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Industrial and Offshore Division

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TECHNICAL REPORT

VERITAS Report No.	Subject Group
78/039	

Title of Report

FRIGG FIELD - QUARTERS PLATFORM DESIGN, FABRICATION AND INSTALLATION RESUME (STRUCTURAL PARTS)

Client/Sponsor of project

ELF AQUITAINE NORGE A/S

Work carried out by

Odd Torset et.al.

Date	
1.1.1978	
Department	Project No.
IOD	601436

Approved by

S. H. Ochi

Client/Sponsor ref.

H. Lye

Reporters sign.

Odd Torset

Summary

4 Indexing terms

QUARTERS PLATFORM
FRIGG FIELD
DFI RESUME

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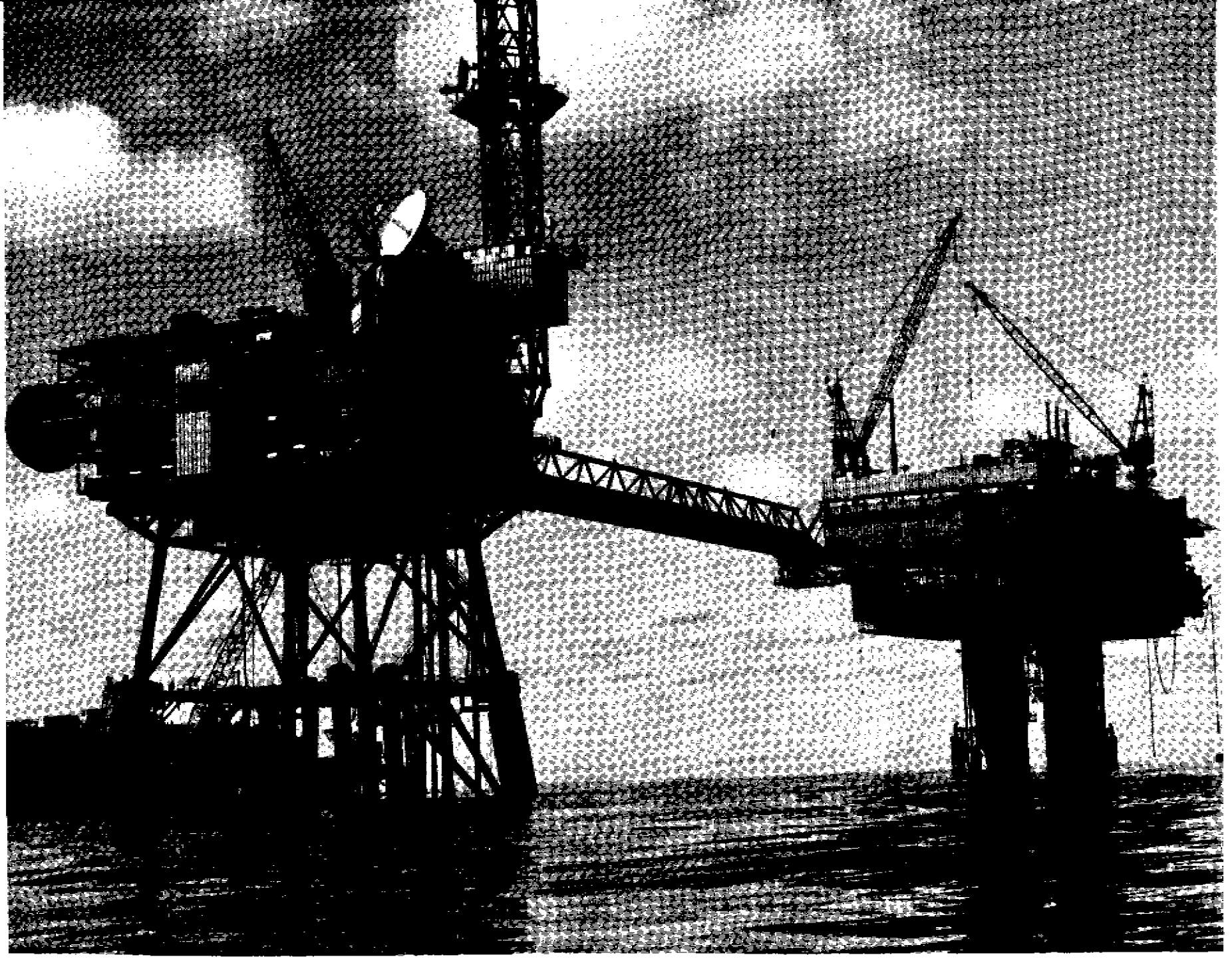


DESIGN-FABRICATION-INSTALLATION

FRIGG FIELD

QUARTERS PLATFORM (QP)

STRUCTURAL PART

1. DESIGN RESUME

1.1 General

Frigg field Quarters platform was installed in the Frigg field, North Sea, during the summer of 1975. The platform which is a steel template sturcture is secured to the seabed by driven and insert piles. A deck support frame is installed on top of the jacket to support two living modules. On top of the living modules some smaller modules (Battery room, generator module , helihangar, helideck, parabolic antennaes and radiomast) are installed.

1.2 Specifications

The following specifications were worked out for materials and fabrication of the structure:

- Elf Norge - Frigg Field - 1052 No. 3-145
  Fixed offshore structures
  Material specification Rev. 3 November 1973
- Elf Norge - Frigg Field - 1052 No. 3 - 155
  Fixed offshore structures
  Fabrication Specification Rev. 1 May 1973

1.3 Project description

Platform	:	Frigg QP
Type	:	Quarter Platform
Field	:	Frigg
Sector	:	British/Norwegian Block 25/1
Location	:	59°52 min 42.37 sec N 2°03 min 53.86 sec E
Waterdepth	:	100.0 m (MLW)
Operator/Company	:	Elf Norge A/S
Designer	:	McDermott-Hudson, London
Builder	:	Union Industriele et D'Entreprise Cherbourg, France
Modules A & B	:	Chantiers de la Garonne, Bordeaux, France
Microwave Tower	:	La Charpente Moderne, Begles, France
QP-Bridge	:	Mercantile Marien Engineering,Belgium
Installation Contractor	:	Oceanic Contractors
Steel Mill	:	
Jacket & Support Frame	:	Sumitomo, Kobe, Japan
Module Framing & Support	:	Rheinstahl, Essen, Germany
Piling	:	McDermott, Ardersier, Scotland

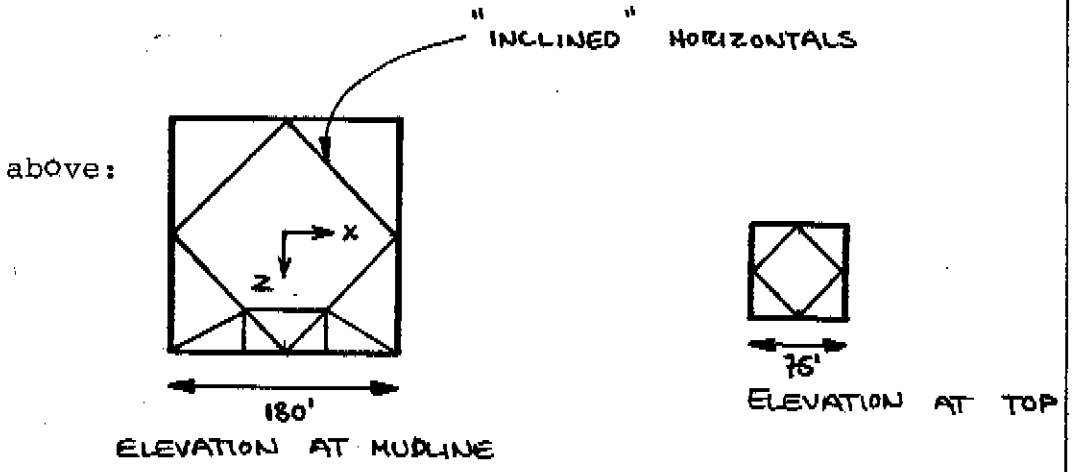
1.4 Design Premises

1.4.1 Platform Description

Brief description: Jacekt-type, Quarters Platform 4 main legs.

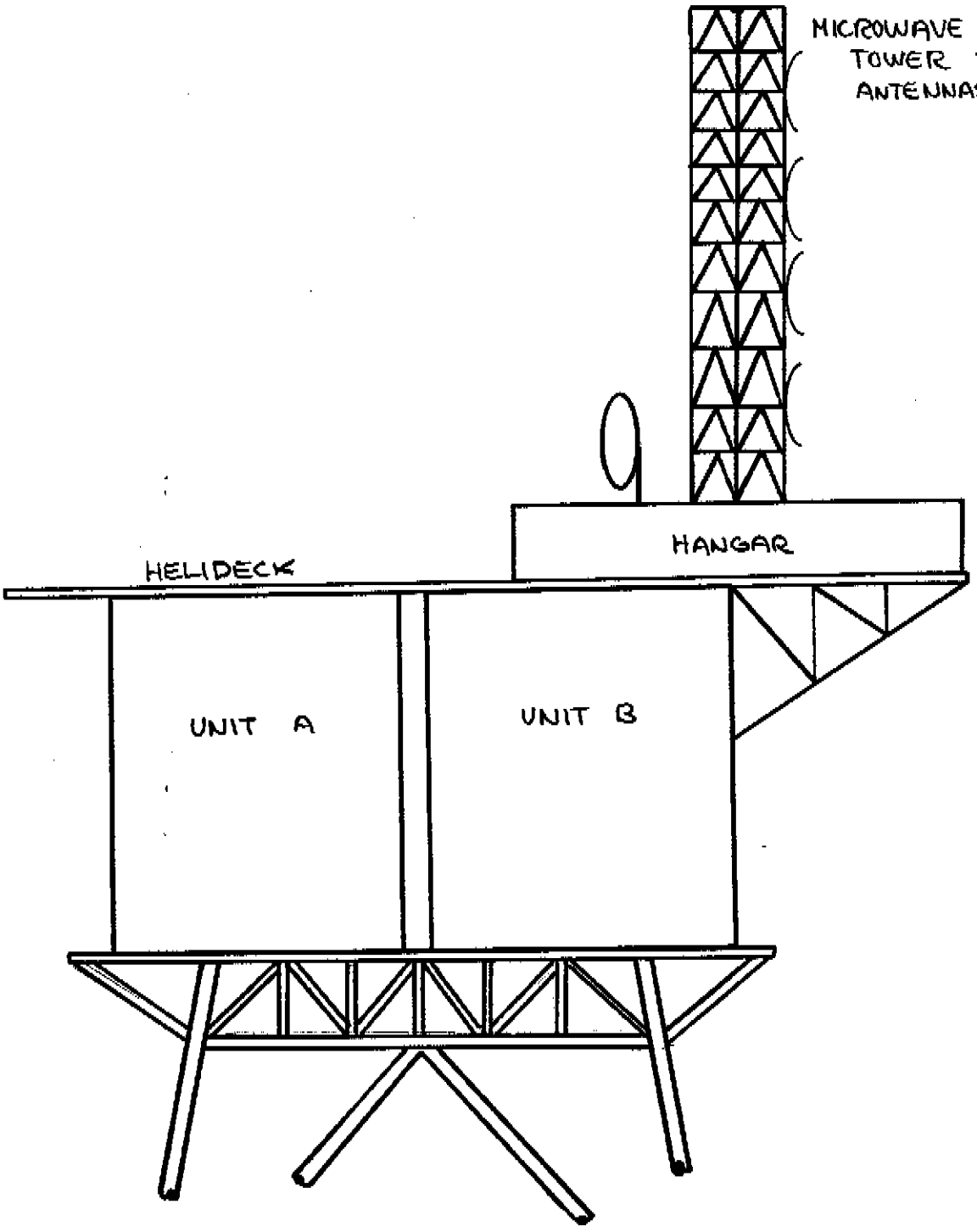
Figures (with main dimensions):

Jacket:



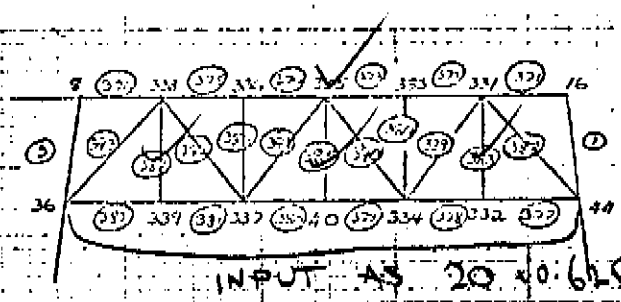
Foundation system:

Primary pile	Ø 54"	172 ft pen.
Insert pile	Ø 42"	380 ft pen.
	Ø 36"	



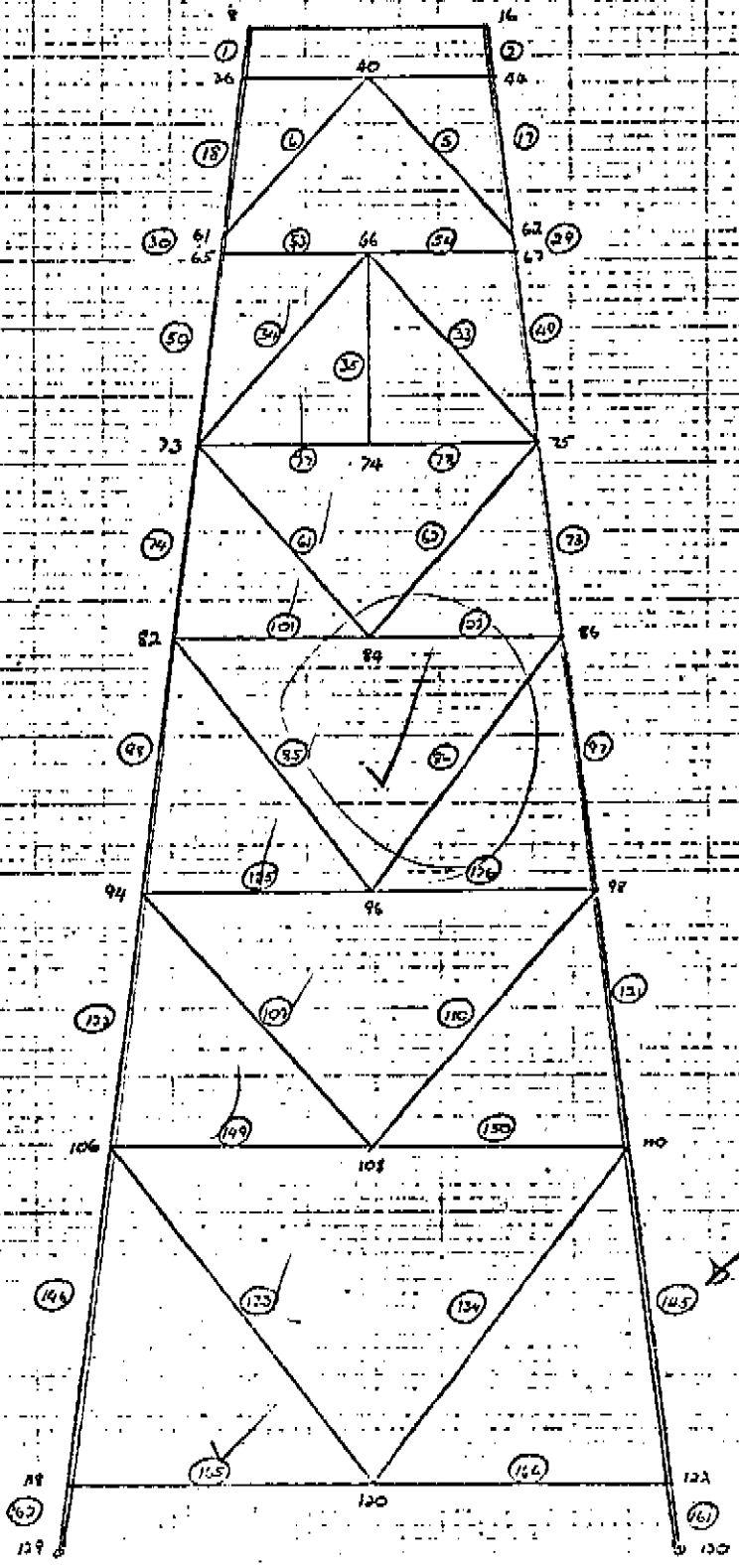
SCHEMATIC DRAWING OF PACKAGE & HELIDECK

MEMBER NUMBERING



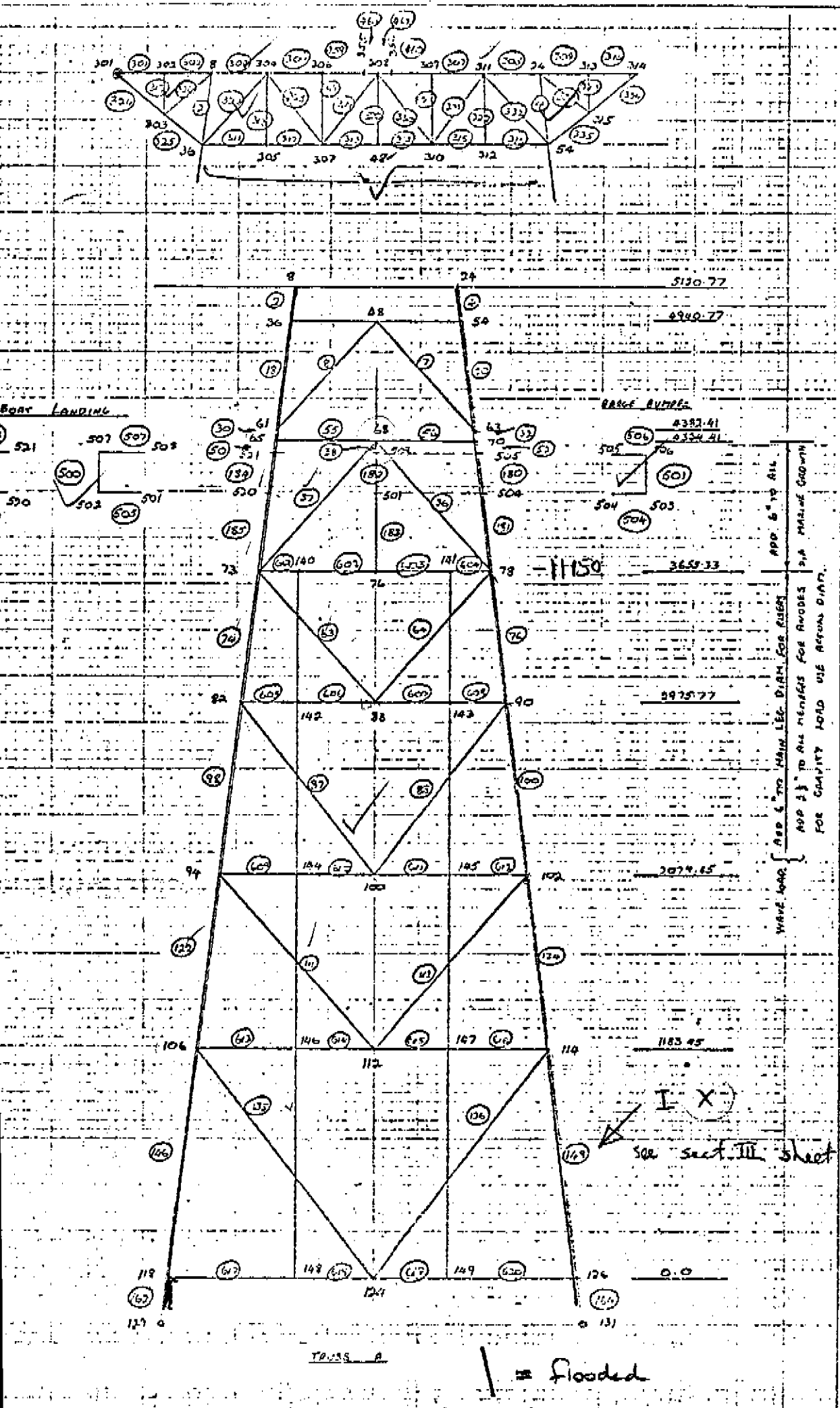
INPUT AS 20 x 0.625
ACTUAL 36 x 1.0

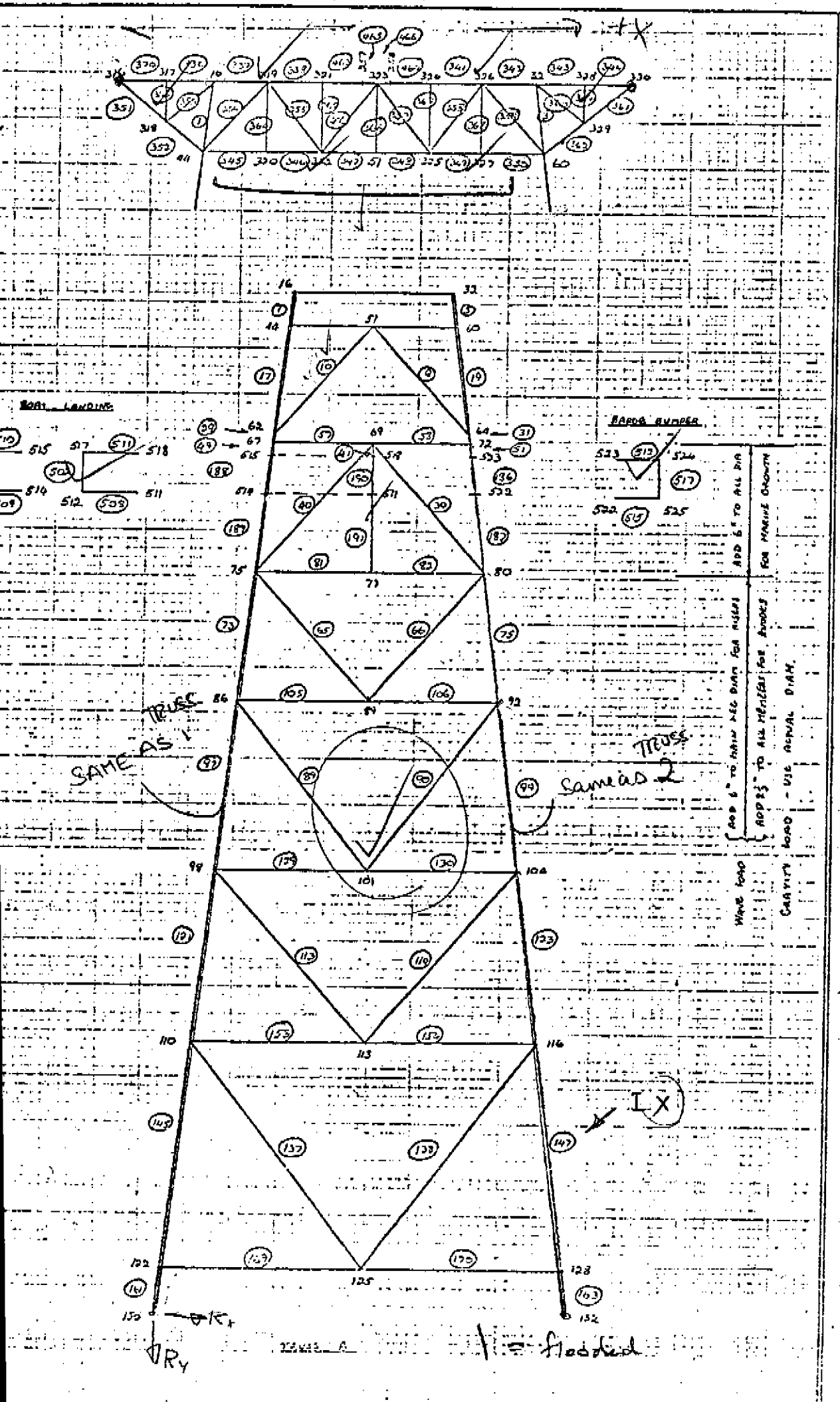
OK

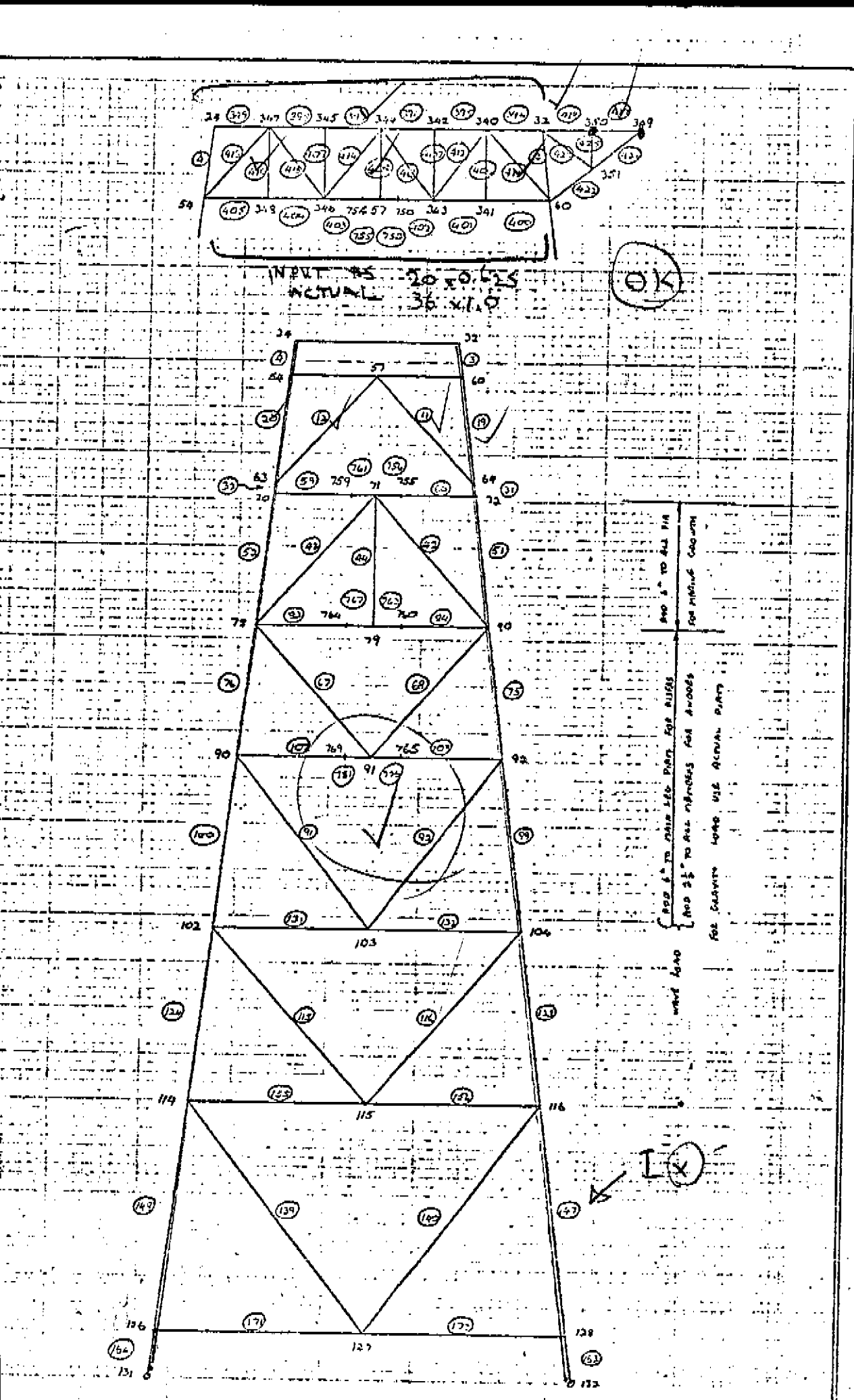


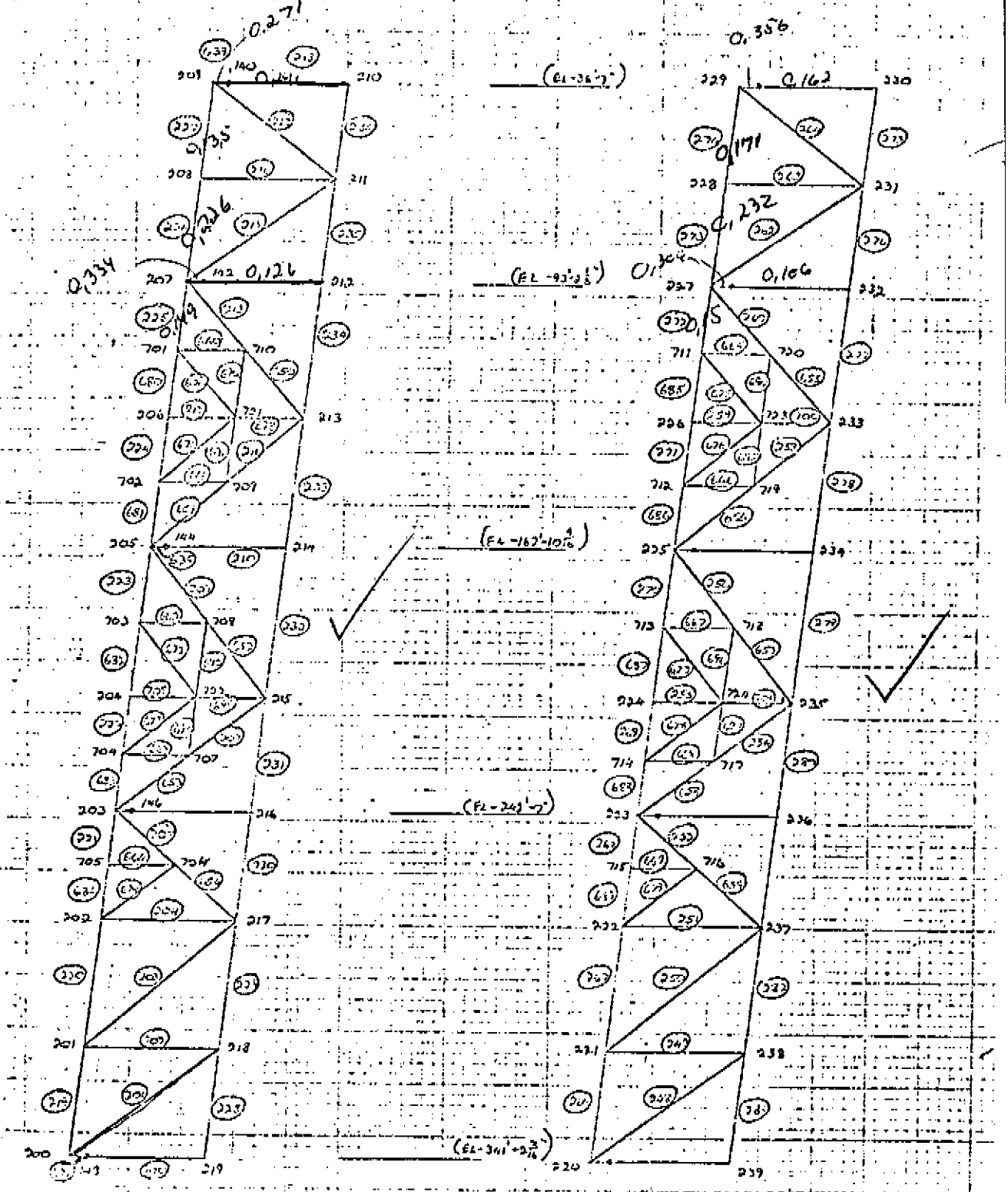
ADD 6" TO MAIN LEG DIAM FOR RISER
ADD 3" TO ALL MEMBERS FOR BUOYANCY
FOR GRAVITY LOAD USE ACTUAL DIAM.
WAVE LOAD

Truss 1 = Bracket








0.271
0.135
0.226
0.334
0.126
0.356
0.162
0.171
0.232
0.106
(FL -36½°)
(FL -93½°)
(FL -162½-10½°)
(FL -243½-7°)
(FL -341½+2½°)
Truss X
Truss Y

McDERMOTT-HUDSON

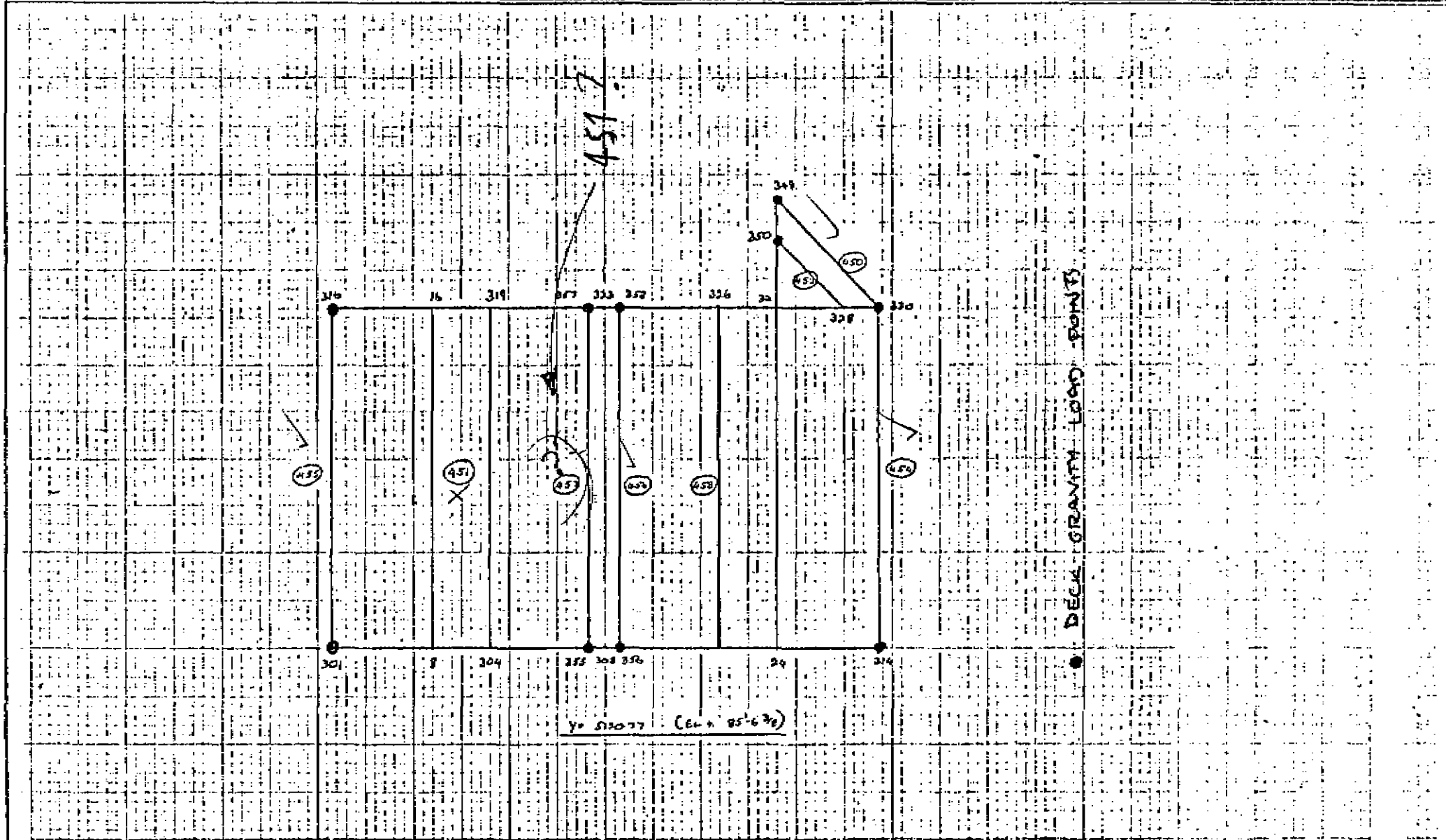
McDERMOTT-HUDSON

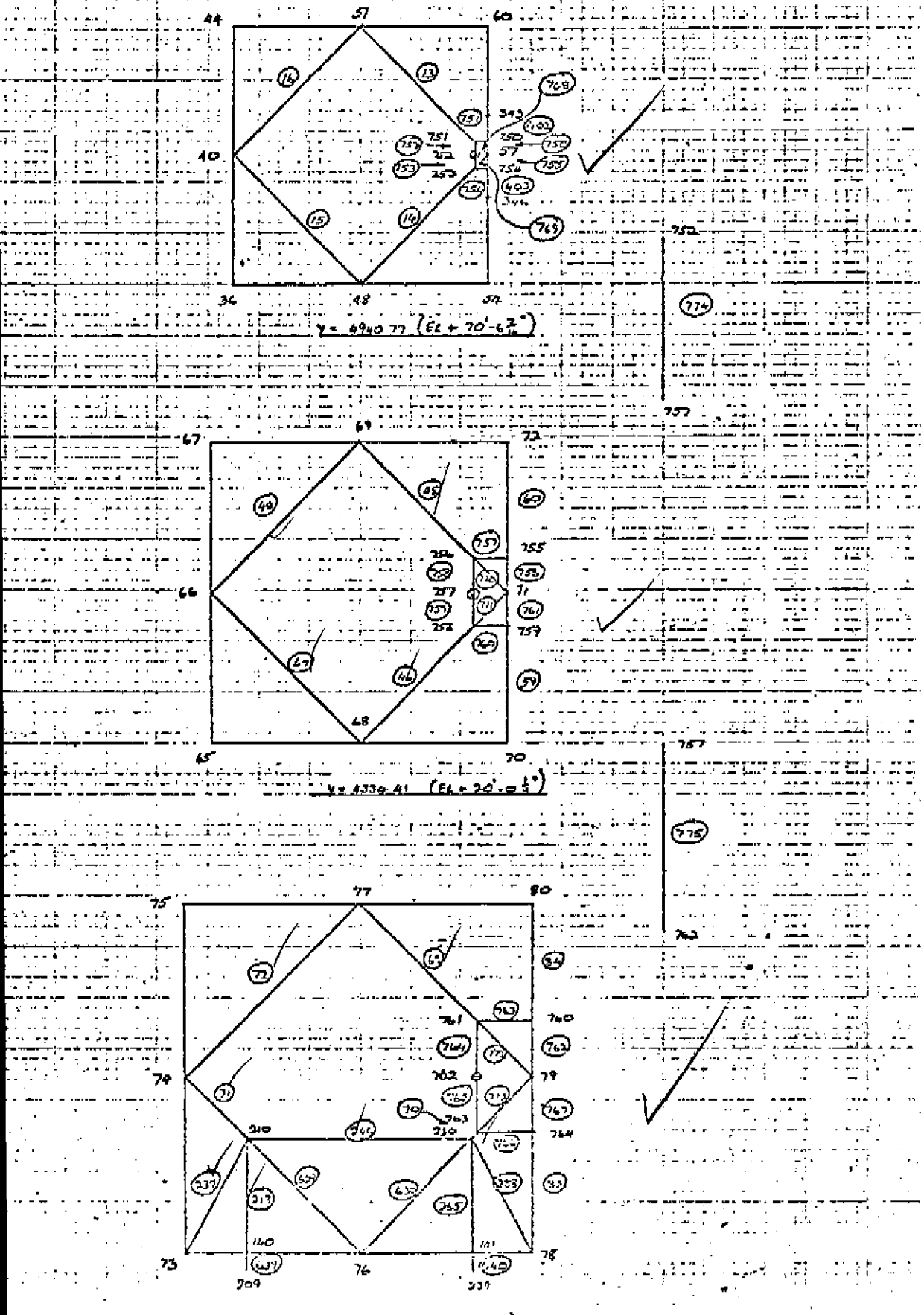
ENGINEERING DEPARTMENT - COMPUTATION SHEET SHEET NO.

