Historic building recording
and watching brief
at what has become known as the Nag's Head Engine House,
more correctly known as
Pontesford Colliery 1784 engine house,
Pontesbury,
Shropshire

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Introduction
Historic building recording and a watching brief at a scheduled engine house (List Entry No: 1018467; 230m north of Home Farm) at Pontesbury, Shropshire (SJ 40852 06376; Fig 1) was undertaken at the request of Mr John Goom. Further documentary research, primarily for comparative information, was also undertaken to fill an acknowledged gap in an earlier report (Cook 2013). Informed opinion was also sought from Mike Shaw. Initially this revealed that the engine house which is the subject of this project is not the one associated with the Nag's Head Colliery, although it has been erroneously referred to as such for years (and also in the scheduling information). Strictly speaking it should be referred to as Pontesford Colliery 1784 engine house (Mike Shaw pers comm). The Nags Head Colliery lay to the south-west on the site of the present secondary school. However, the appellation 'Nag's Head' is a convenient shorthand and is in common use and has therefore been used throughout this report to refer to the current project.

The original project was undertaken in order to provide a descriptive account and interpretation of the historic and architectural development of the building, preparatory to, and to inform the extent of, stabilisation and repair of the monument. This updated report includes additional documentary material and material derived from the watching brief.

The bulk of the previous report has been reproduced below, revised as appropriate, in order to set the new material in its proper context.

Outline development of mining technology with particular reference to coal extraction
It has been suggested that the demand for a higher output of coal was met by innovative changes in the industry's structure and management plus larger and more highly capitalised mines (Newman 2016). However, with few exceptions these increases were achieved by sinking more small mines and using traditional techniques. The domestic demand was for lump, preferably low-sulphur coal, whereas small coal and 'slack' was sold for lime burning or salt making, aiding the viability of many coastal collieries.

Because it was difficult, and expensive, until the 18th century, to transport bulk, low value loads, most English collieries were small affairs serving local markets [see above paragraph in above article]. In 1709 Abraham Derby began the commercial smelting of iron with coke. Derby's success slightly preceded Newcomen's introduction of the atmospheric engine in 1712. For precision foundry uses, pig iron made with coke was superior to that made with charcoal which helped advance the atmospheric engine's development. Together, they raised demand for coal and in turn facilitated deeper collieries.

Steam power was paramount in the 19th century and the only significant fuel available to produce it was coal. While this resulted in larger and deeper collieries, by far the majority remained quite small.

Coal supply and prices regularly oscillated in the 19th century following a roughly five year cycle but what is sometimes called the 'coal famine' occurred between 1871 and 1873. This caused the price of coal to rise from around 9s 6d per ton to 21shillings over two years before falling back to 10s 10d in 1876. Apparently caused by a relatively small under-supply in an otherwise buoyant market, many new collieries were started as a response to it. Shropshire has a number of small coalfields. The Denbighshire coalfield extends into the northern part of the county and was worked in a number of areas including Pontesbury. Both are in the upper coal measures although the available seams are quite different. The belief that seams ran consistently through a coalfield led to the failure of the Asterley and Boycott colliery in the mid-1870s

Coal mines were highly labour intensive and from the 1860s onwards some owners responded by introducing mechanical coal cutters to cut production costs. However, by far the majority did not do so until the early 20th century.

Limits of historical research

Unlike metal mining, there have been comparatively few 'in-depth' studies of specific collieries or coal mining areas. Railway studies cease at the colliery gate and while there have been a considerable number of disaster/conflict studies, these rarely give technical details about the mines concerned or consider their consider their economic history and can contribute little to the understanding of the archaeology.

Technology

Coal mining can be seen as one end of a spectrum of overall mining technology with copper, lead and tin at the other: the mining of a high-bulk, low value seam mineral as opposed to a low-bulk, high value vein deposit. There are similarities and differences between these activities. Coal has tended to take the lead in bulk material-handling, notably rail transport and in ventilation because explosive gas, which is rare in other types of mining, is present.

Most of the available technological information is derived from 18th to 20th century historical sources which describe coal mines in use at that time. In the 17th century technological advance was broadly centred on the development and spread of surface railed transport in order to meet demand by allowing the expansion of large-scale coal-mining into areas more remote from river and sea transport. Most notable were the wagon way systems.

The 18th century was marked by the development of the beam engine. The use of the Newcomen atmospheric engine for pumping allowed the working of deeper and wetter seams and was centred in coal mining areas where its high fuel consumption of small coal, which would otherwise have gone to waste, was acceptable. The introduction of more advanced steam engines (Boulton and Watt and descendants) allowed still deeper and more powerful pumping and the rotary motion necessary for direct steam-powered hauling. Not all coalfields adopted Boulton and Wall engines immediately on introduction due to the cheap coal due to the cheap coal outweighing the cost of the more efficient engines.

In the 19th century, the range and power of steam engines grew rapidly and by the middle of the century the horizontal engine gradually replaced the vertical cylinder beam engine. Railway technology also developed rapidly, both on the surface and underground.

Extracting coal

As with most forms of mineral extraction, early coal miners focussed on the more accessible, shallowest deposits which could be exploited with the least effort and deeper seams were worked later as technology and knowledge improved. However, as so little of the archaeological evidence of the underground parts of early coal mines is available, the chronology of these developments is not particularly refined and interpretation relies heavily on documentary and surface evidence.

Following discovery, extraction generally began along the outcrops of the seams, often in places which have long since lost their connection with the industry and then migrated down dip, usually necessitating deeper sinkings. Where they survive, workings along a seam outcrop of this kind show that a range of techniques of techniques might be used, including a small amount of open-casting, drifts and shallow shafts. The latter are often referred to as 'bell pits'.

Other means of extracting coal underground are the 'pillar and stall' (sometimes referred to as 'room and pillar') and 'longwall' techniques. Pillar and stall was the earlier of the two methods and was certainly in use by the 15th century. Longwall workings, although traditionally assumed to be much later, have been found to have been in use in the early 16th century.

Shaft sinking
Once found the coal could be worked opencast along the outcrop but the increasing depth of overburden usually meant that the seam was followed underground. At early extractive sites this would be done from shallow shafts and, particularly where drainage was needed, drifts or day holes. Where deeper access was required more substantial and enduring shafts were needed.
Where the coal remained fairly shallow it was usual to sink new shafts as the workings progressed. This had the advantage of aiding ventilation but primarily it cut down the distance that coal was hauled from the face to the pit bottom. Timber-lined shafts were either square or rectangular. Later, circular shafts were lined with stone or brick, sometimes laid without mortar so that the materials could be recovered for reuse. As collieries increased in size and depth shafts were sunk at larger diameters (seldom more that 25 feet; 7.2m) to allow larger cages or skips to be used for winding. Nevertheless, many shafts were less than 10 feet (3m) in diameter.

Winding
On shallow shafts of the type used at early coal extraction sites a jackroll or windlass, was used to lift coal or rock in a small kibble. This technology is known to have survived at small-scale operations into the 19th century but as shafts progressed to depths significantly beyond 100 feet they were increasingly wound by horse gins or whims lifting larger kibbles. Some collieries used waterwheels for winding and a few used water balance systems. In the 18th century, the reciprocating action of a steam engine was applied to winding drums.

Pumping
At first water might be bailed from shafts using buckets but horse-powered pumps were used from the late 15th century. These were of unknown type but in the 16th century horse gins were adapted to drive 'rag and chain' pumps. By the 18th century waterwheels were also being used for pumping and winding from shafts. The importance of these wheels has been eclipsed by the steam engine but their former presence is attested by the remains of water courses.

The introduction of Newcomen's atmospheric engine in 1712 meant that massive masonry engine houses quickly appeared on many coal pits. These, and later Watt or Cornish engines, were principally used for pumping, but during the 19th century an increasing number of horizontal winding engines were employed on collieries. At deep shafts, many of these were compound engines, which required large houses, but some areas preferred a vertical cylinder to drive a winding drum through a crank mechanism vertically above it. The later houses were much smaller in plan but often three stories high. No major study or typology of colliery mine engine houses is known.

All steam engines needed a boiler house, the size of which varied to suit the engine. Early engines used haystack boilers, which were like a large kettle supported over a fire. In 1812 Trevithick developed the Cornish boiler which was cylindrical with a single fire tube. Such boilers were suitable for pumping engines that made comparatively small demands for steam. Fairbairn's introduction of the Lancashire boiler in 1844 with its double fire tubes was well suited to the much greater demand for steam made by the large winding and textile engines being developed.

Boiler houses tend to be fairly lightweight constructions in order to facilitate the replacement of boilers and chimneys are the most likely survival. Nevertheless, the masonry seatings for boilers and their blow-down drains may still survive.

Background to the coal extraction industry in Shropshire and the west midlands in general
The 17th century saw the beginning of the decline of the Sussex iron-making centres and there was a direct connection between the stagnation of this older region and the development of the west of England in the history of coal extraction (Court 1953).

During the second half of the 17th century, from the Civil War on, Sussex was in decline whilst the western iron trades were making headway. In 1653 there were 35 furnaces and 45 furnaces in the three counties of Kent, Sussex and Surrey, mostly in Sussex. Fifteen years later the number of furnaces in Sussex was down to *c* 27 of which only 11 were in work. The decline persisted during the 18th century, becoming especially rapid after the war with the colonies. The last furnace at Ashburnham closed about 1809 or 1810, the last forge, at the same place, in 1820.

The main reason for this decline seems to have been the increasing cost of the fuel which was charcoal. The cost of fuel accounted for 63% of the cost of producing Sussex pig iron. Transport was also a difficulty in the supply of London, despite attempts to improve this by the canalization of the Medway, Wey and Sussex Ouse. The Sussex industry was dependent upon water power and was probably at some disadvantage compared to parts of the country with a higher annual rainfall. It may also have been hit by the remarkable dryness of the first half of the 18th century.

The west and west midland counties, Gloucestershire, Shropshire and Staffordshire, possessed opportunities for the making of iron which were first taken up in Tudor and Stuart times. Lower wages, more convenient transport, superior water power and ore and unexhausted woodlands found together probably all counted in their favour. In addition, around the beginning of the 17th century, the technique of the blast furnace was introduced which led to an increase in efficiency which must have appeared formidable at the time.

It was observed at the time that the best iron was in the Forest of Dean and in the Clay-Hill in Shropshire. Leland spoke of the blow-shops of Clee over a hundred years before (Leland 1770). These blow-shops were furnaces specially constructed to take advantage of the strong westerly winds on the Clee Hills. The main iron-making activity, however, seems to have gone on nearer the Severn especially in the woods between Buildwas and Wenlock. This was the origin of the later, great development of the iron industry around the Severn.

By the close of the 17th century there were possibly half a dozen furnaces of small capacity perhaps producing five to ten tons of iron a week. These, like all the furnaces of the time, would not work all the year round. The date of 1658 still stood on the lintel of a furnace at Coalbrookdale (Jenkins 1923) and marked the continuity between the Shropshire charcoal-smelting of the 17th century and the coke-smelting of the 18th.

Coal was being used in the midlands at the smithy, by the numerous metal trades, for domestic purposes and by an increasing variety of industries. By the time of the industrial revolution the Staffordshire householder used coal generally while neighbouring counties derived from Staffordshire their domestic supplies. Most if not all the mechanic professions (except the ironworks) that used much fuel utilized coal (the glasshouses, salt-works, brick-makers and maltsters) all of whom had once been users of charcoal. The coking of coal was known amongst the maltsters, other trades consumed it raw. The burning of coal at the limekiln seems to have been peculiar to the county. Notwithstanding this, until the iron works turned to coal the local pits had not discovered their largest potential market. The common coal of the county, as mined at Wednesbury, Sedgley and Dudley, went largely to domestic use. The growth of production was consequently slow and unaccompanied by serious changes in method. It was the immense demands of the ironworks in the second half of the 18th century which revolutionized the depth and technique of south Staffordshire mining.

Open workings continued in common use until the 17th century and a good deal of the mining seems to have been on a very small scale indeed. In 1625, in Sedgley parish, where abundant coal outcropped in proximity to good iron ore, fire clay and limestone, William Persehouse, a yeoman, let for 16 years to John Bennett, a nailer, coal works and pits for iron ore in an acre of land in a pasture known as Field Leasowe. This ability to contract independently for the raw materials that they needed meant that such men were evidently living under conditions very different from those of a Staffordshire nailer a century later, who had become subject to the nail-master and the services of the slitting mill. It is the smallness of the scale of the operation which is economically interesting showing that there were methods of production other than the tolerably large mine selling commercially.

Surface working, at least of any simple type, was, however, ceasing in this century to satisfy demand for coal in the midlands. 'Flat mines' as they were called, 'where the workmen rid off the earth and dig the coal under their feet and carry it out in wheelbarrows' survived around Wednesbury between the Restoration and 1688. But more difficult undertakings than the flat mine or 'foot-rill' were necessary. By driving an adit into a hillside it was sometimes found possible to approach a seam and follow it on the straight for a hundred yards at a time (Plot 1686). However, the regular pit with the expense of 'drawing all up by hand and sometimes of freeing the mine from water' was becoming more and more important. This is the significance of Plot's discussion of mining method (p 129-31, 146-9) which was a comparatively new subject.

The pits described by such witnesses as Plot did not represent deep mining as it was known a century later. This was in the second half of the 18th century. A deep mine in the 10 yard seam, in pre Civil War days, was a pit 120 feet deep. Most of the pits seem to have been between 24 feet and 60 feet deep. The significance is that the pit was replacing the old open working and, judged by the standards of the time, they were already deep mines. The bulk of 17th century production must have come from such pits and not from the one-man mines described above. The output of these larger mines is difficult to estimate. Dud Dudley (1665) suggests anything between 2000 tons and 5000 tons per annum. In whatever reasonable way one cares to assess this vague estimate, production was clearly far below that of the late 18th century. The first half of the 17th century, to which these figures relate, was concerned with tens, not hundreds, of thousands of tons.

The Shropshire coal industry grew immensely during the 18th century in association with iron production, much of which was sold to south Staffordshire and Birmingham. In one session in 1808 the Shropshire justices noted the number of fatal coal-mining accidents in the hope that colliery-owners would take steps to reduce them (Salop County Records: Orders of Quarter Sessions, iii, 152). Certain areas were involved repeatedly: Wombridge, Wrockwardine, Dawley, Wellington, Lilleshall and Halesowen and these indicate the more active coal-mining parishes. The large number of deaths after 1750 must have been in part a consequence of the determined and successful efforts to expand the production of the Shropshire pits which took place in the second half of the century under the stimulus of an iron industry remodelling its methods.

Three collieries are refereed to: Knowle Hill (Netherton), Paddock and New Park. The receipts all show one decidedly peculiar feature. This is the dwindling of receipts between September and the first three months of the year and the swift increase during the late spring and early summer months. That is, there is a great slackening of business in the winter and active revival of it in the summer months, somewhat contrary to intuitive expectations. The answer may lie in the state of the roads with the 18th century consumer, both domestic and industrial, having different habits from those in an age when heavy and bulky items can be moved easily at any time. Stocks were laid up in the finer weather.

However, what ever the circumstances in particular localities, the late 18th century was for the south Staffordshire coal district as a whole a period of great expansion. The enormous demand which came from the introduction of coke-smelting and puddling into the county; the steady growth of industrial consumption on the part of other industries of many kinds; the additional impetus of periods of war, especially of the wars with France at the close of the century, experienced by a district which rated the Government among its best customers; the arrival of improved steam power and transport all formed irresistible causes of growth.

The use of steam power in the collieries was noticeable in the second half of the century, partly from the extended scale of operations, partly from the setting-up at some mines of the new-style Watt machine. But the history of the steam-engine was closely connected with the south-Staffordshire coal-field from the first and the introduction of power into the Warwickshire, Staffordshire and Shropshire pits goes back to the first half of the century. The evolution of a primitive steam-engineering industry marked an important turn in the economic history of the district.

The great age of midland industrial development falls within the first great century of English science, between 1660 and 1760, as well as within a period of political peace and active commerce. The service which the industries of the midlands performed for the development of the steam engine was to offer, especially through the growth of coal mining, a suitable medium in which experiment could take place. Here the practical problems were to be found which unaided common sense could not solve, and the solution of which might prove highly profitable to enterprising men. The steam-engine's appearance coincided with a stage of considerable difficulty in the development of the coal-fields.

The local mining of the previous century had been limited in the area it affected, as it was small in the quantity of its production. The very immediate vicinity of Wednesbury, Tipton and Dudley seems to have formed the entire chief centre. Down to Plot's day, the Black Country miner kept to the outcrop and the production from open workings had not been completely replaced by pits. The extension of mining in the Black Country in the early years of the 18th century was from the outcrop to the deep. The move was slow and cautious. It was not until much later that deep pits were sunk regardless of distance from the outcrop, as at the Bloomfield Colliery about 1776, the Horseley Iron and Coal Company's colliery about 1780, the Wednesbury Oak and Bagnall's collieries about 1800. The 19th century carried the movement from the old centres outward, both east and west, much further.

Documentary material directly relevant to the current project

Further documentary research at the Shropshire County Record Office and the Shropshire Historic Environment Record took place on the 24th and 25th November 2016. This focused upon identifying comparative material for the engine house. The results were incorporated into the text in the appropriate places below.

Historic mapping

The earliest available map was the tithe map of Pontesbury (CRO ref: PF 220/3/3) dating to 1840 (Fig 2.1). This shows two adjacent and conjoined, slightly staggered structures on the site of the present engine house. This map is difficult to reconcile with the structures as they appear on the ground. However, during the final stages of the fieldwork, when the ground level was being reduced around the south-east and south-west sides of the surviving engine house, evidence for a demolished building in the position shown by the tithe surveyors was found. The field name associated with these buildings is 'Engine House or waste' (plot number 1188). It is likely that this depiction represents the existing engine house and adjacent boiler house. The house and attached, probable engine house, to the north-west is also shown.

The 1st edition Ordnance Survey map of 1873-1884 (Fig 2.1) shows a group of three conjoined rectangular structures, forming an 'L' shape with a detached square structure with a circular open centre to the north-east. The two conjoined structures to the north-east are shown as being roofed and the one to the south-west as being not. It is believed that the roofed rectangular structure with the nearby unroofed square structure are, respectively, the engine house and shaft. The unroofed rectangular structure to the south-west is the remains of a boiler house, at this time disused. The roofed, conjoined rectangular structure to the north-west is the existing lean-to building in this position. A track leads from the engine house to the north-west (to the adjacent house) and from south-west of the engine house to the nearby road. All the nearby shafts are described as 'old'.

By the time of the 2nd edition Ordnance Survey map of 1899-1902 the engine house itself is shown as unshaded and was therefore probably unroofed at this time, although the lean-to building to its north-west apparently retained its roof.

The track to the road was no longer visible when the map was surveyed although the one to the house remained. The house to the north had been extended to the east.

Neither the 3rd nor the 4th edition Ordnance Survey maps were available.

The development, general appearance and features of engine houses

Coal output could not be significantly increased beyond its 16th century level until the solution to the problems of drainage, ventilation and haulage were found (Palmer and Neaverson 1994). Underground drainage tunnels, known as soughs, were in common use for draining mines by 1700. Where the topography was unsuitable for gravity drainage hand or horse-powered pumps were the only means available which limited the depth of the mine.

It was the invention of the steam-powered pumping engine that enabled the coal industry to expand. Thomas Savery's pump of 1678 was intended to drain coal mines but was not successful as its lift was insufficient. Thomas Newcomen's engine, on the other hand, proved to have sufficient capacity and was applied first to collieries, an engine being installed at a colliery in the Black Country in 1712. A working replica of this engine has been constructed near its original site at the Black Country Museum.

In a Newcomen engine the weight of the pump rods lifted the piston to the top of the cylinder, steam was let into the cylinder below the piston and then condensed. This created a partial vacuum which drew the piston down. This movement of the piston operated a rocking beam, or 'bob' which raised and lowered pump rods in the shaft. As the pump rod was raised water was brought up with it and expelled from the shaft. In this type of engine the boiler was placed on the ground with the cylinder above it and the piston rod from the cylinder operating the rocking beam or bob at a higher level. Consequently, the buildings which housed atmospheric engines were tall and narrow and contained massive timbers to support the cylinder. The wall nearest to the mine shaft, the bob wall, was more substantial than the other walls since it supported the bearing for the bob and contained an aperture through which the outdoor section of the bob protruded. The atmospheric engine continued in use on coalfields well into the 19th century, much longer than on metal mining sites where its extravagant fuel consumption made it costly to operate.

The performance and economy of the Newcomen engine were greatly improved by James Watt in the 1770s, especially by his use of a separate condenser. Higher steam pressures were a feature of these engines and in these examples the boiler was no longer housed under the cylinder but in a separate house and the condenser was located in a well within the engine house. Thus, in the field a Newcomen engine house can be distinguished from later beam engine houses by its extra height and lack of a cylinder base, the cylinder being mounted on wooden cross-beams (Palmer and Neaverson 1998). The Nag's Head, as it currently appears (Phase 2) with its cylinder base, is clearly of the later design. However, it is also clear that the cylinder base sits upon a cylinder loading which itself lies within made ground. It is entirely possible that in Phase 1 the space within the engine house was deeper than it now appears and housed a Newcomen engine. This would require substantial timbers, perhaps at about the current floor level, to support the cylinder. There is a single, visible socket in the north west wall (showing on the right hand side of Fig 39), within the condenser pit, that has no clear function with regard to the later engine arrangements. It is possible that other such sockets remain to be discovered beneath the existing floor.

A feature of all beam engine houses, including that at the Nag's Head, was the extra thick 'bob' wall on which the rocking beam was carried. Another feature, common to all mine pumping operations using pump rods, is the 'balance bob' pit by the top of the shaft (eg Fig 4.1, G). A weighted box on a beam pivoted in this pit and was connected to the pump rod to balance the weight of the pump rod so that the only work that had to be done was to lift the water. Another method employed for the same purpose was the hanging of weights directly from the bob. Neither of these arrangements has, so far, been identified at the Nag's Head.

Modifications by Watt brought changes in engine house design: first, a separate boiler house usually adjoining the engine house, allowed the latter to be reduced in height; second, the cylinder assembly was usually mounted upon heavy stone blocks, known as the 'cylinder loading', often of granite, with large holes for holding-down bolts and these cylinder mountings are a prominent feature in many derelict engine houses, as at the Nag's Head. The reason for this was that there was a tendency for the cylinder to lift with every stroke and the tonnage of masonry represented by the cylinder loading was proportional to the power of the engine (Brown 1996). Thus, measurement of these loadings enables the diameter of the cylinder once mounted there to be estimated. The cylinder loading was penetrated by horizontal 'bolt tunnels' (Fig 3.8) which provided access to fit cotters, the cylinder being held down firmly by from four to eight large bolts (four in the case of the Nag's Head engine). Another feature of the Watt type engine was the well in the floor, either in front of the cylinder mounting block or immediately in front of the bob-wall, which contained a tank of water in which the condenser and air pump were immersed. Such a well is another feature of the Nag's Head engine house but it is not known whether it contained such a tank or whether it held suspended weights.

The engine house

A feature of the engine house was that it was not merely an enclosure for the engine: it was actually the engine's frame (Brown 1996). At the Nag's Head, two substantial timbers spanning the length of the engine house had partially survived and were reinstated as part of the programme of work (Figs 3.5, 4.16, 23 and Appendix 2). The building was also designed to assist with the engine's erection.

Engine houses often come in pairs (Palmer and Neaverson 1994). This is probably true at the Nag's Head with the other one now being part of the adjacent house (Fig 8). This other engine house was not in the colliery's 1784 lease. It was probably in a lease of 1805 but no build date has emerged. It is possible that it was built solely to house a winding engine and replace some or all of the horse gins. A usual arrangement would be for one to house the engine that powered the pumps, and in the other the engine that would run the hoisting and crushing machinery (eg Fig 4.15). It is unknown if this arrangement pertained at the Nag's Head. The main function of an engine house was to provide the framework for the engine it contained. Its basic design was essentially established by Newcomen for his atmospheric engine. The distinctive architecture of Cornish beam engine houses links their landscape context – both in the United Kingdom and overseas – with Cornwall and west Devon mining engineering. More beam engines were installed in Cornwall and west Devon than any other mining region of the world: it is thought that around 3,000 engine houses were built in total to house them.

