Experimental Measurements of Wave Overtopping at Seawalls

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Content

Introduction

Vietnam' coastal zone:

- More than 3260 km long coastline and 3.000 islands;
- 28 provinces located in the coastal zone;
- 37,2 million people (2010);
- 125 beaches and bays;
- 405/ 760 cities locating along the coastline;
- sea and island tourism has accounted for approximately 70% of the Vietnam tourism sector's activities.

http://authentictravelvietnam.com/map

Introduction

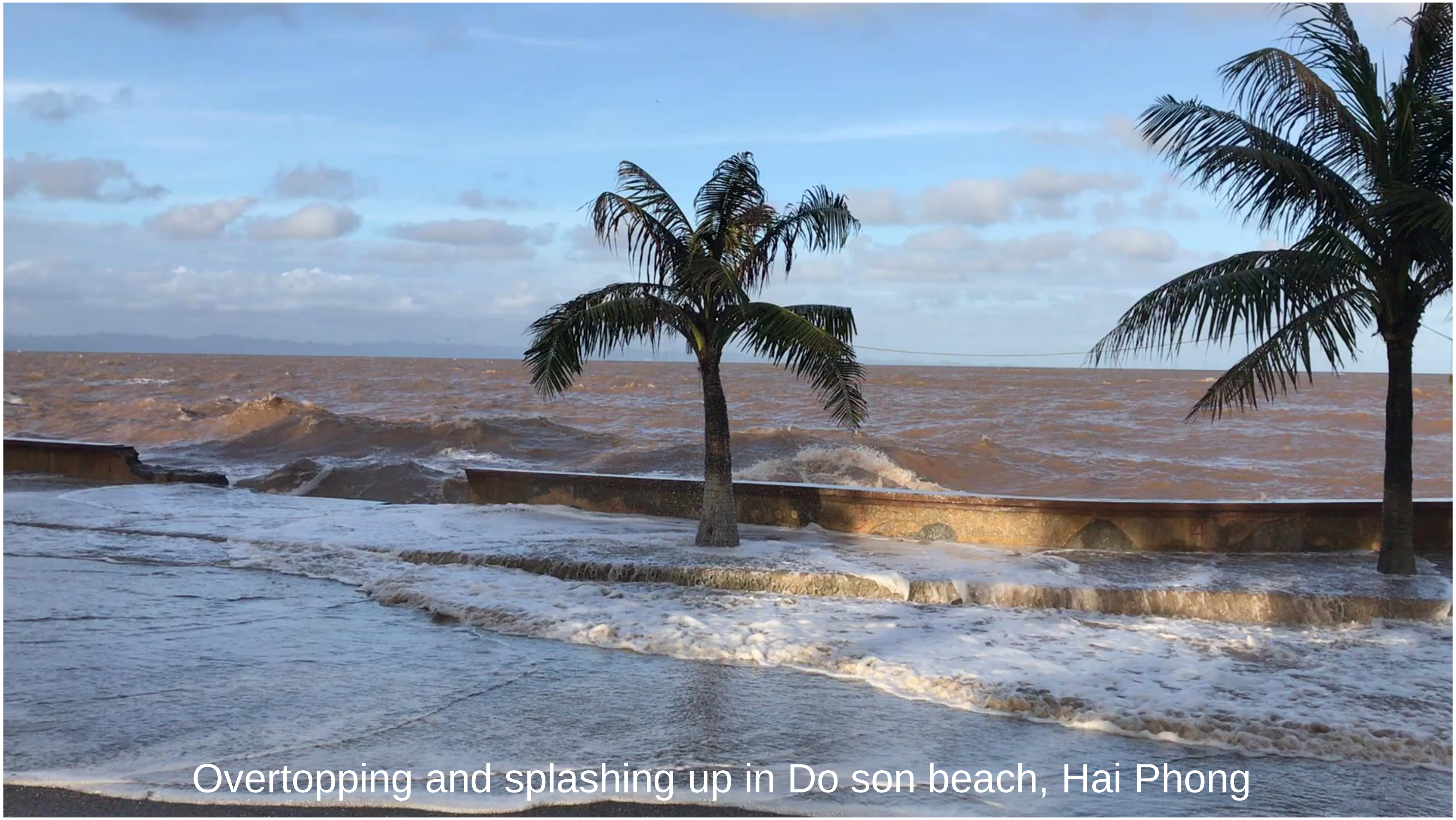
- Seawalls have been constructed with various types of cross-sections to protect many towns and tourism areas.
- Seawalls are often damaged, broken, or collapsed by storms.

