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HAFOD CHAIN BRIDGE EXCAVATION 1998

An archaeological investigation carried out
and written and compiled by:

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1. INTRODUCTION

The remains of the Chain Bridge[1] (also known as the 'Swing Bridge') over the River Ystwyth on the Hafod (Forestry Commission) Estate are located at NGR SN77477357, northeast of Pont Dologau, and the house Dologau (see drg. 1). The bridge was constructed by Thomas Johnes sometime after 1796 and probably before 1805 as part of his 'New' or 'Gothic Arcade' Walk.

The visible remains of the bridge consist of pairs of neo-classical cast iron columns on both the north and south edges of a precipitous gorge above the River Ystwyth. There are also thin posts which delineated the immediate approaches to the bridge. The ground on the south side of the bridge slopes steeply towards the gorge while the terrain on the north side of the bridge is flatter. The remains of the bridge on both sides of the river are within dense plantings of conifers, though some deciduous trees remain close to the bridge on the south side of the river.

2. BACKGROUND TO THIS REPORT[2]

In the Spring of 1997, Mr Peter Holden RIBA of Peter Holden Architects, Pembroke was consulted by the Hafod Trust to consider preparing design proposals for the reinstatement of the Chain Bridge. As part of this, and in keeping with the Hafod Trust's own guidelines it was recognised that an archaeological investigation of the remains of the Chain (or 'Swing') Bridge would be necessary, so as to elucidate the way in which the bridge was engineered and constructed, and to inform any subsequent reinstatement.

Peter Holden asked me, Salvatore Garfi MIFA to give him my provisional thoughts and costings for an archaeological investigation into the Chain Bridge and these formed the basis of a brief specification prepared by the Hafod Trust and submitted to the Hafod Advisory Committee at the beginning of this year. After receiving comments on the draft specification I was asked, through Peter Holden, to provide a more detailed specification[3] of the proposed work which I submitted in March of this year.

The revised archaeological specification was accepted by the middle of May, and Peter Holden was asked by the Trust to commission me to carryout an archaeological investigation of the Chain Bridge. The permission to proceed with the investigation was given on June 1st, 1998.

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1 Hafod Archaeological Database ref. PRN33025.

2 Copies of this report, including copies of its loose drawings, are to be deposited with the Hafod Trust, the Dyfed Archaeological Trust and the National Monuments Record (NMR) for Wales. The original drawings prepared for this report, with the photographs (and negatives) taken during the course of this excavation, are also to be deposited at the NMR - the official place of deposit under the Public Records Act of 1958.

3 Entitled: 'Draft Archaeological Specification for an Investigation into the Construction of The Ystwyth Chain Bridge, Hafod Estate', dated 3 March 1998.

Landmark Surveys[4] was commissioned (by Peter Holden Architects) to undertake an EDM survey of the bridge site, which was carried out in July, and the excavation was commenced in the middle of August.

3. APPROACH AND METHODOLOGY

As outlined in the accepted specification (see footnote 3), the aim of the excavation of the remains of the Chain Bridge was to elucidate the way in which the structure was built and perhaps repaired. The topographic surveying carried out by Landmark Surveys was undertaken to give a context to the bridge remains and to provide a contour survey of the site, and to establish relative heights on both sides of the river gorge.

Landmark Surveys undertook its survey of the site on 6 July 1998, and the excavation of the bridge remains was carried out between the 12th to 19th of August inclusively, with two half days lost due to inclement weather. The site was backfilled on 21 August[5].

Before commencement of the survey and excavation, I liaised with Mr John Isherwood, the Hafod Warden for Forest Enterprises (the Forestry Commission). He was extremely helpful at all times, and since he is a keen mountain climber, he loaned the excavation team some of his own mountaineering equipment which was necessary due to the very nature of the site (see 3.3, *The Excavation*).

3.1 *Definitions and Descriptive Conventions*

'The Site' will refer, as a whole, to the area of visible bridge remains on both sides of the River Ystwyth. The areas excavated are referred to as the North, or NorthernTrench (or North Excavation Trench) for the area excavated on the northern side of the river, and the South, or Southern Trench (or South Excavation Trench) for the area excavated on the southern side of the river. Excavated deposits have been given archaeological context numbers, and these are printed in brackets like so; [3]. The visible and excavated cast iron bridge components are referred to by their relation to the cardinal points. Dimensions are usually given in metres, however, dimensions referring to specific iron bridge components are given in millimetres.

3.2 *The Site Survey*

An arbitrary datum line was pegged out across the ground behind the bridge remains on both sides of the river. The origin for the survey of the site was taken at the western end of the datum line running across the southern remains of the bridge. This was

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4 Address: Pantyfelin Road, Pontarddulais, Swansea, SA4 1PZ, tel. 01799 882146

5 During a meeting on site between S. Garfi, P. Holden and M. Norman of the Hafod Trust on 14 August 1998, it was decided that the excavation trenches should not be fully backfilled. The cast iron fitments were to be kept exposed to bedrock, so that if required, P Holden could have tests on the integrity of the iron carried out.

Before back filling took place, an intervention material was laid in the excavation trenches and the spoil was re-deposited on top of it.

given an arbitrary value of 1000m East, 1000m North and a level of 100m. The survey was aligned on a north compass bearing.

The arbitrary level of 100m was given to the survey origin because there is no Ordnance Survey bench mark within a reasonable distance of the site. However, it is understood that the Dyfed Archaeological Trust is slowly setting out bench marks around the estate, and with this in mind, a temporary benchmark was transferred up the hill to the south of the site and marked on a stone by a field boundary fence. The value of this bench mark is 116.52m[6].

The survey was recorded digitally and printed out onto drafting film at a scale of 1/50. A profile of the gorge was also prepared at the same scale. As a result of the excavations, the topographic survey and the profile had to be changed slightly, but these amendments were manually added to hard copy on drafting film. The completed survey (drg. 2) shows the site before excavation with the salient bridge remains above ground, footpaths leading to the bridge, the excavation trenches and corresponding datum lines, spot heights, contours at 0.25m intervals and the positions of nearby trees. An additional printout was provided by Landmark Surveys at a scale of 1/20 showing the ends of the arbitrary datum lines, and the above ground bridge remains. These were used as base drawings for the drawn field record of the excavations on both sides of the river.

3.3 *The Excavation*

First, it should be noted that this excavation was highly dangerous. The narrowness of the gorge through which the Ystwyth flows turns the river into a rapids. With the remains of the bridge perched precipitously at the very edges of the gorge, and with the water at approximately 7.3m below the bridge remains, extreme safety precautions had to be taken.

Three people were on site at all times during the excavation. Everyone wore climbing harnesses and were attached to a nearby tree by mountaineering ropes, slings and carabiners. Dumar clamps were used to keep the ropes in tension when working near the edge of the gorge. One member of the team was an experienced mountain climber, and he was responsible for insuring that all team members were properly harnessed and attached to their ropes, and that all of the mountaineering equipment was kept in good order.

The excavation trenches, both north and south, were laid out in relation to the arbitrary datum lines pegged out prior to, and recorded by the topographic survey of the site. These datums were roughly parallel to the overall alignment of the river. Excavation trenches were then laid out, extending back from the visible bridge remains and tied into the datum lines. These are clearly visible on drg 2 and the trench excavation plans (drgs. 4 to 8).

The trenches were excavated by hand, using where appropriate, trowels, shovels, hand shovels, buckets and pickaxes. Excavation plans were drawn at 1/20 scale on Museum

[6] The approximate position of this temporary benchmark (TBM) is shown on drg. 1. The benchmark itself is a stone painted white.

of London archaeological planning sheets of drafting film with grids printed on them. Ordinary graph paper was used for section drawing at 1/10 scale. Levels with back sights and fore sights were recorded on their relevant plans. Because it was planned that no trenches would be no more than 9 sq m in area, and it was presumed that the stratigraphy on the site would not be deep and complex, a decision was made not to use pro-forma recording (context) sheets. Instead, a simple note book system was used, with all stratigraphic contexts excavated given a unique number. It should be noted that only three deposits were excavated in the south trench and only one excavated in the north trench.

The cast iron remains of the bridge in both the north and south trenches were recorded by detailed measured sketches with annotations in the note book. These were drawn up at a scale of 1/5 off site, and checked at a later date in the field.

The excavation was recorded photographically in both black and white print film and colour transparencies. However, not all of the exposures include scales since three photographic scales fell into the river during photography. This was due to the precipitous nature of the excavation trenches which sloped downwards at the very edges of the gorge above the RiverYstwyth. A register of all photographs is attached to this report.

4. DESCRIPTION OF THE EXCAVATION

4.1 *The Above Ground Remains of the Chain Bridge*

Thomas Johnes referred to the bridge on this site as either the Chain Bridge, or the Swing Bridge. It was constructed over a rocky gorge in the River Ystwyth more than 6m wide. The southern edge of the gorge consists of a sheer vertical face extending down to the river which for all intents and purposes is a rapids - cascading over rocks and through narrow water cut pools. The northern side of the gorge steps down steeply to where the river narrows to ca. 2.75m in width. The level of the river varies due to rainfall, but during the course of the excavation it was approximately 7m below the level of the cliff edges.

At the start of the excavation, the bridge remains above ground on both sides of the river consisted of two (circular in plan) neo-classical cast iron columns with square bases, narrowing upwards to square caps topped with ball finials. Roughly centrally placed between the columns, and slightly lower than the tops of the square bases of the columns, was the rectangular top of a cast iron fitment with a hole through it. The columns themselves were positioned on similar iron fitments or 'pins', also with holes. How the fitments were set into the bedrock could only be surmised, but it was presumed that they were positioned into holes drilled into the rock and set with molten lead - which the excavation proved to be the case.

On the north side of the river, just above the turf and moss which covered the site there were clearly visible the remains of three other pins, set back from and in line with the columns and their associated centrally placed pin. These pins had stout rods (bolts) running through them with eyelet ends. These ran towards the columns, and in the eyelets there were iron stirrups which were bolted to the ends of short, corroded cable

fragments. The ends of the cable fragments consisted of iron eyelets that were riveted in place. On the south side of the river, only one such cable end was visible. This was preserved in place within the hole in the pin supporting the eastern iron column, nevertheless, it too was badly corroded.

In summary, the three pins furthest back from the edge of the gorge served as anchors (anchor pins) holding horizontal rods with eyelets (anchor rods). These eyelets had cables (which could have replaced earlier chains) secured to them which were guided across the river through the three pins (guide pins) at the very edge of the gorge, of which the outer two supported the cast iron columns.

The columns also had small holes in them to take eyelets which held wires (or very thin cables, see 4.3, *The South Trench,* and The Objects Register) which probably served as gangway guides across the bridge. These also extended away from the river's edge to iron posts which directed pedestrians onto the bridge. There was also a gate hung on the eastern column on the north side of the river. It was an addition to the column and held in place with bolted brackets.

4.2 *The North Trench (see drgs 4 & 5)*

The north excavation trench is 1.75m x ca 2.8m. It extends north at an approximate right angle to the river, from the columns which stand at the edge of the river gorge.

The present day thin cover of turf and moss over the area of, and in the vicinity around the north trench, suggests that when the chain bridge was constructed either the bedrock was exposed as a rocky platform on the northern side of the Ystwyth, or the turf overlying it was as thin as it is today. If the latter was the case, it would have had to have been removed to facilitate the construction of the chain bridge.

The bedrock on the north side of the site of the Chain Bridge slopes down from an average of 99.40m at the north end of the trench to an average of 98.74m at the southern end. That is an overall drop of ca. 0.66m over a distance of ca. 2.8m. To accommodate the anchor pins which secured the bridge cabling, this slope had to be stepped, and a cut was made in the bedrock whereby the level dropped from an average of 99.24m to an average of 98.97m. That is a drop of 0.27m. In fact, the cut was carried out in such a way that it hugged the heads of the anchor pins which were placed in drilled holes, or cuts, in the lower level of the step in the bedrock and set into place with molten lead. The bedrock was also slightly hollowed out so as to accommodate the lie of the anchor rods bolted to the pins. This is especially evident along the eastern rod where there is even further hollowing out, or counter-sinking, of the bedrock to accommodate the head of the anchor pin at the top of the drilled hole into which the pin is set. The western anchor pin is also counter sunk, but this time into a depression due to a probable mistake in the very positioning of the hole.

At the very edge of the gorge, and at an average level of 98.77m, the three guide pins were set into drilled holes. Because the angle of the rock down into the gorge virtually breaks along the line in which the pins were set, the eastern and central pins appear to be in holes which are partially counter-sunk. Nevertheless, these pins, like the anchor pins, have been set into position by having their holes filled with lead. The eastern and

western guide pins also support the cast iron columns which served as a threshold or entrance onto the bridge.

The bedrock was further cut to create a level, though slightly sloping path toward the bridge from the west. This is evidenced by a curved cut which drops approximately 0.2m and leads from the northern central part of the trench to the east side of the eastern anchor pin. There is a 1.1m high iron post, set into the bedrock with iron wedges, at the northern end of this cut, and there is a corresponding post (1.28m high) just over a metre to the west. These acted as guides for pedestrians to the bridge and had three wires attached to them by adjustable eyelets. The wires were presumably attached to the eyelets in the columns at the threshold to the bridge.

