JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Performance Analysis of Bubble Slab Using Rice Husk Ash as a Partial Replacement of Cement

Dr. Ra. B. Depaa[1], V Priyadarshini[2], Mohammed Muzzammil Ahmed[3], Bhaskar Das[4], Sh. Joyshanker Sharma[5]

[12]Asst. Professor,[345]UG Student, Civil engineering Dept., Dr. M.G.R. Educational and Research Institute, Chennai, India

depaa.civil@drmgrdu.ac.in[1], priyavisva24@gmail.com[2], mohammed.muzzammil96@gmail.com[3], bhaskardas742@gmail.com[4], joyshankersharma135@gmail.com[5]

Received: 14 Feb 2020 Revised and Accepted: 25 March 2020

ABSTRACT: Bubble slab is a lightweight, concrete saving slab construction technology. In bubble slab, some amount of concrete is replaced by employing a hollow high-density polyethylene ball. The ball is placed in such parts of the slab where the uses of concrete don't perform any structural function. Uses of high-density polyethylene ball (HDPE) reduces the burden of the slab. Due to the reduction of the load of the slab, the load on the column also reduced. In this performance analysis comparison between bubble slab with a uniform arrangement of HDPE ball and bubble slab with an alternate arrangement of HDPE ball is done. In this paper loading capacity, deflection, and compressive test value of both types of the slab are presented. Also, mix design for M25 concrete with 15% replacing the rice husk ash is presented.

.

KEYWORDS: Bubble slab, Rice husk ash (RHA), High-density polyethylene hollow ball (HDPE), Concrete

.

I. INTRODUCTION

Concrete is the second most consuming material in the world. On the one hand, cement is the main component of concrete. Cement manufacture also increases the emission of a greenhouse gas like greenhouse emission. Cement contributes about 8% of the world's greenhouse emissions. To reduce the uses of cement as well as concrete in construction, high-density polyethylene balls are used in the slab. Concrete is replaced by the HDPE ball which doesn't take the compressive load. The use of an HDPE hollow ball reduces the dead load of the slab. As a result load from slab on column and foundation is reduced. A smaller size of column and foundation can be used due to the reduction of load on it. Bubble slab directly reduces the uses of concrete and helps in saving money in construction.

The high-density polyethylene balls could be recycled after the building is demolished. Due to the lightweight of the slab, it can be used for a large span. Bubble slab is 30% to 50% lighter in weight than the conventional slab. Almost 100 kg of concrete can be replaced by 1 kg of recycling plastic ball in bubble slab technology. Bubble slab can be used as a deck slab, commercial, and residential building slab.

II. Objectives

- The main objective of this paper is performance analysis of bubble slab using RHA as a 15% replacing capability of the Cement.
- To find out the amount of weight reduced due to the uses of high-density polyethylene ball of 63.5 mm diameter.
- To find out the loading capacity of the bubble slab
- To calculate the compressive strength of the slab by performing the Rebound Hammer test on it.

III. Materials used

3.1 High-density polyethylene hollow balls:

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

High-density polyethylene ball is also known as HDPE ball which is manufactured by using high-density polyethylene material. HDPE ball does not react with concrete and reinforcement. The density of HDPE varies from 0.93 to 0.97 g/cm^3. The specific gravity of the HDPE ball varies from 0.94 to 0.965. The diameter of the ball is 63.5mm.

3.2 Rice husk ash:

It is an agricultural waste. It is obtained by burning rice husks in an exceedingly manner. Temperature is maintained between 550 to 700 ^{0}C. Rice husk ash (RHA) contains 90% amorphous silica (SiO_2), 5% carbon (C), and 2% potassium oxide (K_2O). Uses of RHA in concrete increases the compressive strength, chemical resistance and shows better bond strength. The density of RHA is found between 1800 to 2100 kg/m^3.

3.3 Fine aggregate:

Manufactured sand (M Sand) is employed as a fine aggregate.

3.4 Coarse aggregate:

A 20 mm size coarse aggregate is used.

3.5 Grade of concrete:

M25 Grade of concrete is used.

Mix design ratio,

Cement : Rice Husk Ash : Coarse aggregate : Fine aggregate

0.85**:** 0.15: 1**:** 2

3.6 Reinforcement:

In our project, TMT bar of 550 grade is used.

The diameter of the bar is 6 mm. Reinforcement is provided in both directions in the top and bottom. HDPE balls are placed between the upper and bottom reinforcement as shown in the figure

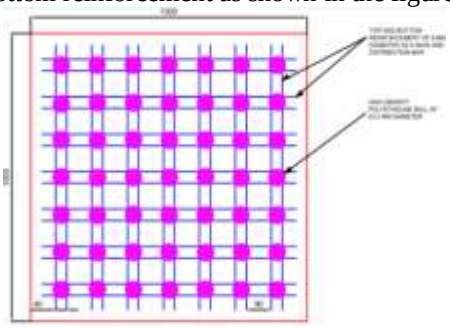

Fig 1: Plan of an arrangement of reinforcement and HDPE ball uniformly.