Local stone was used to build Cornish engine houses. This was sourced from quarries, sometimes from mine waste and often from existing derelict engine houses on the same or adjoining mines. Cut granite was always favoured for the cylinder bedstone, the bob wall and corners – known as ‘coigns’. Gable roofs were covered with Cornish slate and bricks were brought to construct the top most section of the chimney stacks and window and arch details. The necessary strength and size of construction of Cornish engine houses is the principal reason for their survival.

The bob wall

Most surviving engine houses are rectangular in plan with a much thicker wall in the front (the bob wall; Figs 3.8, 4.1, 4.2, 4.8 and 4.14). This was constructed using massive stones (often cut granite) and was perhaps two-thirds of the height of the other walls. It supported the beam (known in Cornish mining as a bob), which transmitted the reciprocating motion of the piston to the pump rods in the adjacent shaft (in the case of a pumping engine) or to the hoisting or crushing machinery. This wall had to withstand both the weight of the bob and associated items (which might be over 50 tons for a large pumping engine) and the rocking forces of the bob.

Other design features

The other walls braced the bob wall and helped to take some of the working stresses of the engine. The rear wall (usually with a gable that supported a pitched roof) contained the cylinder opening through which the cylinder, bob, and other large components were brought into the house. There were usually three chambers internally.

The 'bob platform' protruded from the face of the bob wall at the same height as the bob and provided access for maintenance of the bearings (eg Fig 4.15). The sockets for the timbers that supported this platform are visible in the north-east elevation (Figs 3.1, 11, 12 and 13).

Associated structures include: boiler houses, which were often detached structures; chimney stacks that were either built-in to a rear corner of the engine house or sometimes detached and connected by a flue (Figs 4.1 E and 4.15); and engine ponds (usually up-slope), which stored water for the engine condensers. None of these features have so far been identified at the Nag's Head.

The Pontesbury coal mines and associated industry

The collieries of the Pontesford area were used to supply the fuel for the steam engines and smelters associated with the adjacent metal-mining area (Brown 1976). As early as 1775 a 'fire-engine' (or Newcomen-type of steam engine) was recorded in the vicinity and there is good documentary evidence of several other steam engines used at Pontesford. However, it is not known which engine was installed in the engine house shown at NGR SJ 410 065 (approximately 200m south of Little Halston Farm, north-north-east of the current site). This engine house is also of stone with a brick gable and tall, brick arch-headed opening where the beam once emerged (as at the Nag's Head). This had been infilled in brick with a small glazed window about half-way up the original opening. It is known, however, that this house had been a dwelling since before 1840 as the present occupier's grandfather was born in the house in 1843. The building was divided into three stories and the engine pit was used as a cellar. The pumping shaft was about 6 feet from the lever wall, but is now filled up. The boiler house has been incorporated into the local blacksmith's shop, which is built on the west wall. Nearby is a further smaller engine house, also converted into a three storey dwelling.

The Nag's Head colliery is mentioned specifically by Trinder (1996). This is in connection with the smelting of lead, which was the only other significant use for coal in the area of the Shrewsbury coal field (apart from for lime burning and brick-making). The main smelting works of Shropshire's late 18th century lead industry were at Pontesford (Wadlow 1934). Prior to the early 1780s most of the area's lead was smelted in the Severn Gorge and smelting began at Malehurst (in Pontesbury parish) around the same time as it began in Pontesford and continued there until 1796.

The Boycott mine near Malehurst was another chief supplier of coal (Trinder 1996). There were fourteen colliery steam engine drivers living in Pontesbury in 1861. Trinder refers to the engine house referenced by Brown (SJ 410 065) as being the only surviving engine house in the coalfield. This engine house is on land leased by William Heighway to Lovett in 1805. The first documentary reference to the engine dates from 1817. It was out of use by 1828 and had been adopted as a dwelling by 1842, which purpose it still serves. The pump shaft lies about two metres from the bob wall. Insufficient evidence remains to determine whether it housed a Newcomen or a Boulton and Watt engine.

Lead smelting using ore from Snailbeach and coal from Pontesford seems to have continued until about 1873 (Shropshire Caving and Mining Journal 1980). It was noted in 1934 that some of the buildings which once contained the beam engines for pumping water from the coal mines had been modified slightly to domestic accommodation and have served in this capacity during the last 60 or 70 years (Wadlow 1934).

Pontesbury and Pontesford

In the 17th century mining seems to have been restricted to shallow pits (Pearson 2004) and although a few mine shafts were in Pontesbury itself, most were in Pontesford, close to the road from Snailbeach and Stiperstones to Shrewsbury (of note is that the Pontesford pits are sometimes referred to as being in the Pontesbury coalfield, as well as often being called the Nag's Head Colliery).

In leases dated 22th March 16 Charles II (1663-4) and 8th July 22 Charles II (1670) Richard More requires his tenants '*to carry one wain load or ton of coals from the pits at Pontesbury to the mansion house at Linley*' – Linley Hall. Further leases dated the 28th January 1706-7 (5 Anne) and 30th November 1708 (7 Anne) mentions that the tenants of one of the Robert More's owned farms in the Shelve area must deliver one wagon (hay wayne) load or ton of coal per annum from the Pontesbury pits to the house to the More's Mansion, Linley Hall.

However, it was not until *c* 1784 that mining took off in the area when Thomas Lovett from Chirk, Denbighshire, (a major stake-holder in the Snailbeach Company) leased several fields between the Nag's Head Inn and the Pontesford Brook from William Heighway for a coal mine – part of which is known locally as the Nag's Head Colliery. After 1802 Lovett extended his operations to the east of Pontesford Brook. By this time most of the mines in Pontesford were tenanted by the Snailbeach Company. The White Grit Company owned other mines on the periphery, such as those in Pontesbury. At least 15 shafts are known.

On the 8th February 1805 Thomas Bowyer leased some five parcels of land in Pontesford to Thomas Lovett for 21 years in order to mine coal. Additionally, the lease stated that '*rent for every stack of coal of 3 feet 10 inches square 1s 6d and for slack and small coal 1s 8d per wagon load and 1s 3d per cart load, except what is used working the fire engine or for burning brick for erecting buildings for the use of the colliery only*'.

In 1794 John Lawrence bought lands from the manorial estate in order to dig for coal, which started in 1795. Importantly, in 1793 (May to July) he, John Probert, Francis Lloyd, John Jones, Nathaniel Betton, Thomas Lloyd, Rev Edward Blakeway and his other *adventurers*, (effectively the White Grit Company) purchased a pumping engine from Boulton and Watt for their Pontesbury Colliery. It was a single acting beam engine with a 33 inch cylinder having a seven foot stroke. This is probably the engine that Mr Phillips from Dunnington described during a visit to the Pontesbury Colliery Engine site as pumping at a depth of 65 yards delivering water to the surface – with a cylinder of 33 inches. Such an engine is recorded as consuming 2715 tons of coal in the period July 1808 to July 1811 and at this time was pumping at 225 feet.

Another stone engine house was built around 1847, supervised by the engineers from the Snailbeach Lead Mining Company – the engine type and size is not known and neither is the location; however, a new mine, *new engine pit*, with rotary steam pumping and winding engine was constructed of brick at SJ 4056 0663 *c* 1859. In 1859 the Snailbeach Mining Company did purchase a rotary engine from the Union Foundary Wakefield with a 20 inch diameter cylinder for pumping and probably winding. The New Engine Pit mine shaft was at this time 128 yards deep. This engine was again moved, this time to the Snailbeach mine in 1862, where it was reconditioned. This move probably saw the end of the Pontesford colliery as between 1857 and 1859 it closed, having produced 27652 tons of coal in the preceding decade. Indeed, the owner of the land and local investigator, Heighway-Jones, is on record as complaining that the company left so quickly that dug coal was left in the shaft and that they had broken the lease; his agreement with the Snailbeach Company gave him a set amount for every ton of coal brought to the surface.

The 1841 census lists 40 men and 15 boys working in the Pontesford mines. Kelly's Directory for Shropshire, also for 1841, shows that coal for the White Grit Lead Smelter at Pontesford was coming from their Shorthill Colliery, which eventually connected with the Hanwood Colliery.

In Pontesford the evidence for former coal mining activity is everywhere. There are four former engine houses, two are now dwellings (one that is adjacent to the subject of this project - and another) and two ruins (the one that is the subject of this project - and another). The ruin that is the subject of this project is of particular interest as it has not been altered since it was closed, other than normal weather damage. Inside at ground level is the base for the cylinder with two of the four 35mm diameter bolts remaining (these are set in a square, 1.1m apart) and a condenser pit below ground level. A few former pit mounds remain largely intact. The mound at SJ 4067 0631 has some of the characteristics of a 'bell pit' but as the coal seams were not thick enough it is not a true bell pit. Furthermore, the former shaft at SJ 4074 0640 (Giblet Pit) retains many of the features of what it would have looked like when it closed; to one side it slopes down to allow coal to be taken away and on the top there remain earth indentations which are part of a circle created by the horses when turning the gin. Additionally, the post associated with the gin was still in place in the 1970s. Another earth mound at Pontesford has two concrete capped shafts at least 300 feet deep – one was for coal and the other for men and equipment. It is possible to see into the smaller shaft, which is full of water at just about ground level, this is currently piped by gravity, to a water trough.

It is not possible to fully establish the order for the construction of the engine houses, when they were closed or what type of engine they housed. The engine house that is the subject of this project appears to be one of the earliest engine houses and could have lasted until just after 1860 when the colliery finally closed. It was common for engines to be moved around a coal field when mining moved with the coal seams.

Summary
In the Pontesbury region, mining before the 17th century would have been limited by the depth at which it was safe to mine. The deepest a horse gin is capable of working is about 100 feet. However, the primary limiting factor with mining in the area was the excess of water. The water table most of the year is very close to the surface – often no more than a few feet below ground level. The ability to move large quantities of water quickly was the key factor in the development of the local mining industry. The steam (fire) engine, which was able to pump water, was the solution to overcoming the very high water table, allowing mining to be undertaken at some depth. The reason why the Pontesbury area became the centre of the lead smelting industry for a time was the availability of large quantities of relatively cheap coal for the smelting process and other associated tasks. Up to 1861 everything transported in and out of the area had to be taken by road so the Minsterley Branch Railway and subsequently the Snailbeach Railway were considered at the time as a potential route to greater prosperity for the region.

The coal mined in the Pontesbury region was never regarded as good quality and the seams were thin making mining difficult, with too much water present, resulting in the coal becoming relatively costly to bring to the surface. The prime reasons for the demise of both the coal mining and lead smelting industries in the Pontesbury/Pontesford area was the availability of the new rail links, after 1861, of cheaper and better quality coal (and coke) from locations such as Wrexham and Ruabon, plus the building, in 1863, of a new smelter at Snailbeach.

The fieldwork

General

Initially fieldwork took place on the 11th February 2013. This comprised a walk-around assessment, with as-existing architect's plans and elevations which were annotated with historic information and photographs taken as appropriate. Subsequently, fieldwork took place on the 25th November 2016, 18th January 2017, 17th February 2017, 2nd March 2017, 13th April 2017 and 20th April 2017. This comprised a watching brief on areas of ground reduction and clearance and a photographic record made of the restored structure, utilizing the same as-existing architect's plans and elevations, which were annotated with further historic information with photographs taken as appropriate.

Description
Phase 1: 1784
This comprises the rectangular structure of the engine house (Fig 3.8). The bob wall is constructed of uncoursed, semi-squared stone rubble with squared quoins on its east and north corners, up as far as the bottom of the arched opening through which the 'bob' protruded (Figs 3.1, 7 and Appendix 2). Above this it is constructed in brickwork in English bond. The use of brick probably reflects the fact that it is easier to undertake complicated constructions (eg turning arches, working around structural timbers) in brick than in stone. At a slightly lower level, the stonework itself steps in on the north-east elevation. This probably demonstrates an economy being employed with regard to material – as the structure rises the bob wall could be reduced in thickness without loss of necessary strength.

The arch ring in the gable is segmental and two bricks in thickness. Two substantial timbers, now substantially decayed, especially within the width of the opening, were built into the thickness of the bob wall to provide support for the bearing for the bob. In the upper part of the bob wall are four sockets (Figs 3.1, 11, 12 and 13) which formerly contained timbers which formed the bob platform.

Internally the south-east and north-west walls have sockets (and the decayed remains of timbers; (Figs 3.6, 3.7, 24, 25, 26 and 27) which formerly supported galleries providing access to the bob and upper part of the engine mechanism.

The south-east and north-west walls braced the bob wall (Figs 3.6, 3.7, 3.8, 5, 6, 7 and Appendix 2). These were built of semi-coursed, semi-squared stone. Both walls have blocked, large rectangular openings with timber lintels at first floor level (eg Figs 3.3, and 19) and what appear to be the remains of similar openings at second floor level. Externally, the south-east wall has two sockets which must have supported a timber structure to the south-east (Figs 3.3, 18 and 20) but it is not known what this was. Adjacent to the upper of these sockets is the face of one of the substantial timbers which provided support for the bearing for the bob (Figs 3.3 and 17).

Commentary
There is some slight evidence that this engine house once accommodated a Newcomen engine. It seems fairly clear that the building was constructed by excavating a rectangular hole equivalent in size to the entire footprint of the engine house. Reasons for this are not difficult to infer. With the readily available surveying technology of the time it was probably easier to maintain control over relative levels across an open space than around a peripheral foundation trench. In addition, more space would have been available during the construction of the walls - a significant advantage when manoeuvring large stones at some depth beneath existing ground level. The bottom of the walls was not attained during the excavations but there is no reason to suppose that they are any less that *c* 3m beneath the thresholds in the north-east and south-west entrances (which lie at the same level) and they may be significantly more. There is also reason to believe that the upper part of the engine house has been lowered. The area around the bob opening is rendered in brick (see below: Phase 2 and Figs 3.1, 3.3 and Appendix 2). These circumstances could have provided sufficient height within the engine house for a typical Newcomen engine to have been housed (eg Fig 4.13).

Phase 2: by 1840
The putative Newcomen engine of Phase 1 would have had no need of a separate boiler house. However, the tithe map of 1840 shows two conjoined, staggered rectangles (Fig 2.1): one being the existing engine house and the other what is presumed to be a boiler house. During the reduction in ground level around the south-east and south-west sides of the engine house, the remains of a wall was identified (context 012 in a position that would enable it to form part of the north-west wall of the Phase 2 structure (Figs 3.8 and 43). It is significant that there is a straight joint between context 012 and the south-west wall of the Phase 1 engine house.

During the removal of debris within the well inside the engine house, the junctions between the wall on the well's south-western side and the inside of the north-west and south-east engine house walls were examined. It was not possible to be conclusive but it seemed that there was a straight joint between these structural elements (Fig 3.10). This lends some weight to the interpretation that the well wall, the engine loading and the engine bed were later modifications associated with the replacement of a Newcomen engine with a Boulton and Watt design (eg Fig 4.14) and the construction of an adjacent boiler house, as depicted on the tithe map of 1840.

Information that may make it possible to determine the size of the cylinder and other details relevant to the engine installed during Phase 2 are (Figs 3.8, 3.10, 3.11, 37 and 38) :

- the holding-down bolts in the engine bed are at 1.1m centres.
- from the centre of the holding-down bolts to the centre of the shaft is 6.64m (the bolts are not positioned centrally in the engine bed but are located closer to the side of the engine bed that is adjacent to the shaft).
- from the centre of the holding-down bolts to the centre of the bob wall is 3.005m
- from the centre of the bob wall to the centre of the shaft is 3.635m

Measurement of these values is slightly complicated by the eccentricity of the shaft which is no longer circular. However, since its greatest and smallest diameters are 2.4m and 2.28m respectively, this should have a minimal effect on the disparity of the bob length either side of the bob wall, given that this difference is around 600mm.

Commentary
The well would have formerly contained either a tank of water in which a condenser and air pump would have been immersed or a 'balance bob', if this latter item was not located outside the engine house to the side of the shaft, in the manner of the example at Snailbeach (Fig 4.1; G). The three-dimensional interpretative drawing (Fig 4.16) shows the Phase 2 arrangement with a condenser in the well. An initial appraisal suggests that the cylinder diameter cannot have been significantly in excess of three feet (0.91m).

Phase 3: by 1873-84
By the time of the 1st edition Ordnance Survey map (Fig 2.1) The Phase 2 boiler house had been demolished and another one built to the north-west, on the opposite corner of the engine house (Fig 3.8, 35 and 36). There is a blocked opening in the north-west wall of the engine house at a low level (Fig 4.16) that might have provided for the pipework from the cylinder to a boiler in this location.

Phase 4: by 1873-84
It appears that the Phase 3 boiler house was demolished and in common with other engine houses in the vicinity, the Nag's Head was converted to domestic use (Figs 3.5, 3.6 and 3.8). The evidence for this is a domestic hearth on the ground floor with a flue passing up through the first and second floors (Figs 21, 22 and Appendix 2) and the construction of a privy (Fig 42; contexts 008, 009, 010 and 011). At the lower levels the lower parts of the flue appear to be added against the wall. At the upper-most level it appears to be built into the structure. The upper-most parts of the engine house shown on Section C-C, which are in uncoursed rubble stone (Fig 3.6) may be a later modification contemporary with the construction of the flue. Presumably work was also carried out on the internal floors as there would have been significant gaps to allow for the presence of the various machinery.

Phase 5: by 1873-84
A lean-to structure was built on the north-west side of the engine house (Figs 3.1, 3.2, 3.8, 4.16 and 7). This was constructed of semi-coursed, squared stone and was provided with a lean-to roof. It reused part of the footings of the Phase 3 structure (Figs 3.8 and 41) and the seat of a privy as a lintel over the north-eastern door (Fig 34). This may be the seat employed in the privy of Phase 4 which suggests that other arrangements had been made. Brick detailing was provided around the doors. Its original function is unknown but, given the absence of any recognisable floor, it is likely that it was always intended to be an animal shelter.

Phase 6: by 1899-1902
By the time of the 2nd edition Ordnance Survey map (Fig 2.2) the former engine house was shown as roofless and had presumably ceased to used as domestic accommodation. The Phase 5 lean-to structure was still roofed and probably continued in use.

Discussion including comparative information relating to engine houses in Shropshire

A visit was paid to the historic environment record held by Shropshire County Council.

Pennerley Mine (SMR Number 01313**)**
A field survey report by Wardell Armstrong Ltd (1993) noted that the mine was first recorded as being operational in the 1780s and for the next century was operated in an intermittent basis. A superficial inspection of the main mining area gives the impression that little remains of the structural remains of mining. The site has certainly been affected by demolition and earth-moving operations and only one brick-built building is reasonably intact. However a closer study of the site reveals that, particularly within areas of tree cover, substantial, well-preserved structural remains exist. On exposed parts of the site it would appear that earth-moving operations have consisted of redistribution of spoil rather than excavation and removal of material. There are indications that in these areas structural remains have been covered and their foundations, at the least, have been preserved.

Pennerley was a lead mine but various structures would have been common to it and the Nag's Head establishment. These are:

reference number	item
1)	Cornish engine (pumping)
9)	Beam (winding) engine-house
10)	Fitting shops
11)	Office
13)	Carpenters'/joiners shop
17*	Blacksmiths' shop
19	Magazine

* location uncertain

At the Nag's Head, only the pumping engine house has been identified and studied although there is another engine house a short distance to the north that has been incorporated into a domestic dwelling. It is likely that there would have been an office fitting shop, carpenters'/joiners shop, blacksmiths' shop and a magazine but the locations of other buildings have not been identified. It is believed that winding was carried out by horse whim (Mike Shaw pers comm).

Snailbeach Lead Mine

A watching brief at Snailbeach Lead Mine (Hannaford 2000) studied the structures of the Snailbeach Mining Company, 1782-1911. The remains of the George's Shaft pit head consisted of a roughly rectangular platform within which lay the circular iron grill placed over the top of the shaft after it had been filled after the 1993-4 reclamation works. Traces of stone retaining walls were visible on the south-east, north east and north-west sides of the platform; the northern corner of the platform had collapsed or had been cut back some time in the past. Three of the four sandstone blocks, which had formerly anchored the pit-head gear were also still *in situ*.

The work exposed the remains of a machine bed associated with the Halvan's Engine House. This consisted of a large block of buff sandstone 1.9m square. This is comparable, although a little larger, in size to the one at the Nag's Head which is 1.61m by 1.52m.

A field survey report of Snailbeach Lead Mine by Morriss (1997) throws further light on the Snailbeach site. The remains of four large and several smaller structures were recorded around the shaft head.

Building A – engine shaft

The masonry collar of the engine shaft survived. The shaft is circular, as at the Nag's Head, and the uppermost section at least is lined in carefully coursed rubblestone. At the Nag's Head the visible part of the shaft is in brick. The diameter of the shaft is approximately 1.8m compared with that at the Nag's Head of 2.3m diameter. In its last phase the Snailbeach shaft would have accommodated both the pumping rods operated by the Cornish engine (Building D) and the ropes hauled by the winding engine opposite.

Building A was thought to date to around 1848.

Building B – winding engine house

Nothing comparable has been found at the Nag's Head.

Building C – east boiler house serving the winding engine house (building B)

The site of the boiler house is uncertain at the Nag's Head although there are two possible candidates: one with no visible remains above ground level abutting the engine house's southern corner and the other consisting only of fragmentary remains extending from the engine house's west corner (Fig 3.8).

At the Snailbeach site the engine house was built after Building B, utilising the existing north wall of that building as its south wall in the same manner as the two putative boiler houses at the Nag's Head. There are clear vertical construction breaks in the masonry to show this. The floor of the boiler house at the Snailbeach site is considerably lower than that of the engine house, as is also the case at the Nag's Head..

Overall the boiler house is approximately 17.8m long and 7.8m wide, whereas the possible Nag's Head examples are 4.5m by 4.5m (Phase 2) and 5.5m by 4m (Phase 3) respectively. Its rubblestone walls are a little over 0.6m thick compared with those at the Nag's Head which are about 0.5m thick in each case. The limited structural evidence suggests that the building was single storied, covered by a plain, gabled roof. At the Nag's Head only the lean-to building retains its roof structure and is essentially single storied. The other candidate's walls survive only as low ruins but its semi-detached nature implies that its roof was probably pitched in the same way as the adjacent engine house.

Building D – Cornish engine house

It is a tall structure with large worked stone quoins and jambs. This bears comparison with the Nag's Head where larger stones were used for the quoins. The original openings have, or had, flat timber lintels made up of several timbers with a central connecting bolt. Most of the openings at the Nag's Head are of this kind, although there is a brick arch over the bob opening. Its walls are very slightly battered so that the top is a little narrower than the base. By way of contrast, at the Nag's Head the walls appear to be vertical although the north-east elevation is stepped-in above first floor level. It is approximately 9.5m long, 7.5m wide and nearly 15m tall to its eaves from the foot of its east gable wall (Fig 4.3). This is somewhat larger than the Nag's Head whose comparable dimensions are: 6.6m, 4.8m and 7.5m respectively. Its east wall is approximately 2m thick, almost twice the thickness of the others; this was the 'bob' wall on which the balance beam pivoted in its trunnion. At the Nag's Head the bob wall is approximately 1.2m thick at its base which is a little more than twice the thickness of the others, they being about 0.5m thick.

Until recently the building had a pitched king-post roof with a solid gable at the west end. The apex of this roof was nearly 3m higher still. The masonry gable at the west end has been reduced in height and rather oddly now appears to consist of two low gable ends of a double pile roof. The Nag's Head, too, had a pitched roof although it is not known what form it took. This added a further 2.6m to the height of the building.

