

# **Behaviour of Concrete Deck Slab Using Shear Connectors: A Review**

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**ABSTRACT:** Composite slabs or composite deck slabs consist of profile deck sheet and concrete. In recent years the composite slabs are widely in demand due to its lighter weight, economical construction work and its capability to defend the natural disasters like earthquake. Structurally, composite slab serves the entire requirement in terms of strength and durability of structure recommended by standard codal provision. Several researchers have been studying the behaviour of composite slab but due to its complex behaviour yet it is not completely understood. The behaviour of composite slab directly depends on the deformability and contact strength. Though the work in this area is done in all possible directions yet some questions are unanswered for horizontal shear, ductile designing of slab and dependency of test result. This paper deals with some important literature reviews regarding composite slab behaviour incorporating different profiles.

**KEYWORDS:** Composite Slab, Profile Sheet, Shear Connectors, Deflection, Horizontal Shear.

## **I. INTRODUCTION**

The enhanced inventions are needed in the construction industry to overcome the threat of natural disaster such as earthquake. In the event of such natural disaster mass of structure plays important role in serviceable performance of the structure. Hence, this fact has led to the need of reducing load or mass of structure. The mass of structure using composite slab construction reduces 30% of total weight of the structure. Thus, composite construction satisfies the demand but the behaviour of the composite slab is yet not completely understood. Composite slab construction is very economical and efficient in terms of reducing construction cost, time of construction and deformation of structure as whole [1]. Profile deck sheet is the vital component of composite deck slab [2]. 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 [2], 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 [2]. It is reported that about 40% of high rise buildings are being constructed using composite deck slabs. At present, the concrete deck slabs are designed by following the guidelines given in BS-5950(Part-4) and Euro code-4. These codes contain two methods for designing of the slab namely M-K method, partial interaction method, but generally M-K method is used all over as standard method of designing for designing composite deck slab [3]. But to predict behaviour nearer the exact behaviour of the composite slab generally analytical approach i.e. Finite element method is used. Several researchers have recommended the validation of the analytical approach by considering the full scale model so that the result goes in good agreement with the realistic situations. The behaviour of composite slab directly depends on the deformability

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and contact strength. For contact strength mechanical interlocking proves to be a firm option in case of interlock popularly known as shear connectors. As concrete is not completely confined with the steel it may give rise to the slip and initial stain at the interface while vertical uplift will be observed if there is no proper interlocking. In the current paper the past research on composite slab is studied thoroughly to determine the gap of information to be investigated. To build a correlation between the past and predicted work we need to know the background of the topic. Hence the following points will help us in understanding the composite slab.

## A. COMPONENTS OF COMPOSITE SLAB

A composite slab consists of profile deck sheet, interlocking part and concrete. All these constituents play an important role in behaviour of composite slab and also composite actions. For composite action to take place the slab profile deck sheet should transfer longitudinal shear through the interface for which proper interlocking arrangements are required. In market there are numerous design of profile sheet available with large options for generating proper interlocking in form of mechanical or chemical bonding.

### I.A.1 PROFILE SHEET

Profile deck sheet is formed by rolling cold forming structural steel using rollers with different corrugation depths show in fig.1. The strength of sheet depends on the art of designing the depth of the corrugation so that strength is increased with maximum effective width of the coil. The profile sheet is broadly divided in the two categories they are open through and re-entrant profiles and are designed using Euro Code and British Standards.



Fig. 1 Some Common Designs of Profile Sheet of Open Through Type

To increase the strength of the sheet usually ribs and stiffeners are designed. Numerous designs of profile deck sheet are available with different capacities and choice of the sheet depends on its target length required capacity and stiffness. In composite slab construction the profile deck sheet resist the constructional load and also supports weight of wet concrete. Profile deck sheet acts as positive as well as negative reinforcement during the composite action phase. However, in order to encourage the composite action the sheet layout is modified with desired embossment.

The profile sheet should be designed by using guidelines in BS5950-6 or Euro code. In order to utilize the profile sheet in composite slab construction its design should satisfy the deflection criteria specified in BS 5950-4 and Eurocode-4. Embossment and indentations should not be considered while calculating cross sectional properties [4]. Deflection of the profile sheet should not exceed  $\left(\frac{L_p}{180}\right)$  but  $\leq 20mm$  in case where pounding effect is not considered and  $\left(\frac{L_p}{130}\right)$  but  $\leq 30mm$  in case of pounding effect. Pounding effect is considering additional weight of concrete due to the deflection of sheet while calculating deflection [4].