COMPANY

SUBJECT

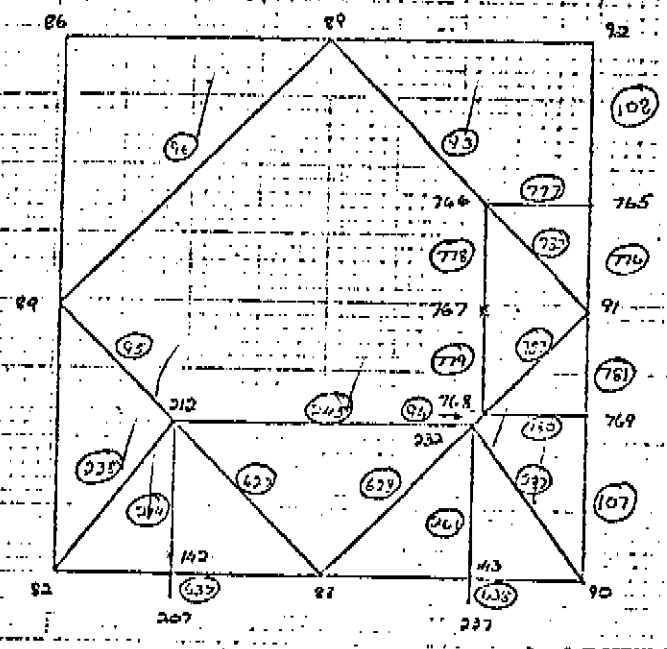
DRAWING NO. COMPUTER CHKD. BY DATE 19



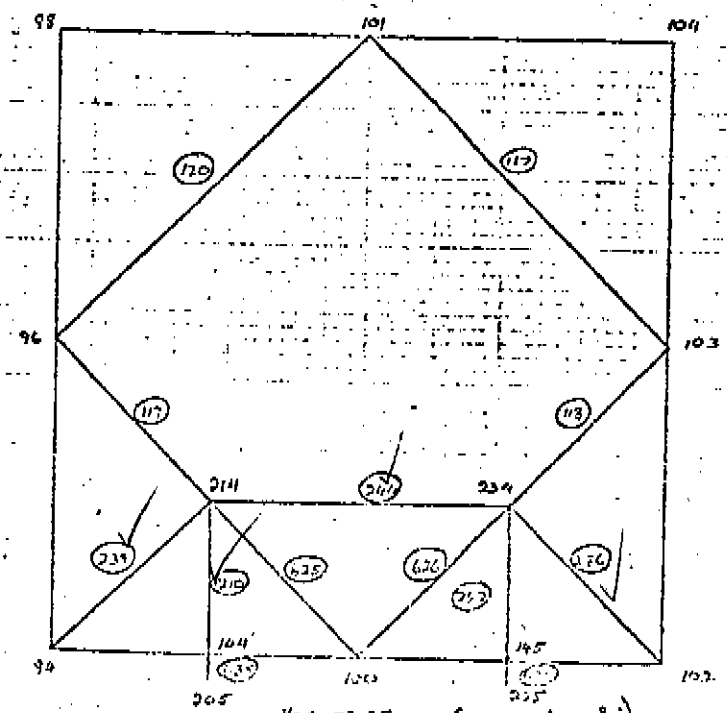


ENGINEERING DEPARTMENT - COMPUTATION SHEET

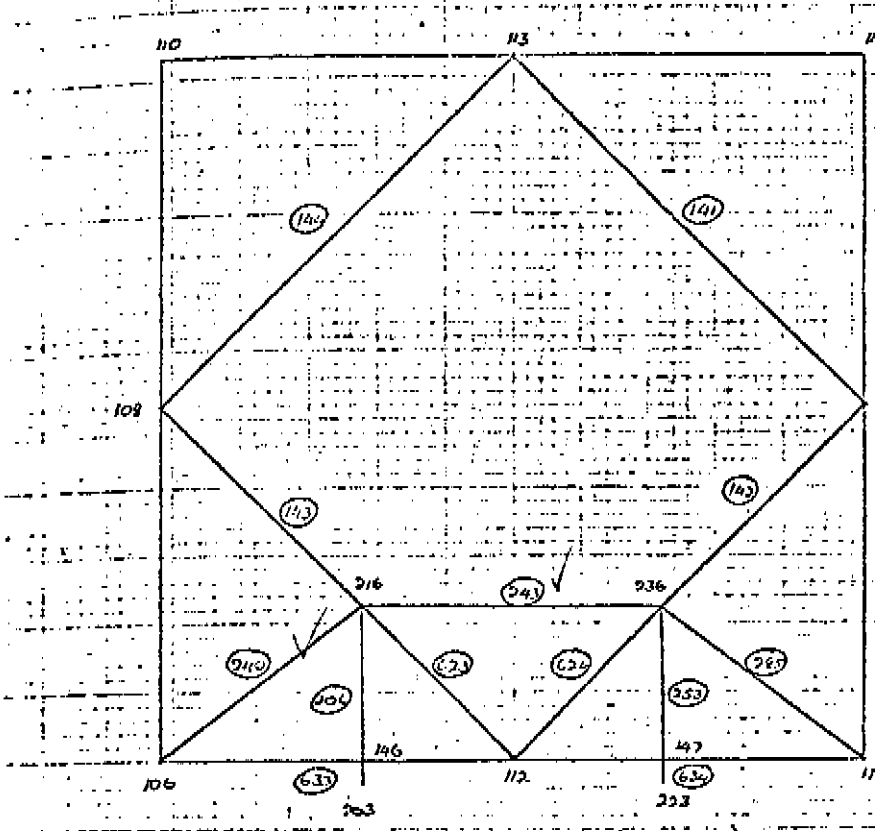
Company
Subject
Drawing No.
Computed
Checked
Date
Sheet No.



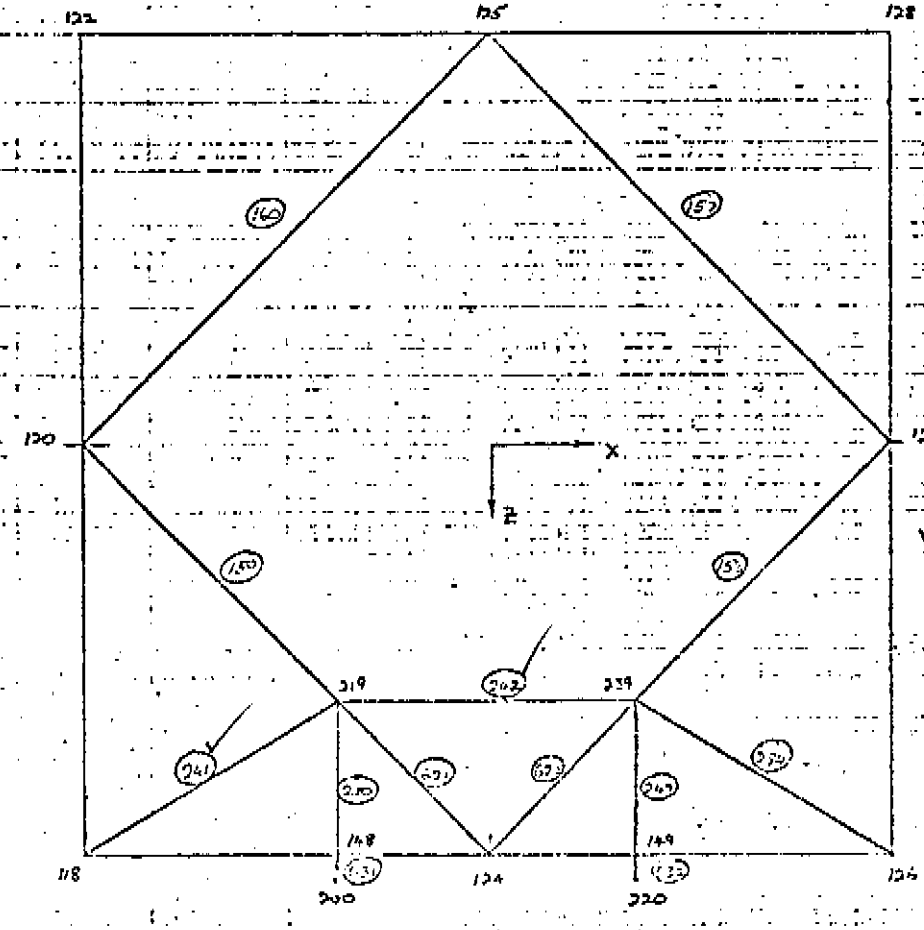
Y = 9975.77 (El - 93'-2")



Y = 9977.95 (El - 93'-10")



Y= 1183.45 (E4 - 242'-7")



Y= 0.0 (E= 3'-2")

1.4.2. Drawings

The drawings listed on the next pages are contained in IOD Fjernarkiv.

I.O.D.

AVD.: 57 STÅL

OL. TEGN. KASSET ARK.NR. 41 PROSJEKT NR.: 60 14 86

GGER: BYGGE-/FABR. NR.:

GGESTED: FELT: RIGG

RUKTUR: 4 LEG TEMPLATE QUARTER PLATFORM EIER: ELF NORGE A/S

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ANM: TEGNINGENE I KASSETTEN ER FORSYNT MED NUMMER TILSVARENDE DE OVERANFØRTE.

I.O.D.

AVD.: 57 STÅL

OL. TEGN. KASSET ARK.NR. 42 PROSJEKT NR.: 60 14 36 QP ELN-2098

GGER: BYGGE-/FABR. NR.:

GGESTED: FELT: FRIGG

RUKTUR: 4 LEG TEMPLATE QUARTERS PLATFORM INST EIER: ELF NORGE A/S

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- AS BUILT

I.O.D.

AVD.: 57 STÅL

L. TEGN. KASSET ARK.NR. 43 PROSJEKT NR.: 60 14 36 ELN 2098

GER: BYGGE-/FABR. NR.:

GESTED: FELT: FRIGG

UKTUR: 4 LEG TEMPLATE QUARTER PLATFORM EIER: ELF NORGE A/S

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ANM: TEGNINGENE I KASSETTEN ER FORSYNT MED NUMMER TILSVARENDE DE OVERANFØRTE.

I.O.D.

Å - AS-BUILT

AVD.: 57 STÅL

OL. TEGN. KASSET ARK.NR.: 49 PROSJEKT NR.: 60 14 36 ELN 2098

GGER: BYGGE-/FABR. NR.:

GGESTED: FELT: FRIGG

RUKTUR: 4 LEG TEMPLATE QUARTER PLAT ØRM EIER: ELF NORGE A/S

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	UNIT A - ANTENNA SUPPORTS SECTIONS & DETAILS SHT. 1 OF 2	As Built	386-3
	UNIT A - ANTENNA SUPPORTS & DETAILS - SHEET 2 OF 2	As Built	387-3
	M ODULE B - TOWER BASE DETAILS SHT 2 OF 2		388-0
	UNIT B LANDING FOR 50 MAN LIFEBOAT	As Built	389-1
	FRAMING DETAILS		390-0
	S ORT FOR DIESEL SIELENCERS (ERECTOR INSTALLED)		391-0
	S PPORT CLAMPS FOR INCINERATOR STACK (ERECTOR INST.)		392-0
	TEMPORARY SUPPORT FOR METEOROLOGICAL EQUIPMENT		394-1
	SKID EXTENSION DETAILS - FOR V6 TANK		395-0
	MODULE Q 9	As Built	396-5
	M IL, MODULE Q 9	As Built	397-5
	MISCELLANEOUS LADDERS & HATCH DETAILS		398-2
	DETAIL OF STAIR NO. 8	As Built	398A-0
	DAVIT ANCHORANGE DETAILS		398b-0
	F IXING DETAILS FOR SAFETY EQUIPMENT		398C-1
	ADDITIONAL STABBING GUIDES SHEET 1 OF 2		398D-0
	WALKWAY SECTIONS AND DETAILS - SHEET 2 OF 2		398E-0
	ADDITIONAL STABBING GUIDES SHEET 2 OF 2		398F-0
	UPPER FLOOR WALKWAY - DETAILS		398G-0
	FLOOR OPENING IN DIESEL GENERATOR ROOM DETAILS		398J-0
	TEMPORARY SUPPORTS FOR TROPO ANTENNA SHEET 1 OF 4		398K-0
	TEMPORARY SUPPORTS FOR TROPO ANTENNA - SHEET 2 OF 4		398L-0
	DETAILS O F TEMPORARY SUPPORT FOR TROPO ANTENNA SHT. 3 OF 4		398M-0
	TEMPORARY SUPPORTS FOR TROPO ANTENNA - DETAILS SHT. 4 OF 4		398N-0
	ADDITIONAL STIFFENING TO UNIT A LIFTIN FRAME		398P-1
	PERMANENT TIE DOWN FOR UNITS A & B		398R-0
	PIPE SUPPORTS G.A. UNIT-B LOWER FLOOR EL-(+) 26'10 T.O.S		399A-1

	TEGNING	APPR. DATO	ANM.
	IPE SUPPORTS G.A. UNIT B MIDDLE FLOOR EL +30875 T.O.S		399B-2
	P IPE SUPPORTS G.A. UNIT 'A' LOWER FLOOR EL(+)26910 T.O.S.		399D-1
	L IFEBOAT LANDINGS - DETAILS & SECTIONS		399G-2
	B ING CHAIR REVOLVIN G ARM		399H-2
	H AR & TELECOMUNICATION ROOM DETAILS OF ANTENNA BEARIN G PLATES		399J-0
	UNIT B - ROOF LANDING TO Q-9 MO ULE		399K-0
	UNIT B REINFORCEMENT UNDER DECK CRANE M 6 B		399L-1
	H ANGAR & TELECOMM ROOM ADDITIONAL FRMG FOR AIR CONDITIONIN UNIT		399M-0
	UNIT B REINFORCEMENT UNDER DECK CRANE M6 A SHT. 1 OF 2		399N-2
	UNIT 'B' REINFORCEMENT UNDER DECK CRANE M6A DETAILS SHT. 2 OF 2		399P-3
	IDENTIFICATION PLATES, NORTH & SOUTH FACES		399Q-0
	IDENTIFICATION PLATES, EAST & WEST FACES		399R-0
	QP. IDENTIFICATION PLATE		399S-0
	SUPPORTS FOR FLOODLIGHT FITTINGS		399T-0
	ROPE LADDER SUPPORTS		399W-1
	CAGE DETAILS AROUND SATELLITE ANTENNA		399Y-1
	UNIT 'A' TRUSS 1		305-7
			312
	UNIT B TRUSS(3)		312-6
	HANG R & TELECOMMUNICATIONS ROOM DETAILS & STABBING POINTS.		342-10
	PIPING & INSTRUMENT DIAGRAM G LOODING & GROUTING		401-2
	FLOODING & GROUTING SYSTEM		401P-0
	FLOODING & GROUTING SYSTEM PLAN AT (+)6100		402-5
	FLOODING & GROUTING SYSTEM. PLAN AT EL(+)6100		402P-0
	FLOODING & GROUTING SYSTEM PIPING AT EL (+) &L//		403-5
	LOODING & GROUTING DETAILS		403P-0
	FLOODING & GROUTING SYSTEM DOUBLER DETAILS		404-3
	FLOODING & GROUTING TERMINATION		404P-0
	G LOODING & GROUTIN G SYSTEM INSIDE LEGS A1 & A2		405-4
	FLOODING & GROUTING SYSTEM INSIDE LEGS B1 & B2		406-6
	FLOODING & GROUTING SYSTEM-ARRGT. OF HYD. LINES		407-1
	FLOODING & GROUTING SYSTEM LEVEL INDICATORS		408-1
	FLOODIN G VALVES FOR LE GS B1 & B2		409-0

ANM: TEGNINGENE I KASSETTEN ER FORSYNT MED NUMMER TILSVARENDE DE OVERANFØRTE.

I.O.D.

AV: 57 STÅL

L. TEGN. KASSET ARK.NR. 45 PROSJEKT NR.: 60 14 36 OP ELN 2193

GER: BYGGE-/FABR. NR.:

GESTED: FELT: FRIGG

UKTUR: 4 LEG TEMPLATE QUARTERS PLATF. EIER: ELF NORGE A/S

	TEGN.	APPR. DATO	ANM.
	(M41 BARGE) JACKET TIEDOWN DETAILS		905-2
	(TITAN 7 BARGE) PILE LOADOUT & TIEDOWN GENERAL ARRGT.		906-1
	PILE TIEDOWN DETAILS. (TITAN 7 BARGE).		907-1
	(TITAN 7 BARGE) INSERT PILES LOADOUT & TIEDOWN DETAILS.		908-1
	INSERT PILE TIEDOWN DETAILS (TITAN 7 BARGE9		909-1
	SUPPORT FRAME LOADOUT ARRANGEMENT ON SHETLAND 1		910-1
	SUPPORT FRAME TIEDOWN DETAILS FOR QP ON SHETLAND 1		911-0
	SKID SHOE TIEDOWN DETAILS ON SHETLAND 1		912-0
	SUPPORT FRAME LOADOUT WELDING TO SKID SHOE		913-0
	UNIT A SKIDDING AND TIEDOWN ARRGT.		914-2
	UNIT 'A' SKIDDING ARRGT DETAILS ON BARGE BRHM. 2 SHT 1 OF 3		915-0
	UNIT 'A' SKIDDING ARRGT DETAILS ON BARGE BRHM 2. SHT 2 OF 3		916-0
	UNIT 'A' SKIDDING ARRGT DETAILS ON BARGE BRHM 2. SHT 3 OF 3		917-0
	NUIT 'A' & HELIDECK TIE DOWNS ON BARGE BRHM 2.		918-3
	UNIT 'A' & HELIDECK LOCNS ON BARGE BRHM 2		919-0
	UNIT 'B' SKIDDING & TIEDOWN ARRANGEMENT		928-1
	UNIT 'B' SKIDDING ARRANGEMENT DETAILS ON MORELAND 5		929-1
	M41 JACKET LAUNCH ARRANGEMENT		930-0
	STIFFENING ON HELIDECK FOR LOAD-OUT CONDITION		938-0
	UNIT 'B' TIE DOWN ON MORELAND 5		939-0
	WINCH PLATFORM AND WALKWAY		970-0
	WINCH PLATFORM & WALKWAY DETAILS		971-0
	LEVELLING STOOLS FOR MODULES A & B		973-0
	INSTALLATION OF LEVELLING STOOLS		974-0
	UPPER DECK WALKWAY BRIDGE DETAILS		975-1
	LOWER DECK BRIDGE DETAIL		976-2
	HANDRIAL CONNECTION DETAILS.		979-0
	CONTROL PANEL GUARD		983-0
	BREAKWATER & PORTAKABIN SUPPORTS DETS. ON M41 BARGE		984-0
	M41 BARGE JKT. GENERAL ARRANGEMENT		904-3
	SUPPORT FRAME PIPING FOR INSTALLATION MODULES		985-0
	SUPPORT FRAME PIPING DETAILS.		986-0
	SKID GUIDE FOR DRILL & STIFF LEG MODULE		987-0
	M41 JACKET LAUNCH DETAILS		988-2
L	PLANS ON PILE INSTALLATION MODULES		989-1

	TEGNING	APPR. DATO	ANM.
	STABBING GUIDES FOR DRILLING & STIFF LEG MODULES		990-5
	DETAILS OF MODULE PLACEMENT GUIDES ON STIFF LEG MODULE		991-0
	TIE DOWN PLATES STIFF LEG MODULE		992-0
	STABBING GUIDES - UNIT 'A' & UNIT 'B'		993-2
	ANCHORAGE DETS FOR DRILLING & STIFFLEG MODLS		994-1
	MODIFICATIONS TOUNIT 'B FOR UNIT 'A' STABBING GUIDES		997-0
	LINK PLATES		998-3
	MODIFICATION & REFITTING OF BRIDGE LANDING AREA		999-0
	FALSE ROTARY TABLE GENERAL ARRANGEMENT OF PILE GUIDES		9001-0
	FALSE ROTARY TABLE EXTENSION FRAMING PLAN - SHT 1 OF 2		9002-0
	FALSE ROTARY TABLE EXTENSION FRAMING PLAN - SHT 2 OF 2		9003-0
	FALSE ROTAy PILE FOLLOWER GUIDE FRAME		9004-0
	FALSE ROTARY TABLE PILE FOLLOWER GUIDE DETAILS SHT 1 OF 3		9005-0
	FALSE ROTARY TABLE PILE FOLLOWER GUIDE - DETAILS SHT 2 OF 3		9006-0
	FALSE ROTARY TABLE PILE FOLLOWER GUIDE DETAILS - SHT 3 OF 3		9007-0
	FALSE ROTARY TABLE - CAGED LADDER		9008-0
	FALSE ROTARY TABLE ROLLER GUIDE SUPPORT FRAME		9009-0
	FALSE ROTARY ROLLER GUIDE DETAILS SHT 1 OF 2		9010-0
	HOLLER GUIDE DETAILS SHT 2 OF 2		9011-0
	FALSE ROTARY TABLE INSERT PILE GUIDES		9012-0
	ADDITIONAL STIFFING REQ'D FOR UNIT A - LOWER FLOOR		9030-0
	ADDITIONAL STIFF'S REQD. UNIT B' LOWER FLOOR		9031-0
	MODIFICATION TO PADEYES & FAIRLEADS		9034-0
	MODIFICATION TO STABBING GUIDES AND WALKWAYS FOR INSTALLATION OF		9038-0
	SKID FOR AIR CONDENSERS ON ROOF-UNIT B		9092-0

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1.4.3. Design reports

Received from McDermott-Hudson

Elf Norge A/S Norway Frigg Field North Sea
Quarters Platform

File:

1. Pile Installation Modules - On Support Frame
   Volume 1 General July 1975
2. Design Calculations
   Volume 1A Jacket, Support Frame and Piles
   March 1974
3. Design Calculations
   Volume 1B Jacket, Support Frame and Piles
   March 1974
4. Design Calculations
   Volume 1B, Addendum 1 Jacket, Support Frame and Piles launch analysis
5. Check Calculations with Module, Antennae Towers Volume 1C, Jacket, Support Frame and Piles September 1974.
6. Design Calculations
   Volume 1C, Addendum 1 Launch Joint Check May 1975
7. Design Calculations
   Volume 2 Quarters Bridge
   March 1974
8. Design Calculations.
   Volume 3 Natural Frequency
   March 1974
9. Design Calculations
   Volume 4 Jacket Installation - Up ending
   April 1974
10. Design Calculations (2 copies)
    Volume 5 Quarters Modules - Floors and Helideck
    March 1974

11. Design Calculations
Volume 5A, 1 Quarters Modules - Hangar - Revised
June 1975

12. Design Calculations
Volume 5A, 2 Miscellaneous Additional Calculations
Quarters Modules
June 1975

13. Design Calculations (3copies)
Volume 6 Quarters Modules
Truss Designs Unit A
March 1974

14. Design Calculations
Addendum to Volume 6 Quarters Modules
Truss line 1 Unit A
June 1975

15. Design Calculations (3copies)
Volume 7 Quarters Modules
Truss lines A and B Unit B
March 1974

16. Design Calculations
Addendum to Volume 7 Quarters Modules
Truss Line 4 Unit B
June 1975

17. Design Calculations (2copies)
Volume 8 Quarters Modules
Truss Line 4 Unit B
March 1974

18. Design Calculations
Addendum to Volume 8 Quarters Modules
Truss Line B Unit B
June 1975

19. Design Calculations (2copies)
Volume 9 Quarters Modules
Truss Line 3 Unit B
March 1974

20. Design Calculations.
Volume 10 Quarters Modules; Battery room etc.
June 1976

21. Design Calculations.
Volume 11, 1 Quarters Modules
Unit B Lift Analysis
July 1976

22. Pile Installation Modules
Volume 11, 2 Computer Printout
July 1975

23. Design Calculations. (2copies)
Volume 12 Quarters Modules
Unit A Lift Analysis (Part 1)
August 1976.

24. Design Calculations (2copies)
Volume 13 Quarters Modules
Unit A Lift Analysis (Part 2)
August 1976

25. Proposed Microwave Tower (2copies)
Design Note Dynamic Analysus
27.10.75

26. Proposed Microwave Tower
Design Note
January 1975

27. Design Calculations
Buoyancy Tanks Revision 1
April 1975

28. Design Calculations
Buoyancy Tanks Revision 2
May 1975

29. Design Calculations
Buoyancy Tanks Revision 3
June 1975

30. Supplement to Design Calculations (2 copies)
Stiffened and Unstiffened Tubulars
Subjected to Hydrostatic Pressure
December 1974

31. Jacket, Support Frame and Module LIfting Eyes
May 1975

32. Wave Slamming Study
January 1975

33. Skidding Stiffleg Module Across Support Frame
July 1976

34. Flotation Study
Febrauary 1975

35. Model Experiments on Quarters Platform Jacket
April 1975

36. Additional Launching Facilities
15.6.75

37. Tender Documents for Fabrication of Frigg QP.
Volume IV
Drawings and Bill og Materials
November 1973

38. Report on the Towing Safety of the Barge "BRHM 2" during Loadout of Quarters Modules from Bordeaux to Frigg Field.
11th March 1976

39. Computer Output
Volume 1 Jacket Stress Run 5
Loading 1 - 9
4.2.74

40. Computer Output
Jacket Stress Run 6
3.9.74

41. Computer Output
Jacket Stress Run 6&5.
Member check and Joint check
4.2.74.

42. Computer Output
Jacket Stress Run 6&5
Member check abd Joint check
3.9.74.

43. Computer Output
Volume 3 Launch Analysis
6.2.74

44. Drawings in Reduced Format.

45. QP/TP-1 Bridge
Addendum Calculations for final length of bridge
23.9.76

46. Microwave Tower
Mill tests and chemical analysis certificates
18.3.77

DESIGN-EVALUATION-FILE: PR. 9.11.77:

47. Calculations on Additional Storage Area in Support Frame

48. Calculations on Storage in Support Frame
9.2.77.

49. Recalculation, Microwave Tower
23.12.75

50. Calculations governing Bridge Landing
23.9.76.

51. Calculations governing Unit B Truss 3
7.9.74.

52. Documentation of tests concerning Grouting of Primary Piles
25.6.75

Received from UIE.

1. Interference Des Soudures
   13.1.75
2. Reinforcement Des Noudes
   27.6.75.

Received from Brown and Root.

1. Procedures for Installation of Insert Piles, Platform QP, Frigg field development
   23.5.75.

Received from Precision Metal Spinnings LTD.

1. Axial & Transverse forces on 12 ft. dia. Focal Plane Paraboloid. (Antennae).
   7.10.74.

Received from Bureau Commun D'etudes Marines.

1. Etude Dynamique de la Plate-Forme QP Octobre 1974 (Fatigue calculations on QP).

1.4.4. Design Codes

The following codes were used as a basis for the design of the platform:

a) Det norske Veritas
Rules for the Design, Construction and Inspection of Fixed Offshore Structures, 1974.

b) American Petroleum Institute - API RP2A
API Recommended Practise for Planning Designing and Constructing Fixed Offshore Platforms.
Sixth edition 1975 and seventh edition 1976.

c) American Institute of Steel Construction
Manual of Steel Construction
Seventh edition, June 1973.

d) American Welding Society (AWS D1.1-72)
Structural Welding Code
September 15, 1972 with revision 1-73 and 2-74.

e) Det norske Veritas
Technical Notes for Fixed Offshore Structures.

It should be noted that the 1/3 increase in allowable stresses allowed by the above documents was not adopted for the design of this platform. The structural design was thus based on basic allowable stresses.

1.4.5 Environmental Condition

Environmental Criteria for Inservice Design Condition.	Extreme	Operating
Return Period	100 years	
Design waterdepth (MLW)	104,0 m	104,0 m
Tide	1,6 m	
Design waveheight:	29,0 m	
Design wave period	15,0 sec.	
Design wind speed up to +10m:		
1 min. sustained	50,0m/sec.	
3 sec. gust	62,5m/sec.	
Design current: at surface	1,35m/sec.	
30 m above seabed	0,70m/sec.	
at seabed	0,30m/sec.	
Drag coefficeint, C_D: Diam.$\leq$ 60 inch.	0,70	
: Diam.$\geq$ 60 inch.	0,75	
Inertia coefficient, C_M: Diam.$\leq$ 60 inch.	1,70	
Diam.$\geq$ 60 inch.	2,00	
Marine growth elevation: +3,5m to -1,5 m	6,5 cm	
-1,5m to -8,5 m	10,0 cm	
-8,5m to -13 m	6,5 cm	
Temperatures; Air maximum	+ 32°C	
Air minimum	- 15°C	
Water maximum	+ 1°C	+ 17°C
Water minimum	+ 17°C	+ 1°C

1.5 Jacket evaluation

1.5.1 General

McD-H have performed the calculations for 9 different loading cases.
First the forces were calculated for all 9 cases, thereafter the stresses were calculated for loadings 6, 7, 8 and 9.
These calculations can be found in Files 39, 40, 41, 42 and 43.

Loading	1	Gravity only	
Loading	2		Wind + Wave 0^{o}
Loading	3		Wind + Wave 45^{o}
Loading	4		Wind + Wave 90^{o}
Loading	5		Wind + Wave 315^{o}
Loading	6	Gravity +	Wind + Wave 0^{o}
Loading	7	Gravity +	Wind + Wave 45^{o}
Loading	8	Gravity +	Wind + Wave 90^{o}
Loading	9	Gravity +	Wind + Wave 315^{o}

The stresses in the jacket elements and in the nodes are caused by wave, current, wind and deck-load forces.
The deck-load forces are composed of dead weights and live loads.
The wave, current and windforces have been evaluated for 0^{o}, 45^{o}, 90^{o} and 315^{o} by McDermott-Hudson.

Calculations have been performed using the geometric jacket model described under "Geometry Simulation" in a 3 dimensional Computer-program. (STRUDL).

Previous comparisons between the wave load program used by McDermott-Hudson on the VERITAS TOWER NO. 1 and DnV's own program have shown reasonable good agreement.
Therefore only spot checks on the wave load calculations performed by McDermott-Hudson have been carried out.

Diagonals, verticals and "inclined" diagonals (see Platform Description) have been checked at all levels.
The results indicate the stress-levels to be acceptable for all cases.

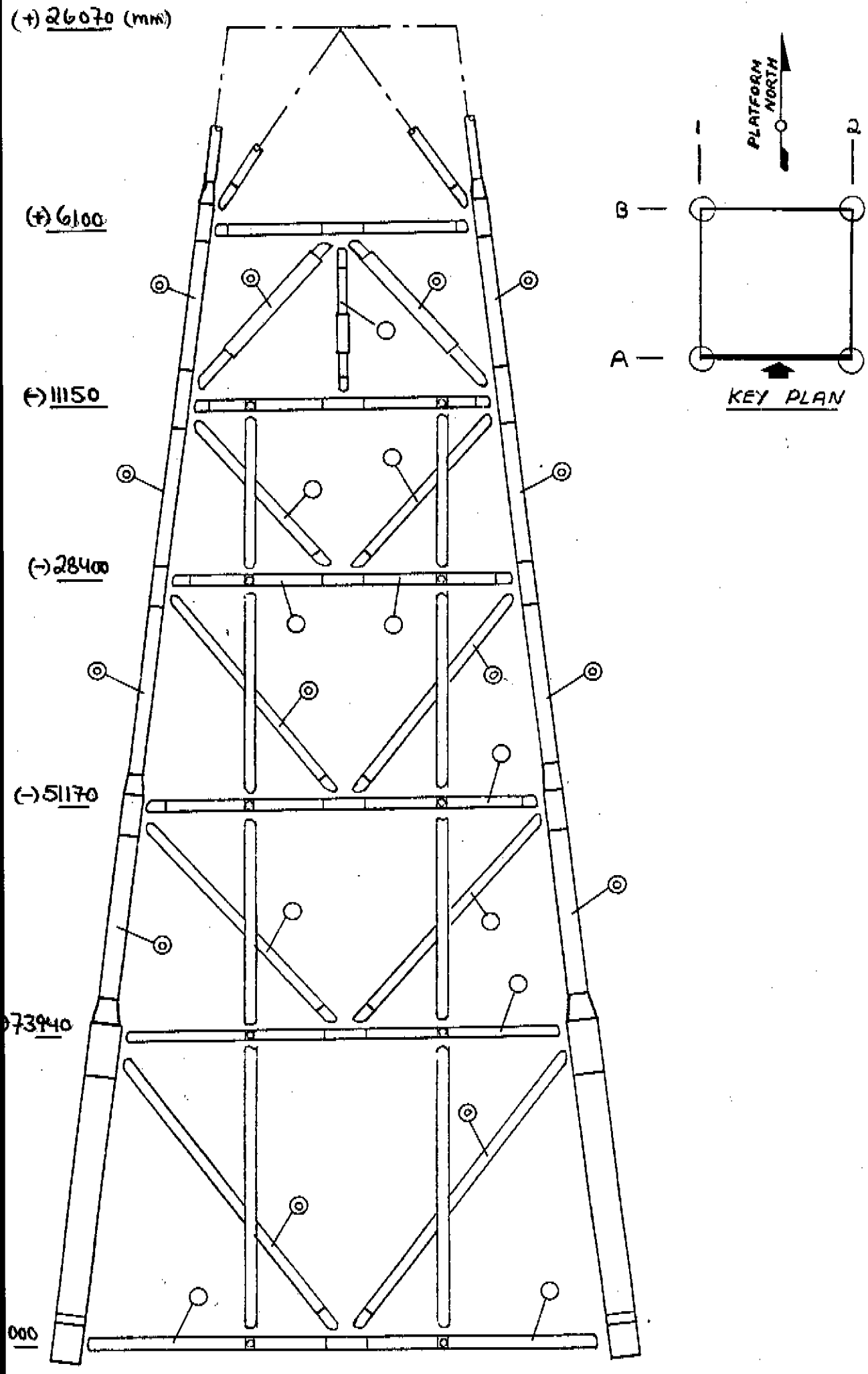
1.5.2 MEMBER BUCKLING

The following figures define the most critical member with respect to overall buckling ie.not buckling or collapse due to external water pressure.

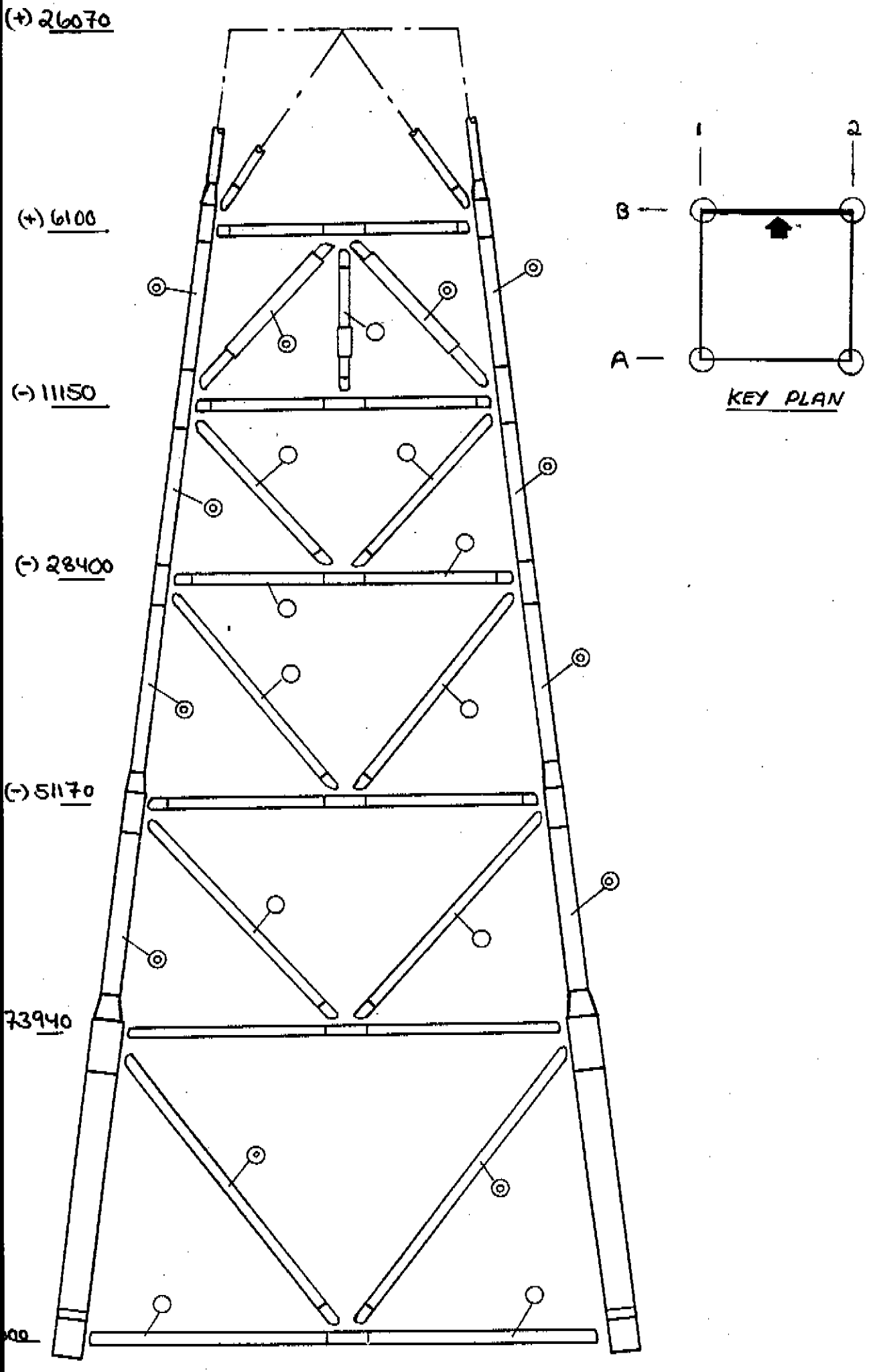
The criteria of AISC "Manual of Steel Construction" has been used as a basis for the following figures; more specifically the formulae 1·6 - 1A has been used.

Members marked with a double cirle (◎) have a buckling ratio equal to or greater than 0.9 in the extreme environmental condition.

