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Research Paper

FLEXURAL RESPONSE OF FERROCEMENT I-BEAM TO THIRD-POINT LOADING

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ABSTRACT

This study aimed to determine the flexural response of ferrocement I-Beam to third-point loading. Three replicates for each test specimen were made. They were cast using the fabricated C- shaped formwork reinforced with 16, 18, 20, and 22 layers of wire mesh reinforcement then installed back-to-back and connected with A-325 bolts to form I-shaped beams. The said beams were subjected to third-point load test using the Universal Testing Machine. An empirical equation for the determination of flexural strength of the form fr (x) =732.19 + 131.18 x was developed. There was a positive response to the number of layers of wire mesh to the ferrocement I-Beam. By converting the number of layers to the volume fraction of reinforcement from the results of Acma (2014) and Acma et al. (2015), a correlation of the studies was made resulting to an empirical equation. The cracking behavior at failure show perceptible, multiple cracks at each of the three replicates but the time-load curve diagram shows a proportional slope implying that the ferrocement I-beam has exhibited the ductile behavior required; the increase in the number of layers of wire mesh reinforcement also made a positive response to the flexural strength of the ferrocement I-beam.

Keywords: Ferrocement I-beam, Flexural strength, Third-point loading

INTRODUCTION

Low-cost housing is a concept which deals with the utilization of effective budgeting and construction technique that helps in reducing cost by cheap and efficient construction materials, simplified construction procedures with building components pre-manufactured in a factory, hauled and assembled on site. The construction procedure is made simpler without sacrificing strength, performance, and life of the structure (Acma, 2014).

Prefabrication offers a number of advantages when applied to low-cost housing. Precast elements that are cast off-site and are assembled onsite will greatly reduce the duration of construction and improves quality due to controlled casting procedures. The worksite is reduced to a minimum, thereby, enhancing the quality of work, reliability, and cleanliness and elimination of scaffolding and shuttering (Adlakha & Puri, 2002).

Ferrocement is a material that has a wide range of applications that include agricultural facilities, rural energy, water supply, repair, rehabilitation, and housing. It is defined as a type of thin-wall reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced layers of continuous and relatively small-sized wire mesh. The mesh may be made of metallic or other suitable materials

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(ACI Committee 549, 1993). The fineness of the mortar matrix and its composition should be compatible with the mesh and armature systems it is meant to encapsulate. The matrix may contain discontinuous fibers. The ferrocement displays a series of advantages to reinforced concrete, among which are a wider range of elasticity; greater resistance to extension; better behavior at dynamic stress; and, increase the value of breaking effort out of extension (Naaman, 2000).

The series of calamities that hit the country and the reality that current construction methodologies are less resilient to calamities such that heavier structures are prone to earthquakedestruction, while lighter structure will be blown away during typhoons, prompted this researcher to find alternative construction materials and construction methods that will be resilient to calamities without compromising strength, durability, and cost. Another problem that the researcher is looking into is the resistance of informal settlers in calamity-stricken urban centers to move out of the areas and be transferred to safer relocation sites for reasons that their sources of incomes are within the urban centers. However, there are limited spaces available in the cities and relocating the settlers within the urban center limits will be a very daunting task. Perhaps, the limited space within the urban center can be fully utilized in low-cost multi-storey residences will be constructed within the urban center.

Acma (2014), developed a ferrocement I-Beam that can be used as a solution to the problem as identified. However, the study still needs to be continued as the Empirical Equation needed to design such beam is still not complete. Additional data is still needed so that this study is proposed. The general objective of this study is to develop an empirical equation to be used in designing a structural ferrocement I- beam. Specifically, it aims to determine the response of ferrocement I-beam provided with 16 layers and above of wire mesh reinforcement to three point loading; to correlate result of the present study to the previous studies conducted by the researcher which at lower reinforcement volume, the beam failed to reach ductile behavior and his understudy, which found out that ductility behavior in the beam started to manifest when the reinforcement was increased to twelve layers; todetermine the ductility behavior of the ferrocement I-beam; and to evaluate the response of the ferrocement I-beam to modulus of rupture.

METHODOLOGY

The ferrocement I-beam used in the study was composed of three replicates for each test specimen. It was cast using the fabricated C-shaped formwork reinforced with 16, 18, 20, and 22 layers of ½ x ½ Gage 19 welded wire mesh

