SETSCO SERVICES (M) SDN BHD (73988-K)

28, Jalan Anggerik Vanilla W31/W,
Kota Kemuning, Seksyen 31,
40460 Shah Alam,
Selangor Darul Ehsan.
Tel: (03) 5121 1928
Fax: (03) 5121 3928

HEAD OFFICE :
SETSCO SERVICES PTE LTD
18, Teban Gardens Crescent
Singapore 608925
Tel : (02) 6566 7777
Telefax : (02) 6566 7718
Website : www.setsco.com

Our Ref.: S 5009/LCA/1

Date: 01/07/11

TEST REPORT

(This Report is issued subject to the terms & conditions set out below)

Subject : Ground radar penetration and concrete cover survey on reinforced concrete (RC) pier at Klang site as requested by Ikram Engineering Services Sdn Bhd.

Tested For : **IKRAM ENGINEERING SERVICES SDN BHD**
Block 7, Taman Ilmu Ikram (Ikram Park),
Jalan Serdang-Kajang,
43300 Kajang,
Selangor Darul Ehsan.
Attn: Mr. Vong / Ms Yasmin

Test Method : Refer to Appendix A

Project Reference : An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan.

Sample Descriptions : A total of two (02) nos of RC piers selected by the client for inspection at site. These RC piers were referenced as "25" and "33".

Results : Refer to attachment.

Mohd Zaki Nudin Dahalan
Testing Officer
F/concretereport/S4499

Lim C A
Engineer

Results:

Table 1: Determination of Concrete Cover, Lap-Length

S/No.	1	2
Pier Reference	33	25
Reinforcement Size (mm)	32	32
Concrete Cover (mm)	35 to 59	36 to 60
Spacing (mm)	180 - 240	200-260
Approximate Lap Length (cross head) (mm)	1250-1500	1300-1500
Approximate Lap Length (column) (mm)	1150-1360	1200-1300
Approximate Lap Length (soffit) (mm)	1250-1550	1250-1550

METHOD STATEMENT

Ground Radar Penetration

1.0 SCOPE OF WORKS

1.1 Scope Brief

The scope of work for this project consisted of two stages, namely the data acquisition (fieldwork) and data interpretation (laboratory post-processing).

1.2 Scope of Work

2.2.1 Data Acquisition (site work)

After a Preliminary Study of the site background and desktop review of drawings, Geophysical Survey by Ground Penetrating Radar (GPR) method was carried out at the locations of concern.

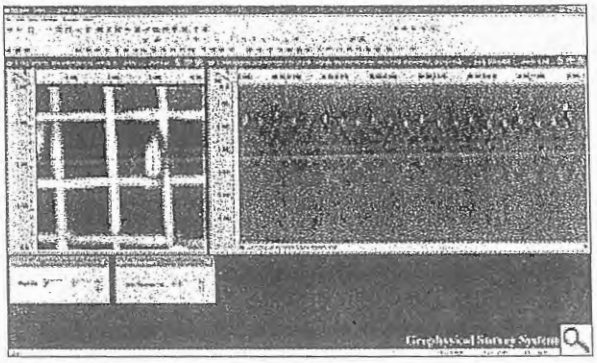
The images captured on the scanning run on the scan lines were stored as raw data to be processed in our laboratory.

1.2.2 Data Interpretation (Post Processing)

The raw data were processed to optimise the resolution of the images. The optimised radar images were classified and interpreted. The confirmation of detected tendons location were by coring method.

2.0 DATA COLLECTION

All data was collected using Geophysical Survey Systems SIR20. Data acquisition was in continuous mode. The distance along each profile was measured by using automatic survey wheel.



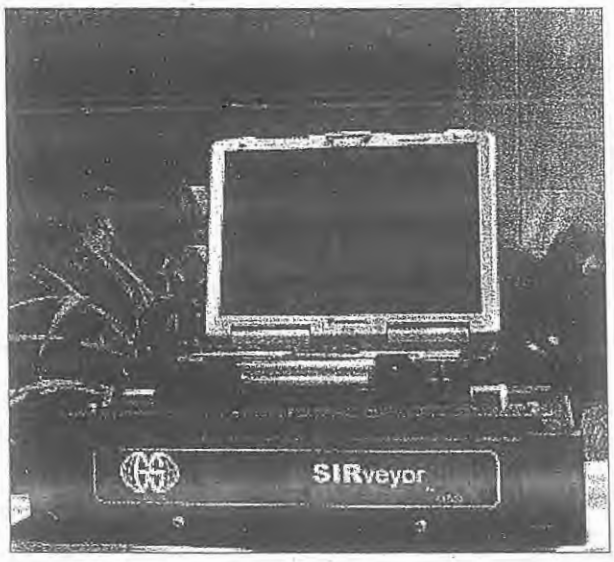
Software RADAN

Review of the reflected waveform and patterns generated during a scan, form the basis of interpretation. When the antenna passed over a localised feature, the return time for the reflected signal is smallest when they are directly above the feature- corresponding to a peak on the trace.

2.3 Depth of Penetration

Depth Penetration is dependent on conditions found at each site. Radar waves are attenuated (absorbed or scattered) by certain properties of the sites' soil, the most important of which is the electrical conductivity of the materials. Generally, better overall penetration is achieved in dry sandy soils. Reduced penetration is achieved in moist, clayey or conductive soils. Considerable depth may be attained in saturated sands. Radar penetration is excellent in massive dry materials such as granite and limestone and reinforced concrete members.

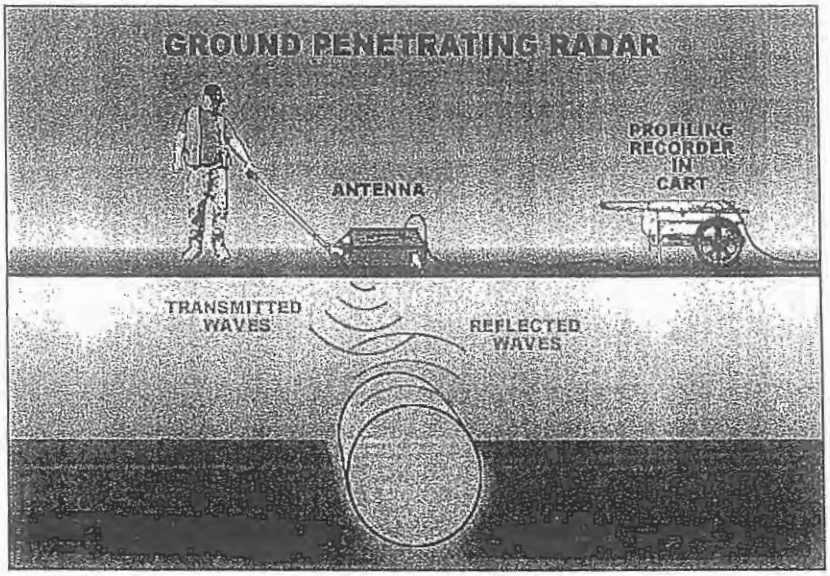
Depth is given by velocity of the material times the travel time. Depths to buried layers or objects are proportional to the time it takes the radar pulse to travel from the surface antenna to the target and back again to the receiver antenna. This time is called two-way travel time and is dependent on the dielectric properties of the media through which the radar pulse travels. These dielectric properties are in turn a complex function of the composition and moisture content of the soil and rock. In almost all cases, the moisture content has the greatest influence because water has a very high dielectric value compared to common soils and rock. The greater the amount of water saturates, the lower the radar velocity and the lower the object will appear in the radar profile.



3.0 GROUND PENETRATING RADAR SURVEY

2.1 Introduction

Ground Penetrating Radar (GPR) uses high frequency pulsed electromagnetic waves to map subsurface information. GPR uses transmitting and receiving antenna, which are dragged along the ground or concrete surface.



The transmitting antenna radiates short pulses of high-frequency radio waves into the ground. The wave spreads out and travels downward. If it hits a buried object or a boundary with different electrical properties, the receiving antenna records variations in the reflected return signal. The principles involved are similar to reflection seismology, except that the electromagnetic energy is used instead of acoustic energy, and the resulting image is relatively easy to interpret. Integration of GPR data with other surface geophysical methods reduces uncertainty in site characterisation. GPR provides the highest lateral and vertical resolution of any surface geophysical method.

2.2 Principles of GPR

The Ground Penetrating Radar (GPR) technique provides cross sectional images of reflectors associated with sharp changes.

This method involves transmitting and receiving electromagnetic (EM) waves. An EM pulse is sent into the surface, which travels at a speed dependent on the electrical properties of the material through which it passes. Radar waves are partially reflected (and partially transmitted) at interfaces where there is a contrast in dielectric properties. The amount of energy reflected (i.e. the strength or amplitude of the return signal) is dependent on the magnitude of the contrast. The phase of the reflection (negative or positive) is an indication of whether the radar wave is passing from a less conductive layer to a more conductive layer, or vice-versa. This can be very useful in determining which reflector relates to which layer boundary. A conductive response will be gained from steel reinforcing whilst a resistive response will be gained from an air void.

All data was processed using RADAN release 6 (June2004). The scanned sections of all lines were filtered using horizontal filters to remove flat lying noise and with band pass filters to remove extraneous radio and atmospheric noise. These enhance the visibility of possible feature of interest and reduce the effects of outside interference.

2.4 Limitations and Concern

Depth of penetration is reduced in moist and/or clayey soils and soils with high electrical conductivity. Penetration in clays and in materials having high moisture is sometimes less than 1 meter. Penetration of depth is further reduces in Marine Clay as it will absorb the radar signals. Radar waves cannot penetrate very far through conductors such as salt water.

The GPR method is sensitive to noise like interference caused by various geological and cultural factors. For example tree roots and other phenomena can cause unwanted reflections or scattering. Cultural sources of noise can include reflections from nearby vehicles and construction activities. Electromagnetic transmission from cellular telephones, two-way radios, television, and radio and microwave transmitters may also cause noise on GPR records.

Penetration of depth is reduces in heavy steel reinforcement bar in the reinforced concrete members. Amount of reinforcing steel may make the inspection of lower layers of concrete very difficult.

Unprocessed images require processing, as they provide only approximately shapes and depths.

