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Middlefield Beam Engine House, Thornton, Fife [NT29NE 6](#) (NT 29193 97269)



View from north west [DP 231994, HES]

Miriam McDonald, Industrial Survey, Survey and Recording Section, Heritage Directorate, HES, 2018.

" THORNTON - COAL The waste of the coal work here collapsed on Friday and Saturday last so as to put a stop to working. The engine pit is squeezed together at the bottom and the cast-iron pumps broken so that the work is at a stand. It will be a great loss to this place and to the whole of Fife as it may raise the price of coal upwards of 23000 loads a week having been sold before. Nobody was hurt. "⁽¹⁾

Middlefield Engine House, Thornton in Fife is located some 5km south of Glenrothes and 7km north of Kirkcaldy. Possibly built in the late 18th century, it is a 3 storey, single bay building of ashlar and squared rubble construction with droved quoins and, on the date of survey, a partially surviving red pantile roof. This building would have contained a beam pumping engine, now removed. The west elevation has a prominent integral buttress, diagnostic of the building's original function. It has been described by Hume as 'a unique example of the buildings of an 'engine pit' of the period...' ⁽²⁾. The engine house is now an isolated structure as the associated structures have been demolished.

Coal has been mined in this area of Fife for many hundreds of years. The coal had been won using various methods, but the introduction of steam technology allowed the working of coal (and ironstone) seams at deeper levels. ⁽³⁾ Throughout the late 18th and into 20th centuries the coal mined in this part of Fife was sold locally to the manufactories along the River Leven and Orr as well as in Kirkcaldy to the south. ⁽⁴⁾

The beam engine in Middlefield engine house pumped water from the mine levels of Thornton Colliery which was located on the Balgonie Estate of David Leslie, 6th Earl of Leven and 5th Earl of Melville. ⁽⁵⁾ The Balgonie Estate, through Thornton Colliery, exploited what is now known as the Dysart Main coal seam. ⁽⁶⁾ The Colliery's workings ran from the vicinity of Balgonie Castle through Coalton of Balgonie to the Bridge of the Ore at Thornton. It is noted in the Old Statistical Account (OSA) that in the year 1785 '...Lord Balgonie...fitted up the present engine'. ⁽⁷⁾ The New Statistical Account (NSA) states that 'coal is presently worked at Thornton by steam power'. ⁽⁸⁾ These references, along with the Middlefield engine house location referred to as 'old engine pit' ⁽⁹⁾ on a drawing held in Fife archives, suggest that beam engine house surviving today at Middlefield, Thornton may be the one 'fitted up' by Lord Balgonie in 1785.

As far as to the depths at which any late 18th century/ early 19th century engine would have been pumping, the NSA states that the Dysart Coal at Thornton was accessible (i.e. could be kept dry) to 30 fathoms (54.9 m/ 80ft) allowing access to the '9 feet or upper seam [of coal] only...'. ⁽¹⁰⁾ The NSA account goes on to say that 'with more powerful engines for drawing off the water, the coal seams at Balgonie may be regarded as inexhaustible.' ⁽¹¹⁾ Within 20 years of this statement, the pumping engine house at Middlefield had been abandoned. ⁽¹²⁾ This abandonment (by 1854) suggests that the pumping house contained an engine that was no longer powerful enough to enable the effective pumping of the mine levels it served. It may also have been economically unviable to upgrade to a more powerful engine. The 1856 depiction on the 1st edition of the Ordnance Survey 6-inch map (see below) suggests that the pumping engine itself was still in situ and had not yet been dismantled.

By 1842 the engine house and pumping engine was owned by James Balfour of the Thornton Colliery. By 1846 it appears that Charles Balfour was the owner and the pump and engine house was still in use. ⁽¹³⁾ From its abandonment prior to 1856 through to the 1970s, the engine house and the buildings were reused. This may be one of the reasons why it was not demolished after the pumping

engine was removed. The pump shaft has been capped at some point in the past for safety reasons, although the outline of the shaft in which the pump rods and guide pipe and pumped mine water drainage system would have been contained could still be seen in 1974 (see SC 454958).

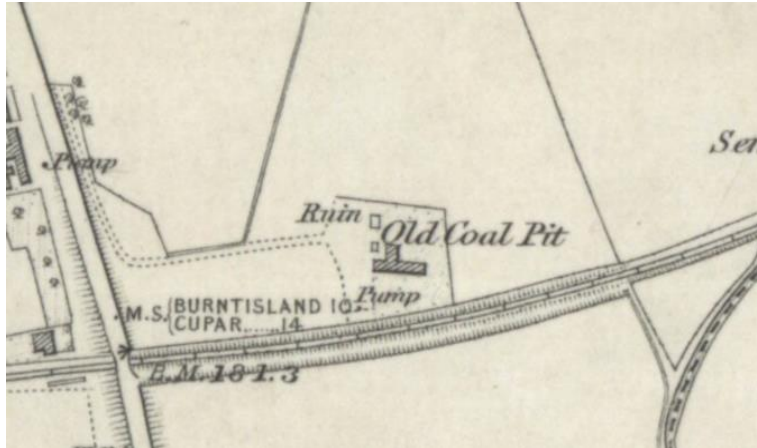


Left: View of Pump Engine House from west, showing the now demolished south range (right). Some of the now demolished buildings may have been part of the colliery. The low footings visible in front of the west wall is the backfilled shaft down which the pump rods of the engine ran. Men may also have used the shaft to get out of the mine workings at the end of their shift. [SC 454959, 1974, John R Hume Collection, National Record of the Historic Environment]

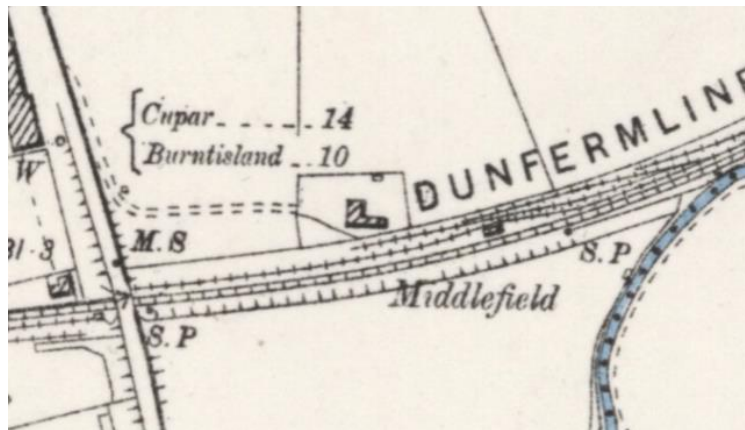
The Site on Ordnance Survey Maps

There are three depictions of the mine pumping engine house that have been published by the Ordnance Survey (OS) at 6-inch to a mile scale between 1856 and 1920 at a scale which shows details of the changes to the building. ⁽¹⁴⁾

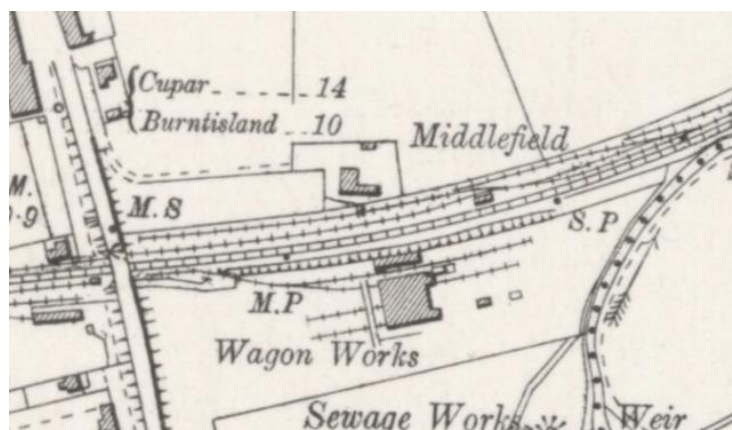
The OS map of 1856 shows one inverted 'T' shaped roofed building (elongated at the east end), depicted and named 'Old Coal Pit' and 'Pump'. The north range of the inverted 'T' shape is the pump house. There are also two, small, rectangular unroofed structures shown to the west of the pump house. The more northerly structure has the word 'Ruin' next to the depiction. The more southerly is, probably, a depiction of the top of the shaft in which the pump rods sat. The south range running west/east would have contained the boiler house and possibly the engineman's dwelling, as well as a coal store for the engine. The OS depictions of 1896 and 1920 show that the west range has been demolished and that the remaining range including the engine house are still roofed and possibly in use. It is known that the buildings were in broadly agricultural use in the 1970s and that the south range was demolished in the mid-1980s. ⁽¹⁵⁾ The engine house was incorporated into a private dwelling in 2017. ⁽¹⁶⁾



Extract from Ordnance Survey 1st Edition 6-inch to the mile map, Fife and Kinross, 1856 (revised 1854), sheet 32. (Reproduced with the permission of the National Library of Scotland)



Extract from Ordnance Survey 2nd Edition 6-inch to the mile map, Fife and Kinross, 1896, sheet XXVIII.SW. (Reproduced with the permission of the National Library of Scotland)



Extract from Ordnance Survey 6-inch to the mile map, Fife and Kinross, 1920, sheet XXVIII.SW. (Reproduced with the permission of the National Library of Scotland)

Middlefield Engine House, its engine and possible layout (see plans and interior section drawings below)

The Middlefield engine house measures externally 4.65m (15ft 3in.) north/south (in length) by 6.75m (22ft 2in.) west/east (in breadth) by 9.0m (29ft 6in.) in height. The interior dimensions of the engine house are 4.24m (13ft 11in.) west/east by 3.3m (10ft 9in.) north/south. The walls measure 0.75m (2ft 6in.) in thickness. The west gable wall or 'bob wall' is buttressed. This was the wall on which the beam of the pumping engine pivoted and measures 1.25m (4ft 1in.) in thickness at ground level.