### I.A.2 SHEAR CONNECTION

Shear connection bonding between the profile sheet and concrete is necessary to transfer longitudinal shear and thus result in composite action. The bonding can be chemical, mechanical or frictional interlocking. Direct connection of profile sheet and concrete without any interlocking is prohibited by the standard codal guideline. They suggest using either any of the provision or combinations of the chemical mechanical or frictional mechanical interlocking etc. Generally mechanical interlocking is used in practice as embossment, welded studs or modifying sheet with ribs deformation at the end. Chemical interlocking is poor as compared to the other interlocking as it does not allow the complete confinement in profile sheet and concrete.

Design of shear connector as per codal provisions should act as end anchorage for simply supported slab and connect the slab to the beam [4]. The stud should also fulfil all the criteria a given below.

$$\begin{aligned} F_a &\leq P_a \\ F_b &\leq P_b \end{aligned}$$

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$$\left(\frac{F_a}{P_a}\right)^2 + \left(\frac{F_b}{P_b}\right)^2 \leq 1.1$$

Where,

$F_a$ - End anchorage force per shear connector.

$F_b$ - Beam longitudinal shear force per shear connector.

$P_a$ - End anchorage capacity per shear connector

$P_b$ - Capacity per shear connector for composite beam design in accordance with BS 5950-3.1:1990.

## B. EXISTING METHOD FOR ANALYSIS AND DESIGN OF COMPOSITE SLAB

Now the analysis and design of the composite slab is done with the available guidelines in British standards and European code but yet the guidelines are not incorporated in Indian standards. European code gives the freedom to design the composite slab by M-K method or partial interaction method as per the purpose of design but British standard is based on the M-K method.

### I.B.1 M-K METHOD

Porter and Ekberg in 1976 proposed method for resisting longitudinal shear based on standardise semi empirical formulae, which are obtained from finding correlations between experimental test results and calculated normal shear strength popularly known as M-K method. Generally worldwide this method is used to design composite slab with elastic-plastic behaviour. For elastic behaviour i.e. there is direct relation between longitudinal shear and vertical shear the equations are simple and do not need semi empirical approach for design. In M-K method, 'M' is mechanical interlocking and 'K' is fiction between the profile deck sheets and can be found by the full scale experiments. These values are given by the manufacture foe the profile sheet. The value of M and K varies with the profile sheet, slab size but generally values are given by profile sheet manufacturer.

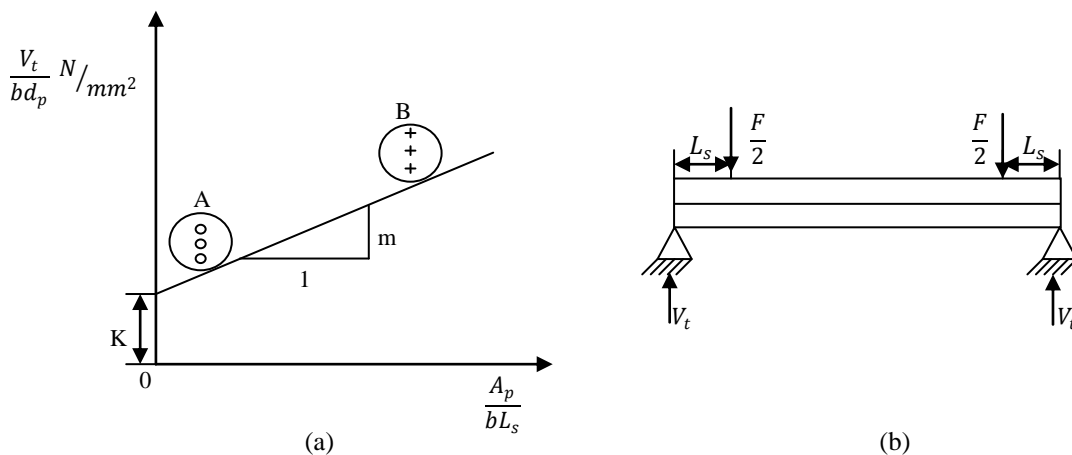


Fig. 1 a - Experimental evaluation graph of the m and k values. b – Arrangements for the experiment.