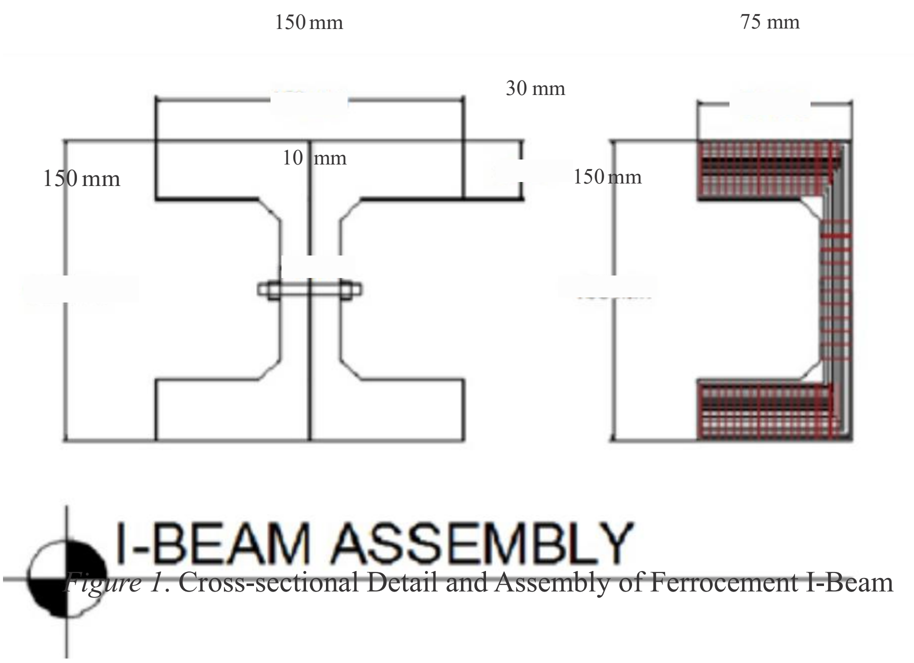

Figure 1. Cross-sectional Detail and Assembly of Ferrocement I-Beam

reinforcement; eight (8) layers in the flange and web section and an additional 8 layers, 10 layers, 12 layers, and 14 layers in the flange section for each of the treatments. The cured and casted C-shaped ferrocement beams were installed back-to-back and connected with A-325 bolts to form I-shaped beams. Figure 1 shows the details of the cross-section and assembly while Figure 2 shows the longitudinal view of the test specimen. The web thickness of the I-Beam includes a 5 mm spacer which allows inconsistencies of the surface of the back of the beam when connected by bolting. The diameter of the bolt is 10 mm while the bolt hole is pre-formed at 12 mm diameter.

In Figure 2, the overall span of the prefabricated ferrocement I-Beam is 1200 mm, and during testing, the placement of support is located 75 mm from both ends of the span allowing an unsupported length of 1050 mm. The four (4) bolts connecting both C-Beams were located 75 mm from the support at a spacing of 300 mm on centers.

The aggregates were taken from the riverbanks of Pulangi River. The type 1P Portland cement was procured from a hardware in Valencia City. The welded wire mesh was procured from a hardware in Cagayan de Oro City. The water used for mixing was taken from the water tap of the College of Engineering which is connected to the University Water System.

The aggregates delivered still contained traces of silts and clay and coarser materials so that the required screening using # 10 sieve was done, after which, the aggregates were washed and air dried. The routine selection of representative sample using sample splitter and the corresponding sieve analysis to determine the soil gradation were done.

Sets of molds for C-beam were fabricated using lumber and bolts. Figure 3 shows the assembly of the cross-section of the mold.

In Figure 3, the colored sections are the hardwood to be assembled. Horizontal bolt is 6 mm diameter while fabricated vertical bolt hole form is 12 mm diameter. The final dimensions of the C-Beam are the flange width and thickness 75 mm x 30 mm, the web thickness is 20 mm, and the overall depth is 150 mm.

The specimen for compressive strength testing is made of steel form having a 100 mm diameter and 200 mm height. Welded wire mesh was cut into desired width and length just enough for a layer of reinforcements. Two sets of cut wire mesh were prepared. One set is for reinforcing the whole flange and web of the C-Beam and another set for the reinforcement of the flange segment only.

