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Highlights

Concrete Containing Red

Fiber Reinforced Concrete

Analytical Study on Cyclic

CFRP Retrofitting Schemes

Discovering Thoughts, Inventing Future

VOLUME 17 ISSUE 1 VERSION 1.0

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CFRP Retrofitting Schemes for Prestressed Concrete Box Beams for Highway Bridges

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Abstract- This paper investigates various retrofitting schemes for a prestressed concrete box beam using carbon fiber reinforced polymer (CFRP) sheets with the goal of increasing flexural strength. A simply-supported box beam is studied with a constant uniformly distributed load and three gradually increasing concentrated loads proportional to HS20 truck loading of the Association of State Highway and Transportation Officials (AASHTO). Various retrofitting schemes are considered each with single, double, and triple CFRP sheets, respectively, installed in high compression and tension regions. Cross-sectional nonlinear moment-curvature relations are developed and coupled with a finite-difference solution algorithm to predict load-deflection relations for both retrofitted and non-retrofitted box beams. The study identifies effective CFRP retrofitting schemes that result in a significant increase in the flexural strength of the prestressed concrete box beam.

Keywords: CFRP retrofitting, highway bridges, box beam, prestressed.

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CFRP Retrofitting Schemes for Prestressed Concrete Box Beams for Highway Bridges

Herish A. Hussein [α] & Zia Razzaq [σ]

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Keywords: CFRP retrofitting, highway bridges, box beam, prestressed.

I. Introduction

Retrofitting prestressed concrete beams to increase their strength is an evolving area of structural engineering research. Retrofitting with carbon fiber reinforced polymer (CFRP) strips or plates has been used in tensile regions of concrete beams [1-3]. CFRP retrofitting material is more advantageous than steel since it is non-corrosive, light-weight, easy to ship, available in practically any length, and easy to install [4-6]. It also exhibits superior fatigue resistance, low thermal expansion, and low relaxation [7-9]. Using CFRP laminar sheets on various parts of beams with high-strength adhesive epoxy can increase flexural strength and even support any damaged strands without having to demolish the affected areas [10-12]. Retrofitting tension regions in beams is of benefit not only to increase strength but also off-set weakness of concrete in tension, and protect prestressing strands from corrosion and vehicle impacts. This paper investigates the effectiveness of using CFRP retrofitting of prestressed concrete box beams in high tensile, compressive, and both tensile and compressive regions. Such retrofitting schemes can provide added strength for highway bridge girders.

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II. Problem Description

Figure 1 shows a simply-supported prestressed concrete box beam used in highway bridges. The beam is subjected to AASHTO-type of loading in addition to the beam self-weight of 0.842 kips/ft. the external loading consists of a uniformly distributed load of 0.64 kips/ft., and concentrated loads 4P, 4P, and P as shown in Figure 1. The AASHTO loading is obtained if P=8 kips, however, in the present study, the value of P is gradually increased up to collapse condition in the presence of constant uniformly distributed loading. The Type BIII-48 box beam section has two rows of 7-wire ASTM Grade 270 ½ in. diameter strands as shown in Figure 2.

To demonstrate the effectiveness of CFRP retrofitting, an AASHTO Type BIII-48 box beam cross section [13] is adopted in the present study. Figure 2a shows the box beam cross section without retrofitting and is used as a reference beam section to determine the effectiveness of various retrofitting schemes. As shown in this figure, the prestressing is achieved with two rows of strands with 23 strands per row. Figures 2b and 2c show the box beam section retrofitted with a single 40 x 1/16 in. CFRP sheet, in tension and compression regions, respectively. Figure 2d shows the box beam with single CFRP sheets in both tension and compression regions. Figures 2e -2g show similar retrofitting schemes with double CFRP sheets while Figures 2h-2j show those with triple CFRP sheets.

In this study, the following nonlinear normal compressive stress-strain relation for concrete given by Lin and Burns [14] has been adopted:

$$f_c = f_c^{'} \, [2(\epsilon_c /\epsilon_\circ) - (\epsilon_c /\epsilon_\circ)^2] \qquad (1)$$

where ϵ_c is the concrete strain, and $\epsilon_\circ$ is the concrete strain at ultimate compression strength, $f_c^{'}$. The numerical results presented in this paper are based on a $f_c^{'}$ value of 5.8 ksi and a concrete modulus of elasticity of 4,383 ksi. Each CFRP sheet used for retrofitting has a thickness of 1/16 in. and a width of 40 in. The Young's modulus of CFRP material is 22,000 ksi and it has an ultimate strength of 260 ksi.

The problem addressed in this study is to determine the effectiveness of various retrofitting schemes shown in Figures 2b through 2j with the objective of maximizing the load-carrying capacity of the prestressed concrete box beam shown in Figure 1. This is achieved by first formulating the nonlinear moment-curvature relations for the ten cross sections shown in Figure 2 followed by theoretical prediction of the load P versus maximum vertical deflection of the beam.

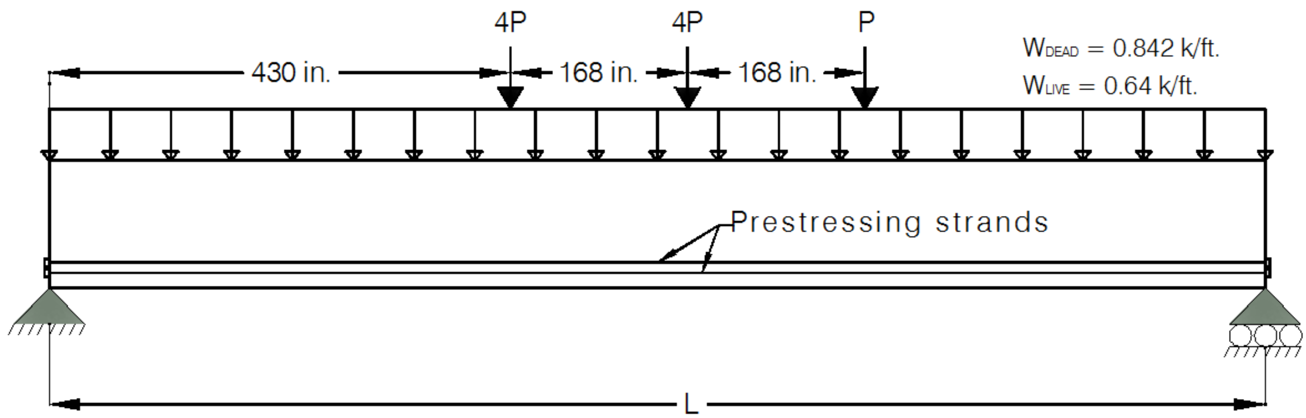

Figure 1: Prestressed concrete box beam with AASHTO-type loading

III. Nonlinear Moment-Curvature Relations

All moment-curvature relations presented in this paper are derived using 7-wire strands prestressed to a force F equal to 160 kips. In the analysis presented, the effects of keys and fillets on the moment-curvature relations for the cross sections in Figure 2 are considered negligible. This approximation results in only a 0.06% difference in the cross-sectional areas. Figure 3 shows the strain and stress distribution for a simply-supported box beam with CFRP retrofitting at the bottom. In this figure, C_c, T_{ps}, and T_{CFRP} are the resultant concrete force, strand force, and CFRP force, respectively. The concrete force is found using:

$$C_c = \int_0^c f_c \times dA = C_{c2} - C_{c1} \qquad (2)$$

where:

$C_{c1} = \int_0^{c1} f_c \times b_1 \times dx$

$C_{c2} = \int_0^{c2} f_c \times b_2 \times dx$

dA = elemental concrete area in compression,

b_1, b_2 = inner and outer cross-sectional widths, and

c_1, c_2 = distances from NA shown in Figure 3b.

As seen in Figure 3c, the concrete strain, ϵ_c, can be expressed in terms of the curvature ϕ and distance x from neutral axis (NA):

$$\epsilon_c = \phi \times x \qquad (3)$$

Substituting Equations 1 and 3 into Equation 2 results in [14]:

$$C_c = b_2 \times f_c' \times \int_0^{c2} \left[\frac{2 \times \phi \times x}{\epsilon_\circ} - \left(\frac{\phi \times x}{\epsilon_\circ}\right)^2\right] dx - b_1 \times f_c' \times \int_0^{c1} \left[\frac{2 \times \phi \times x}{\epsilon_\circ} - \left(\frac{\phi \times x}{\epsilon_\circ}\right)^2\right] dx \qquad (4)$$

which upon integration gives:

$$C_c = b_2 \times c_2^2 \times f_c' \times \frac{\phi}{\epsilon_\circ}\left(1 - \frac{\phi \times c_2}{3\,\epsilon_\circ}\right) - b_1 \times c_1^2 \times f_c' \times \frac{\phi}{\epsilon_\circ}\left(1 - \frac{\phi \times c_1}{3\,\epsilon_\circ}\right) \qquad (5)$$

In Figure 2d, X represents the distance of C_c from the NA, and is found using:

$$X \times C_c = \int_0^{c2} f_c \times b_2 \times x\, dx - \int_0^{c1} f_c \times b_1 \times x\, dx \qquad (6)$$

Using Equations 1, 5, and 6 gives:

$$X = c_2 \left(\frac{8\,\epsilon_\circ - 3\,\phi \times c_2}{12\,\epsilon_\circ - 4\,\phi \times c_2}\right) - c_1 \left(\frac{8\,\epsilon_\circ - 3\,\phi \times c_1}{12\,\epsilon_\circ - 4\,\phi \times c_1}\right) \qquad (7)$$

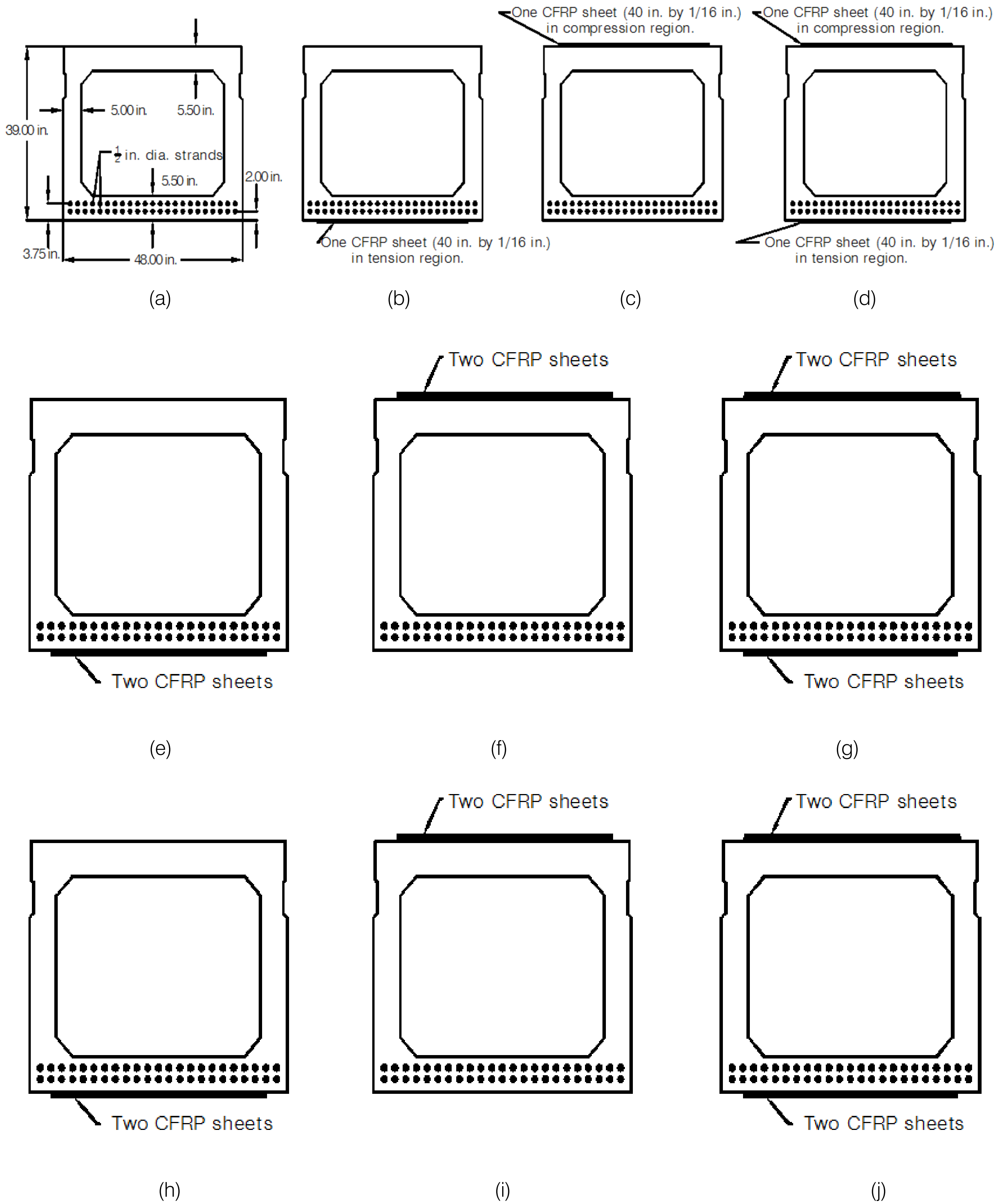

Figure 2: Non-retrofitted box beam section (a), and CFRP retrofitted box beam sections (b) through (j)

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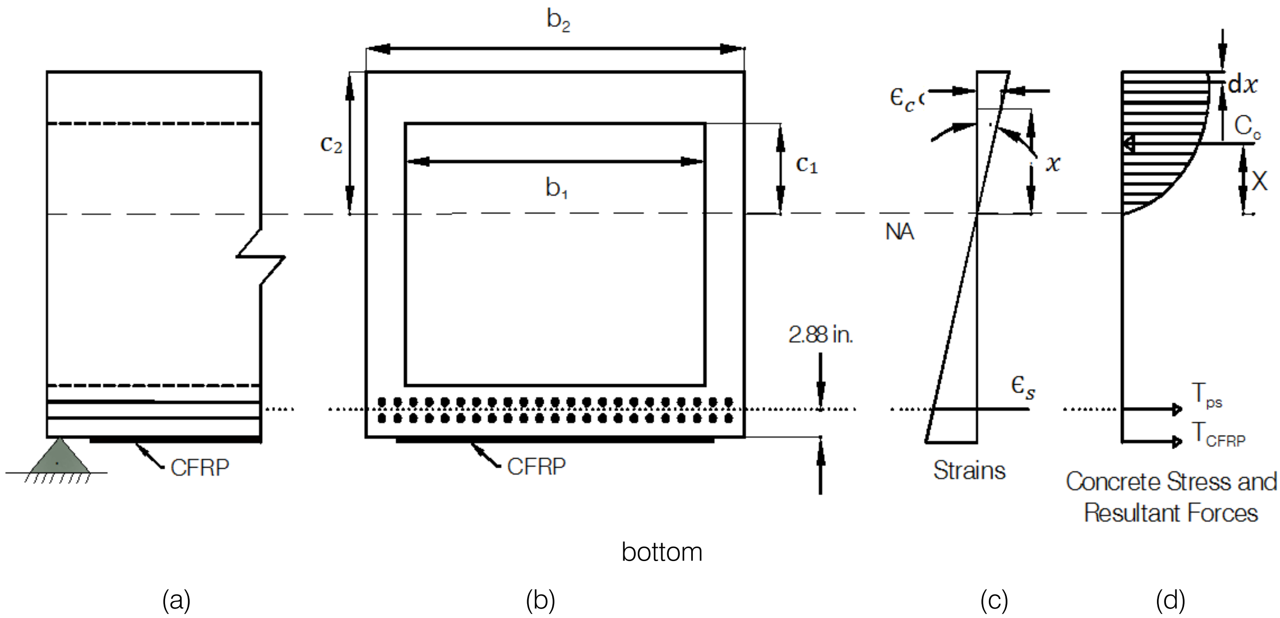

Figure 3: Strain and stress distribution for a simply-supported concrete box beam with CFRP retrofitting at the bottom

Moment-curvature relations are developed for seven different loading stages, namely, at zero external moment, zero strain in concrete at the c.g. of the strands, cracking moment, concrete strain reaching 0.001, 0.002, 0.00248, and 0.003 in./in. The linear portion of the moment-curvature relation is developed using elastic stress-strain distribution. The nonlinear portion of the M-ϕ relation is developed by first assuming the top concrete strain and then determining the NA location iteratively until the axial force equilibrium is satisfied. The converged moment and curvature values are then found using the resulting forces and strain distribution. Using this procedure, the M-ϕ curves are developed for the retrofitted cross sections shown in Figures 2b-2d, 2e-2g, and 2h-2j, respectively. These curves are presented in Figures 4, 5, and 6 including the curve for the non-retrofitted section shown in Figure 2a.

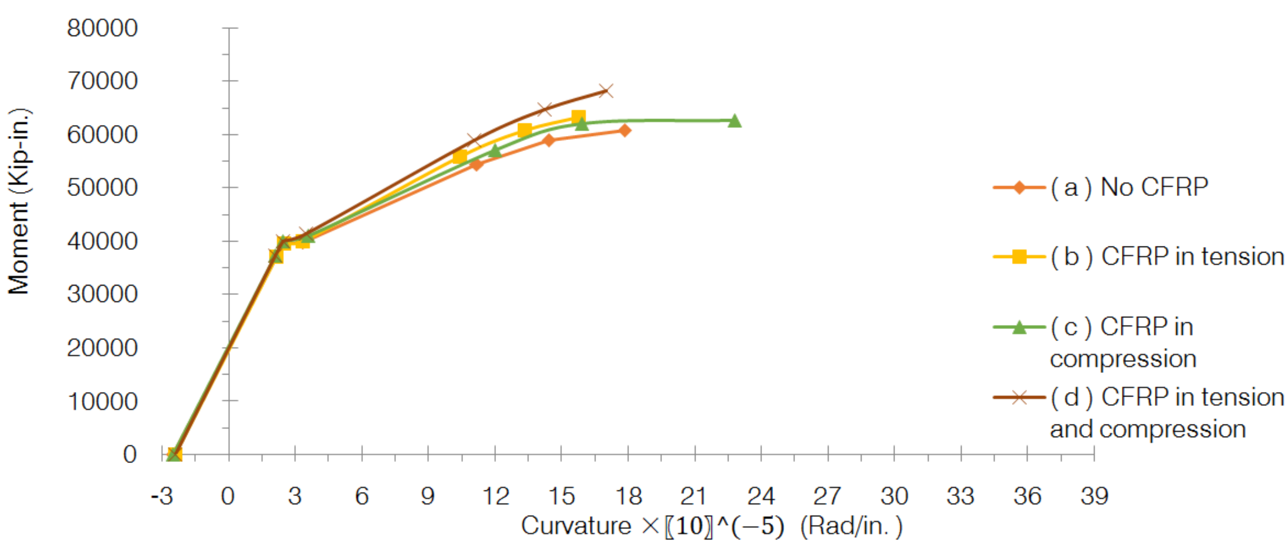

Figure 4: Moment-curvature curves for sections in Figures 2a-2d

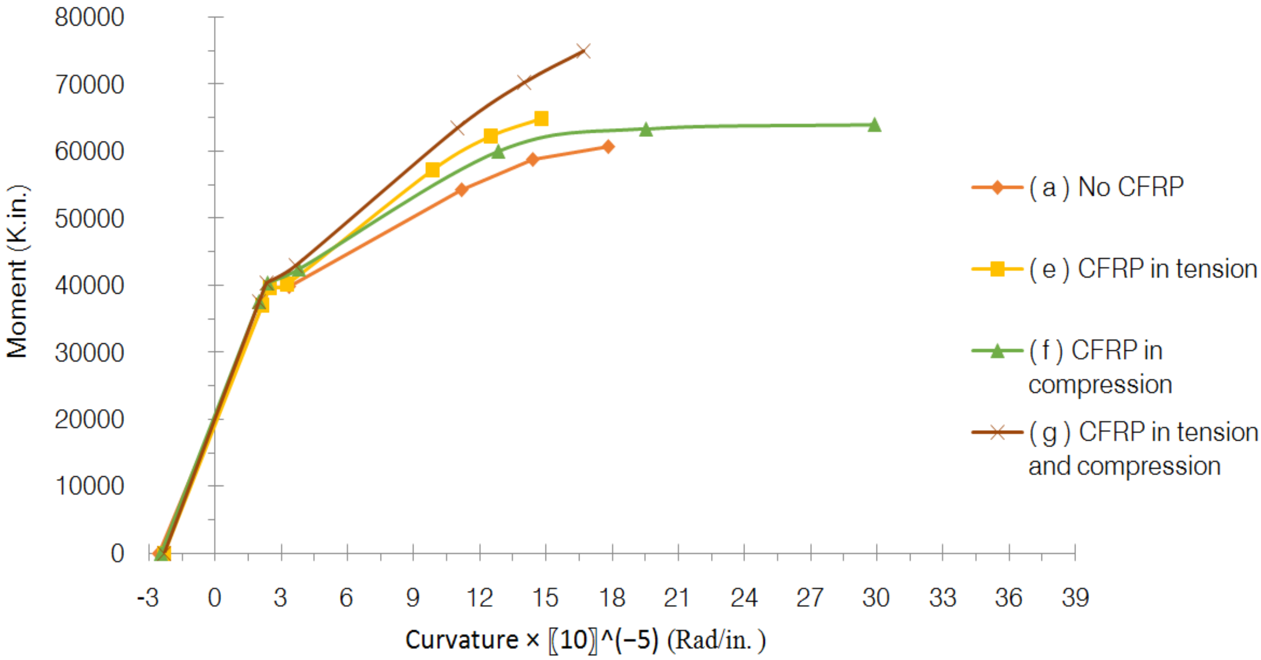

Figure 5: Moment-curvature curves for sections in Figures 2a and 2e-2g

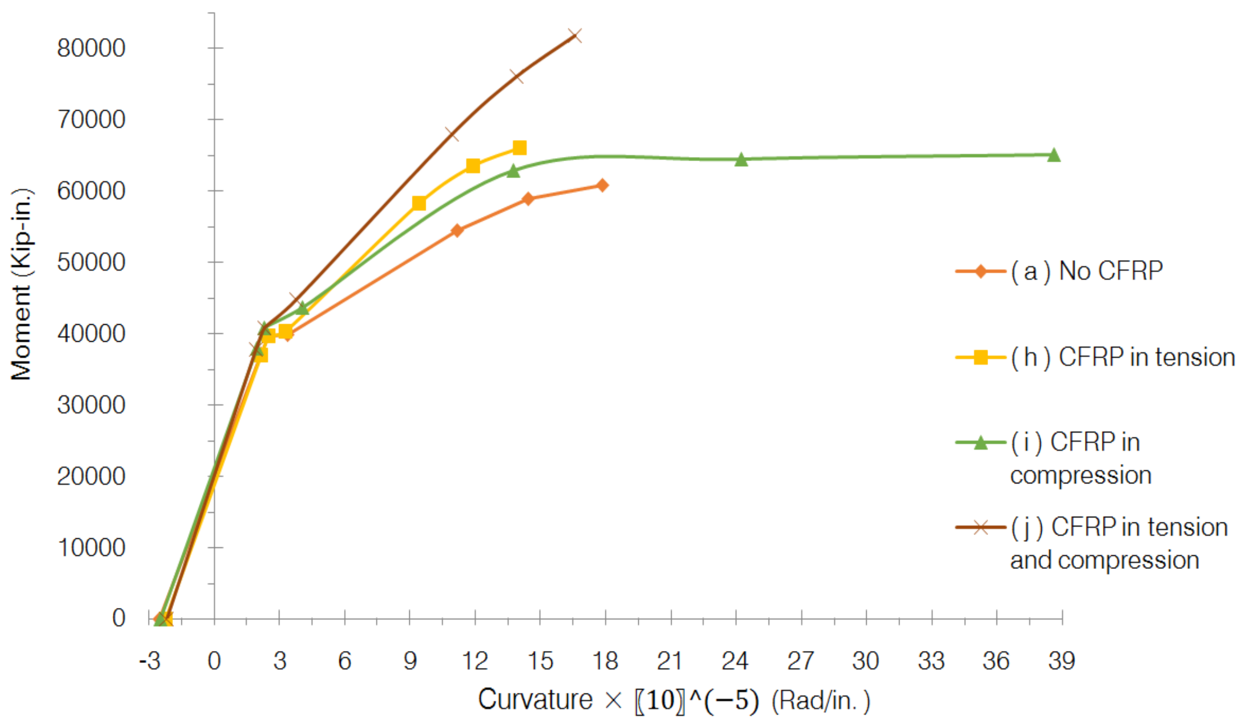

Figure 6: Moment-curvature curves for sections in Figures 2a and 2h-2j

The approximate equation for the linear portion of the M-ϕ relations shown in Figures 4-6 is:

