Bridge of the Month March 2013
The Causey Arch

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News

The OBVIS web site has the latest version of Archie-M, 2.5.1. This is largely a bug fix sorting out problems with activation which now seems to work properly. If you need a version for mounting on a server, contact bill@obvis.com who will give you a link. We thought for a long time that we would be able to use a single version but it seems not. The version on the web site should function as a fully functioning demo program for 30 days after which activation is needed.

Network Rail's level zero assessment programme is now in full swing. Our planned tools to assist with this have been somewhat delayed by the arrival of the next generation. (Arthur Magnus William was born on 7th Feb and has proved to be difficult to keep fed). WE do, though, have tools in development for follow up work, allowing more automated running of Archie (not something we would normally encourage) for large batches of bridges. We plan also to include multi spans in this automated process. A particular development, though, is the ability for "Autorun" to make sensible use of backing. That involves making the backing work truly as part of the arch.

Two papers from Bill in the ICE bridges journal. The first, though printed second, (A spatial view of the flow of force in masonry bridges, ICE Proceedings, Bridges March 2013) about the generality of force flow in arches is a gathering together of thought from the past two decades. The second (Stiffness and damage in masonry bridges, ICE Proceedings, Bridges, Sept 2012) looks at the vexed issue of "spandrel cracks" in arches.

Forthcoming presentations.

4th April, ICE Dorchester: Underneath the Arches, choosing a career in the cold and damp.

11th April UIC, Zurich

16th April ICE Forensic Engineering Conference. London

1st May, ICE Swindon: How Designs go Wrong, The devil is in the detail.

14th May, Archie Seminar Motherwell, Full Day £100, contact Philip@obvis.com

18th July, ICE Poole: How Designs go Wrong

30th August, Scottish Lime Centre, Charlestown, details to be agreed.

Links

www.obvis.com

www.billharveyassociates.co.uk

www.moiretelltales.com

The Causey Arch was built in 1725-7. It has reasonable claims to being the first railway bridge in the world and for 30 years was the longest single span in the UK at 105ft (OK 32m). The mason was Ralph Wood. It was eventually passed by the new Bridge at Pontipridd by William Edwards.

It stands a few miles south west of Gateshead http://goo.gl/maps/xJgG2. It crosses the river at an apparently skew angle, though the bridge itself is square spanning.

The first visible feature of note is the fact that the arch is built up of three independent rings. This is, of course, very common in brick bridges and was done in mediaeval times, but I don't think I have seen a bridge for the modern era built quite like this.

The engineer was clearly very brave, reaching out to a span much greater than any he could have seen. The centring alone must have been a major undertaking. There are putlog holes along the springing line of the arch which were presumably the location of the base of the springing. One feature of multi ring arches is that it reduces the load to be carried since the second and third ring are supported by the first while the centring must simply provide stability.

This picture also shows severe deterioration of the stone, which is, interestingly, concentrated beneath the arch and more or less absent at the edges.

The damage extends upwards for some distance and then largely stops. There is similar damage near the arch crown and at the opposite springing.

At the crown, the damage is even more interesting because it shows deep gouges separated by relatively sound stone. See also the detail below. It seems possible that this is an indication of hollow spandrel construction. The crow damage seems most unlikely to be caused by stress. If it were, the only possibility would be that the abutments had been pushed together. The damage is similar to that at the springings that it seems likely to be frost/water damage. The most likely way for that to accumulate at the crown would be if there were internal spandrel walls and a horizontal cap, when a slight sag in the arch would lead water falling on the bridge to gather near the crown and seep through.

With a span of 30m and semi-circular form. The spandrel walls are about 17m high. To contain earth at such a depth they would need to be very thick, much thicker than the width of the bridge so the bridge would end up being solid masonry. That must be regarded as unlikely possibility.

The photograph below shows the full spandrel face and there is a clear division between wet stone near the top and drier below. This also suggests a flat topped, hollow spandrel construction.

It is interesting how the damage near the crown creates the impression of a pointed arch when the curve is actually quite smooth.

Photograph taken by John-Paul Stephenson on 11 August 2005. From Wikipedia Commons