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Viega Press Pipe Saves the Day at Sea

In the marine market, tight deadlines and budget constraints are common obstacles to overcome. Even finding a qualified welder for a marine application is a challenge, so being able to join pipe without flame can make all the difference in the marine world. Reducing time spent on repairs and labor expenses means you can focus on doing your job and keeping your crew safe. However, when dealing with a work environment that involves floating on a volatile sea, it can be difficult to ensure safety and precision while operating ocean-based support vessels, drill ships and oil platforms.

Founded in 1899, Viega has become the global leader in marine-approved piping systems like Viega ProPress® for copper and stainless, Viega MegaPress® for black iron and galvanized pipe, Viega SeaPress® for copper-nickel systems and Viega PEX Press systems in two different materials, Zero Lead bronze and high-performance polymer. Viega ProPress, Viega MegaPress and Viega SeaPress meet the standards set forth by classification societies. The company serves many markets, but it has been particularly active on the cruise ship front, primarily providing products and systems for repair and refit out of its U.S. office.

Fast, Efficient and Reliable Connections

An incomplete connection could cause substantial damage if it holds pressure during a test and then subsequently fails. Viega SeaPress, Viega ProPress, Viega MegaPress and Viega PEX Press in high performance polymer feature the patented Smart Connect® feature. The Smart Connect feature, designed directly into the fitting, identifies unpressed fittings during pressure testing.

Viega ProPress and Viega SeaPress fittings in small diameters are designed with cylindrical pipe guides to keep the pipe straight and prevent deflection, which protects the sealing element during assembly.

Fittings that do not have cylindrical pipe guides risk making an unsecured connection. Without the pipe guides, pipe deflection can occur which can compromise and damage the sealing element.

In seconds, Viega press fittings are connected in a single step by pressing on each side of and on top of the sealing element. This creates a connection that is secure and proven to last, and unlike other connections, the sealing element is not in the direct flow path.

Another significant advantage to using Viega press technology is the ability to install Viega MegaPress and MegaPressG while the vessel is at sea, making it easier and more cost effective to perform permanent emergency repairs. Viega offers training and technical support to teach designers and engineers how to convert to press technology. Viega MegaPress fittings can easily adapt to both metric and U.S. inch-size applications.

Viega press technology saves time and labor with fittings that reduce installation time by 60 percent to 90 percent, depending on the material, and connections can be made wet or dry. Without the danger and risk of welding, all the trades can work together at the same time, which allows projects to be completed in a more timely manner.

Safe Connections at Sea

Viega SeaPress, a corrosion-resistant, 90/10 copper-nickel fitting, is built especially for corrosive environments. Viega's cold press technology makes brazing and welding a thing of the past, and connections can be completed under the most difficult conditions.

Repairs and modifications can also be carried out while under way at

Photo: Viega LLC

sea, which are ideal prerequisites to ensure you'll always stay on course. Other Viega SeaPress advantages include easy adaptability to metric and standard systems, cylindrical pipe guides and double press action for the best possible security and an extensive range of fittings, flanges and adapters.

Viega SeaPress can be used for a great number of applications, including seawater cooling, fire main wet, dry and foam, sprinkler system and water spray, hot and cold potable water, bilge lines, foam system, ballast system and tank cleaning services.

Whether it's working on tugs, barges, work boats, passenger ferries, casino boats or inland cruise ships, take advantage of Viega's fast, flameless and secure connections. This is important as ships become more technologically advanced. From the world's first vessels powered by liquefied nitrogen gas that reduces sulfur emissions, to high-tech navigational software, the marine industry is eager for technology that will keep things running more efficiently and for longer periods of time. That said, many of today's ships maintain similar design styles to minimize risk. In order to meet the demands of schedule and budget, shipbuilders must increase efficiencies and reduce manpower. But that doesn't mean they have to sacrifice productivity.

"The cruise sector is huge, a key segment and a growing industry," said Yasmin Fortuny, technical manager, shipbuilding and cruise, Viega. "It's a very high maintenance and time-sensitive segment, as these ships are in port for only a few hours, so it is essential that they have the right parts when they need them."

The MegaPress solution is of particular interest to the marine sector, as it is a new fitting that presses onto a metric or standard pipe.

"We take the logistical worry out of the process, alleviating concern about which type of pipe is available in a given situation at a given time," Fortuny said. "With ships, it is more about how fast can you get it onboard, as it is essential to keep those ships running, at full service, without delay."

Viega offers the widest range of marine-approved press pipe-joining systems in the industry. Viega's press technology extends to a full line of marine press fittings that reduce reliance on qualified welders, hot work permits, gas freeing and chemists. Viega fittings for marine are tested and comply with the International Association of Classification Societies, so the engineering approvals are already completed. Viega systems can also reduce the lifecycle cost of vessels and oil platforms.

Recently, Viega received approvals from the American Bureau of Shipping (ABS) and United States Coast Guard (USCG) for marine and offshore applications for the Viega MegaPress and MegaPressG piping system and couplings. With the new approvals, Viega MegaPress and MegaPressG products can be specified throughout an ABS-classed vessel for applications that include hydronic heating, compressed air, fire sprinkler, cooling water, low-pressure steam, fuel, lube and hydraulic oil applications.

Viega Provides Flameless Ferry Solution

The largest ferry system in the United States, Washington State Ferries (WSF), carried more than 23.9 million passengers and 10.5 million vehicles in 2015. That's a lot of weight to bear year after year, with many of them running 16 to 22 hours a day.

A fleet of 22 WSF vessels transports commuters, tourists and tanker trucks, serving as a marine highway, across Puget Sound. The new ferries are designed to last 60 years – with many of them traveling nearly 1 million miles. Building a vessel capable of lasting this long under these conditions probably seems like a daunting task, but not for the team at Vigor. With ten facilities and more than 2,500 employees, Vigor is the largest ship building, ship repair and complex fabricator in the Pacific

Photo: Viega LLC

Northwest and Alaska.

Vigor's 27-acre Seattle facility is located at the hub of the maritime industry in the Pacific Northwest. In addition to building and maintaining WSF ferries, the yard takes on new construction and repair for mid-sized to large vessels. Vigor routinely services fishing vessels, ferries, barges, military ships, and offshore oil and gas vessels.

Kevin Hein, Director of Engineering at Vigor's Seattle shipyard, and his team are responsible for completing the engineering at all phases of new construction.

"My crew works on production drawings, assisting in troubleshooting of components. Just this morning we were procuring a switchboard," Hein said. "We have every conversation under the sun that has a technical thread in the shipyard. The vessels we build and repair for WSF are very complex. They consist of power generation, propulsion systems, fire protection, food service, navigation systems, structure – all of these go together into this floating self-contained city."

As one can imagine, designing these structures takes time and precision. All the pieces must come together perfectly and be approved prior to construction starting. Adopting new technology, like Viega press technology, is changing the way companies like Vigor do business.

"We first discovered Viega during the design phase for the current Washington State Ferry Olympic-class ferries," Hein said. "We were looking for a mechanical-type fitting that was an alternative to hot work, but through conversations with sales reps and the customer, we jointly recognized the benefits of using press products."

At the time, there were restrictions on where Vigor could use Viega products. Those restrictions don't exist today. After decades of performing hot work, which can damage paint and be more costly from a fire watch standpoint, Hein is glad Viega came into play. To date, Vigor has used it on six Washington State Ferries, and is working on their seventh.

