

*Crews work on a bridge deck replacement along the Dalton Highway. Precast concrete panels will save money on repair and maintenance costs and ease impacts on drivers.*



## ALASKA Pioneering Precast in Alaska

### THE 7-MONTH REPLACEMENT OF 18 BRIDGES ON THE STORIED DALTON HIGHWAY

The legendary 414-mile Dalton Highway of Alaska is a workhorse of a road that carries industrial traffic and adventurous tourists from Fairbanks to the north slope oil fields at Prudhoe Bay. It winds its gravelly way due north, starting 80 miles north of Fairbanks, through the Arctic Circle, and on to the midway point of Coldfoot, the only place where food and fuel are available before reaching the end in Deadhorse (permanent pop., 25), just below Prudhoe Bay.

Also known as “Haul Road” and designated as “Alaska 11,” the Dalton Highway was built in the mid-1970s with 32 million cubic yards of gravel for a cost of \$150 million. Its sole purpose was, and still remains, to supply the Prudhoe Bay oil fields on the North Slope of the Brooks Range Mountains. In addition to the people who work the pipeline and the oil fields, truckers deliver supplies along the highway and visitors convene for the spectacular sights along the way. With workers and tourists combined, the road still only carries about 200-250 vehicles daily, mainly heavy-duty trucks and tour buses.

The Dalton Highway features a series of bridges the maintenance of which keeps the Alaska Department of Transportation (DOT) and Public Facilities poised to respond to the range of challenges inherent in the Alaskan weather and terrain. In 1992, a major bridge rehabilitation project would prove to be just such a challenge.

#### Readying for Redecking

John Patterson, Lon Krol and Steve Henry, the Alaska DOT Construction Group Chief, Project Engineer and Assistant Project Engineer respectively, managed and led a project few others in their field have had to face. They were charged with replacing old timber decks on 18 bridges along 128 miles of the Dalton Highway between Fairbanks and Deadhorse (Mile Post 79 to Mile Post 207) to extend the functionality and longevity of the Dalton Highway road system.

Since the bridges first were built, extreme weather and the harsh environment meant that the timber decks—bridge decks made of wood—had to be repaired every eight years. To heighten the challenge, the bridges were not all alike. Some had 30-foot long spans, some had 60-foot long spans, and some combined both. They did have in common 24-foot widths, and the fact that all spans were founded on steel piling, which pointed to the essential soundness of the bridges’ substructure. With such firm foundations, only the timber superstructure components needed to be replaced.

The engineering team knew there was a way to prevent the continual replacement of the timber decks every eight years: precast concrete slabs. The decision to use full-width precast concrete slab units to replace the timber decks is one reason the Dalton Highway bridge replacements of 1992 are showcased by the Highways for LIFE program as a project that achieved safer, better highways and faster, more cost-effective delivery.

### **Precast Deck Panels: Trailblazing thru Technology**

Given the rough terrain of the gravel road surface, the harsh weather of the natural environment (temperatures range from 60 degrees below zero in winter to 85 degrees above in summer) and the length of the Dalton Highway, the need for dependable bridge decks requiring minimal replacement, rehabilitation and maintenance was clear.

Replacing the warped timber decks with hardy, strong, and impervious precast concrete panels that would last for 50 years would not only save on repair and maintenance costs, but would also ease recurring impacts on the traveling public, a key principle extolled by the Highways for LIFE program.

“This project is a great example of the ‘get in and get out quick’ type job that we love to see,” said Steve Boch, who was at the time the Division Bridge Engineer for the Federal Highway Administration in Alaska. He toured the job during the summer of 1992. “By ordering precast deck panels we were able to save money and time on the job,” explained Boch. “It would have been extremely costly to set up a concrete plant in such a remote location. The Dalton Highway bridges replacement project was one of the earliest and best uses of the precast units technology in Alaska.”

### **Getting Started**

One of the first steps in the project was to find a general contractor able to render this imposing scope of work and to save maintenance costs while doing it. The project was advertised on September 10, 1991 and awarded shortly after on December 4, 1991 to Wilder Construction Company at a cost of \$6.375 million, almost \$1 million less than the engineer’s estimate.

The next step was to conduct the as-built survey on all 18 bridges. Wilder worked with Tryck-Nyman-Hayes to perform the survey, which was completed on February 12, 1992. The pre-construction conference was held on February 24, 1992.

At about the same time, materials were ordered. According to Wilder Construction Project Manager, Mark Erickson, a distinct challenge of the job was the logistical task of getting all the materials out to the remote location. “We were going to be working in an area that is about as remote as it gets,” said Erickson. “All the materials had to be ordered and delivered ahead of time, including more than 350 concrete bridge panels.”

According to Erickson, the steel from Red Iron Inc. was rolled in Georgia, cut and painted in Spokane, WA, shipped to Seattle, WA and then loaded on a barge and sent to Alaska. The precast panels were manufactured in Yakima, WA by Yakima Precasters and shipped to Seattle. They joined the steel for the ride to Anchorage. Guardrails were also manufactured in the lower 48 states by Syro Steel and shipped to Alaska. Once all materials reached the Port of Anchorage, they were loaded onto flatbeds and trucked 530 miles to the start point of the project by J.D. Enterprises Trucking, Inc. Each bridge panel weighed 12,000 to 14,000 pounds, so only three or four panels could be carried on each truck. As a steady stream of vehicles carried supplies from Anchorage to the job site, Alaska 11 lived up to its nickname: “Haul Road.”

