Submerged dike stability analysis under extreme wave conditions

Iberian SPH 2015

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    A. Goda
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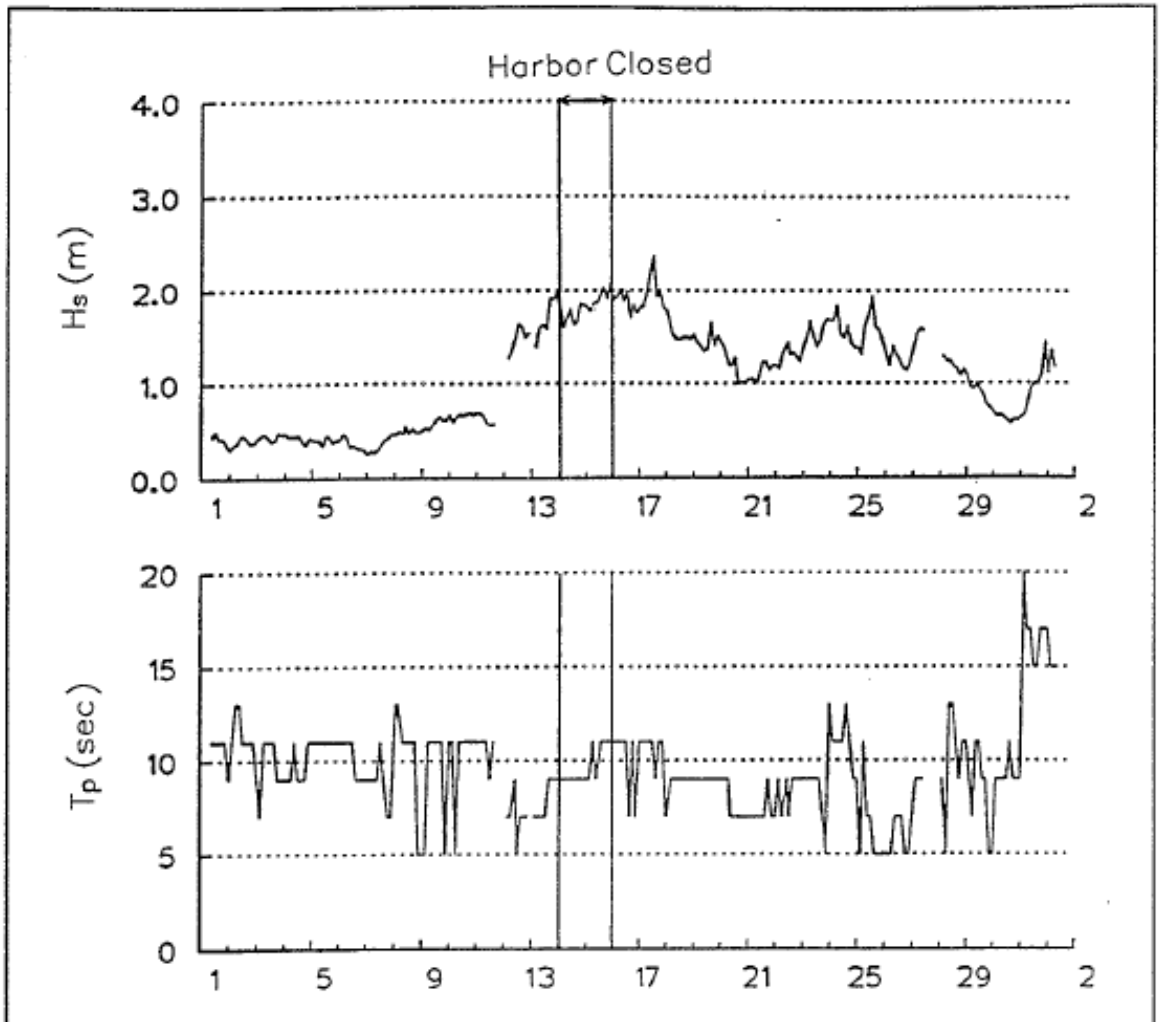
1) Introduction

