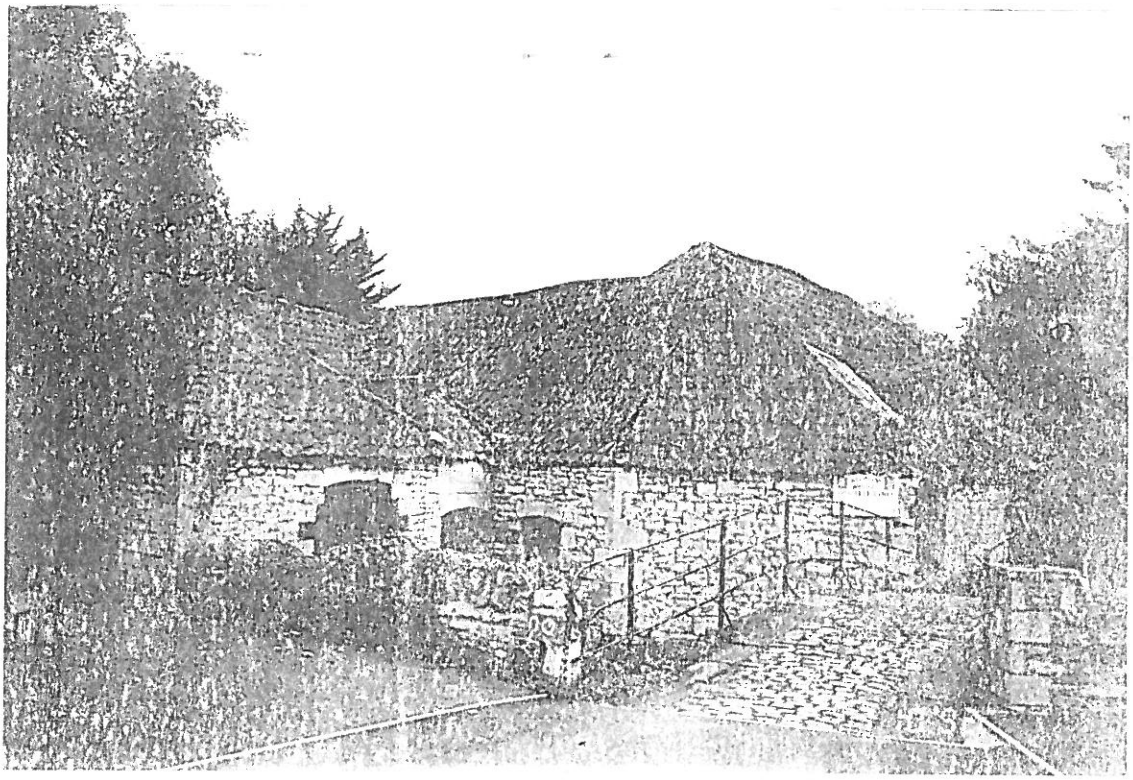
SALTFORD BRASS BATTERY MILL

SALTFORD

AVON



A CONSULTATIVE REPORT

December 1992

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The City of Hereford Archaeology Committee was founded in 1974 and is a registered charity. It operates through the City of Hereford Archaeology Unit, which has a permanent staff of eight people. Besides dealing with the buried archaeology of Hereford - an important Saxon city dating back to the seventh century - the Unit has specialised in recent years in the archaeological recording and analysis of standing buildings. This work has usually been on a commission basis on behalf of English Heritage or developers and the Unit now has considerable experience in this field.

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SALTFORD
AVON
NGR: ST 687 670

A Consultative Report

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December 1992
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1. Introduction

The Saltford Brass Battery Mill, situated on the river Avon below Saltford weir a few miles downstream of Bath, is the best preserved remnant of a once flourishing local industry. Because of its regional and national importance it was scheduled as an ancient monument on the 27th February 1986 (Avon 185). The main buildings are listed Grade II.

The history of the site has been exhaustively researched by Mrs Joan Day, the recognised authority on the Bristol region's brass-making industry. There have been several detailed surveys of the buildings on the site as well as some small-scale excavations within them. As yet, there has not been a structural analysis of the building fabric to assign dates and phases to the multitude of alterations carried out over the past 250 years.

At present, the brass mill is in a deteriorating state, apart from the annealing furnace area recently restored by the lessees of most of the site, the Avon Industrial Buildings Trust. Decisions are now being made as to its future management and a comprehensive report on the various options was produced in 1990 by the Ironbridge Institute, Shropshire. One of the key elements in any long-term strategy for the mill is a full interpretation and understanding of the fabric. In the first instance English Heritage commissioned the City of Hereford Archaeology Unit was commissioned to carry out preliminary work on identifying key sections of the structure, co-operate with the architects, Niall Phillips, appointed to ensure that the buildings were made safe, assess the work carried out to date, and make recommendations for further work.

2. Outline History

2.1 Brass Making in the Bristol Region

Brass, an alloy of copper and zinc, was known in classical times and by the early 13th century monumental brasses were appearing in English churches (le Strange, 1972, 7). The brass sheet for this purpose was imported from the Cologne area of Germany, which is why it was known as *cullen* (Goodall, 1981, 63). Other brass goods, including fine tableware, were imported from Dinant, on the Meuse (*ibid.*). Whilst this imported brass would have been worked by English craftsmen, there is little or no evidence of any brass production in Britain until the late-17th century - despite all the necessary raw materials being available and despite govermental attempts to develop a domestic brassmaking industry.

In the reign of Elizabeth I two monopoly companies were created. The Society of Mines Royal's remit was to produce refined copper, and the Society of Mineral & Battery Works, was to produce brass; although the latter company did find calamine (zinc oxide, Zn O3) in the Mendips in the late 16th century, they failed to produce workable brass (Day, 1984, 32). Both companies seem to have been fairly indolent thereafter and once their monopolies were effectively removed in 1684 the indigenous brassmaking industry at last began to develop; in 1693 a London merchant was granted a patent for casting brass thimbles (Murphy, 1973, 249; Alexander & Street, 1964, 184).

In 1702 Abraham Darby was involved in setting up one of the first brass mills in the Bristol area, combining Cornish copper with calamine from the 'gruffy ground' of the Mendips, probably using German advisors (Cossons, 1987, 144; Day, 1984, 33). The local availability of calamine, the ease by which Cornish copper could be transported up the Bristol Channel and into the navigable reaches of the Avon, and the availability of water power provided the important stimuli for the local brass industry. For the rest of the 18th century the Bristol region was the main brassmaking area in Britain and many brass-processing works were established along the banks of the Avon and its tributaries between Bristol and Bath, mainly by the Bristol Brass Company.

The brass was generally cast into heavy plates that could then be beaten by a variety of water-powered hammers into thinner sheets. The need for water-power led to the creation of purpose-built works on the Avon and tributaries being established upstream from the main smelting works. The sets of hammers were known as *batteries* - hence the term *battery mill.* The thin sheets could then be treated in two ways - to make wire or hollow-ware. Brass wire cut from the sheets could be used in a variety of ways. The wire could be used in the mesh of the frames or '*deckles*' in paper manufacture, and the northern slopes of the Mendips were an important paper producing area; the Wookey Hole Mill near Wells dates back to at least 1610. Wire was also important in the carding machines of the local woollen industry, and was also used to make brass pins. Hollow-ware was created by working the reduced sheets with specially shaped water-driven helve-shaft hammers that literally hollowed them out into a variety of pots and pans of all shapes and sizes for domestic and industrial use.

By the middle of the 18th century the use of hammers to reduce the cast brass plates was gradually being replaced by water-powered rollers, although hammers were still used in the production of hollow-ware. The other main technological change that took place was in the design of the annealing furnaces so vital in the brass making process. The effect of the hammering and rolling distorted the crystalline structure of the metal and made the brass brittle; this could only be rectifying by frequently re-heating the work to soften it and normalise it. The annealing furnaces were originally fueled with charcoal but early in the 18th century attempts were being made to use local coal instead, just as Abraham Darby, newly arrived at Coalbrookdale, was experimenting with coal fuel to smelt iron.

The impurities in coal needed to be kept away from the brass in the furnaces, leading to a variety of innovative designs. Nehemiah Champion, of the Bristol company, patented '*A New Way of Nealing the Plates and Kettles with Pitt Coale*' in 1723, protecting the work in cast-iron containers within the furnace (Day, 1979, 33). Between 1764-68 Nehemiah's son, William, established his own brass battery mill at Kelston, not far from Saltford and developed a more sophisticated furnace (Day, 1979, 34). The work was placed in a separate central area within the furnace, protected from the furnaces gasses which were restricted to flues in the side walls and over the roof of the furnace itself. The use of this muffle furnace meant that the work did not have to be placed in containers, and the whole brassmaking process could be much simpler and more efficient.

Despite his innovations in brassmaking and in the production of metallic zinc, William Champion was declared bankrupt in 1769 and his works were all taken over by the old Bristol Company; it may have been shortly after this time that the surviving annealing furnace at Saltford was built to the basic design of the ones at Kelston (Day, 1979, 35). By the end of the 18th century the local brass industry was in marked decline and smelting of the alloy seems to have stopped by about 1800. Birmingham had become the centre of the brassmaking industry in Britain, although it lingered on in the Bristol area until the start of the 20th century.

2.1.01 Other Surviving Structures in the Area

Considering the importance of the Bristol brassmaking industry there are fairly few obvious reminders of it. Little or nothing survives in Bristol itself of any importance. At Warmley, to the east of the city, is a complicated site occupied by William Champion between 1746 and 1769, and afterwards by the Bristol company itself, which gradually ran the site down. Copper, brass, and most significantly of all, metallic zinc, were all processed on this large site and the remains include Champion's fine Palladian house, the tower of a windmill thought to have powered ore crushers, a small engine house, a variety of ruined industrial buildings later converted into garden follies, and a massive statue of Neptune - once standing on an island in the middle of a man-made lake but now surrounded by caravans.

At the next weir downstream from Saltford, at the end of a narrow lane, a pair of well-preserved annealing furnaces stand on private land and mark the site of the Kelston brass mill. These furnaces were probably the prototypes of the new type of furnace being developed by Champion, but have none of their internal structure remaining. Further downstream still, a long and low disused range of copper slag blocks and covered by a pantiled roof stands near a former office block; these belonged to the Keynsham brass mills. There appear to be no other significant brass-working remains in the area, which is why the virtually intact buildings at Saltford are so important - a fact recognised by the Inspector at the 1986 Public Inquiry. The annealing furnace at Saltford is probably the only one of its type, surviving almost intact, in Europe.

