## **Dorothea Beam Engine House**

## **Archaeological Recording**



## Report No. 397

Prepared for Cyngor Gwynedd Council



Ymddiriedolaeth Archaeolegol Gwynedd Archaeological Trust



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Ymddiriedolaeth Archaeolegol Gwynedd Archaeological Trust



#### Archaeological Recording at Dorothea Beam Engine House

#### 1. Introduction

The Dorothea Engine House sited in the Dorothea Slate Quarry at Nantlle, near Caemarfon, houses a Cornish Beam Engine that was used to pump out water from the adjoining quarry workings. The engine was built in 1904 and was used until the 1950s.

Plans for the restoration and repair of both engine and engine house have been prepared by the Welsh Mines Preservation Trust. The restoration scheme is divided into three stages, of which the removal of asbestos and recording of the beam engine comprise the first stage. The asbestos contamination was carried out by C&A Asbestos Removal Ltd and present and pending restoration work is undertaken by Dorothea Restorations Ltd (DR). Gwynedd Archaeological Trust were contracted by DR Ltd to undertake the required archaeological recording within the present contract.

Archaeological recording at the Engine House complex was carried out at specific locations both during and on completion of decontamination work.

The Engine House is a Scheduled Ancient Monument (SAM No. C165) and all Works were carried out under Ancient Monument Consent to comply with the Ancient Monuments and Archaeological Areas Act (1979).

#### 2. Background

The Dorothea Beam Engine complex comprises the pump house and beam engine, the boiler house, boilers, fuel hopper, flue, chimneystack and windlass. The engine was designed by Nicholas Trestrail, last of the great Comish pumping engineers, and built by Holman Bros. of Cambome, Cornwall in 1904. It is housed within a custom built Engine House built of local slate but designed in Cornwall.

The Beam Engine was installed by 1906, its prime purpose to pump out the deep quarry workings, a task which previously, but increasingly less efficiently was undertaken by a series of waterwheels.

The Engine House structure remains in good sound condition and has been re-roofed in recent years.

The major components of the Engine itself are summarised below :

**Beam**: 34ft long, weighing some twenty-two and one half tons. The beam is apparently constructed of wrought iron, which is unusual. The massive beam is 6ft deep at the centre and some three feet at each end. The work rate was normally five strokes per minute (the maximum rate being nine per minute). The inside stroke was 10ft (at the piston), outside stroke 9ft (in the pumps), equivalent to one lift of the pumps at a depth of 460ft.

**Cylinders**: a single cylinder fourteen feet eight inches high, having a stroke of 10ft and a bore of 5ft 8in, operating at a boiler pressure of 38psi. No trouble of any serious kind was recorded throughout the working life of the installation, and the cylinder cover had not been lifted since it was first bolted in position.

**Boilers** : There are two boilers of Lancashire type, both the shells and the fittings, in all probability, supplied by Mather and Platt. The chimney is located at the end of a curving flue adjacent to the fuel hopper.

The engine is the only surviving example complete with boilers, headgear and winch. The latter is believed to have come from a ship and is almost entirely of non-ferrous metal.

In 1978 Dorothea Restorations Ltd recommended that items that might easily be removed from the site were taken into secure storage. As a result, the more vulnerable parts of the valve gear, controls etc were dismantled. Records were kept of the parts that were removed. At present these items reside at the Cadw depot on the Cibyn industrial estate, Caernarfon, an inventory made and their condition has been assessed by DR and GAT staff.

#### 3. Archaeological Recording

Initial recording work was carried out following the removal of all accessible and loose asbestos that did not require any disassembling of the machinery.

#### Methodology

#### Photographic Record

A photographic survey was undertaken of the interior of the engine house prior to the start of any disassembling work using 35mm colour print film. The initial survey sought only to provide a record of the interior and the presence and location of items within the engine house to aid future management. Following the initial photographic survey, the engine house was cleaned of all loose asbestos so requiring the relocation or storage of particular items. Subsequently a more detailed photographic survey was undertaken to record the cylinders housing, which comprised wooden staves and steel panels enclosing the asbestos surrounding the cylinder body.

Additional photographs (colour print, colour slide and monochrome) were taken of the cylinder after it had been stripped to reveal the cast elements and all remaining asbestos removed from the main structure. The subsequent record reflects this and includes detail of the cockpit and crow beneath the middle (first) floor beam level.

