Appendix A
Proofs of the Same Transmission Coefficient for Raft Devices With Inverse a_1/a_2

For convenience, the comparison between the raft devices with inverse length ratio a_1/a_2 and a_2/a_1 can be transformed into the hydrodynamic problems of a raft device with a_1/a_2 suffering from the waves with incoming angle equal to 0 and 180 degree, respectively.

The wave transmission coefficient when for the opposite coming waves corresponding to Eq. (2.54) is given by

$$\hat{T}'_w = \hat{T}'_{w,0} + \frac{\omega^2 \cosh(kh)}{Ag} \boldsymbol{X}'^{\mathrm{T}} \boldsymbol{A}^-, \tag{A.1}$$

where $\boldsymbol{X}'$ is the rafts motion response vector when suffering from waves propagating in the opposite direction; $\hat{T}'_{w,0}$ is the complex transmission coefficient of the fixed hinged structures for the waves coming from the opposite direction:

$$T'^{\mathrm{D}}_{w,0} = 1 - \frac{\omega \cosh(kh)}{\mathrm{i}Ag} A'^{\mathrm{D}}_{1,1} \mathrm{e}^{\mathrm{i}kx_{1,1}}, \tag{A.2}$$

in which $A'^{\mathrm{D}}_{1,1}$ s the coefficient of the diffraction spatial velocity potential at subdomain 1 for the waves coming from the opposite direction.

It is believed that for two dimensional wave diffraction problem of fixed arbitrary shape (not limited to rectangular section) floats and/or submerged bodies, the complex transmission coefficient of the structures suffering from waves with incoming angle=0 is equal to that suffering from waves propagating in the opposite direction (Falnes 2002; Newman 1976), leading to:

$$\hat{T}_{w,0} = \hat{T}'_{w,0} \tag{A.3}$$

Apart from computing the integral of the incident wave potential and the diffracted wave potential on the wetted surface as shown in Eq. (2.46), the wave excitation vectors for waves coming in x direction $\boldsymbol{F}_{\mathrm{e}}$ and in the opposite direction $\boldsymbol{F}'_{\mathrm{e}}$ can also be expressed, respectively, as follows using Haskind relation:

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$$\boldsymbol{F}_{\mathrm{e}} = -\mathrm{i}\rho g\left[1 + \frac{2kh}{\sinh(2kh)}\right]\sinh(kh)\boldsymbol{A}^{-}, \tag{A.4}$$

$$\boldsymbol{F}'_{\mathrm{e}} = -\mathrm{i}\rho g\left[1 + \frac{2kh}{\sinh(2kh)}\right]\sinh(kh)\boldsymbol{A}^{+} \tag{A.5}$$

Use of Eqs. (2.48) and (A.4) gives:

$$\begin{aligned}\boldsymbol{X}^{\mathrm{T}}\boldsymbol{A}^{+} &= \left[\,(\boldsymbol{F}_{\mathrm{e}})^{\mathrm{T}} \quad \mathbf{0}\,\right]\left(\mathbf{S}^{-1}\right)^{\mathrm{T}}\begin{Bmatrix}\boldsymbol{A}^{+}\\ \mathbf{0}\end{Bmatrix}\\ &= -\mathrm{i}\rho g\left[1 + \frac{2kh}{\sinh(2kh)}\right]\sinh(kh)\left[\,(\boldsymbol{A}^{-})^{\mathrm{T}} \quad \mathbf{0}\,\right]\left(\mathbf{S}^{-1}\right)^{\mathrm{T}}\begin{Bmatrix}\boldsymbol{A}^{+}\\ \mathbf{0}\end{Bmatrix}\end{aligned} \tag{A.6}$$

