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Keystone Bridge Management Corp.

Keystone News

A Message to the Auditor

The Auditor General of Ontario tackled the Ministry of Transportation in his 2009 report to the Province. This was a follow-up to previous concerns arising from his 2004 report. Given the size and complexity of the MTO organization, it is disconcerting that the Auditor focused so narrowly on bridge inspection practices.

Embarrassing revelations included the phenomenon of bridges improving with time despite no intervening rehabilitation. Bridges in the Greater Toronto Area were not being inspected in accordance with the Ministry's own guidelines. Maintenance requirements were not being followed up. There are significant inaccuracies in stored data. Bridges are being short-changed on inspection time.

The Auditor's function is to verify that the policies and procedures instituted by government are being properly acted upon, and to ensure value for money.

The Auditor generally works on the premise that the mandated policies, procedures, regulations, manuals and tools are the appropriate yard-stick to compare actual achievement against.

Is it conceivable that those standards that are the basis for comparison are flawed? For example, is it truly realistic to "spend at least two to three hours at a typical bridge to adequately assess the condition of all elements"?

Is it wise for Ontario to use a very subjective Excellent-Good-Fair-Poor rating system for bridge components when studies have conclusively proven the inadequacies of subjective rating systems?

Is the multi-million dollar Ontario Bridge Management System appropriate given its significant limitations as identified by the Auditor?

The MTO has only 2,800 bridges in its possession, but establishes the rules for 12,000 other municipal bridges in Ontario. Moreover, most of the other provinces look to the MTO for guidance on bridge issues. Clearly the MTO has a compelling duty to adopt best practices.

During the bridge building boom of the 1950's through to the 1980's, the MTO was very deservedly preeminent in Canada, North America and internationally for its innovations in bridge design and code writing. This bridge building epoch is over.

The challenge now is to effectively manage those bridge assets. The message to the Auditor is this: Next time, don't concern yourself to the same extent on compliance. Instead, critically review the premises on which bridge management is founded upon. It could be the first step to a fundamental overhaul of bridge management practices in Ontario, and by extension, Canada.

Auditor's report at:

http://www.auditor.on.ca/en/reports_2009_en.htm

Keystone Bridge Management offers:

- Specialized bridge asset management services
- Municipal bridge inspections
- Bridge management software solutions
- Training in bridge asset management and bridge inspection
- Bridge rehabilitation or replacement planning services
- Bridge load testing
- Design services

Inside this issue:

Bridge Deck Drainage Fundamentals

Salt brine from deck drainage impinging on a prestressed girder will eventually result in damage to the girder.

Getting water off a bridge deck requires more than gravity. One of the most overlooked maintenance items for bridges is ensuring the effectiveness of the bridge deck drainage system.

Poor deck drainage is a traffic hazard and can greatly shorten the life of affected bridge components. Water lying on a deck can result in hydroplaning of vehicles or skidding on icy surfaces in the winter.

Salt laden water lying on a deck will penetrate the deck and curb concrete thus accelerating the onset of delamination and spalling.

Not only must water get off the deck, it must be properly directed away from bridge components like girders and abutments. Salt brine from deck drainage impinging on a prestressed girder will eventually result in damage to the girder. Similarly, deck drainage tubes associated with expansion joint dams must be maintained to ensure directed drainage away from the girders.

Deck drains should extend below the bottom of the girders at least 15 cm. Sometimes, in very windy locations this may not be enough.

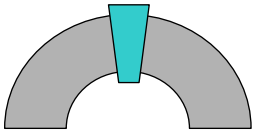
On rigid frame type bridges the drains should extend at least 15cm below the soffit.

Here are some maintenance tips:

- Mark the locations of the deck drains.
- Clean and flush the deck drains every spring and fall.
- Program the replacement of defective drains.
- Repair splash pads where deck drainage is resulting in embankment erosion.