The engine house would have had open central area extending up through the building in which the pumping engine would have sat. The first and second levels allowed open access to the engine to enable operation, repair and maintenance. The ground floor was probably where the engine cylinder base would have been located. The absence of a basement suggests that there was no separate condenser. The engine would have extended up into the first level, with its beam (probably of wood, but many were later changed to iron due to breakages) sitting at the 2nd level. The east end of the beam would have rocked into the first level space on the piston down-stroke (within the cylinder). As the pumping engine worked, it would have caused movement and the cylinder would have to be supported vertically to mitigate any lateral movement that would cause damage to the engine. There is no evidence for an internal chimney in the beam engine house. The boiler for the Middlefield engine sat in its own boiler house (with chimney) in the south range (now demolished, see SC454960).

To access each level of the engine there would have been walkways at first and second levels. These would have allowed access to the engine to enable operation, repair and maintenance. Surviving joist sockets in the walls indicate where the walkway bannisters were located. Access to the ground level of the building is from doorways in the north-west and south-east elevations. There may have been a ladder to enable access to the first level from the ground level. Access to the first level from the boiler house (now demolished, see SC454960) was through a doorway in the south wall. The second level would have been accessed internally by ladder (perhaps in the north-west corner) from the first level only. This is where the beam would have sat and the walkway at this level would have extended out to allow access to the beam.

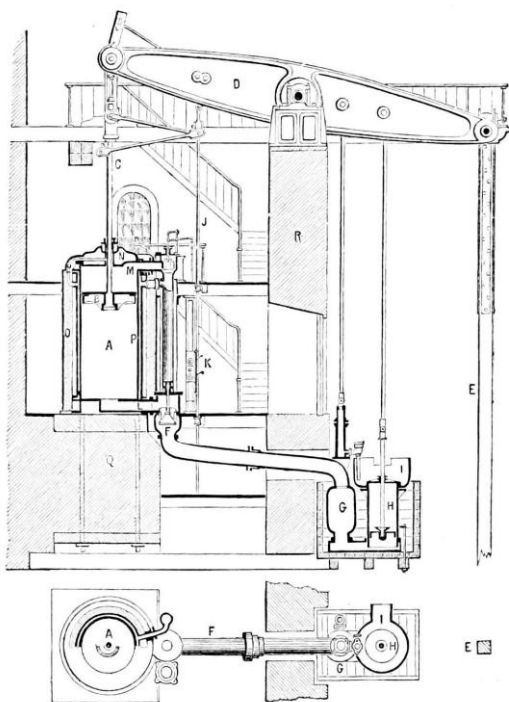
There is little documentary evidence for the type of engine at Middlefield. Due to its possible date (c. 1785) and its early abandonment (before 1856), the engine could have been a late Newcomen-type atmospheric engine. Newcomen Engines in the late 18th century still tended to be of a particular design, with no separate boiler house and chimney. However, the absence of a chimney is unusual if it housed a Newcomen-type engine. The raggles (stones left from the demolished south range) visible on the external south wall of the engine house are 'keyed in' (see Ground Level Plan, (D)) to the structure. This is evidence of a one phase build, again counting against the pumping engine being a Newcomen-type atmospheric engine with integral boiler and chimney. Separate engine houses for Newcomen Engines did exist. An example was recorded in Sheffield in 1790, although this would have been rare at this date. ⁽¹⁷⁾

Alternatively, Middlefield housed a Cornish-type beam engine. It has similarities to the Cornish beam engine house at Kilmux (1838) also in Fife, although later than Middlefield. It has no chimney and had a separate boiler house (now gone). Kilmux's bob wall measures 1.20m in thickness (Middlefield's measures 1.25m) but it is not buttressed, nor does it have a steam pipe aperture from the demolished boiler house into the engine house to carry the steam pipes into the cylinder. ⁽¹⁸⁾

The aperture in the west or bob wall at Middlefield (see First level Plan, (A)) resembles a drawing of a Cornish Beam engine (below). Only mortar or original timber analysis could perhaps provide a construction date for Middlefield.



Left: View of Pump Engine House from north east showing the now demolished south range (left). It is unclear if the chimney was related to the original boiler for the beam engine, although one would assume it would have been of ashlar construction and not brick, as here. Note the east door into the engine house and the ground level change (centre) [SC454960, 1974, JR Hume]



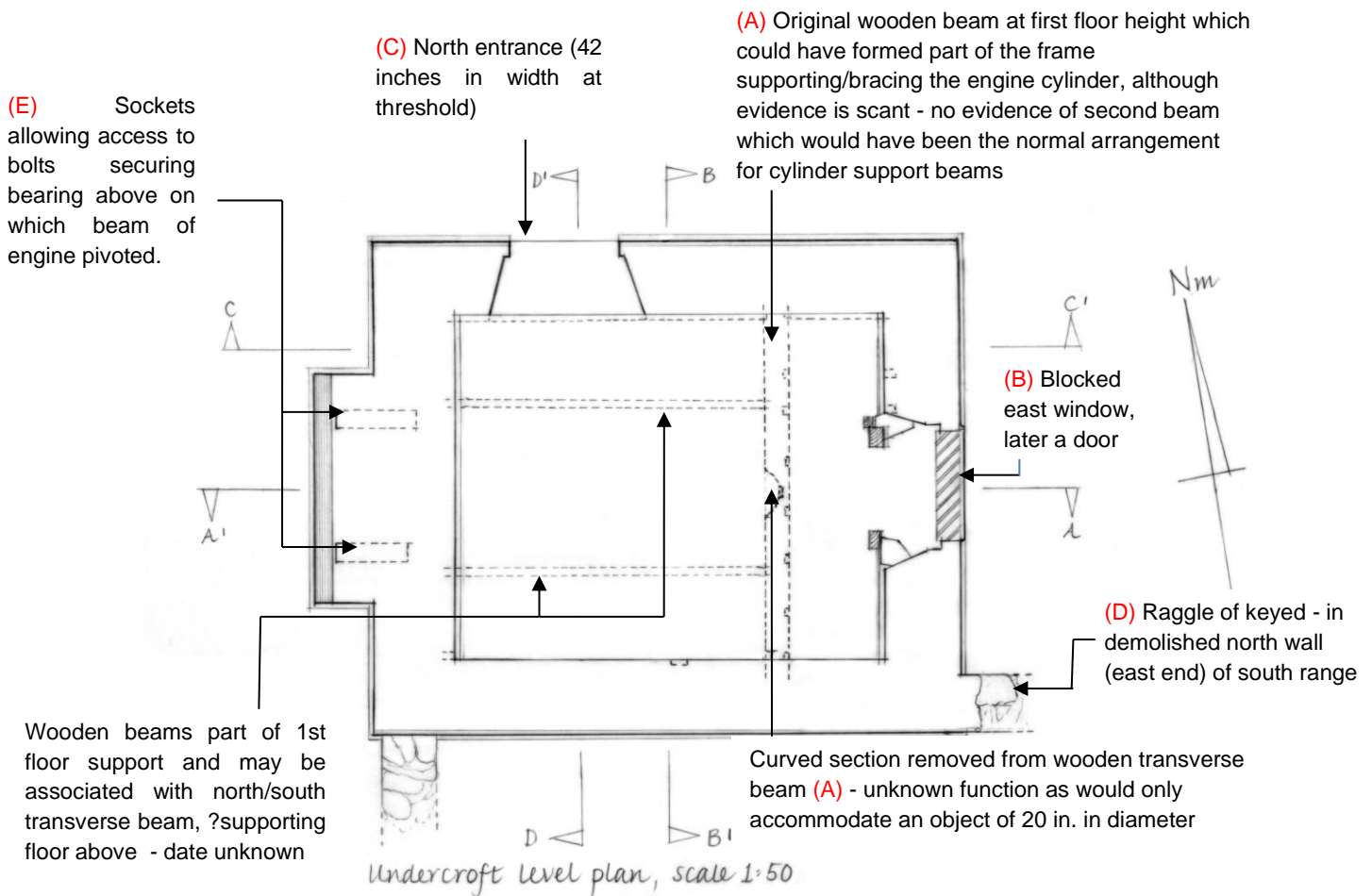
Left: Single acting Cornish beam pumping engine, section drawing from 1877. This section shows a similar aperture to Middlefield in the 'bob' wall through which steam pipes extend and into a separate condenser box. It may be that a similar set up could be seen at Middlefield. Source: https://en.wikipedia.org/wiki/Cornish_engine#/media/File:PSM_V12_D154_The_cornish_pumping_engine_1877.jpg from Popular Science Monthly, Volume 12, December 1877, 142. This file has been identified as being free of known restrictions under copyright law.

There follows a series of labelled digital scans and drawings. These are used to show observations relating to the fabric of the beam engine house. This has many surviving features which may shed light on the engine it contained such as its scale and where it sat within the building. HES produced three ground plans, four interior elevation drawings at a scale of 1:50 and digital 3D scans of the exterior elevations. The owner had inserted scaffolding in order to carry out preparation for building work. This allowed HES staff to access each level of the engine house safely.

Ground Level (see Ground Level Plan)

The floor was covered in loose earth and debris on the dates of survey. When the engine house was being converted into a dwelling, the floor was found to be some 0.5m from the ground surface by the builder working on it. It had been mooted that there would have been a backfilled sub-basement where the cylinder base fixings and voids for original pipework would be visible. This was not the case.

Ground level floor plan



There is a timber beam (see Ground Level Plan, (A)) running north/ south measuring 3.85 m (14ft 4in.) by 0.24m (9in.) in depth by 0.29m (11in.) in height at this level which appears to be original (and has been kept as part of the conversion into a dwelling). There is a section cut out of this beam which looks very like a collar steadying something against it. When this cut out section is extrapolated, it would have accommodated something of a diameter of approximately 0.5m (20in.). This seems unlikely to have been the cylinder due to its size. Neither is it centrally positioned on the beam to link with the piston in the cylinder and the rocking beam above. It may have cradled some other part of the engine or have nothing to do with the building when in use as an engine house. The other mystery is why there is only one heavy beam at this level. In all historic engravings of early beam engines, the cylinder of the beam engine is always shown supported or braced by two beams (also supporting a working floor/platform) and anchored by a 'collar' bolted to the beams, on either side. There is recently blocked east window (see Ground Level Plan, (B)) at ground level which would have maximised natural light for the engine operator. The north door measures 1.067m (3ft 6in. or 42in.) in width at its narrowest point (see Ground Level Plan, (C)) at ground floor level.

