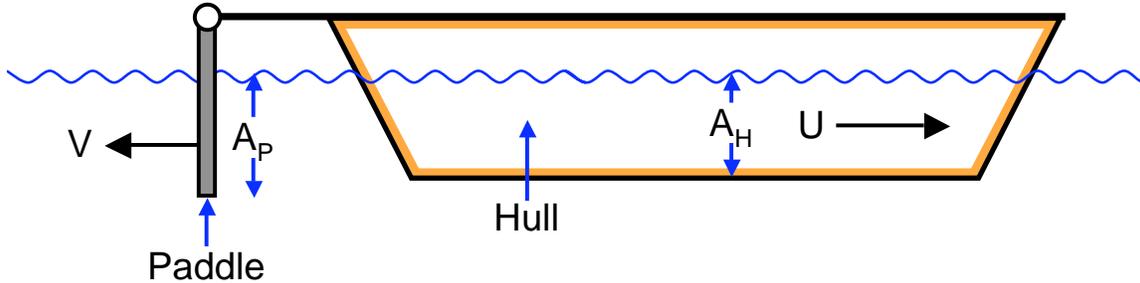


Problem 295A

Consider a simplified view of the propulsion of a paddle steamer:



Suppose that there is always an effective area, A_P , of paddle submerged in the water off the stern of the boat and that this is moving backwards with a velocity, V , *relative to the hull*. Denote the drag coefficient of this effective area of paddle by C_{DP} and assume that the flow around the paddle is unaffected by the presence of the hull. This paddle propels the boat through the water at a forward velocity, U ; denote the drag coefficient for the hull by C_{DH} based on the frontal projected area of the hull, A_H .

1. What is the relation between the propulsion velocity, U , and the relative paddle velocity, V ?
2. What is the efficiency of this method of propulsion in terms of A_P , A_H , C_{DP} and C_{DH} ? Efficiency, remember, is the ratio of useful work done to total work done. Comment on the result and the geometry which would be necessary to obtain reasonable efficiencies given that the drag coefficients will be of order unity.