

Counting the cost of the 'free' bridge

AIA Bulletin 13/2 (the last one) carried a short piece on the testing-to-destruction of an 18th century masonry canal bridge near Shrewsbury and how it refused to concede defeat until a load of 215 tons had been applied. Coincidentally, and rather ironically in view of its close proximity to AIA headquarters at Ironbridge, the Jackfield 'free-bridge' only a few hundred yards from its distinguished neighbour, **the Iron bridge**, is beginning to show its age and a recently applied weight restriction is causing minor chaos, particularly to the administration of Ironbridge Gorge Museum coach excursions. **John Powell writes:**

The ability of the Iron Bridge to outlive its neighbours and rivals — something that it has been doing successfully since the Great Flood on the River Severn in 1795 — now seems certain to continue well into the next century.

The only real challenger for road traffic in the immediate vicinity was the bridge built about three-quarters of a mile downstream at Jackfield, which was opened in 1909 and allowed the Iron Bridge to be closed to road vehicles when it was found to be unsafe in the 1930s. Since it was the first bridge in the Ironbridge Gorge without a toll, this 1909 bridge was, and has been ever since, known as the Free Bridge. It was built by the Liverpool Hennebique Ferro-Concrete Contracting Company Limited, of Bootle, and is an early example of the use of concrete for bridge building. Deterioration in the structure is nothing new: indeed, it began when the bridge was less than thirty years old, but recent tests have resulted in an immediate reduction in the (frequently abused) weight limit of 10 tons down to 3 tons, plus an announcement that the bridge will be replaced (though listed) at an early date. Suggestions that a temporary Bailey Bridge be placed alongside, have been supplanted by a later announcement that this will go 'on top' of the 1909 bridge. The weight restriction has obvious implications for coach parties touring the various sites of the Ironbridge Gorge Museum, and any organisers of such trips should take this into account until the new bridge materialises.

Two miles upstream of the Iron Bridge is the steel girder road bridge at Buildwas. This was built in the first decade of this century (girders marked E C Keay of Birmingham 1905) and replaced the Thomas Telford iron bridge of 1796, itself built as a result of the Great Flood already referred to having destroyed the medieval bridge. Telford's bridge was replaced as a result of land movement, and it appears that this problem may have occurred again (the bridge is not far from the site of the huge landslip of the 1770s, known as the 'Madeley Earthquake'). Unconfirmed rumours suggest that the bridge will be replaced when the recently-approved Ironbridge By-pass is completed, since the by-pass will terminate on the north side of the bridge, and the route is an important outlet for lorries carrying limestone from quarries on Wenlock Edge.

Editorial comment: Obviously Jackfield bridge was not designed to be the strongest bridge in the world for on 19th June 1909, after it had been commissioned, the Wellington Journal reported that the official test load had consisted of a 14 ton steam roller which was in fact 2 tons heavier than had been calculated for. Nevertheless: this relatively early failure seems unusual in view of its ancestry for it was a Mouchel-Hennebique reinforced concrete structure built in an era when this named

combination virtually guaranteed it a long and prosperous existence.

Francois Hennebique, one of the more notable of the French ferro-concrete pioneers, always disapproved of extensive advertising of his system, preferring to rely upon completed works and satisfied customers. Early in his commercial life he established a chain of selected contractors who were chosen from among 'the most competent and confident in the country'¹ and he succeeded in creating an international network of contractors who were licenced to construct to his system and often trained in the parent organisation. Contract supervision was close and attentive and particularly during the first few years of his operation in Britain (1897 - 1909) workmanship was of the very highest quality.

Half a century later the **Building Research Station** and the **Cement and Concrete Association** investigated the durability of early reinforced concrete, which made it inevitable that they examined many Mouchel-Hennebique structures. Just one example was a factory built in Hull in 1900 and said to have 'stood normal and at time rough, usage with negligible maintenance for over 50 years . . . and was in remarkably good condition'.² Associated with this building was a reinforced concrete girder bridge of about 40 ft span over



Jackfield 'free bridge' today

a canal erected in 1902. In 1954 it was 'still carrying heavy industrial traffic without showing any signs of distress'.³

Of course there were failures and the study of defects, resulted in repair methods being evolved. Possibly the Jackfield bridge came in this category and maybe the repairs carried out did not completely rectify the faults which have since become more serious.

