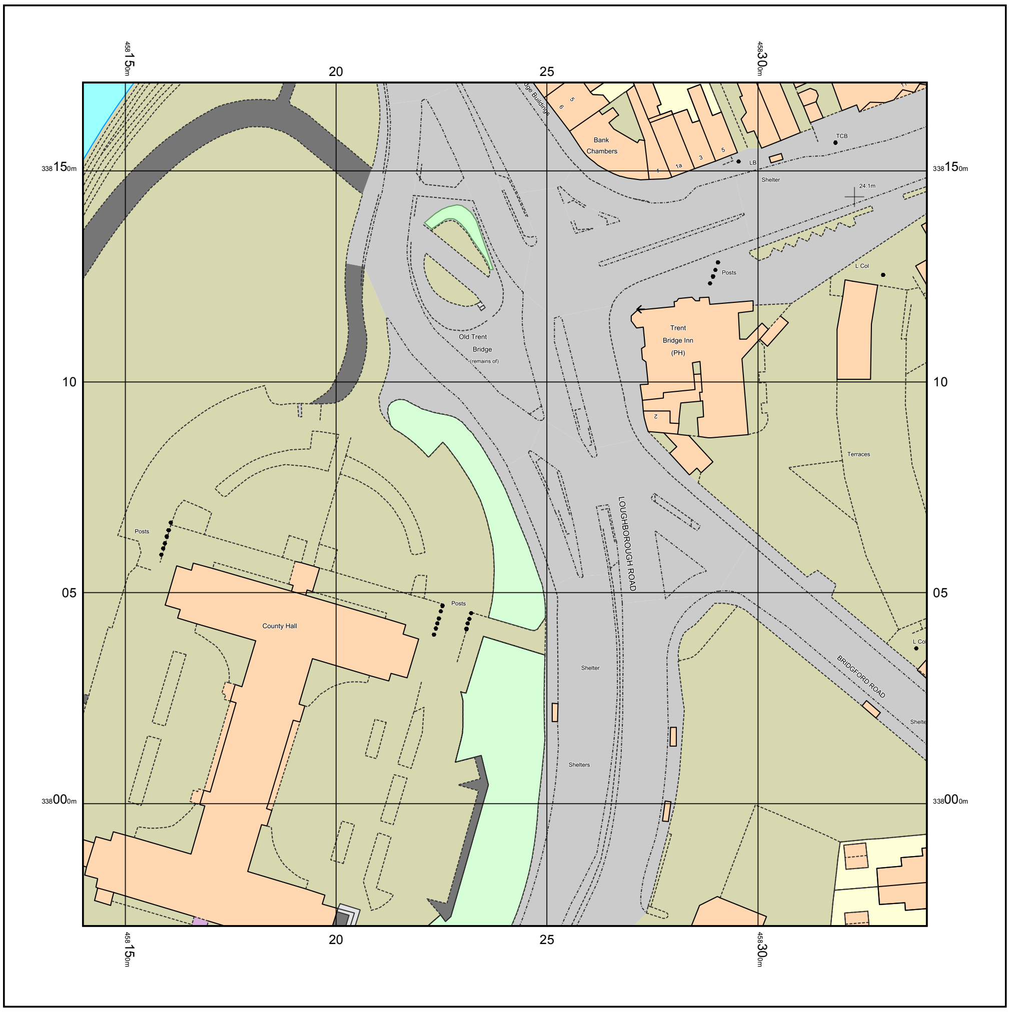
OLD TRENT BRIDGE, NOTTINGHAM

CONDITION SURVEY AND RECOMMENDED REPAIR AND CONSERVATION.

North
25m
Scale 1:1250



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old trent bridge

Brief Historical Summary. The structure under consideration represents a remnant of the original, medieval bridge across the River Trent. The first bridge across the Trent in this location was built after 924 CE, following the occupation of the Danish borough upon the north bank, by Edward the Elder. Edward ordered the construction of two strongholds to the north and south banks, which were connected by way of a bridge of timber-frame construction.

