Experimental Studies on Composite Beam Subjected to Pure Torsion

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Abstract- *The concept of Composite structural elements has grown over the last two decades into a matured concept in the construction industry all over the world. In this project the composite beams of dimension 2300x230x150 was casted, the cold form sheet of thickness 1.2mm and shear connectors with flange 30mm and web 50mm were used. Four composite beams were casted and tested with difference in spacing of shear connectors. The maximum load carrying capacity using torsion equipment was found out. The experimental results were found*

Keywords- Experimental Study, Negative Bending, Shear Connector, Steel-Concrete Composite Beam, Torsional Moment.

I. INTRODUCTION

Modern civilization depends on the continuing performance of the engineering infrastructure ranging from industrial buildings to power stations and bridges. For a structure to function properly the strength of the composite structure should have a satisfactory performance. Commonly encountered engineering challenges such as service loads, design errors, construction errors, changes in use of the structure, degradation problem, changes in design code regulations, seismic retrofits are some of the causes which have lead to the need for new techniques to upgrade the performance of the structure. Characteristic of a structure to resist earthquake, impact and blast loading. Steel has excellent ductile properties. Hence a judicious combination of structural steel and concrete utilizing the strength possessed by and suppressing their weakness resulted in the composite construction

1.1 COMPOSITE STRUCTURES

In about the mid 1960's, a new group of composite materials, called advanced engineered composite material(aka advanced composites),began to emege.

Fig 1.1 Composite Structures

1.2 COMPOSITE CONSTRUCTION

A structural member composed of two or more dissimilar materials joined together to act as a unit is referred to as Binding two dissimilar materials to form a composite member does not only combine the collective strength of two materials, also enhance their physical characteristic and make the composite stronger than the sum of their heights

1.3 STEEL CONCRETE COMPOSITE CONSTRUCTION

Fig 1.2 Composite Construction

In order to design the structural member with maximum efficiency and minimum cost, steel-concrete composite construction is adopted. It is a powerful construction concept in which compressive strength of concrete and the tensile strength of steel are almost effectively used. Steel and concrete have almost the same thermal expansion apart from an ideal combination of strength

1.4 COMBINED STEEL CONCRETE COMPOSITE BEAM

A modern composite construction concept was initially developed in North America and is now used extensively in the UK where it has been further developed and redefined. Early application involved concrete encased steel for which concrete served primarily as fire protection.

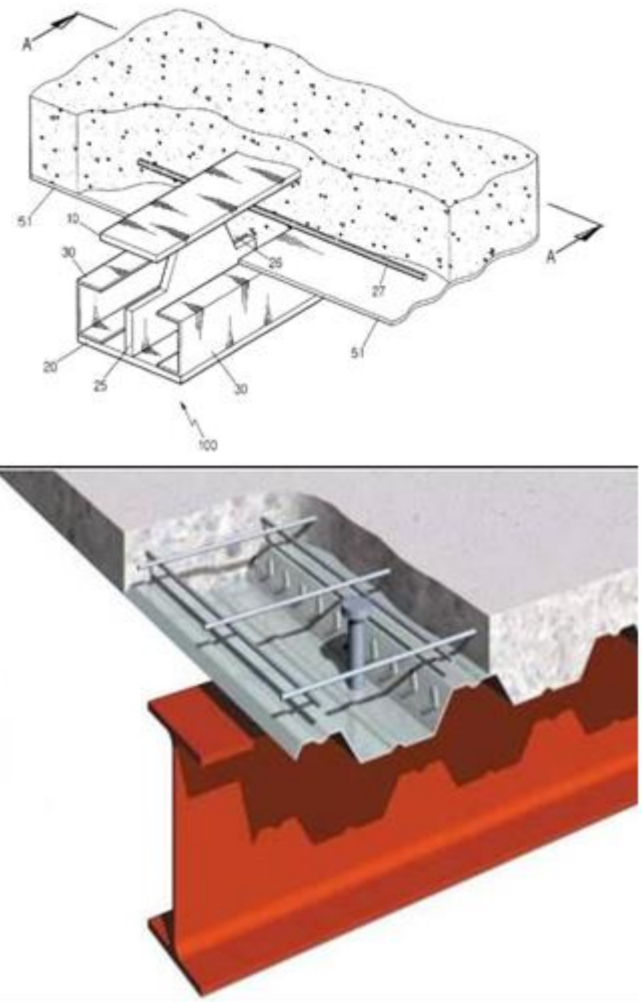

Fig 1.3 Composite Beams

1.5 TYPES OF SHEAR CONNECTORS

RIGID TYPE

As the name implies, these connectors are very stiff and they sustain only a small deformation while resisting the shear force. They derive their resistance from bearing pressure on the concrete, and fail due to crushing of concrete BOND OR ANCHORAGE TYPE

These connectors derive their resistance through bond and anchorage action

Fig 1.4 Shear Connectors

II. METHODOLOGY

2.1GENERAL

For the analysis of the composite beam the knowledge of material properties, mix adopted and compressive strength is essential. Hence experiments were conducted on materials, specimen of concrete cubes and cold form sheet to understand the behavior of materials under composite action.

2.2. MATERIALS USED

CEMENT: The cement conforming to IS1489 (part-1):1991, Premium composite 53 grade of cement is considered for the concrete mix.

WATER: Locally available potable water is used for mixing the concrete.

FINE AGGREGATES: The fine aggregates used for the entire specimen were natural river sand complying with the requirements of IS383:1970.

COARSE A COLD FORM STEEL: Sheet of thickness 1.2mm was adopted for making the beams. From each sheet test coupons were cut and tested in a computerized UTM and the tensile properties were recorded, the stress- strain curves were plotted and the properties of sheet were known from the graph.

