

Walterdale Bridge Rehabilitation Assessment Summary

August 2001

CONDITION OF THE BRIDGE

The following summary of the current condition of the Walterdale Bridge has been extracted from the 2000 Preliminary Engineering Report prepared by BP-TEC.

General

The Walterdale Bridge has provided 87 years of service for the City of Edmonton. The bridge is now showing signs of its age, but with rehabilitation and regular maintenance, it could be expected to continue providing service for a number of years.

The bridge was fitted with a timber road deck for its first 37 years of service. In 1950, the bridge was modified and a light weight (in terms of dead load) open steel grating deck was installed. That deck provided 25 years of service and due to increasing maintenance, was replaced with another open grating deck (the current one) in 1975. This deck is now at the end of its useful life and will have to be replaced in the near future.

The open steel grating deck allows road debris including sand and deicing salts to fall through onto the floor supporting system and the lower portions of the main trusses. A significant amount of corrosion of these members has occurred. This roadway debris also falls onto a pedestrian trail that passes below the south end of the bridge. The steel grating deck presents some driveability concerns, often causing vehicles to shift sideways as they cross the bridge.

The corrosion of the floor system and the truss members has caused loss of steel section and has reduced the strength of some members of the bridge.

The current strength of the bridge is such that truck loadings are limited to the equivalent of a CSA CS 530 loading (54 tonnes gross vehicle weight in a double semi-trailer configuration). New bridges are currently being designed for a CS 750 loading and the current "legal" highway truck loading is equivalent to CS 615.

The bridge has undergone many millions of cycles of loading over its 87 years of service, and fatigue of some of its component members is now becoming a concern.

The current paint system on the bridge was applied in 1983 and 1984. On the underside of the bridge, the paint is at the end of its useful life and is allowing corrosion to continue. The paint on the upper portions of the bridge is still in good condition.

In the following paragraphs, the conclusions from the strength and fatigue analyses and the paint investigation are presented.

Strength and Fatigue Analysis

Traffic wear of the steel grating deck in the wheel paths of traffic has caused 10 to 15 mm of reduction in the depth of the bearing bars and has thus reduced the deck's strength such that it is now overstressed by up to 40%. In many locations, the grating bars have been worn down to the rivets connecting the grating together, resulting in the requirement for frequent maintenance to reconnect loose pieces.

It has been concluded that the steel decking is near the end of its useful life. It is likely that the deck will function for three or four more years, but at the cost of increasingly frequent maintenance expense and traffic disruption. Replacement is required.

The transverse stringers below the steel deck have had some loss of section due to corrosion, but were found to have adequate strength. However, the safe fatigue life of these members has now been exceeded and it is likely that fatigue cracking will be initiated in the near future. These members should be replaced within three to four years.

The longitudinal stringers have had significant loss of steel section due to corrosion. These members have been reinforced and, with the reinforcement, were found to have adequate strength for current loads. The safe fatigue life of the longitudinal stringers has not yet been reached, but it will be exceeded well before 2050. Thus, if the bridge is to be rehabilitated for another 50 years of useful life, it is concluded that the longitudinal stringers should also be replaced.

The floor beams have suffered some loss of section due to corrosion but were found to have adequate strength. The safe fatigue life will be reached in 2038. The floor beams are built-up members comprising four angles and a vertical plate rivetted together. It is concluded that keeping the floor beams in service until 2050 involves an acceptable risk, since it is very unlikely that more than one of its component pieces would have fatigue failure initiated; thus warning of failure (at the time of inspection) would be provided prior to complete member failure.

The various members making up the trusses were found to have adequate strength under current loadings, after considering current loss of section due to corrosion. However, the bottom horizontal members (chord) of the truss are currently actively corroding, and unless this is halted (new paint), there will be loss of section leading to less than adequate capacity.

A number of the other truss members have exceeded their safe fatigue limits; however, as for the floor beam members noted above, most of the members are made up of several components that would provide redundancy in case cracking is initiated in one of the components. The inclined members in the central panel of each truss are comprised of only two components and do not have the redundancy desired. These members should be reinforced.

