Specification Comparative Analysis Between Conventional and Bubble Deck

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Abstract - *The era of prefabricated building technology, which uses Bubble Deck slabs are recently adapted by several industrial construction projects. Hollow balls are used in bubble deck slab instead of the conventional flat slab which are made up of recycled plastic so that it is known as an innovator method. Due to eliminating of concrete sections from the midsection of the conventional slab. Bubble Deck slab is a two-way slab, which is having recycled plastic bubbles in hollow deck. The purpose of cutting non-structural concretely, thereby reducing structural dead weight, and the void is formed in the middle of flat slab which eliminates 32% of self-weight of a slab. In this paper, we discuss the theoretical specification of conventional flat slabs and bubble deck slabs.*

Key Words: **Cement slabs, flat slab, bubble deck slab, construction slabs.**

I. INTRODUCTION

A slab is the irremissible part of the structure which is effectively designed and mostly utilized. It should be optimized because it uses more quantity of concrete than the normal prerequisite. When large load acting on slab & span between two columns is more than the thickness of slab goes on increasing. It contains the most amount of stuff like steel & concrete, so that slabs self-weight moves on increasing. Concrete is heavier material & it contains 5% of the world's CO2 is produced during the fabrication of cement that gets into it. Then there is collection of aggregate that should be removed out and it should be taken out with the help of trucks. Not only that, but more quantity of concrete that is present in the slab is not required, its consuming space between the bottom, where the reinforcing steel is in tension, and the top, where the concrete is in compression.

In a general manner, the slab was designed simply to resist vertical load. Now a day's people have recently wanted a residential environment on which vibration & noise of the slab getting main role. The main Moto of concrete expression that is horizontal slab is having great weight, which should be limit the span. Due to this major development of the reinforced concrete must focus on developing the span, by reduction in weight or overbear concrete nature weakness in tension. In early stages, many attempts had produced to manufacture biaxial slab which has hollow cavities to minimize the weight. Many attempts had done earlier to prepare blocks having light weight fabric which is polystyrene used on top & bottom reinforcement and other type's grid & waffle slab. All these types' only waffle slabs are used in the marketplace. Merely, the use of waffle slab is set due to low resistance to shear, fire & local punching. The approximation of using many blocks of very loose material in slab from the same flaws, so that the usage of this scheme had not gained any acceptance and they are only utilized in a very specific number of tasks.

II. BACKGROUND LITERATURE

Extensive literature review shows that the research on bubble deck slab. The various categories of inquiry that has been performed thus far gives an estimate of the possible things on which intensive research study can be carried out since we do have issues till today in the form of Concrete slabs tend to use more concrete than a necessity, therefore it delivers to be optimized. Literature Review shows that a number of papers have been published on the research work done on using void formers, in this case spherical or elliptical shaped, hollow plastic balls.

On that point are several countries who invented bubble deck slab those are Europe, Australia, Denmark, North & South America, Canada and Middle East. The technology of Bubble Deck slab (Dutch: Bollenplaatvloer, German: Zweiachsigen Hohlkörperdecke, Icelandic: Kuluplotur, Danish: Bobledoek) invented by Jorgen Breuning, locking of ellipsoids between top to bottom reinforcement meshes, so that to create a structural like natural cell which plays as a solid slab. In early stages, creation of voided biaxial slab having the same capacities of a solid slab, but it is holding a lighter weight due to removal of superfluous concrete. The solid slabs acts like a Bubble deck slab. Designing of solid slabs to minimize the load and eliminates quantity of concrete. Thorough investigations, according to Eurocodes are done at the universities in Denmark, Germany & Netherlands, telling that Bubble Deck slab acts like a solid slab.

III. METHODS

This section deals with the course of action of study, i.e. the methodology need to hold out for the achievement of desired goals of it. These methodologies basically have a routine of steps or set of operations discussed. Flow chart of project methodology is shown in Fig.3.1 to achieve the aim of the present investigation, extensive and comprehensive experimental programmed has been projected. The entire investigation has been sorted into various distinct phases of work for thorough and systematic access.

Conventional slab: This is a slab with specifications developed to analyze experimentally with normal concrete of grade M30 by adopting conventional methods of design according IS 456:2000 & IS 10262:2009.

