

## Horkstow Suspension Bridge, Lincolnshire, after 185 years in service

An historical engineering review by Prof/Dr Roland Paxton, *Friends' Patron*

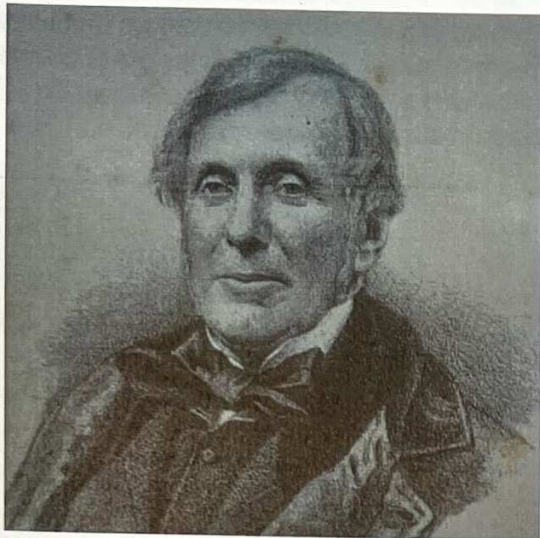


Fig. 1 Sir John Rennie (1794-1874) Civil Engineer

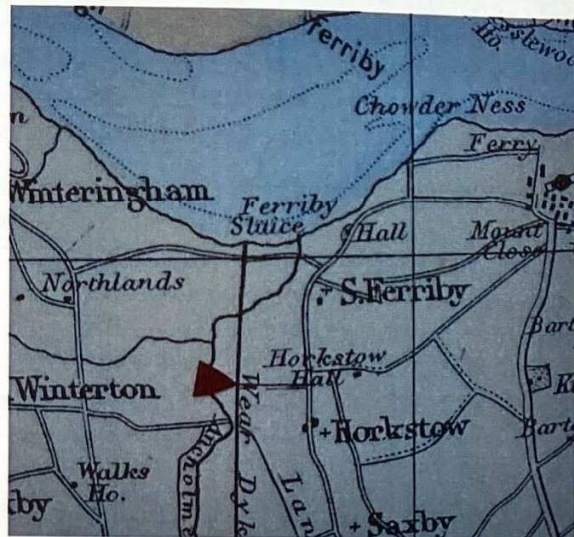


Fig. 2 Bridge over channelised river shown in red



Fig. 3 Horkstow Bridge [at right] as shown in Sir John Rennie's *Ancholme Drainage* paper 1844

**Introduction.** Although not a landmark in bridge development, Horkstow Suspension Bridge [NGR SE 973 190], with its Historic England Grade II\* listing, is nevertheless a first class example of its type that stemmed indirectly from Union Bridge. It was erected to maintain a connection between Horkstow and Winterton parishes, and is still operational for vehicles, now with a 3T weight restriction. The lightly-trafficked bridge carries the minor road from Horkstow over the channelised River Ancholme, near its entry into the Humber, to the west riverside track [Figs 2 & 3]. The bridge formed part of the extensive River Ancholme Drainage Scheme [1825-44] designed and executed under the direction of Sir John Rennie, builder of New London Bridge and son of John Rennie, the masonry design consulting engineer for Union Bridge.

**Origin** Sir John Rennie was influenced by Capt. Brown's introduction of the bar link into suspension bridges, its application at Union Bridge, and as developed at Menai and Hammersmith bridges, to adopt the concept at Horkstow for an economical pier-free river crossing. Horkstow bridge, created when suspension bridge design and technology were in their infancy, was erected in 1835-6 under the supervision of the Drainage Scheme's resident engineer, Adam Smith. Its longevity is testimony to the remarkable skill and professionalism of its engineers; ironfounder and erector, Gospel Oaks Ironworks [J. & E. Walker], Tipton; and the contractor, Jolliffe & Banks.

**Description.** The influential Institution of Civil Engineers has exemplified merit-worthy historic structures nationwide in its *Civil Engineering Heritage* books. *Eastern and Central England* [1973] informs the reader, that Horkstow Bridge “is a fine example of an early suspension bridge, one of only a handful to have remained as originally designed. Because of its secluded location at the end of a little-used country lane it has survived almost intact from the time it was completed in 1836 ... the imposing and well-proportioned rusticated towers, which rise to a height of 36 ft [11m] above river level [with 16ft headroom for vessels] have semi-elliptical arches over the 14 ft [4.2m] wide roadway.” [The chains pass through the towers on a roller/spindle assembly].

“The single 133 ft 9 in [41m] span has double wrought iron suspension chains, one immediately above the other, on either side. Each chain consists of two  $\frac{3}{4}$  by 1 inch [19x25mm] links, 7 ft 3 in [2.2m] long. [Fig. 4] There are 33 pairs of  $\frac{7}{8}$ ” [22mm] square iron hangers from which are slung the timber cross members supporting the simple plank deck. The deck has a pronounced upward curvature [Fig. 5] and its lightweight structure results in a significant motion under live loads even with a 2-ton weight limit. In September 1979 an articulated lorry weighing 21 tons attempted to cross the bridge, the tractor unit fell through the timber deck into the river. The driver was lucky to have escaped unhurt as his cab was completely submerged, one quarter length of the bridge deck was destroyed and the suspenders in this section were bent outwards at their lower ends, one being broken, the masonry arches, chains and remaining three-quarters of the deck survived without damage. The bridge was subsequently repaired” [E.A. Labrum].

