

**PHYSICAL
MODELLING:
STATE OF THE
ART APPLICATION**
N A H R I M
HYDRAULIC AND
INSTRUMENTATION
LABORATORY

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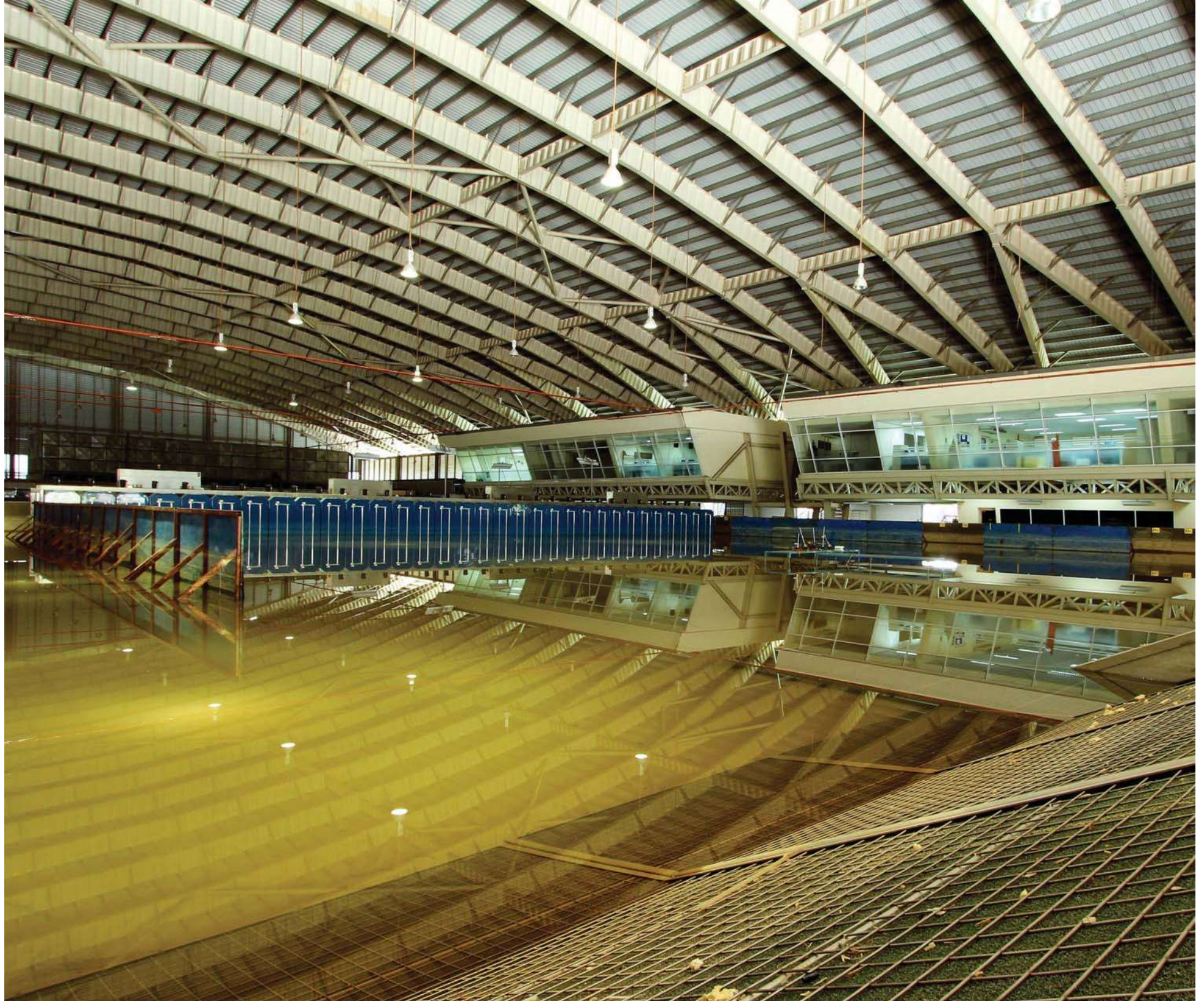
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WATER, LAND AND NATURAL RESOURCES (KATS)

My heartiest congratulations to NAHRIM on the publication of this book. It is indeed a true masterpiece, highlighting on the role of Hydraulic and Instrumentation Laboratory (MHI) and the importance of Research and Development (R&D) in water environment, while showcasing some of the main activities of the laboratory.

