21st CENTURY SAILING MULTIHULLS

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Errata

Page 9:

$$V_B/V_T = \sin\gamma \, \mathrm{ctn}\beta - \cos\gamma \qquad (1\text{-}2)$$

Page 14:

$$V_{B,max} = \left\{ \left| \left[X^2 / \left(X^2 + 2X\cos\gamma + 1 \right) \right] \left[2 / \left(\rho_A C_y \right) \right] \left[(bW) / \left(hA_s \right) \right] \right| \right\}^{1/2} \qquad (2\text{-}14)$$

Page 15:

$$X^4 - a^2 \left[C_L \sin\gamma - C_D (X + \cos\gamma) \right]^2 \left(X^2 + 2X\cos\gamma + 1 \right) = 0 \qquad (2\text{-}21)$$

$$V_{B,max} = \left\{ \left| [(bL)/(\alpha h)] \left[C_L \sin\gamma - C_D (X + \cos\gamma) \right] / \left[(X + \cos\gamma) + C_D \sin\gamma \right] \right| \right\}^{1/2} \qquad (2\text{-}22)$$

Line 13, from bottom of page:
The resistance curve for *Tahiti Bill*, a CSK catamaran, suggests $\alpha = 0.031 \ \mathrm{ft/kt^2}$.

Page 17:

Line 12, from top of page begins:
where ρ_H is the mass density of the water ...

Page 19:

$$V_W = V_B = \sqrt{\frac{\lambda g}{2\pi}} \qquad (3\text{-}3)$$

Page 20:

$$\zeta \propto \left(V_B^2 / g \right) \left[B / \left(C_p L \right) \right]^2 \qquad (3\text{-}14)$$

Line 6, from bottom of page:
for $S \geq 1.34 \ C_p^{1/2}$ and is zero for $S < 1.34 \ C_p^{1/2}$.

Page 21:

$$\tfrac{1}{2} \, B/H = \alpha \qquad (3\text{-}20)$$

Lines 8 & 9, from bottom of page:
and by using the definition of the displacement-length ratio D, Eq. (3-17), we find ...

Line 4, from bottom of page:
We will divide the hull longitudinally about the maximum section into two semi-hulls of equal volume, but (except for proas) of different lengths ℓ_1 and ℓ_2.

Page 25:

$$y(x) = \left\{2x\ell - x^2 + \left[\left(\ell^2 - b^2\right)/\left(2b\right)\right]^2\right\}^{1/2} - \left(\ell^2 - b^2\right)/\left(2b\right) \qquad (3\text{-}29)$$

from which

$$V = \frac{\pi}{2\alpha}\int_0^\ell y^2 dx$$

Skip one line, then:
where $\omega = \ell/b$. Then, using ...

Beginning at line 11, from bottom of page:
which is a function only of $\omega = \ell/b$, and is independent of the choice of section shape. This curve is plotted in Fig. 3-8. We see that for values of $\ell/b = L/B$ of interest, say $10 \leq L/B \leq 25$, C_p has a nearly constant value of about 0.534.

Page 27:

Beginning the second sentence after Eq. (3-36):
If we evaluate Eq. (3-36) at $x = \ell$, $y = b$, and define

$$\phi = e^{-a\ell} \qquad (3\text{-}37)$$

then $b = Y(1-\phi)$, $a = \left(1n\phi^{-1}\right)/\ell$, and we can rewrite Eq. (3-36) as

Page 29

Beginning after Eq. (3-45):
For $\varphi \leq 0.5$ degree, C_p must be greater than 0.65 for $\ell/b \geq 10$, which does not present a problem.

Line 6, from bottom of page begins:
(3-47) to calculate C_{p2}, ℓ_2, and ℓ_1. Our choice ...

Page 31

Line 2, from top of page:
for $C_p \geq 0.70$.

Lines 6 & 7, from top of page:

$$L = 42 \text{ feet} \qquad C_{p1} = 0.534$$
$$C_p = 0.65 \qquad W = 8000 \text{ lbs.}$$

Lines 10 & 11:

$$\text{Eq (3-50)} \rightarrow \ell_2 = 16.44$$
$$\text{Eq (3-47)} \rightarrow \ell_1 = 25.56$$

Beginning on line 15:
arc waterline, so Eqs. (3-32) to (3-35) are used to calculate A_{w1}, A_{wp1}, ψ_1, and A_{lp1} respectively, having first used Eq. (3-23) to ascertain B (and b = $\frac{1}{2}$ B). Solving Eq. 3-40 for ϕ corresponding to $C_{p2} = 0.83$, we find $\phi = 1.49 \times 10^{-4}$ and proceed to calculate A_{w2}, A_{wp2}, ψ_2, and A_{lp2} using Eqs. (3-41) to (3-44).