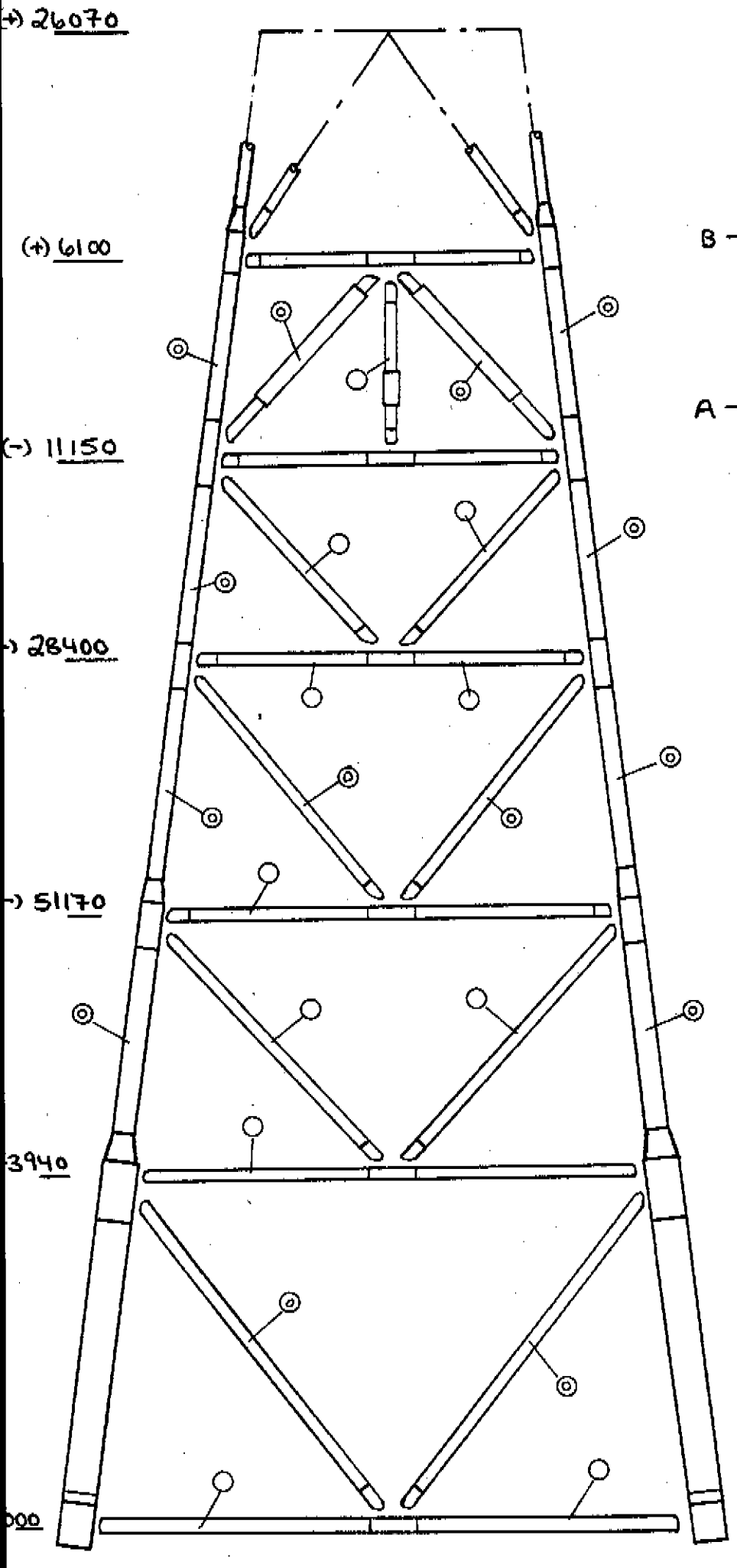
Members marked with a single circle (○) have a buckling ratio between 0.7 and 0.9 in the extreme environmental condition.

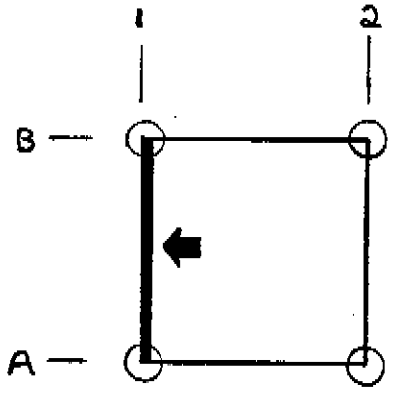

(+) 26070 (mm)
(+) 6100
(-) 11150
(-) 28400
(-) 51170
73940
000
PLATFORM NORTH
1
2
B
A
KEY PLAN

FACE A



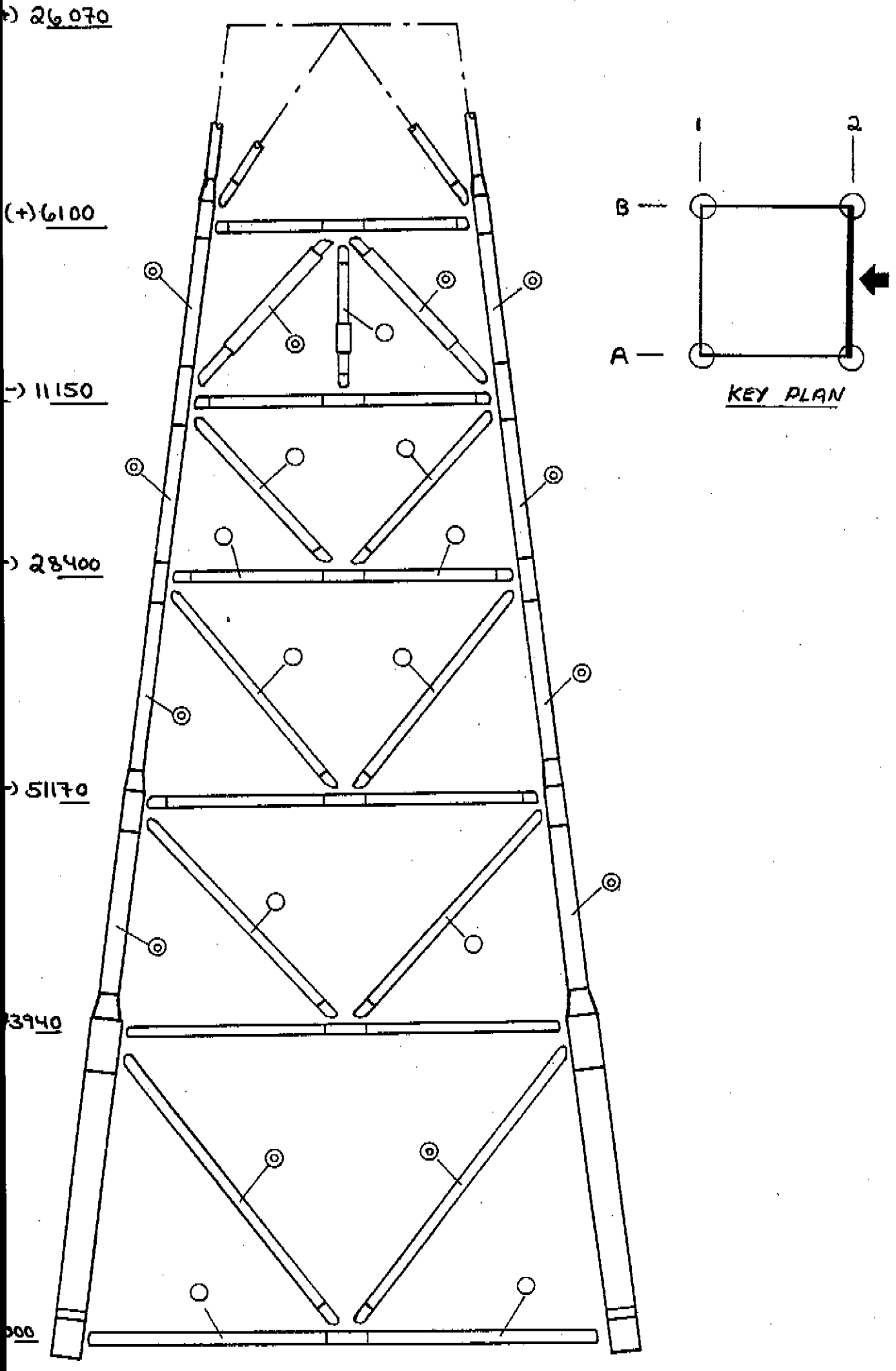
FACE B



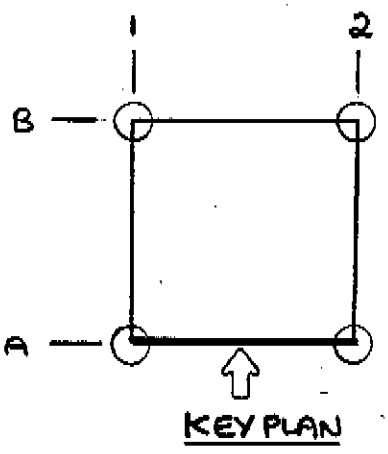


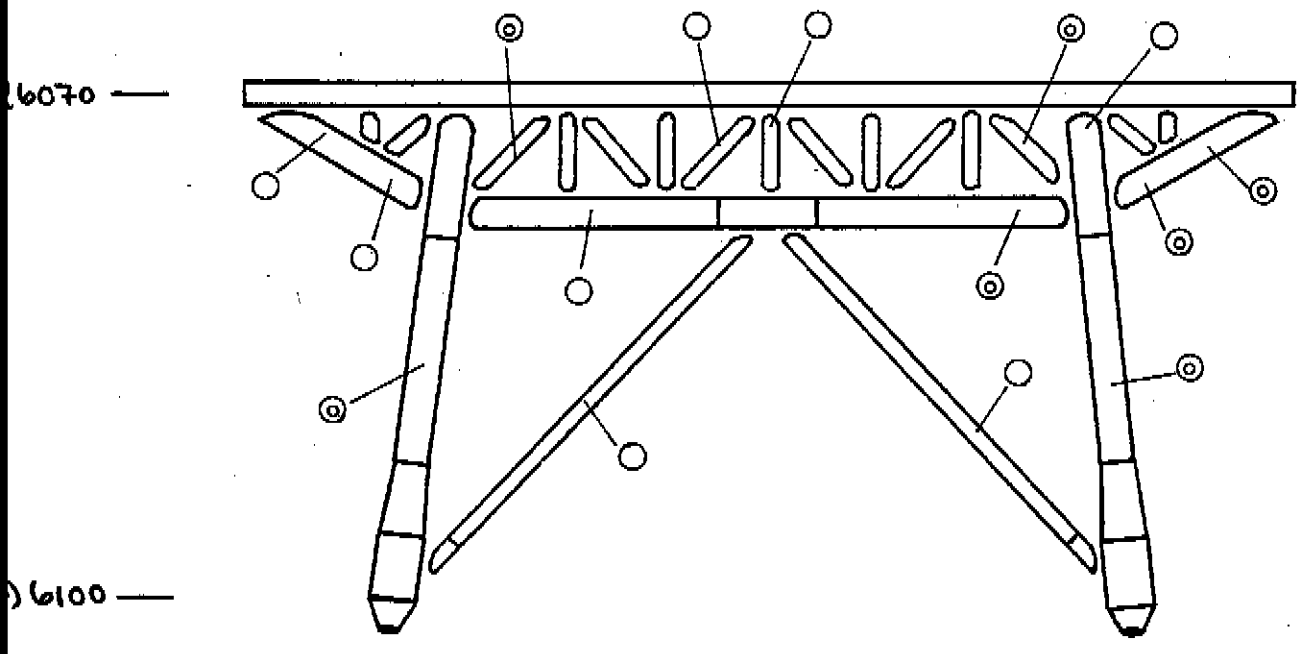
KEY PLAN

FACE 1

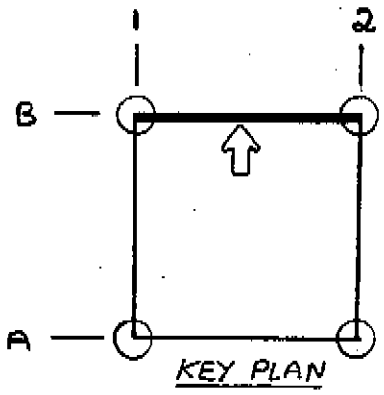


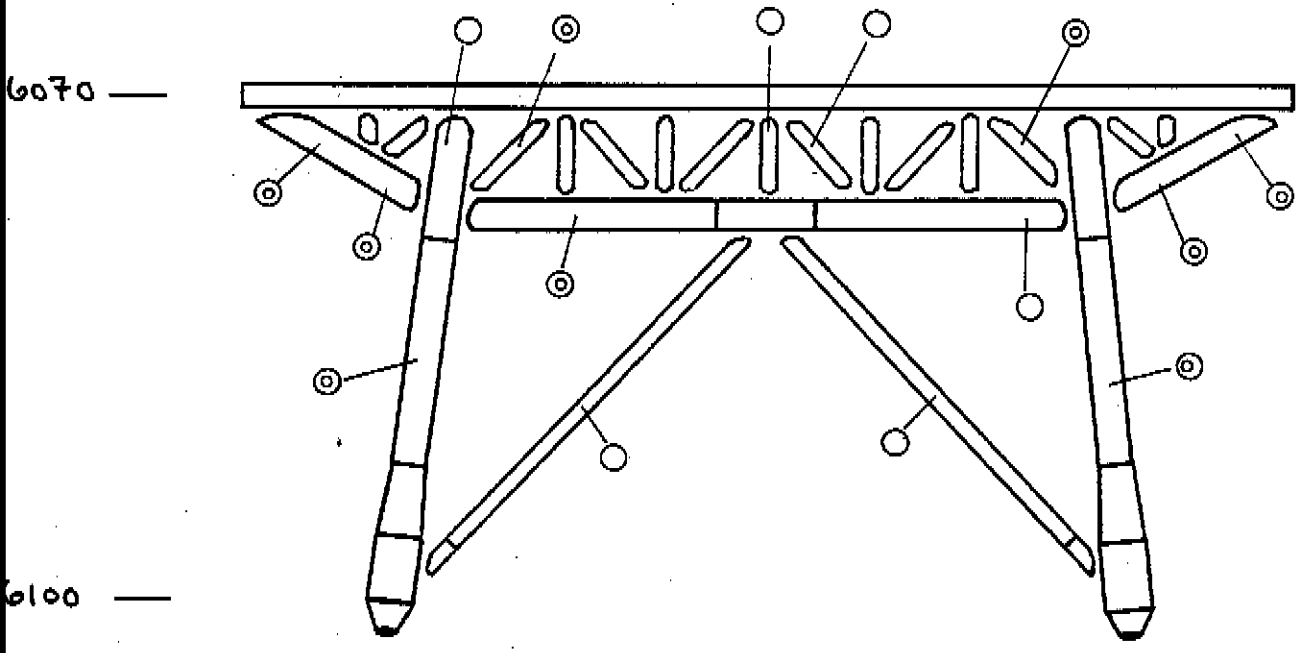
FACE 2



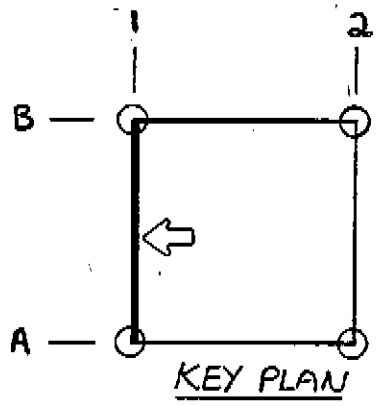


FACE A

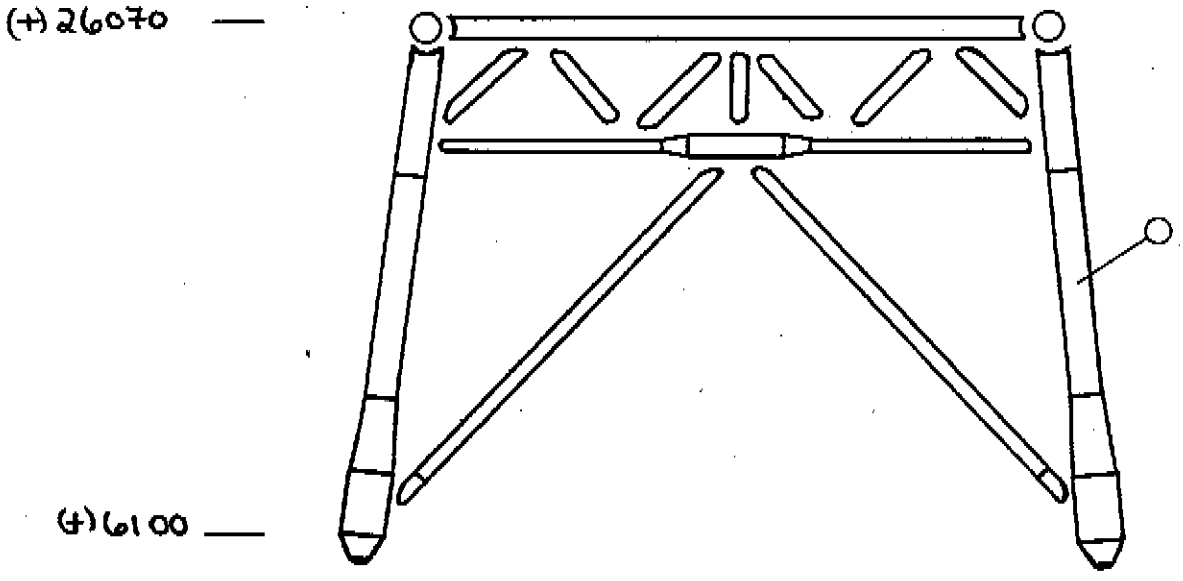




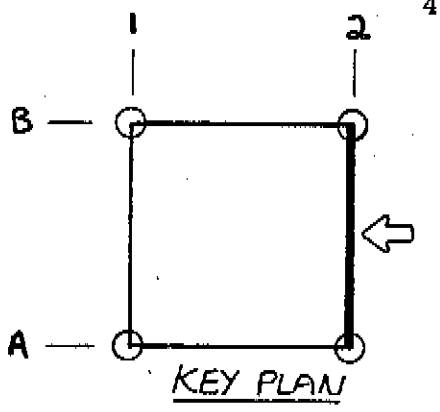
FACE B

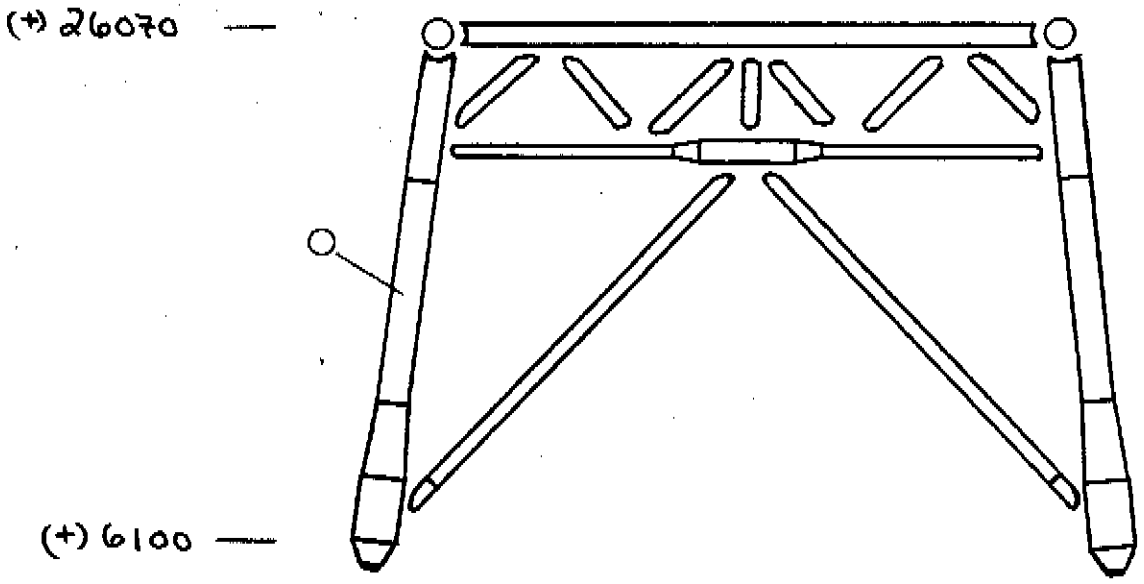


KEY PLAN

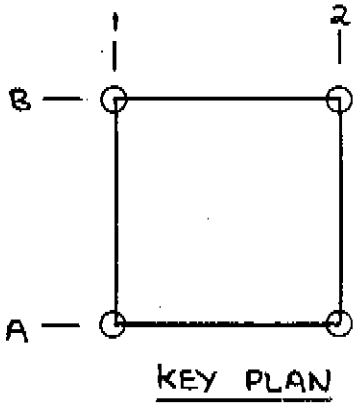


FACE 1

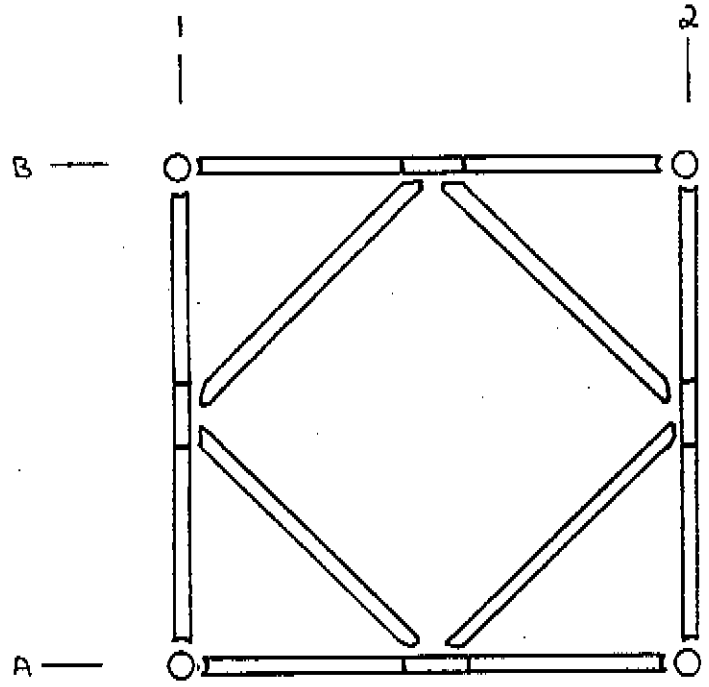




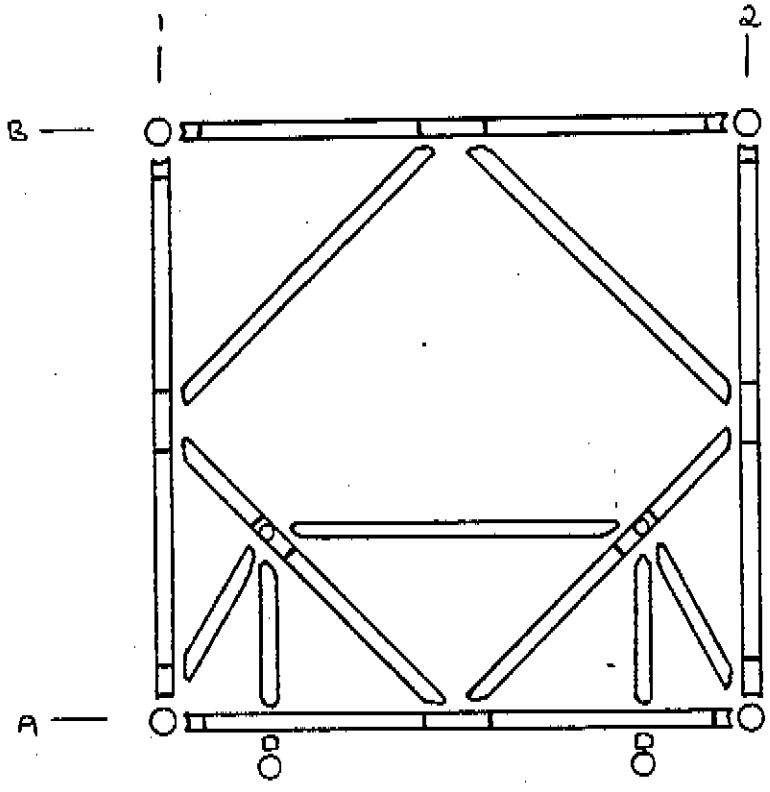
FACE 2



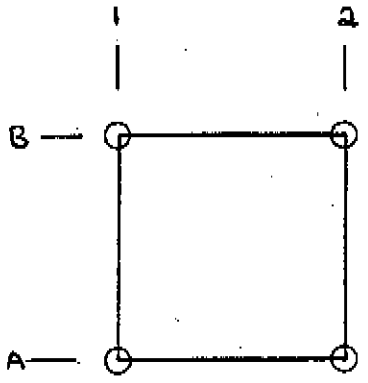
KEY PLAN



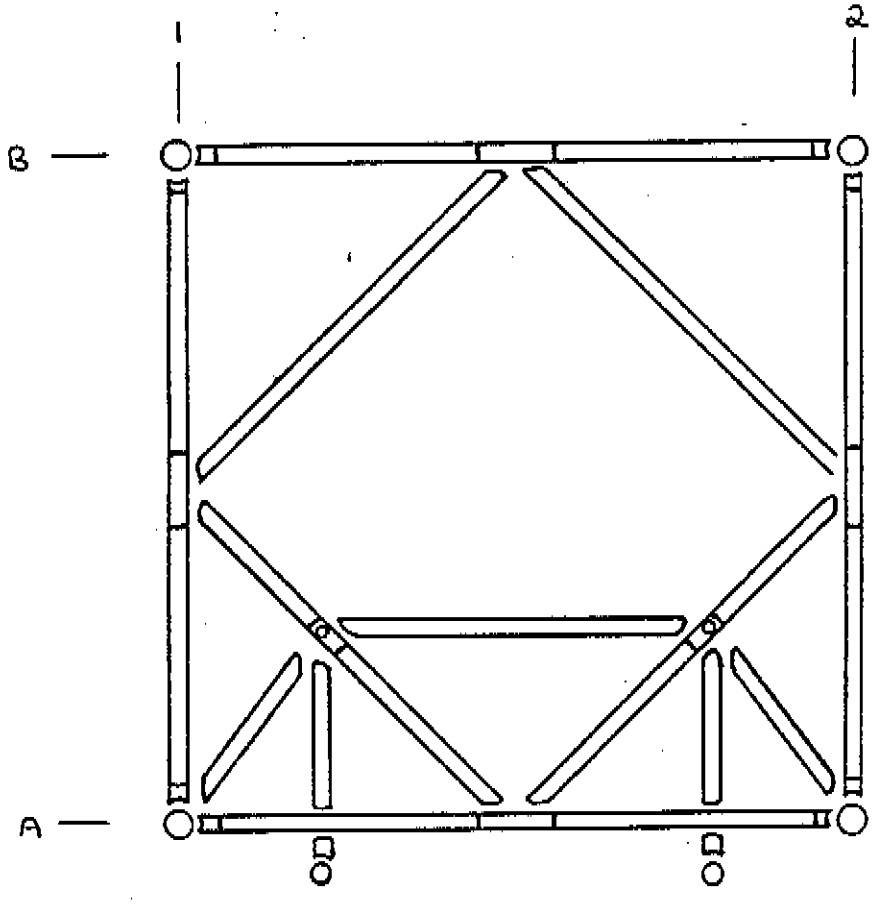
ELEVATION (+)6100



ELEVATION (-)11150



KEY PLAN



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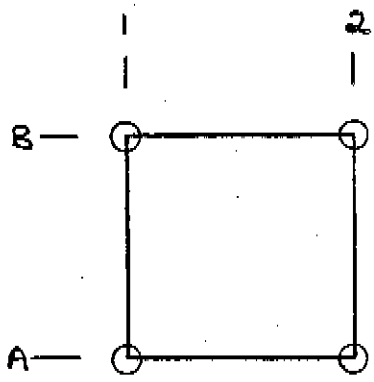
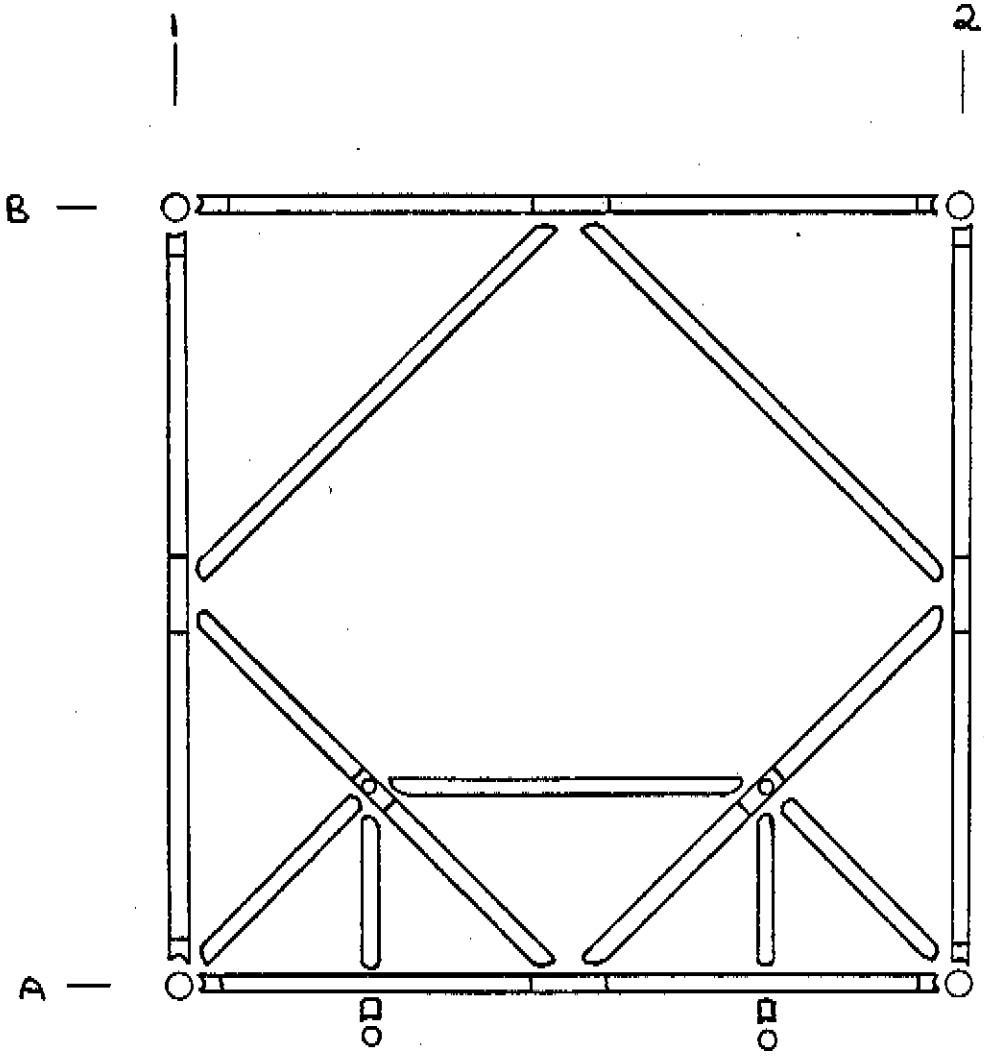
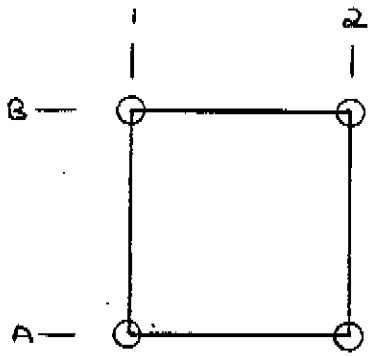


KEY PLAN



ELEVATION (-)51170



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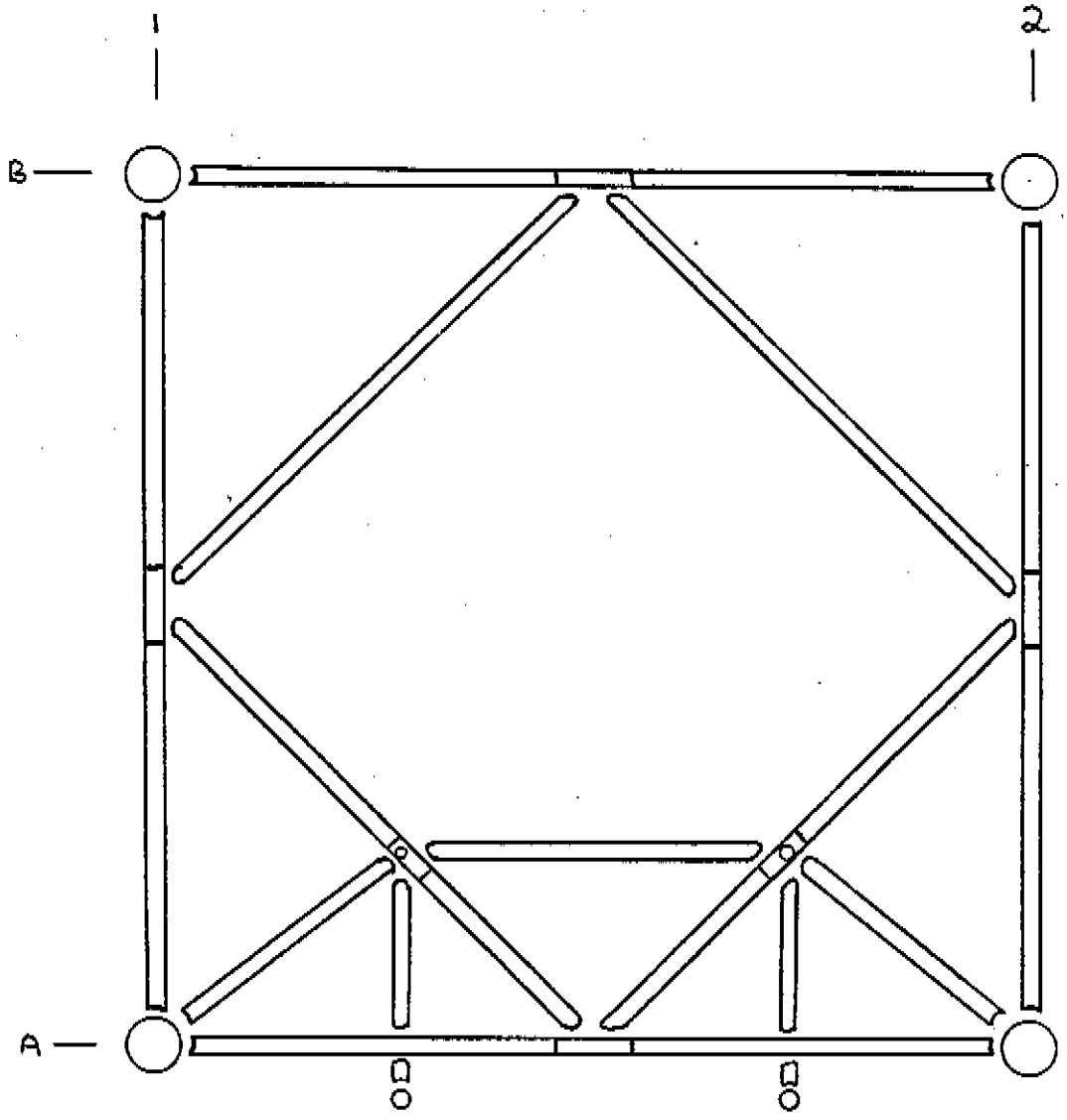
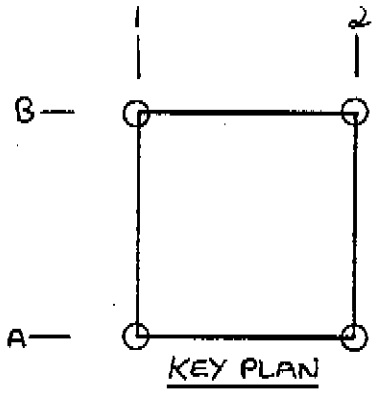
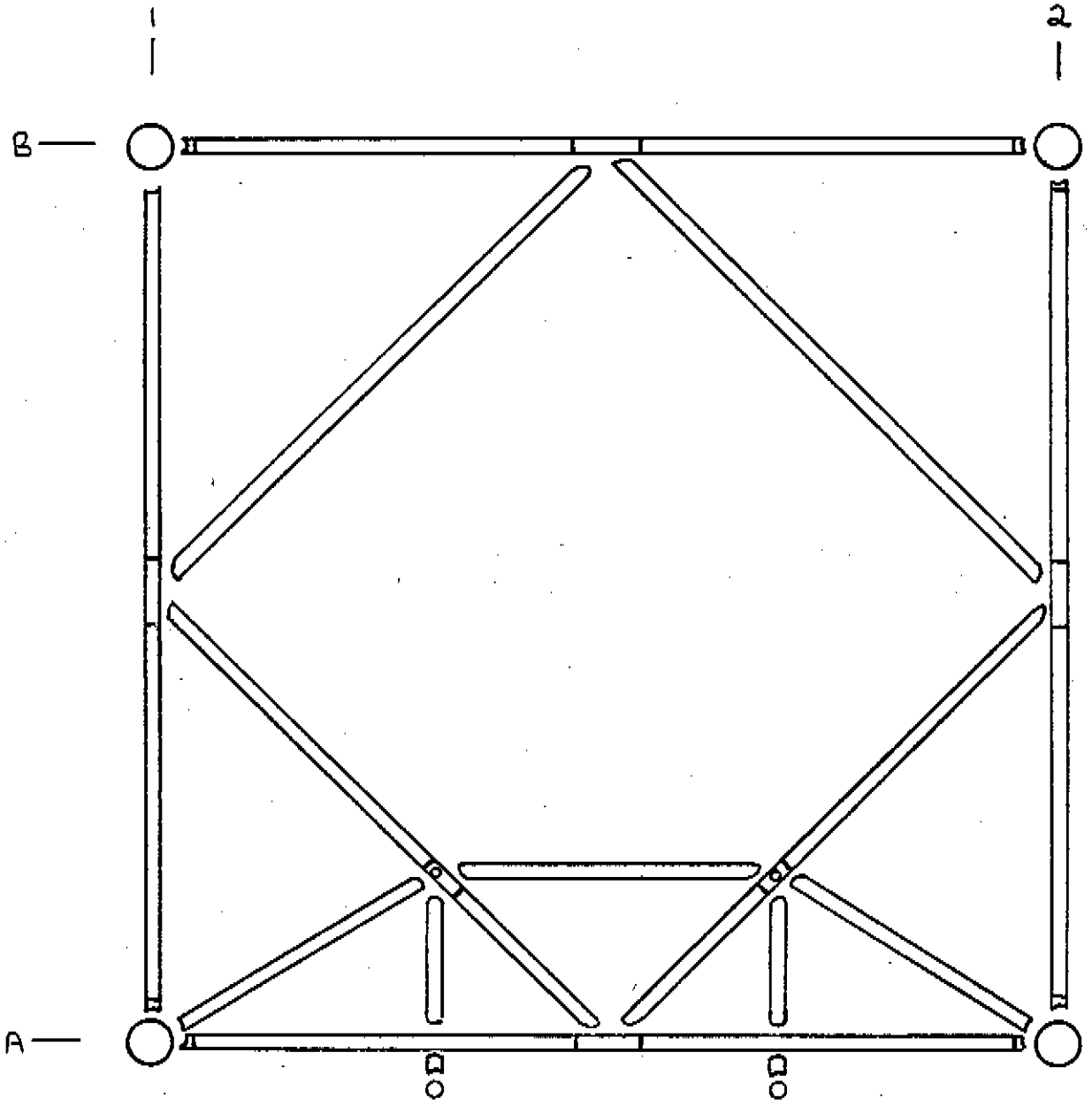


ELEVATION (-)73940



KEY PLAN



ELEVATION (-)104000

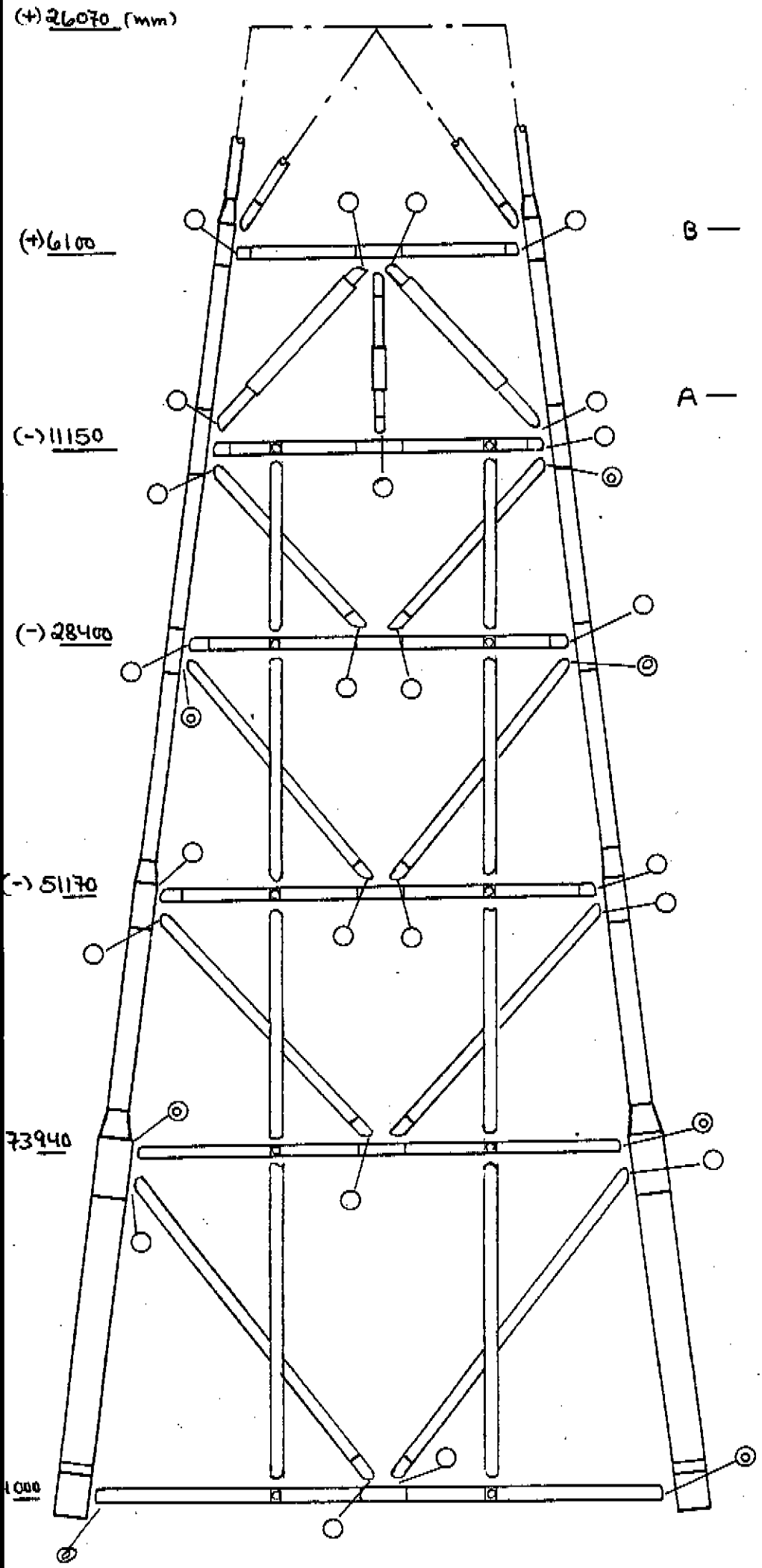
1.5.3 MEMBER END - STATIC STRESS

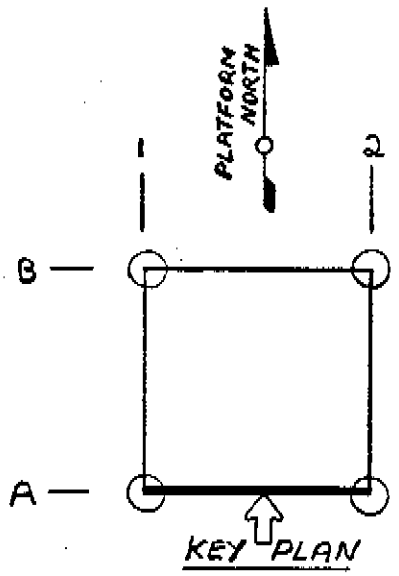
The following figures describe the most heavily stressed member ends and member sections in the structure. It must be noted this marking refers to nominal static axial-plus bending stress only. Thus no attempt has been made to show hot-spot stresses in the following figures. The corner legs are generally highly stressed, and particular attention should be paid to the transition welds between circular and cylindrical sections.