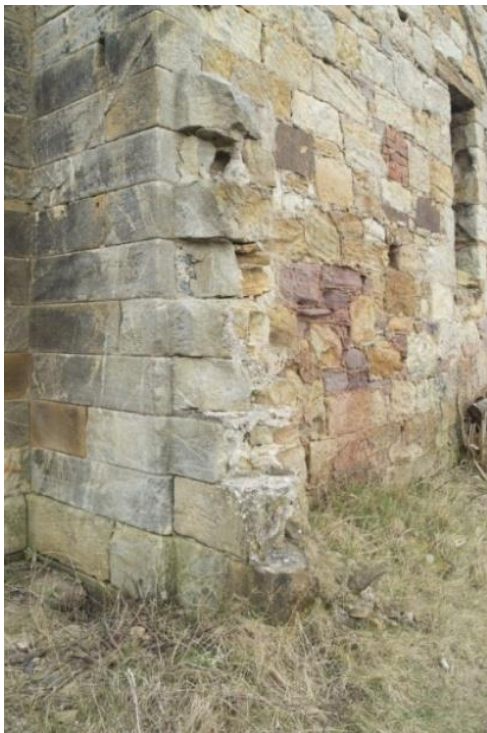
Such engine houses were built in a sequence. First the shaft would have been sunk, then the bob wall was built and the beam installed. This was followed by the securing of the cylinder. The side walls and the roof would then be added. Blacksmithing work on the engine components not bought in would have been carried out as the engine house was being built. Any subsequent work to be done on the cylinder would mean that the north doorway would need to be wide enough to allow it cylinder to be taken out if required. This could suggest that the engine cylinder diameter could have measured up to 1.067m (42in.).

Additional evidence also points to a possible cylinder diameter, although it is less direct. The cylinder would have extended from the ground level to just under the second level to allow the clearance of the engine rocking beam at its east end. In order to have clearance as one entered the ground level through the north-west doorway, and to enter the first floor from the probable engine house from the south east so as to avoid walking into the cylinder, there is a space of about 1.5m suggesting the engine cylinder could have been up to 59in. in diameter. A cylinder 'jacket', usually of cast iron, would also have been fitted *in situ* increasing the diameter of the cylinder.

There are sockets visible at exterior ground/ first level in the buttress of the west gable or 'bob' wall (see Ground Level Plan, (E)) which provided access to a bolting system for securing the beam engine pivot bearing onto the west wall at the second level opening (it is through the opening on the second level that the west half of the rocking beam protruded). This wall measures 1.25m (4ft 1in.) in thickness at ground level. The voids extend up into the buttress but the extent of these could not be ascertained. There is a possibility that a separate condenser box could have been located here (see 1877 section drawing above, p.6).



Left: inside of hole left after large timber beam (see Ground Level Floor Plan, A) removed during conversion work. The beam sits on the right and the packing area to the left. The original mortar is in evidence. [copyright: M Bruce, 2017]

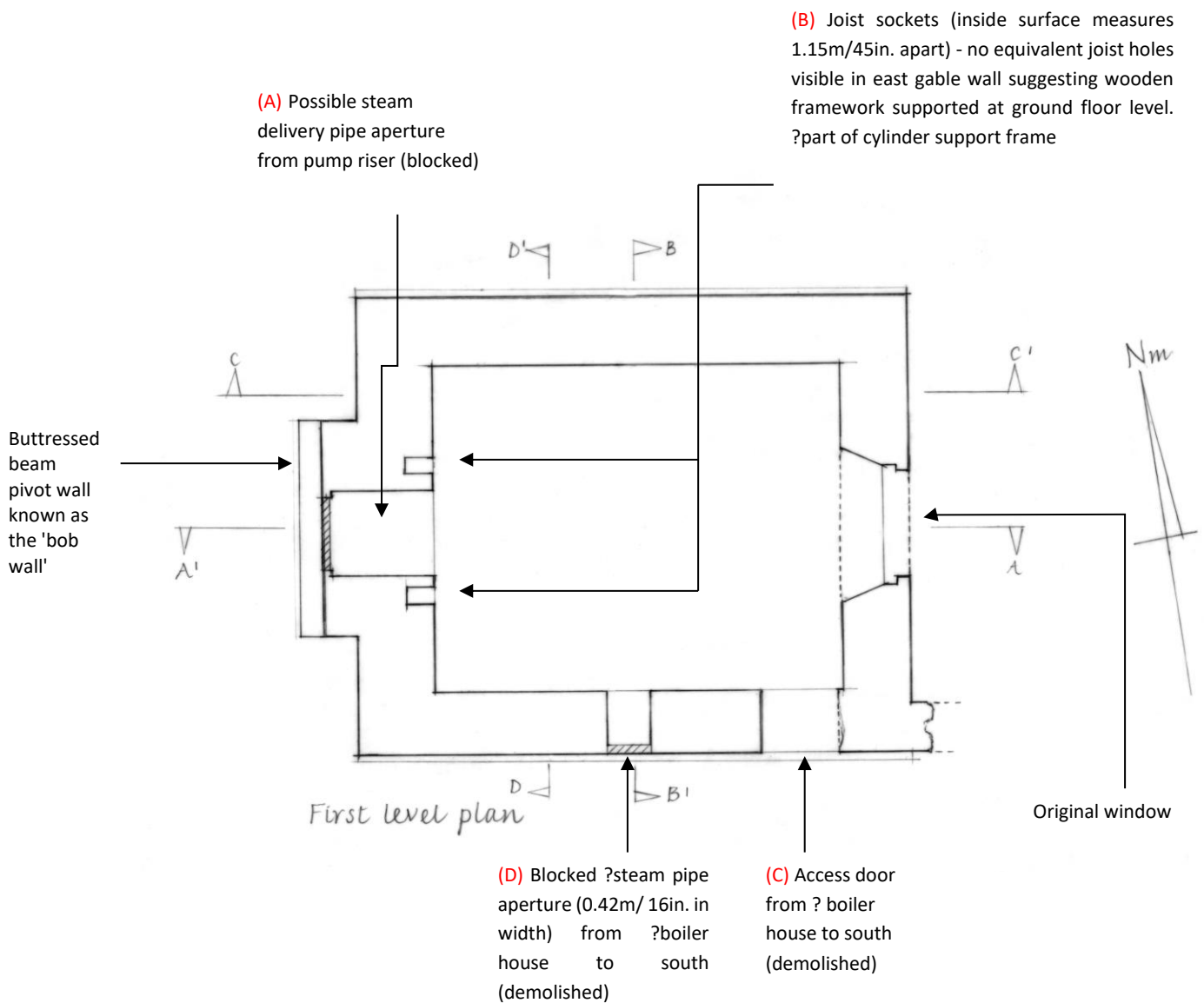


Above left and right: south west corner of engine house showing raggle wall. The masonry is clearly keyed into the engine south wall of the engine house, suggesting that the south range was built at the same time. [DP232016 and DP232015, HES]

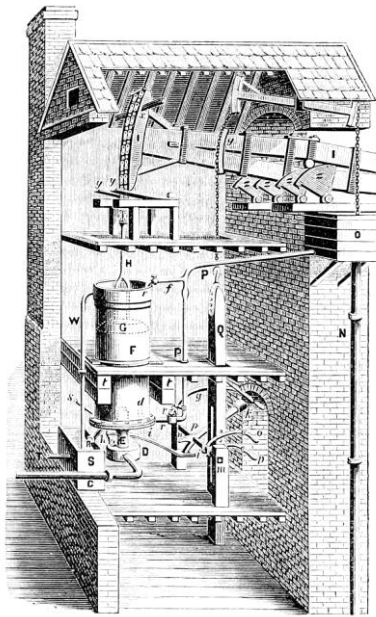
First Level

The first floor level is where, latterly, the cylinder, the probable delivery pipe from the pump riser, steam inlet pipe from the boiler house to the cylinder would have been located along with other mechanism of the pumping engine. The probable delivery pipe from the pump riser aperture in the west wall is blocked but clearly visible (First level plan, (A)).⁽¹⁹⁾ This aperture is well executed, again showing the high quality of this engine house.

First level plan



There are two socket holes visible in the bob wall (west gable wall) interior, above the possible steam delivery pipe aperture from pump riser, measuring 0.30m (15in.) in height by 0.19m (7½in.) in breadth (First level plan, (B)). The inside surfaces of these beams sockets are (1.15m/ 45in.) apart. There are no matching socket holes in the east gable. It is possible that these joist sockets held timbers which supported the cylinder on a partial frame all trace of which have now gone.



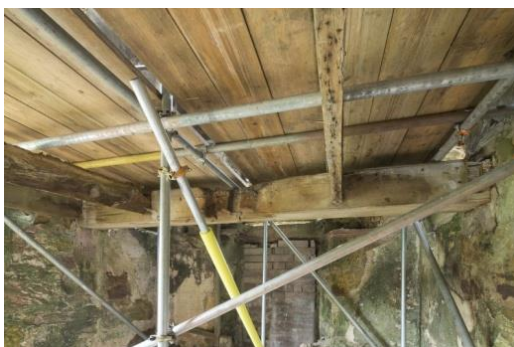
Left: Newcomen engine as improved by John Smeaton. Note the two heavy beams supporting the cylinder ('t'). This, along with other Newcomen Engine Houses has an integrated chimney but a similar layout to many beam engine houses of varying types.

Source:

http://www.wikiwand.com/en/Newcomen_atmospheric_engine

from Popular Science Monthly, Volume 12, December 1877, 130. This file has been identified as being free of known restrictions under copyright law.

On the south wall there is an access door (First level plan, (C)) to what would have been the first storey of the now demolished (possible) boiler house. There is also a wall aperture through which inlet steam pipes to the engine's cylinder probably ran (First level plan, (D)). This aperture is not as well executed as the steam outlet in the west gable or 'bob' wall showing possible later modification.



Left: Interior from west, ground/ 1st level. This beam may be original and could have acted as part of the supporting framework for the engine. It has been utilised to carry floor timbre at some point. The wooden floor is of the modern scaffolding. [DP254031, HES]

Second Level

The second level is where the beam of the pumping engine was located. It would have pivoted on bearings anchored to the west wall (Second level plan, (A)). A walkway (for which there is evidence of surviving railing fittings) would have extended out and around the exposed west end of the beam. Joist holes for the floor survive (although eroded) which would have supported a mezzanine floor or walkway 'wrapped around' the engine (Second level plan, (B)).



