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# Answer above

## Crews design innovative solution for Sandy River Bridges

If necessity is the mother of invention, then the flood risk that the Oregon Department of Transportation (ODOT) faced in replacing the I-84 Sandy River bridges spurred a welcome pair of innovative workarounds.

For most of the water-spanning bridges that ODOT has replaced on the Oregon Transportation Investment Act III State Bridge Delivery Program, the terrain has allowed building both a detour bridge and a work bridge beside existing structures, so we can keep traffic moving during construction and operate efficiently without interfering with fish migration and breeding. Maintaining mobility on this stretch of interstate east of Portland was especially crucial, because it is the busiest of all Oregon's interstates.

The terrain surrounding the Sandy River bridges, however, just east of Portland, Ore., is far from typical. The bridges are located in the delta with the Columbia River. The wide and shallow basin fills with water from both upriver and down, and it is vulnerable to flooding from winter storms that send water rushing down from Mount Hood upstream. Conversely, the same shallow basin is vulnerable to spring surges from the Columbia River downstream, as happened in spring 2011, when rapid melting of Canadian ice packs turned the river below the bridges into a temporary lake.

The solutions in dealing with this challenging topography were a combination of proper planning and extemporaneous invention. When construction began in April 2010, crews from prime contractor Hamilton Construction placed a large number of steel piles in the river to support the project's work and detour bridges, necessary to stage initial construction. Under low-flow conditions, these temporary structures would have a minor effect on the Sandy River's water level. But when the water level rises during a major storm, the steel piles used to support temporary structures cause an increase in backwater upstream of the bridge. Additionally, the steel piles act as a sieve, trapping large amounts of debris against the bridge rather than allowing it to travel down the river freely.

Residents and businesses nearby face the threat of floods every winter, and the team did not want to increase the risk by leaving 168 debris-catching work bridge pilings in place to add to the mix of hazards.

So long before winter, project team members began to look for ways to reduce the effects of high-water levels on surrounding areas. The first step was to lessen the impact by reducing the number of temporary bridge piers and piles in the river during the heavy rain season. To lessen the severity of a potential logjam at the site, the contractor removed three-quarters of its work bridge prior to the start of the winter storm season. ODOT also applied for and received a rarely granted extension to the in-water work window that allowed construction to proceed based on a modification to the construction method, giving more time in the river when there was no chance of adding to the risk of flooding.

In addition to removing steel piles in the river, crews began extracting logs and other debris two to three times per week using a yarder. While common in logging, yarders are usually not necessary in bridge construction.

When torrential rains and heavy winds kicked up in the western end of the Columbia River Gorge over the Martin Luther King Jr. holiday weekend early in 2011, the storm raised water levels in the river and uprooted hundreds of logs and root wads, which became lodged behind the remaining temporary steel piles. The yarder allowed the team to continue to keep the project site relatively clear of debris. Crews worked quickly to remove blockages, leaving as much debris as possible in the river to comply with environmental permits to nourish habitats downstream.

Debris that could not flow safely downstream was removed using the yarder, a grapple, a crane and clam bucket, and an excavator. In just two weeks, crews removed approximately 110 truckloads of debris from the site, donating nearly 40 of those loads to the Oregon Department of Fish and Wildlife. ODFW then donated the logs to the Freshwater Trust, a nonprofit group that will use them to create and restore habitats for rainbow trout and chinook and coho salmon in the Sandy River Basin.

The Sandy River bridges project team devised another unique solution for a unique situation: setting the beams from a crane that operates from above the bridge instead of from a work bridge. Hamilton Construction's $1.2 million specialized twin gantry cranes, constructed on-site for the project, can hook, lift and place steel beams up to 167 ft long and weighing up to 192,000 lb, almost as much as the cranes' combined weight of 250,000 lb. The gantry cranes are supported by only 12 temporary pilings, so they allow the team to keep debris-attracting obstacles out of the river.