Water environment as a whole is vital to life as it could affect health, security and economic well-being of our society. Our survival as a nation depends on effective water management which requires each sector to understand how their water-use affects the resource and the functions of other sectors. The government realises that water scarcity is a real and present danger and that the administrative machinery must gear itself to respond accordingly. The formation of the Ministry of Water, Land and Natural Resources (KATS) and the unification of the two main sectors of water under the Ministry is the first step towards effective management of the Nation's water resources and sectoral water demand.

As a leading National expert in water research, NAHRIM plays a key role in mastering and understanding the complexity of the water environment towards better management, enhancement and preservation for our future generations. The execution of Physical Modelling Similitude in MHI is state of the art that provides an effective tool and reliable methods to assess various effects and impact of developments to our water environment, thus facilitates our effort in enhancing environmental sustainability.

I hope that this book, apart from being an interesting reading material, will also serve as a reference in Physical Modelling Similitude applications in water environment related research.

GENERAL, MINISTRY OF WATER, LAND AND NATURAL RESOURCES (KATS)

I am very pleased and honoured to be given the opportunity to write a few words in this coffee-table book, which showcases the research and development activities in various water environment conducted in NAHRIM.

The importance of conserving and managing our water environment to the best will be a key element in achieving sustainable development. As one of the research institute under KATS, NAHRIM is entrusted to conduct basic and applied research in water environment, encompassing hydraulic engineering, water resources, water services and water quantity as well as quality for various sectors. This is in line with the vision of the Ministry to spearhead the sustainable management of water, land and natural resources for the socio-economic development of the nation and the well-being of the Malaysian citizen.

I believe, as the national leading expert in Physical Modelling Similitude, NAHRIM through Hydraulic and Instrumentation Laboratory (MHI) has all the necessary capacities and facilities to provide and share the knowledge gain with all water research communities.

I would like to take this opportunity to congratulate NAHRIM for their effort in publishing this exciting and informative coffee-table book.

Datuk Zurinah Binti Pawanteh
Ministry of Water, Land and Natural Resources



GENERAL OF NAHRIM

Alhamdulillah. It is been a grateful and great pleasure of me to share thoughts and excitement about this book, which gives an insight into Physical Modelling Similitude activities in our Hydraulic and Instrumentation Laboratory (MHI). This book documented research and development project portfolios undertaken by MHI in the past years. It also explains photographically the challenges we faced in complete cycle of research whilst portraying present and future research spirits.

Physical Modelling Similitude requires accurate, consistent and reliable assessment of hydraulic performances, especially for non standard structures and challenging site conditions. Although the process is rigorous and demanding, knowledge gained from our research allows us to establish a fine unique research methodologies, analysis, as well as to deliver innovative and reliable solutions to our clients. In this view, we will continue to collaborate actively with strategic partners to deliver result-driven research in many facets of the water environment.

I would like to express my thankful and sincerest appreciation to MHI Editorial Committee in making the publication of this book into reality. Moving forward, I envision that MHI will be able to place itself among the leading internationally recognized physical hydraulic laboratory, Insya-Allah.

Dato' Ir. Dr. Haji Md. Nasir Bin Md. Noh
Director General of NAHRIM



A NOTE FROM THE EDITORIAL TEAM

We take pride in sharing our expertise and skills in hydraulic physical modelling through this book. The team is very delighted to be involved in the publication of this coffee table book. We would like to express our appreciation and gratitude to all those who have generously contributed their ideas and worked diligently in making publication of this book a reality. The successful publication of this book would not have been possible without the assistance from the MHI Lab ground staff who have been very dedicated in doing all the hard work in the laboratory.

We hope that you will enjoy reading this book as much as we enjoy publishing it.

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Ir. Dr. Safari Bin Hj. Mat Desa

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ISO 9001:2015

Physical Modelling Management in Hydraulic Engineering
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The Largest Rainwater Harvesting
System for Laboratory

INTRODUCTION

This book gives a holistic view of the roles and responsibilities of the NAHRIM Hydraulic and Instrumentation Laboratory (MHI). The establishment of this lab was inspired and motivated by the urgent need for hydraulic research and the adoption of well-constructed ideas in real engineering applications. The demand to find solutions to the environment problems we were facing further underscore the urgency to establish the MHI. Our environment is ailing due to climate change and uncontrolled anthropogenic activities. Equipped with state-of-the art facilities and well trained engineers, the MHI is experienced and qualified to undertake complex projects which would help to preserve our environment. This book highlights the projects which have been successfully completed in addition to highlighting our competence and ability in conducting hydraulic research. Our lab is recognised both at the national and international levels, and we have facilitated collaboration, partnership, joint effort with other parties with the objective of providing environmentally friendly hydraulic design.

