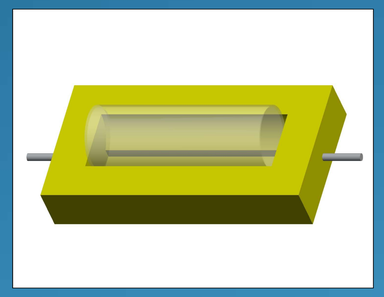
Liquefied Natural Gas Bunkering Barge

Project Statement

Team Marine Refueling Concepts (MRC) worked in collaboration with Moran Iron Works, Inc. to secure a new market for their core product of large pre-fabricated welded metal structures. Recent developments in natural gas extraction and propulsion systems have provided an opportunity to develop a marine construction sector in the Great Lakes region, providing that new market. The focus was on the development and fabrication of liquefied natural gas (LNG) bunkering barges to refuel ships on the Great Lakes. Team MRC conducted a feasibility study and conceptual design of an LNG bunkering barge. Design efforts focused on economic scaling of the barge, layout of refueling tanks and equipment, and capsize stability in Great Lakes waves, allowing for LNG sloshing in tanks, the latter phenomenon studied by simulation and wave tank experiments

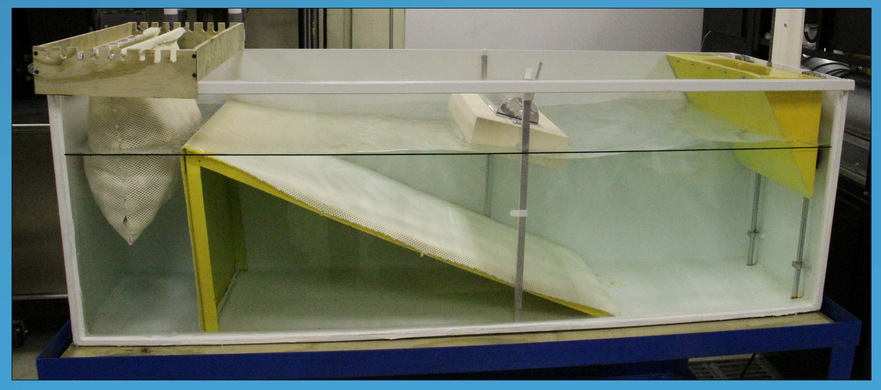
Scale Model

This scale model features a simplified rectangular hull machined from prototyping foam and a single fuel tank constructed from clear acrylic.



Wave Generation Tank

A wedge shaped plunger oscillates up and down to create uniform waves which travel the length of the tank. To prevent the waves from reflecting off the end wall, a ramp and porous sack filled with golf balls was used to dampen the waves. An accelerometer was used to record the wave induced lateral acceleration of the scale model for the case of an empty, half filled and full fuel tank. These results were used to test the validity of the MATLAB computational model.



LSSU Engineering Senior Projects
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Team Members

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Industrial Customer

Moran Iron Works, Inc. Onaway, Michigan
Specializing in custom welding & industrial fabrication

Industrial Contact

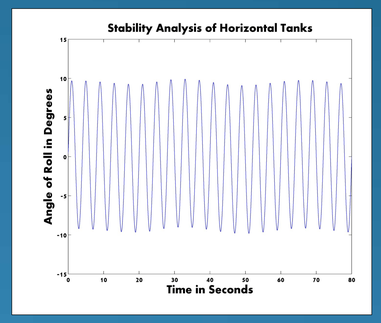
Victor Ruppert

Barge Stability

LNG is stored at –260°F and is 1/600th of its gaseous volume. Since baffles placed inside LNG tanks create friction resulting in boil-off gas, liquid sloshing is a concern. Wave induced liquid sloshing may cause the barge to become unstable and possibly capsize. Team MRC strived to reduce the effect of liquid sloshing by minimizing the free surface area of the liquid within the barge's fuel tanks. Using parameters from Orca3D and a MATLAB computational model, Team MRC verified that the full size virtual model could withstand Great Lakes weather conditions.

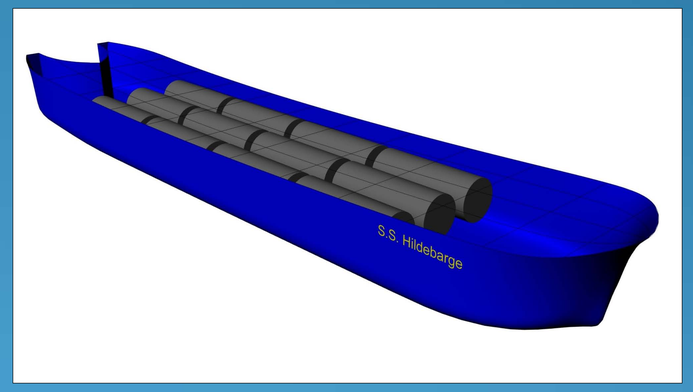
Wave Induced Roll of Full Size Virtual Model

Great Lakes Waves: 10' Amplitude 4s Period



Full Size Virtual Model

This articulated tug barge is outfitted with twelve 52,800 gal (200 m³) LNG tanks. It was designed using Rhino 5 software with the Orca3D plug-in.



Final Design Specifications	
Length Overall	300'
Beam Overall	60'
Depth	30'
Draft Loaded	12' 9"
LNG Capacity	634,013 gal (2400m³)
Displacement Loaded	5,058 tons