



Bridge of the Month No12 December 2011 Lugar Viaduct, Cumnock



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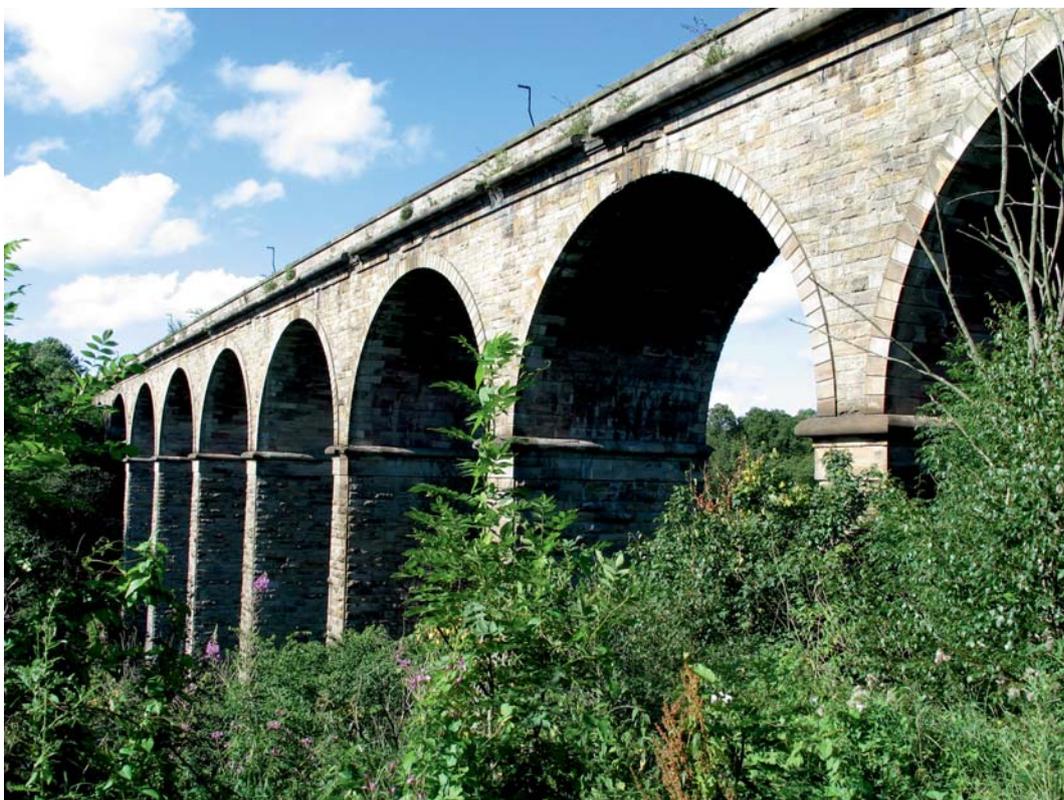
Please consider sending on this newsletter to anyone you think might be interested, including non-engineers.

So, this is the end of year one and I have managed 12, even if some of them have gone very close to the months end. Since it is already 11am on 31st Jan, this one won't be early either.

Time, though, to think a little about my aims in doing these newsletters, because it is a considerable effort. I am deeply concerned about the lack of understanding of masonry bridges exhibited by most of those engaged in their assessment and repair. Over 30 years working on arches I have learnt an awful lot and I cannot raise the energy to work it into papers. Perhaps what I really need to do is a book, but that would be a long term commitment and may have to wait until I am a little older and no-longer have the energy to chase around as I do at the moment.

I hope that these notes will reach people who are not engineers but have a general interest in bridges or masonry, but the main target is young engineers who are exposed to masonry for the first time when they are asked to inspect or analyse a masonry bridge.

I am prompted to bring forward the Lugar viaduct by a discussion with an Archie user earlier this month. One of the aims of this series is to encourage people (especially engineers) to think about how bridges were built and the implications of that on the way they behave. This bridge is at <http://g.co/maps/mdjsr>.