$$\phi = (0.00012M - 2.4) \times 10^{-5} \qquad (8)$$

For the nonlinear portion of the M-ϕ relations corresponding to the sections shown in Figures 2a through 2j, the M-ϕ relations are as follow:

$$\phi_a = (0.14 \times e^{0.00008M}) \times 10^{-5} \qquad (9)$$

$$\phi_b = (0.195 \times e^{0.00007M}) \times 10^{-5} \quad (10)$$

$$\phi_c = (0.136 \times e^{0.00008M}) \times 10^{-5} \quad (11)$$

$$\phi_d = \phi_e = (0.3 \times e^{0.00006M}) \times 10^{-5} \quad (12)$$

$$\phi_f = (0.12 \times e^{0.00008M}) \times 10^{-5} \quad (13)$$

$$\phi_g = (0.0004M - 13.7) \times 10^{-5} \quad (14)$$

$$\phi_h = M^{2.935} \times 10^{-18} \quad (15)$$

$$\phi_i = (0.035 \times e^{0.0001M}) \times 10^{-5} \quad (16)$$

$$\phi_j = (0.0003M - 9.5) \times 10^{-5} \quad (17)$$

Equations 9 through 17 are obtained using Excel curve-fitting for use in load-deflection analysis based on finite-difference procedure. It is noteworthy that the same moment-curvature given by Equation 12 is found to be applicable to both of the box sections in Figures 2d and 2e. Also, in developing Equations 11, 13, and 16, the last point shown on the curves in Figures 4, 5, and 6 for sections 2c, 2f, and 2i, respectively, are excluded. However, these last points were included separately in the solution algorithm.

IV. Solution Algorithm

To predict the load-deflection relations for the prestressed box beam both without and with CFRP retrofitting, an algorithm is formulated based on the nonlinear moment curvature relations coupled with a finite-difference procedure. Figure 7 shows the finite-difference discretization along the longitudinal z axis of the box beam. The node numbers i = 1, 2, …, N used in the finite-deference formulation are also shown in this figure, with nodes 0 and N+1 as the so-called phantom points. In this study, the segment length h is taken as L/10, where L is the total span of 95 ft. The curvature ϕ_i of the box beam at any node i can be expressed in the following central finite-deference form [15]:

$$\phi_i = \left(\frac{d^2v}{dz^2}\right)_i = \frac{V_{i-1} - 2V_i + V_{i+1}}{h^2} \quad (18)$$

In this equation, V_i is the deflection at any node i. Applying Equation 18 at i = 1, 2, …, N, the following matrix expression is obtained:

$$[\,Q\,] \times \{\,V\,\} = h^2 \{\,\phi\,\} \quad (19)$$

where [Q] is a N×N coefficient matrix, and {V} is a deflection vector defined by:

$$\{\,V\,\}^T = \{\,V_0, V_2, V_3, \ldots, V_{N-1}, V_{N+1}\,\} \quad (20)$$

The curvature vector is defined by:

$$\{\,\phi\,\}^T = \{\,\phi_1, \phi_2, \phi_3, \ldots, \phi_N\} \quad (21)$$

In Equation 19, the following zero deflection boundary conditions are incorporated: $V_1 = 0$, $V_N = 0$

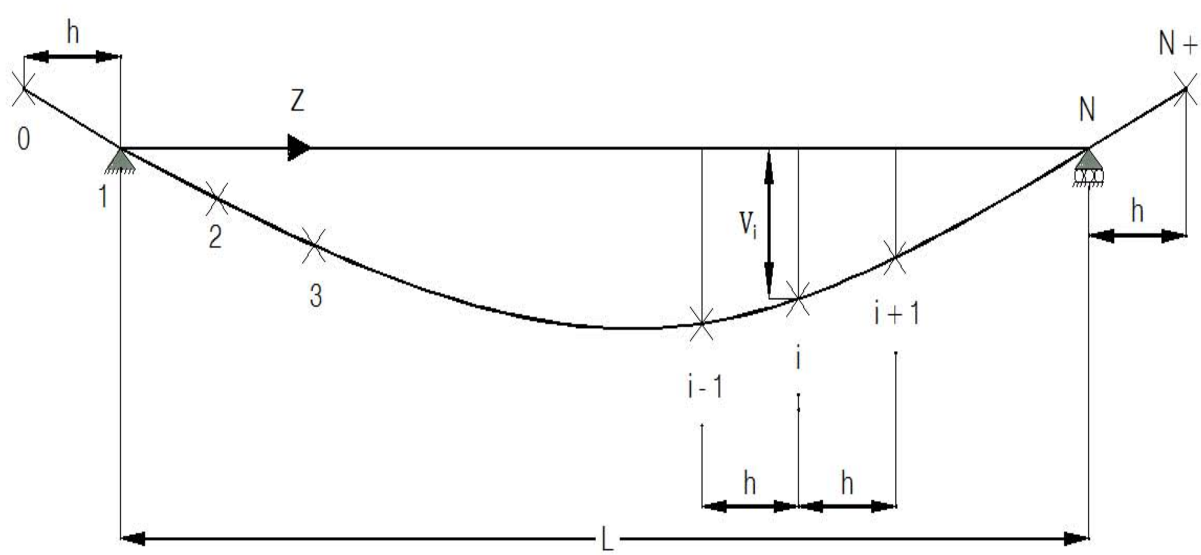

Figure 7: Finite-difference discretization

For a given load level, bending moment value at any location z along the length of the beam is found using the following expressions in their applicable ranges:

$$M_I = (4.721P \times z) + (570w \times z) - (w \times z^2/2) \text{ for } 0 \le z \le 430 \text{ in.} \quad (22a)$$

$$M_{II} = 1720P + (0.721P \times z) + (570w \times z) - (w \times z^2/2) \text{ for } 430 \text{ in.} \le z \le 598 \text{ in.} \quad (22b)$$

$$M_{III} = 4112P - (3.279P \times z) + (570w \times z) - (w \times z^2/2) \text{ for } 598 \text{ in.} \le z \le 766 \text{ in.} \quad (22c)$$

$$M_{IV} = 4878P - (4.279P \times z) + (570w \times z) - (w \times z^2/2) \text{ for } 766 \text{ in.} \le z \le 1140 \text{ in} \quad (22d)$$

In order to develop a load-deflection relation, the following algorithm is formulated and programmed:

1. Define the box beam length, cross-sectional and material properties, intensity of the distributed load w, and a value of P.
2. Discretize the box beam into (N-1) equidistant panels each of length h, associated with cross-sectional nodes i = 1, 2, 3, …, N.
3. Calculate the values of the bending moment M using Equations 22a-22d as applicable for nodes i = 1, 2, 3, …, N.
4. Using the bending moment values from step 3, calculate the curvature ϕ values for the same nodes using Equations 9-17 as applicable, and form the vector of curvatures, { ϕ }.
5. Substitute { ϕ } into Equation 19 and solve for the deflection vector { V }.

Based on the values found in { V }, the largest deflection is found to be at node 6 when N = 11 is used in the present study. Using this procedure, the load-deflection curves for the retrofitted cross sections shown in Figures 2b-2d, 2e-2g, and 2h-2j are developed and shown in Figures 8-10 including the curve for the non-retrofitted section shown in Figure 2a.

V. Results

Table 1 presents a summary of the results based on a rigorous nonlinear analysis of the box beam shown in Figure 1. In this table, c_2 represents the location of the neutral axis at collapse. The values of the collapse load and the corresponding maximum bending moment are represented by P_{max} and M_{max}, respectively. When nondimensionalized using P_{max} and M_{max} values for the non-retrofitted box beam section 2a, they are entered as p_{max} and m_{max} values in this table. It is seen that the p_{max} values for various retrofitting schemes range from 1.05 to 1.52 showing that the retrofitting scheme using section 2j is the most effective of the ones investigated in this study. The range of m_{max} values is seen to be from 1.03 to 1.35. The second most effective retrofitting scheme corresponds to the section 2g providing a p_{max} value of 1.35.

Figure 11 shows the relationships between box beam moment capacity and the CFRP thickness. The upper curve is for retrofitting with CFRP in both tension and compression, and the lower curve is when CFRP is used only in tension. A comparison of the two curves in this figure shows clearly that CFRP retrofitting is significantly more effective when used in both tension and compression regions.

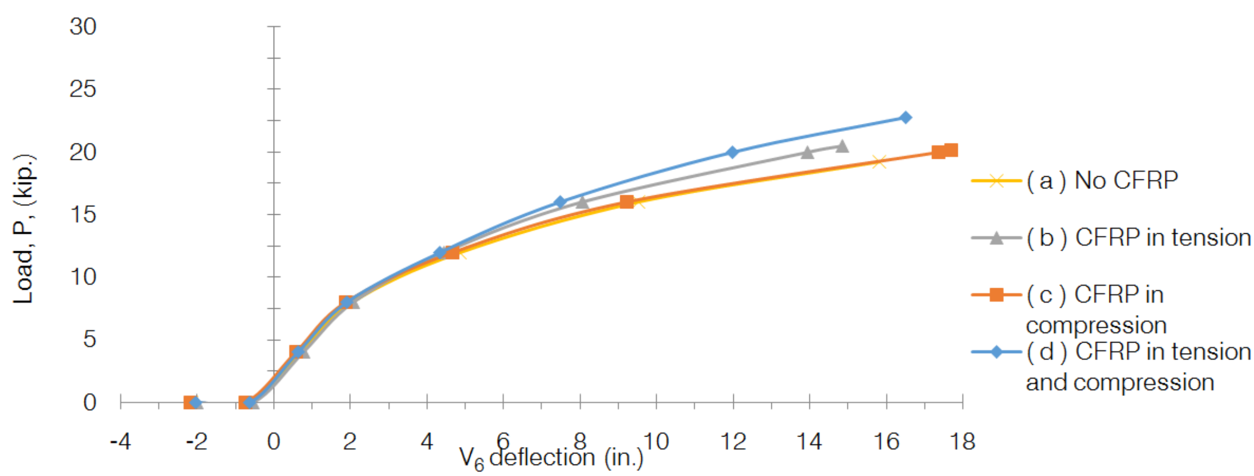

Figure 8: Load-deflection curves for sections in Figures 1a-1d

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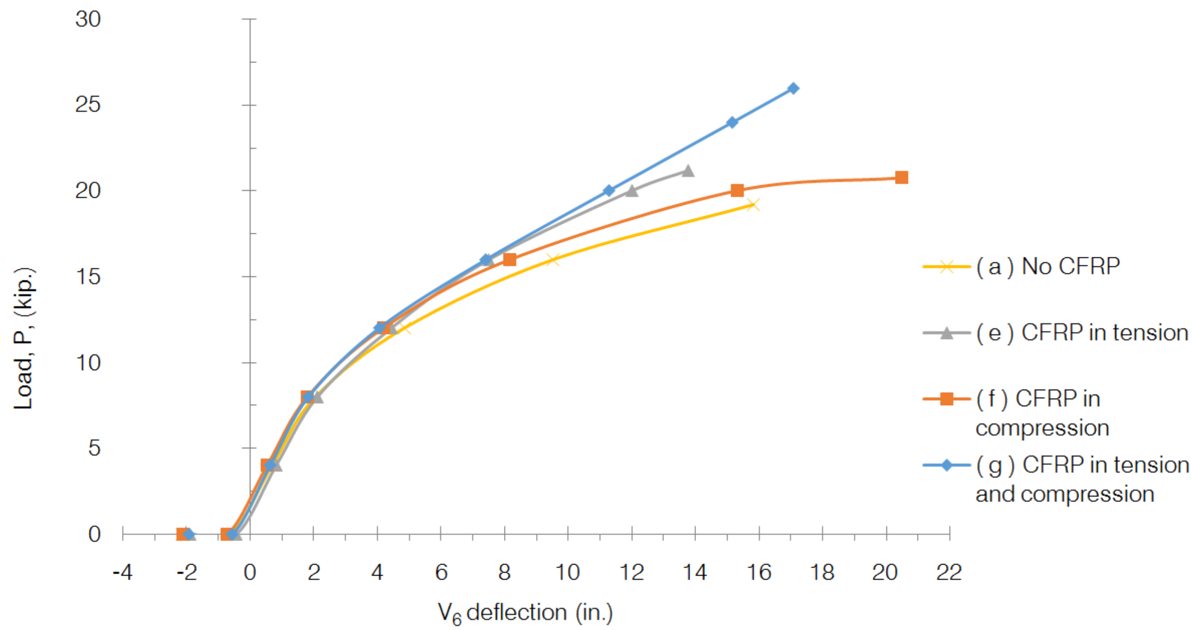

Figure 9: Load-deflection curves for sections in Figures 1a and 1e-1g

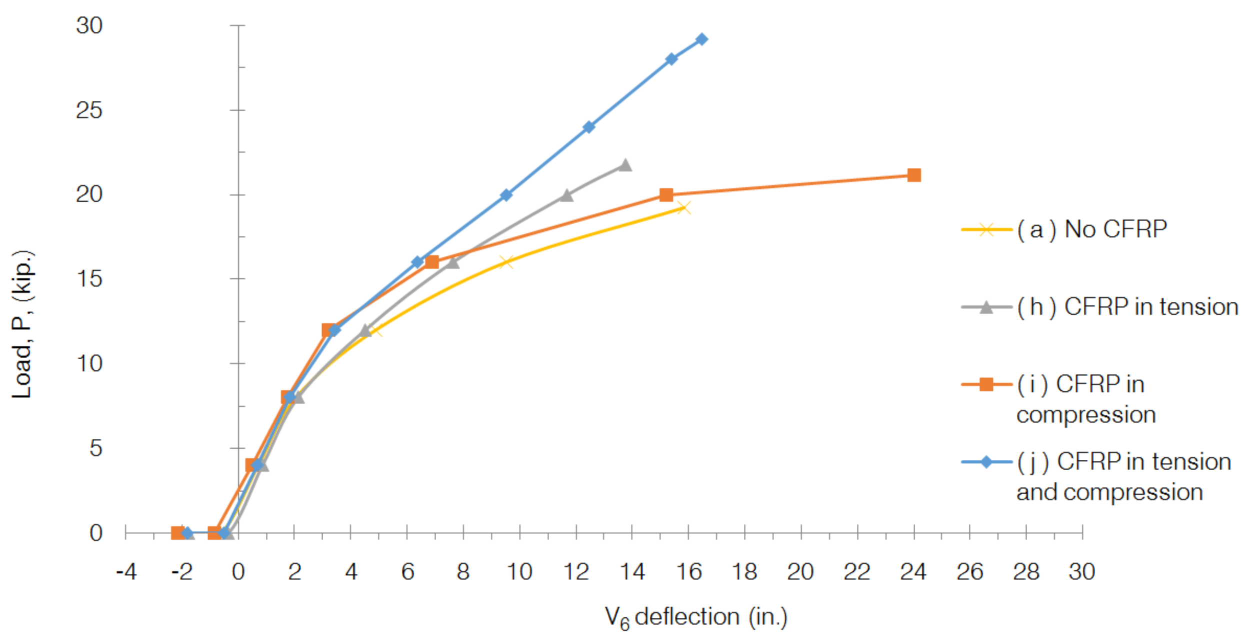

Figure 10: Load-deflection curves for sections in Figures 1a and 1h-1j

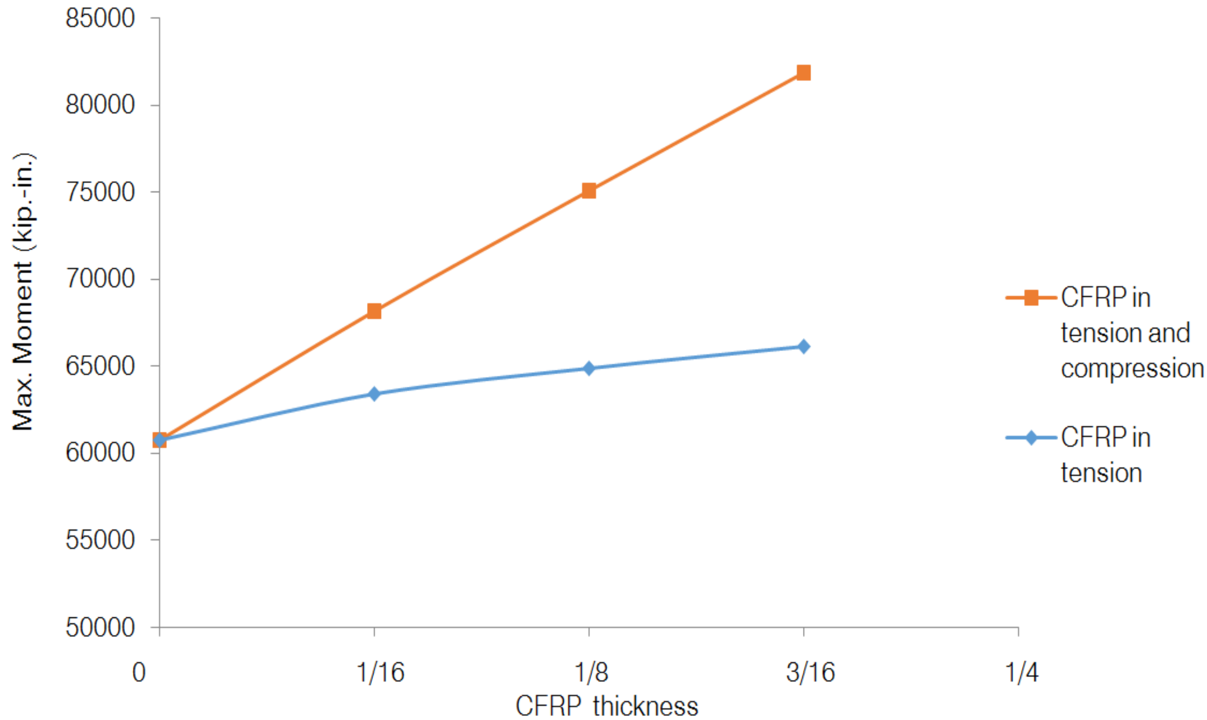

Figure 11: Box beam moment capacity versus CFRP thickness

Table 1: Summary of box beam results at P_{max}

Section (Figure 2)	c_2 (in.)	P_{max} (kips)	p_{max}	M_{max} (kip-in.)	m_{max}
2a	16.81	19.22	1.00	60749	1.00
2b	19.02	20.45	1.06	63364	1.04
2c	13.16	20.12	1.05	62657	1.03
2d	17.64	22.73	1.18	68175	1.12
2e	20.3	21.17	1.10	64876	1.07
2f	10.04	20.78	1.08	64058	1.05
2g	17.94	25.98	1.35	75069	1.23
2h	21.38	21.74	1.13	66098	1.09
2i	7.77	21.27	1.11	65088	1.07
2j	18.12	29.19	1.52	81852	1.45

VI. Conclusions

The following conclusions are drawn from this study:

1. The use of a 3/16-inch thick CFRP retrofitting layer in both tension and compression regions resulted in the largest increase in the load carrying capacity of the box beam.
2. Retrofitting with CFRP simultaneously in both tension and compression regions is for more effective than retrofitting in just the tensile or the compressive region of the box beam.
3. Retrofitting with CFRP in tension only results in practically the same load carrying capacity of the box beam as that obtained with CFRP in compression only.

The nonlinear analysis procedure presented is found to give rapid convergence for the box beam problem studied.