According to Eurocode-4 we can find longitudinal shear as [5],

$$V_{Rd} = \frac{bd_p}{\gamma_{vs}} \left( \frac{mA_p}{bL_s} + k \right)$$

Where,

$A_p$ - Nominal cross section areas of steel profile sheet.

$m$  and  $k$  Values are taken in  $N/mm^2$  from m-k line as shown in fig. or generally given by manufacturer of the profile deck sheet.

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$\gamma_{vs}$  - Partial safety factor.

According to BS code 5950 part 4 the longitudinal shear is defined as [4],

$$V_s = \frac{B_s d_s}{1.25} \left( \frac{m_r A_p}{B_s L_v} + K_r \sqrt{f_{cu}} \right)$$

Where,

$A_p$  - Cross sectional area of profile steel sheet.

$B_s$  - Width of composite slab.

$d_s$  - Effective depth of slab to the centroid of the profile deck sheet.

$f_{cu}$  - Characteristic concrete cube strength.

$K_r$  and  $m_r$  - Empirical parameter in  $N/mm^2$ .

$L_v$  - shear span of composite slab.

### I.B.2 PARTIAL SHEAR CONNECTION (PSC)

This method gives an alternative to the composite slab design for M-K method only when the slab design is needed to be the ductile behaviour of where slab is used for large span. With reference to the work done by Shark and Brekemans rules where preliminary set for partial interaction method. As concrete is not completely confined with the profile deck sheet it is assumed that there is partial connection between sheet and concrete. The exact amount of the connection can be calculated using plastic theory block diagrams and equation the equations of stress will give the exact relation of shear at the interface. Thus it will help in estimating the ultimate moment capacity of the composite slab. Due to partial confinement between two layers there is complete redistribution of the longitudinal shear before reaching to the ultimate moment capacity. Mean of longitudinal shear redistribution will give the exact longitudinal shear strength of the connection. This method is defined in only Euro Code and not interpreted in BS standards [5].

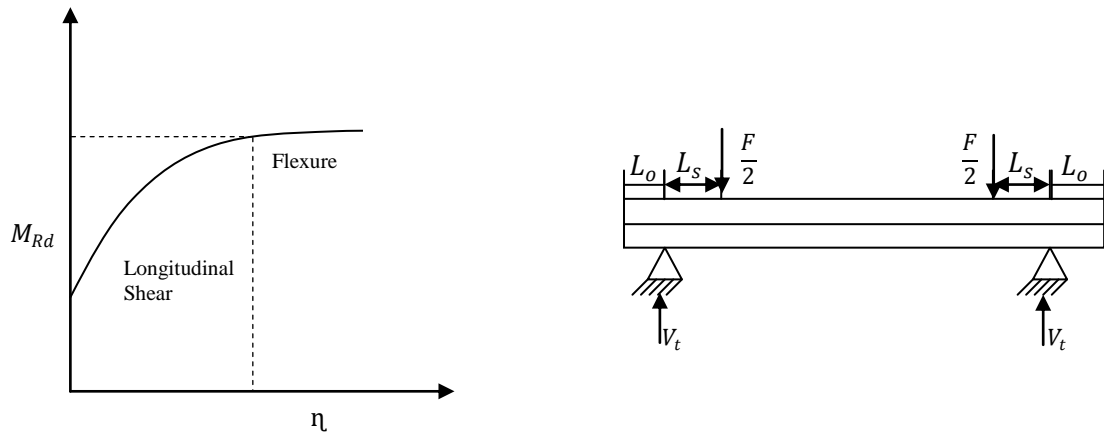


Fig. 2 Partial Interaction Design Diagram

The degree of shear connection is the ratio of compressive force in concrete to compressive force in concrete for full shear connection.

$$\eta = \frac{N_c}{N_{cf}}$$

Where,

$\eta$  - Degree of shear connection.

$N_c$  - Compressive force in concrete.

$N_{cf}$  - Compressive force in concrete for full shear connection.

Now  $\eta$  varies from 0 to 1

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$\eta = 0$ , no shear connection and composite action is absent. Resistance to the longitudinal shear is provided profile sheet alone,  $\eta = 1$ , there is full shear connection and complete redistribution of longitudinal force is done for composite action,  $0 < \eta < 1$ , partial shear connection. The amount of shear varies generally in graphical form as shown in fig below: By excluding effect of support reaction the longitudinal shear strength can be given as,

$$\tau_u = \frac{\eta_{test} N_{cf}}{b(L_s + L_o)}$$

Where,

$\eta_{test}$  - Degree of freedom from test.

b- Width of slab.

