# Manette Bridge

The Manette Bridge has been determined to be both structurally deficient and functionally obsolete. As a result of this assessment, the bridge was officially added to the WSDOT Bridge Replacement Priority Array List in December of 1993. The bridge has been waiting its turn for funding since 1993. Currently, the bridge has a priority of 3 on the statewide list for the 2007-09 biennium. Funding has been programmed for the replacement project over the next 8 years with construction of the new bridge scheduled to begin in 2010.

As a result of inspections, bridges are "rated" for structural sufficiency on a scale of 0 to 100. A brand new bridge would receive a 100. A "structurally deficient" bridge is one that has elements requiring monitoring or repairs. A bridge with an 80 or less warrants corrective action. A bridge with a rating of 50 or less is eligible for federal funding for replacement. The current structural sufficiency rating of the Manette Bridge is 16.80. A deficiency label does not mean a bridge is likely to collapse or is unsafe. Most deficient bridges remain open to traffic during maintenance and repairs. The maximum allowable load on the bridge has been reduced to 80,000 lbs.

A "functionally obsolete" bridge is one in which the deck geometry (lanes widths, etc.), load carrying capacity, clearance or approach roadway alignment no longer meets the usual criteria for the system of which it is an integral part.

The Manette Bridge was originally built in 1930. The bridge was constructed with five steel truss main spans on six concrete piers, elements still part of today's bridge. A 1949 contract replaced the original wooden deck and timber trusses in the outer spans with concrete and steel.

The primary areas of structural deficiencies are in the concrete piers and the structural steel trusses. Most of these elements were built in 1930.


The concrete in the foundations is in varying states of deterioration. Testing and analysis of concrete taken from the main piers from 1976 thru 2003 determined that deterioration in the concrete has resulted from a process called Alkali Silica Reaction (ASR).

Alkali Silica Reaction (ASR) in concrete is a phenomenon that was first recognized in the U.S. around 1940 and has since been observed in many countries. ASR causes deterioration of mortars and concretes due to the swelling of gel formed by the reaction of alkali in cement-based materials with reactive silica in aggregates, in the presence of water. The swelling of the gel generates tensile stresses in the specimen resulting in expansion and cracks.

There is no known way to mitigate and fully address the ASR problem in the concrete foundations of the six piers supporting the steel truss spans.

Overall, the substructure components are in poor condition at the main piers (built in 1930) and in satisfactory condition at the approach piers (built in 1949). Columns and pier walls at the main spans exhibit leaching cracks, rust stains, delaminations, soft concrete, and formwork holes. Exposed rebar is visible above and below the tidal zone, however mass marine growth prevents an exact detailing of this exposure.

The foundation is exposed at all piers in varying degrees. Main Piers 2 and 3 are in the worst condition with the original footing and seals now indeterminate from each other. At the corners, corroded remnants of rebar are visible where the footings have been rounded to an approximate 4 ft. radius. The pedestals at these piers are not distinguishable from the marine growth. Several cofferdams have been constructed around the different piers to shore up soft concrete. Some undermining is occurring at these piers due to local scour conditions.

Contract repairs to the main concrete piers were completed in 1949 (Piers 4 and 6) and 1991 (Pier 5) and 1996 (Piers 4 and 6). These repairs attempted to encase the deteriorating concrete in the concrete foundations but were not affective since the core concrete with ASR continues to deteriorate.

Steel elements of the bridge are also closely monitored. Inspections have identified the following:

- The top and bottom flanges of most of the stringers have extensive areas of laminar rust up to 1/2" thick with up to 25% section loss. Some areas of the stringer top flanges are rusted with up to about 50% section loss.
- There is pack rust between the stringers and floor beams up to 1/2" thick, causing the deformation of many bearing plates.
- Approximately 10% of the stringers have little or no support because the adjacent stringers have been lifted up by pack rust.
- The top flange of the steel floor beams (in truss spans and the steel girder spans) has laminar rust and pack rust at the stringer bearings. On average, there is 25% section loss in the top flanges and 5% section loss in the bottom flanges at those areas.
- Approximately 50% of the rivet heads on the top cover plates of the steel crossbeams at Piers 3A, 4A, 1, 6, 5A, 6A, and 7A are corroded.
- The Pier 6 top tie plate has laminar rust with up to 50% section loss.
- There are rust blooms throughout the thru truss in Span 2. There are small areas of laminar rust in the channel webs along with scalloping of up to half the web thickness, mostly at the edge of member cover plates. There is pack rust up to half the channel thickness between the channels and the gusset/tie plates. Most rivet heads on the bottom chord joints, tie plates, diagonal members, and gusset plates have some rust and 5% have heavy rust with up to 50% section loss. One of the top cover plates on L8-L9 South near L9 has holes from severe deterioration.
- There are rust blooms throughout the deck trusses in Spans 1, 3, 4, and 5. There is pack rust at panel points and at most tie plates of the bottom chords. There are small areas of

laminar rust with up to 1/8" (25%) section loss throughout. There is pack rust between the bottom chord gusset plates and the lateral braces. There is pack rust, up to 1" thick, between the double angle cross-brace members. Several rivet heads connecting the top tie plate to the bottom chord are severely corroded. The bottom gusset plate at L4 North has 50% section loss on the west edge.

In 1993, the WSDOT Bridge Engineer identified that the bridge superstructure (trusses and deck) could be rehabilitated to provide 20 or more years of additional service life. The cost to totally rehabilitate this bridge by: encasing and repairing all the concrete main piers; replacing corroded steel including rivets and connections; repainting the entire bridge and replacing the bridge deck could exceed 50-75% of the replacement costs.

However, there are no practical means to restore or prevent further deterioration in the column and footing concrete. The condition of the reinforcing steel in the highly fractured substructure concrete is an added unknown. As a result of this assessment, it was determined that replacement of the bridge is warranted and necessary. The Legislature and the Governor have provided approximately $65 million for the replacement of the Manette Bridge over the next 8 years with construction of the new bridge scheduled to begin in 2010.