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Slab Panel Using Ferrocement Slab with Fibre: A Review

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Abstract: *Ferrocement composites were widely used in the structures for strengthening of concrete. Thus ferrocement was an ideal material for repairing and strengthening of old or new structures. The flat ferrocement panels are reinforced with different numbers of wire mesh layers. The use of wire mesh layers has the ability to arrest the cracking in structure. The main objective is to study the effect of using number of mesh layers on the flexural strength of flat ferrocement panels and to compare the effect of varying the number of mesh layers and use of polypropylene fibre on the ultimate strength of ferrocement slab panels. This study also gives research gaps and also suggests directions for future research to establish ferrocement as a feasible material for strengthening axially loaded concrete members. Panels were casted with mortar of mix proportion (1:5) and water cement ratio as (0.4). Panels were tested under two point loading system after curing period of 28 days. Test result shows that panels with more number of layers exhibits greater flexural strength and less deflection as that compared with panels having less number of layers of mesh.*

Key words: *Mesh layers, ferrocement, Fibre.*

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I. Introduction

Installation of secondary roofs is one of the passive methods of insulating the building is necessary to provide heat insulation in buildings as compared to other alternatives such as cellular concrete and hollow block [15].

Ferrocement is a thin wall reinforced concrete constructed of hydraulic cement mortar reinforced with completely infiltrated. The larger bond forces are developed between the reinforcing against intense heat. Thus, Eskandari, H. [12] Ferrocement is an attractive material for secondary roofing that mesh and cement matrices, this prevent shrinkage cracking and control of early thermal contraction.

It uses layers of steel wire mesh as reinforcement. The reinforcing steel wire mesh has openings large enough for adequate bonding. It has a better impact and punching shear resistance than reinforced concrete, because of two dimensional reinforcement of the mesh system.

Ferrocement elements are generally more ductile when compared to conventional reinforced concrete elements. It has a very high tensile strength to weight ratio and superior cracking behavior when compared with reinforced concrete. These thin elements can be shaped to produce structural members such as folded plates, flanged beams, wall panels etc.

Polypropylene Fibre was added in the ferrocement to control the cracking, and to change the behavior of the material by bridging of fibre across the cracks. Polypropylene fibre yields the greatest volume of fibre for a given weight [20] . This high yield means that polypropylene fibre provides good bulk and cover, while being lighter in weight. It is the lightest of all fibre which is 34% lighter than polyester and 20% lighter than nylon and is lighter that water.

II. Literature Review

M. Mastalia [20] studied on this paper an experimental investigation on fiber reinforced concrete which improves load carrying capacity and energy absorption. Industrial fibers such as hybrid fibers and Polypropylene fiber were used in plain concrete, whereas increase of polypropylene fibre decreases the compressive strength and deflection. In self consolidating concrete containing different fiber types and it possess flexural strength and splitting tensile strength. Z. Abdollahnejada [20] stated that the increase in fibre results in maximum strength to the concrete. It gives two-parameter which could be adopted to analyze the distribution of the first crack, ultimate crack, and impact resistance. The addition of fiber increases the air voids and reduces the level of compaction. The maximum increase of the compressive strength was measured about 80 MPa. The results obtained reveal that the use of recycled steel bars has more promising results, when compared to the industrial steel bars.

Eskandari, H. [12] described about Ferrocement beams with Expanded Metal Mesh (EMM), Welded Wire Mesh (WWM) or Fibre Glass Mesh (FGM), Aerated light brick core. The Specimens reinforced by EMM shows better ductility than those reinforced by WWM. The stress-strain characteristics of lightweight fibre reinforced ferrocement specimens are in uniaxial tension. As the number of mesh layer increases it will produce maximum strength and water absorption is reduced. It includes that slab panel with varying thickness and number of mesh layers increases it gives maximum load and produces the low ductility. Cracks and load carrying properties were due to the nature of the mesh type, number of mesh layers, mesh wires diameters with opening size and the type of mortar material. Ferrocement elements with fibre glass mesh exhibited a sudden flexural failure with limited number of cracks. Many fine cracks were developed due to the number of mesh layers and type of fibre were used. As observed that use of WWM (Welded Wire Mesh) develops the crack in vertical direction as whole depth.

