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EXPERIMENTAL INVESTIGATION OF COMPOSITE PROFILED BEAMS USING STEEL AND CONCRETE

Prasanth.M[1], Dr. P.A.Edwin Fernando[2]

[1]PG Student, Akshaya College of Engineering and Technology, Coimbatore-642109, Tamilnadu, India'
[2]Assistant Professor (S.G), Akshaya College of Engineering and Technology, Coimbatore-642109, Tamilnadu, India'

ABSTRACT –

Composite structure refers to two load carrying structural members that are integrally connected and deflect as a single unit. In the construction industry, it is now common practice to use cold formed steel decks consisting of profiled sheets both as permanent formwork for the support of soffits of reinforced concrete slab and also as part of the tension steel in the composite profiled slab that is formed after concrete has hardened. Few investigations were carried out on cold formed steel profiled sheets as permanent formwork to the sides of rectangular reinforced concrete beams. Even though Trapezoidal RCC beams are more economical than conventional rectangular beams they are not widely used because of the increase in cost of formwork construction. The objective of the present study is to study the flexural behavior of Rectangular, Trapezoidal Composite Profiled Beam using M20 grade of concrete. The profiled sheets were placed at the sides and bottom becomes permanent formwork. In phase I project preliminary investigation of materials and concrete works were done. In second phase two conventional RCC beams, two rectangular, two trapezoidal section profile beams were casted and tested under central concentrated load. A theoretical procedure for calculation of ultimate moment carrying capacity is also evolved. The ultimate flexural strength, deflection, ductility and stiffness characteristics of Trapezoidal and Rectangular Composite Profiled Beam are studied. It is observed that the moment carrying capacity increases and also the profile sheets can be utilized permanent formworks effectively.

I. INTRODUCTION

MAN's quest for building infrastructure at most economical cost has to the best use of materials. The practice is to utilize the strength possessed by them and to suppress their weakness. Steel-concrete composite structures come under this category. There may be a few who specialize in steel and many more in concrete is not possible. Even a fully RCC structure consists of reinforcing steel and hence an RCC structure itself is a composite.

However in order to build most economic and aesthetically pleasing structure one should utilize a judicious combination of structural steel with reinforced concrete. In steel, the progress of construction is fast. Steel is more efficient in resisting tensile forces and has a better strength to weight ratio. On the other hand concrete is cheap, site mouldable and strong in compression.

The applications of composite members consisting of concrete- steel sections have become increasingly popular in civil engineering structures in recent years. This is due to their advantages over the conventional structural sections in terms of strength, ductility, energy absorption capacity, easy construction procedure, and overall economy. In multistory building, the skeleton may be a steel frame, which can be easily and fastly reacted. Later functional floors can be provided using RCC thus, this system is most efficient, both from the point of view of load resistance and performance. In addition, it is a waste to lay the centering sheet and then to remove them after concrete has hardened instead if profiled sheeting (which also forms part of the reinforcement for the slab) is used one can eliminate waste of time and effort and make the structure elegant.

Composite steel-concrete construction is used in buildings and bridges even in regions of high seismic risk. It is now common practice to use cold formed steel desks consisting of profiled sheets both as permanent formwork for the support to the soffits of reinforced concrete slabs and also as part of the tension steel in the composite profiled slab. Therefore, by using composite concrete-steel structures one up in aesthetic, economical, and functional structures.

II. OBJECTIVES

To determine the flexural strength, ultimate strength, deflection, stiffness, energy absorption, strain and moment curvature of Trapezoidal and rectangular composite profiled beam and to compare the result of conventional and composite profiled beams both experimentally and theoretically. Though composite construction is not a very new technique, its importance in structural construction is of recent realization in this country. With the advancement in the manufacture of structural units, composite construction has assumed great importance. Concrete is stronger in compression than in tension, and steel is susceptible to buckling in compression. By the composite profiled action between the two, their respective advantages can be utilized to the fullest extent.

III. MATERIALS

CEMENT

Cement (PPC) with specific gravity of 3.10 has been used.

FINE AGGREGATE

The fine aggregate used in this investigation was clean river sand passing through4.75mm sieve with specific gravity of 2.62 conforming to zone II.

COARSE AGGREGATE

Hard granite broken jelly (20 mm) was used in the experimental work with the specific gravity of 2.76

WATER

The potable water was used for mixing and curing of concrete. The specification cast was water cured in curing tank by complete immersion.

REINFORCEMENT STEEL

High yield strength Fe 415 bars of size 10mm diameter and mild steel bar of size 6 mm diameter Fe250 graded has been used.

COLD FORMED PROFILED STEEL SHEET

Cold formed steel sheet 1 mm thickness and 1.98 m length was used as formwork of composite beam. The properties of cold formed steel were determined by conducting a coupon test as per IS:1079. Young's modulus = 2x105 Mpa, Yield strength = 351.10 Mpa and Ultimate strength = 408.33 Mpa.