Splashing up at Do Son beach

Damage after storm

Introduction

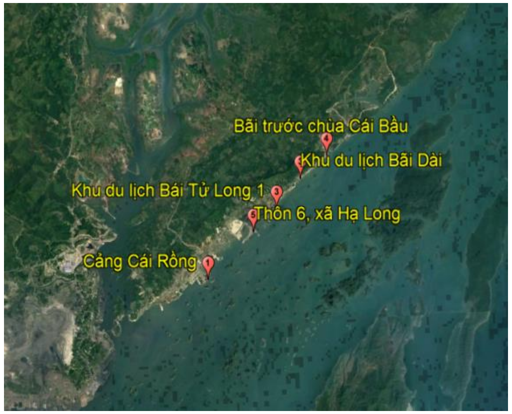
In severe weather conditions, big waves would attack and generate significant overtopping and splashing up.



Overtopping and splashing up in Do son beach, Hai Phong

Introduction

Seawalls in Quang Ninh province



Cai Rong port

Ha Long commune

Bai Tu Long I

Tran island

Introduction

Seawalls in Hai Phong city

Introduction

Seawall in FLC resort, Thanh Hoa

Introduction

Seawall in My Khe beach, Da Nang





Introduction

Seawall in Nha Trang

Duong De

Ba Lang

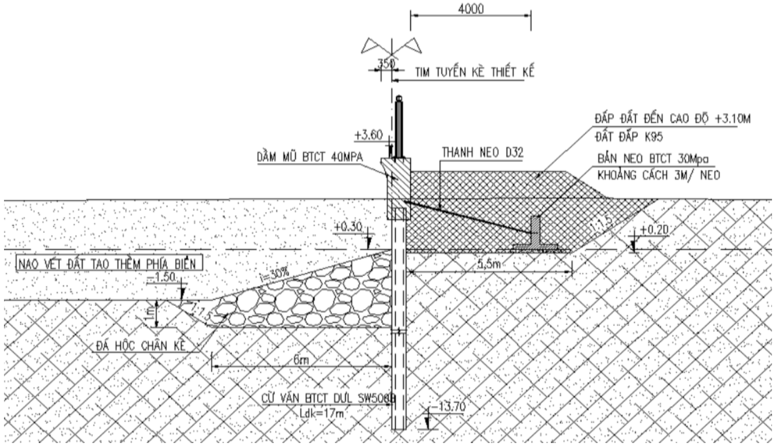
Cai river, Nha Trang

Tran Phu beach – Nha Trang city

Introduction

Seawall in Quy Nhon, Binh Dinh

Quy Nhon



Xuan Dieu, Mui Tan

Introduction

Seawall in Vung Tau

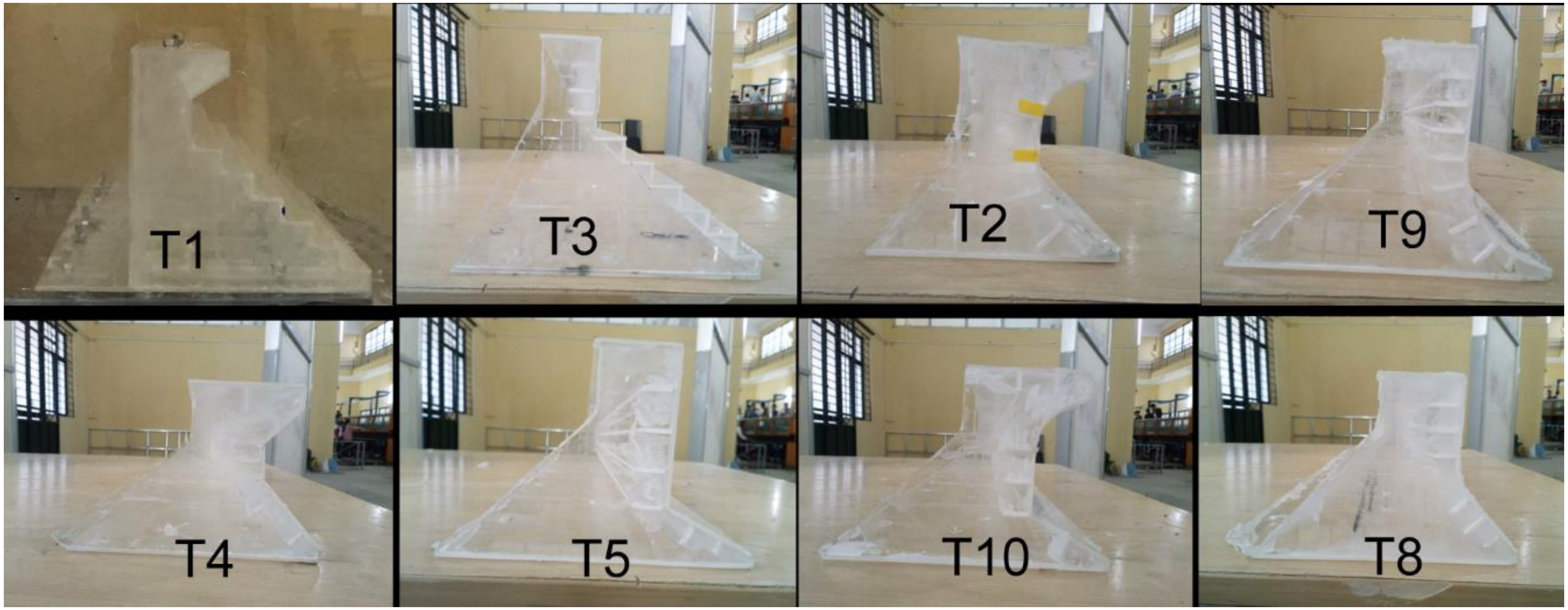
Phuoc Hai

Vietso petro

Methods

Different shapes of the seawall block:

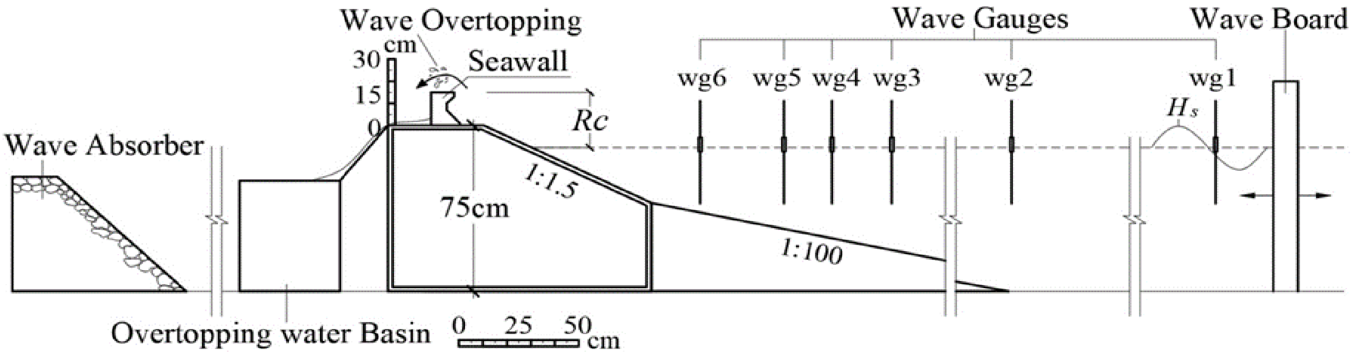
- Different shapes of seawall block with and without bullnose: curved (T2 – T9), steep (T4 – T5), straight (T10 – T8) and stepped (T1 – T3).
- The seawall models are all made of mica plastic.