**Refurbishment.** For the bridge’s sensitive refurbishment in 1999, society is indebted to its owners the Environmental Agency, Anglian Region; Posford Duviver [now Royal Haskoning DHV], consulting engineers; and C. Spencer Ltd, the main contractor, forerunner of the Spencer Group now restoring Union Bridge. In 1999 the project was entered in an Institution of Civil Engineers annual national *Historic Bridge Award Competition*, to **recognise and encourage excellence and innovation** in conservation, for which I served as a judge. The judging panel, after carefully inspecting and considering all aspects the project, awarded it a well-deserved ‘commendation’.

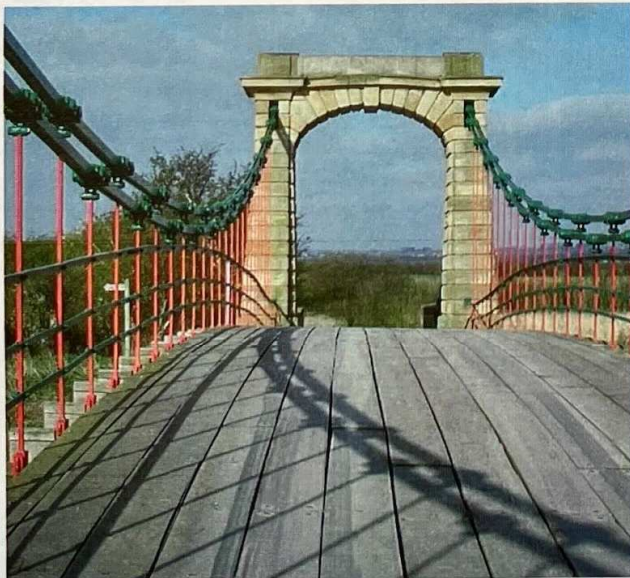


Fig. 3 Note the elegant stone tower with elliptical arch. Deck replaced by harder wood in original form ©Redmore



Fig. 4 Twin bar main chains with drilled eyes, and hexagonal nuts to cross bolts ©Redmore

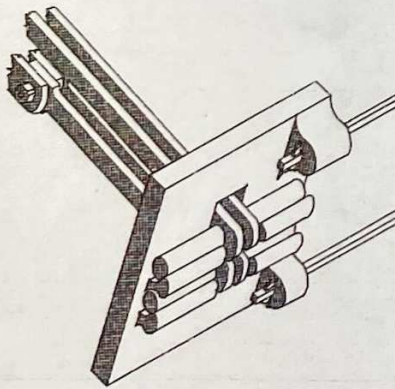
The judging panel was impressed by the minimal intervention to the original structure, Also that a 1993 Departmental Standard BD assessment 21/93 giving the bridge a zero tonnes live load capacity was not actioned by its closure but by the practical expedient of the imposition of a 2-ton weight limit. This decision found support from the bridge's accidental but instructive testing 4 years earlier when it withstood the 21-ton load described above. During refurbishment original ironwork not reused mainly amounted to the four short lengths of partly-corroded underground back chains. Their replacement with 50mm dia. high tensile steel ties [Fig 6] was appropriate and is visually discrete. Figs 3-11 show the present state of the original workmanship, which looks good.



Fig. 5 Replacement deck in its original form utilising the 1836 ironwork  
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Fig. 6 Replacement of lower back chain ©Posford Duvivier



Figs 7-9 Cast iron chain anchor plate 920x1165x100mm in tunnel [Fig. 11] bearing on a substantial masonry wall [see Fig 9, from which the plate top in Fig. 7 was drawn, and Fig. 11] ©Redmore

**Conclusion.** Industrial archaeologist Dr Michael Lewis stated in 1973, that of earlier suspension bridges than Horkstow in the UK, almost all have been altered to some degree. Since then, this process has continued with alterations to Wellington Bridge, Aberdeen; Kalemouth Bridge [new anchorages 1990]; Victoria Bridge, Bath [steelwork 2012]; and impending at Whorlton Bridge [1831], closed 2019 until 2023 for refurbishment, with the amount of replacement ironwork not yet known. Also, at Union Bridge with replacement of 55% of its original links/chain rods. So, at present, Horkstow Bridge is **the earliest, least-altered, vehicle-carrying, suspension bridge in the UK**, a treasure of bridge technology and the environment deserving wider public acclaim.



Fig. 10 Horkstow Bridge in recreational use in June 2021

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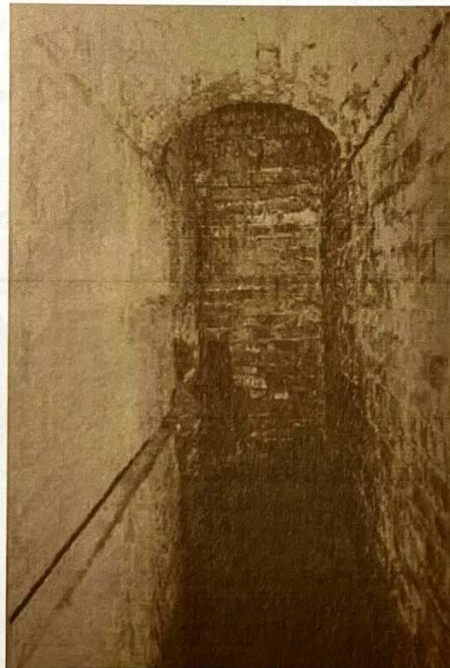


Fig. 11 Anchorage tunnel 6m long x 2.2m x 0.7m.  
Plates on LH wall [as shown in Figs 7-9] ©Lester

**References:** Rennie, Sir John. 'Ancholme drainage'. *Min. Proc. ICE. IV. 1844. 186-211*, plan [Fig. 3]  
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