iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** IV **Month of publication:** April 2019

DOI: https://doi.org/10.22214/ijraset.2019.4294

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

Analysis of Conventional Slab and Voided Slab with U-Boot Technology

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Abstract: ***A voided slab is a concept that simply removes the excess concrete from the expensive part of the structure slab. It was invented by Jorgan Breuning of Denmark about 20 years ago. It is now gaining popularity both in Europe and in Asia. This paper reviewed the several study done on voided slab system. All technical parameters of voided slab system on which experimental study have been carried out by authors are tabulated in this paper systematically. The realization of the proposed objectives involves documentation activity and theoretical study of all work done by several authors on voided slab concept. The resultant conclusion will be used in defining the failing mechanism that can be useful in the formulation of an adequate mathematical model.***

Keywords: Voided slab, Bubble deck, Cobiax, U-boot, Air deck,Bee plate system,Structural behaviour, Punching shear capacity, HDPE

I INTRODUCTION

U-boot is the ideal solution for creating slabs with a large span and or great load bearing capacity; it is particularly suited for structures that require considerable open spaces, such an executive commercial and industrial buildings as well as public, civil and residential structures. It makes it possible to more irregularly distribute the pillars, as beams do not need to be created. It is used to create slabs with large span or that are able to support loads without beams. Light and quick and easy to position, thanks to their modularity the designer can vary the geometric parameters as needed to adapt to all situations with great architectural freedom. The use of u-boot formwork makes it possible to create mushroom pillars, with the possibility to have the mushroom in the thickness of the slab. Thanks to the conic elevator foot, immerging the U-boot formwork in the concrete casting will creates a grid work of mutually perpendicular beams closed from the bottom and the top by a flat plate that is created with a single casting; this results in considerable reduction in the use of concrete and steel. The u-boot technology is used to creating large span or in raft foundation where the soils have low bearing capacity. It makes the structure lighter, economical. By using this, the number of columns can be reduces which gives more architectural freedom. It is used in all applications that requires a structural plate together with the need to use less concrete and therefore for a lighter structure. This is the new lighter structure is achieved by encasing the u-boot inside the solid cast. The lighter structure is comprised of two level layers one over the other separated and associated with each other by beams at right angle.

II LITRETUREREVIEW

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 carried out and researchers suggest voided flat plate slab system to reduce the self-weight of the slab. In building constructions, the slab is a very important structural member to make a space. And the slab is one of the largest member consuming concrete. The main obstacle with concrete constructions, in case of horizontal slabs, is the high weight, which limits the span. For this reason major developments of reinforced concrete have focused on enhancing the span reducing the weight or overcoming concrete's natural weakness in tension. In a general way, the slab was designed only to resist vertical load. However, as people are getting more interest of residential environment recently, noise and vibration of slab are getting more important, as the span is increased; the deflection of the slab is also increased. Therefore, the slab thickness should be increase. Increasing the slab thickness makes the slabs heavier, and will increased column and foundations size. Thus, it makes buildings consuming more materials such as concrete and steel reinforcement. To avoid these disadvantages which were caused by increasing of self weight of slabs, the voided slab system, was suggested.

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Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

III OBJECTIVE

A. To compare self-weight of conventional slab and self-weight of voided slab lightened with U-Boot Beton.

B. To analyse both the slab systems under same conditions in ETABS to find out the deformation due to self-weight of both the slabs.

IV MATERIAL AND METHOD

U-boot slab is composed of three main materials; they are steel, plastic and concrete:

1) *Concrete:* The concrete is made of standard Portland cement with max aggregate size of 20 mm. No plasticizers are necessary for concrete mixture.

2) *Steel:* The steel reinforcement is Fe500 grade. 8mm diameter steel bar is used.

3) U-boot-Generally, we used HDPE recycled plastic material because to reduce wastage of plastics instead of burning the plastics.

4) *Conventional Slab:* This is a slab with specifications developed to analyze experimentally with normal concrete of grade M25 by adopting conventional methods of design according IS 456:2000 & IS 10262:2009.

5) *Voided Slab:* This is a slab with specifications prepared to analyze experimentally with normal concrete of grade M25 by using Hollow strong U BOOT (HDPE- High density polyethylene).

