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GOMACO WORLD

The All-American Canal Special Edition

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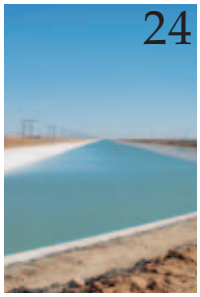

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GOMACO World is published by GOMACO Corporation to inform readers of applied construction technology utilizing GOMACO equipment as well as innovations and concerns in the construction industry throughout the world.

Address all communications to *GOMACO World* Editor. If you do not receive *GOMACO World*, and would like a complimentary subscription, please contact GOMACO Corporation, PO Box 151, Ida Grove, IA, 51445, USA, 712-364-3347 or e-mail bwonder@gomaco.com.

Slipforming 72 Feet (21.9 m) Wide...

Photo by Ric Moser SL-120713 D2

Coffman Specialties slipformed portions of the All-American Canal 72 feet (21.9 m) wide in a single pass with their new GOMACO equipment.

Coffman Specialties has always wanted to do canal work. It's been a goal for the company, a project they have been anticipating for several years and one challenge they had yet to accomplish. Through the years, they have talked with various canal paving experts, researched equipment, and discussed the various aspects of canal paving.

The company is not afraid of taking on the larger, more difficult slipforming projects near their company headquarters in San Diego, California. They've taken on challenging projects on airports, air bases, and highways, including Sky Harbor Airport in Phoenix, Arizona, Moffett Naval Air Station in San Jose, California, McClellan Air Force Base in Sacramento, California, and a large paving project in the Philippines. All the while Coffman Specialties had perfected their craft as slipform pavers. They were ready for another challenge.

A Canal in Southern California –

When the decision came down that a portion of the All-American Canal through the Imperial Valley in California would be lined with concrete, the company saw their chance to once again realize their canal paving goal. Jim Coffman, project coordinator and operation's manager for Coffman Specialities, and his son Kevin, vice president, started to assemble their team of canal experts. The All-American was the canal challenge they wanted, the one they had been waiting for all these years.

They knew for certain they wanted a machine that would incorporate the latest technology available in the marketplace today.

Photo by Ric Moser SL-120706 D11

The All-American Canal paver...

Photo by Ric Moser SL-010807 D1

The original All-American Canal was unlined and substantial amounts of water was lost due to seepage. A new concrete-lined canal will help minimize water lost.

They wanted a machine that could slipform the new canal in just two paving passes. And they knew the machine would have to be large enough to accommodate the size and the scope of the All-American Canal.

"We've done our research and watched other canal paving operations in the past," Jim Coffman explained. "We've seen the size of their equipment. We also noticed that most of the canals of the slipform type, both the trimmer or the paver, is of a 1960s or 1970s vintage, and the technology being utilized is old technology."

Coffmans were determined that when they won the bid, they would give the canal's owner, the Imperial Irrigation District (IID), the best product possible. Building on a 30-year relationship, they brought the project specifications, their ideas and opinions to GOMACO to develop the equipment for this massive project.

"We chose GOMACO because we have a long-standing relationship with the company," Jim Coffman said. "We looked at other manufacturers, but GOMACO, in our view, has the best R&D department. One of the things that drew us to this project, was to use current technology and apply it to the actual paving of the canal prism.

"GOMACO has a commitment to excellence and they also have a commitment to customer satisfaction. We felt we could work with them, relative to the design and the construction of the canal paver, so we would be satisfied with the end product."

Coffman Specialties won the bid to pave Reaches Two and Three of the All-American Canal project. In May 2006, they contracted with GOMACO to build three pieces of canal equipment with delivery required by the end of the year. GOMACO was about to begin their own design/build project to get Coffman the specialized equipment they needed in time to begin their project.

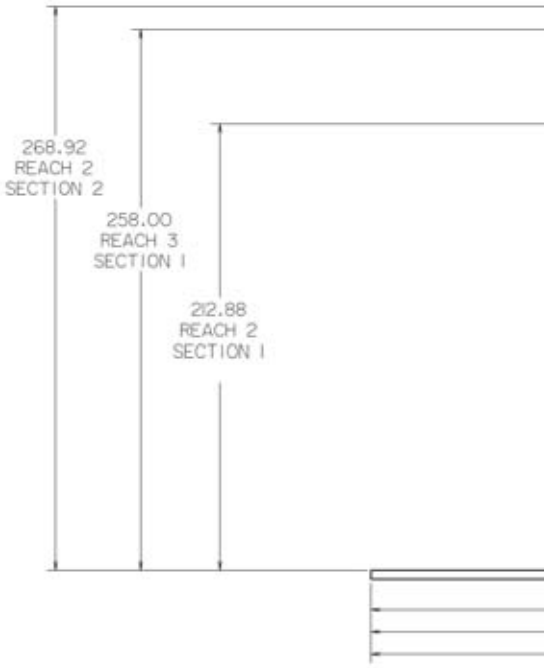
GOMACO Takes On the Challenge –

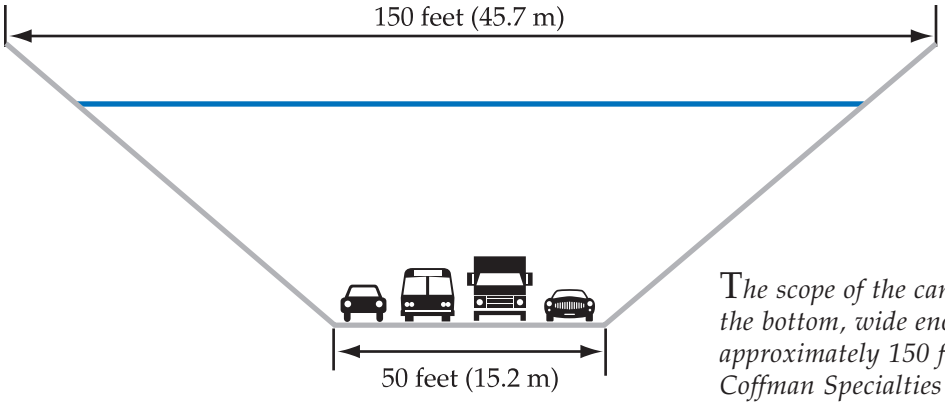
"It was a massive task to undertake and required a huge amount of coordination, cooperation and effort from R&D, engineering, purchasing and all of manufacturing," Kevin Klein, vice president of R&D, said. "I think we were ready to take

Photo by Kelly Krueger OF-080602 D4

Photo by Kelly Krueger OF-080604 D11

Several hours were spent in meetings between GOMACO and Coffman Specialties personnel during the design phases of the equipment.





The scope of the canal... It is 50 feet (15.2 m) wide across the bottom, wide enough for four lanes of traffic, and approximately 150 feet (45.7 m) wide across the top. Coffman Specialties paved the new canal in two passes.

on a challenge of this size."

The deadline for the equipment also created a challenge. GOMACO had to implement some new techniques to the manufacturing process.

"Drawings were being released to the floor as soon as they became available," Jim Homan, GOMACO's assistant manager of R&D and the All-American Canal project manager, said. "With such a tight deadline on the project, we couldn't afford to wait until everything was designed and drawn. Instead, we built the machines in pieces and final assembled later. It was a new way of thinking and handling things in the building process."

Other aspects of the project included quality and tolerance checks of materials from the very beginning. Each part or product was inspected when it arrived at GOMACO to ensure that everything was built to specifications. Every piece of the equipment was accompanied with a green job sheet. The color instantly identified it as a piece of the All-American Canal equipment as it worked its way through the plant. A special staging area, large enough to accommodate the large scope of the equipment, was also created for the finished pieces.

"Communication was the key to our success, through all departments and areas of construction," Homan said. "Meetings were held at the very beginning of the project with production supervisors and other key personnel in both of our manufacturing facilities to make sure they were aware of the scope of the project and the additional demands on their departments. Meetings continued to be held on a daily basis to keep the project on track and to potentially defuse any problem areas."

Meetings were also held with Coffman Specialties and their team of canal experts, both in Ida Grove and in California.

