The Asian Review of Civil Engineering
ISSN: 2249-6203 (P) Vol.7 No.1, 2018, pp.11-14

DOI: https://doi.org/10.51983/tarce-2018.7.1.2255

Experimental Investigation and Comparison of Composite Slab with Perpendicular and Skew Type Steel Decking

E. Navaneetha[1] and V. Niranjan[2]
[1]PG Student, [2]Assistant Professor,
Department of Civil Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India
E-Mail: navaneethamukundan82@gmail.com

Abstract **- Composite floor is widely used in the building industry in the last decades. The casting of concrete is carried out on corrugated steel plate which is supported by beams. The efficiency of composite slabs depends on composite action between the steel and concrete structural members. Composite slab with profiled steel decking has proved over the years to be one of the simpler, faster, lighter and economical constructions in steel-framed building systems. This system is well accepted by the construction industry due to the many advantages over other types of floor systems.**

Composite slab reinforced with profiled steel decking sheet means there is a provision in the system for positive mechanical interlock between the interface of concrete and the steel deck by means of embossments. The profiled decking sheet must provide resistance to vertical separation and horizontal slippage between the contact surface of the concrete and the decking sheet. It also permits the transfer of shear stresses from the concrete slab to the steel deck. The main objective of this project is to investigate and compare the composite slab with perpendicular and skew type steel decking.
Keywords: Composite Slab, Skew Type, Steel Decking

I. INTRODUCTION

Composite floor is widely used in the building industry in the last decades. The casting of concrete is carried out on corrugated steel plate which is supported by beams. The efficiency of composite slabs depends on composite action between the steel and concrete structural members. Composite slab with profiled steel decking has proved over the years to be one of the simpler, faster, lighter and economical constructions in steel-framed building systems. This system is well accepted by the construction industry due to the many advantages over other types of floor systems.

II. OBJECTIVES OF THE STUDY

1. To study the behaviour of composite slab with perpendicular and skew type steel decking.
2. To evaluate and compare load carrying capacity and shear bond slippage by implementing three different angles of steel sheet in composite slab.

III. METHODOLOGY

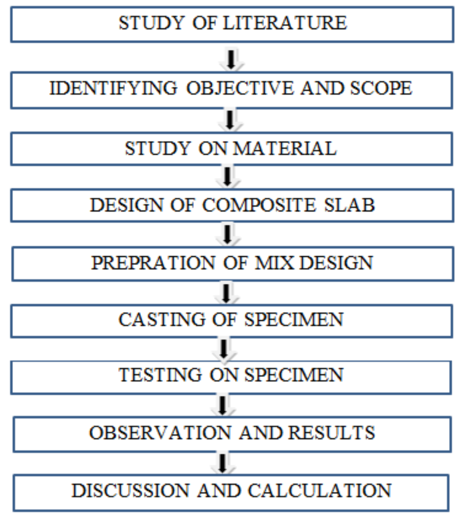

Fig. 1 Methodology

IV. RESULTS AND DISCUSSION

In this chapter the static load tests on composite slabs has been described and the results have been presented.

A. Load Deflection Behaviour

Central point load is given for all the twelve slab specimens and the load deflection behaviour was observed. Fig. 2 indicates the load deflection curve for M20 and M30 grade concrete respectively.

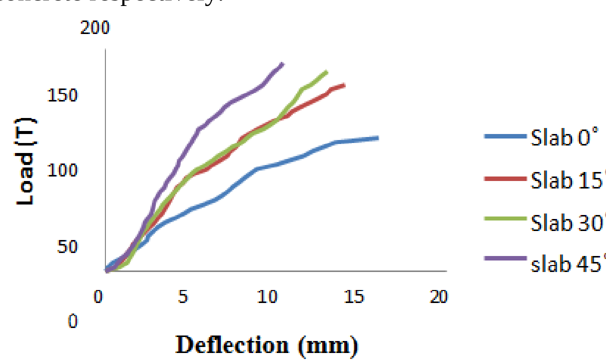

Fig. 2 Load deflection curve for M20 grade concrete slab

From Figure 2it is perceived that the load carrying capacity of slab 45˚ is greater when compared to slab 0˚, slab 15˚ and slab 30˚ and also the load carrying capacity of slab 15˚ and slab 30˚ is more than slab 0˚. In addition to that it is observed that the deflection of slab 45˚ is less when compared to slab 0˚, slab15˚ and slab 30˚. From the graph it is revealed that when skewness of profiled steel decking increases, the stiffness increases and the deflection decreases.