Methods

The wave flume and measurement devices:

- Experimental setup in the wave flume including a wave board, a foreland, a base, a sea wall, a overtopping water tank and a wave absorber (not to scale)



Methods

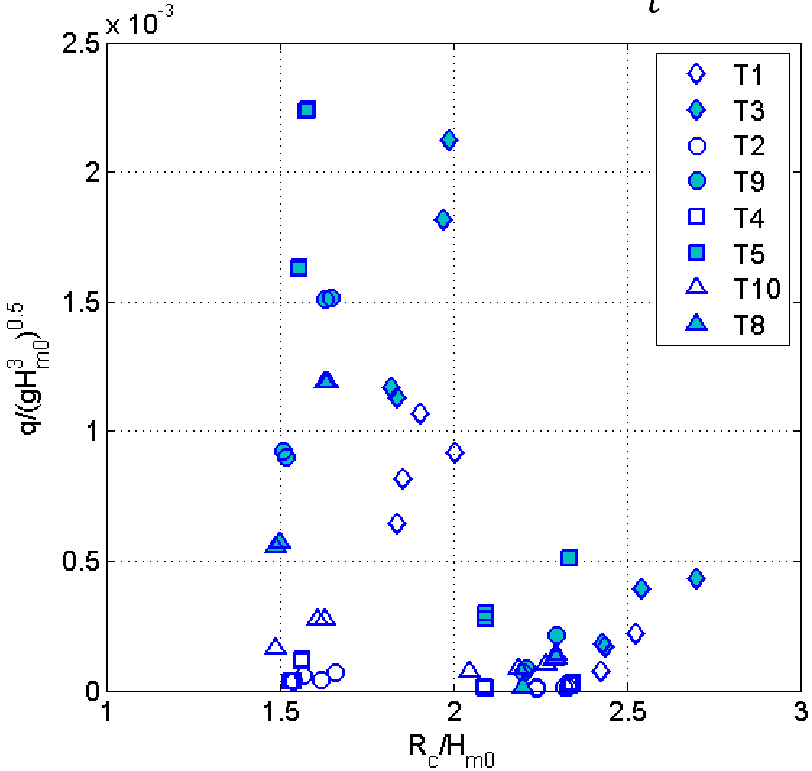
Test scenarios:

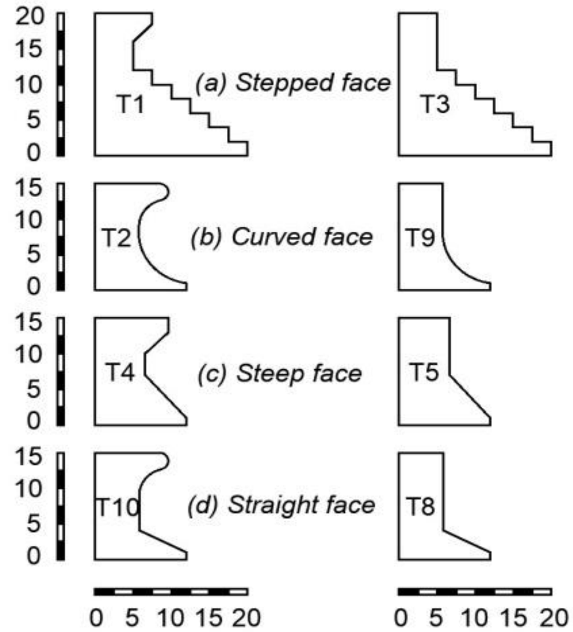
d [m]	H_{m0} [m]	T_p [s]	T2, T9 curved	T4, T5 steep	T10, T8 straight	T1, T3 stepped
0.60	0.15	1.9	X	x	x	x
0.60	0.16	1.5	X	x		x
0.65	0.16	1.9	X	x	x	x
0.65	0.17	1.6	X	x	x	x

Results

Measured data:

- We directly measured the total wave overtopping volume V [m^3] and the test duration t [second]. As the wave flume is 1 m wide, the averaged unit overtopping discharge q [m^3/s per m] is therefore simply derived from these two parameters: $q = \frac{V}{t}$,



