RAPID SCREENING OF PARTIALLY SUBMERGED COASTAL STRUCTURE DESIGNS USING BOUSSINESQ NUMERICAL WAVE MODELING

CIRP IET-20-4 RAPID SCREENING OF STRUCTURES

Marissa J. Torres

Dr. Matt Malej

Dr. Michael-Angelo Y. Lam

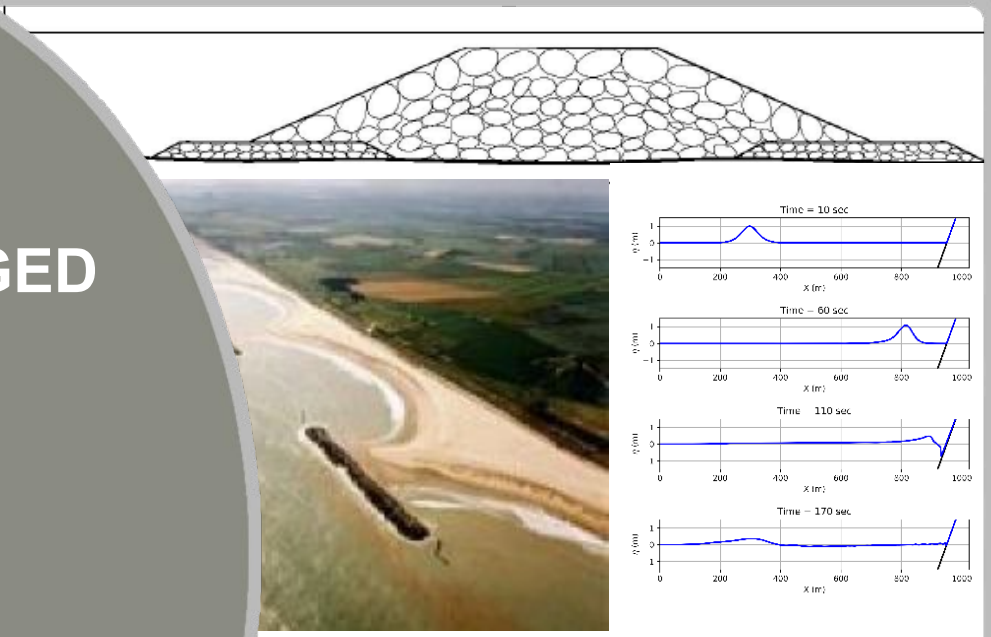
COASTAL INLETS RESEARCH PROGRAM

FY20 IN PROGRESS REVIEW

Mike Ott
HQ Navigation Business Line Manager

Eddie Wiggins
Technical Director

Dr. Katherine Brutsché
Associate Technical Director



District PDT Members

Dr. Andrew Condon, SAJ
Dr. Patrick Kerr, SWG
Rachel Malburg, LRE
Hans Mortiz, NWP
Jessica Podoski, POH
Matthew Wesley, SPL

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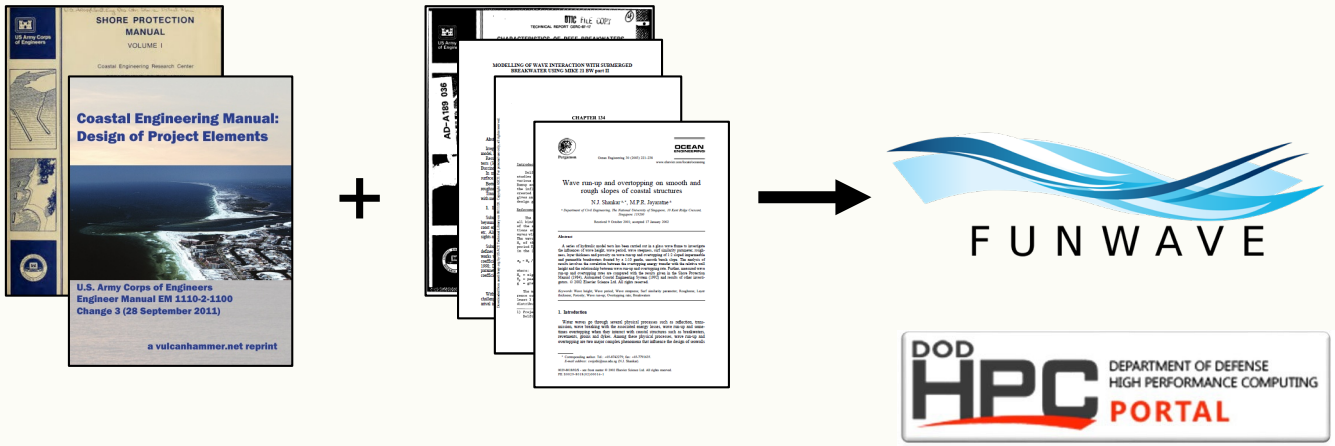
CHL COASTAL & HYDRAULICS LABORATORY

ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

DISCOVER | DEVELOP | DELIVER

Problem Statement

- Coastal structures (e.g., breakwaters and jetties) are vital for navigation, shore protection, and beach stabilization
- There is rarely enough time, money, and resources to execute screening of structure design alternatives or robust assessment of wave-structure interactions
- Objective: To enhance the transition of structure design materials and their respective porosity (transmission), reflection, and absorption properties directly and seamlessly into a phase-resolving nearshore wave modelling framework.