Figure 3 indicates the load deflection curve for M30 grade concrete

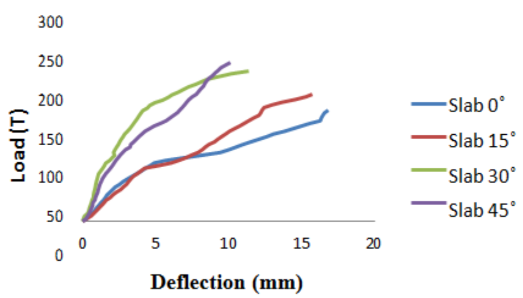

Fig. 3 Load deflection curve for M30 grade concrete slab

From Figure 3 it is observed that the load carrying capacity of slab 45˚ is greater when compared to slab 0˚, slab 15˚ and slab 30˚ and also the load carrying capacity of slab 15˚ and slab 30˚ is more than slab 0˚. In addition to that it is observed that the deflection of slab 45˚ is less when compared to slab 0˚, slab15˚ and slab 30˚. Therefore when skewness of profiled steel sheet increases, the load carrying capacity increases and deflection decreases.

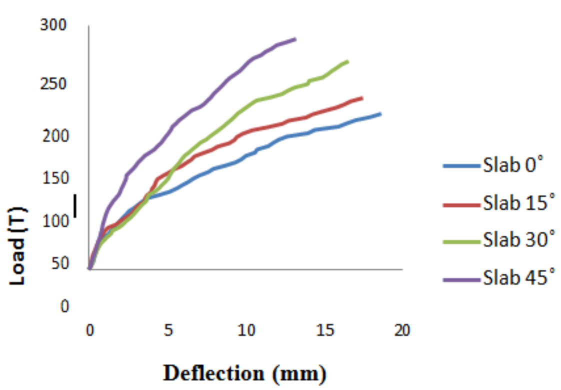

Fig. 4 Load deflection curve for M40 grade concrete slab

From Figure 4 it is observed that the load carrying capacity of slab 45˚ is greater when compared to slab 0˚, slab 15˚ and slab 30˚ and also the load carrying capacity of slab 15˚ and slab 30˚ is more than slab 0˚. In addition to that it is observed that the deflection of slab 45˚ is less when compared to slab 0˚, slab15˚ and slab 30˚. When skew-ness of profiled steel sheet increases, the stiffness increases and deflection decreases.

The initial and final crack load for concrete of grade M20 with four distinct angles 0˚, 15˚, 30˚ and 45˚ are shown in Table I.

TABLE I INITIAL AND FINAL CRACK LOAD FOR M20 GRADE

S. No.	Steel deck angle(in degrees)	Initial crack load (T)	Final crack load (T)
1	0˚	1.6	12
2	15˚	6.8	16.8
3	30˚	4.4	18
4	45˚	7.2	18.8

The initial and final crack load for slab15˚ is 6.8T and 16.8T which is 76.4% and 28.57% greater than slab 0˚ .In slab 30˚, the initial and final crack load is 4.4T and 18T which is 63.6% and 33% greater than slab 0˚. In slab 45˚, the initial and final crack load is 7.2T and 18.8T which is 73% and 36% greater than slab 0˚.

The initial crack was formed in the mid span at the bottom tensile zone of the concrete and on further increase in load the cracks extended towards the top of the concrete. Therefore when skewness of profiled steel sheet increases the load carrying capacity increases

The initial and final crack load for concrete of grade M30 with four distinct angles is shown in Table II

TABLE II INITIAL AND FINAL CRACK LOAD FOR M30 GRADE

S. No.	Steel deck angle(in degrees)	Initial crack load (T)	Final crack load (T)
1	0˚	1.6	16.8
2	15˚	6	19.2
3	30˚	16.8	22.8
4	45˚	18	24

The initial and final crack load for slab15˚ is 6T and 19.2T which is 73% and 12% greater than slab 0˚ .In slab 30˚, the initial and final crack load is 16.8T and 22.8T which is 90% and 26.3% greater than slab 0˚.Similarly for slab 45˚, the initial and final crack load is 18T and 24T which is 91% and 30% greater than slab 0˚.

