



Pilbara Ports Authority

# Dampier Cargo Wharf Pile Assessment

## ASSESSMENT REPORT

WGA222255

WGA222255-RP-MA-0002\_0

18 July 2024



### Revision History

REV	DATE	ISSUE	ORIGINATOR	CHECKER	APPROVER
A	18/10/2023	Draft	OK	-	JG
B	19/12/2023	For Review	OK	JG	JG
0	18/07/2024	Final	OK	JG	JG



# CONTENTS

1	INTRODUCTION.....	1
1.1	Background .....	1
1.2	Scope .....	1
1.3	Structure History .....	1
1.4	Structure Description.....	2
2	REFERENCE DOCUMENTS.....	6
3	CRITERIA AND BASIS OF ASSESSMENT .....	7
3.1	General .....	7
3.2	Structure Life .....	7
3.3	Pile Grids, Labels and Naming Conventions .....	7
3.4	Bathymetry .....	8
3.5	Geotechnical .....	8
3.6	Pile As-Built Information.....	9
3.7	Tidal Data .....	11
3.8	Current Loading .....	11
3.9	Structural Materials .....	15
4	STRUCTURAL ANALYSIS .....	16
4.1	General .....	16
4.2	Limit State .....	16
4.3	Modelling.....	16
4.4	Effective Length Analysis.....	17
4.5	Loading .....	17
4.6	Assumptions and Limitations .....	18
5	GEOTECHNICAL ANALYSIS .....	19
5.1	General .....	19
5.2	Lateral Analysis of Piles .....	19
5.4	Vertical Capacity of Piles .....	21
5.5	Limitations .....	21
6	STAGE 1 – ESTABLISH EXISTING PILE CAPACITIES.....	22
6.1	General .....	22
6.2	Structural Capacities .....	22
6.3	Geotechnical Capacities .....	22
6.4	Governing Capacities.....	22
7	STAGE 2 – DETERMINE FEASIBILITY OF DEEPENING BERTH POCKETS .....	24
7.1	General .....	24
7.2	Current Dredged Depths .....	24
7.3	Effect on Structural Pile Capacity .....	24
7.4	Effect on Geotechnical Pile Capacity.....	25
8	STAGE 3 – DETERMINE THE FEASIBILITY OF ACCOMMODATING NEW LOADS WITH AN UPGRADED WHARF .....	29
8.1	General .....	29
8.2	Assumptions and Criteria .....	29
8.3	Comparison to Current Loading.....	29
8.4	Deck Loading .....	30

8.5	Berthing Operations .....	33
8.6	Mooring Operations.....	37
8.7	Harbour Crane .....	40
8.9	Operational Combinations .....	43
9	CONCLUSIONS AND RECOMMENDATIONS .....	44
9.1	General .....	44
10	SAFETY IN DESIGN.....	50

## Figures

Figure 1: Original DCW Construction .....	1
Figure 2: Extension to DCW .....	1
Figure 3: Northern Strong Point Location .....	2
Figure 4: Original Wharf Cross Section .....	2
Figure 5: Original Approach Bridge Cross Section .....	3
Figure 6: Wharf Extension Cross Section .....	3
Figure 7: Northern Strong Point Elevation.....	4
Figure 8: Small Boat Landing Plan .....	5
Figure 9: Bathymetry Seabed Levels Extract (Doc PHS-20-042-PPA-C001 dated 03-07-20) .....	8
Figure 10: Extract of Geotechnical Borehole Plan (WGA222255-DR-GE-0001) .....	9
Figure 11: Pile Driving Record Extract 1994 (Example) .....	10
Figure 12: Data Reporting Locations 1 and 4 Wave Data – Extract from Baird 2020.....	13
Figure 13: Space Gass 3D Model .....	16
Figure 14: Current and Possible Dredged Depths Cross Section .....	24
Figure 15: Minimum Embedment Depth Required – Current (left) and Dredged -13.5mCD (right) .....	28
Figure 16: Maximum Vertical Deck Loading of Existing Wharf with Current Dredge Levels and Deck Thickness (1.2G+1.5Q).....	32
Figure 17: Mooring Layout Global Highway (Extract 13396.203.R1.Rev0, Figure B1).....	37
Figure 18: Governing Bollard Loading (Extract 13396.203.R1.Rev0, Table 5.2 and 5.4).....	38
Figure 19: Example Mooring Force Application .....	39
Figure 20: General Arrangement of Harbour Crane .....	41
Figure 21: Proposed Works to Upgrade Wharf (refer Table 41 for detail).....	49
Figure 22: Pile Geotechnical Capacities Summary.....	67

## Tables

Table 1: Historical DCW Documents .....	6
Table 2: List of Current Life of Structural Components .....	7
Table 3: Historical Pile Label Nomenclature .....	7
Table 4: Tide Levels.....	11
Table 5: Loading Plans .....	11
Table 6: Deck Live Loading .....	12
Table 7: Berthing Criteria (D15-DE-002, Rev 1).....	12
Table 8: Fender Details.....	12
Table 9: Wave Parameters at Location 4 (ref Appendix B, Table A.4, Location 1, High Hmax/Low High Still Water Elevation).....	13
Table 10: Current Loading Criteria .....	14
Table 11: Drag Factors .....	14
Table 12: Wind Loading Parameters.....	14
Table 13: Pile Grades .....	15
Table 14: Pile Grades .....	17
Table 15: Ground Profile.....	19
Table 16: Structural Loads for Lateral Pile Analysis.....	20
Table 17: Lpile Output - Bending Moment.....	20
Table 18: Minimum Embedment Depth from Lpile Results .....	20
Table 19: Summary of Pile Capacities – Compression.....	23
Table 20: Summary of Pile Capacities – Tension .....	23
Table 21: Summary of Structural Pile Capacities and Proposed Dredged Depths .....	25
Table 22: Summary of Geotechnical Pile Capacities and Proposed Dredged Depths – Compression.....	26
Table 23: Summary of Geotechnical Pile Capacities and Proposed Dredged Depths – Tension .....	26
Table 24: Lpile Output – Bending Moment.....	27
Table 25: Minimum Embedment Depth from Lpile Results .....	28
Table 26: Existing Wharf Piles Utilisations Per Load Case.....	30
Table 27: Maximum Deck Loading .....	30
Table 28: Maximum Deck Loading with Increased Dredged Depths .....	32
Table 29: Maximum Deck Loading with Increased Deck Thickness .....	32
Table 30: Maximum Berthing Reactions .....	33
Table 31: Proposed Vessel Dimensions – Western Berth.....	34
Table 32: Berthing Criteria Summary for Proposed Vessels .....	34
Table 33: Current Fender Performance for Proposed Vessels – Western Berth .....	35
Table 34: Upgraded Fender Performance for Proposed Vessels – Western Berth .....	36
Table 35: Mooring Fender Forces (Extract 13396.203.R1.Rev0, Appendix B).....	38
Table 36: Mooring Results Global Highway and Hoegh Jeddah .....	39
Table 37: Harbour Crane Specifications.....	41
Table 38: Loading Results Harbour Crane – LTM 280 .....	41
Table 39: Loading Results Harbour Crane – LTM 420 .....	42
Table 40: Loading Results Harbour Crane – LTM 550 .....	42
Table 41: Conclusions and Recommendations.....	45
Table 42: Structural Pile Capacities Detail .....	66

## **Appendices**

**Appendix A** Pile Assessment Drawings

**Appendix B** Pile Data Table

**Appendix C** Geotechnical Profile Drawings

**Appendix D** Bathymetry Survey 2020

**Appendix E** Existing Drawings

**Appendix F** Historical Pile Layout Plans

**Appendix G** Pile Driving Records and Plan 1994

**Appendix H** Existing Wharf Loading Plans

**Appendix I** Structural and Geotechnical Capacities

**Appendix J** Existing Pile Utilisations

**Appendix K** Harbour Crane Utilisations

**Appendix L** Harbour Crane Information

**Appendix M** Safety in Design Register

# 1 INTRODUCTION

## 1.1 Background

Pilbara Ports Authority (PPA) is developing options to extend the life of the Dampier Cargo Wharf (DCW) and incorporate it into the new DCW facility to the South. As part of these works, there is a requirement to understand the capacity of the existing piles on the DCW.

PPA has requested an understanding of the existing pile capacities and the effects of deepening the berth pockets and increasing the loading. This is to inform the options available for upgrading the existing facility and the development of a potential deck replacement strategy.

## 1.2 Scope

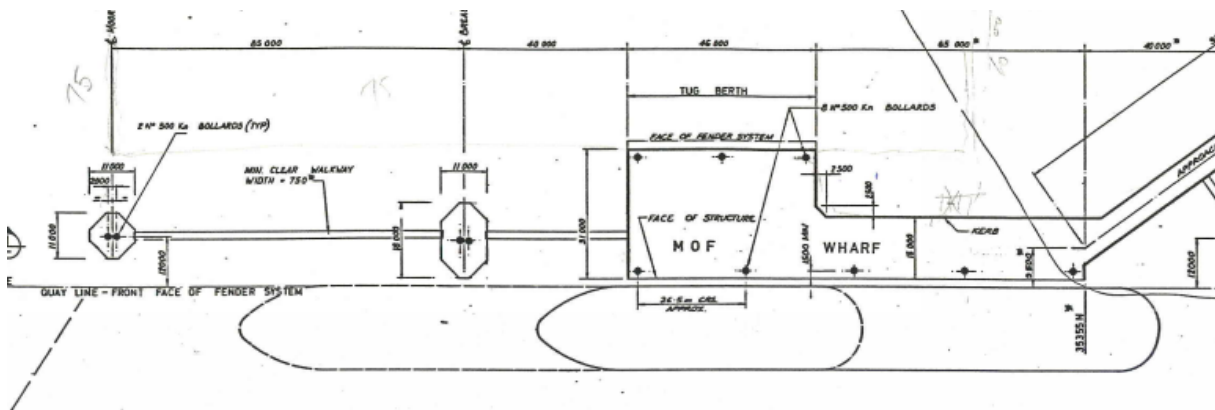
The scope of this report and project is broken into three stages:

1. Stage 1 – Establish DCW existing pile capacity
2. Stage 2 – Determine the feasibility of deepening DCW berth pockets
3. Stage 3 – Determine the feasibility of accommodating new loads with an upgraded wharf

Each stage will conclude with a workshop to present findings and confirm the way forward. Below is a summary of each of these stages and their specific scope.

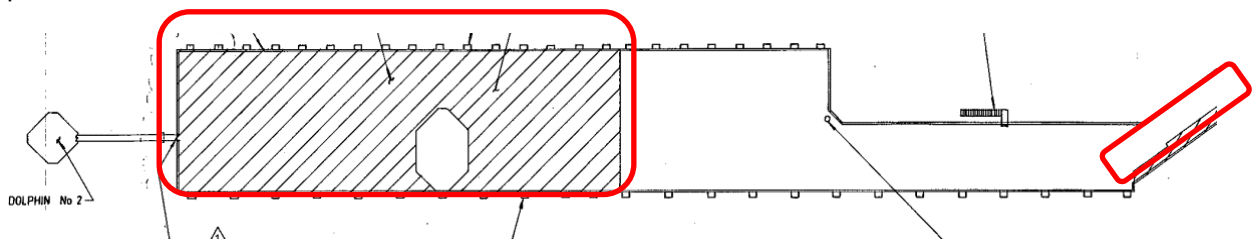
## 1.3 Structure History

The original DCW was built in 1982, including an approach jetty, the main wharf, a berthing dolphin, and two mooring dolphins. The main wharf consisted of a narrow section (67m long) with fenders on the western side only, leading to a wider section (46m long) with fenders on both the western and eastern sides of the wharf.



**Figure 1: Original DCW Construction**

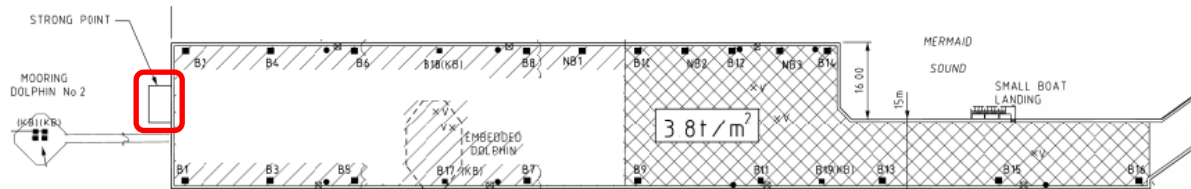
In 1993, the DCW extension was built (extent outlined in red below), which extended the original wharf by 97m with fenders on both the western and eastern sides. The extension deck was doweled into the original wharf deck, utilising the original berthing dolphin as a stiff lateral strong point, making it a middle strong point for the extension. Hence, the rest of the deck was constructed on vertical steel piles.



**Figure 2: Extension to DCW**

In 2006, an additional northern strong point was added to the northern end of the wharf extension (extent outlined in red below). This consisted of four raking piles with a large concrete block superstructure dowelled into the end of the extension wharf concrete deck. Although as-built drawings are present for this structural addition, there is no information on the design criteria used for the design of this structure.

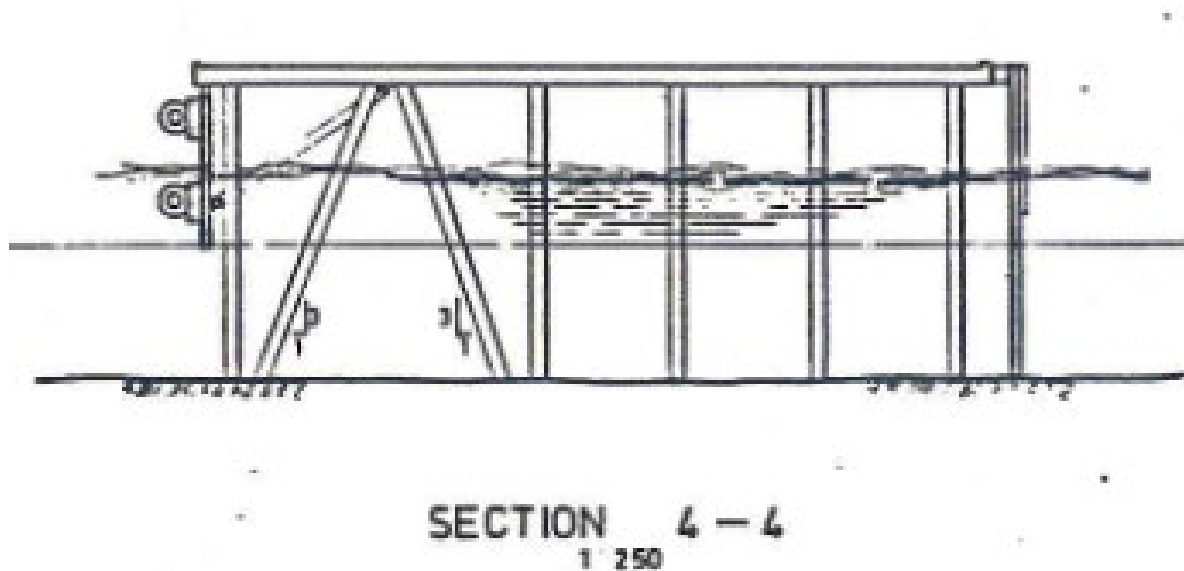
Existing drawings used in the basis of the assessment can be found in Appendix E.



**Figure 3: Northern Strong Point Location**

## 1.4 Structure Description

### 1.4.1 Original DCW Wharf

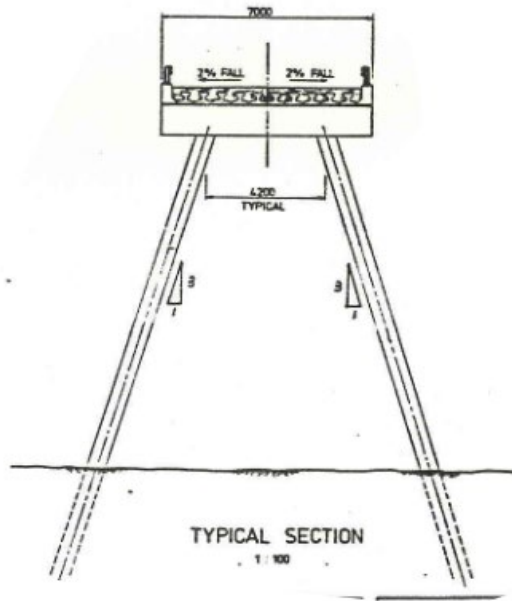


**Figure 4: Original Wharf Cross Section**

The original DCW wharf is a concrete deck comprising vertical and raker piles. All piles are 610 x 16CHS and grade 250MPa (Refer to drawing G7400-DS-038.1).

The raker piles to restrain lateral loading are located on the second row from the wharf's western side. These double pile sets are skewed in plan by 10-15 degrees and rake at an angle of 3:1.

### 1.4.2 Approach Bridge



**Figure 5: Original Approach Bridge Cross Section**

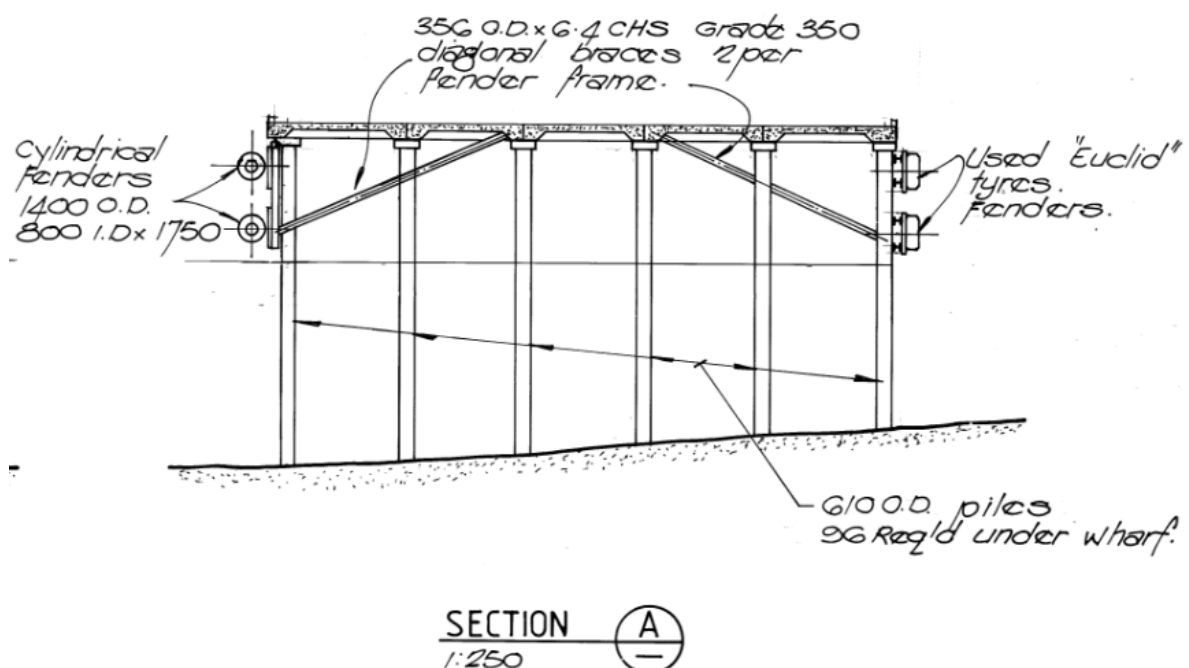
An approach bridge was constructed with the original wharf in 1982 and widened in 1993 along with the extension works. It has a 7-span bridge structure, 87500 long by 7000 wide, and a nominal 12500 spans.

The superstructure consists of concrete, prestressed beams 600 deep and 140-200mm thick concrete deck.

Each original bent consists of a 1000-deep headstock supported by a 1:3 raking 610 x 16CHS typically, except for bent 1, which piles are 760 x 16CHS vertical piles. All these piles are 250 grade.

The 1994 extension piles installed to widen the approach are 610 x 9.5CHS, except Bent 8, which are 457 x 12.7CHS piles. All piles are 350 grade.

### 1.4.3 Extension to DCW Wharf

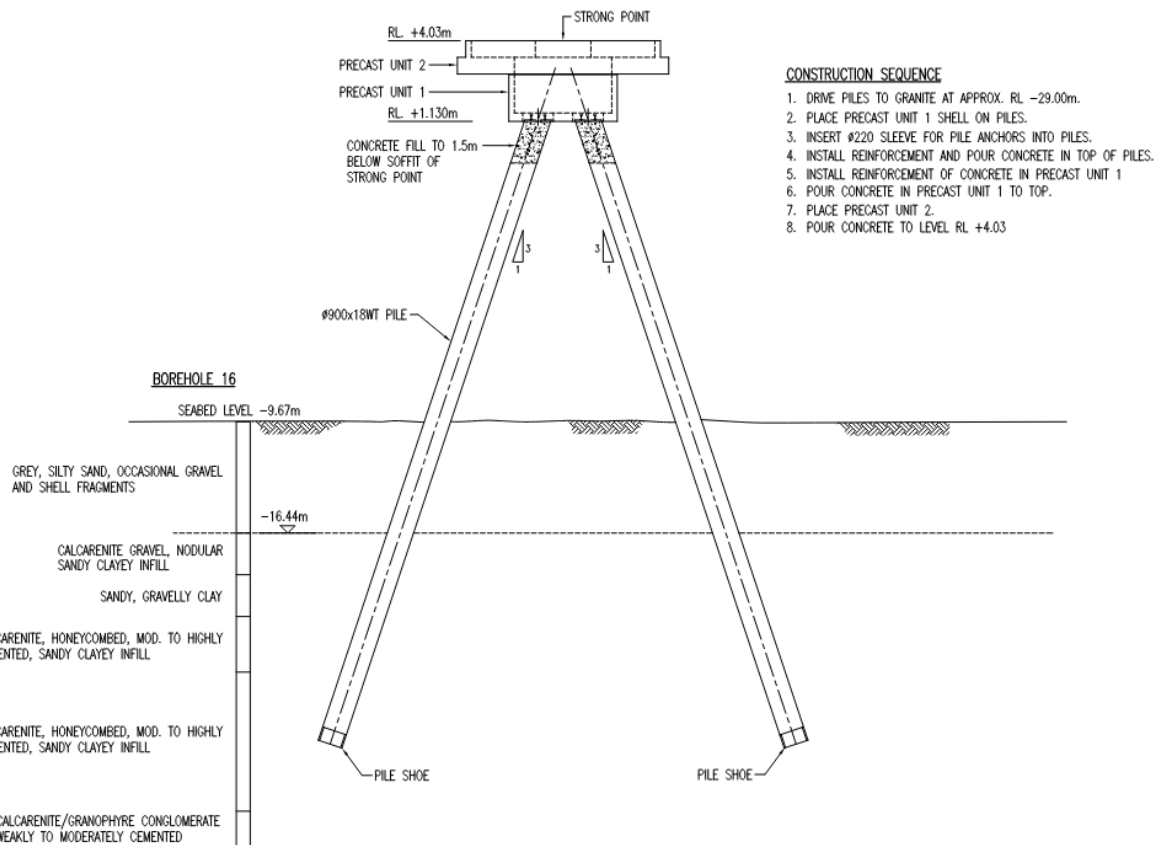


**Figure 6: Wharf Extension Cross Section**

The extension to DCW to the north consists of a concrete deck on vertical piles. These piles are 610 x 9.5CHS and grade 350MPa. The lower 6000mm section of the piles is 610 x 12.7CHS and grade 250MPa.

The original breasting dolphin was connected to provide restraint in the lateral direction. This breasting dolphin consists of 8no 610 x 16.0CHS raker piles at an angle of 3:1 (refer to G7400-DS-041-1).

#### 1.4.4 Northern Strong Point

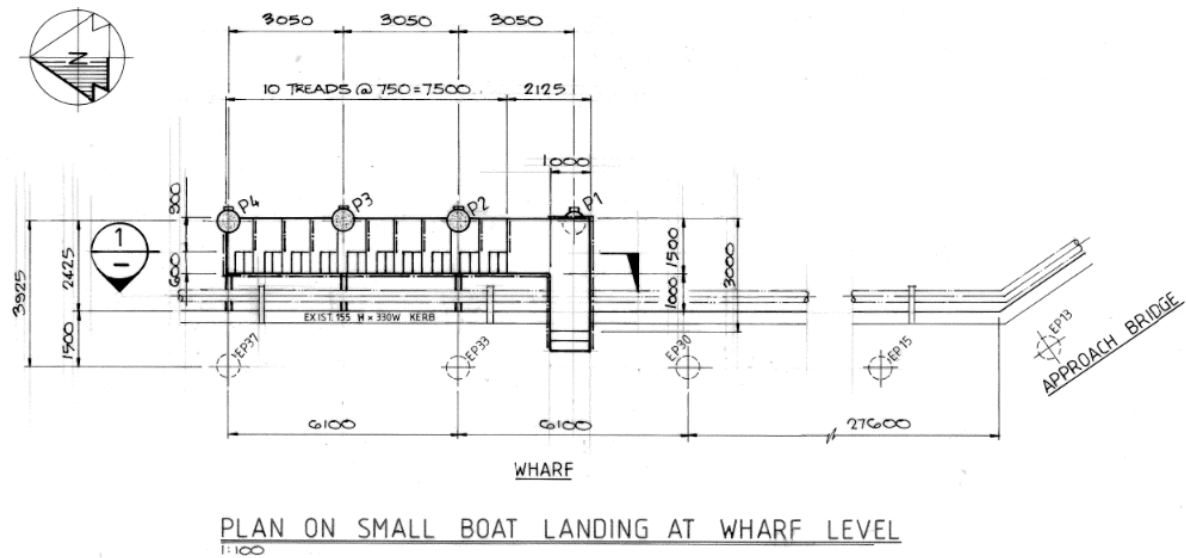


**Figure 7: Northern Strong Point Elevation**

The Concrete precast unit is tied into the wharf extension at the northern end. It is supported by four 900 x 18WT piles (Refer to 950-DGW-500 dated 06-07-2005). No grade was obtained from drawings; however, it is assumed that these are 250MPa as a minimum.



### 1.4.5 Small Boat Landing



**Figure 8: Small Boat Landing Plan**

Four vertical piles 610 x 9.5CHS, 350 grade, are located at the small boat landing and do not take any wharf loading.

## 2 REFERENCE DOCUMENTS

The following documentation was used to undertake the assessment, compiled from input information received from PPA.

**Table 1: Historical DCW Documents**

DOCUMENT NO.	DATE	DESCRIPTION
G 7400 DS 020.1 to G 7400 DS 052.01	1981	Original Wharf Drawing Set
37241 – DS – 001 to 37241 – DS – 039	1993	Extension Wharf Drawing Set
950 – DWG – 500 to 950 – DWG – 504	2005	North Strong Point Drawing Set (As Con)
HY16532	2003	Geotechnical Data – Heavy Lift Loadout Facility, Dampier Public Wharf
Report	1981	MOF – Results of Pile Tension test – Implications for Product Jetty Design
181127143701	-	Maunsell-Nedeco Appendix II Borelogs of Core Boxes
EP-R557	1983	Design of Piled Foundations Materials Offloading Facility North West Shelf Development Project, BHP Engineering The Broken Hill Proprietary Company Limited
A162194	2004	Barclay Mowlem Construction – Factual Geotechnical Report for Dampier Bulk Liquids Berth
A162410	1994	Pile Driving Records, Marine & Civil Construction
37241a55	1996	Dampier Port Authority – Public Wharf Extension Calculations Design Criteria
52393-002-562 / 561- F5850.4	2003	URS - Dampier Bulk Liquids Berth Project Final Factual Geotechnical Report Volume 1 of 2
GEOOTHERD08491AA-AE	2010	Factual Report, Nearshore Geotechnical Investigation, Dampier Cargo Berth Expansion Project
190166RPT001	2019	Dampier Cargo Wharf – East Side Berthing Assessment
12523649-REP-002	2020	DCWELR Geotechnical Investigation Factual Report
12553391-REP-002	2021	DCWELR Landside Geotechnical Investigation Factual Report
3006387-DCW-RPT- MAR-001	2021	WSCAM Inspection and Asset Maintenance Plan
WG222255-SK-GE-0001 to 0002	2023	Geotechnical Subsurface Section with Borehole Information
PHS-20-042-PPA-R001 Rev 0_ApprovedDC	2020	Hydrographic Survey Report – Dampier Annual Survey 2020
PHS-20-042-PPA- C001_2500_ApprovedDC	2020	Drawing Survey Levels – Dampier Annual Survey May-June 2020.
D15-DE-001 (A361033)_Rev Z	Aug 2019	Deck Loading Plan
D15-DE-002_Rev1	July 2022	GA and Max Berthing Capacities

# 3 CRITERIA AND BASIS OF ASSESSMENT

## 3.1 General

The following section outlines the criteria and basis of assessment used for the piles. Assumptions derived from the existing information were collated and presented.

## 3.2 Structure Life

A summary of the life of the structural components at the time of writing is below in Table 2. The documentation available did not highlight the design life of these structures. Maritime structures typically have a design life of 20-50 years.

**Table 2: List of Current Life of Structural Components**

COMPONENT	YEAR OF CONSTRUCTION	AGE OF STRUCTURE (AS AT 2023)
Original Wharf and Approach	1982	41
Extension, Approach Widening and Boat Landing	1994	30
Northern Strong Point	2006	17
Fenders Eastern	2008	15
Western Fenders	2016	7

## 3.3 Pile Grids, Labels and Naming Conventions

Multiple layout plans were provided of the wharf, which reference the piles to different systems. Different nomenclatures have been used historically to identify the piles found in the wharf. A summary of these differences is found in Table 3, and reference drawings are found in Appendix F.

**Table 3: Historical Pile Label Nomenclature**

DATE	DESCRIPTION	DOCUMENT REF	COMMENT
1981	Original wharf and associated structures	G7400-DS-045.1 G7400-DS-038.1	Sequential Pile Numbers from 1 to 130
1994	Wharf extension and approach slab widening	37241-DS-038	Sequential Pile Numbers from 1 to 251
1994	Pile driving record labels	Marine and Civil Construction Pile Driving Records DCW	Driven in grids. Grids 1 to 17 (South to North) Grids A to F (West to East) Small Boat Landing numbered Approach Bridge widening numbered. (i.e., Pile '2-C')
2021	WSCAM Condition Inspection	3006387-DCW-REP-MAR-001	Inspected in grids. Grids A to C, 1 to 9 (Approach) Grids D to O, 10 to 45 (Wharf)

For clarity in the labelling convention used in this assessment, the pile assessment drawings in Appendix A provide a grid system based upon the 2021 WSCAM Condition Inspection. In addition, the original pile numbering systems sequential numerical labels were also included for consistency across the piles.

The pile driving record nomenclature was not presented in the documented drawings but is provided separately in Appendix G, along with the pile driving records.

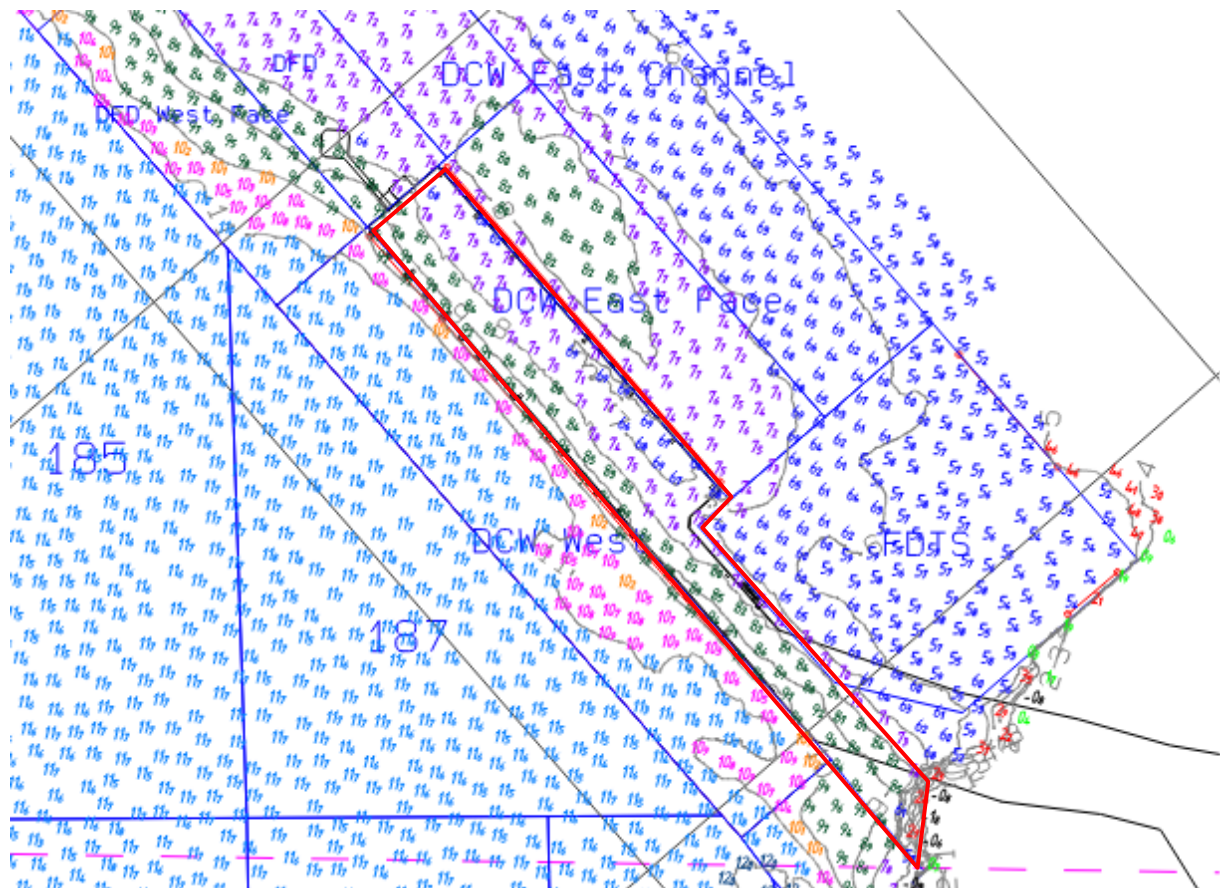
### 3.4 Bathymetry

#### 3.4.1 Recent Survey

The information provided noted that historical bathymetry surveys were undertaken most recently in 2020. Refer to the document “PHS-20-042-PPA-C001\_2500\_AprovedDC 2020, Drawing Survey Levels – Dampier Annual Survey May-June 2020” in Appendix D.

This bathymetry shows the seabed levels at the wharf structure. In general, the western side of the wharf seabed level is at -10.0mCD, and the eastern side is at -7.2mCD, with variations along its length.

These levels were used in the basis of the calculations to provide the most recent seabed levels, affecting the effective length of the piles.



**Figure 9: Bathymetry Seabed Levels Extract (Doc PHS-20-042-PPA-C001 dated 03-07-20)**

#### 3.4.2 Scour Allowance

No scour allowance from the existing seabed has been allowed. It is assumed that future scour measures will be undertaken if required to maintain the embedment depth.

### 3.5 Geotechnical

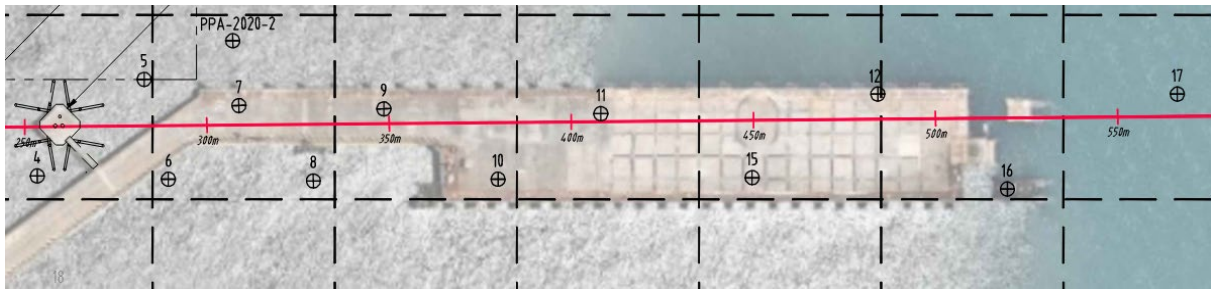
#### 3.5.1 Borehole Data

Various borehole testing had been conducted in the past; a summary of these locations is found in Figure 10.

The most relevant boreholes to the assessment of the existing DCW were boreholes 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16 and 17. Borehole PPA-2020-2 was a shallow borehole of only 4.5m depth which did not prove the top of the founding materials.

All the boreholes along the length of the existing DCW and the proposed DCW extension on the southern side were assessed, and a geological cross-section drawing was produced, which is found in Appendix C.

Rock is found at approximately -21mCD in the southern end to -26mCD towards the northern end. The pile driving records show an average pile toe level of -20mCD, above the anticipated top of the rock layers. The recorded toe levels are consistent with the piles founded within the calcarenite/granophyre conglomerate layer above the rock.



**Figure 10: Extract of Geotechnical Borehole Plan (WGA222255-DR-GE-0001)**

### 3.6 Pile As-Built Information

This section describes the main sources of as-built data used in the assessment of the existing structures (original and extension wharves).

#### 3.6.1 BHP Engineering Report and Original Wharf Pile Driving Record Summary

BHP Engineering prepared a report titled "Design of Piles Foundations Materials Offloading Facility North West Shelf Development Project", dated February 1983. This report includes a compilation of technical data for the design of the existing MOF. It outlines the methodology adopted for the driven piles and pile driving criteria. This report refers to piles 1 to 138 only. Table 2 of the abovementioned report provides a summary of all driven piles.

The data provided in this report was compiled and tabulated in Appendix B, along with the other pile data provided.

This report quoted the design tensile load and indicated pile capacity (compressive load). These capacities were compared against the values obtained in the analysis and commented on in the report.

#### 3.6.2 Pile Driving Records 1994 Extension

Pile driving records were taken during the installation of the 1994 extension to the DCW by Marine and Civil Construction.

These pile driving records included relevant information such as pile cut-off, R.L. pile toe, R.L. ground, blows per 250mm, final set, hammer used, locations and penetration (embedment). All piles were referenced in a grid system described in Section 3.3. This document refers to piles 139 to 247 only.

The blow count table was reviewed to derive the above data if it was not summarised in the record by the contractor. The data in the blow count table was relative to a specific pile driving datum, estimated to start at a level of +7.90mCD and increased positively with depth. This level was estimated from the levels recorded in the blow count table.

An extract of the pile driving records is shown in Figure 11.

These records were collated and tabulated in Appendix B, along with the other pile data provided.



## MARINE & CIVIL CONSTRUCTION

### PILE DRIVING RECORD

DATE : 1-2-94	PILE SIZE : 610φ
HAMMER : KOBES 45	PILE # : 1-D(9)
HELMET : NOVASTEEN	LOCATION : NORTH EXTENSION
HAMMER STROKE : 2.5 m	PITCHED LENGTH : 30.
S + C/2 : 24.5 m R.U. ⇒ 2500 kJ	ADD. LENGTH : NIL
START TIME : 6.25 am	OFFCUT LENGTH :
FINISH : 6.40	FINAL LENGTH : 25.25

R.L. CUTOFF : 5.85 CD	R.L. TOE : -19.40	R.L. GROUND : -9.50
PENETRATION : 9.90 m	FINAL SET : 12.5	MEASURED T.C : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	///	24.0	3	32.0	
0.25							6		
0.5							5		
0.75							4		
1.0		9.0		17.0		25.0	3	33.0	
							7		
							4		
							7		
2.0		10.0		18.0		26.0	6	34.0	
							3		
							2		
							2		
3.0		11.0		19.0		27.0	12	35.0	
							2.5		
					✓		3/100		
4.0		12.0		20.0		28.0		36.0	
					2				
					✓				
5.0		13.0		21.0		29.0		37.0	
					12.				
					✓				
					4				
6.0		14.0		22.0		30.0		38.0	
					5				
					2				
					3				
					5				
7.0		15.0		23.0		31.0		39.0	
					5				
					12				
					2				

**Figure 11: Pile Driving Record Extract 1994 (Example)**

### 3.6.3 Northern Strong Point Drawings

The As-Constructed drawings for the northern strong point provide pile information, including toe depth and capacities. Refer to 950-DWG-500 to 950-DWG-504, 200, North Strong Point Drawing Set (As-Constructed).

### 3.7 Tidal Data

The following tidal data was used as a basis for the assessment in Table 4.

Table 4: Tide Levels

TIDE LEVEL	ELEVATION (mCD)
Highest Astronomical Tide (HAT)	+5.0m
Mean High Water Springs (MHWS)	+4.4m
Mean High Water Neaps (MHWN)	+3.1m
Australian Height Datum (AHD)	+2.7m
Mean Sea Level (MSL)	+2.6m
Mean Low Water Neaps (MLWN)	+2.1m
Mean Low Water Springs (MLWS)	+0.7m
Lowest Astronomical Tide (LAT)/ CD	+0.1m

### 3.8 Current Loading

PPA provided reference loading documentation for comparison to the analysis. Key loading information is provided in Table 5.

The loading described in this section summarises the existing loading conditions of the wharf structure and is for information only. The pile assessment and analysis were undertaken independently from these loads, as this assessment aimed to determine the maximum capacities of the piles.

Table 5: Loading Plans

DOCUMENT NO.	DATE	DESCRIPTION
D15-DE-001 (A361033)_Rev Z	Aug 2019	Deck Loading Plan
D15-DE-002_Rev1	July 2022	GA and Max Berthing Capacities

#### 3.8.1 Dead Loading

- Unit weight of concrete is 26.0kN/m<sup>3</sup>
- Unit weight of steel is 77.0kN/m<sup>3</sup>

All other dead loads shall be determined in accordance with AS 1170.

### 3.8.2 Deck Live Loading

Deck live loading is described in the document D15-DE-001 (A361033) Rev Z, Dampier Cargo Wharf Loading Diagram.

**Table 6: Deck Live Loading**

STRUCTURE COMPONENT	UDL DECK LOADING	MAX CRANE OUTRIGGER LOADS AT PILE LOCATIONS	ASSUMED OUTRIGGER PADS
Original Wharf	38kPa	90t	1.5 x 1.5m 6m min spacing
Approach Bridge	25kPa <sup>1</sup>	Not Applicable	Not Applicable
Wharf Extension	25kPa	90t	1.5 x 1.5m 6m min spacing
Link Bridge (Future)	50kPa	150t	1.0 x 1.0m 8m min spacing

*Note 1: Value is assumed as no information to verify the specific loading from the provided documents.*

It should be noted that the loading limits were assumed to be derived with the concrete deck as the limiting element of the structure, and these loadings may not apply to the pile capacities.

Refer to Appendix H for full versions of these loading plans.

### 3.8.3 Berthing Loads

Berthing criteria are described in the document 'D15-DE-002, Rev 1, Dampier Cargo Wharf General Arrangement and Maximum Berthing Capacities'. The wharf can berth on both sides the following berthing criteria. Refer to Appendix H for full versions of these loading plans.

**Table 7: Berthing Criteria (D15-DE-002, Rev 1)**

LOCATION	MAX DISPLACEMENT	BERTHING VELOCITY	BERTHING ANGLE
Western Berths – Berth 1, 3, 5, 7	35,000t	0.15 m/sec	0-10 degrees
Eastern Berths – Berth 2, 4 and 6	15,000t	0.15 m/sec	0-10 degrees

The fendering arrangement of the wharf is as follows.

**Table 8: Fender Details**

DETAILS	UNIT	WEST	EAST
Current Rated Displacement	t	35,000	15,000
Current Fender		SCN1000E0.9	SCK1150E2.0
Fender Spacing	m	9.1	6
Rated Energy (E)	kNm	338	380
Rated Reaction (R)	kN	570	750

### 3.8.4 Mooring Loads

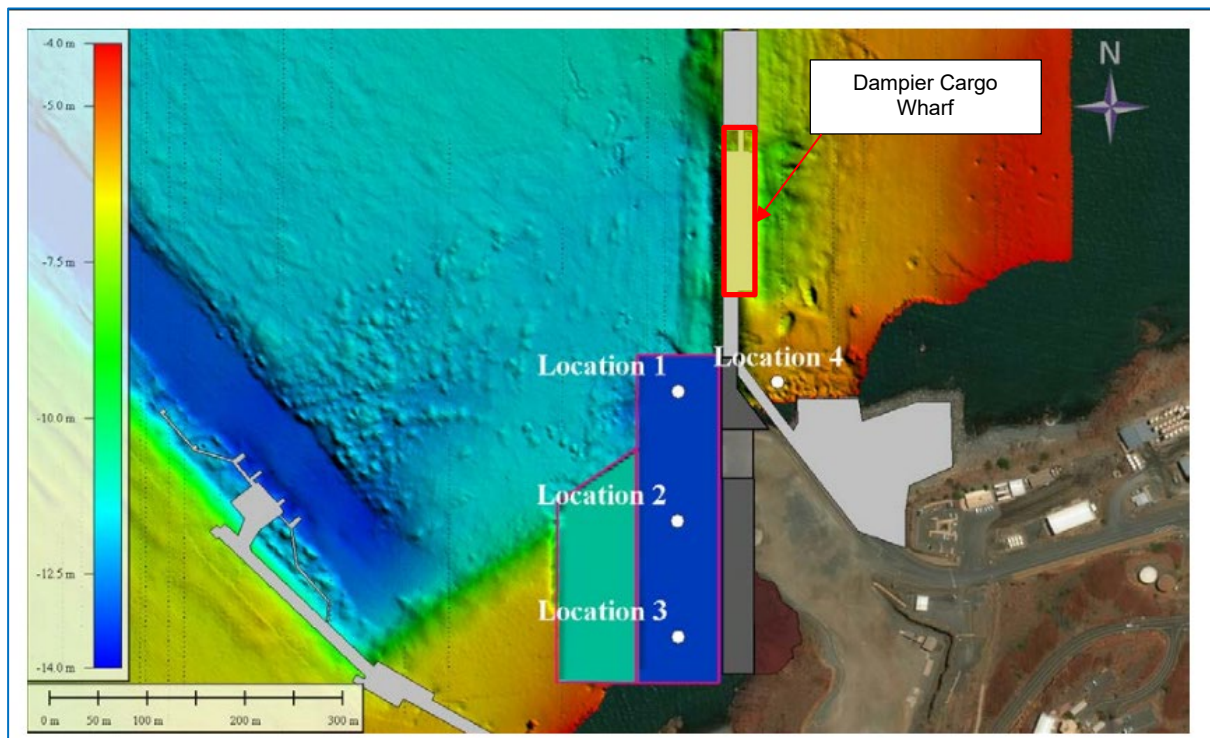
For this assessment, the mooring loads on the western side of the DCW were taken as the full bollard capacity. Bollard capacity of 50t was used based on information on drawing 37241-DS-039.



### 3.8.5 Wave Loading

During the Dampier Cargo Wharf Extension and Landside Development Design undertaken in 2020, a joint probability analysis was performed to determine the design wave heights at the proposed wharf location (Baird 2020). Wave data at Locations 1 and 4, as shown in Figure 12, are included in the wave study. Location 1 is the location most relevant to the Dampier Cargo Wharf structure as it is in proximity to the structure at a similar depth.

It should be noted that the Baird 2020 report was prepared for a separate project, and the wave parameters are only used as a reference in this assessment.



**Figure 12: Data Reporting Locations 1 and 4 Wave Data – Extract from Baird 2020**

As the table below identifies, wave loading shall be determined as per AS 4997 for extreme conditions. The ultimate limit state (cyclonic wave loading) was derived for the 500-year ARI event. Data from Location 1 derived from the wave study shall be used for design as attached.

Wave forces were derived using the high  $H_{max}$  and “Low Still Water Elevation Values”, which were deemed critical. The wave forces on the horizontal members have been calculated using wave velocities rather than typical slam and lift parameters.

Sea level rise has been allowed for in the wave parameters derived from the report.

**Table 9: Wave Parameters at Location 4 (ref Appendix B, Table A.4, Location 1, High  $H_{max}$ /Low High Still Water Elevation)**

PARAMETER	UNITS	OPERATIONAL <sup>2</sup>	ULTIMATE 1/500 YEARS
$H_{max}$	m	Not Provided	8.6
$H_s^1$	m	0.4 – 0.6	4.2
$T_p$	seconds	7 – 8 East 2.5 West	6.8
Peak Total Still Water Level (including wave setup)	mCD	Not Provided	+5.4
Maximum Crest Elevation	mCD	Not Provided	+11.0

Note 1: includes 50-year sea level rise. Note 2: Taken from Dynamic Mooring Analysis Report 13396.203.R1.Rev0

### 3.8.6 Current Loading

Current loading is in accordance with AS 4997, Clause 5.5. The following parameters are shown in the below tables. Debris loading was not included as it was not considered applicable in this case due to being in an open port.

**Table 10: Current Loading Criteria**

PARAMETER	OPERATING (1/25 YEAR RETURN)		ULTIMATE – EXTREME CYCLONIC
	Flood Tide	Ebbing Tide	
Magnitude (m/s)	0.35 <sup>a</sup>	0.35 <sup>a</sup>	0.9 <sup>b</sup>
Peak Direction	West	East	East-West
Source:			
a. Port of Dampier Handbook (DCW Section 40)			
b. Metocean Design Conditions for the Moorings at Port of Dampier, BMT JFA, Ref. R-16025_2 Rev 1, dated August 2017			

**Table 11: Drag Factors**

CIRCULAR MEMBER FACTORS	SMOOTH	ROUGH
Cd	0.7	1.05
Cm	1.6	1.6

### 3.8.7 Wind Loading

The following parameters were used to calculate wind loading on the structure.

**Table 12: Wind Loading Parameters**

PARAMETER	SERVICE 1/25 YRS	ULTIMATE 1/500
Region	D	D
Terrain category	TC 1.0	TC 1.0
Regional wind speed	80m/s	53m/s
Climate change multiplier, $M_c$	1.05	1.05
Wind direction multiplier, $M_d$	0.90	0.90

### 3.8.8 Load Combinations

As stated previously, the assessment undertaken is independent of loading; however, these load combinations are typical of maritime structure in accordance with AS 1170 and AS 4997.

The load combinations examples are as follows:

- 1.35G
- 1.2G+1.5Q(Deck)
- 1.2G+1.5Berthing
- 1.2G+1.5Berthing+1.5Mooring
- 1.2G+1.0Q+1.5Berthing+1.5Mooring
- 1.2G+0.7Wind+1.0Wave+1.5Current (Cyclonic)
- 1.2G+1.0Wind+0.7Wave+1.5Current (Cyclonic)

The documentation provided did not outline the load combinations used in the original designs of the wharf elements. Therefore, the above will be used as a guide.

### 3.9 Structural Materials

#### 3.9.1 Steel Piles

Table 13 notes the material grades adopted to check each main structural element.

**Table 13: Pile Grades**

DOCUMENT NO.	DATE	DESCRIPTION
Original Wharf – Steel Tubular Piles (including wharf piles and extension mid strong point/original breasting dolphin piles)	Grade 250	G7400-DS-038.1 Rev2
Wharf Extension – Steel Tubular Piles	Grade 350 (except for bottom 6m section which is Grade 250)	37241-DS-006 Rev 5
Northern Strong Point – Steel Tubular Piles	Grade 250	Assumed

#### 3.9.2 Concrete

The following concrete strengths were assumed and provided on the drawings:

- Original Wharf 40MPa (G7400-DS-038.1)
- Original Approach Bridge (G7400-DS-046.1)
  - 45MPa Precast Beams
  - 35MPa In-situ Concrete
- Extension and Northern Strong Point 40MPa (Assumed no notes on drawings provided)

# 4 STRUCTURAL ANALYSIS

## 4.1 General

The following section outlines the methodology for the assessment of the structural capacity of the piles at the Dampier Cargo Wharf.

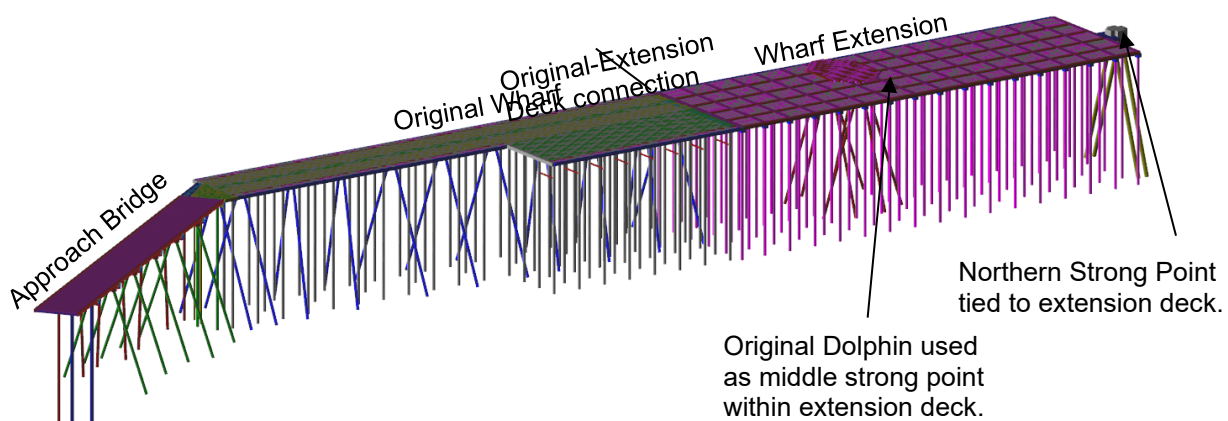
## 4.2 Limit State

The piles were assessed in accordance with the AS 4100:2020 Steel Structures design code. The capacity values stated were calculated using the capacity factors found in Table 3.4, which is  $\Phi = 0.9$  for members subject to design actions. No connections were checked in the analysis.

## 4.3 Modelling

### 4.3.1 Model

The Dampier Cargo Wharf has been modelled in 3D using the structural analysis package Space Gass, as shown in Figure 13. All dimensions and layout of the structure were based upon the provided existing drawings.



**Figure 13: Space Gass 3D Model**

### 4.3.2 Structure Layout

The original wharf side consists of vertical and raker piles, fully fixed to the deck. The extension wharf consists of vertical piles with a top pin connection due to the single dowel connection detail.

As the deck is to be replaced the detail of the fixity of the piles to the deck was assumed as fixed, despite the existing arrangement as shown on the drawings.

The original berthing dolphin (now extension mid strong point) embedded into the extension wharf deck includes raker piles rigidly connected to the concrete deck (thicker deck above the dolphin). Since there is no dowel/reinforcement connection between the dolphin and the extension deck surrounding it, member releases were used to model this area. The surrounding concrete deck effectively encases the dolphin concrete deck to transfer the lateral load to this dolphin's strong point.

The northern strong point was modelled with raker piles rigidly connected to a stiff superstructure and two dummy connection members between this strong point and the wharf extension deck.

The approach bridge was modelled with simply supported concrete beam members longitudinally and transverse deck members. These were supported by the concrete headstocks, which were fixed into the piles.

The approach bridge abutment supports were modelled as pinned to the longitudinal beams.

The wharf concrete deck was modelled using a grillage with 0.6l effective stiffness.

4.3.3 Pile Depth and Fixity

Piles were modelled as fixed to the deck down to the recorded pile toe. Pile toe and seabed levels at the base of the pile were derived from the pile driving records and the recent 2020 bathymetry survey, respectively.

Additional nodes were placed at the seabed level and effective pile fixity. The effective pile fixity was based on the geotechnical analysis. Refer to Section 5 for further commentary. The depth to fixity was calculated at 7 x pile diameters down from the seabed level and was modelled as such.

4.3.4 Corrosion Allowance

Two models were developed for comparison purposes. The first model assumes the structure is as new with no corrosion. The second model provides a 2mm uniform corrosion allowance on each pile.

4.4 Effective Length Analysis

An effective length analysis was undertaken to determine the compressive capacities of the piles and the effective length factors ( $k_e$ ). The following values were used to assess the compressive capacity of the piles.

Table 14: Pile Grades

LOCATIONS	PILE NUMBERS	$k_e$
Wharf Piles	15 – 138 and 148 - 251	0.7 (All Axis)
Approach Bridge Piles	1 – 14 and 139 -147	1.1 (Transverse) 0.7 (Longitudinal)

The  $k_e$  factor was determined by determining the stiffness at each end of the piles and performing a buckling analysis using the Space Gass software.

It was shown from this assessment that the deck and piles provide sufficient stiffness so that the pile is considered a braced member. The top connection to the pile was considered rotationally fixed due to the assumption that the deck will be replaced, and the new arrangement will fix at the connection. The bottom of the pile is considered fixed within the soil at the effective fixity depth.

Therefore, the wharf piles can be considered to act in both axes as a braced fixed-fixed member, which AS 4100, Figure 4.6.3.2 provides an effective length factor  $k_e = 0.7$ .

It should be noted that the idealised effective length factor was calculated to be  $k_e = 0.5$  in the SpaceGass model, but AS 4100 allows for a safety factor in the values quoted. Therefore,  $k_e = 0.7$  was adopted to assess the compressive capacity of the piles.

The approach bridge piles were considered to act as a portal frame, and as such, the effective length factor ( $k_e$ ) was calculated in accordance with AS 4100, Clause 4.6.3.3 Members in Frames for the transverse direction. This method calculated the effective length factor in the transverse direction to be  $k_e = 1.1$ . The longitudinal direction assumes that the top of the pile is braced as the deck is restrained by the abutments and other piles along the structure, and it is considered rotationally fixed; therefore  $k_e = 0.7$ .

4.5 Loading

All current wharf loading applied to the model is based upon the design criteria outlined in Section 3. Additional PPA requirements for future loading will be applied to the model in Stage 3, Section 8.

It was determined that vertical loading, such as dead and live loads, is principally taken by the vertical and raker piles combined.

Lateral loading, such as berthing, mooring, and other environmental loading, is transferred from the concrete deck by diaphragm action to the raker piles in compression and tension. The vertical piles for these loads take only marginal bending due to these loads.

## **4.6 Assumptions and Limitations**

In addition to the assumptions in the above sections, the following assumptions and limitations apply to the calculation of the structural capacities:

- The assessment was undertaken using the information available at the time of the assessment. Any additional information may change the ratings presented.

# 5 GEOTECHNICAL ANALYSIS

## 5.1 General

Borehole data were reviewed to generate the geological cross-section described in Section 3.5.1.

The subsurface layers are inevitably variable. The subsurface layers in the northern section of the site are more clearly defined than in the southern section. In general, the subsurface layers can be classified as follows:

- Layer A – Silty sand
- Layer B – Calcarene gravel
- Layer C – Sandy gravelly clay
- Layer D – Calcarene (vuggy), weakly to moderately cemented
- Layer E – Calcarene/granophyre conglomerate, moderately to highly cemented
- Layer R – Top of rock (granite or granophyre), up to 1m of extremely weathered material in some boreholes.

Table 15 summarises the ground profile of the site.

**Table 15: Ground Profile**

LAYER	TOP OF LAYER mCD		
	Area North 1 (Most Southerly)	Area North 2	Area North 3 (Most Northerly)
Cross-Section Chainage, m (ref Appendix C)	CH290 – CH380	CH380 - CH525	CH525 - >CH640
Related Boreholes	7, 8, 9, 10, PPA-2020-2	11,12,15, 16	17, BBH01
A – Silty sand	-6.8	-6.9	-7.1
B – Calcarene gravel	-10.2	-10.7	-11
C – Sandy gravelly clay	-12.7	-13.9	-12.9
D – Calcarene (vuggy), weakly to moderately cemented	-15.8	-15.8	-16.2
E – Calcarene/granophyre conglomerate	-19	-20.6	-21
R – Granite or granophyre (assume granophyre)	-21.7	-22.8	-25.8

## 5.2 Lateral Analysis of Piles

The geotechnical response of the piles due to the combined lateral, moment and axial loads on piles was assessed using the commercial software Lpile v2019. Lpile models the soil response using the p-y and t-z methods, which idealises soil behaviour as a set of non-linear springs.

The piles have sufficient embedment to be assessed as “long” piles where the structural capacity governs the ultimate lateral capacity. Spring models used in the lateral pile analyses were used in the structural analysis to independently model the development of bending moment and shear forces in the piles.

Pile no. 219 was selected as a representative pile lateral pile analysis. Based on the nearest borehole no. 12, a pile-specific geological profile was used in the lateral pile analysis software Lpile. The Lpile analysis was carried out using the current seabed level at approximately -10mCD. Table 16 shows the structural loads for input to the Lpile analysis. Table 17 shows the bending moment output of the pile for the current level at -10.0mCD.

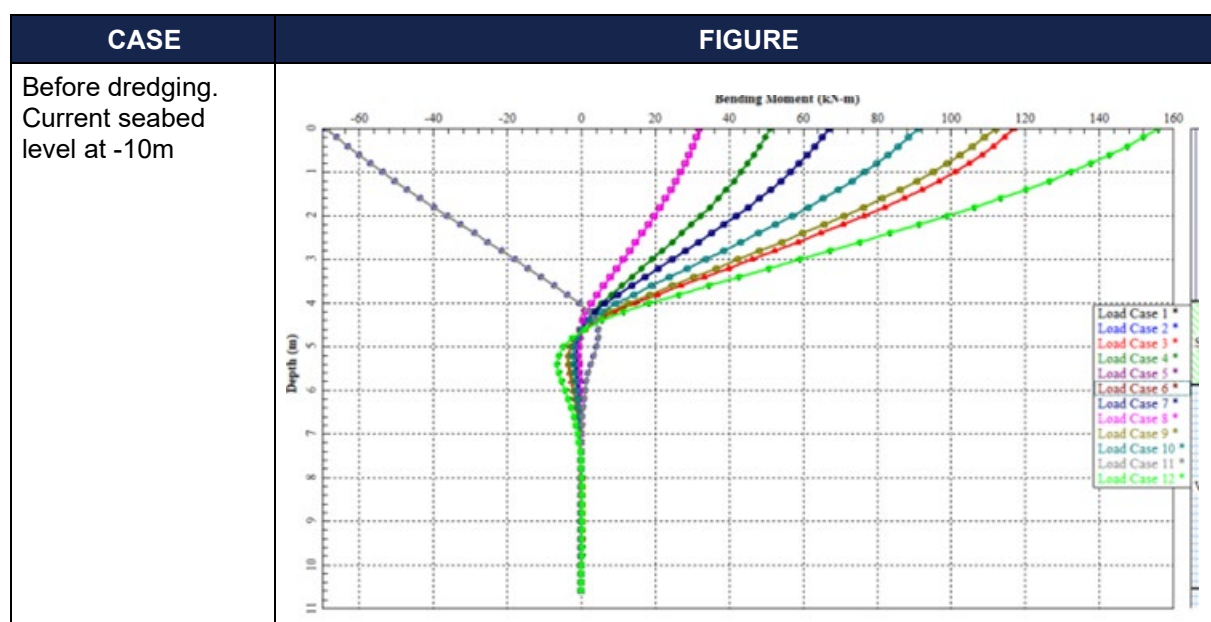


Table 18 summarises the minimum embedment depth of the piles for the level mentioned above.

**Table 16: Structural Loads for Lateral Pile Analysis**

LPILE LOAD CASES	SPACE GASS LOAD CASES	SHEAR FORCE kN	MOMENT kNm	AXIAL FORCE kN
1	567	-24	156	1449
2	564	15	-69	784
3	570	-17	117	1915
4	53	-7	51	-39
5	504	-10	67	749
6	563	-5	32	928
7	504	-10	67	749
8	563	-5	32	928
9	567	-16	112	567
10	467	-13	91	97
11	564	15	-69	784
12	567	-24	156	1449

**Table 17: Lpile Output - Bending Moment**



**Table 18: Minimum Embedment Depth from Lpile Results**

DREDGED LEVEL	DEPTH TO FIXITY m	MINIMUM EMBEDMENT DEPTH BELOW POINT OF FIXITY m	TOTAL MINIMUM PILE EMBEDMENT DEPTH BELOW DREDGED LEVEL m
Current level: Before Dredging (-10m CD)	7D	4D	>12D



## 5.4 Vertical Capacity of Piles

The pile capacity values for each pile were estimated using the software GRLWEAP based on the pile driving records. Due to limited geotechnical test data, emphasis was placed on the pile driving records to derive the vertical pile capacity.

GRLWEAP is a one-dimensional Wave Equation Analysis program that simulates the pile response to pile driving equipment. GRLWEAP predicts driving stresses, hammer performance and the relation between pile bearing capacity and net set per blow. Bearing Graph method of analysis by GRLWEAP with proportional shaft resistance distribution was used. The analysis considered the shaft resistance increasing linearly with depth and assumed the shaft resistance percentage ranged between 60% and 85% of the total pile capacity.

The Bearing Graph depicts the relationship between pile bearing capacities, pile driving stresses and stroke versus blow count. It was used to compute the required blow count for a specified capacity to estimate the pile capacity based on the recorded end-of-driving blow counts converted to blows per metre (bpm).

It is understood that hammer Kobe K45 was used for the pile installation, except for the 760mm diameter Piles No. 1 and 2, where a Delmag D62-12 hammer was reportedly used. The predicted pile capacity is affected by the hammer size/configurations, pile diameter, pile wall (shoe) thickness, and driven depth.

It should be noted that for piles 139 to 247, the pile shoe thickness used in the Lpile analysis was 20mm instead of 9.5mm as tabulated in drawings WGA222255-DR-MA-0031, -0032, -0033 and -0034, Appendix A. The pile shoe thickness of 20mm was estimated from 37241-DS-006, Rev 5, which shows an increased annulus due to stiffening plates.

A geotechnical reduction factor of  $\phi_g$  of 0.65 was used to derive the design pile capacity from the ultimate pile capacity estimated from GRLWEAP. The estimated design pile capacity values for compression and tension are presented in the drawings in Appendix A.

Pile capacities of piles 1 to 247 were estimated from the end-of-driving blow counts using GRLWEAP. The pile capacity of the northern strong point piles (No. 248 to 251, 900mm diameter, 18mm wall thickness) was calculated from the estimated unit skin friction and end bearing resistance derived from the adjacent piles with driving records, namely piles 238 to 241.

## 5.5 Limitations

The pile capacities reported in Appendix A were derived from the driving records and based on the available information related to the pile construction. Note that PDA tests were not carried out to verify the pile capacity.

Cone pull-out failure is to be assessed separately may result in lower predicted pile tension capacity.

# 6 STAGE 1 – ESTABLISH EXISTING PILE CAPACITIES

## 6.1 General

The scope of this stage was to perform an analysis of the existing structure to determine the pile capacities both geotechnically and structurally. All capacities were calculated independently of the proposed loading.

Appendix A presents the full layout drawings and pile schedule. The schedule provides all the obtained pile data, including the calculated geotechnical and structural capacities of the individual piles.

Appendix I provides a detailed summary of the structural and geotechnical capacities and should be referenced in relation to the below sections.

## 6.2 Structural Capacities

Structural capacities were calculated in accordance with AS 4100 and as described in Section 4.

Table 19 and Table 20, the pile capacities were grouped by pile type and depth.

The pile capacities presented in these tables include a 2mm corrosion allowance.

## 6.3 Geotechnical Capacities

As described in Section 5, geotechnical capacities were derived from the borehole and driving record data. A visual summary of the capacities is shown in Appendix I.

The original wharf construction was noted to have marginally higher capacities than the extension piles.

## 6.4 Governing Capacities

Generally, the geotechnical capacities were less than the structural capacities across the wharf piles. Therefore, the governing element of the structure is primarily the soil foundations of the piles rather than the piles themselves.

It should be noted that the vertical piles predominantly take vertical deck loading in compression and are governed by compressive capacities. The raking piles take the lateral loading in tension and compression and are governed by a combination of tension and compression.

**Table 19: Summary of Pile Capacities – Compression**

		STRUCTURAL PILE CAPACITIES <sup>1&amp;2</sup> COMPRESSION (kN)		GEOTECHNICAL PILE CAPACITIES <sup>4</sup> COMPRESSION (kN)		
LOCATION	GRIDS/PILES	MAX	MIN	AVERAGE	MAX	MIN
Approach Bridge	A-C	5,500	4,100 (900 <sup>3</sup> )	2,700	3,600	1,600
Original Wharf	D-I	5,100	4,800	3,200	5,200	2,100
Extension Wharf	J-O	2,800	2,600	2,300	3,700	800
Extension Mid Strong Point (Orig. Breasting Dolphin)	Piles 115-122	4,900	4,900	3,500	3,900	3,300
Northern Strong Point	Piles 248-251	9,300	9,300	3,300	3,500	3,200

**Table 20: Summary of Pile Capacities – Tension**

		STRUCTURAL PILE CAPACITIES <sup>1&amp;2</sup> TENSION (kN)		GEOTECHNICAL PILE CAPACITIES <sup>4</sup> TENSION (kN)		
LOCATION	GRIDS/PILES	MAX	MIN	AVERAGE	MAX	MIN
Approach Bridge	A-C	7,300	5,800 (3,300 <sup>3</sup> )	1,300	1,700	800
Original Wharf	D-I	5,800	5,800	1,500	2,500	1,000
Extension Wharf	J-O	4,400	4,400	1,100	1,800	300
Extension Mid Strong Point (Orig. Breasting Dolphin)	Piles 115-122	5,800	5,800	1,100	1,900	1,500
Northern Strong Point	Piles 248-251	9,900	9,900	1,600	1,700	1,500

**Notes:**

1: A structural capacity factor of  $\phi = 0.9$  has been applied to the values above.

2: Above values include 2mm uniform corrosion allowance

3: This value is the 457DIA piles for the widening of only two piles 146 and 147.

4: A geotechnical reduction factor of  $\phi_g$  of 0.65 was used to derive the design pile capacity from the ultimate pile capacity estimated from GRLWEAP and is applied to the values above.

5: Values have been rounded down to the nearest 100.

# 7 STAGE 2 – DETERMINE FEASIBILITY OF DEEPENING BERTH POCKETS

## 7.1 General

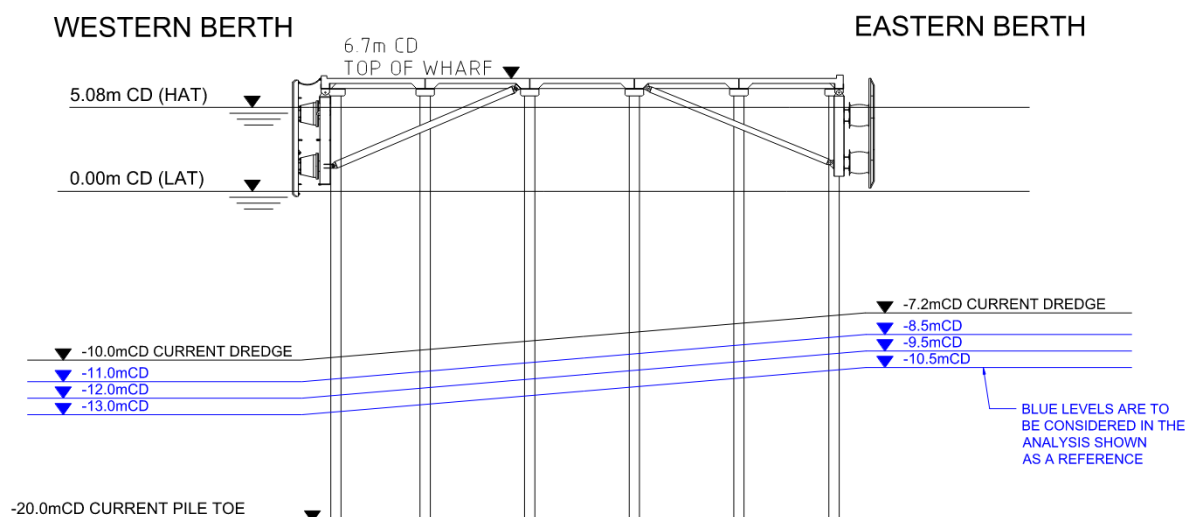
The scope of this stage was to understand the impact of a deeper dredge pocket on the western and eastern berth. The calculations and models developed in Stage 1 were revised to determine the effect of deepening the berthing pockets.

This stage only considered the effects of the increase in dredged depth on the pile capacities. Utilisations and proposed loading will be considered in Section 8.

## 7.2 Current Dredged Depths

As described in Section 3.4, the most recent bathymetry shows the seabed levels at the western side of the wharf at -10.0mCD, and the eastern side is at -7.2mCD, with minor variations along its length.

Figure 14 below shows a cross-section of the wharf with the current dredge depths noted. The other levels in the figure shown in blue are dredge depths to be analysed in this section.



**Figure 14: Current and Possible Dredged Depths Cross Section**

## 7.3 Effect on Structural Pile Capacity

With increased dredged depths, the effective length of the piles in compression increases. This increase in effective length proportionally decreases the capacity of the piles. A summary is found in Table 21.

Overall, the structural pile capacities for each additional 1m of dredged depth decrease by 2-3% for the wharf piles. The northern strong point piles are relatively unaffected, with a maximum reduction of 2.5% over an additional 3m of dredging.

This decrease in structural pile capacities has a negligible effect overall as they remain greater than the geotechnical capacities and are still non-governing.

**Table 21: Summary of Structural Pile Capacities and Proposed Dredged Depths**

		MINIMUM STRUCTURAL PILE CAPACITIES <sup>1&amp;2</sup>			
		COMPRESSION (kN)			
LEVELS EAST LEVELS WEST		-7.2mCD -10.0mCD	-8.5mCD -11.0mCD	-9.5mCD -12.0mCD	-10.5mCD -13.0mCD
DEPTH INCREASE		0.0mCD	~1.0m	~2.0m	~3.0m
LOCATION	GRIDS/PILES	CURRENT			
Original Wharf	D-I	4,850	4,700 (-3%)	4,580 (-6%)	4,450 (-8%)
Extension Wharf	J- O	2,690	2,620 (-3%)	2,560 (-5%)	2,490 (-7%)
Extension Mid Strong Point (Orig. Breasting Dolphin)	Piles 115-122	4,950	4,810 (-3%)	4,690 (-5%)	4,570 (-8%)
Northern Strong Point	Piles 248-251	9,360	9,200 (-2%)	9,190 (-2%)	9,110 (-2.5%)

1: Values have been rounded down to the nearest 10

2: Values above have been based upon minimum structural capacity of the pile groups.

3: Approach bridge piles have not been included as they will not be affected by dredging.

4: Above values include 2mm uniform corrosion allowance.

## 7.4 Effect on Geotechnical Pile Capacity

### 7.4.1 Vertical Capacity

An increase in dredged depth also affects the vertical capacity of the piles due to the loss of the supporting upper layer of soil, which provides resistance to loading. The reduction in embedded soil decreases the skin friction resistance and, therefore, decreases the geotechnical pile capacities accordingly.

Additional dredging is likely to reduce the pile capacities as follows:

- Dredge -1.0m reduction of 5-15%
- Dredge -2.0m reduction of 10-25%
- Dredge -3.0m reduction of 15-30%

Note that this is a generic range and may vary for specific piles. The pile-specific analysis will need to be carried out when the depth and extent of the proposed dredging are finalised.

Refer to Table 22 and Table 23 for a summary of the reduction in geotechnical capacities for each pile group. These tables only apply to piles except for Piles 3, 4, 5, 6 and 7 which have toe levels above -17.38mCD

**Table 22: Summary of Geotechnical Pile Capacities and Proposed Dredged Depths – Compression**

		AVERAGE GEOTECHNICAL PILE CAPACITIES COMPRESSION (kN)			
LEVELS EAST LEVELS WEST		-7.2mCD -10.0mCD	-8.5mCD -11.0mCD	-9.5mCD -12.0mCD	-10.5mCD -13.0mCD
DEPTH INCREASE		0.0m	~1.0m	~2.0m	~3.0m
% CAPACITY REDUCTION		0%	15%	25%	30%
LOCATION	GRIDS/PILES	CURRENT			
Original Wharf	D-I	3,200	2,720	2,400	2,240
Extension Wharf	J-O	2,300	1,955	1,725	1,610
Extension Mid Strong Point (Orig. Breasting Dolphin)	Piles 115-122	3,500	2,975	2,625	2,450
Northern Strong Point	Piles 248-251	3,300	2,805	2,475	2,310

**Table 23: Summary of Geotechnical Pile Capacities and Proposed Dredged Depths – Tension**

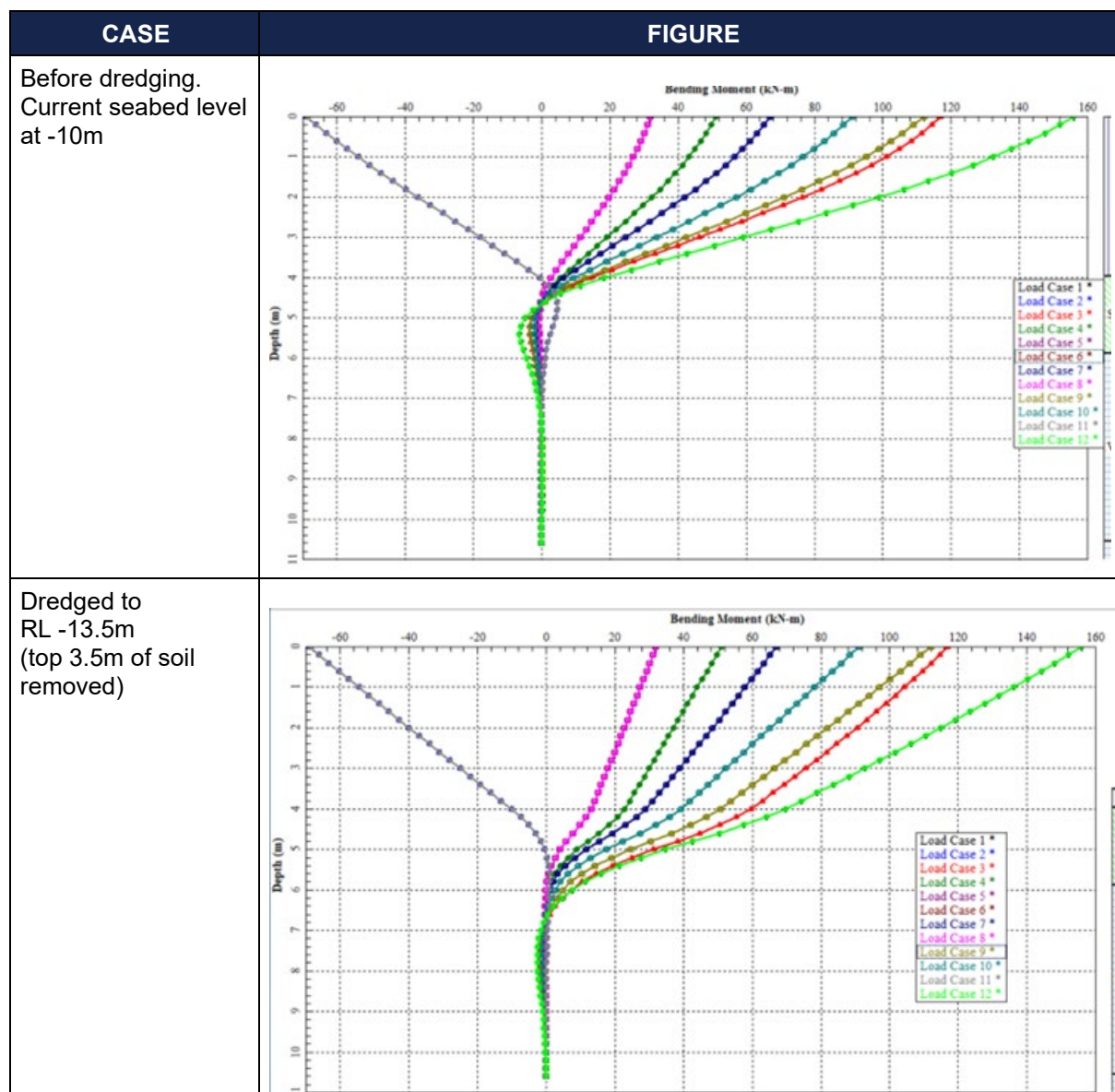
		AVERAGE GEOTECHNICAL PILE CAPACITIES COMPRESSION (kN)			
LEVELS EAST LEVELS WEST		-7.2mCD -10.0mCD	-8.5mCD -11.0mCD	-9.5mCD -12.0mCD	-10.5mCD -13.0mCD
DEPTH INCREASE		0.0m	~1.0m	~2.0m	~3.0m
% CAPACITY REDUCTION		0%	15%	25%	30%
LOCATION	GRIDS/PILES	CURRENT			
Original Wharf	D – I	1,500	1,275	1,125	1,050
Extension Wharf	J – O	1,100	935	825	770
Extension Mid Strong Point (Orig. Breasting Dolphin)	Piles 115 - 122	1,100	935	825	770
Northern Strong Point	Piles 248 - 251	1,600	1,360	1,200	1,120

#### 7.4.2 Lateral Pile Stability

An Lpile analysis was also carried out using an assumed seabed level at approximately -13.50mCD.

Table 24 shows the bending moment output of the pile for the current level at -10.0mCD and increased dredged depth of -13.50mCD for comparison purpose.

**Table 24: Lpile Output – Bending Moment**



To maintain lateral stability and effective moment fixity of the piles, they must achieve a minimum embedment length from the seabed level. The required embedment is estimated as 12D (12 pile diameters) for the -10.0mCD case and reduced to 10D for the -13.5mCD case, refer to Table 24 for the current arrangement of the piles, the typical pile toe depth is -20.0mCD, which is consistent across all the wharf piles. Currently, the piles achieve the minimum embedment depth required to maintain lateral stability and fixity. Figure 15, left diagram, shows the required toe level at -17.3mCD, which is higher than the actual toe level at -20.0mCD and therefore satisfies this requirement.

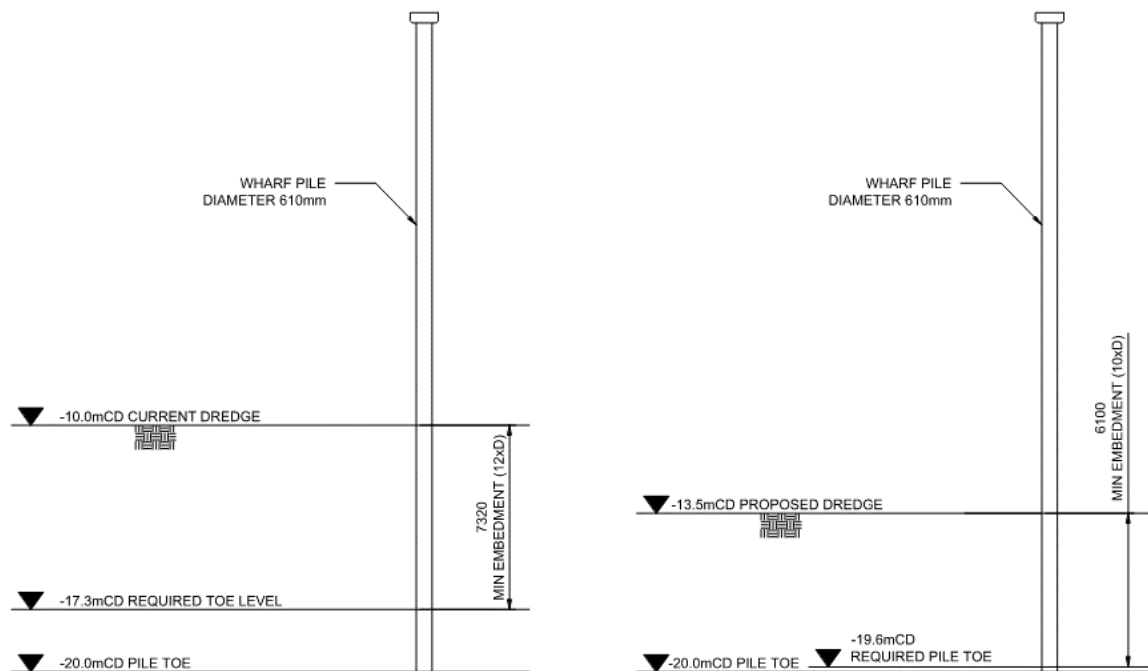
For an increased dredged depth to -13.5mCD, as an ultimate comparison case, the required toe level is -19.6mCD, which is only 0.4m from the current toe level.

It is therefore concluded that lateral stability of the piles can be maintained if dredging is undertaken to a limiting level of -13.5mCD or above.

For the dredged arrangement, the actual toe depths are on the limit of what is required; therefore, caution should be taken in interpreting these results. It should be noted that this analysis is preliminary and is based on expected loadings assumed at the time of writing. A detailed analysis should be conducted during the detailed design of any refurbishment to the wharf to confirm the above for proposed loadings.

**Table 25: Minimum Embedment Depth from Lpile Results**

DREDGED LEVEL	DEPTH TO FIXITY m	MINIMUM EMBEDMENT DEPTH BELOW POINT OF FIXITY m	TOTAL MINIMUM PILE EMBEDMENT DEPTH BELOW DREDGED LEVEL m
Current level: Before Dredging (-10m CD)	7D	4D	>12D
Possible future level: After Dredging (-13.5m CD)	5.5D	4D	>9.5D, rounded up to 10D



**Figure 15: Minimum Embedment Depth Required – Current (left) and Dredged -13.5mCD (right)**



# 8 STAGE 3 – DETERMINE THE FEASIBILITY OF ACCOMMODATING NEW LOADS WITH AN UPGRADED WHARF

## 8.1 General

The scope of this stage was to undertake a sensitivity analysis of the existing piles' structural and geotechnical capacities to accommodate the new loading from an upgraded wharf.

A review of the utilisation of the wharf piles was undertaken in this stage using the capacities and analysis conducted in Stages 1 and 2 (Sections 6 and 7).

From consultation with PPA through workshops and team meetings, future loading arrangements and criteria were determined for analysis in this Section. This criteria will be provided in detail in the relevant sections below.

A range of representative load cases were analysed to understand the wharf pile's performance under future conditions. A comprehensive and detailed analysis of all possible future load cases has not been undertaken.

## 8.2 Assumptions and Criteria

- Ultimate loading was based on the criteria presented in Section 3.8. Capacities of existing piles, both geotechnically and structurally, were derived from Section 6, with appropriate capacity factors applied.
- The structural arrangement analysed with an assumed fixed connection to the deck.
- No changes to deck thicknesses or fenders have been allowed in the analysis of the current loading conditions of the wharf.
- Unless otherwise stated in the discussion, geotechnical capacities govern.
- The analysis determined the maximum deck loads the piles could accommodate based on their geotechnical capacities.
- Fender energy share is assumed to be 60% to top fender and 40% to bottom for each fender pair.

## 8.3 Comparison to Current Loading

To determine the baseline for assessing the piles the existing wharf arrangement and load cases were run in the model to determine current utilisations. This assessment assists in forming the basis for any changes or upgrades to the wharf.

Table 26 presents a summary of the utilisations of the wharf for specific groups of load cases. Earthquake and environmental loading are non-governing; therefore, results are not presented in the table and discussion below. Refer to Appendix J for colour and utilisation maps of the wharf showing specific piles and their utilisations per load case in detail.

It was found that the existing wharf is generally adequate for the current loading conditions. The exceptions to which are as follows:

- Localised piles with lower-than-average geotechnical capacity due to soil or driving characteristics. These are typically single piles in an area, and it is assumed that redundancy in the structure and a stiff concrete deck can spread the load and account for these limiting elements.

- Quarter point berthing on the north side of the wharf in close proximity to the northern strong point piles cause the northern strong point piles to be over utilised greater than 150%. These piles pass if berthing occurs further south toward the extension mid strong point (original breasting dolphin) and is distributed between both raking pile structures.
- Parallel berthing cases show the raker piles at the end of the original wharf, breasting dolphin (wharf extension middle strong point) and northern strong point are overutilized.
- The front piles on the eastern original wharf side are overstressed due to the local connection of the fender to the pile at the lower level, causing bending in the piles.

**Table 26: Existing Wharf Piles Utilisations Per Load Case**

LOAD CASE	UTILISATIONS – STRUCTURAL/GEOTECHNICAL GOVERNING (NUMBER OF PILES)				
	<80%	80 – 100%	100 – 125%	125 – 200%	>200%
1.2G+1.5Q	170	43	7	3	0
1.2G+1.5B(quarter pt) <sup>1</sup>	219	0	2	4	0
1.2G+1.5B(parallel)	204	6	4	5	4
1.2G+1.5M	223	0	0	0	0
1.2G+1.5B(quarter pt)+1.5M <sup>1</sup>	219	0	0	2	2
1.2G+1.5B(quarter pt)+1.5M+1.5Q <sup>1</sup>	150	55	10	6	2

Note 1: Excludes the piles failing locally due to the arrangement of fendering on the eastern side.

Note 2:  $\Phi_g = 0.65$  for the geotechnical reduction factor adopted.

Note 3:  $\Phi_g = 0.9$  for structural reduction factor adopted.

Note 4: 2mm corrosion allowance is included for steel piles.

## 8.4 Deck Loading

### 8.4.1 Maximum Deck Loading

Table 27 shows the maximum deck live load capacity for the ultimate limit state load case considering dead and live loads only (1.2G+1.5Q). It was found that there were marginal increases in the live load rating of the piles.

No changes to deck thicknesses or dredged depths have been included in the summary below. A reduction on these maximum deck loads will be applied for an increased concrete deck thickness and dredged depth, which is found in Sections 8.4.2 and 8.4.3, respectively.

Operational combinations of future loading are considered in Section 8.8.

**Table 27: Maximum Deck Loading**

	LOCATION	DECK LIVE LOAD UDL (kPA)		
		EXISTING RATING	MAXIMUM DECK LOAD	DIFF FROM EXISTING RATING
A	Extension (North)	25	35	+15
B	Extension Mid Strong Point (Orig. Breasting Dolphin)	25	55	+30
C	Extension (South)	25	30	+5
D	Original Wharf	39	45	+6
E	Approach Bridge	25	30	+5

#### 8.4.2 Impact of Dredged Depths on Deck Loading

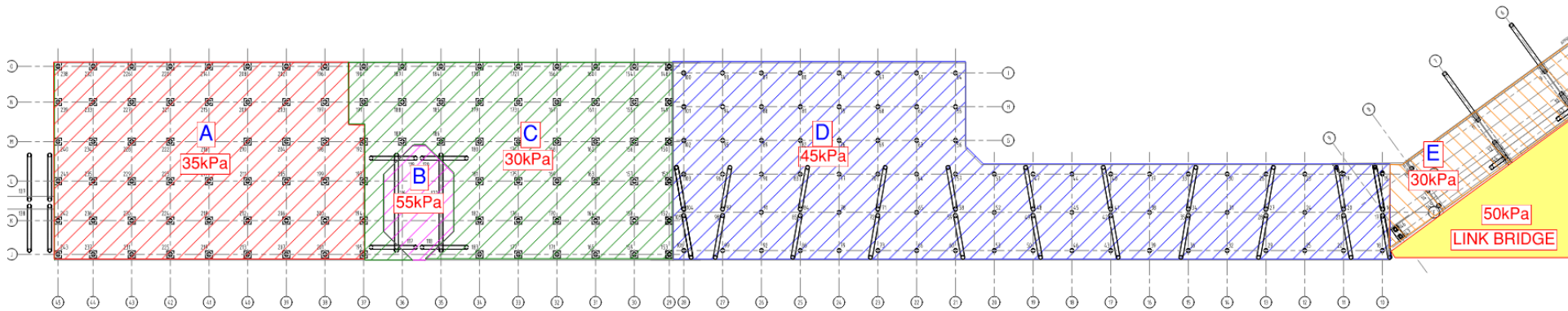
As described in Section 7.4, additional dredging impacts the vertical capacity geotechnical of the piles. As such, a reduction in the rated live load of the structure should allow for an increased dredged depth.

Table 28 indicates the proposed reduction of deck live loading associated with increased dredged depth in one-meter intervals.

#### 8.4.3 Impact of Upgraded Increased Deck Thickness

As previously stated, the above figures are based on the thickness of the existing deck. When the wharf is upgraded in the future, the deck is expected to be thickened to accommodate increased loading conditions.

Table 29 shows an indicative increased deck thickness to be adopted for analysis purposes. No detailed concrete check has been undertaken. For every 100mm thickness increase, an estimated reduction in live load is 2kPa, which is equal to the difference of the equivalent factored dead loads (1.2G+1.5Q)



**Figure 16: Maximum Vertical Deck Loading of Existing Wharf with Current Dredge Levels and Deck Thickness (1.2G+1.5Q)**

**Table 28: Maximum Deck Loading with Increased Dredged Depths**

		MAXIMUM DECK LIVE LOAD UDL (kPa)			
	LEVELS EAST LEVELS WEST	-7.2mCD -10.0mCD	-8.5mCD -11.0mCD	-9.5mCD -12.0mCD	-10.5mCD -13.0mCD
	DEPTH INCREASE	0.0M	~1.0M	~2.0M	~3.0M
	% REDUCTION	0%	15%	25%	30%
	LOCATION	CURRENT			
A	Northern Extension	35	30	26	24
B	Ext. Mid Strong Point	55	46	40	38
C	Southern Extension	30	25	22	20
D	Original Wharf	45	38	33	31

*Note: Approach piles have not been included as dredging is not applicable.*

**Table 29: Maximum Deck Loading with Increased Deck Thickness**

	LOCATION	EXISTING DECK THICKNESS (mm)	PROPOSED DECK THICKNESS (mm)	LL REDUCTION (kPa)	MAXIMUM DECK LIVE LOAD (kPa)
A	Northern Extension	300	600	-6.0	29
B	Ext. Mid Strong Point	750	750	N/A	55
C	Southern Extension	300	600	-6.0	29
D	Original Wharf	700	900	-4.0	41

*Note: Approach piles have not been included as is not applicable*

## 8.5 Berthing Operations

### 8.5.1 General

The following section presents the case and results for the future vessels to be expected on the wharf as confirmed by PPA. No detailed berthing study has been undertaken at this stage; however, reasonable assumptions were provided to allow results to be compared for discussion purposes. Assumptions have been made regarding the fender energy share and other items that need to be refined via a detailed berthing study.

Detailed checks of the deck, connections, and local structure to accommodate the proposed fender reactions have not been considered part of this study.

The northern strong point piles were not considered as they are already failing under current loading conditions. The load path to these piles should be addressed separately. The maximum berthing reactions presented are based upon the critical piles being the wharf rakers, including the extension mid-strong point (original breasting dolphin) rakers. Only quarter-point values are being presented here.

### 8.5.2 Maximum Berthing Reactions

An analysis was undertaken to determine the maximum quarter point berthing load on the wharf for the piles on both sides of the wharf limited by pile capacity. The fender reactions were increased until the critical piles failed, and the maximum berthing reaction scenario was noted.

A summary of the maximum berthing reaction that can be accommodated on the structure is found in Table 30. Two quarter point scenarios were considered utilising four or six fender cones to produce the total reaction.

**Table 30: Maximum Berthing Reactions**

Type	Unit	MAXIMUM RATED REACTIONS FROM MODEL QUARTER POINT (kN)	
		West	East
Total Berthing Reaction on Wharf	All cones combined	5,680	5,640
Berthing Reaction 4 x cones engaged	Per cone	1,420	1,410
Berthing Reaction 6 x cones engaged	Per cone	940	940

### 8.5.3 Proposed Vessels for Berthing Operations – Western Berth

In consultation with PPA, consideration was made to determine if the proposed vessels Global Highway and Hoegh Jemma would be suitable for berthing on the western berth. The details of these vessels are found in Table 31.

**Table 31: Proposed Vessel Dimensions – Western Berth**

DETAILS	UNIT	HOEGH JEDDAH	GLOBAL HIGHWAY
Capacity	Cars	6,500	7,500
Length Overall	m	199.9	200.0
Width	m	32.3	38.0
Depth	m	32.6	38.0
Draft Design	m	9.0	9.0
Estimated Bow Radius <sup>1</sup>	m	85.4	75.3
Displacement Design	t	32,500	41,200
Frontage Wind Design	m <sup>2</sup>	1,000	1,450
Side Windage Design	m <sup>2</sup>	5,770	6,850

Note 1: Estimated bow radius has been based upon guidance in Trelleborg Fender Design Guide p41.

#### 8.5.4 Berthing Criteria and Energies for Proposed Vessels

The following berthing criteria were assumed in the calculation for the energy.

**Table 32: Berthing Criteria Summary for Proposed Vessels**

MAX APPROACH ANGLE (DEG)	ABNORMAL BERTHING FACTOR OF SAFETY	BERTHING TYPE
10	2.0	¼ Point

Berthing velocity has a significant effect on the energies calculated. Table 33 shows the adjusted abnormal energies for different berthing velocities from 0.15 to 0.30m/s. The fender analysis considered the rated energy and reactions after application of the temperature, velocity, and angular correction factors and the manufacturing tolerances.

#### 8.5.5 Existing Western Fender Performance for Proposed Vessels

The current fender systems on the west wharf are SCN1000E0.9 super cone fenders, with fender spacing of 9.10m. Table 33 compares the berthing energies associated with different velocities and provides the adjusted abnormal berthing energy and reactions.

The worst-case condition for energy capacity is assumed to be when the two fenders (four cones) are engaged. It was assumed for each fender that, 60% of the energy goes into the top cone and 40% into the bottom cone fender.

The results show that the current fenders are suitable for a berthing velocity of 0.15m/s; however, are inadequate for velocities greater than this.

The rated reactions of the fenders for the 0.15m/s velocity case are still within the maximum reaction allowable for the structure as outlined in Section 8.5.2. Therefore, the structure is sufficient for these loads.

It should be noted, however, that the critical case for the reactions on the structure is when three fenders (six cones) are engaged. The maximum fender reaction when six cones are engaged is 940kN. The maximum reactions are less than this; therefore, it also satisfies this condition.

**Table 33: Current Fender Performance for Proposed Vessels – Western Berth**

ITEM	UNIT	FENDER PERFORMANCE COMPARISON			
Berthing Velocity	m/s	0.15	0.175	0.2	0.25
<b>Global Highway</b>					
Fender	SCN1000E0.9 Super Cone				
Rated Energy of Fender <sup>4</sup>	Per cone	338			
Max Reaction Allow (Structure)	kN	1,420			
Adj. Abnormal Berthing Energy <sup>3</sup>	kNm	950	1,311	1,714	2,677
Adj. Abnormal Berthing Energy (per cone) <sup>1</sup> – Fender Check	kNm	338	504	659	1030
Adj. Rated Reaction – Structure Check	kN	684	FAIL	FAIL	FAIL
<b>Hoegh Jeddah</b>					
Fender	SCN1000E0.9 Super Cone				
Rated Energy of Fender <sup>4</sup>	Per cone	338			
Max Reaction Allow (Structure)	kN	1,420			
Adj. Abnormal Berthing Energy <sup>3</sup>	kNm	797	1084	1425	2226
Adj. Abnormal Berthing Energy (per cone) <sup>1</sup> – Fender Check	kNm	285	417	548	856
Adj. Rated Reaction – Structure Check	kN	601	FAIL	FAIL	FAIL

*Note 1: It is assumed that the worst case for the energy capacity of the fenders is when 4 fender cones are engaged. The above figures have been presented with this assumption. Energies have been adjusted to assume a 60% share on the top cone and a 40% share on the bottom cone.*

*Note 2: Energies calculated in accordance with BS6349 : Part 4.*

*Note 3: Adjusted adjustment factors applied to both reactions and energies. Reaction factor = 1.2, Energy factor = 0.8.*

*Note 4: Fender energy and reactions are based upon Trelleborg fender catalogue tables.*

*Note 5: Refer to Table 30 for maximum fender reactions for 4 cones as a limiting value.*

### 8.5.6 Upgraded Western Fender Performance for Proposed Vessels

A trial fender SCN1400E0.9 Super Cone was chosen for the western side to accommodate the increased berthing velocities. This increased fender size would accommodate the required energy from the increased velocities and increase the reactions to the structure.

It was determined that the upgraded fenders are suitable for a berthing velocity of up to 0.2m/s. However, these fenders are inadequate for velocities greater than this. Therefore, the rated reactions remained below the maximum rated reaction for the structure and are suitable.

**Table 34: Upgraded Fender Performance for Proposed Vessels – Western Berth**

ITEM	UNIT	FENDER PERFORMANCE COMPARISON			
Berthing Velocity	m/s	0.15	0.175	0.2	0.25
<b>Global Highway</b>					
Fender	SCN1400E0.9 Super Cone				
Rated Energy of Fender <sup>4</sup>	Per cone	927			
Max Reaction Allow (Structure)	kN	1,420			
Adj. Abnormal Berthing Energy <sup>3</sup>	kNm	950	1,311	1,714	2,677
Adj. Abnormal Berthing Energy (per cone) <sup>1</sup> – Fender Check	kNm	338	504	659	1030
Adj. Rated Reaction – Structure Check	kN	1,111	1,060	990	FAIL
<b>Hoegh Jeddah</b>					
Fender	SCN1400E0.9 Super Cone				
Rated Energy of Fender <sup>4</sup>	Per cone	927			
Max Reaction Allow (Structure)	kN	1,420			
Adj. Abnormal Berthing Energy <sup>3</sup>	kNm	797	1084	1425	2226
Adj. Abnormal Berthing Energy (per cone) <sup>1</sup> – Fender Check	kNm	285	417	548	856
Adj. Rated Reaction – Structure Check	kN	1,080	1,111	1,040	1,040

Note 1: It is assumed that the worst case for the energy capacity of the fenders is when 4 fender cones are engaged. The above figures have been presented with this assumption. Energies have been adjusted to assume a 60% share on the top cone and 40% share on the bottom cone.

Note 2: Energies calculated in accordance with BS6349 : Part 4.

Note 3: Adjusted adjustment factors applied to both reactions and energies. Reaction factor = 1.2, Energy factor = 0.8.

Note 4: Fender energy and reactions are based upon Trelleborg fender catalogue tables.

Note 5: Refer to Table 30 for maximum fender reactions for 4 cones as a limiting value.

### 8.5.7 Eastern Berthing

Currently, the eastern fendering is capable of berthing for vessels of displacement 15,000t at a velocity of 0.15m/s and maximum berthing angle of 10 degrees. The fendering arrangement consists of SCK1150E2.0 Cell Fenders at a nominal 6.1m spacing.

No specific vessels were provided for analysis on the eastern side.

A previous study was undertaken on the eastern berthing fenders and limiting elements by WGA. Refer to report number 190166RPT001, revision B, dated 5 August 2019. This report assessed the eastern berth and undertook a structural assessment of the wharf.

The key findings from this report relevant to this study were extracted as follows:

- Generally, the raker piles' structural capacity, which takes most of the lateral loading, is adequate.
- With the proposed replacement fender SCN 1000 E0.9, the berthing vessel displacement can be increased to 20,000t and potentially up to 22,000t with a more detailed analysis. This depends on the range of vessels using the berth, berthing at different tides and consideration and allowance for a flare angle on the hull assumed for quarter-point berthing.
- Northern strong point raker piles show overutilization of geotechnical capacity for both quarter point and parallel.



- The geotechnical capacity of the original wharf raker piles is adequate for quarter-point berthing (1 to 2 fender panel impact) but is overutilised for the parallel berthing case.
- The geotechnical capacity of the extension mid strong point (original breasting dolphin) raker piles is also adequate for quarter-point berthing but overutilised for parallel berthing cases.

This current study confirmed and supported the above conclusions for the eastern berth, as the results were consistent with these cases.

The 15,000t maximum displacement for a berthing vessel on the eastern wharf is likely governed by the dredged depth and vessel geometry rather than the piles' structural or geotechnical capacity. As stated in Section 8.5.2, the maximum berthing reaction the wharf can accommodate with four cones engaged is 1,420kN per cone. This capacity is greater than the current rated reaction of the east side fender, which is 750kN per cone. Therefore, there may be a provision to upgrade the fenders to absorb more berthing energy and accommodate larger vessels.

A detailed berthing assessment should be undertaken if upgraded fenders are considered for the eastern berth.

## 8.6 Mooring Operations

### 8.6.1 Dynamic Mooring Study Loads

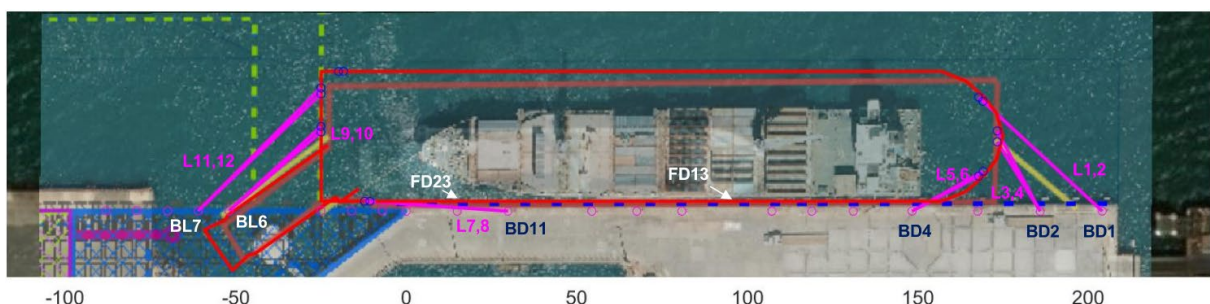
A mooring study was conducted in 2022 for mooring operations for the western side of the Dampier Cargo Wharf to accommodate Ro-Ro vessels which included the Global Highway and Hoegh Jeddah as described previously in this report. This report is titled "Dampier Cargo Wharf Link Bridge: Mooring Analysis", report number 13396.203.R1.Rev0, dated 25 November 2022.

Mooring forces and fender reactions were tabulated in the report for different conditions. These forces were used to assess the piles for the proposed mooring arrangements of both these vessels on the western berth.

Figure 17 shows the mooring layout used as a basis of the assessment.

Figure 18 shows the bollard loads and Table 35 shows the fender reactions applied to the model for assessment. These values were based on 25kn wind for Global Highway, and 20kN wind for Hoegh Jeddah. Any wind speed above this was a breakaway.

The bollard loads were applied in the model with a combination factor of 2.0 for ULS because these are based on the loads in the lines (they are not the bollard SWL). The fender reactions were applied to the model with a factor of 1.5 for ULS.



**Figure 17: Mooring Layout Global Highway (Extract 13396.203.R1.Rev0, Figure B1)**

**Table 5.2: Overall maximum forces on each bollard for the Global Highway car carrier for the governing wind direction**

Wind Spd	Wind Dir	Bow BD1	Breast BD2	Spring BD4	Spring BD11	Stern BL6	Stern BL7
25 kn	E	491	962	469*	364	803	643
50 kn	E	Break-away					

\* ENE wind direction

**Table 5.4: Overall maximum forces on each bollard for the Hoegh Jeddah car carrier for the governing wind direction**

Wind Spd	Wind Dir	Bow BD1	Breast BD2	Spring BD4	Spring BD11	Stern BL6	Stern BL7
10 kn	ENE	132	181	139	130	133	128
15 kn	E	174	263	168	187	221	216
20 kn	E	291	533	254*	292	406	390
50 kn	E	Break-away					

\* ENE wind direction

**Figure 18: Governing Bollard Loading (Extract 13396.203.R1.Rev0, Table 5.2 and 5.4).**

The below mooring fender lean on forces were applied to the model, refer to Table 35.

**Table 35: Mooring Fender Forces (Extract 13396.203.R1.Rev0, Appendix B)**

MAXIMUM FENDER FORCES (kN)													
Vessel	dir	fd12	fd13	fd14	fd15	fd16	fd17	fd18	fd19	fd20	fd21	fd22	fd23
Global Hwy	E	-	647	610	582	560	551	560	584	630	688	761	835
Hoegh Jed.	E	613	497	430	382	352	339	331	360	385	439	526	-

*Note 1: These values were based on 25kn wind for Global Highway, and 20kn wind for Hoegh Jeddah. Any wind speed above this was breakaway.*

## 8.6.2 Load Combinations Mooring

The following load combinations were used to evaluate the mooring on the wharf. Different combination load case sets were analysed for both Global Highway and Hoegh Jeddah.

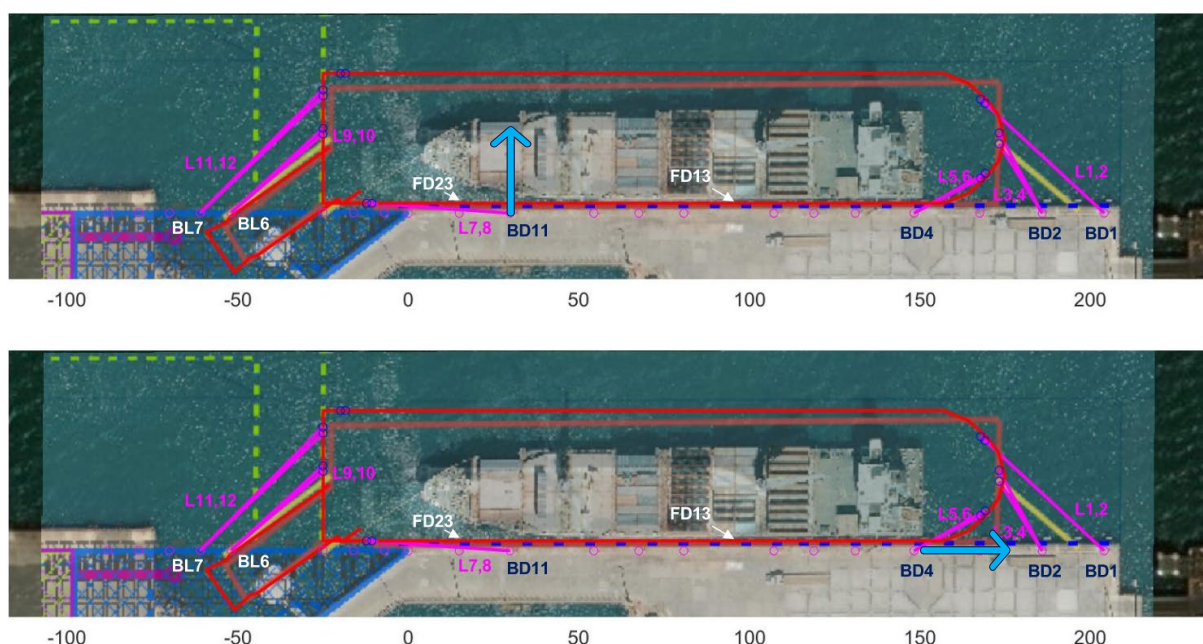
- 1.2G+2.0M(Line Force,W)
- 1.2G+2.0M(Line Force,W)+1.5B.qtr(East)
- 1.2G+1.5M(Fender,W)
- 1.2G+1.5M(Fender,W)+1.5M(East)

For the cases where they were combined with berthing only the quarter point berthing cases that occur south of the extension mid strong point (original breasting dolphin) have been considered. Any cases where a vessel berths closer to the northern strong point causes failure in these piles, and therefore are governed by berthing.

### 8.6.3 Provision for 150 Tonne Bollard

Assessment for the use of a 150t bollards was made to understand the utilisations of the piles for this loading, these are presented in Table 36. The location of the berthing loads was applied at single locations at the existing bollards along the wharf. Examples are shown in the drawing Figure 17-2. The loads were applied at all bollard locations outward and along the wharf. These loads were not applied concurrently.

These loads were applied only with no combinations of berthing. The magnitude of the mooring load applied was 1,500kN with a factor of 1.5 applied combination loading as they are direct bollard loads.



**Figure 19: Example Mooring Force Application**

### 8.6.4 Proposed Vessel Mooring Results

Table 36 shows the maximum utilisations of the piles for these load cases.

It was determined that the wharf piles are adequate for the mooring forces for both vessels.

The exception is for when berthing operations are occurring the northern strong point piles are over utilised. These piles are sensitive to any lateral loading close to the end of the wharf.

With the application of 150T bollard loads, this is acceptable for the Extension Mid Strong Point (Original Breasting Dolphin) and Original Wharf raker piles. The norther strong point piles were inadequate.

**Table 36: Mooring Results Global Highway and Hoegh Jeddah**

MAXIMUM UTILISATIONS OF PILES (%)		
ELEMENT	GLOBAL HIGHWAY	HOEGH JEDDAH
<b>1.2G+2.0M(Bollard,W)</b>		
Northern Strong Point Piles	90%	47%
Extension Mid Strong Point (Orig. Breasting Dolphin)	41%	31%
Original Wharf Rakers	26%	26%
<b>1.2G+1.5M(Fender,W)</b>		
Northern Strong Point Piles	12%	8%
Extension Mid Strong Point (Orig. Breasting Dolphin)	33%	32%

MAXIMUM UTILISATIONS OF PILES (%)		
Original Wharf Rakers	85%	61%
<b>1.2G+1.5M(Fender,W)+1.5M(East)</b>		
Northern Strong Point Piles	27%	33%
Extension Mid Strong Point (Orig. Breasting Dolphin)	42%	42%
Original Wharf Rakers	92%	68%
<b>1.2G+2.0M(Bollard,W)+1.5B(East,South)</b>		
Northern Strong Point Piles	157% <sup>1</sup>	112% <sup>1</sup>
Extension Mid Strong Point (Orig. Breasting Dolphin)	91%	70%
Original Wharf Rakers	71%	60%
<b>1.2G+1.5M(150T Bollard)</b>		
ELEMENT	150T Bollard	
Northern Strong Point Piles	136%	
Extension Mid Strong Point (Orig. Breasting Dolphin)	48%	
Original Wharf Rakers	45%	

*Note 1: The berthing base is considered in combination with mooring in this case. These are failing due to the berthing contribution for berthing locations from the breasting dolphin to the original wharf*

## 8.7 Harbour Crane

A high-level analysis was undertaken on the proposal to provide a harbour crane on the existing wharf. The assessment was undertaken using the Liebherr-type harbour cranes, refer to Table 37 and Appendix L for crane details.

It should be noted that LTM 280 and LTM 420 have similar crane outrigger loads, this is due to the spacing. The LTM 420 has greater max lifting capacity.

The crane outrigger loads were checked using a 1.10 dynamic factor with the load combination of 1.2G+1.5Q(Crane Load). Crane outrigger loads were only applied on the wharf sections.

The crane travelling loads were also applied to the model at all locations, including the approach bridge.

The results for cranes LTM 280, LTM 420 and LTM 550 are found in Table 38, Table 39, and Table 40, respectively. Appendix L shows the utilisation colour map for each of the cranes and shows locations of failing piles.

It was found that the original wharf piles were adequate for the LTM 280 and 480 crane for travelling and lifting cases. The original structure was inadequate for LTM 550 lifting cases and marginal for travelling cases.

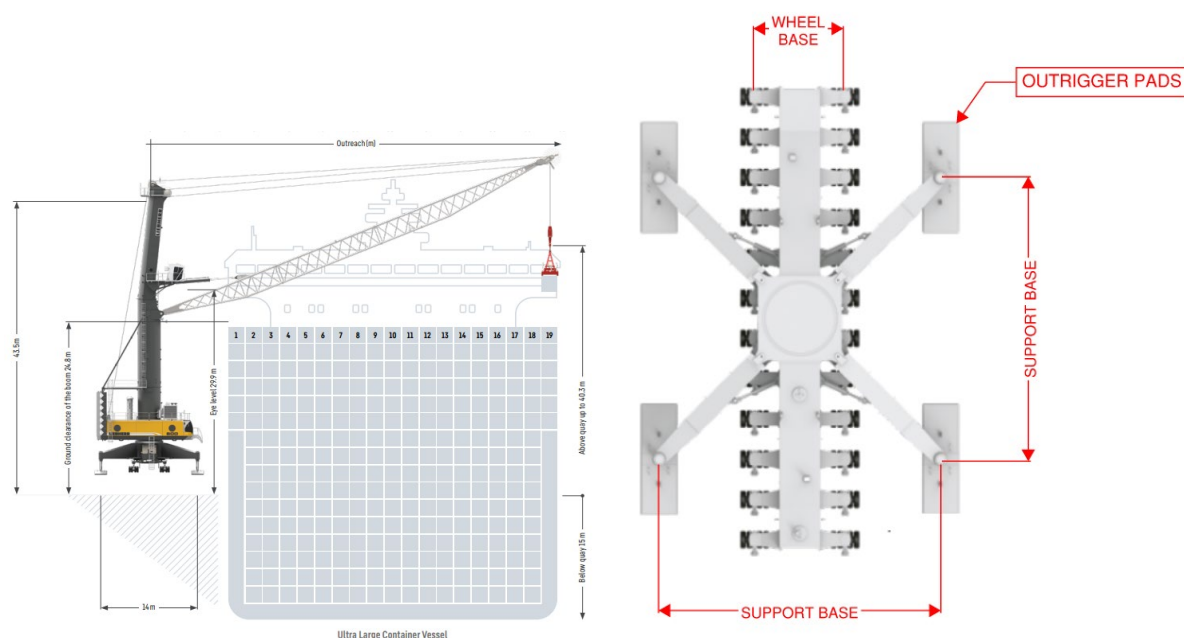
The wharf extension was marginally adequate for the LTM 280 and LTM 420 crane travelling and lifting cases if outriggers were placed midspan to the piles. It was not adequate for all cases for the LTM 550.

The wharf extension is inadequate for all crane lifting loads (LTM 280, LTM 420 and LTM 550) for outriggers placed directly over the piles.

It should be noted that if the outriggers are placed midspan to the piles, this induces a bending moment in the adjacent piles, decreasing the overall utilisation of the piles as they are fixed to the top of the deck. In addition, a thicker deck at these locations will be required to accommodate these increased outrigger point loads, also engaging the deck in bending.

