

Progress Report – Ship Frame Research Program

March 31, 2004

The ship frame research program is progressing on several aspects.

Single Frame Tests

Two initial experiments with single frames have been conducted. As a result of lessons learned, the test frame has been re-designed and is being modified to increase its axial stiffness and moment connections. This work is just about complete and the remainder of these tests will be completed in the next few months. The experimental program has been expanded from six to eight frames, to include a test of an L frame, with central and end load conditions. A problem with the 150,000 lb actuator have been traced to a faulty component in the actuator (the displacement transducer, an LVDT). The repairs have been completed, and everything is ready to continue testing as soon as the support frame is re-installed.

Small Grillage Tests

The design of the support frame for the small (and large) grillage test has now been finalized. An initial design was developed, but proved too costly when bids were received. A new frame, stronger than the earlier one, but incorporating some existing steel that is available in the lab, is now designed. Quotes for fabrication are being obtained. We expect to have this frame ready by mid summer. No problems are foreseen with this work. Figure 1 shows a Rhinoceros™ drawing of the small grillage support frame. Full shop drawings have been sent to the fabricator. This frame will comprise the central portion of the large grillage support frame. Figure 2 shows a Rhinoceros™ drawing of the test grillage, with the boundary plates and frames shown.

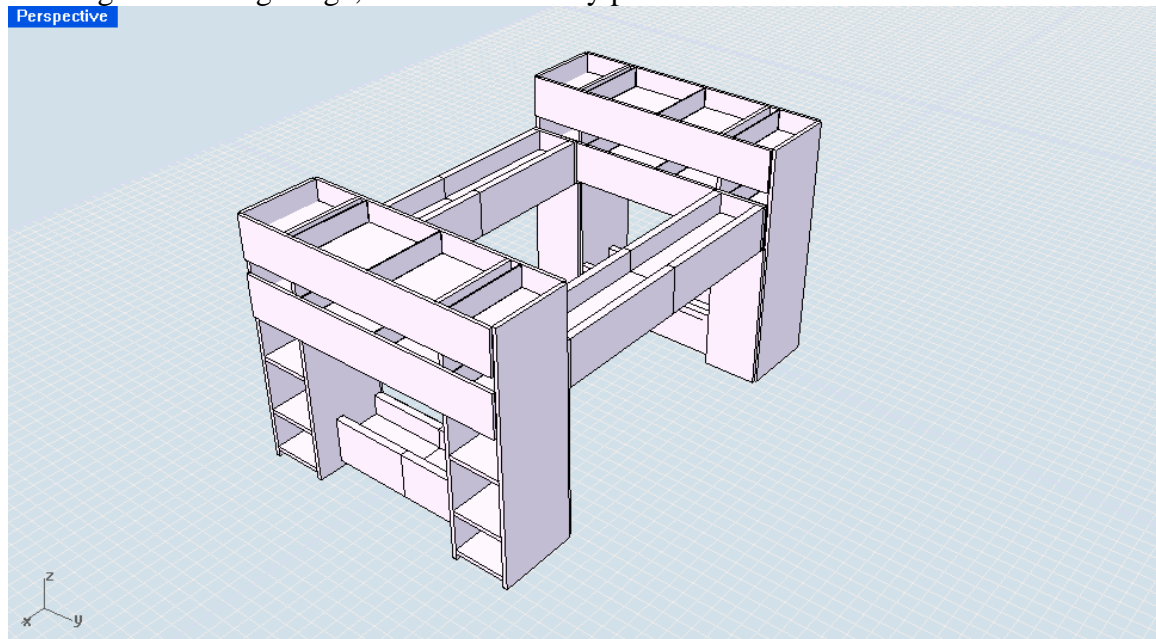


Figure 1. Small Grillage support frame.

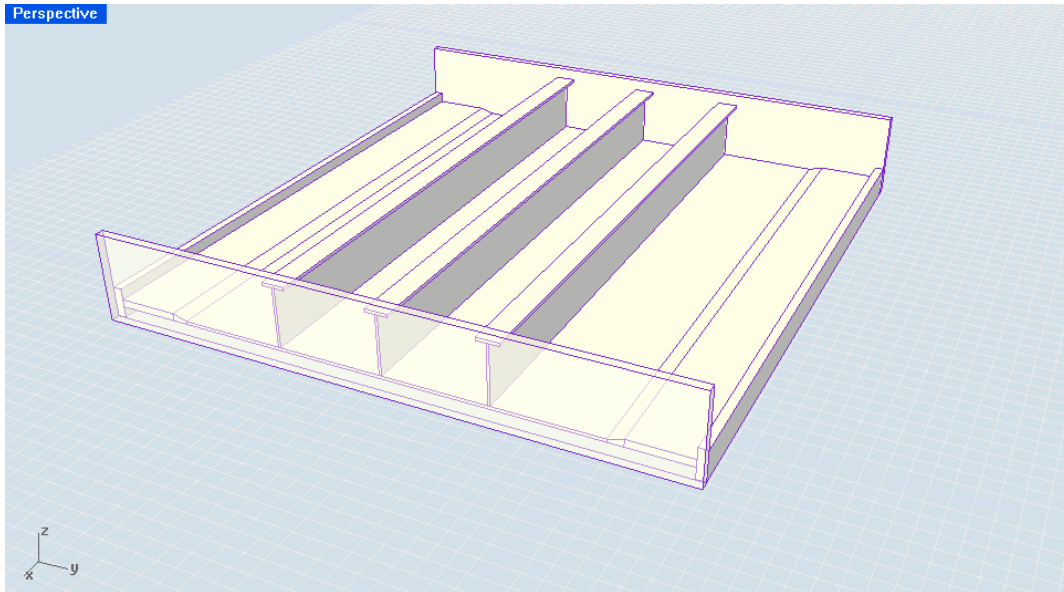


Figure 2. Small Grillage structure with end and edge supports.

Large Grillage Tests

As stated above, the design of the support frame for the large grillage test has been partially finalized. We still need to finalize the free end connection supports. This work is proceeding without difficulty.

Numerical Analysis

A detailed finite element study of a variety of single frames has been completed and is being circulated along with this progress report. The study found a number of interesting results and lead to a number of avenues for further study. The study found a number of interesting relationships between various buckling mechanisms (shear buckling, Web compression buckling and tripping) and the overall plastic collapse. Some of these trends are quite different than what occur in elastic response (with small deflections). The large deflections, with the change in geometry, tend to change the typical relationships. For instance, larger flanges tend to enhance rather than restrict local web bucking, in some cases. The numerical side of the program will continue alongside the experimental tasks.

Point of Concern

Other than the normal concerns to keep the experimental work moving smoothly forward, we are concerned that our approach to measuring overall pattern of distortion may need to be changed. The setup that we have makes use of a **MicroScribe®**. While the system is able to do what we require, there are many concerns about the viability of the system. We are planning to seek a new way to determine the frame deflections. We plan to look into photographic techniques to do this.

Expenditure of Funds

The project is on budget with no difficulties. Funds are being spent, as planned, on frame design, materials purchase, literature search, finite element analyses and support of graduate students and project engineer.