1) External s … Goda [1] and exten…

2) Detailed a… e smoothed … sics developec…

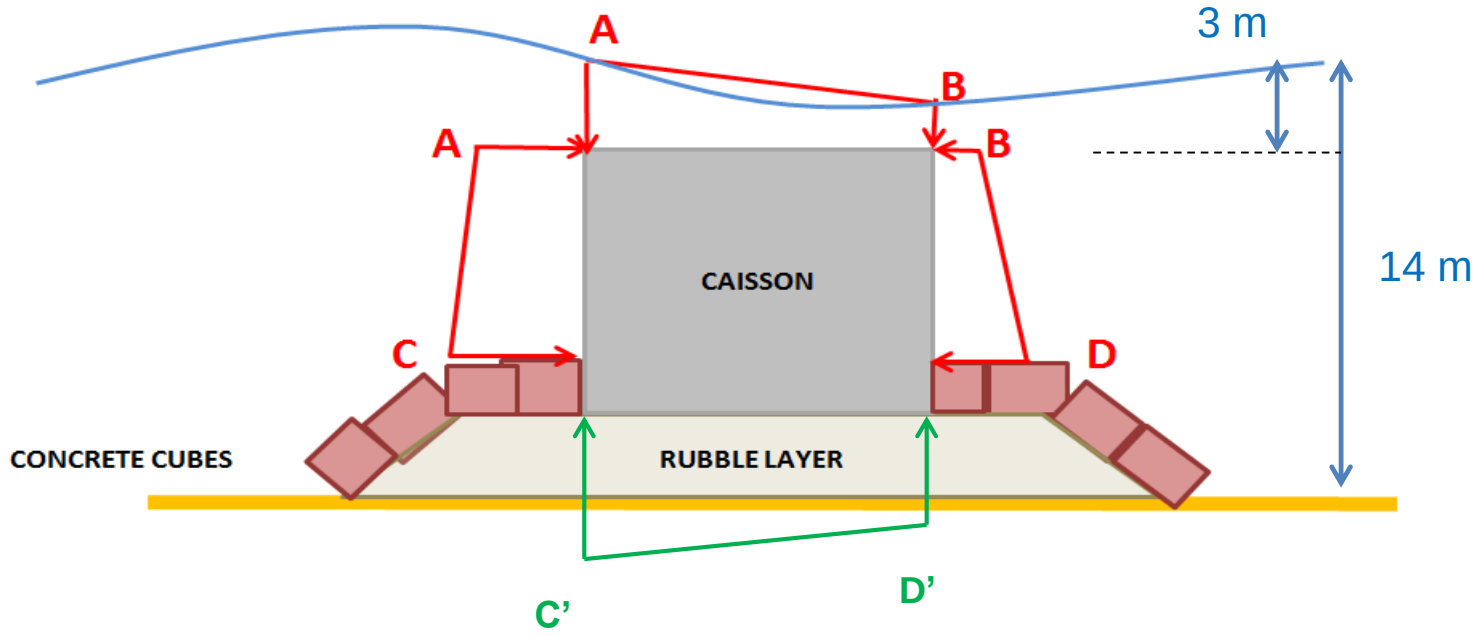
3) Finite Ele… e nodes using Autc…

4) Structural … elements according…

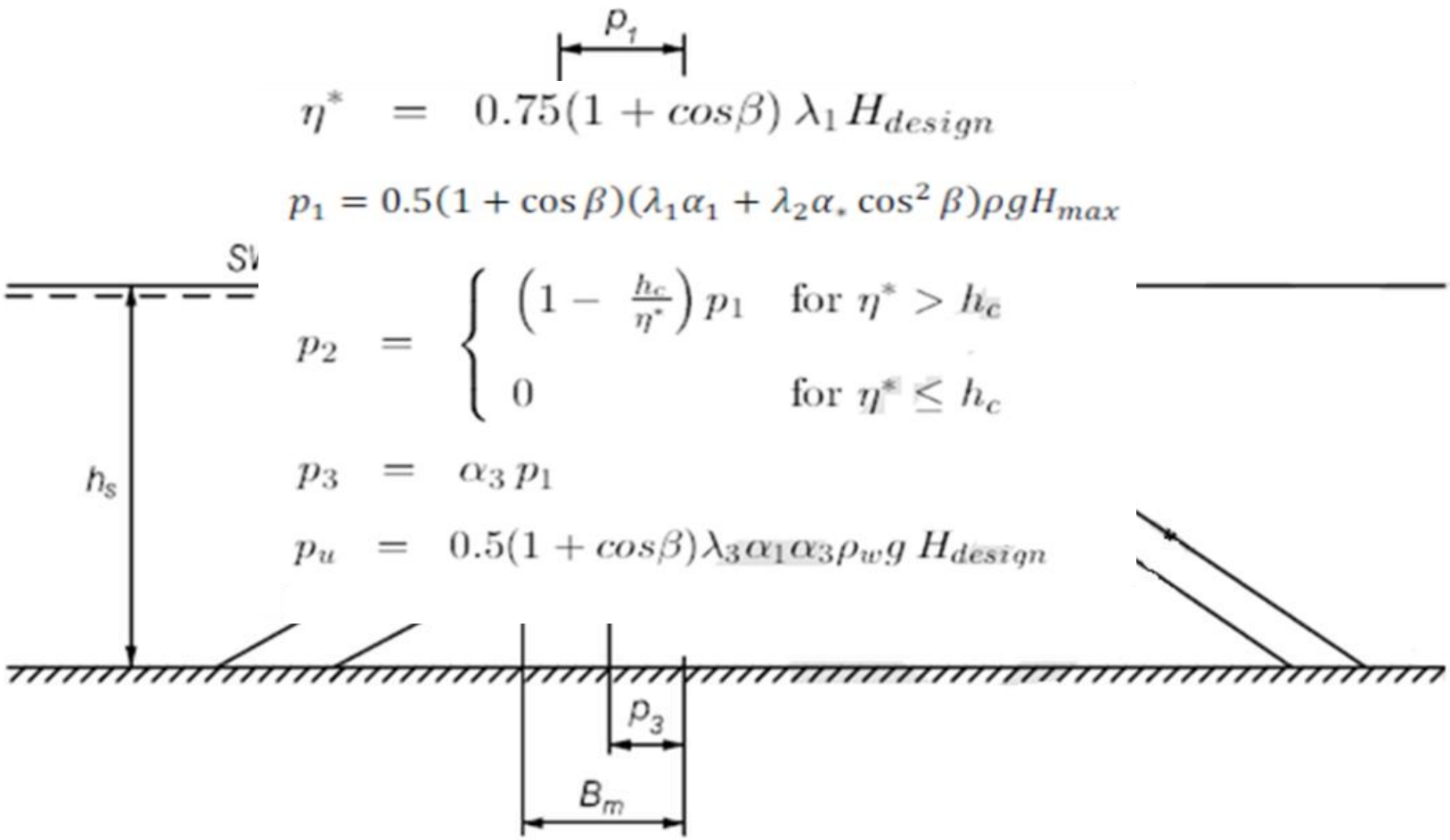


2) Goda Theory

SPHYSICS PRESSURE RESULTS



2) Goda Theory



$$\eta^* = 0.75(1+\cos\beta)\,\lambda_1 H_{design}$$

$$p_1 = 0.5(1+\cos\beta)(\lambda_1\alpha_1 + \lambda_2\alpha_* \cos^2\beta)\rho g H_{max}$$

$$p_2 = \begin{cases} \left(1 - \frac{h_c}{\eta^*}\right) p_1 & \text{for } \eta^* > h_c \\ 0 & \text{for } \eta^* \leq h_c \end{cases}$$

