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Experimental investigation on Flexural Strength of Steel-Concrete composite beam using Steel plate

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Abstract - *Steel-concrete composite beam with profiled steel sheet has gained popularity in the last two decades. Due to the ageing of these structures, retrofitting in terms of flexural strength is necessary to ensure that the aged structures can carry the increased traffic load throughout their design life. Continuous steel-concrete composite beams are widely used in building and bridge constructions; therefore the structural behaviour of composite beams under negative moments is a significant subject. However experimental tests in this field are very lack and information about the efficiency of shear connection when the slab is under tension are really few. In the present paper, experimental tests on steel-concrete composite beams under negative bending are presented. The aim of the experimental program is the analysis of the influence of slab-profile shear connection on the behaviour of beams; thus specimens with the same cross-section, but different arrangement of shear connectors, have been tested. Experimental results concerning deflection, slips and uplifts at the slab-profile interface and curvature are reported detailing many aspects of the structural behaviour.*

Key Words: RCC beam, Composite member, Steel plate, Beams.

1.INTRODUCTION

The composite beams are studied in this report. In recent years, composite members have become an important technique of construction for bridges, residential and commercial structures. It is a technique in which an RCC section formed with the addition of a steel plate of 5mm thickness connected with steel reinforcement using c type steel hook is partially or completely encased in concrete.

The two materials of different properties act as one unit when its subjected to the applied load. Other advantages of composite members include the following:

Less deflection due to greater stiffness under working loads.
Increased fatigue and impact resistance is compared to ordinary RCC member.

2 MATERIALS USED AND METHODOLOGY

2.1 CEMENT

Ordinary Portland cement (OPC) of 53 grade conforming to IS 12269-2013 was used for casting the RCC beam.

2.2 WATER

Water is the most important and least expensive ingredient of concrete. A part of mixing water is utilized in the hydration of cement to form the binding matrix in which the inert aggregate are held in suspension until the matrix has harden. The remaining water serves as a lubricant between the fine and coarse aggregate and makes concrete workable.

2.3 COARSE AGGREGATE

Making sure of the availability of crushed coarse aggregate of nominal size 10mm were used in this work. The coarse aggregate particles passing through 10mm and retained on 12.5mm on IS sieve used as the natural aggregate which met the grading requirement of IS 383-1970.

2.4 FINE AGGREGATE

It confirmed to Zone II of IS 383-1970 Sand is used in the work which has the particle was less than 4.75mm IS sieve.

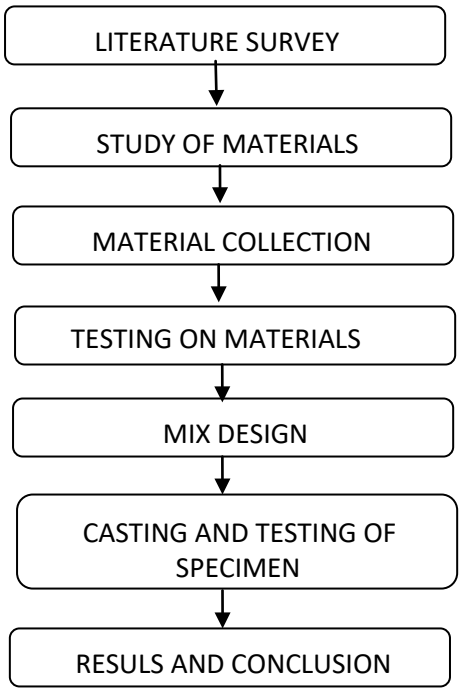
2.5 STEEL BARS

Making the availability of Fe415 grade of bars at 10mm dia bars for the main and shear reinforcement and 8mm dia bars for strips of the beam.

2.6 STEEL PLATE

Making the availability of Fe415 grade of bars at 10mm dia bars for the main and shear reinforcement and 8mm dia bars for strips of the beam.