"For us, it is the first push into this area away from traditional welded or brazed systems," Hein said. "As our workforce ages and we have higher demands on them, we try to do earlier outfitting without damaging paint due to hot work. The use of 'cold work' piping solutions, like Viega, are more and more important."

Hein began utilizing Viega ProPress Copper on potable water and hot water heating in 2008 and today also relies on the Viega copper nickel system for vehicle deck sprinkler systems. According to Hein, the original use of Viega ProPress was the start of the evolution of no hot work piping products and it has expanded as time goes on.

"Both are great products. They are the right choice for those systems. They meet the regulations and they are easy to install. There's a lot of pipe in the vessel so you really see the benefit of the labor savings," Hein said.

Vigor recently completed work on the M/V Tokitae, an Olympic-class passenger ferry. This was Vigor's first experience with Viega SeaPress, a copper-nickel system built specifically to withstand the harsh elements of the sea.

"Even on the new construction side, the reality is that it's so similar to ProPress, you almost don't notice. In terms of installation, those two are direct cousins," Hein said. "It's good that across the Viega family of SeaPress, ProPress and MegaPress that the concepts are very similar. So from the installer's perspective, they are very similar sets of skills."

The similarities don't end there. Viega systems are also designed to last the life of the system. Hein said he believes Viega represents the same life span as conventional piping products, but at a reduced overall cost. Because the majority of Vigor's work is competitively bid against

Photo: Viega LLC

either regional or national markets, their ability to effectively implement labor dollars is extremely important.

"Seattle is not a low cost area, so anything we can do to make our labor hours more effective is part of our plan. This makes Viega a good choice," Hein said. "Any mechanically attached fitting represents better labor dollars which allows us to deliver good value to the citizens of the state whose tax dollars fund these projects."

Labor savings isn't the only benefit Hein has seen, however. Whether Vigor is designing the vessel or doing a retrofit, Viega technology allows installers to reach tight spaces where traditional joining methods would prove difficult. That said, it all requires planning.

"You have to be able to fit the jaws around the pipe completely, so confined spaces do require planning just like a welded or brazed product would," Hein said. "We have found that you really have to think about how you're going to get it in there. For some of our smaller copper lines, sometimes they are crammed into a corner, so the operator's knowledge and familiarity of the product is important to make sure it isn't pushed too far into the corner."

With Viega, you don't need the same access required to weld or get a torch all the way around the product. That means you don't have to cover up the paint that's only two inches away from the pipe or the bulk head for fear of burning it. This knowledge comes not only from years of experience working in the bulk heads of these vessels, but also the expertise of Viega's technical representatives.

"We have a very good relationship with Viega's Technical Manager for Shipbuilding and Offshore. The fact that he's a longtime marine professional that we've done business with as a designer and an engineer helps a lot," Hein said. "I find him to be valuable because he is interested in making sure I have the right product for the right application. It's not a traditional sales relationship, it's a partner/provider relationship, where he's looking at our customer's best interest overall as opposed to just getting a Viega product in the vessel."

Viega representatives are able to bring the technical details and the

Viega MegaPress®

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Precision and safety are essential for ocean-based support vessels, drill ships, and oil platforms. Reducing time spent in repairs and labor expenses means you can focus on doing your job and keeping your crew safe. But can you accomplish that when your work environment is floating on a volatile sea?

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- No flame means no welding, hot work permits, chemists or gas freeing
- Press connections can be made on live systems in seconds
- Suitable for ASTM and DIN spec piping

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viega

installation details to every job and for those unfamiliar with Viega's systems, an onsite demo truck travels around the U.S. year round, allowing installers to see and touch the product.

"There's much more to the Viega team than just our local sales rep. He is the conduit, that when combined with our material suppliers, makes sure we get the right information," Hein said. "The Viega team has been adept at bringing the spectrum of information required for us to install piping products successfully at a competitive cost."

Viega SeaPress Delivers Speedy Seaside Rescue

In its 20 years in business, All Points Boats, based in the Lauderdale Marine Center, has never shied away from complicated projects, but a recent re-piping job was more memorable than most.

A bilge pump is an important piece of equipment on every yacht. Its role is to take water out of the yacht, preventing it from sinking. Regulated by class societies, bilge pumps must be a certain size, have a certain flow rate and the connecting pipe is also required to be a certain size and material.

The engineering crew on the yacht tasked All Points Boats to change out the bilge and fire pumps, but make them work with the existing manifolds, which were made of copper-nickel, a high-grade, sea-worthy material.

"This was a pretty complex operation. There were big copper-nickel lines that are quite tied together," Sheridan said. "It's like a giant twisted trumpet or 54mm French horn."

There were three pumps located in close proximity and each of them needed to have the ability to draw suction either directly from the ocean or from the bilge manifold. There are two options on the suction side and three options on the discharge side, each with its own manifold.

"Each of the three pumps probably required half-dozen fittings to twist and bend and curve around the corner to connect to these manifolds," Sheridan said. "And these are all heavy-walled, copper-nickel manifolds. The material is very expensive and difficult to weld and conceptualize the solutions because of how it's put together."

It's a 150-hour project that two plumbers at All Points Boats had 80 hours to complete. They were feeling pretty good about their accomplishments and were excited to show the engineering crew on the yacht their work.

But a change was needed. Three valves had to be added to the system. That was when Sheridan was glad he had chosen Viega SeaPress, a copper-nickel press fitting system.

"If you had used a welded pipe solution, this would be catastrophic. Essentially half of the work you've already completed would have been scrapped, and you basically would have to start from the beginning," Sheridan said. "This yacht was also under a time crunch, so everything was stacked against us. But because we had used the Viega system, we had only dry-fitted the pipe and fittings but had not pressed them yet."

With Viega's system, they were able to disassemble this large, complex system and incorporate the three valves in a day's time.
"In a welded-pipe scenario, this would have been a major change," Sheridan said. "Not only did Viega help get us out of a pinch, we were able to finish the job on time."

If they had welded, Sheridan estimates the job would have required 50 percent more labor, the equivalent of 300 hours minimum, and 250 hours additional hours with the last-minute addition of the valves. Dry-fitting is easier with Viega systems and it's a practice All Points Boats employs on every job.

