REPORT ON THE ARCHAEOLOGICAL RECORDING OF THE INCLINE DRUMHOUSE AND ASSOCIATED BUILDINGS, PORT DINORWIC

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GWYNEDD ARCHAEOLOGICAL TRUST

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by P.T.Muckle and A.J. Shallcross
with historical analysis by G.Pierce Jones
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Frontispiece

The last wire rope used for hauling wagons up and down The Incline left coiled up on a timber platform in the unloading shed. *(G1063I/01/27*, scale 2 metres).

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1. INTRODUCTION

Gwynedd Archaeological Trust (GAT) were commissioned by Welsh Office Highways Directorate to assess the archaeology along the route of a proposed by-pass across land to the south of Port Dinorwic. The route extends for approximately 5 kilometres, from Griffiths Crossing on the present A487 south of Port Dinorwic northwards to the Vaynol Estate roundabout. The route climbs and descends the north-facing slope of the edge of the Arfon Plateau, from approximately 25m to 90m OD, passing through an area of boulder clay and morainic drift overlying igneous bedrock.

GAT undertook the assessment in November and December 1991 (*Port Dinorwic Bypass - Archaeological Assessment*). One of the recommendations (no. 6) was to record the Incline buildings by photographs, plans, elevations and written records. In February 1992 the following outline programme of work was accepted by Cadw, who act as monitors on behalf of the Welsh Office:

a. A full photographic record, by colour transparency and monochrome negative and print, to include all main elevations and details of individual, interior and exterior fixtures and fittings of the winding shed.

b. Limited clearance of recent debris and preparation of a ground plan at a scale of 1:50 with a total station survey to show the immediate surroundings, including the incline and rail approaches to the winding shed.

c. Drawings of all main external elevations of the winding shed, showing openings and any other features, and a cross-section to show the roof structure, at the same scale as the ground plan. The internal elevations were also recorded in detail and provided much of the data for the external elevations.

d. An index giving the locations of all the photographs in a.

e. A written description and analysis of the structure of the winding shed.

f. Basic photographic record in colour transparency and monochrome negative and print of the incline cottages and associated structures. Index of same.

g. Outline plan of the incline cottages to show their relationship to the winding shed.

h. Brief written description of the incline cottages.

Plate 1 General view of the unloading shed and drumhouse from the south-east. Note the dense curtain of ivy covering the drumhouse. *(G1063I/01/10).*

2. METHODOLOGY

General Note: The building was recorded in May 1992 at which time there was a considerable amount of vegetation around the buildings, obscuring many features. The south face of the drumhouse was covered in a thick curtain of ivy and that almost completely masked the stonework, which on inspection exhibited a clear division between the stone foundation platform and slate drumhouse extension. The north face of the building was impossible to photograph because the ground fell very steeply away to a dense thicket of undergrowth, shrubs and trees. The outbuildings attached to the south face of the drumhouse were similarly foliated and also highly unstable with collapsed timber rafters and corroded corrugated-iron roofs. The internal elevations of the buildings proved to have more evidence of the actual operation of the building and to be more responsive to drawn record than to photgraphy.
1. Surveying. The main internal and external features of the unloading shed/drumhouse were surveyed using a total station and easyCAD software. The resulting plan was plotted at scales of 1:50 and 1:200 and further information added by hand on site. A basic outline survey of the track and carriage house was included.

2. Drawn records. The internal lateral elevations were measured by hand and drawn on site at a scale of 1:50, as was the external west elevation of the drumhouse. The external southern elevation was drawn using key measurements and a series of photographs reproduced at 1:30. The west gable roof support of the unloading shed was drawn at a scale of 1:20, as was the roof support immediately to the east. Three significant timbers were drawn at a scale of 1:10.

3. Photography. Photographs of the building were needed to complement the hand drawn plans and elevations. As it was impractical and unnecessary to make a complete photographic survey it was decided to highlight important details or give good general views. In only one case, the central part of the southern exterior elevation, was a "rectified" photograph required because of the practical problems of drawing the elevation on site. With all the others it was possible to vary the angle of view and maximise the three-dimensional information. Although scales were placed in most of the photographs they are, with the exception of the one rectified view, only intended to give a suggestion of size and degree of foreshortening.

Colour slides were shot on 35mm Kodachrome 64, black and white negatives were made using Ilford FP4, either 120 roll film or 5" x 4" sheet film. Since there was no electricity on site and a lot of uneven daylight from the two entrances and holes in the roof, two hand-held high-powered portable flash units were used to help fill the shadow detail. The position the photograph was taken from and the direction was marked onto a prepared ground plan.

4. Written Records. Detailed notes were added to the field drawings as they were produced, with additional description where relevant. The cottages and sheds were described along side a sketch plan.

5. Archive Search. The indexes to the Dinorwic Quarry Company papers were intensively searched for documents relating to the buildings, but surprisingly yielded no relevant plans or surveys. An interesting pair of photographs were located in two sources; both showing the incline in operation from the tunnel mouth below the buildings (Plates 2 and 3).

6. Site Archive. The archive containing field drawings, a written record and a photographic record is housed with the Gwynedd Sites and Monuments Record at the Gwynedd Archaeological Trust. The archive comprises a 3" disc containing survey data (1063IC.DAT, 1063IC.XYZ, 1063IC.FCD), an index to 97 monochrome photographs in various formats, and an index to 75 colour slide photographs, the field drawings and notes, comprising 8 sheets of A3 and 10 sheets of A4, the prepared publication drawings, various copies of early maps and photographs, and handwritten notes made during the archive search and oral communication.

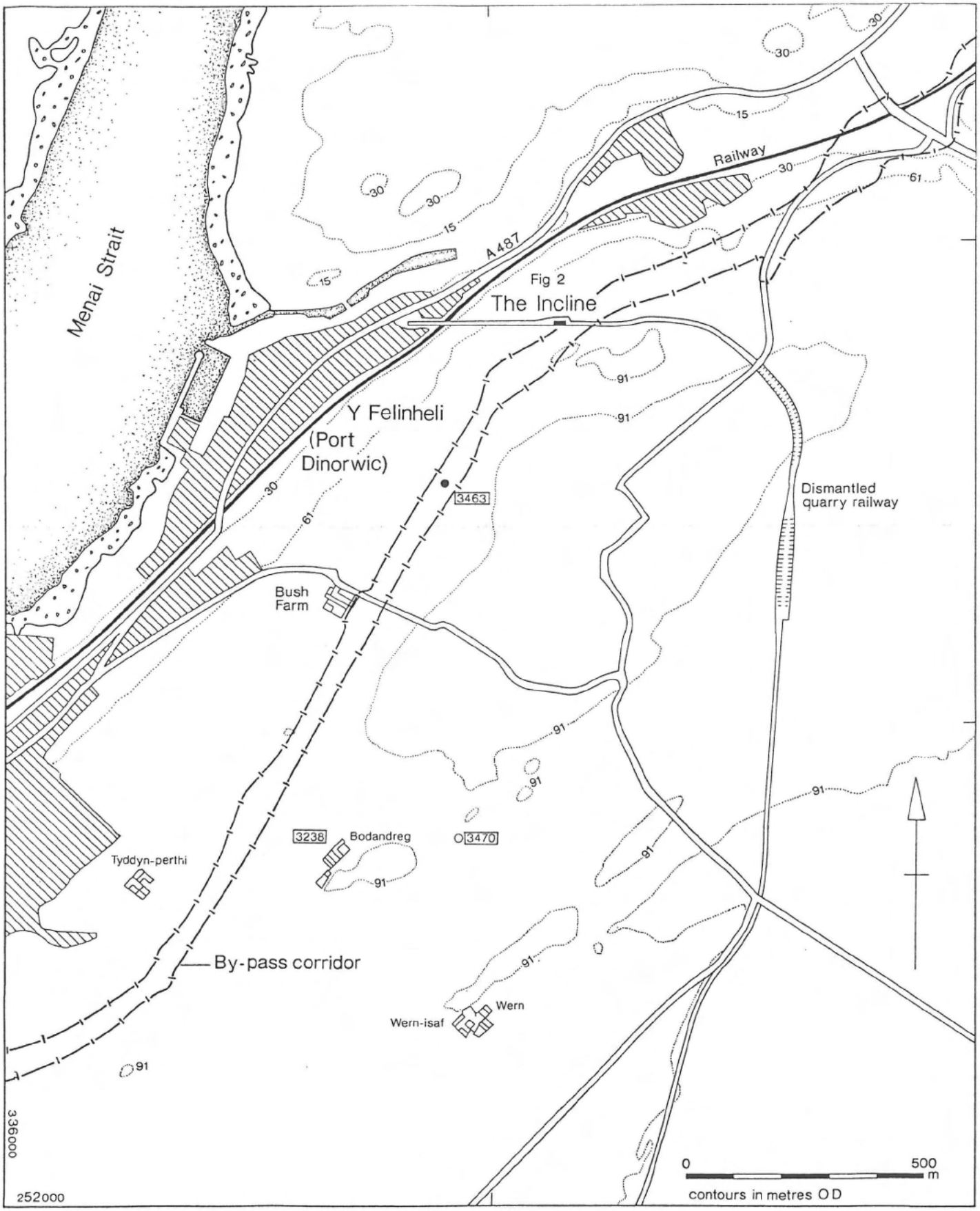


Fig. 1 Map showing the route of the bypass and the location of the Incline.

3. LOCATION

The Incline building and cottages are located about 700m east of Port Dinorwic dock, at the top of the steeply sloping side of the Arfon Plateau at an altitude of c. 90m OD (Fig.1). The buildings are sited on either side of and at the terminus of the old Padarn railway (1843-1961). The rail approach to the unloading shed is presently used as an access road by the residents of the incline cottages. On the south side of the east (road) end of the track are a row of four railway cottages. About 40m west of the cottages on the north side of the track is Pen-Scoins Farm. 20m west of Pen-Scoins on the south side of the track is a long slate-built engine and carriage house with a coaling stage and water tower outside the west gable end (the building stands on a siding, since removed). The track broadens past the building as it approaches the Incline head. On the south side of the track about 200m west of the engine/carriage shed is an unrendered stone-built shed, and 30m further on the same side is a carriage shed (Fig. 2). The unloading shed is built astride the terminus of the track. To the south of the unloading shed are the Incline or Clock Cottages. About 60m east/north-east and below the unloading shed are two more cottages, Woodland View and Chippinover with a further two, Llwyn Onn and Carreg Gwalch about 20m east of them.

