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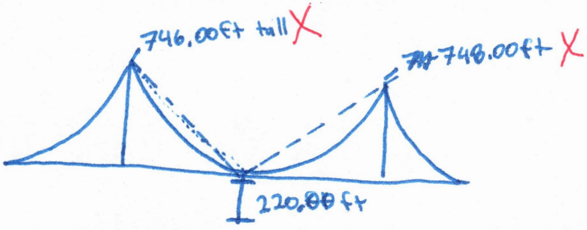
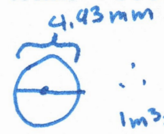
CIV102F Quiz # 1: 1300h-1500h Thursday September 12, 2019
Engineering Computation and Judgment

Shown on the opposite page is a schematic of the Golden Gate Bridge, located in San Francisco and built in 1937. Each of the two cables which support the deck consists of 27,572 high-strength steel wires wound together into a bundle. The diameter of the individual wires is 4.93 mm and the unit weight of steel is 77 kN/m^3. Estimate the total weight of steel contained in the primary cables which hold up the bridge (i.e. ignore the vertical wires which connect the primary cables to the bridge deck). Report your answer in units of tonnes (1 tonne = 1000 kg).





$\therefore r = 2.465\text{mm}$

$1\text{m}^3 = 10^9\text{mm}^3$ ✓+1

$A_c = \pi r^2 = \pi(2.465\text{mm})^2 = 6.08\text{ mm}^2\pi$

$\therefore 6.08\text{mm}^2 \cdot 27572 = \pi 167637.76\text{mm}^2$ per bundle, ✓+1

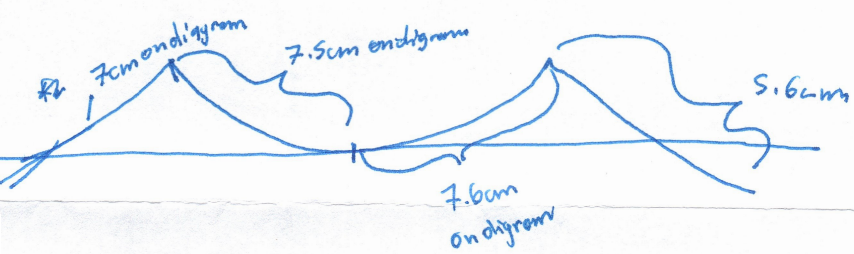
scale: 220ft ~ 1cm on diagram ✓+1 ✓

$\therefore$ from cable start to cable end: 5720ft

Cables nearly straight lines to connecting points ✓+1

$V_B = \pi\, 167637.76\text{mm}^2 \cdot L_{B_T}$ ✓+1

where L_{B_T} is the total length of all primary cables



✓+1

$\therefore$ Tot = 27.7cm ✓+1

$L_B = 27.7\text{cm} \cdot 220.00\text{ft/cm} = 6094\text{ft}$

$6094\text{ft} \cdot \frac{304.8\text{mm}}{1\text{ft}} = 1857451.2\text{ mm}$

You forgot to take into acount 2 cables!

$\therefore V_B = \pi\, 167637.76\text{mm}^2 \cdot 1857451.2\text{mm}$
$\approx 3.11378\times10^{11}\,\pi = 311\,\pi\text{m}^3$

$\therefore$ weight $= 77\text{kN} \cdot 311\pi\text{m}^3 \doteq 75\,300\text{ kN}$. ✓+1

Need it in tonnes so $\frac{\text{weight in kN}}{g}$ = mass in tonnes.

Actual: $L = \sim 4667\text{m}$

$W_T = \sim 19220$ tonnes.

Reminder: Please report all final answers using slide-rule precision (ie, four significant figures if the first digit is a "1", three otherwise)