The path to the bridge, bounded by the posts and the cut in the natural bedrock is also indicated by the preservation of a portion of the buff coloured natural clay (with silt and medium sized stones) which can be seen to overly the bedrock in many places in the vicinity of the site. The bedrock which has a slightly corrugated surface, and was probably exposed during the time in which the bridge was in use had, by the present day, acquired a thin covering of moss and turf. This is the one deposit on the north side of the site which required excavation (context [4]). It was no more than ca. 0.05m thick.

4.3 *The South Trench (see drgs. 6 to 8)*

The southern trench is 1.7m x ca. 2.8m in size, it extends southwards from the columns which stand at the edge of the gorge. The ground is steeply sloped on this side of the river, and in places there is a natural deposit of buff coloured clay beneath the thin turf, and leaf mould which litters the surface. The natural bedrock is not as level on this side of the river as it is on the northern side. There it gently slopes towards the cliff edge while here it drops down in two steps from an average of 99.19m to 98.83m, and then down to 98.61m. From this lower level it then slopes down to an average of 97.38m at the very edge above the gorge where the guide pins for the bridge were inserted (see drg. 6). This is 1.39m lower than on the northern side of the river. The anchor pins for the bridge where also set into bedrock which is at a lower level than on the northern side, that is at an average of 98.54m as opposed to 98.97m - a difference of 0.43m. This difference in overall level between the northern and southern sides of the bridge had a direct bearing on the construction of the bridge and the archaeology of the site.

As on the northern side of the river, the bridge's guide pins and anchor pins were positioned into drilled holes and set in place with lead. However, because the bedrock is lower on the south side of the bridge than on the north side, the pins had to project above the bedrock ca. 0.65m for the guide pins and 0.5m for the anchor pins.

With the pins standing proud above the bedrock, the ground was made-up around them (see drg. 7) by the deposition of (context [3]) buff coloured clay and silt (with occasional gravel and small to medium sized rocks). This material was probably extracted locally, and section D - D (drg. 9) illustrates how it was deposited in a series

of dumps[7]. Its thickness was only ca. 0.06m at the southern end of the trench, but that increased to more than 0.4m around the iron pins themselves. Over time however, erosion has removed some of the deposit at the edge of the gorge, with the greatest amount of erosion along the western edge of the excavation trench. This is reflected in the northern extent of context [3] in section D - D.

The anchor and guide pins also had their edges serrated (see drg. 11). This was not the case on the exposed stems of the pins on the north side of the river, though corrosion could have hidden any signs of them. It is also likely that the pins, quite simply, may not have been exposed high enough above the level of the bedrock since the serrations on the pins in the southern trench begin on average 188mm below the heads of the pins. Also, we cannot be certain whether the pins were serrated prior to their insertion into the bedrock, in which case, the serrations would have keyed them in with the molten lead which set the pins in their drilled holes as well as with the clay, or they were serrated once set in their holes, whereby the serrations served the purpose of keying the pins in only with the relatively stiff clay and silt ([3]) which was dumped around them.

Nevertheless, with the pins secured in their holes, and with the ground made-up to a level averaging 99.27m., a further deposit was laid over [3], this time, and in all probability, as the surface of the path leading from the bridge to the west (context [2]).

Context [2] sloped down, south to north, from an average of 99.45m to 99.20m (see drg. 8). It filled the southern half of the excavation trench with its northern limit irregularly in line with the heads of the cast iron anchor pins for the bridge. The deposit consisted of a very dark grey - almost black on its surface - fine to medium gravel in a coarse matrix of silt and fine sand with a moderate amount of small stone fragments. It was compacted yet friable. The interface of the deposit with [3], labelled as [2a] on section D - D, is a lighter grey in colour and more gritty and friable. It is quite likely that context [2] represents the path that would have had to have been made over the clay and silt of [3] - as an approach to the bridge. It is also possible that the lightening of [2], near its base, is due to the leaching of lime which might have been mixed with the deposit to cement or consolidate it. Also, the very dark grey at the upper surface of the deposit was probably due to the leaching of organic material (humus) from the turf and leaf mould (context [1]) which has accumulated over time, over [2].

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[7] Section D - D illustrates some of the dumps which made up context [3]. They have been given letter suffixes and their basic decriptions are as follows;

3a - Buff to red deposit of clay to fine gravel, relatively loose in texture.

3b - Orange to buff silt and clay deposit.

3c - Buff brown deposit of silt, sand and clay with humus.

3d - Orange to buff silt and clay deposit.

3e - Brown to orange deposit of silt, clay and humus.

3f - As 3e, but more brown and with less humus.

3g - Orange, buff to brown silt and clay.

3h - Blue grey sand, silt and small stone fragments. Probably part of the interface between context [3] and the bedrock.

3i - Buff to brown silt. Has probably worked its way naturally between 3h and the bedrock, perhaps through water running along the interface of the bedrock and context [3].

3j - Orange to buff silt and clay.

NB. All of these deposits include occasional small to medium stones.

Context [2] also shows signs of being banked up against a slight rise in the ground to the east, and just before the rise it seems that the deposit has been slightly eroded away downward from south to north. The erosion has exposed the interface ([2a]) of the deposit with [3] and it is possible that it was caused by water running down the compacted surface of [2], when it was in use as a path to the bridge, with the water turning to drain away northwards to the edge of the gorge, guided by the slight rise in the ground along the eastern side of the south excavation trench.

When context [2] was laid, it was also spread around a thin iron post set into the bedrock ca. 1.7m south of, and roughly in line with, the eastern guide and anchor pins of the bridge. The post is 1.23m high with three adjustable eyelets equidistantly placed along its length. These took wires which served as a guide for pedestrians approaching the bridge, and like the similar posts on the north side of the river, this post was set in the bedrock and held firm with an iron wedge. A similar iron post is over 2m to the west, outside of the excavation trench, and it served as a path delimiter near the edge of the gorge.

Like context [3], context [2] eventually eroded away slightly to the north, and minor spreads of its matrix were clearly visible over the tops of the anchor pins and the anchor rods. When the bridge went out of use, leaf deposits accumulated over the path and the bridge's ground level ironmongery, and this eventually decomposed accommodating a thin grass cover seasonally overlain by the autumn fall of deciduous leaves, context [1]. The only objects (small finds) unearthed during the excavation were found in context [1]. They are described in the Objects Register[8].

5. THE MAKE - UP OF THE BRIDGE COMPONENTS

After examining the cast iron components that make up the remains of the Chain Bridge, it is highly probable that they were all uniformly made. It is not inconceivable that they were bought 'off the shelf'. It can be surmised that the bridge consisted of a gangway, presumably of wooden slats, suspended by three chains or cables across the gorge of the River Ystwyth, supported by iron guides and secured by iron anchor rods bolted to iron anchor pins.

These components making up the bridge can be separated into two types; structural components supporting and anchoring the chain (or cable) bridge, and decorative components.

5.1 *The Structural Components*

The cast iron components which anchored and supported the suspended gangway of the bridge were the anchor pins, the anchor rods (with stirrups which were attached to cables), and the guide pins. All of which have been preserved in situ.

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[8] The objects found were given the numbers, SF1, SF2, SF3 and SF4.

5.1a The Anchor Pins (see drgs. 4, 6, 11 & 12) -

The anchor pins are 80mms square in section. Their heads are 100mm by 80mm and ca. 150mm high. The height is an approximation because the heads of the anchor pins are not well preserved in either of the excavation trenches. The very tops of the pin heads are corroded in the southern trench due to being buried, while in the northern trench, the bases of the heads are obscured by corrosion due to being virtually level with the bedrock. Where the bases of the pin heads are not obscured, they narrow to match the dimensions of the pin shafts by a simple concave quarter of a circle (or ellipse) with an approximate radius of 10mm.

Running at a right angle to the wider side of the head of each anchor pin is a centrally placed, smooth hole of under 40mm in diameter. Its centre is ca. 60mm beneath the top of the pins. These holes took horizontal anchor rods which are still in place.

On both the north and south side of the river there are three anchor pins laid more or less in a line parallel with (from east to west), and under 1m back from the edge of the gorge.

On the north side of the river the outer east and west pins are, from ca.center to center, 0.88m apart with the central pin almost centrally placed. The levels of the heads of the pins are, from east to west, 99.06m, 99.08m and 99.07m. Each pin is situated in an irregularly circular hole averaging 150mm in diameter with both the east and west holes slightly counter sunk (the holes were cut, or drilled, in the bedrock from an average level of 98.97m). In fact, it appears that the western hole was initially cut ca. 140mm further to the west, but after being sunk a couple of centimeters or so (to a level of 98.87m), its position was corrected. The depths of the holes are not known since the pins were set in place with molten lead. The bottoms of the anchor pin heads are virtually flush with the lead, but their interface is very unclear because of iron corrosion.

On the south side of the river only the west and central pins are nearly in line, with the east pin ca. 150mm forward, toward the river. The outer pins are (ca. center to center) 0.9m apart with the central pin 0.52m east of the western pin. The levels of the tops of the pin heads are, from east to west, 99.06m, 99.04m, 99.02m, and they are relatively irregular due to corrosion. These pins stand relatively proud above the level of the bedrock which is at an average of 98.54m, and are positioned in irregularly round to square holes of ca. 160mm in diameter. They have been set in place with molten lead, above which corrosion has caused the pins to widen slightly. Corrosion has also caused deterioration and thinning of the stems of the pins just beneath their heads and roughly level with the top of context [3] which was subsequently packed around them (see section D - D).

5.1b The Anchor Rods (see drgs. 5, 7, 11 & 12) -

All of the anchor pins have anchor rods passing through them. These are relatively uniform in make-up save for the central rod on the south side of the river which may very well be a later replacement. Each rod has an eyelet at the end pointing towards the river, and a pair of 6 sided bolts, ca. 35mm in diameter x ca. 31mm in thickness, at

the other end, screwed up to the rear of the anchor pins. These not only would have held the rods in place, but could have been used to adjust their lengths. All of the rods are preserved to an average length of 0.62m. Their preserved lengths apparently vary due to the effects of corrosion at their nut ends.

The rods taper in thickness from the nut end where they are ca. 35mm in diameter to the eyelet end where they can be ca. 25mm in diameter (however, corrosion can contribute to variability in the dimensions of the rods). The eyelets are ca. 75mm wide by ca. 120mm in length. The thickness of the metal of the loops of the eyelets is ca. 22mm. Some of the anchor rods have exposed threads visible near the nut end and in front of the anchor pins, but there is a good deal of corrosion along the shafts of all of the rods obscuring details. The central anchor rod on the south side of the bridge differs from the others in that its shaft is not tapered, at ca. 37mm in diameter, and its eyelet is virtually oval in shape while the others are more eliptical. The eyelet is ca. 80mm wide by ca. 120mm in length and the thickness of the eyelet loop is ca. 25mm.

The rods do not sit tightly in the heads of the anchor pins. Some of them can still be turned and moved slightly up and down, and sideways.

5.1c Anchor Rod Stirrups (see drgs. 5, 7, 11 &12) -

There are iron stirrups in the eyelets of the three anchor rods on the north side of the river, and one preserved in the eyelet of the eastern anchor rod on the south side of the river. All of the stirrups have been corroded, but like the other iron fitments so far described, they appear to be uniform.

The stirrups are ca. 140mm long x ca. 73mm wide. They consist of a loop made up of iron which is ca. 16mm in diameter. The ends of the loop broaden into flat rounded ends that are parrallel, measuring ca. 20mm thick x ca. 50mm wide. There are holes in the rounded ends to receive a ca. 18mm bolt with a square head (ca. 37mm sq x 18mm thick). The bolt serves to hold the end of a cable in place and is itself held in place in the stirrup, not by a threaded nut, but by having its end hammered into a roughly conical shape, with a base broader than its diameter.

All of the preserved stirrup ends still have short lengths of corroded cables attached to them, and these are the fragmentary remains of the cables which spanned the river gorge and presumably supported the gangway of the bridge. However, the cables were supported by further iron guide pins at the very edge of the gorge, and the cable fragment preserved and attached to the eastern anchor rod on the south side of the river is still positioned in its corresponding guide.

5.1d The Guide Pins (see drgs. 5, 7, 10, 11 & 12) -

All of the anchor pins and rods are nearly in line with corresponding cast iron guide pins positioned at the very edge of the gorge over the River Ystwyth. These further pins are 80mm square in section, and they broaden to 100mm x 80mm where their shape appears to be identical to the anchor pins save that they have elliptically oval holes (94mm x 50 mm) through which the bridge's suspension chains or cables passed.

The eastern and western guide pins on both sides of the river also support the decorative columns leading on to the bridge, while the central guide pins are low lying (they would have been beneath the gangway of the bridge) and their heads appear to be ca.10mm taller than those of the anchor pins.

The guide pins are on average (center to center), 0.84m in front of the anchor pins on the north side of the river. On the south side, the west and central guide pins are ca. 0.81m in front of their corresponding anchor pins, while the eastern guide is around 0.68m in front of its matching anchor pin. With the east and west guide pins on both sides of the river supporting the threshold (entrance) columns onto the bridge, the only levels for the tops of the guides can be ascertained from the central pins, and these are, 99.06m on the northern side of the river, and 99.05m on the southern side.

On the north side of the river the outer guide pins are under 0.91m apart (center to center) and the central pin is 0.5m (center to center) west of the eastern guide pin. The outer guide pins on the south side of the river are 0.86m (center to center) with the central pin 0.43m to the east of the western guide pin.

How the side guide pins support the threshold columns cannot be known without taking the columns apart. However, it is not inconceivable that the side pins extend up into the columns themselves - this is discussed further below (see 5.2a, The Columns).