An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan

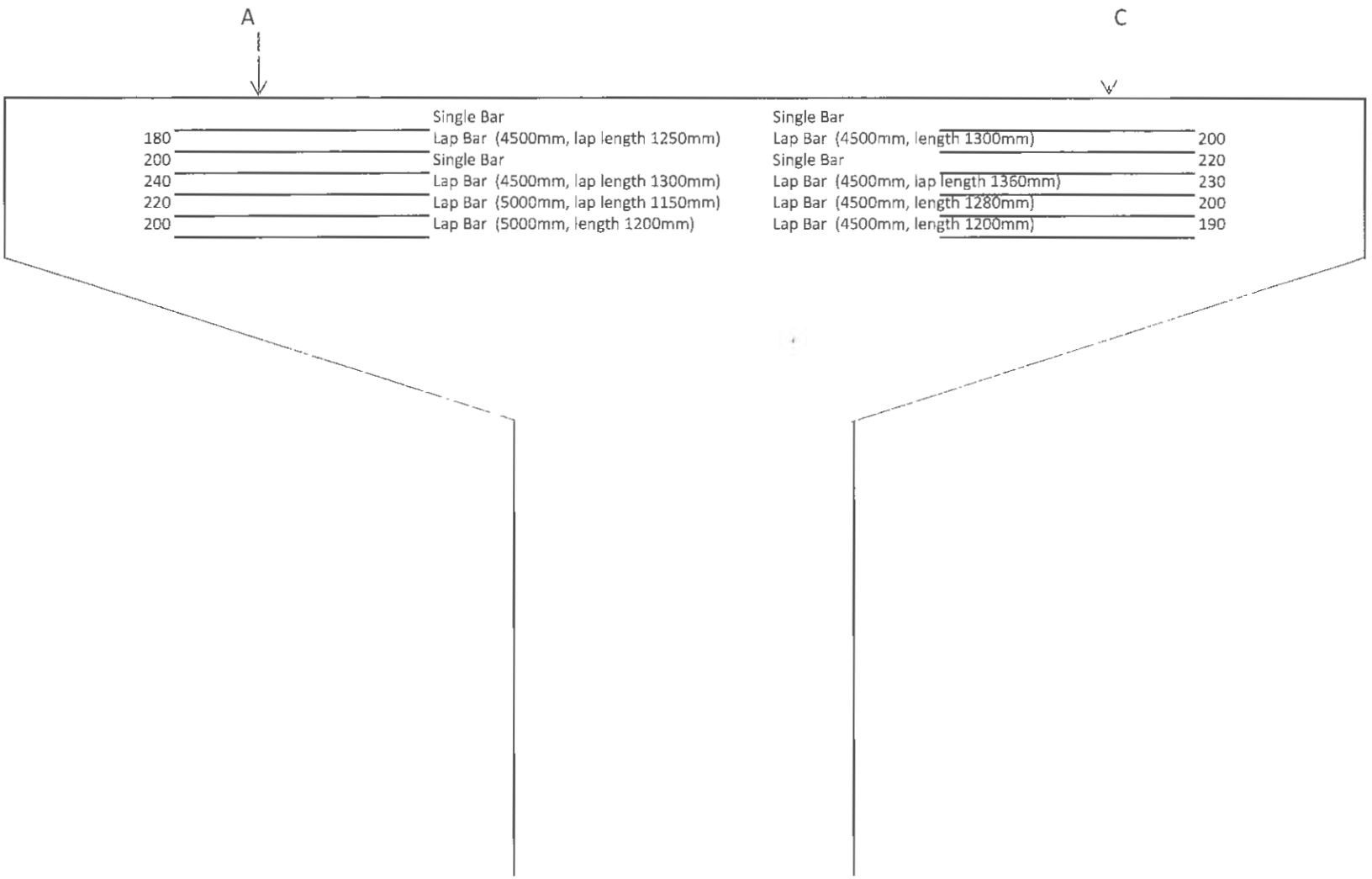


Figure 1: Elevation View of Pier 33 (From Pelabuhan Barat)

An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan

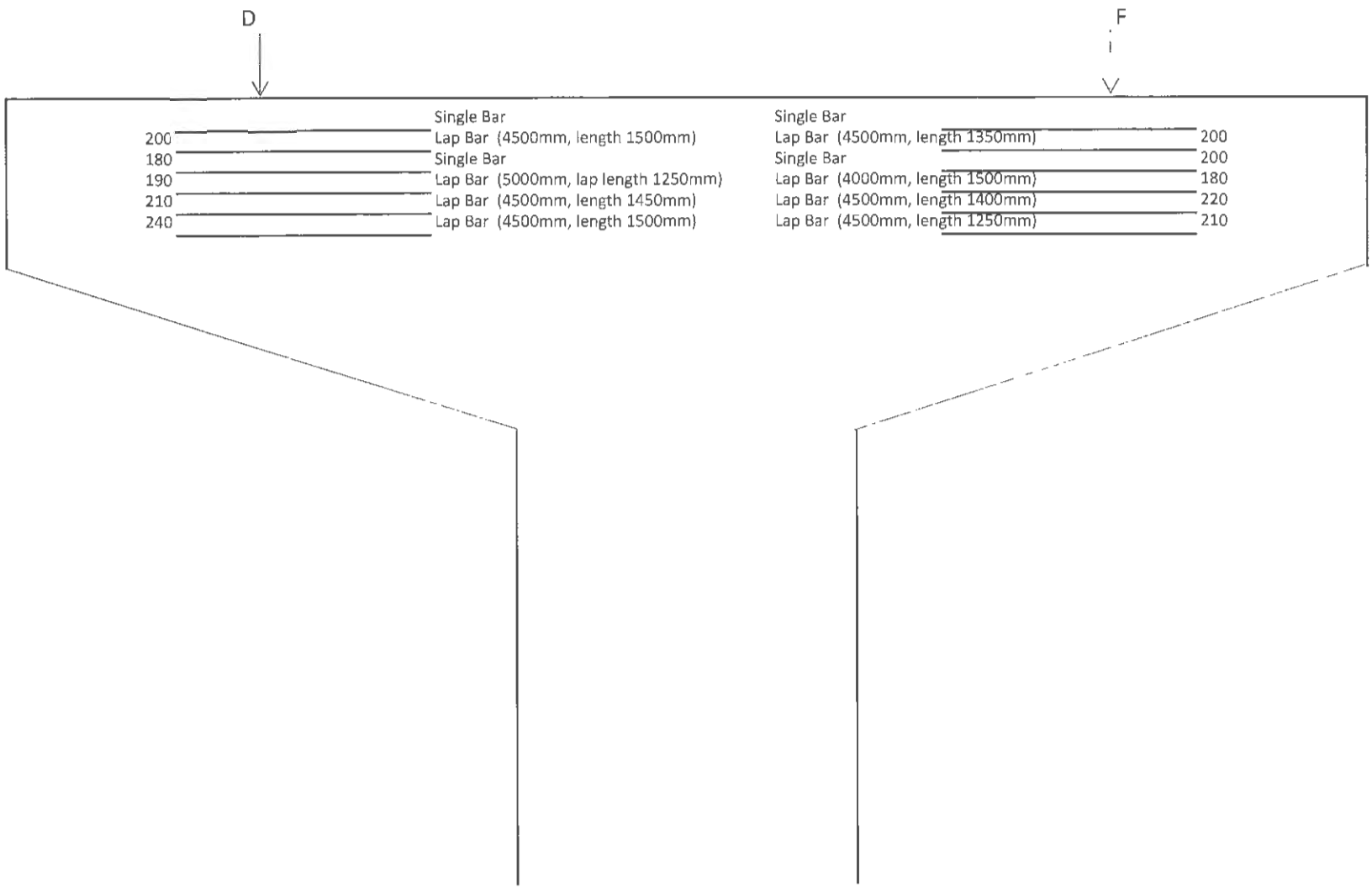


Figure 2: Elevation View of Pier 33 (To Pelabuhan Barat)

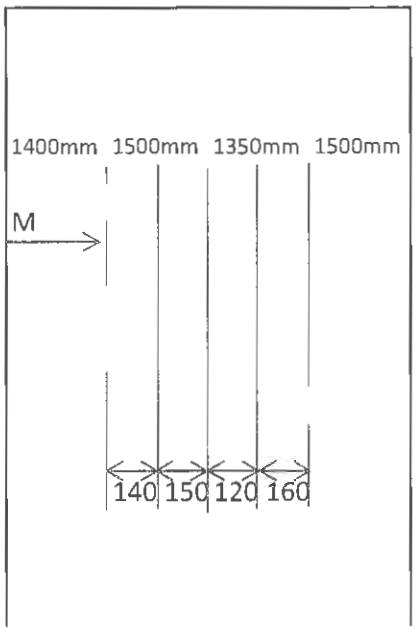


Figure 3: Elevation View of Pier 33 -Soffit (From Pelabuhan Barat)

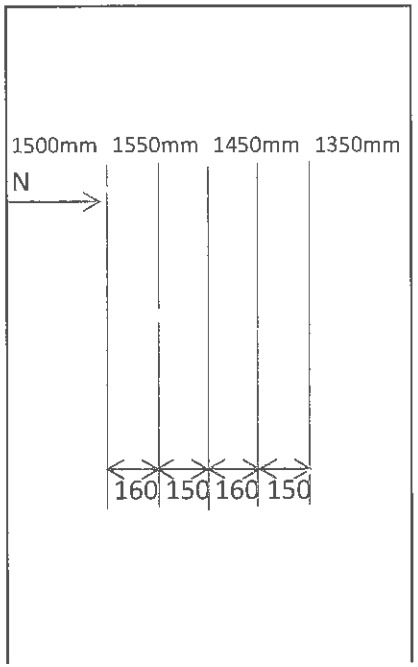


Figure 4: Elevation View of Pier 33 -Soffit (To Pelabuhan Barat)

An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan

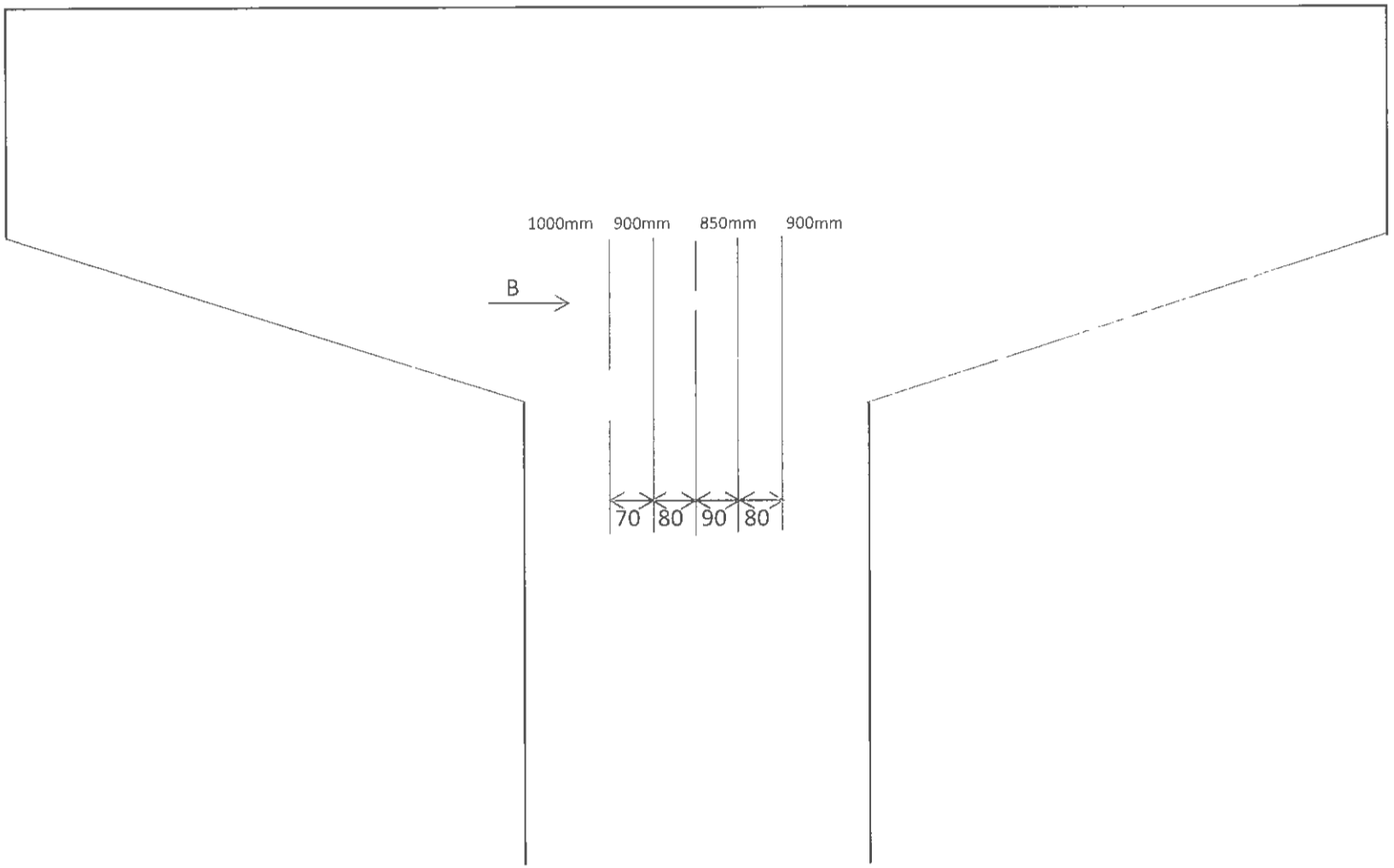


Figure 5: Elevation View of Pier 33 (From Pelabuhan Barat)

