

**ESTIMATION OF ACTUAL EARTH RESISTANCE OF A COMPLEX
EARTHING NETWORK USING SOIL LAYER MODELLING IN THE
FINITE ELEMENT DOMAIN**

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Degree of Master of Science

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University of Moratuwa

Sri Lanka

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Thesis/Dissertation submitted in partial fulfilment of the requirements for the degree
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DECLARATION OF THE CANDIDATE & SUPERVISOR

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The above candidate has carried out research for the Masters Dissertation under my supervision.

Signature of the supervisor:

Date:

Dr. Asanka S. Rodrigo

DEDICATION

To my beloved parents, siblings and my wife for
their endless guidance and support given throughout my life.

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ABSTRACT

Telecom infrastructure growth rate has been rapidly increased due to higher competition among operators for them to provide reliable and quality service to the customers. Rapid increase of telecom tower construction and usage of advanced equipment has been taken in place due to the recent development in telecom sector in Sri Lanka as well. The tower being a tall structure in the environment, act as a direct path for lightning to be grounded. Though it will protect low height buildings and people in the vicinity from direct lightning strikes, having a proper earthing system with low earth resistance is a must to avoid possible hazards by ground potential rise.

Given the smaller area of the tower premises proper earthing network should be incorporated to maintain the lower earth resistance at the tower. Operators have to maintain the earth resistance at tower sites as per the TRCSL guideline for antenna structures which is below 5 ohms [1]

To meet the TRCSL guidelines operators have incorporated complex earthing systems in tower sites. Typically, the tower earthing system includes copper tapes and multiple number of rods which have made a complex earth network to achieve the lowest possible earth resistance.

Measuring earth resistance is quite hard in a complex earthing network due to parallel conductors, intersections and subjected to many assumptions including specially the homogeneity around all directions. Site measurement is the key parameter of reflecting the earth networks effectiveness to surges and lightnings.

This thesis discusses specifically the reasons for deviations in measured and theoretical values. Simulated earth networks thorough ANSYS Maxwell in the finite element domain to achieve earth resistance profile has been elaborated. Site earth resistance measurements has been taken along different directions. compared with the measurements in every direction of the sites. Validation has been done by the comparison between simulation and measurement.

Analysis has done for different types of soil conditions and limitations for study has been discussed. Thesis concludes with the mechanism to estimate the accurate earth resistance of a site for a particular accuracy which also includes the general assumptions.

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ABBREVIATIONS

TRCSL	- Telecommunication Regularity Commission Sri Lanka
GPR	- Ground Potential Rise
ART	- Attached Rod Technique
FEM	- Finite Element Method
DC	- Direct Current
AC	- Alternative Current
3D	- Three Dimensional