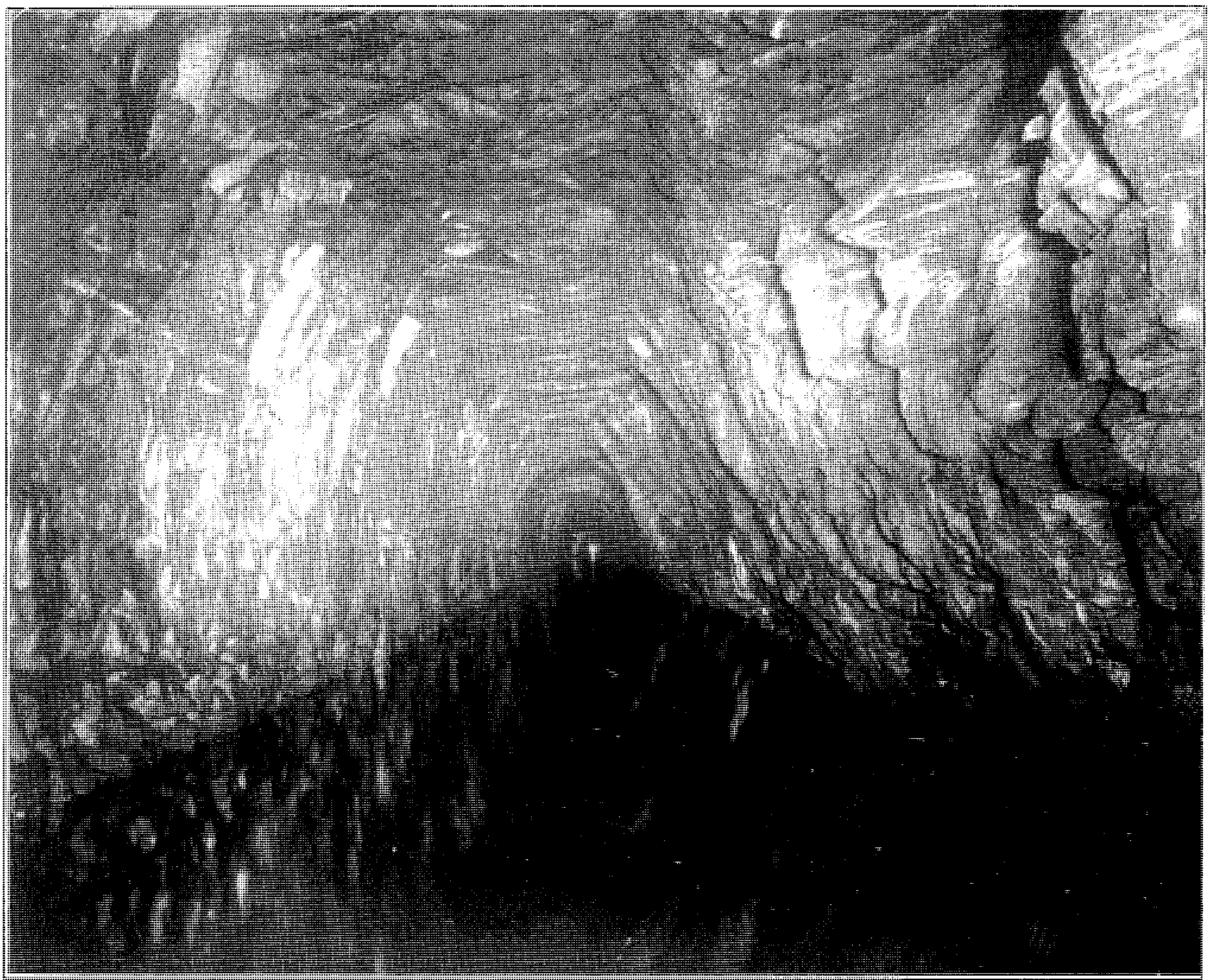
HUDDERSFIELD CANAL SOCIETY

PENNINE LINK

No. 91 March/April 1990



TUNNEL SURVEY SPECIAL

Free to Members

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H.C.S. Ltd.,
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Standedge Tunnel Condition Study
Joint Funding Agencies

British Waterways Board

Huddersfield Canal Society

Kirklees Metropolitan Council

Mersey Basin Campaign

Oldham Metropolitan Borough

Sports Council

Tameside Metropolitan Borough

EDITORIAL 91

HCS Date 189.3 The 20-year mission of the HCS narrowboat 'THROUGH NAVIGATION' to traverse the endless space of bureaucracy to bring about full restoration of our trans-Pennine waterway. In command now is Captain David Sumner, having taken over the ship after the pioneering launch and early missions of the 'People of Vision'.

The ultimate journey over 74 vertical time warps and through two black holes with hyper space between is now over half complete. Of the alien beings encountered by the frequent landing parties to the surface of the planet, most have been convinced of the peaceful nature of the mission, and the intended benefits to mankind. Various brotherhood leaders have consulted their high priests with a view to funding construction fleets and teams of technicians to overcome major space leap barriers.

The major black hole, over three miles long, and connecting two galaxies that were once engaged in bitter conflict, has now been traversed by explorers with a view to re-opening it as a space jump route. The problem now is how to get sufficient funds beamed down from the planet 'Bank Vaults' to complete the project.

Apologies to Captain Kirk for that bit of mickey-taking, but I am sure most readers are aware that the Standedge Tunnel Survey is published, and things are not as black as 'black hole' implies. The survey report is several volumes of words, drawings and pictures, and I have tried to condense it to show the extent of the investigations without too much boring detail, but retaining the general flavour and showing examples of how each aspect was tackled. This issue is of the large A4 size because if it was in A5 as normal it would be too thick. Back to A5 for the next issue.

All measurements associated with the survey are metric. My personal view of this is one of disapproval. The tunnel was built using yards, feet and inches, and I think historic measurement should be retained for this historic monument. (It would be nice to have historic labour costs for repairs too.) Generally I am against a metric system based on the inflexible number ten, when the number twelve would be far better. However, that is a mathematical debate impertinent to these pages, so I will drop the subject.

I hope you find this issue interesting and informative.

ALWYN OGBORN

RESTORATION UP-DATE

KIRKLEES AREA

30 out of a total of 42 locks have been excavated, with 29 being totally rebuilt and approximately 7km of canal dredged to navigable standards.

1. Tunnel End to Slaithwaite north, Locks 42-25 totally restored and operational.
2. Slaithwaite south to Golcar, Locks 20-13 excavated and rebuilt, 20-17 are operational and the canal navigable.
3. Milnsbridge, Locks 11-9 excavated and rebuilt.
4. Huddersfield, Lock 1 excavated and rebuilt, gates fitted but no hydraulic gearing.
5. Locks 21, 22, 23 are part of the Slaithwaite restoration programme, and it is proposed that a slipway be installed at Lock 24 early in 1990. This will allow trailer boats access to the canal.

The remaining locks and pounds are on schedule to be completed by April 1991, less three major blockages at Slaithwaite Town Centre, Sellers Engineering Ltd. and Bates & Co. in Huddersfield. These obstructions will be resolved in subsequent years.

OLDHAM & TAMESIDE AREA

15 out of a total of 32 locks have been excavated, 12 being totally rebuilt and approximately 4.5km of canal dredged to navigable standards. The canal is now connected to the National Waterways Network at Dukinfield Junction (Portland Basin, Ashton-under-Lyne), albeit the first half mile section.

1. Portland Basin to Stanley Square, Stalybridge, Locks 1-3 fully operational and opened to navigation.
2. Millbrook to Scout Tunnel, Locks 9-11 operational and the canal dredged and navigable.
3. Scout Tunnel surveyed and awaiting B.W. mining engineers report.
4. Roaches - Mossley, Lock 15 excavated and rebuilt. Gates arrive in January 1990.
5. Greenfield, Lock 18, chamber excavated with a new by-wash under construction.
6. Locks 19-20 excavated. Gates for Lock 19 arrive in December 1989.
7. Uppermill, Locks 22-23 fully operational and open to navigation. (Passenger boat "Pennine Moonraker" operates on this section of canal).
8. Diggle, Locks 31-32 are being restored by the Society's volunteers. Both have been excavated with 31 rebuilt and head gate fitted.

There are several major blockages in the Oldham & Tameside area that are outside the present restoration sphere of operations. Four road bridges in Uppermill/Greenfield, Lock 12 Mossley (land slippage), Scout Tunnel, Hartshead infill (former C.E.G.B. usage), Stalybridge River Route, and finally, Staly Wharf Marina.

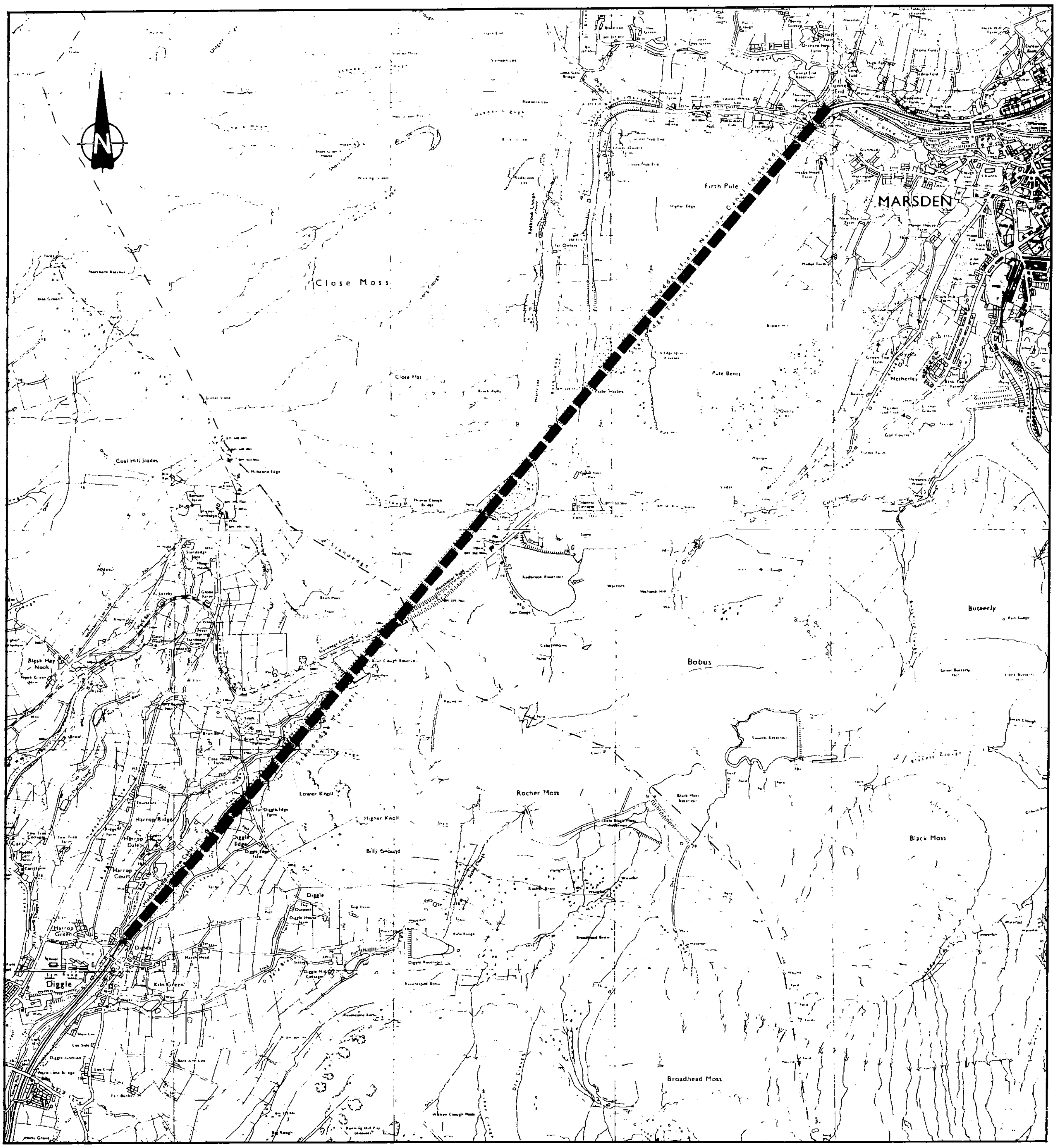
WORK FORCE

Restoration work in the Kirklees area is still being maintained by Kirklees M.B.C. with a supplement of Employment Training Operatives.

In the Oldham and Tameside Area the Society's subsidiary company, HCS Restoration Ltd., continues with the work utilising E.T. operatives and full-time staff.

Confidence is high!

STANDEDGE TUNNEL – LOCATION PLAN.



STANDEDGE TUNNEL

The Tunnel Survey report is a very large document, eleven volumes of various shapes and sizes. Every aspect of history, construction and subsequent deterioration has been examined and reported on, along with the options for its future. The extensive pages of words are backed up by many drawings of the tunnel profile, linear sections, adit details, and ventilation shafts. Geological strata information and photographs complete the report.

I have selected examples of each aspect (except strata), plus some samples of the accompanying drawings. Bearing in mind that the following is only a fraction of the full report, some idea of the complexity and depth can be visualised. Ed.

1. SUMMARY

1.1 General

The Standedge Tunnel, at approximately 5200m length, is both the longest and highest elevated canal tunnel in Great Britain, passing under the Pennines between Marsden, in Yorkshire, and Diggle, in Lancashire. The tunnel was constructed between 1794 and 1811 but with the advent of the railways the canal declined and the Standedge Tunnel was officially closed by an Act of Parliament in 1944. Since that time the tunnel has been used by British Waterways (who have been the responsible body for the canal and tunnel since the mid 1960s), as a route for transferring water.

A desk study of historical data collection and an extensive site investigation was undertaken which included referencing the tunnel at ten metre intervals (commencing at the Marsden Portal), taking laser profiles (which defined the shape of the tunnel) at similar intervals, physical observations of all geological, geotechnical, structural and ventilation aspects of the tunnel. In addition, all the ventilations shafts were videoed for their full depth, and also the tunnel for its full length. A comprehensive series of photographs has also been taken that shows all the construction and areas of particular interest throughout the tunnel. During the on-site period the tunnel was de-watered and the condition below water level recorded where this was physically possible.

Geologically, the tunnel traverses the Upper Carboniferous Millstone Grit series of several sequences comprising Middle Grits, Kinderscout Grit, Grindslow Shale and Shale Grit. These principal sequences are further segregated and include sandstone, mudstone, siltstone and thin coal bands.

The tunnel crosses six significant faults at around chainages 1078, 1968, 3400, 4500, 4630 and 4785. However, only one of these faults, at chainage 4500, is clearly seen in the tunnel.

Having established the condition of the tunnel, remedial works have been recommended accordingly and are summarised in TABLE 3, with each 10m section of the tunnel structure being shown on the Detail Sheets in APPENDIX 10, Vol. 3.

1.2 Water Transfer

The Invert Probing Results, APPENDIX 3, VOLUME 1, and observations made during the canal tunnel dewatering period, showed depths of silt in the invert averaged between 1.0 and 1.5 metres. This, together with the areas of rockfalls (two of which presently prevent through navigation, and several which are less than 0.5 metres below water level), is presently restricting the water flow. If left unchecked, the continuing build-up of silt, and further rockfalls, will inevitably dam the flow within the tunnel completely, thus creating a situation which would be difficult and increasingly expensive to resolve.

The stabilisation of exposed rock is therefore essential to avoid further collapses which could both block the canal tunnel and create a hazardous condition to rectify.

The sections of tunnel permanently lined by stone or brick arches are generally in a satisfactory state, although there are areas of stonework which exhibit profile deformation, possibly caused by stress due to rock pressure which has occurred over the life of the tunnel. The deformation, however, may well be exaggerated by an originally poor profile. Accordingly it is not recommended that any dismantling of lining is carried out as there is a risk that an unstable rock section could become unsupported and the task of relining the section would be more complicated and thus very expensive. This, together with the possibility that the deformed sections have stabilised, suggests that the best course of action is to establish a series of monitoring stations which should be inspected on a regular basis, and the results interpreted to highlight the areas where movement is still occurring and where remedial work may be necessary. A similar course of action is recommended for the brickwork sections which exhibit areas of spalling and joint movement.

Certain of the crossheading bridge structures over the canal pose a threat to the canal as their total collapse into the water could create a dam. The condition of the fourteen crossheadings is such that it is recommended that some 4 No. are replaced as soon as possible due to poor support foundations and decking, whilst the remainder are maintained with a view to future replacement.

The masonry lined adits do not pose a threat to the water flow but are deemed necessary for maintenance access. The remedial works which should ultimately be undertaken are joint repair and eventual jet hosing of the surfaces to remove the soot deposits for joint protection. The unlined adits require a lining at the canal interface to prevent deterioration of the rock.

Although all the ventilation shafts were videoed for their full depth, the primary concern was the base structure over the canal tunnel. It is recommended that all six base structures are replaced and suitable alternative structures have been outlined and included in this Report. For completeness a cost has been included in the report for repairing the ventilation shafts.

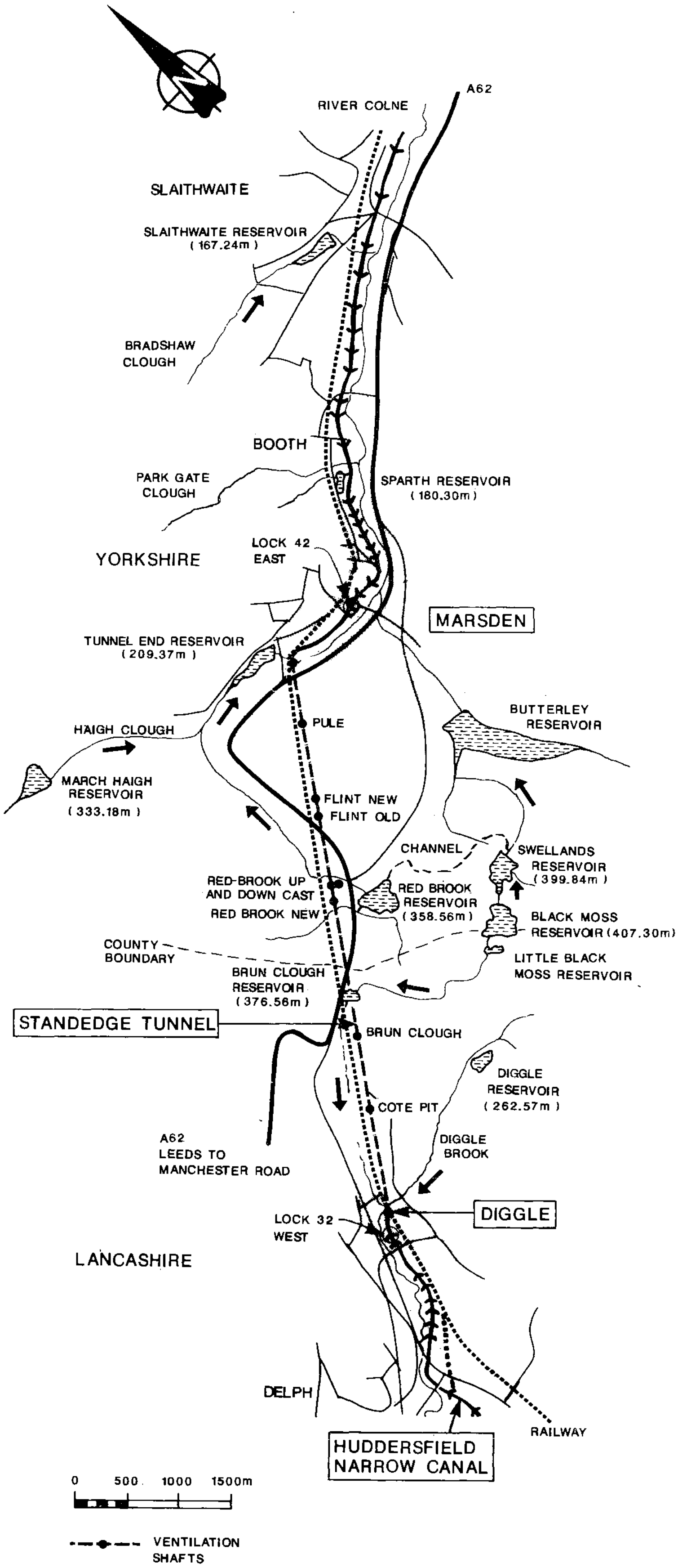
The portal entrance at Marsden (a listed structure) includes a retaining wall to the overlying fill material. This retaining wall is in a poor condition and requires removal and reconstruction to its original condition with replacement of the fill by a free draining material. The portal at Diggle is in good condition, requiring only minor joint repair.

DESILTING AND CLEANING OF INVERT DEBRIS.

An Invert Probe Survey, and observations made during the dewatering of the canal Tunnel showed silt to be deposited to an average depth of 1.0/1.5m and up to 2.0m in places. Several rock falls have occurred in the Tunnel reducing the depth of the canal to less than 0.5m, and debris is above water level at the major fall. The siltation and collapses have reduced the water transfer capacity of the canal, and if left unchecked will eventually stop water flow through the Tunnel.

Cleaning out of the canal invert is therefore a high priority for continued water transfer. The work could be either:

a) carried out by a barge dredger or
b) by dewatering the Tunnel and removing debris by machine.



1.3 Public Navigation

To bring the tunnel up to a condition suitable for public navigation, greater emphasis is placed on the health and safety considerations.

The rock sections require a higher degree of stabilisation, as the risk of any falls must be eliminated. This results in some areas of exposed rock needing to be fully lined, where for water transfer rock bolting only is recommended.

The lined sections require cleaning and joint repair as for the water flow repairs but are a higher priority as the currently 'dirty' environment may deter public use.

1.4 Financial

The remedial work required to repair the tunnel has been costed for under three main headings:

A) Water Transfer
B) Navigation for a distance of 750m from the Marsden Portal.
C) Total Through Navigation.

The costings have been calculated assuming a single contract for each option, which is the most economical way of financing the repairs. If, however, small contracts are necessary or if repairs are made on an 'ad hoc' basis, this will make a significant difference to the final overall cost of the full works, which could vary from those given by up to 50%. Similar cost increases could be expected if access is not possible via the adjacent disused railway tunnel.

Based on the criteria applied, the following budget cost estimates were derived:

A) To maintain water transfer:

Repairs to a Minimum Standard	£	3,135,360
Repairs to a Full Standard	£	5,896,290
Apportioned British Rail Cost	£	930,420
<u>Canal Tunnel Direct Costs (excluding B.R.portion):</u>		
Minimum Standard	£	2,407,165
Full Works	£	4,964,370
Ventilation		

B) To provide limited public navigation (750m):

Repairs to a Minimum Standard	£	237,790
Repairs to a Full Standard	£	372,360
Apportioned British Rail Cost	£	169,970
<u>Canal Tunnel Direct Costs (excluding B.R. portion):</u>		
Minimum Standard	£	3,707,220
Full Works	£	5,374,090
Ventilation Costs	£	1,325,000

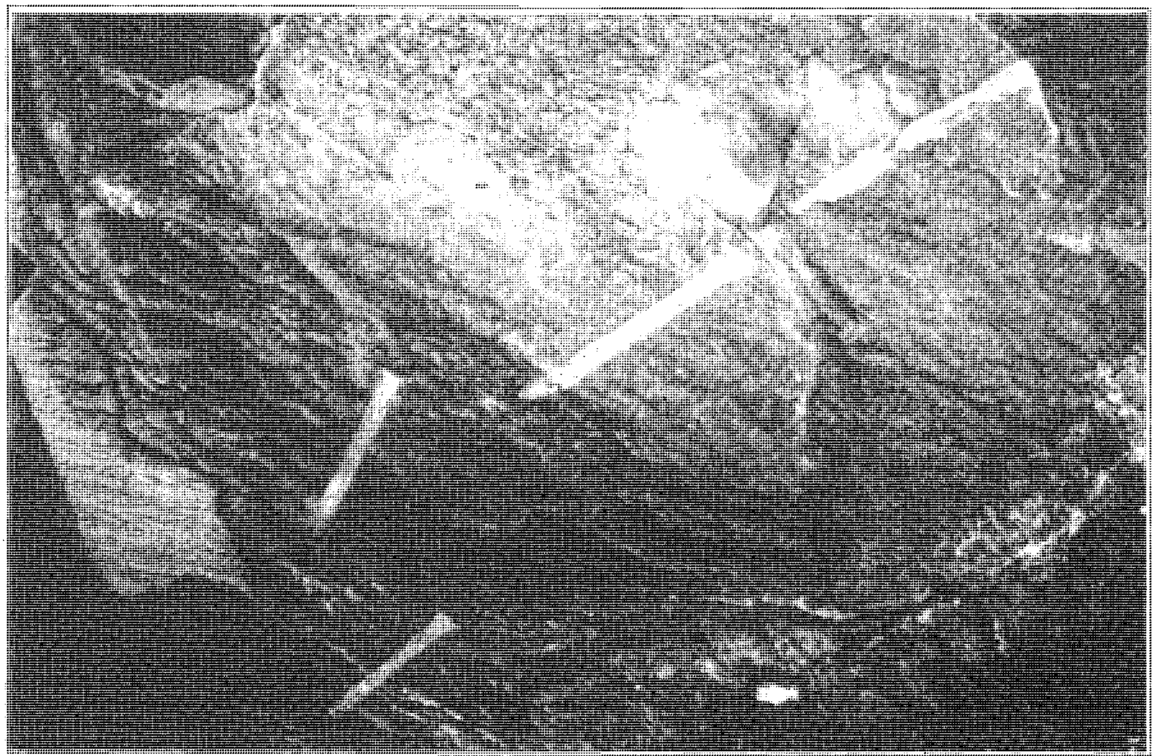


PLATE 1
Evidence of gun powder blast holes used in the construction of the Tunnel.

3. DESK STUDY

3.1 Introduction

3.1.1 General

In advance of the fieldwork a desk study was undertaken to assemble historical, geographical and geological information as an aid to identifying areas of particular interest and highlighting historical events to assist in the understanding of the present condition of Standedge Tunnel.

3.2 History

3.2.1. General

Several historical reference works were reviewed as part of the study in order to gain a knowledge of the way in which the tunnel evolved.

In particular, information was sought pertaining to its construction and the problems encountered.

3.2.2. Construction

The construction of the canal, which took place between 1794 and 1811, was beset by a number of difficulties: bad design, floods and poor workmanship, but perhaps the greatest hardship to face the builders was the construction of the Standedge Tunnel.

Documentation prepared by Benjamin Outram, the engineer in charge of the project at its onset, and surveyor Nicholas Brown, was accepted by a public meeting on the 22nd October 1793. The cost of the complete project was estimated at £182,784, with £55,187 being allocated to the tunnel.

Four steam engines were used for pumping out the wettest pits, the largest being located at Red Brook. The remains of the engine house can be seen to this day.

During the period between 1796 and 1798, the Company's expenditure on the tunnel stood at £20,049. This meant that they had spent more than one-third of the original estimate on only one-seventh of the work.

Survey instrumentation of the simplest kind was used to set out the alignment of the tunnel, probably using an iterative process of open traversing with magnetic compass or by reciprocal ranging using very long poles. Judging by the alignment of the surface shafts, accuracy was poor; the section between Red Brook and Brun Clough is some 7.9m off the proposed centre line (FIGURE 4). Transfer of a parallel line to the base of a shaft was achieved by plummets hanging freely at the pit bottom on twin cords suspended from hooks located on the surface survey line. A parellel line can then be projected into the tunnel mountings (FIGURE 5).

In 1802 the surveyor David Whitehead was employed to check the levels at each end of the tunnel. He assumed the Marsden end to be correct and found the Diggle end to be much higher. Re-excavation to the correct level had to take place, which undermined the foundations of the stone side walls of the already lined section of tunnel. These had to be dismantled, together with the completed arching, and rebuilt.

The renowned Civil Engineer, Thomas Telford, was asked to re-survey the tunnel and provide a full schedule of the remaining works and cost to enable completion to be achieved. At this time work on the tunnel was proceeding at a rate of only 10m a week.

Telford presented his report in January 1807 with a summary of the state of the works and precise dates for completion of the tunnel, section by section. He estimated the cost for completion would be £55,290.7s.4d. The Company followed Telford's directions for construction and on the 4th April 1811 the canal tunnel was opened, just five months later than he had anticipated, and at a total cost of £123,804, this being more than twice the original estimated cost given by Outram.

During the construction of the single line tunnels, the spoil created during the blasting was removed on narrowboats through the canal tunnel. For this purpose a series of adits was constructed from the single line tunnels to the canal.

Despite the enthusiasm which brought into being the concept for the Huddersfield Narrow Canal, it never truly reached its anticipated potential and was officially closed to cargo traffic under the London, Midland and Scottish Railway (Canals) Act of 1944. The last cargo-laden narrowboat in fact passed through the Standedge Tunnel in November 1921.

3.3.3. Aerial Photograph Examination

Aerial photographs of the moorland above the Standedge tunnels were examined for features that may reflect master joint discontinuities in the Millstone Grit Strata.

3.3.4 General Geological Outline

The Standedge Canal Tunnel passes through strata of Upper Carboniferous Millstone Grit (Namurian Age), TABLE 1. This strata consists of a thick sequence of interbedded Sandstones and Mudstones. It also traverses a vertical thickness of strata of about 500m, belonging to the upper part of the Shale Grit, the Grindslow Shale, the Kinderscout Grit and the bottom section of the Middle Grit division.

The Millstone Grit strata were deposited by a major river system draining mountains in Scotland and what is now the northern North Sea. The Millstone Grit strata is traditionally interpreted as a rhythmic succession of deltaic deposits laid down in a slowly subsiding area covered by a shallow Carboniferous Sea (British Regional Geology, Pennines and Adjacent Areas).

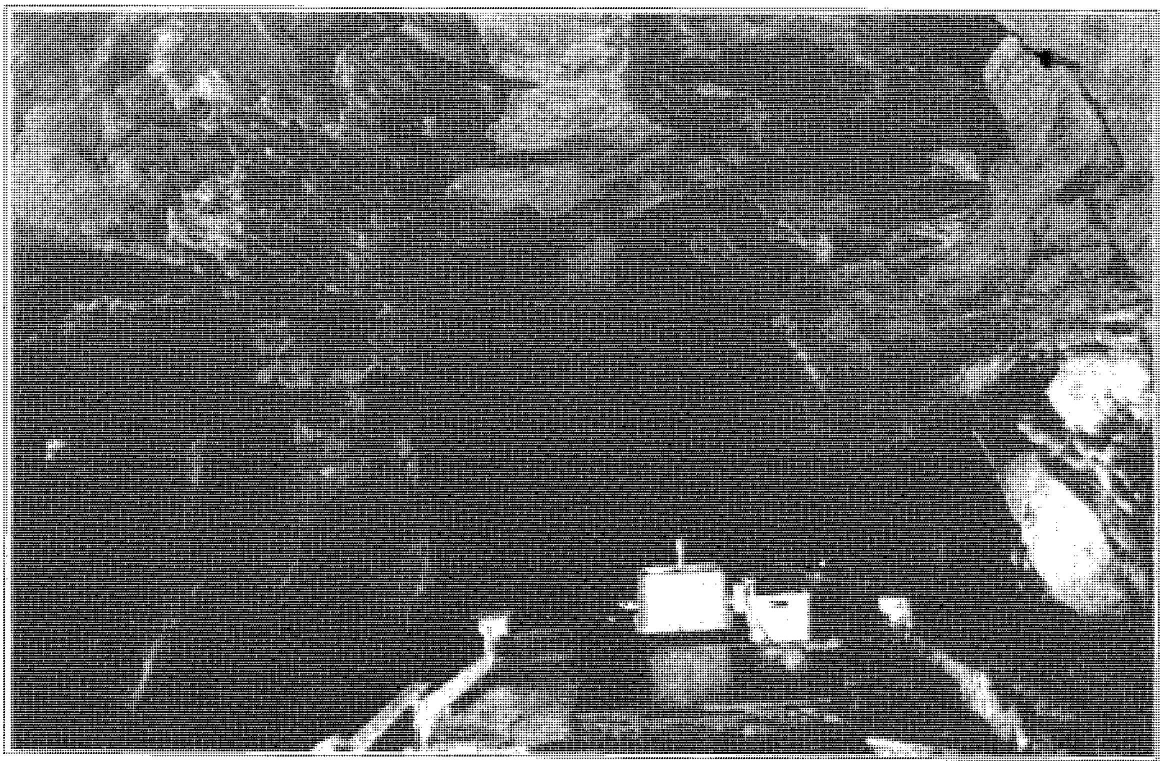
3.4 Canal Water Resources

3.4.1. General

A review of historical references on the canal water resources has revealed that an extremely complex and ingenious system was developed and constructed to serve the tunnel and associated summit section of the canal. Notwithstanding such a provision, considerable problems were experienced during the life of the canal.

PLATE 58
Fault at chainage 4500

PLATE 64
Kinderscout Grit – bottom part, variable lithology. Interbedded massively bedded and thinly bedded Sandstone.