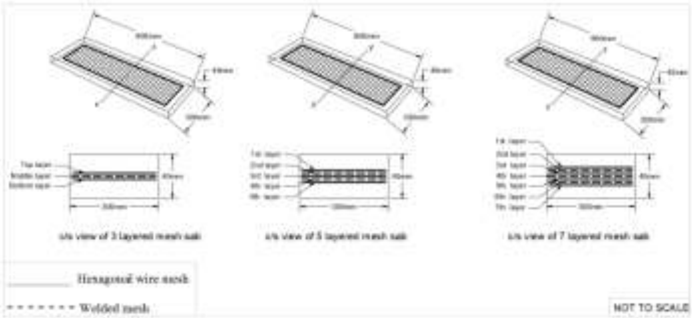

Fig. 1. Arrangement of mesh layer

Lameiras, R., Barros, J. [17] explained about, the fresh and hardened properties of concrete by the addition of Polyolefin (PO) and polypropylene (PP) fibers. Different dosages of PO and PP fibers were adopted. Trial mixtures consist of replacement of PO fibers at the volume fractions of 0.5, 1 and 1.5% and PP fibers at volume fractions of 0.1% and 0.2%. The properties of the mixtures were evaluated using slump and Inverted slump cone tests in fresh state, and meanwhile using compressive, splitting, and flexural tests in hardened state. The results indicated that PO with PP fibers can improve the compressive and splitting tensile strength of mixtures up to 7.5% and 23%. This combination of fibers decreased the corrosion of steel. The combined use of polypropylene fibers leads to better mechanical performance of concrete. Increase in the fiber content generally decreases the slump values of mixtures thereby increasing workability. The specimens were tested and epoxy coating were provided to prevent the chloride penetration. It shows that there is increase in strength and durability of slab panel as increase in polypropylene fibre. The compressive strength become increased with number of fibre increased and mesh layers. Addition of fibre decreased the corrosion of steel and gives the better stiffness. As increase in fibre improve the compressive strength from 1% to 6% compared with plain concrete.

Behera, G.C, Hong Hao [4] emphasizes about the structural load-carrying capacity with composites of Fibre Reinforced Polymer (FRP) or Glass FRP. In order to analyze the flexural behavior slab panels were cast. U-jackets anchorage coverage setup was prepared to investigate the strength parameter. U-jacket anchorage with a load carrying capacity range from 20% to 37.8% was applied, which revealed that the specimen exhibited higher load-carrying capacity but less ductility. The maximum transverse strain in vertical U-jackets was recorded. The use of inclined U-jackets is more effective than the vertical U-jacket when the load-carrying capacity increases to 37.7%. It was concluded that the addition of Fibre Reinforced Polymer or Glass Fibre Reinforced Polymer in concrete slab panel increases the flexural strength. Addition of Fibre increases the strength and thereby reduces the crack in slab. In order to get the high load carrying capacity the continuous fibre sheets were used. It also gives load in compressive strength test and split tensile strength test varies from 61 KN and 63 KN. Initially load will act at marginally and forms the micro cracks in vertical direction. It shows that there was a slight increase in load carrying capacity compared with inverted U-jackets.

