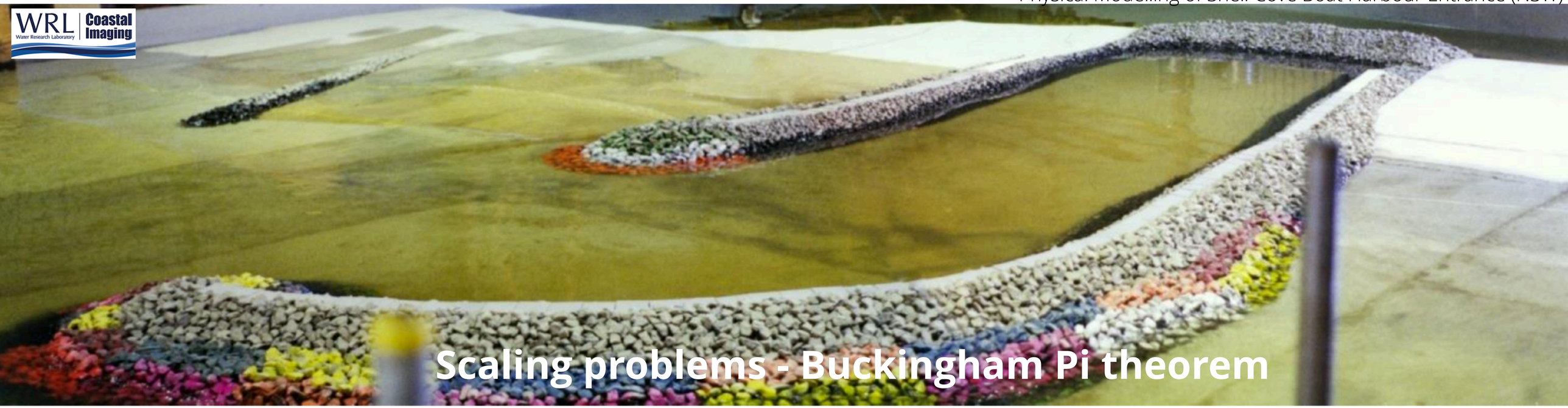
Physical modelling: laboratory models

Physical Modelling of Shell Cove Boat Harbour Entrance (NSW)



$$\frac{Inertia\ force}{Gravity\ force} = \frac{F_i}{F_g} \propto \frac{\rho U^2 L^2}{\rho g L^3} = \frac{U^2}{gL}$$

Dynamic similarity requirement between model and full scale:

$$\frac{U_M}{\sqrt{gL_M}} = \frac{U_F}{\sqrt{gL_F}} = Fn$$

- Equality in Fn in model and full scale will ensure that gravity forces are correctly scaled
- Surface waves are gravity-driven ⇒ equality in Fn will ensure that wave resistance and other wave forces are correctly scaled

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Physical Parameter	Unit	Multiplication factor
Length	[m]	λ
Structural mass:	[kg]	$\lambda^3 \cdot \rho_F / \rho_M$
Force:	[N]	$\lambda^3 \cdot \rho_F / \rho_M$
Moment:	[Nm]	$\lambda^4 \cdot \rho_F / \rho_M$
Acceleration:	[m/s^2]	$a_F = a_M$
Time:	[s]	$\sqrt{\lambda}$
Pressure:	[Pa=N/m^2]	$\lambda \cdot \rho_F / \rho_M$

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$$\frac{U_M}{\sqrt{gL_M}} = \frac{U_F}{\sqrt{gL_F}} = Fn$$

Froude scaling:

$$U_F = U_M \sqrt{\frac{L_F}{L_M}} = U_M \sqrt{\lambda}$$

Using the geometrical similarity requirement: $\lambda = L_F / L_M$