

## TABLE OF CONTENTS

---

CHAPTER 1.....	1
INTRODUCTION.....	1
1.1 GENERAL INTRODUCTION.....	1
1.2 SHEAR LAG PHENOMENON.....	2
1.3 OUTLINE OF THE THESIS.....	4
CHAPTER 2.....	7
LITERATURE REVIEW .....	7
2.1 INTRODUCTION.....	7
2.2 SHEAR LAG IN BOX BEAMS.....	10
2.2.1 Thin Walled Box Beams.....	10
2.2.2 Composite Box Beams.....	13
2.2.3 Multi-Cellular Box Beams.....	15
2.3 SHEAR LAG IN BRIDGES .....	16
2.3.1 Box Girder Bridges.....	16
2.3.2 Thin Walled Box Girder Bridges .....	22
2.3.3 Composite Box Girder Bridges .....	24
2.3.4 Cable Stayed Bridges.....	27
2.3.5 Prestressed Concrete Bridges .....	28
2.3.6 Girder Bridges .....	30
2.4 SHEAR LAG IN FRAMED TUBE STRUCTURES.....	32
2.4.2 Tubular Structures (Multiple Tubes) .....	35
2.4.3 Shear/Core Wall .....	36
2.5 T AND I-SECTION BEAMS.....	37
2.6 OTHER STRUCTURES .....	38
2.6.1 Thin Walled Structures.....	38
2.6.2 Composite Structures.....	39
2.6.3 Multi-Cellular Structures.....	41
2.6.4 Laminated Plate Structures.....	41

2.7 CONNECTIONS.....	43
2.7.1 Steel Section Connections (Bolted Connections and Welded Connections).....	43
2.7.2 Hollow Steel Section (HSS) Connections .....	47
2.7.3 Grouting and Filled Steel Columns .....	48
CHAPTER 3.....	51
OBJECTIVES AND METHODOLOGY .....	51
3.1 RESEARCH OBJECTIVES.....	51
3.2 METHODOLOGY.....	52
3.2.1 Validation of the Methodology .....	52
CHAPTER 4.....	55
PARAMETRIC ANALYSIS OF SHEAR LAG IN BOX BEAMS.....	55
4.1 INTRODUCTION .....	55
4.2 FORMULATION AND SOLUTIONS .....	56
4.3 APPLICATION EXAMPLES .....	62
4.3.1 Expression for SLF for Cantilever Beam Subjected to Uniform Loading .....	62
4.3.2 Expression for SLF for Simply Supported Beam Subjected to Load Variation as Cosine Law .....	63
4.3.3 Expression for SLF for Built-up Beam Subjected to Uniform Loading.....	63
4.5 RESULTS AND DISCUSSION.....	66
4.5.3 Variation of SLF with Varying G/E and Degree of Polynomial ‘a’ .....	70
4.6 SUMMARY AND CONCLUDING REMARKS .....	73
CHAPTER 5.....	75
EFFECT OF CORNER MODIFICATION ON SHEAR LAG PHENOMENON IN TUBULAR BUILDINGS .....	75
5.1 INTRODUCTION .....	75
5.2 PROPOSED MODELS .....	77
5.2.1 Type First Modifications .....	77
5.2.2 Type Second Modifications .....	77
5.3 METHODOLOGY.....	80
5.4 EFFECT OF MODIFICATIONS .....	81
5.4.1 Effect of Type First Modifications.....	81
5.4.2 Effect of Type Second Modifications.....	85
5.5 RESULTS AND DISCUSSIONS .....	91

5.5.1 Type First Modifications.....	91
5.5.2 Type Second Modifications.....	92
5.6 SUMMARY AND CONCLUDING REMARKS.....	93
CHAPTER 6.....	95
DESIGN ASPECTS OF FRAMED TUBE BUILDINGS SUBJECTED TO SLP.....	95
6.1 INTRODUCTION.....	95
6.2 HIGH RISE STRUCTURES .....	96
6.2.1 Variation of Axial Forces .....	96
6.2.2 Lateral Displacement.....	102
6.2.3 Additional Bending Moment and Location of Inflection Point .....	102
6.3 EFFECT OF RELATIVE STIFFNESS OF BEAM AND COLUMN ON AXIAL FORCE IN COLUMNS..	103
6.3.1 Effect of Varying Beam Stiffness .....	104
6.3.2 Effect of Varying Column Stiffness.....	107
6.3.3 Influence of Relative Stiffness of Column and Beam on Lateral Deflection and Base Bending Moments (BBM).....	109
6.4 LOW RISE STRUCTURES.....	111
6.4.1 Variation of Axial Forces .....	112
6.4.2 Additional Bending Moment and Location of Inflection Point .....	116
6.4.3 Lateral and Vertical Displacements of Framed-Tube.....	118
6.5 SUMMARY AND CONCLUDING REMARKS.....	120
CHAPTER 7.....	123
SOIL-STRUCTURE INTERACTION OF TUBULAR FRAMED STRUCTURE .....	123
7.1 INTRODUCTION .....	123
7.2 TYPE OF ANALYSIS.....	125
7.2.1 Quasi-Static (QS) Analysis .....	125
7.2.2 Time-History (TH) Analysis .....	126
7.2.3 Response Spectrum (RS) Analysis .....	126
7.4 EQUATION OF MOTION AND SOIL-STRUCTURE INTERACTION.....	128
7.5 STATEMENT OF THE PROBLEM .....	129
7.6 MATERIAL AND METHODOLOGY .....	130
7.6.1 Model Specifications .....	130
7.6.2 Soil Specifications.....	130

7.6.3 Shake Table Specifications .....	133
7.6.4 Data Analysis .....	133
7.7 RESULT AND DISCUSSIONS.....	135
7.7.1 Displacement vs Time.....	135
7.7.2 Velocity vs Time.....	136
7.7.3 Acceleration vs Time .....	137
CHAPTER 8.....	141
CONCLUSIONS .....	141
8.1 INTRODUCTION .....	141
8.2 CONCLUSIONS .....	141
8.3 SCOPE FOR FUTURE WORK.....	143
REFERENCES .....	145
BIBLIOGRAPHY.....	159
APPENDIX-A.....	161