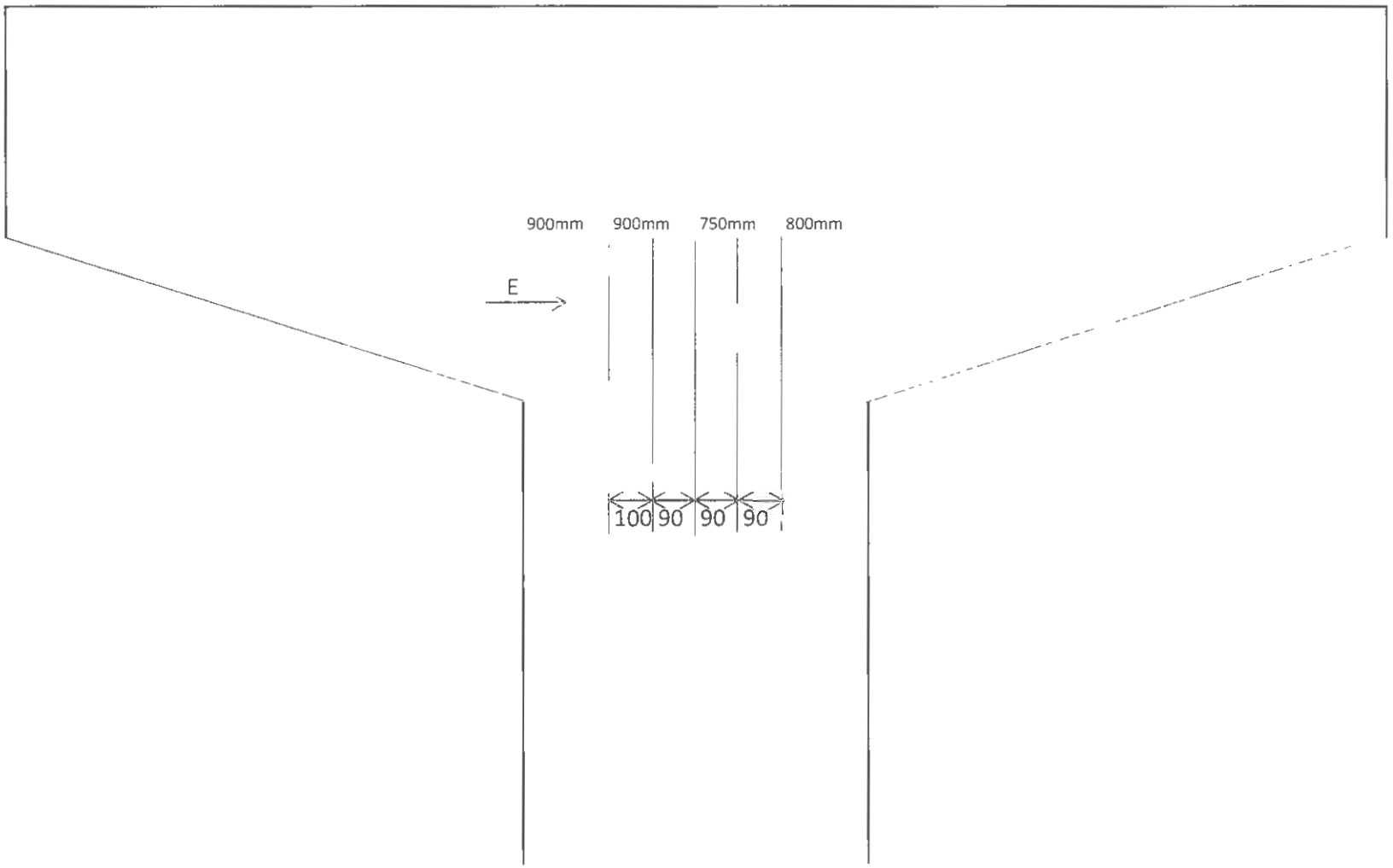


Figure 6: Elevation View of Pier 33 (To Pelabuhan Barat)

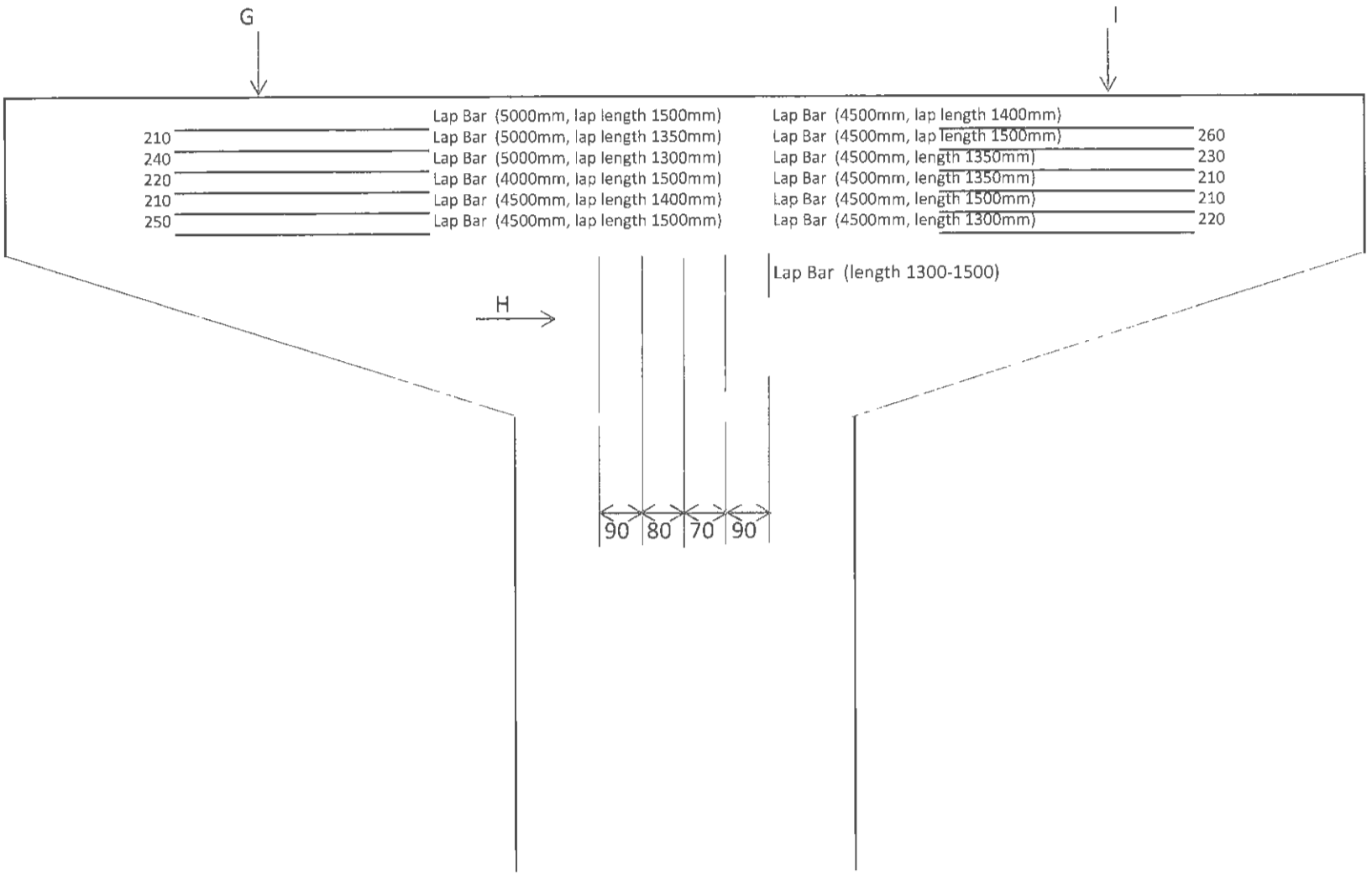


Figure 7: Elevation View of Pier 25 (From Pelabuhan Barat)