Borri, A., Castori, G. [6] explains about Ferro-cement slab was mixture of cement and fibre containing compactly spaced mesh layers. It increases the elastic modulus and decrease brittleness. Thus ferrocement used in wind tunnel, swimming pool, compound walls, modular housing etc. Adding fibre in Ferro-cement slab reduces micro cracks and prevents the propagation of crack development. It increases the compressive strength and flexural strength of Ferro-cement by enhancing the elastic modulus and decreasing the brittleness. On conclusion the compressive strength in the ferrocement slab were found to be increased and more over reduce in the micro cracks and crack propagation were also noted. The various design mixes as,

Mix	1:3 (cement: sand)
A1	Mix + polypropylene 0.5%
A2	Mix + polypropylene 1%
A3	Mix + polypropylene 1.5%
B1	Mix + polyester 0.5%
B2	Mix + polyester 1%
B3	Mix + polyester 1.5%

Compressive strength and flexural strength increases more as curing period increases. P. B. Sakthivel [23] studied that increasing strength of ferrocement slab panel with fibre compared to without fibre.

S. Jeeva Chithambaram [9] discussed about the replacement of 15% cement in normal mortar or concrete by fly ash improved strength and reduces the crack pattern. The flexural behavior of bamboo based ferrocement slab panels reinforced with chicken wire mesh layers. High Water proofing coating used in bamboo which resists corrosion and reduces the crack. The flexural behavior of bamboo based ferrocement slab panels reinforced with chicken wire mesh layers has been studied to improve the serviceability limit. 15% cement replacement by fly ash was cast, cured under 28 days which shows that high improvement in tensile stress. Correspondingly experimental results varies from 13 KN-14 KN. Bamboo strips and wire mesh were used in slab panel produce higher strength, high load carrying capacity and less deflection. Use of ferrocement shows small crack space, width and high tensile strength and modulus of rupture. From this they concluded ultimate load is approximately twice than that of the first crack load. Slab panel has larger ductility, ultimate load found to be double the first crack load as similar to that of plain concrete. Ferrocement and bamboo strips can be considered as one among the building materials that are less capital intensive.

Soltanzadeh, F [25] explained about use of Glass fiber reinforced polymers and carbon fiber reinforced polymers. Slab panels with fibre were subjected to split tensile test. Loading includes degradation and retrofitting of the structures. Ferrocement with jacket, fine aggregate of thickness 20mm were used and test results are observed. Increase of torsion capacity is more prominent in states of torsion while improvement in torsion strength with number of mesh layers in ferrocement in slab panel. Increase in mesh layers also increases the torque twist in slab. Different layers of mesh improve the strength and mechanical properties. As in beam number of mesh layer increases there was a variation in under reinforced beams, longitudinally reinforced beams and transversely over reinforced beams. Use of different mesh layers increases the strength in flexure, shear and torsion capacity as well as changes the failure mode and failure plane as compared to without mesh layers. Ferrocement laminates in the form of Welded Wire Mesh produces corrosion protection, durability.

T.M.Alhajri [2] explained about beams were mainly used due to their stiffness, shear connection due to thickness. Nine specimens were tested, with the ferrocement slabs, by means of a bolted type shear connector. Ferro-cement is a form of thin reinforced concrete structure in which a brittle cement-sand mortar matrix is reinforced with compactly spaced multiple layers of thin wire mesh. A number of wire mesh variations used in ferrocement slab and thickness of the section, the results showed that increasing the number of wire mesh layers as well as the thickness of slab increased the ultimate load carrying capacity. Slabs with 2, 4, 6 wire mesh layers were used for high flexural strength and load carrying capacity. It also reduced the formation of cracks. Slabs with mesh layers perform four shear transfer mechanisms, namely surface bond, pre-fabricated bent-up tabs, pre-drilled holes, and self-drilling screws. In Universal Testing Machine test has been done and resulted. Stress strain relationship has been found by placing strain gauge at the bottom of slab panel tested. Z. Abdollahnejada [20] stated that Stiffness of the slab increases due to the thickness of the panel whereas there is corresponding decrease in deflection as compared to conventional concrete. Wire mesh also cut and all were tested to determine the yield and ultimate tensile strength. They concluded that the specimens developed primary cracks.

