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STRUCTURAL BEHAVIOUR OF FERRO-CEMENT SLAB PANNEL UNDER FLEXURE

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Ferrocement is a construction material comprising wire meshes and cement mortar. It has a wide range of applications in the construction industry due to its lightweight nature, reduced dependency on skilled labor, and absence of the need for frameworks. Ferrocement is a type of thin-wall reinforced concrete commonly constructed of hydraulic-cement mortar reinforced with closely spaced layers of continuous and relatively small wire mesh. The mesh may be made of metallic or other suitable materials.

The various applications of Ferrocement encompass the following: Housing components, including roofs and walls. Boat hull construction.Water tanks and reservoirs.Sculptures and art installations.Prefabricated elements in construction. Marine application of ferrocement finds use in constructing boats, finishing vessels, barrages, docks, floating buoys and fuel or water tanks. Ferro cement is advantageous for marine applications because it fulfils the marine requirements of water tightness, slight thickness, impact resistance and lightweight.Ferrocement is used to construct water tanks, well casings, lining of swimming pools, sedimentation tanks and septic tanks. Ferrocement is used in manufacturing reinforced concrete, prestressed concrete, columns, slabs, beams and many such structures.

Ferrocement concrete has a large specific surface of reinforcement, whereas reinforced concrete has comparatively a low specific surface of reinforcement. RCC uses steel bars or mesh for reinforcement, while ferrocement utilizes fibers of various materials. Ferrocement enhances properties like toughness and crack resistance due to the inclusion of fibers, whereas RCC's improvement in strength primarily relies on steel reinforcement. It has a higher ratio of steel to cement than conventional concrete. Ferrocement is stronger and more flexible than concrete alone.

1.2 SCOPE OF PROJECT-

A extensive research has been carried out for the ferrocement slab pannel over the past years. Parametric design of ferrocement slab pannel, various thickness of ferrocement slab pannel, various mesh layers of ferrocement slab pannel were analysed for ferrocement slab pannel,etc.

From the review of research ,it is noticed that the researchers have been analysing ferrocement slab pannel with changing parameter individual cases has been carried out like various thickness of ferrocement slab pannel,referring various thickness of slab pannel under two point loading .Combining all parameter are not considered i.e., span to depth ratio different cross section and different point loading under simply supporated,cantilever etc. In the current project it is proposed to carry out combinations of said parameter to obtain the suitable slab panel.

An attempt is to made obtain a suitable cross section of slab pannel of various thickness and various mesh layers for combination of various load to deflections ratio under two point loading.

1.3 Aim & objective

Aim

To investigate the structural behavior of ferro-cement slab panel under flexural variation in mesh layer and panel thickness.

OBJECTIVES

1. To design of ferrocement mix proportion as per available is codes.
2. To calculation of tensile strength of expanded metal mesh which is used ferrocement slab panel.
3. To study the effect of variation in number of mesh layers on the flexural strength of slab panels.
4. To study the effect of variation in panel thickness on the flexural strength of slab panels.
5. To study of stress variation over the cross section of the panels.
6. To comparison analysis of flexural strength of various slab panels.

1.4 Layout of Thesis

The thesis presentation has been organized in six chapters.

1. In chapter 1 , brief introductions and singnificance of he presents research along with aim,objective and scope of research is presented. Layout of thesis presented in this chapter.
2. Chapter 2 explains the literature review related to the problem under consideration. Summary of literature review and gap in the literature studied and included in this chapter.
3. Chapter 3 titled as 'Research Methodology', gives the flow of the current research. It contains of ferrocement ingradients,various slab thickness various mesh layers ,different slab panel cross sections experimentally studied.
4. Chapter 4 gives detail of problem formulation. Flow of work and different cross Section of ferrocement slab pannel size and various thickness and layer used for study is also given in this chapter.

5. Chapter 5 'Results and discussion' deals with the output for various cases for deflection and flextural crack strength and ultimate crack strength obtained. This chapter includes discussion on cases considered for study, effect of span to depth ratio for deflection various thickness and various mesh layer, maximum flextural strength and ultimate strength induced in said cross section also discussed.
6. In chapter 6 conclusion of the research work along with recommendation for optimization of cross section of ferrocement slab pannel are given. Scope for future study is also included in this chapter.

Bibliography and details of research publications based on the research work is given at the end.

CHAPTER 2

LITERATURE REVIEW

2.1 General – Ferrocement, a composite material consisting of cement mortar and layers of mesh or small-diameter rods, spans various research wings, including:
Material Properties and Behavior, Investigating mechanical properties, durability, and performance under different environmental conditions.Construction Techniques and Applications: Exploring innovative methods for construction, application in housing, infrastructure, and marine structures.Structural Engineering: Studying load-carrying capacity, structural behavior under static and dynamic loads, and optimization of design parameters.

Durability and Maintenance: Researching durability mechanisms, corrosion protection strategies, and long-term maintenance requirements.Sustainability and Environmental Impact: Assessing environmental benefits, life cycle analysis, and sustainable practices in ferrocement production and application.Innovative Applications and Design: Developing new applications in architecture, art, automotive, aerospace, and other emerging fields.

Each wing contributes to advancing ferrocement's understanding, applications, and potential for sustainable and durable construction solutions.The staggered fashion reinforcement pattern by use of wire mesh plays important role for proper distribution of stresses as compared to the concentrated reinforcing pattern of conventional reinforced concrete with steel bars.

Thus, ferrocement will be a good alternative material for construction of future siphon troughs overcoming the problems faced by conventional siphon.Ferrocement (also call Ferro-concrete) is a rich or composite mortar plaster applied to both sides of a thin and well distributed reinforcement layer (usual a layer metal mesh) normally plaster of 1:2 cement mortar should be applied to a matrix structure made of weld mesh would round the chicken mesh**.** On the basis of experimental and analytical observations, the remarks are carried outs as ferrocement can be formed into any shape and size, it can be formed into arch shape and arch action can be utilized in the construction of the trough slab of siphon.

By using the shell shape for trough slab, tensile stress generated in straight slab gets converted to compressive stresses due to arch action of the shell shape. As the thickness of ferrocement section is very small, dead weight also reduces which reduction in the weight of the structure. From the studies made on conventional reinforced cement concrete, it has been observed drawbacks like inconsistent quality, strength and also the mold ability is not possible with R.C.C. for irregular shapes and profiles. Water exerts lot of load and stresses on the trough slab, which is resisted by conventional RCC trough slab by adopting large thickness. From the observations, it can be concluded that deformations in RCC are more as compared to ferrocement.

