Løsningsforslag delprøve 2
Utvidet til å inkludere effekten av trim
Katamaran

Inngangsdata:

Tetthet sjøvann: $\rho_s := 1025\frac{kg}{m^3}$ $t \equiv kg \cdot 10^3$

Lengde i vannlinjen: $L := 12m$

Lengde baug: $L_b := 2.5m$

Lengde parallell del: $L_p := L - L_b$ $L_p = 9.5\,m$

Total bredde: $B := 5m$

Bredde skrog $B_s := 1.5m$

Dybde: $D := 1.7m$

Dypgang lettskip: $T_{ls} := 0.6m$

KG lettskip: $KG_{ls} := 1.6m$

Last: $L_T := 3m$ $B_T := 2m$ $A := 1m$ $H_V := 0.6m$ $\rho_V := 1.15\frac{t}{m^3}$

Beregninger:

Oppgave A

Vannlinjeareal: $A_{vl} := 2\cdot\left(L_p\cdot B_s + 0.5\cdot B_s\cdot L_b\right)$ $A_{vl} = 32.25m^2$

Deplasement lettskip: $\Delta_{ls} := A_{vl}\cdot T_{ls}\cdot\rho_s$ $\Delta_{ls} = 19.834t$

Tyngdepunkt lettskip: $X_{ls} := \dfrac{\left[L_p\cdot B_s\cdot\dfrac{L_p}{2} + 0.5B_s\cdot L_b\cdot\left(L_p + \dfrac{L_b}{3}\right)\right]\cdot T_{ls}\cdot 2}{\dfrac{\Delta_{ls}}{\rho_s}}$ $X_{ls} = 5.399m$

$Y_{ls} := 0m$

$Z_{ls} := KG_{ls}$ $Z_{ls} = 1.6\,m$

$KB_{ls} := \dfrac{T_{ls}}{2}$ $KB_{ls} = 0.3\,m$

Tverrskips GM:

$I_x := 2\cdot\left[\dfrac{L_p\cdot B_s^{\,3}}{12} + \dfrac{L_b\cdot B_s^{\,3}}{48} + \left(L_p\cdot B_s + 0.5L_b\cdot B_s\right)\cdot\left(\dfrac{B}{2} - \dfrac{B_s}{2}\right)^2\right]$ $I_x = 104.461m^4$

$BM_{Tls} := \dfrac{I_x\cdot\rho_s}{\Delta_{ls}}$ $BM_{Tls} = 5.398m$

$GM_{Tls} := KB_{ls} + BM_{Tls} - KG_{ls}$ $GM_{Tls} = 4.098m$

På grunn av vertikale sider er flotasjonssenteret lik oppdriftssenterets plassering i horisontalplanet:

$$X_0 := X_{ls}$$

Langskips GM:

$$I_y := 2\cdot\left[\frac{L_p^{\,3}\cdot B_s}{12} + \frac{L_b^{\,3}\cdot B_s}{36} + L_p\cdot B_s\cdot\left(\frac{L_p}{2} - X_0\right)^2 + 0.5\,L_b\cdot B_s\cdot\left(L_p + \frac{L_b}{3} - X_0\right)^2\right] \qquad I_y = 318.954\,m^4$$

$$BM_{Lls} := \frac{I_y\cdot\rho_s}{\Delta_{ls}} \qquad BM_{Lls} = 16.483m$$

$$GM_{Lls} := KB_{ls} + BM_{Lls} - KG_{ls} \qquad GM_{Lls} = 15.183m$$

Oppgave B

Vekt av last: $W_L := L_T\cdot B_T\cdot H_V\cdot\rho_v$ $\qquad W_L = 4.14t$

Nytt deplasement: $\Delta := \Delta_{ls} + W_L$ $\qquad \Delta = 23.97t$

Lastens tyngdepunkt:

$X_L := A + \frac{L_T}{2}$ $\qquad X_L = 2.5\,m$

$Y_L := \frac{-B}{2} + \frac{B_T}{2}$ $\qquad Y_L = -1.5\,m$

$Z_L := D + \frac{H_V}{2}$ $\qquad Z_L = 2\,m$

Nytt tyngdepunkt:

$X_G := \frac{\Delta_{ls}\cdot X_{ls} + W_L\cdot X_L}{\Delta}$ $\qquad X_G = 4.899m$

$Y_G := \frac{\Delta_{ls}\cdot Y_{ls} + W_L\cdot Y_L}{\Delta}$ $\qquad Y_G = -0.259m$

$Z_G := \frac{\Delta_{ls}\cdot Z_{ls} + W_L\cdot Z_L}{\Delta}$ $\qquad Z_G = 1.669m$

Oppgave C

Krengning:

Ny middeldypgang: $T := \frac{\Delta}{A_{vl} \cdot \rho_s}$ $T = 0.725\text{m}$

Ny KB: $KB := \frac{T}{2}$ $KB = 0.363\text{m}$

Ny BM_T: $BM_T := \frac{I_x \cdot \rho_s}{\Delta}$ $BM_T = 4.466\text{m}$

Fri flate effekt: $GG_t := \frac{L_T \cdot B_T^{\,3} \cdot \rho_v}{12 \cdot \Delta}$ $GG_t = 0.096\text{m}$

Ny GM_T: $GM_T := KB + BM_T - Z_G - GG_t$ $GM_T = 3.064\text{m}$

Krengevinkel (pos. babord): $\Phi := \operatorname{atan}\left(\frac{Y_G}{GM_T}\right)$ $\Phi = -4.833\text{deg}$

Trim:

BM_L: $BM_L := \frac{I_y \cdot \rho_s}{\Delta}$ $BM_L = 13.637\text{m}$

Fri flate effekt: $GG_l := \frac{L_T^{\,3} \cdot B_T \cdot \rho_v}{12 \cdot \Delta}$ $GG_l = 0.216\text{m}$

GM_L: $GM_L := KB + BM_L - Z_G - GG_l$ $GM_L = 12.115\text{m}$

Med vertikale sider og ender er LCB=LCF: $X_B := X_0$

Trimvinkel (pos. forover): $\Theta := \operatorname{atan}\left(\frac{X_G - X_B}{GM_L}\right)$ $\Theta = -2.367\text{deg}$

Minste fribord: $F := D - T - \frac{B}{2} \cdot \tan(|\Phi|) - X_0 \cdot \tan(|\Theta|)$ $F = 0.54\text{m}$