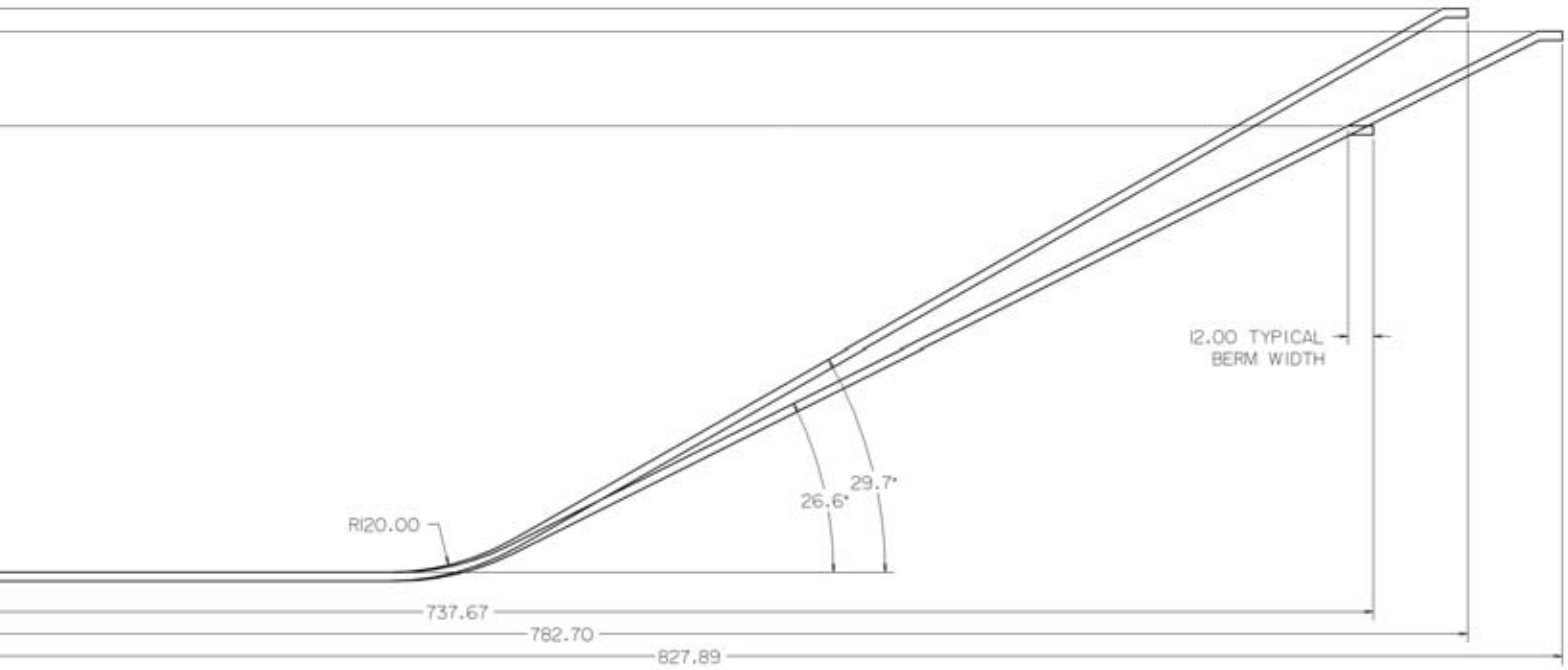
"Those meetings were imperative," Jim Coffman said. "It allowed us to interact and communicate, and ultimately build something that worked very well."

The All-American Canal Reaches Two and Three –

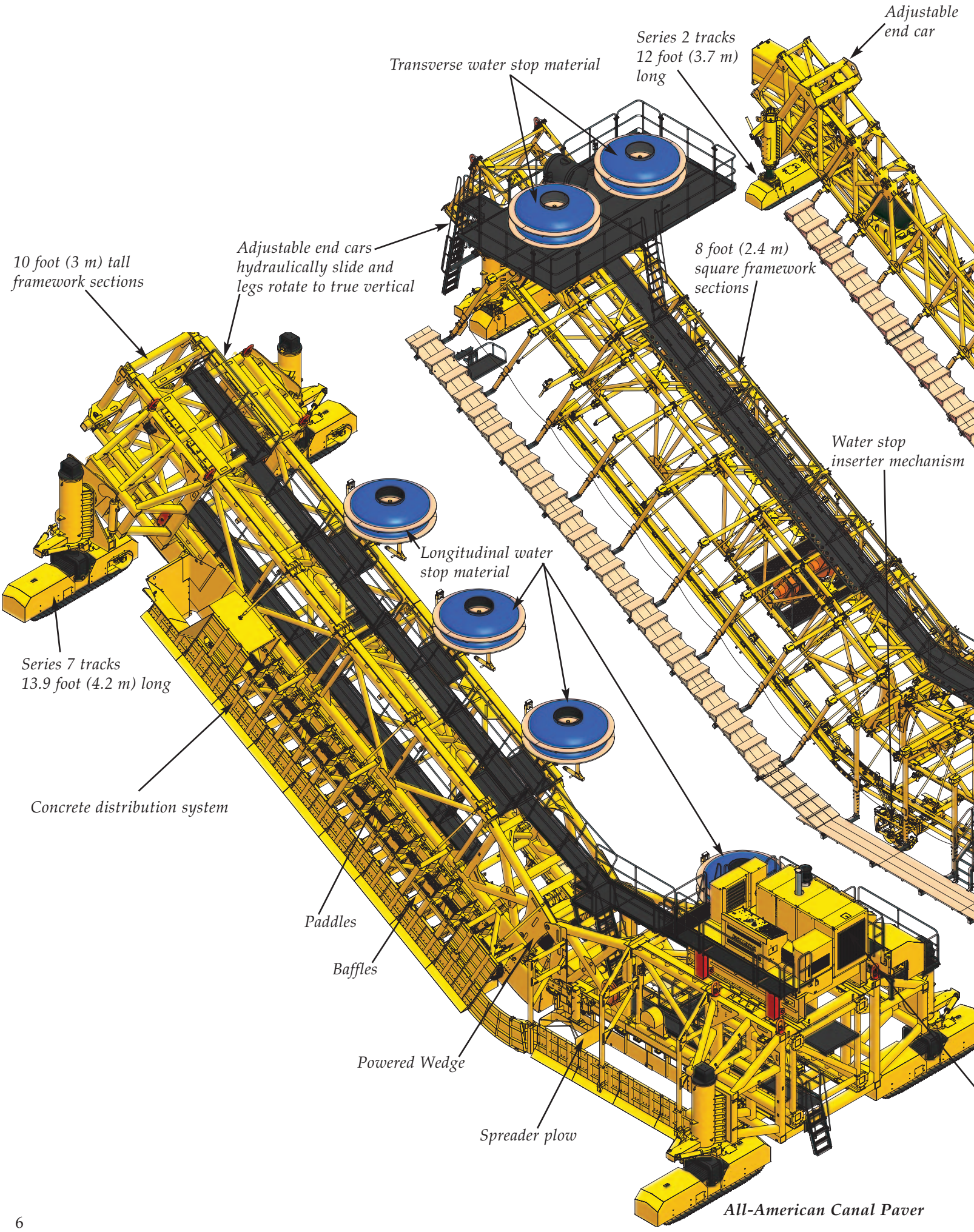
The entire All-American Canal lining project called for a new 23 mile (37 km) long concrete-lined canal to be built parallel to the existing unlined canal.

Coffman Specialties would pave the six mile (9.7 km) long Reach Two and four mile (6.4 km) long Reach Three of the project. The proposed lined sections would have slopes of 1.75:1 and 2:1, a bottom width of 50 feet (15.2 m) and a top width spanning 150 feet (45.7 m).

