IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

FLEXURAL BEHAVIOUR OF RCC COMPOSITE BEAMS WITH LIGHT WEIGHT AND NORMAL DENSITY CONCRETE

[1]Abdul Kareem. M ,[2]Mounica.P , Renin Jeya Gem. J.B, Mythily.R

[1]PG Scholar, [2]Assistant Professor

Department of Civil Engineering,

Cape Institute of Technology Kanyakumari, India

Abstract: The development of composite concrete beams employing conversional concrete (CC) and lightweight concrete (LWC) is the topic of this research. The typical concrete is made to have an M30 strength. The coarse aggregate of 0%, 20%, 40%, 60%, 80%, and 100% will then be replaced by broken bricks in conventional concrete to create the lightweight concrete for the beam. It was anticipated that the density and strength would decrease as more bricks were added. The amount of air entrainment for the matching density will be examined. Finally, a mix with a reasonable density will be selected to be employed in the composite flexural members together with regular concrete. The main goal is to determine where in a flexural member light weight concrete should be used in addition to conventional concrete. First, during compression, the presumptive position of the light weight and conventional concrete in the cross section of the beam will be studied. The test and cast cubes to determine the cubic strength of various assumed cross sections. Using those findings, the beam will be cast to ensure that the composite material's compression strength is at its highest. It will be tested after curing, and more research on the load to deflection parameter will follow. This enables us to determine whether lightweight concrete may be utilized in beams with traditional concrete.

Keywords: coarse aggregate, composite concrete, light weight concrete, compression strength

1.INTRODUCTION

The results of previous research make it abundantly evident that concrete is not required along the entire section of a beam. It only has a significant impact at the cover and the compression zone. We use the concrete that is still on hand to shape the member. The purpose of this project is to identify a cost-effective portion of a composite beam that will incorporate both conventional and light-weight concrete [1]. The most popular building material in the world, according to experts, is concrete. Water, sand, cement, and a rock aggregate are the main components of standard concrete compositions. The coarse aggregate in concrete is the main topic of this project. The other substance will be utilized in place of the normal concrete's coarse rock aggregate [2].

Burn brick will be a part of this. They were picked because they were readily available. The brick production location has burn brick available. Numerous bricks are also rejected throughout the brick-making process because they do not meet the necessary requirements. The warped shape of brick created as a result of the kiln's uneven temperature regulation is one such significant nonconformity. Additionally, these rejected bricks may be a source of coarse material [3]. This would not only make effective use of the material that would otherwise be wasted, but it would also help with disposal issues. The impacts of overburnt brick bat addition on the mechanical characteristics of the concrete matrix in wet and hardened state qualities are presented in this study [4].

Overburnt brick bat was used in place of coarse aggregate to test the mechanical properties of concrete made with overburnt brick bat as a basis. The study and research used experimental methods to determine whether crushed bricks were preferable to burnt bricks when used as substitute coarse materials in concrete [5]. In this project, large clay bricks are ground into concrete's coarse particles to create basic, lightweight concrete. Today, concrete is the most significant and popular building material. Concrete is a synthetic material that serves as the foundation for all structures utilized in civil engineering [6]. Many efforts have been made to produce standard strength or even high strength concrete using brick bat aggregate as an alternate material for concrete. At the same time, population and economic expansion are driving many outdated buildings to be demolished [7]. As a result, there is a significant amount of construction and demolition trash, making recycling of garbage vital to address the issue of landfill site occupancy.

This study details an experimental analysis using recycled brick bat aggregates, which were gathered from several construction sites that had been demolished and compared to concrete constructed with regular brick bat aggregates for physical and mechanical performance [8]. In conventional freezing and thawing tests, the high-strength lightweight concretes displayed excellent performance with almost no degradation. Under simulated arctic offshore conditions, severe damage required prolonged exposure [9]. According to research, aggregate saturation before testing causes aggregates to fail early because cumulative freezing and thawing cycles and moisture content have a significant impact on durability. examines five cooperative industry-research programmes that are focused on offshore concrete structures in brief. The oil and gas sector and adjacent building sectors financed these programmes [10]. High-strength, lightweight aggregate concretes were used in these real-time investigations for both material and structural evaluations. The following is a summary of a few of the high-strength, lightweight aggregate concretes employed in these trials. The necessity for more research is discussed.

2. MIX DESIGN

The grade of concrete to be adopted for this project work has to be similar to M_{30}. Since comparison is to be made with the standard M_{30} mix [11].

- Tests are done with constant strength for conventional Mix of strength = 30 Mpa N/mm^2
- Mix design calculation was done as per IS 10262 : 2009
- Based on the % of brick bat the strength and density of conventional concrete mix will get vary.
- % of brick bat added = 0%, 20%, 40%, 60%, 80% 100%.