The bridge formed part of the main route between York and London until the construction of a bridge across the Trent in Newark during the 1130s.

The timber bridge was substantially replaced in stone, with a timber-frame superstructure (and even arches) after 1156, during the reign of Henry II, by which time the bridge was called Hethbechebrigge, with St Mary's Chapel and other buildings constructed along its length. The name had mutated to Hethbethe Bridge by 1319 and this had fallen into serious disrepair by 1364, a situation and a tendency that prompted the creation of Bridge Wardens after 1374, who were granted lands sufficient to generate revenues for the repair and maintenance of the structure.

During the Civil War, Royalist troops collapsed several of the southern arches to hamper the progress of Parliamentary forces, the structure being still at this time a composite of stone piers and cutwaters beneath timber, according to some sources, although this may seem less likely than in earlier periods.

By 1683, when the bridge was one of many regionally damaged by severe flooding, the arches had been constructed of stone and brick masonry and formed an overall length of 668 feet.

Significant repair and reconstruction followed the floods and further restoration was undertaken in 1725 before further repairs and widening of the arches commenced in 1806.

Foundation repairs took place in 1817 and these were followed by more extensive repair and consolidation facilitated by severe drought conditions in 1826. Further repairs were executed in 1850 and beyond until the completion of the new Trent Bridge in 1871. Most of the old bridge was demolished in 1872, a remnant being left at its southern end, part of its land-based approach.

(source: www.nottshistory.org.uk)

Historic Images.

C1815 (nottshistory.org.uk)

Attributed to Thomas Cooper-Moore, 19thC. Nottingham City Library. (Artuk.org)

