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The Thames Tunnel saga

Malcolm Tucker

Monuments that one thinks of as safe and inviolable sometimes come unexpectedly under threat. Such has been the case of Sir Marc Brunel's Thames Tunnel, which for 125 years happily carried the East London Railway between Rotherhithe and Wapping in East London. Some members of the AIA have fond memories of conducted walks under the river, after the traction current had been switched off at one o'clock in the morning. Since March 1995, however, the tunnel has been closed for 'repairs', the true nature of which has caused considerable misgivings in engineering and IA circles. The battle between preservation and 'repair' has been something of a saga ever since and is still not quite over.

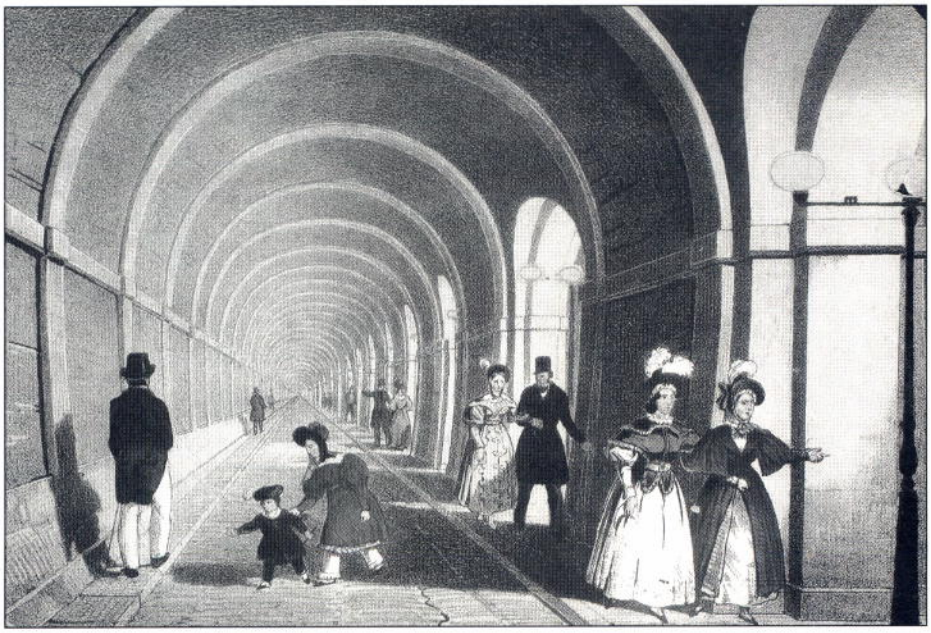
The heroic struggle to construct the world's first river-crossing tunnel is graphically described in Tom Rolt's biography of Isambard Kingdom Brunel,[1] while two recent papers have delved more deeply into the geological and technical circumstances.[2] In summary, Marc Brunel developed his tunnelling shield to construct this first large-bore underwater tunnel, through the soft ground of the Woolwich and Reading Beds. A thick protective clay layer was expected from borings, but a band of silt and sand was found within this which ran and caused the overlying clay to settle and fracture, so letting in large quantities of foul river water and poisonous methane and hydrogen sulphide from the polluted river bed. There were five major inundations, staunched by dumping thousands of tons of clay in bags. In one irruption, six men were drowned and Brunel's son, Isambard, who was then the resident engineer, narrowly escaped with his life. The shield was changed for a stronger one near mid-river, a remarkable operation during which the soil was partly supported by long iron pins driven into the face as anchors, a technique only recently re-invented.

After 18 years of exceptional perseverance, including a seven-year break for lack of funds, the Tunnel was opened for pedestrian traffic in March 1843. Intended spiral ramps for vehicles were never constructed, and the proprietors eventually sold out to the East London Railway Company, which opened its line from New Cross Gate to Wapping in 1869.

The tunnel comprises two horseshoe-arched passageways within a rectangular mass of brickwork 38 ft wide and 22 ft high overall, its crown up to 50 ft below Trinity High Water. The interior is lined with tiles and stucco, classically modelled, with Doric half-columns in arched cross-passages. These have been considerably hacked about later, and the architecture obscured by soot from steam trains. There is a concealed drainage system of circumferential channels within the lining, so hardly a drip appears on the surface – the surrounding strata are in any case relatively impermeable.

In the autumn of 1994 the present owners, London Underground Ltd, announced that the East London Line would be closed for seven months in 1995 for the construction of an interchange station with the Jubilee Line Extension and to cure some leaks. We thought little of this, for we knew that the approach cuttings built by Sir John Hawkshaw through alluvial gravels were extremely wet, in contrast to the under-river tunnel. In December 1994, however, the magazine *New Civil Engineer* discovered that LUL intended to line Sir Marc Brunel's Thames Tunnel with shotcrete and a waterproof membrane. The original lining would be removed and the cross-arches blocked up (indeed, they had already been cutting into the lining for exploratory purposes, and blocking up the arches). LUL claimed the tunnel was deteriorating and leaking badly, that a rising water table was a problem and that the brickwork was on the point of failure according to calculations. All these points were doubted by experts, and later shown to be totally false. Various 'exceptional circumstances' were in due course invoked, for instance that the well-buried tunnel might become damaged by a ship's anchor. A process of elimination led some of us to the real cause of concern, a sensitive one which was not publicly admitted for many months.