CHAPTER 1

ENVIRONMENTAL AND DEVELOPMENTAL ISSUES

Malaysia is currently facing several environmental issues, such as climate pollution of inland and marine waters, and deforestation. These issues need to be tackled to ensure a sustainable Malaysia. The Government of Malaysia has responded by taking serious actions, striking a balance between pursuing developments and preserving the environment, both at national and international levels. Policies have been introduced based on well-grounded scientific research and strictly implemented. A large amount of funding has been allocated for research to ensure that Malaysia fares well in terms of environmental sustainability without adversely affecting her ecosystem and natural resources. Hydraulic physical modelling is one of the ways to assess and evaluate the impact of development on the environment and prevent environmental related problems.





Left, center & right:

Aerial views of the devastation and impact caused by flooding in the district of Gua Musang, Kelantan in December 2014. River banks were severely eroded and the bed profile was profoundly altered due to sedimentation and deposition.





Deforestation debris causing infrastructure damage and hardship to public.



Uncontrolled flooding often caused damage to infrastructures and properties.

Top: Personal belongings damaged by the deposited sediments.



Center: A car left stranded in the rising water level.



Bottom: Total collapse of road due to structural failure of embankment.



One of the major environmental issues of concern is flood. This photo shows the severity of flood which occurred during the monsoon season of 2011 in Segamat, Johor.



The National Coastal Erosion Study, which was conducted in 1986, showed that about 29% or 1,380 kilometres of the country's 4,809 kilometres coastline are eroded.

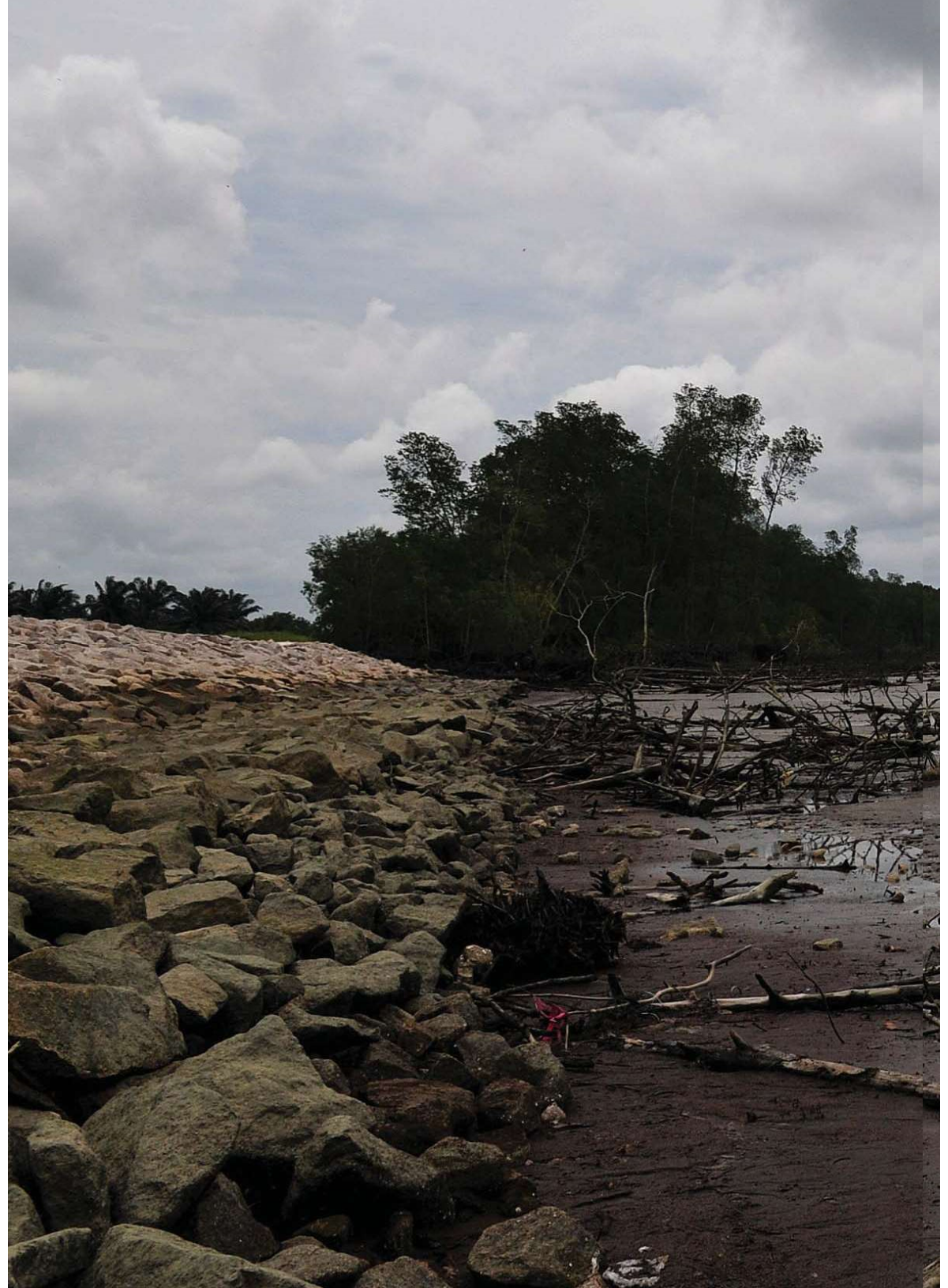
Coastal erosion occurs naturally or are man-induced. In most cases, erosion is caused by human activities which have devastating impact on coastlines.