#### The Drawn Record.

Detailed scale drawings were made of the cylinder casing prior to its removal and included individual, constructional as well as any decorative details at scales between 1:10 and 1: 50 as applicable. Elements of the middle floor (first floor ceiling) beams where also recorded.

The field drawings were subsequently transcribed digitally using Adobe Illustrator computer software and those drawings accompany this report.

Original drawings of the beam engine house are held at the Comwall County Record Office. The archives have seven of Trestrail's original 1904 engine house drawings and photographic copies of these have been obtained. Although these have not been fully scrutinised as yet nor any direct comparisons made in the field it is clear that they are not entirely commensurate with the existing monument. Nonetheless elements of these drawings have been used to put the present phase of recording into context where appropriate. Copies of the original drawings are appended to this report.

#### 4. Synopsis

Two members of GAT staff undertook and completed the archaeological recording over a period of two days. In the first instance this was in the presence of DR staff who were in the process of dismantling the cylinder casing to facilitate the removal of asbestos encasing the casting. In the second instance recording took place after the removal of the cylinder casings on both the bottom (first) and middle (second) floors.

The lower floor casing (which is the main subject of this report) comprised three curving sections of lapping equal sized steel plate, with a shorter section of flat plate completing the circuit adjacent to the adjoining pipes to the rear of the cylinder. Attached around the periphery were five covers for the cylinder anchors in the floor. The main body of the cylinder was clad by vertically set wooden staves that interlocked by means of a steel tongue set into grooves running the length of the edge of the staves. These had been held in place by three metal bands that had encircled the cylinder but were now missing.

The staves had originally been varnished. The whole was bound together by a three-section iron collar that formed a junction between the staves and the lower steel panelling. Decoration on the panels and the anchor covers was still discernible and comprised of red and gold piping on a mid-green background.

A similar arrangement of decorated steel panels was apparent on the top section of the cylinder visible on the second (middle) floor.

Since the removal of the asbestos all the cylinder coverings have been left off and stored within the engine house.

A number of metal components and other items have been recovered from within the engine house during the clean up operation and these still require a provenance.

LIST OF APPENDICES :

- 1. Drawings
- 2. Selected Photographs
- 3. Photographic record
- 4. Trestrail's 1904 Archive plans

APPENDIX 1.

DRAWINGS

DOROTHEA BEAM ENGINE : SINGLE CYLINDER HOUSING



Illustration of a typical Cornish Pumping Engine extracted from the Illustrated Catalogue of the Williams' Perran Foundry Co. 1870.

The highlighted area approximates the extent of the section of the Dorothea cylinder recorded in the accompanying drawings.



Scale 1:20 0 100cm

Title : DOROTHEA BEAM ENGINE : SINGLE CYL	NDER HOUSING extended elevation showing pri	ncipal components	
Ymddiriedolaeth Archaeolegol Gwynedd Gwynedd Archaeological Trust	Client:	Scales: 1:40	27/10/00 LAD
To 01248 352535 D 01248 370925 email : gat@heneb.co.uk Craig Beuno : Ffordd y Garth : Bangor : LL57 2RT	Cyngor Gwynedd Council	Drawing number C:\G1633_Dorothea_0	1_A4.ai 1of2



Dorothea beam Engine House : Plan showing juxtaposition of First Floor (Cylinder level) , cockpit and crow.



The structural detail is extracted from the original 1904 plans and incorporates elements of recent surveys carried out at specific locations.

**APPENDIX 2.** 

Selected Photographs



plate 1. The wrought iron beam. vie w from east





plate 2. The cylinder head, piston and linkage . Cylinder still enclosed. vie w from south east



plate 3. The cylinder head, piston, linkage and v alve chamber, cladding remo ved. vie w from south east



plate 4. The enclosed cylinder. Note location of missing bands . View from east.



plate 5. The cylinder revealed. Note trap to cockpit at centre r ight. View from east.



plate 6. The lower cylinder casing. Note decorative piping. View from west.



plate 1. The wrought iron beam. view from east





plate 2. The cylinder head, piston and linkage. Cylinder still enclosed. view from south east



plate 3. The cylinder head, piston, linkage and valve chamber, cladding removed. view from south east



plate 4. The enclosed cylinder. Note location of missing bands. View from east.



plate 5. The cylinder revealed. Note trap to cockpit at centre right. View from east.



plate 6. The lower cylinder casing. Note decorative piping. View from west.



plate 7. View into cockpit from trap , view north.



plate 8. View into crow pit looking south.



plate 9. Cock pit, view to trap and external door.