2.7 METHODOLOGY



3. RESULT AND DISCUSSION

3.1 FLEXURAL STRENGTH TEST ON RCC BEAM

The beam size of 1000 x 120 x 100 mm in the strength of 20Mpa is cast with different percentage of lapping. Beams are tested by 1000 KN loading frame with the hydraulic jack of capacity 2000KN. Load is applied on the beam by using a two-point loading system to provide constant moment. The beam was supported on two simple supports resting on steel plates of size 200 mm x 100 mm. The front face of the specimen was whitewashed and marked with grids of size 50 mm x 50 mm to study the crack propagation.
The load is applied gradually and the readings are measured every 2 sec. The crack pattern is captured and the failure of the beam is determined at a particular load.

Fig -1: Testing on RCC beam

Fig -2: Failure of RCC beam

3.2 ANALYSIS OF BEAM BY STAAD PRO

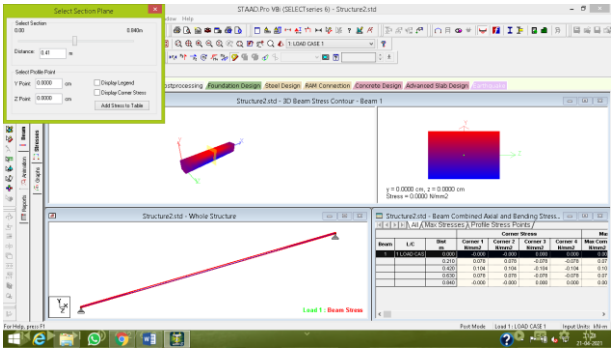


Fig -3:Stess over RCC beam analysed by STAAD PRO

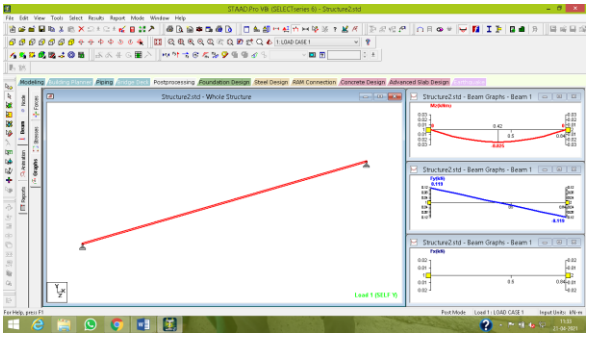


Fig -4:Shear force and Bending moment by STAAD PRO

3.3 DEFLECTION ON RCC BEAM

The below chart represents the Deflection that occurs on the RCC beam with the gradually increasing load over the beam.

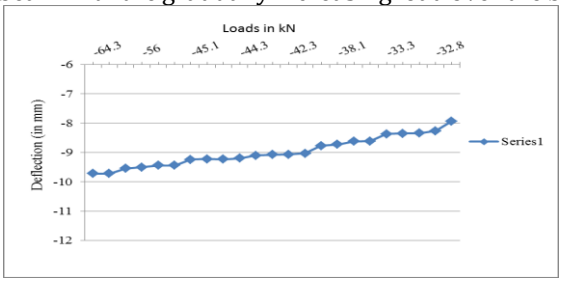


Chart - 1: Deflection of RCC beam

3.4 DEFLECTION ON RCC BEAM WITH STEEL PLATE

The above chart represents the Deflection that occurs on the RCC beam with a steel plate with the gradually increasing load over the beam.

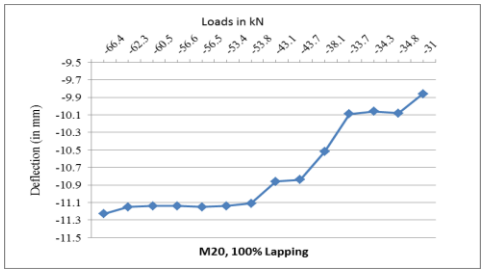


Chart - 2: Deflection of RCC beam with steel plate

4. CONCLUSIONS

- The comparison of both the beam with their compressive strength with the addition of the steel plate to the RCC beam gives them more strength for the RCC beams.
- With the addition of the Steel Plate to the RCC beam of M20 grade of concrete, we can attain a Compressive strength that has been approximately equal to the strength attain by the M25 grade of Concrete in the RC Structure.
- No sudden failure was observed in the concrete and the failure was gradual as the increase in loading was provided.
- The failure that occurred in the beam was a safe manner.
- The flexure strength increases by using the Steel plate. It is concluded that the % increase in flexural strength ranges between 404 & 426 for M20 of concrete.

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