2.2 Saltford Brass Mill

The Saltford site was leased by the Bristol Brass company in 1721. The weir diverting river water into the mill leat may have been on the site of a much older weir, possibly powering a fulling mill on the site, but had almost certainly been recently rebuilt as part of the extension of the Avon navigation upstream to Bath. Saltford initially processed cast plates of brass brought upstream by barge from Bristol, exporting the thinner reduced sheets back in the opposite direction. The tilt hammers used in the battery process were replaced by rollers later in the 18th century, but hollow-ware continued to be produced by battery hammers for the rest of the mill's lifetime.

The most significant alteration in the brassmaking process at Saltford would have been the introduction of the new coal-fired annealing furnaces. Given that the type was only developed by William Champion in the 1760's, the furnace must be slightly later and, therefore, would not have been an original feature of the mill. The local coal presumably arrived at Saltford on river barges.

An inventory taken in 1830 listed a rolling mill powered by two waterwheels (upper and lower rolls being powered by separate axles), and two battery mills, each powered by a single waterwheel and each of three hammers (Day, 1979, 32). A naive engraving in the masonry of one of the ruined annealing furnaces states '*Begun Digging the Rail Road June 11 1836*', this being the Bristol-Bath section of the Great Western Railway running on an embankment immediately to the west of the site. By 1855 the mill was described as being very old and in a decaying state and was up for sale in 1862 when a Sales Catalogue listed the four annealing furnaces for the first time (Day, 1979, 32).

Saltford mill continued to work brass until the early 20th century. The last battery hammers were stopped in 1908 but rolling continued until 1925, by which time only the surviving annealing furnace was still capable of being used (Day, 1979, 36). After the mill closed, a bungalow was built on part of the site, the annealing furnace was adapted to serve as a wine cellar, a full-size squash court was inserted into the main building, and the one working waterwheel was adapted to power an electricity generator (Day, 1979, 36).

In more recent years the fabric has deteriorated rapidly, and the squash court, wine cellar and generator have all become disused. By the 1960's the importance of the industrial heritage was becoming more and more recognised both locally and nationally and by the start of the 1970's the condition of the brassworks at Saltford was beginning to cause concern. In 1977 Mr Taylor bought the site; then, in 1981, the new Avon Industrial Buildings Trust leased the main complex for 99 years at an annual rent of 5p. The eastern part of the site was then leased back to Mr Taylor's company, Downend Leisure Ltd. Between 1986 and 1987 Mr Taylor built a new bungalow on this part of the site. The mill buildings are still in a deteriorating state, but there are now plans to ensure that some renovation work will be carried out.

3. The Site and its Buildings: An Outline Description

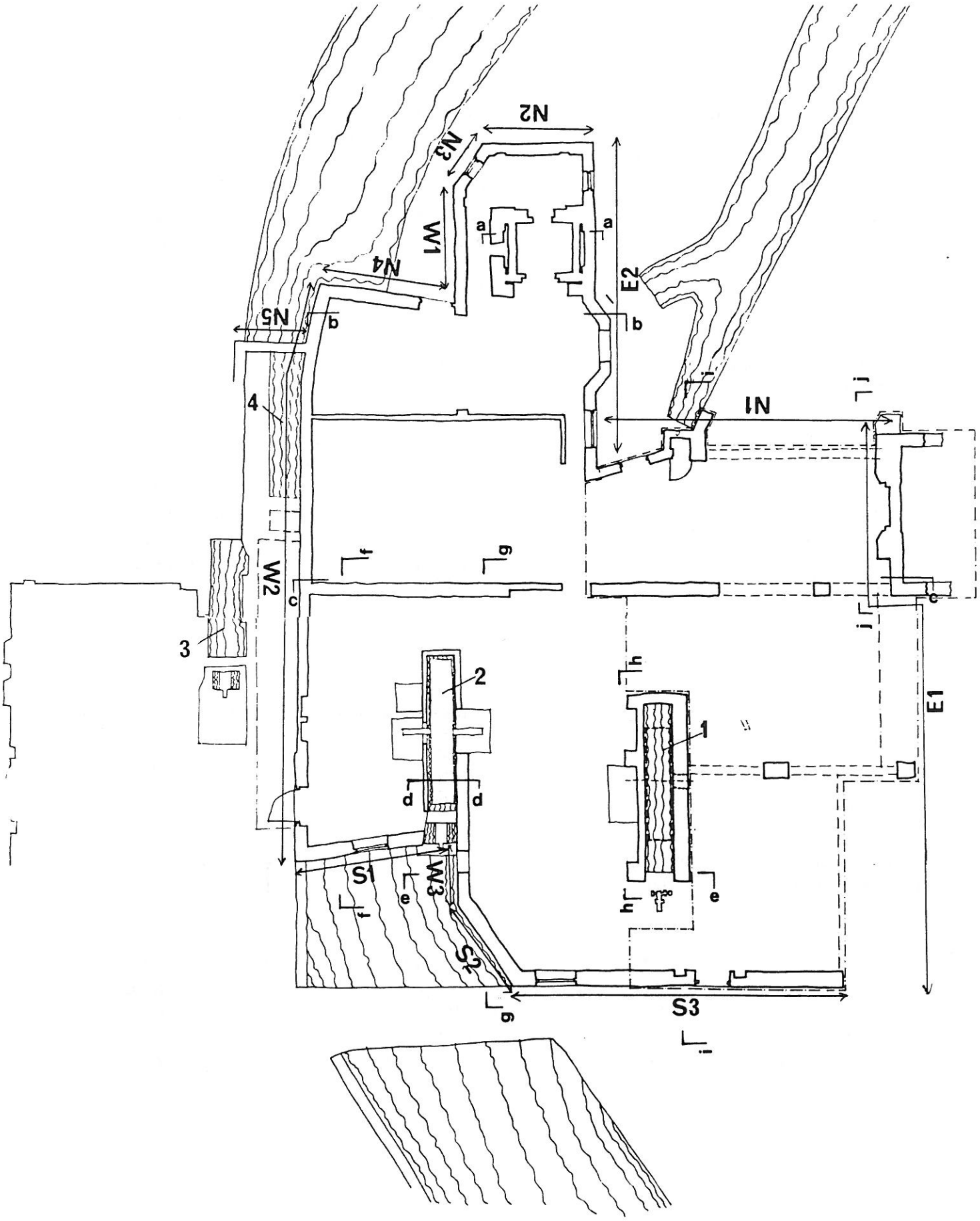
It was not part of the Unit's brief to provide a detailed analysis of the fabric, and indeed, to do so properly would take a great deal of time and need a considerable amount of new survey work. It would also need long ladders, scaffold towers, and portable lighting. Nevertheless, a fairly cursory examination of the fabric clearly indicates that the mill has had a very complex structural development - a fact that is not surprising in an industrial context in which the industrial processes were always changing. Just one elevation was surveyed, in outline, and assessed; this information was then used to check the accuracy of the existing survey drawings. The basic analysis of this elevation clearly shows just how much structural evidence there is in the fabric that needs to be examined in greater depth than can be achieved through an architectural survey - and demonstrates the innate complexity of the site.

The area around the surviving annealing furnace was not considered in any great detail, simply because of the amount of work on its interpretation that has already been carried out by the AIBT and Mrs Day, and because much of it has been restored. However, even so, there were some intriguing features that would need clarification. For example, the window in the north-west angle of the lean-to around the furnace was originally a door; there appear to be beam slots in the west run of the lean-to that could be associated with a gantry to allow the dampers in the kiln itself to be reached more easily; the way in which the west end of the pivot for the balance beam operating the furnace door is most unusual; and the peculiar cast-iron lintel over the bay window in the east wall is clearly re-used and looks to have been part of a large machine.

3.1 Location

Most of the surviving buildings are situated on the island formed between the Avon and the mill race from the weir. This is, not surprisingly, called Mill Island. Immediately to the west of the leat is a narrow lane called The Shallows, and some of the brassmaking buildings are known to have been sited off the island between the leat and the lane, connected to the main site by a bridge that also provides the only access to the island. On the opposite side of the lane to the entrance to the mill is a gabled rubblestone house that appears to be of some antiquity - certainly older than the present buildings and probably of 17th century date. It is not at all clear if this had any connection with any earlier mill on the site - as a miller's house, for example.

At some distance from the main buildings, and close to the weir, is the now isolated grindstone wheel house, and next to the weir is an escape sluice by which stands an amorphous bit of walling incorporating copper slag blocks. It seems quite obvious that all these features were once associated with the brassworks, but for some reason they have seldom been included in the overall plans for the site or in its statutory protection.



SALTFORD BRASS BATTERY: Plan of Main Complex with Identification of Elevations & Cross-Sections

3.2 The Buildings

3.2.01 The Masonry

The main block of interconnected single-storey buildings is built mainly of the local rubblestone, roughly coursed, with fairly rough ashlar quoins. There is a section of better quality of worked and coursed masonry in the west wall of the complex next to wheelpit No.4, but this cannot be seen internally because of the brick and concrete lining to the squash court. To the south on this same elevation is a large section of wall made up of squared copper slag, and clearly inserted; other blocks of slag have also been used in parts of the southern section - for example as blocks in window or door jambs.

