We need to talk about L2 Bridge Inspections

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ABSTRACT

How much confidence do we have in Level 2 Bridge Inspections? They're a staple of the management of road structures such as bridges and culverts and have been so for decades. They are amongst our first 'informers' of a structures condition; providing condition information on the individual structure as well as allowing us to infer the health of the network of structures we manage. But how good are they? There are numerous apparent examples, too many to count really, of inspectors both new and the very experienced making obvious 'misses' in what is essentially an inspection which relies on good observation skills more than anything else. Why does this occur? And is this a problem? Do we put too much reliance on the Level 2 Inspection; should we be more pragmatic and accept their fundamental flaw; that is people; and just deal with an expected level of inaccuracy? Are the Inspectors the problem or is there something else afoot? Perhaps we hand this responsibility over to the machines? This paper will explore these themes and hope to provoke conversation about an inspection that every manager of road structures relies on.

1 INTRODUCTION – WHAT'S THE PROBLEM?

The author of this paper has been involved in the management of Road Infrastructure, specifically bridges and culverts for Regional Roads Victoria for 16 years. An important part of this work is the planning of maintenance activities to ensure the safe operation of these structures and this in turn relies heavily on the eponymous Level 2 Bridge Inspection, see Figure 1.

Figure 1 - A Level 2 Inspection Underway

A Level 2 Inspection is required to measure and rate the condition of structures to help the Asset Manager identify and prioritize their maintenance needs. Level 2 Inspections can also help track previous maintenance performance and some authorities are exploring using Level 2 Inspections in 'Deterioration Modelling' to help them estimate the future requirements of their Maintenance Budgets.

With the above in mind it is easy to see that the humble Level 2 Inspection is an important tool in the management of Road structures but we sometimes fail to remember that they are still just a visual, non-diagnostic inspection reliant on the observer and the author has noted that there are times when critical issues involving road structures have sometimes been apparently missed and as such the

author decided to explore the issue further within Victoria but also with the other Road Authorities in Australia. A number of simple questions were developed designed to probe each of the relevant authorities about their Level 2 Inspections including their level of confidence in the inspections and inspectors; how they use the data they get; what weaknesses they felt the inspections might have had and did they have any recommendations to improve the way L2 Inspections were completed? To ensure a broad range of perspectives members of private industry were also contacted and asked the same questions and from these interviews two broadly defined main themes were identified and they were:

1. The L2 Inspectors are good……but could they be better?
2. The Bridge Inspection Systems are not so good and should be better.

These themes will be explored further in the Discussion.

2 DISCUSSION

2.1 L2 Inspectors are good…but could they be better?

The most pleasing result from the survey was the unanimous agreement of the various authorities and private industry representatives that they felt that most (if not all) the Level 2 Inspectors did a good job with their variety of structures and the L2 Inspections themselves were the right method to measure a structures condition but that as the definition of a structure had expanded over the years so too did the L2 Inspection form and the requirements of the Inspector; see Figure 2.

Figure 2 - Level 2 Inspectors are well thought of

Above all human inspectors were still the preferred option over technological solutions such as drones; most authorities and private contractors saw that this type of technology had a benefit but wanted to see more development in that space.

This is not to say that there were not issues with things being missed during the inspection by the ‘humans’ and the most common appeared to be exposed piles or bearings in poor condition or rapidly moving problems that develop after the inspection has occurred; see Figure 3.

Figure 3 - Left exposed timber piles and Right a dislocated bearing

These common 'misses' during the inspections can be put down to the element not being able to be observed in the case of exposed piles (they may have been previously submerged under water and not visible) or because of the difficulty of access such as the example pictured in Figure 3 of a dislocated bearing which was between a busy road and rail line. Other 'misses' can occur not because the inspector hasn't noted an issue but that the problem has rapidly developed as illustrated in Figure 4; initially described as a network of fine cracking which later turned into a large spall.

Figure 4 - Cracking in the soffit later developed into a large spall

Examples such as these are not rare and according to the consensus view of road authorities should be expected when dealing with an inspection regime relying on the observations of human beings. They are also not critical; that is the structure can continue to be used without impacting on the safety or amenity of the travelling public. Apart from the ability of the individual inspector the strengths of the Level 2 inspection are the speed and the frequency in which they can be completed. Issues missed due to water levels, access problems or further deterioration may be noted in the following inspection only a few years later (most authorities only leave a maximum of five years between inspections).

Perhaps the most common issue raised by private industry was access to the structure. Access does not have as simple a definition as one might expect. Access for the inspector might mean driving to a remote structure only to find that one end has an easily navigable spill through abutment but the other end is a tall soil reinforced wall that requires rope and harness to prevent falls. Or that a structure in a rural area might cross a significant reservoir and the only way to inspect the structure would be by boat. See Figure 5.