**Table 37: Harbour Crane Specifications**

CRANE TYPE	UNIT	LTM 280	LTM 420	LTM 550
Total Weight	t	241	342	499
Max Lifting Weight	t	84	124	154
Support Base	m	11.0 x 11.0	12.5 x 12.5	13.5 x 13.5
Pad Size	m	2.0 x 4.5	5.5 x 1.8	5.5 x 1.8
Wheel base	m	4.5	4.5	4.5
Axle Sets	no	16	20	20
Tyres Per Axle	no	4	4	4
Max Axle Load	t	20	24	27.5
Max Wheel Load	t	5	6	6.9
Max Pad Pressure	kPa	186	172	293
Maximum Pad Force	kN	1,674	1,703	2,901



**Figure 20: General Arrangement of Harbour Crane**

**Table 38: Loading Results Harbour Crane – LTM 280**

UTILISATIONS – STRUCTURAL/GEOTECHNICAL GOVERNING (NUMBER OF PILES)					
LOAD CASE	<80%	80 – 100%	100 – 125%	125 – 200%	>200%
HARBOUR CRANE – LTM 280					
1.2G+1.5Q(Crane Outrigger Lifting – Top of Pile)*1.1dyn					
Original Wharf	74	15	3	-	-
Wharf Extension	21	23	43	15	2
1.2G+1.5Q(Crane Outrigger Lifting – Midspan)*1.1dyn.					
Original Wharf	90	2	-	-	-
Wharf Extension	87	-	15	2	-



UTILISATIONS – STRUCTURAL/GEOTECHNICAL GOVERNING (NUMBER OF PILES)					
1.2G+1.5Q(Crane Travelling)					
Approach Bridge	16	4	2	1	-
Original Wharf	91	1	-	-	-
Wharf Extension	74	23	7	-	-

**Table 39: Loading Results Harbour Crane – LTM 420**

UTILISATIONS – STRUCTURAL/GEOTECHNICAL GOVERNING (NUMBER OF PILES)					
LOAD CASE	<80%	80 – 100%	100 – 125%	125 – 200%	>200%
HARBOUR CRANE – LTM 420					
1.2G+1.5Q(Crane Outrigger Lifting – Top of Pile)*1.1dyn					
Original Wharf	71	18	3	-	-
Wharf Extension	19	22	42	18	2
1.2G+1.5Q(Crane Outrigger Lifting – Midspan)*1.1dyn <sup>1</sup>					
Original Wharf	90	2	-	-	-
Wharf Extension	42	44	16	1	1
1.2G+1.5Q(Crane Travelling)					
Approach Bridge	11	7	2	3	-
Original Wharf	85	7	-	-	-
Wharf Extension	64	15	24	1	-

Note 1: For piles in Grid J these are governed by structural capacity which is induced by bending in pile in combination with axial loading due to pile to deck fixity.

**Table 40: Loading Results Harbour Crane – LTM 550**

UTILISATIONS – STRUCTURAL/GEOTECHNICAL GOVERNING (NUMBER OF PILES)					
LOAD CASE	<80%	80 – 100%	100 – 125%	125 – 200%	>200%
Harbour Crane – LTM 550					
1.2G+1.5Q(Crane Outrigger Lifting – Top of Pile)*1.1dyn					
Original Wharf	23	22	27	20	-
Wharf Extension	4	5	9	67	19
1.2G+1.5Q(Crane Outrigger Lifting – Midspan)*1.1dyn <sup>1</sup>					
Original Wharf	58	29	3	2	-
Wharf Extension	5	1	36	60	2
1.2G+1.5Q(Crane Travelling)					
Approach Bridge	9	7	3	3	1
Original Wharf	81	10	1	-	-
Wharf Extension	53	17	23	11	-

Note 1: For piles in Grid J these are governed by structural capacity which is induced by bending in pile in combination with axial loading due to pile to deck fixity.

## 8.9 Operational Combinations

Consultation occurred with PPA to understand the concurrent loading requirements of the wharf, and the operational conditions associated with deck live load, berthing, and mooring. This was to understand the loading requirements and combination factors to be adopted for the wharf specific to the operations of the wharf.

The following items of note were confirmed by operations during consultation:

- Full operations can occur during berthing and mooring events on both sides of the wharf. (e.g. Full vehicle loading on one side of the wharf for unloading while berthing occurs on the other side).
- Typically, due to the narrow neck of the original wharf it is rare that stacking loads would be applied to the wharf during operations. This area needs to remain clear for traffic.
- Typical cranes used on the wharf and travelling are the 250t and 350t Liebherr Mobile Cranes.
- Currently cargo or containers are unloaded by vessel cranes. The use of a future harbour crane would facilitate increased speed for unloading.
- Typical vehicle loads are typical AustRoads road trucks and mobile cranes which deck loading allows for currently.

Minimal limitations to the deck loading during berthing and mooring events was the key requirement for the design and assessment of the wharf structure. Therefore, allowance for the full rated deck live loading should be able to be accommodated during these berthing and mooring events.

As described in Section 4 the structural arrangement of the wharf consists of vertical piles which take vertical loading (deck loads/crane loads/etc.), and raker piles which take lateral loading (berthing/mooring/environmental). It was confirmed by further analysis that, in general, the deck load capacity is independent of the lateral load capacity and that any increases in deck loading during a lateral loading event is marginal and does not significantly affect the utilisation of the piles.

Therefore, as these two structural systems are independent:

1. Deck loading limitations are based on Section 8.4 (Deck Loading) and Section 0 (Harbour Crane).
2. Lateral loading limitations are found in Section 8.5 (Berthing) and Section 8.6 (Mooring).

In consideration of the live load to be used while berthing and mooring cases occur it is noted that AS 4997 states a load factor of 0.6. It may be justified during detailed design to use a load factor of 0.6-1.0 for deck loading in combination with berthing and mooring events when operational requirements are confirmed.



# 9 CONCLUSIONS AND RECOMMENDATIONS

## 9.1 General

The following conclusions and recommendations have been provided at a high-level basis. Further analysis or investigation may be required to validate or confirm these recommendations for their suitability.

Refer to Table 41 for a detailed summary of all conclusions and recommendations and Figure 21 for visual representation.

**Table 41: Conclusions and Recommendations**

SCOPE	DOC REF	DESCRIPTION	CONCLUSION/FINDING	RECOMMENDATION
<b>1. General Recommendations</b>				
A	Section 5	Geotechnical pile testing	Current geotechnical analysis has been undertaken using pile driving records from construction and historical bore hole results. No pile in-situ testing has been provided for these piles	During construction, pile testing should be undertaken to verify the design pile capacities and determine if additional capacity could be warranted on the wharf.
B	Section 3	Condition assessment of existing piles	A 2mm corrosion allowance has been assumed for the purposes of this analysis. No review of condition assessment per pile has been used in the analysis.	Prior to the design of the new deck a condition assessment should be undertaken on the piles to determine remaining pile thicknesses and verify the piles for reuse. Also, this will identify any piles which may require to be remediated prior to the new deck works commencing.
C	Section 5.2	Maximum dredged depth	It was concluded that the maximum dredge depth which can be accommodated to maintain the lateral stability of the piles is -13.5mCD.	<p>No dredging is to occur below -13.5mCD for new dredged level to maintain lateral fixity of the piles. Dredge levels to be maintained above -13.5mCD by either of the following:</p> <ol style="list-style-type: none"> <li>1. Specify a dredge level that incorporates an agreed scour allowance.</li> <li>2. Detailing around the base of the piles to ensure no risk of scour.</li> </ol> <p>Refer to Section 8.4 for reductions required due to dredging to be applied to the deck live load.</p>
<b>2. Current Operations</b>				
D	Section 8.2	Low single pile capacities	<p>Localised piles with lower-than-average geotechnical capacity due to soil or driving characteristics. These are typically single piles in an area and are over utilised.</p> <p>These piles numbers are 2, 3, 8, 240 and 237</p>	<p>Piles 2, 3, 8, 240 and 237 which have low capacity the following options are recommended:</p> <ol style="list-style-type: none"> <li>1. Pile testing can be undertaken as per Scope 'A'.</li> <li>2. Pile strengthening.</li> <li>3. Pile replacement.</li> </ol>

SCOPE	DOC REF	DESCRIPTION	CONCLUSION/FINDING	RECOMMENDATION
E	Section 8.2	Quarter point berthing case near northern strong point	Quarter point berthing on the north side of the northern strong point piles to be over utilised greater than 150%. These piles pass if berthing occurs further south toward the extension mid strong point (original breasting dolphin) and is distributed between both raking pile structures.	The following options to address this are: 1. Raker piles can be installed at the end of the wharf extension. 2. Scope 'F' can be undertaken to strengthen the wharf to take these lateral loads.
F	Section 8.2	Parallel berthing case	Parallel berthing cases show the raker piles at the end of the original wharf, extension mid strong point (original breasting dolphin) and northern strong point are overutilized.	Provide 5 to 6 additional raker pile pairs (total 10-12 piles) to strengthen the lateral capacity of the wharf.
G	Section 8.2	Original wharf pile struts on Eastern Berth	The original wharf piles on Grids I and H are overstressed due to the local connection of the fender to the pile at the lower level, causing bending in the piles.	Strengthen or amend connection to existing piles and deck at these locations. Piles include 54, 55, 61, 62, 67, 68, 74, 75, 80, 81, 87, 88, 93, 94, 100 and 101.
<b>3. Future Operations</b>				
H	Section 8.3.2	Eastern side increased dredged depth	The proposed dredged to the eastern side approximately 1 meter (-7.2mCD to -8.5mCD). This results in 15% reduction in geotechnical capacity, however, does not affect the current deck load allowances: Extension - 25kPa Original Wharf – 38kPa	Dredging can be accommodated to -8.5mCD. Scour allowances shall be considered.
I	Section 8.3.1	Increased deck loading	The maximum deck loading allowance for the wharf were calculated are as follows: Extension (North) – 35kPa (from 25kPa) Extension Mid Strong Point – 55kPa (from 25kPa) Extension (South) – 30kPa (from 25kPa) Original Wharf – 45kPa (from 38kPa)	Provision for an increased deck live loading can be considered by PPA. Reductions should be made in allowable deck loading for increased deck thickness and dredged depth refer to Section 8.4 for further details. Scope 'D' should be undertaken to strengthen local overutilized piles.

SCOPE	DOC REF	DESCRIPTION	CONCLUSION/FINDING	RECOMMENDATION
J		Berthing capacity western wharf	<p>Global Highway and Hoegh Jeddah can be accommodated on the original wharf structure for quarter point berthing with velocities 0.15m/s or less with the original fenders.</p> <p>If fenders are upgraded from SCN1000E0.9 to SCN1400E0.9 increased berthing velocity can be accommodated up to 0.20m/s.</p> <p>Berthing of these vessels are not suitable for the parallel berthing case or quarter point case near northern strong point.</p>	<p>The following options to allow for berthing of the Global Highway and Hoegh Jeddah on the western berth are as follows:</p> <ol style="list-style-type: none"> <li>1. Berthing velocity is to be restricted to 0.15m/s and on the original wharf only. Only quarter point berthing.</li> <li>2. Upgrade fenders to SCN1400E0.9 and restrict berthing velocity to 0.20m/s and on the original wharf only. Only quarter point berthing.</li> <li>3. Strengthen wharf as per Scope 'F' and 'G' to allow for quarter and parallel berthing along whole wharf.</li> </ol> <p>In any case a detailed berthing study should be undertaken to verify these conclusions.</p>
K	Section 8.4.7	Berthing capacity eastern wharf	<p>Currently the fenders on the eastern side are inefficient. Therefore, a replacement fender will allow for greater berthing energies for the same reaction on the structure.</p> <p>With the proposed replacement fender SCN 1000 E0.9, the berthing vessel displacement can be increased to 20,000t and potentially up to 22,000t with a more detailed analysis.</p> <p>The 15,000t maximum displacement for a berthing vessel on the eastern wharf is also likely governed by the dredged depth and vessel geometry, rather than the piles' structural or geotechnical capacity.</p>	<p>Scopes 'E' and 'F' are to be completed to remedy the deficient capacity of the northern strong point piles and allow for parallel and northern quarter point berthing cases.</p> <p>It is recommended that fenders on the eastern side be upgraded to accommodate increased berthing energy. Preliminary fender sizing nominates a SCN1000E0.9.</p> <p>A detailed berthing study should be undertaken to verify these conclusions.</p>
L1	Section 8.5	Mooring for Global Highway and Hoegh Jeddah	<p>It was determined that the wharf piles are adequate for the mooring forces for Global Highway and Hoegh Jeddah.</p> <p>Except for the combination of mooring with berthing on the north of the wharf.</p>	<p>Scope 'E' is to be completed to remedy the deficient capacity of the northern strong point piles and allow for parallel and northern quarter point berthing cases.</p>

SCOPE	DOC REF	DESCRIPTION	CONCLUSION/FINDING	RECOMMENDATION
L2	Section 8.5	Assessment of 150T Bollards	It was determined that the wharf piles are adequate for the mooring forces for 150T Bollards. Except for the combination of mooring with berthing on the north of the wharf.	Scope 'E' is to be completed to remedy the deficient capacity of the northern strong point piles and allow for parallel and northern quarter point berthing cases.
M	Section 8.6	Harbour Crane Loading – Original Wharf	It was found that the original wharf piles were adequate for the LTM 280 and 420 crane for travelling and lifting cases. LTM 550 cannot be accommodated anywhere on the original wharf.	Original wharf can accommodate LTM 280 and LTM 420. Works required to be undertaken refer to Scope 'D' for strengthening local overutilized piles.
N	Section 8.6	Harbour Crane Loading – Extension Wharf	The wharf extension was marginally adequate for the LTM 280 and LTM 420 crane travelling and lifting cases if outriggers were placed midspan to the piles. Various piles were marginally failing. Outriggers placed above piles cannot be accommodated for all cranes. LTM 550 cannot be accommodated anywhere on the original wharf.	To accommodate harbour crane loads on the wharf extension the following is recommended: <ol style="list-style-type: none"> <li>1. Beams to be provided at Grids J, L, M and O and lifting outriggers to be restricted to these grids.</li> <li>2. Thickening of the existing concrete deck is to be provided to distribute the travelling loading sufficiently.</li> </ol> Works required to be undertaken refer to Scope 'D' for strengthening local overutilized piles.
O	Section 8.6	Harbour Crane Travelling Loading – Extension Wharf	Travelling case for LTM 280 and 420 is sufficient, with the exception of the lower capacity piles. LTM 550 cannot travel on approach bridge.	Works required to be undertaken refer to Scope 'D' for strengthening local overutilized piles.

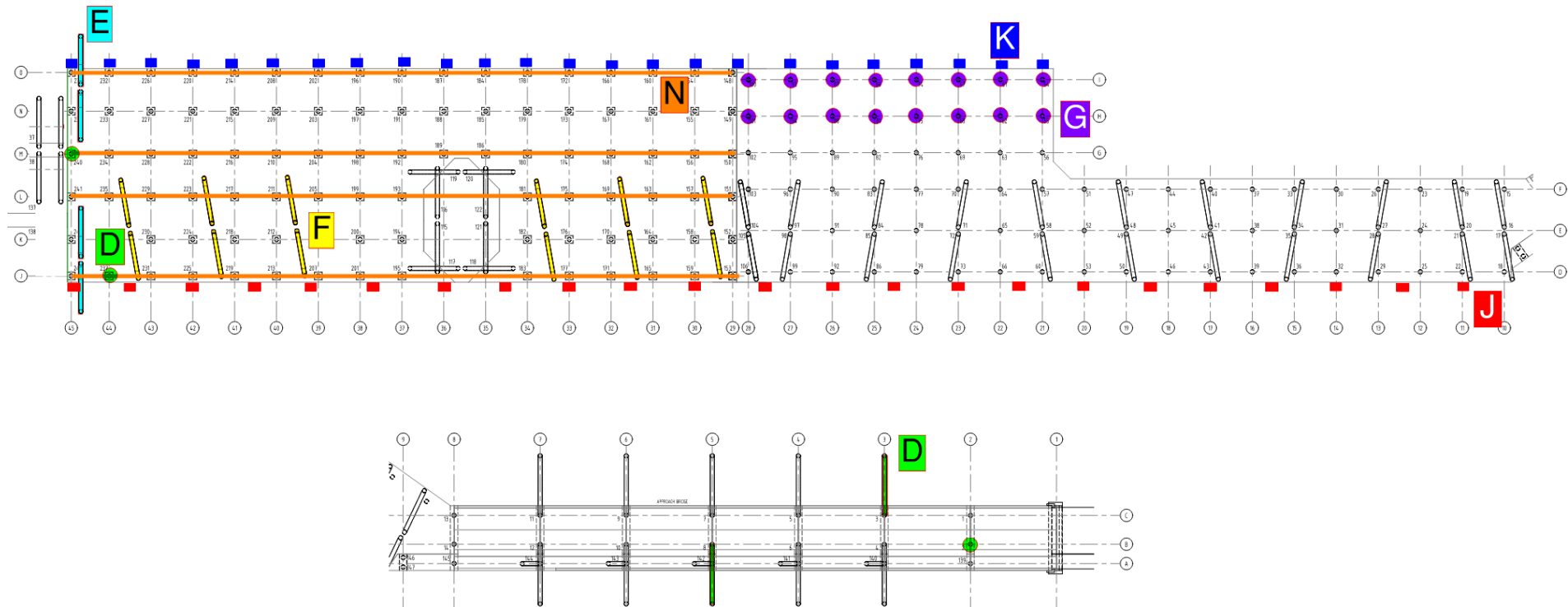


Figure 21: Proposed Works to Upgrade Wharf (refer Table 41 for detail)

# 10 SAFETY IN DESIGN

Refer to Appendix M for a full Safety in Design Register. Project risks for consideration are noted in this register.



# **APPENDIX A**

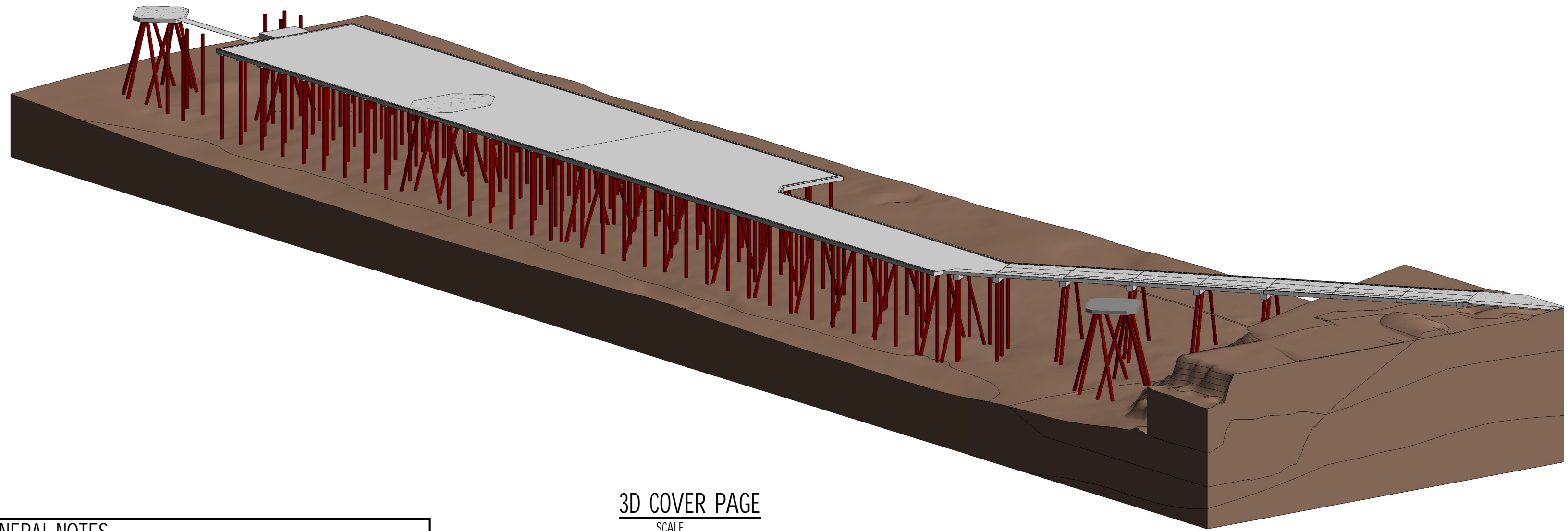
## PILE ASSESSMENT DRAWINGS





## An aerial photograph showing a coastal area with a large concrete structure extending into the water. The structure is labeled 'EXTENT OF ASSESSMENT' and 'EXISTING DAMPIER CARGO WHARF'. A smaller section of the structure is labeled 'APPROACH BRIDGE'. In the foreground, there is a road labeled 'MOF ROAD' and a parking area. The water is a deep blue-green color, and the land is a mix of grey and brown tones.

DRAWING SHEET LIST	
SHEET NUMBER	SHEET NAME
MA-0001	COVER & NOTES SHEET
MA-0011	GENERAL ARRANGEMENT PLAN
MA-0021	PILE SETOUT PLAN - APPROACH BRIDGE
MA-0022	PILE SETOUT PLAN - ORIGINAL WHARF
MA-0023	PILE SETOUT PLAN - WHARF EXTENSION
MA-0031	PILE SCHEDULE - SHEET 1
MA-0032	PILE SCHEDULE - SHEET 2
MA-0033	PILE SCHEDULE - SHEET 3
MA-0034	PILE SCHEDULE - SHEET 4



GENERAL NOTES	
G1	THESE DRAWINGS MUST BE READ IN CONJUNCTION WITH THE PREPARED REPORT: "PILBARA PORTS AUTHORITY - DAMPER CARGO WHARF PILE ASSESSMENT", NUMBER WGA22225- RP-M02. ALL ASSUMPTIONS AND INFORMATION USED IN THE DERIVATION OF THE ASSESSMENT IS PRESENTED THEREIN.
G2	LEVEL DATUM = CHART DATUM U.N.O.
G3	THESE DRAWINGS SHALL NOT BE SCALED. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE (U.N.O.)
G4	COORDINATES PROVIDED IN THESE DRAWINGS ARE NOT AS-CONSTRUCTED. THEY ARE INDICATIVE ONLY FOR INFORMATION PURPOSES.
G5	PILE SCHEDULE IS SHOWN ON DRAWINGS 0031 TO 0034

D1	"PLBARA PORTS AUTHORITY - DAMPIER CARGO WHARF PILE ASSESSMENT", NUMBER WG222255-RP-MA-002.
D2	"DESIGN OF PILES FOUNDATIONS MATERIALS OFFLOADING FACILITY NORTH WEST SHELF DEVELOPMENT PROJECT", DATED FEBRUARY 1983, BHP ENGINEERING
D3	"DECK LADING PLAN", D15-DE-01 (A310303), Rev 2, JANUARY 1999, PPA
D4	"GA AND MAX BEARING CAPACITIES", D15-DE-002, Rev1, JULY 2002
D5	"HYDROGRAPHIC SURVEY REPORT - DAMPIER ANNUAL SURVEY 2020", PHS-20-042-PPA-R001 Rev 0, Approved,DC, MAY JUNE 2020
D6	"WSCAM INSPECTION AND ASSET MAINTENANCE PLAN", 3006387-DCW-RPT-MAR-01, 2021, SMEC
D7	"PILE DRIVING RECORDS, MARINE & CIVIL CONSTRUCTION", 1994 CONSTRUCTION OF EXTENSION WHARF RECORDS
D8	"ORIGINAL WHARF DRAWING SET", 1981, G7400-DS-020:1 TO G7400-DS-052:01
D9	"EXTENSION WHARF DRAWING SET", 1994, 37241-DS-001 TO 37241-DS-039
D10	"NORTH STRONG POINT DRAWING SET (AS CON)", 2001, 950-DWG-500 to 950-DWG-504

GC1	PILES WERE ASSESSED GEOTECHNICAL IN ACCORDANCE WITH AS 2159-2009.
GC2	THE GEOTECHNICAL STRENGTH REDUCTION FACTOR $\phi_g$ USED IN DETERMINING THE DESIGN GEOTECHNICAL CAPACITY IN ACCORDANCE WITH AS2159-2009, $E_d \leq \phi_g$ ULTIMATE GEOTECHNICAL STRENGTH ( $R_d \phi_g$ ), $\phi_g = 0.65$ .
GC3	REFER TO DRAWING WGA-22225-DR-GE-0001, 0002 & 0003 FOR GEOTECHNICAL PROFILES USED IN THE ANALYSIS.
GC4	THE PILE CAPACITIES REPORTED WERE DERIVED FROM THE DRIVING RECORDS AND BASED ON THE AVAILABLE INFORMATION RELATED TO THE PILE CONSTRUCTION. PREDICTED PILE COMPRESSION AND TENSION CAPACITY IS BASED ON FINAL SET DRIVING RECORD. NOTE THAT POA TESTS WERE NOT CARRIED OUT TO VERIFY THE PILE CAPACITY. REFER TO METHODOLOGY OUTLINED IN THE REPORT WGA22225-RP-MA-002 FOR FURTHER DETAIL ON ASSUMPTIONS AND CALCULATIONS.
GC5	FOR PILES 138 - 247 THE PILE SHOE WALL THICKNESS USED IS 20mm WHICH IS BASED UPON THE STIFFENING PLATES AS SHOWN ON DRAWING 27241-DS-006, REV 5.
GC6	PILE CAPACITIES OF PILES 1 TO 247 WERE ESTIMATED FROM THE END-OF-DRIVING BLOW COUNTS USING GRUWEAP. THE PILE CAPACITY OF THE STRONG POINT PILES (NO. 248 TO 251, 900MM DIAMETER, 18MM WALL...
GC7	IT IS ASSUMED THAT HAMMER KOE K45 WAS USED FOR THE PILE INSTALLATION. EXCEPT FOR THE 760MM DIAMETER PILES NO. 1 AND 2, WHERE A DELMAG D62-12 HAMMER WAS REPORTEDLY USED.
GC8	MINIMUM EMBEDMENT DEPTH OF PILES IS TO BE GREATER THAN $12 \times D$ (PILE DIAMETERS) TO MAINTAIN LATERAL PILE FIXITY.
GC9	DEPTH TO FIXITY FOR PILES WAS ESTIMATED TO BE $7 \times D$ (PILE DIAMETERS) FROM SEA BED LEVEL.
GC10	CONE PULL-OUT FAILURE TO BE ASSESSED SEPARATELY AND MAY RESULT IN LOWER PREDICTED PILE TENSION CAPACITY.

51 PILES WERE ASSESSED IN ACCORDANCE WITH AS 4100:2020 STEEL STRUCTURES  
52 CAPACITY FACTORS ADOPTED IN THE ASSESSMENT ARE AS FOLLOWS IN ACCORDANCE WITH AS 4100, TABLE  
3.4:  
- MEMBERS SUBJECT TO AXIAL COMPRESSION,  $\phi = 0.9$   
- MEMBERS SUBJECT TO BENDING,  $\phi = 0.9$

53 IT IS ASSUMED THAT THE CONNECTION OF THE TOP OF THE PILES TO THE DECK IS FULLY FIXED. THIS IS BASED  
ON THE ASSUMPTION THAT THE WHARF WILL BE UPGRADED AND A FIXED CONNECTION DETAIL WILL BE  
PROVIDED.


54 EFFECTIVE LENGTHS WERE CALCULATED IN ACCORDANCE WITH AS 4100, CLAUSE 4.6.3.8 & 3.2. THE FOLLOWING  
ITEMS ARE NOTED:  
- IT WAS DETERMINED THAT THE EFFECTIVE LENGTH FACTOR IS  $k_e = 0.7$  FOR BRACED FIXED-FIXED  
ARRANGEMENT FOR ALL PILES.  
- GEOTECHNICAL ANALYSIS DETERMINED THAT THE EFFECTIVE POINT OF FIXITY IS  $7x$  PILE DIAMETERS  
WHICH HAS BEEN ADOPTED IN THE ANALYSIS.

55 - TOTAL PILE LENGTH IS TAKEN AS TOP OF PILE TO EFFECTIVE POINT OF FIXITY.  
56 ASSUMED PILE GRADIES ARE PROVIDED IN TABLES PS  
57 CONCRETE STRENGTH OF THE DECK IS ASSUMED TO BE 40MPa  
58 PILES HAVE BEEN PRESENTED WITH NO CORROSION ALLOWANCE UNLESS OTHERWISE NOTED.  
59 SEA BED LEVEL ASSUMED IN THE ANALYSIS IS TAKEN FROM THE SURVEY UNDERTAKEN IN 2020.



TELEPHONE : (08) 9159 6555  
EMAIL : [info@pilbaraports.com.au](mailto:info@pilbaraports.com.au)  
POSTAL : LOCKED BAG 5006, KARRATHA WA 6714  
WEB : [www.pilbaraports.com.au](http://www.pilbaraports.com.au)

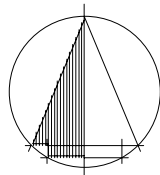
[illegible]

 COPYRIGHT 2022  
PILBARA PORTS AUTHORITY

THIS DOCUMENT AND INFORMATION  
CONTAINED IN IT IS THE SOLE PROPERTY  
OF PILBARA PORTS AUTHORITY AND  
MAY NOT BE USED, EXPLOITED, COPIED,  
DUPLICATED OR REPRODUCED IN ANY  
FORM OR MEDIUM WHATEVER WITHOUT  
THE PRIOR WRITTEN PERMISSION OF  
PILBARA PORTS AUTHORITY

DO NOT ALTER MANUALLY DO NOT SCALE	
DRAWN: LV	DATE: 17.07.24
CHECKED: OK	DATE: 17.07.24
APPROVED: SD	DATE: 17.07.24

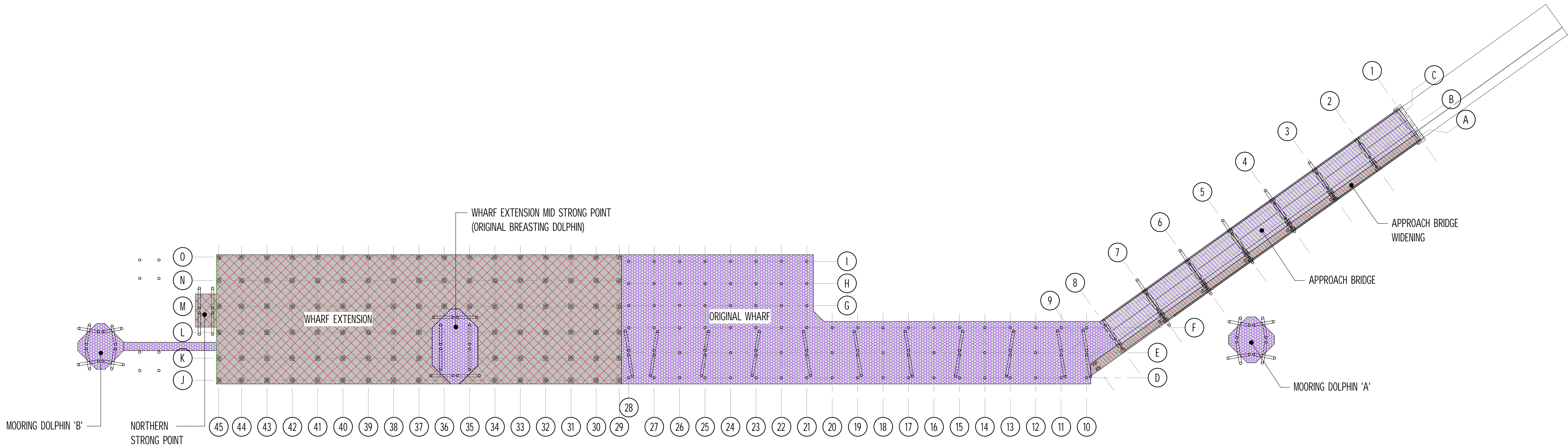
PILBARA PORTS AUTHORITY		A1
PROJECT: DAMPIER CARGO WHARF PILE CAPACITY ASSESSMENT COVER & NOTES SHEET		
PPA DRAWING NUMBER		©
Job Number		Sheet No.
SCALE:	DWG No:	REV:
AS SHOWN	WGA222255-DR-MA-0001	0



**INFORMATION ISSUE**  
NOT FOR CONSTRUCTION



NOTES:  
1. REFER TO DRAWING MA-0001 FOR GENERAL NOTES.



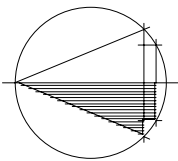
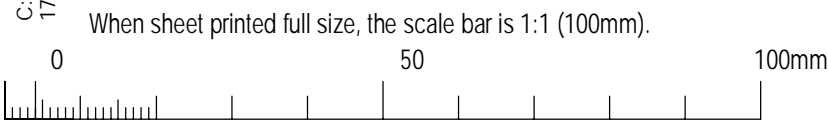
GENERAL ARRANGEMENT  
SCALE 1 : 500

LEGEND:	
	1984 ORIGINAL WHARF
	1984 ORIGINAL APPROACH BRIDGE
	1994 WHARF EXTENSION
	1994 APPROACH BRIDGE WIDENING

PS1 - Pile Schedule					
LOCATIONS	Construction Date	Pile Numbers	Alpha Grid	Number Grid	Pile Grade (MPa)
APPROACH BRIDGE	1981	1 to 14	B to C	2 to 8	250
ORIGINAL WHARF	1981	15 to 106	D to I	10 to 28	250
MOORING DOLPHIN A	1981	107 to 114	-	-	250
ORIGINAL BREASTING DOLPHIN	1981	115 to 122	-	-	250
MOORING DOLPHIN B	1981	123 to 130	-	-	250
REMOVED PILES DURING 1994 EXTENSIONS (NOT SHOWN)	1981-1994	131 to 136	-	-	-
DOLPHIN ACCESS	1981	137 & 138	-	-	250
APPROACH BRIDGE 1994 WIDENING	1994	139 to 147	A	2 to 8	350
WHARF EXTENSION	1994	149 to 243	J to O	29 to 45	350 - NOTE 1
SMALL BOAT LANDING	1994	244 to 247	-	-	350
NORTHERN STRONG POINT	2006	248 to 251	-	-	250 - NOTE 2
FLOATING DOLPHIN PILES	2014	252 to 259	-	-	250 - NOTE 2

NOTE 1 - PILE GRADE FOR THE EXTENSION IS 250MPa FOR THE BOTTOM 600mm SECTION  
NOTE 2 - PILE GRADE IS NOT PROVIDED ON EXISTING DRAWINGS, THEREFORE IS ASSUMED.

C:\BIML PROJECTS\WGA222255-DR-MA-23-0001\_Piles\_Remediation\_Rp\piles.rvt  
17/07/2024 8:07:00 AM

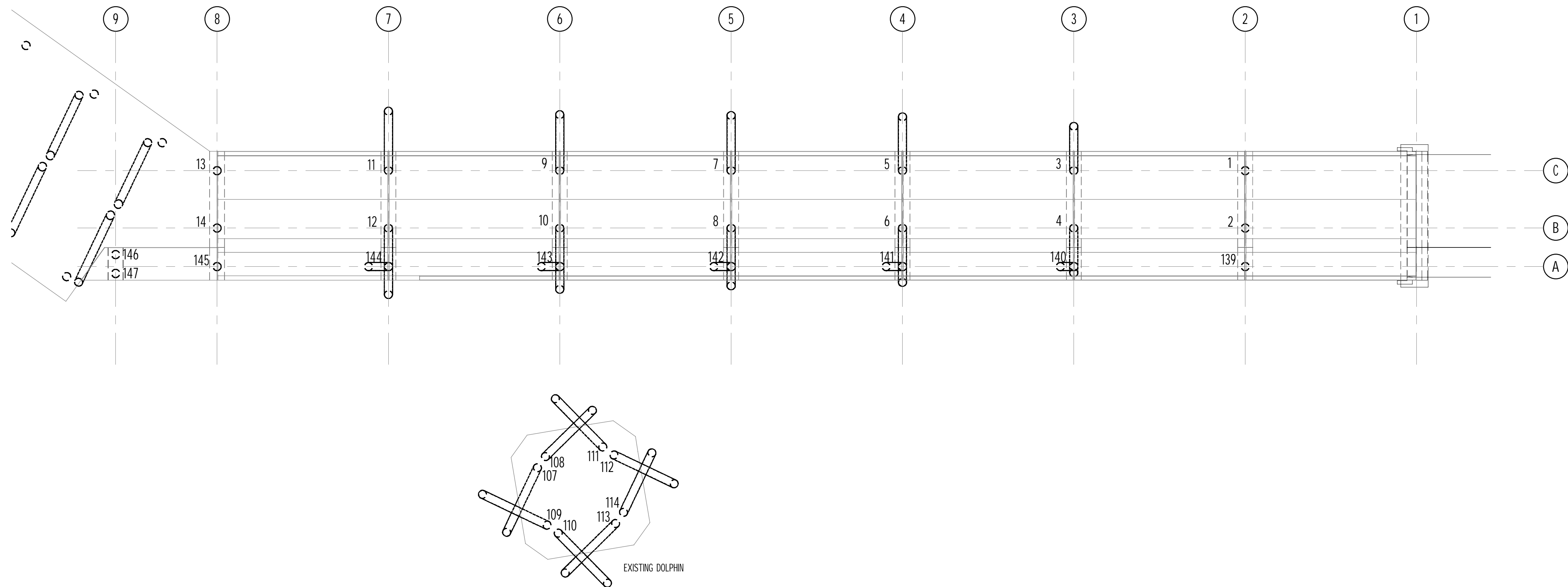


INFORMATION ISSUE  
NOT FOR CONSTRUCTION

												<p><b>©</b> COPYRIGHT 2022 PILBARA PORTS AUTHORITY THIS DOCUMENT AND INFORMATION CONTAINED IN IT IS THE SOLE PROPERTY OF PILBARA PORTS AUTHORITY AND MAY NOT BE USED, EXPLOITED, COPIED, DUPLICATED OR REPRODUCED IN ANY FORM OR MEDIUM WHATSOEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF PILBARA PORTS AUTHORITY</p> <p>DO NOT ALTER MANUALLY DO NOT SCALE</p> <table><tr><td>DRAWN:</td><td>DATE:</td></tr><tr><td>LV</td><td>17.07.24</td></tr><tr><td>CHECKED:</td><td>DATE:</td></tr><tr><td>OK</td><td>17.07.24</td></tr><tr><td>APPROVED:</td><td>DATE:</td></tr><tr><td>SD</td><td>17.07.24</td></tr></table>	DRAWN:	DATE:	LV	17.07.24	CHECKED:	DATE:	OK	17.07.24	APPROVED:	DATE:	SD	17.07.24	PILBARA PORTS AUTHORITY		A1
		DRAWN:	DATE:																								
		LV	17.07.24																								
CHECKED:	DATE:																										
OK	17.07.24																										
APPROVED:	DATE:																										
SD	17.07.24																										
PROJECT: DAMPIER CARGO WHARF PILE CAPACITY ASSESSMENT GENERAL ARRANGEMENT PLAN																											
WGA JOB NUMBER		WGA222255		PPA DRAWING NUMBER		Job Number		Sheet No.		Rev.		SCALE: AS SHOWN		DWG No: WGA222255-DR-MA-0011		REV: 0											

NOTES:

1. REFER TO DRAWING MA-0001 FOR GENERAL NOTES.



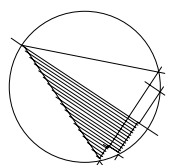
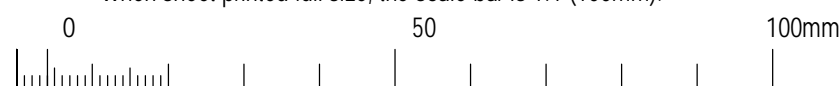
GENERAL ARRANGEMENT - APPROACH BRIDGE

LEGEND:

 32 PILE NUMBER

C:\BIM\_PROJECTS\WGA22255-MD-MA-R23-0001\_Piles\_Remediation\_Rphillipsz.rvt  
17/07/2024 8:07:54 AM

When sheet printed full size, the scale bar is 1:1 (100mm)



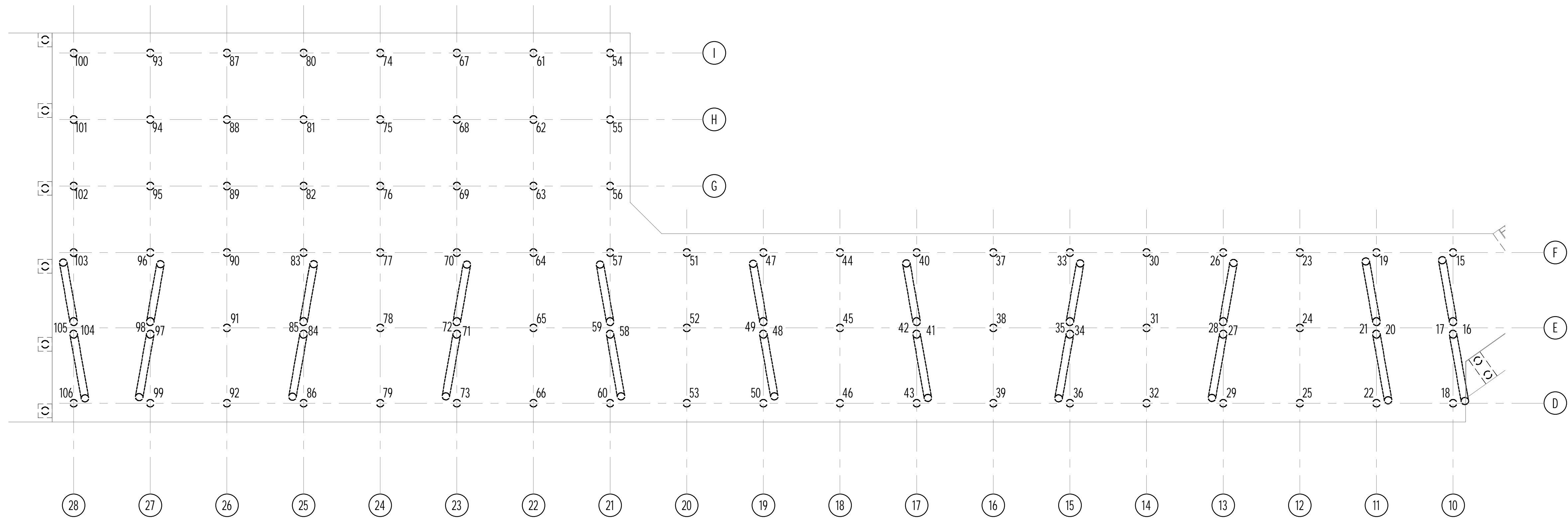
INFORMATION ISSUE  
NOT FOR CONSTRUCTION

<div><div>WGA</div></div>		<div><div><div><div></div><div></div><div></div></div><div>PILBARA PORTS AUTHORITY</div></div></div> <div><div>TELEPHONE : (08) 9159 6555</div><div>EMAIL : info@pilbaraports.com.au</div><div>POSTAL : LOCKED BAG 5006, KARRATHA WA 6714</div><div>WEB : www.pilbaraports.com.au</div></div>														<div><div><div><div>C</div><div>COPYRIGHT 2022 PILBARA PORTS AUTHORITY</div></div><div>THIS DOCUMENT AND INFORMATION CONTAINED IN IT IS THE SOLE PROPERTY OF PILBARA PORTS AUTHORITY AND MAY NOT BE USED, EXPLOITED, COPIED, DUPLICATED OR REPRODUCED IN ANY FORM OR MEDIUM WHATEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF PILBARA PORTS AUTHORITY</div><div>DO NOT ALTER MANUALLY DO NOT SCALE</div><div><div>DRAWN: LV</div><div>CHECKED: OK</div><div>APPROVED: SD</div></div><div><div>DATE: 17.07.24</div><div>DATE: 17.07.24</div><div>DATE: 17.07.24</div></div></div></div>				<div>PILBARA PORTS AUTHORITY</div>		<div>A1</div>																	
				<div><div>PROJECT: DAMPIER CARGO WHARF PILE CAPACITY ASSESSMENT PILE SETOUT PLAN - APPROACH BRIDGE</div><div><div>©</div></div></div>																		<div>PPA DRAWING NUMBER Job Number</div>		<div>Sheet No.</div>		<div>Rev.</div>													
<div>WGA JOB NUMBER</div>		<div>WGA222255</div>		<div>REV.</div>		<div>DATE</div>		<div>DESCRIPTION</div>				<div>BY</div>		<div>CHK</div>		<div>APP</div>		<div>REV.</div>		<div>DATE</div>		<div>DESCRIPTION</div>				<div>BY</div>		<div>CHK</div>		<div>APP</div>		<div>DWG No:</div>		<div>AS SHOWN</div>		<div>SCALE:</div>		<div>REV:</div>	
																				ISSUED FOR INFORMATION				RP		OK		JG		WGA222255-DR-MA-0021		1:1		0					
																				REVISIONS																			



NOTES:

1. REFER TO DRAWING MA-0001 FOR GENERAL NOTES.



### GENERAL ARRANGEMENT - ORIGINAL WHARF

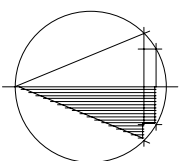
SCALE 1 : 200

LEGEND:



C:\BIM\_PROJECTS\WGA222255-MD-MA-R23-0001\_Piles\_Remediation\_Rphillipsz.rvt  
17/07/2024 8:14:49 AM

When sheet printed full size, the scale bar is 1:1 (100mm).



INFORMATION ISSUE  
NOT FOR CONSTRUCTION



TELEPHONE : (08) 9159 6555  
EMAIL : [info@pilbaraports.com.au](mailto:info@pilbaraports.com.au)  
POSTAL : LOCKED BAG 5006, KARRATHA WA 6714  
WEB : [www.pilbaraports.com.au](http://www.pilbaraports.com.au)

[illegible]

**C** COPYRIGHT 2022  
PILBARA PORTS AUTHORITY

THIS DOCUMENT AND INFORMATION  
CONTAINED IN IT IS THE SOLE PROPERTY  
OF PILBARA PORTS AUTHORITY AND  
MAY NOT BE USED, EXPLOITED, COPIED,  
DUPLICATED OR REPRODUCED IN ANY  
FORM OR MEDIUM WHATEVER WITHOUT  
THE PRIOR WRITTEN PERMISSION OF  
PILBARA PORTS AUTHORITY

DO NOT ALTER MANUALLY  
DO NOT SCALE

DRAWN: LV	DATE: 17.07.24
CHECKED: OK	DATE: 17.07.24
APPROVED: SD	DATE: 17.07.24

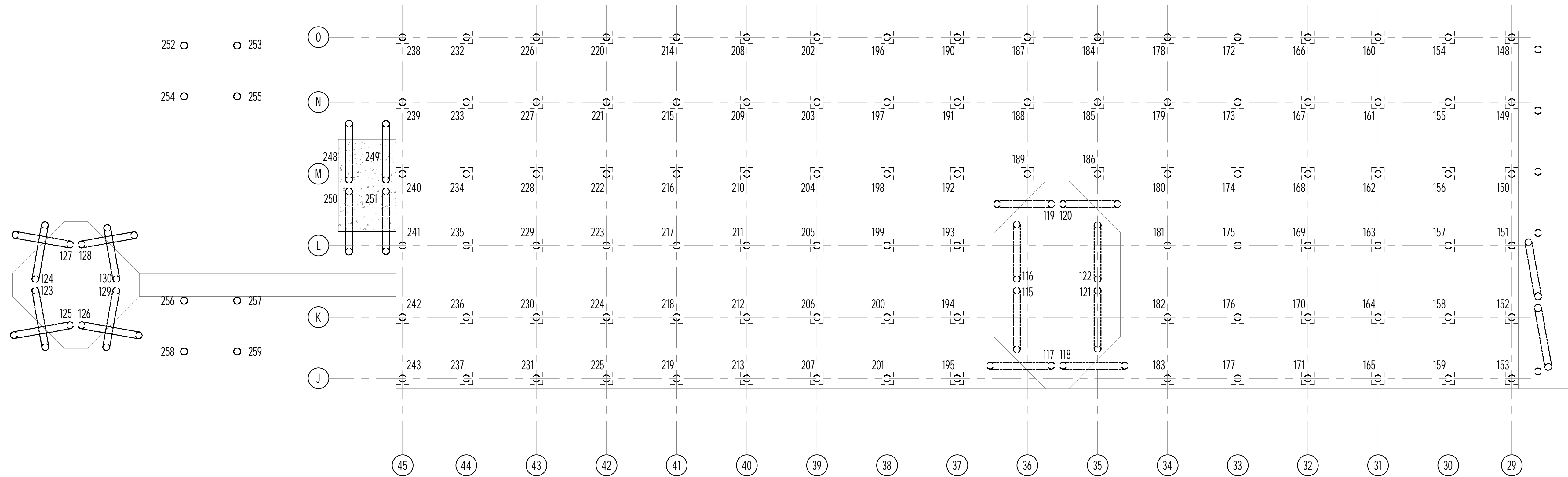
PILBARA PORTS AUTHORITY A1

PROJECT:  
DAMPIER CARGO WHARF  
PILE CAPACITY ASSESSMENT  
PILE SETOUT PLAN - ORIGINAL WHARF

PPA DRAWING NUMBER Job Number		Sheet No.	Rev.
SCALE: AS SHOWN	DWG No: <b>WGA222255-DR-MA-0022</b>	REV: <b>0</b>	


NOTES:

1. REFER TO DRAWING MA-0001 FOR GENERAL NOTES.



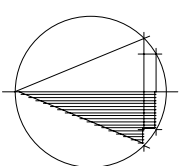
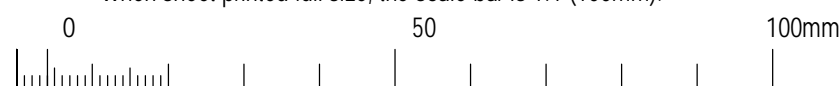
GENERAL ARRANGEMENT - WHARF EXTENSION  
SCALE 1 : 200

LEGEND:

 32 PILE NUMBER

C:\BIM\_PROJECTS\WGA22255-MD-MA-R23-0001\_Piles\_Remediation\_Rphillipsz.rvt  
18/07/2024 9:12:16 AM

When sheet printed full size, the scale bar is 1:1 (100mm).



INFORMATION ISSUE  
NOT FOR CONSTRUCTION



TELEPHONE : (08) 9159 6555  
EMAIL : [info@pilbaraports.com.au](mailto:info@pilbaraports.com.au)  
POSTAL : LOCKED BAG 5006, KARRATHA WA 6714  
WEB : [www.pilbaraports.com.au](http://www.pilbaraports.com.au)

[illegible]

**C** COPYRIGHT 2022  
PILBARA PORTS AUTHORITY

THIS DOCUMENT AND INFORMATION  
CONTAINED IN IT IS THE SOLE PROPERTY  
OF PILBARA PORTS AUTHORITY AND  
MAY NOT BE USED, EXPLOITED, COPIED,  
DUPLICATED OR REPRODUCED IN ANY  
FORM OR MEDIUM WHATEVER WITHOUT  
THE PRIOR WRITTEN PERMISSION OF  
PILBARA PORTS AUTHORITY

DO NOT ALTER MANUALLY  
DO NOT SCALE

DRAWN:	DATE:
LV	17.07.24
CHECKED:	DATE:
OK	17.07.24
APPROVED:	DATE:
SD	17.07.24

PILBARA PORTS AUTHORITY

PROJECT:  
DAMPIER CARGO WHARF  
PILE CAPACITY ASSESSMENT  
PILE SETOUT PLAN - WHARF EXTENSION

PPA DRAWING NUMBER Job Number		Sheet No.
SCALE: AS SHOWN	DWG No: <b>WGA222255-DR-MA-0023</b>	



PILE SCHEDULE																				
LOCATION	PILE No.	GRID No.	DATE INSTALLED	EASTING	NORTHING	PILE OD [mm]	PILE THICKNESS [mm]	PILE GRADE [MPa]	PILE RAKE	PILE TOP [mCD]	SEA BED LEVEL - ORIGINAL 1984/1994 [mCD]	SEA BED LEVEL - BATHY 2020 [mCD]	PILE TOE LEVEL [mCD]	TOTAL PILE LENGTH [m]	ACTUAL EMBEDMENT [m]	DEPTH TO EFFECTIVE LATERAL FIXITY [m]	MAX ULTIMATE TENSION (STRUCTURAL) [kN]	MAX ULTIMATE TENSION (GEOTECHNICAL) [kN]	MAX ULTIMATE COMPRESSION (STRUCTURAL) [kN]	MAX ULTIMATE COMPRESSION (GEOTECHNICAL) [kN]
APPROACH BRIDGE	1	C-2	1982	473877.3599	7720448.283	760	16	250	V	5.2	-	-	-	-	-	6.50	8400	900	6300	1,900
APPROACH BRIDGE	2	B-2	1982	473873.9547	7720445.853	760	16	250	V	5.2	-	-	-	-	-	8.25	8400	800	6300	1,800
APPROACH BRIDGE	3	C-3	1982	473872.7315	7720460.337	610	16	250	1:3	5.2	-3.8	-3.8	-16.2	21.40	12.35	7.75	6700	800	4600	1,600
APPROACH BRIDGE	4	B-3	1982	473864.0358	7720454.132	610	16	250	1:3	5.2	-3.9	-3.9	-14.3	19.50	10.36	5.50	6700	1,600	4300	3,300
APPROACH BRIDGE	5	C-4	1982	473866.037	7720470.916	610	16	250	1:3	5.2	-5.9	-5.9	-15.4	20.60	9.46	2.00	6700	1,700	4600	3,600
APPROACH BRIDGE	6	B-4	1982	473856.2087	7720463.903	610	16	250	1:3	5.2	-6.0	-6.0	-14.8	20.00	8.77	2.00	6700	1,600	4300	3,500
APPROACH BRIDGE	7	C-5	1982	473858.8534	7720481.146	610	16	250	1:3	5.2	-6.2	-6.2	-16.3	21.50	10.08	2.50	6700	1,400	4600	3,100
APPROACH BRIDGE	8	B-5	1982	473848.742	7720473.931	610	16	250	1:3	5.2	-6.8	-6.8	-17.2	22.40	10.41	5.25	6700	900	4300	1,900
APPROACH BRIDGE	9	C-6	1982	473851.6441	7720491.358	610	16	250	1:3	5.2	-6.4	-6.4	-18.7	23.90	12.29	5.75	6700	1,400	4600	3,100
APPROACH BRIDGE	10	B-6	1982	473841.2752	7720483.959	610	16	250	1:3	5.2	-	-7.5	-18.5	23.70	10.95	5.50	6700	1,600	4300	3,500
APPROACH BRIDGE	11	C-7	1982	473844.5892	7720501.68	610	16	250	1:3	5.2	-	-7.2	-18.9	24.10	11.73	5.00	6700	1,400	4600	2,900
APPROACH BRIDGE	12	B-7	1982	473833.7056	7720493.913	610	16	250	1:3	5.2	-	-8.7	-20	25.20	11.31	7.00	6700	1,500	4300	3,300
APPROACH BRIDGE	13	C-8	1982	473833.7951	7720509.333	610	16	250	V	5.2	-	-8.7	-20.5	25.70	11.85	6.00	6700	1,700	4600	3,600
APPROACH BRIDGE	14	B-8	1982	473830.3899	7720506.903	610	16	250	V	5.2	-	-9.1	-20.2	25.40	11.10	5.25	6700	1,100	4300	2,400
MAIN WHARF (ORIG. STRUCTURE)	15	F-10	1982	473833.1335	7720513.778	610	16	250	V	6.1	-	-8.7	-21	27.10	12.30	6.50	6700	1,700	5600	3,600
MAIN WHARF (ORIG. STRUCTURE)	16	EF-10	1982	473832.5226	7720514.64	610	16	250	1:3	6.1	-	-8.8	-20	26.10	11.21	6.75	6700	1,600	5600	3,400
MAIN WHARF (ORIG. STRUCTURE)	17	ED-10	1982	473821.3083	7720512.837	610	16	250	1:3	6.1	-	-10.1	-20.5	26.60	10.38	8.50	6700	1,000	5500	2,100
MAIN WHARF (ORIG. STRUCTURE)	18	D-10	1982	473821.1335	7720513.776	610	16	250	V	6.1	-	-10.2	-22	28.10	11.80	7.75	6700	1,400	5500	2,900
MAIN WHARF (ORIG. STRUCTURE)	19	F-11	1982	473833.1323	7720519.878	610	16	250	V	6.1	-	-8.5	-19.9	26.00	11.40	6.00	6700	1,100	5600	2,300
MAIN WHARF (ORIG. STRUCTURE)	20	EF-11	1982	473832.4281	7720520.724	610	16	250												

NOTES:

1. REFER TO DRAWING MA-0001 FOR GENERAL NOTES.

C:\BIM\_PROJECTS\WGA22255-MD-MA-R23-0001\_Piles\_Remediation\_Rphillipsz.rvt  
17/07/2024 8:15:18 AM

When sheet printed full size, the scale bar is 1:1 (100mm)

INFORMATION ISSUE  
NOT FOR CONSTRUCTION

<div>WGA</div>		<div><div><div></div><div></div><div></div></div><div>PILBARA PORTS AUTHORITY</div></div> <div>TELEPHONE : (08) 9159 6555 EMAIL : info@pilbaraports.com.au POSTAL : LOCKED BAG 5006, KARRATHA WA 6714 WEB : www.pilbaraports.com.au</div>											<div><div><div><div>C</div><div>COPYRIGHT 2022 PILBARA PORTS AUTHORITY</div></div><div>THIS DOCUMENT AND INFORMATION CONTAINED IN IT IS THE SOLE PROPERTY OF PILBARA PORTS AUTHORITY AND MAY NOT BE USED, EXPLOITED, COPIED, DUPLICATED OR REPRODUCED IN ANY FORM OR MEDIUM WHATEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF PILBARA PORTS AUTHORITY</div><div>DO NOT ALTER MANUALLY DO NOT SCALE</div><div>DRAWN: LV CHECKED: OK APPROVED: SD</div><div>DATE: 17.07.24 DATE: 17.07.24 DATE: 17.07.24</div></div></div>			<div><div><div>PILBARA PORTS AUTHORITY</div><div>A1</div></div></div>			
													017.07.24ISSUED FOR INFORMATIONRPOKJG			PPA DRAWING NUMBER Job NumberSheet No.Rev.			
WGA JOB NUMBER	WGA222255											REV. DATEDESCRIPTIONBYCHKAPPREV. DATEDESCRIPTIONREVISIONS			SCALE: AS SHOWN		DWG No: WGA222255-DR-MA-0031		REV: 0



C:\BIM\_PROJECTS\WGA22255-MD-MA-23-0001\_Piles\_Remediation\_Rp\piles.rvt  
17/07/2024 8:15:43 AM

PILE SCHEDULE																				
LOCATION	PILE No.	GRID No.	DATE INSTALLED	EASTING	NORTHING	PILE OD [mm]	PILE THICKNESS [mm]	PILE GRADE [MPa]	PILE RAKE	PILE TOP [mCD]	SEA BED LEVEL - ORIGINAL 1984/1994 [mCD]	SEA BED LEVEL - BATHY 2020 [mCD]	PILE TOE LEVEL [mCD]	TOTAL PILE LENGTH [m]	ACTUAL EMBEDMENT [m]	DEPTH TO EFFECTIVE LATERAL FIXITY [m]	MAX ULTIMATE TENSION (STRUCTURAL) [kN]	MAX ULTIMATE TENSION (GEOTECHNICAL) [kN]	MAX ULTIMATE COMPRESSION (STRUCTURAL) [kN]	MAX ULTIMATE COMPRESSION (GEOTECHNICAL) [kN]
MAIN WHARF (ORIG. STRUCTURE)	64	F-22	1982	473833.1196	7720586.978	610	16	250	V	6.1	-	-7.8	-20.9	27.00	13.10	6.25	6700	1,400	5600	3,100
MAIN WHARF (ORIG. STRUCTURE)	65	E-22	1982	473827.1196	7720586.977	610	16	250	V	6.1	-	-8.4	-21.1	27.20	12.70	6.00	6700	1,500	5500	3,100
MAIN WHARF (ORIG. STRUCTURE)	66	D-22	1982	473821.1196	7720586.976	610	16	250	V	6.1	-	-9.0	-21.6	27.70	12.60	6.75	6700	1,400	5500	3,100
MAIN WHARF (ORIG. STRUCTURE)	67	I-23	1982	473849.0184	7720593.081	610	16	250	V	6.1	-	-6.9	-19.7	25.80	12.80	6.75	6700	1,400	5800	3,000
MAIN WHARF (ORIG. STRUCTURE)	68	H-23	1982	473843.7184	7720593.081	610	16	250	V	6.1	-	-6.9	-20.4	26.50	13.50	6.25	6700	1,500	5700	3,200
MAIN WHARF (ORIG. STRUCTURE)	69	G-23	1982	473838.4184	7720593.079	610	16	250	V	6.1	-	-7.3	-20	26.10	12.70	5.25	6700	1,500	5700	3,100
MAIN WHARF (ORIG. STRUCTURE)	70	F-23	1982	473833.1184	7720593.078	610	16	250	V	6.1	-	-7.8	-20.9	27.00	13.10	5.75	6700	1,500	5600	3,100
MAIN WHARF (ORIG. STRUCTURE)	71	EF-23	1982	473832.1654	7720592.276	610	16	250	I:3	6.1	-	-7.8	-19.5	25.60	11.75	5.65	6700	1,500	5600	3,300
MAIN WHARF (ORIG. STRUCTURE)	72	ED-23	1982	473821.6666	7720593.949	610	16	250	I:3	6.1	-	-9.0	-20.4	26.50	11.42	6.00	6700	1,500	5500	3,100
MAIN WHARF (ORIG. STRUCTURE)	73	D-23	1982	473821.1184	7720593.076	610	16	250	V	6.1	-	-9.2	-20.9	27.00	11.70	6.50	6700	1,400	5500	3,100
MAIN WHARF (ORIG. STRUCTURE)	74	I-24	1982	473849.0173	7720599.181	610	16	250	V	6.1	-	-6.9	-20.4	26.50	13.50	6.68	6700	1,600	5800	3,400
MAIN WHARF (ORIG. STRUCTURE)	75	H-24	1982	473843.7173	7720599.18	610	16	250	V	6.1	-	-6.9	-20.1	26.20	13.20	5.75	6700	1,400	5700	3,000
MAIN WHARF (ORIG. STRUCTURE)	76	G-24	1982	473838.4173	7720599.179	610	16	250	V	6.1	-	-7.3	-20.8	26.90	13.50	6.20	6700	1,600	5700	3,300
MAIN WHARF (ORIG. STRUCTURE)	77	F-24	1982	473833.1173	7720599.178	610	16	250	V	6.1	-	-8.0	-20.6	26.70	12.60	6.00	6700	1,400	5600	3,000
MAIN WHARF (ORIG. STRUCTURE)	78	E-24	1982	473827.1173	7720599.177	610	16	250	V	6.1	-	-8.5	-21.2	27.30	12.70	6.75	6700	1,500	5500	3,200
MAIN WHARF (ORIG. STRUCTURE)	79	D-24	1982	473821.1173	7720599.176	610	16	250	V	6.1	-	-9.4	-20.8	26.90	11.40	5.50	6700	1,500	5500	3,200
MAIN WHARF (ORIG. STRUCTURE)	80	I-25	1982	473849.0161	7720605.281	610	16	250	V	6.1	-	-6.9	-20.7	26.80	13.80	6.25	6700	1,600	5800	3,400
MAIN WHARF (ORIG. STRUCTURE)	81	H-25	1982	473843.7161	7720605.28	610	16	250	V	6.1	-	-6.9	-20.6	26.70	13.70	6.00	6700	1,500	5700	3,200
MAIN WHARF (ORIG. STRUCTURE)	82	G-25	1982	473838.4161	7720605.279	610	16	250	V	6.1	-	-7.3	-20.9	27.00	13.60	6.50	6700	1,500	5700	3,100
MAIN WHARF (ORIG. STRUCTURE)	83	F-25	1982	473833.1161	7720605.278	610	16	250	V	6.1	-	-8.0	-20	26.10	12.00	7.95	6700	1,600	5600	3,400
MAIN WHARF (ORIG. STRUCTURE)	84	EF-25	1982	473832.1942	7720604.471	610	16	250	I:3	6.1	-	-7.8	-20.6	26.70	12.75	5.00	6700	1,600	5600	3,500
MAIN WHARF (ORIG. STRUCTURE)	85	ED-25	1982	473821.6332	7720606.155	610	16	250	I:3	6.1	-	-9.1	-20.5	26.60	11.42	4.70	6700	1,600	5500	3,400
MAIN WHARF (ORIG. STRUCTURE)	86	D-25	1982	473821.1161	7720605.276	610	16	250	V	6.1	-	-9.4	-20.8	26.90	11.40	5.45	6700	1,600	5500	3,400
MAIN WHARF (ORIG. STRUCTURE)	87	I-26	1982	473849.015	7720611.381	610	16	250	V	6.1	-	-6.9	-20.7	26.80	13.80	5.20	6700	1,700	5800	3,500
MAIN WHARF (ORIG. STRUCTURE)	88	H-26	1982	473843.715	7720611.38	610	16	250	V	6.1	-	-6.9	-20.2	26.30	13.30	5.50	6700	1,700	5700	3,500
MAIN WHARF (ORIG. STRUCTURE)	89	G-26	1982	473838.415	7720611.379	610	16	250	V	6.1	-	-7.3	-20.6	26.70	13.30	4.45	6700	1,600	5700	3,400
MAIN WHARF (ORIG. STRUCTURE)	90	F-26	1982	473833.115	7720611.378	610	16	250	V	6.1	-	-8.0	-20	26.10	12.00	5.50	6700	1,700	5600	3,500
MAIN WHARF (ORIG. STRUCTURE)	91	E-26	1982	473827.115	7720611.377	610	16	250	V	6.1	-	-8.5	-20.4	26.50	11.90	6.00	6700	1,500	5500	3,300
MAIN WHARF (ORIG. STRUCTURE)	92	D-26	1982	473821.115	7720611.376	610	16	250	V	6.1	-	-9.4	-20.6	26.70	11.20	6.00	6700	1,500	5500	3,300
MAIN WHARF (ORIG. STRUCTURE)	93	I-27	1982	473849.0138	7720617.481	610	16	250	V	6.1	-	-6.9	-20	26.10	13.10	6.00	6700	1,500	5800	3,200
MAIN WHARF (ORIG. STRUCTURE)	94	H-27	1982	473843.7138	7720617.48	610	16	250	V	6.1	-	-6.7	-19.7	25.80	13.00	4.85	6700	1,500	5700	3,200
MAIN WHARF (ORIG. STRUCTURE)	95	G-27	1982	473838.4138	7720617.479	610	16	250	V	6.1	-	-7.3	-20.2	26.30	12.90	5.25	6700	1,600	5700	3,300
MAIN WHARF (ORIG. STRUCTURE)	96	F-27	1982	473833.1138	7720617.478	610	16	250	V	6.1	-	-8.0	-20.6	26.70	12.60	6.25	6700	1,500	5600	3,200
MAIN WHARF (ORIG. STRUCTURE)	97	EF-27	1982	473832.1919	7720616.671	610	16	250	I:3	6.1	-	-7.8	-20	26.10	12.15	5.75	6700	1,600	5600	3,300
MAIN WHARF (ORIG. STRUCTURE)	98	ED-27	1982	473821.5997	7720618.36	610	16	250	I:3	6.1	-	-9.2	-20.5	26.60	11.33	7.75	6700	1,700	5500	3,600
MAIN WHARF (ORIG. STRUCTURE)	99	D-27	1982	473821.1138	7720617.476	610	16	250	V	6.1	-	-9.4	-20.4	26.50	11.00	5.25	6700	1,500	5500	3,300
MAIN WHARF (ORIG. STRUCTURE)	100	I-28	1982	473849.0126	7720623.581	610	16	250	V	6.1	-	-6.9	-20.1	26.20	13.20	5.20	6700	1,700	5800	3,500
MAIN WHARF (ORIG. STRUCTURE)	101	H-28	1982	473843.7126	7720623.58	610	16	250	V	6.1	-	-6.7	-19.9	26.00	13.20	5.25	6700	1,500	5700	3,200
MAIN WHARF (ORIG. STRUCTURE)	102	G-28	1982	473838.4127	7720623.579	610	16	250	V	6.1	-	-7.5	-20.3	26.40	12.80	5.75	6700	1,500	5700	3,300
MAIN WHARF (ORIG. STRUCTURE)	103	F-28	1982	473833.1127	7720623.578	610	16	250	V	6.1	-	-8.0	-20.3	26.40	12.30	6.00	6700	1,600	5600	3,300
MAIN WHARF (ORIG. STRUCTURE)	104	EF-28	1982	473832.315	7720624.407	610	16	250	I:3	6.1	-	-8.2	-20.4	26.50	12.17	7.50	6700	1,600	5600	3,400
MAIN WHARF (ORIG. STRUCTURE)	105	ED-28	1982	473821.5055	7720622.676	610	16	250	I:3	6.1	-	-9.5	-20.3	26.40	10.84	6.75	6700	1,500	5500	3,300
MAIN WHARF (ORIG. STRUCTURE)	106	D-28	1982	473821.1127	7720623.576	610	16	250	V	6.1	-	-9.5	-19.9	26.00	10.40	7.00	6700	1,700	5500	3,700
MOORING DOLPHIN A	107	-	1982	473824.602	7720476.821	610	16	250	I:3	6.05	-	-9.6	-18.5	24.55	8.95	5.00	6700	1,400	5600	2,900
MOORING DOLPHIN A	108	-	1982	473835.4741	7720476.894	610	16	250	I:3	6.05	-	-8.3	-18.2	24.25	9.88	5.75	6700	1,600	5600	3,300
MOORING DOLPHIN A	109	-	1982	473825.8338	7720479.865	610	16	250	I:3	6.05	-	-9.6	-19.2	25.25	9.65	5.75	6700	1,000	5600	2,200
MOORING DOLPHIN A	110	-	1982	473825.8524	7720468.682	610	16	250	I:3	6.05	-	-9.3	-18.3	24.35	9.03	4.25	6700	1,600	5600	3,400
MOORING DOLPHIN A	111	-	1982	473834.5966	7720479.587	610	16	250	I:3	6.05	-	-8.7	-19.3	25.35	10.60	5.50	6700	800	5600	1,600
MOORING DOLPHIN A	112	-	1982	473834.5876	7720468.933	610	16	250	I:3	6.05	-	-8.5	-18.6	24.65	10.09	5.25	6700	1,200	5600	2,500
MOORING DOLPHIN A	113	-	1982	473824.6652	7720471.622	610	16	250	I:3	6.05	-	-9.4	-19.1	25.15	9.74	5.00	6700	1,000	5600	2,200
MOORING DOLPHIN A	114	-	1982	473835.4751	7720471.563	610	16	250	I:3	6.05	-	-8.3	-18.6	24.65	10.28	5.50	6700	1,300	5600	2,800
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	115	-	1982	473823.0128	7720668.719	610	16	250	I:3	6.05	-	-9.2	-20.6	26.65	11.43	7.65	6700	1,800	5700	3,900
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	116	-	1982	473833.8222	7720668.722	610	16	250	I:3	6.05	-	-8.1	-20.5	26.55	12.45	7.45	6700	1,600	5700	3,500
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	117	-	1982	473821.6037	7720671.032	610	16	250	I:3	6.05	-	-9.8	-21	27.05	11.16	6.65	6700	1,700	5700	3,500
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	118	-	1982	473821.6059	7720659.375	610	16	250	I:3	6.05	-	-9.9	-20.6	26.65	10.67	6.75	6700	1,500	5700	3,300
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	119	-	1982	473835.6038	7720670.434	610	16	250	I:3	6.05	-	-8.0	-20.45	26.50	12.41	6.95	6700	1,600	5700	3,500
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	120	-	1982	473835.6057	7720660.01	610	16	250	I:3	6.05	-	-8.0	-20.55	26.60	12.51	6.40	6700	1,800	5700	3,800
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	121	-	1982	473823.0458	7720661.719	610	16	250	I:3	6.05	-	-9.1	-20.55	26.60	11.47	6.50	6700	1,600	5700	3,300
EXT. MD STRONG POINT (ORIGINAL BREASTING DOLPHIN)	122	-	1982	473833.7919	7720661.722	610	16	250	I:3	6.05	-	-8.0								



C:\BIM\PROJECTS\WGA222255-DR-MA-R23-0001\_Piles\_Remediation\_Rpt\piles.rvt  
17/07/2024 8:16:25 AM

PILE SCHEDULE																				
LOCATION	PILE No.	GRID No.	DATE INSTALLED	EASTING	NORTHING	PILE OD [mm]	PILE THICKNESS [mm]	PILE GRADE [MPa]	PILE RAKE	PILE TOP [mCD]	SEA BED LEVEL - ORIGINAL 1984/1994 [mCD]	SEA BED LEVEL - BATHY 2020 [mCD]	PILE TOE LEVEL [mCD]	TOTAL PILE LENGTH [m]	ACTUAL EMBEDMENT [m]	DEPTH TO EFFECTIVE LATERAL FIXITY [m]	MAX ULTIMATE TENSION (STRUCTURAL) [kN]	MAX ULTIMATE TENSION (GEOTECHNICAL) [kN]	MAX ULTIMATE COMPRESSION (STRUCTURAL) [kN]	MAX ULTIMATE COMPRESSION (GEOTECHNICAL) [kN]
MOORING DOLPHIN B	127	-	1982	473832.9223	7720755.455	610	16	250	1:3	6.05	-	-8.3	-21.2	27.25	12.88	7.35	6700	1,300	5700	2,800
MOORING DOLPHIN B	128	-	1982	473832.8913	7720745.175	610	16	250	1:3	6.05	-	-7.8	-20.55	26.60	12.80	6.72	6700	1,600	5700	3,300
MOORING DOLPHIN B	129	-	1982	473823.1998	7720747.582	610	16	250	1:3	6.05	-	-8.8	-21.9	27.95	13.11	8.25	6700	1,500	5700	3,200
MOORING DOLPHIN B	130	-	1982	473833.5114	7720747.501	610	16	250	1:3	6.05	-	-7.4	-21.6	27.65	14.23	7.50	6700	1,500	5700	3,200
REMOVED DURING 1994 EXTENSIONS	131	-	1982	-	-	610	16	250	-	-	-	-	-20.4	-	-	6.20	-	-	-	-
REMOVED DURING 1994 EXTENSIONS	132	-	1982	-	-	610	16	250	-	-	-	-	-20.7	-	-	8.10	-	-	-	-
REMOVED DURING 1994 EXTENSIONS	133	-	1982	-	-	610	16	250	-	-	-	-	-20.33	-	-	6.00	-	-	-	-
REMOVED DURING 1994 EXTENSIONS	134	-	1982	-	-	610	16	250	-	-	-	-	-20.6	-	-	6.45	-	-	-	-
REMOVED DURING 1994 EXTENSIONS	135	-	1982	-	-	610	16	250	-	-	-	-	-20.6	-	-	7.70	-	-	-	-
REMOVED DURING 1994 EXTENSIONS	136	-	1982	-	-	610	16	250	-	-	-	-	-21.3	-	-	7.25	-	-	-	-
DOLPHIN ACCESS	137	-	1982	473833.9675	7720726.422	610	16	250	-	-	-	-8.5	-20.4	-	11.89	7.25	6700	1,000	5600	2,100
DOLPHIN ACCESS	138	-	1982	473822.871	7720726.419	610	16	250	-	-	-	-9.6	-21.5	-	11.95	7.10	6700	1,500	5600	3,200
APPROACH BRIDGE 1994 WIDENING	139	A-2	1994	473871.6687	7720444.222	610	9.5	350	V	5.2	-7.7	2.0	-20.07	25.27	12.34	8.00	6700	1,000	4500	2,100
APPROACH BRIDGE 1994 WIDENING	140	A-3	1994	473863.8352	7720455.2	610	9.5	350	1:10	5.2	-7.2	-3.9	-14.48	19.68	7.28	5.70	6700	1,200	4500	2,600
APPROACH BRIDGE 1994 WIDENING	141	A-4	1994	473856.453	7720465.545	610	9.5	350	1:10	5.2	-7.0	-6.0	-14.73	19.93	7.78	-	6700	1,100	4500	2,300
APPROACH BRIDGE 1994 WIDENING	142	A-5	1994	473849.1517	7720475.777	610	9.5	350	1:10	5.2	-7.2	-6.7	-17.8	23.00	10.60	3.00	6700	1,100	4500	2,300
APPROACH BRIDGE 1994 WIDENING	143	A-6	1994	473841.8447	7720486.016	610	9.5	350	1:10	5.2	-7.7	-7.5	-18.3	23.50	10.60	3.57	6700	1,500	3700	3,200
APPROACH BRIDGE 1994 WIDENING	144	A-7	1994	473834.5203	7720496.28	610	9.5	350	1:10	5.2	-9.7	-8.6	-19.9	25.10	10.20	3.95	6700	900	3700	1,900
APPROACH BRIDGE 1994 WIDENING	145	A-8	1994	473828.1039	7720505.272	610	9.5	350	V	5.2	-10.5	-9.3	-19.15	24.35	8.70	4.40	6700	1,400	3700	2,900
APPROACH BRIDGE 1994 WIDENING	146	AB-9	1994	473824.5178	7720511.804	457	9.5	350	V	5.2	-10.7	-9.9	-21.8	27.00	11.10	5.60	4200	1,000	1200	2,100
APPROACH BRIDGE 1994 WIDENING	147	A-9	1994	473823.3985	7720511.005	457	9.5	350	V	5.2	-10.7	-9.9	-21.1	26.30	10.40	5.90	4200	1,000	1200	2,000
MAIN WHARF 1994 EXTENSIONS	148	O-29	1994	473850.0622	7720625.852	610	9.5	350	V	5.875	-6.3	-7.0	-19.2	25.08	12.90	5.63	5600	1,300	4300	2,800
MAIN WHARF 1994 EXTENSIONS	149	N-29	1994	473844.4362	7720625.851	610	9.5	350	V	5.875	-6.6	-7.2	-18.85	24.73	12.25	5.50	5600	800	4300	1,700
MAIN WHARF 1994 EXTENSIONS	150	M-29	1994	473838.2272	7720625.849	610	9.5	350	V	5.875	-8.1	-7.7	-18.9	24.78	10.80	4.85	5600	1,300	4200	2,700
MAIN WHARF 1994 EXTENSIONS	151	L-29	1994	473832.0182	7720625.848	610	9.5	350	V	5.875	-9.5	-8.3	-19.4	25.28	9.90	5.85	5600	600	4200	1,300
MAIN WHARF 1994 EXTENSIONS	152	K-29	1994	473825.8092	7720625.847	610	9.5	350	V	5.875	-10.1	-9.0	-19.1	24.98	9.00	5.00	5600	600	4100	1,300
MAIN WHARF 1994 EXTENSIONS	153	J-29	1994	473820.5122	7720625.846	610	9.5	350	V	5.875	-10.1	-9.8	-19.95	25.83	9.85	4.85	5600	700	4000	1,600
MAIN WHARF 1994 EXTENSIONS	154	O-30	1994	473850.0612	7720631.364	610	9.5	350	V	5.875	-7.1	-7.0	-19.7	25.58	12.60	5.26	5600	1,700	4300	3,500
MAIN WHARF 1994 EXTENSIONS	155	N-30	1994	473844.4352	7720631.363	610	9.5	350	V	5.875	-7.4	-7.2	-19.8	25.68	12.40	5.20	5600	900	4300	2,000
MAIN WHARF 1994 EXTENSIONS	156	M-30	1994	473838.2262	7720631.361	610	9.5	350	V	5.875	-8.1	-7.7	-20.1	25.98	12.00	6.00	5600	900	4200	1,900
MAIN WHARF 1994 EXTENSIONS	157	L-30	1994	473832.0172	7720631.36	610	9.5	350	V	5.875	-9.6	-8.3	-19.9	25.78	10.30	5.27	5600	1,400	4200	2,900
MAIN WHARF 1994 EXTENSIONS	158	K-30	1994	473825.8082	7720631.359	610	9.5	350	V	5.875	-10.1	-9.0	-20.2	26.08	10.10	5.60	5600	1,200	4100	2,600
MAIN WHARF 1994 EXTENSIONS	159	J-30	1994	473820.5112	7720631.358	610	9.5	350	V	5.875	-10.1	-9.8	-19.9	25.78	9.80	5.27	5600	1,400	4000	2,900
MAIN WHARF 1994 EXTENSIONS	160	O-31	1994	473850.06	7720637.439	610	9.5	350	V	5.875	-7.3	-7.0	-19.85	25.73	12.55	5.50	5600	800	4300	1,800
MAIN WHARF 1994 EXTENSIONS	161	N-31	1994	473844.434	7720637.438	610	9.5	350	V	5.875	-7.3	-7.2	-20.1	25.98	12.80	5.25	5600	1,000	4300	2,100
MAIN WHARF 1994 EXTENSIONS	162	M-31	1994	473838.225	7720637.436	610	9.5	350	V	5.875	-8.1	-7.6	-20.15	26.03	12.05	5.80	5600	1,400	4200	2,900
MAIN WHARF 1994 EXTENSIONS	163	L-31	1994	473832.016	7720637.435	610	9.5	350	V	5.875	-10.2	-8.3	-20.75	26.63	10.55	5.05	5600	1,500	4200	3,100
MAIN WHARF 1994 EXTENSIONS	164	K-31	1994	473825.807	7720637.434	610	9.5	350	V	5.875	-10.9	-9.1	-21.05	26.93	10.15	5.05	5600	1,400	4100	3,000
MAIN WHARF 1994 EXTENSIONS	165	J-31	1994	473820.51	7720637.433	610	9.5	350	V	5.875	-10.4	-9.9	-19.85	25.73	9.45	5.25	5600	1,000	4000	2,100
MAIN WHARF 1994 EXTENSIONS	166	O-32	1994	473850.0589	7720643.514	610	9.5	350	V	5.875	-6.6	-7.0	-19.75	25.63	13.15	5.13	5600	1,000	4300	2,200
MAIN WHARF 1994 EXTENSIONS	167	N-32	1994	473844.4329	7720643.513	610	9.5	350	V	5.875	-7.4	-7.2	-19.95	25.83	12.60	5.76	5600	1,700	4300	3,500
MAIN WHARF 1994 EXTENSIONS	168	M-32	1994	473838.2239	7720643.511	610	9.5	350	V	5.875	-7.6	-7.6	-19.85	25.73	12.25	5.50	5600	900	4200	1,900
MAIN WHARF 1994 EXTENSIONS	169	L-32	1994	473832.0149	7720643.51	610	9.5	350	V	5.875	-8.1	-8.2	-19.6	25.48	11.50	5.50	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	170	K-32	1994	473825.8059	7720643.509	610	9.5	350	V	5.875	-10.1	-9.1	-20	25.88	9.90	5.30	5600	900	4100	1,800
MAIN WHARF 1994 EXTENSIONS	171	J-32	1994	473820.5089	7720643.508	610	9.5	350	V	5.875	-10.6	-9.9	-19.95	25.83	9.35	5.13	5600	800	4000	1,800
MAIN WHARF 1994 EXTENSIONS	172	O-33	1994	473850.0577	7720649.589	610	9.5	350	V	5.875	-6.6	-7.1	-19.7	25.58	13.10	5.60	5600	1,100	4300	2,400
MAIN WHARF 1994 EXTENSIONS	173	N-33	1994	473844.4317	7720649.588	610	9.5	350	V	5.875	-7.1	-7.2	-19.75	25.63	12.65	5.43	5600	900	4300	1,900
MAIN WHARF 1994 EXTENSIONS	174	M-33	1994	473838.2227	7720649.586	610	9.5	350	V	5.875	-8.1	-7.6	-19.8	25.68	11.70	5.45	5600	1,000	4200	2,200
MAIN WHARF 1994 EXTENSIONS	175	L-33	1994	473832.0137	7720649.585	610	9.5	350	V	5.875	-8.9	-8.2	-19.75	25.63	10.90	4.68	5600	800	4200	1,800
MAIN WHARF 1994 EXTENSIONS	176	K-33	1994	473825.8047	7720649.584	610	9.5	350	V	5.875	-9.6	-9.0	-19.85	25.73	10.25	5.00	5600	800	4100	1,700
MAIN WHARF 1994 EXTENSIONS	177	J-33	1994	473820.5077	7720649.583	610	9.5	350	V	5.875	-10.6	-9.9	-20.1	25.98	9.50	5.00	5600	900	4000	1,800
MAIN WHARF 1994 EXTENSIONS	178	O-34	1994	473850.0566	7720655.664	610	9.5	350	V	5.875	-6.6	-7.2	-20.05	25.93	13.45	5.55	5600	1,700	4300	3,500
MAIN WHARF 1994 EXTENSIONS	179	N-34	1994	473844.4306	7720655.663	610	9.5	350	V	5.875	-7.3	-7.2	-19.85	25.73	12.55	5.75	5600	1,000	4300	2,100
MAIN WHARF 1994 EXTENSIONS	180	M-34	1994	473838.2216	7720655.661	610	9.5	350	V	5.875	-8.1	-7.7	-19.8	25.68	11.70	4.95	5600	1,100	4200	2,400
MAIN WHARF 1994 EXTENSIONS	181	L-34	1994	473832.0126	7720655.66	610	9.5	350	V	5.875	-10.1	-8.2	-20.1	25.98	10.00	4.25	5600	1,000	4200	2,100
MAIN WHARF 1994 EXTENSIONS	182	K-34	1994	473825.8036	7720655.659	610	9.5	350	V	5.875	-10.1	-9.0	-20.15	26.03	10.05	4.00	5600	800	4100	1,800
MAIN WHARF 1994 EXTENSIONS	183	J-34	1994	473820.5066	7720655.658	610	9.5	350	V	5.875	-11.1	-9.9	-20.2	26.08	9.10	4.35	5600	1,100	4000	2,400
MAIN WHARF 1994 EXTENSIONS	184	O-35	1994	473850.0554	7720661.725	610	9.5	350	V	5.875	-6.6	-7.2	-19.75	25.63	13.15	5.65	5600	800	4300	1,700
MAIN WHARF 1994 EXTENSIONS	185	N-35	1994	473844.4294	7720661.724	610	9.5	350	V	5.875	-7.6	-7.3	-19.9	25.78	12.30	5.55	5600	1		



C:\BIM\PROJECTS\WGA222255-DR-MA-R23-0001\_Piles\_Remediation\_Rp\piles.rvt  
17/07/2024 8:16:40 AM

PILE SCHEDULE																				
LOCATION	PILE No.	GRID No.	DATE INSTALLED	EASTING	NORTHING	PILE OD [mm]	PILE THICKNESS [mm]	PILE GRADE [MPa]	PILE RAKE	PILE TOP [mCD]	SEA BED LEVEL - ORIGINAL 1984/1994 [mCD]	SEA BED LEVEL - BATHY 2020 [mCD]	PILE TOE LEVEL [mCD]	TOTAL PILE LENGTH [m]	ACTUAL EMBEDMENT [m]	DEPTH TO EFFECTIVE LATERAL FIXITY [m]	MAX ULTIMATE TENSION (STRUCTURAL) [kN]	MAX ULTIMATE TENSION (GEOTECHNICAL) [kN]	MAX ULTIMATE COMPRESSION (STRUCTURAL) [kN]	MAX ULTIMATE COMPRESSION (GEOTECHNICAL) [kN]
MAIN WHARF 1994 EXTENSIONS	190	O-37	1994	473850.0531	7720673.889	610	9.5	350	V	5.875	-6.8	-7.2	-19.8	25.68	13.00	5.20	5600	1,000	4300	2,200
MAIN WHARF 1994 EXTENSIONS	191	N-37	1994	473844.4271	7720673.888	610	9.5	350	V	5.875	-7.1	-7.3	-20.05	25.93	12.95	5.20	5600	800	4300	1,700
MAIN WHARF 1994 EXTENSIONS	192	M-37	1994	473838.2181	7720673.886	610	9.5	350	V	5.875	-8.3	-7.8	-19.85	25.73	11.55	5.00	5600	900	4200	1,800
MAIN WHARF 1994 EXTENSIONS	193	L-37	1994	473832.0091	7720673.885	610	9.5	350	V	5.875	-9.1	-8.4	-20	25.88	10.90	5.40	5600	1,200	4200	2,600
MAIN WHARF 1994 EXTENSIONS	194	K-37	1994	473825.8001	7720673.884	610	9.5	350	V	5.875	-9.6	-8.9	-20.225	26.10	10.63	5.13	5600	1,200	4100	2,600
MAIN WHARF 1994 EXTENSIONS	195	J-37	1994	473820.5031	7720673.883	610	9.5	350	V	5.875	-10.3	-9.8	-20.475	26.35	10.18	6.13	5600	1,300	4000	2,800
MAIN WHARF 1994 EXTENSIONS	196	O-38	1994	473850.052	7720679.964	610	9.5	350	V	5.875	-7.1	-7.1	-19.975	25.85	12.88	5.88	5600	1,100	4300	2,300
MAIN WHARF 1994 EXTENSIONS	197	N-38	1994	473844.426	7720679.963	610	9.5	350	V	5.875	-7.1	-7.3	-19.925	25.80	12.83	4.08	5600	1,600	4300	3,300
MAIN WHARF 1994 EXTENSIONS	198	M-38	1994	473838.217	7720679.961	610	9.5	350	V	5.875	-8.1	-7.7	-20.25	26.13	12.15	5.15	5600	1,400	4200	2,900
MAIN WHARF 1994 EXTENSIONS	199	L-38	1994	473832.008	7720679.96	610	9.5	350	V	5.875	-9.6	-8.4	-20.275	26.15	10.68	5.68	5600	1,000	4200	2,100
MAIN WHARF 1994 EXTENSIONS	200	K-38	1994	473825.799	7720679.959	610	9.5	350	V	5.875	-9.3	-8.9	-20.2	26.08	10.90	5.10	5600	1,100	4100	2,300
MAIN WHARF 1994 EXTENSIONS	201	J-38	1994	473820.502	7720679.958	610	9.5	350	V	5.875	-9.6	-9.8	-20.13	26.01	10.53	4.78	5600	1,400	4000	3,000
MAIN WHARF 1994 EXTENSIONS	202	O-39	1994	473850.0508	7720686.039	610	9.5	350	V	5.875	-7.1	-7.1	-20.1	25.98	13.00	6.00	5600	1,100	4300	2,300
MAIN WHARF 1994 EXTENSIONS	203	N-39	1994	473844.4248	7720686.038	610	9.5	350	V	5.875	-7.3	-7.3	-20.13	26.01	12.83	5.50	5600	1,400	4300	3,000
MAIN WHARF 1994 EXTENSIONS	204	M-39	1994	473838.2158	7720686.036	610	9.5	350	V	5.875	-8.1	-7.7	-20.37	26.25	12.27	5.80	5600	1,500	4200	3,200
MAIN WHARF 1994 EXTENSIONS	205	L-39	1994	473832.0068	7720686.035	610	9.5	350	V	5.875	-8.6	-8.3	-20.05	25.93	11.45	5.20	5600	800	4200	1,800
MAIN WHARF 1994 EXTENSIONS	206	K-39	1994	473825.7978	7720686.034	610	9.5	350	V	5.875	-9.3	-8.9	-20.5	26.38	11.20	5.45	5600	1,100	4100	2,300
MAIN WHARF 1994 EXTENSIONS	207	J-39	1994	473820.5008	7720686.033	610	9.5	350	V	5.875	-9.8	-9.8	-19.5	25.38	9.70	5.65	5600	1,200	4000	2,600
MAIN WHARF 1994 EXTENSIONS	208	O-40	1994	473850.0497	7720692.114	610	9.5	350	V	5.875	-7.1	-6.6	-19.975	25.85	12.88	5.60	5600	1,100	4300	2,400
MAIN WHARF 1994 EXTENSIONS	209	N-40	1994	473844.4237	7720692.113	610	9.5	350	V	5.875	-7.1	-7.4	-19.88	25.76	12.78	4.80	5600	1,600	4300	3,400
MAIN WHARF 1994 EXTENSIONS	210	M-40	1994	473838.2147	7720692.111	610	9.5	350	V	5.875	-8.1	-7.7	-20.225	26.10	12.13	5.88	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	211	L-40	1994	473832.0057	7720692.11	610	9.5	350	V	5.875	-8.6	-8.3	-20.275	26.15	11.68	5.40	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	212	K-40	1994	473825.7967	7720692.109	610	9.5	350	V	5.875	-9.3	-8.9	-20.4	26.28	11.10	5.00	5600	1,200	4100	2,600
MAIN WHARF 1994 EXTENSIONS	213	J-40	1994	473820.4997	7720692.108	610	9.5	350	V	5.875	-9.3	-9.8	-20.38	26.26	11.08	5.50	5600	1,400	4000	3,000
MAIN WHARF 1994 EXTENSIONS	214	O-41	1994	473850.0485	7720698.189	610	9.5	350	V	5.875	-6.9	-7.1	-20.25	26.13	13.35	5.60	5600	1,400	4300	2,900
MAIN WHARF 1994 EXTENSIONS	215	N-41	1994	473844.4225	7720698.188	610	9.5	350	V	5.875	-7.1	-7.4	-20.2	26.08	13.10	6.10	5600	1,100	4300	2,300
MAIN WHARF 1994 EXTENSIONS	216	M-41	1994	473838.2135	7720698.186	610	9.5	350	V	5.875	-8.1	-7.7	-20.225	26.10	12.13	5.88	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	217	L-41	1994	473832.0045	7720698.185	610	9.5	350	V	5.875	-8.6	-8.3	-20.225	26.10	11.63	5.60	5600	1,100	4200	2,400
MAIN WHARF 1994 EXTENSIONS	218	K-41	1994	473825.7955	7720698.184	610	9.5	350	V	5.875	-9.3	-8.9	-20.25	26.13	10.95	5.10	5600	1,200	4100	2,500
MAIN WHARF 1994 EXTENSIONS	219	J-41	1994	473820.4985	7720698.183	610	9.5	350	V	5.875	-9.9	-9.8	-20.525	26.40	10.63	5.10	5600	900	4000	1,800
MAIN WHARF 1994 EXTENSIONS	220	O-42	1994	473850.0474	7720704.264	610	9.5	350	V	5.875	-7.3	-7.3	-19.975	25.85	12.68	5.30	5600	1,100	4300	2,400
MAIN WHARF 1994 EXTENSIONS	221	N-42	1994	473844.4214	7720704.263	610	9.5	350	V	5.875	-7.3	-7.4	-19.95	25.83	12.65	4.80	5600	1,200	4300	2,600
MAIN WHARF 1994 EXTENSIONS	222	M-42	1994	473838.2124	7720704.261	610	9.5	350	V	5.875	-8.3	-7.7	-20.41	26.29	12.11	6.00	5600	1,100	4200	2,300
MAIN WHARF 1994 EXTENSIONS	223	L-42	1994	473832.0034	7720704.26	610	9.5	350	V	5.875	-9.1	-8.4	-20.6	26.48	11.50	5.50	5600	900	4200	1,900
MAIN WHARF 1994 EXTENSIONS	224	K-42	1994	473825.7944	7720704.259	610	9.5	350	V	5.875	-9.3	-8.9	-20.45	26.33	11.15	5.60	5600	1,000	4100	2,100
MAIN WHARF 1994 EXTENSIONS	225	J-42	1994	473820.4974	7720704.258	610	9.5	350	V	5.875	-9.8	-9.7	-20.6	26.48	10.80	5.20	5600	800	4000	1,800
MAIN WHARF 1994 EXTENSIONS	226	O-43	1994	473850.0462	7720710.339	610	9.5	350	V	5.875	-6.8	-7.4	-20.2	26.08	13.40	5.30	5600	1,200	4300	2,500
MAIN WHARF 1994 EXTENSIONS	227	N-43	1994	473844.4202	7720710.338	610	9.5	350	V	5.875	-7.1	-7.5	-20.12	26.00	13.02	5.70	5600	1,600	4300	3,400
MAIN WHARF 1994 EXTENSIONS	228	M-43	1994	473838.2112	7720710.336	610	9.5	350	V	5.875	-8.6	-7.8	-20.55	26.43	11.95	5.90	5600	1,200	4200	2,600
MAIN WHARF 1994 EXTENSIONS	229	L-43	1994	473832.0022	7720710.335	610	9.5	350	V	5.875	-8.6	-8.4	-20.725	26.60	12.13	5.80	5600	800	4200	1,800
MAIN WHARF 1994 EXTENSIONS	230	K-43	1994	473825.7932	7720710.334	610	9.5	350	V	5.875	-9.6	-9.0	-20.55	26.43	10.95	5.70	5600	900	4100	1,900
MAIN WHARF 1994 EXTENSIONS	231	J-43	1994	473820.4962	7720710.333	610	9.5	350	V	5.875	-10.1	-9.6	-20.525	26.40	10.43	5.60	5600	1,000	4000	2,200
MAIN WHARF 1994 EXTENSIONS	232	O-44	1994	473850.0451	7720716.414	610	9.5	350	V	5.875	-6.6	-7.6	-20.25	26.13	13.65	5.60	5600	1,100	4300	2,400
MAIN WHARF 1994 EXTENSIONS	233	N-44	1994	473844.4191	7720716.413	610	9.5	350	V	5.875	-7.1	-7.8	-20.365	26.24	13.27	5.70	5600	1,800	4300	3,700
MAIN WHARF 1994 EXTENSIONS	234	M-44	1994	473838.2101	7720716.411	610	9.5	350	V	5.875	-8.1	-8.0	-20.725	26.60	12.63	6.30	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	235	L-44	1994	473832.0011	7720716.41	610	9.5	350	V	5.875	-8.8	-8.6	-20.475	26.35	11.68	5.30	5600	900	4200	2,000
MAIN WHARF 1994 EXTENSIONS	236	K-44	1994	473825.7921	7720716.409	610	9.5	350	V	5.875	-9.6	-9.2	-17.375	23.25	7.78	5.50	5600	1,600	4100	3,400
MAIN WHARF 1994 EXTENSIONS	237	J-44	1994	473820.4951	7720716.408	610	9.5	350	V	5.875	-9.8	-9.8	-20.89	26.77	11.09	5.70	5600	500	4000	1,200
MAIN WHARF 1994 EXTENSIONS	238	O-45	1994	473850.044	7720721.926	610	9.5	350	V	5.875	-6.8	-7.6	-20.025	25.90	13.23	5.90	5600	900	4300	2,000
MAIN WHARF 1994 EXTENSIONS	239	N-45	1994	473844.418	7720721.925	610	9.5	350	V	5.875	-7.1	-7.8	-20.25	26.13	13.15	6.40	5600	1,200	4300	2,600
MAIN WHARF 1994 EXTENSIONS	240	M-45	1994	473838.209	7720721.923	610	9.5	350	V	5.875	-8.1	-8.2	-22.1	27.98	14.00	7.70	5600	300	4200	800
MAIN WHARF 1994 EXTENSIONS	241	L-45	1994	473832	7720721.922	610	9.5	350	V	5.875	-8.6	-8.6	-20.3	26.18	11.70	5.40	5600	1,100	4200	2,300
MAIN WHARF 1994 EXTENSIONS	242	K-45	1994	473825.791	7720721.921	610	9.5	350	V	5.875	-9.3	-9.2	-20.225	26.10	10.93	5.30	5600	1,000	4100	2,200
MAIN WHARF 1994 EXTENSIONS	243	J-45	1994	473820.494	7720721.92	610	9.5	350	V	5.875	-9.8	-9.9	-20.63	26.51	10.83	5.70	5600	1,500	4000	3,100
SMALL BOAT LANDING	244	-	1994	0	0	610	9.5	350	V	7.1	-9.1	-7.5	-18.35	25.45	9.25	4.00	5600	300	700	700
SMALL BOAT LANDING	245	-	1994	0	0	610	9.5	350	V	7.1	-8.1	-7.5	-18.85	25.95	10.75	5.20	5600	200	700	500
SMALL BOAT LANDING	246	-	1994	0	0	610	9.5	350	V	7.1	-10.1	-7.5	-18.1	25.20	8.00	5.20	5600	500	700	1,100
SMALL BO																				

## APPENDIX B

# PILE DATA TABLE







PILE INFORMATION

Pile Information														BHP Report 1983										Driving Records 1994				Strong Point Drawings 2006								
Location	Pile No.	Grid No.	Date Installed	Easting	Northing	Pile OD (mm)	Pile Thickness (mm)	Pile Grade	Pile Rate	Top of Pile (mCD)	Pile Sea Bed Level (Original) (mCD)	Pile Sea Bed Level (Survey 2020) (mCD)	Pile Top Level LAT (mCD)	Total Pile Length (m)	Actual Embedment (m)	Depth to Effective Lateral Fifty (m)	Max Ultimate Tension Structural (kN)	Max Ultimate Tension Geotechnical (kN)	Max Ultimate Tension Geotechnical (kN)	Max Ultimate Compression Structural (kN)	Max Ultimate Compression Geotechnical (kN)	Max Ultimate Compression Geotechnical (kN)	Pile Lateral Capacity (Single) (kN)	Total Blows	Final Set (mm/blows)	Hammer Efficiency (%)	Design Tensile Load (kN)	Indicated Pile Capacity Factor of Safety	Pile Driving Record 1994 Grid Ref.	Final Set (mm/blows)	Max Ultimate Compression - Geotechnical (kN)	Max Ultimate Tension - Geotechnical (kN)				
Approach Bridge	1	C-2	1982	473873.9547	7720445.853	760	16	250	V	5.20	-	-	-	-	-	8.25	8400	800	874	6300	1800	1821	246	6.1	273	1570	8.5	-	-	-	-	-	760mm dia. Piles driven by 052-12 hammer.			
Approach Bridge	2	B-2	1982	473872.7315	7720460.337	610	16	250	1.3	5.20	-3.85	-3.85	-16.20	21.40	12.35	7.75	6700	800	805	4600	1600	1677	476	8.0	-	293	2000	6.8	-	-	-	-	-	-		
Approach Bridge	3	C-3	1982	473864.0359	7720454.132	610	16	250	1.3	5.20	-3.94	-3.94	-14.30	19.50	10.36	5.55	6700	1600	1613	3300	3360	3360	368	2.0	325	1400	4.3	-	-	-	-	-	-	-		
Approach Bridge	4	B-4	1982	473866.037	7720470.916	610	16	250	1.3	5.20	-5.94	-5.94	-15.40	20.80	9.46	2.00	6700	1700	1760	4600	3600	3667	258	1.4	100	292	7.00	2.4	-	-	-	-	-	-		
Approach Bridge	5	C-4	1982	473856.2087	7720483.903	610	16	250	1.3	5.20	-6.03	-6.03	-14.80	20.00	8.77	2.00	6700	1600	1699	4300	3500	3540	280	1.7	90	316	7.00	2.2	-	-	-	-	-	-	Pile Anchor	
Approach Bridge	6	B-5	1982	473858.8534	7720481.146	610	16	250	1.3	5.20	-6.22	-6.22	-16.30	21.50	10.58	2.50	6700	1400	1495	4800	3400	3411	279	2.4	80	291	8.00	2.8	-	-	-	-	-	-	Pile Anchor	
Approach Bridge	7	C-5	1982	473848.742	7720473.931	610	16	250	1.3	5.20	-6.79	-6.79	-17.20	22.40	10.41	5.25	6700	900	946	4300	1900	1972	337	6.1	80	358	1320	3.7	-	-	-	-	-	-	-	
Approach Bridge	8	B-6	1982	473851.8441	7720481.358	610	16	250	1.3	5.20	-6.41	-6.41	-18.70	23.90	12.29	5.75	6700	1400	1496	4600	3100	3117	649	2.4	87	337	1470	4.4	-	-	-	-	-	-	-	
Approach Bridge	9	C-6	1982	473841.2752	7720483.959	610	16	250	1.3	5.20	-7.55	-7.55	-18.50	23.10	10.55	5.50	6700	1600	1695	4300	3500	3531	349	1.6	90	362	1400	3.9	-	-	-	-	-	-	-	
Approach Bridge	10	B-7	1982	473833.7056	7720493.613	610	16	250	1.3	5.20	-	-	-8.69	-20.00	25.20	11.31	7.00	6700	1500	1590	4300	3300	3312	477	1.9	90	364	1845	5.1	-	-	-	-	-	-	-
Approach Bridge	11	C-8	1982	473833.7611	7720503.333	610	16	250	V	5.20	-	-	-8.65	-20.50	25.10	11.85	6.00	6700	1700	1773	4600	3000	3063	228	1.3	80	248	1340	6.2	-	-	-	-	-	-	-
Approach Bridge	12	B-8	1982	473830.3899	7720506.903	610	16	250	V	5.20	-	-	-9.10	-20.20	25.40	11.10	5.25	6700	1100	1169	4300	2400	2436	285	4.2	80	264	1320	5.0	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	15	F-10	1982	473833.1335	7720513.778	610	16	250	V	6.10	-	-	-8.70	-21.00	27.10	12.30	6.50	6700	1700	1737	5600	3600	3619	291	1.4	84	72	1695	23.5	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	16	ED-10	1982	473832.5226	7720514.84	610	16	250	1.3	6.10	-	-	-8.79	-20.00	26.10	11.21	6.75	6700	1600	1637	5600	3400	3411	314	1.8	80	77	1770	23.0	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	17	ED-10	1982	473821.3063	7720512.837	610	16	250	1.3	6.10	-	-	-10.12	-20.50	26.80	10.38	8.50	6700	1000	1043	5500	2100	2173	415	5.2	84	329	2000	6.1	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	18	D-10	1982	473821.1335	7720513.776	610	16	250	V	6.10	-	-	-10.20	-22.00	28.10	11.80	7.75	6700	1400	1403	5500	2900	2923	409	2.8	80	0	1770	-	-	-	-	-	-	-	
Man Wharf (Org. Structure)	19	F-11	1982	473833.1323	7720519.878	610	16	250	V	6.10	-	-	-8.50	-19.90	26.00	11.40	6.00	6700	1100	1139	5600	3200	3274	293	4.5	87	98	1540	15.7	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	20	EF-11	1982	473832.4281	7720520.724	610	16	250	1.3	6.10	-	-	-8.51	-19.80	25.90	11.29	6.25	6700	1400	1476	5600	3000	3075	282	2.5	87	90	1620	18.0	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	21	ED-11	1982	473821.3694	7720518.948	610	16	250	1.3	6.10	-	-	-9.93	-19.30	25.40	9.37	6.00	6700	1100	1188	5500	2400	2475	377	4.2	80	304	1540	5.1	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	22	D-11	1982	473821.1323	7720519.878	610	16	250	V	6.10	-	-	-10.00	-21.10	27.40	11.30	6.50	6700	1200	1262	5500	3000	3068	367	3.8	80	106	1695	16.6	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	23	F-12	1982	473833.1311	7720525.978	610	16	250	V	6.10	-	-	-8.40	-19.90	26.00	11.50	6.00	6700	1600	1637	5600	3400	3411	275	1.8	80	106	1540	14.5	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	24	E-12	1982	473827.1311	7720525.977	610	16	250	V	6.10	-	-	-8.00	-21.20	27.30	12.20	5.50	6700	1400	1403	5500	2900	2923	367	2.6	87	153	1400	9.2	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	25	D-12	1982	473821.1311	7720525.978	610	16	250	V	6.10	-	-	-8.00	-21.20	27.30	12.20	5.50	6700	1300	1370	5500	2800	2855	311	3.1	80	0	1320	-	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	26	F-13	1982	473833.13	7720532.078	610	16	250	V	6.10	-	-	-8.20	-19.90	26.00	11.70	6.50	6700	1500	1561	5600	3200	3253	289	2.1	87	103	1695	16.5	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	27	EF-13	1982	473832.2015	7720531.255	610	16	250	1.3	6.10	-	-	-8.13	-19.70	25.80	11.57	6.50	6700	2500	2516	5600	5200	5242	292	0.3	80	106	1695	19.0	-	-	-	-	-	-	-
Man Wharf (Org. Structure)	28	ED-13	1982	473821.5258	7720532.971	610	16	250	1.3	6.10																										



# **APPENDIX C**

## GEOTECHNICAL PROFILE DRAWINGS













<div><div><div></div><div>COPYRIGHT 2022 PILBARA PORTS AUTHORITY</div></div><div><div>THIS DOCUMENT AND INFORMATION CONTAINED IN IT IS THE SOLE PROPERTY OF PILBARA PORTS AUTHORITY AND MAY NOT BE USED, EXPLOITED, COPIED, DUPLICATED OR REPRODUCED IN ANY FORM OR MEDIUM WHATEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF PILBARA PORTS AUTHORITY</div><div>DO NOT ALTER MANUALLY DO NOT SCALE</div></div></div>		<div>PILBARA PORTS AUTHORITY</div> <div>A3</div>	
<div>PROJECT: DAMPIER CARGO WHARF PILE CAPACITY ASSESSMENT GEOTECHNICAL SUBSURFACE SECTIONS - SHEET 2</div>		<div>©</div>	
<div>DRAWN: RMP</div>	<div>DATE: 18.10.23</div>	<div>PPA DRAWING NUMBER</div>	
<div>CHECKED: L</div>	<div>DATE: 18.10.23</div>	<div>Job Number</div>	<div>Sheet No.</div>
<div>APPROVED: SD</div>	<div>DATE: 18.10.23</div>	<div>SCALE: AS SHOWN</div>	<div>Rev.</div>
		<div>DWG No: WGA222255-DR-GE-0003</div>	<div>REV: A</div>

# **APPENDIX D** BATHYMETRY SURVEY 2020





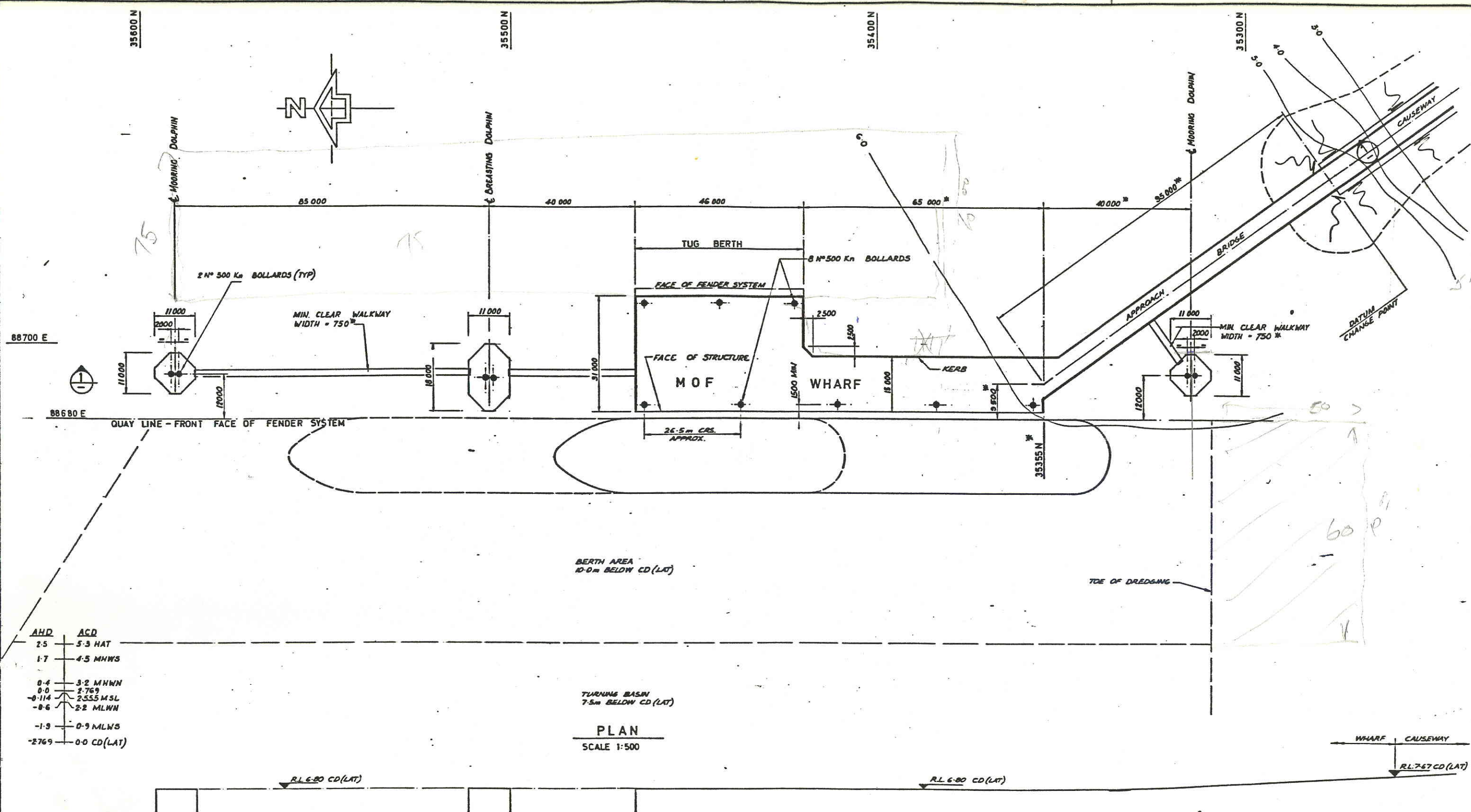




# APPENDIX E

## EXISTING DRAWINGS





NOTE:

REFER TO SPECIFICATION FOR  
WHARF DESIGN CRITERIA.

\* SEE DRG 67400 DS 037-1  
FOR AS BUILT DETAILS

AS BUILT

**Woodside Offshore Petroleum Pty Ltd**

NORTH WEST SHELF DEVELOPMENT PROJECT  
M.O.F. WHARF - GEOMETRY

SCALE 'AS SHOWN'

DRAWING NO  
G 7400 DS 020/1

REVISION  
2

MACDONALD WAGNER & PRIDDLE PTY LTD

33 COLIN STREET  
WEST PLATH 8085  
TELEPHONE 321 2883

BHP

CENTRAL ENGINEERING DIVISION  
City Centre Tower 13th Floor  
44 St George's Terrace  
PERTH WA 6000

67400 DC 0201 CAUSEWAY - LAYOUT & DETAILS
---

### REFERENCE DRAWINGS

SECTION 1

SCALE 1:500 HORIZ.  
1:100 VERT.

