Olmsted Dam is one of the largest civil works projects undertaken by the U.S. Army Corps of Engineers. URS is constructing this 2,700-foot-long concrete dam across the lower Ohio River using an innovative "in-the-wet" method. The public is concerned about this project because 95 million tons of goods are shipped through this reach of the river—more than any other place in America`s inland navigation system. Delays in shipments ultimately raise the price of commodities. Upon completion, total lockage time will be reduced from 5 hours to less than 1 hour.

Major innovations created by URS engineers in order to complete this unique project are listed below. All of these designs have been constructed and in operation for over two years, and will certainly be useful on future construction projects with similar challenges.

1. **Lifting & Placement Equipment:** The world's largest gantry crane of its kind and a Catamaran barge of similar capabilities were designed specifically for this project to lift the concrete shells in the casting yard and transfer them to the river for placement at the dam. Each concrete shell, including the associated lifting frame, weighs up to 5,000 tons! Components include the largest strand jacks in the world.

   In order to achieve the demanding contract tolerances (+/- 1" horizontal, +/- ½" vertical) while setting the concrete shells in a virtual 3D dynamic environment, a shell position monitoring system was developed by URS engineers. The system utilizes two highly accurate robotic stations to track prism targets affixed to the shells' steel lifting frame, which extends above the river surface. Additionally, a dual-axis inclinometer measures the shells' levelness in two directions. The prisms' x-y-z locations and inclinometer data are transmitted wirelessly to the catamaran barge control room and integrated into a custom-designed 3D computer model visualization platform. URS engineers and operators use the real-time, continuously updated models to accurately position the shell and land it safely onto the river bed in the required locations.
2. **Grout Mat Innovation**: A special grout mat was invented to protect the prepared river bed foundation from scour and being swept away during the course of construction. An extensive R&D process was undertaken to find the correct fabric, create the proper configuration for the mattress, formulate a grout filling technique and devise a deployment method. This process led to a mattress configuration which could, during the filling process, maintain a consistent thickness and be filled efficiently. The final dimensions of the mat are 30' wide by 275' long. The 30' of width is made up of a 25' grout filled section. Special equipment was created to roll up, transfer, lower, unroll and deploy on the river bottom. It takes 106 of these grout mats to cover the foundation footprint on the river bottom. Each grout mat weighs over 300,000 lbs.
3. **Tremie Concrete Innovation**:

   The construction plan requires 4,800-ton, precast concrete shells to be set on foundation piles driven into the bottom of the Ohio River in more than 60 feet of muddy water flowing at up to 6 ft. /sec. Concrete must be pumped under the shells to tie them to the foundation piles on the river bottom. Using a tremie process, concrete is delivered through pipes to prevent the freshly placed concrete from mixing with river water. For this process to be successful, it is imperative to know the location and elevation of concrete as it is being placed. After traditional concrete sensing methods failed in the difficult river environment, URS developed a first-of-its-kind air pressure sensing system for determining the real-time location of the concrete filling the shells throughout the multiple-day placement period. The results are displayed in 3-D on monitors, which are used to manage the placements of concrete accurately. The system has functioned flawlessly.
4. **Pile Driving Template**: This innovation was created to drive piles 60 feet down into the running river and meet more exacting tolerances than those usual for dry construction. URS engineers developed, designed and constructed a template that allowed the achievement of the very tight pile driving tolerances productively. Additionally, this template allowed URS to drive the piles to grade, which minimized the number of piles that would have otherwise required under-water cut-off and the use of divers. This feature resulted in substantial cost-savings to the client as well as eliminated many diving and salvaging operations improving project safety. The 3-D model allowed the team to visualize the end product and identify weaknesses and improve various design approaches. Once commissioned, the Pile Template was successful in increasing productivity, quality and safety.

1. Lifting & Placement Equipment:

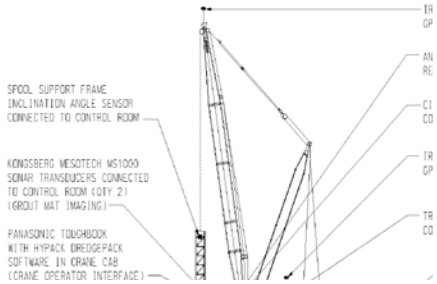
Super Gantry Crane—largest of its kind--capable of lifting up to 5,300 tons.

Catamaran Barge capable of lifting and transferring up to 4,900 tons.

Screenshot of 3D computer model visualization to safely and accurately place concrete shells on river bottom despite flowing and muddy river.

2. Grout Mat:

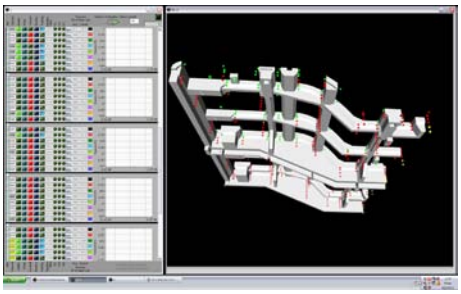
Grout mat being lowered through the guide frame to the river bottom.



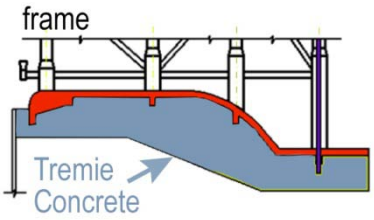
Configuration of the Ringer Crane to place Grout Mat on the river bottom.

3. Tremie Concrete:

URS developed a first-of-its-kind air pressure system installed beneath the concrete shell.

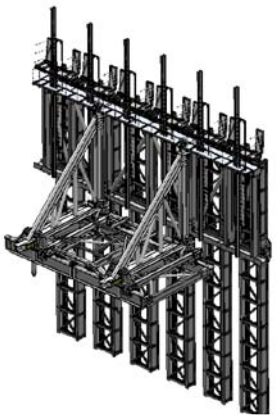


Computer monitors display data from the tremie sensors to determine real-time location of the concrete filling inside the shells.



Thorough coverage of the tremie concrete ties the shells to the foundation piles on the river bottom.

4. Pile Driving Template:



URS engineers designed and constructed a template that allowed achievement of very tight pile driving tolerance safely and productively.

This innovation saved valuable budget dollars and eliminated many diving and salvaging operations which improved project safety.