Table of Contents

Certificate			i
Declaration by the candidate			ii
Copyright transfer certificate			iii
Acknowledgement			iv
Table of Contents			v-ix
List of Figures			x-xii
List of Tables			xiv-xv
Preface			xvi-xix
Chapter 1		**Introduction**	**Page no.**
	1.1	General	1
	1.2	Failure of bridges	3
	1.3	Composite truss bridge	4
	1.4	Motivation	6
	1.5	Organization of thesis	7
Chapter 2		**Literature Review**	**9-32**
	2.1	General	9
	2.2	Brief history of failure of bridges	9
	2.3	Developments in composite truss technology	12
	2.4	Composite truss bridge	15
		2.4.1 Types and examples of composite steel truss bridges	16
	2.5	Shear connection in composite truss bridges	26
	2.6	Critical Observations	31
	2.7	Scope of present study	32
Chapter 3		**Failure Analysis of Chauras Bridge And Success of Garudchatti Bridge: A Case Study**	**33-66**
	3.1	General	33
		3.1.1 Brief history of Failure of I-35W Bridge: A Steel	34

		truss bridge	
	3.2	Failure analysis of Chauras bridge	36
		3.2.1 Geometry of the Chauras bridge	37
		3.2.2 Analysis of Chauras Bridge at collapse	39
		3.2.2.1 Cross section and permissible stress of failed member U13U14	40
		3.2.2.2 Buckling class of the member	42
		3.2.2.3 Casting sequence of deck slab	43
	3.3	Strengthening of Garudchatti bridge	43
		3.3.1 Analysis of Garudchatti bridge	44
		3.3.2 Strengthening details of critical members	47
		3.3.3 Continuation of diagonal compression member at M-Joints	51
		3.3.4 Load testing of Garudchatti bridge	52
		3.3.5 Precautions in load testing	55
	3.4	Discussion on Chauras and Garudchatti bridges	55
		3.4.1 Critical discussion on failure of Chauras bridge	56
		3.4.1.1 Design at Limit State of Serviceability	58
		3.4.1.2 Recommended design at Limit State of Strength	60
		3.4.2 Discussion on strengthening and load testing of Garudchatti bridge	63
	3.5	Concluding remarks	64
Chapter 4		**Steel-Concrete Composite Truss Bridge**	**67-100**
	4.1	General	67
	4.2	Concept of composite truss bridge	68
	4.3	Effect of shrinkage strain on composite action	70
	4.4	Code provisions for composite trusses in buildings	71
		4.4.1 Code provisions in the American code SJI-CJ-2010	72
		4.4.2 Canadian code provisions in CAN/CSA S16.1	76
	4.5	Proposed analysis and design guidelines for composite	77

steel truss bridges
4.5.1 Modelling of the bridge 78
4.5.2 Analysis under various loading conditions 78
4.5.3 Design for service and overload conditions 81
4.6 Reserve strength at plastic collapse 82
4.7 Comparison between non - composite and composite deck type truss bridges. 84
4.7.1 Geometric details and bridge model 85
4.7.2 Material properties 87
4.7.3 Loading on the bridge 87
4.7.4 Load Combinations 88
4.7.5 Design of the bridge 89
4.7.6 Optimized design results 90
4.7.7 Reserve strength at plastic collapse 96
4.7.8 Deflection and steel off take comparison 98
4.8 Concluding remarks 100
Chapter 5 Shear Connection in Composite Truss Bridges 101-122
5.1 General 101
5.2 Behaviour of shear connectors 102
5.2.1 Longitudinal shear flow in solid and open web girder bridges 103
5.3 Code provisions for shear connectors 104
5.3.1 Indian code provisions. 105
5.3.2 Canadian code provisions 105
5.3.3 American code provisions 106
5.3.4 Eurocode provisions 107
5.4 Design of shear studs using standard codes 108
5.4.1 Spacing of shear studs as per IRC: 24 - 2010 110
5.4.2 Spacing of shear studs as per CAN/CSA-S16-01 110
5.4.3 Spacing of shear studs as per SJI-CJ-2010 111
5.4.4 Spacing of shear studs as per Eurocode 113

	5.5	Total longitudinal shear in shear studs using finite element analysis	115
	5.6	Spacing of shear studs	117
	5.7	Recommendations for design of shear studs	119
	5.8	Concluding remarks	120
Chapter 6		**Comparison of Through and Deck Type Truss Bridges and Use of High Tensile Steel**	**123-152**
	6.1	General	123
	6.2	Geometric details of the bridge	124
		6.2.1 Geometric details for the 30.0m span bridges	124
		6.2.2 Geometric details for the 90.0m span bridges	129
	6.3	Analysis and design	131
		6.3.1 Modelling	131
		6.3.2 Loading	131
		6.3.3 Design	132
	6.4	Comparison between the bridges of different geometry	133
		6.4.1 Comparison for the 30.0m span bridges	133
		6.4.1.1 Comparison for service load under (DL+LL) case	133
		6.4.1.2 Comparison for design at limit state of strength for overload condition of 2.25x(DL+LL) case	134
		6.4.2 Comparison for the 90.0m span bridges	136
		6.4.2.1 Comparison for service load under (DL+LL) case	136
		6.4.2.2 Comparison of design at limit state of strength for overload condition of 2.25x(DL+LL) case	137
	6.5	Effect of bridge span on bridge configuration selection	138
	6.6	Abutment and embankment requirements	140
	6.7	Valley profile	141
	6.8	Use of HTS steel in composite steel truss bridges	142
		6.8.1 Properties of structural steel	143
		6.8.2 Design example of 90.0m span truss bridge using mild steel and HTS	144

		6.8.2.1 Geometric arrangement for the 90.0m span bridge	144
		6.8.2.2 Modelling	145
		6.8.2.3 Loading	145
		6.8.2.4 Design	146
		6.8.3 Cost comparison of structural steel in superstructure	147
	6.9	Concluding remarks	149
Chapter 7		**Conclusions and Recommendations**	**153-160**
	7.1	General	153
	7.2	Future scope of study	158
	7.3	Authors contribution and novelty of the work	158
References			**161-166**
Annexure I			**167-184**
List of Publications			**185**