TABLE OF CONTENT

Sr. No.	Topic	Page No.
	List of Tables	**v**
	List of Figures	**vii**
Chapter 1: Introduction		
1.1	Introduction to Rebars	1
1.2	Manufacturing Process	3
1.3	Textile braiding	3
1.4	Aim of the study	4
Chapter 2: Literature Review		
2.0	Introduction	6
2.1	Concepts of Braiding	7
2.1.1	Braiding Techniques	8
	2.1.1.1 Bi-axial and tri-axial braid structures	8
	2.1.1.2 Tubular, flat, square and solid braids	9
2.1.2	Characteristics of Braided Structures	11
2.2	Textile Composites	13
2.2.1	Different types of Textile Composites	13
	2.2.1.1 Fibre-reinforced composites	14
	2.2.1.2 Fabric-reinforced composites	15
	2.2.1.3 Hybrid composites	16
	2.2.1.4 Sandwich composites	16
2.2.2	Characteristics of Textile Composites	16
2.2.3	Reinforcement Material	17
	2.2.3.1 Nylon fibre and its properties	17
	2.2.3.2 Polypropylene fibre& its properties	18
	2.2.3.3 Polyester fibre & its properties	20
	2.2.3.4 Basalt fibre & its properties	21
	2.2.3.5 Carbon fibre & its properties	22
	2.2.3.6 Glass fibre & its properties	23
	2.2.3.7 Aramid fibre & its properties	24
2.2.4	Matrix Material	25
	2.2.4.1 Polyester (unsaturated)	26
	2.2.4.2 Vinyl ester	26
	2.2.4.3 Phenolic	26
	2.2.4.4 Polyurethane	26
	2.2.4.5 Epoxy and its characteristics	26
2.2.5	Braided Composites	27
2.3	Textile Products for Civil Engineering Application	28
2.4	Reinforcement Bars	31
2.4.1	Important Characteristics of Rebar	32

2.4.2 Pros and cons of steel rebar 33
2.4.3 Fibre Reinforcement Rebars 35
2.5 Comparison Between Steel Rebar and FRP Bars 36
2.6 Work Reported So Far 37
2.7 Research Gap and Objectives 44
Chapter 3: Materials and Experimental Methods
3.0 Introduction 46
3.1 Machine Modification 47
3.2 Rope Preparation 50
3.2.1 Tri-axial Rope 51
3.2.2 Testing for Rope 53
3.2.3.1 Grams per linear meter test 53
3.2.3.2 Tensile testing for rope 54
3.3 Rod Preparation 55
3.3.1 Hand Lay Process 56
3.3.2 Testing for Rod 60
3.3.2.1 Grams per linear meter test 60
3.3.2.2 Fiber Volume Fraction (FVF) Analysis 61
3.3.2.3 ATR-FTIR Spectroscopy 61
3.3.2.4 Tensile testing for rod 62
3.3.2.5 Bond strength of FRP 63
3.3.2.6 Beam flexural strength 66
Chapter 4: Results and Discussions
4.0 Introduction 69
4.1 Characterization 70
4.1.1 FTIR Spectroscopy for Resin 70
4.1.2 FTIR Spectroscopy for Hardener 70
4.2 Yarn Properties 71
4.3 Analysis of Braided Rope 72
4.3.1 Linear Density 72
4.3.2 Comparison of Tensile Properties: Between Layers 74
4.3.2.1 Polypropylene braided rope 74
4.3.2.2 Nylon braided rope 76
4.3.2.3 Basalt braided rope 77
4.3.2.4 PP + basalt braided rope 78
4.3.2.5 Nylon + basalt braided rope 80
4.3.3 Comparison of Tensile properties: within Layer 81
4.3.3.1 First layer 81
4.3.3.2 Second layer 82
4.3.3.3 Third layer 84
4.3.3.4 Fourth layer 85
4.3.3.5 Fifth layer 86
4.4 Fiber Volume Fraction Analysis 87

4.4.1 Polypropylene BCR 89
4.4.2 Nylon BC 90
4.4.3 Basalt BCR 91
4.4.4 Polypropylene & Basalt BCR 91
4.4.5 Nylon & Basalt BCR 92
4.5 Tensile Properties of BCR 93
4.5.1 Comparison Between Layer 93
4.5.1.1 Polypropylene BCR 93
4.5.1.2 Nylon BCR 96
4.5.1.3 Basalt BCR 98
4.5.1.4 PP + Basalt 100
4.5.1.5 Nylon + Basalt 101
4.5.2 Comparison within Layer 103
4.5.2.1 First layer 104
4.5.2.2 Second layer 105
4.5.2.3 Third layer 107
4.5.2.4 Fourth layer 109
4.5.2.5 Fifth layer 111
4.6 Bond Strength of BCR by Pull Out 113
4.6.1 Polypropylene BCR 113
4.6.2 Nylon BCR 114
4.6.3 Basalt BCR 115
4.6.4 PP + Basalt BCR 117
4.6.5 Nylon + basalt BCR 118
4.7 Flexural Strength of BCR 120
4.7.1 Polypropylene BCR 120
4.7.2 Nylon BCR 121
4.7.3 Basalt BCR 122
4.7.4 PP + Basalt BCR 123
4.7.5 Nylon + Basalt BCR 124
Chapter 5: A Mathematical Model for Prediction of Tensile Behavior
5.0 Introduction 126
5.1 Mathematical Model 127
5.2 Curve Fitting 128
5.3 Types of Curve Fitting Method 128
5.4 Principle of Least Squares 129
5.5 Curve Optimization 130
5.6 Investigation of Strength Prediction Models for Braided Ropes Made from Different Materials 136
5.6.1 Curve Fitting Analysis for Tensile Strength of Braided Rope 136
5.6.1.1 Finding strength of nylon rope 136
5.6.2 Reverse Curve Fitting 139
5.6.2.1 Reversed Data Analysis 139

5.6.2.2 Methodology for Reversed Curve Fitting 139
5.6.2.3 Reverse Curve Fitting For Nylon 139
5.6.3 Comparative Analysis 141
5.6.3.1 Comparison of Nylon, Basalt & Polypropylene Rope 141
5.6.3.2 Comparison of Nylon, Basalt and Mix Rope 142
5.6.3.3 Comparison of Basalt, Polypropylene, and Mix Rope 144
5.6.4 Importance of Curve Fitting in Material Analysis 145
5.7 Challenges in Curve Fitting 146
5.8 Advanced Fiber-Reinforced Composites 146
5.8.1 Curve Fitting Analysis for Tensile Strength of Composite Rods 147
5.8.1.1 Nylon rod 147
5.8.2 Comparative Analysis for Composite Rods 149
5.8.2.1 Nylon, basalt, polypropylene rod 149
5.8.2.2 Nylon, basalt, nylon+basalt mix rod 151
5.8.2.3 Polypropylene, basalt, polypropylene+basalt mix rod 153
5.9 Artificial Neural Network (ANN) 155
5.9.1 Historical Background of Artificial Neural Network 155
5.9.2 Advantages of ANN 156
5.9.3 Application of Artificial Neural Network in Predicting Tensile Strength 157
5.9.3.1 Nylon Rope 159
5.9.3.2 Nylon Rod 160
Chapter 6: Conclusions 163
Future Scope 168
References 170
Publications 180
Abbreviations 181