Fig. 2. Crack formation

Joseph, J.D.R. [15] described concrete to withstand the environmental condition and to arrest the cracking. On the addition of steel fibre in slab panel increases the shear capacity and ductility of concrete. Corrosion of steel reinforcements embedded in concrete elements is generally known as one of the most common reasons that shorten the service life of the structures. Fibre reinforced polymer in concrete perform better bonding strength, increases the load carrying capacity of the structures. As fibrous composites used in concrete posses micro cracks and crack width of 1.5mm. It gives the load deflection relationship of fibrous composites as load increases with decrease in deflection and aims to contribute in overcoming this problem by replacing steel stirrups as shear reinforcement of concrete beams using a steel fiber reinforced self-compacting concrete (SFRSCC). Corrosion of steel stirrups is one of the most common causes that limits the long-term performance of RC structures. The result obtained that the efficiency of steel fibers as shear reinforcement to increase the ultimate shear capacity and ductility of the structural elements. The steel fibers also contribute to reduce the width and spacing of shear cracks in slab panel.

Hamid Eskandari, Amirhossein Madadi discussed about ferrocement channels of different types of welded or steel wire mesh and to calculate the optimal deflection of ferrocement channels for various spans and size of reinforcement. They found that the ferrocement composite slabs have better ductility, cracking strength, and ultimate capacity compared to ordinary slab panel. Strength obtained due to mesh reinforcement based on yield strength. Arrangement of mesh layers in different forms to withstand the shear capacity of the slab panel. Use of different meshes provide the three longitudinal re-bars as 10mm dia, shear cracking occurred due to shear parts as increase in mesh layers. An increase in length resulted in increased deflection and size of reinforcement also higher load was associated with higher deflection. On the other hand, increasing the diameter of the bars decreased the deflection. They concluded that combination of meshes provided a better strength for construction which provides the compressive strength higher with 50 to 60%.

P. B. Sakthivel [23] Presented the study in Portland cement concrete was a greenhouse gas emission. Steel mesh reinforced cementations composites (SMRCC) and conduct low velocity impact tests. It has been found that steel mesh layers were varied keeping fiber percentage constant. The steel fibre has the ability to create a mechanical bond and reduce the damage to the structure. Long carbon fibre reinforced concrete (LCFRC) tested using impact testing apparatus and observed the first crack. Use of polypropylene synthetic fibre resulted in occurrence of minor crack and increases the yield strength. The galvanized steel weld mesh which is locally available, used in slab panel with the increase in tensile strength and yield stress. As there was increase in percentage of fibre increases the load carrying capacity and were water proof materials were used to avoid corrosion. They concluded that use of SMRCC and number of mesh layers increases the flexural behavior of slab panel. T.M.Alhajri [2] explained about beams were mainly used due to their stiffness, shear connection due to thickness.

Mosaad El-Diasity [19] Said explained about slab above foundation differs from load transfer. In masonry wall it gives both deformations as flexural and shearing. Ferrocement and expanded mesh and sheets of glass woven textile fibre (GFRP). The walls were made and tested up to failure under a combined constant vertical load and in-plane cyclic lateral load. If the structure was damaged load carrying capacity become decreased. In this composite material as adhesive with different arrangement were used and also increases in strength of the structures and occurs in diagonal cracks. They concluded that finite element models showed good agreement with the maximum load and also with less deflection with number of mesh layers were used. Increase in fibre increases the stiffness and flexural strength.

R. Alavez-Ramirez [1] explained about coconut fibre ferrocement were developed. As the cement mortar reinforced with layers of a continuous mesh grid. Coconut fibre and other roofing material as ceramic tiles and aluminum sheeting were added in slab exhibit low thermal conductivity and reduce heat transferred into building. In addition to natural fibre exhibit good insulating property. The experimental analysis performed in this study was based on dynamic climatology; Results indicate that, coconut fibre filled precast ferrocement roofing channel components experience higher solar radiation intensity. In Mexico, Sinaloa, Michoacán, Jalisco, account for around 90% of the coconut production. After being dried, coconut fibre used as thermal insulator filler. Results obtained that the highest temperatures are present during summer and winter season. They concluded that ferrocement fibre has energy saving and thermal comfort in building. It is calculated through its decrement factor as,

