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Behaviour of reinforcement concrete sand wich beams

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ABSTRACT

The sandwich beams are used to reduce the self weight, deflection and shear which are being the major concerns in the case of conventional reinforced concrete beams subjected to loading. In this project work, sandwich beams that are cast by the inclusion of thermocol and weld mesh in the place of steel re bars that are used in reinforced concrete beams are to be used. The shear strength evaluation of reinforced concrete beams has been the subject of several studies devoted to determine the influence of the main parameters. Due to the small value of span-depth ratio, the strength of beams is usually controlled by shear strength rather than flexural strength when normal amounts of longitudinal reinforcement are used. In addition to studies on shear, the yield strength and ultimate capacity of sandwich beams subjected to bending is to be determined through experimental methods. The experimental works are conducted to understand the various modes of failure that could occur due to possible combination of shear and bending moment acting at a given section of a sandwich beam. Apart from highlighting the experimental set-up, typical crack patterns, failure modes, and load-deflection behaviour are to be reported.

Keywords: Sandwich beam, Shear strength, Flexural strength, Typical crack pattern

INTRODUCTIONS

The behavior of RC deep beams is complex. The assumption of “plane sections remain plane in bending” is not applicable in deep beams. The important characteristic of the deep beam is its high shear strength due to internal arch action, which thrusts the load directly on to the end support through concrete struts. As per ACI code (ACI 318), the beams are classified as deep beams when their shear span-to depth ratio is less than or equal to two. If the quantity of flexural reinforcement is high without shear reinforcement, such deep beams fail in shear.

In larger size deep beams, the crack propagates fast causing sudden failure A beam shall be deemed to be a deep beam when the ratio of effective span to overall depth, is less than 2.0 for a simply supported beam; and 2.5 for a continuous beam The ACI-318 (ACI 318-2008) and IS code (IS 456-2000) consider the strength of concrete, percentage of longitudinal and transverse reinforcement and shear span-to-depth ratio as major parameters influencing the shear strength of deep beams. ACI 318 and IS code do not consider the size effect on the prediction of shear strength in deep beams. In deep beams, with shear span to-depth ratio less than or equal to 2.5, there exists significant reserve strength beyond the peak load, resulting in relatively less brittle failure.

In deep beams, the shear reinforcement in the horizontal direction is found to be effective than the vertical shear reinforcement, on the load carrying capacity The shear strength of concrete based on strut-and tie model has been reported . An explicit expression for the shear strength deep beams based on the strut and tie model the effect

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of shear span-to-depth (a/d) ratio, and vertical and horizontal shear reinforcement on the ultimate shear strength and crack width

The web reinforcement does not affect the formation of diagonal cracking; however, it affects the ultimate shear strength. The vertical reinforcement improves the ultimate shear strength, while the horizontal shear reinforcement does not have any influence on the ultimate strength

Reinforced concrete deep beams are used as load distributing structural elements such as transfer girders, pile caps, foundation walls, and offshore structures. The shear strength evaluation of reinforced concrete beams has been the subject of several studies devoted to determine the influence of the main parameters.

OBJECTIVES

- To characterize the plastic aggregates to use the rigid pavement construction.
- To study properties of plastic waste used in concrete.
- To study influence plastic aggregates in concrete to conventional concrete.
- Various percentages plastic fine aggregates is considered to add with concrete

METHODOLOGY

Abstract

⇩

Collection of literature

⇩

Study of literature

⇩

Collection of material

⇩

Testing of material

⇩

Mix design (M25)

⇩

Casting of specimen with conventional concrete

⇩

Report presentation

MATERIAL TESTING

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.

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Table 1 Physical Properties of Cement

Property	Value
Specific gravity	3.15
Initial setting time	30 min.
Final setting time	More than 30 min
Fineness	95%
Standard consistency	35%

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.

Table 2 Physical Properties of Fine aggregate

S.No	Test	Value
1	Specific Gravity Test	2.64
2	Zone	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 22 impact on the strength, durability, workability and economy of concrete.

Table 3 Physical Properties of Coarse aggregate

S.No	Test	Value
1	Specific Gravity Test	2.71
2	Aggregate Crushing Value	11%
3	Abrasion	19%
4	Impact Value	21.40%
5	Devals value	1.10%

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

Water

In all mixes for all types of concretes, curing and washing, tap water was used. It was clean and free from injurious

.