Within the building there are three stories and a basement. Judging from the joist sockets in the walls, this is the same as the Nag's Head, although it is uncertain to what phase of use of the building these floors relate. The basement occupies the eastern half of the building, closest to the shaft. Again, the subterranean part of the Nag's Head is next to the shaft. In its north wall is a doorway that led into the blocked tunnel (Building F). This opening has seen some alterations and has an iron lintel on the outside. Other joist sockets exist in the walls of this pit.

The ground floor was only solid in the western half of the building, the eastern portion above the basement or pit, probably consisting of timber catwalks between the machinery. At the Nag's Head this is also true. However, it is almost certain that the entire footprint of the engine house at the Nag's Head was excavated to the required depth before being partially backfilled. At this level there is a primary door in the north wall above the pit, as at the Nag's Head, and a blocked primary window opposite, with splayed reveals. Just below the first-floor level in the bob wall is a pair of open beam sockets that have shared timber lintels and cills linked by ironwork. These were presumably associated with the timberwork of the head stock over the shaft. There are comparable sockets in the north-east elevation of the Nag's Head.

In the west gable (Fig 4.4) are traces of a wide primary opening that latterly contained a window. However, it was originally a wide doorway with straight sides. These were not finished off with worked stone jambs, but the later, narrower, window was. The original opening was exactly the same width as the engine bed. There is such a doorway in the south-west elevation at the Nag's Head. This is slightly narrower than the total width of the engine bed but at the Nag's Head the engine bed is in two halves.

In the middle of the floor is a square of solid stonework made up of four flush-fitting blocks (Fig 4.2). This was the engine bed, the solid base on which the cylinder was seated and to which it was bolted. The blocks are over 0.5m deep and through each is drilled one of the four holes for the holding-down bolts that kept the cylinder in position. These have a diameter of 120mm and are at 1.4m centres. At the Nag's Head the engine bed is in two halves. These two blocks are about 0.3m deep and there are two holes drilled in each one. Each hole is about 60mm diameter and in two of them the holding-down bolts are still *in situ*. These have a diameter of 35mm. They are at 1.1m centres.

Rows of joist holes in the north and south walls indicate the first-floor level. This was lit by windows in the north wall and west gable. The masonry below that window had been removed and subsequently partially rebuilt. Between its lintel and the cill of the second floor window are a pair of primary sockets that go through the masonry and presumably took substantial beams. There are two similar beams at the Nag's Head.

The end of an even more substantial beam survives, cantilevered out of the north wall (Fig 4.5). This is fitted through a primary opening in the masonry and there is an empty answering opening in the south wall. The beam fragment is at least 700mm square and clearly once spanned the building. The second floor was completely open at the east end and lit by a single window at the west; this window's north splay has been rebuilt.

There is no doubt that this engine house housed the Cornish engine built in 1858. The pit inside the building would have contained some of the ancillary beam operated workings and in this instance it is possible that it also contained the condenser. The cross-section of the pit (Fig 4.7) is very similar to that of the comparable feature at the Nag's Head, having various openings in identical places (cf Figs 3.6, 38 and 39). This may also be true of the Nag's Head. However, that may, as was quite common with Cornish engines, have been in the pit between the engine house and shaft but the evidence either way is inconclusive.

The two upper floors provided access for general maintenance of the moving parts of the steam engine. The only slightly unusual aspect of the building is the ground floor opening in its west gable wall. The original wide opening appears to have been primary but was not finished with worked stone jambs in the way that all the other openings were. The window inserted within the opening was. It seems unlikely that the wide opening without such jambs would have been intended to remain open for long. The fact that the opening was the same width as the engine bed suggests that it was a constructional or erectional feature. It may also have been deemed prudent to provide for the removal of the engine for replacement or curtailing of its operation.

It is possible that the engine was sold to the Snailbeach Company who purchased a beam engine with a seven foot stroke from the foundry for their Pontisford colliery in February 1859.

Building E – west boiler house

Immediately to the north of the Cornish engine house (building D) are the remains of a long rectangular structure with a small attached north wing. Overall it is 14.3m long and just over 7m wide. In the north wall there is a blocked low and narrow opening at ground level with a semi-circular brick head. Low in the middle of the west gable is a square headed opening that leads into a narrow flue that must have lead to the base of the stack. The east end appears to have been open. It is difficult to make any direct comparisons between this structure and the Nag's Head.

Building G – the balance-bob pit

The balance-bob pit lies immediately to the south of the shaft head and consists of a roughly square enclosure cur into the hillside and reached through a narrow passageway. All its walls are, therefore, rubblestone revetments, holding back the earth. The height of the original floor level is not known but it does not appear to have been much lower than the present one.

The main enclosure is 3.6m long and 3.2m wide. The south wall, the tallest is over 5m high. There is a distinct stepped drop in each of the side walls about 1.7m from the south wall, and the walls of the access passage are lower still. In each of the side walls are two long, deep slots in the masonry that line up with those in the opposite wall. These are just under 2m above ground level. In the passageway there are two narrow vertical slots in the west wall and one in the east, evidence for a second in that wall having been removed.

This structure contained the 'balance-bob' attached to the main pumping rod of the Cornish engine to improve pumping efficiency. The bob was simply a large box filled with rubble and scrap. It was attached to a pivoting connecting beam, the other end of which was linked to the main pump rod hanging from the shaft end of the engine's balance beam.

It is difficult to make any direct comparisons between this structure and the Nag's Head.

The engine house need not have been 'house-built' in the standard manner, where the steam engine is in place while the engine house is being built around it. The evidence could suggest that a gap was left in the masonry for the cylinder to be installed after the engine house was finished, with the intention always of converting the opening into a window once the cylinder was in place. It may also have been deemed prudent, particularly in the volatile career of a lead mine, to leave the central portion of the gable wall thinner than the rest to allow it to be removed without too much difficulty if the cylinder needed to be taken out – either for repair, replacement or to be sold.

Tankerville Mine engine house
A survey of the Tankerville Mine engine house was undertaken in 1998 by Shropshire County Council Estate Services Group. The overall dimensions of the plan of the engine house were 8.35m long by 6.12m wide with the bob wall being 1.17m thick and other walls 0.8m thick (Fig 4.8). These compare with the dimensions of the Nag's Head which are 6.6m, 4.8m, 1.2m and 0.5m respectively. The bob opening at Tankerville (Fig 4.12) has a brick arch similar to that at the Nag's Head (Fig 3.1 and Appendix 2), although this example is a four brick arch compared with the Nag's Head which is a two brick example. All the other openings at the Nag's Head are spanned with timber lintels whereas Tankerville has a mixture of arches and lintels (Figs 4.9, 4.10, 4.11 and 4.12).

Areas where further work may be informative
Should the opportunity present itself, further work along the following lines might help to elucidate various aspects of the Nag's Head colliery:

- a geophysical survey may be able to locate other associated buildings and structures.
- further, modest ground level reduction, in the immediate vicinity of the two identified boiler houses might identify the nature of the boilers formerly used.
- modest ground level reduction, in the immediate vicinity of the shaft might be able to identify equipment associated with its use (eg Fig 4.15).

Summary
Survey, documentary research and watching brief undertaken as part of a project for the stabilisation and repair of a scheduled engine house at Pontesbury, Shropshire has demonstrated that the building has four principal phases. Built in the late 18th century (1784) in order to exploit the local coal field for the smelting of lead, the engine house may have originally held a Newcomen beam engine. This seem to have been replaced by 1840 with a Boulton and Watt engine as the tithe map shows an adjacent building, presumed to be a boiler house. This was demolished by 1873-84 when the 1st edition Ordnance Survey map shows another boiler house on the opposite corner of the engine house. Around this time the engine house went out of use and was converted to a domestic dwelling. By the time of the 2nd edition Ordnance Survey map, 1899-1902, the dwelling was itself disused.

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Acknowledgements
The author would particularly like to thank Andy Foster of Foster Surveys, John Goom of John C Goom Architects, the Splitlath team, John Tiernan of Historic England and Mike Shaw for their kind assistance and co-operation.

Archive

The archive consists of:

19	Pages of text
60	Illustrations
1	DVD-ROM
1	Unbound copy of the report
1	Copy of the brief
1	Copy of the WSI

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Fig 1: Location of site

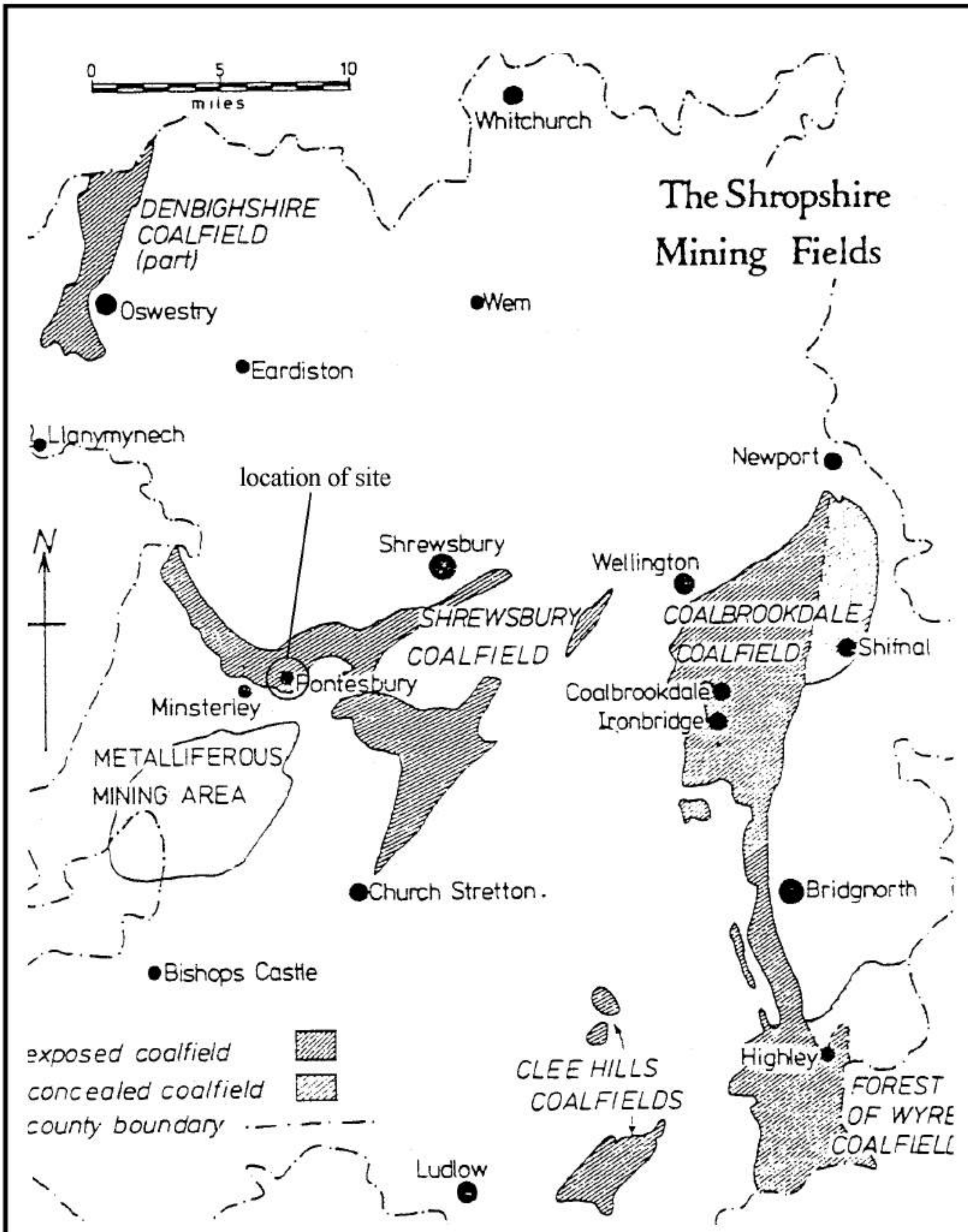
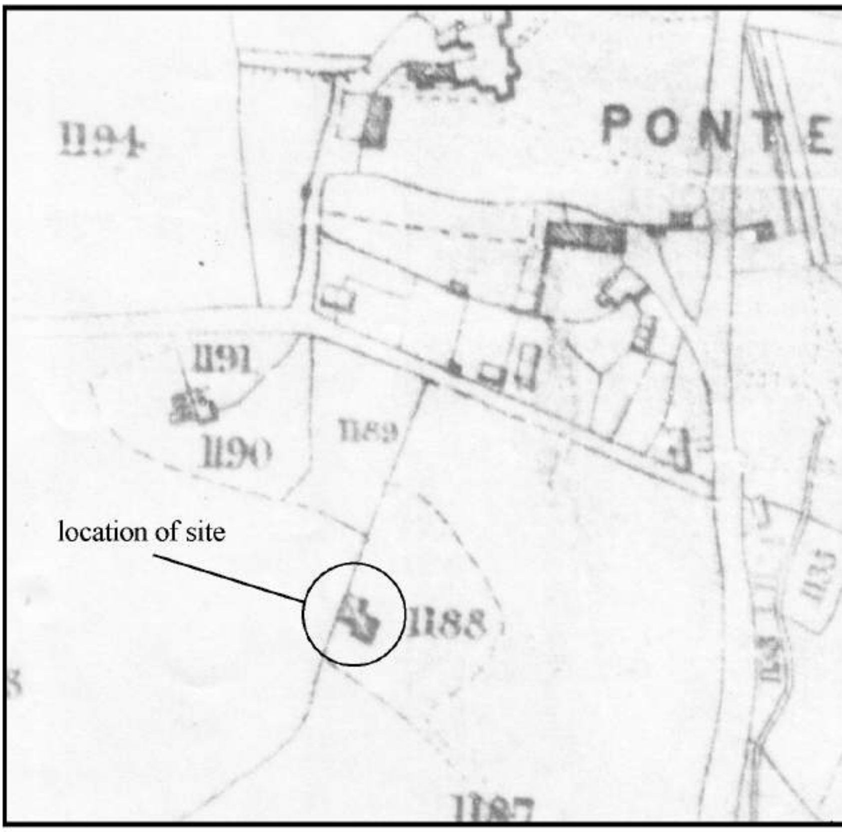


Fig 1.2: The Shropshire mining fields

1840



1873-84

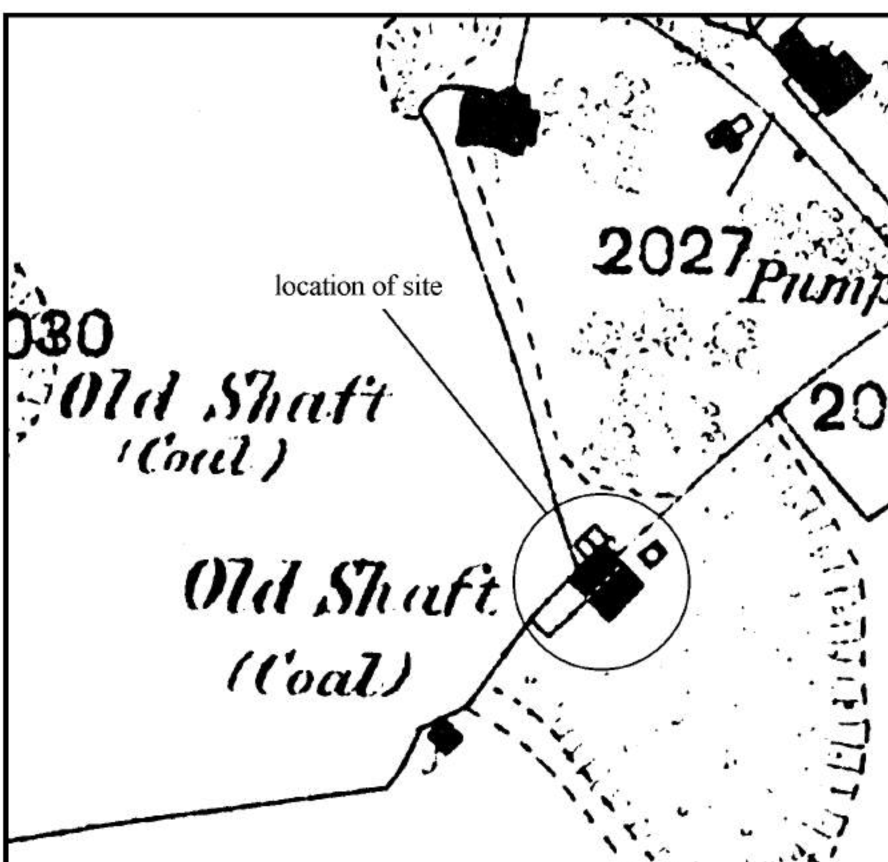


Fig 2.1: Historic mapping

1899-1902

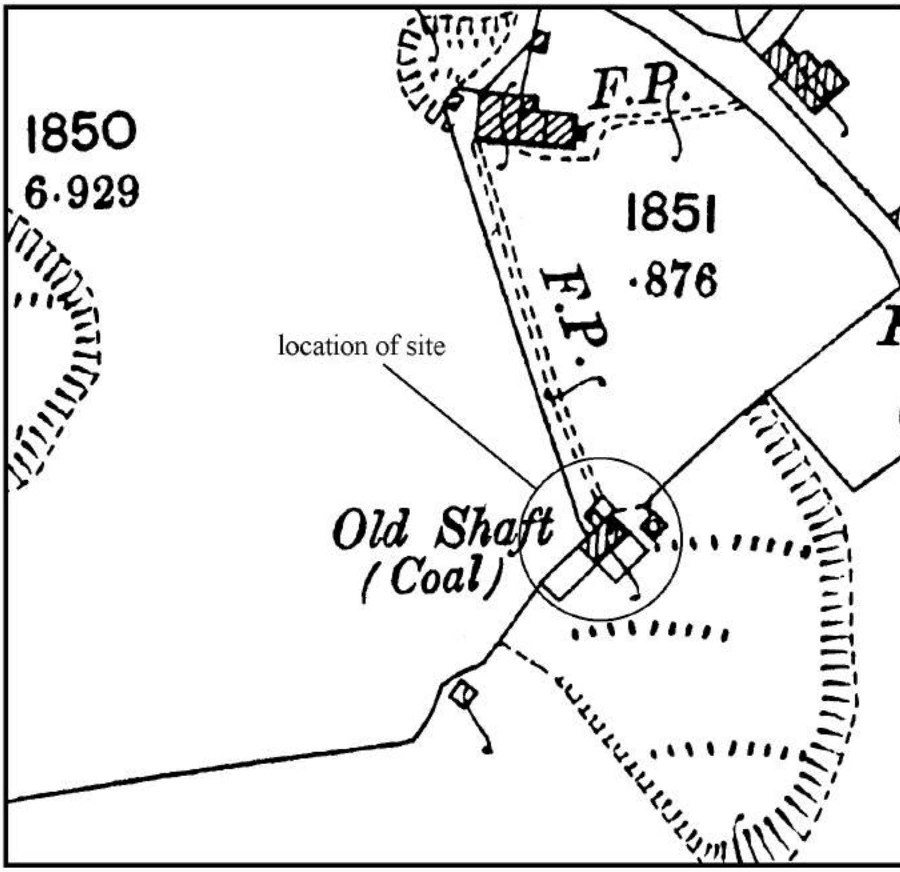


Fig 2.2: Historic mapping

Fig 2.2: Historic mapping

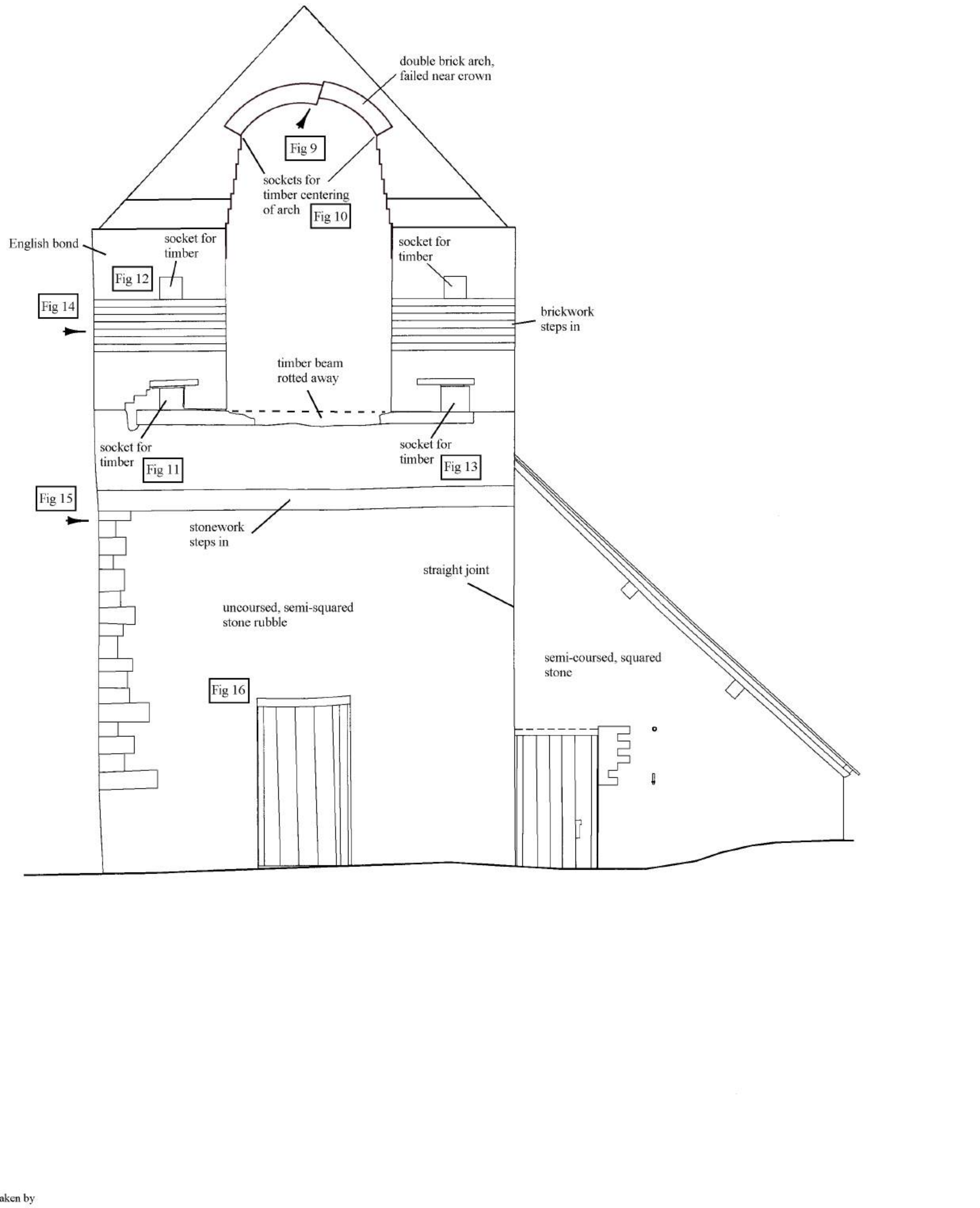


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Fig 3.1: North-east elevation