$$p_3 = \alpha_3\, p_1$$

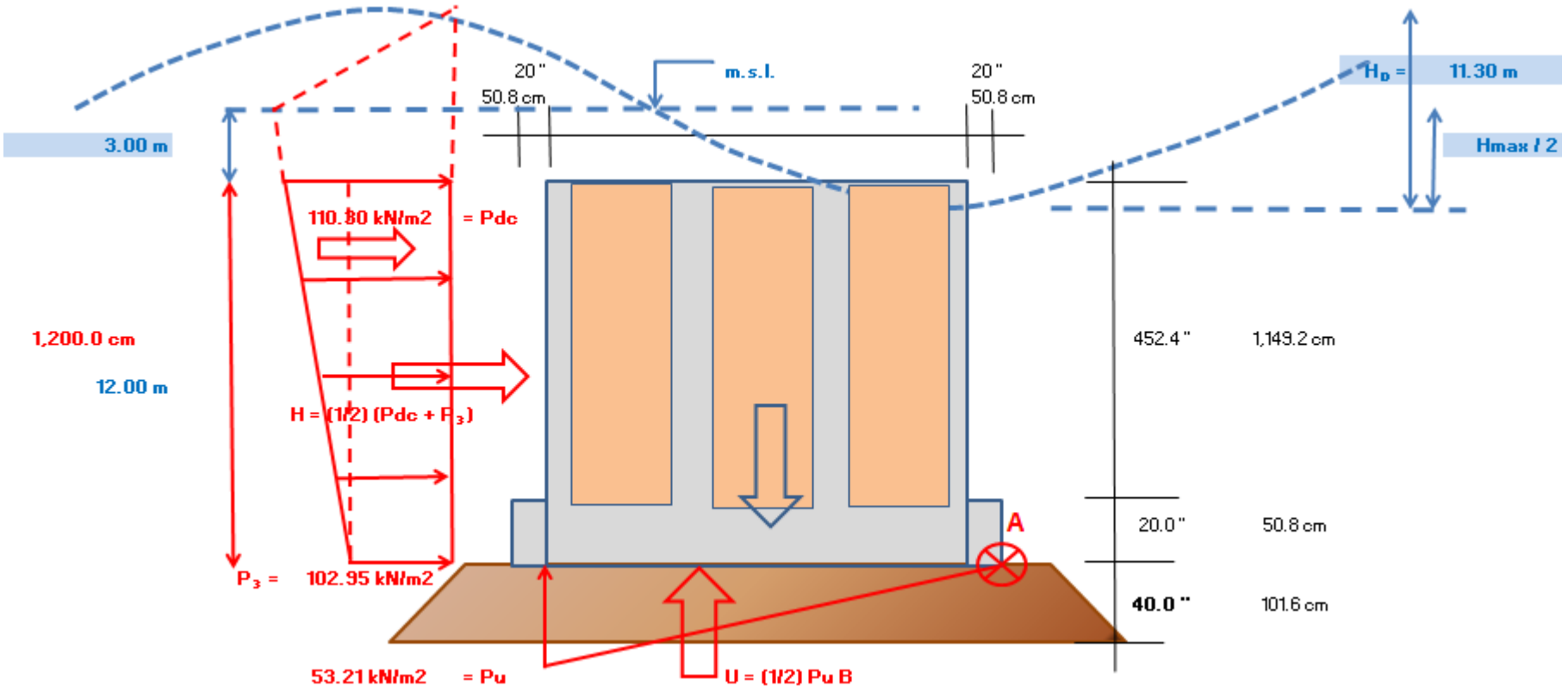
$$p_u = 0.5(1+\cos\beta)\lambda_3\alpha_1\alpha_3\rho_w g\, H_{design}$$