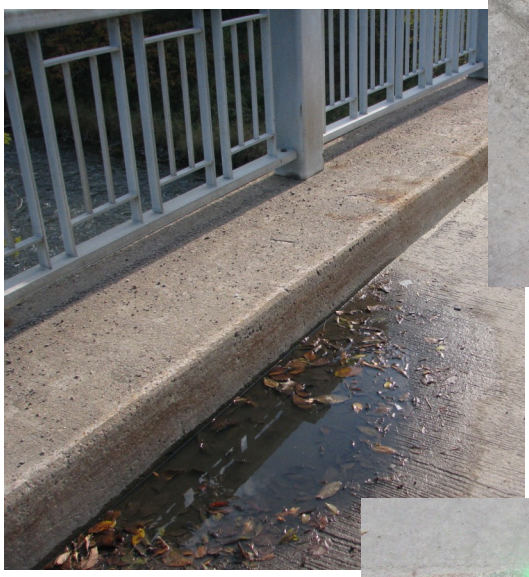
New or replacement deck drains should always be galvanized. Galvanizing will double the life of the drain.

Keeping decks free of sand and gravel, especially along the curb lines will help promote good drainage.



Keystone is your Bridge Asset Management Specialist!

Below: Ponding on deck associated with plugged deck drain.



Above: Severely corroded deck drain requiring replacement.

Right: Poorly maintained deck scupper. Ideally drains should be cleaned spring and fall.

Keystone Models Bridge Depreciation

Keystone overcomes a significant challenge when describing the condition of a bridge. Traditional approaches involve subjective ratings like Excellent, Good or Fair. Another approach utilized in the USA is assigning numbers, where for example 10 is a New condition and 6 is Satisfactory. Research in the US has conclusively demonstrated that subjective approaches are prone to error, and very inconsistent in their application. This begs the question why do we continue to rate bridges subjectively?

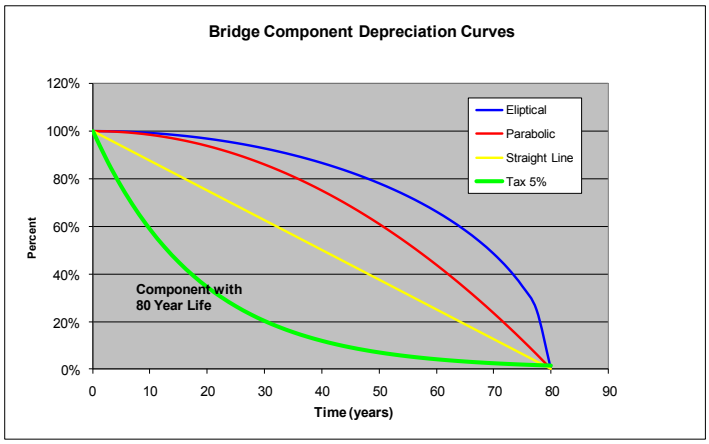
Keystone's approach is to model and report on a bridge's condition in terms of its overall depreciation. Each component of a bridge has a deemed life expectancy and unit value together with its physical attributes. As a bridge ages, each component depreciates in accordance with a decay function. Keystone recommends either straight-line or parabolic decay functions as shown on the top figure to the right.

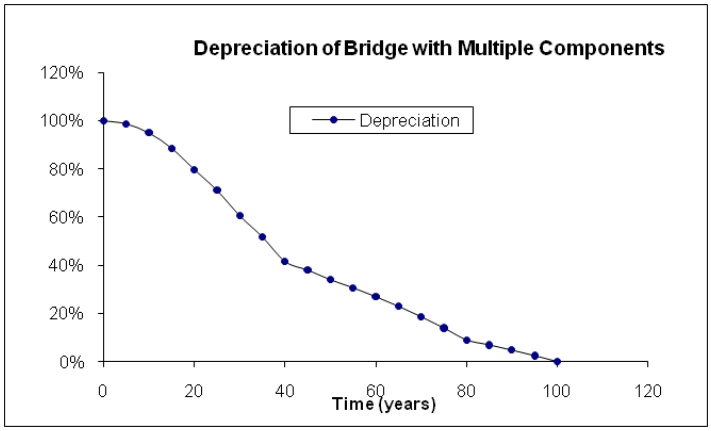
A bridge with multiple components will depreciate in value over time as demonstrated in the figure to the lower right. The condition of the bridge is determined by restating the condition in terms of value.

The advantage of modeling bridge condition with depreciation is its predictability. Subjective assessment is completely avoided. When this approach is adopted it is easily possible to describe and predict the condition of one bridge, or thousands of bridges.

To account for effects such as spalling and delamination, corrosion, and disintegration, Keystone reduces the depreciated value by measuring defects and damage on a bridge when it is inspected. For example, a component that is 20% damaged is considered to have lost all of its value.

