An Experimental Study For Optimum Solutions of Concrete Deck Slabs

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Abstract- *The study of present research paper involves experimental approach for analysis and optimization of concrete deck slabs composite deck slabs with nominal reinforcement. The thickness of specimens used are 150mm, 140mm, 130mm, 125mm, 100mm, 90mm.a comparative analysis of composite deck slabs along with R.C.C slabs for load carrying capacity and deflection is also done on present work.*

Keywords- composite deck slabs, R.C.C slabs, Shear connectors, optimization.

I. INTRODUCTION

Composite deck slabs includes a profiled deck sheet replacing the reinforced mesh in conventional R.C.C slabs. The profile deck sheets acts as tensile reinforcement and permanent frame work. The connection of slab uses shear connectors for steel beams and also it can be used for steel beams. Enhanced inventions are necessary to accelerate the speed of construction along with economy and safety to overcome the threat of natural disaster such as earthquake taking this into considering the mass of structure plays an important role in serviceable performance of structure. It is observed that the mass of structure using composite slab reduces to 30% of the total weight of structure

Advantages

- Economical
- speedy construction
- High strength then R.C.C slab
- Light weight of structure as whole

The common shapes available in the market for profile deck sheet are rectangular and trapezoidal with varying heights and corrugation depths. Profile deck sheet works as a framework under constructional loads and in composite action it behaves as tensile reinforcement as well as supports compressive resistance with concrete. However, a nominal reinforcement needs to be provided to nullify shrinkage and temperature cracks, point load distribution, fire resistance, in case of openings and hogging moments. Investigation result indicates that composite slab construction performances efficiently.

The chemical or mechanical [Shear connectors] interlocking plays an important role in the composite action of both profile deck sheet and concrete. This helps in enhancing ultimate load carrying capacity of concrete deck slab. On account of various advantages such as light weight construction, easy handling, speedy construction work, convenient transportation, more strength than the conventional slab and excellent ceiling finished surface.

II. AIMS AND OBJECTIVES

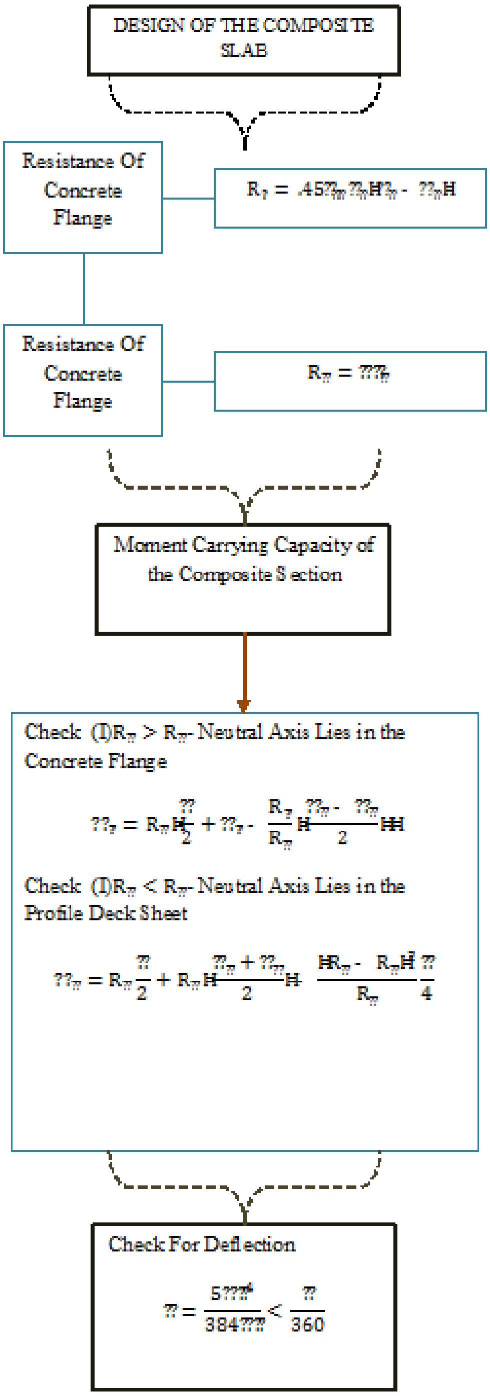
1. To determine critical moment carrying capacity.
2. Optimization of concrete deck slabs applicable practically.
3. Study of nature of failure for composite deck slabs.