Page 39

Second paragraph, third last line ends:
... at the stall point by a further 25

Page 51

$$\tfrac{1}{2}\rho_1 A_1\left(V_A^{\,2} - V_{A\infty}^{\,2}\right) = \rho_1 A_1\left(V_A^{\,2} - V_A V_{A\infty}\right)\left(1 - a_1\right) \qquad (5\text{-}8)$$

Page 52:

$$P_1 = 2\rho_1 A_1 a_1 (1 - a_1)^2 V_A^{\,3} \qquad (5\text{-}13)$$

Page 55:

$$V_B/V_T = X \;;\; V_A/V_T = Y \;;\; (\rho_2 A_2)/(\rho_1 A_1) = \mu \qquad (5\text{-}31)$$

Last paragraph, beginning with the second line:
parameter space, so I have chosen to take μ = 1 in all cases, i.e., $A_1/A_2 = \rho_2/\rho_1 = 837$; I have also chosen ...

Page 56

Top row of top Table 5-2:

	CASE I			CASE II			CASE III		
γ	X	a_1	a_2	X	a_1	a_2	X	a_1	a_2

Top row of bottom Table 5-2:

	CASE IV			CASE V		
γ	X	a_1	a_2	X	a_1	a_2

Page 57:

$$F_2 = 2\rho_2 A_2 a_2 (1 - a_2) V_B{}^2 \tag{5-40}$$
$$P_2 = 2\rho_2 A_2 a_2 (1 - a_2)^2 V_B{}^3 \tag{5-41}$$

Page 58:

Caption for Fig. 5-5:
Fig. 5-5. Polar plot of V_B/V_T as a function of course angle γ for windmill mode cases I - V.

Page 59:

Line 3:
are possible. As before, we will linearize the problem by setting $\eta = \theta = 0$.

Third line after Eq. (5-50):
sufficiently small, or X < 0 if μ is sufficiently large. If we include finite θ,

$$X = \varepsilon / \left[\varepsilon + \mu a_2 - \varepsilon^2 (1 - a_2) \right] \tag{5-52}$$

Page 61:

$$F_2 = 2\rho_1 A_2 a_2 \, (1 + a_2) \, V_A{}^2 \cos^2\beta \tag{5-58}$$

$$P_2 = 2\rho_1 A_2 a_2 (1 + a_2)^2 \; V_A{}^3 \left| \cos^3\beta \right| \tag{5-59}$$

Page 64:

$$V_B/V_T = \left\{(1+4\theta) - \left[(1+4\theta)^2 - (1+4\theta-4\eta)(1+4\theta) \right]^{1/2} \right\} \Big/ (1+4\theta-4\eta) \; ; \; 4\eta < 1+4\theta \tag{5-75}$$

Top row of Table 5-3:

γ	X_I	X_{II}	X_{III}	X_{IV}	X_V

Page 65:

$$L_H = \tfrac{1}{2}\rho_h V_B{}^2 \left(A_{lp} C_{L,h} + A_k C_{L,k}\right) \tag{6-1}$$
$$F_y = \tfrac{1}{2}\rho_a V_A{}^2 A_s \left(C_L \cos\beta + C_D \sin\beta\right) \tag{6-2}$$

Next line begins:
where ρ_h and ρ_a are the mass densities...

Page 71:

Paragraph three, second line, second sentence:
Look to the description of lift production in chapter 7 in terms of the Magnus

Same paragraph, line five:
at right angles to the water velocity vector $-V_B$, and a strong lift is

Last paragraph, first line:
Now let us examine the other type of vertical hydrofoil: rudders. The

Page 77:

Second paragraph, second line:
an angle of attack ϕ to the apparent wind. The rotor produces its lift by

Same paragraph, line four begins:
attack ϕ is taken by the velocity ratio ...

