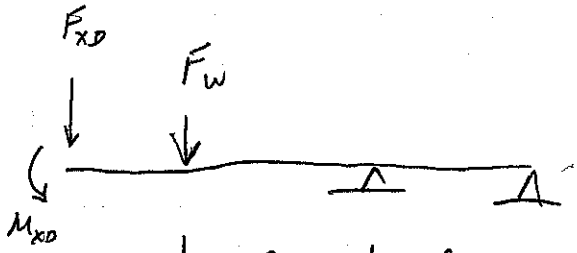
Reaction Loads @ B



Due To W Line Load (F_w)

$$R_B)_{F_w} = \frac{F_w}{l}(l+a)$$

$$= \frac{104.74}{39.75}(45.8125 + 39.75)$$

$$R_B)_{F_w} = 225.45 \text{ lf}$$

Due To ~~X~~Duser Drag Force $F)_{xD}$

$$R_B)_{F_{xD}} = \frac{F_{xD}}{39.75}(70.75 + 39.75) = 117.87 \text{ lf}$$

Due the ~~X~~Ducer Moment M_{xD}

$$R_B)_{M_{xD}} = \frac{M_A + M_B}{l} \quad \text{where } M_A = 0$$

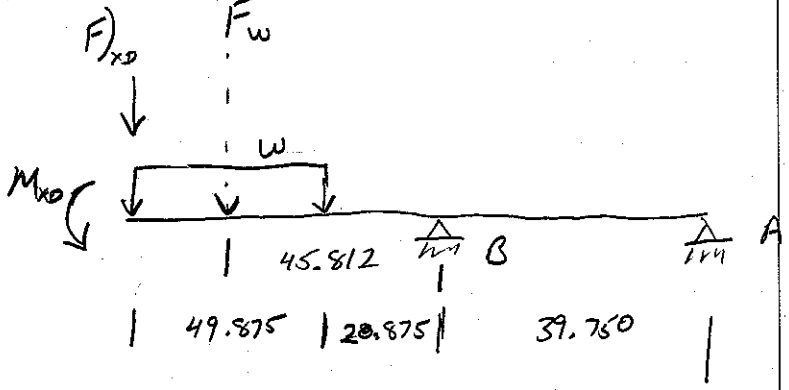
$$M_B = M_{xD}$$

$$R_B)_{M_{xD}} = \frac{269.24}{39.75} = 6.77$$

$$R_B)_{Total} = 225.45 + 117.87 + 6.77 = \boxed{350.1 \text{ lf} = R_B} \checkmark$$

GIVEN:

Pole Beam Dims



Moment @ B Due To line Load

where w = 2.1 lbf/in

Then $F_w = (2.1)(49.875) = 104.74$ lbf (179.5)

Moment at B Due To F_w

$$M_B)_{Fw} = F_w\left[\left(\tfrac{1}{2}\right)(49.875)+20.875\right] = 4,798.3 \text{ lbf·in} \checkmark \quad (8,223.3)$$

Moment @ B Due To xDucer Load F_{xD}

$$M_B)_{FxD} = (42.4 \text{ lbf})(49.875+20.875) = 2,999.8 \text{ lbf·in} \checkmark \quad (72.7,\ 5,143.5)$$

Moment @ B Due To xDucer moment on end of Pole

$$M_B)_{MxD} = M_{xD} = 269.24 \text{ lbf·in} \checkmark \quad 461.6$$

Total Moment @ B

$$M_B = 4,798.3 + 2999.8 + 269.24 = 8,067.34 \text{ lbf·in} \checkmark \quad (13,828.4)$$

+10%

Max Bending Stress (AT Support)

$$\sigma_B = \frac{M}{S} = \frac{8,067 \text{ lbf·in}}{6.45 \text{ in}^3} = 1,480 \text{ psi} \quad (13,828.4 \text{ lbf·in};\ 3537 \text{ psi})$$

Drag Force due to Water Flow

$$F_D = \frac{C_D A \rho V_\infty^2}{2}$$

Compute Area of Pole.

$$A_{pole} = (5.563)(62.5 - 12.7) = 277. \text{ in}^2$$

$$277 / 1.55E3 = 0.1787 \text{ m}^2$$

$$A)_{xducer} (8.858)(12.7) = 112.2 \text{ in}^2$$

$$112.2 / 1.55E3 = .0724 \text{ m}^2$$

$$F_D)_{pole} = \frac{(0.35)(.1787)(1,026)(3.81)^2}{2} = 467.8 \text{ N} = 104.7 \text{ lbf}$$