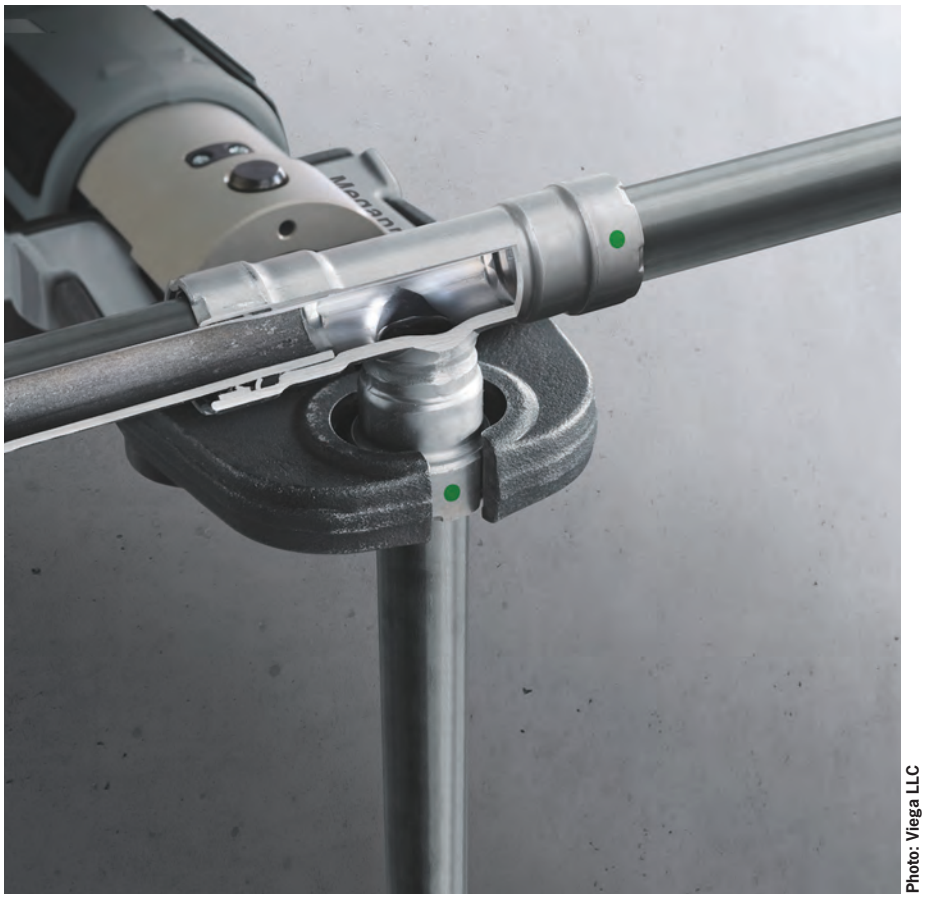

Photo: Viega LLC

"We use the forgiveness Viega offers by being able to dry-fit," Sheridan said. "By checking things two or three times prior to pressing, you can negate any changes with minimal cost in materials."

Even if they needed more SeaPress fittings – or any Viega press fittings – Sheridan knows it's not difficult to get products delivered when they need them.

"Because of the inherent unpredictability of what walks in the door, it's next to impossible to guess what we'll need, so we pretty much buy for the job," Sheridan said. "We don't stock any large amounts because everything is readily available."

To meet the demands of class societies, high-quality materials and the availability of products make Viega systems ideal for marine repair shops like All Points Boats.

"Completing this job would not have been possible without Viega," Sheridan said. "We utilize Viega systems a lot and this project has proven Viega is worth its weight in gold, or in this case – copper-nickel!"

About Viega:

The Viega Group, with a tradition of innovation for more than 115 years, has more than 4,000 employees worldwide and is among the leading manufacturers of pipe fitting installation technology. In metal press systems for industrial, commercial and residential projects, the company is the global market leader. In the U.S., Viega LLC employs nearly 500 people and offers more than 3,000 products. These include Viega ProPress® for copper and stainless, Viega MegaPress® for black iron pipe and Viega PEX Press systems in Zero Lead bronze and high-performance polymer. With the widest range of materials and marine approvals in the industry, Viega has become the global leader in marine-approved piping systems, such as Viega SeaPress copper nickel systems, Viega ProPress® for copper and stainless and Viega MegaPress® for black iron pipe.Viega also specializes in the design, production and installation of ProRadiant™ heating and cooling systems. For more information, visit www.viega.us.

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All stats from 02/14/2017

Designing for Efficiency

Written By: Gregory W. Beers, P.E. / President
Bristol Harbor Group, Inc.

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Introduction

Designing efficient vessels is the heart of what naval architects do. Efficiency in this case is defined as the ratio of useful travelled distance of goods or cargo; divided by the total energy put into the transportation propulsion means. In other words, a more efficient vessel design will require less fuel (cost) to move a given cargo a certain distance. This paper will explain why efficiency is important and will explore some aspects of small coastal vessel design that can improve vessel efficiency. We will also investigate several of the techniques that are used to analyze a vessel's efficiency utilizing Articulated Tug-Barge (ATB) units as case studies.

Background

Bristol Harbor Group, Inc. (BHGI) is a full service naval architecture and marine engineering firm located on the harbor in Bristol, Rhode Island. We have been in business for more than twenty years, and have produced more than 100 unique designs to which hundreds of vessels have been built. We specialize in commercial vessel design and consulting and have experience with tugs, barges, passenger vessels, dredges and yachts.

Our team of dedicated professionals hail from some of the best naval architecture schools in the country. The executive team is comprised of Greg Beers, P.E. and Cory Wood, who met while students at the University of Michigan. Greg and Cory incorporated BHGI (formerly FG Marine Design, Inc.) with two other college friends in 1995. The greater technical team includes University of Michigan, Webb Institute, Virginia Polytechnic Institute, University of Rhode Island, and Rensselaer Polytechnic Institute graduates. Our engineers have much real-world experience, enabling us to make sure that our designs are innovative, yet practical.

BHGI provides naval architecture, marine engineering and project consulting services to clients worldwide. Quality is an important part of engineering, and at BHGI, our engineers follow strict document checking procedures. All drawings and calculations that leave BHGI are checked by a senior or principal naval architect and marine engineer prior to release.

We utilize state of the art computer modeling and design practices to develop innovative and functional designs that meet our customers' diverse requirements. Our engineers also have many years of hands on experience both aboard vessels and in shipyards. This practical experience allows our engineers to better understand both operational and technical issues. BHGI's marine engineering practice focuses on the design of new vessels, but our engineers also work on repowerings and mechanical and electrical upgrades.

At BHGI, we endeavor to over deliver to our clients. This does not mean that we over think issues, but rather that we deliver drawings with more detail than the client might be expecting, and calculation packages with more depth than the client has seen in the past. We do this because we have discovered that this is our preferred work method, i.e., this is what "floats our boat".

Through BHGI's Indefinite Delivery/Indefinite Quantity (IDIQ) contract with the U.S. Army Corps of Engineers (USACE), Marine Design Center, Philadelphia district, BHGI has been tasked with jobs ranging from conceptual vessel designs; to biodiesel and LNG studies; to detail design and analysis of vessels.

Recent experience includes the design of a USACE wicket lifting vessel for operation at Olmsted Lock & Dam on the Ohio River. Currently under construction, the vessel is expected to be delivered in the 3rd quarter of 2017. An interesting aspect of this USACE IDIQ contract is that other federal agencies use the contract vehicle to reach BHGI. A recent example of this is that BHGI will continue to provide design and engineering support to the USACE for the NASA barge PEGASUS. Through BHGI's first contract with the USACE, BHGI was tasked to redesign the PEGASUS's hull, lengthening it from 260 ft. to 310 ft. to

accommodate NASA's new Space Launch System.

Other recent experience at BHGI includes the design of several 80,000 BBL oil barges that are part of ATB units for Vane Brothers Company. The barges are being built by Conrad Shipyard and the lead vessel is expected to be delivered in 3rd quarter 2017 with two follow on units at six month intervals. Another recent project is for the New York Power Authority (NYPA). BHGI was contracted to design and perform construction support services for two new tug vessels. The tugs will be used for the deployment, retrieval and maintenance of the Lake Erie ice boom. The construction for the first of the two, the JONCAIRE II, has been completed and NYPA will soon be soliciting bids for the construction of the B-2 BREAKER tug.