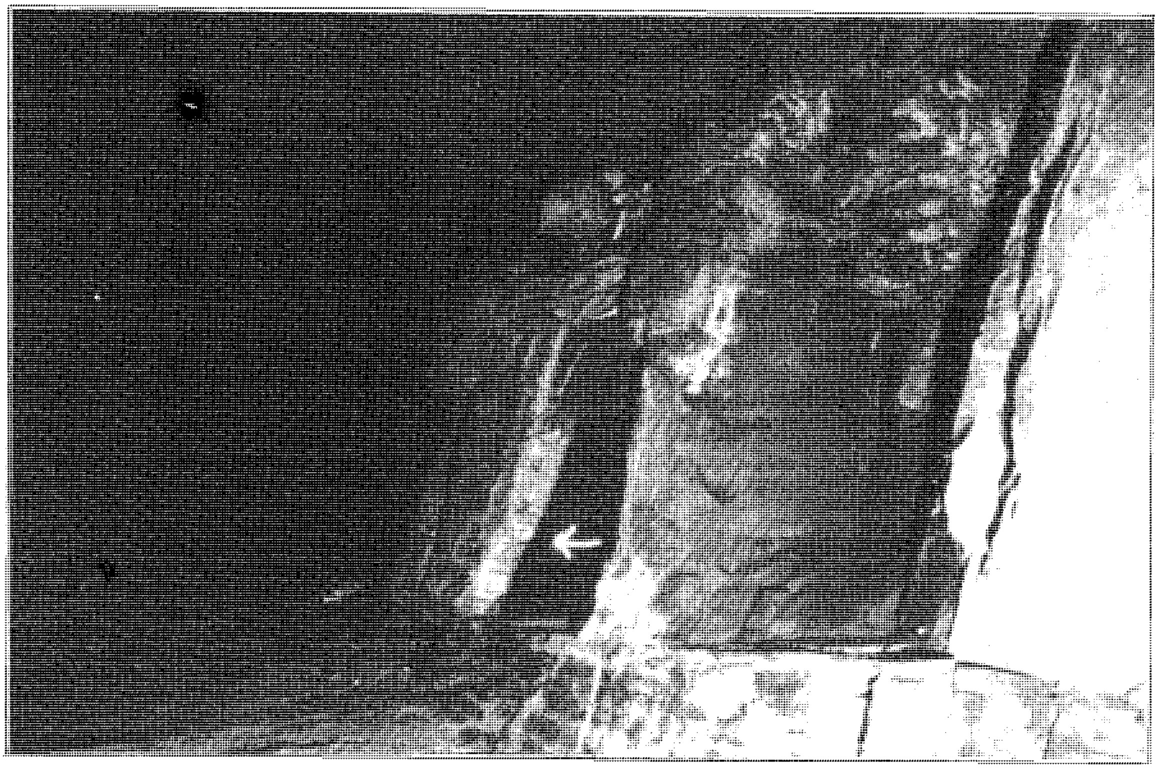


PLATE 66
Kinderscout Grit at ch. 2480, showing prominent jointing

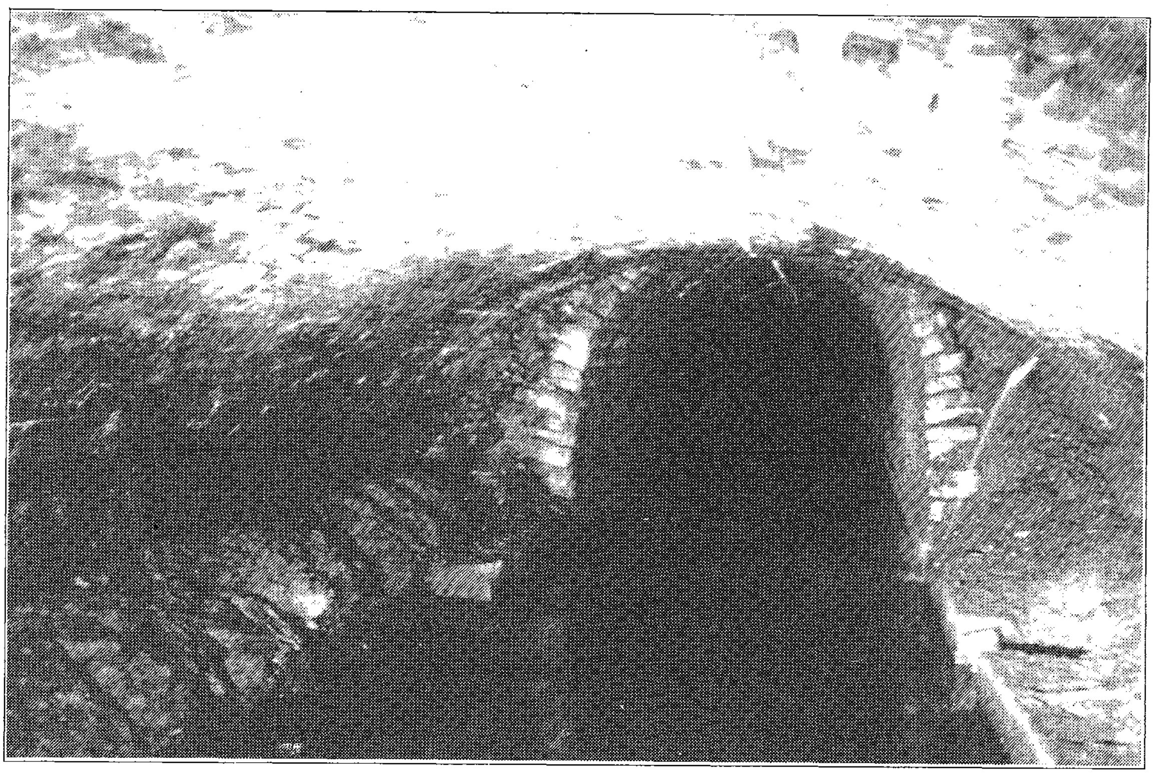


PLATE 67
Middle Grit – basal shaley Mudstone

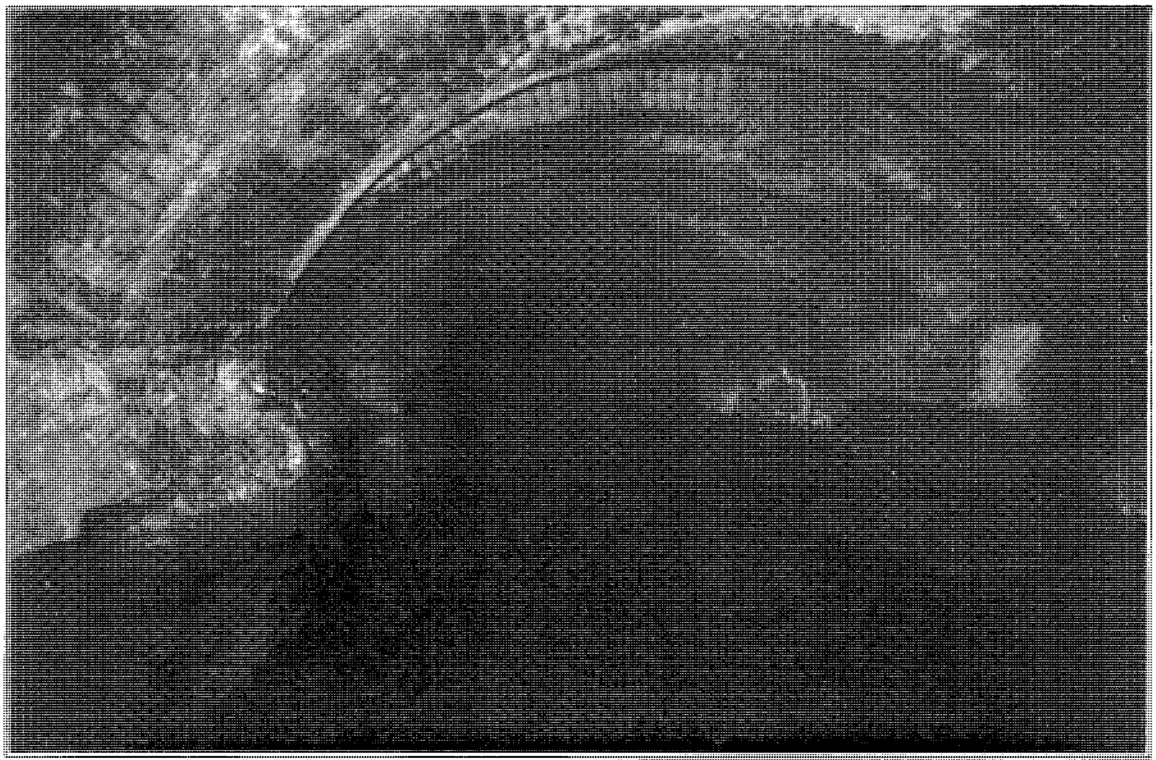


PLATE 70
De-watered section at Ch. 2913, looking towards Diggle. Access gained by cross-heading.
BR.Ref. 132

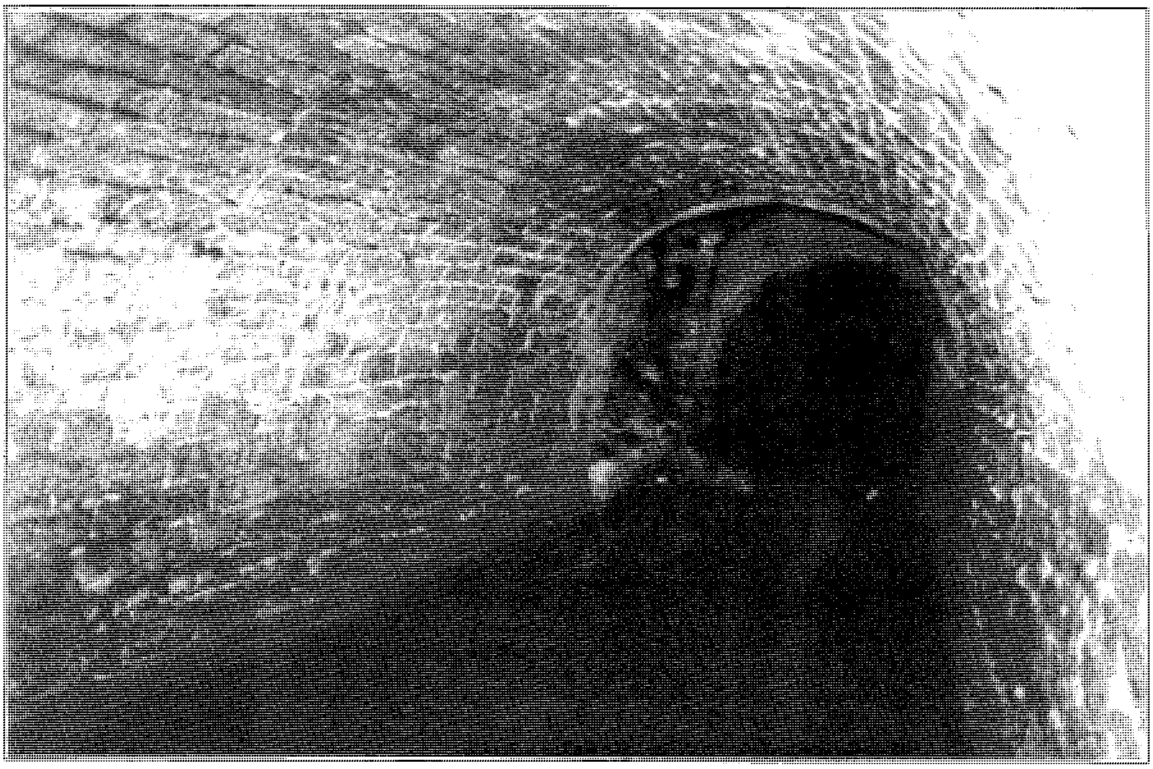


PLATE 73
Ch. 852 – 857 Unstable rock section. Rock debris can be seen on south-east side of canal floor.

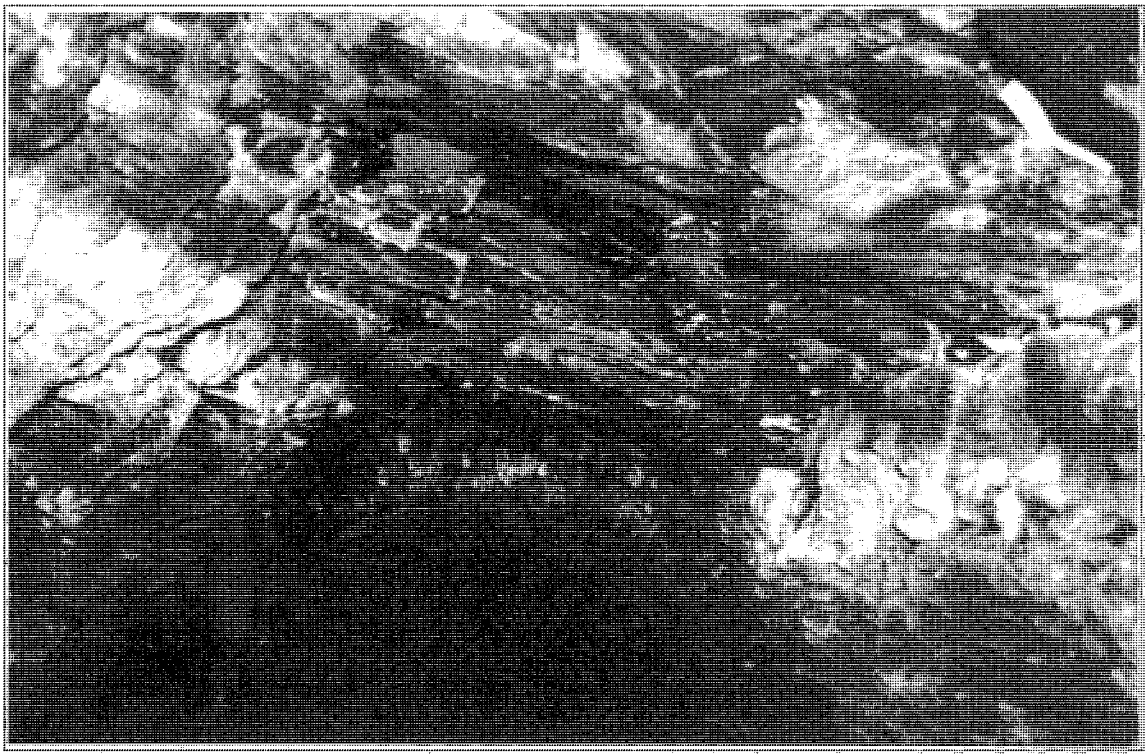
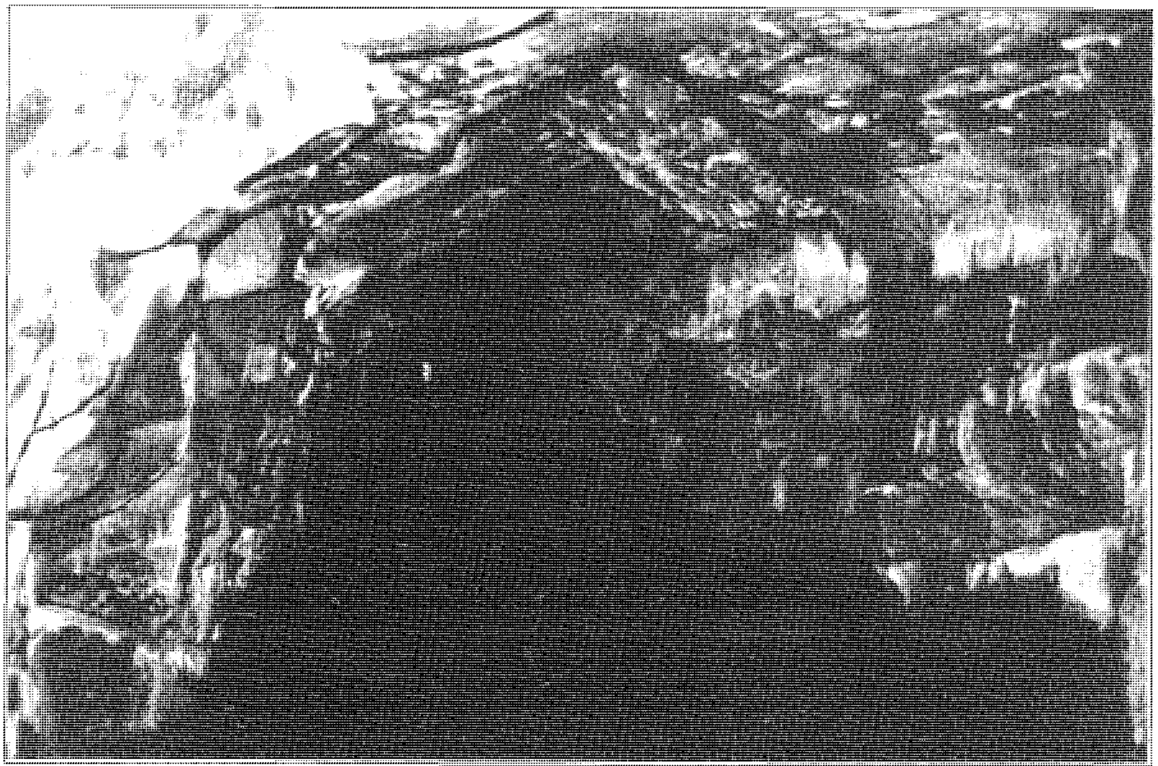


PLATE 81
Ch. 3669 – Ch. 4043 Grindlow shales. Unstable sections will require full lining and rock bolting with mesh and gunite.

PLATE 82
Ch. 82. Tunnel intersects major fault. Walls will require rock bolt and mesh.

PLATE 83
Ch. 4500 Tunnel intersects major fault. Roof will require rock bolting with mesh and gunite

PLATE 84
Ch. 4656 – Ch. 4827 Shale grits. Large blocky structure. Rock bolting pattern for public navigation.



HUDDERSFIELD NARROW CANAL
STANDEDGE TUNNEL

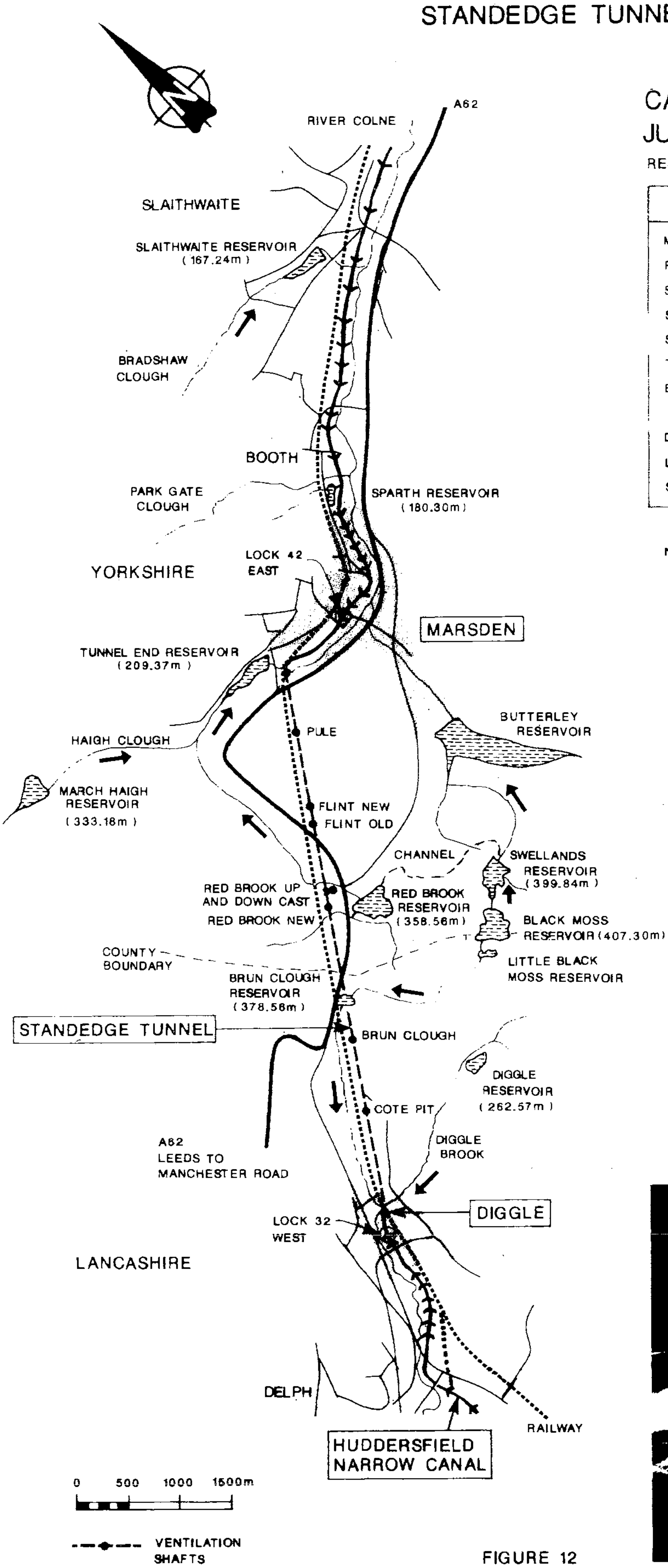


FIGURE 12

CANAL RESOURCE WATER
JULY 1989

RESERVOIR DETAILS

RESERVOIR	APPROX CAPACITY 1000 m³	OPERATING AUTHORITY
MARCH HAIGH 2	322	BWB
RED BROOK 2	308	BWB
SLAITHWAITE	283	BWB
SPARTH	37	BWB
SWELLANDS 2	246	BWB
TUNNEL END 2	103	BWB
BLACK MOSS 2	85 *	BWB
BRUN CLOUGH	39 MILL SUPPLY	BWB
DIGGLE	81	BWB
LITTLE BLACK MOSS 2	10	BWB
STANDEDGE TUNNEL	31	BWB

* (OVERFLOWS INTO SWELLANDS)

NB: 1) CAPACITIES IGNORE SILTATION

2) YORKSHIRE W.A. ABSTRACT WATER FROM THESE RESERVOIRS TO SUPPLEMENT SCAMMONDEN WATER CATCHMENT

NOTES

A) THROUGH AN AGREEMENT WITH THE YORKSHIRE W.A. BWB HAS A RAW WATER ALLOCATION OF

1) 9100m³/ DAY OR

2) 164000m³/ 28 DAYS OR

3) 1282000m³/ ANNUM

B) THE FOLLOWING RESERVOIRS CURRENTLY HAVE THE FACILITY FOR FEEDING INTO THE CANAL

1) SLAITHWAITE

2) SPARTH

3) DIGGLE

C) THE FOLLOWING RESERVOIRS ARE CURRENTLY USED BY THE YORKSHIRE W.A. FOR PUBLIC SUPPLY

1) BUTTERLEY (MAIN PUBLIC SUPPLY RESERVOIR)

2) MARCH HAIGH / TUNNEL END

3) RED BROOK

4) SWELLANDS

5) BLACK MOSS / LITTLE BLACK MOSS

D) ALL RESERVOIRS HAVE THE FACILITY FOR FEEDING INTO THE CANAL BUT WORK IS REQUIRED ON THE PIPEWORK VALVING AND FEEDER CHANNELS FOR ALL EXCEPTING THOSE LISTED UNDER B)

E) FEED WATER FOR MAINTAINING CANAL LEVEL BETWEEN MARSDEN AND DIGGLE IS CURRENTLY SUPPLIED BY THE YORKSHIRE W.A. UNDER AN AGREEMENT WITH BWB, THE POINT OF INFLOW BEING AT LOCK 42 E

F) (262.57m) DENOTES RESERVOIR TOP WATER LEVEL

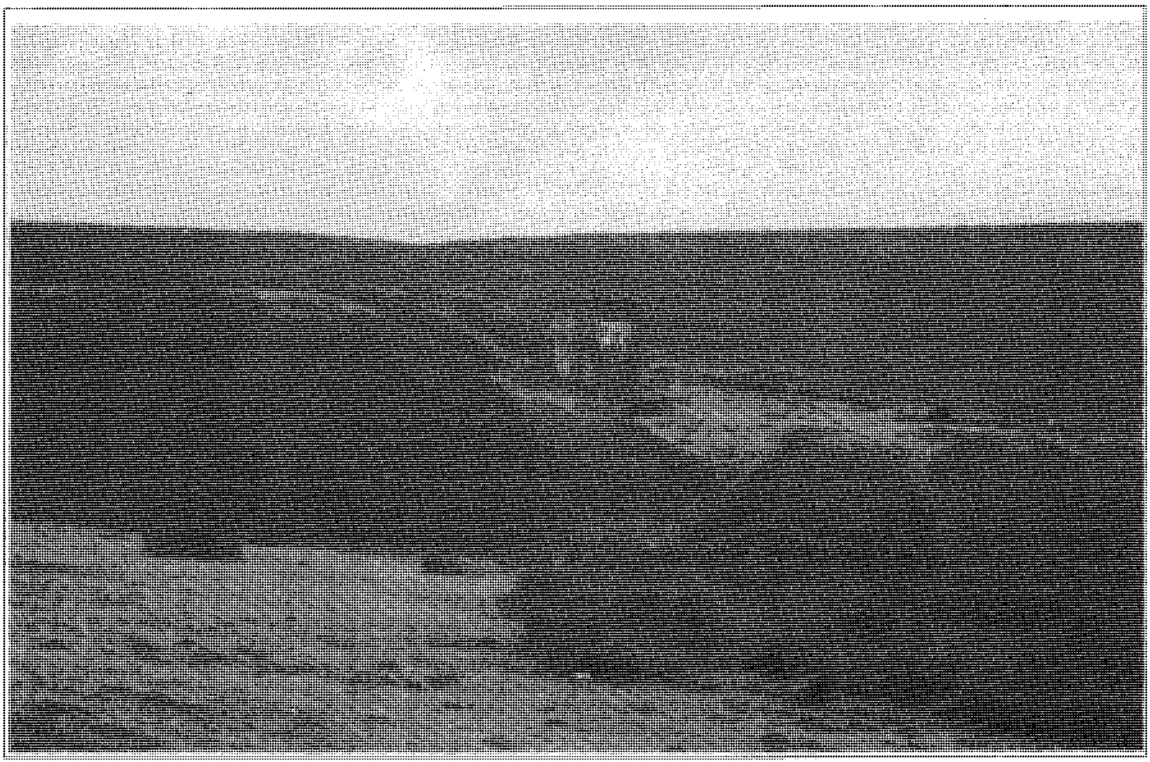


PLATE 2
Red Brook Engine House
Surface position of Red Brook Up Cast, BR Ref. 177, Ch. 2216

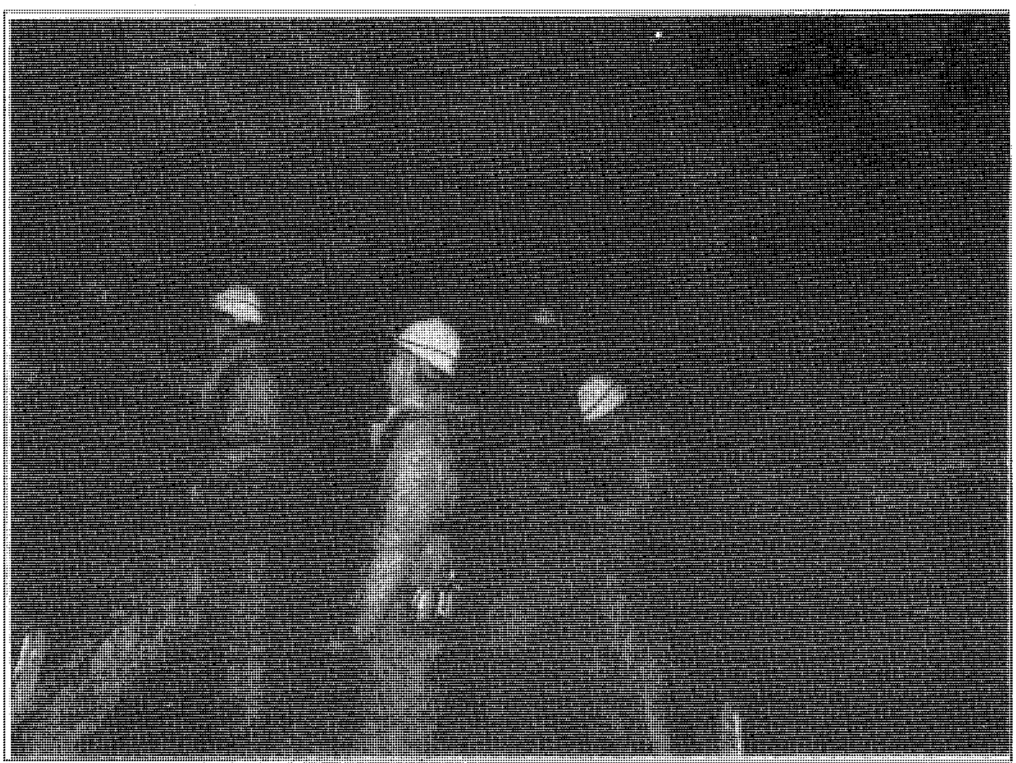
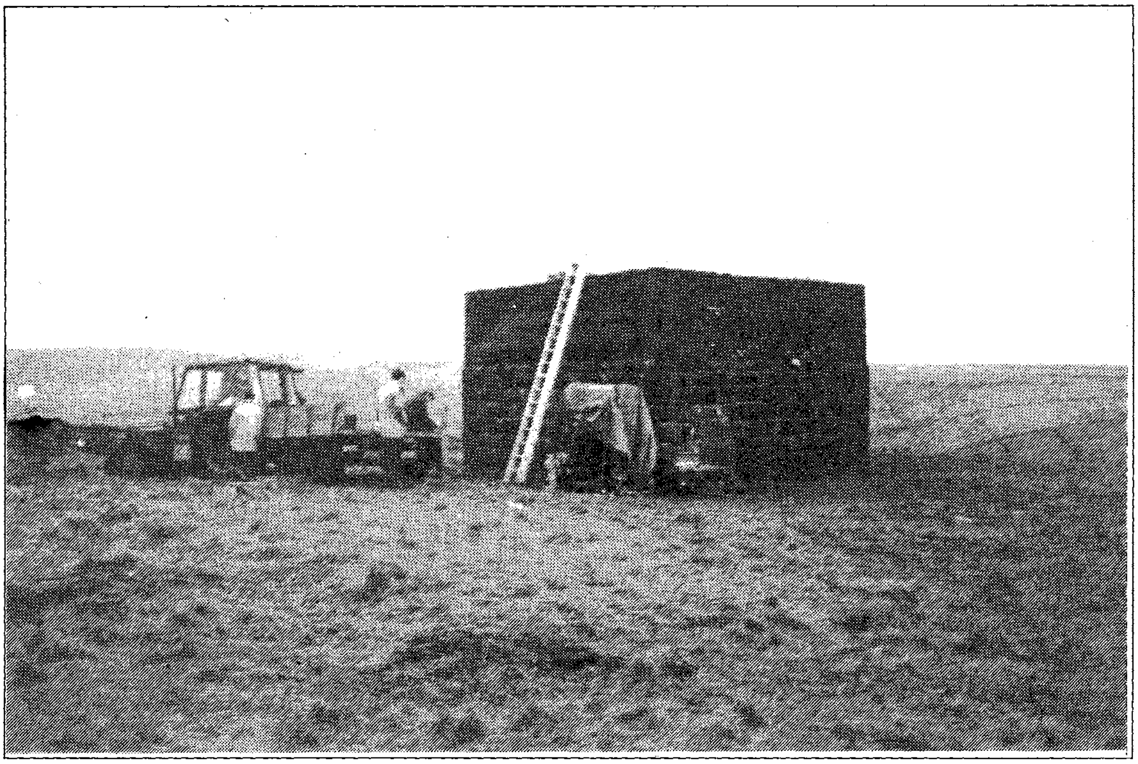


PLATE 3
Ove Arup Engineers, progressing with Condition Study.
Measuring the'Dip and Strike' of the Grindslow Shales



Pule Ventilation Shaft: Surface position, BR Ref. 289, Ch. 536

PLATE 41
Base structure, Pule Ventilation Shaft, 141m below ground level.

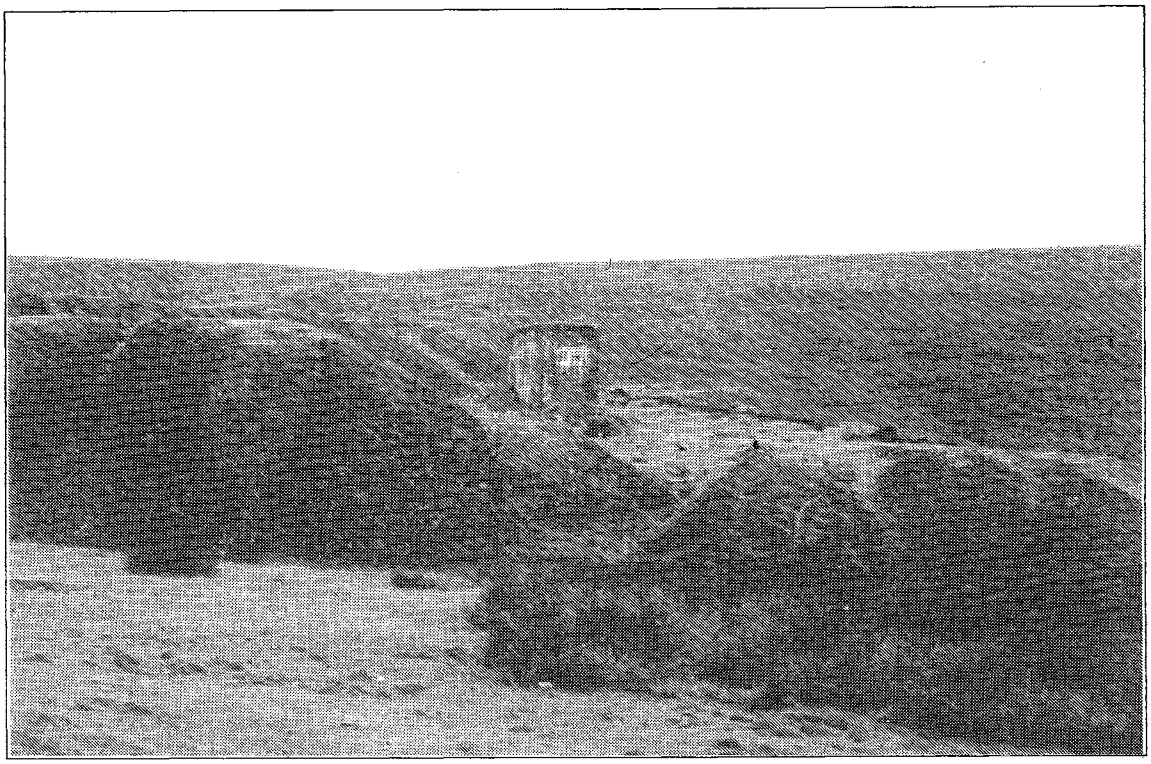
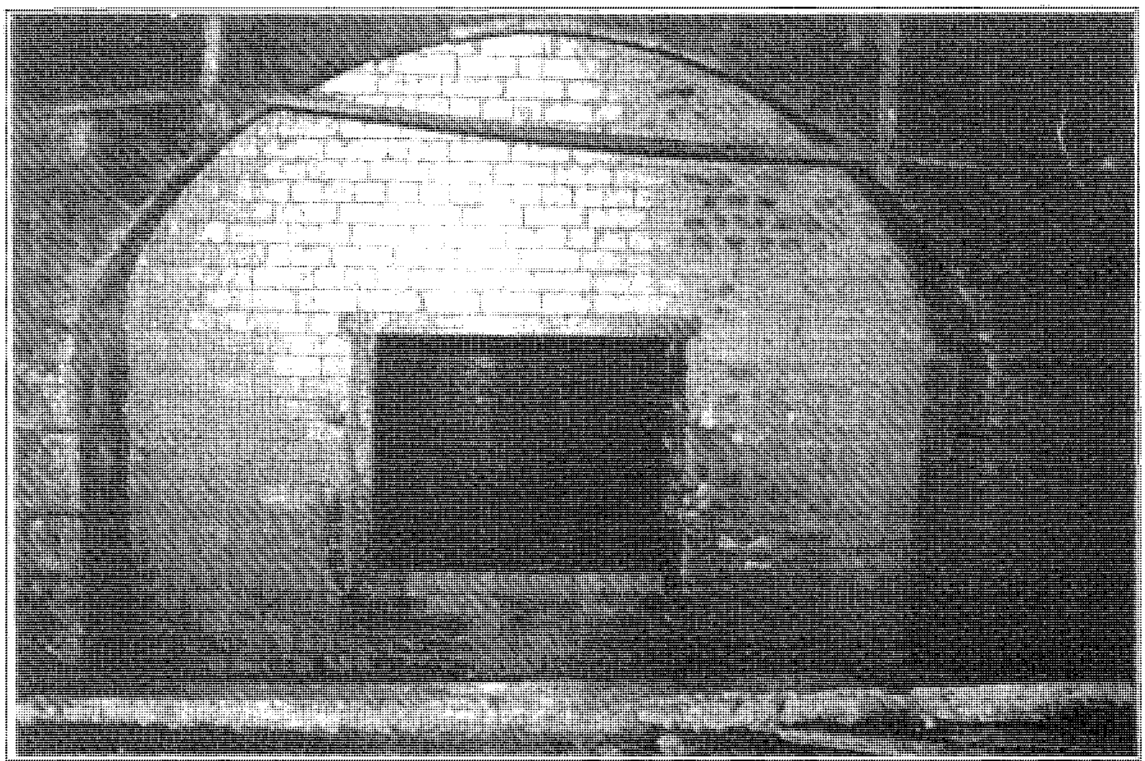


PLATE 43
Red Brook Engine House. Surface position of Red Brook Up Cast, BR Ref. 177, Ch. 2216
and Red Brook Down Cast, BR Ref. 178, Ch. 2203



Base Structure for Red Brook Down Cast Ventilation Shaft. 150mm below ground level.
(Note: Shaft does not enter canal).