2.2 REVIEW OF LITERATURE

M.Amala , Dr.M.Neelamegam [1] This was a study and compare the structural behavior of Ferrocement slabs of different ratios and its mechanical properties. The Ferrocement slabs are made by using cement and copper slag with constant layers of welded meshes. Copper slag is a waste material that is abundant and which is hard to dispose off. Copper slag provides considerable strength and its mechanical properties are quiet convincing. Performance of the tested slabs are presented and discussed in this project. Normally for a Ferrocement slab, 3mm dia. welded wire fabrics are used for construction, in this study very small dia. wires (1mm) and also closely spaced (10 mm) wires are used in order to increase the ductility properties and also durability related properties of Ferrocement. Very fine powdered form of copper slag has been used in this project. The flexural properties of these Ferrocement slabs are evaluated and compared under four point static loading system using specific test setups and comparative study of the test results confirm that Ferrocement slabs made of copper slag are more effective in flexural strength and other mechanical properties

Mr.K.Soundhirarajan [2] This project had been undertaken to study the role of Ferro cement slab panel with wire mesh. The impact, ductile strength and properties of the slab panel were determined, the slab panel is prepared by 1:3 cement mortar with the dimension of 1.20mx0.45mx0.025m. Three different spacing of reinforcements slabs are prepared by using 2.5mm, 5mm and 7.5mm wire mesh and one slab panel by providing chicken mesh with nominal reinforcement. The objective of the work is to minimize the size of the slab to reduce the dead load. This type of slabs is applicable for advance architectural structure. It consist of closely spaced, multiple layers of mesh or fine rods completely embedded in cement mortar. In this type of materials, strength can be increased by adding admixtures.

Ali Kadhim Sallal [3]This research included studies the compression, flexural, fatigue and impact effect on Ferro-cement panels. Ferro-cement has many advantages over conventional reinforced concrete such as improvement in tensile and flexural strengths, ductility, impact resistance and crack arresting properties. Ferro-cement construction was widely accepted in the (Australia- New Zealand- and the United Kingdom). For example In Israel, Ferro-cement is used to improve existing houses and In the Sri Lanka, Ferro-cement houses resistant to cyclones are developed and constructed. The matrix of Ferro-cement is usually cemented mortar, consisting of cement, sand, water and perhaps some additive. The modulus of elasticity of Ferro-cement increases with the increase in the fractional volume of reinforcement and the ultimate strength is mainly determined by the compressive strength of the mortar. Ferro-cement specimens reinforced with un-galvanized welded mesh and water cured showed better flexural fatigue results than those reinforced with galvanized welded mesh and steam cured.

Manish Hajare Dr. M. B. Varma[4] The past study describes the results of testing ferrocement panels reinforced with of different types of meshes. The main objective of the study was to investigate the effect of different types of meshes as reinforcement in thin mortar specimen and select the best suitable mesh for further work. Types of meshes were used expanded metal mesh, galvanized woven mesh and welded mesh has a diameter of 1.58 mm. Size of openings are 20x35 mm, 10x10 mm and 15x15 mm. Panels of a size of 560x150x35 mm were reinforced with three layers of wire mesh. Panels were casted with mortar of mix proportion 1:2 and water cement ratio 0.40. The four specimen were tested under four point loading system on universal testing machine after curing period of 7 days and eight specimen after curing period of 28 days. Test results shows that the flexural strength of the specimen with welded mesh exhibits greater flexural strength than other two types of meshes.

S. Deepa Shri [5] This paper pasts the details of the flexural behavior of self-compacting concrete (SCC) ferrocement fiber reinforced slab panels. A total of 24 slabs were been tested under flexural loading. The size of the slab is 700 mm (length) x 300 mm (width) x 25 mm and 30 mm (thickness). The parameters studied in this investigation include the fiber content, number of weld mesh layers thickness of ferrocement slabs. Test procedures for self compacting (SCC) have been explained in brief and all the tests have been performed as per EFNARC. From the studies, it is observed that the load carrying capacities, energy absorption, deformation at ultimate load are high in the case of SCC ferrocement hybrid polypropylene fibers. Further, it is observed that there is reduction in crack width and increase in number of cracks in the case of SCC ferrocement hybrid polypropylene fibers indicates delay in crack growth. Flexural tests have been carried out on SCC ferrocement fiber reinforced slab panels. A total of 24 slabs have been tested under flexural loading. The size of the slab is 700 mm (length) x 300 mm (width) x 25 mm and 30 mm (thickness). The parameters studied in this investigation include the fiber content, no. of weld mesh layers thickness of ferrocement slabs.

Mohamad N [6] The past paper describes the results of testing folded and flat ferrocement panels reinforced with different number of wire mesh layers. The main objective of these experimental tests was to study the effect of using different numbers of wire mesh layers on the flexural strength of folded and flat ferrocement panels and to compare the effect of varying the number of wire mesh layers on the ductility and the ultimate strength of these types of ferrocement structure. Seven ferrocement elements were constructed and tested each having (600x380mm) horizontal projection and 20mm thick, consisting of four flat panels and three folded panels. The used number of wire mesh layers is one, two and three layers. The experimental results show that flexural strength of the folded panels increased by 37% and 90% for panels having 2 and 3 wire mesh layers respectively, compared with that having single layer, while for flat panel the increase in flexural strength compared with panel of plan mortar is 4.5%, 65% and 68% for panels having 1, 2 and 3 wire mesh layers respectively.

2.3 SUMMARY AND GAP IN LITERATURE

From above literature following points are to be concluded that….

The load carrying capacities, energy absorption, deformation at ultimate load are high in the case of self compacted (SC) ferrocement hybrid polypropylene fibers.Performance of the ferrocement slab is the high, which is having number of layers chicken mesh with reinforcement.Ferrocement slabs of 2 layers of different mix proportions, 1:2.52 cement with copper slag mix had provided the best results having a greater flexural strength and impact strength.

CHAPTER 3

THEORETICAL FORMULATION.

3.1 GENERAL

Ferrocement exhibits several advantageous properties that make it suitable for various applications:

Ferrocement structures are lightweight but possess high strength due to the reinforcement mesh or rods embedded in cement mortar. It has excellent resistance to cracking and fatigue, making it suitable for structures subjected to dynamic or cyclic loading. Ferrocement can be molded into complex shapes and used for thin-section applications, such as shells, domes, and curved surfaces. The dense network of reinforcement helps in controlling cracks and enhancing the overall durability of the structure.Properly designed and constructed ferrocement structures can exhibit good resistance to corrosion, especially when appropriate coatings or admixtures are used. Cement-based materials inherently provide good fire resistance, which is beneficial in various building applications.Ferrocement construction can be cost-effective compared to conventional reinforced concrete, especially for thin-section elements and complex shapes.

