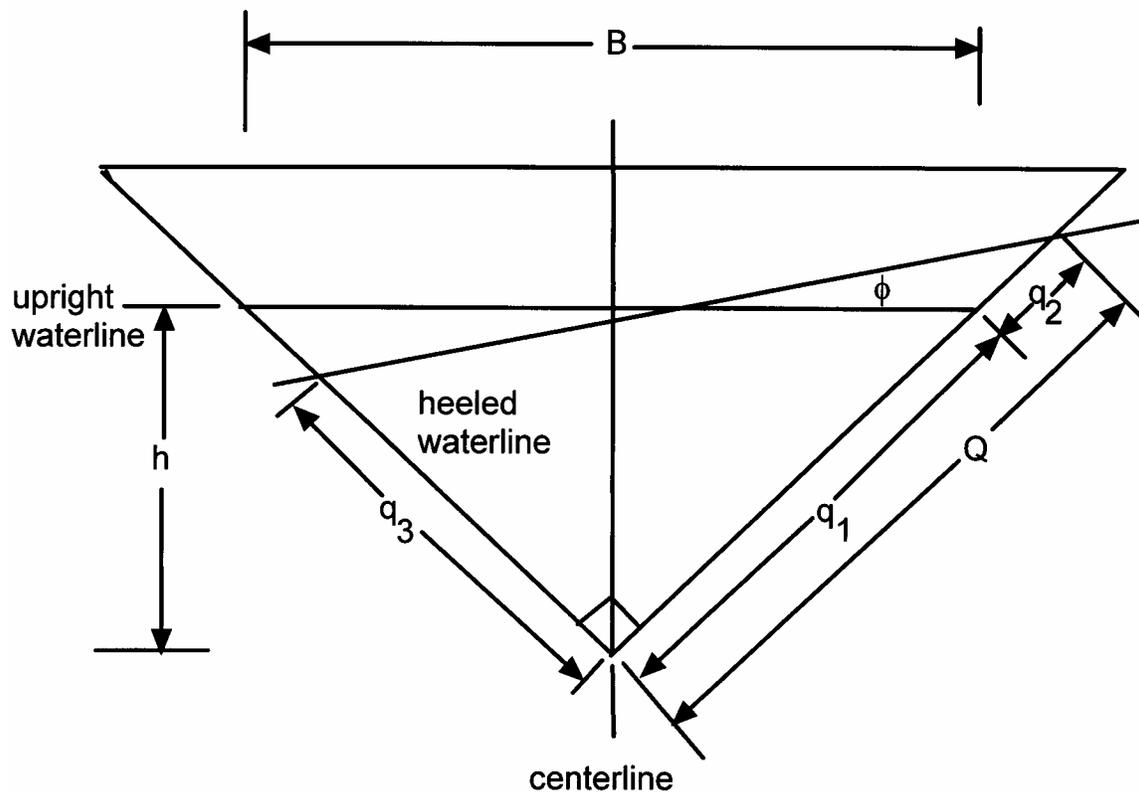


Problem Set 3

Hydrostatic, Small and Large Angle Stability

Problem 1

This is a problem in transverse stability. In order to be able to do the problem with a “pocket calculator”, the vessel is not shaped like a sailboat, but rather a v-bottom barge with vertical ends that has a draft, H , of 8 m, a beam, B , of 16 m, a freeboard of 6 m and a length, L , of 50 m. All the sections are identical and the deadrise angle is 45 degrees which means that the intersection of the sides at the keel has a 90 degree angle. The center of gravity is 8.5 m above the keel (bottom of the barge). The barge is floating in seawater with a density of 1025 kg/m^3 .



- A. Determine the righting moment as a function of heel angle as a linear function of heel angle for small heel angles by calculating BM and BG.

- B. Calculate the righting moment based on the positions of the centers of gravity and buoyancy at heel angles of 5, 10, 15, 20 and 25 degrees. This is most easily done by calculating Q , using trigonometry to obtain the immersed length on the opposite side and using the location of the centroid of a right triangle.
- C. Compare the exact righting moment with the small angle approximation at heel angles of 5, 10, 15, 20 and 25 degrees.

Problem 2

In this problem you will be asked to calculate hydrostatic parameters and small angle stability for a sailing yacht starting from a table of offsets. This is provided in the files "Offsets PS3.xls" in MS Excel format. All the integrations are intended to be done using Simpson's rule.

- A. Calculate the sectional area $A(x)$ at each station, and the vertical position of the centroid of each section $VCB(x)$. As you can see from the table of offsets, some stations have an even number of points and all the station have the bottom point at a different distance than the others. At each station, use Simpson's rule for as many points as you can from the DWL down, then use trapezoidal rule for the last one or two intervals.
- B. Find the waterline length L_{WL} , the waterline beam B_{WL} , the canoe body draft T_C , the canoe body volume ∇_C , the block coefficient C_B , and the prismatic coefficient C_p .
- C. Determine the waterplane area A_{wp} , the longitudinal center of floatation LCF , and the metacentric height GM . Place the vertical center of gravity 0.1 m above DWL.