2	MAY 83	MM	DRWG. WAS A4660 DG 020/
1	MAR 83	GB	A& BUILT - CONTRACT 1023 G

0	26 B B1 AL	APPROVED FOR CONSTRUCTION
A	18 MAR. 81 T.C.	TURNING BASIN & BERTH AREA DREDGED DEPTH REVISED

NO	DATE	BY	CHRGD	DESCRPTION
				REVISIONS

DRAWN MACDONALD  
WAGNER & PRIDDLE

DATE JAN. 1981

CHECKED *h* *h*

APPROVED

W. J. Wilson 12/31

APPROVED

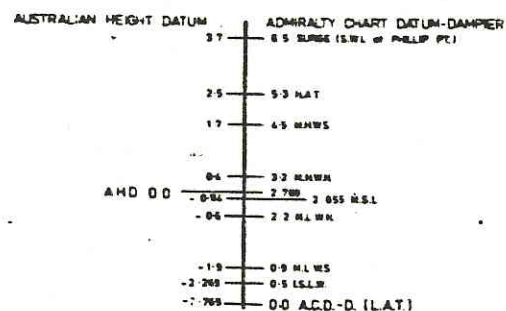
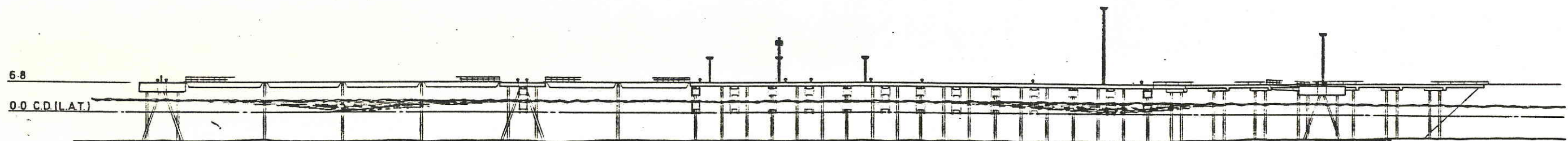
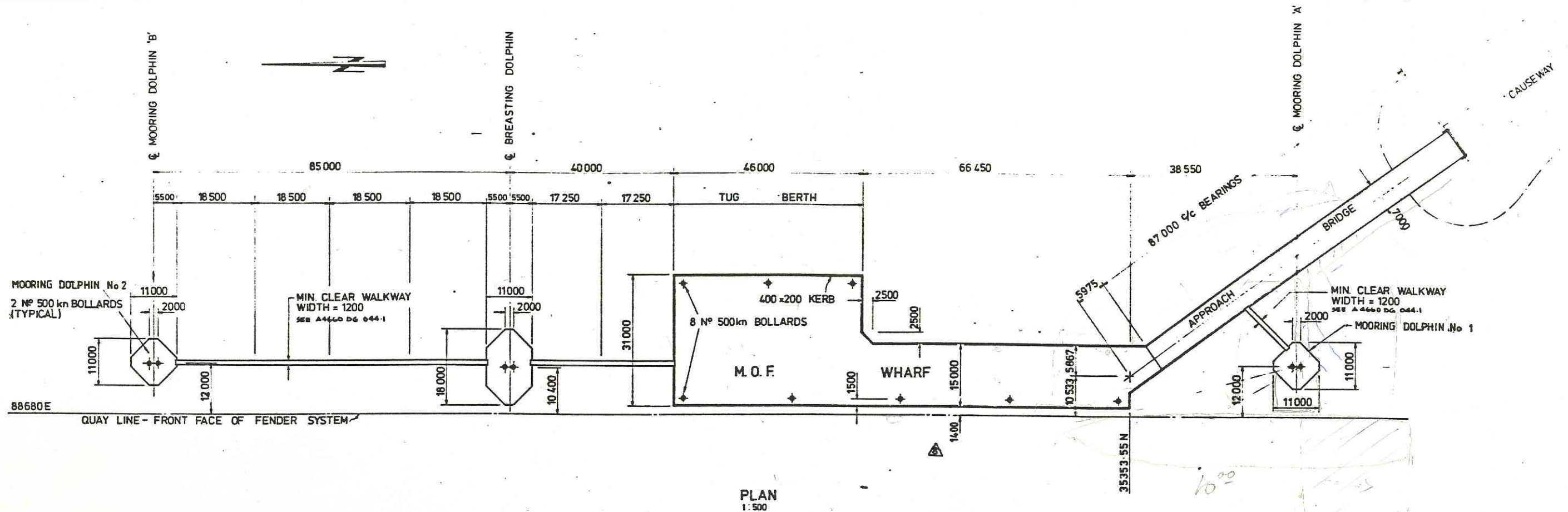
APPROVED

[illegible]

APPROVED

APPROVED





TIDE LEVELS TO AHD & A.C.D.  
HEIGHT DATUM ADMIRALTY CHART DATUM - 0.51 BELOW B.M.C.R.A. 1963  
(B.M.C.R.A. 1963 = 5.841 ABOVE AHD)

**JOHN HOLLAND CONSTRUCTION GROUP**  
7 HARDY STREET, SOUTH PERTH, W.A.  
TELEPHONE 387 4222

**MAUNSELL**  
& PARTNERS PTY. LTD  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower 13th Floor  
44 St George's Terrace  
PERTH W.A. 6000

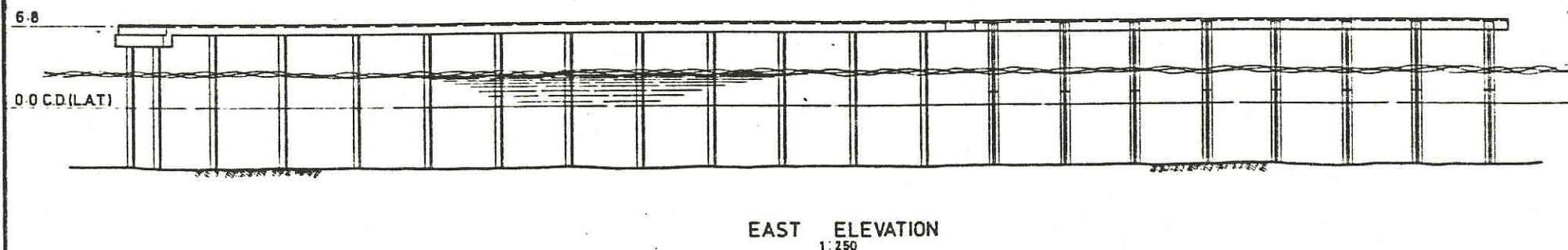
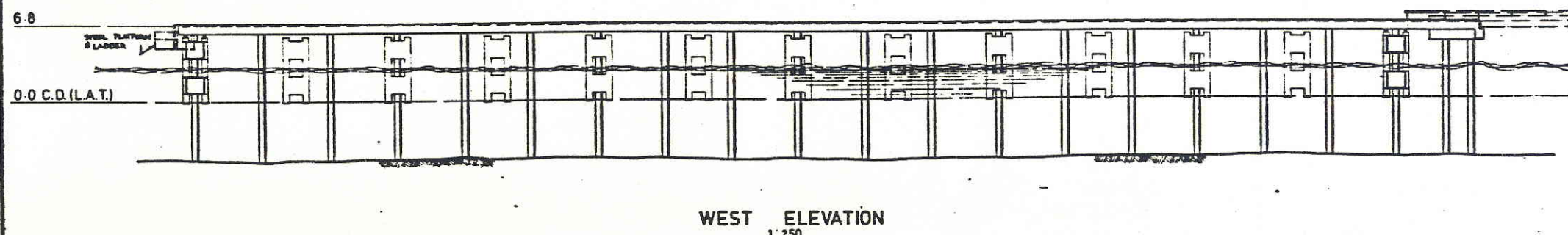
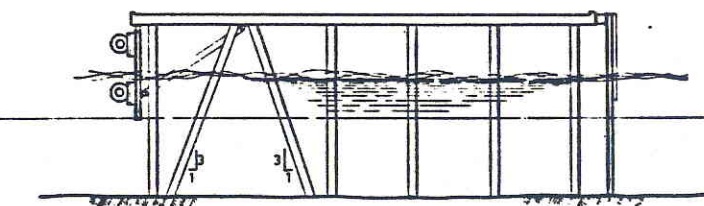
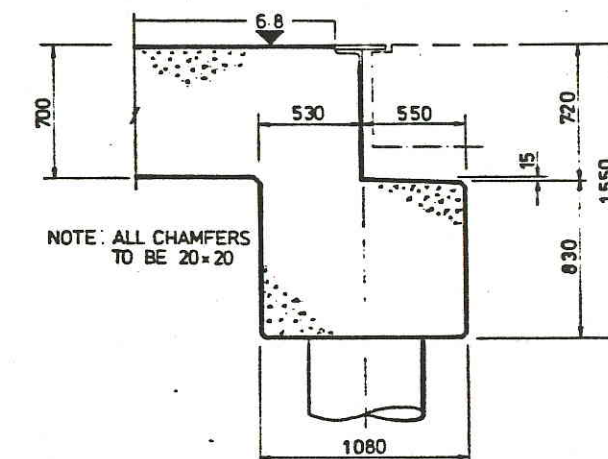
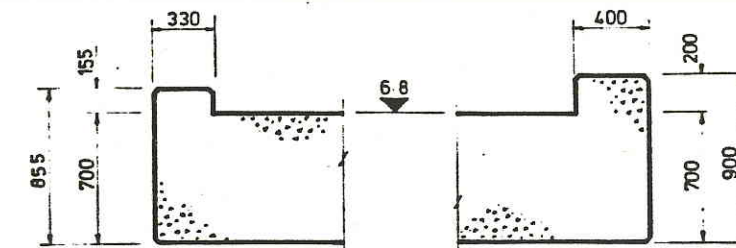
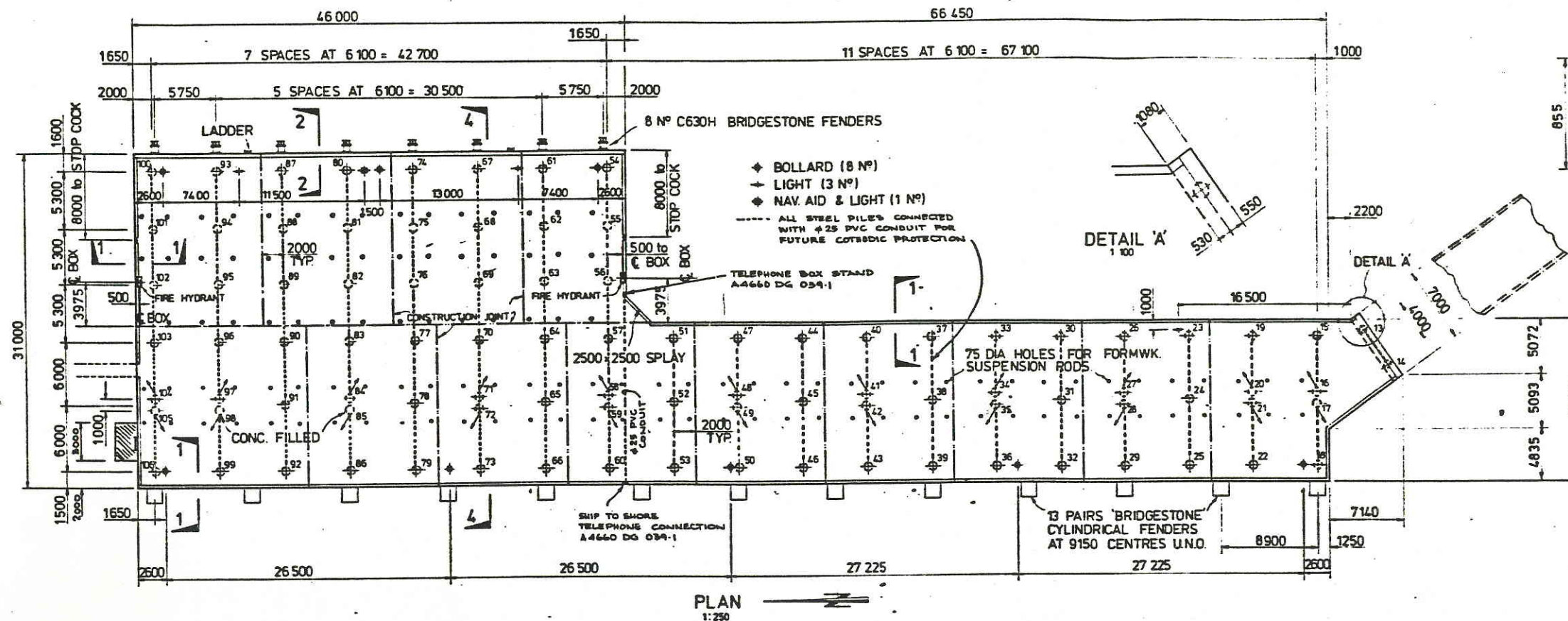
DRAWING NO.	TITLE
	REFERENCE DRAWINGS

NO.	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	MM		DRWG WAS A4660 DG 037.1			
1	MAR 83	G.B.		AS BUILT - CONTRACT 1023 G			
0	6-5-82	G.B.		APPROVED FOR CONSTRUCTION			
5		JW		DIM ADDED NOTE ADDED			
A		BW		INITIAL ISSUE			

DRAWN	BW
DATE	10.9.81
CHECKED	J.S.
APPROVED	J.S.
APPROVED	
APPROVED	
APPROVED	

AS BUILT
<b>Woodside Offshore Petroleum Pty Ltd</b>
NORTH WEST SHELF DEVELOPMENT PROJECT
MATERIALS OFFLOADING FACILITY
GENERAL LAYOUT
SCALE 1:500
DRAWING NO. G7400 DS 037.1
REVISION 2





- NOTES
1. CONCRETE STRENGTH -  $F_c = 40 \text{ MPa}$
  2. PILE INFILL CONCRETE BELOW REINF. CAGE -  $F_c = 15 \text{ MPa}$  WHERE REQUIRED
  3. DOUBLE PILE SETS TO BE RAKED AS SHOWN IN SECTION 4-4 AND ARE TO BE SKEWED IN PLAN BY  $10^\circ - 15^\circ$  TO AVOID ADJACENT PILES. PAIRS OF PILES TO BE IN ONE PLANE. ALL SINGLE PILES TO BE VERTICAL
  4. ALL PILES ARE 610 O.D. x 16 THK
  5. 75 DIA HOLES FOR FORMWORK SUSPENSION RODS TO REMAIN UNFILLED AS DRAINAGE HOLES
  6. PILE REQUIRED CAPACITY  
2000kN BASIC COMPRESSION  
3000kN BASIC TENSION (RAKED PILES)
  7. PILE STEEL GRADE - 250 MPa
  8. THE OPTION TO CONCRETE FILL PILES MAY ONLY BE EXERCISED IF THEY DO NOT SATISFY AGREED DRIVING CRITERIA
  9. PILE PROTECTIVE SYSTEM - COAL TAR EPOXY PAINT AS PER SPECIFICATION DOWN TO R.L. -3.0 (C.D.)

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH, W.A. TELEPHONE 267 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 12th Floor  
44 St George's Terrace  
PERTH, W.A. 6000

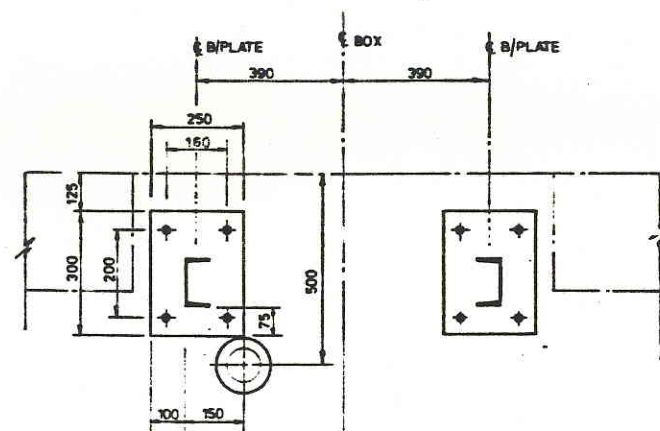
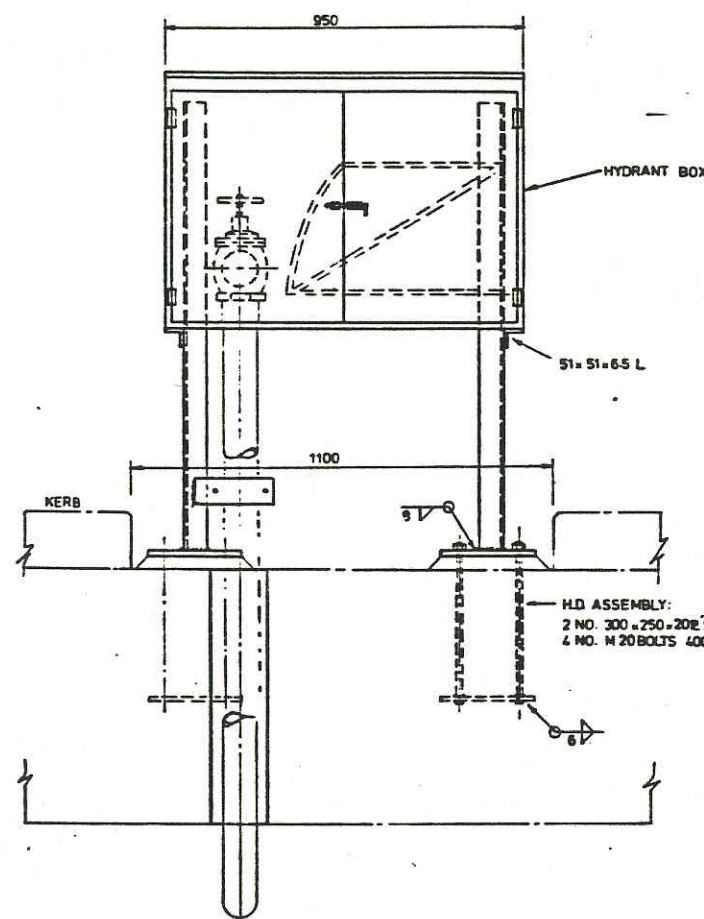
NO.	DATE	BY	CHD	TITLE
07400 DS 038-1				WHARF MISCELLANEOUS DETAILS
0433				FENDER DETAILS (SHEET 3)
0432				" " (SHEET 2)
0431				" " (SHEET 1)
0430				WHARF REINF. (SHEET 4)
0429				" " (SHEET 3)
0428				" " (SHEET 2)
0427				" " (SHEET 1)
0371				GENERAL LAYOUT

NO.	DATE	BY	CHD	TITLE
2	MAY 83	MM		DRWG. WAS A4660 DG 038-1
1	MAR 83	G.B.		AS BUILT - CONTRACT 1023 G
0	6-8-82	G.B.		APPROVED FOR CONSTRUCTION
B		JW		NOTE B MODIFIED
A		BW		INITIAL ISSUE

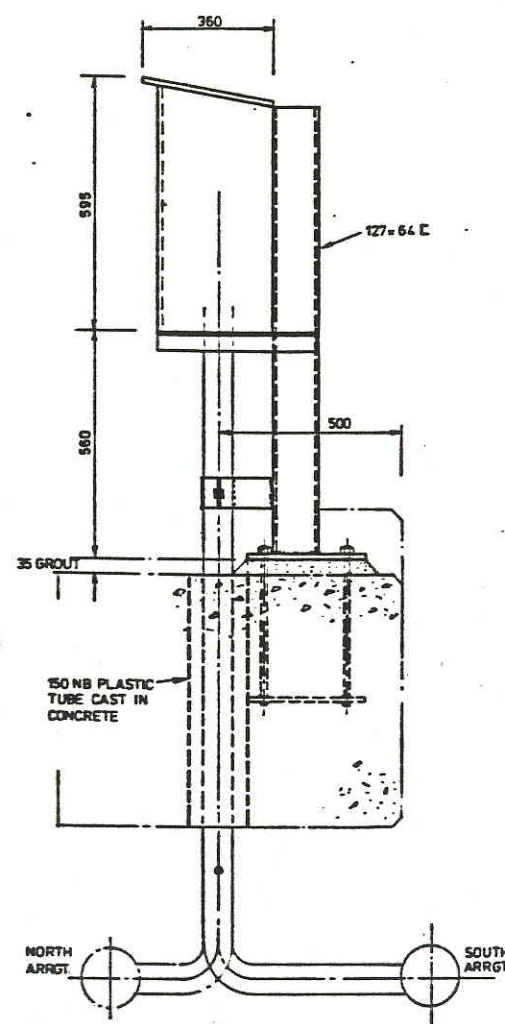
DRAWN	BW
DATE	16.9.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>	
NORTH WEST SHELF DEVELOPMENT PROJECT	
MATERIALS OFFLOADING FACILITY	
WHARF - GENERAL ARRANGEMENT	
SCALE	AS SHOWN
DRAWING NO.	G7400 DS 038-1
REVISION	2

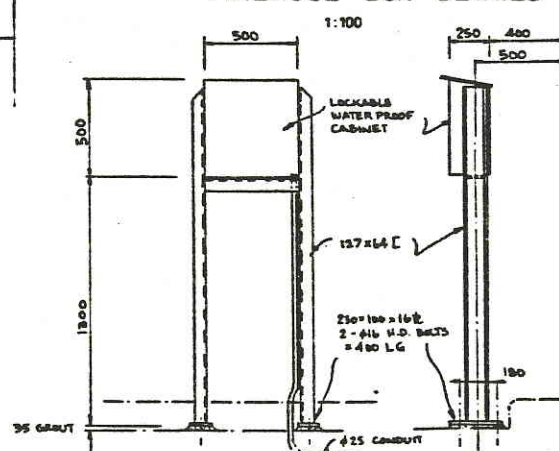




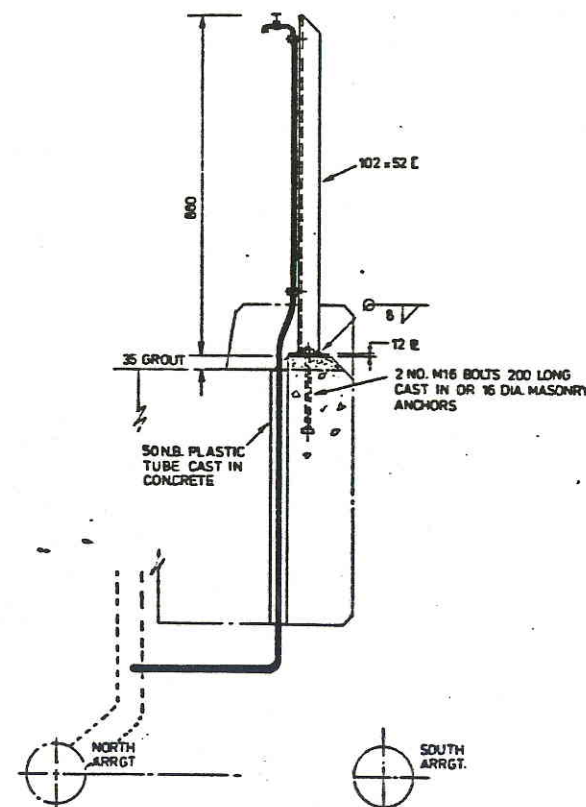
BASEPLATE DETAILS  
1:100



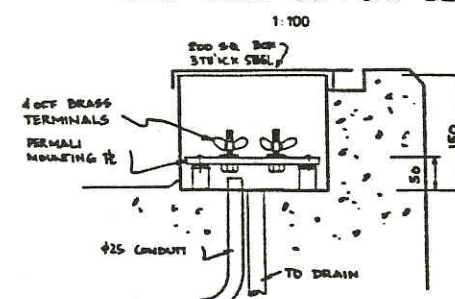
FIREHOSE BOX DETAILS  
1:100



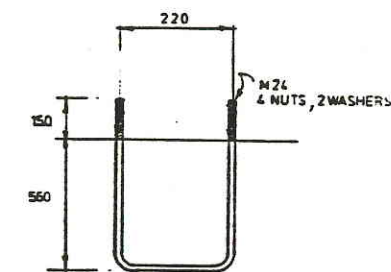
TELEPHONE STAND



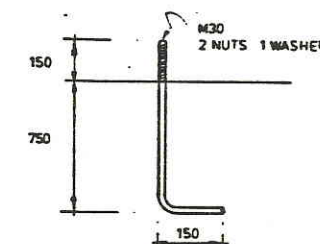
STOP COCK SUPPORT DETAILS  
1:100



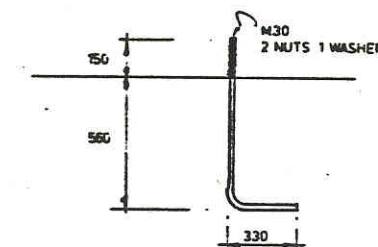
SHIP TO SHORE TEL CONNECTION



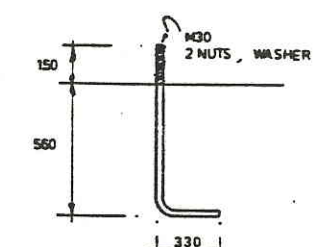
H.D. BOLTS POLES 1A & 1C  
2 N°/POLE AT PCD 311



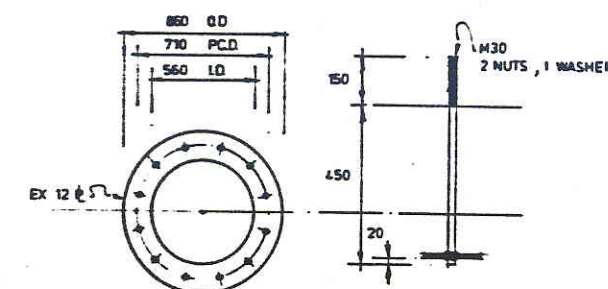
H.D. BOLTS POLES 4, 5, 6, & 7  
16 N°/POLE AT PCD 590



H.D. BOLTS POLE 3  
8 N° AT 424 PCD.



H.D. BOLTS POLE 2  
16 N° AT PCD 590



H.D. BOLTS BEACONS 1 & 4  
N.T.S.

NOTES:

1. HOLDING DOWN BOLT ASSEMBLIES TO BE HOT DIP GALVANISED
2. PROTECTIVE SYSTEM:  
EPOXY ZINC RICH PRIMER AND EPOXY MICACEOUS IRON OXIDE  
AS PER SPECIFICATION

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET SOUTH PERTH W.A. TELEPHONE 267 4222

**MAUNSELL**  
& PARTNERS PTY LTD  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower 13th Floor  
44 St George's Terrace  
PERTH W.A. 6000

DRAWING NO.	TITLE
67400 DS 038.1	WHARF-GENERAL ARRANGEMENT
REFERENCE DRAWINGS	

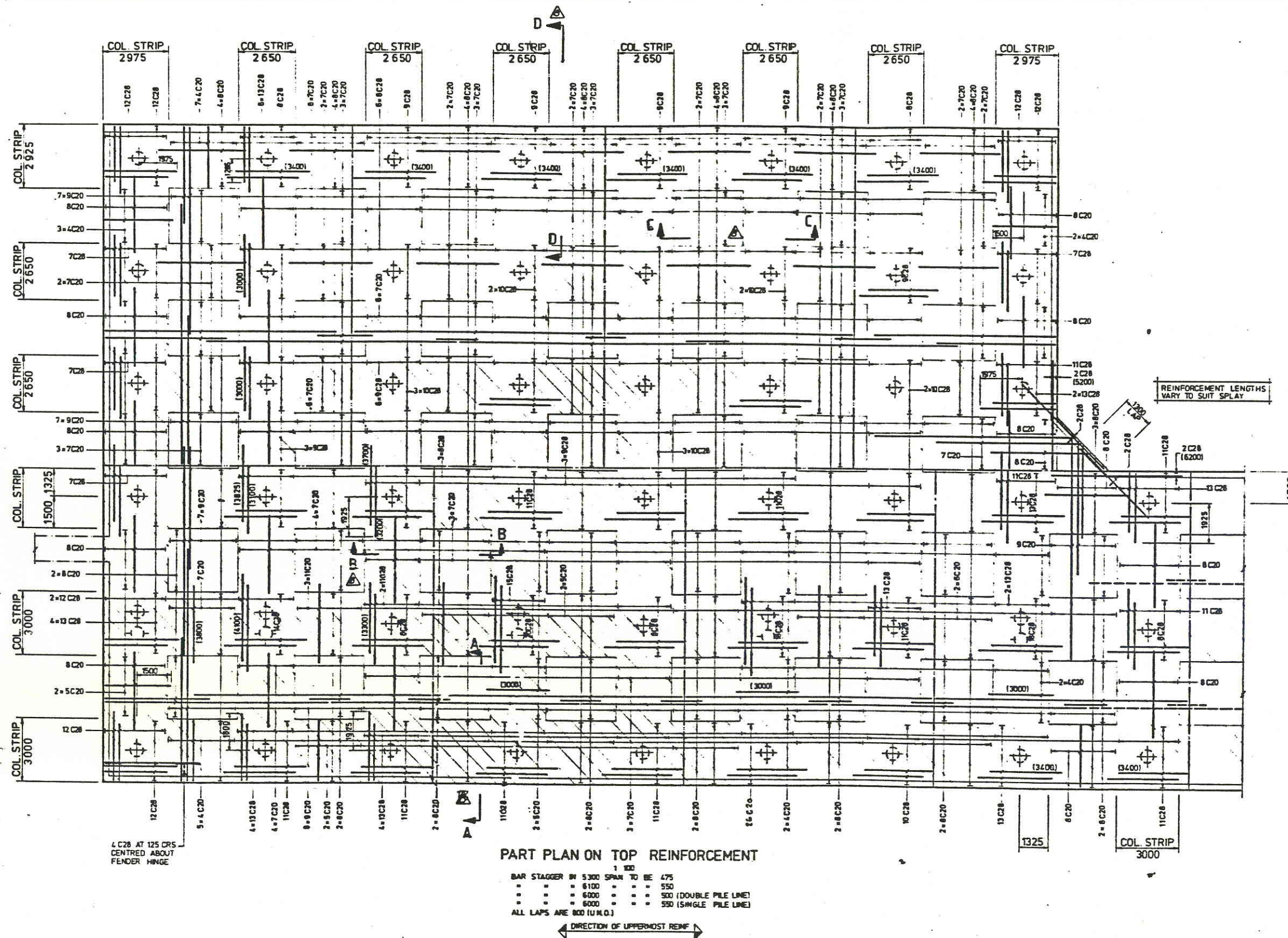
NO.	DATE	BY	CHKD.	DESCRIPTION	ENGR.	ENGR.	ENGR.
2	MAY 83	M.M.		DRWG. WAS A4660 DG 038.1			
1	MAR 83	G.B.		AS BUILT - CONTRACT 1023 G			
0	6.5.82	G.B.		APPROVED FOR CONSTRUCTION			
5	7.4.82	B.K.		H.D. BOLTS AND WASHERS			
A		H.G.		INITIAL ISSUE			

DRAWN	H.G.
DATE	28.11.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>
NORTH WEST SHELF DEVELOPMENT PROJECT
MATERIALS OFFLOADING FACILITY
WHARF MISCELLANEOUS DETAILS
SCALE AS SHOWN
DRAWING NO. 67400 DS 038.1
REVISION

AS BUILT





- NOTES
1. BARS AT ANY SECTION WITHIN COLUMN AND MIDDLE STRIPS TO BE EQUALLY SPACED WITH LAPPING OR CONTINUOUS BARS EVENLY DISTRIBUTED WITHIN THE STRIP
  2. COVER TO REINFORCEMENT - 65 mm (DECK) 40 mm (PILES)
  3. 12C28 DENOTES 12 BARS OF OLD WORKED TWISTED DEFORMED 28 DIA BARS
  4. FOR ALL SECTIONS REFER DRG No G7400 DS 040-4

AS BUILT

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH W.A. TELEPHONE 267 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 10th Floor  
44 St George's Terrace  
PERTH W.A. 6000

DATE	BY	CHKD	TITLE
01/01/01	MM		WHARF REINF (SHEET 3)
02/02			(SHEET 2)
03/01			(SHEET 1)
03/01			WHARF - GENERAL ARRANGEMENT
REFERENCE DRAWINGS			

DATE	BY	CHKD	DESCRIPTION
2 MAY 83	MM		DRWG WAS A4660 DG 040-1
1 MAR 85	G.B.		AS BUILT - CONTRACT 1023 G
0 6 5 02	G.B.		APPROVED FOR CONSTRUCTION
B	JW		SECTIONS ADDED
A	BW		INITIAL ISSUE
DATE	BY	CHKD	DESCRIPTION
			REVISIONS

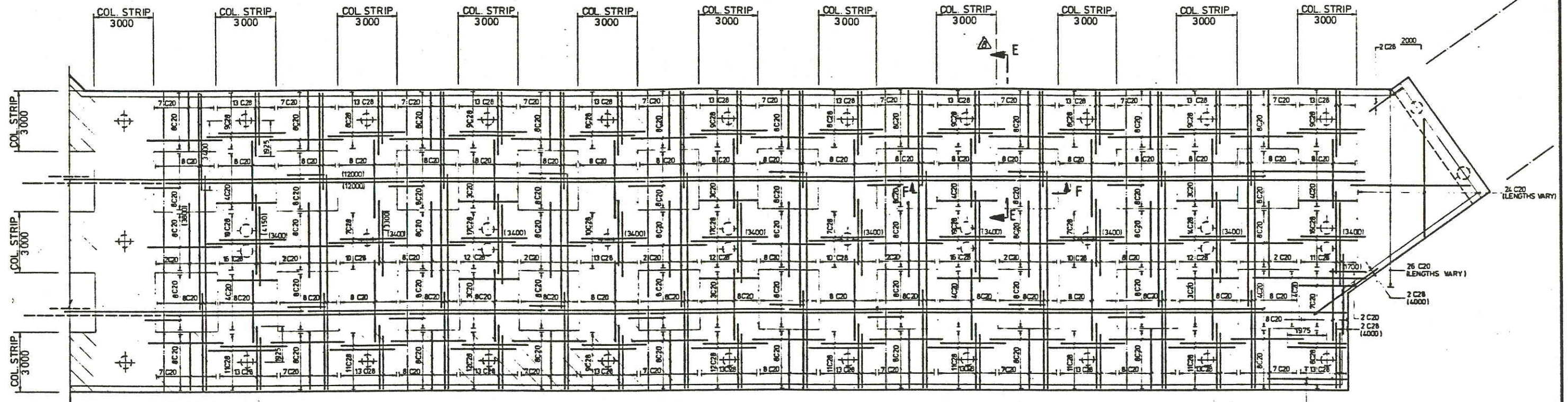
DRAWN	BW
DATE	16-9-81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>
NORTH WEST SHELF DEVELOPMENT PROJECT
MATERIALS OFFLOADING FACILITY
WHARF REINFORCEMENT (SHEET 1)
SCALE 1:100
DRAWING NO G7400 DS 040-1
REVISION 2





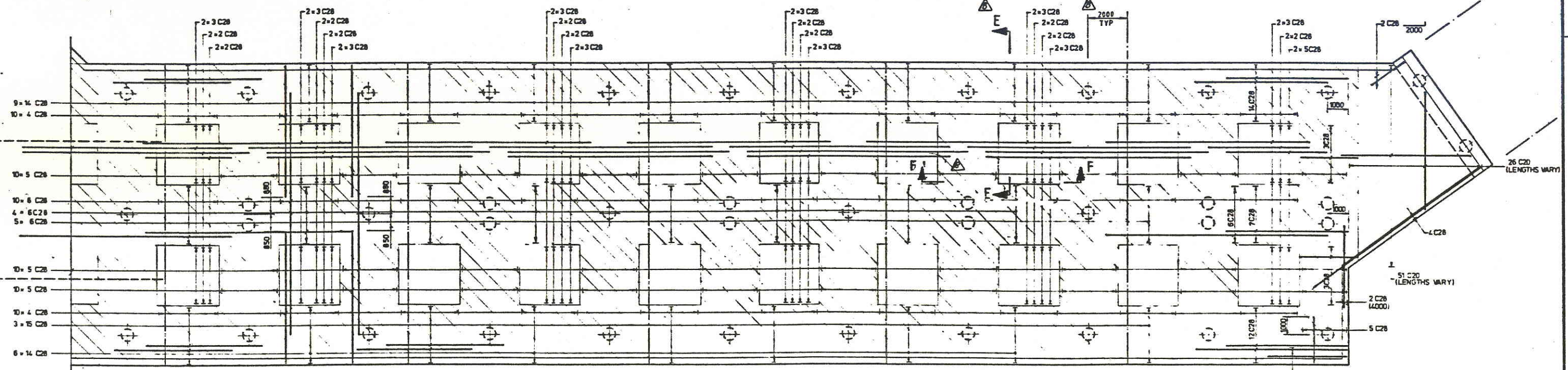




PART PLAN ON TOP REINFORCEMENT

1:100  
ALL LAPS TO BE 800  
ALL STAGGERS TO BE 550

DIRECTION OF UPPERMOST REINF



PART PLAN ON BOTTOM REINFORCEMENT

1:100  
REINF TERMINATION POINTS ARE EITHER ON PILE C OR 900 FROM PILE C U.N.O.  
50% OF EDGE COL STRIP REINF TO EXTEND 650 BEYOND PILE C

DIRECTION OF LOWERMOST REINF

NOTE FOR GENERAL NOTES SEE DRG N° G7400 DS 040-1  
FOR SECTIONS REFER DRG N° G7400 DS 040-6

AS BUILT

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET SOUTH PERTH, W.A. TELEPHONE 387 4222

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 13th Floor  
44 St George's Terrace  
PERTH, W.A. 6000

**MAUNSELL**  
& PARTNERS PTY. LTD.  
CONSULTING ENGINEERS

NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	N.M.		DRWG WAS A4660 DG 040-3			
1	MAR 83	G.B.		AS BUILT - CONTRACT 1023 G			
D	6-5-82			APPROVED FOR CONSTRUCTION			
C	29-4-82	J.W.		SECTIONS ADDED DIM ADDED			
B	6-3-82	P.W.		REV AMENDED			
A		B.W.		INITIAL ISSUE			
DRWING NO	TITLE						
	REFERENCE DRAWINGS						

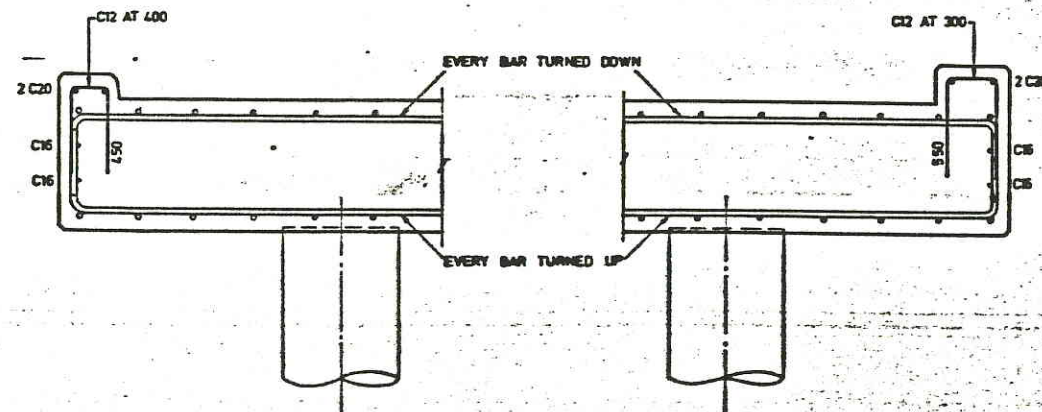
NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	N.M.		DRWG WAS A4660 DG 040-3			
1	MAR 83	G.B.		AS BUILT - CONTRACT 1023 G			
D	6-5-82			APPROVED FOR CONSTRUCTION			
C	29-4-82	J.W.		SECTIONS ADDED DIM ADDED			
B	6-3-82	P.W.		REV AMENDED			
A		B.W.		INITIAL ISSUE			
DRWING NO	TITLE						
	REFERENCE DRAWINGS						

DRWING NO	B.W.
DATE	19.10.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>	
NORTH WEST SHELF DEVELOPMENT PROJECT	
MATERIALS OFFLOADING FACILITY	
WHARF REINFORCEMENT	(SHEET 3)
SCALE	1:100
DRWING NO	G7400 DS 040-3
REVISION	2

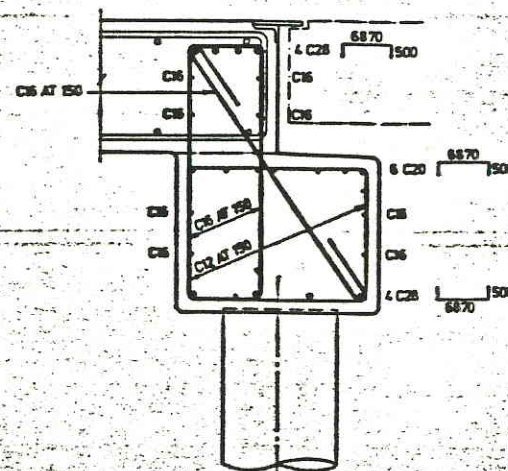


NOTE: LONGITUDINAL EDGE REINFORCEMENT  
TO BE CONTINUOUS WITH 40 DIA. LAP

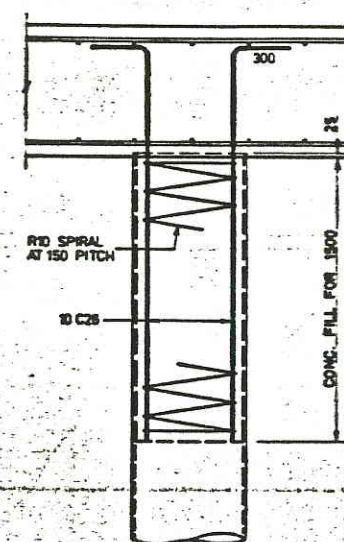


TYPICAL EDGE DETAIL

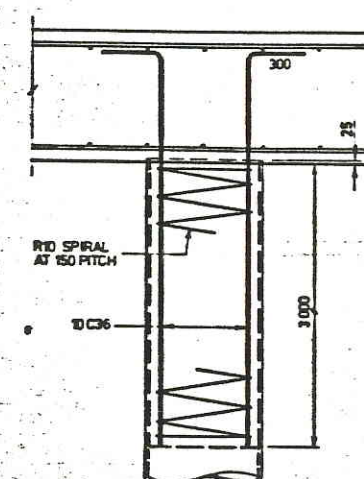
TUG BERTH EDGE DETAIL



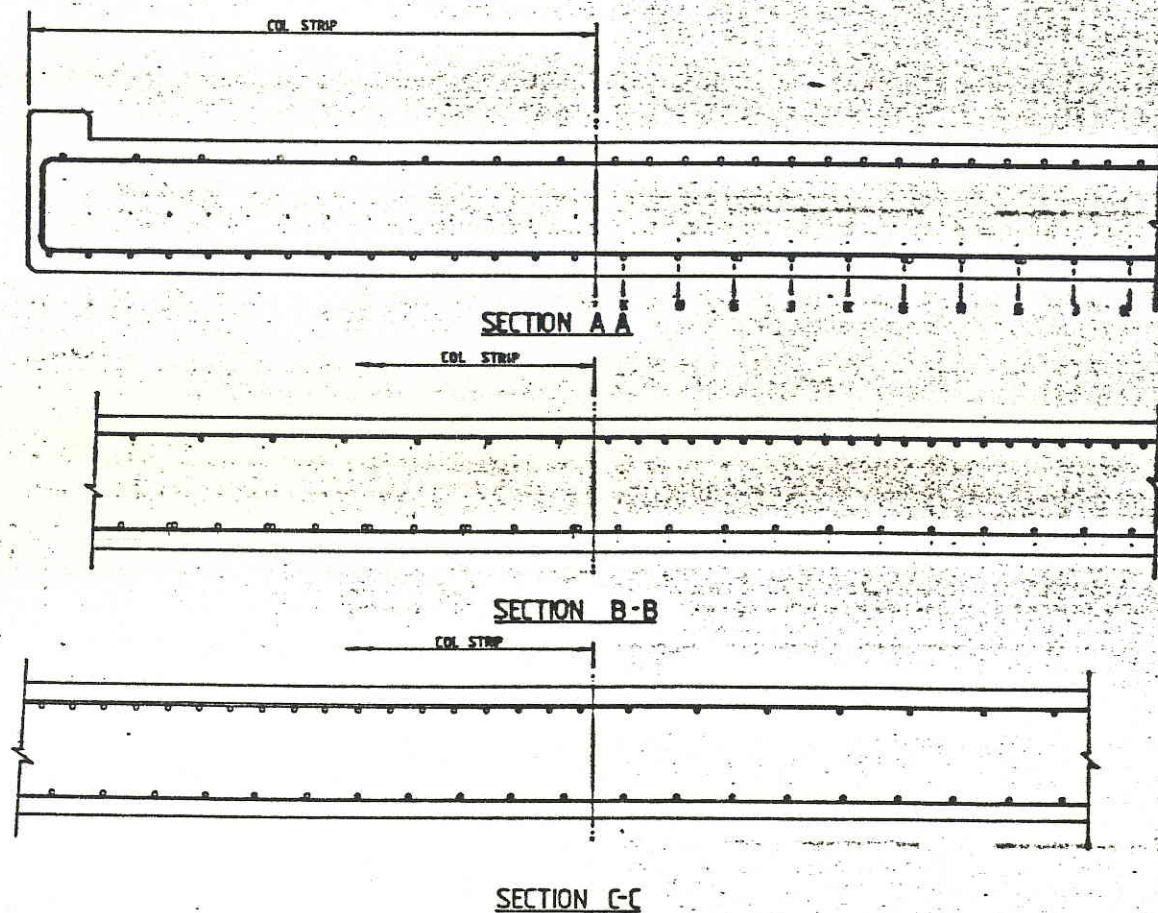
WHARF/APP. BRIDGE  
EDGE DETAIL



TYP. PILE TERMINATION DETAIL



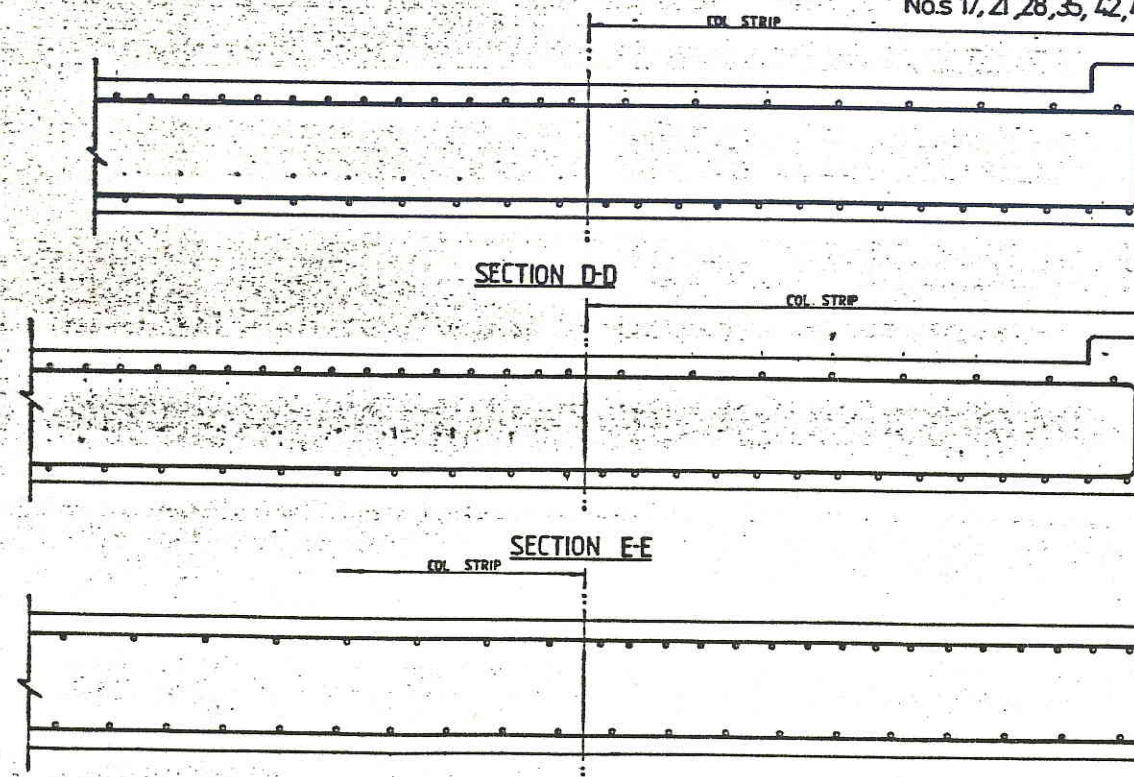
TERMINATION DETAILS FOR PILES  
Nos 17, 21, 28, 35, 42, 49, 59, 72, 85, 98, 105.



SECTION A-A

SECTION B-B

SECTION C-C



SECTION D-D

SECTION E-E

SECTION F-F

G-7400 DS

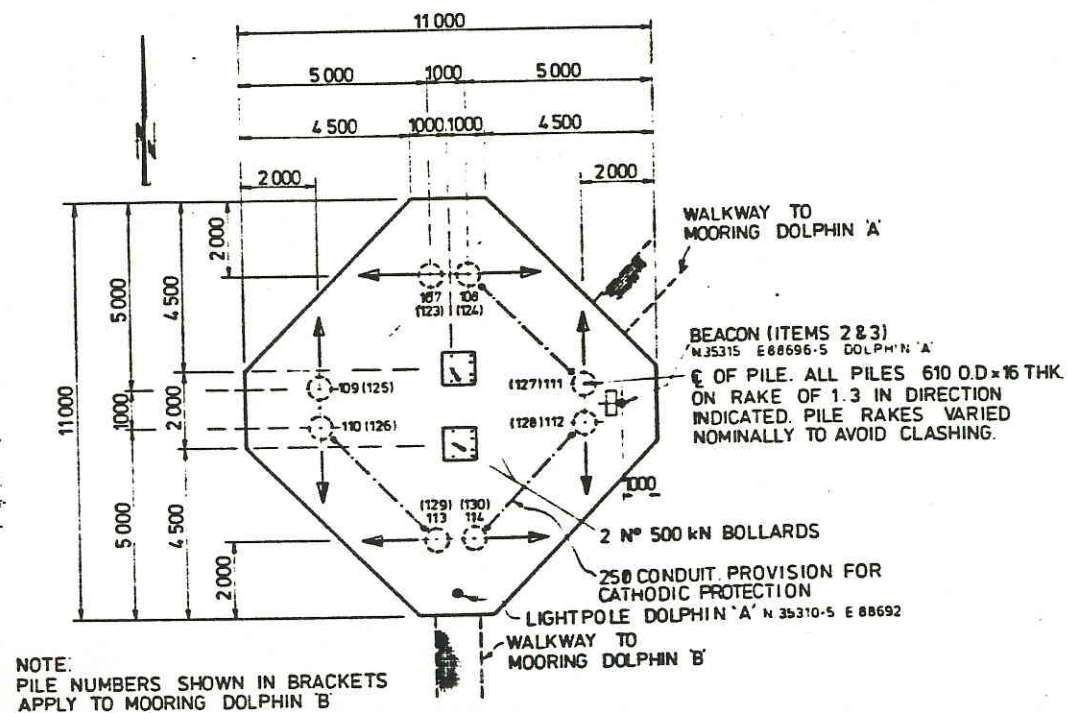
NOTE FOR GENERAL NOTES REFER DRG No G7400 DS 040.4

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH W.A. TELEPHONE 387 4222

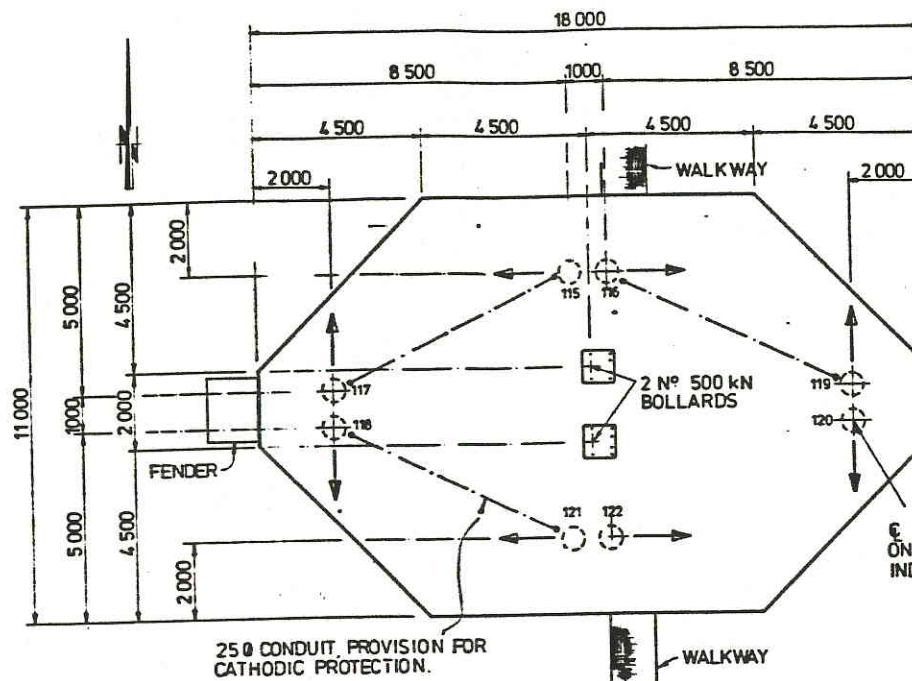
**MAUNSELL**  
& PARTNERS PTY. LTD.  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower 15th Floor,  
44 St George's Terrace,  
PERTH, W.A. 6000

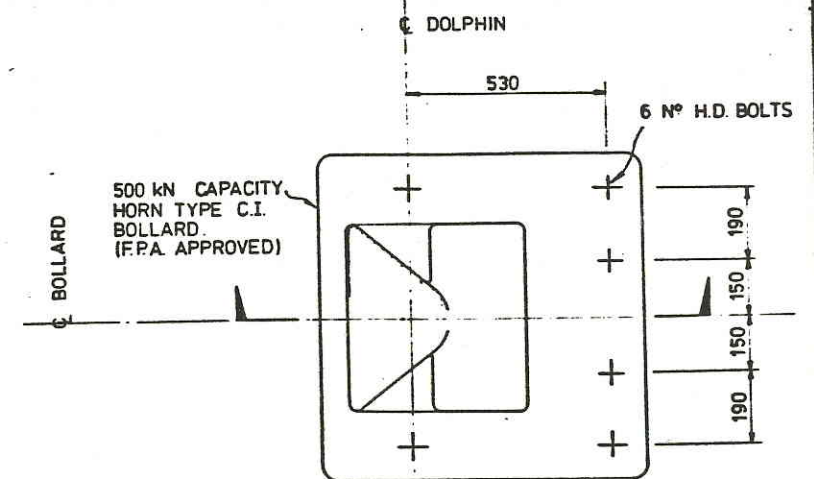


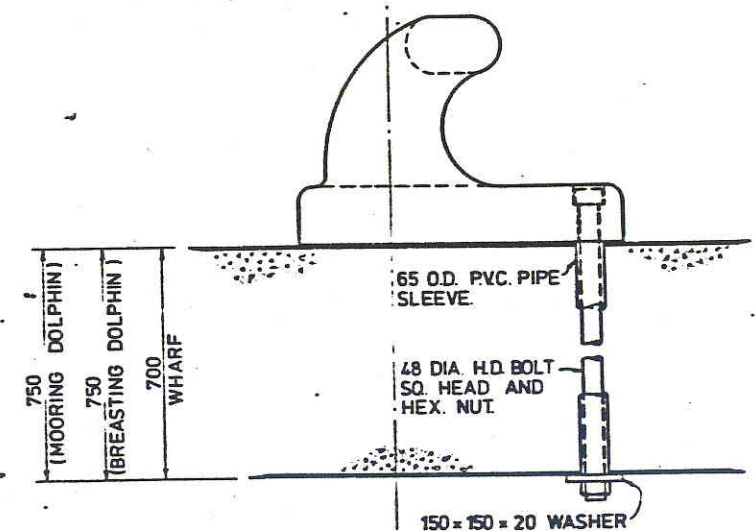
PLAN



PLAN

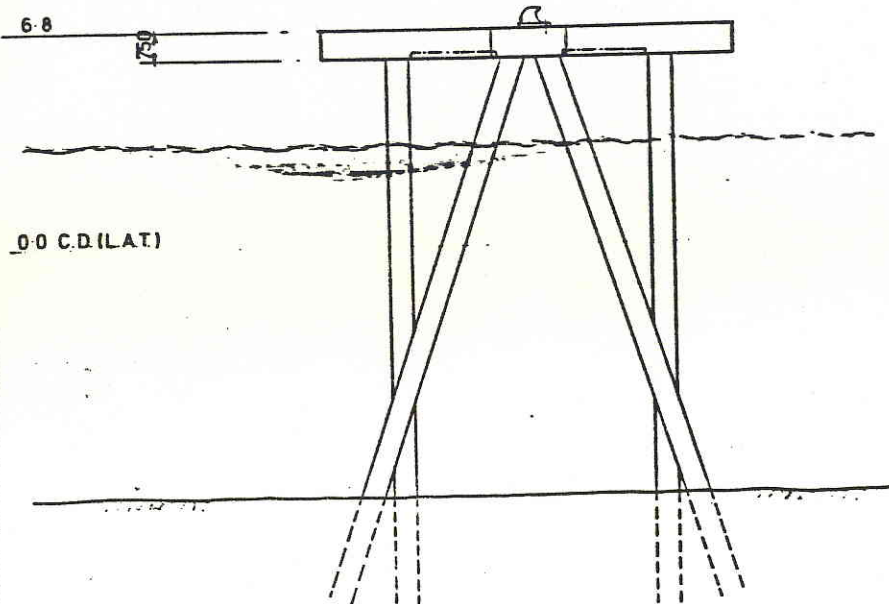


PLAN



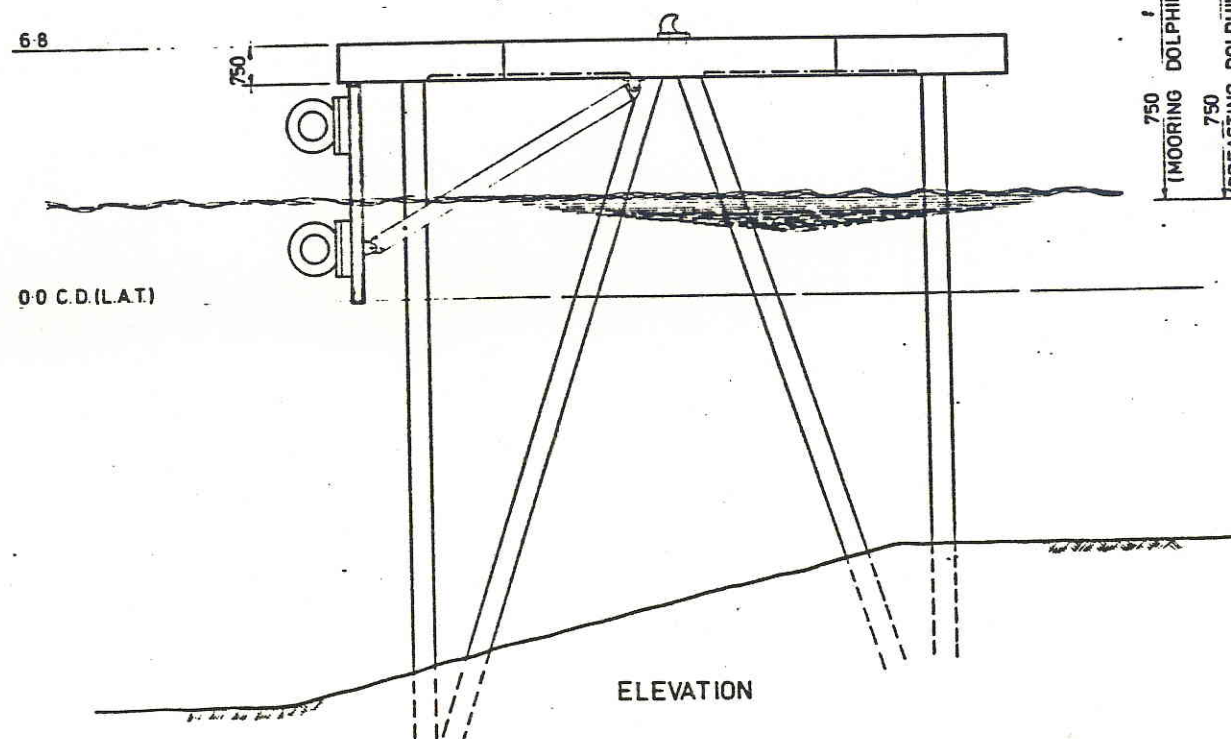
SECTION

BOLLARD H.D. BOLT DETAILS  
1:10



ELEVATION

MOORING DOLPHIN DETAILS  
1:100



ELEVATION

BREASTING DOLPHIN DETAILS  
1:100

- NOTES:
- PILE DESIGN FOUNDING LEVEL -19.5 C.D. (L.A.T.)
  - PILE REQUIRED CAPACITY  
1500 kN BASIC COMPRESSION  
300 kN BASIC TENSION
  - CONCRETE STRENGTH -  $F_c = 40 \text{ MPa}$
  - PILE PROTECTIVE SYSTEM - SEE DRG G7400 DS 038.1

AS BUILT

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH, W.A.  
TELEPHONE 367 4222

**MAUNSELL  
& PARTNERS PTY LTD**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 13th Floor  
40 St George's Terrace  
PERTH W.A. 6000

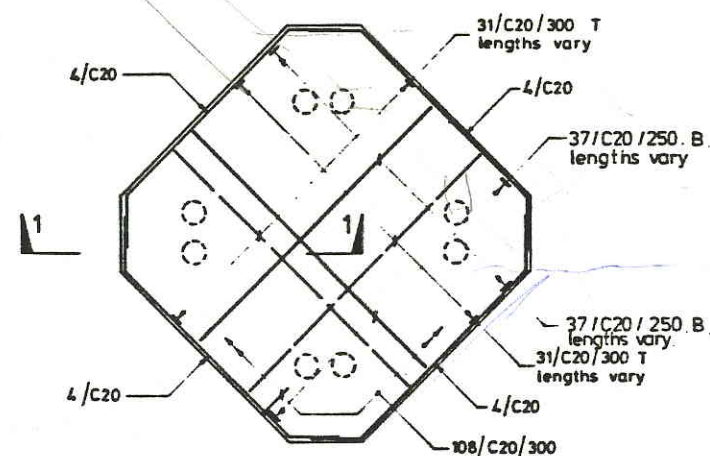
DRAWING NO	TITLE	REFERENCE DRAWINGS
G7400 DS 041	DOLPHIN - REINF DETAILS	
	GENERAL LAYOUT	

NO	DATE	BY	CHKD	DESCRIPTION	REVISIONS
2	MAY 83	MM		DRWG WAS A4660 DGO41-1	
1	MAR 83	GS		AS BUILT - CONTRACT 1013 G	
0	25-6-82	MM		APPROVED FOR CONSTRUCTION	
0	7-4-82	MM		LONG DOLPHIN REDUCED 5 750 mm	
0	5-2-82	FA		30% RELEASE FOR FENDER FRAME MOUNTING	
2		DSR		INITIAL ISSUE	

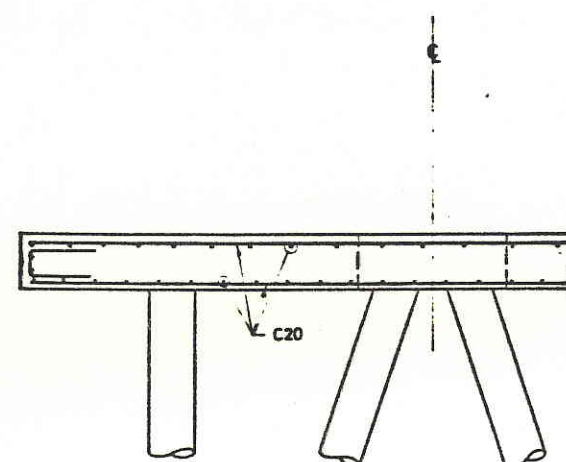
DRAWN	B.W.
DATE	22-9-81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>	
NORTH WEST SHELF DEVELOPMENT PROJECT	
MATERIALS OFFLOADING FACILITY	
DOLPHINS - CONCRETE DETAILS	
SCALE AS SHOWN	DRAWING NO G7400 DS 041-1
	REVISION 2



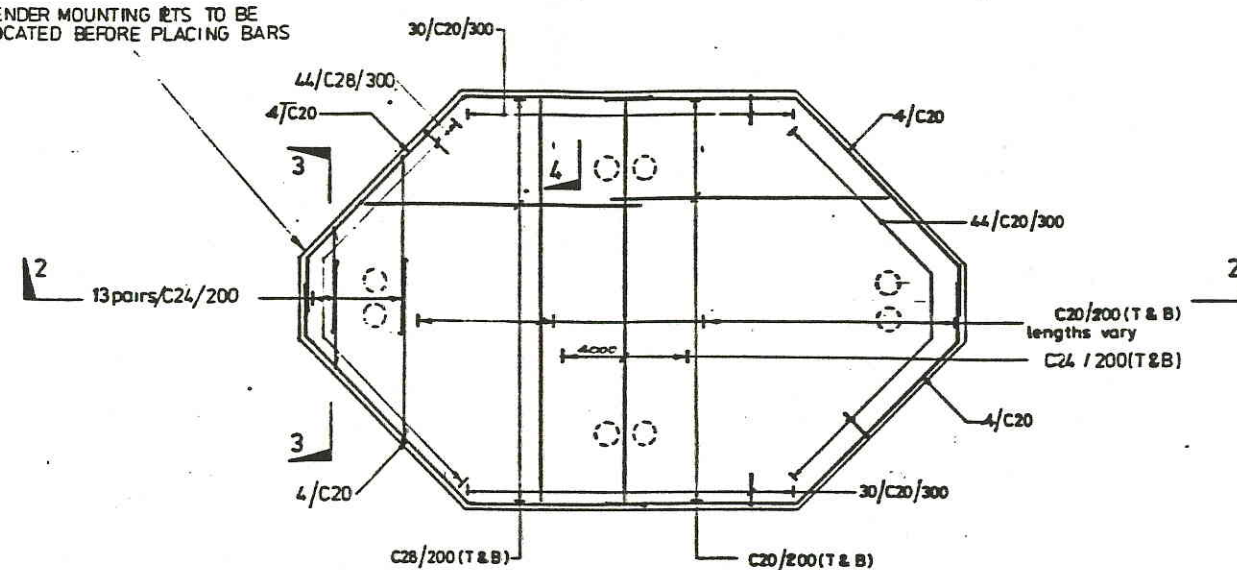


PLAN ON MOORING DOLPHIN  
1:100

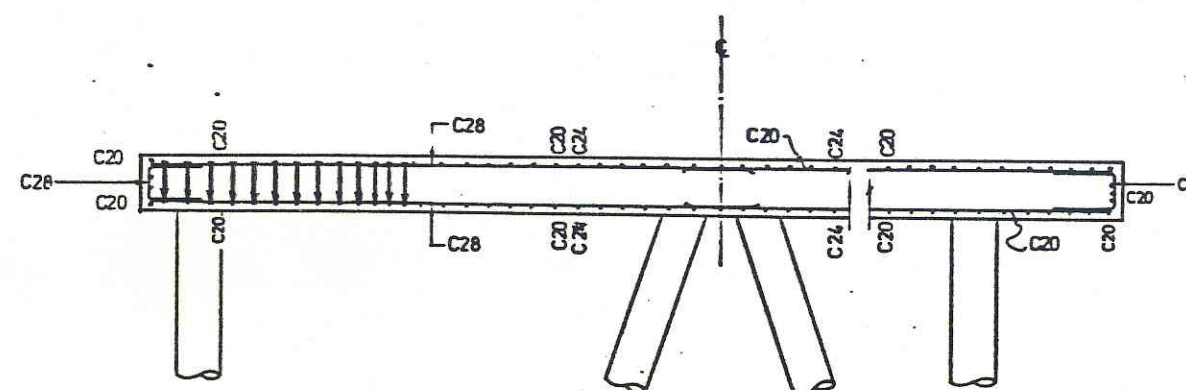


SECTION 1-1  
1:50

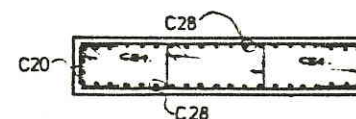
NOTE: FENDER MOUNTING SETS TO BE LOCATED BEFORE PLACING BARS



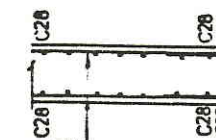
PLAN ON BREASTING DOLPHIN  
1:100



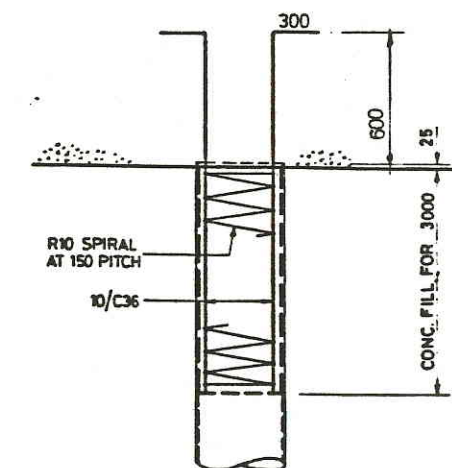
SECTION 2-2  
1:50



SECTION 3-3  
1:50



SECTION 4-4  
1:50



TYP. PILE TERMINATION DETAIL  
1:25

NOTES

- COVER TO REINFORCEMENT: PILE CAP 65mm - PILES 40mm
- CONCRETE STRENGTH: PILE INFILL - SEE NOTE 2 DRG NO 67400 DS 038.1

JOHN HOLLAND CONSTRUCTION GROUP  
2 HARDY STREET SOUTH PERTH W.A. TELEPHONE 367 4227

MAUNSELL  
& PARTNERS PTY LTD  
CONSULTING ENGINEERS

BHP  
CENTRAL ENGINEERING DIVISION  
City Centre Tower 13th Floor  
44 St George's Terrace  
PERTH W.A. 6000

DRAWING NO	TITLE	REFERENCE DRAWINGS
67400 DS 042.1	DOLPHINS - REINFORCEMENT DETAILS	

NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	MM		DRAWG. WAS A4660 DS 042.1			
1	MAR 83	GB		AS BUILT - CONTRACT 1023 G			
0	25-6-82	MM		APPROVED FOR CONSTRUCTION			
C	21-5-82	BSV		REVISION 2 BREASTING DOLPHIN REINFORCEMENT AMENDED			
B	10-2-82	FW		BREASTING DOLPHIN REINFORCEMENT AMENDED			
A		DSR		INITIAL ISSUE			

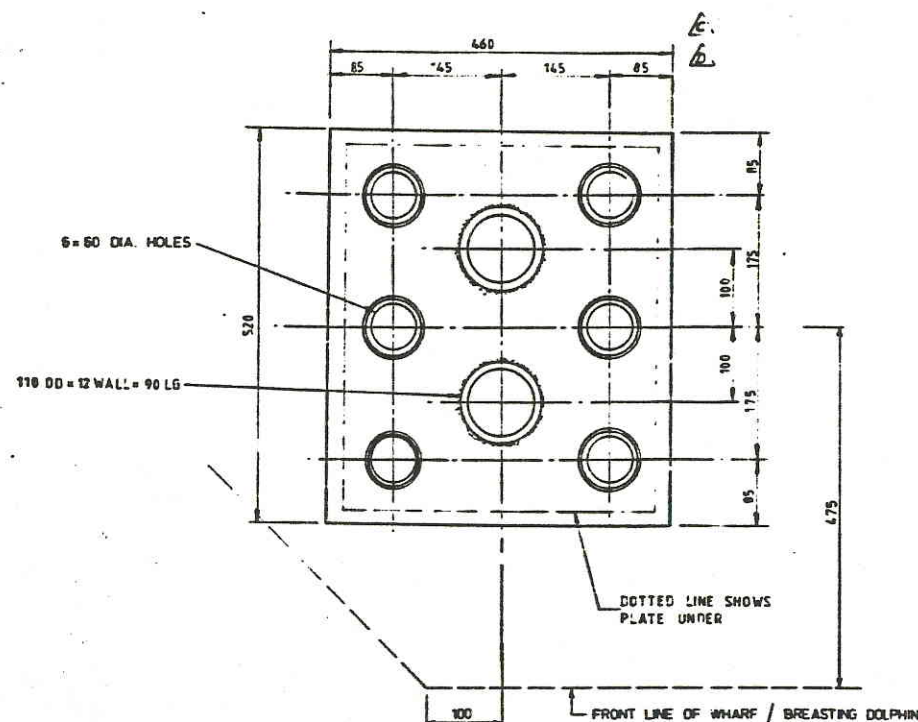
DRAWN	BW
DATE	22-9-81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

AS BUILT
Woodside Offshore Petroleum Pty Ltd
NORTH WEST SHELF DEVELOPMENT PROJECT
MATERIALS OFFLOADING FACILITY
DOLPHINS - REINFORCEMENT DETAILS
SCALE 1:100, 1:50, 1:25
DRAWING NO 67400 DS 042.1
REVISION 2

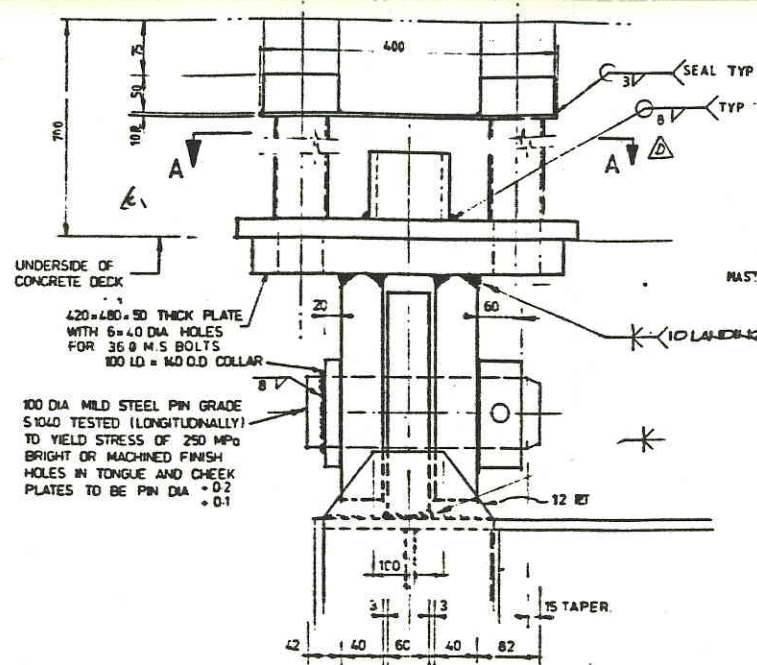




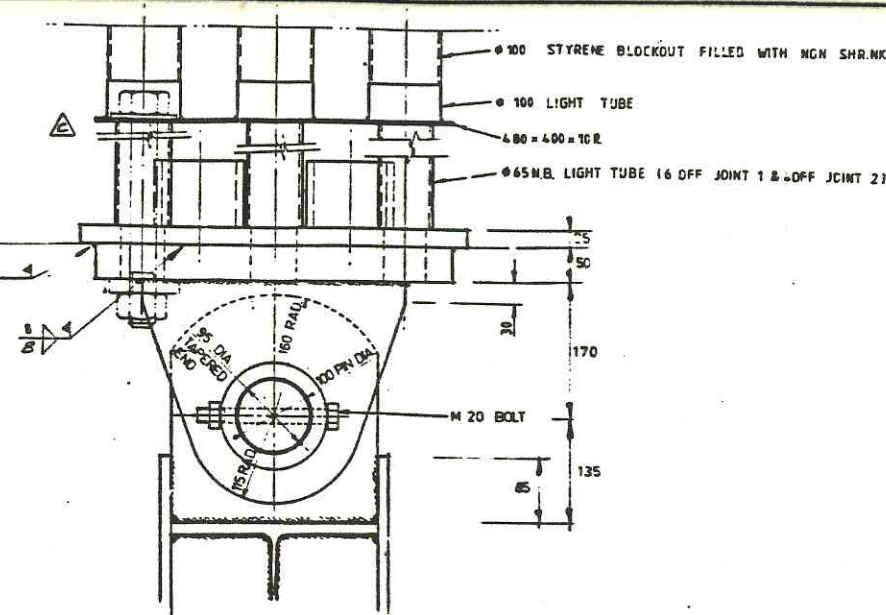




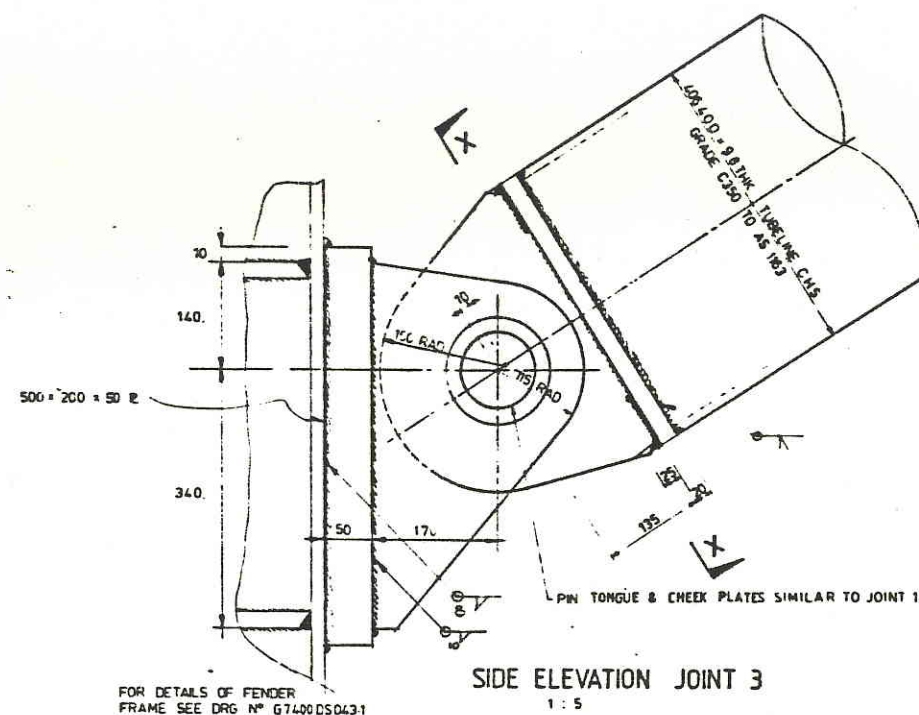
SECTION A-A  
PLAN ON JOINT 1  
PLAN ON JOINT 2 SIMILAR (4 HOLES ONLY)  
1:5



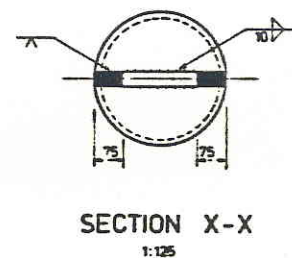
FRONT ELEVATION JOINT 1  
310 UB, OMITTED FOR CLARITY  
1:5



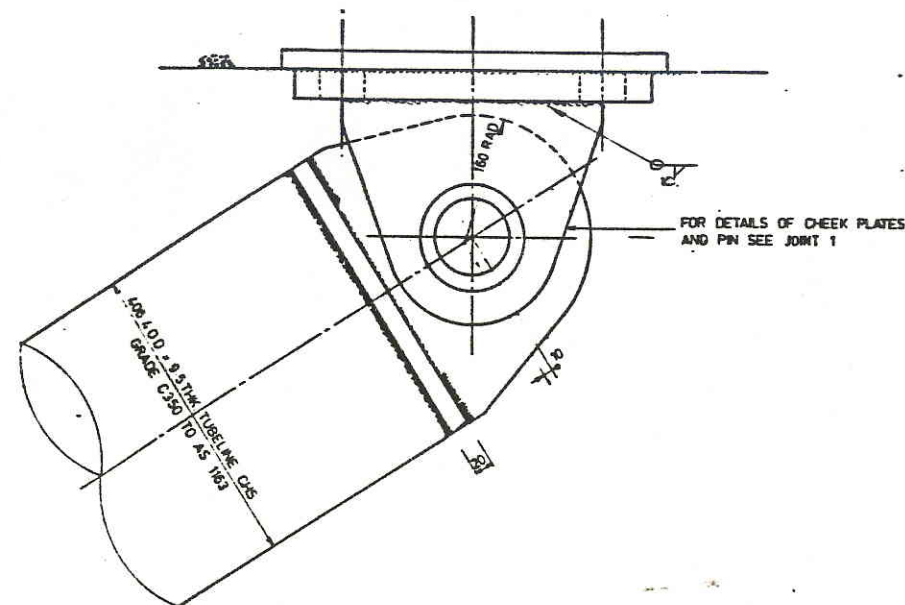
SIDE ELEVATION JOINT 1  
1:5



SIDE ELEVATION JOINT 3  
1:5



SECTION X-X  
1:125



SIDE ELEVATION JOINT 2  
1:5

- NOTES:
1. PROTECTIVE SYSTEM - COAL TAR EPOXY AS PER SPECIFICATION
  2. STEEL GRADE - NOMINALLY 250 MPa U.N.D.

JOHN HOLLAND CONSTRUCTION GROUP  
2 MARCO STREET, SUITE 101, PERTH, W.A.  
TELEPHONE 381 4222

MAUNSELL  
& PARTNERS PTY. LTD.  
CONSULTING ENGINEERS

BHP  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 12th Floor  
44 St George's Terrace  
PERTH, W.A. 6000

NO.	DATE	BY	CHKD.	DESCRIPTION
1	17-7-81	BRP	PMC	APPROVED FOR CONSTRUCTION (REDRAWN)
2	28-8-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
3	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
4	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
5	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
6	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
7	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
8	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
9	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
10	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION

NO.	DATE	BY	CHKD.	DESCRIPTION
1	17-7-81	BRP	PMC	APPROVED FOR CONSTRUCTION (REDRAWN)
2	28-8-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
3	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
4	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
5	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
6	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
7	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
8	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
9	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
10	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION

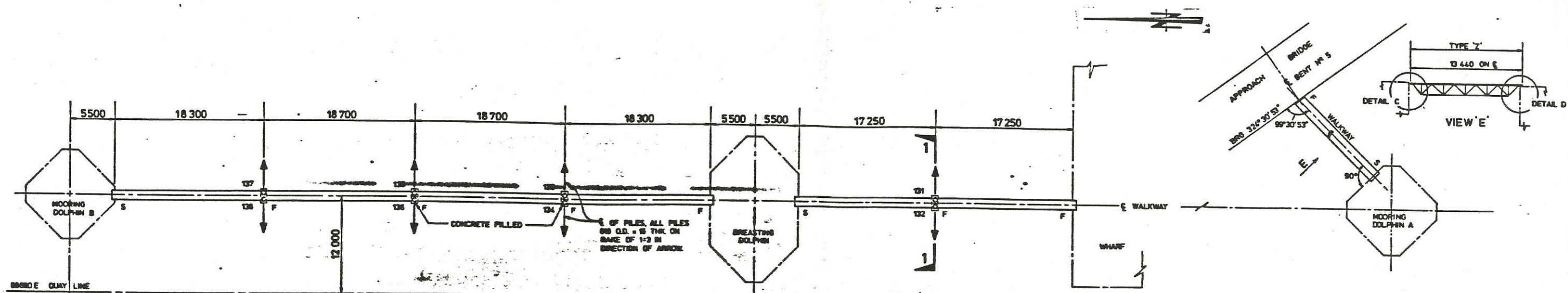
NO.	DATE	BY	CHKD.	DESCRIPTION
1	17-7-81	BRP	PMC	APPROVED FOR CONSTRUCTION (REDRAWN)
2	28-8-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
3	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
4	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
5	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
6	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
7	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
8	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
9	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION
10	12-9-81	BRP	PMC	CHECK & ISSUE FOR CONSTRUCTION

AS BUILT			
Woodside Offshore Petroleum Pty Ltd			
NORTH WEST SHELF DEVELOPMENT PROJECT			
MATERIALS OFFLOADING FACILITY			
FENDER DETAILS		SHEET 2	
SCALE	AS SHOWN	DRAWING NO.	G7400 DS 043.2
REVISION			3

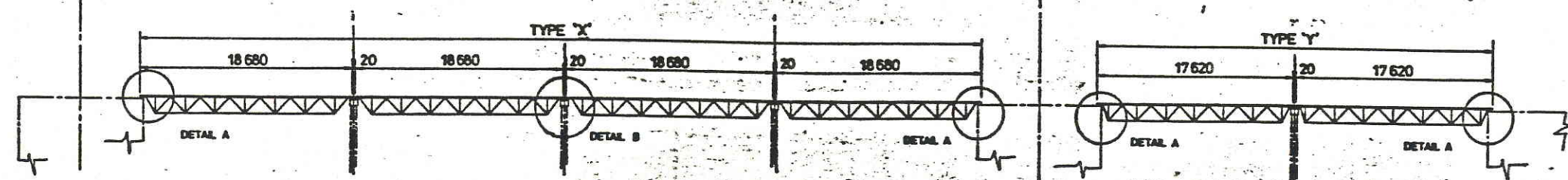




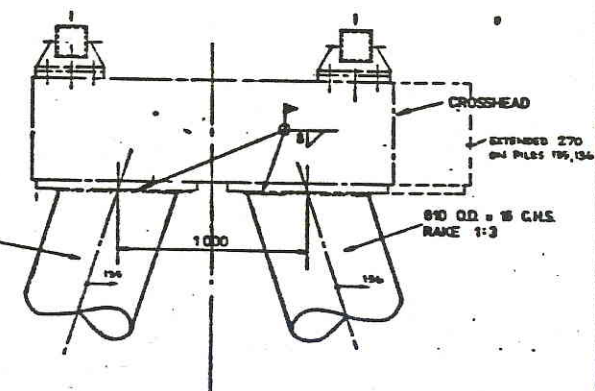




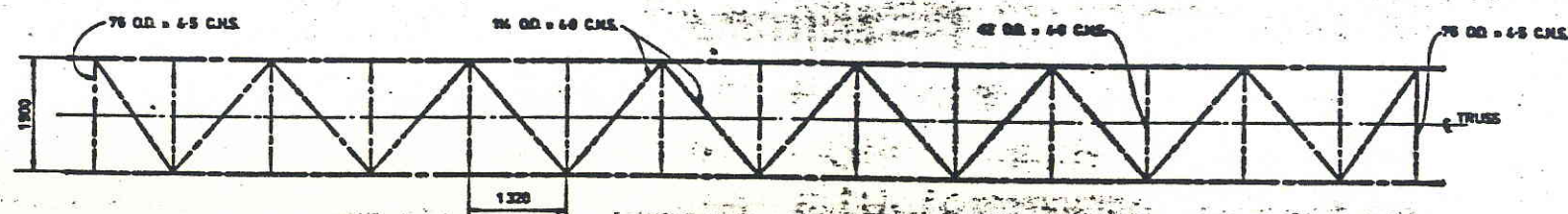
PLAN OF WALKWAYS  
1:200



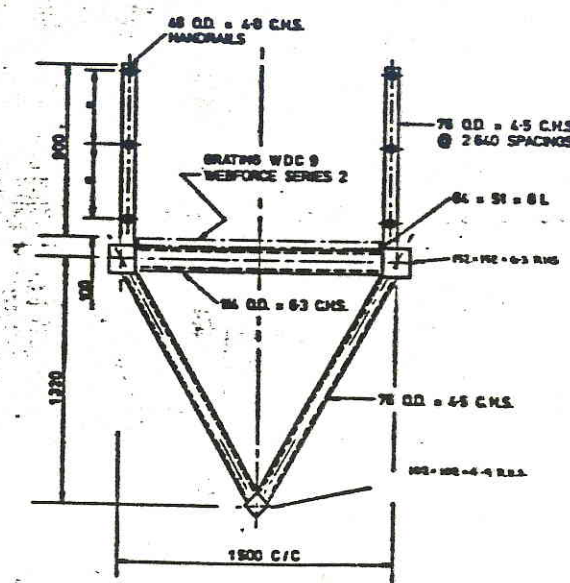
ELEVATION  
1:200



SECTION 1-1  
1:20



PLAN OF WALKWAY TRUSS  
1:50



SECTION 2-2  
1:20

- NOTES:
1. E DENOTES FIXED END  
S. SLIDING END
  2. PROTECTIVE SYSTEM  
EPOXY ZINC RICH PRIMER AND EPOXY MICACEOUS IRON OXIDE. AS PER SPECIFICATION.
  3. PILE REQUIRED CAPACITY  
1000 kN BASIC COMPRESSION  
300 kN BASIC TENSION
  4. PILE CONCRETE INFILL - SEE NOTE 8 DRG G7400 DS 038.4
  5. PILE PROTECTIVE SYSTEM - SEE NOTE 9 DRG G7400 DS 038.4

JOHN HOLLAND CONSTRUCTION GROUP  
7 HARDY STREET, SOUTH PERTH, W.A.  
TELEPHONE 267 4772

**MAUNSELL**  
S-PARTNERS PTY. LTD.  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
Cape Gage Tower, 200 Place,  
44 St George's Terrace,  
PERTH, W.A. 6000

NO.	DATE	BY	CHKD	DESCRIPTION
1	MAY 83	MM	GB	DRWG. WAS A4660 DG 044.1
2	MAY 83	MM	GB	AS BUILT - CONTRACT 1023 G
3	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
4	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
5	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
6	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
7	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
8	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
9	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
10	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION

NO.	DATE	BY	CHKD	DESCRIPTION
1	MAY 83	MM	GB	DRWG. WAS A4660 DG 044.1
2	MAY 83	MM	GB	AS BUILT - CONTRACT 1023 G
3	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
4	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
5	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
6	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
7	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
8	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
9	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
10	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION

NO.	DATE	BY	CHKD	DESCRIPTION
1	MAY 83	MM	GB	DRWG. WAS A4660 DG 044.1
2	MAY 83	MM	GB	AS BUILT - CONTRACT 1023 G
3	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
4	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
5	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
6	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
7	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
8	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
9	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
10	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION

NO.	DATE	BY	CHKD	DESCRIPTION
1	MAY 83	MM	GB	DRWG. WAS A4660 DG 044.1
2	MAY 83	MM	GB	AS BUILT - CONTRACT 1023 G
3	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
4	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
5	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
6	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
7	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
8	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
9	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION
10	JUN 83	MM	GB	APPROVED FOR CONSTRUCTION

AS BUILT
<b>Woodside Offshore Petroleum Pty Ltd</b>
NORTH WEST SHELF DEVELOPMENT PROJECT
MATERIALS OFFLOADING FACILITY
WALKWAY DETAILS SHEET 1
SCALE AS SHOWN
DRG NO G7400 DS 044.1
REVISION 2





WALKWAY "X" WALKWAY "Y"

20 CLEAR

200 170 170 200

350 C/C

TRUSS BRACKETS

FIXED END

BRIDGE

WALKWAY 'Z'

50

170 200

TRUSS BRACKET

TOP OF GRATING

1"

W 6.576 (C.D.)

SUPPORT BRACKET

Technical drawing of a dolphin structure. The drawing includes a cross-section and a plan view. The cross-section shows a vertical pile supporting a horizontal beam, with dimensions 200, 170, and 220. The plan view shows a V-shaped structure with a horizontal beam. The text "DOLPHIN 7. 6.5 (C.D)" is present.

PLAN

300

100

100

125

125

370

4" N° 25 Ø HOLES FOR M24 BOLTS AT FIXED ENDS

SLOTTED FOR SLIDING ENDS & WALKWAY 'Z'

## PLAN

180 in

75 in

30°

15 in

WELD BRACKET TO WALKWAY TOP CHORD

15 E

15N° 26 Ø HOLES FOR M24 BOLTS  
 ♦ DENOTES BOLT HEADS ARE TO BE WELDED TO LB FLANGE

250 625 625 250

100 130 130 100

Ø 2

The drawing shows a symmetrical assembly with a central shaded rectangular area labeled Ø 2. The overall width is divided into four equal segments of 250 units each, with a total width of 1000 units. The overall height is divided into four equal segments of 100 units each, with a total height of 400 units. The central shaded area is 625 units wide and 130 units high. There are 15 holes arranged in a 3x5 grid on each side of the central area. A note indicates that 15N° 26 Ø holes are for M24 bolts and that the bolt heads are to be welded to the LB flange.

## PLAN

## PLAN

30 50

200 35

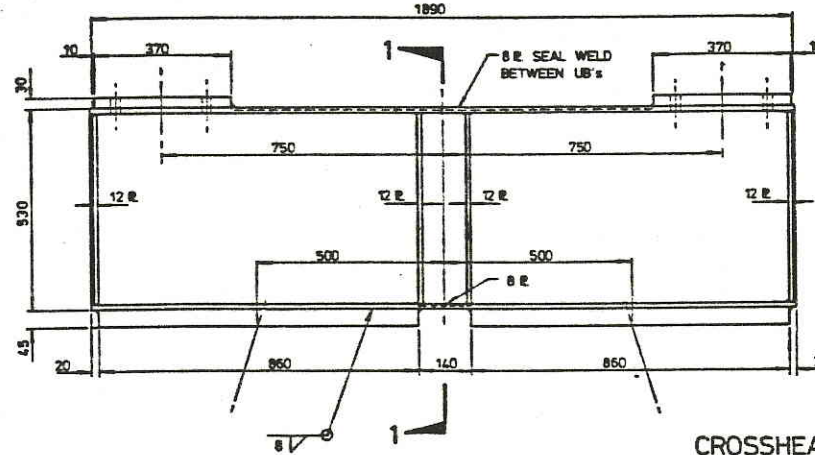
M24 BOLTS.  
HEADS WELDED TO  
PLATE

20 50

[illegible]

### PLAN

\* AVERAGE AT WALKWAY 'Z'  
LE HEIGHT OF SADDLE VARIES  
TO ACCOMMODATE SLOPE  
OF WALKWAY



680

150 280 C.C. 150

12 E 12 E 12 E

200

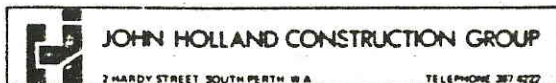
END PLATES BETWEEN U.B.'S PROFILED TO SUIT U.B. WEB RADIUS FOR SEAL WELDING

530 UB 82

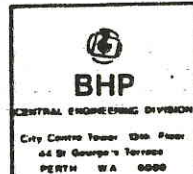
SECTION 1-1

- NOTES:
1. ALL WELDS TO BE CONT. 6FW UNO.
  2. R.H.S. TOP CHORD GRADE 250 OTHERS 200
  3. ALL OTHER STEEL NOMINALLY GRADE 250
  4. FOR PROTECTIVE SYSTEM SEE DRG 67400 DS 044-1

AS BUILT




**MAUNSELL**  
**& PARTNERS PTY LTD**  
**CONSULTING ENGINEERS**



67400D5044 1 DRAWING NO.		WALKWAY DETAILS SH 1	TITLE	

[illegible]

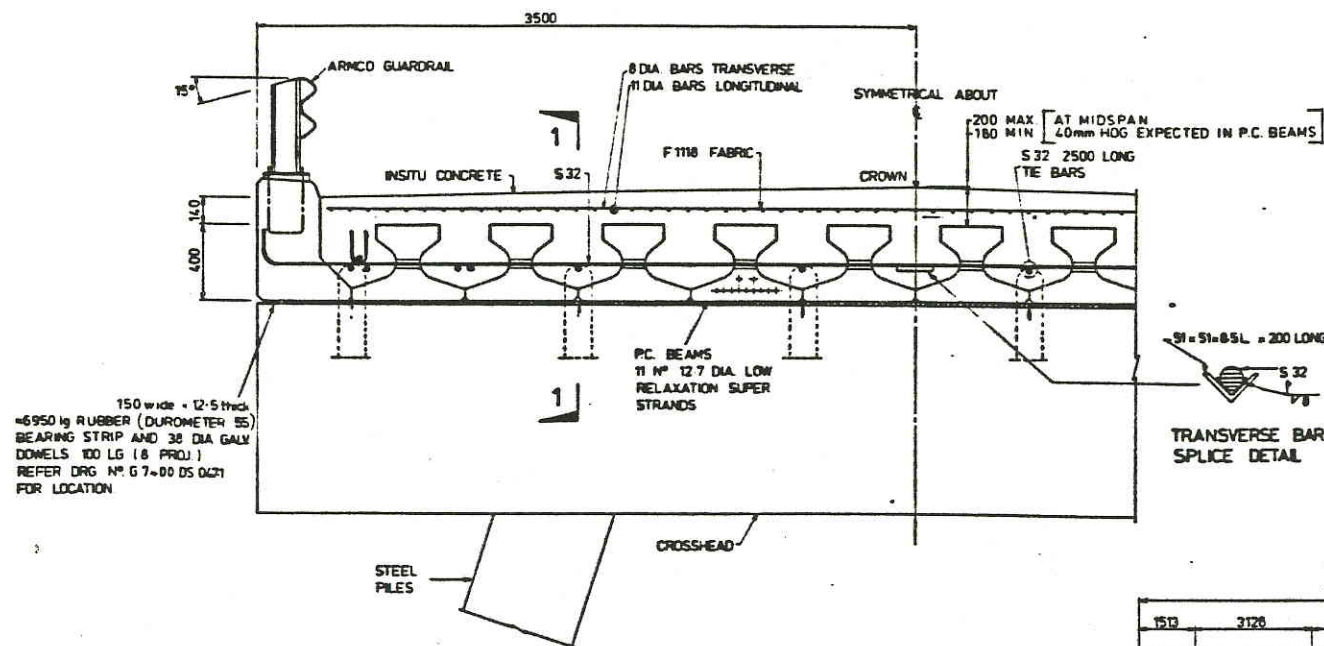
DATE	30 10 81
CHECKED	<i>J. J. J.</i>
APPROVED	<i>[Signature]</i>
APPROVED	
APPROVED	
APPROVED	
APPROVED	

 <b>Woodside Offshore Petroleum Pty Ltd</b>			
<b>NORTH WEST SHELF DEVELOPMENT PROJECT</b>			
<b>MATERIALS OFFLOADING FACILITY</b>			
<b>WALKWAY DETAILS</b>			<b>SHEET 2</b>
SCALE	AS SHOWN	DRAWING NO	REV
		G 7400 DS 044-2	2

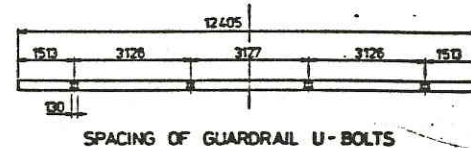




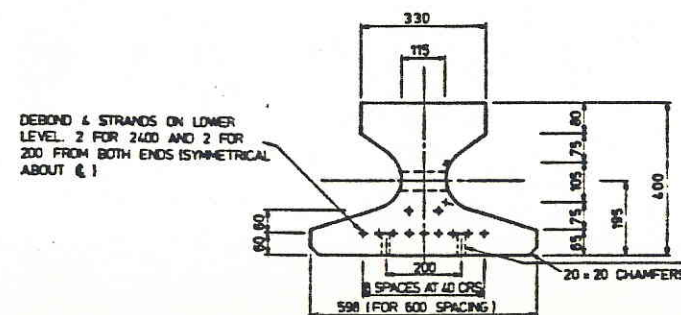




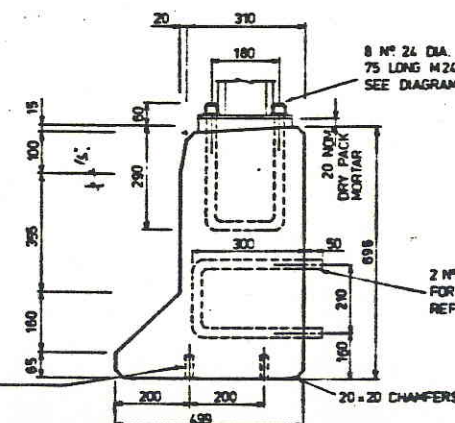
TYPICAL SECTION THROUGH DECK  
1:20



SPACING OF GUARDRAIL U-BOLTS



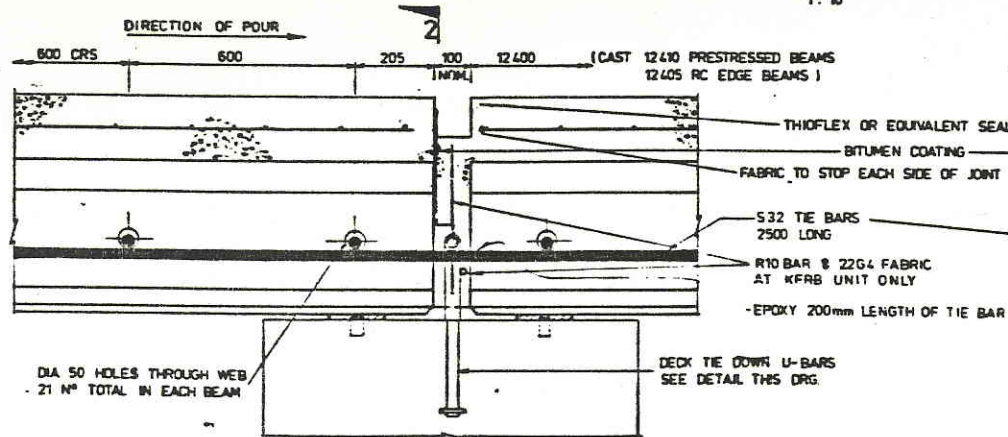
CONCRETE AND PRESTRESS DETAILS OF BEAMS  
1:10



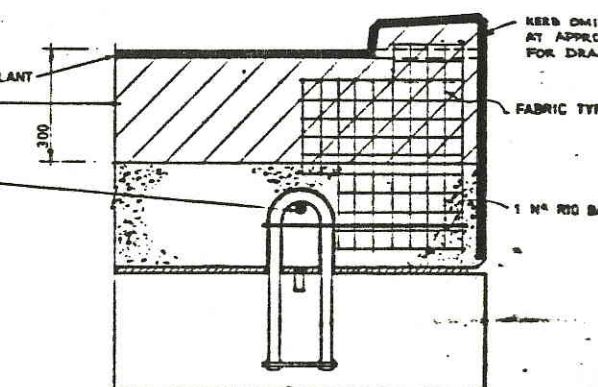
END VIEW ON PRESTRESSED BEAM

NOTE: ENDS OF P.C. BEAMS TERMINATING AT ABUT & WHARF TO BE PAINTED WITH 2 COATS OF 'DINET' 2 PACK EPOXY 'COFON EAS'

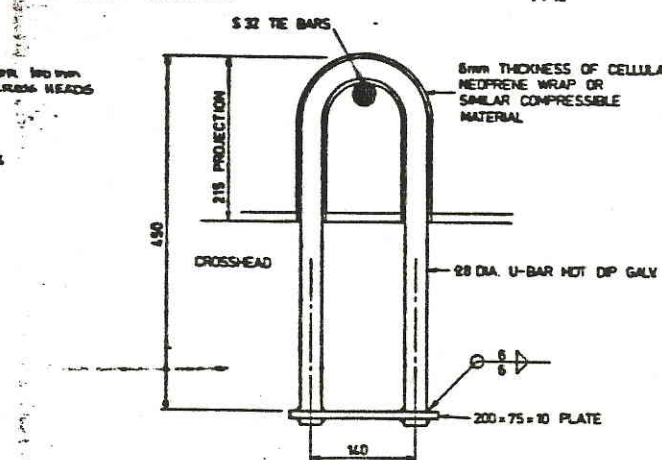
TYPICAL REINFORCEMENT DETAILS  
1:10



SECTION 1-1 - TYPICAL AT CROSSHEADS  
1:10



SECTION 2-2 - THROUGH CONSTRUCTION JOINT  
1:10



DECK TIE-DOWN DETAIL  
1:5

AS BUILT

- NOTES:
- CONCRETE - 28 DAY STRENGTH  
45 MPa FOR PRECAST BEAMS  
35 MPa FOR INSITU CONCRETE  
MINIMUM CEMENT CONTENT 320 kg/m³  
MAXIMUM WATER CEMENT RATIO 0.45
  - PRECAST EDGE BEAMS TO BE CAST 12405 LONG WITH 25 UPWARD PARABOLIC CAMBER
  - PRESTRESSED BEAMS TO BE CAST FLAT 12410 LONG  
11 # 12.7 DIA. LOW RELAXATION SUPER GRADE STRANDS PER BEAM  
INITIAL JACKING LOAD OF 147 kN PER STRAND (6mm DRAW-IN LOSS OVER 40m ALLOWED FOR)
  - U-BOLTS TO BE PROVIDED TO SUPPORT THE WALKWAY THESE ARE TO BE CAST AT 600 AND 800 FROM THE ENDS OF TWO EDGE BEAMS, SYMMETRICAL ABOUT BENT 5
  - 30 DIA DOWELS FOR BEARING ARE TO BE PROVIDED 200 FROM THE ENDS OF ALL BEAMS AT THE ABUTMENT AND WHARF
  - ALL EXPOSED CAST IN FITTINGS TO BE HOT DIP GALVANISED
  - CONC. STRENGTH 15 MPa MIN FOR INSITU DECK BEFORE 101 BHP OR CONCRETE TRUCK CAN TRAVERSE

**JOHN HOLLAND CONSTRUCTION GROUP**  
7 HARDY STREET SOUTH PERTH W.A.  
TELEPHONE 281 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower 12th Floor  
64 St George's Terrace  
PERTH W.A. 6000

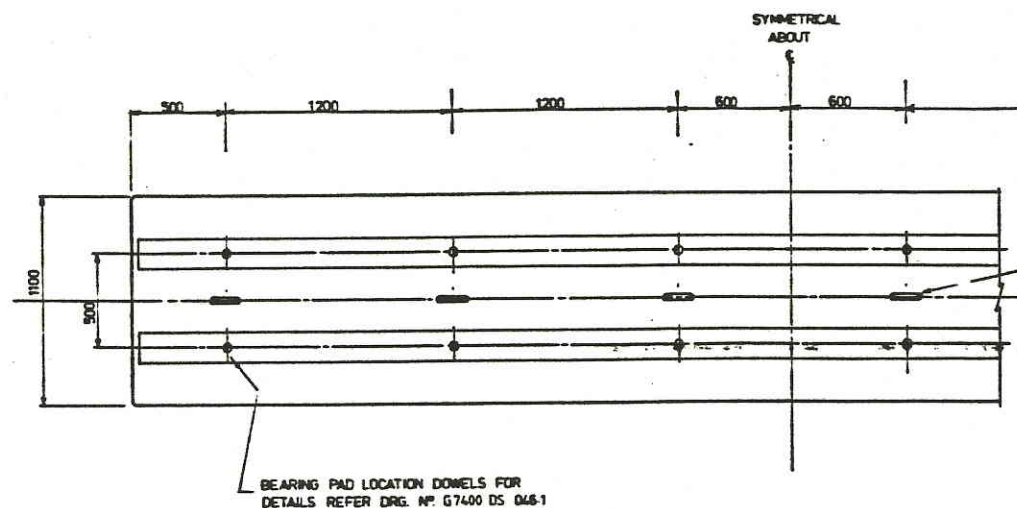
NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 85	N.M.		DRWG. WAS A2660 DS 046.1			
1	MAR 85	G.B.		AS BUILT - CONTRACT 1023 G			
0	6-5-82	G.B.		APPROVED FOR CONSTRUCTION			
C	24-3-82	W.H.		Rubber bearing strip detail location altered			
B	19-3-82	R.H.		RUBBER BEARING STRIP & CONST JOINT AMENDED			
A		BRP		INITIAL ISSUE			
G7400 DS 045.1 APPROACH BRIDGE GENERAL ARRANGEMENT							
DRAWING NO							
TITLE							
REFERENCE DRAWINGS							

NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 85	N.M.		DRWG. WAS A2660 DS 046.1			
1	MAR 85	G.B.		AS BUILT - CONTRACT 1023 G			
0	6-5-82	G.B.		APPROVED FOR CONSTRUCTION			
C	24-3-82	W.H.		Rubber bearing strip detail location altered			
B	19-3-82	R.H.		RUBBER BEARING STRIP & CONST JOINT AMENDED			
A		BRP		INITIAL ISSUE			
G7400 DS 045.1 APPROACH BRIDGE GENERAL ARRANGEMENT							
DRAWING NO							
TITLE							
REFERENCE DRAWINGS							

DRG	BRP
DATE	11.9.81
CHECKED	P.W.S.
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

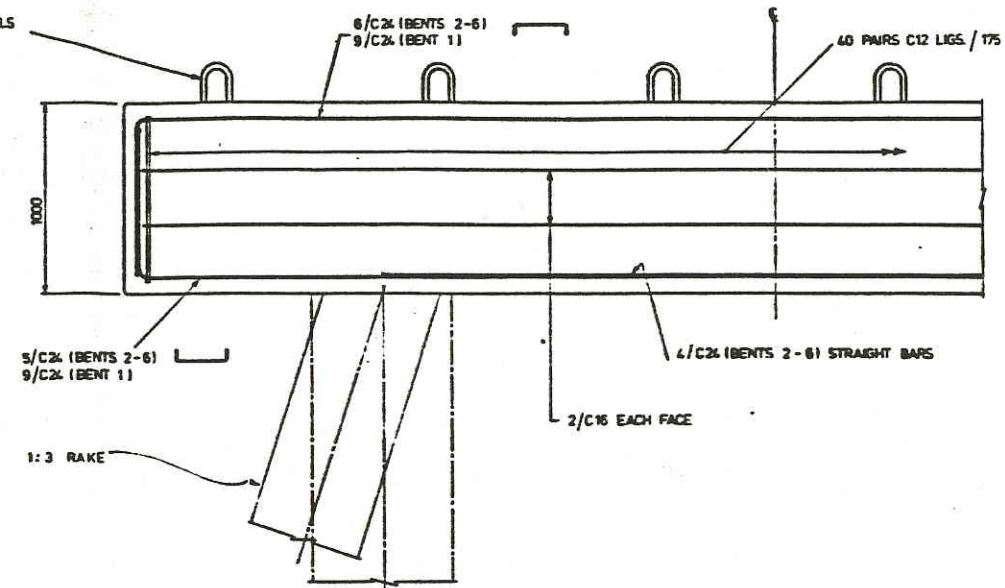
<b>Woodside Offshore Petroleum Pty Ltd</b>		
NORTH WEST SHELF DEVELOPMENT PROJECT		
MATERIALS OFFLOADING FACILITY		
APPROACH BRIDGE - DECK DETAILS		
SCALE	DRAWING NO	REVISION
AS SHOWN	G 7400 DS 046.1	2



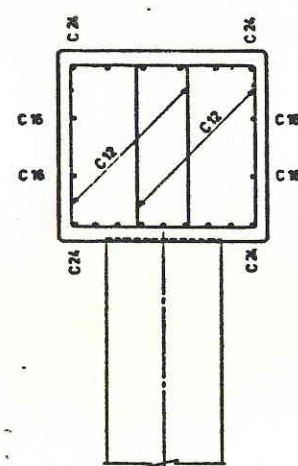


PLAN ON CROSSHEAD  
1:20

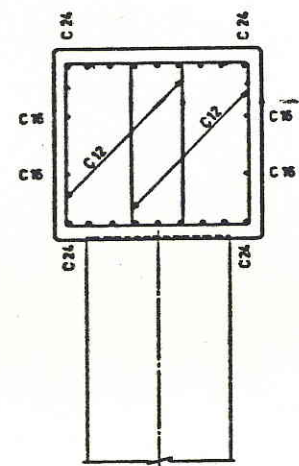
DECK TIE DOWN U-BARS FOR DETAILS  
SEE DRG. NO. G 7400 DS 045-1



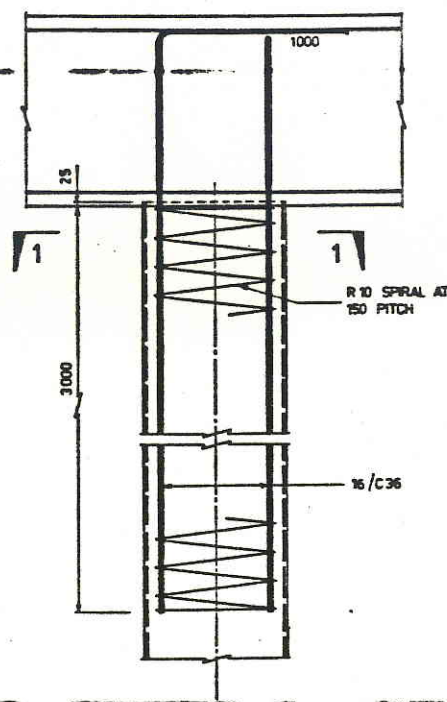
ELEVATION  
1:20



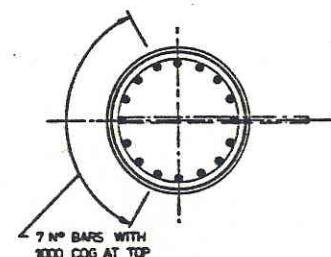
SECTION THRU BENTS 2-6  
1:20



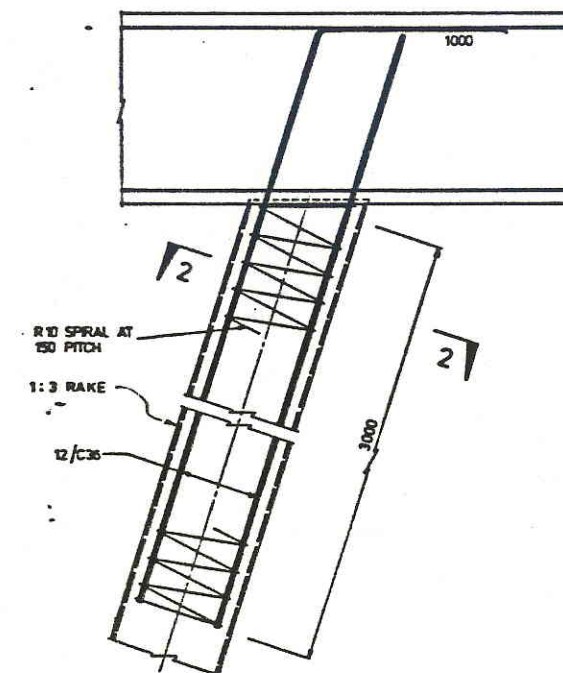
SECTION THRU BENT 1  
1:20



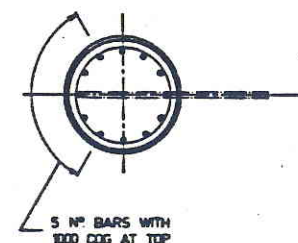
PILE REINF. BENT 1  
1:20



SECTION 1-1  
1:20



PILE REINF. BENTS 2-6  
1:20



SECTION 2-2  
1:20

- NOTES:
1. CONCRETE STRENGTH  $F_c = 35 \text{ MPa}$
  2. REINFORCEMENT  
C - DENOTES COLD WORKED DEFORMED GRADE BARS  
R - DENOTES ROUND STRUCTURAL GRADE BARS
  3. COVER TO REINFORCEMENT  
CROSSHEAD 65mm  
PILES 40mm
  4. PILE CONCRETE INFILL - SEE NOTE 8 DRG NO G7400 DS 038-1
  5. PILES NO 1-6 FILLED WITH CONCRETE. ALL OTHER PILES AS PER DETAIL THIS DRAWING.

