WAVE ENERGY RESOURCE ASSESSMENT FOR SRI LANKA

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Degree of Master of Science

Department of Civil Engineering

University of Moratuwa
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Thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Civil Engineering

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DECLARATION

I declare that this is my own work and this thesis 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 MSc Thesis under my supervision.

Name of the supervisor: Dr P. K. C. De Silva

Signature of the supervisor: ……………. Date: …………………………

Name of the supervisor: Mr. A. H. R. Ratnasooriya

Signature of the supervisor: ……………. Date: …………………………

ABSTRACT

Marine energy is recognised as a widely available alternative for energy generated by burning fossil fuels in countries surrounded by seas and oceans. Among the marine energy resources, wave energy contains the highest energy density world-wide. The widespread availability of wave energy resource and relatively low impact of energy intake on the ocean environment have led to numerous research and developments on wave energy harvesting. The direct south-west swell wave approach and relatively narrow continental shelf create more favorable conditions for wave energy harvesting in Sri Lankan coastal region. The assessment of wave energy characteristics in coastal waters of Sri Lanka is important in identifying such a potential.

In this study, ocean waves are projected by a numerical wave model developed using the Simulated Nearshore Wave (SWAN) model, which used atmospheric data obtained by a Global Climate Model (GCM) within two (02) time slices of “present" and “future”. The model output was validated using measured wave data from the southwest coast and other data sources.

The wave output indicates that the coastal areas of Sri Lanka from the southwest to the south-east have a significant amount of wave power. Under the present wave climate, the available wave power varies between 10-30 kW/m. When waves propagate towards the shoreline on the continental shelf, the wave power reduces. Although the southwest monsoon has greatly modulated the offshore wave power up to 30 kW/m, it mostly remains between 10-20 kW/m throughout the year. The spatial variation of wave power along the coast is also obvious. The study also shows that although minor variations are observed, the inter-annual and decadal-scale wave power variation is almost stable.

According to the future wave projections, the average available wave power in the south-west and south-east coastal areas of Sri Lanka will be slightly reduced in the future. This reduction is mainly due to changes in the south-west monsoon system caused by the global climate change. The available wave power resources associated with the swell wave component remain largely unchanged. Although detailed analysis of monthly and annual average wave power shows that strong seasonal and inter-annual changes in wave power can be seen on most of the western and southern coasts of Sri Lanka. Based on the modeled wave outputs of 25-year period, no decadal scale trends cab be observed. Finally, the results show that the wave power attributed to sea and swell waves very stable over the long term with a slight wave power reduction in the future.

Keywords: Wave power, Wave projections, Climate change, Monsoons, Sri Lanka, Indian Ocean

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AGCM	Atmospheric Global Climate Model
GCM	Global Climate Model
GMO	Galle Modelled data
GE	Galle ERA-Interim data
GM	Galle Measured Data
IOD	Indian Ocean Dipole
NAO	North Atlantic Oscillation
RMSE	Root Mean Square Error
SO	Southern Oscillation
SWL	Still Water Level