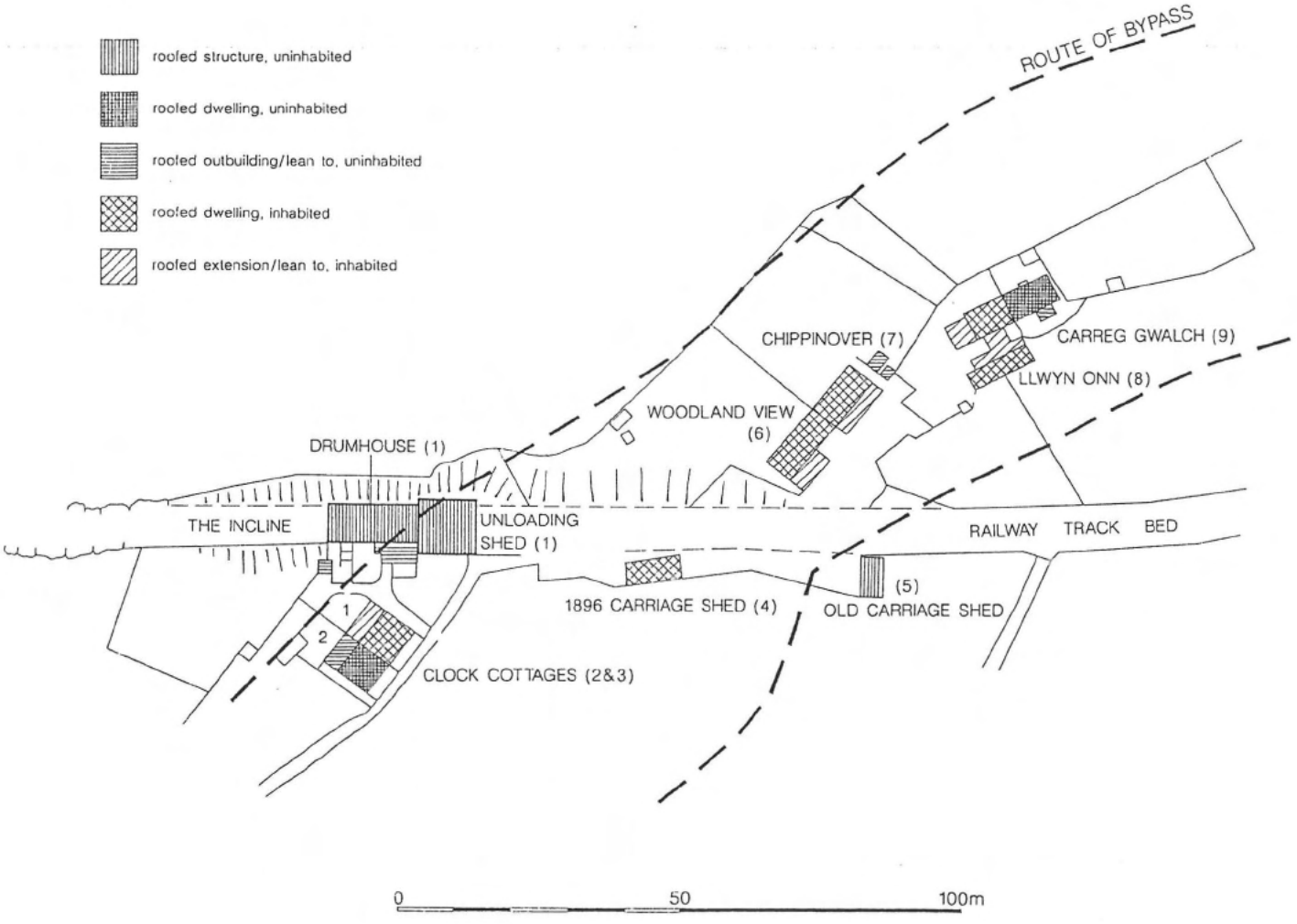


Fig. 2 Plan showing the Incline buildings, rail approach and Incline head.
The numbers refer to the photographic record

4. HISTORICAL SUMMARY AND DEVELOPMENT

Sources

Historical information on The Incline drumhouse has been derived from three sources; published works, archive material and oral history. The definitive work on the Padarn Railway is J.I.C. Boyds' *Narrow Gauge Railways of North Caernarvonshire vol.III* (1986), although there are other relevant publications such as *The Padarn and Penrhyn Railways* (Turner 1975) and more recently *A Gazeteer of the Welsh Slate Industry* (Richards 1991). A full bibliography of works consulted is included.

The UCNW archives were consulted but contained no information on the railways. The Gwynedd Archives (Caernarfon) contained the records of the Dinorwic Quarry company, and over 4000 entries were scanned before about 40 were selected for more detailed appraisal. The entries concerning the Incline were surprisingly scant and had already been summarised by Boyd, his comment being "...many records were destroyed in recent years, or not kept or never made...it could be that once the cost of construction had been met, subsequent fiscal accounts were of little lasting value" (1986, 3). An intensive search in the photographic collection revealed a photograph previously unknown to the Trust through publications of the incline in operation using the wire rope (Plate 3). The photograph was taken from the mouth of the tunnel below the drumhouse and can usefully be compared to the earlier known photograph showing the continuous chain in use (Plate 2). The later development of the terminus, particularly the construction of the 1896 carriage shed and siding, can be traced on early editions of the 25" Ordnance Survey maps (Fig. 3).

The informant of the oral history, Mr. Eric Jones of Braich Melyn, Bethesda, was made known to the Trust by Dr. D. Roberts of the Llanberis Slate Museum. Mr. Jones was a fireman on the Padarn railway taking trains from The Incline to the quarry. He began work in 1956 and continued until 1961, when he brought the last slate train down on the 27th of October of that year. Although he did not normally work on the unloading and lowering of the wagons, he did help on some occasions and was involved in the replacing of the wire rope one weekend. Mr. Jones generously answered general and specific questions on the buildings and the Trust intend to transcribe a fully recorded interview with Mr. Jones in the near future.

An historical analysis of the unloading shed and drumhouse is included in the text following the detailed description. The analysis was contributed by Gwynfor P.Jones, M.A., and is roughly based on material abstracted from Boyd, 1986, although there is also much original interpretation and comment.

Development

The quarrying and exporting of slate was once an important industry in North Wales, with a major period of expansion between 1793 and 1877, when trade output rose from 45,000 tons to 504,000 tons. The Penrhyn Quarry, south of Bethesda was the largest in Wales, the Dinorwic Quarry east of Llanberis being the second largest.

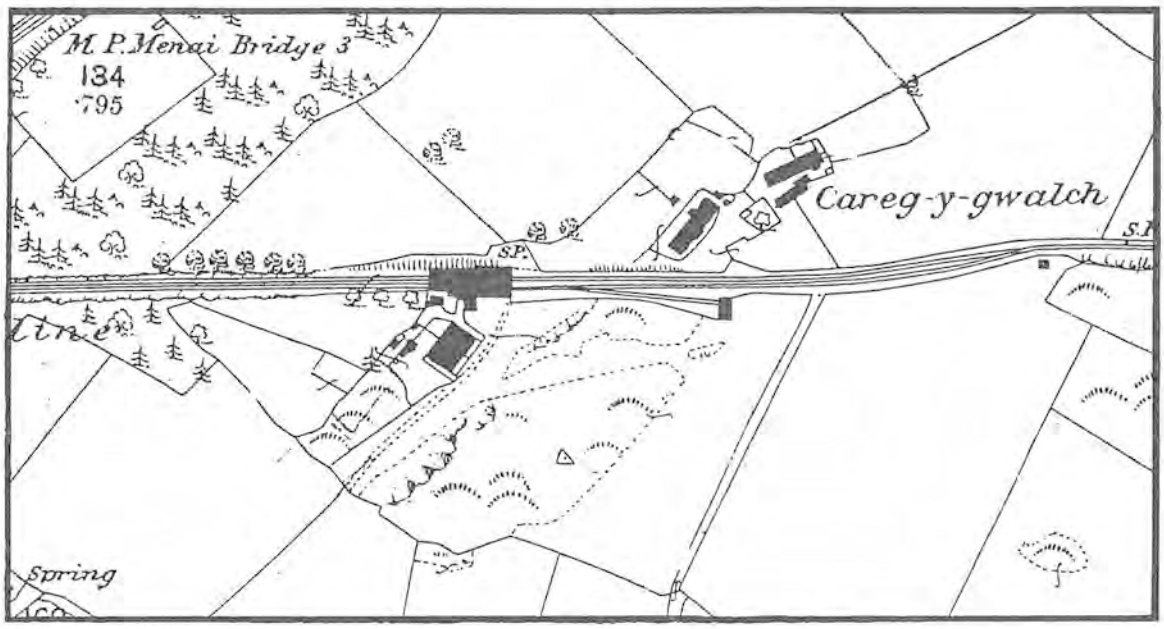
The Dinorwic quarry was owned and worked by the Assheton-Smith family, who also owned the land between the quarry and seaboard. The dual aspect of ownership and operation led to the Dinorwic Quarry railway system becoming one of the largest private railway undertakings in its day, along with the Penrhyn Quarry system.

The main railway system linking the quarry and port can be divided into six episodes, thus;

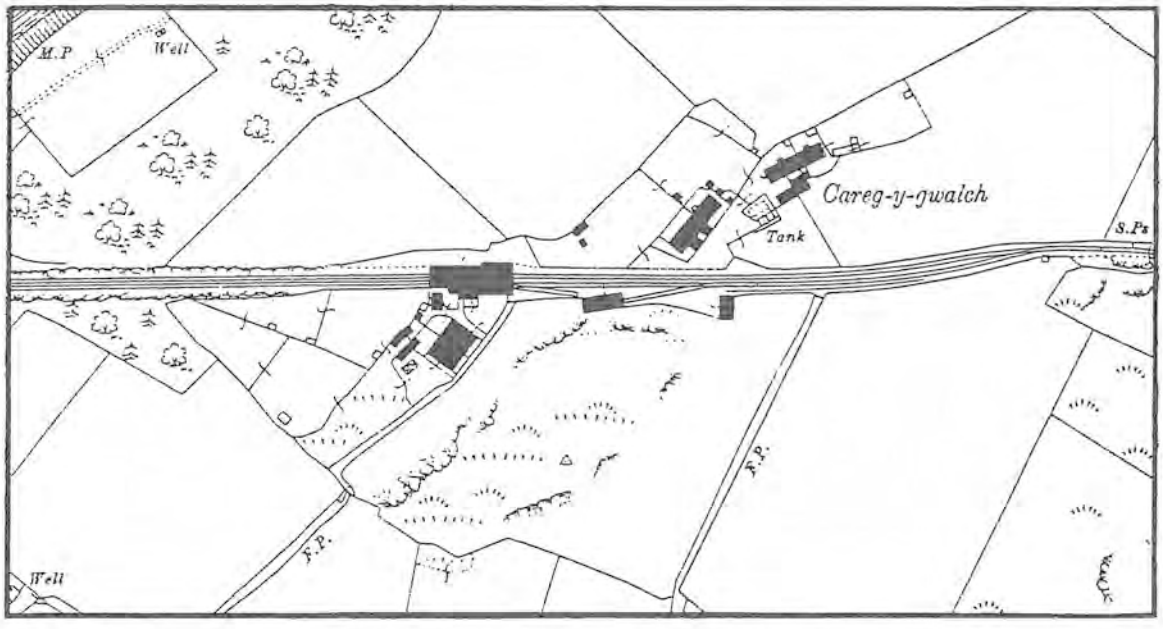
1. A legendary tramway *c.*1800 along the shore of Llyn Padarn: extent unknown.

2. The Dinorwic Railway 1824-43: superseded by the Padarn Railway.

3. Schemes to replace the Dinorwic Railway, probably in the late 1830's and especially at the 600-700 foot contour: none completed.



(a) Ordnance Survey 25" (1889) (Gwynedd Archive)
Showing the Incline before the construction of the Carriage Shed.



(b) Ordnance Survey 25" (1916) (Gwynedd Archive)
Showing the Incline after the construction of the Carriage Shed.

Fig. 3

4. The Village Branch, linking the original Dinorwic area quarries with the mill at Big Quarry: possibly built by *c.*1843.

5. The Padarn Railway, completed December 1842 to replace the Dinorwic Railway.

6. The Padarn-Peris Tram line replacing part of the Padarn Railway at its eastern end.

The Padarn Railway

Construction of the Padarn Railway began in 1841 and was completed by March 1843. The line was built to supercede the Dinorwic Railway (1824-43), which was comparatively inefficient because slate had to be hauled uphill and many of the gradients were severe. The new line was 7 miles 5 chains long with a 4ft (1.22m) gauge, and ran along the side of Llyn Padarn and then by Pontrhythallt and Bethel to Port Dinorwic. The wagons were drawn by horses until 1849 when the Horlock 0-4-0 tender locomotives *Fire Queen* and *Jenny Lind* were introduced. These were replaced by Hunslet 0-6-0 side tanks *Dinorwic* (1882) and *Pandora* (1886). Another Hunslet, *Velinheli*, arrived in 1895. From early years workmen used manually-operated velocipedes, but between 1895 and 1947 a workman's train ran daily, calling at Gilfach Ddu (Dinorwig), Quarry, Penllyn, Pontrhythallt, Crawia, Pensarn, Bethel, Cefn Gwyn, Pen-scoins, and Port Dinorwic. Slate wagons were loaded four at a time on transporter or 'host' wagons, the so-called 'pick-a-back' method. The wagons were brought down from the quarry on a single four foot gauge track which split into two lines about 200 metres before The Incline terminus. The terminus was originally known as 'Garreg-y-Walch', the form of spelling for the Farm Careg-y-Gwalch, and later on became Pen-Scoins or Pensconce.