Statements of Need (SoN):

- Flood Risk Management SoN # 1278 entitled “Boussinesq modeling of wave transformation and interaction with permeable and submerged structures”
- Navigation # 1370 entitled “Testing and evaluation of USACE coastal numerical models”

Capability and Strategic Impact Statement

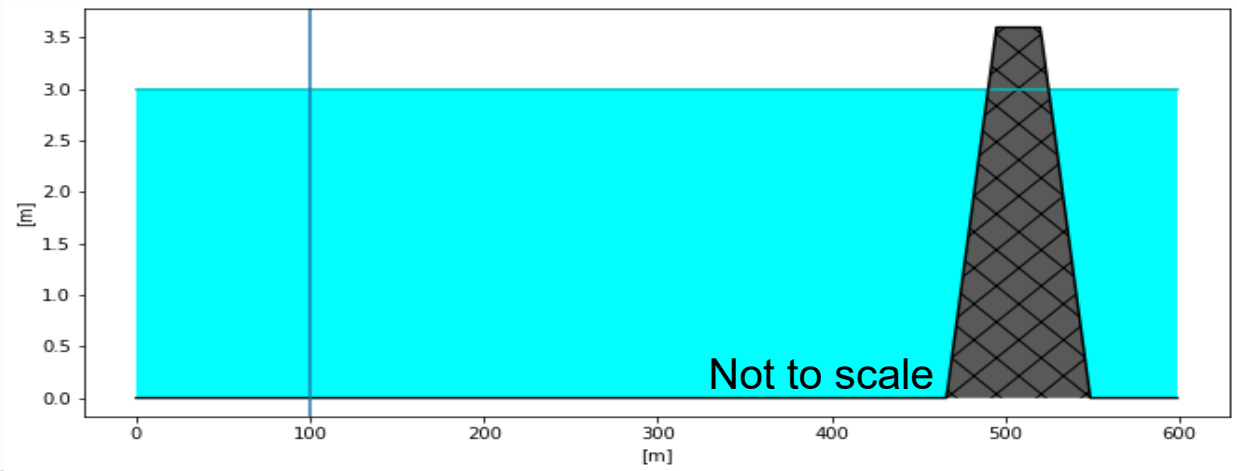
- Recommendations for design and construction materials can be made well in advance when we understand how the coastal structure reflects and absorbs incident wave energy in different wave climates and extreme wave scenarios.

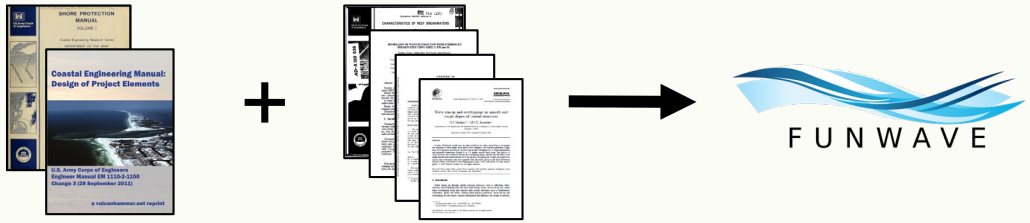
- By connecting planning and design strategies with high-fidelity user-friendly numerical modeling practices that do not extend time and funding resources greatly, this knowledge will improve the management and design of coastal structures through increased reliability of actions, reduced construction costs, plus minimized future maintenance and operating expenses.

- **Saving time & money, and improving the state of practice**

Approach

- **Wave responses:**
  - **Wave reflection and absorption**
  - **Wave run-up**
  - **Wave overtopping and transmission**
- **Overall guidance – Value Added:**
  - **Amount of wave energy dissipation provided by the structure**
  - **Wave run-up exceedance probability**
  - **Wave overtopping rate in extreme scenarios**





Structure Design Properties

Height (freeboard)	Emergent	Submerged
Surface	Smooth	Rough
Porosity	Impermeable	Permeable

Wave Climate Properties

Wave Type	Regular (Monochromatic)	Irregular (TMA)
Dimension	1D	2D normal 2D oblique
Spectra	Wide	Narrow

Summary

FY20 Major Products & Collaborations

- Kickoff meeting 1 JUL 20
- Preliminary numerical test bed development
- Introductory call with external PDT 27 Aug 20
  - Limited resources to provide comprehensive wave modeling for every project
  - Restricted in time (18-24 months) and funding ($100K - $500K)
  - Transition to natural and nature-based submerged coastal features

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FY21 Products/Advances

- Leveraging existing tools and resources from FUNWAVE work unit(s)
- Contributions to comprehensive Wiki guidance
- Monthly PDT meetings
- Quarterly CIRP Technical Discussions
- 2 Webinars (CWG20, CWG21)
- Technical Note (TN) and Technical Report (TR) expected Q3 FY21