These parts of the legs are generally stiffened by circular (ring) as well as longitudinal (parallell to the axis of the member) stiffeners.

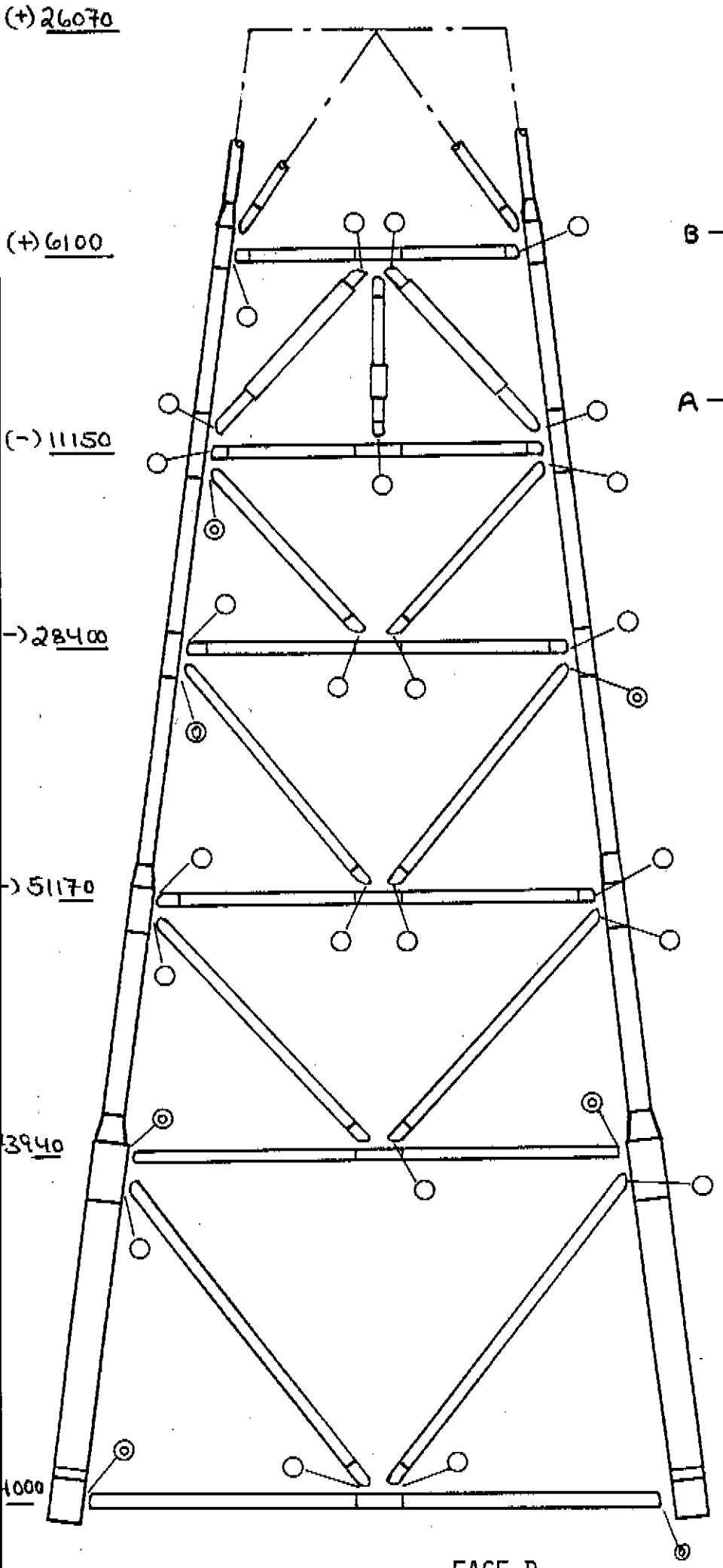
The areas of member ends marked with a double circle (◎) have stresses equal to or above 20 ksi in the extreme condition.

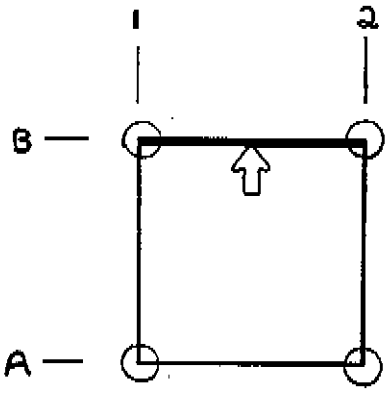
The areas of member ends with a single circle (○) have stresses between 16 and 20 ksi in the extreme condition.


(+) 26070 (mm)
(+) 6100
(-) 11150
(-) 28400
(-) 51170
73940
1000


PLATFORM NORTH
1
2
B
A
KEY PLAN

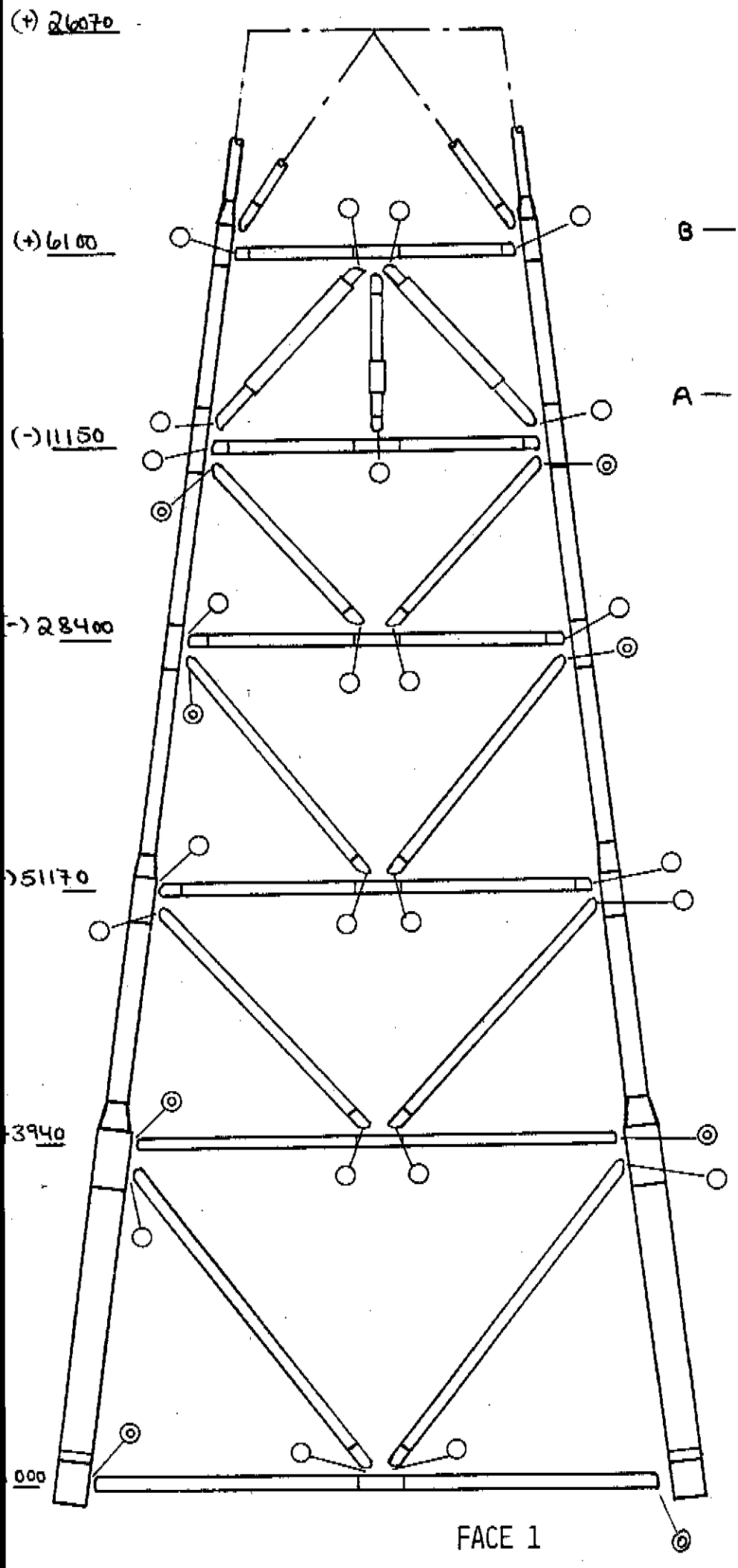
FACE A

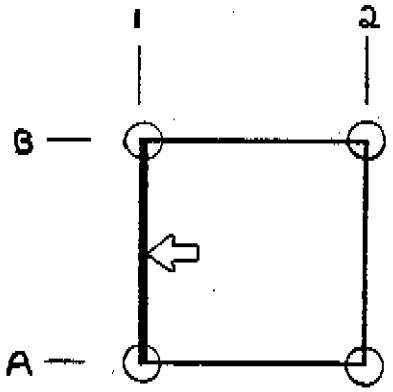




KEY PLAN

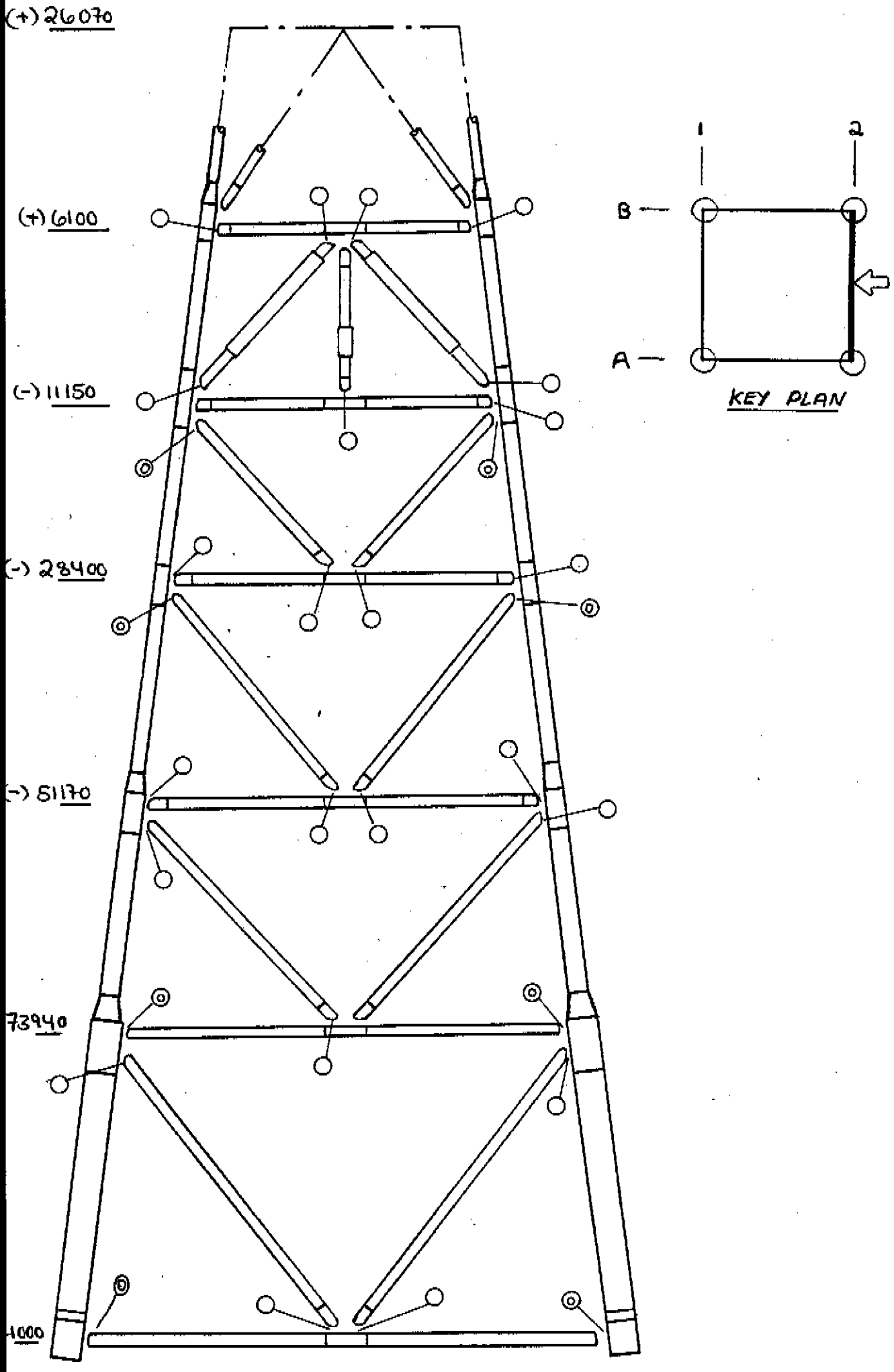
FACE B



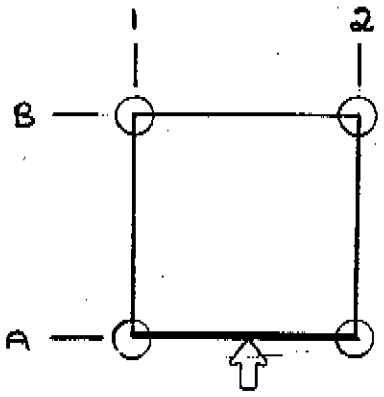


KEY PLAN

FACE 1



FACE 2



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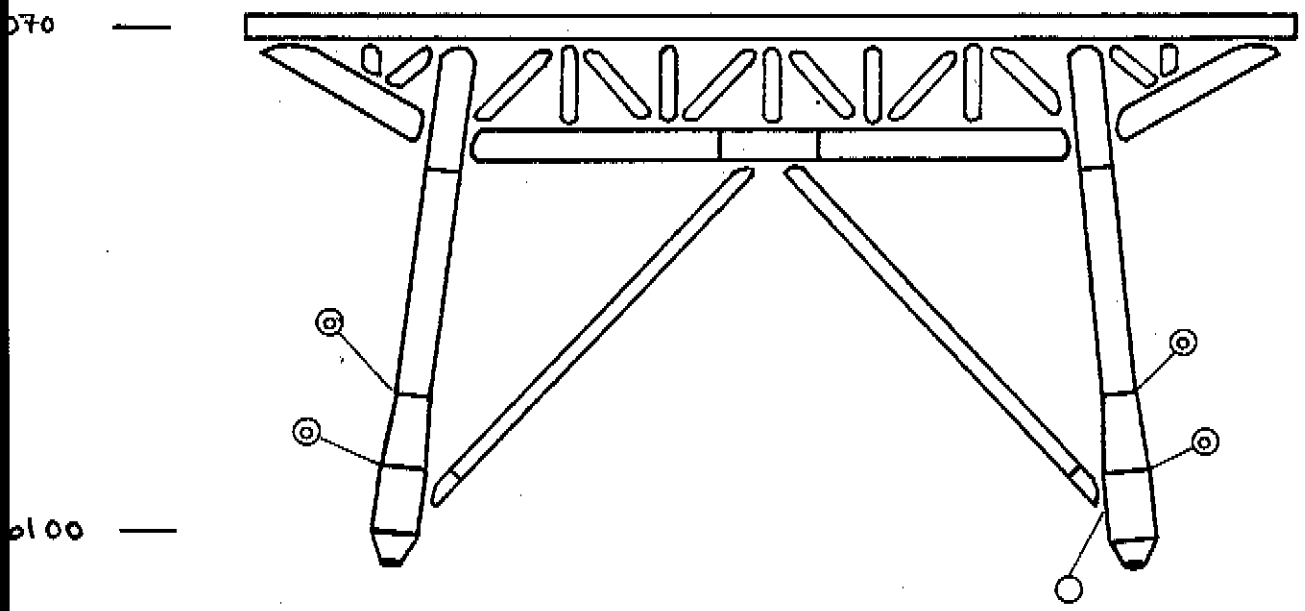
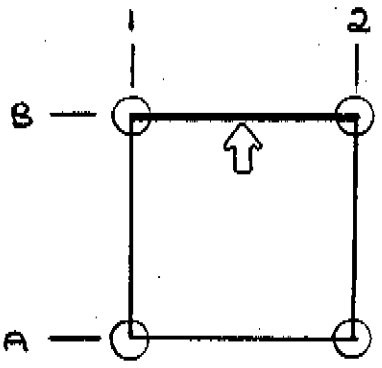
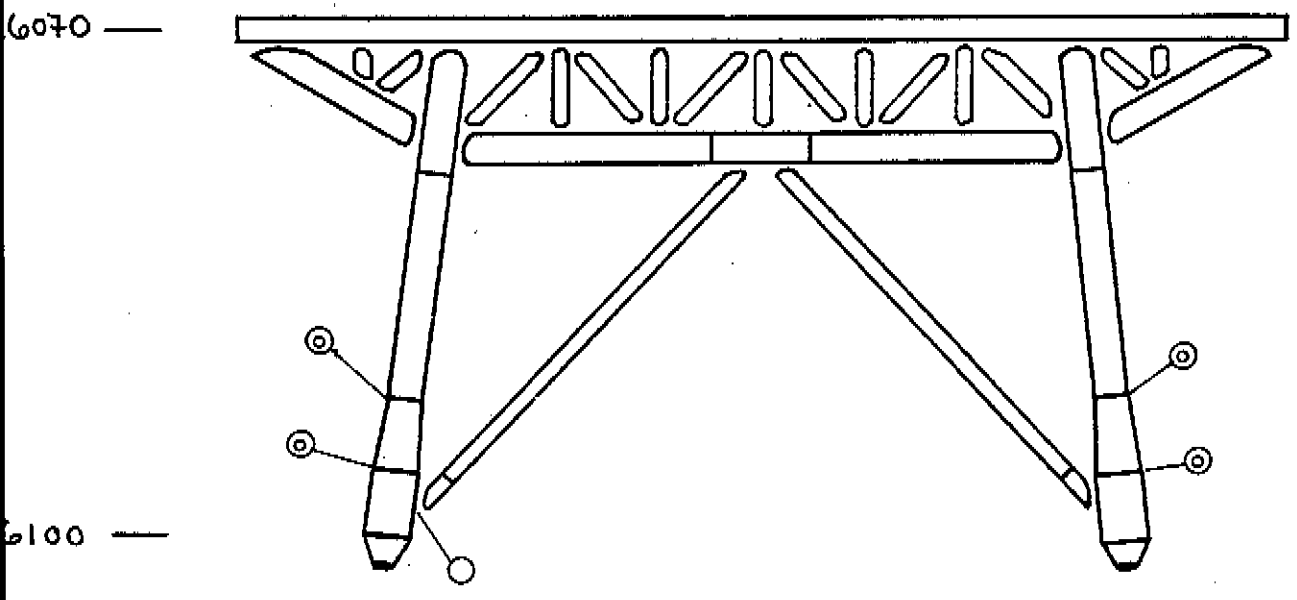


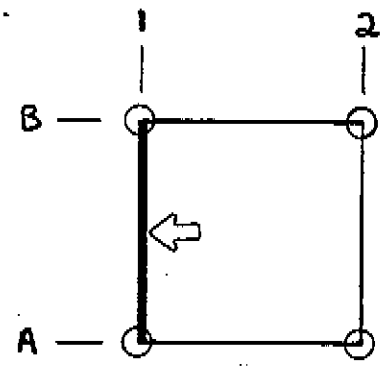
FACE A



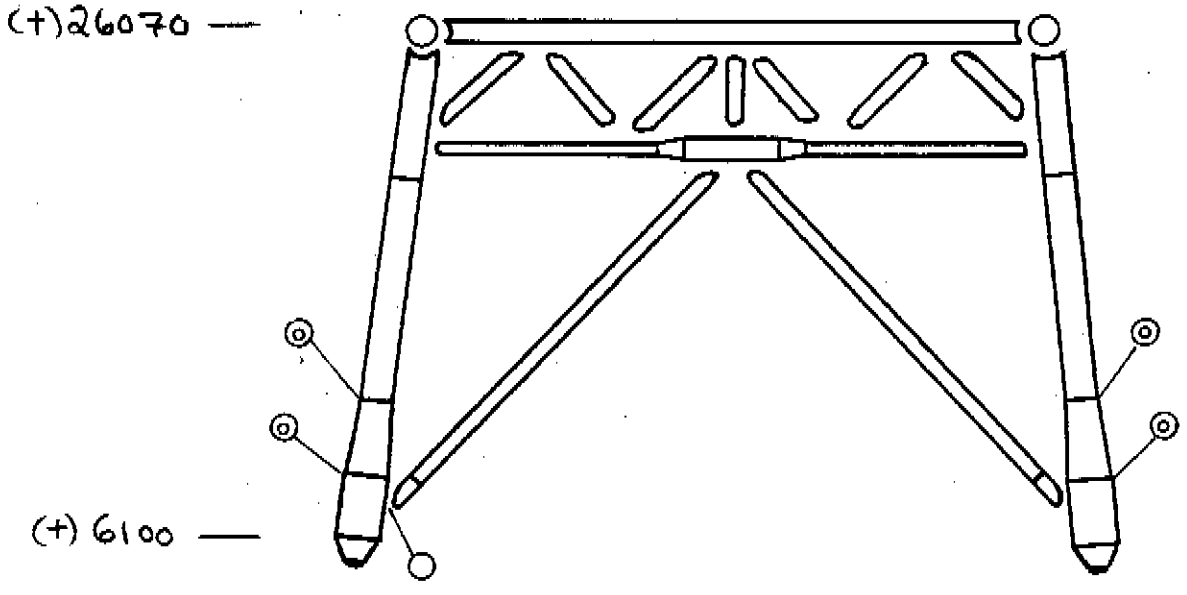
KEY PLAN



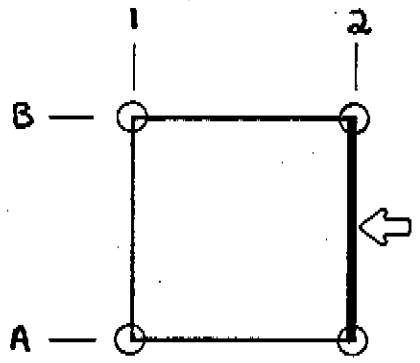
FACE B



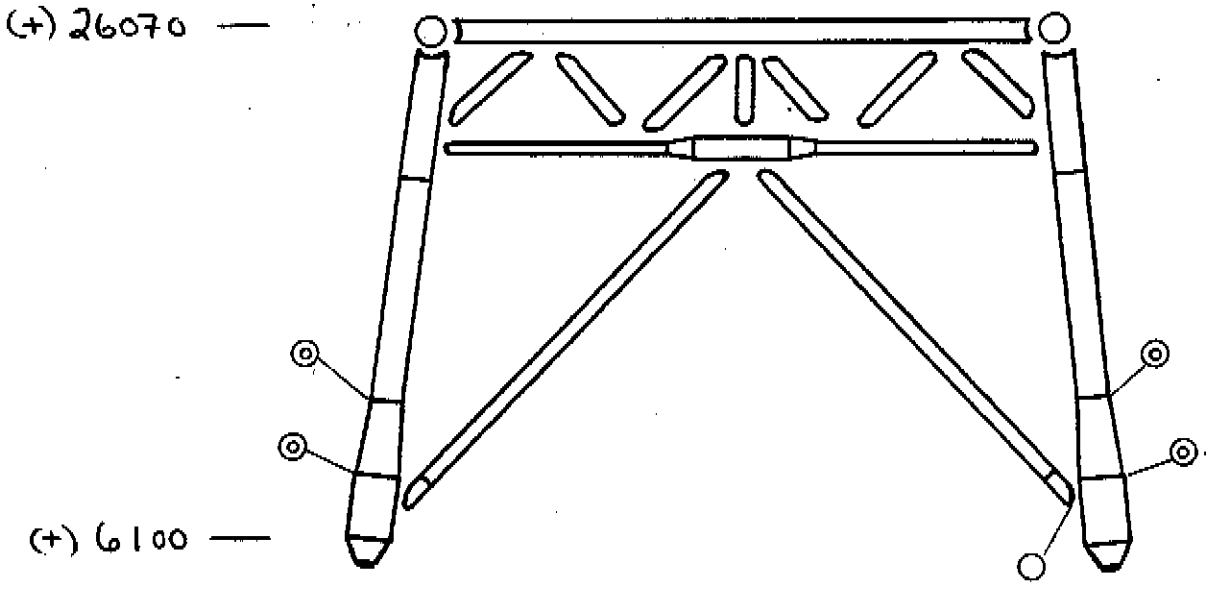
KEY PLAN



FACE 1



KEY PLAN



FACE 2

1.5.4 Fatigue

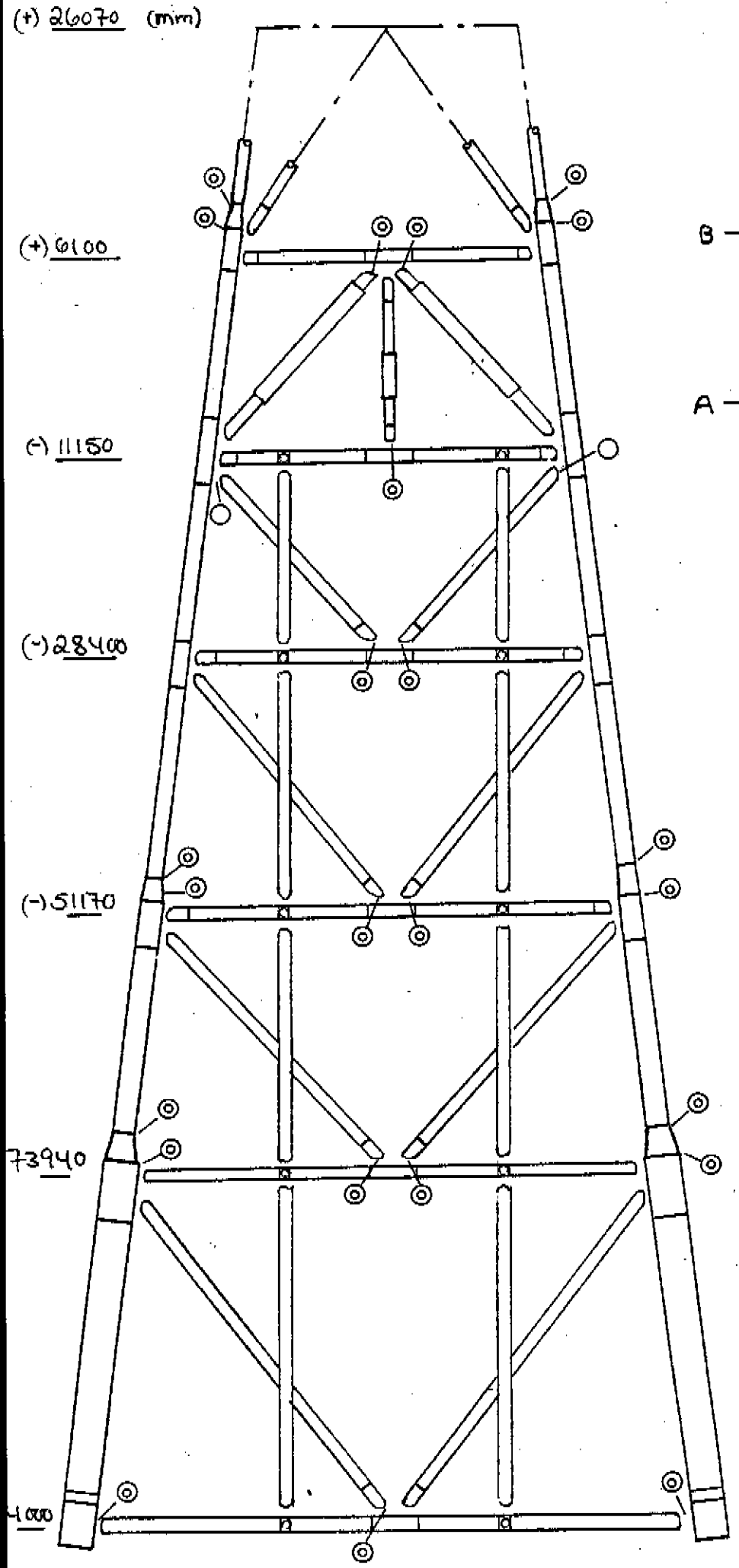
The following figures point out the most critical joints with respect to fatigue.

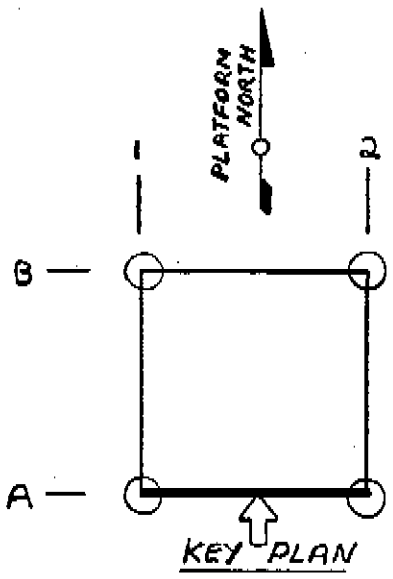
The S-N curves given in AWS D1.1-72 were used to determine the number of cycles to failure whereas the Miner's rule were utilized to determine cumulative fatigue, i.e. usage factors.

The member ends marked with a double circle (◎) have usage factors greater or equal to 0.5.
Member ends marked with a single circle (○) have usage factors between 0.1 and 0.5.

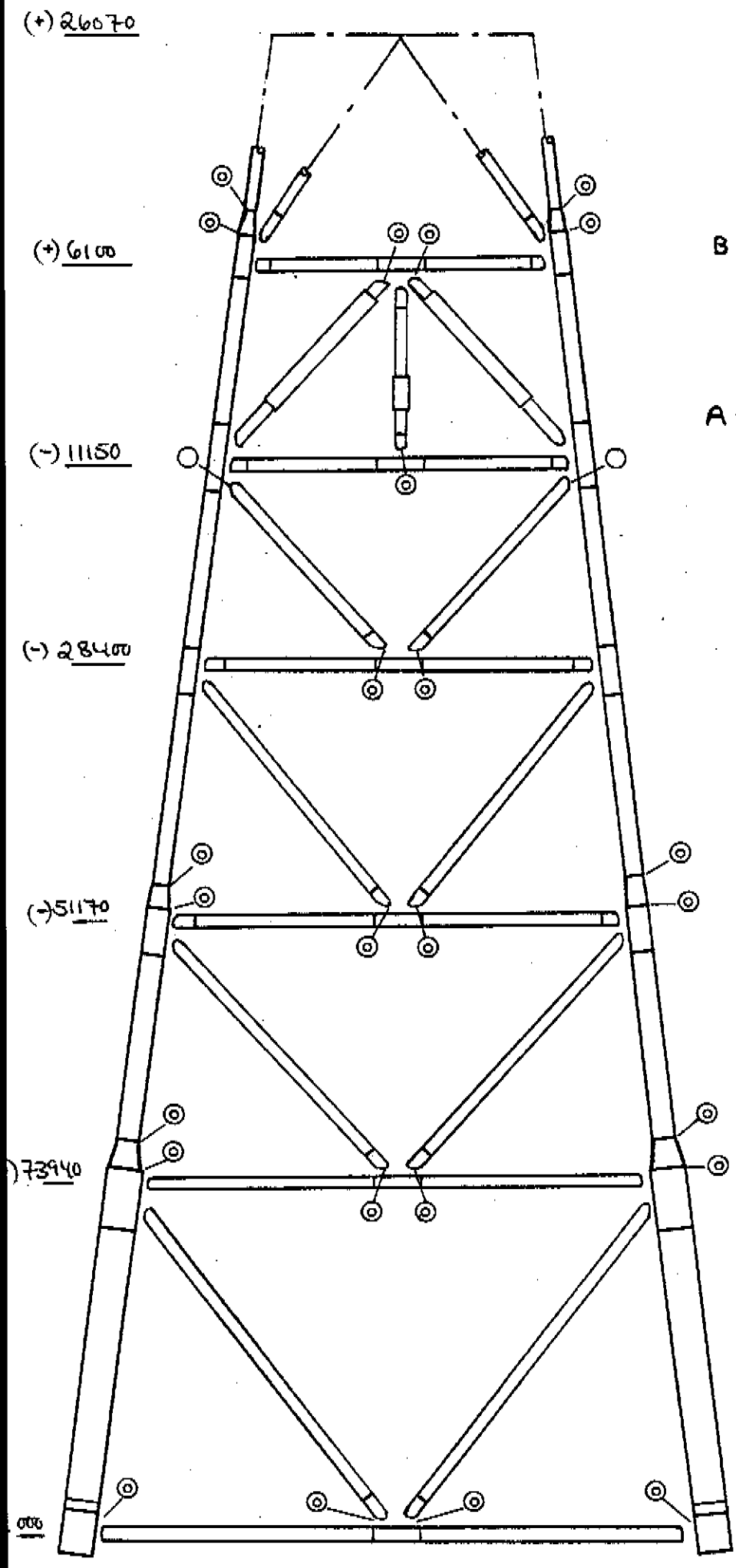
It should be noted that the members located on elevation (+) 6.10 m may be subjected to wave slamming loads possibly leading to fatigue failure.
These members should therefore be subject to future inspection and the most critical joints have been marked with a double circle even if the calculated usage factor in all cases does not exceed 0.5.

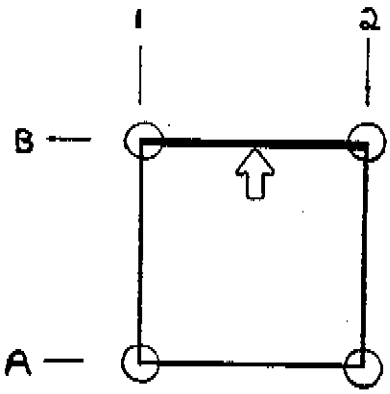
(Note that all waves have been assumed from one direction, which implies that the actual usage factors are about 0.4 of the calculated factors. The factor 0.4 results form a comparison fatigue study between directional distribution of waves and all waves from the same direction).


