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Experimental Investigation on Steel Concrete Composite Floor Slab

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Abstract - *Composite floor systems constructed with cold formed corrugated steel decking covered with concrete are emerging trend in current construction practices for medium to high rise buildings as worldwide. But it is a chicken egg situation because since right kind of profiled sheets were not available in India and its use was not visible in construction.In Indian code for composite structure covering the shear connector area and they mentioned about the deck sheet properties .Hence the aim of the research is to carry out experimental investigation on steel concrete composite floor slab system.*

***Key Words*: Cold formed trapezoidal profile steel sheet, shear connector, Composite truss and Load carrying capacity**

1. INTRODUCTION

In conventional composite floors having rolled and built in structural steel beams are cast in situ into them and bond between floors and beam is created by providing connector over the beam under this both act in single manner .The merit of using composite is utilizing both the property of steel and concrete make them strong enough to withstand the load, it enhance and create the strength and stiffness like prestre concrete.

In recent times, the usage of composite floors profiled sheet decking has become trendy in the West for high rise office buildings. It is mostly preferable where the

flooring construction is to complete within short time period for that we can use deck sheet with concrete floor with the composite action the can held strongly .However its unsuitable for place where dynamic loads and heavy concentrated loads acts such as seismic zones and bridges

The substitute for the above cases we can adopt RCC and Pre stresses slabs .There is presently no Indian standard covering the design of composite floor systems using profiled sheeting. Designing a reinforced concrete slab or pre-stressed concrete slab in composite construction is not different from any conventional R.C. or pre-stressed structures. The structural behavior of these floors is similar to a reinforced concrete slab, with the steel sheeting acting as the tension reinforcement .

The main structural and other benefits of using composite floors with profiled steel decking are:

a) Savings in steel weight are typically 30% to 50% over non-composite construction.

b) Greater stiffness of composite beams results in shallower depths for the same span. Hence lower storey heights are adequate resulting in savings in cladding costs, reduction in wind loading and savings in foundation costs.

c) Faster rate of construction.

The steel decking performs a number of roles, such as:

a) It supports loads during construction and acts as a working platform.

b) It develops adequate composite action with concrete to resist the imposed loading.

c) It transfer in-plane loading by diaphragm action to vertical bracing or shear walls.

d) It stabilizes the compression flanges of the beams against lateral buckling, until concrete hardens.

e) It reduces the volume of concrete in tension zone.

f) It distributes shrinkage strains, thus preventing serious cracking of concrete.

Here in this study, Composite truss is designed for the comparison of composite slab and RCC slab for the same span and loading condition. The casting part is over and now the specimen is under curing.

A continuous floor with 10m span beams spaced at 3m centre is designed for Steel and Concrete Composite truss .The floor is designed to carry an imposed load of 3KN/m2.Based on the actual design values the model is scaled, finally three specimens of RCC slab, composite slab and composite truss are taken for the study.

1. PROPERTIES OF PROFILED DECK SHEET

Cold formed steel decking sheets having trapezoidal shaped profile is used in steel and concrete composite slab. The sheets have strong and reliable shear bond performance which is augmented by cross embossing located in the profile.

Table -1: Properties of deck sheet

Overall Width	925mm
Effective Width	915mm ± 8
Length	Min 1 mtr & above
Coating mass	120, 180 & 275 GSM
Base Metal	CRCS & GI
Yield Strength	550 Mpa
Thickness	0.8 mm to 1.2 mm
Modulus of elasticity of steel	2 x 10^5N/mm^2

2. SHEAR CONNECTOR

The most common type of shear connector used in composite beams for buildings is a 19 mm diameter by either 100 mm or 125 mm long welded stud. For thru-deck welding, this is the only stud diameter that can be used practically, because it is the only one for which suitable ferules are available. Although other heights are available, they are not so easy to obtain. There are a number of other forms of shear connector available, such as angles welded to the top flange. However, most lack a practical application in composite beams, with the exception of shot-fired connectors. These should be considered for smaller projects, those where beams need to be galvanized or top flanges painted for reasons of durability, or indeed any project where the provision of power for stud welding is a problem. They may be particularly appropriate for refurbishment projects, where there is either limited access or no earthing facility. The most common shot-fired shear connector is that produced by Hilti, which is available in heights of 95 mm to 140 mm. It should be noted that a shot-fired connector has less resistance than a welded stud.

In this study Flexible types shear connectors in the form of studs are used in steel and concrete composite slab. M19X100 hexagonal bolt confirming to IS 11384-1985 is used as shear connector in this experiment.

2. FABRICATION OF STEEL TRUSS

A truss consists of typically (but not necessarily) straight members connected at joints, traditionally termed panel points. Trusses are typically (but not necessarily) composed of triangles because of the structural stability of that shape and design. A triangle is the simplest geometric figure that will not change shape when the lengths of the sides are fixed. In comparison, both the angles and the lengths of a four-sided figure must be fixed for it to retain its shape. The joint at which a truss is designed to be supported is commonly referred to as the Munter Point.