The following description of the route is taken from Boyd (1986, 36-39), who walked the route and made field notes in 1946, when the line was in full use. The description begins at the Port end of the line.

> *"From the quays a Quarry-Gauge incline, known as R'Allt Incline or The Incline (but in the Quarry records as Port Incline) raises the rolling stock to the Garreg-y-Walch terminus of the Padarn Railway proper, 260ft above). Thence this stock was conveyed pick-a-back method to the Quarry where the Quarry-Gauge tracks recommenced; the Padarn Railway was thus an isolated 4 ft gauge link in the "Quarry Gauge" chain between Quarry and port.*
>
> *"In recent times the Port Incline was laid in steel bars 3in. x 1in. section set on edge in cast iron chairs, a longer chair being used to make the butt joint between bars: this is similar to other inclines in the Quarry. The quay lines converge - there is a weighing table - in front of a Check Office on the quay level to form a double track, the right hand used for empty wagons returning to the Quarry. The mouth of the Port tunnel, with 10ft wide x 7ft wide bore first cut into the rock face in 1841, is immediately beyond the Check Office (originally a stone-built cottage with wooden verandah), and the tracks curve into the opening. The Incline does not have a regular slope but is parabolic; it crosses the ex-L.N.W.R. Bangor-Caernarvon line in a cutting below and the upper part passes through a cutting on a steep wooded slope above the roofs of Port Dinorwic; the winding drum is perched on a lip of the escarpment at the top. The village is hardly noticeable at lower levels as the tunnel carries the line beneath it and the main street. The Incline was finished in September 1841. At the summit the slate wagons run onto level track and pass beneath the winding drum by means of an open-ended shed to emerge at high level on a loading dock where, four per wagon, they are run onto the host wagons of the Padarn Railway to be carried bodily back to the Quarry. As each host wagon is loaded, it is allowed to run off the dock into a loop line where a train of similarly loaded wagons is raked; the arrival at the dock and discharge of wagons from it is assisted by slight falls in the 4 ft gauge which are therefore at different levels at this place, the loaded host wagons being about 4 ft*

Plate 2 An early photograph showing the endless chain in operation (1896). The photograph was taken from the mouth of the Port Tunnel below the drumhouse. At least six wagons are hitched to either side of the chain, and the idlers can be clearly seen. Attached to the left-hand side of the cutting are brackets supporting the electric bell communication wire. *Gwynedd Archives.*

Plate 3 An early photograph showing the wire rope in operation (post-1924). The photograph was taken from more or less the same location as Plate 2, although from a moreelevated position. The central slate walkway has been removed, and a different type of idler employed. It appears that there are four wagons on each track. The telegraph pole on the right carries telephone wires connecting the Port, Incline drumhouse and Quarry. *Gwynedd Archives*

locomotive engine is used to draw the slates down to within 800 yards of the Port Incline...this is of about the same length and worked by an endless chain of above 1600 yards long'. This terminus was Pen-Scoins, a corruption of Pen-Ysgoi (an escape top) the name dating from the railway. The operating chain of which Lewis writes had six links cut off it each year to compensate for wear - this was done on a Sunday! There was electric bell communication from top to foot and in the days of the chain the wagons were hitched singly to the chains at intervals, eight at a time, up and down. In May 1924 a wire rope replaced the chain on Board of Trade instructions; they insisted that the load be reduced to one wagon, thus increasing the time factor almost eight times! Evan Evans was for many years responsible as lookout man, keeping the track in repair and oiling the chain/wire rollers (his sons, William and Thomas, were both drivers on the Padarn Railway)."

"The endless chain passed round sheaves at top and bottom but the replacement wire rope passes over the summit drum; a bandbrake on the drum controls the speed which moves considerably faster than the original chain. The drumhouse carries two notices:"

PORT INCLINE NOTICE EXCEPT ON BUSINESS NO PERSON OR PERSONS ARE ALLOWED ON ANY PART OF THIS INCLINE

and

PORT INCLINE LENGTH OF INCLINE 1,250 ft. HEIGHT 296 $^{1}/_{4}$ FT.
MEAN GRADIENT 1 IN 4 $^{1}/_{4}$ 11/6/1924

"The wagon loop at Pen-Scoins is 185 yards long and holds a maximum train of 21 wagons; loaded wagons arrive at the north side. By dint of fly shunting, the locomotive works only from the east end of the departing train and does not approach the drumhouse. The stone carriage shed or 'Coach House' beside the drumhouse is entered by a siding connection and a plaque over the door reads '1888' (sic - the plaque actually reads '1896'); *the Saloon is stored within. This shed replaces the original and is ornamented by a windvane showing a fox on the run - a decorative touch in keeping with the Assheton-Smith connection!*

Between it and the drumhouse is a short siding to hold two wagons, connected with the south loop by turntable. This table is also essential to turn the first and last transporter wagons of each slate 'run': the last's load includes the guard's van and it cannot be reloaded with three loaded wagons at the Quarry unless turned onto the end of the empty return working - it is then correctly positioned to be unloaded again at the Quarry..."

5. THE COTTAGES

Incline or Clock Cottages (SH 53136781)

The Incline Cottages, also known as Clock Cottage and No. 2 Clock Cottage, are located to the south and below the Drumhouse. The semi-detached, single storey cottages are orientated south-west/north-east and have a stone-built lean-to extension running along the west wall. There are low chimneys (end stacks) on either gable wall an a longer central chimney (axial stack) serving both cottages. The north gable chimney is blocked up. The cottages are stone-built with slate roofs. The exterior has been rendered and whitewashed. To the west and south of the cottages are garden features defined by paths bounded by low stone walls and connected by slate steps, which lead to an orchard.

Clock Cottage has been inhabited until recently and has been well maintained. The original main

Clock Cottage has been inhabited until recently and has been well maintained. The original main entrance to Clock Cottage is in the east wall, with a window on either side, the southern window has been enlarged; the arrangement is similar in No.2 except that both windows are original. There is a second entrance on the north gable of Clock Cottage where the lean-to abuts the original wall. There is a single window in the gable wall. There is also a clock face set centrally into the wall, which has been removed to the Llanberis Slate Museum (the workings had already been removed). There are two windows in the west lean-to wall. Originally the cottage had one large and two small rooms, with the extension adding a further two rooms, one of which being a kitchen. There are three outbuildings abutted to the south wall of the drumhouse and utilised by Clock Cottage, currently being used as a toolshed, a storeshed and a toilet.

No. 2 Cottage is in a more dilapidated state than Clock Cottage, with fading whitewash and several loose slates on the roof and blocked up entrances. The Cottage has a window in the south gable wall and one in the south extension wall. The west extension wall has a central doorway with two small windows to the north and a larger window to the south. There is an outbuilding to the west, and the remains of a slate foundation platform.

Woodland view and Chippinover (SH 53216785)

These are a row of three cottages converted into two, located east/north-east of the drumhouse and orientated north-east/south-west with a north-west aspect. The cottages are stone built and have slate roofs. There are chimneys on either gable wall and two central chimneys set apart, the south west chimney being the larger. Woodlands view is the larger of the two cottages, being longer and having a stone-built lean-to extension to the rear (south-east aspect). The main entrance in use is in the gable wall. Chippinover has a stone-built lean-to extension kitchen on the gable wall in which is the main entrance used. There is also a timber extension to the rear of the cottage. There are several small outbuildings north-east of the gable extension.

Llwyn Onn and Carreg Gwalch (SH 53256787)

These are a pair of cottages situated west/north-west of Chippinover, orientated west/north-west - east/south-east with a north/north-easterly aspect. Carreg Gwalch is the smaller of the two and has been uninhabited for some years. The cottage is stone built and has a slate roof that has been rendered over. Llwyn Onn is still in occupation and has been extended and converted by the present owner. Originally there was a stable parallel with and to the south of the cottage, with a yard between the two. The two buildings have been connected by an extension to the cottage.

6. THE CARRIAGE SHED (SH 53186782)

The carriage shed lies 25m east of the unloading shed and south of the track. The shed is rectangular, orientated east-west and measures 18ft (5.5m) by 32ft (9.7m). The shed is stone built, rendered and whitewashed, and has a gabled slate roof. There is a plaque in the east gable which reads "1896". The shed originally had a door in the east gable which was 2.9m wide and reached almost to the roof. The doorway has since been partially blocked and a window inserted to convert the shed into a dwelling. The west gable wall also appears to have had an entrance, although it has been rendered so as to obscure the size. There is a door in the north wall slightly to the west of centre with a window on either side. The shed has a brick chimney in the centre of the south wall.

30m east of the carriage shed, and outside the present study area, is a second shed connected to the carriage shed by a length of drystone revetment (SH53226782). The shed is on the south side of the track and is orientated north-south. The shed is stone and slate built, is unrendered and has a slate roof. There is a fireplace in the south-east corner of the building. The shed was an early carriage/engine shed that was superseded by the carriage shed to the west.

Between the 1896 carriage shed and the unloading shed, on the south side of the track is a south-facing brick revetment 2m high and 7m long orientated east-west. To the west of the revetment,

Plate 4 General interior view of the drumhouse and unloading shed, looking east. The remains of the sheave pit and pit-edge timber can be seen in the foreground. The overhead drum mounts and band-brake bracket are on either side in the middle distance. The pulley running along the beam above was probably to hoist the wire rope onto the drums when it was replaced. Note the partially slate-clad gable of the unloading shed in the background and the relationship between the two buildings. *(G1063I/05/92/14).*

and abutted to it is a rectangular slate platform 6m east-west and 4.5m north-south, and between 1-2m high. Both revetments are partially obscured by dense undergrowth. The structures formed the siding from the carriage house to the unloading shed.

7. THE DRUMHOUSE AND UNLOADING SHED

The drumhouse and unloading shed have been separated for the purpose of description because they are in essence two buildings joined to form one. Originally the Unloading Shed was built at the back of a long stone platform, which probably had a small lean-to on the front. When the endless chain was replaced by the wire rope in 1924 the drumhouse was built to protect the drum, and in particular the band brake, from the elements.

The features in plan are described moving from east to west, with the north side of the building described first. The elevations are also described from east to west. References to the monochrome photographic index are given in brackets where relevant.

THE UNLOADING SHED

The unloading shed is a rectangular building orientated east - west and measuring internally 34 ft (10.3m) east - west, 27ft (8.2m) north - south at the east end and 28ft (8.5m) at w end. The walls are 2ft 6in thick at the east gable stub wall, the lateral walls are 2ft 9in (0.98m) thick, narrowing to 1ft 10in (0.55m) in the north-west corner. The gable stub walls are 1ft 10in (0.55m) thick. The roof is hipped at the east end and was originally gabled at the west end (partially tile hung). The apex of the roof is about 6m above the internal ground level, and is supported by a basic frame of tie-beam, kingpost and principals, with a strut on either side of the king post and two hammer posts. The purloins are partially trenched, raising the rafters above the principals. The west gable roof support is partially blocked in (Fig.5). The building is roofed in slate.

Ground Plan

(see Fig.4 for location of features)

(A) tip area
In the north-east corner of the building is a small tip of general household rubbish, obscuring any possible features. To the west of the tip is a low heap of slate rubble c. 2.5m east-west and 2m north-south. To the south of the tip is an abandoned transit van (G1063I/05/92/29).