Prior to casting, the molds were first brushed

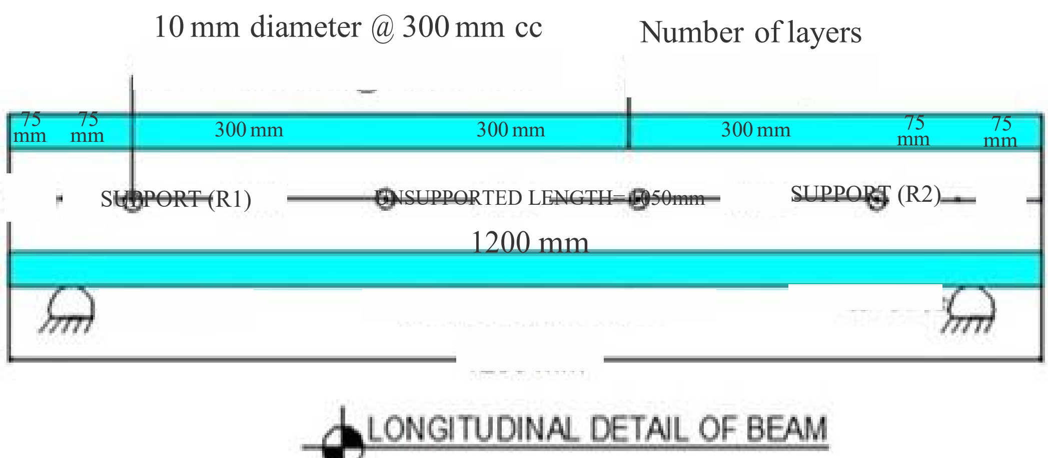

Figure 2. Longitudinal Detail of the Assembly of Ferrocement I-Beam

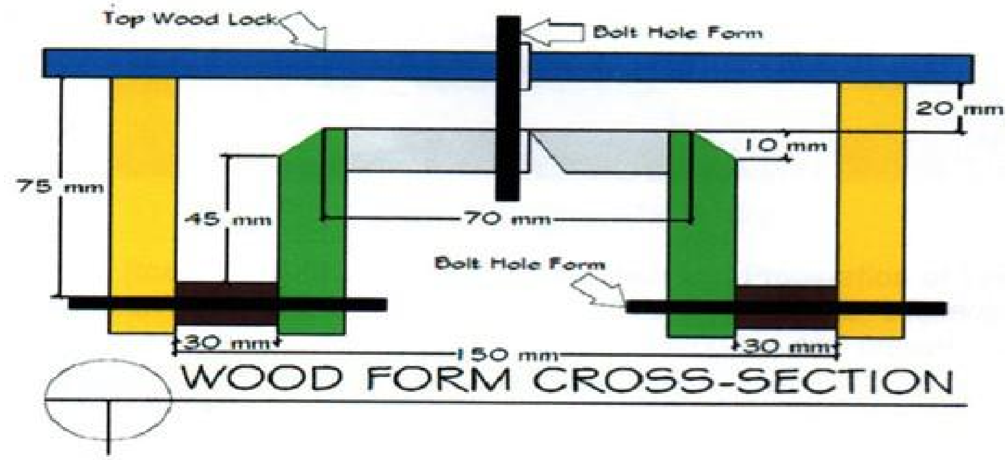

Figure 3. The Cross-section of the Fabricated Wooden Mold

with used oil so that thespecimens would not adhere to the molds upon demolding. The constituent materials were then measured according to the design ferrocement mortar mix. The cement - sand - water ratio for ferrocement design of Type 1P Portland Cement to fine sand to mixing water of 1:2:0.45 measured by weight.

As for the actual casting of six ferrocement C-Beams, a volume of concrete consisting of 90 kg graded sand, 45 kg of cement, and 20.25 kg of water mixed up were assumed to fill all the casting of the test specimen. The additional volume of constituent materials is estimated to cover the volume needed for the concrete cylinder.

After mixing, the mortar mixture is poured into the wooden mold placed on top of a vibrating table for compaction. The vibration was stopped as soon as the leachate rises to the surface of the mold signaling that the mortar was already well compacted. The excess mortar was then stricken off the mold and the surface was smoothened using a trowel to attain the desired shape of the back of the C-Beam. The casting for the compression test specimen was done by pouring concrete into the cylindrical mold up to around 60% of the height. The mortar was then compacted using a 16 mm diameter rod applying 17 strokes of the rod applied in a circular direction. The mold was then filled with mortar up to the brim and rodded 17 more times. The excess mortar was then stricken off the mold and the top surface was smoothened using a trowel in order to maintain a flat surface of the top of the mold.

All specimens were then set aside in the safe area for initial curing 24 ± 4 hours. After the initial curing 24 ± 4 hours, the specimen was demolded and placed in the curing tank filled with water. As a precaution, the specimen top surface must be below the water line at all times. Moist curing was done for the next 28 days. Testing of the specimen was done after 28 days of curing. After curing, all specimens were unloaded from the curing tank and allowed to air dry. C- Beam Specimens were painted with white latex paint before being assembled to form the required I-Beam. The painting was done in order to easily spot any cracks that developed in the beam while testing was going on. Concrete cylinders were also provided with sulfur capping on the upper end of the cylinder. The sulfur capping was provided in order to see to it that the upper surface of the cylinder would be in full contact with the upper paten and ensure equal distribution of load to the concrete cylinder. No capping was provided in the lower end of the cylinder as the bottom paten of the Universal Testing Machine is self-leveling.

Testing

Testing was done in the Materials Testing Laboratory in the College of Engineering. The equipment used was the Universal Testing Machine. The compression Testing was done using the built-in accessories of the machine while the Flexural Testing was accomplished using the fabricated third-point apparatus intended for the research. Figure 4 shows the routine testing of the specimen where; (a) shows the routine third-point testing of the beam using fabricated third-point apparatus, (b) shows the digital recording of the test showing the rate of loading, and (c) is the routine testing of the concrete cylinder to obtain its compressive strength.

The compressive strength of the concrete cylinder was computed as the maximum load at failure divided by the cross-sectional area of the cylinder. The compressive stress of concrete was computed as,

$$\sigma'_c = \frac{P_{max}}{\frac{\pi^2}{4} d^2}$$

Where, P_{max} is the maximum applied load as shown in the computer monitor and d is the diameter of the concrete cylinder. The average of the computed compressive stress excluding the outlier values was considered as the compressive stress of the concrete was used in the study.

