TECHNIQUES OF INTERNALLY GENERATING WAVES ON A CURVE IN A RECTANGULAR GRID SYSTEM

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In order to avoid the re-reflection problem at the wave generation boundary, internal wave generation techniques have been used and sponge layers are placed at the offshore boundary. The techniques are categorized as the line source method and the source function method. In the line source method, the values of water surface elevation or velocity potential are added with desired energy to the corresponding values that are computed by the model equations. If waves in arbitrary direction are generated on a horizontally two-dimensional domain, the wave energy generated internally would be more or less than the target one at a point which meets two wave generation lines orthogonally. Such a problem may be solved by connecting two orthogonal lines with an arc with large radius.

In the line source method, we add the values η^* of water surface elevation with desired energy to the corresponding values η^{model} that are computed by the model equations as

$$\eta^{n+1} = \eta^{\text{model}} + \eta^* \tag{1}$$

The values η^* added at the wave generation line is given by (Lee and Suh, 1998):

$$\eta^* = 2\eta^I \frac{C_e \Delta t}{\Delta x} \cos\theta \tag{2}$$

where η^I is the water surface elevation of incident waves, C_e is the energy velocity, and θ is the angle of incident waves from the x-axis. When waves are generated on the arc instead of the line, the added values η^* should be different from those given by Eq. (1) which is for the line. Fig. 1 shows four cases of the points *a, b, c,* and *d* on the wave generation curve. In these cases, the added values η^* should be

$$\eta^* = 2\eta^I \frac{C_e \Delta t}{\Delta y} \frac{\sin(\alpha+\theta)}{\cos\alpha} \ \text{(point } a\text{)}, \quad \eta^* = 2\eta^I \frac{C_e \Delta t}{\Delta x} \frac{\sin(\alpha-\theta)}{\cos\alpha} \ \text{(point } b\text{)} \tag{3a,b}$$

$$\eta^* = 2\eta^I \frac{C_e \Delta t}{\Delta x} \frac{\cos(\alpha+\theta)}{\cos\alpha} \ \text{(point } c\text{)}, \quad \eta^* = 2\eta^I \frac{C_e \Delta t}{\Delta y} \frac{\sin(\alpha-\theta)}{\cos\alpha} \ \text{(point } d\text{)} \tag{3c,d}$$

where α is the angle of the normal line to the wave generation curve from either the y-axis (for points a and d) or the x-axis (for points b and c).

Using five different layouts of wave generation lines and arcs, numerical experiments are conducted in the cases of the propagation of waves on a flat bottom, and the refraction and shoaling of waves on a plane slope. Numerical experiments are conducted using the extended mild-slope equations of Suh et al. (1997). The 5$^{\text{th}}$ type of wave generation shown in Fig. 2, which consists of two parallel lines connected to a semicircle, yields the more accurate solutions especially when the grid size is small enough.

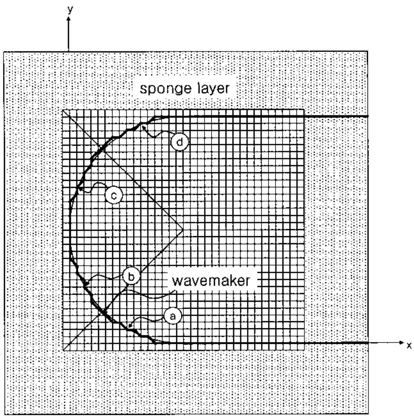

Fig. 1 wave generation points on an arc.

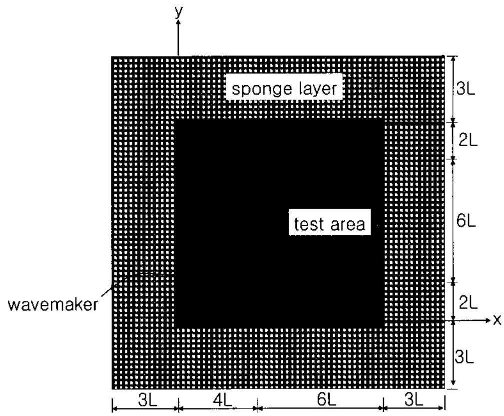

Fig. 2 the 5th type of wave generation.

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