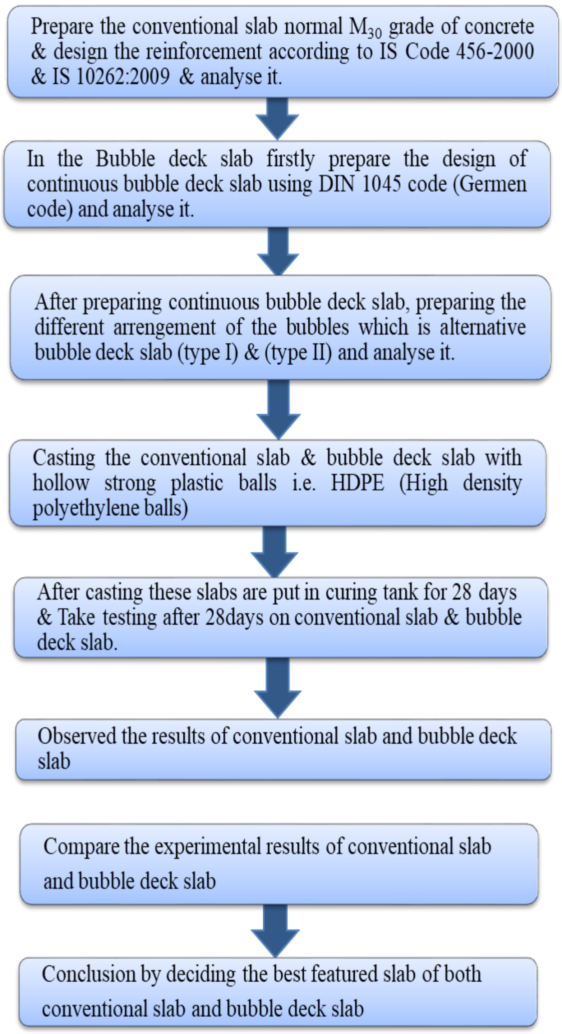
Bubble deck slab: This is a slab with specifications prepared to analyze experimentally with normal concrete of grade M30 by using Hollow strong plastic balls (HDPE- High density polyethylene) with the help of design according to DIN 1045 (1988) or DIN 1045 (2001) code (German code) There are three cases of bubble deck slab are cast:

a) Continuous bubble deck slab
b) Alternative bubble deck slab (type I)
c) Alternative bubble deck slab (type II)

A conventional slab of size 1mx1mx0.125m is cast, Bubble deck slab also casts of size same as conventional slab 1mx1mx0.125m & study of various aspects and structural parameters.

A. Flow Chart Of Methodology

This flow chart shows the methodology adopted in this study to achieve the desired aims.



IV. CONVENTIONAL SLAB: CONVENTIONAL (M_{30}) CONCRETE MIX DESIGN

The conventional concrete, i.e. M_{30} grade concrete is having a mixed design according to the IS 456:2000 & IS10262:2009 is explained in this section.

A. Design constant

a) Grade Designation = M_{30}
b) Type of Cement = OPC 53 grade
c) Maximum Nominal Aggregate Size = 20 mm
d) Minimum Cement Content =320 kg/m^3
e) Maximum Water Cement Ratio = 0.45
f) Workability = 50-75 mm (Slump)
g) Exposure Condition = Severe
h) Degree of Supervision = Good
i) Type of Aggregate = Crushed Angular
j) Chemical admixture = No admixture use

B. Test Data for Materials

a) Cement, Used Birla super OPC 53 grade
b) Sp. Gravity of Cement = 3.15
c) Sp. Gravitational force of Water = 1.00
d) Sp. Gravity of Coarse Aggregate = 2.77
e) Sp. Gravity of Fine Aggregate = 2.60
f) Water Absorption of Coarse Aggregate = 1.24%
g) Water Absorption of Fine Aggregate = 2.80%
h) Free (Surface) Moisture of 10 mm Aggregate = nil
i) Free (Surface) Moisture of crushed Sand = nil

C. Target Mean Strength

a) Target Mean Strength = 38.25N/mm2
b) Characteristic Strength @ 28 days = 30N/mm2
a) 4. Choice of water cement ratio
a) Maximum Water Cement Ratio =0.45
b) Adopted Water Cement Ratio=0.43

D. Choice of water capacity

a) Maximum Water content (10262-table-2) =186 Lit.
b) Estimated Water content for 50-75 mm Slump=192 Lit.

E. Selection of cement capacity

a) Water Cement Ratio=0.43
b) Cement Content (192/0.43) =446.5 kg/m3, which is greater than 320 kg/m3.