$\mu = T_{in} / T_{out}$

Behera, G.C., Gunneswar, R.T. [3] described about enhance the load bearing capacity as well as to increase the life span of the structure. In the recent past 3Rs of construction Technology (Retrofitting, repair and Rehabilitation) has been used. U-wrap retrofitting used in beams and slabs which enhance the ultimate torsion strength. Ferrocement, a thin structural composite material, exhibits better crack arresting capacity, higher tensile strength to weight ratio, ductility, impact resistance and has better strain distribution, crack arresting capacity. Ferrocement with U-wrap shows better strength and durability reinforcement. An experimental investigation is conducted to address the torsion capacity and twist of reinforced concrete beams. The increase in torsion strength over the number of layers for longitudinal reinforcement is very less. The increase in number of layers of mesh reinforcement in the ferrocement has the better strength in reinforcement and crack will be developed in vertical direction.

Bo Li [18] explained about Ferrocement, comprising mortar and wire mesh, was applied to replace concrete cover to enhance shear strength. Diagonal reinforcements were installed to reduce the forces transferred to the joint. Ultra high strength steel bars were used as diagonal reinforcements with measured yield strength at 800 MPa. Types of mortars were used in the ferrocement, including cement–sand mortar, cementations mortar and epoxy-based mortar. Thus epoxy resin plays an important role, Thereby compactly spaced small numbers of wire mesh layers were used for the improvement of strength and durability of slab panel. As the load can been applied flexural cracks were developed and observed in vertical deflection of columns, epoxy coating will be used to decrease number of cracks and improves strength. They concluded that with the displacement cycles, crack was not observed in the columns (or) slab. In general, stiffness of strengthened specimens increases with increasing strength of mortars. Loss of stiffness can be attributed to deterioration of concrete and ferrocement in the joint, anchor bolts improved between ferrocement and concrete for better bonding strength.

Yavuz Yardim [29] emphasizes the use of Autoclaved Aerated Concrete (AAC) panel was used with proposed light weight slab by comparing with that of conventional concrete slab. Weight reduction was achieved by replacing the core of panel with low density concrete. Compared to other conventional slab AAC composite slab panels reduce energy consumption of buildings. In addition AAC act as light weight and thermal insulator. The ferrocement layer of composite slab consists of a wire mesh to resist the tensile stresses. Wire mesh of size 12.7 mm with diameter of 1.1 mm was used. Test on the specimens were carried out on the Universal Testing Machine. Results show that the density of aerated autoclaved concrete was found as 5.8 kN/m3 and compressive strength was found to be 6 N/mm2 than conventional concrete. They also concluded that increase in mesh layer increase in strength and density has been improved as when compared with ordinary concrete or without mesh layers in slab panel. Ferrocement used in slab panels reduces the number of crack and enhances the energy absorption, ductility. It was found that no horizontal cracks were developed over slab panels, generally with micro cracks available.

Yerramala, A. [30] explained about mortar with OPC of 43 grade and metakaolin mortars with 5–25% metakaolin replacement. Ferrocement was a hydraulic cement mortar which requires a compactly spaced Chicken mesh incorporated in one, three and five-layers to investigate the influence of reinforcement, flexural strengths were higher than control ferrocement at all curing ages and for all mesh layers. It was found that 10% metakaolin is the optimum content for maximum flexural strength. With this mortar mixed would be as (i) portion of design water poured into mixture drum; (ii) cement and metakaolin gently placed; and (iii) sand was spread over the powder and started mixing. Thus in the first 7 days of curing, the rate of strength gain for control ferrocement was 62% and for metakaolin ferrocement it was between 53% and 67%. They conclude that highest strength gain was for 10% metakaolin replacement. Increases in the number of mesh layers enhance the flexural strength of the ferrocement for all metakaolin percentages and for all curing ages. It found that use of small layer of wire mesh produce better strength, load carrying capacity. Experimental results revealed that addition of metakaolin in slab gives strength of 15-55% as when compared with ordinary conventional concrete.