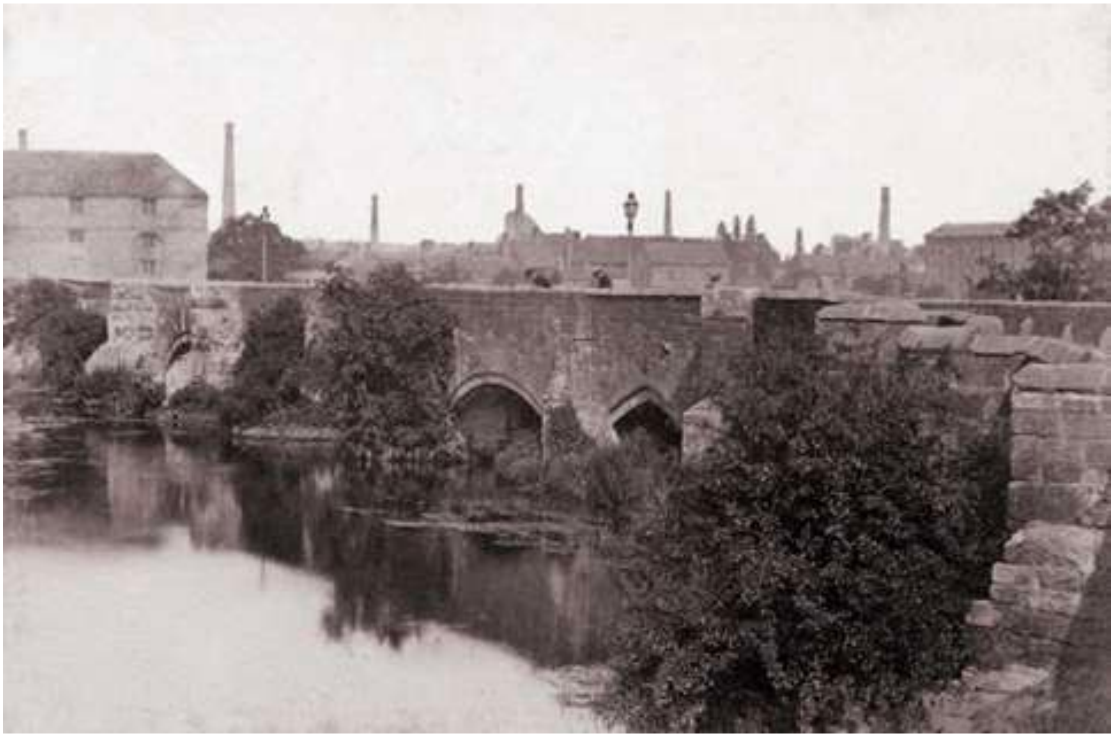
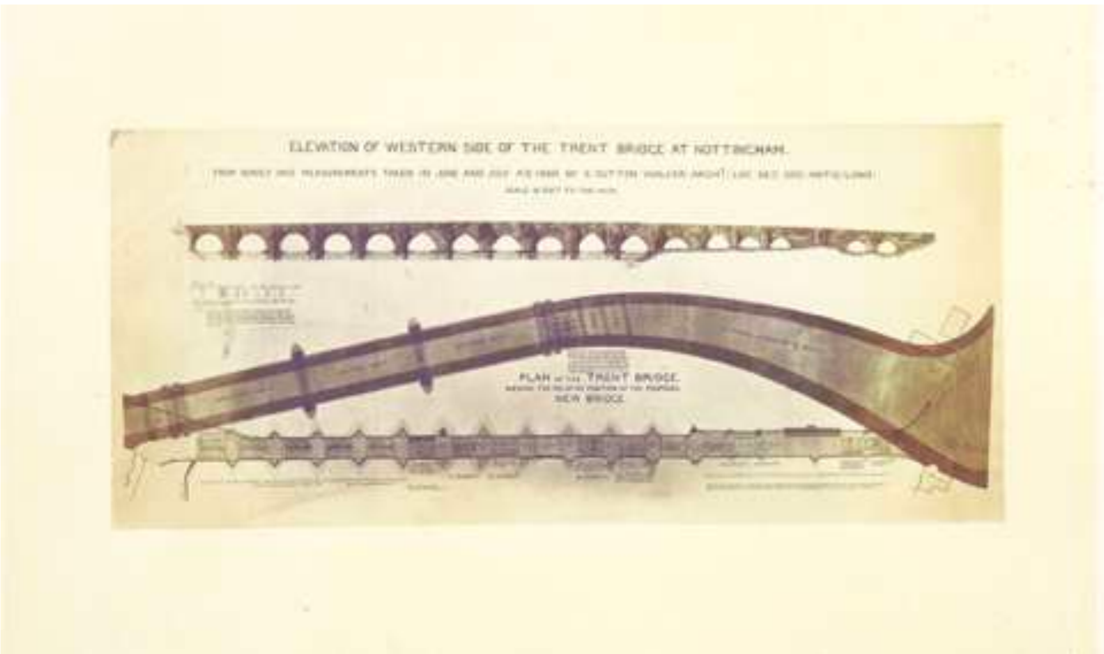


Image: Robin Clay.

1870. (Nottingham City Council).


Date unknown (nottshistory.org.uk).

1871 (nottshistory.org.uk)



Tarbotton, History of Old Trent Bridge.

CONDITION SURVEY.

The urgency of recommended repairs will be identified throughout, (1) being the most urgent.

Estimated costs will be put alongside recommended works, but these are advisory only. The works would ideally be performed by small, independent companies, not by a larger one, with demonstrable expertise in building conservation and repair. Competitive tender would be the least satisfactory method of awarding any such repair contract.

The remnant section of the bridge has been 'monumentalised' in the past, within a sunken landscaped area, accessed via steps at the south end; the upper surface of the bridge being at pavement level and accessible from this level.

Two arches survive intact. Images above show the geometry of the bridge arches to be somewhat variable, both segmental and segmental, or truncated equilateral arches. Current ground level around the bridge is at or around the original springing line of the arches.