An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan

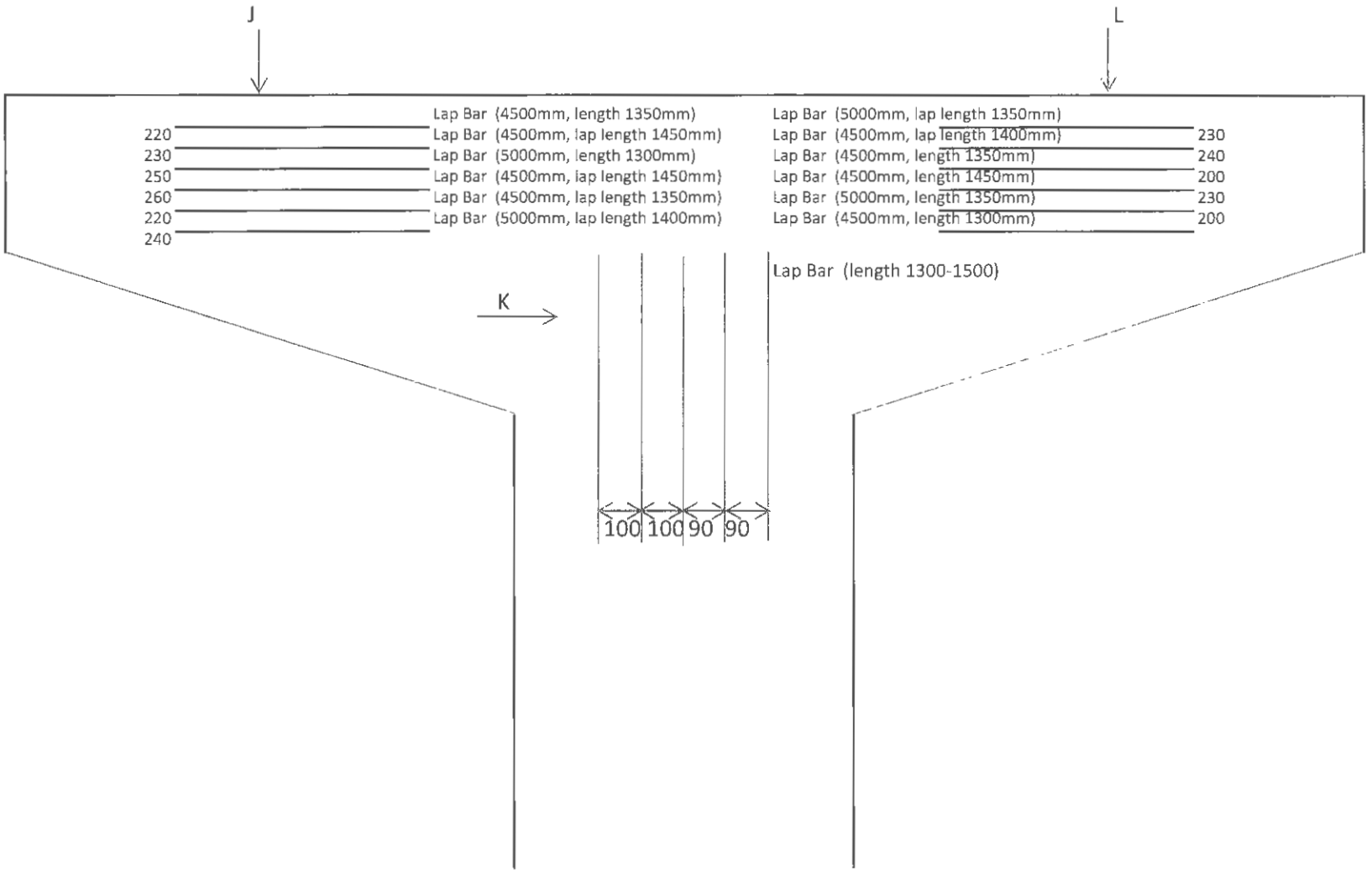


Figure 8: Elevation View of Pier 25 (To Pelabuhan Barat)

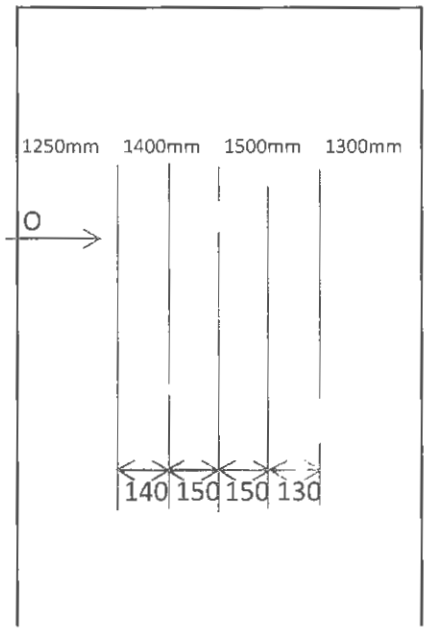


Figure 9: Elevation View of Pier 25 -Soffit(From Pelabuhan Barat)

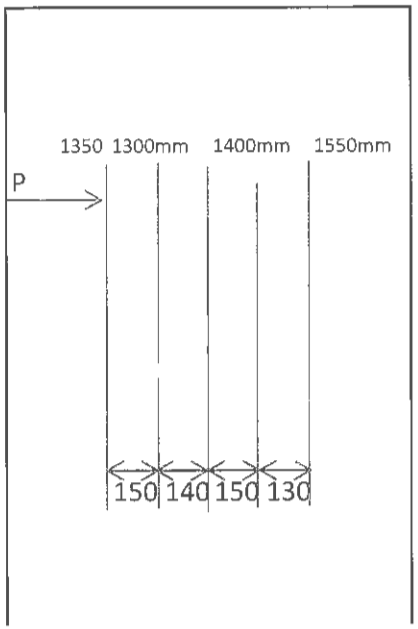


Figure 10: Elevation View of Pier 25 -Soffit (To Pelabuhan Barat)

An Independent Design Check Of The Pier At Viaduct On Federal Route FT 180/001/40 West Port-North Port, Selangor Darul Ehsan

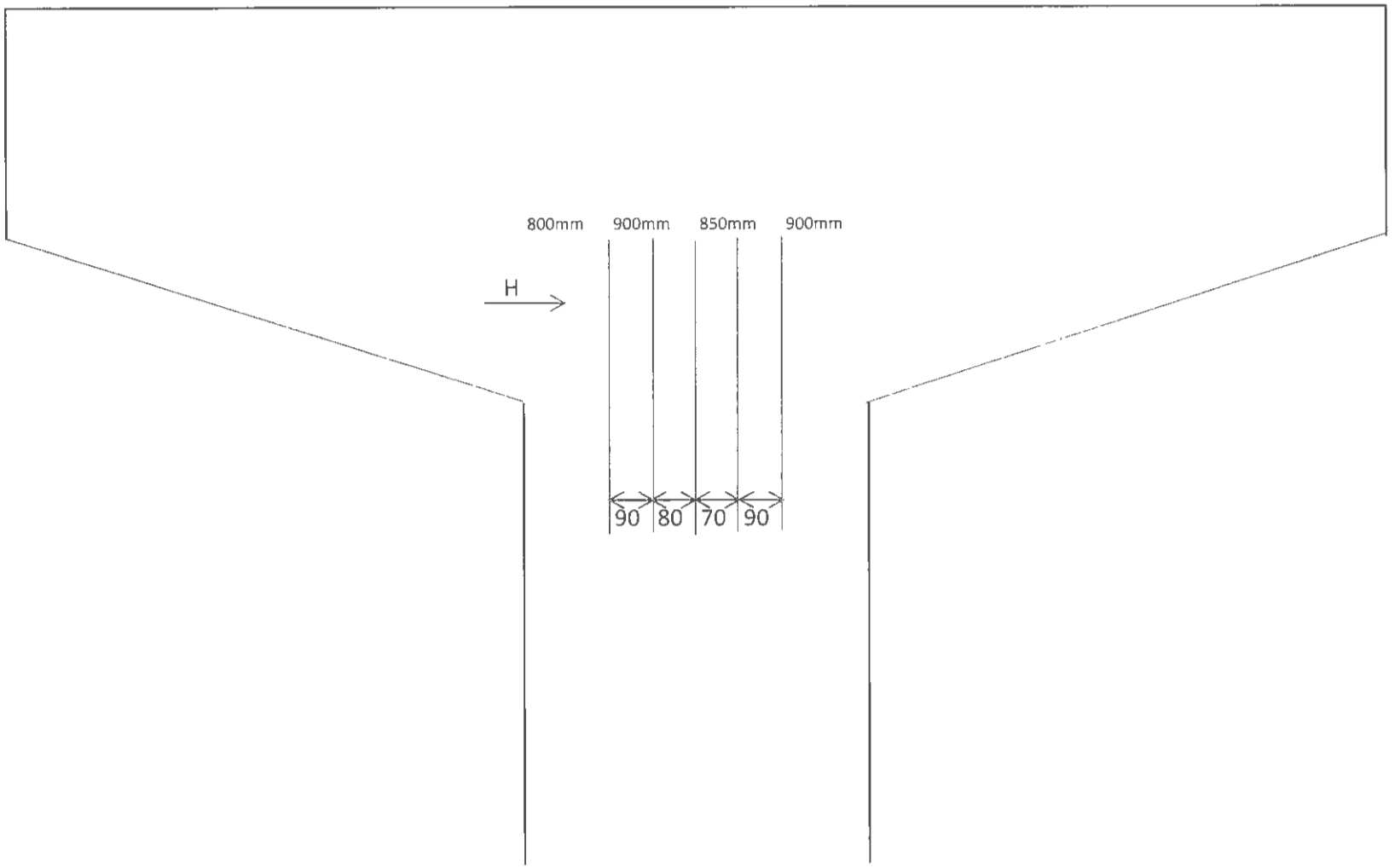


Figure 11: Elevation View of Pier 25 (From Pelabuhan Barat)

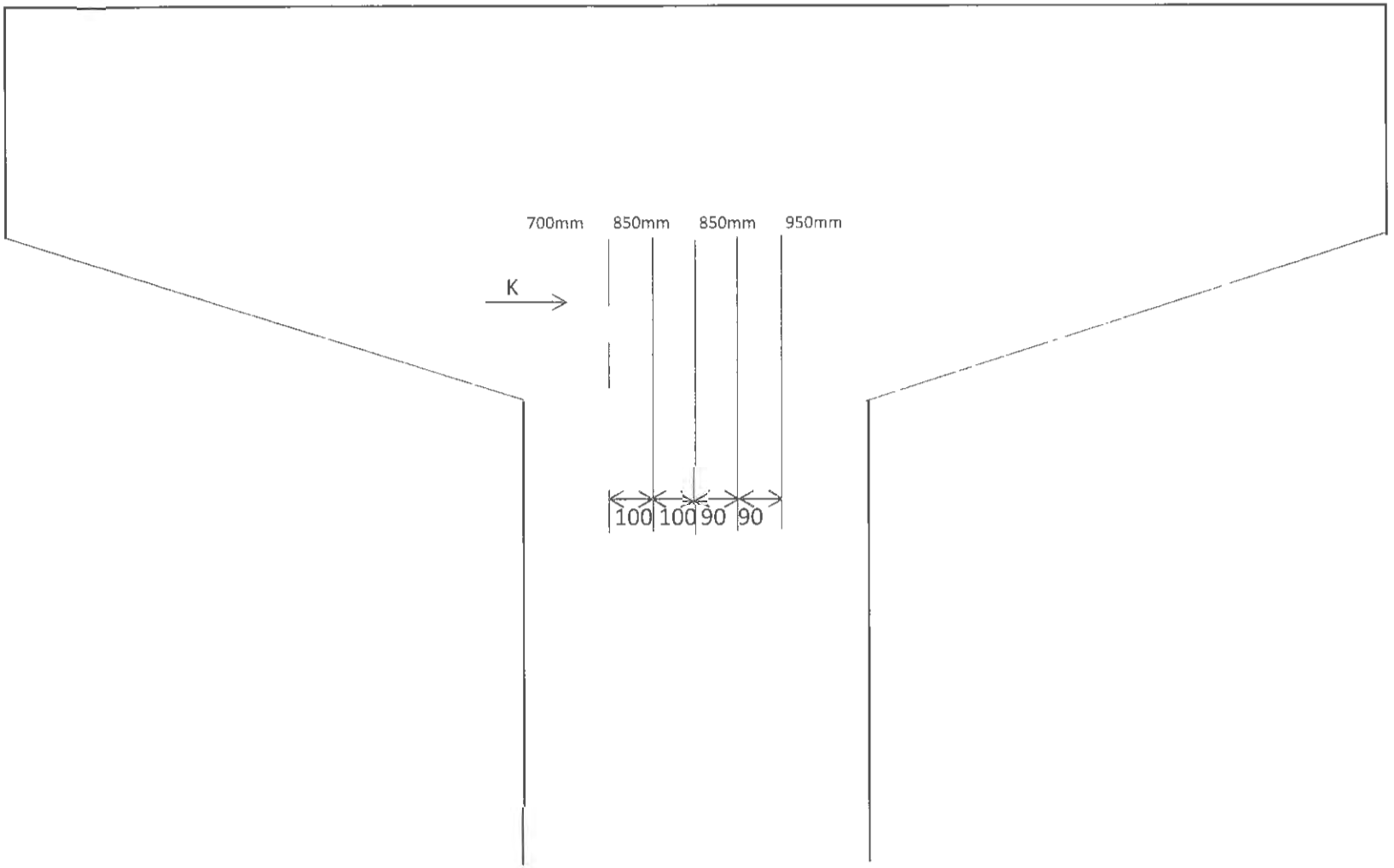
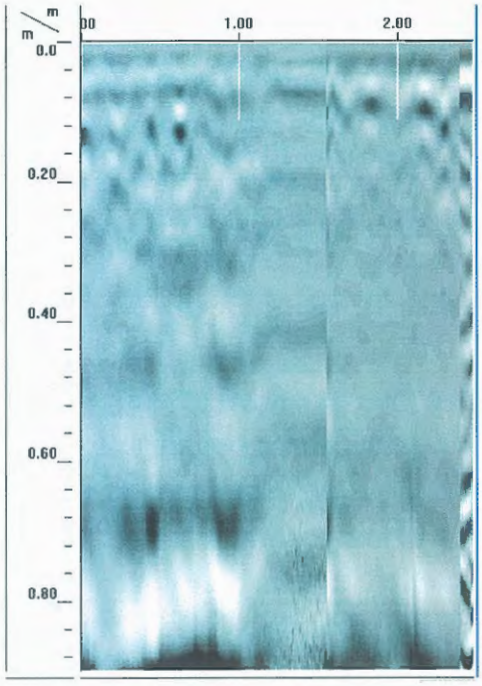
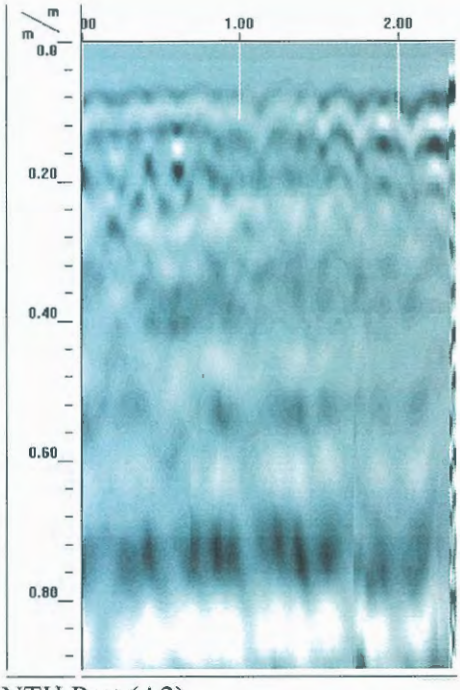