III. METHODOLOGY

Composite deck slabs with varying depths are tested under two point load test the results are then validated by manual calculations. Deflection readings corresponding to respective loads are noted for determining the parameters at each incremental stage of loading.

IV. DESIGN PROCEDURE AS PER BRITISH STANDARDS

Composite slabs are normally designed to BS 5950: Part 4 which is based on the Partial interaction method of design. The method provides determining the critical moment carrying capacities applicable to different profiles of deck sheets.



V. EXPERIMENTAL WORK

The experimental setup consists of two line loading test for flexure bending of specimen for simply supported condition. Deflection is measured by dial gauge exactly at lower fibre at the centre of specimen. Loading was applied by hand operated hydraulic jack with a capacity of 1000KN for loading. Load is applied in uniform increments until the specimen fails either by cracks or excessive deflection whichever is the first.

Slab specimens of size 2100mmX990mm are casted with M20 concrete grade. Curing of specimens was carried out for 28 days under controlled conditions for better results.

Figure 1 - Loading Setup for Slab Testing

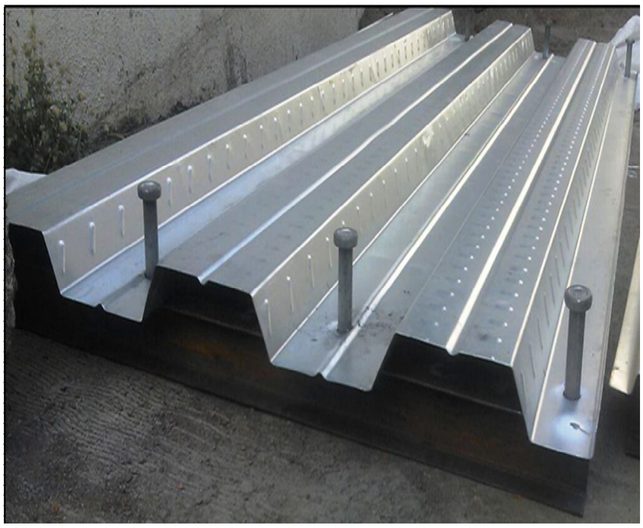
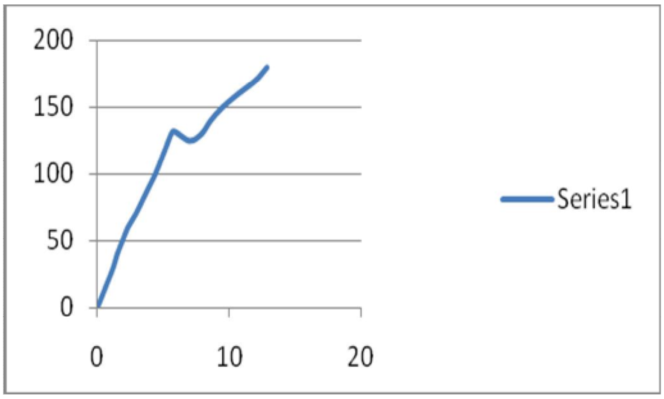