AS BUILT

**JOHN HOLLAND CONSTRUCTION GROUP**  
7 HARDY STREET, SOUTH PERTH, W.A.  
TELEPHONE 387 4222

**MAUNSELL**  
& PARTNERS PTY. LTD.  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 13th Floor  
44 St George's Terrace  
PERTH, W.A. 6000

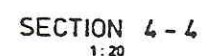
DRWING NO	TITLE	REFERENCE DRAWINGS
G7400 DS040-4	WHARF REINFORCEMENT SHEET 4	
DS045-1	APPROACH BRIDGE GENERAL ARRANGEMENT	

NO	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	M.M.		DRWG. WAS A 4600 DS 047-1			
1	MAR 83	G.B.		AS BUILT - CONTRACT 1823 G			
0	6 5 82	G.B.		APPROVED FOR CONSTRUCTION			
C	30 4 82	BRP		Concrete fill note deleted			
B	26 5 82	BRP		Bearing pad detail deleted			
A		BRP		INITIAL ISSUE			

DRWING	BRP
DATE	21-10-81
CHECKED	BRP
APPROVED	BRP
APPROVED	BRP
APPROVED	BRP
APPROVED	BRP

<b>Woodside Offshore Petroleum Pty Ltd</b>		
NORTH WEST SHELF DEVELOPMENT PROJECT		
MATERIALS OFFLOADING FACILITY		
APPROACH BRIDGE - BENT DETAILS		
SCALE	AS SHOWN	REVISION
		2






- AS BUILT

SHEET 1

SCALE	AS SHOWN	DRAWING NO.	G 7400 DS 0483	REV.	2
-------	----------	-------------	----------------	------	---

**MAUNSELL**  
 & PARTNERS PTY. LTD.  
 CONSULTING ENGINEERS

  
**BHP**  
CENTRAL BUSINESS PRINTER DIVISION  
City Centre Tower 1216 Plover  
44 St George's Terrace  
PERTH WA 6000

77-00 DS. 6-8 3	APPROACH BRIDGE ABUT & MISC DETAILS	SHEET 3
" " 04-8 2	" " " "	" "
" " 04-5 1	" " GENERAL ARRANGEMENT	SHEET 2
DRAWING NO.	TITLE	
REFERENCE DRAWINGS		

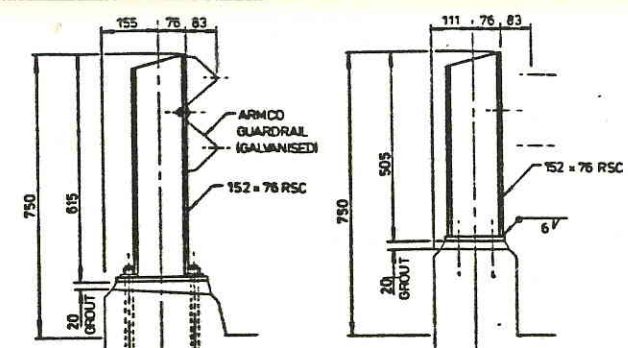
				BSP	PRINCE JN.
2	MAY 83	M.M			
1	MAR 83	G.D.			
O	6 9 81:	G.B			
B	8 2 82	P.W			
A		BRP			
DP	DATE	BY	CHECK	DESCRIPTION	ENGR ENGA ENG
				DRAWG WAS A4660 DG Q&B-1 AS BUILT - CONTRACT 1023 G APPROVED FOR CONSTRUCTION MASS CONCRETE UNDER ABUT SHOWN INITIAL ISSUE	ICD PMC <del>PHS</del> " - DE K

DRUGS	B R P
DATE	9-10-81
CHECKED	P.W.S.
APPROVED	<i>[Signature]</i>
APPROVED	
APPROVED	
APPROVED	
APPROVED	

AS SHOWN

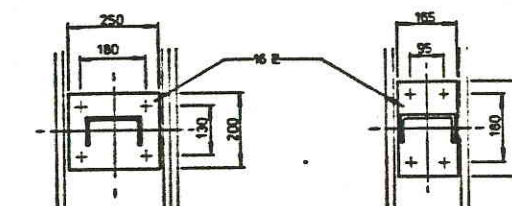
DRUSSY HSC, 804	REV 115
G 7400 DS 048.1	2





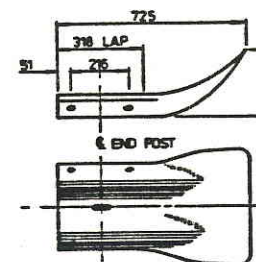
BRIDGE &amp; WHARF

**ABUTMENT**



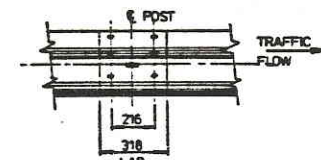
### GUARDRAIL POSTS

1:10



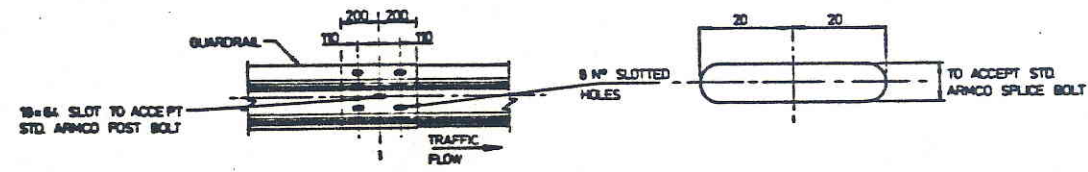
### STANDARD TERMINAL SECTION

NOT TO SCALE



RAIL SPLICE

NOT TO SCALE



### GUARDRAIL EXPANSION DETAIL

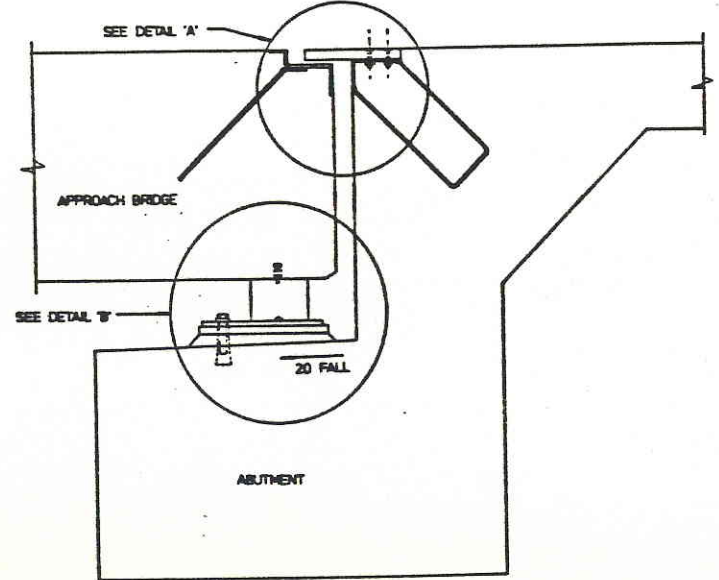
(USE NYLOC NUTS OR SIMILAR)  
NOT TO SCALE

NOT TO SCALE

- NOTE:
- 1 ALL CAST IN FITTINGS TO BE HOT DIP GALV
  - 2 GUARDRAIL POSTS - PROTECTIVE TREATMENT  
HOT DIP GALVANISED

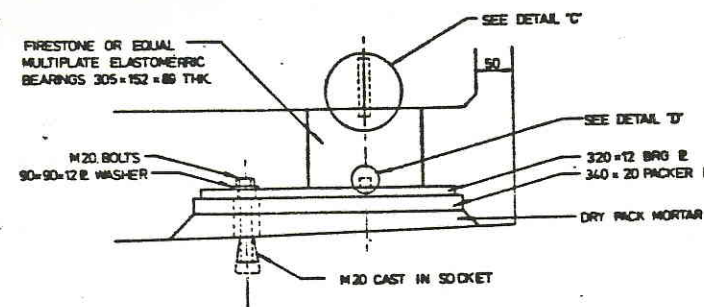
DETAIL 'A' EXPANSION JOINT

**1:2**



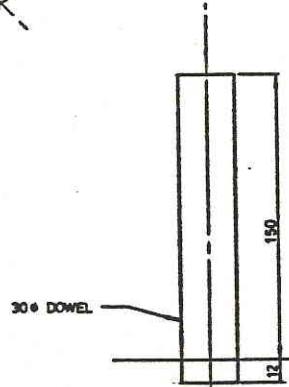
SECTION 1-

1:10



DETAIL 'B' BEARING

9:5



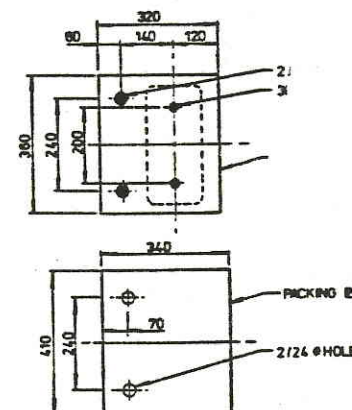
DETAIL 'C' TOP DOWEL

**1:2**



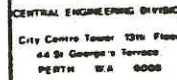
DETAIL 'D' BOTTOM DOWEL

1:2



### BEARING & PACKER PLATES


4:10



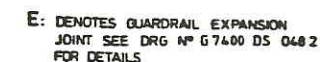
DRAWING NO.	TITLE
	REFERENCE DRAWINGS

[illegible]

DRAWN	DSR
DATE	26 10 81
CHECKED	<del>_____</del>
APPROVED	426
APPROVED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

 <b>Woodside Offshore Petroleum Pty Ltd</b>		
NORTH WEST SHELF DEVELOPMENT PROJECT		
MATERIALS OFFLOADING FACILITY		
APPROACH BRIDGE & ABUTMENT		
MISCELLANEOUS DETAILS		SHEET 2
SCALE	DRAWING NO	REVISION
AS SHOWN	G 7400 DS 048.2	2



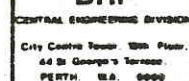


1-200



18

AS BUILT

[illegible]

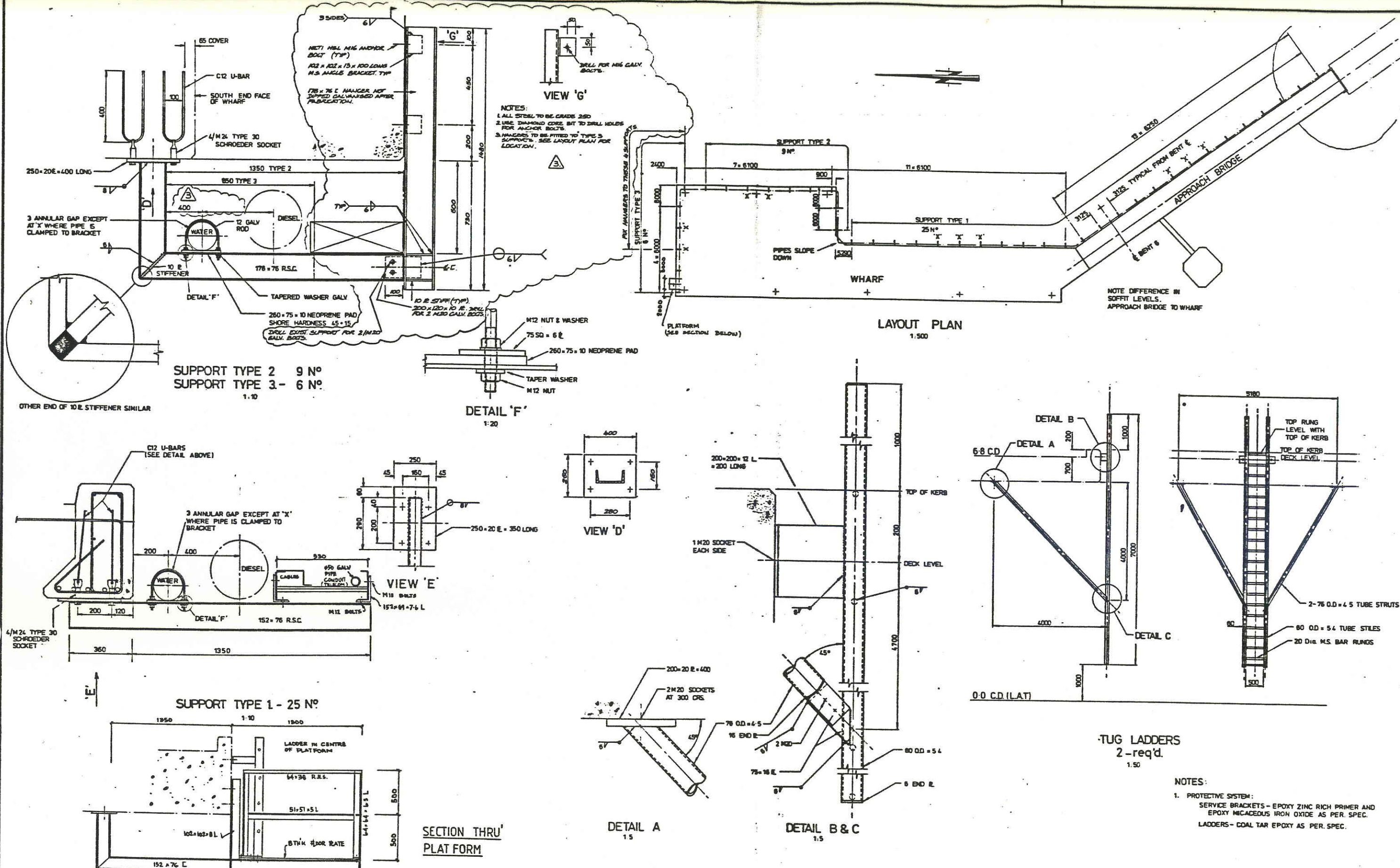
DRAWN	DSR
DATE	19-10-81
CHECKED	<i>JSK</i>
APPROVED	<i>426</i>
APPROVED	
APPROVED	
APPROVED	
APPROVED	

NORTH WEST SHELF DEVELOPMENT PROJECT	
MATERIALS OFFLOADING FACILITY	
APPROACH BRIDGE & ABUTMENT	
MISCELLANEOUS DETAILS	SHEET

SHEET 3

SCALE	DRAWING NO.
AS SHOWN	G7400 DS 048-3





**JOHN HOLLAND CONSTRUCTION GROUP**  
7 HARDY STREET, SOUTH PERTH W.A. TELEPHONE 287 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 12th Floor  
44 St George's Terrace  
PERTH W.A. 6000

DRAWING NO.	TITLE
	REFERENCE DRAWINGS

NO.	DATE	BY	CHKD.	DESCRIPTION	REVISIONS
3	27.5.85	JH		HANGERS ADDED TO TYPE 3 SUPPORTS	
2	MAY 85	JH		DRG WAS A4260 DG 051.1	
1	MAR 85	GB		AS BUILT - CONTRACT 1023 L	
0	6.5.82	GB		APPROVED FOR CONSTRUCTION	
1		DSR		INITIAL ISSUE	

DRAWN	DSR
DATE	16.11.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

**AS BUILT**

**Woodside Offshore Petroleum Pty Ltd**

**NORTH WEST SHELF DEVELOPMENT PROJECT**

**MATERIALS OFFLOADING FACILITY**

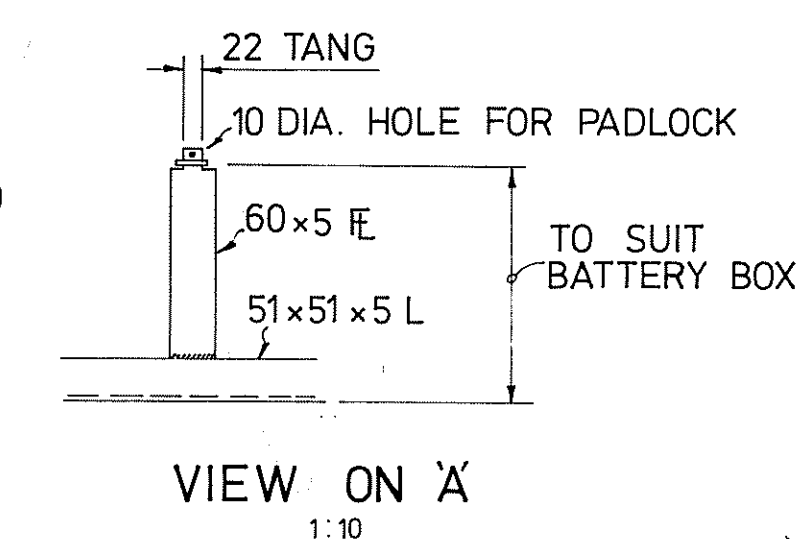
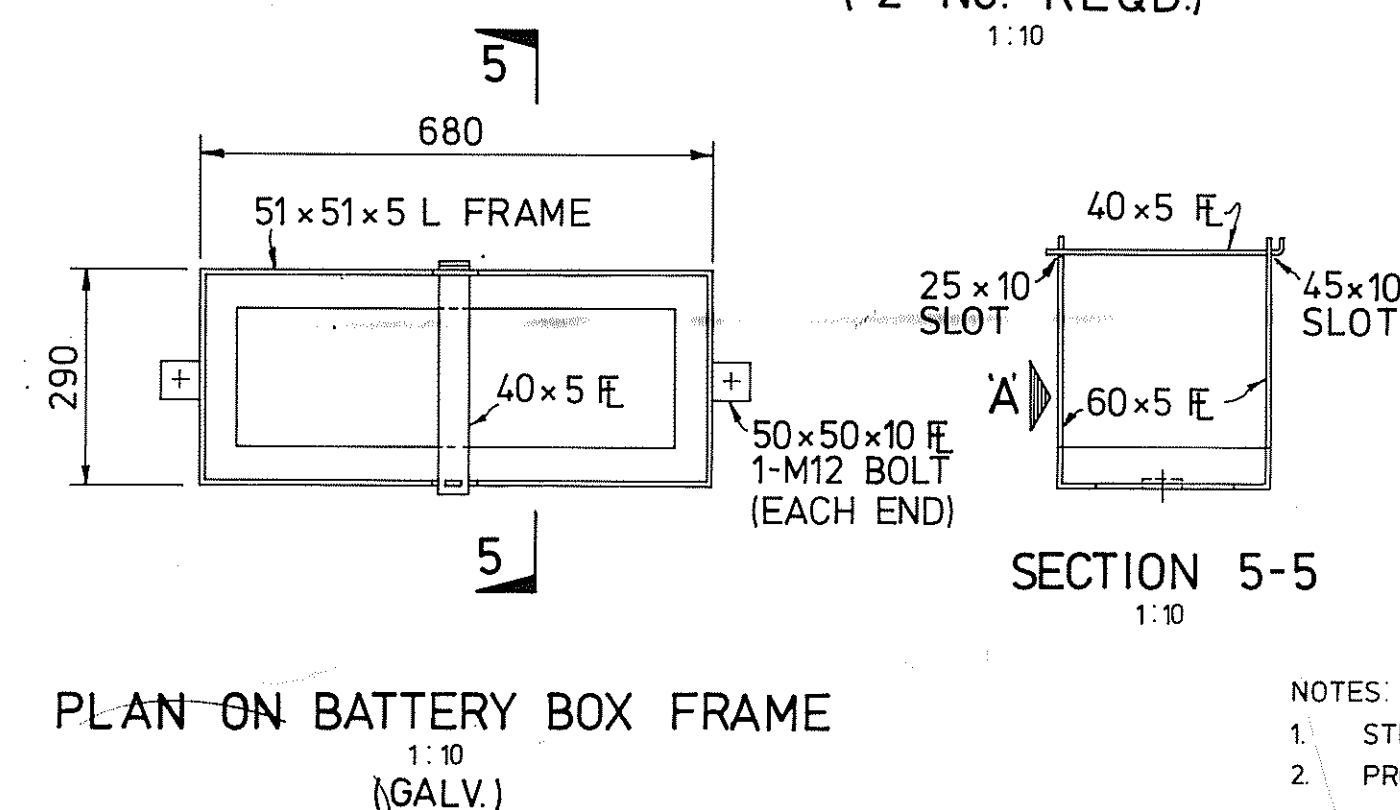
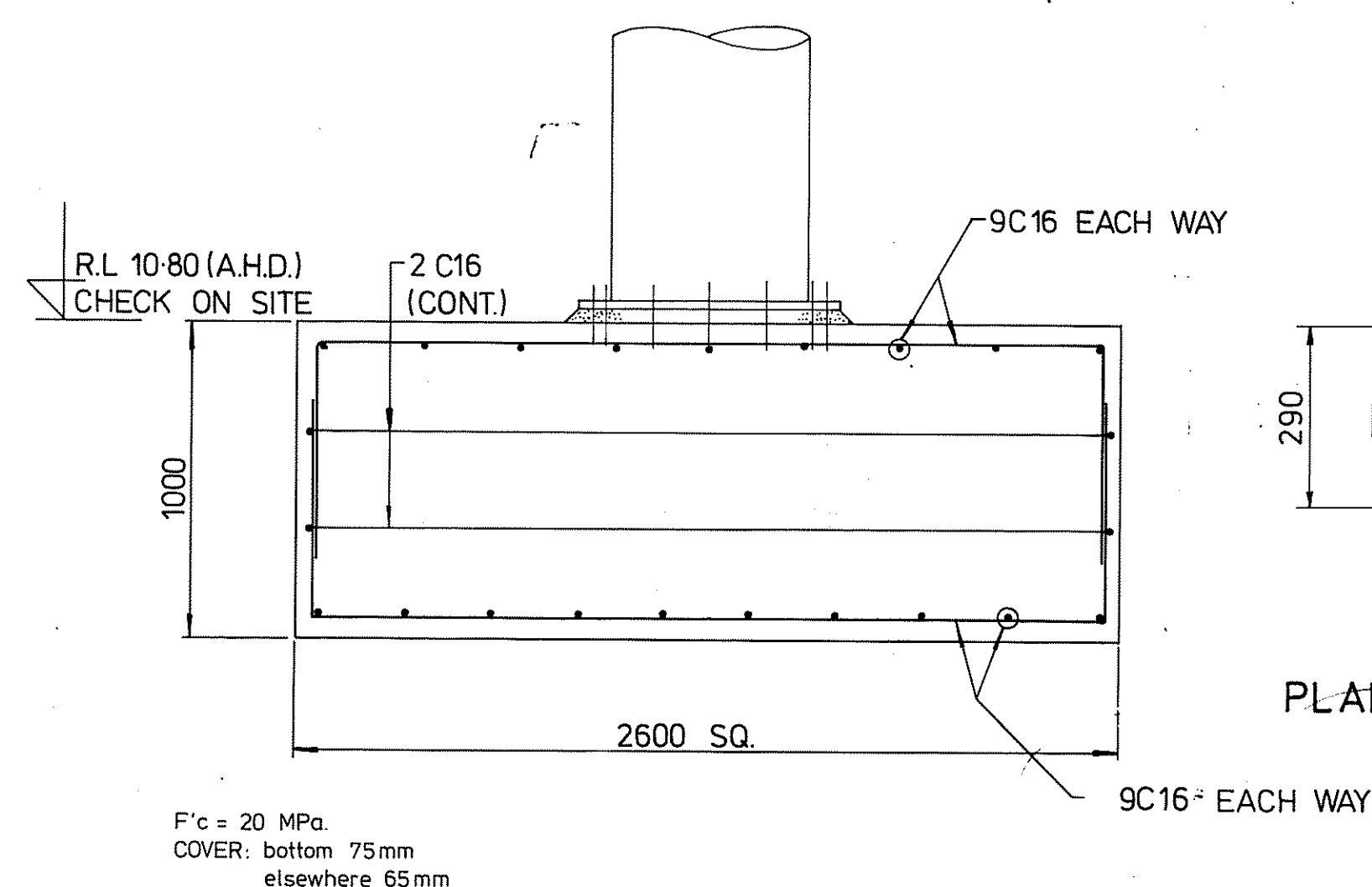
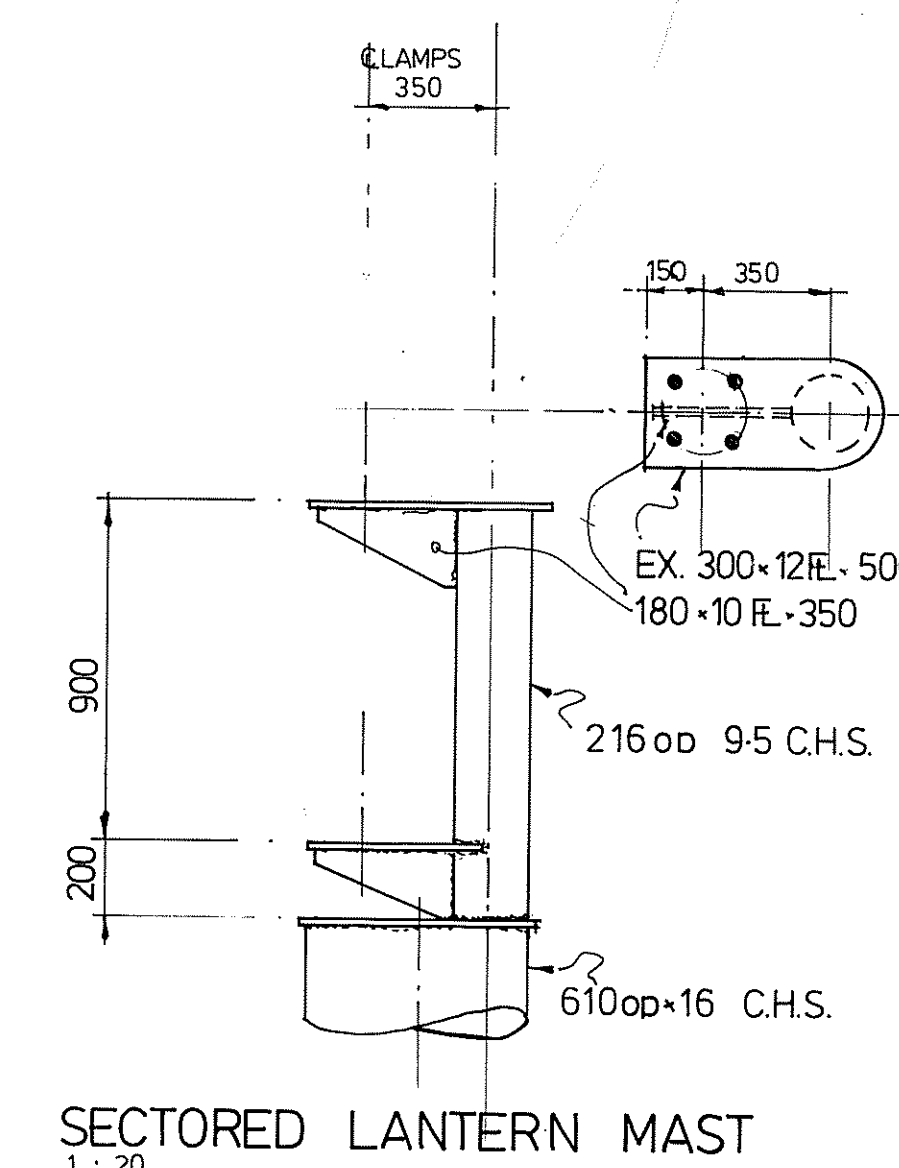
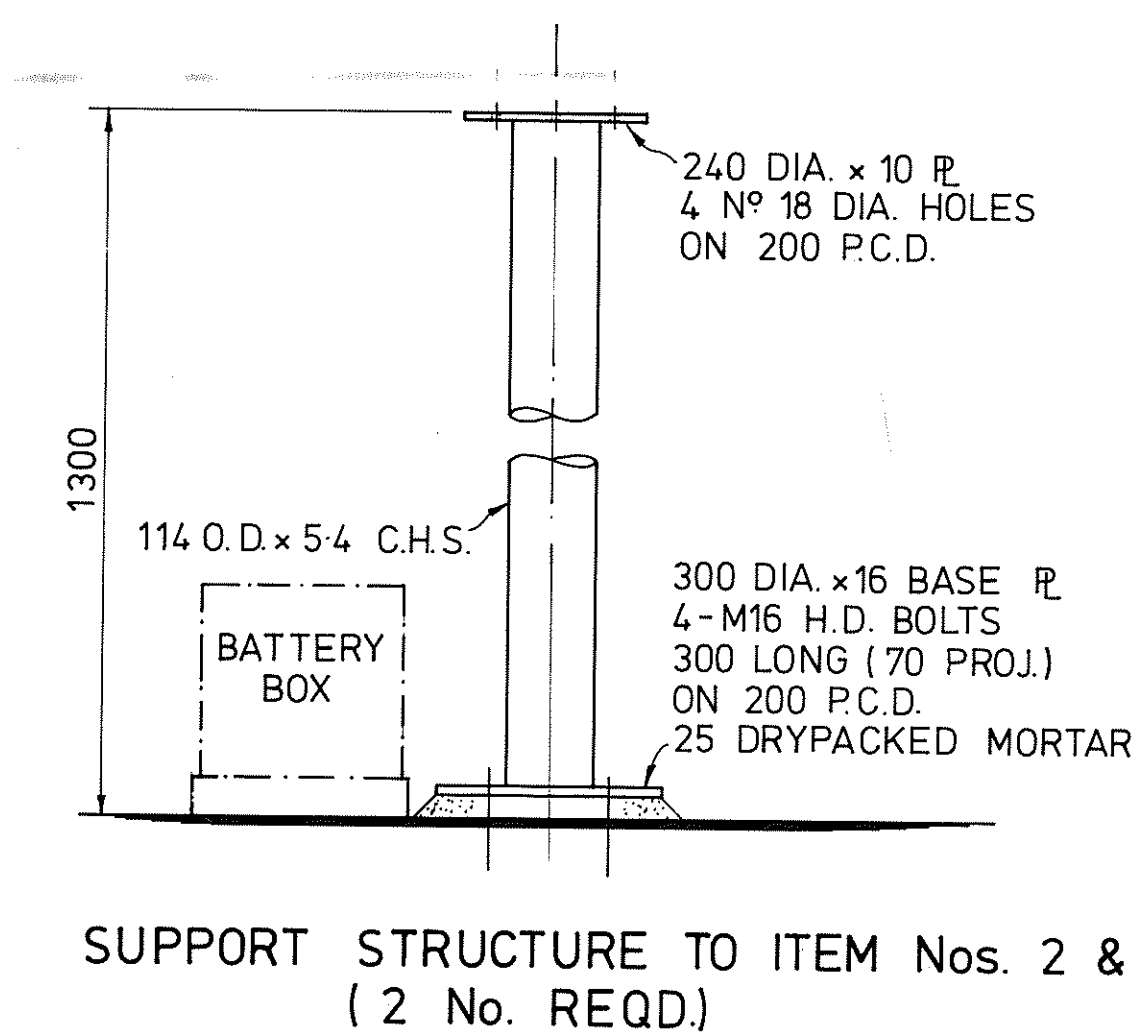
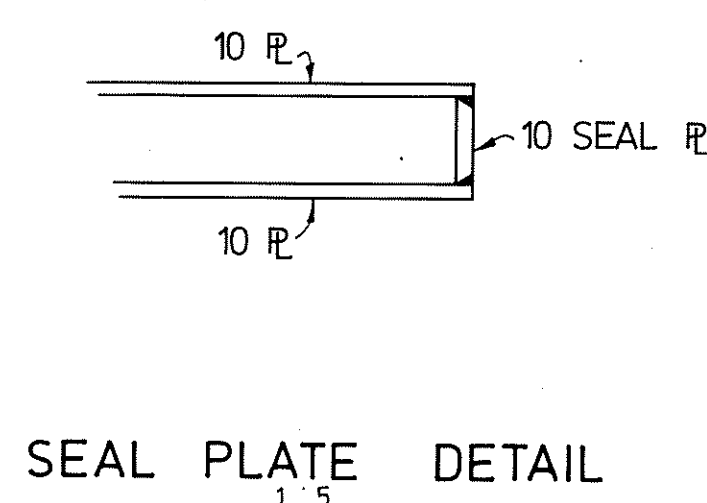
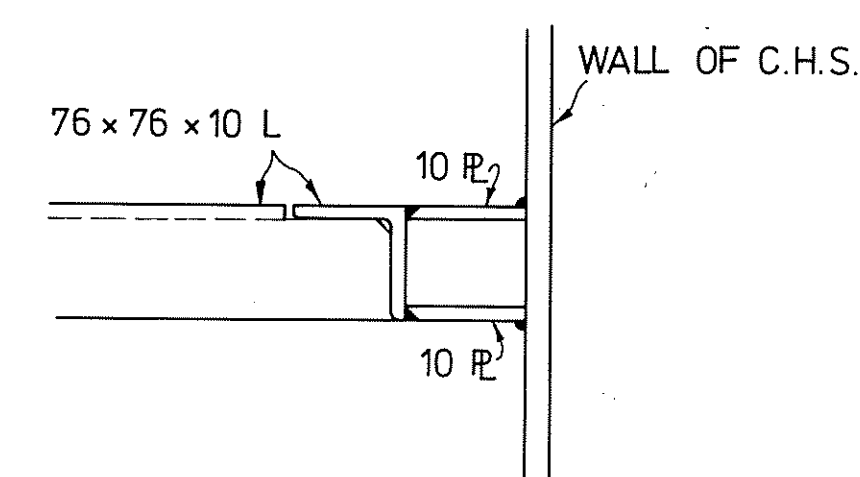
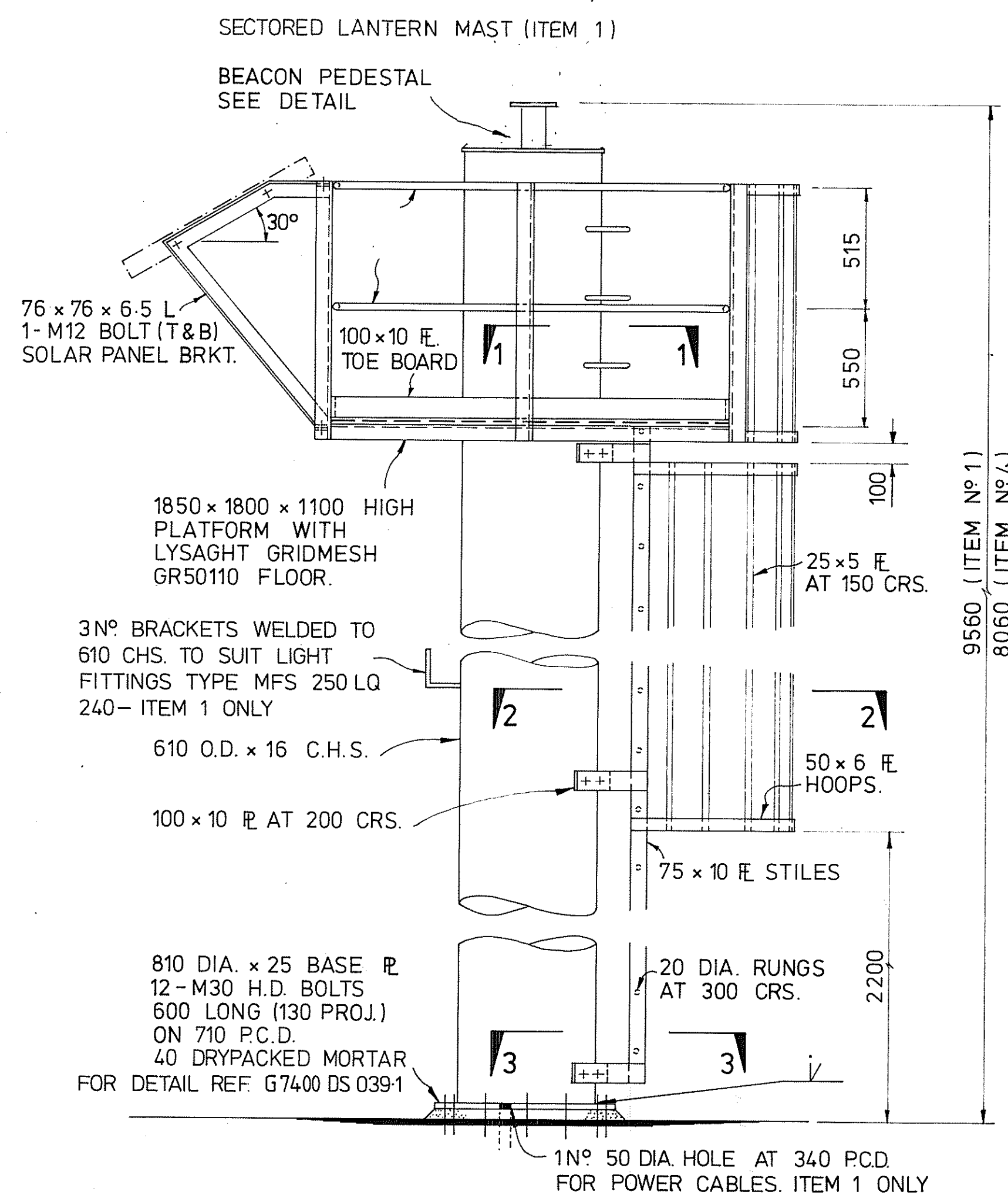
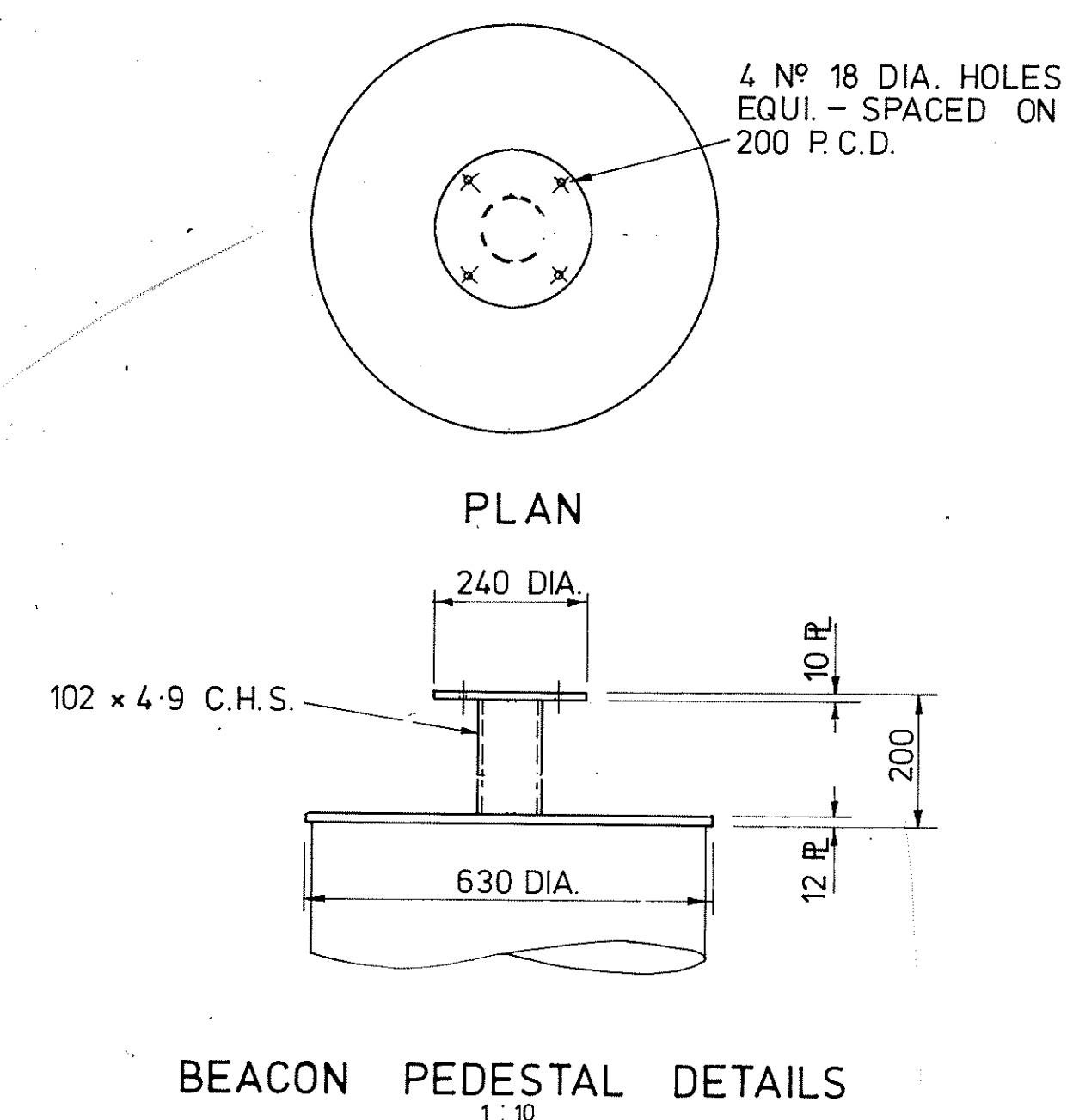
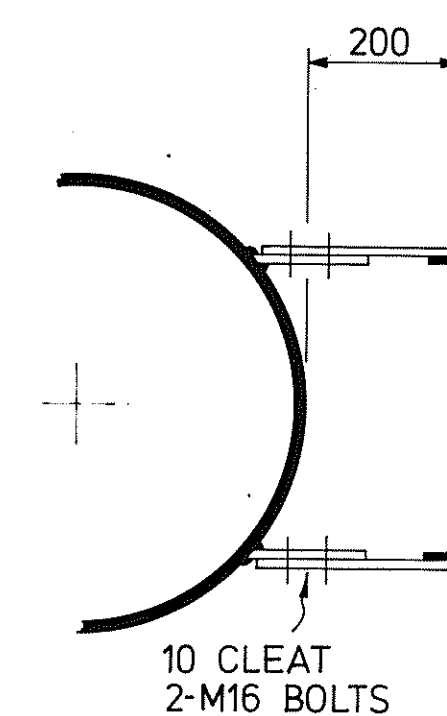
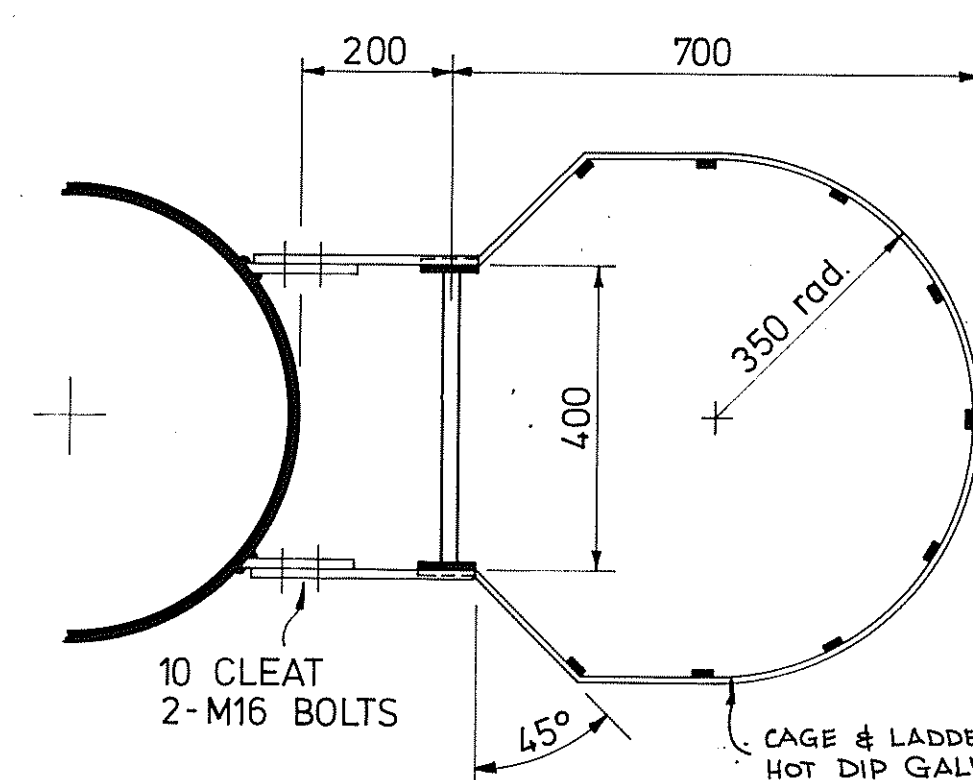
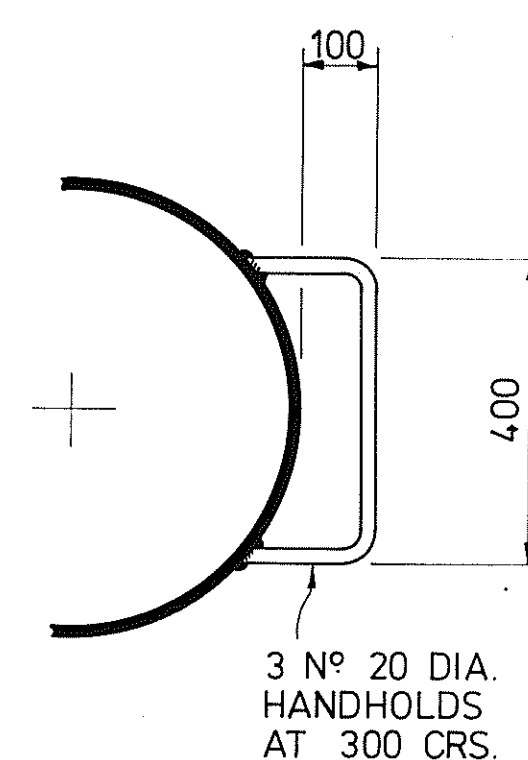
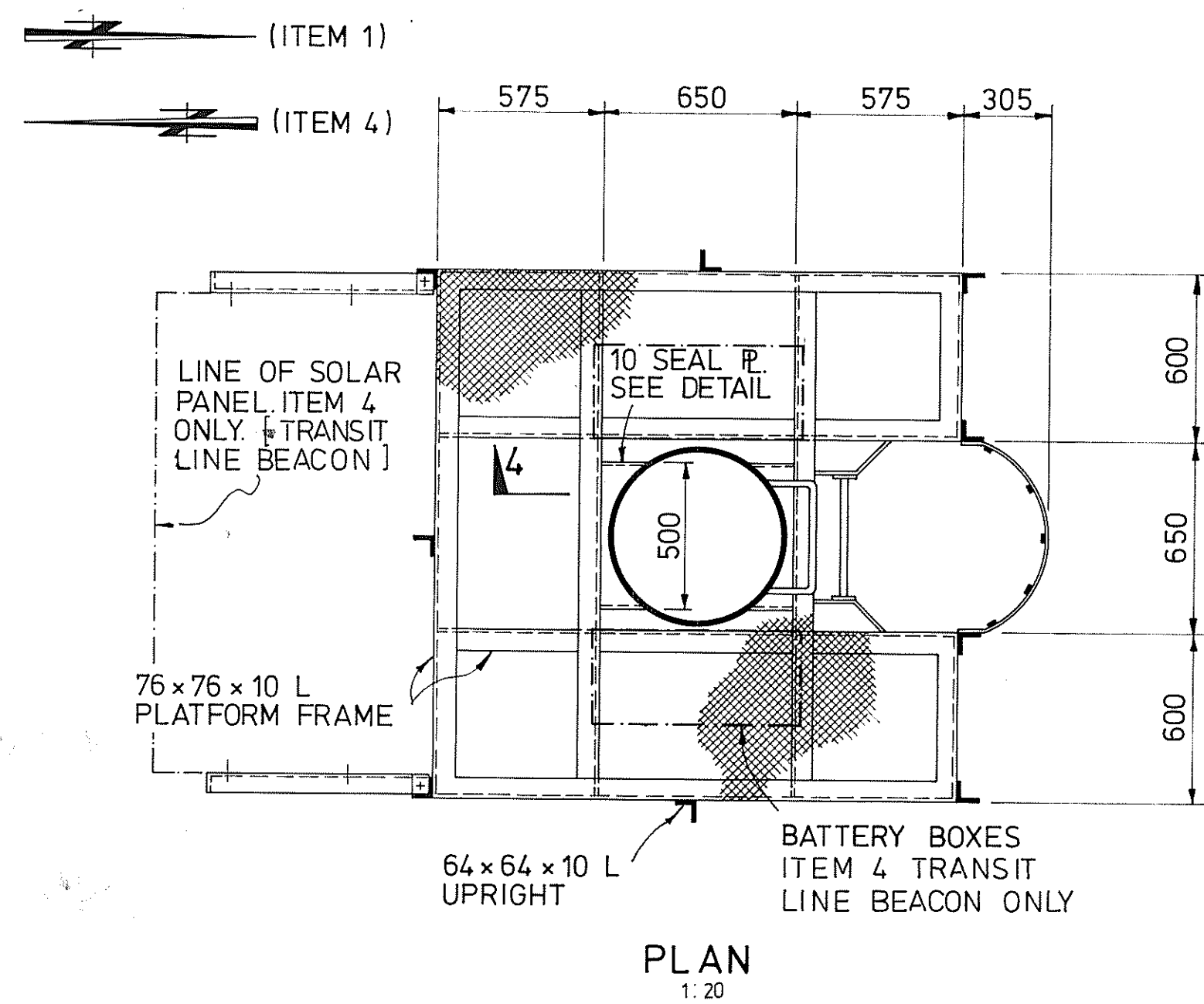
**SERVICES SUPPORT DETAILS**

SCALE: AS SHOWN

DRAWING NO: G7400 DS 051.1

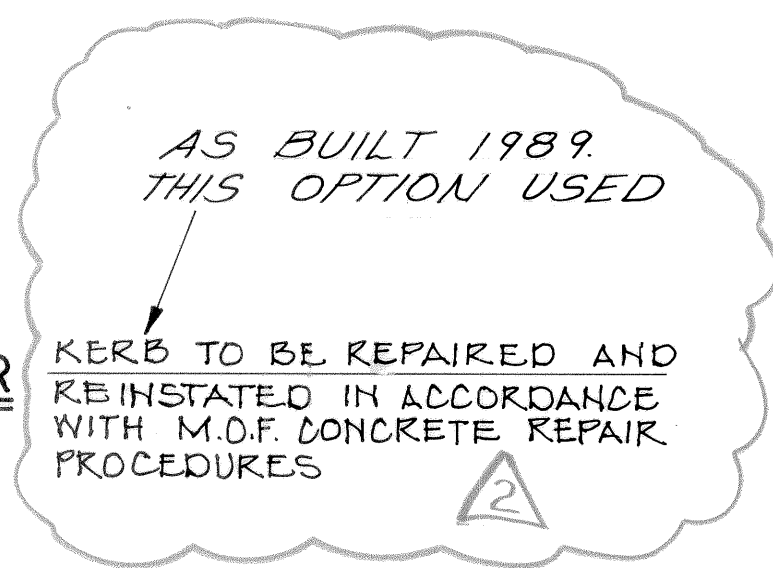
REVISION: 3





- NOTES:
1. STEEL GRADE 250 MPa
  2. PROTECTIVE SYSTEM  
EPOXY ZINC RICH PRIMER AND EPOXY MICACEOUS IRON OXIDE  
AS PER SPECIFICATION (U.N.O.)
  3. WELDS: 6 C.F.W. (U.N.O.)
  4. FOR LOCATION AND DESCRIPTION OF ITEMS 1 to 4 REFER DRG. N° G 7400 DE 0012





A cross-sectional diagram of a concrete curb and kerb assembly. The diagram shows a central concrete curb with a width of 250 units. The curb has a top width of 150 units and a base width of 50 units. The curb is supported by a concrete base. The base has a total width of 250 units, with 50 units on each side of the curb. The base is labeled "NEW CONCRETE". The curb is labeled "NEW TIMBER KERB". The curb is shown in a cross-section, with a vertical line indicating the centerline. The curb is shown in a cross-section, with a vertical line indicating the centerline. The curb is shown in a cross-section, with a vertical line indicating the centerline.

DETAIL 2  
1 : 10

25 MIN.

50

65 MIN.

50

EXISTING  $\phi 12$  LINKS CUT DOWN

NEW CONCRETE

SOUND CONCRETE

200

$\phi 32$  N.B.  $\mu$ PVC. CLASS 18 PIPE SLEEVE AT 1000 CRS.

$\phi 32$  N.B.  $\mu$ PVC. END CAP SOLVENT CEMENTED TO SLEEVE

$\phi 65$  HOLES DRILLED IN CONC. AT 1000 CRS. TO MATCH DOWEL BARS.

CEMENT GROUT TO FILL ANNULUS

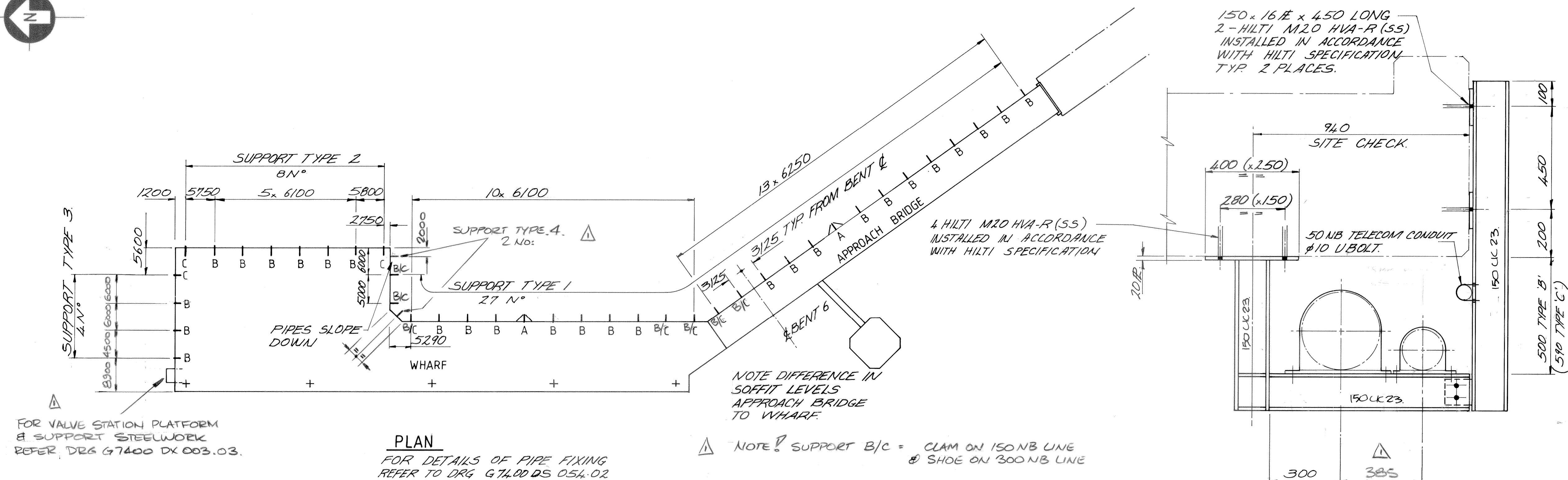
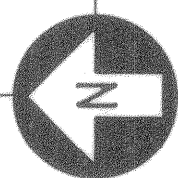
DETAIL 3  
1:2

NOTES

1. REFER TO M.O.F CONCRETE REPAIR PROCEDURES FOR CONCRETE SPEC'S. AND INSTALLATION PROCEDURES.
2. P.V.C. SLEEVES TO BE CUT FROM  $\mu$ P.V.C. PIPE TO AS1477-1
3. TIMBER KERB TO BE SAWN FROM HIGH DURABILITY GRADE TIMBER AS SHOWN IN APPENDIX B OF AS1738
4. GALVANISING TO BE IN ACCORDANCE WITH AS1650 TABLE 61

										<p>2 A-190 CF AK AS BUILT 1989 (REF DRGS ADDED)</p> <p>1 19-7-88 W.M. K.J. CONC. REINSTATEMENT OPTION ADDED</p> <p>0 1-7-88 W.M. K.J. ISSUED FOR CONSTRUCTION.</p> <p>A 17/12/87 D.P.F. ISSUED FOR TENDER.</p>										<p>CONSULT</p> <p>ENGR <i>V. hutch</i> 17 Dec 87</p> <p>ENGR</p> <p>ENGR <i>R. hutch</i> 4.7.88</p> <p>CONST N MGR</p> <p>DESIGN MGR</p> <p>MGR PROJ</p> <p>APPROVAL DATE</p>										<p>WOODSIDE Offshore Petroleum Pty Ltd</p> <p>NORTH WEST SHELF DEVELOPMENT PROJECT</p> <p>MATERIALS OFFLOADING FACILITY</p> <p>REPAIR TO DAMAGED DECK &amp; KERB ON M.O.F. WHARF</p> <p>SCALE: AS NOTED</p> <p>DRAWN: D.P.F.</p> <p>CHK'D: <i>A. hutch</i></p> <p>DRAWING NO: G 7400 DS 053-01</p> <p>REVISION: 2.</p>									
<p>DRAWING NO</p> <p>TITLE</p> <p>REFERENCE DRAWINGS</p>										<p>NO DATE BY CHK'D</p> <p>REVISIONS</p>										<p>CONSULT</p> <p>ENGR</p> <p>ENGR</p> <p>ENGR</p> <p>CONST MGR</p> <p>DESIGN MGR</p> <p>MGR PROJ</p> <p>DATE</p>										<p>SCALE: AS NOTED</p> <p>DRAWN: D.P.F.</p> <p>CHK'D: <i>A. hutch</i></p> <p>DRAWING NO: G 7400 DS 053-01</p> <p>REVISION: 2.</p>									



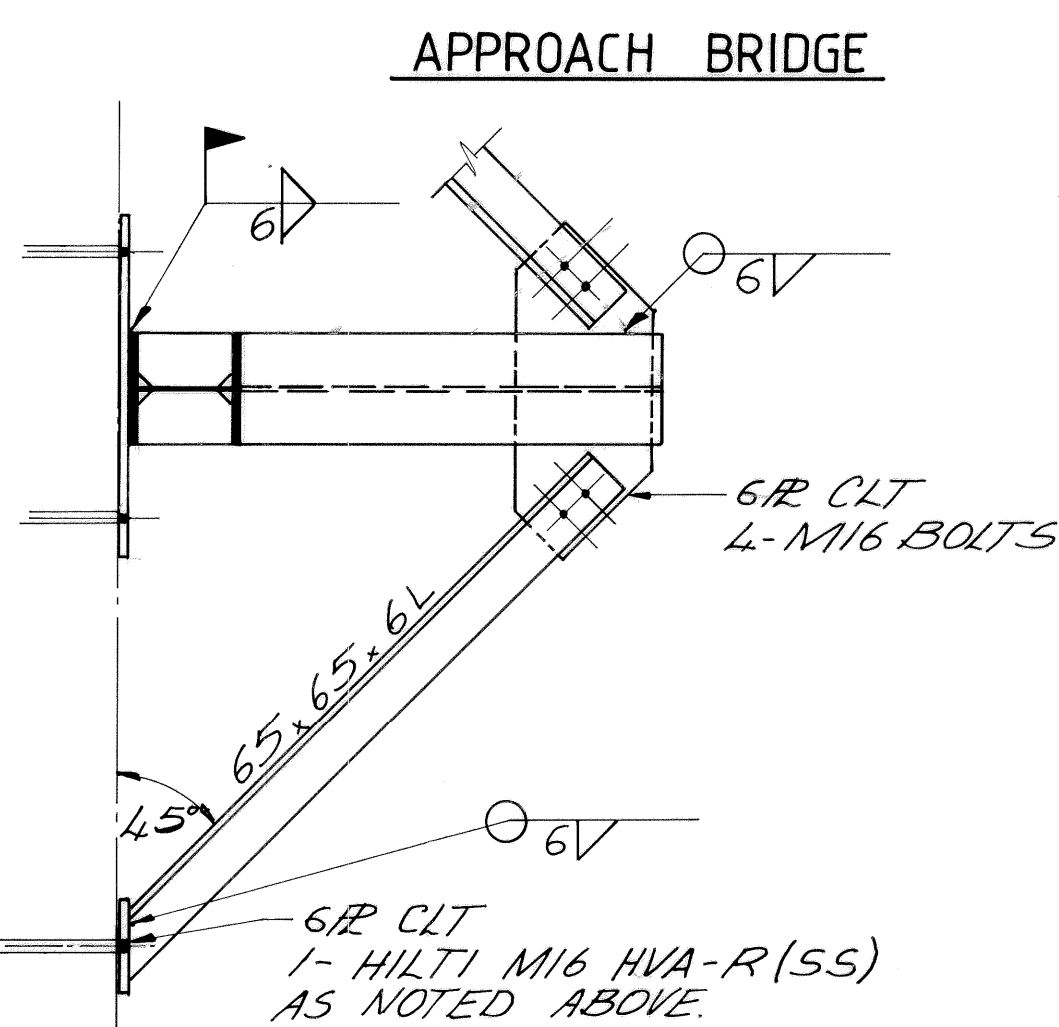
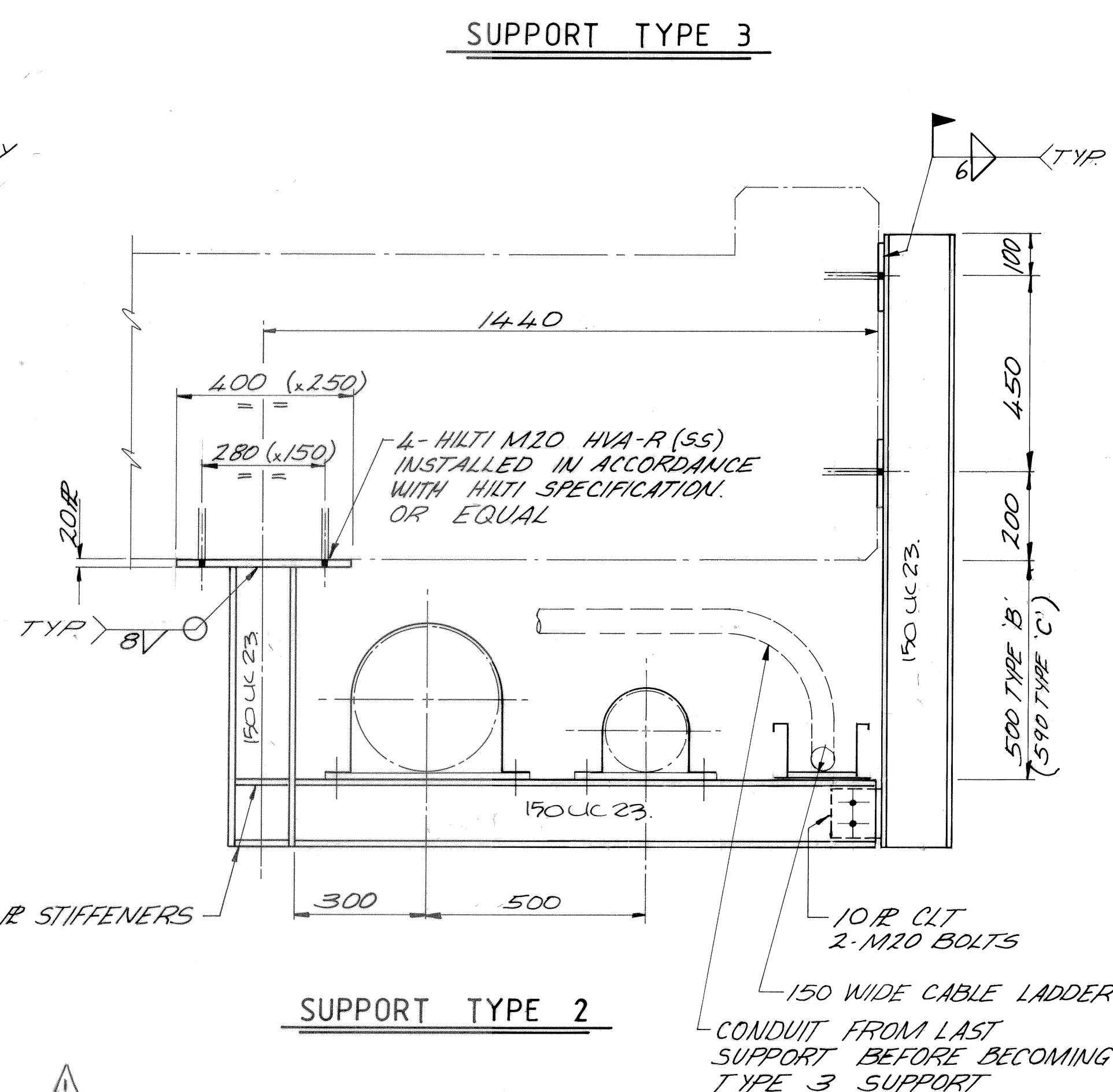
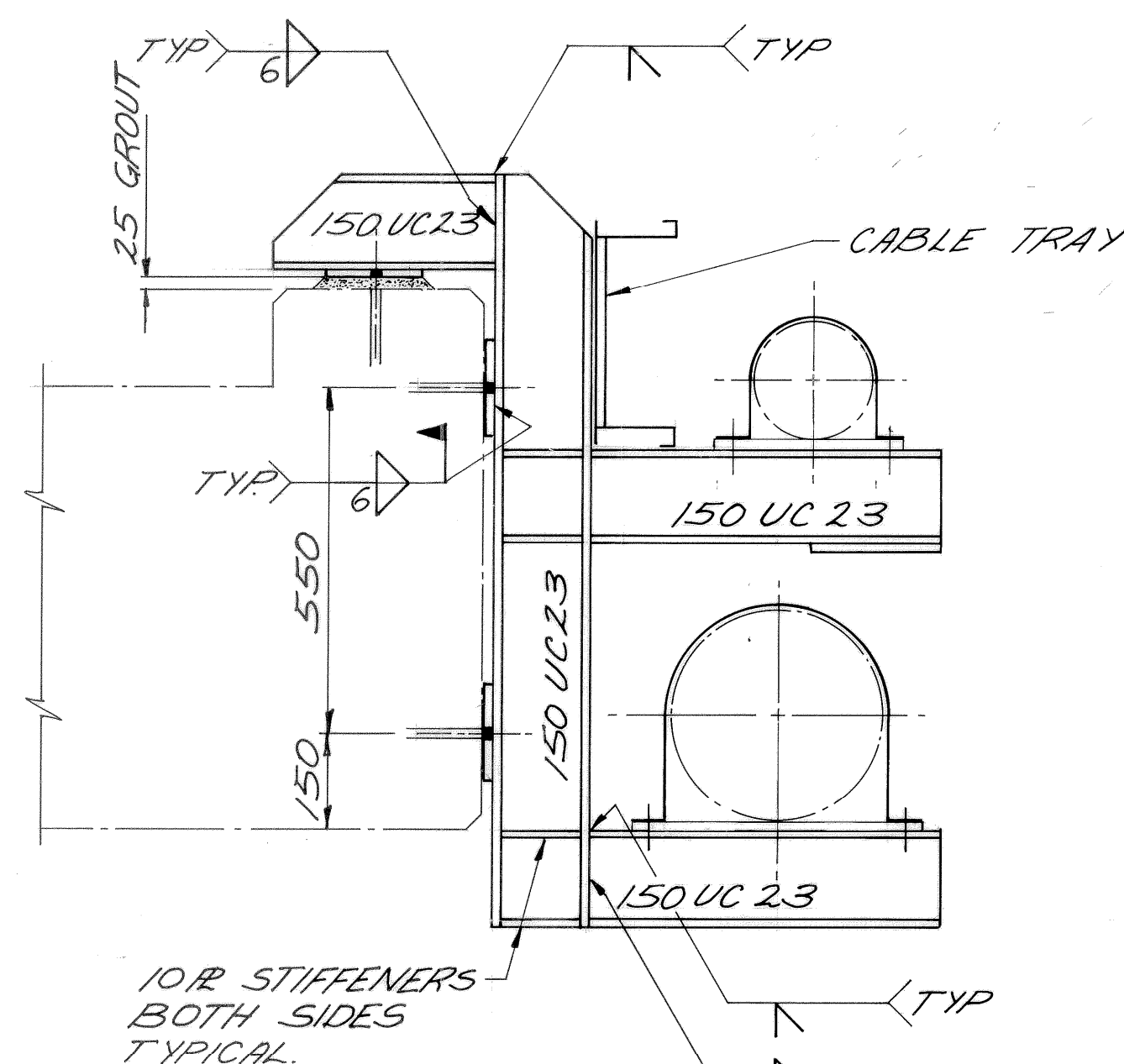
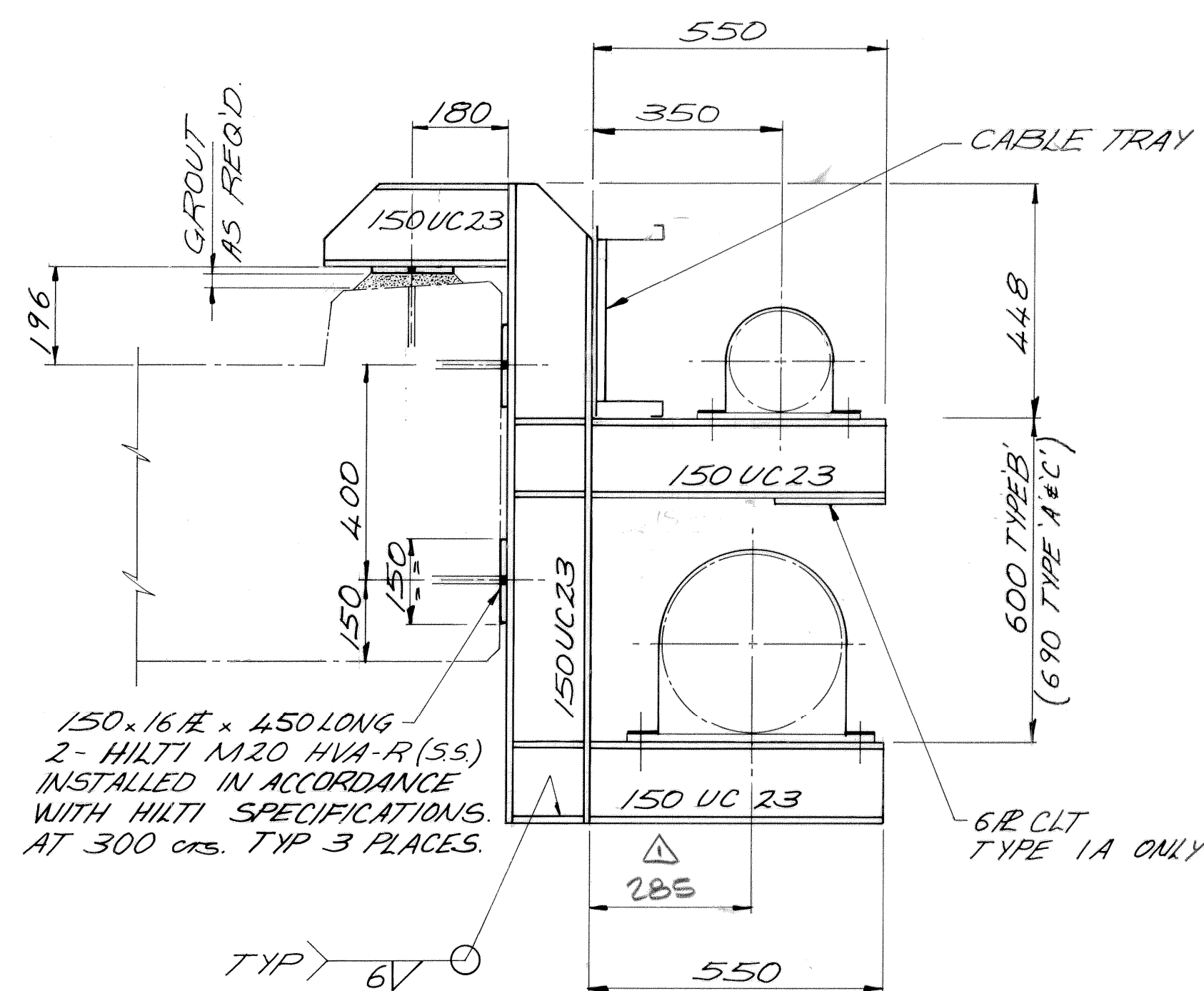


FOR VALVE STATION PLATFORM  
& SUPPORT STEELWORK  
REFER DRG G7400 DX 003.03.

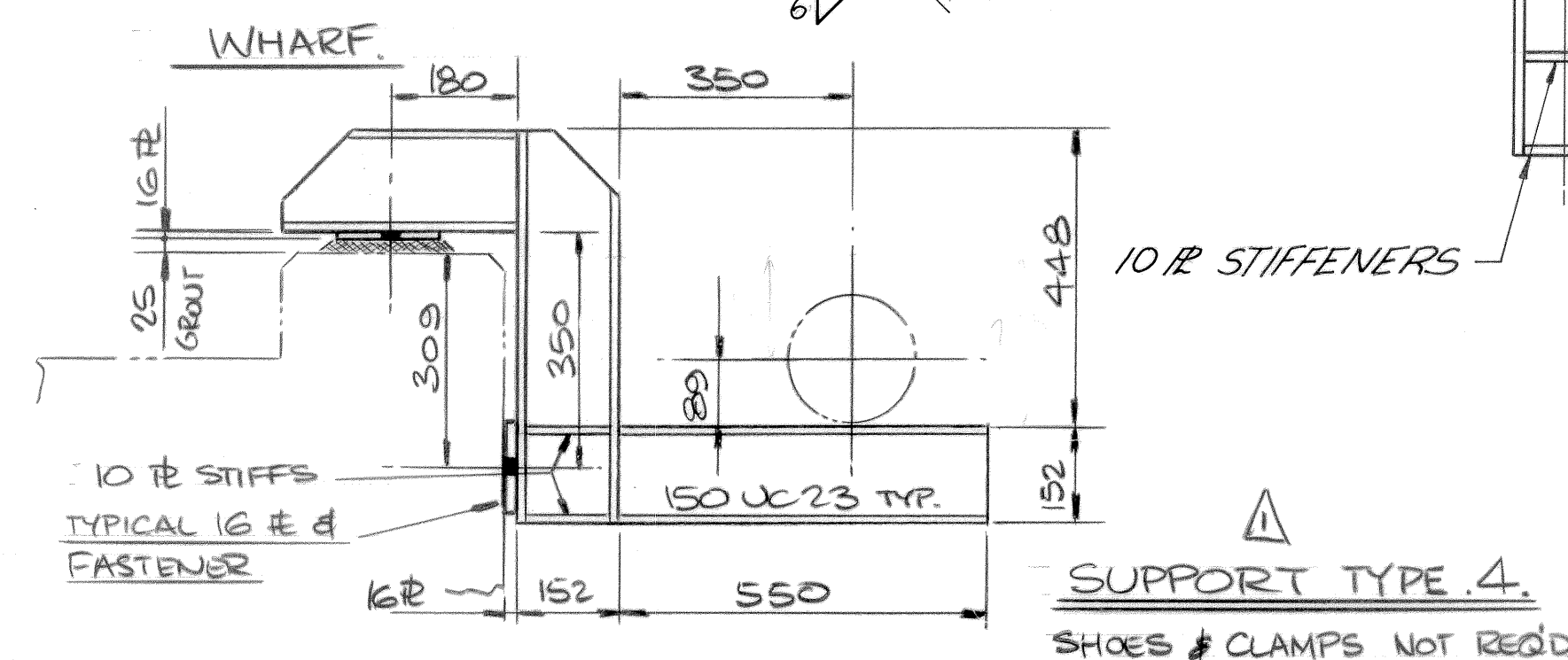
### PLAN

FOR DETAILS OF PIPE FIXING  
REFER TO DRG G7400 DS 054-02

⚠ NOTE! SUPPORT B/C = CLAM ON 150NB LINE  
& SHOE ON 300NB LINE



PLAN SUPPORT TYPE 1A



SUPPORT TYPE .4.

SHOES & CLAMPS NOT REQ'D

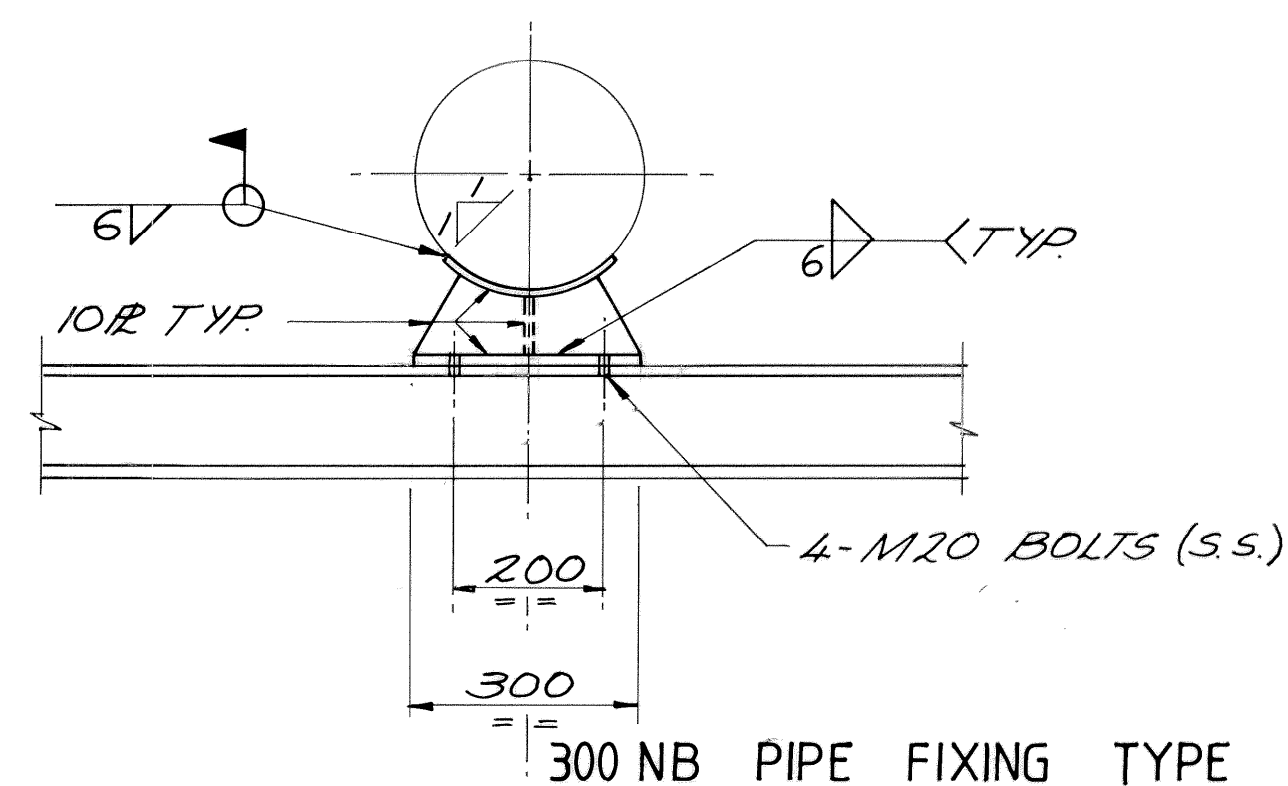
[illegible]



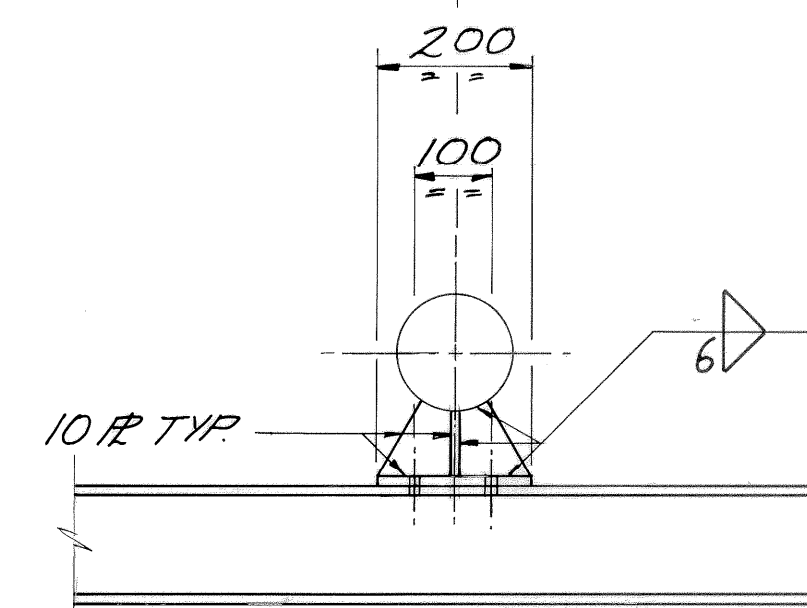
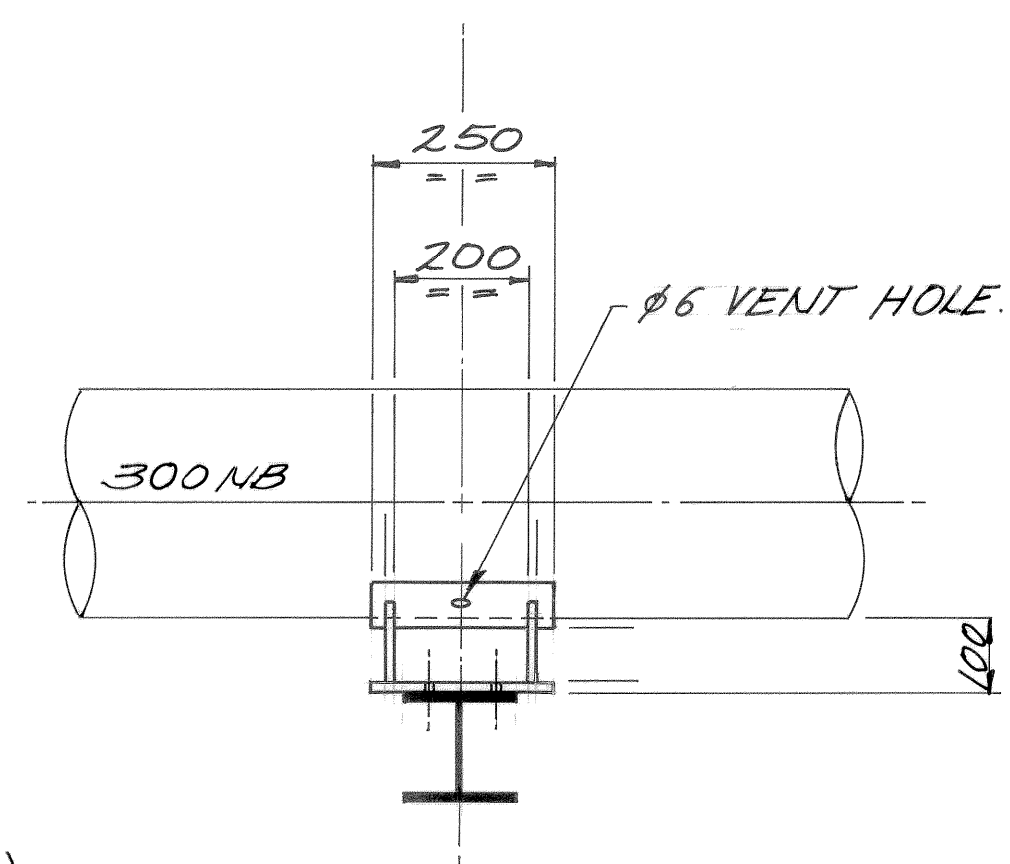
# NOTES

FOR NOTES REFER TO DRAWING NUMBER  
G7400DS054-01

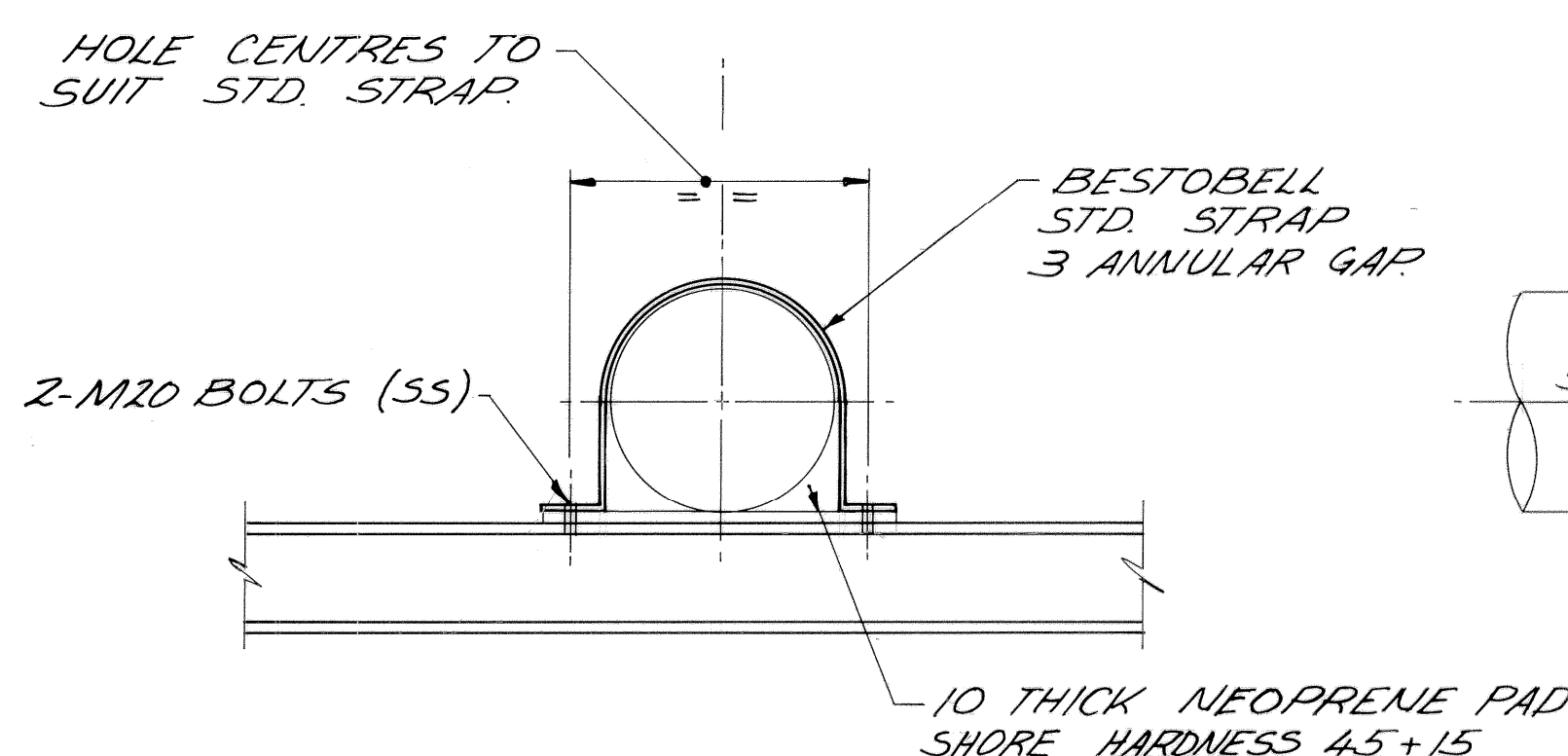
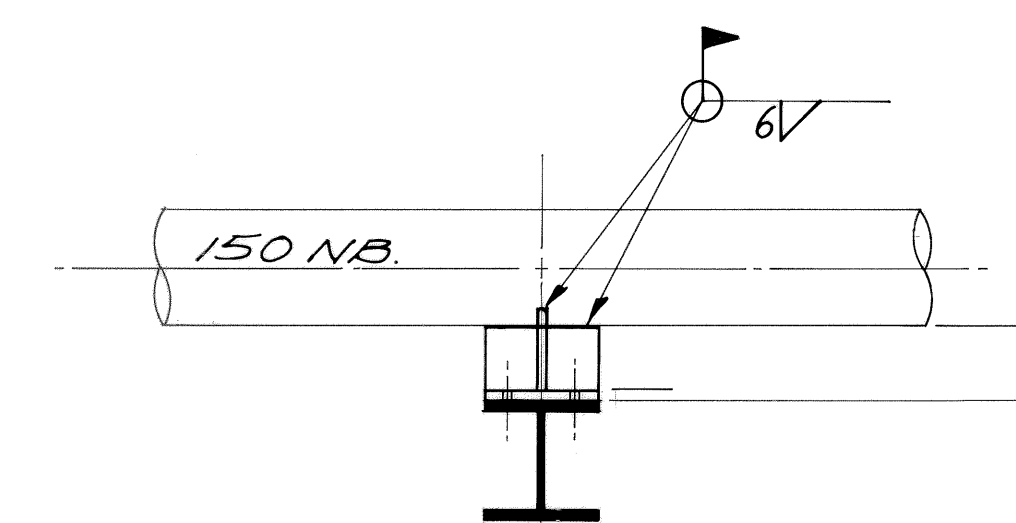
FOR LOCATION OF PIPE FIXING REFER TO  
DRAWING NUMBER G7400 DS 054-01



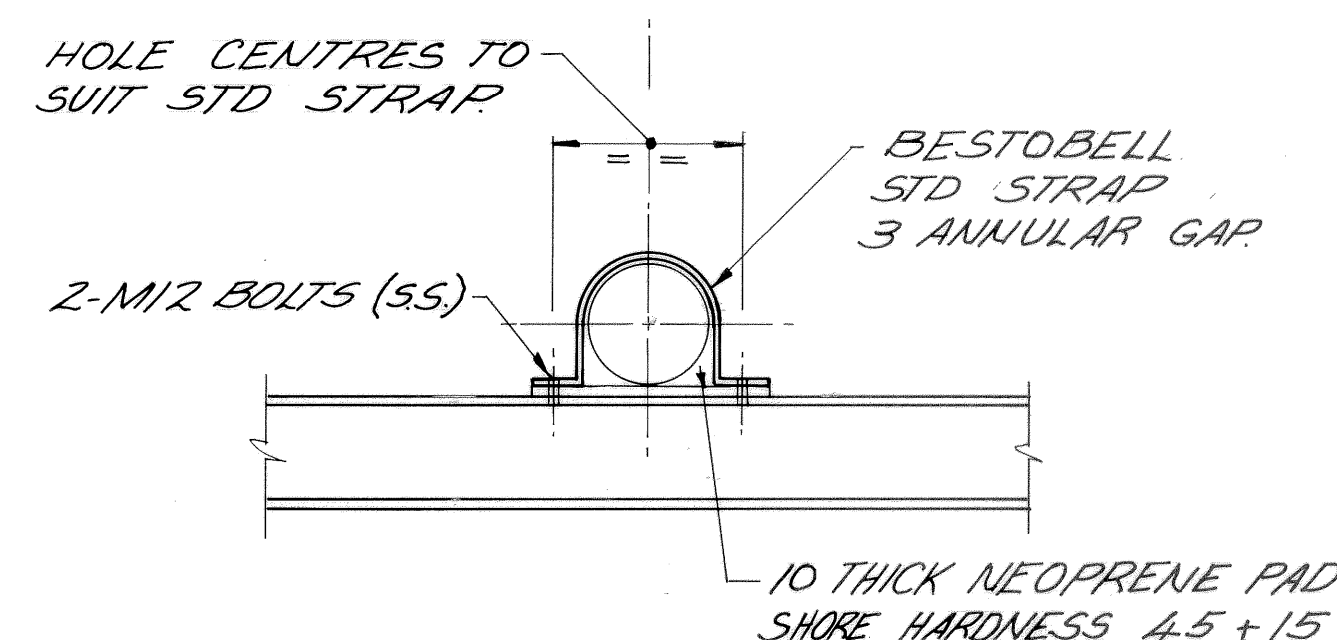
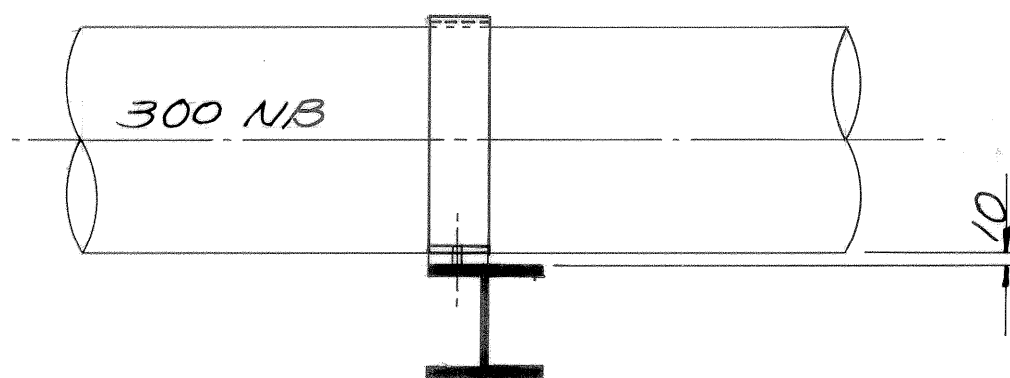
300 NB PIPE FIXING TYPE A



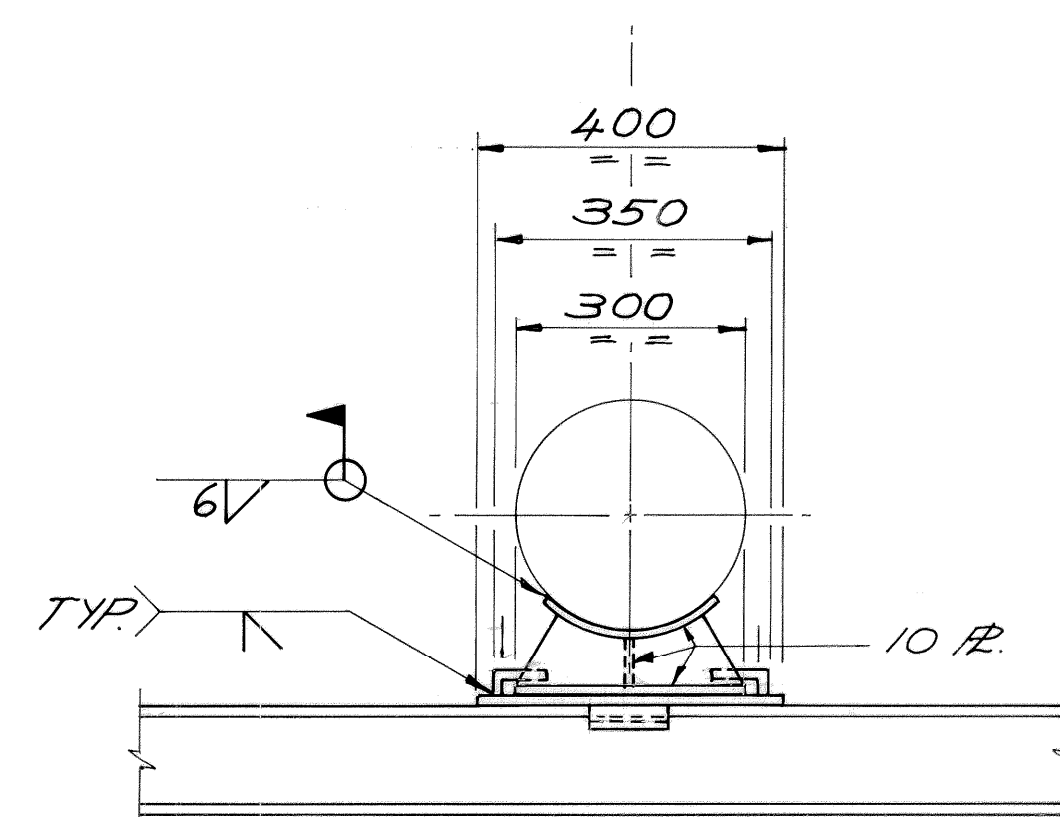
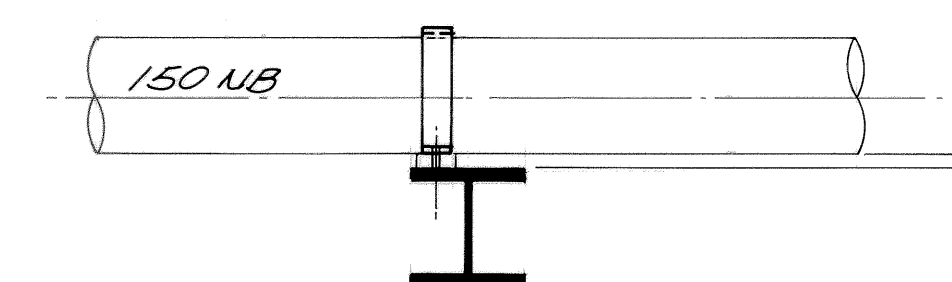
150 NB PIPE FIXING TYPE A



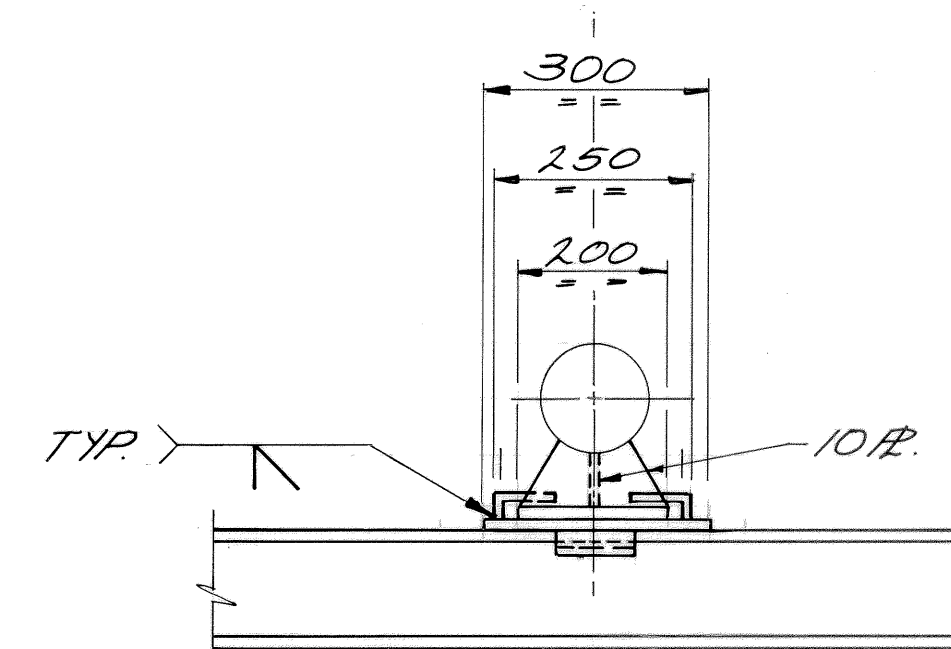
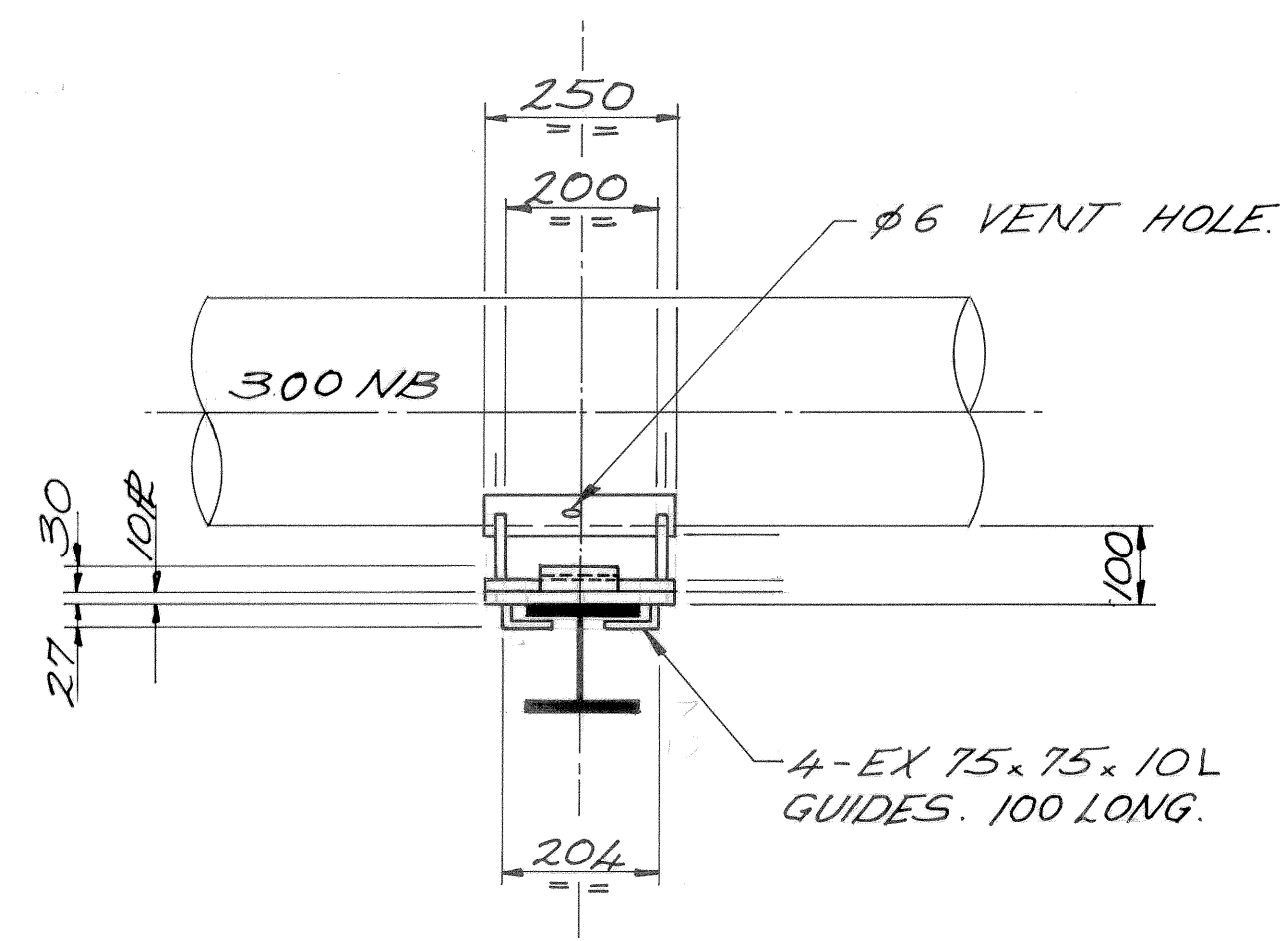
300 NB PIPE FIXING TYPE B



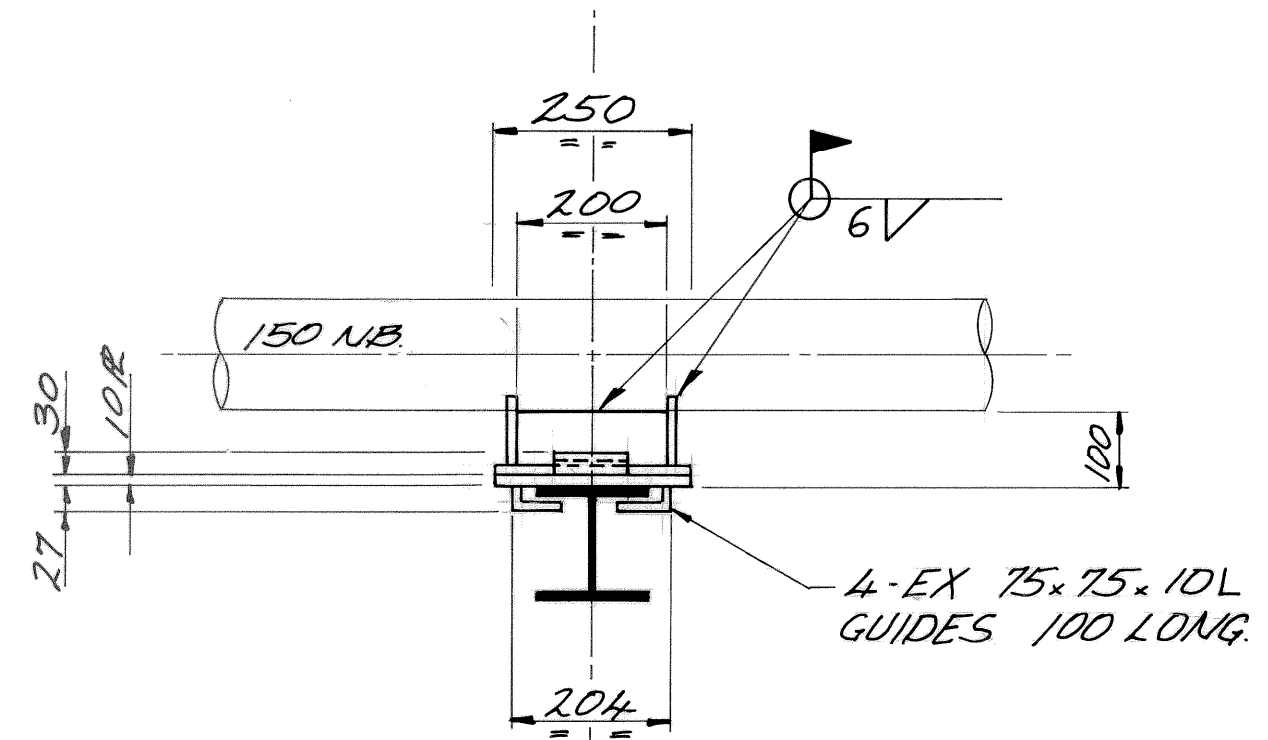
150 NB PIPE FIXING TYPE B



300 NB PIPE FIXING TYPE C



150 NB PIPE FIXING TYPE C




NO	DATE	BY	CHK'D	REVISIONS
1	7/5/90	DBT		AS BUILT
2	11/8/91	CF	C.D.	ISSUED FOR CONSTRUCTION
3	26/6/91	CF		ISSUED FOR TENDER

CONSULT	DATE
ENGR (PLARD)	12-07-89
ENGR	
ENGR	
CONSTN MGR	
DESIGN MGR	
MGR PROJ	

Woodside Offshore Petroleum Pty Ltd			
NORTH WEST SHELF DEVELOPMENT PROJECT MATERIALS OFFLOADING FACILITY REPLACEMENT SERVICES SUPPORT DUE TO CYCLONE 'ORSON' DAMAGE PIPE FIXING DETAILS			
SCALE	DRAWN	CHK'D	DRAWING NO
1:10	CF	C.D.	G 7400 DS 054.02
DATE	DATE	DATE	REVISION
JUNE '89	10-7-89		1



## DRAWING INDEX

DRAWING N°	REVISION	DRAWING TITLE
37241- DS - 001	B	DRAWING INDEX AND NOTES
002	2	KEY PLAN
003	2	GENERAL ARRANGEMENT
004	2	DEMOLITION PLAN
005	1	CAUSEWAY WIDENING (CONTRACT 37241-CN-002)
006	5	PILE DETAILS
007	2	APPROACH BRIDGE PLAN AND ELEVATION.
008	1	APPROACH BRIDGE CROSS SECTIONS
009	1	APPROACH BRIDGE BEAM DETAILS
010	1	APPROACH BRIDGE CROSSHEAD DETAILS SHT 1 OF 2
011	1	APPROACH BRIDGE CROSSHEAD DETAILS SHT 2 OF 2
012	3	APPROACH BRIDGE PRECAST DECK PANEL
013	2	APPROACH BRIDGE ABUTMENT G.A. AND DETAILS.
014	2	APPROACH BRIDGE EXPANSION JOINT DETAILS
015		SPARE
<del>016</del>		<del>CEMENT STORAGE AREA PLAN AND ELEVATIONS</del>
<del>017</del>		<del>CEMENT STORAGE AREA DETAILS</del>
018		SPARE
019	3	NORTHERN EXTENSION PLAN AND ELEVATIONS
020	2	NORTHERN EXTENSION PILE CAP DETAILS
021	2	NORTHERN EXTENSION DECK PANELS SHT 1 OF 6
022	4	NORTHERN EXTENSION DECK PANELS SHT 2 OF 6
023	5	NORTHERN EXTENSION DECK PANELS SHT 3 OF 6
024	1	NORTHERN EXTENSION DECK PANELS SHT 4 OF 6
025	2	NORTHERN EXTENSION DECK PANELS SHT 5 OF 6
026	3	NORTHERN EXTENSION CONCRETE INFILL PANELS
027	2	NORTHERN EXTENSION DECK PANELS SHT 6 OF 6
028	2	NORTHERN EXTENSION EXISTING STRUCTURE INTERFACE
029		SPARE
030	1	FENDER DETAILS WESTERN FACE SHT 1 OF 3
031	1	FENDER DETAILS WESTERN FACE SHT 2 OF 3
032	1	FENDER DETAILS WESTERN FACE SHT 3 OF 3
033	1	FENDER DETAILS EASTERN FACE
034	1	FENDER SUPPORT DETAILS.
035	1	WALKWAY MODIFICATIONS
036	3	SERVICES SUPPORTS PLAN AND DETAILS
<del>037</del>	0	<del>MODIFICATIONS TO EASTERN FACE FENDER FRAMES</del>
038	1	PILE LOCATION PLAN
039	5	BOLLARDS
040		SPARE
37241 - DP - 001	E	RELOCATION OF 300 N.B. DIESEL ALONG CAUSEWAY CONTRACT 37241-CN-003
002	2	WHARF PIPING GENERAL ARRANGEMENT
003	1	150 N.B. WATER LINE ISOMETRIC
004	1	150 N.B. WATER LINE ISOMETRIC
005	2	300 N.B. DIESEL LINE ISOMETRIC

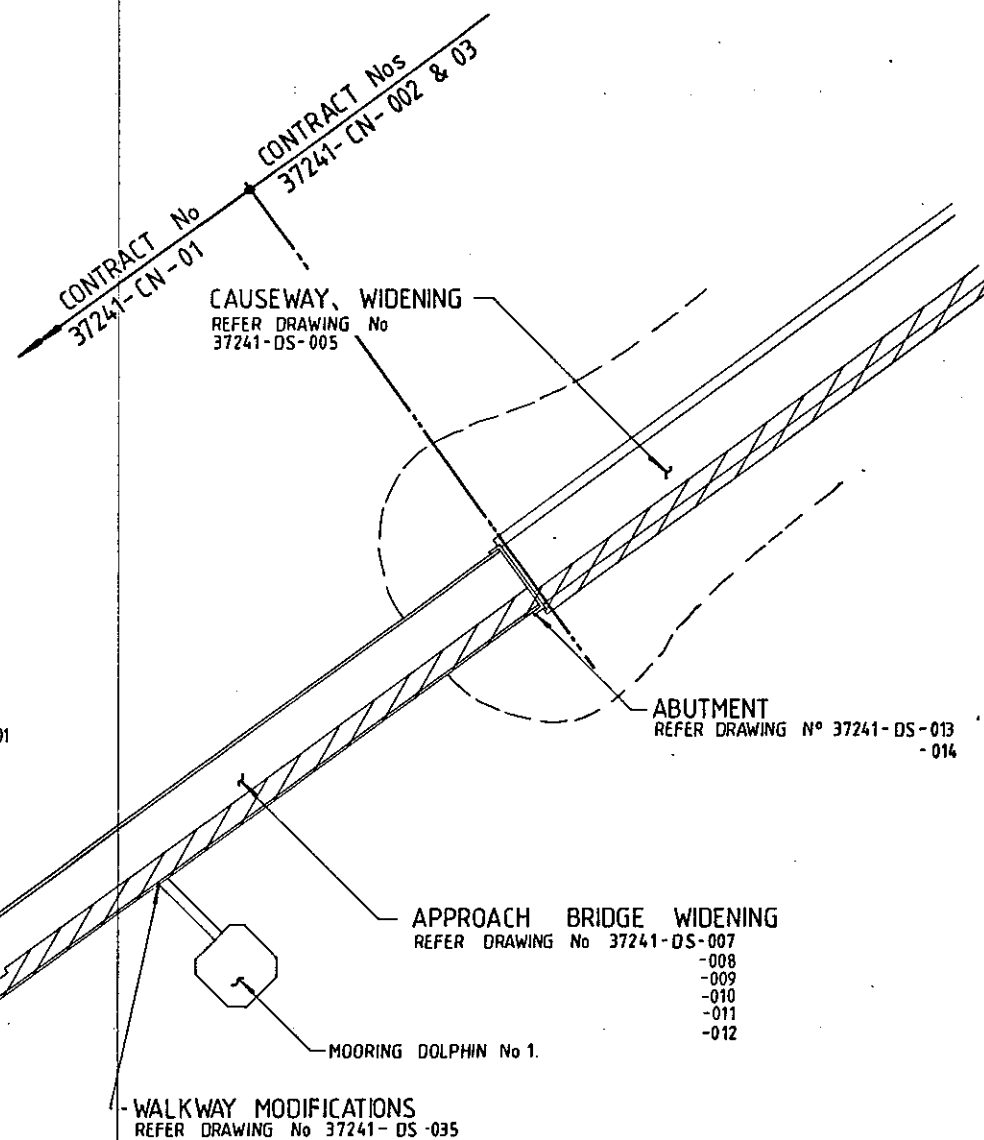
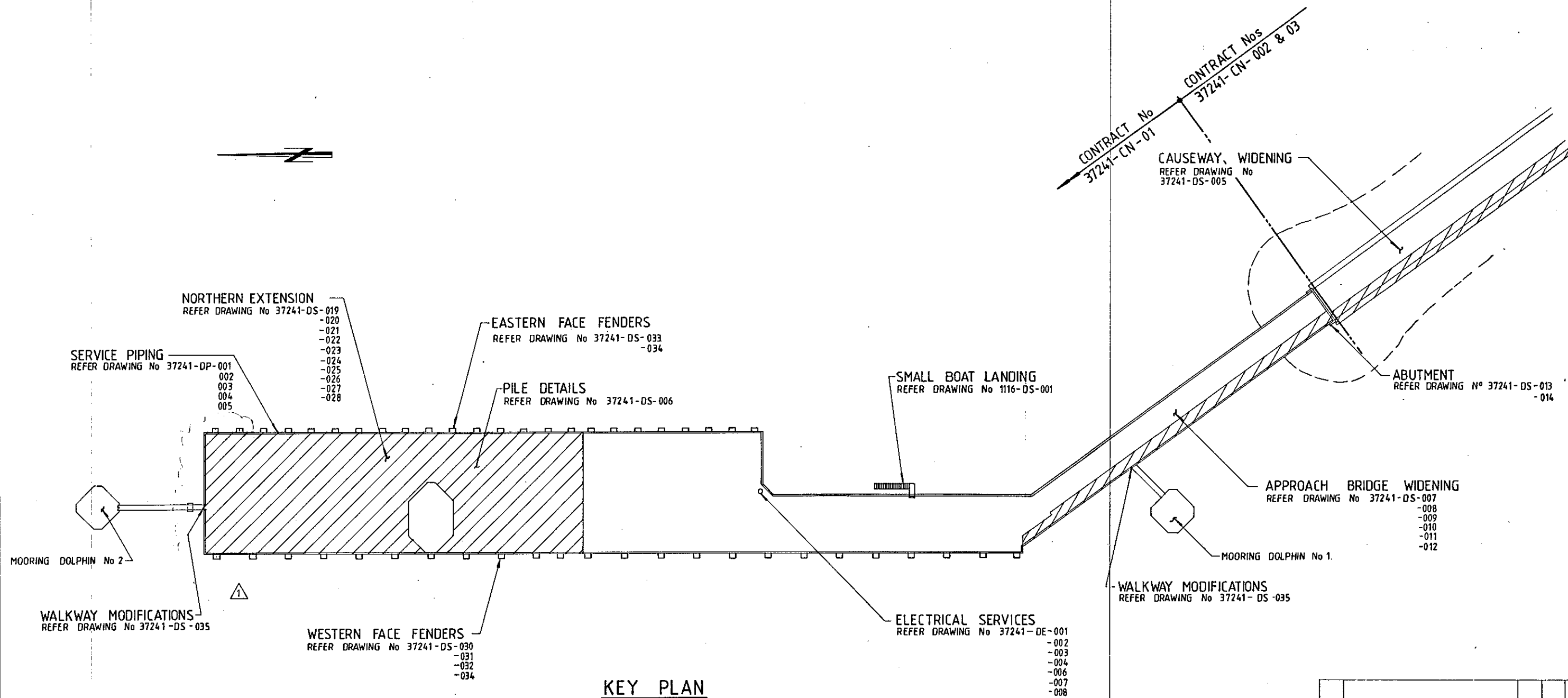
DRAWING N°	REVISION	DRAWING TITLE
37241- DE - 001	0	ELECTRICAL SERVICES LAYOUT
002	0	LIGHT AND POWER SINGLE LINE DIAGRAM
003	1	MAIN DISTRIBUTION BOARD LIGHTING CONTROL EQUIPMENT LAYOUT (EXISTING)
004	0	AREA LIGHTING CONTROL SCHEMATIC DIAGRAM
005	0	SPARE
006	0	MAIN DISTRIBUTION BOARD LIGHTING CONTROL EQUIPMENT LAYOUT (PROPOSED)
007	0	MAIN DISTRIBUTION BOARD CIRCUIT BREAKER SCHEDULE
<del>008</del>	<del>1</del>	<del>AREA LIGHTING POWER LINE CARRIER CONTROL</del>
37241- DU - 001	A	SURVEY OF EXISTING STRUCTURE MAIN WHARF AND BREASTING DOLPHIN
002	A	SURVEY OF EXISTING STRUCTURE APPROACH BRIDGE
003	A	SURVEY OF EXISTING STRUCTURE ROADWAY ALONG GROUYNE
004	A	SURVEY OF EXISTING STRUCTURE CROSS SECTIONS
005	A	SURVEY OF EXISTING STRUCTURE GENERAL ARRANGEMENT
006	A	SURVEY OF EXISTING STRUCTURE RAMP AREA
007	A	SURVEY OF EXISTING STRUCTURE
008	A	BREASTING DOLPHIN SETOUT

## MISCELLANEOUS CONTRACT DRAWINGS:




471 - DS - 001	1	PROPOSED BUNKER LINE FOR SHELL
002	1	SHELL DIESEL LINE
1116 - DS - 001	C	PROPOSED SMALL BOAT LANDING GENERAL ARRANGEMENT
1120 - DA - 001	2	ACCESS & FACILITY MARKING SHT 1 OF 2
002	2	ACCESS & FACILITY MARKING SHT 2 OF 2

REV.	DESCRIPTION	DATE	BY	CHK
B	AS BUILT REVISION	17.11.95		m
A	GENERAL REVISION		llm	pc
 				
Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha, WA 6711 Tel: (091) 44 1673 Fax: (091) 44 2639				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE:				
DRAWING INDEX AND NOTES				
DRAWING N° 37241 - DS - 001				REV: B

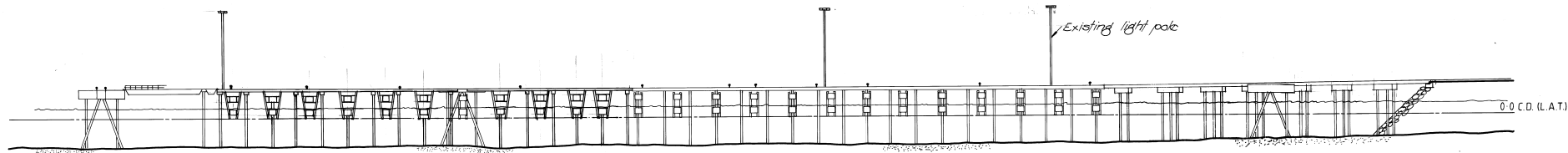
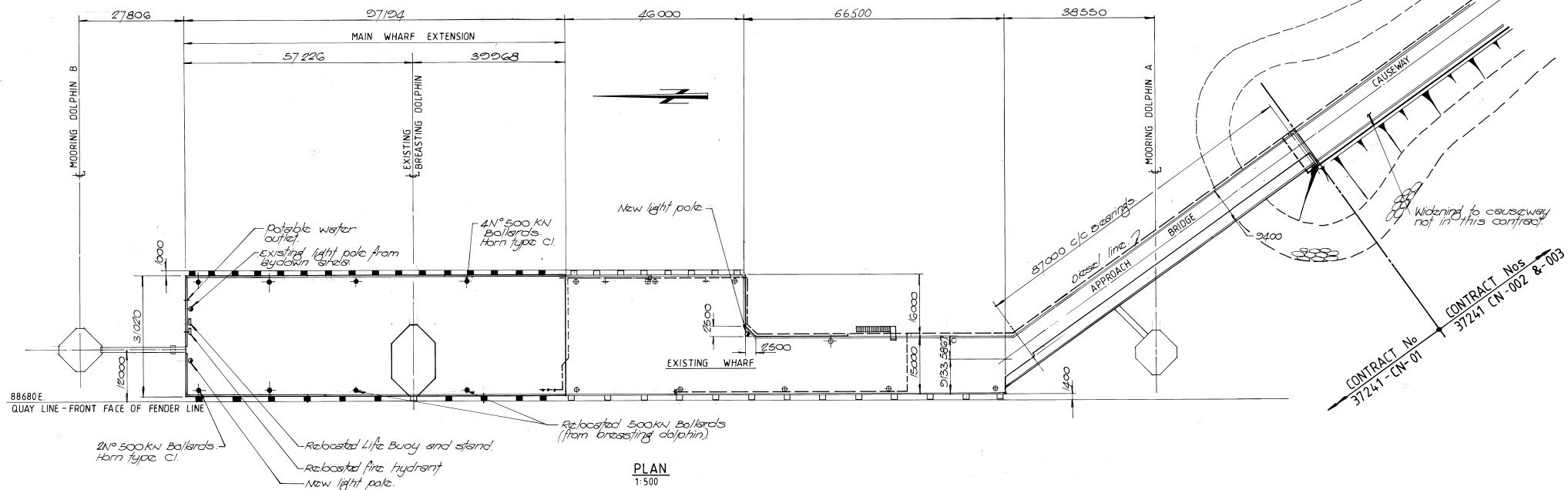





2	AS BUILT	5-595	GM.	R
1	NORTHERN EXTENSION EXTENDED	144-94	GM	R
0	ISSUED FOR CONSTRUCTION	13-12-93	GM	R
A	ISSUED FOR TENDER	30-7	GM.	R.
REV.	DESCRIPTION	DATE	BY	CHK.