Ferrocement is a composite material composed of the following primary ingredients:Cement: Typically ordinary Portland cement (OPC) or other cementitious materials like blended .

Sand: Fine aggregates, usually sand, are mixed with cement to form the mortar matrixcements (such as Portland pozzolana cement).

Water: Necessary for hydration of cement and to achieve workable consistency of the mortar.

Reinforcement: The key distinguishing feature of ferrocement is the use of a dense mesh or layers of small-diameter steel rods (rebars) as reinforcement. These are placed strategically within the cement mortar to provide tensile strength and improve crack resistance.

Additives: Various additives can be included to enhance specific properties of ferrocement. For example:

Admixtures: Used to improve workability, reduce water demand, or impart specific properties such as accelerating or retarding setting times.

Fibers: Sometimes fibers (such as polypropylene fibers) are added to enhance toughness and reduce cracking.

Corrosion Inhibitors: In marine or aggressive environments, corrosion inhibitors can be added to protect the steel reinforcement.

Expanded metal lath, which is formed by slitting thin gauge sheets and expanding them in the

direction perpendicular to the slits, has about the same strength as welded mesh, but is stiffer and hence provides better impact resistance and better crack control. It cannot be used to make components with sharp curves.

3.2 COMPARISION OF FERROCEMENT AND CONVENTIONAL MATERIAL.

Comparing ferrocement with conventional construction materials such as reinforced concrete or traditional masonry involves considering several key aspects-

Ferrocement: Offers high strength-to-weight ratio due to its dense network of reinforcement and thin-section construction. It can achieve comparable or superior strength to traditional materials with less weight.

Conventional Materials: Reinforced concrete and masonry are generally heavier but can achieve high compressive strength. They are suitable for a wide range of structural applications.

Ferrocement: Known for excellent durability against cracking and fatigue due to its reinforcement configuration. Properly designed and constructed ferrocement structures can resist corrosion and weathering effectively.

Conventional Materials: Reinforced concrete and masonry can also be durable but may require additional measures (such as waterproofing, corrosion protection for reinforcement) depending on environmental conditions.

Ferrocement: Highly versatile in terms of shape and formability. It can be molded into complex shapes and used for thin-section elements like shells and domes, which may be challenging with conventional materials.

Conventional Materials: While versatile, the formwork requirements for reinforced concrete can limit flexibility in shape compared to ferrocement. Masonry offers flexibility in construction but is limited to certain shapes and sizes.

Ferrocement: Can be cost-effective for specific applications such as thin-section structures, curved elements, or where labor costs are a significant factor.

Conventional Materials: Generally competitive in cost for standard construction applications due to established construction practices and availability of materials.

3.3 ADVANTAGES OF FERROCEMENT-

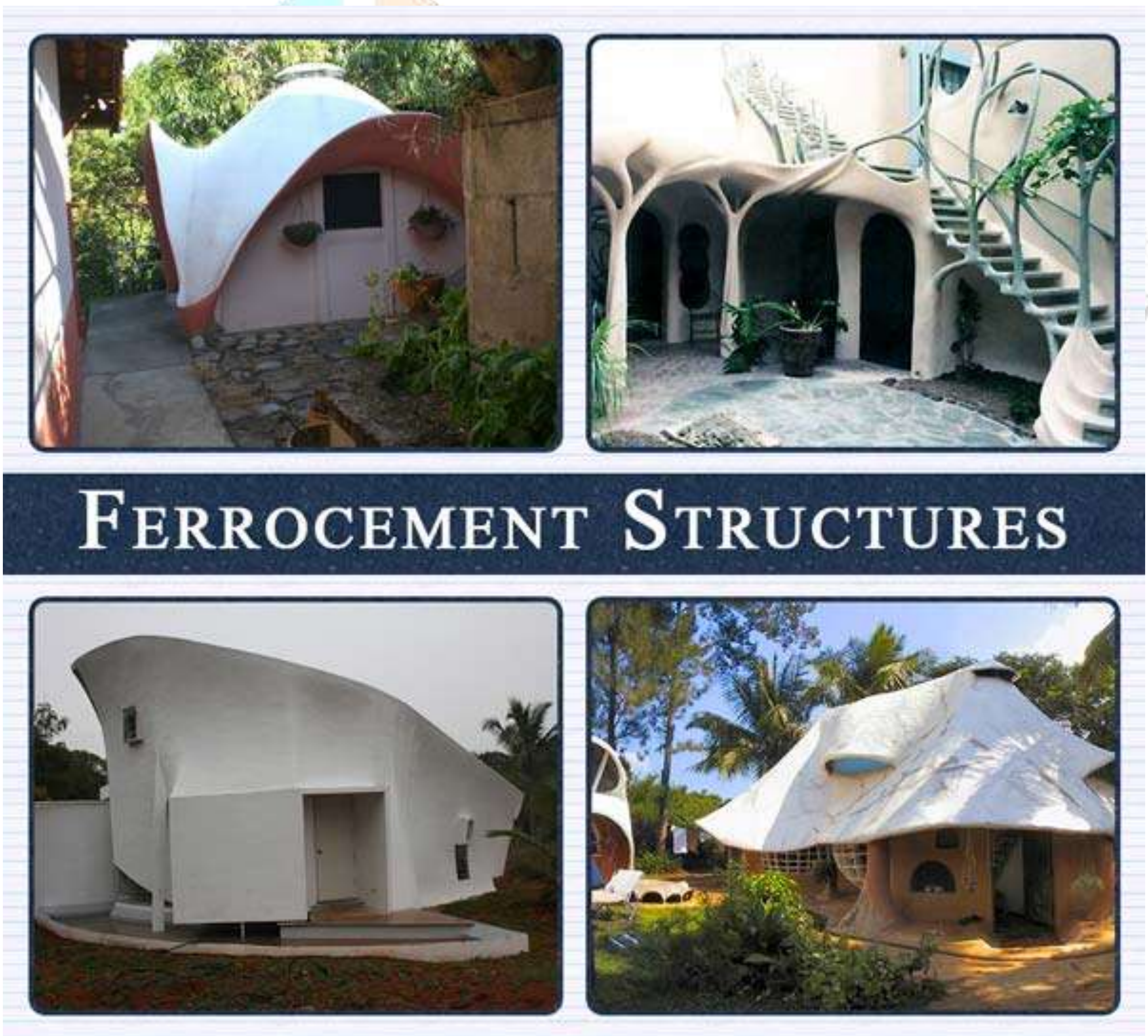
The raw materials used for preparing the ferrocement mix are easily available in most regions. Lightweight construction material. Ferrocement can be moulded into any shape or size. It is more suitable than RCC for this purpose. Requires minimal skilled labor. Absence of formwork reduces construction time. Excellent crack resistance.Versatile application in various construction elements.

