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TECHNICAL REPORT

VERITAS Report No. 503080-54/2	Subject Group
Title of Report: DESIGN, FABRICATION AND INSTALLATION RESUME FOR CDP1 - CONCRETE PLATFORM, FRIGG FIELD	
Client/Sponsor of project: ELF AQUITAINE NORGE A/S, STAVANGER	
Work carried out by: Kjell I. Stokke	

Date: 17th March, 1978	
Department	Project No. 503080
Approved by:	
Client/Sponsor ref.: H. Lye	
Reporters sign.	

DEL 2

APPENDIX I

DORIS DESIGN CRITERIA

26th June 1975

FRIGG MPI / DPI PLATFORM

DESIGN CRITERIA , CODES

I/ DESIGN CODES

1-1 ACI 318-71 for structure and main deck

1-2 For flexure calculations in structure : FIP - CEB with " OSLO CRITERIA "

LOAD CONDITION	S L S		U L S	
	γ_s	Stress kg/cm2	γ_s	
Ordinary	1,0	$\sigma_a = 1600$ $\Delta\sigma_a = 800$	1,5	$\sigma k/\gamma_m$
Extraordinary	-	-	1,1	$\sigma k/\gamma_m$
Towing and Provisional	1,0	$\sigma_a = 2600$ $\Delta\sigma_a = 1300$	1,2	σ_k/γ_m

γ_m = 1,15 for steel
1,50 for concrete

1-3 For flexure design of the deck, the load factors for ULS calculations are :

- Operating conditions Dead load 1,4
Live load 1,7
Wind 1,7

- Storm conditions	Dead load	1,2
	Live load	1,2
	Wind	1,2
	Wave	1,2

2/ MATERIALS DATA

- Concrete strength at 28 days, on cylinders 400 kg/cm^2
- Reinforcement steels f_y = 4000 kg/cm^2 , $\emptyset \leqslant 20$ mm

  f_y = 3800 kg/cm^2 , $\emptyset \geqslant 25$ mm

- Prestressing steels

  Cables FREYSSINET 12 T 15
  Guaranteed minimum breaking strength 25,4 T/strand
  Relaxation at 1000 hours = 7 %
  Initial tension in cables at anchorage 145 kg/mm^2
  Theoretical area : 140 mm^2/strand

APPENDIX II

DECK MODULES. (FROM DNV REPORT FRIGG FIELD CDP1 PLATFORM1 LIST OF APPROVED PLANTS 10.11.76).

FRIGG FIELD

CDP 1 PLATFORM

LIST OF APPROVED PLANS

LIST OF CONTENTS

A. ELF MODULES AND EQUIPMENT

LIST OF APPROVED PLANS FOR FRIGG CDP 1

A. ELF MODULES AND EQUIPMENT

0. LIST OF ELF MODULES

Designation	Name	Yard	DnV Survey Static
PM 3	Scrubber, Desander Module	U.I.E., St.Wandrille	DnV, Le Havre
PM 3	Pig trap module	- " -	- " -
PM 4	Living quarter	- " -	- " -
SD 1	Service deck	Reg.Booth, Hartlepool,UK	DnV, Newcastle
SD 2	Modules	- " -	
SD 3	- " -	- " -	- " -
SD 4	- " -	- " -	- " -
-	Pump and tank house modules	Penn&Bauduin, B.V.,Dordrecht, Holland	DnV, Rotterdam
FB 100/112	Tank	- " -	- " -
FB 105/110	- " -	- " -	- " -
WH 1	Wellhead	De Groot,Holland	- " -
WH 2	Modules	- " -	- " -
BR 1	BR 1	Wilson Walton Ltd., U.K.	DnV, Newcastle
BR 2	BR 2	- " -	- " -
-	East and west flare boom	- " -	- " -
-	Quarters Cantilever	?	None

1. STRUCTURAL DESIGN AND FABRICATION

1.1. Specifications, Brown & Root Modules.

The following structurally related specifications by Brown & Root have been accepted by DnV :

MPX/DP1-A-003, rev. 1, General Fabrication Specifications Sections G-0.0 and G-1.0.

MPX/DP1-M-109 rev. 0, General Fabrication and Welding Specification for all Deck and Riser Facility Steelwork on Drilling Platform.

MPX/DP1-M-110 rev. 0, Structural and Non-Structural Rolled Steel Plate and Sections.

MPX/DP1-X-1 rev. 0, Protective Coating (comments in DnV tlx. 9751 of 30.12.75 are still outstanding according to our records).

1.2. Design, Drawings and Fabrication.

The following design reports, drawings and fabrication of said module on structure have been accepted by DnV.

In the event of acceptance with qualification, these will be noted at the respective structure.

1.2.1. Service Deck Modules.

1.2.1.1. Design report by Brown & Root MPX-DP1 Conversion-Service Deck Design Report dated 4.6.75.

1.2.1.2. Drawings by Brown & Root :

B-EN-SS-091 C, General arrangement of service deck
B-EN-SS-092, Module SD1
B-EN-SS-093 A, Module SD2
B-EN-SS-094 D, Module SD3
B-EN-SS-095, Module SD4
B-EN-SS-096, Module 4 sections
B-EN-SS-140, Stairs Module 1
B-EN-SS-142 A, Material access hatch
B-EN-SS-143, Misc details 1
B-EN-SS-144, Misc Details 2
B-EN-SS-145 C, Detail Plans

B-EN-SS-146 C, Joint Details 1
B-EN-SS-147, Joint Details 2
B-EN-SS-148 A, Joint Details 3
B-EN-SS-149 A, Joint Details 4
B-EN-SS-150, Joint Details 5
B-EN-SS-151 A, Joint Details 6
B-EN-SS-152, Joint Details 7
B-EN-SS-153, Joint Details 8
B-EN-SS-154, Joint Details 9
B-EN-SS-155, Joint Details 10
B-EN-SS-158, Padeyes 1-4
B-EN-SS-159, Winch area & details

CDP 1 - SS-313, Additional support for 20 tons winch

1.2.1.3. Fabrication.

The fabrication of these 4 modules took place at Reg. Booth, Hartlepool, U.K., under inspection supervision by DnV, Newcastle.

1.2.2 Pump and Tank House Modules.

1.2.2.1. Design report by Brown & Root.

MPX-DP1 Conversion Project - Pump and Tank Houses (preliminary submission, dated May 75.

1.2.2.2. Drawings by Brown & Root.

B-EN-SS-113, Plan on pumphouse and tank modules
B-EN-SS-114, P.H. & Storage tank longitudinal truss
B-EN-SS-115 Framing plans for tanks FB100 and FB110 support module
B-EN-SS-116, Framing plans for PH support module
B-EN-SS-117, Framing plans for tanks FB105 and FB110 support modules
B-EN-SS-118, End trusses for tank & pump house support modul
B-EN-SS-119, P.H. Joint Details
B-EN-SS-120, Joint details trusses ABCDE
B-EN-SS-121, Truss ABEF tank, joint details
B-EN-SS-122, Truss ABEF tank, joint details
B-EN-SS-123, Truss ABEF tank, joint details
B-EN-SS-125, Pumphouse misc. details

1.2.2.3.Fabrication.

The fabrication of these 2 module frames took place at Penn & Bauduin, B.V., Dordrecht, Holland, under inspection supervision by DnV, Rotterdam.

1.2.3. Tanks FB100/112 and FB 105/110.

1.2.3.1.Design report by Brown & Root.

CDP1 Conversion Project - Design Report of Tanks (preliminary submission), dated November 75.

1.2.3.2.Drawings by Brown & Root.

CDP1-SS-138 B Plan elev. & details for tanks, FB 100, 112, 105 & 110.

CDP1-SS-139-0 Manway covers, ladders & details

1.2.3.3.Fabrication.

The fabrication of these tanks took place at Penn & Bauduin B.V., Dordrecht, under inspection supervision by DnV, Rotterdam.

1.2.4. Wellhead Modules.

1.2.4.1.Design report by Brown & Root.

Preliminary design report - CDP1 Wellhead Module dated October 74.

1.2.4.2.Drawings by Brown & Root.

B-EN-SS-003 F, Longitudinal truss elevation (south)
B-EN-SS-004 F, Longitudinal truss elevation (north)
B-EN-SS-005 C, End view and section
B-EN-SS-006 A, Intermediate cross section
B-EN-SS-007 A, Floor plans & wind bracing
B-EN-SS-008, Roof plans & wind bracing
B-EN-SS-012 A, Truss details
B-EN-SS-013, Wellhead module floor plan
Wellhead module roof detail

B-EN-SS-014,	Plan
B-EN-SS-017,	Joint details - longitudinal truss
B-EN-SS-017,	Joint details - longitudinal truss
B-EN-SS-018,	Joint details - longitudinal truss
B-EN-SS-019,	Joint details - longitudinal truss
B-EN-SS-020,	Joint details - longitudinal truss
B-EN-SS-021 A,	Joint details - longitudinal truss
B-EN-SS-023,	Joint details - longitudinal truss
B-EN-SS-024,	Splice details
B-EN-SS-025,	Joint details - longitudinal truss
B-EN-SS-028,	Roof deck drain layout arrangement 1
B-EN-SS-029,	Floor deck drain layout arrangement 1
B-EN-SS-030,	Drainage Box Details
B-EN-SS-031,	Drainage Box Details
B-EN-SS-032,	Joint details roof framing
B-EN-SS-033,	Joint details roof framing
B-EN-SS-034 A,	Joint details roof framing
B-EN-SS-035,	Joint details roof framing
B-EN-SS-036,	Joint details roof framing
B-EN-SS-037,	Joint details roof framing
B-EN-SS-038 A,	Joint details roof framing
B-EN-SS-040,	Joint details roof framing
B-EN-SS-041,	Joint details roof framing
B-EN-SS-042,	Joint details roof framing
B-EN-SS-043,	Joint details roof framing
B-EN-SS-049,	Layout of well hatch covers (A1)
B-EN-SS-050,	Layout of well hatch covers (A2)
B-EN-SS-051,	Roof Hatch Details
B-EN-SS-052,	Roof Hatch Details
B-EN-SS-053,	Roof Hatch Details
B-EN-SS-054,	Roof Hatch Details
B-EN-SS-055,	Roof Hatch Details
B-EN-SS-056,	Roof Hatch Details
B-EN-SS-057,	Roof Hatch Details
B-EN-SS-058,	Roof Hatch Details
B-EN-SS-065,	Stairway 1 elevation and section
B-EN-SS-066,	Stairway 1 Plan and details
B-EN-SS-081,	Pad eye details (A1)

B-EN-SS-082, Pad eye details (A1)
B-EN-SS-083, Pad eye details (A1 & A2)
B-EN-SS-084, Pad eye details (A1 & A2)
B-EN-SS-085, Pad eye details (A2)
B-EN-SS-086, Pad eye details (A2)

1.2.4.4.Fabrication.

The fabrication of these A1 and A2 modules took place at De Groot, Zwijndrecht, Holland, under inspection supervision by DnV, Rotterdam.

1.2.5. Start-up Separator Support.

1.2.5.1.Design report by Brown & Root.

Preliminary design report - CDP1 Separator Support Frame, dated July 76.

Fabrication volume

1.2.5.2.Drawings by Brown & Root.

B-EN-SS-170 E, Start-up separator support framing
B-EN-SS-171 C, Separator support - Misc. details

1.2.6. BR1 and BR2 Modules.

1.2.6.1.Design reports by Brown & Root.

CDP1 Conversion Project - Design Report of Module BR1 (preliminary submission) dated 19.9.75.

CDP1 Conversion Project - Design Report of Module BR 2 (preliminary submission) dated September 75.

1.2.6.2.Drawings by Brown & Root.

CDP1-SS-060, Module BR1 Roof and floor plan
CDP1-SS-061, Module BR1 Elevations
CDP1-SS-062, Module BR1 Joint Details
CDP1-SS-063, Module BR1 Joint Details
CDP1-SS-064, Module BR1 Joint Details
CDP1-SS-077 B, Module BR2 plans and elevations
CDP1-SS-078, Module BR2 Joint Details - 1
CDP1-SS-079, Module BR2 Joint Details - 2

CDP1-SS-080, Module BR2 Joint details - 3
CDP1-SS-089, Module BR2 Joint details - 4
CDP1-SS-090, Module BR2 Joint details
CDP1-SS-177 E, BR1 & BR2 Roof Hatches

1.2.6.3. Fabrication.

The fabrication of these 2 modules took place by Wilson Walton Ltd., Middlesbrough, U.K., under inspection supervision by DnV, Newcastle.

1.2.7. East and West Flare Boom.

1.2.7.1. Design reports by Brown & Root.

1.2.7.2. MPX-DP1 Conversion - Burner Boom design report (preliminary submission) dated May 75.

1.2.7.3. Supplement to preliminary design report - CDP1 Burner Booms, dated November 75.

1.2.7.4. Supplement to preliminary design report - CDP1 Burner Booms, dated September 76.

1.2.7.5. Drawings by Brown & Root.

B-EN-SS-097 F, East and West Flare Booms
B-EN-SS-098 C, Flare Boom details I
B-EN-SS-099 E, Flare Boom details II
B-EN-SS-100 C, Walkway details for burner room
CDP1-SS-462 A, Support frames for burner booms
CDP1-SS-463 A, Frame layout
CDP1-SS-464 A, Pinned joint details

1.2.7.6. Fabrication.

The fabrication of the east and west flare boom took place at Wilson Walton Ltd., Middlesbrough, U.K., under inspection supervision of DnV, Newcastle.

1.2.6. Quarters Cantilever (not checked at this date)

1.2.8.1. Design report by Brown & Root.

CDP1 Platform - Preliminary Design Report of Quarters Cantilever dated February 76.

1.2.8.2. Drawings by Brown & Root (not checked at this date)

CDP1-SS-240.0		Location Plan
	241.0	General Arrangement
	242.A	Truss Details
	243.B	Joint Details - Sheet 1
	244.B	Joint Details - Sheet 2
	245.B	Joint Details - Sheet 3
	246.B	Truss End Detail - Sheet 1
	247.B	Truss End Detail - Sheet 2
	248.C	Truss Extension fixing Details, Doris Beam Co.
	249.0	Joint Details - Sheet 4
	250.B	Truss End Details - Sheet 3
	251.C	Truss End Details - Sheet 4
	252.B	Truss End Details - Sheet 5
	253.0	Handrail Details
	254.A	Truss Shop Splices (for erection)
	255.A	Temp. Accommodation Platform
	263	Details of Padeye Positions
	277.B	Truss Extension Fixing Details, Doris Beam 7
	278.A	Truss Extension Welding Details, Doris Beam 7

1.2.8.3. Fabrication (not known at this date)

1.3. Specifications other than those prepared by Brown & Root:

The following specifications have been reviewed and found acceptable :

Elf Norge - Frigg Field - Fixed Offshore Structures :

- Technical Specification for the Design of a Template Type Platform; 72-455, 3rd Edition.

- Material Specification; -115, Rev. 1 - May 1973
- Fabrication Specification; 3-155, Rev. 1 - May 1973
- Painting Specification for Steel Structures; 3-169, Rev. 0 - March 1975

1.4. Permanent Production Modules Nos. PM2, PM3 and PM4.

1.4.1. Design.

The following design reports (most recent issue listed) by McDermott-Hudson Engineering, London, have been reviewed and found acceptable..

- PM2 (Originally Module "B")
  Elf-Norge A/S, Norway
  Frigg Field - North Sea
  CDP1 - Platform
  Review of Structural Design
  Lift and In-Service Conditions
  Deck Unit 'B'. December 1975
  One Volume

- PM3 (Originally Module "C")
  Elf-Norge A/S, Norway
  Frigg Field, North Sea
  CDP1 - Platform
  Review of Structural Design
  Lift and In-Service Conditions
  Deck-Unit 'C'. December 1975
  Part I and II

- PM4 (Originally Module "D")
  Elf-Norge A/S, Norway
  Frigg Field - North Sea
  CDP1 - Platform
  Review of Structural Design
  Lift and In-Service Conditions
  Deck and Unit 'D'. December 1975
  Part I (one volume) and Part II Volume 1, II and III

1.4.2. Drawings.

The below listed construction drawings have been reviewed and found acceptable.

Original McDermott-Hudson drawings : ELN 02020

Module	Drawing No.	Drawing Title	Revision No.
PM2	216	Unit "B" drilling deck framing	0
PM2	217	Unit "B" cellar deck framing	1
PM2	218	Unit "B" truss 3 & 4	1
PM2	220	Unit "B" arrangement & details of drilling deck hatches	1
PM2	222	Unit "B" truss joint dets.	2
PM3	231	Unit "C" drilling deck framing	0
PM3	232	Unit "C" cellar deck framing	1
PM3	233	Unit "C" truss 5 & 6	3
PM3	237	Unit "C" truss details sht 1 of 2	2
PM3	238	Unit "C" truss details sht 2 of 2	1
PM4	246	Unit "D" drilling deck framing	3
PM4	247	Unit "D" cellar deck framing	2
PM4	248	Unit "D" truss 7 & 8	0
PM4	249	Unit "D" truss joint dets.	2
General (All)	251	Plating plan cellar deck	7
PM4	252	Plating plan drilling deck	6
PM4	253	Dets. of drilling deck drains	4
PM4	254	Arrgt.& dets. drilling deck, handrail	2
PM4	255	Arrgt.& dets. cellar deck, handrail	2
PM4	256	Access stairs to drilling deck (+) 86'-7 1/8" to 108'-0 3/8"	1
PM4	257	Arrgt.& dets. of dk. unit padeyes	2

Modifications, McDermott-Hudson drawings : EMN 2200

Module	Drawing No.	Drawing Title	Revision No.
PM2	2001	Unit "B" Cellar Deck Frmg. Reinforcement Details	2
PM2	2004	Unit "B" Drilling Deck - Additional Reinforcement	1
PM2	2007	Modules "B" & "C" Padeyes	2
PM3	2002	Unit "C" Cellar Deck Frmg. Reinforcement Details	2
PM3	2005	Unit "C" Drilling Deck Frmg. Reinforcement Dets.	3
PM3	2007	Modules "B" & "C" Padeyes	2
PM4	2008	Module "D" Padeyes. Sht 1 of 2	2
PM4	2009	Module "D" Padeyes. Sht 2	3
PM4	2010	Unit "D" Intermediate Floor Reinforcement	1
PM4	2011	Unit "D" Truss No. 8 Reinforcement Details	1
General (All)	2012	Drilling Deck Infill Weld Details	0

Modifications, Brown & Root Drawings : CDP1-SS-

Module	Drawing No.	Drawing Title	Revision no.
PM3	201	Elev. East Side North Face, Module PM2 MPX-DP1 Conversion	0
PM3	202	Elev. West Side North Face, Module PM3 MPX-DP1 Conversion	0
PM3	203	Detail Sections Gas Wall North, Module PM3 MPX-DP1, Conversion	0
PM3	204	Detail Sections Gas Wall North, Module PM3 MPX-DP1, Conversion	A
PM3	231	Mod's to PM3 Cellar Deck, MPX-DP1 Conversion	0
PM3	269	See Fasteners for Equipm. in PM3 CDP1 Conversion	0
PM3	270	See Fasteners for Equipm. in PM3 CDP1 Conversion	

1.4.3. Fabrication.

The modules have been fabricated by UIE, St.Wandrille, France, under the supervision of Det norske Veritas and have been found acceptable and in accordance with the relevant specifications.

Modifications to suit CDP1 instead of DP1 have been carried out at UIE, Le Havre, under the supervision of Det norske Veritas. This work has been found acceptable and in accordance with the relevant specifications.

2. SYSTEMS AND EQUIPMENT

2.1. Piping.

2.1.1 Piping Material Specification SFTL-H-102 (For Lummus designed systems).

2.1.2. Piping Material Specification CDP1-H-102 (For Brown & Root designed system).

General comment : As hook up work is still proceeding at time of writing, no final approval of fabrication and testing can be given at this point of time.

2.2. Flowsheets.

Brown & Root Drawings:

B-EN-PP-127	Sea Water Flow Diagram
B-EN-PP-128	Compressed Air-LP-Flow Diagram
B-EN-PP-131	Gas Oil - Flow Diagram
B-EN-PP-132	Compressed Air-LP-Flow diagram
B-EN-PP-135	Soft Water Flow Diagram
B-EN-PP-136	Slops Line-Flow Diagram
B-EN-PP-138	Sea Water - Flow Diagram
B-EN-PP-150	Jet Fuel System - Flow Diagram

Lummus Drawings :

EF-7045-00-5	Process Piping and Instrument Flow Diagram
EF-7045-00-21	Flare System
EF-7045-00-15	Utilities Flow Diagram
EF-7045-400-A	Engineering Symbols and Explanation for Flow Diagrams (for information only)
EF-7045-00-5	Process Piping and Instruments Flow Diagram - Scrubber Detail.

General comment : Documentation for pressure safety valves and flare system have at time of writing not been received by Env. Services to be approved by CPV

2.3. Pressure Vessels.

Item Designation	No. of	Service	Manufacturer
80-1007-1166	1	Air Receiver	Kirkdean
80-1007-1052	1	- " -	S.T.E.R.I.
80-1007-1037	1	- " -	Burbon Corblin
P.A.100 A & B	2	Scraper Traps	Herfilco
P.A.101	1	- " -	- " -
P.A.102	1	- " -	- " -
FA 101 A to Z	24	Scrubber Desanders	Perry Equipment
FA 103 A & B	2	Compressor Air Tanks	Burton Corblin
FA 104	1	Startup Separator	Lozai-Basse
FA 105 A & B	2	Air Receiver	Burton Corblin
FA 111	1	Soft Water Receiver	Painboef
FA 115 A & B	2	Liquide Separator	Lozain-Basse
HA 115 A & B	2	Methanol Gas Contactors	Lozain-Basse

2.4. Lifting Appliances

2.4.1. One Bucyrus Erie MK-60 Crane.
Crane Serial No. 135777
Pedestal Adapter No. 25

The crane will be subject to a thorough examination before a Certificate of Fitness is issued.

2.4.2. Other lifting appliances remain to be tested. None

2.5. Electrical

2.5.1. Specifications from Consip Entreprise.

2.5.1.1. Electrical general specification.

2.5.1.2. Electrical specification, App. A - Navigational aids.

2.5.1.3. Electrical specification, App. B - 380V switchgear and MCC.

2.5.1.4. Electrical specification, App. C - H.V. cubicle.

2.5.1.5. Electrical specification, App. D - Lighting fixtures.

2.5.1.6. Electrical specification, App. E - Power transformers.

2.5.1.7. Electrical specification, App. G - Direct Current 48V.

2.5.1.8. Electrical specification, App. H - Control-board for the electrical utilities.

2.5.2. Drawings from Societe Francaise des Techniques Lummus.

2.5.2.1.	AF-7045-00-55-1	Cable Schedule - Control and Power
2.5.2.2.	DF-7045-00-66-1	Outside lighting - Lighting fitting locatio
2.5.2.3.	BF-7045-04-68-2	Lighting and plug Normal/Emergency Module 4-function diagram.
2.5.2.4.	EF-7045-04-67-2	Module 4-Living Quarters - Lighting drawing.
2.5.2.5.	EF-7045-00-1053-1	Distribution diagram - Direct current 48 V.
2.5.2.6.	EF-7045-04-57A-1	Module 4 - Electrical equipment
2.5.2.7.	DF-7045-04-57B-1	Module 4 - Electrical room - Cable crossing project.
2.5.2.8.	DF-7045-04-1056-1	Electrical room-Switchboard equipment 48V.
2.5.2.9.	BF-7045-00-1055-1	Single wire emergency power supply 48V.
2.5.2.10.	AF-7045-00-1051-1	STC Platform-Grounding details
2.5.2.11.	F-7045-00-54C-1	Skeleton diagram sequence.
2.5.2.12.	[illegible]	[illegible]
2.5.2.13.	DF-7045-04-603-1	Crossing Cable - Fireproof.

2.5.2.14. DF-7045-00-69-1 Beaconage definitive equipment.

2.5.2.15. F-7045-00-61A-1 Alarm skeleton diagram for one of three pumps GA-110 A, B and S.

2.5.2.16. 177291-1 Schematic diagram for contactor starters DB 25 A - EB 50 A.

2.5.2.17. 177291-2 Dr. for FC 80 A - CG 125 A.

2.5.2.18. 177291-3 Dr. for circuit brakers N 100 "MG". Manual operating handle.

2.5.3. Specifications from Brown & Root (U.K.) Ltd.

2.5.3.1. Spec. No. MPX/DP1-E-3 A.C.induction motors.

2.5.3.2. Spec. No. CDP1-EE-508 App. F-Batteries and chargers.

2.5.3.3. Spec. CDP1-EE-503 App. B-380V Switchgear and MCC

2.5.3.4. Spec. CDP1-EE-506 Electrical general specification.

2.5.3.5. Spec. No. MPX/DP1-A-003 General Fabrication Specification.
Section C-4.0 Electrical
Section C-5.0 Instrumentation

2.5.3.6. Spec. CDP1-EE-504 Air duct heaters

2.5.3.7. Spec. CDP1-EE-500 App. E - Power Transformers

2.5.3.8. Spec. CDP1-EE-505 App. E - H.V. Cubick

2.5.3.9. Spec. MPX/DP1-E-5 Electrical Equipment.

2.5.3.10. [illegible] specifications for the [illegible] designated CDP1.

2.5.4. Drawings from Brown & Root (U.K.) Ltd.

2.5.4.1.	B.EN.EE.117	Overall One Line Diagram (Added System).
2.5.4.2.	B.EN.EE.118	One Line Diagram DP1.MCC.AB Modification.
2.5.4.3.	B.EN.EE.110	Distribution Diagram, Direct Current 48 V.
2.5.4.4.	B.EN.EE.120	Distribution Diagram, Direct Current 48V, Modification DP1.
2.5.4.5.	B.EN.EE.125	Module 1, BR1, BR2 and Platform One Line Diagram Lighting Normal.
2.5.4.6.	EN-SK-142	Proposed Additional Generator CDP1.
2.5.4.7.	A1-MPK-DP1-P7101 through P7118	Grounding.
2.5.4.8.	A1-MPX-DP1-P7125 through P7151	Cathodic Protection.
2.5.4.9.	CDP1.EE.181	Transf. incoming MCC/B.
2.5.4.10.	CDP1-EE-180	Diesel Engine incoming MCC/A.
2.5.4.11.	B.EN.EE.152	Switchboard Listing 1/7.
2.5.4.12.	CDP1.EE.162	Cable wags - changes to Module PM2.
2.5.4.13.	B.EN.EE.080	Bill of Material 1/13.
2.5.4.14.	B.EN.EE.079	Mounting principle fastening detail-grounding.
2.5.4.15.	CDP1.EE.078	Cable tray details.
2.5.4.16.	CDP1.EE.167	Cable tray changes to PM3 elevation.
2.5.4.17.	CDP1.EE.166	Cable tray changes to PM3 plan view.
2.5.4.18.	CDP1-EE-160	Module PM3 Cable tray changes in compressor room.

2.5.4.19. CDP1-EE-148	Cable tray & grounding between MP3 & BR2.
2.5.4.20. CDP1-EE-147	Cable tray & grounding between MP3 & BR1.
2.5.4.21. CDP1-EE-146	Cable tray & grounding between PM3 & BR1 Plan view.
2.5.4.22. CDP1-EE-141	PM4 Changes Transformer Room.
2.5.4.23. EN-SK-141	Modifications to MCC in Module MP4.
2.5.4.24. B-EN-EE-112	Transformer Incoming MCC/B-MPX DP1.
2.5.4.25. CDP1-EE-101	Support frame of 380V Switchboards in BR1-PM4.
2.5.4.26. CDP1-EE-138	MCC A & B - Wiring Diagram 118 sheets.
2.5.4.27. CDP1-EE-073	Penetration Details 48 sheets.
2.5.4.28. CDP1-EE-165	Cable Trag Content BR1 & PM4 1/12.
2.5.4.29. CDP1-EE-074	Penetration Details 20 sheets.
2.5.4.30. CDP1-EE-108	Penetration Details 51 sheets.
2.5.4.31. CDP1-EE-90	Location of "MCT" penetration plates and table trag content sections module PM4.
2.5.4.32. CDP1-EE-107	Power cable lists.
2.5.4.33. CDP1-EE-110	Control cable lists.
2.5.4.34. CDP1-EE-115	Cable schedule control and power modif.DP1.
2.5.4.35. [illegible]	Overall electrical system outline.
2.5.4.36. CDP1-EE-127	Equipment layout BP1.

2.6. Hazardous Area Classification.

Brown & Root Drawing : B-EN-FS-005
Area Classification
4 sheets
Approved except as noted for Saipem Drilling Modules.

2.7. Escape Plan Including Emergency Lights.

Brown & Root Drawings : CDP1-FS-009 throug -013.
Fire and Safety Equipment Layout.

General comment : Emergency lights remain to be tested.

2.8. Emergency Shut Down System.

2.8.1. Brown & Root Drawing : CDP1-II-100 Drilling Platform CDP1 Shut-Down & Alarm System Matrix Diagram.

2.8.2. Comment : A revised shut down logic has been required to be prepared. The revised logic will be subject to approval.

General comment : System remains to be tested.

2.9. Living Accommodation.

Brown & Root Drawings : CDP1-SK-146 Plan of First Level Module PM4.
CDP1-SK-147 Plan of Second Level Module PM4.
CDP1-SK-149 PM4 Wall Details

CDP1-SK-150 PM4 Wall Details
CDP1-SK-151 Section Through Module PM4
CDP1-SK-152 Details of Floors and Ceilings in Module PM4
CDP1-SK-145 Details of Firegalls on Modules PM4, BR1 and BR2.
CDP1-SK-144 Detail on Firewall on Module PM4.

2.10. Firewalls (Outside Accommodation).

Brown & Root Drawing : CDP1-AA-020 Typical Sections Through Wall, Roof and Floor on BR1 and BR2.
CDP1-AA-038 Module BR1- Plan Insulatic Walls. CDP1-Platform.
CDP1-AA-039 Module BR2 - Plan Insulatic Walls, CDP1-Platform.

2.11. Operations Manual.

The operations manual is still in the process of being assembled.
Remains to be approved.

B. [illegible]

0. LIST OF SAIPEM MODULES

Designation	Name	Yard	DnV Survey Station	Remarks
1	Derrick and substructure	Unknown	None	These are old modules, previously used in the Adriatic Sea. See text under B 1.3
3	Mud pumps	Unknown	None	
4	Generators	Unknown	None	
6	Living Quarters	Unknown	None	
2A	Mud	Saipem, Ravenna	DnV, Genova	New modules
2B	Mud	" "	" "	" "
5A	Engine room	" "	" "	" "
5B	Mud	" "	" "	" "

1. STRUCTURAL, DRILLING PACKAGES No.s 1, 2A, 2B, 3, 4, 5A 5B AND 6

1.1. Specifications and Design Reports

The following design reports by Saipem (unless otherwice noted) have been reviewed and found acceptable

- Package no. 1 - Derrick with Substructure

  a) Engineering Report: ER 1-74
  Saipem-Modification Skid base # 60637
  oc/90800. Dated February 4, 1974
  by Lee C. Moore Corporation

  b) Engineering Report : ER54-75
  Saipem-147' Derrick, Serial # -1578-20
  oc/83220, Dated November 14, 1975
  by Lee C. Moore Corporation

  c) Calculation Note:
  Saipem -147'Derrick, Serial # -1578-20
  Lee C. Moore c.c.: 83220. Dated Nov. 13, 1975
  by Saipem

d) Calculation Note:

Rig EMSTO C-3
Dr.l Platform. Dated Dec. 1, 1975
by Saipem

e) Calculation Note:

Elf-Norge DP-1 Platform.
Rig EMSCO C-3. Dated Dec. 20 - 75
by Saipem

- Package No. 2A - Mud

a) Calculation Note:
Package 2A. Not dated
by Saipem

b) Calculation Note:

Package 2A. Not dated
by Saipem

c) Calculation Note:

Unit Marine Crane-Model 500-2A. Not dated
by Saipem.