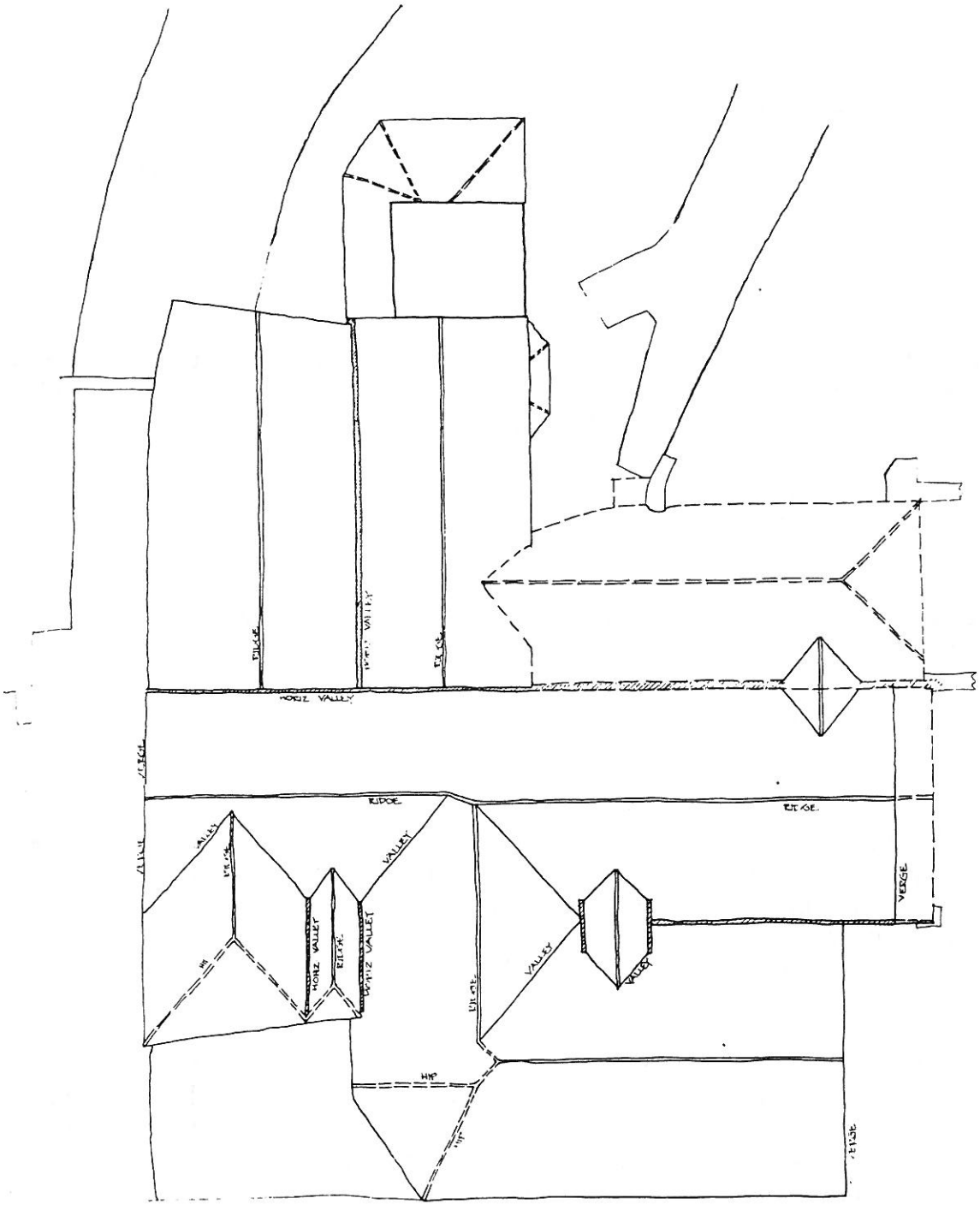
Most of the primary window and door openings have segmental heads. Those in the south elevations are of ashlar blocks. In the northern portion, the heads are of brick. The surviving frames of both windows and doors in these openings have segmental lintels to their frames, properly mortised, tenoned, and pegged; they appear, however, to be 19th century in date rather than any earlier. As an identical doorframe also exists in the south elevation in a doorway with an ashlar head, it is suggested that there must have been some general refurbishment of the site in the mid-19th century.

There is no direct connection in the masonry between the southern portion and the area around the surviving annealing kiln. The construction breaks in the west wall have already been mentioned, and none of the north-west cross-walls link the two sections. The difference in the style between the heads of openings in these two areas seems to suggest different build dates; the southern portion is considered to be the older of the two.

Similarly, there is some evidence to indicate that the surviving annealing furnace and the masonry passage around its west and north sides are not necessarily contemporary - there being an oddity in the masonry on the north-east corner. However, this does not necessarily mean that the two sections of masonry are not of the same phase - as it would have been structurally quite logical to build the furnace as a separate feature and then butt the other wall up against it.

There was clearly a need within the complex for large areas of open floor and for easy access throughout. The need to lay out the brass being worked to allow it to cool after being in the furnaces probably accounts for the need for floor space. The need for the work to be taken several times from the hammers or rollers to the furnaces probably accounts for the need to have easy access within what was a fairly constricted site. However, this has meant that there are few internal walls that can provide clues as to the changes in the internal layouts.

Both wheelpits inside the complex, Nos.1 and 2, are protected by tall, covered masonry chambers but these appear to both be of two periods - a single rubblestone wall, with a second wall of ashlar subsequently added on the opposite side of the waterwheel and in the return on the downstream side of the chamber. It is possible that the waterwheels



SALTFORD BRASS BATTERY: Roof Outline Plan

were initially unprotected. In the case of wheelpit No.2 the ashlar continues round to meet the earlier rubblestone. The ashlar of this pit is integral to that of the segmental-headed opening in the south wall which, in turn, appears to be an insert. In the grindstone wheelhouse the waterwheel is also protected by an ashlar screen, but in that case this appears to be contemporary with the rubblestone of the outer walls of the buildings. However, the interior was not examined during the course of this project. The ashlar presumably comes from the Combe Down quarries near Bath and arrived at Saltford by barge.

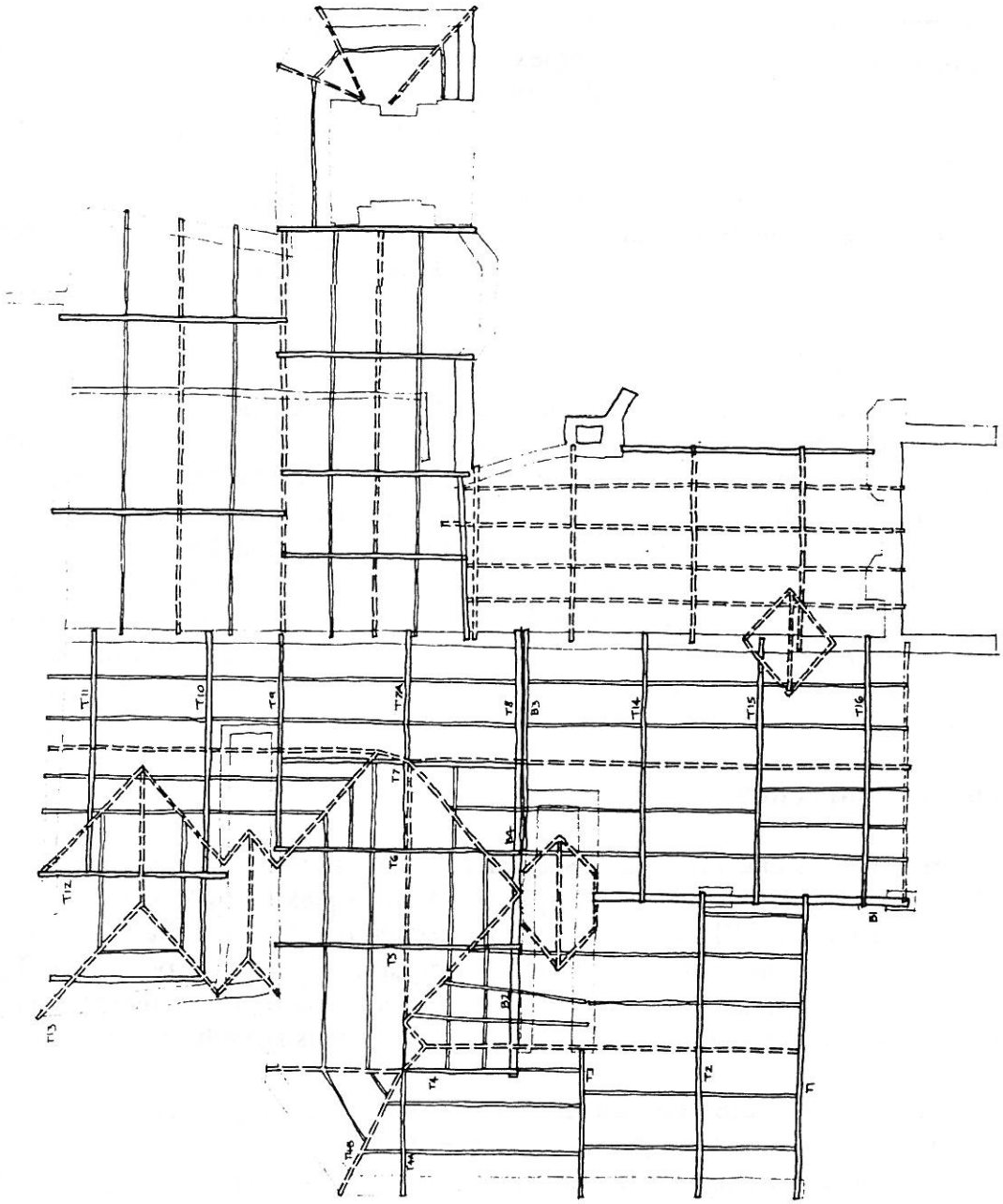
One of the many intriguing elements of the mill's structural past is a possible ghost wall line running west-east through the complex. In the eastern part of the mill this line is quite clear, and is marked by the valley-plate between the two southern roofs in this section. This valley is now carried on a pier and on a peculiar ashlar bracket inserted into the rubblestone east wall of wheelpit No.1. Immediately to the north of this there is a vertical construction break in the rubblestone masonry. This portion of masonry is the only section of internal walling that is as tall as the roof apex. Given the need for good access all round, and the way in which the roof structure has developed, such a wall is somewhat out of place.

Further west, the rubblestone of the east wall of wheelpit No.2 ends more or less on the same line - just south of the axle. Further west still, the external wall returns from the south for a short distance in the west elevation but stops on the ghost line; the continuation of this elevation in copper slag blocks butts against the rubblestone and is clearly secondary. There is also clear evidence that the rubblestone turned again on the ghost line past the sluice of wheelpit No.3 and towards the ruined annealing furnace by the road. This section is now reduced to footings, but appears to be primary to the rest of the southern elevation. It would exceedingly useful to know how the subterranean watercourses tie in with this ghost line. It is, of course, possible that all this is pure coincidence, but only closer study will demonstrate.

3.2.02 The Roof Structure

The roofs are all wide and high - and secondary. The roofs in the northern portion are both 20th century in date. The double-pile over the squash court area has its shared valley supported by an RSJ; this seems to be contemporary with the insertion of the squash court itself and the roof is therefore of comparatively little importance. The roof structure associated with the restored annealing furnace was replaced recently as part of the restoration work, copying the designs of the roof that was already in place.

The collapsed roof structure between the squash court and the pair of ruined annealing furnaces to the east is shown on plans and isometric drawn before its recent collapse as continuing eastwards past the front wall of the southern furnace. Clearly, this furnace could not have operated when the roof was in this position, demonstrating that the roof is secondary. However, when this roof was *in situ* it helped to support a balance beam that in turn opened the fire-door of the furnace - suggesting that the furnace was then in use.



SALTFORD BRASS BATTERY: Roof Structure Plan of Main Complex, with Truss Identification

The similarity of the carpentry of truss types A and B, and the fact that they share a common valley plate, seems to indicate that they are contemporary - but as the Type A trusses are secondary to the south wall masonry, both roof structures are therefore secondary. The fact that the Type B trusses are made of re-used material, but re-used from a similar type of truss, is one that needs to be investigated.