APPENDIX 3.

Photographic Record

g No.	Description	viewing position
01	first floor - cylinder	view from EAST
02	first floor - cylinder and riser	view from NW
03	first floor - cylinder at floor level	view from NW
04	first floor - cylinder& stairs	view from SW
05	first floor - cylinder& stairs	view from SW
06	first floor - cylinder and riser	view from NW
7	first floor - rear of cylinder and riser	view from NW
08	first floor - cylinder casing	view from E
9	first floor - cylinder base	view from SE
10	first floor - cylinder and riser	view from NW
11	first floor - cylinder base, stairs and riser	view from SW
12	first floor - cylinder, stairs and riser	view from SW
13	first floor - rear of cylinder, riser & valve	view from SE
14	first floor - cylinder & damaged casing	view from SE
15	first floor - cylinder, damaged casing & 2nd floor joist	view from SE
16	first floor - cylinder, riser and valve gear mount	view from SE
17	first floor - cylinder, riser and valve gear mount	view from W
18	first floor - cylinder, riser and valve gear mount & roof	view from SW
19	first floor - rear of cylinder & riser	view from S
20	first floor - riser and valve gear mount	view from W
21	first floor - riser and valve gear mount	view from SE
22	first floor - riser and valve gear mount	view from SE
23	first floor - riser and valve gear mount and cylinder	view from NW
24	first floor - riser and valve gear mount and cylinder	view from NW
25	first floor - riser and valve gear mount	view from NW
26	first floor - riser, and valve gear mount, cylinder & 2nd floor	view from WNW
27	first floor - riser, and valve gear mount, cylinder & 2nd floor	view from WNW
28	first floor - cylinder , riser & 2nd floor joist	view from VVINVV
29	first floor - loose items & asb. bags	view from VV
30	first floor - stairway to 2nd floor	view from NVV
31	second floor - cylinder cover & 3rd floor stair	view from NE
32	second floor cylinder cover piston	view from SE
33	second floor - cylinder cover piston	VIEW ITOM SE
34	second floor - cylinder cover piston & riser	view from W
35	second floor - cylinder cover & valve housing	view from NIA
36	second tioor - cylinder cover & valve housing and stair	view from NE
37	second floor - cylinder cover & valve housing and stair	VIEW ITOTTINE

leg No.	Description	viewing position
OA	second floor - cylinder cover piston	view from NE
1A	second floor - cylinder cover motif	view from NE
2A	second floor - cylinder cover motif	view from NE
3A	second floor - cylinder cover & motif	view from N
4A	second floor - cylinder cover & valve chamber	view from NW
5A	second floor - cylinder cover & valve chamber	view from NW
6A	second floor - cylinder cover, valve & gallery	view from SE
7A	second floor - cylinder cover, piston & valve chamber	view from NW
8A	second floor - cylinder cover, valve chamber & gallery	view from NW
9A	second floor - beam, piston & cylinder cover	view from WSW
10A	second floor - valve chamber, view down to 1st floor	view from W
11A	second floor - cylinder cover, piston & valve chamber	view from W
12A	first floor - cylinder casing & 2nd floor joist	view from E
13A	first floor - cylinder casing & base	view from E
14A	first floor - cylinder casing & riser	view from NE
15A	first floor - cylinder casing, base & riser	view from NE
6A	first floor - valve gear controls etc	view from W
17A	first floor - cylinder casing & riser	view from NW
18A	first floor - cylinder casing, base & risers	view from NW
I9A	first floor - 2nd floor joist and riser	view from NW
20A	first floor - 2nd floor joist and riser	view from NW
21A	first floor - cylinder, gear mounts, riser and stair	view from SW
22A	first floor - mounts, 2nd floor joist and riser	view from NE
23A	first floor - risers and back base cylinder	view from S
24A	second floor - cylinder cover, piston & stairway	view from E
25A	second floor -beam, piston& stairway	view from E
26A	second floor - beam, piston & stairway	view from N
27A	second floor - valve chamber and gear, view down to 1 st floor	view from SW
28A	third floor - upper beam, shutters & stairway	view from E
29A	third floor - upper beam, shutters & stairway	view from E
30A	third floor - upper beam, shutters	view from SE
IA	third floor - upper beam, piston view down to cover 2nd floor	view from E
IZA	first floor - cylinder casing, base & stair	view from E
3A	first floor - cylinder casing & base & joists	view from S
4A	first floor - cylinder basept dismantled	view from E
5A	first floor - cylinder casing joists & floorboards	View from E
0A	first noor - cynnder casing, base, nser and gear mount	

