RITE GEOSYSTEMS

ENCARDIO RITE METASENSING FOR MEGA STRUCTURES

Project dossier

PROJECT DOSSIER

Montgomery Locks & Dam, USA

PROJECT OVERVIEW

Montgomery Locks and Dam is a lock and dam on the Ohio River, located 32 miles downstream of Pittsburgh. There are two locks, one for commercial barge traffic that's 600 feet long by 110 feet wide, and the recreational auxiliary lock is 360 feet long by 56 feet wide. Montgomery locks averages about 300 commercial lock throughs every month and 150 lock throughs a month on the recreational auxiliary lock.

Brief history

Montgomery Locks and Dam was constructed from 1932 to 1936. The locks opened in June 1936. This facility eliminated the original Locks and Dams 4 (built 1898-1908), 5 (1898-1907) and 6 (1892-1904). These three dams were old-style wooden wicket dams built by the U.S. Army Corps of Engineers to raise the first shallow navigational pool on this stretch of the Ohio.

MONITORING REQUIREMENT

Montgomery Locks & Dams, built in the 1930s was exhibiting significant deterioration. A catastrophic failure at the site would halt river traffic and likely hamper work at Shell's ethane cracker plant nearby.

Project	Montgomery Locks & Dam Project - Secant Pile construction
Location	Beaver County, PA, USA
Client	U.S. Army Corps of Engineers, Pittsburgh District
Contractor	Richard Goettle, Inc., Cincinnati, Ohio
Consultant	Island Navigation Design Center
Duration	2022

For repair and restoration works, a secant pile wall needed to be constructed at Montgomery Locks and Dam. The secant pile wall was to be constructed downstream of Gate Bay 1, through the concrete apron; with the centerline of the secant wall 14' riverward off of the centerline of Pier 1.

The construction works included Installation of a bulkhead system on top of the fixed crest dam, commonly referred to as "flashboards"; Drilling of exploratory test borings at the center of piles; Construction of demonstration secant piles; Demolition of existing concrete baffles; Drilling and placement of primary & secondary piles.

The design documents specified installation of instrumentation on adjacent concrete apron and Pier 1 during new secant pile wall and supporting construction and demolition. Main secant pile construction activities included coring 4 ft. diameter shafts through 5 ft. thick concrete apron and driving casing through sand and gravel using a vibratory driver, drilling and placing piles.

INSTRUMENTATION & MONITORING PROGRAM

In order to monitor the stability of the existing dam Apron and Pier 1 during secant pile construction activities, sensors were required to be installed on the concrete apron surface and at the top of Pier 1.

Apron instrumentation was to be installed underwater. It included one vibrating wire piezometer, two MEMS tilt meters and two vibrating wire crack meters, along with corresponding cable protection and protective enclosures for the sensors. The underwater sensors were required to be suitable for operation under 60 feet of water.

Pier instrumentation included one MEMS tilt meter and one vibration monitor at the top of Pier 1.

Datalogger was to be installed in the service room, for collecting and recording the sensor data as well to transfer the data to cloud server integrated with a data management system.

Rite Geosystems Inc, USA, was awarded the contract for the instrumentation and monitoring works. Scope of works broadly included

- Supply and installation of geotechnical and geodetic instrumentation
- Automatic monitoring at desired frequency
- Setting up an online web-based data management system (WDMS) and maintenance during the contract period


Site work in progress


Site work in progress


Video monitoring of diver during installation


Datalogger in service room at top of pier

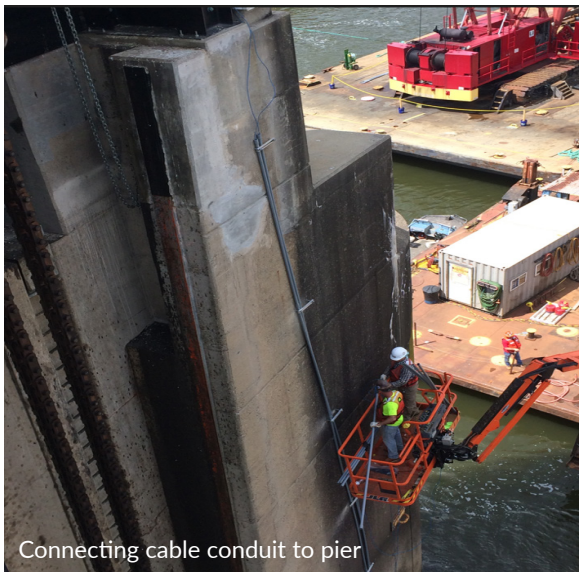
REAL-TIME MONITORING SYSTEM USED

Crack meters	Model EDJ-40V surface crack meter; 2 no. installed on concrete apron surface to monitor contstruction joint opening; suitable for operation under 60 feet of water
Tilt meters	Model EAN-92M stainless steel cylinderical biaxial tilt meter; 2 no. installed horizontally on concrete apron surface to monitor tilt (downstream/upstream and riverward/landward tilt); suitable for operation under 60 feet of water Model EAN-93M box type biaxial tilt meter; 1 no. installed at top of Pier 1 to monitor tilt
Piezometer	Model EPP-40V vibrating wire piezometer installed near apron to monitor pore water pressure.
Vibration sensor	Vibration monitoring device was installed at the top of Pier 1, adjacent to the tilt meter.
Datalogger	Model ESDL-30 datalogger to collect data automatically from installed sensors. The data was collected at required frequency and was sent wirelessly to central server.
Data presentation	Web Based Data Management system with alert thresholds sent via email

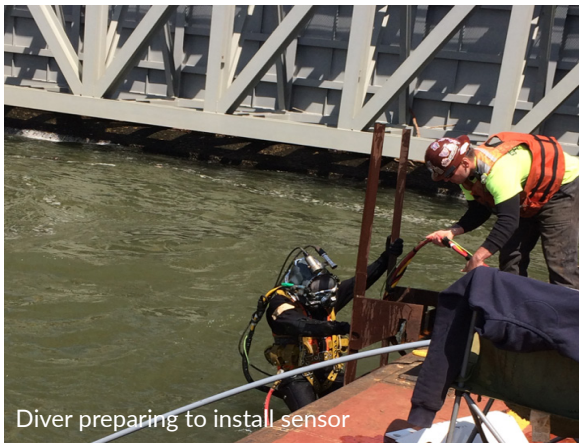
INSTALLATION REQUIREMENT & CHALLENGES

- Prepare installation plan and shop drawings
- Sensors to be factory cabled with sufficient length, no splices
- Verify sensor functionality prior to installation
- All underwater sensors to be protected with steel covers
- Sensor cables to be placed in conduit
- Robust attachment design for sensors and covers – in case flood gates breached

  Note: Before construction started (after sensors were installed), there was a flood event and dam gates were breached. Only one sensor cable was damaged and the sensor was replaced.
- Train dive crew on sensor installation methods
- Direct dive crew via radio and video during installation



Connecting cable conduit to pier



Diver preparing to install sensor

ACHIEVEMENT & RESULTS

Underwater installation and dive work was crucial for this project. Training divers on correct installation of sensors, guiding them during installation underwaters, cable routing and sensor protection underwaters was quite challenging. With RGS & Encardio team's expertise, great job by divers and state-of-art sensors, the project was executed successfully.