As has already been noted, the guide pins on the south side of the river have serrations along their edges. They number about 10 to 13 on the four edges of each pin and they begin under 200mm beneath the heads of the pins. Each serration appears to be the result of the hammering of a sharp object - probably a chisel - into the edge of the pin shaft every ca. 25mm, causing an indent ca. 4mm into the shaft. Similar serrations are not visible on the corresponding anchor pins to the south and the pins on the north side of the river, and the possible reasons for this have already been discussed above (see 4.3, *The South Trench*).

5.1e The Bridge Cables (see drgs. 5, 11 & 12) -

Three cables spanned the gorge of the Ystwyth, presumably supporting the gangway of the bridge which must have been ca. 0.9m wide. It is possible that the cables preserved on site were replacements for earlier chains which spanned the gorge. However, the appelation 'chain bridge' may have been a loose term for any kind of suspended bridge, and it is notable that the bridge was also known by Thomas Johnes, himself, as a 'swing bridge'.

The remaining cable ends (three preserved on the north side of the river and one preserved on the south side) consist of a number of smaller cables wound around each other. Each of the smaller cables is made up wound wires. The cabling is ca. 30mm in diameter, but the ends are thicker at ca. 40mm. Also, the end of each preserved cable fragment is encased in an iron fitment which is secured to its cable end by rivets. These fitments are quite stout. They consist of a loop forged as one piece with two narrow plates which sandwich the end of a cable. They are ca. 280mm long and ca. 35mm wide at the narrow end, while their width increases to ca. 40mm at their shoulder where they then narrow, yet thicken, to form a loop. The loop is ca. 65mm in diameter

with an internal diameter of ca. 30mm. The thickness of the iron of the loop itself is ca. 20mm. The parts of the fitment which sandwich the cable taper to a rounded point at their ends and leave a ca. 20mm gap along the side where the cable is visible. Three roughly equidistant rivets with ca. 15mm heads hold the fitment to the cable along the sandwich ends. No cable fragment preserved in situ is more than 300mm in length[9].

Being attached to stirrups which in turn are attached to anchor rods, the cables must have been kept in a state of tension across the gorge of the river. This must have needed adjusting from time to time, and this would have been accomplished by loosening and tightening the double nuts on the anchor rods. By using two nuts, they could be locked up against each other and firmly secured in place.

5.2 *The Decorative Components*

5.2a The Columns (see drgs. 5, 7, 8, 10 & 11) -

As has already been noted, all of the four threshold or entrance columns are apparently uniform in construction (see, in particular, drgs. 11 & 10) with the same details and dimensions. Their components are almost all hollow, save for the plate and ball finial at their tops. Also, there appears to be patches of a corroded patina on the surfaces of the columns, and this may very well represent a painted finish.

The total height of each column is ca. 1.275m. Each stands on a hollow square base (included in the overall height) which is 210mm x 210mm x 110mm high (the tops of these bases are both at 99.10m on the north side of the river, and both at 99.09m on the south side of the river). There is a plain torus moulding at the bottom of each column with a filet on top. The outer diameter of the moulding is 210mm and it is 33mm high, but the columns themselves taper from 158mm diameter just above the filet (which is 7mm high) over the moulding, to 120mm at their tops. Just beneath the top of each column is a bead (with a diameter of 150mm and a height of 5mm) with a filet underneath it (3mm high), while at the very top of the taper of the columns there is a further filet (4mm high) and a torus bead almost eliptical in section (180mm in diameter and 22mm high).

A separate square plate, 31mm high, sits on top of each column. It is 186mm square but that broadens at its top to 200mm where there is a filet 6mm high. On top of this is a further plate which is integral with an apparently solid ball and these were cast as one iron piece. This is obvious from a mould line that is preserved on all of these uppermost plates and balls, positioned on all of the columns. The ball sits on top of three circular mouldings (the middle one is a filet) which diminish in diameter from 108mm to 86mm to 70mm. When looking at the ball (which is 120mm in diameter) in line with the alignment of the bridge, the mould line is clearly visible, and on the east and west sides of the balls there are rounded (though slightly flattened) protrusions ca. 30mm in diameter. In fact, these protrusions are the only features of the columns which seem to show some real variation. They were probably individually filed into shape during the manufacture of the columns. It should be noted that the upper plate

[9] A cable end fragment was found in context [1], see SF1 in the Objects Register.

(with ball) is broken on the western columns on both sides of the river. This could be due to an attempt to remove them some time in the past.

Just as the plate with its ball on top of each column is a separate piece, it is more than probable that the square base sitting on top of the cable guide pins for each column is also separate. It is also probable that the half oval cuts in the north and south sides of the bases to accomodate the chains or cables running through the guides, were made once the columns were fitted to the guide pins. This is suggested by the fact that the east column on the north side of the river sits slightly to the west on its guide pin and that the cut in the base to accomodate the cabling is correspondingly off center. This is contrary to the other three columns which are much more centrally placed on their guide pins.

The way in which the columns are fixed to their guide pins can only be conjectured at present, but it is not inconceivable that where the guide pins widen to 100mm to accomodate the cable passing through them, and extending up into the hollow interior of the column base (for ca. 165mm), they then decrease in size back to 80mm x 80mm and extend upwards into the hollow column itself. In effect, the wider part of the pin acts as shoulders upon which the square column base is positioned, presumably through a square hole in its top to enable it to be fitted over the pin. An unseen round edge matching the internal diameter of the column could be moulded into the top of the square base, and this could receive the column. With the pin extending upwards through the column, it could reach the top where the uppermost plate with its moulded ball could have been fixed to it. It is also possible that the square plate with a filet, immediately beneath the single moulded plate and ball, is a separate piece which could have been placed over the extended guide pin, immediately on top of the column.

All of the columns have holes drilled into them on their north and south sides. These took threaded eyelets which held wires (or thin cables) which presumably served as guides along the bridge's gangway. On the river facing side of each column, there is a hole (ca. 10mm in diameter) between the eliptical torus moulding at the top of the column and the smaller bead beneath it (that is 940mm above the square column base). Roughly half way down the column, at 520mm above the square base, there is another hole (again at ca. 10mm in diameter), while above the lowest torus moulding, at 122mm above the square, base there is another hole (ca 10mm in diameter). There is also a hole (ca. 10mm in diameter) 25mm beneath the top of the square base (all of these dimensions are taken to the ca. centers of the holes). On the land side of the bridge there are matching holes, except that the central hole has a smaller one (ca. 8mm in diameter) 41mm beneath it.

In the south excavation trench, there are eyelets (with lengths of wire still attached) preserved on the river side of the columns in the holes just above their square column bases. Their stems are ca. 10mm in diameter and they project outwards ca. 80mm. Threads are exposed for ca. 25mm. The loops of the eyelets are ca 34mm in diameter, on the outside, and ca. 17mm in diameter on the inside. The eyelets on the corresponding land side appear to have been cut off, while all of the other holes which could have taken eyelets have presumably had them removed. On the north side of the river, there are no eyelets preserved in the columns save for cut off stubs just above the square base on both the land and river sides of the western column and the land side of

the eastern column. However, on the river side of the east column, just above the square base, there is an eyelet with a swivel head and a short length of wire attached. Its shaft, like the others, is ca. 10mm in diameter and its total length is 117mm. The swivel head is 47mm x 29mm. At 48mm from the column the shaft flatens to a width of 15mm, here there is a 6mm hole, presumably for inserting a tool and turning the eyelet. There are threads on the shaft visible within 35mm of the column. The purpose of this type of eyelet must have been for tensioning the guide wires (or thin cables) which would have extended across the river, to the eyelets on the south side of the bridge.

5.2b The Gate (see drg. 10) -

There used to be a gate across the threshold of the north side of the bridge. However, all that remains of this feature are its hinges, held by iron straps, on the eastern column.

An upper hinge, consisting of a pin pointing downwards from a short bracket is held onto the column by a pair of iron straps at 900mm above the square base of the column. A similar pair of straps is positioned 160mm above the base of the column with a hinge pin pointing upwards from a similar bracket. The straps are 30mm wide x 9mm thick. The strap in each pair with the bracket and pin, wraps around the column and then narrows into two bolt ends, 15mm in diameter. They also widen to ca. 35mm where the brackets extend out of them. The second strap with rounded, slightly larger ends (at ca. 35mm in diameter), fits over the bolt ends and is secured into place on the column by square nuts (29mm square by 15mm thick) with washers.

The upper bracket extends out from its strap by 70mm. It is 18mm thick and ca. 28mm wide. In plan, it is rounded at its end with a diameter of ca. 35mm. Extending downwards from the rounded end is a hinge pin with a slightly conical tip, 15mm in diameter and ca.50mm long. The lower bracket is identical, save that the pin extends upwards and the bracket extends out, away from its strap by only 61mm.

5.2c The Iron Posts (see drgs. 4, 5, 6 & 12) -

As has already been noted that there are two narrow iron posts on both sides of the river. They appear to have outlined the pedestrian approaches to the bridge which were delimited by three wires from each post extending to their corresponding columns at the thresholds of the bridge. The three posts within the limits of the two excavation trenches average 1.2m in height. They are hollow and 50mm in diameter, and each has a relatively uniform flat topped head, 90mm in diameter x 45mm in height. The heads are solid and individually cast and shaped. They are bevelled top and bottom, with the larger bevel on top, narrowing the head to a 40mm diameter, while on the bottom the bevel narrows the head to only 60mm.

There are three laterally drilled holes, in a line up the shaft of each of the posts, and they are equidistantly placed at ca. 412mm (the uppermost hole is ca. 170mm beneath the top of the head of the post). There is an eyelet bolt (ca. 9mm in diameter x ca. 190mm in length) in each hole. A single flat square nut (19mm square) is screwed to each, securing the bolt to the post. The nut could also adjust the length of the eyelet

thereby tightening the wires which were attached to them. Each post was positioned into a tight fitting hole drilled into the bedrock and secured in place with iron wedges.

6. CONCLUDING REMARKS

The excavation accomplished its task of trying to ascertain how the Chain Bridge (or Swing Bridge) was constructed. The structure was approximately 0.9m wide by 7.4m long. It was simply built using simple technology, and it may very well have been 'bought off the shelf'.

There was no complicated archaeological phasing and the bridge was apparently constructed in 'one go'. However, if the calling of the bridge a 'chain bridge' was not a misnomer, then the original three chains which must have supported its gangway were eventually replaced with cables, and one of the bridge's anchor rods was also replaced. It is also possible that the gate on the north side of the bridge was an addition, but this is very far from certain.

Constructed with cast iron pins secured into the bedrock, three chains, or cables, were securely stretched across the River Ystwyth. The bridge could dip and / or swing depending on the adjustment (by simple nuts) of the cables or chains to which they were anchored. With a rudimentary, probably wood slatted gangway, and with simple wire (or cable) guides suspended between the decorative columns at the thresholds to the bridge, a walk across it must have been exhilirating, especially with the Ystwyth cascading beneath it. Assuredly, this must have added to the invigorating delight which the guests of Thomas Johnes must have experienced when visiting Hafod.

7. THE BWLCHWALTER BRIDGE

The Bwlchwalter Bridge is in the Coed Bwlchwalter on the Hafod Estate. It was part of Thomas Johnes' 'Gentlemen's Walk'. Because it was a chain / cable bridge, it was looked at during the course of this investigation for comparative purposes[10]. It is reputed to be of a later date than the Ystwyth Chain Bridge and its detailing supports that.

Like the Chain Bridge, the Bwlchwalter bridge consisted of cables suspended across a guick running water course. In this case a nant which runs northwards from Bryn Mawr to the south and into the River Ystwyth. The span of the bridge was ca. 13.3m and its remains consist, above ground, of two plain cylindrical posts on the east side of the nant and one identical post on the west side. There is also the stub of a post preserved on the west side, and between the posts on both sides of the nant there are single rectangular iron fitments at ground level. The posts and the central iron fitments were the anchor pins for the bridge - there were no guide pins.

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[10] The Bwlchwalter Bridge was only visually inspected with brief written notes compiled. No archaeological drawings or photographs were taken.

7.1 *The Bridge Components*

7.1a The West Side of the Bridge -

A relatively clear path leads to the west threshold of the bridge. Immediately beyond the threshold the ground drops into a now dry part of the bed of the nant. On the north there is a cylindrical column preserved to 1.13m above ground level, 90mm in diameter. The column is hollow and along its top there are threads which extend down more than 30mm. Here, there presumably was a decorative cap screwed into place. At ca. 30mm down from the top of the column, there is an eyelet bolt which passes through it. While at ca. 400mm beneath that, and at ca. 400mm again, there are two further eyelet bolts passing through the column. The shafts are ca. 9mm in diameter and there are square nuts (18mm square by 8mm thick) attached to them on their western ends. The two lower bolts have been bent out of shape but the upper one is almost straight and measures ca. 198mm in length. The outher diameter of its eyelet end is ca. 28mm. On the west side of the column and in line with the eyelet nuts, at ca. 1.08m beneath the top of the feature, there is a large square bolt end ca. 30mm square x 17mm thick. It has been screwed into the shaft of the column. Just beneath the bolt the column has corroded away and this has exposed a solid, cast iron cylindrical pin, which extends into the ground. Presumably, the bolt holds the hollow column onto the solid iron pin, which in all likelihood, has been set into bedrock in the same manner as the pins of the Chain Bridge. Extending eastwards out of the cylindrical pin (by ca. 380mm) there is a substantial tear drop shaped cast iron eyelet rod which passes through it, and is secured on the west side of the column by two bolts just visible along the ground surface.