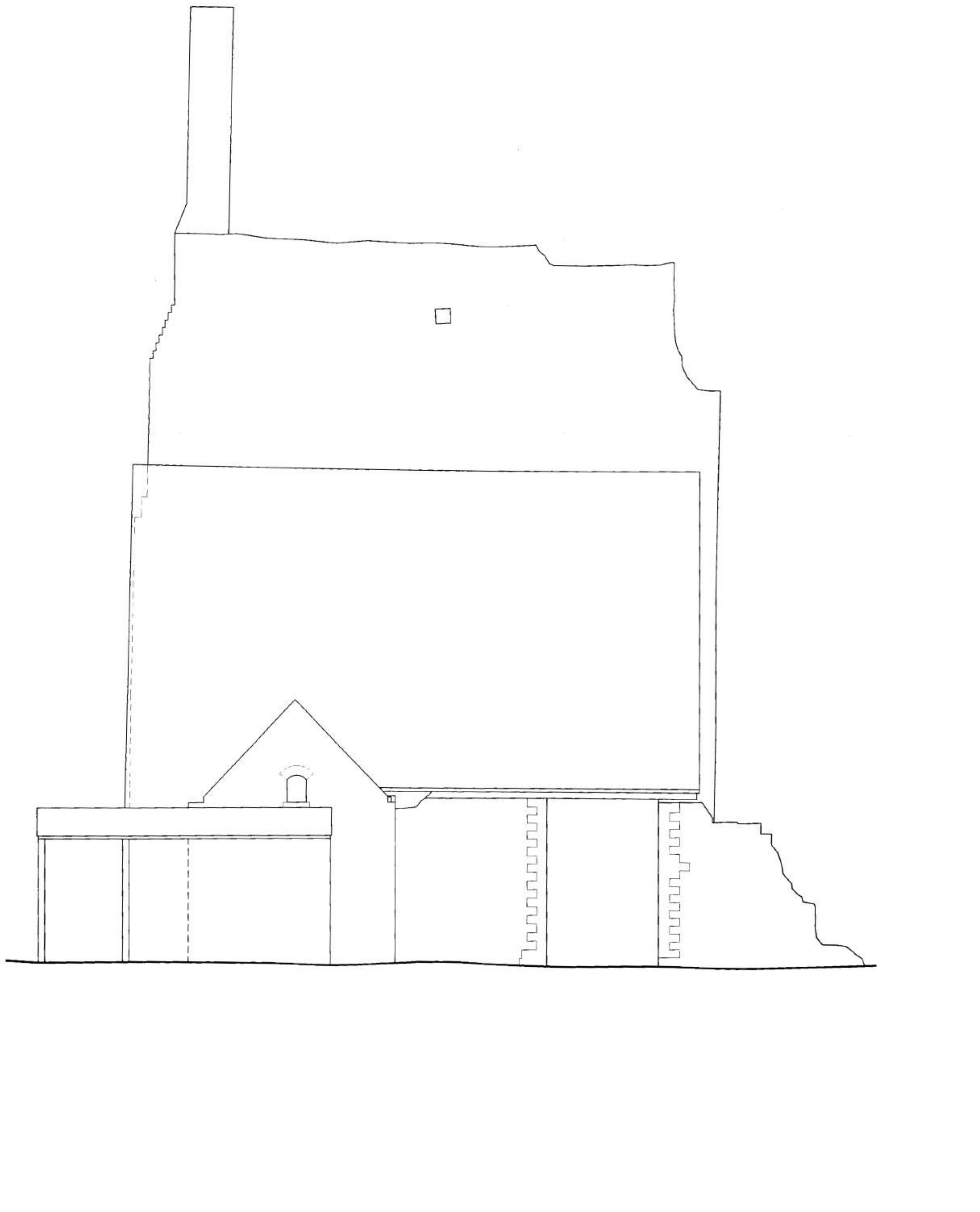

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Fig 3.2: North-west elevation

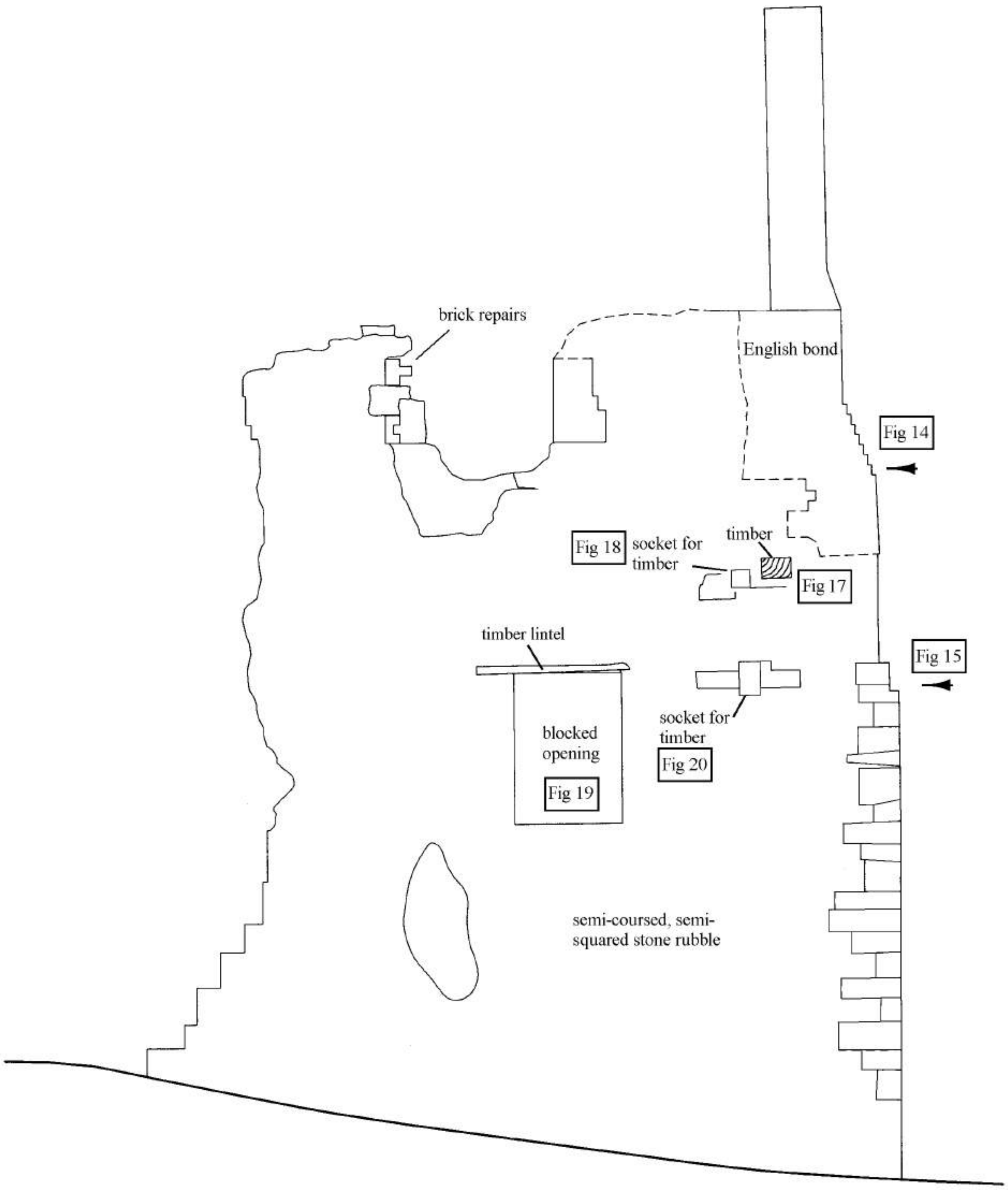

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Fig 3.3: South-east elevation

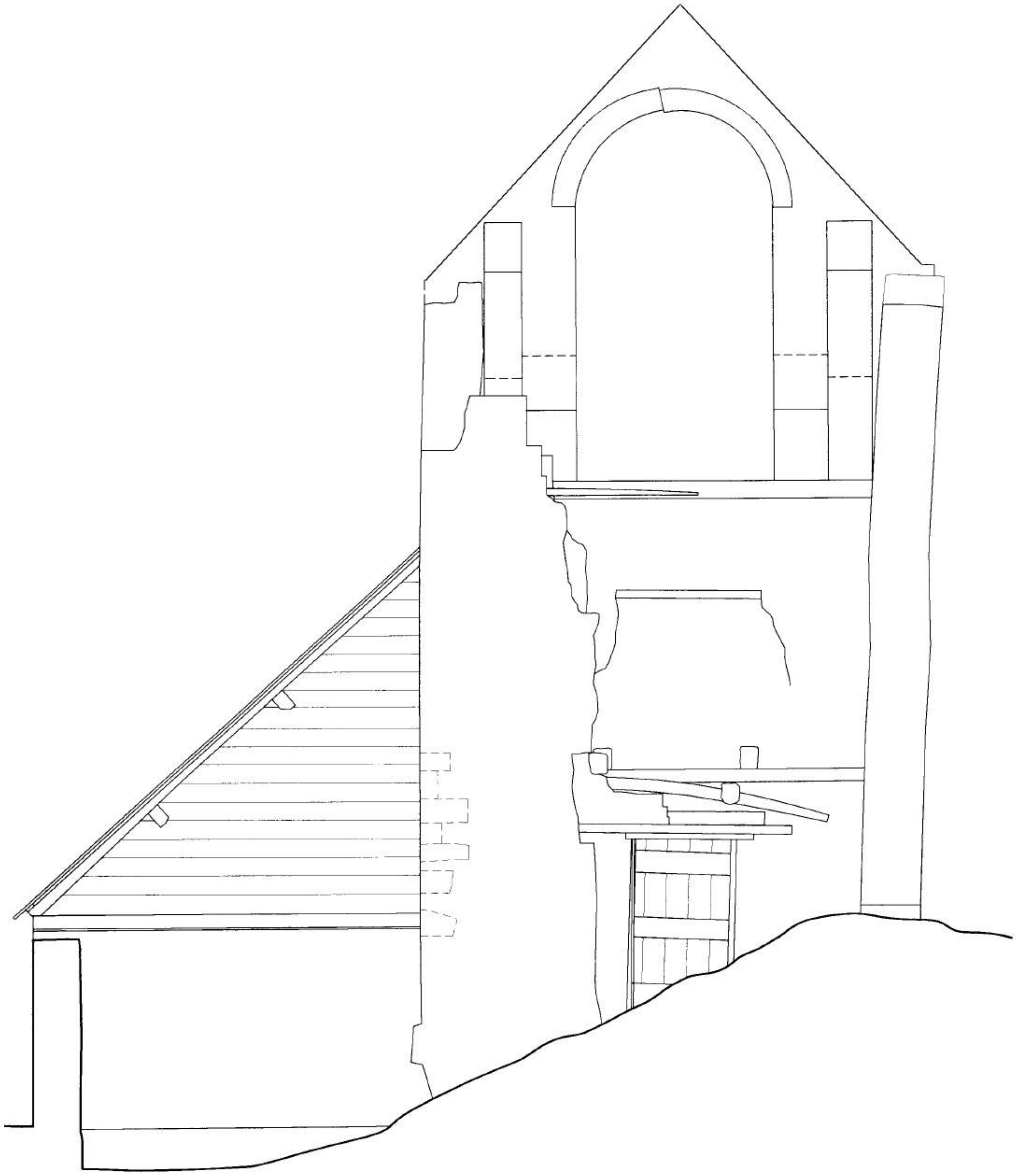

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Fig 3.4: South-west elevation

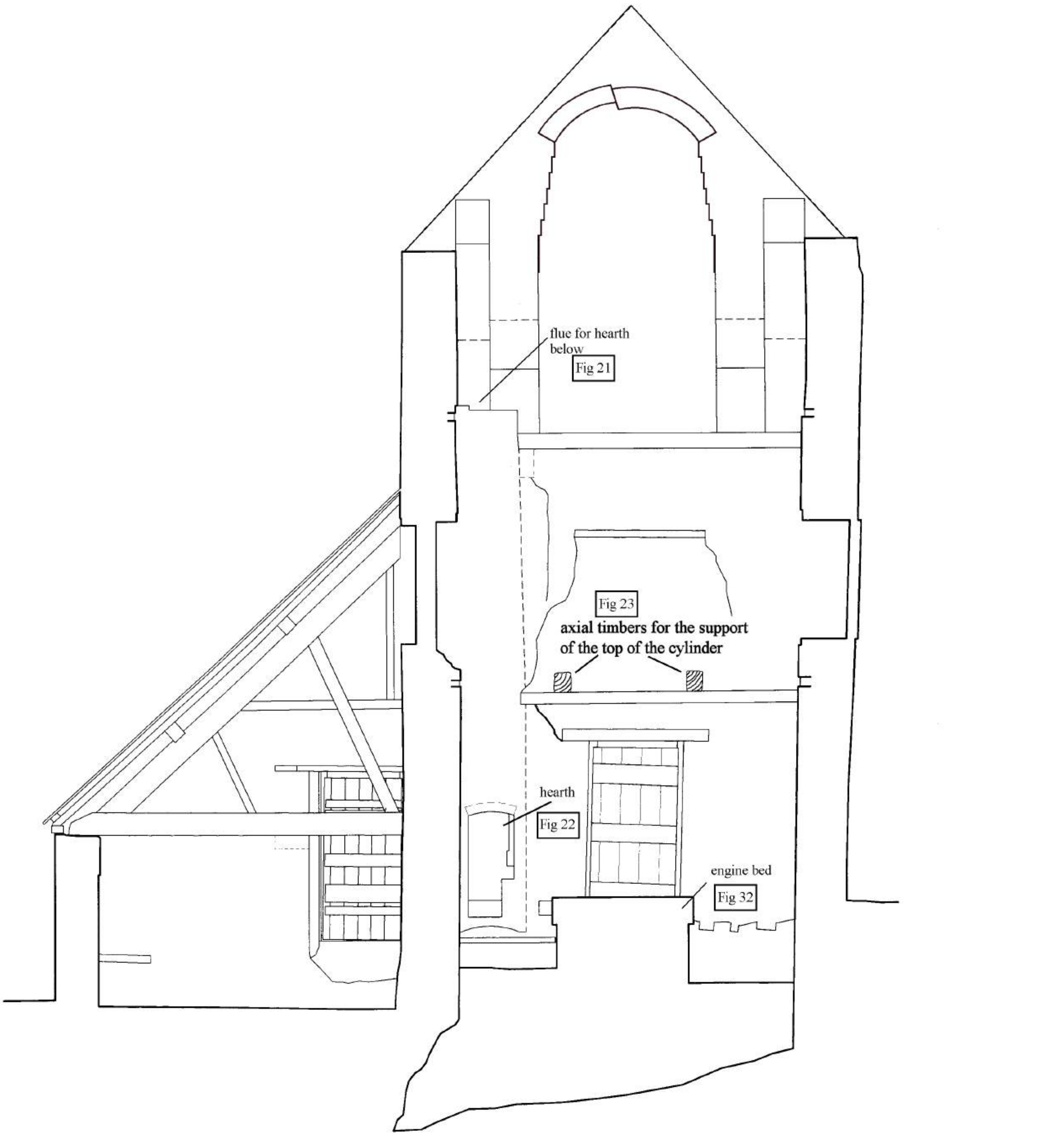

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Fig 3.5: Section B-B

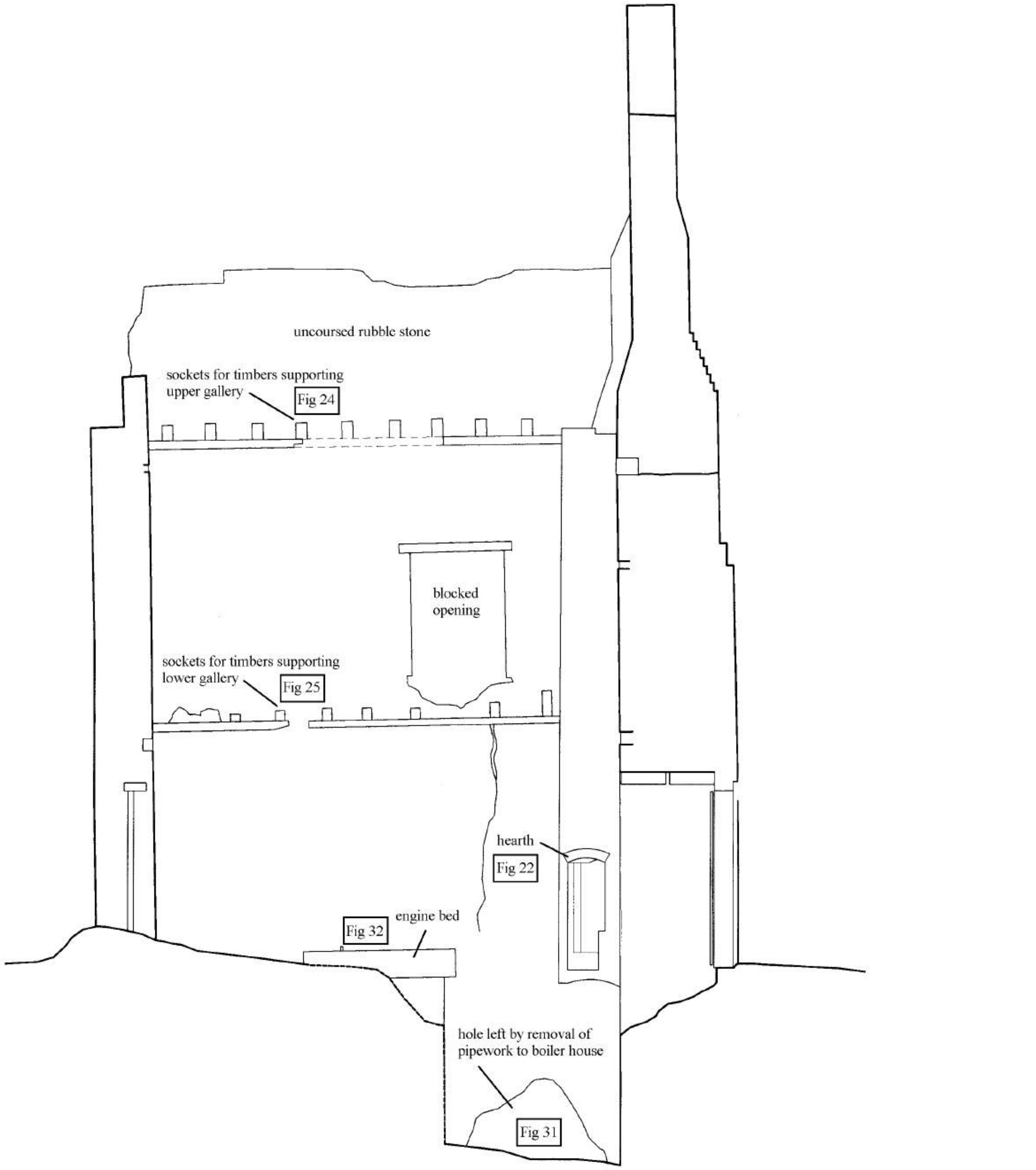

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Fig 3.6: Section C-C

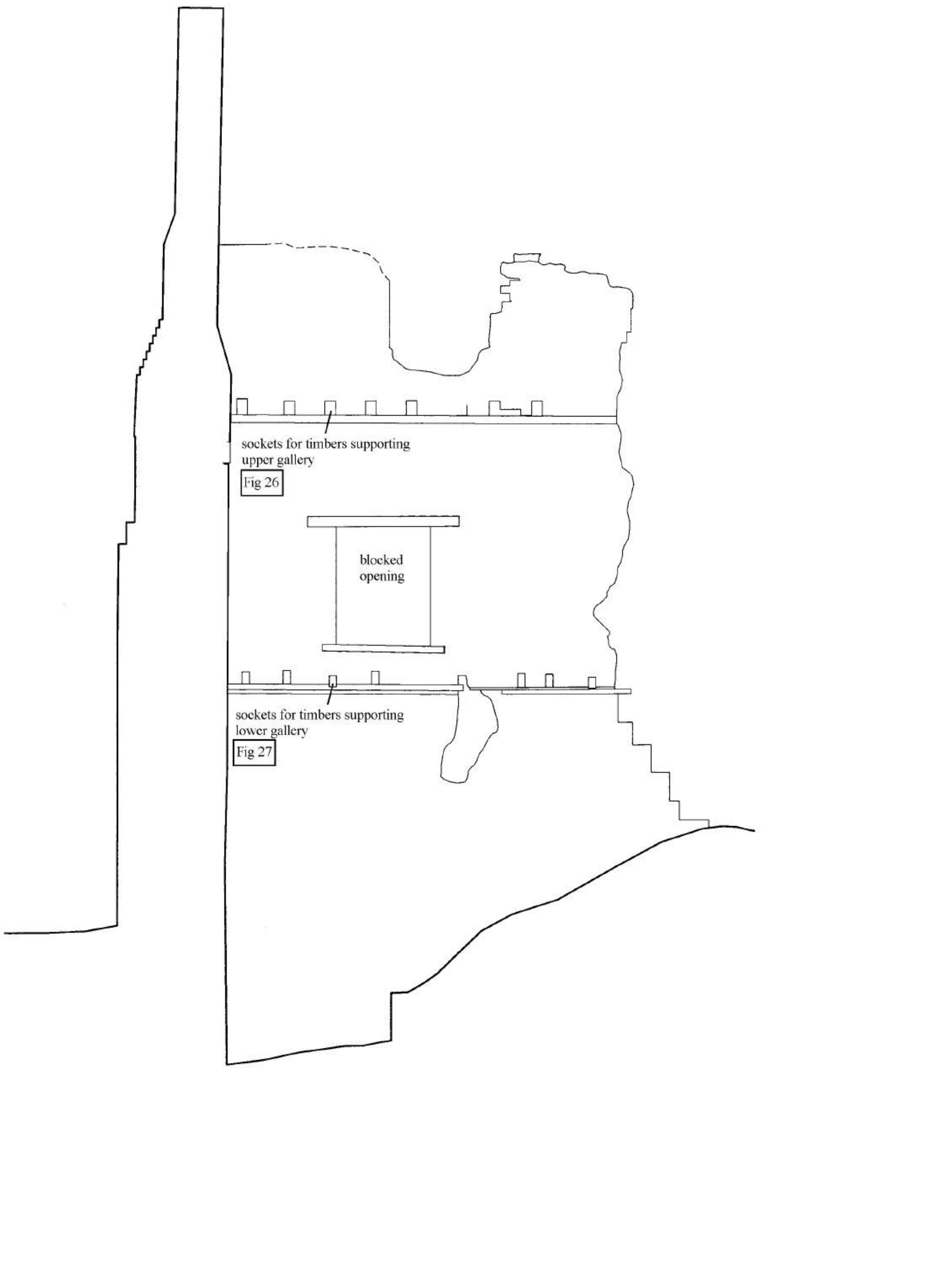

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Fig 3.7: Section D-D

Note: Phases 3, 4 and 5 are very closely contemporary and Phases 3 and 4 may have been very short-lived

- Phase 1: 1784 engine house; possibly housing Newcomen engine
- Phase 2: by 1840; construction of ?boiler hose and possible conversion to Boulton and Watt engine
- Phase 3: by 1873-84; demolition of Phase 2, construction of new boiler house and its disuse
- Phase 4: *c* 1870; reuse of Phase 1 structure as dwelling, construction of privy and insertion of fireplace and flue
- Phase 5: by 1873-84; demolition of privy, construction of lean-to structure
- Phase 6: by 1899 to 1902; Phase 1 structure disused as dwelling, Phase 5 structure continues in use