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Experimental Study on Effect of Concrete Made with Textile Effluent and Treated Effluent Water

By S.Arulkesavan, V.Jayabal, S.Purusothaman, J.Uma Maheshwaran & P.Vignesh

The Kavery Engineering College

Abstract- This paper deals with study of possible utilization of textile water in concrete by analyzing their durability properties The basic properties of different stages of effluent such as raw effluent, anaerobic process outlet, and tertiary treated outlet, reverse osmosis feed effluent from the textile industry were tested and the results were found to be satisfactory such that it can be used for construction purposes. By using the four stages of treated effluent, concrete specimens were casted and tested for its mechanical properties (compressive strength and tensile strength) and the results were found to be optimum for anaerobic and tertiary treated outlet Hence the study was planned to continue for durability properties (Acid attack- sulphuric acid, hydrochloric acid and carbonation) of specimens using anaerobic and tertiary effluent.

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Experimental Study on Effect of Concrete Made with Textile Effluent and Treated Effluent Water

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Abstract- This paper deals with study of possible utilization of textile water in concrete by analyzing their durability properties The basic properties of different stages of effluent such as raw effluent, anaerobic process outlet, and tertiary treated outlet, reverse osmosis feed effluent from the textile industry were tested and the results were found to be satisfactory such that it can be used for construction purposes. By using the four stages of treated effluent, concrete specimens were casted and tested for its mechanical properties (compressive strength and tensile strength) and the results were found to be optimum for anaerobic and tertiary treated outlet Hence the study was planned to continue for durability properties (Acid attack- sulphuric acid, hydrochloric acid and carbonation) of specimens using anaerobic and tertiary effluent.

I. Introduction

Due to urbanization and expanding economic activities, about 13% of the world's population do not have access to safe drinking water. With current trend of water demand, water shortage will become even more intense and approximately, half of the world's population will suffer from major water scarcity by the year 2030 said by UNESCO. Industrial sector, contributes about 20% of the national income. Textile industry contributes nearly14% of the total industrial production in India. There are about 10,000 garment manufactures and 2100 bleaching and dyeing industries in India. Textile waste water includes a large variety of dyes and chemical additions that pose an environmental challenge for textile industry not only as liquid waste but also due to its chemical composition. The shifting of irrigation water to fulfil the need of industrial use as well as water quality and lowering of water table around. The surface as well as ground water quality induces environmental degradation over long period of time because of discharge of highly contaminated effluent accelerated by over exploitation of existing water resources. The world bank estimates that 17 to 20 percent of industrial water pollution comes from textile dyeing and finishing treatment given to fabric majority are concentrated at Tirupur and Karur in Tamil Nadu, Ludiyana in Punjab and Surat in Gujarat. In recent decades, major research project are undergone to develop the utilisation of industrial waste into useful one.

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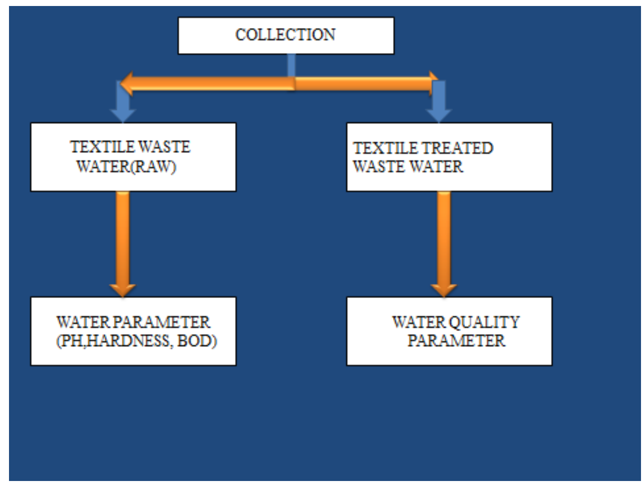
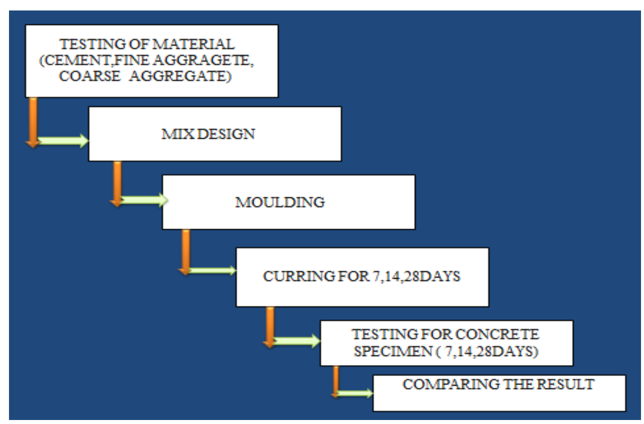
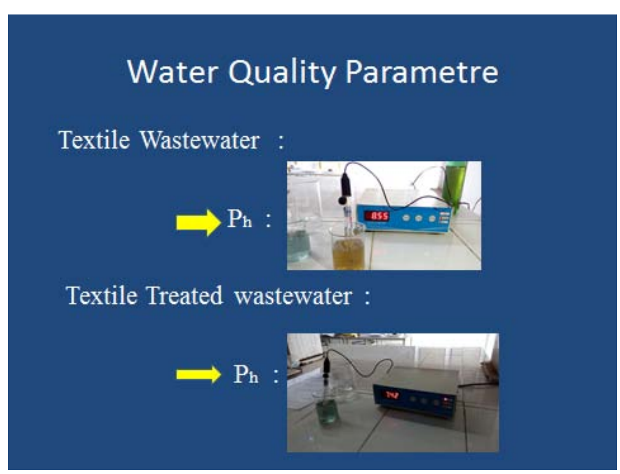
II. Methodology





III. Water Quality Parametre



IV. Testing of Material

a) *Tests For Cement*

✓ Ordinary or low heat Portland cement conforming to IS:269-1976

✓ RAMCO 53 grade ordinary Portland cement (OPC) is used for the study programme.

i. *Setting time test (Vicat apparatus)*

- Initial Setting Time

✓ Lower the needle gently and bring it in contact with the surface of the test block and quick release.

Initial Setting time = 20 min

- Final Setting Time

✓ Replace the needle of vicat apparatus by a circular attachment.

Final Setting time = 10 hrs

ii. *Specific Gravity of Cement*

✓ Take a clean dry pycnometer with its cap and weight it. (M_{1g})Take about 200g of dry cement in the pycnometer and find the weight of pycnometer with cement. (M_{2g})

Specific Gravity of Cement = 3.15

b) *Tests For Aggregate*

i. *Specific gravity of sand*

✓ Fill the pycnometer with distilled water up to the hole in the conical cap and shake it to remove the air. Then take the weight of pycnometer with sand and distilled water. (M3 g).

Specific gravity of sand = 2.68

ii. *Sieve Analysis*

✓ Arrange the sieve set in orders of 4.75mm,2.36mm,1.18mm,1mm, 600μ,300μ,150μ size and a pan at the bottom.

✓ Position the sieves set in the sieve shaker and sieve the sample for a period of 10 minutes

iii. *Tests for Coarse Aggregate*

a. *Sieve Analysis*

✓ Arrange the sieve set in orders of 25mm,22.4mm,20mm,16mm, 12.5mm,10mm,6.3mm, 4.75mm,2.36mm size and a pan at the bottom.

✓ Position the sieves set in the sieve handshakes in top and bottom or rotate in the sieves in approximately 5 minutes.

b. *Impact Strength Test*

✓ The test sample consists of aggregate, the whole of which passes 12.5mm sieve and retained on 10mm sieve.

✓ The test sample is subjected to a total of 15 below with a time interval of not less than one second.

The aggregate impact value = 13.23%

c. *Crushing Strength Test*

✓ The test sample consists of aggregate, the whole of which passes 12.5mm sieve and retained on 10mm sieve.

✓ The test sample is added in thirds, each thirds is tamped by equally distributed strokes of tamping rod. The depth of the aggregate in the cylinder is about 10cm.

✓ The loaded at a uniform rate in such a way that a total load of 400KN is reached in 10 minutes.

✓ The load is released and the whole of the material is removed from the cylinder.

✓ The removed material from the cylinder is sieved on 2.36mm sieve for the fraction passing the sieve is weighed.

The aggregate crushing value = 17.7%

d. Flakiness Index Test:

✓ Each fraction is gauged in turn for thickness gauge. The separate aggregate fractions are passed through the corresponding slots in the thickness gauge as indicated in the table.

✓ The weight of aggregate passing through each of the slot is determined.

Flakiness index= 31.02%

V. Mix Design

Given

Specificgravity of cement= 3.15
Specificgravity of coarse aggregate= 2.90
Specificgravity of fine aggregate= 2.68(ZONE 3)
Degree of workability= 0.90 CF
W/C ratio = 0.38

TARGET MEAN STRENGTH OF CONCRETE (fck)

Fck = 39.9N/mm2

Grade	Cement (kg/m3)	Fine aggregate (kg/m3)	Coarse aggregate (kg/m3)	Water (lit/m3)
M30	504.15	497.13	1285.03	191.58

VI. Test for Fresh Concrete

a) Slump Cone Test

- ✓ A concrete Mix of M_{30} filled in the three layers compacted with tamping rod.
- ✓ Top surface is leveled and mould is raised vertically.
- ✓ The slump which is the difference In height between the top mould and the highest point on the subsided concrete measured.

The sulmp observed = 25 cm

b) Compaction Factor Test

- ✓ The inner surface of the hopper and cylinder are greased. The weight of empty cylinder with its base (W1 gm) is taken.
- ✓ The given concrete mix proportion is prepared. The concrete mix is gently placed and levelled in the upper hopper using the hand scoop.
- ✓ The cylinder is refilled with the sample of concrete in approximately six equal layer. Each layer is being heavily rammed or vibrated so as to obtain full compaction.
- ✓ The top surface of the cylinder is levelled and the outside of the cylinder is wiped and weighted with concrete (W_3 gm)

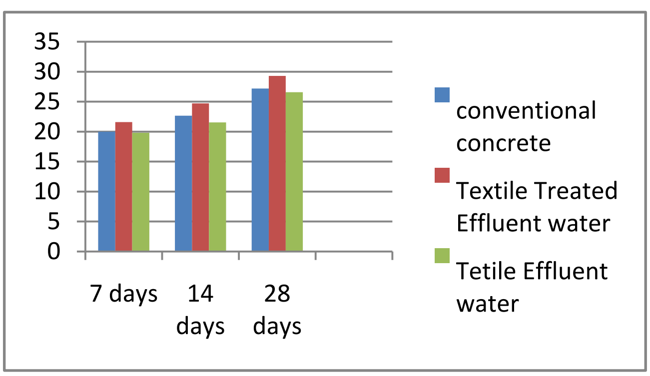
The compaction factor = 0.8

Sl.no	Age of test	Conventional Concrete	TEXTILE TREATED EFFLUENT WATER	TEXTILE EFFLUENT WATER
1	7	20	21.6	19.8
2	14	22.67	24.72	21.54
3	28	27.18	29.30	26.57

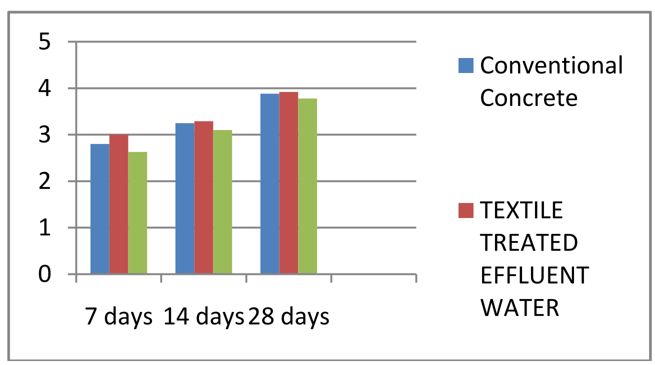
VII. Strength Test

- Compressive strength
- Split tensile strength
- Flexural strength

a) Compressive Test For Concrete In Cube

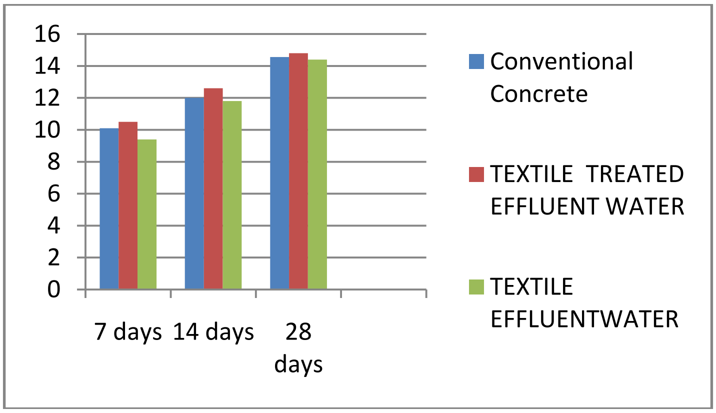


b) Splitting Tensile Strength For Concrete In Cylinder



c) Flexural Strength Concrete in Prism

Sl. no	Age of test	Conventional Concrete	TEXTILE TREATED EFFLUENT WATER	TEXTILE EFFLUENT WATER
1	7	10.1	10.5	9.4
2	14	12	12.6	11.8
3	28	14.56	14.8	14.4



VIII. Conclusion

- ✓ This study shows the possible utilization of textile water in making concrete cubes with good and equivalent strength of concrete cubes made with potable water.
- ✓ Compressive strength of concrete cubes made with TETW and TEW was good and equivalent to potable water.
- ✓ The behavior of acid attack on concrete cubes made with TEW was less compare to the potable water.
- ✓ Further durability studies are needed and planned to know the durability properties in detail
- ✓ The study can be further extended as study of chemical nature of the sludge by undergoing several periodic analyses on sludge produced in different chemical processing industries, leachability and toxicity analysis on the sludge and sludge bricks, and other applications which can utilize sludge.

Sl. no	Age of test	Conventional Concrete	TEXTILE TREATED EFFLUENT WATER	TEXTILE EFFLUENT WATER
1	7	2.83	3.0	2.63
2	14	3.25	3.29	3.1
3	28	3.88	3.92	3.78

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Analytical Study on Cyclic Behaviour of Simple Column-Base Connections

By Gholamreza Abdolahzadeh & Seyed Mostafa Shabanian
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Abstract- Column-base connections are one of the most important elements in steel structures which connect the steel frame to the foundation. Therefore, in structures erected in seismic areas, these connections are critical to convey cyclic inertia forces to the frame. In this paper the author performed a parametric study utilizing Finite Elements Method (FEM) to investigate the cyclic behaviour of the connection. Primarily, the modeling method is verified and calibrated by the use of available experimental data. Afterwards, the parametric computer models are made. Effect of the parameter of column dimensions on overall behavior of connection is investigated for the first time. The mentioned parameter plays an important role in simple column-base connection's behaviour as it alters the moment distribution in the base plate. Additionally, two other separate parameters are considered and their individual impact on the total behavior of joint is investigated.

Keywords: column-base connections, finite element method, cyclic behaviour, parametric study.

GJRE-E Classification: *FOR Code: 090599*

ANALYTICALSTUDYONCYCLICBEHAVIOUROFSIMPLECOLUMNBASECONNECTIONS

Analytical Study on Cyclic Behaviour of Simple Column-Base Connections

Gholamreza Abdolahzadeh[α] & Seyed Mostafa Shabanian[σ]

Abstract- Column-base connections are one of the most important elements in steel structures which connect the steel frame to the foundation. Therefore, in structures erected in seismic areas, these connections are critical to convey cyclic inertia forces to the frame. In this paper the author performed a parametric study utilizing Finite Elements Method (FEM) to investigate the cyclic behaviour of the connection. Primarily, the modeling method is verified and calibrated by the use of available experimental data. Afterwards, the parametric computer models are made. Effect of the parameter of column dimensions on overall behavior of connection is investigated for the first time. The mentioned parameter plays an important role in simple column-base connection's behaviour as it alters the moment distribution in the base plate. Additionally, two other separate parameters are considered and their individual impact on the total behavior of joint is investigated.

Keywords: column-base connections, finite element method, cyclic behaviour, parametric study.

I. Introduction

Column-base connections provide the overall stability of steel frame and additionally convey earthquake ground motions to the structure and back to the earth. Therefore, their dissipative cyclic response is vital to be considered integrally by designers. Even though, studies relating to rotational stiffness of beam-to-column connections historically go back to early 20th century, investigations on the mechanical properties of column-base connections have been commenced relatively late. Primarily, experimental researchers like DeWolf et al, Picard et al, and Thambiratnam et al realized the importance of the issue. Among those studies the investigation carried on at UC-Berkeley might be considered as the most impressive. It has proved that the degree of rigidity is related to properties and configuration of the connection itself as well as the amount of axial load exerted on column. The cyclic ductility has also been considered as an important parameter for seismic design of column-base connections for the first time. Additionally, the simple column-base connections' behaviour has been classified into three separate categories proportional to the base plate thickness [1-8].

In recent years, some researchers have studied the behaviour of this kind of joints through experimental as well as the Finite Element Method (FEM) and have tried to develop appropriate design models for the everyday engineering practice. These investigations, however, chiefly considered the joints under monotonic loading conditions, while to the cyclic behaviour much less efforts have been dedicated. S. Khodaie, M.R. Mohamadi-shooreh and M. Mofid performed a parametric study on initial stiffness of square hollow section (SHS) column bases under monotonic loading conditions. In this research the software SUT-DAM to model this type of connection and developed an analytical approach to study the parametric behaviour of it. Jaspart and Vandegans at university of *Liège* presented a mechanical model to investigate the component method described in Annex J of Eurocode 3. They provided comparisons of the model with their experimental laboratory tests under monotonic loading conditions. In the present research, the moment-rotation responses of those tests are utilized for validating models with monotonic loading conditions [9-12].

Adany et al conducted experimental studies on the cyclic behaviour of end-plate connections. They extended their results for column-base connections as well. They neglected the effect of concrete deformation by installing the base plate on a heavy steel beam instead of concrete pedestal. Their hysteresis moment-rotation curves are utilized to validate the cyclic models of the present research with some considerations which is explained in the succeeding sections [13].

The lack of information about column-base connections might be considered as a result of their complex structures as they are made-up of different materials (Fig. 1). This may cause difficulties for experimental and numerical studies particularly. High order of inherent nonlinearities in the behaviour of these kinds of joints imposes high computational costs and extremely long run times especially in the case of cyclic analysis [14].

Due to the fact that there is limited information about seismic behaviour of column-base connections, a demand for more investigations on this issue is tangible. Additionally, the cyclic behaviour of these connections is rarely investigated by the use of FEM method.

The first aim of this study is to investigate the important characteristics of the simple H-shaped column-base connections in seismic cases. Initially, a complex numerical model with material, contact and geometric nonlinearities is made and validated with corresponding experimental data. Afterwards, the computer models are utilized in order to achieve a better

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understanding of the real seismic behaviour of mentioned connection type specifically. This aim is achieved by studying the effect of three important geometric parameters that have a great impact on the mechanical response and calculating and interpreting the amount of standardized seismic variables like rigidity, ductility, and energy dissipation capacities for each model's hysteresis response. The variable of column dimensions and its impact on overall behaviour of the joint is considered for the first time. The mentioned parameter plays an important role in connection's behaviour as it alters the moment distribution in the base plate.

II. Modelling of Connection

Simple column-base connections are widely used when the designer desires no moment to be transferred from steel structure to foundation . Even though, in accordance to former investigations of the behaviour of steel structure connections they can be called semi-rigid or semi-hinged [15] and their considerable rigidity should not be neglected by the designers. Whereas the Occupational Safety and Health Administration (OSHA, 2001) recommended a minimum of four anchor bolts for the simple column-base connections, such exposed type joints are considered to have the minimum rigidity as the most simple column-base connection types (Fig.1).

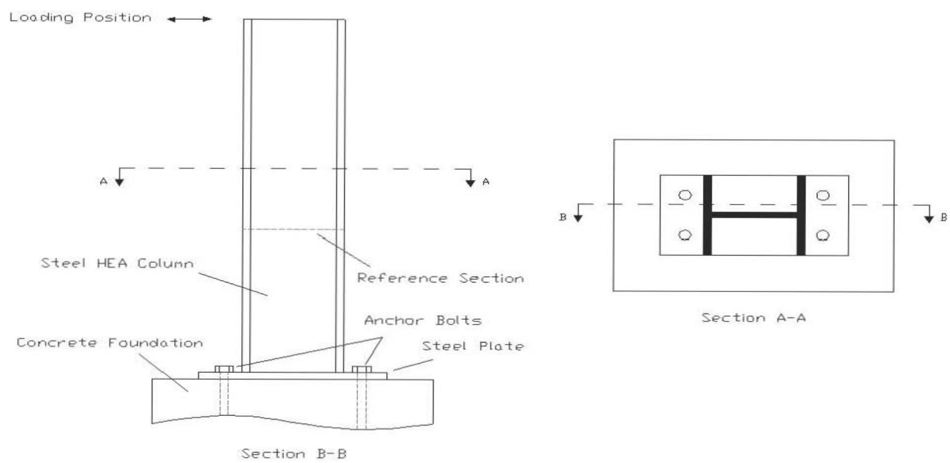


Fig. 1: investigated simple column-base connection

In this research, a FEM analysis was conducted utilizing SUT-DAM, which is nonlinear finite element software developed at the Sharif University of Technology. As there is a complex interaction between different components of connection made from distinct materials, it is important to make an appropriate model for contact areas. The convergence of FEM analysis process lies in the quality of meshing, material models, and contact formulations. Thus, a number of trial models are created and studied initially [14].

III. Generating the Model

By considering proper boundary conditions one half of the connection is simulated. The Lagrangian formulation is utilized to describe the kinematic behaviour of elements. All parts are modelled utilizing 3D eight-node brick elements which have 3 displacement degrees of freedom on each individual node. However, the element sizes are not identical in all components. The concrete pedestal is modelled with largest mesh as the base plate and the bolt heads are modelled with finest elements as shown in Fig. 2. The optimised element size is estimated by studying the changes and verifying responses of each case with the available experimental data [14].