$L_s$ - Shear span.

$L_o$ - Overhang length.

Now after considering the effect of reaction we can redefine the above equation as

$$\tau_u = \frac{\eta_{test} N_{cf} - \mu V_t}{b(L_s + L_o)}$$

Where,

$\mu$ - Friction coefficient.

$V_t$ - Support reaction.

### Case 1- Full Shear Connection

#### a-Neutral axis in concrete

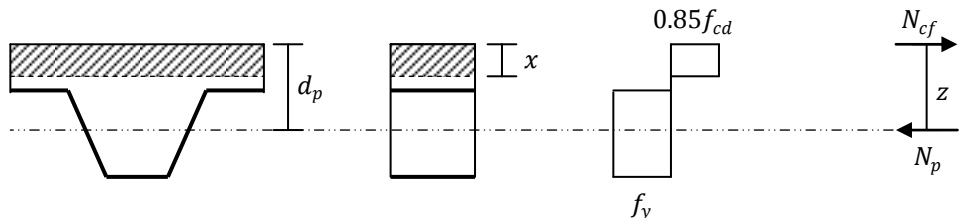


Fig. 3 Plastic Theory Stress Distribution for Neutral Axis in Concrete Zone for Sagging Moment

As there is full shear connection therefore, compressive normal force in concrete flange can be given as,

$$N_{cf} = N_p = A_p f_y$$

Where,

$A_{pe}$  - Effective cross-sectional area of profile deck sheet.

$F_{yp,d}$  - Yield strength of profile deck sheet.

The depth of neutral axis is given as,

$$X_{na} = \frac{N_{cf}}{0.85 f_{cd}} \leq h_c$$

Where,

$f_{cd}$  - Compressive strength of concrete

$h_c$  - Depth of concrete layer

Now the design moment of resistance equation can be written as,

$$M_{Rd} = N_{cf} (d_p - 0.5 X_{na})$$

Where,

$d_p = h - e$  - The distance between extreme fibres of concrete to the centroid distance of the profile deck sheet.

#### b-Neutral Axis In Profile Sheet

Neglecting the compressive strength within the ribs, design compressive force in concrete can be given as

$$N_{cf} = 0.85 f_{cd} b h_c$$

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As we know,  $A_p f_y < 0.85 f_{cd} b h_c$  so we can say that profile sheet have some resistance to bending and hence we can reduce plastic moment resistance can be given as,

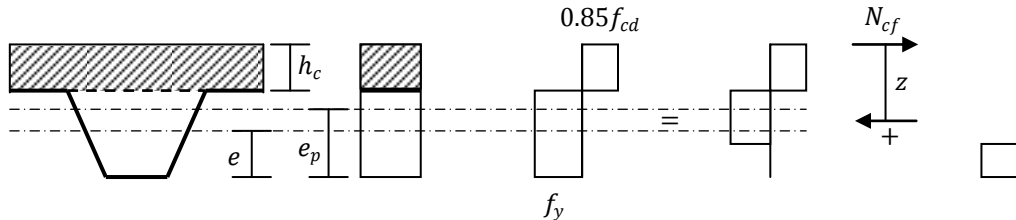


Fig. 4 Plastic Theory Stress Distribution for Neutral Axis at Steel and Concrete Interface for Sagging Moment

$$M_{pr} = 1.25 M_{pa} \left( 1 - \frac{N_{cf}}{A_p f_y} \right)$$

Where,

$M_{pa}$  - Design value of plastic moment

Hence actual design moment of resistance for composite slab can be given as,

$$M_{Rd} = N_{cf} z + M_{pr}$$

Where,

$$z = h - 0.5 h_c - e_p + \left( [e_p - e] \frac{N_{cf}}{A_p f_y} \right)$$

$z$  - Lever arm

$e_p$  - Distance from bottom to the plastic neutral axis

### Case 2- Partial Shear Connection

In this case there is no full connection so the compressive force in slab can be given as