Page 79:

$$U_\theta = 0 \qquad (7\text{-}7)$$

$$\text{for } \theta = 270°,\ r/a + a/r = \alpha \quad ; \quad \alpha \geq 2$$

$$r/a = 1/2\left[\alpha + \left(\alpha^2 - 4\right)^{1/2}\right] \quad ; \quad \alpha \geq 2 \qquad (7\text{-}8)$$

Page 81:

Paragraph two, last line:
and/or by erecting dams or fences to inhibit the axial flow.

Paragraph three, beginning with line two:
function of $\alpha = v/V$ for various values of aspect ratio, $\lambda = 1/2\ \ell/a$. In these experiments there were no fences[7-3]. In Figs. 7-6 and 7-7, we show the results of experiments on a cylinder of aspect ratio $\lambda = 12$ with fences at

Page 85:

$$N = \rho \upsilon V \ell \left(2a \right)^3 \left(\pi^2/R_e\right) \qquad (7\text{-}16)$$

Page 87:

Line 9, from top of page:
Using Eqs. (7-13), (7-15), and (7-18) and expressing the length of the rotor ℓ

Line 14, from top of page:
where we have used $\rho = 2.38 \times 10^{-3}$ slugs/ft^3 and $\mu = 1.22 \times 10^{-5}$ lb/(ft s) [7–11]

Page 89:

Line 10, from bottom of page:
how rotor characteristics vary with aspect ratio λ and fence radius ratio κ;

$$C_D = \left(A_R C_{D0} + A_p C_{Dp}\right)/A_R \qquad (7\text{-}24)$$

Page 90:

Table 7-1, top line:

υ, rev/s	$\alpha = v/V$	R_e	k_q

Table 7-2, top line:

f					$A_R L/W$				
$X\downarrow,\ \alpha\rightarrow$	2.50	4.00	5.50	7.00	$X\downarrow,\ \alpha\rightarrow$	2.50	4.00	5.50	7.00

Page 91:

$$P_p / P_R = 6.46 \left[W/(L\lambda)\right]^{0.62} f^{2.47} V_B^{0.53} \qquad (7\text{-}26)$$

Line 6, from bottom of page:
version of Eq. (7-23) to ascertain the performance of our pedal driven

Line 3, from bottom of page:
constant $\alpha = 2.5$; the performance dead down wind could actually be

Page 93:

$$\text{mpg} = 2.94 \times 10^6 \frac{f^{2.47}}{V_B^{1.47} \left[W/L\right]^{0.379} \lambda^{0.621}} \qquad (7\text{-}27)$$

Page 97:

Beginning after (8-1):
where A_F is the area of the foil. A foil of infinite length operating in an

Beginning after (8-2):
where ϕ_T is the angle of attack in radians measured from the angle of zero

Page 107:

Second paragraph, line one:
Surface-piercing hydrofoils may be monoplanar or multiplanar as shown in

Page 111:

$$F_x h + \tfrac{1}{2} F_1 L = \tfrac{1}{2} F_2 L \qquad (8\text{-}19)$$

Page 127:

$$\sigma_{max} = W\ell h / I \qquad (9\text{-}1)$$

where W is the weight of the boat, ℓ is the length of the beam, h is the half-

$$\sigma_{max} = \tfrac{1}{2} W\ell/(ah\tau) \qquad (9\text{-}4)$$

The weight of the beam is given approximately by

$$W_B = 2\ell\,(a + 2h)\,\tau\,\upsilon \qquad (9\text{-}5)$$

Beginning with line 13, from bottom of page:
we find

$$W_B/W = \ell^2 (\upsilon/\sigma_{max})\,(a + 2h)\,/\,(ah)$$

or

$$\ell = \left\{ (W_B/W)\,(\sigma_{max}/\upsilon)\,[ah\,/\,(a + 2h)\,] \right\}^{1/2} \qquad (9\text{-}6)$$

Page 135:

Line 13, from top of page:
windward foil with force output F_3 and a fixed dihedral angle θ_3. This

Line 7, from bottom of page:
in both cases. The dihedral angle on the forward lee foil is about 28°; this

Page 139:

Second paragraph, first line:
Chapters 4, 5, and 7 are concerned with alternative means to harness the

Page 141:

Second paragraph, line 5:
distance between the two bearings must be at least eight percent of the mast

Page 145:

Second paragraph, line 7:
polar curves of $V_B(\gamma, V_T)$ with confidence. For the calculation, the curve of