Figure 2 – Deck sheet

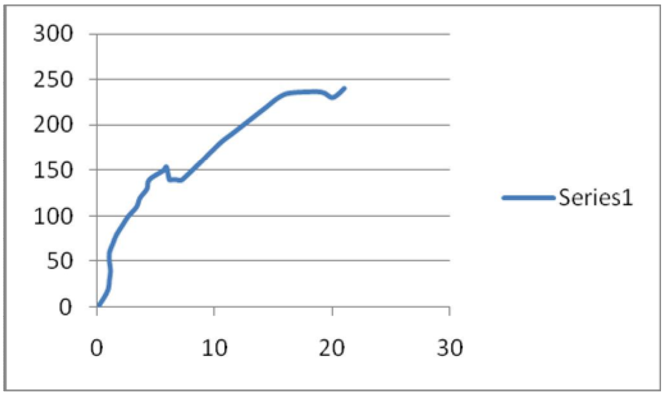
VI. RESULT AND DISCUSSIONS

Table 1 - Ultimate Load Carrying Capacity KN

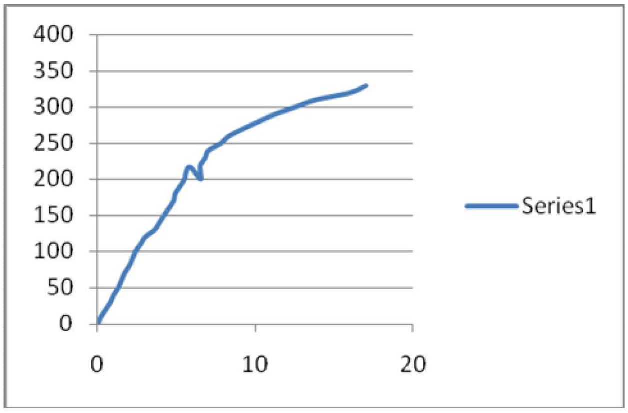
Sr. No.	Slab Thickness	Load carrying capacity (Manual) KN	Load carrying capacity (Experimental) KN	Deflection Limit mm
1	90	132.5	132	5.85
2	100	156	154.5	5.85
3	125	216	217	5.85
4	130	232	232	5.85
5	140	258	259.5	5.85
6	150	287.5	285	5.85



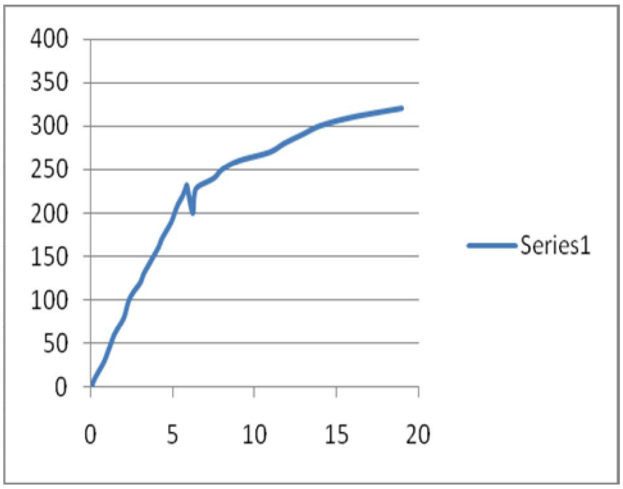
Graph1. load v/s deflection graph for 90mm specimen
X axis –Deflection in mm. Y axis – load KN



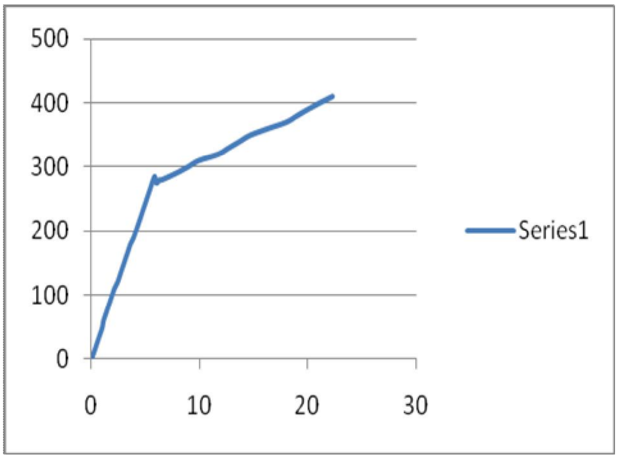
Graph 2 Load V/S Deflection curve for 100mm specimen
X axis –Deflection in mm. Y axis – load KN



Graph 3 Load V/S Deflection curve for 125mm specimen
X axis –Deflection in mm. Y axis – load KN



Graph 4 Load V/S Deflection curve for 130mm specimen
X axis –Deflection in mm. Y axis – load KN



Graph 5 Load V/S Deflection curve for 150mm specimen
X axis –Deflection in mm. Y axis – load KN

VII. RESULT AND DISCUSSIONS

Experimental and Manual calculations reveal that there is a mere deflection in the results obtained and is within acceptable limit. Load carrying capacity increases with increase in depth of slab with area of steel of deck sheet and nominal reinforcement being same. This reveals that area of concrete increases the loading capacity of specimen. Load v/s Deflection curve shows that there is rapid increase in deflection as deflection limit exceeds as per code standards, maximum bending moment at deflection limit is found to be equal to critical moment capacity.