The skill level required for working with ferrocement is not very high. With ferrocement, the ease of construction and life of structure increases, whereas the weight is also reduced. The cost of the constituent materials is also low. Ferrocmenet structures have better resistance to earthquakes.

3.4 APPLICATION OF FERRO-CEMENT-

Ferrocement is used for housing, water supply, sanitation, marine, agricultural, rural energy, and permanent formwork structures. Marine application of ferrocement finds use in constructing boats, finishing vessels, barrages, docks, floating buoys and fuel or water tanks. Ferro cement is advantageous for marine applications because it fulfils the marine requirements of water tightness, slight thickness, impact resistance and lightweight. Ferrocement is used to construct water tanks, well casings, lining of swimming pools, sedimentation tanks and septic tanks. In constructing agricultural structures, ferrocement is widely used to build silos, water tanks, pipes, grain storage bins, irrigation channels and linings of underground pits.

Ferrocement is used in housing applications for constructing shelters, sheds, dome structures, wall panels, housing elements made of precast, sandwich panels, permanent formwork, hollow core slabs, corrugated roofing sheets and repair or rehabilitation of existing structures. Nowadays, ferrocement is widely used for rural construction projects like biogas digesters and holders, solar panels and incinerators. Ferrocement is used in manufacturing reinforced concrete, prestressed concrete, columns, slabs, beams and many such structures.



3.1 Fig ferro-cement structure.

4 Chapter

PROBLAME FORMULATION

4.1 GENERAL

Structural engineering is closely connected in analysis of civil engineering structures, often analysis can be performed independently with accurate result. A comparative analysis is performed to get best cross section of ferro-cement slab pannel ,various slab thickness and various mesh layers. In previous chapter we have seen about the theoretical formulation of ferrocement and its ingradients and comparision of ferrocement and conventional materials and flow and methodology is discussed in current chapter.

4.2 FLOW OF RESEARCH WORK:

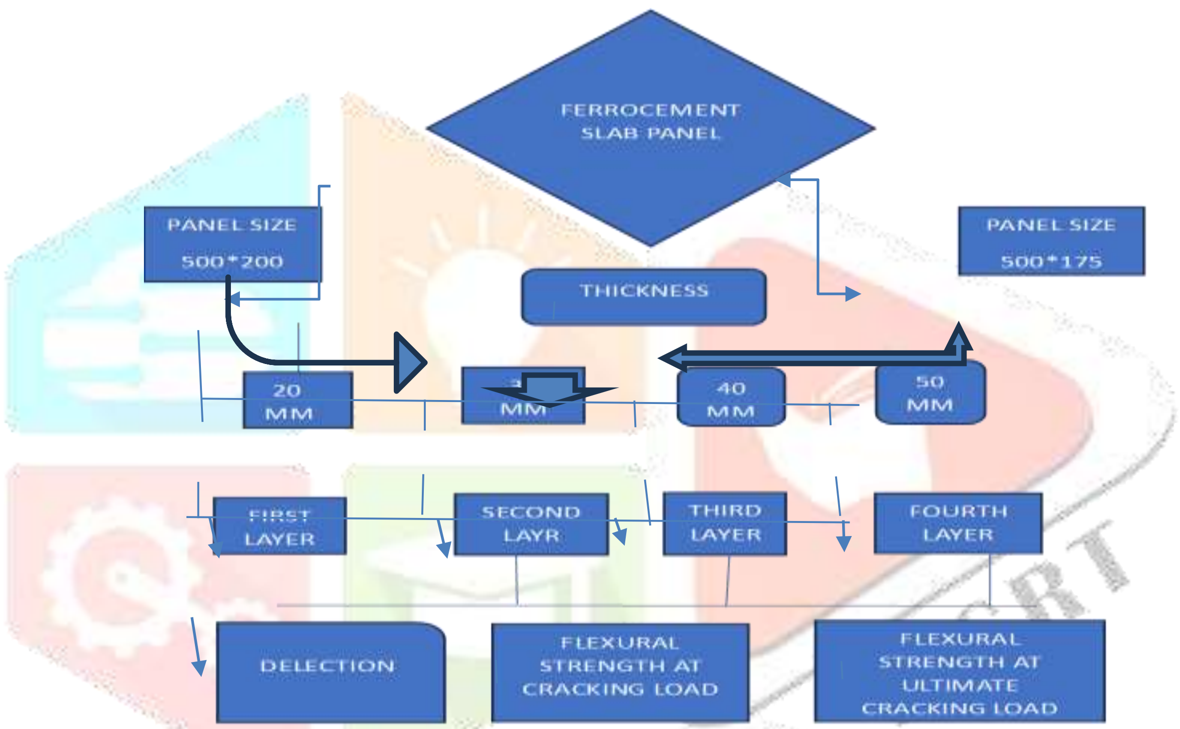


Fig 4.1 Ferrocement slab pannel specification.

4.3 Methodology:

The properties of the compressive strength of mixture, used in the specimens, are shown below:(W/C: Cement: Sand): (0.40: 1: 2) or (Water: Cement: sand And Crushed sand)Nine cubes (70 mm x 70 mm x 70 mm) were tested for specimens to obtain the average compressive strength (*flu*). Cement sand ratio (1:1.75) by weight, Water cement ratio (0.38). For this purpose control cubes of size (70 mm x 70 mm x 70 mm) were casted to achieve 50 Mpa compressive strength. . In this process total 11 trials and in each trial 9 cubes were casted by using cement, water, sand, crushed sand, fly ash and Super plasticizer (Perma PC202). Mix proportion was selected from suitable amount of ingredients in such a way to get a work able and homogeneous mix. Out of these proportions details of finalized mix are as mentioned below.After testing cubes of 11trial proportions the compressive strength of cubes of each proportions were analyzed.