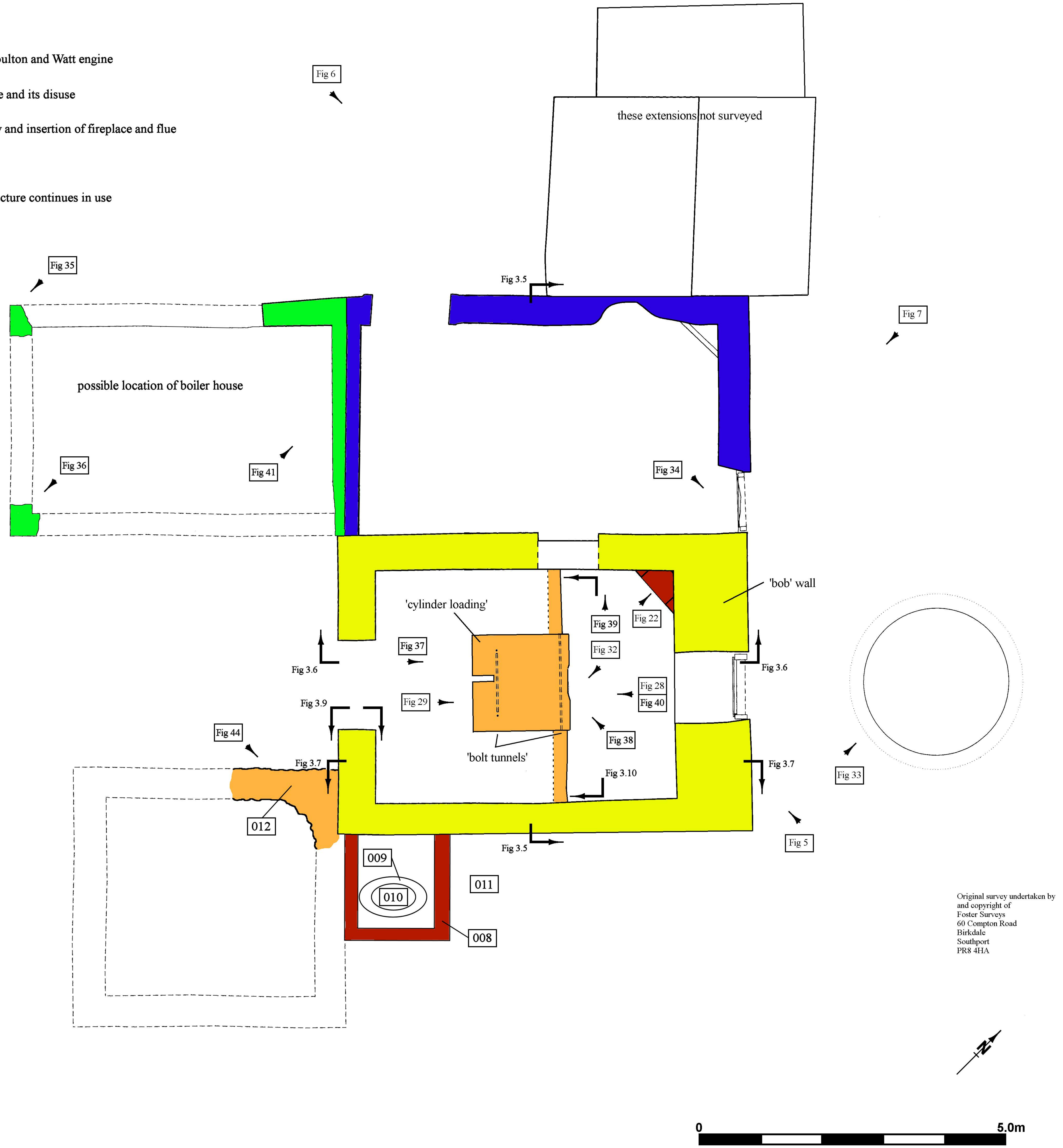
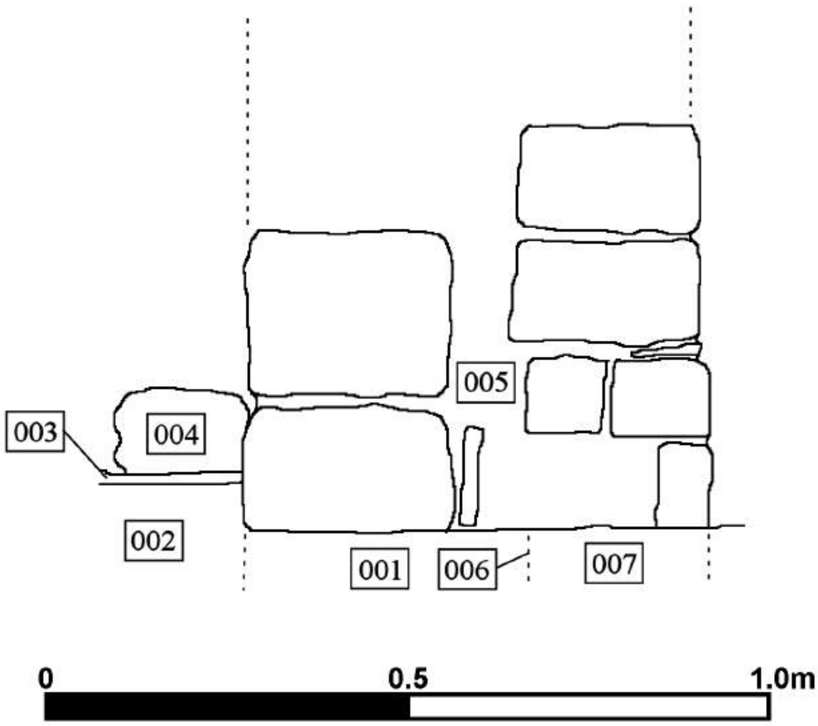


Fig 3.8: Ground floor plan



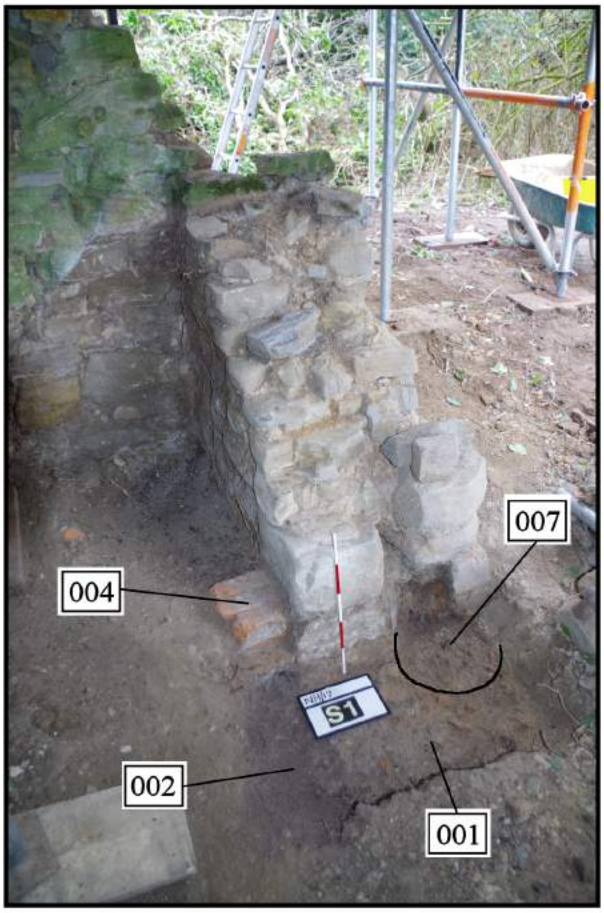


Fig 3.9: Section through Phase 1 engine house wall

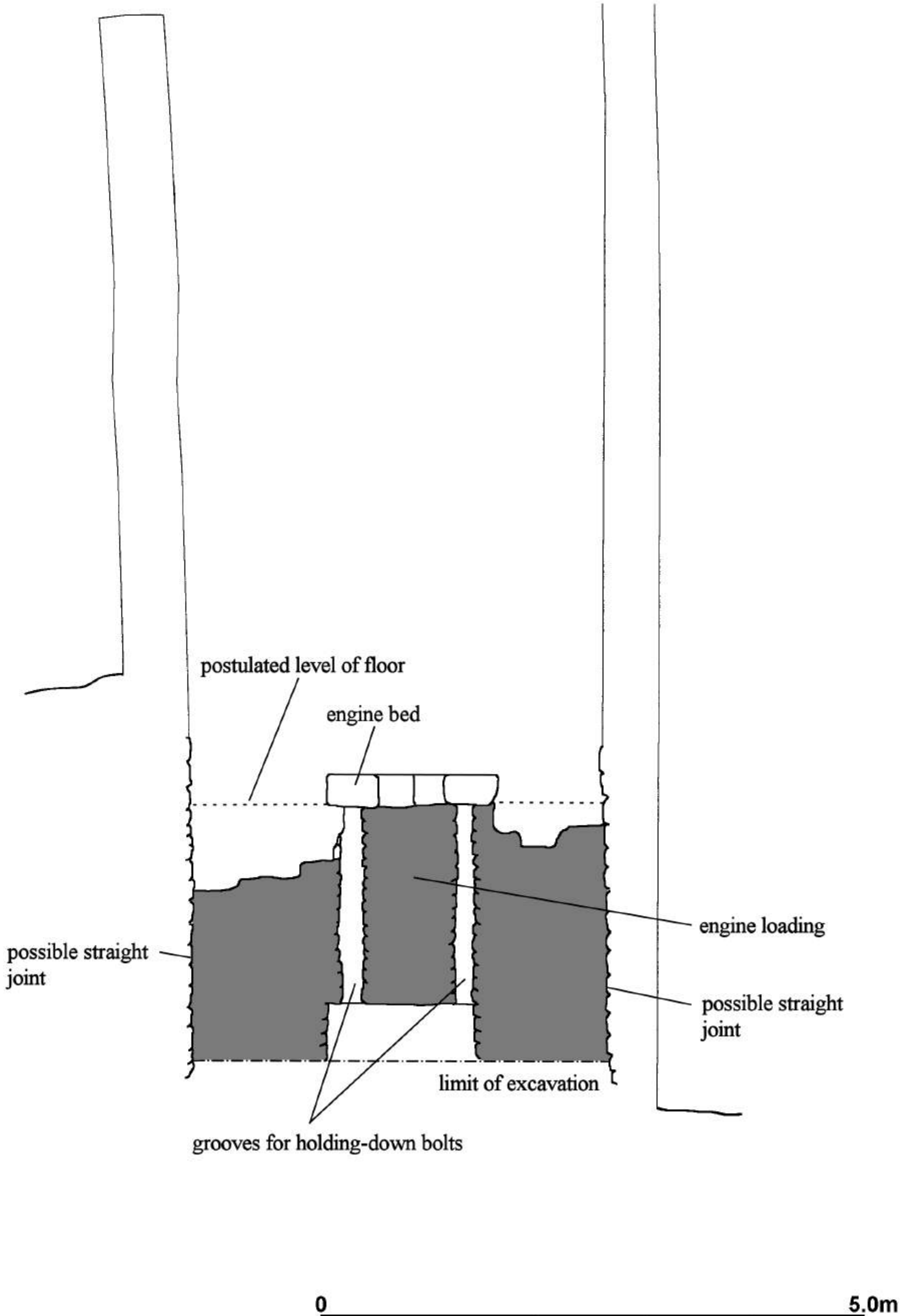


Fig 3.10: Elevation of wall supporting engine loading and engine bed

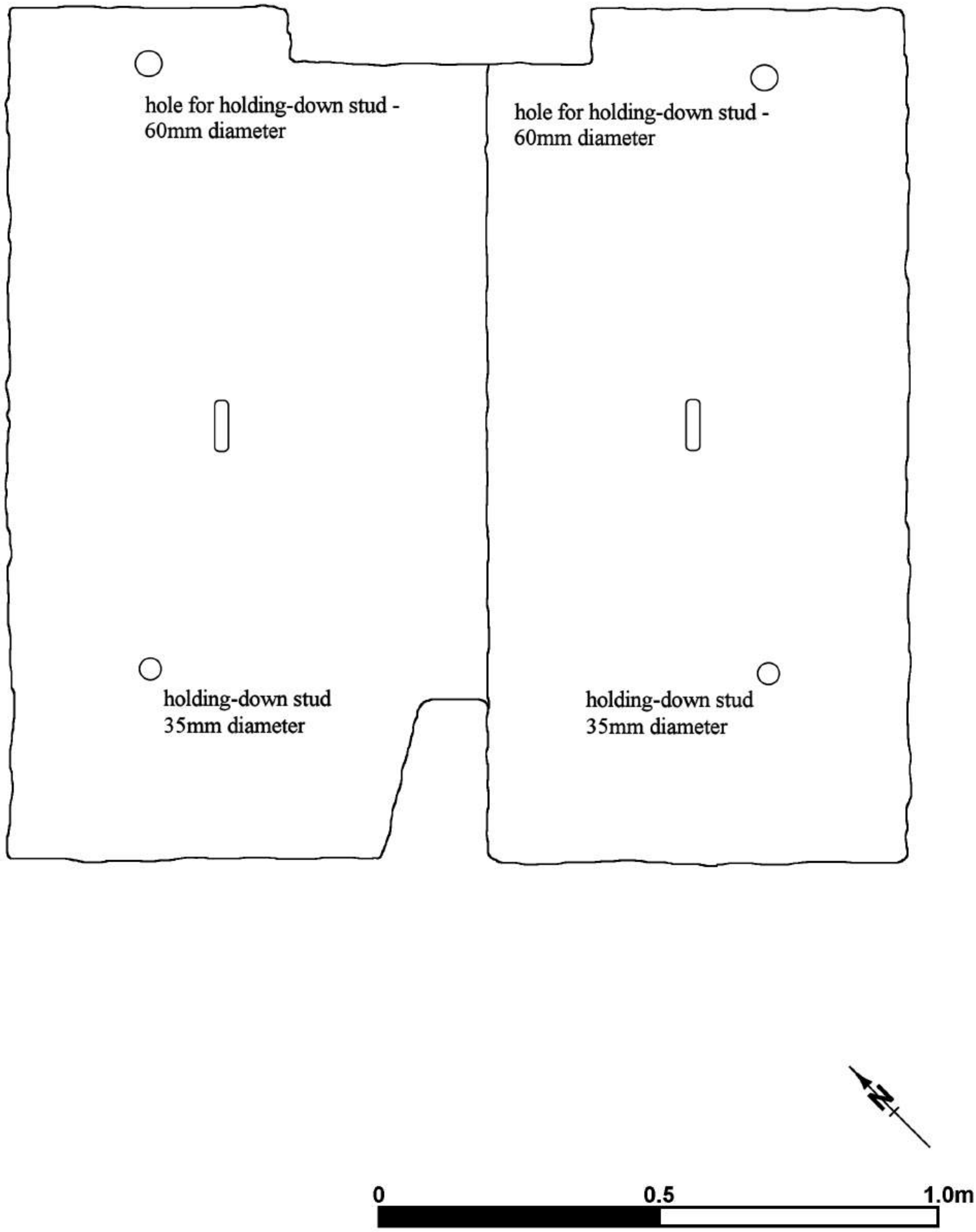


Fig 3.11: Plan of engine bed

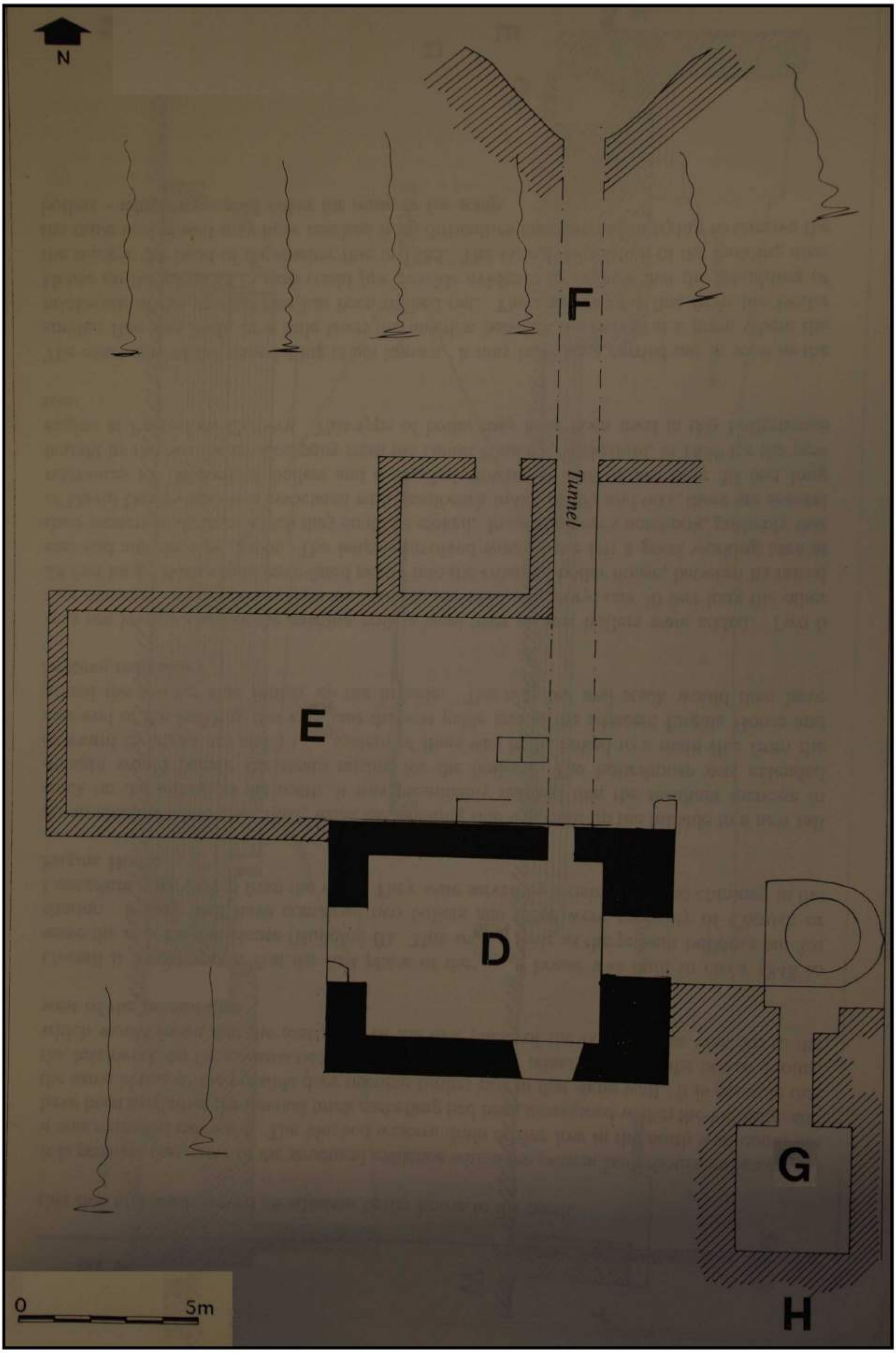


Fig 4.1: Cornish engine house and surrounding structures; Snailbeach, after Morriss 1997

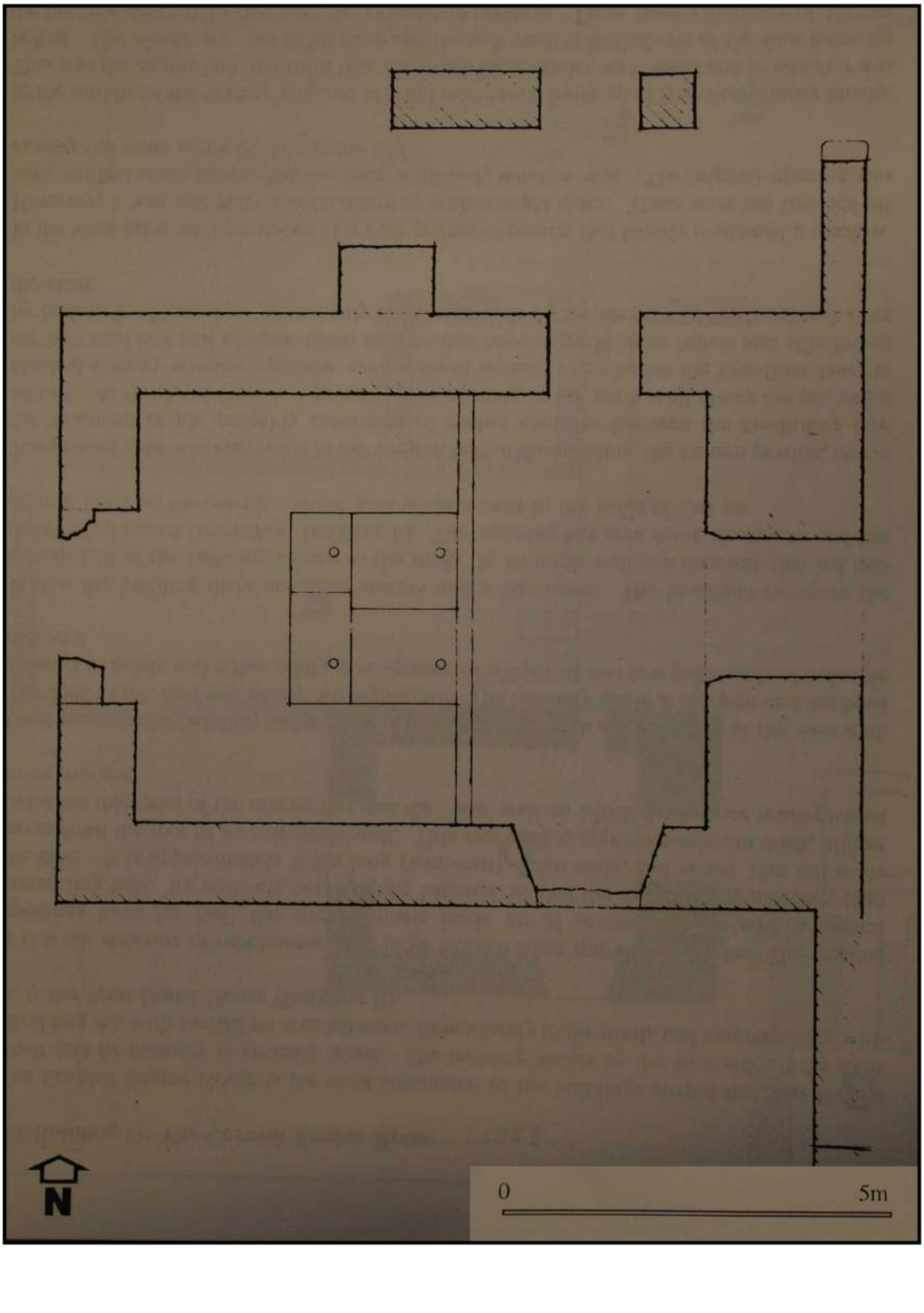


Fig 4.2: Cornish engine house, ground floor plan showing engine bed; Snailbeach, after Morriss 1997

