iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** X **Month of publication:** October 2017

DOI: http://doi.org/10.22214/ijraset.2017.10314

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue X, October 2017- Available at www.ijraset.com

A Review Study on Bubble Deck Slab

Harshit Varshney[1], Nitish Jauhari[2], Himanshu Bhatt[3]
[1, 2, 3] *Department of Civil Engineering Rajshree Institute of Management & Technology, Bareilly*

Abstract: Concrete slab is the most important component of any building structure. Slab provides great thermal comfort and great lifestyle for human beings. Concrete slab consumes more concrete in the casting for providing flooring and roofing. Concrete is heavy in weight and more than 5% of CO2 is created during the manufacturing of cement that goes into it. In this paper we studied that reduction of concrete in slab may be suitable and useful for making lightweight and most effective concrete slab after using High density polyethylene hollow spheres. The use of hollow spheres virtually eliminating all concrete from the middle of the slab which is not performing any structural function, thereby reducing the self-weight and increasing the efficiency of the slab. This method introducing the 30 to 50% lighter slab than can reduce the loads on the columns, walls and foundations. It also useful in reducing the cost and emission of CO2.
Keywords: Recycling, bubble slabs, conventional slab, comparison.

I. INTRODUCTION

In any structure, slab has most important role, used for berthing purpose and for transmitting the loads to other structural elements. The slabs are the plate elements forming floors and roofs of the buildings supported by beams or walls. In general, slabs are classified as one way slab and two way slab. Slabs that primarily deflect in one direction is referred as one way slab. Two way slab is also called as slab spanning in two directions because bending takes place in both directions. Several attempts were used to create biaxial with cavities to reduce the weight. Many attempts have consisted of laying blocks of a light weight material like expanded polystyrene between the bottom and top reinforcement, while other types included waffle slabs and grid slabs.

Bubble deck reduces up to 35% of the structural concrete in slab and upto 20% reduction in other structural members due to this. This method is effective in time saving, use of Bubble deck means floor cycles up to 20% faster than traditional construction methods. Bubble deck system makes the slab lighter in weight, this reduction in weight reduces some column and beam ie. equal to the time saving. There are also a number of green attributes including; use of recycled materials, lower energy consumption, reduction in total construction materials, reduced CO2 emissions, less transportation and crane lifts that make Bubble deck more environmentally friendly than other concrete construction techniques. This study firstly invented by Jorgen Bruenig in 90's who developed the first biaxial slab in Denmark. The bubble deck is also known as voided slab. It is a new technique of construction using recycled spherical balls in slab to reduce the self- weight of the structure. Use of spherical balls to fill the voids in the middle of a slab eliminates 35% of a slab self-weight compared to solid slab having same thickness without affecting its deflection behavior & bending strength.

II. TYPES OF VOIDED SLABS

The Bubble Deck versions come in the three forms- filigree elements, reinforcement modules, and finished planks. For all types of Bubble Deck, the maximum element size is 3m for transportation reason. There is no difference in the capacity if the sections are connected on site.

A. Filigree elements

This type of deck slab is a combination of constructed and unconstructed elements. For making these elements, a 60mm thick concrete layer is precast and brought on site with bubbles and steel reinforcement unattached. The bubbles are supported by temporary stand on precast layer and held in position by a honeycomb of interconnected steel mesh. Some additional reinforcement may be inserted according to the design requirement. After placing reinforcement, full depth of slab is reached by common concreting technique.

B. Reinforcement Modules

A reinforcement module consists of a pre- assembled sandwich of steel mesh and plastic bubbles. These components are bedded on the traditional formwork, connected to any additional reinforcement and then concreted. This category of Deck slab is used for construction area with tight spaces.

C. Finished Plank

This type is a shop- fabricated module that includes the plastic spheres, reinforcement mesh and concrete in finished state. These modules are manufactured in the form of a plank and dlivered to the site.