Running at right-angles to these two roofs at their western ends is another king-post roof, but all the trusses have been considerably altered. The alterations to them appear, however, to have taken place when they were already *in situ*. The basic truss design seems to have been fairly similar to the Type A type of truss, though narrower, although only two of the trusses have retained the bottom section of their king-posts. The principals are not re-used in the truss construction (unlike the Type B's), but the mortise in the tie to take the post's foot tenon are through mortises that would have been wedged (unlike the Type A's). One of the complete king-posts is diminished above the brace junctions, the other is not. For sake of convenience, these have been designated Type C trusses. The main alterations have been carried out to re-inforce the tie-beams and, at the northern end of the structure, to create some type of support gantry presumably associated with machinery. The quality of the carpentry of these major alterations is far better than the roof itself, and the scantling of the machine-cut timbers very thick. The fact that the eastern wall-plate of this structure appears to be of the same type of timber as the repairs, and is supported on secondary pilasters next to the ashlar masonry of the adjacent wheelpit (for Wheel No.1), indicates a considerable rebuild of the roof in this area.

To the west of the Type C truss roof and parallel to it is another roof structure with a single king-post truss (labelled T12). Its tie-beam is clearly a re-used part of a window - ovolo moulded and originally of three lights. However, the basic design is similar to the other king-post trusses, and it once had a single pair of braces from post to principals. The foot of the king-post is tenoned into a through mortise and wedged. For sake of convenience, this can be called a Type D truss. It has had to be strengthened and the roof structure in this area has been altered and repaired frequently.

The remaining major portion of earlier roof structure partially envelops the north end of the roof of Type C trusses and continues the line of the Type B roof westwards to the west wall of the mill. Two of the trusses are very simple 'A' frames without tie-beams (Type E), whilst one is a mutilated king-post truss that looks similar to the Type B's. The westernmost truss is very close to the west wall, suggesting a continuation of the roof westwards before the copper slag infill was built below. According to pre-collapse surveys, this rather poor-quality truss type was also used in the missing section of roof to the north of the Type B roof structure.

If the repaired king-post trusses in the annealing furnace area are accurate replicas of the trusses that they replaced, then the style of truss is again slightly different. The scantling is certainly much thinner and the post-tie joint is strengthened by an iron stirrup, and there are also upstands to support a clerestory roof - presumably to enable better ventilation in this area in front of the furnace.

A great deal of effort had been put into this structure, including the creation of a mini-gabled roof to the south housing the south end of the beam pivot. This paradox may be explained by a later extension to the roof over the furnace once it had become disused, but this would need further investigation. Its 'A'-frame construction is similar to another section of roofing in the western part of the complex.

All the roofs are covered with pantiles, all apparently of the same basic pattern. Despite generally being considered to belong to the eastern counties, it is quite clear that in the Avon valley they were very common and, indeed, still survive in a debased, machine-made form today. Similar pantiles can be seen on the surviving portion of Keynsham brassworks, for example. The glass pantiles in the roof over the squash court are taken to be fairly modern, as, clearly, is the fake glass skylight in the west slope of the south-western roof structure - made of fibreglass (GRP) actually moulded on a section of pantiled roof, removed, and placed in position in the sky-light.

There are, in the complex roof structure, at least five basic types of truss - excluding the 20th century trusses over the squash court area and the rebuilt trusses by the annealing furnace. All bar one type of these trusses are variations of king-posts. The truss designation below is also used in a simplistic way to identify the various different roofs.

The Type A trusses (labelled T1 and T2 on the plans) are the only ones that appear to have been little altered. They are simple king-post trusses with tie-beam, king-post diminishing and tapered above the junctions of the single pair of braces, flared post-head, and principal rafters supporting two pairs of interrupted purlins. The feet of the king-posts are tenoned into a housed mortise in the tie. The same basic style of carpentry, and of carpentry marks, exists in the half-truss to the west, T3, indicating that this is contemporary with the rest of this section of roof. The roof itself respects the later phase of the south elevation (S3), indicating that it is secondary to the earlier masonry. There are no wall-plates.

Parallel to the roof with Type A trusses, and immediately to the north, is a roof with what at first sight appear to be very similar king-post trusses. These are, however, very different. The Type B trusses (T14, T15 and T16; T8 seems to be a much-altered truss of the same basic type) are of the same superficial type as the Type A's, with tie, king-post, single pair of braces, and principals taking two pairs of interrupted purlins. It is clear that the various elements are re-used. The posts do not go with the principal rafters. These once were associated with a king-post structure that had two pairs of braces, and the unused mortises to take those braces can be seen in the soffits of the principals. There are no answering mortises in the king-post. The principals also once took three pairs of purlins, the empty mortises of which are also visible. The housing of the foot tenon of the king-post is also different to the Type A's in that the mortise is a through mortise - the tenon being then held in place by a timber wedge. The head of the king-post is also different, and takes a small scantling ridge-piece. All in all, it is quite clear that these trusses are made of re-used material.

Minor roof structures include a raised section of gabled roof in the valley between the Type C and D roofs, allowing room for the waterwheel below. This mini-roof appears to be contemporary with the slopes on either side of it, but the waterwheel, if not the wheelpit, is almost certainly secondary - adding further evidence for the roof structure being so as well. Both wheelpits inside the building had their own roof covering to reduce the effect of water-splash off the wheels.

There were various lean-to linking roofs with no proper trusses joining the main sections of roof, and also a rather odd cross-gable between the Type B roof and the missing roof to the north, housing the end of the cantilevered beam operating the door the ruined annealing furnace nearby. This in itself is rather curious; the style of the carpentry in the housing for the beam is the same as that used in the modification of the Type C trusses, suggesting a fairly late date. However, the roof itself is shown on pre-collapse surveys to continue over the front wall of the furnace and to end in a simple truss. This would surely have made the furnace unusable. There seems to be no other purpose in the balanced beam other than to open a heavy furnace door - as was the case in the restored furnace. Unless the eastern portion of the roof over the furnace was a later addition, there seems no logical explanation for this feature.

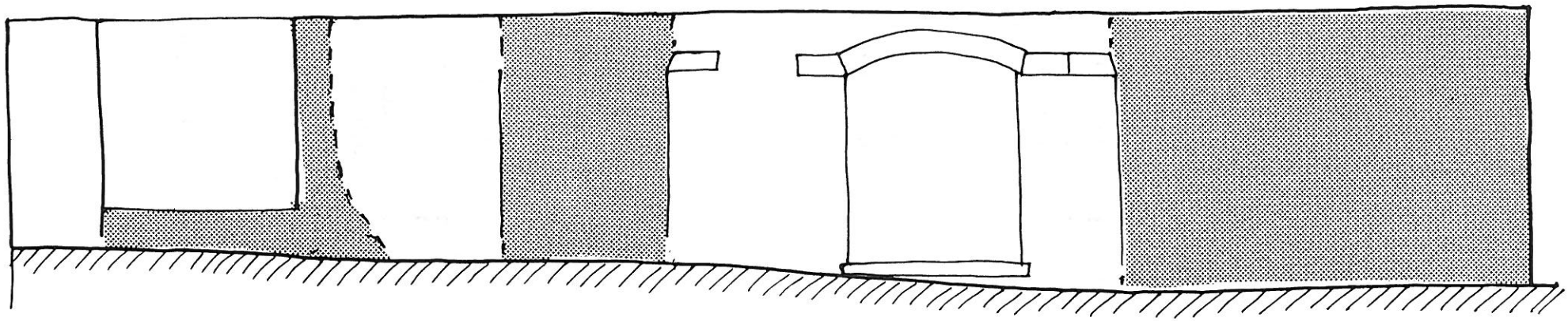
The roof structure has clearly been subject to considerable amounts of repair and alterations over the years. It is suggested that the king-post trusses are earlier than the 'A' frame type, and that most of the changes made to the king-posts was carried out after they were in place.

3.2.03 Analysis of the South Elevation

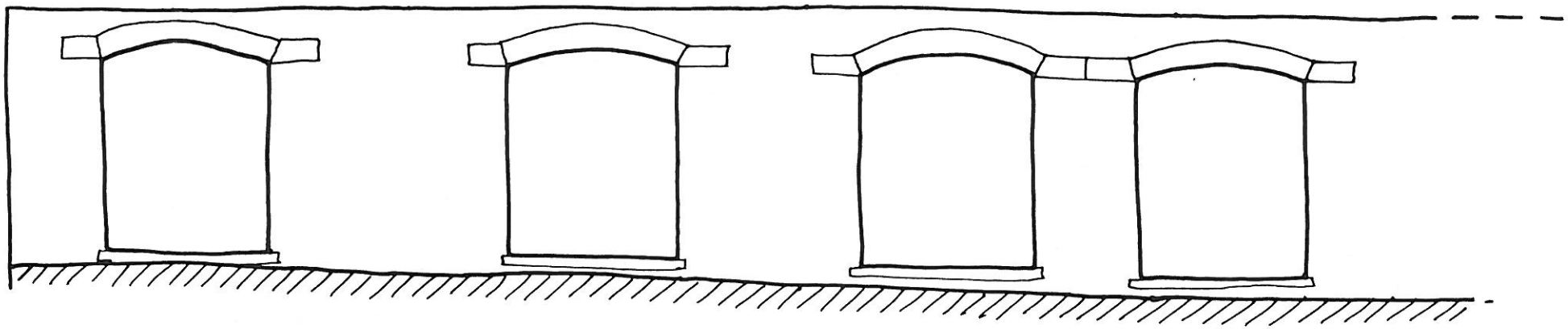
To demonstrate the complexity of the mill, a small section of the south elevation (S3) was measured and analysed. The measurements of part of this elevation were also used as a check against which to measure the existing survey drawings. It is immediately apparent that there are a series of construction breaks in the fabric and that there are, therefore, at least two phases of masonry.

The local rubblestone on this elevation is loosely coursed and there are ashlar quoins on the angles. The segmental heads of primary window and door openings are also of ashlar, and there are also copper slag blocks around the westernmost window. The western portion is set back from the rest and is built over part of the water course network and supported by a wide, shallow, two-centred arch. The opening to the wheelpit (No.2) containing the restored waterwheel has a segmental ashlar head with further ashlar courses above, and ashlar jambs. The straight breaks in the masonry at this point seem to indicate that this opening is inserted. If this is so, then as the ashlar wall around much of the wheelpit, the ashlar courses above the head of the opening, and the pantiled mini-gabled roof over the wheelpit are also all secondary to the earlier fabric. This in turn suggests that this general area of roof is also secondary. In addition,

SALTFORD BRASS BATTERY: Outline Survey of South Elevation (S3)



Secondary Masonry



Suggested Primary Phase of South Elevation (S3)

the bridge providing access from the present entrance drive to the area around the external wheelpits (Nos.3 and 4), butts rather unconvincingly against the south elevation itself and is clearly secondary.