$$\begin{aligned}\boldsymbol{X}'^{\mathrm{T}}\boldsymbol{A}^{-} &= \left[\,(\boldsymbol{F}'_{\mathrm{e}})^{\mathrm{T}} \quad \mathbf{0}\,\right]\left(\mathbf{S}^{-1}\right)^{\mathrm{T}}\begin{Bmatrix}\boldsymbol{A}^{-}\\ \mathbf{0}\end{Bmatrix}\\ &= -\mathrm{i}\rho g\left[1 + \frac{2kh}{\sinh(2kh)}\right]\sinh(kh)\left[\,(\boldsymbol{A}^{+})^{\mathrm{T}} \quad \mathbf{0}\,\right]\left(\mathbf{S}^{-1}\right)^{\mathrm{T}}\begin{Bmatrix}\boldsymbol{A}^{-}\\ \mathbf{0}\end{Bmatrix}\end{aligned} \tag{A.7}$$

where $\mathbf{S}$ is the combination matrix next to the unknown vector at the left hand of Eq. (2.48).

Because of the symmetry of the matrix $\mathbf{S}$, $\mathbf{S}^{-1}$ is also a symmetric matrix $\left(\mathbf{S}^{-1}\right)^{\mathrm{T}} = \mathbf{S}^{-1}$. Both $\boldsymbol{X}^{\mathrm{T}}\boldsymbol{A}^{+}$ and $\boldsymbol{X}'^{\mathrm{T}}\boldsymbol{A}^{-}$ are scalars. By transposing Eqs. (A.6) and (A.7), the author get:

$$\boldsymbol{X}^{\mathrm{T}}\boldsymbol{A}^{+} = \boldsymbol{X}'^{\mathrm{T}}\boldsymbol{A}^{-} \tag{A.8}$$

According to Eqs. (2.54), (A.1) and (A.8), we have

$$\hat{T}_{w} = \hat{T}'_{w}, \tag{A.9}$$

which means that a raft device suffering from waves in opposite directions leads to the same transmission coefficient.

Appendix B
Expressions of T[q,l] and P_3 for Two Hinged Rafts Under Motion Constraints

Expression of $\mathbf{T}[q,l]$:

$$\mathbf{T}[q,l] = \sum_{p=1}^{6} \frac{\mathbf{Y}_2[q,1]\mathbf{Y}_2[l,1]\mathbf{Y}_2[p,2]^2 - (\mathbf{Y}_2[q,1]\mathbf{Y}_2[l,2] + \mathbf{Y}_2[q,2]\mathbf{Y}_2[l,1])\mathbf{Y}_2[p,1]\mathbf{Y}_2[p,2] + \mathbf{Y}_2[q,2]\mathbf{Y}_2[l,2]\mathbf{Y}_2[p,1]^2}{\delta_p + \mu} \tag{B.1}$$

Expression of P_3 of two hinged rafts under motion constraints:

$$P_3 = \frac{1}{2}\sum_{q=1}^{6} \frac{|\boldsymbol{Y}_1[q,1]|^2}{\delta_q} - \frac{1}{2}\sum_{q=1}^{6} \frac{\left| \mu \boldsymbol{Y}_1[q,1] + \frac{\delta_q}{\left(\sum_{p=1}^{6} \frac{\mathbf{Y}_2[p,1]^2}{\delta_p + \mu}\right)\left(\sum_{p=1}^{6} \frac{\mathbf{Y}_2[p,2]^2}{\delta_p + \mu}\right) - \left(\sum_{p=1}^{6} \frac{\mathbf{Y}_2[p,1]\mathbf{Y}_2[p,2]}{\delta_p + \mu}\right)^2} \sum_{l=1}^{6} \frac{\mathbf{T}[q,l]\boldsymbol{Y}_1[l,1]}{\delta_l + \mu} \right|^2}{\delta_q\left(\delta_q + \mu\right)^2} \tag{B.2}$$

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S. Zheng, *Study on Hydrodynamic Characteristics of the Raft-type Wave-Powered Desalination Device*, Springer Theses, DOI 10.1007/978-981-10-5517-1