

**INVESTIGATION ON ENHANCING FIRE
PERFORMANCE OF CARBON FIBRE REINFORCED
POLYMER (CFRP) STRENGTHENED CONCRETE
COLUMNS**

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198036L

Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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Science

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters under my supervision

Name of the supervisor: Prof. (Mrs.) J.C.P.H. Gamage

Signature of the supervisor:

Date:

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This research project provided me with the much needed exposure to both experimental work and numerical modelling. Further it helped in practically implementing the theoretical knowledge I gained from my undergraduate studies to develop an effective product to overcome issues in a commercially available product.

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Himasha M.W.C.

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27.05.2021

ABSTRACT

This study focuses on the development of an adhesive to bond Carbon Fibre Reinforced Polymer (CFRP) fabric with a concrete substrate which performs well under elevated temperature. The epoxy adhesive which is the generally used adhesive for CFRP has a very low glass transition temperature that results in the loss of adhesive properties at higher temperatures. As a solution, Engineered Cementitious Composite (ECC) mortar mix was developed to function as a cementitious adhesive. ECC was developed using locally available materials. Effective bond length for the developed ECC adhesive is 150 mm and the achieved bond strength is 224.9 N/mm². The bond strength was further enhanced up to 570.28 N/mm² by sticking sand on top of CFRP fabric using epoxy adhesive before bonding it using cementitious adhesive as an interface bond enhancing technique. When the bond temperature was incremented up to 100 °C, bond strength reduction was less than 5.5%. Another attempt was made to enhance performance of the epoxy adhesive which has been used in CFRP/Concrete composite by blending with Polyethylene terephthalate (PET) fibres as a commercially viable option. Finally it indicated that developed epoxy can be used to strengthen cylinders using CFRP and a 7% of higher axial confinement was achieved when compared with the bond without modification. This modification has enhanced the performance of composite at ambient temperature as well as at elevated temperature when compared with the CFRP/Epoxy/Concrete bond.

LIST OF PUBLICATIONS

International Journal Papers

1. Bond characteristics of out of plane curved concrete beam strengthened for shear using Carbon Fibre Reinforced Polymer sheets (Processing)
2. Development of cementitious adhesive for bonding Carbon Fibre Reinforced Polymer fabric on concrete (Processing)
3. Modification of epoxy adhesive using Polyethylene terephthalate (PET) fibres to develop the thermal performance (Processing)
4. Investigation on Rice husk ash based insulation for Carbon Fibre Reinforced Polymer strengthened concrete members (Processing)

International Conference Papers

1. Finite element Modelling of reinforced concrete horizontally curved beams strengthened for shear using Carbon Fibre reinforced polymer, 7th International Symposium on Advances in Civil and Environmental Engineering Practices for Sustainable Development (ACEPS-2019) – Published
2. A Review on Cementitious Adhesives used to bond CFRP with Concrete, 10th International Conference on Structural Engineering and Construction Management – Published
3. Modification of engineered cementitious composite mortar to use as an adhesive for CFRP/Concrete bond, 11th International Conference on Sustainable Built Environment (ICSBE-2020) – Published
4. Enhancing the thermal performance of epoxy adhesive used in the CFRP/concrete bond (MERCon-2021) - Submitted

TABLE OF CONTENTS

DECLARATION	i
ACKNOWLEDGEMENT	ii
LIST OF PUBLICATIONS	iv
1 INTRODUCTION	1
1.1 Research Background.....	1
1.2 Research Problem.....	1
1.3 Research Scope.....	2
1.4 Significance and Innovation of the Research	2
1.5 Objectives	2
1.6 Thesis Outline.....	2
2 LITERATURE REVIEW.....	4
2.1 Introduction	4
2.2 The behaviour of CFRP/Epoxy/Concrete bond.....	4
2.2.1 At ambient temperature.....	4
2.2.2 At elevated temperature	5
2.3 Problem identification	5
2.4 Research studies focused on developing new bonding system	5
2.4.1 Cementitious adhesives developed by Hashemi and Al-Mahaidi [22] ..	7
2.4.2 Cementitious adhesive developed by Mohammed, Al-Saadi and Al-Mahaidi [28].....	8
2.4.3 Cementitious adhesive developed using Graphene oxide.....	8
2.4.4 Magnesium Phosphate Cement (MPC) as a cementitious adhesive	9
2.4.5 Engineered Cementitious Composite as an adhesive.....	11
2.5 The research found on modifying the existing bond.....	16