 <b>FRASER CONSULTANTS</b>		 <b>Astron</b> ASTRON ENVIRONMENTAL ASTRON ENGINEERING PTY LTD	Suite 7, Savings House, 11 Hedland Place PO Box 733, Karatha WA 6714 Tel: (091) 44 1679 Fax: (091) 41 2531
DRAWN:	G. MANSFIELD	DATE:	JULY '93
DESIGNED:		CHECKED:	
PROJECT:		SCALE:	1:500
		CERTIFIED:	
DAMPIER PORT AUTHORITY			
EXTENSIONS TO DAMPIER PUBLIC WHARF			
DRAWING TITLE:			
KEY PLAN			
DRAWING No		REV:	

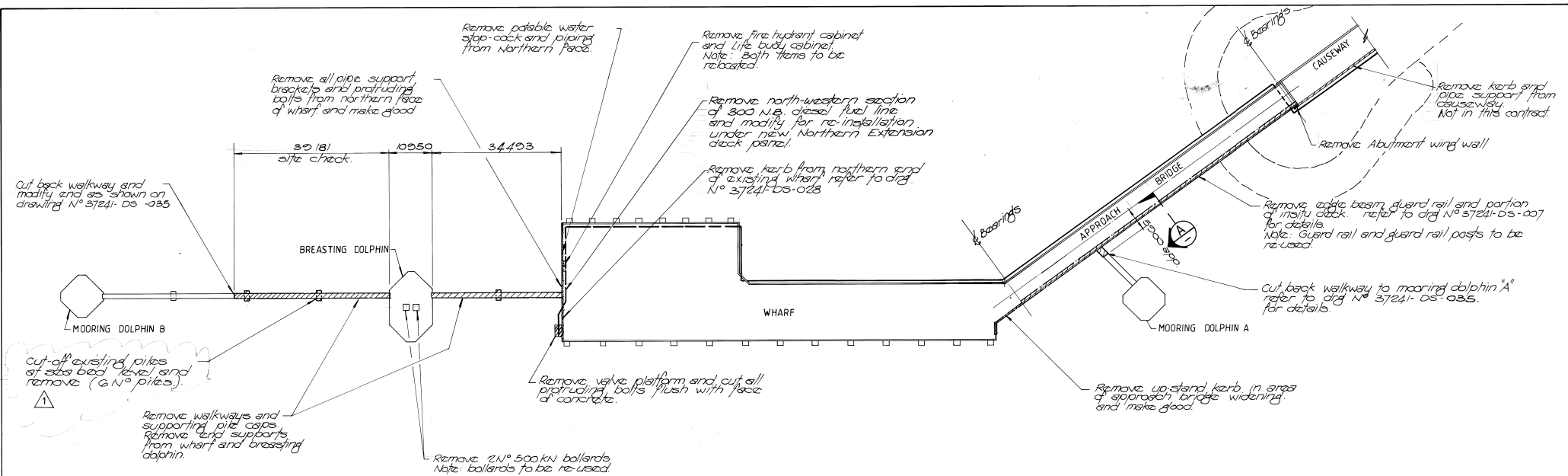
37241-DS-002	2
--------------	---



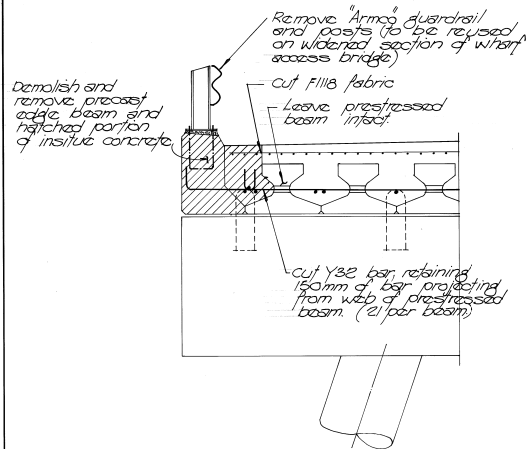
2	AS BUILT	55.95	GM	R	
1	NORTHERN EXTENSION EXTENDED	14.4.94	CM	R	
0	ISSUED FOR CONSTRUCTION	13.12.93	CM	R	
A	ISSUED FOR TENDER	30-7	CM	R	
REV.	DESCRIPTION	DATE	BY	CHK	
<div><div><div><b>FRASER</b> CONSULTANTS</div></div><div><b>Astron</b> ASTRON ENVIRONMENTAL ASTRON ENGINEERING PTY LTD</div></div> <div>Suite 7, Savings House, 11 Hedland Place PO Box 715, Karratha, WA 6714 Tel: (081) 44 1079 Fax: (081) 44 2638</div>					
DRAWN:	G MANSFIELD	DATE:	JULY 93	SCALE:	1:500
DESIGNED:		CHECKED:		CERTIFIED:	
PROJECT: DAMPIER PORT AUTHORITY					
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE: GENERAL ARRANGEMENT					
DRAWING N° 37241 - DS - 003					
					REV: 2

37241 DS003





PLAN 1:500



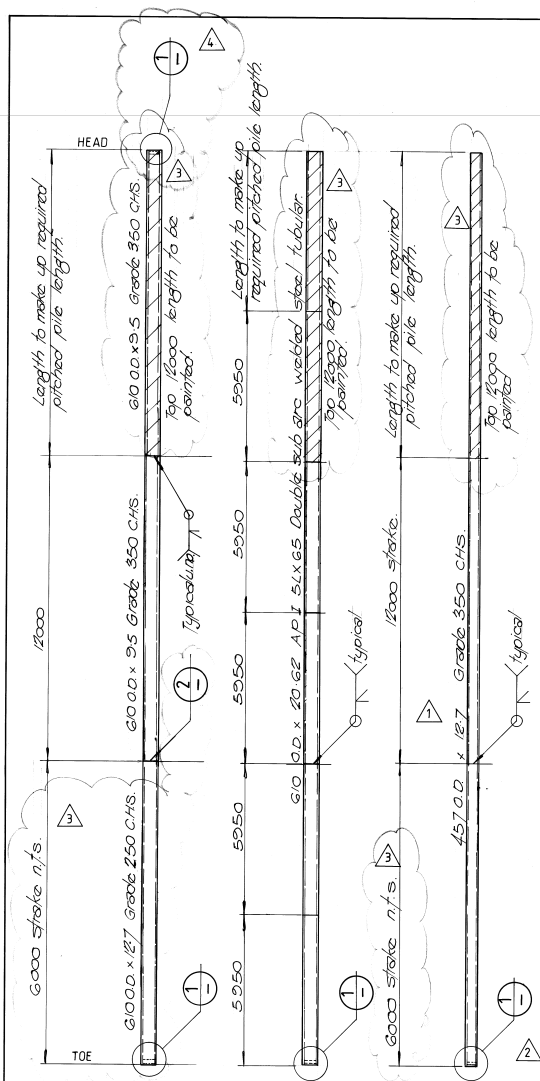
SECTION A-A

2	AS BUILT	5595	GM.	M
1	REMOVE EXISTING PILES	20.12.99	CH	R
0	ISSUED FOR CONSTRUCTION	18.12.99	CH	R
A	ISSUED FOR TENDER	30.7	CH	R
REV.	DESCRIPTION	DATE	BY	CHK.
<div> <div>FRASER CONSULTANTS</div> <div> <div>Astron</div> <div>ASTRON ENVIRONMENTAL ACTION ENGINEERING PTY LTD</div> </div> </div> <div>           Suite 7, Savings House,            11 Hilliard Place            PO Box 715, Karratha WA 6714            Tel: (091) 44 1879 Fax: (091) 44 3530         </div>				
DRAWN:	G. MANSFIELD	DATE:	JULY '93	SCALE:
DESIGNED:		CHECKED:		1:500
		CERTIFIED:	CH	
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: DEMOLITION PLAN AND DETAILS				
DRAWING N° 37241-DS-004				REV: 2

37241 DS004





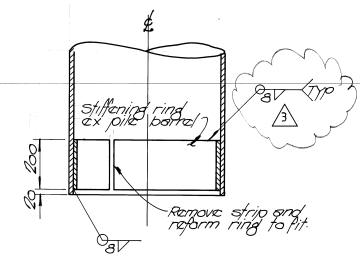


610 O.D. 610 O.D. 457 O.D.

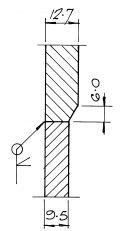
90 REQUIRED 1 REQUIRED 2 REQUIRED  
BENT No 1 BENT No 8

PILE ELEVATIONS

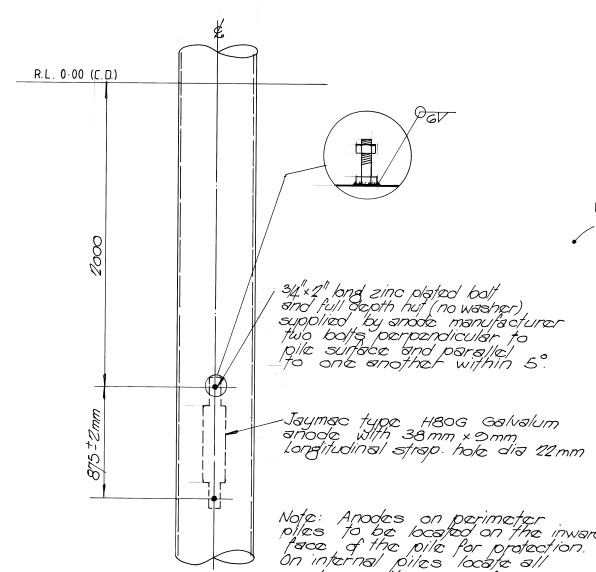
Denotes section of pile to be painted as per specification.  
 Denotes unpainted section of pile.



DETAIL 1



DETAIL 2



CATHODIC PROTECTION  
NOT IN CONTRACT  
37241-CN-01

1

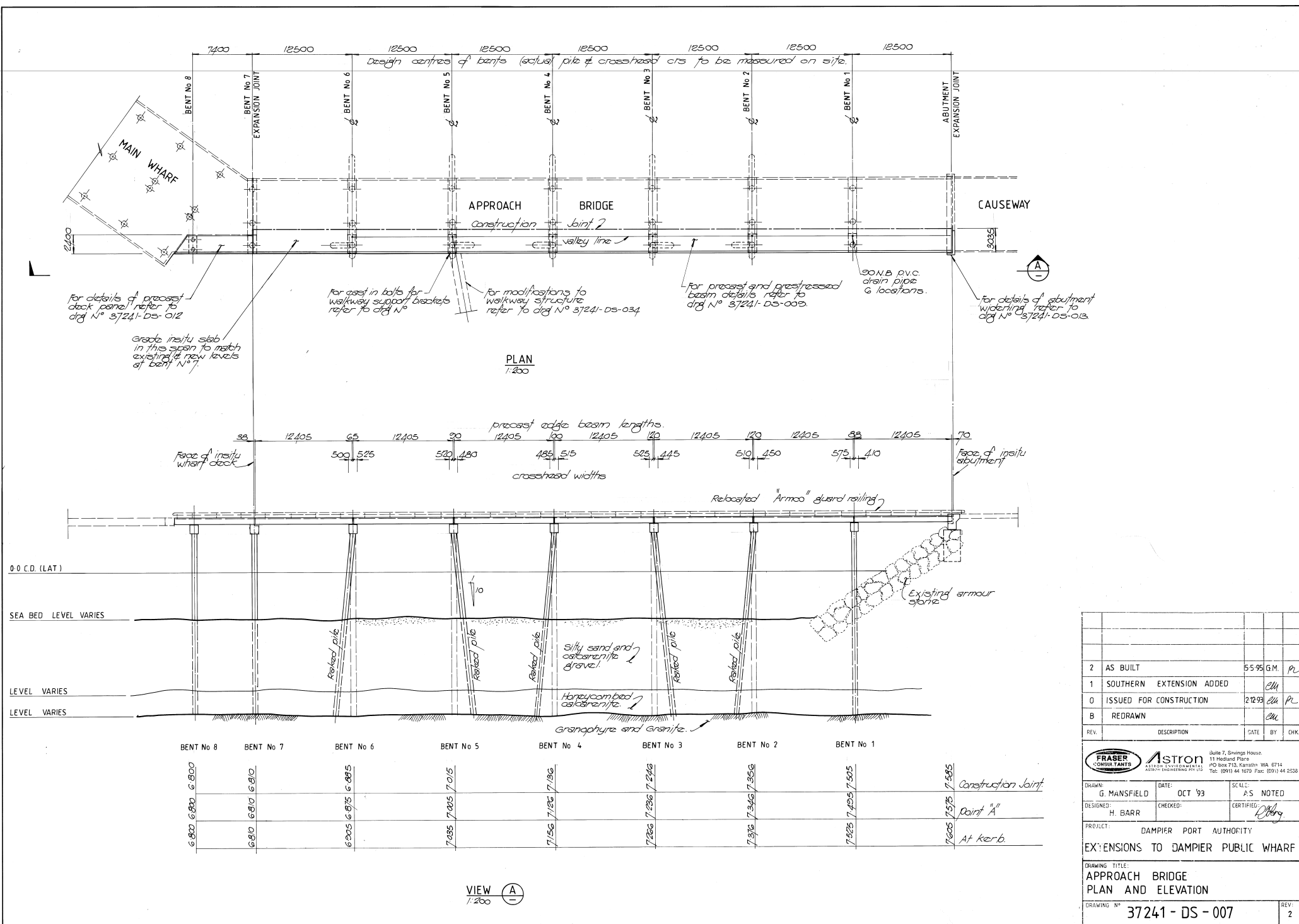
CATHODIC PROTECTION OF PILES



1:20  
Note: Anodes are to be located on piles after driving.

REV.	DESCRIPTION	DATE	BY	CHK.
5	AS BUILT	55.95 GM	PL	
4	DETAIL 1 ADDED TO TOP OF 610 O.D. PILE	12.94	EL	PL
3	GENERAL REVISION	20.12.98	EL	PL
2	DETAIL 1 ADDED TO 457 Ø PILE	10.12.98	EL	PL
1	PILE WALL THICKNESS CHANGED	6.12.93	EL	PL
0	ISSUED FOR CONSTRUCTION	2.12.93	EL	PL

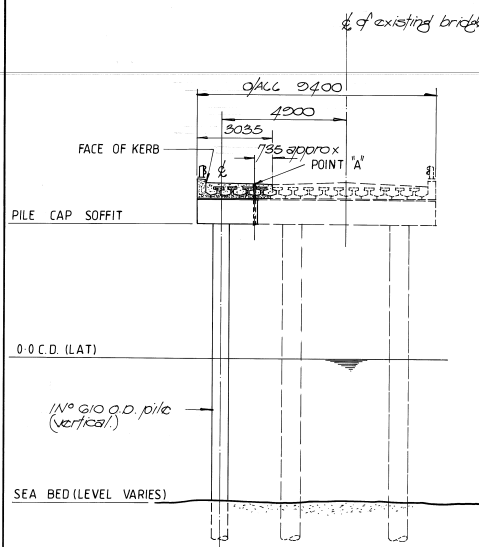
DRAWN: G. MANSFIELD DESIGNED: H. BARR		DATE: OCT '93 CHECKED:	
PROJECT: DAMPIER PORT AUTHORITY EXTENSIONS TO DAMPIER PUBLIC WHARF		SCALE: AS NOTED CERTIFIED:	
DRAWING TITLE: PILE DETAILS			
DRAWING NO: 37241 - DS - 006		REV: 5	

37241 DS 006

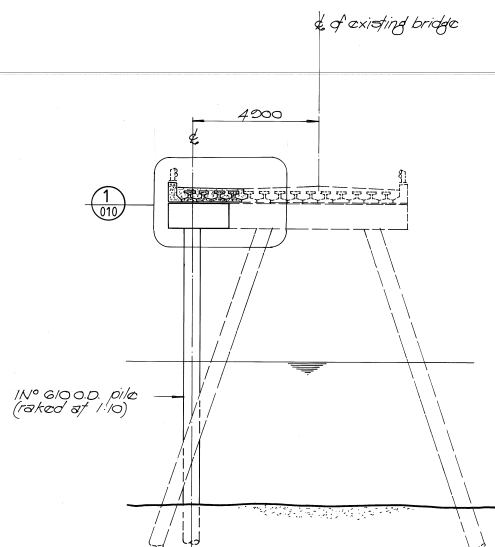


2	AS BUILT		5595	G.M.	PL
1	SOUTHERN EXTENSION ADDED			CM	
0	ISSUED FOR CONSTRUCTION		2129	CM	PL
B	REDRAWN			CM	
REV.	DESCRIPTION		DATE	BY	CHK
 <div style="margin-left: 20px;"> <p>Suite 7, Savings House.          11 Howard Place          JPO Box 715, Kapiwala, VOA 6714          Tel: (09) 41 1679 Fax: (09) 41 2558</p> </div>					
DRAWN:	DATE:	SCALE:			
G. MANSFIELD	OCT '93	A5 NOTED			
CHECKED:	CERTIFIED:				
H. BARR					
PROJECT: DAMPIER PORT AUTHORITY					
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE: APPROACH BRIDGE PLAN AND ELEVATION					
DRAWING NO.	37241 - DS - 007				REV: 2

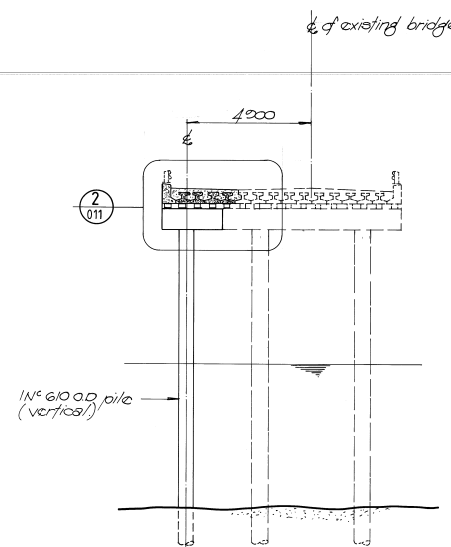




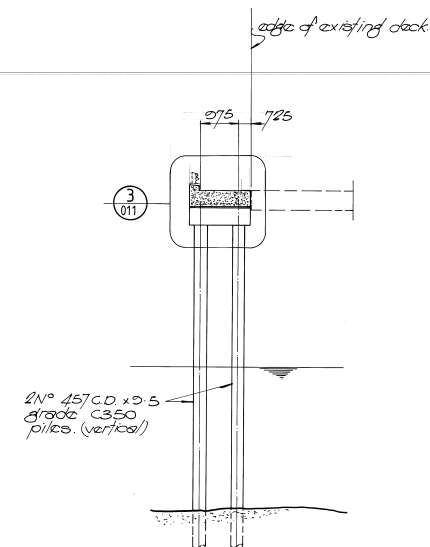
BENT N° 1  
1:100





BENTS N° 2 - 6  
1:100



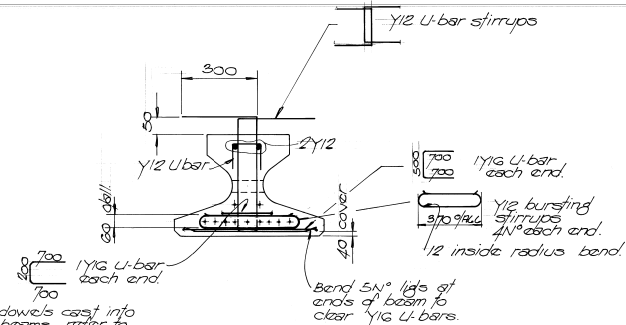
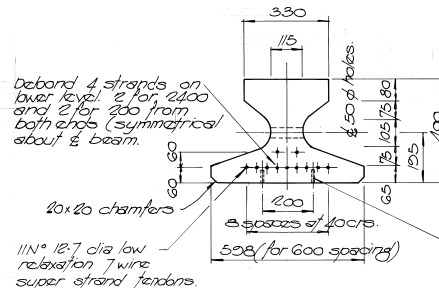
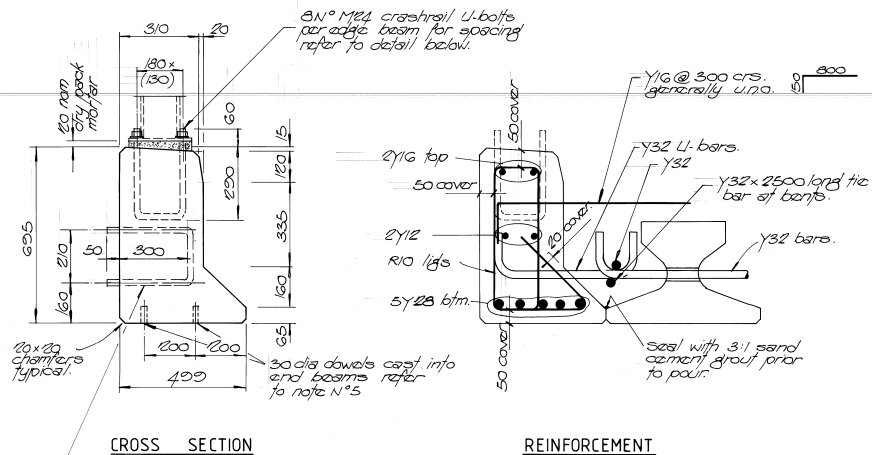
BENT N° 7  
WHARF ABUTMENT  
1:100



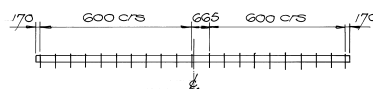
BENT N° 8  
1:100

1	AS BUILT	55.95 GM.	<i>PL</i>
0	ISSUED FOR CONSTRUCTION	2.12.93	<i>du R</i>
B	REDRAWN		<i>du</i>
REV	DESCRIPTION	DATE	BY
  Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha, WA 6714 Tel: (091) 44 1879 Fax: (091) 44 2020			
DRAWN:	G. MANSFIELD	DATE:	OCT '93
DESIGNED:	H. BARR	CHECKED:	
PROJECT:	DAMPIER PORT AUTHORITY		
EXTENSIONS TO DAMPIER PUBLIC WHARF			
DRAWING TITLE:			
APPROACH BRIDGE CROSS SECTIONS			
DRAWING N°	37241-DS-008		REV 1

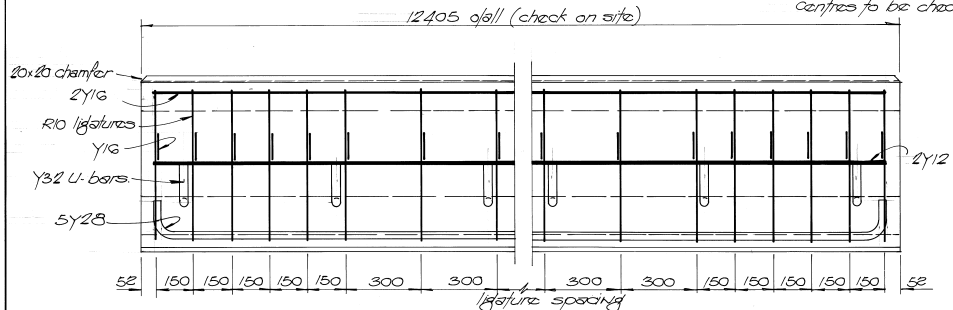
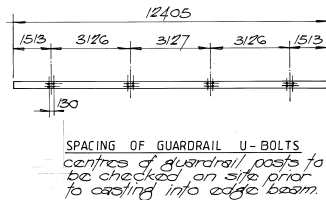
37241-DS008



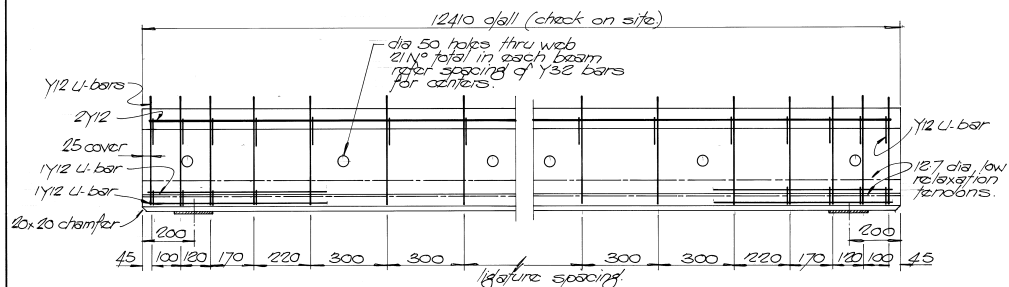
SECTION A



SECTION A




PART ELEVATION ON PRECAST EDGE BEAM



PART ELEVATION ON PRESTRESSED INTERNAL BEAM

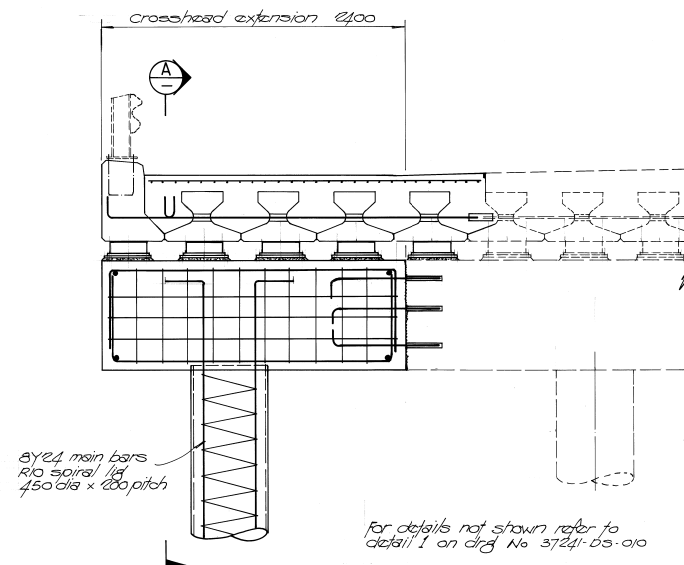
- NOTES
- Concrete properties as specified.
  - Pre-cast edge beams to be cast 1245mm long with a 25mm upward parabolic camber.
  - Pre-stressed beams to be cast flat 1240 mm long 11 N° dia 12.7mm low relaxation super grade strands per beam. Initial jacking load of 147kN per strand (6mm draw-in loss over 40m allowed for).
  - Cast in 4 N° M24 U-bolts into edge beam to support the walkway to Mooring dolphin N° 1 refer to drawing N° 37241-DS-035 for details.
  - 30 dia dowels for bearings are to be provided 200mm in from the ends of all beams at the abutment and bent N° 7.
  - The Contractor shall submit pre-cast beam lifting details for approval prior to fabricating.
  - All exposed cast in fittings to be hot dipped galvanised.
  - Concrete strength 15MPa min for insitu deck before 10t BHP or concrete truck can traverse

1	AS BUILT	55/95	G.M.		PL
0	ISSUED FOR CONSTRUCTION	212/93	ELM		PL
B	REDRAWN				ELM
REV.	DESCRIPTION	DATE	BY		CHK.
<div><div><div><b>FRASER</b> CONSULTANTS</div></div><div><div><b>Astron</b> CONSULTANTS</div><div><small>SUITE 7, SAVINGS 1-JUNE, 11 HEALD PLACE PO BOX 715, KARATHA WA 6714 TEL: (091) 44 1679 FAX: (091) 44 2639</small></div></div></div>					
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>Cheng</i>
PROJECT:	DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE:					
APPROACH BRIDGE					
BEAM DETAILS					
DRAWING: 200	37241-DS-009				REV 1

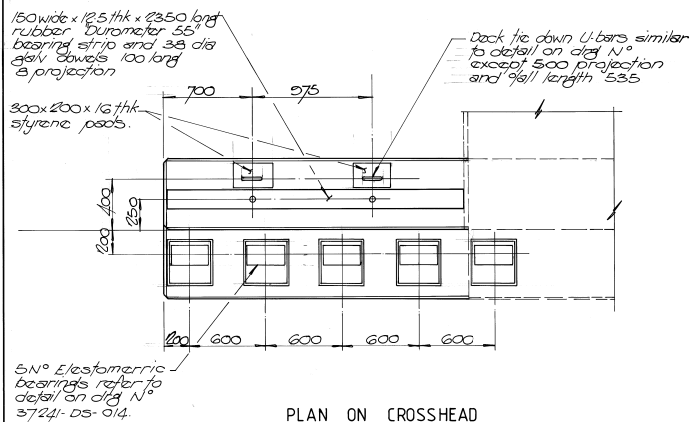
37241 DS009



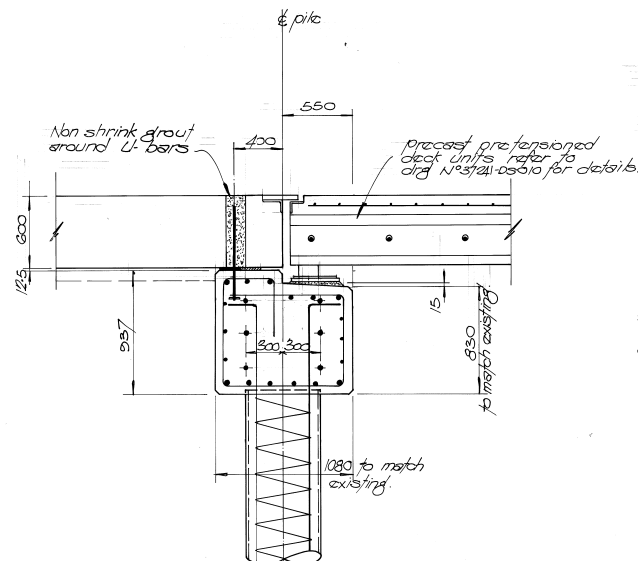




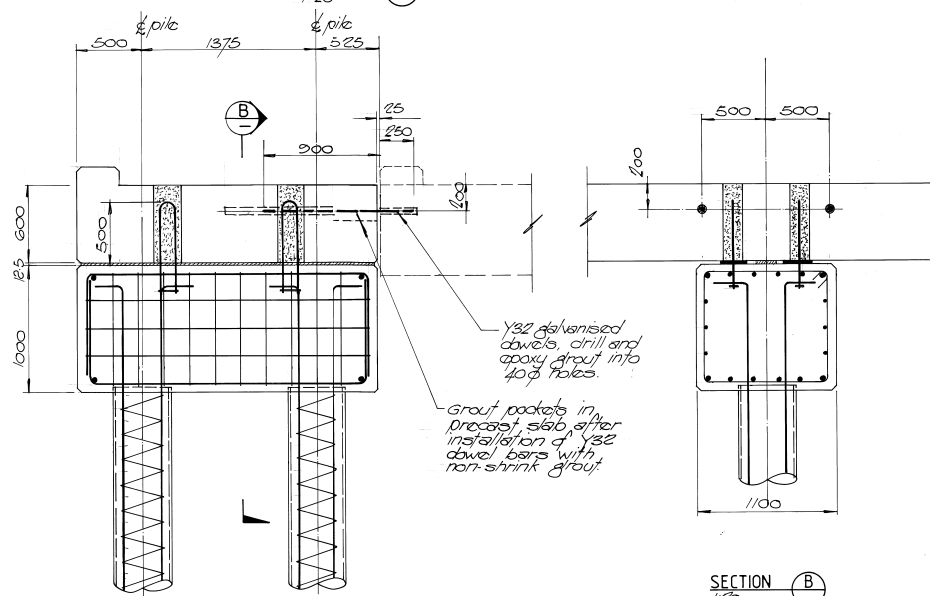
DETAIL 2 BENT No 7  
1:20



PLAN ON CROSSHEAD  
BENT N° 7  
1:20



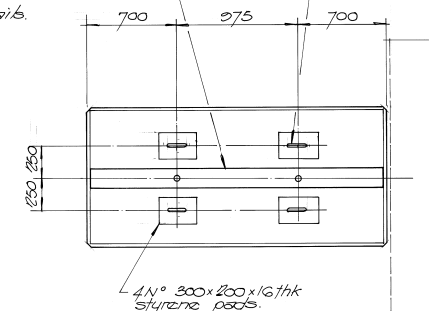
SECTION A  
1:20



SECTION B  
1:20

150 wide x 12.5 thk x 2350 long rubber Durometer 55 bearing strip and 38 dia galv dowels 100 long 8 projection

Deck tie downs U-bars similar to detail on dng N° 37241-DS-010 except 500 projection and 9/11 length 535



PLAN ON CROSSHEAD  
BENT N° 8  
1:20

NOTES:  
1. New crosshead size of bent N° 7 to be the same width as existing site measure prior to ordering materials

REV.	DESCRIPTION	DATE	BY	CHK.
1	AS BUILT	5595	G.M.	R.
0	ISSUED FOR CONSTRUCTION	21293	W.	R.
B	REDRAWN			M.

FRASER CONSULTANTS  
Suite 7, Savoy House,  
11 Hedland Place  
PO Box 713, Karratha, WA 6714  
Tel: (091) 44 1079 Fax: (091) 44 2038

DRAWN: G. MANSFIELD	DATE: OCT '93	SCALE: AS NOTED
DESIGNED: H. BARR	CHECKED:	CERTIFIED: R. BARR

PROJECT: DAMPIER PORT AUTHORITY  
EXTENSIONS TO DAMPIER PUBLIC WHARF

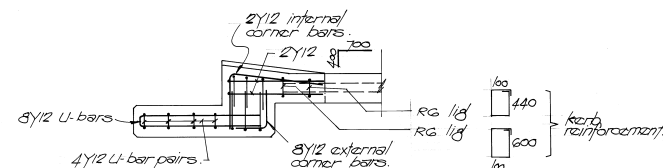
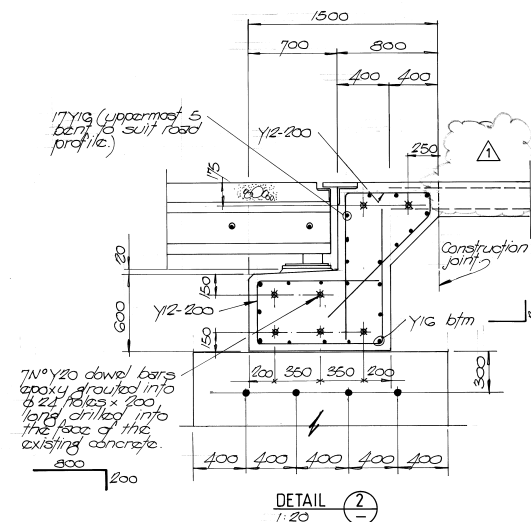
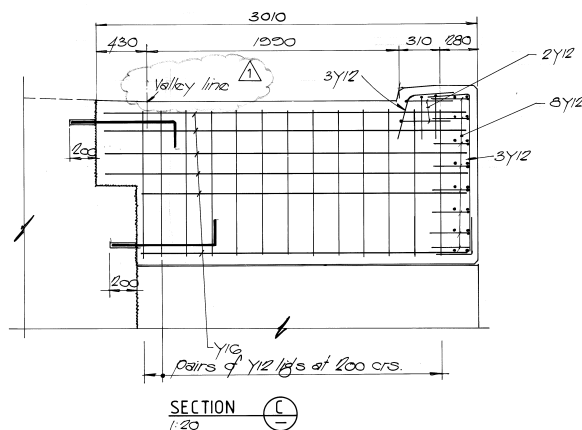
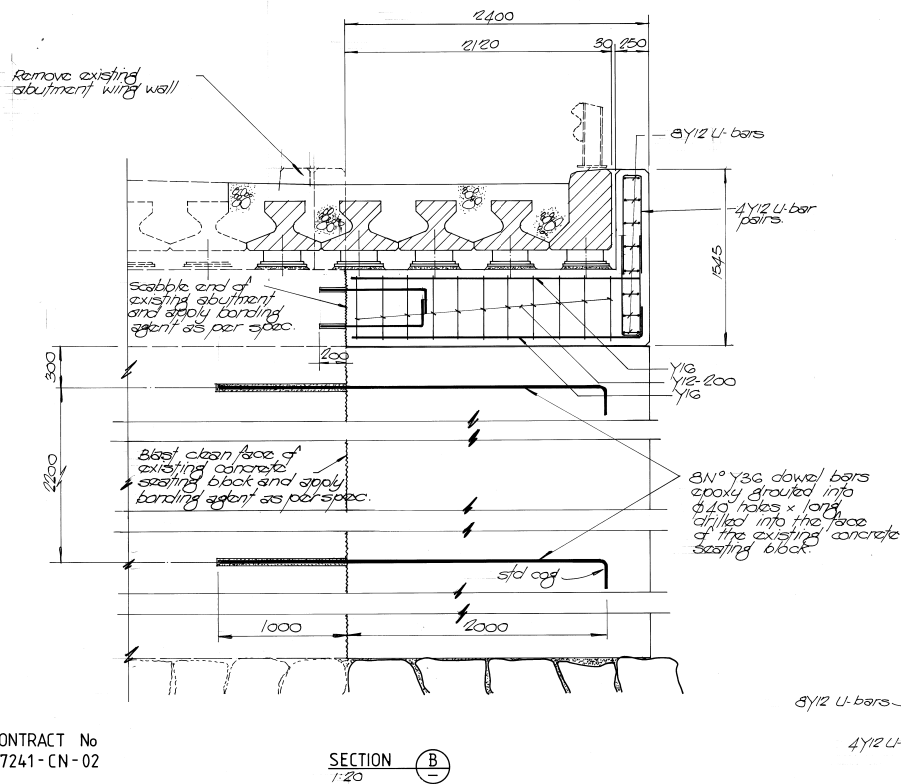
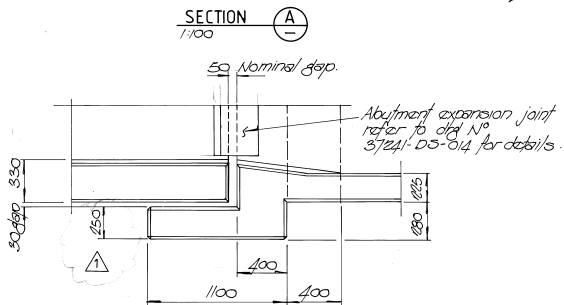
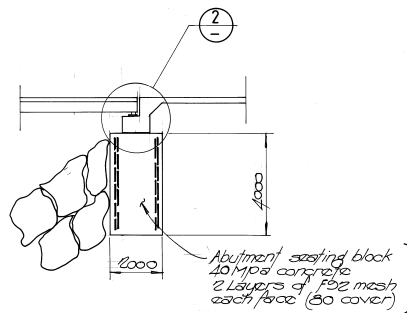
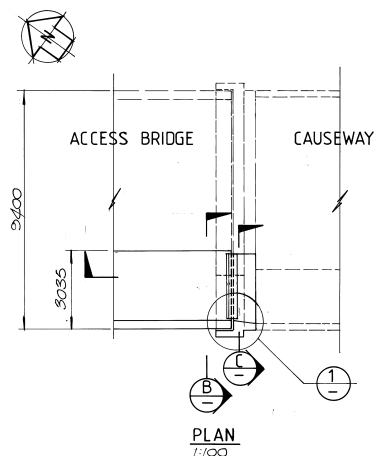
DRAWING TITLE:  
APPROACH BRIDGE  
CROSSHEAD DETAILS SHEET 2 OF 2

DRAWING N° 37241-DS-011  
REV: 1

37241DS011







2	AS BUILT	5595 G.M.	R
1	GENERAL REVISION AS NOTED	21299	el R
0	ISSUED FOR CONSTRUCTION	2311	el R
B	REDRAWN		el R
REV.	DESCRIPTION	DATE	BY CH

**FRASER**  
 CONSULTANTS

Suite 7, Savings House,  
 11 Hedland Place  
 PO Box 713, Karratha WA 6714  
 Tel: (08) 44 1679 Fax: (08) 44 2633

DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	- AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>R. Barry</i>

PROJECT. DAMPIER PORT AUTHORITY

## EXTENSIONS TO DAMPIER PUBLIC WHARF

DRAWING TITLE: APPROACH BRIDGE ABUTMENT G.A. & DETAILS

DRAWING N°	37241 - DS-013	REV	2
------------	----------------	-----	---

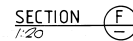
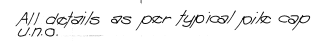
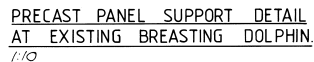
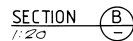
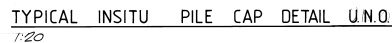
37241 DS013













2	AS BUILT	5595	GM.	PC	
1	PILE CAP CHANGED	1294	ELU	PC	
0	ISSUED FOR CONSTRUCTION	1293	ELU	PC	
B	RE DRAWN		ELU		
REV.	DESCRIPTION	DATE	BY	CHK.	



**FRASER  
CONSULTANTS**



**Astron**  
A STRAIN LIMITED COMPANY  
ASTRON ENGINEERING PTY LTD

Suite 7, Savings House,  
11 Haddon Place  
PO Box 370, Kamuela WA 6754  
Tel: (091) 44 1679 Fax: (091) 44 2638

DRAWN:	DATE:	SCALE:
G. MANSFIELD	OCT '93	AS NOTED
CHECKED:	CHECKED:	CHECKED:
H. BARR		<i>[Signature]</i>

PROJECT: DAMPIER PORT AUTHORITY

EXTENSIONS TO DAMPIER PUBLIC WHARF

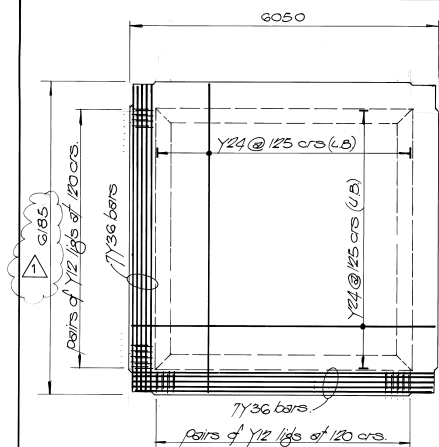
DRAWING TITLE:

NORTHERN EXTENSION - PILE CAP  
AND PANEL SUPPORT DETAILS.

DRAWING NO	3724-I-DS-020	REV
		2

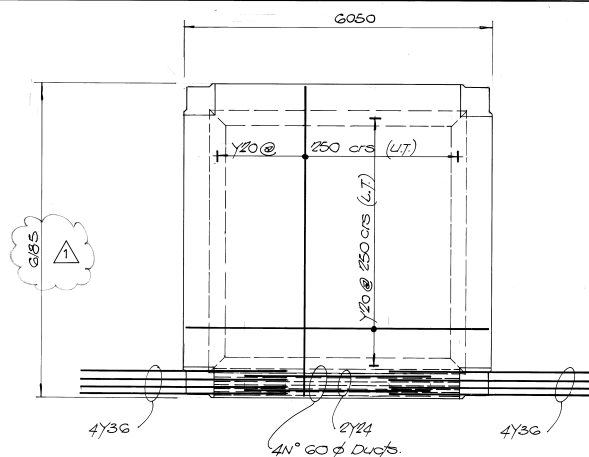






NOTE: Reinforcement shown is typical on all sides

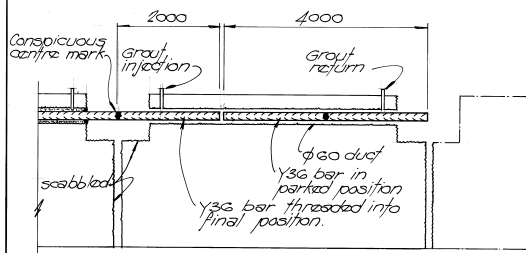
**BOTTOM REINFORCEMENT**



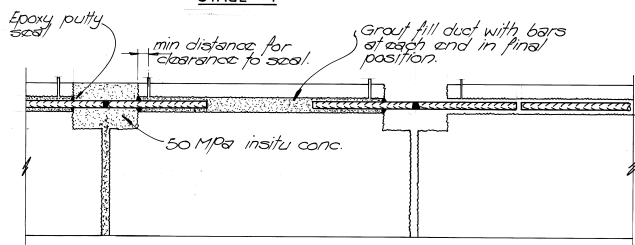
NOTE: All 4 edge beams are reinforced as shown, for lig's refer to bottom reinforcement plan.

**TOP REINFORCEMENT**

**PANEL REINFORCEMENT DETAILS**  
1:50

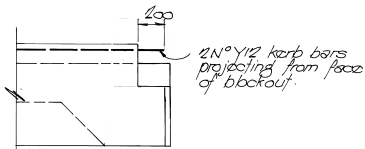


**STAGE 1**

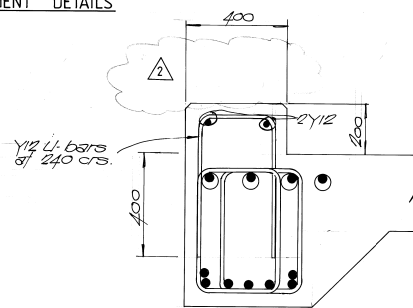


**STAGE 2**

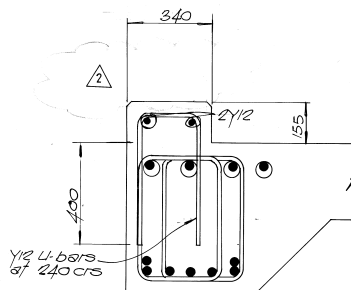
INSTALLATION OF Y36 BARS IN Ø60 DUCTS BETWEEN ADJOINING PANELS  
scale 1:10 vert.  
scale 1:50 horiz.



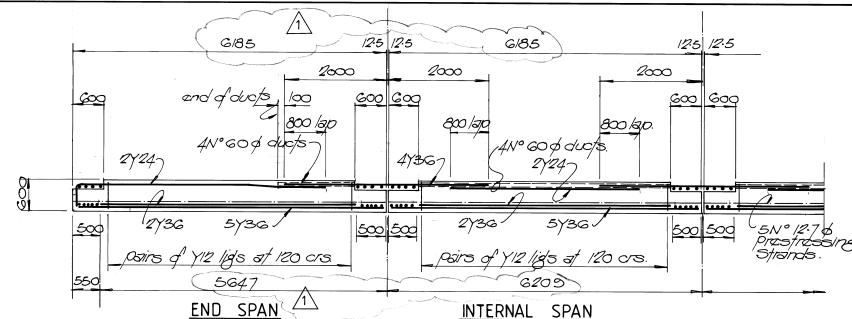
**KERB REINFORCEMENT AT EDGE OF PANEL**  
1:20



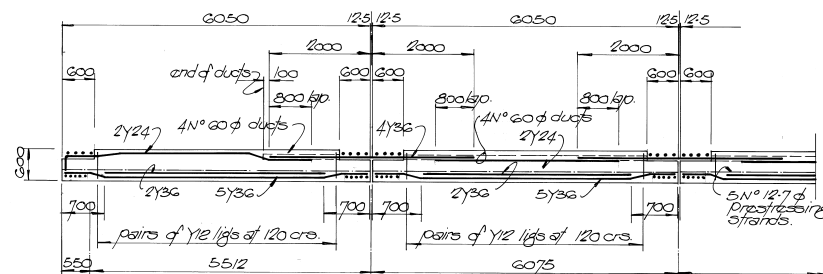
**KERB DETAIL EASTERN SIDE OF NORTHERN WHARF EXTENSION**  
1:10



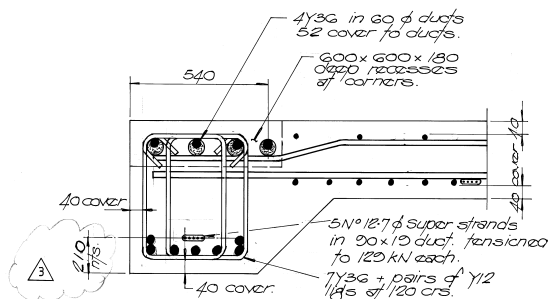
**KERB DETAIL WESTERN SIDE AND NORTH END OF NORTHERN WHARF EXTENSION.**  
1:10



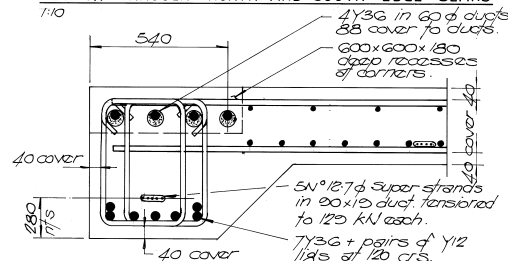
**ELEVATION ON EDGE BEAMS AT NORTH AND SOUTH EDGES OF PANELS.**  
1:50



**ELEVATION ON EDGE BEAMS AT EAST AND WEST EDGES OF PANELS.**  
1:50



**SECTION THROUGH NORTH AND SOUTH EDGE BEAMS**  
1:10



**SECTION THROUGH EAST AND WEST EDGE BEAMS.**  
1:10

**GENERAL NOTES:**

1. Ø60 ducts are deep corrugated metal prestressing ducts.
2. Superstrands are stress relieved by relaxation supergrade 7 wire strands to AS1311.

4	AS BUILT	5595	GM.	PL
3	DUCT LOCATION ALTERED	13/194	ELL	PL
2	TIMBER ON TOP OF KERB REMOVED	31/293	ELL	PL
1	PANEL DIMENSION CHANGED	23/293	ELL	PL
0	ISSUED FOR CONSTRUCTION	31/293	ELL	PL
B	REDRAWN		ELL	
REV.	DESCRIPTION	DATE	BY	CHK.

FRASER

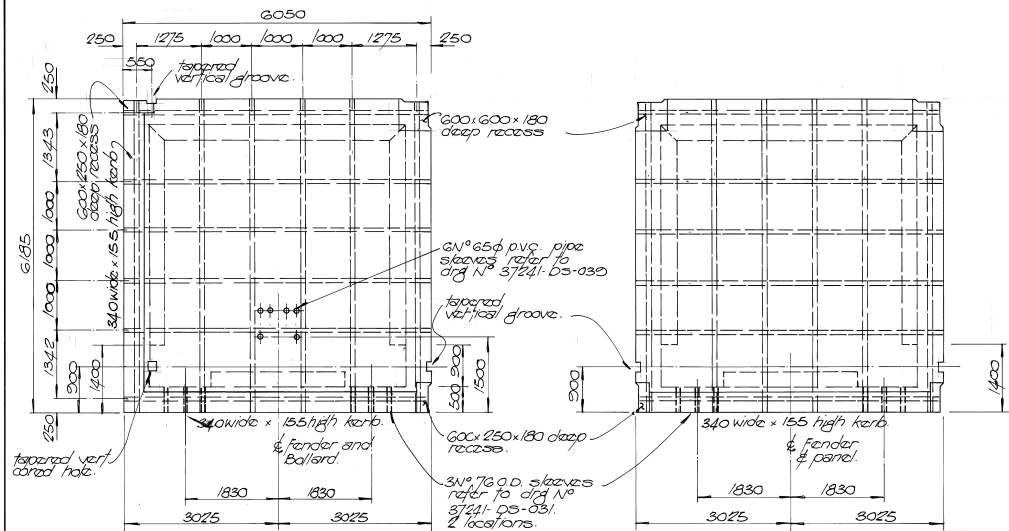
CONSULTANTS

Astron

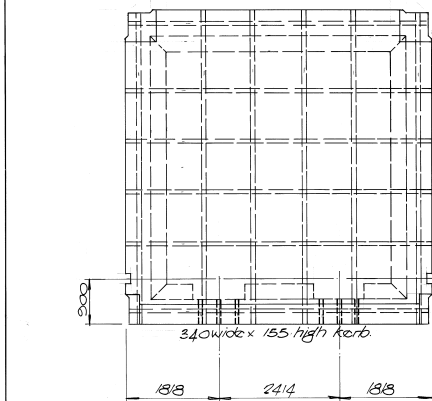
11 HEDLAND PLACE  
PO BOX 713, NORANDA WA 6714  
TEL: (08) 44 1079 FAX: (08) 44 2638

DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>PL</i>
PROJECT:	DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE:					
NORTHERN EXTENSION					
DECK PANEL DETAILS SHEET 2 OF 6					
DRAWING NO.	37241-DS-022				REV:
					4

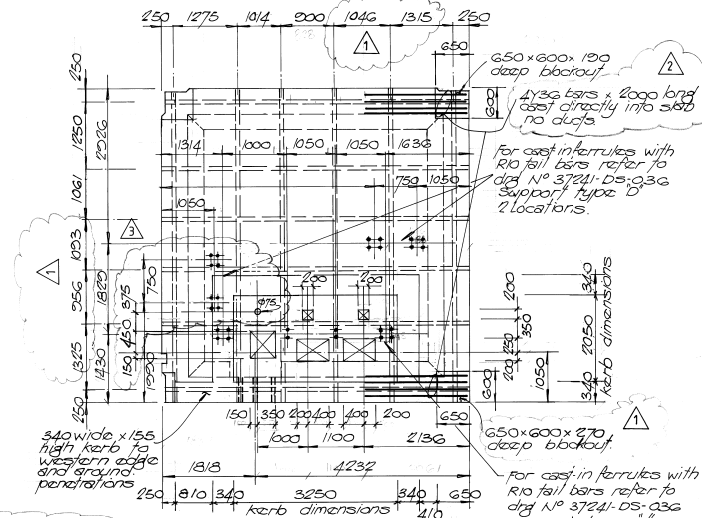
37241-DS-022



CORNER PANEL  
PT9



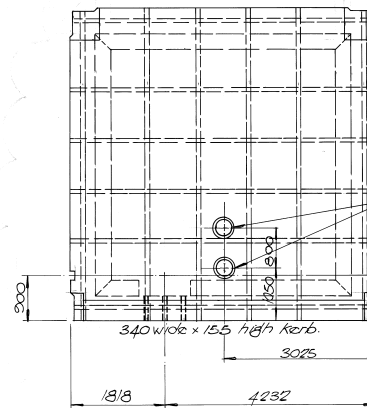
EDGE PANEL  
PT15



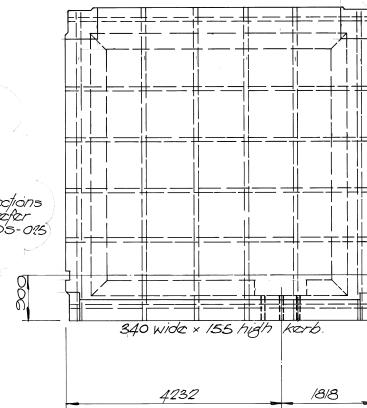
EDGE PANEL  
PT14  
for reinforcement details  
refer to drawing N° 37241-DS-027

#### TYPICAL PRESTRESSED PRECAST DECK PANELS

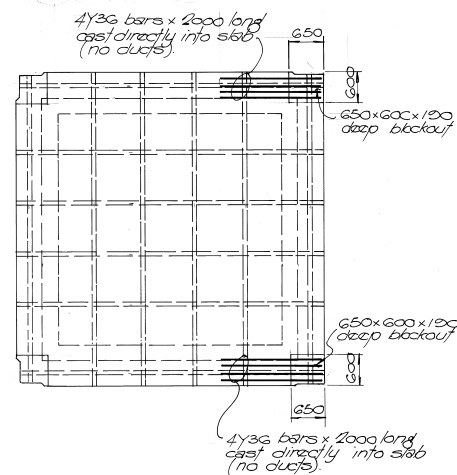
- showing prestressing strand ducts.
- Basins: 1N° 20x15 duct in each basin with 5N° 127 superstrands in each.
- Duct layout, size of panel and blockout sizes are as detailed in panel N° PT3 unless shown otherwise.
- for panel reinforcement, refer to drawing N° 37241-DS-022.
- for blockout and tapered groove details not dimensioned refer to drawing N° 37241-DS-021.
- for cast-in ferrules for pipe support brackets refer to drawing N° 37241-DS-032.
- for general notes on slab ducts and prestressing strands refer to drawing N° 37241-DS-022.



EDGE PANEL  
PT12 AS DRN  
PT17 AS DRN AND NOTED



EDGE PANEL  
PT11



INTERNAL PANEL  
PT7A

5	AS BUILT	5595	G.M.	R.		
4	PT17 ADDED	13494	EL	R.		
3	PT14 AMENDED	21194	EL	R.		
2	BARS ADDED TO PT14	21194	EL	R.		
1	DIMENSION ON PT14 AMENDED	301293	EL	R.		
0	ISSUED FOR CONSTRUCTION	131293	EL	R.		
REV.	DESCRIPTION	DATE	BY	CHK		
<div><div><div><div>FRASER CONSULTANTS</div></div><div><div>Astron</div><div><small>Suite 7, Savings House, 11 Medford Place PO Box 715, Karamba VHA 6714 Tel: (091) 44 1679 Fax: (091) 44 2038</small></div></div></div></div>						
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED	
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	R.P.R.	
PROJECT: DAMPIER PORT AUTHORITY						
EXTENSIONS TO DAMPIER PUBLIC WHARF						
DRAWING TITLE:						
NORTHERN EXTENSION						
DECK PANELS SHEET 3 OF 6						
DRAWING N°	37241-DS-023				REV:	5

37241-DS-023



37241 DS024

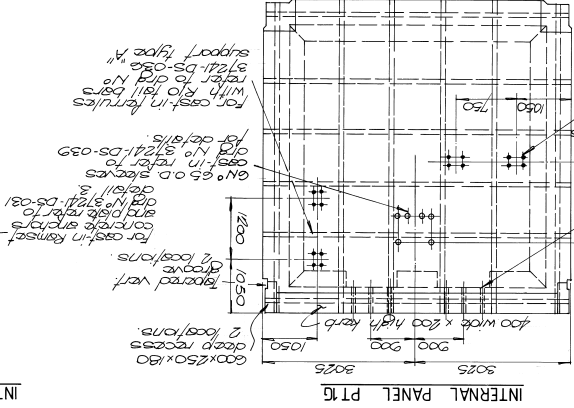
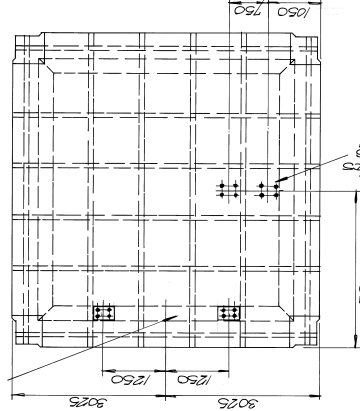
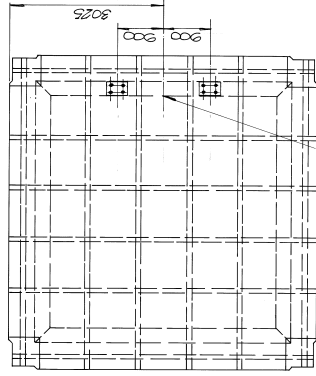
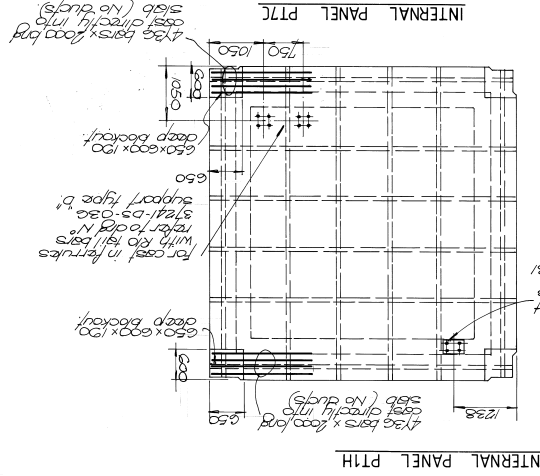
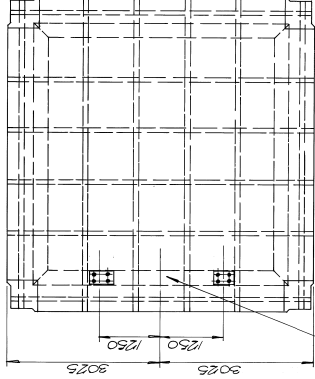
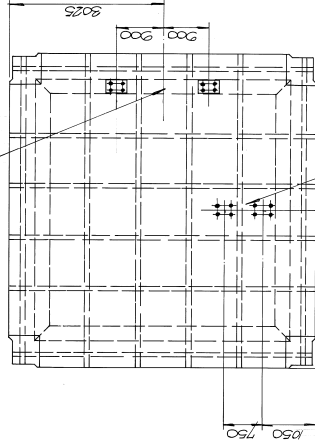
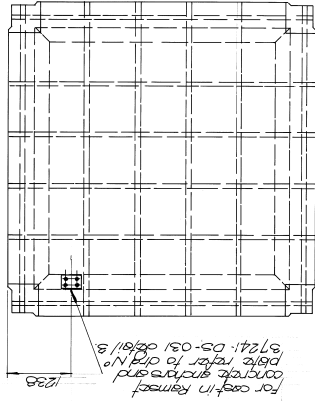
REV.	DESCRIPTION	DATE	BY	CHK.
1	AS BUILT	5/95	GM	h
0	ISSUED FOR CONSTRUCTION	7/93	W	R
1	AS BUILT	5/95	GM	h

DATE	SCALE	AS NOTED	CHECKED	DESIGNED	PROJECT	DRAWING TITLE	DRAWING NO.
OCT 93				G. MANSFIELD	DAMPIER PORT AUTHORITY	NORTHERN EXTENSION DECK PANELS	37241-DS-024

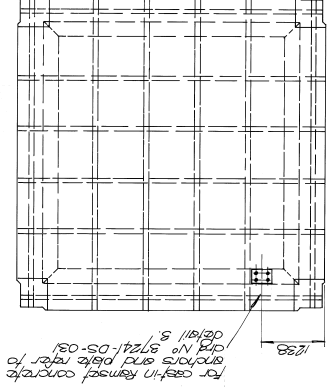
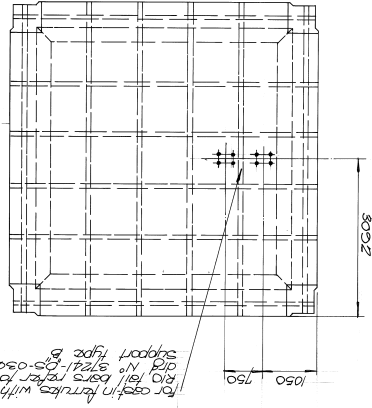
11 Harding Place  
Suite 7, Stanger House,  
Aston Commerce Pty Ltd  
PO Box 175, Kewdale WA 6174  
TEL (091) 44 8729 FAX (091) 44 2838

FRASER  
COMBUSTIBLE  
ASTRON

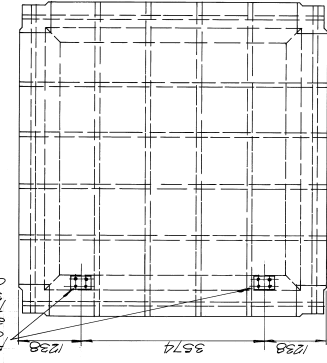
- TYPICAL PRESTRESSED PRECAST DECK PANELS
1. Showing prestressing strand ducts.
  2. Duct layout size of panels and blockout sizes are as detailed in panel PT1 on drawing N° 37241-DS-022.
  3. For panel reinforcement, refer to drawing N° 37241-DS-022.
  4. For blockout and tapered diaphrag details not dimensioned, refer to drawing N° 37241-DS-021.
  5. For cast-in s.s. ferrules for pipe support brackets, refer to drawing N° 37241-DS-032.
  6. For general notes on deck ducts and prestressing strands, refer to drawing N° 37241-DS-022.



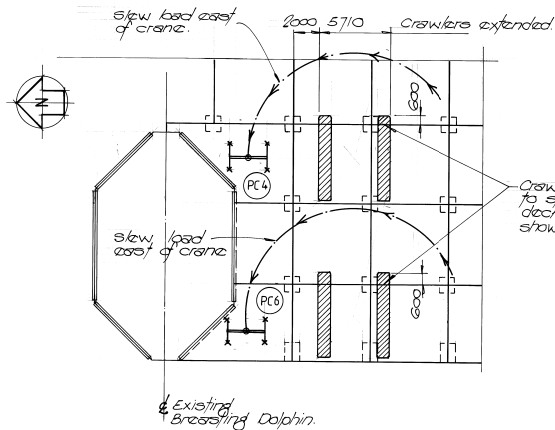
EDGE PANEL PT6



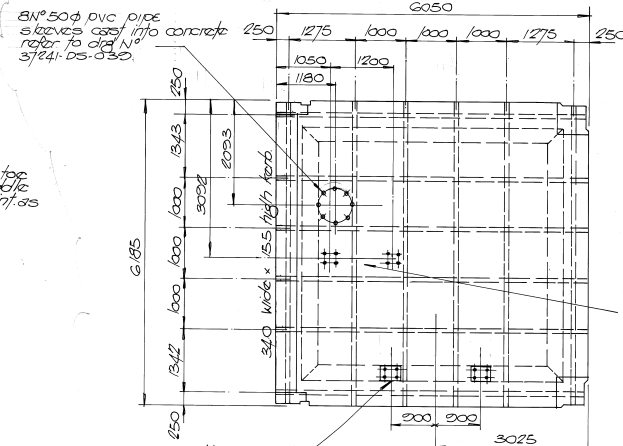
INTERNAL PANEL PT1F



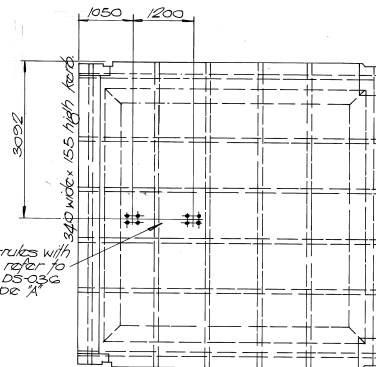
INTERNAL PANEL PT1J



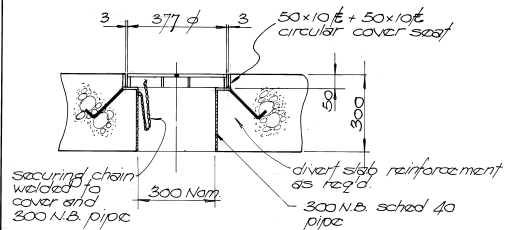
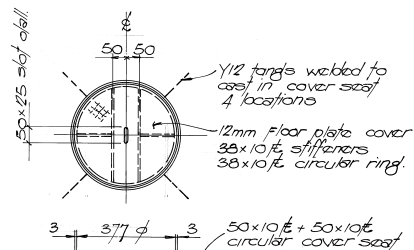
CRANE LOCATION FOR PRECAST PANEL PC4 & PC6  
LIFTING AND PLACEMENT  
1:200



EDGE PANEL PT2A 1:50

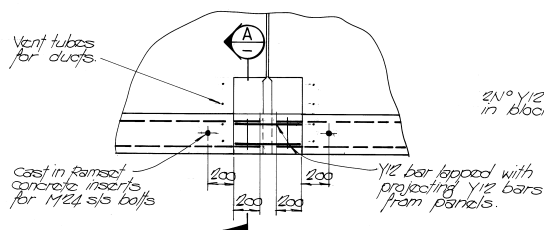


EDGE PANEL PT2B 1:50

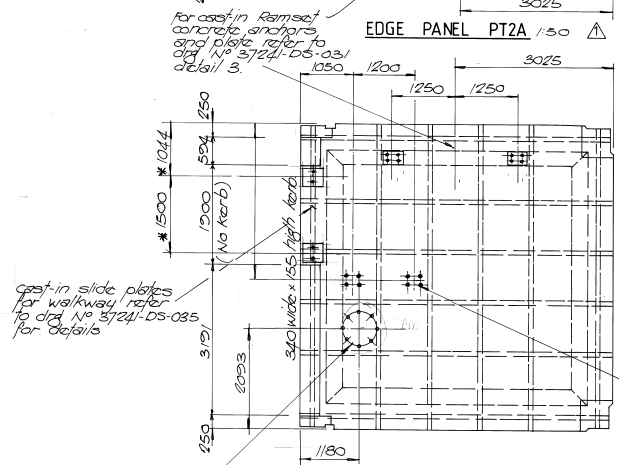


All welds to be 6mm conf. fillet.  
All steelwork to be hot-dip galvanized.

PENETRATION AND COVER DETAILS FOR  
SHELL DIESEL LINE  
1:10

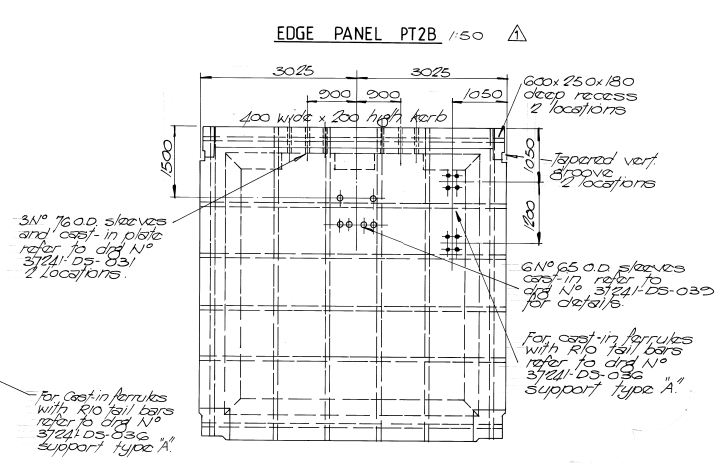


INSITU KERB SECTION AT PANEL JOINTS  
1:20

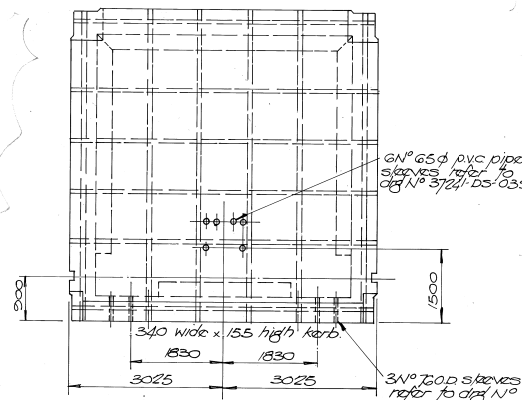


EDGE PANEL PT2C 1:50

\* These dimensions to be site checked by the contractor prior to panel manufacture.



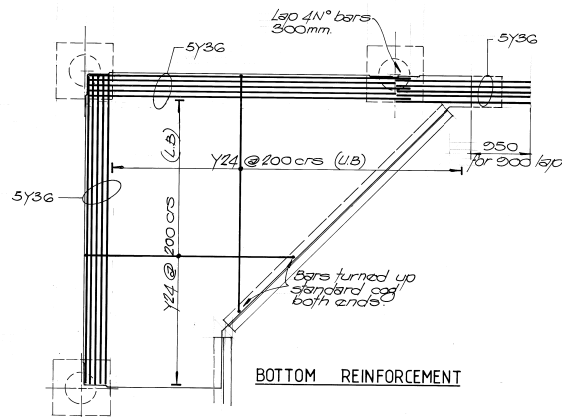
EDGE PANEL PT18



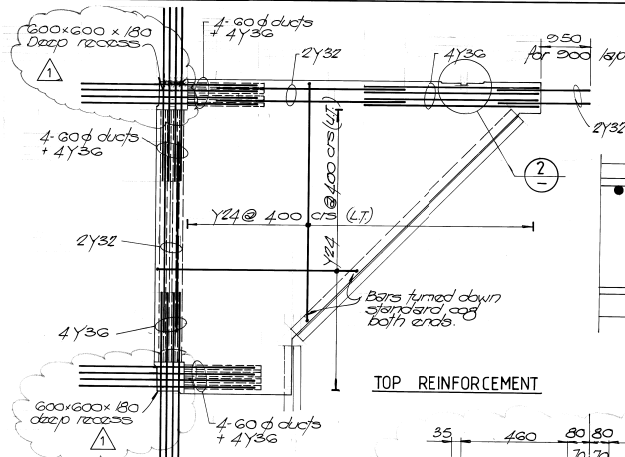
EDGE PANEL PT16

2	AS BUILT	5595	GM	PL
1	PT2A, PT2B, PT2C AMENDED PT18 ADDED PT16 ADDED	18/11/93	GM	PL
0	ISSUED FOR CONSTRUCTION	13/12/93	GM	PL
REV.	DESCRIPTION	DATE	BY	CHK.
<div> <div>FRASER CONSULTANTS</div> <div> <div>Astron</div> <div>ASTRON ENVIRONMENTAL</div> <div>ASTRON ENGINEERING PTY LTD</div> </div> </div> <div> <div>Suite 7, Favington House,</div> <div>11 Haddon Place</div> <div>PO Box 713, Karratha WA 6714</div> <div>Tel: (091) 44 1879 Fax: (091) 44 2838</div> </div>				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		AS NOTED
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: NORTHERN EXTENSION DECK PANELS				
SHEET 5 OF 6				REV 2
DRAWING N° 37241-DS-025				

37241-DS-025

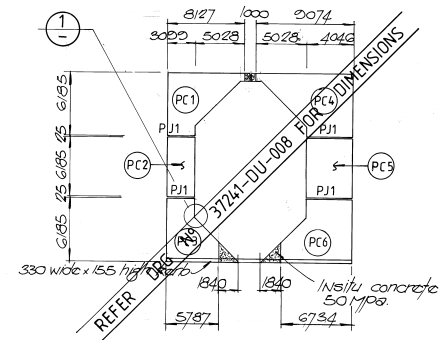


**BOTTOM REINFORCEMENT**



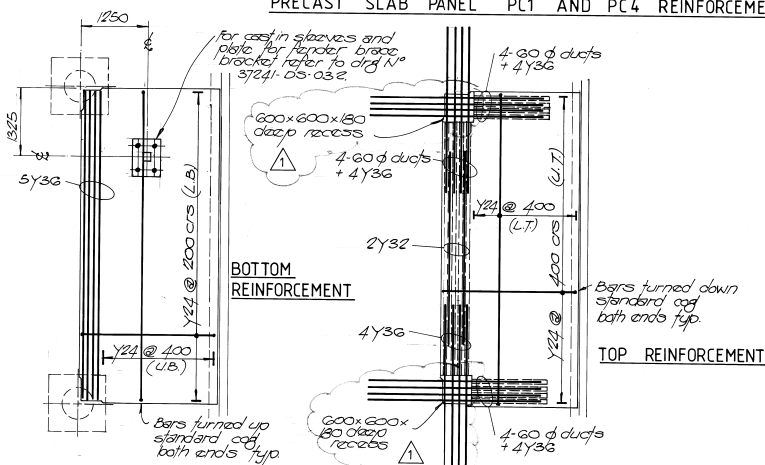
**TOP REINFORCEMENT**

**SECTION (B)**



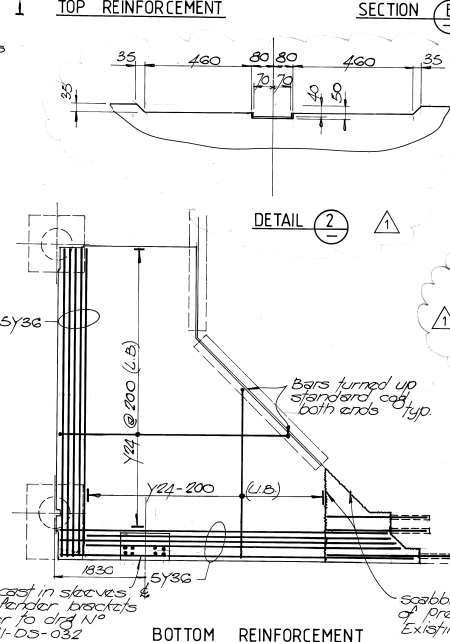
**PANEL KEY PLAN**

\* All dimensions to be checked by contractor prior to fabrication.

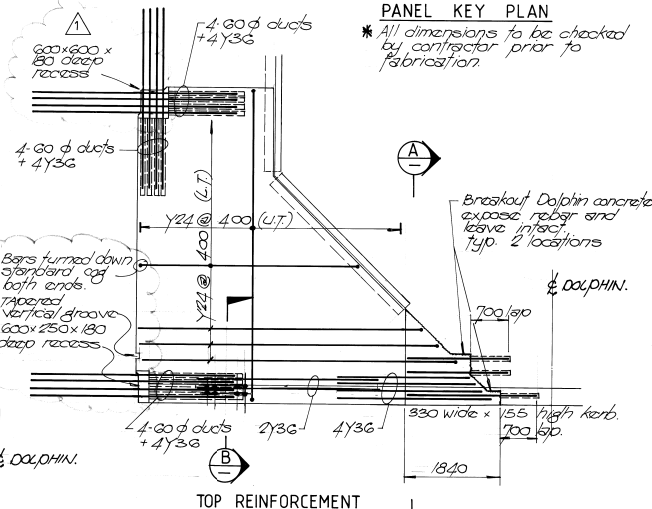


**BOTTOM REINFORCEMENT**

**TOP REINFORCEMENT**



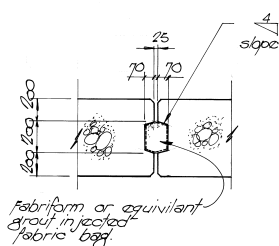
**BOTTOM REINFORCEMENT**



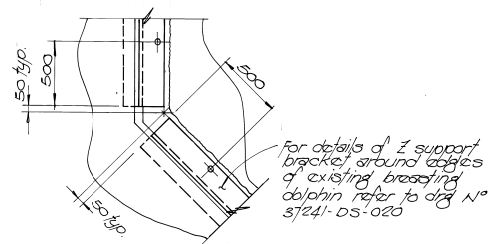
**TOP REINFORCEMENT**

**PRECAST SLAB PANEL PC2 AND PC5 REINFORCEMENT DETAILS**

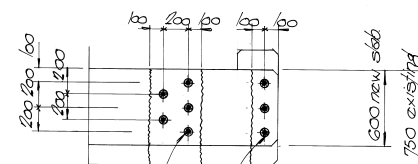
**PRECAST SLAB PANEL PC3 AND PC6 REINFORCEMENT DETAILS**



**PANEL JOINT - PJ1**  
Typical only between precast panels ground breasting dolphin.



**DETAIL (1)** Typical corner detail.



**SECTION (A)**

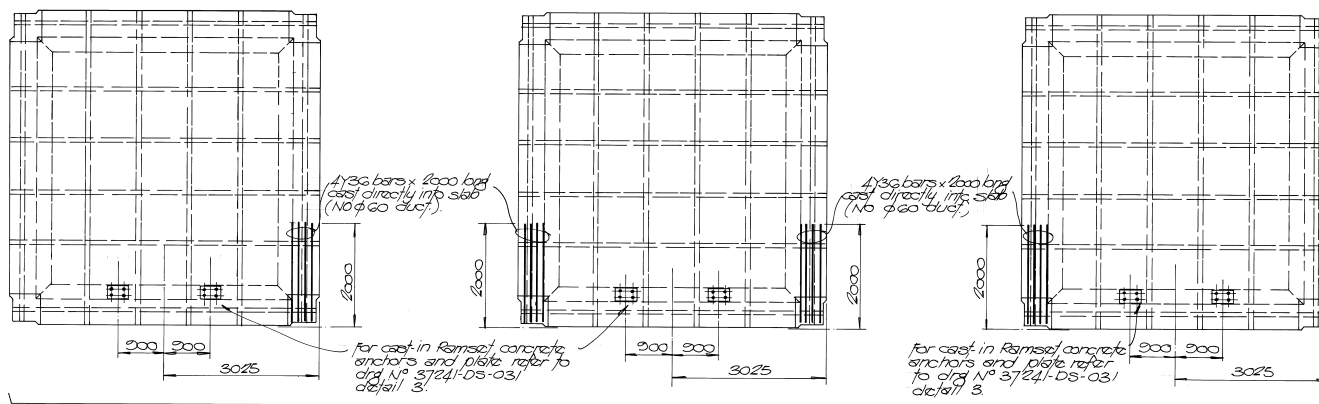
grout in 8N° Y32 bars with latex polyester resin type Lakser P40 in accordance with manufacturers recommended practice.

Jid drilled holes in existing dolphin concrete dia 57mm hole tolerance:  
1. Position tolerance ±20mm  
2. Angle tolerance  
3. In all directions.

3	AS BUILT	5595	G.M.	PL	
2	PANEL DIMENSIONS ALTERED	11294	ELM		
1	GENERAL REVISION	18194	ELM	PL	
0	ISSUED FOR CONSTRUCTION	181293	ELM	PL	
REV.	DESCRIPTION	DATE	BY	CHK.	
<div><div><div><div>FRASER CONSULTANTS</div></div><div><div>Astron</div><div>A CONSULTING ENGINEERING PTY LTD</div></div></div><div><div>Suite 7, Scrivens House, 11 Healdland Place PO Box 113, Karratha WA 6714 Tel: (091) 44 1079 Fax: (091) 44 2038</div></div></div>					
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>RBG</i>
PROJECT:	DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE:					
NORTHERN EXTENSION CONCRETE INFILL PANELS					
DRAWING NO. 37241 - DS - 026					
					REV: 3

37241 DS026



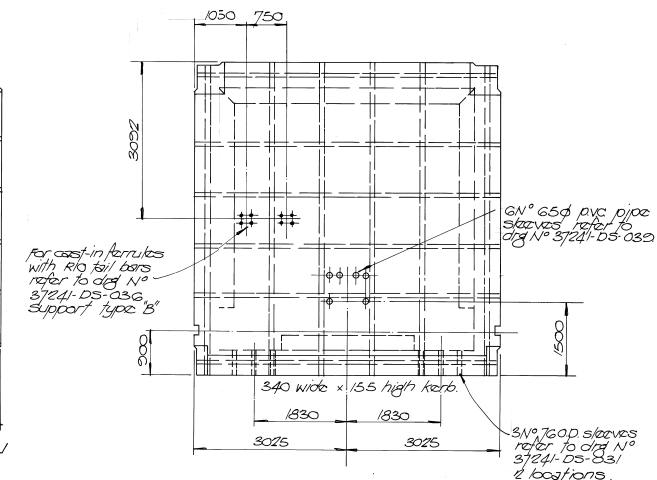


INTERNAL PANEL PT101

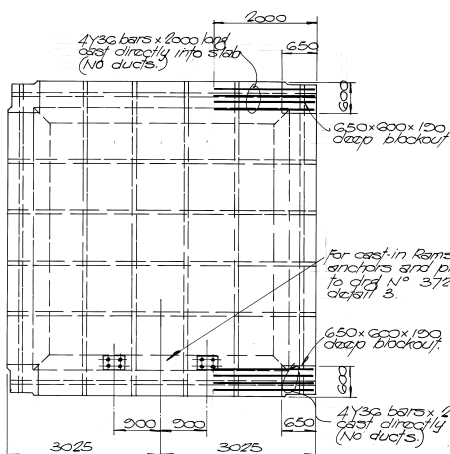
INTERNAL PANEL PT102

INTERNAL PANEL PT103

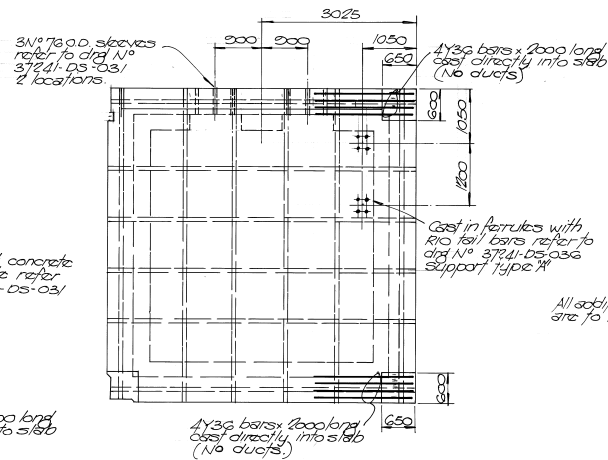
Note: All other reinforcement and arrangement as shown on dtd N° 37241-DS-022



EDGE PANEL PT13



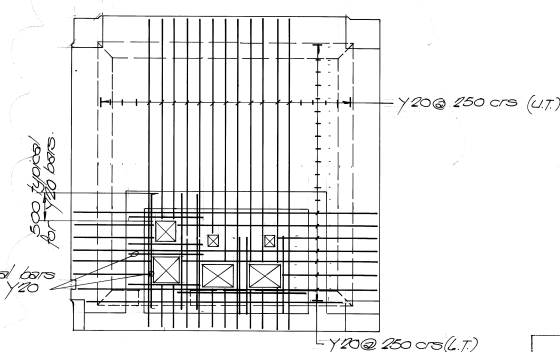
INTERNAL PANEL PT7B



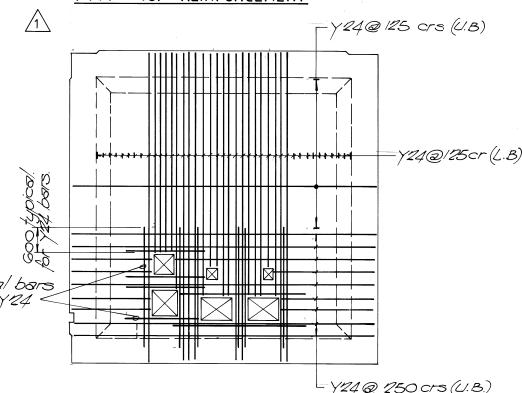
EDGE PANEL PT8

# TYPICAL PRESTRESSED PRECAST DECK PANELS

- showing prestressing strand ducts
- SAB: 4N° 70x120 ducts each way with 4N° 12.7 superstands in each
- BEAMS: 1N° 20x12 ducts in each beam with 5N° 12.7 superstands in each
- duct layout, size of panel, and blockout sizes are as detailed in panel N° PT8, unless shown otherwise
- for panel reinforcement refer to drawing N° 37241-DS-022
- for blockout and tapered groove details not dimensioned refer to dtd N° 37241-DS-021
- for cast in ss. ferrules for pipe support brackets refer to dtd N° 37241-DS-036
- for general notes on 90° ducts and prestressing strands refer to dtd N° 37241-DS-022




PT14 TOP REINFORCEMENT



PT14 BTM REINFORCEMENT

2	AS BUILT	5595	G.M.		PL
1	PT14 REINFORCEMENT ADDED	31293			PL
0	ISSUED FOR CONSTRUCTION	13-12-93			PL
REV.	DESCRIPTION	DATE	BY	CHK.	

(3)

**FRASER**  
CONSULTANTS

**Astron**  
ASTRON ENVIRONMENTAL  
ENGINEERING PT LTD

Suite 7, Savings House,  
11 Hedland Place  
PO Box 713, Karatha, WA. 6714  
Tel: (08) 94 1079 Fax: (08) 94 2638

DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>P. Barry</i>

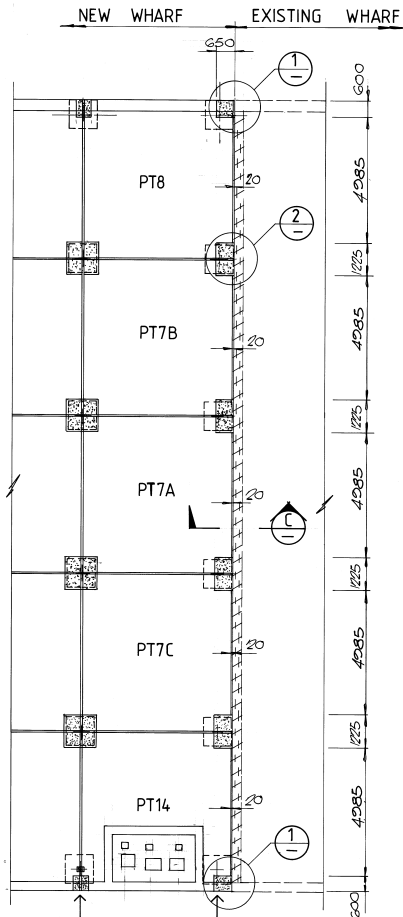
PROJECT: DAMPIER PORT AUTHORITY

EXTENSIONS TO DAMPIER PUBLIC WHARF

DRAWING TITLE: NORTHERN EXTENSION  
DECK PANELS SHEET 6 OF 6

DRAWING N°	37241-DS-027	REV:	2
------------	--------------	------	---

37241DS027



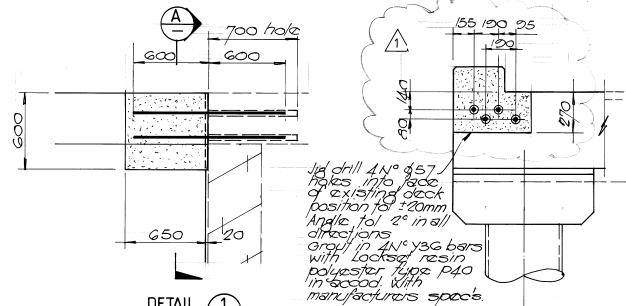
Note: Y&G bars in face of piles along this line are to be installed after first line of piling, have been drafted, refer 37241-DS-028

Note: No projecting Y&G bars from piles along this line.

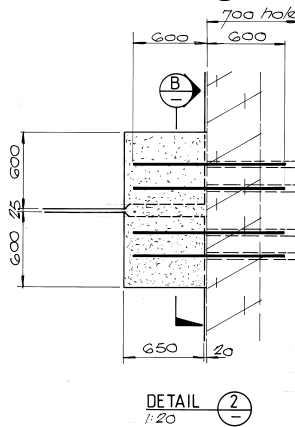
PLAN 1:100

Denotes in situ concrete.

REPL Denotes repaired existing concrete.

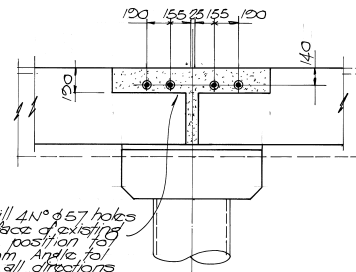


1/2" drill 4N° 657 holes into face of existing deck position for ±20mm. Angle for 2° in all directions. Grout in 4N° Y&G bars with Lockset resin polyester type P40 in accord with manufacturers specs.



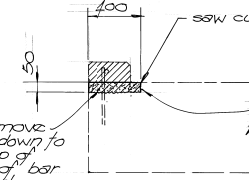
1/2" drill 4N° 657 holes into face of existing deck position for ±20mm. Angle for 2° in all directions. Grout in 4N° Y&G bars with Lockset resin polyester type P40 in accord with manufacturers specs.

SECTION A 1:20



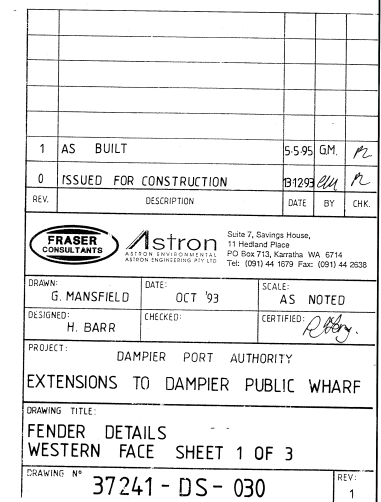
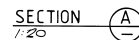
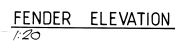
SECTION B 1:20

Saw cut and remove existing kerb down to 50mm below top of deck. Cast end of bar as specified and repair edge of slab with 50 MPa concrete.



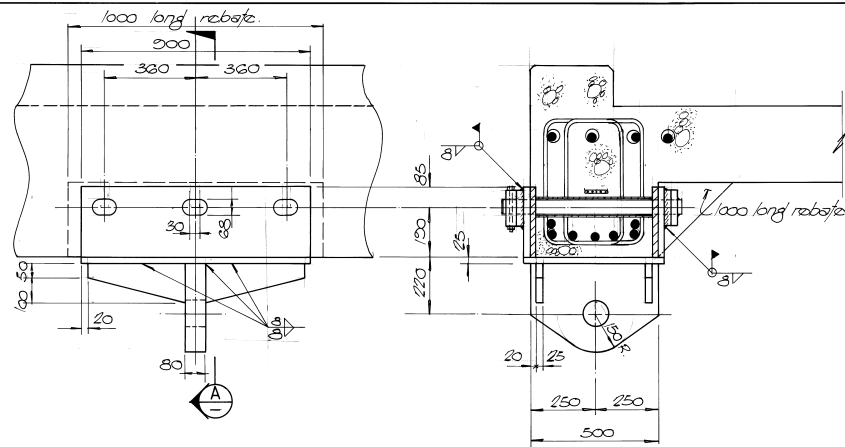
SECTION C 1:20

2	AS BUILT	5595	GM	Pr
1	SECTION A AMENDED	31293	GM	Pr
0	ISSUED FOR CONSTRUCTION	131293	GM	Pr
B	REDRAWN			Pr
REV.	DESCRIPTION	DATE	BY	CHK.
<div> <div>FRASER CONSULTANTS</div> <div> <div>Astron</div> <div>           Suite 7, Savings House,            11 Hedland Place            PO Box 713, Mandurah WA 6714            Tel: (091) 44 1579 Fax: (091) 44 2639         </div> </div> </div>				
DRAWN	G. MANSFIELD	DATE	OCT '93	SCALE
DESIGNED	H. BARR	CHECKED		CERTIFIED
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: NORTHERN EXTENSION				
EXISTING STRUCTURE INTERFACE				
DRAWING NO	37241 - DS - 028	REV	2	

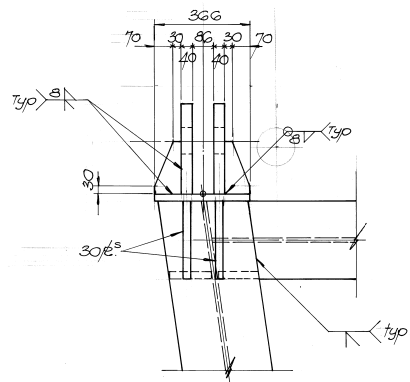


37241DS030

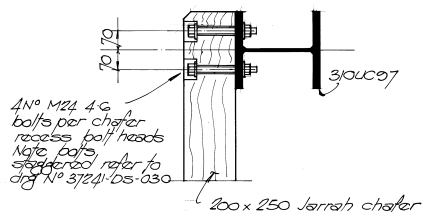




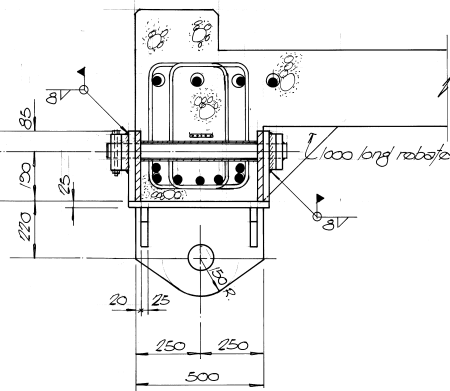
DETAIL 1  
030



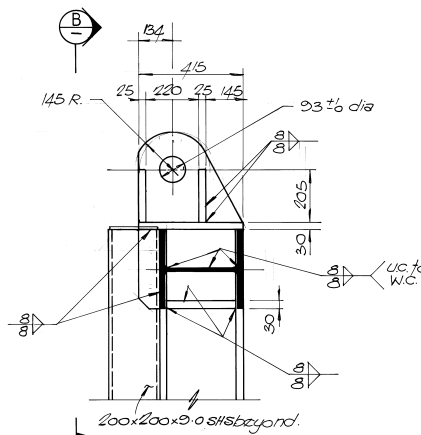
VIEW B  
030



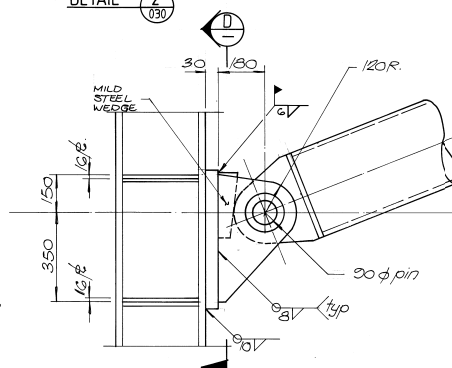
JARRAH CHAFER TO 310 UC



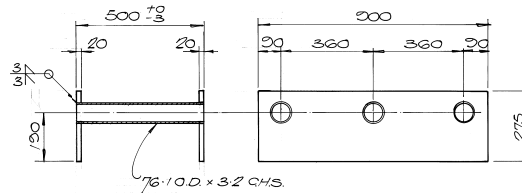
SECTION A  
030



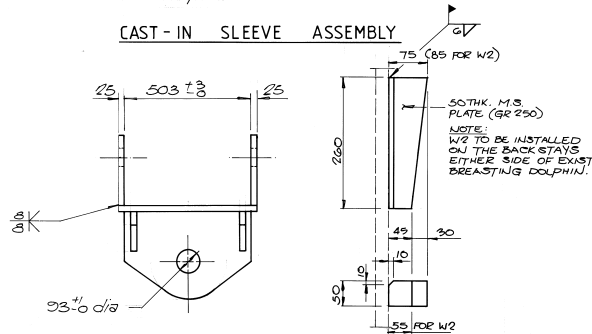
DETAIL 2  
030



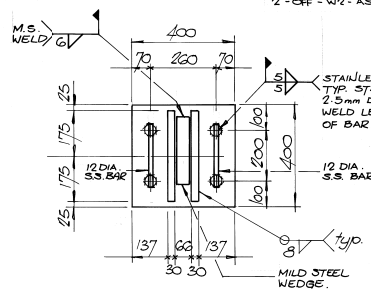
DETAIL 4  
030



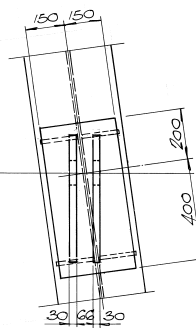
CAST-IN SLEEVE ASSEMBLY



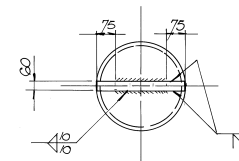
YOKE DETAIL



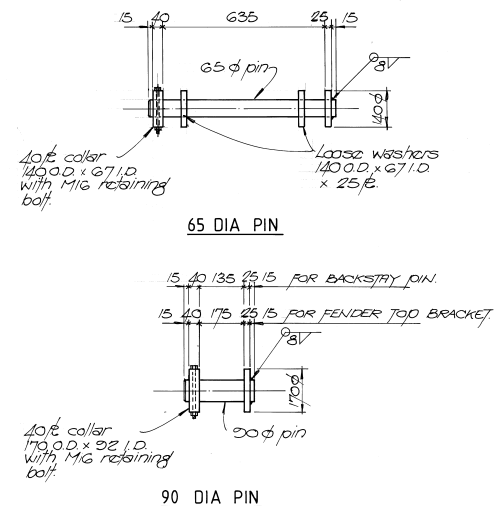
SECTION C  
030



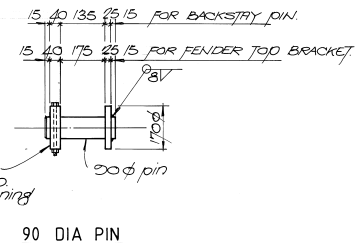
SECTION D  
030



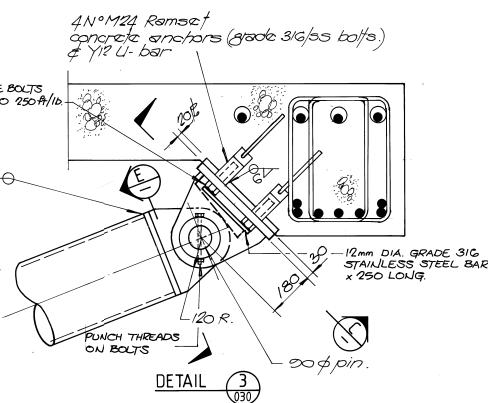
SECTION E  
030



65 DIA PIN



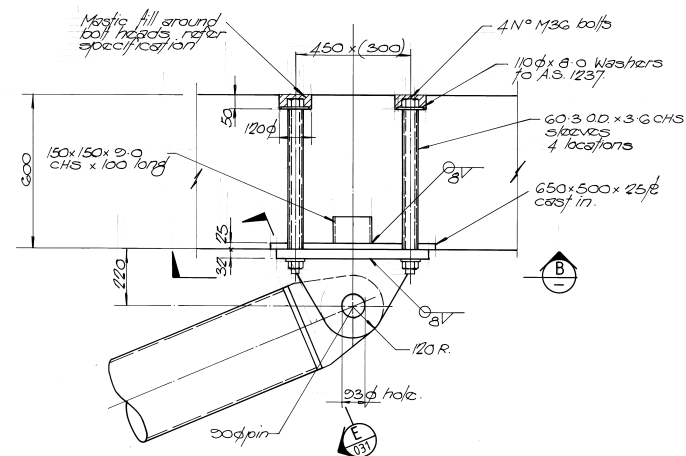
90 DIA PIN



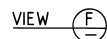
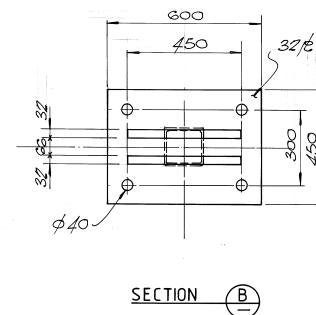
DETAIL 3  
030



1	AS BUILT	55%	GM	PL
0	ISSUED FOR CONSTRUCTION	13/12/93	GM	PL
REV	DESCRIPTION	DATE	BY	CHK
<b>FRASER CONSULTANTS</b> <b>Astron</b> Suite 7, Savings House, 11 Macdonald Place, PO Box 715, Karamba, VIC 3114. Tel: (03) 44 1679 Fax: (03) 44 2633				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: WESTERN FACE SHEET 2 OF 3				
DRAWING N°	37241-DS-031	REV	1	

37241 DS031

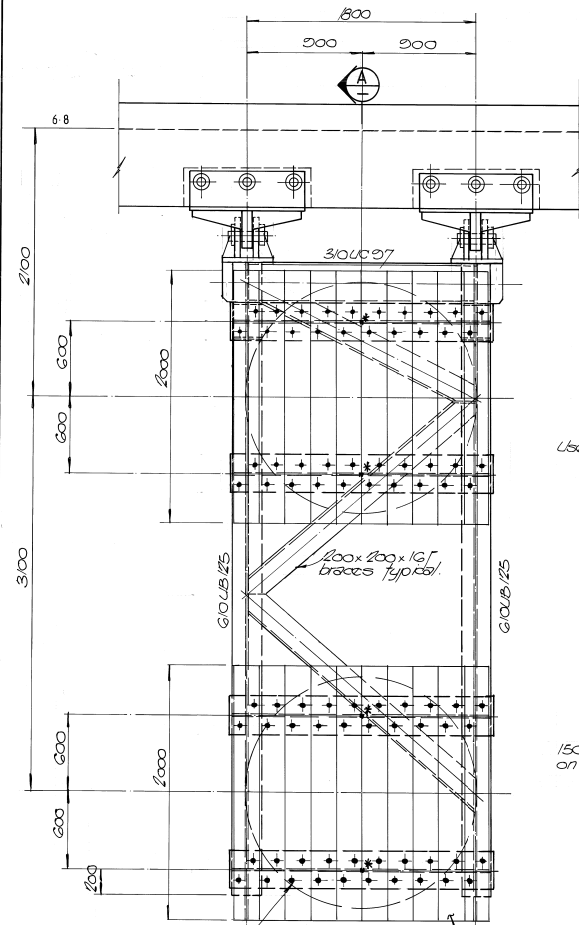
SECTION     A    

BACKSTAY FIXING BRACKET TO PC2 AND PC5

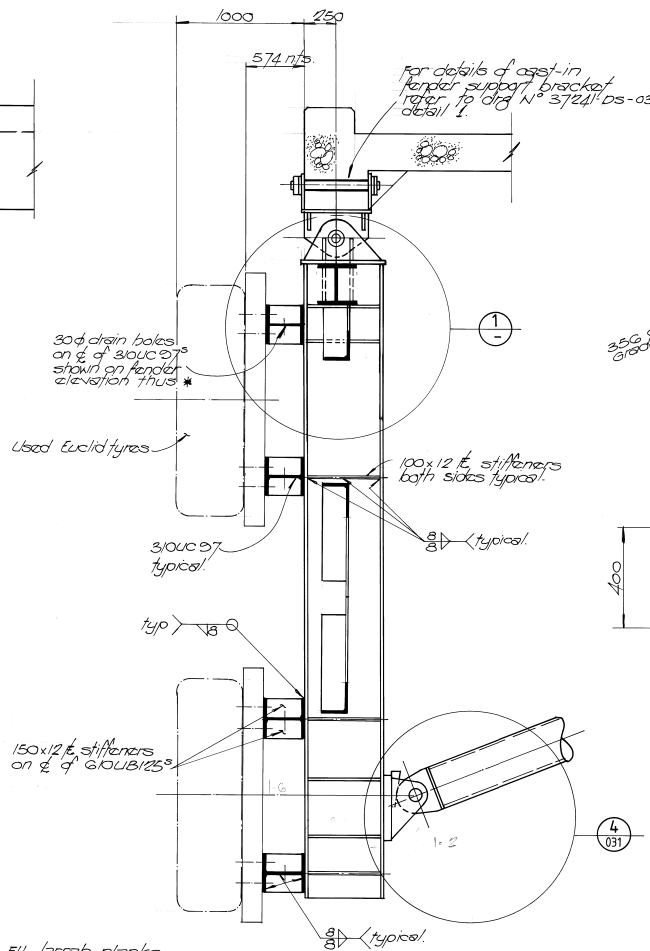


1	AS BUILT	5595	GM	
0	ISSUED FOR CONSTRUCTION	131293	du	
REV.	DESCRIPTION	DATE	BY	
  <div style="float: right; text-align: right;">             Suite 7, Seavue House,              11 Highland Place              PO Box 713, Karratha WA 6714              Tel: (081) 44 1079 Fax: (081) 44 20           </div>				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	
DESIGNED:	H. BARR	CHECKED:		CERTIFIED: <i>Roby</i>
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE:				
FENDER DETAILS				
WESTERN FACE SHEET 3 OF 3				
DRAWING NO. 37241 - DS - 032				
				REV:

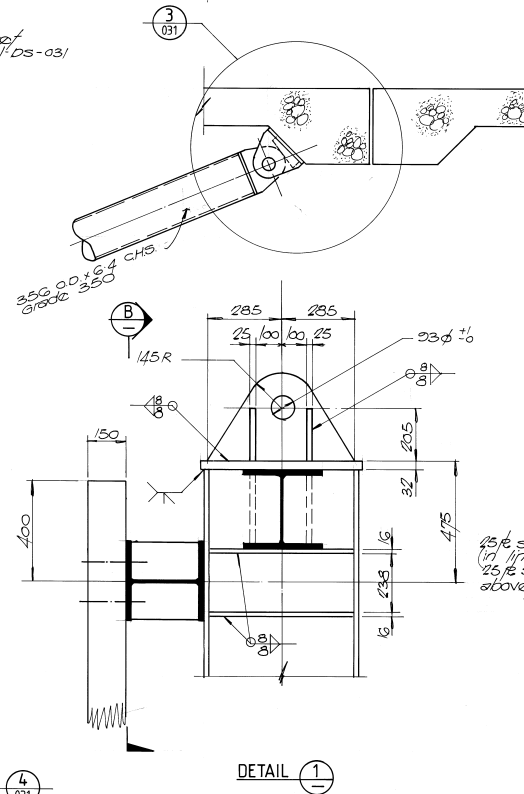
37241DS032



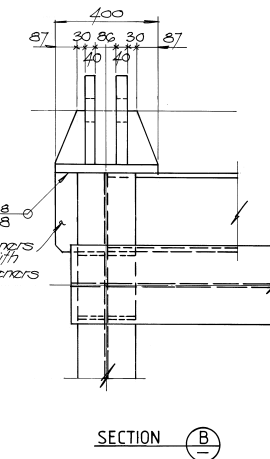
FENDER ELEVATION



SECTION A-A



DETAIL 1



SECTION B-B

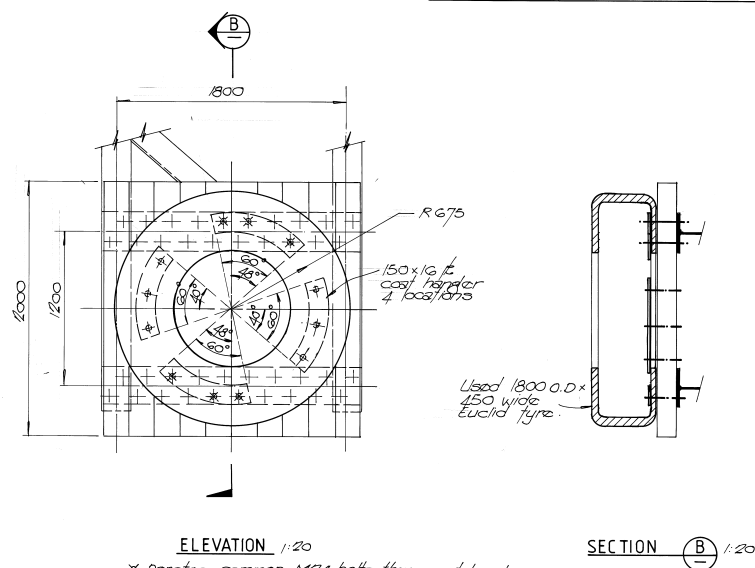
1	AS BUILT	5/5/95	GM	PL	
0	ISSUED FOR CONSTRUCTION	13/2/95	GM	PL	
REV.	DESCRIPTION	DATE	BY	CHK.	
<div><div><div><b>FRASER</b> CONSULTANTS</div></div><div><div><b>Astron</b> A DIVISION OF TROVATIUM PTY LTD ASTRON ENGINEERING PTY LTD</div><div>Suite 7, Savings House, 11 Heilford Place PO Box 713, Karratha WA 6714 Tel: (091) 44 1079 Fax: (091) 44 2638</div></div></div>					
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	<i>RLB</i>
PROJECT: DAMPIER PORT AUTHORITY					
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE:					
FENDER DETAILS					
EASTERN FACE					
DRAWING N°	37241 - DS - 033				REV:
					1

37241 DS033






[illegible]

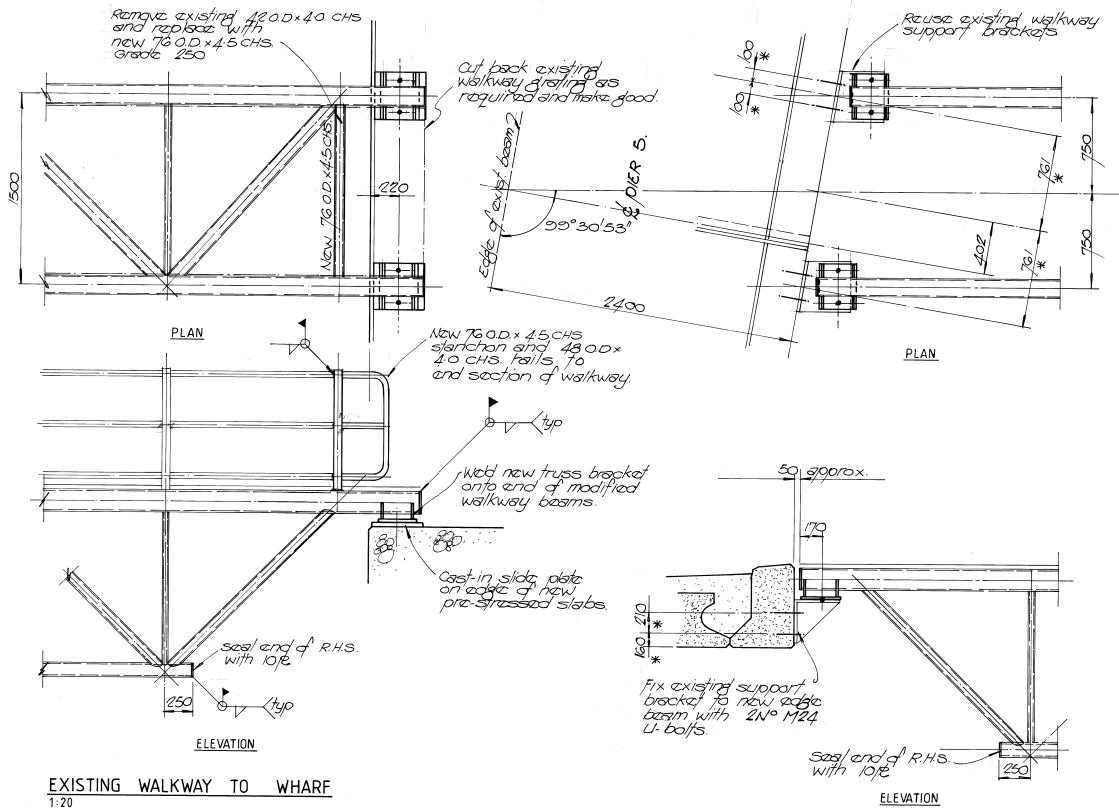
SUSPENSION    BRACKET  
1:19



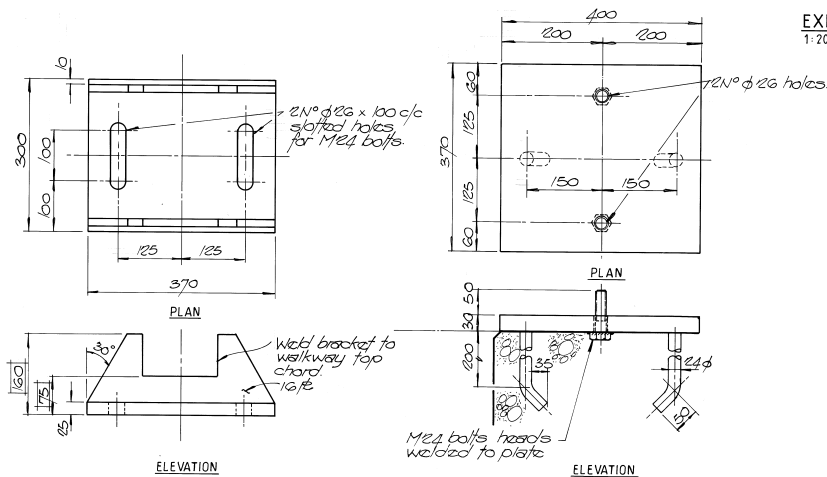
- \* Denotes common M24 bolts thru coat hanger tyre, Jarrah plank & 3/10 UC.
- o Denotes M24 bolts thru coat hanger tyre and Jarrah plank.

E A S T E R N                      F E N D E R                      S U P P O R T

1	AS	BUILT				55 95	G.M.	P.	
0	ISSUED	FOR CONSTRUCTION				13 12 93	M.P.		
REV:		DESCRIPTION				DATE	BY	CL	
									
									
						Suite 7, Savings House, 11 Healdland Place PO Box 713, Karratha WA 6714 Tel: (09) 44 1879 Fax: (09) 44 2805			
DRAWN: <b>G MANSFIELD</b>	DATE: <b>OCT '93</b>		SCALE: <b>A5 NOTED</b>						
DESIGNED: <b>H. BARR</b>	CHECKED:		CERTIFIED:						
PROJECT: DAMPIER PORT AUTHORITY									
EXTENSIONS TO DAMPIER PUBLIC WHARF									
DRAWING TITLE:									
FENDER SUPPORT DETAILS									
DRAWING NO <sup>a</sup>		<b>37241 - DS - 034</b>							
								REV:	1



EXISTING WALKWAY TO WHARF  
1:20



TRUSS BRACKET 1:5




100. Average of walkway approach bridge. Height varies to accommodate slope of walkway.

SLIDE PLATE 1:5

Cast plate into pre-stressed concrete slab at edge of wharf.

EXISTING WALKWAY TO APPROACH BRIDGE  
1:20

Dimensions stated \* shall be site checked by contractor prior to fabrication.

