TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	i
THESIS ABSRACT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF NOTATIONS	xv
CHAPTER (1): INTRODUCTION	
1.1 General Background	1
1.2 Statement of the Problem	3
1.3 Objectives of the Present Research	4
1.4 Thesis Layout	5
CHAPTER (2): LITERATURE REVIEW	
2.1 Introduction	8
2.2 Observed Behavior of Polymer and Non-Polymer Concretes	8
2.2.1 Polymer-Modified Concrete (PMC)	9
2.2.2 Polymer-Concrete (PC)	12
2.2.3 Polymer-Impregnated Concrete (PIC)	14
2.2.4 Non-Polymer Concrete	15
2.3 Behavior of Non-Polymer and Polymer-Concrete Beams in Flexure	16
2.3.1 Non-Polymer Concrete Beams in Flexure	16
2.3.2 Polymer and Polymer-Modified Concrete Beams in Flexure	18
2.4 Behavior of Non-Polymer and Polymer Concrete Beams in Shear	22
2.4.1 Non-Polymer Concrete Beams in Shear	22
2.4.2 Polymer and Polymer-Modified Concrete Beams in Shear	25
2.5 Previous Theoretical Studies on Polymer and Polymer-Modified	
Concerts	27

	2.5.1 Evaluation of Mechanical Properties of Polymer Concrete	
	Materials	27
	2.5.2 Shear Design Studies	30
	2.5.3 Flexural Design Studies	31
	2.5.4 Finite Element Studies	32
CHAPTER	R (3): DESCREPTION OF THE EXPEREMINTAL PROGRAM	
3.1	Introduction	49
3.2	Description of the Test Beams Specimens	49
	3.2.1 Flexure Beams	50
	3.2.2 Shear Beams	51
3.3	Characteristic of the Used Materials	52
	3.3.1 Cement and Water Cement Ratio (W/C)	52
	3.3.2 Concrete Admixtures	53
	3.3.3 Coarse and Fine Aggregates	53
	3.3.4 Epoxy	54
	3.3.5 Steel Reinforcement	55
3.4	Casting and Curing of the Test Beams and Standard Cubes	55
	3.4.1 Concrete Mix Design	55
	3.4.2 Standard Concrete Cubes, Cylinders, and Prisms	56
	3.4.3 Casting and Curing of the Test Beams	56
3.5	Test Setup, Instrumentation, and Testing Procedure	57
	3.5.1 Loading Apparatus	57
	3.5.2 Instrumentation of Measurements	57
	3.5.3 Testing Procedure	58
СНАРТЕК	R (4): EXPERIMENTAL RESULTS FOR EMRC BEAMS IN FL	EXURE
4.1	Introduction	73
4.2	General Behavior and Failure Modes	73
4.3	Measured Load-Deflection Curves	75
	4.3.1 Effect of Volumetric Ratio of Epoxy	76

	4.3.2 Effect of Tension Steel Ratio	/6
	4.3.3 Effect of Bonding Conditions	78
4.4	Measured Load-Steel Strain Curves	78
	4.4.1 Effect of Volumetric Ratio of Epoxy	79
	4.4.2 Effect of Tension Steel Ratio	80
	4.4.3 Effect of Bonding Conditions	80
4.5	Measured Deflections and Strain Profiles	81
	4.5.1 Measured Deflection Shapes	81
	4.5.2 Measured Strain Distribution Profiles	82
4.6	Evaluation of Moment and Curvature Values	83
	4.6.1 Effect of Volumetric Ratio of Epoxy	84
	4.6.2 Effect of Tension Steel Ratio	84
	4.6.3 Effect of Bonding Conditions	85
	4.6.4 Sensitivity Study of Cracking Moment and Ultimate M	oment 86
5.1	Introduction	100
5.1	Introduction	100
5.2	General Behavior of EMRC Shear Beams	101
	5.2.1 Cracking Pattern and Failure Modes	101
	5.2.2 Measured Deflections Profiles	102
5.3	Measured Load-Deflection Curves	103
	5.3.1 Effect of Volumetric Ratio of Epoxy	104
	5.3.2 Effect of Flexural Steel Ratio (ρ_L) and Shear-to-Span	
	Depth Ratio (a/d)	105
	5.3.3 Effect of Stirrups Ratio	106
5.4	Measured Load and Longitudinal Strains Curves	107
	5.4.1 Effect of Volumetric Ratio of Epoxy	107
	5.4.2 Effect of Flexural Steel Ratio (ρ_L) and Shear-to-Span	
	Depth (a/d) Ratio	108
	5.4.3 Effect of Stirrups Ratio	109
5.5	Measured Load-Stirrups Strain Curves	109
	· · · · · · · · · · · · · · · · · · ·	10)

	5.5.2 Effect of Flexural Steel Ratio (ρ_L) and Shear-to-Span	
	Depth (a/d) Ratio	110
5.	6 Sensitivity Study of Cracking Shear and Ultimate Shear Strengths	111
	5.6.1 Cracking Shear Strength	111
	5.6.2 Ultimate Shear Strength	112
CHAPTI	ER (6): FINITE ELEMENT ANALYSIS OF EPOXY-MODIFIED	
	REINFORCED CONCRETE BEAMS	
6.	1 Introduction	134
6.	2 Finite Element Modeling of EMRC Beams	135
	6.2.1 Finite Element Spatial Discretization and Formulation	135
	6.2.2 Matrix Formulation of Concrete Constitutive Law	136
	6.2.3 Solution Technique of the Nonlinear Problem	138
6.	3 Constitutive Modeling of Epoxy-Modified Concrete and Reinforcing	
	Steel	139
	6.3.1 Evaluation of Compressive and Tensile Strength of Epoxy-	
	Modified Concrete	139
	6.3.2 Biaxial Strength Envelope	141
	6.3.3 Constitutive Law of Concrete in Compression	142
	6.3.4 Constitutive Law of Concrete in Tension and Shear	143
	6.3.5 Constitutive Modeling of Reinforcing Steel	145
6.	4 Comparison of Experimental Results and Finite Element Predictions	145
	6.4.1 Comparative Study Flexural Beams	146
	6.4.2. Comparative Study Shear Beams	147
CHAPTI	ER (7): DESIGN STUDIES OF EPOXY-MODIFIED REINFORCE	D
	CONCRETE BEAMS	
7.	1 Introduction	163
7.	2 Proposed Design Equation for Flexure	163
	7.2.1 Main Assumptions of the Proposed Design Approach	163
	7.2.2 Evaluation of the Ultimate Moment Capacity	164