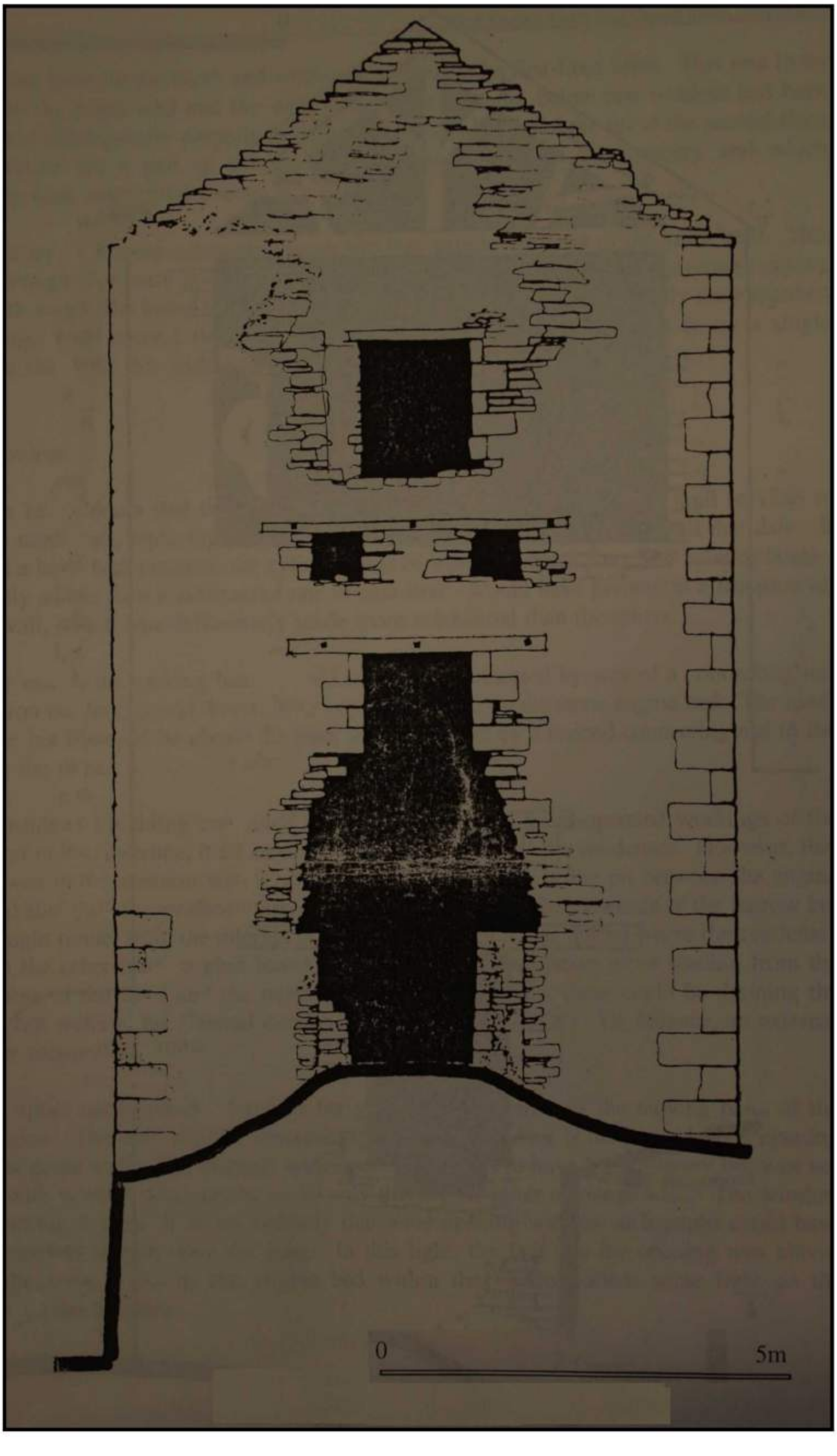


Fig 4.3: Cornish engine house; east elevation, Snailbeach, after Morriss 1997

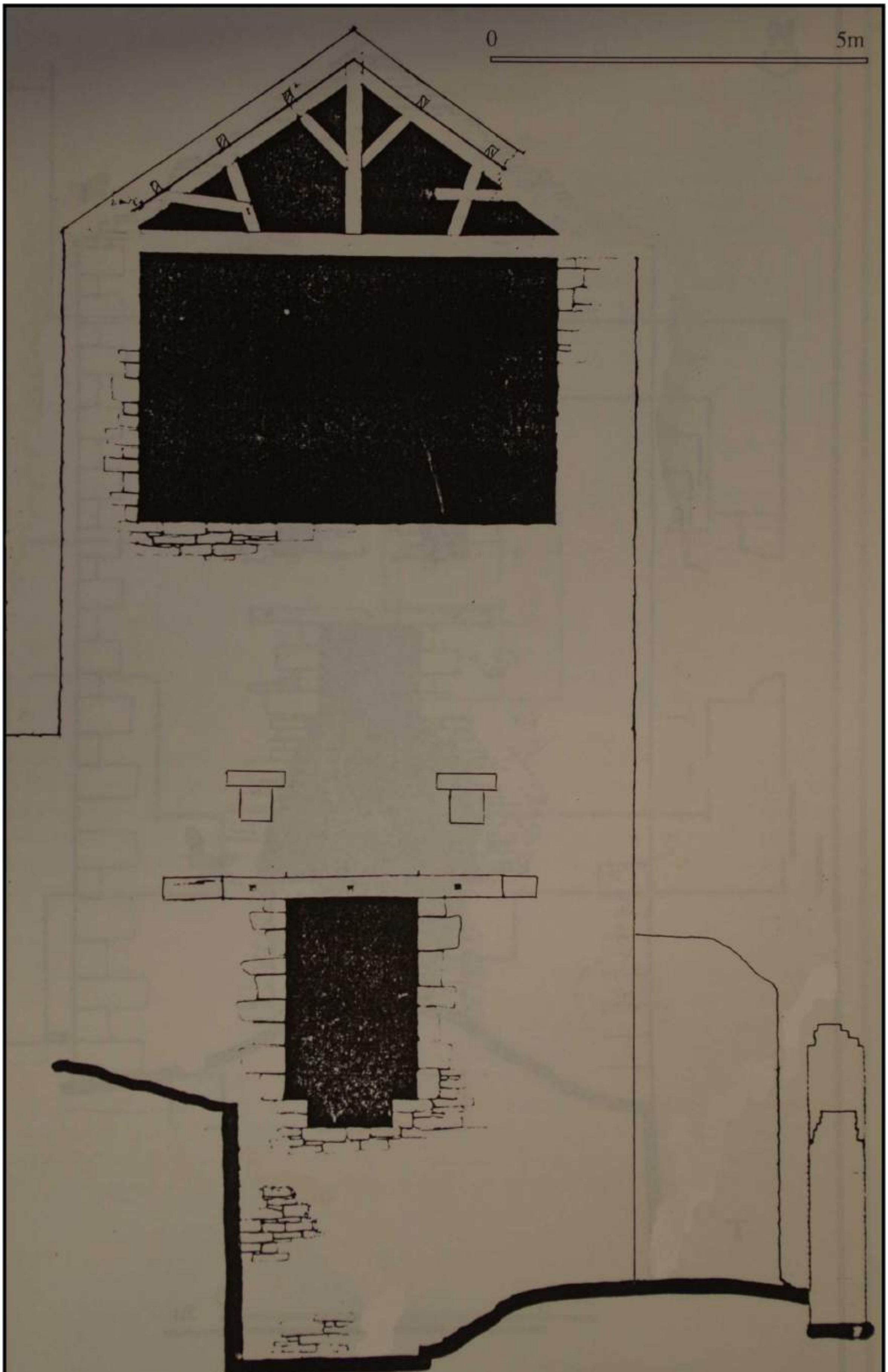


Fig 4.4: Cornish engine house; west elevation, Snailbeach, after Morriss 1997

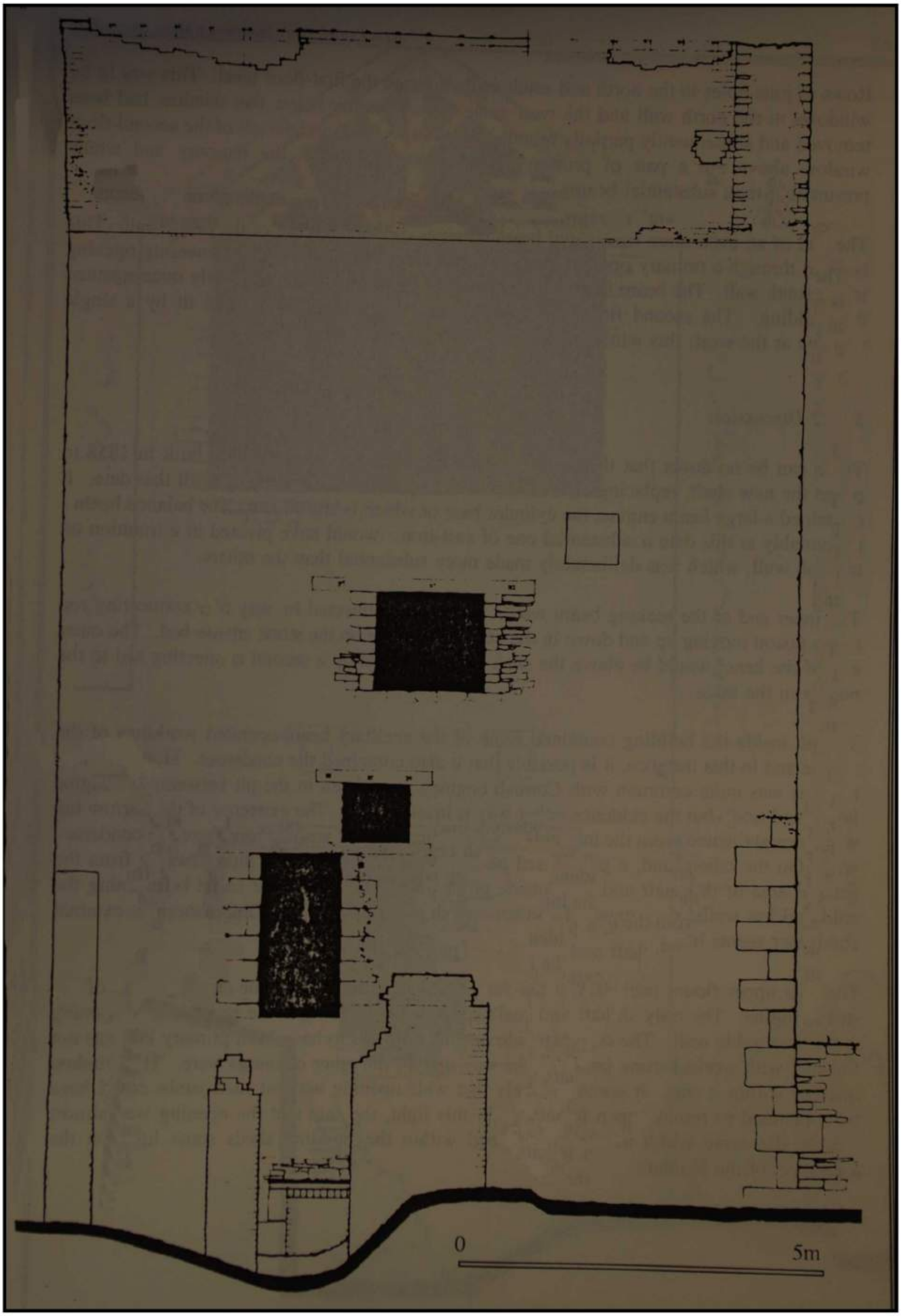


Fig 4.5: Cornish engine house; north elevation, Snailbeach, after Morriss 1997

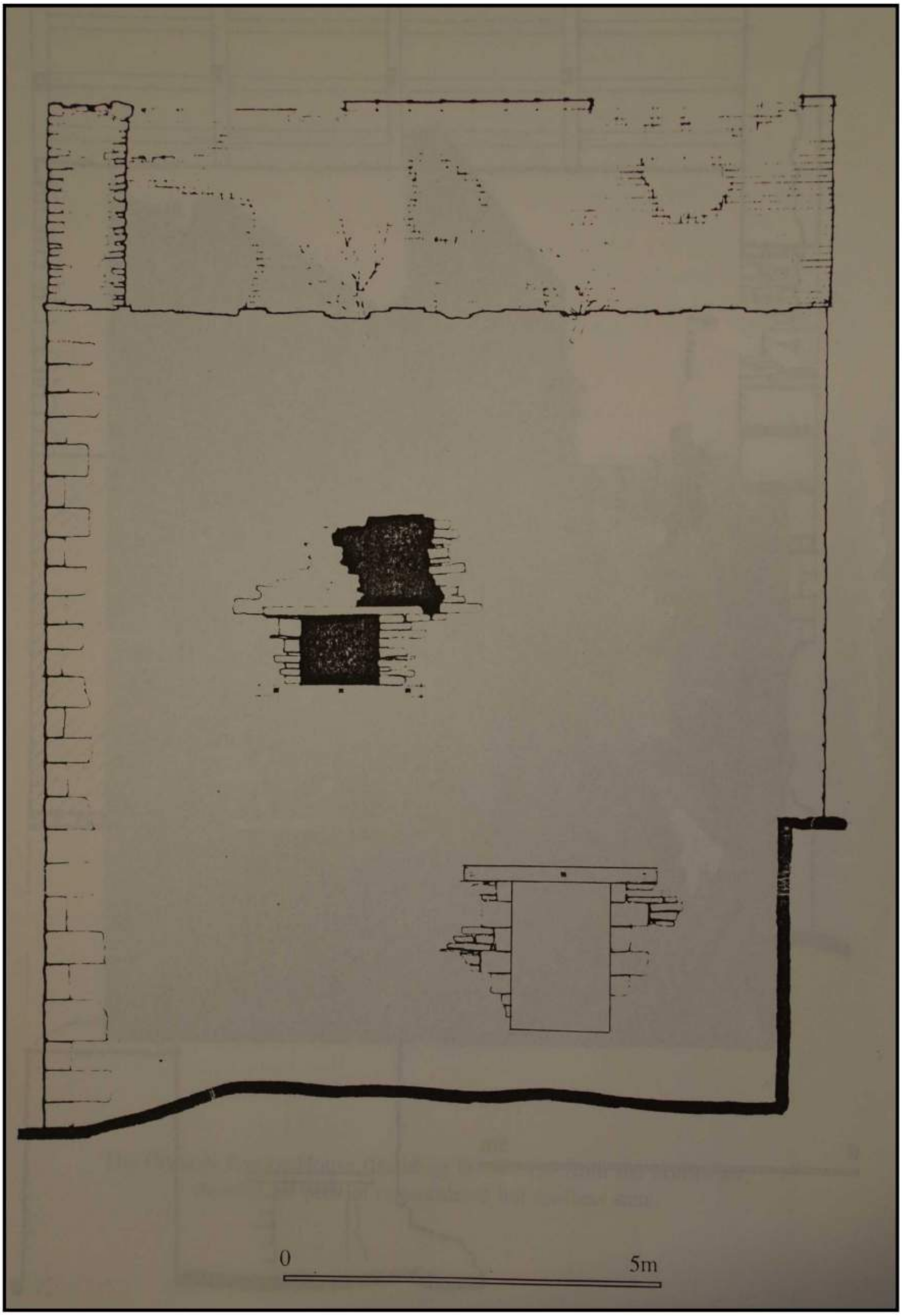


Fig 4.6: Cornish engine house; south elevation, Snailbeach, after Morriss 1997

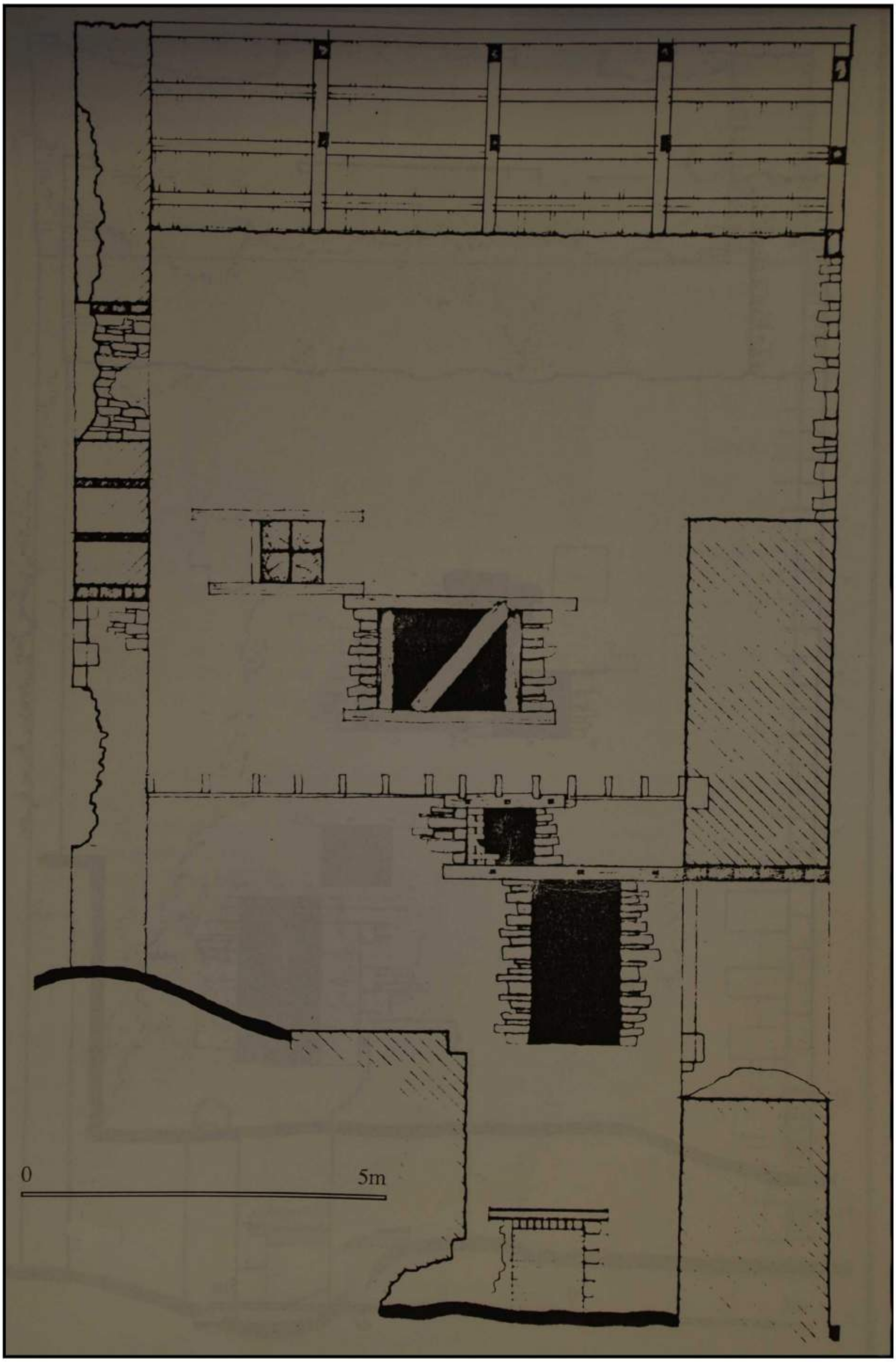


Fig 4.7: Cornish engine house; west to east cross-section, Snailbeach, after Morriss 1997

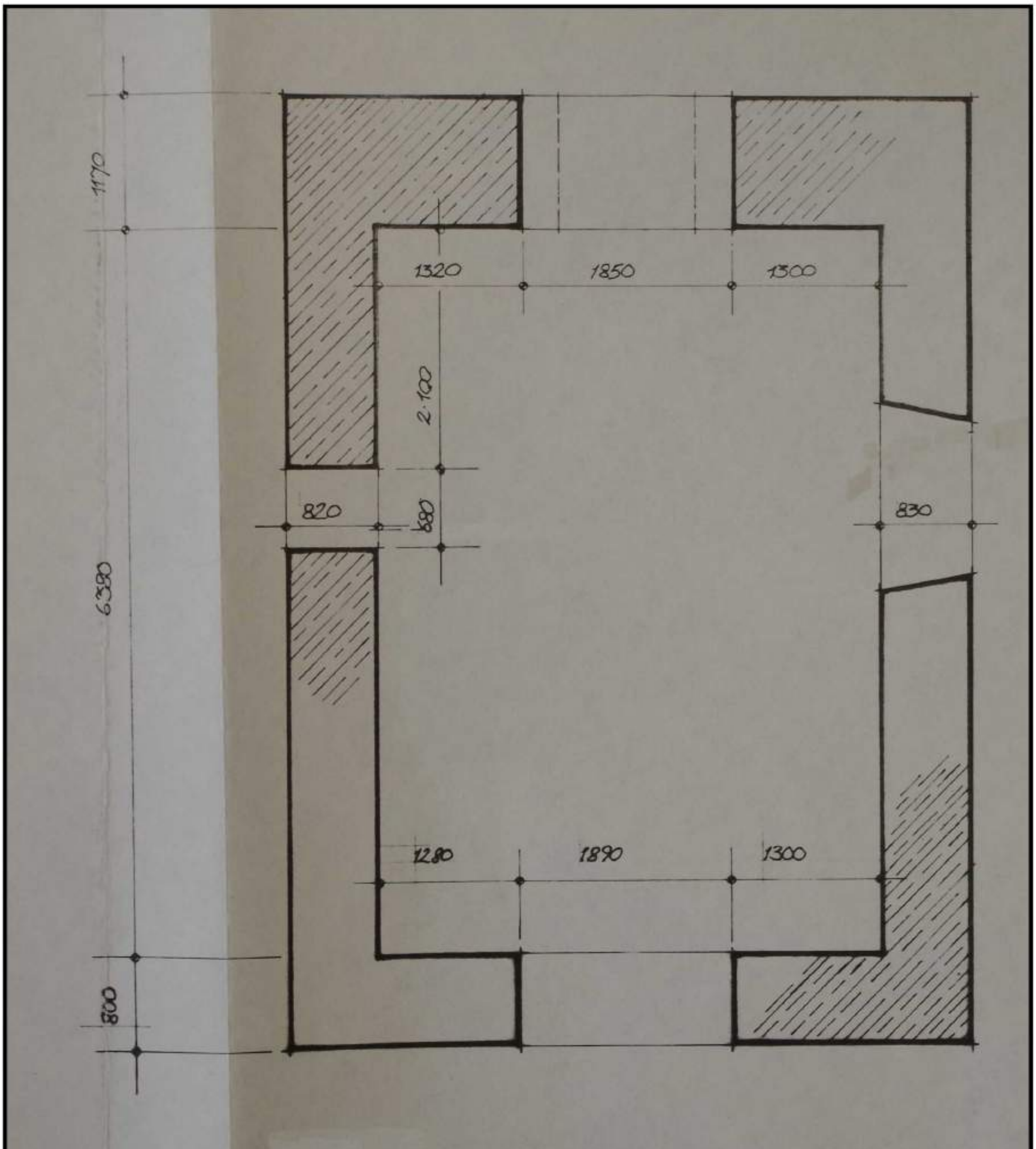


Fig 4.8: Engine house; Tankerville, after Shropshire County Council, 1998

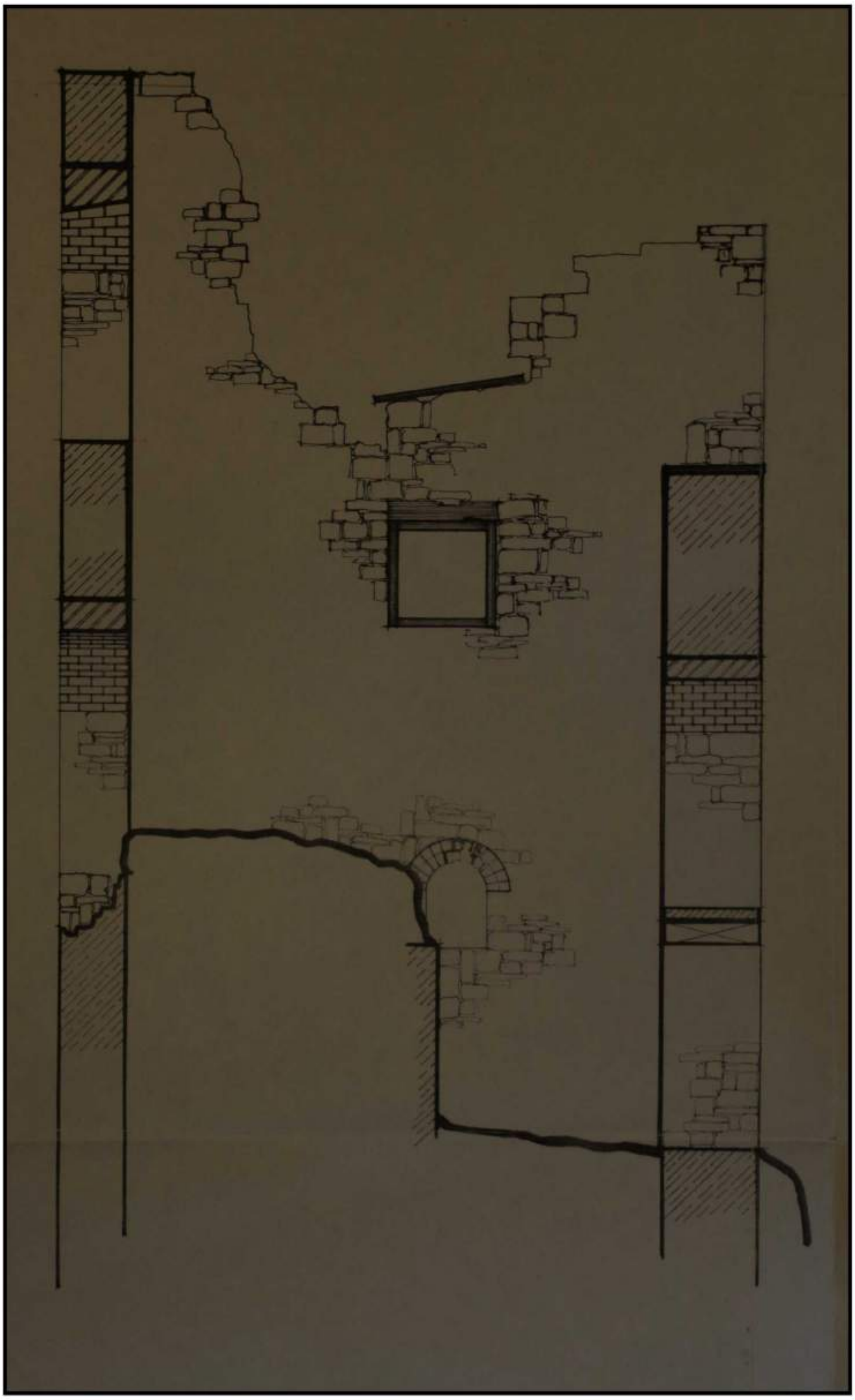


Fig 4.9: Engine house; north elevation, Tankerville, after Shropshire County Council, 1998