Left: Interior detailed view of brick-blocked aperture in the south wall connecting with the south range (First level plan, (D)). This is probably where the inlet steam pipe to the cylinder passed through from the boiler house. It has been modified using brick. The brick blocking is later. [DP254041, HES]

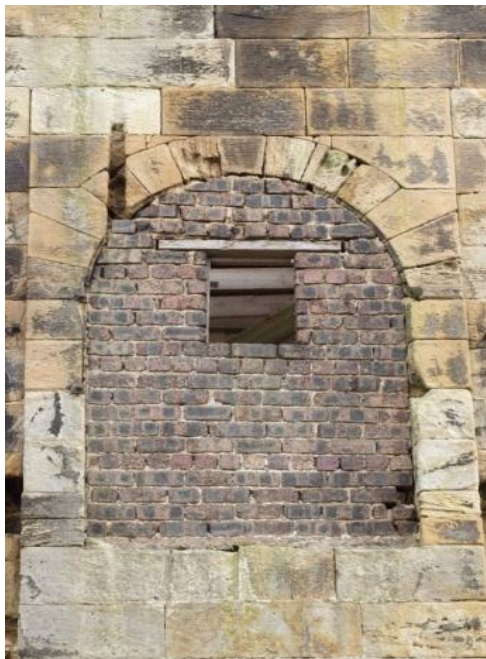
On the west wall is an original arched window - the original frame has long since been removed (Second level plan, (C)). The beam sockets on the east wall (Second level plan, (D)) are not mirrored on the west beam pivot wall (Second level plan, (E)). The beams that would have slotted into these holes are often referred to as 'spring beams' as part of their function was to absorb the jar created by the engine changing direction (in a rocking motion). They may have extended to the base of the bottom of the opening in the bob wall (Second level plan, (F)) and continued as the inspection walkway to the framework that would have sat above the shaft. The bearing(s) on which the engine beam pivoted on the 'bob' wall would have allowed clearance for it to rock up and down.



Above: View of interior, west elevation: Ground/First level. The beam in the foreground may be original and could have been part of the pumping engine [DP231996, HES]



Above: View of interior, west elevation: Ground/First Level. Detail of socket holes and delivery pipe from the pump riser. [DP231999, HES]

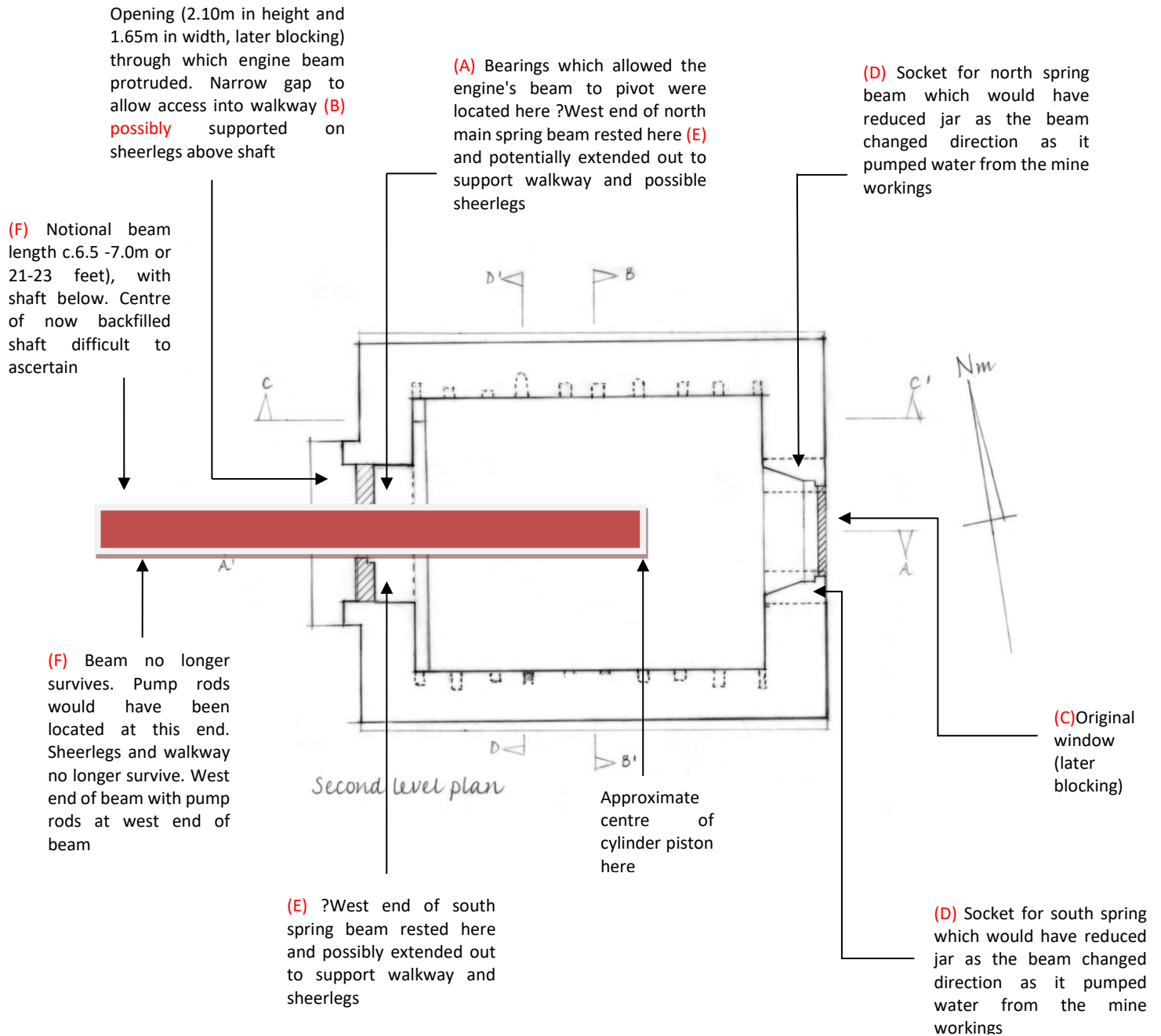


Left: View of the west or 'bob wall' opening through which the western half of the engine beam would have protruded (at Second Level). Note the remnants of handrail fixings. The groove, top left, may have something to do with bracing for the external maintenance walkway/ beam gantry (now gone). [DP232019, HES]

As it is unclear as to the size of the cylinder and the arrangement of the engine was in relation to the walls of the beam engine house, it is only possible to surmise the length of the beam of the engine (Second level plan, (F)). The engine beam could have measured about 7.0m (22ft 11in.) in length. If the engine house was built in the very late 18th century, the rocking beam of the engine would have

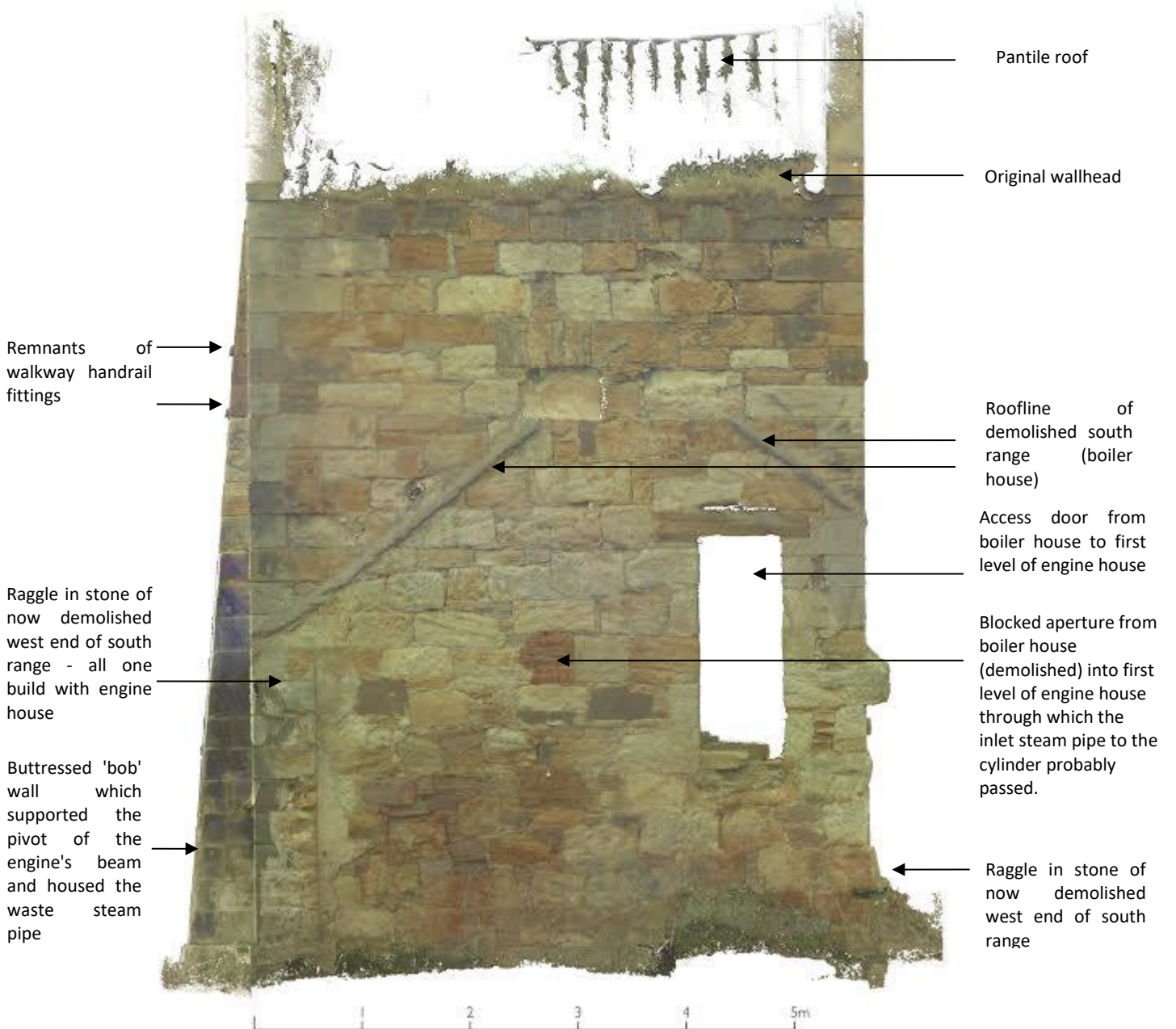
been of timber. The beam opening measures some 2.10m (6ft 10½in.) in height and 1.65m (5ft 5in.) in width with a later brick blocking with inserted window. The distance from the ground to what would have been the centre of the beam at the horizontal would have been approximately 6.0m (20ft).

