Chapter 01- introduction

1.0 Introduction

1.1 Background
Sri Lanka has made significant strides in telecommunications liberalization since the inception of sector reforms in 1991, resulting in a competitive market environment. The results of liberalization have been impressive, with the telecommunications sector growing at one of the fastest paces in Asia.

Several private operators as well as government (Sri Lanka Telecom - SLT) organizations are recently supplying their service in open competitive market of telecommunication service. The Telecommunications Regulatory Commission (TRC) is acting as their regulatory organization in Sri Lanka.

The number of fixed telephone lines subscribers has grown from 121,388 in 1990 to 2,086,774 in 2007 while mobile phone subscribers have increased from a mere 2,644 to nearly 6.0 million in the same period. Along with above rapid growth of telecommunication industry, the numbers of antenna towers also have been increased from about 400 (in 1990) up to nearly 5100 towers during last two decades. (TRC, 2009)

Reference to the collected data from Telecommunications Regularity Commission - Sri Lanka, the summary of tower details are given in figure 1.1.

![Summary of existing Antenna towers in Sri Lanka](image)

Figure 1.1 - Summary of existing antenna towers in Sri Lanka
1.2 Different types of antenna towers
Antenna towers include any type of structures (i.e. Chimneys, concrete structures, etc.) which carries telecommunication antennas, the scope of this report is limited to steel lattice structures and tubular monopoles.
There are three main types of common antenna structures,
- Steel lattice self supporting structures
- Steel lattice or tubular guyed mast structures
- Tubular monopole structures
These structures are further categorized into “Greenfield structures” and “Roof top” according to their place of installation.

1.3 Structural behaviour and safety of antenna towers
The steel lattice type structures are generally considered as one of the most complex and unpredictable type of structures. The principal design criteria of any antenna tower is the pressure due to wind. Self standing antenna structures are basically functioning as vertical cantilever structures. Therefore the items which contribute to an increase of wind loads on the tower such as shielding area of antennas, shielding area and shape of tower itself, installation height of ancillaries from ground level, etc. are considered as primary design criteria of any antenna tower designs.

The importance level of the tower in specific communication network, location of construction, the level of possible damage that may happen to humans in the event of any unexpected collapse and quality of steel fabrication are also considered as another set of primary level design criteria. As the antenna towers are a primary component of vital telecommunication links and usually located in populated locations such as towns and villages, it is always important to adopt correct engineering design of structures and ensure safety of the structure itself as well as the public.

1.4 Main objectives of this study
- Evaluation of engineering codes of practices and identify the correct method and factors of safety that should be used in antenna tower designs in Sri Lanka.
- Understand the relationship between cost of antenna tower and its structural design
- Identify the common mistakes and ill-practices that are currently being practised in Sri Lanka and their effect on safety of the structures.
1.5 Methodology
This research consisted of three types of studies,

1. Literature review – Finding the existing literature that is relevant to the topic and objectives of this research work
2. Field study - Collecting, evaluating and studying about the details/data available in present practice
3. Desk study - Studying and evaluating different criteria which relate to design and safety of antenna towers.

1.6 The arrangement of main chapters,

a. Chapter 1.0 - Introduction.

LITERATURE REVIEW
b. Chapter 2.0 - Literature review.

FIELD STUDY
c. Chapter 3.0 - Basic details of design of steel lattice antenna towers
Brief discussion about the main features of steel lattice antenna towers, correct method of designs and available engineering code in practice. It also includes overview about several computer software (for tower designs) which are available and adopted in present market.

d. Chapter 4.0 - An overview of present practice of design and detailing of antenna towers
Learn briefly about history of antenna tower designs, code of practices, etc. Identify the different loading and their effect on tower, factors of safety imposed by different codes of practices, advantages and limitations of steel antenna structures, detailing methods and preparation drawings, methods of testing and verifications.

e. Chapter 5.0 - Review of reported collapse of antenna towers in Sri Lanka
Brief overview about several reported collapses of antenna towers in Sri Lanka and discussion about the assessment of possible reasons for each of those failures.

f. Chapter 6.0 - Failure analysis of antenna tower
This chapter includes the model analysis of 60m high steel lattice antenna tower and structural behavior of its members under different loading situations

g. Chapter 7.0 - Various other factors which affect tower designs
Discussion about the various other factors (technical as well as non-technical) that can affect the safety of antenna towers. This discussion includes brief discussions on
Technical specification, Process of tender bidding and technical evaluation, Testing and verification, Qualification and experience of people involved, Quality of construction, Post Maintenance procedures, etc.

DESK STUDY

h. Chapter 8.0 - Design of antenna tower to BS8100
   Study about the designing of antenna towers according to the BS8100. Learn the extent of resulting effects when designing towers for different design loads.

i. Chapter 9.0 - Study of the influence of loading types on steel lattice tower design
   Study and discussion about the effect of different design loading on final steel weight/cost of the tower (according to BS8100)

j. Chapter 10.0 - Discussion on the effect of tower design on final cost of construction
   Discussion about effect of final cost due to different design criteria.

k. Chapter 11.0 - Review of several technical specifications
   Brief overview about the (technical) inputs and the quality of several technical specifications that have been included in recent antenna tower supply tender documents.

l. Chapter 12.0 - Some statistics and overview of current tower design practice.
   Provides some statistics about antenna tower distribution in Sri Lanka and brief overview about some shortcomings which exist in current practice of antenna tower designs and construction that include a review of few design reports of existing antenna towers in Sri Lanka.
   This chapter also includes some comments about the selection of suitable factors of safety which are applicable for the conditions in Sri Lanka, etc.

m. Chapter 13.0 - Concluding remarks and Recommendations

Some background data and information are also provided in annex (A).