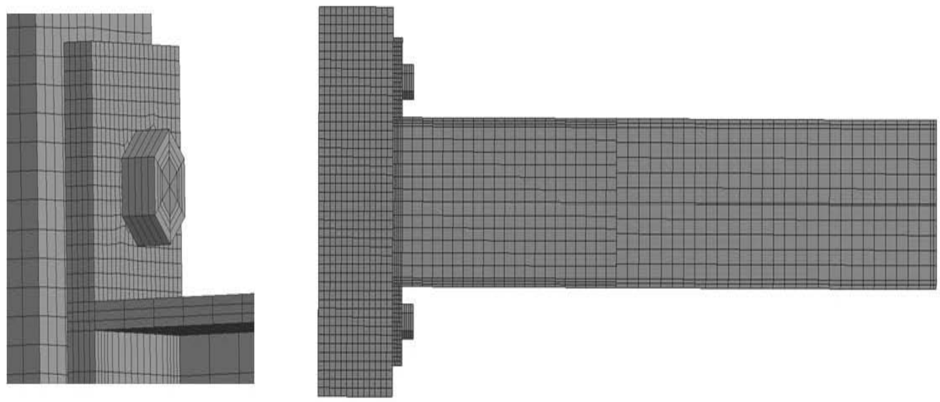


Fig. 2: Meshing

The interactions between components are modelled with 3D surface-to-surface contact elements. The nonlinear frictional contact between bolt head and upper surface of base plate as well as concrete pedestal and base plate can represent the sliding, separation and impact phenomena during the cyclic motions.

The solver utilizes an implicit approach as the load step increments are chosen adequately small and a smooth process of convergence is provided for it. A displacement-loading Newton-Raphson iteration approach is utilized in order to solve the nonlinear problem in each sub-step by reducing the errors. Additionally, a Minimum Residual Displacement Method is used for the analysis of cyclic loads. In order to curb the solution errors the Euclidean norm of displacements are considered as divergence criterion. In this case, the maximum value of vector of unbalanced displacements should be restricted. The limitation value is determined for each model by an empirical approach [14].

The material properties are basically defined in accordance to Adany's specimen which is utilized to calibrate the basic model of connection. However, in nonlinear region of stress-strain curves some adaptations are considered in order to achieve the best coincidence with the test results.

The loading is defined according to ECCS Standard which is repetitive cycles of horizontal displacements exerted on top of the column with increasing amplitudes which are defined as a function of the parameter δ_y -elastic limit of imposed horizontal displacement on the mentioned section. The parameter is calculated after studying F-δ response of an individual model for each connection under monotonic loading conditions. F stands for horizontal reaction force and δ for the imposed horizontal displacement of the mentioned section. The analytical-geometric approach utilized for calculating the amount of δ_y is mentioned in ECCS. Afterwards, the cyclic displacement loading history is applied on cyclic models as shown in the figure below.

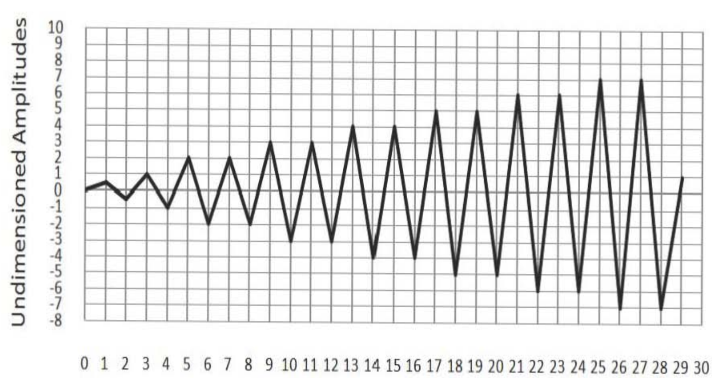


Fig. 3: Cyclic displacements as a factor of δ_y in loading cycles

It can be inferred from the previous paragraphs that the accuracy of cyclic loading in major models is related to the integrity of the corresponded model with monotonic loading condition. Therefore, a base plate model with monotonic loading condition is validated and calibrated separately utilizing available experimental data in the literature. The process is discussed subsequently.

The complete modelling of a column-base connection under cyclic loads needs high amount of computer resources. Therefore, some simplifications are considered in order to save time and increase efficiency.

After any of these changes, the FEM model is calibrated and validated utilizing corresponding test results.

IV. Simplifications of Model

Due to the following reasons complete simulation of a column-base connection under cyclic loads cannot be possible with an ordinary computer

- Large number of DOFs
- Long cyclic loading history
- The highly nonlinear nature of the problem
- Lack of comprehensive information about material characteristics

Therefore, some verified simplifications are considered in order to achieve an efficient simulation of the joint. These simplifications can be divided into two parts: simplifications in material modeling and simplifications in geometry of joints and interactions between relevant parts.

The steel material model utilized for all plates as well as the high strength steel material model for the anchor bolts are modelled based upon a method explained by Diaz et al [16]. The confirmed model is established after utilizing trial and error method and ends with the best calibrated results. According to this method the modulus for segments are defined as:

- Region (a): elasticity modulus (E).
- Region (b): $E_{h1}=E/C_{wh}$, where C_{wh} is the work hardening coefficient.
- Region (c): $E_{h2}=E_{h1}/10$

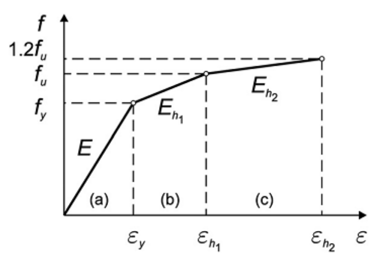


Fig. 4: Non-linear steel material models [16]

Another major type of simplifications is related to the modified geometry of anchor bolts and their interactions with the concrete pedestal. Three major parameters influence the behavior of an anchor bolt: material properties, contact forces between the bar and surrounding concrete, and the restraining of the bar. All these factors affect force-displacement curves which are the most significant characteristics of anchor bolts. In this research, in order to simplify the cyclic model the bar-concrete interaction is considered frictionless and the end of bar is assumed to be fixed. However, in a real case the interaction forces change along the bar length and this can be totally complicated in dynamic cases. This simplification contributed to better solver convergence and shorter run time for the software. On the other hand, reliable bolt material model is discovered by trying different stress-strain curves for the bolt material and studying the load-displacement response of anchor bolt specimens in comparison to the available experimental and theoretical data. These models include a discreet bar with some surrounding concrete which are fixed at the end. A normal tensile force is exerted at the top of the bar and increases monotonically. The force-deflection curve is verified utilizing available experimental data for anchor bars which is explained in the following [17].

V. Validations and Calibrations

Primarily, a discreet model of an anchor bolt with the considered simplifications is verified utilizing the experimental data available in the literature. As it can be seen in Fig. 5, agreement between the simplified numerical and experimental models is well. At the elastic parts of the force-displacement curve the slope of the FE model is less than the test results. This phenomenon is because of simplified bar-concrete contact that is considered frictionless and evidently cannot display the real characteristics of gradual separation between anchor bolts and the encircling concrete.

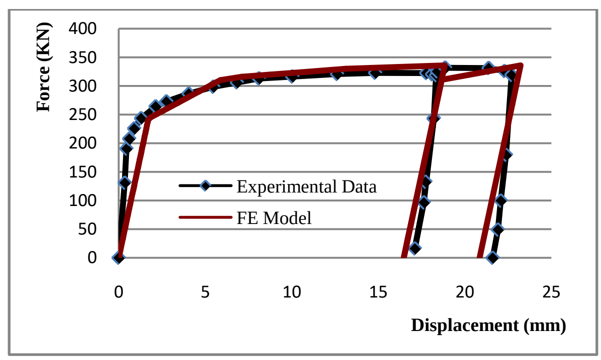
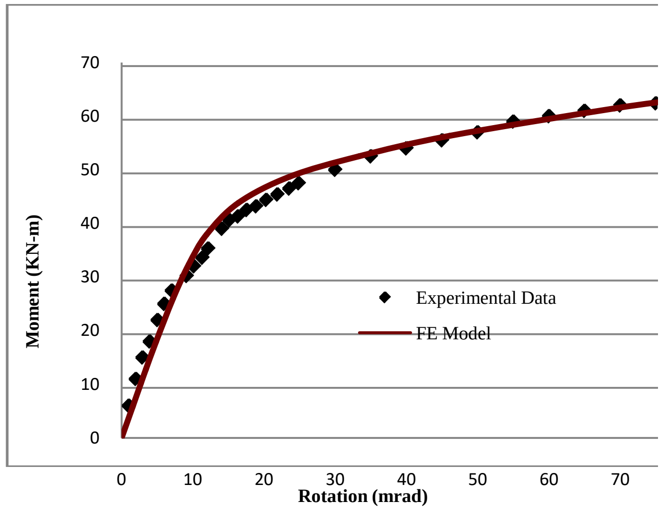


Fig. 5: Verification of discreet anchor bolt model

As explained in section 2.1, in order to define the cyclic loads, we should first calculate the elastic limit for each model from a monotonic test. In order to find the monotonic response of the connections FE models are made correspondingly. There is no available experimental data for calibrating the model of Adany's joint under such loading condition. Therefore, the modelling approach is validated and calibrated in comparison to an experimental research performed by Jaspart and Vandegans at University of Liege. As it is shown in Fig. 5 there is fine agreement between analytical and experimental curves. However, the numerical model has less initial rigidity due to the simplified frictionless interaction. At the non-linear part of curves the difference between curves is related to simplified material model in the lack of thorough information.



As mentioned before the test specimen utilized for validating the present numerical study was erected on a rigid base element instead of concrete pedestal. Therefore, the rotation caused by deformation of concrete pedestal under the base plate is subtracted from overall rotation of the joint in order to compare and verify the results. However, in the parametric models the concrete pedestal is considered in order to achieve more actualized response. Although such deformation may not seem considerable but it plays an important role in stress distribution under base plate which is the ruler factor in plate thickness design. [Dewolf]

The final hysteresis curve is shown in Fig. 5 that can be compared with the similar experimental curve of Adany et al. [6]. In this model the amount of elastic limit displacement is equal to 6 mm. It can be seen from the figure that at the initial parts there are reasonable agreement between numerical and experimental data. However, after 5 non-elastic cycles of loading, unloading and inverse loading the experimental curves start to fail because of fatigue phenomenon which is not considered in numerical models.

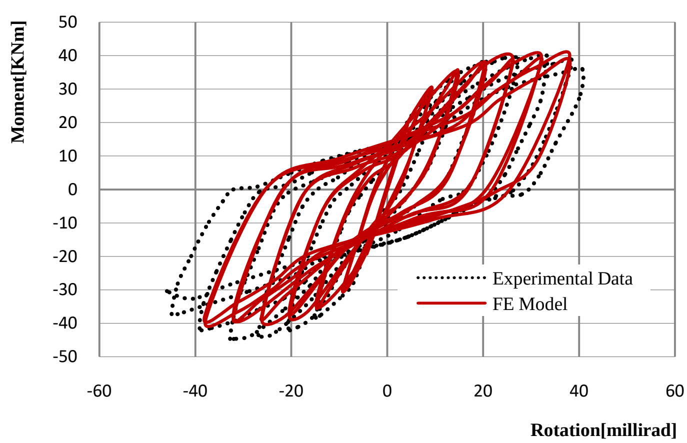


Fig. 7: Cyclic behaviour of calculated connection in the left and of the similar test of Adany et al. in the right

VI. Results

In order to study the overall behaviour of base plate connection $M\text{-}\theta$ graphs are utilized. In these graphs M is the total moment resisted by the connection under cyclic displacement exerted on column and θ is the rotation of the column at a reference section. This section is virtually located at a distance of twice the column section depth from the base plate. The definition is in accordance to Adany's ...

The cyclic parameters defined by the ECCS are considered as standard criteria for analogies between available results. Formulae and notations for the parameters are illustrated in Fig. 6. In these formulae the quantities of ductility, resistance, rigidity and absorbed energy are divided to the corresponding idealised quantities that are related to perfect elastic-plastic behaviour. As in this case all the ratios are equal to zero, their subtraction from the unity represents the deviation from the perfect elastic-plastic behaviour.

Partial Ductility	$\mu_i =$ θ_i [redacted] θ_y
Full Ductility Ratios	$\psi i =$ $\Delta\theta_i$ [redacted] $2\theta_i - \theta_y$
Resistance Ratios	$\varepsilon_i = \frac{M_i}{M_y}$
Rigidity Ratios	$\xi\ i =$ $\tan\alpha_i$ [redacted] $\tan\alpha_y$
Absorbed Energy Ratios	$\eta\ i =$ A_i [redacted] $2M_y(\theta(-\theta\ )_y$

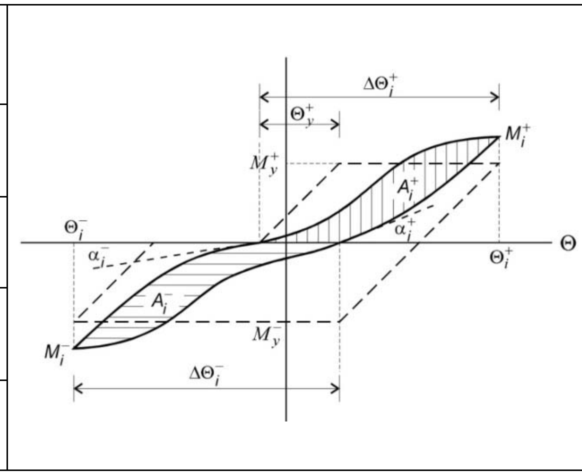


Fig. 5: Cyclic parameters defined by ECCS standard

Defined Variables

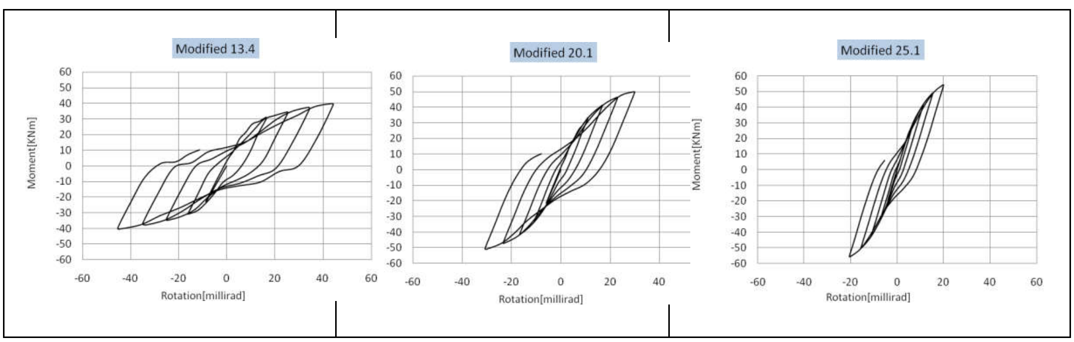
Three geometric variables are defined that each of them are varied two times. (Tab. 1)

Tab. 1: The variables and their practical ranges

Name of Parameter	Diameter of Anchor Bolts	Thickness of Base Plate	Size of Column
High	M30 (d=25.5)	22mm	HEA200
Medium	M24 (d=20.1)	16mm	HEA160
Low	M16 (d=13.4)	12mm	HEA120

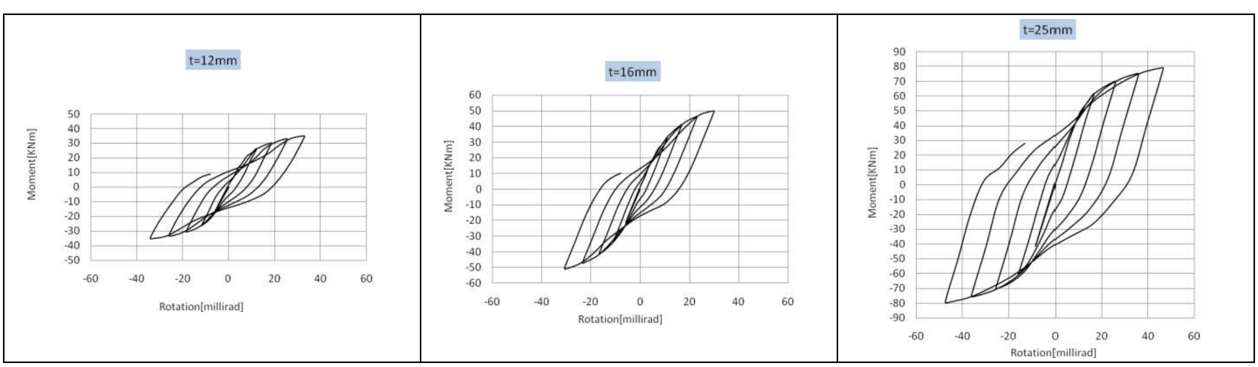
Influence of Anchor Bolt Diameter

In this section the impact of th ɔur of connection is investigated.



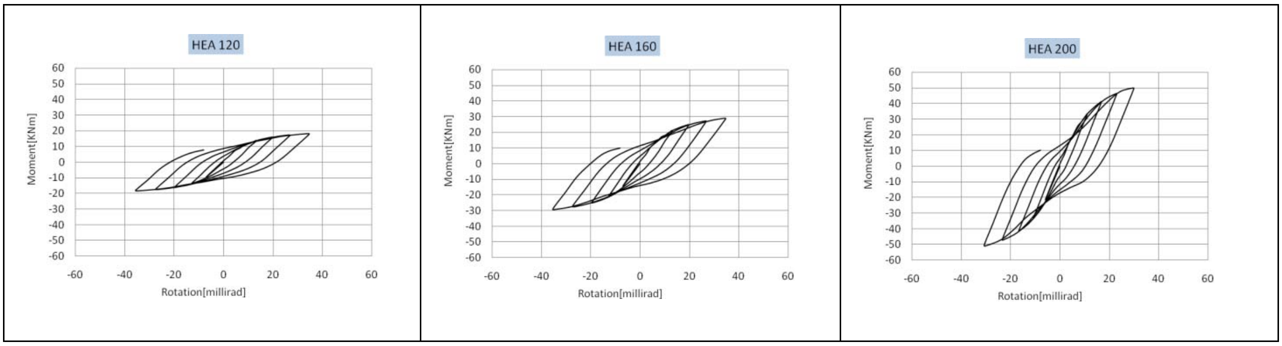
Influence of Base Plate Thickness

As it is shown in Fig. the thickness of b ːlic behaviour.



Influence of Column Size

In this study the change in dɛdepth of HEA columns are investigated as an effɛon the joint's cyclic response. The two altered amou'nts for cmounts for column depths are both smaller than orThat is because the basic model's depth is 200 millimetre which is the largest possible column for a plate with such dimensions.



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Predicting CBR Value from Index Properties of Soils using Expert System

By Ahmad Taha Abdulsadda & Dhurgham Abdul Jaleel

AlFurat AlAwsat Technical University

Abstract- The sub grade gives an establishment to supporting the asphalt structure. The sub review regardless of whether in cut or fill ought to be all around compacted to use its full quality and to conserve consequently on the general thickness of asphalt required. For plan, the sub review quality is evaluated regarding the CBR of the sub review soil in both fill and cut areas. For deciding the CBR esteem, the static entrance test method ought to be entirely clung to. The test should dependably be performed on formed specimens of soils in the research center. CBR test is difficult and tedious; yet once in a while the outcomes are not precise due to the poor laboratory conditions. Advance if the accessible soil is of low quality, appropriate added substances are blended with soil and the subsequent quality of the dirt will be evaluated by CBR esteem, which is unwieldy. In this paper we proposed a new expert system (Multi Layer Perceptron (MLP) neural network) to be working as computer decision maker and predicate the precise CBR value based upon the data.

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PREDICTINGCBRVALUEFROMINDEXPROPERTIESOFSOILSUSINGEXPERTSYSTEM

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Ahmad Taha Abdulsadda[α] & Dhurgham Abdul Jaleel[σ]

Abstract- The sub grade gives an establishment to supporting the asphalt structure. The sub review regardless of whether in cut or fill ought to be all around compacted to use its full quality and to conserve consequently on the general thickness of asphalt required. For plan, the sub review quality is evaluated regarding the CBR of the sub review soil in both fill and cut areas. For deciding the CBR esteem, the static entrance test method ought to be entirely clung to. The test should dependably be performed on formed specimens of soils in the research center. CBR test is difficult and tedious; yet once in a while the outcomes are not precise due to the poor laboratory conditions. Advance if the accessible soil is of low quality, appropriate added substances are blended with soil and the subsequent quality of the dirt will be evaluated by CBR esteem, which is unwieldy. In this paper we proposed a new expert system (Multi Layer Perceptron (MLP) neural network) to be working as computer decision maker and predicate the precise CBR value based upon the data.

I. Introduction

Sub grade quality is generally influenced by thickness of asphalt, in Highway plan. California Bearing Ratio (CBR) is the one of the technique to decide the sub level strength [[1]– [3]].CBR test is relentless and tedious Value of CBR is regularly required for geotechnical arrangements of building street structures. For region advancement ventures utilizing fillings requires position of such fillings in appropriate request for high quality and low compressibility [[4]– [6]]. Gigantic amount of filling material is utilized for development of sub review and CBR esteem for every single such fill is essential parameter and should be surveyed. However, because of high cost and time prerequisite for such testing it for the most part ends up plainly hard to outline variety in their incentive along the alignment [7].A few number of specialists anticipated exact equations displayed in the geotechnical writing that were produced to assess the socked CBR value for coarse grained soils from the physical properties and compaction attributes of soil [8].These models were create to gage CBR value contingent upon minimal effort, less time utilization premise. Such these experimental writing are recipe introduced by NCHRP [9];it where proposed best-fitted condition to associated CBR esteem with D60 for spotless, coarse-grained soil;In [10] they utilized two sorts of soil tests (CL-ML) to setting up connection between's dirt parameters. The soil utilized examples was blend differed sand content (SP).A basic and different linear regression were develop to connect amongst MDD and rate sand content.In [11] they proposed associating between CBR esteem and some list properties. They utilized twenty quantities of plastic and non-plastic soil tests were gather from various areas in India. Set of lab tests were leading on the dirt examples. A basic and different direct relapse examination between record properties and socked CBR esteem.In [12], they applying straightforward and numerous direct relapse investigation to create connection models. Physical and mechanical testicles result like dampness thickness relationship, consistency points of confinement, and CBR tests were utilized as an informational collection. They utilized 387 informational indexes of soil properties and relating CBR values. The groups in [13] they utilized simple and different relapse examination models to associate between some of soil properties and CBR esteem. The experimental formula that associate CBR esteem with sifter investigation and compaction qualities.