Reinforcing Steel

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

Weldmesh

Two various type of diameter used inter locking of concrete in the deep beams.

Specimen Details

Testing was carried out on 5 beams, Beams were simply supported on constant effective span

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of 1200 mm. 12 numbers of beams were tested under two point concentrated symmetrical loads. All the beams were having constant overall span and width of 400 mm and 150 mm respectively. There were four series of beams.

MATERIAL PROPERTIES

1. Durable & corrosion resistant.
2. Good insulation for cold, heat & energy saving and reducing noise pollution.
3. It is economical and has a longer life.
4. Maintenance free & Light Weight.
5. Hygienic & problems.
6. Ease of processing/ installation.

FRESH CONCRETE TEST

Fresh concrete is that stage of concrete in which concrete can be moulded and it is in plastic state. The potential strength and durability of concrete of a given mix proportion is very dependent on the degree of its compaction.

- Slump Cone Test
- Compaction factor test
- Flow test

Slump Cone Test

Unsupported fresh concrete flow to the sides and a sinking in height takes place. This vertical settlement is known as slump. Slump is a vertical measure indicating the consistency or workability of cement concrete.

In this test fresh concrete is filled into a cone of specified shape and dimension and the settlement or slump is measured when supporting mould is removed. Slump increase as water content is increased. It gives an idea of water content needed for concrete be used for different works Bleeding of concrete is said to occur when excess water comes up at the surface of concrete. This causes small pores through the mass of concrete and is undesirable.

Table 4 Slump test on fresh concrete

S.No	W/C Ratio	Slump Value
1	0.45	26mm
2	0.50	55mm
3	0.55	75mm

Flow Test

The flow table test or flow test is a method to determine consistency of fresh concrete. Flow table test is also used to identify transport table moisture limit of solid bulk cargoes.

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Table 6 Flow Test on Fresh Concrete

S.NO	W/C RATIO	Value
1	0.45	0.84
2	0.50	0.82
3	0.55	0.90

Compaction factor test

Compaction factor test is more precise and sensitive than the slump test and is particularly using for concrete mixes of very low workability. This test work on the principle of determining the degree of compaction achieved by a standard amount of allowing the concrete work done by allowing the concrete to fall through a standard height. The degree of compaction is called compaction factor. It is measured by the density ratio. The density achieved in the test to density of same concrete fully compacted.

Table 7 Compaction Test on Fresh Concrete

S.No	W/C Ratio	Compaction Factor
1	0.45	0.84
2	0.50	0.90
3	0.55	0.93

METHODS OF CONCRETE MIX DESIGN

Concrete has become an indispensable construction material. According to the present state-of-the-art, concrete has by passed 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 10262:2019. The mix design methods being used in different countries are mostly based on empirical relationships, charts and graphs developed from extensive experimental investigations. The following are the different methods of concrete mix design

1. DOE Method
2. ACI Method
3. RRL Method
4. IS Method

HARDEN CONCRETE TEST

The water causes the hardening of concrete through a process called hydration. Hydration is a chemical reaction in which the major compounds in cement from chemical bonds with water molecules and become hydrates. The hardened concrete testes are

Compression Strength Test

The compression test specimens were tested on a compression tested on a compression testing machine (CTM) of capacity 2000 KN. The specimen was placed on machine in such a way that its position is at right angle to it shown position which it had at the time of casting. load is applied gradually as the rate 14 N/mm^2/min or 320 KN/min. Cube moulds of size 150 x 150 x 150 mm were casted and allowed for curing in a curing tank for 28 days and they were tested at 7, 14 and 28 days.

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Fig 1 Cube

Split Tensile Strength

The determination of tensile strength of concrete in necessary to determine the load at which the concrete members crack. The cracking forms a tensile failure. The main of this experimental test is to determine the maximum load carrying capacity of test specimens. Cylinders of size 150mm in Diameter and 300mm height were cast for split tensile test. Two numbers of specimens were tested 28days.

Fig 2 Cylinder

Flexural Strength

The main of this experimental test is to determine the maximum load carrying capacity of the beam specimens. Specimen is subjected to two points loading and the load at the failure of the specimen is noted down. Prism of size 100x100x500mm was cast. Two numbers of specimens for each set were tested for 28days. These specimens were tested in Universal Testing Machine (UTM) of capacity 1000kN. The main value of the specimen of each type is taken as final flexure value. Flexural strength of the specimen is expressed as the modules of rupture.100 x 100 x 500 mm sizes of the prism were cast. The specimens were demoulded after 24 hours of casting and transferred to curing tank for 28 days.