Each bridge had not only a name but a number as well. All materials for each bridge were tracked closely and dropped off at the correct spot, where they remained until construction began.

### **Setting Up Camp**

When the nearest metropolitan area – Fairbanks – is several hundred miles away, commuting to the job from home is nearly impossible. In fact, most workers were from Anchorage – a good 500 miles from even the origin point of the job. So the construction team of 25 set up camp and lived along the highway for the entire seven months of the project. The roadway spanned so many miles that the camp moved twice over the course of the job (once on June 27 and again on August 20) to minimize traveling distance.

The camp took shape in April of 1992. According to Henry, “Wilder set up the first camp at Prospect Creek, which is the old site of the pipeline construction camp.” The facility included men’s and women’s bathhouses and laundry facilities. Most people stayed in their own campers and trailers and used the bathhouse. A generator provided power for heat at night and in the washrooms. Wilder handled water supply, waste collection and other details.

Many workers brought their families to live with them in the rugged, beautiful country for the summer, recalled Erickson. The Dalton Bridges project became his “favorite job of more than 20 years in the construction industry.”

### Fighting the Clock

Because the Dalton Highway is the only way in and out of the North Slope, all organizations involved, including the Alaska DOT, Wilder Construction Company and officials of the Alyeska Oil Pipeline, had to work in close partnership. Together, they agreed that the road could be closed to traffic for no more than 12 hours each day.



*Lunch breaks at the work site included spectacular views along the Dalton Highway.*

The Alaska DOT advertised closings in the newspapers, gave notice to Alyeska and the trucking companies, and positioned signs with closure times on both ends of the highway.

Those involved with the project had a clear picture—provided by the design engineers—of just how and by what sequences the span-by-span construction would proceed. “We would normally close the road starting at 3 p.m. and then open the road at 3 a.m.,” said Henry. “Each night we would do either a 30 foot or 60 foot span of bridge deck replacement.”

The process actually began at 2 p.m. with the contractor removing railings and loosening the deck. Traffic would proceed slowly across the deck until 3 p.m., when the road was shut down. The old timber deck on the 60 foot spans was then removed in sections with a 966 loader, leaving only steel girders remaining.

The team then started the generator to weld new shear Nelson studs along the top flange of the steel girders. When the Nelson studs were complete, they would set precast concrete panels in place with a 50-ton crane and seal the outside of the girders with Styrofoam for the concrete pour.

“We would take the bridges and break them down into pieces and put them back together with new materials,” recalled Erickson. “It was like assembling the pieces of a jigsaw puzzle.”

The 30-foot spans were removed entirely, including the timber stringers and deck. The spans were cut in half and lifted out of place with the crane to be deposited on a waiting truck. The new steel superstructure was then lifted into place and bolted up. Steel had been prefabricated to allow for speed in placement. The concrete panels were then placed on the steel stringers and grouted in place.

According to Henry, the majority of the work was performed in May, June, July and August when 24 hours of daylight made it convenient to work at night without the use of artificial light until the middle of August.

The goal was to have all 18 bridge structures complete in one construction season and “thanks to good planning and teamwork,” said Erickson, that goal was met. Work started in April of 1992 and was completed by mid-November of 1992.

### **Decisive Innovations**

Two noteworthy contributors to the success of the Dalton Bridges replacement job were the widespread use of magnesium phosphate concrete, which is specifically designed to cure quickly, and a special invention created by the contractor to place the grout quickly before it could harden (in approximately 20 minutes) with minimum spillage and little waste. Each represents a response to unique challenges that exemplifies the principles promoted by Highways for LIFE.

A mobile concrete mixing truck blended the magnesium phosphate concrete (Set-45, made by Master Builders) that was poured into holes in the precast panels, connecting the deck through the Nelson Studs to the girders. The name “Set-45” is derived from the fact that the material is “set” to take traffic in only 45 minutes.

“The concrete would get very hot,” observed Henry, and “too hot to touch.” It would cure to 2,000 psi in only one hour and to 3,000 psi after only two hours. A mobile concrete cylinder tester was kept in the back of a van on the job site and used to test the concrete to see when it reached 3,000 psi. As a result, the bridge could quickly be re-opened.

According to Boch, “This was one of the largest uses of Set-45 that I’m aware of. The material was brought to the job site in 4,000 pound sacks and mixed in bulk.”

To place the grout, which is self-leveling, Wilder Construction estimator Mary Brownell came up with an idea for a unique wheelbarrow. Using 55-gallon drums, the crew manufactured four such wheelbarrows altogether. The drums were cut in half, wheels were added, and a cone was placed along the bottom of each unit. The wheelbarrows were simply filled and rolled over to where the grout needed to be placed. Since each was only a few inches higher than the grout location, little spillage and waste occurred.