TABLE III INITIAL AND FINAL CRACK LOAD FOR M40 GRADE

S. No.	Steel deck angle(in degrees)	Initial crack load (T)	Final crack load (T)
1	0˚	4.8	19.2
2	15˚	14.4	21.2
3	30˚	17.2	25.6
4	45˚	18.4	28.4

From table III the initial and final crack load for slab15˚ is 14.4T and 21.2T which is 66.6% and 9.43% greater than slab 0˚ .For slab 30˚, the initial and final crack load is 17.2T and 25.6T which is 72% and 25% greater than slab

0˚.Similarly for slab 45˚, the initial and final crack load is 18.4T and 28.4T which is 73.9% and 32.3% greater than slab 0˚.

B. Slip Behaviour of Composite Slab

1. Slip Behaviour for M20 Grade Concrete

The end slip is observed and it is shown in Fig. 5, 6, 7 and 8 for slab0˚, slab15˚, slab 30˚ and slab 45˚ respectively. For slab 0˚ the slip behaviour is in the range of 0 to 1.5cm and for slab 15˚ the end slip in the range of 0 to 2cm, for slab 30˚ the end slip is in the range of 0 to 1cm and for slab 45˚ the end slip is in the range of 0 to 1.5cm. The end shear slip for slab 15˚ and slab 30˚ are 2 cm and 1 cm which is 25% greater and 50% lesser than slab 0˚.

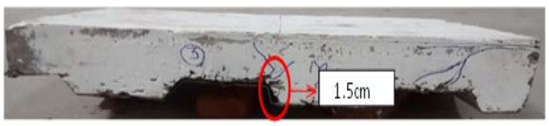

Fig. 5 Slip behaviour for slab 0˚

Fig. 6 Slip behaviour for slab 15˚

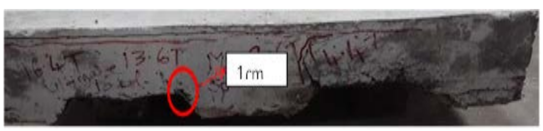

Fig. 7 Slip behaviour for slab 30˚

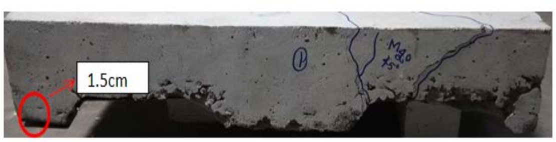

Fig. 8 Slip behaviour for slab 45˚

2. Slip Behaviour for M30 Grade

The end slip is observed and it is shown in Fig. 9,10,11 and 12 for slab0˚, slab15˚, slab 30˚ and slab 45˚ respectively. For slab 0˚ the slip behaviour is in the range of 0 to 2cm and for slab 15˚ the end slip in the range of 0 to 1cm, for slab 30˚ the end slip is in the range of 0 to 0.4cm and for slab 45˚ the end slip is in the range of 0 to 2cm. The end shear slip for slab 15˚ and slab 30˚ are 1cm, 0.4cm which is 50% lesser, 80% lesser than slab 0˚.

Fig. 9 Slip behaviour for slab 0˚

Fig. 10 Slip behaviour for slab 15˚

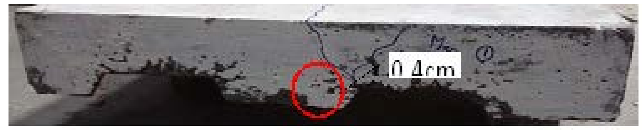

Fig. 11 Slip behaviour for slab 30˚

Fig. 12 Slip behaviour for slab 45

3. Slip Behaviour for M40 Grade

The end slip is observed and it is shown in Fig. 13,14,15 and 16 for slab0˚, slab15˚, slab 30˚ and slab 45˚ respectively. For slab 0˚ the slip behaviour is in the range of 0 to 1cm and for slab 15˚ the end slip in the range of 0 to 1.5cm, for slab 30˚ the end slip is in the range of 0 to 1cm and for slab 45˚ the end slip is in the range of 0 to 2.5cm. The end shear slip for slab 30˚ and slab 45˚ is 1.5cm and 2.5cm which is 33% and 60% greater than slab 0 ˚.