In ANN side,In [14], they have detailed the practicality of utilizing ANN for evaluating the Optimum dampness content and Most extreme dry thickness values for various sorts of soil subjected to various similar endeavors.Other group in [15] built up the ANN based model to foresee the shear parameters of the dirt regarding distinctive soil parameters, for example, dry thickness and versatility record, gravel, rate sand, rate sediment, rate dirt as input parameters gotten through research center tests for soil tests from various parts of India and union and edge of inner rubbing as yield parameters. In [16] the group created ANN model to foresee the building properties of soil, for example, Porousness, Compressibility and Shear Strength parameters as far as Fine Fraction, Liquid Limit, Plasticity Index, Most extreme Dry Density, and Optimum Moisture Content as input parameters acquired through lab tests for soil tests.

In this paper, we proposed a computer decision maker to predicate the value of the CBR as accurate results as what we can be found in the linear and nonlinear regression equations that many researcher have been done in literature. The paper is organized as follow: the experimental data is presented in section 2, the Multi Layer Perceptron (MLP) predicate structure has

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explain in section 3, the verification simulation results details is listed in section 4, finally, the conclusion and future works remark presents in section5.

II. Experimental Data

The soil samples that utilized as a part of this paper were arranged from various size of materials, One hundred number of bothered soil tests were tried from various areas in Al-Najaf city that utilized for asphalt development ventures amid 2010 to 2016. The chose soil tests were tried for Socked CBR esteem, optimum water content, maximum dry unit weight, grain size distribution. These tests were led in Al-Najaf specialized foundation lab. as shown in Fig. 1. Every one of these

Figure 1: Experimental data setup.

tests were performed by ASTM standard. Most of the materials contained non-plastic union less materials that utilized as fill material for street dikes and sub base and base courses material. The Soil parameters utilized as a part of the database were optimum water content (OWC), maximum dry unit weight (MDU),Effective size (D10), The diameter of particles meet 60%, The diameter meet 30%, The coefficient of curvature (Cc), The coefficient of uniformaity (Cu), % Gravel (G), % Sand (S), % Fines (F),. With a specific end goal to survey the sufficiency of the database, clear measurements of every informational index exhibit in the database were resolved.

Table 1 and table 2 present the descriptive statistics of each variable which will be fed to the neural network, where the neural network proposed in this paper has input layer with an 12 input nodes. According to the results, appear in the tables (1and 2), it can be obviously shown that the database consists of a wide range of data.

III. CBR Predication Using Neural Network Processing

As illustrated in Fig. 2, we adopt the multilayer perceptron (MLP) architecture for the neural network. AnMLP network consists of an input layer, a hidden layer, and an output layer, and is the most widely used network structure for nonlinear classification and prediction applications [17].

Table 1: Statistical parameters of database

	Percentage Passing per sieve opening (mm)							Compaction characteristics		CBR value
	25	9.5	4.75	2.36	1.18	0.3	0.075	OMC	MDD	
NO. of tests achieved	100	100	100	100	100	100	100	100	100	100
Maximum ratio gained	100	90	75	75	63	29	17	15	2.280	44
Minimum ratio gained	75	40	28	28	17	8	5	4	2.070	30
Range	25	50	47	47	46	21	12	11	0.210	14
Mean	86.3	64.5	52.2	51.8	41.6	16.3	10.8	9.8	2.201	36.3
Median	86	66	54	53	43	15	11	10	2.202	36
Standard dev.	5.56	7.77	7.30	7.05	7.06	2.08	2.65	2.8	0.017	0.67

Table 2: Result of recalculating the parameters database

	Percentage Passing per sieve opening (mm)							
	G	S	F	D10	D30	D60	Cc	Cu
Maximum ratio gained	72	64	17	0.75	4.75	17	16.29	300
Minimum ratio gained	25	22	5	0.04	0.18	0.55	0.02	7.33
Range	47	42	12	0.71	4.57	16.45	16.27	292.66
Mean	48.37	41.31	10.78	0.09	1.17	8.26	2.91	113.92
Median	48	42	11	0.07	1	7.3	1.87	100
Std. deviation	7.25	7.42	2.65	0.05	0.58	2.78	2.40	56.72
Units	%	%	%	mm	mm	mm	%	%

One could use different features extracted from the experimental output data as the input to the neural network. The number of inputs is the same as the number of experimental data (12) considered. The number of the hidden-layer nodes is chosen through a genetic algorithm (GA)-based

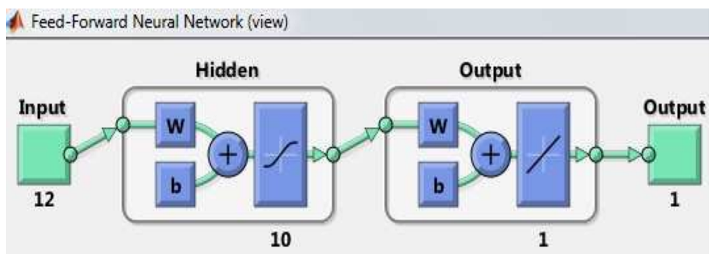

Figure 2: Schematic of the MLP neural network for signal processing of the features

optimization process. Each hidden layer node represents the operation of nonlinear activation, which takes the form of a sigmoid function. The output layer has one nodes, representing the y predicted CBR of value.

The number of hidden-layer nodes and the connective weights between the layers are determined through a two-phase training procedure, using the software simulink matlab. The training data are obtained by in Al Njafa Technical Institute as explained in experimental data section. The objective function is defined as:

$$J = \frac{1}{2M}\sum_{i=1}^{M}(y_i - \hat{y}_i)^2, \qquad (1)$$

where ($\hat{y}_i$) denotes the predicted value for (yi) under the current network structure and weights. The values of the connective weights obtained in the first training phase then serve as the initial condition for weights refinement in the second phase, where the network structure is fixed as determined in the first phase. Delta-bar-delta learning [5], with adaptive learning rate, is used for weights optimization. Let K be the total number of weights. For each weight w_k, $1 \leq k \leq K$, the update rule is

$$w_k^{\text{new}} = w_k^{\text{old}} - \eta_k^{\text{new}} \frac{\partial J}{\partial w_k^{\text{old}}}, \qquad (2)$$

where the adaptive learning rate hk is updated as

$$\eta_k^{\text{new}} = \begin{cases} \eta_k^{\text{old}} + a, & if \ \frac{\partial J}{\partial w_k^{\text{old}}} > 0 \\ b\eta_k^{\text{old}}, & if \ \frac{\partial J}{\partial w_k^{\text{old}}} \leq 0 \end{cases}, \qquad (3)$$

and a,b are constants satisfying $0 < a,b < 1$.

IV. Simulation Results

In traditional proposed methods which were presented in literature as multiple nonlinear regression models to predicate the CBR value based upon the soil properties, for example, rate passing, G, S, F, D_{10}, D_{30}, D_{60}, Cc, Cu, MDU and OWC are considered as the needy factors. Five models, with various soil properties chosen from database were produced for connections. Measurable parameters like relationship coefficients (R^2) qualities is ascertained. The anticipated CBR values with

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genuine CBR values picked up from database are plotted and best direct fit bends are attract to discover the variety between the anticipated values and the correct value as shown in Fig. 3. Fig. 3 shows obviously that the empirical formula proposed by the CBR results governed from the

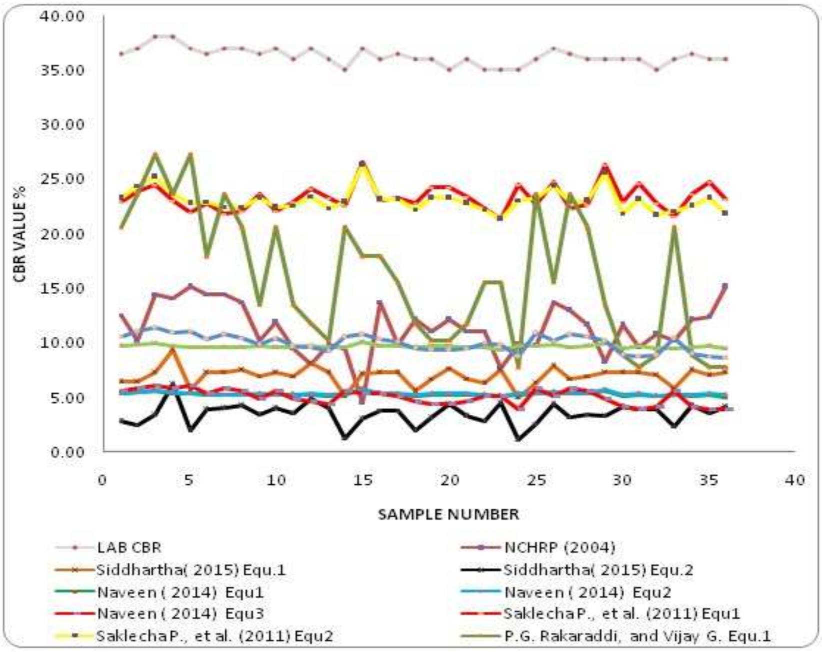

Figure 3: Multiple linear regression schemes

effort of the researchers are smaller than what the laboratory CBR results. In addition that, some of the empirical formula proposed were based on very limited materials while others were based on a good number of materials, that effect on the deviation between the estimated value and calculated value.

Otherwise, with MLP predicator the actual Lab. CBR and the predicate with the MSE are shown in Fig. 4 and Fig. 5, respectivelly. The regression is shown in Fig. 6.

V. Conclusion and Future Works

MLP neural network one of the most accurate nonlinear predicated system, to help the Lab worker to give correct response to the soil tests and make the decision is accurate we have proposed a computer expert system. In this paper we proposed a new scheme for the CBR predicate value.

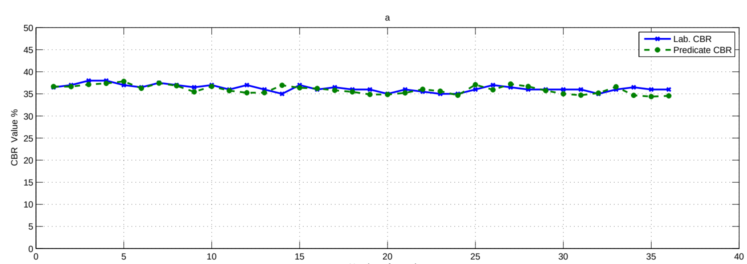

Figure 4: Simulation results: Lab. CBR and predicated responses

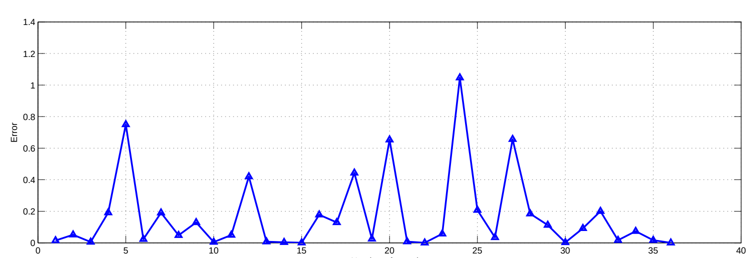

Figure 5: Simulation results: Mean square error response

The simulation results demonstrate the effectiveness of our proposed scheme to predicate the CBR value for the lab. 36 samples with efficiency factor more that 96%. In future work, we suggest to use the fuzzy rule system to determine firstly the standard that the lab. data belongs to then we use the MLP neural network to predicate the CBR value.

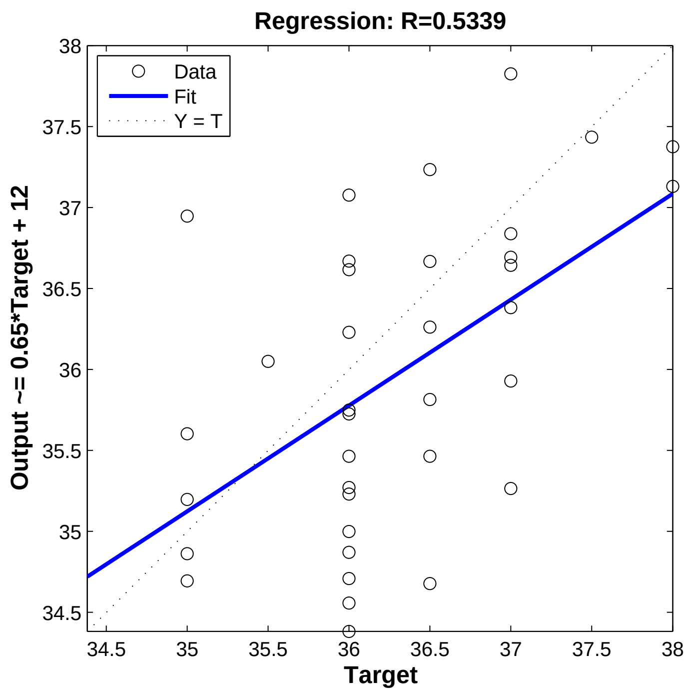

Figure 6: The predicated MLP nonlinear regression function

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Fire Effect on Concrete Containing Red Clay (Homra) as a Partial Replacement of Both Cement and Sand

By Heba A. Mohamed
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Abstract- The partial replacement of cement and sand with red clay (called also homra) in the concrete is investigated in this study, with reference to fire resistance. As a natural pozzolanic material commonly found in desert areas, homra is extensively used in brick manufacturing. As a waste material from this industry, homra is hazardous for the environment, and using homra in concrete production may reduce its environmental impact, with the plus that homra reacts with the lime resulting from the hydration of ordinary Portland cement (OPC). In this study, replacing OPC and sand (15%, 20 %, 25 and 30% by mass) with homra has been investigated to have information on the mechanical behavior of homra-modified concretes after being exposed to fire for half- an- hour or one-hour. After heating, the specimens were either quenched in water or cooled in air. The tests show that the optimal replacement rate is 15% for the cement and 25% for the sand, in terms of enhanced compressive, tensile and flexural strength.

Keywords: cement replacement; sand replacement; red clay/ homra (as a pozzolanic material) fire resistance (of homra-modified concretes); water quench; residual mechanicals properties after heating.

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I. Introduction

The increasing world population is increasing the amount and type of the waste generated by human activities. Many wastes produced today will remain in the environment for hundreds and perhaps thousands of years. One solution to this crisis lies in recycling wastes into useful products [1].

The production of cement has diminished the limestone reserves in the world and requires a great consumption of energy. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overusing the material has led to the depletion of river-sand deposits and to a concomitant cost increase of the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably by products [2].

Sukesh et al. [3] found that replacing sand with quarry powder improves concrete strength in compression, but the greater the replacement ratio, the lesser the workability of concrete, because of water absorption by the powder itself.

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The main objective in using very fine red clay in concrete and mortar production is the reduction of the amount of cement, thanks to the pozzolanic activity of red clay [4]. Using red clay in concrete and mortars brings in, therefore, at least three benefits: less energy consumption, less environmental impact and more recycling of waste materials, as red clay is partly a waste material.

Kunavat and Sonawane [5] studied the use of brick waste as a replacement of cement and sand in cement mortar. The results indicated that richer mixes gives lower value of bulk density and higher values of compressive strength for sand replacement with brick waste up to 40%.

When the building materials are exposed to fire, some deterioration takes place. This deterioration can often reach a level at which the structure may have to be thoroughly renovated or completely replaced. Cement has been used for the immobilization of low and intermediate level radioactive wastes. Compared to other materials, which are used to stabilization of radioactive wastes, cement is a rather cheap raw material [6]. The Portland Cement containing 20 - 30 wt. % fly ash thus possesses good fire resistance and dimensional stability when exposed to high temperature and then high humidity or wetting [7]. The replacement of OPC by 20 wt. % of thermally activated kaolinite in cement paste increases its thermal stability against temperature up to 600 °C [8].

The compressive strength increases with the addition of homra up to 400 °C then decreases. The higher compressive strength of pozzolanic cement pastes containing 10 and 20 wt. % homra than OPC cement pastes at 300 °C is due to the pozzolanic reaction of homra with the free lime to produce additional amounts of calcium silicate and aluminosilicate hydrates [6].

The cracking of cementitious materials that exposed to a high temperature develops during the post cooling period as a result of rehydration of CaO associated with a significant increase in volume by about 44 % [9]. The enhancement of the thermal stability of concrete and the reduction of post cooling cracking have been achieved by the addition of pozzolana that consumes ($Ca(OH)_2$) liberated from the hydration of OPC forming additional calcium silicate hydrates [10]. The replacement of OPC by silica fume, fly ash, metakaolin and homra [11] was found to improve the physico mechanical properties, microstructure, and thermal stability of cementitious materials as well as reduce the extend of cracking when exposed to high temperatures.

II. Research Significance

The main objective of this study is to determine the suitable ratio of homra as a partial replacement of cement and sand to increase fire resistance. As well as the treatment type (quenched in water or cooled in air) will be studied.

III. Experimental Program

In this investigation, 108 cubes (100 x 100 x100 mm), 108 cylinders (100 mm in diameter and 200 mm in length), and 108 prisms (100 x 100 x 400 mm) as shown in Fig. 1 were tested using 2500 KN capacity testing machine to investigate concrete compressive strength, tensile strength by splitting tensile test and flexural strength, respectively. The main variables taken into consideration in this study were the replacement ratio of cement and sand with homra, where homra was used at ratios 15 %, 20 %, 25 % and 30 % as a partial replacement of cement then homra was used as a partial replacement of sand at the same ratios in addition to control specimens without homra. Furthermore, part of specimens were exposed to the fire for half-an-hour and the other part for one-hour as shown in Fig. 2. Then some specimens were allowed to cool down to room temperature in air and some specimens were quenched in water.

Figure 1: The test specimens

Figure 2: Fire effect

IV. Properties of Materials

a) Cement

The cement used in this investigation was Ordinary Portland (OPC) that has been partially replaced by homra at ratios of 15 %, 20 %, 25 % and 30 wt. %. The tests were carried out to determine its physical properties according Egyptian code of Practice [12].

b) Aggregates

Dolomite with 10 mm nominal maximum size was used as coarse aggregate and the fine aggregate was the natural sand free from impurities that has been partially replaced by homra at ratios of 15 %, 20 %, 25 % and 30 wt. %.

c) *Red Clay (Homra)*

Homra is a solid waste material produced from the manufacture of clay bricks and consists mainly of quartz, aluminosilicate, anhydrite, and hematite. Therefore, it acts as a pozzolanic material. These crushed portions of homra are not for commercial use and may be considered as a solid waste to the environment. Homra was collected from brick plant sites and was obtained by grinding the solid shards to produce fine material as shown in Fig. 3.

Figure 3: Homra

d) *Admixture*

In this study, a super plasticizer Sikament NN, was used to improve the workability of concrete.

V. Mix Proportions and Casting Procedure

For this study, the same cement content was adopted for all specimens (i.e. 400 kg / m^3). Homra blended with cement and sand was prepared by a partial replacement of OPC (Type I mixes, i.e. only a share of OPC was replaced with homra) and sand (Type II mixes, i.e. only a share of sand was replaced with homra) with previous mentioned ratios of homra to obtain eight mix proportions more over the control mix without any homra as shown in Table 1. The composition of the control mix is shown in Table 2, the remain mix compositions were adopted by replacement of cement and sand with homra by percentage as shown in Table 1. For each mix proportion, 12 cubes, 12 cylinders and 12 prisms were cast to obtain 324 total specimens. Cement, coarse and fine aggregates were weighed and placed into the concrete mixer for one minute then the mixing water containing super plasticizer was added. The slump test was carried on the fresh concrete as shown in Fig. 4. Fresh concrete was cast in molds then these molds were vibrated for one minute to remove any air bubbles and voids. After 24 hrs, specimens were demolded and cured under water until the desired curing time. After 28 days of curing under water, the hardened specimens were dried and some were exposed to fire for half-an-hour and some for one-hour. After heating, the specimens were partly left to cool in air and partly were quenched in water.

Table (1): The replacement ratios (by mass) of the cement and of the sand with red clay (homra).