References: 1 *Francois Hennebique: The specialist organisation and the success of Ferro-concrete.* A paper read to the Newcomen Society by Dr Patricia Cusack on December 12th 1984. 2 *National Building Studies Special Report number 24* by Dr S B Hamilton, HMSO 1956. 3 *Ibid.*

Appointment of New Chief Executive for British Waterways Board which announces the appointment of Mr B C Dice, as Chief Executive with effect from 1st April 1986.

Mr Dice was formerly a Main Board Director of Cadbury Schweppes plc, having served in various senior capacities with that company since 1960.

South Eastern Region IA Conference. On Saturday 12 April, the fourth SERIAC was held, in Southampton, hosted by Southampton University Industrial Archaeology Group. The theme chosen was 'Sea and Ship', and about 140 delegates attended the meeting, from all over Southern England. The Chairman for the Conference was Maldwin Drummond, a notable

Hampshire figure, and seven papers were delivered — Southampton Docks . . . a History (Edwin Course), Shipbuilding in Victorian Southampton (Adrian Rance), IA of London's Dockland (Bob Carr), Historic Architecture of Portsmouth Dockyard, (Ray Riley), HMS Warrior (John Wells), The Art of Building Ships Down the Ages (James Paffett), The Development of Seaside Resorts (Pam Moore).

A programme of visits was organised for the following day, and the group toured Southampton Docks, Twyford Pumping Station, Portsmouth Dockyard, Southsea and Southwick Brewhouse Museum.

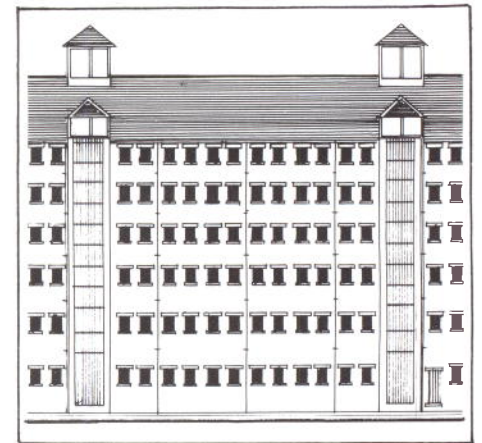
Next year's meeting, to be hosted by GLIAS, is on **Saturday 11 April** and will be taking the theme of Twentieth Century Industrial Archaeology. Further details from Dave Perrett, 33 St Margarets Road, Brockley, London SE4 1YL.

Pam Moore



Buildwas iron-bridge, c1905

Telford's Buildwas iron-bridge of 1796



Approval to convert **Llanthony Warehouse**, one of **Gloucester Docks'** historic warehouses, into the National Waterways Museum and offices has been given by the Secretary of State for the Environment. The opportunity to start work on this imaginative £3.5 million project marks another step forward in British Waterways Board's plans to redevelop Gloucester Dock.

The Museum will be extensive. It will occupy the lower three floors of the warehouse as well as traditional buildings recovered from canalside sites around the country and rebuilt on open space in front of the warehouse. These will house a 'living museum' where craftsmen can demonstrate typical skills, such as blacksmith, rope fender maker and canal art painter found around the waterways in former times. The Museum site is bounded on two sides by water where floating exhibits will be moored. Ample car and coach parking space will be provided for visitors.

The upper floors of the warehouse will be converted to offices, two of which will accommodate the Board's staff based in Gloucester and the further floor will be available for lease on the open market.

The Board have formed the National Waterways Museum Trust to establish and run the Museum with the aim of providing visitors with an accurate record of the development of waterways and their part in Britain's heritage. The Trust will enable all interested parties to support and fund the Museum and associated archives. In the early years the operation and marketing of the Museum will be organised by the Board under the direction of the Trust but it is planned that the Trust should become fully independent of the Board in later years.