The moment at the failure of the specimen was computed based on the maximum load carried by the specimen before failure expressed in kN-m. Since the load applied was in the middle third, the actual moment at failure was computed as,

$$M_A = \frac{PL}{6}$$

The theoretical moment at failure is computed using the equation,

$$(\sigma_m)_{top} = \frac{M_c}{I_{tr}}$$

$$(I_{tr}) = \frac{bc^3}{3} + \sum (n-1)(c-d_i)^2 \sum_n (d_j - c)$$

Since there were two C-Beams installed back-to- back, equation 3 becomes,

$$(M_T) = \frac{\sigma'_c}{Y_t}(2I_{ty})$$

Where, σ'_c is the actual computed compressive stress in the concrete used in the study, (Itr), the moment of inertia of the beam section at first crack, **n** is the ratio of modulus of elasticity of steel to modulus of elasticity of concrete. The modulus of elasticity of concrete was computed from the equation,

$$E_c = [3320\sqrt{\sigma'_c} + 6895]\,(\frac{W_c}{2328})^{1.5}$$

where, w_c, is the unit weight of concrete in kg/cu.m. while σ'_c, is the compressive stress of concrete in MPa.

The theoretical and actual flexural stress or Modulus of Rupture, f_r in the extreme reinforcing layer at the bottom flange of the ferrocement I-Beam was calculated using the equation,

$$\boldsymbol{f_{rA}\ and\ f_{rT} = \frac{nMy_b}{(2I_{tr})\ cracked}}$$

where, f_{rA} is the actual Modulus of Rupture, f_{rT} is the theoretical Modulus of Rupture, yb is the distance from the neutral axis to the extreme fiber in tension.

a) Flexural Test of I-Beam b) Digital Recording of Test c) Compression Test of concrete cylinder

Figure 4. Routine Testing of I-Beam and Concrete Cylinder

The volume fraction of reinforcement, V_r (%) was taken as the ratio between volumes of reinforcement versus the volume of the composite. The volume of the reinforcement may have included the skeletal steel if provided. However, if the skeletal steel was placed in the center of the ferrocement member and if bending was considered, its influence may be ignored (Naaman, 2000). For square or rectangular meshes, V_r (%) is computed as:

$$Vr\% = \frac{n\pi d_w^2}{4h}\left[\frac{1}{D_L} + \frac{1}{D_T}\right]$$

where **N** was the number of layers of mesh, d_w is the diameter of wire mesh, D_L was the distance center to center of the longitudinal wires, D_T was the distance center to center of the transverse wires, and h is the thickness of the ferrocement element.

An empirical equation to determine the flexural strength applicable to the ferrocement I-beam was developed. The equation was based on the results of the test and the theoretical computations following the assumptions and satisfaction of equilibrium and compatibility of strains. The empirical equation was fitted from the straight-line model of the simple linear regression equation with the form:

$$f(y) = \beta_0 + \beta_1 x$$

Where:

f(y) = the random error component of the response variable
β0 = y – intercept of the line
β1 = slope of the line
x = the independent or the predictor variable

RESULTS AND DISCUSSION

Properties of Aggregates

Aggregates used that was taken from one of the quarries along Pulangi River have the acceptable gradation with fineness modulus of 3.37. Figure 5 shows the graphical representation of the aggregates as compared to the limiting values.

Determination of Compressive Strength

Table 1 revealed the result of the compressive strength test. The average compressive stress for all cylindrical samples is computed as 36. 42 MPa. The modulus of elasticity of the concrete is computed to be 23,289.89 MPa. In Table 1, figures marked "*" are considered as non-credible or outliers so that they are no longer included in the computation of compressive strengths marked "**".

Weight of concrete,

w_c = 3.308 kg/[(100)2(π/4)(200)(1/1000)3]
= 2,105.94 kg/cu.m.

Modulus of Elasticity of Concrete

$E_c = [3320\sqrt{(\sigma'_c)} + 6895] (w_c/2328)^{1.5}$
$= [3320\sqrt{(36.4158)} + 6895] (2105.94/2328)^{1.5}$
= 23,289.89 MPa

