

FROM DAVE'S DESK

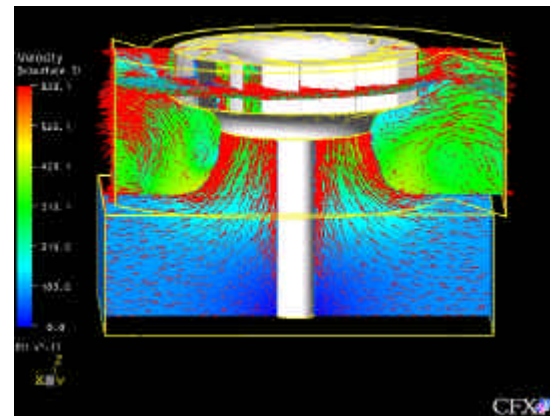
The last three months have been exciting but busy as we finalized the hiring of full-time and part-time associates, expanding our staff by 30%, to support our recent growth in business volume. The additions to our staff are impressive. They include some of the very best naval architects and engineering graduates available from MIT, Webb, Michigan and VPI, plus electrical engineers from VPI and the USNA. Most of this growth in business has resulted from supporting recent hardware design projects in the U.S., South Korea and Norway. In particular, we have seen an increase in our structural design support to NGSS on the LHD 8 Amphibious Ship program and an increase in our systems engineering support to NGSS for the design of the new DD(X) Surface Combatant. Work directly for our navy has included the design of advanced propulsion and lift systems for the Heavy Lift LCAC program. For this effort, we are using advanced inverse CFD design software, developed originally in England, supported by aerodynamic validation tests to be conducted at the University of Maryland wind tunnel this fall. Our work in support of homeland security has also increased this year with innovative systems being developed and installed by our personnel. For South Korea, we are designing the LSF-II military air cushion vehicle. For Norway, we just completed the design and testing of improved lift-air supply fans for the fast combatant SES, SKJOLD. The pages of this newsletter summarize some of this activity. All of these projects result in the construction of hardware and testing, or in-service operation, that provides very valuable feedback to our scientific staff for their use in future projects.

DESIGN OF ADVANCED LIFT FANS USING CFD

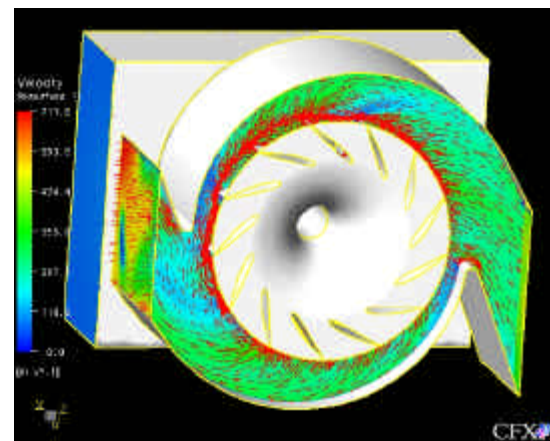
By John Purnell, Senior Engineer

The Heavy-lift Landing Craft Air Cushion (HLCAC) will require new lift fans to meet its more demanding craft requirements. CFD analysis using ANSYS CFX is being performed here to develop a new lift-fan system design. Using CFD, the new lift-fan designs, together with new fan inlet and exit volute designs, can be evaluated together to predict the expected component and system performance to a good degree of certainty.

CFD analysis predicts the pressure and flow fields through the fan system design, and the required input powering and various system efficiencies can be evaluated from this information. Designs can be revised to minimize regions of air-flow separation and to improve overall performance and efficiency. The velocity contours through a fan system design are shown in the following three figures at various fan system angles and various cuts through the inlet, impeller, and volute geometries to illustrate the level of detail available from the CFD.



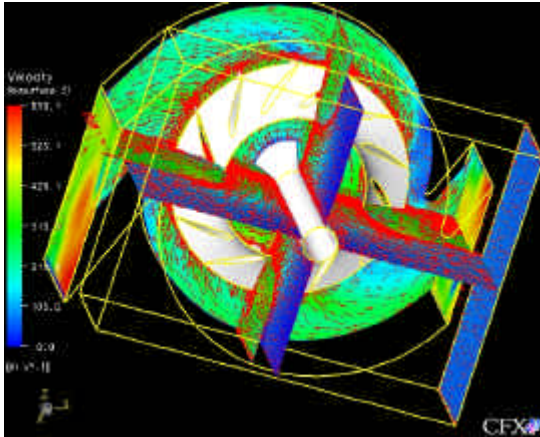
Predicted Lift-Fan Velocity Contours through the Inlet, Impeller and Volute