Fig. 13 Slip behaviour for slab 0˚

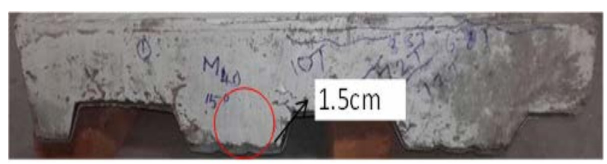

Fig. 14 Slip behaviour for slab 15˚

Fig. 15 Slip behaviour for slab 30˚

Fig. 16 Slip behaviour for slab 45˚

C. Theoretical Shear Bond Slip

The shear bond slip can be calculated theoretically from the formula

$$s = \frac{w}{4Ebh^2}(3L^2x - 4x^3)$$

Composite structures of steel and concrete (Volume1), R.P.Johnson)

Where
S - Shear bond slip (mm)
W - Load per unit length (N)
E - Young's modulus (N/mm^2)
b - Width of composite slab (mm)
h - Thickness of composite slab (mm)
L - Length of composite slab (mm)
x - Distance

V. CONCLUSION

The load carrying capacity of the slabs increases as the angle of skewness of the slab increases. Skew type steel decking increases the strength as compared to perpendicular type steel decking. When skewness of steel decking sheet increases the deflection decreases.

1. In M20 grade concrete the load carrying capacity of slab 15˚ and slab 30˚ are16.8 T and 18 T which is 28.57% and 33.33% higher than slab 0˚.
2. The mid-span deflection of slab 15˚ and slab 30˚ are 14.06 mm and 13.05 mm which is 13.86% and 22.68% lesser than slab 0˚.
3. In M30 grade the load carrying capacity of slab 15˚, slab 30˚ and slab 45˚ are 19.2T, 22.8T and 24T which is 12.5%, 26.3% and 30% higher than slab 0˚.
4. The mid-span deflection of slab 15˚, slab 30˚ and slab 45˚ are 15.8mm, 11.38mm and 10.11mm which is 6.7%, 4.8%and 6.67% lesser than slab 0˚.
5. In M40 grade the load carrying capacity of slab 15˚, slab 30˚ and slab 45˚ are 21.2T, 25.6T and 28.4T which is 9% ,25% and 32.3% higher than slab 0˚.
6. For slab 30˚, the initial and final crack load is 17.2T and 25.6T which is 72% and 25% greater than slab 0˚.
7. The mid-span deflection of slab 15˚, slab 30˚ and slab 45˚ are 17.54mm, 16.59mm and 13.25mm which is 6%, 12.5% and 4% lesser than slab 0˚.

REFERENCES

[1] Bing Wang, Qiao Huang and Xiaoling, "Experimental investigation of steel concrete composite beams with different degrees of shear connection under monotonic and fatigue loads", *Advanced in Structural Engineering,* 2017.

[2] Georgios S. Papavasileion, "Analytical framework for the substitution of steel-concrete composite column with equivalent steel sections in structural design", *Structural Engineering*, 2017.

[3] Katrin Habel, "Composite ultra-high-performance fiber-reinforced concrete (UHPFRC) and conventional reinforced concrete structural members are investigated to assess the rehabilitation potential for existing concrete structures", Vol. 4, No. 37, 2017.

[4] V Aparna, "The experimental investigations on steel tubes filled with different types of concrete", 2017.

[5] R. Baskar, "Study on experimental and finite element modeling of Composite deck slabs with and without embossments", Vol. 12, No. 9, pp.1987-1993, 2017.

[6] P. Indira Devi, "Investigating the improvements of hollow steel tubes filled with concrete and externally bonded with fibre reinforced polymers", 2016.

[7] Kristi L. Selden, **"**Experimental investigations focused on the thermal and structural behavior of composite beams with shear connections subjected to fire conditions", Vol. 142, No. 2, pp.196-217, 2016.