13.122 Ship Structural Design and Analysis

Problem Set 2

A design firm is evaluating the feasibility of increasing the cargo capacity of a 350' ocean-going barge, DBARGE122, by inserting a 90' midbody plug inserted 190 feet forward of the aft perpendicular (AP). As a member of this design team, you have to provide the maximum shear force and bending moments for this section to ensure structural adequacy.

Here are a few general stats: LBP = 440', B =60', D =40', number of stations is 21 (0-20) with 22' spacing.

Working off of your answers for problem set 1, Part B (or the solutions if there is a significant numerical difference), calculate the following using the Excel spreadsheet implementation of the DDS 100-6 available on-line and in the design lab.

A. The combined structural, cargo, and machinery weights per station are provided for the existing structure as detailed below. Using the structural weight per foot calculated in PS1, determine the lumped station weight. Enter this data into the Excel worksheet remembering the concepts discussed in Lecture 2. Note: the allocation is not necessarily unique, so just state your assumptions for your approach.

Station	Combined Cargo & Machinery (lbs)	Total Weight per Station(lbs)
0		95340
1		158400
2		223246
3		318560
4		542854
5		808448
6		1078940
7		1296770
8	1450498	
9	1703648	
10	1737948	
11	1715668	
12		1765070
13		1536350
14		1359210
15		1225850
16		1067080
17		872578
18		652954
19		409847
20		105943

B. Enter the Bonjean data for the midship section into the Excel spreadsheet and plot the Bonjean curves.

C. Before numerically balancing the design, take a close look at the Bonjean curves and familiarize yourself with the overall "shape" of the hull. Taking into consideration the change in section area and lumped mass over the length, comment on how you think the barge will settle in the stillwater, hogging, and sagging conditions (do you think it will trimed down by the bow or stern? Anticipate the effects of changing the trim angle and mean draft once you start to iteratively balance the design).

D. Determine the mean draft and trim angle at amidship (station 10) that will balance this design, i.e. buoyancy equals displacement and LCB equals LCG, for the stillwater, hogging, and sagging conditions. Print the balance plot.

- Note: There are two versions in the design lab. One with and one without an automatic balancer macro. At this writing the macros are not enabled in the design lab so you may have to do a manual balance.

E. Determine and plot the shear and bending moment charts for all three conditions. Comment on any discrepancies you would expect from the ideal case.

F. Provide a summary table with the significant characteristics of DBARGE122, which should include at a minimum: displacement, max bending moment and shear for all three conditions, LCB.

This year the algorithm for calculating shear force and bending moment (given buoyancy and weight at a section) is left for you to insert. Ref: lecture 1.