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# EXPERIMENTAL STUDY ON STRUCTURAL BEHAVIOR OF DEEPBEAM

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*Abstract:* **Deep beam beams are used to lessen the self-weight, deflection, and shear of conventional reinforced concretebeams that are subjected to loading, which are the main issues. Deep beam beams cast with thermocol and weld mesh will be used in this project work instead of steel rebars, which are used in reinforced concrete beams. The shear strength assessment of supported cement footers has been the subject of a few examinations committed to decide the impact of the principal boundaries. When normal amounts of longitudinal reinforcement are utilized, the strength of the beams is typically controlled by shear strength rather than flexural strength due to the small value of the span-depth ratio. Experiments will be used to determine the yield strength and ultimate capacity of bending deep beam beams in addition to studies on shear. The purpose of the experimental work is to comprehend the various failure modes that could result from a potential combination of shear and bending moment acting at a specific section of a deep beam beam.The typical crack patterns, failure modes, and load- deflection behavior are to be reported in addition to highlighting the experimental setup.III. Concluding remarks are given in section IV.**

*Keywords:* **Deepbeam, Weld-mesh, Thermo-col**

## I. INTRODUCTION

Complexity characterizes RC deep beam behavior. Deep beams defy the presumption that "plane sections remain plane in bending." Because of internal arch action, the deep beam has a high shear strength and directs the load through concrete struts directly onto the end support. When the shear span-to-depth ratio of the beams is less than or equal to two, they are considered deep beams according to ACI code (ACI 318). When the ratio of effective span to overall depth is less than 2.0 for a simply supported beam, a beam is considered to be deep. and 2.5 for a beamthat is continuous). The shear span-to-depth ratio, concrete strength, percentage of longitudinal and transverse reinforcement, and the ACI-318 (ACI 318- 2008) and IS code (IS 456-2000) all play a role in determining the shear strength of deep beams. The size effect on the prediction of shear strength in deep beams is not taken into account by ACI 318 or IS code. There is a significant reserve strength beyond the peak load in deep beams with a shear span to depth ratio of less than or equal to 2.5, resulting in relatively less brittle failure. In profound bars, the shear support in the flat heading is viewed as compelling than the upward shear support, on the heap conveying limit the shear strength of cement in light of swagger and tie model has been accounted for. The effect of shear span-to-depth (a/d) ratio, vertical and horizontal shear reinforcement, and the ultimate shear strength on crack width is expressed explicitly for deep beams using the strut and tie model. The formation of diagonal cracking is unaffected by the reinforcement of the web; However, it has an impact on the final shear strength. ACI 318-11[3] defines deep beams as members that are supported on one face and loaded on the other, allowing compression struts to form between the loads and the supports. Shear force presents in radiates atsegments where there are an adjustment of twisting second along the range, it is equivalent to the pace of progress of bowing second. They are utilized as board shafts and, all the more as of late, as profound network walls in seaward gravity-type any bar which has a profundity to traverse proportion sufficiently extraordinary to cause nonlinearity in the versatile flexural worries about the pillar profundity and the dispersion of shear to be non-illustrative. The shear span's combination of bending and shear stresses causes inclined cracks that transform the beam into a tied-arch span ratio large enough to result in nonlinear elastic flexural stresses over the beam depth and a non-parabolicshear distribution. In the shear span, the stresses of bending and shear cause inclined cracks that turn thebeam into a tied-arch.

## II. MATERIALS AND IT'S PROPERTIES

Materials used for the experiment includes ordinary Portland cement of grade 43, Ceramic Powder, fine aggregate of size less than 4.75 mm, coarse aggregate of size less than 20 mm.

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*I.* Cement
The cement used in the study is ordinary Portland cement of 53 grades supplied from Ultra Tech cement factory. It is tested for physical properties as per IS 12269: 2013 standard. The preliminary test results of thecement are tabulated in table1.1

*II.* Coarse aggregate
Locally available crushed blue granite stones conforming to graded aggregate of nominal size 20 mm as per IS 383 – 1970 is used. Properties of aggregates have large impact on the strength, durability, workabilityand economy of concrete. The physical properties of soilare tabulated in table 1.2

*III.* Fine aggregate
Locally available river sand conforming to Grading zone II of IS 383 – 1970 was used in the study. Used as a filler. It accounts 60-80% of volume & 70-80 % of weight of concrete and defines concrete dimensional stability. Soil passing through less than 4.75 mm was used. The physical properties of soil are tabulated in table 1.3

*IV.* Super plasticizer
A commercially available sulphonated naphthalene formaldehyde based super plasticizer (CONPLAST SP 430) was used as chemical admixture to enhance the workability of the concrete.

