Inventory Inspection of the Mike O'Callaghan-Pat Tillman Memorial Bridge

By Craig Smart, P.E. and Dave Severns, P.E.

Figure 1: HDR bridge inspection team leader, Craig Smart, inspects the spandrel columns from ropes while NDOT inspectors access the steel tub girders. Courtesy of HDR, photographer Keith Philpott.

The Mike O'Callaghan-Pat Tillman Memorial Bridge officially opened to traffic on Tuesday, October 19, 2010. Prior to its highly anticipated opening, the Nevada Department of Transportation (NDOT) was provided with a short window of opportunity to perform an inventory inspection of this landmark structure (*Figure 1*). This initial inspection would evaluate the as-built condition of the structure and form the baseline for future inspections.

The Mike O'Callaghan-Pat Tillman Memorial Bridge is a border bridge linking the States of Nevada and Arizona on US-93, located just east of Boulder City, Nevada. The structure is named after former Nevada Governor Mike O'Callaghan and former Arizona football star and U.S. Army Veteran Pat Tillman. The structure is approximately 1900 feet long with a main span of 1090 feet, making it the longest concrete arch in the Western Hemisphere. The composite concrete/steel deck arch design is the first of its kind in the United States. Also unique to this structure are the hollow, tapering, high strength concrete spandrel columns which reach 300 feet in height. At almost 900 feet above the Colorado River, it is the second highest bridge in the United States.

As the concept and design were developed under the direction of FHWA's Central Federal Lands Highway Division, with a design team led by HDR Engineering, Inc. (HDR), the plan for long term maintenance and monitoring was also under development. The unique location of the structure brought together FHWA, the US Bureau of Reclamation, the National Park Service, and the State DOTs from Arizona and Nevada to develop a cooperative agreement for ownership, operations and maintenance. The resulting agreement assigned shared responsibility for operations and maintenance split 50/50 between NDOT and the Arizona Department of Transportation (ADOT), with NDOT taking the primary responsibility for inspection.

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Figure 2: Underbridge inspection trucks work simultaneously on each side of the bridge to facilitate inspection and rope access work. Courtesy of HDR, photographer Keith Philpott.

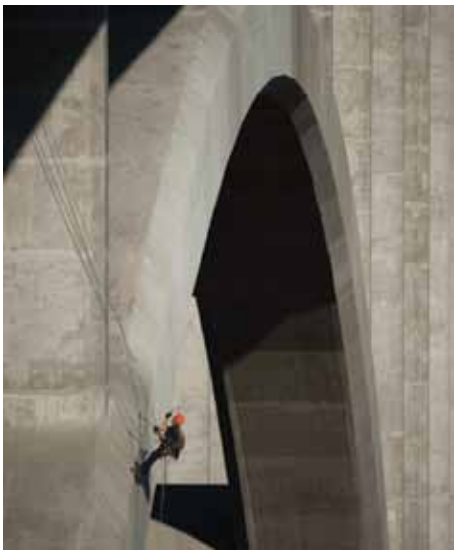


Figure 3: HDR inspector, Craig Smart, utilizes industrial rope access techniques following SPRAT guidelines to gain access to the arch rib and spandrel columns that would otherwise be outside of the reach of traditional inspection equipment. Courtesy of HDR, photographer Frank Huster.

Figure 4: HDR inspector, Al Nelson, inspects the concrete arch rib utilizing a rope-to-rope transfer. Courtesy of HDR, photographer Keith Philpott.

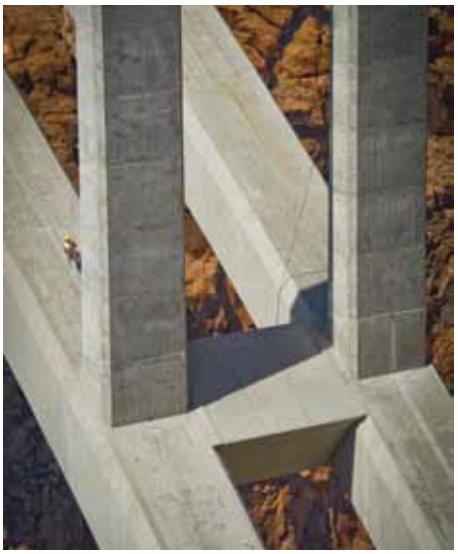


Figure 5: Outside air temperature reaching 108 degrees was just one of the challenges inspectors faced on this high level inspection. Courtesy of HDR, photographer Keith Philpott.