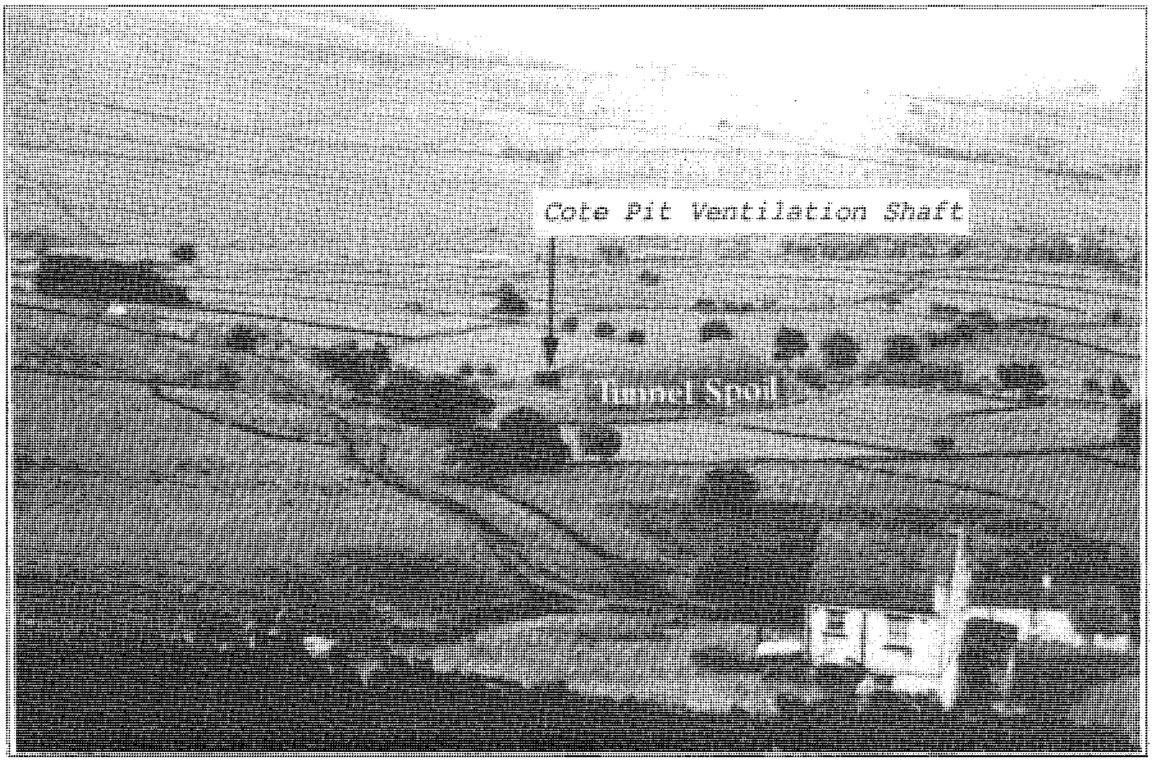
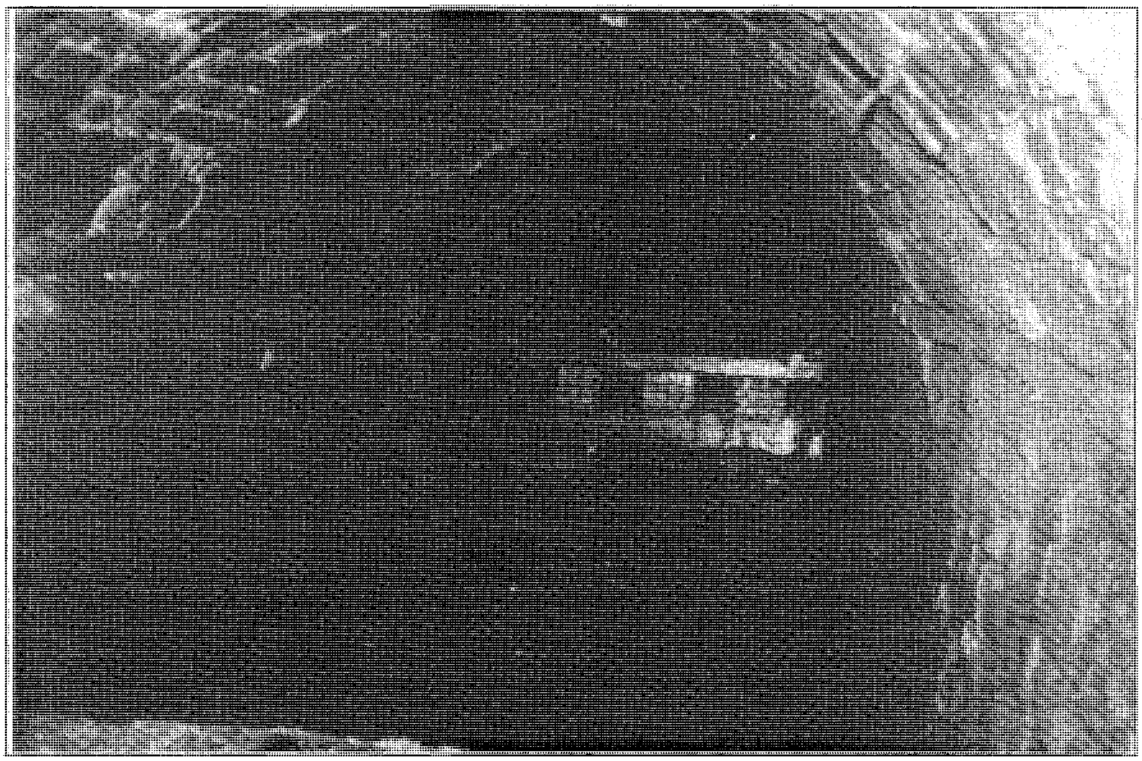


PLATE 47
Cote Pit Ventilation Shaft. Surface position BR. Ref. 51/52, Ch. 4135



Cote Pit Ventilation Shaft. Base structure 67m below ground level.

3.4.2. **Reservoirs – Original Concept**

As part of the design for the canal, and in accordance with the Act, the Engineer (Benjamin Outram) included for the construction of several surface impounding reservoirs (2.76M m^3 – 607 M gall capacity), to provide feed water for maintaining the water level. In the summit area, where there is a high level of precipitation over the watershed, five reservoirs were originally built on the moorland between Marsden and Diggle, these being later (1806 and 1808) supplemented by the construction of Black Moss and Swellands reservoirs respectively. Initially, the water impounded in the summit reservoirs was directed to the main construction shafts (Pule, Red Brook, Flint, etc.), to supply the drive for the water engines and provide forced ventilation within the tunnel workings.

In addition to the summit reservoirs, the Standedge Tunnel also provides storage, having an average water depth of around 2.0m, which gives a capacity of approximately 31,000 m^3 (nearly equivalent to Brun Clough Reservoir).

Despite the construction of these reservoirs, and several others along the canal corridor, the operation of the waterway appears to have been plagued with shutdowns due to insufficient water being available to maintain the system.

4. FIELD WORK

4.1 Background

During the period from December 1988 to February 1989, the study team was mobilised, safety training undertaken and the site established at the British Waterways depot at Marsden.

The field work commenced on the 22nd February 1989 and was completed on the 26th May 1989.

No investigations on the scale of the present study have previously been carried out within the Standedge Canal Tunnel

4.3 Investigations by Ove Arup & Partners (ARUP)

In their Proposal, submitted to British Waterways in July 1985, ARUP set out the following fieldwork components for undertaking the study in accordance with the terms of reference:–

i) Preparation of a detailed safety document for working within the unstable tunnel.
ii) Referencing the tunnel at 10m intervals.
iii) A condition/structural survey (in both geological and geotechnical terms) of the tunnel and structures (above and below water level).
iv) Profiling the tunnel (10m maximum intervals), using laser techniques.
v) Probing the tunnel invert to determine the depth below the water level.
vi) Condition survey of all adits/cross-headings (confirmed as being required at the meeting on 16th November 1988).
vii) Assessment of tunnel ventilation.
viii) T.V. inspection of the 8 No. ventilation shafts.
ix) Photographic record of the complete tunnel – later supplemented with the making of a video film.

4.5 Tunnel Referencing

To facilitate the identification of data in respect of any point within the tunnel, it was first necessary to implement a system of referencing for the full length.

This was achieved through traversing the tunnel by boat and establishing fixed points at 10m spacing, commencing at the Marsden portal. Each reference point, comprising a steel pin and bobbin fixed to the northwest wall at approximately 1.5m above water level, was marked with a chainage figure; zero metre at Marsden, 5198 metre at the Diggle portal face, giving a total length for the tunnel of approximately 5200m.

4.6.3. Tunnel Lining and Structures

4.6.3.1. **Masonry Lining**

The masonry lined sections of the tunnel (constructed in both brick and natural stone), APPENDIX 12, VOLUME 5, totalling some 60% of the full length (including intermediate arches sprung off rock) and the portal structures, were inspected for general stability.

The masonry and steelwork extension to the tunnel at the Diggle end was also inspected.

They were surveyed in terms of:

profile distortion
collapse
cracking
crushing
spalling
water penetration
missing masonry
perished masonry
joint condition
foundation supports
corrosion

4.6.3.2. **Structures**

i) Timber Decking

The general condition of all existing bridge structures was logged as part of the overall condition survey.

Throughout its length the tunnel is spanned by numerous timber structures forming crossheading decking and ventilation shaft base decking.

Each of the timber structures, totalling twenty-one in number, (7 No. ventilation shafts, 14 No. crossheadings), were inspected from the boat at canal level, also at walkway level, where possible, via access from the adjacent disused single railway tunnel.

4.7 Tunnel Profiling

In order to assess the tunnel's compliance with the British Waterways minimum navigation standard (and therefore its ability to take boat traffic), the shape above the water line was determined on ARUP's behalf by Tunnel Investigations Ltd. of Glasgow, using computerised laser techniques.

The equipment and instrumentation was mounted on two modified British Waterways boats, PLATE 28, which were used to traverse the tunnel, one entering from the Marsden side, the second from the Diggle end. Such a procedure was necessary due to a rock fall at CH 1400, which prevented through navigation.

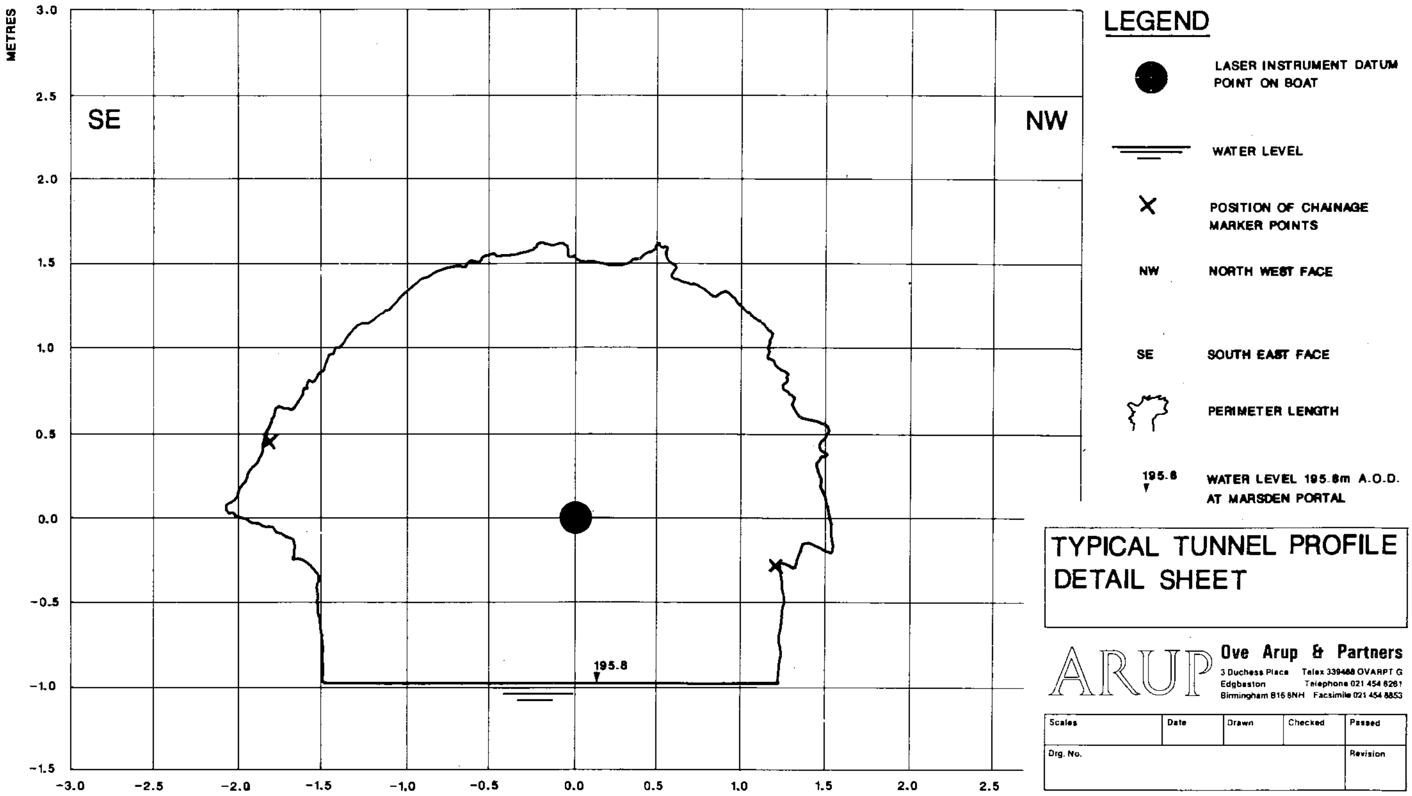
The laser emission head, PLATE 28, had the facility of 360° rotation, the beam registering the tunnel shape and transmitting the measurement data back to the computer V.D.U. and data logger for disc storage, PLATE 28.

A profile measurement was taken where possible at every 10m referenced location and also at intermediate points where a distinct change in tunnel shape was noted.

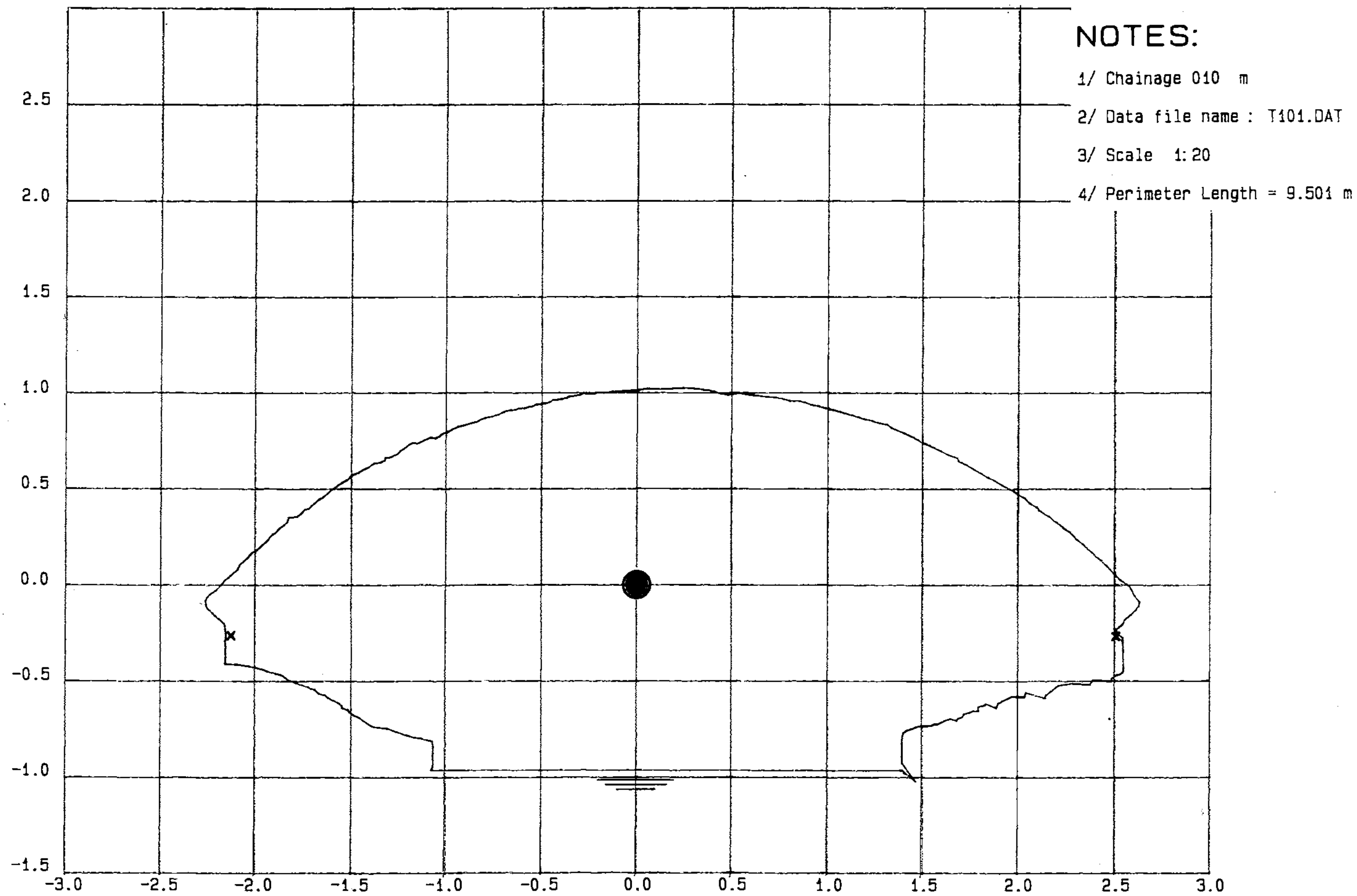
Several problems were identified by the sub-contractor during the tunnel profiling:–

– instability of the tunnel in certain areas was considered unacceptably high, which deterred the sub-contractor from holding the boat in position for the period required to profile.
– shallow water which gave cause for concern in respect of not being able to move the boat clear after profiling.
– water pouring into the tunnel which prevented the use of the equipment.
– large variation in tunnel size which extended beyond the instrument range.

EXAMPLES OF TUNNEL PROFILE RESULTS



A profile drawing taken every 10 metres of tunnel is included in the Report, i.e., 520 drawings.


NOTES:
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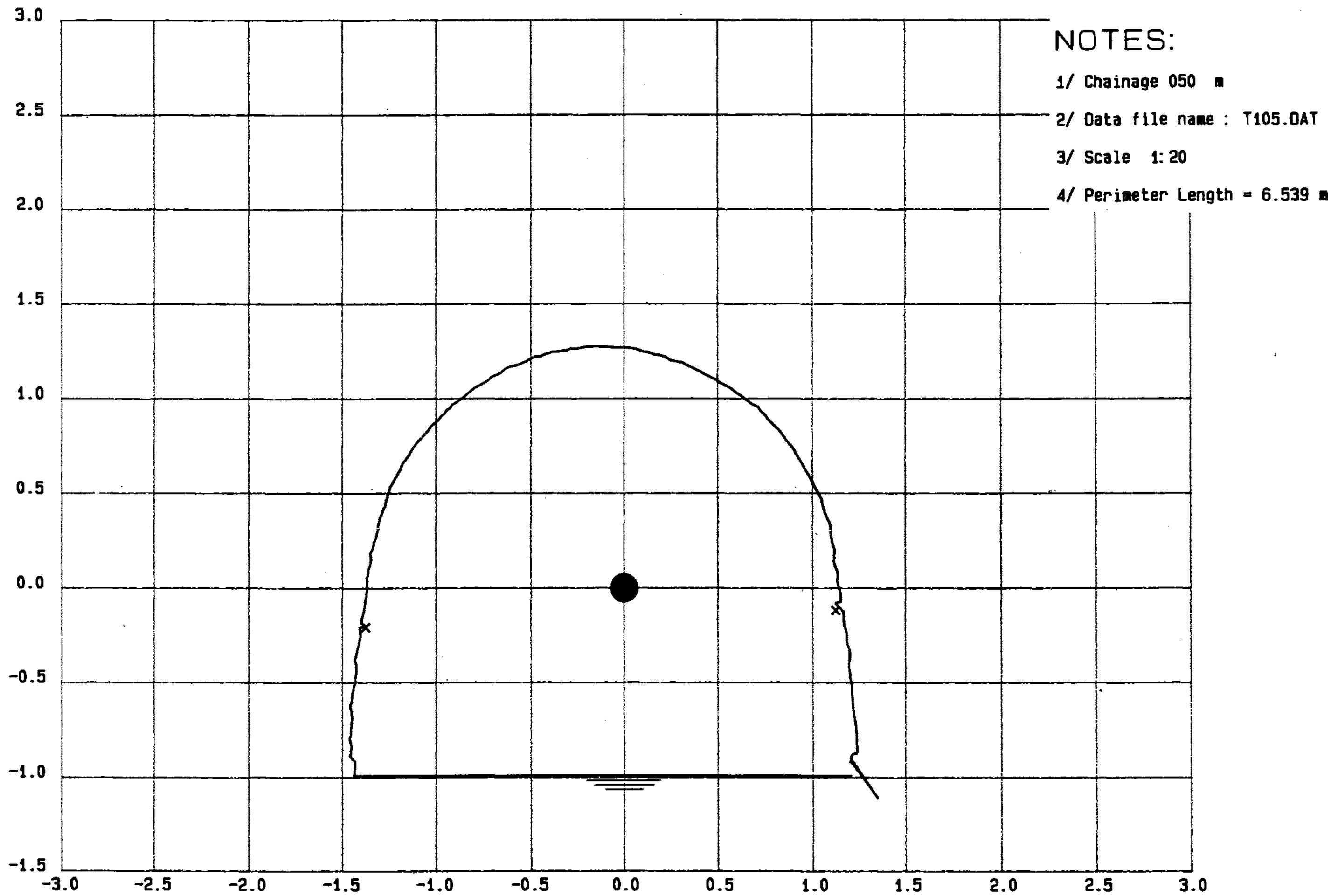
3/ Scale 1:20
4/ Perimeter Length = 9.501 m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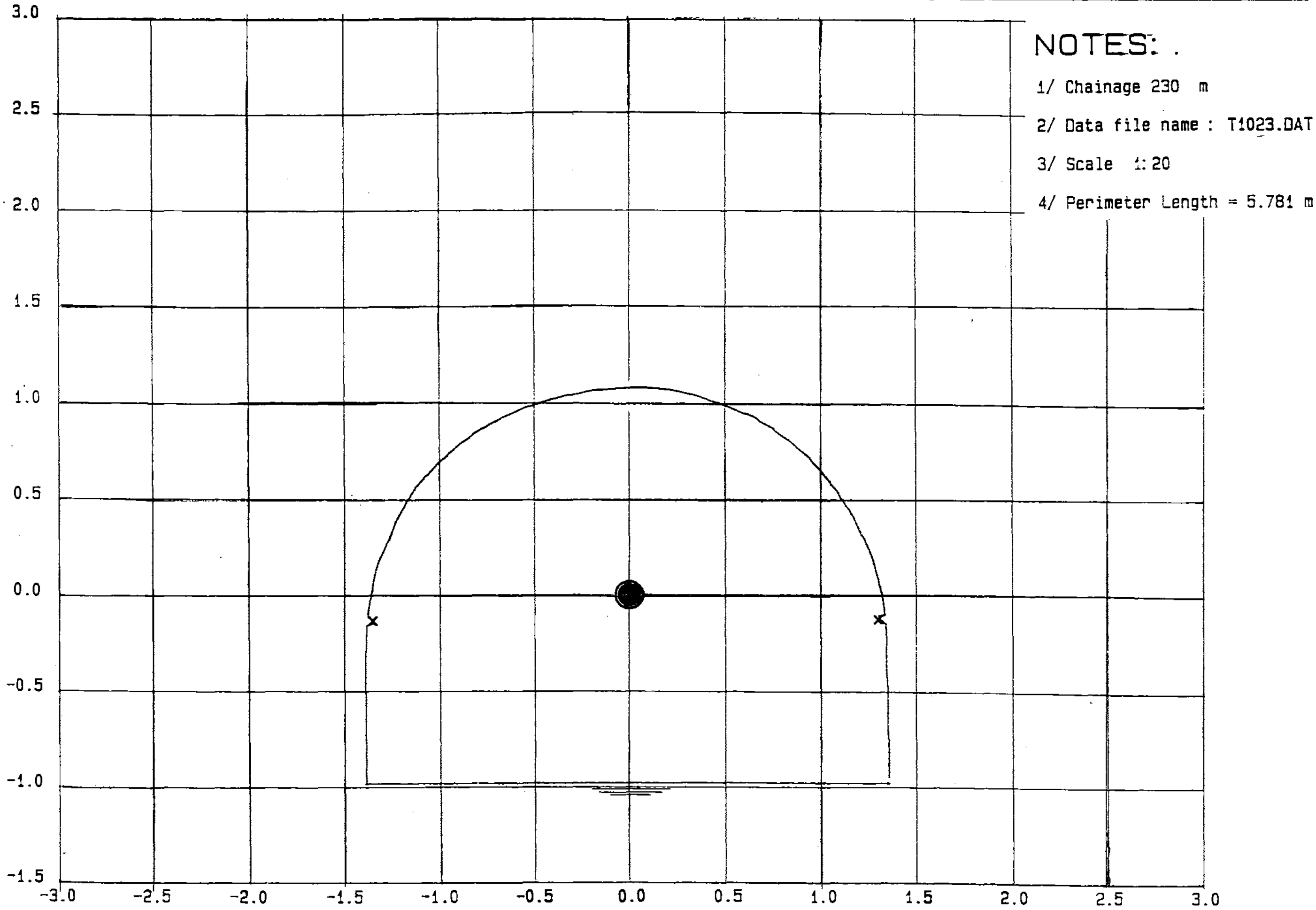
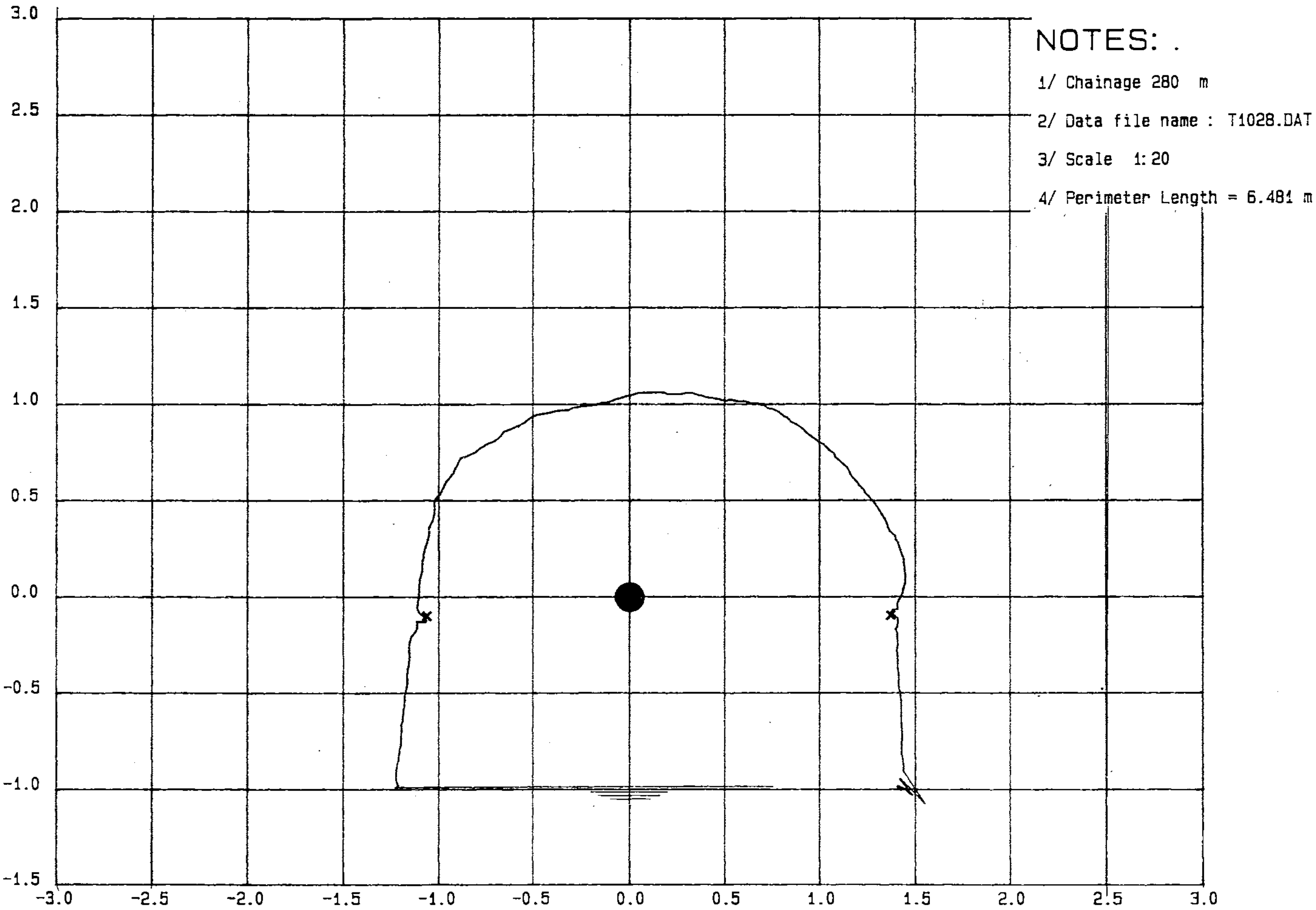
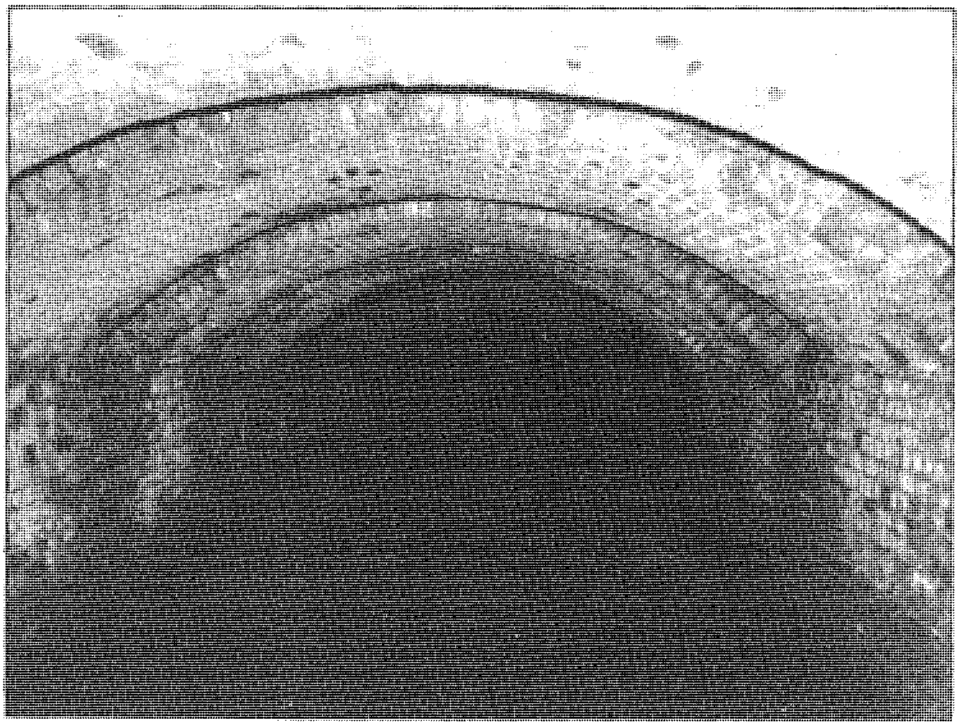
3/ Scale 1:20
4/ Perimeter Length = 6.539 m


NOTES: .
1/ Chainage 230 m
2/ Data file name : T1023.DAT
3/ Scale 1:20
4/ Perimeter Length = 5.781 m


NOTES: .
1/ Chainage 280 m
2/ Data file name : T1028.DAT
3/ Scale 1:20
4/ Perimeter Length = 6.481 m

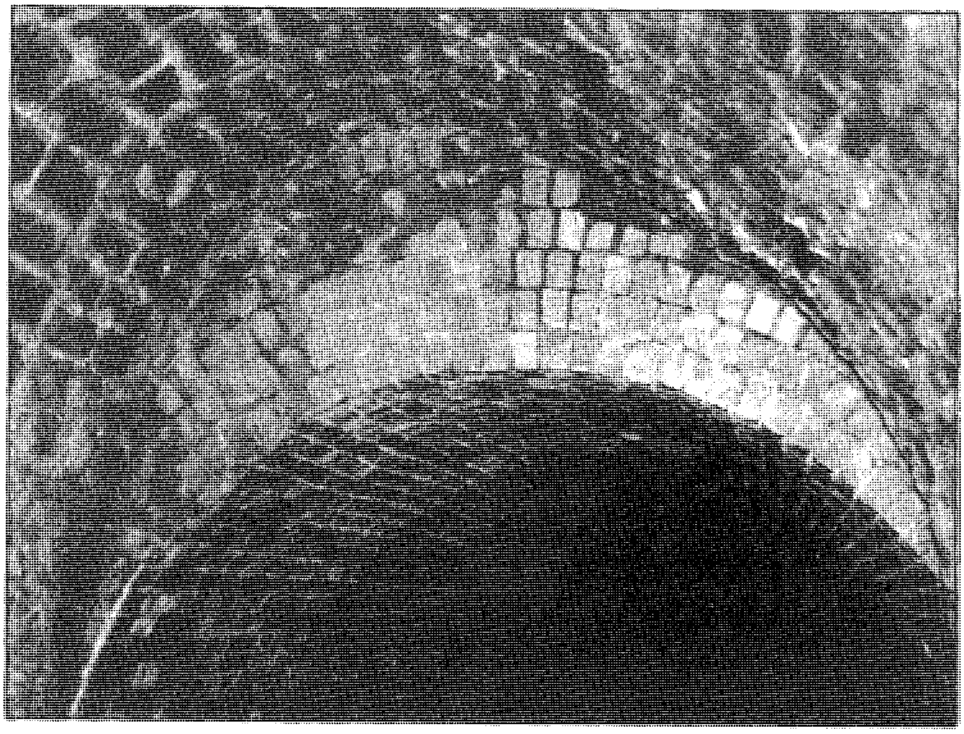
MASONRY LINING.

Nearly sixty per cent of the total tunnel length has been lined during its lifetime by some form of masonry lining. There are sections of stone archwork, dating back to 1811, and also sections of brick archwork, and intermediated brick arches (alternate short sections of arch and rock). The masonry is generally in good condition apart from some sections of stonework where the profile is deformed. The surface is coated in oily soot (also found in the adits), and these deposits are attacking the lime mortar in the masonry. This creates a long term danger that sections could become totally debonded and unstable. It is therefore recommended that all the soot is jet washed off the linings to preserve the condition. The deformed areas need to be monitored to check on any future movement.



A typical example of intermediate brick arches. These are segmental where the canal width is wider than usual.