On the eastern part of the south elevation, only one primary doorway survives. There were clearly two others, one on either side of it. The easternmost door's west jamb is visible, but all the masonry to the east of that is rebuilt. This later masonry is associated with the present end truss, which is of the same pattern as the other truss in this section of roof. Again, the suggestion, therefore, is that the roof is secondary to the earlier masonry. At the west corner of this part of the elevation the large window was clearly once a doorway, there being a straight construction break below its west jamb to the ground level. The construction break between the inserted masonry associated with the window and the earlier masonry to the east is just to the east of the window itself.

This brief assessment clearly indicates that the southern elevation has been considerably altered since it was first built. In the earliest phase there were four doorways in the eastern part of the elevation, all presumably with the same style of ashlared segmental head, but no windows. The eastern extent of this wall is unknown, because the present east end is secondary. In the western portion, there was probably no opening for the wheelpit (No.2), possibly indicating no wheelpit in this phase. Finally, all the indications are that the present roof is also secondary. Clearly what initially appears to be a reasonably simple elevation proves to be very complex. This has been shown to be the case on the west elevation as well, and almost certainly every section of the mill complex will be as difficult to interpret.

3.3 General Comments

The structural complexity of Saltford is obvious and only general comments can be made as to the way it has developed. It is possible that the oldest portion of it is the rubblestone wall to the east of wheelpit No.1, possibly explaining why this is the only masonry to reach the roof apex inside the complex. This masonry is also associated with a suggested ghost wall running west-east.

The southern elevation, with its ashlared segmental heads, appears to be older than the rest of the external elevations, but the complex west elevation has yet to be thoroughly analysed. Nevertheless, it seems that the southern portion of the structure is older than the northern portion around the annealing furnace. The general impression of the southern elevation is of 18th century date, but such a date can only be extremely general. The brick-heads to the openings in that area seem to suggest a later date in that century, or even one in the 19th. The surviving annealing kiln itself seems of 18th century date and could be earlier than the masonry around it; only closer analysis will tell.

The development of the roof structure is so complex that any assumptions at this stage have to be very general. It is clear, however, that the entire roof is secondary to the oldest portions of masonry. The relationship between the roof and the internal wheelpits

suggests that the roof was largely rebuilt when the wheelpits were inserted or new and larger waterwheels added. This could even mean a mid-19th century date, though many of the trusses of earlier roofs were probably re-used entire, or in some cases, reconstructed.

In broad terms, the main phases appear to be connected with major technological changes in the brassworks, beginning with the first battery mill in the early 18th century. This in itself may have incorporated the remains of an earlier structure. The construction of the new muffle-type annealing furnaces later in the century probably led to a major remodelling, possibly associated with the introduction of two new wheelpits inside the buildings (possibly connected with the introduction of rolling?). In the 19th century there appear to have been attempts to alter matters again, though whether such alterations were simply associated with the introduction of new waterwheels and different apparatus for manoeuvring or working goods within the mill is unclear. Clearly the buildings were radically altered again after the brassworking ceased, and the squash court added.

4. Immediate Repairs and Consolidation Work

The main buildings are in a very poor condition and parts are in danger of imminent collapse. Part of the Hereford Unit's brief was to liase with the architects and ensure that any proposals for immediate consolidation work interfere as little as possible with the historic integrity of the mill.

4.1 Short-Term Repair Philosophy

Before any decisions could be made as to the extent of the short-term repairs, a basic outline repair philosophy had to be agreed. As yet no overall philosophy for the long-term future of the mill has been established, although the main options have been put forward in the Ironbridge report. Until the long-term management strategy for the mill is agreed, it is considered that all interim repair work respects the multi-period *status quo* of the buildings.

In practise, this means that everything from the earliest sections of 18th century masonry to the brick walls of the 20th century squash court should be treated in the same way - and with the same respect. In addition, the internal fixtures and fittings, from waterwheels to early 20th century electrical switchboards, should be retained and not disturbed. Only once agreements have been reached concerning the long-term future of the mill should any parts of it be materially altered, for only then will decisions have been made as to which features should be retained and which can be removed.
This general rule should apply to ***all*** the buildings on the mill site, whether or not they are in the main AIBT lease area or in Mr Taylor's sub-lease area to the east. The only exception to this rule should be the modern house to the east, but it should cover, in addition to the bulk of the mill buildings and adjacent ruined structures, the grindstone

wheelhouse near the weir, the fragment of walling by the escape sluice by the weir, the escape sluice itself, and the masonry sides of the watercourses (some of which may be associated with wharves).

4.2 Immediate Repairs

Clearly the priority at the moment is to ensure that the main portion of the brassworks is made structurally sound and weathertight. Most of the masonry appears to be in reasonable condition, but clearly a structural engineer's report is needed to confirm or modify this assumption. Any repairs need to comply with English Heritage's latest guidelines for emergency repairs, set out for example, in Eleanor Michell's *Emergency Repairs for Historic Buildings* (English Heritage/Butterworth 1988).

Most of the openings can be made weather-tight by repairing or replacing windows and doors. Clearly, the existing design elements need to be retained in this exercise. However, where window or doors are in a very poor condition, it may be better if they are removed from site for storage to await repair, and the openings temporarily blocked.

Several areas in the building have been propped in recent times and in one or two cases the props themselves are either in need of replacement or unsuitable to the use to which they are being put. In the long-term, repairs to the structure should eliminate the need for the use of these intrusive props and they can then be dispensed with. However, in the interim there is a need to check the props and ensure that they are capable of doing what they are intended to do. If they do need to be replaced, a policy of like for like replacement is one option, but there are no valid archaeological reasons for not inserting new timber props that are emphatically of the current repair phase.

The main problem areas are the roof structure and the two areas where there are no walls - the present east gable ends of the building and the west wall south of the ruined annealing furnace.

4.2.01 The Roof

It is suggested that repairs to the roof structure should not be compromised by short-term expediency. There seems very little point in trying to carry out a temporary repair to the roof structure that will, almost inevitably, be short-lived, relatively inefficient, and need to be replaced within a few years. Such a policy would also mean that the structure would be subjected to two separate campaigns of repair and that the possibility of the roof's historic integrity being compromised would be doubled. It is considered that no expense should be spared in ensuring a comprehensive repair of the roof structure, and that such a repair should be considered as a long-term repair no matter what type of temporary repairs are carried out elsewhere in the complex.

The roof is a multi-phase affair given unity only by its uniform, and attractive, pantile covering. Its basic structure is, at least in part, made up of re-used material and the general impression appears to be that it is all secondary to the earliest portions of masonry. Its importance to the building is more aesthetic than archaeological, but a closer analysis is certainly needed to try and date the various phases in it and to assess how these relate to the areas below.

The double-pile roof over the squash court is of 20th century date and appears to be in reasonably good condition. Any repairs to this section will presumably consist of rectifying tile loss and repairing the glass pantiles in the sky-lights. The roof next to the annealing furnace is even more modern, having been rebuilt in the last few years. However, the rest of the roof is in an extremely poor condition, and a large portion of it collapsed quite recently; the rest, unless repaired soon, will probably go the same way within a few years.

Most of the trusses appear to be in reasonable, or at least, repairable, condition, although the two exposed trusses over Mr Taylor's workshop area at the east end of the buildings have weathered badly and one of the tie-beams has had to be propped with ACROs recently. These will have to be replaced eventually, and are clearly not of any historic value. There are few real wall-plates as such, which has meant that the stresses carried by the trusses have tended to push out the small truss pads resting on top of the masonry; these will clearly need to be looked at, but until the roof structure is repaired this particular problem will still exist (and indeed, may still exist even once the roof has been repaired, as it is a structural weakness in the overall design).

Most of the rest of the repairs needed to make the roof watertight appear to be connected with the secondary and tertiary roof members - *ie.* the common rafters and the tile battens. The pantiles will all have to be removed, along with most of the timber battens and several common rafters. Archaeologically this presents no real problems as such repair work is standard in older buildings; indeed, it is only really maintenance work - although in this case extremely long overdue.

The repair work needs to be done with care, of course, and must respect the existing work. Thus any replacement common rafters should be in the same position as the old; whether such replacements are of the same scantling as the ones that are replaced, or whether all the new rafters are deliberately of the same scantling and unmistakably modern is a moot point. In general it is suggested that the repairs are honest, in that the timbers should all be machine-sawn rather than riven or hand-sawn, of a uniform but appropriate scantling, and of a slightly different colour and texture than any surviving earlier timbers. The fixing of the pantiles has not changed in any way so can be carried out in a traditional manner. Overall, the character of the building will not be unduly compromised, but at the same time the repair work will be subtly obvious and not deliberately misleading.

The multi-gabled pantiled roof gives Saltford much of its character and it is vital that this is preserved in any repair work. Fortunately, this was the case when the squash court was built earlier this century, and when the area near the annealing furnace was repaired recently. There seems to be only one general pattern and profile of pantiles used, and there are many pantiles stacked around the mill. Clearly, these pantiles are the only material that can be considered for any repair work. This will also mean that the replacement battens have to be in the same positions as the old.

The one area of roof that has collapsed should be replaced for both aesthetic and structural reasons. Without the roof covering the exposed area of the building, and the adjacent areas to south and east, are already suffering from the elements. Priority should be given to re-roofing this area to both protect the fabric of the building and to restore its spatial integrity. Discussions about the design of the roof centre on whether a temporary or more permanent roof is required. It is suggested that if a temporary roof be chosen then it could be of any design - *ie.* light-weight composite trusses for example - providing the pitch and the covering matched the old. However, if a more permanent structure is decided upon, it should be a fairly simple matter to recreate the bay-pattern of the old roof and use soft-wood replicas of the old trusses - all this work to be based on the earlier survey drawings with some attention given to the salvaged timbers of the roof lying in the squash court area. The importance of recreating the original pitch and covering the roof in salvaged pantiles is critical.

4.2.02 The Screening of the East End

The main buildings certainly continued further to the east than they do now, and almost certainly extended as far, and probably beyond, the site of the modern bungalow. There were once three parallel gabled roofs aligned east-west but the extent of the missing portions of the building could only be demonstrated by trial excavations across or along the supposed wall lines and there are no plans at present to undertake these.

At present the two southern roofs stop on what were once intermediate trusses, and the northern roof has, as explained above, collapsed. There is no walling of any kind beneath the surviving 'end' trusses and the area below is thus exposed to the elements. This section is in Mr Taylor's sub-lease and is used as a workshop.