The mixing procedure is important for obtaining the required workability. Materials were mixed manually. Fine aggregate and cement were mixed as dry mix. Next, the water was added gradually to the mixture, and the operation of mixing was continued until homogeneous concrete mix was obtained. The interior faces of the moulds were oiled and then the first layer of cement mortar was poured in moulds. The first layer of mesh was laid with the cover of about 3 mm to 5 mm from bottom, then the mortar was placed and the other layers of meshes were also laid. After placing the mesh, pouring of the mixture continued to the level of the mould and smoothened afterwards. The flexural strength was carried out by using two-point loading test.

4.4 Summary

As per researcher methodology various parameters are considered for analysis of ferro-cement slab pannel . Two different sections with four different slab thickness and four different mesh layers are considered for Analysis. Deflection & flextural cracking strength and ultimate cracking strength are obtained from the analysis from each case considered the obtained results are as per given in Appendix A. Variation of parameters are plotted and discussed in next chapter.

Chapter 5

Results and Discussion

5.1 General

For ferro-cement slab pannel of various thickness and mesh layer are most adopted structural form. The parameters are varying which influences structural performance ofslab pannel, the extensive research survey indicates various parameters as mentioned in previous chapter. Considering various parameters flow of study also discussed in the previous chapter.

Considering these various parameters two cross section of ferrocement slab pannel i.e., size 500 *200 and size 500* 175 is finalized for study. The combination of various thickness & mesh layer and two point loading method and the cases and results obtained are discussed in subsequence section.

5.2 Cases Considered For Study

From the literature review various parameters influencing ferro-cement slab pannel performance are identified and combine effect of these parameter is selected as a task, with this objective size 500 * 200 and 500 * 175 MM cross section offeror-cement for thickness 20mm, 30mm, 40mm & 50mm under simply supporated two point loading variation of actual deflection in comparison with permissible value are plotted and observation are noted in previous section also variation in flextural crack strength and ultimate crack strength are studied and observation are worked out.

Based on observation mentioned in previous subsection conclusion are drawn which are mentioned in subsequent chapter.

The cases obtained from combination of above parameters are studied, and for comparison following terms are defined.

Various thickness and varying number of four mesh layer.

Study of maximum flextural crack strength and ultimate crack strength for simply supporated beam under two point loading.

Study of Deflection for various thickness and various number of mesh layers .

5.3 Effect Of Mesh Layer On Slab Pannel :

A) Slab Pannel Size 500 * 200 MM

Figure 5.1 Variation Deflection against load for 20mm with different layer of mesh curves .

OBSERVATION-

- Variation of mesh layer shows that for when the load on increasing then also increases deflection.
- Thickness of layer increasing then goes on increasing then deflection of slab panel.
- In 20mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility and capability.
- Increasing the thickness of ferrocement slab panels span ratio significantly increases the flexural strength at cracking and ultimate load at cracking.

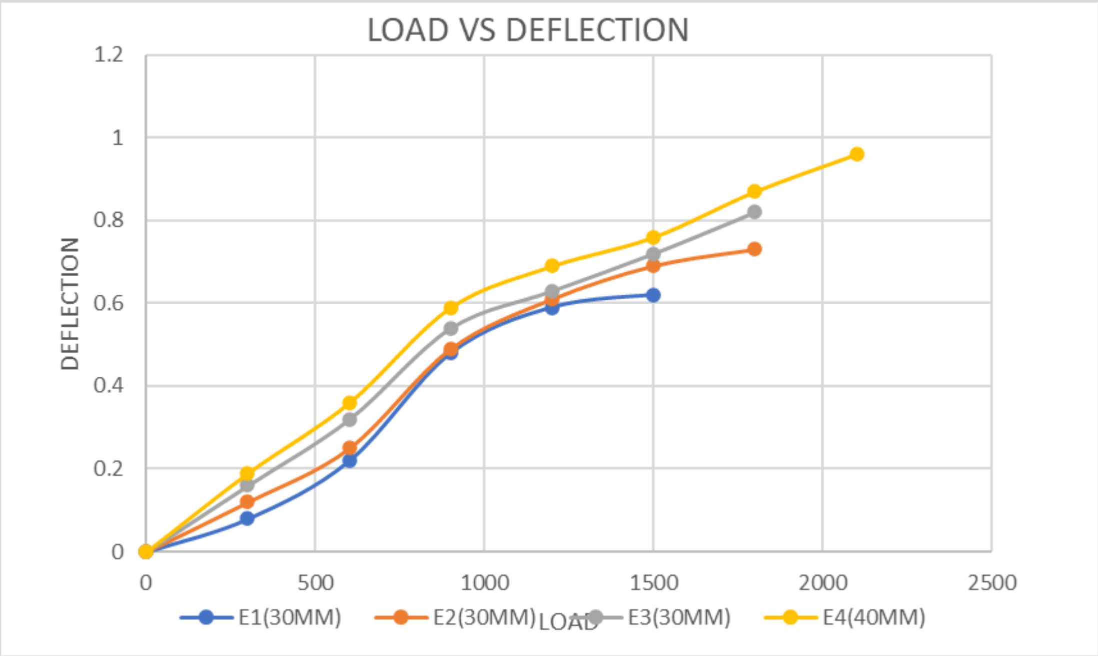


Figure 5.2 Variation Deflection against load for 30mm with different layer of mesh curves

OBSERVATION:

- In 30mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.
- For this 30 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility.
- Increasing the thickness of ferrocement slab panels span ratio significantly increases the flexural strength at cracking and ultimate load at cracking.