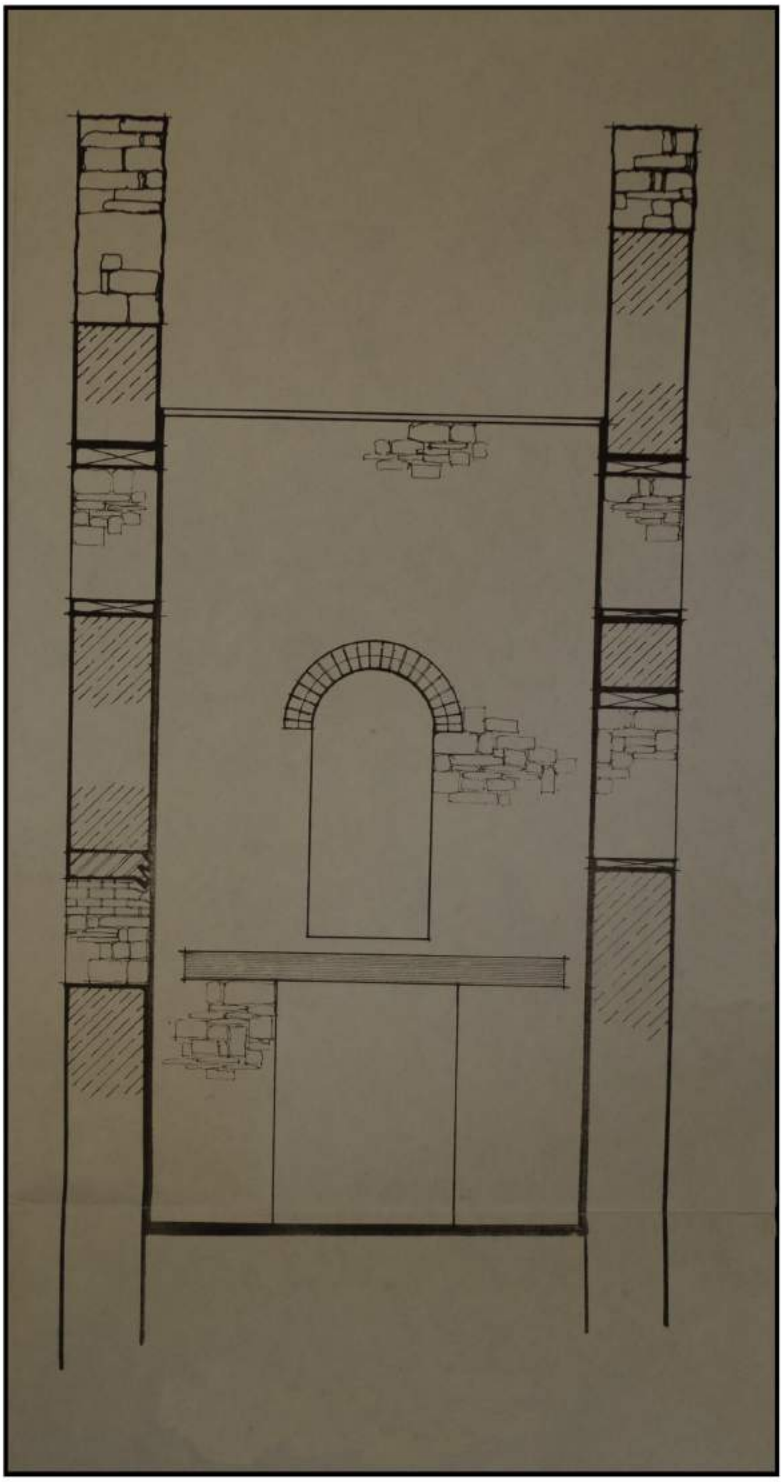


Fig 4.10: Engine house; east elevation, Tankerville, after Shropshire County Council, 1998

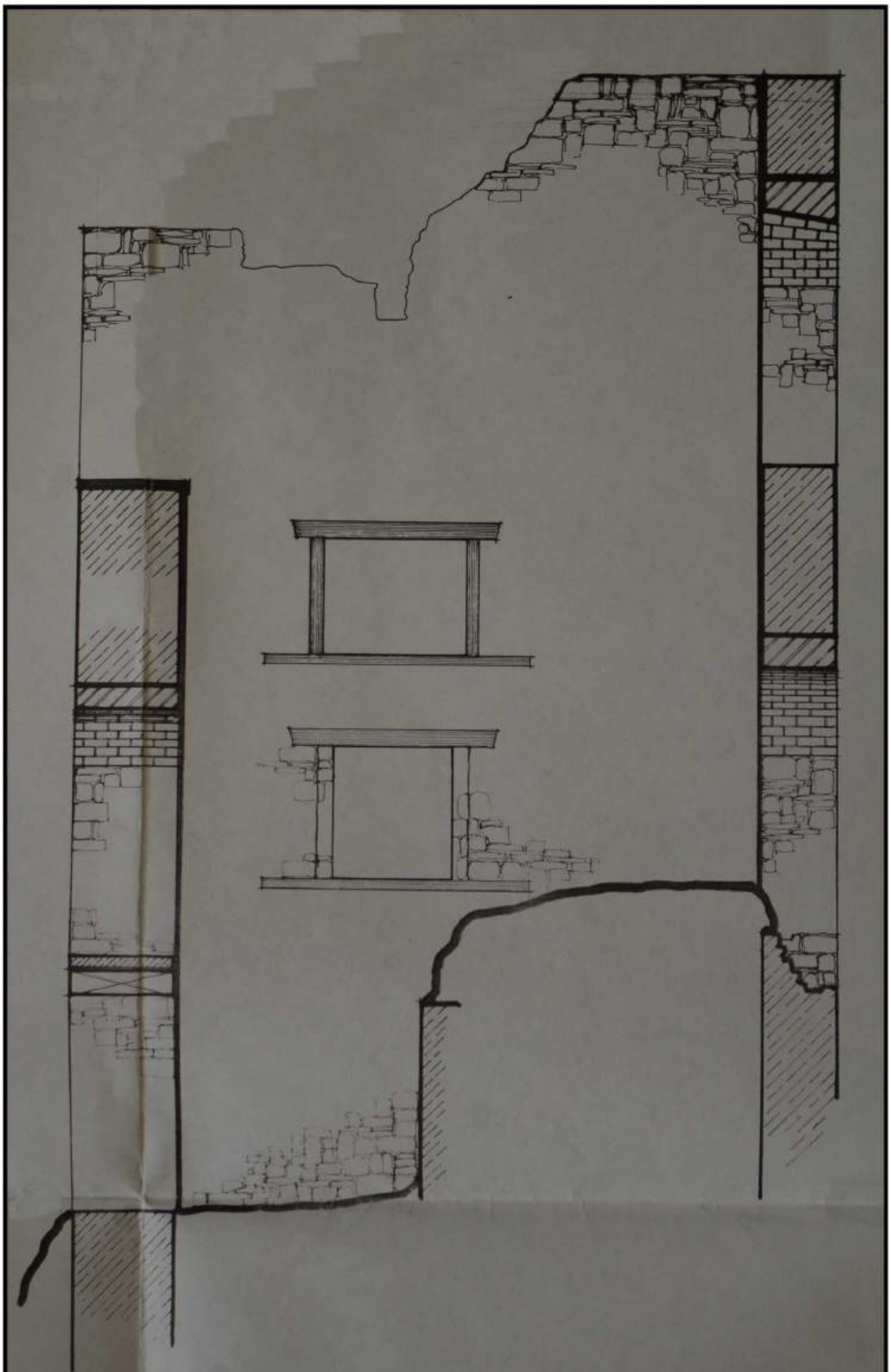


Fig 4.11: Engine house; south elevation, Tankerville, after Shropshire County Council, 1998

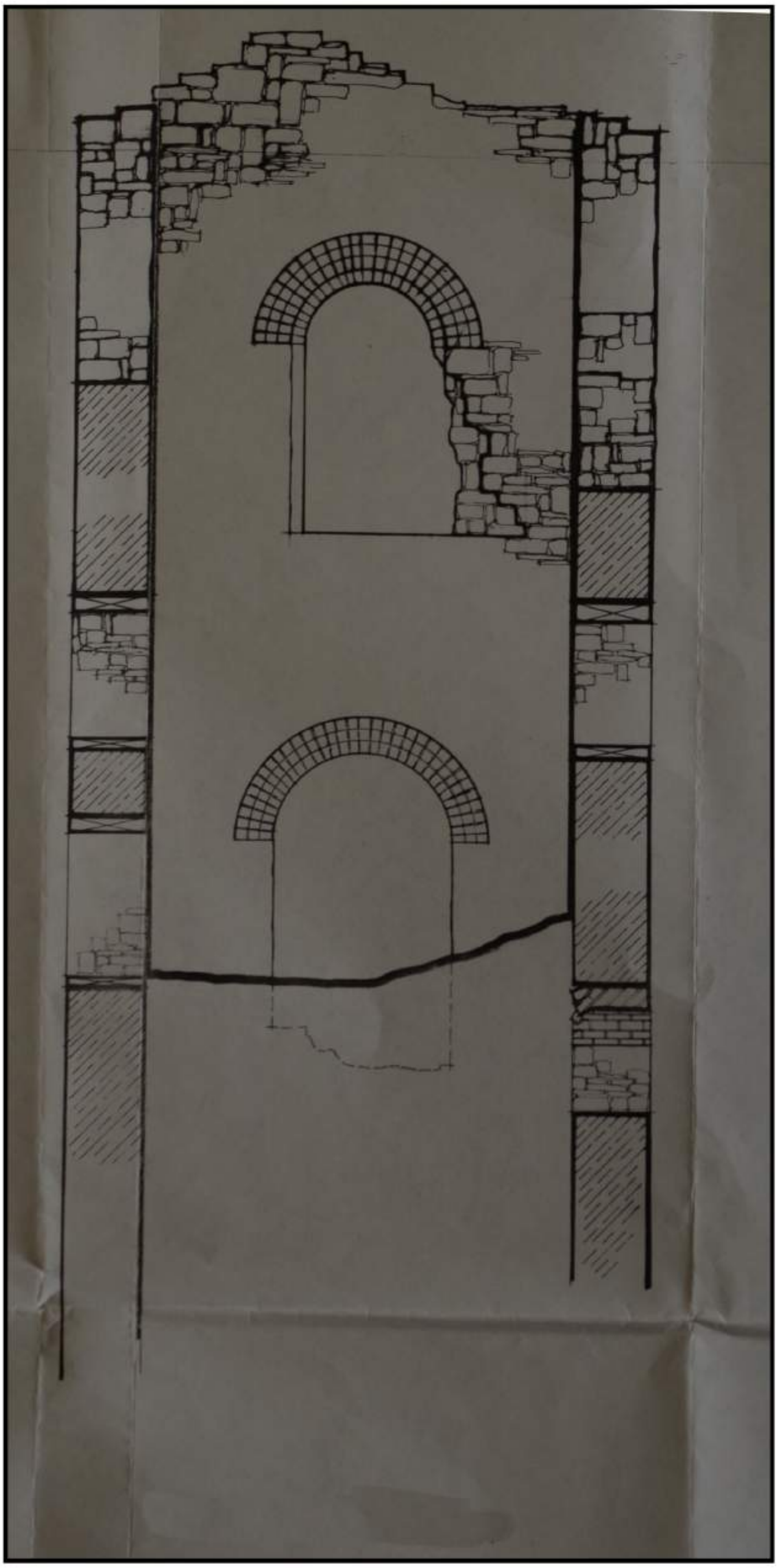


Fig 4.12: Engine house; west elevation, Tankerville, after Shropshire County Council, 1998

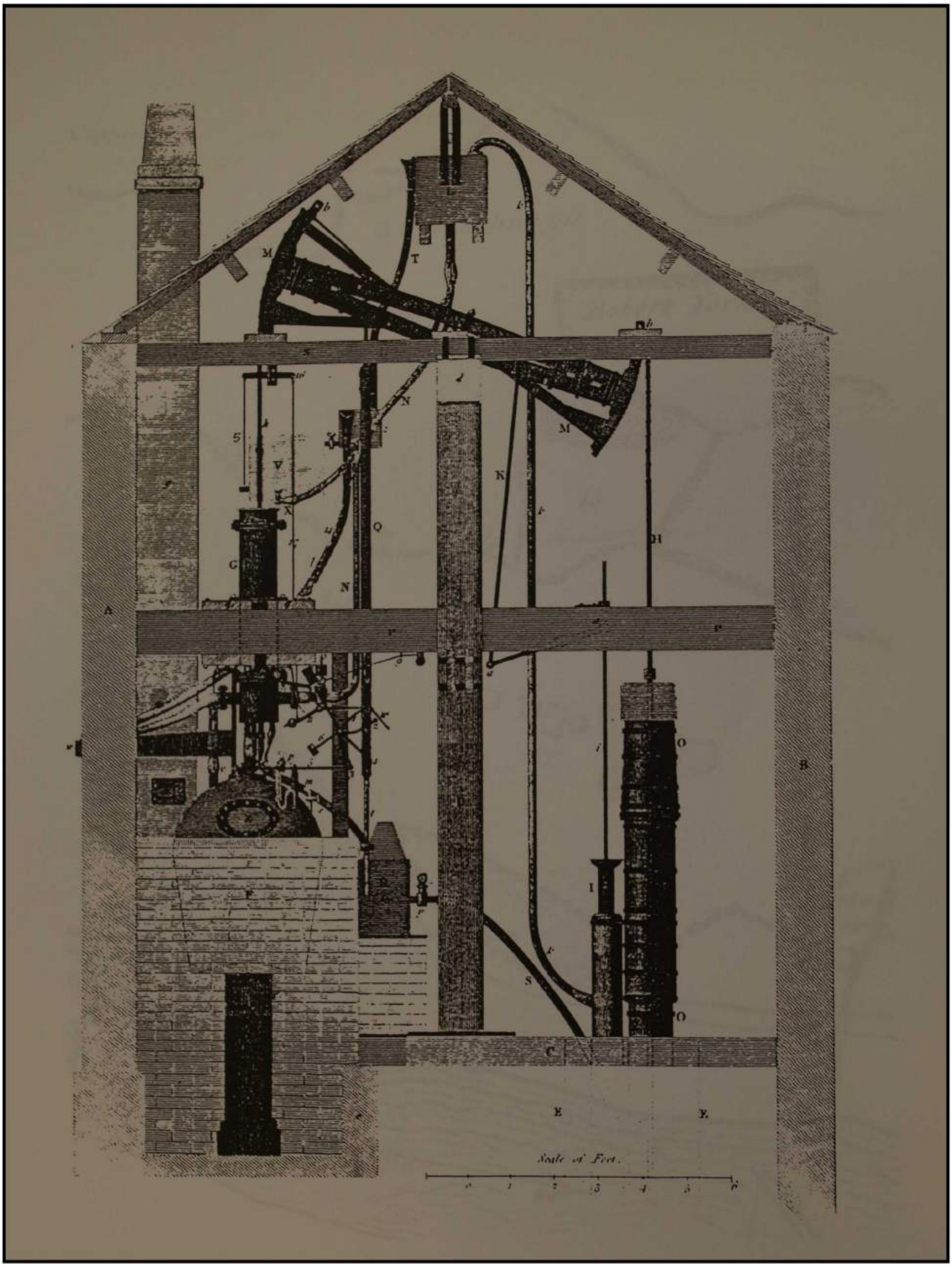


Fig 4.13: An early Newcomen pumping engine showing the boiler directly beneath the cylinder
after Rees 1819-20, quoted in Heyman 1996

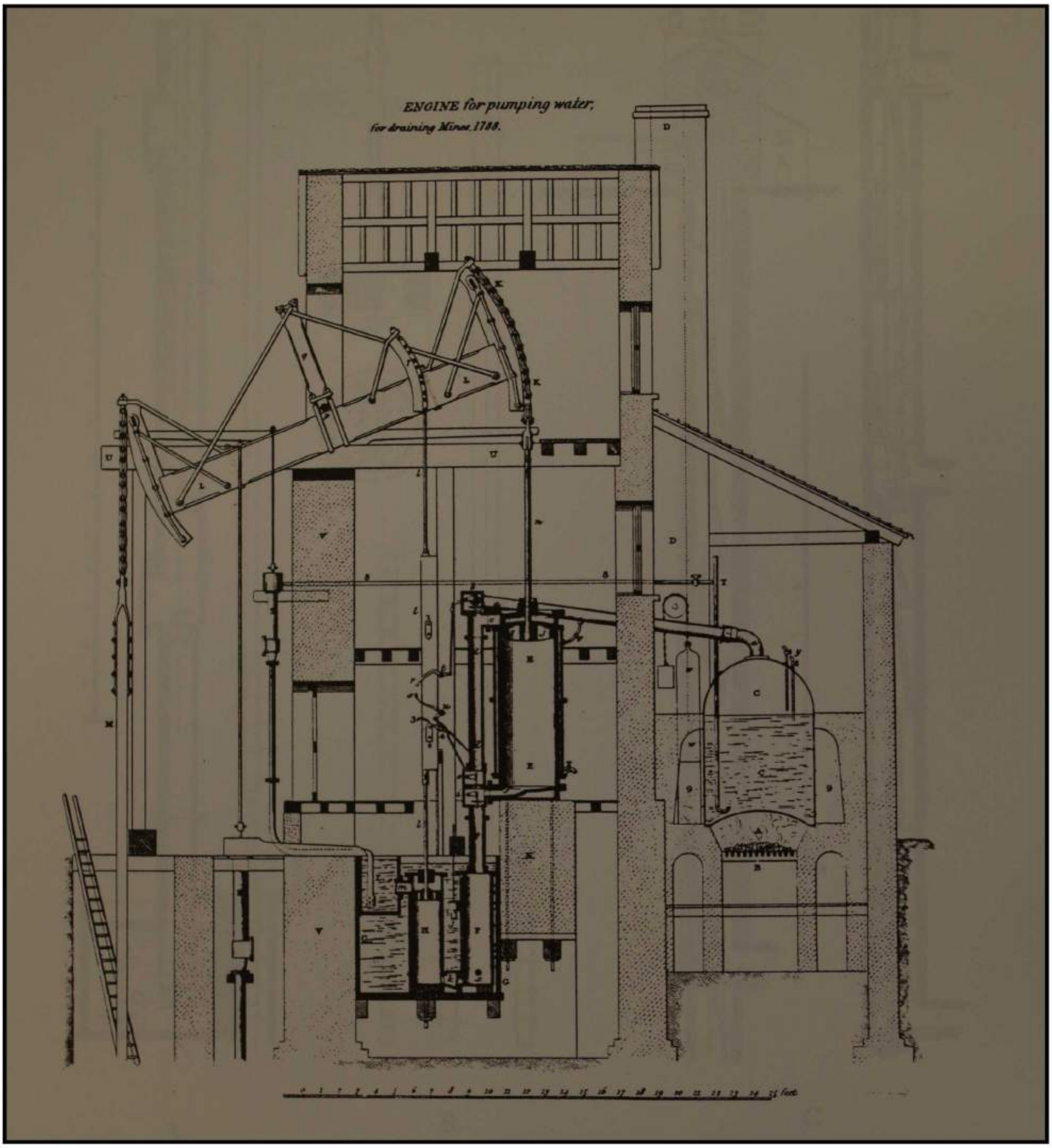


Fig 4.14: A Boulton and Watt pumping engine; after Farey 1827, quoted in Heyman 1996

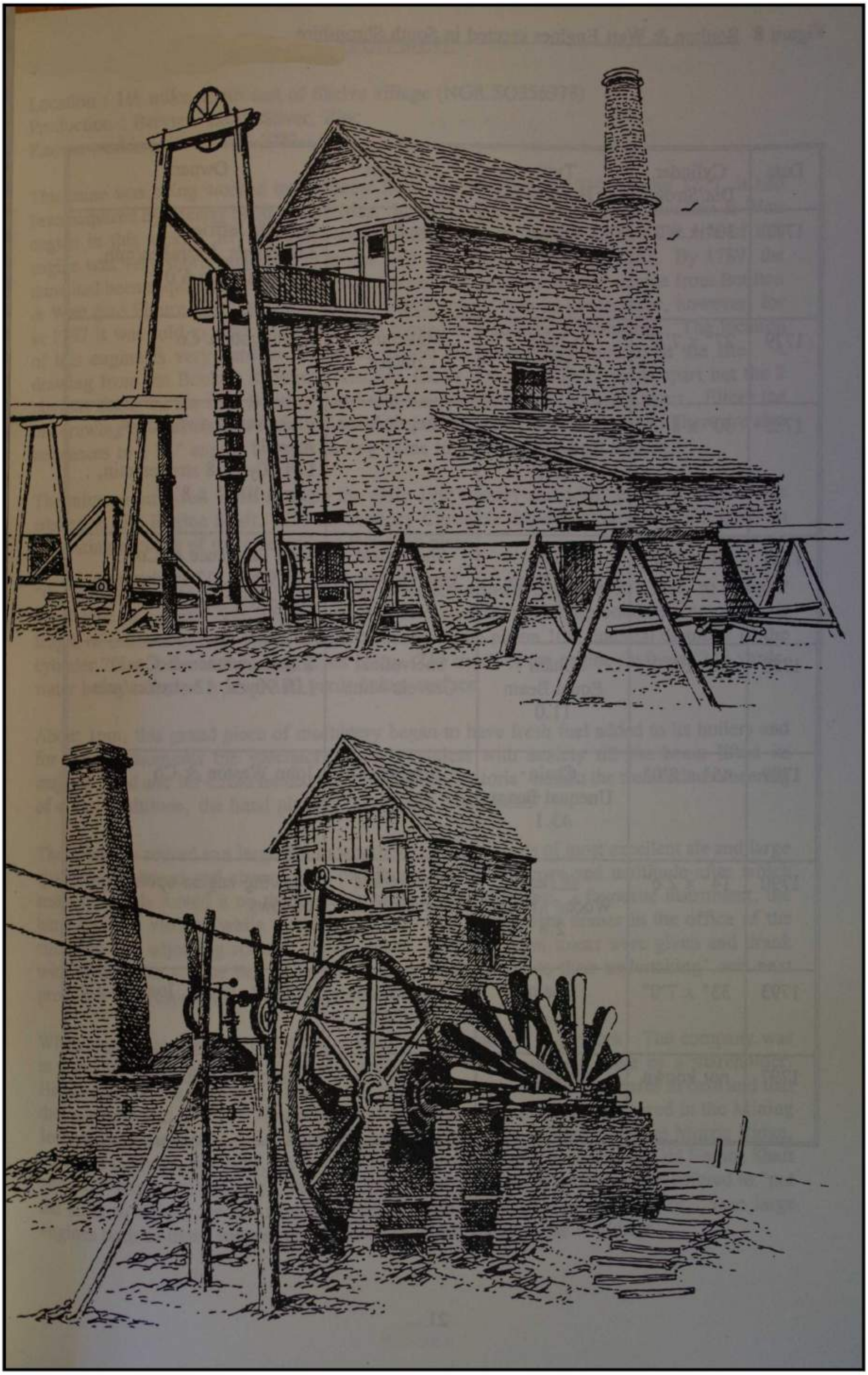


Fig 4.15: Typical examples of a pumping engine (top) and a winding engine (bottom) after Shropshire Caving and Mining Club, account no 18