- Package No. 2B - Mud

a) Calculation Note:

Package 2B. Not dated
by Saipem

b) Calculation Note:
Crane NAT OS-435-2B. Not dated
by Saipem.

- Package No. 3 - Mud Pumps

Calculation Note No. 150900 :
Frigg Field - Package No. 3
Strength Analysis. Not dated
by Saipem

- Package No. 4

  Calculation Note. no. 150900:

  Frigg Field - Package No. 4
  Strength Analysis. Not dated
  by Saipem

- Package No. 5A. Engine Room
  Calculation Note:
  Package No. 5A. Not dated
  by Saipem

- Package No. 5B Mud
  a) Calculation Note.

     Package No. 5B. Not dated
     by Saipem

  b) Calculation Note:

     Package 5B. Not dated
     by Saipem

- Package No. 6 - Quarters and Helideck

  Calculation Note:

  Modules of Accommodation for Platform Off-shore
  Calculation of existing Part and New Heliport.
  Not dated
  by Dall 'Asta e Gadda

1.2. Drawings

The following drawings have been received and found acceptable.

Package No.	Drawing No.	Drawing Title	Revision No.
1	KA1230C	Crown Block Sheave Guide For Type # 5332/6	2
	JA1578	147'-0 "Angle Leg" "K Type" Derrick-30'-0" Base-7' 11 3/8" Top with 86.8 Knot Wind Capacity	14

Package No.	Drawing No.	Drawing Title	Revision No.
4	J209b-3	Studio di Massima Package No. 3- 12x21x5.5m Package No. 4- 10x21x5.5m	1
	J209b-21	Assieme e Particolari Struttura Box Sala Motori	3
	J209b-25	Particolari Struttura Box Sala Motori	1
	J209b-28	Particolari Struttura Box & Sala Motori	2
	J209b-39	Parcotubi Copertura Box Sala Motori	3
	J209b-55	Box Sala Motori-Copertura Pareti e Pavi Mentazionein Grigliato	2
	J209b-59	Box Sala Motori & Parco Tubi Assieme	1
	J211b-38	Box Sala Motori & Pompe Modifica Golfari di Sollev.	1
5A	J211b-45	Package 5A-Piante	1
	J211b-46	Package 5A-Elevazioni	1
5B	J211b-47	Package 5B-Piante	1
	J211b-48	Package 5B-Elevazioni	0
6	J209b-103	Progetto di Sistemazione Alloggi in Box Da mt 21.24 x 8.05 Sistemati Su 4 Ponti (N.52 Posti letto) Soluzione "C"	0

Package No.	Drawing No.	Drawing Title	Revision No.
2A	J211b-41	Package 2A-Piante	0
	J211b-42	Package 2A-Elevazioni	0
	J211b-77	Adattamento Sostegno Gru da 16 Ton-Package 2A	0
	J209b-107	Colonna Sostegno Gru Ubicazione e Particolari	2
2B	J211b-43	Package 2B-Piante	0
	J211b-44	Package 2B-Elevazioni	0
	J211b-52	Colonna Sostegno Gru Package 2B	2
3	J209b-3	Studio di Massima Package No. 3-12x21x5.5m Package No. 4-10x21x5.5m	1
	J209b-5	Assieme e Particolari Struttura Box Sala Pompe & Silos	3
	J209b-6	Particolari Strutture Box Sala Pompe & Silos	1
	J209b-7	Particolari Struttura Box Sala Pompe & Silos	1
	J209b-14	Parcotubi Copertura Box Sala Pompe & Silos	2
	J209b-45	Package da 12x21x5.5m Piante Distribuzione Carichi e Studio di alcuni Travi	0
	J209b-58	Box Sala Pompe Silos & Parco Tubi-assieme	0
	J211b-38	Box Sala Motori e Pompe Modifica Golfari di Sollev.	1

Package No.	Drawing No.	Drawing Title	Revision No.
	J211b-26	Struttura Eliporto Piante e Sezioni	0
	J211b-27	Sistemazione Pannelli Rete di Protezione Ponte Elicotteri	0
	J211b-28	Sistemazione Pannelli Rete di Protezione Ponte Elicottero	
	J211b-29	Modifica Scala Acc. Elipor. e Relativi Pianerottoli	0
	J211b-30	Impianto Luci Ponte Elicotteri	0

1.3. Fabrication

The modules have been fabricated in Ravenna by Saipem

The materials for these modules have been made to the UNI standard and not to the standards/specifications mentioned in item 1. above.

The modules no. 1, 3,4 and 6 are "old" structures built in 1968 and used in the Adriatic sea and have not been fabricated under the supervision of Det norske Veritas. These modules have, however, been subject to inspection and the material qualities have been spot checked by titring samples from the existing structures. The remaining modules as well as modifications to the "old" packages have been carried out under the supervision of Det norske Veritas and found acceptable.

1.4. Limitations

The derrick with substructure and shid beams is accepted for maximum loads as follows:

- Hook load/Rotary table load 350 t and
- Set back load 100 t

This have been required entered in the operations manual.

2. SYSTEMS AND EQUIPMENT

Drawing numbers used are according to Saipem Operation Manual (May 1976) except where specifically noted.

2.1. Flowsheets

Drawing 2.01. Mud High Pressure Flow Diagram
2.03. Mud Low Pressure Flow Diagram
2.05. Pulverulents Flow Diagram
2.07. Compressed Air Flow Diagram
2.09. Gasoil Flow Diagram
2.11. Potable Water Flow Diagram
2.13. Industrial Water Flow Diagram
2.15. Sea Water Flow Diagram
2.19. Steam Water Flow Diagram
2.20. Oil System Flow Diagram

General comment : Documentation for pressure safety relief valves have at time of writing not been received by DnV. Remains to be approved

2.2. Piping.

Piping project specification	no. J.211b.111
Piping welding spec.	w-1-P
Piping welding spec.	w-2-P
Piping welding spec.	w-3-P

2.3. Pressure Vessels

Service	No. of	Manufacturer	Remarks
Air Receiver	2	Atlas Copco	18ata/1500 l
Air Receiver	1	Atlas Copco	18ata/300 l
Air Receiver	3	Ingersoll	17ata/1500 l
Hydrophor-Drinkable Water	1	Marelli	6ata/1000 l
Hydrophor-Sea Water	1	Marelli	6ata/1000 l
Cement Silos	6		
Mud Silos	4		

2.4. Lifting Appliances

2.4.1. National OS-435 Pedestal Crane
Serial No. 147
ABS report no. 74-BT4473
Pedestal adapter, ABS report no. 75-BT5216-583.

Load test and through examination must be carried out before Certificate of Fitness is issued.

2.4.2. Unit Mariner Crane

Model 500
Load test and through examination must be carried out before Certificate of Fitness is issued.

2.4.3. Other lifting appliances remains to be tested.

2.5. Electrical

2.5.1. Drawings

2.5.1.1.	No. Archivo 13058	460-220 V 60 Hz Power A.C.main Control panel
2.5.1.2.		Section 440 V and 220 V. Power analysis.
2.5.1.3.		Power flexible cable supplier G.E. D.C. power
2.5.1.4.	No. Archivo 13056	Electrical layout
2.5.1.5.	" " 13057	Light plant
2.5.1.6.	" " 13059	Emergency panel 460 V 60 Hz
2.5.1.7.	" 41B555975 General Electric	Schematic Diagram oil well drillin. (D.C. main switchboard)

2.6. Hazardous Area Classification

Drawing 2.21 Area Classification
To be revised according to DnV telex no. 90642 of 14.9.76. Modules 2a, 2b and 5b to be reclassified as division one.

2.7. Escape Plan Including Emergency Lights

Drawing 2.32. Fire and Safety Equipment, Four Sheets

General comment: Emergency lights remains to be tested.

2.8. Emergency Shut-down System

Drawing 2.23. Schematic Engines Shutdown System

Brown & Root drawing: CDP1-II-100 Drilling Platform
CDP1 Shutdwon & Alarm System
Matrix Diagram

See DnV comment re Esc Modules shutdown system, item A 28.2.

General comment: Emergency shutdown to be tested.

2.9. Living Accommodation

Drawing: 2.35 Lodgin Quarters, Layout

Saipem Drawings:

Dis.J211b-135	Lodgin Quarter Main Deck
Dis.J211b-136	Lodgin Quarter First Deck
Dis.J211b-137	Lodging Quarter Second Deck
Dis.J211b-138	Lodging Quarter Third Deck

Saipem Operation Manual item 5.39.
Kaefer Isoliertechnik drawings :
745-2.3904 Feuerschutzisalierung A-60 Küche
745-4.3905 Ausführung d. Isolierung

The Saipem Living quarter is not in accordance with the regulations as regards structural fireprotection. This was discussed with Department of Energy representatives on 7.11.1974. An agreement was reached allowing Saipem to install the living quarter on the CDP1 platform provided certain modifications were carried out. The agreed modifications have been carried out to the satisfaction of DnV.

2.10. Ventilation

Drawing: 2.26 Force Vented Flow Diagram
2.29 D.C. Motors Ventilation Flow Diagram
2.29a D.C. Motor Ventilation Axonometric
2.30 Module 6 Living Quarter
Module 5A Additional Living Quarter
Conditioned Air System Flow Diagram
2.31 Conditioning System Axonometric

Ventilation system is not in accordance with regulations to be tested.

2.1.1. Helicopter Deck Arrangement

Saipem Drawing: Dis.J 211b-28 Sistemazione Pannelli Rete Di Protezione Ponte Elicottero

Saipem Drawing: Dis.J 211b-118 Obstruction Lights

Saipem Drawing: Dis.J 211b-135 Danger's Classification

2.12. Operations Manual

Approved except as commented in DnV letter of November 5th, 1976.

10.11.1976
Kår/Thag/Alf/PKGu/Nils/Mia/SK

APPENDIX III

SECONDARY STRUCTURE, FROM LLOYDS REPORT CONSTRUCTION OF THE PLATFORM (2)

3.2 Secondary Structure

3.2.1 Main Deck Columns

These were supplied by Messrs. Steri, Ennery, France, on C.G. Doris Order Nos. 74/1239, 75/229, 75/230 and 75/338 and are covered by Lloyd's Saarbrücken Surveyors Certificate No. SAR 400934.

3.2.2 Precast Concrete Deck Beams

The precast concrete deck beams were constructed in a precasting yard adjacent to the quay in Andalsnes. The inspection and quality control were covered by the Society's Surveyors engaged on the construction of the platform.

3.2.3 Seal Caissons - 6 off

These were supplied by S.A. Sorenam, Moult par Caen, on C.G. Doris Order No. 74/536 and are covered by Le Havre Surveyors Certificate No.400231.

After replacement of the dished ends, which had been removed at site to facilitate access, the Caissons were hydraulically tested to 12 bars with satisfactory results.

3.2.4 Conductor Guide Frames

Level A

Guide Frames were manufactured on site from ST37 steel supplied by Messrs. G. Aspelin, Trondheim, on Brown & Root Order No. 13.360. Welding was carried out by suitably qualified welders.

Levels B and C

Guide Frames were manufactured at Messrs. Steri, on C.G. Doris Order No. 75/644, and are covered by Lloyd's Nancy Certificate No. NCY 500094.

The corbels were manufactured on site from STS2.3N material supplied by Messrs. Steri, on C.G. Doris Order Nos. 75/S43 and 75/1005, which is covered by manufacturer's certificates. Welding and assembly was done by Messrs. Eumech, using suitably qualified welders and procedures. All welds were magnetically crack detected and in addition to the insitu welds to the base plates incorporated in the structure were subject to 100 % ultrasonic examination with satisfactory results.

Levels D and E

Guide Frames were manufactured at Messrs. Steri, on C.G. Doris No. 75/644 and are covered by Lloyd's Nancy Certificate No. NCY 500094.

Corbels were manufactured on site by Messrs. Eumech from STS2.3N material supplied by Messrs. Steri on C.G. Doris Order Nos. 75/843 and 75/1005, which is covered by manufacturers certificates.

Assembly and welding was done on site by Messrs. Eumech, using suitably qualified procedures and welders. All welds were magnetically crack detected and in addition the full penetration filled welds on to the vertical base plates were subject to 100 % ultrasonic examination with satisfactory results.

3.2.5 Conductor Guide Pipes

The 36" dia. guide pipes were made by Le Tube Spirale on C.G. Doris Order No. 75/231 and are covered by manufacturers certificates.

3.2.7 Towage Links

These were supplied by Messrs. Societe Française des Acieries de Blanc - Misseron on C.G. Doris Order No. 74/804 and are covered by Lloyd's Valenciennes certificate No. VLN 500001.

3.2.8 Platforms, Ladders, etc. in Central Shaft

These were manufactured by Messrs. Seagull Manufacturing Co. Ltd. Lowestoft on Total Oil Marine Order No. 78-5701-11058 and are covered by Lloyd's Ipswich certificate No. IPS 401900.

3.2.9 Boat Landings

These were manufactured by Messrs. ACMC, Carpiquet, on C.G. Doris Order No. 75/0643 and are covered by Lloyd's Le Havre certificate No. 500187.

3.2.10 Access Stairways

These were manufactured by Messrs. ACMC, Carpiquet, on C.G. Doris Order No. 75/927 and 75/997 and are covered by Lloyd's Le Havre certificate No. 500173.

3.2.11 Main Deck Panels

These were manufactured by Messrs. ACMC, Carpiquet, on C.G. Doris Order No. 75/780 and are covered by Lloyd's Le Havre certificate No. 500137.

3.2.12 KM 60 Pedestal Cranes - 2 off

The base structures for the pedestals of these two cranes were supplied by M.A.N. on Brown & Root Order No. 11094 and are covered by Lloyd's Mannheim certificate No. MHM501126/2.

3.2.13 External Ladders and Walkways

Ladders and walkways for divers access to exterior of seal caissons were manufactured by Messrs. Eumech, Great Yarmouth, and are covered by Lloyd's Ipswich certificate No. IPS 401109. Welding to place at site was carried out using approved procedures and qualified welders. The pad eyes were manufactured by Eumech, Great Yarmouth, and are covered by Lloyd's Ipswich certificate No. IPS 401109. Further welding was carried out at Messrs. Bolsønes Verft, Molde, by qualified welders using approved procedures and spot checks by ultrasonic and magnetic crack detection were carried out on 20 % of the welds with satisfactory results.

3.2.14 Skid Beams

These were manufactured by Messrs. ACMC, Carpiquet, on C.G. Doris Order No. 75/0973 and are covered by Lloyd's Le Havre certificate No. 500173.

APPENDIX IV

CONCRETE COMPRESSIVE STRENGTH

1966 SOCAL CDP-1

Concrete Quality Control Summary

Batch No.	Date	Placing Remarks	Batch Size m³	W/C	Mix Proportions by Weight	Slump cm	Air %	Compressive Strength kg/cm² 7 days	14 days	28 days	90 days	1 year
P 1	19/5	Lower slab, Part 1	460	0.38	LP : 4 1 R : 5 1	7	2.8	22	25	422	497	555	372	455
P 2	20/5	" "	460	0.40	LP : 4 1 R : 5 1	10	2.7	23	22	-	-	-	358	440
P 3	20/5	" "	460	0.39	LP : 4 1 R : 5 1	10	2.9	19	17	419	492	566	366	440
P 4	20/5	" "	460	0.40	LP : 4 1 R : 5 1	9	2.5	17	13	-	-	-	410	461
P 5	21/5	" "	460	0.40	LP : 4 1 R : 5 1	9	2.7	15	10	434	456	543	390	421
P 6	21/5	" "	460	0.39	LP : 4 1 R : 5 1	6	2.2	16	11	-	-	-	404	459
P 7	21/5	" "	460	0.38	LP : 4 1 R : 5 1	13	2.6	16	12	429	493	563	365	417
P 8	21/5	" "	460	0.39	LP : 4 1 R : 5 1	10	2.5	12	17	-	-	-	394	420
P 9	21/5	" "	460	0.39	LP : 4 1 R : 5 1	9	2.8	16	10	430	463	552	363	422
P 10	21/5	" "	460	0.40	LP : 4 1 R : 5 1	9	2.3	16	9	-	-	-	362	419
P 11	22/5	" "	460	0.38	LP : 4 1 R : 5 1	11	2.1	16	8	401	453	504	350	396
P 12	22/5	" "	460	0.38	LP : 4 1 R : 5 1	10	2.3	15	9	-	-	-	370	442
P 13	22/5	" "	460	0.39	LP : 4 1 R : 5 1	8	2.4	17	15	429	479	568	363	452
P 14	22/5	" "	460	0.40	LP : 5 1 R : 5 1	14	2.5	17	15	-	-	-	353	402
P 15	22/5	" "	460	0.38	LP : 5 1 R : 5 1	9	2.0	17	13	397	455 435	540 472	351	436
P 16	22/5	" "	460	0.38	LP : 5 1 R : 5 1	8.5	2.2	18	11	-	-	-	364	423
P 17	23/5	" "	460	0.38	LP : 5 1 R : 5 1	9	2.2	18	9	439	462	520	375	436
P 18	23/5	" "	460	0.39	LP : 5 1 R : 5 1	9	2.0	16	16	-	-	-	360	409
P 19	23/5	" "	460	0.39	LP : 5 1 R : 5 1	9	2.2	19	15	471	500	564	365	444
P 20	23/5	" "	460	0.39	LP : 5 1 R : 5 1	9	2.2	19	19	-	-	-	374	457
P 21	24/5	Crane pedestal in Bottom Slab	460	0.40	LP : 5 1 R : 5 1	16	-	-	-	316	424	510	-	-
P 22	4/6	Lower slab, part 2	460	0.39	LP : 4 1 R : 5 1	7	1.9	14	19	-	-	-	403	463
P 23	4/6	" "	460	0.40	LP : 4 1 R : 5 1	10	2.2	16	13	394 350	467 454	559	331(3) 391(7)	449
P 24	4/6	" "	460	0.39	LP : 4 1 R : 5 1	10	2.0	16	12	-	-	-	393	441
P 25	4/6	" "	460	0.39	LP : 4 1 R : 5 1	6	1.9	16	9	421 387	451 454	534	319(3) 376(7)	410
P 26	5/6	" "	460	0.39	LP : 4 1 R : 5 1	9	2.0	15	8	-	-	-	395	467
P 27	5/6	" "	460	0.39	LP : 4 1 R : 5 1	10	2.1	16	8	453 430	501 466	-	360(3) 397(7)	445
P 28	5/6	" "	460	0.39	LP : 4 1 R : 5 1	9	2.2	16.5	9	-	-	-	399	459
P 29	5/6	" "	460	0.39	LP : 4 1 R : 5 1	10	2.0	17	12	413 417	537 469	-	329(3) 396(7)	455
P 30	5/6	" "	460	0.39	LP : 4 1 R : 5 1	10	2.1	17	12	-	-	-	400	467
P 31	5/6	" "	460	0.40	LP : 4 1 R : 5 1	9	2.2	19	10	401 395	468 454	569	336(3) 377(7)	430
P 32	6/6	" "	460	0.39	LP : 4 1 R : 5 1	9	2.0	15	8	-	-	-	387	407
P 33	6/6	" "	460	0.39	LP : 4 1 R : 5 1	8	2.2	17	8	423 417	458 477	555	[illegible]	440
P 34	6/6	" "	460	0.40	LP : 4 1 R : 5 1	11	1.9	15	13	-	-	-	395	458
P 35	6/6	" "	460	0.40	LP : 4 1 R : 5 1	10	2.0	16	14	426 379	469 458	537	[illegible]	449
P 36	6/6	" "	460	0.40	LP : 4 1 R : 5 1	9	2.2	17	12	-	-	-	389	430

NOTES:
WORK TEST SK
PRECAST CONCRETE AS

* 15 cm cubes
(3) 3 days
(7) 7 days

Concrete Quality Control Summary

Batch no	Date	Structural element	Cement kg/m³	w/c	Air-entr. adm. kg/m³	Slump cm	Air %	Temperature °C		Compressive strength N/mm²			Flexural strength N/mm²	
F 37	5/6	Lower slab, part 2	400	0.50	4 LP 3 R	8	2.0	17	10	316 *375	479 448	409	3d(1) 36d(1)	409
F 38	7/6	" "	460	0.40	"	10	2.7	"	8	-	-	-	349	415
F 39	0/6	Fundament crane 3	460	0.40	"	8	-	15	14	346	414	480	314	376
F 40	7/6	Lower slab, part 3	480	0.40	6 LP 5 R	11	2.0	27	26	-	-	-	371	439
F 41	"	" "	440	0.39	"	15	2.7	20	22	374	396	511	349	422
F 42	9/6	" "	"	0.40	"	6	2.2	25	21	-	-	-	372	411
F 43	"	" "	"	0.39	"	10	2.2	20	20	-	-	-	369	429
F 44	"	" "	"	0.39	"	9	2.2	21	25	410	499	502	348	413
F 45	"	" "	"	0.40	6 LP 6 R	13	2.2	26	27	-	-	-	369	404
F 46	"	" "	"	0.39	6 LP 5 R	9	1.9	26	25	417	474	533	369	422
F 47	"	" "	"	0.39	"	12	2.3	20	17	337	400	478	350	436
F 48	9/6	" "	"	0.40	"	7	2.2	23	15	-	-	-	355	409
F 49	"	" "	"	0.39	"	8	2.2	19	22	432	446	528	361	430
F 50	"	" "	"	0.39	"	11	2.1	24	21	-	-	-	374	426
F 51	9/6	" "	"	0.39	"	11	2.6	24	25	459	487	555	373	415
F 52	"	" "	"	0.38	"	10	2.2	23	24	-	*420	*502	343	410
F 53	"	" "	"	0.39	"	11	2.3	19	16	356	409	488	353	399
F 54	9/6	" "	"	0.40	"	8	2.5	20	15	-	-	-	349	424
F 55	"	" "	"	0.39	"	10	2.4	20	14	379	479	515	354	411
F 56	"	" "	"	0.39	"	9	2.1	19	15	362	403	513	349	429
F 57	"	Breakwater wall unit B - C	"	0.38	4 LP 3 R	5	2.0	21	20	-	-	-	342	415
F 58	"	Pedestal crane 2	"	0.40	"	15	2.1	21	20	-	402	499	-	-
F 59	4/6	Breakwater wall A-B	"	0.40	6 LP 1.5 R	7	2	21	21	-	-	-	351	409
F 60	5/6	Breakwater wall 4-5	"	0.42	"	9	2.3	16	13	-	-	-	329	403
F 61	6/6	Lower slab, part 4	"	0.40	"	15	2	16	10	-	-	-	350	424
F 62	"	" "	"	0.40	"	12	1.9	17	12	329 *335	473	549	2d(2) 3d(1)	425
F 63	"	" "	"	0.40	"	11	1.9	19	16	-	-	-	358	438
F 64	"	" "	"	0.39	"	9	2.3	18	15	327 *332	473	549	28d(2) 56d(2)	437
F 65	"	" "	"	0.38	"	10	2.5	20	9	-		-	363	424
F 66	7/6	" "	"	0.38	"	10	2.4	19	7	433 *392	501	556	368	452
F 67	"	" "	"	0.39	"	10	2.2	19	9	-	-	-	335	425
F 68	"	" "	"	0.39	"	9	1.4	20	17	406 *395	485	597	3d(2) 37d(2)	434
F 69	"	" "	"	0.39	"	9	1.8	21	17	-	-	-	369	451
F 70	"	" "	"	0.39	"	10	1.8	20	15	417 *409	469	573	360	439
F 71	"	" "	"	0.38	"	10	2	19	11	384 *302	437	524 *525	371	440
F 72	9/6	Breakwater wall E-F	"	0.39	"	11	2.3	18	13	-	-	-	364	432
		Main values				10	2.2			Bottom slab			3d(1) 37d(1)	451
		Standard deviation				-	-			405 *397 511 *532	460 *456 [illegible]	561 [illegible]	[illegible]	37.5
		Bottom slab Part 1 " 2 " 3 " 4								Main values - comparative strength				
										421 413 394 393	470 433 475 472	569 559 510 [illegible]	371 364 361 367	431 440 419 457

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A/S

Drwg No 13133-10 Date

* 15 cm cubes
(3) 3 days
(7) 7 days
F 50 concrete Patchmix R in 20% concentration

Concrete Quality Control Summary

Pour No	Date	Structural Member	Cement kg/m³	W/C	Admixture per cent	Slump cm	Air %	Temperature °C		Compressive Strength N/mm²				
										Normal Mix			Retarding Mix	
										σ_1	σ_2	σ_{28}	σ_7	σ_{28}
Y 73	1974 24/7	Exterior slip-form 1.25 m	400	0.39	6 LP 1.5 R	12	1.8	16	10	-	-	-	400	491
Y 74	"	" 1.50 m	400	0.39	6 LP 2 R	6	1.9	20	19	462	500	565	383	475
Y 75	"	" 1.00 m	460	0.39	"	7	2.2	20	20	-	-	-	378	467
Y 76	"	" 2 m	"	"	"	8	2.1	22	18	452	507	506	365	465
Y 77	"	" 2.10 m	"	0.38	5 LP 2 R	9	2	21	13	-	-	-	367	466
Y 78	25/7	" 2.30 m	"	0.39	"	10	2.2	19	11	425	478	566	407	491
Y 79	"	" 2.50 m	"	"	"	9	1.9	20	11	-	-	-	349	456
Y 80	"	" 2.60 m	"	0.37	"	6	1.8	20	16	455	514	578	362	465
Y 81	"	" 2.80 m	"	"	6 LP 2 R	7	1.6	22	17	-	-	-	407	458
Y 82	"	" 3.10 m	"	0.39	"	9	2.1	21	16	477	540	626	405	496
Y 83	"	" 3.10 m	"	"	6 LP 2.5 R	9	2	22	14	-	-	-	395	475
Y 84	26/7	" 3.30 m	"	"	6 LP 2 R	10	2.1	20	10	411	484	583	402	494
Y 85	"	" 3.50 m	"	"	5 LP 2 R	9	1.9	15	10	-	-	-	397	487
Y 86	"	" 3.65 m	"	0.38	"	6	1.8	20	15	482	545	635	395	496
Y 87	"	" 3.90 m	"	0.40	"	6	2	21	16	397	455	536 *491	380	478
Y 88	"	" 4.10 m	"	"	"	13	2.2	18	15	320	432	508	329	427
Y 89	"	" 4.25 m	"	"	"	11	2	20	10	-	-	-	378	455
Y 90	27/7	" 4.45 m	"	0.39	"	10	1.8	20	10	437	492	555	369	452
Y 91	"	" 4.60 m	"	0.40	"	11	2	20	10	-	-	-	364	446
Y 92	"	" 4.80 m	480	0.39	"	10	1.9	16	15	420	488	547	368	447
Y 93	"	" 5.00 m	"	0.38	"	9	2	18	10	-	-	-	400	465
Y 94	"	" 5.10 m	"	0.36	"	9	2	16	10	409	455	543	367	443
Y 95	"	" 5.35 m	"	0.38	5 LP 1.5 R	12	2	18	9	-	-	-	356	457
Y 96	28/7	" 5.60 m	"	0.38	"	8	1.9	19	9	372	462	571	389	442
Y 97		" 5.85 m	"	0.36	"	9	1.9	20	8	-	-	-	380	447
Y 98	"	" 6.10 m	"	0.37	"	5	1.5	20	12	352	479	590	334	476
Y 99	"	" 6.70 m	460	0.40	"	8	2.2	19	14	-	-	-	374	449
Y 100	"	" 6.50 m	"	0.38	"	10	2	20	13	325	475	543	346	406
Y 101	"	" 6.75 m	"	0.38	"	6	2.1	20	10	-	-	-	369	459
Y 102	29/7	" 7.00 m	"	0.38	"	5	2	19	10	435	472	594	393	476
Y 103	"	" 7.25 m	"	"	"	6	2.1	20	10	-	-	-	375	464
Y 104	"	" 7.50 m	"	0.39	"	11	1.9	19	12	419	469	544	379	428
Y 105	"	" 7.80 m	480	0.37	4 LP 1.5 R	9	1.8	22	13	-	-	-	396	442
Y 106	"	" 8.05 m	"	0.38	"	9	2.2	20	9	410	469	571	381	466
Y 107	30/7	" 8.30 m	"	"	"	7	2	19	10	-	-	-	360	417
Y 108	"	" 8.55 m	"	"	"	10	2.1	20	10	412	449	561	379	432
Y 109	"	" 8.80 m	"	0.37	5 LP 1.5 R	9	1.8	20	13	-	-	-	371	430
Y 111	"	" 9.15 m	460	0.38	4 LP 1.5 R	6	2	22	17	432	508	585	392	449
Y 112	"	" 9.35 m	"	0.39	"	5	2.1	22	16	-	-	-	367	431
Y 113	"	" 9.55 m	"	0.38	"	6	2	21	13	382	469	534	378	432
Y 114	31/7	" 9.80 m	"	0.40	"	6	2.7	20	11	-	-	-	373	430
Y 115	"	" 10.00 m	"	"	"	8	2	19	10	394	449	532	369	409
Y 116	"	" 10.35 m	"	0.39	"	8	2	21	19	-	-	-	363	410
Y 117	"	" 10.55 m	"	"	"	9	1.8	21	15	397	493	545	367	423
Y 118	"	" 10.75 m	"	"	"	"	2.1	23	15	-	-	-	354	423
Y 119	"	" 11.00 m	"	"	"	6	2	19	13	474	495	509	393	415
Y 120	1/8	" 11.25 m	"	0.40	"	10	2.1	19	10	-	-	-	366	427
Y 121	"	" 11.55 m	"	"	"	7	2	19	9	537	447	501	354	435

NOTEBY
NORSK TEKNISK BYGGEKONTROLL A/S

Drwg No 13133-10 Date:

* 15^3cm
Y 110 dark cut exist

Concrete Quality Control Summary

Batch No	Date	Structural Member	Quantity m³	%	Consistency Method	Slump cm	Air %	Temperature °C		Compressive Strength N/mm² 7 days			Bending Strength N/mm² 28 days	
V 123	2/4 1/8	Retaining wall from 11.15 m	460	0.39	4 LP 1.5 R	9	2.1	21	17	-	-	-	340	418
V 125	"	" 12.00 m	"	"	"	6	2	23	17	424	486	551	369	447
V 124	"	" 12.55 m	"	0.40	"	7	2	21	16	-	-	-	383	437
V 125	"	" 12.85 m	"	"	"	6	2	21	11	390	440	514	339	425
V 126	2/8	" 13.00 m	"	"	"	7	2	21	12	-	-	516	352	420
V 127	"	" 13.25 m	"	"	"	10	2.1	20	11	397	433	499	322	417
V 128	"	" 13.45 m	"	0.39	"	8	2	21	15	-	-	-	337	413
V 129	"	" 13.70 m	"	0.39	"	6	1.8	21	17	420	472	545	366	424
V 130	"	" 13.95 m	"	0.39	"	8	1.9	22	14	-	-	-	356	454
V 131	"	" 14.15 m	"	0.38	"	5	2.4	21	14	385	447	528	356	435
V 132	3/8	" 14.40 m	"	0.40	"	6	2.2	20	9	-	-	-	364	416
V 133	"	" 14.80 m	"	0.39	5 LP 1.5 R	8	2	21	16	431	411	478	327	413
V 134	"	" 14.95 m	"	"	4 LP 1 R	6	1.9	22	17	-	-	-	360	420
						Mean Value				410	472	552	372	449
						Standard Deviation				-	-	-	19.4	25.3