As the end of construction and grand opening of this signature structure drew closer, officials at NDOT were busy planning the highest level and possibly the most highly visible bridge inspection in Nevada history. With all of the agencies involved and the transfer of responsibility for this structure to the state of Nevada, NDOT wanted to perform a very thorough inspection and establish a baseline condition for the first bridge in Nevada to be assigned a 100 year design life. This inventory inspection would also serve to introduce the bridge into both ADOT and NDOT bridge inventories, and to establish the bridge inspection frequency.

NDOT immediately identified a need for specialized inspection access to thoroughly assess the bridge. The NDOT-owned under-bridge inspection trucks (UBITs), with a maximum vertical reach of approximately 72 feet below the bridge deck, would only be able to reach the crown of the arch under the middle 3 spans. Knowing of their specialized experience and capabilities in rope access inspections, NDOT turned to HDR, and together they began the process of preparing a detailed bridge inspection plan.

The scope of the inspection was a detailed and thorough "hands-on" inspection of all primary bridge components. The inspection plan outlined the bridge components and assigned primary responsibility to HDR or NDOT personnel working as a combined inspection team. The plan also assigned the appropriate access method to each bridge component. HDR teamed with partner Mistras Ropeworks to assist with planning the rope access inspections, and to provide rigging and supervisory personnel following the Society of Professional Rope Access Technicians (SPRAT) guidelines. Multiple planning sessions took place to define and refine the inspection plan, including a detailed plan of how the traditional "snooper truck" access plan would be orchestrated with the rope access plan. These planning sessions also provided an opportunity to familiarize the project team with the specific rope access techniques that would be used to access the arch ribs and the spandrel columns.

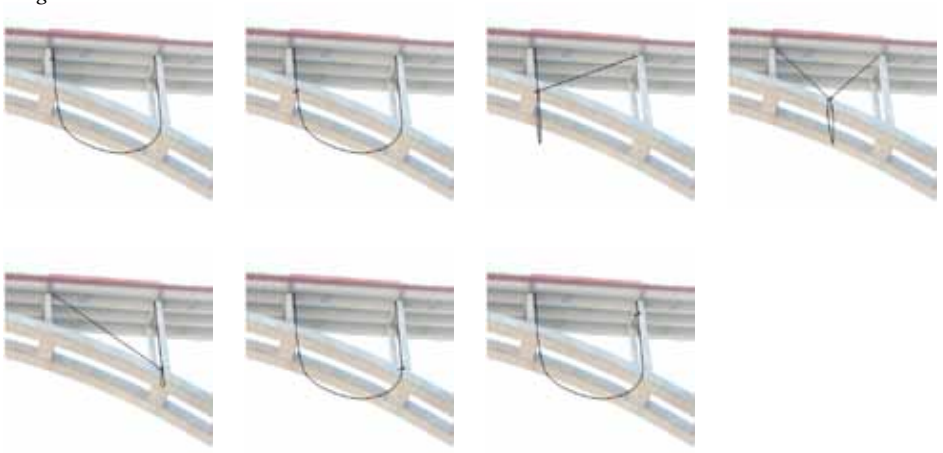
Vital to the inspection planning process was the implementation of a pre-inspection job walk. The purpose of the job walk was to verify field conditions, and to be able to discuss and "walk through" the inspection plan prior to the actual inspection taking place. One key aspect of the job walk was to identify locations for rope anchors (i.e. anchorage points for attaching the climbing ropes to the bridge itself). In this manner, rope anchor locations were identified that were not readily envisioned via a review of the bridge plans. The job walk also allowed for an on-site meeting between key stakeholders in the project to finalize schedule and logistics.