If a bridge is rehabilitated, those components that are renewed have their values correspondingly reset to the undepreciated state. The efficacy of investment in bridges can be measured by the net improvement to asset value resulting from capital expenditures on the bridge.





KBMS Software Update

Keystone has tried to overcome the significant shortcomings of traditional bridge management systems and approaches by adopting the Triple-D philosophy of describing a bridge's condition. Triple-D stands for **D**epreciation, **D**efects, and **D**amage. You can learn more on this by visiting the Keystone website www.keystonebridge.ca.

In order to operationalize the Triple-D approach Keystone developed its own proprietary bridge management system; KBMS.

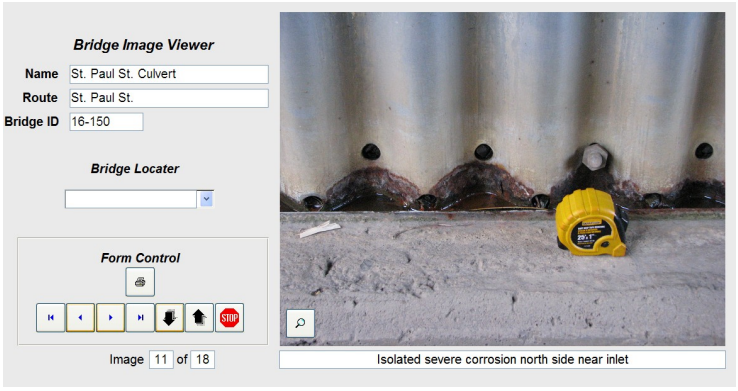
KBMS is a highly sophisticated database application that has been used exclusively for over 400 municipal bridges in Ontario.

Every municipality thus far that has retained Keystone Bridge Management has elected to chose the Keystone approach to assessing their bridges over the prescribed OSIM methodology.

The KBMS software continues to evolve in response to this overwhelming endorsement.

Key features of the KBMS software are the compact inspection reports and the generous amount of images included with the reports.

Contact Keystone to obtain a free evaluation copy of KBMS.



Screen shot of image viewer within KBMS.

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Check out the web site at:
www.keystonebridge.ca
(Updated for 2010)

Young swallows nesting inside a CSP

"Bridges give flight to the ground."

Culverts, the lowly Cousin of Bridges

The Province of Ontario requires the biennial inspection of all road structures with clear spans equal to or exceeding 3.0 metres. Approximately one-third of such qualifying structures are culverts.

Culverts are defined in the bridge code as "a structure that forms an opening through soil." In most instances culverts are buried under at least 60 cm of cover. However there are many that are in effect gravel topped bridges.

Culverts require every bit as much attention as bridges. A failing bridge usually gives some warning. This is not always so for culverts. A few years ago a corrugated steel pipe failed suddenly on Hwy 40 in Quebec. The failure propagated from an unbalanced load condition created by excavation at one end. The culvert progressively failed from outlet to inlet in a matter of minutes.

Corrugated steel culverts are highly vulnerable to acidity in the water and stagnant water containing salt brine. Some regions have relatively benign environments for corrugated pipes. Many other areas are very aggressive, and in those circumstances the culverts can corrode and perforate in less than 30 years.

Concrete rigid frame box culverts are superior in span ranges from two to six metres. These are now available in precast form and are readily finding acceptance in many municipalities.

Proper inspection of a culvert requires good lighting conditions and a pair of hip-waders. A culvert is not properly or sufficiently inspected unless it is walked through for its full length. This can be challenging when the water depth exceeds 60 cm, or the stream bottom consists of a thick deposit of soft mud.

Inspection of a culvert may reveal any of the following:

- Stream bed aggradation
- Stream bed scour
- Corroded and perforated steel
- Undesirable deformation of the culvert shape
- Obstructions in the waterway
- Undercut footings
- Deteriorated concrete
- Settlement induced sag
- Uplifting of inlet ends
- Unstable embankments

Inspecting and recording the conditions of large culverts helps ensure these important drainage structures can be relied upon and provide many decades of trouble-free service.

An otherwise good open-footing rigid frame concrete culvert where the foundations have been compromised by channel lowering to suit agricultural land drainage.