Chee Ban Cheah [7] explained high calcium wood ash (HCWA) used in ferrocement slab panels. The ferrocement panels contained varying HCWA cement replacement levels from 2% to 10% by wood ash. Acid corrosion were used to avoid corrosion. The number of cracks developed with measurements of average crack width, crack spacing and failure mode. The flexural response of ferrocement panel fabricated using wire mesh reinforcements and high performance mortar. Crack width occurs on the centre to centre of wire mesh in slab panel. All test variables of the specimens remained constant except the percentages of high calcium wood ash incorporated as a partial cement replacement material in the high performance mortar matrix. Tests on water gives $P_{H\ value}$ ranges from 6.5-7.5. Ductility performance of ferrocement panels can be enhanced by the use of HCWA in the mortar matrix and flexural stiffness of the fabricated ferrocement panels.

R.H. Haddad [14] explained about the slab with steel fiber reinforced concrete (SFRC) layers from 79% to 84% with a corresponding increase in stiffness. As the use of steel fiber in concrete shows increase in load carrying capacity and reduces the deflection. HBCS fiber in concrete shows the highest tensile strength and stiffness. Micro cracks were developed in compression side (top view), tension side(bottom view), mid side. Damages were based on

- extensive surface cracks that penetrate across depth;
- possible spalling;
- upward cambering of surface; and
- Plastic deformation of reinforcing steel.

As composite materials with unbounded fiber reinforced polymer sheets and rods were used in strengthening one and two-way slabs. The ultimate load capacity for slabs with CFRP and GFRP exceeded that of controls by 58% and 29% with a corresponding decrease in deflections by 66.5% and 45.1%, respectively. The stiffness showed significant improvements by about 219% and 97%, while the flexural toughness was reduced by about 55.5% and 44.6% respectively.

Waleed A. Thanoon , Yavuz Yardim [27] explained about the slab panel consists of two layers joined together, the first layer is a precast ferrocement layer which acts initially as a formwork, while the second layer consists of bricks and mortar. As ratio increases produce large deflection and gives warning before failure. The results in terms of load–deflection, crack pattern, strain distribution and failure loads. Deflection under the middle-third and the cracks were marked with the progress of the applied load and two layer starts to separate by forming horizontal longitudinal cracks. Increasing load is due to cracking of concrete in ferrocement layer, cracking of the mortar in the connector embedment regions and yielding of steel reinforcement. Increase in ferrocement layers in slab panel increases the strength with or without addition of fibre.

Waleed A. Thanoon, M.S. Jaafar [26] described about Major cracks in concrete structures may occur due to overloading, corrosion of reinforcement. Cracking of concrete and spalling of the reinforcement occurs due to oxidation process also. The slabs were loaded to failure stage and the structural response of each slab specimens have been predicted in terms of deflection. Fibre reinforced plates (FRP) increase the strength of flexural members and increases the structural capacity of members, whereas use of Carbon Fibre Reinforced Polymer increases the strength to its weight ratio and increases the flexural capacity with the load carrying capacity ranging from 60-40%. Percentage of wire mesh increases there occurs slight deflection and micro cracks. This paper explains that bottom surface of the slab was roughened and a number of holes have been drilled to a depth equal to the effective depth of the slab. Tests showed that at the mid span deflection is decreased where as increases in stiffness. Slabs having higher cracking and ultimate loads and ferrocement layers showed higher strength and ductility performance. Experimental results show first crack load, cracking pattern and ultimate load. Test was remained constant until the specimen has been collapsed.