### **Overcoming Challenges**

No construction job as large and complex as the Dalton Highway bridge replacement project is free of obstacles. The ingenuity and capability with which the Alaska team surmounted every challenge merits amplification through the Highways for LIFE program.

Erickson will never forget the night back in May 1992, early on in the job, when he was awakened at 3 a.m. because grout cylinders did not achieve strength requirements and one of the structures could not be opened to traffic. With “burly truckers lined up on both sides of the bridge” demanding it be opened, engineers had to assess the problem and quickly determine next steps.

Upon further investigation, it was determined that the grout strength was strong enough to open the bridge. The reason tests indicated otherwise was that the cylinders were exposed to the elements, which at that at the time in May, north of Fairbanks, Alaska, meant snow, ice and freezing rain. The top ½ inch of the material wasn’t testing properly, but the rest of the grout was fine.

Because of such problems with “finicky grout,” in Erickson’s words, the crew decided to head north to complete the bridges requiring the most grout work before the coming colder weather. The pace at which the bridges were completed increased dramatically to one complete span per day. By June 27, almost all the bridge work south of Coldfoot was completed and on June 29 the contractor moved camp to MP 175 and began work on the bridges north.

As the weather got colder, water was heated for each of the pours. One of the bridges – the Kanuti River Bridge – was also tented and space heaters were placed under the span for heat.

Other bumps along the road, all of which were readily addressed, included a tour bus company whose schedule conflicted with that of the contractor, flooding rivers that washed over the staging area at a few bridges, and a fire that burned salvaged bridge panels.

The contractor provided a tour bus to transport people to the Arctic Circle in order to work around the bus scheduling issue. The boarding area was staged on the far side of the bridge and riders simply walked across a scaffold plank, climbed onboard the second bus, and continued their journey to the Arctic Circle, returning in the same manner.

Fortunately, when the river flooding problem arose, crews were working at other locations and simply had to wait until the waters receded to move on to those structures.

As for the fire at the Jim River Maintenance Camp in July, Alyeska responded quickly, dug a trench around the blaze and allowed the panels to burn. The fact that salvaged bridges were burning wasn't a showstopper, but the incident did add some excitement to the job. Wilder ended up replacing the lost materials with new materials that were compatible with the new bridges should any repairs be necessary. Burnt timbers were subsequently tested and no pentachloride was found in the creosote timber. Wilder then hauled any contaminated soil from the fire area to Fairbanks for disposal.

### Wrapping Things Up

On August 19, Diamond Fence finished installing guardrail on the bridge approaches. Some of the Wilder crew stayed in Coldfoot working on signage, painting, and other details while the rest of the crew moved south.

Camp and crew picked up and moved back south to MP 87 on August 20 to complete work on two bridges – the Kanuti River and No-Name Creek. Deck panels were cut in half on the Kanuti River Bridge so one lane could remain open while the team worked on the other half. Wilder coordinated the road closures at MP 98 and MP 111 with a flagperson who had radio contact with the site to keep information flowing about bridge availability. The structure re-opened several times during the day to accommodate tour buses. In addition, a nighttime flagger was stationed on the bridge and flood lights were used to ensure safe passage over the one lane span.

On September 1, crews wrapped up the bridge work at Kanuti River. No-Name Creek was completed less than a week later. According to Erickson, "On September 5th, the day I left the job site, it began to snow," leaving him to believe they finished in the nick of time. The camp was demobilized from September 5 to September 15.

All bridge work was completed between May 1 and September 6, with additional guardrail and rip rap work continuing until November. The Project Completion letter was signed on November 13, 1992.

### Advice for Others/Lessons Learned

In considering lessons learned on the project, Erickson singled out communications to bolster teamwork and partnerships. He explained, “When your entire team knows what they are doing, things work like clockwork.” He noted that the 25 workers on the job represented five different unions, and despite working in a remote location, none left the project for other work.

Logistics emerged as a constant challenge. “But by spending a lot of time on detailed planning, the hurdles can be overcome, and were on this project, he concluded.”

From a materials standpoint, one particular piece of solid advice stands out from the “Lessons Learned” section of the State DOT’s Completion Report dated March 31, 1993. “The magnesium phosphate grout should have been tested in the design stage to see if it actually worked and what drawbacks could arise with the temperature and time constraints we were working with. Any time a new ‘latest technology’ material is used it should be independently tested before coming to the construction site for incorporation into a project.” The grout would not get hot or set up in the 45 minutes if the temperature was below 40 degrees F. We found this out the hard way, when we had to wait an extra hour for the grout to set before we could open the bridge to the angry truckers.

### Safe and Sound

Today, thirteen years after the wooden bridges were streamlined and modernized with precast concrete, the engineers look back with much satisfaction. Only minor repairs have been needed since that time.

Travelers now face the 414 miles of gravel road on the Dalton Highway knowing that all bridges are in top condition and likely to remain so. The Alaska DOT, like other State agencies dealing with commerce and tourism, provides travel advisories: visitors are reminded that, aside from the “northernmost truck stop in the world” about halfway up the route in Coldfoot, the Dalton Highway offers little more than a lot of Alaska – and some very fine bridges to help ensure safe passage.