It is another viaduct on the Glasgow and South West Railway not far down the line from Ballochmyle, which appeared in March. John Millar designed the whole line with much repetition of detail and general construction. For example, the rolled string course forming a colossal drip check is common to all the bridges. It is now clear that all of Millar's under line bridges have internal spandrel walls. They have been found even in the standard access bridges which are only 12 ft (3.65m) span. His design was quite unusual in that the spandrels passed completely over the top of the arch and were then surmounted by slabs.



The scale of the stones used is clear from the nosings, some of which have broken off. The arch ring is about 30in thick and the nosings are only slightly smaller, perhaps 2ft thick, 3ft long and at least 3ft back into the wall to provide stability (see also the section on page 6).

One contributory factor in this construction is the quality of the stone readily available in the whole run of the line. I suspect that there was a certain amount of hauling but many of the bridges were built from stone quarried within a few hundred yards.



The arrows here mark the points where the construction changes. Both the spandrel wall and the arch soffit show different weathering above and below the line where the masonry is solid through. The upper level of the internal voids corresponds with the ashlar course below the (somewhat fractured) nose. Careful inspection of the first photograph will show that there are water runs on the surface of this ashlar which come from the top level of the deck slabs.

Many years ago (I can't remember when now but before 1990) I was walking across Glasgow from the University to the station when I happened on a second-hand book shop. I scanned it with only about 10 minutes to spare and found, in that short time, a volume of the *Modern Carpenter and Joiner and Cabinet Maker* (Volume 6 published by Gresham in 1903) which included a chapter on bridge construction. It happens that this volume includes drawings of the centring for Lugar which also shows the detail of the internal construction.

Closer inspection will almost certainly show banded weathering on the soffit indicating the outlines of the spandrel walls.



The stone was described by the masons as Freestone. In theory, that meant it could be cut and dressed in any direction but here we can see one stone which has been cut against the grain. Is that lack of skill on the part of the mason concerned, lack of care or even simply that when green the stone showed no real evidence of bedding?

Here you can also see the damage that ensues when water is allowed to run down the face without stop. The stone below the broken nosing is in rather worse condition than that which has been protected.



Here we see a drain at the arch crown, which is a strange idea if you do not realise that the deck is a notionally flat slab which will necessarily drop at mid span after decentring. There is a very wet stripe below the drain which might be splash from the drain itself or might be showing the line of the central void.