1	AS BUILT	5595	GM		PR
0	ISSUED FOR CONSTRUCTION	21293			CH PR
REV.	DESCRIPTION	DATE	BY	CHK.	
<div><div><div><b>FRASER</b> CONSULTANTS</div></div><div><div><b>Astron</b> 21293 ENVIRONMENTAL ASTRON ENGINEERING PTY LTD</div></div><div><div>Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha WA 6714 Tel: (091) 44 1679 Fax: (091) 44 2638</div></div></div>					
DRAWN:	G MANSFIELD	DATE:	JULY '93	SCALE:	AS NOTED
DESIGNED:		CHECKED:		CERTIFIED:	
PROJECT:	DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF					
DRAWING TITLE:					
WALKWAY MODIFICATIONS					
DRAWING N°	37241- DS- 035				REV
					1

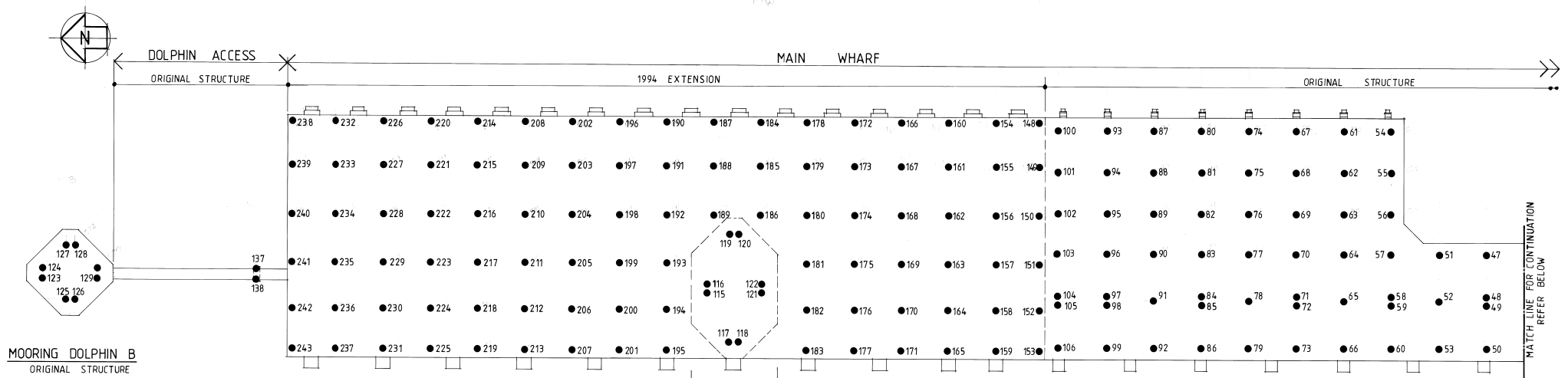
37241-DS035



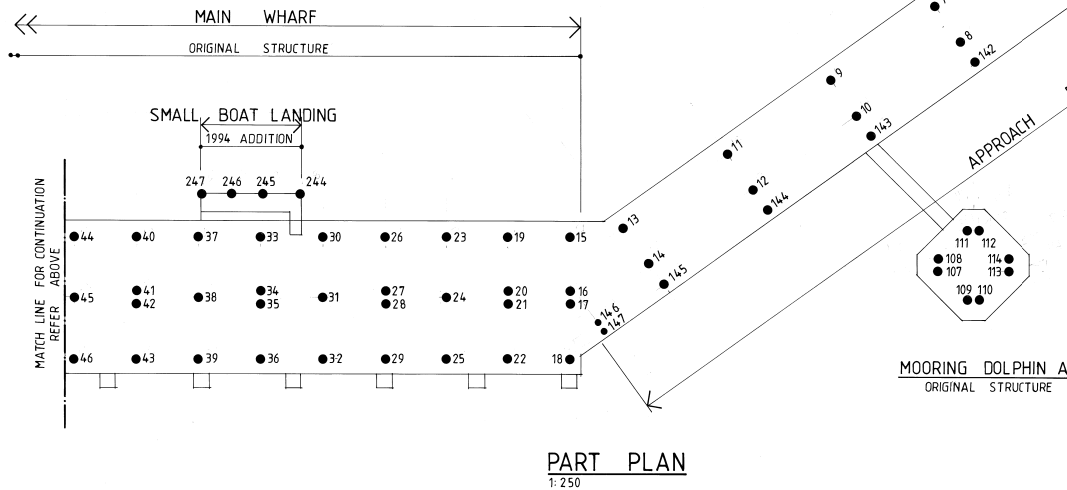




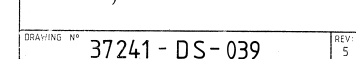
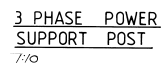
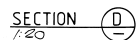
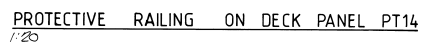
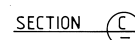
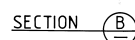
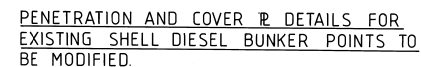
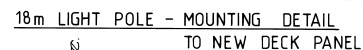
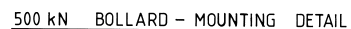
37241 DS038



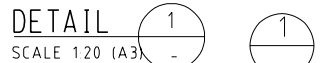
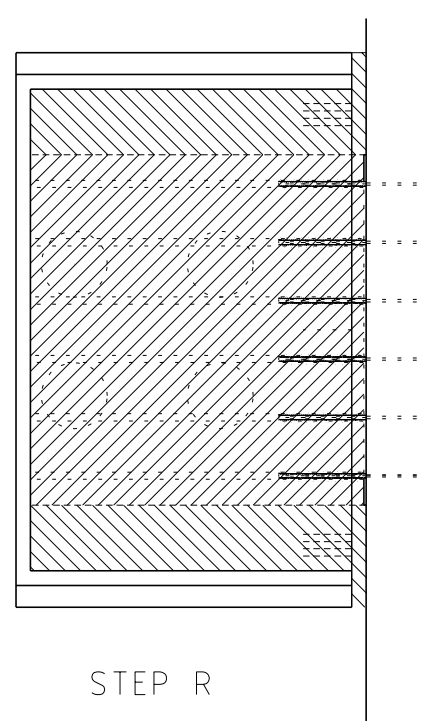
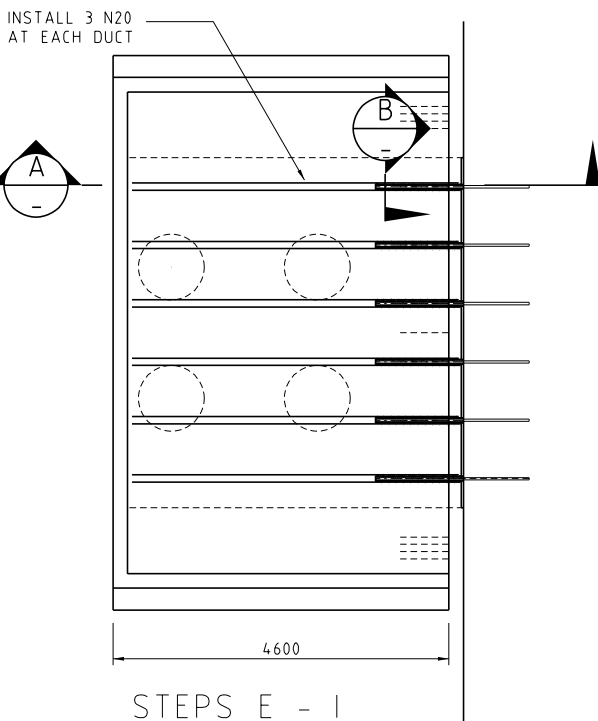
PILE SCHEDULE	
PILE NUMBER	PILE LOCATION
1 TO 14	APPROACH BRIDGE
15 TO 106	MAIN WHARF (ORIGINAL STRUCTURE)
107 TO 114	MOORING DOLPHIN A
115 TO 122	MAIN WHARF (BREASTING DOLPHIN)
123 TO 130	MOORING DOLPHIN B
131 TO 136	REMOVED DURING 1994 EXTENSIONS
137 & 138	DOLPHIN ACCESS
139 TO 147	APPROACH BRIDGE 1994 WIDENING
148 TO 243	MAIN WHARF 1994 EXTENSIONS



1	AS BUILT	7-94	GM	PL
REV.	DESCRIPTION	DATE	BY	CHK.
<div style="display: flex; justify-content: space-between;"> <div> <b>FRASER CONSULTANTS</b>  <small>ASITRON ENGINEERING PTY LTD</small> </div> <div> <b>Astron</b>  <small>SUITE 7, SAVINGS HOUSE,  11 HEDLAND PLACE  PO BOX 715, KARRATHA, WA 6714  Tel: (091) 44 1679 Fax: (091) 44 2638</small> </div> </div>				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE:				
PILE LOCATION PLAN				
DRAWING N° 37241 - DS - 038				REV: 1







1 ALL WORKMANSHIP AND MATERIALS TO COMPLY WITH THE REQUIREMENTS OF AS3600  
2 FOLLOW THE INTENT OF THE WORK PROCEDURE LISTED BELOW  
3 ALL DIMENSIONS TO BE VERIFIED ON SITE  
4 CONCRETE MIX TO CONFORM WITH THE REQUIREMENTS OF THE MASDEN GIERSENG SPECIFICATION  
5 USE AN APPROVED CONCRETE RETARDANT WHERE SPECIFIED  
6 USE POLYSTYRENE FOAM WHERE INDICATED ON THE DRAWINGS FOAM DENSITY TO BE 25KG/CUM

A SCABBLE THE END OF THE JETTY FACE TO 5mm DEPTH  
B INSTALL FORMWORK WHERE INDICATED ON THE PLAN VIEW  
C INSTALL THE POLYSTYRENE ON THE FACE END OF THE JETTY, ENSURE THE CONCRETE SIDE SURFACE IS ROUGHENED  
D INSTALL THE CORRUGATED STEEL DUCTS OVER THE STARTER BARS. INSTALL ADDITIONAL LIGATURES TO RIGIDLY SUPPORT THE DUCTS.  
E INSTALL THE NEW 3 N20 AT EACH DUCT  
F INSTALL END CAPS ON THE DUCTS  
G INSTALL TWO PUMP IN GROUT TUBES PER DUCT AS PER THE DETAIL  
H INSTALL ONE AIR OUT GROUT TUBE PER DUCT AS PER THE DETAILS  
I LIBERALLY APPLY RETARDANT TO THE SIDES OF THE FORMWORK  
J POUR THE CONCRETE IN THE MAIN BODY OF PRECAST UNIT 2  
K AFTER INITIAL SET OF THE CONCRETE USE A SOLVENT TO DISOLVE POLYSTYRENE  
L REMOVE FORMWORK THE FOLLOWING DAY AND WATER BLAST SIDES TO EXPOSE AGGREGATE  
M MAINTAIN NEW CONCRETE WET FOR 7 DAYS  
N EPOXY GROUTING OF THE CORRUGATED DUCTS - LOKFIX EA - ESTIMATED VOLUME IS 25L FOR THE DUCTS

```

AT 35 DEGREES CENTIGRADE IT WILL GEL IN 25 MINUTES
AT 20      "              "              "      5 MINUTES
AT 5       "              "              "      18 MINUTES

```

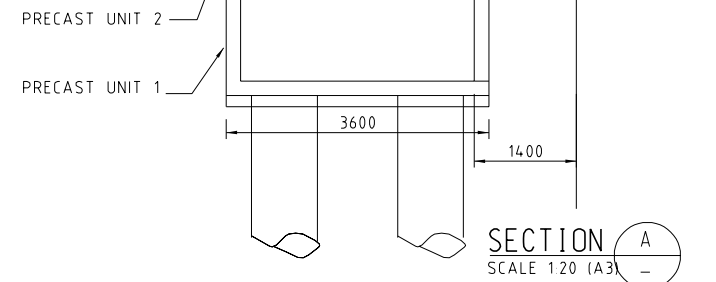
O FILL THE GAP BETWEEN THE STRONG POINT AND THE JETTY WITH CONBEXTRA HES - 25MPa AT 120MINUTES - POURABLE 60 LITRES

P ALL EPOXY GROUTING SHALL BE INSTALLED IN THE COOL OF THE NIGHT

Q THE EPOXY WILL ATTAIN STRENGTH IN 60 MINUTES

R INSTALL THE REMAINDER OF THE CONCRETE ON THE SIDES TO THE ORIGINAL SPECIFICATION

AS C

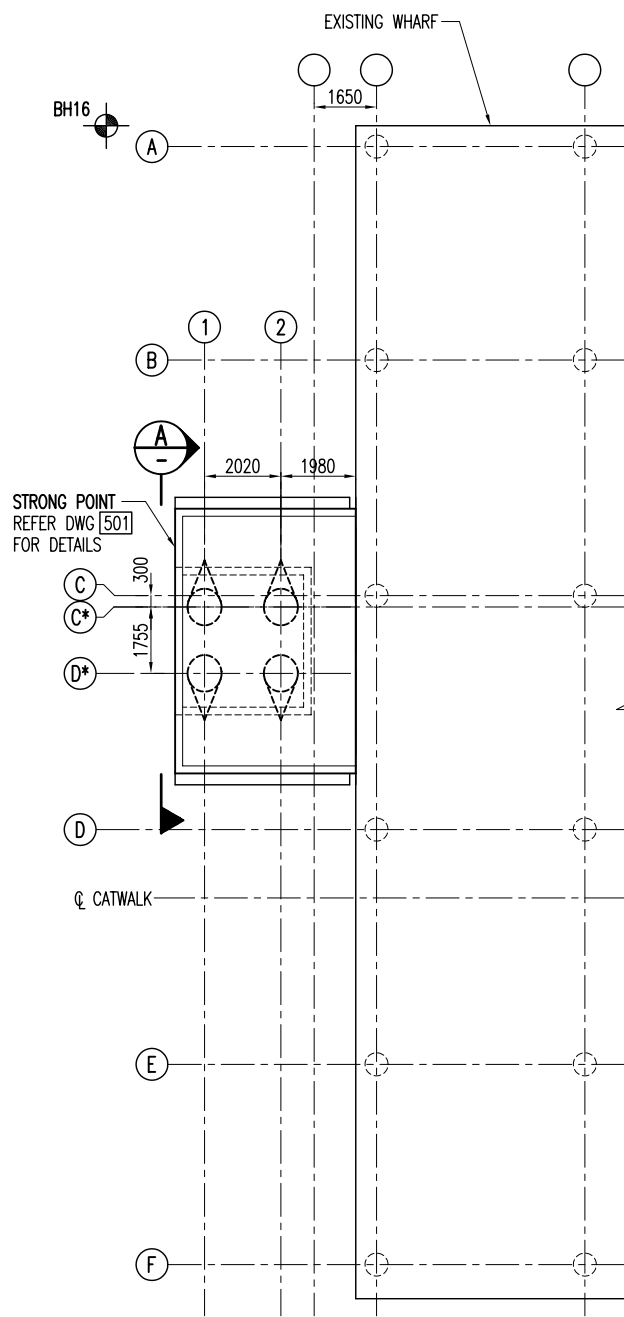


DATE \_\_\_\_\_



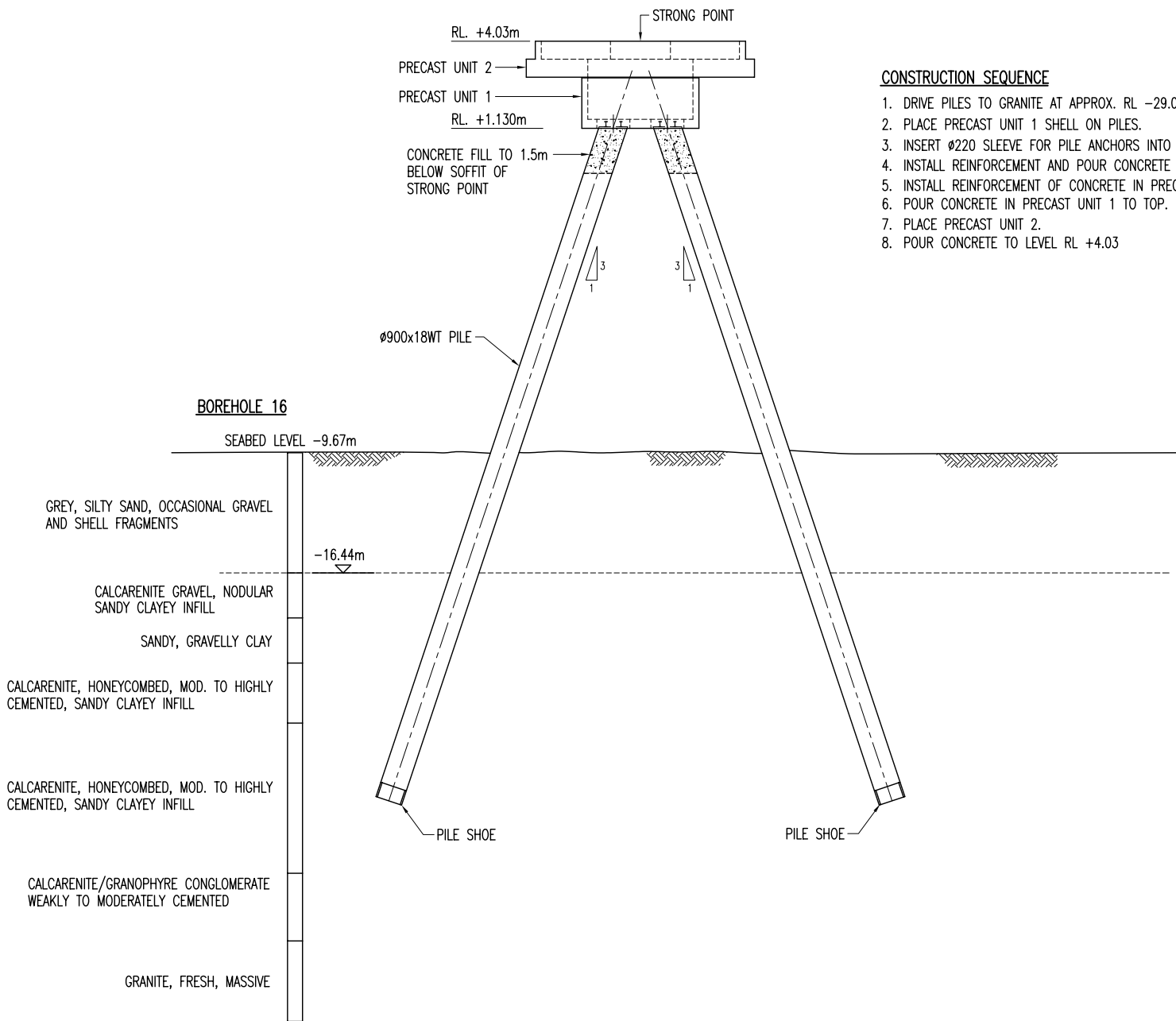
**MKN**  
CONSULTING  
ENGINEERING  
ACN 101 059 830

THIS DOCUMENT AND INFORMATION  
CONTAINED IN IT IS THE SOLE PROPERTY  
OF MKM CONSULTING ENGINEERING AND  
MAY NOT BE USED, EXPLOITED, COPIED,  
DUPLICATED OR REPRODUCED IN ANY  
FORM OR MEDIUM WHAT SO EVER WITHOUT  
THE PRIOR WRITTEN PERMISSION OF  
MKM CONSULTING ENGINEERING



PILE LOCATION		C*-1	C*-2
RAKE		1:3	1:3
CUTOFF LEVEL		+1.180	+1.180
CAPACITY (kN)	TENSION	2550	2550
	COMPRESSION	4130	4130
FOUNDING LEVEL		-23.8	-22.3

PILE LOCATION		D*-1	D*-2
RAKE		1:3	1:3
CUTOFF LEVEL		+1.180	+1.180
CAPACITY (kN)	TENSION	2550	2550
	COMPRESSION	4130	4130
FOUNDING LEVEL		-22.7	-22.8



#### CONSTRUCTION SEQUENCE

1. DRIVE PILES TO GRANITE AT APPROX. RL -29.00m.
2. PLACE PRECAST UNIT 1 SHELL ON PILES.
3. INSERT Ø220 SLEEVE FOR PILE ANCHORS INTO PILES.
4. INSTALL REINFORCEMENT AND POUR CONCRETE IN TOP OF PILES.
5. INSTALL REINFORCEMENT OF CONCRETE IN PRECAST UNIT 1
6. POUR CONCRETE IN PRECAST UNIT 1 TO TOP.
7. PLACE PRECAST UNIT 2.
8. POUR CONCRETE TO LEVEL RL +4.03

SECTION  
SCALE: 1:100

NOTE:  
ALL LEVELS TO A.H.D.

COPYRIGHT All rights reserved  
These drawings, plans and specifications and the copyright therein are the properties of Madsen Giersing Pty. Ltd. and must not be used, reproduced or copied wholly or in part without written permission of Madsen Giersing Pty. Ltd.

#### AS CONSTRUCTED

DOCUMENT CONTROL STATUS  
UNLESS STAMPED OTHERWISE IN RED THIS DRAWING IS UNCONTROLLED AND MUST BE KEPT AGAINST A CONTROLLED COPY OF THE DRAWING PRIOR TO USE TO ENSURE IT IS THE CURRENT ISSUE.

NOTES:  
1. NOMINATED COMPRESSION AND TENSION CAPACITIES ARE ULTIMATE VALUES.

CLIENT				PROJECT			
BARCLAY MOWLEM CANDAC Performance Built on Trust				DAMPIER PORT AUTHORITY - CARGO WHARF UPGRADE			
MADSEN GIERSENG consulting engineers P.O. BOX 1218 MILTON QLD 4064 EMAIL: mgc@madsengiersing.com.au WWW: www.madsengiersing.com.au				STRONG POINT DETAILS - SH. 1 OF 5			
DRAWN: L.C.R. CHECKED: J.A.M. DESIGNED: L.P.M. APP. FOR CONSTRUCTION: CLIENT APPROVED:				SCALE: AS SHOWN JOB No.: 950 DRAWING No.: 950-DWG-500			
REV. BY DATE APPROVED FOR CONSTRUCTION DRAWING HISTORY				REV. BY DATE APPROVED FOR CONSTRUCTION DRAWING HISTORY			
4	NPK	06.07.05	AS CONSTRUCTED	JAM	LPM		
3	LCR	29.03.05	PILE LOCATIONS & NOTES AMENDED	JAM	LPM	C1	LCR 08.03.04 80% COMPLETION ISSUE
2	LCR	06.01.05	PILE LOCATIONS REVISED	JAM	LPM	C	LCR 17.03.04 ISSUED FOR INFORMATION - LEVELS REVISED
1	LCR	09.06.04	STRONG POINT LOCATION AMENDED	JAM	LPM	B	LCR 16.03.04 ISSUED FOR INFORMATION - STRONG POINT REVISED
0	LCR	15.04.04	APPROVED FOR CONSTRUCTION	JAM	LPM	A	LCR 25.02.04 ISSUED FOR INFORMATION
REV.	BY	DATE	APPROVED FOR CONSTRUCTION DRAWING HISTORY	CHK	APP	REV.	BY DATE PRE-CONSTRUCTION DRAWING HISTORY

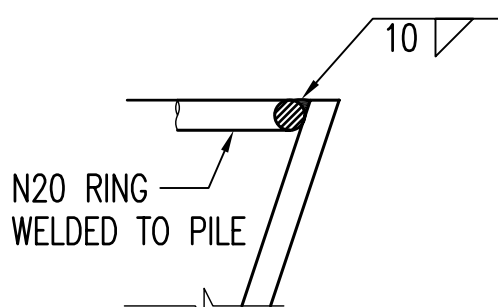
COPYRIGHT All rights reserved

These drawings, plans and specifications and the copyright therein are the properties of Madsen Giering Pty. Ltd. and must not be used, reproduced or copied wholly or in part without written permission of Madsen Giering Pty. Ltd.

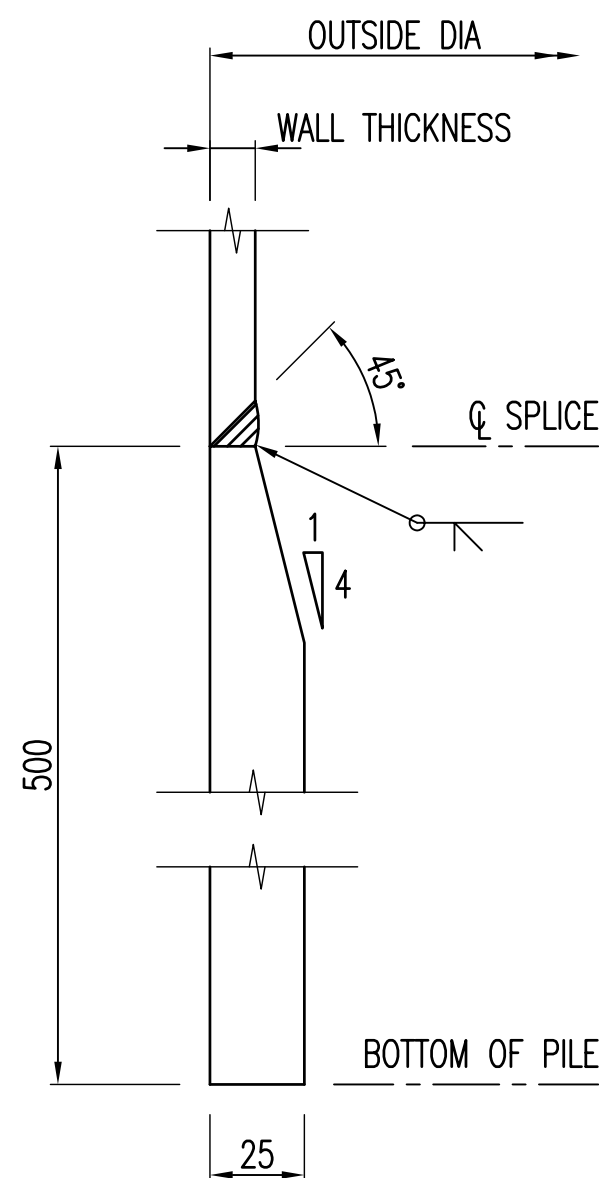
AS CONSTRUCTED

DOCUMENT  
CONTROL  
STATUS

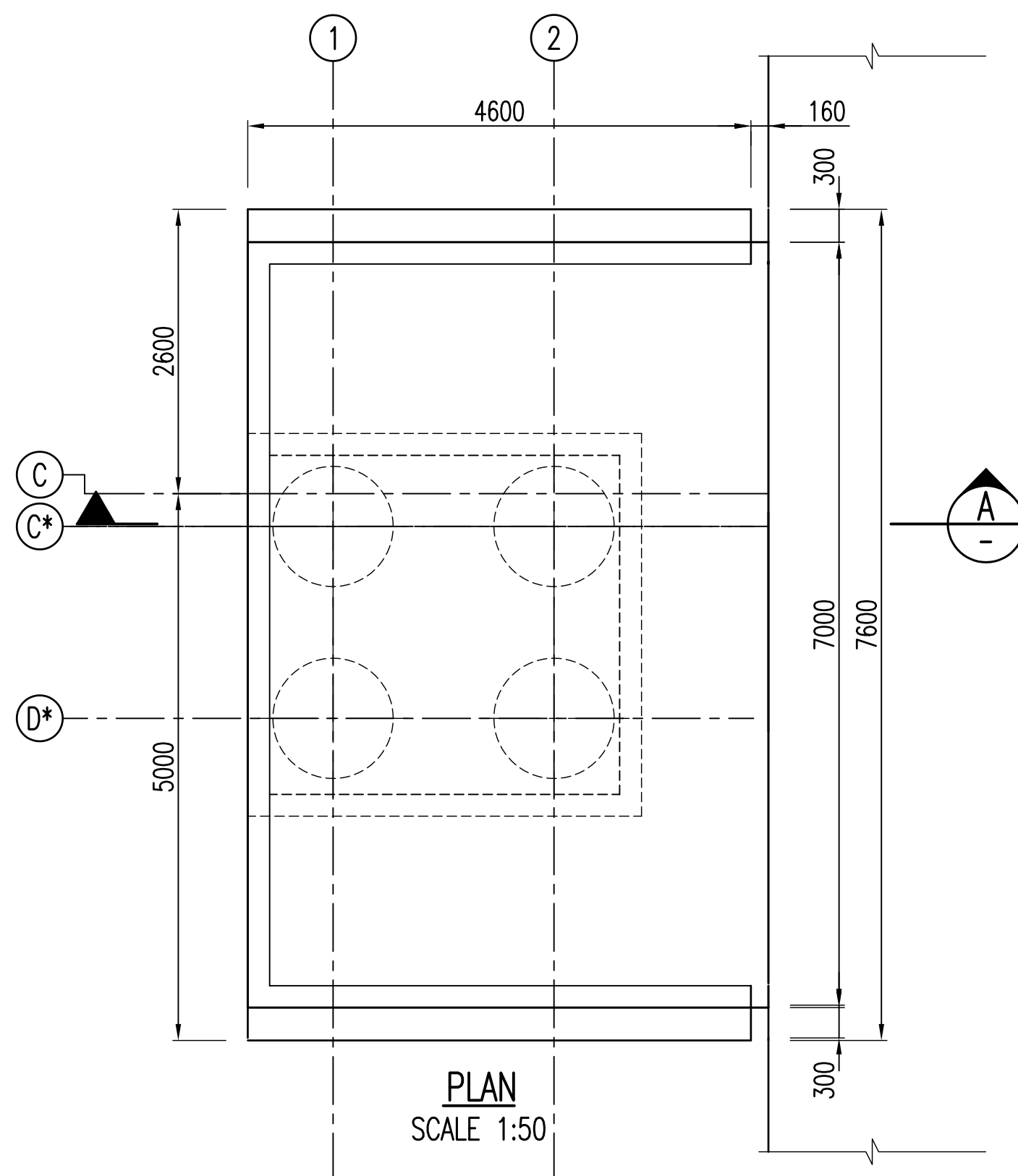
UNLESS STAMPED OTHERWISE IN RED THIS DRAWING IS UNCONTROLLED AND MUST BE VERIFIED AGAINST A CONTROLLED COPY OF THE DRAWING PRIOR TO USE TO ENSURE IT IS THE CURRENT ISSUE.



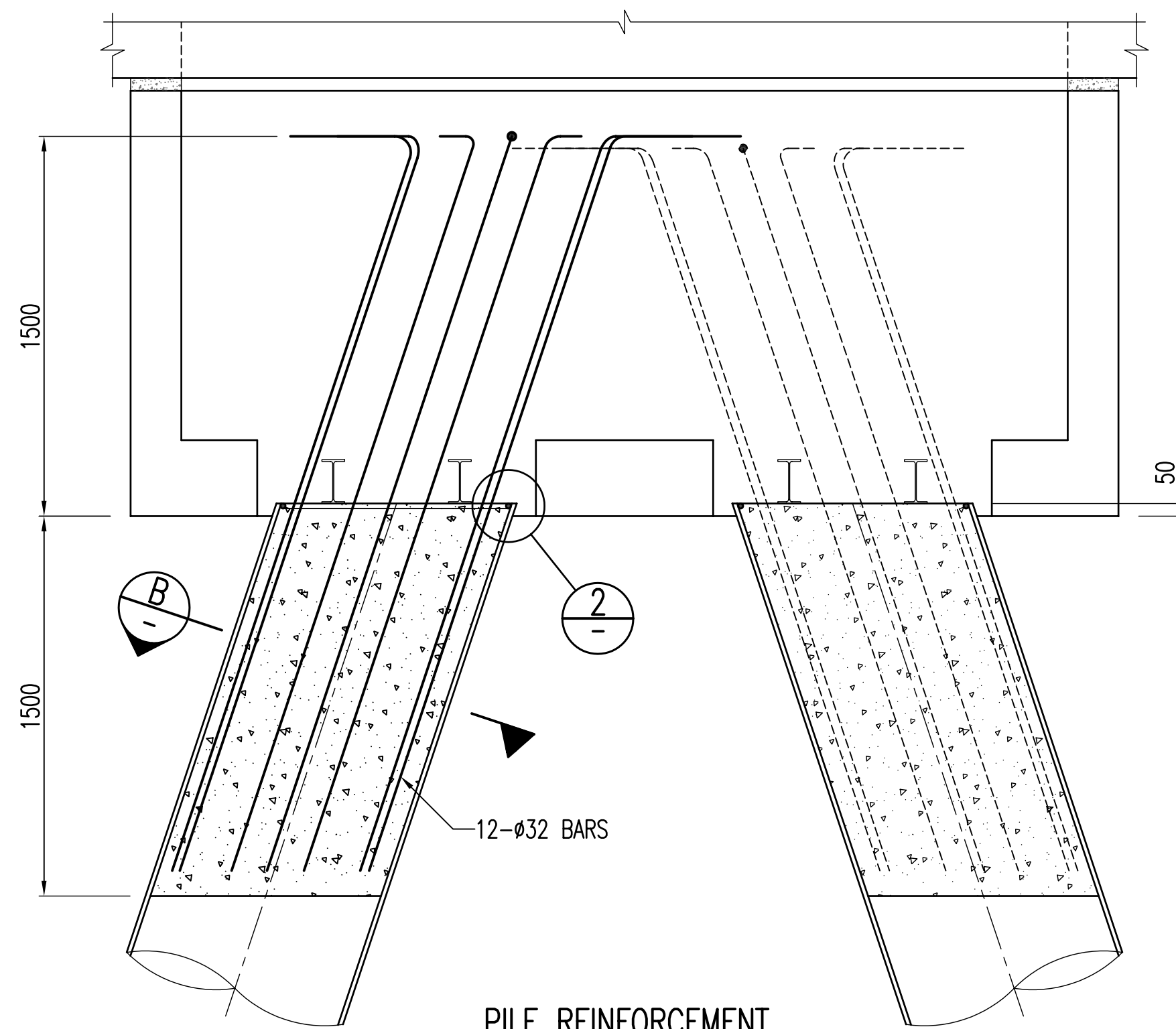
DETAIL  
SCALE: 1:5



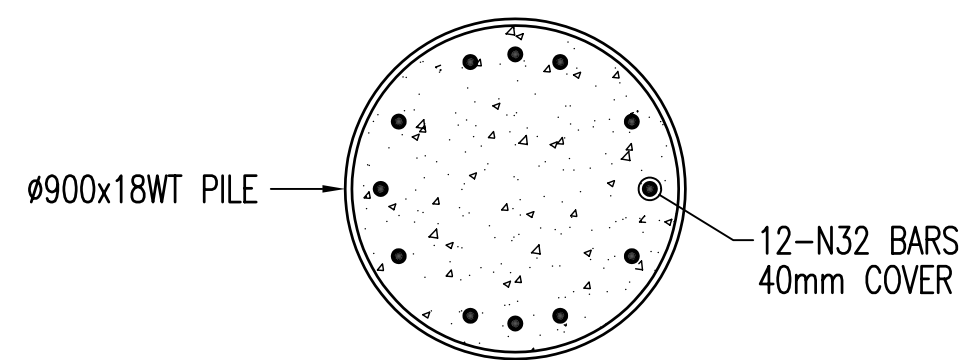
DETAIL  
SCALE: 1:2



PLAN  
SCALE 1:50



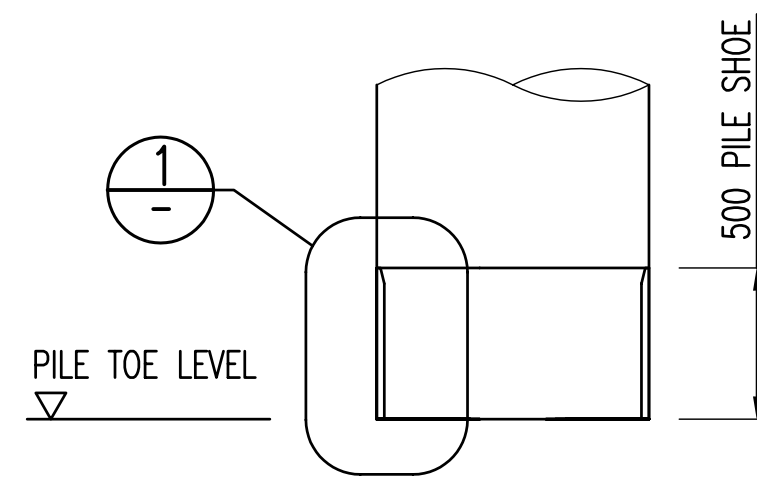
PILE REINFORCEMENT  
SCALE 1:20



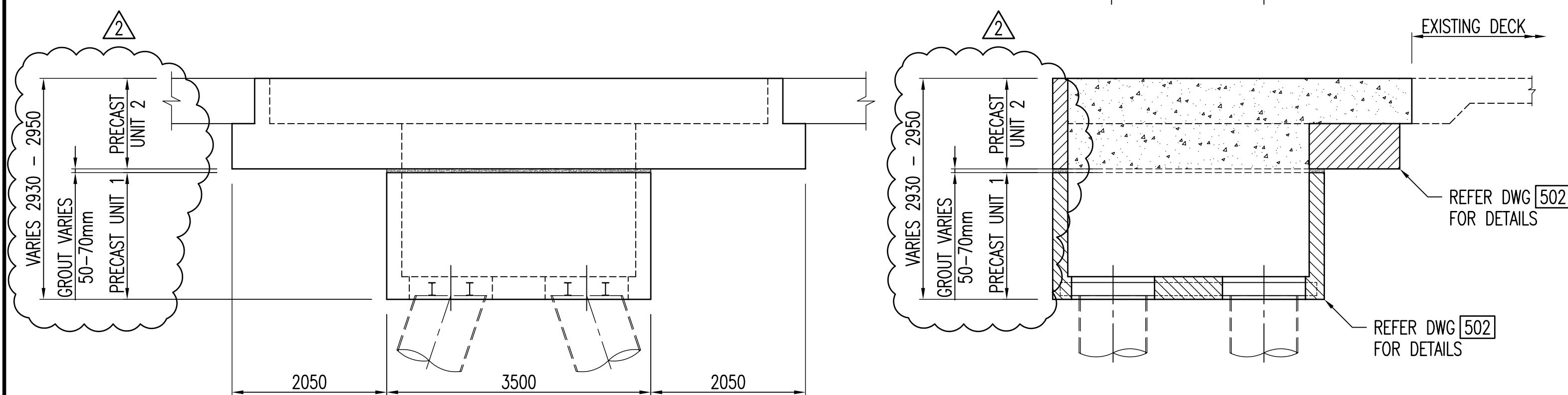
SECTION  
SCALE: 1:20

PILE REINFORCEMENT DETAIL

NOTE: LOCATE REINFORCEMENT TO AVOID 180UB16'S (TYPICAL)



PILE SHOE DETAIL  
SCALE 1:25



SIDE ELEVATION  
SCALE 1:50

SECTION  
SCALE: 1:50

STRONG POINT GENERAL ARRANGEMENT

REV.	BY	DATE	APPROVED FOR CONSTRUCTION	DRAWING HISTORY	CHKD	APP	REV.	BY	DATE	PRE-CONSTRUCTION DRAWING HISTORY	CHKD	APP
2	LCR	10.08.06	REVISED AS CONSTRUCTED		JAM	LPM	C1	LCR	08.04.04	BOX COMPLETION ISSUE	LM	LPM
1	NPK	06.07.05	AS CONSTRUCTED		JAM	LPM	B	LCR	16.03.04	STRONG POINT REVISED	LM	LPM
0	LCR	15.04.04	ISSUED FOR CONSTRUCTION		JAM	LPM	A	LCR	25.02.04	SHEAR RING DETAIL ADDED	LM	LPM
										ISSUED FOR INFORMATION	LM	LPM

CLIENT



MADSEN GIERING  
consulting engineers  
P.O. BOX 1218 Tel: (07) 3367 2321  
MILTON QLD 4064 Fax: (07) 3369 3880  
EMAIL: mgc@madsengiering.com.au  
WWW: www.madsengiering.com.au

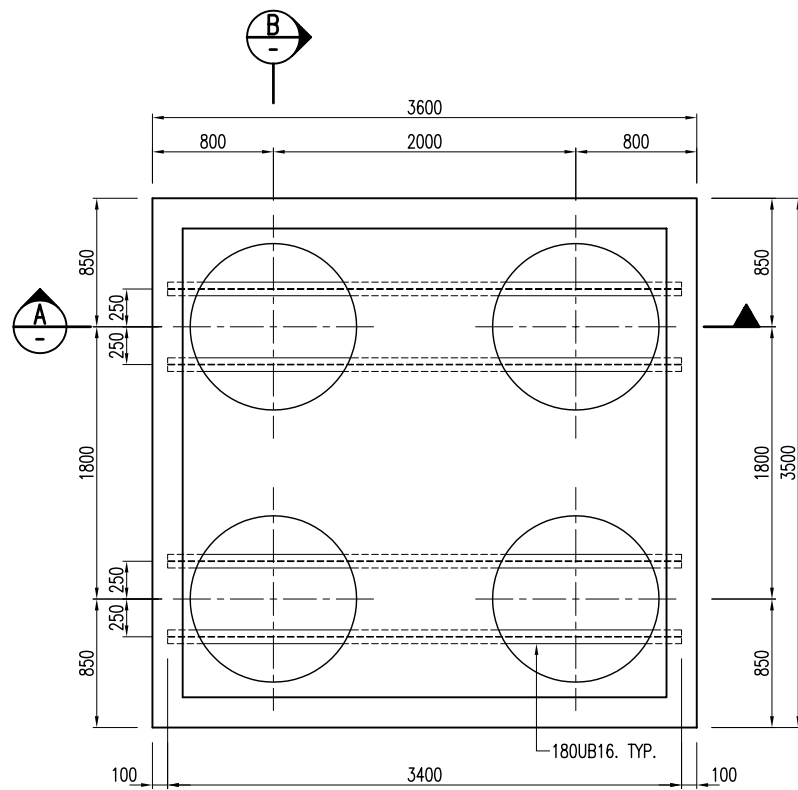


FILE NAME  
950DW501.DWG

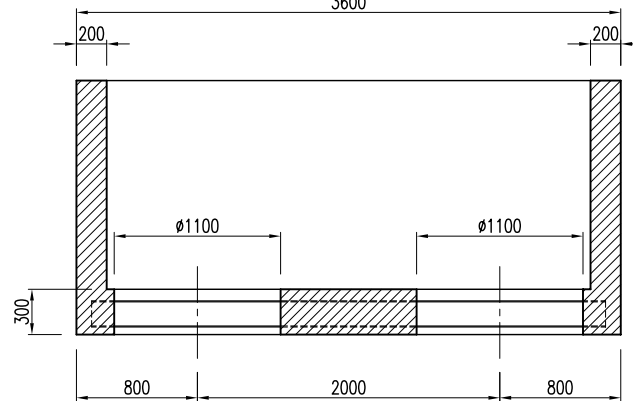
DRAWN:	L.C.R.
CHECKED:	J.A.M.
DESIGNED:	L.P.M.
APP. FOR CONSTRUCTION:	
CLIENT APPROVED:	

PROJECT:	DAMPIER PORT AUTHORITY – CARGO WHARF UPGRADE		
TITLE:	STRONG POINT DETAILS – SH. 2 OF 5		
SCALE:	AS SHOWN	JOB No.: 950	DRAWING No.: 950-DWG-501
REV:			2

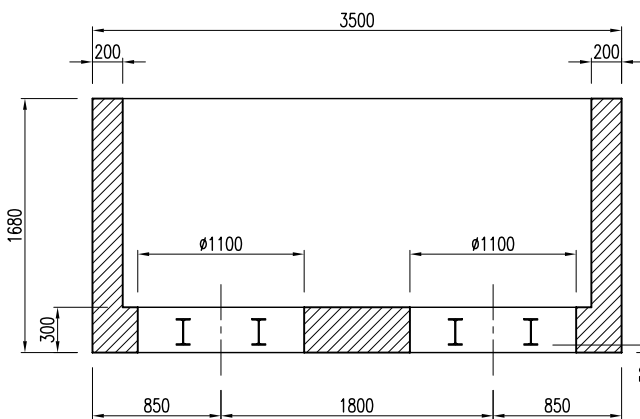




**PLAN**  
SCALE: 1:25



**SECTION A**  
SCALE: 1:25

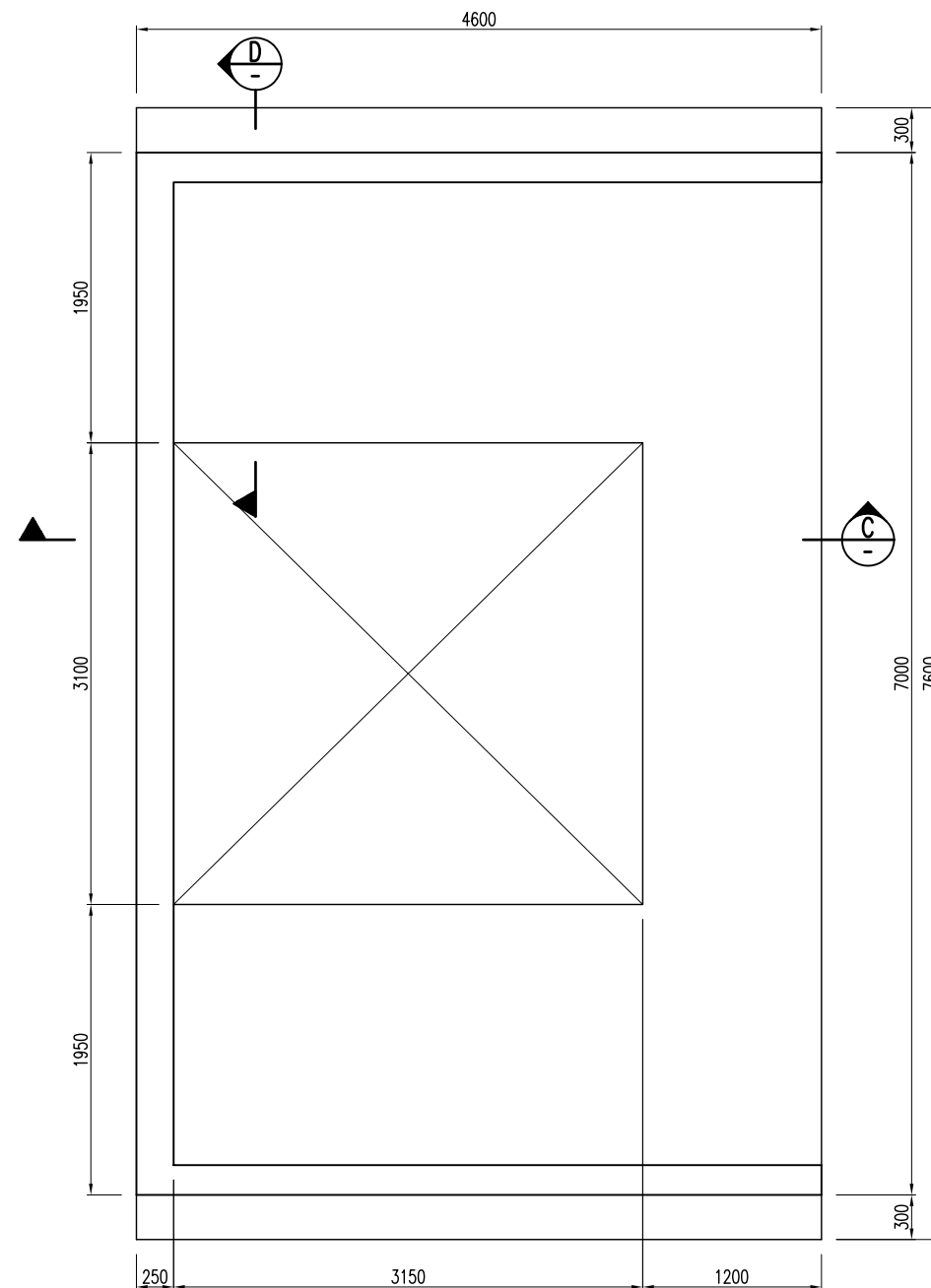


**SECTION B**  
SCALE: 1:25

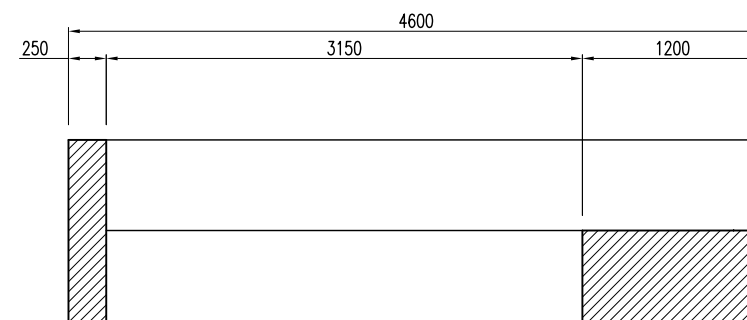
**PRECAST UNIT 1**

**STRONG POINT PRECAST DETAILS**

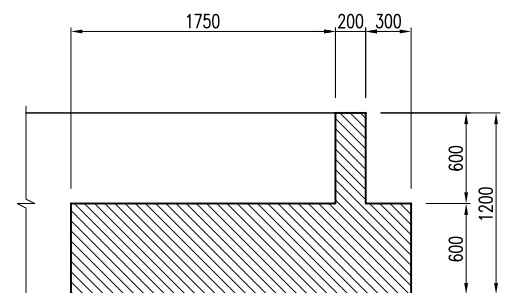
NOTE: INSIDE OF PRECAST UNIT TO BE ROUGHENED.



**PLAN**  
SCALE: 1:25



**SECTION C**  
SCALE: 1:25



**SECTION D**  
SCALE: 1:25

**PRECAST UNIT 2**

**STRONG POINT PRECAST DETAILS**

NOTE: INSIDE OF PRECAST UNIT TO BE ROUGHENED.

**COPYRIGHT** All rights reserved  
These drawings, plans and specifications and the copyright therein are the properties of Madsen Giersing Pty. Ltd. and must not be used, reproduced or copied wholly or in part without written permission of Madsen Giersing Pty. Ltd.

**AS CONSTRUCTED**  
**DOCUMENT CONTROL STATUS**  
UNLESS STAMPED OTHERWISE IN RED THIS DRAWING IS UNCONTROLLED AND MUST BE VERIFIED AGAINST A CONTROLLED COPY OF THE DRAWING PRIOR TO USE TO ENSURE IT IS THE CURRENT ISSUE.

REV.	BY	DATE	APPROVED FOR CONSTRUCTION	DRAWING HISTORY
1	NPK	06.07.05	AS CONSTRUCTED	
0	LCR	15.04.04	ISSUED FOR CONSTRUCTION	
APPROVED FOR CONSTRUCTION DRAWING HISTORY				

<b>BARCLAY MOWLEM CANDAC</b> Performance Built on Trust				<b>MADSEN GIERSENG</b> consulting engineers P.O. BOX 1218 MILTON QLD. 4064 TEL: (07) 3367 2321 FAX: (07) 3369 3880 EMAIL: mgc@madsengierseing.com.au WWW: www.madsengierseing.com.au				<b>950DW502.DWG</b> DRAWN: L.C.R. CHECKED: J.A.M. DESIGNED: L.P.M. APP. FOR CONSTRUCTION: CLIENT APPROVED:				PROJECT: DAMPIER PORT AUTHORITY – CARGO WHARF UPGRADE TITLE: STRONG POINT DETAILS – SH. 3 OF 5 SCALE: AS SHOWN JOB No.: 950 DRAWING No.: 950-DWG-502 REV: 1			
--	--	--	--	---	--	--	--	---	--	--	--	--	--	--	--





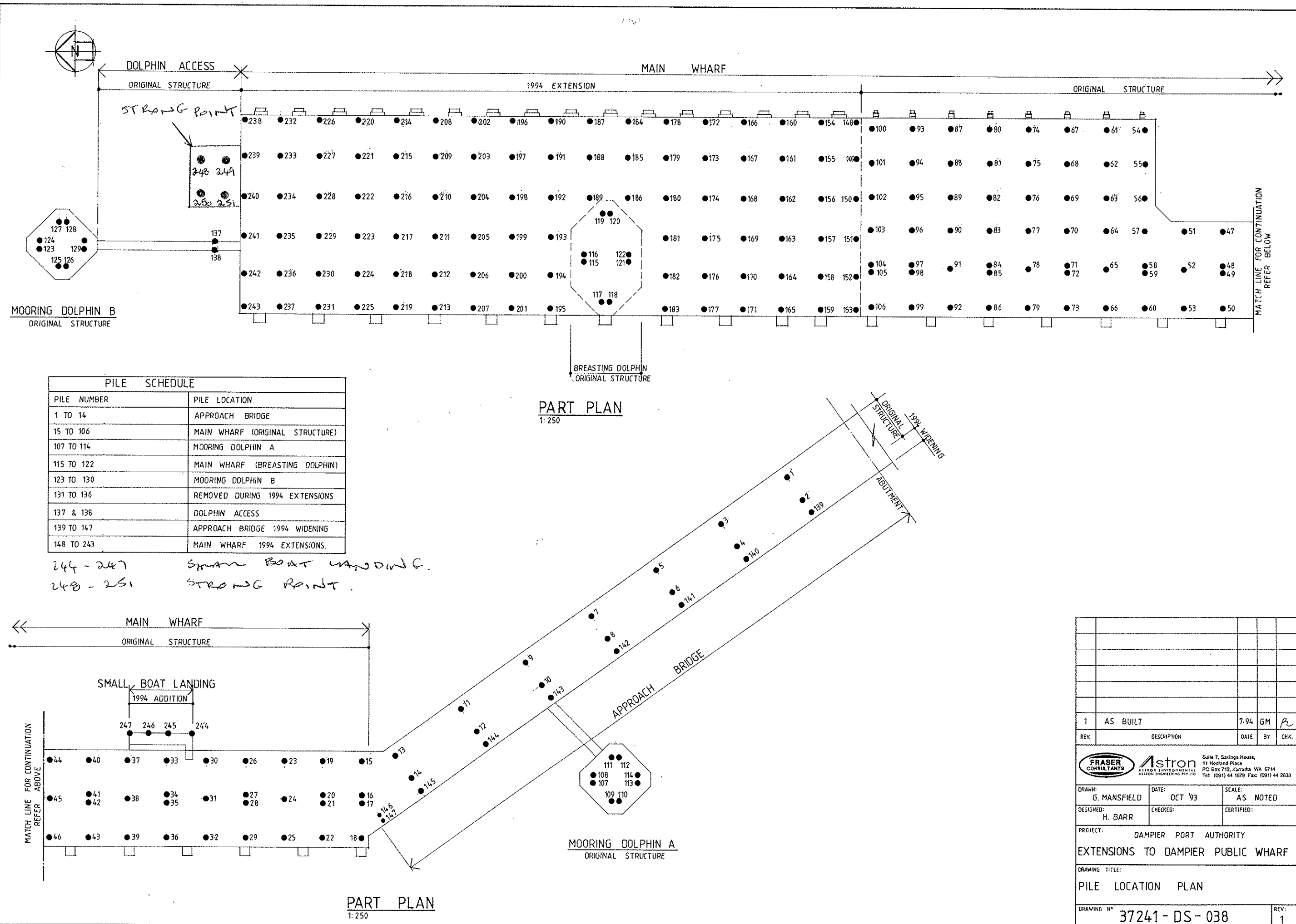


# **APPENDIX F**

## HISTORICAL PILE LAYOUT PLANS



# DCW PILE NUMBERING WHARF

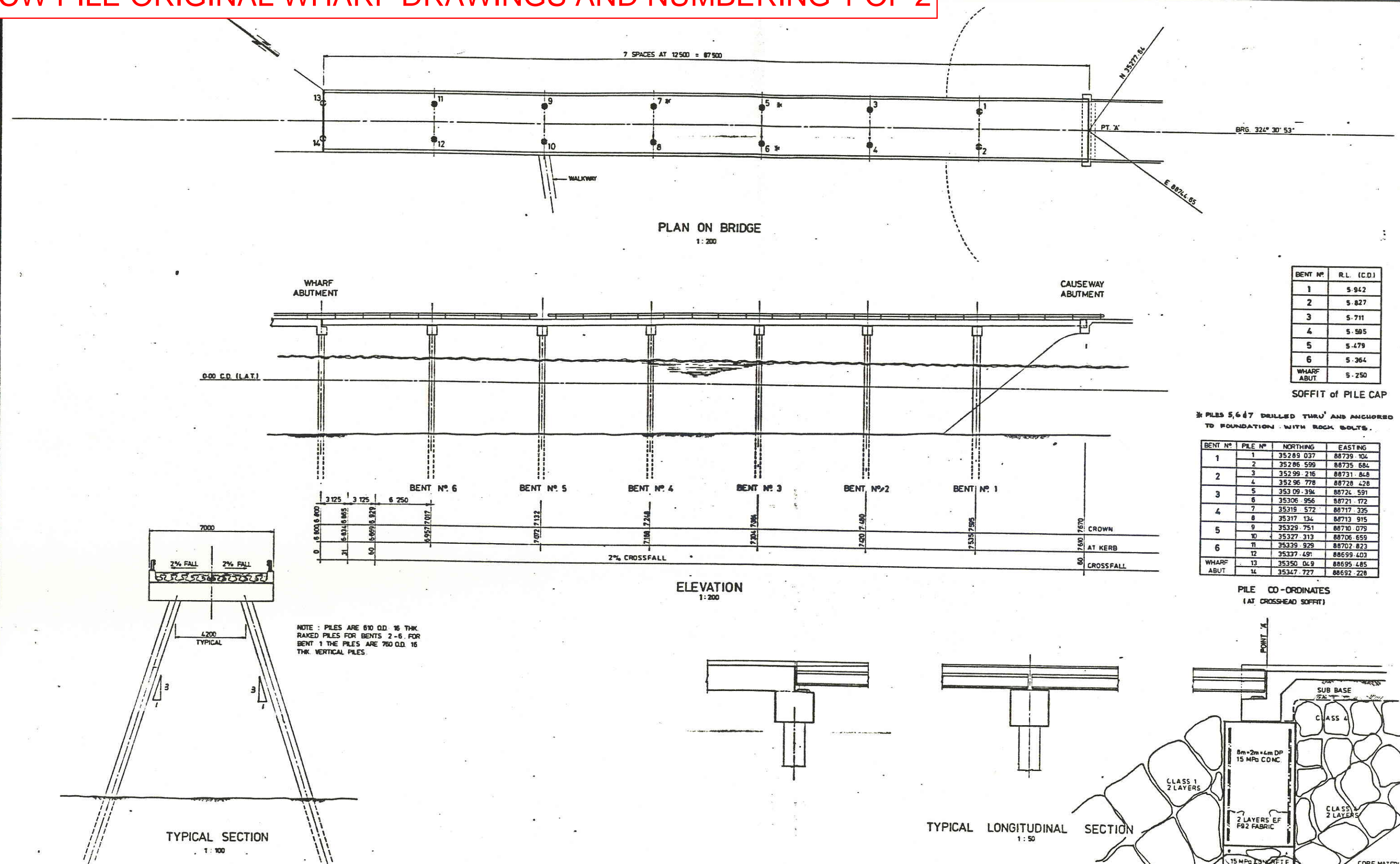


37241DS038

1	AS BUILT	7-94	GM	PC
REV.	DESCRIPTION	DATE	BY	CHK.
Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha WA 6714 Tel: (081) 44 1579 Fax: (081) 44 2638				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY				
EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE:				
PILE LOCATION PLAN				
DRAWING N° 37241-DS-038				REV: 1



# DCW PILE ORIGINAL WHARF DRAWINGS AND NUMBERING 1 OF 2



**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH W.A.  
TELEPHONE 357 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 12th Floor  
64 St George's Terrace  
PERTH W.A. 6000

DRAWING NO.	TITLE
G7400DS 0483	APPROACH BRIDGE ABUT & MISC. DETAILS SHEET 3
0482	" " " " " " " " SHEET 2
0481	" " " " " " " " SHEET 1
0471	" " " " " " " " BENT DETAILS
0461	" " " " " " " " DECK DETAILS
0371	" " " " " " " " GENERAL ARRANGEMENT

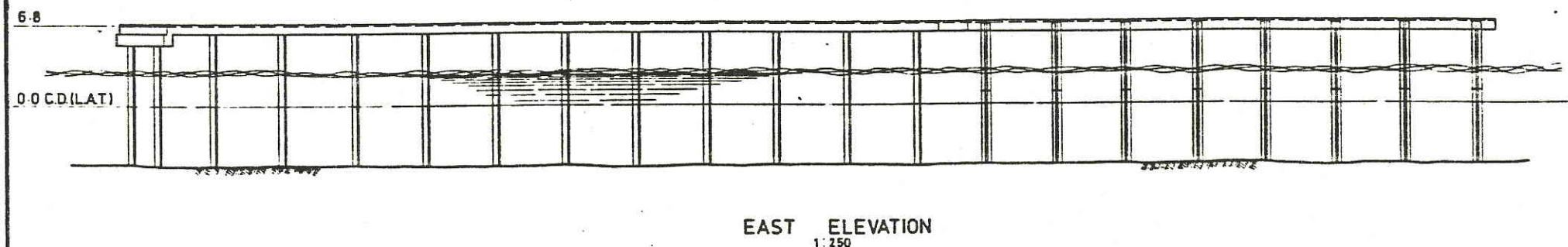
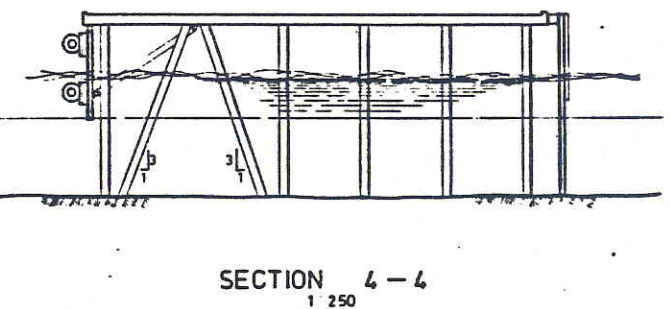
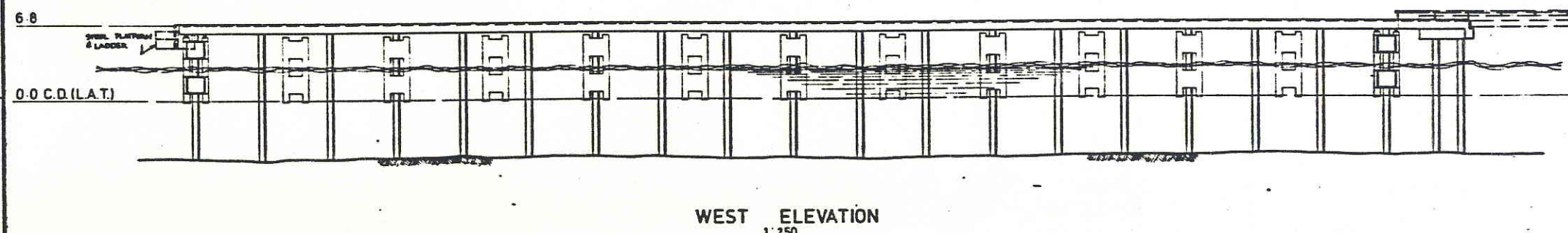
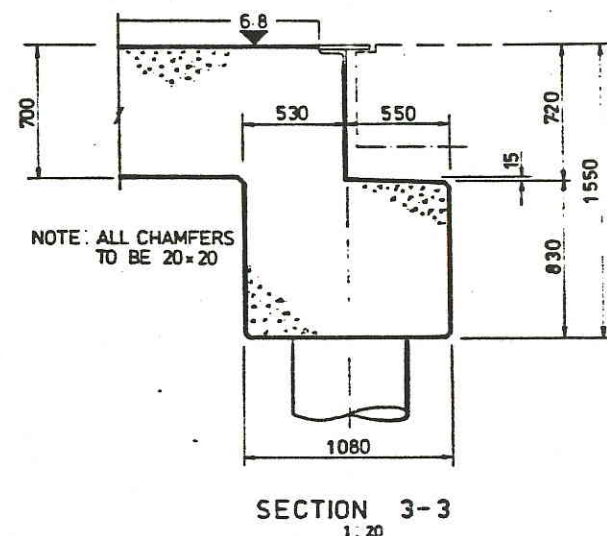
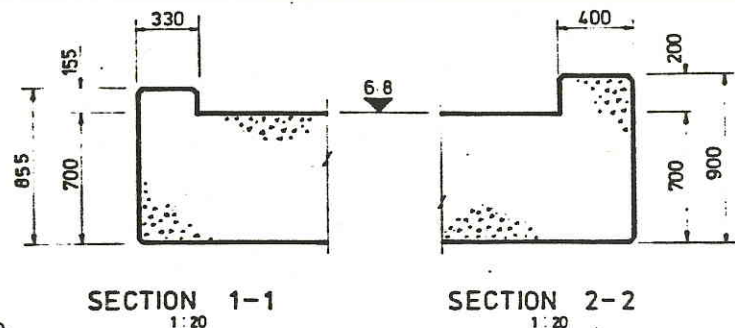
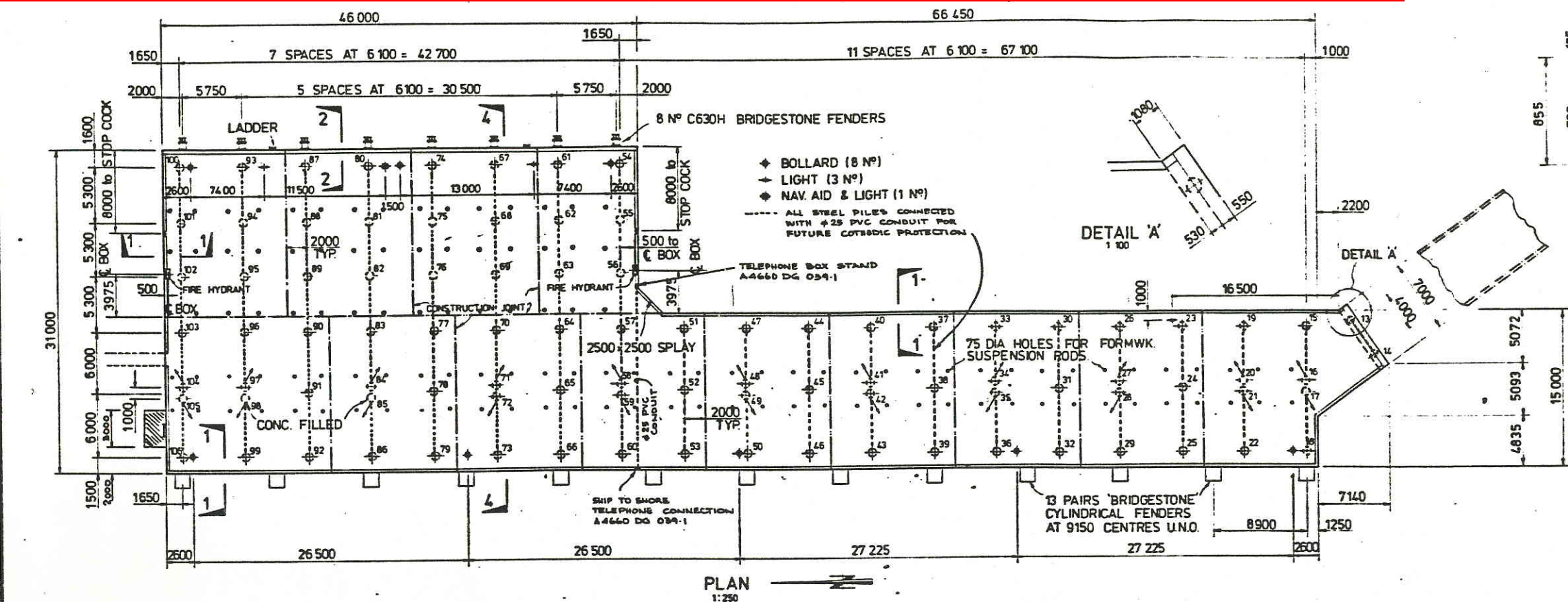
NO.	DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2	MAY 83	MM		DRWG. WAS A2620 DG 045.1			
1	MAR 83	GB		AS BUILT - CONTRACT 1023 G			
0	6.5.82	GB		APPROVED FOR CONSTRUCTION			
D	25.8.81	CLF		PILE RAKE SHOWN			
C	12.2.82	FW		ABUT FOUNDATION REINF. AMENDED			
B	8.2.82	FW		ABUT FOUNDATION AMENDED			
A		BRP		INITIAL ISSUE			

DRAWN	BRP
DATE	16.9.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

**Woodside Offshore Petroleum Pty Ltd**  
NORTH WEST SHELF DEVELOPMENT PROJECT  
MATERIALS OFFLOADING FACILITY  
APPROACH BRIDGE - GENERAL ARRANGEMENT  
SCALE AS SHOWN  
DRAWING NO. 97400 DS 045.1  
REVISION 2



# DCW PILE ORIGINAL WHARF DRAWINGS AND NUMBERING 2 OF 2



- NOTES
- 1 CONCRETE STRENGTH -  $F_c = 40 \text{ MPa}$
  - 2 PILE INFILL CONCRETE BELOW REINF. CAGE -  $F_c = 15 \text{ MPa}$  WHERE REQUIRED
  - 3 DOUBLE PILE SETS TO BE RAKED AS SHOWN IN SECTION 4-4 AND ARE TO BE SKEWED IN PLAN BY  $10^\circ - 15^\circ$  TO AVOID ADJACENT PILES. PAIRS OF PILES TO BE IN ONE PLANE. ALL SINGLE PILES TO BE VERTICAL
  - 4 ALL PILES ARE 610 OD x 16 THK
  - 5 75 DIA HOLES FOR FORMWORK SUSPENSION RODS TO REMAIN UNFILLED AS DRAINAGE HOLES
  - 6 PILE REQUIRED CAPACITY  
2000kN BASIC COMPRESSION  
3000kN BASIC TENSION (RAKED PILES)
  - 7 PILE STEEL GRADE - 250 MPa
  - 8 THE OPTION TO CONCRETE FILL PILES MAY ONLY BE EXERCISED IF THEY DO NOT SATISFY AGREED DRIVING CRITERIA
  - 9 PILE PROTECTIVE SYSTEM - COAL TAR EPOXY PAINT AS PER SPECIFICATION DOWN TO RL -3.0 (C.D.)

**JOHN HOLLAND CONSTRUCTION GROUP**  
2 HARDY STREET, SOUTH PERTH, W.A. TELEPHONE 267 4222

**MAUNSELL & PARTNERS PTY. LTD.**  
CONSULTING ENGINEERS

**BHP**  
CENTRAL ENGINEERING DIVISION  
City Centre Tower, 12th Floor  
44 St George's Terrace  
PERTH, W.A. 6000

DRAWING NO.	TITLE
G7400 DS 038-1	WHARF MISCELLANEOUS DETAILS
0433	FENDER DETAILS (SHEET 3)
0432	" (SHEET 2)
0431	" (SHEET 1)
0434	WHARF REINF. (SHEET 4)
0435	" (SHEET 3)
0432	" (SHEET 2)
0431	" (SHEET 1)
0371	GENERAL LAYOUT

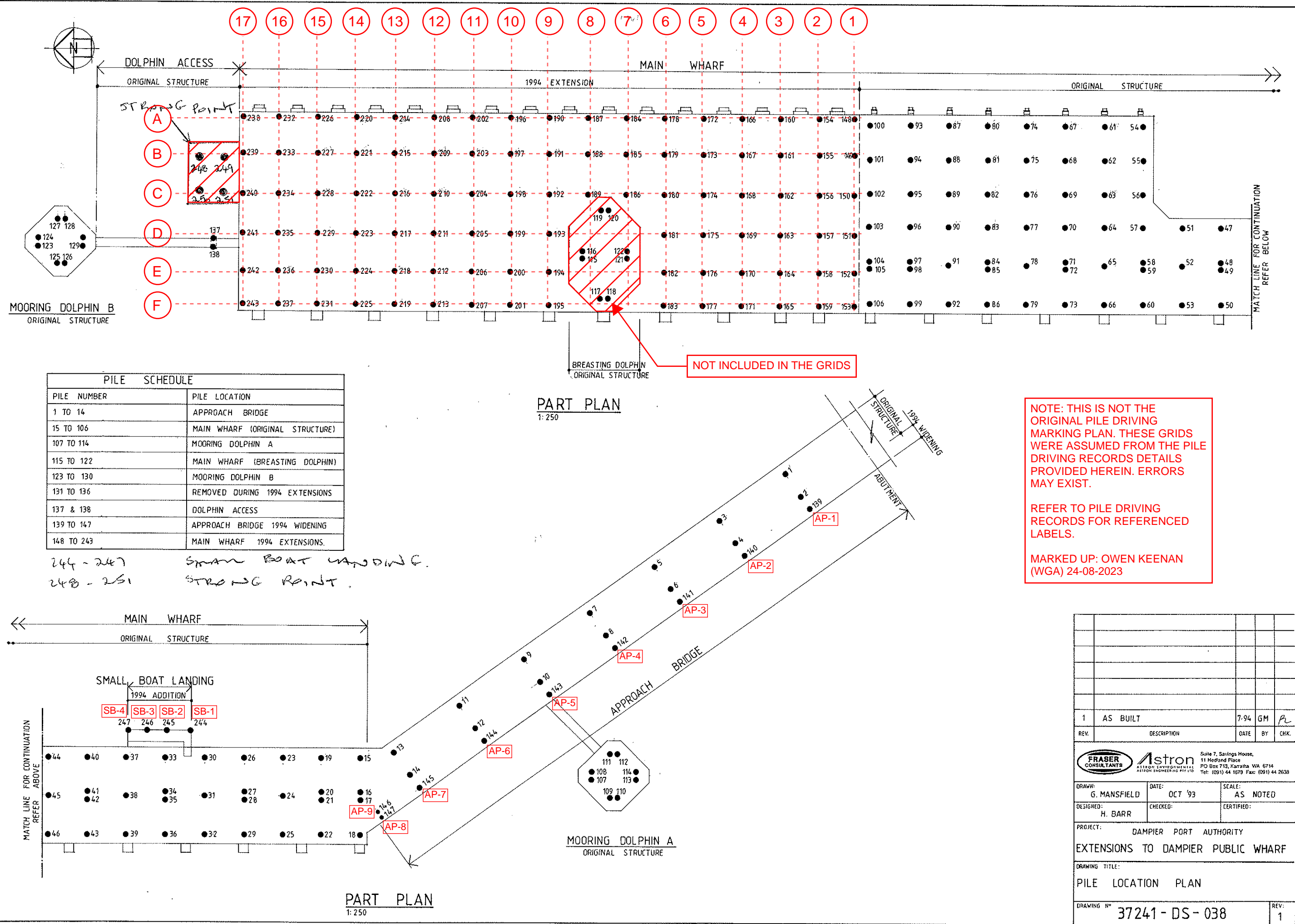
DATE	BY	CHKD	DESCRIPTION	ENGR	ENGR	ENGR
2 MAY 83	MM		DRWG. WAS A4660 DG 038-1			
1 MAR 83	G.B.		AS BUILT - CONTRACT 1023 G			
0 6-82	G.B.		APPROVED FOR CONSTRUCTION			
8	JW		NOTE 8 MODIFIED			
A	BW		INITIAL ISSUE			

DRAWN	BW
DATE	16.9.81
CHECKED	
APPROVED	
APPROVED	
APPROVED	
APPROVED	

<b>Woodside Offshore Petroleum Pty Ltd</b>	
NORTH WEST SHELF DEVELOPMENT PROJECT	
MATERIALS OFFLOADING FACILITY	
WHARF - GENERAL ARRANGEMENT	
SCALE	AS SHOWN
DRAWING NO.	G7400 DS 038-1
REVISION	2



DCW EXTENSION PILE GRIDS FOR PILE DRIVING RECORDS 1994

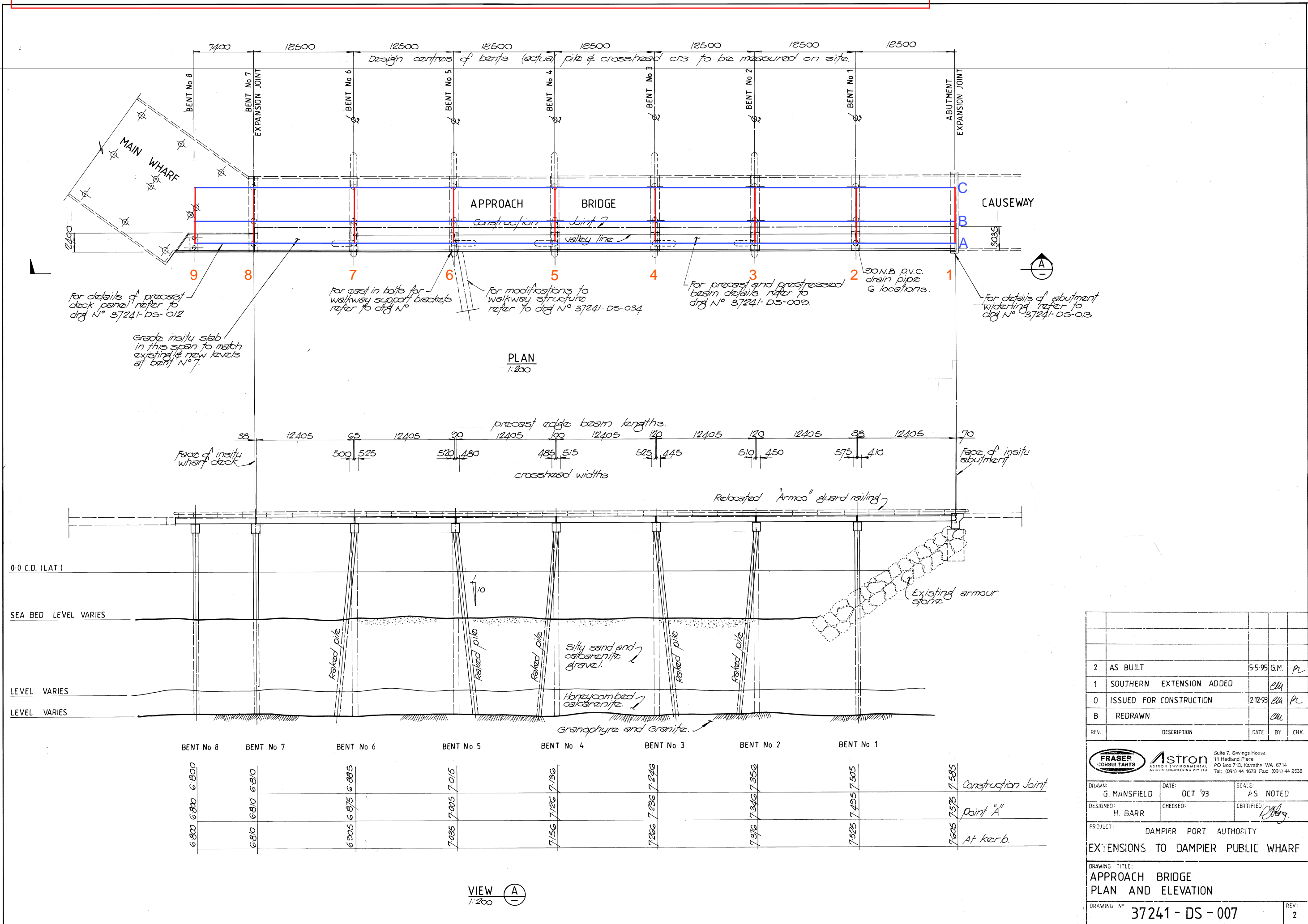


PILE SCHEDULE	
PILE NUMBER	PILE LOCATION
1 TO 14	APPROACH BRIDGE
15 TO 106	MAIN WHARF (ORIGINAL STRUCTURE)
107 TO 114	MOORING DOLPHIN A
115 TO 122	MAIN WHARF (BREASTING DOLPHIN)
123 TO 130	MOORING DOLPHIN B
131 TO 136	REMOVED DURING 1994 EXTENSIONS
137 & 138	DOLPHIN ACCESS
139 TO 147	APPROACH BRIDGE 1994 WIDENING
148 TO 243	MAIN WHARF 1994 EXTENSIONS.



244 - 247 Small Boat Landing.  
248 - 251 STRONG POINT.


1	AS BUILT	7-94	GM	PC
REV.	DESCRIPTION	DATE	BY	CHK.
<div><div>FRASER CONSULTANTS</div><div>Astron</div><div>Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha WA 6714 Tel: (081) 44 1579 Fax: (081) 44 2638</div></div>				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: PILE LOCATION PLAN				
DRAWING N° 37241-DS-038				REV: 1

37241DS038



2	AS BUILT	55.95	G.M.		pr
1	SOUTHERN EXTENSION ADDED		cm		
0	ISSUED FOR CONSTRUCTION	212.93	cm		pr
B	REDRAWN		cm		
REV.	DESCRIPTION	DATE	BY		CHK.

				Suite 7, Savings House. 11 Hedland Place PO Box 713, Karratha WA 6714 Tel: (091) 44 1679 Fax: (091) 44 2538	
ASTRON ENGINEERING PTY LTD					

DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:	AS NOTED
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:	

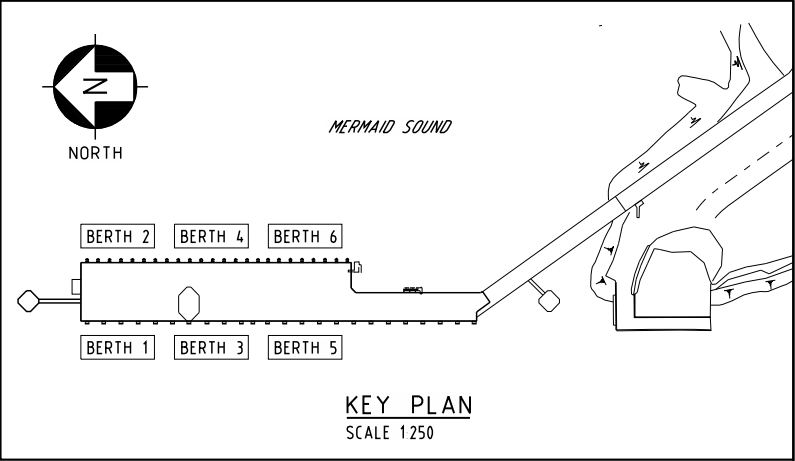
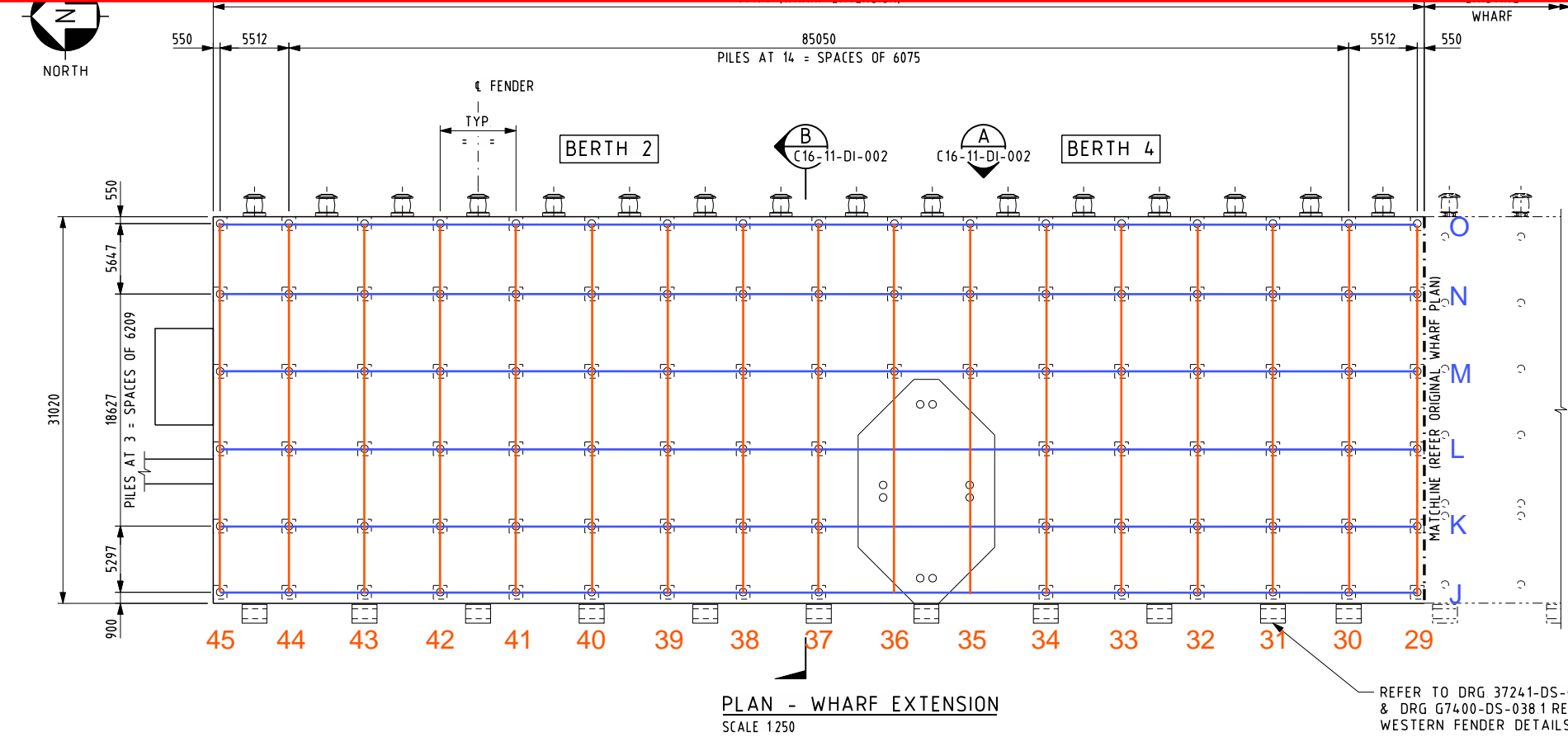
PROJECT: DAMPIER PORT AUTHORITY

EXTENSIONS TO DAMPIER PUBLIC WHARF

DRAWING TITLE:	
APPROACH BRIDGE PLAN AND ELEVATION	
DRAWING N°	37241 - DS - 007
	REV: 2

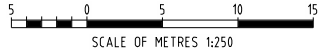
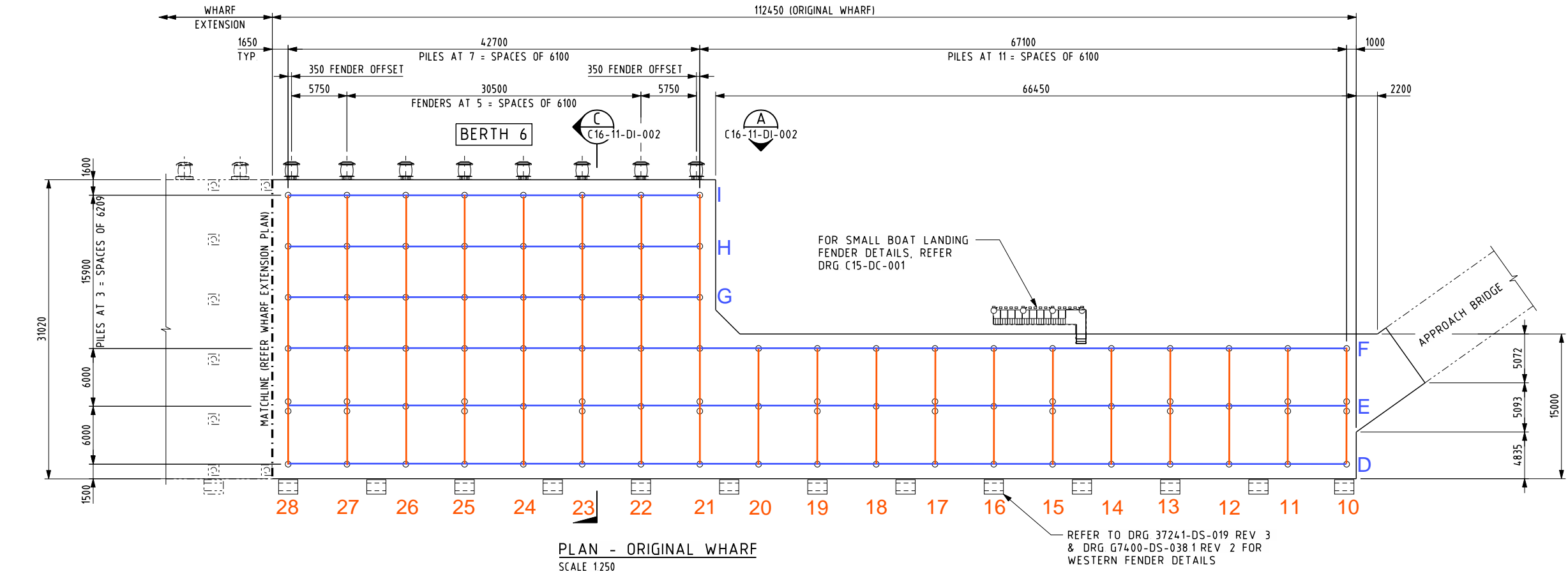
37241 DS007







NOTE REFER TO DPA DRG D15-DE-001 REV P FOR FENDER BERTHING CRITERIA FOR EAST AND WEST BERTHS

GENERAL NOTES  
1 ALL DIMENSIONS ARE FROM PREVIOUS DPA DRAWINGS AND NO SURVEY HAS BEEN UNDERTAKEN TO VERIFY THESE DIMENSIONS

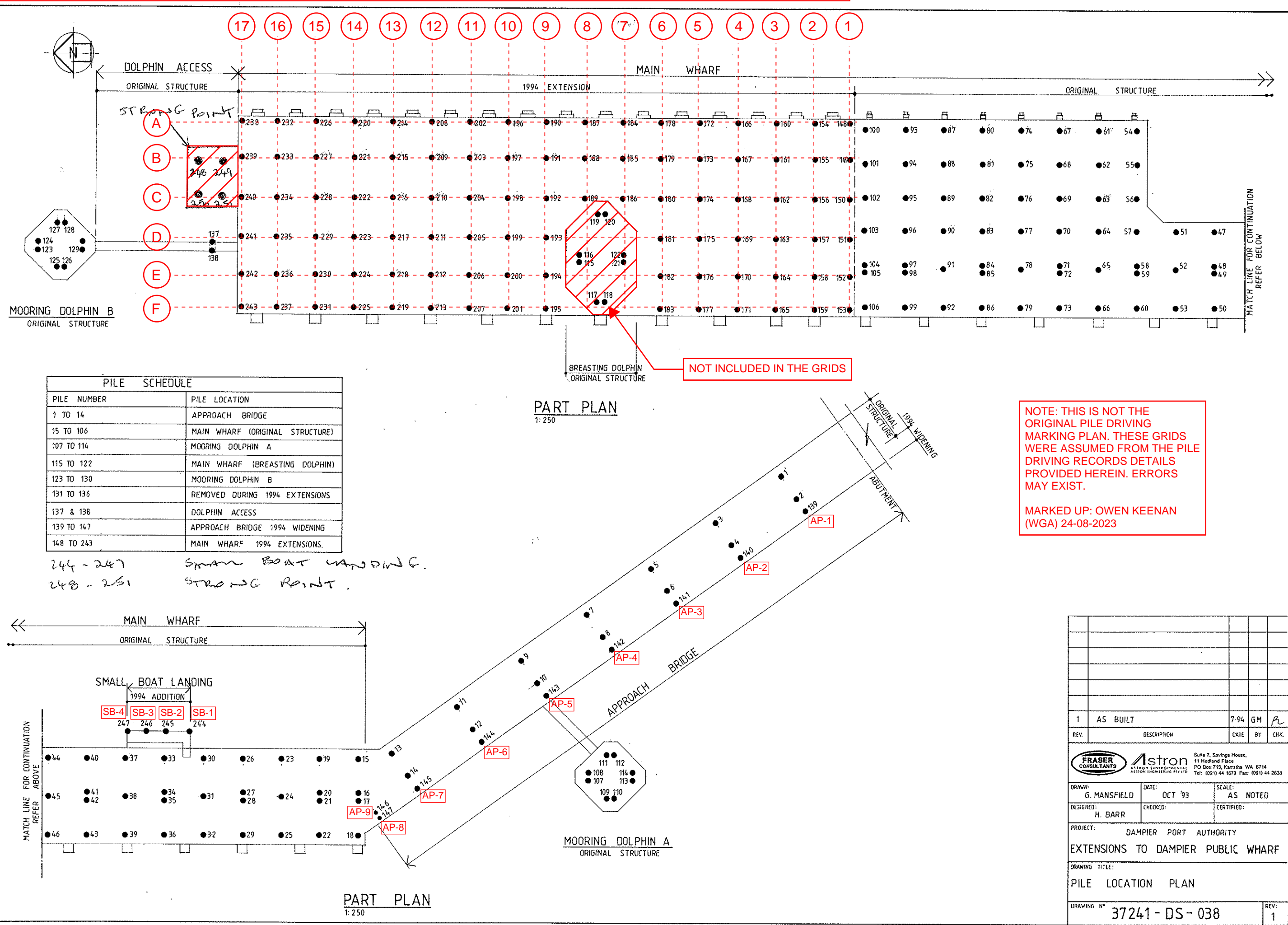


 Phone 08 9322 1077 Fax 08 9322 3270 Email admin@bchengineering.com.au Web www.bchengineering.com.au		 TELEPHONE (08) 9159 4555 EMAIL info@dpa.wa.gov.au POSTAL P O Box 285 DAMPIER WA 6713 WEB www.dpa.wa.gov.au		<table><tr><td>REV</td><td>DATE</td><td>BY</td><td>CHK'D</td><td>DESCRIPTION</td><td>ENG</td></tr><tr><td>0</td><td>05 05 2011</td><td>TW</td><td></td><td>AS-BUILT</td><td>RH</td></tr></table>		REV	DATE	BY	CHK'D	DESCRIPTION	ENG	0	05 05 2011	TW		AS-BUILT	RH	<table><tr><td>DRAWN</td><td>T. WHINNEN</td><td>DATE</td><td>05 05 11</td><td>CLIENT REVIEW</td><td>DATE</td></tr><tr><td>DESIGNED</td><td></td><td>DATE</td><td></td><td>CLIENT APPROVAL</td><td>DATE</td></tr><tr><td>CHECKED</td><td>R. HINCKFUSS</td><td>DATE</td><td>05 05 11</td><td>VERTICAL DATUM</td><td>HORIZ DATUM</td></tr><tr><td>APPROVED FOR TENDER</td><td></td><td>DATE</td><td></td><td>SCALE</td><td></td></tr><tr><td>APPROVED FOR CONSTRUCTION</td><td></td><td>DATE</td><td></td><td></td><td></td></tr></table>	DRAWN	T. WHINNEN	DATE	05 05 11	CLIENT REVIEW	DATE	DESIGNED		DATE		CLIENT APPROVAL	DATE	CHECKED	R. HINCKFUSS	DATE	05 05 11	VERTICAL DATUM	HORIZ DATUM	APPROVED FOR TENDER		DATE		SCALE		APPROVED FOR CONSTRUCTION		DATE				<table><tr><td>CLIENT</td><td>DAMPIER PORT AUTHORITY</td></tr><tr><td>PROJECT</td><td>DAMPIER CARGO WHARF</td></tr><tr><td>TITLE</td><td>BERTHS 2, 4 &amp; 6 FENDERS GENERAL ARRANGEMENT PLAN</td></tr><tr><td>ORIGINAL SHEET SIZE</td><td>A1</td></tr><tr><td>BCH JOB NO</td><td>8075</td></tr><tr><td>DRG No</td><td>C16-11-DI-001</td></tr><tr><td>REVISION</td><td>0</td></tr></table>	CLIENT	DAMPIER PORT AUTHORITY	PROJECT	DAMPIER CARGO WHARF	TITLE	BERTHS 2, 4 & 6 FENDERS GENERAL ARRANGEMENT PLAN	ORIGINAL SHEET SIZE	A1	BCH JOB NO	8075	DRG No	C16-11-DI-001	REVISION	0
REV	DATE	BY	CHK'D	DESCRIPTION	ENG																																																										
0	05 05 2011	TW		AS-BUILT	RH																																																										
DRAWN	T. WHINNEN	DATE	05 05 11	CLIENT REVIEW	DATE																																																										
DESIGNED		DATE		CLIENT APPROVAL	DATE																																																										
CHECKED	R. HINCKFUSS	DATE	05 05 11	VERTICAL DATUM	HORIZ DATUM																																																										
APPROVED FOR TENDER		DATE		SCALE																																																											
APPROVED FOR CONSTRUCTION		DATE																																																													
CLIENT	DAMPIER PORT AUTHORITY																																																														
PROJECT	DAMPIER CARGO WHARF																																																														
TITLE	BERTHS 2, 4 & 6 FENDERS GENERAL ARRANGEMENT PLAN																																																														
ORIGINAL SHEET SIZE	A1																																																														
BCH JOB NO	8075																																																														
DRG No	C16-11-DI-001																																																														
REVISION	0																																																														

**APPENDIX G**  
PILE DRIVING RECORDS AND PLAN  
1994



DCW EXTENSION PILE GRIDS FOR PILE DRIVING RECORDS.



37241DS038

1	AS BUILT	7-94	GM	PC
REV.	DESCRIPTION	DATE	BY	CHK.
<div>FRASER CONSULTANTS Astron Suite 7, Savings House, 11 Hedland Place PO Box 713, Karratha WA 6714 Tel: (081) 44 1579 Fax: (081) 44 2638</div>				
DRAWN:	G. MANSFIELD	DATE:	OCT '93	SCALE:
DESIGNED:	H. BARR	CHECKED:		CERTIFIED:
PROJECT: DAMPIER PORT AUTHORITY EXTENSIONS TO DAMPIER PUBLIC WHARF				
DRAWING TITLE: PILE LOCATION PLAN				
DRAWING N°	37241-DS-038			REV: 1



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 1-2-94  
 HAMMER : K4S  
 HELMET : NOVESTEEN  
 HAMMER STROKE : 2.5  
 S + C/2 : 16.5  $\therefore R_u = 4000 \text{ kN}$   
 START TIME - 5.55 PM  
 FINISH - 6.05

PILE SIZE :  
 PILE # : 12  
 LOCATION : 1-A  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : -  
 OFFCUT LENGTH :  
 FINAL LENGTH : 25.05

R.L. CUTOFF : 5.85      R.L. TOE : -19.20      R.L. GROUND : -6.30  
 PENETRATION : 13m 12.90      FINAL SET : 3.5 mm      MEASURED T.C : 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25							6		
0.5							4		
0.75							4		
1.0		9.0		17.0		25.0	4	33.0	
							2		
							4		
2.0		10.0		18.0		26.0	7	34.0	
							7		
							10		
							18		
3.0		11.0		19.0		27.0	30	35.0	
							33/25	PILE FAILURE	
4.0		12.0		20.0	2	28.0		36.0	
					2				
					4				
5.0		13.0		21.0	3	29.0		37.0	
					3				
					3				
6.0		14.0		22.0	5	30.0		38.0	
	TOP OF GROUND				4				
					5				
7.0		15.0		23.0	4	31.0		39.0	
					3				
					3				
					4				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 1-2-94  
 HAMMER : K45  
 HELMET : NOVESTERN  
 HAMMER STROKE : 2.5  
 S + C/2 : 21.1 ∴  $R_0 = > 3000 \text{ kJ}$

PILE SIZE :  
 PILE # : 13  
 LOCATION : 1-B  
 PITCHED LENGTH : 30 m  
 ADD. LENGTH : —  
 OFFCUT LENGTH :  
 FINAL LENGTH : 24.7

START TIME : 3.55 pm

FINISH : 4.00

R.L. CUTOFF : 5.85 CD

R.L. TOE : -18.85

R.L. GROUND : -6.60

PENETRATION : 12.25 m

FINAL SET : 8.1

MEASURED T.C : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25							7		
0.5							6		
0.75							5		
1.0		9.0		17.0		25.0	6	33.0	
							4		
							4		
							3		
2.0		10.0		18.0	↓	26.0	3	34.0	
							3		
							9		
						12.25 Pen →	17		
3.0		11.0		19.0		27.0	31	35.0	
					↓				
					1				
4.0		12.0		20.0	1	28.0		36.0	
					2				
					3				
5.0		13.0		21.0	2	29.0		37.0	
					1				
					3				
6.0		14.0		22.0	5	30.0		38.0	
					4				
	TOP OFFCUT				3				
					2				
7.0		15.0		23.0	5	31.0		39.0	
					13				
					15				
					13				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 21.2.94

HAMMER : K45

HELMET : NOVESTEEN

HAMMER STROKE : 2.5

S + C/2 : 16.7  $\therefore R_u = 73700kN$

START TIME - 2.20 PM

FINISH : 2.30

PILE SIZE :

PILE # :

LOCATION :

PITCHED LENGTH :

ADD. LENGTH :

OFFCUT LENGTH :

FINAL LENGTH :

14

1-C

30.3m

—

—

24.75

R.L. CUTOFF : 5.85 CD.

PENETRATION : 10.80

R.L. TOE : -18.90

FINAL SET : 3.7

R.L. GROUND :

-8.10

MEASURED T.C

: 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	14	32.0	
0.25			TOP RATE				11		
0.5							7		
0.75							9		
1.0		9.0		17.0		25.0	11	33.0	
							9		
							8		
							8		
2.0		10.0		18.0		26.0	8	34.0	
							8		
							12		
							27		
3.0		11.0		19.0		27.0	27/100	35.0	PILE FAILED
4.0		12.0		20.0	2	28.0		36.0	
					2				
					3				
5.0		13.0		21.0	7	29.0		37.0	
6.0		14.0		22.0	4	30.0		38.0	
					4				
					4				
7.0		15.0		23.0	6	31.0		39.0	
					9				
					10				
					11				



$\lambda$ 

## PILE DRIVING RECORD

PILE SIZE : 610 $\phi$   
PILE # : 1-D(9)  
LOCATION : NORTH EXTENSION  
PITCHED LENGTH : 30.  
ADD. LENGTH : NIL  
OFFCUT LENGTH :  
FINAL LENGTH : 25.25

R.L. CUTOFF : 5.85 CD R.L.TOE : -19.40 R.L.GROUND : -9.50  
PENETRATION: 9.90 m FINAL SET : 12.5 MEASURED T.C : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	///	24.0	3	32.0	
0.25							6		
0.5							5		
0.75							4		
1.0		9.0		17.0		25.0	3	33.0	
							7		
							4		
							7		
2.0		10.0		18.0		26.0	6	34.0	
							9		
							9		
							5		
3.0		11.0		19.0		27.0	12	35.0	
							26		
					V		5/100		
4.0		12.0		20.0		28.0	-	36.0	
					2				
					V				
5.0		13.0		21.0		29.0		37.0	
					12.				
					V				
					4				
6.0		14.0		22.0		30.0		38.0	
					5				
					2				
					3				
					5				
7.0		15.0		23.0		31.0		39.0	
					5				
					12				
					2				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 31.1.94  
 HAMMER : KOB 45  
 HELMET : NOVASTON  
 HAMMER STROKE : 2.5  
 S + C/2 : 26.1  $\therefore R_u = 2500 \text{ kN}$   
 START TIME - 5.10 PM.  
 FINISH " - 5.25

PILE SIZE : 610  $\phi$   
 PILE # : 1E (10)  
 LOCATION : NORTH EXTENSION  
 PITCHED LENGTH : 30.5  
 ADD. LENGTH : NIL  
 OFFCUT LENGTH :  
 FINAL LENGTH : 24.95

R.L. CUTOFF : 5.85 CD R.L. TOE : -19.10 R.L. GROUND : -10.100  
 PENETRATION : 9.0M FINAL SET : 13.1 MEASURED T.C : 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	12	32.0	
0.25							14		
0.5							15		
0.75							11		
1.0		9.0		17.0		25.0	13	33.0	
							15		
							12		
2.0		10.0	TOP CHISE	18.0	XXXX	26.0	12	34.0	TOP FAILED
							12		
							13		
3.0		11.0		19.0		27.0	12	35.0	
							19		
4.0		12.0		20.0	✓	28.0		36.0	
					1				
					2				
					3				
5.0		13.0		21.0	✓	29.0		37.0	
					3				
					✓				
6.0		14.0		22.0	1	30.0		38.0	
					2				
					3				
					4				
7.0		15.0		23.0	5	31.0		39.0	
					6				
					7				
					12				
					13				
					12				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE	: 31.1.94.	PILE SIZE	: 610 $\phi$
HAMMER	: KOBEL 45	PILE #	: 1 F (11)
HELMET	: NOVA STEEN	LOCATION	: NORTHERN EXT.
HAMMER STROKE	: 2.5 m	PITCHED LENGTH	: 30.3"
S + C/2	: 22.1 $\therefore R_u < > 2900 kJ$	ADD. LENGTH	: NIL
START TIME	: 2.45	OFFCUT LENGTH	:
FINISH	: 3.00	FINAL LENGTH	: 25.8
R.L. CUTOFF	: 5.85 CD	R.L. TOE	: -19.95
PENETRATION:	: 9.85	FINAL SET	: 9.1
		R.L. GROUND	: -10.10
		MEASURED T.C	: 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25						25.0	9		
0.5							8		
0.75							6		
1.0		9.0		17.0		25.0	4	33.0	
							8		
							3		
							6		
2.0		10.0	TOP GATE	18.0	XXXXXX	26.0	7	34.0	
							10		
							10		
							9		
3.0		11.0		19.0		27.0	10	35.0	
							17		
							23		
							11/100"		
4.0		12.0		20.0	2	28.0		36.0	
					2				
					3				
5.0		13.0		21.0		29.0		37.0	
					2				
					3				
6.0		14.0		22.0		30.0		38.0	
					4				
					7				
7.0		15.0		23.0		31.0		39.0	
					12				
					7				





# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 8-2-94  
 HAMMER : K-45  
 HELMET : NOVELTIE  
 HAMMER STROKE : 1.8  
 S + C/2 : 19.1  $\therefore R_u = 72400 \text{ kN}$   
 START TIME : 12.15  
 FINISH : 12.32

PILE SIZE : 610 OD  
 PILE # : 16  
 LOCATION : 2-B  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH : —  
 FINAL LENGTH : 25.65  $\frac{D}{LEV.} = 1.1m$

R.L. CUTOFF : 5.85 CD  
 PENETRATION : 12.40  
 R.L. TOE : -19.80  
 FINAL SET : 6.1  
 R.L. GROUND : -7.40  
 MEASURED T.C : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	13	32.0	
0.25							17		
0.5							16		
0.75							12		
1.0		9.0		17.0		25.0	9	33.0	
							5		
							3		
							8		
2.0		10.0		18.0		26.0	6	34.0	
							4		
						STOP	6		
							7		
3.0		11.0		19.0		27.0	8	35.0	
							17		
							30		
							33/240		
4.0		12.0		20.0		28.0		36.0	
5.0		13.0		21.0	2	29.0		37.0	
					4				
6.0	D/LEV. 14.0	XXXX		22.0		30.0		38.0	
					5				
					5				
7.0		15.0		23.0	5	31.0		39.0	
	TOP BENT	XXXX			4				
					4				
					8				

## PILE DRIVING RECORD

R.L.GROUND : 1-8.10  
MEASURED T.C : 24+2

[illegible]



# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 20  
LOCATION : 2-D  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.75 — 1.1 DPK  
21.65

R.L.GROUND : 17.5 TOP  
MEASURED T.C : -960 Bottom  
24+2

[illegible]



# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 20  
LOCATION : 2-D  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.75 — 1.1 DUCK  
LEVEL

R.L.GROUND : 17.5 TSP  
MEASURED T.C : -960 <sup>Summ</sup>  
24+2

[illegible]

# PILE DRIVING RECORD

MEASURED T.C

[illegible]



# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 18  
LOCATION : 2-E  
PITCHED LENGTH : 30 m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 26.05

R.L.GROUND  
MEASURED T.C

5  
- 1.1 <sup>10</sup> acc  
LEVI  
:  
~~18~~  
~~TOP~~  
- 10.10  
24 + 2

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 11.2.94  
 HAMMER : K-25  
 HELMET : NOVA  
 HAMMER STROKE : 2.2  
 S + C/2 : 16.3  $\therefore R_v \Rightarrow 3400 \text{ kN}$   
 START : 11.20  
 FINISH : 11.35

PILE SIZE : 610  
 PILE # : 19  
 LOCATION : 2-F.  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH :  
 FINAL LENGTH : 25.75m

R.L. CUTOFF : 5.85 CD  
 PENETRATION : 9.80

R.L. TOE : -19.90  
 FINAL SET : 3.3

R.L. GROUND : 13m Top L.  
 MEASURED T.C : -10.10  
 : 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	15	32.0	
0.25							12		
0.5							9		
0.75			DECK LEVEL				12		
1.0		9.0		17.0		25.0	8	33.0	
							9		
							7		
							9		
2.0		10.0	TOP PLATE	18.0		26.0	9	34.0	
							7		
							7		
							12		
3.0		11.0		19.0		27.0	15	35.0	
							16		
							25		
							38		
4.0		12.0		20.0		28.0	6/20mm	36.0	
					2				
					3				
5.0		13.0		21.0	2	29.0		37.0	
					2				
					1				
					3				
6.0		14.0		22.0		30.0		38.0	
					1				
					1				
					3				
7.0		15.0		23.0	6	31.0		39.0	
					5				
					5				
					5				

### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 19  
LOCATION : 2-F.  
PITCHED LENGTH : 30 m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.75 m

R.L.GROUND : 18" TOP R  
MEASURED T.C : -10.10  
24 + 2

[illegible]



### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 51  
LOCATION : 3-A  
PITCHED LENGTH : 30.3.  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.7

FINISH : 11.15

R.L.TOE : -19-85

FINAL SET : 7.3

R.L.GROUND

MEASURED T.C

$$\begin{array}{r} 15 \cdot 2^7 \\ - 7 \cdot 2^6 \\ \hline 24 + 2 \end{array}$$

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	/	24.0	//	32.0	
0.25							11		
0.5							13		
0.75							16		
1.0		9.0		17.0 /		25.0 /	18	33.0	
							16		
							8		
							3		
2.0		10.0		18.0 /		26.0	6	34.0	
							+		
							4		
							6		
3.0		11.0		19.0 /		27.0 /	7	35.0	
						-	11		
							16		
							34		
4.0		12.0		20.0		28.0		36.0	
					V				
					I				
5.0		13.0		21.0 /	L	29.0		37.0	
					v				
6.0		14.0		22.0 /	2	30.0		38.0	
	DECK LEVEL.				v				
					6				
					5				
7.0		15.0		23.0 /	5	31.0		39.0	
	FOR PRINTING XXXX				A				
					6				
					7				

# PILE DRIVING RECORD

FINISH 10.50

FINAL LENGTH : 25.95

MEASURED T.C : 17.50

[illegible]

# PILE DRIVING RECORD

-1.1 DECK  
LEAVE

R.L.GROUND : 10<sup>m</sup> TOP SOIL  
MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	<i>Top Layer</i> 16.0	X X X X		24.0	20	32.0	
0.25							18		
0.5							15		
0.75							12		
1.0		9.0	17.0			25.0	11	33.0	
							9		
							12		
							14		
2.0		10.0	18.0			26.0	11	34.0	
							11		
							10		
3.0		11.0	19.0			27.0	11	35.0	
							11		
							17		
							25		
4.0		12.0	20.0			28.0	15	36.0	
				V			15/50 <sup>mm</sup>		
				I					
5.0		13.0	21.0	2		29.0		37.0	
				↓ 3					
				↓ 3					
6.0		14.0	22.0	✓ 3		30.0		38.0	
				I					
				3					
				5					
7.0		15.0	23.0	5		31.0		39.0	
				8					
				9					
				10					



### PILE DRIVING RECORD

WATER DEPTH 17-700

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	18	32.0	
0.25							21		
0.5							20		
0.75							22		
1.0		9.0		17.0		25.0	23	33.0	
							26		
							24		
				.7	<del>11.0</del>		22		
2.0		10.0		18.0		26.0	18	34.0	
							17		
							17		
							15		
3.0		11.0		19.0	1	27.0	22	35.0	
							33		
							41		
							16/50		
4.0		12.0		20.0		28.0		36.0	
5.0		13.0		21.0		29.0		37.0	
					2 Blows				
6.0		14.0		22.0		30.0		38.0	
7.0		15.0		23.0	4	31.0		39.0	
					12				
					6				
					7.				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 19-3-92  
 HAMMER : K45  
 HELMET : NOVSTEEN  
 HAMMER STROKE : 2.5 +  
 S + C/2 : 15.8  $\therefore R_u \Rightarrow 4000 \text{ kJ}$

PILE SIZE : 610  $\phi$   
 PILE # : 26  
 LOCATION : 3-E  
 PITCHED LENGTH : 30  
 ADD. LENGTH : —  
 OFFCUT LENGTH : —  
 FINAL LENGTH : 26.6

2.45 - 305 pm

WATER DEPTH : 17.00  
 R.L. CUTOFF : 5.85 CD  
 PENETRATION : 10.55  
 POSITION OK

R.L. TOE : -20.75      R.L. GROUND : -10.20  
 FINAL SET : 2.8      MEASURED T.C. : 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	25	32.0	
0.25							23		
0.5							20		
0.75							27		
1.0		9.0		17.0		25.0	25	33.0	
					^		18		
					1		19		
2.0		10.0		18.0		26.0	16	34.0	
							17		
							15		
							13		
							27		
3.0		11.0		19.0	1	27.0	32	35.0	
							31		
							32		
					✓		18/5000		
4.0		12.0		20.0		28.0		36.0	
					3 DE				
5.0		13.0		21.0	↓	29.0	1	37.0	
					↓				
6.0		14.0		22.0	4 ↓	30.0		38.0	
					1				
					4 ↓				
					2				
7.0		15.0		23.0	6	31.0		39.0	
					5				
					8				
					1 1/2				

### PILE DRIVING RECORD

PILE SIZE : 6.0 ~~0~~  
PILE # : 24  
LOCATION : 3-F  
PITCHED LENGTH : 30.0  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.70

WATER DEPTH. 18.3

RLGROUND : -10.40

FINAL SET : 5.4

MEASURED T.C : 24 + 2

25mm NORIN

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	14	32.0	
0.25							10		
0.5							11		
0.75							11		
1.0		9.0		17.0		25.0	8	33.0	
							9		
							11		
							5		
2.0		10.0		18.0		26.0	6	34.0	
				.3	/ / / /		5		
							5		
							12		
3.0		11.0		19.0		27.0	11	35.0	
							12		
							18		
							46		
4.0		12.0		20.0		28.0		36.0	
				.3	/ / / /				
					5 ↓				
5.0		13.0		21.0		29.0		37.0	
					6 ↓				
6.0		14.0		22.0		30.0		38.0	
					2 ↓				
					2				
7.0		15.0		23.0	3	31.0		39.0	
					5				
					8				





### FILE DRIVING RECORD

PILE SIZE	:	610
PILE #	:	
LOCATION	:	4-B
PITCHED LENGTH	:	30"
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND

MEASURED T.C

-1.1 TO PECK  
LEVER  
:14-STEP<sup>III</sup> BATH

[illegible]

# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 28  
LOCATION : 4-C  
PITCHED LENGTH : 30 m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.70  
-1-1 DECK

R.L. CUTOFF : 5.85 CD R.L. TOE : -19.85 R.L. GROUND : 15.5 TOE  
PENETRATION : 12.25 FINAL SET : 6.6 MEASURED T.C : -7.60  
TOE WEST 20" 24 + 2

[illegible]



### PILE DRIVING RECORD

FILE SIZE : 610

PILE# : 33

LOCATION : 4 - D

PITCHED LENGTH : 30"

ADD. LENGTH : \_\_\_\_\_

OFFCUT LENGTH :

FINAL LENGTH : 26.45  
-1.1 To Peak

R.L.TOE : -19.60

RL GROUND : 16<sup>m</sup> Tot

FINAL SET : 6.3

MEASURED T.C : - 8.10

TOE WEST 20<sup>mm</sup>

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 26.2.94

HAMMER : K.45

HELMET : NOVA

HAMMER STROKE : 2.3.

S + C/2 : 16.3, R<sub>0</sub> ⇒ 3500kN

START TIME 10.15

FINISH 10.30

PILE SIZE : 610

PILE # : 35

LOCATION : 4 - E

PITCHED LENGTH : 30

ADD. LENGTH : —

OFFCUT LENGTH :

FINAL LENGTH : 25.85

-1.1 TO DECK

R.L. CUTOFF : 5.85 CD

R.L. TOE : -20.00

R.L. GROUND :

18" TOP

PENETRATION : 9.90

FINAL SET : 3.3

MEASURED T.C

-10.10

TDE ~~WAST~~ 40"

24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	2	32.0	
0.25							19		
0.5							21		
0.75			DECK LEVEL				15		
1.0		9.0		17.0		25.0	15	33.0	
							12		
							10		
							13		
2.0		10.0	TOP BEAM	18.0	XXXXX	26.0	10	34.0	
							9		
							10		
							10		
3.0		11.0		19.0	V	27.0	11	35.0	
					V		22		
					V		29		
					V		35		
4.0		12.0		20.0	XXXXX	28.0	15/55	36.0	
					V				
					3				
5.0		13.0		21.0	1	29.0		37.0	
					3				
					V				
6.0		14.0		22.0	3	30.0		38.0	
					3				
					V				
					2				
7.0		15.0		23.0	4	31.0		39.0	
					3				
					3				
					2				

### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 34  
LOCATION : 4-1F  
PITCHED LENGTH : 30  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.80  
-1.1 TO DECK

R.L.GROUND :  $18.5^m$   
MEASURED T.C :  $-10.60$   
 $24 + 2$

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0 /	7	32.0	
0.25							9		
0.5							14		
0.75						/	14		
1.0		9.0		17.0		25.0	15	33.0	
			DECK				13		
							14		
						/	14		
2.0		10.0		18.0		26.0	8	34.0	
							8		
			TOP FORM	XSSX		?	9		
						/	9		
3.0		11.0		19.0		27.0	9	35.0	
							13		
							26		
							27		
4.0		12.0		20.0		28.0 /	16/125	36.0	
							1		
						V			
					-3				
5.0		13.0		21.0		29.0	1	37.0	
					1				
					1				
					1				
6.0		14.0		22.0		30.0		38.0	
					1				
					↓ 2				
					1				
7.0		15.0		23.0		31.0		39.0	
					2				
					3				
					3				
					2				



# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 31  
LOCATION : 5-17  
PITCHED LENGTH : 30 m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.55

MEASURED T.C :  $\frac{-6.60}{24+2}$

$$: 24 + 2.$$
[illegible]

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 1.3.92

HAMMER : K-25

HELMET : NOVA

HAMMER STROKE : 2-4.

$$S + C/2 : 19.5 \therefore K_U \Rightarrow 3000 \text{ kN}$$

START TIMES : 10.05<sup>AM</sup>

Finish : 10-20

R.L. CUTOFF : 5.85m

PENETRATION: 12.65

100 20 100

PILE SIZE : 610

PILE# : 32

LOCATION : 5-15.