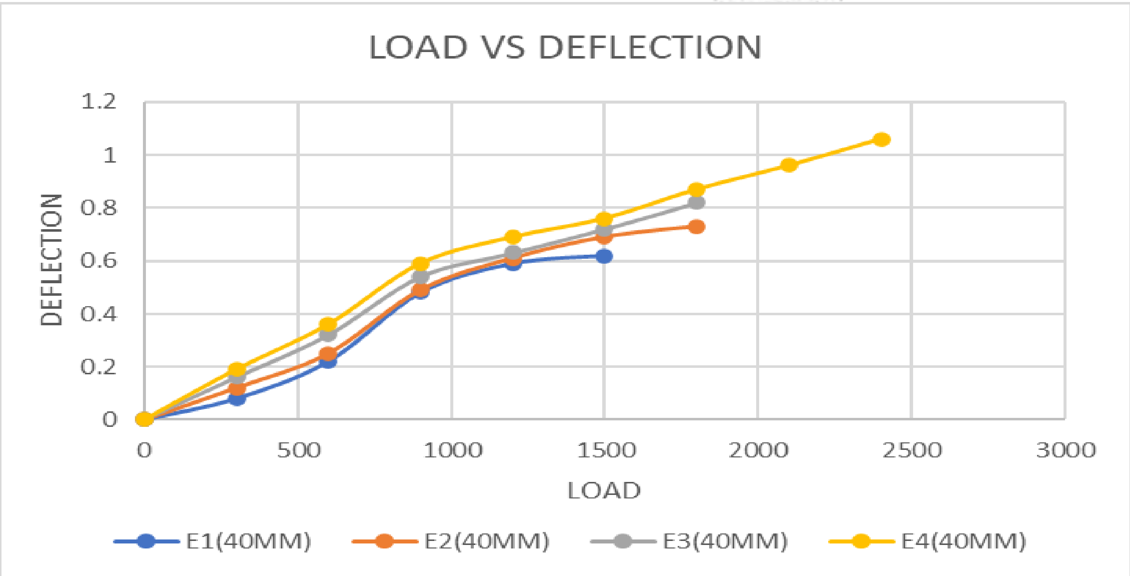


Figure 5.3 Variation Deflection against load for 40mm with different layer of mesh curves.

OBSERVATION:

- In 40mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.

- For this 40 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases**.**

- For this 40 mm thickness of single layer as compared to second layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility of ferrocment slab pannel.

Figure 5.4 Variation Deflection against load for 50mm with different layer of mesh curves.

OBSERVATION:

- Variation of mesh layer shows that for when the load on increasing then also increases deflection.

- Thickness of layer increasing then goes on increasing then deflection of slab panel.

- In 50mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.

- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility of ferrocement slab pannel.
- As compared to single layer to double layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.
- As compared to three layer to fourth layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.

B) Pannel Size 500 * 175 MM

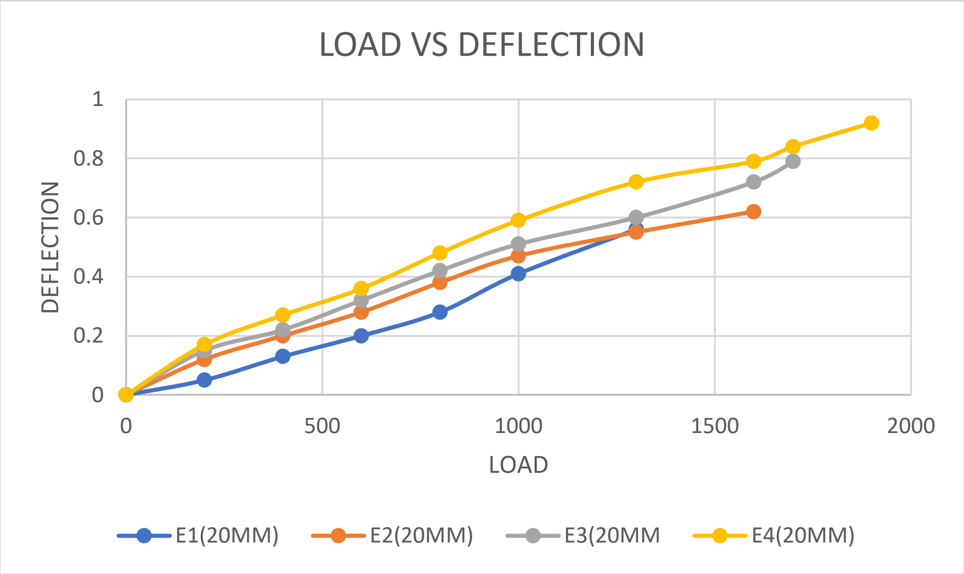


Figure 5.5 Variation Deflection against load for 20mm with different layer of mesh curves.

Observations

- In 20mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.

- For this 20 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.

- For this 20 mm thickness of single layer as compared to second layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.

- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility of ferrocment slab pannel.

Figure 5.6 Variation Deflection against load for 30mm with different layer of mesh curves.

Observations

- Variation of mesh layer shows that for when the load on increasing then also increases deflection.
- Thickness of layer increasing then goes on increasing then deflection of slab panel.
- In 30mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility of ferrocement slab pannel.
- As compared to single layer to double layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.
- As compared to three layer to fourth layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.

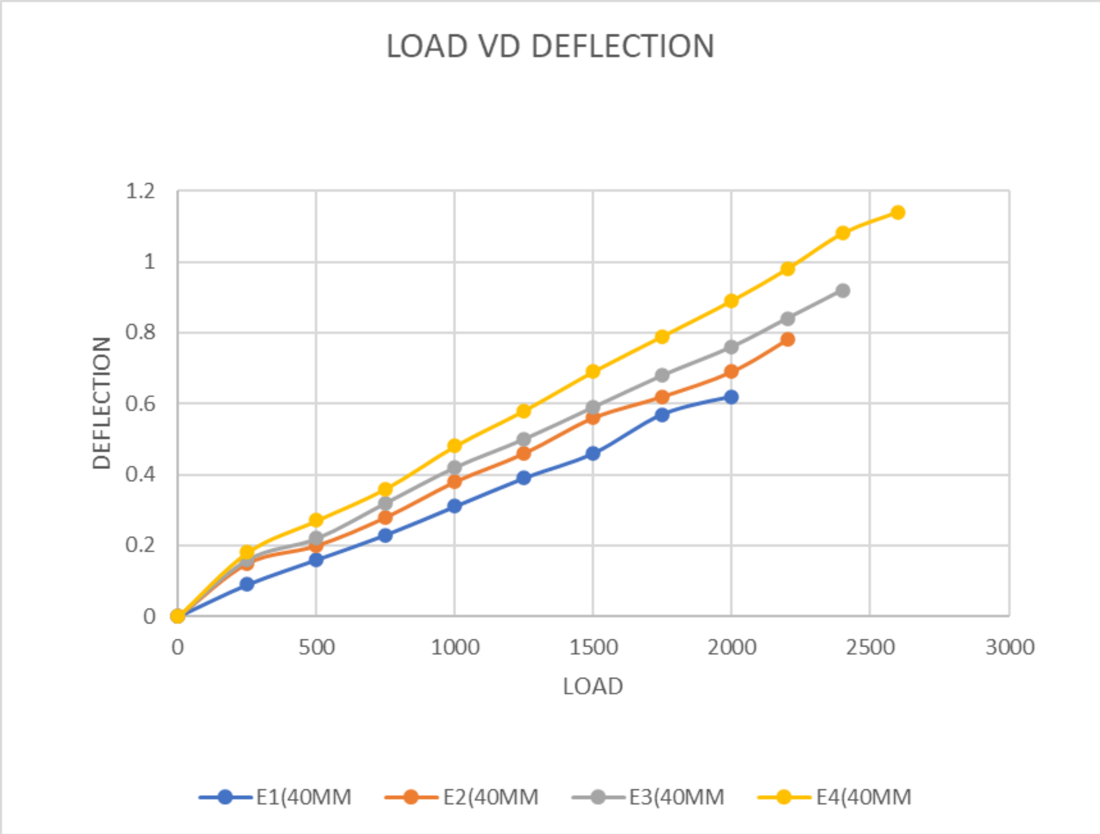


Figure 5.7 Variation Deflection against load for 40mm with different layer of mesh curves.

