International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **06** Special Issue **01** | **2021**

Experimental Study On Bubble Deck Slab

S.S.Pawar[1], A.S.Pawar[2]

[1] *Assistant Professor, Civil Eng. Department, Pdm.V.B.Kolte College Of Eng.Malkapur, Maharashtra, India*
[2] *PG Student,PGP-Quantity Surveying & Contract Management , NICMAR Hyderabad, Telangana, India*

ABSTRACT

The bubble deck slab is flat slab that spans in two directions, in which plastic balls are incorporated to replace & therefore eliminate the concrete in middle of conventional slab which does not contribute to its structural performance. The main objective of this paper is to study performance of flat slab, to estimate the amount of concrete reduced as result of plastic balls introduction into flat slab and to analyze the results of load vs deflection. Conventional Reinforced concrete slabs are one of the most common components in modern building construction consume the most concrete. Due to the large amount of concrete required to produce these slabs, the self-weight of these structures is very large. The concrete in the middle of these slabs does not perform any structural function. Bubble Deck is a revolutionary method of virtually eliminating concrete from the middle of conventional slab, thereby dramatically reducing structural self-weight by linking air and steel directly. This slab uses hollow spherical or elliptical balls made by recycled plastic. Plastic voided slabs are capable of reducing the amount of concrete necessary to construct a building by 30 percent or more. Voids in the middle of a flat slab eliminate 35% of a slab's self-weight removing constraints of high dead loads and short spans. This provides a wide range of cost and construction benefits.

Keyword : - Bubble deck slab, Conventional , self-weight, Hollow spherical balls, HDPE etc.

1.INTRODUCTION

The Bubble deck slab is a revolutionary biaxial concrete floor system developed in Europe in 1990's by Jorgen Breuning (Bubble deck-UK 2008). 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 50% allowing much longer spans and less supporting structure than traditional solutions. Therefore, the Bubble Deck has many advantages as compare to traditional concrete slab, such as: lower 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.

Bubble deck is a revolutionary method of virtually eliminating concrete from the middle of a floor slab not performing any structural function, thereby dramatically reducing structural dead weight. Bubble deck is based on a new patented technique - the direct way of linking air and steel. Void formers in the middle of a flat slab eliminates 35% of a slabs self-weight removing constraints of high dead loads and short spans. Incorporation of recycled plastic bubbles as void formers permits 50% longer spans between columns. Combination of this with a flat slab construction approach spanning in two directions – the slab is connected directly to in situ concrete columns without any beams - produces a wide range of cost and construction benefits.

Bubble Deck has proved to be highly successful in Europe since its invention ten years ago. In Denmark and Holland over 1 million square meters of floors have been constructed in the last seven years using the Bubble Deck system in all types of multi-story buildings.

1.1 Definition Of bubble deck slab

Bubble Deck slab, is a technique in which recycled hollow plastic spherical bubbles (balls) are used in between the steel reinforcement in tension and compression as a void former & slab is casted in concrete.