*V.* Reinforcing Steel
Deformed steel bars were used in the longitudinal reinforcement with diameters (10) in order to satisfy the specific longitudinal reinforcement ratio.

*VI.* Weld mesh
Two various type of diameter used inter locking ofconcrete in the deep beams

*VII.* Thermo-col
Rectangular shape of thermo-col used in the deepbeam and it cannot act homogenous material.

Table1.1: Properties of cement

| **Sl. No** | **Physical properties** | **Values** |
|---|---|---|
| 1. | Specific gravity | 3.15 |
| 2. | Fineness | 95% |
| 3. | Initial setting time | 30 minutes |
| 4. | Consistency | 35% |
| 5. | Final setting time | More than 30 minutes |

Table 1.2: Properties of Coarse Aggregate.

| **Sl.no** | **Physical properties** | **Values** |
|---|---|---|
| 1. | Specific gravity | 2.71 |
| 2. | Crushing value | 11% |
| 3. | Impact value | 21.40% |
| 4. | Abrasion value | 19% |

Table 1.3: Properties of Fine Aggregate.

| **Sl.no** | **Physical Properties** | **Values** |
|---|---|---|
| 1. | Grading zone | II |
| 2. | Water Absorption | 0.6% |
| 3. | Fineness Modulus | 3.36 |
| 3. | Maximum size | 4.75mm |

## III. MIXTURE PROPORTION ANDTEST PREPARATION

a. Mix design proportion
Concrete has become an indispensable construction material. According to the present state-of-the-art, concrete has bypassed the stage of mere four component system, i.e. cement, water, and fine aggregate, coarse aggregate. It can be a combination of far more number of ingredients such as fly ash, GGBS, silica fume, rice husk ash, metakoline and super-plasticizer. The objective of proportioning concrete mixes is to get the most economical and practical combinations of different ingredients to produce concrete that will satisfy the performance requirements under specified conditions of use. Beam specimens of size 100×100×500 mm were casted using the mix proportion arrived for M30 grade concrete as per IS 10262:2009.
The mix design methods being used in different countries are mostly based on empirical relationships, charts and graphs developed fromextensive experimental investigations

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b. Compressive Strength

The tests are required to determine the strength of concrete for the required grade of concrete: Representative samples of concrete shall be taken and used for casting cubes 15 cm x 15 cm x 15 cm. The specimen shall be stored at site for 24+ ½ h under damp matting or sack. After that, he samples shall be stored in clean water at $27+2^0$C; until the time of test. Specimen shall be tested immediately on removal from water and while they are still in wet condition. The bearing surface of the testing specimen shall be wiped clean and any loose material removed from the surface. In the case of cubes, the specimen shall be placed in the machine in such a manner that the load cube as cast, that is, not to the top and bottom. Align the axis of the specimen with the steel platen, do not use any packing. The load shall be applied slowly without shock and increased continuously at a rate of approximately 140 kg/sq.cm/min until the resistance of the specimen to the increased load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and any unusual features noted at the time of failure brought out in the report.

d. Flexural Strength

The split tensile test were conducted as per IS. The size of cylinder is 300mm length150mmdiameter. The specimen were kept in water for curing for 7 days, 14 days and 28days and on removal were tested in wet condition by wiping water and grit present on the surface. The test is carried out by placing a cylindrical specimen horizontally between the loading surfaces of a compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The maximum load applied to the specimen was then recorded and the appearance of the concrete for any unusual features in the type of failure was noted. Average of three values was taken as the representative of batch. The test is carried out by placing a cylindrical specimen horizontally between the loading surfaces of a compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. To find split tensile strength following formula has used. Figure 5.1 shows the testing of split tensile test. Split tensile strength = 2P/ (πDL)Split Tensile Strength

e. Split Tensile Strength

Special arrangement were made through putting steel plate at loading and supporting locations andcenter the beam under the loading point and dividing it by stiff steel beam. The locations of loading and supporting, concrete strain gage, inclinometer and dial gage were appointed as shown in typical sketch in Figure(3), at time of starting the loading process, all indicators were adjusted. The load was increased gradually of range 20 and 50 kN for respectively. At each increment of loading, up to failure, the steel and concrete strain gages, dial gage and inclinometer were recorded. Linear variable differentiable transducers (LVDT) were mounted to monitor the central deflection of the beams. At every load increment, the central.