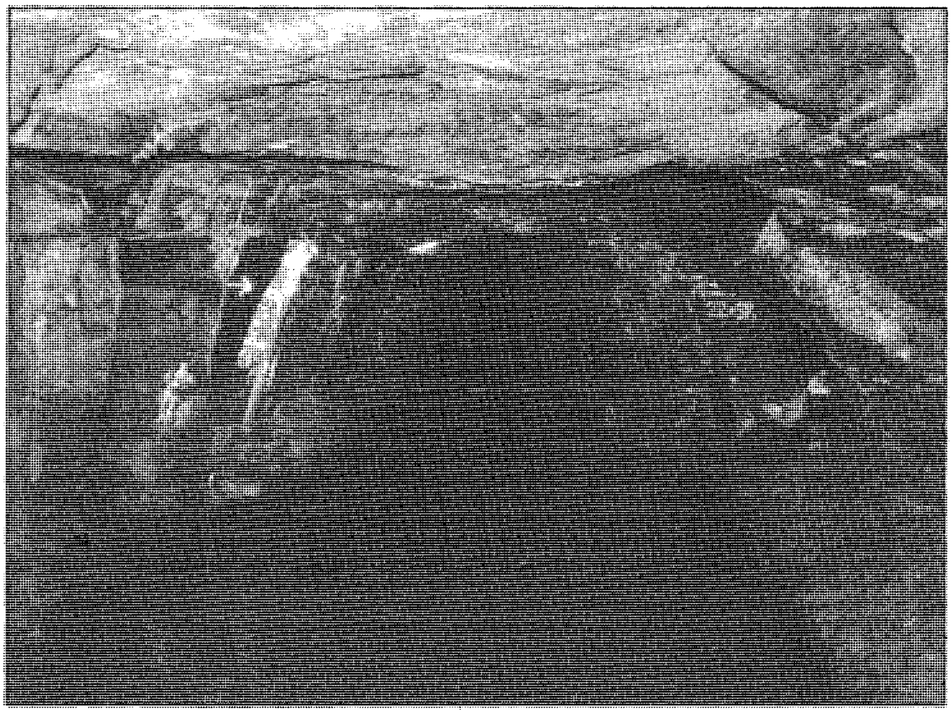
Example of a change of construction from stonework to brickwork. Note the extent of the oily soot encrusted on the walls and roof.



EXPOSED ROCK.

Monitoring.

Exposed rock areas where support is not presently required will still need to be regularly checked for signs of instability. It is recommended that certain areas need to be monitored using simple "tell-tale" gauges so that the potential for collapse can be periodically assessed. The need to carry out any future support work can be through a controlled programme rather than as an urgent expediency resulting from an unforeseen occurance.

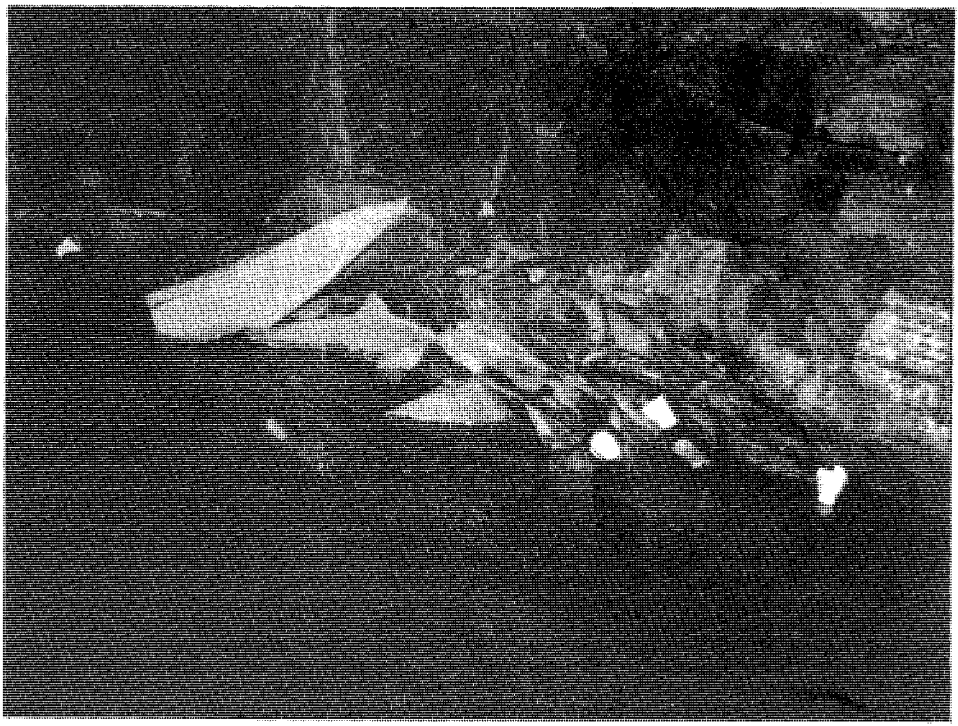


Section of unstable rock. The white arrow on the left indicates a loose slab

Typical example of exposed rock tunnel which has remained unsupported since the tunnel was constructed. Monitoring is recommended however to ensure future degradation is checked.

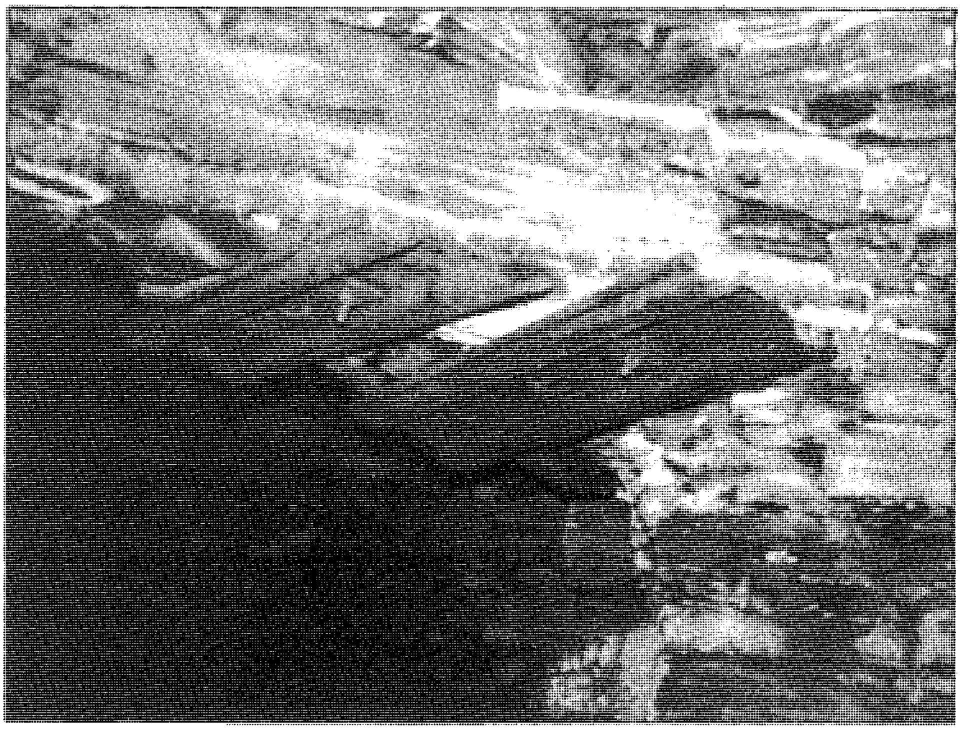
EXPOSED ROCK.

Over forty per cent of the tunnel comprises the unsupported rock that the tunnel was driven through nearly two hundred years ago.
In many sections the drill rod blast holes are still evident in the rock where the drillmen hammered out the shot holes before the face was charged with black powder and fired to advance the tunnel.
Most of the exposed rock now requires supporting and stabilising. During its life the rock is under continuous degradation from weathering, and slow rock mass movements which has created unstable areas. Where the joint patterns are unfavourable, wedges can become dislodged. There exists a major collapse towards the Marsden end of the tunnel which prevents through navigation. The fall has produced a large cavernous area. A similar situation exists towards Diggle where there is a major fault. Previous attempts to arrest the progressive rock fall is evident but this can only be considered a temporary solution.
There are various ways that rock can be supported, depending on the extent and degree of the instability.
Rockbolts can be inserted which bolt the rock back into the rock mass.
A steel mesh can be fixed over the rock surface to prevent spalling. A spray concrete called gunite or shotcrete can be pressure sprayed over the rock surface or a treatment of all three may be used. If however the instability is very severe the only long term solution is a permanent lining which may be masonry, as exists, or concrete segments which form a permanent shield. Steel hoops with an infill panel is also an option.
If water transfer were the only concern a mixture of rockbolts, mesh and spray concrete is adequate for most conditions but where the safety of the public is required, some areas of the tunnel need to be fully lined to ensure there is no risk from rock falls.



Rock fall from the tunnel side walls evident in unstable areas.

Efforts to arrest the rock spalling from the roof can be seen at the location of a major fault.



In total, 486 positions were profiled, these being supplemented by physical measurement where instrumentation measurement was not possible but where an indication of the tunnel shape was needed to provide information for budget costing purposes and show the typical tunnel profile within that area of the tunnel where the instrument could not be used.

4.8 **Invert Probing**

To augment the data obtained by the laser profiling of the tunnel above water level, a system of invert probing was undertaken at each 10m reference location to enable the general shape below water to be determined. This was also carried out from a boat traversing the tunnel and using a system of high water pressure jet probing to facilitate penetration through any silty material lying in the invert to establish base level, or level of hard rockfall debris.

4.9 **Tunnel Dewatering**

On completion of the investigation of the tunnel above water level, the canal was dewatered with the objective of:–

i) Permitting the inspection of as much as possible of the tunnel section below water level.
ii) Verifying that it was physically possible to dewater the tunnel.
iii) Facilitating the taking of silt samples for analysis, it being recognised that the tunnel invert probably contained a high level of siltation, and that the clearance and disposal of the anticipated large amount could present problems Accordingly, knowledge of its composition would be necessary to provide information in respect of silt disposal.

British Waterways personnel, under ARUP supervision, commenced the draining operation on the 10th May 1989.

The dewatering was undertaken in a strictly controlled manner, it being acknowledged that with the removal of the water, the altered regime within the tunnel could further influence its stability to the extent that incidents of rockfalls might be induced.

During the period of draining ARUP Engineers frequently monitored the situation, particularly in the section between ch. 2500 and ch. 3300 where the canal tunnel runs within 3–4m of the operational railway tunnel.

The observations were made several times each day from the adits and crossheading that offered access to the Canal Tunnel.

By the 22nd May 1989 sufficient water had been drained off between head locks at Marsden and Diggle, to give consideration to commencing the inspection. At this time the Diggle end was drained of water, PLATE 29, but the Marsden end contained approximately 500m of water above the silt level of 1 metre depth, PLATE 30. This standing water was due primarily to the non-operation by this date of the Marsden side-sluice, although some ponding within the tunnel was a result of dams created by the rock falls.

Prior to entry being made, and in accordance with Health and Safety Legislation, the tunnel was checked by the Consultants' Safety Officer, who on inspection determined that safe access was not possible due to the depth of silt lying in the invert (1 – 1.5m), which would seriously restrict foot progress along the invert, this constituting danger at an unacceptable level within the unstable tunnel.

Therefore, although the dewatering operation proved that the canal tunnel could be generally drained of water, the level of silt found within the invert prevented the carrying out of a detailed inspection of the tunnel below water level, both in physical terms and on safety grounds.

During the period of draining of the Canal Tunnel, the opportunity was taken to acquire samples of the silt lying within the invert.

EXAMPLES OF TECHNICAL TERMINOLOGY

5. **FINDINGS**

5.1 **Geological**

The section between chainage 1968 and 3377 encompasses dominantly silty sandstone strata at the top of the Grindslow Shale and the base of the Kinderscout Grit. It is also noted that the surface outcrops examined vertically overlie this section, and show the dominant 090°–119° joint direction.

5.1.2 **Types of Rock Mass Discontinuity Present**

The persistent discontinuity directions of 090°–110° and 155°– 165° are likely to relate to the regional structural geology. The 155° – 165° direction is probably related to the important fault at chainage 1078, which trends at 155°.

Many of the discontinuities measured in the tunnel, particularly in the section between chainage 1968 and 3377 do not obviously form part of the tectonic directions and may result from stress release on the rock mass adjacent to the tunnel.

5.1.3 **Bedding Plane Discontinuities**

Within the tunnel rock sections, the bedding plane discontinuities are often poorly developed, particularly within the sandstone strata, where false bedding and locally deltaic forset structures often dominate. In the Shale Grit division particularly, the sandstones often form descrete lenticular masses with a complete absence of 'bedding plane' structures, PLATE 57.

5.3.2. **Permanent Lining**

5.3.2.1 **General**

The permanent lining which represents nearly 60% of the total length of the tunnel consists of brickwork or stonework constructed as either individual arches, continuous archwork or intermediate arches with open natural rock sections.

The majority of the archwork is continuous below water level, although all types of arching were found to be supported off natural rock in places.

The arch construction falls into two categories:–

i) Semi circular arches are usually built with engineering bricks or rough cut stonework, and formed in three courses.
ii) Segmental arches are built with engineering bricks, also in three courses, and generally occurring where the tunnel widens to greater than a typical span.

Where the original tunnel has been extended at the Diggle end, the construction comprises vertical stone masonry walls supporting a steel decking of rolled steel joists with steel plating or small brick arches. These form a bridge for the main railway line above.

5.3.2.2. **Stone Arches**

5.3.2.2.2. **Gauge**

The stonework was constructed to a very tight gauge with joints of 8 – 12mm wide which would have required a high standard of workmanship to achieve.

5.3.2.2.3 **Type and Mortar**

Stonework is of York Stone constructed using a sand/lime mortar.

5.3.2.2.4 **Condition**

The majority of the stonework was found to be in a stable condition. The main concern is the thick sooty deposit (inherited from the days of steam locomotives) which is now encrusted on the tunnel profile throughout its length. These sooty deposits are of a high acidic nature and have been attacking the lime mortar over many years. This has caused the mortar at the surface of the stonework to "boil", becoming friable and falling out of the joints, particularly at the crown of the arches.

From chainage 1338 deformation is evident on the north-west face of the tunnel and at 1348 in the crown. No cracking of the joints was evident, which suggests that the tunnel was either constructed to this profile or the distortion is a result of a very slow process of movement during its life.

At chainages 1363 and 4788, 2m wide steel liner plates cover the perimeter of the tunnel where heavy water seepage suggests the location of two original construction shafts. The steelwork is, in both cases, badly corroded.

5.3.2.3. **Brick Arches**

5.3.2.3.2 **Gauge**

Original brick arches were constructed using a very close gauge with joints between 3 and 6mm thick.

Recent sections of brickwork are constructed using a 10mm thick joint width.

5.3.2.3.3 **Type and Mortar**

All brickwork is constructed in blue or red engineering bricks.

Older brick arches have been constructed using a sand/lime mortar; however, the more recent sections of brickwork are sand/cement mortar.

5.3.2.3.4 **Condition**

The majority of the brick arches were found to be in good condition. The main areas of concern were chainage 3377 to chainage 3436 where some cracking and displacement of horizontal joints is evident, the brickwork generally showing signs of over stressing. From chainage 3447 to 3488 some distortion and cracking of brickwork is apparent. Between chainage 3488 to 3518 brickwork has spalled in the crown and the north west face is noticeably distorted.

5.3.2.4 **Intermediate Brick Arches**

5.3.2.4.2 **Gauge**

The construction of the brickwork to the intermediate arches is similar to that noted for brick arches.

5.3.2.4.4 **Condition**

All intermediate brick arches are generally of sound construction and in good condition. The only area of concern is the section between chainage 2700 and 3298 where the brick arching is supported off natural rock. This section of rock is of poor structural quality and rock spalling is causing undermining of the arch foundations (See Geotechnical Section). Some previous repairs are evident in the form of concrete underpins which are rock bolted to the walls and supported on concrete-filled hessian bags.

British Waterways confirm these works to be of a temporary nature, which makes the effectiveness of these underpins suspect.

5.3.3. **Adits**

5.3.3.1 **General**

During the construction of the two single track railway tunnels (completed in 1849 and 1871), several adits were driven to gain access between them and the canal tunnel. Similarly, to the base of four of the existing ventilation shafts.

Forty-six adits (not including the crossheading accesses to the operational British Rail tunnel constructed in 1894) were noted. These adits occur at random locations throughout the tunnel length and vary in construction, being either fully masonry lined, partially lined, or natural rock (PLATE 31). Several were found to be back-filled and sealed off from the canal.

5.3.3.3 **Condition**

All lined adits were found to be in good condition, the only defect being the sooty deposit which occurs in various degrees to all surfaces and which has affected and weakened the jointing of sand/lime mortar.

5.3.4 **Crossheadings**

5.3.4.1 **General**

Crossheadings provide access over the canal from the disused railway tunnel built in 1849 to the operational railway tunnel built in 1894. A typical example is shown in PLATE 32.

There are fourteen crossheadings (one passing beneath Brun Clough ventilation shaft), of which seven also provide access to the canal.

The structural condition of the crossheadings ranges from seriously degraded, and dangerous in some cases (PLATE 33), to apparently sound (PLATE 34).

SAMPLE:

5.3.4.5 **Crossheading CH 1320 (BR Ref. 237)**

This comprises large timber beams with a timber sleeper decking supported on brickwork at the canal walls. It was noted as being generally sound.

5.3.4.15 **Crossheading CH4828 (BR Ref. 6)**

This comprises timber sleepers spanning transversely to the canal, on secondary timber beams, which rest on primary timber beams across the canal. These are supported by brick, rock and timber bearings (PLATE 40). /the timber is partially wet and highly degraded and the bearing brickwork is in poor condition (PLATE 33).

5.3.6 **Ventilation Shafts**

5.3.6.1 **General**

Of the original construction/ventilation shafts eight remain in existence, the others having been backfilled or possibly capped below ground level, and sealed off from the canal by the lining. Seven of the existing shafts lie directly over the canal, whilst 'Red Brook' down cast is off-set by some 7.9m to the south east. Six of the existing shafts were sunk during the canal works and two were sunk for the double track railway tunnel completed in 1894. Brun Clough, originally a canal shaft, was widened to 6m diameter during the 1894 railway works.

5.3.7 **Ventilation Shaft Base Structures**

5.3.7.1 **Introduction**

Every shaft has some form of structure at its base. It is judged that the primary purpose of these is to intercept falling water and debris.

In general they are all in seriously dilapidated condition, principally due to the effect of falling water on the timbers. There is also distressed and failed brickwork and masonry.

SAMPLE:

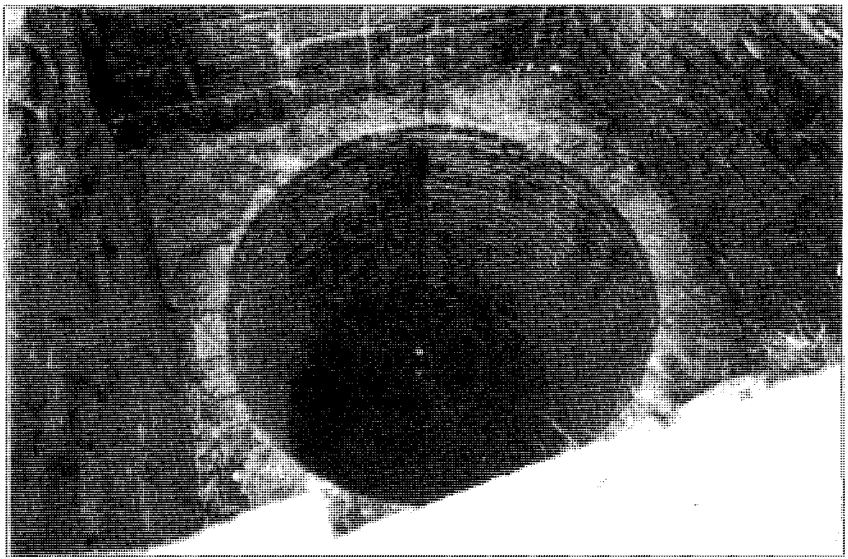
5.3.7.2 **Pule Shaft Ch. 536**

The timber structure at the base was found to be totally rotten, with the majority of it having already callapsed into thje canal. The remaining section contained medium sized (up to 200mm) debris (PLATE 48).

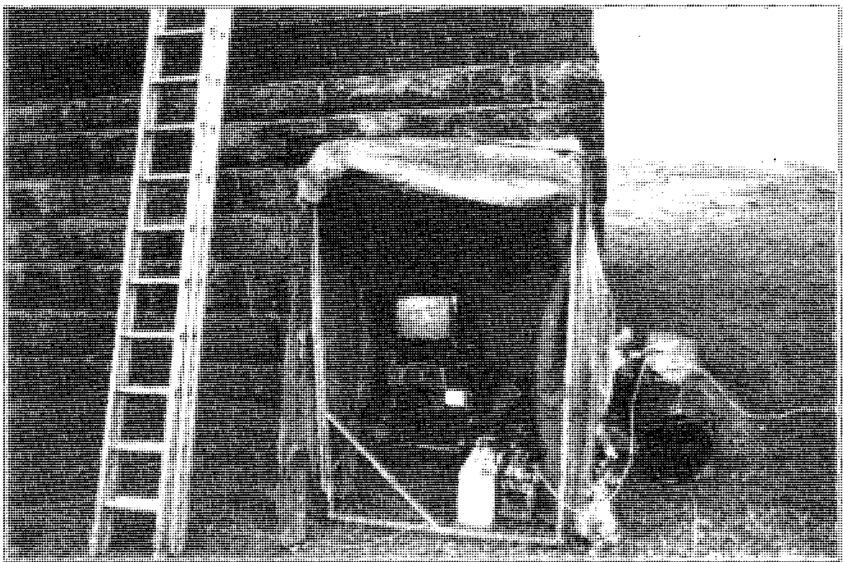
5.3.7.4 **Flint Old Shaft Ch. 1492**

The timber structure at the base of the shaft comprises four large-section timber beams spanning the canal and overlain by sleepers which contains small/medium sized (up to 100mm) debris. These timbers are now heavily saturated and considered to be structurally inadequare (PLATE 49).

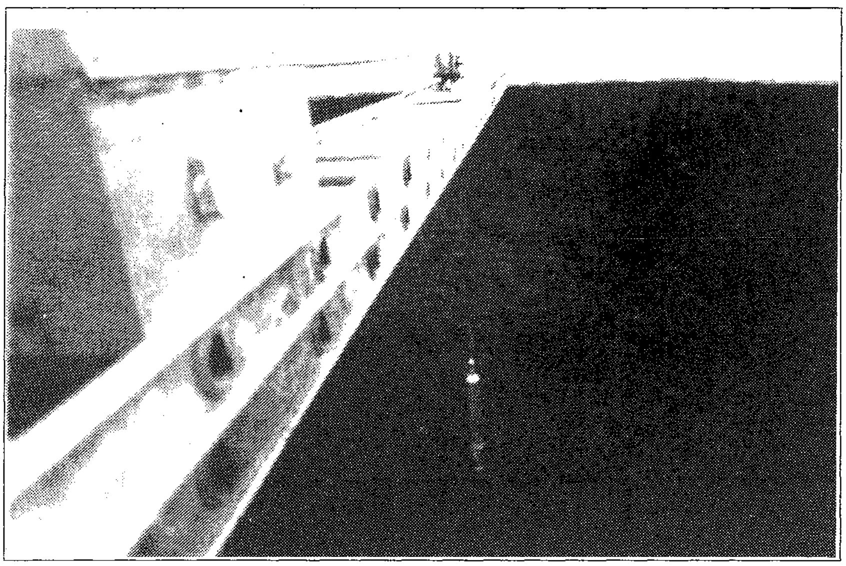
PLATE 4



Pule Ventilation Shaft: BR Ref. 289, Ch. 536
CCTV Camera being lowered



Pule Ventilation Shaft: Mobile TV Monitor and Video



Flint New Ventilation Shaft: BR. Ref. 234, Ch. 1368
Detail of Camera support and lowering mechanism

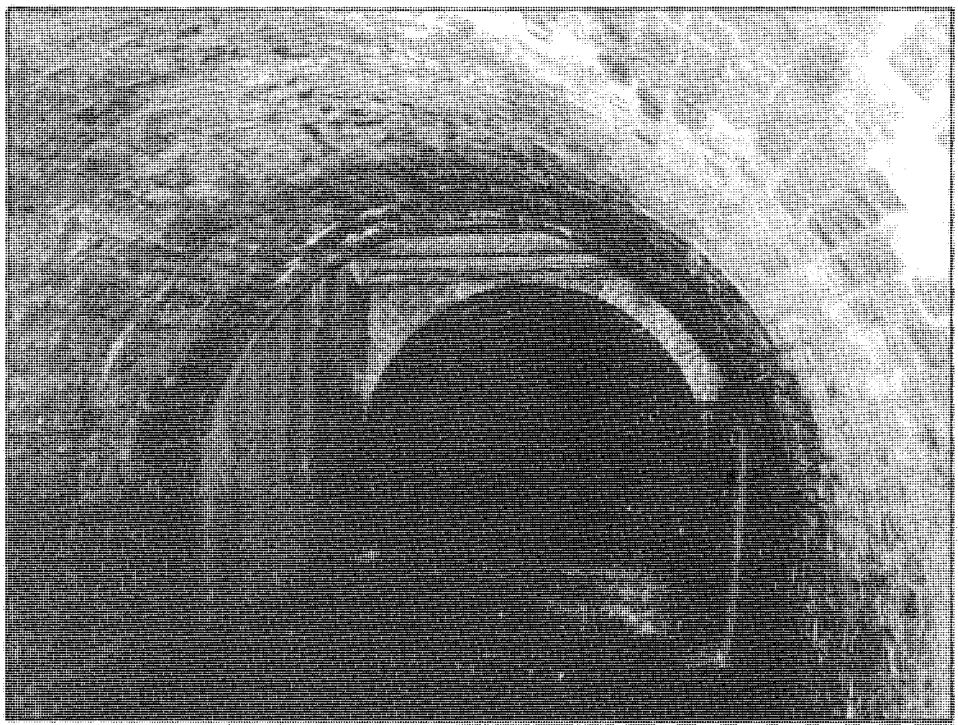
VENTILATION SHAFTS.

There are eight ventilation shafts of which seven are located directly over the canal. The shafts were all inspected by video camera, primarily to view the base structure which consists of heavy timbers spanning the canal, and also to determine their general condition.

The base structures are all in a poor condition and replacement structures are required. These should provide protection from falling debris and redirect the water discharge to the canal sides. A new base structure has been designed which also provides maintenance access.

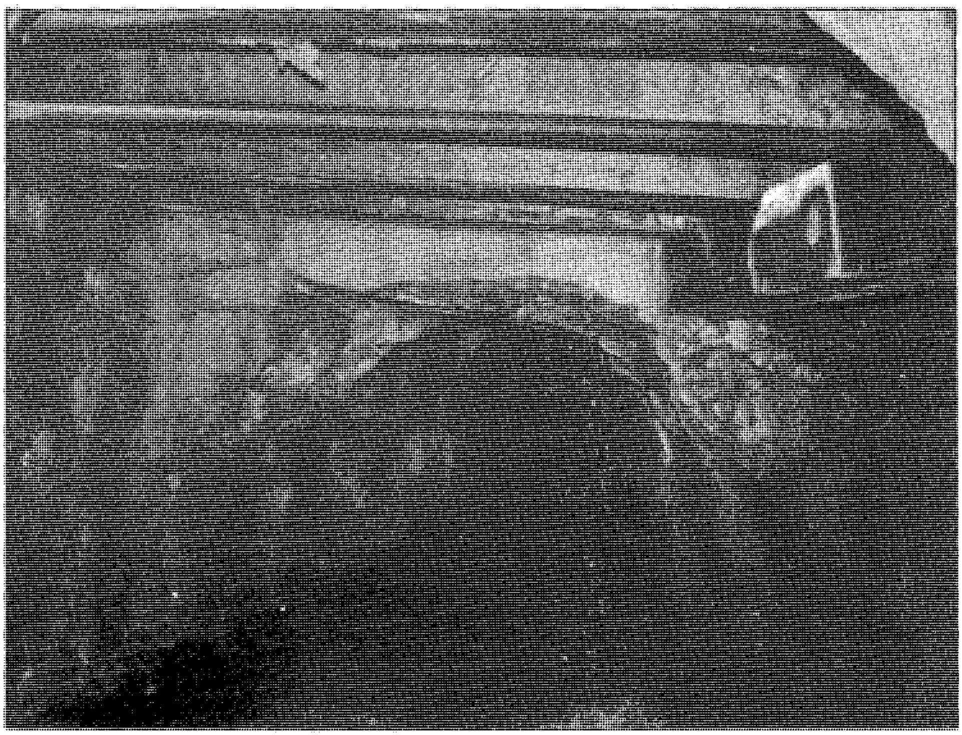
The majority of ventilation shaft chimneys are only partially masonry lined. The video inspection did not indicate any obvious areas where collapse was imminent. It is recommended that consideration be given to installing additional lining to all of the shafts which lie directly over the canal for the total safety of canal tunnel users.

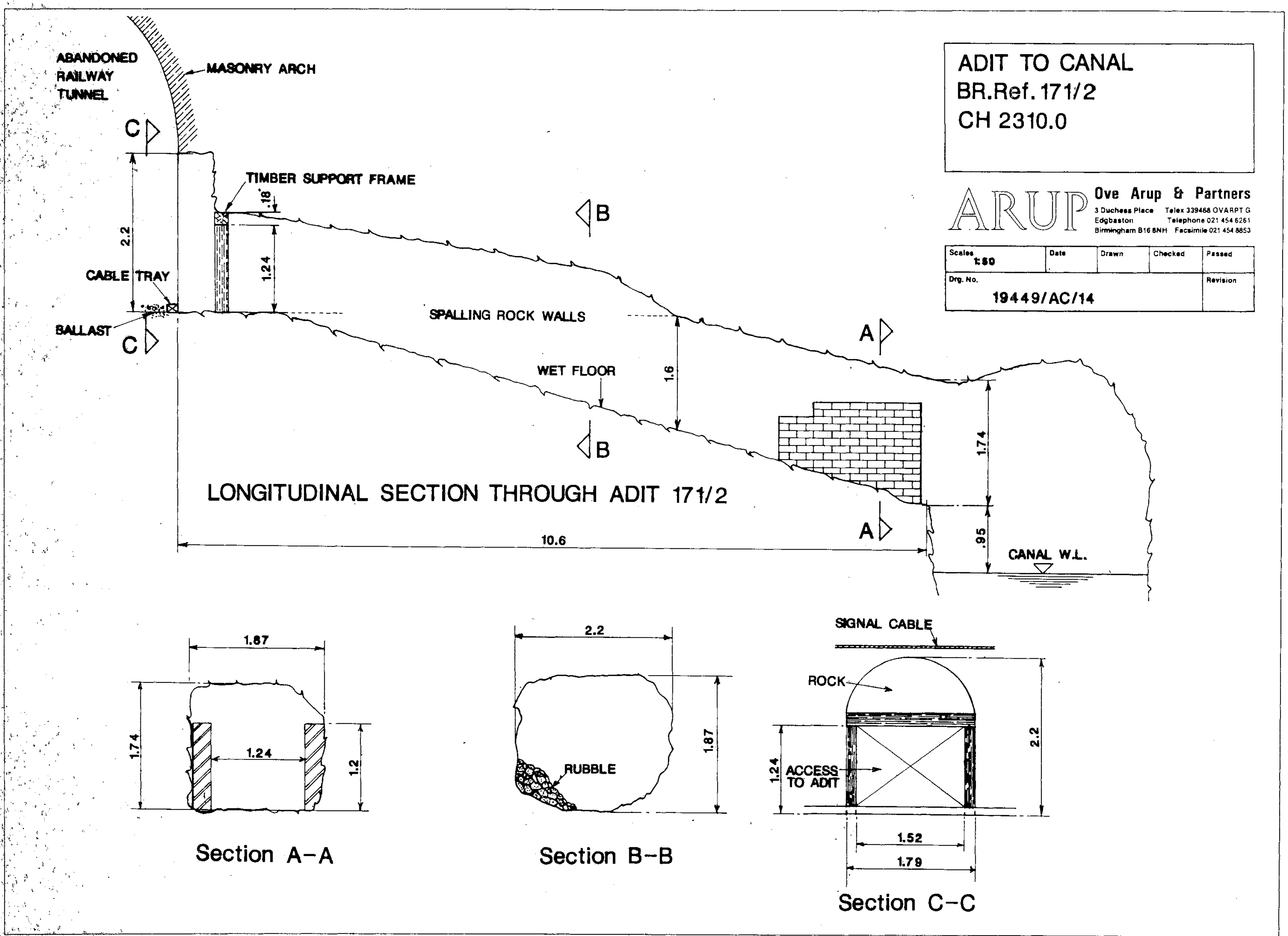
Based on the observations made, the extension lining could be in the form of a metal cage with sprayed concrete. All existing linings require joint repair.



Pule ventilation shaft. The base structure is totally decayed and water is freely pouring down into the canal.

Flint old ventilation shaft. The water downpour has coated the rock wall with iron oxide.




ADIT TO CANAL
BR.Ref. 171/2
CH 2310.0
ARUP
Ove Arup & Partners
3 Duchess Place Edgbaston Birmingham B16 8NH
Telex 339468 OVARPT G
Telephone 021 454 6261
Facsimile 021 454 8853
Scales 1:50
Date
Drawn
Checked
Passed
Drg. No. 19449/AC/14
Revision
ABANDONED RAILWAY TUNNEL
MASONRY ARCH
TIMBER SUPPORT FRAME
CABLE TRAY
BALLAST
SPALLING ROCK WALLS
WET FLOOR
CANAL W.L.
LONGITUDINAL SECTION THROUGH ADIT 171/2
2.2
.18
1.24
1.6
1.74
.95
10.6
Section A-A
1.87
1.74
1.24
1.2
Section B-B
2.2
1.87
RUBBLE
Section C-C
SIGNAL CABLE
ROCK
ACCESS TO ADIT
1.24
2.2
1.52
1.79

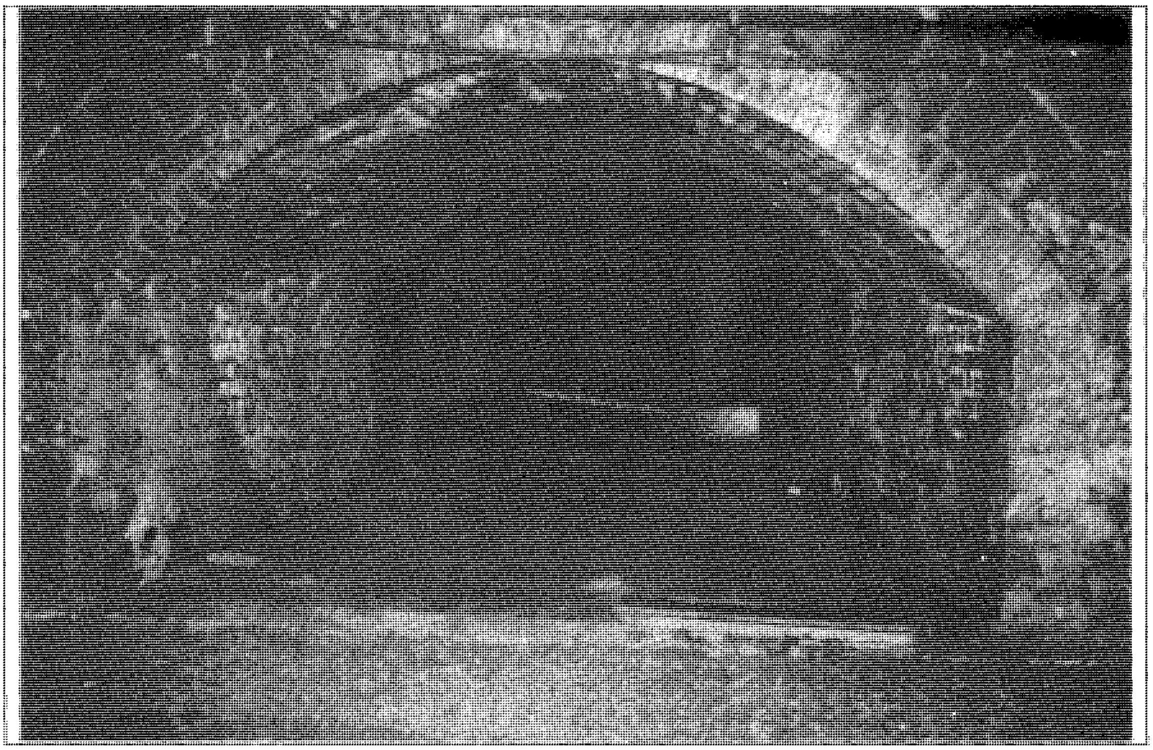


PLATE 8
Pule Ventilation Shaft, BR. Ref. 289, Ch. 536
Figure 19449/AC/3 Appendix Volume 2
Photograph taken from disused Northern Rail Tunnel.