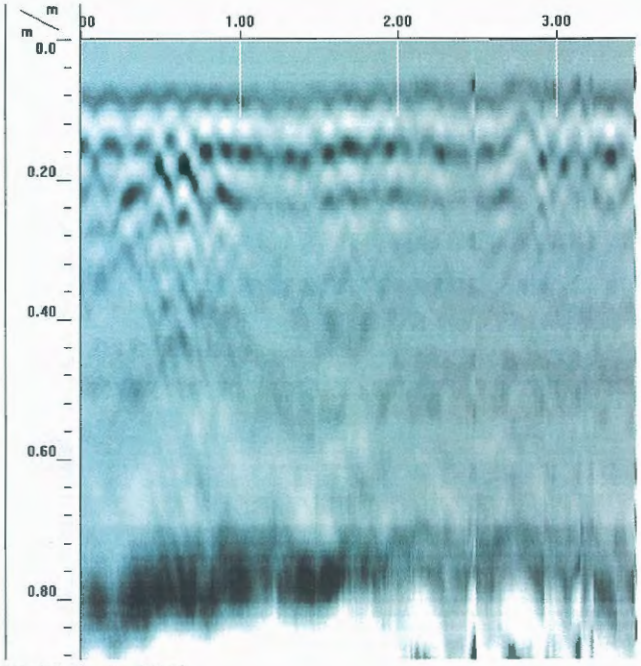
Figure 12: Elevation View of Pier 25 (To Pelabuhan Barat)



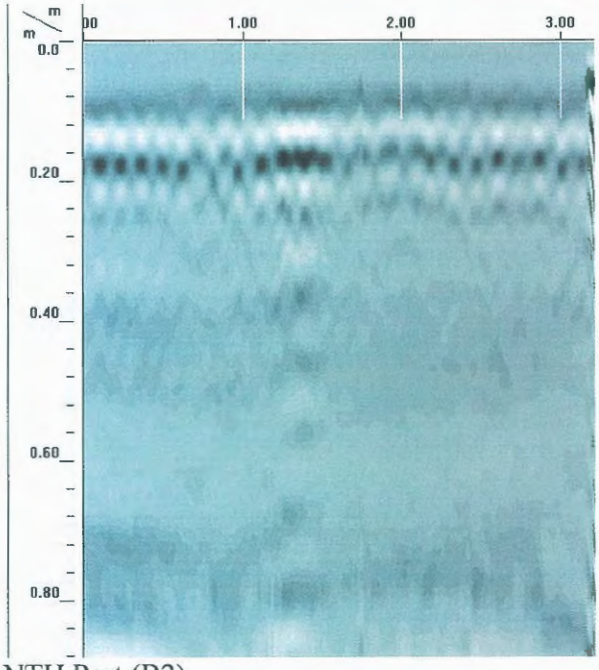
NTH Port (A1)



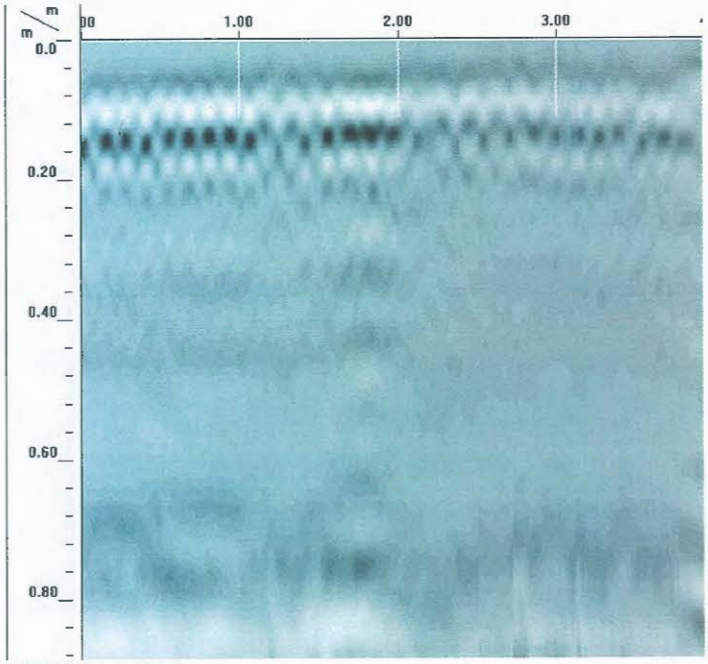
NTH Port (A2)



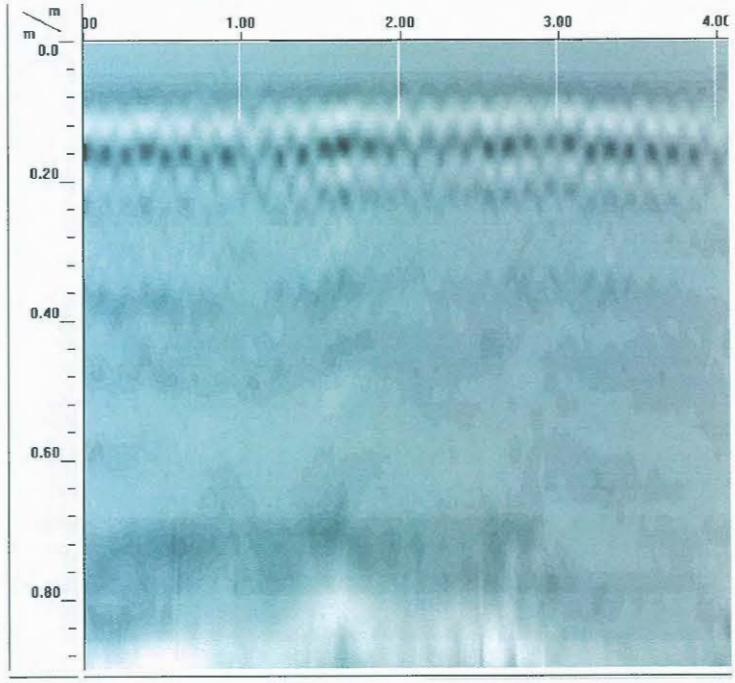
NTH Port (B1)



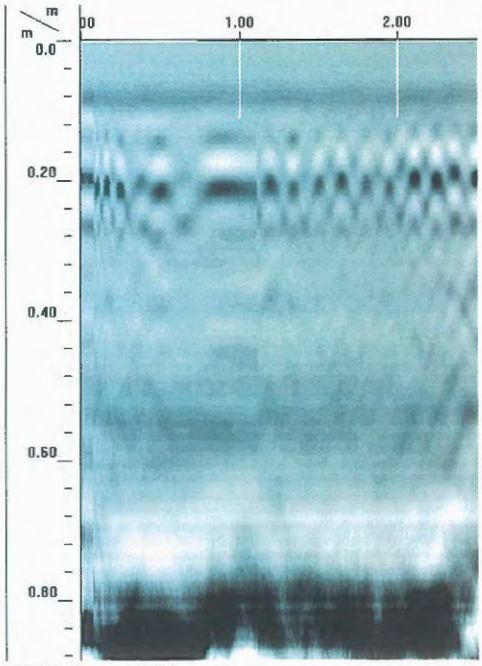
NTH Port (B2)



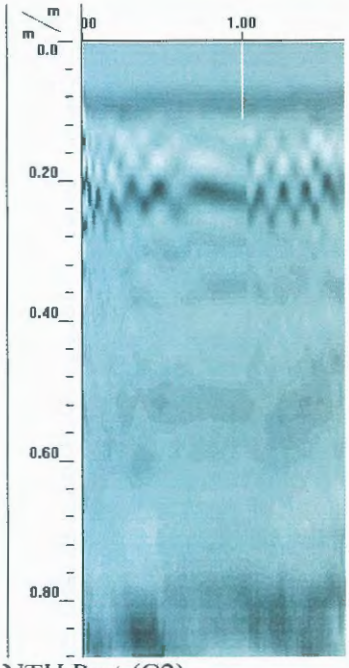
NTH Port (B3)