There is an urgent need to make this area weathertight, but decisions have to be made on the way in which it should be screened. In the short-term, the logical answer seems to be to create a translucent screen of reinforced polythene on a softwood studwork frame on the truss lines. This would be cheap and, in the short-term, effective and would also allow some light through to the work area. However, it is not a long-term solution as the polythene and studwork will almost certainly need to be replaced within a few years.
More importantly, the whole question of where to terminate the covered portion of the main buildings on the eastern side needs to be considered within the overall long-term plan for the site. The creation of a hard end walls on the line of the former intermediate trusses is clearly historically inaccurate and thus misleading; the true extent of the mill is

obscured. In addition, there will be a problem in the rebuilding of the northern roof, as the pre-collapse drawings indicate that it continued over the ruin of the adjacent annealing furnace in its last phase, into an area now taken over by the adjacent house and no longer within the accessible area of the mill. If the rebuilt roof was ended at the last intermediate truss there would be a large area of uncovered floor between it and the wall of the ruined furnace - which would clearly be ridiculous; it would certainly have to be continued at least to the line of the annealing furnace.

It could be argued that the creation of new gable ends on intermediate trusses is a twentieth century response to changes in the mill's use and the development of the Mill Island as a whole. However, one other possible solution for the long-term could be to create an entirely new and artificial east wall line immediately to the east of the two surviving 'end' trusses. This could be built in a deliberately foreign material, such as rendered breeze-block, to distinguish it from the less mechanical rubblestone of the rest of the building. The pantiled roof could be extended to this new line of solid gables with little detrimental effect on the appearance of the mill as a whole, and the original trusses would not need to be altered in any way to become weathertight end trusses. Internally, it would be easier to appreciate that the building did indeed carry on further eastwards, simply because of the way the trusses would be so close to the new end wall, and because of the obvious newness of the wall itself.

The new east wall line would be easy to establish for the two eastern roof sections, but there would have to be some negotiation over how it can be achieved over the ruined annealing furnace. Ideally, it would cover a portion of it and thus allow public inspection of part of the interior of the furnace, but the present partitioning of this part of the site may mean that the end gable of this section of roof will have to be on the line of the west (front) wall of the furnace itself, and thus set back from the rest of the suggested new east wall line.

The suggested extension of the building to the east will mean that consideration needs to be given to how the existing south wall is continued to meet the proposed new east gable wall. There is some evidence to suggest that the present end of the south elevation could be associated with a lost door opening of some kind, so the addition of a new doorway at this point may be totally appropriate. It should be emphasised that excavation will be needed to demonstrate the continuation of the building eastwards before the principle of creating a new east wall can be seriously considered.

4.2.03 The North Wall Area

The north 'wall' of the building once supported the north slope of the roof that recently collapsed, and consists simply of a thick-scantling wall-plate running between the privy over the tail race and the ruined annealing furnace to the east. There was clearly no partition beneath the wall-plate, and the building presumably continued further northwards. This thesis seems to be supported by the remains of a rubblestone wall running north-eastwards from the privy along the line of the east bank of the tail race and

gradually petering out in the undergrowth. The polygonal-shaped extension was presumably roofed, at least in part, by another gabled roof aligned parallel to the three to the south, the feet of its southern rafters resting on the surviving section of wall-plate.

In the short-term, protection will have to be provided against the weather in this area, and a simple studwork partition carrying polythene on the line of the wall-plate seems a logical answer. In the long term, the same problems of architectural and archaeological integrity met with in sealing of the eastern side of the building arise. A new solid wall on this alignment will be historically misleading, but structurally logical. However, given the present sparsity of archaeological knowledge of the extent and design of the northern extension, trying to recreate an earlier structural phase would be perilous - especially given the obvious problems in trying to roof it.

5. Assessment of Work to Date

Saltford Mill has been the subject of a great deal of work, but much of this has been rather disjointed as it has been carried out by different individuals and organisations. This is particularly the case in the survey and interpretation of the fabric.

5.1 Historical Research

As already mentioned above, the historical and documentary evidence concerning the mill has been exhaustively researched by Mrs Joan Day, the undisputed expert on the brassmaking industry of the Bristol region. This results of this work have been published in various articles in relevant journals, and in Mrs Day's history of the regional brassmaking industry (see Bibliography). It is generally accepted that Mrs Day's researches are very comprehensive and that little else needs to be done in this field.

However, the one drawback of Mrs Day's published work is in the inevitable restrictions on space in the journals and, indeed, in the book. This clearly means that much of her comprehensive research has yet to be made public, and some of this may have a direct bearing on the structural development of the buildings.

5.2 Surveys and Analyses

So far, no less than six separate modern surveys have been identified. Three of these are comprehensive surveys of the whole site, one is simply a single site plan, and two are detailed drawings of individual parts of the mill - *viz.* the annealing furnace and part of the west wall. The quality, accuracy and utility of these surveys varies. What they all share is a complete lack of any attempt at interpretation. If any field notes accompanying the plans exist, they have yet to be found - or at least, have not been passed on to the Unit.

There are some common faults with all the surveys bar one. For example, on no plan is the open portion of the water channel immediately south of the sluice of wheelpit No.4 clearly marked - which nearly led to this investigator appreciating the effects of both gravity and moving water in rapid succession. Seriously, this is a dangerous omission from the plans, particularly as the opening is loosely covered by debris (which is probably why it isn't on the plans in the first place). Close by, on each elevation the wide arch carrying the building over the main mill race to the west of the complex is shown as still rising where it meets the masonry of the bridge built at right angles to it. In fact, the apex of the arch is at least 0.5m to the east of the junction between the two. Finally, there are several angled facets to the building, but these are all incorporated in general elevations and drawn on the angle, rather than face on, and are clearly not drawn to archaeological standards.

To clarify matters, in this assessment the possible elevations and cross-sections have been marked and numbered on the base plan and will be referred to in describing the surveys carried out so far.

5.2.01 Avon County Council Survey, May/June 1977

Oldest in date order, this comprehensive set of plans is signed by 'M.T.' but attributed to M H Kenchington, the County Architect. The scales used are imperial, either 1:48, 1:96 or 1:192. The plans consist of:

Drawing No.1: Plan as existing

A 1:96 outline plan of the main buildings showing the position of cross-sections, elevations etc.

Drawing No.2: Key Plans as Existing

A small (ie.1:192) plan of the site to identify survey areas and, on the same page, a same scale plan of the roof layout and, at 1:96, a plan of the visible members of the roof structure (ie trusses, purlins and common rafters, when not boarded). Trusses are numbered with a 'T' prefix, purlins numbered without prefix and various beams numbered with a 'B' prefix.

Drawing No.4: Elevations as Existing (Sheet 1 of 2)

Schematic elevations at 1:48, numbered 1 to 6 and mostly part-covered in ivy:

Elevation 1: N3 and W1 (the former at an angle, not face on)

Elevation 2: N2, N3 (at an angle), N4

Elevation 3: Ell

Elevation 4: N1, with arches of cross-section c-c beyond

Elevation 5: E1

Drawing No.5: Elevations as Existing (Sheet 2 of 2)

Schematic elevations at 1:48, as per Drawing No.4, numbered 6 and 7:

Elevation 6: Long overall elevation of south side of brass mill, *ie.* S1, S2 (on an angle), and S3.

Elevation 7: Long overall elevation of west side of the brass mill, *ie.* W2.

Drawing No.6: Sections & Internal Elevations as Existing (Sheet 1 of 2)

Schematic cross-sections at a scale of 1:48 (ACC lettering in italics):

Section A-A: Section b-b

Section B-B: Section a-a

Section C-C: Section c-c

Section D-D: Section j-j

Section E-E: Section f-f

Drawing No.7: Sections & Internal Elevations as Existing (Sheet 2 of 2)

Cross-sections as per Drawing No.6:

Section F-F: Section i-i

Section G-G: Section e-e

Section H-H: Section h-h

Section J-J: Section j-j

Section K-K: Section d-d

Section L-L: Section g-g

General Comments

The survey was clearly a comprehensive one. However, there are no detailed internal elevations or enhanced larger-scale details of individual features such as trusses. It has to be said that the quality of the work is architectural, rather than archaeological and no attempt has been made to try and analyse the fabric. None of the obvious construction breaks, and few of the obviously blocked openings, are recorded.

Despite the depth of recording, much of this is clearly schematic and each drawing does come with a standard 'Do not scale drawing - Check all dimensions on site' warning. This is needed, because the accuracy is occasionally suspect. Something has certainly gone very wrong in the measurement of the roof structure. It seems that the heights of the roof ridges have been guessed at - wrongly - although the widths are more or less accurate. The net result is that the roof slopes are all awry, as the ridges on the drawings are up to 1.5 metres lower than they really are. This affects every single drawing - elevation or cross-section - and all the details in the roof structure.

The accuracy of the plans is also questionable in parts, even given the possible distortion through photocopying. On the checked elevation - along the south elevation (S3 on the base map), the relevant running measurements, and heights, converted to metric, are (with check measurements in brackets):-

Horizontal:

0.91m (*0.77m*); 2.47m (*2.37m*); 7.32m (*6.98m*); 8.69m (*8.43m*); 13.11m (*12.77m)*

Vertical:

East: 1.83m (*2.30m*); Door Jamb: 1.52m (*1.80m*); West: 1.75m (*1.82m*)

The sketchy nature of the elevations, the inaccuracies in the measurements and the lack of detail and interpretation mean that this set of plans is inadequate as a true record of the buildings or as a potential tool for architectural and archaeological analysis. Clearly, however, they were never designed to be so. As architects' plans they would have been passable had it not been for the basic flaw in the roof heights.

5.2.02 Avon County Council, July 1977

A single sheet plan, also stamped with M H Kenchington, County Architect's stamp and presumably associated with the set of drawings above (5.2.01). Oddly enough the scale is a metric one (1:200) rather than imperial:

Plan No. A.L.S. 36 - Outline plan of the site.

General Comments

It presents an outline plan of the whole site, from the weir to the outfalls of the tail races. The only possible check measure that could be used was the overall length of the south elevation (S3). Unlike the larger scale imperial plans, this was well within reasonable parameters of accuracy - approximately 12.70m as compared to the check measurement of 12.77m. The plan only positions the outline of the main buildings, along with mill races, river course, and trees. Although only an outline plan it is perfectly adequate as a site plan on which to base a report, showing as it does the main elements on the mill island with a reasonable degree of accuracy.

5.2.03. Megan Thomas, September 1977

This set of plans and drawings appears on one very large single sheet. Despite the use of three different scales and of three different types of drawings the manner in which the drawings have been laid out is well thought out and clear. The three main drawings are isometric, viewed from the south-east and diagonally set out across the sheet, whilst site plan and selective elevations are sited where they best fit:

Site Plan: 1:500

Isometric - showing existing roof covering of pantiles: Detailed 1:96 drawing.