The majority of the masonry is of local Sherwood sandstone in the form of squared ashlar facing and rubble core-work, both laid up originally in a hot mixed lime mortar. The vaults or arch soffits are comprised of sandstone and of brick, with defined boundaries between them, indicative, perhaps, of the widening of the bridge circa 1806, but suggestive, at least, of previous widening before this.

The bridge roadway is paved with York stone flags between remodelled wall-tops. The latter would seem to be a Ministry of Works-era rebuild at upper levels, using cementitious mortars with coarse, sharp sand aggregates. These are probably 1:1:6, Portland cement: hydrated lime: sand. This has been durable and has not caused decay to the uppermost stones of the remnant parapet. However, to the east elevation, lower courses of the same have suffered significant frost damage contributed to by such mortar and the associated run-off from the upper parapet. Much of the pointing to the stone flags has been lost, or is fractured, adding to the potential burden of water within the lower former parapet wall, as well as within the arch vaults, which latter exhibit extensive salt crystallisation, as well as salt-induced decay to brick and stone surfaces, as well as to original construction mortars. The cementitious mortars remain substantially intact and well-attached and should be left. In the absence of their promoting decay, they are fit for purpose (in the absence of weathering detail) and were well-executed. The paving should be repointed with similarly robust and frost-resistant mortar to reduce the water (and salt) burden within the arch vaults beneath. (1).

West elevation

A) & B) the upper two courses wholly rebuilt using probable 1:1:6 mortar. Water run-off has led to somewhat accelerated weathering of the ashlar beneath.

East elevation

C) *Water run-off has exposed the weaker ashlar stones to significant frost damage at higher levels; rising moisture being trapped by cementitious repointing at lower level has contributed to similar damage at this level, D). This would ideally be rectified by the introduction of projecting stone copings. Providing a proper drip function (1).*

Salt incrustations to the arch vaults, indicating significant passage of water and periodic wetting and drying. Salts within the brick or stone will promote their progressive disintegration

The cutwater to the west side remains substantially intact; only a stub of the same survives to the east side. All remnant cutwaters have been 'rough-racked' to greater or lesser extents, using the same cementitious mortar as above and being part of the same 'Ministry of Works' scheme. This has been less successful, inviting significant growth of vegetation, but remains substantially intact. Rough-racking extends above the more southerly arch to the west side, all but its lower order of voussoirs having been lost. The rough-racking in this location has been lost or is deficient and this should be re-consolidated (1) and only a single skin of brickwork survives at parapet level.

Rough-racking to west side, to cutwaters and above disrupted arch


E)


F)

G)

H)

Part of the northerly arch on the west side has been rebuilt using soft red bricks – in the spirit of an ‘honest repair’. This happened long ago and was effected using traditional, hot mixed lime mortars.


I)

The more sheltered faces of arch-stones to the west side have developed gypsum sulphate skins in response to air pollution. The monument is close to a busy road and is in a sunken area, where particularly diesel exhaust particles will accumulate and attach to the stonework, the more so the wetter the fabric of the bridge is. Where this stonework is not routinely rain-washed, these particles will react with lime in the stone, as well as with free lime that might be leeched from lime or cement-lime mortars to the adjacent stonework, creating such skins. These will cause powdering of the stone face beneath. Their presence may suggest some calcareous content in the local sandstone used in the bridge.