Cob and Pise de Terre. To those who live in Devon or visit the county, cob is a familiar material for it has been used down the centuries for the construction of very many domestic and agricultural buildings over a wide area.

Cob houses of the Elizabethan period are not uncommon and walls of this material remain in good condition for long periods provided they have dry foundations and a good protecting roof. Hence the old Devon saying 'Giv' un a gude hat and pair of butes an' er'l last for ever'. Early examples which support this statement include, among many others, Lewishill at Dunsford dating from the latter part of the sixteenth century and Hayes Barton at East Budleigh, where Sir Walter Raleigh was born.

The slightly wavy surfaces of rough rendered cob walls and the soft contours at angles and changes of direction are characteristic of most domestic and agricultural buildings in this material but it has been used also for more formal buildings and there are large 'Georgian' and 'Victorian' houses in both the rural areas of the county and the smaller towns where a thicker ruled and trowelled rendering with precise angles hides walls constructed of cob.

Historically, there have been few brickworks in Devon and stone suitable for building occurs in only a few areas. The soil of Devon, however, as in many parts of Wessex and in Wales, is well suited to the formation of cob and this allowed the old Devonian countryman in need of a house to build it himself from materials readily to hand.

Cob is a mixture of shale and clay, straw and water, though the relative proportions of the first two ingredients varies depending on their individual peculiarities and heather was sometimes used in place of straw. As with so many country crafts, the variations of local custom arose from sound practical experience in the use of the available materials. Shale, or shillet, is a stratified formation of a slaty nature which is common throughout the area and most types of clay soil found in Devon are suitable for cob making. Some years ago a sample of typical old cob walling was analysed and found to contain:

Stones (residue on 7x7 mesh sieve)	24.40 per cent
Coarse sand (residue on 50x50 mesh sieve)	19.70 per cent
Fine sand (through a 50x50 mesh sieve)	32.50 per cent
Clay	20.60 per cent
Straw	1.25 per cent
Water etc	1.55 per cent
	100.00 per cent

It is significant that, when placed in water, this sample quickly fell to pieces.

The old method of mixing was to place the shale and clay in a heap about 6 ft in diameter, four men usually working together. Two men, each with a 'cob pick' (a tool like a small iron fork with a wooden handle about 4 ft long) turned over the material, standing on and treading it all the time, whilst the remaining pair sprinkled on water and barley straw. The material was then turned over again in the other direction, treading continuing until all the ingredients were well combined. 'Twice turning' was usually considered sufficient. There is some evidence to suggest that in early times the mixture was trodden together by oxen.

The depth of foundation required for a cob wall naturally depended on the character of the site as also did the spread of the footings, if any.

The bottom of a cob wall is its most vulnerable part, exposed as it is to driven rain, back splash and casual impact and it is there that deterioration often begins. A base wall of brick or stone is very desirable and this should be carried up about 2 ft above the surrounding ground level and finished with a damp course, preferably of slates in cement, off which the cob construction is started, though damp courses were not used in many buildings. In fact the base of many old walls is of cob and not masonry and the traditional method is to provide a deep skirting of pitch or tar, or a mixture of both, applied to the rendering that should completely cover the exterior of all cob work.

The thickness of cob walls can be anything from 18 in, which might be found in single-storey buildings, up to 3 ft, though an average width for a two-storey cottage would be about 2 ft. The first floor walls are generally the same thickness as those below because if they were reduced in width the extra weight thrown to one side of the ground floor walls would tend to make them bulge unless quite dry and thoroughly set.