PITCHED LENGTH : 30m

ADD. LENGTH :           

OFFCUT LENGTH

FINAL LENGTH : 25.60

100

R.L.TOE : -19.75

R.L.GROUND : 15<sup>th</sup> EMB

FINAL SET : 6.5

MEASURED T.C :  $-7.10$   
:  $24 + 7$

[illegible]

# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 30  
LOCATION : 5-C  
PITCHED LENGTH : 30"  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.65

R.L. CUTOFF : 5.85 CD R.L. TOE : -19.80 R.L. GROUND : 15<sup>m</sup> 5.10  
PENETRATION : 11.70 FINAL SET : 5.0 MEASURED T.C : -8.10  
Total 20 Wt : 24 + 2.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	Top Layer	16.0		24.0	20	32.0	
0.25							13		
0.5							12		
0.75							11		
1.0		9.0		17.0	/	25.0	9	33.0	
							11		
							8		
							7		
2.0		10.0		18.0	X	26.0	6	34.0	
							6		
							7		
							10		
3.0		11.0		19.0	/	27.0	10	35.0	
							15		
							26		
							40/200 <sup>mm</sup>		
4.0		12.0		20.0	-	28.0	-	36.0	
5.0		13.0		21.0	/	29.0		37.0	
6.0		14.0		22.0	/	30.0		38.0	
7.0		15.0		23.0	/	31.0		39.0	



### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 38  
LOCATION : 5-D  
PITCHED LENGTH : 30  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.60

FINISH 2-40

R.L.GROUND

MEASURED T.C : - 8.85  
21.17

Top EAST 30<sup>nm</sup>

$$: 24 + 2$$
[illegible]

## PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 37  
LOCATION : 5-E  
PITCHED LENGTH : 30 m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.70  
-1.12000

TOE NEST 15mm

[illegible]

### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 36  
LOCATION : 5-F  
PITCHED LENGTH : 30.0  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.95  
7-1 DEC

R.L.GROUND : 19.5 TB  
MEASURED T.C : -10.60  
24 + 2

[illegible]



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 4.3.94  
 HAMMER : K-45  
 HELMET : Nova  
 HAMMER STROKE : 2.6  
 S + C/2 : 14.9  $\therefore R_v \Rightarrow 4200$   
 START TIME : 1.30  
 FINISH : 1.45

PILE SIZE : 610  
 PILE # : 39  
 LOCATION : 6-A  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH : —  
 FINAL LENGTH : 25.90  
 -1.1 Deck

R.L. CUTOFF : 5.85  
 PENETRATION : 13.45  
 R.L. TOE : -20.05  
 FINAL SET : 1.9  
 R.L. GROUND : 14.5 for beam  
 MEASURED T.C : -6.60  
 : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	13	32.0	
0.25							11		
0.5							8		
0.75							7		
1.0		9.0		17.0		25.0	7	33.0	
							8		
							7		
							7		
2.0		10.0		18.0		26.0	5	34.0	
							5		
							5		
							8		
3.0		11.0		19.0		27.0	8	35.0	
							10		
							37		
							50		
4.0		12.0		20.0		28.0	26/50m	36.0	
5.0		13.0		21.0	2	29.0		37.0	
					3				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					2				
					5				
7.0		15.0		23.0	4	31.0		39.0	
					3				
					2				
					6				

### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 40  
LOCATION : 6-B  
PITCHED LENGTH : 30.00  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.70 4.1 DECK

Tox. 30<sup>th</sup> EAST

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 4.3.94  
 HAMMER : K-45  
 HELMET : No/A  
 HAMMER STROKE : 17.4 m RJ  $\Rightarrow$  3500 kJ  
 S + C/2 : 2.4  
 START TIME : 1.50  
 FINISH : 2.05

PILE SIZE : 610  
 PILE # : 41  
 LOCATION : 6-C  
 PITCHED LENGTH : 30  
 ADD. LENGTH : —  
 OFFCUT LENGTH : —  
 FINAL LENGTH : 25.65  
 — 1.1 Deck

R.L. CUTOFF : 5.85 CD.  
 PENETRATION : 11.70  
 R.L. TOE : -19.80  
 FINAL SET : 44  
 R.L. GROUND : 16" for  
 MEASURED T.C : -8.10 m  
 24 + 2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	16.0	24.0	5	32.0			
0.25					8				
0.5					7				
0.75					9				
1.0		9.0	17.0	25.0	8	33.0			
					1				
					5				
					5				
2.0		10.0	18.0	26.0	8	34.0			
					8				
					12				
					11				
3.0		11.0	19.0	27.0	15	35.0			
					25				
					23				
					45/200"				
4.0		12.0	20.0	28.0		36.0			
					2				
5.0		13.0	21.0	29.0	2	37.0			
					4				
					1				
6.0		14.0	22.0	30.0	1	38.0			
					1				
					1				
					1				
	Deck				3				
7.0		15.0	23.0	31.0	3	39.0			
					2				
					3				
					4				



### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 44  
LOCATION : 6-D  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.95  
-1.1m DUCK

R.L. GROUND : 18<sup>m</sup> Top ~~Point~~  
MEASURED T.C : -10.10  
: 24 + 2

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 5.3.94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2.3  
 S + C/2 : 14.8  $\therefore R_v \Rightarrow 3700 \text{ kN}$   
 START Time 12.20  
 FINISH 12.30

PILE SIZE : 610  
 PILE # : 42  
 LOCATION : 6-E  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH :  
 FINAL LENGTH : 26.0 - 11m DECK

R.L. CUTOFF : 5.85 CD  
 PENETRATION : 10.05  
 TOE 20 WBS

R.L. TOE : -20.15  
 FINAL SET : 1.8  
 R.L. GROUND : 18m TOE  
 MEASURED T.C. : 10.10  
 : 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	5	32.0	
0.25							6		
0.5							6		
0.75			DECK				7		
1.0		9.0		17.0		25.0	9	33.0	
							9		
							7		
							8		
2.0		10.0	TOP BEAM	18.0	XXXX	26.0	6	34.0	
							5		
							5		
							5		
3.0		11.0		19.0	1	27.0	7	35.0	
							8		
							15		
							27		
4.0		12.0		20.0		28.0	22	36.0	
							11/20m		
5.0		13.0		21.0	2	29.0		37.0	
					5				
6.0		14.0		22.0		30.0		38.0	
					5				
7.0		15.0		23.0	2	31.0		39.0	
					2				
					3				
					3				

### PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 43  
LOCATION : 6-F  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 26.05

-1.1<sup>m</sup> DECK

: 19<sup>th</sup> Jan

$$: \frac{-11.10}{24 + 2}$$
[illegible]



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 9.3.94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2.3.  
 S + C/2 :  
 START TIME : 2.40  
 FINISH : 2.50

PILE SIZE : 610  
 PILE # :  
 LOCATION : 7-A  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

R.L. CUTOFF :  
 PENETRATION :  
 TOE :

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 14.5m  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	11	32.0	
0.25							13		
0.5							15		
0.75							16		
1.0		9.0		17.0		25.0	11	33.0	
							12		
							7		
							7		
2.0		10.0		18.0		26.0	5	34.0	
							7		
							8		
							10		
3.0		11.0		19.0		27.0	10	35.0	
							17		
							30		
							47/150m		
4.0		12.0		20.0		28.0		36.0	
5.0		13.0		21.0	1	29.0		37.0	
					1				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					2				
					3				
					7				
7.0		15.0		23.0	7	31.0		39.0	
					5				
					4				
					8				

# PILE DRIVING RECORD

PILE SIZE : 610  
PILE # :  
LOCATION : 7-13.  
PITCHED LENGTH : 30"  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

- 1.1 Deck

R.L.GROUND  
MEASURED T.C

15.5

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 9-3-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-2  
 S + C/2 :  
 START TIME : 2-55  
 FINISH : 3-10

PILE SIZE : 612  
 PILE # :  
 LOCATION : 7-C  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :  
 -1-1 DECK

R.L. CUTOFF :  
 PENETRATION :  
 105 25" EAST  
 R.L. TOE :  
 FINAL SET :  
 R.L. GROUND : 16" TOP  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25							10		
0.5							11		
0.75							12		
1.0		9.0		17.0		25.0	3	33.0	
							9		
							10		
2.0		10.0		18.0		26.0	9	34.0	
							8		
						4	7		
							6		
3.0		11.0		19.0		27.0	7	35.0	
							13		
							28		
							54		
4.0		12.0		20.0		28.0		36.0	
5.0		13.0		21.0	1	29.0		37.0	
					1				
					1				
6.0		14.0		22.0	3	30.0		38.0	
					1				
					2				
7.0		15.0		23.0	2	31.0		39.0	
					3				
					4				
					5				



## PILE DRIVING RECORD

PILE SIZE : 610  
PILE # : 48  
LOCATION : 8-A  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.45  
-1.1m DECK

R.L. GROUND .15<sup>m</sup> TOP

MEASURED T.C. : -7.10

MEASURED T.C. :  $-7.10$   
 $24 + 2$

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 12-3-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2.3  
 S + C/2 : 18.6  $\therefore R_v \Rightarrow 3200 \text{ kJ}$   
 START TIME : 9.55  
 FINISH : 10.05

PILE SIZE : 610  
 PILE # : 49  
 LOCATION : 8-B  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH : —  
 FINAL LENGTH : 25.70  
 -1.1" DECK

R.L. CUTOFF : 5.85 CD R.L. TOE : -19.85 R.L. GROUND : 15m TP  
 PENETRATION : 12.75 FINAL SET : 5.6 MEASURED T.C. : -7.10  
 TOP & 24+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	✓	24.0	✓ 3	32.0	
0.25					↓		5		
0.5							8		
0.75							9		
1.0		9.0		17.0	✓	25.0	✓ 9	33.0	
							8		
							5		
							3		
2.0		10.0		18.0	✓	26.0	✓ 3	34.0	
					↓		4		
							5		
							7		
3.0		11.0		19.0	✓	27.0	✓ 7	35.0	
							8		
							15		
							45		
4.0		12.0		20.0	✓	28.0		36.0	
					↓				
					1				
5.0		13.0		21.0	✓	29.0		37.0	
					1				
					1				
					1				
	PELIC				1				
6.0		14.0		22.0	✓	30.0		38.0	
					1				
					1				
					2				
7.0	TOP	15.0		23.0	✓	31.0		39.0	
					2				
					3				
					↓				

## PILE DRIVING RECORD

PILE SIZE : 810  
PILE # : 60  
LOCATION : 8-C  
PITCHED LENGTH : 30m  
ADD. LENGTH : —  
OFFCUT LENGTH :  
FINAL LENGTH : 25.90  
-1.1m DECK

R.L.CUTOFF :	5.85	R.L.TOE :	-20.05	R.L.GROUND :	16.5" TOP
PENETRATION :	11.45	FINAL SET :	2.5	MEASURED T.C :	-8.88" <del>TOP</del>
TOE 15" WEST					24+2.

[illegible]



2-1

FINISH : 8.05

PILE SIZE : 610  
PILE # :  
LOCATION : 9-A  
PITCHED LENGTH : 30  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

-10- DECEMBER

R.L. CUTOFF :  
PENETRATION :  
DE 25 mm EAST

R.L.TOE :  
FINAL SET :

R.L.GROUND : 14-7 TOP  
MEASURED T.C : 13.50

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE	: 15.3.94	PILE SIZE	: 610
HAMMER	: <del>NOVA</del> K-45	PILE #	:
HELMET	: NOVA	LOCATION	: 9-B
HAMMER STROKE	: 2.4	PITCHED LENGTH	: 30
S + C/2	:	ADD. LENGTH	:
START Time	: 7.40	OFFCUT LENGTH	:
FINISH	: 7.50	FINAL LENGTH	: -1.1m DECK

R.L. CUTOFF :	R.L. TOE :	R.L. GROUND : 15m TOP
PENETRATION :	FINAL SET :	MEASURED T.C. :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	3	32.0	
0.25							6		
0.5							7		
0.75							9		
1.0		9.0		17.0		25.0	7	33.0	
							8		
							7		
							7		
2.0		10.0		18.0		26.0	8	34.0	
							7		
							8		
							9		
3.0		11.0		19.0		27.0	8	35.0	
							10		
							15		
							22		
4.0		12.0		20.0		28.0	24/200"	36.0	
5.0		13.0		21.0	3	29.0		37.0	
	DECK								
6.0		14.0		22.0		30.0		38.0	
7.0	TOP Beam	15.0	XXXXXX	23.0	2	31.0		39.0	
					3				
					2				

# PILE DRIVING RECORD

PILE SIZE	:	610 mm
PILE #	:	
LOCATION	:	9-C
PITCHED LENGTH	:	30 m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1-1<sup>m</sup> Deck  
16-2<sup>m</sup> TOP  
Bottom

MEASURED T.C.

[illegible]



## PILE DRIVING RECORD

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 9-D  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1.1 m DECK

R.L.GROUND : 17<sup>M</sup> 10<sup>P</sup>  
BIRM

MEASURED T.C :

:17<sup>M</sup> TOP  
BURN

[illegible]

## PILE DRIVING RECORD

PILE SIZE	:	610
PILE #	:	
LOCATION	:	9-E
PITCHED LENGTH	:	30 m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1.1<sup>m</sup> DECE

MEASURED T.C

: 17.5<sup>m</sup> TOP  
Beam

[illegible]

### PILE DRIVING RECORD

PILE SIZE : 810 mm  
PILE # :  
LOCATION : 9-F  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1-1 m DEC 15

R.L.GROUND : 18.2 ~~50~~  
MEASURED T.C :

[illegible]



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 18-3-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2-3  
S + C/2 :  
START TIME : 1-55  
FINISH : 2-05

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 10-A  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1-1' DECK

R.L. CUTOFF :  
PENETRATION :  
108 &

R.L. TOE :  
FINAL SET :

R.L. GROUND : 15<sup>m</sup> TOP  
MEASURED T.C. : BOTTOM

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	12	32.0	
0.25							14		
0.5							12		
0.75							8		
1.0		9.0		17.0		25.0	6	33.0	
							8		
							8		
							8		
2.0		10.0		18.0		26.0	8	34.0	
							6		
							6		
							11		
3.0		11.0		19.0		27.0	10	35.0	
							8		
							17		
							29		
4.0		12.0		20.0		28.0	26/125	36.0	
5.0		13.0		21.0	2	29.0		37.0	
6.0	DECK	14.0		22.0	6	30.0		38.0	
					2				
					5				
7.0	TOP DECK 15.0			23.0	2	31.0		39.0	
					2				
					2				
					6				

## PILE DRIVING RECORD

PILE SIZE : 610  
PILE # :  
LOCATION : 10-B.  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1-1<sup>m</sup> DECK.

R.L. GROUND : 15<sup>m</sup> TOP  
MEASURED T.C. :

[illegible]





### PILE DRIVING RECORD

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 10-D  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1.1<sup>m</sup> DECK

R.L.GROUND : 17.5" TOP  
MEASURED T.C. : ~~Bottom~~

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	7	32.0	
0.25			DECK				8		
0.5							8		
0.75							6		
1.0		9.0		17.0		25.0	7	33.0	
							8		
			TOP L&PM				8		
						5	8		
2.0		10.0		18.0		26.0	12	34.0	
							15		
						4	15		
							15		
3.0		11.0		19.0		27.0	14	35.0	
							12		
							18		
							22		
4.0		12.0		20.0		28.0	35	36.0	
							30/175 mm.		
5.0		13.0		21.0		29.0		37.0	
						4			
6.0		14.0		22.0		30.0		38.0	
						1			
						2			
7.0		15.0		23.0		31.0		39.0	
						2			
						3			
						4			

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 21.3.94  
 HAMMER : K.45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3  
 S + C/2 :  
 START TIME : 7.30  
 FINISH : 7.40

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 10-E  
 PITCHED LENGTH : 30<sup>m</sup>  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

-1.1<sup>m</sup> DECK

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND :

PENETRATION :

FINAL SET :

MEASURED T.C :

: 17.2 TOP

TOE 15<sup>mm</sup> EAST

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK	16.0		24.0	3	32.0	
0.25							6		
0.5							10		
0.75							8		
1.0		9.0		17.0		25.0	8	33.0	
			TOP DECK				9		
							9		
							9		
2.0		10.0		18.0		26.0	9	34.0	
							9		
						3	9		
							10		
3.0		11.0		19.0		27.0	9	35.0	
							9		
							12		
							13		
4.0		12.0		20.0		28.0	26	36.0	
					V		20/105 <sup>mm</sup>		
					1				
					1				
5.0		13.0		21.0	1	29.0		37.0	
6.0		14.0		22.0	11	30.0		38.0	
					V1				
7.0		15.0		23.0	1	31.0		39.0	
					2				
					1				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 21-3-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3+  
 S+C/Z :  
 START TIME : 8.05  
 FINISH : 8.20

PILE SIZE : 300 mm  
 PILE # :  
 LOCATION : 10-F  
 PITCHED LENGTH : 30 m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

1-11-1994

R.L. CUTOFF :  
 PENETRATION :  
 TOE

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 17.5 m  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	4	32.0	
0.25							7		
0.5							11		
0.75							13		
1.0		9.0		17.0		25.0	13	33.0	
							13		
							14		
							18		
2.0		10.0		18.0		26.0	15	34.0	
							14		
							15		
							17		
3.0		11.0		19.0		27.0	17	35.0	
							13		
							12		
							30		
4.0		12.0		20.0		28.0	40	36.0	
							10/20"		
5.0		13.0		21.0	1	29.0		37.0	
					2				
					2				
					1				
6.0		14.0		22.0	2	30.0		38.0	
					2				
					1				
					1				
7.0		15.0		23.0	1	31.0		39.0	
					1				
					2				
					3				

### PILE DRIVING RECORD

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 11-A  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1.1<sup>m</sup> DICK

R.L.GROUND : 15' 10" 15-10-77  
MEASURED T.C :

[illegible]



## PILE DRIVING RECORD

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 11-13  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH : -1.5 m 2500

R.L.GROUND : 15.0  
MEASURED T.C :

[illegible]

## PILE DRIVING RECORD

PILE SIZE	:	610 mm
PILE #	:	
LOCATION	:	11-C
PITCHED LENGTH	:	30 m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND : 15.00  
MEASURED T.C. :

[illegible]

## PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	11-D
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1.1<sup>m</sup> DECK.

: 16.5" Top

MEASURED T.C

TOE  $\Phi$

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 27.3.94  
HAMMER : K.45  
HELMET : NOVA  
HAMMER STROKE : 2.2  
S + C/2 :

START TIME : 11.20

FINISH : 11.30

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 11-E  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

-1.1<sup>m</sup> DECK.

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND :

17.2<sup>m</sup> TOP PARTN.

PENETRATION :

FINAL SET :

MEASURED T.C :

TOE 40<sup>mm</sup> WEST

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK.	16.0		24.0	6	32.0	
0.25							8		
0.5							10		
0.75							12		
1.0		9.0		17.0		25.0	12	33.0	
			TOP PARTN		XXXX		9		
							11		
							12		
2.0		10.0		18.0		26.0	10	34.0	
							10		
							8		
							12		
3.0		11.0		19.0		27.0	10	35.0	
							10		
							10		
							11		
4.0		12.0		20.0		28.0	11	36.0	
							23		
							31/150 <sup>mm</sup>		
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
7.0		15.0		23.0	1	31.0		39.0	
					2				
					2				
					3				



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 27.3.94.  
 HAMMER : KHS  
 HELMET : NOVA  
 HAMMER STROKE : 2.3  
 S + C/2 :  
 START TIME : 11.55  
 FINISH : 12.05

PILE SIZE : 610 mm  
 PILE # :  
 LOCATION : 11-F  
 PITCHED LENGTH : 30 m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH : -1.1 m DECK.

R.L. CUTOFF :  
 PENETRATION :  
 TOE 20 mm LEAST

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 17.7 m TOP Beam  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	4	32.0	
0.25							6		
0.5			DECK				12		
0.75							11		
1.0		9.0		17.0		25.0	10	33.0	
							8		
							7		
			TOP BEAM		XXXX		4		
2.0		10.0		18.0		26.0	10	34.0	
							8		
							8		
							9		
3.0		11.0		19.0		27.0	8	35.0	
							9		
							11		
							14		
4.0		12.0		20.0		28.0	15	36.0	
							34		
					HANDED		29/150 m <sup>2</sup>		
					2				
5.0		13.0		21.0	2	29.0		37.0	
					3				
6.0		14.0		22.0		30.0		38.0	
					4				
7.0		15.0		23.0	2	31.0		39.0	
					4				
					4				
					4				

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 5.4.94

HAMMER : K-25

HELMET : NOVA

HAMMER STROKE : 2.2

$$S + C/2 \quad :$$

START TIME : 5.15

Ensign 1 5:35

R.L. CUTOFF :

R.L.TOE :

R.L.GROUND

PENETRATION:

FINAL SET :

MEASURED T.C

30<sup>mm</sup> EAST

-1.1" D.C.  
: 15" T.P.  
P.C.

[illegible]

## PILE DRIVING RECORD

PILE SIZE	:	610
PILE #	:	
LOCATION	:	12-B
PITCHED LENGTH	:	30m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND : 15" 20"

[illegible]

## PILE DRIVING RECORD

MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	70P 60P	16.0	HX-100	24.0	8	32.0	
0.25							14		
0.5							16		
0.75							15		
1.0		9.0		17.0		25.0	11	33.0	
							16		
							19		
							16		
2.0		10.0		18.0	PX-1	26.0	15	34.0	
							10		
							7		
							10		
3.0		11.0		19.0	V	27.0	11	35.0	
							13		
							16		
							22		
4.0		12.0		20.0	Handwritten notes	28.0	35	36.0	
							22/25"		
							7		
					2				
5.0		13.0		21.0	1	29.0		37.0	
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					2				
					3				
7.0		15.0		23.0	3	31.0		39.0	
					3				
					1				
					2				



## PILE DRIVING RECORD

PILE SIZE : 610<sup>m</sup>  
PILE # :  
LOCATION : 12-D  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L.GROUND : -1.1<sup>m</sup> DECK  
MEASURED T.C : 16.5<sup>m</sup> TOP  
: BOTTOM

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	6	32.0	
0.25							12		
0.5			Top Beam.		XXXXXX		17		
0.75							13		
1.0		9.0		17.0		25.0	11	33.0	
							9		
							10		
2.0		10.0		18.0		26.0	9	34.0	
							9		
							8		
							12		
3.0		11.0		19.0		27.0	13	35.0	
							12		
							13		
							15		
4.0		12.0		20.0		28.0	25	36.0	
							23/175 <sup>mm</sup>		
5.0		13.0		21.0	2	29.0		37.0	
6.0		14.0		22.0	4	30.0		38.0	
7.0		15.0		23.0	2	31.0		39.0	
		DECK.			2				
					2				
					2				
					2				

## PILE DRIVING RECORD

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 12-E  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

-1.1<sup>m</sup> Deck.

MEASURED T.C

: 17-2<sup>m</sup> Top

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK	16.0		24.0	3	32.0	
0.25							9		
0.5							8		
0.75							7		
1.0		9.0		17.0		25.0	7	33.0	
			TOP LIGN		XXXXX		9		
							12		
							9		
2.0		10.0		18.0		26.0	8	34.0	
					Pile		3		
							7		
							8		
3.0		11.0		19.0		27.0	9	35.0	
					Hollowed		3		
							8		
							9		
4.0		12.0		20.0		28.0	9	36.0	
							16		
							12/50m		
5.0		13.0		21.0		29.0		37.0	
					1				
					4				
6.0		14.0		22.0		30.0		38.0	
					/				
					/				
					/				
7.0		15.0		23.0		31.0		39.0	
					/				
					2				
					5				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 7-4-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3  
 S + C/2 :  
 START TIME : 11-10  
 FINISH : 11-20

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 12-F  
 PITCHED LENGTH : 30<sup>m</sup>  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND : 17.2<sup>m</sup> TOP BEAM

PENETRATION :

FINAL SET :

MEASURED T.C :

TOE 40<sup>mm</sup> LEAST

-1.1<sup>m</sup> DECK

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK	16.0		24.0	4	32.0	
0.25							4		
0.5							5		
0.75							6		
1.0		9.0		17.0		25.0	4	33.0	
			TOP BEAM		XXXXX		3		
							4		
						3	6		
2.0		10.0		18.0		26.0	7	34.0	
							6		
							7		
						2	6		
3.0		11.0		19.0		27.0	7	35.0	
							7		
							6		
							8		
4.0		12.0		20.0		28.0	15	36.0	
							29		
							10/30 <sup>mm</sup>		
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
7.0		15.0		23.0	2	31.0		39.0	
					2				
					2				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 8-4-94

HAMMER : K-45

HELMET : NOVA

HAMMER STROKE : 2.2

S + C/2

START TIME : 4.15

FINISH : 4.30

R.L. CUTOFF :

PENETRATION :

TOK

R.L. TOE :

FINAL SET :

R.L. GROUND :

MEASURED T.C :

PILE SIZE : 610<sup>mm</sup>

PILE # :

LOCATION : 13-A

PITCHED LENGTH : 30<sup>m</sup>

ADD. LENGTH :

OFFCUT LENGTH :

FINAL LENGTH :

-1.1<sup>m</sup> DEC

:14.3 TOP

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	16	32.0	
0.25							22		
0.5							19		
0.75							17		
1.0		9.0		17.0		25.0	15	33.0	
							15		
							13		
2.0		10.0		18.0		26.0	13	34.0	
							11		
							7		
3.0		11.0		19.0		27.0	7	35.0	
							13		
							15		
4.0		12.0		20.0		28.0	37	36.0	
							60		
							42/150 <sup>mm</sup>		
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
	DECK				2				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
	TOP 1 <sup>st</sup> FORM				3				
7.0		15.0		23.0	3	31.0		39.0	
					3				
					6				
					5				



## PILE DRIVING RECORD

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 13-13  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

STA : -1.1<sup>m</sup> DECK  
R.L.GROUND : 15<sup>m</sup> TOP  
MEASURED T.C : BEAM

[illegible]

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 8-4-94

HAMMER : K. 45

HELMET : *NORA*

HAMMER STROKE : 2.3

$$S + C/2 \quad :$$

START TIME: 4.00

FINVBN : 4-10

R.L. CUTOFF :

R.L.TOE :

R.L.GROUND

PENETRATION :

FINAL SET :

MEASURED T.C

TOE C

-1.1<sup>m</sup> Dec  
:16<sup>m</sup> Top  
Bottom

[illegible]



## PILE DRIVING RECORD

PILE SIZE	:	610 mm
PILE #	:	
LOCATION	:	13-E
PITCHED LENGTH	:	30m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND : 17.2" *TOP*  
MEASURED T.C : *Bottom*

[illegible]



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 10-4-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2.2  
 S+C/Z :  
 START TIME : 12.05  
 FINISH : 12.15

PILE SIZE : 610mm  
 PILE # :  
 LOCATION : 13-15  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

-1.1m DECK

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND :

17.8m TOP

PENETRATION :

FINAL SET :

MEASURED T.C. :

TOP 30mm WEST

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	7	32.0	
0.25							8		
0.5			DECK.				10		
0.75							9		
1.0		9.0		17.0		25.0	8	33.0	
							7		
							10		
			TOP IS 5mm		XXXXX		11		
2.0		10.0		18.0		26.0	10	34.0	
							9		
							11		
							13		
3.0		11.0		19.0		27.0	14	35.0	
							13		
							10		
							12		
4.0		12.0		20.0		28.0	13	36.0	
							22		
							25/175mm		
							1		
5.0		13.0		21.0		29.0		37.0	
6.0		14.0		22.0	7	30.0		38.0	
7.0		15.0		23.0	1	31.0		39.0	
					1				
					2				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 12-4-94  
 HAMMER : K-45  
 HELMET : Nova  
 HAMMER STROKE : 2-3  
 S + C/2 :  
 START TIME : 12-15  
 FINISH : 12-30

PILE SIZE : 610mm  
 PILE # :  
 LOCATION : 14-A  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

R.L. CUTOFF :  
 PENETRATION :  
 TOP 40mm EAST

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 15.2m TOP  
 MEASURED T.C : 1.1m TO DECK

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	10	32.0	
0.25							12		
0.5							12		
0.75							12		
1.0		9.0		17.0		25.0	15	33.0	
							16		
							17		
							19		
2.0		10.0		18.0		26.0	15	34.0	
							10		
							8		
							9		
3.0		11.0		19.0		27.0	17	35.0	
							16		
							27		
							20		
4.0		12.0		20.0		28.0	28/125	36.0	
5.0		13.0		21.0	2	29.0		37.0	
6.0	DECK	14.0		22.0	2	30.0		38.0	
					1				
					2				
7.0		15.0		23.0	4	31.0		39.0	
	TOP 40mm				3				
					2				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 12-4-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3+  
 S + C/2 :  
 START TIME : 11-40  
 FINISH : 11-50

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 14-B.  
 PITCHED LENGTH : 30<sup>m</sup>  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

R.L. CUTOFF :  
 PENETRATION :  
 TOE  $\Phi$

R.L. TOE :  
 FINAL SET :

R.L. GROUND :  
 MEASURED T.C :

-1.1<sup>m</sup> TO DECK  
 : 15.2<sup>m</sup> TOP  
 BENT

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	13	32.0	
0.25							17		
0.5							16		
0.75							14		
1.0		9.0		17.0		25.0	15	33.0	
							13		
						12	18		
							15		
2.0		10.0		18.0		26.0	14	34.0	
							10		
							10		
						7	11		
3.0		11.0		19.0		27.0	10	35.0	
							14		
							25		
							44		
4.0		12.0		20.0		28.0	24/100 <sup>mm</sup>	36.0	
5.0		13.0		21.0		29.0		37.0	
6.0	DECK	14.0		22.0		30.0		38.0	
7.0		15.0		23.0		31.0		39.0	
	TOP 15.24m		XXXX		3				
					2				
					5				

### PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	14-C
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND  
MEASURED T.C

-1.1<sup>m</sup> TO D&C  
46.2<sup>m</sup> TOP  
BENT

[illegible]



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 13.4.94  
 HAMMER : K.45  
 HELMET : NOVA  
 HAMMER STROKE : 2.3  
 S + C/2 :  
 START TIME : 1.50  
 FINISH : 2.00

PILE SIZE : 610 mm  
 PILE # :  
 LOCATION : 14-D  
 PITCHED LENGTH : 30 m.  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

R.L. CUTOFF :  
 PENETRATION :  
 TOE R.

R.L. TOE :  
 FINAL SET :

R.L. GROUND :  
 MEASURED T.C :

-1.1 m TO DECK  
 : 17" TOP  
 /

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	10	32.0	
0.25							9		
0.5							6		
0.75							6		
1.0		9.0		17.0	XXXX	25.0	6	33.0	
							7		
							5		
							11		
2.0		10.0		18.0		26.0	9	34.0	
							9		
							6		
							10		
3.0		11.0		19.0	↓	27.0	9	35.0	
							8		
							8		
							11		
4.0		12.0		20.0	↓	28.0	11	36.0	
							18		
							37		
5.0		13.0		21.0	↓	29.0		37.0	
6.0		14.0		22.0	↓	30.0		38.0	
7.0		15.0		23.0	6	31.0		39.0	
					2				
					2				
					5				
	DECK								

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 13.4.94  
HAMMER : K.45  
HELMET : NOVA  
HAMMER STROKE : 2.3.  
S + C/2 :

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 14-E  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

START TIME: 1.35  
FINISH : 1.45

R.L. CUTOFF :  
PENETRATION :  
TOE 30" BAST

R.L. TOE :  
FINAL SET :

R.L. GROUND : 17.2 TOP BEAM  
MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK	16.0		24.0	18	32.0	
0.25							17		
0.5							11		
0.75							8		
1.0		9.0		17.0		25.0	7	33.0	
			Top 12" start				10		
							11		
							10		
2.0		10.0		18.0		26.0	8	34.0	
							7		
							6		
							10		
3.0		11.0		19.0		27.0	8	35.0	
							9		
							9		
							8		
4.0		12.0		20.0		28.0	15	36.0	
							27		
							18/100" m		
5.0		13.0		21.0	1	29.0		37.0	
					1				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
					1				
7.0		15.0		23.0	2	31.0		39.0	
					2				
					1				
					5				

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 13.4.94  
HAMMER : K.45  
HELMET : NOVA  
HAMMER STROKE : 2-3.  
S + C/2 :  
START TIME : 2.10  
FINISH : 2.20

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 14-F  
PITCHED LENGTH : 30 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L. CUTOFF :  
PENETRATION :  
TOE 20" LTTST

R.L.TOE :  
FINAL SET :

R.L.GROUND : 17.7 TOP  
MEASURED T.C : BEAR

[illegible]

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 19-4-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2-3+  
S + C/2 :  
START TIME : 9.00  
FINISH : 9.10

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	15-A
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L. CUTOFF :  
PENETRATION :  
TOE 20<sup>mm</sup> WEST.

R.L.TOE :  
FINAL SET :

R.L.GROUND : 14.7" TOP  
MEASURED T.C : REAR

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	13	32.0	
0.25							14		
0.5							15		
0.75							13		
1.0		9.0		17.0		25.0	11	33.0	
							9		
							10		
							14		
2.0		10.0		18.0		26.0	10	34.0	
							9		
							2		
							3		
3.0		11.0		19.0		27.0	9	35.0	
					Hammers		9		
					1		12		
					1		20		
4.0		12.0		20.0	1	28.0	23	36.0	
					1		23/100 mm		
					1				
5.0		13.0		21.0	2	29.0		37.0	
	DECK								
6.0		14.0		22.0	5	30.0		38.0	
	TOP LIDEN	XXXXX							
7.0		15.0		23.0	2	31.0		39.0	
					3				
					2				
					2				



### PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	15-B
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND : 15<sup>m</sup> TOP  
MEASURED T.C : Bottom

[illegible]

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE	:	19-4-94
HAMMER	:	K-45
HELMET	:	NOWA
HAMMER STROKE	:	2-3
S + C/2	:	
START TIME	:	8.40
FINISH	:	8.50

PILE SIZE	:	610 mm
PILE #	:	
LOCATION	:	15-C
PITCHED LENGTH	:	30 m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1.1<sup>m</sup> TO DECK.

R.L. CUTOFF :  
PENETRATION :  
TOE 20" EAST.

R.L.TOE :  
FINAL SET :

R.L.GROUND : 16.5<sup>m</sup> TOP  
MEASURED T.C : BEAN

[illegible]

## PILE DRIVING RECORD

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 20-4-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2.3  
S + C/2 :

START TIME : 1.50

FINISH : 2.00

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 15-E.  
PITCHED LENGTH : 30m.  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

-1.1<sup>m</sup> To DGE

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND :

17.5<sup>m</sup> TOP REAR

PENETRATION :

FINAL SET :

MEASURED T.C :

TOP E

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	14	32.0	
0.25			DECK				14		
0.5							10		
0.75							10		
1.0		9.0		17.0		25.0	8	33.0	
							10		
			TOP REAR		XXXX		10		
							8		
2.0		10.0		18.0		26.0	8	34.0	
							7		
							7		
							8		
3.0		11.0		19.0		27.0	8	35.0	
							9		
							10		
							10		
4.0		12.0		20.0		28.0	13	36.0	
							21		
							30/2.05 <sup>m</sup>		
5.0		13.0		21.0		29.0		37.0	
					3				
					2				
6.0		14.0		22.0		30.0		38.0	
					1				
					1				
					1				
7.0		15.0		23.0		31.0		39.0	
					2				
					2				
					2				
					7				



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 20-4-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2.34.  
S + C/2 :  
START TIME : 2.05  
FINISH : 2.15

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 15-15  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L. CUTOFF :  
PENETRATION :  
TOE. ~~40 mm~~ ~~W20T~~

R.L. TOE :  
FINAL SET :

R.L. GROUND : 18<sup>m</sup> ~~TOP~~ ~~Bottom~~  
MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25							10		
0.5							12		
0.75			DECK				14		
1.0		9.0		17.0		25.0	15	33.0	
							13		
							12		
							11		
2.0		10.0	TOP BERM	18.0	XXXX	26.0	10	34.0	
							10		
							3		
							12		
3.0		11.0		19.0	↓	27.0	10	35.0	
					↓		9		
					↓		11		
					↓		13		
4.0		12.0		20.0	↓	28.0	14	36.0	
					↓		27		
					↓		32/175 <sup>mm</sup>		
5.0		13.0		21.0	2	29.0		37.0	
					2				
					↓				
6.0		14.0		22.0	↓	30.0		38.0	
					↓				
					↓				
7.0		15.0		23.0	3	31.0		39.0	
					2				
					4				
					3				

## PILE DRIVING RECORD

DATE : 27-4-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2-3 +  
S + C/2 :  
START TIME : 9-30  
FINISH : 9-45

PILE SIZE : 610 mm  
PILE # :  
LOCATION : 16 - A  
PITCHED LENGTH : 30 ~~m~~ 75 m  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :  
- 1.1 m To Del

R.L. CUTOFF :	R.L.TOE :	R.L.GROUND :	14-5 <sup>m</sup> TOE BLM
PENETRATION :	FINAL SET :	MEASURED T.C :	
TOE 30 <sup>mm</sup> EAST.			

[illegible]

## PILE DRIVING RECORD

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 16-13  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L.GROUND : 15<sup>m</sup> TOP  
MEASURED T.C : Bottom

[illegible]

## PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	16-C
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1.1<sup>m</sup> To D<sub>25</sub>

R.L.GROUND : 16<sup>m</sup> TOP  
MEASURED T.C : BEAR.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	TOP BEAM	16.0	X X X X	24.0	5	32.0	
0.25							4		
0.5							7		
0.75							9		
1.0		9.0		17.0		25.0	12	33.0	
							10		
							7		
							8		
2.0		10.0		18.0	Pile	26.0	8	34.0	
							8		
							5		
							5		
3.0		11.0		19.0		27.0	8	35.0	
							9		
							10		
							12		
4.0		12.0		20.0	Hollow	28.0	14	36.0	
							22		
							35		
5.0		13.0		21.0	↓	29.0	20/125 <sup>m</sup>	37.0	
					2				
					2				
					2				
6.0		14.0		22.0	↓	30.0		38.0	
					4				
					3				
					2				
DECK.									
7.0		15.0		23.0	2	31.0		39.0	
					3				
					2				
					3				



## PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	16-D
PITCHED LENGTH	:	3φ-5m.
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1-1<sup>m</sup> TO DEC

R.L.GROUND : 16-7<sup>m</sup> TOP  
MEASURED T.C : REM.

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 28.4.94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3  
 S + C/2 :  
 START Time : 11.50  
 FINISH : 12.30

PILE SIZE : 610 mm  
 PILE # :  
 LOCATION : 16-E  
 PITCHED LENGTH : 30 m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

-1.1 m TO DECK  
17.5 m TO TOP BENT

R.L. CUTOFF :  
 PENETRATION :  
 TOE 20 mm WEST

R.L. TOE :  
 FINAL SET :

R.L. GROUND :  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	7	32.0	
0.25			DECK				10		
0.5							8		
0.75							8		
1.0		9.0		17.0		25.0	8	33.0	
							10		
			TOP BENT		XXXX		15		
							32		
2.0		10.0		18.0		26.0	34	34.0	
							20		
							23		
							29		
3.0		11.0		19.0		27.0	23	35.0	
							22		
							18		
							21		
4.0		12.0		20.0		28.0	25	36.0	
							30		
							12/25 mm		
5.0		13.0		21.0	1	29.0		37.0	
					1				
					2				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
					1				
7.0		15.0		23.0	2	31.0		39.0	
					2				
					2				
					2				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 28-4-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3+  
 S + C/2 :  
 START TIME : 1.35  
 FINISH : 1.45

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 16-1F  
 PITCHED LENGTH : 30.9m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :  
 -1.1m TO DE

R.L. CUTOFF :  
 PENETRATION :  
 TOE  $\phi$

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 17.7<sup>m</sup> TOP  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	5	32.0	
0.25							5		
0.5			DECK				7		
0.75							6		
1.0		9.0		17.0		25.0	5	33.0	
							7		
							9		
			TOP BERM XXX				11		
2.0		10.0		18.0		26.0	9	34.0	
							8		
							7		
							6		
3.0		11.0		19.0		27.0	6	35.0	
							6		
							7		
							9		
4.0		12.0		20.0		28.0	11	36.0	
							14		
							18		
							30		
5.0		13.0		21.0	2	29.0	18/40 <sup>11</sup>	37.0	
					2				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					2				
					1				
					2				
7.0		15.0		23.0	2	31.0		39.0	
					1				
					2				
					3				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 3.5.94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2.3.  
S + C/2 :

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : 17-A  
PITCHED LENGTH : 30<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

START TIME : 10.10

FINISH : 10.20

R.L. CUTOFF :

R.L. TOE :

R.L. GROUND :

PENETRATION :

FINAL SET :

MEASURED T.C :

TOE: 30<sup>mm</sup> ~~WST~~

-1.1<sup>m</sup> To DEE

: 14-7<sup>m</sup> TOP

Beam

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	5	32.0	
0.25							11		
0.5							11		
0.75							11		
1.0		9.0		17.0		25.0	11	33.0	
							15		
						12	23		
							24		
2.0		10.0		18.0		26.0	20	34.0	
							18		
							14		
						12	14		
3.0		11.0		19.0		27.0	17	35.0	
							17		
							20		
							20		
4.0		12.0		20.0		28.0	28/175 <sup>mm</sup>	36.0	
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					2				
					2				
					2				
7.0		15.0		23.0	3	31.0		39.0	
					4				
					3				
					4				

DECK

TOP / DECK

XXXXX



# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 3-5-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3  
 S + C/2 :  
 START TIME : 9-45  
 FINISH : 10-00

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 17-B  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :  
 -1.1<sup>m</sup> TO DEC

R.L. CUTOFF :  
 PENETRATION :  
 TOE : 10<sup>mm</sup> WEST  
 R.L. TOE :  
 FINAL SET :  
 R.L. GROUND : 15<sup>m</sup> TOP BOTTOM  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	27	32.0	
0.25							20		
0.5							22		
0.75							24		
1.0		9.0		17.0		25.0	36	33.0	
							35		
						2	20		
							19		
2.0		10.0		18.0		26.0	14	34.0	
							9		
						2	12		
							12		
3.0		11.0		19.0		27.0	5	35.0	
							19		
							17		
							22		
4.0		12.0		20.0		28.0	30	36.0	
							32/150 <sup>mm</sup>		
					1				
5.0		13.0		21.0	1	29.0		37.0	
					2				
					2				
					1				
6.0	DECK	14.0		22.0	2	30.0		38.0	
					1				
					2				
					2				
7.0	TOP OF PILE	15.0	XXXXXX	23.0	3	31.0		39.0	
					4				
					3				
					2.5				

## MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 3-5-94  
HAMMER : K-45  
HELMET : NOVA  
HAMMER STROKE : 2-2 +.  
S + C/2 :  
START Time : 10-25  
FINISH : 11-50

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	17-C
PITCHED LENGTH	:	30 <sup>m</sup>
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

-1.1<sup>m</sup> TO DGC

R.L. CUTOFF :  
PENETRATION :  
TOL 4

R.L.TOE :  
FINAL SET :

R.L.GROUND : 16<sup>m</sup> TOP  
MEASURED T.C : 12.5m

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 4.5.94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 2-3.  
 S + C/2 :  
 START TIME : 2.05  
 FINISH : 2.20

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 17-D  
 PITCHED LENGTH : 30m.  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :  
 -1.1" TO DEC

R.L. CUTOFF :  
 PENETRATION :  
 TOE : 20mm WEST  
 R.L. TOE :  
 FINAL SET :  
 R.L. GROUND : 16.5m FSP  
 MEASURED T.C : 25m

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	3	32.0	
0.25							5		
0.5			TOP 1st		XXXX		7		
0.75							7		
1.0		9.0		17.0		25.0	7	33.0	
							7		
							15		
							20		
2.0		10.0		18.0		26.0	17	34.0	
							11		
							10		
							8		
3.0		11.0		19.0		27.0	9	35.0	
							11		
							13		
							22		
4.0		12.0		20.0		28.0	25	36.0	
							10/200mm		
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
					1				
7.0		15.0		23.0	3	31.0		39.0	
					2				
					2				
					5				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 4-5-94  
 HAMMER : K-H5  
 HELMET : NOVA  
 HAMMER STROKE : 2.2+  
 S + C/2 :  
 START TIME : 1.35  
 FINISH : 1.50

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : 17-E  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

-1.1m TO DE

R.L. CUTOFF :  
 PENETRATION :  
 TOP 30<sup>mm</sup> EAST

R.L. TOE :  
 FINAL SET :

R.L. GROUND : 17.2<sup>m</sup> TOP  
 MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	DECK	16.0		24.0	6	32.0	
0.25							8		
0.5							11		
0.75							12		
1.0		9.0		17.0		25.0	16	33.0	
			TOP 15 <sup>mm</sup>				19		
							33		
							25		
2.0		10.0		18.0		26.0	19	34.0	
							18		
							15		
							16		
3.0		11.0		19.0		27.0	16	35.0	
							15		
							16		
							21		
4.0		12.0		20.0		28.0	30	36.0	
							23/125 <sup>mm</sup>		
5.0		13.0		21.0	1	29.0		37.0	
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					1				
7.0		15.0		23.0	2	31.0		39.0	
					2				
					2				
					2				



## PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	17-F
PITCHED LENGTH	:	30m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

FINAL LENGTH :  $-1.1^m$  To DE

R.L.GROUND 17.7<sup>m</sup> TOP  
MEASURED T.C : 13.5m

R.L. CUTOFF :  
PENETRATION :  
TOE 20mm WEST.

R.L.TOE :  
FINAL SET :

R.L.GROUND  
MEASURED T.C

[illegible]

# MARINE & CIVIL CONSTRUCTION

ASSUME F.D.L.  
(FINISHED DECK LEVEL)

## PILE DRIVING RECORD

+ 6.8 C.D.

DATE : 15-1-94  
HAMMER : KOBÉ 45  
HELMET : NOVA STEEN TO STEEL  
HAMMER STROKE : 2.5  
S + C/2 : 15.6 mm

PILE SIZE : 610.0  
PILE # : API  
LOCATION : APPROACH BR.  
PITCHED LENGTH : 30  
ADD. LENGTH : NIL  
OFFCUT LENGTH :  
FINAL LENGTH : 25.350

$R_u \approx > 4000 \text{ kN}$

R.L. CUTOFF : 5.27 CD  
PENETRATION : 12.34

R.L. TOE : -20.07  
FINAL SET : 5.6 mm

R.L. GROUND : -7.73  
MEASURED T.C : 20 mm

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	16	24.0	12	32.0	
0.25					25		11		
0.5					13		9		
0.75					8		9		
1.0		9.0		17.0	5	25.0	10	33.0	
					5		9		
					3		9		
					3		9		
2.0		10.0		18.0	3	26.0	10	34.0	
							12		
					8		16		
3.0		11.0		19.0		27.0	20	35.0	
					✓	STOP	40		
				STOP	11		45		
					15				
4.0		12.0		20.0	35	28.0		36.0	
					34				
					91				
					65				
5.0		<del>13.0</del>		21.0	45	29.0		37.0	
		2			29				
		↓			23				
		↑		STOP	29				
6.0		14.0		22.0	25	30.0		38.0	
		5			21				
		9			19				
		↓			24				
7.0		15.0		23.0	20	31.0		39.0	
		4			21				
		3			20				
		14			21				



E2: PILE DRIVING LOG

PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF

PRINCIPAL: DAMPIER PORT AUTHORITY

SUPERINTENDENT: FRASER CONSULTANTS

CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP #1</u>	DATE OF DRIVING	<u>15-1-94</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	
STEEL GRADE		LOCATION	<u>Approach BR.</u>

## PILE HAMMER:

Hammer Type	<u>KOBE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVASTEN</u>

## DRIVING RECORDS:

ASSUME BRIDGE DECK RL = 0

Time Pitched		Driving Start	<u>7:00</u>
Total Blows		Driving Finish	<u>8:00</u>
Rate of Driving	<u>/250mm</u>	Toe RL	<u>-27.25</u>
Bed RL	<u>-13.00 m.</u>	Cutoff RL	<u>25.350</u>
Offcut Length			
Ground Level inside Pile			
		Pile Dead Weight	m
		Pile and Hammer	m
		Driven	m
		Total	m
		Final Set	mm

## CHECKED:

Contractor

Superintendent

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 15.1.94  
 HAMMER : KOBÉ 45  
 HELMET : NOVA STEEL TO STEEL  
 HAMMER STROKE : 2.5  
 S + C/2 : 16.2

PILE SIZE : 610 x  
 PILE # : AP 2  
 LOCATION :  
 PITCHED LENGTH : 30m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH : 19.75

$R_u = > 4000 \text{ kN}$

Top of PILE FOLDED

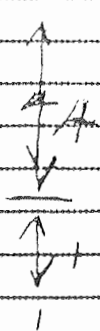
R.L. CUTOFF : 5.27 CD  
 PENETRATION : 7.28

R.L. TOE : -14.48  
 FINAL SET : 4.2

R.L. GROUND : -7.2  
 MEASURED T.C : 22 + 2  
 TAKEN AT 21.50

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0	4	24.0		32.0	
0.25					5				
0.5					6				
0.75					6				
1.0		<del>8.0</del>		17.0	5	25.0		33.0	
					4				
					3				
					2				
2.0		10.0		18.0	2	26.0		34.0	
					2				
					1				
3.0		11.0		19.0	8	27.0		35.0	
4.0		12.0		20.0	4	28.0		36.0	
					4				
					7				
5.0		13.0		21.0	10	29.0		37.0	
					7				
				STOP	2360				
6.0		<del>14.0</del>		22.0		30.0		38.0	
7.0		15.0		23.0		31.0		39.0	

DECK LEVEL







PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP # 2</u>	DATE OF DRIVING	<u>15.1.94</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	<u>12.7 <math>\phi</math> 9.5</u>
STEEL GRADE	<u>250 <math>\phi</math> 350</u>	LOCATION	<u>Approach BR.</u>

## PILE HAMMER:

Hammer Type	<u>KOBE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOY &amp; STEEN</u>

## DRIVING RECORDS:

ASSUME BRIDGE DECK R.L. = 0

Time Pitched	<u>                    </u>	Driving Start	<u>                    </u>
Total Blows	<u>                    </u>	Driving Finish	<u>                    </u>
Rate of Driving	<u>/250mm</u>	Toe RL	<u>- 21.50</u>
Bed RL	<u>- 14.00 m.</u>	Cutoff RL	<u>19.25</u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		

NOTE: PILE HEAD START  
 TO BE DAMAGED ON  
 21.5 m. LENGTH.

Pile Dead Weight	<u>                    </u>	m
Pile and Hammer	<u>                    </u>	m
Driven	<u>                    </u>	m
Total	<u>                    </u>	m
Final Set	<u>                    </u>	mm

## CHECKED:

Contractor *[Signature]*  
 Superintendent

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

10

PILE SIZE : 610  $\phi$   
PILE # : AP-3.  
LOCATION : APPROX. RR.  
PITCHED LENGTH : 30 meters.  
ADD. LENGTH : 7.50  
OFFCUT LENGTH :  
FINAL LENGTH : 20.00

R.L.GROUND : -6.95  
MEASURED T.C : 22+2

[illegible]

## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP # 3</u>	DATE OF DRIVING	<u>16.1.94</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	<u>12.7 <math>\phi</math> 9.5</u>
STEEL GRADE	<u>GRADE 250</u> $\phi$ <u>350</u>	LOCATION	<u>Approach BR.</u>

## PILE HAMMER:

Hammer Type	<u>KOBE <math>\phi</math> 5</u>	Hammer Weight	<u>4.5 TONS</u>
Hammer Drop	<u>2.5 m</u>	Packing	<u>NOVA STEEN</u>

## DRIVING RECORDS: ASSUME BRIDGE DECK RL = 0

Time Pitched	<u>                    </u>	Driving Start	<u>                    </u>
Total Blows	<u>                    </u>	Driving Finish	<u>                    </u>
Rate of Driving	<u>1/250mm</u>	Toe RL	<u>- 21.60</u>
Bed RL	<u>- 13.75</u>	Cutoff RL	<u>20.00</u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		

NOTE: ① HEAD OF PILE

START TO BE DAMAGED 21.5m.

AFTER 49 BLOWS.

② SEE SKETCH @ BACK

Pile Dead Weight	<u>                    </u>	m
Pile and Hammer	<u>                    </u>	m
Driven	<u>                    </u>	m
Total	<u>                    </u>	m
Final Set	<u>                    </u>	mm

## CHECKED:

Contractor

Superintendent

A handwritten signature in dark ink, likely belonging to the contractor, written over the 'Contractor' line.

## PILE DRIVING RECORD

PILE SIZE : 610 Ø  
PILE # : AP#4  
LOCATION : ~~4000~~ BR  
PITCHED LENGTH : 30  
ADD. LENGTH : NIL  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L.GROUND : -7.2  
MEASURED T.C : 22+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	36	32.0	
0.25							36		
0.5						10.6	49		
0.75						STOP	16		
1.0		9.0		17.0		25.0		33.0	
2.0		10.0		18.0		26.0 -		34.0	
3.0		11.0		19.0		27.0		35.0	
4.0		12.0		20.0		28.0		36.0	
5.0		13.0		21.0		29.0		37.0	
6.0	D / LEVER	14.0	XXXX	22.0		30.0		38.0	
7.0		15.0		23.0		31.0		39.0	
				STOP					



## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP# 4</u>	DATE OF DRIVING	<u>16.1.94</u>
PILE DIAMETER	<u>610 Ø</u>	PILE THICKNESS	<u>12.7 &amp; 9.5</u>
STEEL GRADE	<u>GRADE 250 &amp;</u> <u>GRADE 350</u>	LOCATION	<u>Approach BR.</u>

## PILE HAMMER:

Hammer Type	<u>KOBE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVA STEEL</u>

DRIVING RECORDS: ASSUME BRIDGE DECK R.L. = 0

Time Pitched	_____	Driving Start	_____
Total Blows	_____	Driving Finish	_____
Rate of Driving	<u>/250mm</u>	Toe RL	<u>-24.6 m.</u>
Bed RL	<u>-14 m.</u>	Cutoff RL	_____
Offcut Length	_____		
Ground Level inside Pile	_____		

NOTE: HEAD OF PILE  
 START TO BE DAMAGED  
 AFTER 36 BLOWS @  
23.75 m. INSTRUCT  
 TO PROCEED UNTIL  
 300 mm of HEAD COMPACT

Pile Dead Weight	_____ m
Pile and Hammer	_____ m
Driven	_____ m
Total	_____ m
Final Set	_____ mm

## CHECKED:

Contractor [Signature]  
 Superintendent \_\_\_\_\_

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 20.1.93.

HAMMER : K45

HELMET : NOVSTEEL

HAMMER STROKE : 2.5

S + C/2 : 14.4 mm ∴  $R_u \geq 4250 \text{ kN}$

START TIME 11.50 am.

FINISH TIME 12.00.

PILE SIZE :

PILE # :

LOCATION : AP-5

PITCHED LENGTH : 30 m.

ADD. LENGTH :

OFFCUT LENGTH :

FINAL LENGTH : 23.57

R.L. CUTOFF : 5.27 CD.

PENETRATION : 10.6 m

R.L. TOE : -18.3

FINAL SET : 2.4 mm

R.L. GROUND : -7.7

MEASURED T.C : 22+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	11	32.0	
0.25					✓		13		
0.5							13		
0.75							10		
1.0		9.0		17.0		25.0	11	33.0	
					10.6 STOP		29/70 mm		
2.0		10.0		18.0	2	26.0		34.0	
3.0		11.0		19.0		27.0		35.0	
					✓				
					3				
4.0		12.0		20.0	1	28.0		36.0	
					9				
5.0		13.0		21.0	✓	29.0		37.0	
					3				
					8				
6.0		14.0		22.0	32	30.0		38.0	
					11				
DECK LEVEL <del>XXXXXXXXXXXX</del>					12				
					20				
7.0		15.0	✓	23.0	13	31.0		39.0	
					13				
					11				
					11				

## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

<b>PILE DETAILS:</b>			
PILE REFERENCE	<u>AP # 5</u>	DATE OF DRIVING	<u>20-1-94</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	<u>12.7 <math>\pm</math> 9.5</u>
STEEL GRADE	<u>GRADE 250/350</u>	LOCATION	<u>Approach BR.</u>
<b>PILE HAMMER:</b>			
Hammer Type	<u>KOBE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVASTEEN</u>
<b>DRIVING RECORDS:</b> <u>Assume BRIDGE DECK LEVEL = 0</u>			
Time Pitched	<u>                    </u>	Driving Start	<u>                    </u>
Total Blows	<u>                    </u>	Driving Finish	<u>                    </u>
Rate of Driving	<u>/250mm</u>	Toe RL	<u>-35.70 m.</u>
Bed RL	<u>-14.50</u>	Cutoff RL	<u>                    </u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		
stop @ 29 Blows/70mm penetration pile Head damage		Pile Dead Weight	<u>                    </u> m
		Pile and Hammer	<u>                    </u> m
		Driven	<u>                    </u> m
		Total	<u>                    </u> m
		Final Set	<u>                    </u> mm
		<b>CHECKED:</b>	
		Contractor	<u><i>[Signature]</i></u>
		Superintendent	<u>                    </u>

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 20.1.94.  
 HAMMER : K45  
 HELMET : NOVSTEEN  
 HAMMER STROKE : 25  
 S + C/2 : 18.6 ∴ R<sub>u</sub> ⇒ 3500 KN  
 START Time : 3.20 PM  
 FINISH Time : 3.35 PM

PILE SIZE :  
 PILE # :  
 LOCATION : AP-6.  
 PITCHED LENGTH : 30.2 m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH : 25.17

R.L. CUTOFF : 5.27 CD  
 PENETRATION : 10.20

R.L. TOE : -19.90  
 FINAL SET : 6.6

R.L. GROUND : -9.70  
 MEASURED T.C : 22+2.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	9	32.0	
0.25							11		
0.5							8		
0.75							8		
1.0		9.0		17.0		25.0	6	33.0	
					1		6		
					2		5		
					1	STOP	30/200	PILE DESTROYING	
2.0		10.0		18.0	1	26.0		34.0	
					1				
3.0		11.0		19.0		27.0		35.0	
					↓				
					2				
4.0		12.0		20.0	3	28.0		36.0	
					2				
					↑				
					2				
5.0		13.0		21.0	↓	29.0		37.0	
					↓				
					6				
					↓				
6.0		14.0		22.0	68	30.0		38.0	
					26				
					11				
					10				
7.0		15.0		23.0	9	31.0		39.0	
					10				
					11				



## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP #6</u>	DATE OF DRIVING	<u>20.1.74</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	<u>10.7 <math>\frac{1}{2}</math> 9.5</u>
STEEL GRADE	<u>GRADE 250 &amp; 350</u>	LOCATION	<u>Approach Br.</u>

## PILE HAMMER:

Hammer Type	<u>KOBEL 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVSTEEN</u>

## DRIVING RECORDS: ASSUME BRIDGE DECK LEVEL = 0

Time Pitched	_____	Driving Start	_____
Total Blows	_____	Driving Finish	_____
Rate of Driving	<u>/250mm</u>	Toe RL	<u>25.200</u>
Bed RL	<u>-16.5 m.</u>	Cutoff RL	_____
Offcut Length	_____		
Ground Level inside Pile	_____		

stop @ 30 Blows / 200 penetration  
 pile head damaged.

Pile Dead Weight	_____	m
Pile and Hammer	_____	m
Driven	_____	m
Total	_____	m
Final Set	_____	mm

CHECKED:

Contractor

Superintendent

A handwritten signature in dark ink, likely belonging to the contractor, written over the 'Contractor' line.

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 20-1-94  
 HAMMER : K45  
 HELMET : NOVESTEEN  
 HAMMER STROKE : 25  
 S + C/2 : 15.4  $\therefore$   $R_u \Rightarrow 4000KN$

START TIME - 5.55 PM  
 FINISH TIME - 6.05 PM

PILE SIZE : 7  
 PILE # : 8  
 LOCATION : AP-7  
 PITCHED LENGTH : 30.2 m.  
 ADD. LENGTH : —  
 OFFCUT LENGTH :  
 FINAL LENGTH : 24.42

R.L. CUTOFF : 5.27 CD  
 PENETRATION : 8.70

R.L. TOE : -19.15  
 FINAL SET : 3.4

R.L. GROUND : -10.45  
 MEASURED T.C : 22+2.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	10	32.0	
0.25							8		
0.5							6		
0.75							6		
1.0		9.0		17.0		25.0	5	33.0	
			DECK LEVEL			8	4		
							5		
							15		
2.0		10.0		18.0		26.0	59/200	34.0	
					✓	8.7			
3.0		11.0		19.0	1	27.0		35.0	
					✓				
					2				
4.0		12.0		20.0	2	28.0		36.0	
					✓				
					3				
5.0		13.0		21.0	✓	29.0		37.0	
					MIN PEN				
					2				
					2				
6.0		14.0		22.0	6	30.0		38.0	
					11				
					9				
					10				
7.0		15.0		23.0	10	31.0		39.0	
					13				
					14				
					13				

## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>AP #7</u>	DATE OF DRIVING	<u>20.1.94</u>
PILE DIAMETER	<u>610 <math>\phi</math></u>	PILE THICKNESS	<u>12.7 <math>\pm</math> 9.5</u>
STEEL GRADE	<u>GRADE 250/350</u>	LOCATION	<u>Approach Dr.</u> <u>BENT No. 5</u>

## PILE HAMMER:

Hammer Type	<u>KOBE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVASTEEN</u>

## DRIVING RECORDS: ASSUME BRIDGE DECK LEVEL = 0

Time Pitched	<u>                    </u>	Driving Start	<u>5:55 P.M.</u>
Total Blows	<u>                    </u>	Driving Finish	<u>6:25 P.M.</u>
Rate of Driving	<u>                    /250mm</u>	Toe RL	<u>- 25.95</u>
Bed RL	<u>- 17.25</u>	Cutoff RL	<u>                    </u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		

STOP @ 59 Blows/200 mm.

PILE HEAD DAMAGE BY 300 mm.

Pile Dead Weight	<u>                    </u>	m
Pile and Hammer	<u>                    </u>	m
Driven	<u>                    </u>	m
Total	<u>                    </u>	m
Final Set	<u>                    </u>	mm

CHECKED:

Contractor

Superintendent

A handwritten signature in dark ink, likely belonging to the contractor, written over the 'CHECKED:' label.

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 21.1.94  
 HAMMER : K4S  
 HELMET : NOVESTON  
 HAMMER STROKE : 2.5  
 S + C/2 : 18.8  $\therefore R_u \Rightarrow 4000 \text{ kN}$   
 START TIME : 5.20 PM  
 FINISH : 5.30

PILE SIZE :  
 PILE # : 7  
 LOCATION : AP-8  
 PITCHED LENGTH : 30 m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH : 27.07

R.L. CUTOFF : 5.27 cd      R.L. TOE : -21.80      R.L. GROUND : -10.70  
 PENETRATION : 11.10      FINAL SET : 3.8      MEASURED T.C : 22+2.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	6	32.0	
0.25							5		
0.5							5		
0.75							4		
1.0		9.0		17.0		25.0	5	33.0	
							2		
			DECK LEVEL		XXXXXX		3		
							3		
2.0		10.0		18.0		26.0	7	34.0	
							7		
							9		
							12		
3.0		11.0		19.0		27.0	11	35.0	
						STOP	4/15		
							63		
						STOP	24/100		
4.0		12.0		20.0		28.0		36.0	
					4				
5.0		13.0		21.0	V	29.0		37.0	
					1				
					3				
6.0		14.0		22.0		30.0		38.0	
					17				
					9				
					4				
7.0		15.0		23.0	4	31.0		39.0	
					5				
					7				
					7				



## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF  
 PRINCIPAL: DAMPIER PORT AUTHORITY  
 SUPERINTENDENT: FRASER CONSULTANTS  
 CONTRACTOR:

<b>PILE DETAILS:</b>			
PILE REFERENCE	<u>AP# 8</u>	DATE OF DRIVING	<u>21.1.94</u>
PILE DIAMETER	<u>457 <math>\phi</math></u>	PILE THICKNESS	<u>12.7</u>
STEEL GRADE	<u>350</u>	LOCATION	<u>Appurtenant Br.</u>
		<u>BENT No. 8</u>	
<b>PILE HAMMER:</b>			
Hammer Type	<u>KOTSE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVASTEEN</u>
<b>DRIVING RECORDS:</b> <u>Assume Bridge Deck Level = 0</u>			
Time Pitched	<u>                    </u>	Driving Start	<u>                    </u>
Total Blows	<u>                    </u>	Driving Finish	<u>                    </u>
Rate of Driving	<u>                    /250mm</u>	Toe RL	<u>27.600</u>
Bed RL	<u>-17.5</u>	Cutoff RL	<u>                    </u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		
		Pile Dead Weight	<u>                    </u> m
		Pile and Hammer	<u>                    </u> m
		Driven	<u>                    </u> m
		Total	<u>                    </u> m
		Final Set	<u>                    </u> mm
<p>NOTE          stop @ 26 Blows/100 penetration          Head of Pipe start to be          damaged.</p>			
		CHECKED:	<u>David S</u>
		Contractor	<u>                    </u>
		Superintendent	<u>                    </u>

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 22-1-94  
 HAMMER : K4S  
 HELMET : NOVSTEEN  
 HAMMER STROKE : 2.2  
 S + C/2 : 16.3  $\Delta$  Rv  $\Rightarrow$  3500 kJ  
 START TIME : 7.50 am.  
 FINISH : 8.10 am.

PILE SIZE :  
 PILE # : 8  
 LOCATION : AP-9  
 PITCHED LENGTH : 30m  
 ADD. LENGTH : —  
 OFFCUT LENGTH :  
 FINAL LENGTH : 26.37 m

R.L. CUTOFF : 5.27cd      R.L. TOE : -21.10      R.L. GROUND : -10.70  
 PENETRATION : 10.40      FINAL SET : 4.3      MEASURED T.C : 22+2

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	7	32.0	
0.25							5		
0.5							5		
0.75							4		
1.0		9.0		17.0		25.0	3	33.0	
							3		
							3		
						STOP	3 6		
2.0		10.0		18.0	↓	26.0	7	34.0	
					↓		9		
					↓		7		
					↓		8		
3.0		11.0		19.0	↓	27.0	7	35.0	
					↓		9		
					↓		35		
					↓		46		
4.0		12.0		20.0	2	28.0	47/200	36.0	
					2	STOP			
					↓				
5.0		13.0		21.0	3	29.0		37.0	
					↓				
					↓				
6.0		14.0		22.0	6	30.0		38.0	
					↓				
					15				
					10				
					7				
7.0		15.0		23.0	3	31.0		39.0	
					5				
					9				
					9				

## EXTENSIONS TO THE DAMPIER PUBLIC WHARF

E2: PILE DRIVING LOG



PROJECT: EXTENSIONS TO THE DAMPIER PUBLIC WHARF

PRINCIPAL: DAMPIER PORT AUTHORITY

SUPERINTENDENT: FRASER CONSULTANTS

CONTRACTOR:

## PILE DETAILS:

PILE REFERENCE	<u>Ap # 9</u>	DATE OF DRIVING	<u>22.1-94</u>
PILE DIAMETER	<u>457 <math>\phi</math></u>	PILE THICKNESS	<u>12.7</u>
STEEL GRADE	<u>350</u>	LOCATION	<u>Approx Br -</u> <u>BENT No. 8</u>

## PILE HAMMER:

Hammer Type	<u>KORSE 45</u>	Hammer Weight	<u>4.5 TONS.</u>
Hammer Drop	<u>2.5 m.</u>	Packing	<u>NOVSTEEN</u>

## DRIVING RECORDS: ASSUME BRIDGE DECK LEVEL = 0

Time Pitched	<u>                    </u>	Driving Start	<u>                    </u>
Total Blows	<u>                    </u>	Driving Finish	<u>                    </u>
Rate of Driving	<u>                    /250mm</u>	Toe RL	<u>- 27.950</u>
Bed RL	<u>- 17.5 m.</u>	Cutoff RL	<u>                    </u>
Offcut Length	<u>                    </u>		
Ground Level inside Pile	<u>                    </u>		

NOTE  
STOP @ 47 Blows / no penetration  
pile Head Damage.

Pile Dead Weight	<u>                    </u>	m
Pile and Hammer	<u>                    </u>	m
Driven	<u>                    </u>	m
Total	<u>                    </u>	m
Final Set	<u>                    </u>	mm

CHECKED:

Contractor

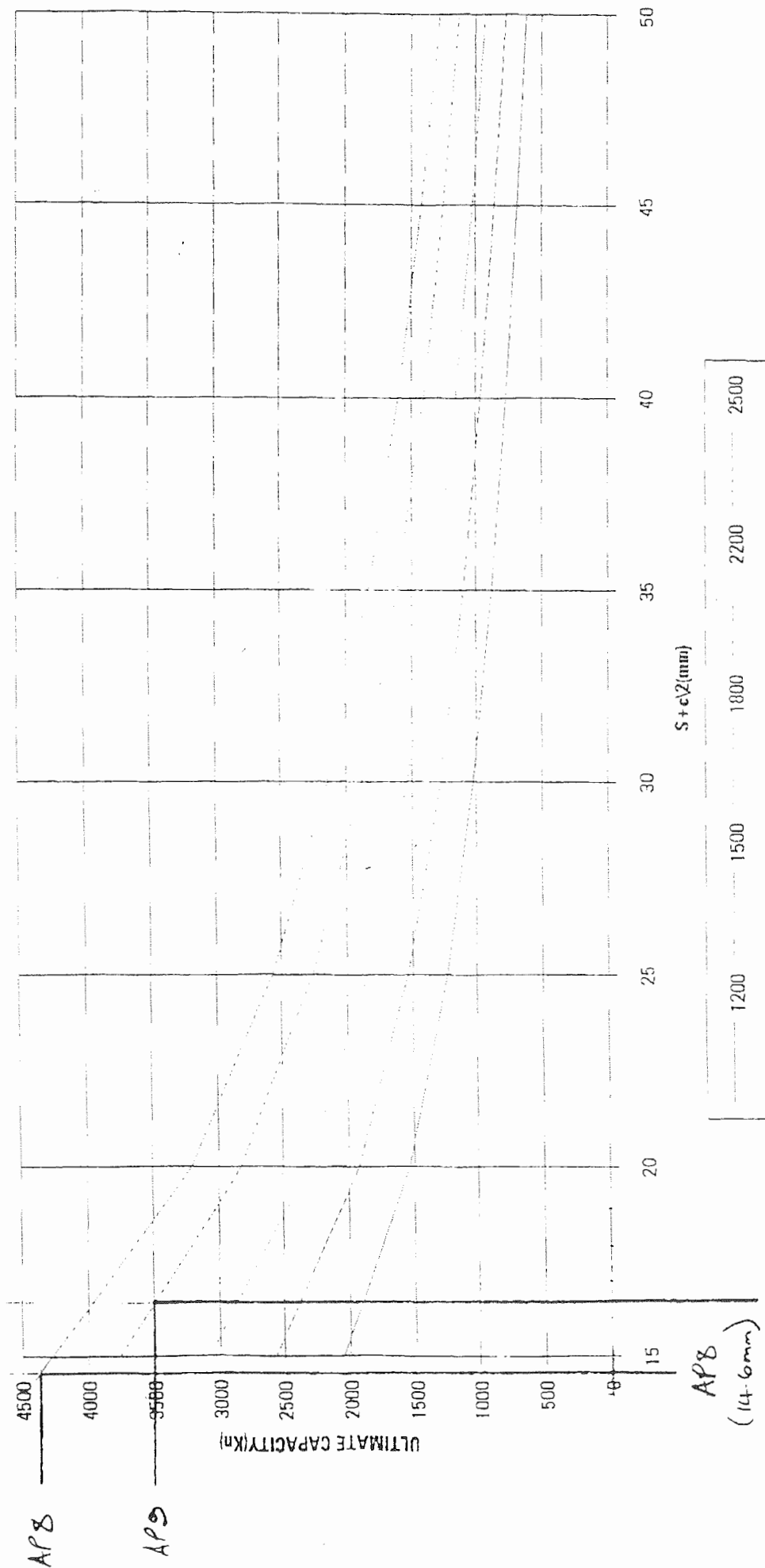
Superintendent

A handwritten signature in dark ink, appearing to be 'D. J. ...', written over the 'Superintendent' line.

ATTN: Les Brown.

031 85 1428

# EXTENTION TO DAMPIER PUBLIC WHARF (K45 Hammer)



AP8  
(14.6mm)  
AP9  
(16.3mm)



## PILE DRIVING RECORD

PILE SIZE	:	610 <sup>mm</sup>
PILE #	:	
LOCATION	:	S15 - 1ST#
PITCHED LENGTH	:	27-5m
ADD. LENGTH	:	
OFFCUT LENGTH	:	
FINAL LENGTH	:	

R.L.GROUND  
MEASURED T.C

-15<sup>m</sup> to 20<sup>m</sup>  
:17<sup>m</sup> TOP  
RSH.

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0		16.0		24.0	4	32.0	
0.25							1		
0.5							1		
0.75							1		
1.0		9.0		17.0	XXXX	25.0	5	33.0	
					1		1		
2.0		10.0		18.0	124 V	26.0	1	34.0	
					1		1		
3.0		11.0		19.0	1	27.0		35.0	
					2				
					1				
4.0		12.0		20.0	1	28.0		36.0	
					V				
5.0		13.0		21.0	2	29.0		37.0	
					1				
					1				
6.0		14.0		22.0	1	30.0		38.0	
					1				
					3				
					2				
7.0		15.0		23.0	4	31.0		39.0	
					5				
					12				
					+				

## PILE DRIVING RECORD

PILE SIZE : 610<sup>mm</sup>  
PILE # :  
LOCATION : SB-2-  
PITCHED LENGTH : 27-5<sup>m</sup>  
ADD. LENGTH :  
OFFCUT LENGTH :  
FINAL LENGTH :

R.L.GROUND : 16<sup>m</sup> 15<sup>m</sup>  
MEASURED T.C : (24 ÷ 2)

[illegible]

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 6-5-94  
 HAMMER : K-45  
 HELMET : NOVA  
 HAMMER STROKE : 1.8m  
 S + C/2 :

PILE SIZE : 610<sup>mm</sup>  
 PILE # :  
 LOCATION : S.B.-B.  
 PITCHED LENGTH : 28m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH : -1.5m to B.

R.L. CUTOFF : R.L. TOE : R.L. GROUND : 18m TOE  
 PENETRATION : FINAL SET : MEASURED T.C :

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	TOP PILE	16.0	X	24.0	5	32.0	
0.25					1		6		
0.5							9		
0.75							12		
1.0		9.0	<del>10.0</del>	17.0	<del>XXXX</del>	25.0	13	33.0	
					1		15		
					2		16		
2.0		10.0		18.0	2	26.0	17	34.0	
					3				
					2				
3.0		11.0		19.0	2	27.0		35.0	
4.0		12.0		20.0	3	28.0		36.0	
					1				
5.0		13.0		21.0	3	29.0		37.0	
					2				
					2				
6.0		14.0		22.0	1	30.0		38.0	
					2				
	DRILL				3				
					4				
7.0		15.0		23.0	4	31.0		39.0	
					5				
					6				
					7				

# MARINE & CIVIL CONSTRUCTION

## PILE DRIVING RECORD

DATE : 6-5-94  
 HAMMER : 1K-45  
 HELMET : NOVA  
 HAMMER STROKE : 17m  
 S + C/2 :

PILE SIZE : 610mm  
 PILE # :  
 LOCATION : SB-4  
 PITCHED LENGTH : 29m  
 ADD. LENGTH :  
 OFFCUT LENGTH :  
 FINAL LENGTH :

-1.5" to Dec

R.L. CUTOFF :  
 PENETRATION :

R.L. TOE :  
 FINAL SET :

R.L. GROUND :  
 MEASURED T.C :

: 18" TOP  
 Bottom

M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS	M	BLOWS
0.0		8.0	TOP	16.0	16	24.0	5	32.0	
0.25					17		6		
0.5					18		7		
0.75					19		8		
1.0		9.0		17.0		25.0	9	33.0	
							10		
							11		
2.0		10.0		18.0	2	26.0	12	34.0	
					1		13		
					2		14		
3.0		11.0		19.0	3	27.0	15	35.0	
					4		16		
					2		17		
					1		18		
4.0		12.0		20.0	1	28.0	19	36.0	
					1		20		
					1		21		
5.0		13.0		21.0	2	29.0	22	37.0	
					1		23		
					3		24		
					1		25		
6.0		14.0		22.0	2	30.0	26	38.0	
					2		27		
					2		28		
					3		29		
7.0		15.0		23.0	2	31.0	30	39.0	
					2		31		
					2		32		
					2		33		

DECK



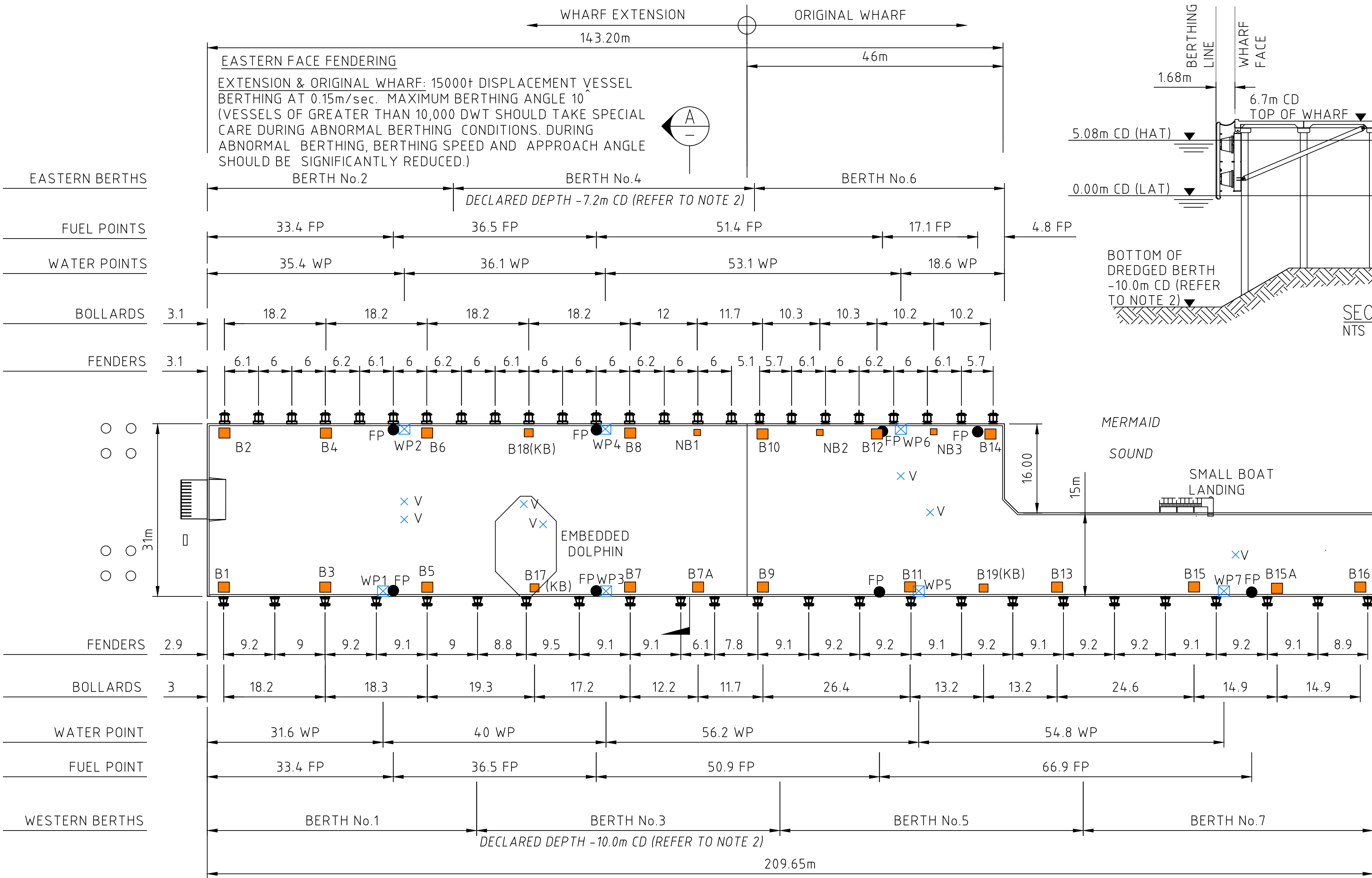
# APPENDIX H

## EXISTING WHARF LOADING PLANS





NOTE:  
1. ALL LEVELS ARE RELATIVE TO 0.0m CHART DATUM (CD)  
2. REFER TO PORT OF DAMPIER MARINE NOTICES FOR LATEST INFORMATION ON THE DECLARED DEPTHS FOR THE BERTHS



LEGEND

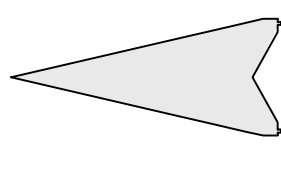
- FP FUEL POINT
- ⊠ WP WATER POINT
- TEE BOLLARD 50 TONNE
- (KB) KIDNEY BOLLARD 30 TONNE
- × V WATER CUT OFF VALVE
- B3 BOLLARD NUMBER (TYP.)
- NB3 NAVY BOLLARD 20 TONNE
- HAT HIGHEST ASTRONOMICAL TIDE
- LAT LOWEST ASTRONOMICAL TIDE
- ≡ FENDER

NOTE: ALWAYS CHECK WITH PPA ENGINEERING FOR THE LATEST REVISION OF THIS DRAWING

PLAN ON DAMPIER CARGO WHARF

NOTE: ALL DIMENSIONS IN METRES  
DO NOT SCALE FROM THIS PLAN  
DIMENSIONS SHOWN SUBJECT TO SURVEY  
ALL LEVELS TO CHART DATUM

**WESTERN FACE FENDERING**  
EXTENSION & ORIGINAL WHARF:  
35000t DISPLACEMENT  
VESSEL BERTHING AT 0.15m/sec.  
MAXIMUM BERTHING ANGLE 10°



NORTH

0 15 30 45 60 75m

METRES

IMPORTANT NOTE:

THIS PLAN IS PREPARED BY THE PILBARA PORTS AUTHORITY FROM A COMBINATION OF FIELD SURVEY & EXISTING RECORDS FOR THE PURPOSE OF THE WHARF PLAN. LAYOUT INFORMATION SHOWN MAY BE INACCURATE AND NOT REFLECT WHAT EXISTS ON SITE. THE PILBARA PORTS AUTHORITY HOLDS NO RESPONSIBILITY FOR ANY INACCURACIES AND OUTDATED INFORMATION PROVIDED.



TELEPHONE : (08) 9159 6555  
EMAIL : info@pilbaraports.com.au  
POSTAL : LOCKED BAG 5006, KARRATHA WA 6714  
WEB : www.pilbaraports.com.au

REV.	DATE	DESCRIPTION	BY	CHK	APP	REV.	DATE	DESCRIPTION	BY	CHK	APP
1	11/07/2022	REVISE DREDGED DEPTHS				LC	TU	TU			
0	20/09/2018	ISSUE FOR USE				LC	TU	TU			

© COPYRIGHT 2022  
PILBARA PORTS AUTHORITY

THIS DOCUMENT AND INFORMATION CONTAINED IN IT IS THE SOLE PROPERTY OF PILBARA PORTS AUTHORITY AND MAY NOT BE USED, EXPLOITED, COPIED, DUPLICATED OR REPRODUCED IN ANY FORM OR MEDIUM WHATEVER WITHOUT THE PRIOR WRITTEN PERMISSION OF PILBARA PORTS AUTHORITY

DO NOT ALTER MANUALLY  
DO NOT SCALE

DRAWN: LC DATE: 20/9/18  
CHECKED: TU DATE: 20/9/18  
APPROVED: TU DATE: 20/9/18

PILBARA PORTS AUTHORITY

A1

PROJECT:  
PILBARA PORTS AUTHORITY  
DAMPIER CARGO WHARF  
GENERAL ARRANGEMENT &  
MAXIMUM BERTHING CAPACITIES

AUTOCAD FILE No. D15-DE-002.DWG SCALE: 1:1000(A3) 1:500(A1) DWG No. D15-DE-002 REV: 1



# **APPENDIX I**

## STRUCTURAL AND GEOTECHNICAL CAPACITIES





Table 42: Structural Pile Capacities Detail

Pile Information													No Uniform Corrosion <sup>4</sup>		2mm Uniform Corrosion <sup>4</sup>	
Structure	Grid/Group	Pile Sea Bed Level <sup>1</sup> [mCD]	Pile Toe Level [mCD]	Top of Pile Level [mCD]	Depth to fixity from seabed level <sup>2</sup> [m]	Length to Fixity [m]	Pile Diameter [mm]	Pile Thickness [mm]	Pile Grade [MPa]	L(Total Length) [m]	Effective Length Fact ke <sup>3</sup>	Le Effective Length [m]	ΦNc Compressive Capacity [kN]	ΦNt Tensile Capacity [kN]	ΦNc Compressive Capacity [kN]	ΦNt Tensile Capacity [kN]
Approach Bridge	Approach 760 Piles	-8.32	-	5.20	5.32	18.84	760	16	250	18.84	1.1	20.724	6,300	8,400	5,500	7,300
Approach Bridge	A2 - A5	-7.70	-16.77	5.20	4.27	17.17	610	16	250	17.17	1.1	18.887	4,500	6,700	3,900	5,800
Approach Bridge	A6 - A8	-10.70	-20.50	5.20	4.27	20.17	610	16	250	20.17	1.1	22.187	3,700	6,700	3,300	5,800
Approach Bridge	A9 457 Piles	-10.70	-20.50	5.20	3.20	19.10	457	9.5	350	19.10	1.1	22.187	1,200	4,200	900	3,300
Approach Bridge	B	-8.32	-18.11	5.20	4.27	17.79	610	16	250	17.79	1.1	19.569	4,300	6,700	3,800	5,800
Approach Bridge	C	-7.20	-17.67	5.20	4.27	16.67	610	16	250	16.67	1.1	18.337	4,600	6,700	4,100	5,800
Original Wharf	D	-10.00	-20.46	6.10	4.27	20.37	610	16	250	20.37	0.7	14.259	5,500	6,700	4,800	5,800
Original Wharf	E	-9.44	-20.30	6.10	4.27	19.81	610	16	250	19.81	0.7	13.867	5,500	6,700	4,900	5,800
Original Wharf	F	-8.88	-20.30	6.10	4.27	19.25	610	16	250	19.25	0.7	13.475	5,600	6,700	4,900	5,800
Original Wharf	G	-8.32	-20.45	6.10	4.27	18.69	610	16	250	18.69	0.7	13.083	5,700	6,700	5,000	5,800
Original Wharf	H	-7.76	-20.13	6.10	4.27	18.13	610	16	250	18.13	0.7	12.691	5,700	6,700	5,000	5,800
Original Wharf	I	-7.20	-20.16	6.10	4.27	17.57	610	16	250	17.57	0.7	12.299	5,800	6,700	5,100	5,800
Extension Wharf	J	-10.00	-20.24	5.20	4.27	19.47	610	9.5	350	19.47	0.7	13.629	4,000	5,600	2,600	4,400
Extension Wharf	K	-9.50	-20.04	5.20	4.27	18.97	610	9.5	350	18.97	0.7	13.279	4,100	5,600	2,700	4,400
Extension Wharf	L	-8.92	-20.16	5.20	4.27	18.39	610	9.5	350	18.39	0.7	12.873	4,200	5,600	2,700	4,400
Extension Wharf	M	-8.33	-20.19	5.20	4.27	17.80	610	9.5	350	17.80	0.7	12.460	4,200	5,600	2,700	4,400
Extension Wharf	N	-7.74	-19.94	5.20	4.27	17.21	610	9.5	350	17.21	0.7	12.047	4,300	5,600	2,800	4,400
Extension Wharf	O	-7.20	-19.89	5.20	4.27	16.67	610	9.5	350	16.67	0.7	11.669	4,300	5,600	2,800	4,400
Mooring Dolphin	Mooring Dolphin A	-9.00	-18.73	6.05	4.27	19.32	610	16	250	19.32	0.7	13.524	5,600	6,700	4,900	5,800
Mooring Dolphin	Mooring Dolphin B	-8.00	-21.29	6.05	4.27	18.32	610	16	250	18.32	0.7	12.824	5,700	6,700	5,000	5,800
Extension Wharf	Ext. Mid Strong Point	-9.10	-20.60	6.05	4.27	19.42	610	16	250	19.42	0.7	13.594	5,600	6,700	4,900	5,800
N. Strong Point	Northern Strong Point	-8.10	-20.10	3.93	6.30	18.33	900	18	250	18.33	0.7	12.831	10,500	11,200	9,300	9,900
Extension Wharf	Small Boat Landing	-7.50	-18.85	7.10	4.27	18.87	610	9.5	350	18.87	2.2	41.514	700	5,600	600	4,400

Notes:

(1) Pile Seabed levels were taken from the most recent bathymetry survey in 2020. No scour has been allowed for.

(2) Depth to fixity from seabed level was derived from geotechnical analysis undertaken and as a 7x pile diameter.

(3) Effective Length factor is taken as per AS4100 as described in Section 4.4.

(4) Values have been rounded down to the nearest 100

(5) Structural capacity factor used Φ=0.9, in accordance with AS4100, Table 3

### Figure 22: Pile Geotechnical Capacities Summary



# **APPENDIX J**

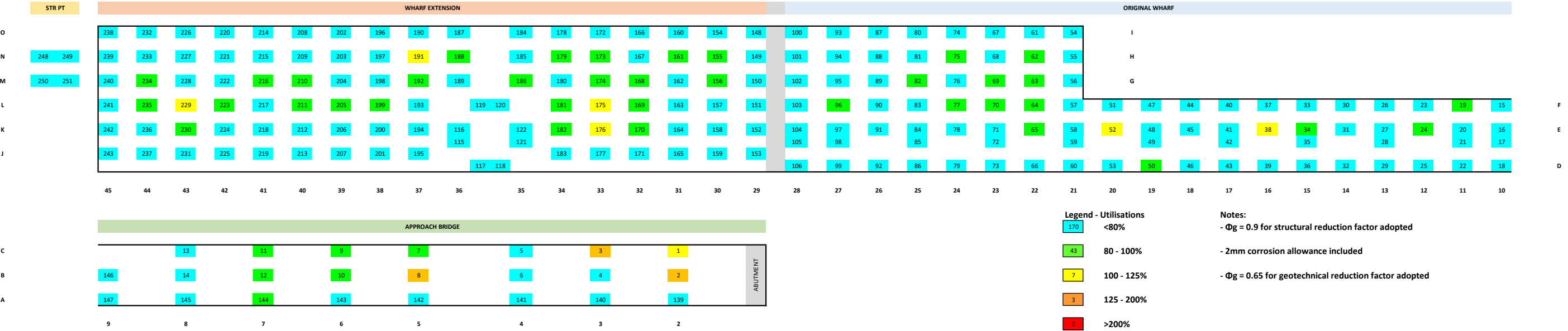
## EXISTING PILE UTILISATIONS



Load Cases: 1.2G+1.5Q

STRUCTURAL & GEOTECH COMBINED

Pile Numbers










## STRUCTURAL & GEOTECH COMBINED

## STR PT

## WHARF EXTENSION

## ORIGINAL WHARF

<b>Legend - Utilisations</b>		<b>Notes:</b>	
	<80%	- $\Phi_g = 0.9$ for structural reduction factor adopted	
	80 - 100%	- 2mm corrosion allowance included	
	100 - 125%	- $\Phi_g = 0.65$ for geotechnical reduction factor adopted	
	125 - 200%		
	>200%		

## STR PT

### WHARF EXTENSION

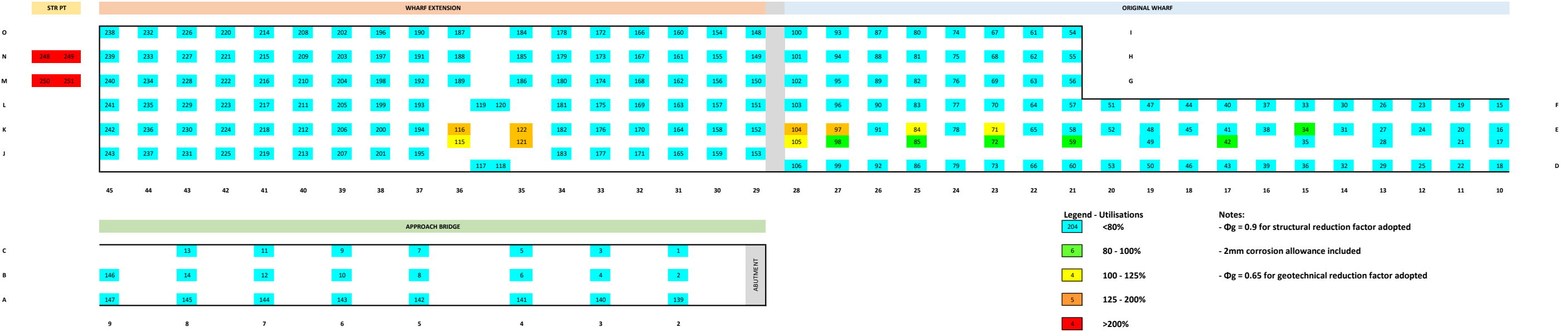
## ORIGINAL WHARF

[illegible]

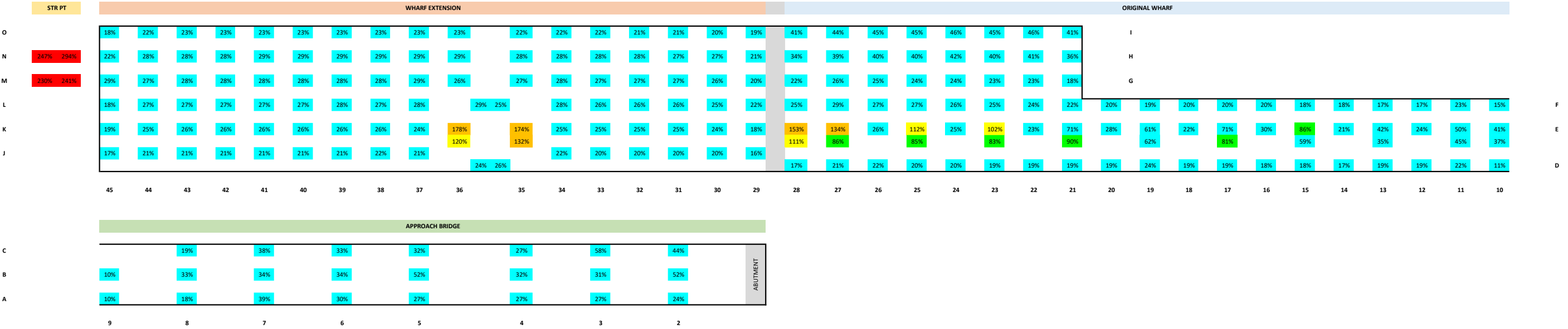
Load Cases: 1.2G+1.5B(parr)

STRUCTURAL & GEOTECH COMBINED

Pile Numbers



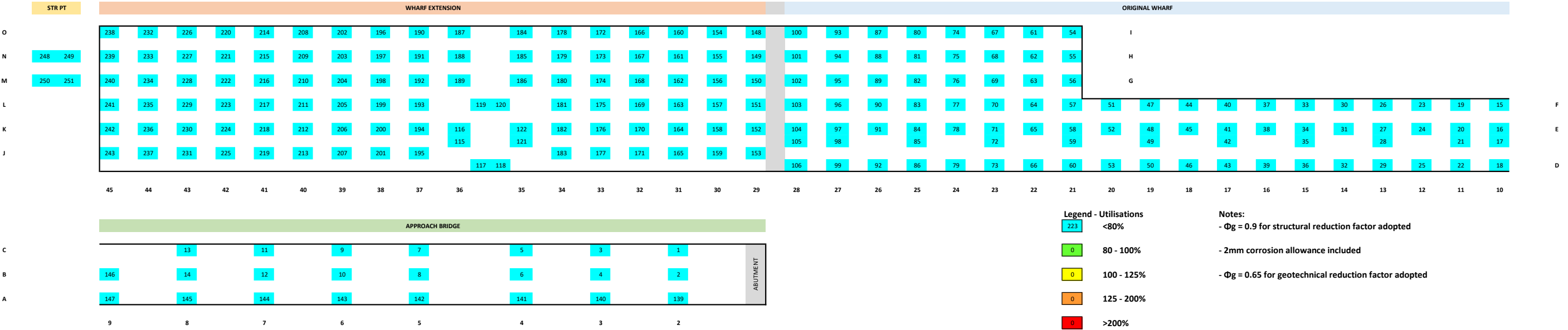
Pile % Utilisations



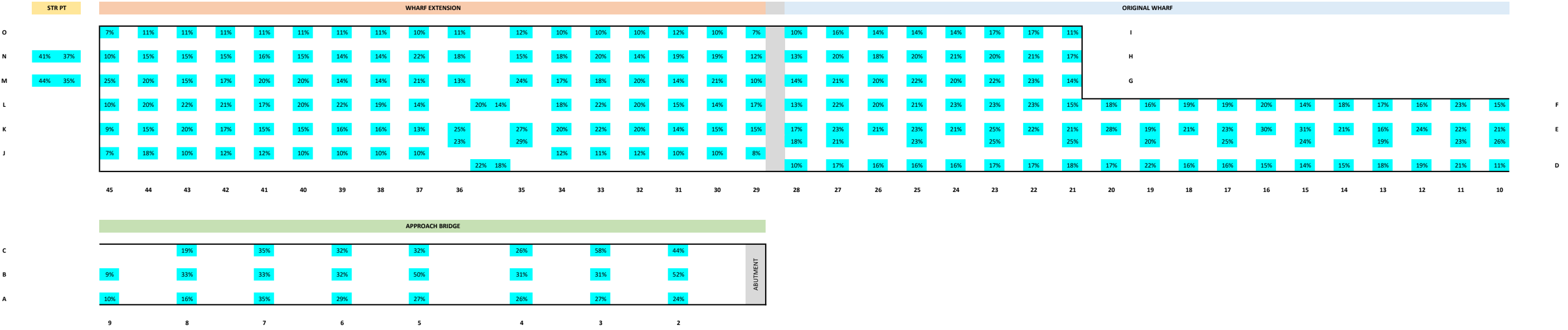
Load Cases: 1.2G+1.5M

STRUCTURAL & GEOTECH COMBINED

Pile Numbers



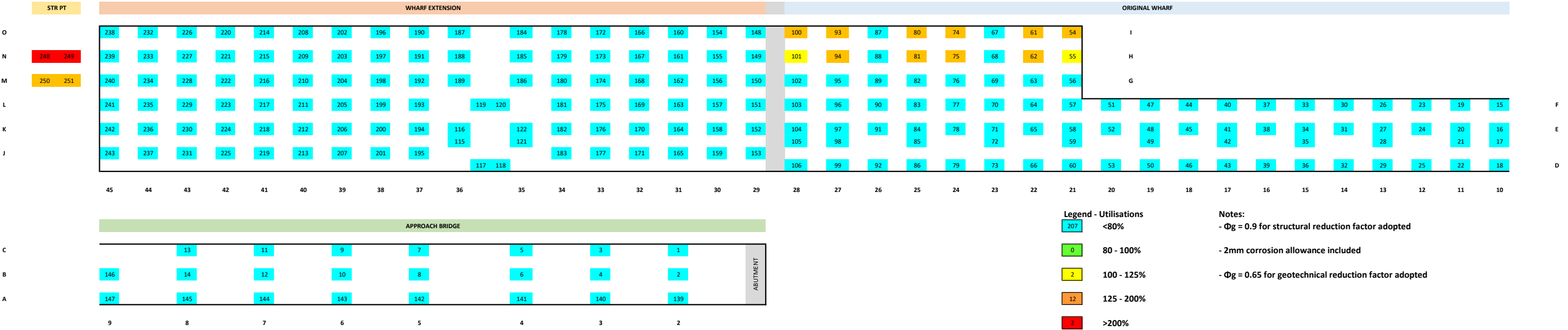
Pile % Utilisations



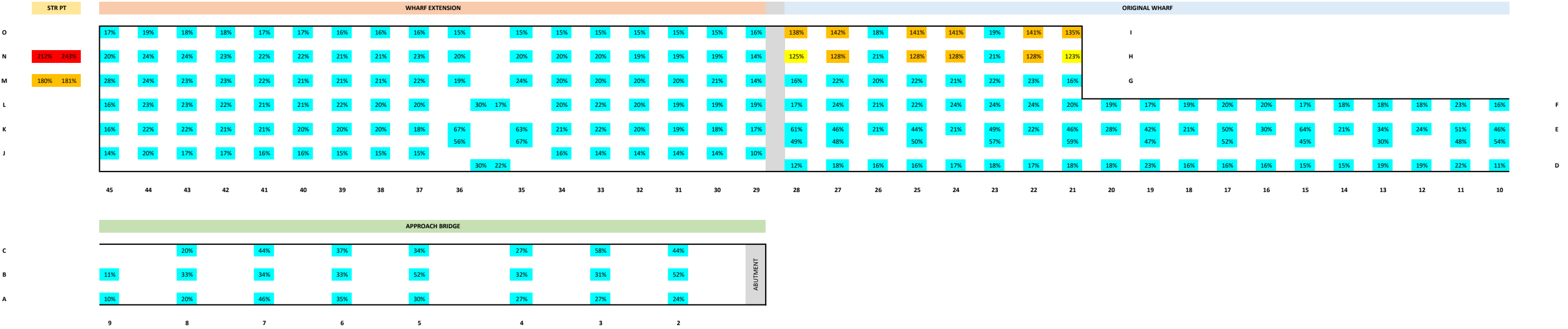
Load Cases: 1.2G+1.5M+1.5B(qtr)

STRUCTURAL & GEOTECH COMBINED

Pile Numbers



Pile % Utilisations





## STR PT

## WHARF EXTENSION

## ORIGINAL WHARF

[illegible]

### APPROACH BRIDGE

C		13	11	9	7	5	3	1	ABUTMENT
B	146	14	12	10	8	6	4	2	
A	147	145	144	143	142	141	140	139	
	9	8	7	6	5	4	3	2	

### Legend - Utilisations

138	<80%
55	80 - 100%
10	100 - 125%
18	125 - 200%
2	>200%

**Notes:**

-  $\Phi_g = 0.9$  for structural reduction factor adopted

- 2mm corrosion allowance included

- $\Phi_g = 0.65$  for geotechnical reduction factor adopted

### Pile % Utilisations

## STR PT

## WHARF EXTENSION

## ORIGINAL WHARF

[illegible]

**APPROACH BRIDGE**

	9	8	7	6	5	4	3	2	ABUTMENT
C		44%	96%	87%	84%	70%	152%	114%	
B	17%	78%	85%	83%	133%	80%	80%	140%	
A	17%	39%	96%	78%	72%	68%	69%	63%	

# **APPENDIX K**

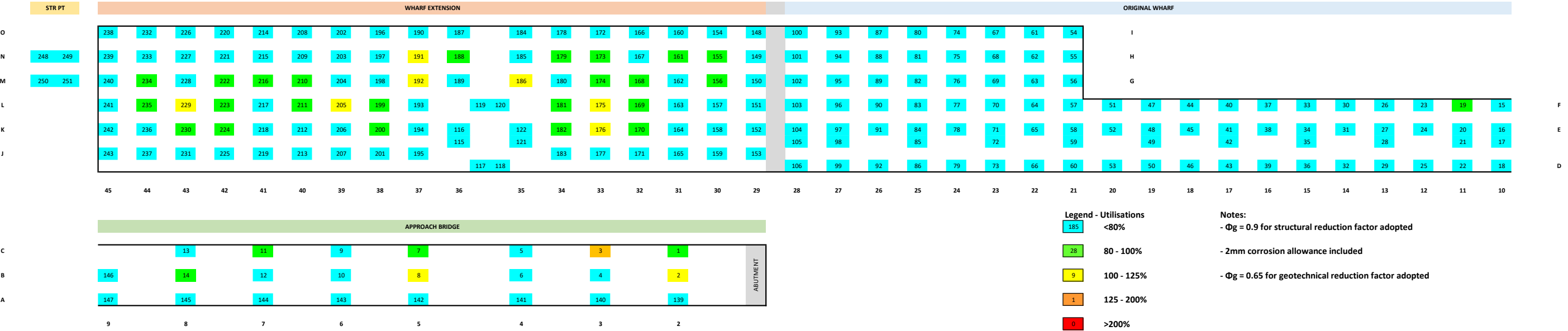
## HARBOUR CRANE UTILISATIONS



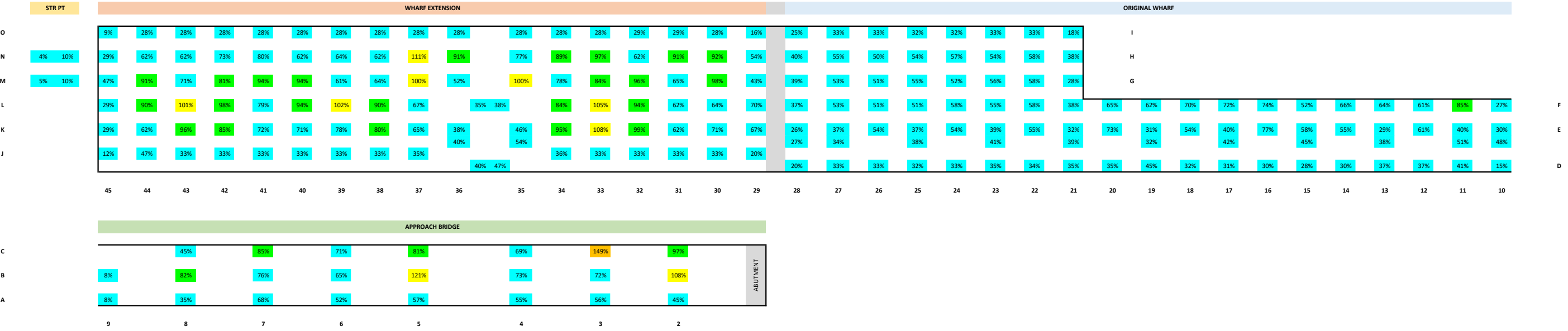
Load Cases: 1.2G+1.5\*1.1\*Q(LTM280\_Travel)

STRUCTURAL & GEOTECH COMBINED

Pile Numbers

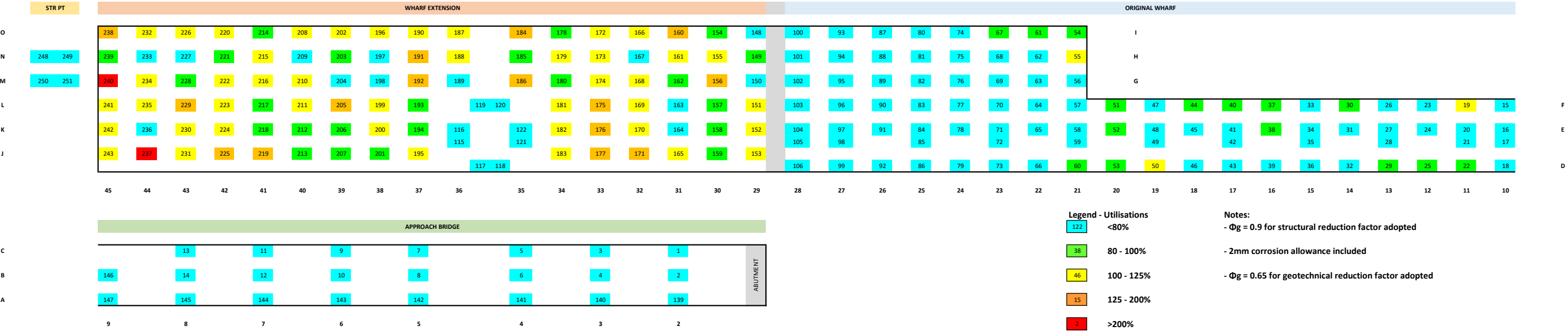


Pile % Utilisations



Load Cases: 1.2G+1.5\*1.1\*Q(LTM280 Crane Outrigger - Pile Top) STRUCTURAL & GEOTECH COMBINED

Pile Numbers



Pile % Utilisations

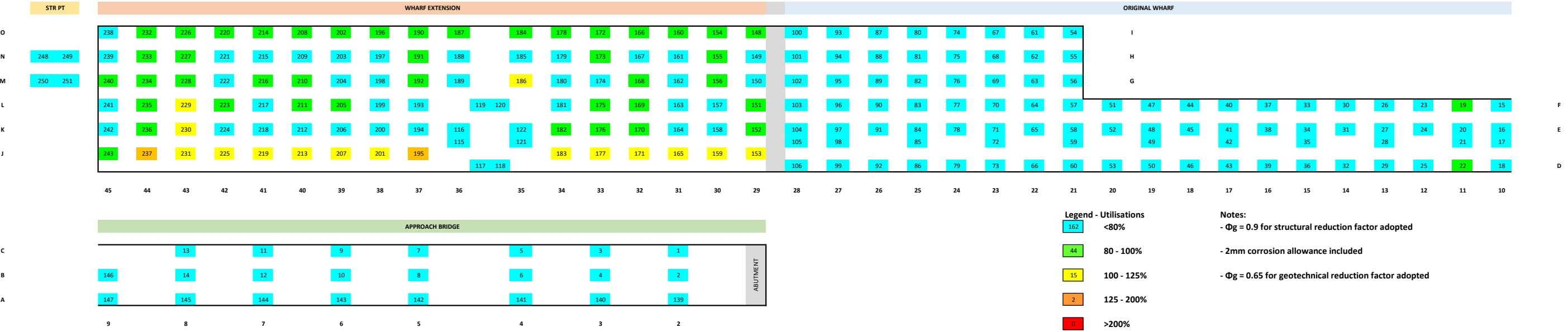




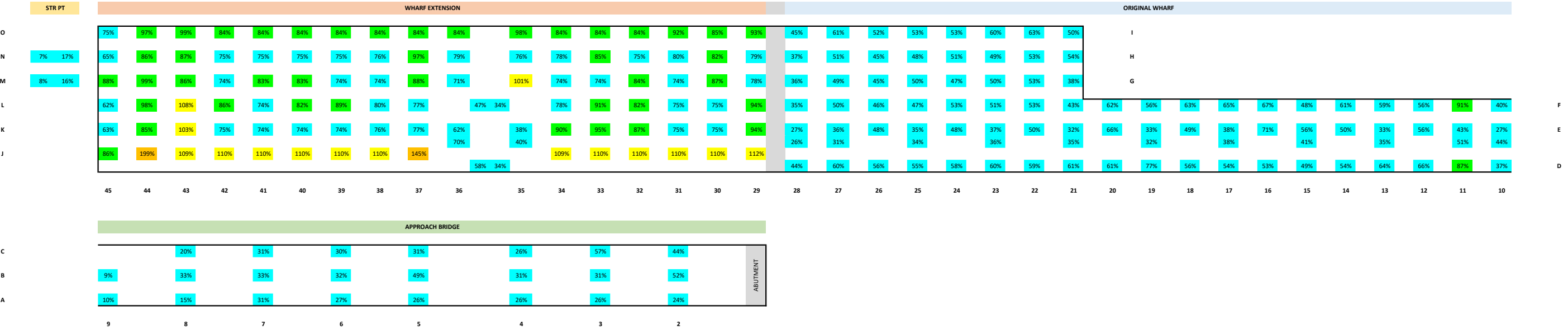
Load Cases: 1.2G+1.5\*1.1\*Q(LTM280\_Outrigger\_Middle of Piles)

STRUCT & GEOTECH COMBINED

Pile Numbers

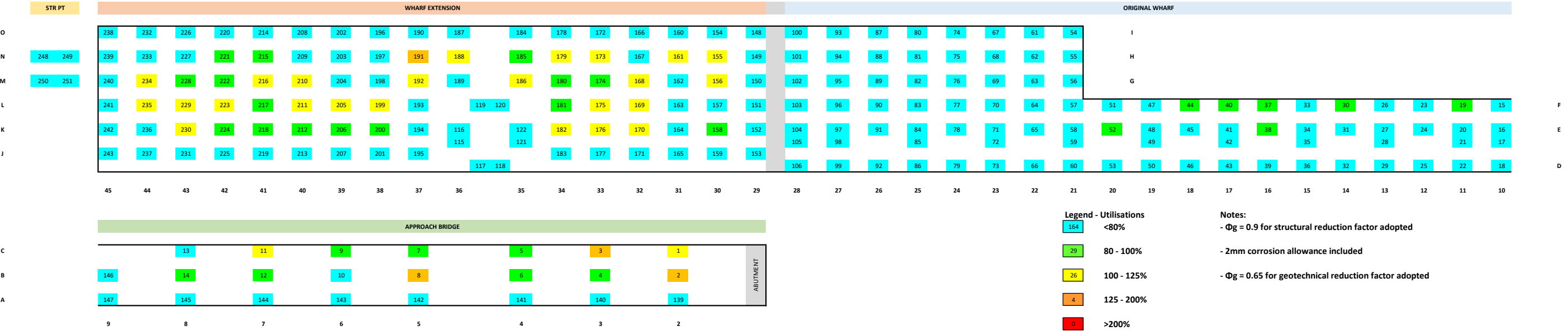


Pile % Utilisations

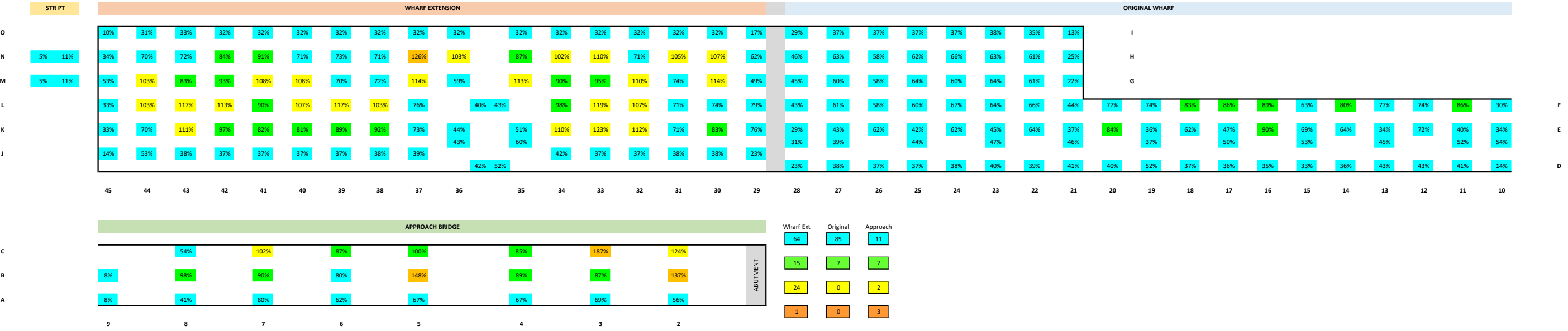


Load Cases: 1.2G+1.5\*1.1\*Q(LTM450 Travelling) STRUCTURAL & GEOTECH COMBINED

Pile Numbers

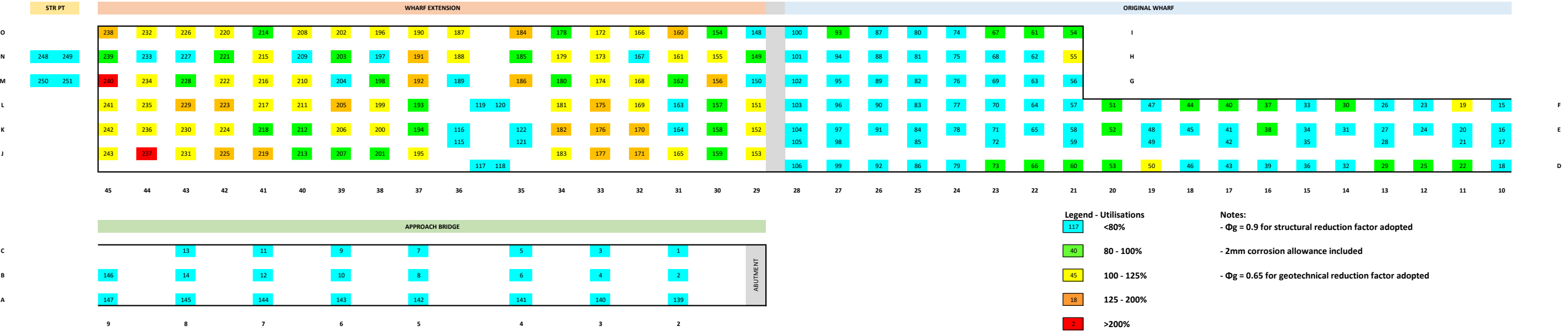


Pile % Utilisations



Load Cases: 1.2G+1.5\*1.1\*Q(LTM420 Crane Outrigger - Pile Top) STRUCTURAL & GEOTECH COMBINED

Pile Numbers

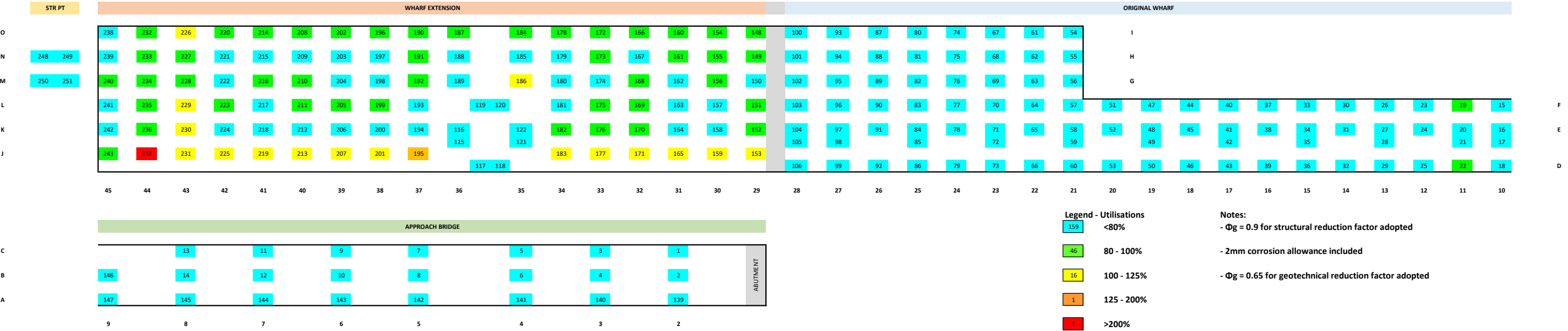


Pile % Utilisations



Load Cases: 1.2G+1.5\*1.1\*Q(LTM420\_Outrigger\_Middle of Piles)      STRUCTURAL & GEOTECH COMBINED