$$N_c = \tau_{uRd} b L_x \leq N_{cf}$$

Where,

$$\tau_{uRd} = \tau_{uRk} / \gamma_{vs}$$

$\tau_{uRd}$  - Design shear strength

$\tau_{uRk}$  - Characteristic shear strength

$\gamma_{vs}$  - Safety factor

$L_x$  - Distance of section from the support

Hence reduced moment of resistance can be written as,

$$M_{pr} = 1.25 M_{pa} \left( 1 - \frac{N_c}{A_p f_y} \right)$$

Now actual design moment of resistance is given as

$$M_{Rd} = N_{cf} z + M_{pr}$$

Here,

$$z = h - 0.5 h_c - e_p + \left( [e_p - e] \frac{N_c}{A_p f_y} \right)$$

$z$  - Lever arm

$e_p$  - Distance from bottom to the plastic neutral axis

### C. COMPOSITE ACTION AND BEHAVIOUR OF THE COMPOSITE SLAB

The behaviour of the composite slab can be seen in three phases in construction phase the sheet should support the wet weight of concrete in composite slab phase the imposed load should be property distributed to the beam and in composite beam phase the beams joined with the shear connectors to the slab should support the imposed as well as transverse load. The composite slab should support both negative and positive moment. The negative moment due to

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self weight is carried by deck alone. The positive moment in the slab is supported by cross-section area of the profile sheet [2].

The main constituent that results in the ultimate strength of the slab is horizontal shear, contact strength and deformability. Horizontal shear depends on factors which include the shape of steel deck profile, type and frequency of embossment, thickness of steel sheeting, arrangement of loads, length of shear span, thickness of concrete, strain in the steel sheeting, support friction, natural clamping due to curvature under bending and type of end anchorage [6]. The statistic plot horizontal shear bond stress verses end slip gives correct interpretation of the interaction behaviour between steel and concrete. The property of horizontal shear can be tested by push out test, pull out test, slip block test. Contact strength is mainly depended on the mode of interlocking it may be either mechanical or chemical interlocking. Generally mechanical interlocking i.e. shear connectors is used on the large scale in practice.

### D. BEHAVIOUR OF SHEAR CONNECTORS UNDER LOADING

Composite action is the heart of the design to ensure this headed stud shear connector is used. Dimension of headed stud shear connectors geometrics and direction of profile sheeting reinforcement area and position compressive strength of concrete and location of the stud within the ribs of the profile sheeting these all factors will decide the behaviour of the headed stud [7]. Capacity of shear connectors and load slip behaviour of shear connector is determined by the push out test. The main role of shear connectors is to transfer the longitudinal shear which depends on strength of shear connectors and resistance of concrete slab against longitudinal cracking induced by high concentration of shear forces [8]. The change in position of the shear stud is led by the stiffing rib of the modern profile. It is placed either at favourable or unfavourable side of the rib [9]. As there is lager zone of concrete under compression in front of the favourable stud in its load bearing direction than the compressive zone behind it hence stud on favourable side is stronger than on the unfavourable side. Stud placed on the side of the stiffener away from the mid-span is favourable side while stud place close to mid-span is on unfavourable condition. Favourable position of stud is generally recommended by many codes of design. The stud in favourable position showed less ductile load slip behaviour then the unfavourable stud position. The failure mode for unfavourable stud was rib punching and eventual tearing of the steel deck and foe favourable it was observed concrete cone failure. The headed stud is influence by profile sheet strength in unfavourable condition and by concrete strength in favourable condition.

### E. FAILURE MODES PREDICTED FROM THE PAST RESEARCH

Now the failure patter generally observed is described in four types of failure as shown in fig-5 [11].

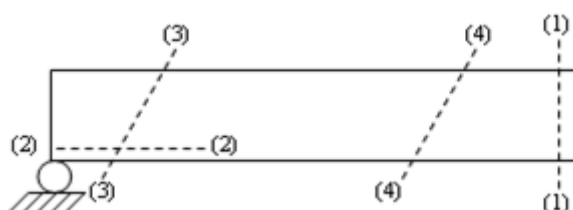


Fig -5 Failure Modes of Composite Slab

#### (1) Flexure Failure

This failure is seen due to the bending action in the slab. The moment once reach its ultimate capacity at the critical condition. We can see minor vertical slip is observed at the edge the profile. At the plastic regain yield is observed and concrete is crushed but the longitudinal bond between the two components is safe.

#### (2) Longitudinal Shear Failure Or Horizontal Shear Failure

This failure is seen when the composite slab reaches to ultimate position for caring normal shear any more. This ends up with the composite action between steel and concrete completely which results in sudden rise in deformation of slab.

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The slip occur horizontally between the interface of concrete and profile which resembles the separation bond between concrete and steel after the failure the section acts differently with two different material without any contact separately.