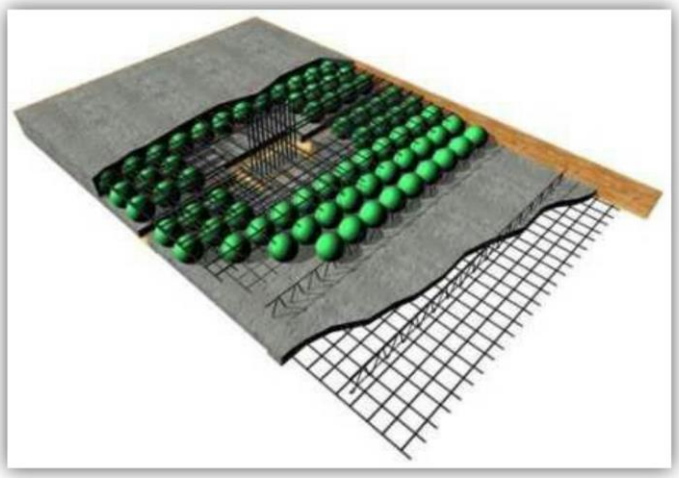

Fig -1: Cut-through section of Bubble deck

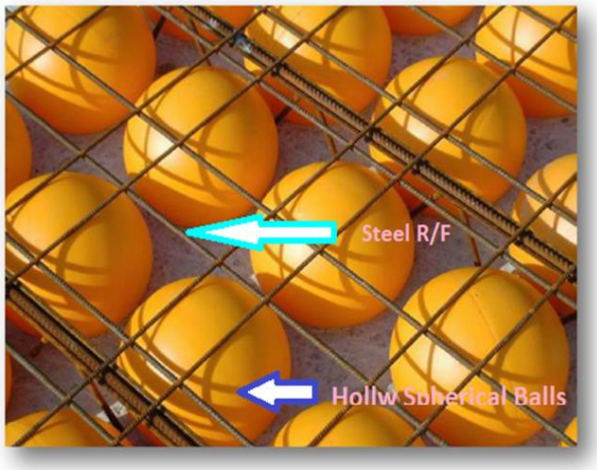

Fig -2: Components of Bubble deck slab

2. MATERIALS USED

Bubble deck is composed of three main materials i.e., Steel, Plastic spheres and Concrete.

❖ **Steel R/F**

The steel reinforcement of grade Fy415 or fy500 strength or higher is used. The steel is fabricated in two forms- meshed layers for support and diagonal girders for vertical support of the bubbles. The reinforcement of the plates is made of two meshes, one at the bottom part and one at the upper part that can be tied by binding wire. The distance between the bars is corresponding to the dimensions of the bubbles that are to be used in the slab. (Fig.3)

❖ **Hollow Spherical Ball**

The bubbles are made using high density polyethylene (HDPE) materials. These are usually made with nonporous material that does not react chemically with the concrete or reinforcement bars. The bubbles have enough strength and stiffness to support safely the applied loads in the phases before and during concrete pouring. The diameter of bubble is 180mm and the distance between bubbles is 12mm. The bubbles are spherical in shape. (Fig.4)

❖ **Cement**

Ordinary Portland cement (OPC) of grade 53 according to the IS 456-2000 standard was used manufactured by Birla Super brand. Cement was fresh and free of lumps

❖ **Fine aggregate (River Sand)**

The fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand and crushed Sand is being used as fine aggregate conforming to the requirements of IS: 383

❖ **Coarse aggregate (River Sand)**

The fractions from 10 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from 10 mm are used conforming to IS: 383 is being use. and aggregate of 20 mm size is used in conventional slab. (Fig.5)

❖ **Water**

Potable water is used for mixing and curing as per IS 456:2000. From durability consideration water cement ratio should be restricted as in case of normal concrete and it should preferably be less than 0.4

Fig -3: Steel R/F used for Bubble deck

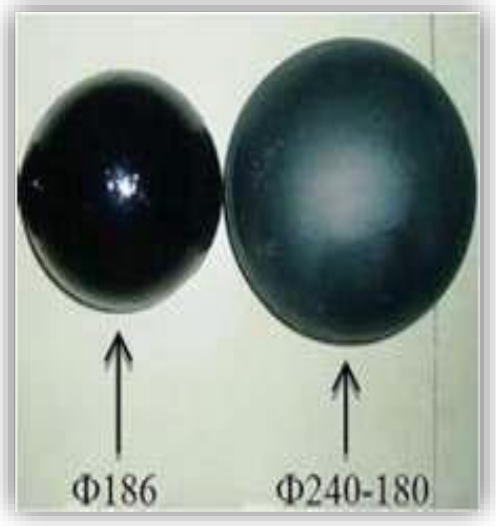

Fig -4: Hollow Spherical Balls 180 mm dia.

Fig -5: Coasre Aggregates

Fig -6: Location & placing of hollow balls

3. METHODOLOGY

The main objective of this paper is to study the performance of flat slab, to estimate the amount of concrete reduced as result of plastic balls introduction into flat slab and to analyze the results of load vs deflection, for this study one no. of conventional flat slab panel & 2 nos. of bubble deck slab panels are prepared.

