Tensile Behaviour of Welded Wire Mesh and Hexagonal Metal Mesh for Ferrocement Application

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Abstract: Tension tests were conducted on welded mesh and hexagonal Metal mesh. Welded Mesh is available in the market in different sizes. The two types are analysed viz. Ø 2.3 mm and Ø 2.7 mm welded mesh, having opening size 31.75 mm x 31.75 mm and 25.4 mm x 25.4 mm respectively. Tensile strength test was performed on samples of welded mesh in three different orientations namely 0°, 30° and 45° degrees with the loading axis and hexagonal Metal mesh of Ø 0.7 mm, having opening 19.05 x 19.05 mm. Experimental tests were conducted on samples of these meshes. The objective of this study was to investigate the behaviour of the welded mesh and hexagonal Metal mesh. The result shows that the tension load carrying capacity of welded mesh of Ø 2.7 mm of 0° orientation is good as compared to Ø 2.3 mm mesh and ductility of hexagonal Metal mesh is good in behaviour.

Keywords: Hexagonal Metal Mesh, Load-Displacement curve, Tension test, Welded mesh.

1. Introduction
Ferrocement is a building material which consists of closely spaced wire mesh impregnated in mortar. This is a very old material but need to be updated from the point of view of different applications. So research work had been carried out to verify the basic behaviour of the welded mesh and hexagonal Metal mesh specified in ACI 549 code [2]. Local market manufacturers are not concerned with quality production so it is required to check the quality before starting any experimental work. Ferrocement structural designers will not be confident for its material properties, so it should meet necessary minimum requirements. On the basis of testing of welded wire mesh and hexagonal metal mesh it is possible to build and design any kind of ferrocement structure.

2. Material Used
2.1 Welded mesh- The Welded mesh of Ø 2.3 mm with opening 31.75 mm x 31.75 mm and 2.7 mm with opening 25.4 mm x 25.4 mm were used for tension test.

2.2 Hexagonal Metal Mesh- Hexagonal metal mesh of Ø 0.7 mm with opening 19.05 mm x 19.05 mm was used for tension test.

3. Experimental Investigation
The main objective of the present investigation was to study the performance of welded mesh and hexagonal mesh samples of tensile strength for different orientation to arrive design inputs for ferrocement casting.
3.1 Preparation of Test set up

Test facility details - Mechanical test set up consists of bed plate, portal frame, 2000 kg capacity servo hydraulic actuator with force transducer. Test fixtures were fabricated using C channels to mount specimens. Instrumentation test set up consists of a multi channel digital controller with data acquisition system, Piston type external linear variable differential transducer was used for displacement measurement. Refer Fig.1 and Fig.2

![Fig.1 Schematic Test set up](image1)

![Fig.2 Laboratory Tension test set up](image2)

3.2 Preparation of test samples

Welded wire mesh is a sandwich between 10 mm MS flat plates and tightening torque was applied to gripping bolts to generate a grip effect in the sandwich joint. Dimensions of gripping plates and number of bolts were selected considering sandwich area grip requirement. The size of welded wire mesh is taken as per clause given in ACI 549 code.

Hexagonal Metal mesh sample is prepared by embedding both sides in a mortar as per clause given in ACI 549.1R-93 code as per clause 7.1.3.

![Fig. 3 Gripping arrangement test sample of welded wire mesh in MS plate](image3)

![Fig.4 Gripping of hexagonal Metal mesh in mortar](image4)
3.2.1 Specimen Sizes for tension test

Specimen of welded wire mesh of Ø 2.7 mm and 2.3 mm, were taken for different orientation as 0°, 30°, 45° and for each orientation three samples were taken. Hexagonal Metal mesh of Ø 0.7 mm was taken for testing. The purpose of different orientation is to know tensile behaviour for proper alignment for ferrocement casting.

4 Results & Discussion

4.1 Testing of welded wire mesh and Hexagonal Metal mesh

Samples of welded wire mesh and two samples of Hexagonal Metal mesh were tested as shown in table no. 1.

The arrangements of test specimens were shown for different orientations, the results of the test specimen are presented in the form of load vs. displacement curves, which represent the average of test specimens.