History

Marine transportation is exceptionally efficient to start with. When comparing inland barge transportation to trucks and rail, the differences are stark. One train operator, CSX, runs a wonderful advertisement that notes that trains are four time more fuel efficient than trucks[1]. However, they fail to mention that barge transportation is even more efficient. The advert speaks in terms of ton miles, noting that one ton of freight is moved 471 miles on one gallon of fuel by CSX trains. However, a report for the U.S. Maritime Administration and the National Waterways Foundation[2] notes that inland towboats and barges move one ton of freight 576 miles on one gallon of fuel. Both modes primarily use medium speed diesel engines as prime movers, so the comparison is quite valid. Although this paper does not focus on inland barges and towboats, a white paper by our sister company, The Shearer Group, Inc., slated for later this year will focus on similar efforts in that market, so stay tuned!

Historically, vessels have been either fast or efficient. The two attributes often oppose one another. In this paper, we will focus on efficiency, not speed. There are many things vessel owners do operationally to increase efficiency, such as slow steaming, coating the hull with slick bottom paint, and keeping the hull clean. Additionally, there are many aspects of a vessel's mechanical design that can improve efficiency such as the use of diesel electric and / or battery technologies. When hunting for efficiency, these other avenues are ripe with opportunity, especially as the U.S. fleet wrestles with the implementation of Tier IV complaint engines. However, this paper will focus on the some of the things that naval architects can do to simply create more efficient hull designs rather than operational or mechanical improvements.

Techniques

First Principles

Naval architects have been working to reduce the resistance of vessels (a.k.a. increase the efficiency) for centuries. A simple truth about marine transportation that is well understood is the efficiency of scale. Marine vessels can generally move more cargo at the same speed with less power per ton of cargo as they grow in size. Further, the lighter the part of the ship that is NOT cargo (i.e. the lightship weight of the vessel), the more tons of cargo the ship can move at a given speed for a given horsepower. Therefore, lighter vessel structure and minimizing the use of ballast both contribute to the efficiency of a vessel.

These first two concepts are simple and easy to understand. A large light vessel is more efficient than a small heavy ship. However, there are other aspects of hull design that are harder to understand. For instance, a longer, finer vessel will produce less wave making (and eddy) resistance, but will likely have more wetted surface which adds to the

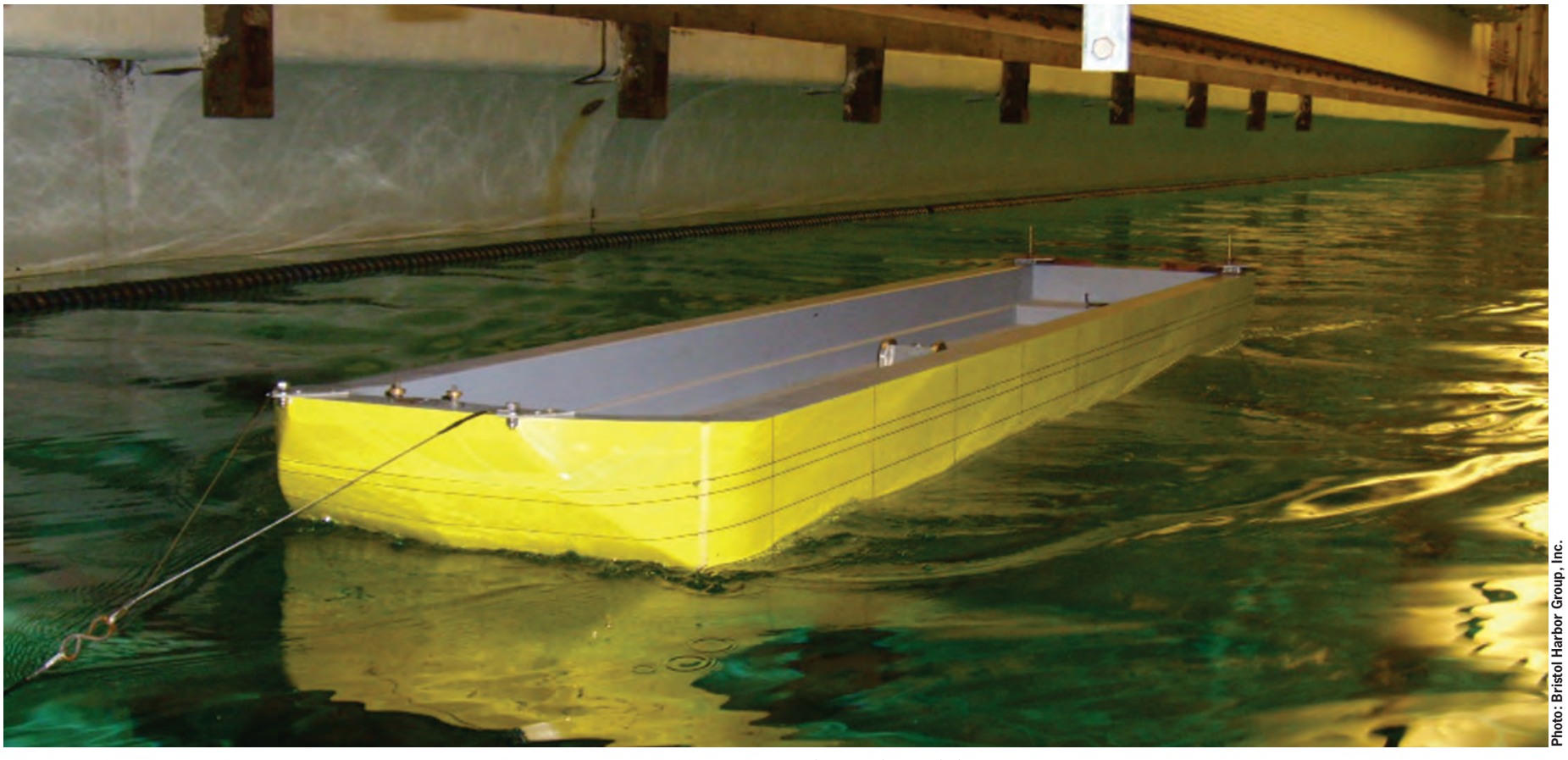

Photo: Bristol Harbor Group, Inc.

Figure A - Barge Physical Model

[1] www.csx.com / About Us / Fuel Efficiency

[2] *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*, Center for Ports and Waterways, Texas Transportation Institute, December 2007.

