The Resistance Coefficient of Perforated Walls for Jarlan-type Caissons

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Background

Jarlan-type perforated caisson (See Figs. 1 and 2)
- Caisson front walls are punched (wave absorbing chamber between front and rear walls)
- Merits of low reflection coefficients and small wave forces
- Often used for building breakwaters and quaywalls

Estimating reflection coefficient \( C_R \)
- The reflection coefficient can be generally well estimated by linear potential theory
- The effect of perforated wall (energy dissipation and phase shift) must be known a priori

An often used perforated wall condition (Yu, 1995)
- Horizontal fluid velocity passing through the perforated wall is proportional to the pressure difference between two sides of the wall

\[
\phi = \frac{\partial^2 u}{\partial z^2} = -\partial^2 f
\]

Objective of present study
- Develop new method to estimate resistance coefficient (including wave parameter effects)

Resistance Coefficient Formula

Method for getting many values of resistance coefficients on different conditions
- A most simple single-chamber fully perforated caisson (See Fig. 3)
- Calculate \( C_R \) using analytical solution, then fit experimental data and obtain many \( f \) values

An empirical formula for estimating \( f \) in terms of Keulegan-Carpenter (KC) number (See Fig. 4)

\[
KC = \frac{U}{2H} (1 - \epsilon) B_d
\]

Wave number
- Incident wave height, wave period and wavelength.

Validations

Comparison between present and previous formulas (See Fig. 5)
- \( \text{Porosity of 1st wall} = 0.2 \)
- \( \text{Porosity of 2nd wall} = 0.2 \)

Single-chamber perforated caissons
- Estimate reflection coefficient \( C_R \) based on the new formula of resistance coefficient
- Compare calculated \( C_R \) with experimental data from literature given in Fig. 4 (See Fig. 6)
- Compare calculated \( C_R \) with experimental data in Kondo (1979) and Kakumo et al. (1992) (See Fig. 7)

Scale Effect

Resistance coefficient formula based on large scale model tests (Bergmann, 2008)
- Fitting the four data gives a value of the resistance coefficient for one incident wave condition
- Develop a resistance coefficient formula based on large scale model tests (See Fig. 10)

We present new formulas for estimating resistance coefficients of perforated walls. The resistance coefficient has a remarkable correlation with \( KC \) number. Wave height and period have significant effects on the resistance coefficient. The scale effect exists in the resistance coefficient formula. More complicated Jarlan-type caissons will be examined in the next study.

References
Bergmann (2000), PhD, University of Kiel, Germany

This work was supported by the Natural Science Foundation of China (Grant Nos. 51379203 and 51279224)