A planar truss is one where all the members and nodes lie within a two dimensional plane, while a space truss has members and nodes extending into three dimensions. The top beams in a truss are called top chords and are generally in compression, the bottom beams are called bottom chords and are generally in tension, the interior beams are called webs, and the areas inside the webs are called panels.

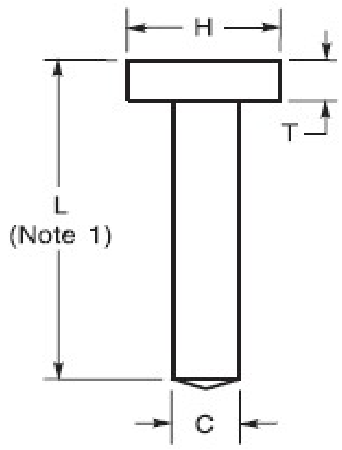

Fig-1: Shear Connector (Stud)

3. FABRICATION OF COMPOSITE TRUSS WITH PROFILED SHEETING AS THROUGH DECK WELDED SYSTEM

Truss was designed as per procedure with T section at top and bottom chord member and web member as steel rod, its fabricated from the welding shop as shown in fig .The trapezoidal decking sheet as shown in FIG .2 is collected from the manufacture for the required length and breadth .The composite slab is made through deck welded system by making connections with steel truss and concrete through the profile deck using shear connectors. Here the end anchorage of composite slab is in the form of steel shear studs, 20mm diameter and of length 100mm, one at each through the steel sheeting to the top flange of the top chord of truss member. The fabrication of the through deck welded system is as shown in Fig.2.

Fig-2: Deck sheet with Shear Connector (Stud)

4. CASTING OF TEST SPECIMENS

The composite Truss (CT) is cast with the profiled sheet as the base .The sheet is thoroughly cleaned before concreting. The casting was conducted in fully supported conditions on the laboratory floor .Steel reinforcing bar meshes(Using 6mm diameter bars) of the required size were prepared with the bars spaced at 150mm c/c in both directions. The slab is cast and cured for 28days .Fig .3 shows the embossed sheet with steel bar mesh and details of composite slab. The slab specimens are manufactured with the same type of concrete from the comparison 4specimen's .The concrete grade M20 is prepared .The aggregate was siliceous sand and gravel with a maximum size. The cement used was Ordinary Portland cement of grade 53. The properties of the concrete were determined from cube a specimen of size 150*150mm. Compressive strength was determining by simple compression tests.

5. TEST PROCEDURAL

For the static test, the specimens were placed over the supporting hinge arrangements and the loading points were marked. The load is applied manually by increment of 2 kN, up to the stage when the cracks are propagated well in depth. The midspan deflection of the slab is measured by means of dial gauge. The composite slab is tested by the above mentioned procedure up to maximum deflection and the corresponding deflection is marked. No significant crack or any form of failure has not been observed. The screw jack and proving ring setup is dismantled and the slab can also tested using Hydraulic jack with pumping system arrangement. The ultimate load carrying capacity of the slab is noted.

6. OBSERVATION AND RESULT

In Five wavelengths deck slab, first crack was developed at a certain load. Local bucking was not discovered in any of the profile sheet .At the time of testing spalling of small piece of concrete over the corner due to irregular smooth finish surface, there is no separation between sheet and concrete and diagonal shear crack was observed in Composite truss.

7. THEORETICAL STUDY

The theoretical load carrying capacity of composite truss slab has been calculated from the theoretical moment of resistance value. The theoretical deflections are calculated as per the formula given in Euro code 4. Theoretical load carrying capacity has been arrived from the theoretical moment of resistance value .The theoretical moment of resistance of slab has been equated to the experimental maximum bending moment value.

NA within Sheeting

Ncf = bhc x 0.36 x fck

Ultimate Moment Resistance

MpRd = Ncf (dp-0.42hc)

Theoretical Ultimate load obtained is 114KN, from this we getting 2KN loading deflection must be 0.322mm.

8. CONCLUSION

Based on the results on the experimental investigation, the following conclusion is arrived.

1. The Ultimate load carrying capacity of the composite floor is more while considering the strength property than as compared to nominal concrete slab.

2. The Stiffness of the composite floor slab truss is more the stiffness more the serviceability property.

In case of truss used as beam member we need to concentrate on top chord and bottom chord tension member whereas web member should be strong enough to withstand load applied on the top chord member. Based on the pioneer research most of the failure occurs at truss member joints with trapezoidal deck sheet .Hence in current research paper there is no appreciable failures in floors.

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