A.W. Hago [13] explained the ultimate and service behavior of ferrocement roof slab panels. Ferrocement slab panel with compactly spaced welded wire mesh with the thickness of 10 to 25mm respectively. Because of small sized ferrocement slab panel the meshes were arranged at the middle and strength can be calculated. The parameters of study include: the effect of the percentage of wire mesh reinforcement by volume and the structural shape of the panels on the ultimate flexural strength, first crack load, crack spacing and load-deformation behavior. Multiple cracks in slab panel occur only after the concrete gets collapsed. Ferrocement construction can be easy but with high labors and used in floor decks, swimming pools, water towers, and small deck bridges. Yavuz Yardim [27] stated that Cracks found were less in compactly arrangement of mesh layers in slabs. At each load increment cracks found on the underside of the ferrocement slab panels. They concluded that there are large deflections compared to the small thickness of the panels. Cracks found less in ferrocement slab panel with mesh as when compared to ordinary slab concrete.

A. Masood, S. Akhtar [20] [22] discussed about the performance of ferrocement panels under normal, moderate, and hostile environments, there occurs corrosion of reinforcement and reduce the life of the structures. Fly ash, a waste material, was also used as partial replacement of cement. The ferrocement slab panels cast with varying number of woven and hexagonal mesh layers were tested under flexure. It includes 1. First pouring of cement mortar 2. Mesh layers were arranged in different layers. Compressive and tensile strength of control specimens and load-carrying capacity of the panels under flexure with and without fly ash were investigated. It was concluded that the presence of NaCl increases the crack width. The results revealed that specimens with low water cement (w/c) ratio exhibited less corrosion, the panel constructed in such mesh layer with a curing period of 28 days and tested shows first crack load, ultimate load, and deflection at various stages. In ferrocement panels with woven and hexagonal wire mesh, multiple cracks are formed. The strength of panel increases with fly ash dosage in saline casting and curing condition.

Shaaban, I.G. [24] emphasizes about the welded wire mesh in slab panel. In order to study the flexural behavior of Ferro cement, sandwich panels have been used. There occurs a shear transfer in panels as horizontally, and there was a stiffness strength increases with deflection decreases. Ferrocement panel with different thickness and number of mesh layers used have a superior cracking pattern and increases the flexural strength. Load increases with decreases in the stiffness, horizontal cracks were formed over the whole span. Use of different wire mesh layers in slab panel it undergoes the cracking pattern at bottom of slab. Use of fine aggregate in concrete also depends on strength increment. Test conducted in fine aggregate were specific gravity and water absorption. It also shows that water absorption with 2.0% gives optimum strength. The result revealed that good arrangement of wire mesh layers in slab panel shows crack pattern and also gives strength higher as when compared with sandwich panels.

Douglas Tomlinson [28] described about flexural response of ferrocement slab panel. The compactly spaced wire mesh includes parameters as diameter, shear modulus and steel reinforced polymer or fibre reinforced polymer. Use of this fibre reinforced polymer concrete posses the low thermal conductivity. The sandwich panels were used in concrete and tests used were four-point bending. Insub Choi [10] Due to load condition in slab panel there were increase in stiffness and shows that load increases with decrease in deflection. Use of steel fibre in concrete gives high tensile strength. It also shows that increase in fibre increases the load carrying capacity.

Diasity, M [11] discussed about Glass Fibre Reinforced Polymer (GFRP), Steel Fibre Reinforced Self-Compacting Concrete (SFRSCC). It also revealed that slab panel with small size has more efficient for handling, bent wire connectors, decreasing the thermal efficiency of the slab panel. Replacement of GFRP with metal wire showed the high thermal behavior. SFRSCC reinforcement in addition of mesh layers presents high crack-width capacity, ductility, impact resistance, and water tightness of the slab panel. Thus the crack width limited to 0.3mm. Thickness of the mesh layer varies according to their building structure and improves the flexural strength. In SFRSCC under point load, load transfer between steel fibre and then transfer to the mesh layers. As minimum thickness provided in concrete it gives more effectiveness, Different GFRPs used and gives tensile strength, stiffness and stress–strain relationship. The result revealed that high load capacity, maximum tensile stresses, minimum deflection and gives good performance. It revealed that use of SFRSCC and GFRP has more efficient gives better strength and micro cracks were available.