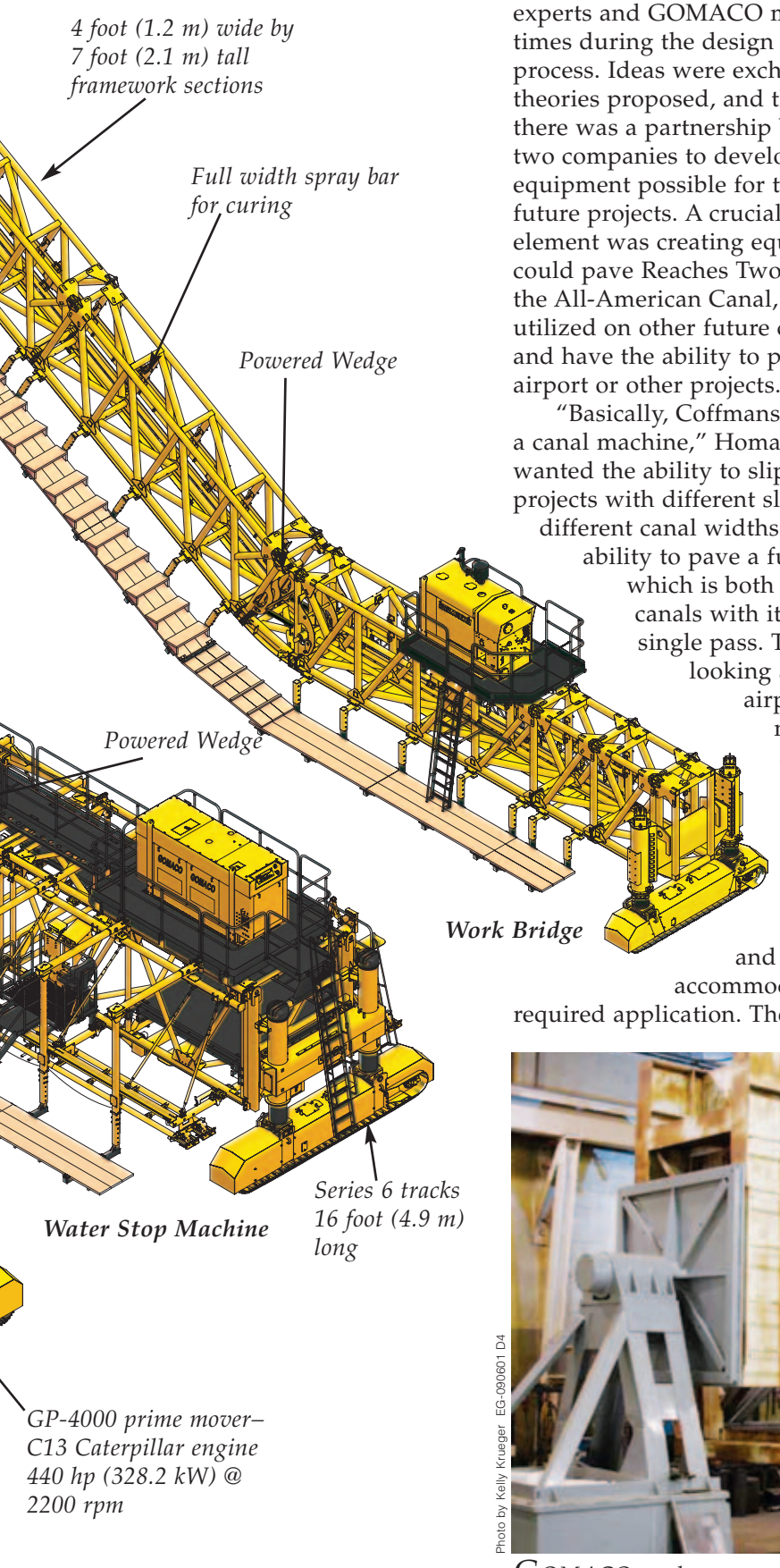
Slope widths would be variable, between 37.3 feet (11.4 m) and 45.7 feet (14 m). The concrete lining itself would be four inches (102 mm) thick.



Engineers' drawings illustrate the slope and length of the canal floor and slope.



All-American Canal Paver



The All-American Canal Paver –

Meetings between Coffman Specialties and GOMACO's sales and engineering staff started even before the bid was submitted for the project. Coffman Specialties and their team of experts and GOMACO met several times during the design and building process. Ideas were exchanged, theories proposed, and through it all, there was a partnership between the two companies to develop the best equipment possible for the project and future projects. A crucial design element was creating equipment that could pave Reaches Two and Three of the All-American Canal, but also be utilized on other future canal work, and have the ability to pave flat on airport or other projects.

"Basically, Coffmans did not want a canal machine," Homan said. "They wanted the ability to slipform future projects with different slope angles, different canal widths and the ability to pave a full prism, which is both sides of the canals with its invert in a single pass. They were also looking at some airport work and needed to be able to pour flatwork. And they didn't want to spend days changing the machine in and out to accommodate the required application. They wanted a machine that could do all of that."

The answer was a paver that incorporated new technology and engineering to accommodate all of the requests...

A GOMACO GP-4000 prime mover, set on top of a ten foot (3 m) tall framework, provides the power plant and control system for the paver. The mold sections are a 5000 series paving mold which were slightly modified. The machine is mounted on four tracks that are 13 feet, nine inches (4.2 m) long, 30 inches (762 mm) wide and 40 inches (1016 mm) high.

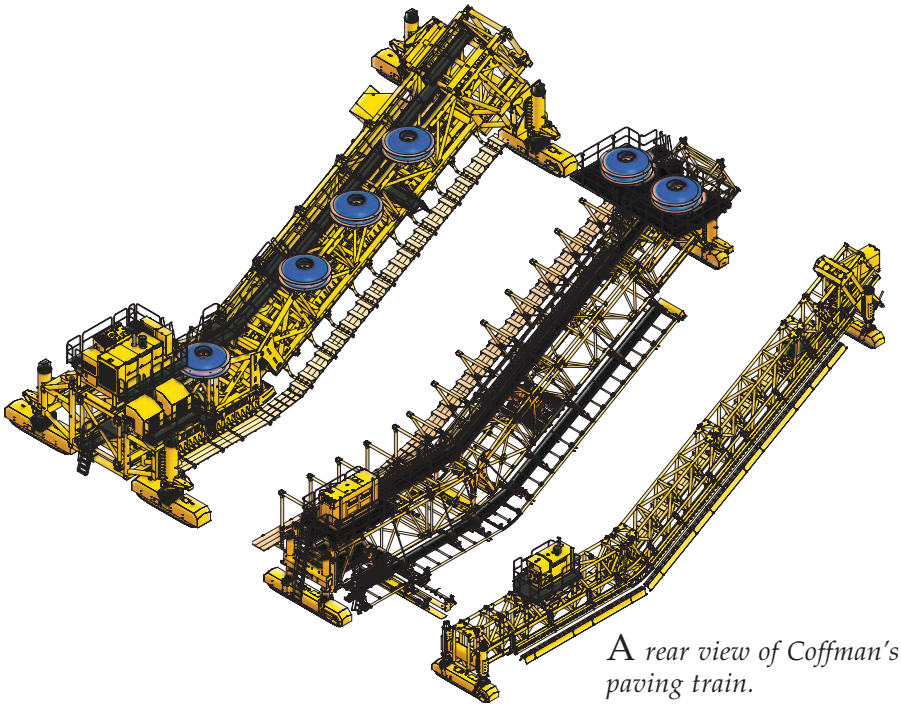
Placing concrete down the 1.75:1 or 2:1 slope and across the 25 foot (7.6 m) wide canal floor was a serious challenge. One of the unique aspects of the paver is its concrete distribution system mounted to the front. Concrete trucks dump into a standard GOMACO RTP-500 rubber-tracked placer, which then places the concrete into the distribution system on the paver.

The paver's distribution system is basically a paddle system with baffles that run along the slope of the canal. The paddles move the concrete down the slope and the baffles collect the concrete to keep it from sliding down to the bottom of the slope. The paddle system also has the ability to reverse direction. If too much concrete slides toward the bottom of the canal, the paddles can be reversed to carry it back up the slope.

Thirty-five standard vibrators are mounted transversely, rather than perpendicular, to the mold at 24 inch (610 mm) intervals. Because the slab is

Photo by Kelly Krueger EG-090601 D4

GOMACO workers assemble and weld the 10 foot (3 m) tall canal paver framework.



A *rear view of Coffman's paving train.*

only four inches (102 mm) thick, it was necessary to operate the vibrators at less than full speed to prevent over-vibrating the concrete. It also allowed better vibration coverage across the entire slab.

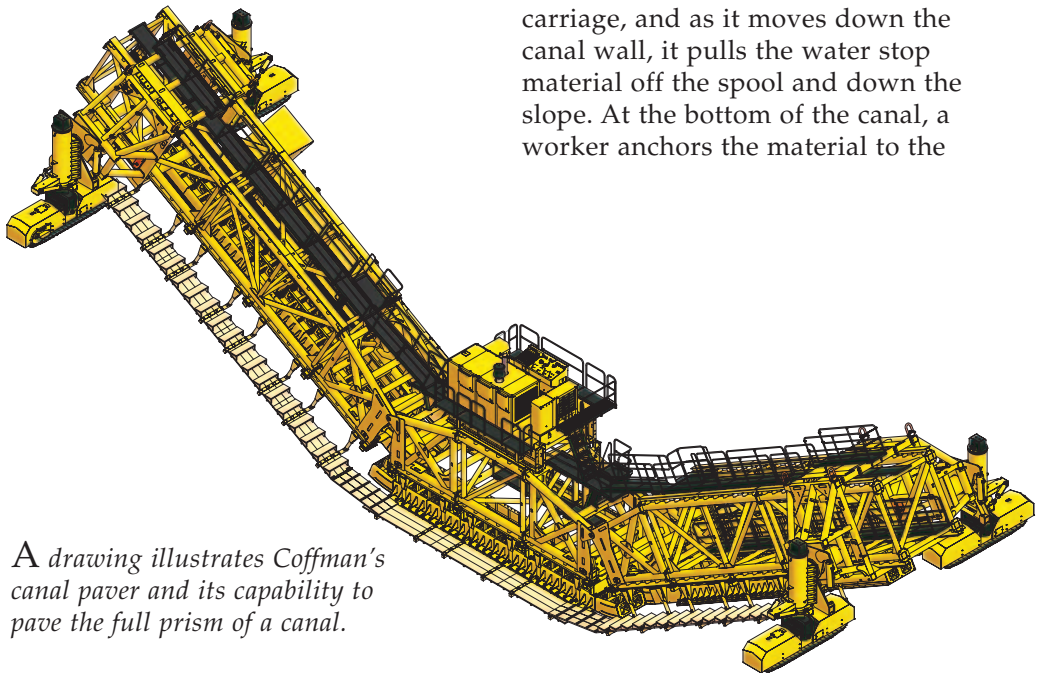
A spreader-plow, on the bottom 25 foot (7.6 m) wide section of the canal floor, moves the concrete across that width.

