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APPENDIX

This appendix is given the non-zero arbitrary functions appearing in the general solutions given by equation (3.40)-(3.46) corresponding to different type of loads.

A.1 Arbitrary Functions for vertical loading

$$A_1 = \frac{\eta_2 e^{-\gamma_1 z'}}{2\mu N_1}\overline{T}_z(\xi) \tag{A.1}$$

$$B_1 = \frac{\eta_2 (v_5 e^{-\gamma_1 z'} + 2\xi^2 v_3 e^{-\gamma_2 z'} - 4\xi^2 S_1 v_1 e^{-\gamma_3 z'}}{2\mu N_1 R}\overline{T}_z(\xi) \tag{A.2}$$

$$C_1 = -\frac{\eta_1 e^{-\gamma_2 z'}}{2\mu N_1}\overline{T}_z(\xi) \tag{A.3}$$

$$D_1 = \frac{\eta_1 (2\xi^2 v_4 e^{-\gamma_1 z'} - v_6 e^{-\gamma_2 z'} + 4\xi^2 S_1 v_1 e^{-\gamma_3 z'}}{2\mu N_1 R}\overline{T}_z(\xi) \tag{A.4}$$

$$E_1 = \frac{\xi v_1 e^{-\gamma_3 z'}}{2\mu \gamma_3 N_1}\overline{T}_z(\xi) \tag{A.5}$$

$$F_1 = \frac{\xi v_2 (v_4 e^{-\gamma_1 z'} - v_3 e^{-\gamma_2 z'}) + \xi v_1 v_7 e^{-\gamma_3 z'}}{2\mu \gamma_3 N_1 R}\overline{T}_z(\xi) \tag{A.6}$$

$$B_2 = B_1 - A_1 e^{2\gamma_1 z'} \tag{A.7}$$

$$D_2 = D_1 - C_1 e^{2\gamma_2 z'} \tag{A.8}$$

$$F_2 = F_1 + E_1 e^{2\gamma_3 z'} \tag{A.9}$$

where

$$v_1 = \eta_1 - \eta_2 \tag{A.10}$$

$$v_2 = \eta_1 \beta_2 - \eta_2 \beta_1 \tag{A.11}$$

$$v_3 = 4\eta_1\gamma_2\gamma_3 \tag{A.12}$$

$$v_4 = 4\eta_2\gamma_3\gamma_1 \tag{A.13}$$

$$v_5 = S_1 v_2 - \xi^2 (v_3 + v_4) \tag{A.14}$$

$$v_6 = S_1 v_2 + \xi^2 (v_3 + v_4) \tag{A.15}$$

$$v_7 = S_1 v_2 + \xi^2 (v_3 - v_4) \tag{A.16}$$

and

$$N_1 = 2\xi^2 v_1 - v_2 \tag{A.17}$$

$$R = -S_1 v_2 + \xi^2 (v_3 - v_4) \tag{A.18}$$

In the above equations, $\overline{T}_z(\xi) = sJ_0(\xi s)$ is the zeroth-order Hankel transform of the applied axisymmetric vertical ring load of radius s at $z = z'$.

A.2 Arbitrary functions for radial loading

$$A_1 = \frac{\xi\eta_2 e^{-\gamma_1 z'}}{2\mu\gamma_1 N_2}\overline{T}_r(\xi) \tag{A.19}$$

$$B_1 = \frac{\xi(\eta_2 v_5 e^{-\gamma_1 z'} + 2\xi^2\eta_1 v_4 e^{-\gamma_2 z'} - S_1 v_1 v_4 e^{-\gamma_3 z'})}{2\mu\gamma_1 N_2 R}\overline{T}_r(\xi) \tag{A.20}$$

$$C_1 = -\frac{\xi\eta_1 e^{-\gamma_2 z'}}{2\mu\gamma_2 N_2}\overline{T}_r(\xi) \tag{A.21}$$

$$D_1 = \frac{\xi(2\xi^2\eta_2 v_3 e^{-\gamma_1 z'} - \eta_1 v_6 e^{-\gamma_2 z'} + S_1 v_1 v_3 e^{-\gamma_3 z'})}{2\mu\gamma_2 N_2 R}\overline{T}_r(\xi) \tag{A.22}$$

$$E_1 = \frac{v_1 e^{-\gamma_3 z'}}{2\mu N_2}\overline{T}_r(\xi) \tag{A.23}$$

$$F_1 = \frac{4\xi^2 v_2(\eta_2 e^{-\gamma_1 z'} - \eta_1 e^{-\gamma_2 z'}) + v_1 v_7 e^{-\gamma_3 z'}}{2\mu N_2 R}\overline{T}_r(\xi) \tag{A.24}$$

$$B_2 = B_1 + A_1 e^{2\gamma_1 z'} \tag{A.25}$$

$$D_2 = D_1 + C_1 e^{2\gamma_2 z'} \tag{A.26}$$

$$F_2 = F_1 - E_1 e^{2\gamma_3 z'} \tag{A.27}$$

where

$$N_2 = v_1(\xi^2 - {\gamma_3}^2) \tag{A.28}$$

In the above equations, $\overline{T}_r(\xi) = sJ_1(\xi s)$ is the first-order Hankel transform of the applied axisymmetric radial ring load of radius s at $z = z'$.

A.3 Arbitrary functions for fluid source

$$A_1 = \frac{e^{-\gamma_1 z'}}{2\delta(\chi_1 - \chi_2)\gamma_1} i\sqrt{\frac{\rho}{\mu}}\overline{Q}(\xi) \tag{A.29}$$

$$B_1 = \frac{v_5 e^{-\gamma_1 z'} + 2\xi^2 v_4 e^{-\gamma_2 z'}}{2\delta(\chi_1 - \chi_2)\gamma_1 R} i\sqrt{\frac{\rho}{\mu}}\overline{Q}(\xi) \tag{A.30}$$

$$C_1 = \frac{e^{-\gamma_2 z'}}{2\delta(\chi_2 - \chi_1)\gamma_2} i\sqrt{\frac{\rho}{\mu}}\overline{Q}(\xi) \tag{A.31}$$

$$D_1 = \frac{2\xi^2 v_3 e^{-\gamma_1 z'} - v_6 e^{-\gamma_2 z'}}{2\delta(\chi_1 - \chi_2)\gamma_2 R} i\sqrt{\frac{\rho}{\mu}}\overline{Q}(\xi) \tag{A.32}$$

$$E_1 = 0 \tag{A.33}$$

$$F_1 = -\frac{2\xi v_2\left(e^{-\gamma_1 z'} - e^{-\gamma_2 z'}\right)}{\delta(\chi_2 - \chi_1) R} i\sqrt{\frac{\rho}{\mu}}\overline{Q}(\xi) \tag{A.32}$$

$$B_2 = B_1 + A_1 e^{2\gamma_1 z'} \tag{A.33}$$

$$D_2 = D_1 + C_1 e^{2\gamma_2 z'} \tag{A.34}$$

$$F_2 = F_1 \tag{A.35}$$

In the above equations, $\bar{Q}(\xi) = sJ_0(\xi s)$ is the zeroth-order Hankel transform of the applied ring fluid source of radius s at $z = z'$.

BIOGRAPHY

Mr. Sikarn Mani was born in Bangkok 1978. He graduated from Faculty of Engineering, Mahidol University in 1998. He continued his study for Master Degree in Civil Engineering at Chulalongkorn in 2000.