(.6) (179.5) ÷ 4.448

$$F_D)_{xDucer} = \frac{(0.35)(.0724)(1026)(3.81)^2}{2} = 188.7 \text{ N} = 42.4 \text{ lbf}$$

(.6) (72.7)

Assume: the xDucer Drag is a Moment on the end of the Pole & $F_D)_{pole}$ is a line load in (lbf/inch)

Then for a simply supported over-hung Beam

$$\omega = \frac{F_D)_{pole}}{l} = \frac{104.7 \text{ lbf}}{62.5 - 12.7} = \underline{\underline{2.1 \text{ lbf/in}}}$$

179.5

3.599 lbf/in

$$M)_{xDucer} = (F_D)_{xDucer})(12.7/2) = \underline{\underline{269.24 \text{ lbf} \cdot \text{in}}}$$

461.6

$$F)_{xDucer} = 42.4 \text{ lbf} \quad (\text{at Beam end})$$

72.7 lbf

Req: Determin the Water induced Drag Force & stress in Pole for Worst Case. 4 kts ship speed plus 15° roll @ 10 sec.

Assume: Roll +/- 15 deg @ 10 sec.

ship speed original spec. $V = 4 kts$

$\Rightarrow (4 kts)(0.514) = 2.176 m/s$

30" pole extension = 62.5 exposed Length

Given: 5 in Nom. schd 40 Pipe in 304 S.S.

$d = 5.563 in = 0.14134 m$

$S_y = 30 ksi$

$\nu)_{CH_2O} = 1.4 \times 10^{-6} m^2/s$ Kinematic Viscosity

$\rho)_{CH_2O} = 1.026 kg/m^3$

Soln:

Velocity of Pole thru water $V_o = 4 kts + \dot{x})_{max}$

$V_o = 2.176 m/s + 1.63 m/s = 3.81 m/s$

Compute Reynolds No.

$$R_e = \frac{V_o d}{\nu} = \frac{(3.81 m/s)(0.14134 m)}{1.4 \times 10^{-6} m^2/s} = 3.84 \times 10^5$$

Then from Graph pp 418 $C_D = 0.35$

.6
.25

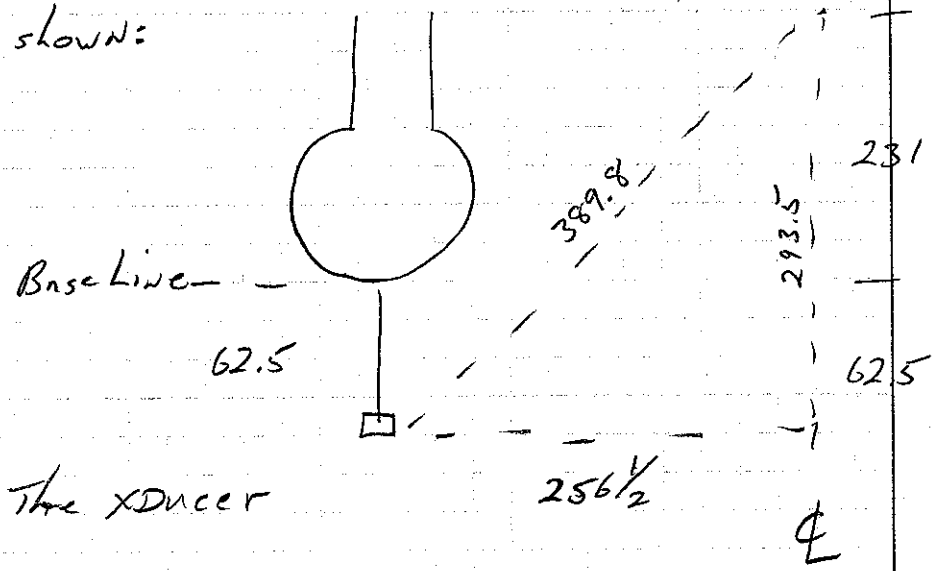
Req: Determine The Roll Velocity (speed Thru The water) at the Sonardyne xDucer due To Roll.

Assume: 30" Pole extension = 62.5 inch Below Keel
+/- 15° Roll angle @ 10 sec Period.
= .2618 rad.