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A.S

Concrete Quality Control Summary

Pour No	Date	Structure Element	Slump cm	%	Vibrator Size mm	Temp °C	Air %	Cylinder Size	Compressive Strength N/mm²			Bending Strength	
									1 day	3 days	7 days	3 days	7 days
P 135	13/8	Interior slip-form 1.9 m	450	0.39	5 LP 1 R	9	1.7	22	15	-	-	-	364	437
P 136	"	" 2.40m	"	"	5.5 LP 1 R	4	1.8	-	11	330	453	554	390	450
P 137	15/8	" 2.45m	400	0.39	6 LP 1 R	8	1.9	21	10	-	-	-	392	462
P 138	"	" 2.75m	"	0.38	" "	11	2.2	22	15	416	440	536	360	442
P 139	"	" 3.05m	"	"	" "	6	2.2	23	16	-	-	-	371	463
P 140	"	" 3.35m	"	0.39	" "	7	"	21	16	405	481	546	397	463
P 141	"	" 3.54m	"	0.36	" "	10	"	23	14	392	460	541	386	451
P 142	16/8	" 4.00m	"	0.38	" "	8	1.9	23	13	416	450	546	393	435
P 143	"	" 4.15m	"	"	" "	9	2.1	22	13	-	-	-	378	437
P 144	"	" 4.45m	"	"	6 LP 1.5 R	9	2.0	22	20	433	503	550	380	453
P 145	"	" 4.75m	"	0.39	" "	8	2.0	24	20	-	-	-	384	451
P 146	"	" 4.90m	"	"	" "	6	2.0	23	17	421	492	590	376	443
P 147	"	" 5.10m	"	"	" "	"	"	20	15	-	-	-	379	449
P 148	17/8	" 5.30m	"	0.39	" "	8	2.1	22	12	416	461	452	394	400
P 149	"	" 5.55m	"	0.38	6 LP 1 R	7	2.0	22	12	-	-	-	397	415
P 150	"	" 5.75m	"	"	" "	10	2.4	21	15	384	478	452	375	426
P 151	"	" 5.95m	"	"	" "	8	2.2	21	16	-	-	-	382	400
P 152	"	" 6.15m	"	0.37	" "	6	2.2	23	16	406	491	452	394	441
P 153	"	" 6.23m	"	0.39	" "	6	2.1	21	13	-	-	-	393	427
P 154	18/8	Yardwater wall Lift 2	480	"	" "	12	2.0	20	13	405	448	540	352	409
P 155	"	Interior slip-form 6.55m	"	"	5 LP 0.5 R	15	2.1	19	11	-	-	-	359	392
P 156	"	" 6.70m	"	0.37	" "	8	2.2	20	13	413	466	542	369	417
P 157	"	" 6.85m	"	"	" "	"	2.0	21	13	-	-	-	305	428
P 158	"	" 7.15m	"	0.38	" "	7	2.2	21	12	403	468	547	362	418
P 159	"	" 7.35m	"	0.39	" "	10	1.9	20	11	-	-	-	355	407
P 160	"	" 7.65m	460	0.38	" "	9	2.3	20	10	397	441	462	353	384
P 161	19/8	" 7.85m	"	"	" "	"	1.9	20	9	-	-	-	333	374
P 162	"	" 8.25m	490	0.39	5 LP	10	2.1	21	12	381	453	462	356	386
P 163	"	" 8.50m	"	"	"	"	2.3	"	16	-	-	-	373	390
P 164	"	" 8.80m	"	"	"	12	2.4	22	16	362	402	414	340	358
P 165	"	" 9.00m	"	"	" "	9	2.3	21	13	-	-	-	349	408
P 166	20/8	" 9.40m	"	0.40	" "	5	2.1	20	11	416	458	377	360	376
P 167	"	" 9.70m	"	0.39	" "	10	2.2	19	10	-	-	-	356	359
P 168	"	" 9.90m	"	"	" "	6	2.0	20	15	382	432	481	364	382
P 169	"	" 10.30m	"	"	" "	9	2.2	22	20	-	-	-	365	398
P 170	"	" 10.70m	"	0.40	" "	10	2.4	22	18	373	447	503	359	386
P 171	"	" 10.90m	"	"	6 LP 0.5 R	8	2.0	22	13	-	-	-	382	407
P 172	21/8	" 11.20m	"	"	" "	6	2.5	21	15	426	493	521	373	407
P 173	"	" 11.60m	"	"	6 LP	12	2.4	19	13	-	-	-	373	411
P 174	"	" 11.77m	"	0.38	" "	9	1.9	22	16	400	468	515	373	380
P 175	"	" 12.05m	"	0.39	" "	9	2.4	22	20	-	-	-	394	421
P 176	"	" 12.47m	"	0.40	" "	9	2.3	24	19	416	493	526	361	400
P 177	"	" 12.70m	"	0.39	" "	11	2.0	22	16	-	-	-	371	411
P 178	22/8	" 13.06m	"	0.40	" "	5	2.2	20	14	389	455	506	339	424
P 179	"	" 13.45m	"	0.39	" "	9	2.1	20	15	403	443	492	391	404
P 180	"	" 13.75m	"	"	" "	10	2.0	21	17	-	-	-	362	403
P 181	"	" 13.97m	"	0.36	" "	"	2.1	22	16	411	450	507	373	403
P 182	"	" 13.20m	"	0.39	" "	"	1.9	22	14	-	-	-	365	417
P 183	23/8	" 14.45m	"	0.41	5 LP	7	2.2	21	13	400	440	507	304	403
P 184	"	" 14.61m	"	0.40	" "	"	"	20	12	-	-	-	363	405
P 185	"	" 15.10m	"	0.39	" "	6	1.9	19	14	391	454	517	356	422

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A.S

Drwg No 13143-10 Date

* 15 cm

Concrete Quality Control Summary

Sample No	Date	Structural Member	Cement kg/m³	%	Admixture kg/m³		Air Content %		Slump mm		Compressive Strength N/mm²			Flexural Strength N/mm²	
											3 days	7 days	28 days	7 days	28 days
P 1-4	1/8	Interior Wall-Comp 15.00m	490	0.39	5	LP	8	2.1	20	16	-	-	-	339	343
P 5-7	"	" 15.95m	"	"	"		6	2.0	21	15	417	453	447	347	424
P 163	"	" 16.10m	"	"	"		10	2.1	21	13	-	-	-	346	422
P 165	24/8	" 16.30m	"	"	"		7	2.2	19	12	405	447	514	353	400
P 190	"	" 16.45m	"	"	6	LP	8	2.1	20	12	-	-	-	363	401
P 191	"	" 16.77m	"	"	0.5	R	10	2.0	19	14	414	456	552	391	409
P 192	"	" 16.90m	"	"	6	LP	9	2.1	20	15	-	-	-	363	429
P 193	"	" 17.30m	"	"	"		10	1.9	21	15	390	408	521	369	430
P 194	"	" 17.60m	"	0.39	5	LP	9	1.9	20	14	-	-	-	376	441
									Mean Value		402	456	530	366	414
									Standard Deviation		-	-	-	14.4	26.0
P 195	26/8	Breakwater wall Axis D	"	0.39	6	LP	11	2.4	21	17	-	-	-	357	421
P 196	"	B.wall Axes D-E	"	"	1	R	10	"	20	16	358	426	512	359	402
P 197	27/8	" " " E-F	"	"	"		"	2.3	19	13	-	-	-	338	428
P 198	"	" " " F-A	"	"	"		12	2.1	18	13	359	402	534	368	376
P 199	31/8	" " " B-C	460	"	"		9	2.2	19	11	-	-	-	307	432
P 200	"	" " " D	"	0.40	"		5	-	21	18	-	-	-	372	447
P 201	3/9	" " " E 5	"	"	"		11	-	19	15	-	-	-	357	441
P 202	"	" " " E 6	480	0.39	"		"	2.2	19	15	423	474	544	374	439
P 203	4/9	" " " F	"	0.39	5	LP	10	-	20	18	-	-	-	372	416
P 204	"	" " " F-A	"	"	"		7	2.1	21	21	370	436	514	376	451
P 205	6/9	" " " A 4th lift	"	0.40	"		12	-	18	11	-	-	-	378	442
P 206	"	B.wall Axis 2 4th lift	"	"	"		8	2.1	20	20	-	442	520	355	431
P 207	"	B.wall 4th lift	"	"	"		12	2.0	20	15	-	-	-	354	406
P 208	7/9	" " Axis 3	"	"	"		13	-	18	11	-	-	-	335	399
P 209	9/9	" " " 5-6 4th lift	"	0.39	"		10	-	2	19	-	-	-	330	417
P 210	"	B.wall Axis 5	"	0.40	"		13	-	18	12	-	-	-	339	390
P 211	10/9	Central Shaft 2	"	"	"		16	-	17	11	362	434	477	351	403
P 212	11/9	B.wall Axis2-C	"	0.39	"		9	2.2	17	16	-	-	-	359	416
P 213	"	Central Shaft 6	"	0.40	"		13	-	18	12	-	-	-	336	406
P 214	12/9	B.wall 5th lift	"	0.38	"		10	2.2	16	10	405	431	548	315	440
P 215	"	" "	"	0.39	"		13	-	15	10	-	-	-	315	408
P 216	13/9	Central Shaft	"	0.40	"		11	-	17	-	-	-	-	359	414
P 217	14/9	Seal Caisson Axis B	"	"	"		14	-	18	10	-	-	-	339	400
P 218	16/9	Exterior Elm-pompa 15-19m Axes A-5	"	-	-		13	2.1	19	15	-	-	-	336	408
P 219	18/9	B.wall Axis B 6th lift	"	0.38	"		9	2.2	16	11	347	390	469	367	425
P 220	19/9	B.wall Axes 2-5 6th lift	"	"	"		11	-	16	12	-	-	-	352	420
P 221	"	B.wall Axis 5 6th lift	"	0.39	"		10	2.2	17	10	403	438	492	370	427
P 222	20/9	B.wall Axis 6 6th lift	"	"	"		11	2.2	16	9	-	-	-	368	439
P 223	22/9	Central Shaft Top triangle	490	0.40	5	LP	15	2.4	16	10	-	-	-	347	403
P 224	"	" " Axis C	"	"	1	R	17	-	16	16	-	-	-	336	416
P 225	25/9	Seal Caisson Axis E	"	0.39	5	LP	13	2.1	16	12	363	396	479	379	403
P 226	"	Diaphragm Axis B	"	0.40	2	R	14	2.3	16	14	-	-	-	364	431
P 227	26/9	B.wall Axes C-4 2 I	"	"	6	LP	14	-	15	14	-	-	-	370	443
P 228	27/9	B.wall Axis C 6th lift	"	0.38	5	LP	9	2.0	15	9	417	469	559	356	434

Concrete Quality Control Summary

Report no.	Date	Structural member	Design strength	%	Admixtures per 100 kg	Slump cm	Air %	Temperature °C	Age days	Compressive strength N/mm² 1 day	2 days	3 days	7 days	28 days
	1974													
P 22	27/9	Tunnel A	440	0.40	6 LP 1 R	13	-	15	8	-	-	-	359	490
P 23	28/9	" "	"	"	"	11	2.5	13	7	410*	451	546	357	479
P 23	28/9	" "	"	"	"	15	-	15	12	-	-	-	362	477
P 23	28/9	" "	"	"	"	"	-	15	6	-	-	-	359	445
P 23	1/10	Int.shaft wall Axis F	"	"	"	16	2.2	15	10	-	-	-	360	478
P 23	"	Tunnel F	"	0.39	"	13	-	15	5	378	440	531	370	496
P 23	"	Diaphragm No.14	"	"	"	17	-	13	2	-	-	-	343	443
P 23	2/10	Tunnel D	"	0.40	"	13	2.5	14	11	359	405	515	350	464
P 23	"	" "	"	0.39	"	16	2.4	15	12	-	-	-	344	474
P 23	3/10	" C	"	0.40	"	"	-	12	0	338	405	522	340	437
P 23	4/10	" E	"	"	"	"	2.4	13	8	-	-	-	344	460
P 23	"	" E	"	"	"	12	2.3	13	6	376	425	535	342	460
P 24	5/10	" B	"	"	"	9	2.2	13	7	379	457	442	375	394
P 24	11/10	Diaphragm No.44 1H - 21.00 m	460	0.39	"	15	4.1	11	7	-	-	-	371	433
P 24	10/10	Ringbelt Axes 1-7	"	"	"	"	-	12	9	-	-	-	343	399
P 24	"	Ringbelt Axes 4-5	"	"	5 LP 1 R	13	2.4	10	6	358	409	482	350	453
P 24	22/10	Ringbelt Axes 5-m	480	"	5 LP 0.5 R	11	2.4	13	8	348	402	457	325	396
P 24	"	Diaphragm Wall No. 45	460	0.40	5 LP 1 R	"	2.2	11	8	-	-	-	349	412
P 24	"	Ringbelt Axes 2-4	480	0.39	"	12	3.1	12	7	-	-	-	350	418
P 24	24/10	Ringbelt Axis 3-4	"	"	"	"	2.4	11	5	278	353	422	299	345
P 24	25/10	Ringbelt Axes 6-1	"	0.36	"	"	2.2	11	7	-	-	-	372	415
P 24	27/10	Bottom Centre Shaft	"	0.37	"	9	2.6	7	7	-	-	-	349	426
P 25	7/11	Diaphragm Wall No. 45	"	0.40	6 LP 1 R	14	-	-	9	-	-	-	372	445
P 25	17/11	Kanalen Dyrkk- water wall	"	0.39	"	12	-	17	12	-	-	-	375	459
P 25	"	Exterior Dia- phragm 55	"	0.40	"	10	2.4	14	7	-	452	524	371	440
P 25	"	Exterior Dia- phragm 25	"	"	"	11	3.2	10	4	402	477	571	***324 382	474
P 25	17/11	Exterior Dia- phragm 14-15-66	"	"	"	12	3.4	15	2	-	-	-	344	470
P 25	20/11	Exterior Dia- phragm 16.70m	"	0.39	6 LP 0.5 R	10	"	"	"	427	452	564	375	449
P 25	"	" 18.45m	"	0.39	"	5	2.4	16	4	-	**402	*555	376	424
P 25	"	" 18.60m	"	0.40	6 LP	6	2.3	19	5	402	437	536	373	431
P 25	"	" 18.85m	"	0.39	"	10	-	18	5	-	-	-	373	402
P 25	"	" 19.05m	"	0.40	"	4	2.2	20	5	474	477	565	390	440
P 25	"	" 19.15m	"	0.39	6 LP 1 R	10	2.6	15	0	-	-	-	375	439
P 25	21/11	" 19.40m	"	0.40	6 LP 0.5 R	8	2.6	17	0	437	487	564	396	441
P 25	"	" 19.55m	"	"	"	10	2.3	13	2	-	-	-	385	430
P 25	"	" 20.00m	"	-	"	7	2.4	12	2	417	497	609	413	503
P 25	"	" 20.20m	"	0.39	"	6	2.2	17	1	-	-	-	389	470
P 25	"	" 20.35m	"	0.40	"	15	2.3	12	-2	377	417	524	402	510
P 25	"	" 20.50m	"	"	6 LP 1.5 R	8	2.1	9	-1	-	-	-	377	452
P 25	22/11	" 20.70m	"	"	6 LP 1 R	7	2.0	17	0	0---- 393	447	-	407	466
P 25	"	" 20.85m	"	"	"	7	2.0	17	0	-	-	-	396	459
P 25	"	" 21.05m	"	"	"	6	2.1	15	0	442	497	611	443	492
P 25	"	" 21.20m	"	0.39	"									

NOTESBY
NORSK TEKNISK
BYGGEKONTROLL A.S

Date:

* 4 days
** 16:00 o'clock
** 3 days
* 2 days

Concrete Quality Control Summary

											Compressive strength N/mm²					
											% - level			% - level		
											f_{cy}	f_{cm}	f_{cu}	f_{cy}	f_{cu}	
7271	2374 23/11	Grundmur(11); Dorm 22.0 m	400	0.40	6 LP 1 R	6	2	14	1	-	-	-	472	484		
7272	"	" 22.0m	"	"	"	7	-	17	1	457	477	504	409	475		
7273	23/11	" 22.20m	"	"	"	14	2.1	9	0	-	-	-	350	423		
7274	"	" 22.10m	"	"	"	9	2.1	13	0	427	457	506	325	423		
7275	"	" 22.40m	"	0.33	"	4	2.1	12	1	-	-	-	307	400		
7276	23/11	" 22.65m	"	0.40	"	7	2	19	2	-	-	-	377	479		
7277	"	" 22.90m	"	0.40	"	9	1.9	17	2	432	467	520	397	494		
7278	24/11	" 23.05m	"	"	"	13	3.1	17	3	-	-	-	306	472		
7279	"	" 23.20m	"	0.33	"	17	3.1	8	3	417	462	506	376	447		
7280	"	" 23.50m	"	0.40	6 LP 2 R	16	2.2	12	5	-	-	-	305	445		
7281	5/12	" 23.60m	"	0.39	6 LP	5	-	18	5	-	-	-	391	456		
7282	4/12	" 23.90m	"	"	"	5	2.0	19	7	422	467	538	432	451		
7283	"	" 24.10m	"	0.40	"	6	-	18	7	-	-	-	325	451		
7284	"	" 24.10m	"	0.39	5.5 LP	11	2.4	16	9	432	462	542	360	470		
7285	4/12	" 24.65m	"	"	"	12	2.2	17	9	-	-	-	342	393		
7286	"	" 24.90m	"	0.40	"	8	-	20	8	415	447	529	267	432		
7287	"	" 25.10m	"	"	"	9	2.2	20	6	-	-	-	382	445		
7288	5/12	" 25.65m	"	0.39	"	4	2.2	19	5	457	511	538	303	438		
7289	"	" 25.80m	"	"	"	6	-	13	5	-	-	-	422	456		
7290	"	" 26.20m	"	0.40	"	13	2.2	19	-	472	501	576	376	443		
7291	"	" 26.50m	"	"	"	12	-	19	7	-	-	-	300	432		
7292	"	" 26.70m	"	"	"	9	2.4	19	6	402	447 *453	506 *511	377	387		
7293	"	" 27.10m	"	0.39	"	11	-	19	6	-	-	-	329	403		
7294	6/12	" 27.30m	"	"	"	6	-	19	6	442	470	559	305	443		
7295	"	" 27.50m	"	"	"	5	1.9	18	6	-	-	-	419	492		
7296	"	" 27.65m	"	"	6 LP	9	2.1	17	4	422	467	553	339	451		
7297	"	" 27.90m	"	"	6 LP 1 R	10	2	18	4	-	-	-	417	492		
7298	"	" 28.15m	"	"	"	7	-	15	6	432	452	561	396	482		
7299	"	" 28.30m	"	0.40	6 LP	9	2.9	13	-	-	-	-	373	440		
7300	7/12	" 28.74m	"	0.39	5.5 LP	6	-	18	5	422	514	563	383	447		
7301	"	" 28.95m	"	"	"	7	2.1	17	5	-	-	-	362	422		
7302	"	" 29.15m	"	0.40	"	9	2.3	14	-	415	467	549	333	424		
7303	"	" 29.35m	"	"	"	9	2.2	17	-	-	-	-	379	440		
7304	"	" 29.70m	"	"	"	7	2.4	19	4.5	412	452	530	351	437		
7305	"	" 29.90m	"	0.39	5.5 LP 1 R	6	-	18	4.5	-	-	-	335	441		
7306	8/12	" 30.30	"	"	"	5	2.3	18	4	447	508	546	353	437		
7307	"	" 30.65m	"	0.40	"	7	2.3	19	4	-	-	-	362	436		
7308	"	" 30.90m	"	0.39	"	5	-	15	6	457	499	523	330	456		
7309	"	" 31.05m	"	0.40	5.5 LP	5	2.4	19	-	-	-	-	375	425		
7310	"	" 31.35m	"	0.39	"	6	2.5	19	6	437	457	551	374	417		
7311	"	" 31.65m	"	0.40	"	6	2.4	19	6	-	-	-	348	435		
7312	9/12	" 32.04m	"	"	"	9	2.3	18	7	477	500	591	373	426		
7313	"	" 32.15m	"	"	"	8	-	13	7	-	-	-	399	412		
7314	"	" 32.40m	"	"	"	10	3.0	17	8	455	485	565	365	401		
7315	"	" 32.70m	"	"	"	7	-	19	8	-	-	-	354	405		
7316	"	" 33.05m	"	"	"	6	2.3	20	7	415	475	551	373	438		
7317	"	" 33.30m	"	"	5 LP	7	2.5	20	7	-	-	-	377	434		
7318	10/12	" 33.90m	"	"	"	7	2.2	19	-	447	514	571	394	425		
7319	"	" 34.20m	"	"	"	7	2.1	20	4	-	-	-	371	435		
7320	"	" 34.50m	"	"	"	8	2.7	17	4	400	475	536	339	420		
7321	"	" 34.90m	"	0.39	"	11	-	16	-	-	-	-	357	445		

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A.S

Drwg No 13133-10 Date:

Concrete Quality Control Summary

Batch no	Date	Structural member	Batch size m³	%	Aggregate max size mm	Slump cm	Air %	Compressive strength kp/cm² 3 days	7 days	7 days	28 days	28 days
P322	10/12	Interior slip form 35.20m	460	0.40	5 12	7	2.4	16	5	392	462	576	360	445
P323	"	" 35.40m	"	0.39	"	5	2.5	"	6	-	-	-	350	458
P324	11/12	" 35.60m	"	0.40	"	7	2.4	17	"	417	467	531	361	402
P325	"	" 35.75m	"	"	"	"	-	16	"	-	-	-	339	401
P326	"	" 36.35m	"	"	"	"	2.5	15	2	392	469	529	353	403
P327	"	" 36.50m	"	0.39	"	"	2.4	14	5	"	439*	536*		
P328	"	" 36.55m	"	0.40	"	12	-	15	"	-	-	-	355	417
P329	"	" 36.80m	"	0.38	"	7	2.5	"	2	392	477	524	371	409*
P330	"	" 37.00m	"	0.39	"	5	"	16	5	"	-	-	383	436
P331	12/12	" 37.30m	"	"	"	"	"	11	0	422	496	565	393	463
P332	"	" 37.55m	"	"	"	6	-	14	0	-	-	-	391	451
P333	"	" 37.85m	"	"	"	"	2.5	15	-1	412	492	554	369	422
P334	"	" 38.05m	"	"	"	5	-	15	"	-	-	-	374	417
P335	"	" 38.20m	"	0.40	"	11	2.4	20	"	422	506	566	396	445
P336	"	" 38.50m	"	"	"	6	2.5	17	0	-	-	-	383	460
P337	13/12	" 38.65m	"	0.39	"	7	2.4	15	-2	427	457	554	371	435
P338	"	" 38.90m	"	"	"	6	-	16	-3	-	-	-	357	434
P339	"	" 39.10m	"	0.40	"	7	2.3	19	0	422	484	501	362	421
P340	"	" 39.20m	"	0.39	"	6	-	22	3	-	-	-	423	432
P341	"	" 39.55m	"	"	"	6	2.3	21	3	425	506	571	408	457
P342	"	" 39.90m	"	"	"	"	2.4	16	5	-	-	-	366	424*
P343	14/12	" 40.15m	"	0.40	"	8	2.3	"	8	450	490	576	372	456
P344	"	" 40.45m	"	"	"	7	-	19	7	-	-	-	371	428
P345	"	" 40.70m	"	0.39	"	7	2.1	17	5	402	461	521	360	396
P346	"	" 41.00m	"	"	"	5	-	17	"	-	-	-	373	440
P347	"	" 41.60m	"	"	"	6	2.4	16	7	427	464	544	360	422
P348	"	" 41.90m	"	"	"	5	2.5	15	8	-	-	-	383	416
P349	15/12	" 42.10m	"	0.40	"	13	2.6	16	2	407	445	509	319	401
P350	"	" 42.40m	"	"	"	12	-	15	2	-	-	-	359	417
P351	"	" 42.70m	"	0.39	"	6	2.5	15	5	437	457	549	359	434
P352	"	" 42.90m	"	"	"	"	2.3	22	3	-	-	-	362	428
P353	"	" 43.35m	"	0.40	"	12	-	17	2	375	437	496	359	408
P354	"	" 43.55m	"	"	"	"	-	"	"	-	-	-	341	403
P355	16/12	" 44.00m	"	"	"	7	3	15	1	407	448	504	353	405
P356	"	" 44.30m	"	"	"	"	-	20	1	"	-	-	350	415
P357	"	" 44.60m	"	0.39	"	"	2.2	"	0	410	472	531	377	424
P358	"	" 44.80m	"	"	"	5	2.1	19	1	-	-	-	382	449
P359	"	" 45.20m	"	"	"	8	-	22	2	425	460	526	371	420
P360	"	" 45.35m	"	0.40	"	7	2.5	19	2	-	-	-	369	418
P361	"	" 45.65m	"	-	"	"	2.2	"	4	377	435	519	361	398
P362	17/12	" 45.90m	"	0.39	"	5	-	20	6	-	-	-	352	405
P363	"	" 46.15m	"	"	"	"	2.3	"	"	428	472	531	375	438
P364	"	" 46.50m	"	"	"	6	2.5	24	6	-	-	-	372	403
P365	"	" 46.65m	"	0.40	"	11	1.9	21	5	416	486	556	361	410
P366	18/12	" 47.65m	"	0.39	"	8	-	20	-	-	-	-	360	417
P367	"	" 48.10m	"	"	"	7	2.1	18	6	-	-	596	400	459
P368	19/12	Column in interior wall fair faced concrete	"	0.40	"	9	-	14	8	-	-	-	350	398
P369	19/1	Strengthening of bottom slab	"	0.39	"	8	2.6	26	7	419	480	551	344	401
P370	16/1	Interior slip form 48.50m	"	"	5.5 12	5	3	20	20	447	501	569	402	470
P371	"	" 48.70m	"	"	"	"	-	"	"	"	-	-	350	418
P372	"	" 49.90m	"	0.40	"	7	2.4	19	9	442	497	631	393	426

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A/S

* 15 cm cubes

Concrete Quality Control Summary

Pour No	Date	Location	Slump mm	%	Admixture	Cube No	Mix No	Cement kg/m³	Agg. kg/m³	Compressive Strength N/mm² 7 days			28 days		
										C_1	C_2	C_{av}	C_1	C_2	C_{av}
P373	19/1	Interior pier 3W & 4E	480	0.39	5.5 LP	6	1.9	70	7	-	-	-	475	455	474**
P374	"	" 49.70m	"	"	"	8	-	19	4	457	499	571	509	435	
P375	"	" 49.90m	"	"	"	-	1.8	19	"	-	-	-	397	432	434***
P376	17/1	" 50.10m	"	"	"	6	2.2	"	3	462	511	556	472	426	
P377	"	" 50.40m	"	"	5 LP	5	-	"	1	-	-	-	405	428	491**
P378	"	" 50.55m	"	0.38	"	"	2	"	3	457	524	566	403	424	
P379	"	" 50.90m	"	0.39	"	6	2.1	16	5	-	-	-	398	428	506***
P380	"	" 51.55m	"	"	"	8	2	"	3	450	479	511	390	407	
P381	"	" 51.75m	"	"	"	7	-	15	"	-	-	-	396	438	491**
P382	18/1	" 52.00m	"	0.40	"	10	2.8	17	2	437	487	531	382	403	
P383	"	" 52.15m	"	0.39	"	7	-	19	"	-	-	-	391	426	497***
P384	"	" 52.45m	"	-	"	8	2.3	29	3	432	501	536	390	424	
P385	"	" 52.80m	"	0.39	"	7	2.7	19	4	-	-	-	400	434	483**
P386	"	" 52.90m	"	"	"	15	2.8	70	5	432	475	482	371	415	
P387	"	" 53.10m	"	"	"	6	-	21	"	-	-	-	420	449	531***
P388	19/1	" 53.55m	"	"	"	"	2.1	22	"	462	470	514	368	418	448**
P389	"	" 53.80m	"	0.40	"	9	-	20	"	-	-	-	382	426	
P390	"	" 54.20m	"	0.39	"	6	2.1	"	3	450	487	536	394	435	
P391	"	" 54.40m	"	"	"	7	-	"	4	-	-	-	394	419	460***
P392	"	" 54.70m	"	"	"	5	2.3	15	5	422	477	536	398	428	
P393	"	" 54.97m	"	0.40	"	12	-	21	"	-	-	-	399	463	517**
P394	20/1	" 55.30m	"	0.39	"	7	-	"	2	467	524	589	417	472	543***
P395	"	" 55.55m	"	"	"	5	1.9	19	"	-	-	-	440	514	
P396	"	" 55.85m	"	"	"	8	"	19	6	432	477	546	383	445	
P397	"	" 56.10m	"	"	"	"	2.3	19	7	-	-	-	382	426	454**
P398	"	" 56.45m	"	0.38	"	10	2.1	17	"	427	482 418*	586 507*	375	453	
P399	"	" 56.95m	"	0.39	"	6	-	18	-	-	-	-	394	441	470***
P400	21/1	" 57.15m	"	0.38	"	"	2.1	19	8	440	489	565	367	459	
P401	"	" 57.40m	"	0.39	"	7	-	18	5	-	-	-	380	450	
P402	"	" 50.05m	"	"	"	"	2.2	19	6	-	-	-	362	435	466***
P403	"	" 58.45m	"	"	"	"	-	16	5	459	485	565	371	449	
P404	"	" 58.70m	"	0.38	"	5	2.1	17	"	-	-	-	376	463	494**
P405	22/1	" 59.05m	"	"	"	"	"	"	6	447	526	619	399	460	
P406	"	" 59.45m	"	"	"	"	-	16	4	-	+	-	403	463	518***
P407	"	" 60.25m	"	"	"	"	-	20	4	427	497	556	411	469	
P408	"	" 60.75m	"	0.39	"	9	-	18	-	-	-	-	376	440	
P409	23/1	" 60.95m	"	"	"	6	-	21	8	452	529	578	399	428	
P410	"	" 61.25m	"	"	"	8	-	19	7	-	-	-	399	439	497***
P411	"	" 61.65m	"	"	"	7	1.9	17	-	457	487	565	394	443	
P412	"	" 62.25m	"	"	"	6	-	22	4	-	-	-	400	439	
P413	"	" 62.65m	"	0.38	"	8	-	18	-	437	475	565	380	439	
P414	24/1	" 62.85m	"	"	"	4	1.8	20	4	480	543	561	382	422	
P415	"	" 63.30m	"	0.39	"	7	-	17	"	-	-	-	396	437	477***
P416	"	" 63.70m	"	"	"	"	-	"	"	427	496	514	362	402	
P417	25/1	" 64.45m	"	0.40	6 LP 0.5 B	"	-	16	2	-	-	-	385	440	491**
P418	"	" 64.70m	"	0.39	-	9	-	15	5	445	472	556	387	430	
P419	"	" 65.0m	"	0.40	5.5 LP	8	-	17	3	-	-	-	353	413	422***
P420	"	" 65.65m	"	0.39	5 LP	"	-	13	4	445	506	606	391	438	
P421	26/1	" 66.50m	"	"	"	"	-	17	"	425	452	467	330	420	
P422	"	" 67.10m	"	"	"	"	-	-	2	-	-	-	354	459	534**
P423	"	" 67.65m	"	"	"	"	-	20	-	475	460	506	362	443	
									Mean % up	42.7	47.8	55.0	37.9	43.6	
									Range	2.3	2.5	3.0	2.1	2.4	

* 35 cm , ** 91 days, *** 90 days

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A/S

Drwg No 13133-10 Date:
Page 10

Concrete Quality Control Summary

Batch No.	Date	Structural Member	Cement kg/m³	w/c	Admixture kg/m³	Slump cm	Air %	Temperature °C: Fresh	Temperature °C: Ambient	Compressive Strength N/mm²: 1 day	3 days	7 days	28 days: Cyl.	28 days: Cube	
P424	13/5 14/2	Ringbelt Axis A	400	0.39	5 LP 0.75 L	12	5	23	-2	-	-	-	383	441	450 XXX
P425	15/2	" " "	"	0.40	"	7	4.2	8	-5	360	405	514	381	449	
P426	"	" " "	"	0.39	-	11	6.8	18	-	-	-	-	366	422	500 XX
P427	16/2	" " C+F	"	0.38	5 LP 0.70 L	12	9	20	-2	529	563	672	422	456	
P428	"	" " "	"	"	"	-	"	"	"	-	573	697	353	426	
P429	20/2	Reinforcement in Bottom Slab Axis C	"	0.40	5 LP	11	1.9	18	5	-	-	-	382	437	480 XXX
P430	"	Ringbelt Axis B	"	"	"	10	-	22	8	445	472	534	395	447	
P431	"	" " E	"	"	"	"	2	20	"	-	-	-	402	451	480 XX
P432	21/2	" " B	"	"	"	"	2.1	"	5	407	457	539	385	453	
P433	-	" " B+C	"	0.39	"	7	-	18	7	-	-	-	405	472	531 XXX
P434	"	" " E	"	"	5 LP 0.75 L	8	3.8	22	10	395	482	586	388	468	
P435	22/2	" " A	"	"	5 LP	11	-	23	10	-	-	-	373	468	451 XX
P436	23/2	" " D	"	0.40	"	9	1.8	21	5	435	474	544	370	434	
P437	"	" " D	"	0.39	"	"	-	20	"	-	-	-	383	433	457 XXX
P438	"	" " A	"	"	"	8	1.9	"	8	417	457	556	395	451	
		& Strengthening of Bottom Slab Axis C													
P439	"	Ringbelt Axis D	"	0.40	"	9	-	-	25	-	-	-	388	439	474 XX
P440	28/2	Tunneling Drover (Strut) Axis F	-	"	"	8	-	16	7	400	475	568	390	432	
P441	"	" Dr. " G	-	-	"	10	-	18	-	-	-	-	359	407	460 XXX
P442	5/3	" " D	"	"	"	8	1.8	19	9	422	470	551	398	451	
P443	6/3	" " E	"	"	"	10	2	17	6	-	-	-	385	420	451 XX
P444	"	Damage in Node Axis 3 Injection Mortar	-	-	25 kg ZDM(S)	-	-	15	6	343	390	487			
P445	7/3	Damage in Node Axis 3 Mortar	"	0.39	5 LP	-	-	20	7	442	506	-			
P446	8/3	Strut (2nd part) Axis F + P.water wall (1st lap) Axis C	"	0.40	"	6	-	16	10	-	-	-	400	451	520 XXX
P447	"	P.water Wall 1st lap	"	"	"	8	-	20	11	402	455	559	391	445	
P448	"	Strut Axis C + P.water wall Axis A	"	"	"	7	-	16	-	-	-	-	330	406	463 XXX
P449	9/3	P.water wall 1st lap Axis D	"	"	"	6	-	"	5	457	462	529	391	439	
P450	"	P.water wall 1st lap Axis E + Strut Axis E 2nd part	"	"	"	7	2	15	"	-	-	-	393	453	465 XX
P451	10/3	P.water wall 1st lap Axis B	"	"	"	8	-	16	"	416	491	544	383	420	
P452	11/3	Strut Axis B 2nd lap	"	"	"	"	1.9	17	4	-	-	-	395	474	497 XXX
											Mean Value		379	437	
											St.Deviation			23	

NOTEBY
NORSK TEKNISK BYGGEKONTROLL A/S

Drwg No 13133-10 Date:

XX 56 days, XXX 90 days.

