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INVESTIGATION ON CONCRETE FILLED SKINNED BEAMS

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Abstract - Steel-Concrete-Steel Sandwich (SCSS) beam is a relatively new and innovated form of construction consisting of a layer of concrete, sandwiched between two relatively thin plates of steel which are connected to the concrete by shear connectors. In this project we investigated the difference between conventional Beam strength & concrete filled skinned beams strength. These skinned beams consist 1.5mm thick Steel plate and 1m in length, welded with 4 nos of 8mm diameter bar using shear connector consists of 12mm dia bar placed at spacing of 150mm in two rows of longitudinal section. It is a composite sandwich concrete section.

Key Words: 1.5mm Steel plate 1m, 4 nos of 8mm diameter, M25 concrete.

1. INTRODUCTION

Steel-Concrete-Steel Sandwich (SCSS) construction is a relatively new and innovative form of construction consisting of a layer of plain concrete, sandwiched between two layers of relatively thin steel plates, connected to the concrete by shear connectors. SCSS construction was originally conceived as an alternative form of construction for immersed tube tunnels, but has since been considered for a variety of offshore and onshore applications including oil production and storage vessels, caissons, core shear walls in tall buildings and impact and blast resistant structures because of the advantage where the full depth shear connectors transfer normal and shearing forces between the concrete and the steel plates, and also act as transverse shear reinforcement. The results of early experimental and theoretical studies of SCSS construction established the structural integrity of the system and indicated that the behavior of SCSS elements could be quantified in accordance with conventional theories for reinforced concrete and composite steel and concrete structures.

2. RESEARCH METHODOLOGY

The various journals were collected and studied on the different materials in concrete. According to these journals the process of the experiment and the method of experimentation different test conducted in those were studied.

The preliminary test was conducted to the materials know the properties such as specified gravity fineness modulus and the water absorption. Based on the properties the mix was done to know the quantity of the materials required for the M25 grade concrete. The beam specimen 230mm x 230mm x 2100mm are casted using MS steel plate 1.5mm, 8mm dia of main bars and distribution bars then 12mm dia bar placed at spacing of 150mm in two rows of longitudinal section. as shear connector. The concrete specimen is tested for compressive strength at the age 7, 14 and 28 days.

3. MATERIAL USED

The following materials were used in this research:

i) Cement
ii) Fine Aggregate (M – Sand)
iii) Coarse Aggregate (20mm)
iv) Mild Steel Plate
v) TMT Bars

4. MATERIALS TESTING

4.1 CEMENT

As per IS 12269-1970, Fineness of cement, Specific Gravity for Cement, Consistency of Cement and Setting Time tests were Conducted. The test values are given below:

Table – 1: Cement Properties

Test Particulars	Result obtained	Requirements As per IS 12269-1970
Fineness of cement (%)	4.3	3-7
Specific gravity	3.1	3.1-3.15
Normal consistency (%)	32	30-35
Initial setting time (min)	32 min	30min

4.2 TEST ON AGGREGATE

As per IS 2386-1963 aggregates test were conducted. The test results are tabulated below:

Table – 2: Aggregate Properties

SI.NO	Description	Fine Aggregates	Coarse Aggregates
1	Specific Gravity	2.77	2.83
2	Fineness Modulus	4.2	3.51
3	Water Absorption	0.4%	1.5%

5. MIX DESIGN

Concrete mix design is the process of finding right proportions of cement, sand and aggregates for concrete to achieve target strength in structures. So, concrete mix design can be stated as Concrete Mix = Cement: Sand: Aggregates. This process is usually adopted for structures which requires higher grades of concrete such as M25 and above and large construction projects where quantity of concrete consumption is huge. Benefits of concrete mix design is that it provides the right proportions of materials, thus making the concrete construction economical in achieving required strength of structural members. Mix design for M25 grade of concrete was prepared by using the guidelines of IS: 10262-2009

(Recommended Guidelines for Concrete Mix Design). The following proportions were obtained.

Table – 3: Mix Design Proportions

Cement Content	Fine Aggregate	Coarse aggregate	Water
425.73kg/m^3	676.20 kg/m^3	1190.32 kg/m^3	191.58 lit/m^3

6. EXPERIMENTAL INVESTIGATION

Initially, we conducted the basic test for concrete such as Workability for fresh concrete and Compressive and tensile strength test for Hardened Concrete. The test results are discussed below:

6.1 COMPACTION FACTOR TEST

The compaction factor is one of the most efficient tests for measuring the workability of concrete as per IS: 1199-1959. It is the most precise, sensitive and particularly useful for concrete mixes of very low workability as are normally used. The workability of fresh concrete is expected to be mild.

$$Compaction\ Factor = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

After conduction of the test, we obtained the High workability Compaction Factor of 0.95

6.2 SLUMP CONE TEST

The slump test is the simplest workability test for concrete, involves low cost and provides immediate results. Due to this fact, it has been widely used for workability tests since 1922. The slump is carried out as per procedures mentioned in ASTM C143 in the United States, IS 1199 – 1959 in India and EN 12350-2 in Europe. Generally, concrete slump value is used to find the workability, which indicates the water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value.

After conduction of the test, we obtained the True Slump of 75mm which is for High Workability of Concrete.