Flow Chart Of Methodology This flow chart shows the methodology adopted in this study to achieve the desired aims

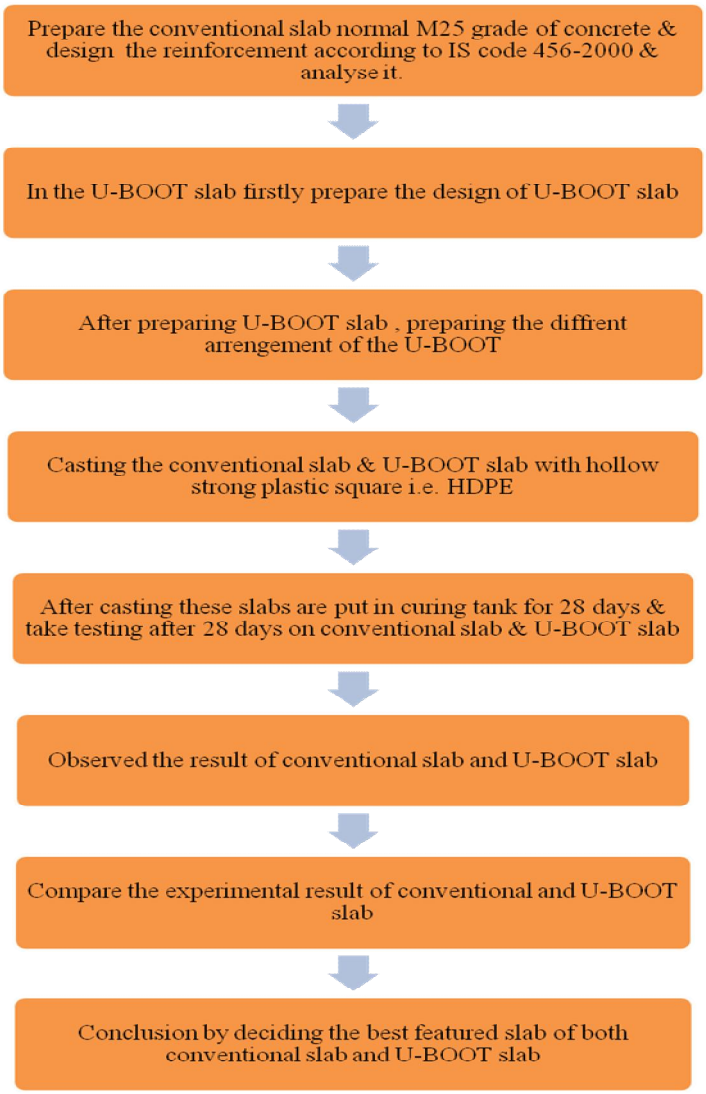

Fig.1. HDPE material

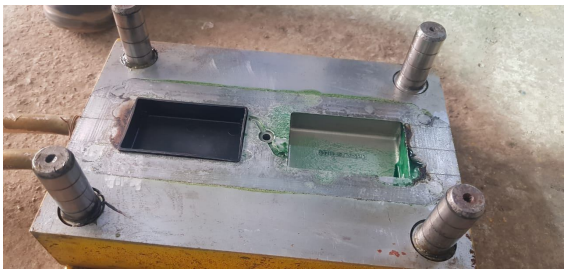

Fig.2. Plastic mould

Fig.3. Casting of U-Boot slab

A. Design Constant

1) Grade Designation = M25
2) Type of Cement = OPC 53 grade
3) Maximum Nominal Aggregate Size = 20 mm
4) Minimum Cement Content =320 kg/m3
5) Maximum Water Cement Ratio = 0.45
6) Workability = 50-75 mm (Slump)
7) Exposure Condition = Severe
8) Degree of Supervision = Good
9) Type of Aggregate = Crushed Angular
10) Chemical admixture = No admixture use

B. Test Data for Materials

1) Cement, Used Birla super OPC 53 grade
2) Sp. Gravity of Cement = 3.15
3) Sp. Gravitational force of Water = 1.00
4) Sp. Gravity of Coarse Aggregate = 2.77
5) Sp. Gravity of Fine Aggregate = 2.60
6) Water Absorption of Coarse Aggregate = 1.24%
7) Water Absorption of Fine Aggregate = 2.80%
8) Free (Surface) Moisture of 10 mm Aggregate = nil
9) Free (Surface) Moisture of crushed Sand = nil

C. Quantity of Material

1) For Conventional Slab

a) Total concrete volume for conventional slab = 0.0675 cu.m
b) Volume of cement = 0.016 cu.m
c) Volume of sand = 0.016 cu.m
d) Volume of agg. = 0.033 cu.m
e) Quantity of steel =7.5 Kg

2) For U Boot Slab

a) Total volume of concrete= 0.0535 cu.m
b) Volume of cement = 0.013 cu.m
c) Volume of sand = 0.013 cu.m
d) Volume of agg. = 0.026 cu.m
e) Quantity of steel =7.5 Kg

V RESULT AND DISCUSSION

Here we can observe that the deformation due to self-weight of concrete in voided slabs with U-Boot Beton is less than conventional slab, the unnecessary concrete in middle strip of slab is replaced by voids created by the U-Boot Beton and thus reduced floor weight causes less deformation due to dead load in case of voided slabs with U-Boot Beton.