Concrete Quality Control Summary

Mix No	Date	Mix Description	Slump mm	Air %	Max Agg mm	Cement kg/m³	w/c	Fly Ash %	Water Red. Admix %	Compressive Strength N/mm² f_{c1}	f_{c2}	f_{c3}	f_{c7}	f_{c14}	f_{c28}
	13.3														
Y-435	14.3	D.W.Wall,Axle F	140	-	10	0.75	9	5.4	24	-	353	331	370	259	433[1]	
Y-436	"	"	180	0.37	5.0	0.75	9	5.7	19	4	-	-	-	248	470	505[2]
Y-437																
Y-438	16.3	" Axle E	180	0.37	5.0	0.75	14	9.0	21	2	374	412	459	385	465	
Y-439	18.3	" " D	180	0.37	5.0	0.75	14	8.5	24	3	-	-	-	350	428	474[1,2]
Y-440	"	Concr.top Ballast														
		Bands, Axle D	230	0.75	3.0		18	-	19	5	-	48	121[1]			333[1,2]
Y-441	20.3	D.W.Wall,Axle C	180	0.37	5.0	0.75	7	4.5	15	0	417	492	510	403	496	
Y-442	21.3	Foundation Axle B	180	0.40	5.0	0.25	13	7.1	24	5	-	-	-	380	434	
Y-443	22.3	Central Shaft Level				0.75										
		69.45	180	0.38	5.0	0.75	8	4.9	20	0	-	-	-	374	449	480[2]
Y-444	"	" 70.20	180	0.38	5.0	0.75	5	4.3	22	0	409	462	526	349	408	
Y-445	"	" 71.10	180	0.39	5.0	0.75	7	4.8	27	5	-	-	-	385	424	538[2,3]
Y-446	"										-	453[1]	551[1]			553[1,3]
Y-447	23.3	" 73.00	180	0.37	5.0	0.75	7	5.1	20	-	405	477	482	405	426	
Y-448	"	" 73.90	140	0.37	5.0	0.75	9	5.4	22	6	-	-	-	321	438[1]	451[2,3]
Y-449	"	" 74.90	180	0.38	5.0	0.75	5	4.7	23	4	417	480	553	378	449	
Y-450	24.3	"										502[1]	585[1]			546[1,3]
Y-451											-	-	-	425	499	517[2]
Y-452	"	" 76.40	180	0.37	5.0	0.75	9	6.0	22	3	-	-	-	321	424	
Y-453	25.3	" 77.30	180	0.37	5.0	0.75	9	4.7	22	-	492	462	-	457	482	520[2,3]
Y-454	"	" 78.30	180	0.37	5.0	0.75	8	4.9	23	2	"	"	"	374	424	
Y-455	"	" 79.60	180	0.37	5.0	0.75	7	5.1	23	1	407	465	519	374	424	
Y-456	26.3	" 80.10	180	0.37	5.0	0.75	8	5.3	25	0	-	"	"	377	424	497[2,3]
Y-457	"	" 80.90	180	0.37	5.0	0.75	7	4.8	26	3	-	"	"	371	423	
Y-458	"	" 81.50	180	-	5.0	0.75	7	5.1	26	5	-	"	"	403	469	540[2,3]
Y-459	"	" 81.75	180	0.39	5.0	0.75	7	5.0	25	5	439	500	569	397	449	
Y-460	"													480[1]	504[1]	603[1,2]
Y-461	"										-	-	-	411	468	500[2,3]
Y-462	27.3	" 82.10	180	0.37	5.0	0.75	8	4.8	24	3	-	-	-	374	426	
Y-463	"	" 82.40	180	0.38	5.0	0.75	6	5.0	27	2	-	-	-	339	445	
Y-464	"	" 83.10	180	0.39	5.0	0.75	6	4.4	26	5	-	-	-	341	424	491[2]
Y-465	"	" 83.95	180	0.37	5.0	0.75	7	5.0	25	5	-	-	-	321	457	
Y-466	"	" 84.40	180	0.38	5.0	0.00	0	4.5	25	2	-	-	-	378	424	491[2,3]
Y-467	28.3	" 84.85	180	0.37	5.0	0.18	10	4.9	24	2	-	-	-	403	459	
Y-468	"	" 85.50	180	0.37	5.0	0.00	10	4.6	25	6	-	-	-	420	474	489[2]
Y-469	"	" 86.95	180	0.37	5.0	0.19	7	4.9	20	3	-	-	-	419	482	
Y-470	29.3	" 87.25	180	0.38	5.0	0.19	7	5.1	23	3	-	-	-	350	453	543[2,3]
Y-471	"	" 87.75	180	0.38	5.0	0.20	7	5.1	24	1	-	-	-	-	-	-
Y-472	"	Mortar	180	0.39	4.5	0.00	-	-	27	2	471	472	543	-	-	-
Y-473	"	Central Shaft Level														
		89.00	180	0.38	5.0	0.20	11	6.1	20	4	-	-	-	411	443	-
Y-474	-	" 89.30	180	0.38	5.0	0.20	9	4.9	21	2	-	-	-	385	451	497[2]
Y-475																
Y-476	30.3	" 90.70	180	0.38	5.0	0.00	6	4.8	22	0	-	-	-	350	433	
Y-477	"	" 90.90	180	0.38	5.0	0.00	6	4.5	20	4	-	-	-	423	470	548[2,3]
Y-478	"	" 91.20	180	0.37	5.0	0.00	8	4.8	20	-	-	-	-	430	457	
Y-479	"	" 91.75	180	0.38	5.0	0.00	7	5.0	22	2	-	-	-	417	463	505[2]
Y-480	-	" 92.25	180	0.38	5.0	0.00	9	4.8	25	2	-	-	-	374	424	
Y-481	31.3	" 92.50	180	0.38	5.0	0.00	7	5.1	23	2	-	-	-	427	433	470[2,3]
Y-482	"		180	0.38	5.0	0.00	6	5.0	24	2	-	-	-	418	518	
Y-483	"	E.W.Wall	180	0.38	5.0	0.00	6	5.0	24	2	-	-	-	457	495	571[2]
Y-484	1.4	" Axle E	180	0.37	5.0	0.75	7	4.9	16	1	-	-	-	457	482	
Y-485	2.4	" " A and D	180	0.38	5.0	0.75	6	5.3	25	3	465	516	632	422	482	
Y-486	3.4	" " A and C	180	0.37	5.0	0.75	6	5.1	25	0	-	-	-	386	451	
Y-487	"	" " D " F	180	0.39	5.0	0.75	9	6.0	25	5	392	462	520	368	441	
Y-488	"	" " F	180	0.37	5.0	0.80	9	6.9	21	1	-	-	-	440	492	540[2]
Y-489	"	" " E	180	0.38	5.0	0.75	7	4.1	23	4	435	475	539	341	441	
Y-490	4.4	" " A " E	180	0.38	5.0	0.70	7	4.9	23	3	-	-	-	358	422	511[2,3]
Y-491	5.4	" " D	180	0.38	5.0	0.70	7	5.3	20	11	382	445	497	358	428	
Y-492	"	" " F	180	0.38	5.0	0.70	8	5.5	20	0	-	-	-	452	447	492[2]
Y-493	6.4	" " C	180	0.38	5.0	0.71	7	5.0	25	6	367	447	497	395	439	
Y-494	"	" " B " E	180	0.38	5.0	0.70	8	4.7	25	-	-	-	-	341	432	520[2,3]
Y-495	7.4	" " D	180	0.38	5.0	0.71	5	4.1	20	10	453	482	556	405	463	
Y-496	"	" " F	180	0.38	5.0	0.71	7	4.5	23	10	-	-	-	405	459	527[2]
Y-497	8.4	" " C " F	180	0.37	5.0	0.69	9	5.1	24	2	445	470	499	370	443	
Y-498	"	" " A " C	180	0.38	5.0	0.68	8	4.3	21	8	-	-	-	368	441	497[2,3]
Y-499	"	" " B	180	0.38	5.0	0.70	9	4.7	20	6	477	539	573	347	457	
Y-500	"	" " D	180	0.38	5.0	0.70	8	4.8	22	4	-	-	-	436	478	520[2]
Y-501	9.4	" " B " A	180	0.38	5.0	0.68	7	4.8	24	-	-	-	-	385	430	457[2]
Y-502	"	" " F " E	180	0.38	5.0	0.68	7	4.8	24	-	-	-	-	-	-	511[2,3]
Y-503	"	" " F " E	180	0.37	5.0	0.67	10	5.3	25	4	405	460	519	447	484	
Y-504	-	" " C	180	0.37	5.0	0.67	7	4.9	23	12	-	-	-	413	437	497[2,3]
Y-505	10.4	" " B	180	0.38	5.0	0.68	8	5.0	26	6	427	502	581	405	451	
Y-506	"	" " A " B	180	0.37	5.0	0.67	8	4.3	21	-	-	-	-	405	437	463[2]
Y-507	11.4	" "	180	0.37	5.0	0.67	8	5.0	23	5	442	502	581	405	451	
Y-508	"	" "	180	0.37	5.0	0.67	8	5.0	23	5	-	-	-	405	451	

[1] 56 days [2] 112 days [3] 365 days

[1] 15 cubes.

NOTERY
NORSK TEKNISK
BYGGEKONTROLL A/S

Drwg No 13193-10 Date:

[illegible] Concrete Quality Control Summary

Pour No.	Date	Location	Volume m³	%	Slump mm	Air %	Temp °C	Cement kg/m³	Concrete strength N/mm² 1 day	3 days	7 days	28 days	56 days	90 days
F-540	11.4	E.W.W. Axle F	480	0.39	5.0	0.75	7	5.0	24	0	-	-	-	34	43[illegible]	483***
F-541	12.4	" Axle E	480	0.37	5.0	0.75	5	4.8	23	2	475	541	541	431	497	
F-542	"	" Axle C	480	0.37	5.0	0.75	9	4.8	29	6	-	-	-	317	440	469*
F-543	13.4	" " A	480	0.37	5.0	0.75	8	5.0	19	3	358	427	494	371	483	
F-544	"	Slab B	480	0.39	5.0	0.75	9	5.3	25	0	-	-	-	349	475	534***
F-545	14.4	E.W.W. Axle D	480	0.39	5.0	0.75	9	4.5	21	8	338	378	430	349	422	
F-546	"	Slab A " F	480	0.38	5.0	0.75	9	5.0	21	11	"	"	"	340	434	483*
F-547	15.4	Central D affy														
		above 94.77	480	0.38	5.0	0.75	7	4.3	23	5	402	455	-	377	513	
F-526	"	" " 93.00	480	0.36	5.0	0.75	9	4.9	29	-	-	-	-	425	493	559***
F-527	"	" " 93.40	480	0.35	5.0	0.75	9	5.5	23	12	370	427	447	417	474	
F-528	16.4	" " 95.00	480	0.35	5.0	0.75	10	5.1	25	6	-	-	-	397	445	477*
F-529	"	" " 95.20	480	0.38	5.0	0.75	10	5.2	23	12	348	410	477	385	428	
F-530	"	" " 95.75	480	0.37	5.0	0.75	8	4.9	22	12	-	-	-	352	437	491***
F-531	"	" " 96.05	480	0.37	5.0	0.75	9	5.1	20	6	323	393	480	334	413	
F-532	"	" " 96.45	480	0.37	5.0	0.75	11	5.0	22	6	-	-	-	411	455	497*
F-533	17.4	" " 96.75	480	0.35	5.0	0.75	9	4.8	19	6	412	455	529	374	432	
F-534	"	" " 97.50	480	0.38	5.0	0.75	10	5.2	24	10	-	-	-	308	445	497***
F-535	"	" " 97.85	480	0.37	5.0	0.75	9	5.3	19	8	-	-	-	434	478	516*
F-536	"	" " 98.45	480	0.37	5.0	0.75	10	5.0	23	3	442	516	561	420	495	
F-537	18.4	" " 98.75	480	0.36	5.0	0.75	9	5.1	20	7	-	-	-	385	452	516***
F-538	"	" " 98.80	480	0.37	5.0	0.75	8	5.3	18	7	372	407	507	377	426	
F-539	"	" " 99.10	480	0.38	5.0	0.75	9	5.7	21	10	375	377	455	374	426	
F-540	"	" " 99.90	480	0.35	5.0	0.75	10	5.5	22	15	-	-	-	331	430	502*
F-541	"	" " 100.35	480	0.37	5.0	0.75	8	4.9	21	10	350	437	501	408	446	
F-542	19.4	" " 100.75	480	0.37	5.0	0.75	8	5.0	20	-	-	-	-	383	492	465***
F-543	"	" " 101.00	480	0.38	5.0	0.75	10	5.2	23	10	410	460	511	411	493	
F-544	"	" " 101.45	480	0.35	5.0	0.75	9	5.5	21	15	-	-	-	351	492	450*
F-545	20.4	" " 102.10	480	0.38	5.0	0.75	9	6.0	23	10	367	417	502	397	479	
F-546	"	" " 102.90	480	0.33	5.0	0.75	10	5.5	22	-	-	-	-	408	496	483***
F-547	"	" " 103.40	480	0.38	5.0	0.69	7	5.0	21	12	402	462	547	438	471	
F-548	"	" " 103.60	480	0.39	5.0	0.69	8	5.7	22	13	-	-	-	403	479	483*
F-549	"	" " 103.90	480	0.39	5.0	0.75	7	5.6	22	11	412	477	561	356	429	
F-550	21.4	" " 104.60	480	0.37	6.0	0.80	10	5.0	21	8	-	-	-	369	441	511***
F-551	"	Pour 1	480	0.37	5.0	0.75	8	5.0	21	13	357	407	480	341	453	
F-552	"	Centreline 105.70	470	0.37	6.0	0.80	8	4.9	18	10	-	-	-	414	472	529*
F-553	"	Axle B	480	0.37	5.0	0.75	5	5.3	22	7	422	465	539	403	457	
F-554	22.4	" " 106.00	480	0.37	5.0	0.75	9	5.1	20	-	-	-	-	353	430	497***
F-555	"	" " 106.30	480	0.37	5.0	0.75	9	5.9	20	13	417	462	539	374	437	
F-556	"	" " 106.60	480	0.35	5.0	0.65	11	6.2	21	11	-	-	-	385	465	521*
F-557	"	"	480	0.38	5.0	0.68	11	-	20	-	457	482	546	394	437	
F-558	23.4	" " 107.30	480	0.38	5.0	0.68	12	5.7	21	6	-	-	-	405	460	520***
F-559	"	" " 107.45	480	0.38	5.0	0.75	12	4.7	20	9	405	450	500	377	455	
F-560	"	" " 107.75	480	0.37	5.0	0.75	8	5.4	20	-	-	-	-	309	434	490*
F-561	"	" " 108.30	480	0.38	5.0	0.68	8	5.3	19	6	357	420	476	383	447	
F-562	"	" " 108.70	480	0.37	5.0	0.75	8	5.2	21	-	-	-	-	411	463	520***
F-563	24.4	" " 109.00	480	0.37	5.0	0.75	10	5.7	20	8	392	435	489	418	473	
F-564	"	" " 109.30	480	0.38	5.0	0.75	9	5.9	21	9	-	-	-	421	475	534*
F-565	"	" " 109.70	480	0.38	5.0	0.75	9	5.2	20	7	475	490	546	424	487	
F-566	"	" " 109.85	480	-	5.0	0.68	8	4.9	17	7	-	-	-	334	454	477***
F-567	"	" " 110.00	480	0.38	5.0	0.68	11	5.4	15	6	417	452	530	383	460	
F-568	"	" " 110.30	480	0.37	5.0	0.75	8	5.7	20	6	-	-	-	414	472	477*
F-569	25.4	" " 110.50	480	0.37	5.0	0.68	7	4.9	19	7	445	475	532	408	472	
F-570	"	" " 111.00	480	0.37	5.0	0.68	11	5.3	20	10	-	-	-	383	478	540***
F-571	"	" " 111.35	480	0.38	5.0	0.68	6	5.0	19	10	-	-	-	417	495	
F-572	"	" " 111.60	480	0.38	5.0	0.68	10	5.2	19	-	309	432	496	-	453	
F-573	"	" " 112.15	480	0.37	5.0	0.68	10	5.6	19	6	-	-	-	433	484	
F-574	26.4	" " 112.45	480	0.38	5.0	0.68	8	5.7	20	8	472	518	599	-	478	
F-575	"	" " 112.90	480	0.38	5.0	0.68	9	5.3	19	-	-	-	-	432	472	477* 547***
F-576	"	" " 113.45	480	0.37	5.0	0.68	8	4.9	20	-	447	503	546	-	457	
F-577	"	" " 113.75	480	0.38	5.0	0.68	+10	5.2	21	-	-	-	-	434	483	
F-578	"	" " 113.90	480	0.38	5.0	0.68	9	5.0	20	-	420	467	544	-	474	
F-579	"	" " 114.00	480	0.37	5.0	0.68	7	5.1	19	6	-	-	-	358	457	
F-580	27.4	" " 114.50	480	0.37	5.0	0.68	8	5.0	20	8	440	492	553	-	483	
F-581	"	" " 114.85	480	0.37	5.0	0.68	10	5.0	17	-	-	-	-	369	430	480* 486***
F-582	"	" " 115.15	480	0.38	5.0	0.68	10	5.2	20	-	340	430	504	-	464	
F-583	"	" " 115.45	480	0.38	5.0	0.68	10	5.3	17	-	-	-	-	418	470	
F-584	"	" " 115.70	470	0.38	5.0	0.68	11	5.2	17	-	363	409	472	-	470	
F-585	"	" " 115.95	480	0.38	5.0	0.68	10	5.6	20	-	-	-	-	368	436	
F-586	28.4	" " 116.45	480	0.37	5.0	0.75	10	5.4	19	-	374	436	550	350	-	432
F-587	"	" " 116.70	480	0.38	5.0	0.75										

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL AS

[illegible] Date:

*56 days, **90 days

Concrete Quality Control Summary

Pour No.	Date	Location	Design Strength	%	Slump	Air	Temperature		Compressive Strength N/mm²				
									7 Days			28 Days	
					mm	%	°C	°F	C_7	C_{7a}	C_{7b}	C_{28}	C_{28a}
P-027	28.4	Crystal Gr. 117.10	450	0.40	5.0	0.37	9	5.9	17	-	-	-	398	424	421* 510**
P-028	"	" 117.45	450	0.40	5.0	0.35	9	5.9	20	-	459	437	474	-	418	
P-029	"	" 117.55	450	0.35	5.0	0.34	9	5.7	6+	9	-	-	-	388	472	
P-040	29.4	" 118.05	450	0.38	5.0	0.34	10	5.9	22	6	402	421	521	-	447	
P-041	"	" 118.55	450	0.37	5.0	0.35	8	6.0	17	19	-	-	-	398	451	465* 526**
P-042	"	" 119.05	450	-	5.0	0.40	9	5.6	17	10	467	499	606	-	495	
P-043	30.4	" 119.50	450	0.37	5.0	0.40	9	5.4	18	6	-	-	-	434	513	
P-044	"	" 119.70	450	0.37	5.0	0.40	10	5.7	19	7	447	494	594	-	518	
P-045	"	" 120.00	450	0.38	5.0	0.40	7	6.0	20	+	-	-	-	408	463	424* 543**
P-046	"	" 120.40	450	0.35	5.0	0.40	9	6.0	-	23	422	457	537	-	442	
P-047	"	" 120.80	450	0.37	5.0	0.40	10	5.6	20	9	-	-	-	405	451	
P-048	31.5	" 121.20	450	0.37	5.0	0.40	11	6.7	19	6	440	487	551	-	522	
P-049	"	" 121.70	470	0.37	5.0	0.35	7	6.8	17	11	-	-	-	405	483	491* 565**
P-050	"	" 122.00	450	0.38	5.0	0.35	9	5.8	19	-	419	467	573	-	436	
P-051	"	" 122.20	450	0.38	5.0	0.35	7	6.2	18	11	-	-	-	388	451	
P-052	"	" 122.30	450	0.35	5.0	0.35	8	6.7	17	11	452	519	599	-	459	
P-053	2.5	" 123.00	450	0.38	5.0	0.50	11	6.5	19	6	-	-	-	394	463	
P-054	"	" 123.20	450	0.38	5.0	0.55	11	5.5	18	-	417	501	561	-	425	441* 507**
P-055	"	" 123.40	450	0.38	5.0	0.55	8	5.0	18	7	-	-	-	369	449	
P-056	"	" 123.80	450	0.38	5.0	0.55	11	6.5	18	7	416	465	571	-	432	
P-057	3.5	" 124.15	450	0.38	5.0	0.55	11	6.6	23	6	-	-	-	377	404	
P-058	"	" 125.05	450	0.38	5.0	0.55	7	6.5	18	7	445	502	565	-	436	454* 522**
P-059	"	" 125.30	450	0.38	5.0	0.55	8	5.0	21	8	-	-	-	385	439	
P-060	"	" 125.60	450	0.38	5.0	0.55	11	6.1	22	6	430	492	581	-	462	
P-061	4.5	" 126.20	480	0.38	5.0	0.55	9	5.2	22	5	-	-	-	394	453	
P-062	"	" 126.60	470	0.38	6.0	1.0 0.55	12	5.0	20	16	450	528	614	-	502	542* 593**
P-063	"	B.V.M. Node 6	450	0.38	5.0	0.55	10	5.4	22	9	-	-	-	353	418	
P-064	5.5	" Axis C	450	0.38	5.0	0.55	9	6.0	23	8	-	-	-	348	425	472*
P-065	"	" " Anode	450	0.33	5.0	0.55	15	6.2	14	15	371	432	504	365	405	
P-066	"	" " B	450	0.37	5.0	0.55	9	10.0	22	12	-	-	-	414	484	531***
P-067	6.5	" " A	450	0.35	5.0	0.55	8	6.2	24	6	427	497	546	395	442	
P-068	"	" Node 5	450	0.35	5.0	0.55	9	5.9	23	19	-	-	-	355	402	467*
P-069	7.5	" Axis F	450	0.35	5.0	0.55	8	5.4	21	-	371	450	529	323	417	
P-070	"	" Node 6	450	0.36	5.0	0.40	8	5.5	23	13	-	-	-	362	405	
P-071	8.5	" " A, Axis D	450	0.35	5.0	0.40	7	6.8	19	-	430	492	587	369	411	431* 511***
P-072	"	" " E	450	0.38	5.0	0.40	10	5.4	22	13	-	-	-	365	419	435*
P-073	9.5	" Node 1, E	450	0.38	5.0	0.40	8	5.2	22	-	402	470	539	370	428	
P-074	"	" " A	450	0.39	5.0	0.40	8	5.7	23	8	-	-	-	367	451	494***
P-075	"	" Axis A	450	0.38	5.0	0.40	7	6.0	23	13	432*	493	569	-	473	
P-076	10.5	" Node 1	450	0.38	5.0	0.35	8	6.8	19	15	-	-	-	359	433	469*
P-077	"	" Axis C	450	0.38	5.0	0.35	11	6.9	18	17	424*	492	569	368	441	
P-078	11.5	" Node 4	450	0.37	5.0	0.35	10	5.0	22	-	-	-	-	360	435	496***
P-079	12.5	" Axis B	450	0.38	5.0	0.35	9	5.9	17	12	-	459	550	374	428	584*
P-080	13.5	" " E	450	0.39	-	-	10	-	17	12	-	97	127	-	-	
P-081	-	" " E	450	0.37	5.0	0.35	12	6.8	17	12	504*	435	497	-	-	
P-082	14.5	" " E	450	0.38	5.0	0.35	8	6.8	25	9	-	-	-	374	450	454*
P-083	-	" " C and E	450	0.39	5.0	0.35	9	6.8	17	10	-	427	490	377	438	509*
P-084	15.5	" " E									300	410	466			
P-085	16.5	" " B and E	480	0.40	5.0	0.35	10	6.3	14	10	370	420	510	327	407	
P-086	17.5	" " E	450	0.40	5.0	0.35	10	6.7	15	8	-	-	-	373	436	342*
P-087	"	" Node 1	480	0.40	5.0	0.35	11	6.8	15	10	415	472	534	317	417	
P-088	18.6	" " A	450	0.39	5.0	0.35	10	6.7	14	15	-	-	-	326	405	435*
P-089	19.6	" " 3	450	0.39	5.0	0.35	11	6.5	-	-	422	472	526	359	410	
P-090	"	" " 3	450	0.38	5.0	0.35	10	6.6	-	14	-	-	-	305	436	474***
P-091	"	" " 6	450	0.39	5.0	0.35	11	6.9	17	18	419	-	551	359	422	
P-092	20.6	" " 6	450	0.39	5.0	0.35	12	6.5	16	12	-	-	-	377	426	446*
P-093	"	Ingolstadt Axis F	480	0.39	5.0	0.35	15	6.9	17	19	426	467	536	373	428	
P-094	21.6	Node 6	450	0.39	5.0	0.35	15	3.9	20	18	-	-	-	362	417	491***
P-095	22.6	" 2	490	0.40	5.0	0.35	10	6.7	19	19	419	542*	599	354	403	
P-096	"	" 2	450	0.40	5.0	0.35	13	6.7	-	-	-	-	-	336	401	417*
P-097	23.6	Spread Axis A	470	0.37	5.0	0.35	11	5.9	19	19	422	472	541	373	409	
P-098	24.6	Ingolstadt D	450	0.39	5.0	0.35	12	5.8	18	10	-	-	-	333	415	474***
P-099	25.6	" " C	450	0.40	5.0	0.35	13	6.5	21	12	460	502	577	361	404	
P-100	26.6	Console " 1	450	-	6.0	2.0 0.35	16	7.0	17	-	447	499	573*	373	447	462*
P-101	27.6	"	480	0.39	6.0	2.0 0.35	17	6.8	18	12	447	496	550*	402	475	534***
P-102	28.6	Connection Level														
		3.00-217.00	440	0.39	6.0	1.0 0.45	13	6.2	20	18	417	460	559	343	411	
P-103	29.6	3.00-217.00	480	0.34	6.0	1.0 0.45	10	5.6	19	19	-	-	-	373	428	574*
P-104	30.6	3.00-217.00	450	0.39	6.0	2.0 0.45	14	6.2	19	17	501	557	637	333	403	

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A.S
Drwg No 13133-10 Date

* 50 days, ** 90 days, *** 3 days, T days

Concrete Daily Control Summary

Part no.	Date	Structural member	Volume m³	%	Air content mm			Slump mm	w/c ratio	Temperature °C		Cube strength N/mm²			Cylinder strength N/mm²		
F-C(1)*	29.7	Foundation Zone A	480	0.39	6.0	1.0	0.4	14	0.6	16	17	-	-	-	344	407	463***
		133.00 - 137.00															
F-C(2)*	30.7	133.00 - 137.00	460	0.37	6.0	1.0	0.4	17	0.7	17	17	331	399	452			
															359	421	
F-C(3)	*														393	478	
F-C(4)	29.7	137.00	480	-	6.0	1.0	0.35	15	0.5	-	-	-	-	-	372	453	431*
F-C(5)	29.7	Corbels Axle F	480	0.37	6.0	1.0	0.35	17	0.6	18	21	-	-	-	334	405	416***
F-C(6)	30.7	Level 126.60	480	0.38	6.0	1.0	0.35	18	0.6	16	20	-	-	-	345	401	-
F-C(7)	31.7	" 127.60	480	0.37	6.0	1.0	0.35	17	0.6	15	15	411	-	-	347	401	411*
F-C(8)	3.8	Axle A	470	0.38	6.0	1.0	0.3	15	0.7	16	15	-	-	-	347	401	
F-C(9)	5.8	Joints, Lines	480	0.35	6.0	1.0	0.3	13	0.5	18	20	-	427	498	372	430	
F-C(10)	6.8	" Level 126.60	460	-	6.0	2.0	0.35	14	0.6	21	23	-	-	-	371	459	463***
F-C(11)	7.8	" " 126.60	480	-	6.0	1.0	0.30	14	0.5	19	23	419	-	-	327	445	
F-C(12)	14.8	Axle C and D	70	0.43	-	-	-	-	-	-	-	-	273	341	-	-	
F-C(13)	15.8	" "	70	0.39	0.2	-	-	-	-	-	-	-	215	276	-	-	
F-C(14)	17.8	Prefab (8.00	480	-	6.0	1.0	0.4	-	0.8	19	-	370	462	526	376	411	
F-C(15)	20.8	" (5.00	480	0.37	6.0	1.0	0.3	10	0.8	18	-	432	499	524	376	462	
F-C(16)	28.10	Tunnel Line D	480	0.39	6.0	2.0	-	11	2.5	-	10	-	525	660	393	479	
F-C(17)	4.11	Tunnel Line D	480	0.39	6.0	2.0	-	10	-	-	10	-	393	481	299	369	
F-C(18)	6.11	Cross line F, joints A and G	480	0.39	6.0	2.0	0.4	10	5.2	9	9	303°	392	-	309		

* 10 days, ** 90 days, *** 28 days

NOTEBY
NORSK TEKNISK
BYGGEKONTROLL A/S

Drwg No 13133-10 Date:

