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# DEVELOPMENT OF AN ANALYTICAL MODEL TO STUDY WAVE MOTION THROUGH POROUS VERTICAL COASTAL STRUCTURES

Thesis submitted in partial fulfilment of the requirements for the Degree of Master  
of Engineering in Environmental Engineering and Management

By

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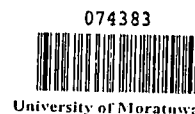
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DEPARTMENT OF CIVIL ENGINEERING  
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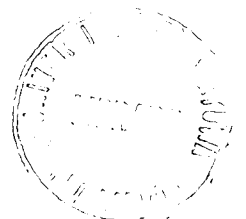
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## ABSTRACT

This study is concerned with the development of an analytical model to predict wave reflection and transmission characteristics of porous, vertical coastal structures. Because of the complexity of the problem the study was limited to non-breaking, small amplitude, long waves normally incident to the structure.

The input data for the model are the incident wave characteristics and the properties of the porous media. The wave climate is identified by the wave height, the wave period and still water depth. The porous structure is characterised by its length, overall porosity and the laminar and turbulent flow coefficients (determined under steady flow conditions). The Forchheimer equation was used for the hydraulic gradient-velocity relationship. Continuity and momentum equations are linearised for the inclusion in the model.

The model was verified with results obtained from hydraulic model investigations carried out at Imperial college, London and Lanka hydraulics institute, Sri Lanka. Satisfactory agreement was obtained between experimental and predicted values.



## ACKNOWLEDGEMENT

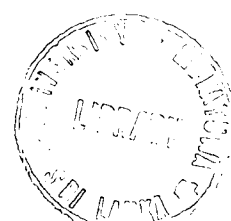
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## LIST OF SYMBOLS

The most important symbols used in the text are listed below. Variables which have been used locally are not listed but are defined in the text.

$a$	steady laminar flow coefficient in the Forchheimer equation
$b$	steady turbulent flow coefficient in the Forchheimer equation
$b$	back interface of the open block structure
$B$	length of the structure
$E_k$	mean kinetic energy per unit surface area
$E_p$	mean potential energy per unit surface area
$E_T$	total energy per unit surface area
$f$	front interface of the open block structure
$g$	acceleration due to gravity
$h$	constant water depth outside the structure
$H_o$	height of the wave at the front interface
$H_i$	incident wave height
$H_t$	transmitted wave height
$H_r$	reflected wave height
$H_{if}$	incident wave height at the front interface
$H_{ib}$	incident wave height at the back interface
$H_{tf}$	transmitted wave height at the front interface
$H_{tb}$	transmitted wave height at the back interface
$H_{rf}$	reflected wave height at the front interface
$H_{rb}$	reflected wave height at the back interface
$I$	hydraulic gradient
$j$	loss coefficient at the interface
$j_f$	loss coefficient at the front interface
$j_b$	loss coefficient at the back interface
$k$	coefficient of permeability
$k^*$	coefficient of effective permeability

$K_T$	coefficient of transmission
$K_R$	coefficient of reflection
$K_{tf}$	coefficient of transmission at the front interface
$K_{tb}$	coefficient of transmission at the back interface
$K_{rf}$	coefficient of reflection at the front interface
$K_{rb}$	coefficient of reflection at the back interface
$P$	porosity
$P_1$	porosity of medium 1
$P_2$	porosity of medium 2
$T$	wave period
$t$	time
$u$	horizontal component of the macroscopic (bulk) velocity
$u_p$	particle velocity
$u_i$	particle velocity of the incident wave
$u_r$	particle velocity of the reflected wave
$u_t$	particle velocity of the transmitted wave
$W_i$	energy flux of the incident wave
$W_d$	energy flux of the dissipated wave
$W_t$	energy flux of the transmitted wave
$W_r$	energy flux of the reflected wave
$\alpha$	phase difference with respect to the incident wave
$\delta$	phase difference between $\eta$ and $u$
$\eta$	free surface elevation relative to still water level
$\eta_i$	free surface elevation of the incident wave relative to still water level
$\eta_r$	free surface elevation of the reflected wave relative to still water level
$\eta_t$	free surface elevation of the transmitted wave relative to still water level
$\tau$	square root of tortuosity
$\gamma$	unit weight of fluid