Mix No. *	Type I mixes (homra / cement) %	Type II mixes (homra / sand) %
1	-	-
2	15 / 85	-
3	20 / 80	-
4	25 / 75	-
5	30 / 70	-
6	-	15 / 85
7	-	20 / 80
8	-	25 / 75
9	-	30 / 70

* *For each mix, 12 cubes, 12 cylinders and 12 prisms were cast*

Table (2): Mix design

Cement content	(Kg /m^3)	400 *
Coarse aggregate	(Kg /m^3)	1286
Fine aggregate	(Kg /m^3)	551*
Water content	Kg(/m^3)	180
Super plasticizer	(Kg /m3)	5
W / C ratio		0.45

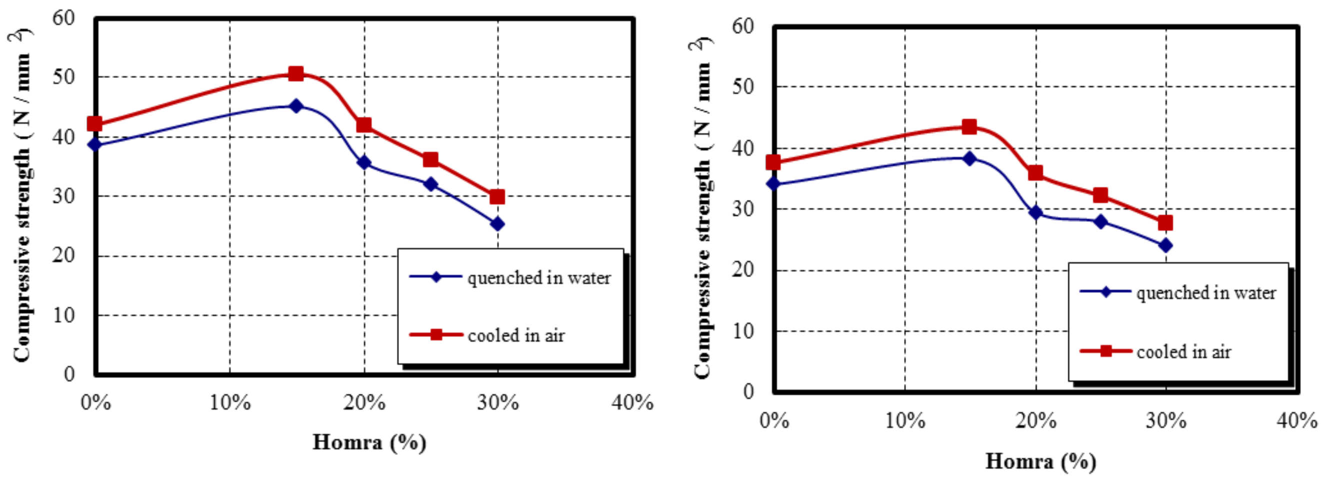
* The quantities of homra is used as the replacement of cement and sand (fine aggregate) content by percentage as shown in table (1)

Figure 4: The slump test

VI. Test Results and Disscusion

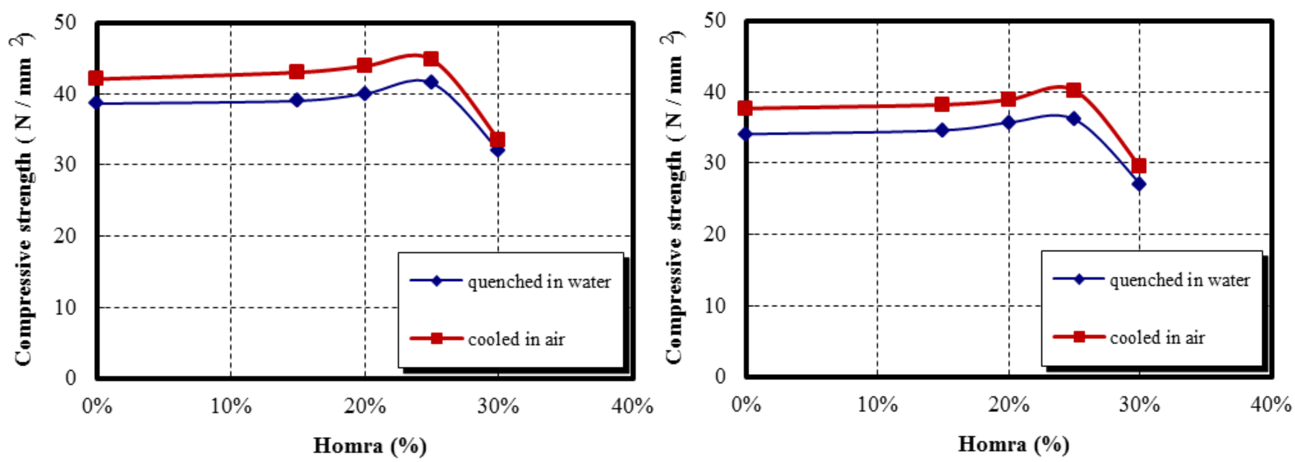
a) *Concrete Compressive Strength*

The values of concrete compressive strength according to different replacement of cement and sand with homra are shown in Figs. 5 and 6, respectively. These figures indicate that, in Type I mixes, the highest value of concrete compressive strength was obtained from replacement of cement by 15 % of homra. One may note (Fig. 5(a)) that replacing 15 % of cement (by weight) with homra brings an increase in concrete compressive strength equal to 16.8 % and 20.14 % with respect to the control specimen, after quenching the specimens in water or cooling them in air, respectively (half-an-hour of fire exposure). However, after one-hour fire exposure the increase in the compressive strength was lower (equal to 12.33 % and 15.18 %, after quenching in water or cooling in air, respectively). The compressive strength of pozzolanic cement pastes containing wt. 15 % homra was higher than that of OPC pastes at high temperature due to the pozzolanic reaction of homra with the liberated lime to produce additional amounts of calcium silicate and aluminosilicate hydrates. These hydrates deposit within the pore system as shown from scanning electron microscopy (SEM) micrographs (Fig. 7). The decrease of the compressive strength with higher percentage of homra is due to the decrease of the clinker content. In Type II mixes, the higher the percentage of homra the higher the values of compressive strength up to 25 %, after that the increase in the percentage of homra leads to decrease in values of concrete compressive strength. It can be notice that specimens of Type I mixes with 15 % of homra as a replacement of cement give higher values of concrete compressive strength than those of Type II mixes with 25 % of homra as a replacement of sand. Fig. 8 (a) and (b) gives the effect of fire duration on concrete compressive strength in case of Type I and Type II mixes, respectively. The more prolonged the fire, the lower the values of the compressive strength whether specimens quenched in water or cooled in air after fire. The cement pastes made with pozzolanic materials as a partial replacement of Portland cement are more sensitive when exposed to fire. In case of Type I mixes with 15 % homra, the value of compressive strength decreased by 14.13 % when cooled in air and by 15.16 % when quenched in water. However, these values for Type II mixes with 25 % homra were estimated by 10.27 % when cooled in air and 12.92 % when quenched in water. Also, These figures demonstrate, therefore, that the specimens cooled in air exhibit a residual compressive strength greater than that exhibited by the specimens quenched in water, for both Type I and Type II mixes containing homra.



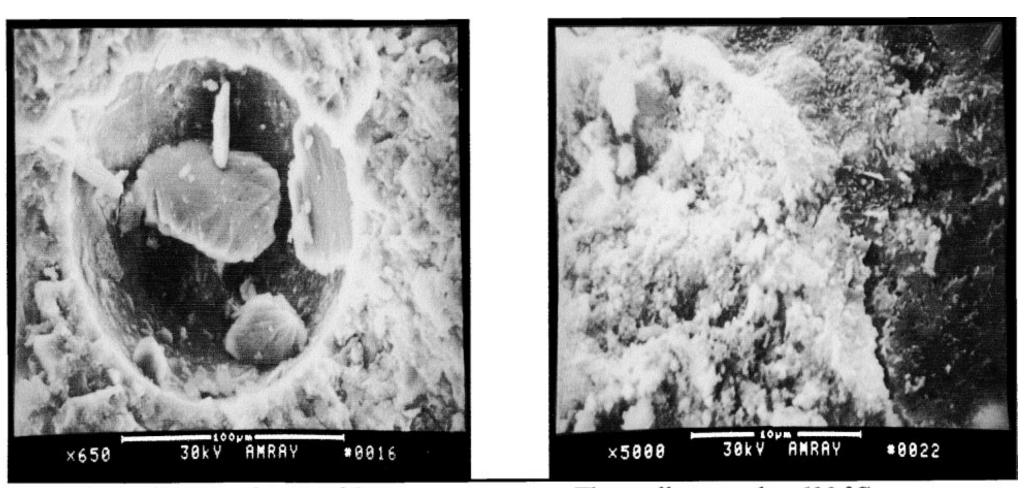
(a) (b)

Figure 5: Compressive strength for Type I mixes: (a) fire duration = half-an-hour ; (b) fire duration = one-hour.



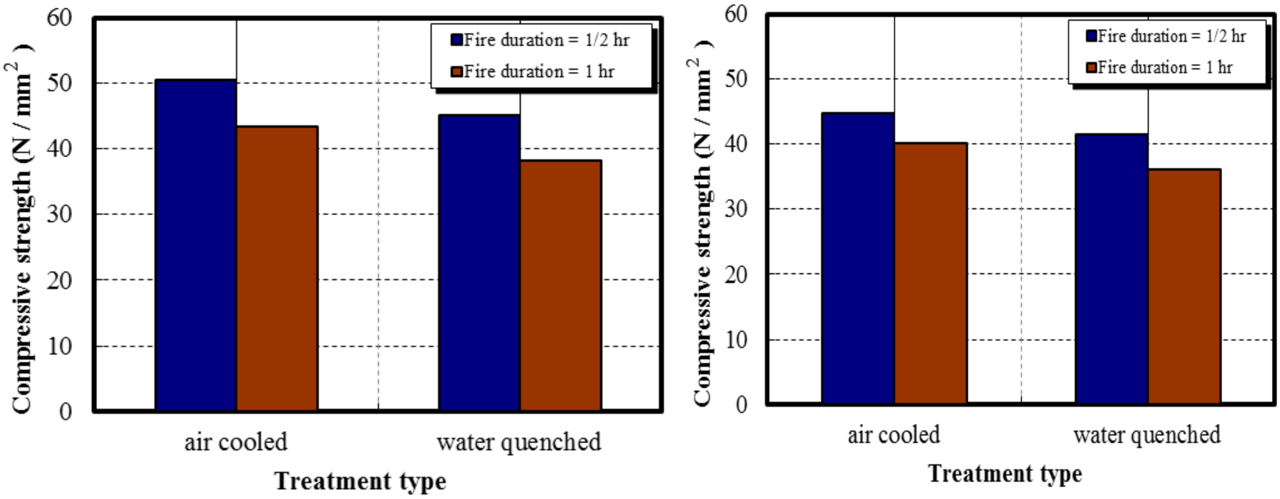
(a) (b)

Figure 6: Compressive strength for Type II mixes: (a) fire duration = half-an-hour ; (b) fire duration = one-hour



Thermally treated at 300 °C Thermally treated at 600 °C

Figure 7: SEM micrographs of thermally treated pozzolanic cement paste containing Homra [6]

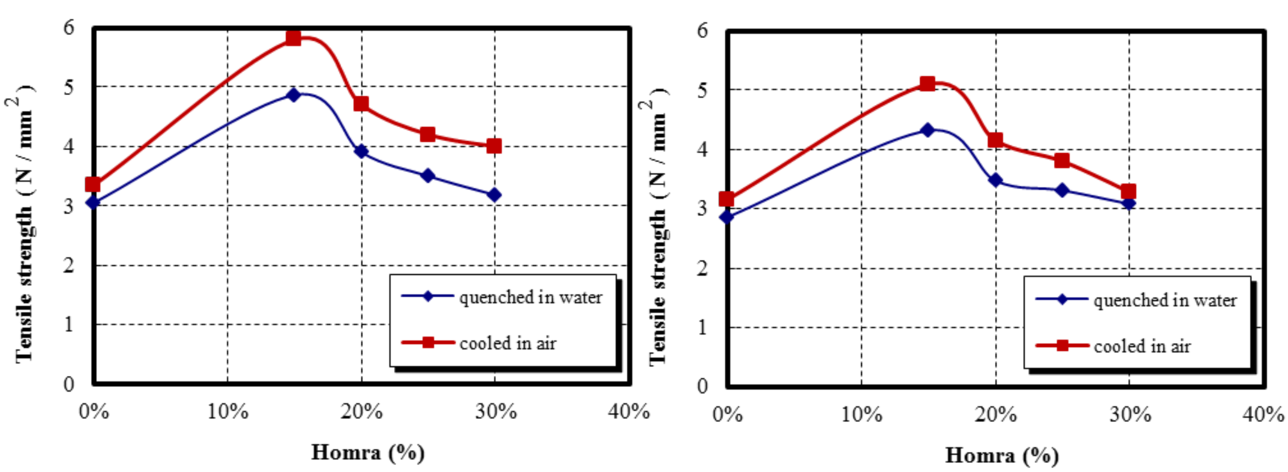


(a) (b)

Figure 8: Effect of fire duration on compressive strength : (a) Type I mixes ; (b) Type II mixes

b) Tensile Strength

The values of tensile strength according to different ratios of homra from both cement and sand are plotted in Figs. 9 and 10 for Type I and Type II mixes, respectively. The replacement of cement by 15 wt. % of homra leads to an increase in tensile strength by 61.4 % and 51 % when specimens cooled in air and quenched in water, respectively for time exposer to fire = one-hour. However, when fire duration = half-an-hour these values were estimated by 73.13 % and 59.7 %. The highest value of the tensile strength for Type II mixes was at replacement of sand by 25 wt. % of homra, where the tensile strength was increased by 38.92 % and 33.9 % when specimens cooled in air and quenched in water, respectively for fire duration = one-hour. For fire duration = half-an-hour, the increase in tensile strength was estimated by 52.8 % and 34.1 %. The relation between treatment type and tensile strength is plotted in Fig. 11 (a) and (b) for Type I and Type II mixes, respectively. One can see that for Type I mixes and fire duration = 1 hr when specimens cooled in air, the tensile strength was increased by 18 % than that quenched in water at replacement 15 % by homra and by 19.1 % for fire duration = half-an-hour. For Type II mixes, at replacement 25 % by homra, the tensile strength was increased by 14.65 % when exposed to fire for 1 hr and by 25.18 % when fire duration = half-an-hour. These figures indicate that the tensile strength of air – cooled specimens decreased by 12.1 % and 14.26 % for Type I and Type II mixes, respectively when the fire exposure increased from half-an-hour to one-hour. A similar trend is exhibited by water - quenched specimens, whose tensile strength decreases by 11.3 % and 6.38 % for Type I and Type II mixes, when the fire exposure is increased.



(a) (b)

Figure 9: Tensile strength for Type I mixes: (a) fire duration = half-an-hour; (b) fire duration = one-hour

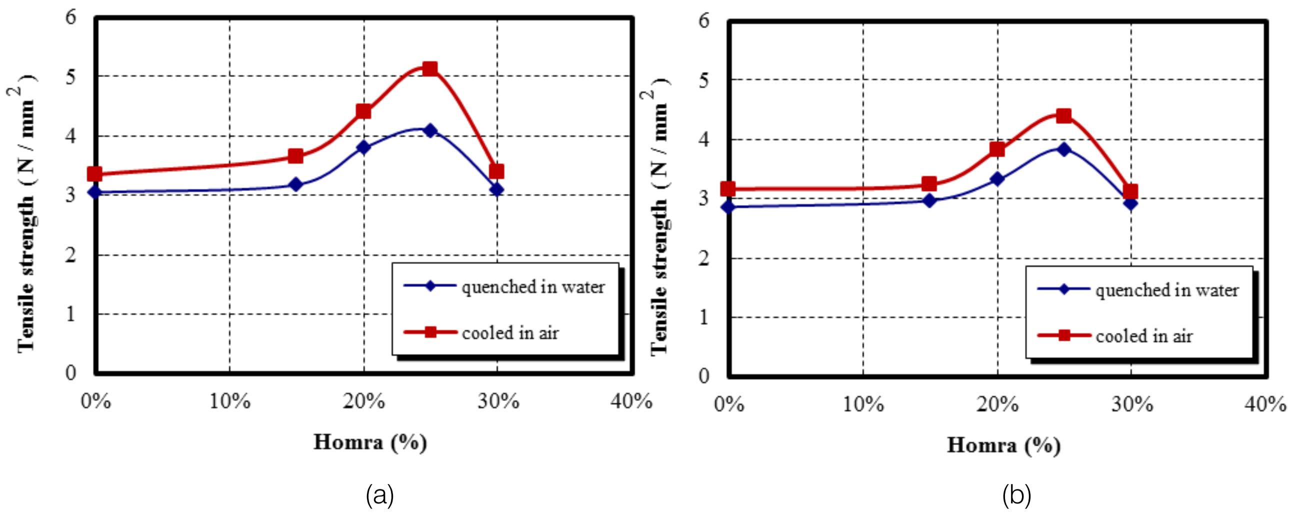


Figure 10: Tensile strength for Type II mixes: (a) fire duration = half-an-hour ; (b) fire duration = one-hour

c) *Flexural Strength*

As the same in compressive and tensile strength, the highest value of flexural strength was obtained in Type I mixes at percentage of homra = 15 % and in Type II mixes at percentage of homra = 25 %. Figs. 12 and 13 show the values of flexural strength according to different percentages of homra for Type I and II mixes, respectively. These figures indicate that the increase in flexural strength for Type I mixes was estimated by 60.7 % and 55.6 % when cooled in air for fire duration = half-an-hour and one-hour, respectively and by 49.1 % and 46.7 % when quenched in water. For Type II mixes, the increase when cooled in air was estimated by 36.1 % for fire duration = half-an-hour and 29.6 % for fire duration = one-hour and by 27.3 % and 24 % when quenched in water. The effect of fire duration on flexural strength are shown in Fig. 14 (a) and (b) for Type I and Type II mixes, respectively. The figure indicate that for Type I mixes at percentage 15 % of homra and fire duration = one-hour when specimens cooled in air the flexural strength was increased by 18.3 % than that quenched in water and by 19.5 % for fire duration = half-an-hour. For Type II mixes at percentage 25 % of homra, the increase was estimated by 16.7 % for fire duration = one-hour and by 18.6 % for fire duration = half-an-hour. The increase the time that specimens exposed to fire the decrease the value of flexural strength. For Type I mixes, the decrease equals to 14.3 % and 13.4 % when specimens cooled in air and quenched in water, respectively. In similar conditions, for Type II mixes exhibit a decrease in the flexural strength equals to 15.7 % and 14.3 %, respectively.

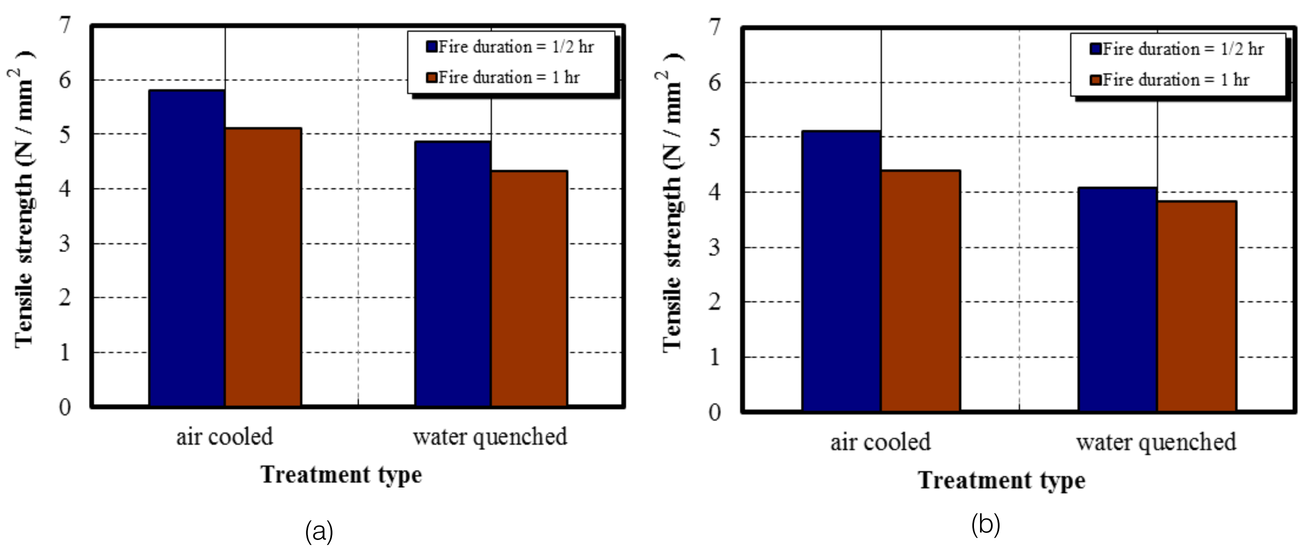


Figure 11: Effect of fire duration on tensile strength : (a) Type I mixes ; (b) Type II mixes

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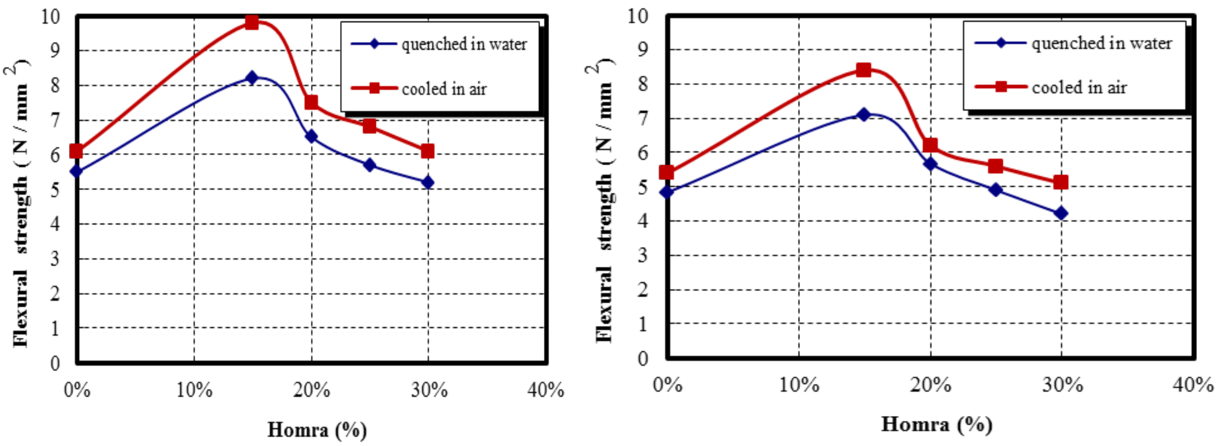
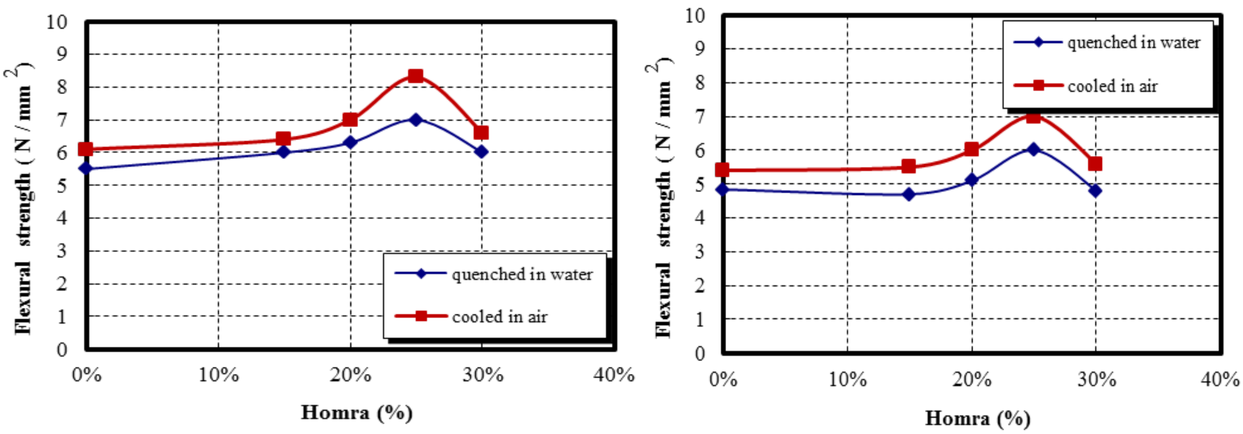