Above: Visible coastal erosion at Pantai Tok Jembal, Terengganu.

Retreat of land due to the degradation of mangrove forest which serve as a natural coastal protection.

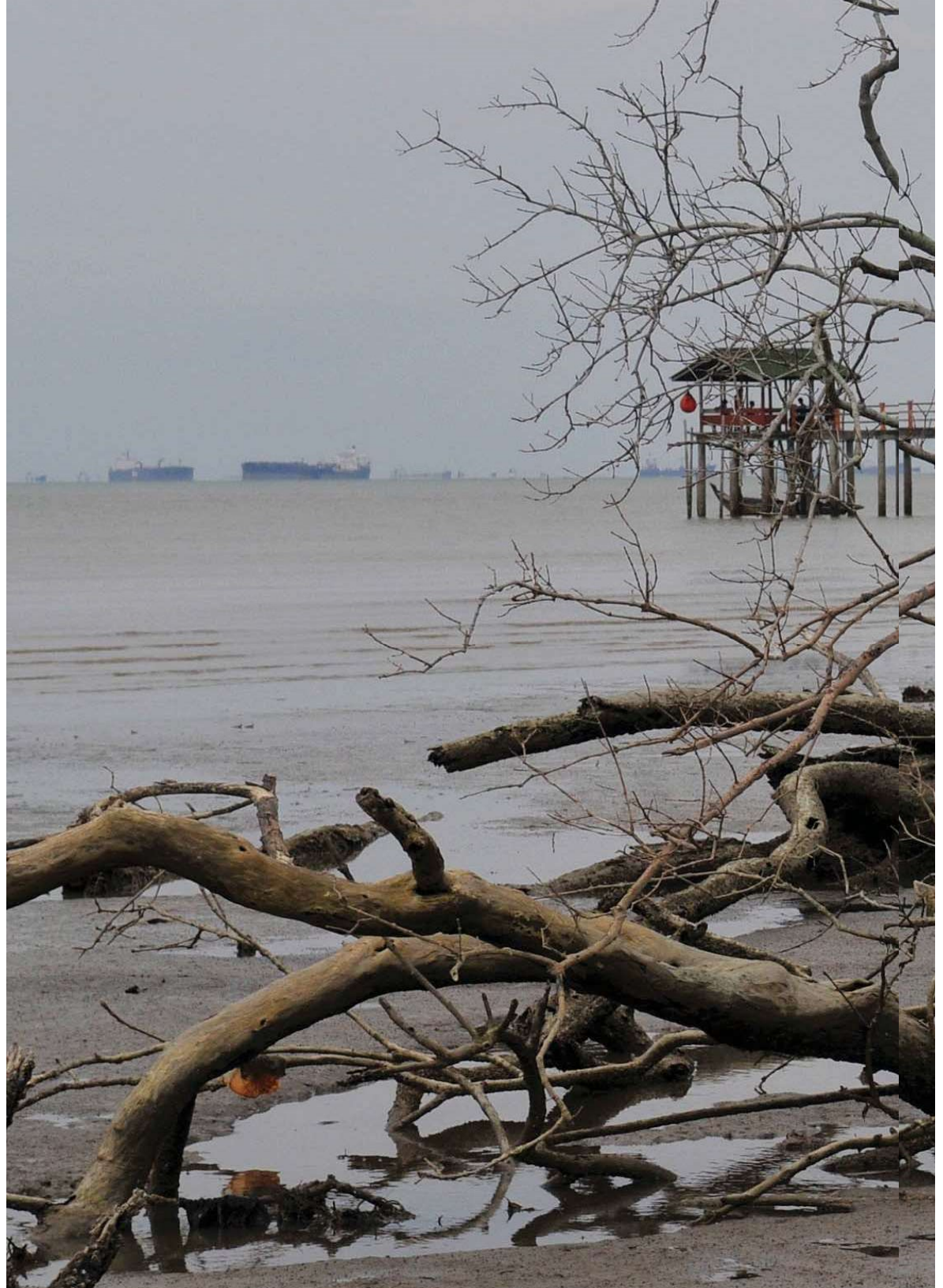
The rock revetment was constructed to protect the coastal bund; it is a final line of defense before land.

