Week F2a

Tuesday, November 24, 2020 10:39 AM

document

Chapter 29

Boats Week 2a: Curves and Surfaces and Boats

Schedule

29.1 Mathematical Representation of a Curved Surface [90 mins]

In the homework assignment we learned about describing, visualizing, and working with curves and surfaces in different ways. In this activity, we are going to apply what we learned and develop a mathematical representation of the hull of a specific boat. The boat we are going to model is called the *Spray*.

The *Spray* was used by Joshua Slocum in 1895 when he single-handedly sailed around the world. There has been much debate about the seaworthiness of the *Spray*. On the next page are the boat lines for the *Spray*. You'll have to take some time to understand these because there is a lot going on.

Once you think you've got it figured out, we'd like you to build up a representation of the hull by designing curves that are a good match for the *waterlines* and *sections*. You are going to do this by proposing particular functional forms and then finding the best-fit curve that captures the hull data. You will also have the option of creating a surface representation for the hull.

Exercise 29.1

Review the boat lines for the *Spray*. The *waterlines* are shown in the *plan view* in the central figure, and the *sections* are shown in the *section view* in the bottom figure. The *buttocks* are shown in the *profile view* in the top figure. Observe that data for the waterlines and the sections is presented in the table on the left: the waterlines are read from left to right, while the sections are read from bottom to top.

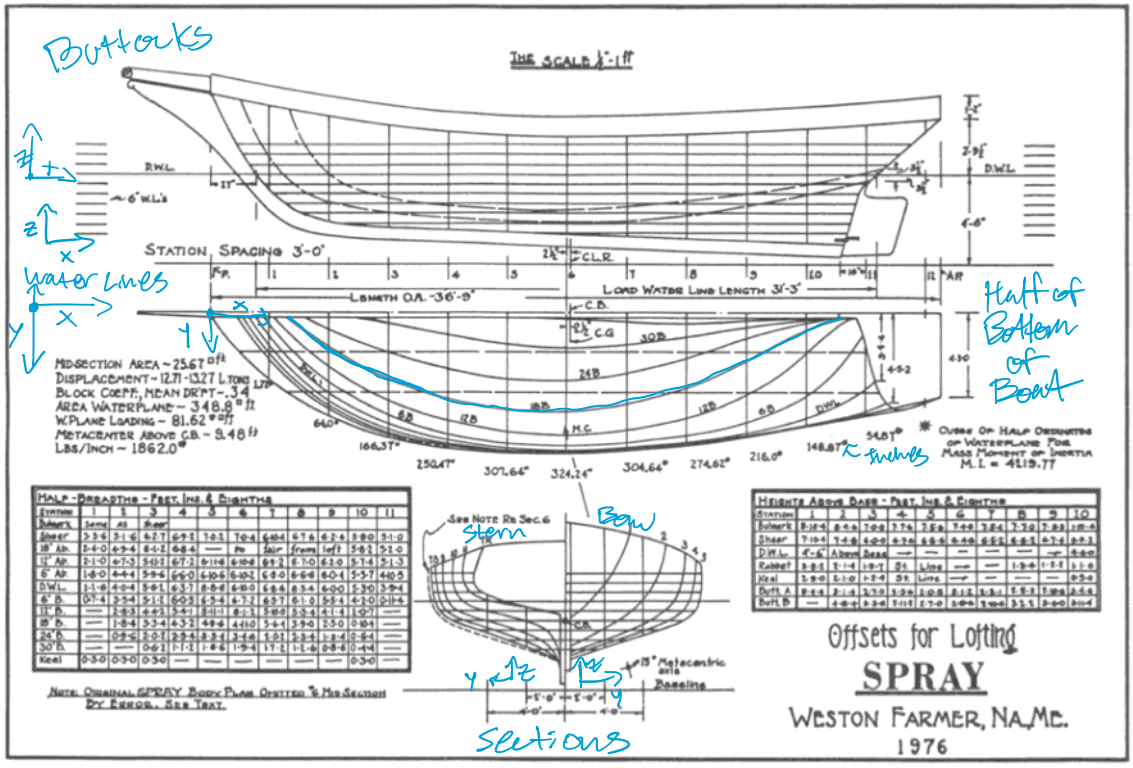
waterlines: XY plane sections: YZ buttocks: XZ

1. The *waterlines* are the curves defined by the intersection of the hull of the boat with horizontal slices at different heights. Which intersections do the *sections* and *buttocks* correspond to?
2. Propose a rectangular coordinate system (xyz) for the Spray, and discuss at least three options for where you might locate the origin. What units are used in the plans?
3. Trace out the waterline called 18B on your lines plan and plot the data points from the table on the left. Now propose a **quadratic** function, e.g. $y = g(x-h)^2 + k$, to describe the waterline curve you have visualized. Estimate some of the function parameters that define your curve. Visualize your curve and compare it to your data points.

252

units: inches
I'd put the origin at the bottom-front-center with z going up, x going aft, and y going starboard/port. I could see an argument for swapping x & y, putting the origin at the top, or at the bow, or the y origin at either side.

4. Now trace the section curve defined at station 2 in the section view and plot the data points from the table on the left. Now propose a **power** function, e.g. $y = \alpha x^{\beta}$, to describe it. Estimate some of the function parameters that define your curve. Visualize your curve and compare it to your data points.
5. Now find the best-fit parameters for each of your curves using the technique outlined in the homework. For the *power* function you will need to convert it to a more suitable form by taking a logarithm.
6. Choose another waterline curve and another section curve. Can you tweak the parameters of the same functions to find a good fit?
7. Using the data in the table on the left, can you propose a function that would represent the surface of the hull? Go ahead and find the best-fit parameters.


Buttocks
THE SCALE 1"=1ft
STATION, SPACING 3'-0"
Water Lines
Half of Bottom of Boat
Sections
Offsets for Lofting
SPRAY
WESTON FARMER, NA.ME.
1976