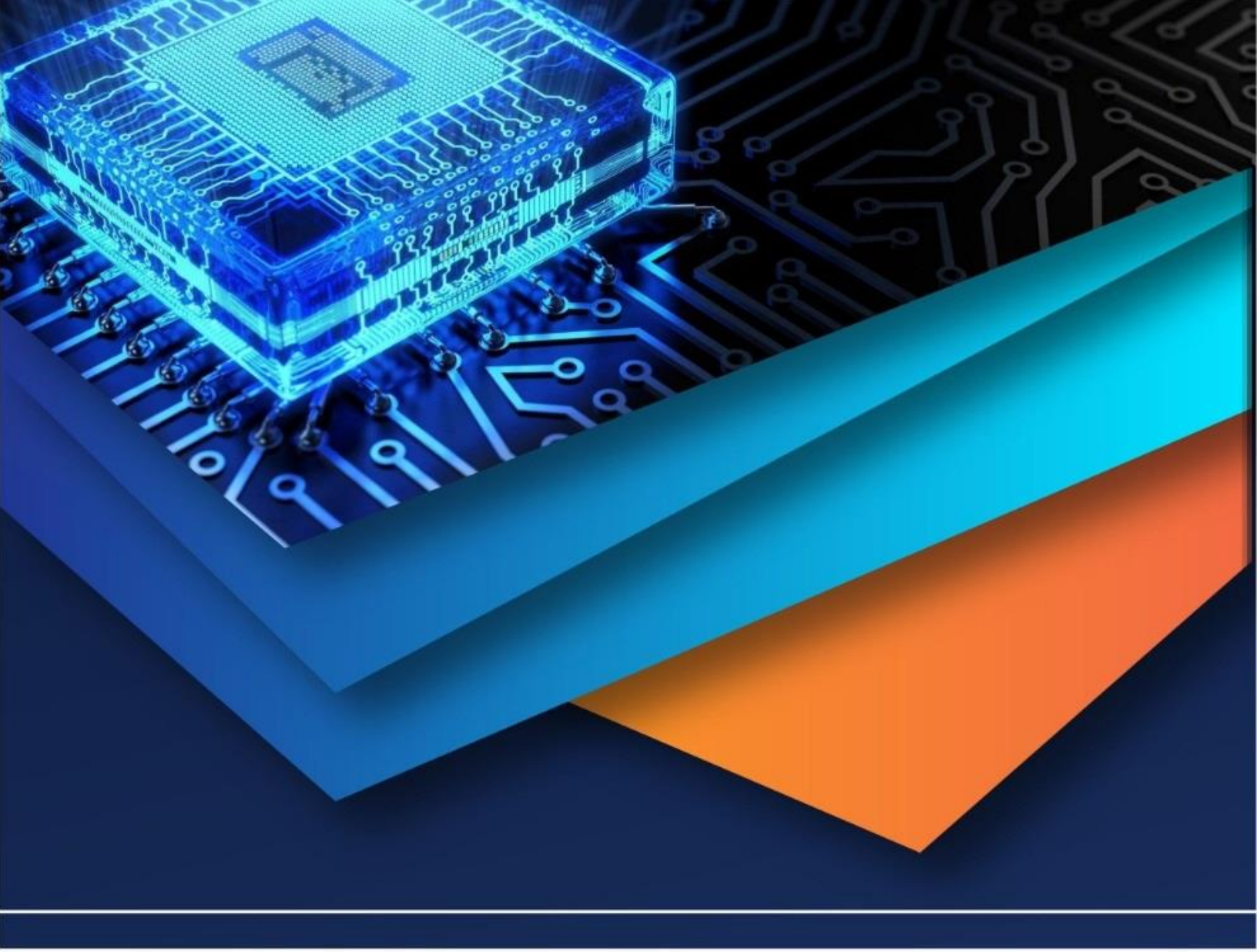

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