This photo was taken in Tg. Piai.





Severe erosion at one area of mangrove forest due to severe wave attack. Continuous wave attack makes it impossible for the mangrove forest to survive or regenerate, or for restoration work to be carried out.







The construction of rock revetment requires detailed design and must be monitored by engineers to ensure that the design is strictly followed. Billions of ringgit were spent each year for erosion control and coastal protection works.

CHAPTER 2

SOLUTIONS THROUGH PHYSICAL MODELLING
STUDY

Environmental issues, such as coastal erosion and flood, have devastating impact on the socio-economic and livelihood of the people and might even cause loss of lives. Precautions and actions can be taken through hydraulic physical modelling, which is used to investigate design and operation issues in the field of hydraulic engineering. The modelling includes water movement and sediment transport in rivers and coastal zones; hydraulic performance of water intakes; spillways and outlets; performance of coastal structures such as breakwater, dykes, groynes, floating structure or ships; and effluent-mixing process. Physical modelling is not restricted only to big structures but is also useful in studying the flow around various objects and the performance of hydromachines such as turbines and pumps.

Hydraulic modelling gives an approximation of flow characteristics and represent the actual behaviour of one studied subject. Scaled model compliments mathematical models and are irreplaceable in complex development projects. This kind of work is important and is seen as a required preliminary step in ensuring that the hydraulic design and the proposed technical solution are safe. The MHI at NAHRIM provides solution and unparalleled resource for modelling and analysing environmental issues.