2.1 Determination of target strength

From IS 10262:2019 Table 2, Standard deviation, S = 5 N/mm^2

From IS 10262:2019 Table 1, X = 6.5 N/mm^2

a) The target average compressive strength at 28 days = f_{ck}+ 1.65 × S

= 30 + (1.65x5)

= 38.25 N/mm^2

b) The target average compressive strength at 28 days = f_{ck}+ X

= 30 + 6.5

= 36.5 N/mm^2

The higher value is to be adopted.

Take, Target strength at 28 days = 38.25 N/mm^2

2.2 Selection of water cement ratio

From IS 10262:2019 Figure 1 Free water cement ratio required for the target strength of 38.25 N/mm^2 is 0.49 for OPC53 grade curve. This is higher than the maximum value of 0.45 prescribed for 'severe' exposure for reinforced concrete as per Table 5 of IS 456.

0.49>0.45, hence take water cement ratio 0.45.

From Table 5 of IS 456, minimum cementitious material content for 'severe' exposure condition.

Minimum cement content = 320kg/m^3

344 kg/m^3 > 320kg/m^3

2.3 Proportion of volume of coarse aggregate and fine aggregate content

From IS10262:2019 Table 5, volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone II) for water-cement ratio of 0.50 = 0.62.

In the present water-cementitious ratio is 0.45. Therefore, volume of coarse aggregate is required to be increased to decrease the fine aggregate content. As water-cement ratio is lower by 0.05.

The volume of coarse aggregate increased by 0.01 (at the rate of ± 0.01 for every ± 0.05 change in water-cement ratio). Therefore, corrected proportion of volume of coarse aggregate for the water-cementitious ratio of 0.378 = 0.62 + 0.01 = 0.63. say 0.63m^3

Volume of fine aggregate content = 1-0.63

= 0.37m^3

2.4 Coarse aggregate replaced by brick bat.

Table 1 shows the materials required per cubic meter

SI No	Water kg/m^3	Superplasticizer kg/m^3	Cement kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	Brick Bat kg/m^3
1	168	3.44	344	740	1238	0
2	192	3.44	344	740	990	224

3	217	3.44	344	740	743	447
4	240	3.44	344	740	495	670
5	264	3.44	344	740	248	894
6	289	3.44	344	740	0	1117

Figure 1 Compressive strength test on cube specimen

3. ANALYSING OF FRESH CONCRETE PROPERTIES

Concrete samples are tested for 28 days of flexural strength and 7 and 28 days of compressive strength.

Some of the tests measure the parameters very close to workability and provide useful information. The following tests are commonly employed to measure workability.

- Slump cone test
- Compacting factor test

Fig 2 Slump Cone Test

Fig 3 Compacting Factor Test

The most typical method for gauging consistency is the slump cone test. It does not account for all elements influencing workability. It serves as a control test and reveals if batches are uniform.

Table- 2 Slump Cone Test Results

	W/c ratio in (%)	Compaction factor
Slump Cone Test Results	0.45	0.8
compaction factor test	0.45	0.8

4.RESULTS AND DISCUSSION

4.1 RESULTS FOR COMPRESSION TEST

Table 3. 7- days and 28-days Compression test results for specimens with conventional concrete and light weight concrete

Sl.No	Mix	% of coarse aggregate replacement	7 Days compressive strength (N/mm^2)	28Days compressive strength (N/mm^2)
1	Mix1	0%	25	35.7
2	Mix2	20%	24.3	31.5
3	Mix3	40%	23.7	26.7
4	Mix4	60%	20.4	24.8
5	Mix5	80%	19.3	22.5
6	Mix6	100%	17.5	20.4