At 0.92m to the north, center to center, there is clearly visible, the apparently cut off stub of a matching cast iron cylindrical pin, surrounded by the snugly fitting corroded remains of a hollow column. The pin is 78mm in diameter. Extending out to the east (by 445mm) is another tear drop shaped cast iron eyelet rod.

Almost equidistant between the pins is a rectangular fitment, a pin, 46mm thick by 110mm wide, and extending out (by 500mm) to the east from this feature is a third iron eyelet. The heads of the eyelet rods are 100mm wide by more than 100mm in length, and ca. 27mm thick. Internally, the tear drop shaped loops are 40mm wide. The shafts of all of the rods are ca. 32mm.

7.1b The East Side of the Bridge -

Both cylindrical columns are preserved on this side of the bridge, they are 0.93m apart, center to center. They are positioned above a part of the nant through which water still cascades. The columns are identical to the one remaining on the west side of the course of the nant, including the presence of eyelet bolts and their details, and the remains of threads along the top. The northern post is 1.14m high while the southern post is 1.11m high. Almost equidistant between them is the top of a rectangular pin, also identical to the one on the opposide side of the river. There are three substantial cast iron eyelet rods just visible beneath the ground surface, extending west from the columns by ca. 500mm. The northern and southern rods still have attached to them

stirrups and the ends of cables. The ends of the cables are virtually identical to the cable ends preserved at the Chain Bridge, but their looped, forged iron ends are shorter at ca. 265mm in length. What is also striking is that the bolts through the stirrups securing the cable ends, have pins passing through their ends so that they could not fall out. This is different from the ends of the same bolts at the Chain Bridge which appear to have been hammered into broader shapes. The pins consist of a thin flexible metal (ca. 5mm wide) bent along a short strip of iron which passes through the ends of the bolts with their ends slightly bent back on themselves.

7.2 *Summary*

It is clear that the solid cylinders supporting the hollow columns on both sides of the thresholds to the bridge, on both sides of the nant, are anchor pins, along with the central pins which would have been under the very gangway of the bridge. Out of these extended eyelet, or anchor rods, to which the bridge's cabling was attached. There were no guide pins. The cylindrical columns had wires attached to them which served as pedestrian guides along the sides of the ca. 0.9m wide gangway. The columns had some kind of finials screwed on to their tops which have since been removed. There are also in places, the corroded patina of a finish to the columns, perhaps paint.

In purely structural terms, this bridge is similar to the Chain Bridge, but the detailing is quite different - note the shapes of the anchor pins and rods. However, the use of a removable pin in the bolt through the cable stirrups is most striking, and this was probably an improvement to the way in which this type of bridge was put together, supporting the notion that this bridge is, in all probability, later than the Chain Bridge.

8. OBJECTS REGISTER - HAFOD CHAIN BRIDGE EXCAVATION 1998

The following objects were all found in **Context [1]**, the humic deposit of thin turf cover and leaf mould which covered the South Excavation Trench. None have had conservation measures carried out on them. They have been given small finds, 'SF', numbers. They belong to the Hafod Trust.

SF1 Heavily corroded end fragment of bridge suspension cable with iron eyelet end.

Approximately 450mm long x 65mm to 35mm wide x 30mm to 40mm thick. The iron eyelet opening at the end is 25mm x 30mm in diameter.

The cable consists of more than six smaller cables of wound wires ca. 8mm in diameter. The iron eyelet fitment at the very end of the cable is clearly visible on only one side. This is due to less corrosion. The fitment is quite stout. It consists of an iron loop forged as one piece with two narrow plates which sandwich the cable end. The length of the fitment is 260mm. Its details are unclear due to corrosion; eg. the rivets which are known to be part of fitments such as this one - from the excavation of the bridge site - are not clearly visible.
Object not photographed or drawn.

SF2 Iron nail; considerably corroded.

105mm long. The shaft, rectangular in section is ca. 5mm wide by ca. 4mm thick. The head is irregular in shape and angular at ca. 15mm in diameter.
Object not photographed or drawn.

SF3 Iron nail; head considerably corroded.

110mm long. The shaft of the nail is much less corroded than that of SF2. It is more square in section at ca. 5mm x 5mm. The head is heavily corroded with no easily recognisable shape. It is under 20mm in diameter.
Object not photographed or drawn.

SF4 4 Fragment lengths of corroded narrow cabling which could have served as the pedestrian guide wires across the chain bridge.

The shortest length is 115mm, while the longest is 350mm (though bent). The cabling is only 5mm in diameter and each consists of probably 6 wires wound together. Each wire is just over 1mm in diameter.
Objects not photographed or drawn.

9. **PHOTO REGISTER - HAFOD CHAIN BRIDGE EXCAVATION 1998**
S. Garfi - Photographer
NB. All films are 35mm, *and colour films are listed in italics.*

Roll 1, black and white film, Ilford FP4 Plus (125 ASA)

Neg. No.	**Exposure Description**
2	General view of the site on the south side of the river. Looking east.
3 to 5	General view of the site on the south side of the river. Looking west.
6 to 7	Area of south excavation trench after removal of leaf cover. Looking west.
8 to 9	Area of south excavation trench after removal of leaf cover. Looking north.

NB. This roll of film was not fully exposed because it was too slow. This was made worse due to the fact that it was overcast for almost every day of the excavation, and the work took place under dense (dark) tree cover.

Roll 2, *colour slide film, Agfachrome (100 ASA)*

Exp. No.	***Exposure Description***
1 to 3	*General view of the site on the south side of the river. Looking west.*
4 to 5	*Area of south excavation trench after removal of leaf cover. Looking west.*
6 to 7	*Area of south excavation trench after removal of leaf cover. Looking north.*

NB. This roll of film was not fully exposed because it was too slow. This was made worse due to the fact that it was overcast for almost every day of the excavation, and the work took place under dense (dark) tree cover.

Roll 3, black and white film, Ilford HP5 Plus (400 ASA)

Neg. No.	**Exposure Description**
2a to 4a	South excavation trench at the start of digging. Looking north.
5a to 6a	South excavation trench during removal of humus and turf cover (context [1]) down to context [2]. Looking west.

7a to
8a South excavation trench after removal of humus and turf cover (context [1]) down to context[2]. Looking north.

9a to
11a South excavation trench with context [3], clay dumps exposed. Looking north.

12a to
14a South excavation trench with context [3], clay dumps exposed. Looking northeast.

15a to
16a General view of the site on the north side of the river. Looking east.

17a to
18a View of the site of the north excavation trench, looking south, with digging in progress on the south side of the river.

19a to
20a North excavation trench with humic layer of turf and moss (context [4]) removed and with bedrock and bridge fitments exposed. Also visible is the cut in the bedrock delineating the path to the bridge. Looking east.

21a to
22a North excavation trench with humic layer of turf and moss (context [4]) removed and with bedrock and bridge fitments exposed. Looking south.

23a to
24a North excavation trench. View of anchor pins and anchor rods. Note the cuts in the bedrock to accommodate the pin heads. Looking south.

25a to
26a North excavation trench. View to the south side of bridge through the bridge threshold columns (supported by guide pins and with a central guide pin between them).

27a to
28a North excavation trench. View of the anchor pins, anchor rods and bolts, cable stirrups, corroded ends of cables which supported the bridge gangway, and the guide pins and columns. Also the cuts in the bedrock to accommodate the anchor pin heads and rods. Looking west.

29a to
34a North excavation trench. Base, with iron wedges, of the north most narrow post which outlined the path to the bridge. Looking north. (Scale: post is 50mm in diameter.)

35a to
36a The gorge of the River Ystwyth, looking east from the north side.

Roll 4, *colour slide film, Fujichrome (400 ASA)*

Exp. No.	***Exposure Description***
1 to 2	*South excavation trench at the start of digging. Looking north.*
3 to 4	*South excavation trench during removal of humus and turf cover (context [1]) down to context [2]. Looking west.*
5 to 6	*South excavation trench after removal of humus and turf cover (context [1]) down to context[2]. Looking north.*
7 to 9	*South excavation trench with context [3], clay dumps exposed. Looking north.*
10 to 12	*South excavation trench with context [3], clay dumps exposed. Looking northeast.*
13 to 14	*General view of the site on the north side of the river. Looking east.*
15 to 16	*View of the site of the north excavation trench, looking south, with digging in progress on the south side of the river.*
17	*North excavation trench during excavation. Looking east.*
18 to 19	*North excavation trench with humic layer of turf and moss (context [4]) removed and with bedrock and bridge fitments exposed. Looking south.*
20 to 21	*North excavation trench. View of anchor pins and anchor rods. Note the cuts in the bedrock to accommodate the pin heads. Looking south.*
22 to 23	*North excavation trench. View of the anchor pins, anchor rods and bolts, cable stirrups, corroded ends of cables which supported the bridge gangway, and the guide pins and columns. Also the cuts in the bedrock to accommodate the anchor pin heads and rods. Looking west.*
24 to 25	*North excavation trench. View to the south side of bridge through the bridge threshold columns (supported by guide pins and with a central guide pin between them).*
26 to 29	*North excavation trench. Base, with iron wedges, of the north most narrow post which outlined the path to the bridge. Looking north. (Scale: post is 50mm in diameter.)*

30 *South excavation trench being dug. Looking south across the river gorge.*

31 *The gorge of the River Ystwyth, looking east from the north side.*

Roll 5, black and white film, Ilford HP5 Plus (400 ASA)

Neg. No.	Exposure Description
1 to 2	North excavation trench. Medium close up of anchor pins and rods. Looking east. (Scale: side of anchor pins is 80mm.)
3 to 4	North excavation trench. Close up of west most anchor pin. Note the relatively large cut in the bedrock - a probable mistake when the pins were inserted; also, the nuts and the threads in the anchor rod. Looking east. (Scale: side of anchor pin is 80mm)
5 to 6	North excavation trench. Medium close up of corroded end fragments of cables attached to anchor rods by stirrups. Looking east. (Scale: base of column is 210mm square.)
7 to 8	North excavation trench. Plan view of east most anchor pin, anchor rod, and stirrup and cable end. Note the cut in the bedrock to accommodate the iron fitments. (Scale: pin head is 100 x 80mm.)
9 to 10	North excavation trench. Medium close up of iron stirrup and cable end in line with the central guide pin. Looking south. (Scale: the guide pin is 100mm wide.)
11 to 12	North excavation trench. Close up of western guide pin supporting column. Note corrosion and the lead filling the hole in which the pin is located. Looking north. (Scale: the guide pin is 100mm wide.)
13 to 14	North excavation trench. Close up of central guide pin in its hole cut into the bedrock. Looking north. (Scale: the stem of the pin is 80mm square.)
15 to 16	North excavation trench. Close up of eastern guide pin in its hole cut into the bedrock and filled with lead. Note the corrosion. (Scale: the stem of the pin is 80mm square.)
17 to 18	South excavation trench. Context [3] has been removed and all of the iron fitments (pins and associated rods) are visible, being set into the bedrock. Looking west.
19 to 21	South excavation trench. Context [3] has been removed and all of the iron fitments (pins and associated rods and the threshold columns) are visible. Looking north.

22 to
23 South excavation trench. Medium close up of iron anchor pins, anchor rods and guide pins. Note that the central pin is different from the other two. (Scale: the base of the column is 210mm square.)

24 to
25 South excavation trench. Medium close up of guide pins including the threshold columns. Note that the eastern, visible anchor rod is still linked to a stirrup and cable fragment which is lodged in the hole of the guide pin supporting the eastern column; also, the lead filling the holes in which the pins are placed is visible. Looking north. (Scale: the central guide pin is 100 x 80mm).

26 to
27 South excavation trench. Medium close up of the anchor pins with one of the anchor rods and its bolts visible. Note the holes filled with lead for the pins. Looking east. (Scale: the head of the pin is 100 x 80mm.)

28 to
29 South excavation trench. Medium close up of guidepins set in their lead filled holes in the bedrock. Note the serrations on the stems of the pins. Looking east. (Scale: the pin stems are 80mm square.)

30 to
31 South excavation trench. Close up of cable fragment with its stirrup attached to the eastern anchor rod. Looking east. (Scale: the column base is 210mm square.)

32 to
33 South excavation trench. Close up of the central anchor rod which is probably a replacement. Note the visible threads. Looking east. (Scale: the rod is ca. 0.45m long.)

34 to
35 South excavation trench. Close up of the western column top. Note that the mould line and that the plate which is integral with the ball is broken - possibly the result of an attempt at removing the plate and ball, perhaps to dismantle the column. Looking north. (Scale: the top plate of the column is 200mm square.)

36 South excavation trench. Medium close up of the western column base and the central guide pin. Looking north. (Scale: the base of the column is 210mm square.)

Roll 6, *colour slide film, Fujichrome (400 ASA)*

Exp. No. ***Exposure Description***

1 to 2 North excavation trench. Medium close up of anchor pins and rods, looking east. (Scale: side of anchor pins is 80mm.)