Tidal Gate Operational Testing

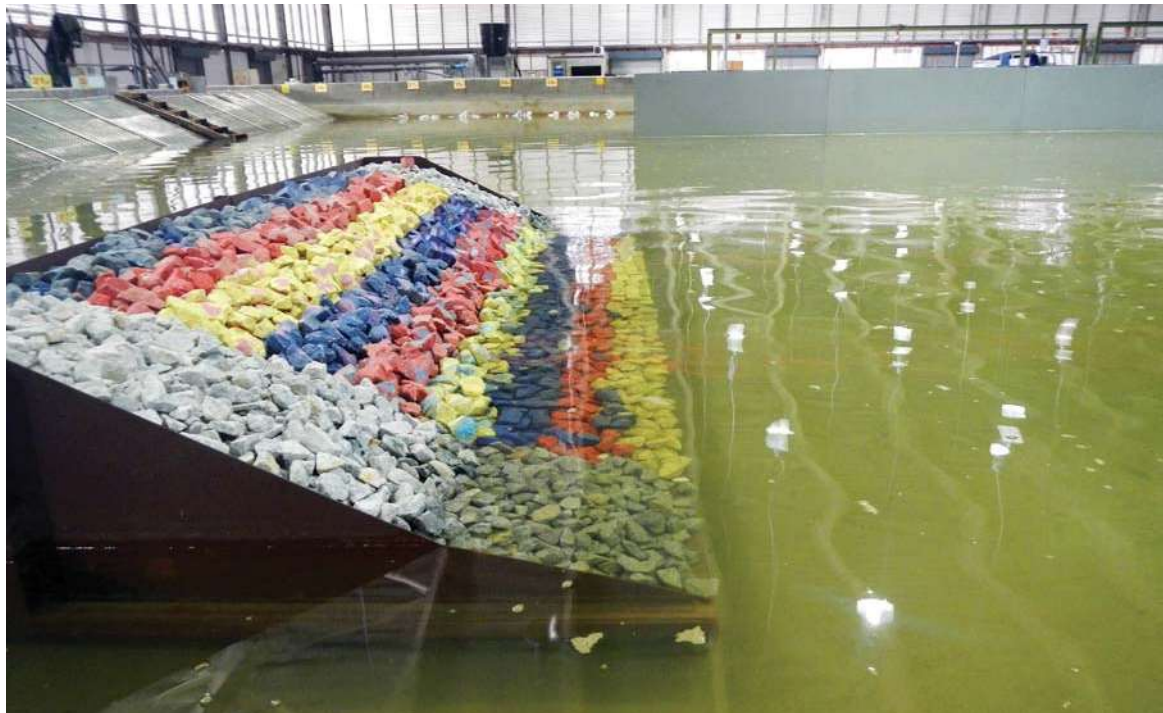


Top: Flow behaviour testing around an airfoil.

Bottom: Wave impact study.



Wave energy devices being developed and tested.



Top: Coastal protection structure test.
Bottom: Breakwater stability test.

CHAPTER 3

THE ROLE OF NAHRIM HYDRAULIC AND
INSTRUMENTATION LABORATORY (MHI)

NATIONAL HYDRAULIC RESEARCH INSTITUTE OF MALAYSIA (NAHRIM)

The realization of the need to establish the National Hydraulic Research Institute of Malaysia (NAHRIM) began in 1990 after a visit from YAB Prime Minister of Malaysia Tun Dr. Mahathir Mohamed to similar hydraulic research institute in Poona, India to conduct experimental simulation and numerical hydrodynamic analysis, and simulate ecological and morphological processes and their interaction with human activities. Since then, NAHRIM has grown out of its infant stage and now has a pool of experts; it conducts research and provides services in planning, designing, building, and policy making. NAHRIM is striving to become the National Focal Point which coordinate research in hydraulics engineering in Malaysia.

NAHRIM HYDRAULIC AND INSTRUMENTATION LABORATORY (MHI)

NAHRIM Hydraulic and Instrumentation Laboratory, better known as the MHI, was established as a result of organizational restructuring on 16 April 2007. The main purpose of this laboratory is to conduct research and development through physical modelling. Its scope of work is anything related to water and is not restricted to river and coastal area. The laboratory is also capable of conducting experimental work on the integrity of hydraulic structures, including breakwater structures, seawall, groyne, dams, bridges, port and harbour.

With a surface area of 12,000m² and an in-house machinery workshop, the MHI is capable of performing physical modelling, from construction to analysis, of any kind of hydraulic related project. This lab offers service and laboratory facilities for physical modelling to the public and private sectors to test and calibrate measuring instruments, equipment, and management of facility.

The MHI is ISO 9001:2015 certified and has received recognition at the national and international levels in physical modelling management in hydraulic engineering. We have actively participated in research innovation exhibition and have won gold medal in the British Invention Show 2015 and ITEX 2016 for our Wave Breaker and Coral Restorer (WABCORE) product. This lab is also provide assistance in building and operating models to other laboratories; technical inspections and quality audits; and rental of flumes and basins; the lab also rent out equipment and instrument as well as models.