2.6	Adhesives used in aerospace engineering structures.....	17
2.7	Further Research needed	19
3	MATERIAL CHARACTERISTICS AND TESTING METHODOLOGIES ...	21
3.1	Introduction	21
3.2	Collection of raw materials	21
3.3	Material properties	23
3.4	Thermal conductivity test.....	25
3.5	Direct pull out test	27
3.6	Chapter summary	29
4	DEVELOPMENT OF EPOXY ADHESIVE FOR ELEVATED TEMPERATURE PERFORMANCE (PETCO-EPOXY).....	31
4.1	Introduction	31
4.2	Preparation of the fibre modified epoxy adhesive.....	31
4.3	Selection of optimum fibre content	32
4.3.1	Optimum fibre content under ambient temperature	32
4.3.2	Optimum fibre content under elevated temperature.....	37
4.3.3	Selection of optimum fibre content under overall performance	40
4.4	Effective bond length	41
4.5	Material properties of modified epoxy adhesive.....	44
4.6	Thermal performance	48
4.7	Chapter summary	52
5	DEVELOPMENT OF CEMENTITIOUS ADHESIVE FOR ELEVATED TEMPERATURE PERFORMANCE (ECC ECO).....	53
5.1	Introduction	53
5.2	Preparation of ECC	53
5.3	Selection of best mix design proportion for ECC adhesive	54

5.4	Effective bond length and bond strength.....	58
5.5	Enhancing bond strength	60
5.6	Material properties of ECC adhesive	63
5.7	Thermal performance	66
5.8	Chapter summary	68
6	COMPARISON OF DEVELOPED PRODUCTS AND APPLICATION FEASIBILITY	70
6.1	Introduction	70
6.2	Comparison of developed products	70
6.3	Application of developed adhesives on column prototypes	71
6.4	Chapter summary	73
7	NUMERICAL MODELLING	74
7.1	Introduction	74
7.2	Finite Element Analysis (FEA)	74
7.3	Finite Element Model	74
7.3.1	Model geometry	75
7.3.2	Defining Elements.....	75
7.3.3	Mesh Size Analysis	76
7.3.4	Boundary conditions	76
7.3.5	Material models.....	76
7.3.6	Bond slip behaviour	81
7.4	Validation	82
7.5	Parametric studies.....	85
7.5.1	Effect of bondline thickness of ECC adhesive.....	85
7.5.2	Effect of bond width of CFRP	87

7.5.3	Bond stress along the bondline at different load levels.....	89
7.5.4	Bond shear stress along the bondline at different load levels	90
7.5.5	Bond stress contours on CFRP fabric at different load levels	91
7.6	Chapter summary	92
8	CONCLUSIONS AND RECOMMENDATIONS	94
8.1	Development of a cementitious adhesive	94
8.2	Modified epoxy adhesive	95
8.3	Recommendations	97
	REFERENCES.....	98
	ANNEXES	106
	Annex A - Technical specification of ECC-ECO adhesive	106
	Annex B - Technical specification of PETCO-Epoxy adhesive	109
	Annex C – Publications.....	112