Figure 5 – Note the vertical abutment on one structure and the need for a boat on the other.

It can also mean that for an inspection on a busy arterial road or highway requires significant traffic control, even using a 'Truck Mounted Attenuator' (TMA); effectively something for errant vehicle to crash into rather than the inspector or their vehicle. Or if traffic delays caused by extensive traffic control systems the hire of an 'under-bridge' unit would be required, see Figure 6:

Figure 6 – A TMA and an 'under-bridge' unit required for some L2 Inspections

When one thinks that a Level 2 Inspection is essentially a detailed visual inspection the lengths that some inspectors have to go to complete them seems a little extreme. The managers of structures are getting better at identifying and making allowances for those structures that require considerably more effort than others and ensuring that the inspectors are aware of those challenges before they tender a price but as noted previously by the inspectors themselves: market place competition has not necessarily led to a better standard of inspection just a cheaper one. This in turn can lead to some tenders being accepted but the contractor being unable to do much more than a cursory job as they do not have the specialized equipment necessary.

Improved technology such as drones may alleviate this but the take up is slow and despite the difficulties raised the different groups involved in the industry appear to want to stick with the status quo.

However what was also common amongst the interviewees was the belief that the Inspectors and the Inspection format itself could be improved. It was recognized that the definition of what constitutes a road structure has expanded (in the Victorian experience) since the Level 2 Inspection was first developed to now include not only Bridges and Major Culverts but also Architectural Features, Emergency Boom Gates, Emergency Bridge Systems, High mast lighting systems, concrete pavements on piles, Noise Walls, Retaining Walls, Gantry Signs and Weigh bridges. There are also greater demands in the Occupational Health and Safety area in particular traffic control measure and confined space provisions. As previously noted technology such as drones could help in areas such as these but the status quo remains. As such the space in which the Inspectors operate has moved apace whilst the inspections themselves, apart from adding new element and their codes have progressed a little more slowly. Take, for example, figure 7 below:

Figure 7 – Both of these structures use the same L2 Inspection

One structure is a simple, single span bluestone structure with elements dating form the 19th century the other is a 4 span simply supported concrete structure from the 1950's. Two very different structures requiring different levels of effort with the L2 Inspection but the difference can be more stark than above; refer to Figure 8 below:

Figure 8 – And these.

Above, one structure completed just a few years ago is a two span Super T that is 60m long and the other a 3 x 1200mm cell Pipe Culvert and although they use the same form they're very different. The different Road Authorities broadly agreed that for some structures more engineering expertise was desirable as illustrated by Figures 5 & 6 and this in turn could mean that L2 Inspections may be better broken into 2 different camps, L2 – Simple and L2 – Complex. Breaking up L2 Inspections in this way may provide a better result but also address one of the concerns of private industry – that competition in the market place wasn't leading to an improved product but rather just a cheaper one. From this the author wishes to make the following recommendation:

L2 Inspections be broken into L2 Simple and L2 Complex where not only the differing levels of engineering complexity are addressed but also the access and technological requirements.

From the inspectors themselves a final issue or rather preference for an improved way forward and that was they wished that they had more communication with the local structure teams. They saw this as beneficial in a few different ways: first it meant that any issue that struck them with immediate alarm could be communicated and hopefully addressed quickly with clear positive connotations for the safety of the travelling public; second it may be that a simple issue such as the structures location or access could be determined – inspectors like to inspect and do not feel comfortable to arrive at a site to find that they could not do their job. Better communication can be easily achieved in this smart phone age and would bring the Asset Manager and the Inspector together on the same page especially where maintenance priorities may lie.

The author wishes to make a second recommendation:

The L2 Inspectors and the local Asset Manager are put into regular contact at the start of the Inspection process to facilitate better outcomes.

2.2 Bridge Inspection Systems are not so good

Another unanimous point of view from both the authorities and the contractors was that the Bridge Inspection Systems or Programs and their associated databases needed to be improved. See Figure 9 below:

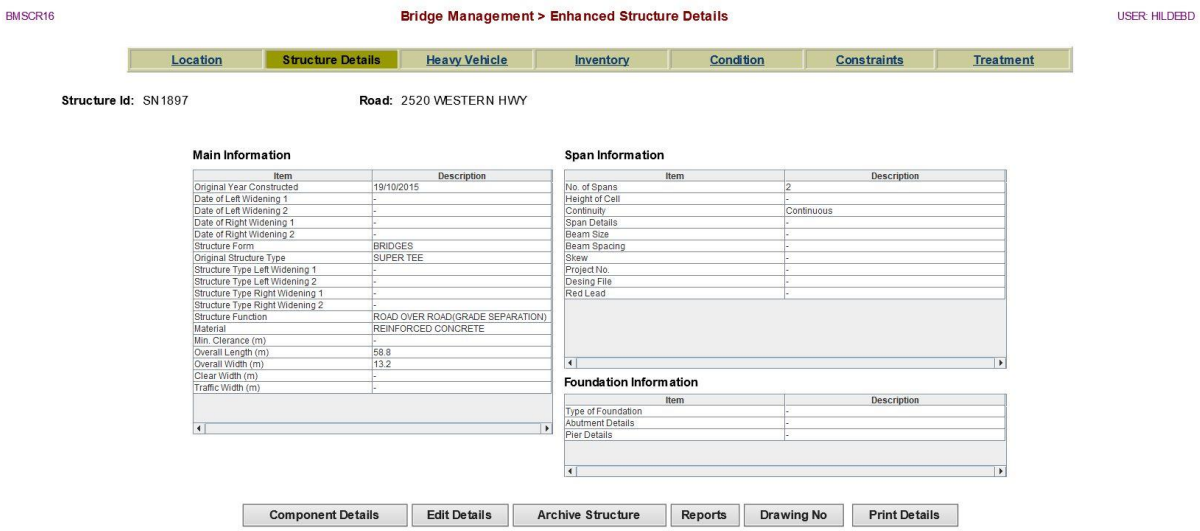

Figure 9 – A screen capture of the (in)famous VicRoads RAS.

Regional Roads Victoria use our Bridge Inspection System to record our L2 Inspections and rely on the Road Asset System or RAS to store our bridge inspection data along with any other relevant information related to our structures on the road network. Both the users and managers of these programs acknowledge that at 25 years of age (in the case of RAS) is an eternity in Information Technology terms. Indeed it was the ability to get the information from the BIS into the database and then into the hands of the Maintenance Planner that proved to be the most fraught and responsible for more 'misses' than the Inspectors themselves. If there was one overwhelming negative from the responses received it was about this process with L2 Inspectors noting that in some cases the BIS software was so old it wouldn't work with up to date operating systems and with the lack of apparent 'flagging' of issues Inspectors would often return to a structure only to find the same issues, untreated, that they identified previously. This is a frustrating issue for both the inspector and Asset Manager; if as previously noted the Inspectors are thought to be good at their work and so by extension the information the produce must be of a similar standard then why is that information not making it into the hands of the Asset Manager? Road Authorities and Inspectors were united in the belief that elements in poor condition needed a better mechanism to bring them to the immediate attention of the structure managers whether this was oversight by the Structural Team within the Road Authority or an automatic piece of programming did not matter – all agreed it had to improve.

The author makes a third recommendation:

Road authorities need to better use the data in the L2 Inspection to faster highlight issues of concern and include regular upgrading of systems to ensure that usability is guaranteed.

3 CONCLUSION

During the development of this paper two broadly defined main themes were identified and they were:

1. The L2 Inspectors are good……but could they be better?
2. The Bridge Inspection Systems are not so good and should be better.

All interviewed felt that the Inspectors were good at their job and the L2 Inspections were the right method to measure a structures condition but that as the definition of a structure had expanded over the years so too did the L2 Inspection form and the requirements, including safe access of the Inspector had also expanded.

From the information gained it is also clear that the different Road Authorities Bridge Inspection System and Bridge Information storage systems are increasingly becoming difficult to use and do not provide quick feedback or closing of the 'loop' when an issue is identified.

As such the author makes three recommendations to improve the L2 Inspection process:

L2 Inspections be broken into L2 Simple and L2 Complex where not only the differing levels of engineering complexity are addressed but also the access and technological requirements.

The L2 Inspectors and the local Asset Manager are put into regular contact at the start of the Inspection process to facilitate better outcomes.

Road authorities need to better use the data in the L2 Inspection to faster highlight issues of concern and include regular upgrading of systems to ensure that usability is guaranteed.

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5 AUTHOR BIOGRAPHY

David Hildebrand is a Senior Asset Management Officer with Regional Roads Victoria based in Ballarat. He has 16 years of experience in the management of Rural Arterial Bridges and Culverts. He has overseen the planning of countless structural maintenance projects as well as numerous bridge strengthening and bridge replacement projects nearly all of which have their genesis in a received L2 Inspection highlighting a defect. Amongst his responsibilities is to keep a 'local' eye on the quality of L2 Inspections received and to ensure that the quality doesn't drop. He is a passionate 'bridgey' who loves his work and enjoys the company of and supporting other Structures orientated people.