波浪特性

1. 反射率、通過率及能量損失

因海底地形變化或結構物引起反射率k_r及通過率k_t為

$$\left.\begin{aligned} k_r &= |A_0| \\ k_t &= |B_0| \end{aligned}\right\} \tag{6.100}$$

因空隙物質引起波能量損失k_1

$$k_1 = \left[1 - k_r^2 - \frac{N_0' k h}{N_0 k' h'} k_t^2 \right]^{1/2} \tag{6.101}$$

2. 水面波高分佈

（1）等水深入射波領域

$$\left|\frac{\zeta}{\zeta_0}\right| = \left| e^{ik(x-\ell)} + A_0 e^{-ik(x-\ell)} + \sum_{m=1}^{\infty} A_m e^{-k_m(x-\ell)} \right| \tag{6.102}$$

ℓ 為座標原點至入射波領域假想邊界面的距離

（2）等水深透過波領域

$$\left|\frac{\zeta}{\zeta_0}\right| = \left| B_0 e^{ik'(x+\ell')} + \sum_{n=1}^{\infty} B_n e^{k_n'(x+\ell')} \right| \tag{6.103}$$

ℓ' 為座標原點至透過波領域假想邊界面的距離

（3）地形變化或結構物存在領域

$$\left|\frac{\zeta}{\zeta_0}\right| = |\phi| \tag{6.104}$$

（4） 空隙物質領域

$$\left|\frac{\zeta}{\zeta_0}\right| = |\beta\phi^*| \tag{6.105}$$

3. 流速分佈

領域內水分子運動速度可以經由邊界上各點速度勢對x及z的偏微分求得：

$$u(t)=\frac{\partial\Phi(x,z;t)}{\partial x}$$

$$=\frac{1}{2\pi}\int_{\Gamma}\left[\frac{\partial\Phi(\xi,\eta;t)}{\partial n}(\frac{\partial}{\partial x}\ln\frac{1}{r})-\Phi(\xi,\eta;t)(\frac{\partial}{\partial x}\frac{\partial}{\partial n}\ln\frac{1}{r}\right]d\Gamma$$

$$=\frac{1}{2\pi}\int_{\Gamma}\left\{\frac{\partial\Phi(\xi,\eta;t)}{\partial n}\left(\frac{\xi-x}{r^2}\right)-\Phi(\xi,\eta;t)\left[\frac{\partial x}{\partial n}\left(\frac{1}{r^2}-\frac{2(\xi-x)^2}{r^4}\right)-\frac{\partial z}{\partial n}\left(\frac{2(\xi-x)(\eta-z)}{r^4}\right)\right]\right\}d\Gamma$$

$$w(t)=\frac{\partial\Phi(x,z;t)}{\partial z}$$

$$=\frac{1}{2\pi}\int_{\Gamma}\left[\frac{\partial\Phi(\xi,\eta;t)}{\partial n}(\frac{\partial}{\partial z}\ln\frac{1}{r})-\Phi(\xi,\eta;t)(\frac{\partial}{\partial z}\frac{\partial}{\partial n}\ln\frac{1}{r}\right]d\Gamma$$

$$=\frac{1}{2\pi}\int_{\Gamma}\left\{\frac{\partial\Phi(\xi,\eta;t)}{\partial n}\left(\frac{\eta-z}{r^2}\right)-\Phi(\xi,\eta;t)\left[\frac{\partial z}{\partial n}\left(\frac{1}{r^2}-\frac{2(\eta-z)^2}{r^4}\right)-\frac{\partial x}{\partial n}\left(\frac{2(\xi-x)(\eta-z)}{r^4}\right)\right]\right\}d\Gamma$$

將上列各式以線形元素離散化，得流體領域內任意1點的x及z方向流速u及w為

$$u(t)=\frac{\partial\Phi(x,z;t)}{\partial x}$$

$$=\frac{1}{2\pi}\sum_{j=1}^{n}\int_{\Gamma}\left\{\left(M_1\bar{\Phi}_j(\xi,\eta;t)+M_2\bar{\Phi}_{j+1}(\xi,\eta;t)\right)\left(\frac{x-\xi}{r^2}\right)\right.$$

$$\left.-\left(M_1\Phi_j(\xi,\eta;t)+M_2\Phi_{j+1}(\xi,\eta;t)\right)\left[n_x\left(\frac{1}{r^2}-\frac{2(x-\xi)^2}{r^4}\right)-n_z\frac{(x-\xi)(z-\eta)}{r^4}\right]\right\}ds_j$$

$$w(t)=\frac{\partial\Phi(x,z;t)}{\partial z}$$

$$=\frac{1}{2\pi}\sum_{j=1}^{n}\int_{\Gamma}\left\{\left(M_1\bar{\Phi}_j(\xi,\eta;t)+M_2\bar{\Phi}_{j+1}(\xi,\eta;t)\right)\left(\frac{x-\eta}{r^2}\right)\right.$$

$$\left.-\left(M_1\Phi_j(\xi,\eta;t)+M_2\Phi_{j+1}(\xi,\eta;t)\right)\left[n_x\left(\frac{1}{r^2}-\frac{2(x-\eta)^2}{r^4}\right)-n_z\frac{(x-\xi)(z-\eta)}{r^4}\right]\right\}ds_j$$

(6.107)

其中 M_1、M_2 為形狀函數，$M_1=(1-\chi),M_2=(1+\chi)$，$\chi$ 為各元素所使用之無次度座標系。

回邊界元素法 回分類索引 回海洋工作站