J)

K)

There has been a general attrition of pointing mortars, except to the upper courses of the remnant parapet wall. In places, original pointing and/or bedding mortars are visible, cementitious repointing having fallen away. The original mortars were hot mixed directly from quicklime and were lime rich. They were likely based upon non-hydraulic lime, with some low level pozzolanic addition. Wood ash or brick dust and aggregate were the most commonly used pozzolanic additions in vernacular craft practice at the time that the bridge was built. Some charcoal inclusions may be discerned in exposed original mortars. Such inclusions have in the past be interpreted as fuel debris mixed with the quicklime from the kiln. This is generally unlikely, however. Even in primitive limekilns, the lump lime emerges clean, with 'lime ash' debris at the base of the kiln, a mixture of disintegrated quicklime and fuel ash. Such lime-ashes had specific uses, historically. Whenever charcoal is observed within a traditional lime-rich mortar, it is likely to have been a deliberate addition by the stonemason, offering a feeble hydraulic reaction, assisting (as a water retainer) the steady curing of the mortar. Whilst it assisted durability, recent research would suggest that it also enhanced capillarity, increasing effective porosity (Fusarde 2018).

original or earlier lime-rich, hot mixed lime mortars

L)

RECOMMENDED REPAIRS.

The overall condition of the monument is reasonable, but it is in need of some localised repair and of repointing more generally, as well as some improvements to its immediate setting, which currently offers an ambience of neglect with excessive tree growth and extensive colonisation by weeds and grass. The setting would benefit from more regular maintenance, once essential repairs have been effected.

East Elevation

- Remove all gypsum soiling to arch stones using fine stainless steel brushes and water. (1) £600
- Repoint 90% using a mildly pozzolanic hot mixed lime mortar. This might be 1 part powdered quicklime: 2 parts coarser sharp sand: 1 part fine sharp sand plus 5% pozzolanic brick dust as a proportion of the slaked lime (10% of the quicklime), or wood ash (fines and charcoal) added at similar proportion. More exposed areas might receive 20% wood ash as a proportion of the quicklime. (1) £1500
- Replace 2 # outer arch voussoirs with matching sandstone and dressing, southerly arch. (1) £900
- Replace 4 # ashlar stones like-for-like, new stones to be at least 6″ deep. If the same stone cannot be sourced, these repairs may be effected using low-fired, handmade clay plain tiles, consistent with the historic significance of the original fabric. (1) £800
- Remove all weed growth and cut vegetation and remove immediately around the monument. (2) £400
- Remove all self-seeded tree saplings (1) £250


M)


N)

Arch Soffits/Vaults:

- Brush away all salt efflorescence, gathering removed salts and carrying away from site (1) £500
- Repoint brick and stonework 100%. Intact original pointing mortars will be salt-infused and friable. Joints should be cut back approximately 25mm, removing zones of heaviest salt contamination. Mortar should be as above but with 15% graded brick aggregate addition, approximately 5% of which should be in fine powder form to offer pozzolanic reaction. Brick aggregate enhances the management of salts. (1) £1800