Given: Geometry as shown:

$t = 10$ sec

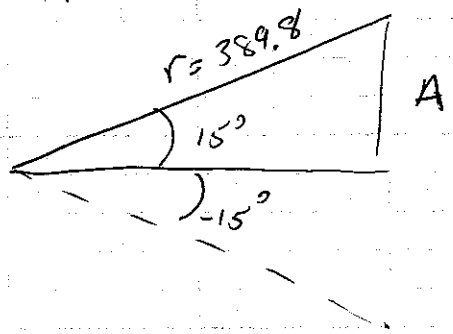
$\omega = \frac{2\pi}{t}$



Distance Traveled by The xDucer in Roll

$A = r\theta = (389.8)(.2618\ \text{rad}) = 102.1$ inch

$A = \frac{102.1}{39.37} = 2.592$ m

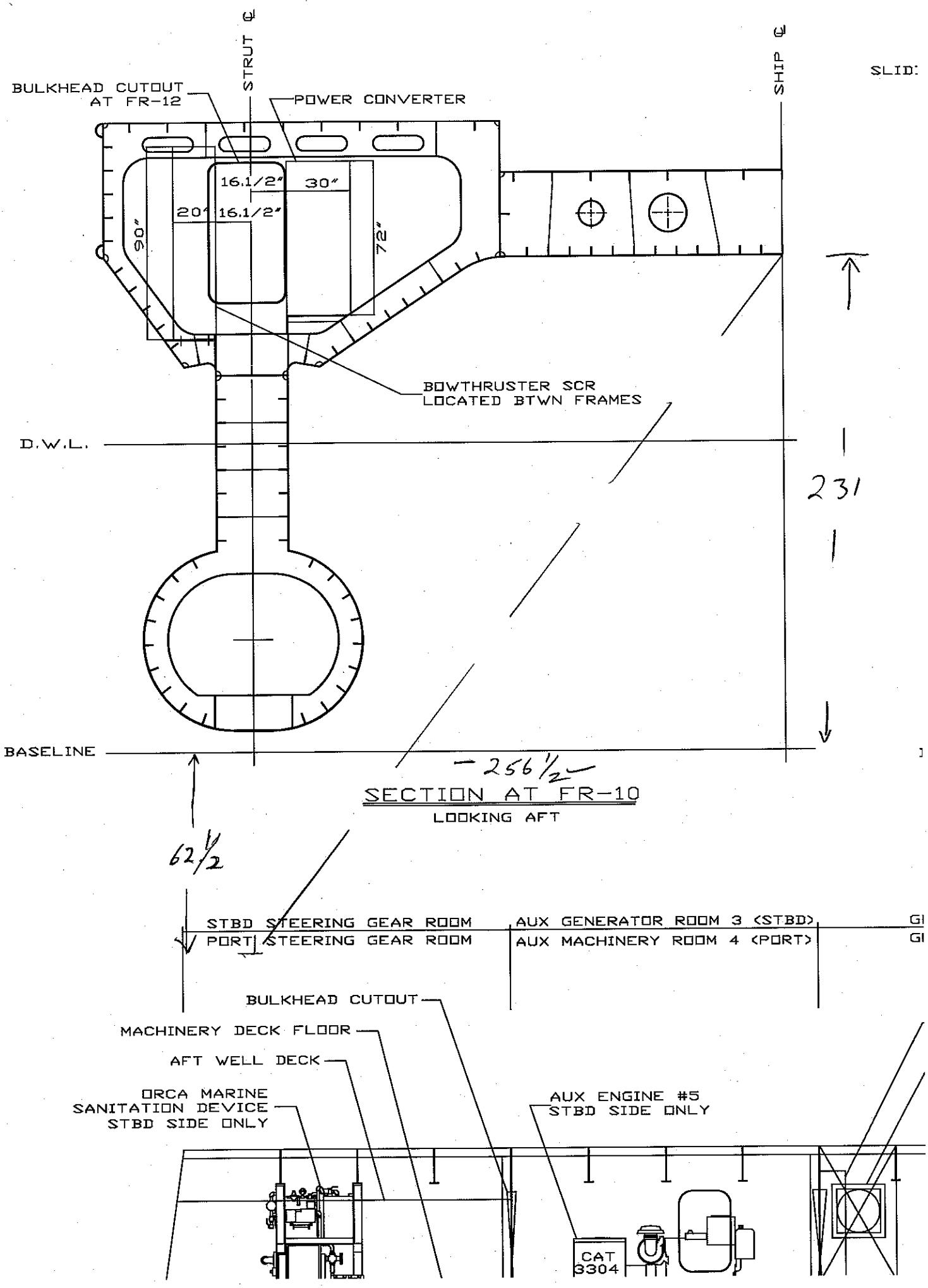


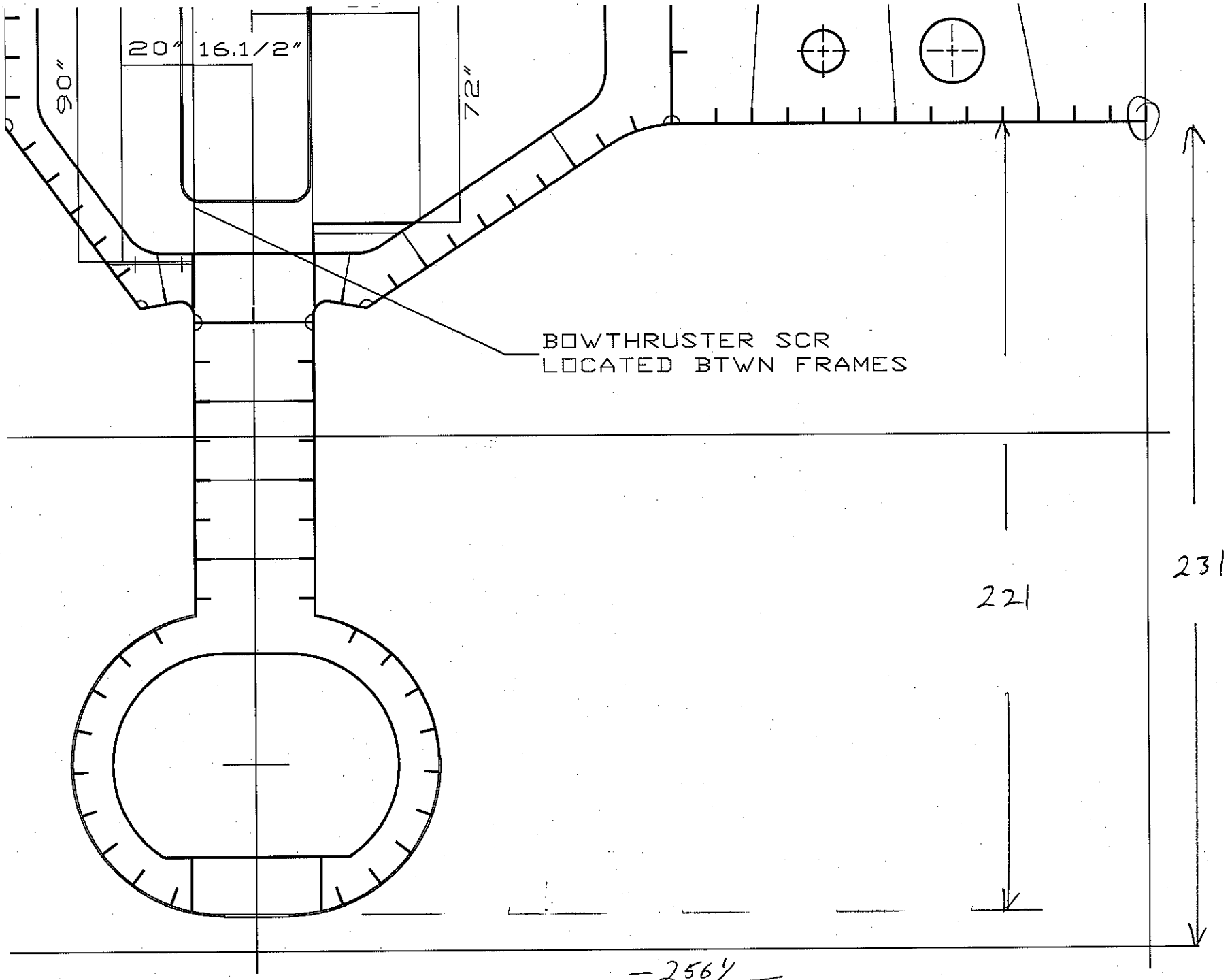
Velocity $\dot{x} = \omega A \cos(\omega t)$

Maximum Velocity @ $\cos(\omega t) = 1$

Then $\dot{x})_{max} = \omega A = \frac{2\pi}{t} A = \frac{2\pi}{10.}(2.592\text{m})$