In building, a man would stand on the low base wall and lay the material handed up to him on the cob pick, thoroughly treading it into position and using his heels to ensure compaction. The courses were often about 2 ft high and the cob was laid and trodden in diagonal layers to achieve proper bonding. The construction period was usually from March to September and each course took two or three weeks to dry. Internal plastering and fitting could be done in the winter but a year, or even two years, had to be allowed before the walls were dry enough for external rendering and so building in cob was a lengthy business. The material was rarely laid between any form of shuttering as the boards would have delayed the drying-out process. The usual method was to allow the material to project beyond the base wall an inch or two on each side. At the completion of each course the corners were plumbed up from the base wall, a line was stretched through and the wall was then pared down plumb with the 'paring iron' (a flat iron blade about 8½ in wide attached to a straight wooden handle about 6 ft long) by a man standing on the wall.

The external rendering was usually composed of lime and hair mortar, either 'rough rendered' or of 'slap dash' and was finished with lime whitening. A better mix for modern repairs is cement, lime and sand in the proportions 1:1:6 and the finish given in these days is often of emulsion paint.

'Pise de terre' is merely the French for rammed earth. Pise is the very simple manual operation of compressing earth in moulds or cases and was introduced into France by the Romans and used for centuries in the construction of walls, mainly in the province of Lyons.

Pise is essentially different from cob in that one ingredient only, earth, is used dry, always between moulds or shutters, and adhesion is achieved by ramming to unite the particles together and thus encourage the natural attraction which is also a characteristic of the particle formation of stones. Cob, on the other hand, might be regarded as a kind of mud or clay concrete reinforced with straw. One is dry and the other a wet construction.

Traditionally, walls of pise de terre were built off masonry base walls rising about 2 ft above ground and 18 in thick. Open-ended timber box shutters about 10 ft long and 2 ft 9 in high were placed thereon and were

filled with soil in layers three to four inches deep spread by the men's feet and then well beaten and compressed with the rammer before further soil was added. When the shuttering was filled a section of wall about 9 ft long and 2 ft 6 in high had been completed and the shutter box was then taken to pieces and reassembled to form the next length until the first course was completed. The next course then proceeded in the opposite direction, vertical joints of alternate courses being staggered or bonded. The rammer or 'pisoir' was generally of hardwood, square in section where adjoining the long wooden handle but with curved sides tapering to a point. Repeated strokes of this tool forced out the superfluous water and consolidated the earth, which was a loamy or gravelly soil from which all vegetable material had been removed.

On completion walls were indented with a hammer or an axe to form a key and rough-cast rendered externally with a lime and sand mortar, a new coating being added perhaps every 12 or 15 years.

Both cob and pise de terre are perfectly practicable forms of walling today and no doubt could easily achieve the thermal insulation levels required by current building regulations. Though the cost of the materials would be minimal, present labour rates would almost certainly make these forms of construction uneconomic, however, even if 'building operatives' prepared to use such unsophisticated substances could be found.

James Rowe

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Boulton & Watt Rotative Steam Engine in Australia. The engine is reputed to be the oldest surviving rotative engine in the world. Its creation marked a turning point in the industrial revolution because it allowed the application of steam power to all kinds of machinery, thereby making power available on a scale previously unknown.

It was designed by James Watt and built by Boulton & Watt in 1785 and initially installed in Samuel Whitbread's brewery in London to drive the malt crushing mill.

It quickly became one of the sights of the capital, and its fame reached even the Court. On May 14, 1797, King George III with Queen Charlotte and their four children visited the brewery and inspected the 'wondrous works to be seen there' — this engine foremost amongst them.

The Whitbread engine itself was of special significance as a prototype of rotative steam power. Once installed it was so successful that shortly after, other London brewers were eager to follow suit. Boulton & Watt were deluged with orders for 'an engine like Mr Whitbread's and by 1796 eleven others were at work.

This engine features all the main inventions in steam engine technology for which James Watt is famous, including the separate condenser, sun and planet gear and double acting engine, parallel motion and the centrifugal governor.

How the Engine Came to Sydney. In 1887, the engine was dismantled to make room for a more powerful one. The engineer in charge of the work at Whitbread's happened to be a friend of Archibald Liveridge, a Trustee of the Museum of Applied Arts and Sciences who in turn happened to be in London at the time.