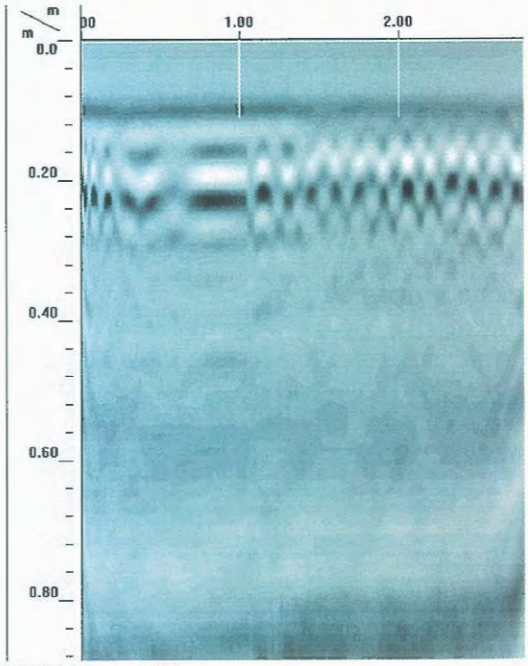
NTH Port (B4)



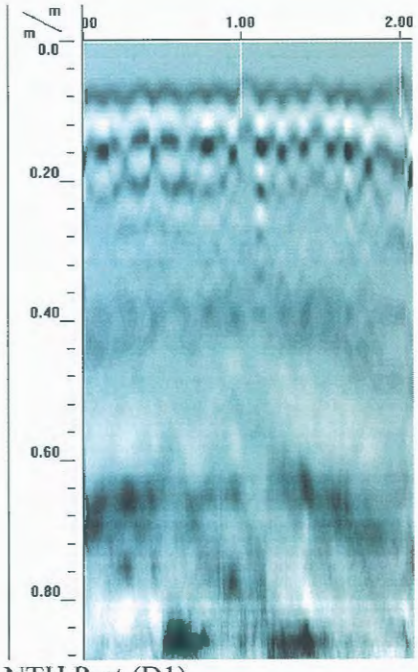
NTH Port (C1)



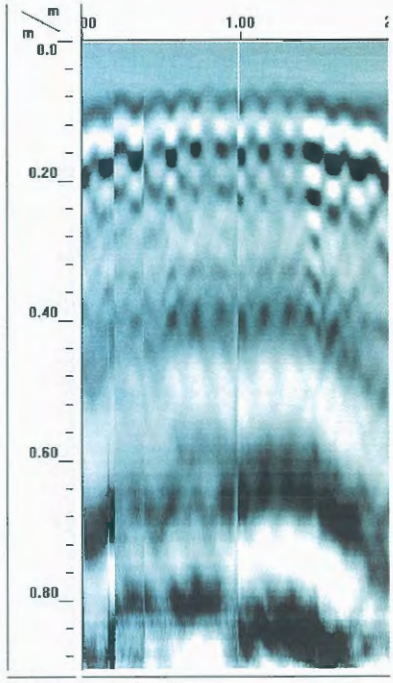
NTH Port (C2)



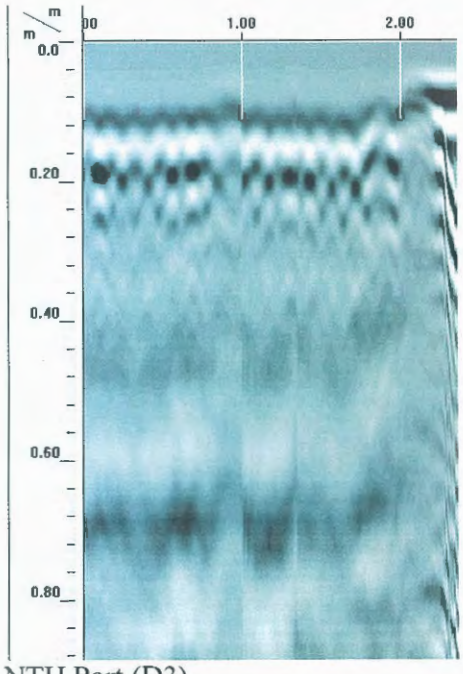
NTH Port (C3)



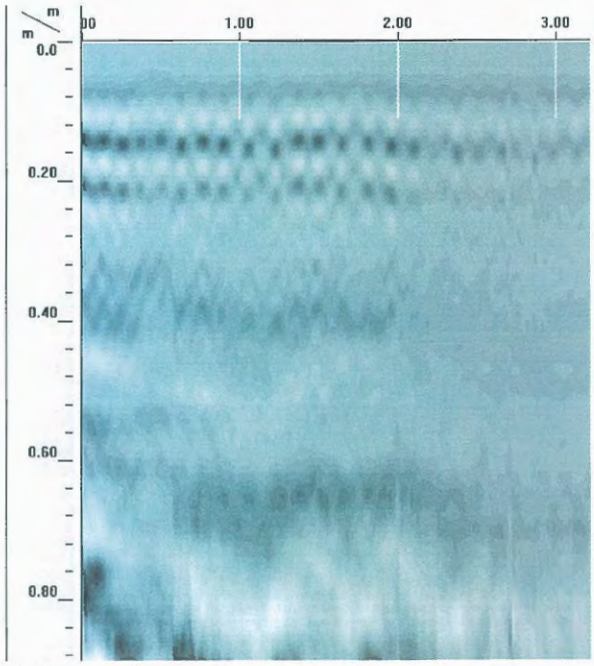
NTH Port (D1)



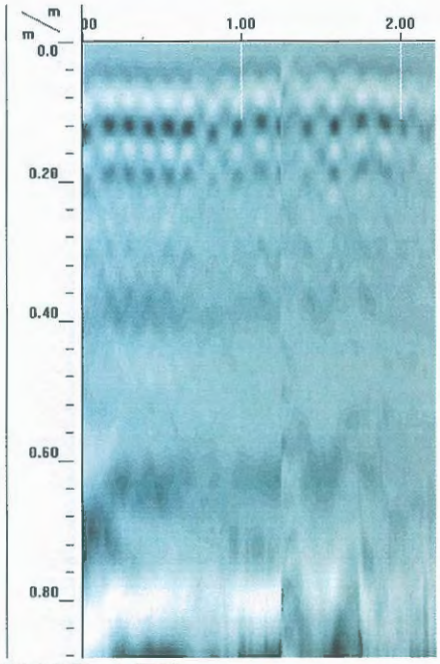
NTH Port (D2)



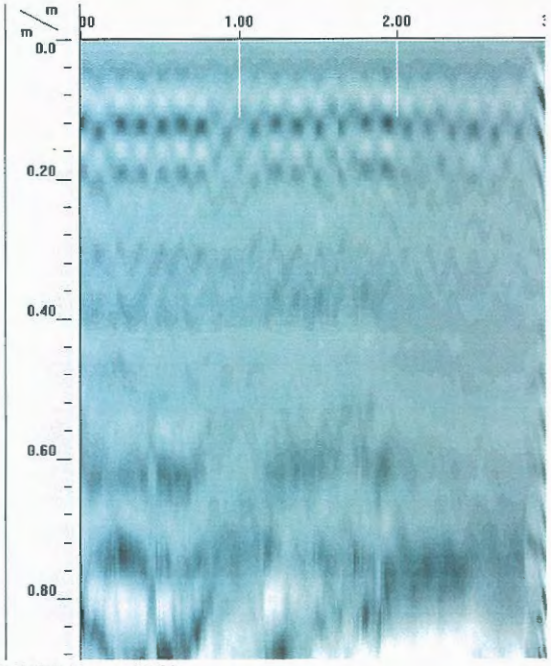
NTH Port (D3)



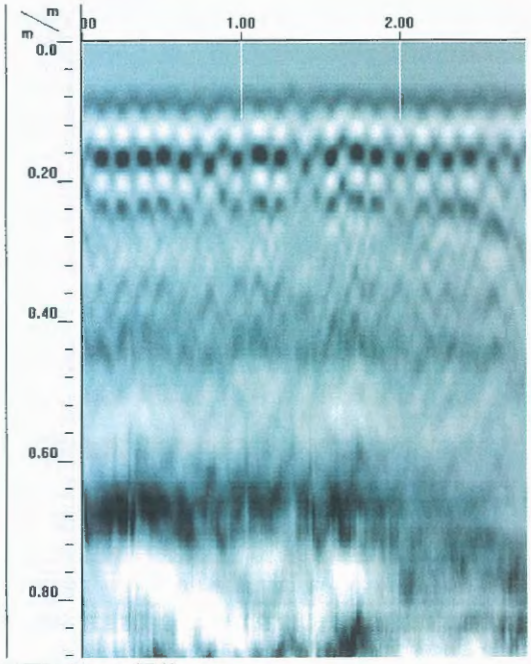
NTH Port (E1)



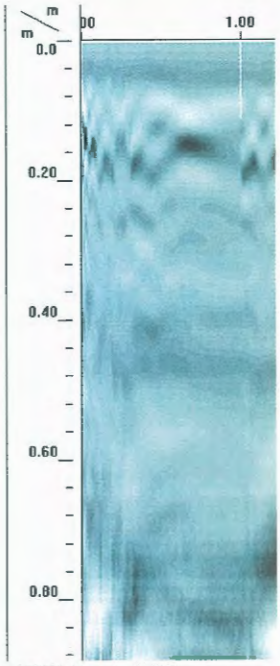
NTH Port (E2)



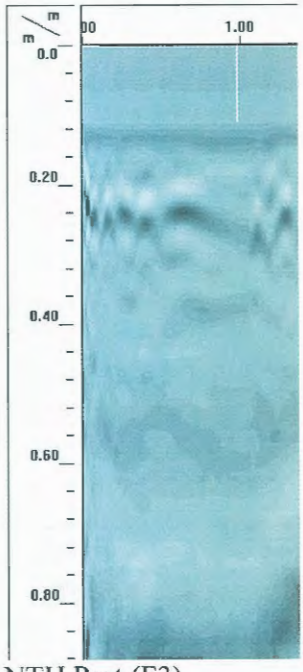
NTH Port (E3)



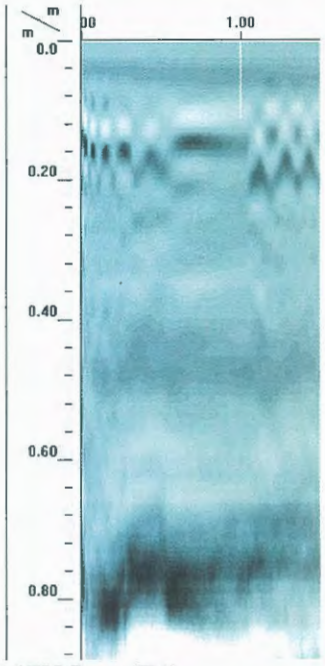
NTH Port (F1)



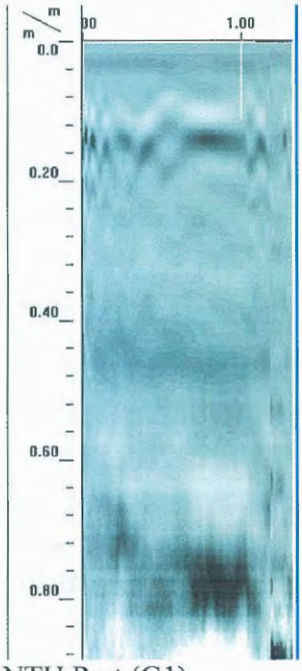
NTH Port (F2)