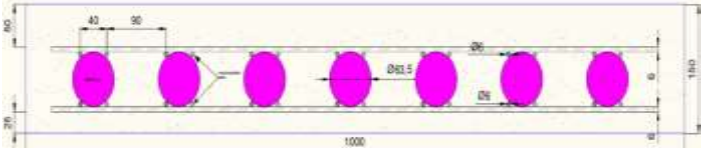

Fig 2: Section of the reinforcement and HDPE ball uniformly.

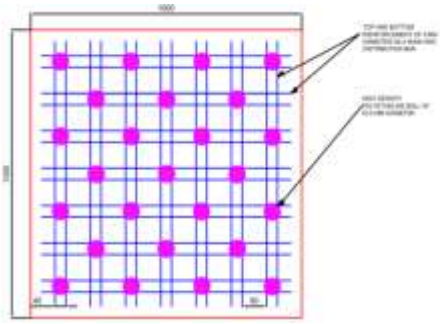

Fig 3: Plan of the arrangement of reinforcement and HDPE ball in an alternate way.

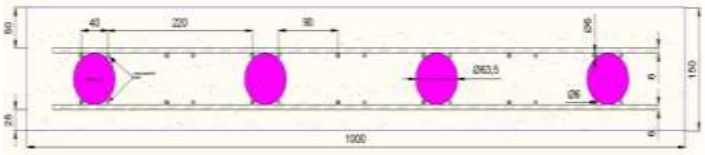

Fig 4: Section of an arrangement of reinforcement and HDPE ball in an alternate way.

4. 3-d view of ball and reinforcement arrangement

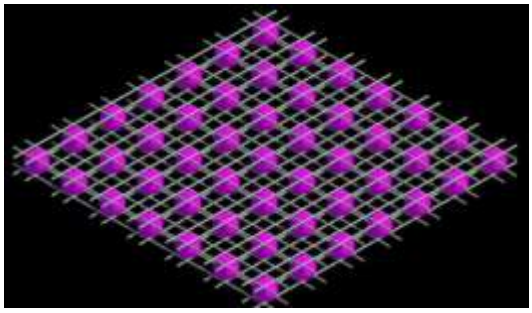

Fig 5: 3-D view of ball and reinforcement of continuous slab

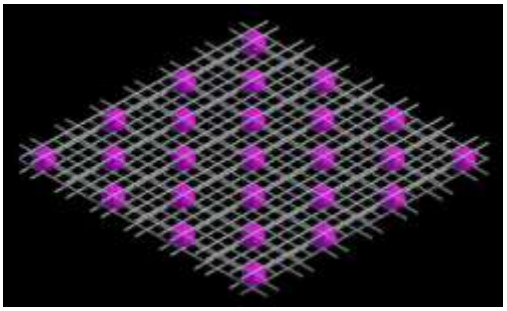

Fig 6: 3-D view of ball and reinforcement of alternative slab.

IV. Literature papers

Gupta Priyanka et al (2017) this paper focuses on "Optimum Replacing of Cement by RHA in Conventional Concrete", Dept. of Civil Engineering, Aadiswar College, Kalol, Gujrat.
Y. Sombabu, K. Prabhakar, P Madhuri et al (2017) this chapter deals with "Partial Replacement of Cement with Rice Husk Ash", Assistant professor, Department of Engineering Sciences, Mother Teresa Institute of Science and Technology.
Ankit Kumar et al (2016) this paper focuses on "Replacing of Cement in Concrete with Rice Husk Ash", National Institute of Technology, Kurukshetra.
Ritika Bhowmik, Sourish Mukherjee, Aparna Das et al (2017) this paper explains the "Necessity of the Bubble in the slab", B. Tech, Department of Civil Engineering, Narula Institute of Technology, and Kolkata, India.
Harshit Varshney, Nitish Jauhari, Himanshu Bhatt et al (2017) this paper focuses on "A Review on Bubble Slab", Rajshree Institute of Management and Technology, Bareilly.
K.R. Dheepan, S. Saranya, S. Aswini et al (2017) this paper deals with "Experimental Study on Bubble Deck Slab Using Polypropylene Balls, S.A. Engineering College, Poonamallee - Avadi Main Road, Chennai - 77, India.
Sankalp K. Sabale, Sandip R.Sule, Pranam D. Utkhede, Onkar S. Phalke, Dr. N.K. Gupta et al (2019) this paper explains the "Study on Bubble Deck Flat Slab", Department of Civil Engineering, Dr. D.Y. Patel Institute of Technology, Pune, Maharashtra, India.

V. Methodology

- ***Bubble slab with uniform ball arrangement:***

This slab is cast with an M25 grade of concrete by placing the high-density polyethylene ball. The spacing of 90mm is provided between the two balls.

- ***Bubble slab with alternate ball arrangement :***

This slab has cast with an M25 grade of concrete.
HDPE ball was alternately placed at a 220 mm spacing between them.