3.1 Conventional Flat Slab

Conventional Flat Slab is prepared of M30 grade of concrete using Indian Standard recommended method of concrete mix design as per design code IS: 10262-1982 with Size 900 mm x 450 mm x 100 mm as per IS 456-2000

3.2 Bubble Deck Flat Slab

This slab is prepared of M30 grade of concrete with Size 900 mm x 450 mm x 100 mm. The diameter of plastic bubble is 180 mm and the distance between bubbles is 12mm. The bubbles are spherical in shape.

4. INSTALLATION PROCEDURE (BUBBLE DECK SLAB)

- The bubble deck slab panels are prepared, for installation initial step is laying of R/F which is provided in the form of mesh.
- Three numbers of main bars are provided at top and two numbers of main bars are provided at bottom and is connected by stirrup having diameter 8mm.The reinforcement bars are provided in such a way that the steel balls should not be disturbed while compacting. A special tying arrangement is adopted so that no displacement of balls occurred.
- The hollow plastic balls are placed on bottom concrete as per design. 36 no. of balls having 180 mm diameter and distance between two balls is 36mm for each slab.
- The concrete is placed at the bottom of slab which act as bonding for balls
- After placing the plastic balls concrete is poured manually and compacted by using tamping rod.
- Curing is done for 28 days after 24 hours of casting. Ponding method is used for curing

5. TEST PROCEDURE RESULTS

For testing purpose total 4 no of slab panels were casted i.e 2 conventional & 2 bubble deck slab panels. Testing was carried under UTM machine for flexure test.The panel specimen after curing of 28 days was removed from tank for testing. The panels were placed on roller support on both ends leaving a space of 100 mm at ends. Two-point loading system was installed by using jaw of 200 mm at center as shown.

Fig.7 100 mm Thick Panel Under Two Point Loading System (Flexural test)

Table -1 RESULTS

Type Of Slab	Load (KN)	Deflection (mm)	Weight (kg)
CS1	365.49	12.92	140
CS2	349.14	13.14	135
BD1	303.31	14.80	128
BD2	315.12	15.32	118

6. CONCLUSIONS

- From the results it has been concluded that deflection of bubble deck flat slab is higher as compared to conventional slab.
- Construction Cost were reduced to 16 % when compared with conventional concrete.
- Ultimate load carrying capacity was reduced in bubble deck flat slab by 11.22%.
- The bottom cracks are longitudinal as well as diagonal. Most of the cracks are longitudinal and similar in both the cases.
- Advantage of Bubble Deck system is the significant cost saving, because of the possibility of obtaining great spans with less support elements.
- By using the hollow spherical balls, the better load bearing capacity in Bubble Deck was achieved.
- Concrete usage is reduced as 1 kg of recycled plastic replaces 44.05 kg of concrete. This avoids the cement production and allows reduction in global CO2 emissions. Hence this technology is environmentally green and sustainable.
- Reducing material consumption made it possible to make the construction time faster, to reduce the overall costs. Besides that, it has led to reduce dead weight up to 50%, which allow creating foundation sizes smaller

7. REFERENCES

[1]. Saifee Bhagat, Dr. K. B. Parikh, Comparative Study of Voided Flat Plate Slab and Solid Flat Plate Slab

[2]. Amer M. Ibrahim, Nazar K. ali, Wissam D. Salman, Finite element analysis of reinforced concrete slabs with spherical voids

[3]. Mihai Bindea, Raul Zagon, Zoltan Kiss, “Flat slabs with spherical voids. Part II: Experimental tests concerning shear strength

[4]. Harishma K.R., Reshmi K N., “A study on Bubble Deck slab”

[5]. Bhagyashri G. Bhade & S.M Barelikar (June -2016), “an experimental study on two way bubble deck slab with spherical hollow balls”

[6]. M.Surendar, M.Ranjitham (2016) “Numerical and Experimental Study on Bubble Deck Slab [4]. Harishma K.R., Reshmi K N., “A study on Bubble Deck slab”

[4]. Harishma K.R., Reshmi K N., “A study on Bubble Deck slab”

BIOGRAPHIES (Not Essential)

	Prof.S.S.Pawar Assistant Professor, Padm Dr.V.B. kolte College of engineering Malkapur M tech (Structure) B.E. Civil Engineering
	Mr.A.S.Pawar PG Student, NICMAR,Hydarabad PGP (QSCM) B.E. (Civil Engineering)