Predicted Lift-Fan Velocity Contours in a Double Exit Volute Arrangement

Continued on Page 2

DESIGN OF ADVANCED LIFT FANS USING CFD, Continued from Page 1



Predicted Lift-Fan Velocity Contours Viewed from the Inlet Side

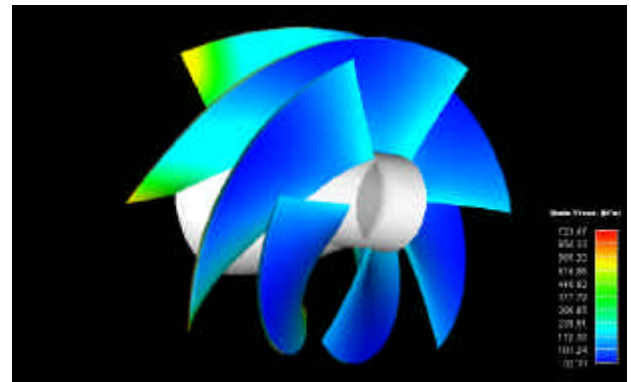
The various fan system components are initially designed using other various state-of-the-art methods, such as TURBOdesign¹, developed by Advanced Design Technology, Inc., to develop the blade geometries. CFD is an invaluable tool for analyzing the fan system designs in that all the components can be analyzed together with their interaction effects and the system performance evaluated. Evaluation of a component, like the double exit volute design to be used with the lift fan, would be nearly impossible without the aid of CFD. Using an interactive approach between our various design tools and methods and the CFD results, the component designs are refined to develop a fan system that will most efficiently meet the HLCAC system requirements.

ADVANCED MARINE WATERJET DEVELOPMENT USING CFD

By Alan Becnel, Senior Engineer

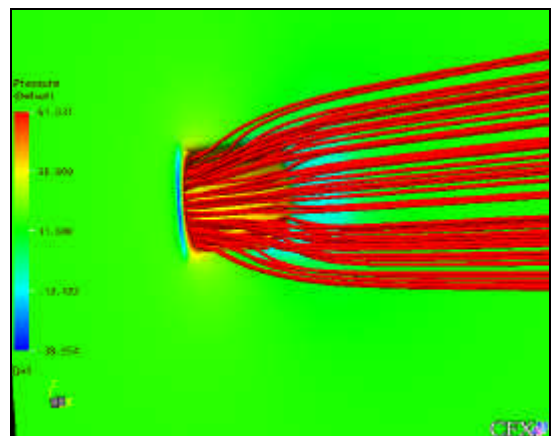
Our capabilities to design advanced marine waterjet propulsors have been greatly enhanced by the introduction of 3-dimensional Computational Fluid Dynamics (CFD) design and analysis software. We currently have two software packages leased for the design and analysis of marine waterjet propulsors, TURBOdesign¹ for the design of waterjet rotors and stators, and ANSYS-CFX 5.6 for the analysis of ship hulls, inlets, rotors, stators and nozzles. By using these advanced tools, waterjet designs have been generated that are more efficient, have better cavitation performance, are easier to manufacture, and weigh less than current waterjet designs. In the past, we would team with other companies or government agencies, or contract out the CFD analysis, but this limited the number of iterations that could be investigated for a given project. With the CFD analysis now in house, many more design parameters can be varied to arrive at the best design while still meeting the time constraints of the project.

TURBOdesign¹ is a fully 3-dimensional inverse CFD design code for turbomachinery that designs the blade surfaces from a given swirl distribution supplied by the user. The swirl distribution is inputted in both the hub-to-tip direction as well as in the chordwise (along the axis of rotation) direction, and since the blade surface pressure distribution is a function of the swirl distribution, the surface pressure and, therefore, cavitation can be controlled by using the proper swirl distribution. The figure below shows a sample waterjet rotor developed using TURBOdesign¹ with the blade surface pressure distribution.

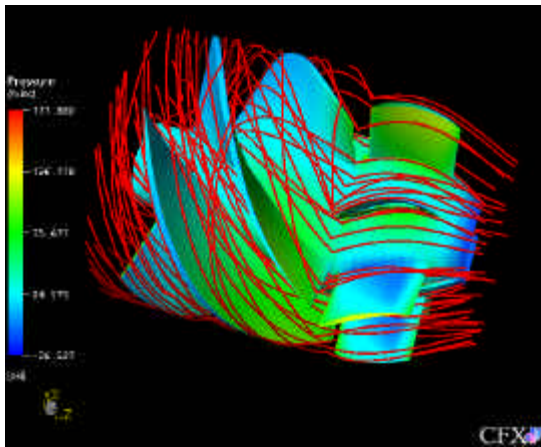


6-Bladed Waterjet Rotor Design using TURBOdesign¹

The viscous analysis of the waterjet components, as well as the entire waterjet system, is carried out using the Navier-Stokes solver ANSYS CFX 5.6. The hull, inlet, rotor, stator and nozzle are analyzed at the component level before the components are assembled together for the complete system level computations. The following two figures show the pressure distribution and streamline pattern into the waterjet inlet from under the hull, and through a waterjet rotor-stator, respectively.