English Heritage was embarrassed to find that, although the Wapping portal was listed Grade II, and the pumping engine house at Rotherhithe was a scheduled ancient monument, the Tunnel itself had no statutory protection. EH promptly applied for listing but



The remarkable Thames Tunnel, as seen by sightseeing visitors in the 1830s, before completion

Courtesy: Julia Elton

the Secretary of State for National Heritage at first indicated that the Tunnel did not meet the necessary criteria. However, after concerted lobbying by informed and influential persons, including letters to *The Times* from home and abroad, the listing of the Tunnel in Grade II* was announced late on Friday 24th March 1995 (many consider that Grade I would be more appropriate). This was a few hours before the works were due to commence. Thereupon, LUL had to apply for listed building consent, while English Heritage was able to appoint a small panel of eminent engineers to advise it and enter into dialogue with LUL and its consultants.

It is understood that the panel had the utmost difficulty in obtaining essential information since LUL were under direction from the Home Office not to discuss the heart of the matter, and there was little meeting of minds. The two sides were able to agree that a short length beneath the land at Rotherhithe need not be lined in any event, and this was incorporated in the otherwise unmodified scheme which the Planning Committee of the London Docklands Development Corporation approved conditionally at the end of May 1995. Crucially, English Heritage had advised the committee and the national amenity societies that it was the panel's conclusion that defects and risks warranted major intervention and that there was no practical alternative to the proposals. This was not the panel's conclusion and later EH retracted this advice.

After much technical work, the panel's full report was released on 24th July. It found the Tunnel in good condition and expressed considerable doubt on the need for a lining of concrete against terrorist attack, while regretting the lack of time for definitive tests. It was also seriously concerned that an impermeable, undrained lining would induce erosion of the brickwork by the peristaltic pumping action of passing trains. Paradoxically the Secretary of State for the Environment announced he would not 'call in' the scheme that same day, without having seen the report.

In October, LUL came up with a costly 'compromise' scheme, still lined but with smooth-finished, reinforced concrete simulating the pilasters and cross-arches of the original lining and with internal drainage. This was sufficient for the chairman of the panel to withdraw his objections in principle, and the new scheme passed the planning committee on 28th November, subject to the approval of details, there being considerable pressures to get the Tunnel open again.

This is not the end of the matter. It is now acknowledged that the historic lining will have to be stripped, if only because the tunnel was listed so late in the day that time was no longer available for investigations needed to justify alternatives. But there have been strong technical misgivings about LUL's scheme as submitted. For instance it would in places cut into and weaken the existing brickwork, and an impervious lining could produce dangerous water pressures if its built-in drainage system failed to function. There was no provision for inspection, and LUL seem to have regarded their new lining as taking over from the old structure, making the latter dispensible.

As the submission fell far short of the level of detail expected for listed building consents, the Victorian Society and the Georgian Group have been keeping in close contact with English Heritage to try to ensure that the details are not approved until the experts are satisfied that further long-term damage will not be caused by the works. It is understood that LUL have now addressed the issues more positively so that agreement may be reached.

The case raises broader issues, and the Victorian Society, the Newcomen Society, the Institution of Civil Engineers and the Science Museum are pursuing with English Heritage the statutory protection of other great tunnels, as at Harecastle, Standedge, Kilsby and Box. It is hoped that an advance-warning consultative system may be established with the owners of historical engineering works.

On the recording front, the Royal Commission on the Historical Monuments of England has powers to record listed buildings before they are altered. Until the listing, its photographer was only allowed through the Tunnel in the company of a large group of fairwell visitors. RCHME has since been back, and will be granted access to the works as the lining is stripped and features of the original brickwork are revealed. Resources are lacking for full archaeological recording since the planners consider the Tunnel falls outside the guidance of PPG 16, but by negotiation various survey work should now be deposited in the National Monuments Record. The salvage of representative samples of the lining and brickwork for the Science Museum or a similar repository has yet to be arranged.

REFERENCES

1. Rolt, L.T.C., *Isambard Kingdom Brunel*, Longmans Green, 1957, Chapter 2.

2. Skempton, A.W. & Chrimes, M.M., 'Thames Tunnel: geology, site investigation and geotechnical problems', *Geotechnique* Vol 44 (June 1994), 191-216; Muir Wood, A.M., 'The Thames Tunnel 1825-43: where shield tunnelling began', *Proc. Instn. Civ. Engrs, Civil Engineering*, Vol 102 (Aug 1994), 130-139.

The Dale Street waterwheel

Steve Stockley

A project by the Manchester Region IA Society was to record the remains of the Rochdale Canal Company's waterwheel, associated machinery and structures surviving at Dale Street in Manchester, and to trace the development of the site using documentary sources. This work won M.R.I.A.S. a highly commended prize in the AIA Fieldwork and Recording Awards last year.