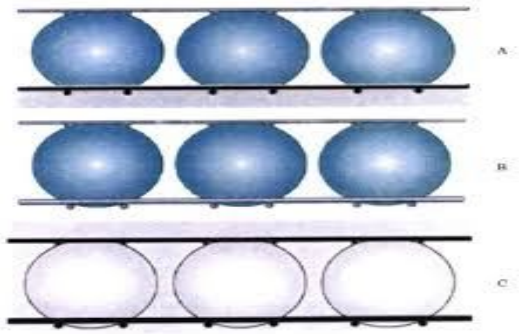


Fig. 1 Types of bubble deck slabs

III. ADVANTAGES OF DECK SLABS:

A. Structural

1) Less in weight as compared to traditional concrete slab.
2) Increased strength
3) No need of beams
4) Only few columns are required to support deck slab
5) Free choice of Shape
6) Less foundation depth

B. Construction

1) Light in weight less equipment is required
2) Easy incorporation of ducts and pipes into slab
3) Less work on construction site

C. Engineering

1) The biaxial flat slab system and columns are ideal for structures with high resistance against Explosions
2) These slabs and column system acts as an elastic membrane which transfer horizontal forces to stiff vertical structures which is used for Earthquake resistant designs.

D. Environmental

1) Material and energy consumption is less
2) Reduction of CO2 emission up to 40 kg/m2
3) 1kg of plastic replaces 100kg of concrete
4) Every component is recyclable

E. Economy

5) Savings in materials
6) Transportation costs reduced
7) Faster construction time
8) Buildings can be more flexible and easy in installations

IV. STRUCTURAL PROPERTIES OF BUBBLE DECK SLABS

A. Compressive strength and Flexural capacities

Bubble deck slab is conceptualized to exclude a significant volume of concrete as compared to a solid slab in the central core where the slab is principally un-stressed in flexure. The depth of compressed concrete is usually a small proportion of the slab depth.The

concrete between the ball and the surface so there is no reasonable difference between the behaviour of a Bubble Deck and solid slab. The only working rudiments are the steel on the tension side and the outer 'shell' of concrete on the compression side. In terms of flexural strength, the moments of resistance are the same as for solid slab.

B. Durability

The durability of bubble deck slab is not essentially different from ordinary solid slabs. The concrete is standard grade and combined with suitable bar cover provides most control of durability equal with normal standards for solid slabs. When the filigree slabs are manufactured, the reinforcement module and balls are vibrated into the concrete and produce the uniformity of compaction so that a density of surface concrete is produced which is at least as impermeable and durable? Bubble deck slab joints have a chamfer on the inside to assure that concrete surrounds each bar does not allow a direct route to air from the rebar surface. This is mainly a fucion of the fire resistance but is also relevant to durability.

C. Fire Resistance

The fire resistance of the slab is a complex matter but is chiefly dependent on the ability of the steel to retain sufficient strength during a fire when it will be heated and lose significant strength as the temperature rises. The temperature of the steel is controlled by the fire and the insulation of the steel from the fire. In a fire, it is likely that the air would escape and the pressure dissipated. If the standard bubble material is used, the products of burning are relatively benign. In an intense prolonged fire, the ball would melt and eventually char without significance or detectable effect. Fire resistance depends on concrete cover nearly 60-180 minutes. While Bubble deck slabs are not designed to provide thermal insulation due to encapsulation of the air bubbles within the center of the concrete slab Bubble deck achieves between 17% to 39% higher thermal resistance than an equivalent solid slab of the same depth. Bubble deck slabs can therefore make a useful contribution towards the thermal insulation achieved by the overall construction.