West Elevation

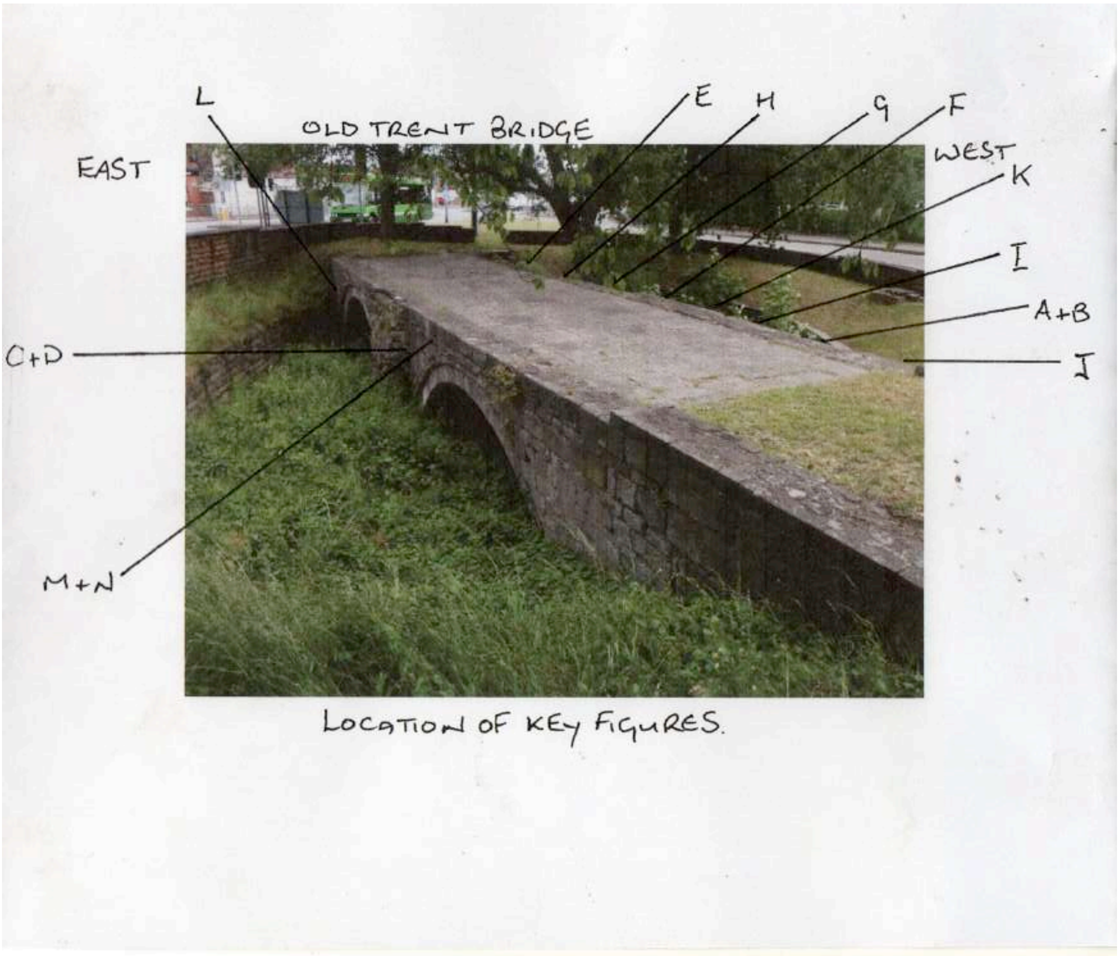
- Remove all weed growth from rough-racked cutwaters and over disrupted arch; assess stability of rough-racking and reconsolidate as necessary using a hot mixed mortar as above but with 25% meta-kaolin addition as a proportion of the quicklime by volume. Provide weatherings throughout to shed, rather than to trap, received water. (2) £600
- Provide mortar weatherings to exposed arch voussoir tops. (1) £200
- Repoint approximately 40%, leaving all intact original or earlier hot mixed lime mortars.(1) £800

Paving

- Remove all weed-growth and roots £100
- Remove all degraded cementitious mortar £150

- Repoint with 1:2:7 mortar: 1 part white Portland cement: 2 parts hydrated lime, run to a lime putty the day before mixing: coarse, well-graded sharp sand. (1) £900

LOCATIONS OF FIGURES ABOVE



RECOMMENDED MATERIALS:

Powdered quicklime: Calbux90 from Lafarge-Tarmac, Buxton, Derbyshire
Pozzolanic brick dust: from Eden Hot Lime Mortars, Cumbria
Brick aggregates: Bulmer Brick and Tile, Suffolk or York Handmade Brick Company, Alne, Easingwold.
Sandstone: buff or grey Grinshill sandstone:
http://grinshillstonequarry.co.uk/gallery.html

Conservation principles for the continued maintenance of the structure over (at least) a 10-year period