(B) pit
On the north side of the building to the west of centre is a possible rectangular pit 1.75m long and 0.5m wide, defined on the south and east sides by a low slate kerb. The pit is filled by slate rubble. The function of the pit is unknown.

(C) fireplace/old floor
In the north-west corner of the building is a brick fireplace with a slate hearth measuring 1.4m east-west and 0.85m north-south. The hearth is raised 0.1 - 0.2m above the surrounding surface. To the south of the fireplace are the remains of a slate floor measuring 2m east-west and 1.5m north-south, which is raised about 0.05m above the surface to the south. The area was at one time enclosed with a roofed timber structure or *caban*, as confirmed by Mr. Jones (G1063I/05/92/15).

(D) slate sleeper/rail chair
In the approximate centre of the building is a cast iron chair, west of which is a slate rail guard. The chair is in line with a linear series of tarmac bases c. 0.15m-0.2m wide and 0.2m - 0.4m long located on the track west of the unloading shed entrance (G1063I/05/92/30). Immediately west of the sleeper is the most likely location of the transfer dock as suggested in the relatively recent photograph reproduced in Boyd 1986, Plate XXXVII.

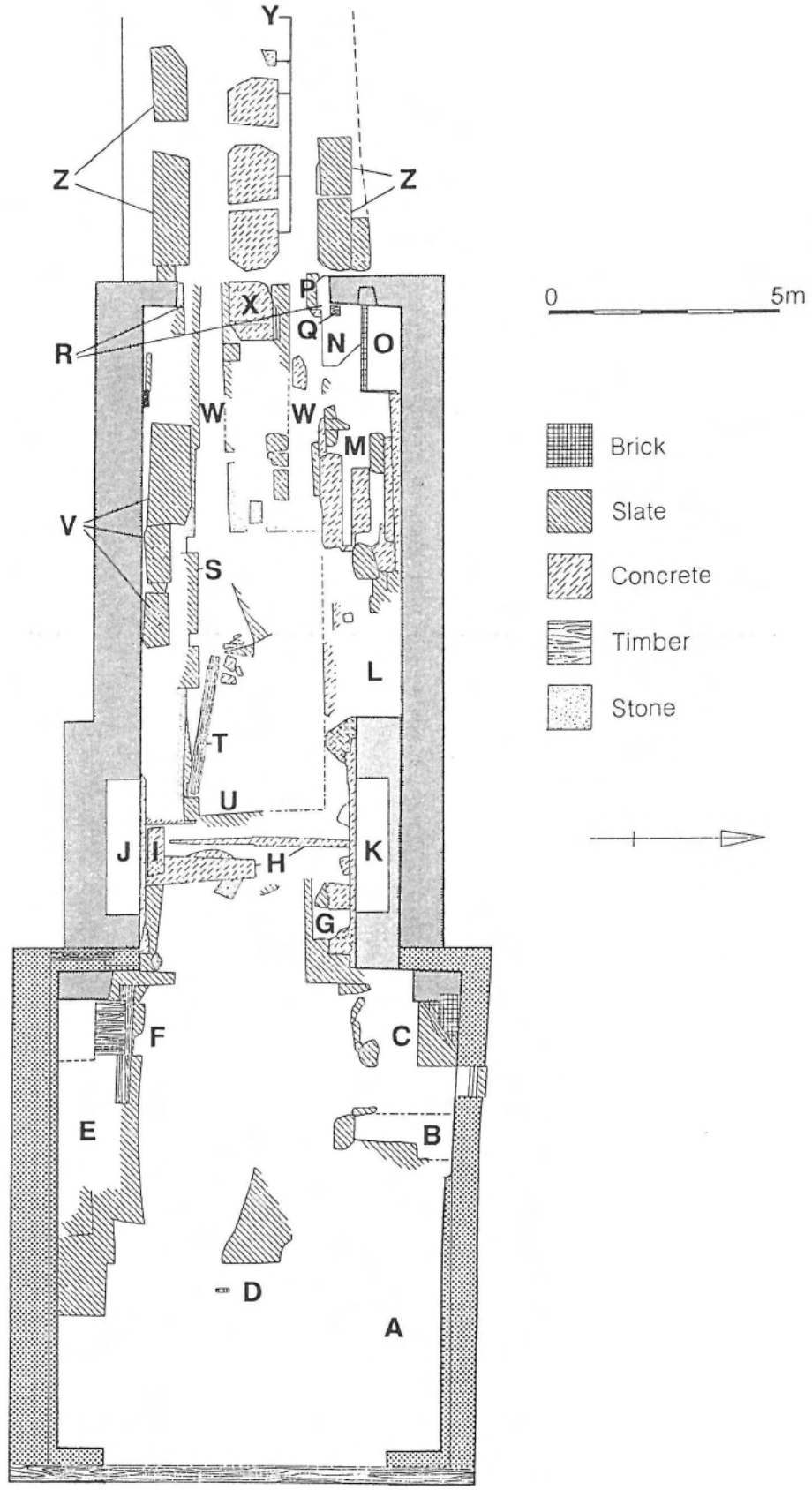


Fig. 4 Detailed ground plan of the Unloading Shed and Drumhouse

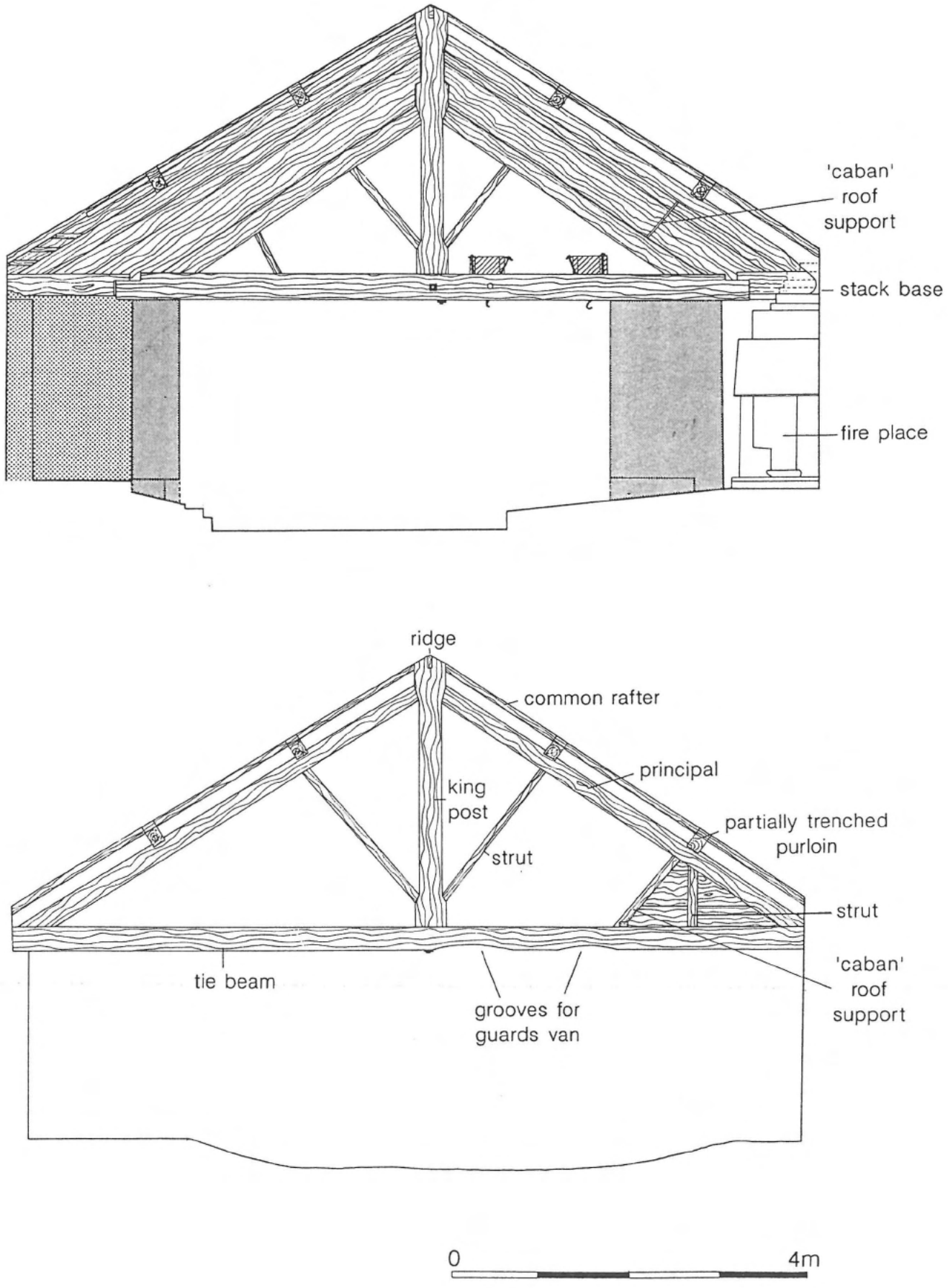


Fig. 5 Unloading Shed roof construction (a) and internal west gable (b).

(E) slate sill/rubble
In the south-east corner of the building is an area of rubble with some household rubbish. There is a low slate-built sill appearing to run the length of the south wall, beginning 1.85m west of the south-east corner. The sill is mostly covered in rubble and is 1m wide at the east end but broadens to about 1.6m after about 2m. The sill is about 0.3m high.

(F) timber beam/plank platform (Fig. 6)
At the west end of the sill is a plank-built platform whose northern end is resting on a square timber beam. The platform measures 1.2m east-west and up to 1.5m north-south, and the planks are 0.08m thick. There are two coils of steel cable resting on the platform. The timber that supports the platform is 2.54m long and 0.26m square. There are two shallow recesses cut out of the north-facing side of the beam. There is a 0.05m diameter hole in the centre of the west end of the beam, and a 0.05m square slot in centre of the beam to the east of the platform. There is a carved inscription "VII" on the west end of the north face of the timber which may represent "Vaynol". There is an iron right-angled bracket 0.31m x 0.31m bolted to the north side of the west end of the beam. The decayed remnants of a second timber running north at right angles to the main timber can be seen bolted to the east side of the angle-iron. The second timber was supported by a low slate wall/footing, traces of which can be seen running northwards (Frontispiece).