Waterjet Inlet Surface Pressure Distribution and Streamline Pattern



Waterjet Rotor and Stator Surface Pressure Distribution and Streamline Pattern

M/V FORT JEFFERSON DELIVERED TO EVERGLADES NATIONAL PARK

By Dan Bagnell, Director of Naval Architecture

During this past Memorial Day weekend, the Everglades National Park Service took delivery of the M/V Fort Jefferson, their new 110-foot crew/supply boat. This boat will replace the 65-foot M/V Activa. The mission of the M/V Fort Jefferson is to deliver fuel, water, supplies, construction materials, and park personnel to the historic Fort Jefferson.

Band, Lavis and Associates, BLA (now the Systems Development Division (SDD) of CDI Marine) was contracted by the National Park Service to conduct an Assessment of Alternatives, evaluate the impact of design requirements on size and cost, and develop a concept design and a performance specification. Once the proposals were received, BLA assisted with the proposal evaluations, construction oversight, and acceptance trials. The boat was built at Swiftships Shipbuilders in Morgan City, Louisiana.

The M/V Fort Jefferson is powered by three Caterpillar 3412 diesel engines driving fixed pitch propellers. During the trials, the M/V Fort Jefferson made 22 knots in a fully loaded condition; 4 knots faster than the required 18 knots. Designed as both a crew boat and supply boat, the M/V Fort Jefferson can deliver, in various combinations, 5000 gallons of fuel, 20,000 pounds of deck cargo, 3000 pounds of dry, chill and frozen cargo, and 20 passengers. The boat will be manned by a crew of three.

The M/V Fort Jefferson will make weekly runs out to Fort Jefferson, which is located approximately 90 miles west of Key West in the Dry Tortugas. Fort Jefferson was originally built in the 1800's to protect shipping lanes, but later became a notorious prison during the Civil War. Although currently popular for its fishing and snorkeling, Fort Jefferson is most famous, historically, for some of its "residents"; Dr. Samuel

Mudd (who set John Wilkes Booth's broken leg) and three inmates who were convicted of conspiring to assassinate President Abraham Lincoln. For anyone who is interested, information on the fort can be found at www.fortjefferson.com.



M/V Fort Jefferson

SKJOLD SES LIFT-FAN REDESIGN

By Mark McCain, Mechanical Engineer

The Norwegian Navy, through UMOE Mandal, contracted BLA to redesign the lift fans onboard the SKJOLD Surface Effect Ship (SES). SKJOLD can be seen in the picture below.



SKJOLD SES

A review of the lift-air flow rate requirements revealed that the current design lift-air flow rate for the SKJOLD was insufficient. Our evaluation recommended a nearly 22% increase. Using this new design point for the lift system, an analysis was completed to choose the optimal lift-fan geometry for installation on the SKJOLD (see article on advanced lift fans on page 1). A model-scale test program for the selected fan was completed and showed good agreement with the predicted fan performance.

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 **THE QUARTERLY DIGEST**
of CDI Marine Systems Development Division

LITTORAL COMBATANT SHIP

By Dan Bagnell, Director of Naval Architecture

The U.S. Navy recently released an RFP for a high-speed Littoral Combatant Ship (LCS). This ship is intended to operate at top speeds in the range of 40 knots to 50 knots. Northrop Grumman Ship Systems (NGSS) asked Band, Lavis and Associates (BLA) (now CDI Marine Systems Development Division), as recognized experts in the design of high-performance craft, to team with them as their naval architects for the design of the LCS. Also on the NGSS team is Kockums AB of Sweden. For this effort, Kockums is providing the composite hull structure technology they used to build their VISBY-class patrol boats.

BLA conducted an extensive evaluation of numerous hullforms for NGSS last fall during the U.S. Navy FMS program. Based on these studies, NGSS selected a CFRP monohull for their baseline LCS design using the VISBY-class as a technology parent.

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During the LCS proposal effort, BLA redesigned the FMS concept to meet the new LCS requirements.



Littoral Combatant Ship

Contract award for the design and construction of a Flight-0 ship is expected this July.

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