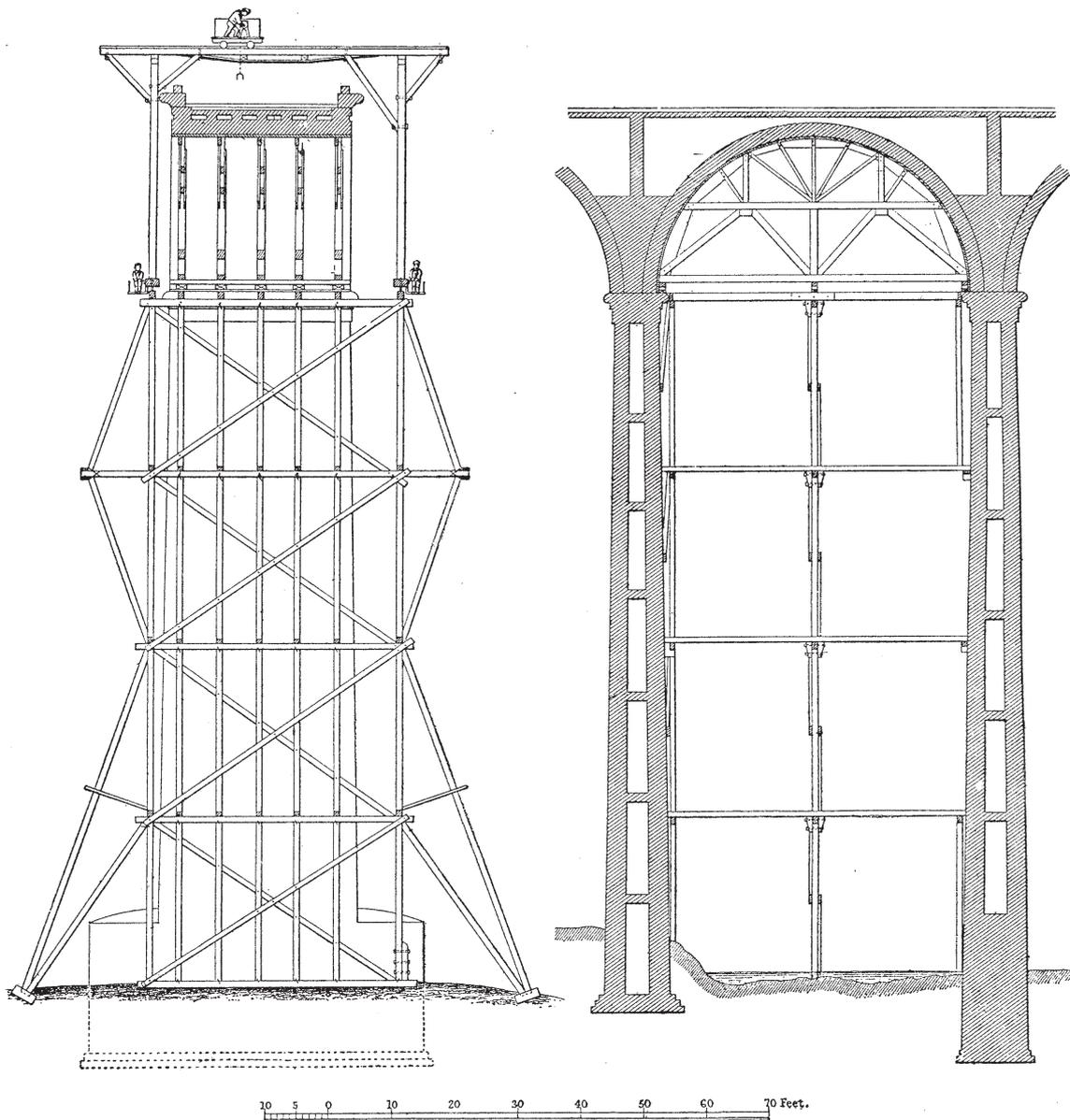


This beautifully weathered stone is included particularly for Heather Jackson of the National Museum of Wales. We had a heated discussion over Christmas about whether the main value of rock was that it was a good material for building bridges or the main value of stone bridges is that they show off stone to the best advantage. Strange that in this whole bridge there should be just one example of such a weathered piece.

And now it is time to look at those drawings. They were clearly intended first to illustrate the timber work of the centring. The scale of the timbers is spectacular, 12" square sections up to 60 feet long (0.3x0.3x18.3m). The timber gantry crane was 40 feet high and must have swayed alarmingly as the winch man wound up the large stones.

The centring itself is in two completely independent sections. A table is formed at half height of the arch with a very simple truss and a lighter and more complex frame sits above to carry the main part of the span. Unfortunately, there are no details of the wedges that carried the centre and allowed it to be dropped.

Note that the cross section shows six letterbox openings over the crown. So 5 internal spandrel walls. I think I need to run this on into next month and say rather more about the construction, the stiffness and the potential for deterioration.





One last picture to show how the weathered stone stands alone in the structure. Clearly a function of the stone rather than the environment.

News

Bridge Management and Maintenance: Bill is convenor of the Study Group at IStructE. It is open to anyone with an interest in bridges. Ideas for meetings are always welcome. We are trying to set up a discussion group and also a meeting to discuss preparation for and response to floods and issues of mechanical parts of bridges (eg bearings and expansion joints. Contact to join or bill@obvis.com with any ideas or offers of assistance.

Archie-M The latest version of can be downloaded from: <http://obvis.com>

Seminars and courses. Courses are run as a profit making concern by Bill Harvey Associates and need take £3000 to cover the costs so say 10 people at £300 each. The standard charge for Seminars, run as part of the support for Archie-M is £100 which is intended to cover costs only.

If you would like us to run a course (a full day intensive training) or a seminar (intended as an update on arch studies and Archie plus discussion between users) near you, please let Philip@obvis.com know.

Continuing (if sporadic) thoughts about arches and Archie at <http://billharvey.typepad.com>
Moiré Tell Tales: High sensitivity, long range reading. <http://bit.ly/BillH6>

Happy new year everyone. I must stop now and prepare for it.