

**DIRECTIONAL BEHAVIOR OF MEASURED EARTH
RESISTANCE OF ANTENNA STRUCTURES AND
ESTIMATION OF EARTH RESISTANCE**

Kasun Sameera Hettiarachchi

(128763X)

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

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Dissertation submitted in partial fulfillment of the requirements for the
Degree Master of Science in Electrical Installations

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DECLARATION OF THE CANDIDATE & SUPERVISOR

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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K.S.Hettiarachchi

128763X

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Signature of the supervisor:

Date

Emeritus Professor J R Lucas

ABSTRACT

The rapid increase in the use of mobile phones during the past two decades in Sri Lanka, a large numbers of tall Telecom Towers (20m to 100m) has been constructed, which due to the inherently slim and tall nature attracts lightning to itself. While this action protects the neighbourhood from direct lightning strikes, the lightning current thus caused need to be dissipated to earth within the small base area of the tower, giving a rise in the ground potential and a possible hazard to the neighbourhood.

For high soil resistivity and soil with a high degree of discontinuities, there should be a properly designed earthing arrangement. Under the guidelines of the TRCSL, earth resistance values need to be maintained below 5Ω .

The behavior of earth resistance is very hard to predict. The earth resistance is measured through an earth resistance meter, and the interpretation of the readings are subject to many assumptions, including homogeneity in all directions. This thesis emphasizes the key reasons for observed deviations in directional earth resistance values, measured from tower legs.

Simulated ER profiles of base stations have been compared with the calculated and measured ER results of actual base stations. Calculations have been done with reference to the as-built drawings of earthing arrangement. The same earthing arrangement was modelled in Ansys Maxwell software which developed from Maxwell equations, to simulate the ER profile. Based upon the comparison of the calculated and measured values, simulated ER profiles have been validated.

This thesis extends the analysis of Earth resistance towards different soil formations and soil types. With that analysis this thesis concludes the reasons for directional ER variation of a base station and highlights key parameters to get an accurate ER measurement.

DEDICATION

To my loving parents and wife
who made all of this possible,
for their endless
encouragement and patience.

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LIST OF ABBREVIATIONS

Abbreviation	Description
BTS	Base Transceiver Station
TRCSL	Telecommunications Regulatory Commission of Sri Lanka
GPR	Ground Potential Rise
SPD	Surge protective device
IEEE	Institute of Electrical and Electronic Engineers
LPES	Lightning Protection and Earthing System