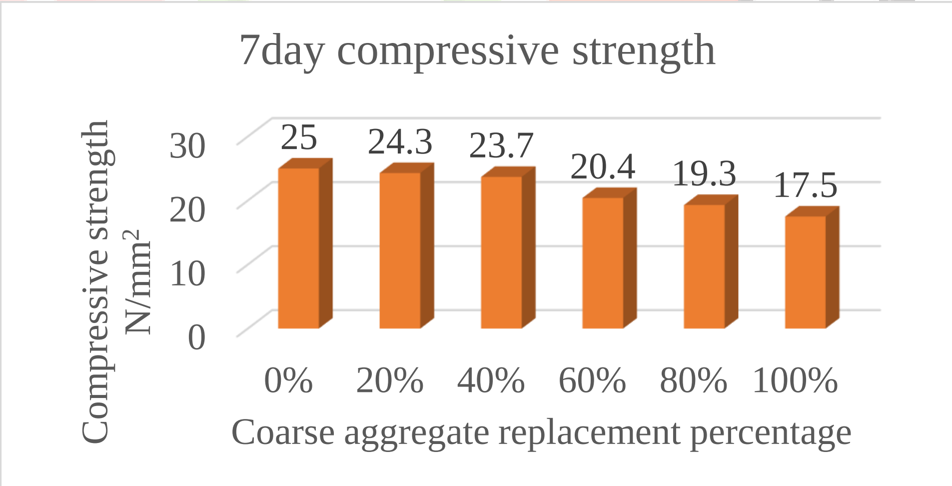

Figure 4 .7days Compression Test results for CC and LWC

4.2 RESULTS FOR SPLIT TENSILE STRENGTH TEST

Table 4. 7- days and 28-days Split tensile strength test results for specimens with conventional concrete and light weight concrete

Sl.No	Mix	% of coarse aggregate replacement	7 Days split tensile strength (N/mm^2)	28Days split tensile strength (N/mm^2)
1	Mix1	0%	2.44	3.48
2	Mix2	20%	2.37	3.07
3	Mix3	40%	2.31	2.60
4	Mix4	60%	1.99	2.42
5	Mix5	80%	1.88	2.19
6	Mix6	100%	1.71	1.99

4.3 FLEXURAL BEAM TEST RESULTS DISCUSSION

Table 5- Flexural Test Results for Beam Specimen with L.W.C placed (1/3) D from bottom.

Specimen Details	First Crack load (kN)	Ultimate Load (kN)	Deflection at Ultimate Load (mm)
S1	55	76	1.04
S2	58	79	1.09
S3	56	77	0.95

Table 6- FLEXURAL TEST RESULTS FOR BEAM SPECIMEN

Specimen	Specimen Details	First Crack load (kN)	Ultimate Load (kN)
S1	FULLY CONCRETE	73	78.3
S2	2/3 CONCRETE @ BOTTOM	65.3	83.67
S3	1/2 CONCRETE @ BOTTOM	60.3	78.3
S4	1/3 L.W.C @ BOTTOM	56.33	77.33

S5	1/3 CONCRETE @ BOTTOM	55.3	71.66
S6	1/2 L.W.C @ BOTTOM	55	66.3
S7	2/3 L.W.C @ BOTTOM	51.66	70
S8	FULLY L.W.C	32.67	39.3

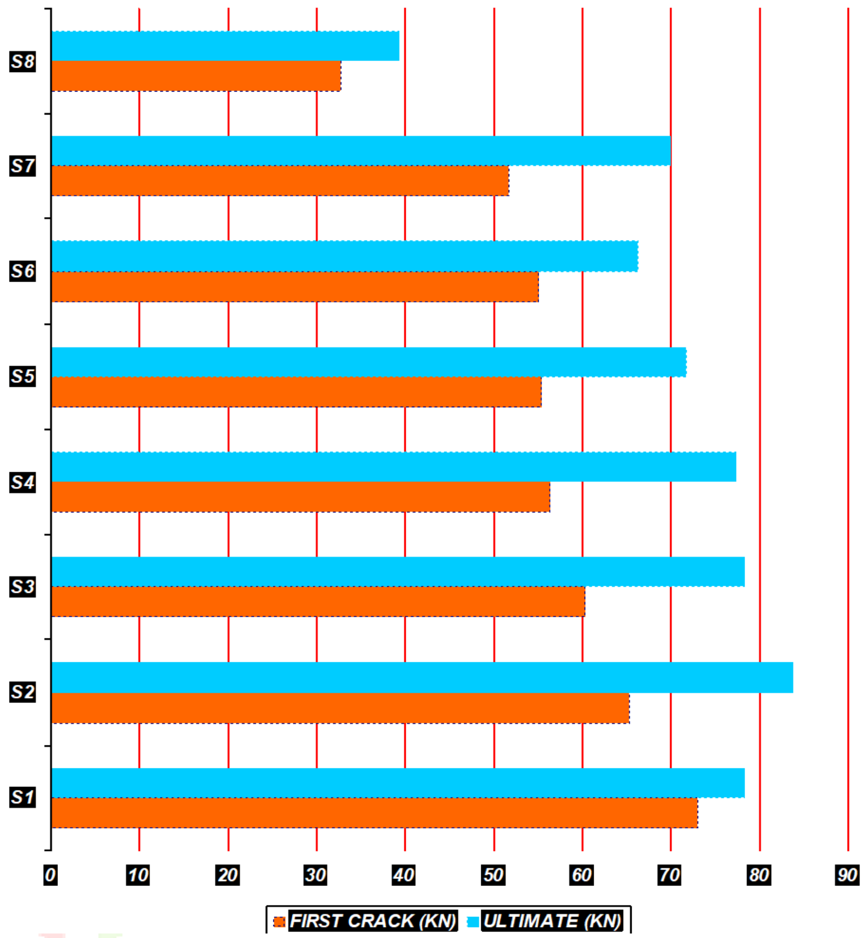

Figure 5 Comparison of First Crack Load and Ultimate Load (Flexure)