Second level plan

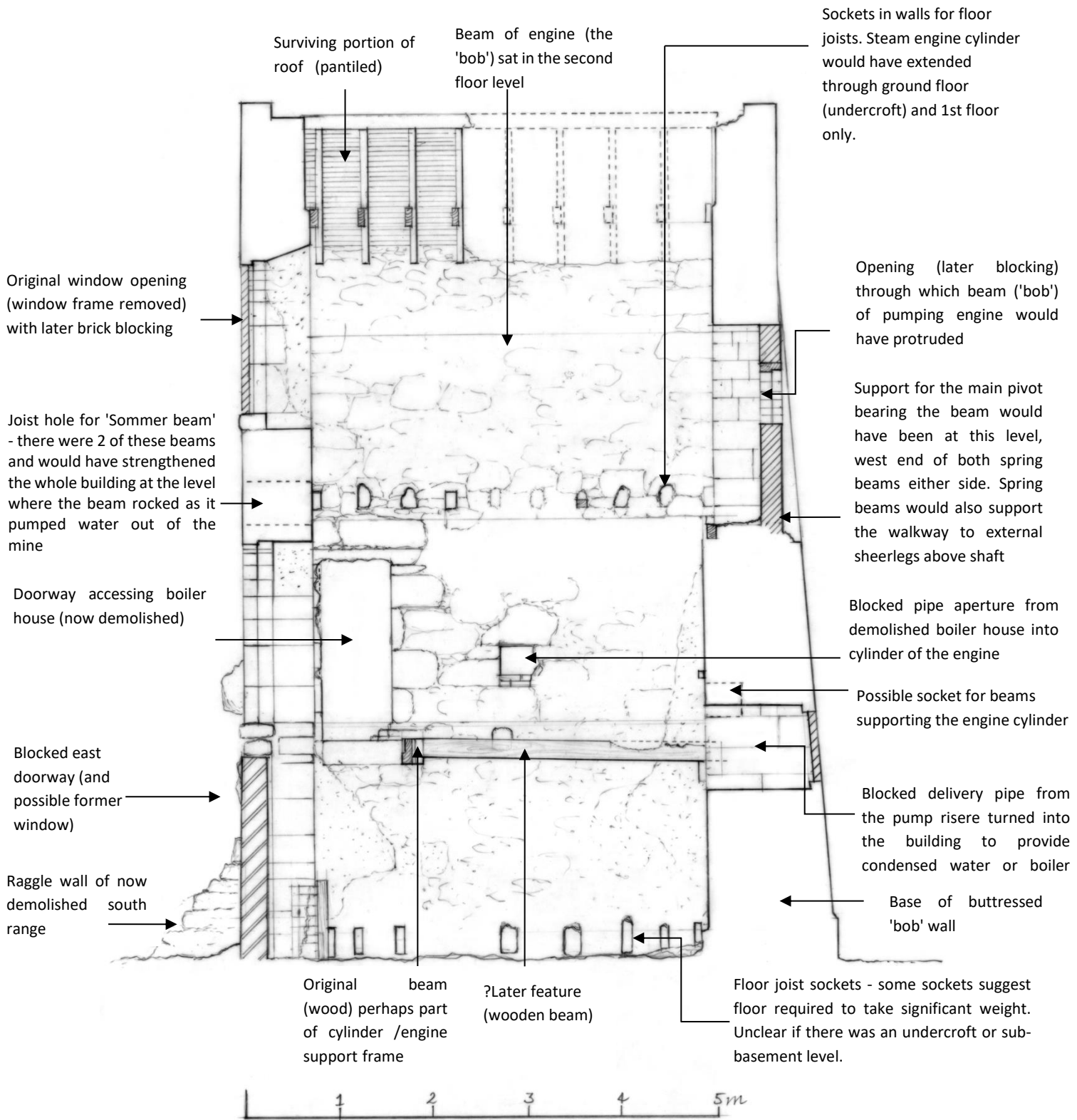


South elevation

Thomton, Middlefield Beam Engine House
 Canmore ID 52882
 Site Number: NT29NE 6
 NGR: NT 29193 97269
 South elevation: created from laser scanned points.
 Scale: 1:50.

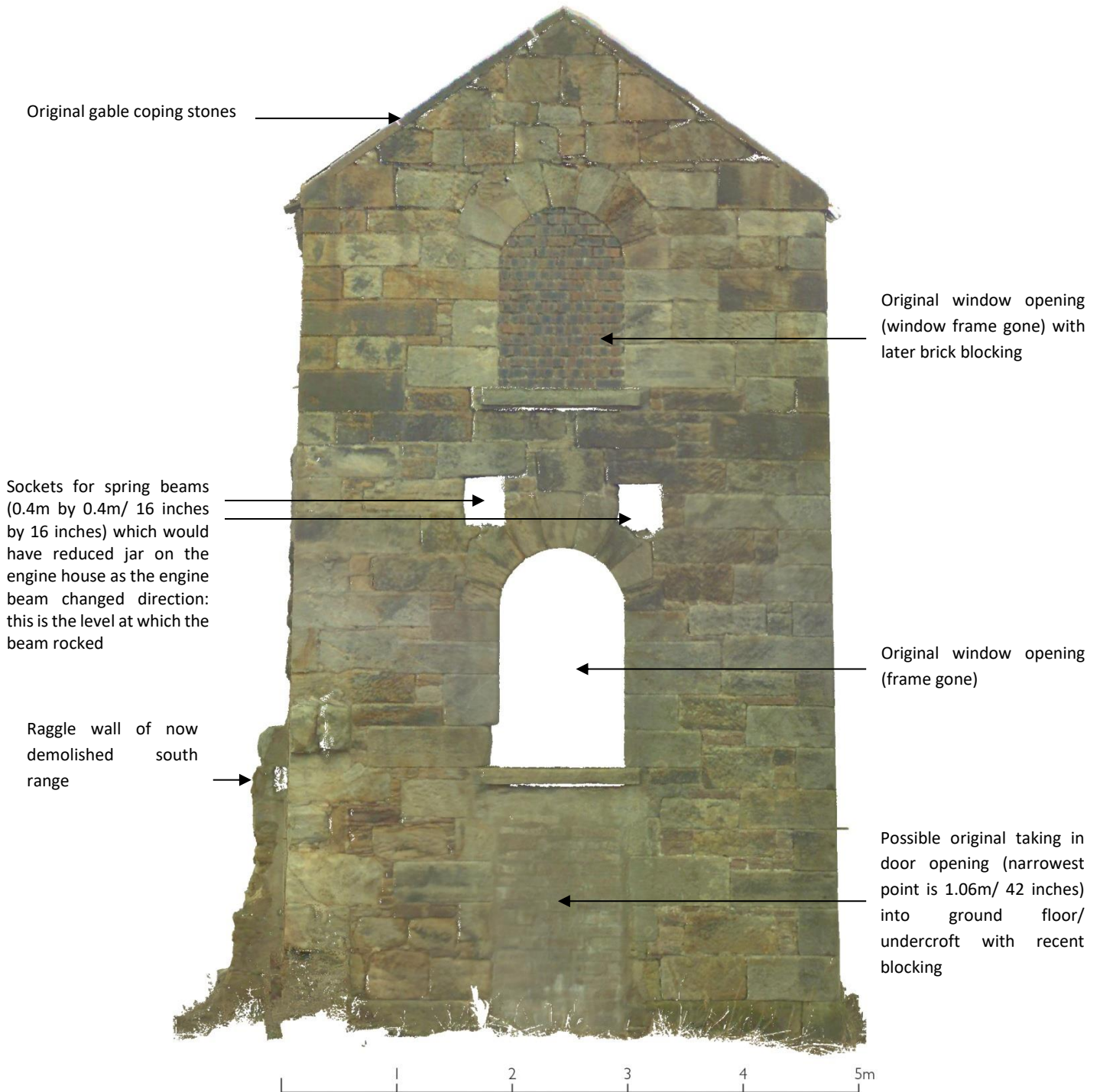


Interior facing south - section



East elevation

Thornton, Middlefield Beam Engine House
Canmore ID 52882
Site Number NT29NE 6
NGR NT 29193 97269
East elevation: created from laser scanned points
Scale 1:50





View of east gable showing the windows (frames and glazing gone) and the east doorway (blocked) at ground level. This doorway may have originally been a window feature. [DP231993, HES]