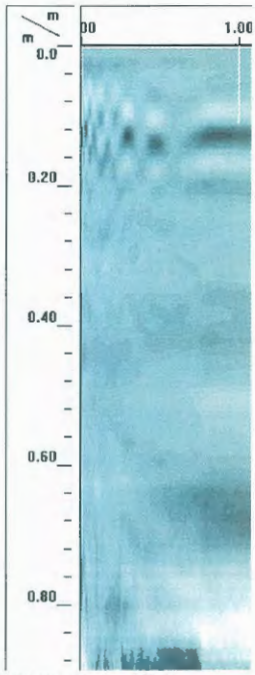
NTH Port (F3)



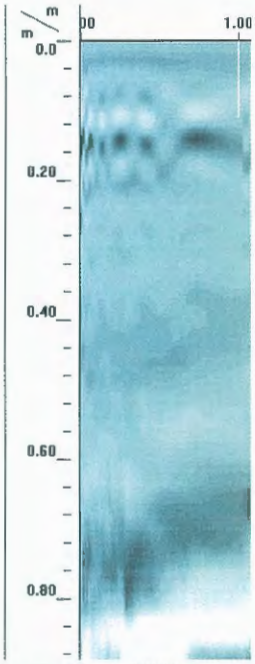
NTH Port (F4)



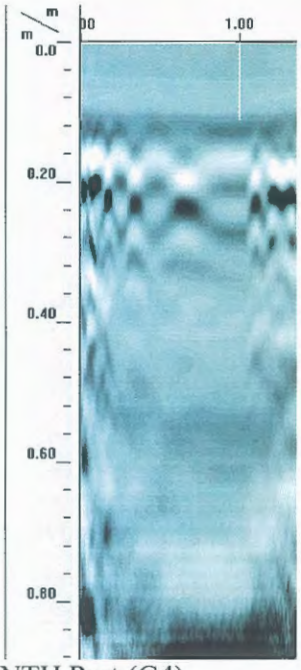
NTH Port (G1)



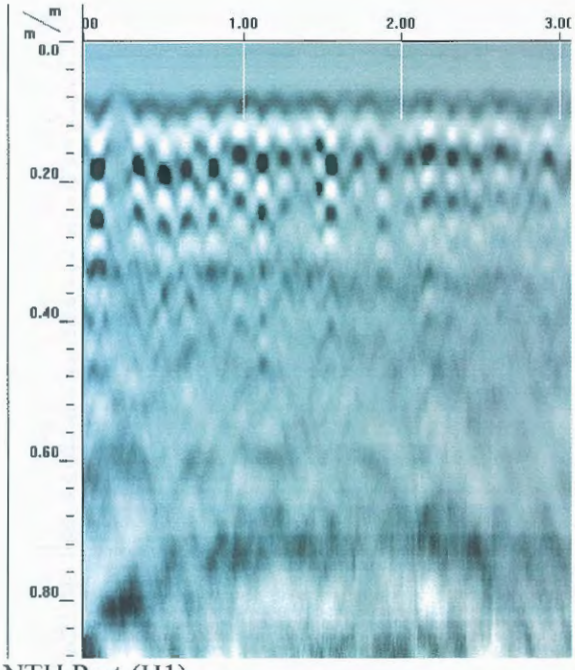
NTH Port (G2)



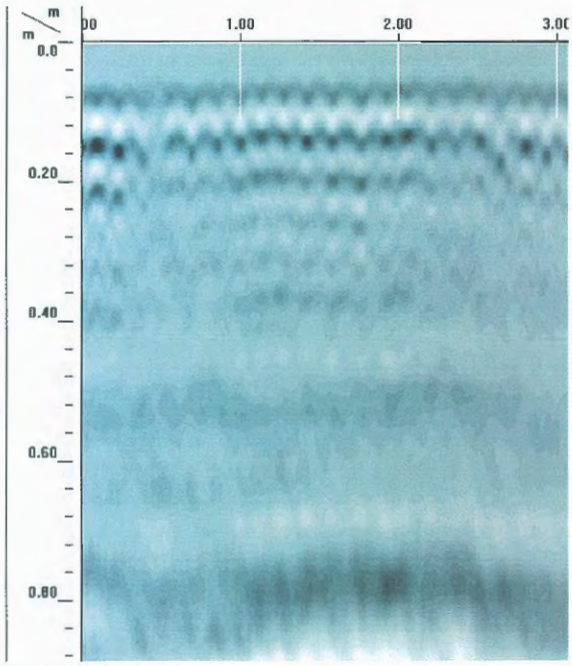
NTH Port (G3)



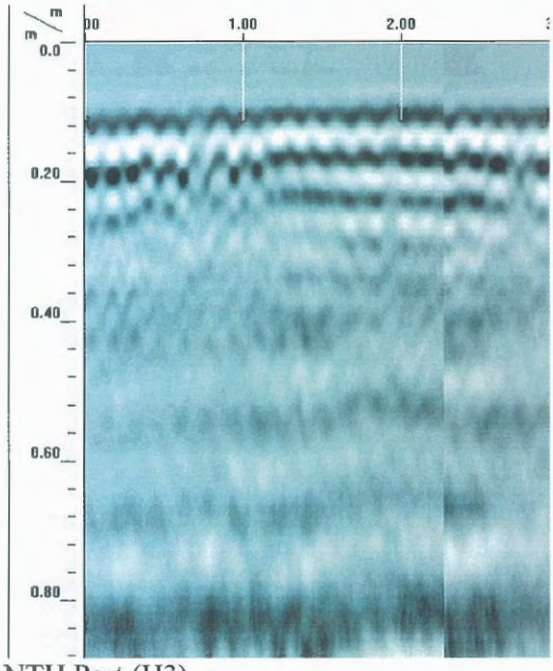
NTH Port (G4)



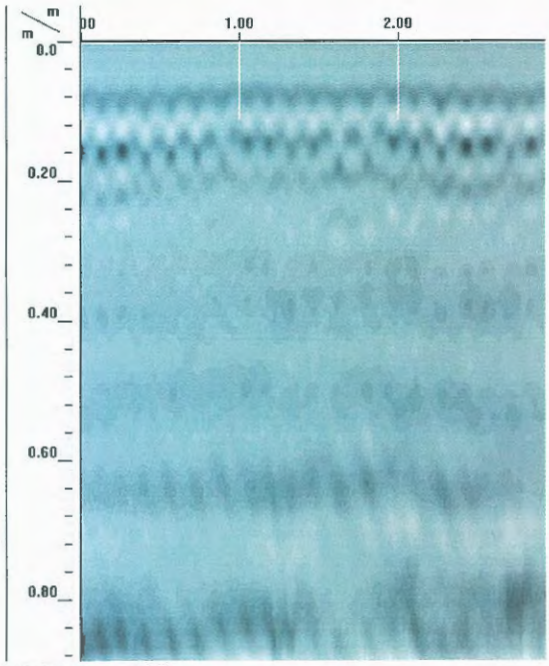
NTH Port (H1)



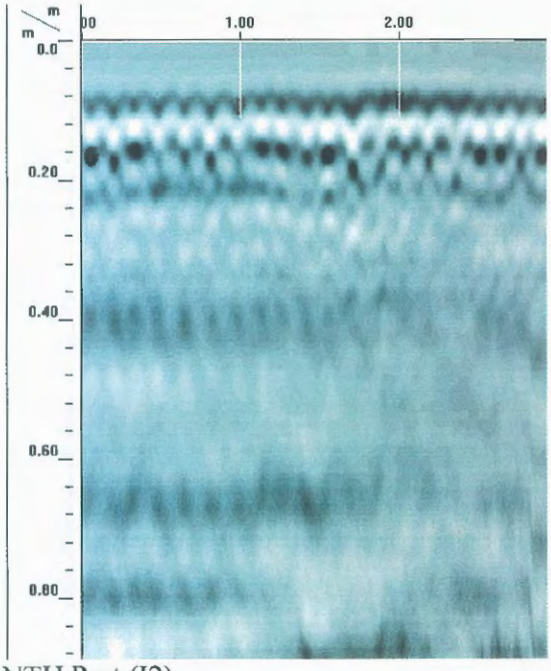
NTH Port (H2)



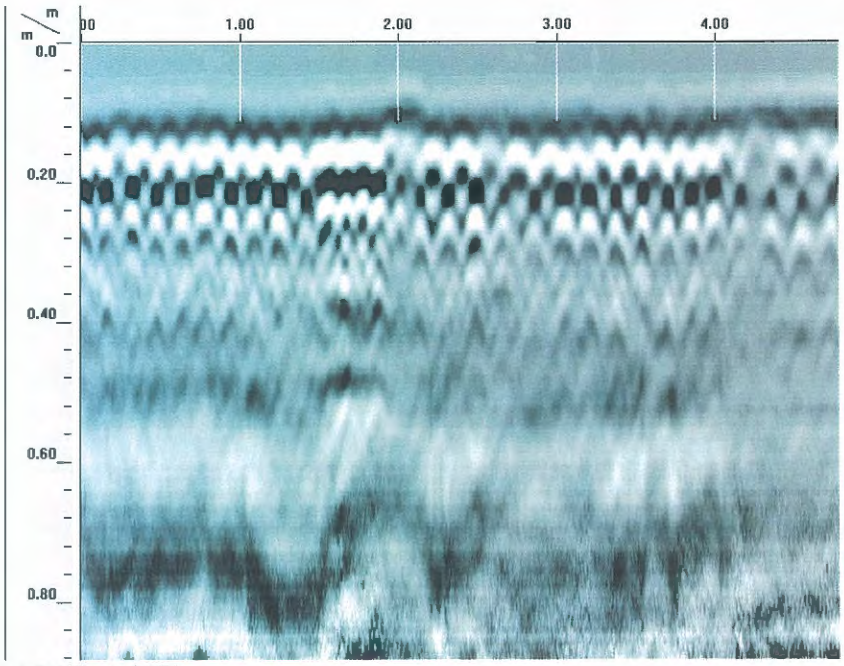
NTH Port (H3)



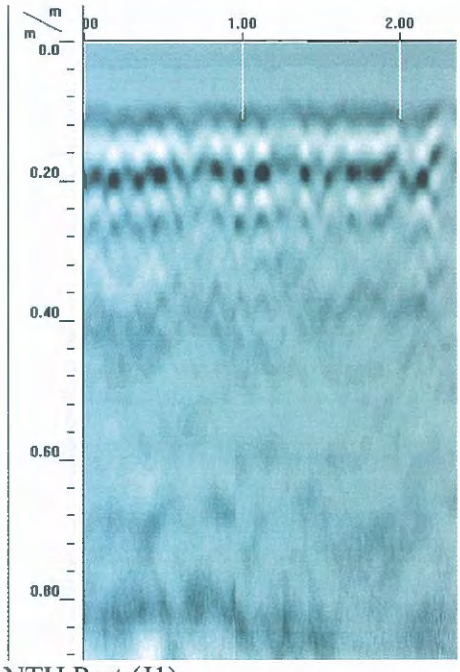
NTH Port (I3)