Concrete Quality Control Summary

Sample no.	Date	Structural member	Design strength kp/cm²	%	Consistency cm	Air %	Temperature °C	Age days	Compressive strength kp/cm² 3 days	7 days	28 days	Cube 28 days	Cyl. 28 days	
YP1	1974 20/11	Base Stavanger Top Deck	400	0.39	6 LP 2 P 0.2 L	7	5.2	12	4	-	-	-	393	463	
YB2	22/11	Precast Element C 46	"	"	6 LP 2 R 0.3 L	18	8.5	21	1	-	-	-	353	434	
YB3	28/11	" " A 65	"	"	"	16	8.7	19	4	-	-	-	370	405	
YB4	29/11	" " B 67	"	"	6 LP 2 R 0.28 L	"	8.2	"	2	-	-	-	305	373	
YB5	2/12	" " C 67	"	"	"	14	7.7	18	6	-	-	-	393	442	
YB6	3/12	" " H 67	"	"	"	17	7.5	"	5	-	-	-	331	399	
YB7	4/12	" " K 46	"	"	"	14	7.8	20	8	-	-	441*	362	402	
YB9	6/12	" " A 56	"	"	6 LP 2 R 0.49 L	12	8	7	2	-	364	427	335	407	
YB9	9/12	" " I 66	"	"	6 LP 2 R 0.48 L	"	7.4	12	5	-	-	-	348	417	
YB10	13/12	" " I 36	"	"	"	14	8	10	1	-	-	-	355	420	
YB11	1975: 8/1/75	" " 7 A1	"	"	6 LP 2 R 0.25 L	"	8.8	15	-3	-	-	-	351	459	
YB12	14/1	" " B 67	"	"	6 LP 2 R 0.405 L	15	6.8	7	8	-	-	-	348	410	
YB13	22/1	" " A 45	"	"	6 LP 2 R 0.41 L	11	6.7	"	2	-	-	-	330	402	
YB14	"	" " 7 G1	"	"	6 LP 2 R 0.420 L	12	8.2	6	4	-	-	-	333	417	
YB15	23/1	" " E 46	"	"	6 LP 2 R 0.40 L	13	6.1	7	6	-	-	-	345	420	
YB16	28/1	" " F 67	"	"	6 LP 2 R 0.45 L	"	8	20	1	-	-	-	374	414	
YB17	"	" "E7-10	"	"	"	14	7.9	16	2	-	-	-	380	445	
YB18	30/1	" " 1 G2	"	"	"	"	6.9	18	3	-	-	-	342	419	
YB19	"	" "10 G1	"	"	"	12	6.2	21	2	-	-	-	360	429	
YB20	3/2	" "16 G1	"	"	"	"	6.7	"	"	-	-	-	371	466	
YB21	5/2	" "20	"	"	"	"	8.1	"	4	-	-	-	387	443	
YB22	6/2	" " 8 A2	"	0.38	-	11	6.7	19	"	-	-	-	360	457	
YB23	"	" " 5 A1	"	0.39	"	13	8.1	20	"	-	-	-	386	458	
YB24	7/2	" "B-2-4	"	"	"	14	8.3	15	2	-	-	+	348	430	
YB25	"	" "B-7-9	"	"	"	12	7.4	20	2	-	-	-	365	470	
YB26	12/2	" "GG-10	"	"	"	14	8.9	"	2	-	-	-	394	478	
YB27	13/2	" " F 46	"	"	6 LP 2 R 0.43 L	12	7.5	18	-5	-	-	-	391	459	
YB28	"	" " C 76	"	"	"	15	8.3	15	-3	-	-	-	341	430	502
YB29	"	" " 9 F3	"	"	"	"	"	"	"	-	-	-	341	430	
YB30	14/2	" " F 14	"	"	6 LP 2 R 0.42 L	13	6.9	19	-6	-	-	-	394	465	
YB31	18/2	" " 9 F6	"	"	"	12	7	"	4	-	-	-	388	455	
YB32	"	" " 2 K4	"	"	"	"	"	"	"	-	-	-	389	495	
YB33	21/2	" " 2 F2	"	"	6 LP 2 R 0.43 L	"	6.7	14	5	-	-	-	380	443	509
YB34	"	" " 9 D5	"	"	"	"	"	"	"	-	-	-	380		
YB35	"	" " 4 G1	"	"	"	14	8.5	15	5	-	-	-	365	445	497
YB36	26/2	" " G16	"	"	"	13	7	18	0	-	-	-	362	492	537
YB37	27/2	" " B 76	"	"	"	14	6.7	14	2	-	-	-	400	440	517
YB38	"	" Strata 8	"	"	"	"	"	"	"	-	-	-	400		

*15 cm

NOTEBY
NORSK TEKNISK BYGGEKONTROLL A/S

Drwn No 13132-10 Date:

Concrete Quality Control Summary

	Date	Structural member									Compressive strength N/mm²					
F215	4/5 5/5	Precast element 7 FC	480	0.39	6 SP 2 R 0.40 L	14	7.2	16	8	-	-	-	391	486	538
F240	7/5	" *6 PI	"	"	"	13	6.4	20	5	-	-	-	402	489	524
F241	"	" " Strute E	"	"	"	"	"	"	"	-	-	-	402		
F242	12/5	" Element 4 DC	"	"	"	14	"	22	5	-	-	-	399	495	545
					SP R L										
.43	14.5	Precast element 5 AB	480	0.39	6.0 2.0 0.40	12	6.8	20	5	-	-	-	397	499	523
F5 44	"	" Strute B	480	0.39	6.0 2.0 0.40	12	6.8	20	5	-	-	-	397	499	523
F5 45	"	" D 20	480	0.39	6.0 2.0 0.40	14	6.9	20	5	-	-	-	353	470	517
F5 46	20.5	" Strute C	480	0.39	6.0 2.0 0.40	13	7.0	18	2	-	-	-	351	428	463
F5 47	"	" 5 AB	480	0.39	6.0 2.0 0.40	13	7.0	18	2	-	-	-	351	428	463
F5 48	"	" 2 34	480	0.39	6.0 2.0 0.40	13	7.0	18	2	-	-	-	351	428	463
F5 49	21.5	" D C9	480	0.39	6.0 2.0 0.40	10	7.1	17	7	-	-	-	-	447	450
F5 50	"	" 5 AB	480	0.39	6.0 2.0 0.40	13	6.9	16	7	-	-	-	-	460	500
F5 51	4.6	" Strute F	480	0.39	6.0 2.0 0.40	13	7.5	16	5	-	-	-	377	466	500
F5 52	"	" prodrager m23	480	0.39	6.0 2.0 0.40	13	7.5	16	5	-	-	-	377	460	500
F5 53															
F5 53	8.5	Precast element Y 63	480	0.39	6.0 2.0 0.36	13	6.9	21	1	-	-	-	425	481	523
F5 54	10.5	" 6 BL	480	0.39	6.0 2.0 0.35	15	6.5	18	0	-	-	-	400	470	543
F5 55	"	" Strute (52)	480	0.39	6.0 2.0 0.35	13	6.5	18	0	-	-	-	400	470	543
F5 56	11.5	" Y 33	480	0.39	6.0 2.0 0.35	15	6.5	23	0	-	-	-	332	434	542
F5 57	12.5	Columns B 7	480	0.38	5.0 " 0.75	12	9.9	17	2	-	-	-	318	401	511
F5 58	"	" B 4	480	0.38	5.0 " 0.75	12	9.9	17	2	-	-	-	318	401	511
F5 59	15.5	" B 7, B C	480	0.35	5.0 " 0.75	13	5.3	21	-	-	-	-	398	454	517
F5 60	16.5	Precast element Y 43	480	0.39	6.0 2.0 0.37	14	6.9	22	5	-	-	-	365	415	445
F5 61	18.5	"	480	0.39	6.0 2.0 0.37	12	6.9	24	15	-	-	-	368	432	497
F5 62	24.5	" Y 23	480	0.39	6.0 2.0 0.37	13	6.1	20	6	-	-	-	352	413	460
F5 63	26.5	" ,218,217,25E 25F	480	0.39	6.0 2.0 0.37	14	6.0	20	12	-	-	-	352	447	497
F5 64	7.5	Columns	480	0.38	5.0 " 0.38	12	5.8	20	15	-	-	-	338	429	543
F5 65	9.5	"	480	0.39	6.0 1.0 0.20	12	6.0	18	15	-	-	-	373	442	457
F5 66	13.5	Precast element Columns	480	0.39	6.0 1.0 0.20	13	6.5	17	13	-	-	-	359	439	477
F5 67	13.5	" "	480	0.39	6.0 1.0 0.17	10	5.2	17	12	-	-	-	380	441	499
F5 68	14.5	" B-6-7	480	0.40	7.0 2.0 0.36	15	7.5	16	10	-	-	-	358*	415	
F4 69	15.5	" Columns	480	0.39	6.0 1.0 0.20	13	5.5	18	10	-	-	-	302	412	480

NOTEBY
NORSK TEKNISK BYGGEKONTROLL A.S
Dwg No 13133-10 Date

* 13 dage

APPENDIX V

CONCRETE CORE STRENGTH

NORSK TEKNISK
BYGGEKONTROLL A.S

CONSULTING ENGINEERS
SOILS AND FOUNDATION ENGINEERING
ENGINEERING GEOLOGY AND GEOPHYSICS
CONCRETE TECHNOLOGY MATERIALS TESTING

CONCRETE CORE STRENGTH

Core Identification	Structural member	Age at testing	Core dimensions	Testing strength	Equivalent cylind. strength (kg/cm^2)
	Base Slab (V)				
A	Axix A	70 days	Ø9.8x12.3	392	368
"	"	70 "	Ø9.8x12.2	441	415 392
C	Axis C	80 days	Ø9.8x12.3	477	448
"	"	80 "	Ø9.8x12.3	466	438 443
E	Axis E	90 days	Ø9.8x12.3	443	416
"	"	90 "	Ø9.8x12.3	477	448 432
	Precast Element B 67				
FB4	Upper part (V)	90 days	Ø15x22.5	263	247
"	"	90 "	Ø15x29.8	279	279
"	"		Ø15x30.1	275	275 267
FB4	Lower part (H)	105 days	Ø15x22.5	397	385
"	"	105 "	Ø15x26.4	406	402
"	"	105 "	Ø15x26.4	327	322 370
	Strut Axis E (V)				
I	"	8 days	Ø10x20	296	296
II	"	8 "	Ø10x20	301	301
III	"	8 "	Ø10x20	317	317 305
	Ringbelt Axis E (V)				
I	"	12 days	Ø10x15	392	380
II	"	12 "	Ø10x20	357	357
III	"	12 "	Ø10x20	360	360 366
	Ringbelt Axis F (V)				
I	"	19 days	Ø15x30	372	372
II	"	19 "	Ø15x22.5	352	341
III	"	19 "	Ø15x18.5	346	332 348

Last element was rejected.

NORSK TEKNISK
BYGGEKONTROLL A.S

CONSULTING ENGINEERS
SOILS AND FOUNDATION ENGINEERING
ENGINEERING GEOLOGY AND GEOPHYSICS
CONCRETE TECHNOLOGY, MATERIALS TESTING

CONCRETE CORE STRENGTH

Core Identification	Structural member	Age at testing	Core dimensions	Testing strength	Equivalent cylinde strength (kg/cm^2)	
	Lower Breakwater Wall,1st/2nd lap					
	Axis F,left	45 days	Ø15x22.5	324	314	
	" " "	45 "	Ø15x18.8	280	263	300
	" " "	45 "	Ø15x22.8	332	322	
	Axis F,right	45 "	Ø15x22.5	315	306	
	" " "	45 "	Ø15x18.8	304	286	299
	" " "	45 "	Ø15x22.8	314	304	
	Axis B	45 "	Ø15x22.5	365	354	
	" "	45 "	Ø15x22.8	322	312	321
	" "	45 "	Ø15x18.8	317	298	
	Interior Sl.f. +8.50-+9.50 m					
I	Axis 2, +8.70	42 days	Ø15x22.5	297	288	
II	" " "	42 "	Ø15x22.5	332	322	328
III	Axis 1, +9.50	42 "	Ø15x21.0	385	374	
I	Axis 5	56 days	Ø14.9x22.5	332	322	
II	Axis 6	56 "	Ø14.9x15.0	426	388	
III	Axis 6	56 "	Ø14.9x22.5	361	350	351
II	Axis 4	56 "	Ø14.9x22.5	354	343	
I	Axix 3	56 "	Ø14.9x22.5	367	352	
III	Axis 3	56 "	Ø 9.8x15.0	412	399	413
IV	" "	56 "	Ø 9.8x15.0	441	427	
I	Int.Wall,Axis A	63 days	Ø14.9x22.8	364	354	
II	" " " "	63 "	Ø14.9x22.8	342	332	330
III	" " Axis B	63 "	Ø14.9x22.8	332	321	
IV	" " " "	63 "	Ø14.9x22.8	323	314	
I	Axis 2	68 days	Ø14.9x22.5	368	357	359
II	" "	68 "	Ø14.9x22.5	372	361	

(H)-horisontal drilling direction

TEKNISK
KONTROLL A.S

CONSULTING ENGINEERS
SOILS AND FOUNDATION ENGINEERING
ENGINEERING GEOLOGY AND GEOPHYSICS
CONCRETE TECHNOLOGY, MATERIALS TESTING

CONCRETE CORE STRENGTH

Core Identification	Structural member	Age at testing	Core dimensions	Testing strength	Equivalent Cylinder strength (kg/cm^2)	
	Exterior Sl.f.					
I	Axis 2-level +2.50	100 days	Ø14.9x22.5	440	427	
II	Axis 2-level +2.50	100 "	Ø9.8x15.0	402	390	
III	" " " "	100 "	Ø9.8x15.0	421	409	401 √
IV	" " " "	100 "	Ø9.8x15.0	417	405	

(H) - horisontal drilling direction

APPENDIX VI

NOTE ON TUNNEL CRACKS, C.G. DORIS NOTE QD-1839-I.

TOTAL OIL MARINE LIMITED
LONDON

Frigg field to Scotland pipe line
Intermediate manifold platform

EUROPE
ETUDES

PARIS E.E. 9105

C.G.DORIS

John Howard

DESIGN CALCULATIONS

NOTE ABOUT

TUNNELS CRACKS

REVISION

N°	DESIGNATION	DATE	BY	CKD
1	ISSUED FOR APPROVAL	16.05.79	S.F.	
2				
3				
4				
5				
6				
7				
8				
9				
10				

	DESIGNED	CHECKED	APPROVED	PROJECT N°	NUMBER	REV
BY	S.F.				A4.MP.QG.1839	1

Objet : MP-1 - Tunnels

FRIGG INTERMEDIATE PLATFORM

RAFT TUNNELS

REPORT ABOUT CRACKS

A - CONSTRUCTION OPERATIONS ON SITE

- Bottom slab has been finished at the end of June, 1974
- Tunnels were cast in following order:
  one block around seal caisson near tided wall
  one block near central shaft
  the rest of tunnel : about 20 m -
- the dock began to be flooded just after casting the last tunnel, on October 11th - In this phase tunnels cables were not yet tensioned, and tunnels were suffered to support upwards water pressure applied to bottom slab as reinforced beams -
- Prestressing of tunnels finished on october 21st, the draught being about 9,0 m.

B - DIFFERENT TYPES OF CRACKING

- Cracks perpendicular to tunnel axis, going from bottom slab or mid-height of walls, to roof -

those cracks were observed approximatively 2 weeks after casting, on the 6 tunnels and they are supposed to be shrinkage cracks due to fact that shrinkage of walls and roof was restrained by the bottom slab which has been poured a least 3 months earlier _

- Cracks parallel to tunnel axis located on the thicker part of the roof, near central shaft, on the first four of each tunnel.
those cracks might be due to a transversal shrinkage = hydraulic and also thermal shrinkage since the roof is quite thick in this aera

- Diagonal cracks located on the walls of the 6 tunnels, at about mid-height of the vertical part of the wall and at an approximative distance of 2,0 m. from the casting joint near central shaft.
those cracks were systematically observed at beginning of december, i.e. after prestressing but some people think that

some ones appeared before prestressing -

C - CHECK OF SHEAR STRESSES DURING DIFFERENT CONSTRUCTION PHASES

Ref note 1810

1) Draught of 9 meters in dry dock, without prestressing

Instead of forces of the end of towing, computed page 4 of note 1810, we have

- on tunnel $-9,0 \times 2,20 = -19,8$ t/lm.
  instead of 115,0 t/lm : ratio 0,172
- on slab $-1,0$ t/m² instead of $-43,7$ t/m² = ratio 0,206

mean value of ratio $\simeq 0,19$

Therefore instead of shear $76 - 944 = -868$

on section 2/10, we would have

$$76 - (944 \times 0,19) = -103 \text{ t}$$

and, in section of significative shear, at 2,50 m from central shaft axis :

$$T = -103 \times \frac{920}{868} = -110 \text{ t}$$

$\rightarrow$ $V_u = 110 \times 1,2 = 132$ t $\rightarrow$ $v_u = 5,6$ kg/cm²

even with young concrete, this stress is very weak.

2) Draught of 9 meters, with prestressing -

- calculation of shear according to ACI

$V_u = -110\,t \times 1,20 - 2350\,t \times \sin 20°5 \times 1,20 = -1120\,t$

$\tau_u = 47,5\ kg/cm^2$

in the case of draught of 18 meters, we get

$V_u = -1120 - 110 \times 1,20 = -1252\,t \rightarrow \tau_u = 53\ kg/cm^2$

- calculation of principal forces -

Normal force due to prestressing

$2350 \times 1,20 = 2820\ t$

Normal force due to hydrostatic pressure on loked wall (see page 6)

$6\ t/m^2 \times 18\ m^2 = 108\ t$

total = $N = 2930\,t \rightarrow \sigma = 58,5\ kg/cm^2$

→ principal tension is

$$t = \frac{58,5}{2} - \sqrt{\frac{58,5^2}{4} + 47,5^2} = -26,5\ kg/cm^2$$

with draught of 18 meters, we get

$N = 2820 + 15\ t/m^2 \times 18\ m^2 = 3090\,t \rightarrow \sigma = 61,5\ kg/cm^2$

$\rightarrow t = -30,5\ kg/cm^2$

therefore it is possible that these diagonal cracks are due, simultaneously, to

- a third of vertical shrinkage, due to fact that, in vertical direction, concrete could be restrained by the longitudinal stiffness of the tunnel itself, particularly sensible near the ends which were cast before, and on this section which could be weakened by ducts -
- in addition a tensile stress of 30 kg/cm² -

D - INJECTIONS

Cracks have been injected with epoxy resin by one of those ways

1) - Sealing of cracks on both sides
   - Epoxy injected from outside through injection tubes each 50 cm -
2) - Sealing of cracks on inside face.
   - Epoxy injected from inside through tubes each 30 cm - Check of injection by waiting effluition of epoxy out of the next tube after injection tube -

Epoxy used : STABILOPOX P 600
Hardening time 24 h.
Young modulus ≃ 20 000 kg/cm²
Ultimate resistance : 700 kg/cm² (cube 7cm×7cm)

For few small cracks, Epoxy STABILOPOX TM 151, having a better viscosity, have been used.

E CONCLUSION _ PROPOSAL FOR MP2 -

All those cracks, and particularly diagonal cracks, were very thin = there was no leakage through diagonal cracks which were not yet injected during water tests, with 10 m of water, at beginning of January 1975.

In addition, transversal cracks were afterward confirmed by prestressing

We do not think that those cracks have importance for the structural resistance of tunnels - (It is recalled that, during service phase, shear is much weaker and of opposite sign than during floating)

Any way to avoid those cracks and injections and to suppress doubts, we propose following modifications for MP 2

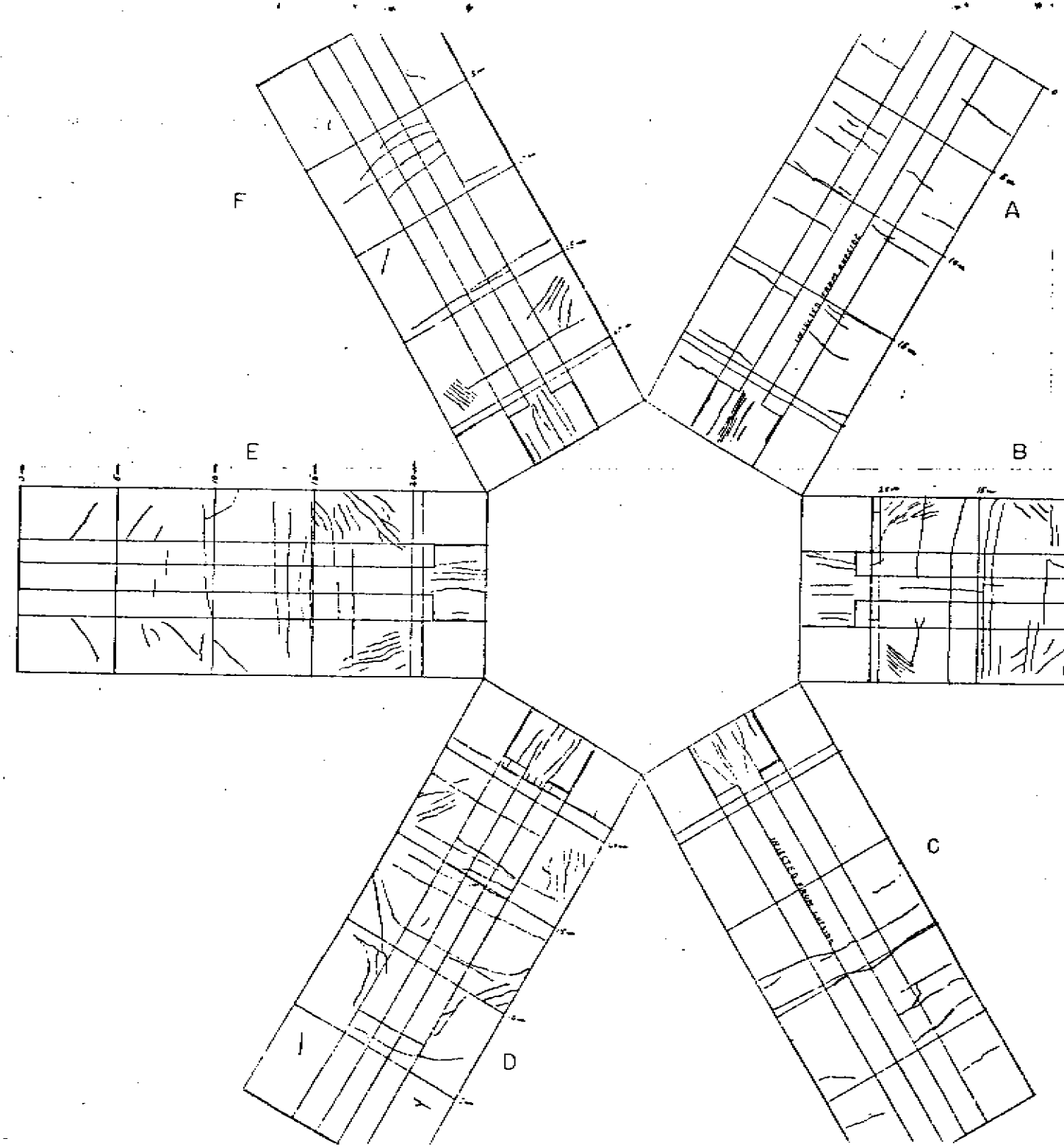
1) In addition of the two ends, tunnels will be cast in 2 parts of 12 m. maximum

2) longitudinal reinforcements are increased all along the tunnel (ϕ20 @ 20 cm instead of ϕ16 @ 20 cm on R.P1)

3) Just after pouring, the two ends of the tunnels, will be cooled by circulation of cold water on pipes embeded into concrete and then injected with mortar.

4) Transversal reinforcements will be increased on the thicker part of the roof near central shaft and the zone of diagonal cracks

5) The cables inclination will be decreased in order to have weaker tensile stresses.



INJECTED DRAINS IN TUNNELS - TRANSVERSAL

1/100

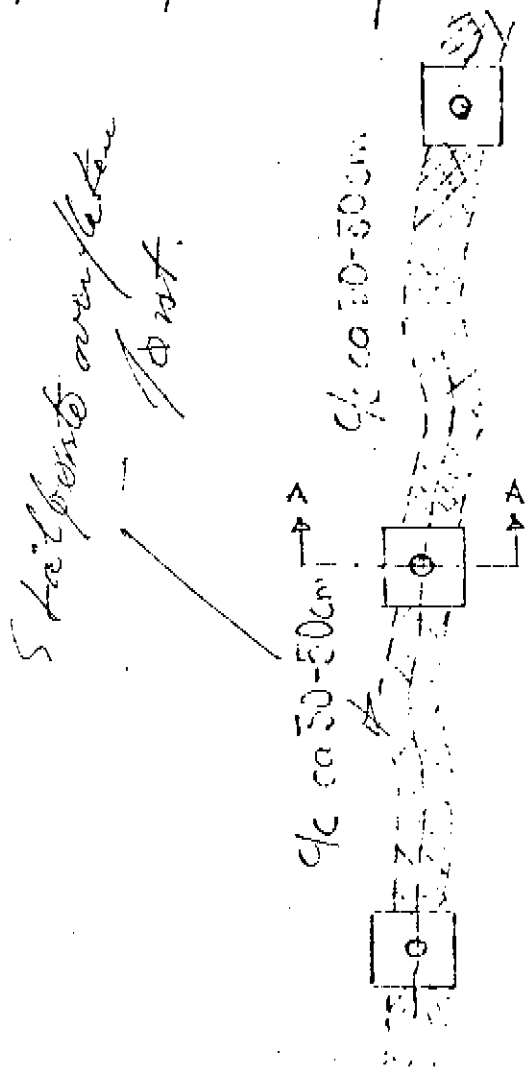
04-006 B

APPENDIX VII

PROCEDURE FOR INJECTION OF CRACKS

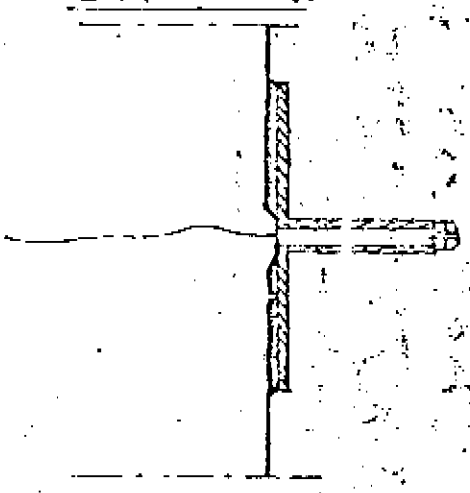
31.10 74 | Akad. | Fnr | 1.
Utskrivet | A. Ahrengren | Ekonr

Principskiss över utförande av plastinjektering i tunnlarna A-F.



□ = Bricka med nippel
▨ = Plastlim, IB-Pox S-20
⟆ = Spricka
▬ = Limlager i plast Sc21

Det. A-A.



Utförande:

Sprickan lokaliseras.

Med jämna mellanrum klistras plattor, enl. del. A-A, fast mot betongen. Därvid tillses att inget lim kommer över sprickan mitt för hålet i plattan.

Mellan plattorna stryks S-20 över sprickan för att förhindra läckage vid injekteringen.

Före limningen skall tillses att betongen omkring sprickan är torr. Om det finns fukt i sprickan

måste torkning ske med propanpanelåga.
Injekteringen utföres med IB-Pox P600 med
en speciell plastinjekteringspump EPL-5, se bild 1
IB-Pox S-20 och IB-Pox P600 är härdplaster
av epoxytyp.

Åmotfors den 31.10.74

APPENDIX VIII

REPAIR TO UPPER BREAKWATER WALL

Appendix VIII

Middlesex, 15th April, 1975.

Norwegian Contractors
Postboks 190
6500 AALESUND,

Dear Sirs,

The following are the repair procedures agreed for the above mentioned vessel:-

1. Cracks in plating.

a) Small cracks. Epoxy fill ground on.
b) Large cracks. Cut back and seal with epoxy filler.

Please note that Lloyds have reserved their approval of bonding on epoxy for the splash zone until they have given this further consideration.

2. Torn foam.

Cut back and refill using Isocham 5A with a bonding agent.

3. Spalling.

Refill with Isocham 5A with a bonding agent.

4. Pipe holes.

Where unsuitable for [illegible] with epoxy.

5. Open internal fillets.

Seal with epoxy.

Yours faithfully,

APPENDIX IX

REPAIR PROCEDURE FOR HONEYCOMBING

Lowestoft, 26th February, 1975.

Total Oil Marine Limited
Site

For the attention of Mr. Renault

Frigg Field to Scotland Pipeline
Intermediate Manifold Platform

Our ref: M/MS/MEH - 1575
Your ref: 0650
Subject: Honeycombing in node 65 - 69,20 m. level.
Repair Procedure.

Sachbearbeiter	Kopie an:
Müller	
FEB 1975	
Bestätigt	Wiedervorlage

Dear Sirs,

Please find enclosed one copy of repair procedure, approved to-day, the 26th February, 1975, by your Mr. Renault and Mr. Scarlett of Lloyds Register of Shipping, Site.

Very truly yours,

T. Michel
Project Manager

Copy with enclosure:
Lloyds Register of Shipping, Site
Attn.: Mr. Scarlett

Norsk Hydro Petroleum, Site
Attn.: Mr. Webb

APPENDIX X

REPAIR PROCEDURE FOR UPPER BREAKWATER WALL NODE CONSTRUCTION JOINT

Andalsnes, 23rd June, 1975.

Norwegian Contractors
Postboks 190
6501 ANDALSNES

For the attention of Mr. Mâre

Frigg Field to Scotland Pipeline
Intermediate Manifold Platform
Our Ref: TH/THP/TEW - 2044
Your Ref:
Subject: U.K.W.A. NODE CONSTRUCTION JOINTS.
"Confirmation of hand-written letter".

Dear Sir,

Further to the discussion at the progress meeting this morning (Friday, 20th June) we confirm that on the evidence of the water tests carried out on the vertical sections the upper pressure will hold. The construction joints are not considered acceptably watertight. We therefore require that you carry out remedial works at every node construction joint to ensure a sound joint.

The remedial works are to be carried out as follows :-

1. Expose the construction joint - formwork, reinforcement and concrete run-down from the lift above to be cut back so that the joint is fully exposed.

2. Clean the joint by wire brush and air-jet.

3. Hydraulically breach on every third even a period of about 15 minutes (joint to be dry).

4. Where exposing the joint has necessitated significant cutting into the wall the face is to be made up by painting Sikalatex and applying dry mortar.

If you consider that the results of the water tests are not typical, we are prepared to consider the results of more tests carried out on the manhole chamber this morning:-

1. Core through the horizontal plane of the joint.

2. Grout and bond in a steel tube.

/Cont'd .....

APPENDIX XI

BETOKEM SPECIFICATION FOR REPAIR MATERIAL

BETOKEM A/S
SIVILINGENIØR JOHS. RUTLE
OFFICE: FRITZ KIAERSV. 11, N-OSLO 3. — TLF. 47-2-70 17 23

April -73

BETOKEM ExM-PRODUCTS

Dry mortars with no plastic shrinkage

The products listed in the following table are used for underpouring of machines, concrete elements as well as for filling of ducts and for anchoring of bars.

Designation	28 days strength kp/cm²	(MN/m²)	Expansion %
Betokem ExM	450 – 550	(45 – 55)	5 – 6
Betokem ExM-S	600 – 700	(60 – 70)	1 – 2
Betokem ExM-V	500 – 600	(50 – 60)	3
Betokem ExM-AF	350 at -10°C	(35)	2 – 3

ExM-V is a mortar for underpouring of layers thicker than 2 cm. ExM-AF is a special mortar for pouring at temperatures below freezing.