The design of the canal itself presented an interesting challenge for GOMACO engineers while designing the paver. The slope of the canal is not constant and the length of the slope is variable. The paver has to be able to accommodate the changes as quickly and easily as possible. These were crucial elements for not only this project, but future projects as well. This paver had to be adaptable to different specifications. GOMACO spent a lot of time and effort engineering end cars and a "Powered Wedge" to meet the requirements.

Two different types of end cars are mounted to the framework of the paver - a fixed end car and an adjustable end car. The adjustable end car can be slid in or out hydraulically while the paver is stopped to accommodate the different slopes. It allows the length changes to be made without having to add or remove any sections of framework.

The other crucial feature is the Powered Wedge. When the length of the slope changes, it also changes the angle of slope on the canal and the pivot point on the paver. The Powered Wedge makes the machine adjustable to the canal's different angles and helps the paver match the grade the canal trimmer is preparing.

The specifications on the canal require a longitudinal and transverse fracture joint every 15 feet (4.6 m). Four massive spools of blue cross-shaped, polyvinyl chloride rubber strips are mounted to the paver. The material is inserted by a specially designed inserting mechanism into the four inch (102 mm) thick concrete on-the-go, during the slipforming process. The longitudinal water stops then creates the canal's fracture joints.



A *drawing illustrates Coffman's canal paver and its capability to pave the full prism of a canal.*

"It creates a 15 foot (4.6 m) section for the concrete to fracture to allow for soil movement and other conditions," Homan said. "Once the fracture takes place, the water stop is bound into the concrete slab and allows it to move and flex. It's also creating a seal that keeps water from leaking through the canal into the soil below."

The Water Stop Machine –

The second piece of equipment GOMACO built for the All-American Canal paving train is the water stop machine. It follows directly behind the canal paver inserting the transverse water stop material every 15 feet (4.6 m). The production rate on the project is all dependent on this one machine, and that created an extra challenge in the design process.

The water stop machine is made of eight foot (2.4 m) square frame sections. It features a fixed and hydraulically-adjustable end car and Powered Wedge similar to the paver to match the canal profile. The inserter is powered by an 80 horsepower (59.7 kw) engine and runs on Series Six tracks that are 16 feet (4.9 m) long with 20 inch (508 mm) polyurethane track pads.

The rubber water stop material is inserted into the wet concrete by a specially-designed inserter mechanism that rides on a rail-mounted carriage. A platform positioned horizontally above the framework on the top side has reels that hold two spools of material.

The material is attached to the carriage, and as it moves down the canal wall, it pulls the water stop material off the spool and down the slope. At the bottom of the canal, a worker anchors the material to the

canal floor. The carriage, with the inserter mechanism, then moves up the canal wall while vibrating and inserting the water stop material to a job specific depth and orientation.

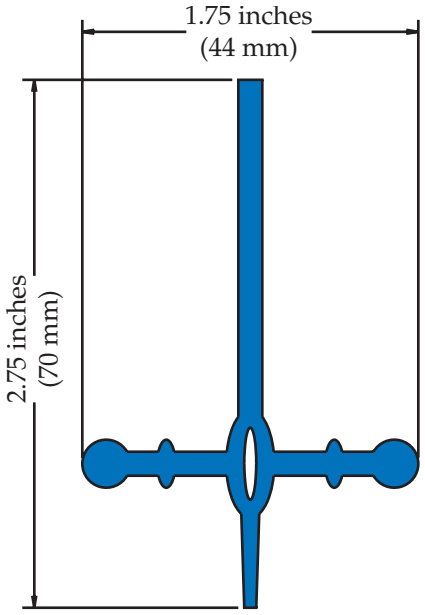
The top of the rubber water stop material is placed one-eighth of an inch (3 mm) below the surface to allow for controlled cracking in the canal. The inserter is designed to capture the twisted material and place it untwisted and in the vertical, upright position in the concrete. When the carriage reaches the top, a worker cuts the material to complete the joint. He then pulls from the spool above and clamps the material to the carriage to be pulled down the slope again. The process is repeated every 15 feet (4.6 m) along the length of the canal. The entire process has be to completed in under three minutes to allow the machine to keep up with the paver.

The water stop machine has to be able to keep up with the paver so the concrete doesn't cure and become too hard to insert the material. That's one challenge. Another challenge is project specifications.

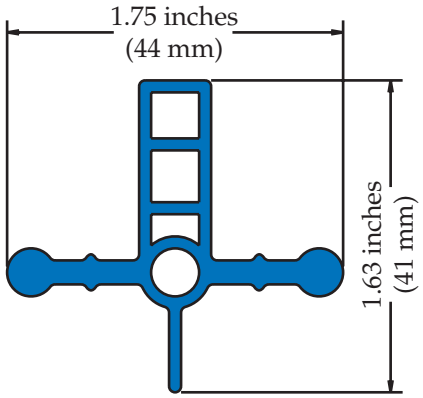
"This machine has to be able to insert a joint every three minutes to be able to pave five feet (1.5 m) per minute," Steve Johnson, GOMACO R&D senior engineer, said. "If they can keep concrete in front of the paver for that kind of production, this machine is certainly capable of keeping up."

Extensive research and testing took place to create the insertion device. Not only does it have to place the material on-the-go in the paving process, but place it at the required depth, standing in the upright position, and with the concrete consolidated around the material.

"The concept itself is relatively easy," Homan explained. "But in the environment the inserter has to work in, the complications of going through a radius, and other aspects, make this an interesting challenge, and thus a very important machine in the canal paving process."



Longitudinal water stop material...



Transverse water stop material...

Photo by Kelly Krueger OF-060822 D7

A *core sample taken from the All-American Canal proved to inspectors that the water stop material, both longitudinal and transverse, was being placed accurately.*

The Canal's Work Bridge/ Cure Machine –

Like all the machines for this project, the work bridge is a unique design with several different aspects to it. It mirrors the paver and water stop inserter in several features to match the changing dimensions of the canal, including a fixed and hydraulically-adjustable end car and Powered Wedge. The continuation of the same components on the different canal machines helps out in the field with operation and maintenance.

The framework itself is four feet (1.2 m) wide by seven feet (2.1 m) tall, with the console located at the bottom of the machine. It runs on Series Two tracks equipped with 19.7 inch (500 mm) polyurethane track pads. During the second paving pass, the machines run on the concrete from the first pass. The extra large track pads keep the work bridge from cracking or marring the surface of the new canal.

The work bridge is the third piece of equipment in Coffman Specialties' canal paving train. It gives finishers a platform to work from and is used to cure the finished canal. A curing mechanism is mounted to the back of the work bridge to apply the white curing compound.

Photo by Kelly Krueger EG-090601 D2

Service representatives Ric Moser (left) and Jimmy Remmick study a machine drawing as they work on assembling the equipment.

Testing the Equipment at Home –

The final phase of the equipment's design and manufacturing was full machine assembly. GOMACO constructed a new canal assembly and testing site at their company headquarters in Ida Grove, Iowa, USA. The site includes a concrete pier that is 16 feet (4.9 m) tall, 60 feet (18.3 m) long, and 72 inches (1829 mm) wide. It can accommodate almost any size canal paver, as the All-American Canal equipment has proven.

Each piece of the equipment was fully assembled and then placed on the pier so engineers could test its various features and performance capabilities. Ric Moser, a GOMACO service representative, was assigned to the canal equipment from the very beginning of the project. He was involved in the design process, assembly and later followed the equipment to the project site.

"It was very important and helpful for us to pre-assemble the equipment here on the pier and work it through several tests," Moser said. "These were custom built machines and this allowed us to make sure we had all of the angles correct, get it up on its own load and under its own weight to see how the frame was going to behave."