By setting the beams from above, the project team keeps traffic moving on the detour bridge, adheres to the logistics and environmental timetables and, most importantly, avoids the need for a work bridge in the river during the winter high-water season.

Though gantry cranes have been around since 1840 and are used extensively in shipbuilding and manufacturing, this model, from North American Industries in Massachusetts, is decidedly high tech. It can be operated at the push of a button from the control platform.

The cranes do the heavy lifting, but the process still involves the basics of human ingenuity and forethought and on-the-ground logistics. As always in infrastructure construction, the numbers are both gargantuan and minutely calibrated: The tracks that guide the base of the crane out across the river extend for 840 ft, the same length as the bridges themselves. The two tracks must be aligned exactly 90 ft apart. The north track had to be laid only inches away from the already-operating detour bridge.

Because the beams are steel, pile bucks are essential to the process. They had to cut off the excessive lengths of bolts on the existing detour bridge one by one to make room for the track. When the beams are spliced together—sometimes on the ground before placement and other times while suspended from the crane—ironworkers secure them with over 800 bolts—top, bottom, back and front—first lining up all the holes with pins and then fastening them permanently with bolts.

Altogether, the eastbound bridge alone will require almost 40,000 bolts. Rather than rely on the laborious

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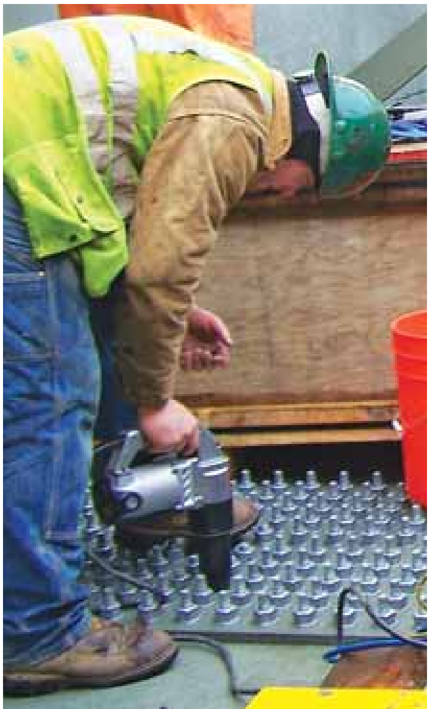

Rather than rely on the laborious method of tightening each nut so many turns to reach the steel's capacity, the crew installs each bolt with a shear gun.

and potentially inaccurate method of tightening each nut so many turns to reach the steel's capacity, the crew installs each bolt with a shear gun. The 7/8 bolts are tension-controlled so that a tension knob shears off a bolt after it is tightened to the specified capacity of 39,000 lb. The eastbound and westbound bridges will require a total of seven steel-tub girders made from 91 sections of structural steel.

After two months of assembly—including nine truckloads of components—and careful testing, the cranes began setting beams in February, including the furthest haunch—the T-section for the interior bents that gives the bridge its deck arch elegance—in the first span.

In addition to innovative solutions, the project's success has hinged on strong partnerships between state and federal agencies. The team recently hosted Phillip Ditzler, the Federal Highway Administration's Oregon division administrator, and Emily Lawton, assistant division administrator, on a tour of the project. Ditzler confirmed the importance of these two bridges on a vital freight route for the region, state and the country and noted that the project has attracted positive attention at the federal level and with Congress.

If weather permits, the entire superstructure for the eastbound bridge—52 sections—will be laid and spliced in just under three months. Having warded off the water danger, the team now monitors interference from the air: The same high winds that make the Columbia River Gorge a popular destination for windsurfers can be a big problem for airborne steel girders. In summer 2012, when the eastbound bridge is finished, it will serve as the detour bridge as the team begins to build the westbound structure. R&B

Lauer is the manager of the Oregon Department of Transportation's Major Projects Branch.

**For more information about this topic, check out the Bridge Channel at www.roadsbridges.com.**