3 to 4 *North excavation trench. Close up of west most anchor pin. Note the relatively large cut in the bedrock - a probable mistake when the pins were inserted; also, the nuts and the threads in the anchor rod. Looking east. (Scale: side of anchor pin is 80mm)*

5 to 6 *North excavation trench. Medium close up of corroded end fragments of cables attached to anchor rods by stirrups. Looking east. (Scale: base of column is 210mm square.)*

7 to 8 *North excavation trench. Plan view of east most anchor pin, anchor rod, and stirrup and cable end. Note the cut in the bedrock to accommodate the iron fitments. (Scale: pin head is 100 x 80mm.)*

9 to 10 *North excavation trench. Medium close up of iron stirrup and cable end in line with the central guide pin. Looking south. (Scale: the guide pin is 100mm wide.)*

11 to 12 *North excavation trench. Close up of western guide pin supporting column. Note corrosion and the lead filling the hole in which the pin is located. Looking north. (Scale: the guide pin is 100mm wide.)*

13 to 14 *North excavation trench. Close up of central guide pin in its hole cut into the bedrock. Looking north. (Scale: the stem of the pin is 80mm square.)*

15 to 16 *North excavation trench. Close up of eastern guide pin in its hole cut into the bedrock and filled with lead. Note the corrosion. (Scale: the stem of the pin is 80mm square.)*

17 to 18 *South excavation trench. Context [3] has been removed and all of the iron fitments (pins and associated rods) are visible, being set into the bedrock. Looking west.*

19 to 20 *South excavation trench. Context [3] has been removed and all of the iron fitments (pins and associated rods and the threshold columns) are visible. Looking north.*

21 to 22 *South excavation trench. Medium close up of iron anchor pins, anchor rods and guide pins. Note that the central pin is different from the other two. (Scale: the base of the column is 210mm square.)*

23 to 24 *South excavation trench. Medium close up of guide pins including the threshold columns. Note that the eastern, visible anchor rod is still linked to a stirrup and cable fragment which is lodged in the hole of the guide pin supporting the eastern column; also, the lead filling the holes in which the pins are placed is visible. Looking north. (Scale: the central guide pin is 100 x 80mm).*

25 to
26 *South excavation trench. Medium close up of the anchor pins with one of the anchor rods and its bolts visible. Note the holes filled with lead for the pins. Looking east. (Scale: the head of the pin is 100 x 80mm.)*

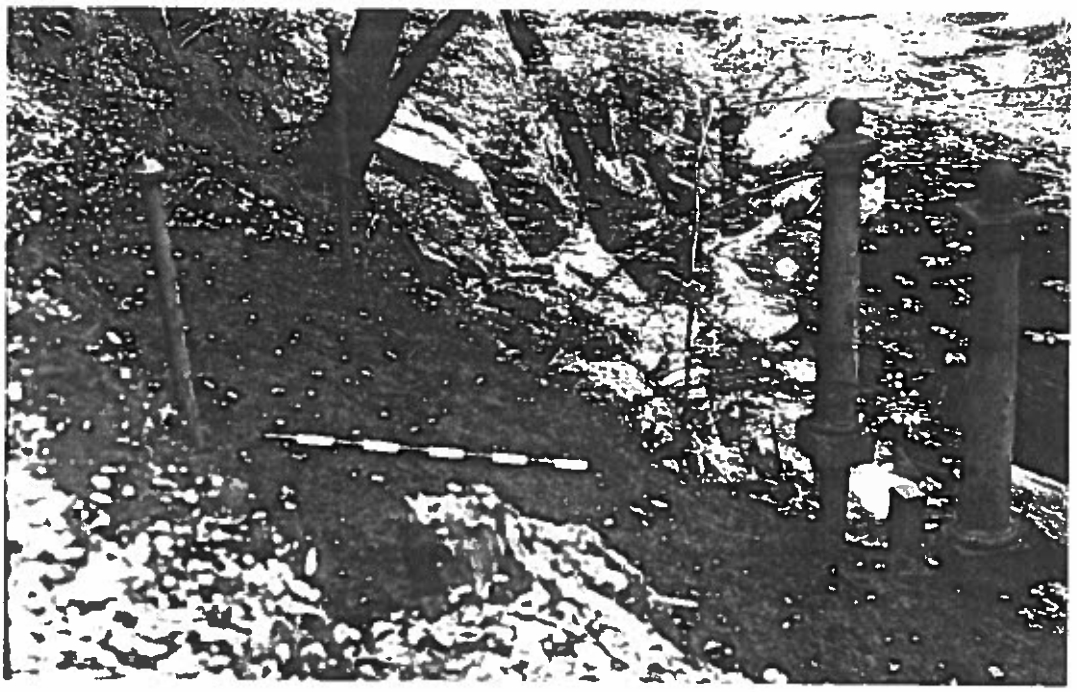
27 to
28 *South excavation trench. Medium close up of guidepins set in their lead filled holes in the bedrock. Note the serrations on the stems of the pins. Looking east. (Scale: the pin stems are 80mm square.)*

29 to
30 *South excavation trench. Close up of cable fragment with its stirrup attached to the eastern anchor rod. Looking east. (Scale: the column base is 210mm square.)*

31 to
32 *South excavation trench. Close up of the central anchor rod which is probably a replacement. Note the visible threads. Looking east. (Scale: the rod is ca. 0.45m long.)*

33 to
34 *South excavation trench. Medium close up of the western column base and the central guide pin. Looking north. (Scale: the base of the column is 210mm square.)*

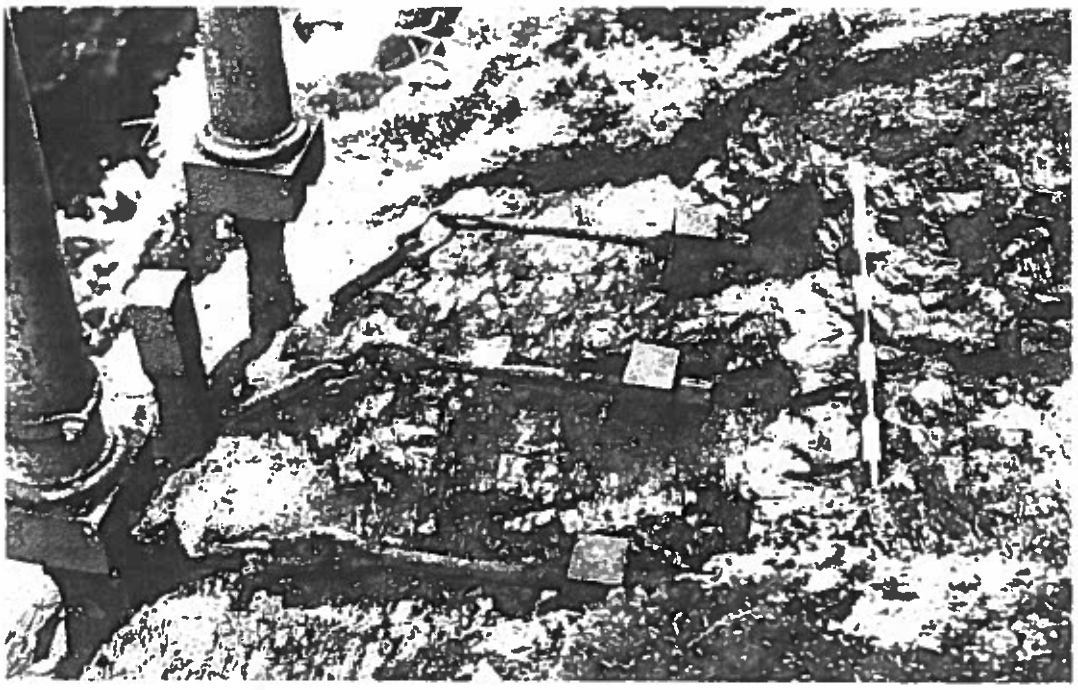
35 to
36 *View of north excavation trench from the south side of the river.*



1/7 Area of south excavation trench after removal of leaf cover, looking west.

3/9a South excavation trench with the clay dumps of context [3] exposed, looking north.

3/20a North excavation trench with humic layer of turf and moss (context [4]) removed, and with bedrock and bridge fitments exposed. Also visible is the cut in the bedrock delineating the path to the bridge. Looking east.



3/28a North excavation trench. View of the anchor pins, anchor rods and bolts, cable stirrups, corroded ends of cables which supported the bridge gangway, and the guide pins and columns. Also cuts in the bedrock to accommodate the anchor pin heads and rods. Looking west.

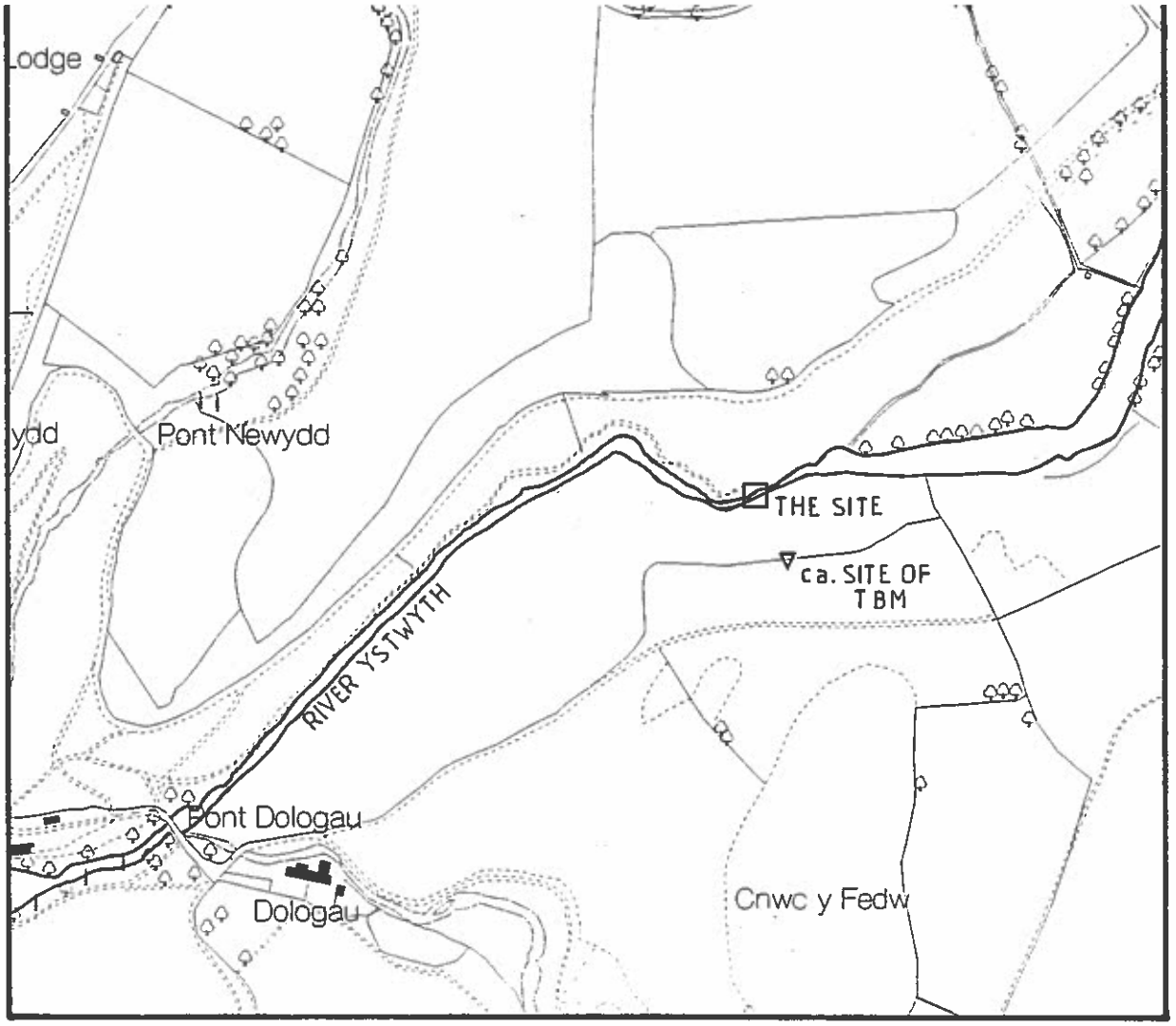
10. **DRAWING REGISTER - HAFOD CHAIN BRIDGE EXCAVATION 1998**

Drawings prepared by S. Garfi

Drg. No.	*Scale and Title/Description*
1	1/5000 - Site location plan of Hafod Chain Bridge Excavation 1998 (A4)
2	1/50 - Hafod Chain Bridge 1998 site plan; showing features and contours prior to excavation (A1)
3	1/50 - Hafod Chain Bridge 1998 site profile (A2)
4	1/20 - Plan of North Excavation Trench showing bedrock, cut for path to bridge, and anchor and guide pins (A3)
5	1/20 - Plan of North Excavation Trench showing all iron fitments for bridge (A3)
6	1/20 - Plan of South Excavation Trench showing bedrock, anchor and guide pins (A3)
7	1/20 - Plan of South Excavation Trench Showing all iron bridge fitments and context [3] (A3)
8	1/20 - Plan of South Excavation Trench showing remains of path (context [2]) to bridge (A3)
9	1/10 - Section D - D, along the west edge of the South Excavation Trench (A3) *See drg. 7 for the location of this section*
10	1/5 - Elevations E - E and F - F, showing the iron guide pins and columns in the North Excavation Trench (A3) *See drg. 5 for the location of these elevations* NB. Dimensions shown on drawings 10 to 12 are in millimetres
11	1/5 - Elevation A - A, the iron fitments along the east side of the South Excavation Trench (A3) *See drg. 7 for the location of this elevation*
12	1/5 - Elevation B - B, South Excavation Trench, showing elevation of post; Elevation G - G, North Excavation Trench, showing iron anchor and guide pins, and cable fragment with anchor rod *See drg. 7 for the location of elevation B - B* *See drg. 5 for the location of elevation G - G*