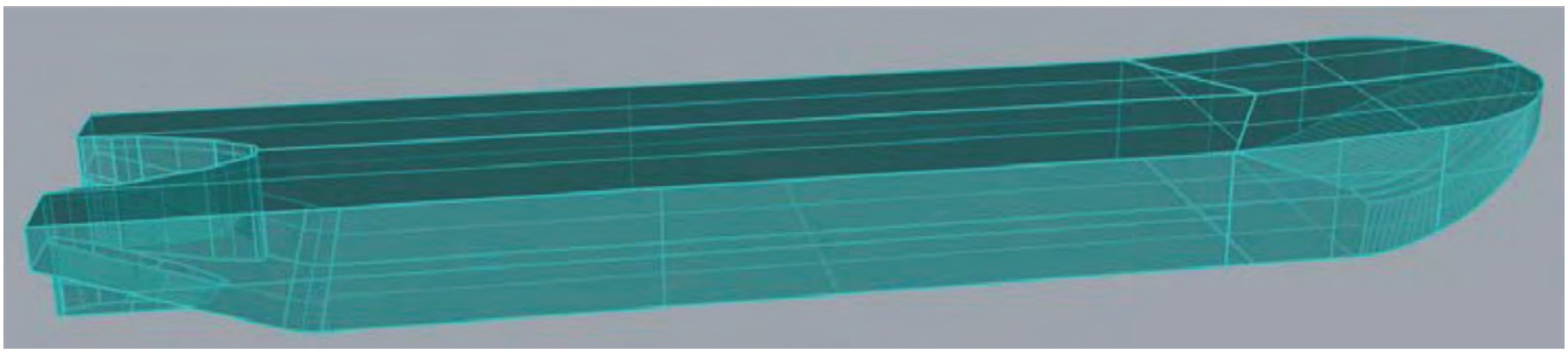

Figure B - Spoon Bow

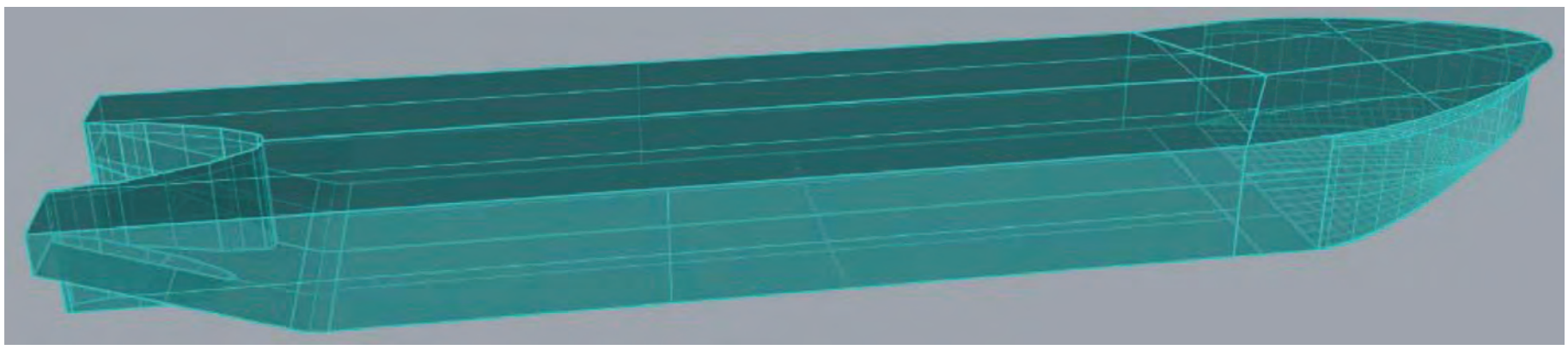

Figure C - Ship Shape Bow

Photos: Bristol Harbor Group, Inc.

vessel's frictional resistance. Similarly, appendages add resistance, and propellers can be designed to maximize the thrust needed to overcome said resistance. There are rules of thumb and empirical regressions to aid in the design of vessels and their appendages, but we will look at two specific methods of testing and analysis that can be used to quantify the resistance of a vessel. We will first investigate the use of model testing in towing tanks, and then the use of Computational Fluid Dynamics (CFD) which can be used to test hull models virtually (i.e. on a computer).

Tow Tank Testing

Tow tank testing is accomplished by using a ship model basin to perform hydrodynamic tests to refine the design of a vessel to improve its performance. The world's first facility to perform this type of testing was a shipbuilding company called William Denny and Brothers in Dumbarton, Scotland in 1883. Modern towing tanks vary in size with one of the longest being the 2,968 ft long high-speed basin at The David Taylor Model Basin at the Carderock Davison of the Naval Surface Warfare Center. Generally, a carriage runs on two rails on either side of the basin and is equipped with computers that are able to control the speed, propeller thrust, torque, etc. to run resistance and propulsion tests to determine how much power the vessel will need to achieve the desired speed.

Case study:

Bristol Harbor Group, Inc. has tested many vessel designs in several different hydrodynamic laboratories, including the Marine Hydrodynamic Laboratory at the University of Michigan and the tank at BC Research, Inc. Ocean Engineering Center. For this paper, we will investigate a 311' x 68' x 24.5' 60,000 BBLS barge that is part of an ATB unit. The requirements for the barge were that it needed to be efficient when being pushed by the tug in the notch, but also stable (dynamic towing stability) when being towed by the tug astern on a hawser. Therefore, a model of the barge (Figure A) was built with two different bow designs that could be swapped out.

One bow design was a more conventional spoon bow (Figure B), and the other was a ship shape bow (Figure C). This model and these two bows were tested at the University of Michigan Marine Hydrodynamics Laboratory. The barge was towed on a model hawser to evaluate its the dynamic towing stability with each bow, and to evaluate the resistance of the hull in each configuration. As with most engineering problems, the results were conflicting. The spoon bow barge had higher resistance, but tracked better (i.e. had better dynamic towing stability) than the ship shape bow.

In this case, the client opted for the 5% to 8% increase in resistance in favor of the dynamic towing stability gains that the spoon bow offered. However, had the increase in resistance been higher, say 20%, perhaps the ship shape bow would have been chosen. This case study is an excellent example of the use of towing tanks for comparative design.

Computational Fluid Dynamics

CFD is an alternative to tow tank testing that allows naval architects to obtain engineering data they need to verify or alter a design early in the design process. This form of hydrodynamic analysis looks at the interaction between the hull, its propulsor, its appendages and how they all interact with environmental conditions. Performing physical hydrodynamic testing at a model scale as described above can produce uncertain results regarding vessel performance. Further, by using CFD technology such as STAR-CCM+, naval architects are able to virtually test hulls and improve the design of the vessel without building the expensive physical models that are required for tow tank testing.

Case Study

ATB's are unique vessels, especially from a hydrodynamic perspective. The interaction between the tug bow and barge stern notch is inherently inefficient. Turbulence in the notch creates increased resistance and reduced propeller efficiency, the latter of which is further exacerbated by the fact that tugs are relatively shallow vessels.

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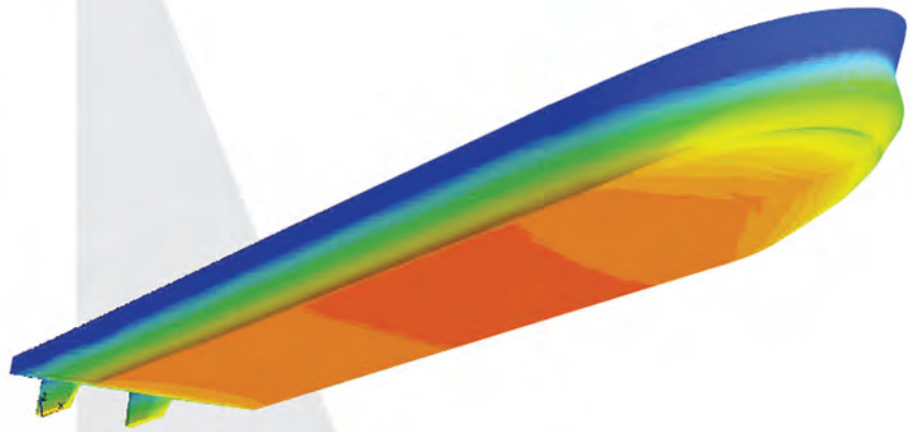


