Wave resistance of an isolated rudder at zero yaw and zero heel

NACA 00xx Profile, rectangular planform

Approximation of results computed with Michlet

Wave resistance $$R_W = \frac{\rho}{2} V^2 \cdot A_{WPL} \cdot C_W$$

V = Velocity

ρ = density of water

A_{WPL} = Waterplanearea of rudder at intersection with the free surface

FN = Froude number based on chord length c

$FN < 0.38$

$$C_W = FN/0.38 \cdot C_{W\max} \cdot \left[SIN\left(\frac{\pi}{2} \cdot \frac{FNpeak}{0.38} \right) \right]^X$$

$FN > 0.38$

$$C_W = C_{W\max} \cdot \left[SIN\left(\frac{\pi}{2} \cdot \frac{FNpeak}{FN} \right) \right]^X$$

$$C_{W\max} = 2.205 \cdot TC \cdot \left(1 - e^{-3.13 \cdot AR}\right) \cdot f_h$$

$$FNpeak = 0.555 + 0.53 \cdot HC - 0.065 \cdot e^{-1.85 \cdot AR}$$

$$X = Max(4.77 - 0.2 \cdot AR, 4.0)$$

$$f_h = 0.5 \cdot e^{-16 \cdot HC} - 5.113 \cdot HC^3 + 5.672 \cdot HC^2 - 2.504 \cdot HC + 0.5$$

$$f_h > 0$$

TC = thickness ratio t/c

AR = Aspect ratio of the submerged area

HC = submergence ratio h/c, $HC \geq 0$

h = distance of top of rudder to the water surface, positive when submerged

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