Additional:

There are 3 further drawings provided by Landmark Surveys (in hard copy and on disk) they are;



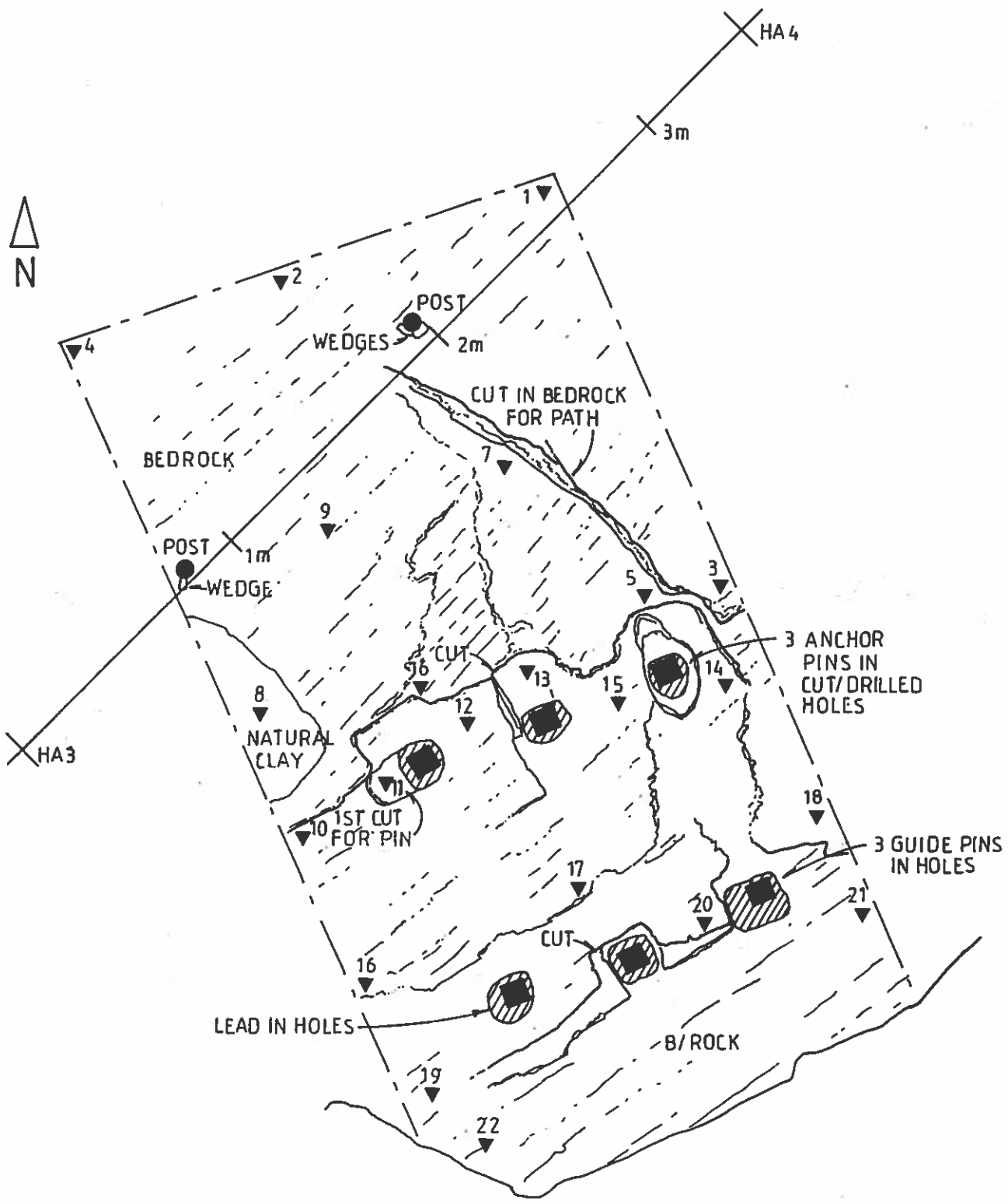
Drg. 1

Site Location Plan of Hafod Chain Bridge Excavation 1998
Scale: 1/5000
(from 1st ed. of O.S. map, 1/2500 scale)

TBM:116.52m

drg 4 Levels Shown ▼

1: 99.51
2: 99.39
3: 99.45
4: 99.30
5: 99.17
6: 99.11
7: 99.28
8: 99.12
9: 99.27
10: 98.85
11: 98.87
12: 99.01
13: 98.99
14: 99.02
15: 98.98
16: 98.76
17: 98.91
18: 98.94
19: 98.52
20: 98.77
21: 98.65
22: 98.40



Hafod Chain Bridge 1998
Plan of North Excavation Trench
Showing Bedrock, Path and Anchor and Guide Pins
scale: 1/20 Drg. 4

Drg. 4

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996 998 1000

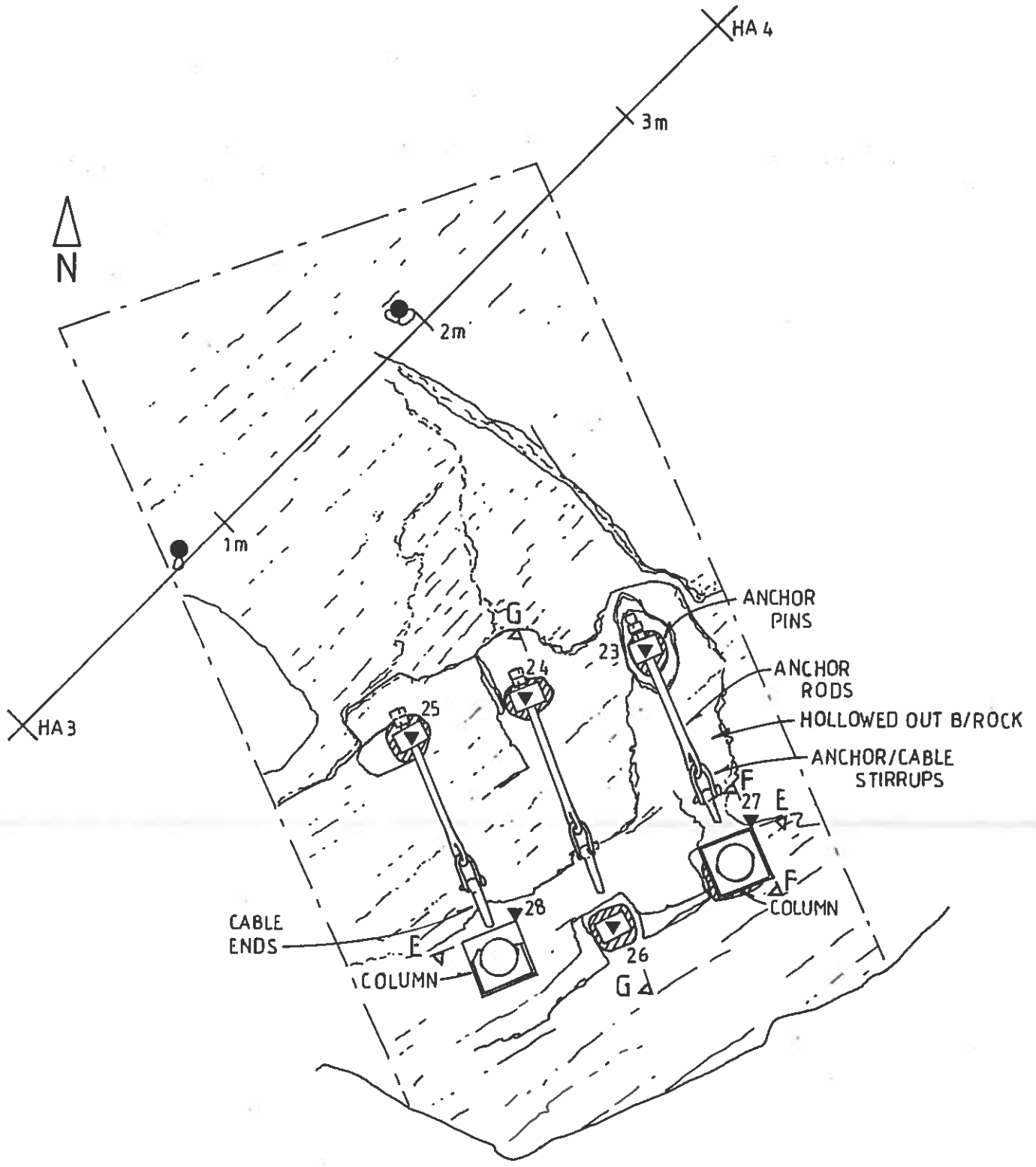
drg 5 Levels
Shown ▼

23: 99.06
24: 99.08
25: 99.07
26: 99.06
27: 99.10
28: 99.10

1014

1012

1010



0 m 1m 2m

Hafod Chain Bridge 1998
Plan of North Excavation Trench
Showing All Iron Fitments for Bridge
scale: 1/20 Drg.5

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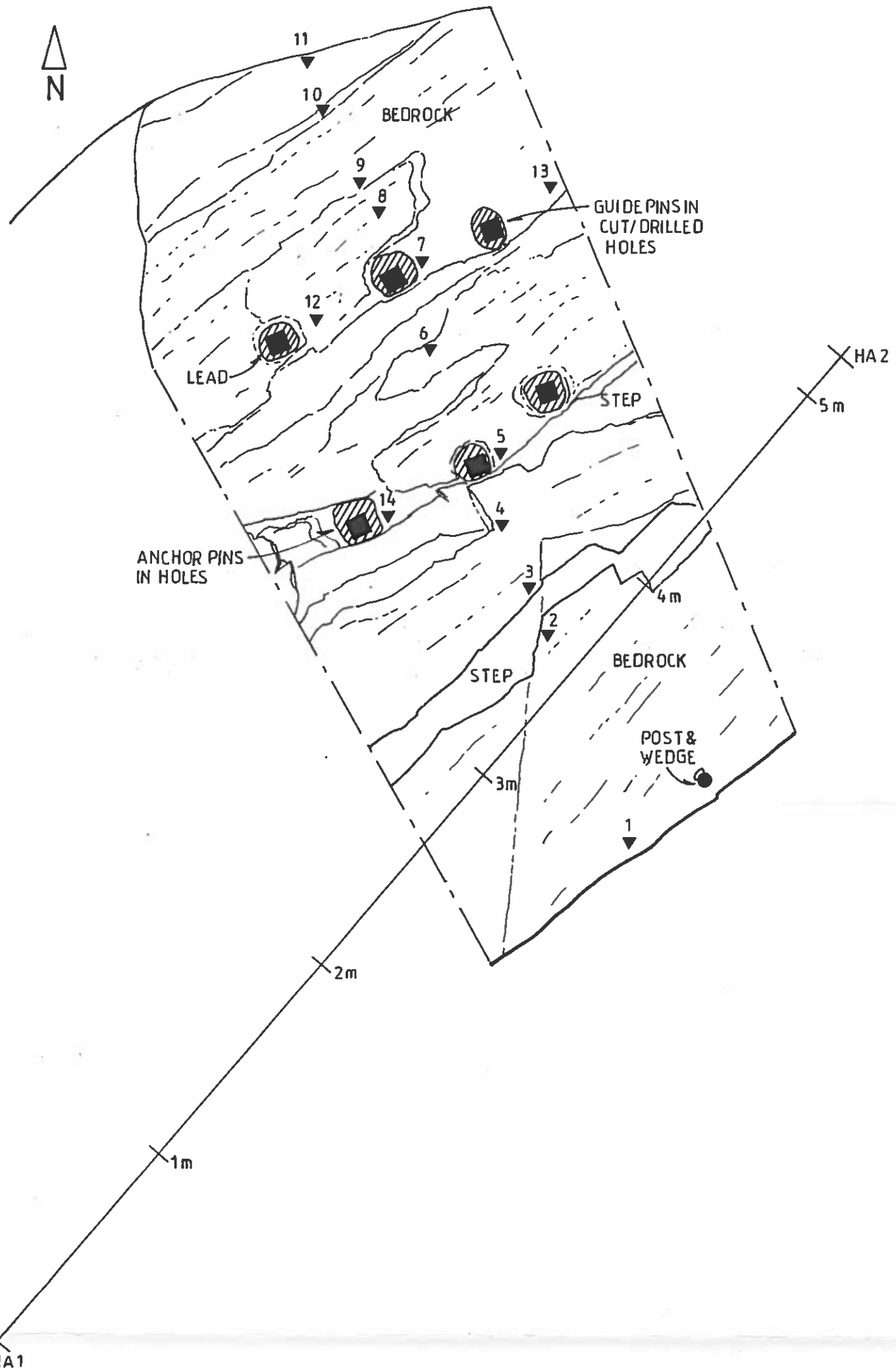
Drg. 5

996 998 1000

drg 6 Levels Shown ▼

1: 99.23
2: 99.14
3: 98.83
4: 98.82
5: 98.61
6: 98.57
7: 98.36
8: 98.40
9: 98.31
10: 98.16
11: 97.81
12: 98.40
13: 98.37
14: 98.47



