

**OPTIMUM DESIGN FOR MEDIUM VOLTAGE POWER
DISTRIBUTION IN PLANNED CITY UNDER
CONSTRAINTS**

A CASE STUDY: COLOMBO PORT CITY

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Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

June 2017

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Thesis/Dissertation submitted in partial fulfilment of the requirements for the degree
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DECLARATION

“I declare that this is my own work and this thesis / 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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The above candidate has carried out research for the Masters’ Thesis/ Dissertation under my supervision.

.....

Signature of the supervisor:

(Dr. W D Asanka S Rodrigo)

.....

Date

ABSTRACT

Rapid population growth, resource scarcity, rural-urban migration, severe poverty, socioeconomic inequality etc. can be recognized as the foremost challenges, faced by the most of the countries in the world including Sri Lanka. Almost all the major cities are now rapidly becoming urban, which leads to emergence of massive problems related to infrastructure, portable water & sanitation, electricity, housing development etc. As a result, planned cities have been introduced while giving solutions for complex processes of urban planning.

One of the critical challenges in urban planning is to provide sufficient medium voltage distribution, to cater the increasing demand associated with the development. Even though many numbers of researches has been conducted to introduce optimum solutions to address this matter in various places in the world, no literature was found to discuss the optimum value for medium voltage distribution and optimum locations for the complete distribution system. It was evident that common papers about optimal distribution design do not include practical examples of a true multi objective optimization of an actual complete system of significant dimensions as those papers were discussing on existing networks or extensions to existing networks as improvements.

This paper presents new criteria for medium voltage selection, optimum location selection and minimization of losses in the Medium Voltage network. Finally a general model was developed to assist city planners to arrange the medium voltage power distribution for the planned cities.

Due to easy access to information, Colombo port city was selected as the case study in this research study. There are four available locations (A, B, C & D) for GSS in port city conceptual master plan and it was found that “B” and “C” were optimum locations for GSS. The optimum value for the MV power distribution is 22kV. The significant gain of the discussed methodology is that, it provides a set of solutions that can be considered simultaneously. Accordingly, this guide will not only raise awareness and build capacities in this regard, but will also offer directions for upcoming initiatives in this regard.

Key Words - Mega cities, optimum solution, medium voltage (MV), Colombo port city, novel concept

DEDICATION

I dedicate this thesis, which I completed successfully as my first research work, to my mother Mrs. H A L Kulathunga and my father, late Mr. Y K D P Ranaweera, who were always there as my strong pillars and my source of inspiration, by supporting me to make my dreams come true. I also dedicate this to my wife, Mrs. Asha Ranaweera, to my children and to all other knowledge seekers, who attempt to develop a better future.

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LIST OF ABBREVIATIONS

ACSR	-	Aluminium –Conductor Steel- Reinforced
CBD	-	Central Business District of Colombo City
CEB	-	Ceylon Electricity Board
EMF	-	Electric and Magnetic Fields
GCTDLRP	-	Greater Colombo Transmission & Distribution Loss Reduction Project
GIS	-	Gas Insulated Switch Gear
GSS	-	Grid Substations
HDB	-	Housing Development Board
HDD	-	Horizontal direct drilling
HV	-	High Voltage
kV	-	Kilo Volt
kVA	-	Kilovolt - Ampere
LV	-	Low Voltage
MV	-	Medium Voltage
MVA	-	Megavolt –Ampere
NGO	-	Non-Government Organization
PPC	-	Preliminary Permission Clearance
PUCSL	-	Public Utilities Commission of Sri Lanka
R&D	-	Research & Development
SL	-	Sri Lanka
UG	-	Under Ground
XLPE	-	Cross Linked Polyethylene