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Bridge inspection and testing – cost saving through innovation

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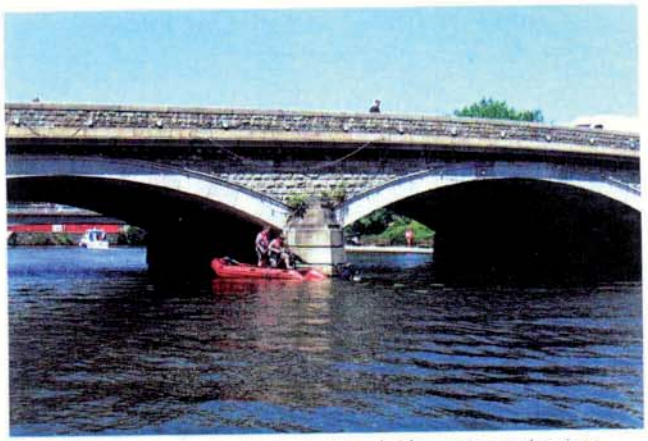
Bridges play such an important part in the UK infrastructure network as they are vital links for road, rail, and pedestrian users.

Some of our bridges have been in existence since Norman times, but it was in the 19th-20th century that bridge building played its vital role in connecting and smoothing journeys of all kinds. Today we find we are responsible for not only the construction of fantastic new bridge structures, but also for the sympathetic nursing of the old.

An understanding of how to repair these structures is almost as important as knowing how to survey them.

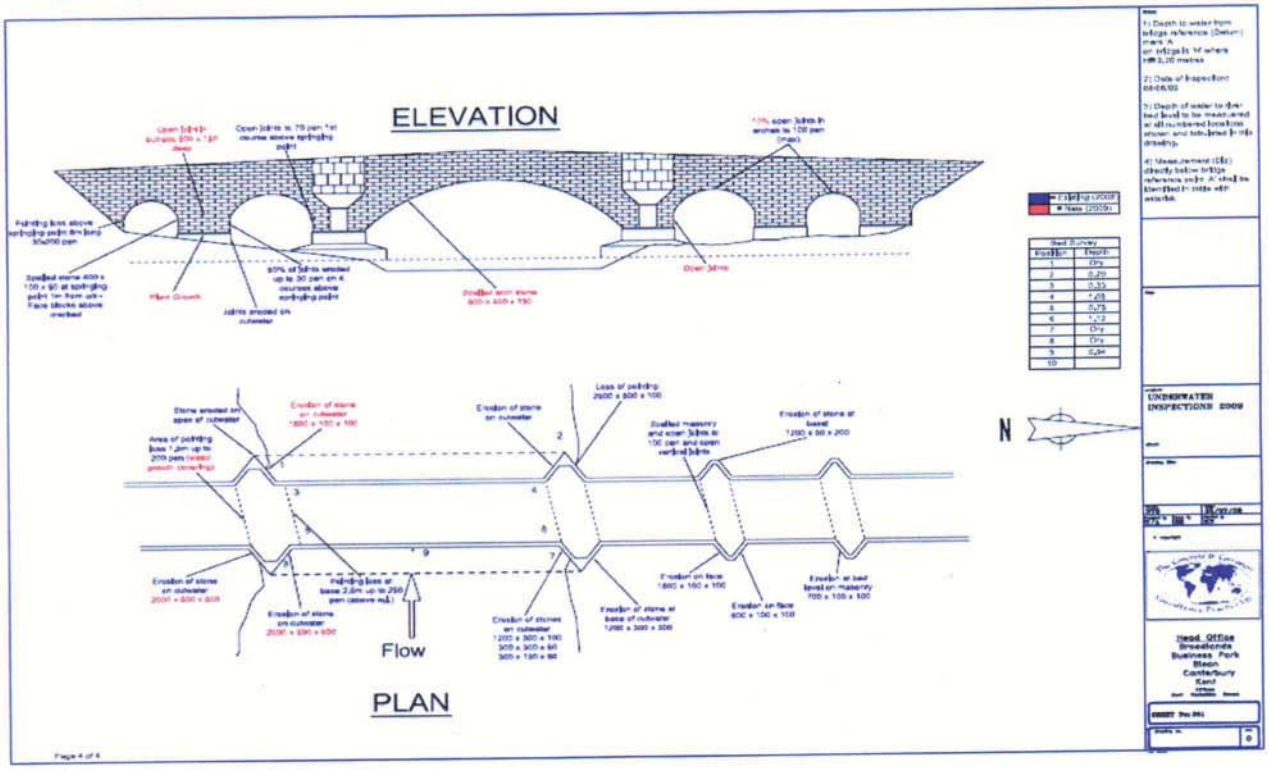
The way in which bridge inspection contracts are let is changing from batch orders and *ad hoc* surveys to large volume, multi-year contracts.