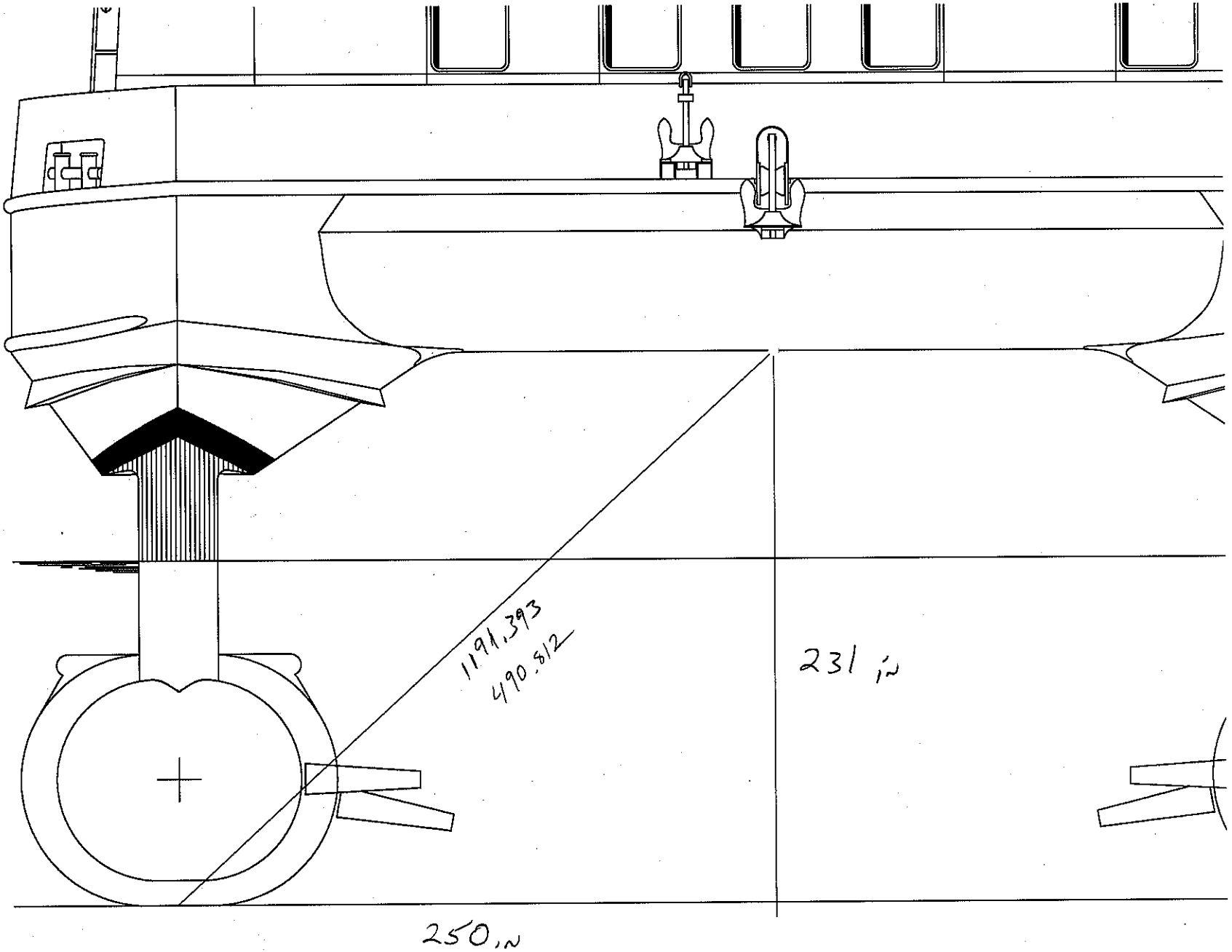
$\dot{x})_{max} = \boxed{1.63\ \text{m/s}}$


STRUT ℄
SHIP ℄
BULKHEAD CUTOUT AT FR-12
POWER CONVERTER
16.1/2"
30"
20"
16.1/2"
90"
72"
BOWTHRUSTER SCR LOCATED BTWN FRAMES
D.W.L.
231
BASELINE
256 1/2
SECTION AT FR-10
LOOKING AFT
62 1/2
STBD STEERING GEAR ROOM
PORT STEERING GEAR ROOM
AUX GENERATOR ROOM 3 (STBD)
AUX MACHINERY ROOM 4 (PORT)
BULKHEAD CUTOUT
MACHINERY DECK FLOOR
AFT WELL DECK
ORCA MARINE SANITATION DEVICE STBD SIDE ONLY
AUX ENGINE #5 STBD SIDE ONLY
CAT 3304



SECTION AT FR-10

LOOKING AFT



D5.DXF

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