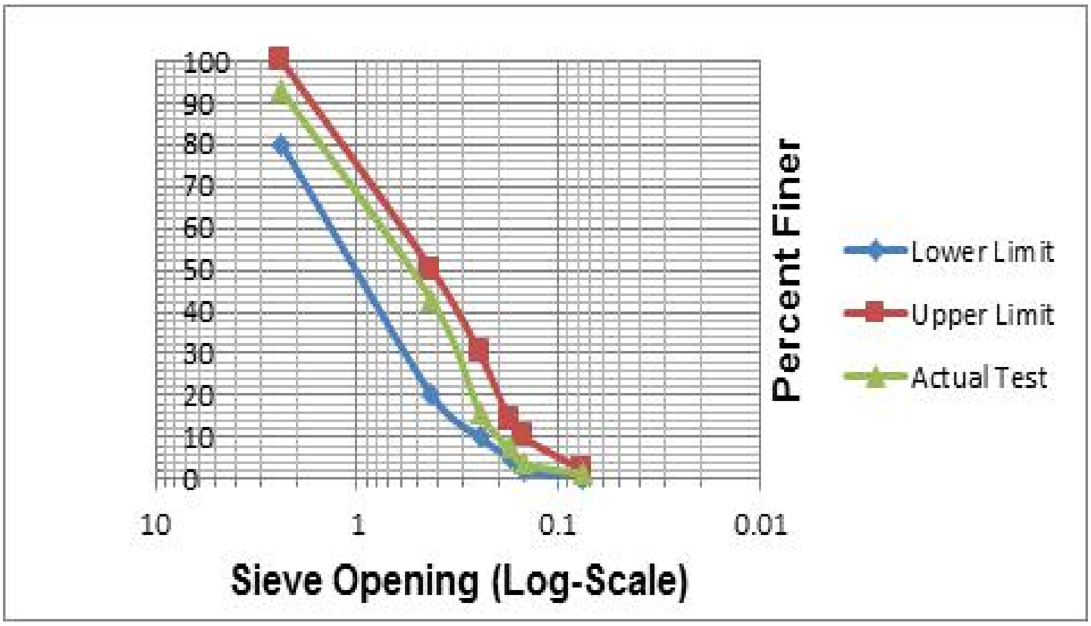

Figure 5. Graphical Representation of Soil Gradation Result

Table 1

Compression Properties of Mortar Specimen

Specimen	Load at Failure (kN)	Weight of Specimen (kg)	Compressive Stress, σ'$_c$ (MPa)
21	361.7	3.35	44.614
22	318.4	3.3	39.274
23	206.4*	3.3	**
31	303.7		37.88
32	271.0		33.802
33	209.1*		**
41	271.7	3.3	33.513
42	267.9	3.3	33844
43	308.9	3.3	38.101
51	303.7		37.46
52	271.0		33.427
53	267.9		33.044
Average		3.308	36.4158

Determination of Flexural Strength

The property of the section was computed following equations 1 to 4. Table 2 presents the summary of the result of the analysis. Beam samples were first weighed, subjected to the third-point test, load at failure recorder, and corresponding cracks observed. Table 3 summarizes the result of the test.

Table 2 reveals the theoretical moment of failure which was computed using the property shown in Table 2 and Equations 5 to 7. The trend of the theoretical moment at failure is shown in Figure 6. The average moment at failure results from 16 layers to 22 layers of welded wire mesh reinforcements shows increasing order.

The specimen with 18 layers of reinforcement produced lesser moment at failure than beam with 16 layers because of some factors observed during the casting; the welded wire mesh became whorled resulting in a loss in its flexural strength he routine sample preparation during casting was not properly followed.

The flexural strength or modulus of rupture was computed using equation 7. Figure 7 graphically illustrates the results of the computation for both theoretical flexural strength. It can be shown that for the particular test, there is a downtrend response of the beam. As the volume fraction of reinforcement is increased corresponding to the increase in the number of layers of wire mesh reinforcement, there is also a reduction of the flexural strength. The red curve represents the theoretical flexural strength while the blue curve represents the actual flexural strength.

Performance Evaluation on Ductility

Table 3 illustrated the description of the result of third-point load test of the ferrocement I-Beam. Figure 8 shows the actual cracking pattern of the beam at failure.The behavior of cracking in the ferrocement I-Beam can be best described below:

a) Each replicate showed visible cracks ranging from few to multiple and each crack was found in the near middle third of the span;
b) Where there were only a few cracks to occur, these were concentrated near opposite where the load was applied.
c)The number of cracks increases with increasing number of welded wire mesh reinforcement.

Correlation with the Study of Acma (2014)

The study of Acma (2014) was conducted using Three-Point Load Test for the flexural strength test. The compressive strength of mortar cylinder had an average value of σ'_c = 37.65 MPa. The computed elastic modulus of concrete was, Es = 31,402.696 MPa and the ratio of modulus of elasticity between welded wire mesh and mortar was, n = 6.37. In this study, the ferrocement

Table 2

Summary of Computed Cracked Moment of Inertia

Layers of Wire Mesh Reinforcement	N.A from Top Fiber, y_t(mm)	Neutral Axis from Bottom Fiber, y_b (mm)	(I_{tr}) cracked $(mm)^4$	2(I_{tr}) cracked $(mm)^4$
16	27.8127	122.1873	3, 586, 566.5	7, 173, 133.0
18	20.3281	121.6719	3, 818, 420.3	7, 636, 440.6
20	29.5394	120.4606	4, 042, 836.1	8, 085, 672.2
22	30.4815	119.5185	4, 468, 192.09	8, 936, 384.18