VIII. CONCLUSION

1. Load carrying capacity increases with increase in depth of slab.

2. Load carrying capacity decreases rapidly as soon as the deflection limit is reached.

3. Load V/S Deflection graph indicates rapid fall of strength as deflection exceeds as maximum deflection limit as per codal provisions.

4. Experimental results and manual calculations are found to be compatible.

5. Slip behaviour was observed accompanying failure along the shorter side

IX. ACKNOWLEDGMENT

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REFERENCES

[1] Baskar. R, Antony Jeyasehar.C, 'Experimental and Numerical Studies on Composite Deck Slabs', International Journal of Engineering Research and Development (22-32), Volume 3, 2012.

[2] British code 5950-4, Code of Practice for Design of Composite Slabs with Profile Steel Sheeting, BS 5950-4:1994.

[3] Burnet MJ, Oehlers DJ., 'Rib shear connectors in composite profiled slabs', Journal of Constructional Steel Research(1267–87), vol. 57, 2001.

[4] Calixto JM, Lavall AC, et al., 'Behaviour and strength of composite slabs with ribbed decking', Journal of Constructional Steel Research (211–2), vol. 46, 1998.

[5] Crisinel M, Marimon F. 'A new simplified method for the design of composite slabs', Journal of Constructional Steel Research(481–91), vol. 60, 2004.

[6] Emad El-Dardiry, Tianjian Ji, 'Modeling of the Dynamic Behavior of Profiled Composite Floors', Engineering Structures (567–579), Volume 28, 2006.

[7] Eurocode-4, Design of Composite and Concrete Structures Part 1.1 General Rules and Rules for Building, EN1994-1-1:2004.

[8] Jawed Qureshi, Dennis Lamb and Jianqiao Yea, 'The Influence of Profiled Sheeting Thickness and Shear Connector's Position on strength And Ductility of Headed Shear Connector', Engineering Structures (1643–1656), Volume 33, 2011.

[9] J. M. Calixto, G. Brendolan and R. Pimenta, 'Comparative Study of Longitudinal Shear Design Criteria for Composite Slabs', IBRACON Structures and materials journal (124-141), Volume 2, 2009.

[10] Makelainen P, Sun Y., 'The longitudinal behaviour of a new steel sheeting profile for composite floor slabs', Journal of Constructional Steel Research (117–28), vol. 49, 1999.

[11] M. A. Bradford, R. I. Gilbert, R. Zeuner and G. Brockc, 'Shrinkage Deformations of Composite Slabs with Open Trapezoidal Sheeting', Procedia Engineering (52–61), Volume 14, 2011.

[12] M.E. A-H Eldib , H.M. Maaly, A.W. Beshay and M.T. Tolba, 'Modeling And Analysis of Two-Way Composite Slabs', Journal of Constructional Steel Research (1236-1248), Volume 65, 2009.

[13] Ollgaard, J.G., R.G. Shelter, and J.W. Fisher, 'Shear Strength of Stud Connectors in Lightweight and normal Weight Concrete', AISC (55-64), vol. 8, 1971.

[14] Porter ML, Ekberg CE., 'Design recommendations for steel deck floor slabs', Journal of the Structural Division, ASCE (2121–35), vol. 102, 1967.

[15] Redzuan Abdullah, W. Samuel Easterling, 'New Evaluation and Modeling Procedure for Horizontal Shear Bond in Composite Slabs', Journal of Constructional Steel Research (891-899), Volume 65, 2009.

[16] Shiming Chen, Xiaoyu Shi, 'Shear Bond Mechanism of Composite Slabs — A Universal FE Approach', Journal of Constructional Steel Research (1475–1484), Volume 67, 2011.

[17] Tenhovuori AI, Leskela MV., 'Longitudinal shear resistance of composite slab', Journal of Constructional Steel Research (228), vol. 46, 1998.

[18] V. Maimuthu, S. Seetharaman, S. Arulv Jayachandran and A chellappan, 'Experimental Studies on Composite Deck Slabs to Determine the Shear Bond Characteristic (M-K) Values of the Embossed Profile Sheet', Journal of

Constructional Steel Research (791–803), Volume 63, 2007.