(+) 26070 (mm)
(+) 6100
(-) 11150
(-) 28400
(-) 51170
73940
4000

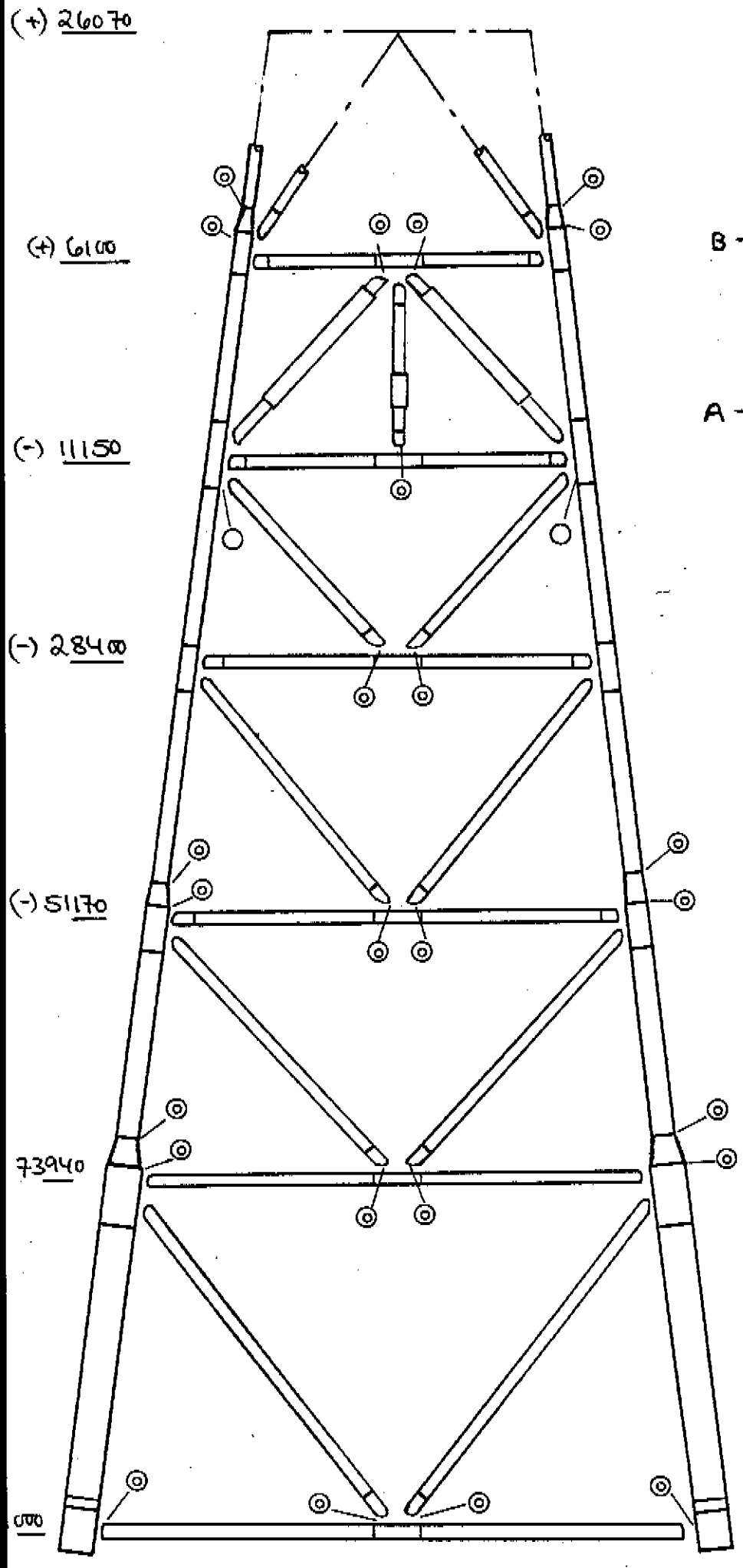

PLATFORM NORTH
B
A
KEY PLAN

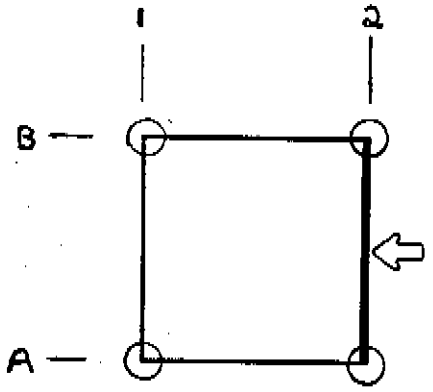
FACE A





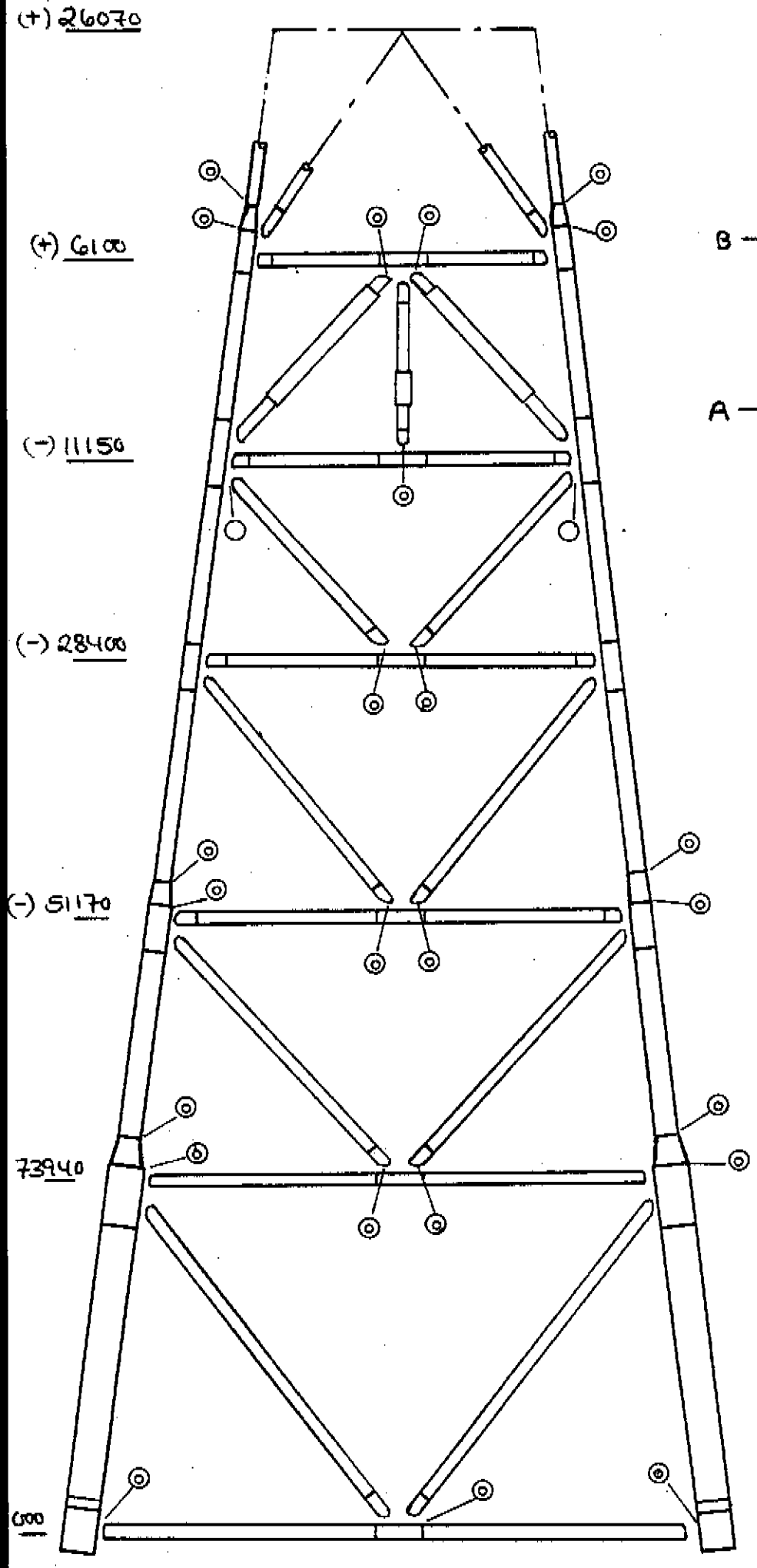
FACE B

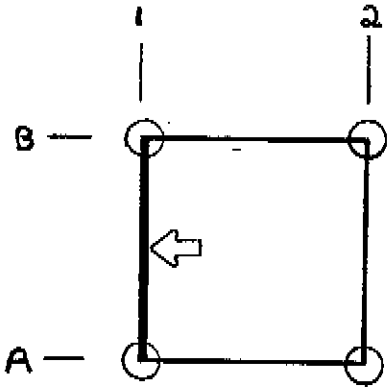




KEY PLAN

FACE 2





KEY PLAN

FACE 1

1.5.5 Dynamic calculations

A time history dynamic analysis have been carried out for regular waves of different periods using the dynamic program DYNADOG.
The platform is simplified to include only lumped masses at each bracing level in addition to one lumped mass at level 137 m above sea bed to account for deck and modules.
Using the simplified model, the deflections is calculated for both a dynamic and a static analysis for each level, and the dynamic amplification factor for stresses arrived at.

The results was as follows:

1. natural period: 1,64 sec.

Dynamic amplification (averaged over all levels)

H = 29,0 m,	T = 15 sec	DLF = 1.044
H = 17,4,	T = 12 sec.	DLF = 1,053
	T = 8 sec.	DLF = 1,07
	T = 4 sec.	DLF = 1.38

The above dynamic amplification factors have been used in the fatigue calculations.

1.5.6 Environmental forces

- Wave theory	:	Stokes 5th order
- Wave force method	:	Morrizon equation (deterministic)
- Drag coefficient	:	0,75 for $D \geq 60"$ 0,70 for $D > 60"$
- Inertia coefficient	:	2,0 for $D \geq 60"$ 1,7 for $D < 60"$
- Wave direction	:	0^{o}, 45^{o}, 90^{o}, 315^{o}

Max shearforce at mudline: 7733 kips
Max overturning moment $2,15 \times 10^{6}$ ft. kips.

1.5.7 Corrosion Protection

Cathodic Protection

Specifications:

Design calculations for the cathodic protection system is presented in Elf-Norge A/S' letter 1052. No. 4-759 - dated 12.12.74 and the anode location is shown on the following drawings:

Secco	1120 - 108
Secco	1120 - 109
McD-H	147
McD-H	148
McD-H	149

Design criteria

Design life	:	20 years
Current density in seawater	:	130 mA/m^2
Current density in mud	:	35 mA/m2
Current density in concrete	:	5 mA/m^2
Current density for coated steel	:	50 mA/m^2

Anode type : Al-In - BA 777

Anode net-weight	:	365 kg
Anode total number	:	395 kg

Level	Anode number
- 11,15 m	39
- 11,15 m to - 28,40 m	39
- 28,40 m	20
- 28,40 m to - 51,17 m	46
- 51,17	27
- 51,17 m to - 73,94 m	47
- 73,94 m to -104 m	108
-104 m	40

Anode dimentions

Length	:	2630 mm
Height	:	240 mm
Bottom breadth	:	260 mm
Top breadth	:	220 mm
Stand of core	:	500 of 750 mm

Potential measurements

An initial potential survey to check the functioning of the cathodic protection system has not been carried out.

Coating

Specifications:

The governing coating specification is:
1052 No. 3 - 169 - JPS/J6 - Elf Norge
Frigg Field Painting Specification for
Steel Structures - Rev. 1 - March 1974.

Application of coating

No deviations from the specifications have been reported.

Splash zone protection

The splash zone of the jacket is protected by coating and a corrosion allowance of 12,5 mm.

Due to the fact that the actual water depth was less the basis for the design, the lower limit of the splash zone range became 0,276 m short compared to the DnV-rules. This was accepted by DnV. (Final waterdepth not yet confirmed).

Comments/Evaluation

The corrosion protection systems for the QP-jacket are expected to give sufficient protection provided the necessary surveys and maintenance is carried out periodically.

An initial potential survey to check the performance of the cathodic protection system and an initial visual examination of the coating condition in the splash zone is strongly recommended.

PHOTO 1
Typical anode configuration on QP Jacket

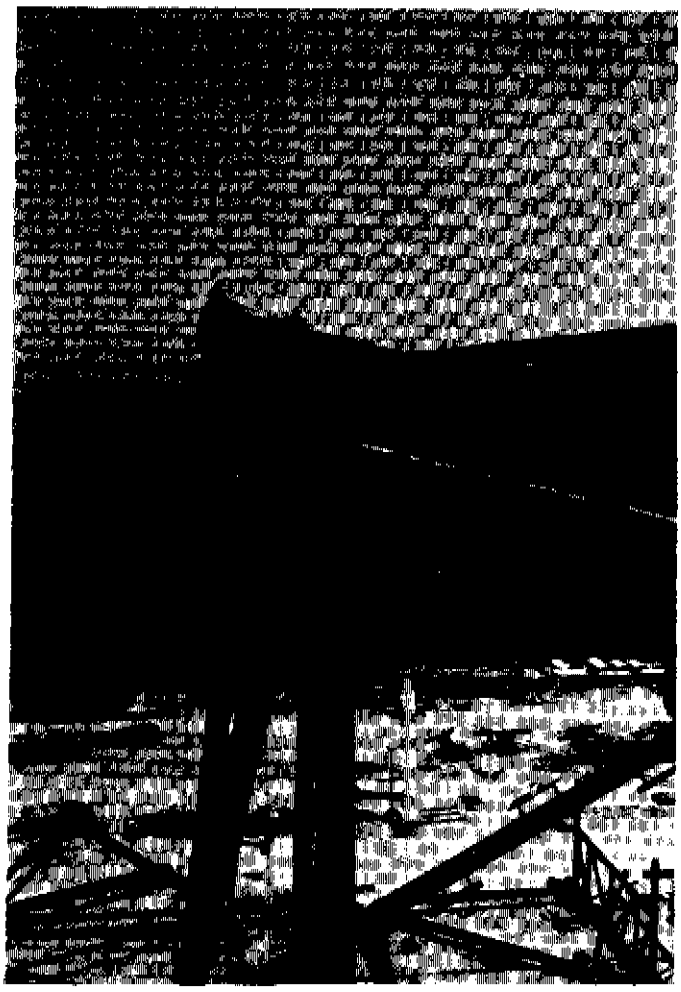


PHOTO 2

Lower end of QP Jacket
bottle B 1

1.5.8 Foundation

The factors affecting the foundation of the jacket have been evaluated. Based on borings performed by NGI (B6-A and B6-B), which is considered representative for the seabed at QP jacket, there is no comments to these. The shear strength used to compute the p-y curves and the axial capacity seems reasonable conservative, the same is valid for the factors regarding the pile group effect. The shear strength is compared with NGI's drilling 6 B in report 73048.
Both stress levels and desplacements appears acceptable.

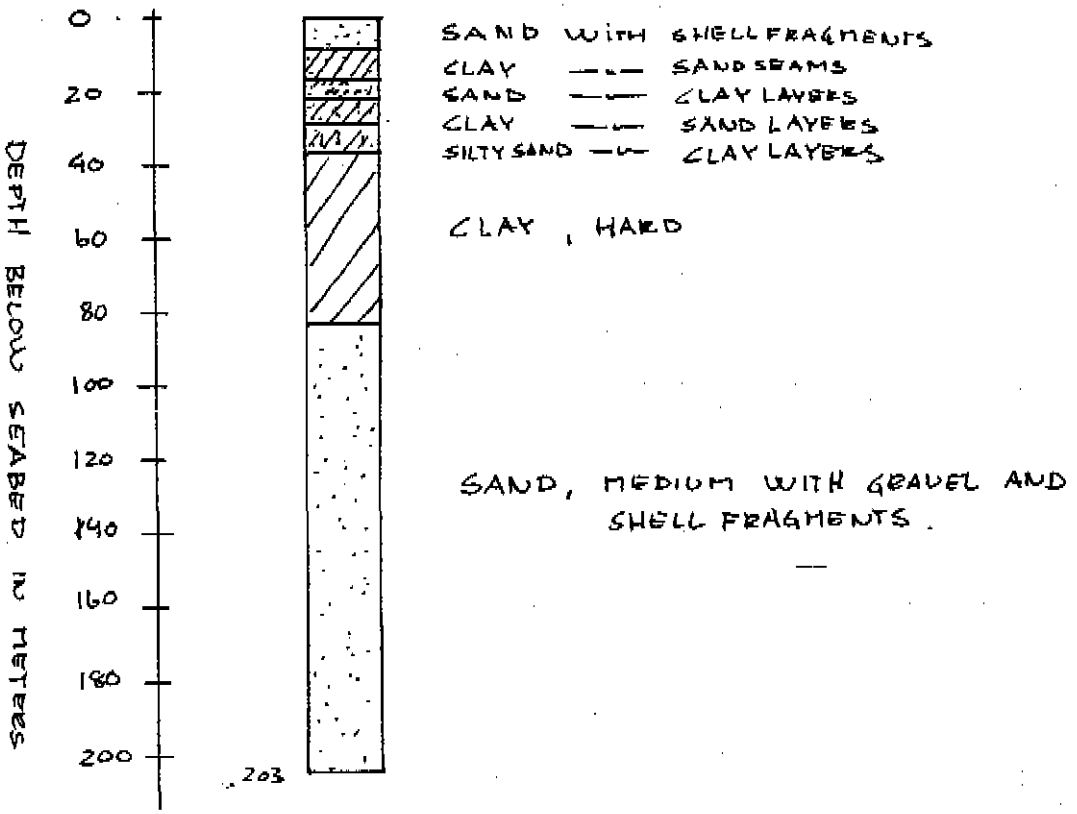
The following basic figures have been used as input:

Max. compression:	6713 kips (loading 9)
Max. tension	4462 kips (loading 9)
Scour	6,6 ft.

1.5.8 Foundation

Soil condition

Several site investigations have been carried out at the Frigg Field. Boring no.B6A and B6B is representative for the Q.P. location. The borings reveal a soil profile consisting of sand and clay inlayers partly mixed up with silt for the upper 36 m Between 36 m and 83 m depth a fairly uniform clay-layer was found. Below this claylayer and down to 102 m at which depth the deepest boring was terminated the soil consisted of sand. The figure below gives a simplified picture of the soil profile.
The soilprofile is reported by Norwegian Geotechnical Institute in enclosure to letter dated 18.12.73.
LABORATORY DATA BORING GROUP B6, TP1 AND QP, FRIGG FIELD.



SOIL PROFILE Q.P. FRIGG FIELD

Foundation design

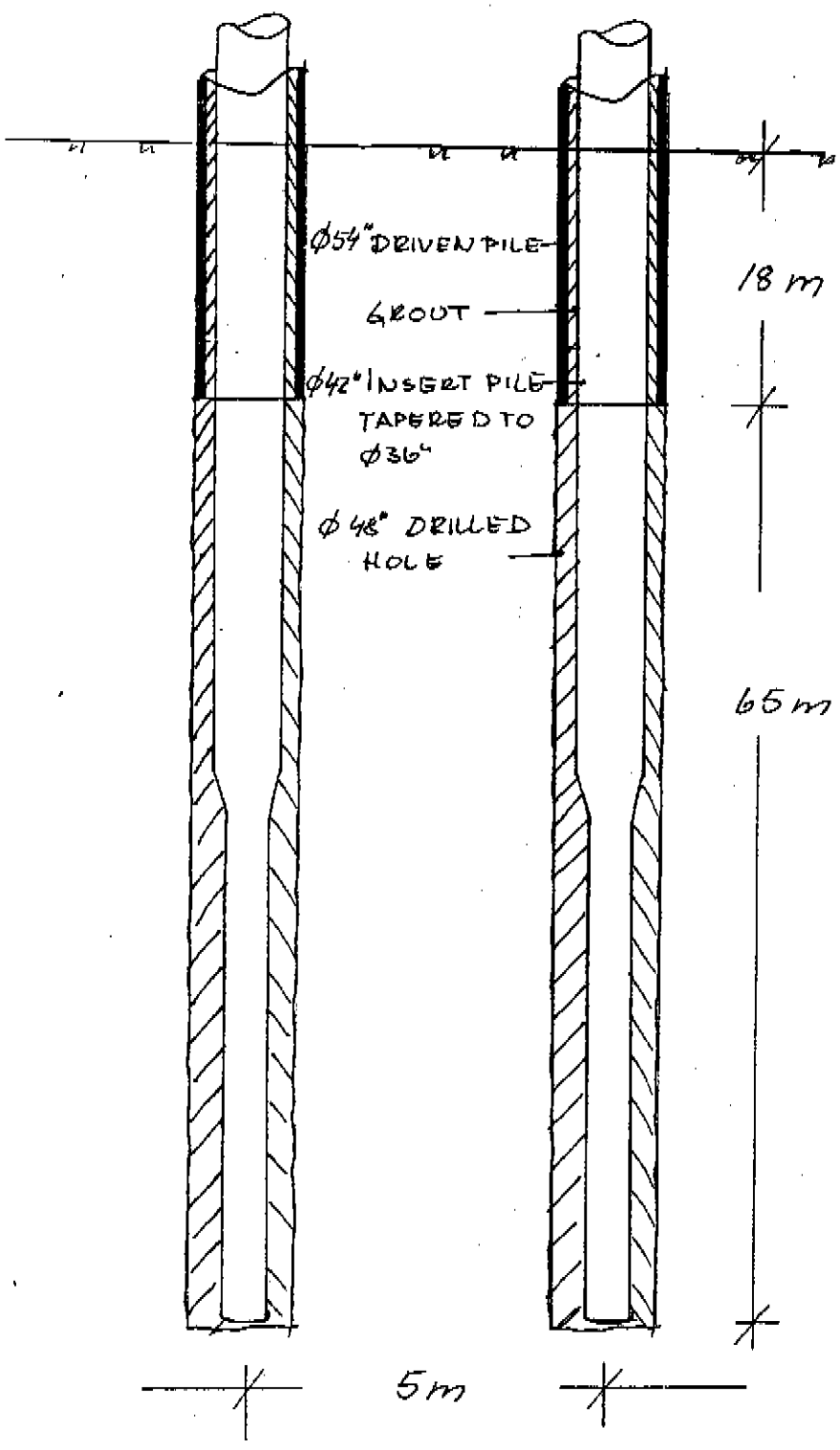
Based upon the data obtained from the soilinvesti-gation engineering data for the piledesign was made.

The basic results from this ultimate pile capacity curve for axial loads and the p.y. curves used for calculating the lateral load capacity, is given below.

Due to group effect a y factor of 1.43 was used to calculate lateral loads. The groups axial capacity was set to two times a singel piles capacity.
The pile design was made by McDermott Hudson ref. File No. 3, design clac. Volume 1 B.

The pile configuration consists of a two pile group in each corner.
The pile is a combination of a driven main pile and a drilled and grouted insertpile. The piles have a total penetration of 83 m out of which the driven part is 18 m long.
The figure below gives the pile configuration.

DnV has evaluated the soilinvestigation and pile design. The designed pilepenetrations was found sufficient to carry the axial loads with a f.o.s. of minimum 1.5 for storm conditions and 2.0 for operating conditions.
The combined axial and bending stresses in the piles was found to be within acceptable limits.



PILE CONFIGURATION Q.P.

The compability between horizontal movement top pile - bottom jacket was also found acceptable. This displacement is calculated to be in the magnitude of 3 - 4 cm in storm conditions. In the design a general scour of 2 m was incorporated.

For installation of the piles, see chapter 3.4.

1.5.9 Launching calculations

The launching calculations have involved 2 loadcases:

a) Jacket balanced on rocker-arms
b) The bottom of the jacket balanced on the rocker-arms and the top supported by buoyancy tanks in the water.

The analysis indicates that some of the x-joints was over-stressed in compression during launching. The joints specially exposed was node No. 144 and 145 but also to some extend 146-147-148-149. It was decided (minutes of meeting NO. 102/74) to reinforce all the above mentioned joints by one internal ringstiffener. The 4 remaining x-joints in the launch truss (No. 140-141-142-143) was not considered necessary to reinforce.

1.6 Modules

The two quarter modules (A and B) has been analysed as two-dimensional plane frames. Generally the stresses are within acceptable limits, but in some cases 1/3 increase in stresses had to be allowed. This was mainly in the support trusses of the Radio mast, places where discontinuity in the diagonals appeared due to access for doors etc. and in the areas around the support of the modules.

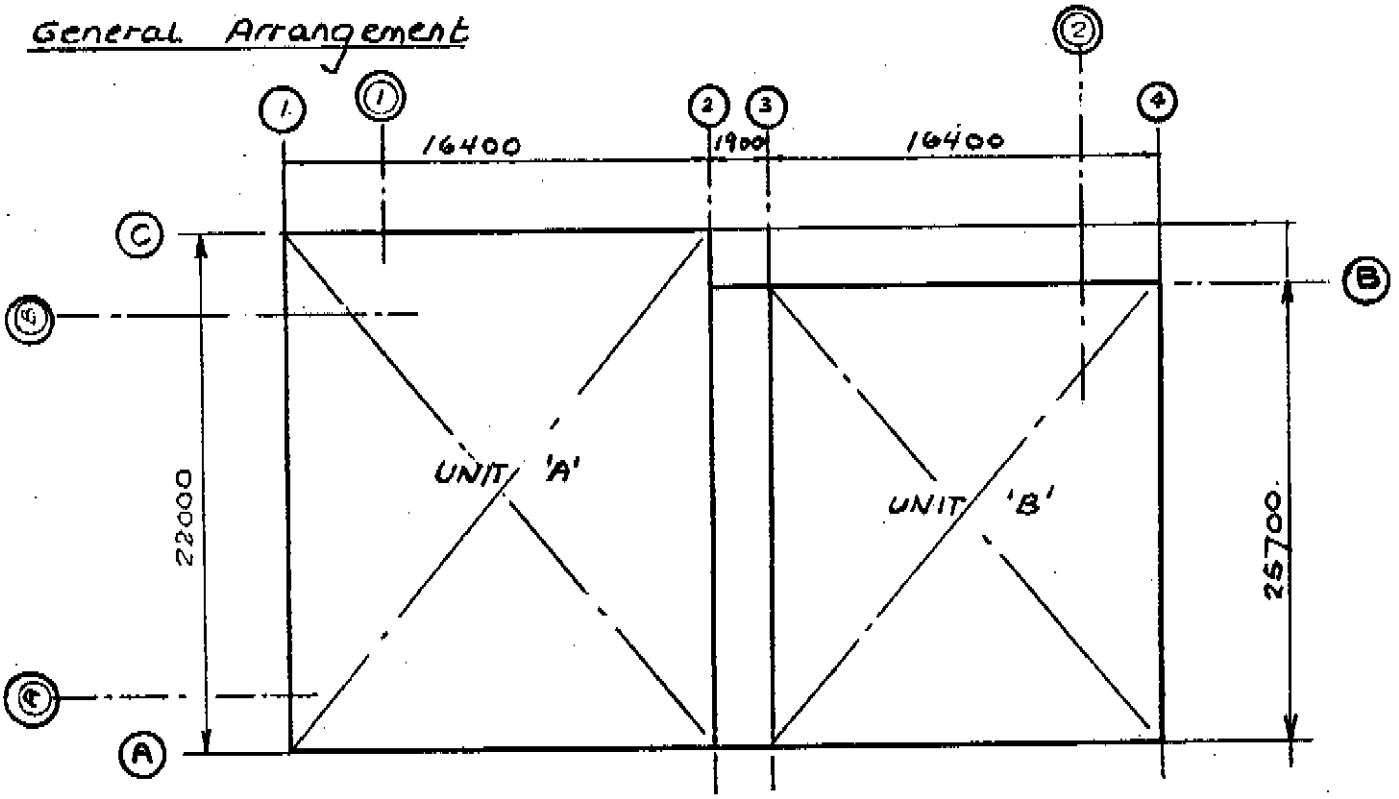
The weight of all modules are given below:

Module A	815 st
Module B	1027 st
Hangar and Telecommunications	242 st
Goods lift	15 st
Q9 Module	50 st
Microwave Tower	160 st
Two Cranes	36 st each
Fuel Tank	30 st
Water Tank	11 st
Battery Room	100 st
Helideck	183 st

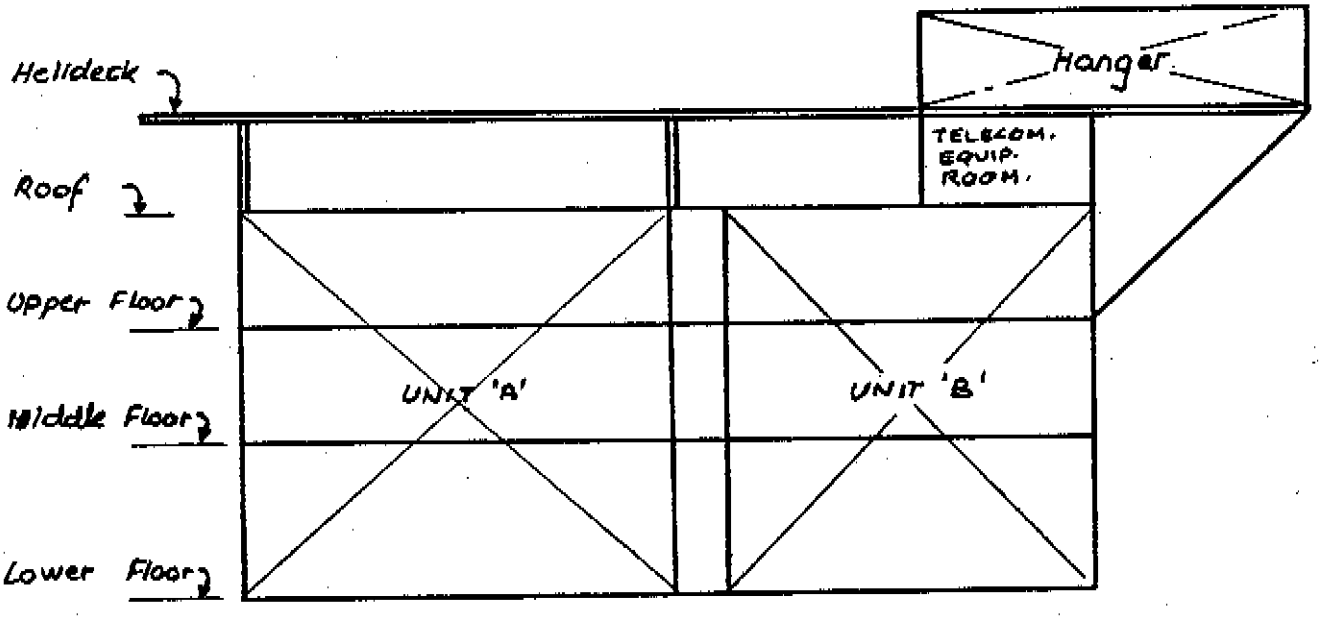
Plus numerous small lifts less than 10 st. each

QUARTERS TRUSSES

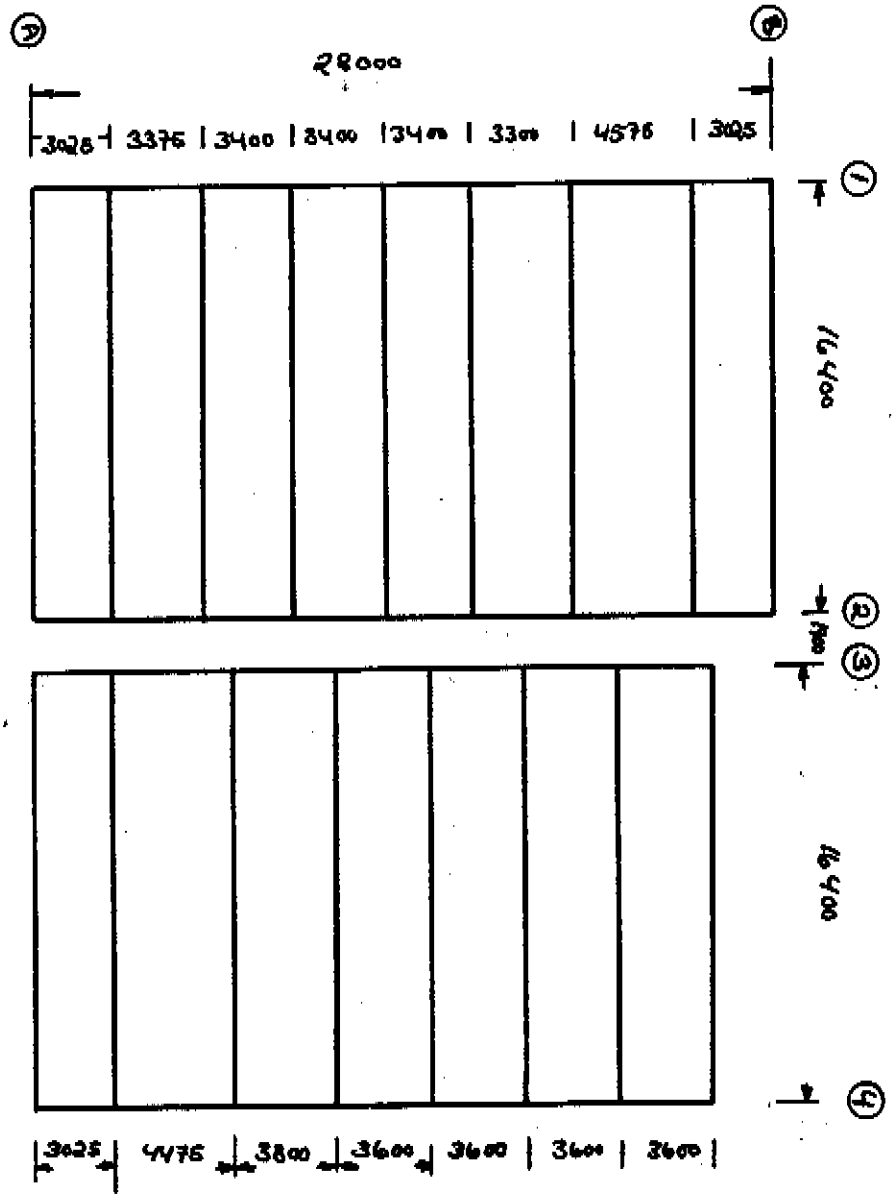
General Arrangement



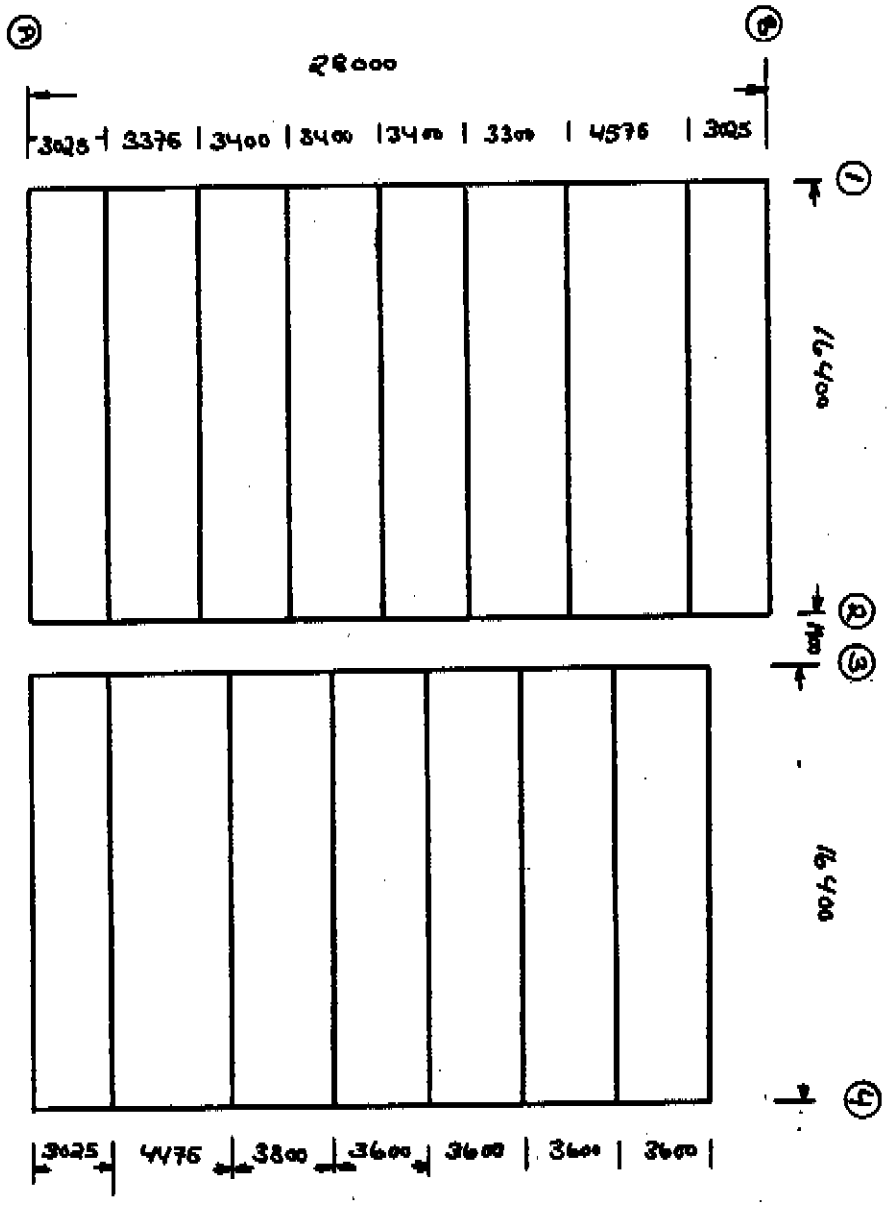
PLAN.



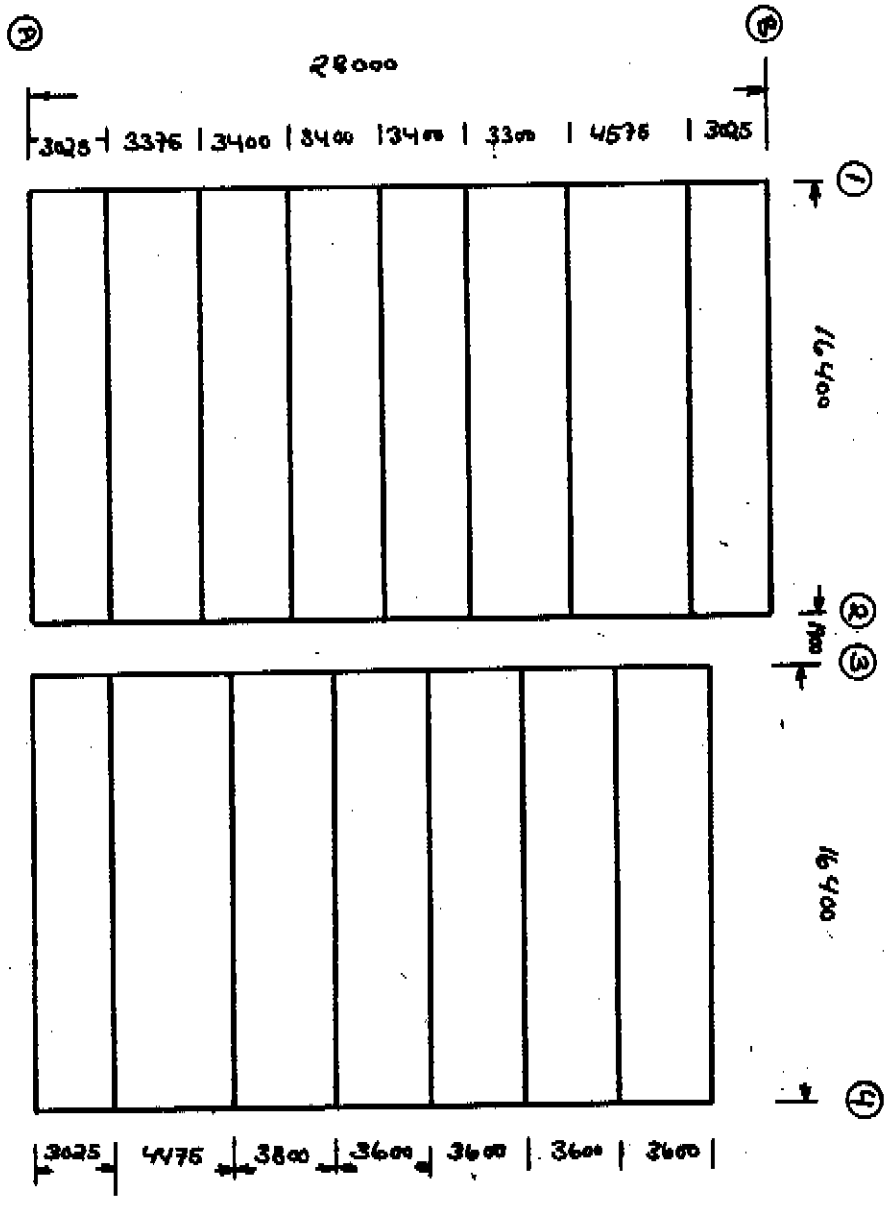
ELEVATION.