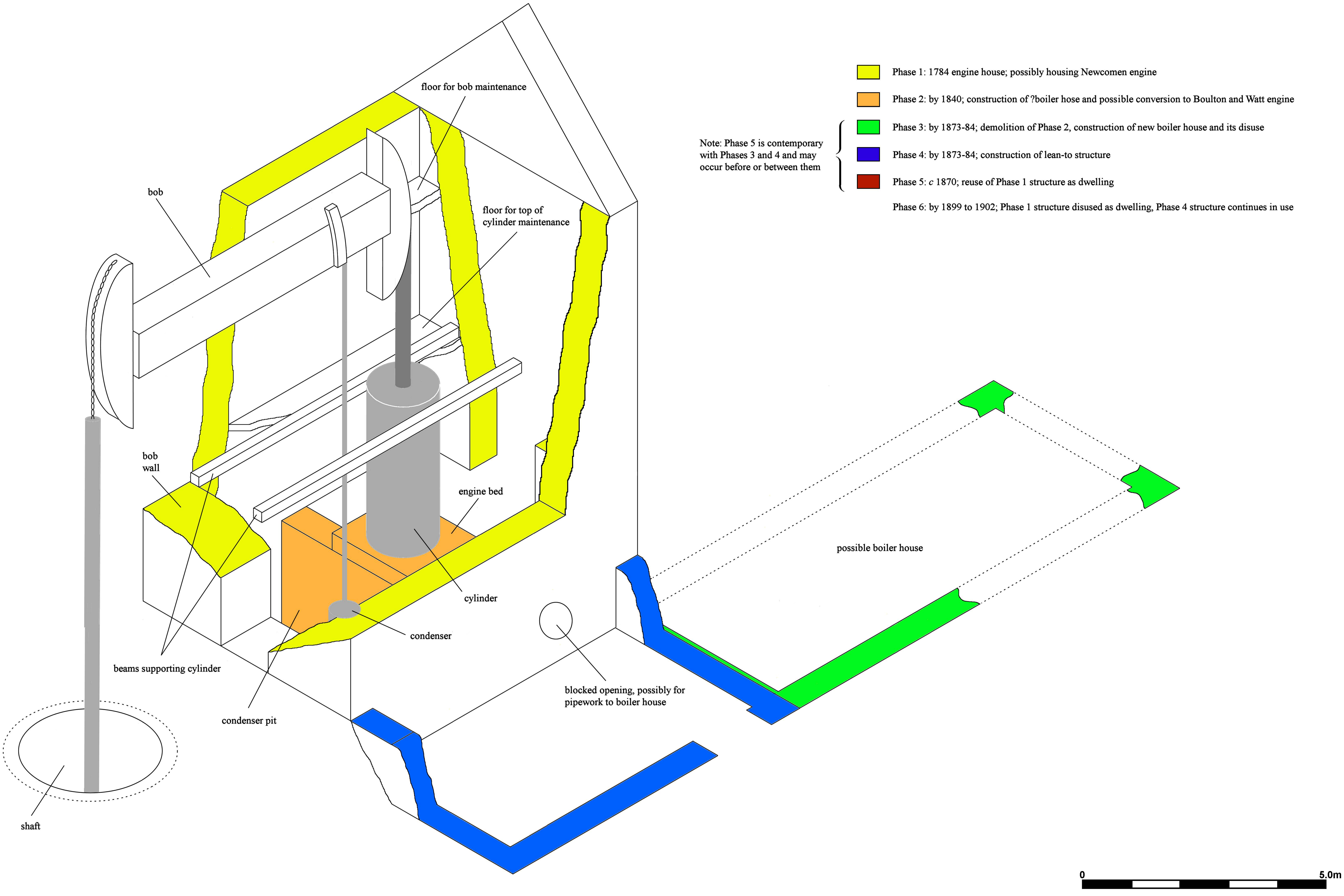


Fig 4.16: Interpretative three-dimensional phased illustration

Fig 5: South-east elevation

Fig 6: North-west elevation

Fig 7: North-east elevation

Fig 8: View of adjacent property showing companion engine house

Fig 9: North-east elevation showing damage to arch above bob opening

Fig 10: North-east elevation showing holes for formwork under bob opening arch

Fig 11: North-east elevation showing socket for bob platform

Fig 12: North-east elevation showing socket for bob platform

Fig 13: North-east elevation showing socket for bob platform

Fig 14: South-east elevation showing stepped brickwork

Fig 15: South-east elevation showing stepped stonework

Fig 16: North-east elevation showing ground floor entrance

Fig 17: South-east elevation showing timber formerly supporting bob pivot

Fig 18: South-east elevation showing socket for attached structure

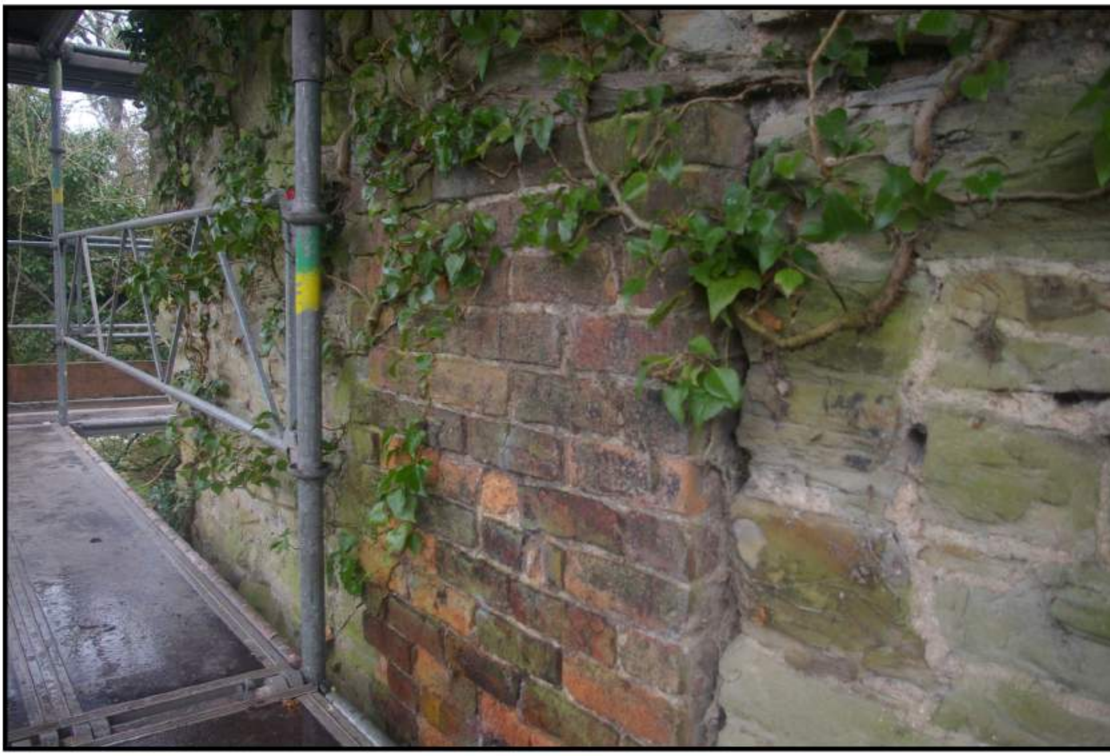


Fig 19: South-east elevation showing blocked opening

Fig 20: South-east elevation showing socket for attached structure

Fig 21: Phase 3 domestic hearth

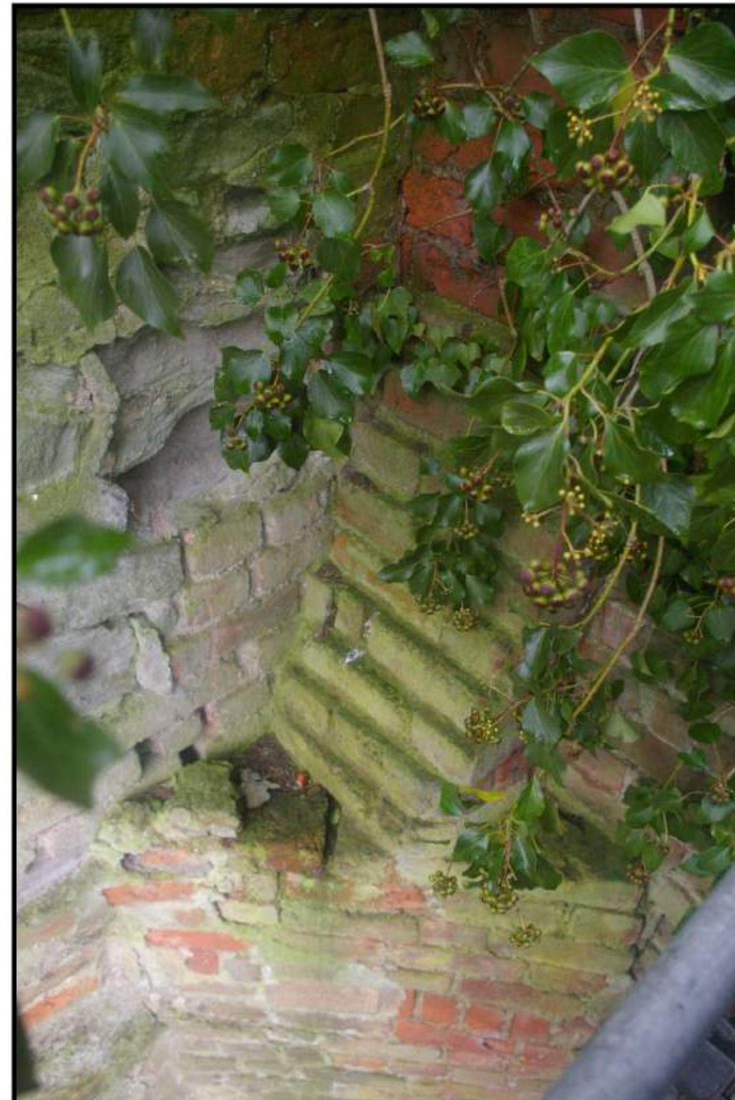


Fig 22: Phase 3 flue for domestic hearth

Fig 23: Longitudinal timber supporting the top of the cylinder

Fig 24: Sockets for transverse beam supporting galleries

Fig 25: Sockets for transverse beam supporting galleries

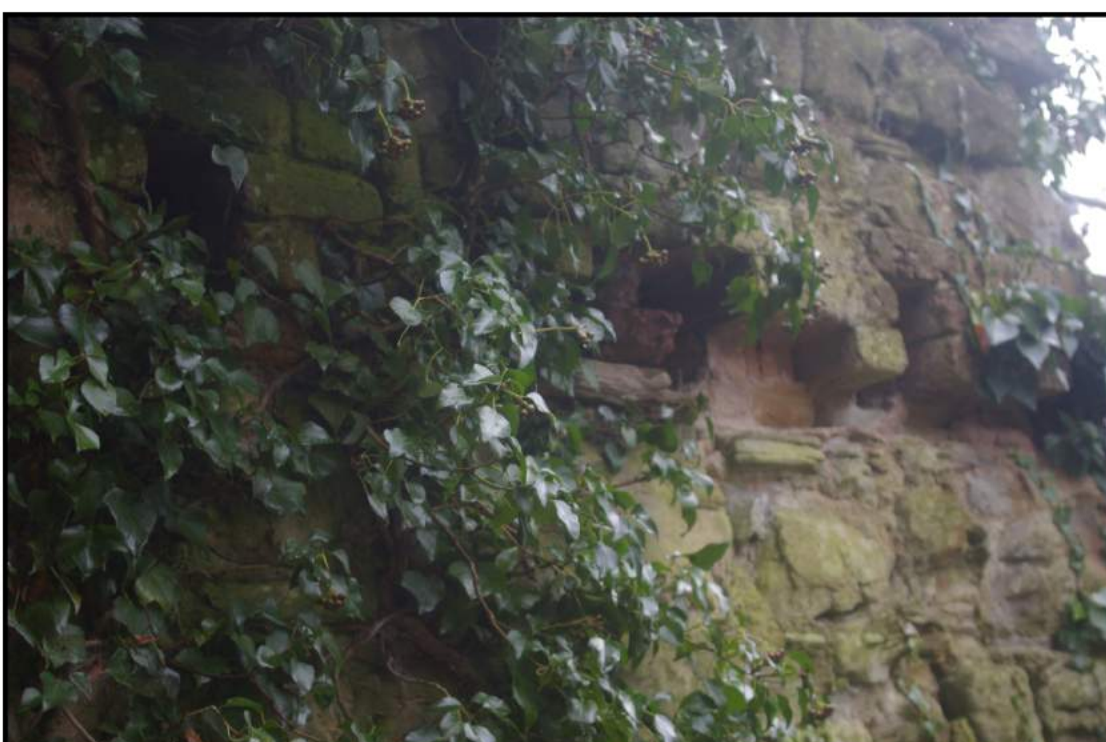


Fig 26: Sockets for transverse beam supporting galleries

Fig 27: Sockets for transverse beam supporting galleries

Fig 28: View from top of engine house showing longitudinal beams

Fig 29: View from top of engine house showing longitudinal beams

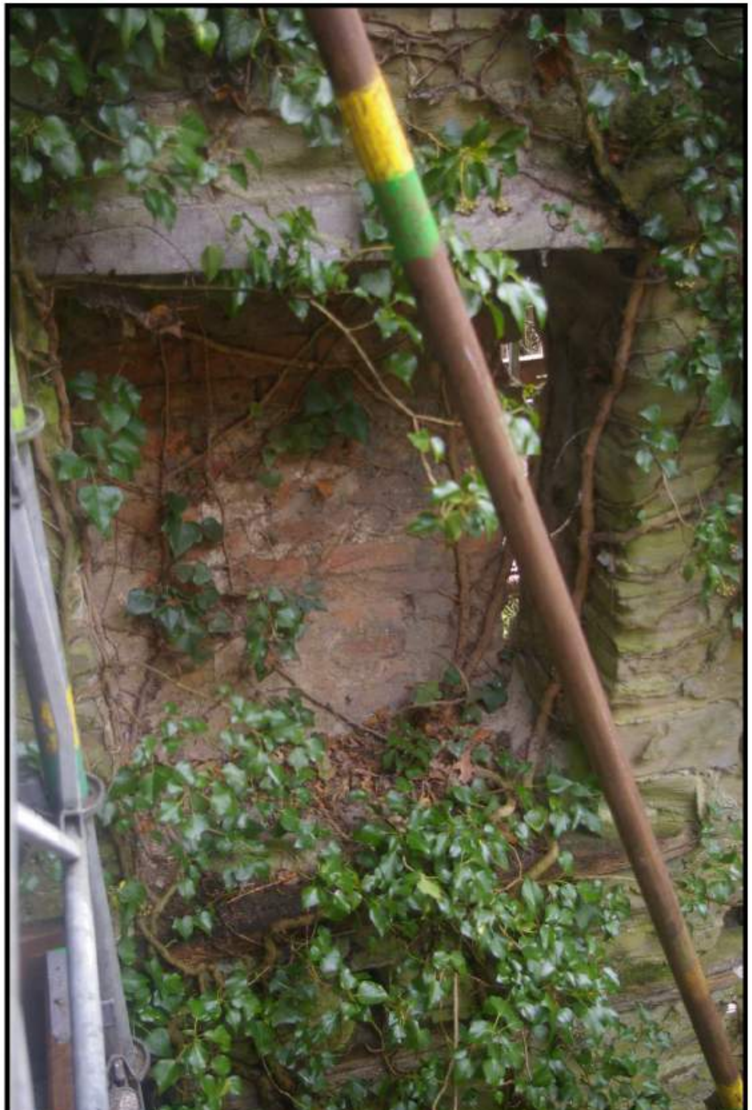


Fig 30: North-west elevation showing blocked opening

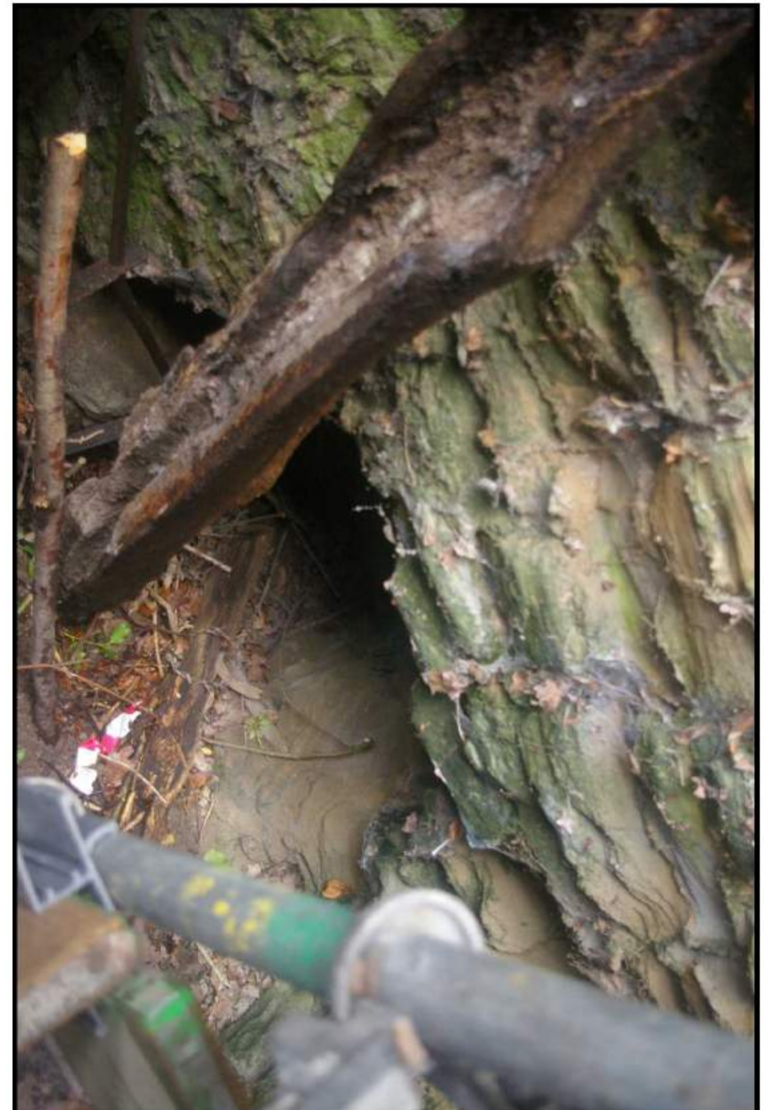


Fig 31: North-west elevation showing gap in wall

Fig 32: Cylinder loading

Fig 33: Top of shaft


Fig 34: Privy seat reused as lintel


Fig 35: East corner of Phase 3 structure

Fig 36: South corner of Phase 3 structure

Fig 37: Phase 2 engine bed

Fig 38: Phase 2 engine loading showing grooves for holding-down bolts

Fig 39: Opening in north-west engine house pit wall

Fig 40: Roof tiles used as 'levelling shims' between engine bed and engine loading

Fig 41: Showing Phase 4 structure sitting upon remaind of Phase 3 structure

Fig 42: Showing remains of Phase 5 structure; context 008

Fig 43: North-west wall of Phase 2 structure; context 012

Fig 44: Arched structure, presumably part of privy; context 013

Appendix 1: List of the contexts

Context number	Description	Interpretation
001	Light grey brown mixture of soil, lime mortar and broken brick and plaster	Material underlying south-west wall
002	Mid grey ash and clinker	Backfill of construction trench for Phase 1 structure
003	Pink brown mortar screed	Sub-base for brick floor 004
004	Brick floor	Floor associated with Phase 2 structure
005	Step in stonework	Door reveal, south-west wall
006	Cut	Post hole for door frame
007	Light grey brown sandy loam	Fill of 006
008	Brick wall	Wall of privy – Phase 5
009	Oval structure, now defined by mortary soil	Pit for privy – filled with 110
010	Very dark grey, almost black, humic loam	Fill of 009
011	Bricks laid in irregular pattern to north-east of 008	Path in front of privy
012	Jumble of brick, clinker and mortar	North-west wall of Phase 2 structure. This could either be a rubble core or the backfill of a robber trench. Overlain by 014
013	Arched brick structure adjacent to privy, 008	This was found at the limit of excavation around the south-east and south-west corners of the Phase 1 structure. It is believed to be a culvert associated with the adjacent privy, rather than a flue associated with a boiler house because of the lack of burning or soot within it.
014	Speckled black and dark grey clayey silt with abundant charcoal (finds from this layer)	Layer containing abundant burnt material, overlying 012

Appendix 2: Post-repair photographs

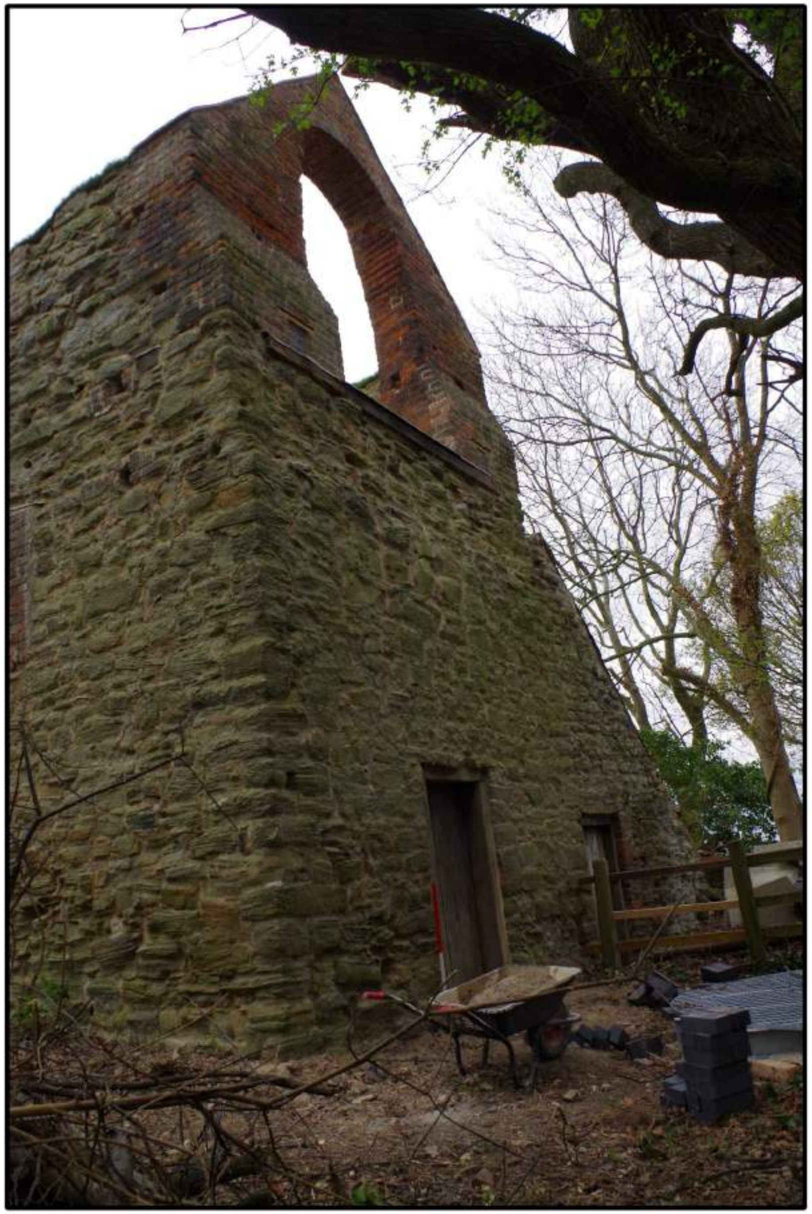
Repair to bob arch

Engineering bricks indicating former position of purlin near springing of bob arch

Engineering bricks indicating former position of purlin near springing of bob arch

Repair to bob wall near springing of bob arch

Repair to north-west wall of engine house adjacent to bob opening



North-east wall of engine house after repair

South-east wall of engine house after repair

Southern corner of engine house after rebuilding

South-west wall of engine house after repair

North corner of interior of engine house after repair

East corner of interior of engine house after repair

North-east interior wall (bob wall) of engine house after repair