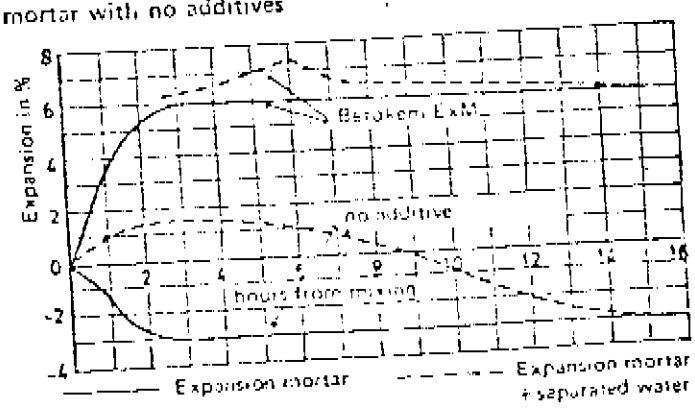
Materials

The ExM-products are dry mortars composed of cement, sand, expanding and stabilising agents. They are ready for use, only water has to be added at the site. The maximum size of the sand fraction is 1.5 mm except for ExM-V where the maximum size is 4.0 mm. The products contain no poisonous ingrediences and no chlorids or other components which can step up the corrosion.

Physical properties

NOTEBY (Norsk Teknisk Byggekontroll) – an authorized test laboratory – has carried out tests for measuring the expansion and plastic shrinkage of ExM compared with a mortar without additives composed of 1 part cement : 1.5 parts sand (by weight). The expanding-shrinkage test were performed by filling a graduated cylinder with a premixed mortar/water mix and the surface level of the mix were observed at certain time intervalls. The results are shown in the following diagram.

Expansion resp. shrinkage for Betokem ExM and mortar with no additives



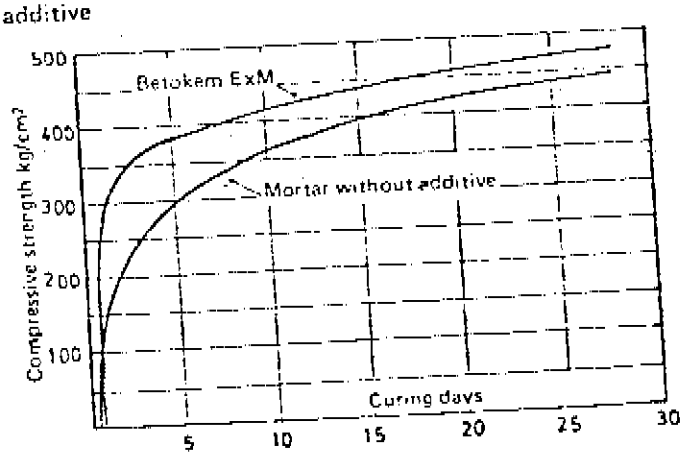
The dotted curve indicates the level of the separated water above the mix and the fulldrawn curve the level of the grout itself. Because of the chemical interactions the separated water is absorbed gradually 4–6 hours after mixing and is completely eliminated after approximately 12 hours.

Mortar with no additives always shows a plastic shrinkage which increases with increasing bleeding (water separation). ExM expands while the mix is plastic and fills completely the space into which it is poured. The product does not expand after hardening and therefore no cracks arise due to the expansion. The pressure exercised on the surroundings during the expansion is very slight and any damage due to this has never been experienced.

The diagram also shows the compressive strength for the mortar mixes. As will be seen the ExM has a considerable higher strength than the mix without any additives.

NOTEBY (Norsk Teknisk Byggekontroll) has also measured the anchorage bond for a smooth bar poured in a ExM mortar. As will be seen the bond strength is very high even for a smooth bar.

Cube strength for Betokem ExM and mortar with no additive



ExM-S and ExM-V

The compressive strength for 7 cm cubes cured at 20°C are shown in the following table.

Compressive strength for 7,1 cm cubes cured at 20°C

	Water litres per bag 40 kg	Compressive strength kp/cm² 1 day	7 days	28 days
ExM-S	7,2	370	575	680
	7,0	380	600	690
ExM-V	5,5	240	470	570
	6,5	220	450	540

ExM-AF

Compressive strength at lower curing temperatures

Curing temperature	Compressive strength kp/cm²		
	3 days	7 days	28 days
- 24°C	9	35	84
- 15°C	54	98	190
- 10°C	100	195	350
- 5°C	200	300	400

Packing -- Warehouse Properties

The ExM-products are delivered in 40 kg paper bags with one layer of waterproof paper. They can be stored for years provided dry conditions and not too much pressure i.e. piles of maximum 10 bags height.

Betongkjemisk A.S.
Frits Kiærs vei 11
Oslo 3

Re.: Bond strength of bars poured in Betokem ExM-mortar

As requested by you and in agreement with Mr. Saltröe, A.S. Höyer-Ellefsen we have been in charge of carrying our bond strength test with 20 mm smooth bars st. 37 poured in ExM-mortar.

3 pieces of concrete speciments 14 x 14 x 25 cm with a centric hole of 3 cm diameter were prepared (sketch A)

After one week curing of the concrete speciments the bars were poured in with ExM-mortar (sketch B)

After one more week the bond strength was measured (sketch C)

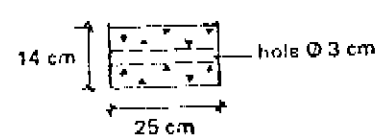
Results

Compressive strength		Max. load at initial sliding of bolts	Pulling out force after sliding
Concrete	mortar		
384 kp/cm²	431 kp/cm²	7 120 kg	2 480 kg
393 kp/cm²	435 kp/cm²	7 120 kg	2 480 kg
384 kp/cm²	427 kp/cm²	7 120 kg	2 480 kg

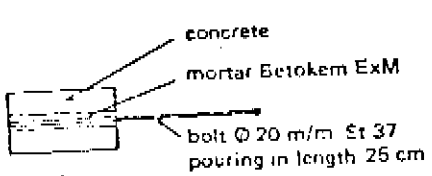
No damage was observed for the bond between the concrete and the mortar.

NORSK TEKNISK BYGGEKONTROLL A/S

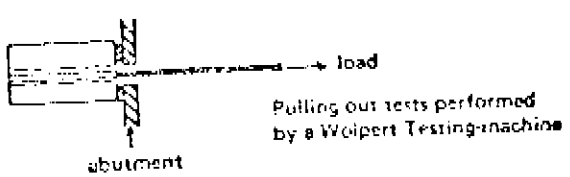
Sketch A



Sketch B



Sketch C



Instruction for underpouring of machines and concrete elements

The ExM products have to be correctly used in order to fulfill their purpose.

PREPARATION OF THE CONCRETE SURFACE

The concrete surface which comes in contact with ExM-mortar has to be completely cleaned. Loose particles and laitance must be removed by chiping, ting. scrubing or sand blasting.

Also the lower surface of the bedplate has to be cleaned. Sometimes the surface has to be degreased as well.

The concrete surfaces have to be moistened until they are saturated the day before pouring. The surfaces have to be subjected to drying some hours before pouring so that they have a slight suction ability when the pouring takes place. Half an hour before pouring occasional water in holes and grooves are removed by air blowing.

FORMS

The forms are build around the bedplate. The form material has to be of good quality with very low suction ability. The form is build a few cm higher than the surface of the ExM-mortar and has to be firmly attached so that no sliding occur during the pouring. The formwork has to be performed so that the pouring can take place from one side. Between the bedplate and the other form sides there has to be a gap of 4 – 5 mm in order to allow control of the ExM mortar that it completely fills the space it is intended to fill and further to facilitate escape of the air. For plates with a corrugated bottom each section has to be fitted with an air went to allow the air to escape.

MIXING

For small jobs a high speed drill is a suitable tool. For big jobs a colcrete mixer is recommended. A suitable dispender for addition of water should be available. Depending on the consistency aimed at 5.5 – 6.5 litre/bag has to be used for ExM-V and ExM-AF and 7 – 8 litre/bag for ExM and ExM-S.

The bulk of the water is added to the mixer, then the mixer is started and the ExM mortar added while stirring. The stirring is continued for 2 minutes until the mix is entirely homogeneous. The mix is allowed to stand for a couple of minutes and additional water is added to a suitable consistency while stirring until the mix is homogeneous.

The mix should then have a plastic or fluid consistency. The consistency is adjusted to fit the actual job. If the space is easy to fill the viscosity can be rather high and in the contrary if the space is difficult to fill the viscosity has to be rahter low.

The pouring has to be finished not later than 20 minutes after the mixing otherwise too much expansion is lost.

THE POURING

The mix is filled in from one side and the filling continued until the mix penetrates all the openings between the bedplate and the form. The filling of the form is facilitated by knocking on the outside of the form.

A steel band is a suitable tool for pushing the mortar under the bedplate, by drawing the band forth and back under the plate. Viburation should not be used. The pouring operation should not be interrupted before it is finished.

CURING

As the binding agent in the ExM-mortar is Portland Cement the same curing methods are recommended as for the regular cement mortars. The temperature in the mortar has to be kept above + 2°C for at least 2 days after pouring (does not apply to ExM-AF).

As soon as the finishing of the mortar surface is completed the free surface has to be protected against drying out in one of the following ways:

A. The surface is oversprayed with Betokem O (Curing compound). This will be a good curing which, however, can be further improved by spraying water on the surface after a couple of days. In case the surface has to be painted later, Betokem MH (a high quality and more expensive curing compound) is recommended instead of Betokem O.

B. Plastic sheets covering is utilized for at least 7 days.

The former curing method (A) should be preferred because of the drying shock which might occur when the plastic sheet is removed.

Observe the high drying effect of the cold winter air especially when artificial heating is used.

PRODUCTION AND MARKETING

Betongkjemisk A/S, siv.ing. Johs. Rutle, Oslo 3, Norway

Betokem ExM-AF

Extract from report no 7200 from Swedish Cement and Concrete Research Institute at the Royal Institute of Technology, Stockholm:

8. Summary of test results

The test confirms that the hardening of Betokem ExM-AF takes place at a temperature of −10°C. The strength increase follows more slowly at this temperature than at a temperature of +20°C. However, after 28 days the strength of the −10°C cubes are higher than for corresponding cubes at a temperature of +20°C. The highest strength after 28 days is obtained with cubes cured at −10°C for 7 days followed by a curing at +20°C until 28 days. Most probably the mortar has not frozen at −10°C. Any pattern of ice crystals could not be observed.

If the temperature of the speciments were −10°C or above 0 (stored in warm water before crushing) when the strength was measured, the obtained result was the same for both temperatures, (which shows there was no addtitional strength because of ice crystals — translator's remark).

With regard to the chlorid content, this is below the level which can initiate any corrosion on the reinforcement.

Oslo, April 1973

SIVILINGENIØR JOHS. BUTLE

KONTOR: FRITZ KIERS VEI 11, OSLO 3 - TLF. OSLO 245012
FABRIKK: INDUSTRIVEIEN 17, 1473 SKÅRER - TLF. LØRENSKOG 02-701721
BANKKONTO 5024.05.47093 - TELEGRAMADR.: «BETOKEM - OSLO» - JERNBANE: LØRENSKOG STASJON

Betokem-Epoxy UV

What is U.V.

U.V. is a gray solventfree epoxy adapted for underwaterworks, as it attaches well to moisten surfaces and curing takes place also under water. The U.V. mix is fitted for trowling of defects in concrete structures above as well as under water.

The mix attaches well to vertical surfaces without forms. Typical applications are repairs of quaycolumns, bridgecolumns (protection of the reinforcement), tighting of concrete dams etc.

Packages

The U.V. mix is delivered in 2 ready for use components, resins and curing agent, packed in right proportion in units (resin + curing agent) of 2.4 kg or 10 kg.

Mixing

The content of one box resin and one box curing agent is placed on an iron plate. The mixing is performed by a trowel and the mass is kneeted until it atains a uniform gray colour without black or white strips. The mass should have a temperature of 15 - 20°C when it is mixed. The potlife is about 1 hour, when the temperature is higher the potlife is shorter.

Placing of the mix

The concrete has to be clean and sound. Defects on the concrete surface must be thoroughly cleaned.

The U.V. mass is placed by a trowel. The trowelling is facilitate by moistening the tool.

The work under water can be performed in 2 different ways:

1. The U.V. mix is placed in layers of 10-15 mm pieces of dry canvas or any other strong fabric in convenient working area. The pieces of canvas are handed down to the diver who pushes them and places them for instance over a crack. It is importan to push instantly in the middle of the piece and finally on the borders of the piece so that no waterpockets occur. The diver must continue the work until the canvas touches the substrate over the entire area. The canvas must remain on place at least 24 hours.
2. The U.V. mix is rolled in balls and handed down to the diver who evens it out with his hand.

   When this method is used the layer has to be 2-3 mm thicker because the upper layer is apt to be washed out.

Curing

The U.V. mass should not be used at temperatures below 3-4°C. At such low temperatures it will take weeks to achieve a complete curing. As a rule 24 hours hardening is sufficient to avoid washing out of the mass.

Safety precautions

Rubber gloves has to be used. If any of the components touches the skin it has to be washed with warm water and soap.

Cleaning

The tool can be washed with warm water with scrubbing.

Storing

The U.V. mass can be stored in unbroken packages for one year without suffering any damage.

The above information is presented in good faith. As, however, the use of the product is out of our control we give no warranty for the results obtained in the field.

Oslo, january 1975

SKELLEFTEÅ JOHNSON

KONTOR: BRITA VIAKS VEI 11, OSLO 3 - TLF. OSLO 243512
FABRIKK: INDUSTRIVEIEN 12, 1473 SKÅREK - TLF. LØRENSKOG 02 * 704723
BANK: Oslo 5024.05.17003 - TELEGRAADR.: «BETOKEM OSLO» - JERNBANE-LØRENSKOG STASJON

Betokem - Epoxy P and P-1

P and P-1 are epoxy formulations used as a gluing agent for binding new concrete to hardened concrete. The glues can also be used as binding agents in epoxy-mortars.

Materials

Epoxy P and P-1 are two-components epoxy compounds containing a resin and a hardener. Both compounds are solvent free.

Physical properties

P hardenes at temperatures as low as -5°C. At these low temperatures the hardening is very slow.

P-1 hardenes at temperatures down to +5°C. Unlike P the product P-1 does not smell and is somewhat more convenient to handle than P. The potlife of P at 20°C is approximately 20 minutes. The potlife of P-1 is a little shorter. At lower temperatures the potlife is longer. P should not be used in direct contact with food or drinking water.

Consumption

0,5 - 1,0 kg/m^2. With a more rough surface the consumption is about 1,0 kg/m^2.

Requirements to the concrete and steel surface

The surface of the concrete has to be clean and solid. Laitance and loose concrete particles must be removed. The most used methods for preparing the concrete surface is sand blasting, bush-hammering or acid etching (1 part commercial grade concentrated hydrochlorid acid to 4 parts water) succeeding washing with water. The concrete should preferably be as dry as possible during the operation. Free water on the surface must be removed and workable methods are to treat the surface with a propanflame or jetting with dry compressed air.

(We also have a glue that is specially fitted for this type of under-water works). It is an advantage to vacuum-clean or blow the surface. The application work has to be undertaken as soon as possible after the cleaning.

The steel has to be free of rust and fat. So far sand-blowing has given the best results. For smaller jobs thorough wire brushing is sufficient both for concrete and steel.

Mixing and applying

The components ought to have a temperature of 15-25°C during the mixing. If you do not use entire packages each component has to be stirred prior to the weighting. The components have to be mixed for 3-4 minutes until the glue is completely homogeneous. Concerning packages above 2 kg we recommend a slowly going drill with blades in order to secure a homogeneous mixture. Immediately after mixing the glue is brushed on the surface with a stiff brush or a roller. If the surface is tolerably smooth it could be more convenient to use a stopping knife or a rubberswab. The temperature on the surface of the concrete should be at least 2°C during the execution. At too low temperatures the glue attains a higher viscosity and consequently is harder to handle. The best temperature is 15 - 20°C.

Casting and finishing treatment

New concrete should be supplied not earlier than 2-3 minutes after the glue has been brushed on the area and always when the glue still is tacky. At a temperature of 20°C not more than 1 hour should elapse, at a temperature of 10°C maximum 2 hours should elapse and at 5°C maximum 3 hours should elapse before the concrete is placed in the construction. If the concrete is placed too late the glue acts reverse on the desired effect. In cases of doubt a new brush with Epoxy P should be used. The concrete which is used should have a slump not higher than 5 cm. It is an advantage to use 1,5 l Betoken LP per m^3 concrete.

Constructions without formwork on vertical areas and on the ceilings require training before you obtain a working-routine. The glue can move somewhat because of the weight of the mortar, especially if you have a thick layer of glue. The problem diminishes if you let the epoxyglue harden a little bit on the area (for example 15-20 min. at 20°C) and apply the mortar in two or three layers.
Spraying of the mortar on the area is also an effective method. To secure the cement-mortar proper curing condition it should immediately be covered with a plastic sheet, or more preferably to spray the area with the curing compounds Betoken O or Betoken MH. Due to the high tensile strength of the adhesive, thin overlays can be applied and featheredged where required. However, the best way is to saw-cut to a depth of at least 2,5 cm.

Handling precautions.

During the job gloves should be used. If one of the components of the glue touches the skin it must immediately be washed with soap and warm water, solvents as aceton, xylol or other thinners should never be used. Provide adequate ventilation during inndoor jobs. Some persons are allergic against the hardener which results in some form of skin dermatitis. Good personal hygiene and changing of dirty working-clothes are important factors to be aware of.

Cleaning

Tools have to be cleaned immediately after they have been used with Betoloen Tynner (eventually tri, aceton or xylol). Epoxyglue which has hardened is difficult to remove.

Warehouse properties

Both the components resin and hardener should be stored in closed packages. If the storing conditions are favourable the quality of the product will not be reduced during the first 6 months.

The above information is presented in good faith. As, however, the use of the product is out of our control we give no warranty for the results obtained in the field.

Oslo, january 1975

SVENSKA BYGGFORSKNINGSINSTITUTET
KONTOR: FRITZ KIÆRS VEI 31, OSLO 3 - TLF. OSLO 213011
FABRIKK: INDUSTRIVEIEN 12, 1473 SLÆKER - TLF. LØRENSKOG 02 * 701721
BANKGIRO 5024.05.17093 - TELEGRAFR. ARETOKEM - OSLO - JERNBANE LØRENSKOG STASJON

Detokem-Epoxy ML-4 (ML-1)

What is ML-4 (ML-1)

ML-4 is a solvent-free epoxy formulation of low viscosity which is used as binding agent in epoxy mortar and concrete. The mortars (concrete) are used for repair of concrete-structures, holding bolts, binding of concrete elements, casting and repairs of bridge noses (expanding joints) and for industry floor coverings.

The viscosity is approximately 600 cps at 25°C, specific weight approximately 1,1.

ML-4 is also delivered as a spattle i.e. ready for use without addition of aggregates at the site.

ML-1 is a winter quality of ML-4 used at temperatures below 5°C and under moist conditions. ML-1 also hardenes under water. ML-1 hardenes at temperatures down to -5°C though very slowly. Mixed with dry sand 1 : 1 ML-1 is very well fittet for binding of fresh concrete to hardened concrete or steel (see brochure for Detokem Epoxy P). The viscosity of ML-1 is higher than for ML-4. ML-1 is not fadeless, as the mortar assumes a brownish color after a while. The ML-1 mortars should not be used in direct contact with food or drinking water.

Packing

The glue is delivered in two components (harpiks - resin, herder - hardener) packed in right proportions and ready for use.

Packings: ML-4 1 - 5,4 - 13,50 and 270 kg (two components)
ML-1 1 - 5,1 - 13,50 and 300 kg (two components)

We also deliver dry sand in bags suitable for the epoxy-package.

Requirements to the concrete and steel surface

The surface of the concrete has to be clean and solid. Laitance and loose particles must be removed. Suitable methods for preparing the surface is sand blasting, bush-hammering or acid atching (1 part commercial hydrochlorid acid to 4 parts water) followed by washing with water. The concrete should preferably be as dry as possible during the operation. Free water on the surface must be removed with a propan flame or with dry compressed air (for floor covering 4-5 % humidity in the concrete is required). Immediately before the epoxy-mortar is being used the concrete has to be vacuum cleaned or just blown clean. The steel has to be free of rust and fat. Sand-blowing gives the best results. For smaller jobs thorough wire brushing is sufficient.

How much sand should be used

The ratio epoxy/sand depends for which purpose the glue is used.

Mixing proportions glue/sand (weight)	Amount kilogram glue per litre mortar	Properties (applications)
1 : 1-3	0,75 - 0,5	Selflevelling, sticky and can be levelled out by a float or trowel. Relatively easy to mix. Used for: holding of bolts, binding of elements, self-levelling floor covering, grouting etc.
1 : 3-6	0.5 - 0.3	Sufficient glue for moistening the mortar. Easy to level out. Primer (pure glue) is often necessary. Used for: repair of concrete floors, floor covering of epoxymortars.
1 : 6 or more	0.3	The primer should be used to secure good bound- strength. Very heavy to mix. Only mixing by machine is satisfactory. Has to be vibrated and packed properly when poured. Used for: repair of concrete structures, bridge noses etc.

It is of decisive importance that the sand is clean, dry and of proper grading. The particle size of the sand should not exceed 1/3 of the thinnest mortar-layer. The coarser the sand the better the workability of the mortar.

When epoxy-mortars are being used where large temperature variations occur it is necessary to be aware of the fact that the termal expansion is considerably higher than for ordinaty concrete. The higher the sand content of the epoxy the smaller the difference.

Mixing of the mortar

During the mixing the components should have a temperature of at least 15°C. The components should be mixed thoroughly for 3-5 minutes. (When the whole package is not used the components should be weighted). The mixing is performed very efficient by a slow rotating drill which does not introduct too much air. A plastic container might be used for mixing. Small batches can be mixed by a drill. However, a paddle-mixer should be used for large batches or mortar with much sand (i.e. above 1 : 6). The potlife is approximately 1 hour for a mortar 1 : 6 at 20°C. At lower temperature the potlife is considerably longer. The higher the temperature the easier the handling of the mortar. By hand-mixing it is an advantage to warm the components to 30°C prior to mixing.

Attention: The potlife is considerably shorter when the mortar is warm. If the mortar has to be used on vertical surfaces without forms it is necessary to mix the sand with micro-talc, asbestos powder or Aerosil (5-50 %) to prevent moving of the mortar. Another possibility is to use ML-4 glue mixed with sand to a proper consistency.

Though ML-4 is less sensitive to moisture than is ML-1 during the bound-curing period, it is preferable to use dry concrete: The bound-strength to the concrete can be decreased if the concrete is too moist.

A mixing and curing temperature of 15 - 25°C is most preferable for both ML-4 and ML-1.

Curing and strength
During the curing period the ML-4 mortar should have a temperature of at least 5°C. After 24 hours of curing the strength is higher than for ordinary concrete. At a temperature of 20°C the final strength is reached after 3-7 days.

Norsk Teknisk Byggekontroll (an authorized laboratory) has tested some bars specimens (4x4x16 cm) of epoxy mortar (ML-4). The aggregates are delivered by Betongkjemisk A/S (0-13 mm). Each figure is an average of 3 specimens.

Mixing proportion epoxy/sand	Volume-weight	Compressive strength kp/cm^2	Flexurable strength kp/cm^2
1/10	2.28	1013	238
1/10	2.35	1158	265

For ML-1 mortar the final strength is reached after 2-5 days at a temperature of 20°C, however, at 0°C it might take several weeks. When the mortar is mixed at 20°C, 50 % of the strength is reached after 3-4 days at a curing temperature of 0°C. The final compressive strength for a mortar 1 : 6 is 700 - 800 kg/cm^2.

Handling precautions.
During the job gloves should be used. If one of the components touches the skin it must immediately be washed with soap and warm water. Some persons are allgergic against the hardener which results in some form of dermatitis. Working-clothes that are soiled with unhardened binding components must be changed as soon as possible. Provide adequate ventilation during inndoor jobs.

Cleaning
Epoxy-glue which has hardened is difficult to remove. Machines and tools have to be cleaned immediately after use with Betokem Thinner. The mixer should be cleaned with some sand mixed with Betokem Thinner.

Warehouse properties
Both components resin and hardener should be stored in closed packages. If the storing conditions are favourable the quality of ML-4 will not be reduced during the first year. After a long period of storage below 12°C ML-1 resin might thicken (crystallize), so that it must be heated to a temperature of 40-50°C before use. The resin should preferably be cooled down to the actual working temperature before use. ML-1 can be stored for at least 6 months.

The above information is presented in good faith. As, however, the use of the product is out of our control we give no warranty for the results obtained in the field.

Oslo, april 1975

APPENDIX XII

REPORT ON OFFSHORE SAND BALLAST, C.G. DORIS

DOCUMENT NO. IOI03.

SAND BALLASTING OF CDP. I

FILE : 52/1664

Document : 10103
Date : 19.12.1975

C. G. DORIS

FRIGG C.D.P.1 PLATFORM

QUANTITY OF SAND BALLAST TO BE PLACED IN THE STRUCTURE

1. Required dead weight of the Platform	206.000 T
2. Weight of the platform when emplaced on site, empty of ballast	113.600 T
3. Packages Dead Load	+ 5.606 T
4. Water in Central Shaft	+ 7.660 T
5. Dead weight of the Platform without any additional sand ballast	126.866 T
- Necessary sand ballast	79.134 T
- Sand density in the sea water	0,95
6. Necessary sand volume to be put into the Platform	83.299 m3
- Ballast volume to be put up to level +15m	3.962 m^3
- Ballast volume to be put above level +15m (83.299 - 3.962)	79.337 m3
- Area of the six cells to be ballasted : 6 x 397,7 m^2	2.386 m^2

7. Theoretical level of ballast :

$$x = 15 + \frac{83.968}{2.386} = 15 + 33.30$$

$$x = 48,30 \text{ meters.}$$

Document : 10103
Date : 19.12.75

SAND BALLASTING HISTORY

FROM 2 SEPT 75 TO 11 DEC 75

DATE	NUMBER OF CARGOES	AMOUNT OF SAND SENT BY THE DREDGERS (m^3)	AMOUNT OF SAND RECEIVED INTO THE PLATFORM. LOSSES ESTIMATED TO 15% (m^3)	SAND WEIGHT RECEIVED SPECIFIC GRAVITY ESTIMATED TO 0.95 (Tons)	TOTAL SAND WEIGHT RECEIVED (Tons)	WEIGHT OF THE PLATFORM (Tons)
						113.600
2/9	0	0	0	0	0	113.600
7/9	1	1.117	949	901	901	114.501
11/9	1	1.585	1.347	1.280	2.181	115.781
18/9	2	3.335	2.835	2.693	4.874	118.474
27/9	2	3.494	2.970	2.821	7.695	121.295
3/10	2	3.466	2.946	2.799	10.494	124.094
8/10	2	3.284	2.791	2.651	13.145	126.745
10/10	2	3.580	3.043	2.891	16.036	129.636
12/10	1	1.750	1.488	1.414	17.450	131.050
14/10	2	3.682	3.130	2.973	20.423	134.023
15/10	1	1.710	1.454	1.381	21.804	135.404
17/10	2	3.650	3.103	2.948	24.752	138.352
18/10	1	1.803	1.537	1.461	26.213	139.813
19/10	1	1.678	1.426	1.355	27.568	141.168
20/10	2	3.596	3.058	2.905	30.473	144.073
22/10	2	3.571	3.035	2.883	33.356	146.956
24/10	2	2.922	2.484	2.359	35.715	149.315
26/10	2	3.764	3.199	3.039	38.754	152.354
28/10	2	3.613	3.071	2.917	41.671	155.271
29/10	2	3.616	3.074	2.921	44.592	158.192
31/10	2	3.427	2.913	2.768	47.357	160.960
						+ 2.000 (packages estimated)
TOTAL AT 31/10	34	58.650	49.853	47.360	47.360	162.960

Document : 10103 Date : 19.12.1975

SAND BALLASTING HISTORY

FROM 2 SEPT 75 TO 11 DEC 75

DATE	NUMBER OF CARGOES	AMOUNT OF SAND SENT BY THE DREDGERS (m^3)	AMOUNT OF SAND RECEIVED INTO THE PLATFORM. LOSSES ESTIMATED TO 15% (m^3)	SAND WEIGHT RECEIVED SPECIFIC GRAVITY ESTIMATED TO 0.95 (Tons)	TOTAL SAND WEIGHT RECEIVED (Tons) 0.95	WEIGHT OF THE PLATFORM (Tons)
TOTAL AT 31/10	34	58.650	49.853	47.360	47.360	162.960
2/11	2	3.659	3.110	2.954	50.314	165.914
3/11	2	3.603	3.063	2.910	53.924	168.824
5/11	2	3.706	3.150	2.992	56.216	171.816
7/11	2	3.426	2.912	2.766	58.982	174.582
9/11	2	3.755	3.192	3.032	62.014	177.614
10/11	1	1.660	1.411	1.340	63.354	178.954
11/11	1	2.057	1.748	1.661	65.015	180.615
12/11	2	3.576	3.040	2.888	67.903	183.903
14/11	2	3.889	3.306	3.141	71.044	186.644
15/11	1	1.710	1.454	1.381	72.425	188.025
19/11	2	3.727	3.168	3.010	75.435	191.035
22/11	2	3.449	2.932	2.785	78.220	193.820
24/11	1	1.731	1.472	1.398	79.618	195.218
26/11	1	1.633	1.388	1.319	80.937	196.937
1/12	1	1.590	1.351	1.284	82.821	197.821
11/12	1	1.671	1.420	1.349	83.570	194.774
TOTAL AT 11/12	59	103.492	87.970	83.570	83.570	199.170

N.B. Taking into account the final weight of packages 5.606 T and water in central shaft and tunnels, The total minimum weight of the platform when in operation will be 212.436 T

Document : 10103
Date : 19.12.1975

SAND HEIGHT IN CELLS (METERS)

Date	A	B	C	D	E	F
8 Oct	19,40	18,90	22,30	20,60	21,80	19,70
12 Oct	21,90	23,10	22,30	20,60	21,80	22,20
17 Oct	24,80	24,90	25,60	25,60	24,70	24,50
20 Oct	26,60	27,40	27,50	27,90	27,40	27,10
27 Oct	30,90	29,20	31,60	31,10	30,20	29,20
13 Nov	44,20	43,40	43,80	43,10	42,70	42,30
23 Nov	47,00	47,20	48,40	49,80	48,10	46,90
25 Nov	48,20	49,30	48,50	50,20	48,00	46,80
26 Nov	48,20	49,40	48,80	50,20	49,00	49,20
3 Dec	50,50	49,60	50,20	50,40	49,20	49,20
FINAL LEVEL :11 Dec	50,10	50,00	50,20	51,50	50,80	50,00

Final mean Level : 50,40 m

Document : 10103
Date : 19.12.1975

CDP 1 PACKAGES WEIGHT

Modules North of axis D	3 515 tons
Drilling Modules	1 261 tons
Service Deck	346 tons
Tanks	82 tons
Steel decking (estimated to 900 m2).	180 tons
Cranes	222 tons
TOTAL	5 606 tons

Above figures taken from following documents :

BROWN ROOT DRAWINGS

BEN AA 030 D
031 C
032 B
034
036

Document : 10103

Date : 19.12.1975

OSIRIS Survey Projects Limited

(Formerly Dredging Investigations Limited)

PORT CAUSEWAY, BROMBOROUGH, WIRRAL, MERSEYSIDE L62 4SY

TELEPHONE: 051-645 2293 TELEX: 62470

Your Ref.

Our Ref. KWV/LD/DG75096

2nd January, 1975.

C. T. Doris,
83-85 Boulevard de la Guerre,
75640 Paris.

For the attention of M. H. de la Cochetiere

Dear Sir,

Samples Ex Banff / Cromarty Firth / Invergordon

The gradings of four samples submitted from the above sites are attached.