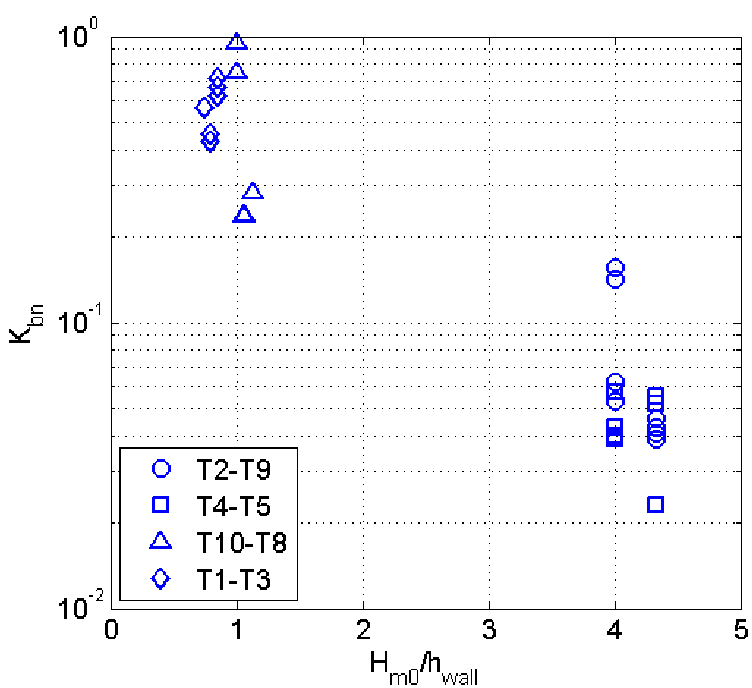


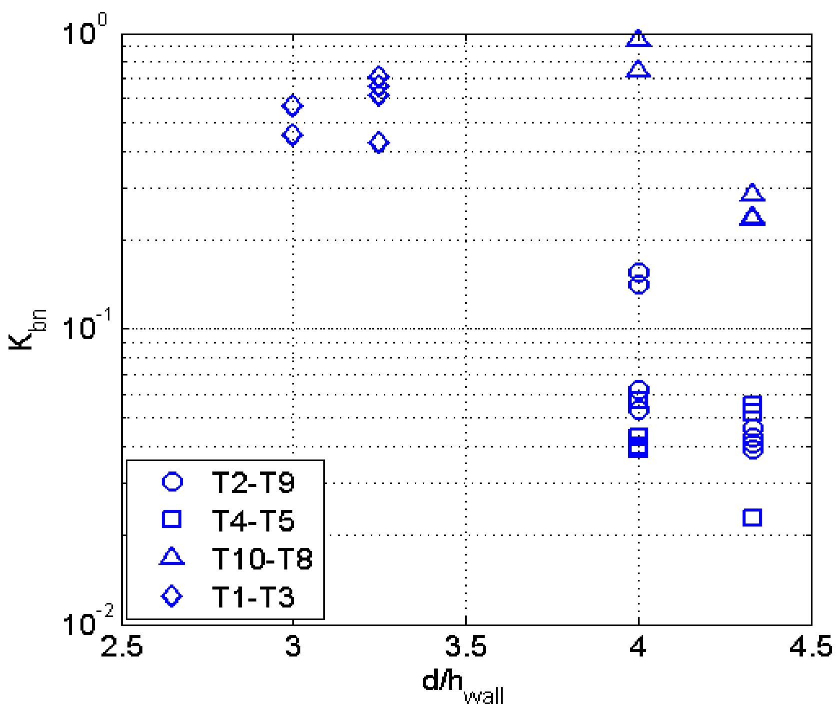
Relative cress freeboard vs. dimensionless overtopping discharge.

Results

Reduction effect due to the bullnose:

- Inspired by existing theories, a reduction factor is computed to quantitatively estimate the effect of bullnose as: $k_{bn} = \frac{q_{bn}}{q_{nobn}}$

