A Question of Scale

By Allan Wing

The other morning at one of our meetings at Galaxy Noel brought in his model of a freighter and had questions about scale speed. His model was almost 4 feet long and was a very nice 1/96 scale of the original freighter. The original had a cruising speed of 9 knots. He was trying to figure the scale speed and then figure out how to make his model go that speed. We decided that strictly speaking the scale speed would be 9 knots divided by 96 or about 1/10 knot.

I did a search on the internet for articles on scale speed. For over 100 years ship designers have used scale models to test their designs for such things as drag and handling in waves. They found that dividing the speed by the scale factor did not provide realistic results. The reason is that many of the effects of the water reacting with the hull do not scale in a linear fashion. In the 1880's a gentleman named William Froude did a series of tests pulling 3, 6 and 12 foot models through a tank. He developed something called the Froude number which is still used in naval architecture today. It is more complicated than what we need but the basic result is that speed in the tests should be based on the square root of the waterline length. That means that if we want to have our boats operate in a realistic manner we should pick a speed that is the actual speed of the original ship divided by the square root of scale or in Noel's case 9 knots divided by the square root of 96 giving us about 1 knot.

The question then becomes which definition of scale speed should we use. Below is an example of using the scale speed as the real speed divided by the scale and using the scale speed as the real speed divided by the square root of the scale.

To demonstrate this I will use my Henry Foss as an example. I have a good bit of data, pictures and experience with this boat. The original Henry Foss was 90 feet long and my model is 3 feet long so the scale is 1/30. This may seem odd but that was the length of the blueprint I got From Foss Maritime in the early 70's. If we use a cruising speed of 9 knots for the full size boat we can look at the two options for scale speed. The first is the 9 knots divided by the 30 or 0.3 knots (Scale speed = 9/30). The second is 9 knots divided by the square root of the 30 (square rood of 30 is 5.5) or 1.6 knots (Scale Speed= 9/5.5). Below are pictures of the model going at about these two speeds as well as one picture going at a maximum speed.

The figure 1 shows the Henry Foss going rather slow approximately the 0.3 knots. At this speed there is virtually no wake and the boat is very slow to turn. The Figure 2 shows the Henry Foss going about 1.6 Knots. At this speed the wave action looks more realistic and the boats handles well.



Figure 1 Slow moving little wake slow turning



Figure 2 Realistic wake better handling

The Figure 3 shows the Henry Foss going Full Speed. Figure 4 is a picture from the tugboat races showing the Craig Foss going full speed



From these pictures I think it shows that operating our models at speeds picked by using the square root of the scale provides a more realistic look.