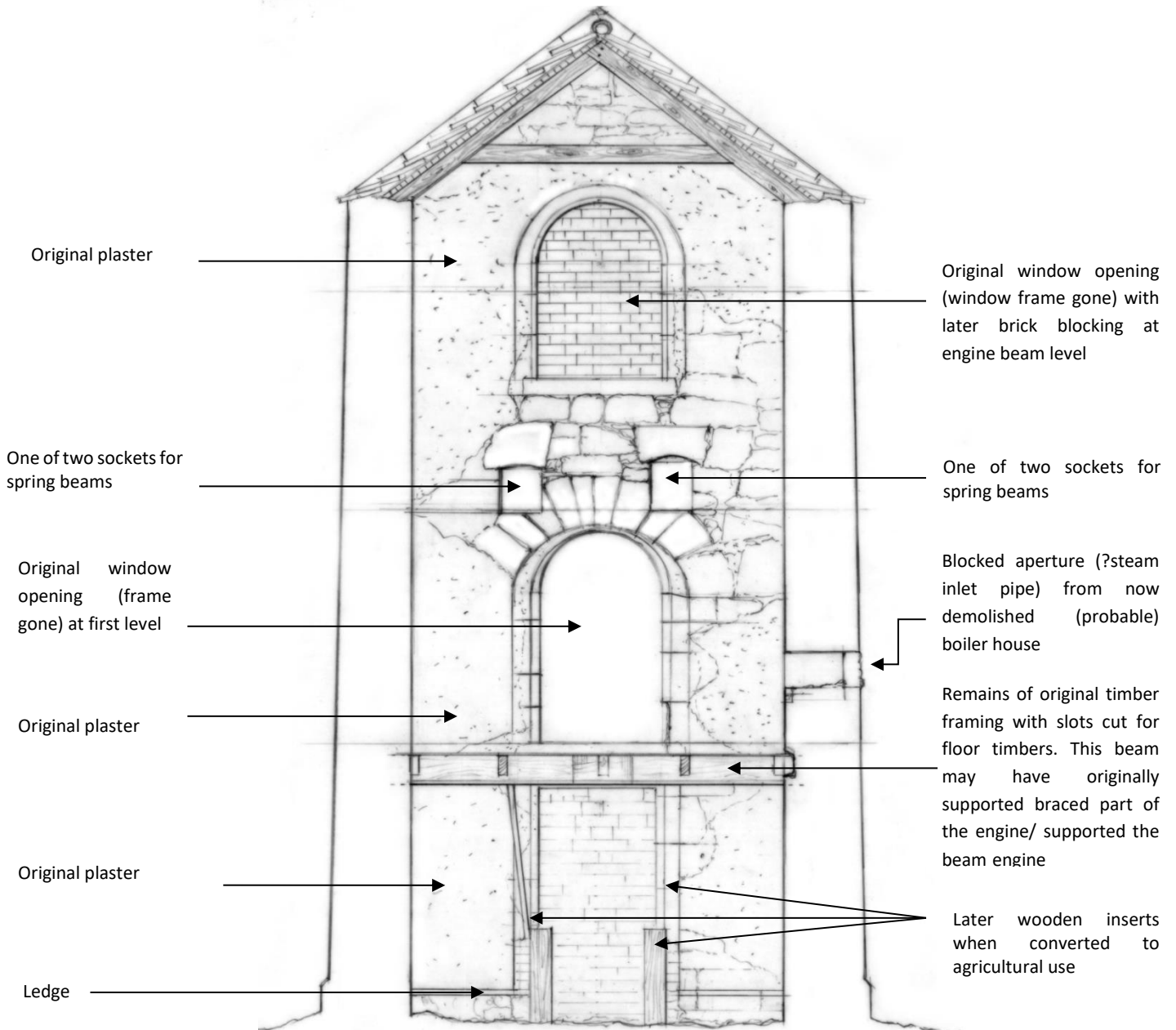


Above: Interior view of blocked east gable doorway with later brick built wing walls and wood facing. The east doorway may have originally been a window. [DP254023, HES]



Left: Interior view of the east wall at 1st floor level, showing deep, splayed window. This would have originally contained a glazed timber window frame, maximising the natural light level. The eastern end of the beam would have bobbed down into this area. You can glimpse the now empty joist holes for the spring or main engine support beams at the top of the image. [DP254043, HES]

Interior facing east - section



Section B-B'





Above: View of base of west gable or 'bob wall' from west showing the buttress and the two slots in the wall fabric. These do not go right through the wall, but allowed access to the bolts which anchored the bearing on which the engine beam would have pivoted. The brick blocked aperture above is probably the waste steam pipe outlet which may or may not have connected with an external condenser box. [DP23201, HES]



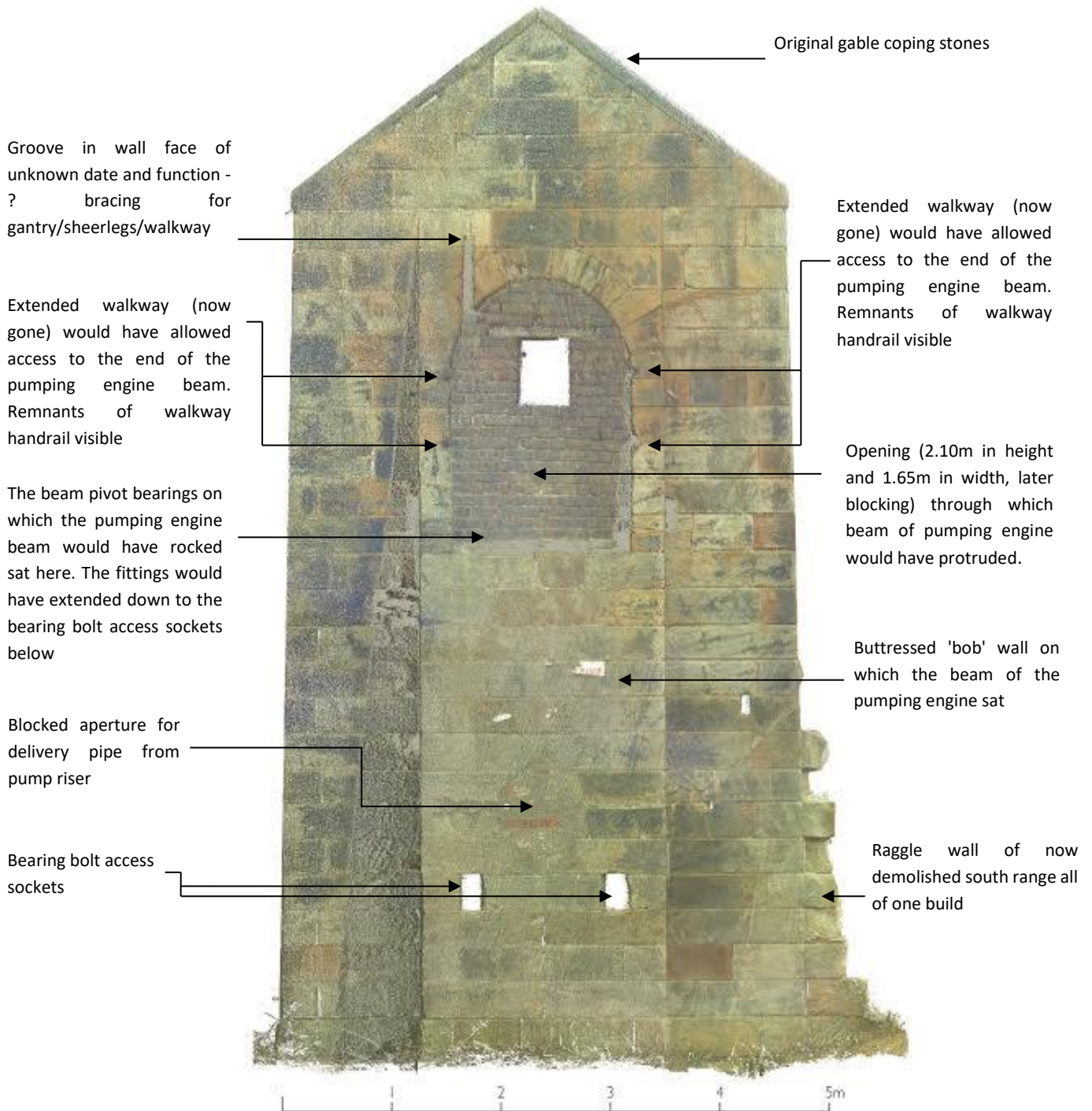
Above: View of base of west gable or 'bob wall'. The buttress would have strengthened the wall as it bore the weight of the beam of the engine where it pivoted. [DP232009, HES]



Left: View of west gable or 'bob wall' showing the quality of the ashlar masonry and the buttressed masonry which strengthened the wall as the beam of the engine would have pivoted on this wall as it pumped water from the mine workings below. [DP231995, HES]

West elevation

Thornton, Middlefield Beam Engine House
 Canmore ID 52882
 Site Number NT29NE 6
 NGR NT 29193 97269
 West elevation: created from laser scanned points
 Scale:1:50



Original gable coping stones

Groove in wall face of unknown date and function - ? bracing for gantry/sheerlegs/walkway

Extended walkway (now gone) would have allowed access to the end of the pumping engine beam. Remnants of walkway handrail visible

The beam pivot bearings on which the pumping engine beam would have rocked sat here. The fittings would have extended down to the bearing bolt access sockets below

Blocked aperture for delivery pipe from pump riser

Bearing bolt access sockets

Extended walkway (now gone) would have allowed access to the end of the pumping engine beam. Remnants of walkway handrail visible

Opening (2.10m in height and 1.65m in width, later blocking) through which beam of pumping engine would have protruded.

Buttressed 'bob' wall on which the beam of the pumping engine sat

Raggle wall of now demolished south range all of one build

Interior facing west - section

Groove in wall face of unknown date and function - possibly associated with external walkway/ sheerlegs/ gantry?

The beam pivot bearings on which the pumping engine beam would have rocked sat here