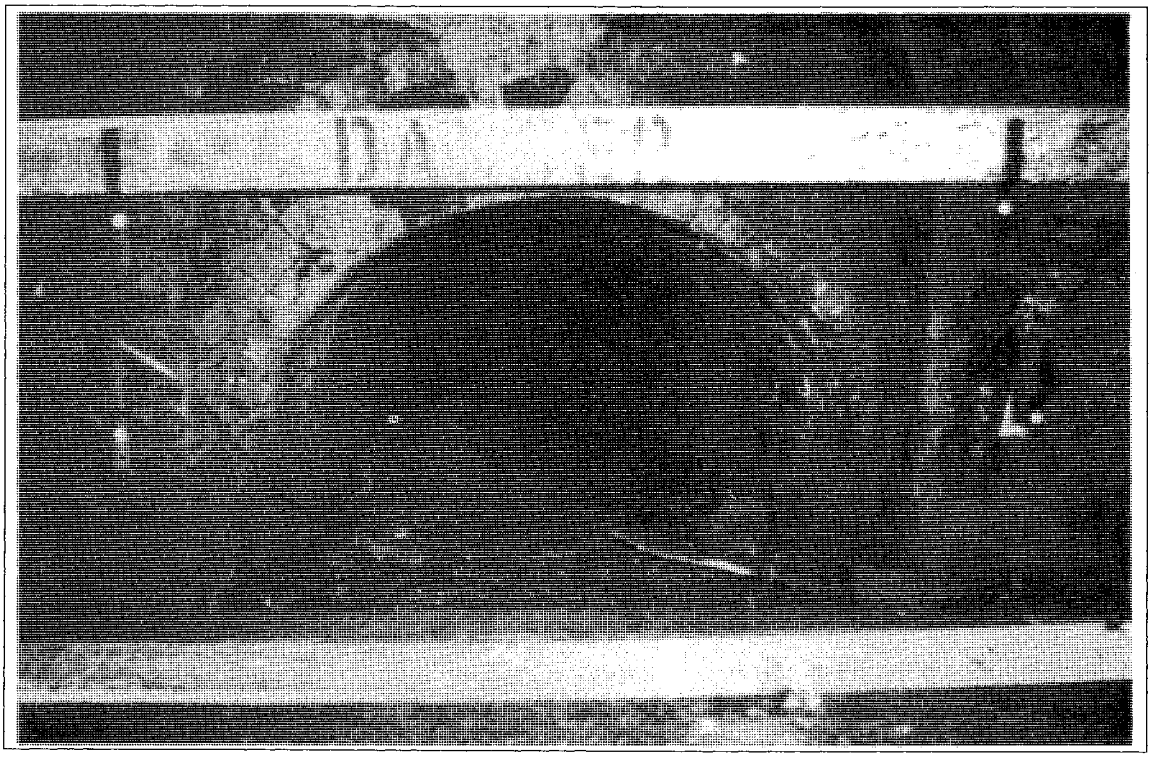


PLATE 9
Adit to Canal, BR. Ref. 287, Ch. 563, Figure 19449/AC/4
Appendix Volume 2
Photograph taken from disused Northern Rail Tunnel

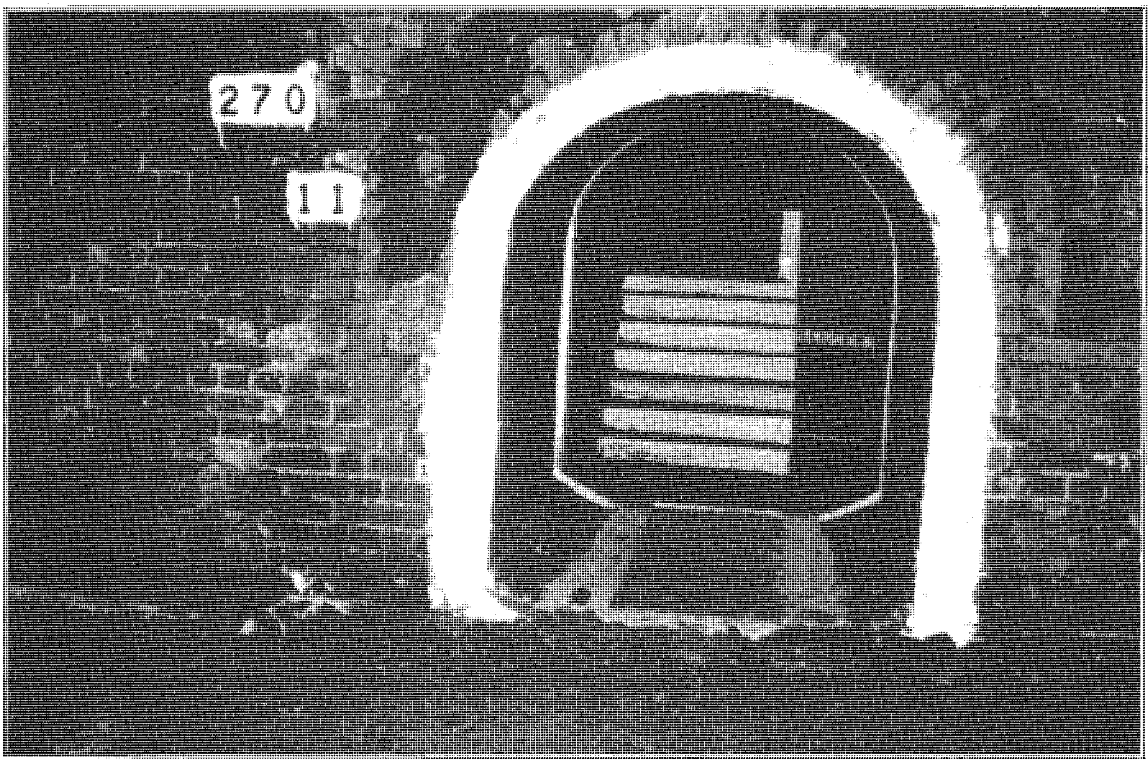
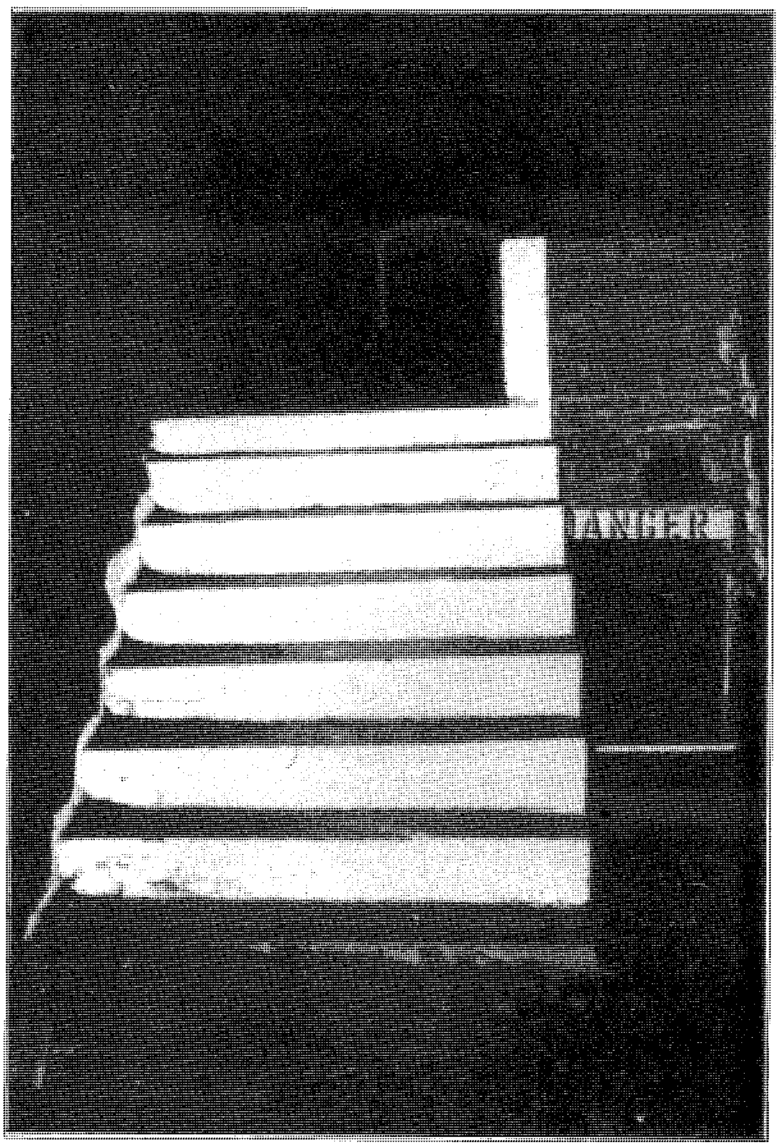


PLATE 10
Crossheading BR Ref. 270, Ch. 821.
Figure 19449/AC/5, Appendix Vol. 2
Photograph taken from disused Rail Tunnel.



View of Crossheading.
Note Canal access to right-hand side.

HUDDERSFIELD CANAL SOCIETY

NOTICE IS HEREBY GIVEN THAT THE TENTH ANNUAL GENERAL MEETING OF THE ABOVE-NAMED COMPANY WILL BE HELD AT THE MARSDEN CONSERVATIVE CLUB VICTORIA STREET MARSDEN HUDDERSFIELD WEST YORKSHIRE ON SUNDAY THE 22nd DAY OF APRIL 1990 AT 11.30 a.m.

TO TRANSACT THE FOLLOWING BUSINESS

A. To receive and adopt the Accounts for the Company for the year ending 31st December 1989 together with the report of the Council of Management and of the Auditors thereon.

B. To re-elect Messrs. Revell Ward of Huddersfield as Auditors and to authorise the Council of Management to fix their remuneration.

C. To re-elect David M. Sumner as a Member of the Council of Management retiring by rotation.

D. To re-elect Trevor Ellis as a Member of the Council of Management retiring by rotation.

E. To re-elect Leslie C.D. Winnard as a Member of the Council of Management retiring by rotation.

F. To re-elect Sue Chadwick as a Member of the Council of Management retiring by rotation.

G. To re-elect Kenneth Goodwin as a Member of the Council of Management retiring by rotation.

H. To consider any other nominations.

I. Any other Business.

"(i) That the number of the Members of the Council of Management shall not be less than five nor more than twenty-five including the Treasurer and Secretary".

DATED the SEVENTH day of FEBRUARY 1990

By Order of the Council

J.M. Fryer, Company Secretary

Registered Office: Ramsdens, Ramsden Street, Huddersfield, HD1 2TH.

NB. A Member entitled to attend and vote at the Meeting is entitled to appoint a proxy to attend and vote on his/her behalf. A proxy must be a Member of the Company.

FORM OF PROXY

I/WE ____________________

of ____________________

in the County of ____________ being a Member/Members of the above-named Society hereby

appoint ____________ of ____________

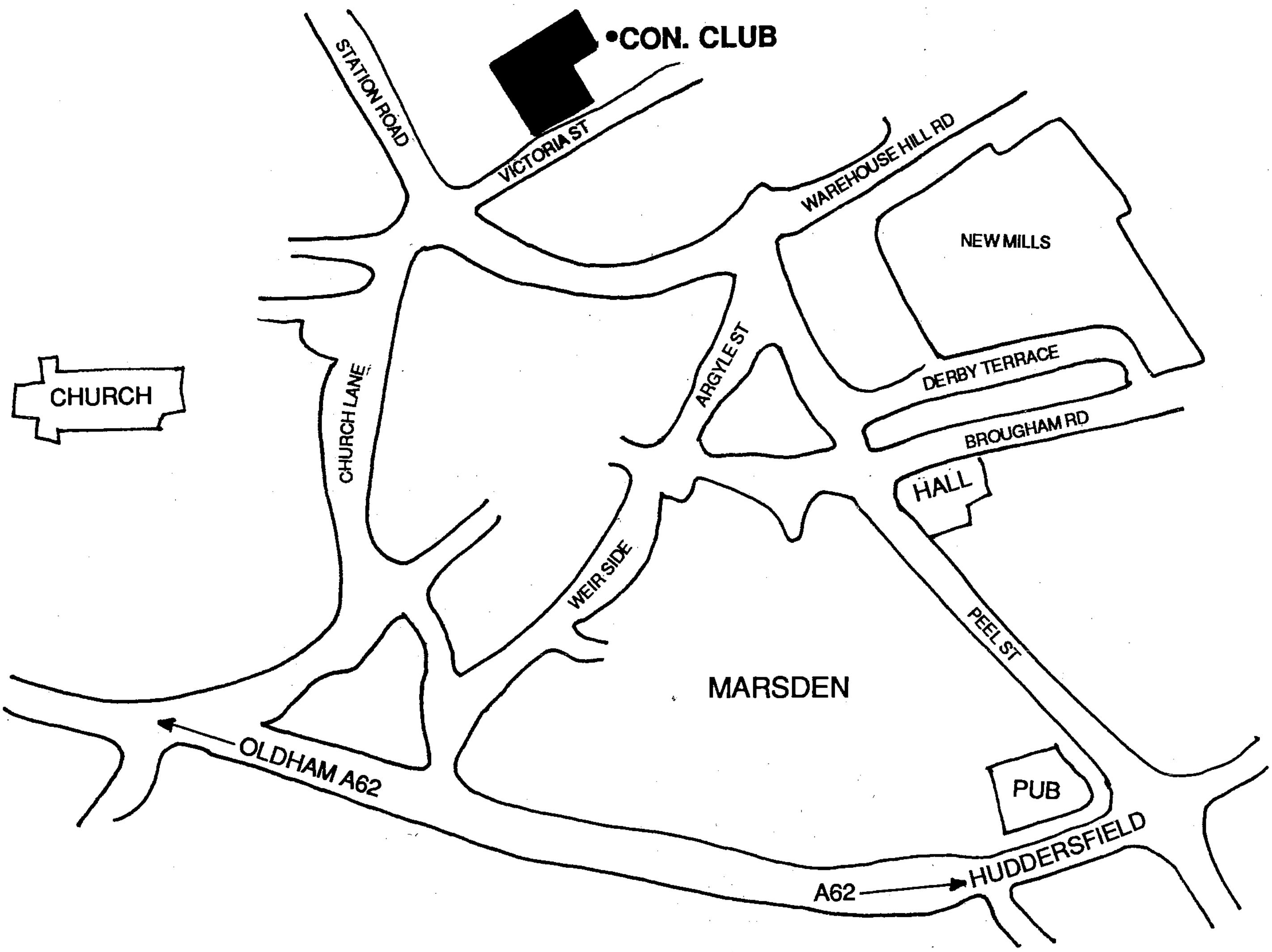
as my/our proxy to vote for me/us on my/our behalf at the Annual General Meeting of the Society to be

held on the ________ day of ________ 1990 and at any adjournment thereof.

Signed ____________________

DATED this ____________ day of ____________ 1990

A.G.M. – HOW TO GET THERE ....



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Rochdale Canal Book	£1.15 + 30p p & p

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" "	XXL	Pale blue only	£9.50 + 50p p & p
HCS Tee Shirts:	S, M, L & XL	Red & blue logo on white	£4.50 + 30p p & p
Digglettes with "I swam through Standedge Tunnel" label			35p + SAE

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set of three — £12.00

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I/We wish to join the Huddersfield Canal Society.

Name/s

Address

Postcode   Telephone

Occupation

Amount enclosed £   Cheque/PO/Cash

I heard about the Society from

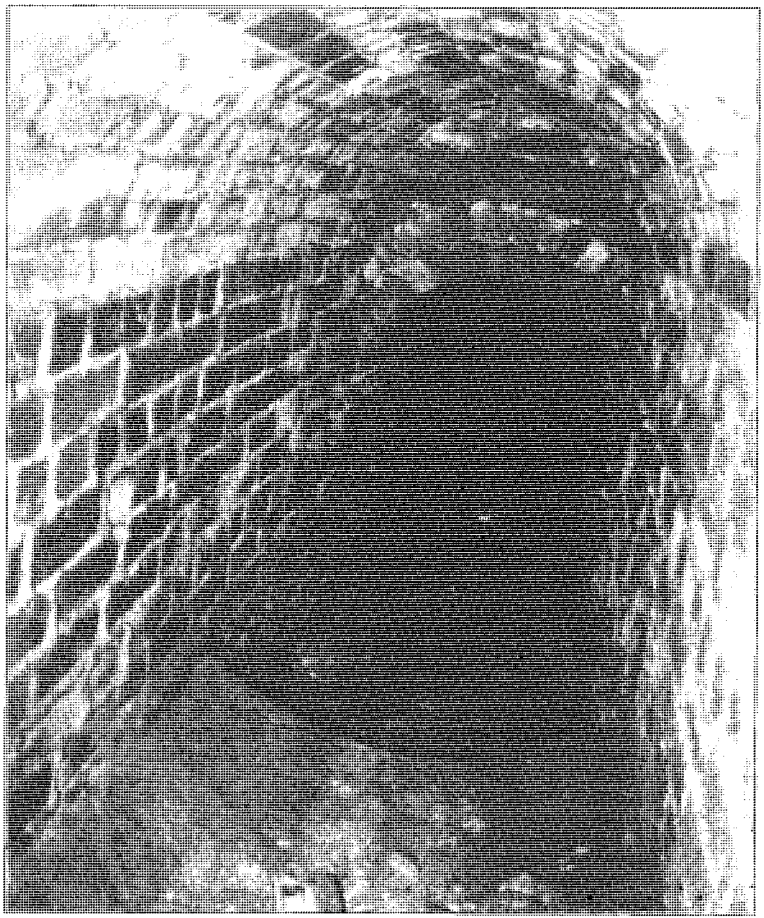
MEMBERSHIP RATES: Family Membership: £6.00 Junior (under 18): £2.00 Associate: £10.00 (Voluntary Society's) Corporate: £20.00 (min.) Life: £75.00

If elected I/we agree to abide by the Memorandum and Articles of Association of the Company.

To: Membership Secretary,
Huddersfield Canal Society,
10 Hightown Lane, Holmfirth,
Huddersfield, HO7 1HY

Fold to show HCS address in window envelope

PLATE 11
Adit to Canal, BR Ref. 253/4, Ch.1070.
Figure 19449/AC/6 Appendix Vol. 2
Photograph taken from disused
Northern Rail Tunnel.



View into Adit

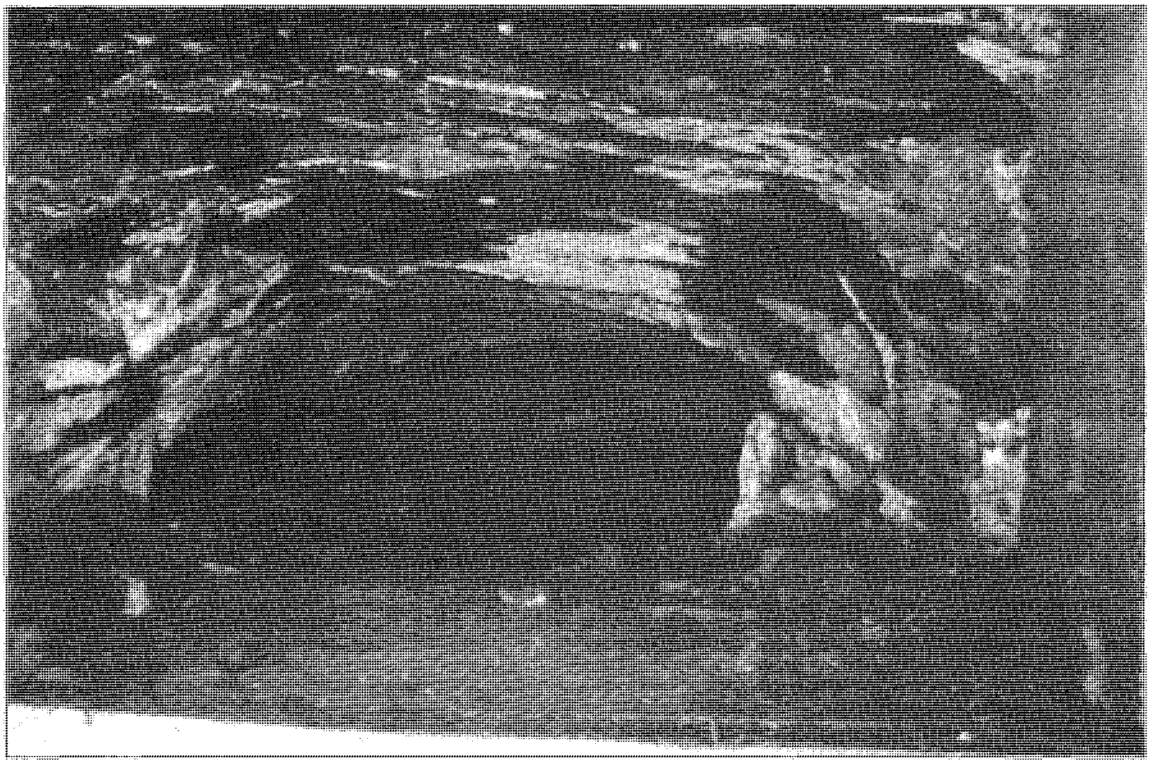


PLATE 20
Adit to Canal. BR Ref. 135/6, Ch. 2863 Figure 19449/AC/15
Appexdix Volume 2.
Photograph taken from disused Northern Rail Tunnel

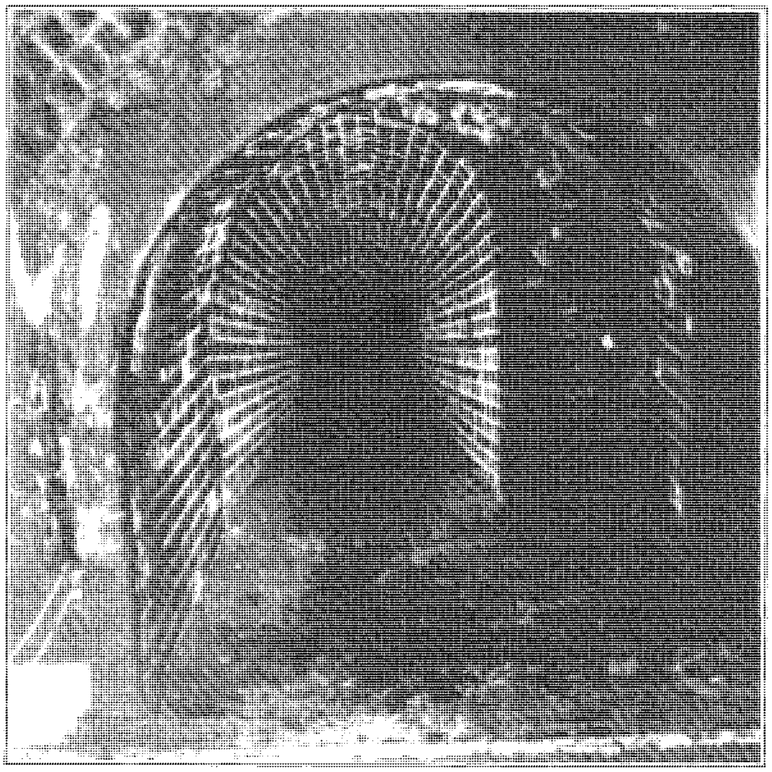
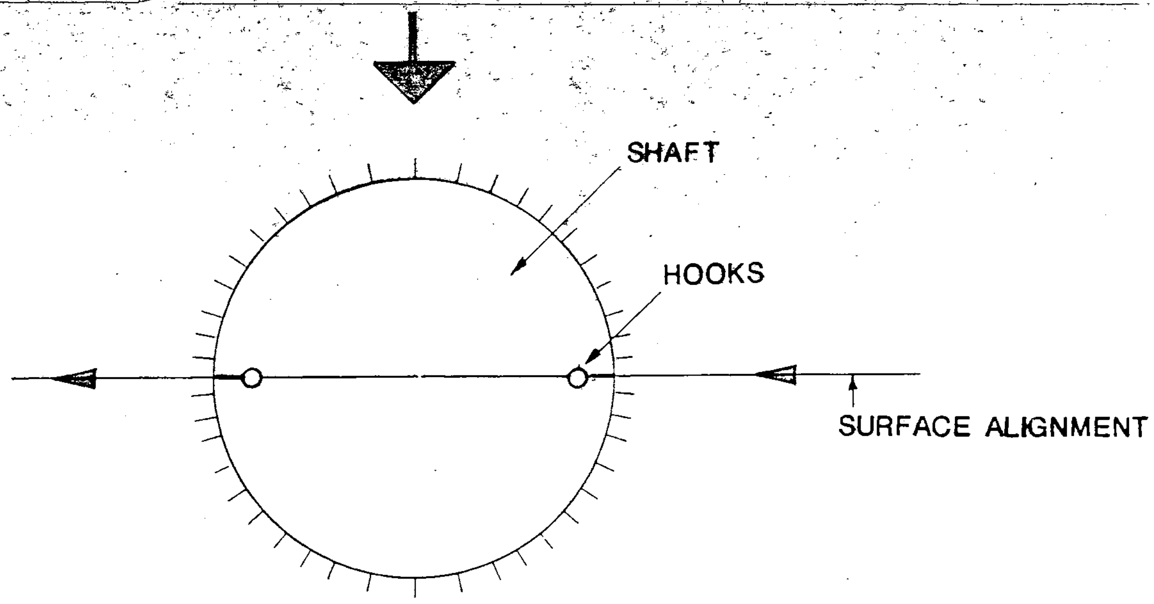


PLATE 23
Adit to Canal. BR. Ref. 87, Ch. 3599. Figure 19449/AC/18,
Appendix Volume 2.
Photograph taken from disused Northern Rail Tunnel.



PLAN

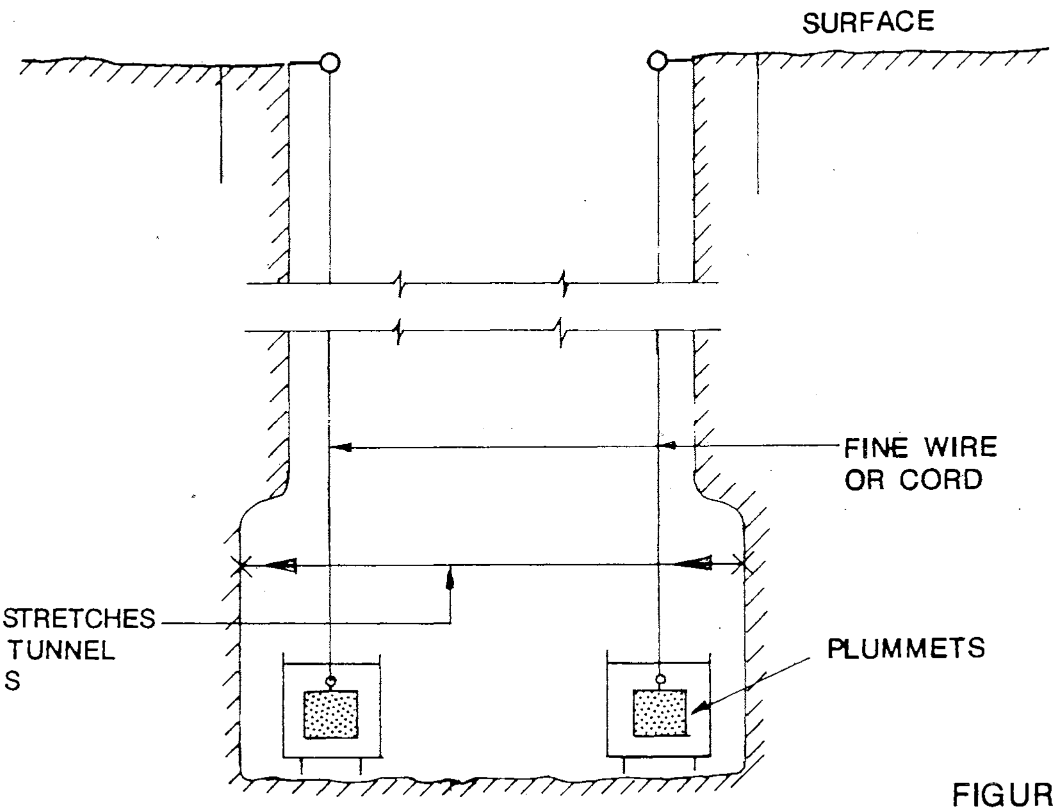


FIGURE 5

SECTION

TUNNEL ALIGNMENT

ARUP

5.3.8. **Miscellaneous**
5.3.8.1 **Tunnel Extension under Railway Line**
5.3.8.8.1 **General**

The original canal tunnel was extended in 1894 to allow the new railway to pass over the top at the Diggle end.

The section from Ch. 4930 to the "new" Diggle portal at Ch. 5190 was consequently bridged by a method of "cut and cover", the system adopted utilising steel decking, supported off vertical stone masonry walls.

5.3.8.1.4 **Condition**

Although in its present condition the cover structure is apparently able to support the ground works above, there is concern about its integrity and ability to continue to safely withstand the heavy rail traffic without major repair.

6.3 **Geotechnical**
6.3.1 **Historical Events**

Records of construction show that significant problems were experienced, through water inundation, roof falls, deaths, etc. These all related to rock conditions encountered during the driving of the canal and the parallel railway tunnels.

6.3.2 **Findings from the Field Work**

Many of the geological features which were the cause of construction problems are still evident, and are affecting the weathering process and natural degradation of rocks within the tunnel.

SAMPLE:

Ch. 900 – 1078

This predominantly lined section passes through the top of the Kinderscout Grit sandstone horizon. There is a fault at about Ch. 1078. The strata is variable, probably with many discontinuities associated with the fault. Between Ch. 998 and Ch. 1010, a length of rock roof is exposed, which appears to be in good condition. The original shot firing holes can still be identified in the roof, which indicates that no rock has fallen off since blasting took place during driving of the tunnel.

Ch. 1078 – 1230

The Kinderscout Grit is exposed over this section, and is assessed by the CSIR classification as fair rock. This rating is the best recorded in the tunnel and is confirmed by the lack of support needed over this length.

Ch. 1370 – 1480

A major roof fall has occurred at Ch. 1388, and has resulted in a large unstable dome above the tunnel. The fall is at the location where the lower thick coal seam in the Kinderscout Grit was exposed in the tunnel roof. The coal seam would provide a weakness in the strata, and the weathering process would reduce the stability of the rock until collapse occurred.

Ch. 4815 – 4830

This is the final section of tunnel where rock is exposed. The Shale Grit is a massive bedded sandstone with some open joints. There is potential for block failure, which is reflected in the "poor rock" CSIR rating.

Ch. 4830 – 5190

The entire length of tunnel through the thickly bedded sandstones of the Shale Grit is completely lined. It is presumed that lining was necessary due to disturbance of the rock structure by faulting.

6.3.3. **Summary**

To summarise, the present day condition of the tunnel reflects both the geological conditions encountered during construction and the process of weathering and degradation which has occurred since completion. Many sections of the tunnel have been supported, either during construction of at some time after, to combat the effects of the rock mass structure or faulting. The unlined areas of the tunnel may have been stable during construction, but the effects of degradation over time has reduced the stability and resulted in many falls within the tunnel.

6.4 **Lined Tunnel Sections**

The detailed inspection of the lined sections of the tunnel showed them to be generally in a satisfactory condition with only a few localised areas requiring consideration of repair work.

Even in these areas it is recommended that there is no need to dismantle the lining and reconstruct it, such an operation being extremely costly and, without the knowledge from a detailed investigation of the rock behind the lining, releasing the stressing to the arch, could induce greater problems than currently exist.

Such problems are typified by minor profile distortion and joint displacement, also masonry spalling and jointing material degradation caused by soot deposits.

Accordingly, an approach is considered under the Remedial Work Section whereby a system of monitoring points be established at such locations within the tunnel to determine the degree of movement, if any, in the lining.

This method of approach, together with some minor repair works, is considered to be the most cost effective, based on the findings of the condition survey. It is important that the monitoring stations be established prior to the tunnel being opened to the public and a programme for checking the stations be established and adhered to such that any possible further movement in the lining can be identified at an early stage.

The results of the monitoring will determine the level and timing of any future remedial works to the lining and will permit use of the tunnel for public navigation without high capital expenditure in the immediate term.

6.4.1 **Intermediate Brick Arches**

At a number of locations between Ch. 2700 to Ch. 330 there is a series of intermediate brick arches, comprising alternate short sections of lined arch and rock. The detailed inspection of the brickwork showed them to be in a good condition throughout. Inspection of the supports to the arches showed that some repair works had taken place and that more was needed.

6.5 **Adits and Crossheadings**

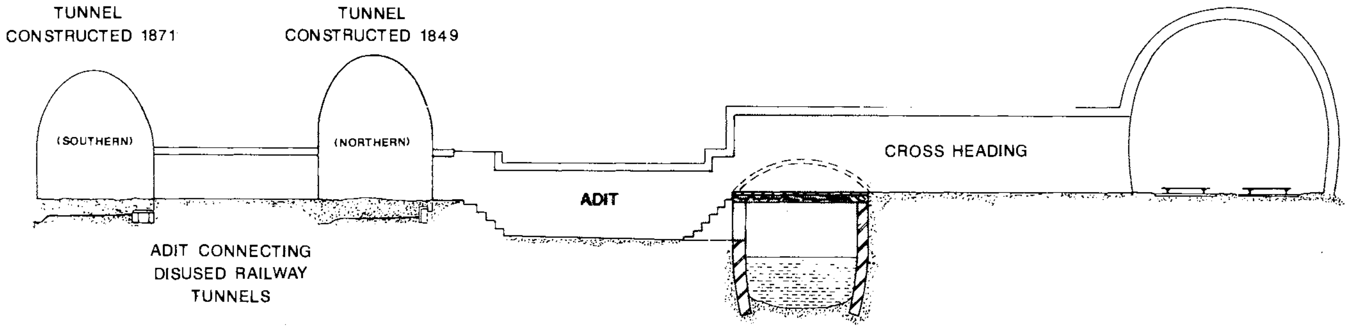
Numerous adits and crossheads form part of the Standedge canal and railway tunnels system.

The adits (lined and unlined), of which there are 46 in total, form a direct link between the disused railway tunnels (built in 1849/1871), and the canal. The crossheadings (all lined), comprising 14, form the link between these tunnels and the operational double railway tunnel (1894). Seven of the crossheadings provide limited access into the canal tunnel.