The inspection took place during a two-week window in late September/early October of 2010, prior to the grand opening of the bridge. The bridge site was still a secured construction zone at that time, with the contractor putting the finishing touches on sidewalk appurtenances, the pedestrian plaza, and other facilities. The first day of inspection began with a briefing to the entire project team to discuss security protocols and access to the site, inspection procedures and site safety information. The project team consisted of bridge inspectors and UBIT operators from NDOT's Structures Division, equipment operator and traffic control personnel from the two additional NDOT districts, 2 SPRAT Level 3 technicians from Mistras Ropeworks, and 4 HDR bridge inspectors (3 of which are SPRAT Level 1 workers).

The steel tub girders were inspected by NDOT personnel, using both visual and Non-Destructive Testing methodologies. Access to the inspection platforms interconnecting pairs of girders was provided via the NDOT UBITs, working simultaneously from each side of the bridge (*Figure 2, page 19*). While the NDOT inspectors performed their tasks, Mistras Ropeworks technicians rigged rope anchor points for the rope access inspection work. In order to minimize load on the UBIT platforms and to maximize the number of people in the buckets, ropes were pre-rigged and staged on the bridge deck prior to connecting to the anchors and deploying them over the side of the bridge. HDR rope access bridge inspectors were then deployed to the rope locations via the NDOT UBITs to begin inspection of the spandrel columns and arch ribs (*Figure 3*).

The spandrel columns and arch ribs were inspected utilizing a rope access technique called a rope-to-rope transfer (*Figure 4*). The maneuver involves the inspector transferring from one two-rope system to a second two-rope system. In the process of the transfer, the inspector is able to position himself along the geometry of the arch in order to perform a thorough inspection. *Diagram 1* shows the process of

Diagram 1



Inspection "Firsts" for Nevada:

- **First "Signature Bridge" inspection**
- **Two simultaneous UBIT operations; required by tight inspection window**
- **Participation by staff from all 3 NDOT Districts**
- **Interaction with multiple stake-holders**
- **Rope-access inspection methodology employed**
- **Integrated State/consultant inspection team**
- **NV/AZ stamped bridge inspection report**

a rope-to-rope transfer. For the spans adjacent to the tallest spandrel columns, this technique required approximately 1500 feet of rope. The 20-foot wide and 14-foot deep, hollow concrete arch ribs do not contain any permanent stairs, walkways or other inspection appurtenances. Therefore, rope access methods were used to inspect the inside of the arch ribs in the steeper portions of the arch. Natural ventilation was provided by opening the access hatch and ventilation ports in the arch.

The inspection team faced various challenges throughout the inspection process. The beginning of the first week of inspections was unseasonably warm, with outside air temperatures reported to be as high as 108 degrees. This made the already strenuous activity of ascending the 300-foot spandrel columns even worse (*Figure 5*). It also created stifling conditions inside the enclosed confines of the steel tub girders and the concrete arch ribs. As temperatures cooled during the second week of inspections, thunderstorms and lightning threatened to hamper the inspection efforts. With the end of the 2-week deadline fast approaching, operations were halted on one occasion due to high winds that exceeded the UBIT manufacturer's safe working limits.

Also complicating the logistics of the inspections were the amount of personnel on site during the inspections. In addition to the inspection team itself, contractor employees were busy putting the final touches on the bridge. There were also visiting dignitaries taking advantage of the opportunity to experience the bridge, and local law enforcement visiting to familiarize themselves with a new stretch of freeway that would be part of their jurisdiction. At one point, a few bicyclists by-passed the locked security gates and made their way on to the bridge, apparently curious about what was happening on the bridge.

In the end, the inspection was completed one day ahead of the very tight deadline. All of the planning and preparation of the inspection team was rewarded with an inspection that accomplished all of the goals set out by NDOT, and allowed for a smooth opening of one of America's latest iconic structures.■

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