Isometric - showing roof structure of trusses and purlins: 1:96 drawing with pantiles and common rafters removed.

Isometric Plan - showing original usage: 1:96 ground annotated ground plan.

South Elevation: 1:48 outline of all south elevations - (S1; S2 (on angle); S3).

East Elevation: 1:48 outline of annealing furnace area - (E3)

East Elevation: 1:48 outline of all north elevations - (N1-N5 (N3 on angle) and, beyond, part of Section c-c.

General Comments

These plans are visually attractive and very informative and could form an ideal basis for any display panels. They include a huge amount of detail of the roof structure - particularly useful for the reconstruction of the missing portion of the roof. Clearly a great deal of time and effort went into their production.

They are not, however, archaeological as such. The elevations are quite sketchy and large areas are obscured by artistic under and overgrowth. Some minor errors have crept into the drawings - for example the two 20th century king-post trusses over the squash court area are shown as having king-struts, with the vertical members ending below the principal rafters, whereas they are actually true king-posts in which the post rises above the principals.
The dimensional accuracy is, in general, acceptable for the purpose for which they were drawn, but is not within archaeological tolerances as comparisons on the check-measured south elevation show (checks in brackets):

Horizontal

0.91m (*0.77m*); 2.44m (*2.37m*); 7.35m (*6.98m*); 8.72m (*8.43m*); 13.17m (*12.77m)*

Vertical

East: 1.89m (*2.30m*); Door Jamb: 1.40m (*1.80m*); West: 1.65m (*1.82m*)

More importantly, there has been no attempt to analyse the fabric, with none of the obvious construction breaks drawn. Equally, none of the internal elevations have been drawn. The annotations of usage on the isometric plan are claimed to be 'original usage' - clearly misleading in a multi-phase industrial site; indeed, the usage indicated would almost certainly have been those of the final phase of brassmaking, rather than the first.

These are a very useful set of plans in their own right and are extremely useful in the interpretation of how the mill operated in its last brassmaking phase. They do not, however, help significantly in the understanding of the mill's structural development.

5.2.04 AIBT (?) Survey of the Annealing Furnace, No date

Partially detailed survey drawing of the lower portion of three sides of the annealing furnace at a scale of 1:20 on one single sheet of paper. There is no title on the drawing, and no attribution:

Front Elevation (*ie.* South elevation)

Rear Elevation (*ie.* North elevation)

Side Elevation (*ie.* West elevation)

General Comments

Although slightly schematic the survey does appear to be reasonably accurate dimensionally - although the details are somewhat stylised. Some reworking would be needed to add further details and provide some analysis. The drawings were obviously done from ground level - as they stop more or less above head height! Providing a fuller check on the dimensions and drawn details is carried out successfully, these could provide the basis for a proper survey of the whole furnace. There is, however, no attempt at structural interpretation, though there may well be notes available in the AIBT archive.

5.2.05 Architecton, January 1987

A comprehensive architectural survey of the main buildings, but with limited archaeological details and fairly outline elevations. The scale of the main drawings is 1:50, but there are also larger scale details of all the roof trusses at 1:25 and a 1:100 roof plan.

350 100 - 1:100 plan of roof - with details of valleys etc.

350 101 - 1:50 plan of the main buildings with details

350 102 - 1:50 diagrammatic survey of roof structure.

350 103 - 1:50 outline elevations of all the south elevations (*ie.* S1, S2 (on angle), and S2), and of the west elevations (N3 (on angle), W1, W2, W3, and S2 (on angle)

350 104 - 1:50 composite elevations and cross-sections: One includes elevation drawings of N1-5 (N3 on angle), with a partial cross-section just a little beyond on the line C-C. The other is a cross-section along the line F-F, continued through into elevation drawing of E3.

Truss Drawings - Drawings of all trusses in some detail at 1:25 - but not quite archaeological. With each one is an 'as proposed' drawing for repairs - some of these do not fit the structural evidence available.

General Comments

This set contains detailed plans but outline elevations. All the drawings are annotated and there is a logical numbering system for the various features - such as doors, windows, roof trusses etc. However, they do not include any internal elevations. The plans and elevations are architectural with little or no attempt to pick up on any important archaeological details, such as construction breaks. They are certainly more accurate than the Avon CC drawings but still not really within normal archaeological tolerances. The relevant check measurements on the south elevation are (controls in brackets):

Horizontal:

1.00m (*0.77m*); 2.65m (*2.37m*); 7.15m (*6.98m*); 8.74m (*8.43m*); 12.92m (*12.77m*)

Vertical:

East: 2.60m (*2.30m*); Door Jamb: 1.70m (*1.80m*); West: 1.85m (*1.82m*)

The detailed truss drawings are more or less schematic. For example, the tapering of the king-posts on some trusses is not shown, many empty mortises (particularly the small cuts for the diagonal struts) are not shown, and the position of purlin mortises are often rather suspect.

As architects' drawings these are very good, and will be invaluable for the work of quantity surveyors and structural engineers. However, they do not provide sufficient archaeological information to aid any interpretation of the fabric and in some case the accuracy is not within archaeological tolerances. They could, possibly, be adapted for a very basic archaeological analysis but this could well end up being surprisingly time-consuming and rather unsatisfactory.

5.2.06 Dr Lane's

A full stone-by-stone 1:20 survey of a portion of the west elevation (W2) of the mill, coupled with outline drawings of other external and internal elevations at 1:50.

Main Survey Drawing

An inked stone-by-stone 1:20 scale drawing, lacking comments or interpretation, of the western section of the west elevation (W2). This was clearly drawn archaeologically and the wall was presumably properly levelled and gridded with

how useful this type of survey is - all the obvious changes in wall fabric and any significant breaks in the masonry become quite clear. This wall is one of several that will need very detailed analysis if any outline idea of the buildings' structural development is to be achieved.

Smaller Outline Elevations

Outline elevations at a scale of 1:50 showing very few details, but including some significant archaeological features such as construction breaks. None of the drawings are labelled or identified, but they clearly consist of:

The Main South Elevation (S3)

The South Internal Elevation

The Western South Elevation (S1)

The South-Western Splay and Adjacent Elevation by Mill Race (S2 & W3)

The East Elevation of the Annealing Furnace Area (E3)

The North Elevation of the Annealing Furnace Lean-to (N2)

The North-West Angle of the Annealing Furnace Lean-to (N3)

General Comments

This is by far the best set of drawings related to the mill, but it is clearly by no means complete. The benefits of stone-by-stone archaeological recording are clearly demonstrated in the part survey of the west elevation, but perhaps more significantly, the benefits of surveying the building with an eye to its archaeology rather than to its appearance are clearly demonstrated by the smaller outline elevations. These have more archaeologically significant detail on them than either of the sets of architectural plans, showing the significant construction breaks. They are also very accurate, as can be seen by comparing the relevant check measurements on the south elevation (check measurements in brackets):

Horizontal:

0.76m (*0.77m*); 2.43m (*2.37m*); 7.01m (*6.98m*); 8.37m (*8.43m*); 12.80m (*12.77m*)

Vertical:

East: 2.31m (*2.30m*); Door Jamb: 1.79m (*1.80m*); West: 1.89m (*1.82m*)

All in all, this is an excellent set of plans. It is a pity that the rest of the building was not surveyed even in the outline detail of the smaller scale elevations, but presumably there was neither the time or funding available. This set of drawings must be kept. The larger stone-by-stone survey can be incorporated into any eventual complete survey of the mill. Similarly, if there was only sufficient funding for an outline analysis, the smaller scale elevations could be used as the basis for such work.

5.2.08 Mrs Joan Day's Surveys

In the two articles on Saltford by Mrs Day, and in her book *Bristol Brass*, there are reduced outline drawings of parts of the complex, presumably carried out by herself and/or the AIBT. These comprise:

The Annealing Furnace - South elevation, cross-section, and plan

Waterwheel Number Two (ie. the complete one) - Plan and End elevation

The Grindstone Wheelhouse - Plan and Cross-Section

General Comments

These drawings are used as an aid to understanding the text. The illustrations of the annealing furnace are not identical, there being changes made to the original drawings for the 1979 article. For example, on the balance beam operating the furnace door the second drawing has a Newcomen-type chain support presumably because of research carried out after the first article was published. These drawings were produced as an aid to understanding how the furnace operated, and do that job admirably.

The drawings of both the surviving waterwheel and the grindstone wheelhouse both appear in the 1976 article and are also both fairly outline in nature, but do provide an important part of the growing archive of Saltford. Oddly, although the grindstone wheelhouse is illustrated, there is no reference to it in the text. Nevertheless, it is good to see that this building is seen as an integral part of the brassmaking complex - a fact that seems to have been ignored in the other surveys and reports.

The 1976 article also includes an outline sketch plan of the mill, with the suggested uses of various areas marked; this is a useful indication of how Saltford worked in its latter stages.

5.3 Archaeological Excavations

Limited excavations were undertaken in 1986 by members of the Avon Industrial Buildings Trust, directed by Mr Bob Isles (now of English Heritage). These were sited in the squash court area and in the north-west corner of the mill. In the squash court area a masonry base, presumed to be associated with a single tilt-hammer, was uncovered. Such a hammer would presumably have been associated with the thinning of the cast brass into sheets. The batteries used for hollow-ware were generally in threes and consisted of much smaller hammers working at much higher speeds. As rolling replaced hammering in the reduction of the cast brass by the mid-to-late 18th century at Saltford, it seems reasonable to assume that the excavated hammer base was associated with a very early phase of the brassmaking process. All the records of the excavation are apparently held by Mr Isles. It is, nevertheless, quite clear that there is considerable archaeological potential in the main buildings, and that this will probably be the case on most of the mill island.

6. Suggestions for Further Research and Survey Work

6.1 Historical Research

Although the outline results of Mrs Joan Day's exhaustive research into the history of Saltford Mill have been published in article form and as sections in her general book on the local brassmaking industry, it is clear that a considerable amount of material had to be left out because of the space allowed. It is recommended that Mrs Day be commissioned to produce a much fuller account of the mill's history, unrestricted by such constraints.

Such a report should, at least, be a typescript with copies held in the public domain - for example, in the National Monument Record, the Public Records Office, the Avon County Records Office, the Ironbridge Institute library and any other relevant society archives, as well as in the local libraries in Bath and Bristol. The historical account could, eventually, form part of a monograph incorporating the survey and analysis suggested below.

Mrs Day is obviously the person to be commissioned to produce a fuller history of the site, but if she is unable to do so because of other commitments she may be able to recommend someone else who can. If anyone other than Mrs Day is to write such a report then they will inevitably have to consult Mrs Day's archives (and no doubt, rely a great deal of her co-operation and advice).