Hafod Chain Bridge 1998
Plan of South Excavation Trench
Showing Bedrock, Anchor and Guide Pins
scale: 1/20 Drg.6

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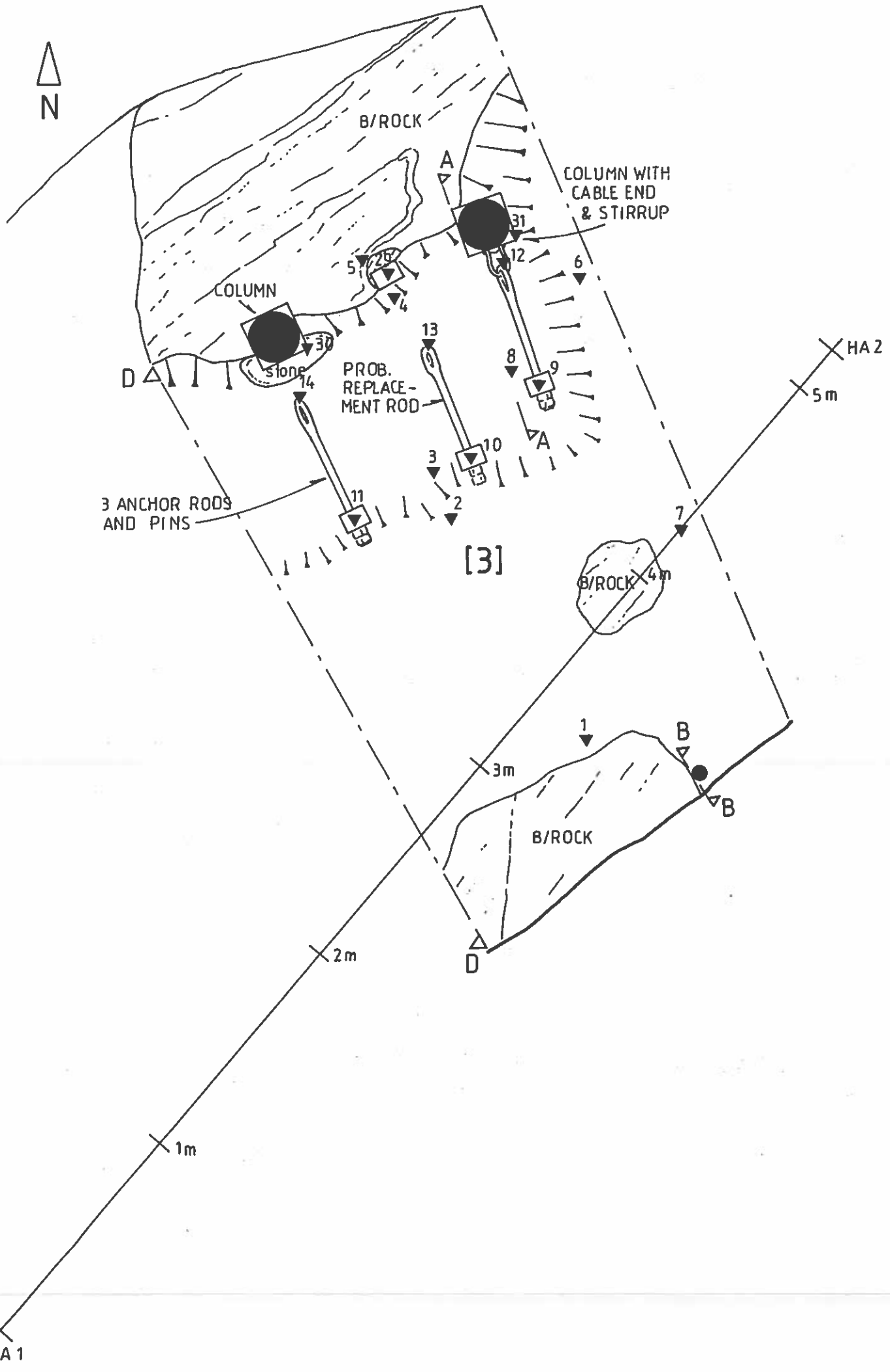
Drg. 6

drg 7 Levels Shown ▼

1: 99.22
2: 99.11
3: 98.92
4: 98.68
5: 98.42
6: 99.03
7: 99.25
8: 98.83
9: 99.10
10: 99.04
11: 99.02
12: 99.00
13: 98.99
14: 98.92
29: 99.05
30: 99.09
31: 99.09



Hafod Chain Bridge 1998
Plan of South Excavation Trench
Showing Bridge Fitments and Context [3]
scale: 1/20 Drg.7

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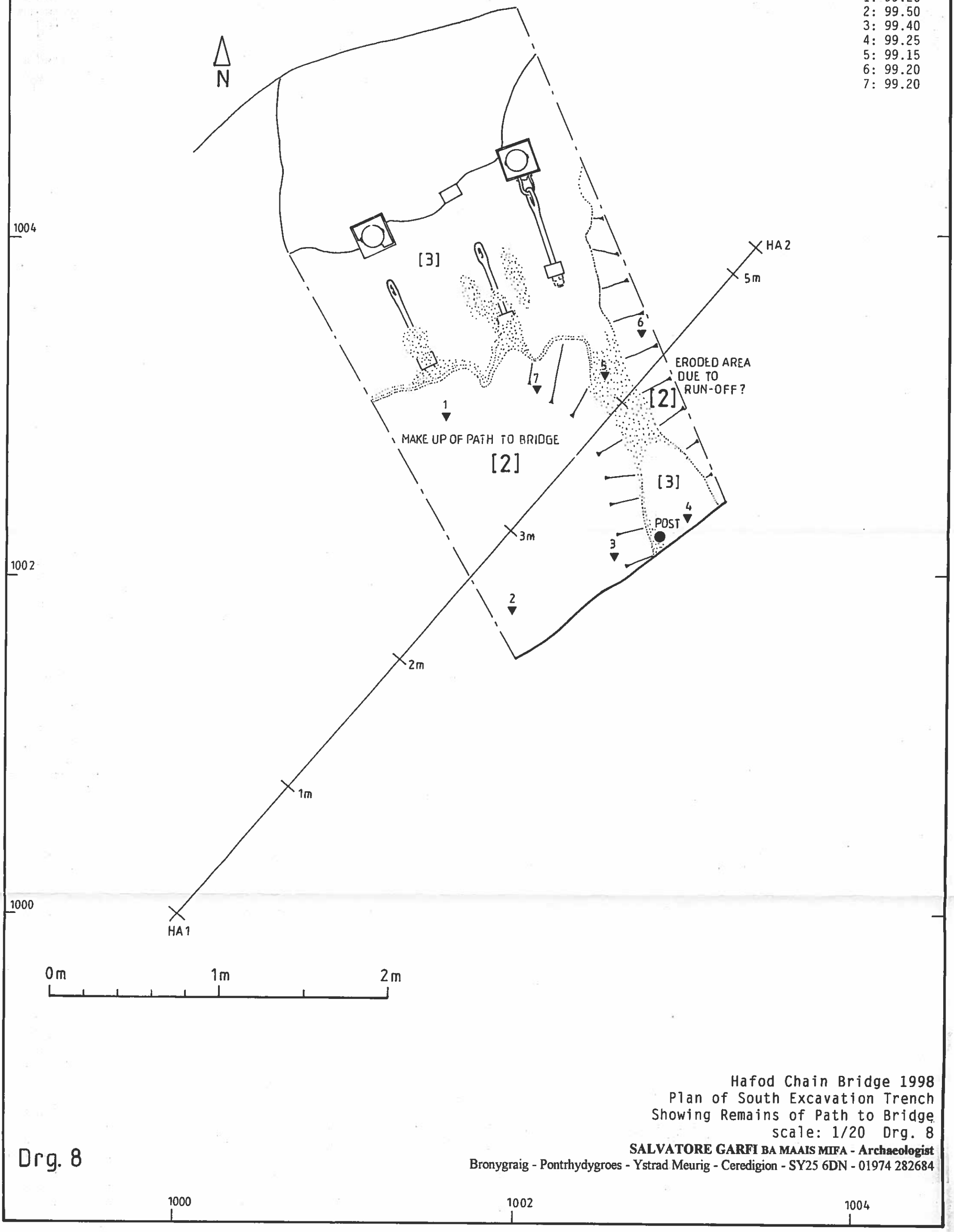
Drg. 7

drg 8 Levels Shown ▼

1: 99.20
2: 99.50
3: 99.40
4: 99.25
5: 99.15
6: 99.20
7: 99.20



Hafod Chain Bridge 1998
Plan of South Excavation Trench
Showing Remains of Path to Bridge
scale: 1/20 Drg. 8

Drg. 8

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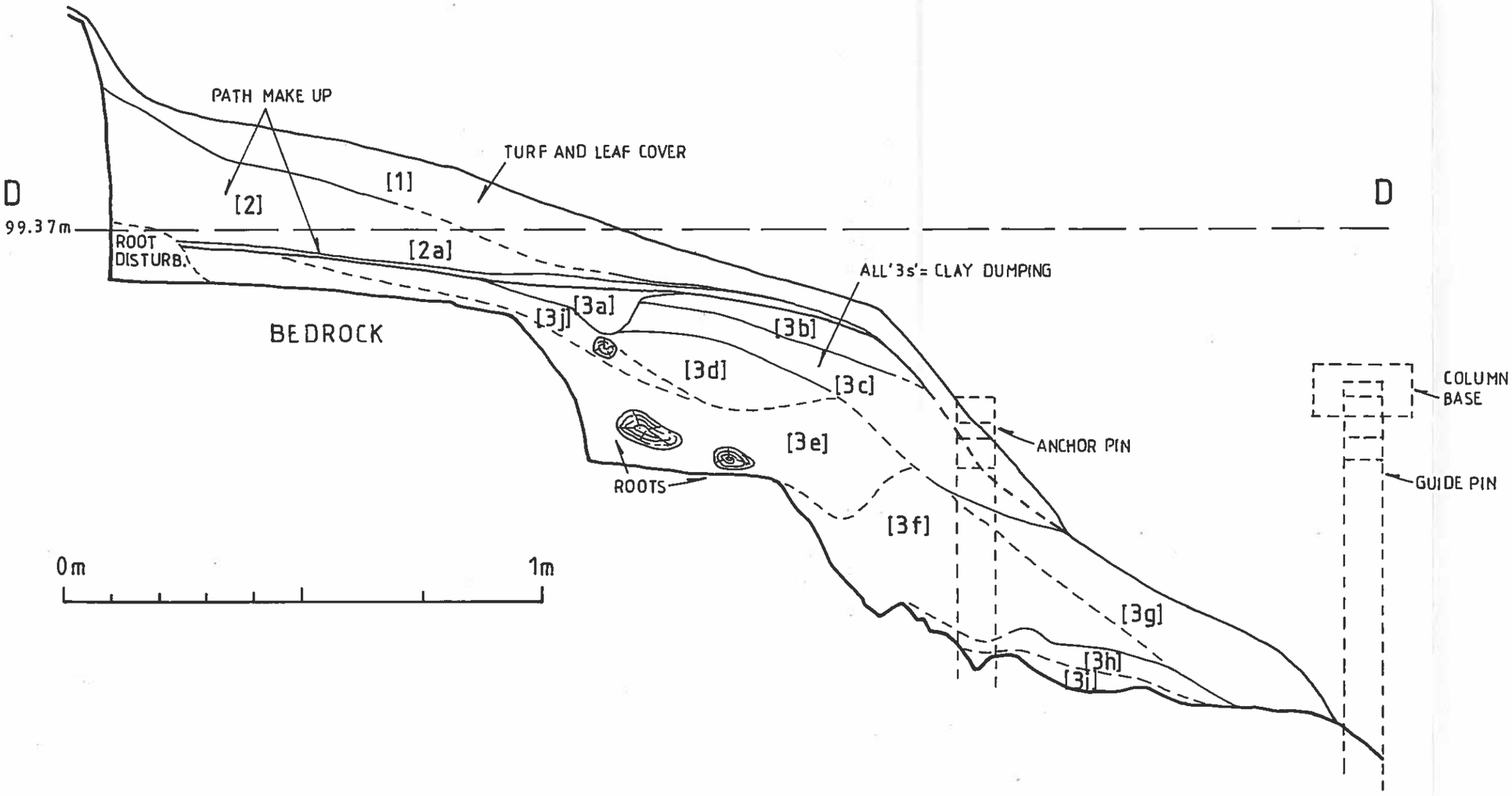
SOUTH

NORTH



Hafod Chain Bridge 1998
Section D - D
Along West Edge of South Excavation Trench
scale: 1/10 Drg. 9

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Drg. 9

F-F

HINGE

118

45

30

18

343

41

HINGE

15

155

122

25

E
(EAST)

F-F

CORROSION

BEDROCK

LEAD

0m

0,5m

SWIVEL
EYELET

F

F

80

100

99.05m

c. 90x 50

160

350

250

LEAD

200 sq

186 sq

120 dia

152

1010

EYELET
STUB

158 dia

99.09m

210 sq

110

89

E
(WEST)

80x 80

LEAD

Hafod Chain Bridge 1998
Elevations E - E and F - F
Iron Guide Pins and Columns in North Excavation Trench
scale: 1/5 Drg. 10