6.3 COMPRESSIVE STRENGTH

The compressive strength is a measure of the concrete's ability to resist loads which tends to crush it. The compressive strength was conducted on the cube of size 150mm x 150mm x 150mm were tested as per IS: 516-1959 specifications. The density of the specimens was also determined at the same time. These cubes were for compressive strength at 1st day of after 24 hours de-moulded and 7th day, 14th and 28th days. The results for average of three cubes,

Table – 3: Test Results for Compressive Strength Stress

Grade of Concrete	After curing 7 days (N/mm^2)	After curing 14 days (N/mm^2)	After curing 28 days (N/mm^2)
M25	18.25	24	28.3

6.4 SPLIT TENSILE STRESS

The Cylinders of dimensions 300mm X 150mm are used for calculating the split tensile strength. Concrete cylinders were cast with M25-grade concrete. The split tensile strength of cylinders for 7, 14, and 28 days was tested. The load is applied continuously without slip.

Table – 4: Test Results for Tensile Strength Stress

Grade of Concrete	After curing 7 days (N/mm^2)	After curing 14 days (N/mm^2)	After curing 28 days (N/mm^2)
M25	2.56	2.93	2.99

6.5 R.C.C BEAM DEFLECTION TEST

The Beam of dimensions 230mm X 230mm X 2100mm are used for calculating the Deflection in RCC Beam. Reinforced Beam were cast with M25-grade concrete. In this project, we compared the results between Conventional Beam and Composite Skinned Beams. The deflection test were conducted at 28 days. The load is applied continuously without slip on both the beams

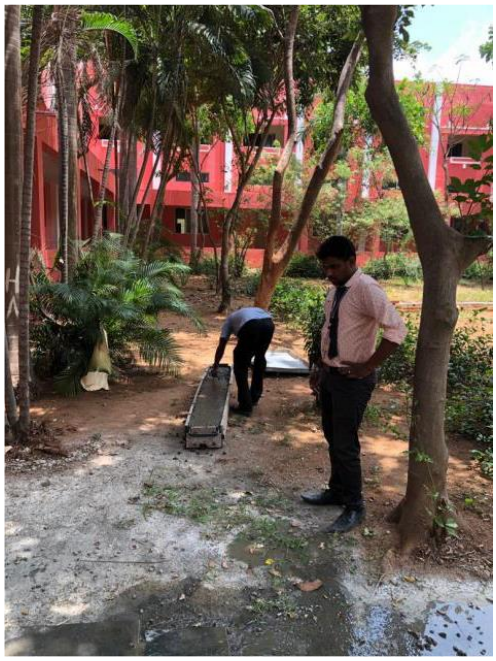

Fig – 1: Casting of Conventional Beam

Table – 5: Deflection Test Results for Conventional Beam

SI.NO	Load (kN)	Deflection (mm)
1	0	0
2	100	5
3	200	10
4	300	15.5
5	400	20.5
6	500	25.5

Fig – 2: Casting of Composite Skinned Beam

Table – 6: Deflection Test Results for Skinned Beam

SI.NO	Load (kN)	Deflection (mm)
1	0	0
2	100	3.5
3	200	7
4	300	10.5
5	400	14
6	500	18

7. RESULTS AND DISCUSSION

We had completed our physical property test and we discussed our design mix of concrete & we cast our cube for 7 days & 14 days & 28 days for checking its compressive strength. We cast our convection beams & composite beams for 28 days for comparing their deflection test. Finally, we compare our flexural behavior of our conventional beam & composite beam Size of beam we used 230mm x 230mm x 2100mm maximum load we given in both conventional & composite beam 500 KN. In Conventional beam we achieve maximum deflection 25.5mm in maximum load 500KN. In Composite beam we achieve maximum deflection 18mm in maximum load 500KN, comparatively our composite beam achieves less deflection than conventional beam.

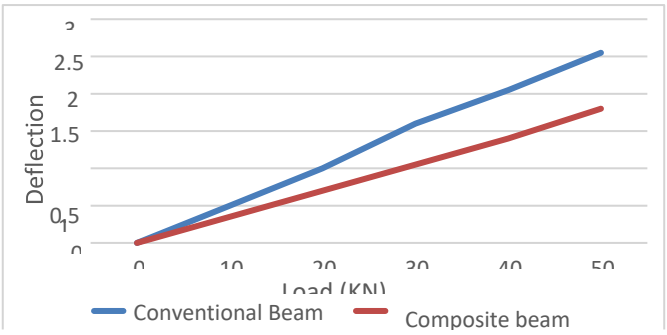

Fig – 3: Comparative graphical representation of conventional beam & Composite beam Deflection Test

8. CONCLUSION

In this project, Steel-concrete-steel sandwich (SCSS) beam is a relatively new and innovated form of construction consisting of a layer of concrete, sandwiched between two relatively thin plates of steel which are connected to the concrete by shear connectors. The perceived advantage of SCSS construction is that the external steel plates act as both primary reinforcement and formwork also as impermeable and impact and blast resisting membranes. We investigated the difference between conventional Beam strength & concrete filled skinned beams strength with deflection parameter. In the above examinations concrete filled skinned beam get the positive results.

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