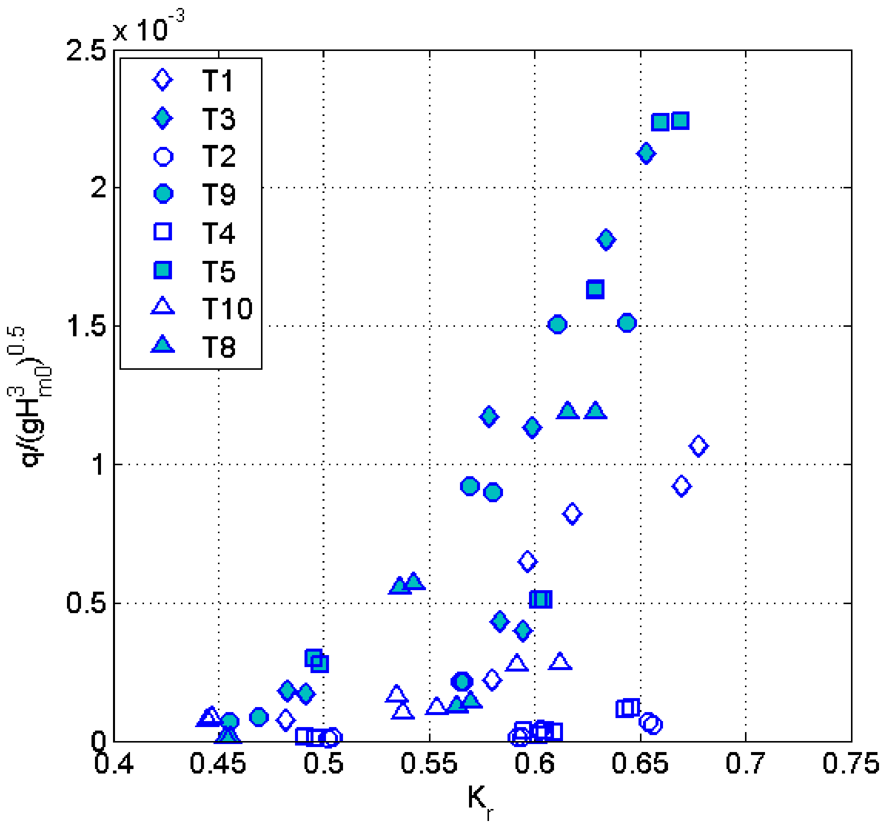


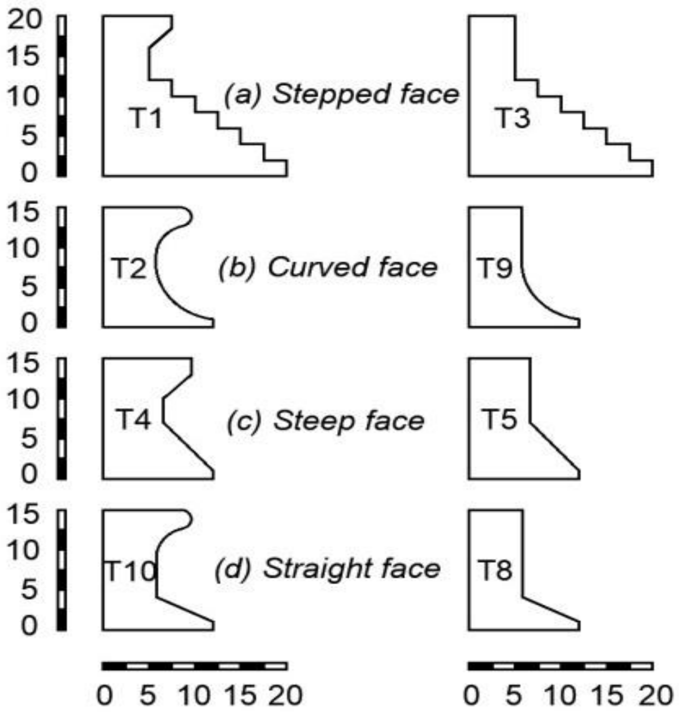


Influence of wave height H_{m0} (left) and water depth d (right) on k_{bn} factor (in log scale).

Results

Wave reflection versus overtopping:





Wave reflection coefficient vs. dimensionless overtopping discharge.

Conclusions

- Bullnoses help to undermine wave overtopping discharge, and more considerably in case of lower freeboards

=> Seawalls with bullnose perform more properly when sea level rise takes place

- Bullnoses help to eliminate reflected waves.

⇒ Toe protection would possibly be thinner and lighter in front of a seawall with bullnose

The findings are expected to partly set-up the base to reduce the scale of coastal protection structures under impact of climate change and sea level rise


Thank You