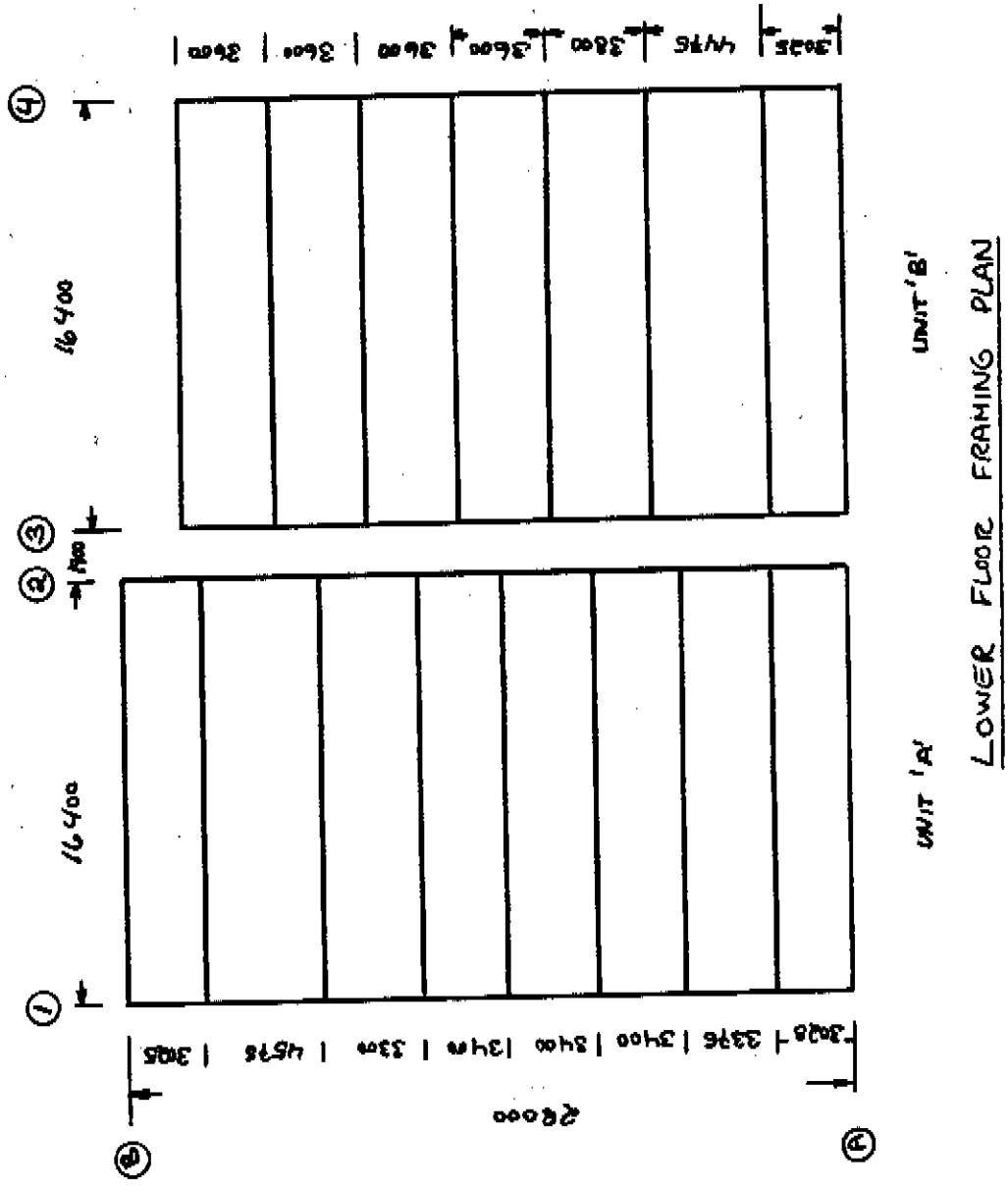
FLOOR PLAN - UPPER FLOOR



FLOOR PLAN - MIDDLE FLOOR



ROOF FRAMING PLAN


LOWER FLOOR FRAMING PLAN
UNIT 'A'
UNIT 'B'
16400
16400
3025 4575 3300 3400 3300 3376 3025
3025 4575 3600 3600 3600 3600 3600
26000

1.7 QP - TP 1 Bridge

1.7.1 General

DESIGNER : McDermott-Hudson, Wembley U.K.

BUILDER : Mercantile Marine Engineering' Antwerp, Belgium

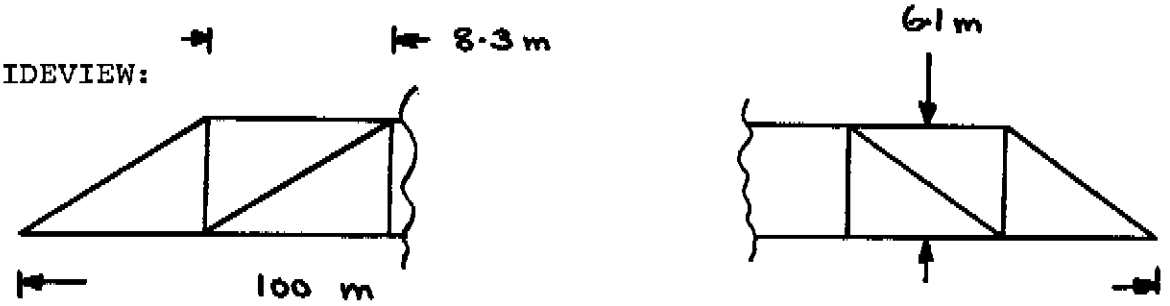
STEEL MILL :

SCHEDULE : Installed September -76.

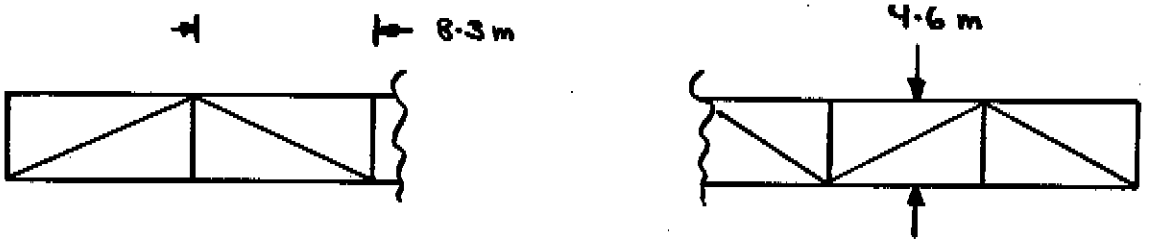
1.7.2 Bridge description

A space-frame type bridge carrying electrical and instrument cables plus a walkway between the QP and TP 1 Platforms

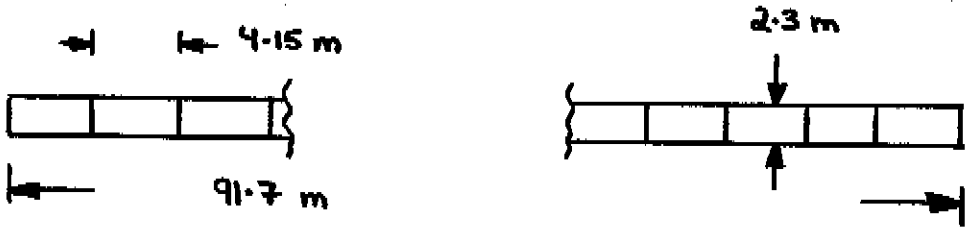
SIDEVIEW:



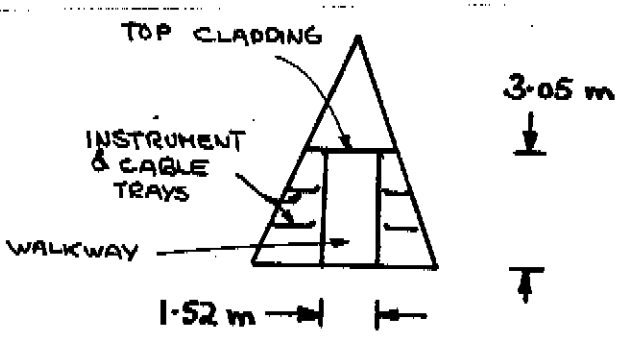
ABOVE:



TOP OF CLADDING:



TYPICAL SECTION:



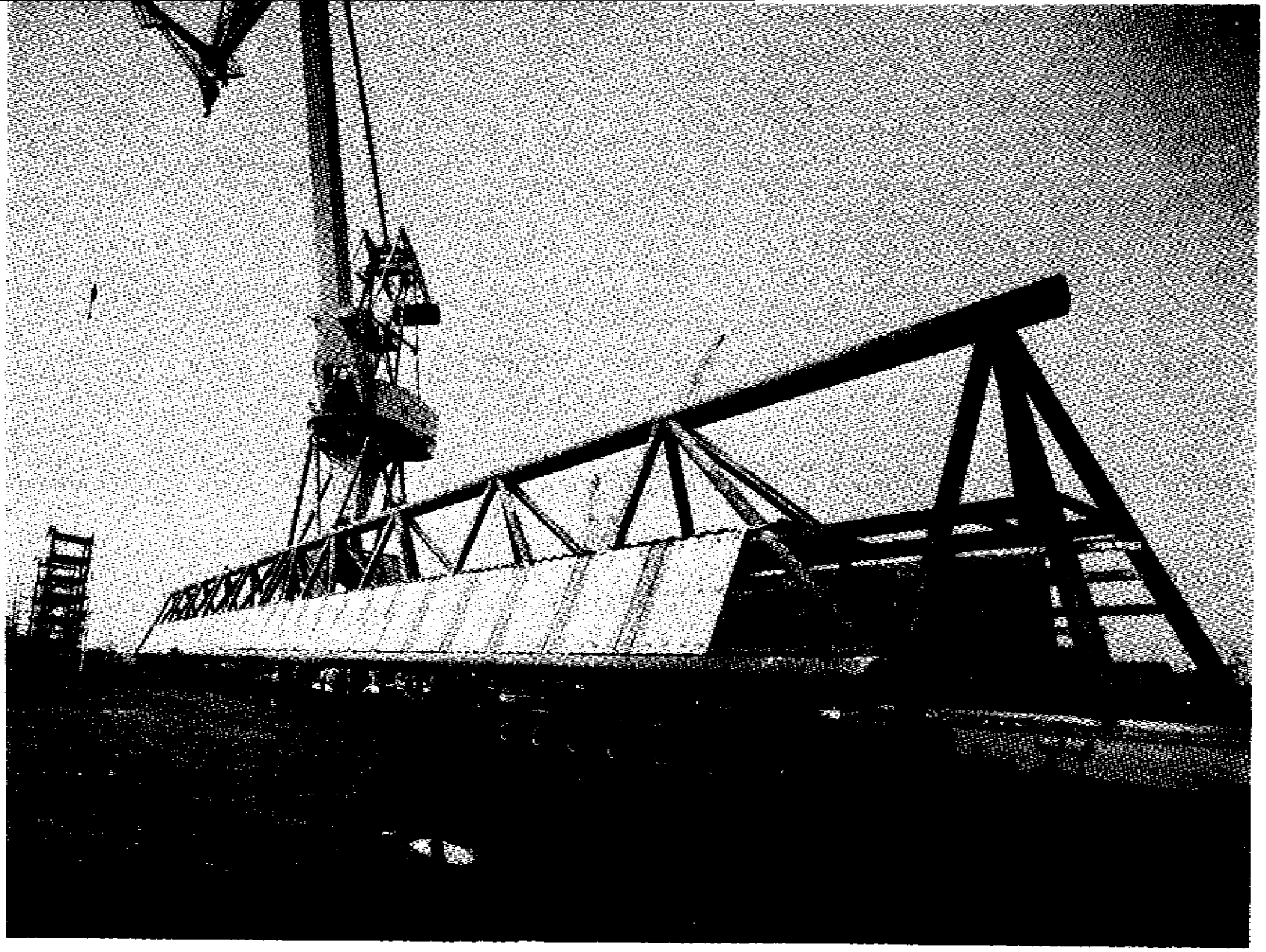


PHOTO 3 QP BRIDGE DURING TRANSPORT (1)

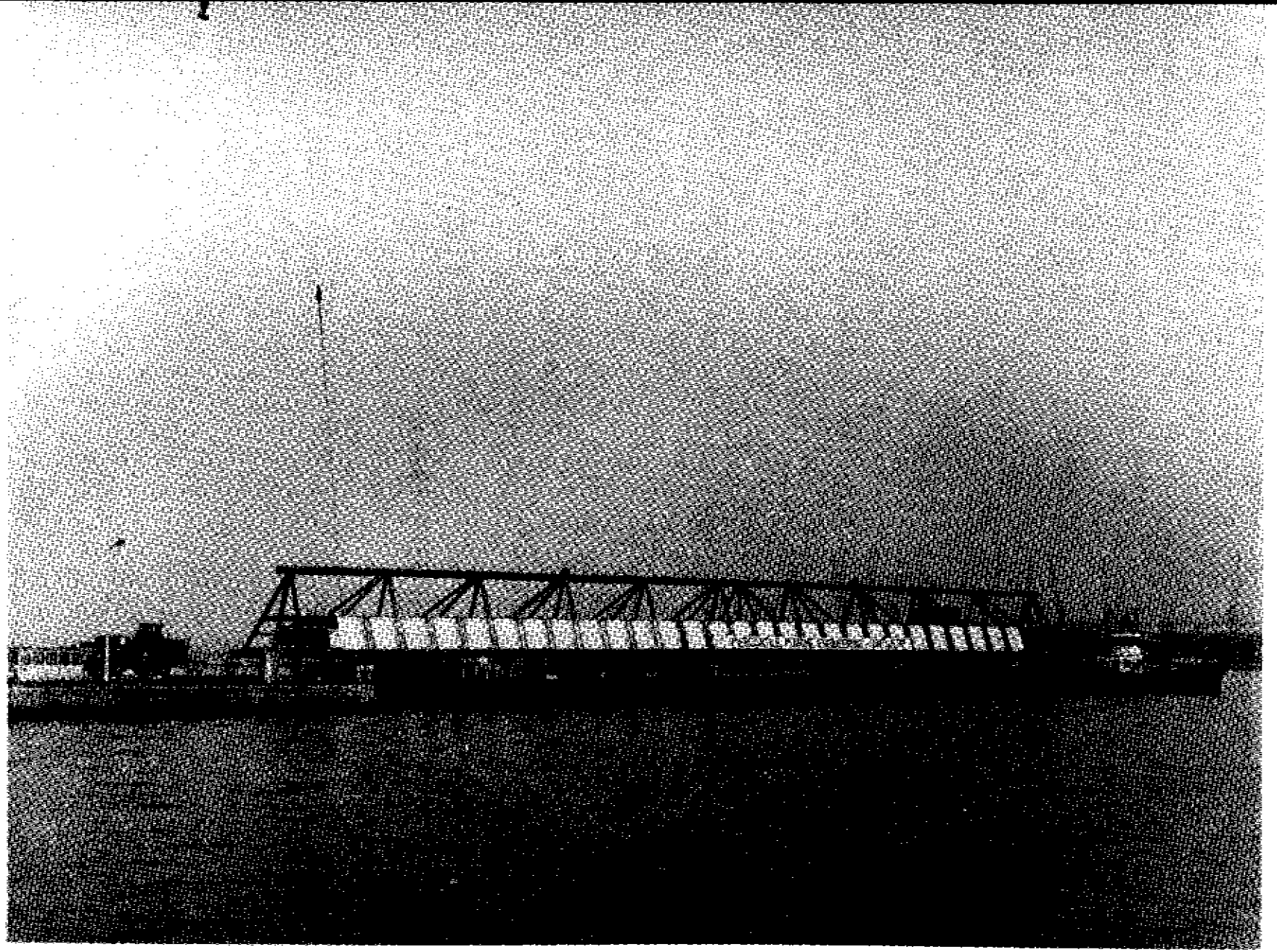


PHOTO 4 QP- BRIDGE DURING TRANSPORT (2)

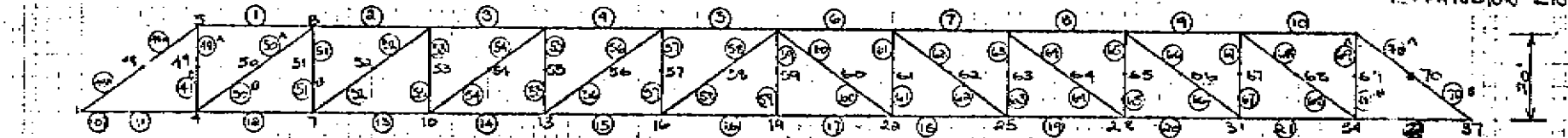
1.7.3 Geometry simulation

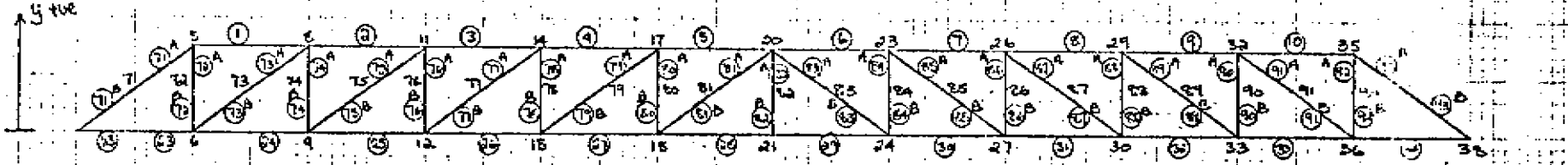
The QP-bridge has been modelled by McDermott-Hudson for use in Computer calculations.

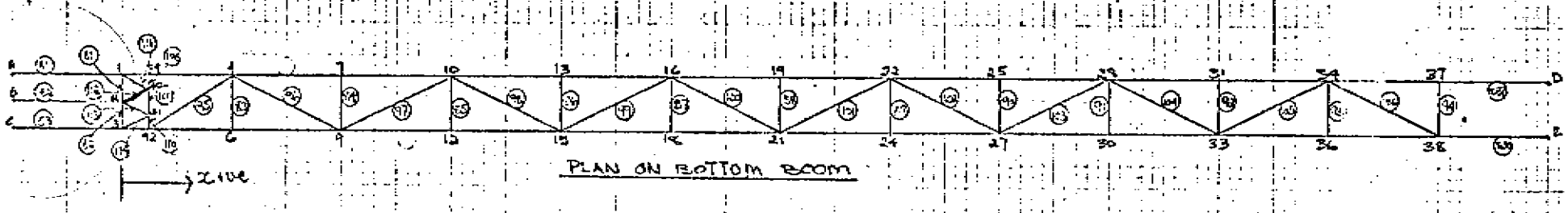
The bridge is considered fixed at the QP-side whilst it is considered simply supported and free to rotate and displace at the TP 1-side.
This corresponds to the real structure which can "slide" at the TP 1-side.

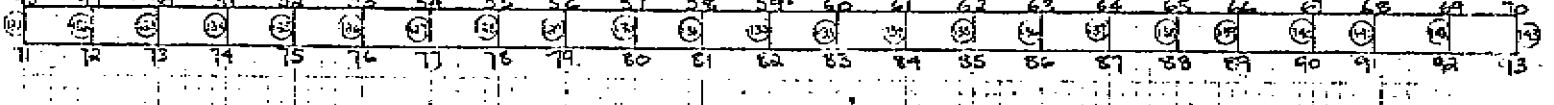
The geometry-simulated model is shown overleaf.

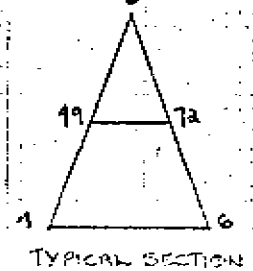
QUARTERS BRIDGE (COMPUTER INPUT)











1.7.4 Design evaluation

McDermott-Hudson has evaluated the forces on the bridge composed from dead weight, wind and live loads.
The wind forces have been calculated for wind along bridge, wind at 45° to bridge and wind at 90° to bridge.

A 15 sec. gust wind (63,9 m/s at bridge level) have been applied for the calculations. This is somewhat higher than DnV minimum requirements.
Even for this case the calculations was generally shown to be sound.

Spot-checks have been performed to check the calculations and the stress levels have been found acceptable for all cases.

It was found difficult to predict with certainly if vortex-shedding would develope or not so this has to be kept in mind for future in-service inspection.

After installation of QP on TP-1, the final length of the bridge was determined to be 88,4 m.

1.7.5 Member buckling

The following figures define the most critical member with respect to overall buckling ie not buckling or collapse due to external water pressure.
The criteria of AISC "Manual of Steel Construction" has been used as a basis for the following figures; more specifically the formulae 1.6-1A has been used.

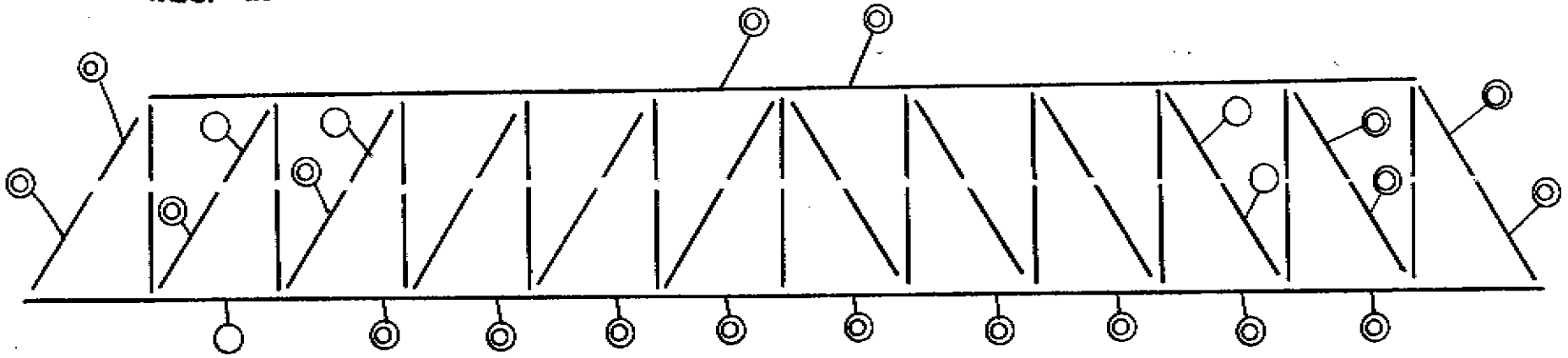
Members marked with a double circle (◎) have a buckling ratio equal to or greater than 0.9 in the extreme environmental condition.

Members marked with a single circle (○) have a buckling ratio between 0.7 and 0.9 in the extreme environmental condition.

QP- PLATFORM

NORTH

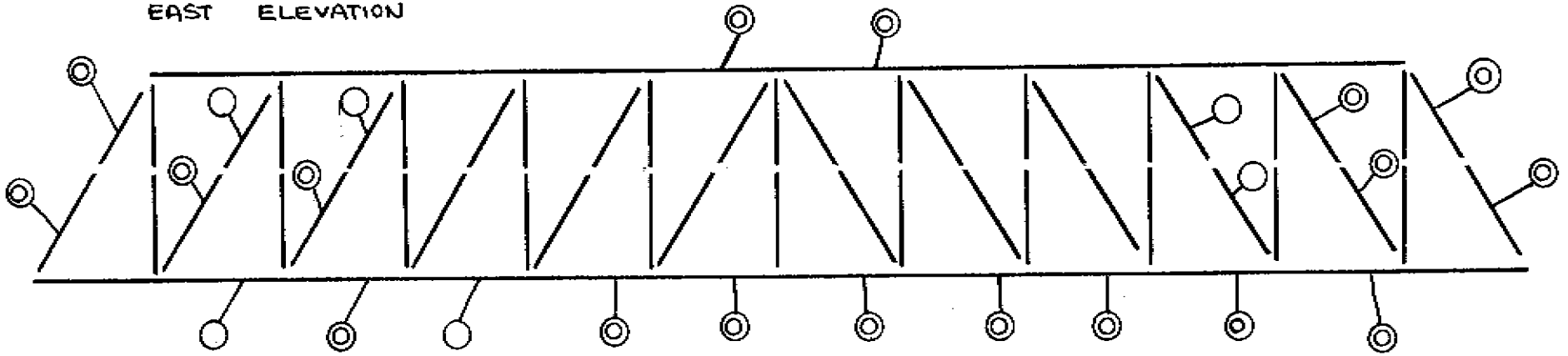
WEST ELEVATION



QP-SIDE

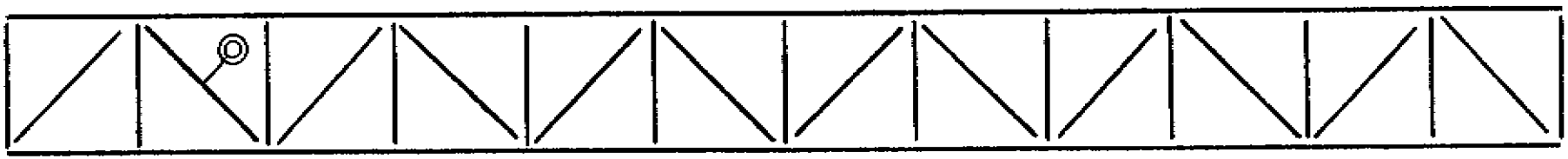
TP1 - SIDE

EAST ELEVATION



QP= PLATFORM
NORTH

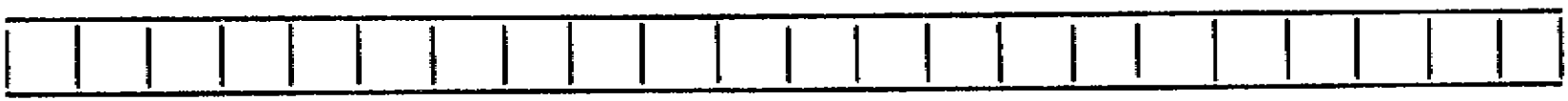
BOTTOM BOOM, TOP VIEW



QP SIDE

TP 1 SIDE

TOP OF CLADDING, TOP VIEW



1.7.6 Member end static stress

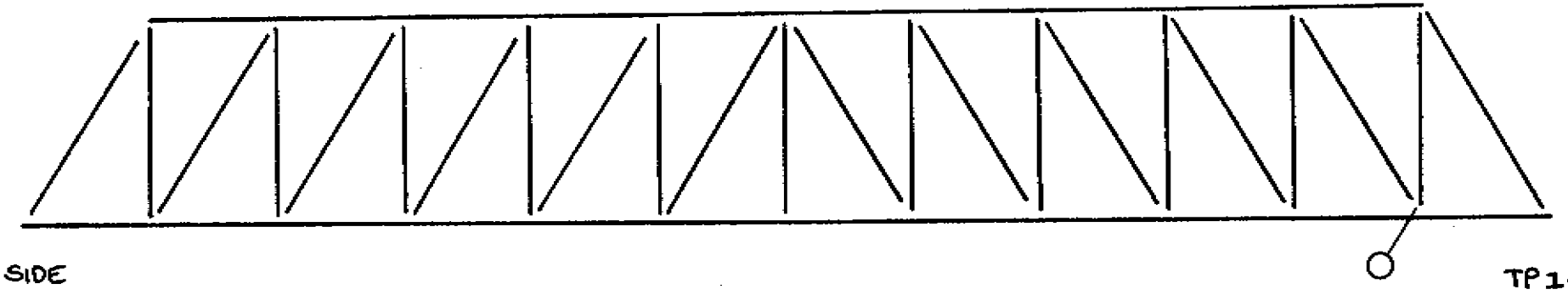
The following figures describe the most heavely stressed member ends and member sections in the structure. It must be noted this marking refers to nominal static axial-plus bending stress only. Thus no attempt has been made to show hot-spot stresses in the following figures.

The areas of member ends marked with a double circle (⊙) have stresses equal to or above 20 ksi in the extreme condition.

The areas of member ends with a single circle (O) have stresses between 16 and 20 ksi in the extreme condition.

QP- PLATFORM
NORTH

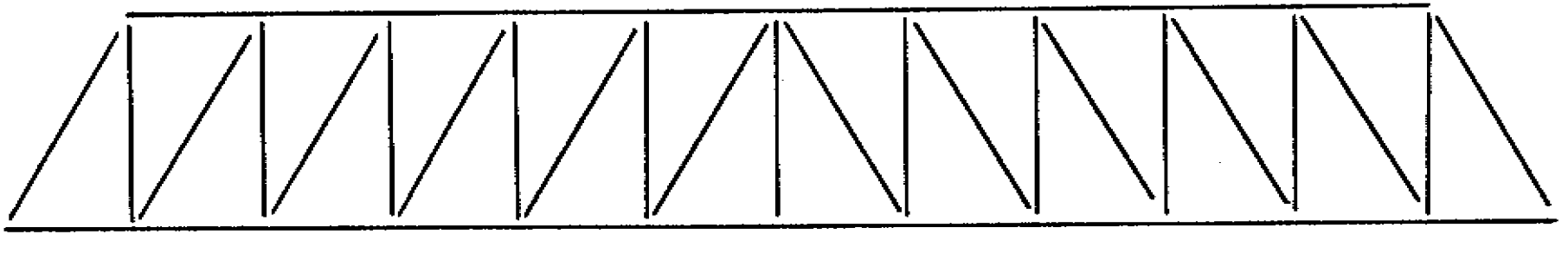
WEST ELEVATION



QP- SIDE

TP 1- SIDE

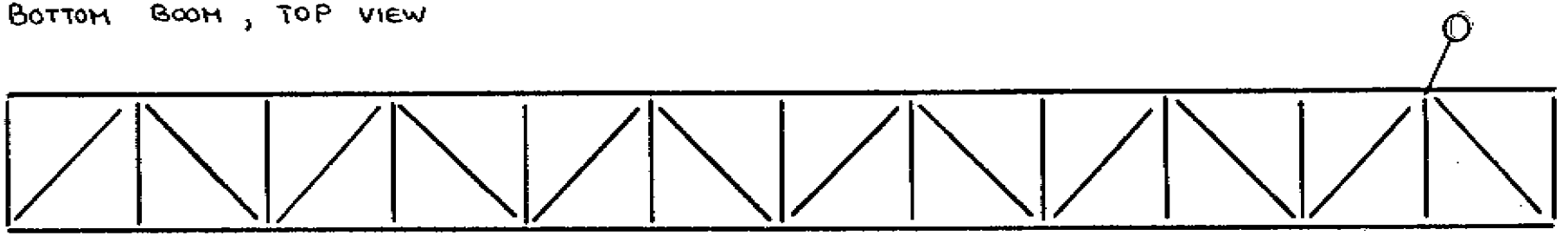
EAST ELEVATION



2

QP= PLATFORM
NORTH

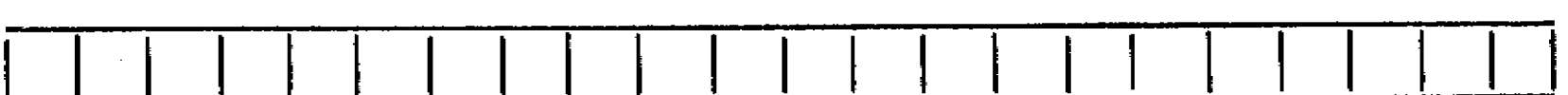
BOTTOM BOOM, TOP VIEW



QP-SIDE

TP 1-SIDE

TOP OF CLADDING, TOP VIEW



1.8 Microwave tower

Designer : Charpenter Moderne

Code : French Standard NF A 35501

Material : E 26 quality 4 steel for:

- chords
- ties
- diagonal
- reinforcement plate
- assembly plate
- framework carrying the parabolas

E 26 quality 2 for:

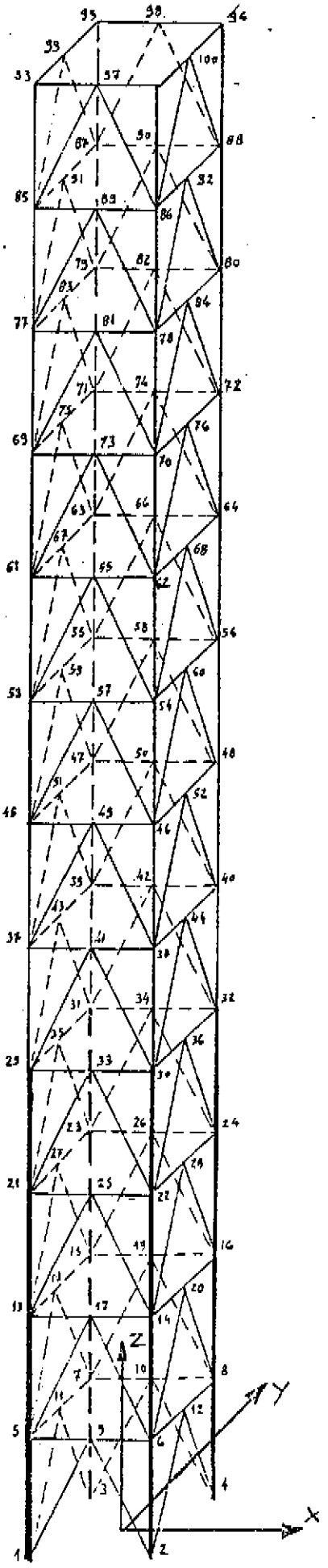
- walkways
- brackets

A three dimensional computer model have been used for the calculations of the tower.
The final forces arrived at is based on french code NV 65 (which allow for the dynamic behaviour of the tower) and a basic input wind speed of 45 m/s as 1 min. sustained wind speed.

For the tower itself the stresses is generally found quite acceptable.

The support reactions an however just on the limit for the design of the module trusses. Thus the support members transfering and distributing the reaction forces into the module should be closely inspected.

A geometry simulation and a sketch of the tower are shown in the figures below.



MICROWAVE TOWER MODEL

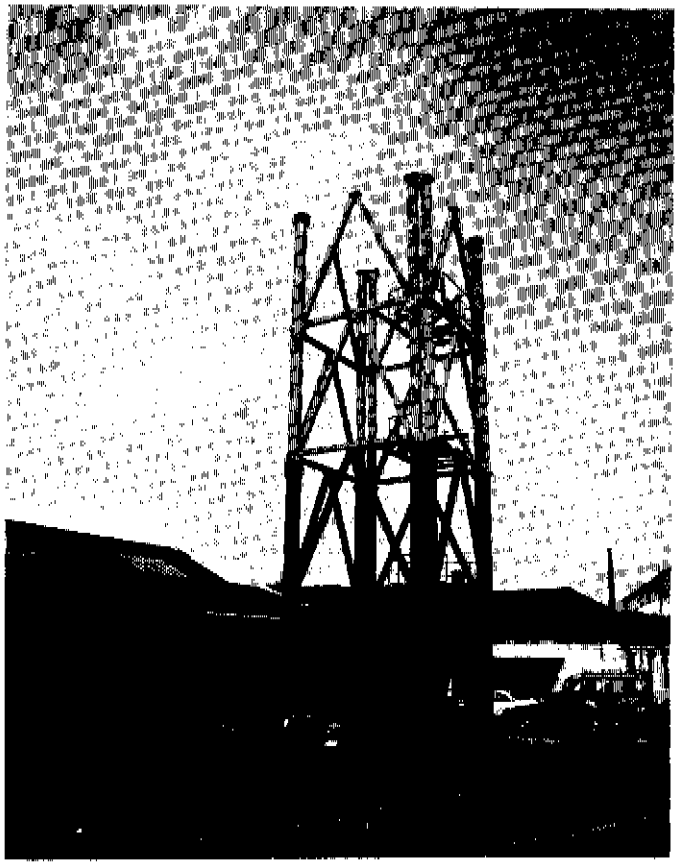


Photo 5
Section of microwave tower during construction

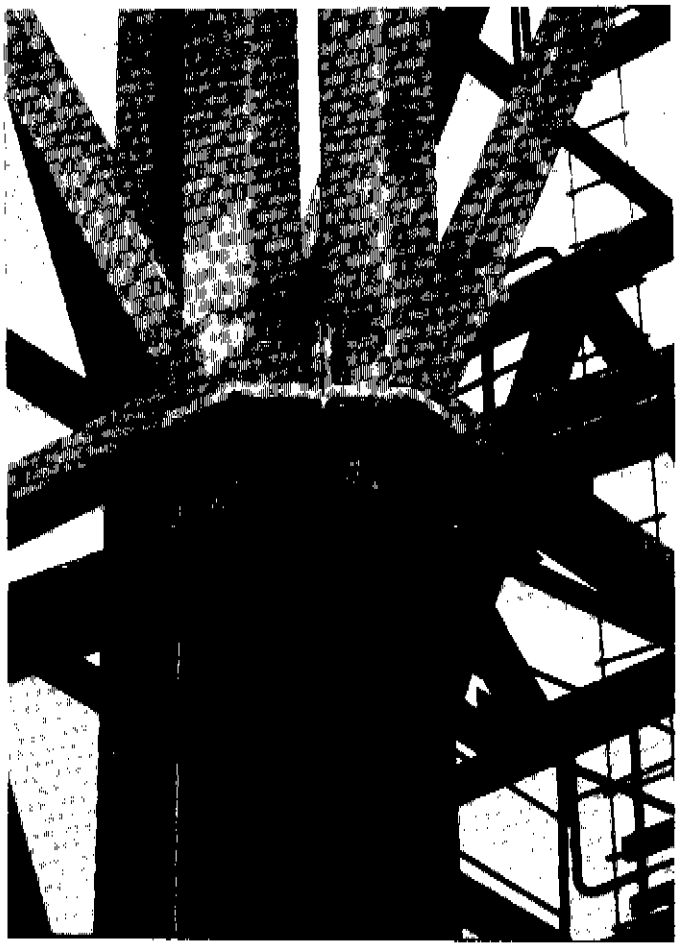


Photo 6
Detail of connection between sections of micro-wave tower

+93.000

Antenne de tête
top antenna

A

A

+86.358

Axe paraboles
CL of parabolas

A

A

+71.358

Axe paraboles
CL of parabolas

17.4568

6.9137

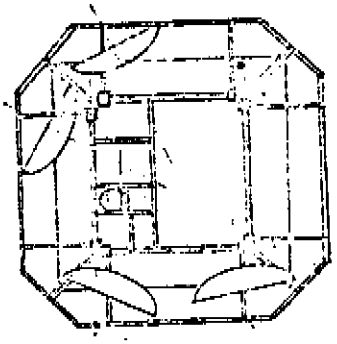
54825

+38.175

Elevation suivant face 4
level according to face 4

5.691

SECTION A A



2. FABRICATION RESUME

2.1 Fabrication yards

The main building-contractor has been Union Industrielle et C'entreprice, Cherbourg France who built the jacket itself.
The subcontractors are listed below together with the structural parts which they built.