Preventative Maintenance

- Where possible avoid or reduce the use of road salt on the bridge to try and limit waterborne salts which will cause accelerated decay of the masonry.
- Routinely brush efflorescence from the surfaces of bricks and stonework and gather up to prevent rewetting and dissolving back into the structure.
- On no account should any stone or brick be painted with a 'waterproofing' paint (or similar) as all masonry, carved or otherwise, needs to remain 'breathable'. The application of any surface layer of this type will trap water within the masonry and cause more significant damage through frost-thaw action.
- Similarly, the use of Natural Hydraulic or strongly cementitious hydraulic mortars should be avoided. Proprietary pre-mixed mortars MUST NOT be considered, as these frequently contain air entrainer and water repellants which will eliminate effective porosity in the mortars and promote decay of adjacent stone or brick.
- Regularly inspect all surface drains and ensure that they are free of silt and debris and are working satisfactorily, allowing water to disperse rapidly from the highway.
- Put in place a regular programme of light touch vegetation removal to prevent growth of large woody shrubs which could damage stonework and hold moisture against stone
- Carefully remove any redundant metal fixings. Any future fixings (including for wiring) should be discrete with fixings located in joints.
- Inspect pointing annually and renew pointing to open or damaged joints as required. New pointing should only be done with an appropriate lime mortar to an agreed specification (see above).

Cleaning

- The masonry should not be cleaned with any mechanical, abrasive or chemical processes as this will potentially damage the stonework, and cause loss of detail. Chemical cleaning can mobilise minerals that might discolour the stone and mechanical cleaning can remove the stone face, roughening the underlying surface, which tends to accelerate re-soiling, attracting fine particles, particularly of very fine carbon particles from diesel fuels.
- Some carved areas have developed a sulphation skin which – because it is a sandstone - is protecting carved features. The blackened layer offers protection against decay and takes up to 100 years to establish. This can be damaged through vigorous cleaning and should be manually brushed to remove soiling and salts. Any debris should be removed to prevent reabsorption. Where such sulphation is promoting the detachment of surface layers (as in a limestone, or when the sandstone contains calcium carbonate to any significant degree, cleaning should be with water and fine stainless steel brushes only or with a conservation-approved Joss system and any works with this must be carried out by individuals of experience in such methods and conservation accreditation.

Removal of earlier repairs

- Examples of earlier stone 'cement' or 'plastic' repairs have been undertaken with a cementitious mortar but these are generally shallow and cosmetic in nature. Where these are sound they should be left. Where they are failing they should be removed and, for details such as string courses, run in situ using a non-proprietary 'restoration mortar' matched to the colour and texture of the stone. For skim or fillet repairs that are failing should be replaced with a lime mortar to an agreed specification.

Alterations or repairs

- The bridge has had extremely little alteration to its overall aesthetic design over the centuries. Although listed building consent is not generally required for repairs, no repair work should be undertaken without prior consultation with the local conservation officer. Some repairs or (even temporary) removal of elements (e.g. the war memorial) may require listed building consent.
- Care must be taken to design a palette of compatible repair mortars to be used upon this structure. Modern Portland cement and modern NHL are unlikely to deliver the necessary compatibility and would be unlikely 'like-for-like'. An equivalent natural cement is currently available, and might be used for underwater or 'close-to-water' works. Repair mortars to the superstructure should be designed around hot mixed air lime mortars with appropriate pozzolanic additions. Any larger-scale programme of repairs should be preceded by professional mortar analysis to inform the design and character of any new repair mortars. The recommended material scientist would be Bill Revie of CMC Ltd, Wallace House, Whitehouse Road, Stirling, FK7 7TA, Scotland.

Reinstatement of lost features

- There should be no speculative additions or alterations to the appearance of the bridge or its elements. Any work should be informed by a full understanding of the bridge's significance and the materials used in its construction.

Paving

- Stone paving slabs have a patina of age which is difficult to replicate. If undertaking the localised renewal of slabs, from a conservation point of view, the ideal is that broken slabs should be retained as far as possible and reused to avoid changes in colour and patination. Where slabs have suffered a single break, for example, these should generally be lifted and re-laid with the fracture pointed, upon a solid base of mortar.
- Any replacement flag stones should be carefully sourced to match the existing geology and colour as far as possible.

NIGEL COPSEY 2019.

ICON
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