Fabrication Afloat

By Beth S. Pollak with Craig Lewis, S.E.

A design-build project on San Nicholas Island was smooth sailing due to the early involvement of AISC-member fabricator Nova Group, Inc.

Studies by the Construction Industry Institute show that early involvement by steel fabricators for new projects can maximize communication, scheduling, and cost-effectiveness on a project—and fabricators can effectively take the lead in initiating a design-build or teamwork process. Nova Group Inc., in Napa, CA did just that when they began working on a surface transportation pier (to be located off of San Nicholas Island near southern California) for the U.S. Navy.

A Shore Thing

"It's a bridge ramp connecting to a concrete pier that meets barges containing materials and equipment for the island," said Matt Weber, P.E., Nova Group's engineering and fabrication manager. "Being on board from the beginning of the project was nice. We had a really good relationship with [structural engineer] Winzler & Kelley Consulting Engineers. If we recommended they take a look at something, they would. We ran stuff by them if we had a question on anything. Plus, it's great to influence the design up front."

Nova Group fabricated the 173.9'-long-by-22'-wide-by-6'-deep ramp in four sections. Next, they assembled it and arranged for it to be towed in the open ocean to the island. "It's the first open-ocean roll-on/roll-off ramp of its kind," said Craig Lewis, S.E., of Winzler & Kelly.

Familiar Crew

Winzler & Kelley and Nova Group previously worked together on other projects, but this was the first time the two companies collaborated as a design-build team. "We came up with the design, the Navy reviewed it, and then we integrated Nova Group's comments," Lewis said. "The project worked back and forth that way."

This was one of Winzler & Kelley's first design-build projects. "It was a good experience. Communication worked well, since Nova is located only 40 miles away. We were able to speak directly to the contractor before the project was even designed."

"We held weekly meetings in our office, and the whole team from Winzler & Kelley came here every single Wednesday for a month," said Jill Miller, Nova Group's marketing manager. "Normally you don't see an A/E come to your office. To have them here for that amount of time worked enormously well. It definitely improved communication with all the key people involved."

The face-to-face interaction was helpful for the pier project. "It's better than talking over the phone and using e-mail," she said. "Especially with something unique like this, it was important to have the visuals, the drawings, and the design concepts in front of you."

Setting the Course

Nova Group works with piping and fueling systems, as well as waterfront structures—and its latest project is its biggest yet. "We started out 20 years ago,

A 180-ton crane moved sections of the ramp around the fabrication yard.

working on pre-insulated steam piping, which evolved into other products," Weber said. "When we got out of piping, we shifted our focus to fueling systems and waterfront work. Making products for steel-construction projects was another goal of ours."

Nova Group also works as a fabricator and construction company. "Our fab shop is a little more than 50,000 sq. ft," said Weber. "The fabrication that we do is in support of our construction projects. We work in fueling systems for the Air Force, which deals with mechanical construction."

Working on tight military schedules helps Nova Group handle the logistics of projects. "It's beneficial for us to meet navy and government schedules," Miller said. "It gives us more control. We know how long it will take to manufacture and ship members, because we make the pipe and steel members right in own backyard. We do work all over the U.S. and internationally."

Design-Driven

Design of the ramp was driven by the criteria that it must support a live load of two HS20-44 loads or a 50-ton crane load at any location along the ramp length. Localized plate stresses due to the wheel loads also were considered. The ramp also had to sustain a 50-year service life. "We produced stresses due to fatigue, based on the anticipated number of load cycles for the roll-on/roll-off operations and reviewed the ramp members and connection using AASHTO criteria," Lewis said. It was also a design requirement that the plate steel meet the Charpy V-Notch requirement as specified in 1996 AASHTO (Section 10.3.3).

To be towed in the ocean, the ramp had to be designed to travel as efficiently as possible. This required the side and bottom plates be designed for hydrostatic loads. The ramp was analyzed for both sag and hogging conditions, determined by the position of the ramp in a sea wave. The bulkheads also had to be watertight to maintain buoyancy.

Connection points—steel plate padeyes with 6"-diameter holes—were designed for the chain-jack reactions on either side of the ramp and the mooring-line load on the end of the ramp. Thicker plate, reinforced with cheek plates, was required for these items. Thick side plates were also necessary at the hinge connection to the pier. The connections for the ramp consist exclusively of welded joints. The majority of the welds are fillet welds, with full-penetration welds required at the plate splices, chain-jack bulkhead plates and side plates at the pier hinges.

All Aboard

The ramp consists of an orthotropic closed section, with cross-stiffened $^5/_8$" (16 mm) steel plating acting as the deck surface. The side plates are braced top and bottom with transverse frames on approximately 5' centers, made up of bent $^3/_8$" (10 mm) plates and WT section diagonal bracing. Orthogonal to the transverse frames are the longitudinal ribs (angle sections) that provide flexural rigidity to the deck and bottom plates. The outer surfaces of the ramp are constructed of $^5/_8$" (16 mm) plates for the deck and side plates, and $^3/_8$" (10 mm) for the bottom plate. Thicker plate sections were required for the bulkheads supporting the hydraulic chain-jack connection padeyes. All steel specified is ASTM A572, Grade 50.

The rotation of the ramp occurring at the pier end is performed by two hinges, each with an 8"-diameter (203 mm) pin, rotating within engineered-plastic bushings that are press-fit into the hinges. The lifting mechanism consists of two hydraulic chain jacks located 127.9' (38.98 m) from the centerline of the pier-hinge pins. On either side of the ramp are the chain jacks, each sustained on a pile-supported "dolphin" concrete cap.

The chain jacks have the capability to move the ramp from the stowed position to the low-tide operating position at a range of approximately 13.5 degrees. It is also possible to lock out the chain at 1' intervals along the travel to adjust for tidal changes during operation. Chain jacks are connected to the ramp using shackles and padeyes extending upward from the bulkhead side plates.

Smooth Sailing

"We've never built a structure like this before," Weber said. "Some of the challenges are just the member sizes. We purchased the plate in 8' by 20' sections, and dealing with it has been challenging. The 3/8" plate is such a thin plate. When we need to weld it, it is first pre-welded into sections, since there's lots of heat distortion from the welding. Because the sections are so big, we split them into four sections that are roughly 44' long by 22' wide, and 7' in height. They weigh about 80,000 lb per piece."

Nova Group also coated the steel. "We

The ramp was towed into its final position. The structure had to be analyzed for its response to sea waves.

used a three-coat moisture-cured urethane system on both the bottom and sides," Weber said. "The interior gets a zinc primer, supplied by Wasser High-Tech Coatings. On the top, we used an Ameron epoxy coating system that they put on aircraft carriers for its non-skid properties. It's a really thick system, about 50 mils thick." In comparison, a typical paint system consisting of a shop primer and urethane finish coat is 9 to 10 mils thick.

Anchors Aweigh

For ramp transportation, Nova Group used a 180-ton crane to move the sections around. "We had to get overweight and oversize permits to use the roads between here and the Napa Pipe facility. At that facility, we lined up the sections, splice-welded them together, and finished the fabrication. We used two cranes—one held 200,000 lb, while the other held 120,000 lb. The project stayed afloat, and upon completion of the ramp (almost 180' long), we finally set it in the river." ★

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