Ain Shams University
Faculty of Engineering

CONSERVATION OF ENERGY IN LIGHTING SYSTEM DESIGN

BY

EHAB ABD EL-ALIEM SELIEM

A THESIS

Submitted in Partial Fulfillment of
The Requirements of the Degree of Master of
Science in Electrical Enginerring

SUPERVISED BY

Prof. Dr. MAGDI M. A. SALAMA

Dept. of Elect. Power Machines
Faculty of Engineering
Ain Shams University

CAIRO - 1990

بسم الله الرحمن الرحيم

الله

بسم الله الرحمن الرحيم

EXAMINERS COMMITTEE

Name , Title & Affiliation	Signature
1. Prof Dr. S. A. HASSAN Professor, Dept. of Elect. Power & Machines Dean, Shibien El-Koum Faculty of Engineering Menofia University.	Hassan
2. Prof. Dr. A. K. EL-KHARASHI Head of Dept. of Elect. Power & Machines Faculty of Engineering, Ain Shams University.	Kharashi
3. Prof. Dr. MAGDI M. A. SALAMA Professor. Dept. of Elect. Power & Machines Faculty of Engineering, Ain Shams University.	Magdy Sal

Date: 13 / 8 /1990

STATMENT

This dissertation is submitted to Ain Shams University for the degree of Master in Electrical Engineering.

The work included in this thesis was carried out by the author in the Department of Electical Power and Machines, Ain Shams University, from 13 / 10 / 1986 to date.

No part of this thesis has been submitted for a degree or qualification at any other University or Institution.

Date : 13-8-1990

Signature: Ehab Abd El-Alien Seliem

Name : Ehab Abd El-Aliem Seliem.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

The objective of this thesis is to develop a method to calculate the saving in the cost of an existing artificial lighting system in an office room in an office building when relamping the system by another energy efficient lamps, replacing the system by another energy saver artificial system or by a system combining between daylighting and artificial lighting. The latter is considerably elaborated since utilisation of daylighting becomes now one of the most important energy efficient techniques in lighting system design.

In this thesis, the various methods for calculating the daylighting level at the reference point on the working plane area by means of calculating the daylight factor "DF" are summarised. Finally the thesis concludes by a comparison between relamping the artificial lighting system and the combination between daylighting- artificial lighting system, the resulting reduction in the life-cycle-cost.

ACKNOWLEDGEMENTS

Great thanks to **GOD** for helping to complete this work. Many thanks to my father for encouraging me to continue my way into higher studies.

I wish to acknowledge, with appreciation and gratitude Professor Dr.Magdi M. Salama for his supervision, valuable support and guidance, throughout the thesis.

Also i wish to thank my colleagues at Dar Al-Handasah Consultants, and every body who assisted me in preparing this thesis.

ABBREVIATIONS

AEG	Allgemeine Elektricitats- Gesellschaft.
bre	Building Research Establishment Digest.
BRS	Building Research Station.
CIBS	Chartered Institution of Building Services.
CIE	Commission International de l'Eclairage.
EC&M	Electrical Construction and Maintenance.
LD&A	Lighting Design and Application.
IES	Illuminating Engineering Society.
IEEE	Institute of Electrical and Electronics Engineers.
ilr	international lighting review.
DF	Daylight Factor.
SC	Sky Component of Daylight Factor.
ERC	Externally Reflected Component of Daylight Factor.
IRC	Internally Reflected Component of Daylight Factor.
HVAC	Heat Ventilation and Air-Conditioning System.
D	Luminaire dirt depreciation Factor.

DEFINITIONS

Energy Conservation: Energy conservation deals with Engineering, Design, Application, Utilisation and to some extent the operation and maintenance of the electric power systems to provide for the optimal use of energy. Optimal in this case refers to the design or modification of a system to use minimum overall energy where the potential or real energy savings are justified on an economic or cost benefit basis. Optimisation also involves factors such as comfort, healthful working conditions, the practical aspects of productivity, aesthetic acceptability of the space and public relations.

Energy Management: Energy management is the more inclusive term for energy conservation, involving many professions and fields such as Engineering, Organisation, Economic and Financial Analysis, Operation Research, Metering and Measurement and Control Systems.

Daylight Factor(DF): Daylight Factor at a point indoor is defined as the illuminance received at that point from a sky of known or assumed luminance distribution expressed as a percentage of the horizontal illuminance outdoor from an unobstructed hemisphere of the same sky. Direct sunlight is excluded from both illuminances.

It is usually considered that the Daylight Factor comprises three components; the sky component, the externally reflected component and the internally reflected component.

Sky Component(SC): Sky Component is the ratio of that part of the daylight illuminance at a point on a given plane which is received directly from a sky of assumed or known luminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky.

Direct sunlight is excluded from both values of illuminances.

Externally Reflected Component(ERC): Externally Reflected Component is the ratio of that part of daylight illuminance at a point on a given plane which received directly from external reflecting surfaces illuminated directly or indirectly by a sky of assumed or known luminance distribution,