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Drg. 10

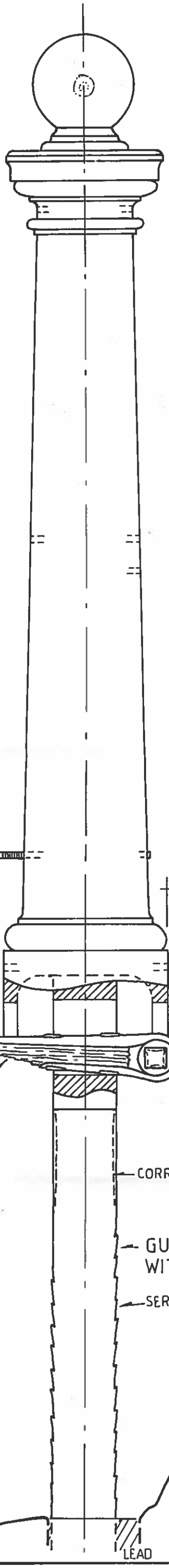
Contractors must check dimensions on site

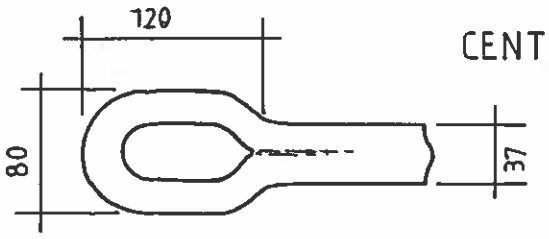
NORTH

0m 0.5m

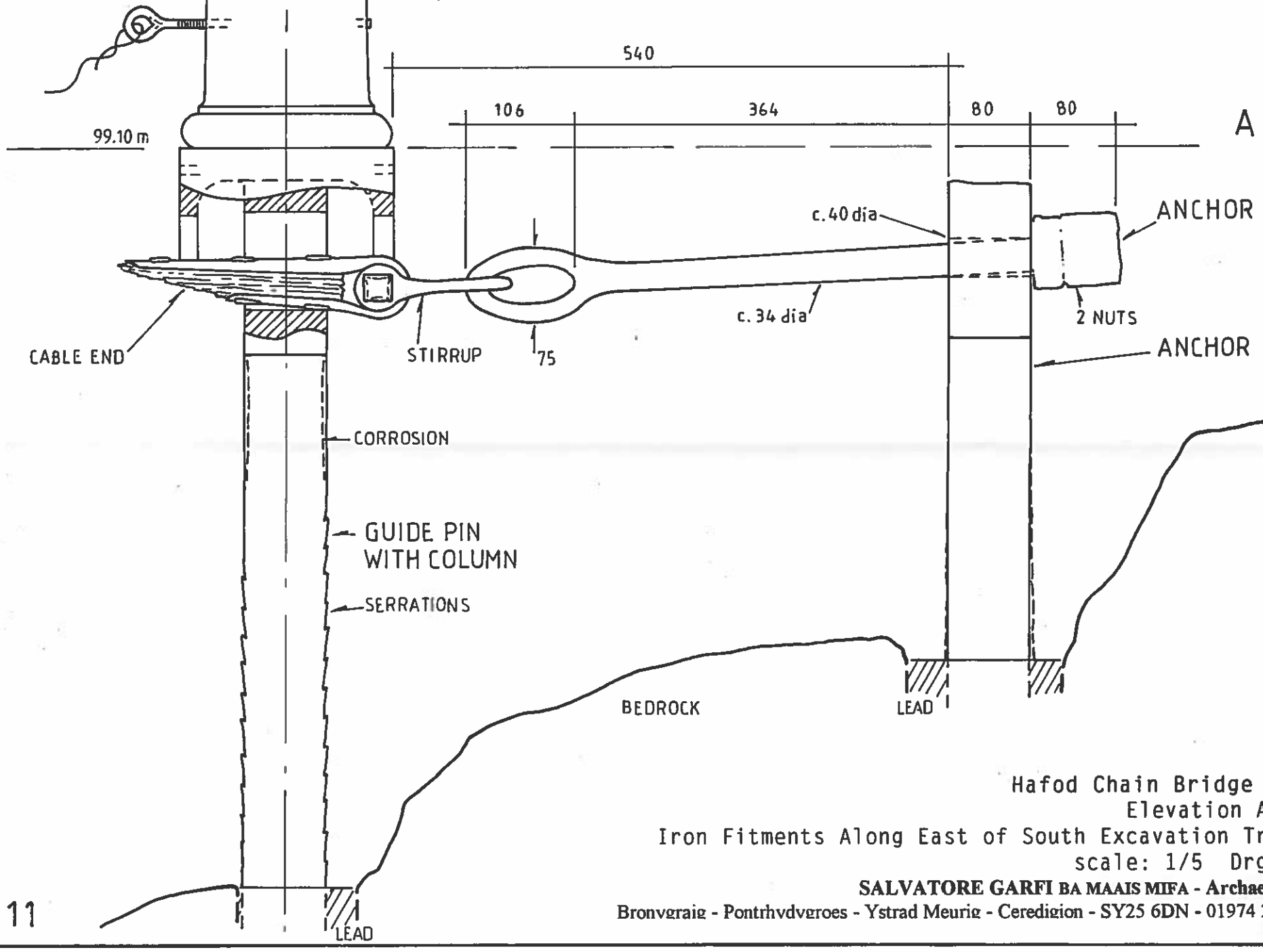
SOUTH

Contractors must check dimensions on site





CENTRAL ANCHOR ROD



Hafod Chain Bridge 1998
Elevation A - A
Iron Fitments Along East of South Excavation Trench
scale: 1/5 Drg. 11

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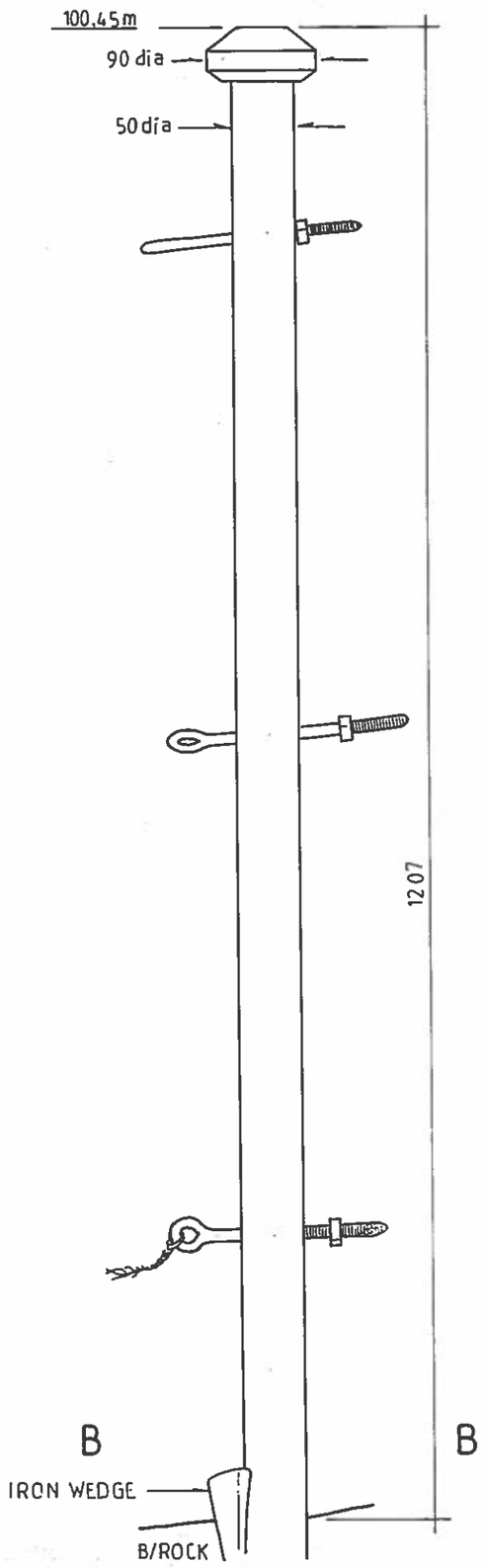
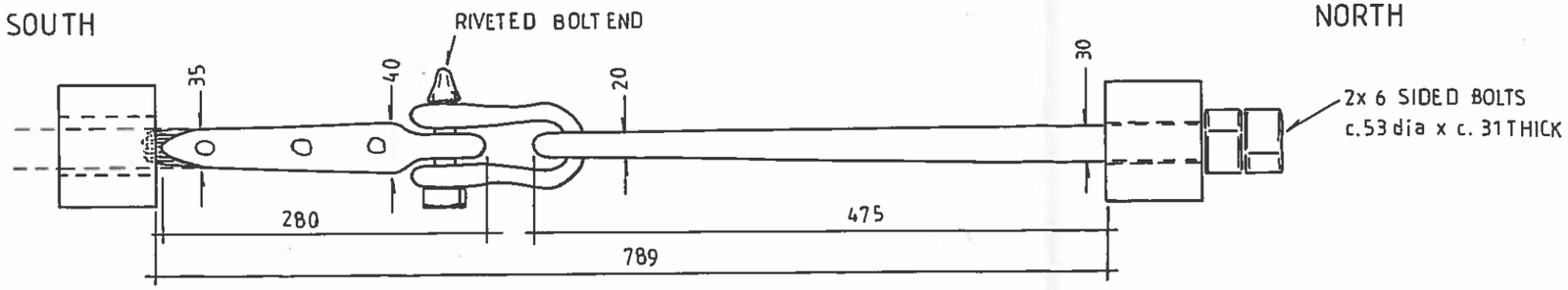
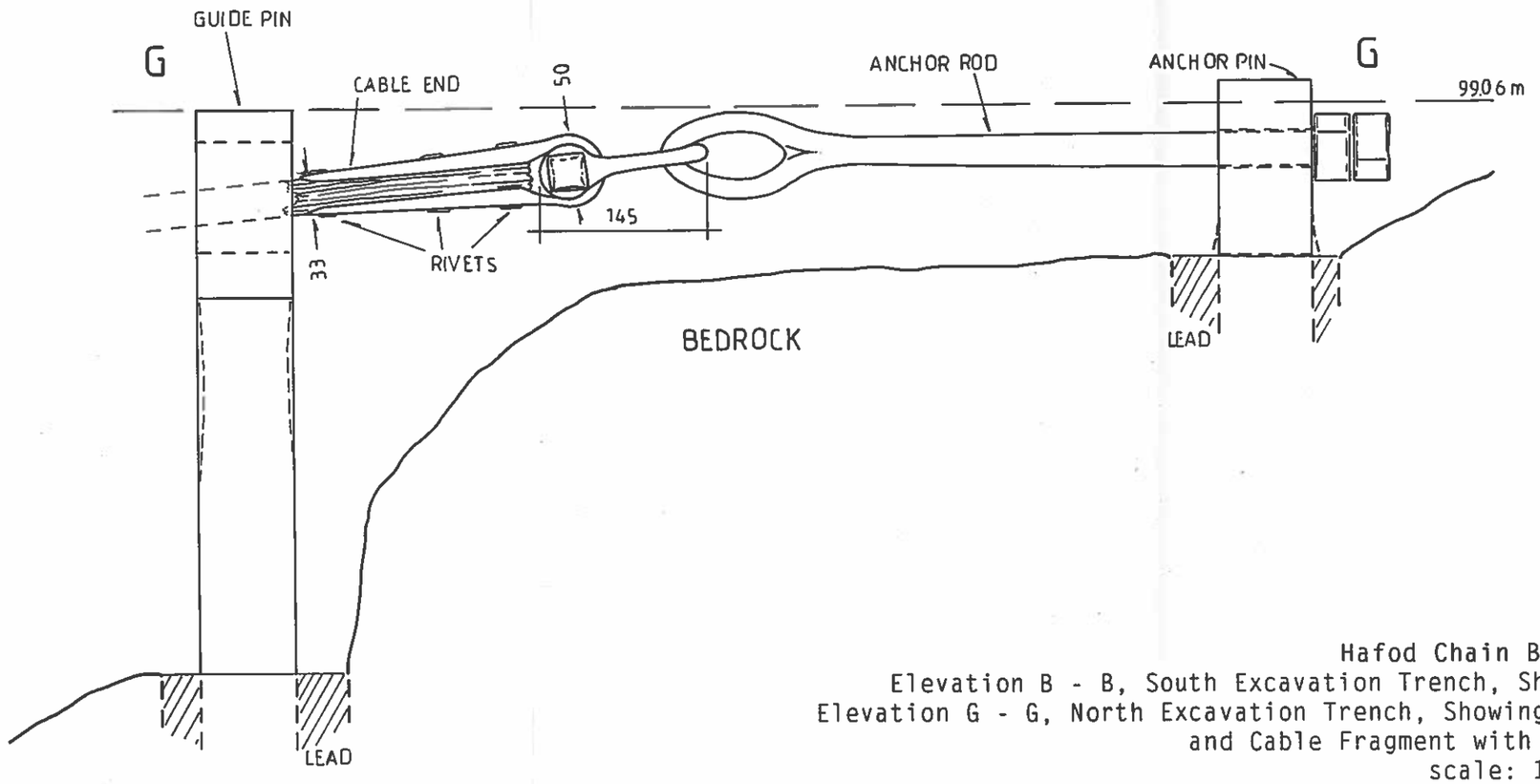
Drg.11







Hafod Chain Bridge 1998
Elevation B - B, South Excavation Trench, Showing Post
Elevation G - G, North Excavation Trench, Showing Iron Pins
and Cable Fragment with Anchor Rod
scale: 1/5 Drg.12

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Drg. 12