Pile Numbers



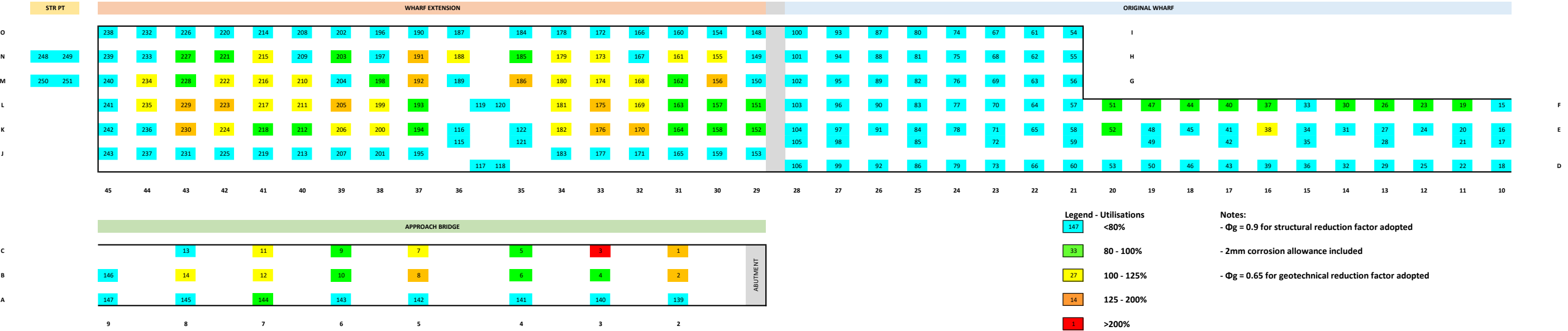
Pile % Utilisations





Load Cases: 1.2G+1.5\*1.1\*Q(LTM550 Travelling) STRUCTURAL & GEOTECH COMBINED

Pile Numbers

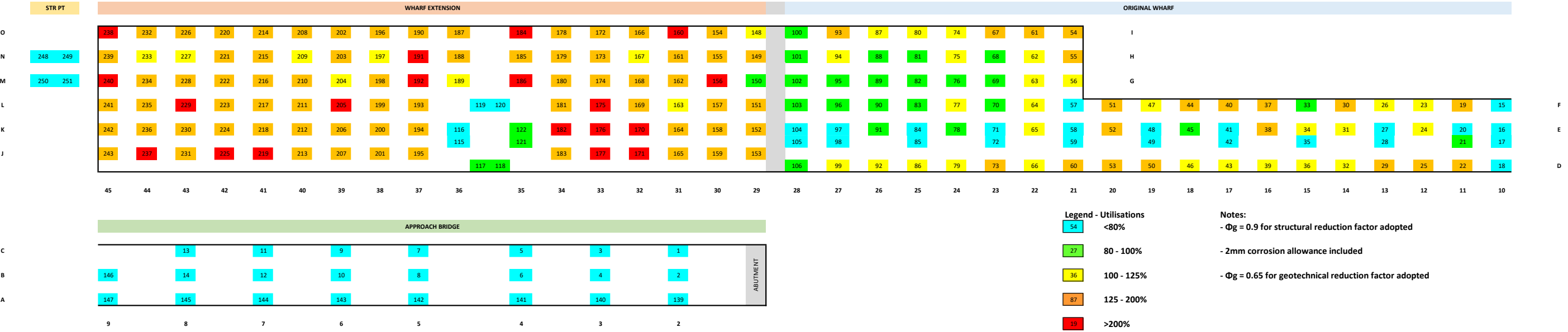


Pile % Utilisations

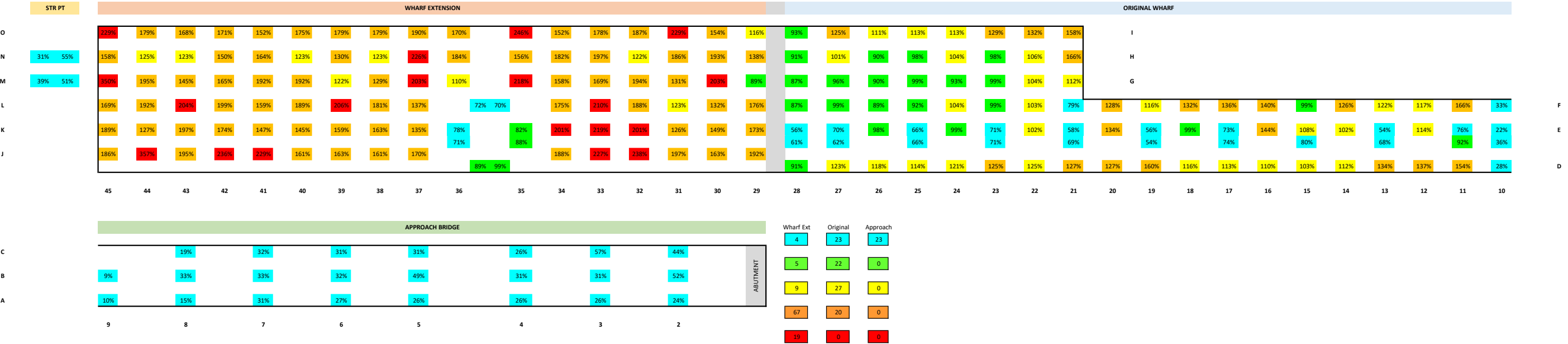


Load Cases: 1.2G+1.5\*1.1\*Q(LTM550 Crane Outrigger) STRUCTURAL & GEOTECH COMBINED

Pile Numbers

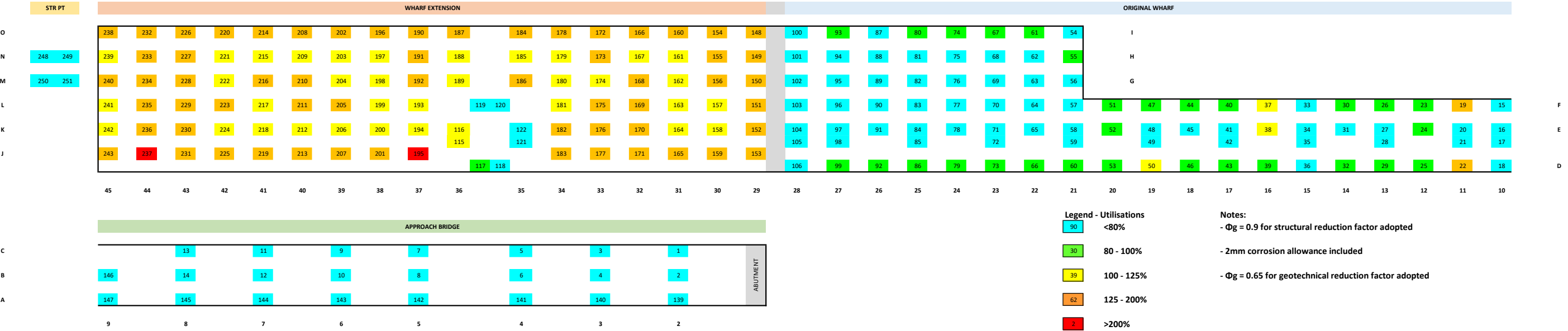


Pile % Utilisations



Load Cases: 1.2G+1.5\*1.1\*Q(LTM550\_Outrigger\_Middle of Piles)      STRUCTURAL & GEOTECH COMBINED

Pile Numbers

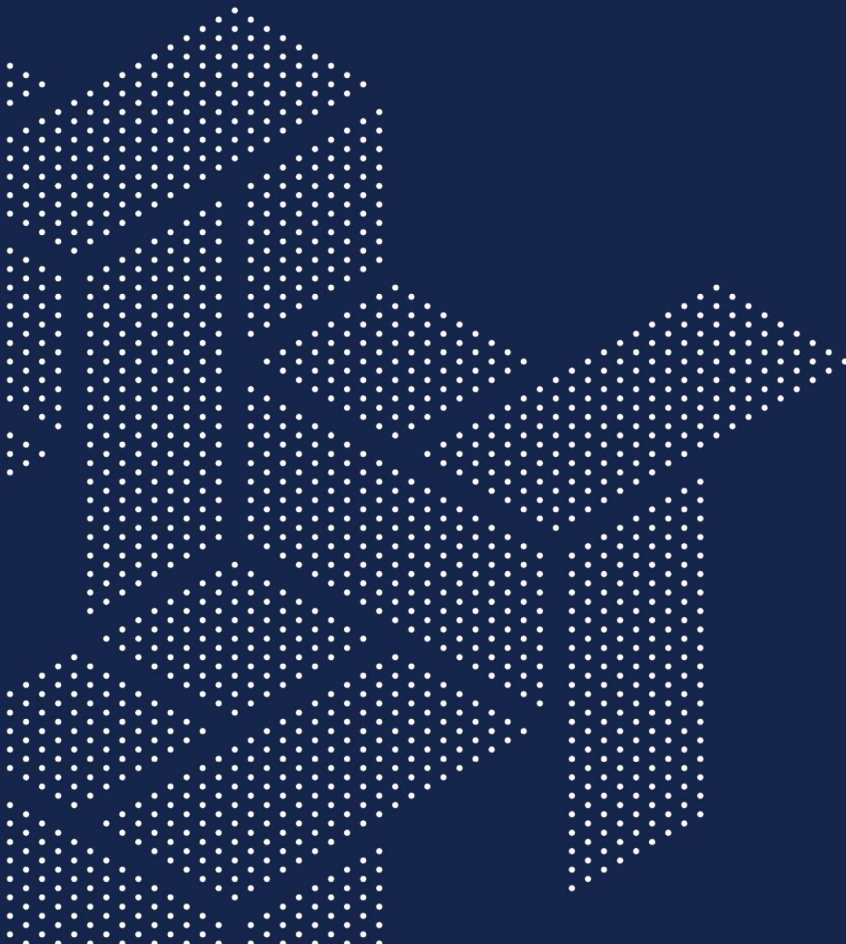


Pile % Utilisations



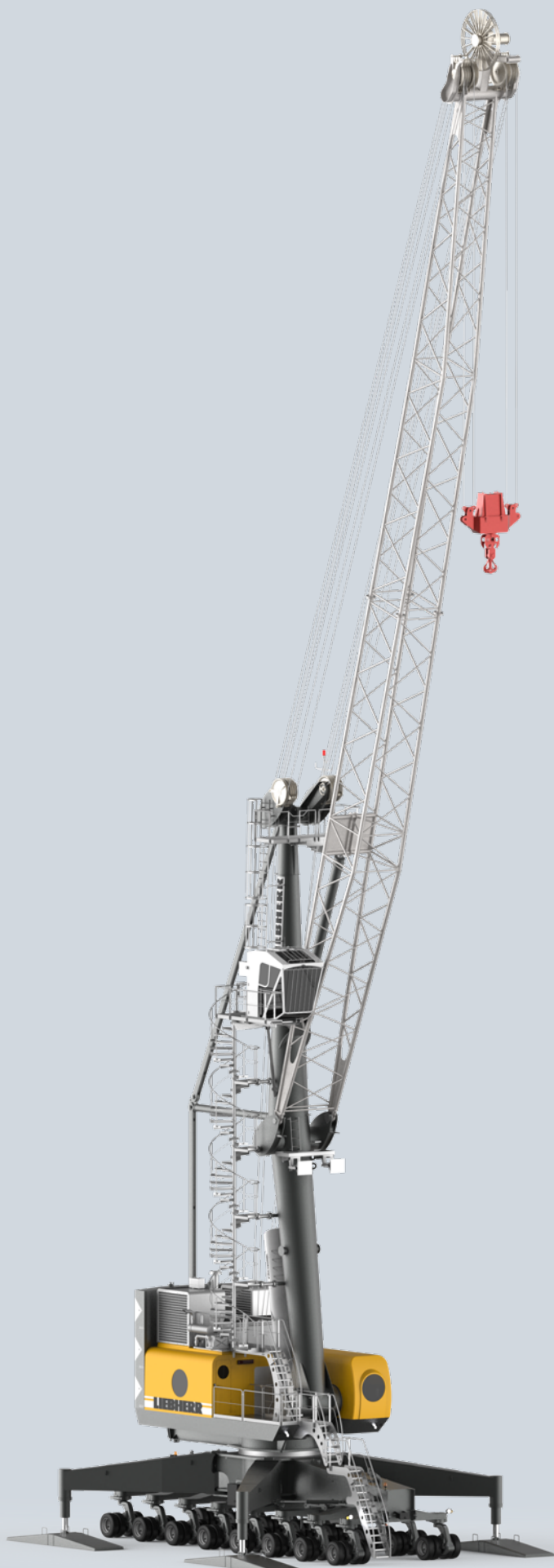
# **APPENDIX L**

## HARBOUR CRANE INFORMATION





EN



---

# LHM 280

---

[www.liebherr.com](http://www.liebherr.com)

## LIEBHERR

**Mobile harbour crane**

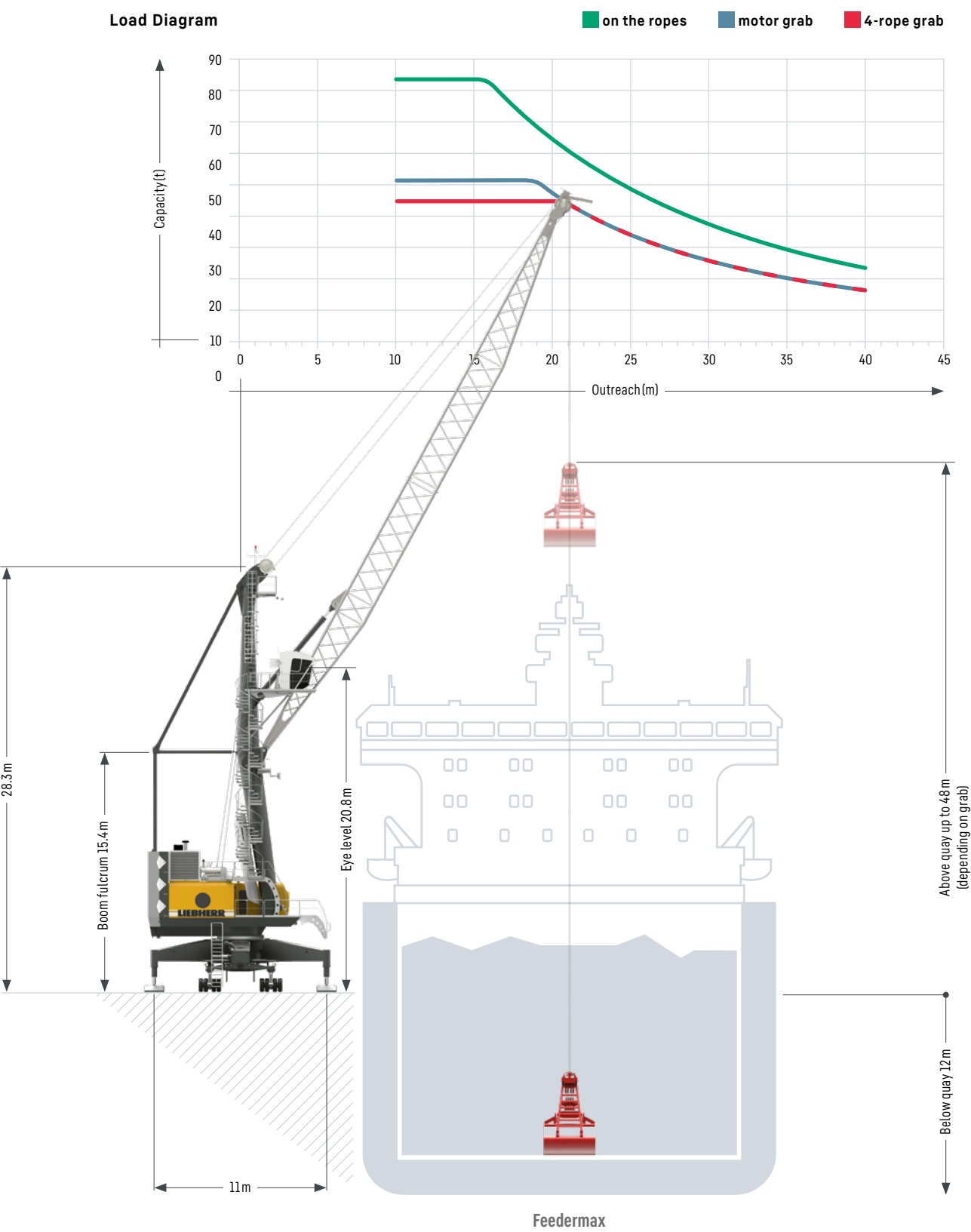
**Maximum  
lifting capacity**  
84 t

**Maximum  
outreach**  
40 m

**Ship size**  
Feedermax,  
Handymax

# Main dimensions

## Bulk operation



# Lifting capacities

## Bulk operation

Maximum crane capacity 84 t				Maximum crane capacity 64 t			
Outreach (m)	Hook operation	Grab operation		Outreach (m)	Hook operation	Grab operation	
	on the ropes (t)	4-rope grab (t)	motor grab (t)		on the ropes (t)	4-rope grab (t)	motor grab (t)
10	84.0	45.0	52.0	10	64.0	35.0	42.0
11	84.0	45.0	52.0	11	64.0	35.0	42.0
12	84.0	45.0	52.0	12	64.0	35.0	42.0
13	84.0	45.0	52.0	13	64.0	35.0	42.0
14	84.0	45.0	52.0	14	64.0	35.0	42.0
15	84.0	45.0	52.0	15	64.0	35.0	42.0
16	81.8	45.0	52.0	16	64.0	35.0	42.0
17	76.5	45.0	52.0	17	64.0	35.0	42.0
18	72.8	45.0	51.7	18	64.0	35.0	42.0
19	68.3	45.0	48.5	19	64.0	35.0	42.0
20	65.1	45.0	46.3	20	64.0	35.0	42.0
21	62.2	44.2	44.2	21	62.2	35.0	42.0
22	58.6	41.7	41.7	22	58.6	35.0	41.7
23	55.0	39.1	39.1	23	55.0	35.0	39.1
24	51.4	36.5	36.5	24	51.4	35.0	36.5
25	48.5	34.5	34.5	25	48.5	34.5	34.5
26	45.6	32.4	32.4	26	45.6	32.4	32.4
28	40.7	29.0	29.0	28	40.7	29.0	29.0
30	36.6	26.0	26.0	30	36.6	26.0	26.0
32	33.1	23.5	23.5	32	33.1	23.5	23.5
34	30.1	21.4	21.4	34	30.1	21.4	21.4
36	27.4	19.5	19.5	36	27.4	19.5	19.5
38	25.1	17.9	17.9	38	25.1	17.9	17.9
40	22.6	16.1	16.1	40	22.6	16.1	16.1

Weight ramshorn hook 3.0 t; Weight

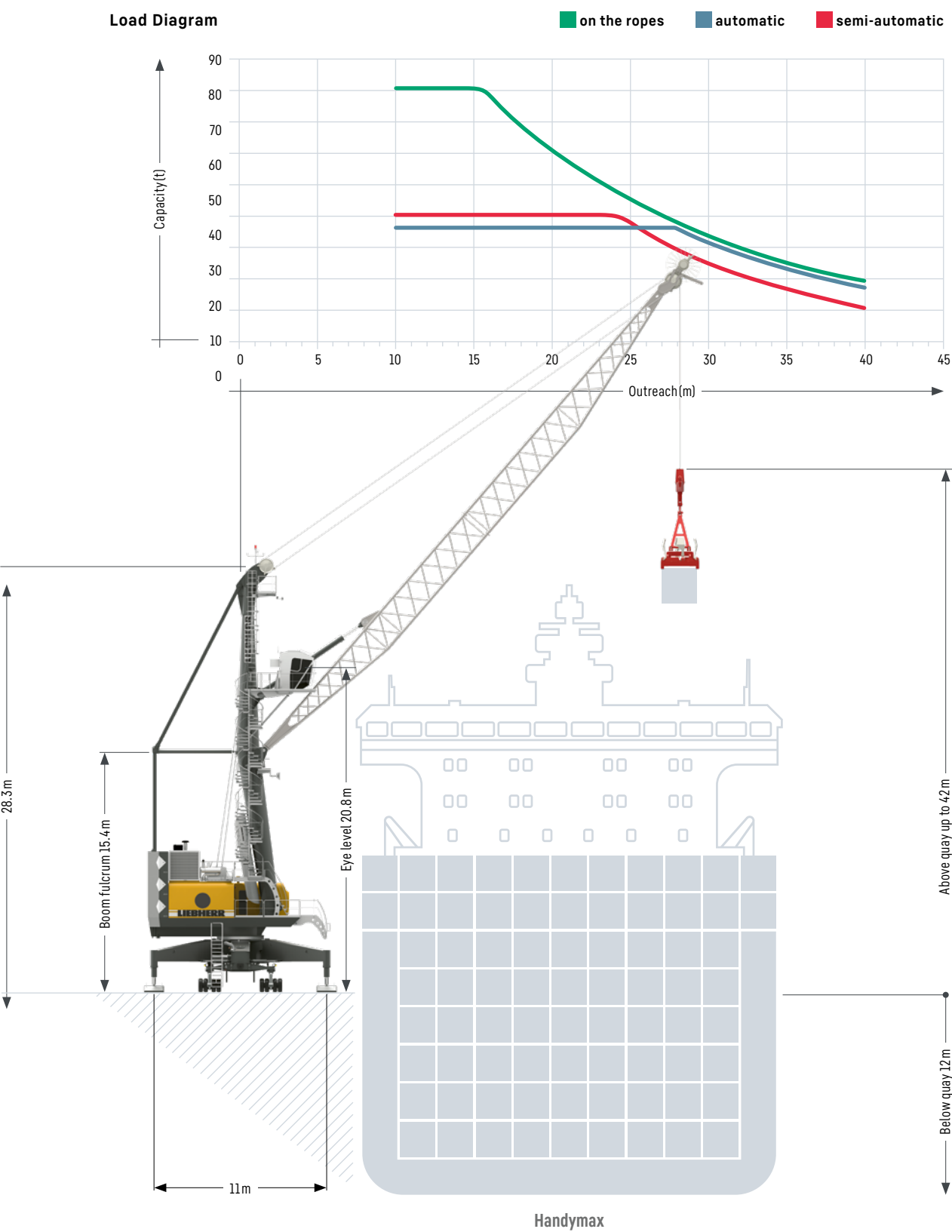
Weight ramshorn hook 3.0 t; Weight rota

**Professional bulk handling – Turnover up to 1,000 t per hour**

The powerful hydrostatic transmission and advanced Liebherr electronics ensure short, productive working cycles during bulk handling.

# Main dimensions

## Container operation



# Lifting capacities

## Container operation

Maximum crane capacity 84 t				Maximum crane capacity 64 t			
Outreach (m)	Hook operation	Capacity under 40' spreader		Outreach (m)	Hook operation	Capacity under 40' spreader	
	on the ropes (t)	automatic (t)	semi-automatic (t)		on the ropes (t)	automatic (t)	semi-automatic (t)
10	84.0	41.0	36.0	10	64.0	41.0	36.0
11	84.0	41.0	36.0	11	64.0	41.0	36.0
12	84.0	41.0	36.0	12	64.0	41.0	36.0
13	84.0	41.0	36.0	13	64.0	41.0	36.0
14	84.0	41.0	36.0	14	64.0	41.0	36.0
15	84.0	41.0	36.0	15	64.0	41.0	36.0
16	81.8	41.0	36.0	16	64.0	41.0	36.0
17	76.5	41.0	36.0	17	64.0	41.0	36.0
18	72.8	41.0	36.0	18	64.0	41.0	36.0
19	68.3	41.0	36.0	19	64.0	41.0	36.0
20	65.1	41.0	36.0	20	64.0	41.0	36.0
21	62.2	41.0	36.0	21	62.2	41.0	36.0
22	58.6	41.0	36.0	22	58.6	41.0	36.0
23	55.0	41.0	36.0	23	55.0	41.0	36.0
24	51.4	39.9	36.0	24	51.4	39.9	36.0
25	48.5	37.0	36.0	25	48.5	37.0	36.0
26	45.6	34.1	36.0	26	45.6	34.1	36.0
28	40.7	29.2	35.6	28	40.7	29.2	35.6
30	36.6	25.1	31.5	30	36.6	25.1	31.5
32	33.1	21.6	28.0	32	33.1	21.6	28.0
34	30.1	18.6	25.0	34	30.1	18.6	25.0
36	27.4	15.9	22.3	36	27.4	15.9	22.3
38	25.1	13.6	20.0	38	25.1	13.6	20.0
40	22.6	11.1	17.5	40	22.6	11.1	17.5

Weight rotator 2.5t  
Weight fully automatic (telescopic) spreader 9t  
Weight semi-automatic spreader 1.3t (20ft), 2.6t (40ft)

**Professional container handling – Turnover up to 35 cycles per hour**

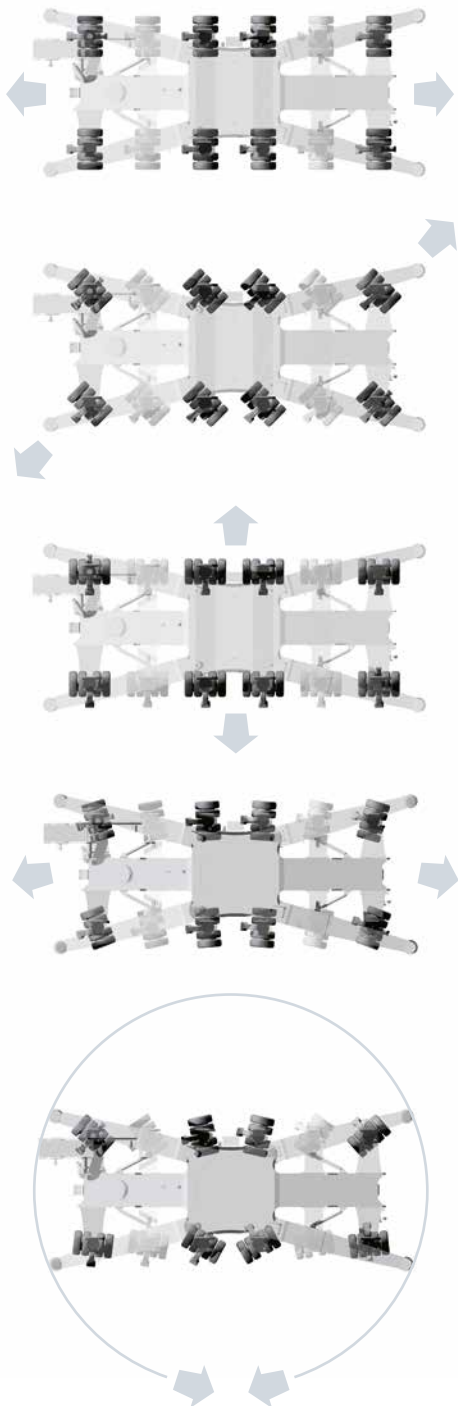
**Precision to perfection:** With incredibly short acceleration times for all crane motions, Liebherr is the top performer in container handling.

# Undercarriage

### Mobility

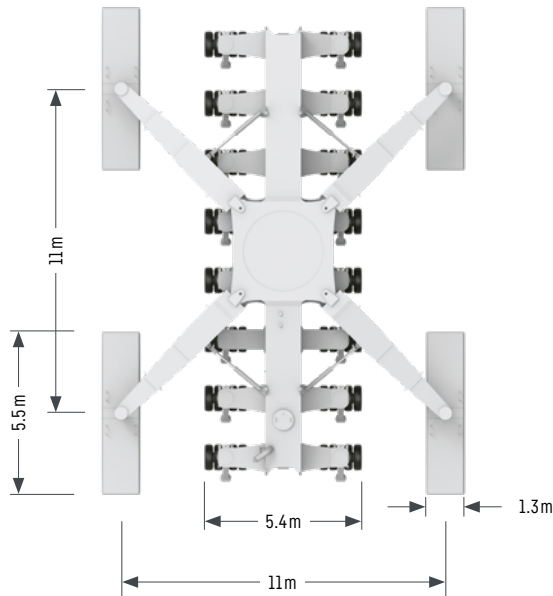
- Outstanding mobility and manoeuvrability
- Curves at any possible radii and even slewing on the spot

### Schematic diagram



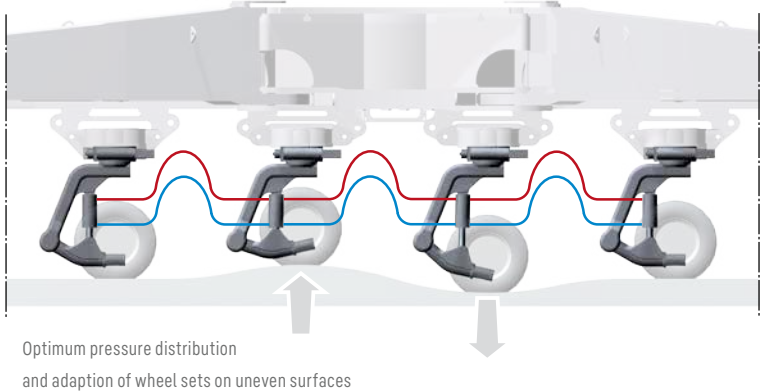
### Modular propping system

- Minimised stress and strain of undercarriage due to cruciform support base which directs the load path from boom tip to quay
- Modular system allows further reduction of quay loads by installing additional axle sets
- Easy adaptation to various sizes of support pads and bases



### Hydraulic load distribution

- Hydraulic suspension avoids overloading of individual wheel sets
- Standard trailer tyres making requisition of spares economical and time-saving
- Increased lifetime of tyres due to individually steerable wheel sets



# Technical data

### Capacity and Classification

	Capacity	Classification
Four rope grab operation	≤ 36t	A8
Four rope grab operation	≤ 45t	A7
Motor grab operation	≤ 45t	A7
Container operation	≤ 55t	A6
Heavy lift operation	≤ 84t	A4

### Main Dimensions

Min. to max. outreach	10 – 40 m
Height of boom fulcrum	15.4 m
Tower cabin height (eye level)	20.8 m
Overall height (top of tower)	28.3 m
Overall length of undercarriage	16.2 m
Overall width of undercarriage	5.4 m

### Working Speeds

Hoisting / lowering	0 – 115 m/min
Slewing	0 – 1.6 rpm
Luffing (average horizontal speed)	0 – 50 m/min
Travelling	0 – 5.4 km/h

### Propping Arrangements

Standard supporting base	11.0 m x 11.0 m
Standard pad dimension	5.5 m x 1.3 m
Standard supporting area of pads	7.15 m <sup>2</sup>
Optional size of supporting pads and bases on request	

### Quay Load Arrangements

Uniformly distributed load	1.63 t/m <sup>2</sup>
Max. load per tyre	5.0 t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

### Weight

Total weight of crane LHM 280	approx. 241t
-------------------------------	--------------

### Hoisting Heights

Above quay at minimum radius	48.0 m
Above quay at maximum radius	22.0 m
Below quay level (approx)	12.0 m

# Optional Equipment

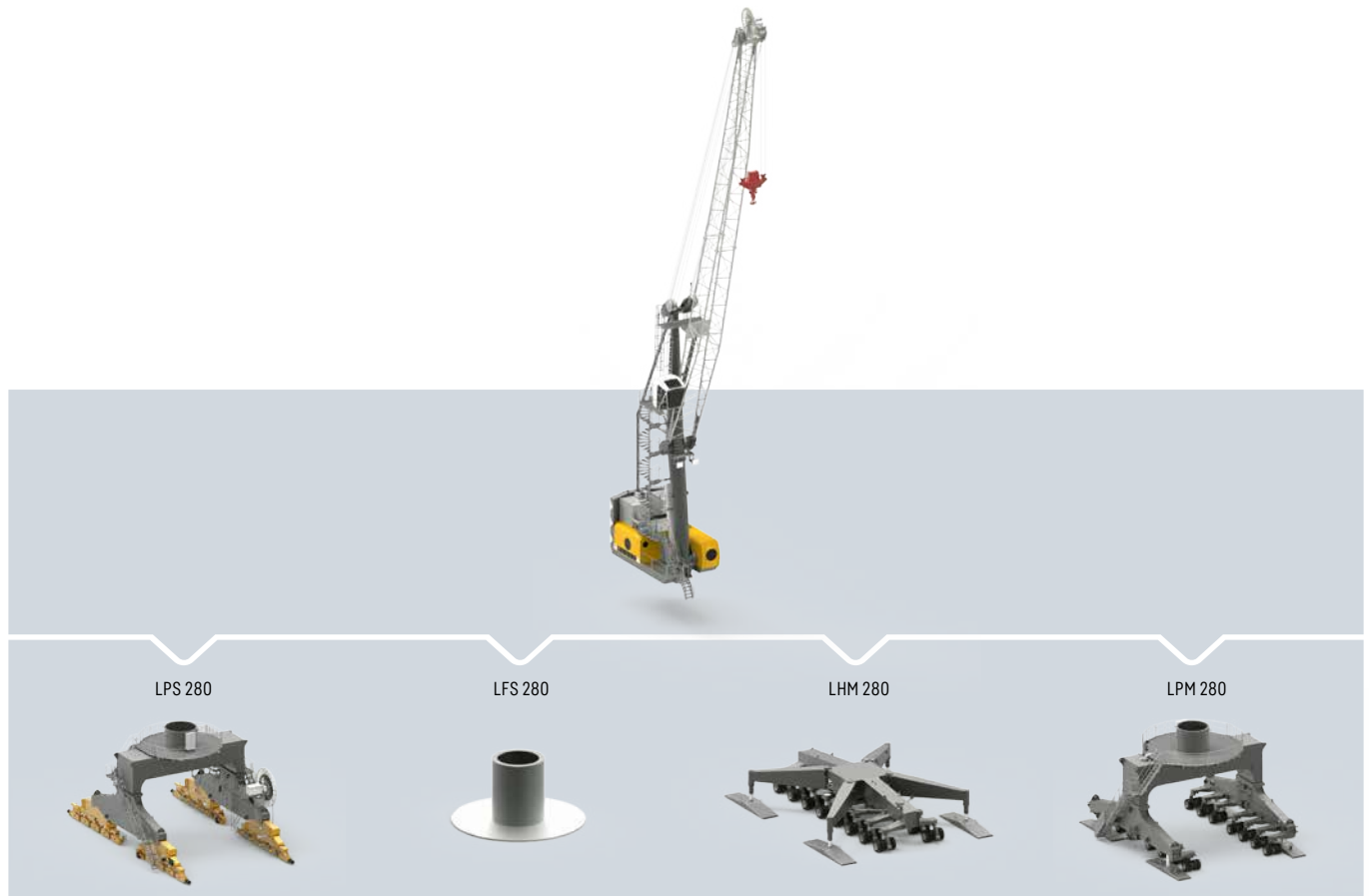
### Additional products and services

- Cycoptronic® – anti-sway system
- SmartGrip – intelligent grabbing
- Teach-In – semi-automatic point to point system
- Sycratronic® – synchronizing crane control system
- Vertical Line Finder – diagonal pull preventing system
- Collision alert system
- LiDAT® – smartApp
- Economy software – for optimised fuel consumption
- Video monitoring system

- Radio remote control
- Autopropping undercarriage
- Cyclone air-intake system for the engine
- Low temperature package
- Customer-specific painting & logo
- Additional (driven) axle sets
- Axle sets equipped with foamed tyres
- Different supporting bases and pad sizes
- And many more as per customers' requirements



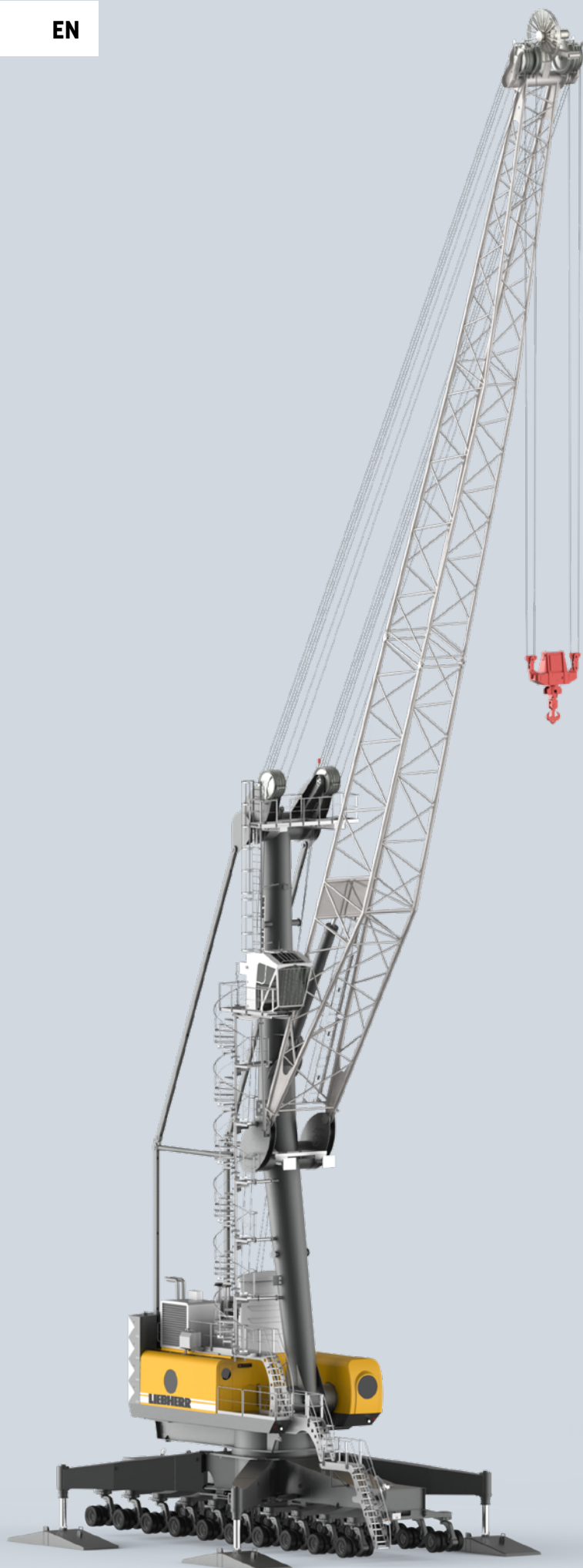
# Practical solutions



## Liebherr develops and produces special designs and solutions to meet customer-specific requirements

- The Liebherr Portal Crane (LPS) is an efficient combination of a space-saving portal (mounted on rails) and the proven mobile harbour crane concept. Particularly on narrow quays, individual portal solutions permit (railway) trains and (road) trucks to travel below the portal.
- Liebherr Fixed Slewing Cranes (LFS) are an efficient combination of a mobile harbour crane upper carriage and a fixed pedestal. LFS cranes provide an economical and space-saving solution for the installation on quaysides and jetties, especially where room for manoeuvring is limited and low ground pressure is essential. Additionally LFS solutions are also ideally suited for the installation on crane barges.
- The Liebherr Portal Mobile Crane (LPM) is the perfect combination of a space-saving portal undercarriage, efficient mobile harbour crane technology and unrestricted mobility. A gantry on rubber tyres enables the crane to be travelled from one quay to another. Supporting pads allow the crane to be used on quays with or without rail tracks. The LPM offers the same 360-degree mobility as the LHM. Driving in longitudinal, diagonal or transverse direction. Performance of conventional steering or slewing on the spot is possible and provided as standard.

EN



---

# LHM 420

---

[www.liebherr.com](http://www.liebherr.com)

## LIEBHERR

**Mobile harbour crane**

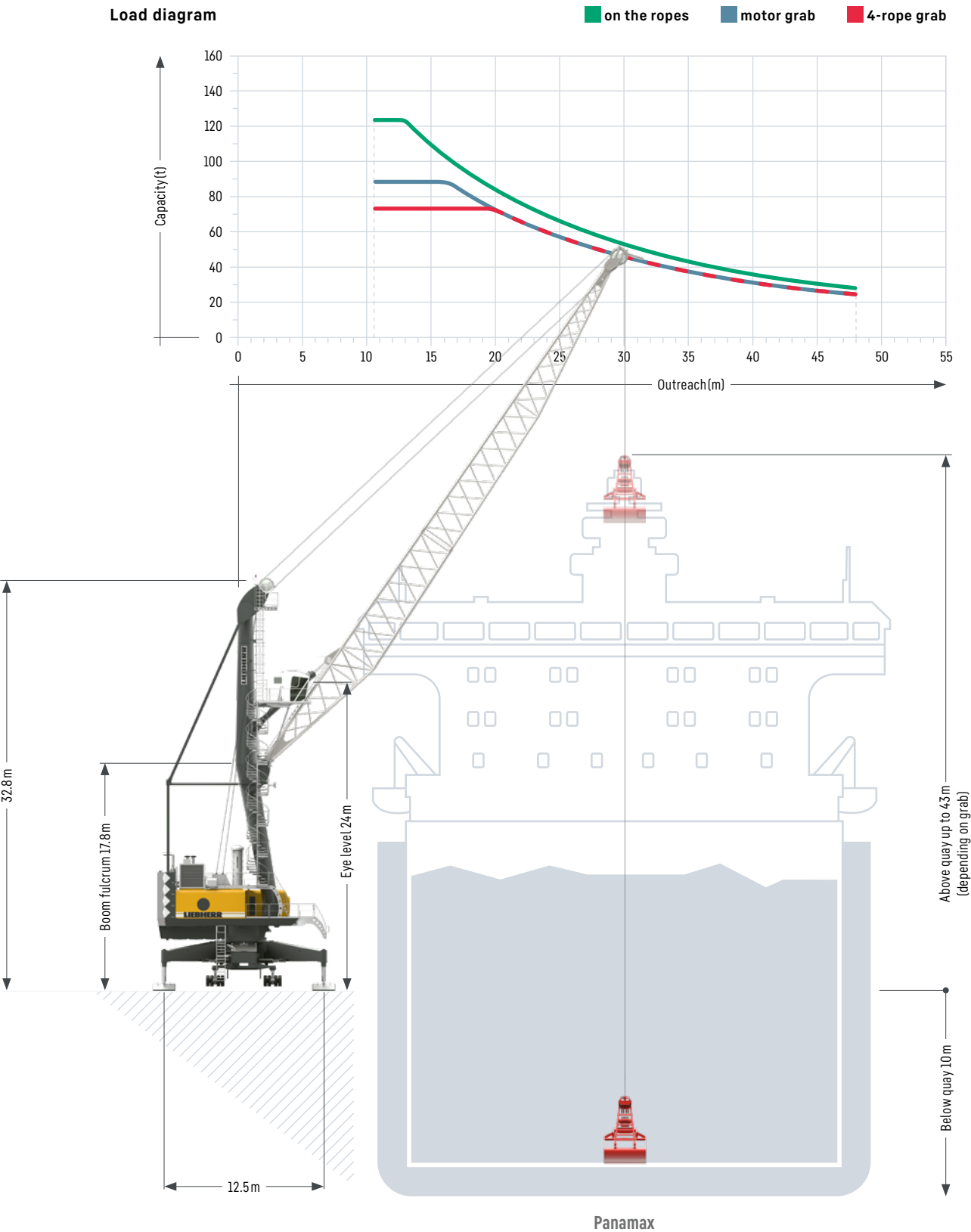
**Maximum  
lifting capacity**  
124 t

**Maximum  
outreach**  
48 m

**Ship size**  
Panamax,  
Post-Panamax

# Main dimensions

## Bulk operation



# Lifting capacities

## Bulk operation

Maximum crane capacity 124 t				Maximum crane capacity 84 t			
Outreach	Hook operation	Grab operation		Outreach	Hook operation	Grab operation	
(m)	on the ropes	4-rope grab	motor grab	(m)	on the ropes	4-rope grab	motor grab
	(t)	(t)	(t)		(t)	(t)	(t)
10.5 - 12	124.0	75.0	90.0	10.5 - 12	84.0	45.0	52.0
13	117.6	75.0	90.0	13	84.0	45.0	52.0
14	111.5	75.0	90.0	14	84.0	45.0	52.0
15	105.6	75.0	90.0	15	84.0	45.0	52.0
16	100.1	75.0	90.0	16	84.0	45.0	52.0
18	90.0	75.0	81.0	18	84.0	45.0	52.0
19	85.3	75.0	76.8	19	84.0	45.0	52.0
20	81.0	72.9	72.9	20	81.0	45.0	52.0
22	73.1	65.8	65.8	22	73.1	45.0	52.0
24	66.2	59.6	59.6	24	66.2	45.0	52.0
26	60.2	54.2	54.2	26	60.2	45.0	52.0
28	55.1	49.5	49.5	28	55.1	45.0	48.9
30	50.6	45.5	45.5	30	50.6	45.0	45.0
32	48.6	42.1	42.1	32	48.6	41.6	41.6
34	43.4	39.1	39.1	34	43.4	38.6	38.6
36	40.5	36.5	36.5	36	40.5	36.0	36.0
38	38.0	34.2	34.2	38	38.0	33.8	33.8
40	35.7	32.1	32.1	40	35.7	31.7	31.7
42	33.5	30.2	30.2	42	33.5	29.8	29.8
44	31.4	28.3	28.3	44	31.4	27.9	27.9
46	29.3	26.3	26.3	46	29.3	26.0	26.0
48	27.3	24.5	24.5	48	27.3	24.2	24.2

Weight ramshorn hook 3.0t;  
Weight rotator 3.5t

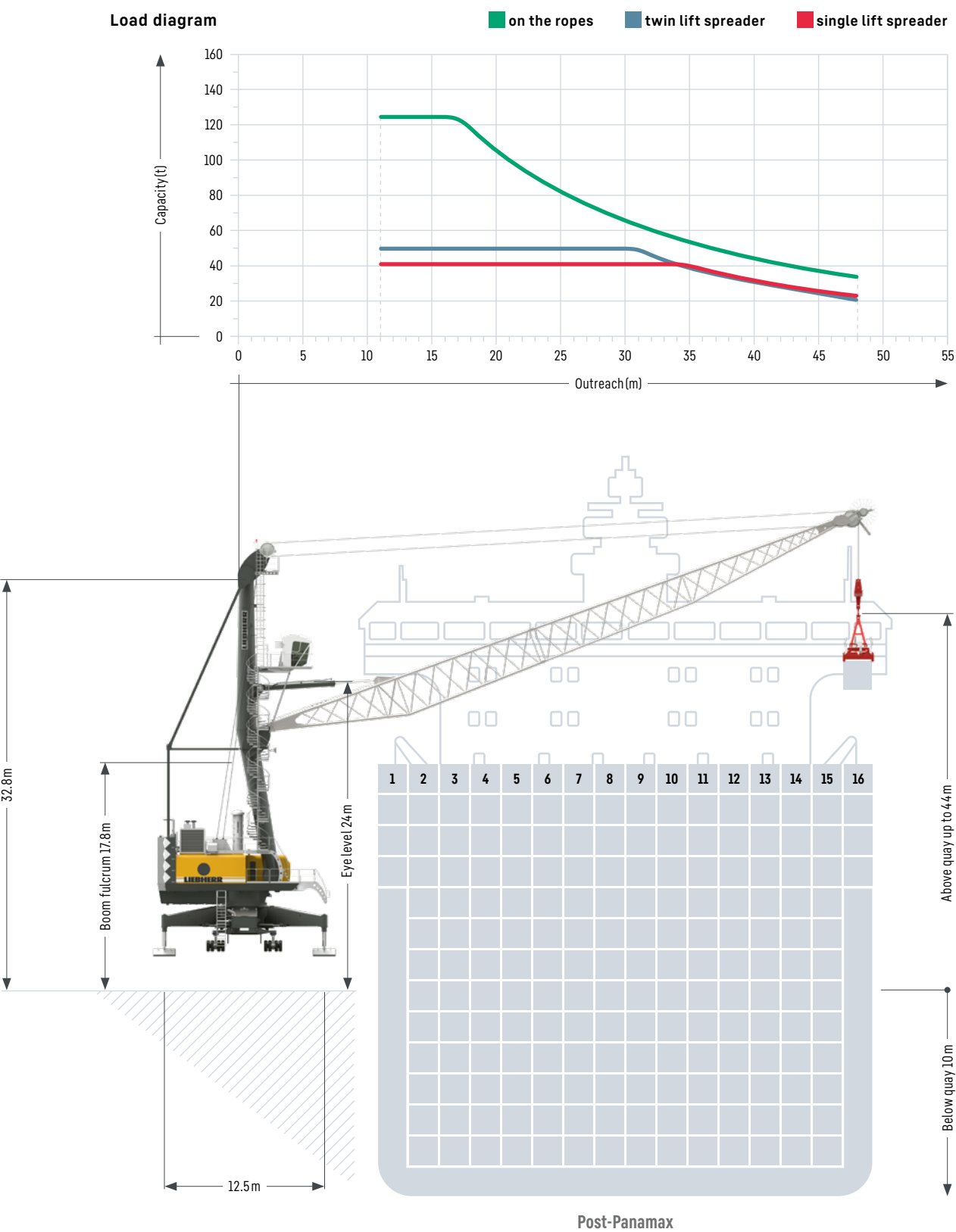
Weight ramshorn hook 3.0t;  
Weight rotator 2.5t

**Standard configuration – Turnover up to 1,500 t per hour**  
**Pactronic® – Turnover up to 2,000 t per hour**

The powerful hydrostatic transmission and advanced Liebherr electronics ensure short, productive working cycles during bulk handling.

# Main dimensions

## Container operation



# Lifting capacities

## Container operation

Maximum crane capacity 124 t

Outreach (m)	Spreader operation under		Hook operation on the ropes
	Single lift (t)	Twin lift (t)	Heavy lift (t)
11	41.0	50.0	124.0
12	41.0	50.0	124.0
13	41.0	50.0	124.0
14	41.0	50.0	124.0
16	41.0	50.0	124.0
18	41.0	50.0	113.9
20	41.0	50.0	102.5
22	41.0	50.0	92.5
24	41.0	50.0	83.8
26	41.0	50.0	76.2
28	41.0	50.0	69.7
30	41.0	49.9	64.1
32	41.0	45.0	59.2
34	41.0	40.8	55.0
35	40.5	38.8	53.0
36	38.8	37.1	51.3
38	35.6	33.9	48.1
40	32.7	31.0	45.2
42	30.0	28.3	42.5
44	27.3	25.6	39.8
46	24.6	22.9	37.1
48	22.0	20.3	34.5

Weight rotator 3.5t  
Weight fully automatic (telescopic) spreader 9t  
Weight twin lift spreader 10.7t

Maximum crane capacity 84 t

Outreach (m)	Spreader operation under		Hook operation on the ropes
	Single lift (t)	Twin lift (t)	Heavy lift (t)
11	41.0	50.0	84.0
12	41.0	50.0	84.0
13	41.0	50.0	84.0
14	41.0	50.0	84.0
16	41.0	50.0	84.0
18	41.0	50.0	84.0
20	41.0	50.0	84.0
23	41.0	50.0	84.0
24	41.0	50.0	83.8
26	41.0	50.0	76.2
28	41.0	50.0	69.7
30	41.0	50.0	64.1
32	41.0	46.0	59.2
34	41.0	41.8	55.0
35	41.0	39.8	53.0
36	39.8	38.1	51.3
38	36.6	34.9	48.1
40	33.7	32.0	45.2
42	31.0	29.3	42.5
44	28.3	26.6	39.8
46	25.6	23.9	37.1
48	23.0	21.3	34.5

Weight rotator 2.5t  
Weight fully automatic (telescopic) spreader 9t  
Weight twin lift spreader 10.7t

**Standard configuration – Turnover up to 32 cycles per hour**  
**Pactronic® – Turnover up to 38 cycles per hour**

**Precision to perfection: With incredibly short acceleration times for all crane motions, Liebherr is the top performer in container handling.**

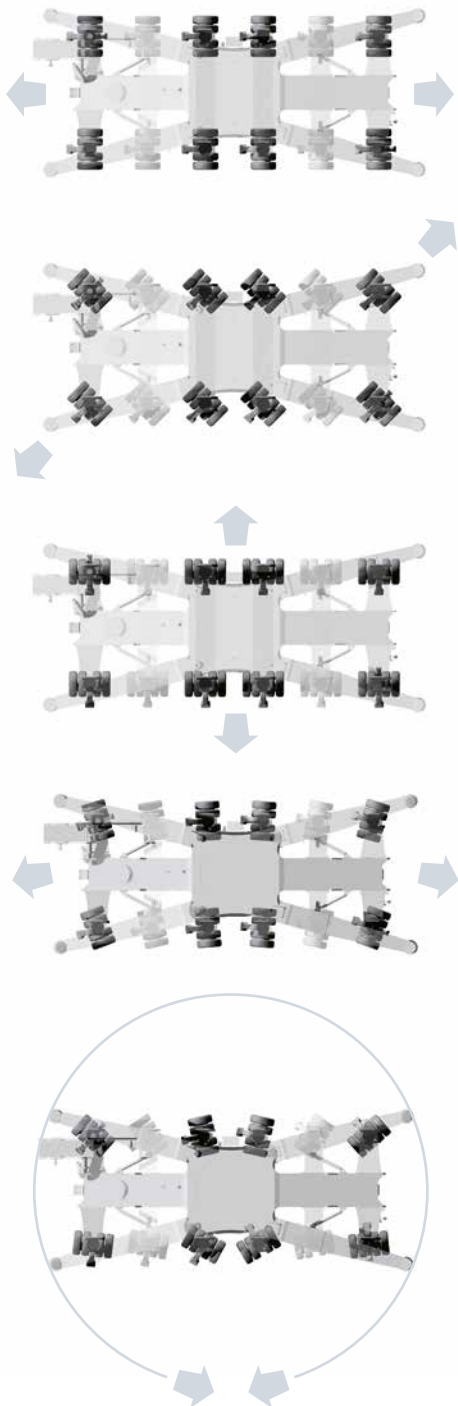


# Undercarriage

### Mobility

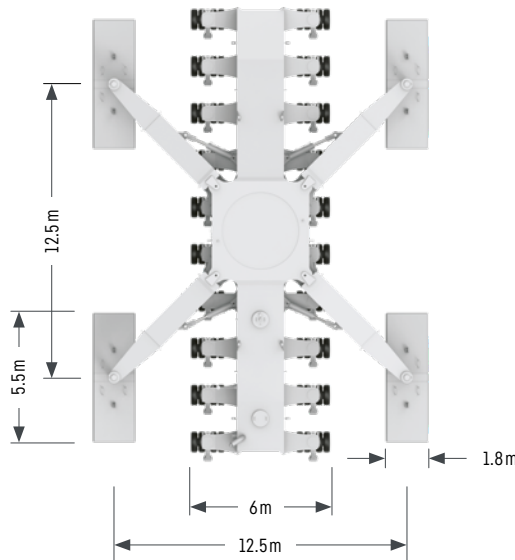
- Outstanding mobility and manoeuvrability
- Curves at any possible radii and even slewing on the spot

### Schematic diagram



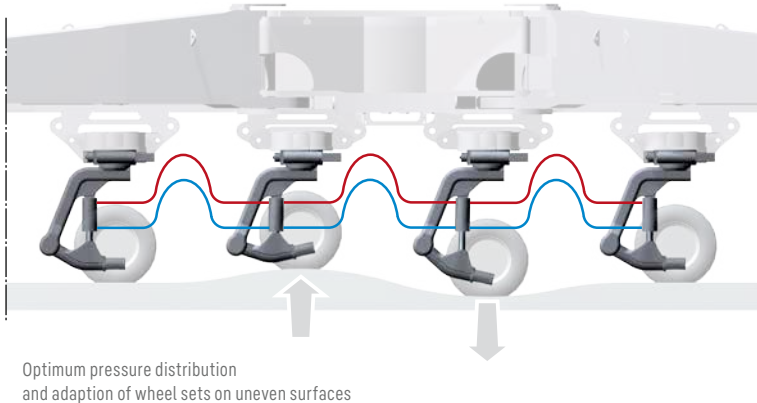
### Modular propping system

- Minimised stress and strain of undercarriage due to cruciform support base which directs the load path from boom tip to quay
- Modular system allows further reduction of quay loads by installing additional axle sets
- Easy adaptation to various sizes of support pads and bases



### Hydraulic load distribution

- Hydraulic suspension avoids overloading of individual wheel sets
- Standard trailer tyres making requisition of spares economical and time-saving
- Increased lifetime of tyres due to individually steerable wheel sets



# Technical Data

### Capacity and Classification

	Capacity	Classification
Four rope grab operation	≤ 52t	A8
Four rope grab operation	≤ 60t	A7
Motor grab operation	≤ 52t	A8
Container operation	≤ 57t	A7
Heavy lift operation	≤ 124t	A3

### Main Dimensions

Min. to max. outreach	11 – 48 m
Height of boom fulcrum	17.8 m
Tower cabin height (eye level)	24.0 m
Overall height (top of tower)	32.8 m
Overall length of undercarriage	20.0 m
Overall width of undercarriage	6.0 m

	Bulk	Container
Number of axle sets (standard)	14	16
Number of axle sets (optional)	24	24

### Working Speeds

Hoisting / lowering	0 – 120 m/min
Slewing	0 – 1.6rpm
Luffing (average horizontal speed)	0 – 55 m/min
Travelling	0 – 5km/h

### Propping Arrangements

Standard supporting base	12.5m x 12.5m
Standard pad dimension	5.5m x 1.8m
Standard supporting area of pads	9.9m²
Optional size of supporting pads and bases on request	

### Quay Load Arrangements

	Bulk	Container
Uniformly distributed load	1.9t/m²	1.9t/m²
Max. load per tyre	6.0t	5.8t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

### Weight

	Bulk	Container
Total weight of crane LHM 420	approx. 342t	approx. 371t

### Hoisting Heights

Above quay at minimum radius	45.0 m
Above quay at maximum radius	29.0 m
Below quay level (approx.)	12.0 m

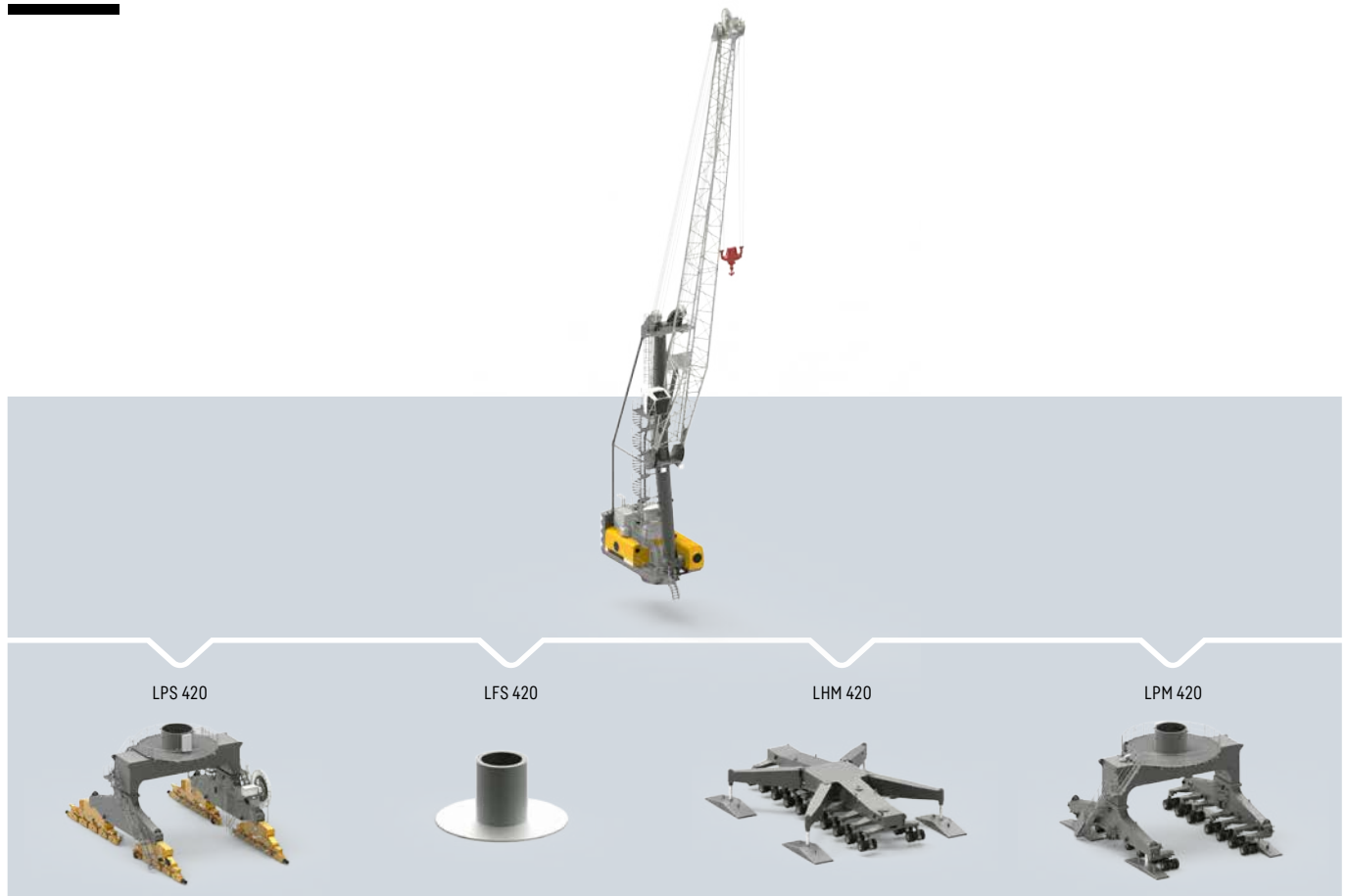
# Optional Equipment

### Additional products and services

- Pactronic® - power by accumulator and electronics
- SmartGrip - intelligent grabbing
- Cycoptronic® - anti-sway system
- Teach-In - semi-automatic point to point system
- Sycratronic® - synchronizing crane control system
- Vertical Line Finder - diagonal pull preventing system
- Collision alert system
- LiDAT® - smartApp
- Economy software - for optimised fuel consumption
- Video monitoring system
- Radio remote control
- Autopropping undercarriage

- Cyclone air-intake system for the engine
- Low temperature package
- Customer-specific painting & logo
- Additional (driven) axle sets
- Axle sets equipped with foamed tyres
- Different supporting bases and pad sizes
- And many more as per customers' requirements

# Practical Solutions



## Liebherr develops and produces special designs and solutions to meet customer-specific requirements

- The Liebherr Portal Crane (LPS) is an efficient combination of a space-saving portal (mounted on rails) and the proven mobile harbour crane concept. Particularly on narrow quays, individual portal solutions permit (railway) trains and (road) trucks to travel below the portal.
- Liebherr Fixed Slewing Cranes (LFS) are an efficient combination of a mobile harbour crane upper carriage and a fixed pedestal. LFS cranes provide an economical and space-saving solution for the installation on quaysides and jetties, especially where room for manoeuvring is limited and low ground pressure is essential. Additionally LFS solutions are also ideally suited for the installation on crane barges.
- The Liebherr Portal Mobile Crane (LPM) is the perfect combination of a space-saving portal undercarriage, efficient mobile harbour crane technology and unrestricted mobility. A gantry on rubber tyres enables the crane to be travelled from one quay to another. Supporting pads allow the crane to be used on quays with or without rail tracks. The LPM offers the same 360-degree mobility as the LHM. Driving in longitudinal, diagonal or transverse direction. Performance of conventional steering or slewing on the spot is possible and provided as standard.

### 1.4 Dimensions

Support base	12.5 m x 12.5 m	
Size of supporting pads	5.5 m x 2.3 m	
Supporting area of pads	12,65 m <sup>2</sup>	
Overall width without supporting pads	6,0 m	
Overall width with supporting pads and swung in outriggers	10,2 m	
Overall width in traveling position and deployed outriggers	14,3 m	
Overall length of undercarriage	20,0 m	
Length of boom (centre sheaves)	48,6 m	
Overall height (top of tower)	32,8 m	
Height of boom fulcrum	17,8 m	
Cab height (eye level)	24,0 m	
Turning radius	0,0 m	inner
incl. supporting pads	13,0 m	outer
Tail swing radius	7,0 m	
Max. hoisting height (measured at crane rope socket)		(not valid for 4-rope grab)
above quay at minimum radius	43,0 m	
above quay at maximum radius	29,0 m	
below quay	10,0 m	
Winchconfiguration	2x62t	
Number of winches	2 (2 ropes per winch)	
Diameter of hoisting rope	40 mm	
Diameter of sheaves at boom head	1040 mm	
Ratio between diameter of hoisting rope to sheaves	1 : 26,0	
Diameter of rope drum	900 mm	
Ratio between diameter of rope to drum	1 : 22,5	
Number of axle sets	14	
Axle sets driven	5	
Axle sets steerable	all	
No. of tyres	4 per axle set	
Tyres	285/70 R 19.5 make Continental	
Tyre pressure	10 bar max	

### 1.5 Environmental Conditions

Ambient temperature	-20° C to +45 ° C
Humidity (relative)	97 %
Max. wind speed in operation	24 m/s
Max. wind speed out of operation	42 m/s
Max. wind speed during travelling	20 m/s

### 1.6 Requirements on Quay

During crane operation and driving, the following pressures are relevant (calculations based on 5.5 m x 2.3 m supporting plates).

#### Assumed Conditions:

Normal	=	all static loads are included
Extreme	=	all static loads and dynamic factors are included

Max. axle set loading:	Normal	appr.	23,6 t
( 2 axle sets = 1 axle line)	Extreme	appr.	28,9 t

#### Max. Corner Loading:

		<b>75%</b>	<b>66%</b>	<b>Grab</b>
Normal	boom 45°	204,4 t	187,6 t	189,2 t
(static excl. wind)	boom 90°	162,5 t	155,8 t	156,5 t
Normal	boom 45°	218,1 t	200,9 t	202,4 t
(static incl. wind)	boom 90°	168,1 t	161,2 t	161,8 t
Extreme	boom 45°	232,4 t	213,8 t	227,0 t
(dynamic incl. wind)	boom 90°	175,0 t	171,9 t	179,3 t

#### Max. Area Pressure:

		<b>75%</b>	<b>66%</b>	<b>Grab</b>
Normal	boom 45°	16,2 t/m <sup>2</sup>	14,8 t/m <sup>2</sup>	15,0 t/m <sup>2</sup>
(static excl. wind)	boom 90°	12,8 t/m <sup>2</sup>	12,3 t/m <sup>2</sup>	12,4 t/m <sup>2</sup>
Normal	boom 45°	17,2 t/m <sup>2</sup>	15,9 t/m <sup>2</sup>	16,0 t/m <sup>2</sup>
(static incl. wind)	boom 90°	13,3 t/m <sup>2</sup>	12,7 t/m <sup>2</sup>	12,8 t/m <sup>2</sup>
Extreme	boom 45°	18,4 t/m <sup>2</sup>	16,9 t/m <sup>2</sup>	17,9 t/m <sup>2</sup>
(dynamic incl. wind)	boom 90°	13,8 t/m <sup>2</sup>	13,6 t/m <sup>2</sup>	14,2 t/m <sup>2</sup>



EN



# LHM 550

[www.liebherr.com](http://www.liebherr.com)

## LIEBHERR

**Mobile harbour crane**

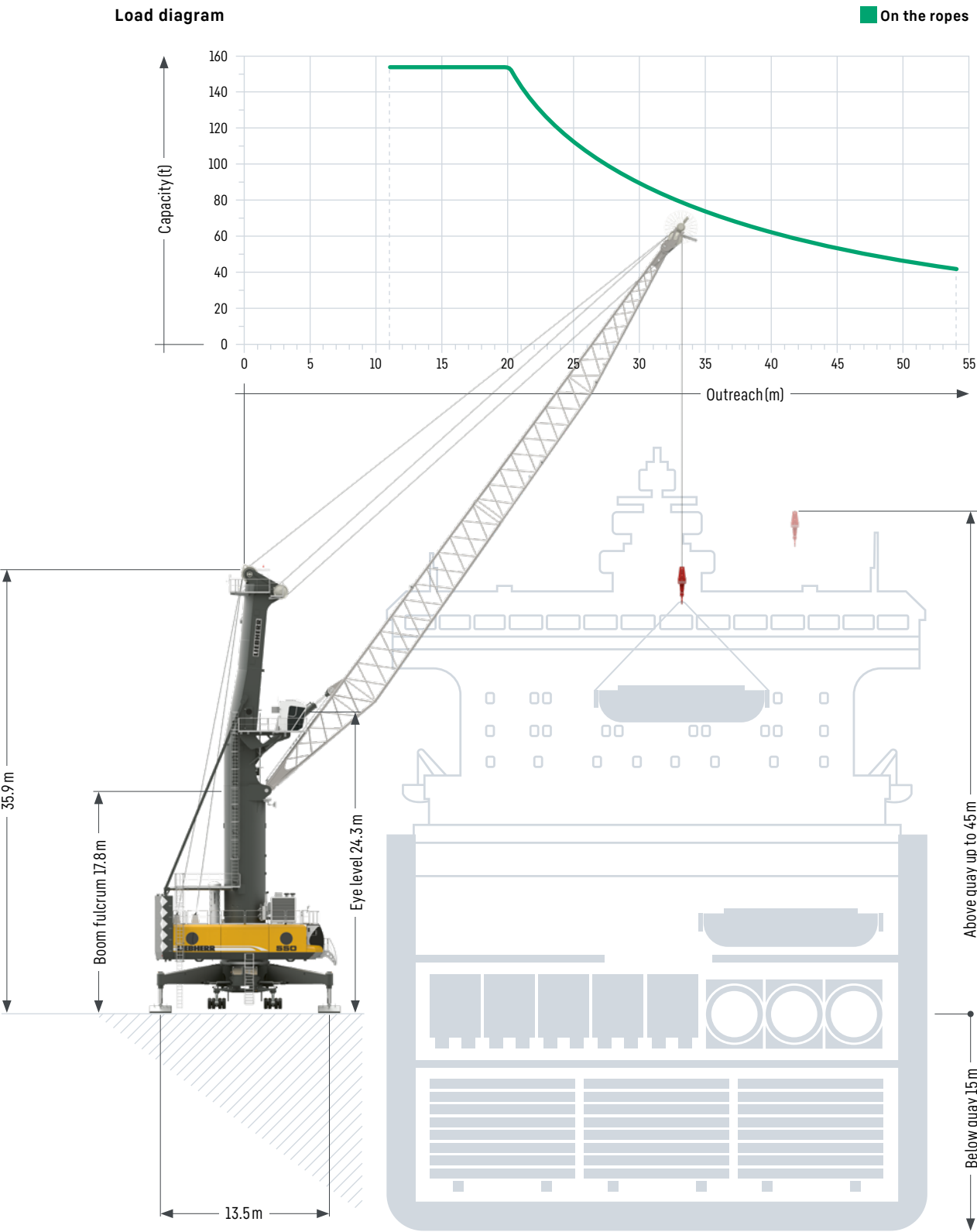
**Maximum  
lifting capacity**  
154 t

**Maximum  
outreach**  
54 m

**Ship size**  
New Panamax,  
Capesize

# Main dimensions

Heavy lift operation



# Lifting capacities

Heavy lift operation

Maximum crane capacity 154 t

Hook operation	
Outreach (m)	On the ropes (t)
11	154.0
12	154.0
13	154.0
14	154.0
16	154.0
18	154.0
20	144.9
22	130.5
24	117.9
26	107.2
28	97.7
30	89.2
32	82.3
34	76.0
36	70.7
38	66.0
40	62.0
42	58.4
44	55.2
46	52.2
48	49.3
50	46.4
52	43.6
54	40.9

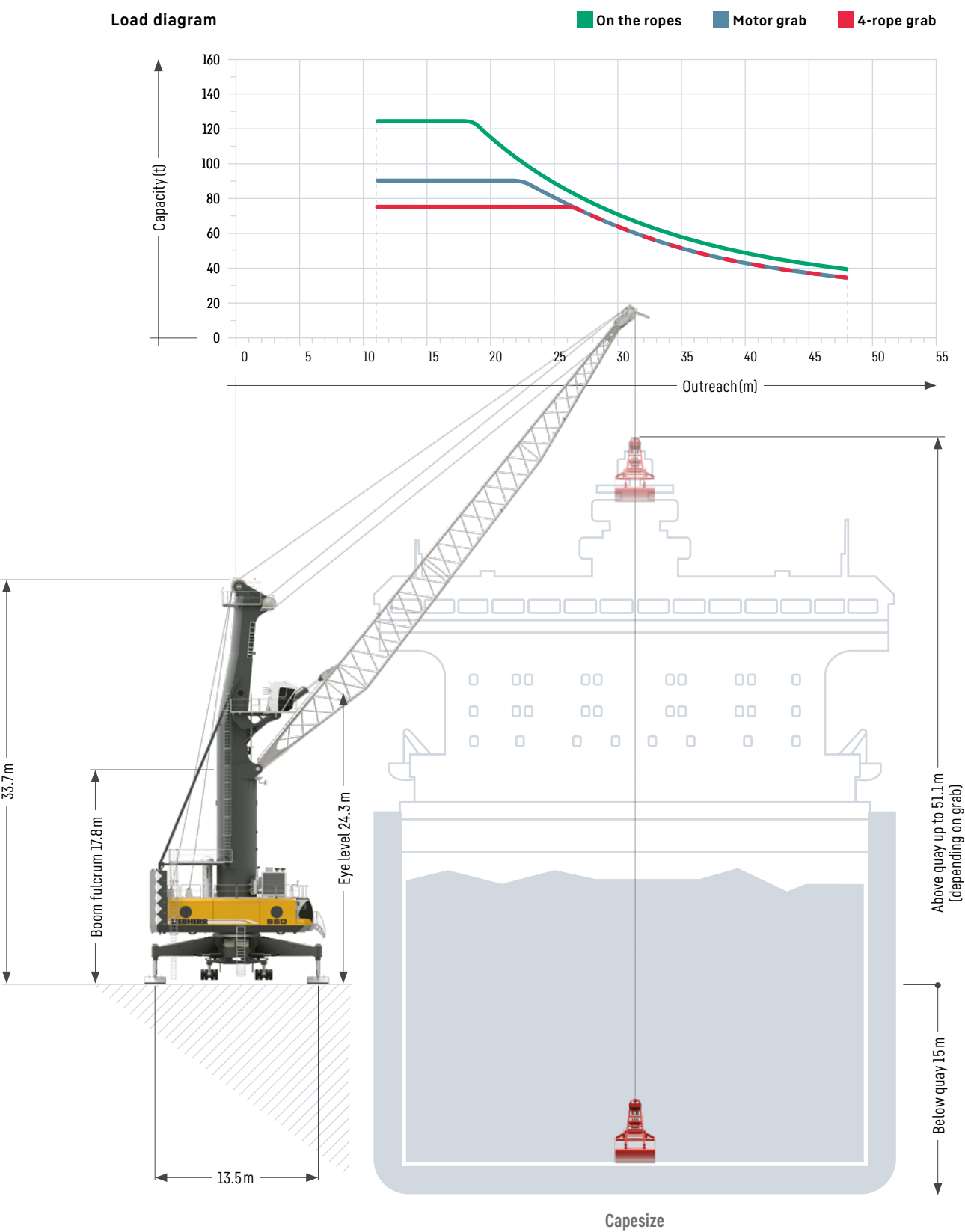
Weight rotator 4.0 t

Project cargo & heavy lift up to 154 tonnes

Safety and precision are the most important criteria when lifting heavy goods.

# Main dimensions

## Bulk operation



# Lifting capacities

## Bulk operation

Maximum crane capacity 124 t

Outreach (m)	Hook operation	Grab operation	
	On the ropes (t)	4-rope grab (t)	Motor grab (t)
11 - 18	124.0	75.0	90.0
19	120.5	75.0	90.0
20	114.5	75.0	90.0
22	103.1	75.0	90.0
23	97.9	75.0	88.1
24	93.1	75.0	83.8
25	88.7	75.0	79.9
26	84.7	75.0	76.2
27	81.0	72.9	72.9
28	77.2	69.5	69.5
29	73.7	66.3	66.3
30	70.5	63.4	63.4
31	67.6	60.9	60.9
32	65.0	58.5	58.5
33	62.5	56.2	56.2
34	60.1	54.1	54.1
36	55.8	50.3	50.3
38	52.2	47.0	47.0
40	49.0	44.1	44.1
42	46.2	41.5	41.5
44	43.6	39.3	39.3
46	41.2	37.1	37.1
48	38.9	35.0	35.0

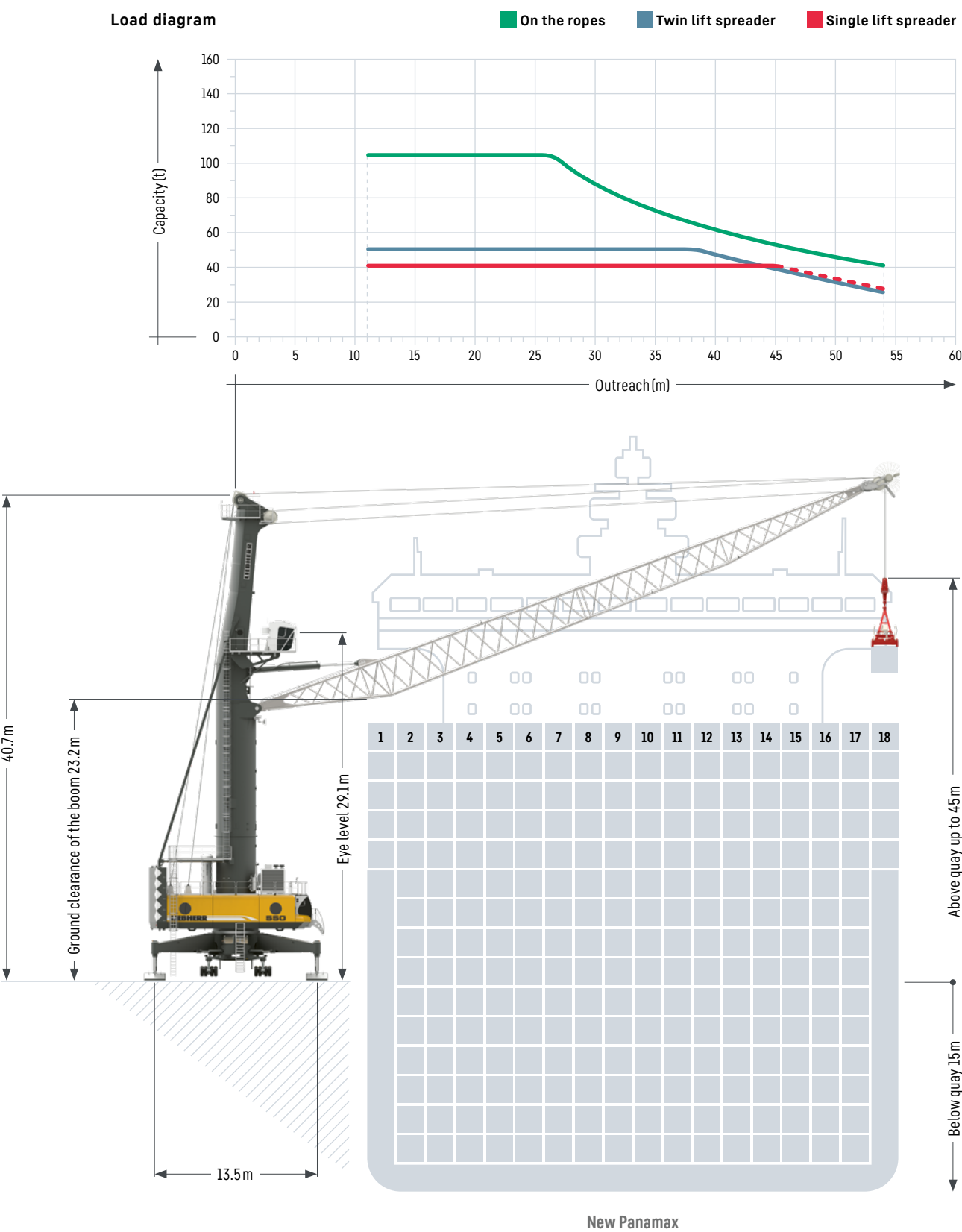
Weight ramshorn hook 3.8t; Weight rotator 4.0t

## Standard configuration – Turnover up to 1,500 t per hour

The powerful hydrostatic transmission and advanced Liebherr electronics ensure short, productive working cycles during bulk handling.

# Main dimensions

## Container operation



# Lifting capacities

## Container operation

Maximum crane capacity 104 t				Maximum crane capacity 154 t		
Outreach (m)	Spreader operation under		Hook operation on the ropes Heavy lift (t)	Outreach (m)	Spreader operation under	
	Single lift (t)	Twin lift (t)			Single lift (t)	Twin lift (t)
11-13	41.0	50.0	104.0	11-13	41.0	50.0
14	41.0	50.0	104.0	14	41.0	50.0
16	41.0	50.0	104.0	16	41.0	50.0
18	41.0	50.0	104.0	18	41.0	50.0
20	41.0	50.0	104.0	20	41.0	50.0
22	41.0	50.0	104.0	22	41.0	50.0
24	41.0	50.0	104.0	24	41.0	50.0
26	41.0	50.0	104.0	26	41.0	50.0
28	41.0	50.0	97.7	28	41.0	50.0
30	41.0	50.0	89.2	30	41.0	50.0
32	41.0	50.0	82.3	32	41.0	50.0
34	41.0	50.0	76.0	34	41.0	50.0
36	41.0	50.0	70.7	36	41.0	50.0
38	41.0	50.0	66.0	38	41.0	50.0
39	41.0	49.7	63.9	39	41.0	49.2
40	41.0	47.8	62.0	40	41.0	47.3
42	41.0	44.2	58.4	42	41.0	43.7
44	41.0	41.0	55.2	44	41.0	40.5
45	41.0	39.5	53.7	45	40.7	39.0
46	39.7	38.0	52.2	46	39.2	37.5
48	36.8	35.1	49.3	48	36.3	34.6
50	33.9	32.2	46.4	50	33.4	31.7
52	31.1	29.4	43.6	52	30.6	28.9
54	28.4	26.7	40.9	54	27.9	26.2

Weight rotator 3.5t  
Weight fully automatic (telescopic) spreader 9t  
Weight twin lift spreader 10.7t

Weight rotator 4.0t  
Weight fully automatic (telescopic) spreader 9t  
Weight twin lift spreader 10.7t

Standard configuration – Turnover up to 32 cycles per hour  
Pactronic® – Turnover up to 38 cycles per hour

Precision to perfection: With incredibly short acceleration times for all crane motions, Liebherr is the top performer in container handling.



# Technical data

## Heavy lift operation

Capacity and classification		
	Capacity	Classification
Standard operation	≤ 77 t	A6
Heavy lift operation	≤ 154 t	A3

Main dimensions	
Min. to max. outreach	11–54 m
Height of boom fulcrum	17.8 m
Tower cabin height (eye level)	24.3 m
Overall height (top of tower)	35.9 m
Overall length of undercarriage	20.7 m
Overall width of undercarriage	6.5 m
Number of axle sets (standard)	20
Number of axle sets (optional)	24

Working speeds	
Hoisting / lowering	0 – 120 m/min
Slewing	0 – 1.6 rpm
Luffing (average horizontal speed)	0 – 55 m/min
Travelling	0 – 5.0 km/h

## Bulk operation

Capacity and classification		
	Capacity	Classification
Four rope grab operation	≤ 52 t	A8
Four rope grab operation	≤ 63 t	A7
Motor grab	≤ 52 t	A8

Main dimensions	
Min. to max. outreach	11–48 m
Height of boom fulcrum	17.8 m
Tower cabin height (eye level)	24.3 m
Overall height (top of tower)	33.7 m
Overall length of undercarriage	20.7 m
Overall width of undercarriage	6.5 m
Number of axle sets (standard)	18
Number of axle sets (optional)	24

Working speeds	
Hoisting / lowering	0 – 120 m/min
Slewing	0 – 1.6 rpm
Luffing (average horizontal speed)	0 – 55 m/min
Travelling	0 – 5.0 km/h

Propping arrangements	
Standard supporting base	13.5 m x 13.5 m
Standard pad dimension	4.0 x 5.5 m x 1.8 m
Standard supporting area of pads	9.9 m²
Optional size of supporting pads and bases on request	

Quay load arrangements	
Uniformly distributed load	1.6 t/m²
Max. load per tyre	5.8 t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight	
Total weight of crane in heavy lift version (154 t winch, 54 m boom, Pactronic®)	approx. 444 t

Hoisting heights	
Above quay at minimum radius	51.1 m
Above quay at maximum radius	31.5 m
Below quay level (approx.)	15.0 m

Propping arrangements	
Standard supporting base	13.5 m x 13.5 m
Standard pad dimension	4.0 x 5.5 m x 1.8 m
Standard supporting area of pads	9.9 m²
Optional size of supporting pads and bases on request	

Quay load arrangements	
Uniformly distributed load	1.7 t/m²
Max. load per tyre	5.8 t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight	
Total weight of crane in bulk version (124 t winch, 48 m boom, Pactronic®)	approx. 400 t

Hoisting heights	
Above quay at minimum radius	51.1 m
Above quay at maximum radius	29.3 m
Below quay level (approx.)	15.0 m

## Container operation

Capacity and classification		
	Capacity	Classification
Standard operation	≤ 77 t	A6
Container operation	≤ 63 t	A7

Main dimensions	
Min. to max. outreach	11–54 m
Height of boom fulcrum	22.6 m
Tower cabin height (eye level)	29.1 m
Overall height (top of tower)	40.7 m
Overall length of undercarriage	20.7 m
Overall width of undercarriage	6.5 m
Number of axle sets (standard)	20
Number of axle sets (optional)	24

Working speeds	
Hoisting / lowering	0 – 120 m/min
Slewing	0 – 1.6 rpm
Luffing (average horizontal speed)	0 – 55 m/min
Travelling	0 – 5.0 km/h

Propping arrangements	
Standard supporting base	13.5 m x 13.5 m
Standard pad dimension	5.5 m x 1.8 m
Standard supporting area of pads	9.9 m²
Optional size of supporting pads and bases on request	

Quay load arrangements	
Uniformly distributed load	1.6 t/m²
Max. load per tyre	5.8 t

Due to a unique undercarriage design the quay loads specified above can even be reduced. Pad sizes, supporting base and the number of axle sets can easily be adapted to comply with the most stringent quay load restrictions.

Weight	
Total weight of crane in container version (154 t winch, 54 m boom, 4.8 m tower extension, Pactronic®)	approx. 454 t

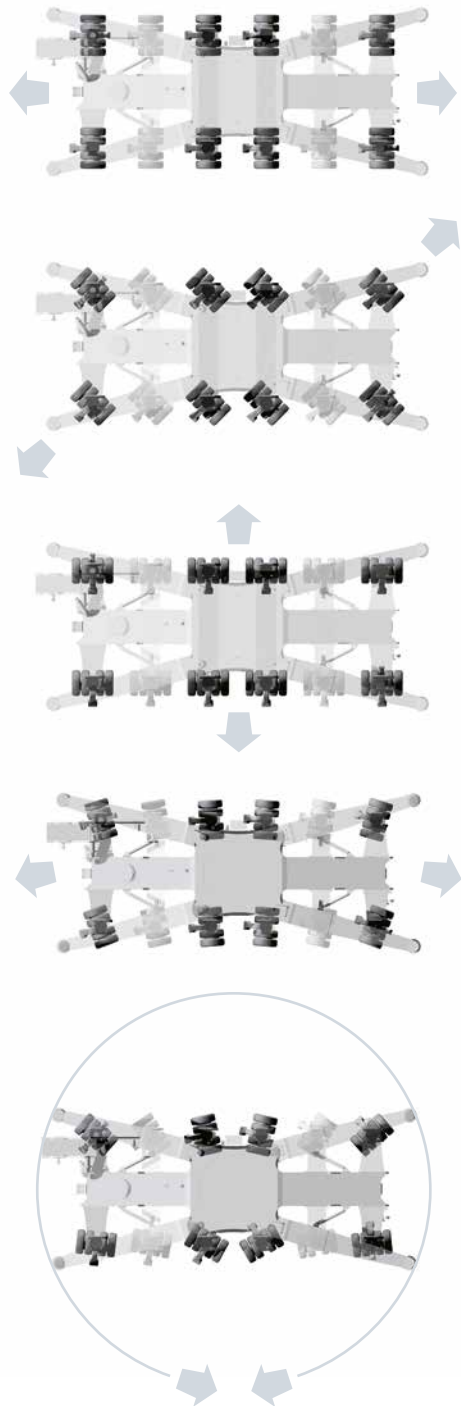
Hoisting heights	
Above quay at minimum radius	51.1 m
Above quay at maximum radius	36.3 m
Below quay level (approx.)	15.0 m

# Undercarriage

## Mobility

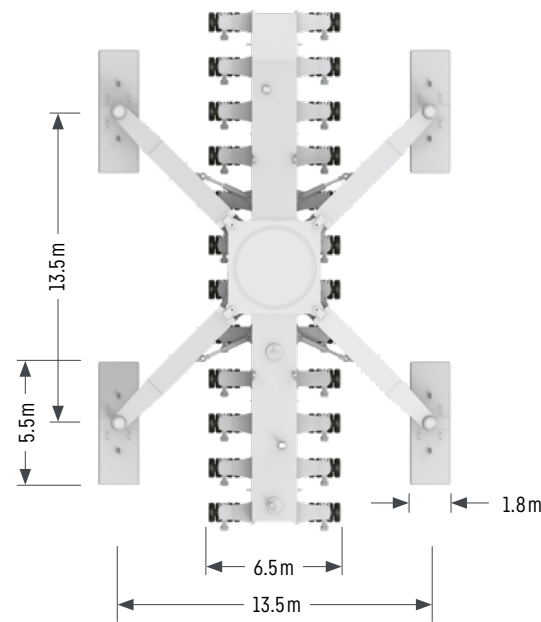
- Outstanding mobility and manoeuvrability
- Curves at any possible radii and even slewing on the spot

## Schematic diagram



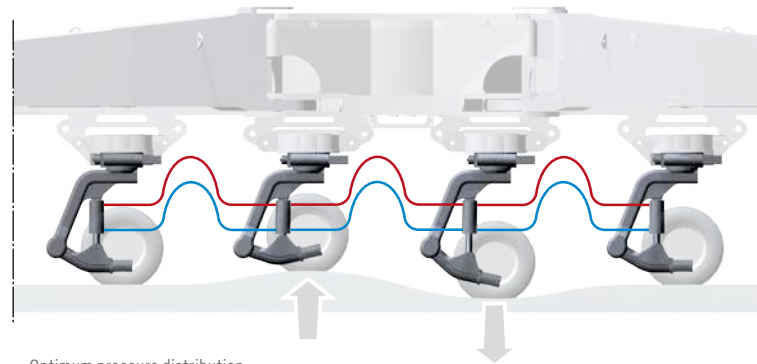
## Modular propping system

- Minimised stress and strain of undercarriage due to cruciform support base which directs the load path from boom tip to quay
- Modular system allows further reduction of quay loads by installing additional axle sets
- Easy adaptation to various sizes of support pads and bases



## Hydraulic load distribution

- Hydraulic suspension avoids overloading of individual wheel sets
- Standard trailer tyres making requisition of spares economical and time-saving
- Increased lifetime of tyres due to individually steerable wheel sets



Optimum pressure distribution and adaption of wheel sets on uneven surfaces

# Optional equipment

## Additional products and services

- Pactronic® - power by accumulator and electronics
- SmartGrip - intelligent grabbing
- Cycloptronic® - anti-sway system
- Teach-In - semi-automatic point to point system
- Syctratronic® - synchronizing crane control system
- Vertical Line Finder - diagonal pull preventing system
- Collision alert system
- LiDAT® - smartApp
- Economy software - for optimised fuel consumption
- Video monitoring system
- Radio remote control
- Autopropping undercarriage
- Cyclone air-intake system for the engine
- Low temperature package
- Customer-specific painting & logo
- Additional (driven) axle sets
- Axle sets equipped with foamed tyres
- Different supporting bases and pad sizes
- Tower extension - 4.8 m
- And many more as per customers' requirements

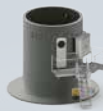
# Practical solutions



LPS 550



LFS 550



LHM 550



LPM 550



LBS 550



LHM 550 on barge

## Liebherr develops and produces special designs and solutions to meet customer-specific requirements

- The Liebherr Portal Crane (LPS) is an efficient combination of a space-saving portal (mounted on rails) and the proven mobile harbour crane concept. Particularly on narrow quays, individual portal solutions permit (railway) trains and (road) trucks to travel below the portal.
- Liebherr floating cranes (LBS) can be used for transshipment and midstream operation between ocean-going vessels and river barges on different types of waterways, including those having no or few quays. In addition, the LBS solution allows direct cargo transfer from ship to shore – especially when quays reach capacity limits.
- Depending on customer specifications, the LBS range may have varying lifting capacities due to tailor-made design solutions.
- Liebherr Fixed Slewing Cranes (LFS) are an efficient combination of a mobile harbour crane upper carriage and a fixed pedestal. LFS cranes provide an economical and space-saving solution for the installation on quaysides and jetties, especially where room for manoeuvring is limited and low ground pressure is essential. Additionally LFS solutions are also ideally suited for the installation on crane barges.
- The Liebherr Portal Mobile Crane (LPM) is the perfect combination of a space-saving portal undercarriage, efficient mobile harbour crane technology and unrestricted mobility. A gantry on rubber tyres enables the crane to be travelled from one quay to another. Supporting pads allow the crane to be used on quays with or without rail tracks.

# LIEBHERR

## MOBILE HARBOUR CRANE

### TYPE

**LHM 550 Litronic®**

### TECHNICAL DATA

3508.03.05

Owner:	WGA, Australia
Inquiry/Project No.:	Dampier
Liebherr Project/Offer No.:	-----

MCR  
19.08.2022

Rev. -



## TECHNICAL DATA

### TABLE OF CONTENTS

<b>1</b>	<b>MAIN DATA</b>	<b>3</b>
1.1	Load Table	3
1.1.1	Load Capacity Chart	3
1.1.2	Travelling Window	4
1.2	Operating Speeds	4
1.3	Weights	4
1.4	Dimensions	5
1.5	Environmental Conditions	6
1.6	Requirements on Quay	6
1.7	Drive System	7
1.8	Hydraulic Oil	7
1.9	Lighting	8
1.10	Heating	8
1.11	Group Classification of Crane and Components	9
1.12	Documentation	9
1.13	Protective Coat/Painting	10

# 1 MAIN DATA

## 1.1 Load Table

### 1.1.1 Load Capacity Chart

Dead weight Rotator = 3,5 t

Dead weight Single Lift Spreader = 9,0 t

SWL Single Lift Spreader = 41,0 t

Dead weight Twin Lift Spreader = 10,7 t

SWL Twin Lift Spreader = 50,0 t

Radius (m)	Hook Operation				Spreader Operation		Motor Grab or/and Electro Magnet on Rope (t)
	Utilisation of Tipping		Utilisation of Tipping		under		
	75%		66%		Single Lift	Twin Lift	
	on Rope (t)	on Hook (t)	on Rope (t)	on Hook (t)	Spreader (t)	Spreader (t)	
11	104,0	100,5	104,0	100,5	41,0	50,0	90,0
12	104,0	100,5	104,0	100,5	41,0	50,0	90,0
13	104,0	100,5	104,0	100,5	41,0	50,0	90,0
14	104,0	100,5	104,0	100,5	41,0	50,0	90,0
15	104,0	100,5	104,0	100,5	41,0	50,0	90,0
16	104,0	100,5	104,0	100,5	41,0	50,0	90,0
17	104,0	100,5	104,0	100,5	41,0	50,0	90,0
18	104,0	100,5	104,0	100,5	41,0	50,0	90,0
19	104,0	100,5	104,0	100,5	41,0	50,0	90,0
20	104,0	100,5	104,0	100,5	41,0	50,0	90,0
21	104,0	100,5	104,0	100,5	41,0	50,0	90,0
22	104,0	100,5	104,0	100,5	41,0	50,0	90,0
23	104,0	100,5	104,0	100,5	41,0	50,0	88,1
24	104,0	100,5	104,0	100,5	41,0	50,0	83,8
25	104,0	100,5	99,8	96,3	41,0	50,0	79,9
26	104,0	100,5	95,3	91,8	41,0	50,0	76,2
27	102,5	99,0	91,1	87,6	41,0	50,0	72,9
28	97,7	94,2	86,9	83,4	41,0	50,0	69,5
29	93,3	89,8	82,9	79,4	41,0	50,0	66,3
30	89,2	85,7	79,3	75,8	41,0	50,0	63,4
31	85,6	82,1	76,1	72,6	41,0	50,0	60,9
32	82,3	78,8	73,1	69,6	41,0	50,0	58,5
33	79,0	75,5	70,3	66,8	41,0	50,0	56,2
34	76,0	72,5	67,6	64,1	41,0	50,0	54,1
35	73,3	69,8	65,1	61,6	41,0	50,0	52,1
36	70,7	67,2	62,8	59,3	41,0	48,6	50,3
37	68,3	64,8	60,7	57,2	41,0	46,5	48,5
38	66,0	62,5	58,7	55,2	41,0	44,5	47,0
39	63,9	60,4	56,8	53,3	41,0	42,6	45,5
40	62,0	58,5	55,1	51,6	41,0	40,9	44,1
41	60,1	56,6	53,5	50,0	41,0	39,3	42,8
42	58,4	54,9	51,9	48,4	39,4	37,7	41,5
43	56,8	53,3	50,5	47,0	38,0	36,3	40,4
44	55,2	51,7	49,1	45,6	36,6	34,9	39,3
45	53,7	50,2	47,7	44,2	35,2	33,5	38,2
46	52,2	48,7	46,4	42,9	33,9	32,2	37,1
47	50,7	47,2	45,1	41,6	32,6	30,9	36,0
48	49,3	45,8	43,8	40,3	31,3	29,6	35,0
49	47,8	44,3	42,5	39,0	30,0	28,3	34,0
50	46,4	42,9	41,3	37,8	28,8	27,1	33,0
51	45,0	41,5	40,0	36,5	27,5	25,8	32,0
52	43,6	40,1	38,7	35,2	26,2	24,5	31,0
53	42,2	38,7	37,5	34,0	25,0	23,3	30,0
54	40,9	37,4	36,3	32,8	23,8	22,1	29,1

## 1.1.2 Travelling Window

For travelling the boom of crane must be positioned either over front part (slew angle = 0°) or over rear part of undercarriage (slew angle = 180°).

The maximum load on ropes during travelling is (travelling in both directions) 25t .

Special travel windows are possible with additional axle sets or customer specific modifications.

## 1.2 Operating Speeds

- \* 100 percent infinitely variable speed control from zero to maximum speed
- \* electronic-controlled acceleration/deceleration, to avoid shocks to crane and load and to enable smoother speed control
- \* automatic power output regulators
- \* slewing, luffing, hoisting can be operated simultaneously

ac- / deceleration time			
Hoisting / Lowering	appr. 1 sec	21,0 m/min with	104 t
		25,0 m/min with	90 t
		37,0 m/min with	60 t
		56,0 m/min with	40 t
	appr. 3 sec	120,0 m/min with	empty hook
Slewing	appr. 5-6 sec	0 - 1,6 rpm	
		280 m/min	max speed boom head
		360 °	unlimited slewing range
Luffing	appr. 2 sec	47 sec	theoretical with full load from max. to min working radius without ac- and deceleration
		55 m/min	average horizontal speed
Travelling	appr. 6 sec	0 - 5 km/h	without load
Max. inclination in transverse direction		2%	without load, during travelling
Max. inclination in longitudinal direction		5%	without load, during travelling

(Steeper gradients can be negotiated with additional driven axle sets)

## 1.3 Weights

Total weight of crane	appr.	449 t
-----------------------	-------	-------

## 1.4 Dimensions

Support base	13,5 m x 13,5 m	
Size of supporting pads	5.5 m x 1.8 m	
Supporting area of pads	9,9 m <sup>2</sup>	
Optional size of supporting pads	on request	
Overall width without supporting pads	6,5 m	
Overall width with supporting pads	10,2 m	
and swung in outriggers		
Overall width in traveling position	15,3 m	
and deployed outriggers		
Overall length of undercarriage	20,7 m	
Length of boom (centre sheaves)	55,0 m	
Overall height (top of tower)	35,9 m	
Height of boom fulcrum	17,8 m	
Cab height (eye level)	24,3 m	
Turning radius	0 m	inner
incl. supporting pads	13,8 m	outer
Tail swing radius	7,4 m	
Max. hoisting height		(measured at rope socket)
above quay at minimum radius	49,5 m	
above quay at maximum radius	31,4 m	
below quay	15,0 m	
Winchconfiguration	1x104t	
Number of winches	1 (2 ropes per winch)	
Diameter of hoisting rope	46 mm	
Diameter of sheaves at boom head	1046 mm	
Ratio between diameter of hoisting rope to sheaves	1 : 22,7	
Diameter of rope drum	1100 mm	
Ratio between diameter of rope to drum	1 : 23,9	
Number of axle sets	20	
Number of axle sets (optional)	24	
Axle sets driven	6	
Axle sets steerable	all	
No. of tyres	4 per axle set	
Tyres	285/70 R 19,5 make Continental	
Tyre pressure	10 bar max	



## 1.5 Environmental Conditions

Ambient temperature	-20° C to +45 ° C
Humidity (relative)	97 %
Max. wind speed in operation	24 m/s
Max. wind speed out of operation	42 m/s
Max. wind speed during travelling	20 m/s

## 1.6 Requirements on Quay

During crane operation and driving, the following pressures are relevant

Assumed Conditions:

Normal	=	all static loads are included
Extreme	=	all static loads and dynamic factors are included

Max. axle set loading:	Normal	appr.	22,4 t
( 2 axle sets = 1 axle line)	Extreme	appr.	27,5 t

### Max. Corner Loading:

		<b>75%</b>	<b>66%</b>	<b>Grab</b>
Normal (static excl. wind)	boom 45°	276,3 t	256,6 t	219,9 t
	boom 90°	238,4 t	223,4 t	193,8 t
Normal (static incl. wind)	boom 45°	290,1 t	270,1 t	232,1 t
	boom 90°	248,2 t	232,9 t	202,4 t
Extreme (dynamic incl. wind)	boom 45°	308,8 t	281,6 t	248,4 t
	boom 90°	252,6 t	241,5 t	213,2 t

### Max. Area Pressure:

		<b>75%</b>	<b>66%</b>	<b>Grab</b>
Normal (static excl. wind)	boom 45°	27,9 t/m <sup>2</sup>	25,9 t/m <sup>2</sup>	22,2 t/m <sup>2</sup>
	boom 90°	24,1 t/m <sup>2</sup>	22,6 t/m <sup>2</sup>	19,6 t/m <sup>2</sup>
Normal (static incl. wind)	boom 45°	29,3 t/m <sup>2</sup>	27,3 t/m <sup>2</sup>	23,4 t/m <sup>2</sup>
	boom 90°	25,1 t/m <sup>2</sup>	23,5 t/m <sup>2</sup>	20,4 t/m <sup>2</sup>
Extreme (dynamic incl. wind)	boom 45°	31,2 t/m <sup>2</sup>	28,4 t/m <sup>2</sup>	25,1 t/m <sup>2</sup>
	boom 90°	25,5 t/m <sup>2</sup>	24,4 t/m <sup>2</sup>	21,5 t/m <sup>2</sup>

## 1.7 Drive System

Prime mover	Diesel Engine	
Make	LIEBHERR	
Type	D 9512 A7	
Combustion system	Diesel	
Emission standard	Stufe 5 / Tier 4F	
Number of cylinder	12	
Cooling system	Water	
Max. torque	4750 Nm	at 1500 rpm
Output on the drive shaft	750 kW	at 1700 rpm acc. ISO 9249
Average consumption	198 g/KWh	
Fuel tank capacity	13000 l	
AdBlue® / DEF tank capacity	1000 l	
Starter	Bosch QB	
Output	9 kW	
Dynamo	Bosch	
Nominal current	140 Amp	
Voltage	24 V	

## 1.8 Hydraulic Oil

Oil	See table of lubricants
Oil cooling	The hydraulic driven oil cooler is located outside the machinery room, protected via cover, cooling medium is fresh air

## 1.9 Lighting

Appropriate illumination is fitted in

- machinery room
- switch cabinet room
- cabs
- access to the crane

Floodlight type

- LED

Position

- two on the boom
- one on the tower

Rating (per floodlight)

- 355 W

Steps from the tower cabin are provided with battery-buffered 24 VDC emergency lights. Two warning lights (on undercarriage) and a ringing bell when travelling are standard.

## 1.10 Heating

- Heating of driver's cabin (tower cab 6 kW, optional lower cab 6,5 kW)
- Heating of switch cabinet room (1 x 2 kW)
- Standstill heating of slipring collector, switch cabinet
- Total installed heating capacity approx. 14,5 kW

Optional:

- Heating of the hydraulic tank (1.4 kW)
- Preheating of cooling water (2 kW)

## 1.11 Group Classification of Crane and Components

Authorities, Regulations

EN, FEM, DIN, VDE, VDI, IEC, ISO

### Classification of crane as a whole in appliance groups

	Crane group at operation with			<b>Grab</b>
	<b>Load</b>	<b>75%</b>	<b>66%</b>	
Hook operation	< 104t	A4	A4	
Hook operation	< 77t	A6	A6	
Spreader Operation	< 63t		A7	
Motor Grab Operation	< 52t			A8

### Classification of individual mechanisms

	Mechanism group			
	<b>Hook operation</b>	<b>Hook operation</b>	<b>spreader</b>	<b>motor grab</b>
Winch gear	M7 (70t)	M4 (104t)	M8 (63t)	M8 (63t)
Luffing gear	M7	M7	M7	M7
Slewing gear	M6	M7	M6	M7
Travelling gear	M4	M4	M4	M4

## 1.12 Documentation

Standard scope of delivery includes

- 3 operation/maintenance manuals
- 3 spare parts books
- 3 works certificates

## 1.13 Protective Coat/Painting

### I GENERAL

- Liebherr LH N° 983593014
- Cleaning and Substrate Preparation  
Solvent Cleaning/Degreasing  
Shot Blasting SA 2.5 (ISO 8501-1)
- Surface Profile: Comparator Type "G"  
Segment 2-3 (ISO 8503-1)

### II CRANE - INTERNAL SURFACES

#### Film thickness

#### 1 Priming Coat

2-Pack Zinc Rich Epoxy Primer  
Interzinc 315 or equiv.

75 microns

#### 2 Finish Coat

2-Pack Epoxy Finish Coat  
Amerlock 400C or equiv.

125 microns

-----  
**Total Min. Dry Film Thickness**

**200 microns**  
=====

### III CRANE - EXTERNAL SURFACES

#### Film thickness

#### 1 Priming Coat

2-Pack Zinc Rich Epoxy Primer  
Interzinc 315 or equiv.

75 microns

#### 2 Intermediate Coat

2-Pack Epoxy Finish Coat  
Amerlock 400C or equiv.

130 microns

#### 3 Finish Coat

2-Pack Polyurethane Final Paint  
Amercoat 450E or equiv.

75 microns

-----  
**Total Min. Dry Film Thickness**

**280 microns**  
=====

#### Note:

Above values are related to primary structure.

The final colour shade for undercarriage, slewing platform steel construction, counter weights and tower is RAL 7043.

The colour shade for the slewing platform is Liebherr yellow (RAL 1006-1007), jib and housing of the cooling devices are in RAL 7047.

The cabin is in RAL 9002.

All ladders, stairs, walkways, etc. are hot dip galvanised.

- Subject to engineering modification -



# **APPENDIX M**

## SAFETY IN DESIGN REGISTER



## SAFETY IN DESIGN

Project Title	DAMPIER CARGO WHARF PILE ASSESSMENT
Principal Client	PILBARA PORTS AUTHORITY (PPA)
Limitations	<ol style="list-style-type: none"><li>1. Only hazards reasonably foreseeable at the time of design, and that could result from design aspects of the project that WGA are responsible for, have been considered.</li><li>2. Only hazards that are associated with the particular design, and not with other designs of the same type of product, have been considered.</li><li>3. Any hazards arising due to normal site construction, maintenance or operation as covered by Australian codes and standards, local codes and guidelines etc. have not been considered in this assessment</li><li>4. It has been assumed that the contractor and owner will undertake their own risk assessments to appropriately consider construction and operational risks.</li></ol>

Job Number:	WGA222255	Author(s) /	OK	JG
Creation Date:	3/Apr/24	Attendees:		

REVISION CONTROL			
Date	Revision	Project Phase	Author
3/4/2024	A	<input checked="" type="radio"/> Concept <input type="radio"/> Detailed Design	OK

## SUMMARY

Residual Risk Score	Item No.	Risk Description	Control Measures	Action Owner (s)
Medium	2-1	Geotechnical failure of the piles	<p>A full review of all piling records and analysis on these were undertaken.</p> <p>Compare these with previous records and capacities.</p> <p>Adopt conservative geotechnical reduction factors at this stage of design/assessment</p> <p>During construction pile should be undertaken to verify the design capacities of the piles</p>	<p>WGA</p> <p>WGA</p> <p>WGA</p> <p>PPA</p>
Medium	2-2	Structural failure of the piles	<p>A full condition assessment of the piles should be undertaken to confirm the condition of the piles prior to detailed design being undertaken.</p>	PPA
Medium	2-3	Structural and geotechnical failure of the piles due to berthing loading which is a lateral force that engages the raker piles and northern strong point	<p>Quarter berthing should be away from the northern strong point. Control shall be put in place to reduce berthing velocities.</p> <p>Restriction on parallel berthing to be implemented.</p> <p>Provide additional raker piles to be installed in the detailed design of the wharf to increase the strength of the wharf to sustain berthing loads.</p>	PPA
Medium	2-4	Structural failure of piles 54, 55, 61, 62, 67, 68, 74, 75, 80, 81, 87, 88, 93, 94, 100 and 101 due to strut detailing causing bending.	<p>Strut detail at these piles is to be amended to ensure that bending is limited in the piles</p>	PPA
Medium	2-5	Application of Harbour Crane loads causing geotechnical failure in the piles.	<p>Detailed assessment of specific harbour cranes that will be used on the wharf.</p> <p>Consideration should be made to load the deck mid-span between the piles to reduce and spread the loading on the piles.</p> <p>Possible installation of beams along Harbour Crane track lines to further spread the loading.</p>	PPA
Medium	3-1	Scour to the base of the piles	<p>Provide scour prevention detailing for the base of piles.</p> <p>Scour assessment can also be completed by a specialist to determine if required.</p>	PPA

1.0	Pre-design phase	Complete	Designer comments
-----	------------------	----------	-------------------

1.1 What is the project scope that WGA is responsible for?

WGA is responsible for assessing the existing piles, including determining their geotechnical and structural capacity. WGA is to provide an assessment of the wharf piles for proposed loading requirements as specified by PPA. No design is being undertaken however this will inform the design decisions.

1.2 Which disciplines are involved the project scope?

- ☒ Structural  
☐ Civil  
☐ Geotech  
☐ Mechanical  
☐ Electrical  
☐ Process  
☐ Other  
☒ Designer (WGA)  
☐ Designer  
☒ Client  
☐ Contractors  
☐ Other

1.3 Who will be involved in the Safety in Design process?

1.4 Is an external risk assessment workshop required?

- ☐ Yes  
☒ No

2.0	Concept design phase	Complete	Designer comments
-----	----------------------	----------	-------------------

2.1 Are there unusual or site specific design related hazards associated with the following?

- Electrical
- Fire and Explosion
- Access, Egress and Movement
- Slipping Tripping and Falling
- Manual Tasks and Ergonomics

- ☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No


- Crushing and Entanglement
- Cutting, Stabbing or Puncturing
- Shearing and Striking
- Working Environment and Noise
- High Pressure Fluid
- Construction Plant
- Amenities and Facilities
- Earthworks
- Groundwater
- Structural Safety
- Hazard Combinations (controls system failure)
- Radiation and Substances
- Stored Energy (temperature, gravitational, chemical, mechanical etc.)
- Other (please specify in comments)

☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☒ Yes ☐ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☒ Yes ☐ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No  
☐ Yes ☒ No

Determination of crane loading and other use of the wharf.
Assessment for reuse of the existing piles for future upgrades

3.0	Detailed design phase	Complete	Designer comments
-----	-----------------------	----------	-------------------

- 3.1 Have there been any changes to the design that affect the outcome of Section 2?
- 3.2 Does the risk assessment need to be updated?

☐ Yes  
☒ No  
☐ Yes  
☒ No


4.0	Project close out	Complete	Designer comments
-----	-------------------	----------	-------------------

- 4.1 Provide a copy of Safety in Design report to client

☐ Complete

--

## HAZARD REGISTER

Hazard Identification			Initial Risk Rating			Controls		Residual Risk Rating			Status	
Item (No.)	Risk Description	Possible causes	Consequence	Likelihood	Risk score	Control measures	Action owner (s)	Consequence	Likelihood	Risk score	Completion Status	Comments / Follow Up
1	Design for safe construction											
2	Design for safe use											
2-1	Geotechnical failure of the piles	<p>Pile capacities are underestimated in the analysis by the adoption of assumptions that are not correct.</p> <p>Localised piles that do not achieve the required geotechnical capacity for loading conditions.</p> <p>Lack of specific piling or bore hole records that are applicable to the assessment.</p>	Major (D)	Possible (3)	High	<p>A full review of all piling records and analysis on these were undertaken.</p> <p>Compare these with previous records and capacities.</p> <p>Adopt conservative geotechnical reduction factors at this stage of design/assessment</p> <p>During construction pile should be undertaken to verify the design capacities of the piles</p>	<p>WGA</p> <p>WGA</p> <p>WGA</p> <p>PPA</p>	Major (D)	Unlikely (2)	Medium	Open	PPA to ensure testing of piles is scoped into the construction phase.
2-2	Structural failure of the piles	Pile failure due to deterioration of the piles is not accounted for in the assessment. Such as localised defects.	Major (D)	Unlikely (2)	Medium	A full condition assessment of the piles should be undertaken to confirm the condition of the piles prior to detailed design being undertaken.	PPA	Major (D)	Very Unlikely (1)	Medium	Open	PPA to plan for condition assessment to be undertaken prior to detailed design.
2-3	Structural and geotechnical failure of the piles due to berthing loading which is a lateral force that engages the raker piles and northern strong point	<p>Raker piles at the northern strong point are noted to not have sufficient capacity when quarter point berthing loads are concentrated to the north end of the wharf.</p> <p>Parallel berthing loads provide increased lateral loading on the piles, which causes failure in the rakers. Currently the wharf does not have sufficient capacity for a full parallel berthing load and has a risk of failure.</p>	Major (D)	Possible (3)	High	<p>Quarter berthing should be away from the northern strong point. Control shall be put in place to reduce berthing velocities.</p> <p>Restriction on parallel berthing to be implemented.</p> <p>Provide additional raker piles to be installed in the detailed design of the wharf to increase the strength of the wharf to sustain berthing loads.</p>	PPA	Major (D)	Unlikely (2)	Medium	Open	<p>PPA to review berthing procedures to limit quarter point berthing at strong point and parallel berthing.</p> <p>PPA to ensure that the design considers the installation of additional raker piles for berthing loads.</p>
2-4	Structural failure of piles 54, 55, 61, 62, 67, 68, 74, 75, 80, 91, 87, 88, 93, 94, 100 and 101 due to strut detailing causing bending.	Currently the arrangement of the fender and strut to the second grid of piles is causing additional bending in the piles. For existing berthing loads at these piles the piles are inadequate.	Major (D)	Possible (3)	High	Strut detail at these piles is to be amended to ensure that bending is limited in the piles	PPA	Major (D)	Unlikely (2)	Medium	Open	PPA to include provision for the amendment to the strut detail in the detailed design
2-5	Application of Harbour Crane loads causing geotechnical failure in the piles.	The adoption of harbour cranes on the wharf which are in excess of capacity of the piles.	Major (D)	Possible (3)	High	<p>Detailed assessment of specific harbour cranes that will be used on the wharf.</p> <p>Consideration should be made to load the deck mid-span between the piles to reduce and spread the loading on the piles.</p> <p>Possible installation of beams along Harbour Crane track lines to further spread the loading.</p>	PPA	Major (D)	Unlikely (2)	Medium	Open	PPA to include scope for assessment of the wharf for harbour crane loads in the detailed design and solutions to address overutilization to be formulated.
3	Design for safe maintenance											
3-1	Scour to the base of the piles	Scour due to current velocities occurring at the base of the piles which increases the effective length and decreases their capacity.	Moderate (C)	Possible (3)	Medium	<p>Provide scour prevention detailing for the base of piles.</p> <p>Scour assessment can also be completed by a specialist to determine if required.</p>	PPA	Moderate (C)	Very Unlikely (1)	Medium	Open	PPA to explore the option for scour protection for the piles.
4	Modification											
5	Demolition and dismantling											

REFERENCES

Risk Rating Matrix						
Consequence		Likelihood				
		Very Unlikely (1)	Unlikely (2)	Possible (3)	Likely (4)	Very Likely (5)
		Conceivable, but only in extreme circumstances.	Known to occur, but only rarely.	May occur, and has occurred in a minority of similar projects.	Is likely to occur during the project, or has occurred on similar projects.	Expected to occur at least once during the project.
Insignificant (A)	Insignificant impact to health and safety resulting in minor injuries not requiring medical assistance.	Low	Low	Low	Medium	Medium
Minor (B)	Minor impact to health and safety resulting in injuries requiring first aid assistance.	Low	Low	Medium	Medium	High
Moderate (C)	Moderate impact to health and safety resulting in injuries requiring medical assistance.	Medium	Medium	Medium	High	Very High
Major (D)	Major impact to health and safety resulting in lost time due to injury or illness.	Medium	Medium	High	Very High	Extreme
Catastrophic (E)	Catastrophic impact to health and safety resulting in fatality.	Medium	High	Very High	Extreme	Extreme





FOR FURTHER INFORMATION CONTACT:

Jane Gagaleski  
Principal Structural Engineer

T 08 9336 6528

E [jgagaleski@wga.com.au](mailto:jgagaleski@wga.com.au)

[WGA.COM.AU](http://WGA.COM.AU)  
[WGANZ.CO.NZ](http://WGANZ.CO.NZ)