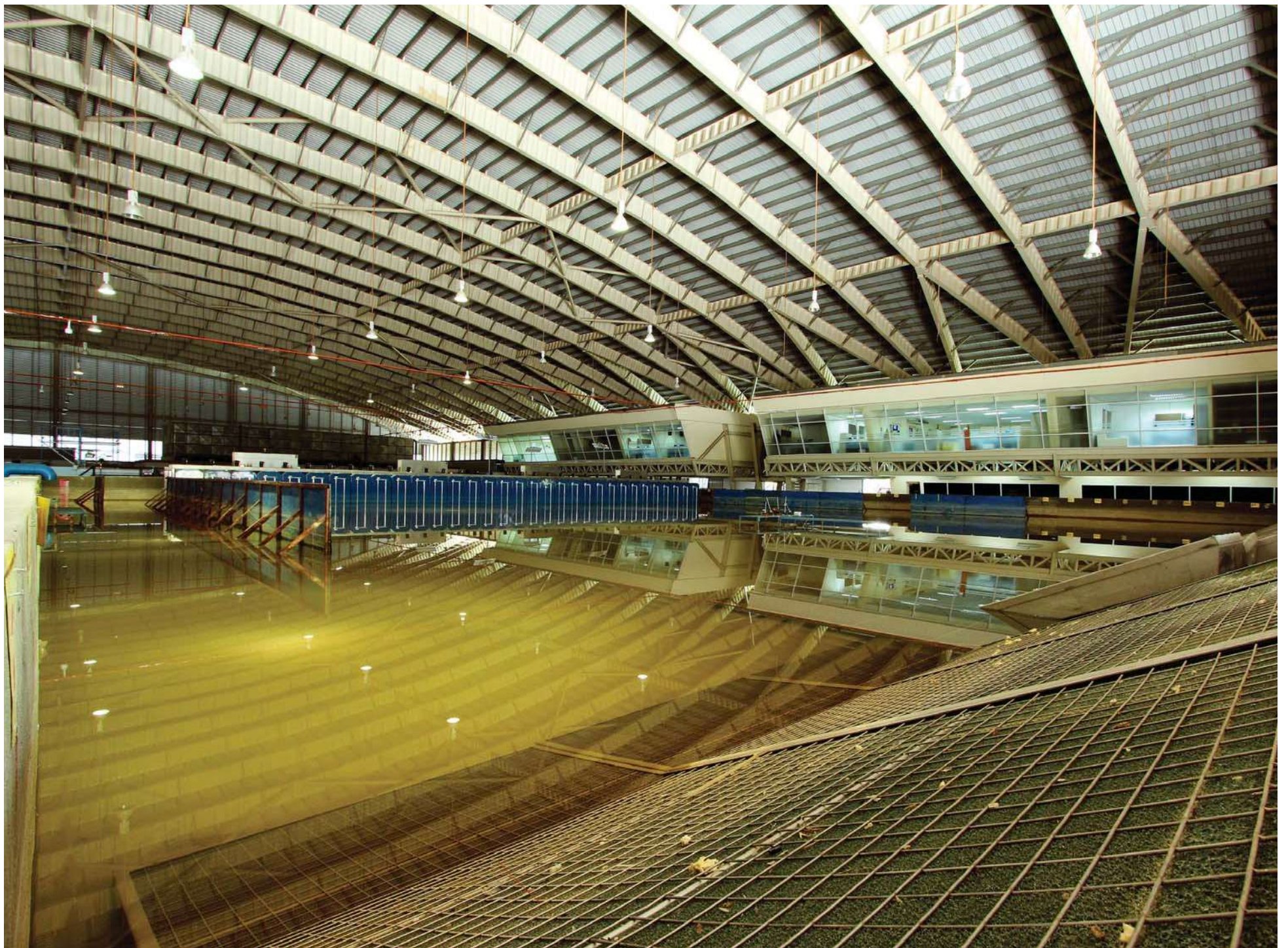
MHI advances into new milestone later in 2018 in the recognition by Malaysia Book of Record as The Largest Rainwater Harversting System For Laboratory.



Main entrance of the large hydraulic and instrumentation laboratory.



MHI aspires to become a sustainable and environmental friendly research laboratory. Shown here is the storage pond for rainwater harvesting which serve as one of the water sources for physical modelling.



One angle in MHI Lab.



Engineers and technicians at the MHI not only work with local hydraulic specialists but also with specialists from international organisations. We continue to improve ourselves by taking up new challenges, including implementation of complex projects. Our technicians and machinists are capable of fabricating and utilizing different types of plastics, wood, ceramics and metals. Qualified personnel oversees and supervises the fabrication processes, sheet metal work, welding, carpentry, heavy equipment operation, and steel and concrete construction.

The laboratory is also furnished with facilities for the development small-scale to prototype-scale model. We provide cost effective services, from developing, designing, constructing, testing and