F. Ratio of volume of coarse Aggregate & Fine Aggregate Content

a) Vol. of C.A. As per table 3 of IS 10262 = 62%
b) Adopted Vol. of coarse Aggregate = 55%
c) Adopted Vol. of Fine Aggregate = 45%

G. Mix Calculations

a) Volume of Concrete in m^3 = 1.00
b) Volume of Cement in m^3 = 0.142
(Mass of Cement) / (Sp. The gravity of Cement) x1000
c) Mass of Water in m3 = 0.192
(Mass of Water) / (Sp. Gravity of Water) x1000
d) Volume of All in Aggregate in m^3 = 0.67
e) Volume of Coarse Aggregate in m^3 = 0.55
f) Volume of Fine Aggregate in m^3 = 0.45

H. Mix Calculations

a) The mass of Cement in kg/m^3 = 446.5
b) Mass of Water in kg/m^3 = 192
c) Mass of Fine Aggregate in kg/m^3 = 784
d) Mass of Coarse Aggregate in kg/m^3 = 1021
e) Water Cement Ratio = 0.43

V. BUBBLE DECK SLAB: CONTINUOUS BUBBLE DECK SLAB (M30) CONCRETE MIXTURE DESIGN

A. Design Constant

a) Grade Designation = M30
b) Type of Cement = OPC 53 grade
c) Maximum Nominal Aggregate Size = 10 mm
d) Minimum Cement Content =320 kg/m3
e) Maximum Water Cement Ratio = 0.45
f) Workability = 50-75 mm (Slump)
g) Exposure Condition = Severe
h) Degree of Supervision = Good
i) Type of Aggregate = Crushed Angular
j) Chemical admixture = No admixture use

B. Test Data for Materials

a) Cement, Used Birla super OPC 53 grade
b) Sp. Gravity of Cement = 3.15
c) Sp. Gravitational force of Water = 1.00
d) Sp. Gravity of Coarse Aggregate = 2.77
e) Sp. Gravity of Fine Aggregate = 2.60
f) Water Absorption of Coarse Aggregate = 1.24%
g) Water Absorption of Fine Aggregate = 2.80%
h) Free (Surface) Moisture of 10 mm Aggregate = nil
i) Free (Surface) Moisture of crushed Sand = nil

C. Target Mean Strength

a) Target Mean Strength = 38.25N/mm^2
b) Characteristic Strength @ 28 days = 30N/mm^2

D. Choice of water cement ratio

a) Maximum Water Cement Ratio =0.45
b) Adopted Water Cement Ratio=0.43

E. Choice of water capacity

a) Maximum Water content (10262-table-2) =208 Lit.
b) Estimated Water content for 50-75 mm Slump=214 Lit.

F. Selection of cement capacity

a) Water Cement Ratio=0.43
b) Cement Content (214/0.43) =497.67 kg/m^3. Which is greater than 320 kg/m3?

G. Ratio of volume of coarse Aggregate & Fine Aggregate Content

a) Vol. of C.A. As per table 3 of IS 10262 = 62%
b) Adopted Vol. of coarse Aggregate = 55%
c) Adopted Vol. of Fine Aggregate = 45%

H. Mix Calculations

a) Volume of Concrete in m^3 = 1.00
b) Volume of Cement in m^3 = 0.142
(Mass of Cement) / (Sp. The gravity of Cement) x1000
c) Mass of Water in m3 = 0.214
(Mass of Water) / (Sp. Gravity of Water) x1000
d) Volume of All in Aggregate in m^3 = 0.644
e) Volume of Coarse Aggregate in m^3 = 0.55
f) Volume of Fine Aggregate in m^3 = 0.45

I. Mix Calculations

a) Mass of Cement in kg/m^3 = 497.67
b) Mass of Water in kg/m^3 = 214
c) Mass of Fine Aggregate in kg/m^3 = 753
d) Mass of Coarse Aggregate in kg/m^3 = 981
e) Mass of 10mm Aggregate in kg/m^3 = 981
f) Water Cement Ratio = 0.43

VI. RESULTS & DISCUSSION

We celebrated the structural parameters are load carrying capacity, deflection behavior, self-weight of the slab and comparison between conventional slab, continuous bubble deck slab, Alternative bubble deck slab (type I), Alternative bubble deck slab (type II) with respect to structural parameters.