leg No.	Description	viewing position
1	lower floor - cock pit counterweight levers and pulleys	view from N
2	lower floor - cock pit counterweight levers and pulleys	view from N
6	lower floor - cock pit counterweight levers and pulleys	view from N
7	lower floor - cock pit counterweight levers and pulleys	view from N
8	lower floor - cock pit - ladder & ext.door	view from S
9	lower floor - cock pit - ladder & ext.door	view from S
10	lower floor - cock pit - ladder & detail of pulleys	view from S
12	lower floor - cock pit - ladder & detail of pulleys	view from S
13	lower floor - cock pit - south end detail of pulleys & weights.	view from N
14	lower floor - cock pit detail & view down to crow	view from E
15	crow pit detail view from cockpit access	view from S
16	crow pit detail view from cockpit access	view from S
17	lower floor - cock pit - general view from first floor access	view from S
19	lower floor - cock pit - general view from first floor access	view from S
21	first floor - exposed cylinder and cock pit trap	view from E
22	first floor - exposed cylinder and cock pit trap	view from E
23	first floor - exposed cylinder and riser	view from SE
24	first floor - exposed cylinder and riser	view from SE
25	first floor - exposed cylinder and riser	view from SE
25	first floor - exposed cylinder and riser	view from NE
27	second floor - exposed cylider, piston & valve chamber	view from NE
28	second floor - exposed cylider, piston & valve chamber	view from NE
29	second floor - exposed cylider, piston & valve chamber	view from WSW
31	second floor - exposed cylider, piston & valve chamber	view from WSW
32	second floor - exposed cylider, piston & valve chamber	view from SE
33	second floor - exposed cylider, beam, piston & valve chamber	view from SE
34	first floor - exposed cylinder and cock pit trap	view from ENE

1 2 6 7 8 9	lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys	view from N view from N view from N
2 6 7 8 9	lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys	view from N view from N
6 7 8 9	lower floor - cock pit counterweight levers and pulleys lower floor - cock pit counterweight levers and pulleys	view from N
7 8 9	lower floor - cock pit counterweight levers and pulleys	A State Street Street
8 9 10		view from N
9	lower floor - cock pit - ladder & ext.door	view from S
10	lower floor - cock pit - ladder & ext.door	view from S
	lower floor - cock pit - ladder & detail of pulleys	view from S
12	lower floor - cock pit - ladder & detail of pulleys	view from S
13	lower floor - cock pit - south end detail of pulleys & weights.	view from N
14	lower floor - cock pit detail & view down to crow	view from E
15	crow pit detail view from cockpit access	view from S
16	crow pit detail view from cockpit access	view from S
17	lower floor - cock pit - general view from first floor access	view from S
19	lower floor - cock pit - general view from first floor access	view from S
21	first floor - exposed cylinder and cock pit trap	view from E
22 1	first floor - exposed cylinder and cock pit trap	view from E
23 1	first floor - exposed cylinder and riser	view from SE
24 1	first floor - exposed cylinder and riser	view from SE
25 1	first floor - exposed cylinder and riser	view from SE
25 1	first floor - exposed cylinder and riser	view from NE
27 :	second floor - exposed cylider, piston & valve chamber	view from NE
28 :	second floor - exposed cylider, piston & valve chamber	view from NE
29 :	second floor - exposed cylider, piston & valve chamber	view from WSW
31 8	second floor - exposed cylider, piston & valve chamber	view from WSW
32 9	second floor - exposed cylider, piston & valve chamber	view from SE
33 8	second floor - exposed cylider, beam, piston & valve chamber	view from SE
34 f	first floor - exposed cylinder and cock pit trap	view from ENE

**APPENDIX 4.** 

Nicholas Trestrail's 1904 Plans





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