3) Storm conditions

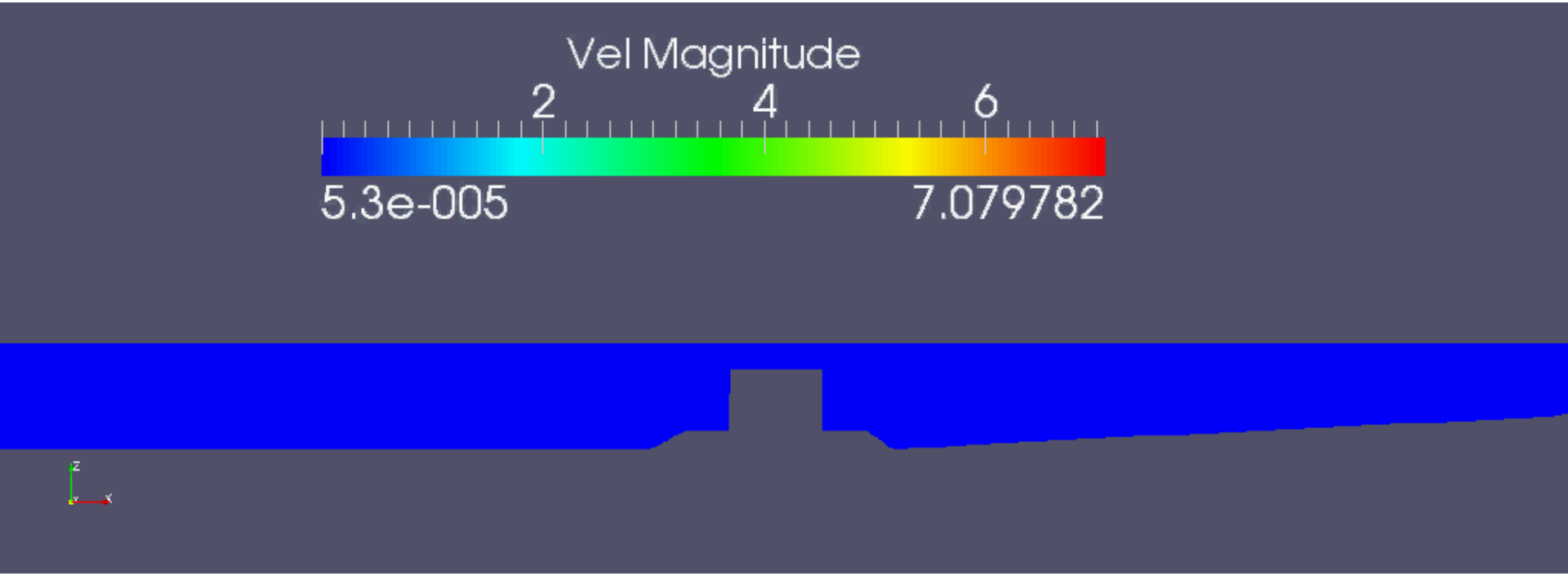
1. H_d = 11.3 m
2. T_p = 17 s
3. Angle = 17.5º