Table 3

Result of Third-Point Load Test of Ferrocement I-Beams

Specimen	Weight (kg)	Load at Failure, P (kN)	Moment at Failure M_A (kN-m)	Remarks
W161	37.2	37.36	6.538	Few cracks
W162	36.0	37.6	6.405	Multiple cracks
W163	37.4	34.64	6.602	Few cracks
W181	38.1	35.34	6.185	Multiple cracks
W182	37.7	33.9	5.933	Multiple cracks
W183	36.8	36.8	6.440	Multiple cracks
W201	34.0	39.0	6.825	Multiple cracks
W202	38.4	38.26	6.696	Multiple cracks
W203	36.5	38.76	6.783	Multiple cracks
W221	38.0	40.86	7.151	Multiple cracks
W222	37.9	42.72	7.476	Multiple cracks
W223	37.9	43.74	7.655	Multiple cracks

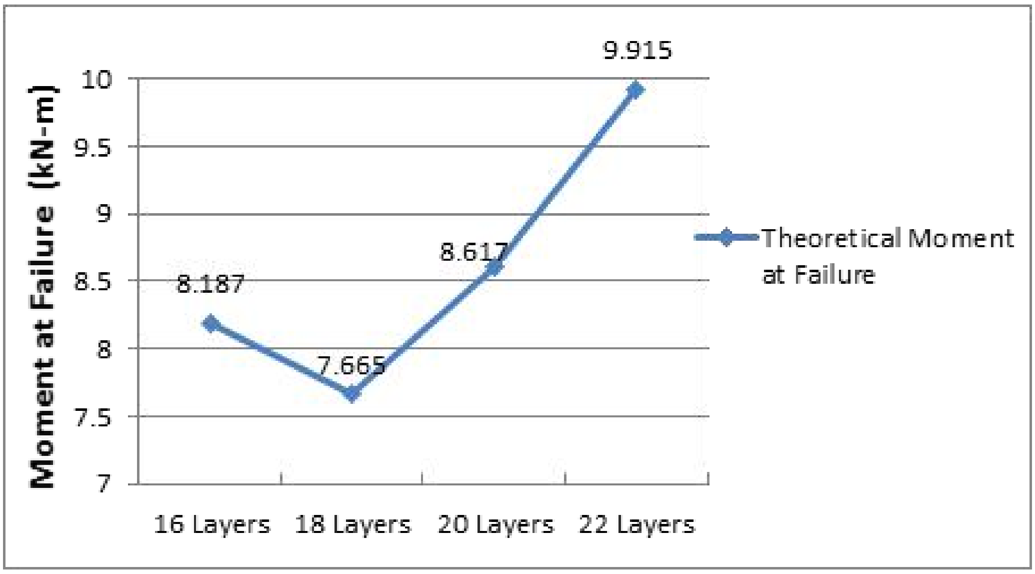

Figure 6. Trend of the Computed Theoretical Moment at Failure

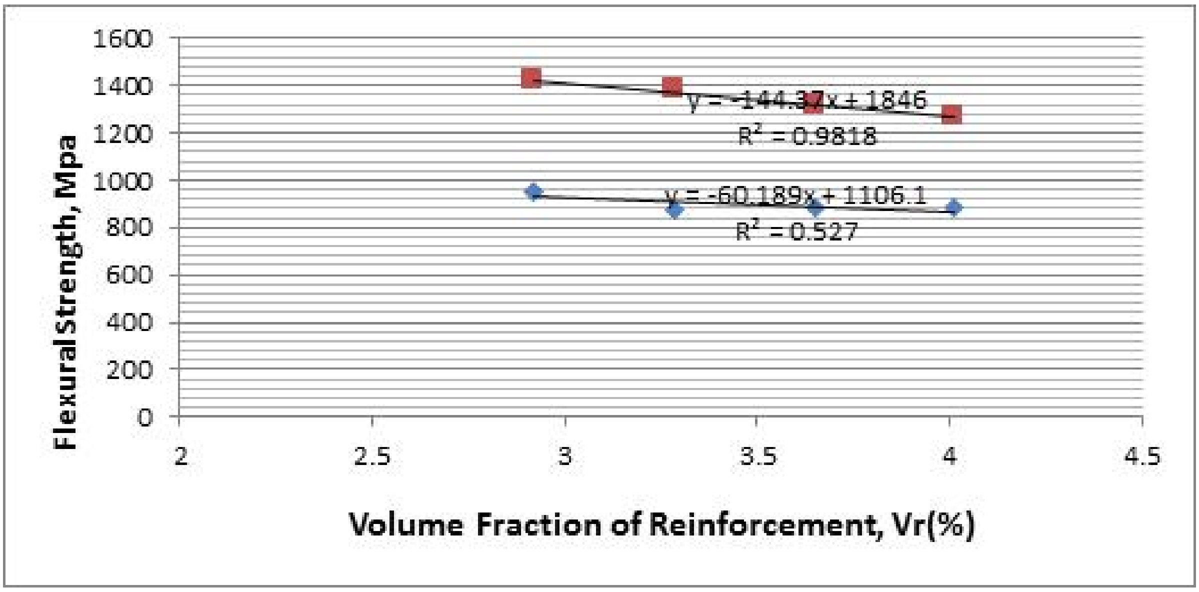

Figure 7. Response of Ferrocement I- Beam to Modulus of Rupture

beam had a length of 1200 mm, unsupported span of 1050 mm, depth of 150 mm, thickness of flange and web of C-beam was 20 mm. The wire mesh reinforcement used was installed in a 3.2 mm diameter deformed bar so that the computed volume fraction of reinforcement included the deformed bar frame. Table 4 presents the result of the three-point load test for the flexural strength of concrete.