Our Core Purpose... is to **Create.**

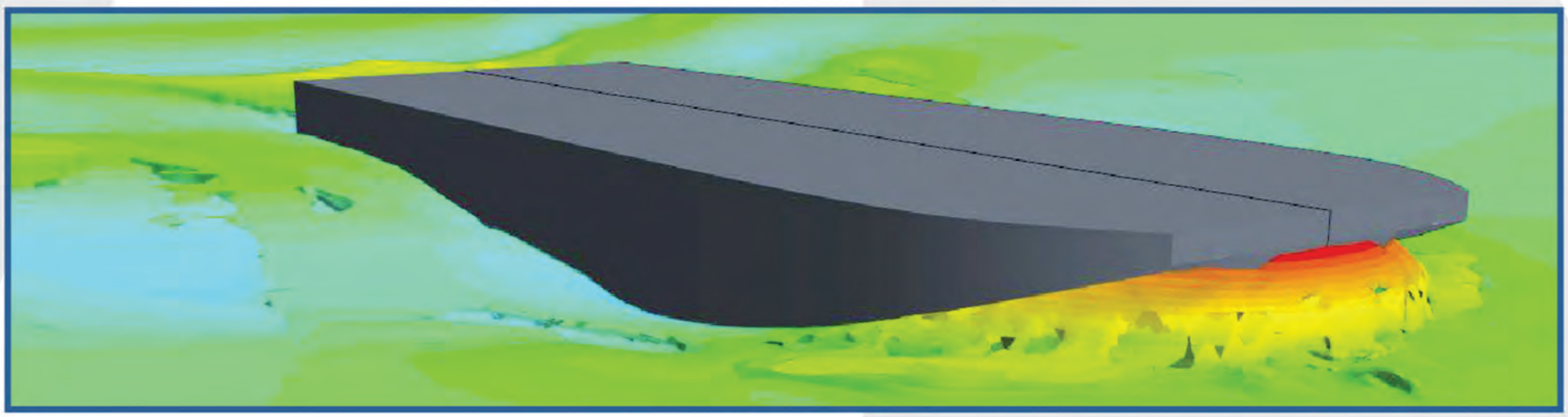


Photo: Bristol Harbor Group, Inc.

Figure D - 311' x 68' x 24.5' 60,000 BBLS Barge

For this case study, BHGI started with an existing design for a 399' x 74' x 30' 80,000 BBL double hull oil tank barge and a 120' x 40' x 18'- 6" twin screw ocean service tug. CFD and Finite Element Analysis (FEA) were used extensively during the design effort for these vessels making them a good starting point for hydrodynamic experimentation. CFD analysis had been previously performed to determine the calm water resistance of the combined unit and to optimize the tug forebody and stern rake geometry of the barge. The vessel specifics follow:

ATB Tug:	
Dimensions:	120'x 40'x 18.5'
Classification:	ABS *A1, *AMS, ABCU, Oceans Towing Vessel Unlimited Service certified under SOLAS/IMO/MARPOL
ATB Double Hull Oil Barge:	
Dimensions:	399'x 74'x 30'
Capacity:	80,000 BBL
Classification:	ABS *A1, Unlimited Oceans, Permissively Manned

The goal of this additional experimentation was to determine if the resistance of the ATB unit could be reduced further by incorporating changes to the barge's stern and the bow design that were not possible for the existing design. BHGI was able to reduce the resistance of the combined unit by upwards of 20% by further refining the barge stern design as shown below in Figure H (as compared to Figure G).

BHGI then looked at alternate bow designs for a vessel of this size and service. Interestingly, a fuller "elliptical" bow (Figure I) provided an additional reduction in resistance for the combined unit. This reduction was greater than 10% at certain speeds.

CFD Results

Finally, BHGI looked at combining the improved bow and stern designs to quantify the total potential reduction in resistance. Although the improvements were not additive, incorporating both alterations to the baseline design showed a greater reduction in resistance at a given speed than only modifying the bow or stern.

Real World Observations

As anyone who works with computers knows, there is always the potential for "garbage in – garbage out" when it comes to computer based analysis. To ensure that BHGI is not falling prey to this truism, we make good use of real world observations. One good source for this is AIS software such as MarineTraffic[3] . Using this tool, we track actual ATB units to see what kind of real world transit speeds they are attaining. In one example, we tracked a unit for 10 months, looking at her speed when loaded and when empty, and we note that her loaded transit speed lines up very well with that calculated for the unit operating at 80% of the tug's main engines' maximum continuous rating (see Figure K).

Conclusion

As noted above, BHGI is a firm believer and user of the latest technology to create more efficient vessel designs. In fact, BHGI has been involved in custom propeller and appendage design using similar tools (model testing and CFD analysis). However, we also understand the importance of grounding our analytic efforts in the real word. This is evidenced by the first case study where a less efficient hull design was selected because it had better operational characteristics (better dynamic towing stability); and by our efforts to monitor real world observations and check our analytic work against this data. Said simply, we "trust but verify" the tools in our tool chest.

BHGI / TSGI Efficient Together

BHGI has designed and provided construction oversight for both conventional and z-drive ocean-going tugboats ranging from 660 bhp to 5,000 bhp. Our sister company, The Shearer Group, Inc. (TSGI) has designed a myriad of conventional and z-drive towboats for the inland waterways. Most notably, TSGI recently designed two different revolutionary z-drive towboats for Southern Towing Company, eight