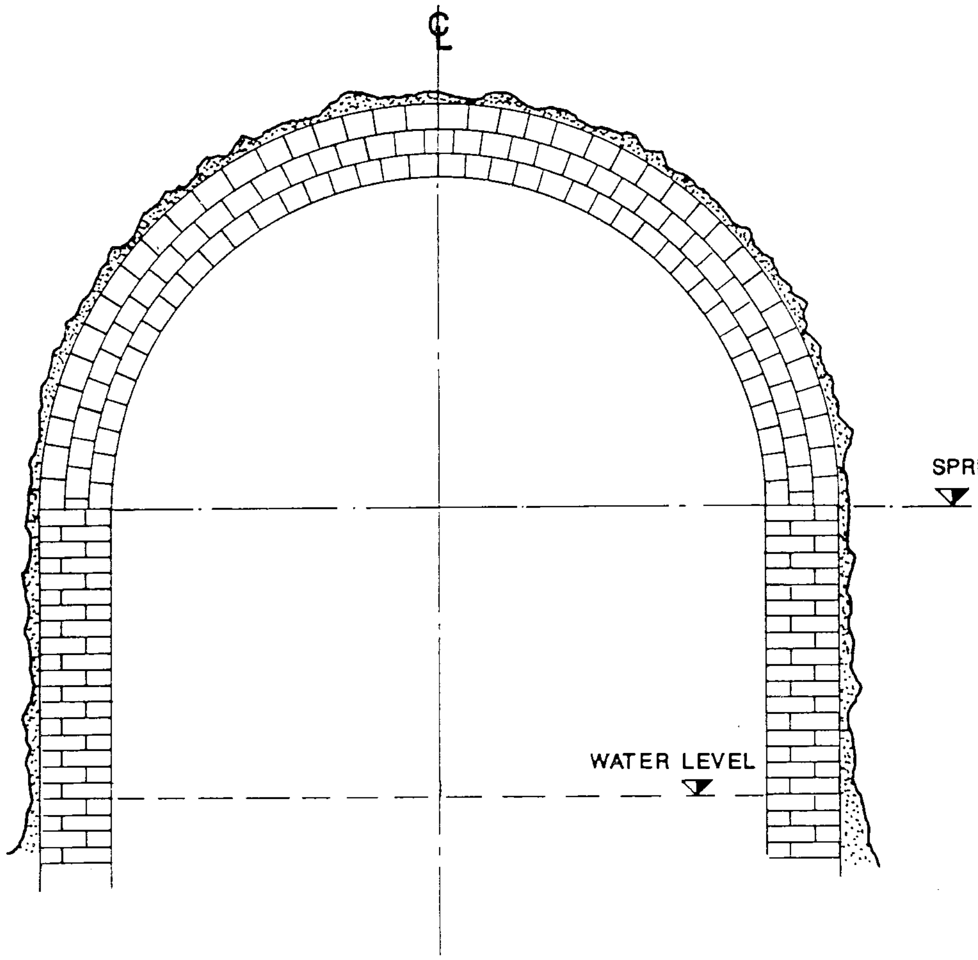
In surveying the condition of the adits and crossheadings, in terms of their effect on the canal tunnel, note was taken of their potential for providing feature areas within the tunnel, such details being advised to the Leisure Consultant for evaluation.

Two adits at chainages 1070 and 4830, being lined and of large size, offer immediate potential for public access with little capital expenditure being required on them.

Others (some three) within the central area of the tunnel, being cavernous and unlined, offer potential for development as interest points, but require considerable sums being spent to make them stable.

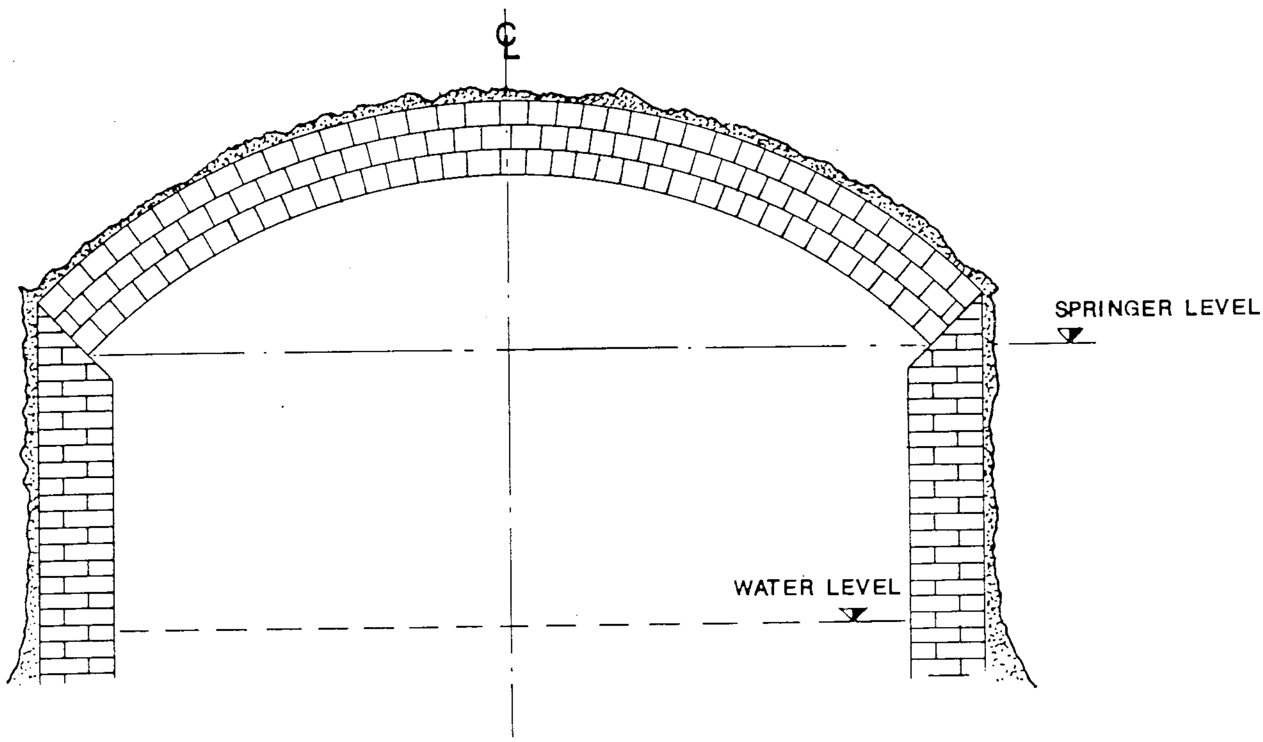


Cross section viewed towards Diggle.



TYPICAL SEMICIRCULAR BRICK ARCH

Fig. 31



TYPICAL SEGMENTAL BRICK ARCH

Fig. 32

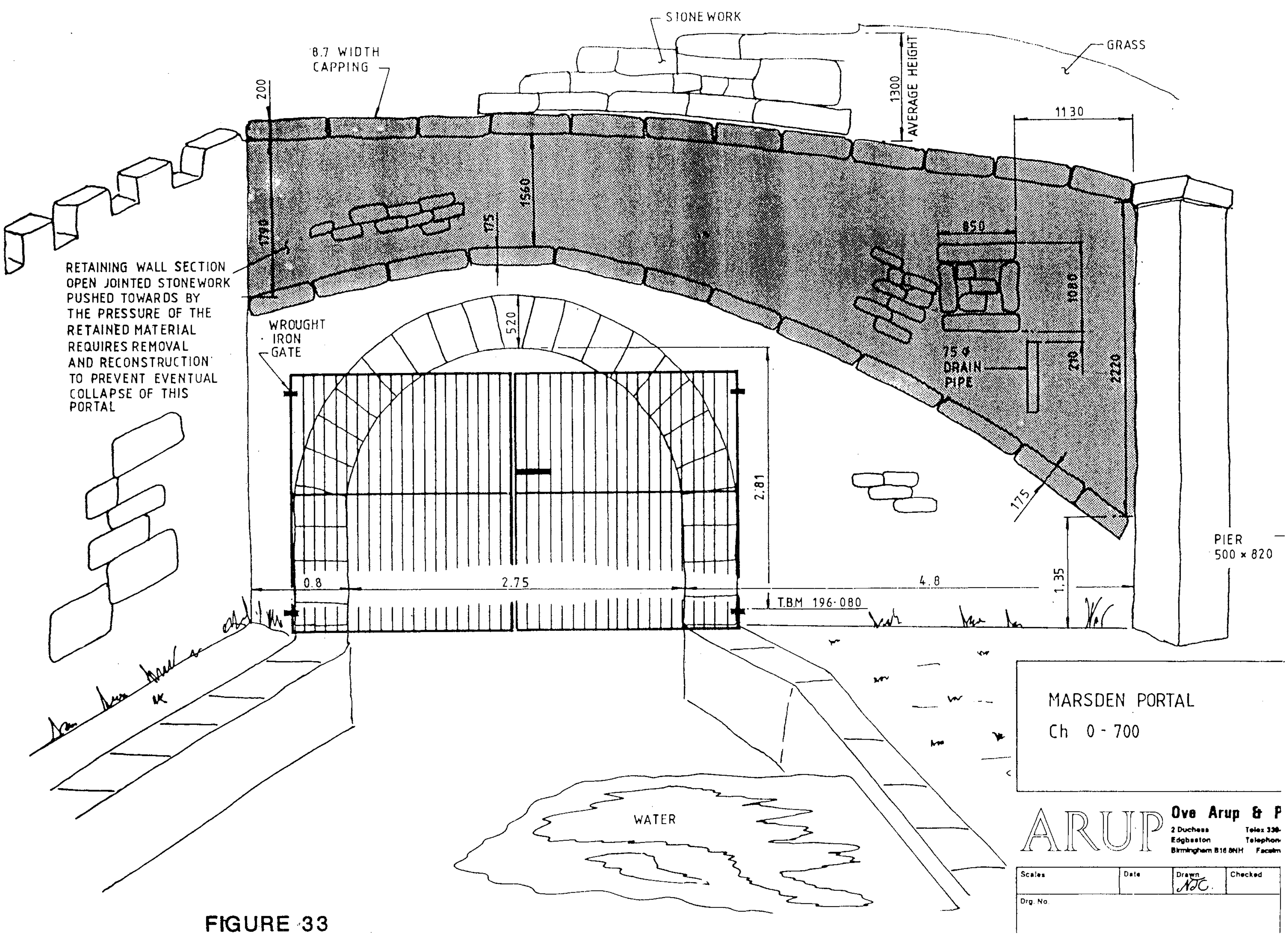

STONEWORK
GRASS
8.7 WIDTH CAPPING
200
1300 AVERAGE HEIGHT
1130
1560
175
1790
850
1080
210
2220
75 ⌀ DRAIN PIPE
RETAINING WALL SECTION OPEN JOINTED STONEWORK PUSHED TOWARDS BY THE PRESSURE OF THE RETAINED MATERIAL REQUIRES REMOVAL AND RECONSTRUCTION TO PREVENT EVENTUAL COLLAPSE OF THIS PORTAL
WROUGHT IRON GATE
520
2.81
175
PIER 500 x 820
0.8
2.75
4.8
1.35
T.B.M 196·080
WATER
MARSDEN PORTAL
Ch 0 - 700
ARUP
Ove Arup & P
2 Duchess
Edgbaston
Birmingham B16 8NH
Scales
Date
Drawn
Checked
Drg. No.

FIGURE 33

6.6 **Structures**

The canal tunnel is spanned by numerous structures through its length. These comprise timber crossheading "bridges" and ventilation shaft base structures for containing fallen debris, also the metal "bridge" extension at the Diggle end which carried the operation railway over the canal.

All were found to require attention either in the way of wood or steelwork treatment, foundation repair or total reconstruction.

6.6.1 **Crossheading Structures** (excluding Brun Clough)

There are fourteen crossheadings (one passing below the Brun Clough ventilation shaft), which pass between the disused railway tunnels and the operational one.

The condition of the structures varies greatly. A number of them are in an apparently sound condition while others are seriously dilapidated.

Moisture is the primary cause of decay of the timber and steel elements. The worst condition occurs when these naterials are exposed to both water and air, that is, when damp but not fully saturated. In these circumstances there is accelerated development of corrosion in steel and biological degradation in timber.

The crossheadings which have been subjected to dripping water must be considered as dangerous. Those which appear to be substantially dry should still be regarded as having suspect bearing areas.

6.6.2 **Ventilation Shaft Base Structures**

There are eight ventilation shafts, seven of which are constructed directly over the canal tunnel. For this report the timber structures spanning the canal at roof level have been deemed part of the tunnel. These structures have suffered the greatest degree of decay in the tunnel.

Not surprisingly the falling water is the main cause of their decay. All the timber has reached an advanced state of degradation, the worst instance being at Pule Shaft where the structure is partially collapsed.

6.7 **Ventilation Shafts**

The eight structures were inspected by C.C.T.V. as a means of gaining a general idea of their structural condition and to establish the level of deterioration since the detailed survey undertaken by Noslen Access Co. for British Rail in Sept./Nov. 1985.

Seven of the shafts lie directly over the canal, Red Brook Down Cast being offset some 7.9m to the south east and for which reason no remedial works are considered necessary.

6.9 **Canal Dewatering**

On completion of the 'above water' condition survey within the tunnel, action was initiated to draw off the water to facilitate an inspection of the 'below-water' section. The operation successfully proved that the tunnel can be drained of water.

However, access to carry out the inspection was not possible due to the 1-1.5m depth of silt lying within the tunnel invert.

6.10 **Invert Siltation Clearance & Disposal**

During the period the tunnel was drained, the opportunity was taken to acquire samples of the exposed silt, six samples in all being taken. It is recognised that a major problem to be overcome, both in logistic and cost terms, in bringing the tunnel back into use, is the removal and disposal of the debris lying in the bottom and estimated to amount to some 15–20,000 cubic metres.

6.11 **Tunnel Profiling**

An 'Above-water' profile check was undertaken at every 10 metre maximum distance along the lengths of the tunnel, using laser instrumentation with computer recording facility.

In addition to the laser profiling, an exercise of invert probing was carried out at all laser profiled positions, APPENDIX 2, VOLUME 1.

6.12 **Water Transfer**

British Waterways are required by legislation to provide a continuous supply of up to 9100m^3/day of raw water for industrial use, primarily on the western side of the tunnel.

Accordingly, any tunnel remedial works which necessitate the damming of the canal waters will require a compensatory flow of water to be provided by the Contractor, such provision having a cost implication.

6.13 **Tunnel Ventilation**

The primary purpose of the investigation of tunnel ventilation was to establish a strategy for the use of the tunnel by the general public.

The investigations were designed to establish typical ventilation rates within the tunnel to establish if these would be adequate or were capable of being augmented to produce satisfactory conditions for public use.

6.13.3.2 **Ventilation of the Tunnel and Adits**

Trial readings using a vane anemometer indicated that air flow velocities were too low to be reliably measured by this instrument. Instruments capable of measuring low airflow velocities below 0.7m/s, such as hot wire anemometer or thermistor anemometer, were too fragile for use within the conditions which existed in the tunnel, making it difficult to accurately establish a velocity vector, thus giving misleading results.

A system of airflow measurements was devised which used the observation of white smoke, generated by a Drager Smoke Generator, within the tunnel, using the work boat as an observation platform. The white smoke was easily observable against the dark background of the tunnel. The velocity of the air was established by measuring the time taken for the smoke to traverse the length of the work boat. The smoke's arrival was detected by allowing it to pass through the beam of a hand held lamp which was directed at 90° to the tunnel axis.

6.13.6 **Tunnel Environmental Factors**

The principal consideration of whether diesel or petrol engined boats could operate satisfactorily through part of the entire length of the tunnel is related to exhaust products and their dilution to acceptable standards by ventilation air.

7. **Remedial Measures**

7.1 **Introduction**

This section details the recommended remedial works required within the tunnel.

Alternative remedial works are described where there is clearly a variance between the two primary objectives of the study, a) water transfer, and b) public navigation. Although recommended repair techniques are described in detail the extent of the work involved will not be fully quantifiable until the time of repair.

7.2.2.2. **Repair Techniques**

The following techniques are considered for various sections of the tunnel:

i) Clean and Scale.
ii) Rockbolt.
iii) Bolt and Net
iv) Bolt and Mesh
v) Gunite
vi) Bolt, Mesh and Gunite.
vii) Lining.

i) **Clean and Scale**

This technique will involve the cleaning off of the accumulated dirt and grime, principally soot deposits caused by the passage of steam trains in the nearby railway tunnels before the advent of diesel locomotives.

ii) **Rockbolts**

Rockbolts are recommended where support is required to potentially unstable wedges or blocks which are free to fall or slide under their own weight.

iii) **Bolt and Net**

This method is used as for ii) above but with the addition of netting to catch small spalled rock fragments.

iv) **Bolt and Mesh**

Bolting as described above in (ii) is supplemented by mesh which is used to support small pieces of loose rock.

v) **Gunite**

Also known as shotcrete, gunite is a pneumatically applied mortar and concrete used for the support of underground excavations.

vi) **Bolt, Mesh and Gunite**

This method is an extension of method (iv) above with the substitution of a weldmesh for chainlink mesh and the application of gunite to give added support and to delay degradation.

vii) **Lining**

Total lining and, where indicated, packing and grouting behind the lining, has been recommended where the tunnel condition is such that no other technique is considered applicable for the proposed tunnel usage.

7.2.2.3 **Remedial Measures**

Chainage 555 to 560:

The existing gunite to be removed where found to be deboned. Rock bolting to be carried out where the underlying rock is found to be unstable, and the whole area to be resprayed with gunite or shotcrete to a depth of 50mm minimum.

Chainage 998 to 1010:

Although there is no immediate remedial action necessary it is recommended that this area is monitored for future instablility.

Chainage 1381 to 1400:

As this is a geologically unstable area resulting in a recent rock fall, a cavernous domed roof, PLATE 69, which has prevented through navigation of the tunnel, a fully lined solution is recommended requiring permanent lining packing and infill grouting.

7.2.3 **Lined Tunnel Sections**

Generally the masonry lined sections were found to be in fair condition and presently do not pose a threat to maintaining the tunnel for water transfer. There are however local poor areas, usually associated with adits and crossheadings, and sections of stonework identified in the structures report as being of poor profile.

7.2.4 **Adits**

7.2.4.1. **General**

Several of the adits are unlined and exhibit signs of instability. As such it is deemed necessary to construct a lining at their interface with the canal in order to ensure stability at this point.

7.2.4.2 **Remedial Measures**

The adits pose little threat to the transfer of water other than the need to carry out local masonry repairs and cleaning of sooty deposits within the lined areas to ensure their continued use for maintenance accesses.

7.2.10 **Desilting and Cleaning of Invert Debris**

7.2.10.1 **General**

The jet probe survey results and the observation made during the dewatering of the canal over the tunnel length, proved that there presently exists a depth of siltation averaging 1.0/1.5m with localised depths of some 2.0m of rock debris. In most areas of rockfall, the effective depth of water has been reduced to less than 0.5m. At the major fall (Ch.1400), which occurred post 1985, the level of the majority of debris is above water level.

The depth of siltation and rockfall debris has already significantly reduced the volume of water within the tunnel and hence its transfer capacity. If the build up of siltation continues unchecked, coupled with possible further rock falls, there will inevitably be a damming effect which will ultimately stop the flow of water through the tunnel.

7.2.10.2 **Remedial Measures**

Based on the findings of the Study and in order to bring the tunnel back to full transfer capacity, the cleaning out of the canal invert is considered a high priority.

The cleaning out of the invert will provide access for a contractor to carry out remedial works in the dewatered tunnel, or provide a stable base if the works are undertaken from a floating platform.

7.3 **Remedial Works Necessary for Public Navigation**

7.3.1 **General**

The remedial work necessary to allow public navigation is primarily concerned with Health and Safety.

The public can only be invited to use the canal tunnel once the risk of any collapse has been eliminated, and a safe means of egress is available in the event of emergency.

7.3.3. **Lined Sections**

7.3.3.1 The lined sections of the tunnel are generally considered safe for public navigation, and the distorted areas of stone lining should be monitored for the same reason as argued for water transfer requirements, i.e.:–

i) the linings are stable despite the poor appearance.
ii) The movement may well have ceased.
iii) the distortion may well be 'in-built' at the time of construction.

7.3.3.2 **Remedial Measures**

The distorted sections of stonework should be monitored and regularly inspected using 'tell tale' gauges positioned across the joints at regular intervals. The results of these inspections would check for movement, if any, and highlight areas of concern. Stable areas would require less frequent inspections once no movement is detectable over a longer period of say two or more years.

A degree of joint repair is necessary to local areas of masonry.

8. **Financial**

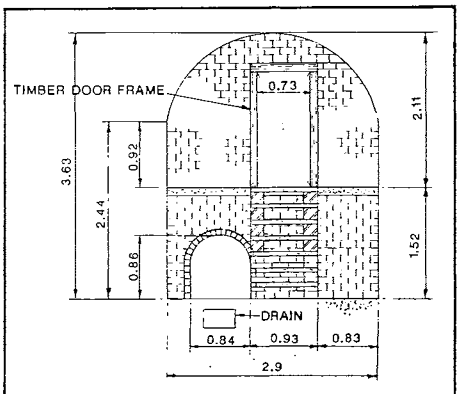
8.1 **General**

This section of the report addresses the financial requirements for carrying out the remedial works within the tunnel.

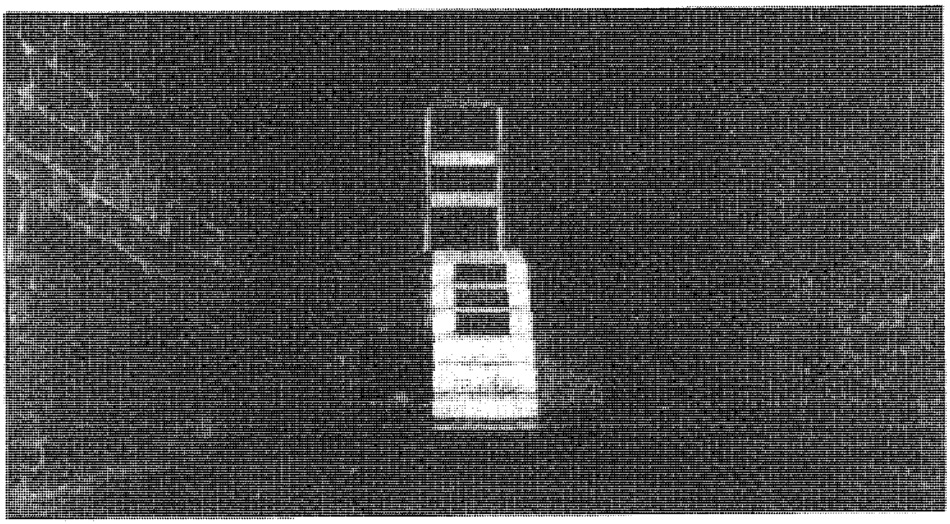
To assist the Client, three options have been considered and budget estimates developed to evaluation the level of financing that will be required to be made available.

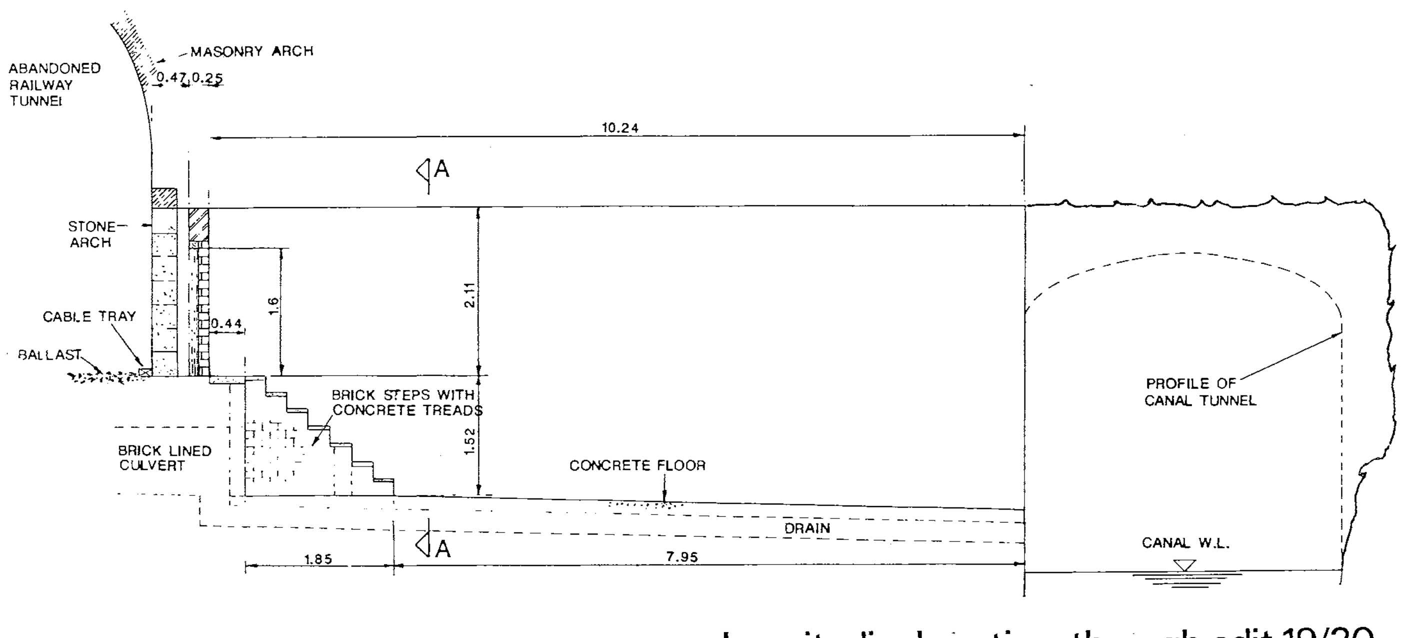
ADITS.

Adits are access tunnels driven to gain access to the canal tunnel during the construction of the railway tunnels in 1849 and 1871.
Forty-six adits were noted during the field study, some of which are now blocked off, others being masonry lined as permanent access. The remainder are in their original natural rock state. The adits could provide two important functions for the future public use of the canal tunnel. One is to allow emergency access and exit, the other is to maintain the ventilation of the tunnel. It is recommended that a lockable grillage is installed which permits controlled access and ventilation whilst preventing unauthorised access to British Rail property. The lined adits are generally in good condition but are covered in an oily sooty coating inherited from the days of steam trains. This coating needs to be cleaned by jet hosing in those adits where access is considered essential. The unlined rock adits are unsafe for public use but need to be preserved for ventilation and would provide historic interest to the public.



Section A-A.





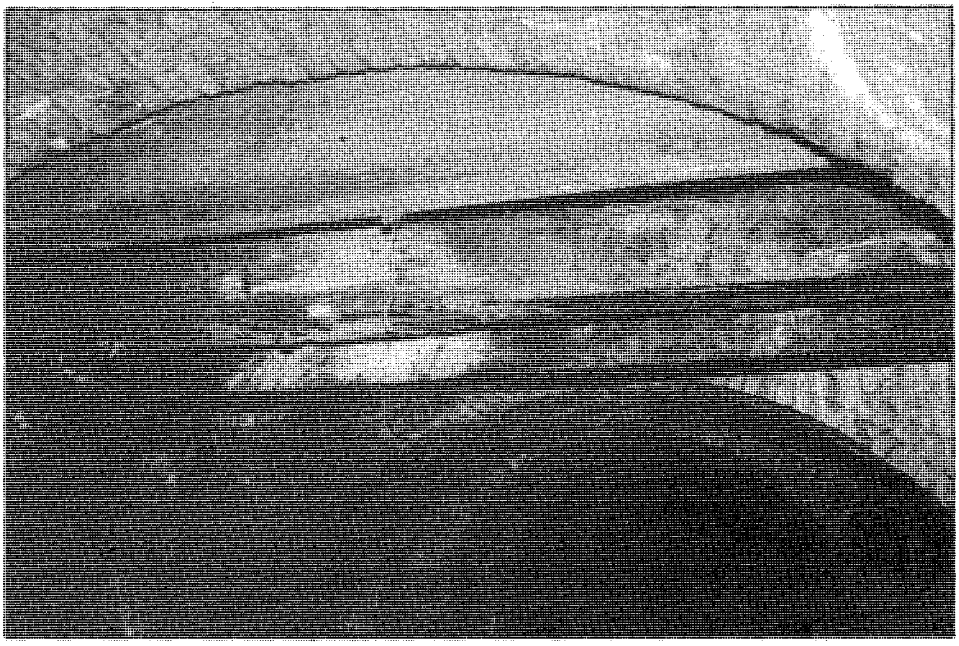
Longitudinal section through adit 19/20.

CROSSHEADINGS.

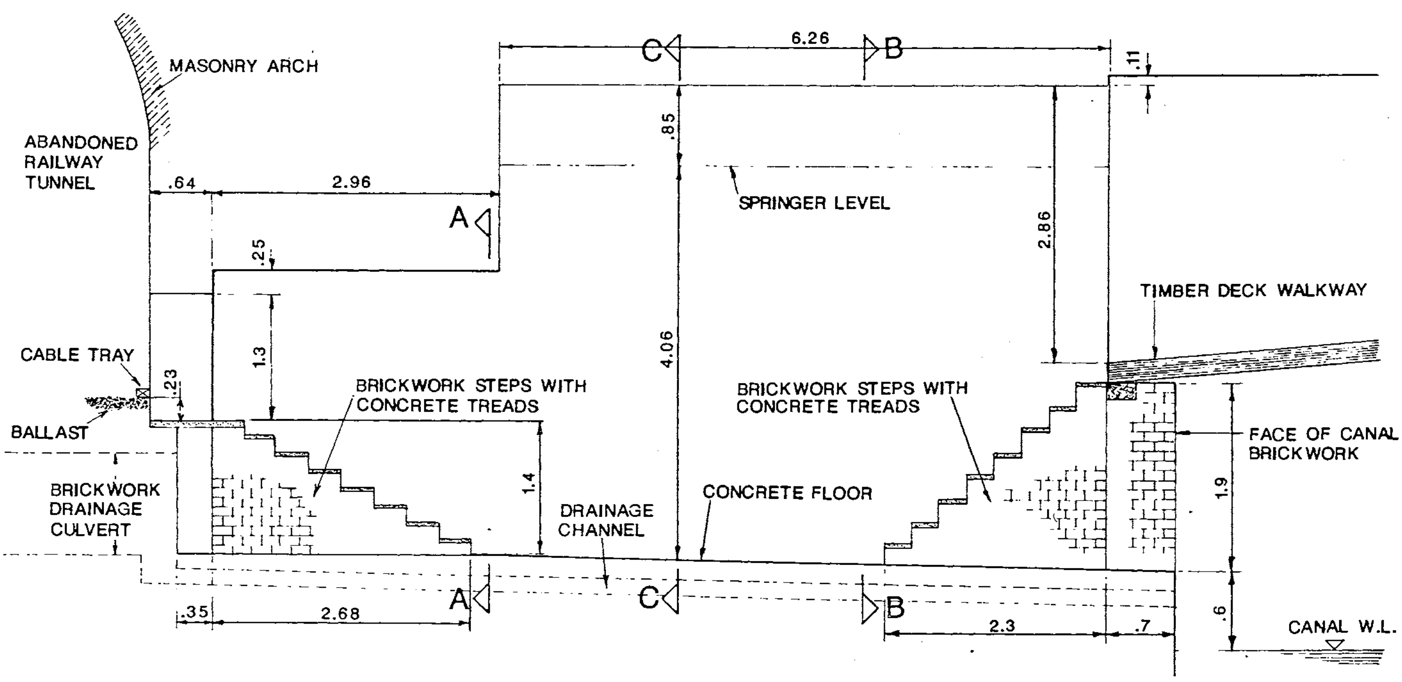
During the building of the 1894 double track railway tunnel, the construction of crossheadings over the canal provided access between both rail tunnel systems. These are now utilised by British Rail for maintenance.

The crossheadings were tunnelled to the canal edge and the canal bridged by sleeper decking supported off timber or steel beams on to masonry or rock walls. There are fourteen crossheadings, of which seven provide access to the canal tunnel.

Some crossheadings are in a poor state state and a replacement bridge structure is required. The majority however can be retained, at least for the forseeable future, by treatment to the timber decay and improvement to the masonry supports.



Crossheadings with canal access chainage 4830 (BR. REF 6).



Longitudinal section through crossheading 4830 (B.R.Ref 6).

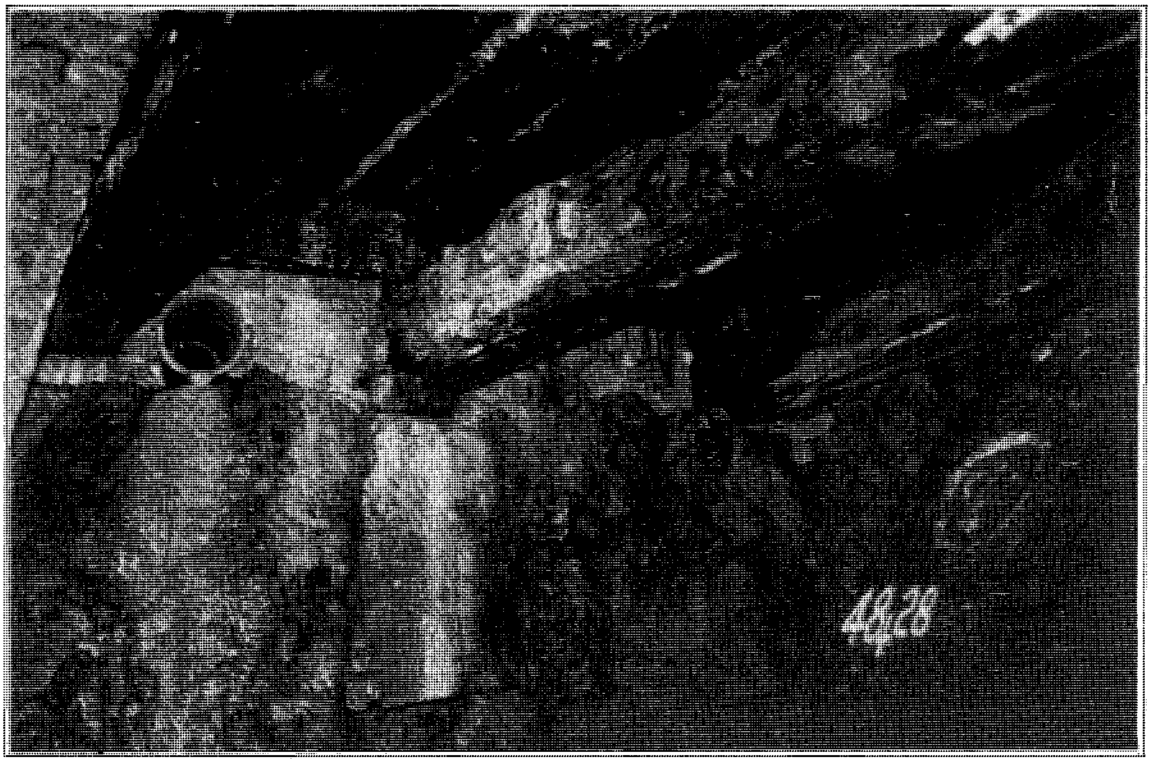


PLATE 33
A typical crossheading at BR.Ref. 6, Ch. 4629, in a state of serious degradation

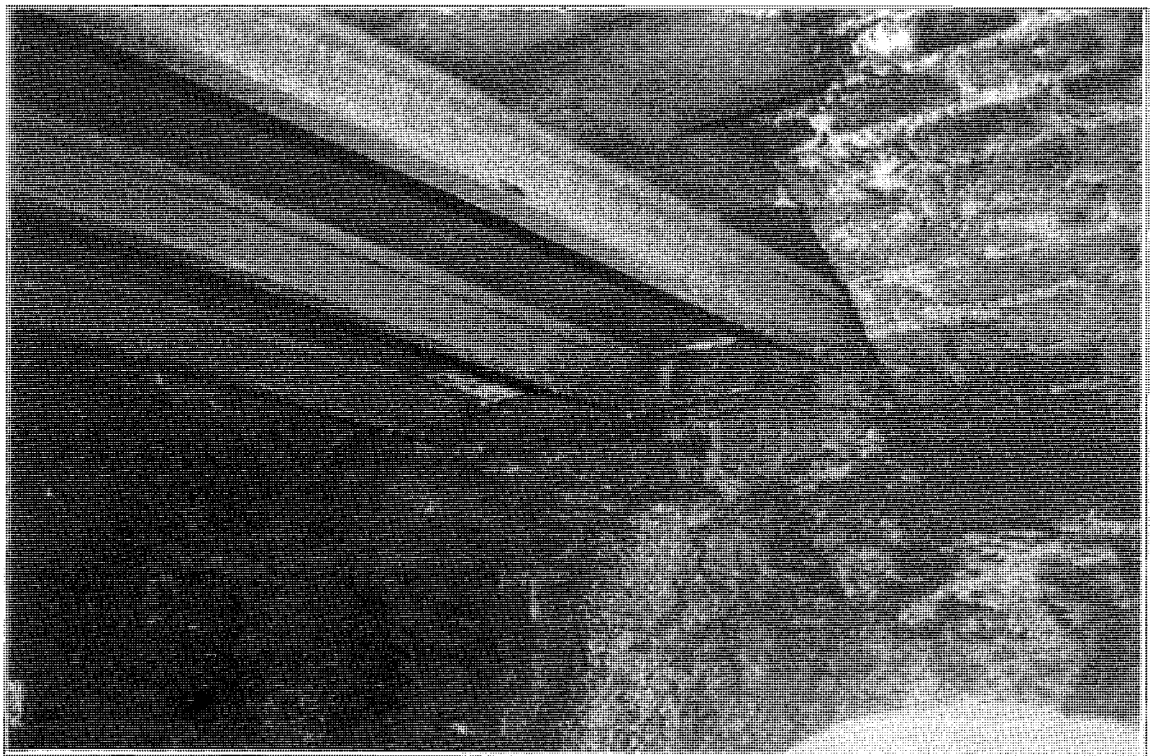


PLATE 38
Crossheading, BR. Ref. 53, Ch. 4106.
Timber decking supported by bullhead rails. Evidence of degradation in timber and corrosion to steel.