5.CONCLUSION

The analysis of light weight concreter suggests that it is effective to replace discarded foundry sand and ceramic waste in the concrete mix with fine aggregate and coarse aggregate. We can make concrete lighter and able to support heavier loads by using thin materials. When compared to regular concrete, the concrete's compressive strength, split tensile strength, and flexure strength all rise. Another conclusion that can be drawn from the findings is that lightweight concrete reinforcement in steel composite beams gives them a high load-bearing capacity. The flexural members built of conventional concrete at the bottom and brick bat concrete at the top received good strength and it seems equal to totally conventional concrete. Replacement of coarse aggregate with brick bat behaves as a light weight and low strength concrete.As a result, the research of the flexural behaviour of R.C. beams made of ordinary concrete and brick bat concrete was successful.

REFERENCES

1. Akash Vijaykumar Kankal, M.S. Kariappa (2022) Experimental study on effect of partial replacement of coarse aggregate by over burnt brick bats
2. Akshay N Kadu, P.M Kulkarni (July 2020) Use of partial replacement of over brunt brick and demolish brick bats as a coarse aggregate in hardened concrete.
3. Akshay N. Kadu1, Prof. P.M. Kulkarni (Aug 2020) Use of partial replacement of over brunt brick and demolish brick bats as a coarse aggregate in fresh concrete.
4. Arivalagan S (May 2020) Experimental study on the strength behaviour of brick bat aggregate as partial replacement of normal granite aggregate in concrete.
5. Akshay Takle, Priyanshu Kawade, Shubham Mhasade, Aditya Bahikar (2014) Analysis on partial replacement of coarse aggregate by jhama brick in concrete
6. Alexander M. Vayasburd (Jan 1993) durability of lightweight concrete and its connections with the composition of concrete, design, and construction methods.
7. Bidve Ganesh Shivkanth, G. N. Shete (April 2019) Experimental study on effect of partial replacement of coarse aggregate by over burnt brick bats.
8. D.Whiting and R.Burg(Aug1991) freezing and thawing durability of high-strength lightweight concretes.
9. G. S. Patil Mr. P. B. Autade (Aug 2015) Effect of partial replacement of coarse aggregate by jhama class brick in concrete.
10. G. S. Sylva, N. H. Burns, and J. E. Breen(Feb 2004) composite bridge systems with high-performance lightweight concrete.
11. George c. Hoff(Nov 1990) high-strength lightweight aggregate concrete-current status and future needs.
12. MicaelaDemichela(Sep 2007) self-triggering reaction kinetics between nitrates and aluminium powder.
13. M.C. Kulkarni,O.O. Ochoa(May 2012) mechanics of light weight proppants: a discrete approach.
14. Nilesh Kumar, Anil Kumar Saxena, Gourav Soni (2017) Analysis on concrete made from over burned bricks
15. Neha Dixit (July 2021) Analysis & compressive strength study of eco-friendly concrete by partial replacement of recycle brick with over-burnt brick aggregate.
16. Narayanan ,K. Ramamurthy(Oct2000) structure and properties of aerated concrete: a review.
17. Ravi Sharma, Mr. Sanjeev Sipani, Dr. Vishnu Sharma (Feb 2021) A Study of Effect on mechanical properties of standard concrete by using jhama brick coarse aggregates.

18. R.N.SwamyA.B.Ibrahim(Jan1974) deflection characteristics of structural lightweight reinforced and prestressed concrete beams.
19. R. N. Swamy and E. D. Jiang(Jan 1993) pore structure and carbonation of lightweight concrete after 10 years' exposure.
20. Shreenivas Reddy Shahapur, Md Aadil (Sep 2022) Experimental study on partial replacement of coarse aggregate by over burnt brick with addition of crimped steel fibres
21. S Kanchidurai, G Bharani and K Saravana Raja Mohan (2017) Strength and durability studies on concrete with partial replacement over burnt brick bat waste.
22. Vinaya Shyam D, Naveen Kumar, Virangouda G Patil, Navya K M, Sonali G (May 2019) Durability of lightweight concrete by partial replacement of rice husk as fine aggregate and brick bats as coarse aggregate.