6.2 Systematic Clearance and Salvage

The main buildings are fairly cluttered with a wide variety of materials - from ladders and work-benches, to old lifejackets and Esso signs. Before any analysis work can begin, all this needs to be carefully cleared out. Within the debris there may well be artefacts connected to the brassmaking process - such as the changeable hammerheads used in the battery process, for example.

It is suggested, therefore, that the clearance work is carried out under a degree of archaeological supervision so that the possibility of loss is substantially reduced. Any material considered to be of historic importance can then be marked and stored before being assessed and either discarded or retained.

6.3 Architectural and Structural Analysis

Despite the amount of survey work carried out on the brassworks it has been demonstrated above that very little has been done to analyse the fabric. At present, very little is known about how the mill has developed since the 1720's, or indeed if any pre-brassmaking structures survive within the complex. Only one small portion of the west elevation has been surveyed to an archaeological standard. Ideally, the whole complex should be surveyed to that standard, at a reasonable scale, and in detail. If stone-by-stone recording is considered too expensive, then at least all the relevant construction breaks, changes in building material, and all structural elements used or disused need to be recorded accurately.

Industrial buildings, by their very nature, are usually built simply to shelter the variety of processes being carried on within them. The machinery involved in such processes would usually have an intimate relationship with the fabric of the buildings. Alterations and improvements in the techniques involved would often result in considerable changes to the fabric, but sometimes the position of the older machinery is indicated by empty bearing-box recesses, wheel scars, and beam sockets *etc.* in the masonry.

There was generally less need in industrial buildings to conceal changes or tidy the walls as there was when domestic or public buildings were altered. The internal walls of industrial buildings can, therefore, become palimpsests, providing the evidence of older industrial processes long since abandoned in favour of the new. For this reason, the detailed surveys of the internal elevations are of as much, if not more, importance to the understanding of the development and use of industrial buildings as the surveys of the external elevations. Bearing this in mind, it is suggested that any survey work at Saltford should include the insides as well as outsides of the standing walls.

In addition, the internal faces of the wheelpits warrant examination. It is quite evident from the two pits within the building that the waterwheels were not always running true, and that the buckets scarred the soft stone linings. In those two pits, there is only one radius of scarring on the ashlar wall, suggesting that they are contemporary to the

present waterwheels. It may be possible, by close examination of the opposite, rubblestone, walls, to detect scars of earlier waterwheels and thus work out their radii. Wheelpit No.4 appears to have been part of a new battery mill in the 19th century that was never used (Day, 1976, 20). However, it is clear from the scars in the masonry next to the site of the wheel that there was indeed a working waterwheel in this pit for some period of time; its radius can be worked out by measuring the scars, and then a function has to be found for it.

Often, where funds are restricted, analysis of fabric can be carried out using existing plans and elevations provided by architects. The Architecton plan of the building appears to be reasonably accurate and could be used as the basis for a more detailed plan with additional information, such as construction breaks and blocked openings, added. However, architectural plans are drawn and designed for a specific purpose - to help the architects and the other related specialists such as structural engineers and quantity surveyors. The needs of the architectural archaeologist are very different and in virtually every case it is better for the archaeologist to re-survey the building.

In any case, with the notable exception of the detailed stone-by-stone survey drawing of Dr Lane and his outline elevations, none of the existing drawings are drawn to the accuracy needed for thorough archaeological evaluation. Experience has shown that trying to use existing drawings as a base on which to add further details is often more time-consuming, and certainly much less satisfactory, that a completely new survey.

It is recommended that the whole complex, including the grindstone wheelhouse and the section of wall by the run-off sluice near the weir, be surveyed by a suitable archaeological unit. Ideally the survey should be at a scale of 1:20 and suitably detailed; it should include every external and internal face (drawn individually - with no facets drawn at an angle as has been the case in the existing surveys). In addition, although large areas of the floor have been concreted this century, there are earlier exposed floor levels of different material. The more important features in the earlier floor levels, such as significant junctions between types of flags, or significant ridges in the brick floors, need to be recorded as some of these will be of importance.

There seems to be no need to re-draw all the individual roof trusses. The roof is certainly secondary, and possibly tertiary or even later still, and the precise details of its trusses will not present any significant new evidence for the development of the building or the processes carried out within it. However, the basic design of the trusses and the way in which they have been altered needs to be recorded. It is suggested that the Architecton truss drawings could be used as the basis of such work, suitably corrected and amended. This will result in considerable savings compared with a complete re-survey of each truss.

Once a fully detailed set of survey drawings is available it will be easier to consider exactly how the mechanisms and processes within the brassworks operated, and there will be a better opportunity to try to identify earlier phases of the mill's operation.

6.4 Survey of the Watercourses

Some of the watercourses below the mill buildings have been explored by members of Mrs Day's team in the early 1980's, but no survey of them is available. Such a survey would be of immense usefulness in trying to understand the way in which the water power systems worked. Exploration of the subterranean leats, with suitable safety procedures, could also show the way in which the water courses have been altered over the years and help to locate older wheel pits or channels. This work is vital to the comprehensive of the building's superstructure. It is the type of thing that a local sub-aqua club might be interested in.

6.5 Photographic Survey

It is suggested that a detailed and comprehensive photographic survey be undertaken before any work on the mill begins, and that photography is continued throughout the renovation process. This will provide a suitable archive of the mill and the work done to it. An initial survey is probably best carried out using black and white film and medium format camera equipment. Colour prints should also be taken to indicate the differences in the building materials, either on medium format or on 35mm. The watching brief photographs could be all on 35mm colour stock with occasional black-and-white medium format for any significant features exposed during the work.

6.6 Limited Archaeological Excavation

Excavation of non-threatened archaeological deposits is no longer considered a reasonable use of the limited resources available for archaeological research, and there would almost certainly be a distinct bias against excavating an unthreatened scheduled ancient monument. However, limited trial excavations should be considered if they can help to demonstrate the original extent of the existing buildings to allow a better understanding of how they developed. In addition, the excavation of the ruined annealing furnaces (three of which have been identified) could be of use in understanding the technological developments involved in the evolution of the muffle type of annealing furnace. Any excavations will have to have the agreement and support of English Heritage, and the necessary scheduled monument consent would have to be obtained.

7. Extension of Statutory Protection

At present the main building complex is listed Grade II and the immediate area around it is a Scheduled Ancient Monument. However, any industrial complex should be seen in its entire context and specific elements should not be divorced from that context and given preferential protection unless there are reasonable archaeological, historical, or architectural reasons for doing so. In the case of Saltford only a part of the complex is

protected by listing or scheduling - although the whole island is within a Conservation Area inside the designated Green Belt, which should act as a break on detrimental development.

7.1 Extension of the Scheduled Area

The very fact that the main block of buildings was included in the scheduling - and not just the annealing furnace - was tacit recognition that one specific structure could not be seen in isolation from those around it. The annealing furnace may be of European significance, as argued in the Ironbridge report, but it was only one part of the brassmaking complex.
It is suggested that the various elements of the brassworking complex occupied most, if not all, of Mill Island. The structural shows that the main buildings extended further to the east and to the north-east than they do now. In addition, the grindstone wheelhouse and the run-off sluice were also clearly associated with the brassworks. The mill race was probably adapted to supply the necessary waterpower to the works, and there were probably wharves on the river bank or sides of the tail races for the barges bringing in the brass and fuel, and taking away the finished products.

Bearing this in mind it is clear that there may be significant buried archaeological levels outside the present scheduled area on the mill island. It is suggested that consideration be given to extending the scheduled area to include the rest of the island - even though there is no immediate threat to the buried levels.

7.2 Additional Listing

Three structures near the weir seem to be connected with the brassworks but are neither listed not within the scheduled area - and are thus only protected by the conservation Area legislation.

The grindstone wheelhouse is a complete structure, probably of late 18th or early 19th century date and in its construction has similarities with the main mill complex. Built of local rubblestone under a pantiled, trussed-rafter, roof, its main openings have rubblestone segmental heads. Inside it retains most of its machinery, including a complete composite waterwheel. This is shielded from the rest of the floor-space by an ashlar wall - as is true of the wheelpits in the main buildings. It is a significant building in its own right and could well be of sufficient historic importance to warrant a Grade II listing - especially as it is associated with the scheduled brassworks.

The listing of miscellaneous and incomplete structures like the run-off sluice is a more complex matter. The ironwork of the sluice is dated 1840. Although some of the timberwork on the bridge railing and sluice control was repaired in the mid-20th century (and dated 1948), the sluice is mostly unaltered. It would probably be difficult to support the listing of the sluice structure on its own merits, but it is an important element

in the water supply system to the brassworks and could be listed because of that connection. The amorphous masonry wall immediately between the run-off sluice and the weir itself appears to be contemporary with the brassworks, being built of the same rubblestone material and incorporated blocks of copper slag. Its function is unknown, but it almost certainly is related to the works. Clearly there is too little of this structure left for it to be listable in its own right, but it is suggested that thought be given to giving it listed status, either as a part of the run-off sluice, or listed for its group value with the brassworks. If this is not done, and the scheduling is not extended, this piece of masonry will not be protected, and it could be significance in the understanding of the brassmaking complex as a whole.

8. Conclusions

The scheduling of the main part of the Saltford Brass Battery Mill in 1986 was a clear recognition of the historic and archaeological importance of the site. It was also a significant affirmation of the importance of our industrial heritage as a whole. The past twenty years or so has seen a marked change in the way in which the national heritage is seen, with a definite broadening of view as to the type and date range of what is worthy of preservation. However, if the status and protection now given to important industrial monuments is to be seen to be genuine, rather than merely theoretical, then sites such as Saltford need to be treated with the same amount of respect - and given the same degree of resources - as any medieval castle, for example. Scheduling *per se* should mean that this is automatically the case and that any work has to meet the standards required by the Secretary of State.

In direct contrast to the comprehensive documentary research on Saltford, very little has been done on the structural interpretation and most of the survey work that has been carried out has been architectural rather than archaeological. The buildings are now in a parlous state and in urgent need of repair. However, if such repair work were to be carried out before any thorough archaeological analysis of the fabric has been undertaken, there is an obvious danger that vital pieces of structural evidence could be unwittingly removed without being recorded. In addition, in the consolidation of the building, key decisions as to elements of the work, and its physical extent, need to be made - but without the benefit of a better understanding of the fabric such decisions could be difficult to make, and mistakes could be made.

If the buildings are to be treated with the respect that their scheduled status warrants, then a thorough understanding of the way in which they have developed needs to be arrived at before the long-term repairs are started. The only way in which that can be achieved is by a thorough archaeological recording of the fabric, exploratory excavations of key areas, and a synthesis of the results of archaeological and historical research.

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