Cut out the guesswork

An Australian company leading in NDT of bridge structures

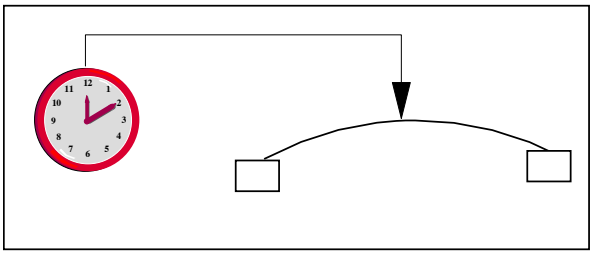
Turn of the century concrete bridge

Bridge testing and bridge assessment in the past, and to some extent to day, is a combination of guestimate of the strength of the various elements in a bridge followed by detailed calculations to arrive at a capacity. Bridge deck failures account for 15% of bridge failures meaning that there is a need to evaluate bridge decks. Integrity has been testing piles since the mid 70's breaking the 1 million mile stone in the mid eighties during the Asian construction boom.

In 1982 Integrity was asked to develop a fast and accurate method to measure bridge deck capacity and pile capacity of railway bridges. Since then Integrity Testing Pty. Ltd has been accurately measuring the capacities of bridges by measuring the insitu capacity of the bridge and removing the guestimate from the calculation.

Emergency evaluation of damaged bridge for partial usage

Over the past twenty years Integrity has tested over five hundred bridges from 5 m span to 192m span structures. With new players now coming on to the scene dynamic bridge testing systems (DBTS) are now widely available. The method used by various companies vary but they all basically measure the structural capacity of the bridge deck as outlined below.

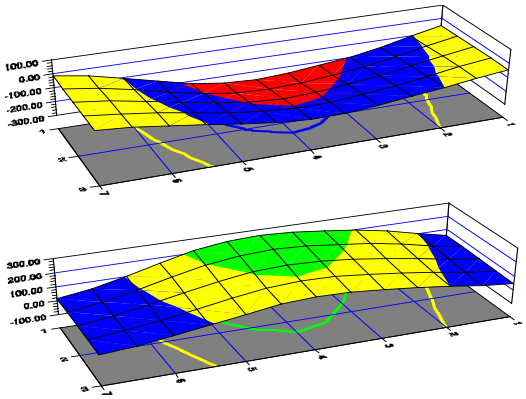


The time period of the vibration of the deck is recorded from which the capacity of the deck is given by

$$1/time = k \times \sqrt{\frac{EI}{L^4 \times M}}$$

Where EI is the structural stiffness of the deck, M the mass per unit length, L the length of the deck and the time is the time period of the vibration, k is a constant depending on how the deck is supported or fixed.

The structural stiffness measured is the same as that used in static load testing. The measurement of time rather than deflection improves the overall accuracy and with multiple location recording the fixing conditions can be known. Hence an accurate measurement of the bridge deck can be obtained.



Typical measured mode deflection plot

Load test correlations, with some bridges loaded to destruction, have shown that failure can be accurately*(?)* predicted and especially so with concrete.

Provided the structure will bend or deflect under load then its capacity can be determined. This equally applies to trusses, in fact it is a valuable tool to identify weak connections or suspect rivets in steel trusses. Furthermore, with the addition of animation the method of resistance of the deck to load can be seen i.e. is it shear at the supports or is it in bending?

How does your bridge assets fair? Well data from over 1000 spans measured by Integrity Testing show a variation in construction types and current capacity. The table gives the % number of spans and types which were measured as to be capable of being used by the given vehicles.

Type of bridge	T-44	B-Double	Rigid Axle
Concrete	70%	60%	90%
Steel (truss etc)	65%	45%	80%
All Timber	45%	35%	75%
Timber/steel girder	80%	65%	95%

The all timber faired the worst but this was mainly due to the combination of defects in the pile/pier supports. With these repaired then the all timber bridges would be on par with the concrete.

Conclusion

Accurate measurement of bridge deck capacities, cuts out the guesswork and allows greater use or extension of valuable bridge assets