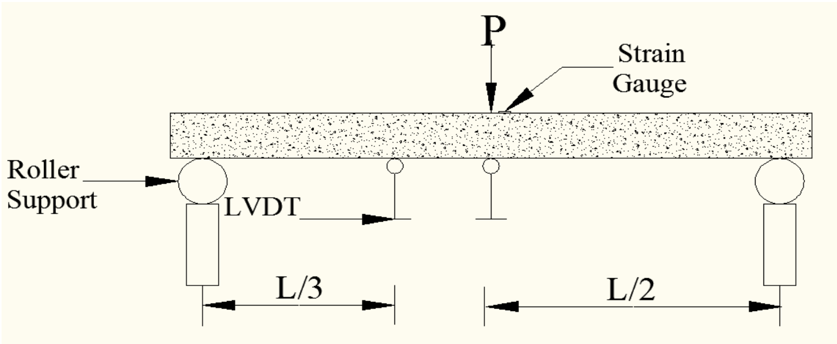
IV. MIX PROPORTIONING OF CONCRETE

The mix design was arrived M20 grade of concrete as per IS: 10262-2009. The proportion found from mix design was 1:2.04:3.36:0.55 (Cement : Fine Aggregate : Coarse Aggregate : Water) with a cement content of 348.320 kg/m^3.

Sl No.	Materials	Weight in kg/m^3
1	Cement	348.320
2	Fine Aggregate	711.274
3	Coarse Aggregate	1172.000
4	Water	191.580
5	Water Cement Ratio	0.55

V. TEST PROCEDURE AND TEST SETUP

The behaviour of composite profiled beams for two different configuration and different diameter of the reinforced bar were studied by applying single point load using loading frame. All the specimens were tested for flexural strength under the single point loading after 28 days curing. The specimens were tested with simply supported end condition, cantered over bearing blocks adjusted for an effective span 1780mm. The load was transferred to the specimens by single point loading at a distance of 890mm from each support. The load was increased till the ultimate failure of the beam took place. The deflection at the mid span, and at a distance of 593mm from support were recorded for each increment of load using LVDT having a least count of 0.01mm and strains were measured by using electrical strain gauges. The resistance of strain gauge is 350 ohms. The crack patterns and local buckling were also recorded for RC and composite Profiled Beams respectively at every load increment. The specimens were tested in a loading frame of capacity 500 kN. The experimental setup and instrumentation of the beams.



VI. TEST RESULT

The following are the results for the experimental and theoretical work for conventional concrete (M20).

- ✓ The compressive strength of concrete is greater than the targeted mean strength of concrete.
- ✓ The split tensile strength of concrete is 2.64N/mm^2. The tensile strength of concrete is about 1/10 of the compressive strength of concrete.
- ✓ The modulus of rupture is 3.923N/mm^2. This value closely agrees with modulus of rupture calculated based on IS 456:2000.
- ✓ From the theoretical computations, it is observed that the Load carrying capacity of the composite profiled beam is estimated as 45% -95% higher than the load to be carried by conventional concrete beam.
- ✓ Among the composite profiled beams, the trapezoidal profiled beam seems to have 10% - 20% higher load carrying capacity compared to rectangular profiled beam.

VII. CONCLUSION

- ✓ The ultimate strength, load deflection curve and crack pattern were studied for conventional beams. Since the beams were under reinforced, yielding of the tensile reinforcement occurred in pure bending.
- ✓ The conventional beams exhibited considerable amount of deflection, which provide ample warning to the imminence failure.
- ✓ The ultimate load of composite profiled is ranges from 2.23-2.6 times of conventional beams. While comparing the profiled beams, the ultimate load of PTB's carried 12.3-16 percentage more than PRB's.
- ✓ Stiffness, Energy absorption capacity, Energy ductility are depends on the profiled cross section and diameter of steel bar.
- ✓ Composite profiled beams shows large amount of energy absorption capacity that of RCC beams and also PTB's more energy absorption capacity.
- ✓ Provision of lips gives good bonding between concrete and profiled sheet.
- ✓ Local buckling and crushing failure occurred, when the composite profiled beams almost reaches maximum load.
- ✓ The addition of profiled sheet to the sides of reinforced concrete beams increase flexural strength. While increasing area of reinforcement in profiled beam more stiffness and reduces ductility.

VIII. REFERENCES

1. Deric John Oehlers (1993)- "Composite Profiled Beams" journal of structural engineering, Vole 119, No.4 April 1993. ASCE page 3320.
2. Deric John Oehlers, Howard D,Wrightand Matthew j. Burnet – "Flexural strength of profiled beams" journal of structural engineering, Vol 120, No 2. February, 1994. ASCE, Page NO. 4960.
3. Brian Uyand Mark Andrew Bradford, Member ASCE - "Ductility of profiled composite beams". Part 1: Experimental study 1995 Vol 121, No.5 May 1995. ASCEpage7851.
4. Brian Uy and Mark Andrew Bradford, Member ASCE - "Ductility of profiled composite beams". Part2:Analytical study 1995.Vol121,No.5 May 1995. ASCE page7852.
5. Kottiswaran N and Sundararajan R (2005) "An Experimental investigation on flexural behaviour of steel concrete composite beam made up of thin walled cold formed steel.
6. Hyung-JoonAhn and Soo-Hyun Ryu (2006) "Modular composite profile beams".
7. Arivalagan Sundararajan, Kandasamy Shanmugasundaram [2008] "An Experimental study of normal mix, flyash, quarry waste, and low strength concrete (Brick-bat lime concrete) contribution to the ultimate moment capacity of square steel hollow sections".
8. Siva A and Kumar V (2012) "Shear bond characteristics of composites lab made of cold-formed profiled steel sheeting".
9. S.Ramamrutham (2006) "Design of Reinforced Concrete Structures".
10. IS 1022:2009 concrete mix proportioning – guidelines.
11. IS 456:2000 plain and reinforced concrete – code of practice.