Floor joist socket / floor level

Original wooden beam at sill level

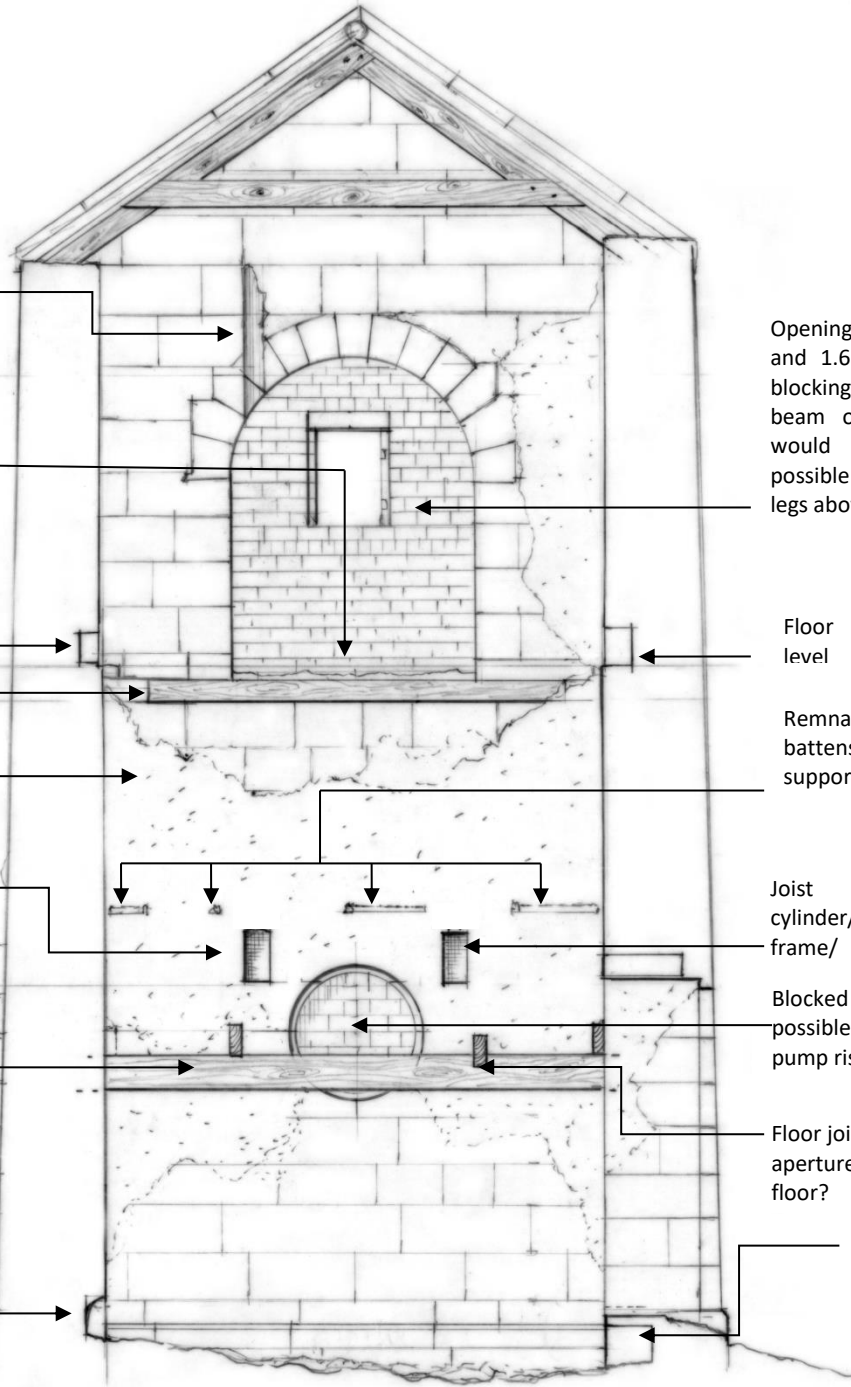
Original plaster

Joist socket for ?engine support frame/ working floor or internal condenser box

Narrow timber beam perhaps part of floor support but obstructs aperture - so post engine removal

Raggle of wall of now demolished south range

Floor joist socket



Opening (2.10m in height and 1.65m in width, later blocking) through which beam of pumping engine would have protruded, possible walkway and sheer legs above shaft, beyond

Floor joist socket/floor level

Remnants of slight wood battens - ? part of engine support frame or later floor

Joist socket for cylinder/engine support frame/ working floor

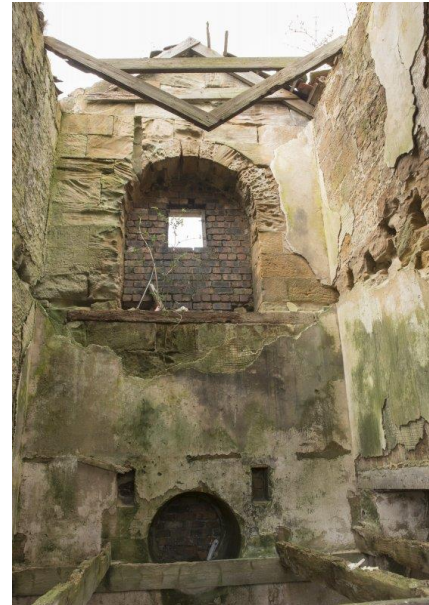
Blocked aperture for possible delivery pipe from pump riser

Floor joists - later than aperture indicating a later floor?

Floor joist socket



Right: Interior view of west gable or 'bob wall' from east showing (top of image) the now blocked opening through which the west end of the engine beam would have protruded. Two floor levels can be identified, plus two joist slots (empty) in which wooden beams would have rested. These could be part of an engine frame but there are no matching joist holes in the east gable wall interior. The timbers that can be seen at the bottom of the image appear to be part of a ?later floor, now mostly gone. The round aperture is possibly accommodated the delivery pipe from the pump riser which provided the engine with condensed water. [DP231998, HES]



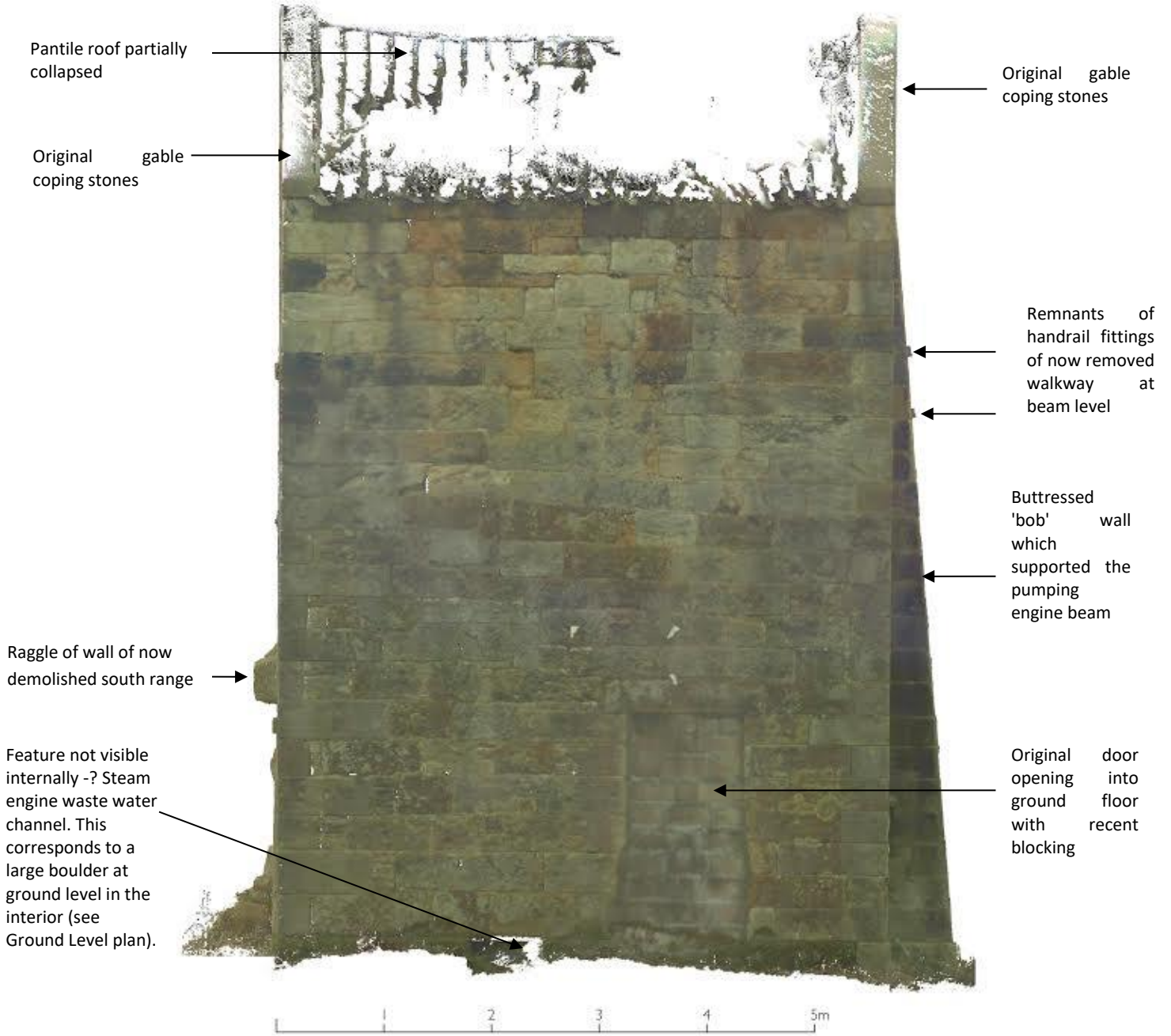
Left: View of north wall showing blocked access. This would have been a main access into the ground level of the engine house. [DP232003, HES]; Right: Detail of north wall showing what appears to be part of a drain outlet. [DP232007, HES]

Right: The internal evidence for the partial drain outlet feature was found by the owner during building work. [copyright: M Bruce, 2017]