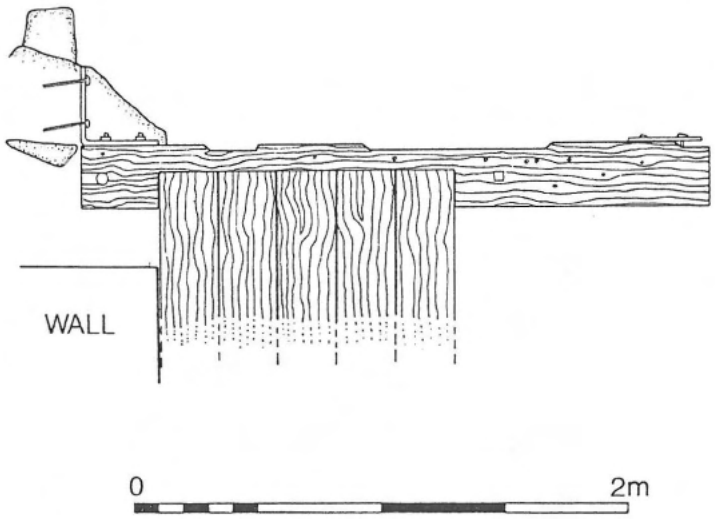
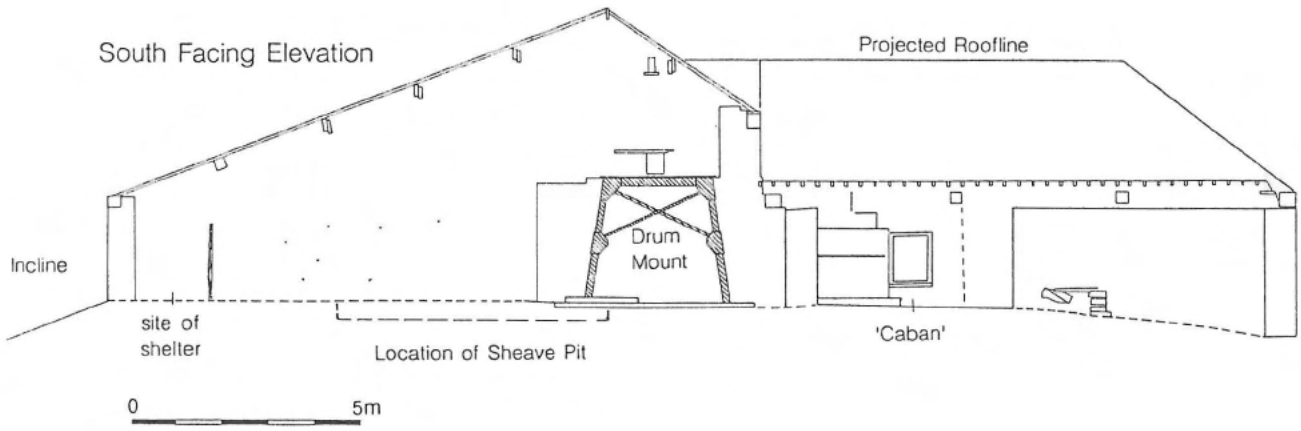


Fig. 6 Plan of timber beam and plank platform supporting the wire rope coil

North Facing Elevation (Fig. 7)

The walls of the unloading shed are of stone that is undressed in the main although with dressed stones used in the corners. The wall is rendered with a dark grey coarse render for a distance of 1.5m west of the entrance. The rest of the wall is rendered with a lighter grey coarse render. There is a shelf 0.18m deep running along the entire length of the wall 2.85m above the lowest ground level. The shelf supports four timber tie beams sitting on timber supports. There is a slate wall/pillar buttressing the south-west internal corner of the building. There is a recess 0.25m square and 0.26m deep in the approximate centre of the eastern half of the wall. There are four bolts protruding from the wall to the east of the recess, and a single bolt below beam 3. There is an uneven recess/void just inside the entrance measuring 0.6m by 0.8m, with a maximum depth of 0.62m though averaging 0.46m. The void may have resulted from the dismantling of the building.



Internal Elevations of Unloading Shed/Drumhouse,
Penscoins Incline, Port Dinorwic.

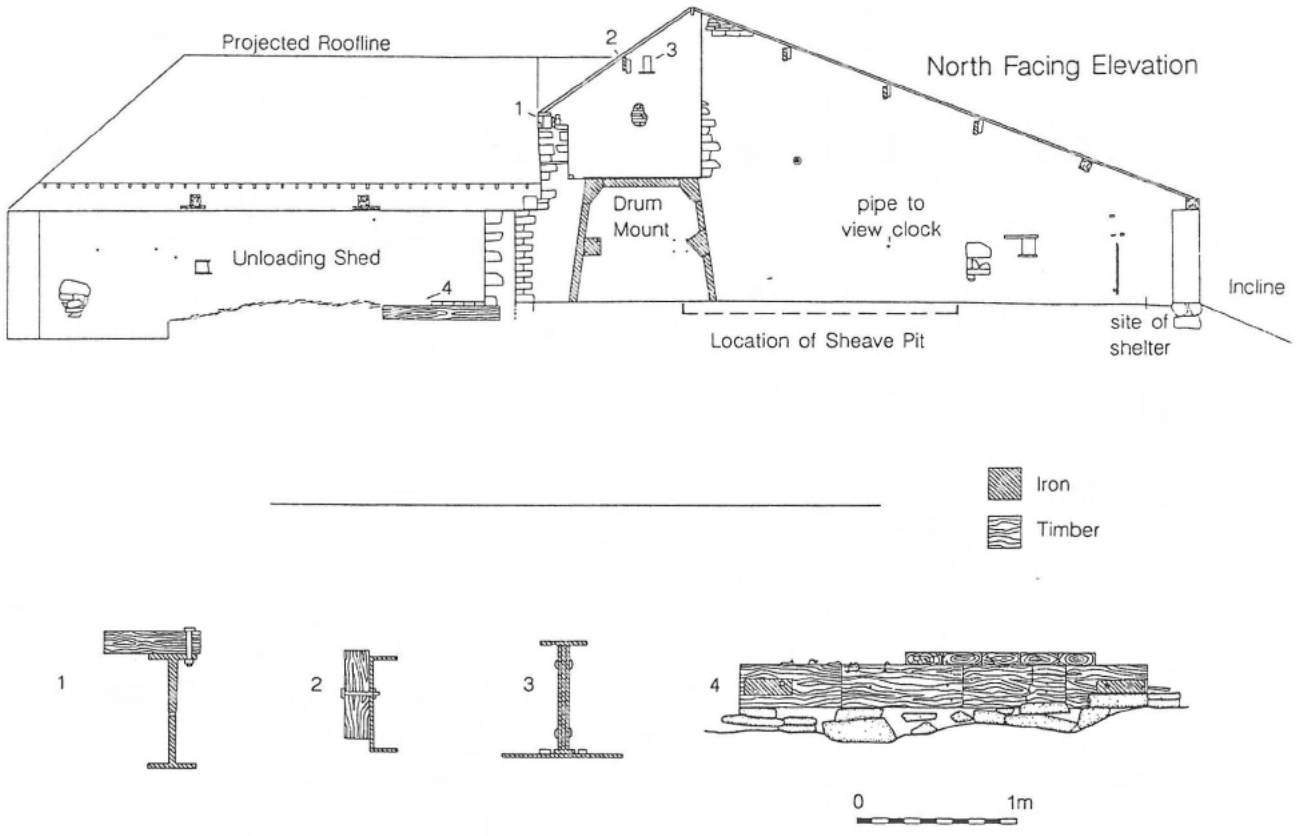


Fig. 7 Internal elevations of Unloading Shed and Drumhouse, Penscoins Incline, Port Dinorwic.

Exterior Gable of Unloading Shed

The west face of the west gable wall was originally the exterior of the unloading shed. The gable was originally slate hung, and there may have been a lean-to extension, as suggested by the sawn-off timber and slot on the principals (G1063I/05/92/14).

South Facing Elevation (Fig.7)

The general construction of the wall is similar to the south wall, except that the sill supporting the beams does not run for the whole length of the wall, but extends 5.45m west of the north-east corner. There is a blocked entrance 1.75m wide on the west side of the sill wall (G1063I/05/92/29). West of the sill wall is a window 0.75m wide and 1m high, with a timber ledge 0.45m above the ground level. 0.3m east of the window is the line of the east wall of the room once enclosing the fireplace. The render on the wall west of the line is blackened and calcified as a result of the fire. The brick-built fireplace has an opening 0.65m wide and 0.8m high (G1063I/05/92/29).

THE DRUMHOUSE

The drumhouse is a rectangular building orientated east-west and measuring 44ft 10in (13.7m) east-west and 18ft 4in north-south. The lateral walls are on average 3ft (0.9m) thick, whilst the two west "stub" walls are 2ft 3in (0.7m) thick. The roof is gabled, though with the gables north - south and not east-west as the unloading shed. The ridge is not central but is offset to the east, making the west pitch nearly three times as long as the east. The roof is supported by timber beams bolted onto iron girders, with two timber beams at the west end of the roof. The apex of the roof is about 6.5m above the internal ground level. The roof is joined to the unloading shed roof by means of extending the ridge of the unloading shed roof into the east pitch of the gable (Plate 5).

Ground Plan - The North Side (Fig. 4)

(G) slate and concrete floor
In the north-east corner of the drumhouse where it abuts the unloading shed is a slate and concrete floor measuring 1.1m north-south by 2.2m east-west. The floor has a solid slate edge that rises 0.2m above the surrounding ground level to the south. The feature may relate to the timber beam/slate footing wall in the south-west corner of the unloading shed.

(H) tapering concrete bases
Extending from the south wall is a tapering concrete base 0.2m high, being 0.65m wide at the south end, 2.4m long and 0.4m wide at the north end. 0.25m west of the base is a second base that is longer and narrower, being 0.1 - 0.2m wide, 4m long and 0.1m high. The bases may have been the siting of the original transfer dock.

(I) concrete sill
At the base of the drum mount is a concrete sill 0.2m wide and 0.2m high, the result of shuttering.

(J) & (K) iron drum mounts
There are two iron drum mounts, one on either side of the building at the east end. The southern mount (J) is recessed 0.72m into the south wall, whilst the northern mount (K) has had a buttress 0.8m wide built around it. See elevations for more detail (G1063I/05/92/16).

(L) concrete edge to pit
The underfloor pit that held the sheave pulleys is not clearly defined on the north side of the building. A concrete edge 0.05m high and 1.5m long may represent this.

Plate 5 Detail of roof construction between the unloading shed and drumhouse. The ridge of the unloading shed has been extended into the east pitch of the drumhouse roof. *(G1063I/01/92/09)*.

(M) slate and concrete floor with planks removed
Along the north side of the building and slightly to the west of centre is a composite floor of slate and concrete, with the impressions of two planks lying parallel to each other. The Floor is about 3.5m east-west and 1.8m north-south, and is raised 0.2 - 0.1m above the level to the south. There is a slate kerb defining this edge. The impressions of the planks in the concrete suggests that they were about 2.3m long and 0.2m wide (G1063I/05/92/28).

(N) concrete flooring
There is a coarse concrete floor to the west of the slate/concrete floor with an indistinct edge.

(O) brick edge to shelter
In the north-west corner of the building is a possible shelter defined by a brick and slate edge. The position of a partition wall can be seen in the elevation. The shelter may have related to the early phase of the building when the east end was open to the elements and shelter was needed for the men hooking on the wagons (G1063I/05/92/28).

(P) concrete/slate edge to rail
At the base of the north side of the west entrance to the building is a concrete edge 0.25m high. below the edge is a less substantial slate edge 0.15m high. The edges represent the outer limits of the incline rails.

(Q) upright composite timber (Fig. 8)
Set immediately inside the entrance is an upright composite timber plank with the remains of a handle built in. The handle may have operated the signalling system, indicating to those below when the full truck was properly hitched to the chain or cable (G1063I/05/92/22).

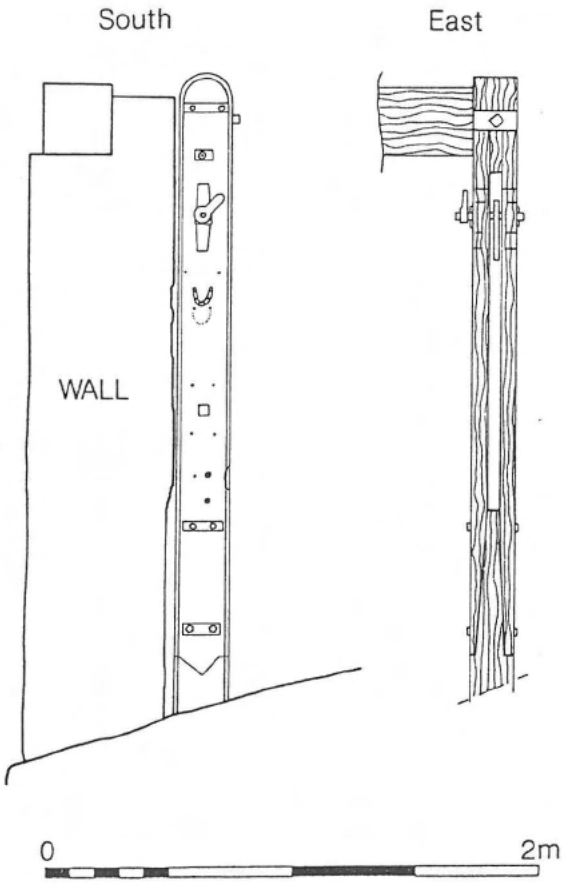


Fig. 8 South and east facing elevations of composite timber upright.