LIST OF FIGURES

Figure 2.1. (a) Tensile strength variation of ECC prepared with different fibres [38] (b) Compressive strength variation of ECC prepared with different fibres [38] (c) Flexural strength variation of ECC prepared with different fibres [38].....	13
Figure 2.2. (a) Compressive strength variation under elevated temperature[26] (b) Tensile strength variation under elevated temperature[26].....	14
Figure 2.3. SEM images of ECC at (a) room temperature (b) 500 °C [26]	15
Figure 2.4. ECC-Concrete substrate bond at different temperatures[26].....	15
Figure 2.5. (a) Bond strength variation under elevated temperature[26] (b) Bond strength variation under different CFRP embedded lengths[40]	16
Figure 2.6. Temperature-dependent tensile strength properties of structural adhesives [57].....	18
Figure 3.1 – Materials used to develop ECC adhesive, (a) Portland cement (b) Fly ash (c) Silica sand (d) Water (e) PET fibers.....	21
Figure 3.2 – Material collected locations[74]	22
Figure 3.3 - (a) CFRP fabric (b) Epoxy adhesive-Hardener (c) Epoxy adhesive-Base	22
Figure 3.4 – (a) Lee’s disc apparatus (b) Software used to record data from Lee’s disc apparatus	25
Figure 3.5 – (a) Casting samples in the mould (b) Casted samples	25
Figure 3.6 – Mounting the sample in the apparatus	26
Figure 3.7 – Schematic diagram of setup used to mount pull out test samples (a) Front view (b) Side view	28
Figure 3.8 – Preparing samples for direct pull out test	29
Figure 3.9 – Testing samples in Universal Testing Machine.....	29
Figure 4.1 – (a) Fabricated samples (b) Testing a sample	32
Figure 4.2 – (a) CFRP rupture at the gap between steel plate grip and concrete block (b) Failure modes of samples	33
Figure 4.3 – Graphical interpretation of test results to find the optimum fibre content	35
Figure 4.4 – Debonding failure occurrence.....	36

Figure 4.5 – Nature of failure mode.....	37
Figure 4.6 – (a) Testing the sample (b) Flashlights (c) Data logger	38
Figure 4.7 – Fabricated samples.....	39
Figure 4.8 – Failure mode in samples (a) S-10 (b) S-30 (c) S-50.....	40
Figure 4.9 – Bond strength - % of PET addition.....	41
Figure 4.10 – Samples used to check the effective bond length	41
Figure 4.11 – CFRP bond strength - Bond length.....	42
Figure 4.12 - Failure modes of samples with modified epoxy in direct pull out test.	43
Figure 4.13 - Failure modes of samples with pure epoxy in direct pull out test.....	44
Figure 4.14 – (a) Tensile strength testing sample (b) Conducting the test (c) Failure mode of a sample	45
Figure 4.15 – (a) Fabricated samples (b) Testing a sample	46
Figure 4.16 – (a) Flexural strength testing sample (b) Testing a sample.....	46
Figure 4.17 – (a) Normalized viscosity – Time graph (b) Conducting the test	48
Figure 4.18 – Samples fabricated by bonding CFRP using (a) epoxy adhesive (b) modified epoxy adhesive (c) Testing the sample	49
Figure 4.19 – Bond strength vs. Bond temperature	50
Figure 4.20 – Failure modes of samples with the pure epoxy adhesive	51
Figure 4.21 - Failure modes of samples with the modified epoxy adhesive.....	51
Figure 5.1 - (a)Cement (b) Silica sand (c) Fly ash (d) Water (e) PET fibres.....	53
Figure 5.2 – Temperature deviation curve for sample MP-2-3-2	56
Figure 5.3 – Temperature deviation graph for sample MP-2-4-1	57
Figure 5.4 – Thermal conductivities of samples	58
Figure 5.5 – Failure modes in samples.....	59
Figure 5.6 – Bond strength vs. bond length	60
Figure 5.7 (a) Sticking sand on CFRP fabric (b) Sticking silica sand on CFRP fabric	61
Figure 5.8 – Fabricated samples to perform direct pull out test (a) E-M-S-1/2 (b) E-M-SS-1/2 (c) E-S-N-1/2.....	61
Figure 5.9 – Bond failure occurred in each bond strength enhancing technique.....	62
Figure 5.10 – Testing the compressive strength.....	64