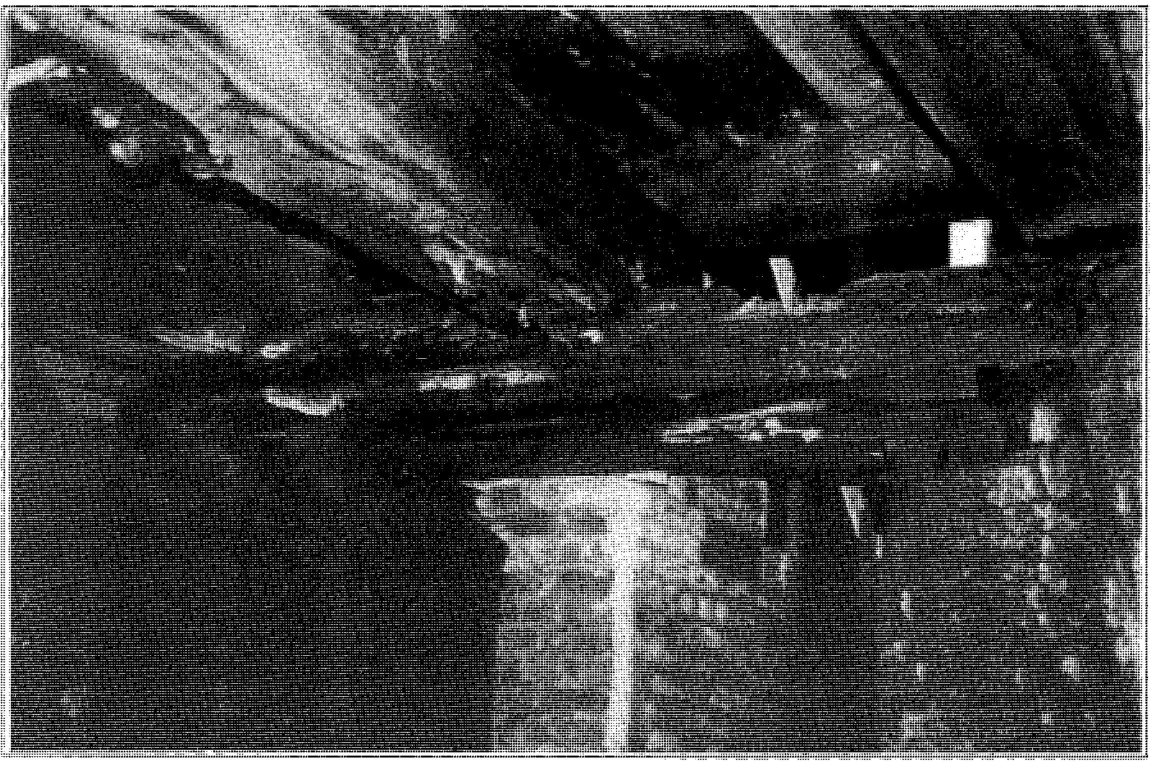
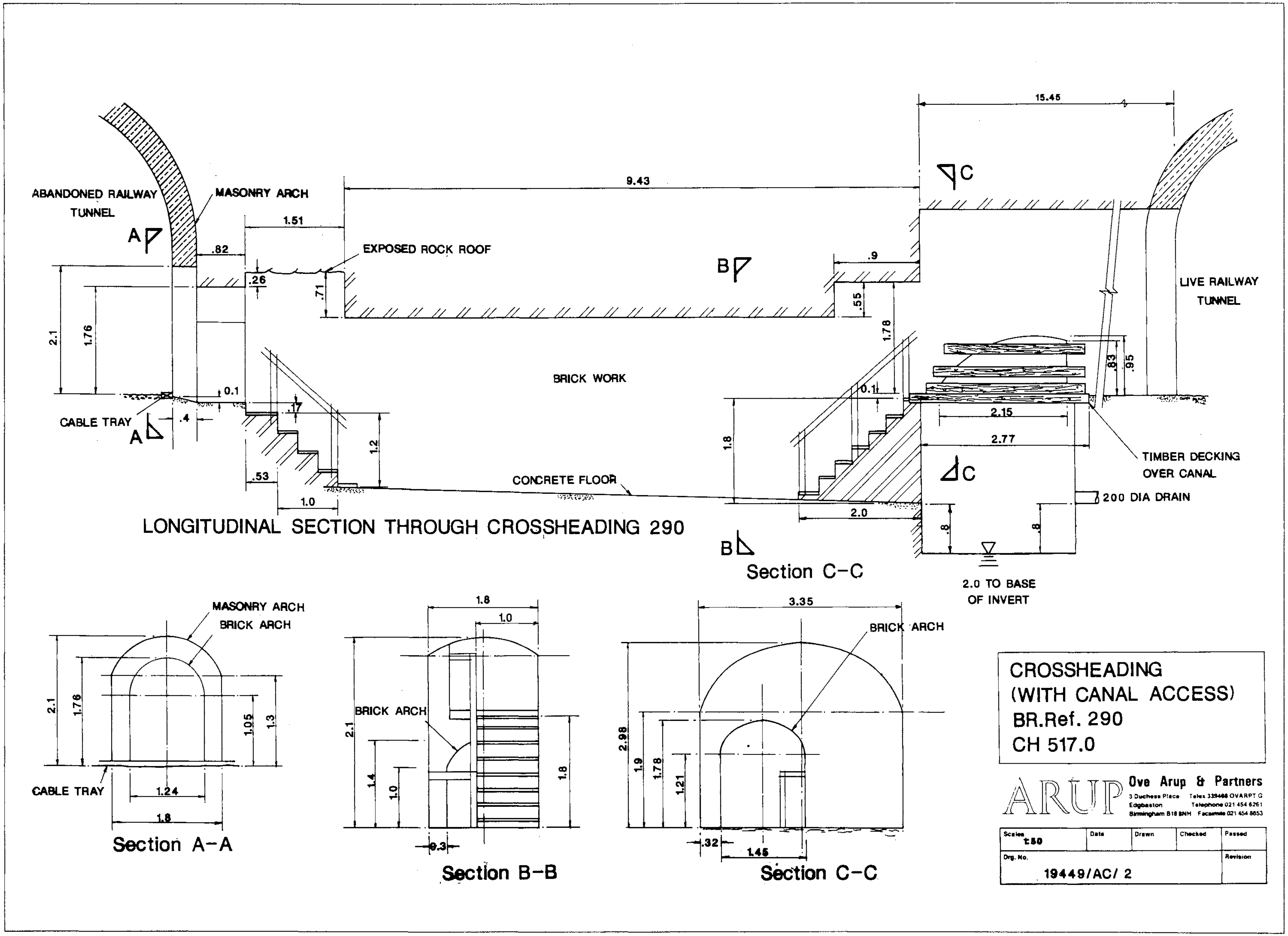


PLATE 40
Crossheading, BR Ref. 6, Ch. 4828
Timber beams highly degraded. Bearing brickwork in poor condition


ABANDONED RAILWAY TUNNEL
MASONRY ARCH
EXPOSED ROCK ROOF
BRICK WORK
CABLE TRAY
CONCRETE FLOOR
LIVE RAILWAY TUNNEL
TIMBER DECKING OVER CANAL
200 DIA DRAIN
2.0 TO BASE OF INVERT
LONGITUDINAL SECTION THROUGH CROSSHEADING 290
Section C–C
MASONRY ARCH
BRICK ARCH
CABLE TRAY
Section A–A
BRICK ARCH
Section B–B
BRICK ARCH
Section C–C
CROSSHEADING
(WITH CANAL ACCESS)
BR.Ref. 290
CH 517.0
ARUP
Ove Arup & Partners
Scales 1:50
Date
Drawn
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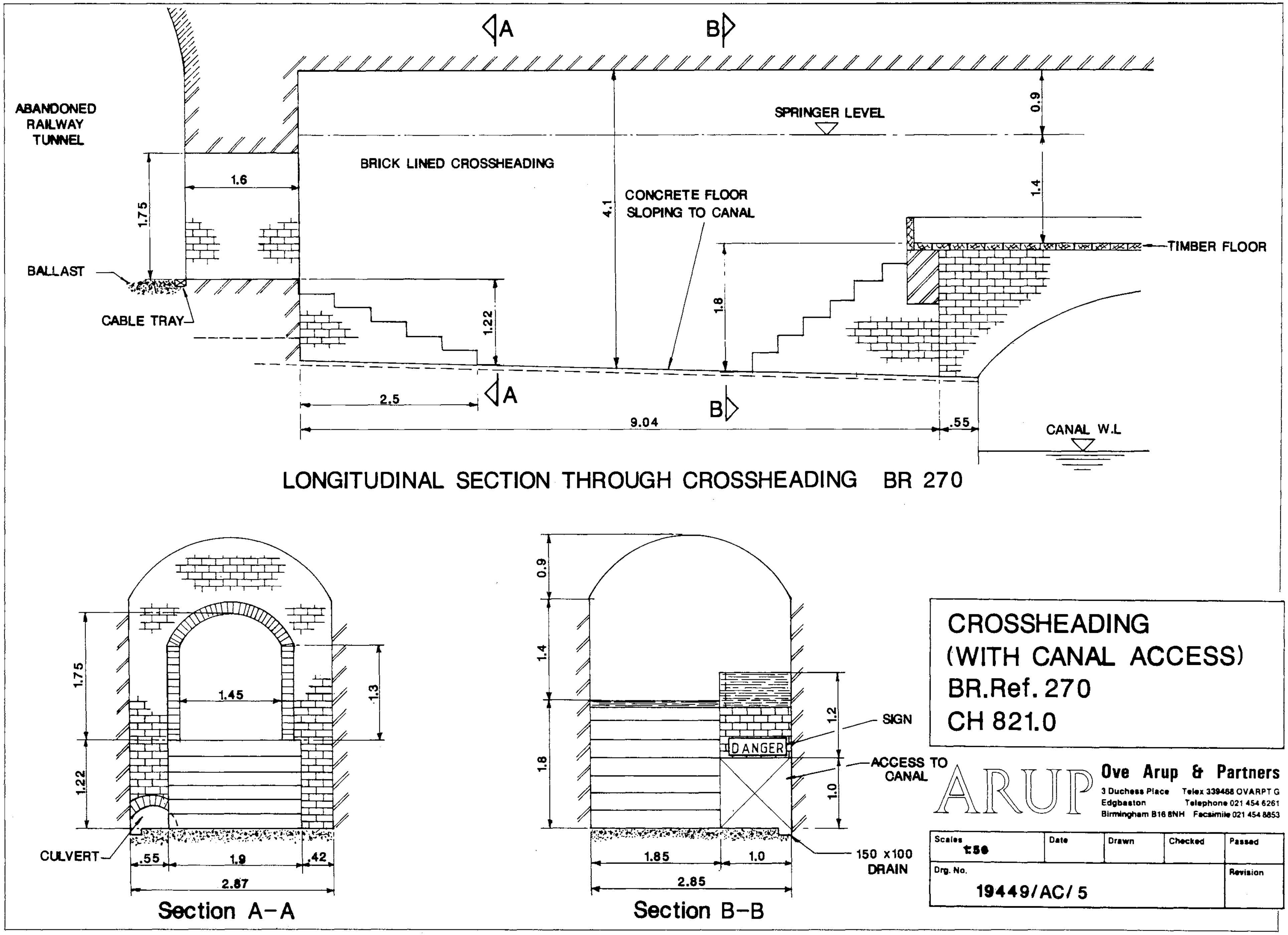
Drg. No.
19449/AC/ 2
Revision

TUNNEL SURVEY



CROSSHEADING
(WITH CANAL ACCESS)
BR.Ref. 270
CH 821.0

ARUP Ove Arup & Partners
3 Duchess Place Edgbaston Birmingham B16 8NH
Telex 339468 OVARPT G
Telephone 021 454 6261
Facsimile 021 454 8853

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P·E·N·N·I·N·E · L·I·N·K

The repair options considered include for:–

A. Water transfer only.
B. Public navigation of 750m of the tunnel from the Marsden portal (a proposal included in the L & R report)
C. Public navigation through the entire length of the tunnel.

Also, for each of the options the repair strategy takes account of the work priority categories. Work category 4 aims for full public safety.

TABLE 14 – BUDGET COST SUMMARY

	Option A	Option B	Option C
TOTAL COST (Min. Standard)			
A4 Works	3,135,360		
B4 Works		237,790	
C4 Works			4,760,530
Ventilation		25,000	1,075,000
TOTAL COST			
A4 + 3 Works	3,484,940		
B4 + 3 Works		371,380	
C4 + 3 Works			5,378,530
Ventilation		25,000	1,075,000
TOTAL COST ALL WORKS	5,896,290	372,360	6,427,400
Ventilation		65,000	1,325,000
B.R.PROPORTION AGAINST TOTAL WORKS	930,420	169,970	1,053,310
TOTAL 'DIRECT' TUNNEL COSTS			
MIN. STANDARD	2,407,165	67,820	3,707,220
FULL WORKS	4,964,370	202,390	5,374,090
Ventilation		65,000	1,325,000

ACKNOWLEDGEMENTS

Ove Arup and Partners acknowledge the assistance of the following persons and organisations whose help and advice made easier the carrying out of this complex study:

British Railways Board

For allowing access from the disused railway tunnels throughout the period of the fieldwork.

British Waterways

With particular thanks to Mr. D.M. Stakes, Principal Mining Engineer, and Mr. B.P. Haskins, Engineering Manager NW Region, whose knowledge and assistance, always freely given, were most valuable.

Huddersfield Canal Society

Particularly Mr. M. Thompson, Consultant to the Society, whose support was always readily offered on behalf of the Huddersfield Narrow Canal Joint Committee.

Huddersfield Central Library

For their assistance in making available historical documents on the Standedge Tunnel.

Supporting Bodies

On behalf of the Huddersfield Narrow Canal Joint Committee the opportunity is taken to record their appreciation for the help afforded by the Yorkshire and Humberside Regional Council for Sport and Recreation, the Department of the Environment (London and Manchester offices), the Mersey Basin Campaign Office, the European Commission DG.XVI in Brussels and local MPs and MEPs who have given freely of their time to assist in their many and various ways the commissioning of this study.

Without their strong and valuable support and encouragement the study of this vital historic link through the Pennines would not have been possible.

Quantity Surveyors

Messrs. Crelley and Williams of Balvac Whitley Moran Ltd., also Messrs. Bell and Miller of Mowlem Northern, who made the time to discuss costing strategy for operating within such a tunnel as Standedge.

SUMMARY OF TECHNICAL TERMS

Adit — A small access tunnel connecting the disused northern rail tunnel with the canal tunnel.

Anticline — A rock fold system in the form of an arch

Chainage — Distance measurement along the canal tunnel referenced at 10 metre intervals, starting at the Marsden portal.

Crossheading — Bridge across the canal within an access tunnel, connecting the disused northern rail tunnel with the operational rail tunnel.

Deltaic Foreset Bed — Bed formed in a river delta and built outwards from the seaward face of the delta.

Dip — Angle of a bedding plane to the horizontal

Discontinuity — A layer which separates zones within the Earth.

Downthrow — The side of a fault which is relatively lower than the other side (the Upthrow).

Fault — Displaced fracture of rock mass.

Gauge — Depth of coursing of masonry including mortar joint.

Geological Survey — An examination of the geology of an area.

Geotechnical — The mechanics of the rock stability and support

Grit — A group of sedimentary rocks typically sandstone where partical size ranges from 1/16mm to 2mm.

Gunite — Proprietory name for pressure sprayed concretee to support loose rock.

Hade — The angle which a fault plane makes with the vertical plane.

Huddersfield Narrow Canal Joint Committee — Commissioning Committee for the Standedge Tunnel study comprising:–

Kirklees M.B.C.
Oldham M.B.C.
Tameside M.B.C.
British Waterways
Huddersfield Canal Society (Honorary Member)

Interbedded — Literally 'between two layers' e.g., a limestone may be interbedded between two layers of shale.

Intermediate Arches — Section of tunnel comprising alternate brick (typically 1.8m wide) and natural rock (typically 0.9m wide).

Invert — Arched or flat section of tunnel bed below water level.

Joint — A fracture in a rock with no relative movement of the sides.

Lineament — A large scale linear feature which exposes itself in terms of topography which gives an indication of underlying structural features.

Parting — A small joint, typically in a coal seam.

Profile — Cross Sectional Shape of the tunnel cut normal to the centre line.

Pyrite — Most common display layering or bedding.

Rockbolt — A threaded steel rod (typically 25mm diameter by 6m long) capable of anchoring loose rock back to more stable rock.

R.S.A. — Rolled steel angle

R.S.C. — Rolled steel channel

R.S.J. — Rolled steel joist

Scan Line — Notional horizontal line on the tunnel wall along which all joints are measured (set 1.5m above the water level).

Shale — A group of sedimentary rocks typically mudstone where partical size ranges from 1/256mm to 1/16mm.

Springer — Point where the vertical section of tunnel begins to arch to form the roof.

Strata — Rocks which display layering or bedding.

Stratigraphy — The study of the age of rock strata and their historical sequence.

Strike — Horizontal direction of joint plane.

Syncline — The reverse form of an anticline (trough or basin).

Tectonics — The study of the major structural features of the Earth's crust or the broad structure of a region.

Throw — The measure of the vertical displacement of the sides of a fault.

Underpinning — Strengthening to wall foundation.

Ventilation Shaft — A shaft sunk from the surface vertically over the line of a tunnel for construction of the tunnel and subsequently left open to provide ventilation to the tunnel system.

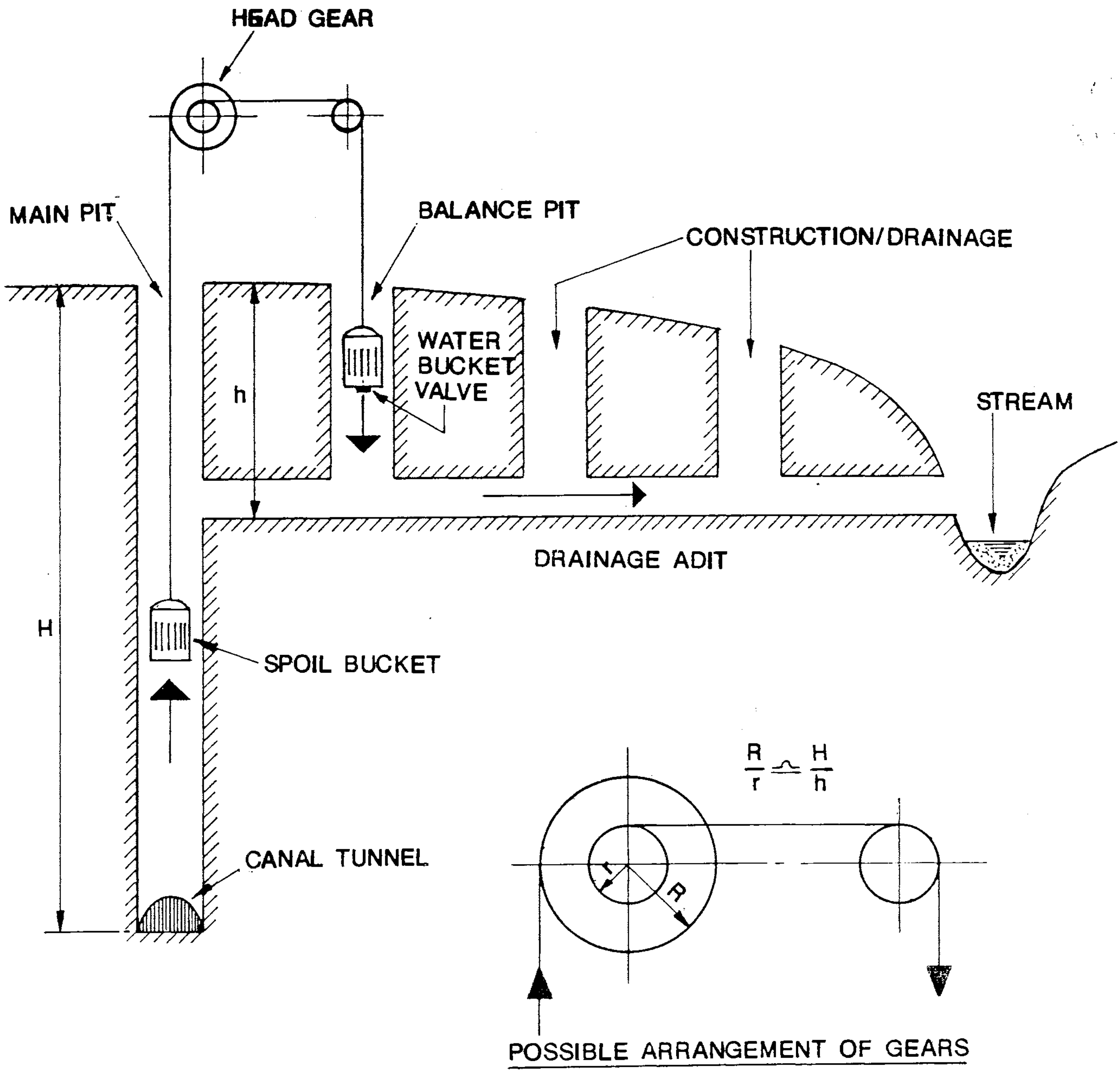

FIGURE 3

WATER ENGINE

ARUP
Ove Arup & Partners
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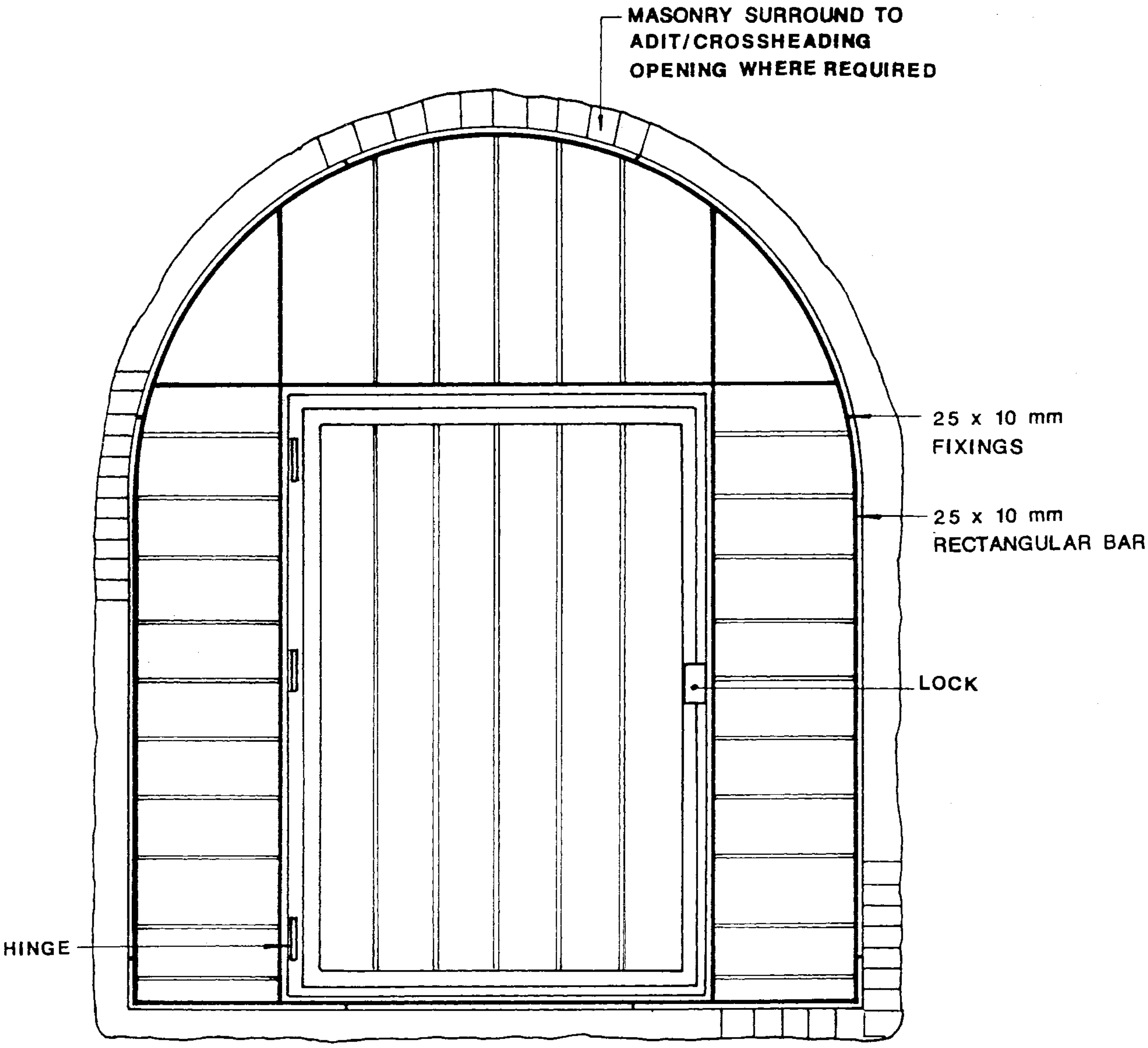
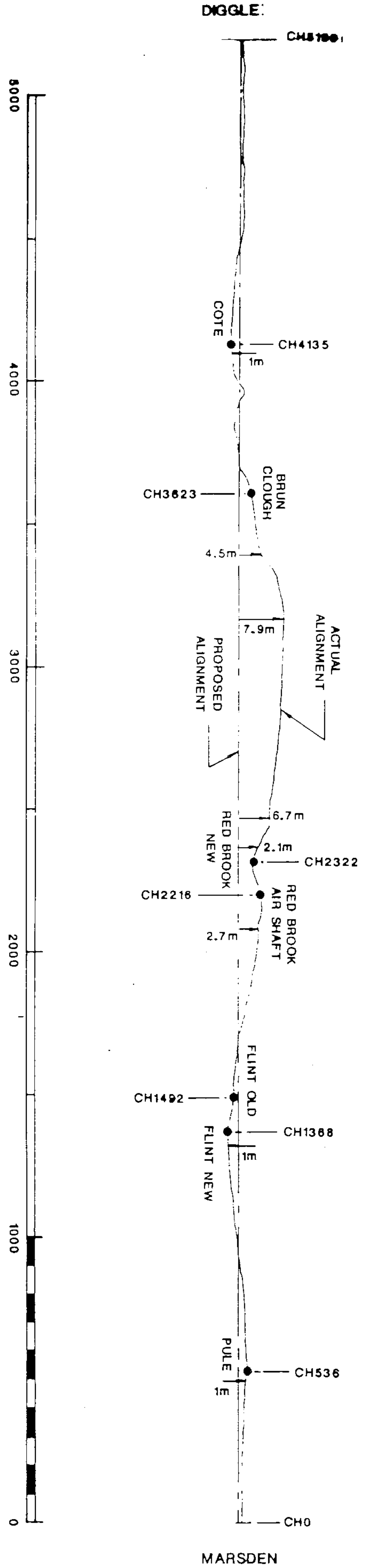


TYPICAL DETAIL SHOWING LOCKABLE GRILLE FOR
ADITS AND CROSSHEADINGS WITH CANAL ACCESS

NOTE

FRAMES TO BE MADE FROM
25 x 10mm MILD STEEL BARS.
GRILL BARS MADE FROM 12 ø
MILD STEEL RODS
ALL HOT DIP GALVANISED

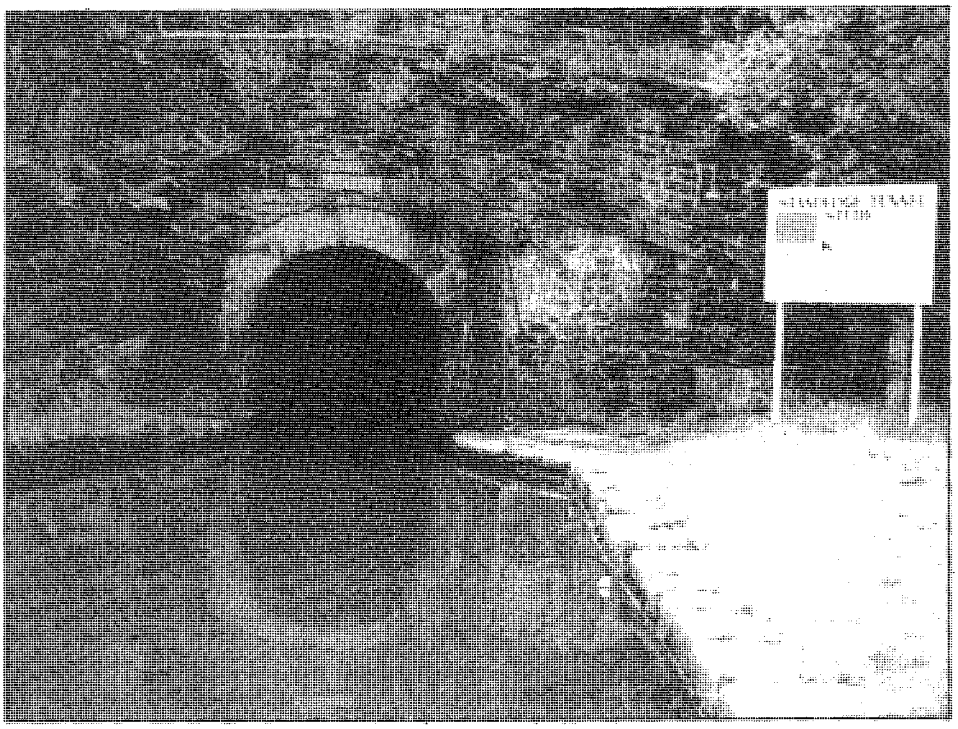
FIGURE 34



PLAN SHOWING ACTUAL AND PROPOSED ALIGNMENTS

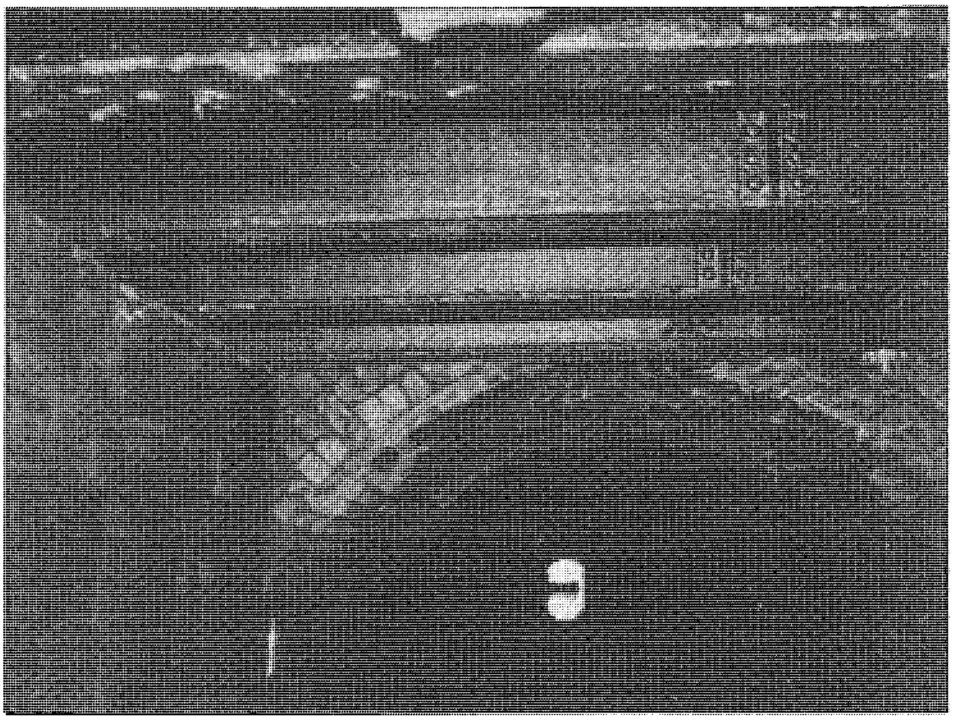
MARSDEN PORTAL.

Marsden portal is the arched stone entrance to the Standedge Tunnel at the Eastern end. This listed structure remains as constructed in 1811, but is now in danger of collapse. The stonework joints are dry and open, and the top section is under pressure from the ground behind it. The top section needs to be dismantled and rebuilt and a free-draining material used to replace the existing soil.



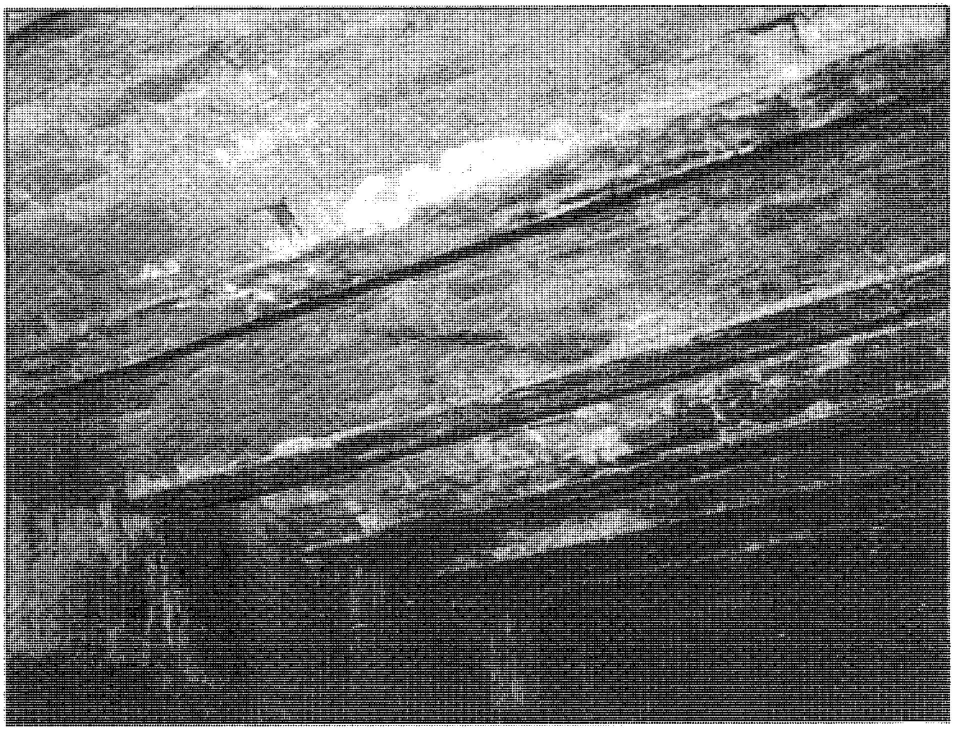
RAILWAY EXTENSION, DIGGLE.