(R) stone footings
The north wall of the entrance is slate in the main resting on stone footings. The corresponding south wall is slightly shorter and the stone footings protrude slightly. The footings probably relate to the early phase of building before the drumhouse was enlarged in 1924.

Ground Plan - The South Side (Fig. 4)

(S) & (T) The sheave pit and mounting beam
The sheave pit is located in the centre of the east end of the drumhouse, and represents the earlier use of a continuous chain before the cable system was introduced in the 1920's (s). It is not clear whether the pulley or sheave around which the chain ran was on a vertical or horizontal axis. A.J. Richards says of the incline sheave: "A grooved pulley wheel, occasionally used instead of a drum at the head of a balanced incline. Set with on (*sic*) vertical axle, either in an underfloor pit, or in a "drumhouse". If underground, almost invariably with the axle horizontal." (page 236). The pit measures 6m east-west and 2.7m north-south at its maximum extent. The pit is most clearly defined on the south side, which has a slate edge built over the original stone work. There are four beam mounting sockets, one at either end and two closer together towards the centre. There is a timber beam (t) bolted into the most easterly of the beam sockets (Fig. 9). The surviving depth of the pit varies between 1.3m and 0.4m on the southern side (G1063I/05/92/19).

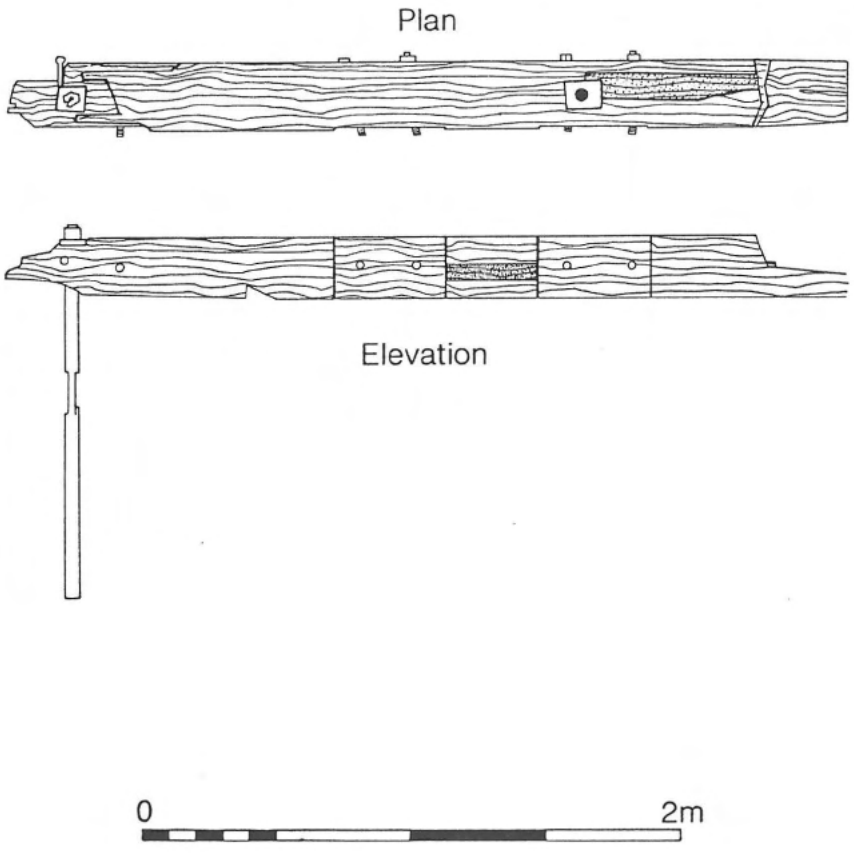


Fig. 9 Plan and elevation of pit-edge timber beam mount.

The eastern end of the pit is partly defined by a slate edge (u), although much has been obscured by slate rubble. The north side of the pit is less clear, although a narrow concrete edge 1.5m long and 0.05m high probably represents this. The northern two-thirds of the pit has been completely filled with rubble.

(V) slate mounting blocks
Between the pit and the south wall are two slate slabs 1.2m east-west, 0.5m north-south and 0.15-0.2m thick. In the centre of each slab, and aligned with each other, are four mounting bolts 25mm diameter and 60mm long, set 0.25m apart. The mountings probably relate to the large bracket on the wall to the east which supported the braking mechanism. There is a larger slab immediately to the west of the mounting slabs, which measures 2.3m east-west and 0.85m north-south, and is 0.2-0.3m thick. This was probably the brakeman's platform. There is a smooth elongate scoop with a maximum depth of 40mm running east-west along the north half of the slab. The scoop may have also been related to the braking system on the drum. To the west of the slate slabs at the base of the south wall is a shallow pit 0.35m east-west and 0.1m north-south, and 0.25m deep. Immediately west of the pit is a slate 0.8m east-west and 0.1m north-south. The slate may have helped to retain a post in the hole, although there is no direct evidence of this.

(W) chain race and rail channels
The west side of the pit is defined by a low slate kerb which can be more clearly seen at the southern end. There are two channels 0.7m wide running west from either side of the pit. The most southerly channel is clearly defined and is slate edged. There is a 0.3m drop into the pit from the channel. The channel runs towards the west entrance of the building, becoming narrower (0.5m wide) as it does so. The north channel is less clearly defined because of rubble, although the course can be traced. There is a slate floor separating the channels at the eastern end.

(X) & (Y) concrete plinths
There is a concrete plinth built over the slate floor separating the channels (x). The plinth is sloping from east to west, with a groove running north-south across the top and the remains of one on the north side running east-west. The plinth measures 1.3m east-west and 1.1m north-south overall, and is 0.24m high at the east end and 0.1m high at the west end. It is likely that the plinth was built to boost inertia after the drum was installed, giving a the loaded trucks a few extra inches in height. The plinth is the first in a series of five that run down from the top of the incline (y). The plinths are on average 1.1m wide (north-south) and 1.2m long (east-west), and are separated by a gaps of 0.25m, 0.15m, 0.35m and 0.25m (east-west), which may represent sleeper beds. The last plinth in the series is grass grown and cannot be clearly traced. The gap between the first and second plinths is on a line with the external wall face of the building and may have been to allow a door to slide across (see below).

(Z) slate slabs
Running parallel with the plinths down the incline head are large slate slabs, lying on either side of the plinths to form the outer edge to the rail support. There are two slabs to the south, one being 2.5m east-west and 0.75m north-south and 0.1m thick, the other being 1.6m east-west and 0.75m north-south. The first slab is bevelled on the outer south face.

The Incline

About 40m of the incline was investigated, revealing several drilled slates and a cast iron idler of the type seen in Plate 3. The incline has a drop of 10.25m over the first 40m, counting from the top of the first concrete plinth, giving a mean gradient of 25% or 1 in 4. The Incline is slightly parabolic and has an overall mean gradient of 1 in $4^{1}/_{4}$.

Internal South Elevation (Fig. 7)

The south wall of the drumhouse is entirely slate-built at the east end where the building abuts the drumhouse. The render on the upper parts of the wall is flaking to reveal slate blocks, whilst the central part of the wall is smoother. The wall at the west end is partially rendered revealing

the central part of the wall is smoother. The wall at the west end is partially rendered revealing stone and not slate construction, suggesting a different phase.There are two iron girders with timber beams supporting the roof to the east of the timber ridge, and a further three to the west of the ridge, with two timber beams at the west end of the building, again suggesting two phases of construction.

Set into a recess 0.72m deep is the southern iron machine mount (the northern machine mount is more exposed therefore it is referred to for measurements). The wall on either side of the mount has been built flush against the slope of the legs of the mount, suggesting that the mount was *in situ* when this part of the wall was constructed (G1063I/05/92/16). The mount appears to have been pre-fabricated and was presumably designed to be self-supporting. Bolted on to the east leg of the mount is a cast iron bracket 0.36m (14.5in) square with rounded corners (G1063I/05/92/17). It is suggested that the bracket is connected to the braking system used in conjunction with the drum. There are four bolts at the same level on the west leg, suggesting that a similar bracket may have been removed. 2.3m above the mount is an iron girder running n-s across the building, though not utilised as a roof support. There is an iron running wheel carrying a crane attachment on the girder, probably to hoist the wire ropes onto the drum during adjustment and replacement (G1063I/05/92/8).

Other features in the wall include iron nails and pins, a sawn-off bolt with a timber sheath, and a 40mm diameter pipe running through the wall at a slight downwards angle. The pipe is immediately above the brakeman's platform and was to allow the clock on the north gable of Clock Cottage to be viewed. Within this area is a recess 0.35m high and 0.25 wide, with a depth of 0.26m. To the west of the recess can be found traces of a partition wall similar to that on the north wall, including timber mounts set into the wall on a vertical line with a line of rendering obviously formed against a wall (G1063I/05/92/11).

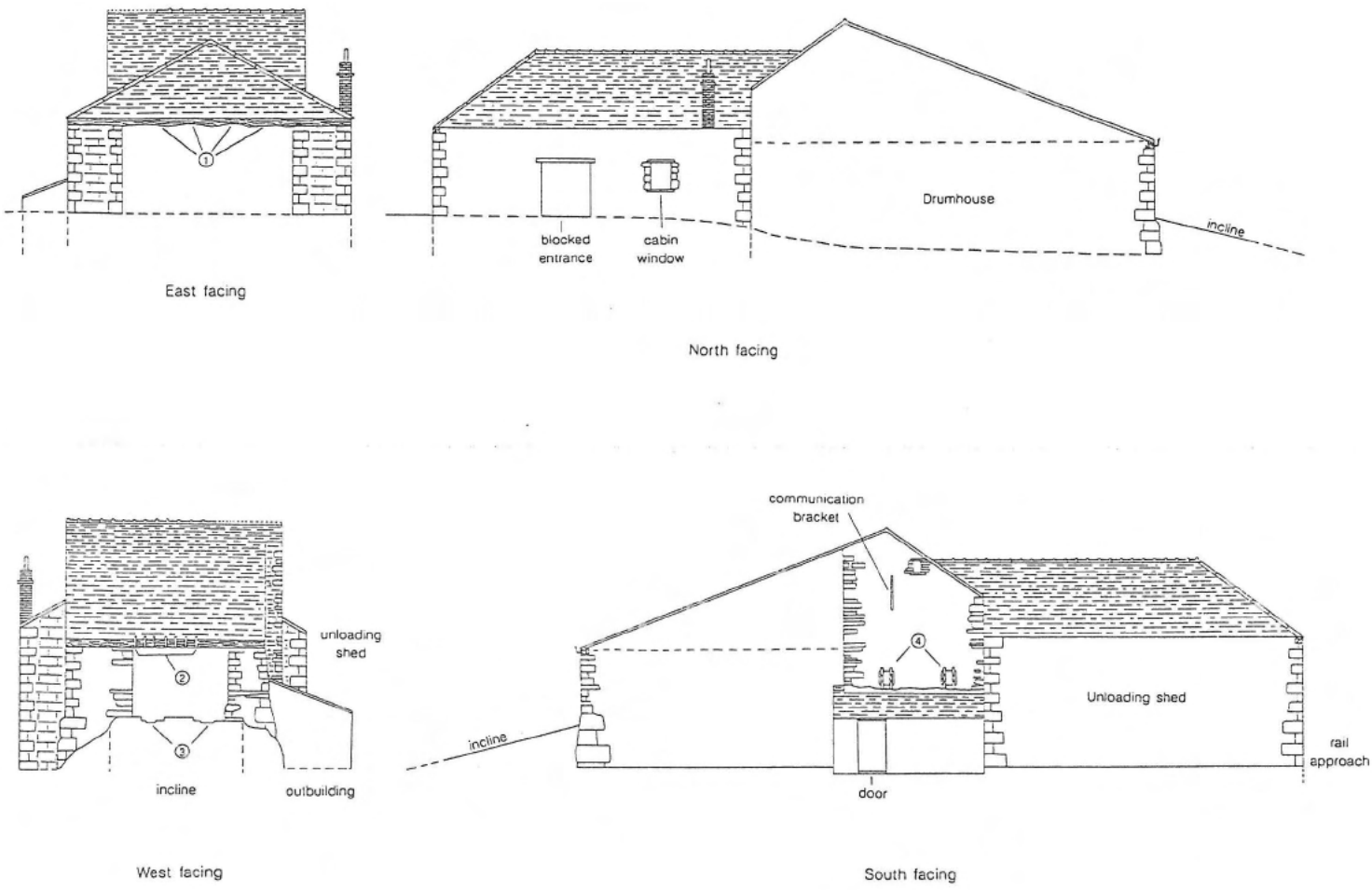
External West Elevation (Fig. 10)

The external west elevation of the drumhouse reveals the stone/slate phasing reasonably well. The quoins are of massive blocks of dressed stone and slope outwards at an angle of about seven degrees (G1063I/05/92/12). The ends of the gable stubs have been re-built using slate blocks, although the protrusion of stone footings in the south wall suggests originally the entire wall was of stone that was re-inforced with slate during the alteration of the building. There is a timber beam supporting the roof, which has 7 iron brackets bolted to it, and several iron bolts and nails (G1063I/05/92/13). The function of the brackets is unclear; they are most likely to have been part of the tele-communication system between the Port, Drumhouse and Quarry.