The canal equipment was later disassembled and shipped. Twenty truckloads were needed

Photo by Kelly Krueger EG-100631 D8

GOMACO's testing pier in Ida Grove simulates the slope of the canal and allowed engineers to test the different operations of the

to transport all of the canal paving equipment to California.

Assembly in the Desert –

It was a monumental task coordinating the assembly of not only the GOMACO equipment at the project site, but other extremely large pieces of equipment, as well. GOMACO's 20 truckloads of equipment was just part of the deliveries going into the desert.

"Logistically, it was significantly complex in that there was quite a lot of big equipment that had to be moved to site," Jim Coffman explained. "For example, our 275 ton Kobelco crane that we used to assemble and position the paving equipment was 13 truck loads, itself. The canal trimmer was another 10 loads. It wasn't

Photo by Jimmy Remmick EG-090705 D17

Assembly in the California desert was done in the flat configuration, with the equipment placed fully assembled into the trimmed canal.

insurmountable, but there were a lot of loads of equipment to get there and put together. It took us two and one-half months to put all the equipment together initially."

Assembly on the GOMACO equipment began in July 2007. Moser was on hand for final assembly and to help coordinate the GOMACO team and Coffman Specialties' crew.

"Assembly in the desert clicked along because we spent so much time at the canal testing site in Ida Grove assembling these machines and testing all of their functions," Homan said. "Ric was involved in all that, and then he took his expertise out there on final assembly and everything went together really well."

"Everything was preassembled on-site in the flat configuration," Moser added. "Coffmans provided plenty of help, all the necessary tools and equipment, lifting devices both large and small, and the assembly went together pretty good. Everybody pulled together as we accomplished the final assembly."

canal equipment and its many specially-designed features.

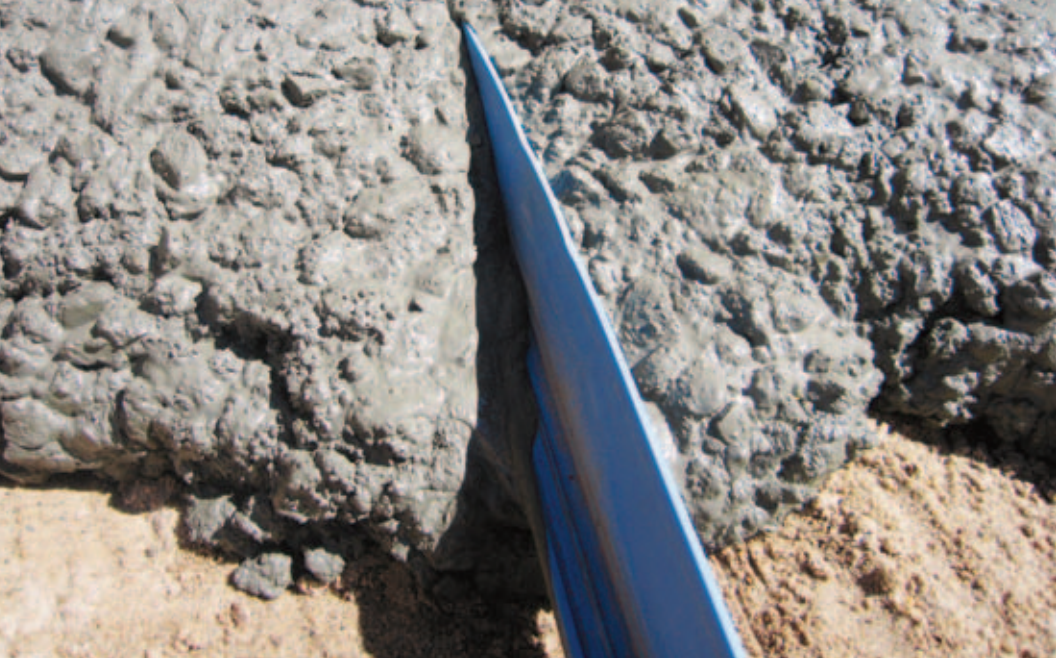


Photo by Steve Johnson EG-100704 D12

The blue water stop material stands in the correct upright position as Coffman's crew comes off the header to start the day's canal paving.

The Test Pours –

With final assembly completed, the equipment in the canal and set to the proper slope, it was time for a series of test pours in early October 2007. The new machines would have concrete run through them for the first time. All of the new technology on the machines, from the water stop inserter mechanisms to the paddle concrete distribution system, was about to be tested in the California desert.

"I have to admit, I was a little nervous before that first test pour," Homan said. "We weren't dealing with just one new thing, everything was new. It wasn't just one machine, it was three machines. It was a little nerve wracking and kind of like having a child all over again. There were just so many things that had to happen to keep that paving train moving down the line."

One of the main concerns of the test pour was getting the proper slope angle set on both the paver and the water stop machine. They had to be able to match the grade the trimmer was preparing. The water stop machine also had to match the paver for the proper insertion of the water stop material. Keep in mind, also, that these machines were paving almost 72 feet (21.9 m) wide at a 1.75:1 slope on the initial test pour and for the first section of canal.

"Going into the paving portion of the canal, I was concerned about a few things," Coffman said. "I knew it would be challenging to get concrete delivery to the paver and then distribute that concrete onto the slope. The insertion of the water stops, the four longitudinally and the one transverse, was also a very large concern.

"We decided to have three test pours so we could really learn what we were doing so when we started paving, we were ready to go. It gave us a chance to emulate the actual work that we were going to be accomplishing."

During the first test pour, approximately 150 feet (45.7 m) of concrete was poured. More importantly, crucial information was learned about the paving process, what things worked successfully and what things would need to be tweaked for the next test pour.

"We had a few starts and stops that first day, literal starts and stops due to delivery, and getting concrete from the plant to the machine," Moser said. "We had a few first day problems, but nothing that couldn't be sorted out. I know my happiest day on the project was when I saw that first bit of concrete come out from behind the paver. I was always confident the paver and the slipform process would work and that first test pour proved it."

Two more test pours were conducted in October, each one used to continue to refine and tweak the equipment and the canal paving process. Actual paving of the canal began in early November 2007.

Excavating the Canal –

Coffman Specialties' joint venture partner, Ames Construction, Inc., with corporate headquarters in Burnsville, Minnesota, was responsible for the excavation portion of the new canal. Ames brought in their fleet of rubber-tracked Caterpillar® Challenger tractors with tandem-drag scrapers. All of the canal prism was excavated using GPS technology and GPS controlled equipment. It allowed Ames to leave the newly excavated canal at a certain depth, with approximately eight to 12 inches (203 to 305 mm) left for final trimming.

A mandrel, bucket-wheeled trimmer was used to trim the excess material to the final grade. GOMACO even had a hand in renovating Coffman's canal trimmer.

"We utilized GOMACO's past knowledge and current technology to improve and change the drive system on our trimmer," Coffman said. "We gave it a hydraulic drive system that made it much more maneuverable. With the old system, it would only

Photo by Kent Godbersen SL-110702 D13

Photo by Bob Coats SL-040806 D7

A *complex dewatering system was constantly at work to keep the water level below the prism of the canal.*

travel four to six feet (1.2 to 1.8 m) per minute in any one direction whether it was trimming or not. We improved that travel speed to 22 feet (6.7 m) per minute and GOMACO helped us do that.

"Also, we put a GOMACO G21 control system on it to get better control and more up-to-date sensoring abilities in order to be able to trim the final grade more accurately."

Approximately five million cubic yards (3,822,774 m^3) of sandy material was excavated on the Ames/Coffman joint venture portion of the All-American Canal.

Timing the trimming operation to the paving operation was a crucial aspect of the project. Specifications restricted how far ahead of the paving the trimming operation could be.

"The specifications require no more than 6000 feet (1829 m) ahead with the trimmer," Kevin Coffman explained. "With the desert and the maintenance on the slope, we always have to properly gauge that so we're as effective as possible. If there's a storm coming in with extreme winds, we have to pull the trimmer back in and get the paver right on its tail. Then, vice versa, when we get good weather we try to run that trimmer out as far as possible and let the paver get a good run at it."

Dewatering the Canal –

Another significant portion of the joint-venture's project is dewatering the canal. Seepage from the old, unlined canal wants to leak into the newly created canal. Project specifications require the water table must be kept 24 inches (610 mm) below the paving invert at the time the pavement was to be slipformed.

Wells were placed every 100 feet (30.5 m) on centers along the length of the canal. Each well pumps 600 gallons (2271 l) per minute in order to keep the water table below the canal prism. The dewatering of the canal process has to continue until paving is complete and water from the old canal is diverted into the new concrete lined canal.

The water was also used as part of a sprinkler system. The top trimmed lines of the canal are kept wet with a continuous sprinkler system to keep the wind from eroding the profile and blowing the sandy surface away.