### (3) Vertical Shear Failure

When the depth of slab is relatively small than its length, failure may occur. In this type we observed the diagonal slips at support similar to normally we design the slab for ultimate moment by the limit state method but during failure it hardly reach the ultimate moment because shear is proceeding.

### (4) Punching Shear Failure

Composite slab is not good in bearing concentrated load. In this case researcher observed that the concentrated load will cause the conical slips under the loading. The behaviour of these cracks is due to tension followed by loss of bond between concrete and steel.

## II. RELATED WORK

**Wang Yu Hang and NIE Jian Gua, (2015)** [11], studied theoretical model for ultimate load carrying capacity of composite slabs cast with profiled steel sheets considering the relation between ultimate moment carrying capacity of the section and tensile force resisted by the profile deck sheet. Analytical study was carried out by considering two span continuous slabs subjected to one point load, two point load and uniformly distributed load. Based on the developed stress diagram an equation was derived for all these three cases. The study was also carried out by experimentally testing the specimens considering same loading conditions to validate the theoretical work. The investigators state that the results of other, analytical and experimental study are found to be similar. It is recommended that though the M-K method is convenient for designing the composite slabs, it cannot be used for direct practical approach it is repetitive in nature and this tends to uneconomical design. Hence, in this paper researcher suggested an alternative method for calculating ultimate load carrying capacity of the composite slab known as simplified calculation method. The method is based on the dimension less parameters considering both flexure and longitudinal failure but can be used only in case of uniformly distributed loading condition.

**Baskar R Antony Jeyasehar C, (2012)** [12], studied the behaviour of composite deck slab analytically as well as experimentally. The finite element analysis of slab was carried out using ANSYS 8 software. The composite slab specimens of 3200mm x 645mm were tested by providing simple supports and considering L/4 shear span (i.e. two line loading test set up). Three different types of composite slab specimens were prepared. (i) Specimens with profile deck sheet possessing embossment, (ii) specimens with profile deck sheet possessing embossment as well as stud shear connector and (iii) specimens with profile deck sheet and shear connector. The results of ultimate loading carrying capacity were determined and compared with values obtained for control composite deck slab specimens. The results indicate that the specimens with embossed of profile deck sheet showed 13% increase while specimens with embossed profile deck sheet and shear connector showed 54% increase and specimens with profile deck sheet with shear connectors showed 36% increase over the controlled specimens. However, the ultimate load carrying capacity of the slab specimens as determined analytically and experimentally was found to be approximately same.

**Shiring Chen and Xiaoyu Shi, (2011)** [13], studied the shear bond mechanism of composite slab using nonlinear contacts at the interface of the profile and concrete, as the concrete is not completely confined with the profile deck sheet. The researchers have carried out the analysis of full scale specimens using finite element based ANSYS software to predict the behaviour of composite slab under uniform loading. The analytical and experimental results indicated similar failure loads for composite slab. The investigators conclude that the initial fine cracks in the composite slab are responsible for shear debond between concrete and profile deck sheet. However, the shear bond exists till the failure in the area of the shear span. Further, the investigator states that the longitudinal shear failure occurs in composite slab as composite action at the interface comes to an end. The sudden drop in the load was seen at the moment the composite slab fails but it was observed as the shear span increases the longitudinal resistance capacity of the composite slab is decreases.

**M A Bardford et al, (2011)** [14], studied the long term effect due to shrinkage of concrete which will result in initial indirect strain in composite slab as creep in concrete is observed in initial stage after casting. The researcher derived a



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new for deflection and stress equation based on virtual work method by considering the partial shear interaction between concrete and steel sheet subjected to shrinkage straining. It was observed in experimental study that quantification of the shrinkage and partial interaction is seen in the uncracked area as it allows strain to be transferred through the depth of the slab due to difference in corrugation depths of the profile deck sheet. The results indicated that forecast response for the slab was complex as the combination of the shrinkage and partial interaction gave rise to the small concrete stresses which should be analytically studied for giving the application based structural mechanism.