The NDT-reports and test certificates for the subcontractors are contained in the Frigg QP Survey report. A fabrication report from the surveyor in Cherbourg is included.

Company	Item
SOCOMET, LA TRAIT FRANCE	QP-bottles (lower part of legs)
UIE St. WANDRILLE FRANCE	QP Support Frame
UIE Sandouville GRANCE	QP Boat landings
MCDERMOTT-HUDSON ARDERSIER,SCOTLAND	QP-Jacket Tubulars QP-Platform Piling
IMEPSA, St. ASTIER FRANCE	QP-Storage Tanks
CHANTIERS DE LA GARONNE, FRANCE	QP-Modules
RICHARD DUCROS ALES FRANCE	QP-Bridge Landing

LA CHARPENTE MODERNE, FRANCE	QP-Microwave Tower
SOTRACOMET, FRANCE	QP-Buoyancy Tanks
ACTIME DREUX, FRANCE	QP-Floating Tanks

2.2 Requirements to materials and fabrication for template piles and support frame

General.

This note gives a brief summary of materials and fabrication conditions for the template, piles and support frame of QP-platform. These specifications were accepted by DnV.

1. Material specification.

Selection of materials has been based on

- Elf Norge's general specification "1052 No. 3 - 145/Rev.", 3. nov. 1973 and "Special Material Specification for TP 1 and QP "1052 No. 3" - 620/Rev. D, Nov. 1973.

and applied for delivery of plates, shapes and welded tubes. These have been produced from high strength steel and mild steels. The designations used on drawings have been as listed below reflecting the mechanical characteristics and typical applications:

Table 1: Structural steels - designation, type and application.

Designation	Steel grade acc. DIN 17100	Typical application	Elevation
HSS 20	St. 52-3N modified	Crans, braces, girders, trusses, plates, shapes	
SHSS 20	St. 52-3N modified	Heavy wall cans, braces, piles, main girders and trusses	
SHSS 40	St. 52-3N modified	Nodes	

All structures steels have been specified to be made acc. to DIN 17100 and modified as considered appropriate for the grade and application. ASTM A537-Gr.A is specified as an equivalent grade provided the required modification is accounted for (see Table 2). The following main modifications/supplementary requirements have applied for high strength steel, St. 52-3N:

Table 2: Supplementary requirements.

Designation	Chemical composition(1)	Mechanical properties	Soundness of steel plates
HSS20	Max 1.60% Mn Max 0.035 P Max 0.035 S Max 0.35 Si $t \leq 30$mm:CE $\leq$ 0.44 $t > 30$mm:CE $\leq$ 0.46	$t > 50$mm: $\sigma_{0.2} \leq 34\ kp/mm^2$ Transv. impact: CV_T=Ave 30ftlbs min 25ftlbs Testing temp: $\div 20^{\circ}C$ Shear area: Ave 50% Bend tests with former 3.5t for $t > 50$mm Each mother plate/min every 40 tons to be tested	Plate edges: Level 3 of S.E.-0.62/69 "Ultraschall geprüftes grobbleche" Body of plate ASTM A435
SHSS20	As for HS 20 except: max 0.22 %C max 0.015 %S CE $\leq$ 0.46	As for HS 20 except that Z-direction ductility to be $RA_Z \geq 30\%$ (2)	Plate edges and plate body: Level 2 acc. SE -062/69
SHSS40	As for HS 20 except: max 0.22 %C max 0.015 %S CE max 0.46	As for HSS 20 except that impact testing at $-40^{\circ}C$ and Z-direction ductility to be $RA_Z \geq 30\%$ (2)	As for SHSS 20

Notes (1): $CE = C + Mn/6 + Si/24 + \frac{Cr + Mo + V}{5} + \frac{N + Cu}{15}$

(2): RA_Z = Reduction of area measured acc. to DnV Recommendations (1973) or acc. to IIS/IIW doc. IXF-74-18.

General delivery conditions have been based on ASTM A6 "Standard specification for delivery of rolled steel plates, shapes sheet piling and bars for structural use", as regards dimensions and straightness.

Certificates have been issued by steel mill, and endorsed by an official inspector.

2. Shop fabrication of welded structural tubulars.

All shop rolled tubulars have been manufactured in accordance with API-2B: "Fabricated Structural steel pipe".

Tubulars have been made by cold rolling for $t \leq 50$mm. For greater thickness hot forming or hot rolling were applied, the former in temp.range 650-900°C and the latter above 900°C. Normalizing was compulsory for hot rolling, and if micro structural modifications did occur when hot forming. Mechanical properties were retested in the final condition.

Welding of tubulars has been based on AWS D1,1-72 "Structural welding code" with following supplementary requirements for procedure qualification:

- Charpy V-notch testing of base metal, weld metal and HAZ (O, f.l. 2&5 mm positions) to meet base material specification.
- Hardness/macro testing to meet max. 300 HV5.
- Restricted qualified range to appr. 1/2" above and below test thickness.

Welding has been by the submerged arc and/or the manual metal arc. processes. For the latter only low hydrogen electrodes were to be selected. Manual welders were qualified based on visual and radiographic examination and mechanical testing in accordance with AWS D1.1/ASME VIII codes.

Longitudinal welds have been visually examined and ultrasonic tested full length and interpretated acc. to ASME VIII/Div. 1. 200 mm of each end has been x-rayed. All girth welds have been visually examined and x-rayed. All x-rays have been interpretated to AWS D1.1-72. Procedures for NDT have been according to AWS D1.1-72. All tubulars made from high strength steels have been checked for hard spots acc. API 5LX, ie. max hardness in body of tube is not to exceed 327 HB.

Each finished tube have been dimensionally checked.

Production tests have been asked for at start-up and during regular production taking two tests during first 25 lengths and once every 50 lengths respectively. The production tests consisted of tensile bend, hardness and impact tests and to meet plate requirements, and applied to both circumferential and longitudinal welds.

3. Non-structural materials.

Non-structural materials have been used for secondery members being of:

- Plates/shapes: DIN 17100/St. 37-2U, ASTM A 285 Gr. C or ASTM A 36.
- Tubes: DIN 1629/BL.3 - St. 35, API 5L Gr. B or ASTM A 53 Type E or S, grade B.

4. Bolts.

All bolts and nuts 1/2" and smaller are of stainless type 316 while greater corform to ASTM A-325 and hot dipped galvanized.

5. Assembleying and construction.

Assembleying and construction of the different structures of QP platform have been based on:

- Elf-Norge specification 1052 No. 3-155/JPS/HR/hc Rev. 2 of February 1974.

which lists accepted reference codes/standards and gives detailed requirements to preparation of structural members, materials, fabrication tolerances, welding, inspection etc.

Design of welded connections, joints and splices and fabrication tolerances: API-PR 2A, AWS D1,1-72, AISC "Steel construction manuals".

Welding: The same conditions and requirements as specified for shop welding have applied for assembleying and construction. For welding if tubular joints special procedure tests were required and these were subject to visual inspection, and ultrasonic examination full length, macrosections taken at four specified positions (12, 3, 6

and 9 o'clock) as well as Charpy V-notch tests (of weld metal and HAZ) and hardness tests. These sample joints had to meet the project material specification.

Welders were qualified in general to AWS D1,1-72 except that backing plates were not permitted. For welding of tubular joints (nodes) the welders had further to made a prototype joint in actual position and this being examined vusually and by macrosections.

Post weld heat treatment were carried out only when instructed by Elf-Norge.

Inspection: All full penetration welds have been examined 100 % by UT or X-ray. Additionally other welds were inspected 10 % by one of these methods. Procedures and interpretation of NDT-tests have been according to standards as specified for shop-welding. Magnetic particle testing were carried out to the discretion of the fabricator(s) and Elf-Norge.

2.3. Final survey report jacket and support frame

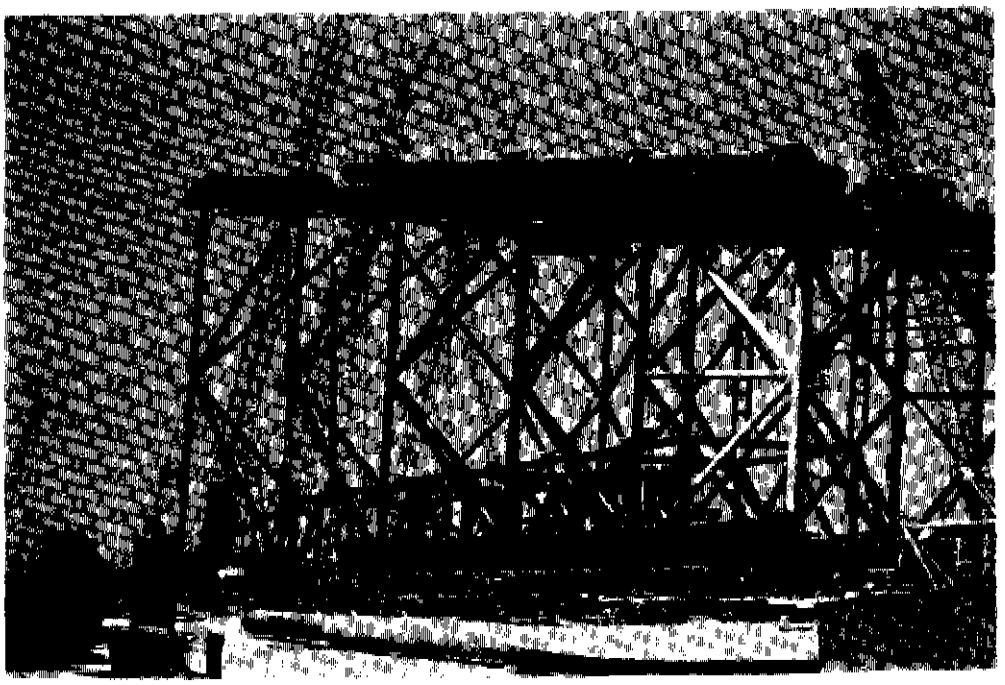


PHOTO 7

QP Jacket before load out in Cherbourg

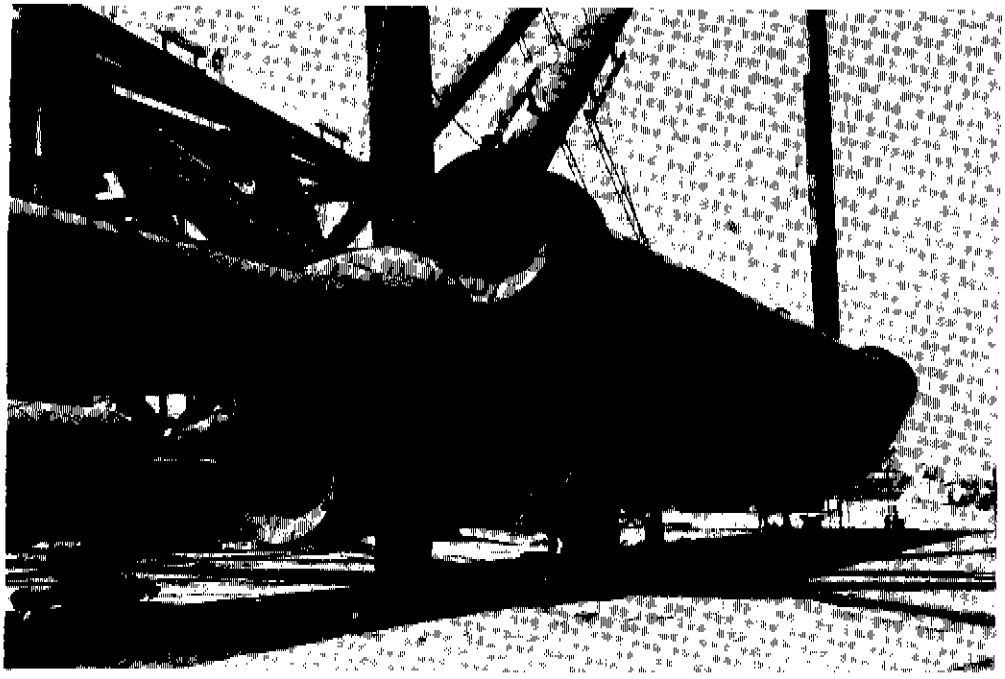


PHOTO 8

Bottle A 1 - Shear plates (Bottle A1)

PHOTO 9

Bottle A 1 - Underside of bottle A 1.

FRIGG PROJECT

QUARTERS PLATFORM

THIS IS TO CERTIFY THATthe undersigned surveyor to this society did attend the works of Union Industrielle et D'entreprise,Etablisement de Cherbourg, France,for the purpose of inspecting the fabrication of:

QUARTERS PLATFORM

The main responsible contractor for the structure has been Union Industrielle et D'entreprise,Paris.

The work has been carried out in accordance with the following drawings:

101 - 6 Jacket vertical framing col.line A.
102 - 6 Jacket vertical framing col.line B.1&2.
103 - 8 Horizontal frmg. plan at el.+6100 and +11150
104 - 4 Horizontal frmg. plan at el. +28400
105 - 1 Horizontal frmg. plan at el. +51170
106 - 1 Horizontal frmg. plan at el. +73940
107 - 1 Horizontal frmg. plan at el. +104000
108 - 3 Launch truss X & Y
109 - 1 Launch truss joint details
110 - 0 Joint details sheet 1 of 4
111 - 0 Joint details sheet 2 of 4
112 - 2 Joint details shhet 3 of 4
113 - 0 Joint details sheet 4 of 4
114 - 2 Internal joint stiffening at el. +51170
115 - 3 Internal joint stiffening at el. +73940
116 - 8 Arrangement and details of pile sleeve sheet 1 of 2
117 - 6 Details of pile sleeve sheet 2 of 2
118 - 2 Arrangement & details of pile guides at el. +6100
119 - 2 Details of pile guides at el. +11150

120 - 2	Arrangement & details of pile guides at el. +28400
121 - 2	Arrangement & details of pile guides at el. +51170
125 - 5	Arrangement and details of barge bumpers
127 - 4	Boat landing sheet 1 of 3
128 - 4	Boat landing sheet 2 of 3
129 - 5	Boat landing sheet 3 of 3
130 - 1	Boat landing staires & overboard ladder
131 - 6	Arrangement of walkways at el. +6505 T.O.G.
132 - 0	Jacket launch runners
133 - 1	Jacket launch runners details
134 -	
135 -	
136 -	
137 - 2	Miscellaneous details
138 -	
139 - 2	Buoyancy tank guide arrangement and details
140 - 2	Watertight bulkhead arrangement and details
141 -	
142 -	
143 - 4	8.5/8" Ø Electrical risers
144 - 2	14",18",22",&,24" Ø Pump casing details
145 - 2	Pump casing clamp details at el. +6100
146 - 1	Pump casing guide details
147 - 0	Anode arrangement on vertical framing
148 - 0	Anode arrangement on launch truss
149 - 0	Anode arrangement on horrizontal framing
150 - 1	General arrangement of 62"Ø and 100"Ø buoyancy tanks
151 - 3	62"Ø buoyancy tanks details sheet 1 of 3
152 - 0	62"Ø buoyancy tanks details sheet 2 of 3
153 - 2	62"Ø buoyancy tanks details sheet 3 of 3
154 - 3	100"Ø buoyancy tanks details sheet 1 of 3
155 - 2	100"Ø buoyancy tanks details sheet 2 of 3
156 - 4	100" Ø buoyancy tanks details sheet 3 of 3
157 - 1	Location of referance electrodes
158 - 2	Jacket handeling padeyes

Form No. 40.91a

160 - 0 Mods.to pile sleeve shear B's for leg B1 only

161 - 1 General arrangement of flooding control panel support

162 - 1 Details flooding control panel support

163 - 1 Arrangement and details of jacket caged access ladder to flooding control panel

164 - 1 Jacket towing line details

165 - 2 Launch lug details sheet 1

166 - 1 Launch lug details sheet 2

167 - 1 Fixed stair no.1 (erector installed)

168 - Location of new and existing doubler plates for boat landing, barge bumper and electrical riser

169 -

170 - 0 Jacket draft marks

171 -

401 - 2 flooding and grouting system

402 - 5 Flooding and grouting system - plan at (+) 6100

403 - 5 " " " " piping " "

404 - 4 " " " " doubler details

405 - 4 " " " " inside legs A1 & A2

406 - 6 " " " " " " B1 & B2

407 - 1 " " " " Arr.of hydraulic lines

408 + 2 " " " " Level indicators

The above drawings are returned under separate cover and in stamped order.

Materials :

All structural steel tubular sections used in the structure are certified by Det norske Veritas and are used in accordance with the Contract Specification. Material certificates are returned with the drawings.

Welding :

Procedure tests and welders performance tests have been carried out according to Contract Specifications with satisfactory results. All welders have been optical inspected.

.../...

Non destructive testing :

All buttwelds on structural steel tubular sections used in the structure have been subject to radiographic or ultrasonic inspection. All can/brace joints have been ultrasonically tested. Magnetic particle spot checks have been carried out. All of these mentioned joints have been accepted. On fillet welds visually inspection and magnetic particle spot checks have been carried out with satisfactory results.

Cherbourg, 25th.August 1975

C. BLOM

Form No. 40.91a

DET NORSKE VERITAS · OPPRETTET 1864 ·

FRIGG PROJECT

QP Platform

Bouteilles A1, A2, B2 and cones

The work at Socomet started ultimo October 1974 with prefabrication and longitudinal welding of pile sleeves and legs.

The welding procedures have been followed throughout the fabrication. For manual welding the electrode used has been ESAB'S OK 5500, for automatic submerged arc, the wire/flux has been Lincoln L61/Lincoln 860.

The welders who have been working on the bouteilles, pile sleeves and cones have been qualified to one of the following categories :

- category A for can section joint and buttwelds
- category B for buttwelds and
- category C for fillet welds

The prefabrication and assembling have been carried out indoors. The workmanship and welding quality have been good.

The non destructive testing has been as follows :
100 % radiographic or ultrasonic on all main structural parts.
Magnetic particle control has been carried out in addition to radiographic and ultrasonic where cracking in surface might occure and on fillet welds.

The radiographic control has been carried out by UIE's own people. All films have been controlled by the undersigned after having assured that the quality of the weld was in accordance with ASME Boiler and Pressure Vessel Code Section VIII.

Ultrasonic control has been performed by pipeline services and UIE.

../..

Form No. 40.91a

Magnetic particle has been performed by UIE and witnessed by the undersigned.

Separate UIE's reports for the radiographic, magnetic particle and ultrasonic controls are enclosed.

The structural steel has been quality ST 52 3N or equivalent.

Material certificates received will be sent by separate post.

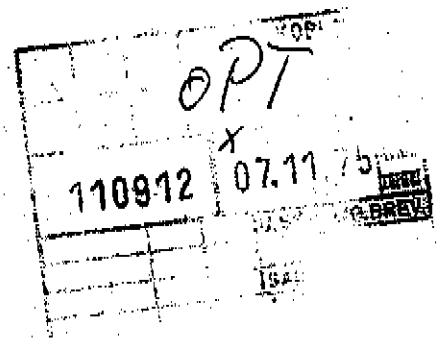
The steel has been controlled for Det norske Veritas stamp and quality identification.

The drawings have been checked and signed and follow enclosed.

The last bouteille B2 was loaded out 3.3.1975 and left for Cherbourg.

Le Havre, 5th March, 1975.

H. Karlsen.



S. Ringöen
VMI
OSLO

TON/ma 20th October, 1975

Dear Sirs,

Reports regarding QP support frame

Please find enclosed the following complete sets of reports and supplementary documentation regarding the fabrication and inspection of the Frigg Field QP Support Frame, client Elf Norge :

(i) radiographic reports
(ii) ultrasonic reports
(iii) magnetoscopic reports
(iv) welding procedures
(v) drawings showing orientation of joint nos.
(vi) the "as carried out" drawings

for the above the following should be noted :

a) Radiographic data

Type of fay : gamma
Radiation source : Iridium 192
Activity : 120 Curie, min. 25 Curie
Size of source : 3x2, 2x2 or 3x3 mm.
Film for up to 2 in. wall thickness :
Gevaert D5 Structurix Pb, 2/100 mm screen
Film for 2 in. wall thickness and over :
Kodak M, 2/10 mm lead screen

../..

../..

Type of radiation equipment :
UIE : A.G.S. type 2 GAM 120, Uranium Container
Pipeline Service : P.L.S. Type 2 AGECI, Uranium Container
Film developer : Automatic developer PAKO Pakoral, traded by Gevaert.
Penetrameters : Acc. to DIN 6Z F3,
1/7 thickness 38 to 200 mm
6/12 " 8 " 80 mm

Otherwise radiographis were produced in accordance with AWS D1.1, Section 6, Part II and evaluation of radiographs in accordance with ASME Boiler and Pressure Vessel Code, Ed. 1971, Division 1, Section VIII, § UW-51.

b) Ultrasonic data

Ultrasonic apparatus : Krautkrämer US M2.
Make, soundhead : Krautkrämer
Frequency : 2-6 MHz, normally 4 MHz.
Otherwise ultrasonics were performed and evaluated in accordance with ASME Boiler and Pressure Vessel Code, Ed. 1971, Division 1, Sect. VIII

c) Magnetoscopic data

Magnetoscopic apparatus : Picker Andrex
Magnetising current : max. 1000 A, norm. 800 A
Distance between poles : max. 6 in.

Otherwise magnetoscopic inspection with ASME Boiler and Pressure Vessel Code, Ed. 1971, Division 1, Section VIII and evaluated in accordance with AWS D1.1, Section IX, § 9.25.

d) The "as carried out" drawings

All structural drawings have been stamped and signed.
The following should be noted regarding the drawings :

no. ELN 2098 sheet no. 205 :

rev. 12 has been stamped and signed whilst the structure in fact was built to rev. no. 11 at the yard. The specified change between the two to be carried out off-shore.

../..

../..

no. ELN 2098 sheet no. 222 :

Latest rev. no. received from HO is no. 1, rev. no. 2 has been stamped and signed. Item specified on drawing to be shipped loose, departure Le Trait 14th October, 1975.

no. ELN 2098 sheet no. 225 :

Latest rev. no. received from H.O. is no. 1, rev. no. 0 has been stamped and signed. Alteration rev. 1/rev. 0 not carried out.

no. ELN 2098 sheet no. 229 and no. 230 :

Items specified presently under construction. To be shipped loose, (together with item sheet no. 222).
Departure Le Trait 14th October, 1975.

Yours faithfully,

for J. Bergström.

Form No. 40.91a

OBJECT : BRIDGE LANDING A10-A13-A17

INTENDED FOR : QUARTER PLATFORM ELF NORGE A/S

MANUFACTURER : RICHARD DUCROS ALES

ORDER N° 74598/01.12

PURCHASER : UIE

ORDER N°

In connection with the above mentioned order, the undersigned surveyor attended at Richard Ducros,shop, Alès on the 22nd of March in order to witness fabrication of the bridge landing A10-A13-A17.

The bridge landings have now been finally inspected. All x-rays found acceptable as well as the dimension control.

The bridge landings A10-A13-A17 were finally stamped NV.

MARSEILLE 1.04.75

1st April 1975

ODDMUND STANDAHL

2.4. Final survey report modules, QP-TPl bridge and microwave tower

flo/vwh/eb 23.4.76 tlxno 6859

elf, paris
att.: messrs. pelissier/champetier

copy sent to:
mcdermott-hudson, att. messrs. stagg/gair
dnv, marseille, att. mr. fjelldal
dnv, cherbourg, att. mr. blom

frigg field -qp jacket
module a

please be informed that det norske veritas through
-review of mcdermott-hudson's construction dwgs,
-review of mcdermott-hudson's desogn calcs.,
and
-own calcs.

is satisfied that the module a is designed in accordance with the regulations of the u.k. department of energy.

as to the lifting padeyes of the module a, the structural design has been reviewed and found satisfactory acc. to the assumptions made by mcdermott-hudson with regard to the weight of the module and the loads imposed during handling, including the chosen shock factor.
dnv, marseille will shortly advise us by telex a statement that the material fabrication, fabrication and assembly work of both module and lifting padeyes, is carried out to our local surveyors satisfaction.

regards olbjoern/torset

veritas o+++

kk
16192b verit mb
jaramachud wem

lex no 397 30.09.76 cw/gd

attn: v m i olbjoern / torset

hereunder copy of telex sent to elf, paris on 20.09.76

quote:

telex no 373 20.09.76 of/gd

attn: mr. charpentier - elf paris
cc: chantiers de la garonne

==========

project frigg qp - no 601436 - yard: chantiers de la garonne quai de brazza, bordeaux.

we have the following remarks regarding the above:

module b :
- reservation:
structural: fire doors to be replaced by 15 doors.
special test: fire pump in working condition
motor control center in working condition
lower sterilizer unit
air conditionning
fire detector and e s d system
gas detector system

- helihangar: reservation
pressure testing of fire line
- helideck: no reservation
- battery room: no reservation
- lift motor room: no reservation
- q 9 : reservation - final test.

departure
=========
module b, helihangar, lift motor room, q 9, left 13th september 1976 to stavanger.

module a :

module b :
- reservation:
structural: fire doors to be replaced by 15 doors.
special test: fire pump in working condition
motor control center in working condition
lower sterilizer unit
air conditionning
fire detector and e s d system
gas detector system

- helihangar: reservation
pressure testing of fire line
- helideck: no reservation
- battery room: no reservation
- lift motor room: no reservation
- q 9 : reservation - final test.

departure
=========
module b, helihangar, lift motor room, q 9, left 13th september 1976 to stavanger.

module a :
completed 8th july 1976. no reservation.

d n v marseille

unquote.

for your information, in addition to the above:
we inform you that the padeyes (module a, b, q 9) have been fabricated according to the specification. no reservation.

chr. wintermark d n v marseille

end+++

16192a verit n
verit_mars

16192a verit n⌀
elftf a 611218f

olb/o⌀ opt/vwh/th 24.6.76 telxno 9817

86

elf norge, paris
att.: messrs. pelissier/champetrier

copy sent to:
mcdermottt-hudson, london, att. messrs. stagg/gair
mcdermott-hudson, london, att. mr. robbins
dnv, marseille

quarters platform
techn. acceptance of structural elements

please be informed that det norske veritas through review of
- mcd-h design calcs.
- mcd-h construction dwgs.
- own calcs.

are satisfied that the following items are designed and fabricated in acc. with the regulations of the u.k. dept. of energy:

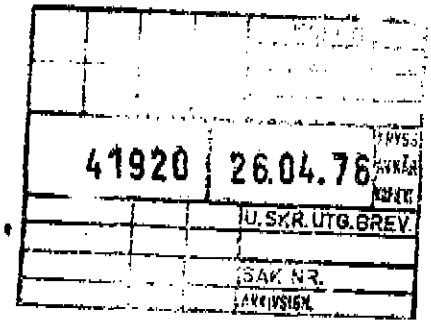
a) module b
b) hangar room
c) helideck.

so far we cannot see to have received info./calc. of battery room and lift motor room and we have therefore no comments to these elements.

regards olbjoern/torset
veritas, oslo ++++
16192a verit n⌀
elftf a 611218f

norverit marsl
101224 verit n

telex no 105 ref.: of/loev marseille 23 april 1976



attention v.m.i.
++++++++++++++++

elf
qp - frigg atl. chantiers de la garonne.

this is to certify that the module a has been completed according to drawings, and tested satisfactorily. the only remaining point is checking of insultation resistance on the electrical installation. this will be done next week.

regards
fjeldal
dnv,marseille

norverit marsl

jaramachud ldn
16192c verit n

opt/kh/janb 1.10.76 telex no 100015

elf norge paris
attn: messrs pelissier/champetier

copy :
elf norge, stavanger attn: bjoernestad
mcdermott-hudson, london attn: messrs stagg/gair
mcdermott-hudson, london attn: mr.robbins
dnv, marseille

frigg field quarters platform
technical acceptance of structural elements

please be informed that det norske veritas through review of
- mmcd-h design calcs volumes 10, june 1976
- mcd-h construction dwgs
- fabrication reports

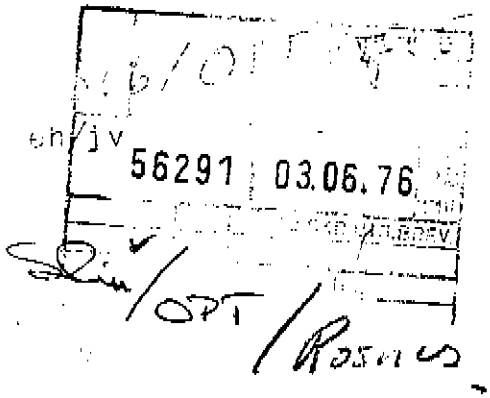
is satisfied that the following items are designed and fabricated in accordance with the regulations of the u.k. dept of energy.
a) battery room
b) goods lift
c) q9 generator module

regards olbjoern/torset
veritas, hovik+++

jaramachud ldn
16192c verit n

15.02 @
16192a verit mrs
16192a verit n
norverit marsl

telex no 172 marseille 3/6/76 eh/jv



v.m.i.

att. eri/olbjorn

subject : elf / frigg field cp platform bordeaux

the following items have been inspected according to specification and drawings, and with following reservations :

1. helihangar - reservation :
insulation test of electric cables.

2. helideck - res.:

pressure testing of fire line.

3. battery room - no reservation

4. lift motor room - no reserv.

for your information :

module b will be charged on barge end of this month. testing at finished. n

regards.

2.5 Final survey report microwave tower

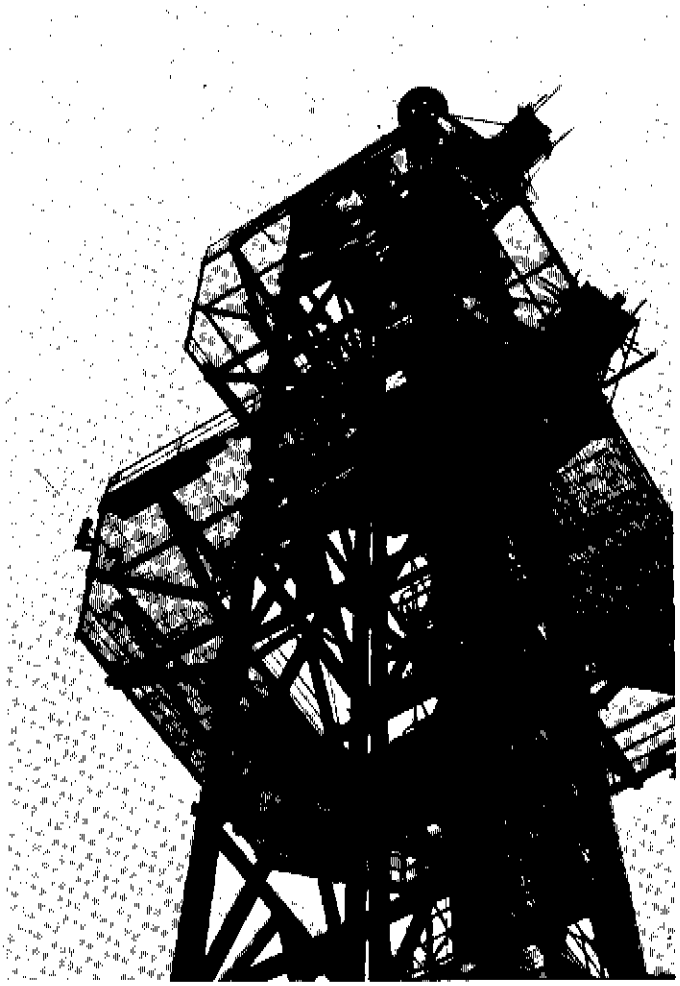


Photo 10: Microwave Tower

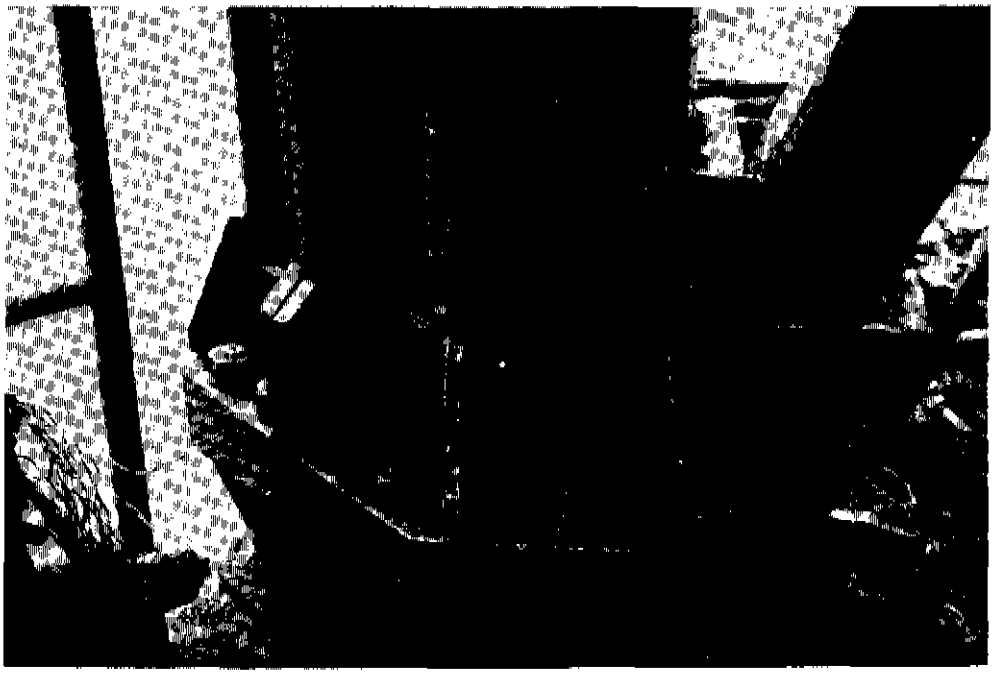


Photo 11: Support, Microwave Tower

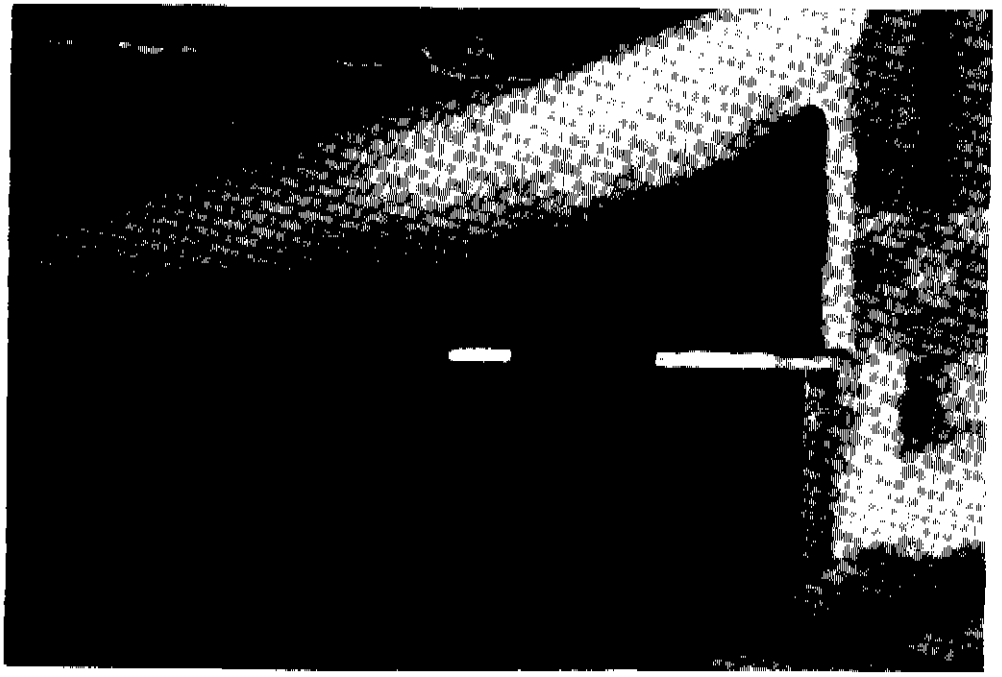


Photo 12: Support, Micowave Tower - Summer 1977

BORDEAUX - 14-5-76

This is to certify that the undersigned surveyor, at the request of

LA CHARPENTE MODERNE
143 Rue Berthelot
33322 BEGLES,

did attend at their works for the purpose of examining the fabrication of the below mentionned material ordered by :

ELF NORGE
Order : 2111-20- R 05 - P 000 4
Works order : 8645

MICROWAVE TOWER

- The fabrication of the microwave tower has been carried out according to drawing s CHARPENTE MODERNE n°7436 01 to n° 7436- 19 approved by Mac Dermott.
- The material certificates have been examined and found in order.
- The welding were made according to agreed welding procedures and by approved welders.
- Ultra-sonic test were made satisfactorily.
- The workmanship was good.
- Visual examination and dimensional check have been carried out in presence of ELF and Mac Dermott representative.

F.RULLIER

DET NORSKE VERITAS BORDEAUX

2.6 Final survey report QP-TP1 bridge

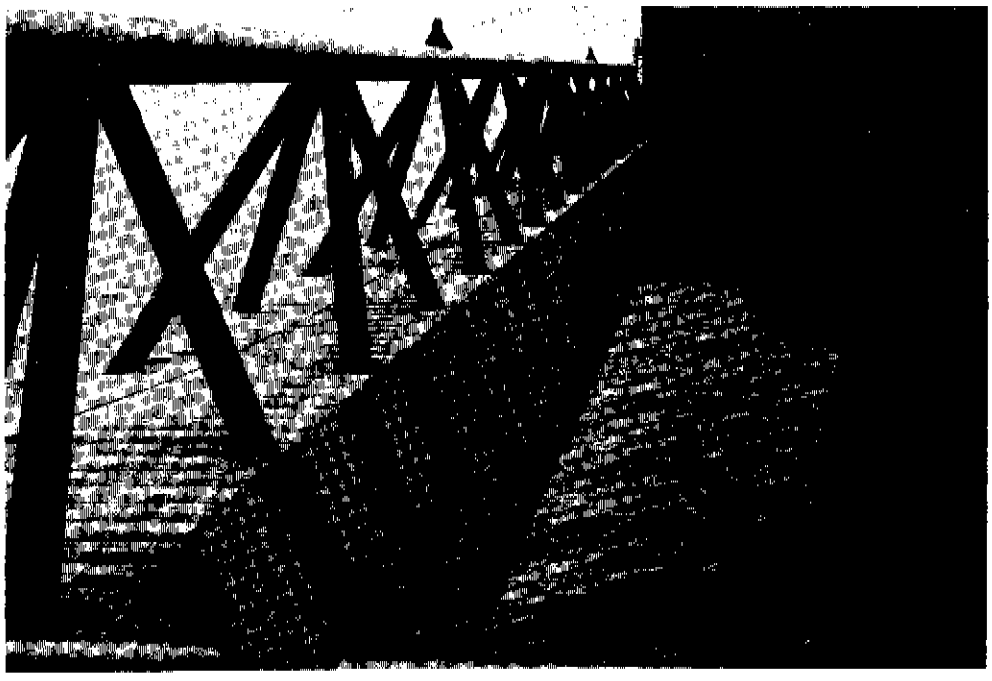


Photo 13: Bridge QP - TP 1 (Taken from QP)

Photo 14:
Center pin in bridge support

Photo 15: Bridge Support on QP

Photo 16:
Close-up of shim plate bridge support on QP

o: mc.dermott hudson, wembley
att: mr. b. homayoun

cc: elf norge, paris
att: messrs. nicot/dussert tlx 611218
cc: elf norge, stavanger
att: messrs. bjoernestad/maillotte tlx 33174

re: frigg field - bridge tp1-qp

ref. is made to mc.d.h. telexes no 2059 dated dec. 10, no 2090 dated dec. 13, 1976 and transmittal of shim details dated nov. 16. 1976.