Supplying the Concrete –

Coffman Specialties has a 12 cubic yard (9.2 m^3) Erie Strayer central mix plant set up on site mixing all of the concrete for their portion of the canal project. The plant has production capabilities of 300 cubic yards (229 m^3) per hour.

The concrete is a conventional mix design with an approximate 60 percent course aggregate and

A *GOMACO 9500 trimmer prepares the final grade on the 50 foot (15.2 m) wide floor of the All-American Canal.*

Photo by Kelly Krueger SL-040835 D14

Facts and Figures for Reaches Two and Three of the All-American Canal

10 miles (16.1 km) of canal slipform paving

2.5 months to assemble all of the various pieces of equipment on site
20 truckloads of GOMACO equipment, 13 truckloads for the Kobelco crane,
10 truckloads for canal trimmer, plus miscellaneous other trucks, lifting equipment, and supplies

5 million cubic yards (3,822,774 m^3) of material excavated

95,000 cubic yards (72,633 m^3) of concrete paved four inches (102 mm) thick

8 articulated dump trucks with 40 ton hauling capacity made over 4000 trips to get all of the concrete to the RTP-500

One GOMACO RTP-500 placed all 95,000 cubic yards (72,633 m^3) of concrete

Water stop joints every 15 feet (4.6 m), both longitudinal and transverse
464,600 feet (141,610 m) of water stop material inserted longitudinally
494,000 feet (150,571 m) inserted transversely
Total: 958,600 feet (292,181 m) or 182 miles (293 km) of water stop material
2000 feet (610 m) of material per reel = 480 reels of material used
Reels weigh 300 pounds (136 kg) each = 144,000 pounds (65,318 kg) of material

7,040 transverse joints placed by water stop machine

Photo by Kelly Krueger SL-040808 D15

A *truck dumps its load of concrete into the GOMACO RTP-500 as the placer continuously feeds the concrete into the handling system on the paver.*

GOMACO's *auto-index feature uses a sensor unison with the canal paver.*

40 percent fine aggregate make-up with a 3000 psi (25 MPa) strength requirement. Slump averages three inches (76 mm). For Coffman Specialties, the workability of the mix is its most important attribute.

"The important thing was the mix had to have good characteristics of workability," Jim Coffman said. "Not only for placement, but also for inserting the water stop material and then closing up that void around the water stop as it was inserted. Workability was imperative."

It was apparent, too, that conventional trucks used to transport concrete on highway projects would not be capable of handling the project's sandy conditions. It would be very difficult for 10 to 12 cubic yard (7.6 to 9.2 m^3) trucks to keep up with the supply demands of the huge paver.

Coffman Specialties used eight Volvo A40D 6x6 articulated haulers to haul the concrete. Each one is capable of traveling over the sandy terrain while hauling a complete load of concrete to the paving site.

Navigating through the desert's sandy terrain was definitely a challenge, not only for the concrete trucks, but for everyone on the project. Vehicles getting stuck in the loose sand was a common occurrence.

"It was impossible to drive in the sand and I never did learn how to do it without getting stuck," Moser said. "I'd go in the morning and put my tow strap on the hood of my truck and leave it there all day. I knew I'd need to be pulled out at least once or twice before the day was out."

Placing the Concrete –

The articulated haulers have a maximum six mile (9.7 km) trip to deliver concrete to the paving site from the batch plant. At the site, they dump their load into the hopper of a GOMACO RTP-500 rubber-tracked placer. The hopper was slightly modified by Coffman's fabricators and made wider to more easily accommodate the width of the haulers.

"We were able to unload 10 loads per hour if everything was in sync," Coffman said. "The RTP and the articulated haulers really marry up well together. You're actually backing in half as many times per hour with these types of trucks."

The RTP-500 is equipped with the auto-index feature to help make things easier for the operator. Auto-index uses a sensor mounted to the end of the RTP-500's placing belt. The sensor touches against the leg of the paver and as the paver moves forward, the RTP moves forward in unison with it. The operator doesn't have to worry about pulling too far ahead of the paver and dumping concrete onto the ground instead of into the concrete handling system. Or vice versa, not moving ahead enough and having the paver run into the RTP's belt.

"When the paver presses the sensor, the RTP-500 automatically begins to travel forward proportionally," Moser said. "If the paver goes slow, the RTP goes slow. It's as simple as that with auto-index. It frees up the operator so he can

Photo by Kent Godbersen SL-110722 D27

The exclusive GOMACO Powered Wedge on the canal equipment allowed them to match the canal's trimmed grade and changing angles.

Photo by Kelly Krueger SL-040818 D16

that allows the RTP-500 to move forward in

Photo by Kent Godbersen SL-110701 D5

The concrete was a workable mix design for inserting the water stop material and closing up the void around the material.

focus on steering the RTP, turning the belts on and off, and watching the trucks. A full-time guy on the ground guided the trucks in and out. It all worked good and was very well orchestrated."

One RTP-500 placed all of the concrete for Coffman Specialties, approximately 95,000 cubic yards (72,633 m^3).

Paving the Canal –

"The overall size of the paver is just overwhelming," Homan said. "You see the specifications of the machine, the numbers that correspond with its size on a piece of paper, and you don't realize what that translates to in actuality. We started to get an idea when we were setting it up at the canal testing site. Standing at the top of the paver, we could see over the tree tops. Then we flew out for the test pours and we saw it sitting down in the canal... Wow, that's a big piece of equipment."

Coffman Specialties paved Reach Two of the canal project first. Paving began in November 2007 and was completed the beginning of February 2008. Reach Three was started the beginning of March and was finished by the middle of April.

"Reach Two had a 1.75:1 slope with a 25 foot (7.6 m) bottom, a 10 foot (3 m) radius between the floor and the slope, a 35.5 foot (10.8 m) slope, and a 12 inch (305 mm) top," Jim Coffman explained. "We were pouring 71.5 feet (21.8 m) wide in a single pass.

"Reach Three had a 2:1 slope with a 25 foot (7.6 m) bottom, a 10 foot (3 m) radius between the floor and the slope, a 37.9 foot (11.6 m) slope, and a 12 inch (305 mm) top. For that reach we were pouring 73.9 feet (22.5 m) wide in a single pass. That's a big machine."

Going into the project, Coffmans hoped to have an average daily production of 1600 feet (488 m) per day. Their hopes were exceeded.

"I would say it took us three days to get everybody so they knew what the equipment was and to learn the capabilities of the equipment," Jim Coffman said. "Then we worked on refining those techniques, but overall, it took less time than I thought it would. Quite frankly, our crew got better every day. Production actually went up each and every day that we paved."

Part of the learning curve for Coffman's crew was just adapting to

Photo by Kelly Krueger SL-040827 D20

The All-American Canal paver, on the second paving pass, featured a zero-clearance trailing form to allow the tracks to travel on the grade and not the finished concrete.

working on a slope instead of a flat project. The slipforming principle was basically the same, they were just adding in a lot of steps to get up and down the slope of the canal.

"The concept and the principle is the same between slope paving and flat paving," Moser explained. "You have a paver with a pan that levels the concrete and forms it to shape, the stainless to finish the surface, and you have to get the concrete slump right. Like any piece of slipform gear, you want it moving. I would rather have it moving dead slow with fresh material going through it all the time. It's not different than flat... it's just harder to get up and down the hill."

"It's a lot of stairs and I think everyone lost 10 to 20 pounds (4.5 to 9.1 kg) each that first month," Kevin Coffman continued. "You're either going up or down. You're never standing on the flat. That's one thing we missed about the horizontal paving."

As the crew got in shape, they continued to perfect their slope paving skills and tweak the GOMACO equipment. All of the new innovations were being fully tested and they were working out very well.

Inserting the water stops to the correct depth and upright position was one of the biggest concerns of the project. Inspectors took several coring samples to test the accuracy. All of them came back acceptable and well within the tolerances.

A major concern was concrete overrun. A big variable going into the project was the trimmer and how accurately the paver could match the trimmed grade. Several different variables could cause concrete overrun even though the trimmer and paver were running off the same stringline. The Powered Wedge helped the paver more accurately match the trimmed grade.

"One of the things that was important to us was to make sure the framework would marry up to the area we trimmed," Jim Coffman explained. "The biggest cost you have is the material itself. It's a four inch (102 mm) slab and the overrun can be significant. The way the legs are attached to the frame is unique. They rotate, so that allows us to rotate not only the Powered Wedge in the frame, so to speak, but also to keep the legs vertical at any slope that we're paving. GOMACO did a really good job in the way the legs attach to the frame. I think that's one of the keys... the frame is made in a way that is absolutely strong enough to perform the task."