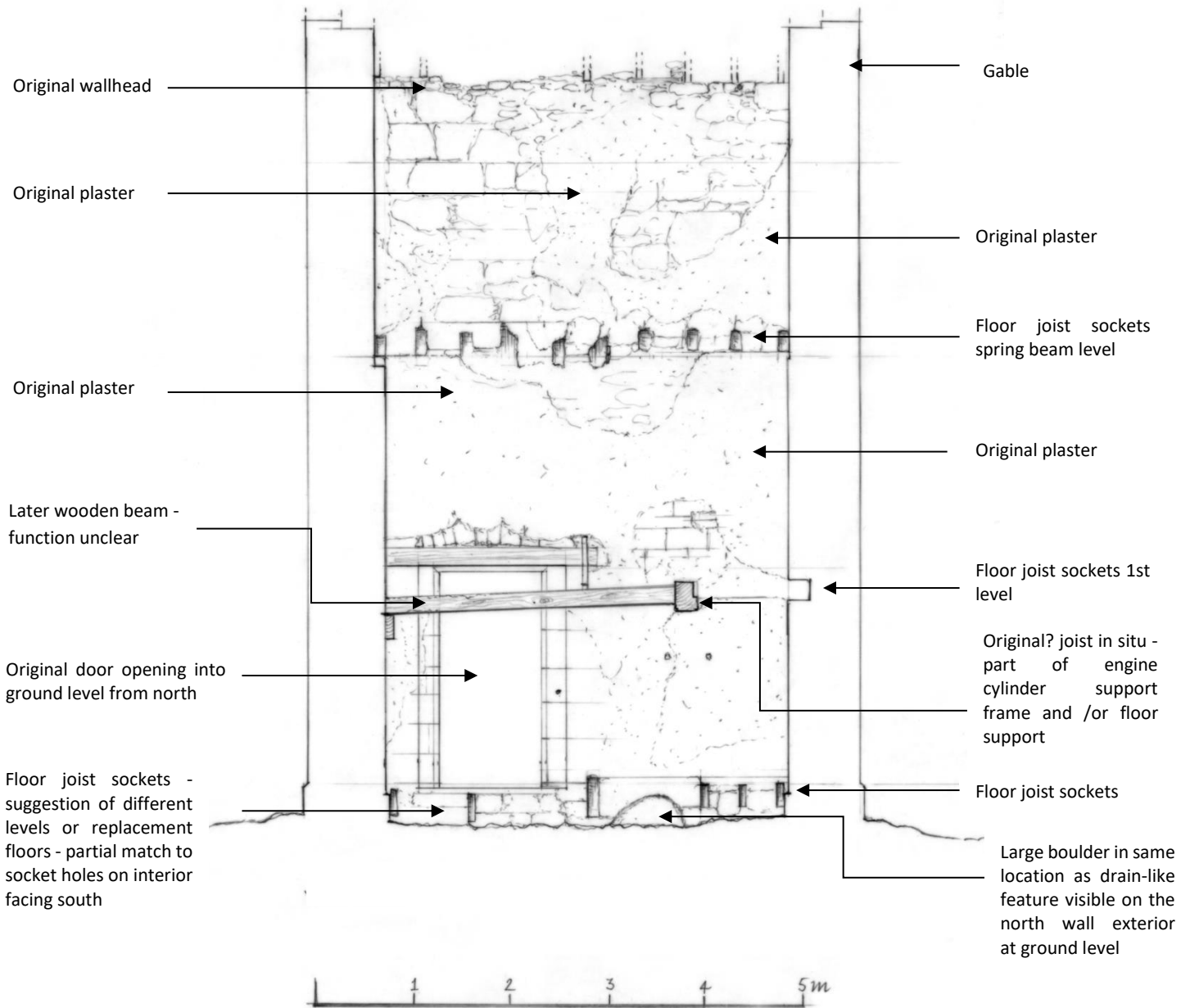


North elevation

Thornton, Middlefield Beam Engine House
Canmore ID 52882
Site Number NT29NE 6
NGR NT 29193 97269
North elevation: created from laser scanned points
Scale:50



**Interior facing north - section (taken beyond
buttressed area of west wall - see plans)**



Conclusions

The Middlefield engine is unusual in that it was adapted for reuse quickly after the pumping engine ceased working. As a result many structural and internal indicators of its original function and use have survived. The following points can be made about Middlefield:

- high quality build
- one of only a few surviving early 'pit engine' houses of the late 18th/early 19th century in Scotland (may possibly date from in or around 1785)
- rare survival in Fife - two others: Kilmux (1838), and Preston Island (early 19th century, integrated chimney with separate boiler house)
- possible early date (1785) and early abandonment (pre-1854) suggests that it could have contained a Newcomen atmospheric engine, although there is no internal chimney evidence and has strong similarities to Kilmux (1830s, Cornish-type beam engine house)
- existence of an undercroft (a usual feature in a beam engine house) uncertain, suggesting that the cylinder foundation sat at ground level on a cast-iron 'table' support
- no evidence of an integrated chimney in the beam engine house, the boiler house was probably in a separate wing to the south
- engine house and now demolished south range appear to date from one period
- clear indication of 'spring beams' or main structural and engine supporting beams (which absorbed the 'jar' of the rocking motion of the beam) at second level indicative of a beam engine and an enduring feature of beam engine house construction from early 18th century - early 19th century
- remnants of wooden framework possibly relating to engine 'bracing' or support frame survive
- no trace of the pumped mine workings water drainage system can be seen although this would have probably been sub-surface
- mine shaft probably survives but has been backfilled and capped at an unknown date

Acknowledgements

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References

⁽¹⁾ *Fifeshire Journal*, 13 February 1845 see the FifePits website: <http://www.fifepits.co.uk/> for East Fife, Thornton [Accessed: 13 June 2017]

⁽²⁾ J.R. Hume, *Industrial Archaeology of Scotland*, Vol. 1: Lowlands (1976), XXX

⁽³⁾ There is little written evidence of mining in the area of Thornton before the 18th century. See G.P. Bennet, *Notes from The Past at Work: Around the Lomonds*, (1992), chapters 3 & 4. The Old Statistical Account (OSA) comments that '...Balgonie Coal...was discovered and wrought upwards of 300, some say 500 years ago.', J. Thomson, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife (Edinburgh, 1791-1799), OSA, Vol.12, p. 538-9.). From mining outcrops to bellpits and the use of levels to drain the mines, by the 19th century the well-established mining method was 'stoop and througher' - stoop means 'pillar' and 'througher' meaning ventilation galleries driven between levels or main roads in the mine. By the in mid-19th century in the Balgonie coalfield, the stalls or '...working rooms are 13 feet wide, and the pillars 15 feet; the width of the rooms contracting in nearing the crop, or where the roof is insecure...'. See J. Sieveright, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife. (Edinburgh, 1845, account of 1834-5), NSA, Vol. 9, 661

⁽⁴⁾ J. Thomson, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife (Edinburgh, 1791-1799), OSA, Vol.12, 539

⁽⁵⁾ The Earls of Leven and Melville also held the title Lord Balgonie (from 1641). The name Leslie is the name of the Earls of Leven and Melville of the Earls of Melville, both titles falling eventually to the same person, see H. Chisum (Ed.) 'Leven and Melville, earls of', *Encyclopaedia Britannica* 16 (Cambridge University Press, 1911)
https://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Leven_and_Melville,_Earls_of [Accessed 13 June 2017]

⁽⁶⁾ <http://www.fifepits.co.uk/> for East Fife, Thornton [Accessed: 13 June 2017]

⁽⁷⁾ J. Thomson, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife (Edinburgh, 1791-1799), OSA, Vol.12, 539

⁽⁸⁾ J. Sieveright, 'the parish of Markinch' in the *Statistical Account of Scotland*, County of Fife (Edinburgh, 1845, account of 1834-5) Vol. 9, 661-662

⁽⁹⁾ Glenrothes Development Corporation Drawings, Fife Archives (GDC/22/7/4/2), Fife Archives, 'Balgonie Colliery Dysart Lower Coal Workings, Scale 1:2500 datum for levels is 10,000 feet below Ordnance Datum'. This possibly dates to post-1952 and shows 'OLD ENGINE PIT' [Middlefield, Thornton engine house and pit] and the note, 'old workings in 1846' and showing the 'stoop and througher' layout.

⁽¹⁰⁾ J. Sieveright, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife. (Edinburgh, 1845, account of 1834-5) Vol. 9, 661. This would have dictated the power needed to pump and thus the size of the cylinder required and the engine stroke needed.

⁽¹¹⁾ J. Sieveright, 'the parish of Markinch', *Statistical Account of Scotland*, County of Fife. (Edinburgh, 1845, account of 1834-5) Vol. 9, 663.

⁽¹²⁾ Ordnance Survey 1st Edition 6-inch to the mile map, Fife and Kinross, 1856 (revised 1854), sheet 32)

⁽¹³⁾ See <http://www.fifepits.co.uk/> - East Fife, Thornton [Accessed: 13/06/2017]

⁽¹⁴⁾ Ordnance Survey 1st Edition 6-inch to the mile map, Fife and Kinross, 1856, sheet 32, Ordnance Survey 2nd Edition 6-inch to the mile map, Fife and Kinross, 1920, sheet XXVIII.SW.)

⁽¹⁵⁾ Information from owner, Mr M. Bruce, 2016.

⁽¹⁶⁾ The engine house has been converted into a dwelling (2017).

⁽¹⁷⁾ It is known that John Curr of Sheffield constructed a Newcomen engine at Attercliffe Common Colliery in 1790. This had two boilers, each housed in separate boiler houses. This is noted as being perhaps the first documented evidence of departure by engine builders from the typical Newcomen engine layout of integral boiler and chimney within the engine house. See Grace's Guide to British Industrial History, http://www.gracesguide.co.uk/John_Curr [Accessed: 27/06/2017]

⁽¹⁸⁾ Kilmux Beam Engine House, Fife measures 10.5m (34ft 5in.) in height at gable ends with a surviving wall head at 8.6m (28ft 2^{1/2} in.), and with a beam height of c. 4.2 metres (13ft 9in.). It contained a 47hp engine and was pumping to a depth of some 99.0m (54 fathoms or 324ft) by 1838 (see D. Bell, 'the parish of Kennoway', *Statistical Account of Scotland*, County of Fife. (Edinburgh, 1845, account of 1838) Vol. 9, pp.384-5. There are access voids in the 'bob' wall to allow access to the bearing bolts as at Middlefield and the bob wall although 1.2m (3ft 11in.) in thickness is not buttressed as at Middlefield. The opposite gable wall measures 0.73m (2ft 5in.) in thickness, its side walls 0.75 (2ft 5^{1/2} in.) metres in thickness with an internal measurement of 4.42m (14ft 6in.) gable to gable and 3.12m (10ft 3 in.) from side wall to side wall. Externally, Kilmux measures 6.34m (20ft 9in.) by 5.89m (19ft 4in.); see NRHE MS/762/61. The external dimensions of Middlefield engine house are considerably smaller than Kilmux, at 4.2m (13ft 7in.) in length and 3.2m (10ft 6in.) in width. Preston Island has two engine or pump houses. The westerly engine house has an integrated chimney, external measurements of 6.2m (20ft 4in.) by 4.8m (15ft 9in. - similar dimensions to Middlefield) and walls about 0.7m in thickness and may have contained a Cornish type steam powered, beam, pumping engine, c.1800, disused by 1840 (see NRHE MS/500/2/1).

⁽¹⁹⁾ This aperture for the possible delivery pipe from the pump riser would have turned into the building to provide condenser water and maybe even a boiler water feed using a preheater which would then have been led away from the pump house to a nearby watercourse. (Per. Comm. from JS Mitchell, ACR FIESIS, conservation engineer, Industrial Heritage Consulting Ltd., June 2018).