**Eldid *et al*, January', (2009)** [15], studied the behaviour of two way composite slab using finite element analysis in COSMOS/M26 software. The researcher compared one way and two way slabs using nonlinear material properties and full-scale models with varying parameters such as slenderness ratio and slab aspect ratio. The analytical results were compared in respect of ultimate load carrying capacity, reaction distribution and deflection of composite slab. The side perpendicular to the ribs of profile deck sheet of a composite slab is usually the weaker side, whereas the side along the ribs is stronger. Hence, the study of behaviour of composite deck slab along the weaker side helps in enhancing the ultimate load carrying capacity of the slab. The investigators report that, though the slab is a two way slab its failure at ultimate load resembles as that of one way slab, because value of load factor at serviceability limit and percentage of reaction is greater on weak side. However, Shear connectors and cold steel straps fixed at bottom steel deck prevents or say reduces the deflection and considerably increase the strength of composite slab.

**Redzuan Abdullah and W Samuel Easterling, (2008)** [16], studied new procedure to estimate the horizontal shear in which slab slenderness ratio is considered to be the predominant factor affecting the horizontal shear force. The researcher derived new equation based on force equilibrium method for deriving the relation between shear bond stress and end slip. The justification of the derived relation was also carried out with the conventional partial interaction method. The relation between shear bond stress and end slip was similar by both the methods. To validate the results of the analytical work experimentation carried out for bending test with two point load bending test and slip observed was larger in compact slab than in slender slab. For full interaction slab shear bond and end slip curve was plotted along the vertical axis i.e. end slip does not occur for the slab with full interaction. While in partial interaction the shear bond is unchangeable. The researcher concluded that the shear bond property changes with change in combination of slenderness or geometry or material. For particular case for same material and geometry the only property that affects shear bond is slenderness. So most important property horizontal shear bond stress–end slip relation can be obtained from force equilibrium method which is very important for numerical analysis.

**Maimuthu *et al*; (2006)** [2] studied experimentally, the shear bond characteristic values (mechanical interlocking 'm' and friction coefficient 'k') of composite slabs cast using M20 grade concrete and embossed profile sheet following design guidelines of Eurocode-4. The results indicated that the behaviour of the composite slab depends on the shear span. Researchers reported that shear bond failure was observed mainly in shorter span while flexural failure was observed in longer span.

**Emad El Dardiry and Tianjim Ji, (2005)** [17] studied the dynamic behaviour of composite slab using isotropic and orthotropic plate model. The properties of section were kept same in both direction for isotropic model but different in orthotropic model. The analytical results of the study indicate that the mode shapes checked for each panel are either concave or convex though the complex behaviour is taken in consideration. However, the isotropic model proves to be slightly better than orthotropic model. In case of effect of boundary condition, orthotropic model proves to be stiffer and its effective thickness remains constant, while good performance was noted for isotropic plate where thickness varies from 5 to 6%. In case of load combination less error was noted for isotropic plate i.e. 4 % and for orthotropic plate 10% was noted. Now eccentricities are considered to find effect on natural frequency and it was found that ratio of natural frequency for model with and without eccentricities vary from 74% to 78%. Natural frequency is not sensitive to location of natural axis of slab and beam as far as eccentricity is considered. The composite slab contributes 16% of total stiffness of structure. The prediction of natural frequency is affected by the thickness of slab.

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**Marciukaitis et al; (2005)**, [18] studied the connection between profile sheet and concrete directly affect the overall deflection for the composite slab which directly depends on the shear stiffness due to connection. The researcher evaluated a new method to evaluate deflection of composite slab considering all the factors starting from loading to the ultimate moment. The connection between profile sheet and concrete is not rigid or stiff, but it is partially in contact with each other. The stiffness between the layers changes with the action of external forces. As there are two different materials they will undergo different deformations under loading. Though there are shear deformations these deformations are largely governed by the difference in deformation. For small shear forces the slab behaves elastically and for larger shear forces the plastic behaviour is noted. According for elastic small deformations is noted and large deformations are seen in plastic behaviour. The equation where derived by considering two layers composite member deflection. The researcher proved that there is no stiff bond between profile sheet and concrete. Hence partial stiffness should be considered while calculating deflection.

### III. CONCLUSION

The study until now was performed on analysing and predicting the behaviour of the composite steel structure with concrete deck slab. Many researchers derived the expressions for deflection, ultimate moment, load carrying capacity and many more. Some questions regarding the behaviour of the slab for horizontal shear resistance and design requirements to achieve ductile failure. The optimization of the design for the proper combination of different corrugated profile sheets and type of mechanical interlocking to be provided is not yet completed. Though codal provisions are based on experimental results the finite element analysis of composite deck slab with nonlinear contacts between the profile, shear connectors and concrete is required to be studied for the complex composite action.

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