[3] www.marinetraffic.com

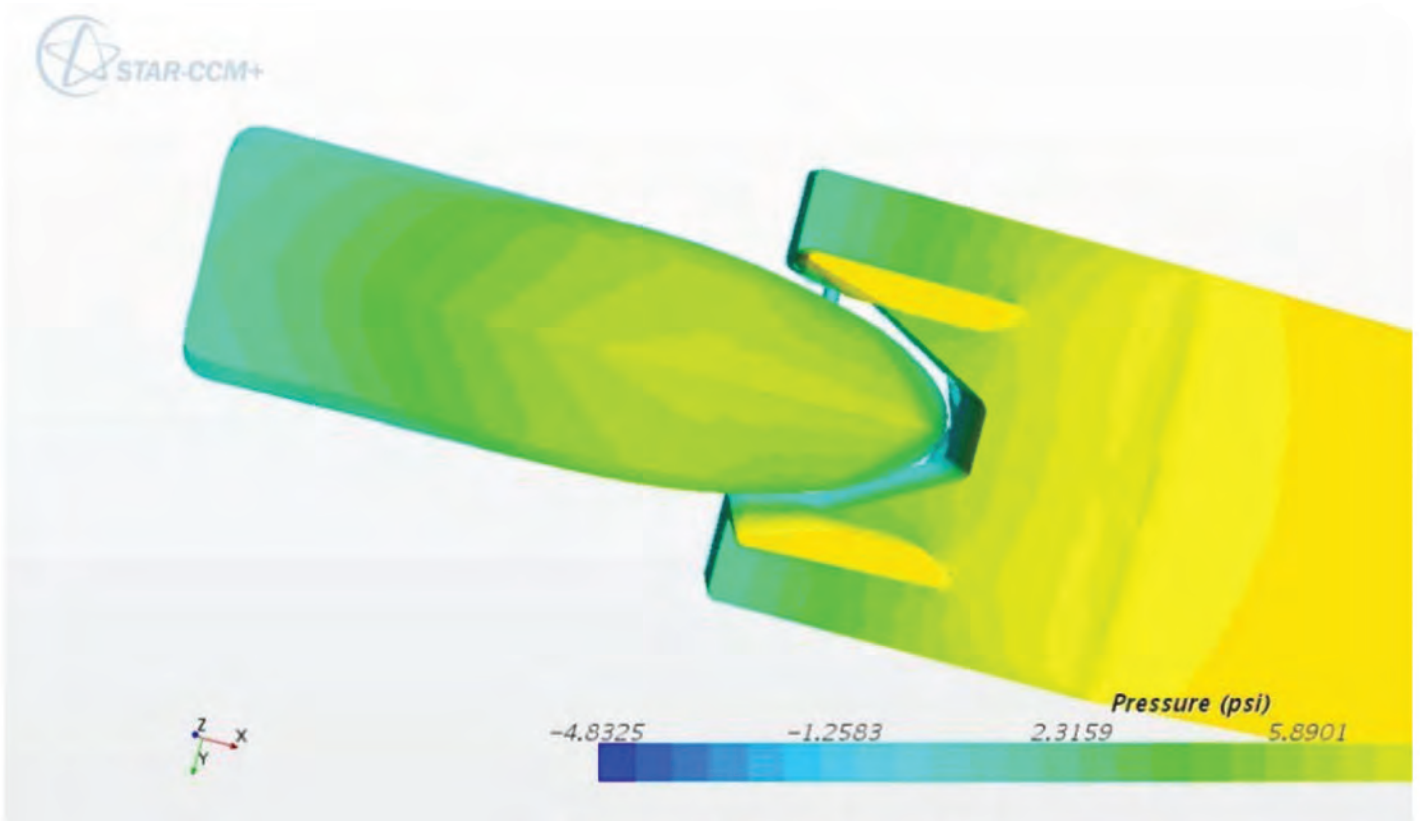


Figure E – ATB Tug / Barge Interface

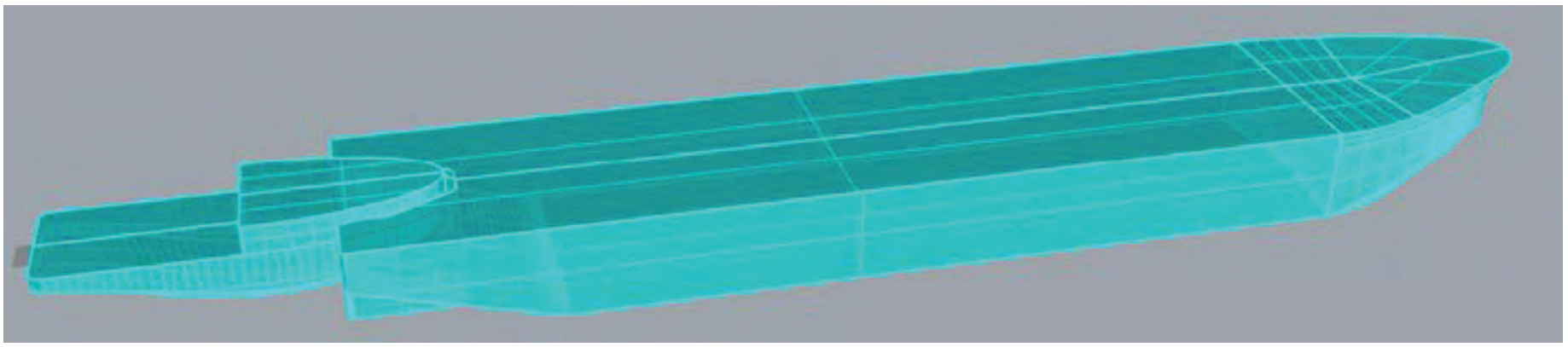


Figure F – ATB Computer Model

of which were built (six 3,200 HP and two 2,400 HP vessels). TSGI is a leader and innovator in the inland towboat industry. BHGI and TSGI are intimately familiar with the current U.S. Coast Guard loadline, and class requirements. Further we were involved in critiquing the recently released Subchapter M rule. This has positioned BHGI and TSGI well for designing new Subchapter M compliant tugs and towboats or bringing existing vessels into compliance.

BHGI & TSGI have completed hundreds of unique barge designs ranging from 90' deck and crane barges to 400' double hull oil barges, and 400' loadline deck cargo barges. The companies have also designed passenger vessels range from high speed catamaran ferries, to 600 passenger only ferries, to a double-ended ferry for the Texas Department of Transportation. Other passenger vessel designs include dinner vessels and paddlewheelers. BHGI has also provided owner's representation and construction oversight services for passenger and cargo / passenger vessels for both public and private operators. In regards to aluminum vessels, BHGI has designed a variety of small custom patrol boats and water taxis.

BHGI and TSGI both have extensive knowledge of liquefied natural gas (LNG) and have been involved in LNG projects since 2009. BHGI was contracted by Conrad Orange Shipyard to design a 232', 2,200m³ LNG bunker barge. It is the first bunker barge in North America and is expected to be delivered in 2017. As for TSGI, they too are engaged in LNG projects, having developed the design of a LNG powered towboat

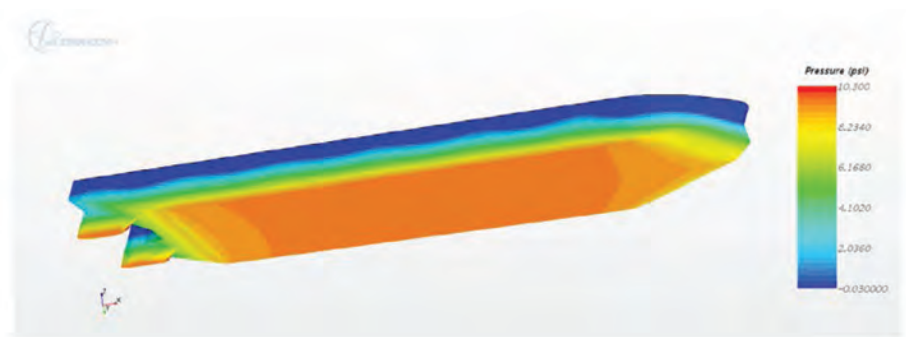


Figure G – Conventional Barge Hull Design

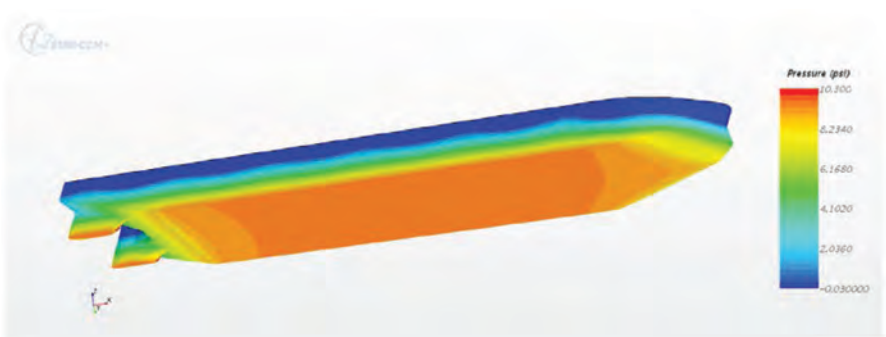


Figure H – Alternate Stern Design

Photos: Bristol Harbor Group, Inc.