Where the Liverpool and Leeds main railway line crosses the Standedge tunnel at the Diggle end, there is a bridge section constructed in three sections. The steelwork in these sections are suffering from extensive corrosion which needs to be treated before the condition becomes critical. Many of the rivets and bearing plates need to be replaced and all of the steelwork needs sand blasting and painting with a corrosion protection paint.



Large section beams with steel plate decking under the railway extension at Diggle. There is evidence of corrosion in the steelwork that will require treatment.

Example of steel beams with brick infill. Note the corrosion to the steel beams that will require treatment.



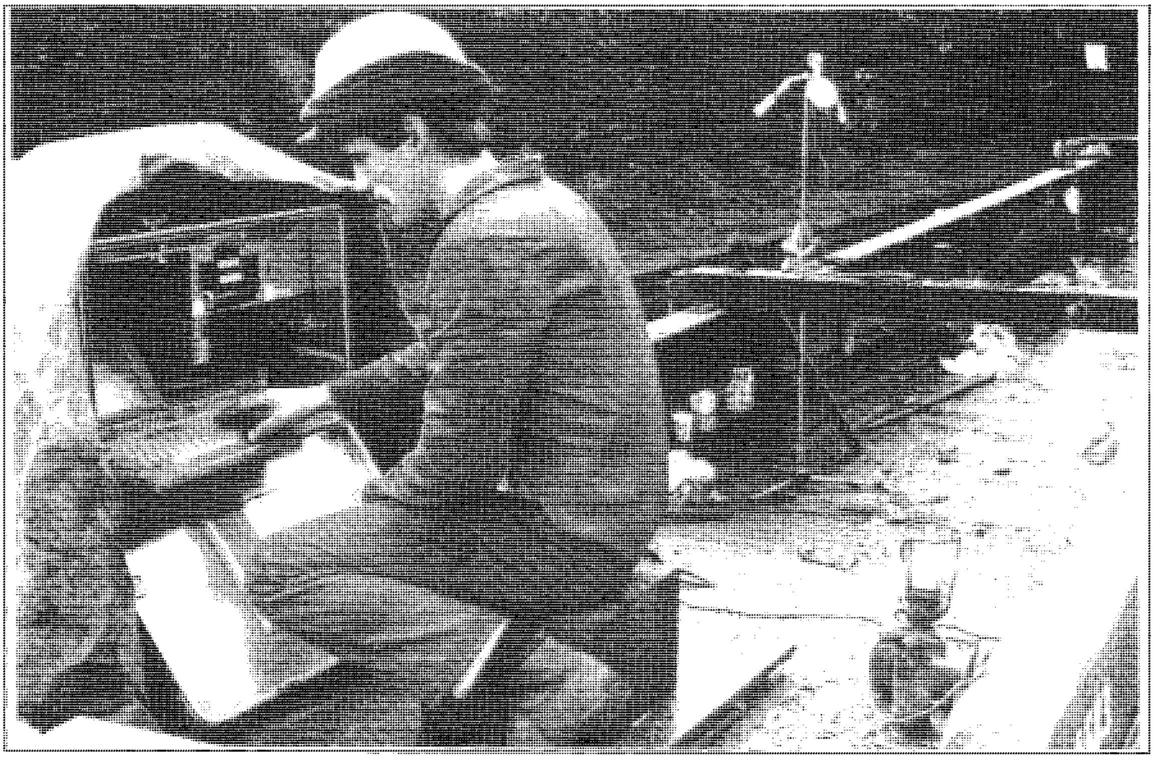


PLATE 28
Views of laser profiling equipment and computer recording instrumentation mounted on converted British Waterways boat.

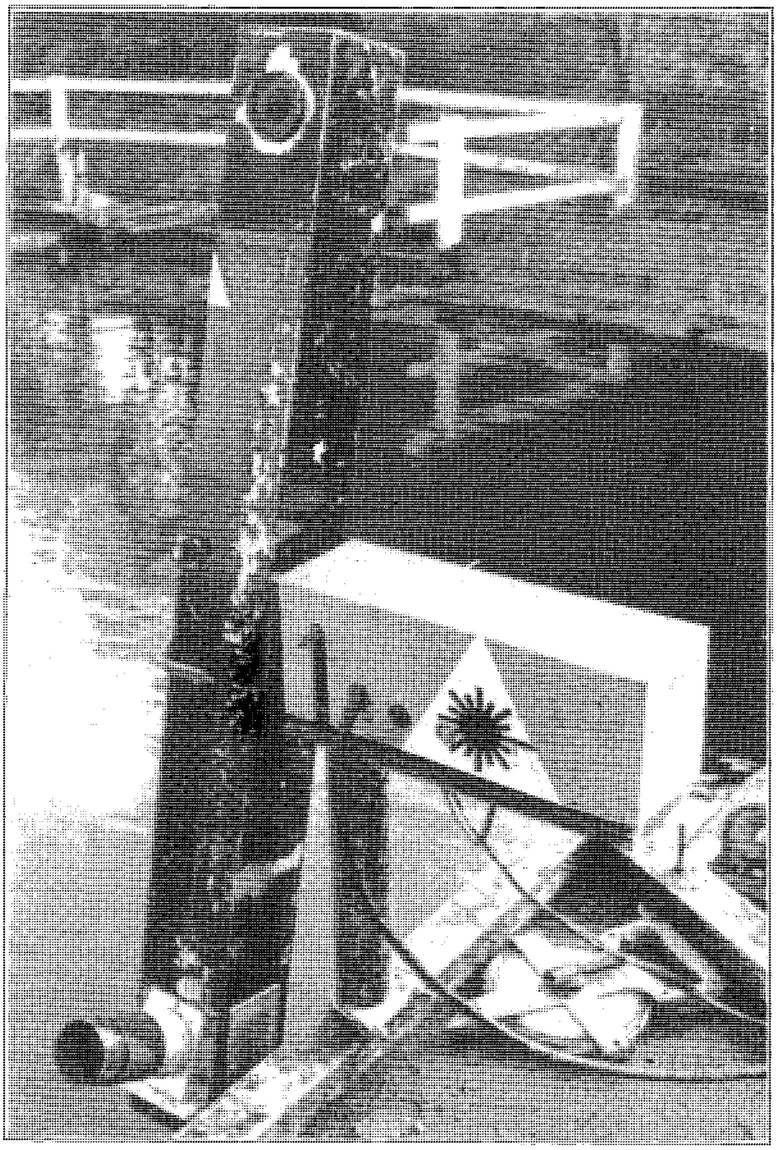
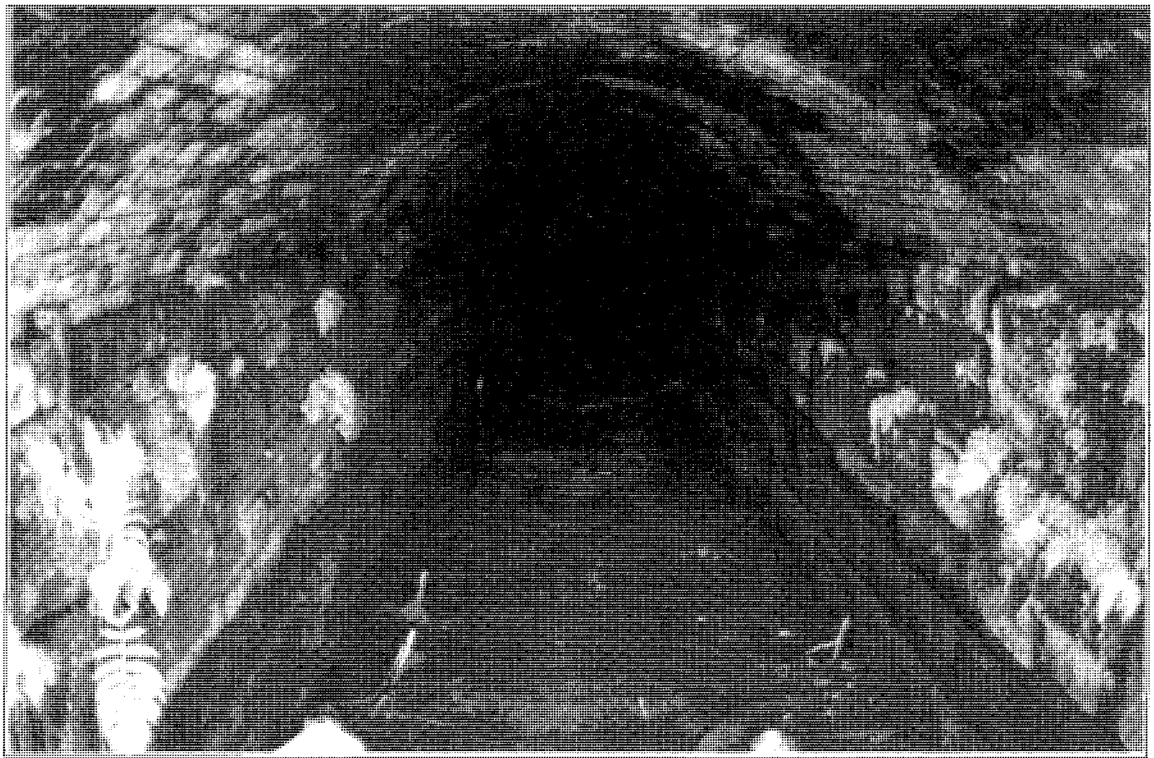


PLATE 29
Diggle Portal and Canal Basin after de-watering had taken place



"WIND LASS" and the HINCHLIFFES at ASPLEY BASIN

My wife and I have been cruising canals for many years. We first hired a boat in 1949 and occasionally thereafter until our first purchase of a very small cruiser in 1968. Twelve years and two other owned boats brought us up to 1981 and the design and purchase of a 38' steel narrow boat - "Wind Lass". The name encompassed the usual gender, the open air and the implement without which one cannot negotiate the numerous locks to be encountered.

Late in the 1970s we found that my forebears had been canal people in the Huddersfield area and in 1983 I enquired of the Huddersfield Canal Society whether they had any records relating to the family. Initially no information came to light, but after the Society had placed a copy of my letter in the "Huddersfield Examiner" of 15th April 1983, I received a letter from Mr. Ernest Cooke of Newsome. He and his wife, who has recently passed away, had lived next door to one of my late father's late cousins, Hanson Hinchliffe (his mother's maiden name was Hanson). I should add that I had known for many years that my family came from Huddersfield, but it was through Mr. Cooke that we established the canal connection.

Following visits to Huddersfield Library and Wakefield Archive Office, we established that my grandfather, another Edward Hinchliffe, had been born at Bradley, Huddersfield, and that his brother Abram and other members of the family had lived at Nos. 7, 8, 9, 12 and 14 Back Colne Street, very close to Aspley Basin at that time. Abram was known to have been in charge of two narrowboats on the canal, "Florence" and "Lily", owned by Messrs. J. & E. Morton of Milnsbridge, and used to carry tar between Marsden and Sowerby Bridge.

In September 1984 an article in the "Examiner" included a photograph submitted by yet another Mr. Edward Hinchliffe of Lockwood, of a boat called "Gleaner" being used to carry a Rock Mission day trip in about 1905. That gentleman, as a small boy, his mother, grandmother and sister are to be seen in the photograph. This was a most fortunate report for, having contacted this Edward, we were able to confirm that he and I are related, our respective grandfathers being brothers. At the same time we are both great-nephews of Abram of canal boat "Gleaner", on which boat Edward had indeed travelled on a number of occasions in his youth.

Further research at Stoke Bruerne has convinced me that the boat Cleaner was the one which had been raised from the canal bed at Marsden and was that owned at one time by Abram. It was not the same boat as that shown in later photographs carrying visitors through the Standedge Tunnel during the 1950s and 1960s, for I have discovered that the original "Gleaner" was sunk in 1951 (November) and its remains, recently moved from Marsden, showed it not to have been cut down to a square stern. After purchase by the Railway/Canal Company, the boat was renamed "Marsden" - hence some of the confusion. The latter boat was that used to carry visitors through the tunnel.

Other members of Abram's family were employed on the canal in various capacities. We now know, for example, that it was my grandfather, Edward, who suffered an accident whilst legging through the tunnel, which resulted in amputation of a big toe - an injury which caused him great discomfort for the rest of his life. Perhaps it was that injury that caused him to leave Huddersfield for pastures new. He next appeared in Welshpool, where he married, before settling down in Shrewsbury.

This is a very brief commentary on my family connection with the canal at Huddersfield and which led us to make a four week canal journey from Nantwich to Aspley Basin, Huddersfield, in 1988, via Worsley, Wigan, Leeds, Castleford, Wakefield and Cooper Bridge, a distance of 180 miles and 131 locks each way, to meet again on the water, and to enjoy the company of the new-found Edward (Ned) and three other generaztions of his family. A Hinchliffe boat once again at Aspley Basin, after so very many years.

Gone are all the cottages in which, along with other canal workers, lived so many of the Hinchliffe family until about 1950/51, when Alice and Martha, Abram's daughters, died. Further family research shows that the earlier generations were also involved with the canal, probably from its inception.

It is hoped that many more boats will visit Aspley Basin in the future to bring back the boating atmosphere. Sir John Ramsden's canal is now easily navigable. The lift bridge close to Huddersfield town is in good working order - much to the surprise of some local residents who declared that they had never before seen it operated. A stalwart group of people on both sides of the Pennines is working hard to make the narrow canal navigable and we wish them all success. Perhaps our next visit to Aspley Basin will be by the shorter route, through the Standedge Tunnel.

During our 1988 journey we had the good fortune to be accompanied by Phyllis and Alan Cashin on their boat "Naiad". They were a great help and excellent company.

If anyone reading this is able to provide any more information of the Hinchliffe family connection with the canal - or otherwise, the writer will be most grateful.

E.B. HINCHLIFFE
"Acorns", 36 Whirlow Road,
Wistaston, Crewe, Cheshire, CW2 6SR.

I.W.P.S. TOWPATH WALKS

Those of you who worked on the Uppermill Restoration Project will probably remember the prominent figure of Pete Yearsley (alias Teddy Bear). Although he doesn't do much digging these days, Pete has organised some very interesting towpath walks on various 'disused' canals. So far, these have included the Bolton & Bury, the Shropshire Tub Boat Canals, and of course the Huddersfield Narrow. The walks are organised on behalf of the Inland Waterways Prootection Society (IWPS), but all are welcome. The provisional programme for 1990 is as follows:

7th April:	Sheffield Canal, Sheffield Basin & Tinsley Locks
2nd June:	Lancaster Canal, Tewitfield & beyond
4th August:	Montgomery Canal, Garthmyl to Slattocks
6th October:	Droitwich Canals, Ladywood to Hanbury
1st December:	Rochdale Canal, Chadderton to Slattocks

Venues may change if something more interesting turns up. Final details are usually available about two weeks in advance. For further information you can phone me or write direct to:

Peter Yearsley,
41 Tatton Street,
Knutsford, Cheshire,
WA16 6AE.

LAURENCE SULLIVAN (061-303 7785)

CALDER NAVIGATION SOCIETY

THE ANNUAL INTER SOCIETY / CANAL GROUP QUIZ WILL BE HELD ON

Wednesday, April 18th at 8 p.m. at the
BARGE & BARREL
at Elland, as before.
ALL CANALAHOLICS WELCOME!
We look forward to meeting your members again.

A VOYAGE INTO A HILLSIDE

The dark flooded tunnel disappearing into the hillside lay ahead as we slipped past the 'leggers' cottages on our two-and-a-half hour voyage through the Pennines These cottages stand as monuments to the men who, before the age of steam, used to push fully loaded narrowboats through this three mile long tunnel by paddling with their legs against the walls. The wages were a shilling (5p) a trip.

It was April 1st 1967; I and some members of the North Eastern Branch of the Inland Waterways Association had previously been invited by the Waterways Board to join this inspection trip of the Standedge Canal Tunnel.

Well wrapped up and waterproofed, we soon slipped into the darkness, relieved only by the glare of the large carbide lamp fixed on the bow. Just inside the tunnel our boat passed the narrow ledges where tramps once waited, offering to help 'leg' the boats and take a free trip to the other side of the Pennines.

With an emergency dinghy in tow, our inspection boat, formerly an Ice Breaker on the Ashton Canal, soon passed the first of the 50-yard markers fixed to the roof of the tunnel. Many of the markers were still in place and throughout the journey these were a good guide to the distance we had covered. Very soon the pointed stonework gave way to bare rock and the periodic hack arches built to save the company money.

Construction of this tunnel virtually bankrupted the Huddersfield Canal Company and there were insufficient funds to line the tunnel for all its length. Opened in 1811, with great ceremony, after eleven years of construction, it had cost £125,000 for the 3 miles - as much, fact, as the other 17 miles put together.

In the roof of this bare rock was the evidence of the original drill marks some 4 to 5 ft. long, used for the charges of black powder, a crude blasting material which took its toll with eleven deaths during construc-tion. At one place a simple plaque on the roof marks the spot where one navvy was killed, a testimonial to the dreadful and dangerous conditions which would not now be tolerated.

Our waterproofs soon became useful when we were faced with the occasional showers of water cascading down from the reservoirs on the moorland above to feed the canal.

The entrance at Tunnel End was but a pinprick of light and now we could see just what kind of an engineering achievement we were sailing through. Without the instruments of the modern civil engineer, the tunnel was built by digging simultaneously, in candlelight, from both sides of the hill, meeting only six feet off centre in a tunnel whose total length exceeds three miles. An architectural kink in the heart of the hillside marks that meeting place. The problem of maintaining the correct level during construction was overcome by periodically flooding the workings and then pumping them dry again.

On we sailed through another shower and soon a distant rumbling through the hillside reminded us of the present day. It was the passage of a diesel express train through a parallel tunnel just a few feet away. This was also a reminder of what the railways did to the canals.

In 1845 the canal company was bought up by the Huddersfield and Manchester Railway Company and it was in the following year that work began on the first of the single bore railway tunnels. By 1849 the first rail traffic was passing under the Pennines. During construction of this first railway tunnel the canal was used to take away the spoil. At intervals througout its length there are passages leading from the rail to the canal tunnel, where the spoil was taken to be loaded into the boats.

The coming of the railways, and later, road transport, made the carrying of goods by canal less and less competitive and there was a decline in the use of the Huddersfield Narrow Canal as a commercial waterway, although some boats still sailed through the Pennines as late as the 1940s, when finally the London Midland and Scottish Railway Co. announced its intention to abandon the canal.

A faint speck of light ahead marked the Diggle end of the tunnel, although we still had a mile or so to go. This was surely a time to reflect on our journey, of being able to witness this tremendous achievement hidden away below Standedge; of being able to see tell-tale evidence of the history which had been made during construction. The tunnel was now over 150 years old and despite twenty years or more of neglect it was still navigable, although at times our boat had scraped and ground along the bottom over rock which at some time had fallen from the roof.

On this journey we had certainly been a privileged few. How many more inspection journeys were to be made we did not know. We only knew that the Huddersfield Narrow Canal was abandoned as a remainder waterway, probably for ever, a sad and unwarranted destiny. Little did we know of the coming of the Huddersfield Canal Society and the impact it would have.

Gradually the faint view of the distant moorland became clear, framed by the arch of the tunnel and all too soon we sailed out into the pale April sunshine.

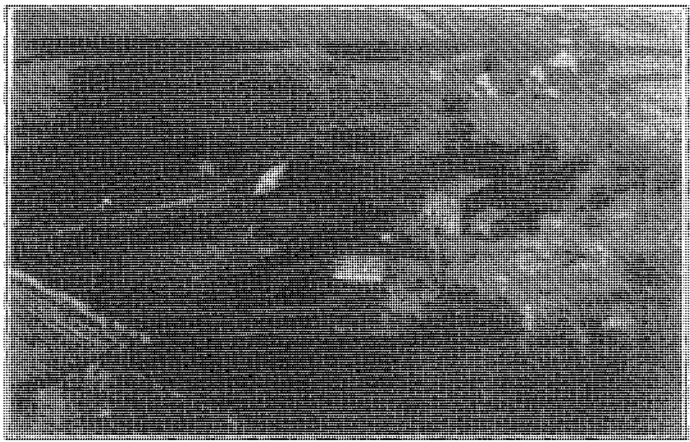
MELVYN GIBSON, 14th January 1990

ADVERTISING RATES

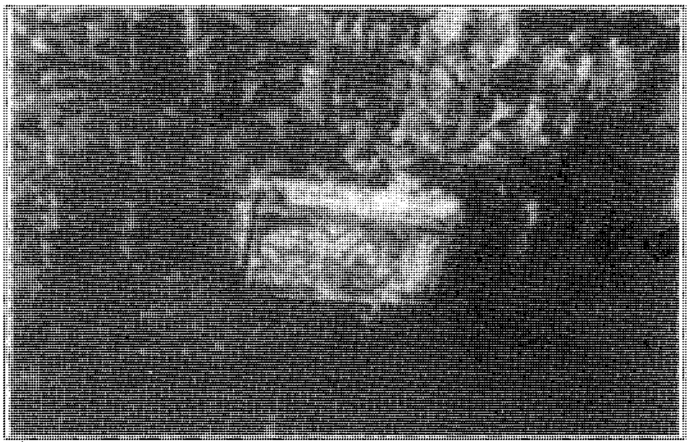
	Per Issue	Per Six Issues
Quarter Page	£4.50	£22.50
Half Page	£8.25	£41.25
Full Page	£15.00	£75.00

NEXT PRESS DATE

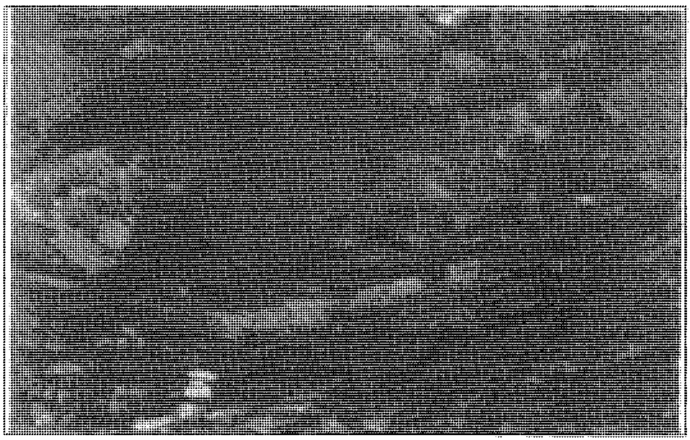
Articles, Letters, etc., for the May/June issue of Pennine Link should reach the Editor by 15th April 1990



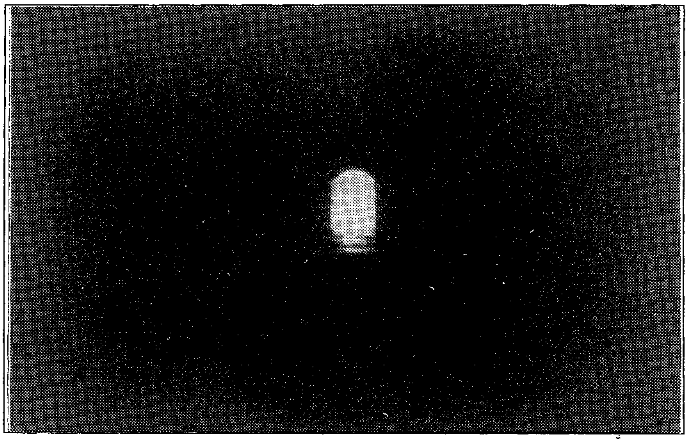
1. A general view of tunnel end before our journey.
The boat tied up outside the cottages.



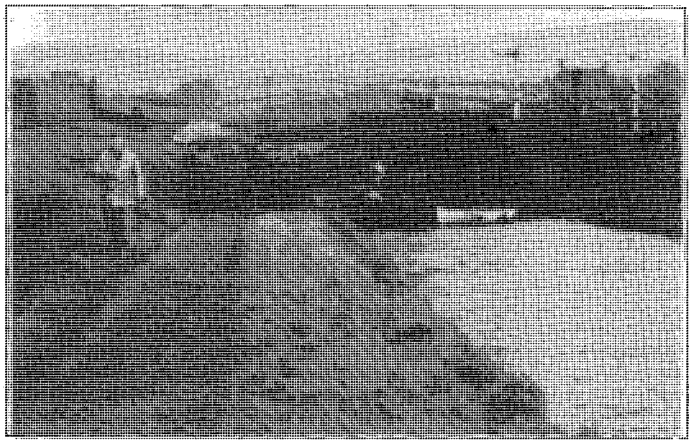
2. A roof marker – No. 103. Beginning at tunnel end, these mark the distance through the tunnel in 50-yard increments (103 x 50 yds = 5150 yds from tunnel end)



3. The bare rock of the unlined tunnel



4. Approaching Diggle end



5 & 6 Views of the boat and our party at the end of the voyage.

Dear Ed,

Jean and Ron Buckley (HCS members), Peter and myself spent 2 hours and four pints trying to figure out your 'What is it?' We came up with 'Beer Crate Clamp', 'Windlass Holder', and then finally 'Diggle Detector', but 'Handy Dog Carrier' – marvellous! Will you be marketing this at some future date to sell at the festivals?

Let's have more teasers please!

JULIE FREEMAN, Golcar, Huddersfield

Thanks for the letter Julie. I would like to have more teasers, but the problem is the supply of suitable material, as many such drawings are totally unprintable. I would be pleased to consider any suggestions sent to me by readers. All letters, etc., are welcome. Ed.

Dear Mr.Ogborn,

We have just received November/December 1989 Pennine Link, and being new members would like to say we are very impressed with its presentation.

My purpose in writing is to ask if is possible to obtain a print of the picture on page 23 (top) (Best Boat), as we have not seen this before, probably because we don't live in the Huddersfield area and therefore don't see the local press. Obviously we will pay for this print.

Yours sincerely,

M.R. WEBSTER (Mrs.)

I have sent your request to the photographer responsible for the picture Mrs. Webster, and I hope the response it positive. Ed.

Dear Sir,

Following a close scrutiny of your latest Pennine Link (No. 90), I feel honoured to have received an indirect mention in the form of a reference to 'a gentleman from down South'! It was, however, only via the subtle hint that I realised that I had not received the outstanding raffle tickets. Now I find myself in a similar position to Dave and Dianne Calverley, as I can't find their address. Rather than sending in the bailiffs could you please advise them that any outstanding monies may be regarded as a donation. I would note also that your efforts did not go unappreciated as I realise from experience that 'stuffing' 1000 envelopes is a considerable feat worthy of mention.

Whilst writing I consider it essential to add a caption for your 'Frank in the cut' picture, spurred on by the recent water privatisation. Perhaps an apt phrase would be "Where's my share?"

I must also add my appreciation for your efforts in the production of Pennine Link, as it is a vital form of communication for us 'down South', stirring memories of the mid-1950s when the Huddersfield was a working canal. Although I venture as far as Uppermill occasionally I still read P.L. for the detail.

Yours in appreciation,

MICHAEL WRIGHT

P.S. Does 1 Park Lane mean anything?

Not to me Michael. What about you readers? Ed.

CANAL BOAT

Come home with me at dusk.
Be one with me in this lovely night.
Feel leaping joy at the sunset's child-art sky;
Enter soft my peace.
For this is my only world.
The rest is dream.
(Ripples gently rouse the reeds,
And spreading smooth from stem to stem
Are left behind: mementoes of
We two that were, and are.
Dark, darker dark, unreal light,
Uncertain shapes that half-appear,
Then hide in bridge-holes' hump-backed sleep).
Come home with me at dusk,
But enter imperceptibly in me,
For in my quietest boat on this canal
I'm halfway west to Avalon,
Where moving being shall stop, and be.

TREAD NOT ON MY DREAMS

We will walk together
You and I,
And share a rhapsody.

We will sing a song
In sympathy –
A two part unison.

We'll agree and disagree,
But always feel
For one another's feelings.

And we will worship dreams,
Compassionately
Tiptoe round their passionate reality.

Both poems sent in by Mr. Guy Nuttall of Edgbaston, Birmingham

UNIVERSITY OF HARTSHEAD PIKE ENTRANCE EXAMINATION 1990

Time allowed:- From when the little hand is on Mickey Mouse until it gets to Noddy

Candidates (that's you) must try to answer at least one question

Anyone found copying will be awarded double marks for initiative

* * * * * * *

1. In the 1988 Sheep Dog Trials, how many dogs were found guilty?
2. Approximately how many Commandments was Moses given?
3. Who invented Stevenson's rocket?
4. At what time does News at Ten come on T.V.?
5. Spell either (a) PHOTOGRAPH or (b) IDENTIFICATION
6. What is a silver dollar made of?
7. Who won the Second World War? (For extra marks, who came second?)
8. Do you understand the Einstein Theory of Relativity? (Answer yes or no).
9. There have been six kings of England called George. The last one was George the Sixth. Who were the other five?
10. Write down the numbers 1 to 10. (Marks will be deducted for numbers out of sequence).
11. Of what country is Dublin the capital? (Do not write on more than two sides of the paper).
12. Name the odd man out:- Sheamas O'TOOLE
    Sean O'FLAHERTY
    Mahatma GHANDI
13. Is a Dunker:- (a) A person who dips his biscuits in his tea?
    (b) A contraceptive?
    (c) A lorry on motorway construction?
14. Name the winning jockey in the 1988 Greyhound Derby
15. Who built the Pyramids:- (a) McAlpines
    (b) Wimpey
    (c) The Pharaohs
16. Name the odd man out:- (a) The POPE
    (b) Cardinal HEAGAN
    (c) Jack the RIPPER
17. Discuss Newton's four Laws of Gravity or write your name in block capitals.

* * * * * * *

THE SOCIETY WELCOMES THE FOLLOWING NEW MEMBERS :

1733 Mr. & Mrs. Malcolm R. Webster, [redacted]

1734 Mr. Paul Taylor & Ms Hazel Mellor, [redacted]

1735 Mr. Martin D. Johnson, [redacted]

1736 Mr. David Halsey, [redacted]

1737 Dr. & Mrs. A.M. Dupton, [redacted]

1738 Mr. Neil Whittaker, [redacted]

1739 Mr. Stephen Morley, [redacted]

1740 Mr. Alexander Father, [redacted]

1741 Mr. David J. & Dorothy Smith, [redacted]

1742 Miss Eileen Pugh, [redacted]

1743 Mr. & Mrs. F.M.L. Williams, [redacted]

1744 Mr. & Mrs. Iain Gerrard, [redacted]

1745 Mr. Peter J. Taylor, [redacted]

1746 Mr. William J. Horsley, [redacted]

1747 Mr. Mike Roberts, [redacted]

1748 Mr. D. & Mr. S. Thurstan, [redacted]

1749 Mr. David Leigh, [redacted]

1750 Mr. & Mrs. Ernest Broadbent & Family, [redacted]

BACK NUMBERS

BACK NUMBERS AS FOLLOWS ARE AVAILABLE FREE FROM

John Maynard,
29 Thick Hollins Drive,
Meltham, Yorkshire

Please send an A5 size stamped, addressed envelope (24p)

Issue No.	Number in Stock
10	6
24	21
25	18
26	2
31	6
33	3
34	1
36	6
38	10
41	6
42	1
43	1
46	2
47	19
48	21
49	7
52	5
54	16
55	3
56	15
58	17
59	17
66	3
67	1
68	9
69	4
72	1
73	2
74	14
75	24
76	1
77	9
78	2
79	25
80	22
81	16
82	16
83	27
84	2
85	13
86	7
87	14
88	5
90	3

CAPTION COMPETITION

Several inventive readers have come up with captions to fit our 'Frank in the Cut' picture above. First prize – the book "Pennine Passage", goes to Margaret Knott, second prize – an H.C.S. T-shirt, goes to Julie Freeman. A special prize of a book of Canal Architecture goes to G.Nall for being the only person to respond to the first printing.

Entries were as follows:

Harry Murgatroyd,
23 Course View,
Holts Estate, Oldham.

1) Dog: "I know you play with boats in the bath, but this is taking it too far!"
2) Dog: "You always wanted to make a splash. Now you've done it! What next?"
3) Man: "You have a drink. I'm going for a pint."

Margaret Knott,
264 Yew Tree Lane,
Dukinfield, Cheshire.
1st

"Look – I'm on patrol, and Diggles are not allowed in this section!"

Jack Patterson,
29 Sunnyside Grove,
Ashton-under-Lyne, Lancs.

1) Dog: "Why don't you get in the queue like everybody else?"
2) Man: "I said I'd come back for you – only I couldn't get the boat through Standedge Tunnel."
3 Man: "Don't drop your dog carrier in again!"
4) Man: "I . . . I . . . I . . . meant it was only in the <u>channel</u> they use dog fat."

L. Thompson,
16 Tyrung Road.
Lower Knowles, Bristol.

1) "Here! Grab my paw, I had a hairdo before I came out."
2) "You've made me cross. We were enjoying ourselves on a quiet walk and not expected to be playing in the water."
3) "Hurry up! The people will be only too pleased for *me* to be first in the queue, but I'm not sure about you."

Julie Freeman,
4 Heath Hill, Golcar,
Huddersfield.
2nd

Dog: "That's the last time I bring you out without the lead!"

G. Nall,
33 Elmcroft Road,
Yardley, Birmingham.
Special

"That's the sloppiest dog paddle I've ever seen."

John Maybard,
29 Thick Hollins Drive
Meltham, Huddersfield.

"There is nothing so friendly as a wet human."

SPECIAL EVENTS – 1990

	EAST SIDE		WEST SIDE
Wednesday 11th April	Joint East/West Meeting, "The Cross Keys," Uppermill Lecture, David Booth: "I.o.M. Steam Railway." (Provisional)		
Wednesday 9th May	General Meeting "The Sair," Linthwaite	*	General Meeting "The Farrar's Arms," Grasscroft, Oldham
Wednesday 13th June	Joint East/West Meeting, "The Sair," Linthwaite, Huddersfield Lecture. David Calverley: "South & North Yorkshire Canals."		
Wednesday 11th July	General Meeting "The Sair". Linthwaite	*	General Meeting "The Tollemache Arms " Mossley
Wednesday 8th August	Joint East/West Meeting. "The Cross Keys." Uppermill Lecture: To be announced		
Wednesday 12th Sept.	General Meeting "The Sair," Linthwaite	*	General Meeting "The Tollemache Arms" Mossley
Wednesday 10th October	Joint East/West Meeting, "The Sair", Linthwaite, Huddersfield Lecture: To be announced		
Wednesday 14th Nov.	General Meeting "The Sair," Linthwaite	*	General Meeting "The Buck & Hawthorn" Ashton-under-Lyne.
Wednesday 12th Dec.	Joint East/West Meeting, "The Cross Keys," Uppermill Lecture: To be announced		

N.B. All meetings commence at 8.00 pm

"The Sair"	Hoyle Ing., Linthwaite, Huddersfield
"Cross Keys Inn"	Church Lane, Uppermill, Saddleworth
"Tollemache Arms"	Manchester Road, Mossley
"Farrars Arms"	Oldham

HUDDERSFIELD CANAL SOCIETY

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