Observations

- In 40mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.

- For this 40 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.

- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility.

- Increasing the thickness of ferrocement slab panels span ratio significantly increases the flexural strength at cracking and ultimate load at cracking.

Figure 5.8 Variation Deflection against load for 50mm with different layer of mesh curves.

Observations

- Variation of mesh layer shows that for when the load on increasing then also increases deflection.
- Thickness of layer increasing then goes on increasing then deflection of slab panel.
- In 50mm thickness shows that for when the effect of variation in number of mesh layers on the flexural strength of slab panel over the increases.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility of ferrocement slab pannel.
- As compared to single layer to double layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.
- As compared to three layer to fourth layer when load on increasing on ferro- cement slab panel then increases the deflection of slab pannel.

5.4 Effect Of Slab Thickness On Slab Pannel.

A) Pannel Size 500 * 200 MM

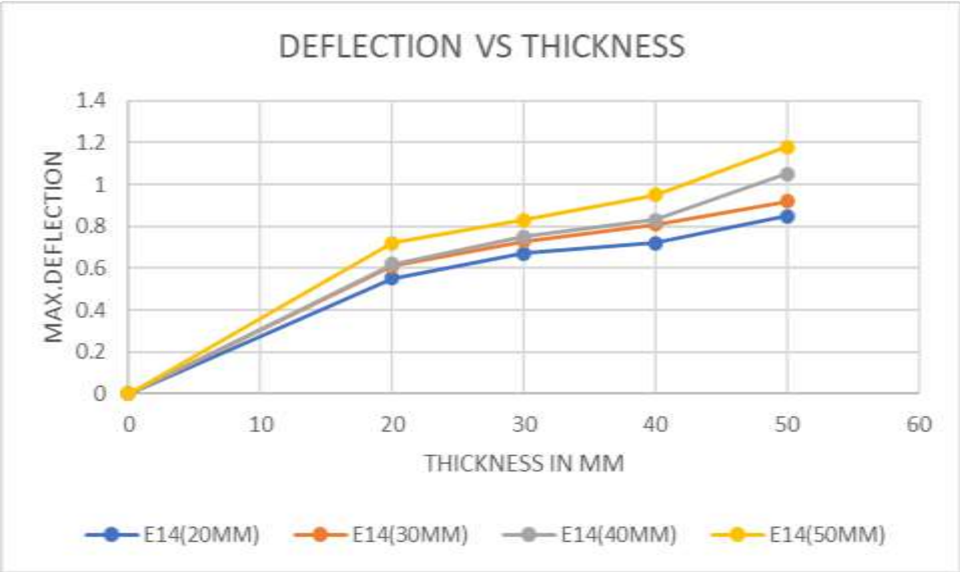


Figure 5.9 Variation Max. Deflection against Thickness for different layer of mesh curves.

Observations

- For this 20 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- In 20 mm thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural strength of slab pannel**.**
- For this 30 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- In 30 mm thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural strength of slab pannel
- For this 40 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- In 50 mm thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural strength of slab pannel.

B) Pannel Size 500 * 175 MM

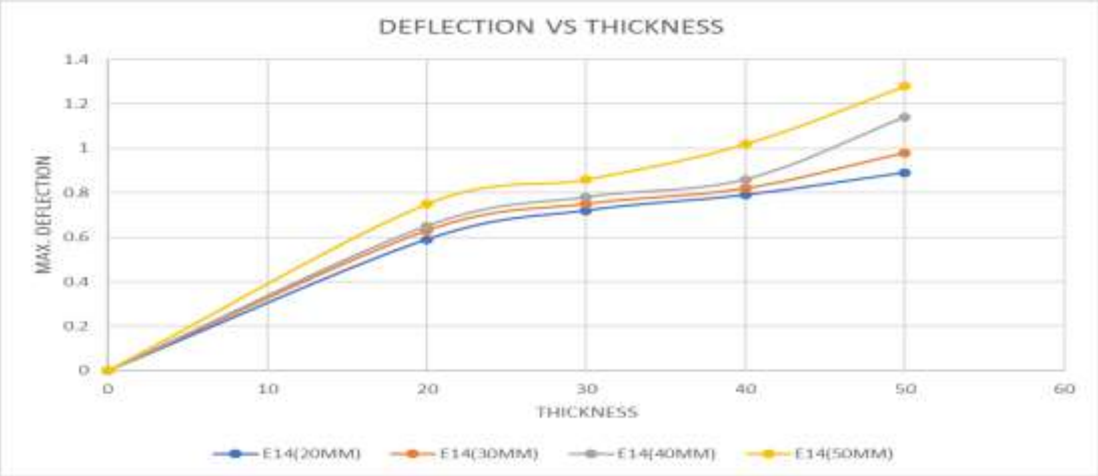


Figure 5.10 Variation Max. Deflection against Thickness for different layer of mesh curves .

Observations:

- In 20mm thickness of Slab pannel when number of mesh layer increases then goes on increasing the deflection of the slab pannel.
- When slab panel thickness increases then also increasing the flextural strength of crack and ultimate strength **.**
- In 30 mm thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural strength of slab pannel
- For this 40 mm thickness of single layer shows that for when the effect of variation in number of mesh layers on deflection of slab panel over the increases.
- In 50 mm thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural strength of slab pannel.

