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Experimental Investigation of Composite Profiled Beams

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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 form works effectively.

Keywords— Beams, Composite Profiled Beams

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. 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.

Thin steel products are extensively used in building industry, ranging from purlins to roof decking. Generally these are available for use as basic building elements for assembly at or as prefabricated frames of panels. These thin steel sections are cold-formed, i.e. their manufacturing process involves forming steel sections in a cold state (i.e. without application of heat) from steels of uniform thickness. These are given the generic title cold formed steel sections. Sometimes they are also called light gauge steel sections or cold rolled steel sections. The thickness of steel sheet used in cold formed construction is 1 to 3 mm. much thicker material up to 8 mm can be formed if pre-galvanized material is not required for the particular application.

COMPOSITE PROFILED BEAMS

Composite Profiled Beam (CPB) been described as "The most revolutionary development in steel concrete composite construction for several decades". Originally developed to offset a growing shortage of skilled labor, it has proved beneficial economic because of a number of factors, including:

1. Reduction in site manpower, Faster construction.
2. Materials are easily available.
3. Formwork is not required.
4. Depth of section may be reduced, reduction in weight and reduction in story height.

5. Provided only few numbers of props.
6. Reduced noise levels, absence of centering.
7. Safer working environment.
8. Profiled sheets act as a tension member, so it is satisfactory to provide a nominal reinforcement.

REVIEW OF LITERATURES

An experimental investigation on flexural behaviour of steel concrete composite beam made up of thin walled cold formed steel was done. The ultimate strength capacity and the deflection characteristics of the beams where determined. The results are compared with conventional reinforced concrete beam. The area of tension steel in the conventional RCC beam was computed and replaced by thin walled cold formed steel which can produced the same tensile force in the composite beam. The cold formed steel sheet was used in the tension zone of the beam and effectively bonded with concrete using shear connecter. The cold formed steel sheet of thickness 1 mm and 1.5 mm with different cross sections, plain rectangular sheet, channel section without lip. (Unstiffened channel) and channel section with lip (Stiffened channel).Provided at the bottom as the principle reinforcement. The moment carrying capacity at failure and first crack are also reported. The following points are concluded the ultimate load carrying capacity of the composite beam with plate and channel with lip or higher than that of control beam, designed for the same tensile force. The ultimate carrying capacity of composite beam of channel without lip is lesser than that of control beam because of depending of web portion of the channel from concrete. Composite beams undergo more deformation then conventional reinforced concrete beam, designed for the same tensile force (KOTTISWARAN N AND SUNDARARAJAN R (2005)

Studied a series of experiments on profiled composite beams is reported. The experiments include two profiled composite beams and two reinforced concrete beams that were previously tested under sustained service loads. The tests reported were used to ascertain the flexural strength of the beams and to validate the hypotheses of the previously reported service-load tests. Companion specimens of concrete cylinders were tested for compressive strength and elastic modulus properties, for both sealed conditions. Specimens of profiled steel-sheeting coupons and reinforcing steel bars were tested in tension to ascertain their yield stress and elastic modulus. The tests here are shown to verity the previously mentioned hypotheses and to provide benchmark results used to validate the theoretical predictions of a companion paper. Failure is shown to occur progressively through a combination of bond-slip failure and local buckling of the steel sheeting. The tests are then used to calibrate a theoretical model for the cross- sectional behaviour of profiled composite beams. Local buckling was observed and predicted by the use of a finite-strip method developed elsewhere.

Profiled composite beams are an innovative construction method and provide many advantages to the construction industry and for other structural applications. The profiled composite beam system provides increased long-term stiffness, improved ductility, and reduced construction times. The flexural experiments presented in detail herein have provided benchmark data for profiled composite beam construction, and have verified the hypothesis that profiled composite beams deflect less than reinforced concrete beams under long-term loads when designed for the same flexural strength.

A theoretical model based on a simple cross-sectional analysis was shown to be in good agreement with the experimental data for the short-term moment-curvature response. The load deflection characteristics of the model have also shown to agree well with the experimental results. A finite-strip model for the calculation of the local buckling stresses reported elsewhere also predicts the onset of local buckling, which is in agreement with the experiments (BRAIN UY AND MARK ANDREW BRADFORD, 1994)

MIX PROPORTION

S 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

COLD FORMED PROFILED BEAMS

High yield strength Fe 415 bars of size 10mm diameter and mild steel bar of size 6 mm diameter Fe 250graded has been used. The cold-formed steel sheet making as the profiled sheet by using the of breaking machine. The profiled sheet is 1.98m length. 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.

TEST RESULTS

This chapter presents the test results of reinforced concrete beam and composite profiled beams and also Cube test, Split tensile, Modulus of rupture for M20grade conventional concrete. The behaviour of the specimen in terms of flexural strength, ultimate strength, deflection, stiffness, energy absorption capacity, ductility, crack development and failure mode was observed from the test. The compressive and tensile strains of concrete surface and strains in bottom of the profiled sheet where also recorded. The results of the composite profiled beams where compared with that of conventional reinforced concrete beam both experimental and theoretically.

STIFFNESS

Stiffness may be defined as load required causing a unit deflection. The stiffness values of conventional specimens and composite profiled specimens at elastic load and ultimate load are presented in the table 5.9 and 5.10 respectively. The slope values of load deflection curve are the stiffness value within elastic limit. The percentage reduction in stiffness

SUMMARY

In reinforced concreted beams that use steel decking consisting of profiled as a permenent form to both the soffit and side of the beam. This form of beams are called profiled beams. In this project 1.00 mm thickness of cold formed plates has used to fabricate the profile sheet. This profile sheet having 1.98 m length and two different shapes of rectangular and trapezoidal configurations. Lips were provided in the profile sheet to make good bonding between the concrete and plates. The trapezoidal and rectangular profile beams were casted each two numbers and it's varied by diameter of reinforcement bar, in addition that two conventional rectangular beams were casted and varied by diameter of reinforcement bar. All the beams pored by M20 grade concrete and tested as a single point load and load, deflection and strain were observed. Stiffness, energy absorption, bending stress and moment curvature were evaluated from the observation and these results were compared with the conventional beams.

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 obsorbtion capacity, Energy ductility are depends on the profiled cross section and diameter of steel bar.

Composite profiled beams shows large amount of energy obsorption capacity that of RCC beams and also PTB's more energy obsorption 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 sids of reinforced concrete beams increase flexural strength. While increasing area of reinforcement in profiled beam more stiffness and reduces ductility.

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