Experimental planning I: Facilities & set-up

Dr Carlos Perez-Collazo
11th Sep 2018
Facilities
- Wave generation and absorption
- Basin and flume flow
- Towing tanks
- Blockage effects
Wave generation

- Wave makers
  - Deep water generation
  - Shallow water generation
Piston wavemaker

Soliton emitted

Free surface

Wave maker

Fluid domain

impermeable bottom

Joint PRIMaRE and UK&CHN | CORE
Summer School
10-14th of September 2018

Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter
(Penryn Campus)
### Table 4.1 Biésel transfer functions for four common types of wavemakers

#### Piston

<table>
<thead>
<tr>
<th>$S(z) = S_0$</th>
</tr>
</thead>
</table>

$$
H = \frac{2 \sinh^2(kh)}{\sinh(kh) \cosh(kh) + kh}
$$

#### Elevated Piston

When $(z + h) > h_0$

$$
S(z) = S_0
$$

When $(z + h) < h_0$

$$
S(z) = 0
$$

$$
H = \frac{2[\sinh(kh) - 2 \sinh(kh_0) \sinh(kh)]}{\sinh(kh) \cosh(kh) + kh}
$$

Flap wavemaker

Joint PRIMaRE and UK&CHN|CORE
Summer School
10-14th of September 2018

Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter
(Penryn Campus)
Joint PRIMaRE and UK&CHN|CORE Summer School
10-14th of September 2018

Flap wavemaker

Table 4.1 Biéssel transfer functions for four common types of wavemakers

**Hinged**

\[
S(z) = \frac{S_0}{h} (h + z)
\]

\[
H = \frac{2 \sinh^2(kh)(1 - \cosh(kh) + kh \sinh(kh))}{kh(\sinh(kh) \cosh(kh) + kh)}
\]

**Elevated Hinged**

\[
S(z) = S_0 \frac{h + z - h_0}{h - h_0} ; \quad (z + h) > h_0
\]

\[
S(z) = 0 \quad ; \quad (z + h) < h_0
\]

\[
H = \frac{2[\sinh(kh)((h - h_0)k\sinh(kh) - \cosh(kh) + \cosh(kh_0))]}{k(h - h_0)[\sinh(kh) \cosh(kh) + kh]}
\]

Wave absorption

Images from: http://www4.edesign.co.uk
Flumes

Joint PRIMaRE and UK&CHN | CORE
Summer School
10-14th of September 2018

Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter (Penryn Campus)
Towing tank

Joint PRIMaRE and UK&CHN CORE
Summer School
10-14th of September 2018

Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter
(Penryn Campus)
Limitations
Limitations

Joint PRIMaRE and UK&CHN | CORE
Summer School
10-14th of September 2018

Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter
(Penryn Campus)
Blockage effect

Waves
Model width to tank width > 5 : 1

Currents
Cross-section of the model to cross-section of the channel < 10%.
## Standard tests - wave

<table>
<thead>
<tr>
<th>Test series</th>
<th>TRL Level</th>
<th>Facility</th>
<th>2D-3D</th>
<th>Test duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series A: Linear regular waves</td>
<td>1-4</td>
<td>flume-basin</td>
<td>2D</td>
<td>50-100 waves (300 if resonance)</td>
</tr>
<tr>
<td>Series B: Non-linear regular waves</td>
<td>3-5</td>
<td>flume-basin</td>
<td>2D</td>
<td></td>
</tr>
<tr>
<td>Series C: Long-crested irregular waves</td>
<td>1-5</td>
<td>flume-basin</td>
<td>2D</td>
<td></td>
</tr>
<tr>
<td>Series D: Spectral shape</td>
<td>2-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td>1 h full scale or (&gt; 700 waves)</td>
</tr>
<tr>
<td>Series E: Directional long-crested waves</td>
<td>2-5</td>
<td>Basin</td>
<td>3D</td>
<td></td>
</tr>
<tr>
<td>Series F: Short-crested waves</td>
<td>2-5</td>
<td>Basin</td>
<td>3D</td>
<td></td>
</tr>
<tr>
<td>Series G: Combined waves and ocean currents</td>
<td>2-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td>test specific</td>
</tr>
<tr>
<td>Series R: Repeatability</td>
<td>1-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td></td>
</tr>
<tr>
<td>Test series</td>
<td>TRL Level</td>
<td>Facility</td>
<td>2D-3D</td>
<td>Test duration</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-----------</td>
<td>--------------</td>
<td>---------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Series H: Long-crested</td>
<td>2-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td></td>
</tr>
<tr>
<td>Series I: Long-crested and directional</td>
<td>3-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td></td>
</tr>
<tr>
<td>Series J: Short-crested</td>
<td>3-5</td>
<td>basin</td>
<td>3D</td>
<td>3 hrs (full scale)</td>
</tr>
<tr>
<td>Series K: Combined wave and ocean current</td>
<td>3-5</td>
<td>basin</td>
<td>3D</td>
<td></td>
</tr>
<tr>
<td>Series R: Repeatability</td>
<td>2-5</td>
<td>flume-basin</td>
<td>2D-3D</td>
<td></td>
</tr>
</tbody>
</table>
Joint PRIMaRE and UK&CHN CORE Summer School
10 - 14th of September 2018
Hydrodynamic Modelling and Well-being in Engineering
University of Plymouth (COAST Lab) and University of Exeter (Penryn Campus)