Specimen Preparation

All the beams were rectangular in cross-section with 150mm width. The overall depths of the three beams were; 400mm respectively. The shear span to depth ratio was 0.75. The effective span-to-depth ratio was 1.5. The overall length (L) of the beam was 70mm respectively. The effective cover to the reinforcement was 50mm with a clear cover of 25mm in all the beams. The horizontal shear reinforcement was 0.2 and 0.3%, distributed uniformly over the total depth (UN) and uniformly distributed over 0.3d (CN).

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RESULTS

Table 8 Compressive Strength and Split Tensile Strength hardend concrete for 7 days (Trail I)

S.No	Compressive strength N/mm^2	Split Tensile Strength N/mm^2
1	30.95	2.39
2	33.57	2.25
3	33.17	2.34

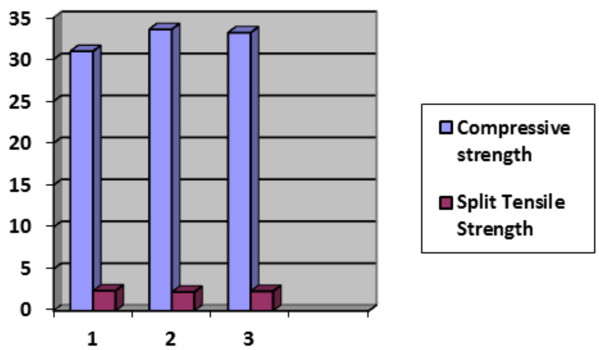

Fig 3 Flow Chart for Conventional Concrete Compression Strength and Split Tensile Strength Results for Trail I (7 Days)

Table 9 Compressive Strength and Split Tensile Strength hardend concrete for 28 days (Trail III)

S.No	Compressive strength N/mm^2	Split Tensile Strength N/mm^2
1	34.00	2.45
2	35.31	2.40
3	35.75	2.55

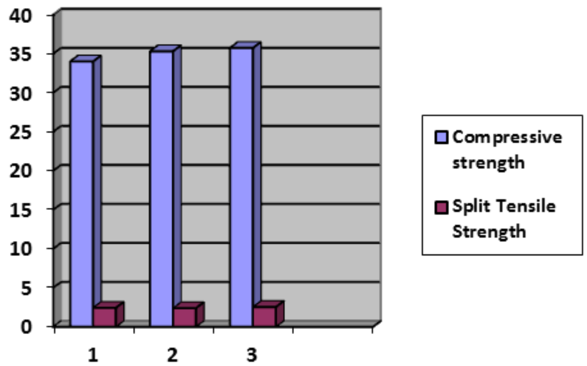

Fig 4 Flow Chart for Conventional Concrete Compression Strength and Split Tensile Strength Results for Trail I (14 Days)

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Table 10 Compressive Strength and Split Tensile Strength hardend concrete for 14 days (Trail II)

S.No	Compressive strength N/mm^2	Split Tensile Strength N/mm^2
1	31.82	2.40
2	33.57	2.34
3	34.00	2.53

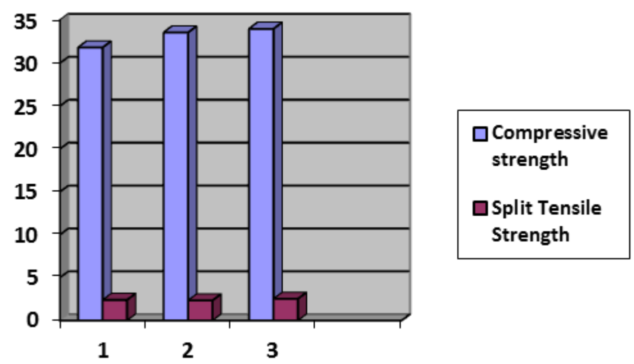

Fig 5 Flow Chart for Conventional Concrete Compression Strength and Split Tensile Strength Results for Trail I (28 Days)

CONCLUSION

The idea of lightweight concrete deep beams and weldmesh and thermocol added concrete deep beams were proposed the main conclusions were,

- The failure of deep beams is by the diagonal strut failure.
- Comparing to normal concrete deep beams light weight concrete deep beams show poor behavior in deflection, cracking and the design became non conservative.
- Addition weldmesh and thermocol of to 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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