.Avg .flexural strength of ferrocement panels of 550 mmx200 mm dimension

Test group and Thickness (mm)	Compressive strength (28 Days) N/mm^2	Avg. flexural strength at cracking load(σcr) N/mm^2	Avg .flexural strength at ultimate load(σult) N/mm^2
E1(20mm)	**42.95**	**6.75**	**10.125**
E2(20mm)	**42.95**	**6.76**	**10.14**
E3(20mm)	**42.95**	**7.87**	**11.805**

E4(20mm)	**42.95**	**8.43**	**12.64**
E1(30mm)	**42.95**	**10.12**	**15.18**
E2(30mm)	**42.95**	**11.81**	**17.71**
E3(30mm)	**42.95**	**11.88**	**17.82**
E4(30mm)	**42.95**	**13.50**	**20.255**
E1(40mm)	**42.95**	**15.75**	**23.62**
E2(40mm)	**42.95**	**16.87**	**25.03**
E3(40mm)	**42.95**	**18.00**	**27**
E4(40mm)	**42.95**	**20.25**	**30.375**
E1(50mm)	**42.95**	**22.50**	**33.75**
E2(50mm)	**42.95**	**23.90**	**35.85**
E3(50mm)	**42.95**	**25.31**	**37.965**
E4(50mm)	**42.95**	**28.12**	**42.18**

Observation Table:

- The flexural loads at first crack and ultimate loads depend on number of expanded metal mesh layers used in ferrocement.
- As increase in thickness and number of mesh layer, flexural strength of slab panel goes on increasing.
- Increasing the number of layers of wire mesh from 2 to 4 layers significantly increases the ductility .
- Increase in number of mesh layers improves the ductile behavior of ferrocement slabs**.**

Table 53. Avg. flexural strength of ferrocement panels of 550 × 175 mm dimension

Test group and Thickness (mm)	Compressive strength (28 Days) N/mm^2	Avg. flexural strength at cracking load(σcr) N/mm^2	Avg .flexural strength at ultimate load(σult) N/mm^2
E1(20mm)	42.95	5.14	7.71
E2(20mm)	42.95	6.42	9.63
E3(20mm)	42.95	7.71	11.565
E4(20mm)	42.95	9.00	13.5
E1(30mm)	42.95	11.57	17.355
E2(30mm)	42.95	13.50	20.25
E3(30mm)	42.95	15.42	23.13
E4(30mm)	42.95	17.31	25.965
E1(40mm)	42.95	20.57	30.85
E2(40mm)	42.95	23.14	34.71
E3(40mm)	42.95	25.71	38.565
E4(40mm)	42.95	28.28	42.42
E1(50mm)	42.95	32.14	48.21
E2(50mm)	42.95	35.35	53.025
E3(50mm)	42.95	38.57	57.85
E4(50mm)	42.95	41.78	62.67

Observation table :

- As increase in thickness and number of mesh layer, flexural strength of slab panel goes on increasing..
- Increase in thickness of slab panels and increase in mesh layer, central deflection of slab panel goes on reducing.
- The increasing the thickness of ferrocement slab panels span ratio significantly increases the flexural strength at cracking and ultimate load at cracking.

5.5 Summary

All the results data regarding to Ferro-cement Slab Pannel size 500*200 and 500*175 interpreted in this chapter, with of different Thickness, consideration , as well as different mesh layer mentioned in chapter no.4.

Next chapter elaborates all the conclusion of this research work.

Chapter 6

Conclusion

6.1 General

In previous chapter, discussion of all results has been carried out. Cases considered and their results discussed with under two point loading conditions.

In this chapter, results of two ferrocement slab pannel cross-sections sizely 500*200 and 500*175 have been presented. The results presented highlight, the effects of span to depth of slab panel and the cross-sectional shape on the behaviour in terms of development of deflection and flextural crack strength and ultimate strength.

The varied thickness to mesh layer quantitative relation is taken for the analysis of ferro-cement slab pannel, and for all the cases, deflection and flextural crack strength and ultimate strength .

6.2 Effect Of Mesh Layer On Flextural Strength.

1. Form the variation of mesh layer it is deflection of single layer is on lower side that of double layer upto fourth layer and so on.

2. As the span to depth ratio increases the deflection increases.

3. The flexural loads at first crack and ultimate loads depend on number of reinforcing mesh layers used in ferrocement. As increase in thickness and number of mesh layer, flexural strength of slab panel goes on increasing.

4 .Increasing the number of layers of wire mesh from 1 to 4 layers significantly increases the deflection. Increase in number of mesh layers improves the ductile behavior of ferrocement slabs.

5. The load is distributed more uniformly over the entire slab due to the extensive reinforcement, resulting in smaller crack widths compared to plain concrete.

6.For single-layered slabs, cracks and failures were sudden and brittle in nature**.**

6.3 Effect Of Thickness Of Slab Pannel On Flextural Strength.

- Increase in the thickness also affect on the final breaking load for slab panels. Therefore increasing the thickness of ferrocement panels from 20 mm to 50 mm significantly increases the deflection.
- Increase in thickness of slab panels and increase in mesh layer, central deflection of slab panel goes on reducing.
- In variation of thickness of slab pannel as compared to single to fourth layer when layer increasing then deflection increases by layer to layer and effect on flextural Crack strength of slab pannel and ultimate flextural load.
- As compared to slab pannel if Span to Depth ratio increases then goes on increasing the ferro-cement slab flextural strength and ultimate strength .
- As compared to slab pannel ,Span to Depth ratio decreases then decreasing the deflection but goes on increasing the ferro-cement slab flextural strength and ultimate strength.

CHAPTER 7

SCOPE OF FUTURE WORK.

In future the research can be carried out on the following points

- Effect on flexural strength of Ferrocement composite can be studied by varying percentage of steel fibers and using different types of fibers.
- Similar parameters can be studied by replacing cement by fly ash and sand by crushed sand.
- Ferro-cement has many advantages over conventional reinforced concrete such as improvement in tensile and flexural strengths, ductility, impact resistance and crack arresting properties.
- Replacing ordinary steel bars with welded wire mesh in slabs can lead to a considerable cost reduction.
- Similar work can be carried out by keeping different specimen thickness.

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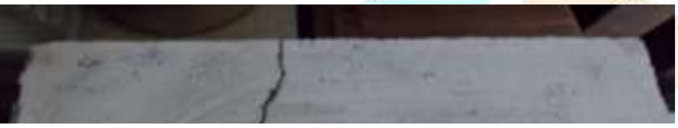
APPENDIX

Top view of crack pattern for 20mm thick panel

Top view of crack pattern for 30mm thick panel



Top view of crack pattern for 40mm thick panel

Top view of crack pattern for 50mm thick panel