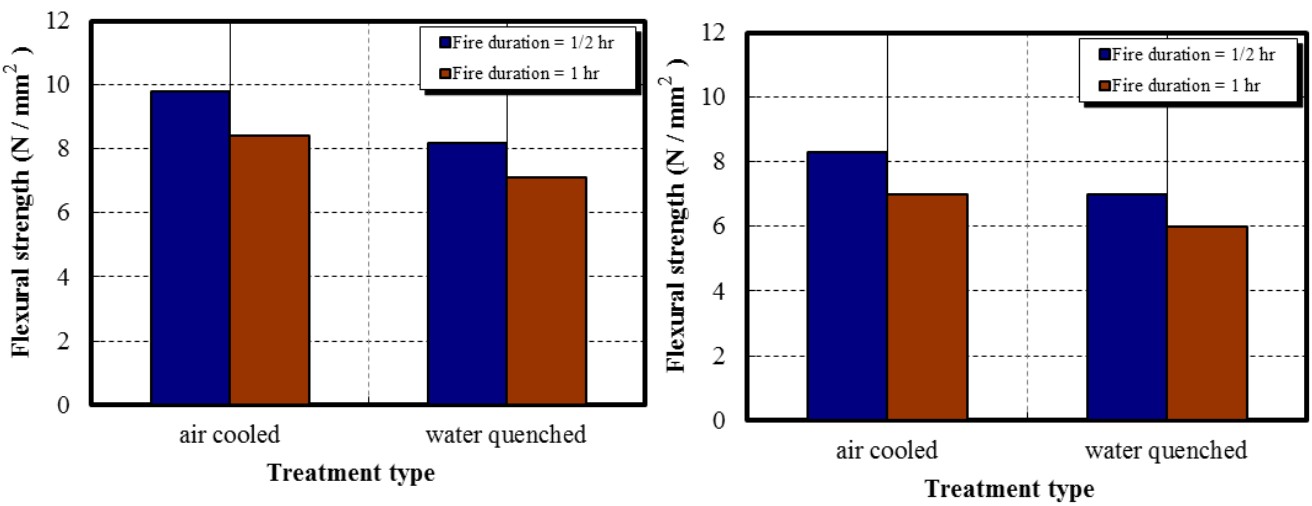
(a) (b)

Figure 12: Flexural strength for Type I mixes: (a) fire duration = half-an-hour ; (b) fire duration = one-hour



(a) (b)

Figure 13: Flexural strength for Type II mixes: (a) fire duration = half-an-hour ; (b) fire duration = one-hout



(a) (b)

Figure 14: Effect of fire duration on flexural strength : (a) Type I mixes ; (b) Type II mixes

VII. Conclusions

An experimental campaign is presented in this paper about the effect of fire on a number of concretes, whose cement and sand have been partially replaced with red clay (homra). The focus is on concrete strength in compression, tension and bending. The following main conclusions can be drawn:

- Using red clay in concrete not only contributes to ecology, but improves concrete mechanical properties in fire, when ordinary Portland cement or sand are partially replaced with red clay.
- Replacing 15% of cement and up to 25% of sand – by mass - with red clay improves all the mechanical properties of concrete.
- Replacing 15% of cement with red clay improves concrete mechanical properties more than replacing 25% of sand.
- Cooling the specimens in air after heating significantly increases concrete mechanical properties with respect to quenching the specimens in water; however, the longer the fire duration, the lower the residual mechanical properties, either after cooling in air or quenching in water.
- Replacing 15% of cement with red clay increases concrete compressive strength by 15.18 % and 20.14 % after one-hour and half-an-hour fire duration, respectively, provided that the specimens are cooled in air.
- In the same conditions as in the previous point, concrete tensile strength by splitting increases by 61.4 % and 73.13 % after one-hour and half-an-hour fire duration, respectively.
- In the same conditions as before, concrete flexural strength increases by 55.6% and 60.7 % after one-hour and half-an-hour fire duration, respectively.

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Influence of Fly Ash on the Properties of Self-Compacting Fiber Reinforced Concrete

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Abstract- Self-compacting concrete (SCC) has high flowability and high resistance to segregation and bleeding. These characteristics facilitate the mixing, casting and finishing of SCC without using compacting or vibrating machines. Adding mineral admixtures, such as fly ash (FA), and superplasticizers improves SCC properties by preventing segregation and bleeding and by increasing rheological parameters. SCC requires high flowability under the influence of self-weight to completely fill all mold parts for full compaction. This investigation discusses the results of experimental tests on the properties of SCC and self-compacting fiber reinforced concrete (SCFRC) mixtures with the inclusion of polypropylene fibers (PFs) and containing FA at replacement rates of 0%, 20%, 40%, and 60 % cement mass. The compressive, flexural, and split tensile strengths of the prepared concrete samples were investigated at ages of 7, 14, 28, and 90 days. The workability of fresh concrete mixtures was also studied through segregation, bleeding, slump flow, slump flow T50, L-box V-funnel T5, and V-funnel tests.

Keywords: compressive strength, fly ash, fresh concrete, polypropylene fibers, self-compacting concrete.

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Influence of Fly Ash on the Properties of Self-Compacting Fiber Reinforced Concrete

Abdullah Mohsen Ahmed Zeyad [α] & Abdullah Mustafa Saba [σ]

Abstract- Self-compacting concrete (SCC) has high flowability and high resistance to segregation and bleeding. These characteristics facilitate the mixing, casting and finishing of SCC without using compacting or vibrating machines. Adding mineral admixtures, such as fly ash (FA), and superplasticizers improves SCC properties by preventing segregation and bleeding and by increasing rheological parameters. SCC requires high flowability under the influence of self-weight to completely fill all mold parts for full compaction. This investigation discusses the results of experimental tests on the properties of SCC and self-compacting fiber reinforced concrete (SCFRC) mixtures with the inclusion of polypropylene fibers (PFs) and containing FA at replacement rates of 0%, 20%, 40%, and 60 % cement mass. The compressive, flexural, and split tensile strengths of the prepared concrete samples were investigated at ages of 7, 14, 28, and 90 days. The workability of fresh concrete mixtures was also studied through segregation, bleeding, slump flow, slump flow T50, L-box V-funnel T5, and V-funnel tests. Results showed that the best properties of fresh SCCs were obtained when FA was added at replacement rates of 20% and 40% cement mass. In addition, the inclusion of PFs at a volumetric ratio of 0.22% decreased segregation and bleeding and improved the flexural and tensile strengths of SCFRCs.

Keywords: compressive strength, fly ash, fresh concrete, polypropylene fibers, self-compacting concrete.

I. Introduction

Self-compacting concrete (SCC) and self-compacting fiber reinforced concrete (SCFRC) are special types of concrete mixture that is characterized by resistance to bleeding and segregation. SCC can be cast without need to using vibration machine or compaction. Products made with SCC have high quality, excellent finish, and are virtually free of flaws, such as large voids, because of the excellent filling ability of SCC without honeycomb formation (Okamura and Ouchi, 2003; Brouwers and Radix, 2005; Nanthagopalan and Santhanam, 2011). SCC is produced with the addition of fine industrial wastes, including fly ash (FA), silica fume, and furnace slag (Siddique, 2011). FA and some types of pozzolanic materials have been successfully used as mineral admixtures in SCC (Gesoglu and Ozbay, 2007; Ramanathan et al., 2013). The addition of mineral admixtures results in the sufficient viscosity of SCC, consequently reducing bleeding, segregation, and plastic shrinkage. In addition to fine mineral admixtures, agricultural waste materials, including palm oil fuel ash or rice husk ash, can be used as admixtures in SCC (Safiuddin et al., 2011; Mohammadhosseini et al., 2015). FA is added to concrete mixtures to prevent segregation and bleeding, increase flowability, and control hardened concrete properties, including compressive, indirect tensile, and flexural strengths (Siddique, 2012; Ashtiani et al., 2013; Celik et al., 2014;). The use of FA in SCC production requires the addition of a superplasticizer (SP) to the concrete mix to achieve high workability and appropriate mix proportions. A high SP dosage, however, increases bleeding and segregation in fresh concretes. These problems can be avoided by adding a viscosity-modifying admixture (VMA) to increase the viscosity of fresh concretes. Furthermore, the use of fine mineral admixtures can reduce the amount of SPs required to achieve the desired rheology. Moreover, the use of FA as an alternative material reduces the need for VMAs (Ouchi et al., 1997; Cyr and Mouret, 2003; Felekoğlu et al., 2007). Nevertheless, replacing the fine mineral admixtures of cement mass, especially at high mass replacement, affects the characteristics of SCCs because of the variations in cement mass and in water/cement ratio. The addition of fibers improves the flexural strength, toughness, and tensile strength of concrete. Numerous researchers have reported that adding fibers at volumetric ratios of 0.1% to 1.0% improves the strength and engineering properties of ordinary concrete (Mohamed, 2006; Banthia and Gupta, 2006; Al Qadi et al., 2011; Islam and Gupta, 2016). The addition of fibers to concrete, however, has negligible effects on compressive strength and the modulus of elasticity. Moreover, the workability and flowability of SCRFCs decrease upon the addition of polypropylene fibers (PFs). The reduction of SCRFC workability due to the addition of fibers depends on many parameters, such as fiber type, dosage, and shape (Corinaldesi and Moriconi, 2011; El-Dieb and Taha, 2012). FA has been successfully added to SCC at replacement rates of up to 60% cement mass, and at a replacement rate of 35% cement mass to cement mixtures without the inclusion of PFs. Previous studies on the properties of SCCs have reported that replacing 30% of cement mass with FA produced concretes with excellent flowability and workability without the addition of fibers. The goal of the present investigation is to study the properties of fresh

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and hardened SCC and SCRFC. In this study, FA was added at replacement rates of 0%, 20%, 40%, and 60% cement mass. Then, PFs were added to the cement mixtures at a volumetric ratio of 0.22% to produce SCFRC. Segregation, bleeding, slump flow, slump flow T50, L-box V-funnel T5, and V-funnel tests were conducted on fresh concrete. In addition, the compressive, flexural, and tensile strengths of hardened concrete at ages 7, 14, 28, and 90 days were investigated.

II. Materials and Methods

a) Materials

The tests carried out in order to study behavior the SCC during states the fresh and hardened concrete with (SCCF) and without polypropylene. The Slump flow, slump flow T50, L-box V-funnel T5, V-funnel, segregation and bleeding tests are conducted during the fresh state. After casting then curing concrete samples in the water basin until the ages of testing, compressive, tensile and flexural strength tests have been carried out. Production of the SCC and SCCF requires application stringent on materials selecting and its quality, also determine the proportions all of the ingredients according to the mix design method, taking into consideration.

b) Cement

Ordinary Portland cement (OPC) was used in the present investigation. Cement characterization tests were conducted in accordance with ASTM C150 (ASTM, 2004). Tables 1 and 2 shown the chemical composition and physical characteristics of cement respectively.

Table 1: Percentage of Oxide Composition and Main Compounds

Oxide composition	Abbreviation	Content (percent)	Limit of ASTM specification
Lime	CaO	63.68	60-67
Silica	SiO_2	20.68	14-25
Alumina	AL_2O_3	6.12	3-8
Iron Oxide	Fe_2O_3	3.8	0.5-6
Sulphate	SO_3	2.68	1-3
Soda	Na_2O	0.29	0.2-1.3
Potassa	K_2O	0.42	
Magnesia	MgO	1.21	0.1_4
Loss on Ignition	L. O. I	1.55	≤ 4
Tricalcium Silicate	C_3S	41.51	45-55
Di Calcium Silicate	C_2S	28.16	20-30
Tri Calcium Aluminate	C_3A	9.87	8-12
Tetra Calcium Alumina Ferrite	C_4AF	11.57	6-10

Table 2: Cement Physical Properties

Physical properties	Test Results	Limit of ASTM specification
Specific Surface area (Blaine method , cm^2/gm)	3220	≥ 2300.0
Initial Setting time, min Final Setting time, min	120 480	Min 30 Mix 365
Compressive strength of mortar: 14- days, MPa	27	Min 19

c) Fly ash

FA meets the general requirements of ASTM C618 Class F (ASTM, 2004). Table 3 presents the chemical composition and physical characteristics of fly ash.

Table 3: Chemical and Physical Properties of FA

Oxides	Content %	ASTM C 618 Class F
SiO_2	51.45	>70%
Fe_2O_3	5.19	
Al_2O_3	27.26	
CaO	7.73	-
MgO	5.16	-
SO_3	0.5	5.0 max
K_2O	2.5	-
L.O.I	0.19	6.0 max
Physical Properties		
Fineness (Blain)	4020 cm^2/g	-
specific gravity	2.32	-

d) Aggregate

A crushed basalt rock with a maximum size of 12.7 mm was used as a coarse aggregate (CA), and natural sand was used in the concrete mixtures as a fine aggregate (FA). The CA and FA had a specific gravity of 2.63 and 2.71, and water absorptions of 0.6 and 0.9 % respectively.

e) Fine Aggregate

The particle shapes and grade of FAs are important factors in SCC production. In this investigation, natural sand, which conforms to ASTM C33 specification, (ASTM, 2004) was used. Table 4 shows the grading analysis of FA.

f) Coarse Aggregate

Table 4 shows that the grade of the CA, which conforms to the ASTM C33 specifications (ASTM, 2004).

Table 4: Grading of Coarse and Fine Aggregate

Sieve size (mm)	% Passing by weight	
	FA	CA
19	100	100
12.5	100	95
9.5	100	66.3
4.75	96.4	4.3
2.36	92.5	1.4
1.18	78.4	0
0.60	40.8	0
0.30	11.6	0
0.15	3.1	0
Fineness Modulus	2.8	-

g) Polypropylene fibers

In this paper, 12 mm PFs were used, some of their physical properties are provided in Table 5.

Table 5: Physical properties FPs

Properties	FPs
Form	White color fibers
Density	0.91 kg/l
Fiber Length	12 mm
Fiber Diameter	18 micron
Softening point	160 °C
Specific surface area	200 m^2 / kg
Tensile strength (MPa)	350 MPa

h) Superplasticizer

High-reduce water range (HRWR) superplasticizer, a new generation of copolymer-based superplasticizer, designed for the production of self-compacting concrete (Viscocret 5030), was used in this study.

i) Mix design methods

Mix design methods for SCC differ considerably from the regular conventional concrete design. There are many mix design methods. Estimating the required batch weights involves sequence of steps. These steps fit a proportioning procedure that covers a combination of: selection of aggregate to provide the desired passing ability; a cementitious (powder)/water ratio and mortar-paste fraction ratio that have been historically proven to produce SCC with the required slump flow; and stability. These steps, in combination with the addition of the appropriate admixture technology, should yield a trial batch with the desired fresh SCC properties. The following is a summary of steps for determining performance requirements and proportioning of SCC mixes.

Step 1: Determine slump flow performance requirements;

Step 2: Select coarse aggregate and proportion;

Step 3: Estimate the required cementitious content and water;

Step 4: Calculate paste and mortar volume;

Step 5: Select admixture;

Step 6: Make trial batch mixtures;

Step 7: Test. When assessing the workability attributes of SCC (stability, filling ability, and passing ability), the slump flow test as well as a test to evaluate stability and passing ability (such as column segregation, or L-box) should be run; and

Step 8: Adjust mixture proportions based on the test results and then re-batch with further testing until the required properties are achieved.

The proportions of the concrete mixtures are summarized in Table 6.

Table 6: Proportions of the concrete mixtures

Mixture	Cement	FA	CA	FA	FPs	Water	SP
	(kg/m^3)						
SCC0	500	0	794	809	0	200	7.5
SCCF	500	0	794	809	0	200	7.5
SCC20	400	100	794	809	0	200	7.5
SCCF20	400	100	794	809	2	200	7.5
SCC40	300	200	794	809	0	200	7.5
SCCF40	300	200	794	809	2	200	7.5
SCC60	200	300	794	809	0	200	7.5
SCCF60	200	300	794	809	2	200	7.5

j) Mixture proportions

The preliminary investigations of this study include evaluation of the equipment and test procedures, evaluation of the mixture proportioning method chosen, mixing procedure and replacement of the FA, PF and dosage of superplasticizer. Testing for these initial investigations is limited on fresh concrete properties.

k) Mixing and casting of specimens

In this investigation, the required quantities of materials were weighed for the correct mixing proportions. Then, cement was mixed with fly ash. The mixture was added to the coarse and fine aggregates. Then, all of the materials were mixed while dry for two minutes. Water was added to the mixtures in two stages: Half of the amount of water was initially added at the start of concrete mixing. The remaining water was then added after 30 s of concrete mixing. To obtain a homogeneous mixture, the concrete was continuously mixed for three min after the addition of water. After carrying out tests for fresh properties, mixing was immediately followed by casting. The specimens were removed from molds after 24 h of storage under laboratory conditions. Storage conditions were in accordance with ASTM C192.

III. Testing of the Samples

a) Fresh concrete tests

For determining SCC properties at fresh concrete state, the slump flow, slump flow T50, V-funnel, V-funnel T5, L-box, segregation and bleeding tests were applied. In order to reduce the influence of workability loss on tests' results of concrete samples, properties of fresh concrete were determined within 20 minutes of adding water.

- The Flow test was performed in according with the European Guidelines for Self-Compacting Concrete (EFNARC) standards (Concrete, 2005). Flow test using the cone, which allows the flow and movement of the SCC of unimpeded to can be characterized. It includes measuring slump flow diameter (D) after lifting the concrete cone, and in the same time measuring the time taken the concrete to spread in diameter 50 cm (T50).
- V-funnel test was performed in according with EFNARC standards .V-funnel is used to evaluate the fluidity, pass ability and segregation of self-compacting concrete. The test time of V-Funnel is the time in seconds from the opened the outlet at the in the bottom the device until seen the light from above. In order get good properties in a fresh concrete of SCC, it requires to have test time between 6 to 12 second.
- L-box test was performed in according with EFNARC standards. L-box is used to assess the possibility of obstruction the filling capacity of the concrete in a confined construction elements. The filling capacity, determined as the ratio of the height the concrete in H2 at end of L-box with H1 at exit outlet (H1/H2), the ratio must be higher than 0.8. Figures 1 a, b, c and d show fresh concrete tests.
- The segregation test is carry out by filling the concrete into a cylinder a 66 cm high and diameter of 20 cm, which has split into three parts. The first part from the bottom is 16.5 cm in height, the middle section is 33 cm in height and the top part is 16.5 cm in height. After filling the apparatus left the concrete undisturbed or movement for 15±1 minutes, then collecting the concrete in the top and bottom parts and washed over a sieve a 4.75 mm to maintain the CA. The relative weight of CA in the top and bottom of the apparatus is used as an indication of resistance the segregation.
- Bleeding test was carried out on ASTM C 232. with maintaining the surrounding temperature of 18 to 24°C. Immediately record the mass of the container and its contents. Then place the container on a level platform free of vibration and cover the container to inhibit evaporation the water of the concrete sample. Must keep the cover of the container during time of the test. Water suction by pipet or similar instrument the, the accumulated water on the surface, at every 10-min through the first 40 min then at every 30 min thereafter until cessation of bleeding.


Fig. 1(a): Slump flow T50 test


Fig. 1(b): Slump flow test


Fig. (1) c: Bleeding test


Fig. (1) d: V-Funnal test


Fig. (1) e: Segregatin test


Fig. 1(f): L-Box test

Fig. 1: Fresh concrete test

b) Hardened concrete tests

In the state of hardened concrete, the tests that were carried out are compressive, indirect tensile and flexural strength. Compressive strength test according to ASTM C39 standard cubes measuring 150 x150 x 150 mm were used. Indirect tensile tests were carried out according to ASTM C496. The dimensions of the standard cylinder are 150 D x 300 H mm. Flexural tests were carried out according to ASTM C78. The dimensions of the standard prisms are 100 x100 x 400 mm. All tests were conducted at 7, 14, 28 and 90 days. The average value of the three specimens for each test age is determined and recorded.

IV. Results and Discussion

a) Properties of fresh concretes

The results of the slump flow test are presented in Table 7. The results represent the maximum spread (the final diameter of slump flow) and T50, the time required for the concrete flow to fill a 50-cm-diameter circle. EFNARC recommends that concrete mixtures should have slump flow diameters of 55 cm to 75 cm to be considered as self-compacting mixture (EFNARC, 2002). Slump flow that exceeds a 75-cm diameter may cause concrete to segregate, whereas that with less than a 55-cm diameter may indicate concrete with flow rates that are insufficient for passing through an overcrowded reinforcement. The results showed that concrete mixtures with PF (SCFRC) and without PF (SCC) and with the addition of FA at replacement rates of 20% and 40% cement mass met the slump flow requirements for SCCs. Concrete mixtures with the addition of FA at replacement rates of 0% and 60% cement mass exhibited low slump flow. Moreover, the results showed a wide range of variations, illustrating the effects of FA replacement rates and PF addition on SCC and SCRFC flowability. The decrease in the workability and flowability of SCC may be attributed to the addition of a high volume of FA as an alternative material. Slump flow rates increased by 40% and 34% when FA was added at replacement rates of 20% and 40% cement mass, respectively. The workability and flowability of all SCRFC mixtures were lower than those of all SCC mixtures. Moreover, the flowability SCC and SCFRC mixtures that contained FA at replacement rates of 0% and 60% cement mass did not meet the minimum requirements of the T50 test. Results also showed that the slump flow rates of SCFRCs decreased by 21%, 12%, and 17% when FA was added at replacement rates of 0%, 20%, and 40% cement mass, respectively. In general, increasing the replacement rates of FA from 20% to 40% cement mass did not significantly decrease the workability of concrete. Adding FA to cement at a replacement rate of 06% has a negative effect on properties of SCC.

