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Structural Behaviour of Bubble Deck Slab

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ABSTRACT: The new prefabricated construction technology using Bubble Deck slab is recently applied in many industrial projects in the world. Bubble Deck slab uses hollow spherical balls made by recycled plastic which is basically high-density polyethylene balls and therefore it is an innovator method of virtually eliminating the concrete part within the middle of conventional slab which does not contribute to the structural performance. This hence reduces significantly the structural self-weight. The advantages are less energy consumption - both in production, transport and completing, less emission - exhaust gases from production and transport, especially CO2. The aim of this paper is to debate about various properties of Bubble deck slab supported the varied studies done abroad

KEYWORDS: Concrete slab; spherical bubbles; reinforcement; Bubble deck slab; HDPE; voids; dead load.

I. INTRODUCTION

Bubble deck slab is a biaxial hollow core slab invented in Denmark in 1990's by Jorgen Breuning. It is a way of virtually eliminating all concrete from the middle of a floor slab not performing any structural function (fig 1), thereby dramatically reducing structural dead weight. Bubble deck slab is predicated on a replacement patented technique which involves the direct way of linking air and steel. Void forms within the middle of a flat slab by means of plastic spheres eliminate 35% of a slab's self-weight. Therefore, the Bubble Deck has many advantages as compare to traditional concrete slab, such as: lower total cost, enhanced structural efficiency, decreased construction time, and is a green technology. The saving on weight obtained during this way has the result that a Bubble deck slab floor can provide the required loadbearing capacity at a smaller thickness this leads to a further advantage, resulting in a saving of 40 to 50 % of the material consumption in the floor construction.

This is not the last of the benefits of the Bubble deck slab floor system: due to the lower weight of the ground system itself, also the supporting constructions such as columns and foundations can be less heavy. This can result eventually during a total weight or material saving on the building construction of up to 50 %. Since the load of the structure reduced, this sort of structure can useful to scale back earthquake damage.

These slab elements have a bottom and an upper concrete part connected with vertical ribs that go round the gaps. The reinforcement of the plates is formed of two meshes one at rock bottom part and one at the upper part which will be tied or welded. The distances between the bars correspond to the dimensions of the bubbles that are to be embodied and therefore reform the quantity of the reinforcement from the longitudinal and the transversal ribs of the slab. The two mashes are connected after placing the spheresinto places so as to make a rigid shell. The bubbles are made by embodying HDPE balls in the concrete, arranged according to the project and placed between the reinforcement meshes. The material that are made of don't react chemically with the concrete or the reinforcement, it has no porosity and has enough rigidity and strength to take over the loads the maximum amount as from pouring of the concrete as from the next phases of this process.

II. MATERIALS DESCRIPTION PROPERTIES

2.1 Concrete

The Concrete is formed of ordinary hydraulic cement with a maximum aggregate size of ¾ inch. No plasticizers are necessary. Concrete of M25, M30 and M40 are used for bubble deck slab construction.

2.2 Hollow plastic Balls

Generally recycled plastic balls are used, because to scale back wastage of plastics rather than burning the plastics and also reduce the environmental pollution. Cost of plastic ball is extremely low. The plastic balls don't react chemically with concrete or reinforcement. Generally hollow plastic balls made from high density polyethylene.

2.3 Steel

The steel reinforcement is of grade Fe 415, Fe 500 strength or higher is usually used. The steel is fabricated in two forms. Meshed layer for lateral support and diagonal girder for vertical support of the bubble. An equivalent grade of steel is employed in both in top and bottom

III. PROPERTIES OF A BUBBLE DECK SLAB

3.1 Shear strength

In any sort of flat slab, design of shear resistance is typically critical near columns. The shear stresses remote from the columns diminishes rapidly and out of doors the column zones it's been demonstrated by testing and calculation the transverse and longitudinal shear stresses are within the capacity of the Bubble deck slab system. Near the columns, bubbles are overlooked so in these zones a Bubble deck slab is meant precisely the same way as a solid slab. Shear resistance of Bubble deck slab is 0.6 times the shear resistance of a solid slab of the equivalent thickness. If this is often exceeded by the applied shear, at a column for instance, we skip the balls and use the complete solid shear values. Using Euro code 2, we might calculate the applied shear at 2d and subsequent perimeters from the column face as per the code requirements, also at the column face itself. We might then compare this to our calculated resistance. If the applied shear is smaller amount than he un-reinforced hollow slab resistance, no further check is required. If the applied shear is bigger than the hollow slab resistance, we'll remove balls and make it solid then Check the solid part. We use Euro code 2, which is fully compatible with the system, for our design and which is somewhat more up so far BS8110.