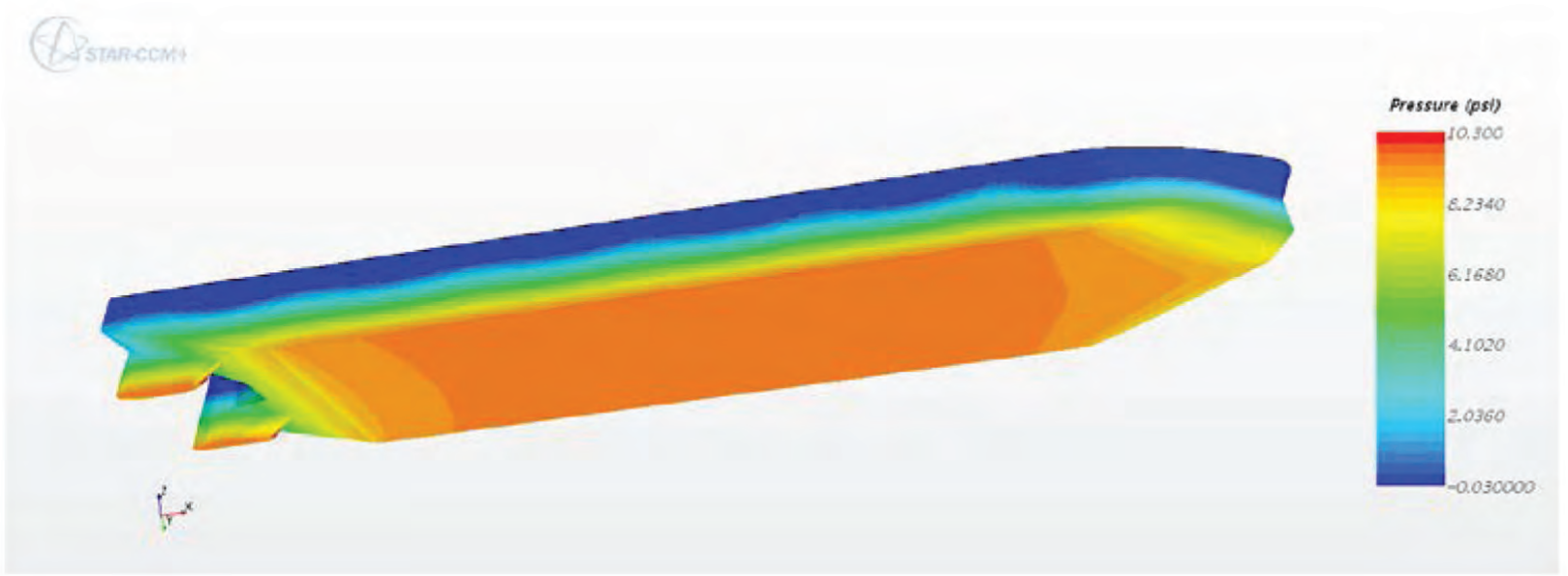
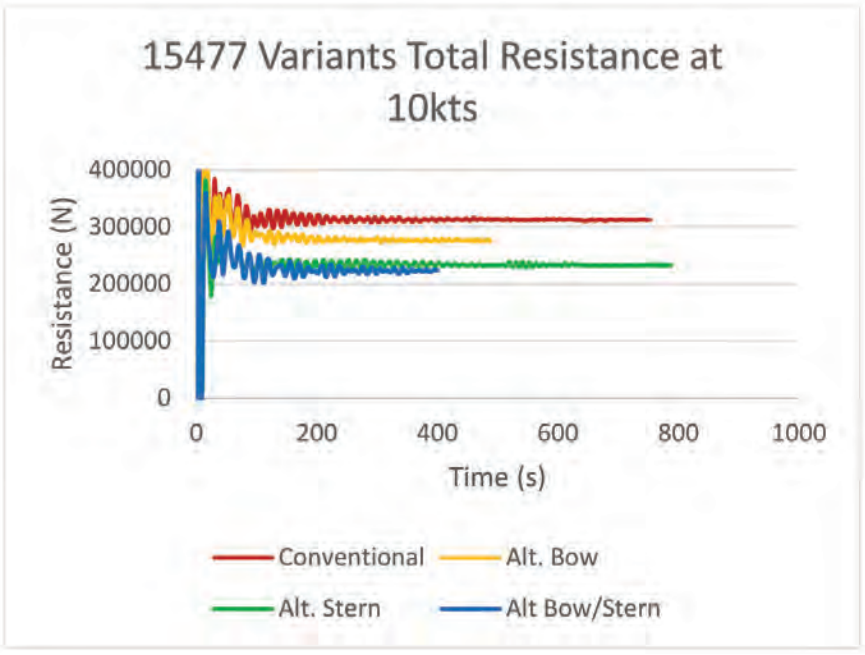


Figure I – Alternate Bow and Stern Design

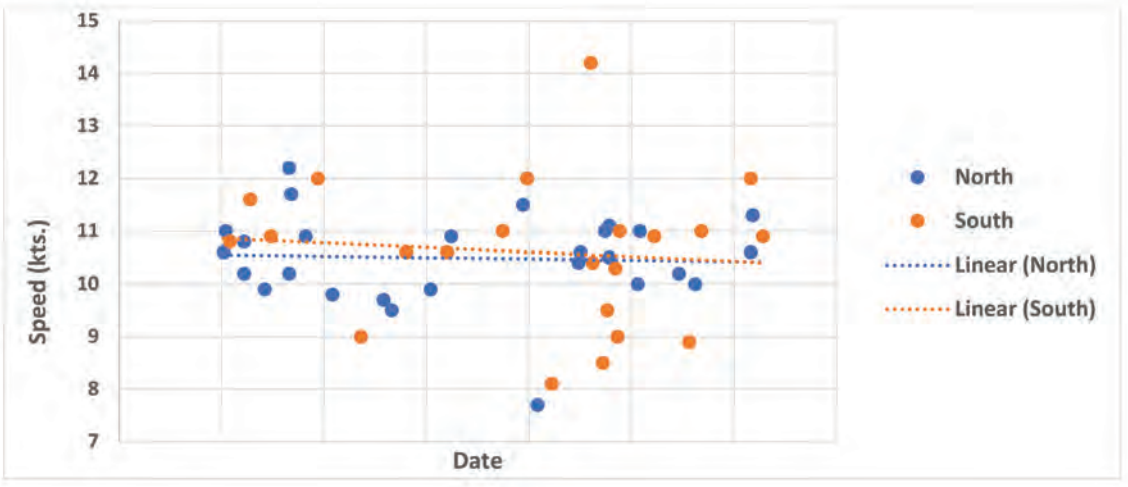
utilizing a proven towboat design. The team was awarded AiP by ABS for this design as well. TSGI is currently working with Pittsburg Region Clean Cities (PRCC) and Clean Fuels Clean Rivers (CFCR) on the conversion of an inland towboat to dual fuel (diesel/LNG) to reduce diesel emissions of marine vessels.

As described above, both companies are committed to their core value which is "To Create", and to using the latest technologies to design more efficient vessels. Later this year, TSGI will issue a white paper continuing this theme but focused on efficient design of inland towing vessels. Many of the concepts discussed in this paper relate to the brown water industry and we look forward to sharing some of our thoughts and observations on efficient vessel design for the inland market next.



Variant	Speed (kts)	BHGI Resistance (N)
Conventional	10	312,351
Alt. Bow	10	276,341
Alt. Stern	10	232,945
Alt. Bow/Stern	10	223,162

Figure J – Alternate Bow and Stern Design Results



Photos: Bristol Harbor Group, Inc.

Figure K – Real World Observations for 80,000 BBLS ATB

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