Correlation with the Study of Dumpasan, Mansaguiton, and Salva (2015)

There were three separate studies conducted by Geovanni C. Dumpasan, Menard P. Mansaguiton, and Mark Lloyd I. Salva in 2015 as a BSCE theses with Dr. Acma as the chair of the advisory committee. The study used the same material, forms, concrete mixes, and test conducted so that each individual study was considered a single

Figure 8. Actual Cracking Pattern of the Beam at Failure

treatment and the researchers prepared three beam specimens each which were considered as replications. The flow of the current research followed the same pattern as that of this research. The flexural strength test was conducted using Third-Point Load test or four-point load test to distinguish the test conducted by Acma (2014) that employed the three-point load test. As in the beam specimen used by Acma (2014), the beam had a length of 1200 mm, unsupported span of 1050 mm, depth of beam of 150 mm and thickness of web and flange of C-beam was 20 mm. However, the wire mesh reinforcement was no longer placed onto a deformed bar frame so that the computed volume fraction of reinforcement only included the wire mesh.

In this study, the compressive strength of mortar was found to be 41.76 MPa, modulus of elasticity of concrete, Es, was computed to be 32, 649.83 MPa so that ratio of modulus of elasticity, n = 6.13. Table 6 shows the result of the third-point load test.

Fitting the Results of the Correlated Studies

Considering the results of the studies conducted by Acma (2014), Dumpasan et. al (2015), and the present study, the results were collated.

Table 4

Three-point Load Test Result of Ferrocement I-beam (Acma, 2014)

Equivalent Volume Fraction of Reinforcement, Vr %	Load at Failure, kN	Actual Moment at Failure, kN-m	Remarks
2.125	41.2	10.815	Single crack
2.651	40.90	10.632	Single crack
2.651	48.5	12.61	Single crack
3.177	47.92	12.459	Single crack
3.177	49.32	12.823	Single crack
3.177	52.82	13.733	Single crack

Table 5

Computed Moments and Flexural Strengths of Ferrocement I-beam (Acma, 2014)

Equivalent Volume Fraction of Reinforcement, Vr %	σ'_c (MPa)	y_b (mm)	Actual		Theoretical	
2.125	37.65	119.3915	10.818	760.13	13.31	935.488
2.651	37.65	117.7885	11.622	771.77	13.204	876.83
3.177	37.65	116.5461	13.005	818.807	13.22	832.343

Table 6

Three-point Load Test Result of Ferrocement I-beam (Dumpasan, Mansaguiton, Salva 2015)

Specimen No.	Equivalent Volume Fraction of Reinforcement, Vr (%)	Load at Failure, kN	Actual Moment at Failure, kN-m	Remarks
51	2.74	36.82	6.44	Single crack
52	2.74	34.64	6.01	Single crack
53	2.74	38.02	6.65	Single crack
61	3.284	46.84	8.197	Multiple cracks
62	3.284	40.20	7.035	Single crack
63	3.284	41.12	7.196	Few cracks
71	3.832	47.38	8.29	Multiple cracks
72	3.832	47.16	8.25	Multiple cracks
73	3.832	50.52	8.84	Multiple cracks

Table 7

Computed Moments and Flexural Strengths of Ferrocement I-beam (Dumpasan, Mansaguiton, Salva 2015)

Equivalent Volume Fraction of Reinforcement, Vr %	σ'_c (MPa)	y_b (mm)	Actual		Theoretical	
2.74	41.76	124.086	6.37	766.278	10.232	1230.76
3.284	41.76	122.96	7.476	809.79	10.738	1163.125
3.832	41.76	121.842	8.46	830.53	11.274	1106.786

The commonly known parameter is the Equivalent Volume Fraction of Reinforcement while the common unknown variable is the theoretical and actual flexural strengths. Table 7 summarizes the result.

The data summarized in Table 7 is fitted into a curve as shown in Figure 9 given the data flexural strength in MPa versus volume fraction of reinforcement, Vr(%). The data plotted is used in developing an empirical equation that is fitted from the straight-line model of the simple linear regression.

The empirical equation developed for flexural stress based on actual result of the test is

$$f_{ra}(x) = -37.998x^2 + 292.22x + 301.78$$

with $R^2 = 0.3112$, and x is the volume fraction of reinforcement expressed in percentage.

