Technical Comments

Comment on "Statics and Dynamics of Anchoring Cables in Waves"

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IN Ref. 1, Goodman and Breslin determined the effect of hydrostatic pressure on an extensible cable in a heavy liquid by an integration of the fluid pressure on the cable surface. A different and more direct approach to this problem has been presented[2] for the case of an inextensible cable, but, as will be seen in the following, the extensibility of the cable is easy to include.

Let us first consider a segment of the cable of length ds. The total buoyance of the segment with "open ends" equals $w_b = \rho g A_0 ds$ and acts in the vertical z direction (see Fig. 1). Because of the assumption of an incompressible material, there will be no strain due to this pure hydrostatic pressure. Now, in order to compensate for the lack of pressure at the ends of the segment, we have to introduce axial tension as shown in Fig. 1. This axial tension introduces strain in the segment such that the area changes from A_0 to $A_0/(1+\epsilon)$. Combination of the two end forces and the buoyant force w_b results in a net buoyant force dF_n, which acts in the center of gravity of the segment in a direction normal to the centerline and with the mangitude

$$dF_n = \rho g A_0 \left(\cos\Phi + \frac{h-z}{1+\epsilon}\right) ds$$

Introducing the tangential drag force per unit length of the stretched cable G^* and the normal drag force F^* (see Fig. 2), together with the weight of the cable in vacuo W, equilibrium in the tangential direction gives

$$\frac{dT}{ds} = W \cdot \sin\Phi - G^*$$

and equilibrium in the normal direction gives

$$T\frac{d\Phi}{ds} + F^* + \rho g A_0 \left(\cos\Phi + \frac{h-z}{1+\epsilon}\frac{d\Phi}{ds}\right) - W\cos\Phi = 0$$

Received Feb. 9, 1977.
Index category: Marine Mooring Systems and Cable Mechanics.
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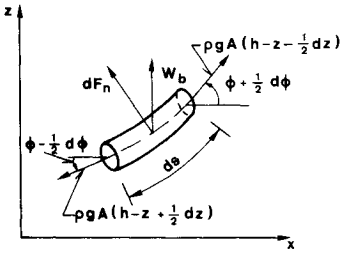

Fig. 1 Buoyancy on cable element.

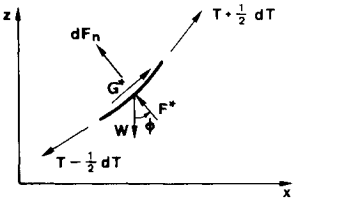

Fig. 2 Forces acting on cable element.

These static equilibrium equations are identical to Eqs. (14) and (15) in Ref. 1.

References

[1] Goodman, T.R. and Breslin, J.P., "Statics and Dynamics of Anchoring Cables in Waves," *Journal of Hydronautics*, Vol. 10, Oct. 1976, pp. 113-120.
[2] Pedersen, P.T., "Equilibrium of Offshore Cables and Pipelines during Laying," *International Shipbuilding Progress*, Vol. 22, Dec. 1975, pp. 399-408.

Reply by Authors to P. T. Pedersen

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THE authors would like to thank Professor Pedersen for his Comment and are pleased to see the simple derivation of the static equilibrium equations, including extensibility, which we obtained in our paper.

Received March 16, 1977.
Index category: Marine Mooring Systems and Cable Mechanics.
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