

DECLARATION

I, **Chisala Kapumpu** do hereby declare that the contents of the dissertation being submitted herein are my original work and they have not been previously submitted to any University for the award of a degree or any other qualification.

Signature.....Date.....

CERTIFICATE OF APPROVAL

This dissertation submitted by, Chisala KAPUMPU is approved as fulfilling the requirements for the award of the degree of Masters of Engineering in Thermo-fluids at the University of Zambia.

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ABSTRACT

The requirement for insolation models has been appreciated for many years in designing solar energy systems properly, for locations lacking insolation data base. Unfortunately, for most geographical areas in Zambia, insolation data is not available. This research thesis gives an account of global solar radiation measurements on a horizontal surface, mean daily maximum temperature, mean daily relative humidity, mean daily pressure, mean daily maximum dew point temperature, and hours of bright sunshine for seven selected locations in Zambia. The considered locations represent the different atmospheric weather conditions of Zambia. Kasama and Mansa are in the north, Lusaka and Ndola in the middle, and Livingstone and Mongu in the south, Mfuwe in the east of Zambia. Correlations between the daily measurements of global solar radiation and the meteorological parameters were presented for the considered locations. A common relationship for all Zambia was also established to estimate global solar radiation. The correlation and the regression coefficients and the standard errors of estimate were established. The values of correlation coefficients varied from 53% to 97% and the errors of estimation were between 0.24 and 0.84.

DEDICATION

I dedicate this thesis to:

My late mum, Mwelwa Kapumpu;

My wife, Mildred and;

Our children, Mwelwa, Chimbali and Chisala.

ACKNOWLEDGEMENTS

There are a number of people without whom this thesis might not have been written, and to whom I am greatly indebted.

To my supervisors Dr. P.C Chisale and Dr. N Kwendakwema, I would like to express my heartfelt gratitude for the useful comments, remarks and engagements through the learning process of this master thesis. Your advice on both research as well as on my career have been priceless. You continually and persuasively conveyed a spirit of adventure with regards to research and an excitement to teaching. Without your supervision and constant help this thesis would not have been possible.

To my family and friends, a special thank you. Words alone cannot express how grateful I am to my father, mother-in law and father-in-law, for all of the sacrifices that you have made on my behalf. Your prayer for me was what sustained me thus far. I would also like to thank all of my friends who supported me in writing, and incited me to strive towards my goal. Finally, I would like to express appreciation to my beloved wife Mildred whom I spent sleepless nights with and was always my support in moments when there was no one to answer my queries.

I would like to express the deepest appreciation to Professor F. D Yamba for having introduced me to many topics in Thermo-fluids, Mr. Edwin Luwaya for his ever unfailing encouragements; my colleague Adam Daka for being there for me when I felt like failing to do it. I would also like to express my gratitude to the Zambia Meteorological Department (ZMD) for their sincere cooperation in providing the files and documents available in their archive containing meteorological information. Without this information, this research would have not been successful. Special thanks to University of Zambia (UNZA) for the opportunity to pursue my studies.

Finally, but definitely not the least, I would like to express my appreciation to all the Lecturers in the Department of Mechanical Engineering and indeed the academic members of staff in the School of Engineering for their support.

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LIST OF ABBREVIATIONS

SE	Standard Error
CC	Coefficient Correlation
GGAM	Geographical, Geometrical, Astronomical and Meteorological
UNZA	University of Zambia
ZMD	Zambia Meteorological Department
IEA	International Energy Agency
EIA	Energy Information Administration
WEC	World Energy Council
ZESCO	Zambia Electricity Supply Corporation
LHPC	Lunsemfwa Hydropower Company
RMSE	Root Mean Square Error
MAPE	Mean Average Percentage Error,
MBD	Mean Bias Differences
MBE	Mean Bias Error
MAD	Mean Absolute Deviation
MPE	Root Mean Square Error

NOMENCLATURE

$a, b, c, d, e, f, g, h, i$	Regression Coefficients
H_o	Mean daily extraterrestrial solar radiation,
n/N	Average daily ratio of sunshine duration,
R_h	Mean daily relative humidity,
T_{max}	Mean daily maximum air temperature
$T_{dp,max}$	Mean daily maximum dew point temperature
P	Mean daily atmospheric pressure
C	Cloud cover,
H	Mean Daily monthly global solar radiation at earth's surface
n^*	Hours of measured sunshine
n	Day of year
N	Potential astronomical sunshine hours
I_{sc}	Solar constant
I_o	Extraterrestrial Solar irradiance
\emptyset	Latitude angle
ω	Hour angle
ω_s	Sunset hour angle
θ_z	Solar zenith angle
δ	Solar declination angle