The maximum and minimum densities of these samples were determined. The samples were first dried and the minimum density (Relative Density = 0) was obtained by pouring the dry soil into a container of known volume from a height of about 300mm. The maximum density was obtained by vibrating the dry soil within the container using a vibrating hammer (Kango hammer). Although these tests are not standardised, the variations in the results between the various methods adopted for these parameters is generally small, particularly for a reasonably uniformly graded soil. The results are summarised in Table 1.

TABLE 1

Sample	Max. Dry Density (g/cc)	Min. Dry Density (g/cc)
1. "Tideway", Banff	1.73	1.51
2. "Tideway", Cromarty Firth	1.78	1.60
3. "Geopotes", Banff	1.62	1.40
4. "Geopotes", Invergordon	1.75	1.61

The variation in the results is almost certainly due to the differences in gravel and shell content, since the sand fraction of the soil is essentially similar in grading for the four samples.

The saturated densities of the materials were determined using four techniques.

(A) The saturated density was measured directly by pouring the soil into a weighed 55cm long (2,000cc) cylinder filled with water. The excess water was syphoned off and the total volume recorded. The cylinder was next weighed to determine the total weight of saturated soil. The water content of the whole sample was determined by standard methods using oven drying. The density of the saturated soil, related to its dry weight, was then calculated by dividing the saturated density by (1 + water content).

(B) A known weight of dry soil was poured into about 1,000cc of water contained in a 2,000cc graduated cylinder. The volume was recorded and the saturated density, related to its dry weight, computed directly.

(C) As B, but with the water stirred gently by a glass rod whilst pouring the sand.

(D) As C, but with the water stirred violently.

The results are given in Table 2.

TABLE 2

	Sat. density (g/cc)	Water content (%)	"Dry" density (g/cc)	Method B "Dry" density (g/cc)	Method C "Dry" density (g/cc)	Method D "Dry" density (g/cc)
"Tideway" Banff	1.93	34	1.44	1.47	1.52	1.52
"Tideway" Cromarty Firth	1.96	27	1.54	1.57	1.60	1.61
"Geopotes" Banff	1.87	32	1.42	1.41	1.44	1.43
"Geopotes" Invergordon	1.94	25	1.55	1.58	1.61	1.61

The adoption of the "dry" density as a measure of the density obtained is convenient as it is independent of water content and therefore permits a useful comparison of the results.

The variation in density is evidently created by the differences in grading. In particular it will be observed that with the exception of the "Geopotes" Banff sample, which was almost solely sand-sized, the density when poured through still water was less than the minimum density obtained in the dry state (of Table 1).

Agitation of the water, even gently, increased the density slightly to about the same level as given by the minimum density when tested in the dry state the greatest effect being obtained on samples containing some coarse particles.

Since it would appear probable that, during filling of the caissons on site the water was in at least in some motion, the densities given by Tests C and D, would appear to be the most relevant. Thus assuming, conservatively, that the water content recorded in Test A is relevant even at the slightly higher densities, the saturated densities of the fill in the caisson would be expected to be:-

For Sample	Saturated Density (g/cc)
1. "Tideway" Banff	2.04
2. "Tideway" Cromarty Firth	2.04
3. "Geopotes" Banff	1.89
4. "Geopotes" Invergordon	2.01

Evidently the highest densities are obtained using soils having gradings which are nearer to a well graded soil.

Yours faithfully,
OSIRIS SURVEY PROJECTS LIMITED,

(K. W. VICKERY)
Projects Manager.

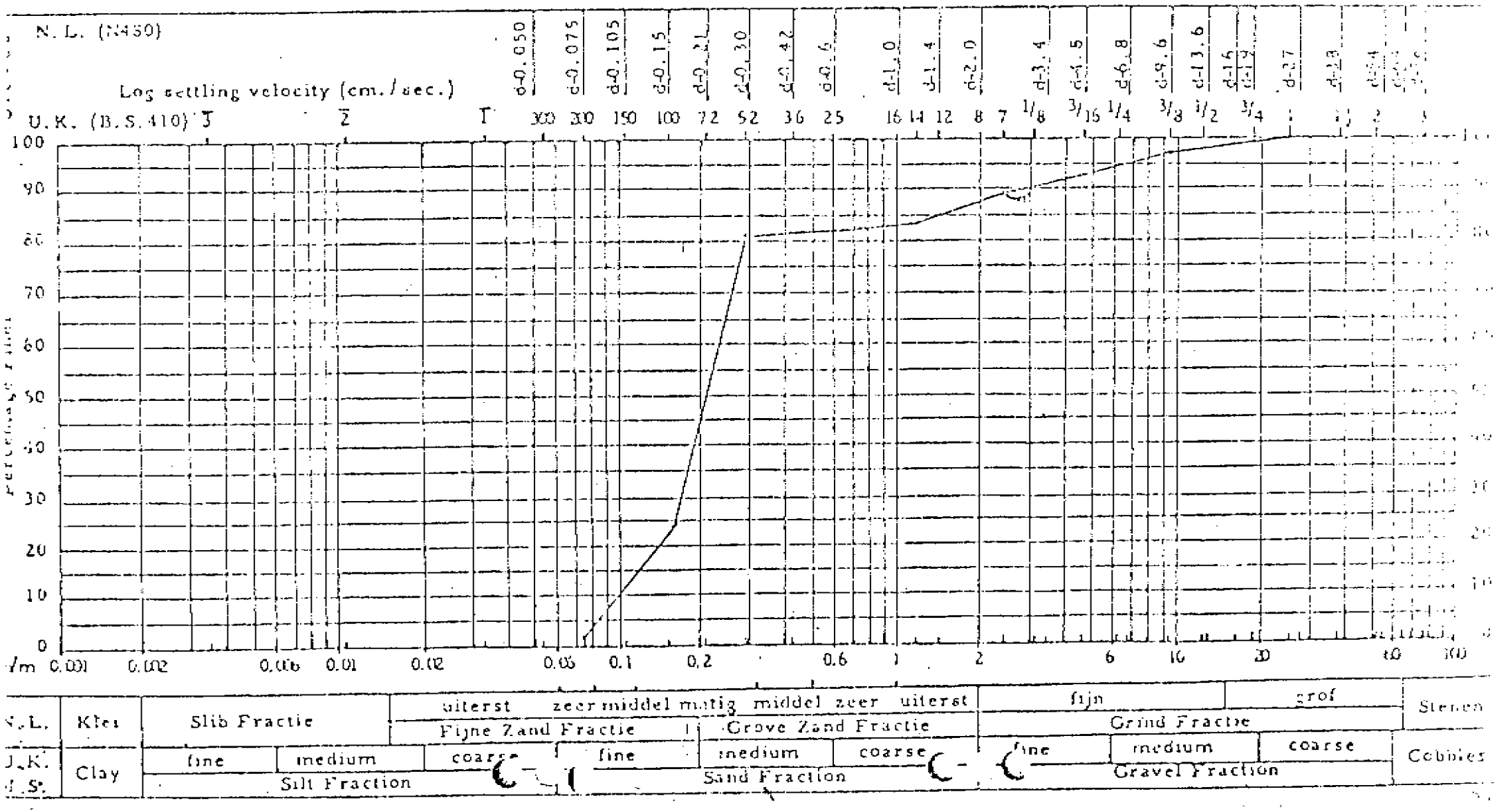
DREDGING INVESTIGATIONS LIMITED

GEOTECHNICAL LABORATORY

PARTICLE-SIZE DISTRIBUTION

epartment Job No. . DG75096.....
ob Location .....Doris Project,...
.....Banff.....
.sual Description ...Grey brown fine and medium SAND a little shell gravel.....

Borehole No. .....
Sample No. Tidewat...
Depth .....
Date ...November,...



DREDGING INVESTIGATIONS LIMITED

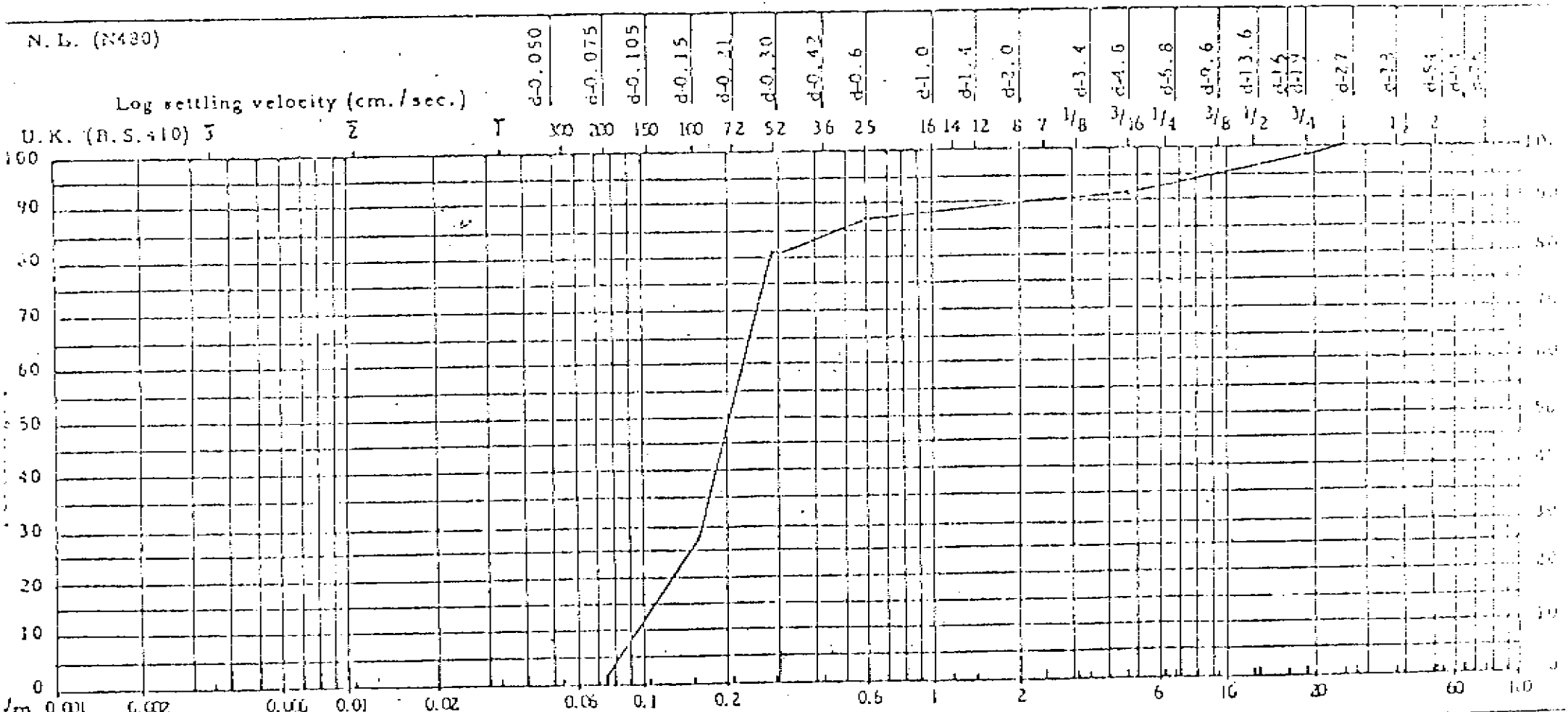
GEOTECHNICAL LABORATORY

PARTICLE-SIZE DISTRIBUTION

partment Job No. ..DG75096.....
b Location .....Doris Project....
.....Banff.....

Borehole No. .....
Sample No. Tideway
Depth ....Cromarty....
Date ....November....

ual Description ...Grey brown fine and medium SAND a little gravel and shell.....



DREDGING INVESTIGATIONS LIMITED

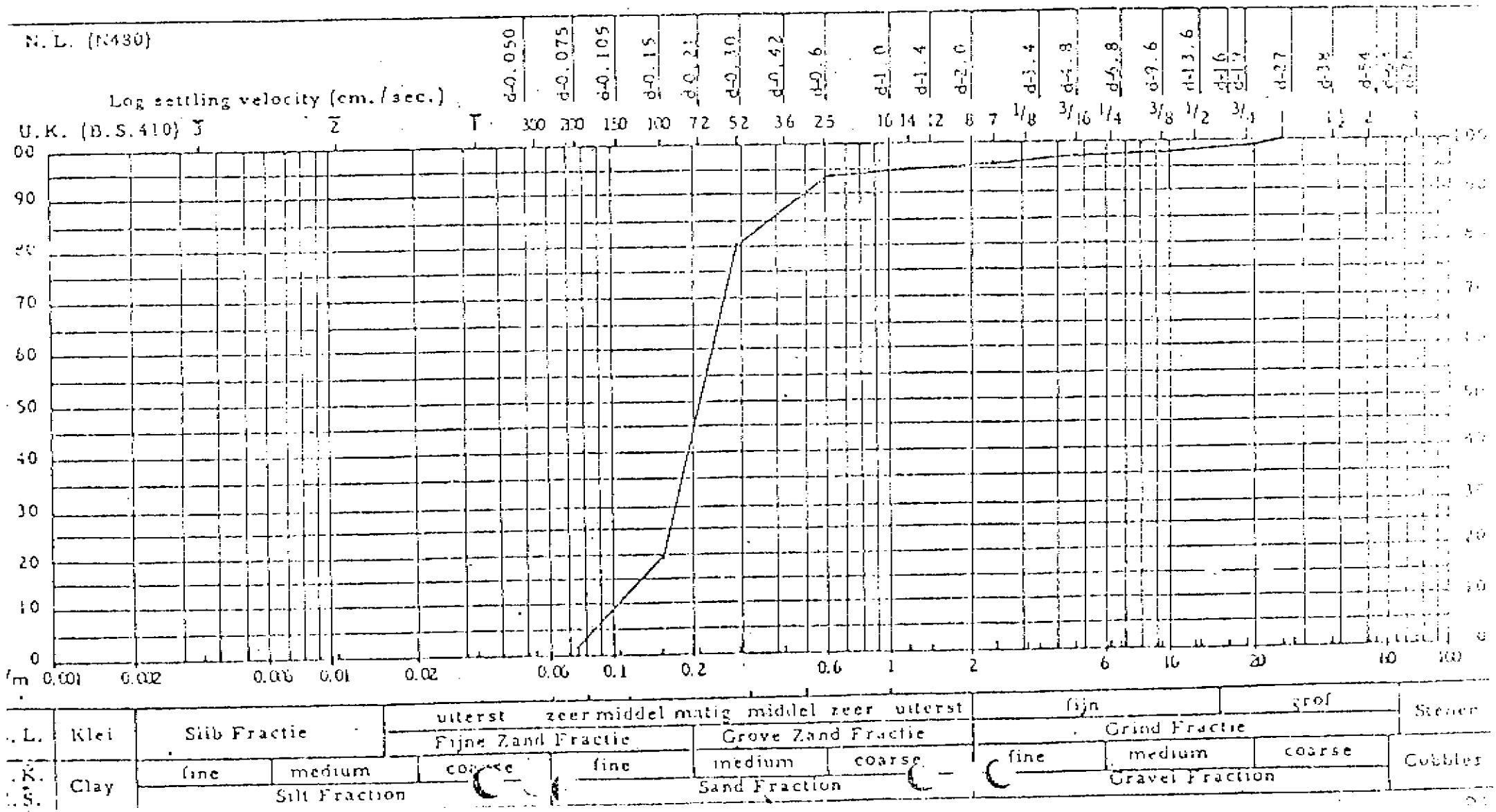
GEOTECHNICAL LABORATORY

PARTICLE-SIZE DISTRIBUTION

artment Job No. ..DG75096.....
Location .....Doris Project,...
.....Basil.....

ual Description ...Grey brown fine and medium SAND traces of shell.....

Borehole No. .....
Sample No. Composite
Depth .....
Date ....November



DREDGING INVESTIGATIONS LIMITED

GEOTECHNICAL LABORATORY

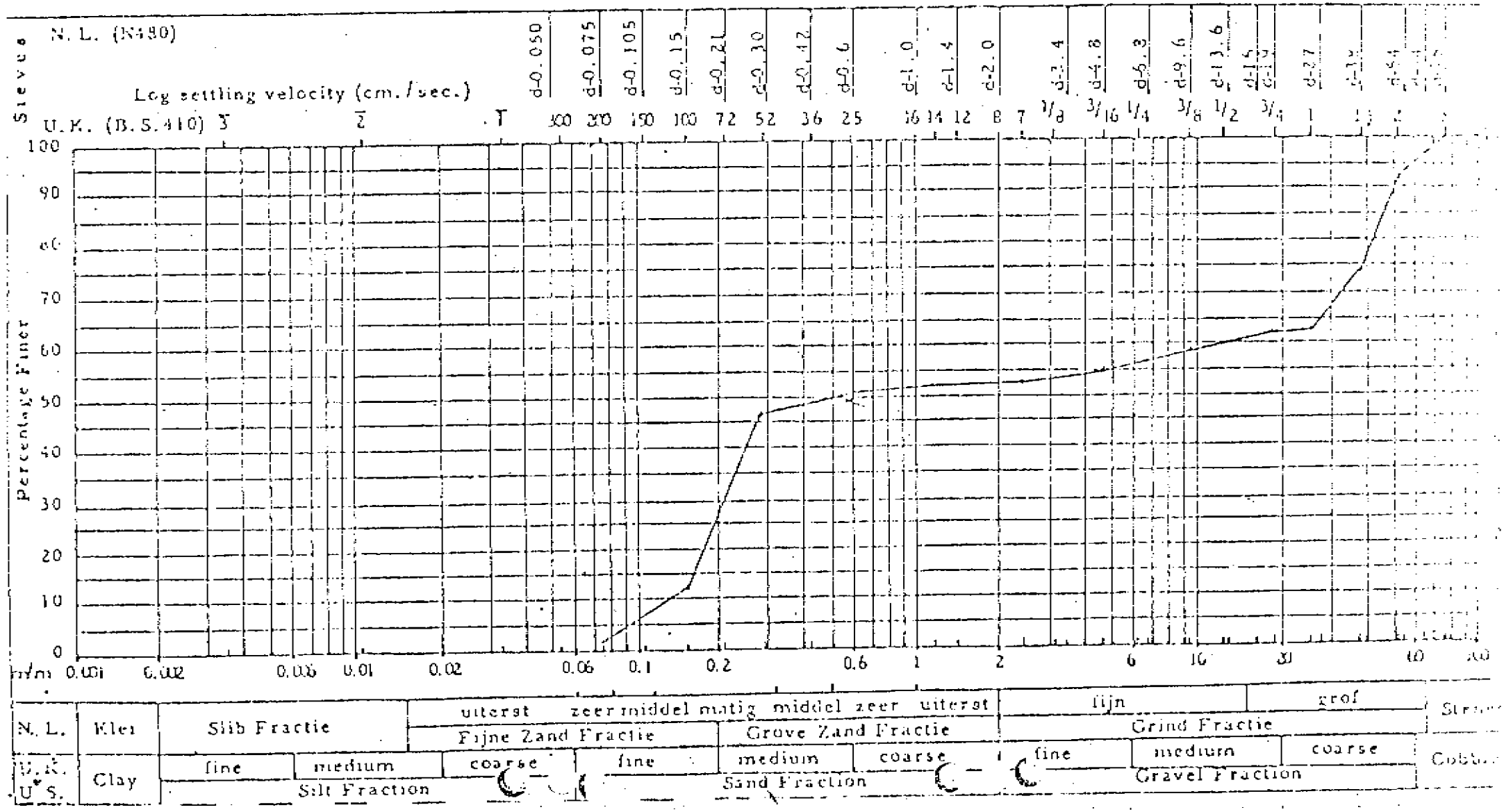
PARTICLE-SIZE DISTRIBUTION

Department Job No. ..DG75096.....
Job Location .....Doris Project..
.....Banff.....

Borehole No. .....
Sample No. ..Core...
Depth .....

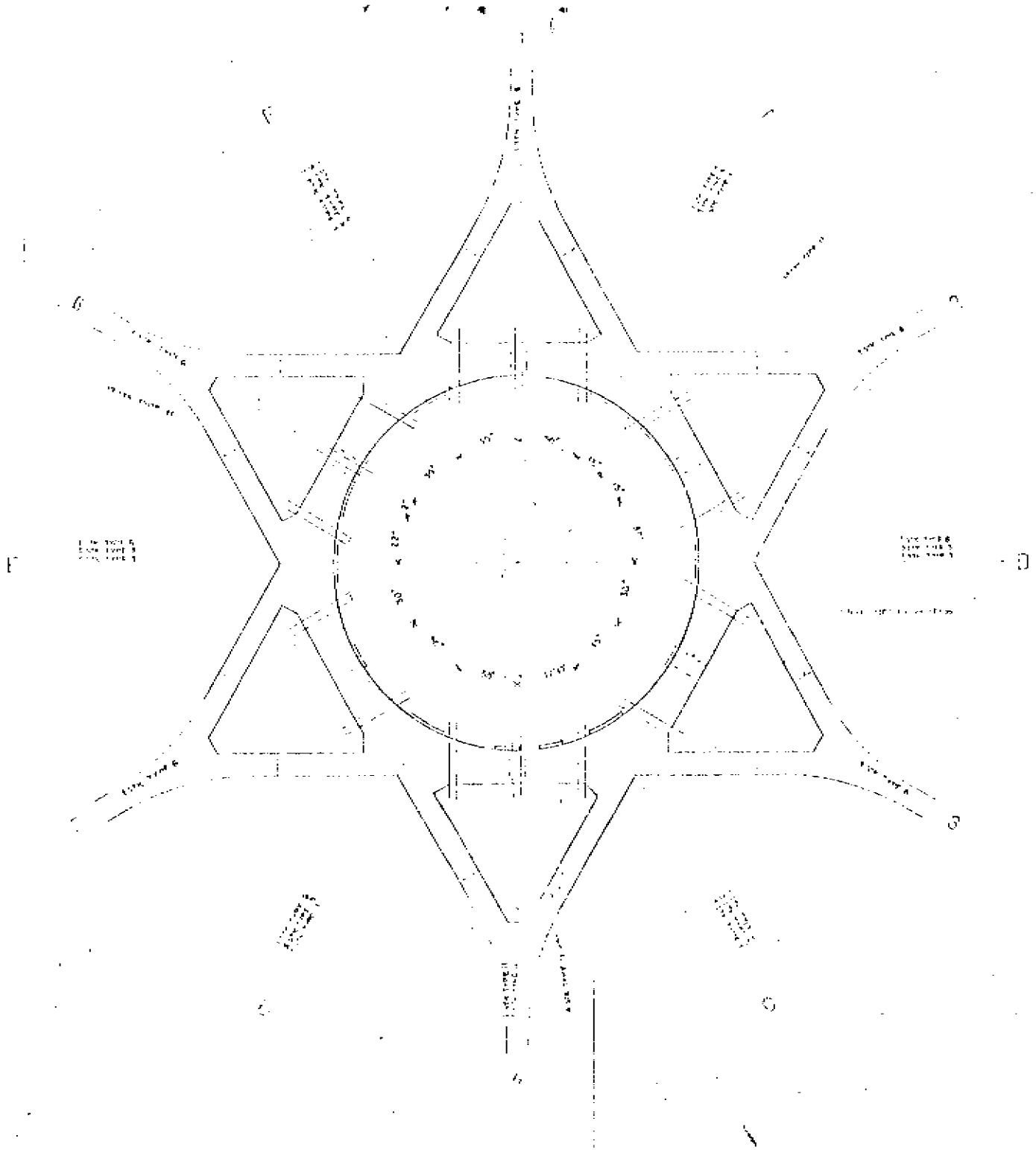
Visual Description ....Grey, brown fine and medium SAND and coarse GRAVEL, and shells.....

Date ....November...



APPENDIX XIII

LOCATION OF BUILT-IN STEEL ITEMS



FORPLØDIG 22.5.79

FRIGG FOTAL

NORWEGIAN CONTRACTORS

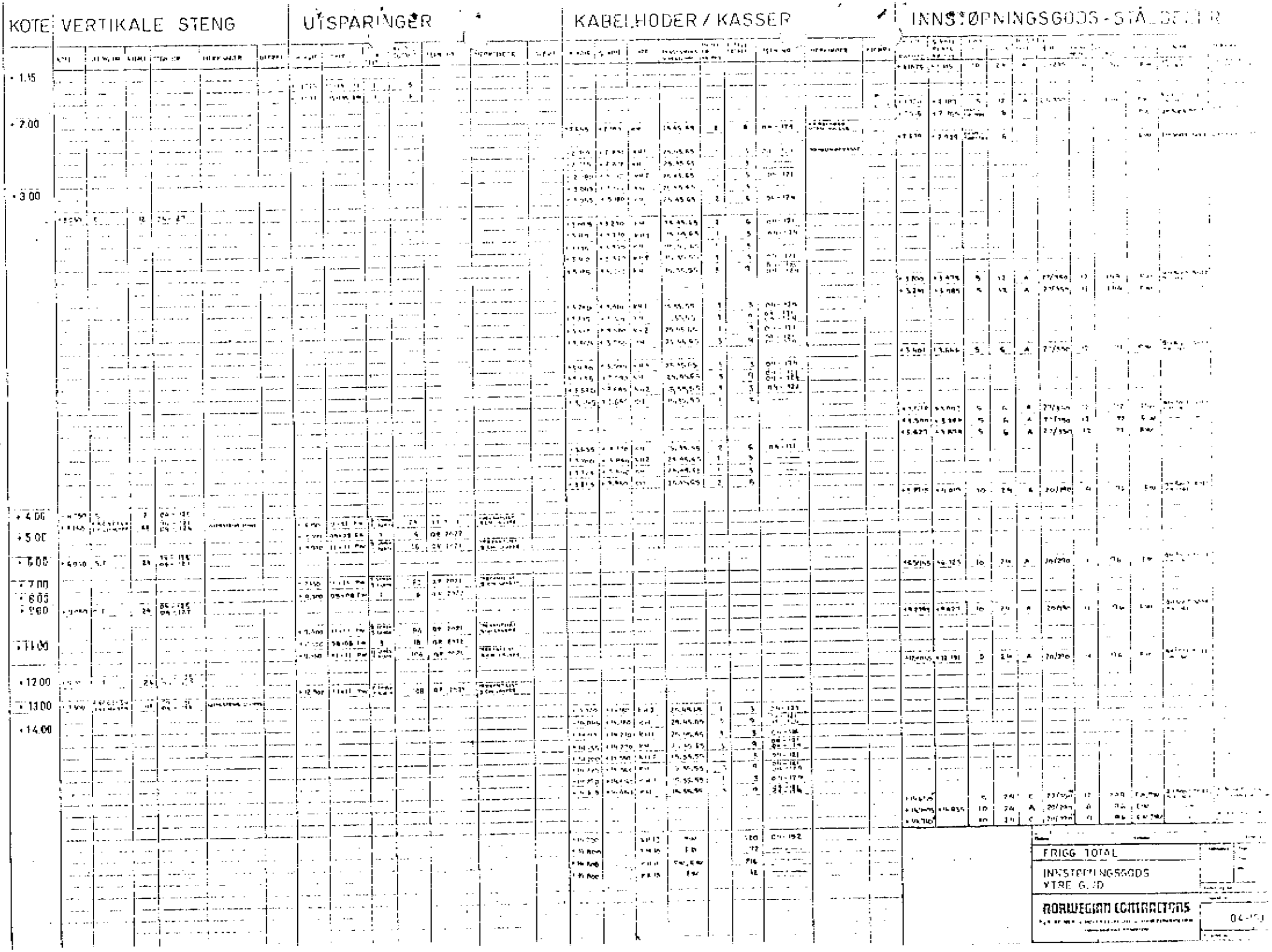
℄ KOTE	DIV. KOTE INNSTØPN.DEL	BETEGNELSE	KLAS	ANTALL	TEGNING NR.	MERKNADER
		FORSTERKNING AV TUNNEL/FJELL		6	QM 5003, 5017	
+ 3.170		BASE PLATE TYPE 5. RAMME 5/A MED 12 STK BOLTER TYPE A/27/480	YS	6	QM 5007, 5022.04-161	YS - YTTERSIDE
+ 3.600		LEIDERFESTE. 4 BOLTER Φ/L = 20/220 PR. FESTE	YS	6	QM 5025	BLAZ IKKE ...
+ 5.400		LEIDERFESTE. — " —	YS	6	QM 5025	
+ 5.425	+ 5.180	BASE PLATE TYPE 5. RAMME 5/A MED 12 STK BOLTER A/27/480	YS, IS	12	QM 5007, 5022.04-161	IS - INNERSIDE
+ 7.525	+ 7.260	BASE PLATE TYPE 5. — " —	YS	6	QM 5007, 5022.04-161	
+ 7.550		LEIDERFESTE. 4 BOLTER Φ/L = 20/220 PR. FESTE	YS	6	QM 5025	
+ 9.700		LEIDERFESTE. — " —	YS	6	QM 5025	
+ 11.250		FORTØYNINGSFESTE 10 TONN.	YS	6	09-407, -415	
+ 11.850		LEIDERFESTE. 4 BOLTER Φ/L = 20/200 PR. FESTE	YS	6	QM 5025	
+ 12.000		FORTØYNINGSFESTE 50 TONN. 2 STK PLASTHYLSER Φ=68 PR. FESTE.		6	09-432, -434	
+ 12.060		FORTØYNINGSFESTE 25 TONN. 1 STK HYLSE FOR Ø=8 BOLT	YS	4	09-434, -436	
+ 12.236		FORTØYNINGSFESTE 25 TONN. — " —	YS	2	09-438	
+ 12.500	+ 12.240	SLEPEFESTE 50 TONN	YS	4	09-410, -415	
+ 12.540	+ 12.540	SLEPEFESTE 20 TONN	YS	8	09-410, -415	
+ 12.850	+ 12.600	FESTE FOR FORTØYNINGSKRAN	YS	6	09-407, -418	
+ 13.950		AZ - STAG TIL FANGDAM		312	05-001	
+ 14.100		LEIDERFESTE. 4 BOLTER Φ/L = 20/220 PR. FESTE	YS	6	QM 5025	
+ 14.200	+ 14.160	FESTE FOR PLATTING VED FORTØYNINGSKRAN	YS	9	09-407	
	+ 14.320	FESTE FOR STAG FORTØYNINGSKRAN	TOPP VEGG	6	09-407, -415	
	+ 14.650	BASE PLATE TYPE 5. RAMME 5/C MED 12 BOLTER C/27/480	— " —	12	QM 5007, 5022.04-161	
	+ 14.710	BASE PLATE TYPE 10. RAMME 10/C MED 4 BOLTER C/20/400	— " —	12	QM 5007, 5022.04-161	
		BOLTER Ø25 FOR FANGDAM	— " —	156	05-001	