Table 1: Load, Deflection and Weight of Different Slab

Type of slab	Load (KN)	Deflection (Mm)	Weight (Kg)
Conventional Slab	260	8.70	321
Continuous Bubble deck	320	9.20	242
Alternative bubble deck type I	290	8.95	278
Alternative bubble deck type II	275	8.80	281

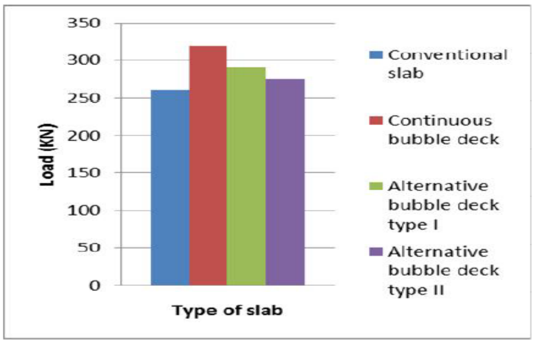


Fig. 1: Load Carrying Capability of the Slab

Fig.1, we can conclude that the load carrying capacity of the continuous bubble deck slab is high as compare to other slab. It is mentioned three cases of bubble deck slabs carries more freight than the conventional slab. The continuous bubble deck slab is 23% more load carrying capacity than the conventional slab. The alternative bubble deck slab (type I) is 11% more load carrying capacity than the conventional slab. The alternative bubble deck slab (type II) is 6% more load carrying capacity than the conventional slab.

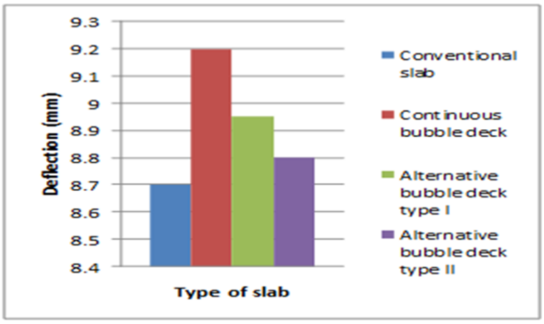


Fig.2: Deflection Behavior of Slab

Fig.2, we can conclude that the bending behavior of the continuous bubble deck slab is high as compare to other slab. It is mentioned three cases of bubble deck slabs carries more deflection than the conventional slab. The continuous bubble deck slab is 6% more deflection behavior than the conventional slab. The alternative bubble deck slab (type I) is 3% more deflection behavior than the conventional slab. The alternative bubble deck slab (type II) is 2% more deflection behavior than the conventional slab.

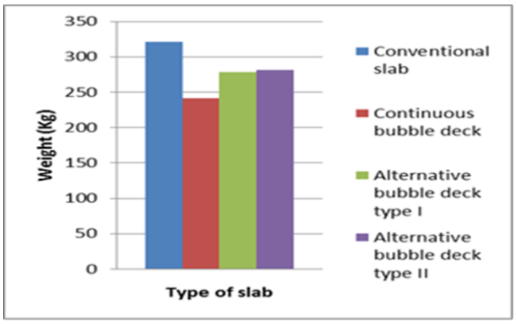


Fig. 3 Type of Slabs and the Weights

Fig.3 concludes that the self-weight of the continuous bubble deck slab is less as compared to other slab. It is mentioned three cases of bubble deck slabs carries less self-weight than the conventional slab. The continuous bubble deck slab is 33% less weight than the conventional slab. The alternative bubble deck slab (type I) is 15% less weight than the conventional slab. The alternative bubble deck slab (type II) is 14% less weight than the conventional slab. As the volume of concrete is replaced by bubbles so the weight of a bubble deck slab is observed to be less than the conventional slab.

VII. CONCLUSION & FUTURE WORK

In that experiment found that the bubble deck (continuous) has brought down the concrete volume so that slab of weight ultimately decrease. Simultaneously the load along the bubble deck slab (continuous) has also a 23 % increase as compared to conventional slab. But the placement of the balls is effected on load carrying capacity of the slab, in alternative arrangement of bubbles are 11% & 6%, increasing the loaded carrying capacity than a conventional slab but less than a continuous bubble deck of the slab. Simultaneously, a slab of bubble deck has improved the elasticity property of the slab, such as conventional slab is 6% less deflect than bubble deck, and quantity of bubbles in slab also an effect on the this elasticity property. Weight reduction is the important ingredient is found in a slab of bubble deck. Conventional slab weight is 33% more than the bubble pack of cards. Cost and time saving by using bubbles in slab like the weight of slab, concrete volume indirectly load on the shaft and the walls also decrease/ less so that building foundations is designed for smaller dead loads. It is concluded that Load, deflection and weight parameters give better results for bubble deck slab as compared to conventional slab.

Analytical work can be done to study of bubble deck slab with respect to earthquake loading by using suitable software. Present work can be extended to durability testing with bubble deck slab.

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