V. LITERATURE REVIEW

M.Surendar, et al. (2016), worked on experimental and numerical Study on Bubble Deck Slab with the aim of reducing the amount of concrete in the middle of the slab by using recycled sphere balls. Plastic hollow spheres balls were used to replace the in-effective concrete in the center of the slab, this reduces the dead weight and increasing the efficiency of the floor and to heighten the performance of the bubble deck slab in moderate and severe seismic susceptibility areas. They carried out by using the Finite Element Analysis software ANSYS to study structural behaviour of the slab. The slab of Conventional and Bubble deck slab both are subjected to uniformly distributed load. The ultimate load, stress, deformation was measured by analytically. After analysis the found that the conventional slab carried the stress of about 30.98MPa by applying the UDL load of about 340kN and causes deflection of 12.822mm. The bubble deck slab carried the stress of about 30.8 MPa by applying the UDL of about 320kN and causes deflection of 14.303mm. So the results of experiment shown thatbubble deck slab can withstand 80% of stress when compared with conventional slab. The stress and deformation results of bubble deck slabs werecompared with conventional slabby using FEA. From the comparison of these results we found that Bubble Deck Slab gives better performance than that of the conventional slab.

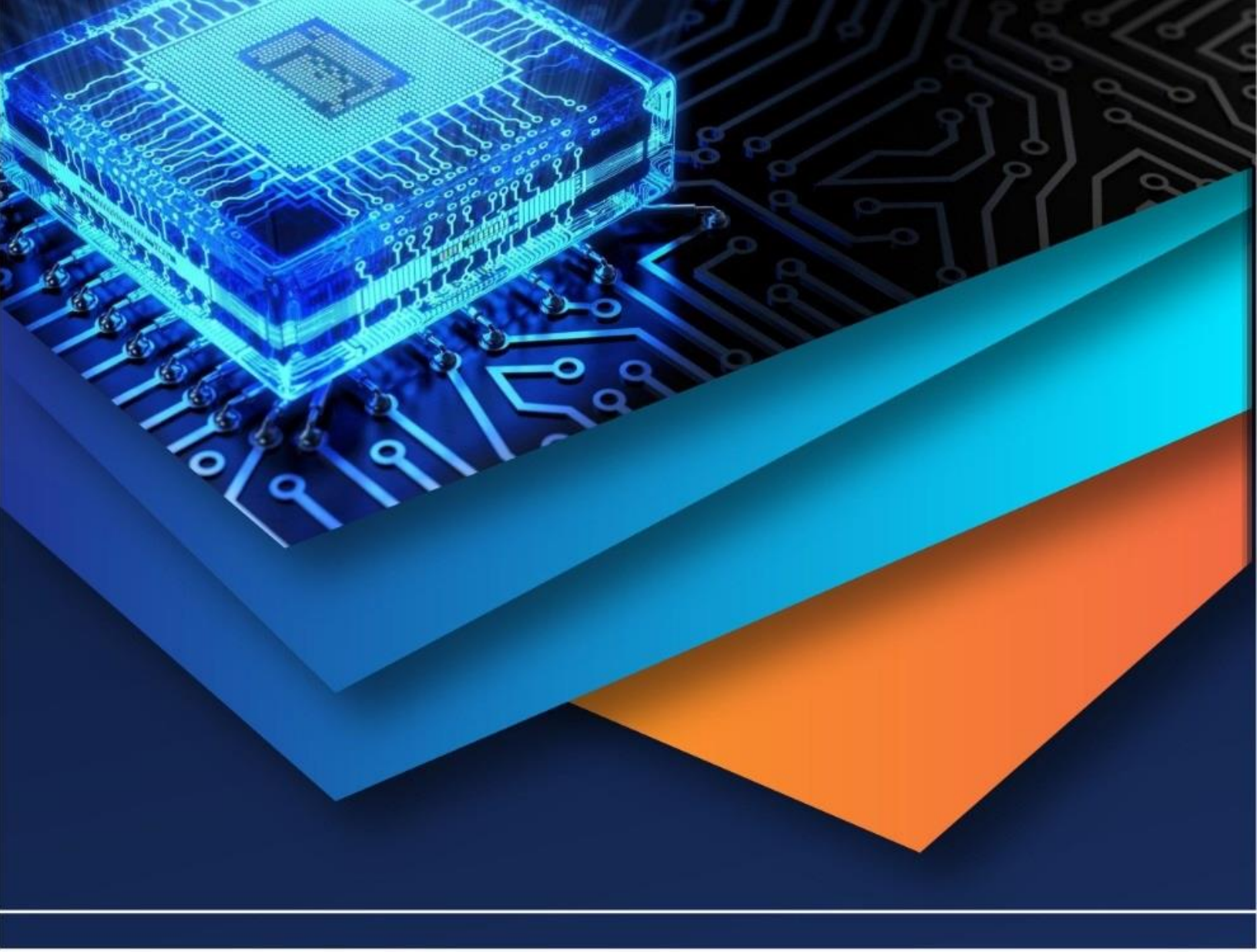
Arati Shetkar & Nagesh Hanche (2015) In this experimental, the applied force is from the bottom to the top of the slab, until the cracks occur in the slabs and the failure modes were recorded. The results obtained that better load bearing capacity in Bubble Deck can be achieved using the hollow elliptical balls and to reduce the overall costs. Reducing of the material consumption make the construction time faster. The results of the study also shows a reduction in deadweight up to 50%, which allow creating foundation sizes smaller. This experimental study done on Bubble Deck Slab System with Elliptical Balls. Behavior of Bubble Deck slabs is influenced by the ratio of bubble diameter to slab thickness. Bubble diameter varies from 180mm to 450mm and the slab depth is 230mm to 600mm.

