MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering

2.701 PRINCIPLES OF NAVAL ARCHITECTURE
Fall 2014

PROJECT #3: SHIP INTACT STABILITY

Date issued: October 1, 2014
Date Due: October 10, 2014

1. Introduction/background:

An intact stability analysis follows naturally from the hydrostatic analysis. Hydrostatics (determination of KM and knowledge of KG) can be used to predict initial stability. This intact stability analysis will evaluate the range of stability at various angles of inclination.

Various computational tools can be used to compute the hydrostatic properties and righting arms for an inclined hull form. For this assignment we will use the Advanced Surface Ship and Submarine Evaluation Tool (ASSET) and the Program for Operational Ship Salvage Engineering (POSSE). Computers with ASSET and POSSE software loaded are available in the 2N Ship Design Lab.

2. Assignment:

From baseline the ship developed in Project #1, produce righting arm (GZ) cross-curves and static stability curves for a displacement range of design $\Delta \pm 1000$ LT.

Load your Project #1 ship into ASSET and save it under a new name. Use the Hydrostatic Analysis Module to produce general stability curves for your ship. Then import the ship into POSSE to generate the cross-curves of stability.   Detailed instructions "Taking a ship from Asset 6.3 to POSSE 5.1" and a macro-enabled spreadsheet are provided.

3. Procedure / Deliverables

3-1: Generating Static Stability curves in ASSET

        a) Run the Hydrostatic Analysis Module. ASSET will generate your static stability curves and also calculate limiting KGs for 100 kts beam winds and high speed turns. You can see these limiting KGs on the "Intact Static Stability" report. For this first run, your displacement should match your "design" displacement. You can verify this by checking the displacement on either of the graphic reports or on the "Hydrostatics Summary."

        b) To generate curves at other displacements, open the editor and change the "Hydrostatic Indicator" to WT TRIM (see the ASSET help files to understand what this means). Then change the value of "Hydrostatic Weight" to the displacement desired (e.g., 500 tons less than design).

Run the Hydrostatic Analysis Module again, selecting the same reports as before. ASSET will also ask you to enter several other hydrostatic condition parameters. Use the values from the design condition for all cases. Displacement should match your "input" displacement. Repeat for other values of displacement.

D-1: A plot of the general stability curve (intact static stability curve) for your ship at displacements from design $\Delta \pm 1000$ LT in 500 LT increments. Discuss your results, noting trends.

3-2: For the Roll period calculation below, refer to Introduction to Naval Architecture, Gillmer and Johnson, page 265-266, for a suitable relationship between roll period and GM. Use 0.45 as your value of "C."

D-2: For the three displacements $\Delta \pm 500$ LT, determine the maximum KG for each of the following conditions:
   a) Beam winds (100 kts)
   b) High Speed turning (35 kts)
   c) Roll period ≤ 15 seconds
   d) GM ≥ 2.0 ft

Which of these conditions is the "limiting" condition for each displacement, and which is limiting overall? What does this mean to you as a ship designer?

3-3: Generating Static Stability curves in POSSE

   a) Follow the attached instructions "Taking a ship from ASSET 6.3 to POSSE 5.1" Part I to generate the offsets file for your ship.
   b) Use the POSSE Ship Project Editor to import the offsets file and generate the cross curves of stability at the specified displacements.

D-3: A plot of the cross curves of stability for your ship at displacements from the design $\Delta \pm 1000$ LT in 500 LT increments. Discuss your results, noting trends.

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