The six expansion bearings supporting the trusses have had a large amount of corrosion and are not functioning adequately. The bearings would require extensive rehabilitation or replacement in order to continue to function into the future.

The paint system on the bridge members below the deck has now reached the end of its useful life and should be replaced in the near future. The paint system on the trusses above the deck level is in good condition now and will continue to protect the steel for a number of years. Over-coating the upper portion of the bridge in the near future is a cost effective method of extending the life of the existing system.

The concrete piers and abutments supporting the bridge were found to have adequate strength and with some maintenance, will continue to safely support the bridge for many years in the future. There are cracks and surface delaminations, particularly on the abutments, that will require rehabilitation in the near future to ensure that they remain in good condition.

PROPOSED REHABILITATION WORK

Based on the current condition of the Walterdale Bridge as described above, BP-TEC has developed a rehabilitation strategy that would include the minimum amount of work required to ensure that the bridge will continue to provide safe and relatively maintenance free service for a period of up to ten years. This approach will allow the bridge to "deteriorate" through the ten year period, such that replacement at the end of the period will be a necessity.

In the proposed rehabilitation work, the existing deck grating would be removed and replaced with a similar "Armtex Reticuline" grating. Several traverse stringers, including those at the ends of the truss spans, would also be replaced.

The remainder of the transverse stringers would be left in place. Although they have exceeded their theoretical fatigue life, the particular fatigue detail of concern is such that the member would most likely crack over the longitudinal stringers. Cracking at these locations would result in a re-distribution of bending moments to the midspan portion of the transverse stringer which has been calculated to have adequate strength for the increase in bending.

The longitudinal stringers and the floor beams of the trusses have been determined to be adequate for a further ten year period, and other than a close inspection during the deck replacement work (and repair as necessary), no work is proposed to be done on them.

The bottom chord members of the trusses, and the lower portions (below deck level) of the vertical and diagonal truss members, would be prepared and repainted to prevent any further corrosion during the ten year period. Areas with pack rust under gusset plates would have corrosion inhibitor inserted between the plates and the edges of the plates would be sealed prior to the repainting.

Loose and worn expansion joint components would be repaired or replaced. Bearings where rollers have escaped their cages would be repaired.

Delaminated and deteriorated portions of the abutments would also be repaired to ensure that they have adequate strength for the next ten years.

It is believed that the above rehabilitation work will allow the bridge to remain in service until 2011 without significant maintenance work being required.

It must be noted that the Walterdale Bridge is approaching the end of its useful life and that there are other fatigue and corrosion damage concerns that are not proposed to be corrected for the further ten year period. These are addressed in BP-TEC's December 2000 report and will require ongoing inspection of the truss and floor members in order to ensure that cracking or other problems that are initiated are observed and repaired before any failure can occur. For this reason, inspection access platforms hung below the truss spans have been recommended, and the cost of providing the platform has been included in the rehabilitation work. A thorough inspection of the truss members including ultrasonic testing to detect cracks behind gusset plates would be done at the time of the deck replacement work.

In order to carry out the deck replacement, and to install the enclosure system required to contain 90% of the spoil resulting from surface preparation for painting the bottom truss chords, total closure of the bridge for the six to seven week estimated construction period is considered to be necessary.

Existing utilities suspended from the bridge will make the repainting work more difficult, but it is believed that the work can be done without affecting the utilities. No allowance for utility relocation has been included.

SUMMARY

In summary of the preceding sections, the Walterdale Bridge is nearing the end of its economical life. The floor grating is currently worn out and requires ongoing repair work. A number of members have corroded to the point where there is no reserve strength remaining. The paint system on the portions of the bridge below the deck level is at the end of its useful life and will no longer protect against corrosion. A number of members have reached or surpassed their theoretical fatigue lives. The bridge now requires extensive rehabilitation or replacement.

It would be possible to carry out a moderate amount of rehabilitation work on the bridge in order to ensure that it will provide ten more years of service (until 2011), with little ongoing maintenance work required. The rehabilitation work, including replacement of the steel grate deck, repainting of the bottom portions of the trusses, installation of moveable inspection platforms and miscellaneous other work has been described in sections above.