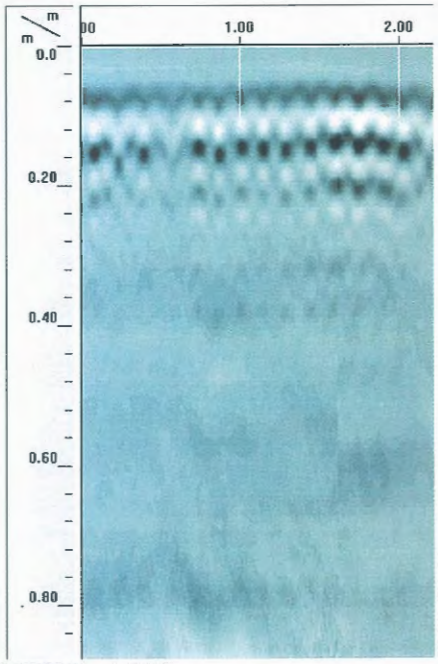
NTH Port (I2)



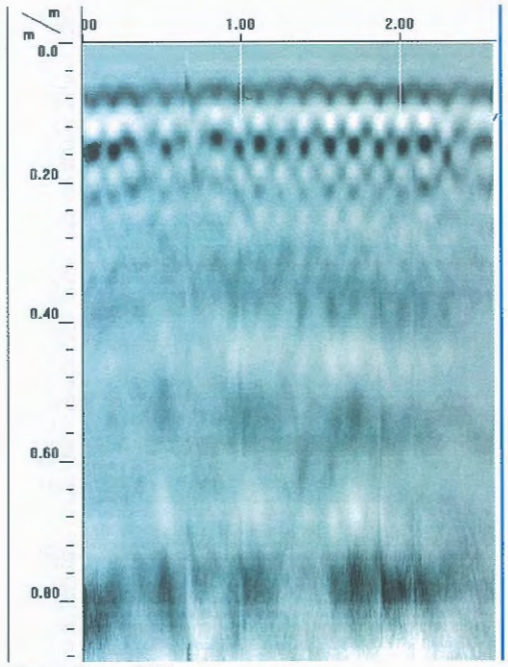
NTH Port (K2)



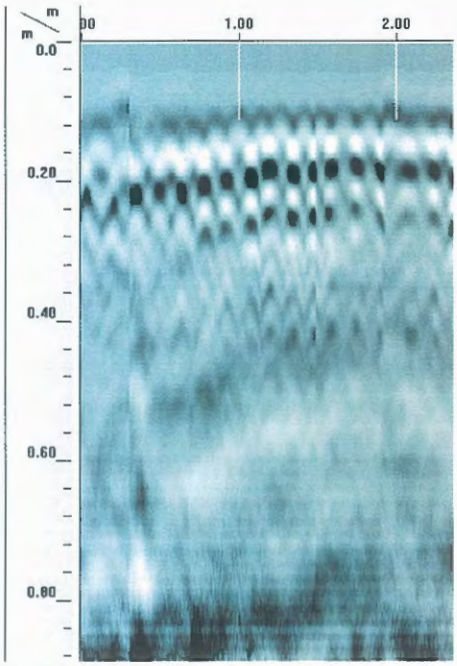
NTH Port (J1)



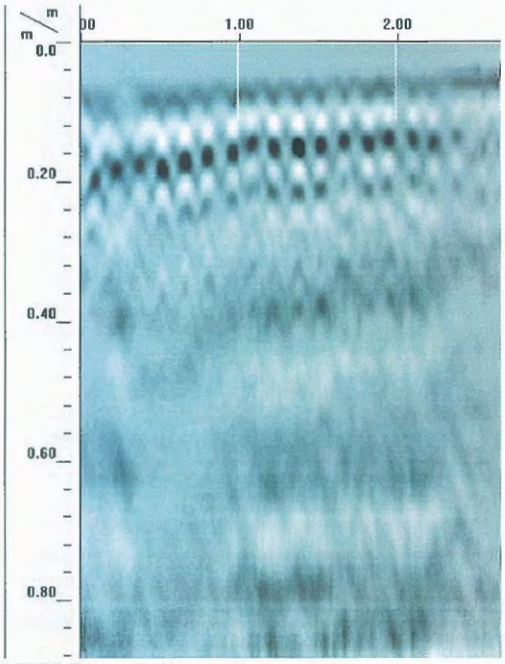
NTH Port (J2)



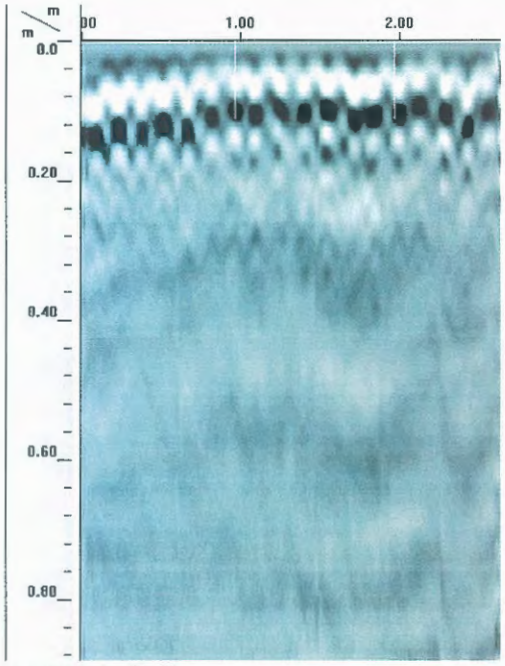
NTH Port (J3)



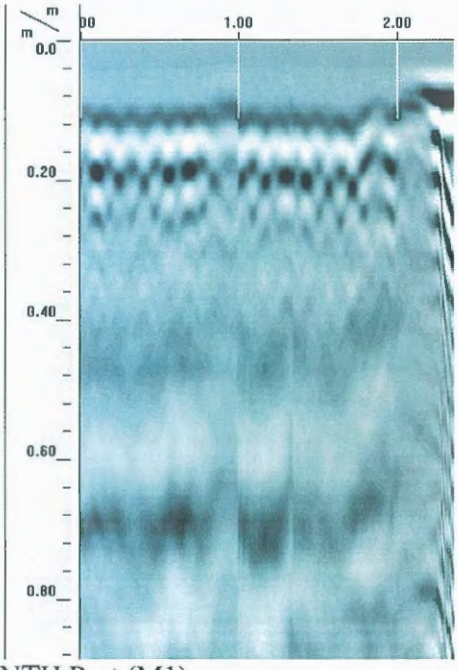
NTH Port (L1)



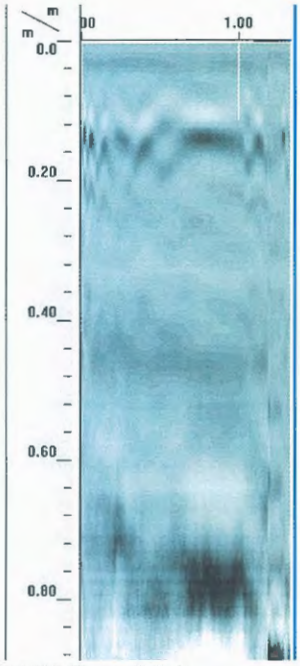
NTH Port (L2)



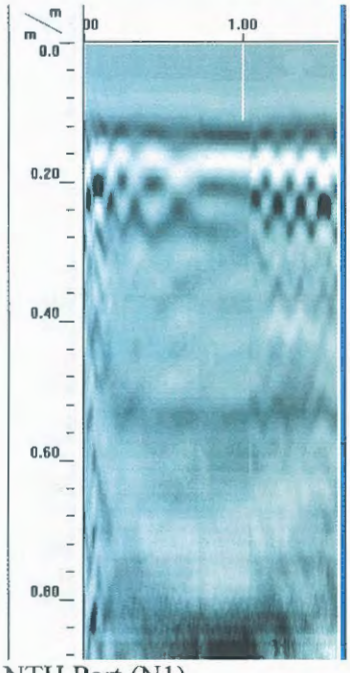
NTH Port (L3)



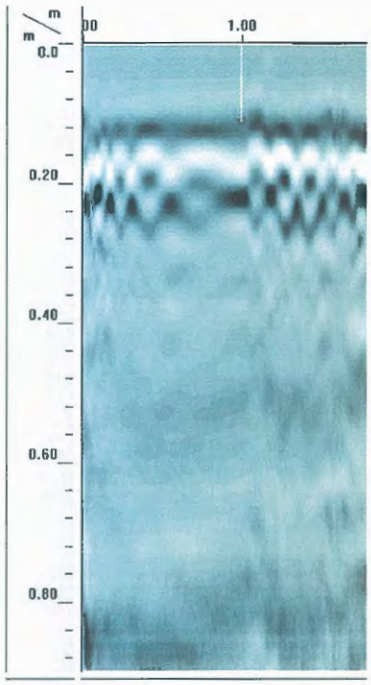
NTH Port (M1)



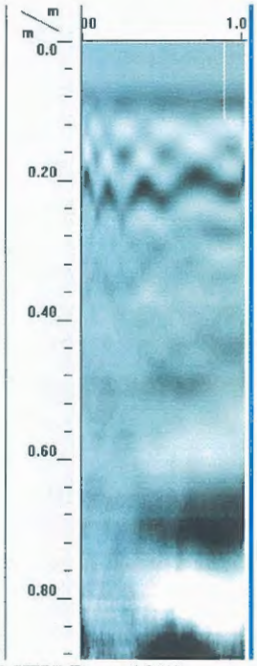
NTH Port (M2)



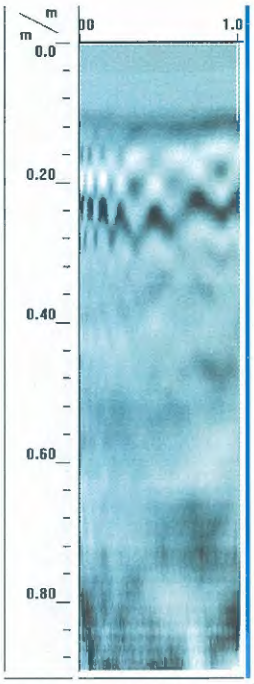
NTH Port (N1)



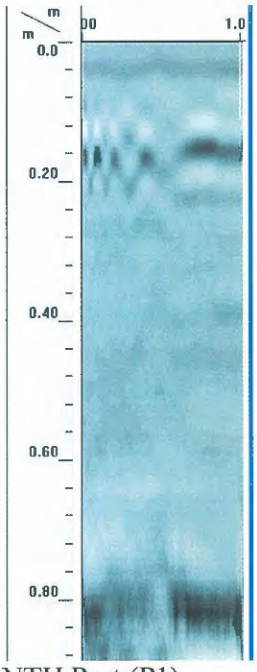
NTH Port (N2)



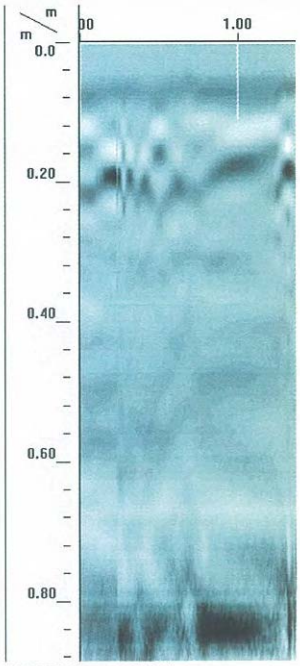
NTH Port (O1)



NTH Port (O2)



NTH Port (P1)



NTH Port (P2)