at Belah in the Pennines (Input 7). The caisson on one such pier (no. 54) burst in August 1875, and six men were killed by the inrush of mud and water. By April 1876, construction had proceeded well with 76 of the 85 spans being built, so only 18 further spans were needed to complete the structure.

Later, in February 1877, when the high girders were being lifted into position on top of the finished piers, there was another accident that should have served as a warning of the problem of high winds on the structure.

The two southernmost spans had been floated out on pontoons, and raised by hydraulic jacks ready to be lowered onto the pier heads. The girders were normally raised onto the piers at a low height, and the columns raised with the girders held above them by hydraulic jacks. They hung on metal pins supported by temporary columns five feet above the pier heads. The pins were moved into different holes until a girder was in place.

A gale suddenly sprang up as night approached, and at about 8.15 pm the girders were blown from their positions into the water below. The wind must have been strong, because temporary shacks in the girders used by the workers were blown away. One worker died, but the damage was repaired.

The bridge was first crossed by the directors of the NBR on 26 September 1877, and detailed tests conducted on its stability by Major-general Hutchinson in February 1878. He spent three days examining the bridge, finally testing its loading capacity with no fewer

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**Input 7  Bouch's bridge at Belah**

A higher bridge (195 feet) of similar design had previously been built by Bouch at Belah in the Pennines. About 4 miles from Brough, the viaduct carried the South Durham and Lancashire railway across a gorge in Westmoreland. It was based on well known technology, making use of cast-iron columns and wrought iron struts and braces to form a space frame to support girder spans carrying the railway.

A similar method was used to construct the famous Crystal Palace for the Great Exhibition of 1851, a building with a cast-iron frame, timber floors and vast amounts of glass (Figure C11). The building was constructed in only 9 months. It was disassembled after the exhibition and re-erected in South London before destruction by fire in the 1920s.

The bridge built by Bouch at Belah was 1000 feet long overall, and carried on 15 piers, each arranged in a rectangular shape of hollow cast-iron columns bound together with wrought iron bracing bars. They were attached to the columns by circular straps. The columns were 50 feet apart at their base, tapering to 22 feet apart at their apex where they supported the railway (Figure C12).

The large batter undoubtedly made a stable structure, and the manufacture of the piers was carefully performed using precision machine tools – according to Mr Rothery at the later Board of Trade enquiry on the Tay Bridge. The viaduct served its purpose well for many years before demolition in 1966.

Although not designed by Bouch, bridges of similar construction still survive at Okehampton (the Meldon viaduct) and at Ilkeston (the Bennerley viaduct). Although now disused, they are preserved as Grade II listed structures.