The canal paver was also equipped with grade skis that sensored off the trimmed grade to help minimize the problem.

"We're tracing the slope using the GOMACO sensoring system," Kevin Coffman explained. "A ski sensor attached to the paver in the invert steers it on the slope, while ones up on the top and the bottom chase the grade. Essentially we're steering the grade, maximizing efficiency and yield."

The four longitudinal water stops were inserted off the paver. The second piece of equipment in Coffman's paving train was the water stop machine. Its job was to place the transverse water stop at 15 foot (4.6 m) intervals. It, too, was a concern because the entire production amount was dependent on this machine's ability to install the water stop and finish around it and still be able to keep up with the paver.

"We knew we needed the machine to do its cycle in under three minutes to keep up with our paving speed," Kevin Coffman said. "If the machine falls behind at all and the concrete gets hard, it becomes nearly impossible to put the water stops in.

Photo by Kelly Krueger SL-040826 D5

The sandy desert conditions created travel challenges for all of the vehicles on the project, even this tractor needed a push to deliver a load of cure and water stop material to the paving site.

Photo by Kent Godbersen SL-110702 D15

Versatility was a major design consideration for the paver. It was built with a Powered Wedge and adjustable end cars to accommodate various widths and slopes.

Photo by Kent Godbersen SL-110707 D19

Reels of blue water stop material were mounted to the paver and the material fed down through brackets into an inserter mechanism mounted in the paving pan.

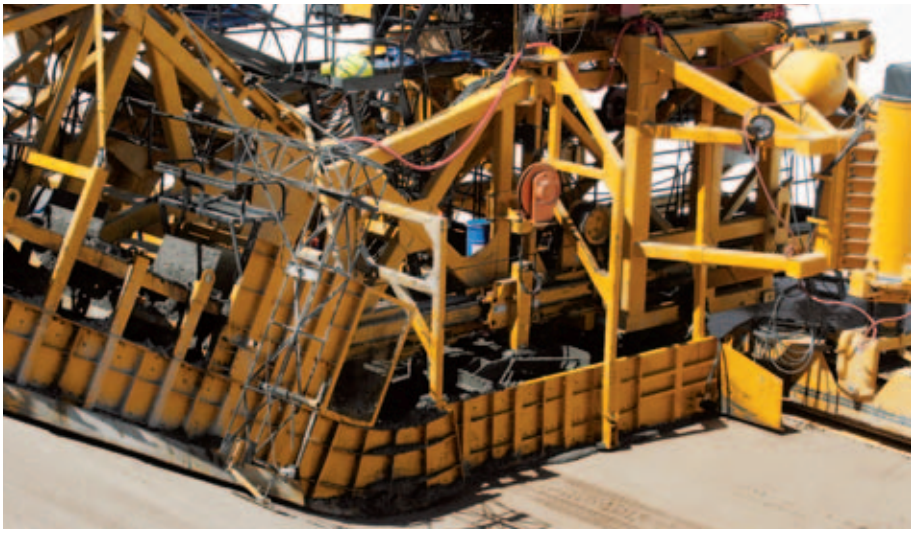


Photo by Kelly Krueger SL-040809 D12

A paddle system with baffles controlled the placement of concrete down the slope of the canal wall, while a spreader plow worked to spread the concrete across the 25 foot (7.6 m) bottom width of the canal's floor.

Photo by Kelly Krueger SL-040832 D5

Grade skis at various points on the paver sensored off the trimmed grade to precisely match the grade to eliminate concrete overrun on the project.

Photo by Kelly Krueger SL-040812 D8

Workers notched out the top of the water stop material behind the paver. This allowed the material for the transverse water stop to fit on top of it.

Photo by Kelly Krueger SL-040811 D9

A grade ski mounted on the paver, right behind the paving pan, sensors off the top line of the canal during the slipforming process.

Photo by Kelly Krueger SL-040835 D5

The transverse water stop inserter mechanism inserted the material as it made a run up the slope of the canal wall.

Photo by Ric Moser SL-120705 D19

Two operators ran the water stop machine. One in front controlled the travel and water stop insertion, while the operator in back operated the carriage with finishing pan.

Photo by Steve Johnson SL-040839 D7

Workers lined up the joint to a yellow paint mark left by a paint system on the paver.

Photo by Kelly Krueger SL-040816 D10

A float pan and 17 foot (5.2 m) long finishing cylinder working from the rear of the water stop machine helped repair and finish any wounds left over from inserting the water stop.

Photo by Kelly Krueger SL-040813 D15

Each transverse joint had to be inserted in under three minutes to maintain a five foot (1.5 m) per minute paving production rate.

Photo by Ric Moser SL-120711 D16

The paving train slipforms by the batch plant while paving Reach Two. The longest concrete haul was six miles (9.7 km).

With the reliability and the expertise of GOMACO, we've been able to insert the transverse joint effectively, very effectively."

An operator working from a station on the front of the machine controlled the travel mode and the water stop insertion device. An operator working from a station on the back of the machine controlled the float pan.

A paint system on the paver, like the one used with GOMACO's IDBI (In-The-Pan Dowel Bar Inserter) system, counts out the distance and marks the location for the joint. Laborers working from a work bridge on the back of the paver have to notch out the top piece of the longitudinal water stop material to allow the transverse one to sit on top of it, effectively creating the joint. Laborers on the water stop machine locate the paint mark and activate the mechanism that inserts the transverse joint in the proper location. A vibrating float pan mounted to the back of the insertion mechanism repairs the insertion mark and finishes the concrete around it. The entire cycle is completed in under three minutes, easily keeping up with the paver and allowing for maximum production.

"The contract required joints in the concrete on a 15 foot (4.6 m) grid," Jim Coffman explained. "We could do those with either a tooled joint and sealant or insert a water stop as we were paving. We inserted the water stops off reels that were mounted on the main frame of the paver. Those reels fed down through the water stop brackets. We fed it through with vibration and inserted them into the concrete from the paver longitudinally. The water stop was probably our largest concern. The one thing that no one else could get done right was how you inserted the water stop and got the slab to close up.

"Everybody has problems with the material turning or flipping on them, rock pockets along the side and other things. We had no problems at all. It worked out very well. There was a lot of effort and thought put into that and GOMACO did a lot of R&D time on it. It has never been done that well in the past... at least that's my assessment and my research. We had absolutely no problem putting the water stop in... zero."

The water stop machine inserted approximately 7040 transverse joints, making it a very important piece of equipment in the paving train. If it had not been able to keep up while placing the material accurately, Coffman Specialties would not have been able to meet their production requirements.

The total amount of water stop material placed into the canal by both the inserters on the water stop machine and the paver is astounding. In the 10 miles (16.1 km) of canal that Coffman Specialties paved, 464,600 feet (141,610 m) of material was inserted longitudinally, and 494,000 feet (150,571 m) transversely, for a total of 958,600 feet (292,181 m). That calculates to approximately 182 miles (293 km) of water stop material in the 10 mile (16.1 km) length of canal.

Following behind, and the last machine in Coffman's canal paving train, was a work bridge with a full width spray bar for curing. Laborers work off the bridge's platform and use bull floats to fix any imperfections left behind. Once final finishing is accomplished, the machine applies the white spray cure.

"We have effectively taken one

Photo by Adam Larsen SL-040841 D3

The water stop inserter machine followed the canal paver. The holes in the concrete are pockets created by workers trimming a piece out of the longitudinal water stop material.

Photo by Kent Godbersen SL-110707 D1

The work bridge was the final piece of equipment in Coffman's paving train. Workers fixed any left-over imperfections from the bridge and then applied a white spray cure.

Photo courtesy of Coffman Specialties SL-020801 D1

The initial transition area, near the Interstate 8 bridge, was designed in order to connect to the existing unlined canal. Half of the canal prism is paved and sheets of metal create a dam to keep the water from the existing canal from flooding the new canal.

complete machine out of the system because we're not running a cure machine and a work bridge," Kevin Coffman explained. "We're only running a work bridge/cure bridge. We've saved one machine on this project by the efficiency and speed of this machine."

Finishing the Transition Areas –

Coffman's canal project includes transition areas where the new canal meets up with structures from the existing canal, drop structures or dams.

"The transitions are areas where we're marrying up to existing facilities," Jim Coffman said. "The transitions are also areas where we have to be able to integrate the new canal into the existing canal configuration. There are four transition areas and each one is built longitudinally in half. We can

Photo by Ric Moser SL-010804 D16

Coffman's work behind the sheet metal dam. The top photo shows just how close to the water the working conditions were.

Photo by Ric Moser SL-010807 D3

The water stop machine was equipped with a C-450 finishing cylinder and operated in reverse to finish the transition areas while inserting the material for the transverse water stop.

actually put water in half of the area so we can then go and work where the existing canal with the water flow was."