Internal North Elevation (Fig. 7)

The north wall differs from the south wall in that the drum mount is not recessed into the wall but is set into a slate abutment that is built up to the mount. The mount has four legs slightly angled outwards supporting a platform. The platform is 2.6m long and 0.7m wide at the top, and the legs 0.15m wide and set 3.25m apart at the base. The mount is made of riveted sections of iron plate with cross members 50mm thick to stabilise the whole structure. Slightly above the mount is a recess 0.45m high, 0.4m across and 0.3 - 0.4m deep, possibly to hold the axis of the drum. The abutment built around the drum is 4.1m long, 2.9m high and protrudes a distance of 0.9m (G1063I/05/92/16).

The north wall is built in the main of slate blocks with occasional stone, and has been rendered in places, particularly above and west of the drum mount abutment. Immediately west of the drum mount, extending 3.5m along the wall and 2m high, the wall is built of large blocks of dressed stone that is largely unrendered, possibly reflecting an earlier phase of building. There are seven iron pins and brackets protruding up to 0.26m from this section of wall. There is a vertical edge of render 1.6m east of the west corner of the wall, indicating the position of a partition wall similar to that on the south wall. The wall is largely unrendered at this point and is built of irregularly-sized blocks of undressed stone. This section of walling can be traced on a line with the top of the stub gable wall for a distance of 3.25m (G1063I/05/92/26).



① Timber beam shaped to allow passage of guards van
② Brackets for telecommunication
③ Rail channels
④ Supporting plates for drum mounts

Fig. 10 External elevations of the Unloading Shed and Drumhouse.

8. HISTORICAL ANALYSIS by G.P.Jones, M.A.

Historical Perspective

The Port Incline of the Padarn Railway was the final portion of the route of this transport system which carried the produce of the Dinorwic Slate Quarry to the joint harbour and standard-gauge railway transshipment facility of Port Dinorwic.

The Padarn Railway was an 1840s replacement (or addition) to the earlier railway exit route known as the Dinorwic Railway, constructed in 1842. The original line had followed the route of the private Slate Road of 1812, to connect the quay at Port Dinorwic with the contemporary main portion of the Dinorwic Quarry, located on a high contour. A newer portion of the quarry, at a lower altitude than the Dinorwic Railway terminus, required an initial up-hill haulage to reach the exit line, but this cannot have caused any great problems within the relative scale of working in the various portions of the site in the 1820s.

However, by the 1830s, a survey had been made for a new lower-level exit railway by the influential railway engineer, J. Spooner, of Porthmadog. The new railway was obviously meant to serve the newer portion of the quarry, down-slope of the Dinorwic Railway terminus. This suggests that the lower quarrying site must have developed at a quicker pace than originally anticipated. Thus it is probable that an unexpectedly larger amount of finished slate was being raised up to the original railway by the late 1830s, and must have overturned the original calculation upon the basis of which the route of the Dinorwic Railway had been determined.

This proposal had its quarry terminus at an intermediate altitude between the older line and the eventual new Padarn Railway, and obviously was likely to emulate the original error of not serving future lower-level workings without up-hill haulage. This Spooner-survey line was not constructed, probably because of this, and due to its expensive proposed tunnels. However, the final portion of the route was the present Port Incline, which was the only part utilised.

The route taken by the new exit tramway that was eventually adopted in the early 1840s, was at the lowest possible level, along the shore of the Padarn Lake, and capable of serving the lowest workings of the Dinorwic Quarry. It is claimed that upon its opening, the new railway totally superceded the old high-altitude route. This is not satisfactorily proven, and it is likely that both were in use at least until the end of horse-haulage on the new railway, in 1848. Some local sources maintain that the track on the upper railway remained in place until possibly the early years of the present century, and that the line was used by the local inhabitants on occasions after the last load of slate had long gone past.

The old Dinorwic Railway was always horse-operated, as was the newer Padarn Railway in its first half-decade of working. When steam locomotives were substituted for the horses in 1848, the gauge of the line traversed by the engines was 4ft. The Port Incline had track of 2ft. gauge, matching the gauge of the railways used in the quarry. To save re-loading the slates at the breaks of gauge at either end of the loco-hauled section, a transporter-car system was used. The 2ft. quarry-gauge slate wagons fitted well onto the 4ft. gauge transporters, being loaded longitudinally, two abreast, four to a host wagon.

When horse-worked, it would have been illogical to use 4ft. gauge transporter cars, being added dead-weight to drag. Reducing the efficiency of the horses in this way was not the hallmark of Victorian engineers. Were the new railway to have been 4ft. gauge from the start, then 4ft. gauge slate wagons would have been used for the whole of the journey, giving the minimum *tare* weight possible. There would have needed to have been a loading platform at the quarry end, but at the harbour terminus the option was simpler. The Port Incline could easily have been built to the wider gauge with no extra cost using existing incline working methods such as the single-track with passing loop system.

On the basis of the above considerations, it is almost certain that the original Padarn Railway of 1843 was of 2ft. gauge, and that the Port Incline was the sole surviving portion of the original

route that survived in its original gauge after 1848, probably owing to the high cost of conversion. In keeping this incline unchanged, the use of the transporter system was forced upon the quarry proprietor; this was more critical than the transport arrangements at the quarry end, where changes and modifications were commonplace.

The Incline Formation

Construction of the incline was commenced in 1841, and it must have been in operation by 1842, before the whole railway was completed. It has been suggested that construction of the line began from the quarry terminus only, but in view of the above information, it is more probable that work commenced from both termini (and probably at intermediate points) to speed up the rate of progress. Track-laying was also said to have been from the quarry end, but why drag rails to the furthest point away from the coast when the harbour end of the formation was ready? It is more than likely that the incline was, in fact, the first section of the new line to be completed.

The formation of the incline is parabolic, or more likely a catenary. This being a common profile for long inclines, giving an initial acceleration for the down-going loaded wagons to counteract the inertia of the system, and a complimentary gentler initial gradient for the up-going empties. In rope-worked inclines, the catenary profile was additionally advantageous for keeping the trailing length in contact with the track-mounted rollers, thus reducing any tendency to impart a lifting force onto the leading wagon of the rake when travelling up, or on the last one when descending. In the case of the Port Incline, operating presumably with an endless chain system from the beginning, the second advantage of the profile was not relevant.

The oldest portions of the incline formation are the tunnel under the main road, near its foot, and the platform under the later drumhouse at its top; possibly the rubble from the former found its way into the later. The bridge half-way down, where the Bangor-Caernarfon (later part of the L.N.W.R.) cut through the incline formation, was not constructed until 1851-2. It would have been interesting to have seen how this was done, without disturbing the operation of the incline.

System of Operation

The endless-chain system of haulage on an inclined plane was established technology half a century before the construction of the Port Incline. It presumably had its roots in the early haulage systems of canals and mines, and was recommended for use on a proposal for a combined canal/railway outlet for the Penrhyn Quarry, dated 1799. Chain was a stronger, more reliable material than hemp rope, which was rather susceptible to internal rotting when constantly in wet conditions. Using an endless system rather than a windlass (or winding drum) was simpler technology, although there was a variant of the counter-balanced rope-working which used only a single or sometimes double return sheave system, often located in a pit at the incline head.

The endless-chain system had one advantage over the counter-balanced system, in that it allowed for both 'batch' and 'unbalanced' working. Counter-balanced gravity inclines required a rake of full wagons to be passed down against a rake of empties which was being drawn upwards by the tail of the single winding wire on a sheave mechanism, or by a counterwound independent wire with a split drum system. This method of working could also be used with an endless-chain system, but the great advantage was the capability of sending down full wagons without having to wait for the returning empties to be available. In the context of the maritime secondary transport of slates from Port Dinorwic, it would have been advantageous to send down as many loads of slate as was possible in order to minimise the turn-around time for the vessel being loaded. Obviously, some thought had to be given to retrieving the empties from the quay, but with sufficient traffic on the line, and a large stock of wagons, this could be resolved within the quiet periods between sailings.

A photograph of c1896 (Plate 2) showing the chain system in operation, shows a distance between each wagon in motion. This must have been to allow the hooker/unhookers time to hitch/unhitch the wagon chain-hook off the chain whilst the whole haulage system was in

motion. In theory, there was no reason why the chain should stop within working hours, assuming there was a constant supply of loaded wagons available. In view of the high inertial mass of the whole chain system, it would have been distinctly advantageous to keep it in constant motion. Thus, the physical arrangements at the summit and foot of the incline was likely to reflect such a working practice.

At present only the outline of an underfloor pit is visible at the summit of the incline (Fig. 4). There is sufficient visible to show that this pit was occupied by a heavy timber frame, anchored by vertical posts, this being the rigid mounting of the upper return sheave. This particular sheave would have been mounted horizontally on a vertical axle (or possibly one at a slight angle from the vertical). This sheave of about 4ft. diameter, would have been braked by either an integral narrow brake drum, or one fixed onto the common axle; the brake would have probably been a single band or a split system having a self-servo linkage mechanism owing to the constant direction of rotation. This brake wheel would have been probably mounted below the chain wheel to provide a clearance for the lever operating mechanism. Owing to the assumed constant operation of the chain, the brake system would have been in heavy use, although mostly operating as a speed control rather than under a heavy stopping load. Thus, the brake operating lever must have had a locking mechanism to allow the operator respite from the strain of working against the brake, and this may have been of a geared variety with a 'ship-wheel' control, such as found on some inclines at the quarry. This brake mechanism was probably located on the northern side of the drumhouse, owing to the location of the new drum brake system on the opposite side; the latter would have been erected whilst the former was still in operation.

The lower return sheave would have been of similar specification to that already described, but without a brake mechanism. It would have been located in a pit in a direct line to the incline, but sufficiently away from the foot of the incline to allow for a length of level track where the wagons could be hooked/unhooked on and off the moving chain before the attaching hook was in danger of being dragged into the return sheave.

The chain system was replaced in 1924 by a conventional counter-wound drum system (Plate 3). It is said that this was done at the insistence of the Board of Trade, although it is not understood how this body came to be involved, the Padarn being a private line and not a statutory railway. By this date, the volume of traffic over the line was considerably reduced on that of the late nineteenth century. Therefore, the listed advantages of the chain system would not have been so crucial, and the operation of that old system would probably have been less convenient under a reduced loading.

