

RAYMOND W. HENN, PhD, PG

Owner

Tunnel Inspection and Condition Surveys

Mr. Henn has performed 14 Tunnel Inspections and Condition Surveys.

- **Colorado Department of Transportation Tunnel Inventory, Inspection and Condition Survey**

Mr. Henn is a member of the team assigned to inspect and perform condition surveys on all of the Colorado Department of Transportation owned tunnels within the state.

- **Denver Water Tunnel Inspection Manual**

Mr. Henn was Senior Consultant for the recent effort to revise the Denver Water Tunnel Inspection Manual. As part of the team Mr. Henn helped prepare the original inspection manual in 2008. In 2013, Denver Water retained Brierley Associates to update the manual to be comprehensive for use by facility caretakers, Denver Water technical staff, and other outside consultants. The manual will become the standard document used in inspections of all Denver Water's tunnels and underground facilities.

- **B Street/ New Jersey Trunk Sewer, Washington DC**

Mr. Henn helped develop an inspection plan for the 17,000 foot long cast-in-place concrete sewer tunnel.

- **Washington Aqueduct, Mac Arthur Boulevard, Maryland**

Mr. Henn led the project team for a design review and walk-through inspection of two parallel 9 ft diameter, 9 mile long raw water conduits. One conduit is constructed of brick and the other is cast-in-place concrete. The shallow tunnels run under roadways and the US Army Corps of Engineers had to know the condition of the tunnels and effect of live loads from the roadway on the structures. Tunnel lining prior to putting the tunnel in service.

- **Moffat Water Tunnel, Winter Park Colorado**

Mr. Henn supervised the walk-through reconnaissance condition survey inspection of the 6.2 mile long Moffat Water Tunnel. This reinforced concrete lined tunnel ranges in size from 5 ft – 8 inch for 2,000 feet to 10ft - 6inch for 31,264 ft.

- **Red Hill Underground Fuel Storage Facility, Pearl Harbor, Hawaii**

Mr. Henn was a member of a three person panel of experts who performed a field inspection and provided structural repair recommendations for the Red Hill underground complex which is comprised of approximately 4.6 miles of tunnels and 20 fuel tank chambers approximately 250 ft tall by 100 ft in diameter.

- **Twin Lakes Tunnel, Leadville, Colorado**

Mr. Henn supervised the walk-through condition survey inspection of this 3.85 mile long, 9.2 ft inside diameter cast-in-place concrete lined tunnel which included inspection of the intake gate structure and the portal. Mr. Henn also provided repair recommendations and cost estimates for proposed repairs.

■ **Redondo Beach Desalination Project, Carson, California**

Mr. Henn evaluated two 10-ft diameter reinforced precast concrete lined tunnels originally designed for cooling water at a power plant which is being converted over for use on a pilot desalination project at Redondo Beach. The existing tunnels were constructed in the late 1940's and are approximately 2,000 feet long. This inspection/condition survey of the tunnels was performed using a Remote Operated Vehicle (ROV). Concrete cores from the tunnel liner were first visually inspected and then tested for Ph, chloride content, alkaline aggregate reaction carbonization, petrographic analysis, and compression strength.

■ **Strontia Spring Dam, Rampart Tunnel #1, Colorado**

Mr. Henn supervised the underwater inspection/condition survey of the cast-in-place concrete intake structure and cast-in-place concrete 1,450 ft long tunnel. The inspection/condition survey was conducted using a Remote Operated Vehicle (ROV).

■ **Piney Creek Diversion Tunnel at Lake De Smet, Buffalo, Wyoming**

Mr. Henn supervised the underwater inspection/condition survey of the intake and outlet shafts and tunnel for the Piney Creek Diversion Tunnel. The cast-in-place concrete lined shafts are 16 ft in diameter. The 8ft - 7 in. ID cast-in-place concrete line tunnel is approximately 8,300 ft long. The inspection/condition survey was conducted using a Remote Operated Vehicle (ROV).

■ **Raystown Hydroelectric Project, Huntingdon, Pennsylvania**

Mr. Henn led the inspection team during four separate tunnel/penstock inspections. One inspection was performed in the dry after tunnel unwatering, the other three inspections were performed in the wet using a Remote Operated Vehicle (ROV). The 12 ft diameter tunnel is lined with cast-in-place reinforced concrete which transitions to a 12 ft diameter steel penstock. Total length is approximately 1,700 ft.

■ **Delaware Aqueduct, Roundout Tunnel, New York**

Mr. Henn was a member of the panel of experts studying water leakage out of the Rondout Tunnel. The 14 ft diameter, 700 ft deep high pressure rock tunnel was excavated by the drill and blast method and lined with non-reinforced cast-in-place concrete. A condition survey of the tunnel was performed using a specially designed Autonomous Underwater Vehicle (AUV). The survey focused on an approximately 15,000-ft long section of the 45 mile long tunnel. Mr. Henn also consulted on the existing Number 6 shaft and the proposed Number 6A shaft in support of tunnel repair construction.

■ **Barrow Utilidor Tunnel, Barrow, Alaska**

Mr. Henn performed the tunnel inspection of the 7 mile long utilidor tunnel. The purpose of the inspection was to evaluate the use of a grouting program to help reduce leakage into the tunnel.

■ **Bradley Lake Hydroelectric Project, Alaska**

Mr. Henn performed the inspection in the dry of the cast-in-place reinforced concrete 17,000-ft long pressure tunnel lining prior to putting the tunnel in service.