1. H_d = **8.6** m
2. T_p = 17 s
3. Angle = 17.5º

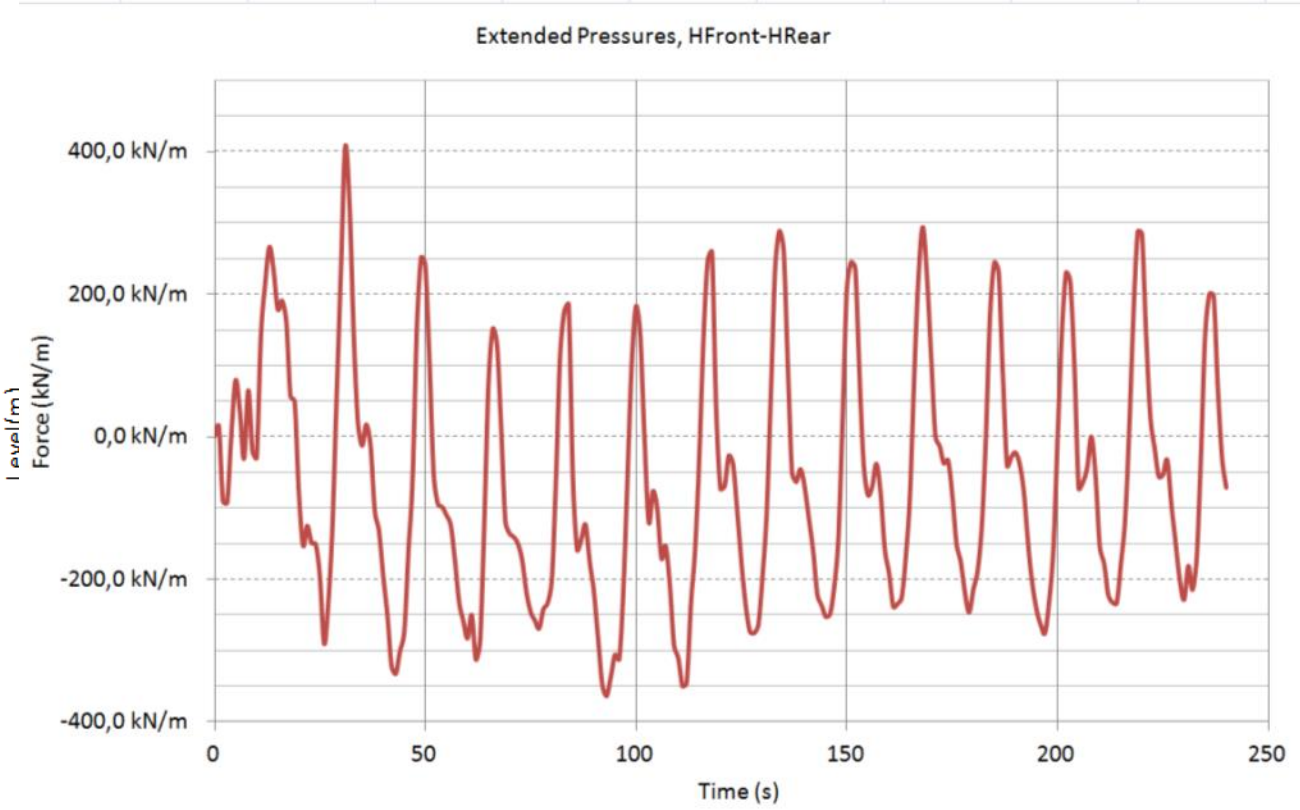
4) Results: Goda



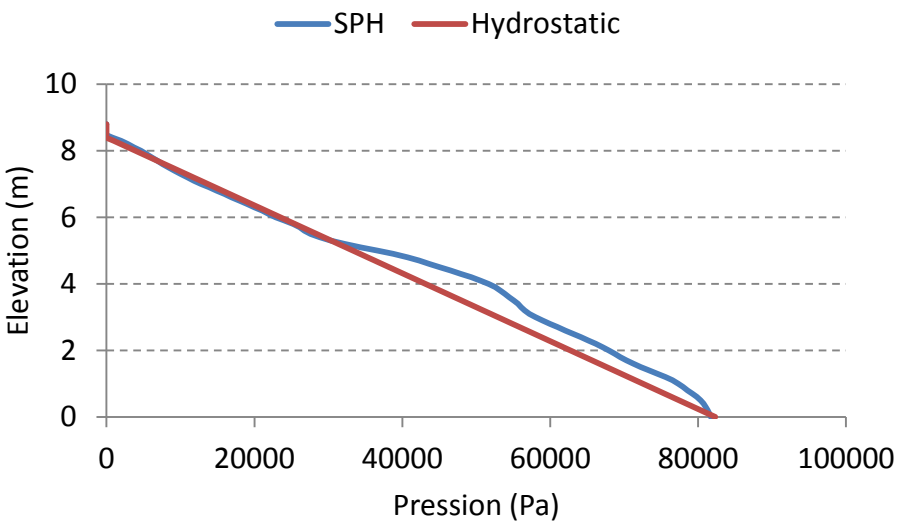
4) Results: SPH

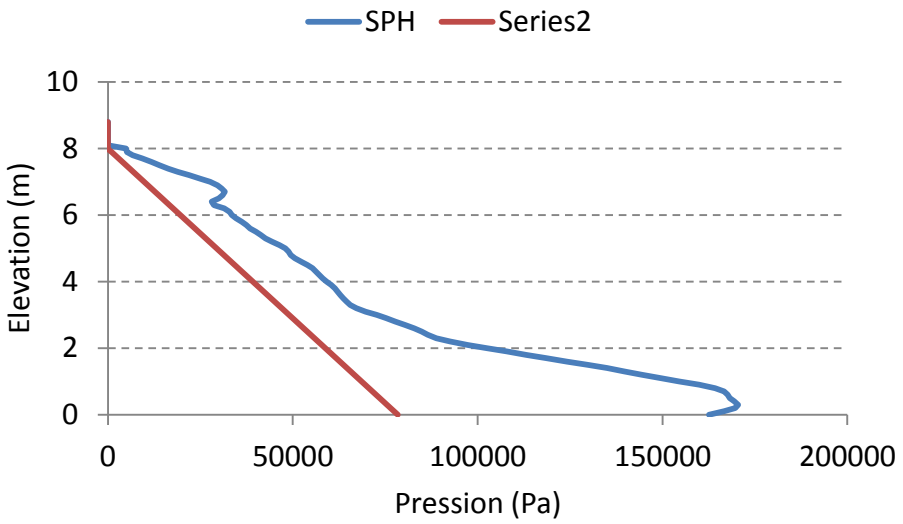


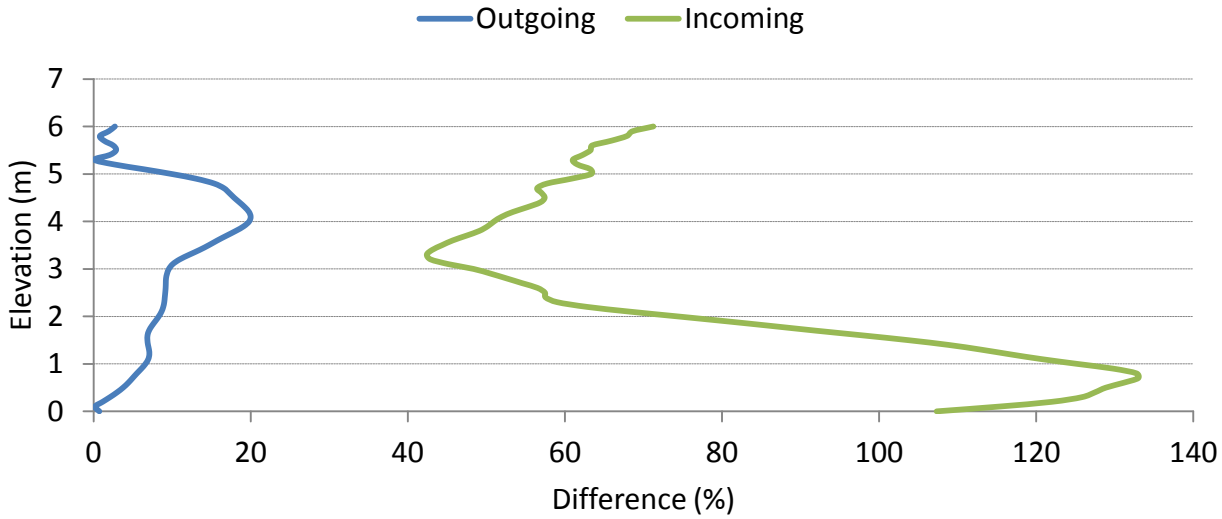
4) Results: SPH



4) Results: SPH

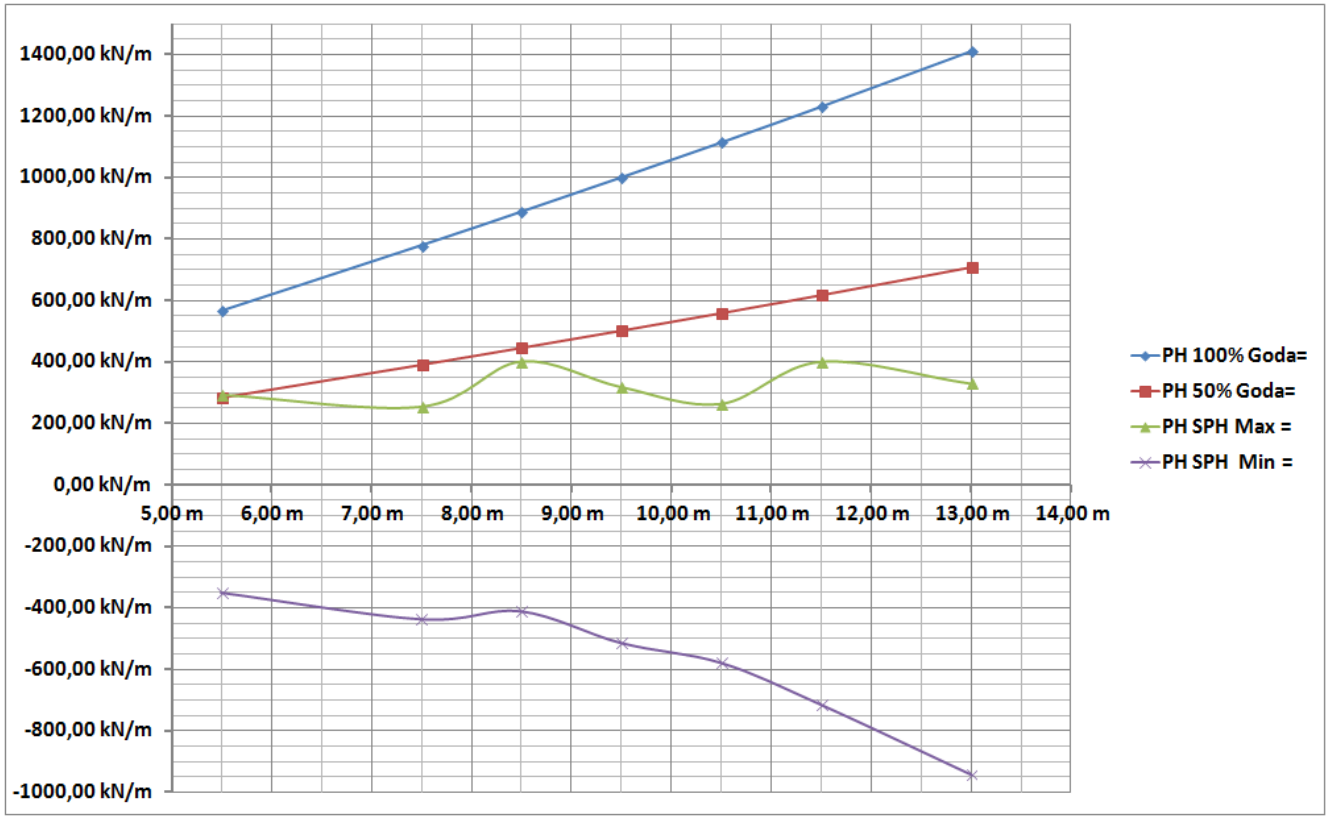






4) Results: Comparison

Hd =	5,50 m	7,50 m	8,50 m	9,50 m	10,50 m	11,50 m	13,00 m
PH 100% Goda=	565,40 kN/m	779,14 kN/m	888,70 kN/m	1000,40 kN/m	1114,47 kN/m	1231,17 kN/m	1411,71 kN/m