This drum system would have been one manufactured by the quarry's own foundry at Gilfach Ddu, and the present remains suggest that it was of standard construction, albeit erected unconventionally. The drum would have been of a cast iron spider frame consisting of two end-castings with flanges and a surface for bolting the drum sheeting of either timber planking or a rolled iron sheet; a central supporting segment, probably with a central flange standing proud to direct the separate ropes for left and right hand tracks onto their respective halves of the drum when overlapping the first lap of wound rope; and a separate narrow brake drum located on the southern side of the north-south oriented axle. In this arrangement both tracks had separate ropes, counter-wrapped so as to achieve counter-working on each of the twin parallel rail tracks on the incline. It is likely that owing to the width of the drum, it is unlikely to have been greater that about 4ins. proud.

The brake drum would have had a split band brake, operated by a lever system with quadrants, connecting to a single operating lever. The mounting of the common pivot axle of the twin brake bands remains *in situ*, but only the locating bolts of the front bearing box for the final operating quadrant remains. Similarly, two sets of bolt holes in slate slabs on the floor of the drumhouse show the position of cast iron vertical stanchions marking the (eastern) fulcrum of the operating lever and the (western) pin-down fitting for the lever; the operator's position at the leading edge of the brake operating lever is marked by wear-marks on a slate slab near the edge of the incline slope.

The drum mechanism was erected upon a pair of pre-fabricated steel pediments, such that the new unit could be fixed in place rapidly during the changeover from the chain system, probably commencing one Saturday lunchtime and continuing over to the Sunday, this being the only time when the incline would not have been in operation. These steel pediments were retained thereafter, but were at some date partially encased in concrete, probably owing to corrosion from the sea air, or due to some structural deficiency in their construction or design.

The lip (or *crimp*) of the incline would have most likely been different in each of the two phases of operation. In the chain system, it may have had a slight slope away from the *crimp* in an easterly direction, to assist the process of attaching or unhitching the wagon chain-hooks from the main chain. The chain itself ran in a shallow trench at the *crimp*, coming up from the covered chain-sheave pit at an angle to the loading points on both tracks; this feature is still in evidence. The track was probably sitting on longitudinal timber baulks at this point, so as to cross over the sheave pit, and because cross-sleepers would have fouled the moving chain. In the cable operated days, it is likely that there was some type of movable arrestor at the lip of the incline, so as to prevent runaways. This was most likely comprised of a pair of hinged timbers crossing the tracks, with the remaining short holding-down bolts presently between the tracks being the mountings for the pivots.

The Drumhouse

The 1888 Ordnance map shows a building on the site of the present drumhouse, although the existing building is of more recent construction. The c1896 photograph shows what is probably this earlier building, albeit in the distance. It was apparently a conventional incline drumhouse building (minus the drum), i.e. two parallel walls running with the tracks, with a gabled roof at right angles. In the operating circumstances of the movement of material through the building, this design was the most logical to erect if a shelter was desired, regardless of the presence of a drum or not. The only difference was that owing to the under-floor sheave system, the building could be closer to the edge of the incline than normal; in fact, the incline appears to have continued into it some several feet distance. The roof apex must also consequently have been somewhat lower than if housing a drum. The present remains show stone at the western end of the present drumhouse, corresponding to the lower courses of the original building. It cannot be stated whether this shelter was an original feature or a pre-1888 addition, but it is likely to have been early in date owing to the stonework which matches the foundation platform. Yet, it is more than likely that because there is rough slate walling overlying the western portion of this early period walling, that the original was simply two shelters on either side of the incline top, with the old 'drumhouse' being added later.

The new construction of 1924 (marked by graffiti engraved in the cement rendering) was put up after the drum unit had been erected on its pre-fabricated steel mountings, as shown by the relationship of the new masonry to the mountings where both abut. Its site was that occupied by an eastern extension of the old 'drumhouse', which was demolished to make space for the new drum unit and re-modelled building. The shape of the new building was dictated by the position and height of the drum, placed further east than the sheave pit to correspond with a projection of the upper steep slope of the incline, thus preserving the catenary profile for the ropes.

To enable the brake operator to view the traffic on the incline, it was required that the new roof covered the whole distance from the edge of the slope back to the new drum position. This was achieved by constructing an asymmetric gable, with two-thirds of the apex on the western side. The eastern apex was cut short by the presence of the unloading shed to the east. Matching the new building to the latter required the extension of the loading shed east-west ridge board into the drumhouse east apex, albeit somewhat crudely, and the sheeting of the new drumhouse east side that lay outside the connecting roof valley, with slate-hung timber boarding. The requirement of the extra spacing for the brake wheel and mechanism on the south side of the drum axle necessitated the southern steel pediment to be located asymmetrically from the centre line of the incline, i.e. a little further away from the mid-line. Thus, the new building erected around the drum had to take a 'sideways step' around the south pediment, giving an unusual shape to this south gable.

The most westerly portions of both north and south walls show the marks of former timber partitions, which must have provided a little shelter for the operators from the effects of the strong through-draft experienced in this tunnel-like building on a windy day.

The Unloading Shed

This building was where the transporter cars from the quarry were unloaded of the 2ft. gauge wagons containing the finished slate, which thereafter ran on 2ft. gauge tracks down the incline to the quay. It was also where the returning empties were loaded onto transporter cars for the return journey to the quarry. The present remains are of a greatly modified building.

The unloading shed appears on the 1888 Ordnance plan, but is likely to have been newer than the first 'drumhouse'. If the present theories are correct, it cannot be any older than 1848, when the transporter cars are thought to have been introduced. However, a graffiti on one of the roof trusses showed the date 1873, preceded by the numbers 7 and 22 (22 July?), all following an undecipherable series of letters. This may have been significant as a building, re-roofing or merely a date of repair work; unfortunately, the true meaning of this information is not clear. Assuming that this was the date of construction, how does this fit into a possible scenario of development?

In theory, the unloading shed as built, was not strictly necessary. The eastern extension of the old 'drumhouse' was probably the site of the original unloading platform of 1848; suggestions of this can be seen on the ground just east of the later drum mountings. It is likely that the requirement for a new unloading shed came about with an increase in traffic volumes, which fits the given date well. The new building is significantly not built on the old incline foundation pattern, but rises directly from ground level to the eaves in a single construction; it probably straddles an earlier narrower causeway leading to the incline head. The increased width of the formation thus provided, would have allowed the construction of a twin unloading dock facility, each being a single-track neck of a pair of tracks outside (one leading in and the other releasing the returning empties), with the point-work just inside the building.

This would explain the four cut-outs in the timber lintel on the eastern entrance to the shed. The first roof truss of the shed has only a shallow scallop above one track, but may have had sufficient clearance from the ground, but the second roof truss has two cut-outs, but as a pair only on the northern side of the mid-line. It may be hypothesised that the ground level was a little higher here to give a gradient to release the 'empties', and that the unloading docks were staggered rather than being in-line. These cut-outs in the timber lintel and trusses must surely must have had a significance in terms of clearing the chimney of a locomotive, probably that of the 1848 Horlock engines which had no automatic decoupling mechanism and had to work right up to the dock. The later Hunslet locos, bought in 1882; 1886 and 1895, were taller than the Horlocks and could not come into the unloading shed. These newer engines worked the incline-head sidings by fly-shunting the transporter cars.

The single modern photograph of this building in use shows a single 4ft. gauge railway track entering from the east, immediately forming a trailing point with the track leading out to the return loop (Boyd 1986, Plate XXXVII) . The neck of the point was latterly in the form of a short length of track within an unloading bay, holding one transporter car only. The layout and the internal arrangements must have been changed, possibly when traffic levels decreased during the present century.

The unloading shed had latterly an internal office for the foreman in its north-western corner, this probably doubling as a mess-room (or *caban*). The brick fire-place and chimney are additions to the original structure, and the exterior window appears to have been an insert. The two internal walls were of timber partitions, carried up onto the roof trusses. There was probably an internal window plus one door in the timber walls, but the location of these features is now uncertain.

There was a blocked opening in the north wall, the significance of which is not known. The platform edges along the longitudinal interior walls of the building could not be interpreted with

any confidence, but were certainly associated with the remains of the internal unloading platform which has been completely removed.

The roof of this building was unusual. The gable ran east-west, along the longest dimension, which was sensible, and was supported by three timber king-post trusses, which was standard procedure. The east end was not gabled, but had a full hipped roof, often a sign of mid-C19th or later design. The west end was peculiar. It had a composite truss having dual diagonal pieces as part of the original (Fig. 5). The space between the upper and lower diagonal were covered by an external slate hanging covering, showing it had been external before the roof was extended in 1924 into the new drumhouse. This slate hanging was nicely cut to shape, and had not been broken after being put in place. There was also some sawn off timbering on the innermost diagonals.

The only possible explanation is, that the roof continued westwards on the same orientation, but at a lower level, necessitated by the extension being a narrower building. This building (now demolished) was between the unloading shed and the old drumhouse, and provided some sort of covered passage between the two, as shown in plan on the Ordnance maps. From the projected gable height of this vanished building, it appears that it approximately corresponded to the probable height of the gable of the old 'drumhouse'. Thus the two roofs, at right angles, would have met in a symmetrical valley arrangement.

Conclusion

The Port Incline was in some ways a typical gravity-powered double-acting haulage system. In its use of endless-chain haulage, it was not in any way breaking new technological ground, but was amongst a very small number of known installations of this type in the North Wales slate industry. It was probably the only identified surviving site where field remains could give some detail to the theoretical knowledge available of the chain haulage system, although the full opportunity to investigate the site was not taken owing to economic limitations. Fortunately, the accessible features of the upper portion of the incline were recorded in considerable detail, providing valuable evidence of a site which at first sight was deceptively simple, but turned out to be quite the opposite.

9. ACKNOWLEDGEMENTS

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10. APPENDIX

Chronological summary of Padarn Railway (after Turner,1975).

1787 - Thomas Assheton-Smith lets the largest Dinorwic quarry to the Dinorwic slate Co.
1793 - Assheton-Smith enlarges quay at Y Felinheli, re-named Port Dinorwic.
1799 - Gallery system adopted at Port Dinorwic.
1809 - Assheton-Smith lets Dinorwic Quarry Co.
1816 - First quarry tramroads built.
1824 - Dinorwic Tramroad built.
1841 - June. Padarn railway begun.
1843 - December. Padarn Railway completed and working (horse traction). Dinorwic Tramroad abandoned.
1848 - Steam locomotives introduced on the Padarn Railway.
1852 - Bangor and Caernarvon Railway reaches Port Dinorwic.
1856 - B & CR constructs siding down to quay at Port Dinorwic.
1869 - July 1st. LNWR branch to Llanberis opened.
1870 - Steam traction introduced at Dinorwic.
1895 - Workman's passenger service commences.
1896 - Assheton-Smith's private saloon constructed.
1924 - May. Port incline converted from continuous chain to self-acting cable.
1926 - January 22nd. Fatal accident with oil lorry on Padarn Railway.
1935 - Internal combustion locomotives introduced at Dinorwic.
1947 - November 8th. Workmen's service ceases.
1954 - Major rockfall at Dinorwic.
1961 - October 27th. Last working run over Padarn Railway. October 30th. Port Dinorwic closes.
1962 - September 7th. Llanberis branch closes.
1963 - Lifting of Padarn Railway completed.
1967 - Steam working ceases at Dinorwic.
1969 - July. Last 350 workers laid off at Dinorwic. December 12th and 13th. Quarry equipment auctioned.
1970 - June 23rd. Quarry auctioned.
1971 - May 28th. Llanberis Lake Railway inaugurated.

1992 - July. The Drumhouse and cottages demolished.

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