FRIGG TOTAL

BREAKWATER WALL
INNSTØPNINGSDELER - STÅL

NORWEGIAN CONTRACTORS
A/S T. SELMER • HOVER ELLEFSEN • THOR FURUHOLMEN
i samarbeid med JERNBETON

04 - 179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UTSPARINGER
KABELHODER / KASSER
INNSTØPNINGSGODS - STÅLDETALJER
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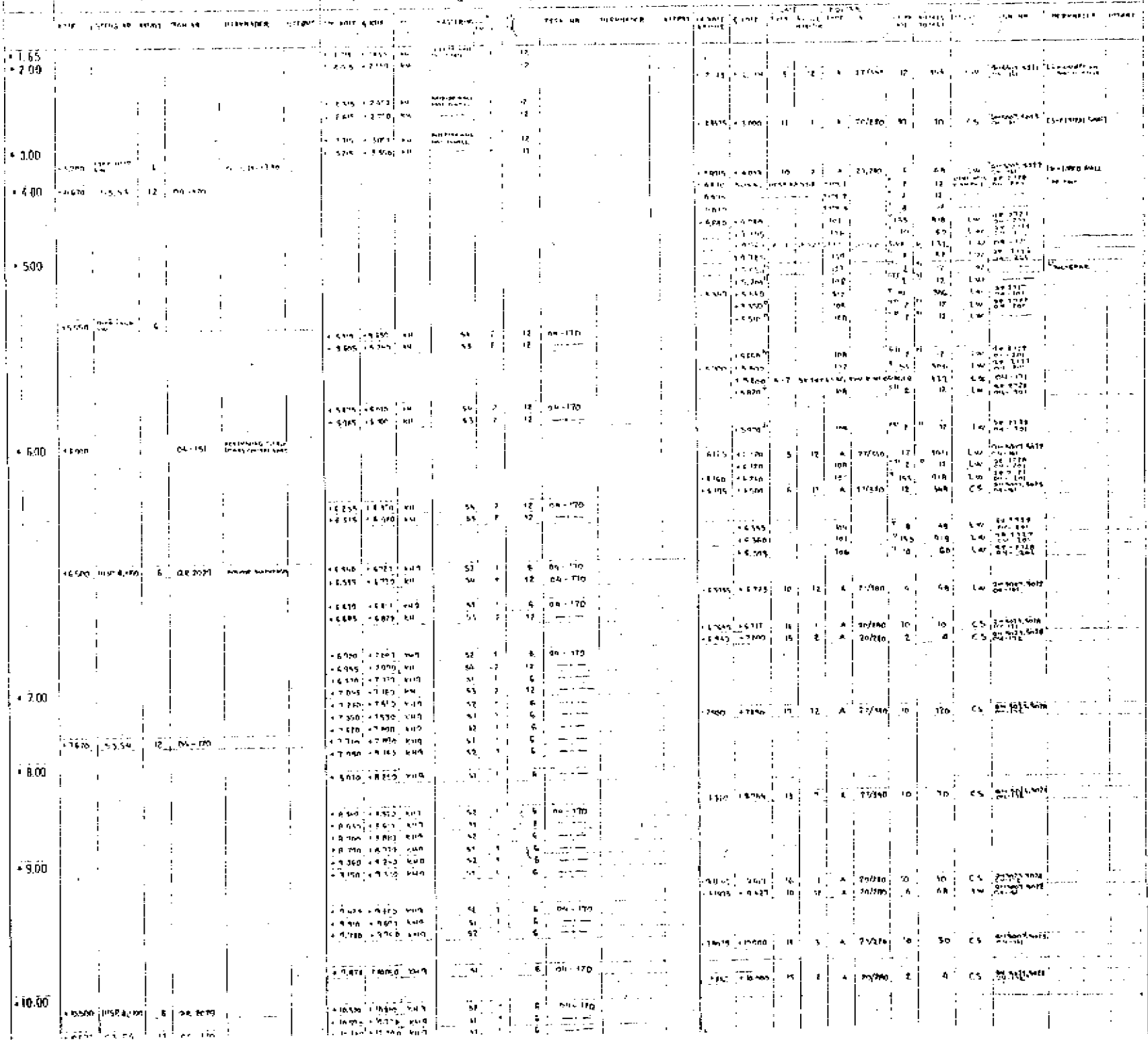
+ 2.00
+ 3.00
+ 4.00
+ 5.00
+ 6.00
+ 7.00
+ 8.00
+ 9.00
+ 11.00
+ 12.00
+ 13.00
+ 14.00
FRIGG TOTAL
INNSTØPNINGSGODS
YTRE GJD
NORWEGIAN CONTRACTORS


FRIGG TOTAL
NORWEGIAN CONTRACTORS

KOTE STENG/UTSPARINGER | KABELHODER / KASSER | STÅLDELER

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+14.00

+15.00

+16.00

+17.00

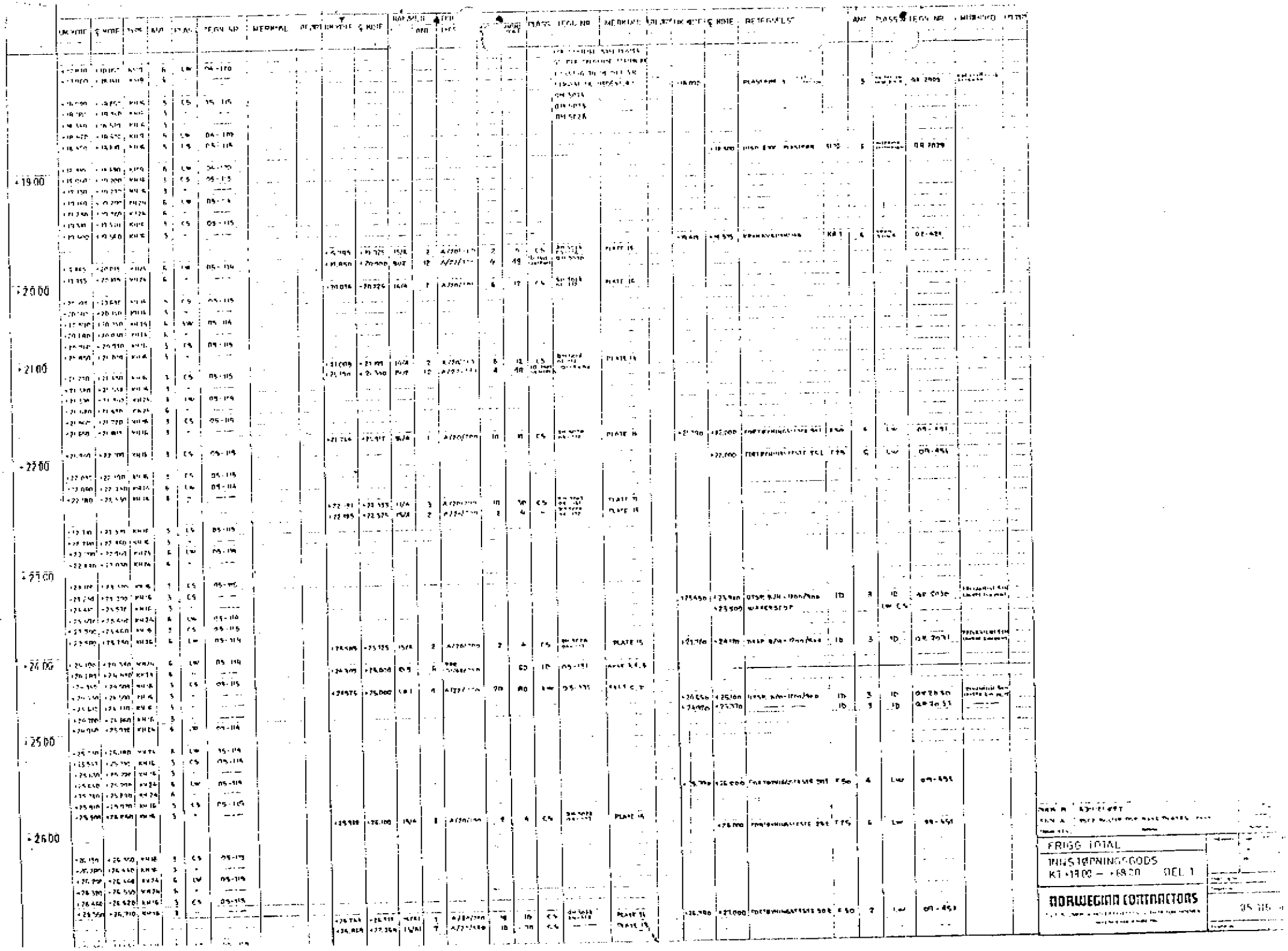
+18.00

FROG TOTAL

INNSTØPINGSGODS

INDRE GUD KT 15.00 - 19.00

NORWEGIAN CONTRACTORS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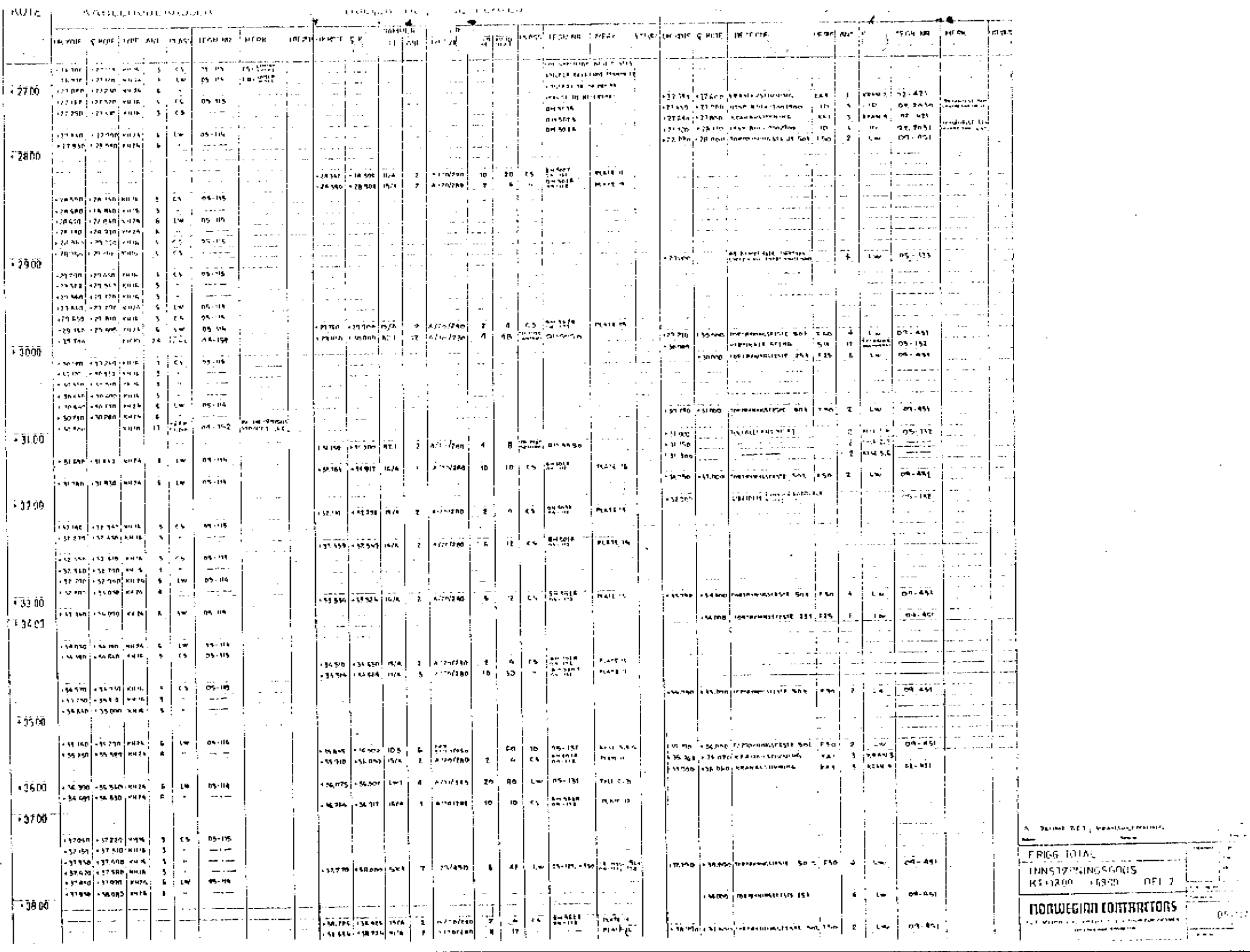
KT +19.00 – +26.00 DEL 1
NORWEGIAN CONTRACTORS
05-115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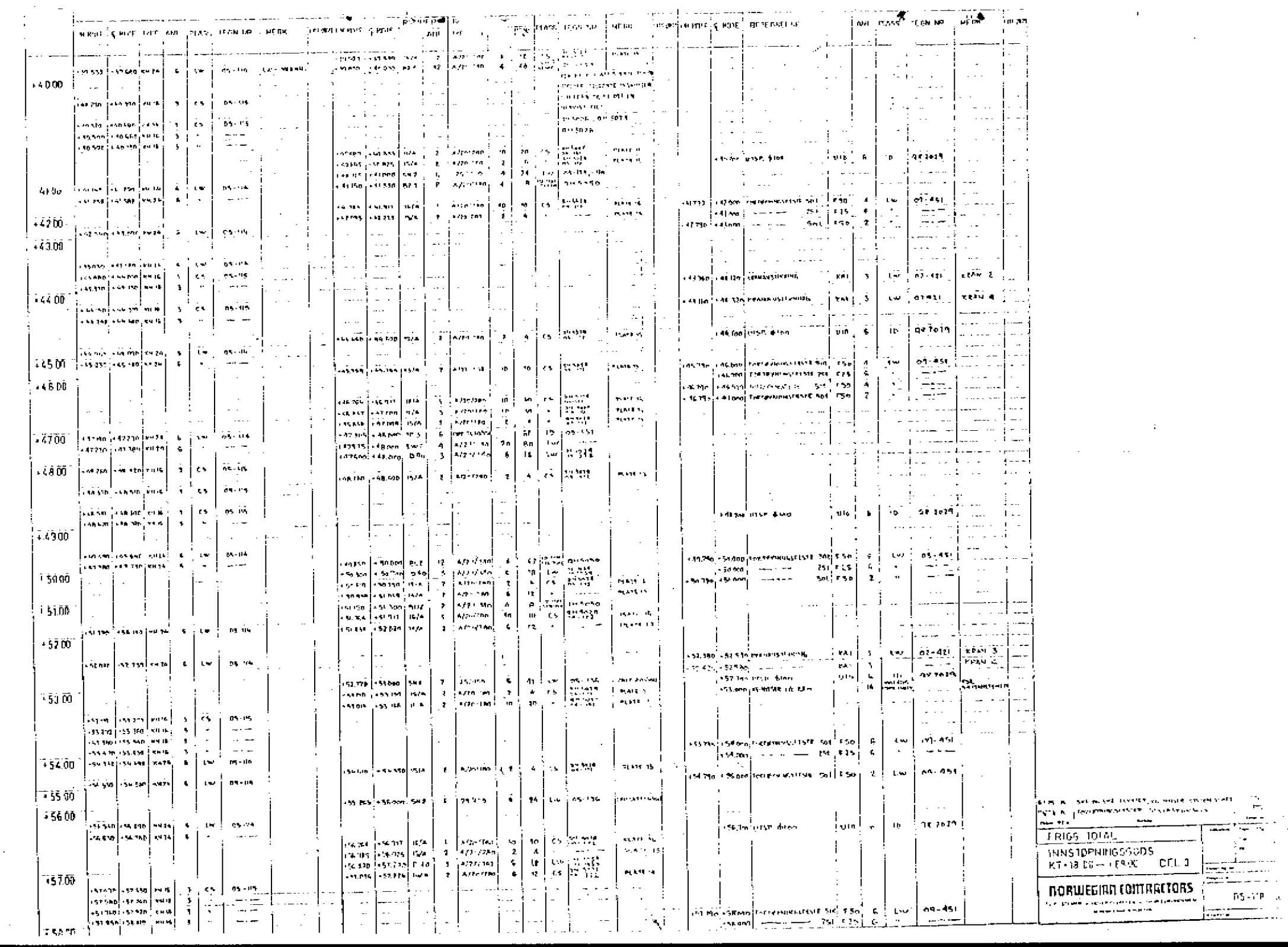
NORWEGIAN CONTRACTORS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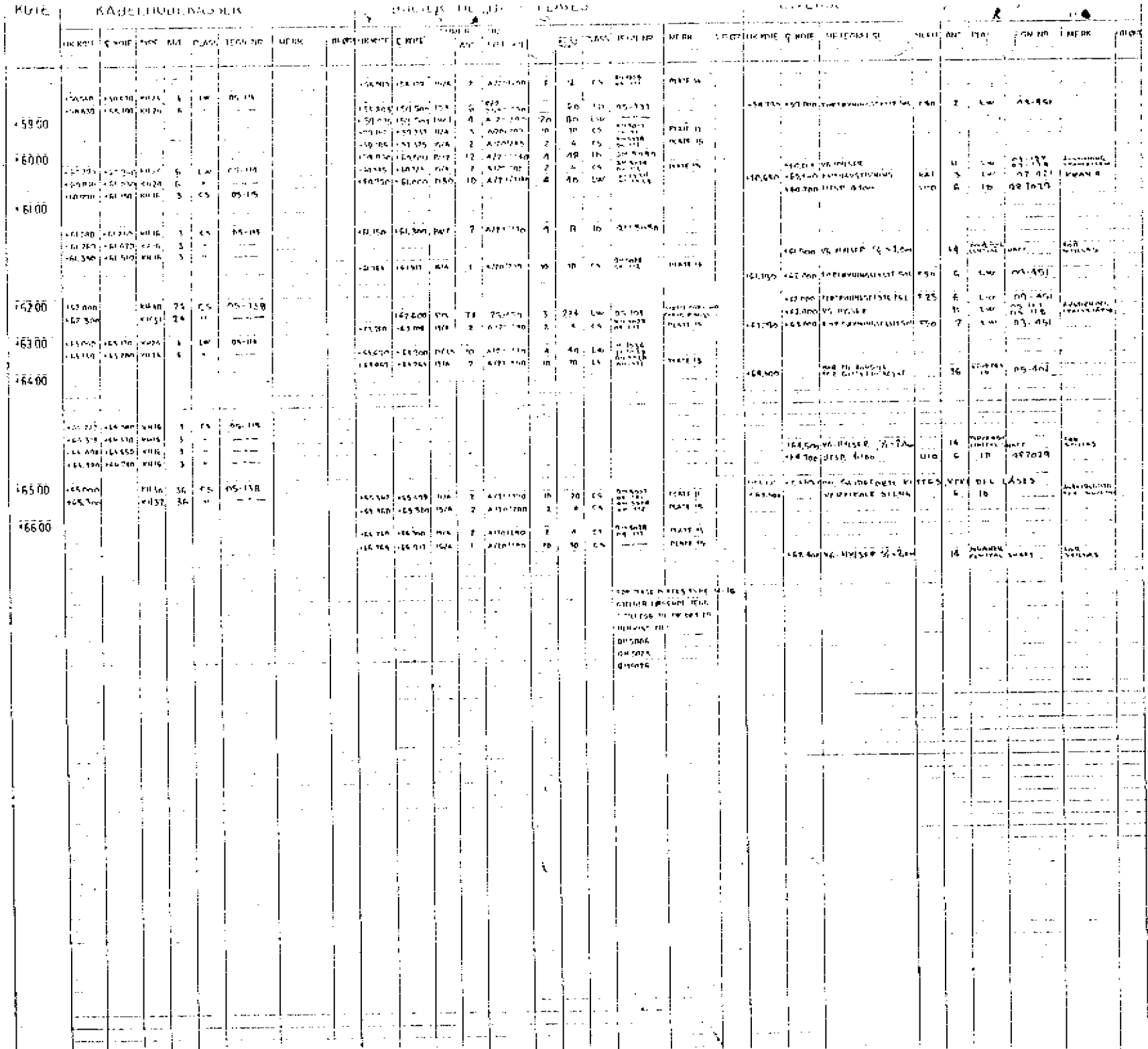
INNSTØPNINGSGODS
KT+18.00 — FRIGG CELL 3
NORWEGIAN CONTRACTORS
05-118



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INNSTØPNINGSGODS

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NORWEGIAN CONTRACTORS

05-195

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[illegible]	[illegible]	[illegible]	[illegible]	A/[illegible]	4	9	[illegible]	
[illegible]	[illegible]	[illegible]	1	A/[illegible]	[illegible]	7	[illegible]	
[illegible]	[illegible]	[illegible]	2	A/[illegible]	4	[illegible]	[illegible]	
[illegible]	[illegible]	B7.5	2	A/[illegible]	3	6	[illegible]	
[illegible]	[illegible]	[illegible]	1	A/[illegible]	[illegible]	10	[illegible]	
	[illegible]	[illegible]	[illegible]				SKISSE	
[illegible]	[illegible]	[illegible]	2	A/[illegible]	2	4	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	A/[illegible]	[illegible]	20		
[illegible]	[illegible]	[illegible]	[illegible]	A/[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	2	A/[illegible]	4	8	[illegible]	
[illegible]	[illegible]	[illegible]	2	A/[illegible]	2	4	[illegible]	
[illegible]	[illegible]	16/A	1	A/[illegible]	10	10	[illegible]	
[illegible]	[illegible]	B7.5	4	A/[illegible]	[illegible]	47	[illegible]	
[illegible]	[illegible]	[illegible]	2	A/[illegible]	2	4	[illegible]	
	[illegible]	[illegible]	2				[illegible]	
[illegible]	[illegible]	[illegible]	2	A/[illegible]	4	8	[illegible]	[illegible]
[illegible]	[illegible]		10	[illegible]	4	40	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	2	A/[illegible]	2	4	[illegible]	[illegible]
	[illegible]			[illegible]		4	SKISSE	
[illegible]		[illegible]		[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	2	A/[illegible]	4	8	[illegible]	
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	[illegible]			[illegible]		36	SKISSE	[illegible]
[illegible]	[illegible]	[illegible]	2	A/[illegible]	2	4	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	4	A/[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	13/A	3	A/[illegible]	[illegible]	[illegible]		[illegible]
[illegible]		[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	2	A/[illegible]	3	6	[illegible]	
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[illegible]	[illegible]	[illegible]	2	A/20/[illegible]	2	4		[illegible]
[illegible]	[illegible]	13/A	4	A/[illegible]	[illegible]	[illegible]		
[illegible]				[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]		[illegible]
	[illegible]			[illegible]		[illegible]	SKISSE	
	[illegible]			[illegible]		4	SKISSE	[illegible]
[illegible]	[illegible]	[illegible]	1	A/[illegible]	[illegible]	12	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
[illegible]				[illegible]		23	SKISSE	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	A/[illegible]	2	4	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]				[illegible]

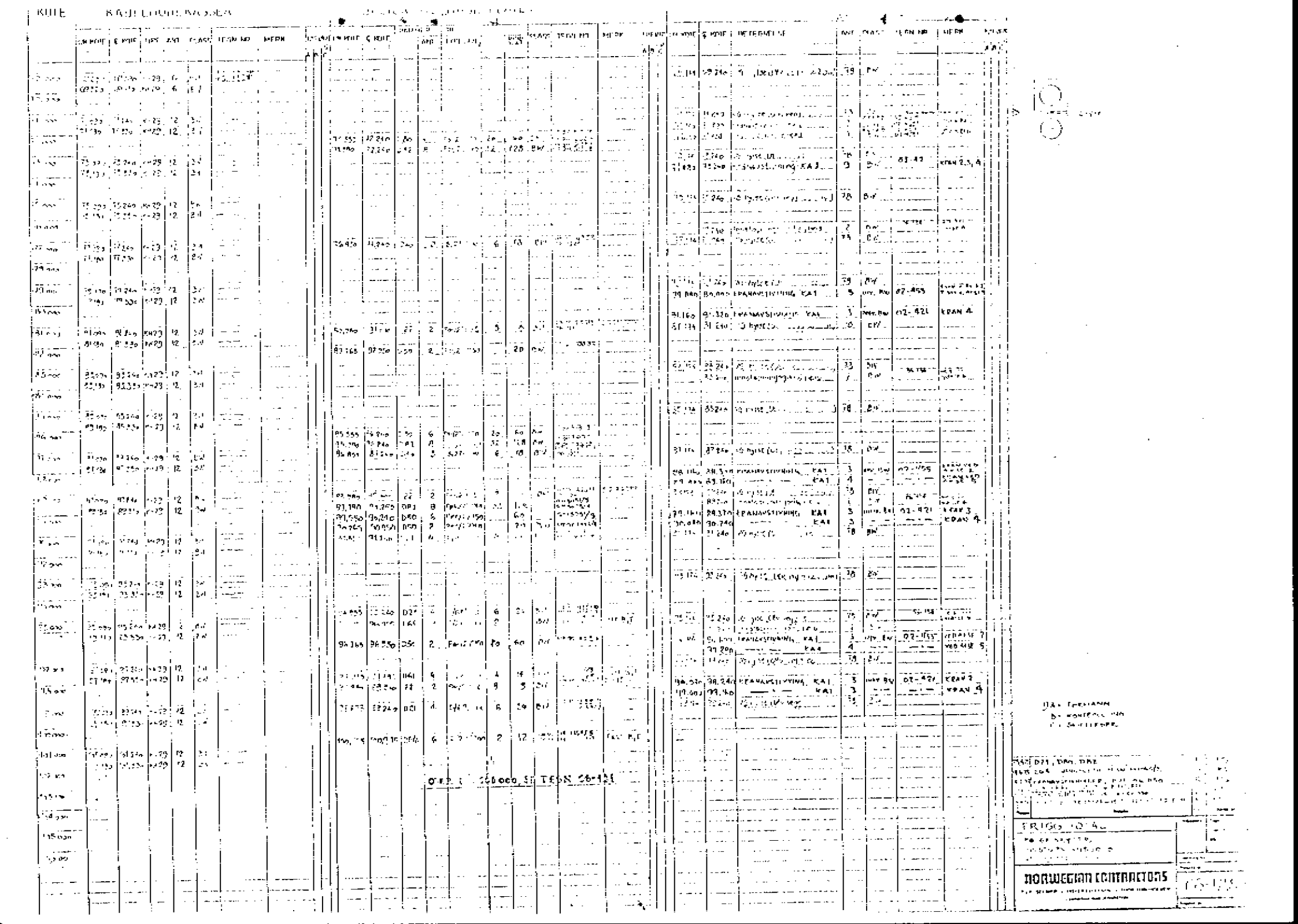
NB! SKJØTBOLIER FOR [illegible] I [illegible] [illegible] [illegible] KFR. TEGNING [illegible]

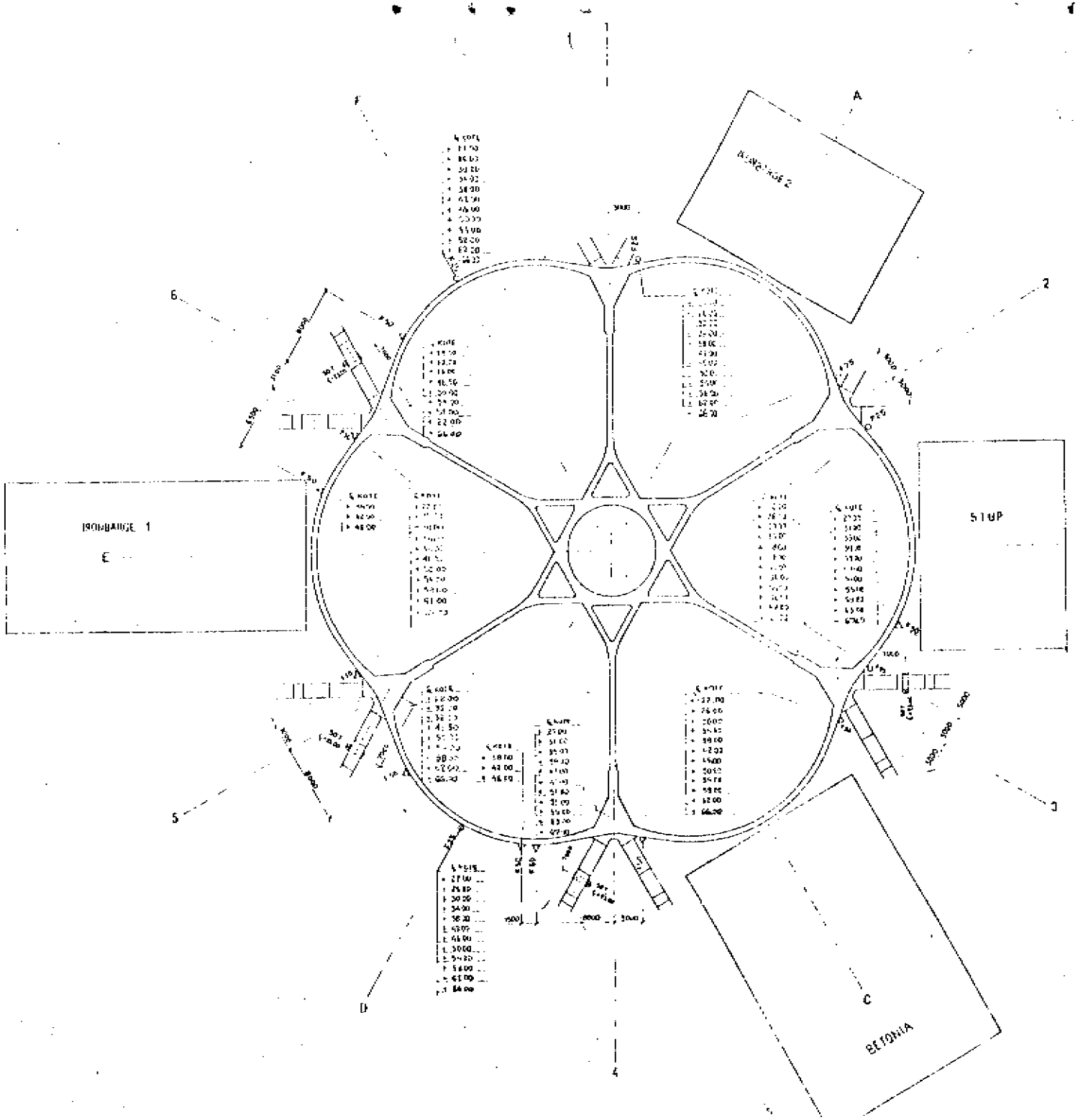
[illegible]

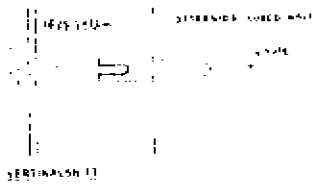
A = [illegible]
B = [illegible]
C = [illegible]

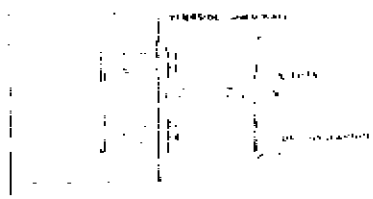
FRISON [illegible]

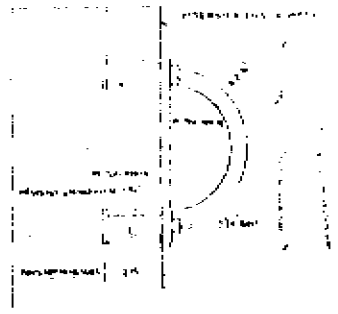
NORWEGIAN CONTRACTORS











FRISE TOTAL

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APPENDIX XIV

INSPECTION OF PRECAST BEAM

[illegible] at the precast-yard were inspected on the [illegible] by Messrs Gordon Cranmer, Doug Bound, and Hayes. [illegible] following remarks were made:

1. Generally:

a) The shrinkage cracks on top of the beams should be impregnated with epoxy PM 151.

b) All steel iron formwork etc. should be cut flush and painted with epoxy P 1.

c) All nails should be cut flush and painted with epoxy P 1.

d) All pieces of wood should be chiselled out and concrete repaired by an approved method.

e) All construction and casting joints should be prepared by wire brushing or chiselling.

f) The concrete, if there is any, should be removed from the Macalloy lifting holes.

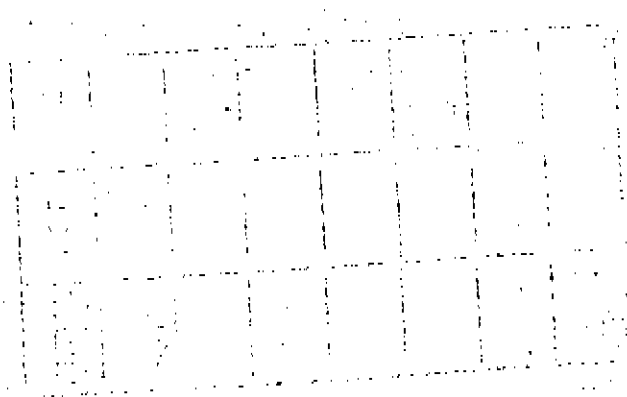
g) The AB-bolts and nuts for the formwork should be removed.

h) The holes for the steel bars should be checked and cleaned out, held clear for grouting of neoprenes.

i) When the beams are [illegible] free of heavy formwork they must be inspected [illegible] and, if necessary, repair work be done.

j) The steel should deliver clips for necessary [illegible] of plates for assembly [illegible].

k) The [illegible] should be repaired to the ends.



[illegible] we [illegible] of [illegible] [illegible] of [illegible] [illegible]

[illegible]