Table no. 1: Tension test results for welded mesh and hexagonal mesh

| Sr.No | Sample No | Degree | Length - mm | Width - mm | Wire Ø - mm | Spacing, mm | Load - kg | Displacement - mm |
|-------|-----------|--------|-------------|------------|-------------|-------------|----------|-------------------|
| a     | Welded Mesh | 1     | 0           | 570        | 190         | 2.7         | 25.4 X 25.4 | 1700   | 11.70             |
| b     | Welded Mesh | 2     | 0           | 570        | 190         | 2.7         | 25.4 X 25.4 | 1580   | 07.00             |
| c     | Welded Mesh | 3     | 0           | 570        | 190         | 2.7         | 25.4 X 25.4 | 1940   | 11.00             |
| d     | Welded Mesh | 4     | 30          | 570        | 190         | 2.7         | 25.4 X 25.4 | 380    | 104.0             |
| e     | Welded Mesh | 5     | 30          | 570        | 190         | 2.7         | 25.4 X 25.4 | 360    | 107.0             |
| f     | Welded Mesh | 11    | 45          | 570        | 190         | 2.7         | 25.4 X 25.4 | 393    | 162.0             |
| g     | Welded Mesh | 7     | 45          | 570        | 190         | 2.7         | 25.4 X 25.4 | 140    | 112.5             |
| h     | Welded Mesh | 8     | 0           | 570        | 190         | 2.3         | 31.75 X 31.75 | 1132  | 08.96             |
| i     | Welded Mesh | 6     | 0           | 570        | 190         | 2.3         | 31.75 X 31.75 | 1114  | 05.66             |
| j     | Welded Mesh | 10    | 30          | 570        | 190         | 2.3         | 31.75 X 31.75 | 15    | 46.75             |
| k     | Welded Mesh | 12    | 30          | 570        | 190         | 2.3         | 31.75 X 31.75 | 66    | 30.42             |
| l     | Welded Mesh | 9     | 45          | 570        | 190         | 2.3         | 31.75 X 31.75 | 121   | 80.00             |
| m     | Welded Mesh | 16    | 45          | 570        | 190         | 2.3         | 31.75 X 31.75 | 121   | 88.00             |
| n     | Hexagonal Mesh | 13   | -           | 225        | 52          | 0.7         | 13 x 13 mm    | 45    | 65.00             |
| o     | Hexagonal Mesh | 14   | -           | 215        | 52          | 0.7         | 13 x 13 mm    | 54    | 73.00             |
4.2 Load vs. Displacement Curves

Tensile strength set up arrangement for welded wire mesh for orientation 0°, 30° and 45° as shown in Fig. 1. Tensile Strength of all samples were calculated curve was derived from the load - displacement data for each sample.

Fig. 5 Test set up of Welded Mesh Ø 2.7 mm, 0°orientation

Fig. 6 Load vs. Displacement curves for Welded Mesh 0°orientation Ø 2.7 mm,

Fig. 7 Test set up of Welded Mesh Ø 2.7 mm, 30°orientation

Fig. 8 Load vs. Displacement curves for Welded Mesh of Ø 2.7 mm, 30° orientation

Fig. 9 Welded Mesh Ø 2.7 mm, 45° orientation

Fig. 10 Load vs. Displacement curves for Welded Mesh of Ø 2.7 mm, 45° orientation
Fig. 11 Welded mesh Ø 2.3 mm, 0° orientation

Fig. 12 Load vs. Displacement curves for Welded Mesh Ø 2.3 mm, 0° orientation

Fig. 13 Load vs. Displacement curves for Welded Mesh Ø 2.3 mm, 30° orientation

Fig. 14 Load vs. Displacement curves for Welded mesh Ø 2.3 mm, 45° orientation

Fig. 15 Hexagonal Mesh Ø 0.7 mm

Fig. 16 Load vs. Displacement curves for Hexagonal Mesh Ø 0.7 mm
5. Conclusion

1. Tensile strength of Ø 2.7mm and Ø 2.3 mm of welded wire mesh having 0° orientation is suitable than 30° and 45° orientation.
2. The study shows the tensile strength of welded wire mesh Ø 2.7 mm is higher than Ø 2.3 mm in all orientations as per graphical representation.
3. Hexagonal metal mesh is found suitable for design of ferrocement work.

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