Figure 5.11 - (a) Hounsfield Tensometer (b) Dumbbell shaped sample (c) Mounting the sample.....	64
Figure 5.12 – (a) Conducting the three point bending test (b) Failure mode of a sample	65
Figure 5.13 – Testing the sample	66
Figure 5.14 – Bond strength – Bondline temperature graph	67
Figure 5.15 – Failure modes of samples	68
Figure 6.1 – CFRP bonded using (a) pure epoxy adhesive (b) modified epoxy adhesive (c) ECC adhesive.....	71
Figure 6.2 – Failure modes of concrete cylinders (a) without CFRP (b) CFRP wrapped with pure epoxy adhesive (c) CFRP wrapped with modified epoxy adhesive (d) CFRP wrapped with ECC adhesive	73
Figure 7.1 – Developed model	75
Figure 7.2 – (a) C3D8R element (b) M3D4R [98].....	76
Figure 7.3 - (a) Meshed model (b) Boundary conditions and loading	76
Figure 7.4 – Modified tension stiffening model for ABAQUS [99].....	77
Figure 7.5 – Tensile stress vs. strain graph of Grade 30 concrete	78
Figure 7.6 – Compressive stress-strain relationship for ABAQUS [99].....	79
Figure 7.7 – Compressive stress vs. strain graph of Grade 30 concrete	79
Figure 7.8 – Tensile stress vs. strain graph of ECC	80
Figure 7.9 – Compressive stress vs. strain graph of ECC	80
Figure 7.10 - Load vs. Displacement graph for the effective bond length 150 mm ..	82
Figure 7.11 - Crack initiation in the test setup	83
Figure 7.12 - CFRP-ECC interface debonding	83
Figure 7.13 - Resultant movement of the top ECC adhesive layer	84
Figure 7.14 – Load vs. displacement graph for bond strength enhanced setup	84
Figure 7.15 – ECC – Concrete interface surface bonding failure	85
Figure 7.16 - Effect of ECC adhesive thickness	87
Figure 7.17 – Effect of CFRP bond width	88
Figure 7.18 – Bond failure modes predicted by FE models.....	89
Figure 7.19 – Bond stress along bondline for different load levels	90

Figure 7.20 – Shear stress along bondline for different load levels.....	90
Figure 7.21 – Stress contours on CFRP for loads 6.58 kN, 5 kN and 4 kN.....	91
Figure 7.22 – Stress contours on CFRP for loads 3 kN, 2 kN and 1 kN.....	92

LIST OF TABLES

Table 2.1 - Contents in the cement based adhesives[22]	7
Table 2.2 - Contents in the cementitious adhesive[27]	8
Table 2.3 - Mixing proportions of MPCs [34]	10
Table 2.4 - Initial and residual compressive strengths [34]	10
Table 2.5 - Mix proportion of ECC developed (All the quantities are in kg/m ³) [26], [40]	14
Table 3.1 – Chemical composition of fly ash	23
Table 3.2 – Properties of PET fibre	24
Table 3.3 – Manufacturer-provided properties of CFRP fabric [75]	24
Table 3.4 - Manufacturer-provided properties of epoxy adhesive [76]	24
Table 4.1 – Test results of checking optimum fibre content.....	33
Table 4.2 – Test results of the second attempt to find the optimum fibre content.....	34
Table 4.3 – Bond strength of CFRP/concrete bond at 150 °C	38
Table 4.4 – Bond strength at room temperature and elevated temperature	40
Table 4.5 – Test results of single lap shear test.....	42
Table 4.6 – Tensile strength test results	45
Table 4.7 - Compressive strength test results.....	46
Table 4.8 – Flexural strength test results	47
Table 4.9 – Results of viscosity test.....	48
Table 4.10 – Comparison of thermal performance between pure epoxy and modified epoxy adhesives	49
Table 5.1 – Mix Proportions	53
Table 5.2 – Thermal conductivity values of samples.....	55
Table 5.3 - Results of direct pull out test	58
Table 5.4 – Test results of bond strength enhancing techniques.....	62

Table 5.5 – Compressive strength test results	63
Table 5.6 – Tensile strength test results	65
Table 5.7 – Flexural strength test results	65
Table 5.8 – Test results of the thermal performance of ECC adhesive.....	67
Table 6.1 – Comparison of adhesives	70
Table 6.2 – Test results of CFRP strengthened cylinders	72
Table 7.1 – Dimensions of the model	75
Table 7.2 – Properties for ECC and concrete.....	79
Table 7.3 – Material properties of CFRP fabric [101]	81

LIST OF ABBREVIATIONS

Abbreviation	Description
CFRP	Carbon Fibre Reinforced Polymer
ECC	Engineered Cementitious Composite
FRP	Fibre Reinforced Polymer
GO	Graphene Oxide
MPC	Magnesium Phosphate Cement
PVA	Poly Vinyl Alcohol
PET	Polyethylene terephthalate
PE	Polyethylene
PP	Polypropylene
ASTM	American Society for Testing and Materials
JSCE	Japan Society of Civil Engineers