Amer M Ibrahim, et. al. (2012) A study has been conducted on the flexural strength of reinforced two-way Bubble deck slabs. To reduce the self- weight of the slabs a Bubble deck slab has a two dimensional arrangement of voids. The behavior of Bubble deck slabs is determined by the ratio of bubble diameter to slab thickness. To verify the flexural behavior of Bubble deck slab such as ultimate load, deflection, concrete compressive strain and crack pattern, two dimensional flexural tests were conducted by using special loading frame. After experimental the results shows that the crack pattern and flexural behavior depend on the void diameter to slab thickness ratio. The ultimate load capacities for Bubble deck slabs having bubble diameter to slab thickness of 0.01 to 0.64 were the same of solid slabs, the ultimate capacities were reduced to about 10%.

Prabhu Teja and P Vijay Kumar(2012) studied about the durability of Bubble deck slab and is explained on the basis of creep and shrinkage. A Bubble deck element with two spherical hollows was compared with a solid concrete block of the same dimension and of the same concrete grade. They conclude the difference between the shrinkage strains of Bubble deck slab and solid concrete block was measured. The results show that Bubble deck element has a negligible larger marginal shrinkage strain than a solid slab with equivalent dimensions, under the same exposure to environmental conditions. The influence of carbonation shrinkage can be neglected in the design of concrete structures with Bubble deck system, because only a small part of the concrete cross- section is exposed to this kind of shrinkage.

REFERENCES

[1] Amer M. Ibrahim, Nazar K. Ali, Wissam D. Salman. (June 2013). "Flexural capacities of reinforced concrete two-way bubble deck slabs of plastic spherical voids", Diyala Journal of Engineering Sciences, ISSN 1999-8716, Vol. 06, No. 02, June 2013.
[2] M.Surendar M.Ranjitham (2016). Numerical and Experimental Study on Bubble Deck Slab Research Article Volume 6 Issue No. 5 DOI 10.4010/2016.1445 ISSN 2321 3361 © 2016 IJESC.
[3] Arati Shetkar and Nagesh Hanche. (2015). "An experimental study on bubble deck slab system with elliptical balls". ISSN: 0976-2876.
[4] Chung J.H., Choi H.K., Lee S.C, "Shear Capacity of Biaxial Hollow Slab with Donut Type Hollow Sphere", Procedia Engineering, Vol. 14, Pp. 2219 -2222, 2011.
[5] A. Churakov, "Biaxial hollow slab with innovative types of voids", Construction of Unique Buildings ad structures, Vol. 6(21), Pp. 70-88, 2014.
[6] Neeraj Tiwari Sana Zafar, (2016). Structural Behaviour of Bubble Deck Slabs and Its Application: Main Paper IJSRD - Internatio n al Journal for Scientific Research & Development| Vol. 4, Issue 02, 2016 | ISSN (online): 2321-0613.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY