Experimental Study on Flexural Behaviour of Steel-Concrete Composite Beam using Epoxy Adhesive Bonding

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Abstract— Structural systems incorporating steel-concrete composite beams have been widely used throughout the world for building and bridge structures. The steel-concrete composite structures can resist the fire. This project deals with the experimental study on the flexural behaviour of steel-concrete composite beam using epoxy adhesive bonding. The flexural strength of the profiles is determined by two-point loading test and the flexural behaviour is obtained with deflection occurring very well.

Key words: Steel-concrete composite beams, Epoxy adhesive, Steel profiles, Slabs and beams

I. INTRODUCTION

The steel-concrete composite beams have been widely used throughout the world for building and bridge structures. The steel-concrete composite structures can resist the fire. The composite beams are always lighter than the reinforced concrete beams. In the composite beams, a combination material called epoxy resin is used to provide the cooperation between the prefabricated reinforced concrete plate and the steel profile. During the cooperation between the concrete and the steel profile, the sliding and the lifting forced between the two materials are reacted by the help of the epoxy resin. [1]

II. EXPERIMENTAL STUDY

The steel section used for the composite beam is based on the Indian standard of medium weight ISMB 150 for both concrete slabs and concrete beams. The thickness of flange, web; width of flange is as shown in fig 1., [7]

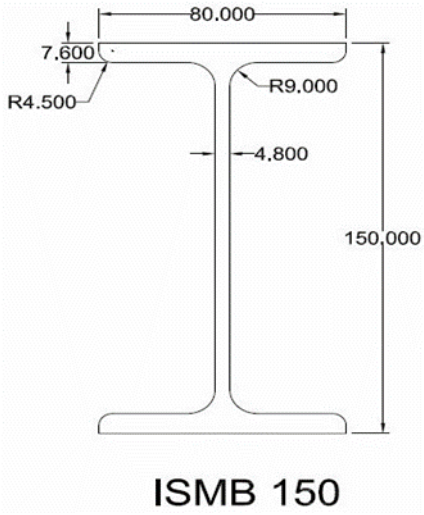


Fig. 1: Steel profile

The concrete slab is 500 mm wide and 100 mm thick, six steel reinforcing bars of 12mm diameter of 180mmc/c are provided. The distribution provided is 8mm diameter of 150mmc/c. [2] Three cubic 150x150x150 mm3 concrete specimens have been also tested for each beam, to evaluate the concrete mean compressive strength that resulted in 25 MPa.

The reinforcement details of the epoxy bonded composite beam is as shown in fig 2.,

The casting of beam and slab is as shown in fig 3.,

The curing is done with gunny bags and it is for the period of 28 days. As the curing is finished, the structures is bonded with the steel profile as shown in fig 4 and fig 5

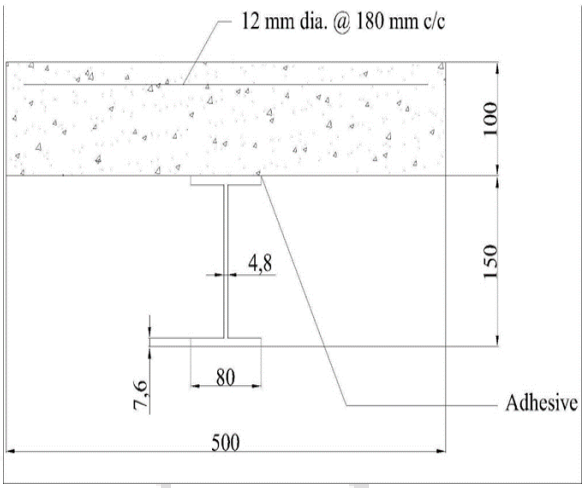


Fig. 2: Reinforcement details of composite beam

Fig. 3: Beam and Slab Casting

Fig. 4: Applying of Epoxy in the concrete beam

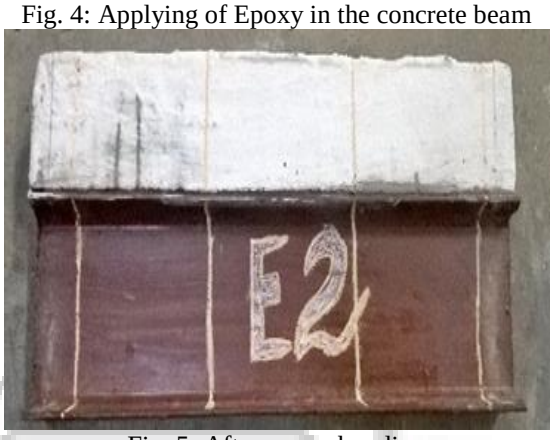


Fig. 5: After epoxy bonding

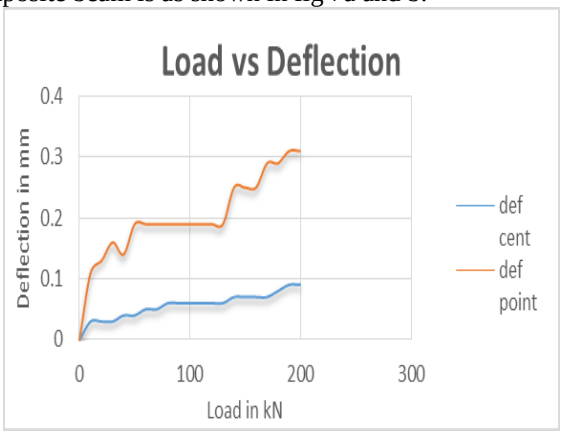
A. Testing

The testing of the composite beam is determined by two-point loading and the test setup includes dial gauge and LVDT for measuring the deflections and slips. The setup is as shown in fig 6.,[4]

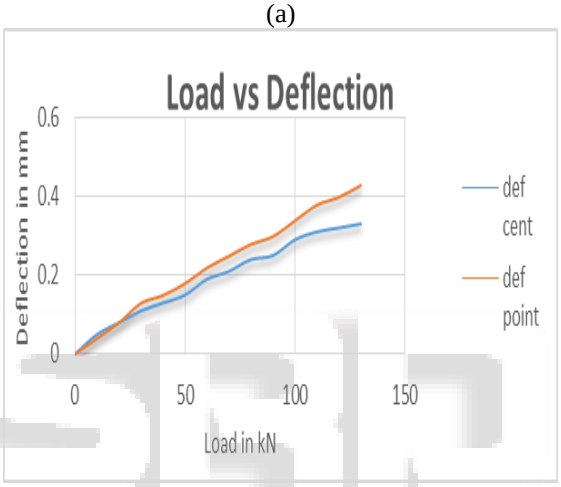
Fig. 6: Test setup for the composite beam

B. Deflection

The composite beam deflects very well. The deflection value ranges from 0.09 to 0.43mm. The deflection for the composite beam is as shown in fig 7a and b.



(a)

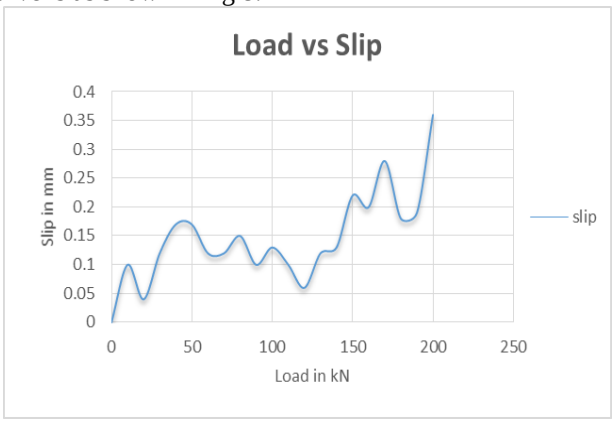


(b)

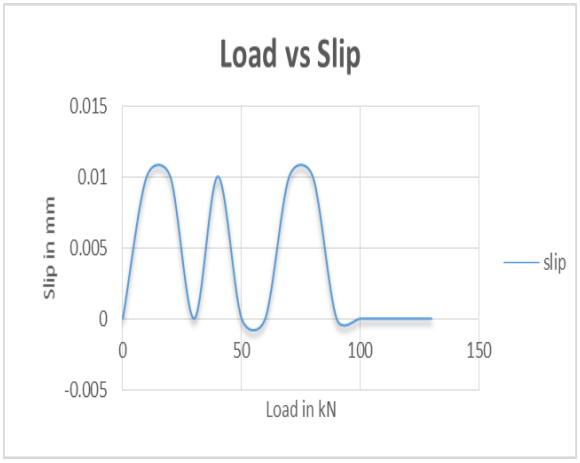
Fig. 7: Load vs Deflection curve (a) Composite beam [I profile with concrete slab](b) Composite beam [I profile with concrete beam]

C. Slip:

The composite beam has the maximum slip value of 0.36mm for I-beam with concrete slab and 0.01mm for I-beam with concrete beam. This shows that composite beam [I profile with concrete slab] slips very well compared to that of composite beam [I profile with concrete beam]. The slip curve is as shown in fig 8.



(a)



(b)

Fig. 8: Load vs Slip curve (a) Composite beam [I profile with concrete slab] (b) Composite beam [I profile with concrete beam]

D. Maximum and Failure Load:

The Ultimate load for the composite beam [I profile with concrete slab] and composite beam [I profile with concrete beam] is 200kN and 130kN respectively. There is no failure load for composite beam [I profile with concrete slab] and the failure load for the composite beam [I profile with concrete beam] is 100kN and the cracked pattern is as shown.

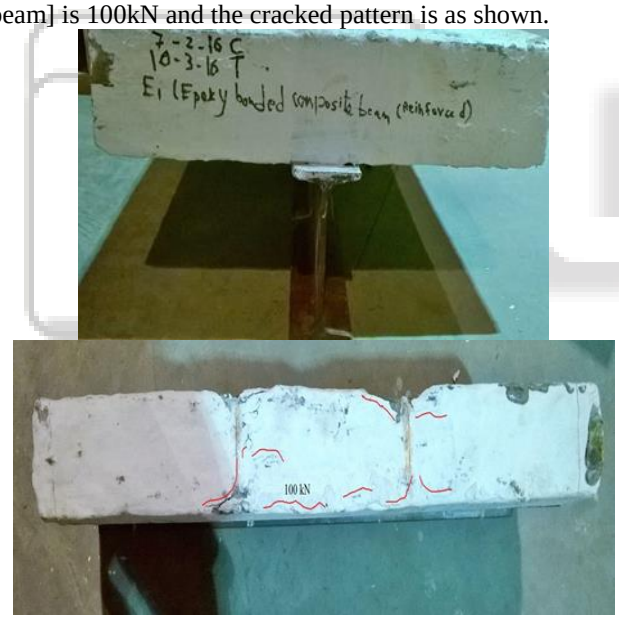


Fig. 8: Failure load of composite beam

III. CONCLUSION

The following are the results obtained.

- The beams gave perfect deflection and slip with the maximum load carrying capacity.
- The load-deflection curve of both the composite beams gave good rapport with the ultimate load carrying capacity.
- The load-slip curve of the composite beam [I profile with concrete beam] doesn't slip very well compare to the composite beam [I profile with concrete slab].
- Thus, the strength occurs are as equal to that of theoretical calculations. Also, both the composite beam can be preferred based on their usage in the construction field.

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