Hamid Kazem [16] described about addition of high degree Carbon FRP. Load transfer mechanism includes parameters such as grid length, type and their thickness. Testing of panel under flexural without carbon FRP strength of the panel will be decreased. It also reviewed that spacing between CFRP increases strength and interface area but there were decrease in strength of the panel. Fibre used was glass fibre produce more creep than carbon fibre. Slab panel with these fibre were under flexural loading produce ultimate load carrying capacity greater than 20%, 30%,50% in short duration. As the strength decreases there occurs deterioration of structure with the decreasing in life of structure. Thus air voids in concrete will reduce the bond between concrete and form. Thus use of these fibre increases 30% of the ultimate shear strength capacity in the slab panel.

A. Benayoune [5] evaluated about precast concrete sandwich panels (PCSP) under flexural. As compared with solid slab panel it gives mode of failure and crack pattern in PCSP were similar. PCSP placed vertically between foundation and roof, as the load applied vertically in panel. Application of load in panel gives strain distribution as fully composite, partially composite. A.A. Abdul Samad [5] Specimen were placed in correct position with application of load and found the crack pattern. In addition strain gauge and dial gauge were fixed for obtaining strain pattern. As the load applied in mid-span and find the first crack and deflection compared with one way slab panel. It was noticed that elastic theory plays an important role finding the crack pattern occurred. It includes that varying thickness posses the various load carrying capacity. It concluded that use of PCSP was similar to solid slab panel with slight variation in strength.

Rockwood, D. [21] described about use of fiber-reinforced cementations composite (FRCC) which provide thermal comfort, narrow floor plate and ventilation. It plays an important role in modular housing system as Elevated floor, Natural ventilation for positive aspects of strength and durability. Fiber reinforced cementitious composite (FRCC) decrease construction waste and disposal problems. FRCC and epoxy resin used for corrosion protection, mainly bolted connection were used. It was used in roof improves thermal comfort and structure can be remolded. Different use of fibre in concrete with different proportions shows shear strength and less deflection. It was observed that addition of fibre will improve the load carrying capacity and reduce deflection as when compared with presence of fibre.

Insub Choi [10] explained about use of glass fibre reinforced polymer grid produce initial stiffness and ultimate strength with that mechanical properties were included. The result indicated that bond occurs between slab panel and glass fibre reinforced polymer grid, addition of glass fibre reinforced polymer grid improves the design strength. It provides low thermal conductivity indoor and outdoor of the concrete. In slab panel to avoid corrosion epoxy resin with 31% and glass fibre with 69% has been used to achieve corresponding strength, as load increased the bond break between concrete and fibre.

III. Summary Conclusion

Based on the results obtained, the following conclusions were made,

a. They concluded that flexural strength increases with the increase in number of mesh layers i.e., flexural strength of slab panel with 7 mesh layers are higher when compared to the slab panels of 5 and 3 mesh layers.
b. They concluded that increasing the number of layers of wire mesh from three to seven significantly increases the ductility and capability to absorb energy of the panels.
c. They concluded that Slab panels casted with the addition of polypropelene fibre have reduction in crack width and increases the flexural strength of the panels.
d. They concluded that initially the central deflection of the slab panel goes on reducing while increase in number of mesh layers.
e. They concluded that slab panel having crack width was narrow in considered.

f. They concluded that it achieves higher stiffness, cracking moment.
g. They conclude that slab panel has better service load and reliability.
h. Increase in mesh layer increases the flexural strength and decrease the deflection.
i. They concluded that ferrocement structural elements involved in this study are having a simple cross section and helps in simple formwork.
j. They conclude, use of ferrocement with mesh layers gives more flexural strength, stiffness as when compared to conventional concrete.

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