ABSTRACT

In the current scenario steel concrete composite profile deck slab are widely used as flooring system in construction industry. Now-a-days construction industry requires completion of projects within time and composite construction has gained a significant place due to its faster rate of construction. Generally composite deck slab consists of cold formed profile sheets of thickness varying from 0.6 mm to 2.5 mm, concrete of nominal thickness and nominal shrinkage reinforcements. This composite deck slab floor system has many advantages over conventional floor systems by providing a suitable working platform and formwork for casting concrete. It also acts as a reinforcement taking the tensile forces which reduces the time taken for bar bending activities. The embossments or indentation are provided in the composite slab to provide effective friction between the cold form profiled sheeting and concrete to enhance composite action. The advantage of cold form profiled sheeting is that it can be transformed into variable shapes such as trapezoidal, dove-tailed or re-entrant and rectangular shapes for better performances.

The scope of the present investigation is to understand the longitudinal shear bond characteristics of steel-concrete composite specimens by conducting experimental investigations on different configuration of specimens. Finite element modelling and analysis of steel-concrete composite slab specimens were also carried out and compare with the test results. Steel concrete composite specimens were cast for elemental bending test and full scale testing of composite slabs. A total of 18 specimens were cast for elemental bending tests and 36 specimens were cast for full scale bending tests.
Commercially available cold formed steel sheets of thickness 1 mm was procured from market and material properties like yield strength, ultimate strength, elongation etc. were evaluated as per standard tension coupon tests. Different types of embossments (chevron, rectangular and inclined tablet) were made in the sheet by rolling followed by press braking. Once embossments are created, the sheets are pressed into different profile shapes like re-entrant, rectangular and trapezoidal. In addition to the embossments, shear studs were provided in all specimens at corners to enhance the longitudinal shear capacity. The material properties evaluated were used as input in finite element modelling and analysis.

Elemental bending test was carried out on steel concrete composite specimens to understand the composite behavior of different profile geometry under two point loading. Eighteen specimens were cast for experimental investigations which comprised of rectangular, trapezoidal and re-entrant profile sheets. For each profile sheet 6 specimens were cast: 3 numbers with embossments (rectangular) and 3 numbers without embossments. The specimens were subjected to two point loading using a hydraulic jack. Three laser displacement transducers were instrumented at midspan and quarter span to measure deflections. A majority of specimens failed under longitudinal shear, bending and de-bonding of profile sheet from concrete. Finite element modelling and analysis was carried out for the composite specimens. The results and failure modes were comparing well with that of the experimental results.

Full scale two point bending test on steel concrete composite slab specimens were carried out on 36 specimens. Initially three categories of specimens were tested by varying the profile shapes with rectangular embossments in the flange. Then three more categories of specimens were tested with trapezoidal profile sheet having different types of embossments (rectangular, chevron and inclined tablet) in the web portion of the profile sheet.
Three groups of specimens were tested for different types of profile sheets for short shear span (300, 325, 350 mm) and long shear span (500, 525, 550 mm) each for evaluating the m-k values.

The slab specimens were tested under two point bending using a hydraulic jack. The load applied was recorded using a load cell. The specimens were instrumented with five displacement transducers, three at top and two at bottom. Four displacement transducers were instrumented in lateral direction to measure the end slip during loading. The distance between the support and load point was varied for short and long span loading conditions. Finite element modelling and analysis of the steel concrete composite slab specimens were carried out with (ABAQUS) commercially available software package. The results such as failure modes obtained from the finite element analysis were similar to those obtained from the experimental investigations.

Based on the experimental investigations the trapezoidal profile sheet with embossment has a higher ultimate load capacity when compared to rectangular and re-entrant profile sheets. The chevron embossment had better performance in terms of resistance to longitudinal shear and load carrying capacity when compared with other types. The chevron embossments provided in the profile deck plays an important role by enhancing the longitudinal shear capacity when compared to other type of embossments. The failure mechanism was found to be similar for all the full scale specimen. The developed m-k curves can be utilized for predicting the shear bonding strength and will act as a design aid for the designers. The composite action between the profile sheet and concrete is enhanced by providing the mechanical and end anchorage connecter.