PH 50% Goda=	282,70 kN/m	389,57 kN/m	444,35 kN/m	500,20 kN/m	557,23 kN/m	615,59 kN/m	705,85 kN/m
PH SPH Max =	293,90 kN/m	255,40 kN/m	399,60 kN/m	318,40 kN/m	264,40 kN/m	398,90 kN/m	329,00 kN/m
PH SPH Min =	-349,90 kN/m	-436,30 kN/m	-410,50 kN/m	-513,70 kN/m	-578,50 kN/m	-715,00 kN/m	-943,00 kN/m



5) Open questions

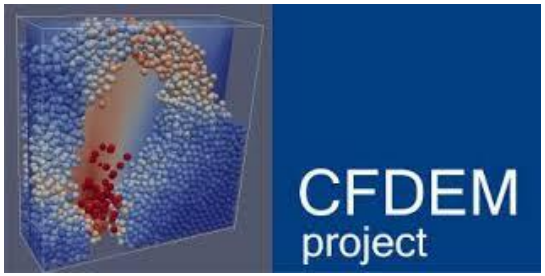
Positive features:

-Fast
-Simple
-Multiphase

Negative features:

-Noisy pressure
-Turbulence scales

5) Open questions: SPH DEM



11) References

[1] Goda, Y. (1974), “New wave pressure formulae for composite breakwater, Proc. of 14th Int. Conf. Coastal Eng., Copenhagen, Denmark, ASCE, New York (1974), pp. 1702–1720.

[2] Tanimoto, K., Moto, K., Ishizuka, S., and Goda Y. 1976. “An Investigation on Design Wave Force Formulae of Composite-Type Breakwaters,” Proceedings of the 23rd Japanese Conference on Coastal Engineering, pp. 11-16.

[3] Gómez-Gesteira M., Rogers B.D., Crespo A.J.C., Dalrymple R.A, Narayanaswamy M. and Dominguez J.M. (2012). "SPHysics - development of a free-surface fluid solver- Part 1: Theory and Formulations". Computers & Geosciences, Vol. 48. pp 289-299. November