In the search to keep costs down many clients are letting three-year projects with extensions of up to another two years. This type of agreement is useful as it not only allows the client an accurate forward cost plan, but also maintains consistency in surveying and reporting.

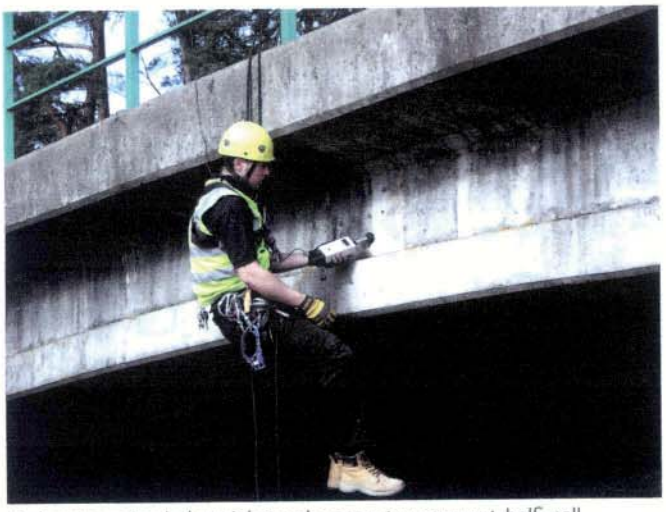


Dive inspection team at a large masonry bridge over a major river

Added value is being looked at more and more, with combinations of survey contents being used more so as to avoid duplication and mobilisation/demobilisation costs.



CAD drawing of a typical bridge inspection



Technician using industrial roped access to carry out half-cell potential tests

Recording of information is crucial and whilst standard format reporting exists (for example Highways Agency formats) it is surprising to see how many clients still have, for example, hand sketches of structures instead of CAD drawings.

Bridges are truly amazing structures; they stand often in the most aggressive, exposed environments, are used continuously and yet stand the test of time. Many are unseen as one passes over them and yet many, as well as being fantastic engineering achievements, are things of beauty! From the mighty Tunkhannock Viaduct to the humble concrete culvert, they are all important structures.

Keeping track of their condition and keeping them serviceable is a huge operation every month of every year.

For many clients the ability to transfer past drawings, some of which are likely to be hand sketches into AutoCAD format drawings is extremely valuable as this means all details can be uploaded to the database and then updated yearly.

Databases on bridge management also vary and uniformity should be considered.

Presentation of reports will depend on the extent of survey with a visual condition survey covering approximately 15 pages including AutoCAD drawings, photographic support and inspection records through to full diagnostic surveys, which often extend to in excess of 150 pages.

Whatever level of report/survey is carried out the contents of the report needs to be detailed, factual and give definitive conclusions – too many reports today still tell the client little more after a survey than they knew before!

Survey types

Bridge surveys range from visual inspection appraisals to full diagnostic inspection and testing surveys.

Special investigations are carried out either following a visual inspection where distress has been identified or as part of feasibility upgrade works.

Whichever level of survey is carried out care must be taken to ensure value is achieved for example by combining tasks that would normally have been carried out in isolation.