The smaller paving runs in the transitional areas required a different approach. The trimmer and the paver were too big to fit in the smaller areas.

Grade was excavated like normal, with the tractors and scrapers running on GPS controls. The final canal trimming, though, was accomplished with Coffman's GOMACO C-650 with trimming undercarriage attachment.

The water stop machine was modified to do the concrete finishing work. A C-450-style undercarriage with four foot (1.2 m) finishing cylinder was mounted to the machine instead of the vibrating pan. The RTP-500 placed concrete into an RC Conveyor which placed the concrete down the slope of the canal. The water stop machine was operated backwards, or in reverse, to allow the concrete to be finished first

Photo by Ric Moser SL-010806 D5

A GOMACO C-650 (pictured in the foreground), with a trimming undercarriage attachment, trimmed the final grade in the transition areas of the canal.

by the cylinder finisher and then the transverse water material was inserted to form the joint. Longitudinal joints were hand-tooled in using a device Coffmans created. The work bridge followed behind with workers applying the final finish and spray cure.

A Successful Completion to the Canal Project –

Coffman Specialties finished the slipform paving portion of the All-American Canal in April 2008. The company could finally add another distinction to their work resume... canal paving.

"Of course, there is a sense of relief now that the slipforming is all done, but there is also a sense of accomplishment, and that's a good thing," Jim Coffman said. "A big success of these types of stories is that the industry worked together to accomplish something that an owner needed. There hasn't been major canal paving, to a large degree, in the United States in the last 20 years. This project created a need and the

Photo by Kelly Krueger SL-040824 D14

Photo by Kelly Krueger SL-040823 D14

Coffman's crew makes the second paving pass on Reach Three of the canal project. Just a few days of concrete paving was left for the crew when this photo was taken.

Photo courtesy of Coffman Specialties SL-020801 D5

Coffman Specialties paved one of the canal's transition areas while the excavation of the next phase continued ahead of them.

Photo by Kelly Krueger SL-040823 D20

Finishing Each Night's Header –

Coffman Specialties had a unique way of handling each night's header. The slope of the canal created challenges getting the extra concrete out each night. They developed a solution to overcome the problem. Photo #1 shows Coffmans' workers laying down a heavy rubber mat behind wooden planks used to form the header. The mat has wooden steps on it to keep the concrete from sliding off when the mat is pulled up the steep slope of the canal. In the second photo, the canal paver approaches the header and paves over the rubber mat. The paver has pulled off the header in photo #3. The finishers do the work necessary for the rubber mat to be pulled up the slope and out of the canal. Two large dozers, chained together, work to pull the mat and its load of excess concrete out of the canal in photos #4 and #5. With the excess concrete out of the canal and out of the way in a quick and easy manner, workers can finish off the night's header faster and more easily. It was a huge time and material savings for the company and just one of Coffman Specialties' unique innovations on the All-American Canal project.

Photo by Adam Larsen SL-040845 D15

Photo by Kent Godbersen SL-110720 D9

Photo by Kent Godbersen SL-110720 D12

Photo by Kelly Krueger SL-040826 D3

Photo courtesy of Coffman Specialties SL-020802 D10

The new, concrete-lined All-American Canal will carry water more efficiently to California's Imperial Valley region.

Photo courtesy of Coffman Specialties SL-020801 D3

Old next to the new... The new concrete lined section of the All-American Canal runs along side of the existing canal before the water is diverted into the newly lined canal.

industry worked together to supply an end product that was very well suited for what the owner wanted. That's what it's supposed to be about."

"This was a partnership between Coffman Specialties and GOMACO in every sense of the word," Homan said. "They had expertise and we had expertise. We could sit down together, bounce ideas off each other and work together to develop this equipment. My hat is off to Coffman and his crew. They utilized the equipment to the max and slipped a good, quality product."

The hundreds of hours spent in meetings, teleconferences, design and fabrication, testing and assembly paid off. The canal lining and the equipment used to accomplish the task was a success. In fact it was so successful, that Coffman Specialties is already bidding on another canal project in Southern California. It has different specifications than the All-American, but their equipment was built to be versatile, and they should have no problems accommodating it to the new set of requirements.

"We're looking forward to the next one," Jim Coffman said. "I would say that my expectations for this equipment were surpassed.

"GOMACO has grown to a point where they can take on a project like this. They have the expertise, as well as the manpower. It just shows the growth of the company and the tremendous capacity the company has. We had to design, we, meaning the people at GOMACO and Coffman Specialties, a machine that would work. And it did. It worked because of the tremendous commitment that GOMACO made to it, and the commitment their people made to it, particularly Jim Homan. They put their heart and soul into it, especially Jim, and that's what made the thing a success."

Goodbye Friend...

James "Jim" Homan, 44, of Ida Grove, passed away unexpectedly on Monday, April 28, 2008, from the effects of a cerebral aneurysm.

He was the Assistant Manager of GOMACO Research and Development, and had worked at GOMACO for 16 years.

His primary duties were to guide and assist the R&D staff in their projects. Jim also worked closely with manufacturing to assist with any production issues or questions. He spent a good deal of his time working with outside vendors to specify which products would be purchased.

Jim was involved with many GOMACO projects over the years. He was the primary designer for the GHP-2800 and GP-2600 pavers, the PS-2600 placer, and the Commander III. Most recently, he had taken the lead in the design and development of the All-American Canal project.

"I was shocked, saddened and broken hearted. It's like losing a son or a brother," said Gary Godbersen, GOMACO President and CEO. "He was always there to help, not only GOMACO, but the fire department, country club, friends and family. Jim could reach outside the walls of GOMACO and work with customers, vendors and others. The relationships that he had and the people's lives that he touched were evidence of his knowledge, work ethic and sincerity. We will all miss him."

Survivors include his wife, Ann; three sons, Andy Homan (23) of Sioux City, and Nate Homan (19) and Nick Homan (16), both of Ida Grove.

Photo by Kelly Krueger EG-100605 D14

Jim Homan (left) stands on top of the canal paver as it is assembled in Ida Grove, Iowa. He was GOMACO's project manager for the All-American Canal equipment.

Editor's Note: *This special edition of GOMACO World is dedicated to Jim's memory. The All-American Canal would be his last great project and its success is a testament to the man he was. His dedication, professionalism and knowledge will be severely missed here at GOMACO and for everyone who knew him. Most of all though, we will miss his friendship.*
–Kelly Krueger, GOMACO World Editor

Photo by Kelly Krueger EG-060702 D5

Jim oversees the successful testing of the water stop inserter device in Ida Grove.

"It is with great regret we received word that Jim Homan passed away. There are no words that can replace him or match the feelings of his family and close friends. We can only offer our warmest regards, thoughts, and prayers. This past week I was interviewed by Ms. Kelly Krueger of GOMACO in regard to the All American Canal; and she asked me why I wanted to bid and build a project like the canal, especially since we had never performed this kind of work before...

In life we choose paths for our journey, with some yearning for the experience and adventure. For years Carl Carper (retired GOMACO Vice President), Marty Keane (Coffman Specialties) and of course, myself, had talked about building a canal with GOMACO slipform equipment, never knowing if the opportunity would present itself. When we choose paths, hopefully we have the proper bearings and plan, but it is never for sure what the road may bring; some execution of the framework of our thoughts and some unexplainable experiences/fate. We were successful in getting a contract for a canal and we began our journey with GOMACO. This is when we truly got to meet and know Jim Homan. I can tell you it was an honor and privilege to work with Jim on this project. His dedication, abilities, and absolute commitment to the goal was truly one of the greatest pleasures I have experienced in my career. And the end result speaks for itself. My only regret is I won't get the chance to shake his hand one more time.

I'm sure Jim lived his life with the same commitment and passion for which his family enjoyed with great devotion. The loss of Jim can never be explained, excepting faith and knowing his path was chosen by others. They say the Lord works in mysterious ways, but it is times like this that test our faith. I know he will be received by the Lord with open arms to continue his journey. Please give our/my regards to Jim's family and convey to them our deepest feelings. I know my life has been touched by a truly grand person, for which I will be always thankful for the opportunity to share a place on a path with him.

Best Regards and God Bless, Jim, Colleen, Kevin, Kelly, and Dylan Coffman - Coffman Specialties, Inc., San Diego, California"

Photo courtesy of Coffman Specialties

Celebrating a Job Well Done...

Coffman Specialties had approximately 50 workers involved with the canal project on any given day. The paving crew working with the GOMACO equipment achieved some outstanding production and quality figures. They took a moment to celebrate and pose for a photo after finishing the paving of Reach Two at the end of February 2008.

ASR American Systems Registrar

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