5.1 Experimental procedure for a slab with a uniform arrangement of HDPE ball:

Grade of concrete M25
Size of the slab 1m X 1m X 0.15m
Size of cover block 25mm

5.1.1 Reinforcement:

A total of 56 reinforcements are used as an upper and bottom reinforcement.
The diameter of the reinforcement is 6 mm
Grade of reinforcement is TMT550 The reinforcement detail is shown in fig. 1 & 2

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Fig 7: Reinforcement and HDPE ball arrangement

5.1.2 Concreting:

Concrete is mixed using the clinker. Concrete is poured into three-layer. In each layer, up to 50 mm concrete is poured. Finally, concrete was tamped properly to get rid of honeycomb**.**

Fig 8: After one day of casting

5.1.3 Curing:

A jute bag is used for curing up to 28 days.

5.2 Experimental procedure for a slab with an alternate arrangement of HDPE ball:

Grade of concrete M25

Size of the slab 1m X 1m X 0.15m

Size of cover block 25mm

5.2.1 Reinforcement:

A total of 56 reinforcements are used as a top and bottom reinforcement.

The diameter of the reinforcement is 6 mm

Grade of reinforcement is TMT550

The reinforcement detail is shown in fig. 3 & 4

5.2.2 Concreting:

Concrete is mixed using the clinker. Concrete is poured into three-layer. In each layer, up to 50 mm concrete is poured. Finally, concrete was tamped properly to get rid of honeycomb.

5.2.3 Curing:

A jute bag is used for curing up to 28 days.

VI. Mix design

Material	OPC Design	OPC+RHA Design
OPC	638	554.4
Rice Husk Ash	0	83.16
Coarse Aggregate of size 20mm	1108.8	1108.8
Fine Aggregate (m-sand)	554.4	554.4
Water	235.55	235.55

Table 1: Concrete mix proportion in weight per cubic meter

VII. Results

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Slump test:

Rice husk ash %	Average slump value
15	81

Table 2: Slump test result

Compression test:

Days	0% RHA	15% RHA
1	20.41	19.32
14	28.26	25.89
28	31.80	27.87

Table 3: Compression test result

Loading and deflection test:

Type of slab	Load (KN)	Deflection (mm)	Weight (Kg)
Continuous bubble slab	320	9.20	318.11
Alternative bubble slab	290	8.80	325.17

Table 4: Table for load, deflection, and weight

VIII. Conclusions

1. The result shows that 15% replacing of cement with rice husk ash which increases the compressive strength of concrete.
2. RHA is a material that can partially replace the uses of cement in concrete and does not emit greenhouse gases.
3. Bond strength of partially replaced RHA concrete is better than Ordinary Portland cement concrete.
4. Due to uses of high-density polyethylene ball in our continuous slab and alternative slab, 13.1% and 9.6% weight are reduced respectively
5. Dead load above the beam, column, and foundation from the slab is reduced because of the lighter in weight of bubble slab than the conventional slab.
6. Reduction of the dead load from slab results in a reduction of the size of the column, beam, and foundation which directly reduces the cost of construction.
7. Plastic garbage can be reduced by using high-density polyethylene ball which is made of recyclable plastic.

IX. Future scope

1. Due to lighter in weight than the normal conventional slab, it can be used for a larger span.
2. Used in high rise building to reduce the dead load on the foundation.
3. Best suitable for parking areas, theatres, and auditorium, etc.
4. Cement can be replaced partially with RHA which is a green material and provides more strength to concrete.
5. Uses of concrete can be reduced.

Acknowledgment

We would like to articulate our gratefulness to our project guide **Dr. Ra B Depaa** for her wholehearted guidance, assistance, and useful assessment concerning the Journal Paper. We would also like to appreciate our civil department HOD **Dr. R Sudhakar** for his advice regarding the publication of the journal. Our thanks are also extended to the Chennai Institute of Technology for providing us the great opportunity to present our journal paper at the National Web Conference.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

Finally, we would like to appreciate each and everyone who has helped in our project to the best of their

X. REFERENCES

[1] Gupta Priyanka, Patel Bina B., Zala Kartik, "Optimum Replacing of Cement by RHA in Conventional Concrete", Dept. of Civil Engineering, Aadiswar College, Kalol, Gujrat, 2017.

[2] Y. Sombabu, K. Prabhakar, P Madhuri, "Partial Replacing of Cement with Rice Husk Ash", Assistant professor, Department of Engineering Sciences, Mother Teresa Institute of Science and Technology, October 2017.

[3] Ankit Kumar, "Replacing of the Cement in Concrete with RHA", National Institute of Technology, Kurukshetra, July 2016.

[4] Ritika, "Review on Bubble Deck with Sphere Hollow Balls", B. Tech, Department of Civil Engineering, Narula Institute of Technology, Kolkata, India, August 2017.

[5] M. Surendar, M. Ranjitham, explains that the "Numerical Study on Bubble Deck Slab", Coimbatore, India, 2016.

[6] IS 456: 2000