## IV. TEST RESULTS

a. Compressive Strength of Concrete: The test results are tabulated below in 1.4

| **Trial** | **7 Days** | **14 Days** | **28 Days** |
|---|---|---|---|
| 1 | 14.80 | 17.65 | 24.80 |
| 2 | 16 | 18.80 | 25 |
| 3 | 16.35 | 19.90 | 25.55 |

b. Flexural Strength of concrete:

The test results are tabulated below in 1.5

| **Trial** | **7 Days** | **14 Days** | **28 Days** |
|---|---|---|---|
| 1 | 2.25 | 2.65 | 3.25 |
| 2 | 2.44 | 2.75 | 3.40 |
| 3 | 2.50 | 2.85 | 3.80 |

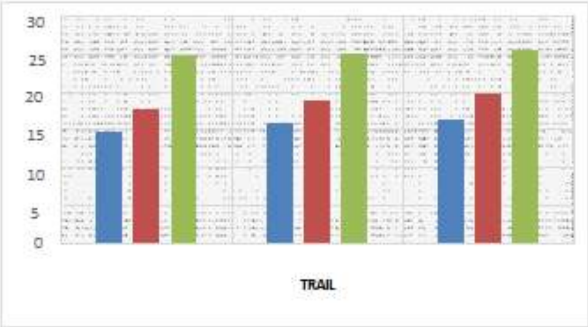
c. Split tensile Strength of concrete:

The test results are tabulated below in 1.6

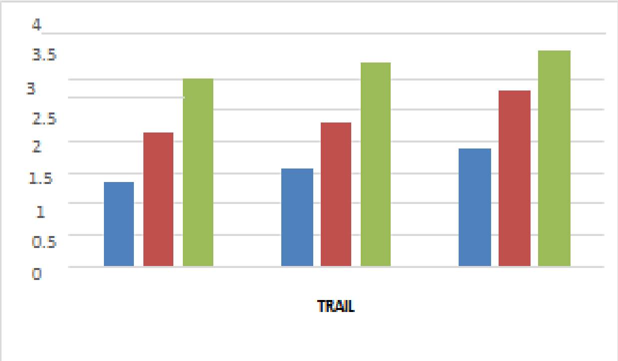
| **Trial** | **7 Days** | **14 Days** | **28 Days** |
|---|---|---|---|
| 1 | 1.35 | 2.15 | 3.00 |
| 2 | 1.57 | 2.30 | 3.27 |
| 3 | 1.90 | 2.82 | 3.45 |

## V. COMPARISON OF SPECIMENS

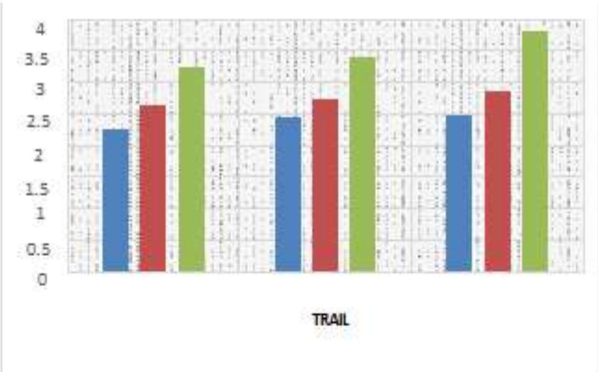
The variations between the various parameters such as compressive strength, flexural strength and split tensile strength were charted below:




**Compressive strength of concrete**




**Split tensile strength of concrete**




**Flexural strength of concrete**

## VI. DISCUSSION

In this study that concrete with trail 2 by the weight of cement showing the higher compressive strength results compared to the conventional concrete at 7- and 28-days results. It was found that the compressive strength values increased by 12.5% compared to conventional concrete. It was found that the split tensile strength of the concrete was 11.04% more than the conventional concrete. The flexural strength is increased by 8.9%.

## VII. CONCLUSION

The idea of lightweight concrete deep beams and weld mesh and thermocol added concrete deep beams were proposed the main conclusions were, The idea of lightweight concrete deep beams and weld mesh and thermocol added concrete deep beams were proposed the main conclusions were, Under the compression test on concrete cubes for 7 days , 14 days and 28 days is 15.72 N/ mm$^2$, 18.78 N/ mm and 25.11N/mm$^2$. For the split tensile test on cylindrical specimens for 7 days, 14 days and 28 days is 1.6 N/ mm$^2$ and 3.2 N/ mm$^2$. Flexural test values such as 2.40 N/ mm$^2$, 2.75 N/ mm$^2$ and 3.48 N/ mm$^2$ was assigned for 7, 14 and 28 days. Addition weld mesh and thermocol of lightweight concrete deep beams improves its performance in cracking and deflection. The load at which cracking start is increased significantly. The inclusion of weld mesh and thermo-col in concrete mix provides effective shear reinforcement in deep beams. Both the first crack strength and ultimate strength in shear increase with the provision of web reinforcement

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