Table I Rate analysis for conventional slab

Sr. no.	Material	Quantity	Cost (Rs)	Total (Rs)
1	Cement	25 Kg	175	892.5
2	Coarse Aggregate	50 Kg	115	
3	River Sand	25 Kg	250	
4	Reinforcement	7.5Kg	352.5	

Table II Rate analysis for U-BOOT slab

Sr. no.	Material	Quantity	Cost(Rs)	Total(Rs)
1	Cement	20 Kg	140	930.5
2	Coarse Aggregate	40 Kg	98	
3	River Sand	20 Kg	200	
4	Reinforcement	7.5 Kg	352.5	
5	U-boot	20 Nos	140	

VI CONCLUSION

A. Concrete usage is reduced as 1 kg of recycled plastic replaces 8 kg of concrete. This avoids the cement production and allows reduction in global CO_2 emissions. Hence this technology is environmentally green and sustainable.

B. As per the study, this technology is not feasible for small works as the smaller U-BOOT size does not achieve economy as compared to mass.

VII FUTURE SCOPE

A. U-boot is the ideal solution for creating slabs with a large span and or great load bearing capacity.

B. It is particularly suited for structures that required considerable open spaces, such as executive, commercial and industrial buildings as well as public, civil and residential structures.

C. It makes it possible more irregularly distribute the pillars, as beams to do not need to be created.

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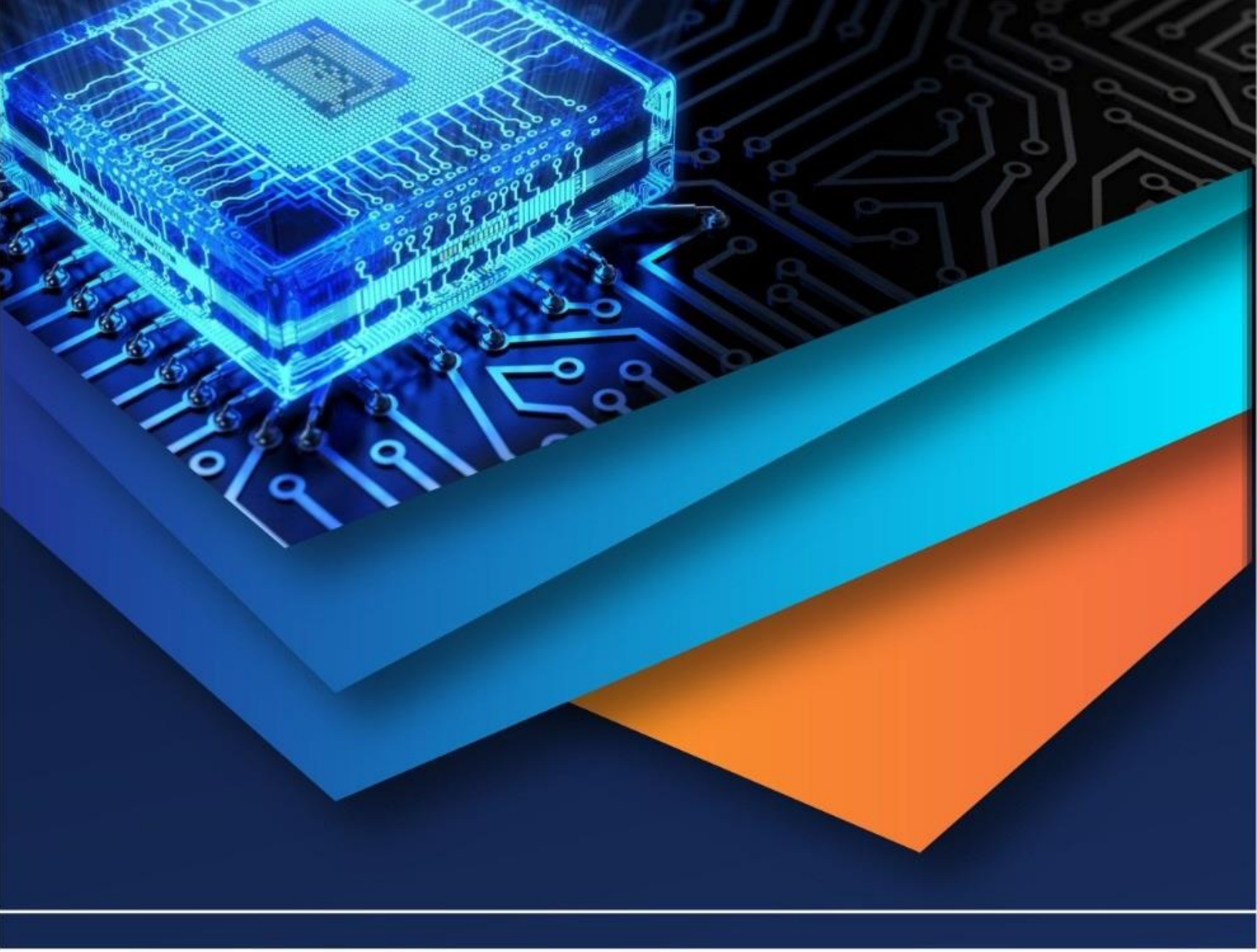

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