3.2 Durability

Durability of bubble deck slab isn't different from ordinary solid slab. When the filigree slabs are manufactured, the reinforcement module and balls are vibrated into the concrete and therefore the standard and uniformity of compaction is such a density of surface concrete is produced which a minimum of impermeable and sturdy, arguably more so, thereto normally produced on site. The concrete is standard structural grade concrete and combined with adequate bar cover determined in accordance with BS8110 provides most control of durability commensurate with normal standards for solid slabs. It's a chamfer on the within to make sure that concrete surrounds each bar and doesn't allow an immediate route to air from the rebar surface. This is often a primary function of the Cracking in Bubble deck slab isn't worse, and doubtless better, than solid slabs designed to figure at an equivalent stress level. In fact, Bubble deck slab possess endless mesh, top and bottom, throughout the slab and this ensures shrinkage restraint is well provided for and that cracking is kept to a minimum whether it's intrinsic or extrinsic cracking.

3.3 Flexural Strength

Bubble deck slab is conceived to get rid of big volume of concrete as compared to a solid slab within the central core where the slab is principally un-stressed in flexure. In terms of flexural strength, the moments of resistance are an equivalent for solid slabs provided this compression depth is checked during design in order that does't encroach significantly into theball.

Comparison of Bubble deck slab and Solid slab

	Same Strength	Same bending stiffness	Same concrete volume
Strength	100	105	150^
Bending stiffness	87	100	300
Volume of concrete	66	69	100

On the condition of an equivalent amount steel. The concrete itself has 220% greater effect

3.4 Fire Resistance

The fire resistance of the slab may be complex matter but is chiefly hooked into the power of the steel to retain sufficient strength during a fireplace when it'll be heated and lose significant because the temperature rises. The temperature of the steel is controlled by the hearth and therefore insulation of the steel from the hearth. In any case, all concrete is cracked and, in a fire, it's likely that the air would escape and therefore pressure dissipated. If the quality bubble material is employed (HDPE), the products of combustion are relatively good, certainly compared to other materials that might be burning within the vicinity. In an intense, prolonged fire, the ball would melt and eventually char without significant or detectable effect. Fire resistance depends on concrete cover nearly 60-180 minutes. Smoke

Resistance is about 1.5 times the hearth. Depth of smokeless is than 10 m on each side. Balls simply carbonize. No toxic gasses are going to released.

3.5 Sound Insulation

A comparison was made between Bubble Deck and one-way prefabricated hollow deck of comparable height. The noise reduction with Bubble Deck was 1db above than the one-way prefabricated hollow deck the most criterion for reducing noise is that the weight of the deck and therefore Bubble Deck won't act otherwise than other deck types with equal weight..

IV.CONCLUSION

Due to the rise in heating concerns and threat to climatic condition lifetime of people is in danger burning of plastic isn't an ultimate option because it creates more pollution so we've to beat in additional innovative way. As we all know the market of construction floors within building industry consists mainly of massive concrete floors, prefabricated filigree slab floors and hollow core slab floors. This example has not changed for more than quite 20 years. But this innovative slab construction technology is proven to be more efficient than standard biaxial concrete slab in an office floor system. because the use of HDPE balls which is essentially made up of recycled plastic thus reduces the pollution. The finite element models of the office slabs created for this study in SAP2000 verify the prior analysis and experiments.

A) Weight reduction is 35% compared to solid slab.

B) Shear resistance of bubble deck slab is 0.6 times the shear resistance of the solid slab of same thickness.

C) Bending stresses within bubble deck slab are found to be 6.43% lesser than that of a solid slab.

D) Deflection of Bubble deck is 5.88% quite the solid slab because the stiffness is reduced thanks to the hollow portion.

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