The Rochdale Canal was officially opened on 21 December 1804, and was the first trans-Pennine canal to be completed. The Piccadilly section was opened in late 1799, where it had connections with the rest of the inland waterway network via the Bridgewater Canal, the Ashton-under-Lyne Canal and the Manchester & Salford Junction Canal.

In 1804, the canal company decided to build wharves and a basin at Dale Street. Two warehouses were built in 1806-8 and 1817, and in 1821 the company identified the requirement for a hoisting system to improve goods handling. They approached a Mr Hughes (later spelt Hewes in company minute books) of Manchester to carry out a survey for a waterwheel-powered hoisting system, and to install it for a cost not to exceed £180. We suggest this was T.C. Hewes, the eminent Millwright and Engineer associated with the development of waterwheel technology in the early nineteenth century.

Additional warehousing was built in 1822 alongside the 1817 warehouse. In the same year the company added a stone entrance arch between the new warehouse and their office.

In 1824, the water-powered hoisting system was sited in an underground chamber at the side of the 1806 warehouse. Six years later, the system was extended at a cost of £593 into the 1822 warehouse by means of a 70-foot (21.3 metre) drive shaft in a tunnel below the warehouse yard. The waterwheel would have been used up to the late 1890s, when it was replaced by two hydraulic jiggers which received high pressure water at 1,120 p.s.i. from the Manchester Corporation public hydraulic power distribution system that operated from 1894.

East elevation of the 1806 warehouse, showing former canal entrance *Photo: M.R.I.A.S.*

Perched in a hole: Steve Stockley (left) and Gordon Browne of MRIAS inspecting the underground waterwheel *Photo: M.R.I.A.S.*

The author measuring the waterwheel, a view showing the difficult conditions encountered by the survey team *Photo: M.R.I.A.S.*

That the waterwheel and its associated machinery has survived is down to its location and surroundings, being shrouded within a subterranean environment. This has meant that it was not economical to scrap it, and it is out of sight of vandals. The wheel is also protected from the weather, which has contributed to its remarkable state of preservation.

In 1983, the Ashton Canal Society were working in the Dale Street area, and they can take credit for the re-discovery of this waterwheel and the removal of silt which partly buried it. The author started the survey for the A.C.S. in 1985 but sadly, work stopped two years later when the society ceased to exist. After joining M.R.I.A.S., the project was re-started in May 1990 and all the fieldwork completed in December 1992. Most of the recording work was carried out by M.R.I.A.S., with specialists brought in when necessary.

It was found that the waterwheel was supplied with water taken from a canal arm that once entered the 1806 warehouse. The water was directed to the wheel via a cast-iron launder and discharged into the wheel's buckets through a large rectangular orifice measuring 6 feet (1.83 m) wide and 10 inches (254 mm) high.

The high breast waterwheel has an outside diameter of 15 feet 10½ inches (4.84 m) and a width of 6 feet 11 inches (2.11 m), and once had 56 buckets. It is of composite construction, using both cast iron and timber to give a reasonably long life without the full expense of an all-iron wheel. The head of water acting on the wheel was 13 feet 4 inches (4.064 m). The theoretical shaft power was calculated at 16.8 horse power (12.53 kW), and to supply this the wheel would have rotated at 8 RPM with a flow rate of 6,385 gallons per minute (483 litres per second).

The wheel transmitted its motion to the hoists in the 1806 and 1822 warehouses via gears and line shafts, in which the horizontal components remain in two tunnels. The length of the 1806 horizontal shaft is 7 feet 8¼ inches (2.34 m) while the 1822 shaft is 69 feet 5 inches (21.15 m), made up from seven sections joined with box (muff) couplings. It was found that this shaft could have been isolated from the wheel through the use of a claw coupling or dog clutch. An interpretation of part of the shaft system in the 1806 warehouse was possible. Slight traces of evidence are discernable, suggesting a vertical shaft ran from the main shaft driven by the wheel up to the fourth floor; and for a horizontal shaft that ran along that floor. At the end of this shaft our investigations suggest that the motion was finally transferred to the warehouse attic via a flat belt pulley.

The completion of the survey, drawings, documentary research and writing of the report did not mark the end of our interest in the Dale Street waterwheel. Although the 1806 warehouse (waterwheel, associated equipment) has a Grade II* listing, this does not necessarily guarantee continual survival. The next stage was to ensure that all relevant details were included on the Sites & Monuments Records held with the Greater Manchester Archaeology Unit. The ideal opportunity came about through the Index Record for Industrial Sites (IRIS) initiative as proposed by the AIA. Most of the significant features associated with the Rochdale Canal in the city centre and at Dale Street were surveyed by M.R.I.A.S. in 1994.

A close watch has to be kept on Dale Street Basin, as it is to become the site of the athletes' village for the 2002 Commonwealth Games. We can only hope that the wheel, the 1806 warehouse and the tunnel system will be restored as part of this multi-million pound development.

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