Table 7: Results of Slump flow Tests

Mixture	Slump flow (cm)	T50 (sec)
SCC0	52	8
SCCF	41	-
SCC20	73	2.3
SCCF20	64	5
SCC40	70	2.5
SCCF40	58	4
SCC60	47	-
SCCF60	46	-

In addition to the slump flow test and slump flow T50, the V-funnel test was conducted to estimate the flowability of SCC and SCFRC mixtures. The V-funnel flow time was calculated in seconds between the time of the beginning of opening the bottom outlet until the light became noticeable from the bottom outlet. EFNARC recommends that concretes should have V-funnel flow times of 6 s to 12 s and a L-box ratio H2/H1 greater than 0.80 to be considered as SCCs (EFNARC, 2002).

Table 8 shows the results of V-funnel test and L-box. The results indicated that SCC and SCFRC mixtures that contained FA at replacement rates of 20% and 40% cement mass met the requirements for SCC. By contrast, SCC and SCFRC mixtures that contained FA at replacement rates of 0% and 60% cement mass did not meet the requirements for SCC. The decrease in the passing and filling abilities SCCs likely resulted from the high volume of added FA. Moreover, all SCRFC mixtures had lower passing and filling abilities than SCC mixtures. SCC and SCFRC mixtures containing FA at a replacement rate of 60% cement mass did not pass the V-funnel and L-box V-funnel T5 tests. The results suggested that increasing the replacement rate of FA to 60% cement mass exerted the greatest negative effect on the passing and filling abilities of the cement mixtures.

Table 8: Results of L-box and v-funnel tests

Mixture	V-funnel (sec)	V-funnel (T_5) (sec)	L- Box ratio (H_2/H_1)
SCC0	10	17	0.76
SCCF	-	-	0.55
SCC20	5.2	7	0.86
SCCF20	6.3	9	0.81
SCC40	5.3	8	0.88
SCCF40	7.6	10	0.89
SCC60	14	16	0.71
SCCF60	17	26	0.59

Table 9 shows the results of the bleeding and segregation tests. SCC and SCFRC mixtures that contained FA at replacement rates of 20% or 40% cement mass had high rates of bleeding and segregation. By contrast, SCC and SCFRC mixtures that contained FA at replacement rates of 0% or 60% cement mass had the lowest rates of bleeding and segregation. The addition of a high volume of FA likely decreased the bleeding and segregation of SCCs. Furthermore, the bleeding and segregation rates of SCFRC mixtures were lower than those of SCC mixtures.

Table 9: Results of bleeding and segregation tests

Mixture	Segregation index, %	Total bleeding water(ml/cm^2)
SCC0	3.2	0.08
SCCF	2.3	0.0
SCC20	5.6	0.12
SCCF20	3.5	0.09
SCC40	7	0.18
SCCF40	4.1	0.09
SCC60	2.5	0.02
SCCF60	1.8	0.0

b) Compressive strength

Figures 2, 3, and 4 show the compressive strength test results for SCC and SCRFC at ages 7, 14, 28, and 90 days. Results showed that the evolution of compressive strength varied in SCC and SCRFC. The decline in compressive strength became apparent when FA replacement ratio increased to 60% cement mass. The decline in the compressive strength of SCC and SCRFC may be attributed to the addition of FA at the high replacement rate of 60% cement mass, which introduced air bubbles in hardened concrete and decreased compressive strength. The best compressive strength of SCCs at ages 7, 14, 28, and 90 days was obtained when FA was added at the replacement rate of 20%. The compressive strength of SCCs increased by 16.1%, 7.4%, 3.9%, and 1.2% at ages 7, 14, 28, and 90 days, respectively, when FA was added at the replacement rate of 20% cement mass. In addition, the compressive strength of SCCs increased by 8.5% and 1.5% at ages 7 and 82 days, respectively, when FA was added at the replacement rate of 40% cement mass. Compressive strength decreased by 18.8%, 24.1%, 15.9%, and 11.8% at ages 7, 14, 28, and 90 days, respectively, when FA was added at the replacement rate of 60% cement mass. The compressive strength of SCRFCs s decreased compared with that of SCCs. Adding FA at the replacement rate of 60% cement mass greatly decreased the compressive strength of SCRFCs s. The percentages of decrease in compressive strength were higher in SCRFC mixtures. Thus, this finding may be attributed to the negative effect of fibers on concrete rheology, which affected the degree of concrete compaction and consequently decreased the compressive strength of concrete(Akinpelu et al., 2017).

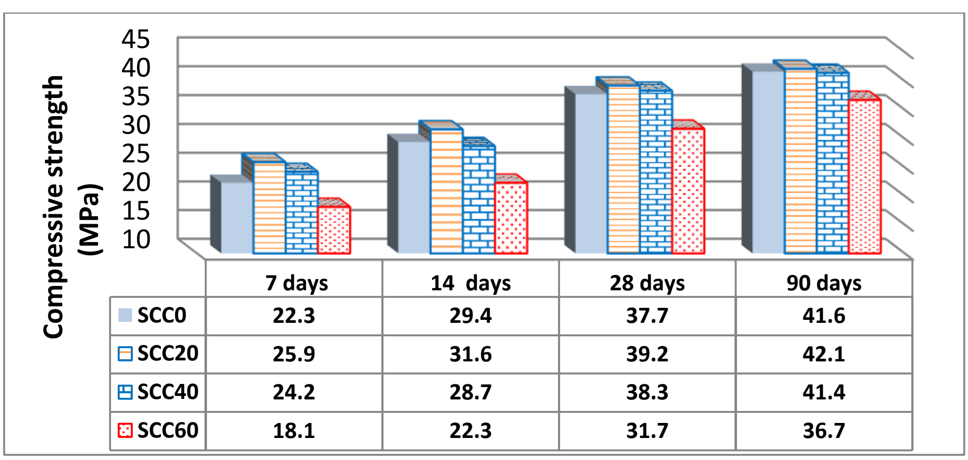
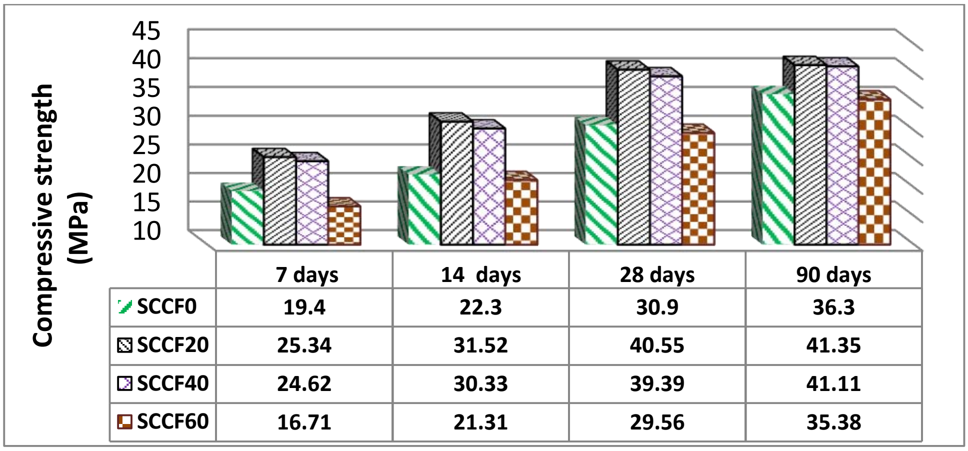


Fig. 2: Results of Compressive Strength Test of SCC



	7 days	14 days	28 days	90 days
SCCF0	19.4	22.3	30.9	36.3
SCCF20	25.34	31.52	40.55	41.35
SCCF40	24.62	30.33	39.39	41.11
SCCF60	16.71	21.31	29.56	35.38

Fig. 3: Results of Compressive Strength Test of SCCF

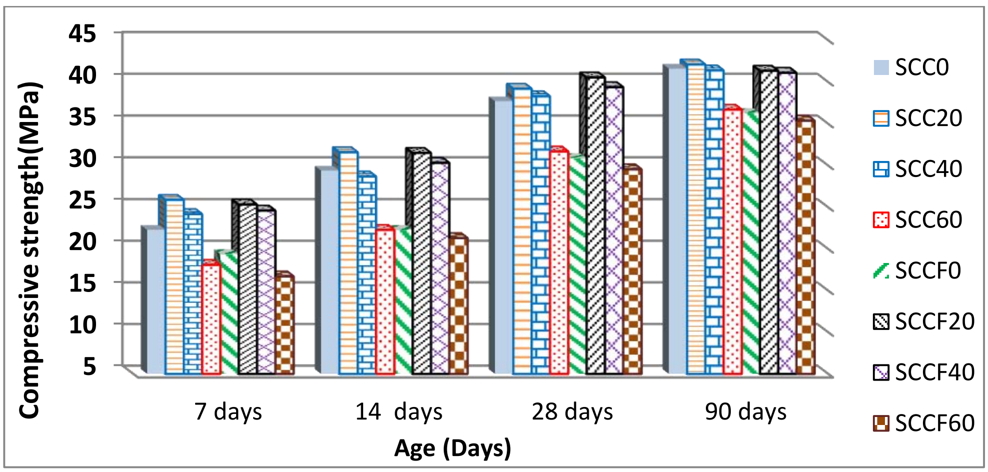
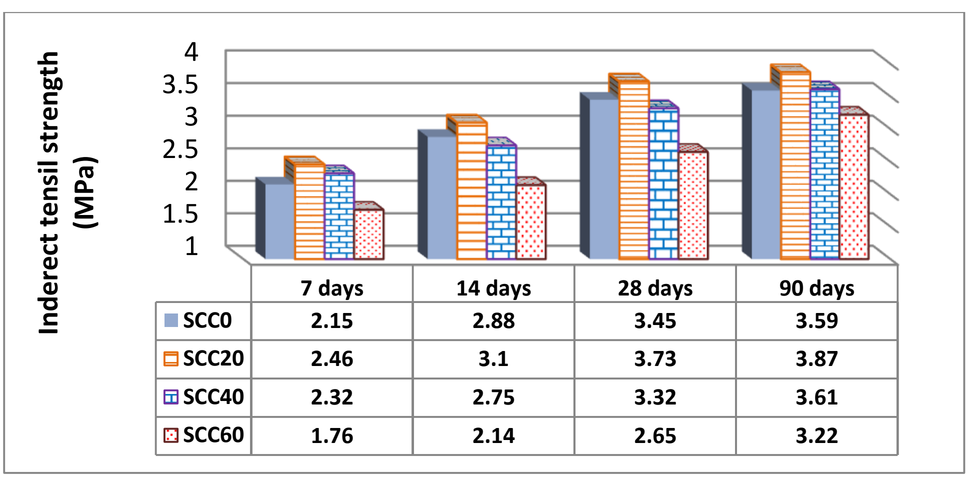


Fig. 4: Results of Compressive Strength Test of SCC and CCF

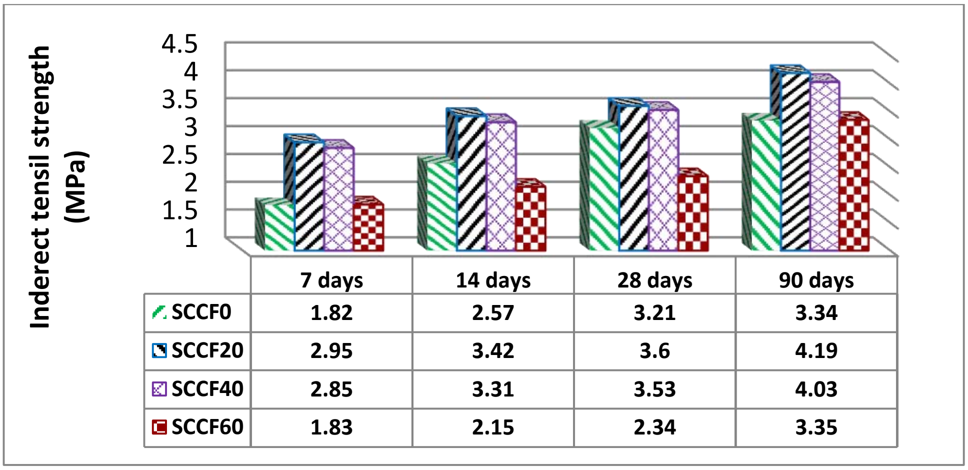
c) *Indirect tensile strength*

Figures 5, 6, and 7 show the results of the indirect tensile strength for SCC and SCRFC mixtures at ages 7, 14, 28, and 90 days. The indirect tensile strength of SCRFC concrete slightly improved compared with that of SCC, thus suggesting that the addition of PFs improved the tensile strength of hardened concretes.



	7 days	14 days	28 days	90 days
SCC0	2.15	2.88	3.45	3.59
SCC20	2.46	3.1	3.73	3.87
SCC40	2.32	2.75	3.32	3.61
SCC60	1.76	2.14	2.65	3.22

Fig. 5: Results of Indirect Tensile Strength Test of SCC



	7 days	14 days	28 days	90 days
SCCF0	1.82	2.57	3.21	3.34
SCCF20	2.95	3.42	3.6	4.19
SCCF40	2.85	3.31	3.53	4.03
SCCF60	1.83	2.15	2.34	3.35

Fig. 6: Results of Indirect Tensile Strength Test of SCCF

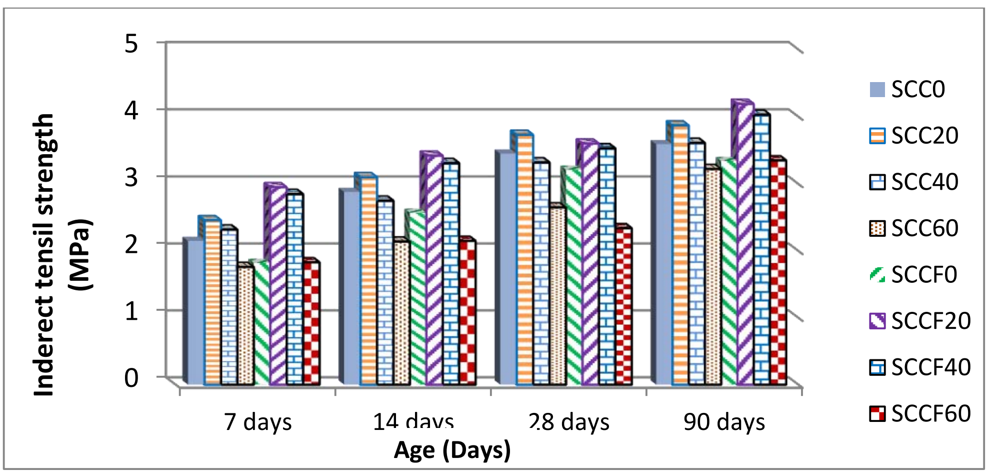
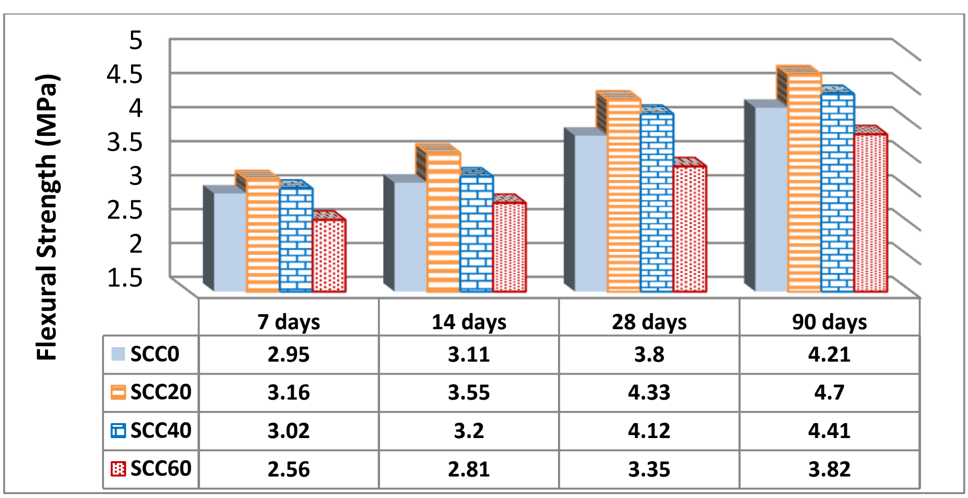


Fig. 7: Results of Indirect Tensile Strength Test of SCC and SCCF

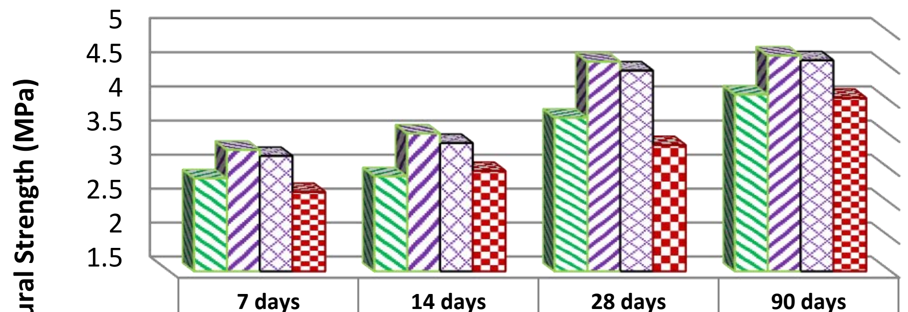
d) Flexural strength

Figures 8, 9, and 10 show the results of flexural strength for SCC and SCRFC mixtures at ages 7, 14, 28, and 90 days respectively. The results showed that indirect tensile strength of SCRFC slightly improved compared with that of SCC, indicating that the addition of PFs improves the flexural strength of hardened concretes.



	7 days	14 days	28 days	90 days
SCC0	2.95	3.11	3.8	4.21
SCC20	3.16	3.55	4.33	4.7
SCC40	3.02	3.2	4.12	4.41
SCC60	2.56	2.81	3.35	3.82

Fig. 8: Results of Flexural Strength Test of SCC



	7 days	14 days	28 days	90 days
SCCF0	2.87	2.9	3.76	4.1
SCCF20	3.29	3.53	4.58	4.67
SCCF40	3.2	3.39	4.45	4.6
SCCF60	2.67	2.98	3.36	4.05

Fig. 9: Results of Flexural Strength Test of SCCF

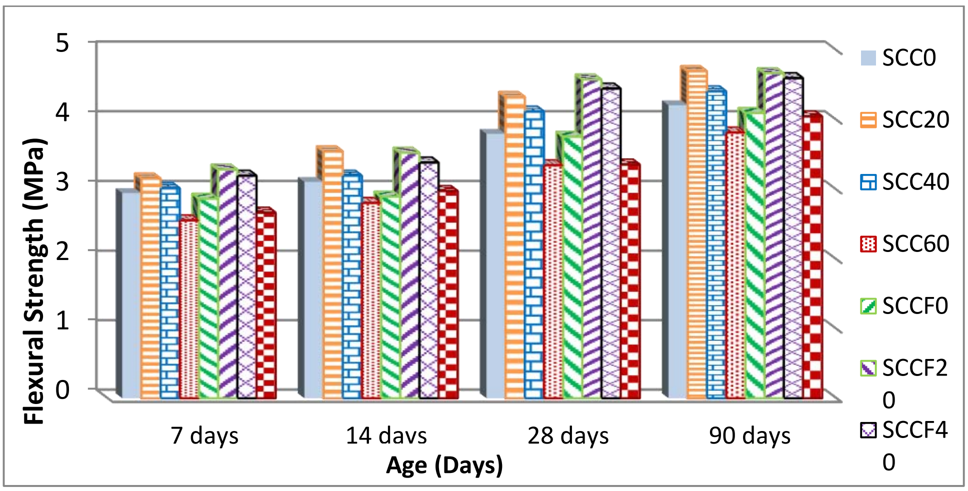


Fig. 10: Results of Flexural Strength Test

V. Conclusions

The following conclusions were drawn from the results of this study:

1. The addition of FA positively affected the properties of fresh concrete and the compressive strength of mixtures at all ages.
2. SCCs with and without PFs were obtained by adding FA at the replacement rates up to 40% cement mass.
3. The best SCC workability was obtained when FA was added at replacement rates of 20% and 40% cement mass without PFs. Fresh SCC samples with this formulation exhibited slump flow diameters of 73 cm and 70 cm; blocking ratios of 0.86 and 0.88; and flow times of 5.2 to 5.3 s.
4. Based on the test results, FA should be utilized to produce SCC with high strength at 90 days. Compressive strength reached 41 MPa when FA was added at replacement rates of 20% and 40% cement mass to SCC and SCRFC.
5. The addition of FA at different replacement ratios to SCC and SCRFC mixtures exerted different effects. Thus, for reasons of economy, FA should be added to SCCs and SCRFCs s at replacement rates of 20% to 40% cement mass.
6. The addition of PFs decreased the properties of fresh concrete but improved flexural and indirect tensile strengths.

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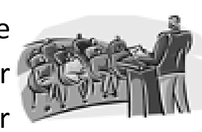

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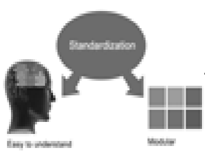

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The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

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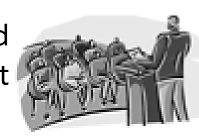

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

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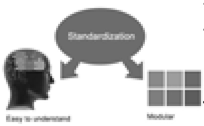

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

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Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

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28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

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- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation)
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Topics	Grades		
	A-B	C-D	E-F
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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