HEADED STUDS: The diameter of headed stud used in these beams is 6mm and the shank diameter is 50mm having a flange width of 30mm which is T –shaped.

BRACINGS: Cold rolled sheets of thickness 1.2 was purchased and made into the required shape.

2.3 MIXES ADOPTED

Mix ratio as per IS method is adopted for the design mix. Plain concrete cubes, cylinders, plain beams of standard size were cast, cured and tested in UTM and the results were obtained.

a) Strength of Shear Connectors

The strength of the shear connection in push specimens depends on the ability of the shear connections to redistribute loads among themselves of the shear connectors.

- They must transfer direct shear at their base.
- They must create a tensile link into the concrete.
- They must be economic to manufacture and fix.

b) Behavior Shear Connectors

Push out tests carried out from the earlier literature revealed the behavior of shear connectors and the characteristics of the interfaces that is effective transfer.

c) Headed Connectors

Head stud type shear connectors shown in were used to achieve proper bond between steel and concrete interface. Fe 415 grade stud of shank

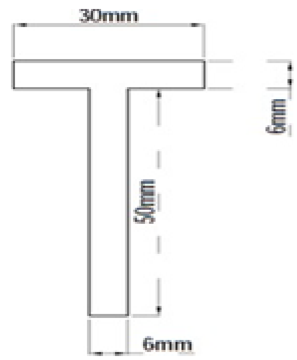

Fig 2.1 Shear Connector

III. TESTING OF SHEAR CONNECTORS AND RESULTS.

Pushout tests can be performed to understand the behaviour of shear connectors. The pushout specimens were constructed using cube specimens. The cold formed sheets were welded with headed studs which were kept inside a cube mould.

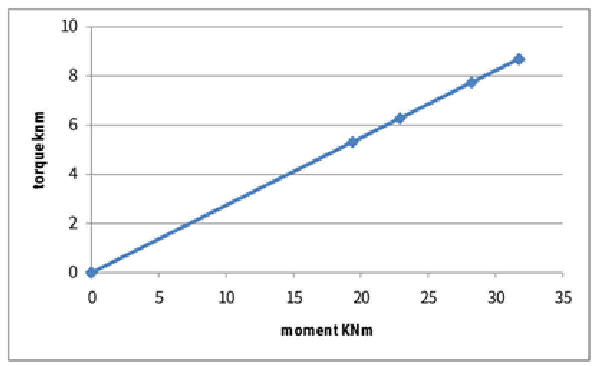

Fig 3.1 Moment Vs Torque

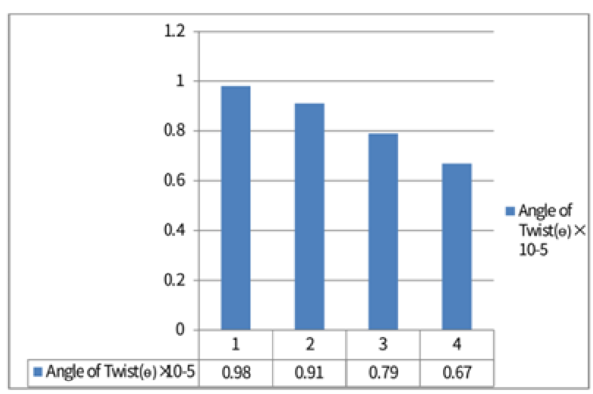

Fig 3.2 Compare Type Of Beam Vs Angle Of Twist

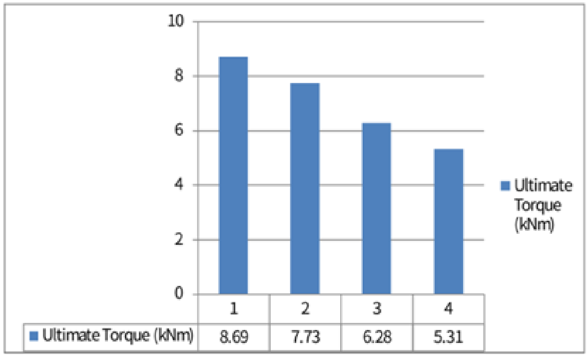

Fig 3. 3 Compare Type Of Beam Vs Torque

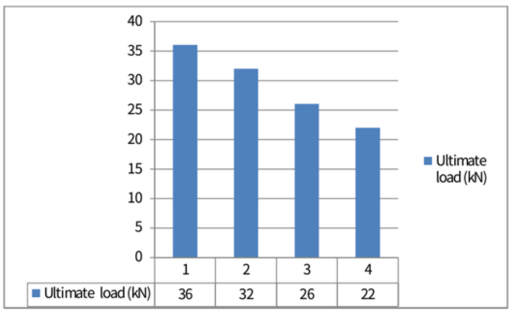

Fig 3.4 Compare Type Of Beam Vs Load

TEST RESULTS

	Beam ID	Dimensions (mm)	Thickness of the Sheet (mm)/spacing of bracing (mm)	Ultimate load (kN)	Ultimate Torque (average) (kNm)	Angle of Twist(θ) (radians) x 10^{-5}
1	A	150 x 230 x 2300	1.2 / 75	36	8.69	0.98
2	B	150 x 230 x 2300	1.2 / 100	32	7.73	0.91
3	C	150 x 230 x 2300	1.2 / 125	26	6.28	0.79
4	D	150 x 230 x 2300	1.2 / 150	22	5.31	0.67

From the dial gauge readings, twisting moment was found by multiplying the lever arm distance and the total load obtained in the dial gauge divided by 2.

IV. CONCLUSION

- Experiments were conducted on cement , aggregates, reinforcement bars , cold formed sheet and plain concrete cubes to determine their properties.

- The enhancement in strength due to confinement was observed from earlier literature .

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