The empirical equation developed for flexural stress based on theoretical result of the test is

$$f_{rt}(x) = -138.99x^2 + 995.58x - 569.37$$

Table 8

Summary of the Computed Flexural Strengths Based on Vr (%)

Equivalent Volume Fraction of Reinforcement, Vr (%)	σ'_c (MPa)	f_{ra} (MPa)	f_{rt} (MPa)
2.74	41.76	766.278	1230.76
3.284	41.76	809.79	1163.125
3.832	41.76	830.53	1106.786
2.125	37.65	760.13	935.488
2.651	37.65	771.77	876.486
3.177	37.65	818.807	832.343
2.919	36.4158	955.76	1416.965
3.284	36.4158	872.92	1385.31
3.649	36.4158	881.17	1315.28
4.014	36.4158	879.78	1214.66

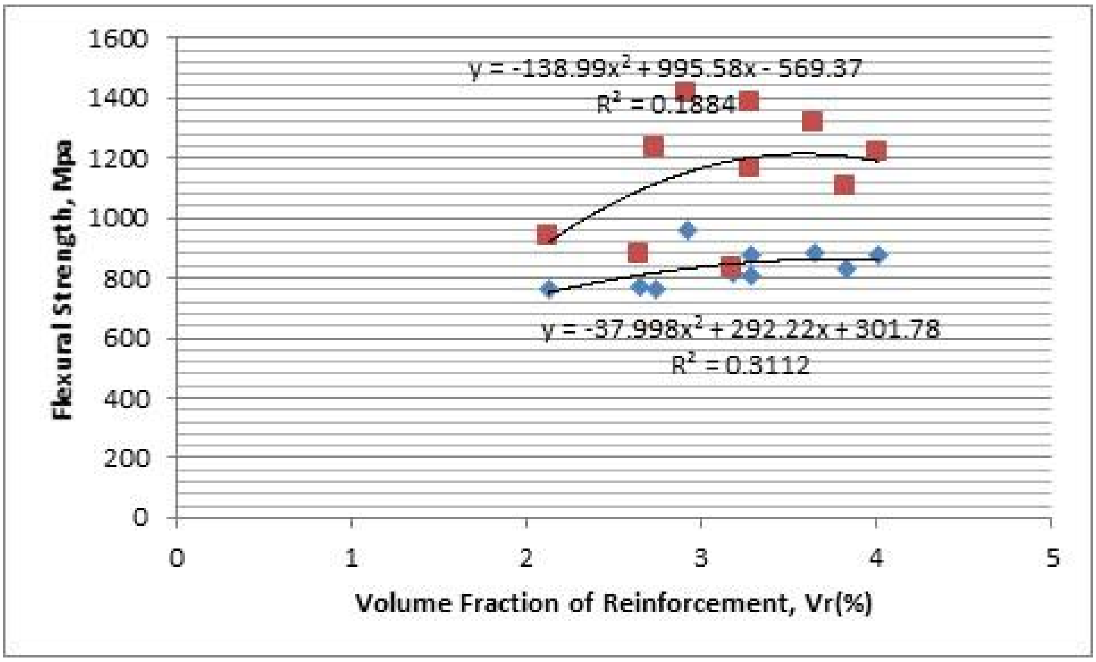

Figure 9. Curve Fitting of Flexural Strength vs. Vr(%)

with $R^2 = 0.1884$, and x is the volume fraction of reinforcement expressed in percentage.

If the ratio $f_{rt}(x)/f_{ra}(x)$ is taken, the resulting value will be the estimated Factor of Safety of the Allowable Flexural Strength of the Ferrocement I-Beam.

$$FOS = 2.14$$

CONCLUSION

From the results of this study, an empirical equation to determine the flexural strength of the form is

$$f_r(x) = -138.99x^2 + 995.58x - 569.37.$$

The resulting equation has a variance of $R^2 = 0.1884$. In the equation developed, x is the independent or predictor variable represented by the volume fraction of reinforcement V_r (%). When applying such equation for design, a factor of safety shall be used as a denominator for the equation with the equation of the form

$$FOS = 2.14.$$

The following conclusions are drawn:

First, there was the positive response to the number of layers of wire mesh to the ferrocement I-Beam. As the number of layers increases, the actual load at failure and moment at failure also increases. Second, by converting the number of layers and/or presence of skeletal steel to volume fraction of reinforcement, the results of Acma (2014) and Dumpasan et al. (2015), a correlation of the studies is made resulting to an empirical equation as described above. Third, the cracking behavior at failure show a perceptible, multiple cracks at each of the three (3) replicates Lastly, the increase in the number of layers of wire mesh reinforcement made a positive response to the modulus of rupture or flexural strength of the ferrocement I-beam. However, there was a reduction of both the actual and theoretical flexural strength of the beam as the number of layers of wire mesh reinforcement is increased from 16 to 22. This result is not consistent with the earlier results of Acma (2014) and Mansaguiton et al, (2015) where there was an increase in the actual flexural strength as the number of layers of wire mesh reinforcement is increased.

RECOMMENDATIONS

The following recommendations are based on the results of the study on the response of ferrocement I-Beam to third – point loading. First, a similar study may be conducted to determine the limits of the volume fraction of reinforcement that can be used for welded wire mesh reinforced beam. Second, to conduct a similar study to find the possibility of using a fixed end for the beam for structural design purposes. Lastly, to develop a structural design sequence for ferrocement I-Beam utilizing the empirical equation derived in this study.

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