Safety surveys are carried out, usually at short notice and will include not only identifying and quantifying potentially dangerous elements, but also often the emergency make-safe removal of these elements for example dangerous spalling concrete over road, rail, pedestrian areas etc.

Innovation and added value are key requirements as financial constraints increase (they should be important whatever the financial situation).

There are many tasks that can be combined during a survey that will give added value.

One such example is the introduction of multi-point riverbed depth and profile rigs. This equipment gives important point position and average bed depths and the results are presented in a 3D net graph that is overlaid in a different colour over the previous years results for interrogation.

Monitoring systems are also important including remote digital crack monitoring where sensors are placed over cracks and via data loggers the information is sent to the computer software in the consultants offices upon which reports are issued monthly.

There are many types of surveys and many types of testing available, which when brought together can give the highest levels of understanding of a structures condition and performance and by using innovative thinking throughout, the costs can be hugely reduced.

Resources

If the services required to carry out the many tasks are to be resourced in-house then the inspection team often consists of a roped access team, a dive team and a confined spaces team (although obviously some members will possess more than one of the skills).

Continuity of staff is a key factor in the success of long-term bridge inspection programmes as it removes the initial learning curve that exists on all new contracts.

Fully updatable database systems are now more commonly used so that interrogation of information and cross-referencing is faster and easier.

The huge number of bridges in the UK alone range from rail, road, pedestrian, and are all controlled by a vast number of private and public organisations, uniformity is the key to inspection, testing and reporting and will remove waste and duplication.

Liaison/experience is also important as working with organisations such as Railtrack, Highways Agency, Environment Agency etc can make the difference between a trouble free project and access problems.

An important part of inspection and testing bridges is the range of diagnostic testing equipment used to identify the cause and accurately quantify distress.

Roped access technicians carrying out steelwork inspection as well as the concrete bridge soffit

This large concrete bridge was the subject of a full conduction survey using roped access

Equipment includes:

For testing steel structures:

- Ultrasonic coating and steel thickness gauges
- Weld testing equipment
- Corrosion monitoring and analysis
- Fixing fitness for purpose
- Barrier impact test rigs.

For testing concrete & masonry structures:

- Digital remote crack monitoring systems
- Brick and stone hardness tests
- Petrographic analysis
- Chloride content and carbonation depth
- Concrete strength
- Reinforcement cover and spacing.

There is a vast range of analytical tests that can be carried out that will on interrogation give an accurate indication of a bridges condition and maintenance requirements.

Bridge deck waterproofing is tested using a combination of thermal imaging and electronic pinhole/lead detection to ensure that the deck is being protected correctly as a QA measure during re-surfacing.

As important as all the above is the requirement for any survey to be carried out by experienced staff who have in-depth knowledge of bridge inspection and diagnostic testing. Experience is vital to accuracy and success.

Access and innovation

Large savings can be made by looking at innovative approaches to how the entire process works.

Early involvement and a team approach between client and engineers can save much pre-start time by sharing of information for set-up.

To access bridge soffits and abutments etc by industrial roped access is almost always less intrusive, faster and far more cost-effective than all other forms of access.

All forms of diagnostic testing can be carried out via roped access so there are no restrictions.

When working over water, specialist netting access systems can be used that allow fast access to bridge soffits safely. In conjunction with roped access, these systems have been very successfully used over canals where the need not to affect canal traffic was paramount. The nets were simply raised to the soffits to allow narrow boats to pass.

Dive teams are regularly used to inspect bridge sections in water and are required to hold HSE certification for commercial diving as well as medical certificates.

Many water-based inspections with depths of <400mm are impractical for a dive team or engineers in waders as the bed is disturbed to the point where visibility becomes zero. In these instances, underwater camera equipment, linked to screen and capture equipment in an inflatable boat, gives much better results.

The conclusion from all the above is that in-house capabilities, including diving, industrial roped access and confined spaces, are all required in this demanding and often hostile environment.

The author's company carries out hundreds of bridge inspections each year. He would welcome feedback or further discussion of this article. Email: michaelnugent@concorr.co.uk