1. shim details for bridge support at tp1 and qp. the design of these shim details appears acceptable to dnv.

2. restraint of bridge support guides.
our own calculations indicate that with the calculated rotations and translations of qp and tp1, no restrain of the bridge support pads in the adjacent guides will occur. although complete documentation of this phenomena still have not been forwarded to dnv, we find further theoretical considerations unnecessary.

3. influence from vibration of tp1 and qp.
we realize the difficulty in making complete theoretical evaluation of the above item. if resonance phenomena occur, the natural period may be changed
in order to follow up the actual behaviour of the bridge and possible interaction effects platform/bridge, field observations may be undertaken .
we would appreciate to have some further discussion with you in order to arribe at a set-up for these observations/measurements.

4. vortex shedding.
the calculations performed by dnv indicate that vortex shedding phenomena may occur for certain frequently occuring windspeeds , resulting in vibrations and large forces. as these calcualtions suffer of uncertainties dueto the structural configuration, field observations may also in this case be necessary to reveal possible problems.

regards olbjoern/torset
veritas oslo++++++++++++++++
33174b elf n
16192z verit n.

loes/opt/eke 3.11.76 tlx no 110236

elf norge
paris

att.: nicot/dussert

copy to: elf norge, stavanger att. mr. maillotte/bjoernestad
mc dermott, wembley att. mr. b. homayoun

subject: frigg field - bridge tp1-qp

reference is made to dnv-telex no. 100848, dated 15.10.76, to mc dermott telex no. mh 1834/2099 dated 22.10.76 , to ''addendum calculation for final length of bridge qp/tp1'' mc dermott-hudson, dated 23.9.76 and to elf telex no. 10561, dated 1.11.76.

reference is also made to the following mc dermott-hudson drawings:

eln no. 2099	sheet no. 290
--''--	--''- 291
--''--	--''- 292

we note that the bridge has been installed although it is not yet formally approved. dnv, antwerpen, has given a release note stating that the fabrication of the bridge is satisfactorily carried out, and in accordance with inspection sheets and inspection diagram. however, the release note includes reservations to dnv-approval of the structural calculations and drawings.

we have the following comments to the structural part of the bridge and bridge landings :

1) bridge feet

we have not received calculations of the main bearing pin. our own check shows that it has too low capacity, mainly due to bending. please clarify.

2) static analysis

the gravity loads based upon lift weight of bridge are acceptable, provided that possible additional loads after installation will not exceed the total weight of 446 kips.
wind loads are acceptable.
based upon these static loads the design of the bridge has sufficient capacity.

3) dynamic analysis

possible vortex shedding of individual members does not seem to be a problem. however, in line- and crossflow vibrationsat resonance may occur for certain wind speeds, due to vortex shedding from the cladded part of bridge.this has to be investigated.

considering the dynamic behaviour of the tp1 and qp and corresponding effects upon the bridge the following comments apply:

- we agree that waves with pase peose periods in the order of 0.5 ϕ 1.0 second contain too little energy to be of major importance.
  however, even for sea states with much higher mean periods (e.g. storms) the main response of the platform deck may still occur at its natural modes.

  thus the bridge will feel the vibration of the platform deck as its excitineee exitiating force.

for a more complete evaluation of possible dynamic effects, we would appreciate you to consider the first modes of vibration for the deck as a whole , not only local vibration of the side landing. torsional mode to be included.

5) bridge landings

bridge movement along centerline of bridge landing due to deflections of the platforms, thermal expansion etc. and rotations of the bridge due to opposite movements of the platforms, will justify the following considerations :

a. the extreme positions of the application of support loads.

b. the total area swept by the bridge feet.

we note that the frictional force obtained by the teflon pads is of minor importance.

regards
olbjoern/torset/ekeberg
det norske veritas, oslo +++

16192b verit mb
jaramachud ldn

2.7 Special selected periodic reports

Periodic reports containing significant aspects of the jacket construction which has been carried out are included.

The Frigg QP Survey Report contains the full list of received week to week reports.
All NDT-reports and test-certificates for the structural parts of the jacket are also contained there.

Form No. 40.91a

Frigg project

Periodical report 15.1. - 31.1./75

QP Platform Socomet

The second bouteille A.2 finished and final inspection carried out except for visual inspection internally on the peeles sleeves which could not be done as they were closed at the time Socomet had called for the inspection.

A part of the flange on the yoke as indicated on the enclosed drawing was deformed and have to be replaced. As it was no time to have it done here it will be taken care of in Cherbourg.
DnV Cherbourg is informed.

The work on bouteille B2 continues with good progress.

The visual, radiographic and U.S control show good welding and workmanship.

QP. support frame St Wandrille

The work started 29th January, 1975. About 25 % of the steel arrived.

Le Havre, 31st January, 1975.

H. Karlsen.

Form No. 40.91a

Project no: 931436.1.

Period : 16-29/6-75

Cherbourg 2/7-75

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1. The repair of internal ring-stiffeners in the cones between the legs and the bottles are in good progress and the work is expected to be finished 3/7.
The work has been slow,mainly because of very difficult workingconditions in particular in the upper bottles.The stiffeners have been put in in three and four pieces and welded out to the cone before beeing welded together,this to prevent cracking in the cone-material.The alignment of the stiffeners seems adequate the conditions taken into consideration.

2.Four cans on panel A. levels +11150 and +28400 have been found deformed after loadout.Exact cause of deformation not known.The magnitude is up to approximately ± 50 mm.The deformation will be repaired by grouting the cans.Please see enclosed U.I.E. drawing.

3.The repaires on the buoyancy-tanks have been carried out and the tanks accepted.

Form No. 40.91a

4.Apart from the damage to the cans on panel A. the loadout 17/6 was carried out without problems.

5.New schedule for departure is 10/7.

Yours sincerely:

Christopher Blom

Project : n° 92.1436.1

Period : 2.6 - 15.6

[redacted]une 18. 1975

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1 - Internal inspection of the legs and the bottles are finished,quite a few minor defects were found and it has been rather difficult to have the repairs done properly. Certain areas have been inspected up to three times before they were accepted.

2 - Pressure test of corrosion wraps, piping and internal bulkheads are finished without defects found.

3 - Removal of dogs, tacks, etc. are in progress and the result seems to be good.

4 - Load out is Tuesday 17.6.75 and the date will be kept.

Yours faithfully,

C. BLOM

Form No. 40.91a

bject no : 92.1436.1

[redacted] June 2. 1975

riod : 18/5 - 1/6

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1 - All bracings are now in position and the structural welding is for all practical purposes finished. Quite much cleaning up work is still left to be done.

2 - Inspection of the interior of the legs has begun, leg A2 was done, but so many defects were found that it was refused to carry out anymore such inspections before UIE had checked that everything was O.K.

3 - 62" buoyancy tanks have been fitted around the legs A1 and A2. After fitting, two pile sleeves had to be cut to enable pushing of the jacket. These will later be re-aligned and re-welded. A number of damaged parts have been found on bebuoyancy tanks;mostly because of bad handling by UIE. Several plates have been cut out and replaced.

4 - Preliminary tests of valves for flooding and grouting system have been done; all were working, but the system still needs purging.

5 - The last pressure tests on the corrosion wraps are in progress. Many leaks were found by the yard yesterday.

Yours faithfully,

C. BLOM

Form No. 40.91a

Project : no 921436.1

Period : 21/4-3/5 75

[redacted]/5-75

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1. Face A has now been completed and some minor problems have been dealt with,mainly bad fit-ups and misalignment.This have caused difficulties for the welders and for the ultra-sonic operators who are doing the control. Some defects mainly lack of penetration and lack of fusion have been found,but be-cause of the bad fit-ups the control has been difficult and there have been some doubt if the defects were reparable or not. In the period we have also been troubled with cap-undercut and a number of welds have been recaped because of this and be-cause of bad profile.

2.The diagonals between the launchtruss and the structure on the horizontal levels have been put in place and most of them have had windows cut in them to enable erection.

3.The two braces N1D3 and N1D4 had to be cut and pieces inserted because the bevel to brace AH1 had been wrongly cut and the welding gaps were up to 60 mm. high.

4.In general it seems that the yards self-control is reduced.Incidents involving lack of preheating,cold electrodes etc. are increasing.

Yours:

Christopher Blom

Form No. 40.91a

roject n° 92 1436.1

eriod : 24/3 - 5/4.

[redacted] 7 Avril 1975

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1 - Line 1 and 2 : lift up was carried out 26th. and 27th. of March without problems and adjusting of the position of the panels was done over the Easter week-end.

It seems that line 1, in particular 1H6, is slightly bent. Accurate measurement is not available.

2 - The five first braces on face B, BH1, BH2, BV1, BD1 and BD2 which were pre-assembled on the ground have been fitted and the horizontal members welded. Due to some misunderstanding about the drawings, the brace BD1 is too short and an insert piece will be fitted.

3 - The launch truss is completely welded and the insert into the main structure is planned to take place on the 9th.

4 - The grinding, u.s. inspection to ASME + 6db. and M.P.I. is pratically finished.

Yours faithfully,

C. BLOM

Form No. 40.91a

ect : n° 92 1436.1

od : 10.23/3

[redacted] le 24 Mars 1975

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1 - LINE 1 :
Only work carried out during the last two weeks are fitting of pile guides, painting, welding of stubs and removal of mis-aligned shear plates on bottle B1.

Lift up of the panel is expected this week.

2 - LINE 2 :

As for line 1, only minor work have been carried out.

Lift up expected this week.

3 - LAUNCH TRUSS X & Y :

These were lifted 12.13/3 and most braces between them are fitted in but not welded. The fit up is in many cases fairly poor, but not very much can be done to correct that. The staging around the trusses are bad and I have complained to U.I.E. without result

4 - GRINDING , M.P.I. & U.S. INSPECTION :

Not finished yet on the legs and should be completed as soon as possible before the lift up.

.../...

Form No. 40.91a

oject : n° 921436.1

riod : 24/2 - 9/3/75

[redacted] 10.3.1975

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1) Line 1 :
This line is now completed what concerns mainly structural work. Only fitting of electrical risers and other minor welding is now taking place. The release and realigning of the five shear plates on bottle B1 have not started yet, but is expected to start this week. Other minor modifications of internal stiffening in the bottle are still not carried out.

2) Line 2 :
This line is completed except for bottle B2 which arrived seemingly in good condition last week. The change of face plate on the top yoke of bottle A2 has started and is expected to be finished this week. Minor fitting out work is in progress.

3) Line 1 and 2 :
During the past weeks, stubs for face B have been put on leg B1 and B2. U.I.E. decided they had been erected in a wrong angle to the other braces and 17 stubs, 9 completely welded were released and realigned. The realigning is completed but the welding has not started yet.

4) Launch trusses X and Y :
Both are now completed and lift up is expected this week.

5) Grinding, M.P.I. and ultrasonic inspection of cans that should have been stress relieved are proceeding slowly, approximately 40% is done with no defect found.
The node BH3 which developed a crack after stress relieving is now repaired.

.../...

Form No. 40.91a

DET NORSKE VERITAS

TOTAL PROGRESS TO 28.2.1975

face A	181.475 T.
face B	262.904
line 1	664.253
line 2	602.856
truss X	192.281
truss Y	181.752
el. + 6100	25.580
- 11150	54.392
- 28400	59.238
- 51170	49.901
- 73940	84.875
- 104000	106.819

TOTAL WEIGHT PREFABRICATED : 2.406,325 T. or: 88,9 %.

Yours faithfully,

C. BLOM

Form No. 40.91a

ect : 921436.1

d : 10 - 22.2

Cherbourg, 24.2.1975

FRIGG PROJECT

QUARTERS PLATFORM

PROGRESS REPORT

1 - Line 1 and 2 are now nearing completion with only a few remaining braces to be installed, mainly bottle B2 which is not yet arrived. Stubs are at present being welded to the lines to faciliate the installation of face A. One of these had to be removed because of a long fracture on the first pass and also because of bad fit up. The welding of braces with steep angles to the legs tends to be difficult because of the usual angle (down to 15°) of the bevel.
In my opinion, this angle should never be less than 20-25° and if this is not possible, a different type of joint should be used. The welders here complain daily about impossible joints. Mis-alignment of butt welds is also a problem. One joint with 15 mm mis-alignment at the bottom was found ready for welding. This joint was released and realigned.

2 - Four cans and two nodes have so far been stress relieved at Socomet Le Trait. The result has been good exept for one node, BH3 which developed a 60 cm crack which now will be repaired. Most of the grinding and U.S. inspection have been carried out but the M.P.I. still remains to be done.

3 - The planning has again been revised and target date for delivery is now in the beginning of June. The situation is a bit fluid at present and further revisions will probably come.

4 - Total progress to 14.2.75 :

Face A	170.29 M/T.
Face B	69.95
Line 1	501.49
Line 2	376.97
Truss X	190.78
Truss Y	165.28

.../...

Form No. 40.91a

el. + 6100	25.59
el. - 11150	53.42
el. - 28400	60.19
el. - 51170	58.89
el. - 73940	93.89
- 104000	72.12

This makes a percentage of : 68%.

Yours faithfully,

C. BLOM

Form No. 40.91a

Period 13-26/1 75

Project no:921436

FRIGG PROJECT

QUARTERS PLATFORM

Progress report

The following braces have now been fitted to line 1 and 2 : 1V1,1H1,1D1,1D2,1D3,1D4,1H3, 2H1,2V1,2D1,2D2,2D3,2D4,2H3.
Most are completely welded and there have been few problems with the fit up.The connections between 1D3&1D4 and 2D3&2D4 have no priority member and steps have been taken to make it possible to examine the common weld from the inside.This will be difficult on a number of other similar connections and we are now working on the problem.
No stress relieving have at the moment been carried out on cans with dangerous welds.
If heat treatment is necessary this will pose a problem,because the subcontractor is not able to start before the middle or end of February, when line 1 and 2 are practically finished.
Two ringstiffeners in bracesection AH22 developed serious fractures in the brace-metal and AH22 will now be exchanged for a new one.The internal stiffeners in these sections will from now on be cut in three pieces which are welded together after the welding to the bracing this to reduce the stresses.

./.

Form No. 40.91a

A 10 cm. fracture was found in the weld between bracing 2H1 and A2-1.Probable cause was failure in a tackweld that later was incorporated in the main weld.From now on all tackwelds will be removed before the main weld is done.

Total progress to 23-1.

Face A	141,45 t.
Face B	Nil
Line 1	431,35 t.
Line 2	339,9 t.
Truss X	185,26 t.
Truss Y	116,58 t.
El +6100	25,59 t.
÷11150	53,42 t.
÷28400	60,19 t.
÷51170	58,89 t.
÷73940	93,89 t.
÷104000	66,25 t.
Total	1572,77 t.

This makes a percentage of 60%.

Cherbourg 27/1 75

C.Blom

Period 15-31/12

Project no.921436.1

Frigg Project
Quarters platform

Progress report

1. The bottle B-1 from Steri is now nearing completition here.The extra ultrasonic inspection is now carried out and the operator found approximately 40% of the welding between the shearplates and the bottle and the pile-guides to be repaired.These repairs will not be carried out before a third a third ultrasonic opperator has checked the welds.This is in agreement with the owner and Steri.
2. There is some delay in the fabrication of can sections because of the ongoing discussion about treatment of welds that falls inside certain areas of bracing intersection,and also because of the failure of one welding procedure to qualify.In addition some of the ÷40 steel have not yet been approved by D.n.V. in the rolling mill.

./.

Form No. 40.91a

Total tonnage completed as pr.19/12 100% finished bracing.

Face A.	116.420
Face B.	
Line 1.	283.937
Line 2.	266.732
Truss X.	156.134
Truss Y.	91.917
+ 6100	19.191
- 11150	43.621
- 28400	55.764
- 51170	37.764
- 73940	71.584
- 10400	40.332

This makes a total of 44.8 %

Cerbourg 31/12 74.

Form No. 40.91a

Period 1/1-10/4-75

Project n° :921436.1

FRIGG PROJECT

Quarters Platform

Progress report

1) The first bracings have now been hung in place and some problems are occuring with bad fitting and unequal lenght of bracings. In addition the fit of the corrosion wraps is not particularly good.
The bracings have up to now been fitted with total disregard to our recomendations concerning stress relieving. The matter will again be discussed at a meeting here 14.1.
There has also been some trouble with bracings with common welds. In the end of September last year, we asked U.I.E.to weld the stubs together first, and then add the rest of the bracing, this to enable inspection and possible repair from the inside. We are now being faced with the problem that this has not been done in some cases.

2) I have given the yard permission to cut holes in stiffeners and brackets where they cross other structural welding, this to prevent interference of welds.

Form No. 40.91a

DET NORSKE VERITAS · GRUNDLAGET 1864 ·

TOTAL TONNAGE COMPLETED as per 10.1.75.

Face A	126.259
Face B	-
Line 1	361.170
Line 2	266.732
Truss X	175.383
Truss Y	98.548
el. + 6100	19.191
" - 11150	43.621
" - 28400	55.761
" - 51170	46.768
" - 73940	93.886
" - 104000	40.332
TOTAL.....	1327.651

Percentage of total : 50,3 %

[redacted] January 13th., 1975

C. BLOM

2.8 Special problems during fabrications

a) Shear plates between leg and pile sleeve

The main legs was fabricated in sections. The lower sections, from elevation - 69975 and down, is called bottles. It was a requirement that the shear plates intending to transfer the loads from the piles to the main leg (photo 8,page 109) should be made continuous. Due to some misunderstanding at the yard, bottle B1 was fabricated with discontineous shear plates, i.e. the stifferners was made continuous. By measurement at the assembly yard, mismatch of the shearplates was found. This was however repaired to the satisfaction of the DnV surveyor.

b) Grouting of damaged nodes

As referred to in section 1.5.9, six of the launch truss nodes were required reinforced with internal ringstiffeners due to a calculated overstress when being launched from the barge. Due to settlements of the slipway during load-out, the four remaining launch truss nodes at level -11150 and -28400 (nodes nos. 140, 141, 142 and 143) was slightly deformed in compression. Internal plates was welded in on each side of the nodes and expanding grout filled in between the plates. Ths method of repair was found satisfactory to DnV.

c) Internal ringstiffeners at elevation -73940

In the transition zone between leg and bottle at elevation -73940, the internal ring stiffener was supposed to be placed excatly at the knuckle.

By a mistake this ringstiffener was placed approximately 2" off position. All stiffeners was cut down and welded in exact position just before load out on barge.

d) Reinforcement of support frame

Due to large support loads from the modules, the support frame was locally reinforced with an external ringstiffener and web and flange along the middle vertical member.

e) Additional storage area in support frame

After installation on field, two additional storage decks/frames have been incorporated in the support frame. The loads have been transferred both to upper and lower chord of support frame. The calculations show only a minor increase in the stresses due to those additional storage areas.

3. INSTALLATION RESUME

3.1 Installation Schedules

ITEM	REMARKS
JACKET	Launched from barge DB 22 on 16.7.75. Final positioning and installation on 18.7.75. Installed uncorrectly with 1 leg 10 m inside Norwegian Sector.
PILING	Preparations started immediately after launch of jacket. Piling initiated beginning of August 1975. All main piles in place by November 1975. Piling work finally completed September 1976.
SUPPORT FRAME	Lifted into place and installed 12.10.75.
SUB-STRUCTURE STIFFLEG-CRANE	Installed 16.10.1975.
SUB-STRUCTURE DRILLING MODULE	Installed 26.10.75
STIFFLEG CRANE	Lifted into position and installed 30.4.76.
TEMPORARY LIVING	Lifted into position and installed 18.5.76. Skidding and lifting of modules was performed between 10-24.8.76. The temporary living quarters and the accompanying helideck were removed 22.3.77 to give the

permanent quarters.

MODULE B	Lifted into position and installed 29.10.76.
BRIDGE QP-TP 1	Lifted into position and installed 30.10.76.
MICROWAVETOWER	Installed mid-January 1977
MODULE A & HELIDECK	Installed 18.4.77

3.2 QP-TP1 Bridge Support

In the design of the support it was assumed that the bridge was free to rotate both in the horizontal and vertical plane, see photos 14, 15 and 16 (p. 133-134).

Due to low capacity of the bearing pin (photo 15 and 16) it was agreed to support the pin in a way that would not restrain the connection. However, after installation a shim plate was welded on in a way that restrain the bridge from rotation in the vertical plane without rotating the complete support. However, due to very small rotation expected, the support was accepted provided carefully inspection is regularly carried out.

3.3. Installation of piles

3.3.1 Main pile installation

- Pile driving

All piles has been driven to final penetration with a Vulcan 060 and 560 hammer without any need for relief drilling. The blowcount was fairly low except for a peak at 55' penetration. The final penetration of the piles are:

A 1.1 60'	B 1.1 62'
1.2 60'	1.2 56,5'
2.1 60'	2,1 60'
2.2 57'	2.2 57'

DnV has reviewed the piledriving and found it sound and in accordance to the specifications. The under and over drive of some of the piles is wihtin the tolerances set in the design.

3.3.2 Main pile grouting

All piles has been grouted to the main structure. In one case pile A.1.2. plugging in the groutsystem occured. However, corrective steps was taken and all annuluses have been grouted in a acceptable way.

In a proper handeling of groutsamples taken resulted in an incomplete confirmation of compressive strength.
However, the indication received and the fact that class b cement was used make the result acceptable.

3.3.3 Insert pile drilling and installation.

The insert piles were installed in holes drilled with1,22 m diameter bits shrough the driven piles. The holes were drilled with a reverced circulation drilling technique and mud as drilling fluid.

In some cases loss of drilling fluid occured and the hole had to be stabilized by grouting in localized areas.
Otherwise, the installation records are reviewed and the work carried out is found to be according to specifications.

Grouting of insert piles

The insert piles were grouted to the soil and the main piles in a two stage operation. In some cases hydraulic fracturing of the soil happened during grouting. However, a review of the installation records shows that.

The necessary steps were taken and that finally the annuluses were completely filled with grout.

For insert pile grouting a diacemoil type cement grout was used in order to get leight weight slurry to avoid fracturing in the soil.
Compression test of the grout samples revealed results below what was specified, and a discussion has arisen upon what the actual bondstrength is.
It has been agreed that the bond strength is to be documentated by additional tests. Such tests are in progress at the DnV laboratory.

3.4 Final installation report

Det norske Veritas

INSPECTION SERVICES, WEST NORWAY

ADDRESS: CARL KONOWSGT. 36, N-5031 LAKSEVÅG, NORWAY TELEPHONE: (05) 26 00 12

TELEX: 42 913 dnvbg n

TECHNICAL REPORT

VERITAS Report No.	Subject Group
601436/77/36/1	

Title of Report

INSTALLATION OP STRUCTURE FRIGG FIELD

PHASE I

Client/Sponsor of project

ELF AQUITAINE NORGE A/S

Work carried out by

SULEN / DAHLBERG

Date	
28.11.77	
Department: RV36	Project No.: 601436

Approved by

M. OLSEN

Client/Sponsor ref.

Reporters sign.

Summary

This report is a summary of the inspection work carried out offshore by DnV-surveyors from DnV-Bergen office.

The report covers all phases of installation of the Jacket - Piles - Deck Modules. It does not cover hook-up of production equipment.

4 Indexing terms

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Date of last rev.	Rev. No.

Number of pages

INTRODUCTION

This report is a summary of the work done offshore by DnV-Bergen during the installation of QP structure on the Frigg Field.

The report covers:

1. Launching and installation
2. Pile - Installation - MAIN
3. Deck Support Frame
4. Welding - Fieldsplice DSF/Jacket
5. Temporary modules installation
6. Pile installation - insert
7. Permanent module installation
8. Miscellaneous
9. APPENDIX

1. Launching and installation

The QP Jacket was towed out from Cherbourg, France to the Frigg Field on barge Intermac 600. It was launched in the English part of the Frigg Field in the morning of July 16th, 1975. After upending and towing to location it was finally set down on the bottom in position:

N. 59°52'42.42"
E. 02°03'53.83"
ORIENTATION 334,3° TRUE NORTH

The operation was supervised by Oceanic Contractors from barge DB 22. After releasing the towing tugs, barge DB 22 moved in and anchored up alongside the Jacket. A underwater survey by submarine was carried out, without revealing any structural damages.

2. Pile installation - main

The installation of the eight 54" mainpile started with B2.2 and continued with B1.2 - A1.2 and A2.2. The Jacket was then levelled by pumping air into the corner legs. Keeping the Jacket afloat and level, grouting between the three mainpiles B2.2 - B1.2 - A2.2 and the structure was completed. Samples from the grout during grouting were taken. Six cubes 4" x 4" x 4" were made at the beginning and the end on each stage. Together with the sample a PILE GROUTING RECORD was written and signed by the field DnV-surveyor. All the records were sent to DnV-headoffice for evaluation. The grout samples were sent to laboratory for 7 and 28 days' test. The grouting was carried out in one stage according to procedure. After receiving new supply of cement the grouting of A1.2 was prepared. By mistake of the supplier in Aberdeen, Scotland the type of cement was wrong.

This was discovered because it was not possible to obtain the right slurry weight. The grouting of A1.2 was stopped and the cement replaced. Accidently the groutline was plugged. No further attempt was made to grout this mainpile before May, 1976. By using flexible connection and divers the grouting of A1.2 was then successfully completed by barge ETPM 1601. In the meantime, however, the remaining four mainpiles were installed and grouted. All mainpiles, except A1.2 were installed and grouted in the beginning of November 1975. The PILE DRIVING RECORDS and the PILE GROUTING RECORDS were signed by the field DnV-surveyor and sent to DnV-headoffice for evaluation. All the eight mainpiles were driven to penetration within limit of design without any jetting or drilling. The piles were driven with a Vulcan 060 and 560 hammer.

The screwed connection (rockwell) on the top of mainpile and between temporary followers did not work as fast as planned. Because of the small tolerances, it took up to sixteen hours to complete one rockwell. In some cases they gave it up and cut out the rockwell connectors and made it a welded connection. This was done because of the design of False Rotary Table with no possibility to adjust misalignment. The installation work was done by Oceanic Contractors and barge DB 22.

3. Deck Support Frame

When the corner primary pile installation was completed, the top of the four corner legs was cut, bevelled and prepared for setting of Deck Support Frame.

The Deck Support Frame was lifted onto QP-Jacket with barge DB 22. The lift was carried out on October 12th, 1975, and went as planned. After a survey on the four legs permission to weld the fieldsplice was given.

4. Welding - fieldsplice DSF/JACKET

The four fieldsplices between DSF/JACKET were welded according to accepted welding procedure SW-70 2G position, prescribing min. 150°C preheat and ESAB OK-73.68 electrodes. All welders were certified ASME 6G. After completion of the four welds magnetic particle inspection and ultrasonic inspection were carried out and acceptable to ASME VIII. The welding was carried out by welders from barge DB 22 and supervised by Oceanic Contractors.

5. Temporary modules - installation

After the four fieldsplices were completed, barge DB 22 left the Frigg Field due to contract completion. Barge ETPM 1601 took over and performed two lifts. On October 16th, 1975 ETPM 1601 lifted the "crane substructure module" and October 26th, 1975 the "drilling substructure module" was lifted. From that day and until April 30th, 1976 no work whatsoever was done on QP due to bad weather during the winter. In the meantime the barge "Blue Whale" had a major accident on February 23rd, 1976 when the crane boom fell overboard close to QP. There was,however,no damage on the Jacket.

Then on April 30th, 1976 barge ETPM 1601 lifted the "stiffleg crane module" on QP, and during the middle of May, 1976 barge L.B.Meaders lifted Temporary Quarter/ Helideck module. In a few days the necessary hook-up

work was done, and the crew for installing insert pile moved in.

6. Pile - Installation - insert

The installation of the eight insert piles started on June 2nd, 1976 and was completed on October 20th, 1976. The work was carried out by Oceanic Contractors. For the welding of the insert pile a welding procedure was carried out and accepted, prescribing 150°C and PHILIPS 36S electrode. All welds on the insert pile were subject to magnetic particle and ultrasonic inspection and accepted according to ASME VIII. If welds did not meet with the requirements, they were repaired to the DnV-surveyors satisfaction. During drilling of the holes for the insert pile, circulation of the drilling fluid were lost due to leak in the rockwell connections and hydraulic fracturing of the soil several times. However, in the soil cement plugs were made and afterwards drilled through. Because clay was balling up on the big diameter bit (1,22m) the drilling speed was very slow only two feet/hour normally.

Insert pile B1-2 was the first one completed, then A1-1, B1-1 and A1-2. Each pile was grouted in two stages, and twelve samples of the grout were taken of each stage. Using the same sample procedure as for main piles. After these four insertpiles were completed, all the temporary modules had to be turned around in order to install the insert pile on A2 and B2 legs. The operation was done partly by lifting of some modules, performed by barge ETPM 1601, and by skidding some modules. Before the skidding started, the filled welds under the top of the DSF was reinforced based on calculation from Oceanic Contractors and accepted by DnV. The whole operation was completed between August 10th and 24th, 1976. Then installation of B2.1 started

and continued with A2-1, B2-2 and A2-2. The same problems during drilling and grouting occurred as for A1 - B1 installation. All PILE GROUTING RECORDS were signed by the field DnV-surveyor and sent to DnV-head-office for evaluation.

7. Permanent module installation

On October 29th, 1976 barge ETPM 1601 lifted off the drilling rig and temporary drilling substructure modules. The same day they lifted the permanent module B onto QP. The next day, October 30th, 1976, the bridge between TP1 and QP was installed by ETPM 1601. No further lifting was performed before March 18th, 1977 when barge ETPM 1601 lifted off the rest of the temporary modules and a week later installed the permenent module A and the helideck.

8. Miscellaneous

When it was decided to skid the crane substructure module instead of lifting it off QP, it was necessary to cut off the bridge landing on QP facing TP1. After completion of the skidding the bridge landing was welded back in position again, inspected and accepted according to ASME VIII. Walkways, handrail, container platform and ladders were installed. General clean up and removing of temporary structures and attachments were done. Magnetic particle examination was carried out to the satisfaction of the field DnV-surveyor. All exposed area and fieldwelds were sandblasted and painted. Boatbumpers were installed according to drawings. Boatlanding is at present not installed.

The antennamast is installed. Where nothing else is specified, the offshore inspection by DnV-surveyors is carried out in accordance with:

ASME section V and VIII

ELF-NORGE FRIGG FIELD
FIXED OFFSHORE STRUCTURES
FABRICATION SPECIFICATION REVISION 2

ELF-NORGE FRIGG FIELD
QUARTER PLATFORM
INSTALLATION PROCEDURE REVISION 1

DnV TECHNICAL NOTE FOR FIXED OFFSHORE STRUCTURES

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A P P E N D I X

1. Telex and welding procedure
2. NDT reports from clean up
3. Surveyors' reports.

} See DnV report 601436/77/36/1

3.5 Special selected periodic reports

Periodic reports containing significant aspects of the work and installation which has been carried out are included.

Accident which have occured are marked with red lines as are important points concerning future in-service-inspection.

F R I G G F I E L D

Perioden 22.7 - 5.8. 1975

Ordre nr. 92 14 36

Frigg Field - Phase 1/QP

DB "22".

Arbeid utført i perioden:

Sleperepene på A2 og B1 er fjernet.

I forbindelse med demonteringen av disse, som ville henge seg opp i guider og bracingen, ble det brukt endel kraft ved hjelp av kraner og to vinsjer. På spørsmål til dykkersuperintendant, ble det gjort klart at de ikke kunne rapportere noen skade i disse aktuelle områdene. En ide for ettertiden ville kansje være å montere en innordning slik at disse sjaklene lettere kunne åpnes, eventuelt også fra overflaten.

Buoyancy tanks no. A1.2, A2,2, A2,2, B1.2, B2.2 er fjernet.

Uhell i forbindelse med ankerforflytting.

Et glipp ved en ankerforflytning gjorde at en ankerwire hengte seg opp i legg A2. Se vedlagte skisse. Her ble brukt betydelige krefter, ca. 1000 amper på ankerspillmotor, høy gear, samt slepebåtens trekk-kraft. Ut fra dette ytret jeg ønske om inspeksjon av denne leggen for å få klargjort hvor ankerwiren hadde hengt seg opp og om noen skade var blitt gjort. Forøvrig måtte wiren kuttes for at vi skulle få anker og wire ombord. - Etter et møte mellom DB-22's superintendant, Elf's representant Touchet, fire mann fra Ubåtkompaniet Intersub og meg, ble det bestemt at inspeksjonen skulle foretaes fra deres Ubåt, samt at eventuelle skader skulle video-tapes.
Resultatet av inspeksjonen viste at alt var forden. Det kunne kun rapporteres om noen blanke overflatestriper ved A2÷ 242 og A2÷ 302. Det er da sansynelig at wiren hengte seg opp i ørefeste/sjakkelpartiet ved A2÷242. Inspeksjonen viste og at samtlige gulder på A2 var ok.

Primær-pile B2.2 ferdig drevet uten jetting.

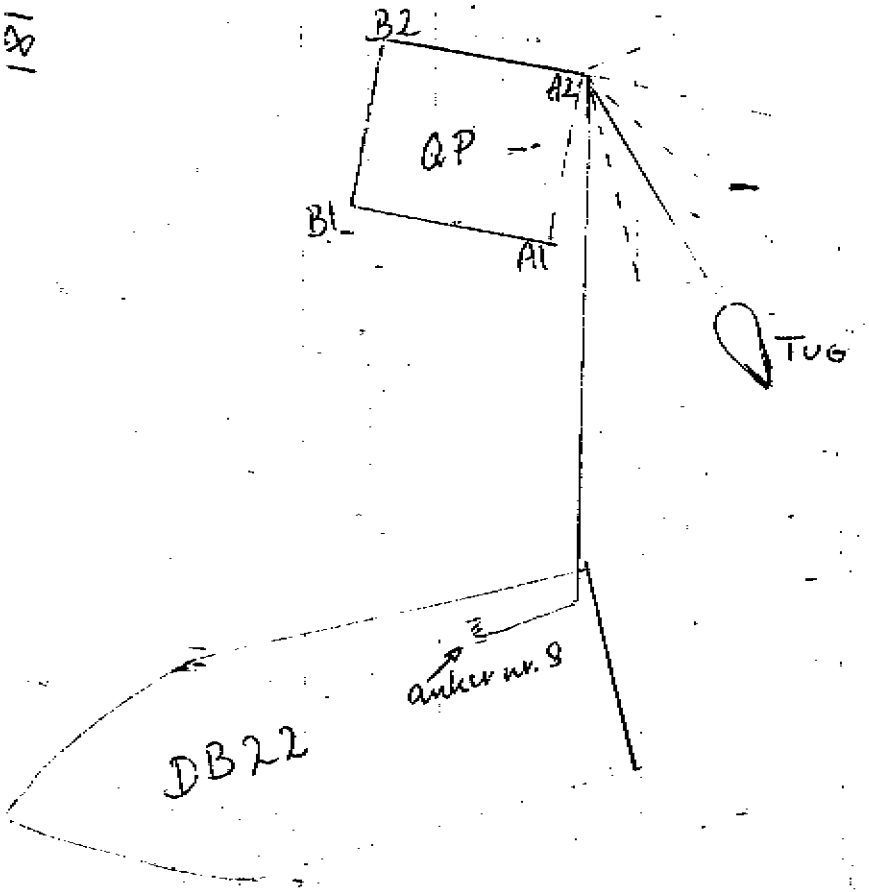
Primær-pile B2.2 er drevet til 57' under mud-line. En kopi av "Piling Driving Record" er lagt ved. Her må nevnes at followersystemet burde vært ca. 10' lengre for å lettet drivingen mot slutten slik at man hadde sluppet å komme i konflikt med False Rotary table.

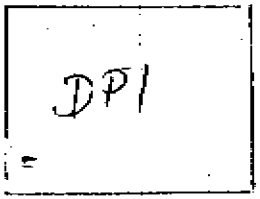
False Rotary table flyttet til B1.2, klart for piling.

Bergen, 19. august 1975

Alf Brekke

SKISSE





F R I G G F I E L D

Ordre nr. 92 14 36

Perioden 19.8. - 2.10. 1975

DB "22"

Q plattform

Arbeid utført i perioden.

Det ble foretatt en prosedyreprøve i 2 G posisjon på 2" plate, stålkvalitet st 52-3N, forvarming 150°C under sveising.

Main pile A2.1 og B2.1 ble drevet ned til foreskreven dybde.

Under låring av mainpile B2.1 røk wirene slik at pilen med followerne fikk et fritt fall på 8-12' med den følge at pilen penetrerte 12'.

Det ble foretatt en nivilering på toppen av horisontalene på el+20', se vedlegg.

Main pile A2.1 ble grautet. Det var anskaffet ny sement og vekten av graut før pumpen var 15,4-15,2-15,4-15,2-15,3 og 15,6 lbs/gallons på returen.

Da det skulle sirkuleres sjøvann på main-pile A1.2 før grauting viste det seg at grautinglinjen var tett. Denne ble trykket med 1500 psi. En flyttet så over til returlinjen som også viste seg å være tett. Det ble opplyst ombord at en tidligere hadde prøvet å graute denne pilen, men at en ikke kunne få opp vekten til 15,0 lbs/gallon på grauten så en hadde sluttet å pumpe og begynt å sirkulere sjøvann inntil returen synest å være rent sjøvann.

Bergen, 12. september 1975

Aksel Dahlberg

Aksel Dahlberg

4 vedlegg.

av/ 183

F R I G G F I E L D

Ordre nr. 921436

DB "22" og ETPM 1601

Q-PLATTFORM

Arbeid utført i perioden 14.10. - 28.10.75

Ved ankomst ombord i DB 22, ble det opplyst at ETPM 1601 skulle overta arbeidet med løftingen av drillingsutstyret på QP.

Da ETPM 1601 ikke hadde godkjente sveisere ombord, ble DB 22 liggende ved QP til leggene var ferdig sveist før bargen forlot QP.

ETPM 1601 ankret så opp ved QP, og løftet "sub-struckture, stiff-leg crane" opp på QP. Denne enheten ble satt opp 5 - 6 ft. for langt mot A 2, siden over legg A 2 - B 2.

Under arbeid med kutting av sjøfestene for "stiff-leg crane" enheten ombord på barge 258, tippet denne enheten over, og skadet en drillingsenhet. Det oppstod en del skader på begge enhetene, og disse skadene må repareres før utstyret igjen er operasjonsklart.

Materiallekteren ble tauet til Stavanger, og ETPM 1601 gikk etter for så å ta "sub-struckture drilling modul" ombord.

Ved tilbakekomst til QP, ble denne enheten løftet på plass over A 1 og B 1 leggene.

Ultralydkontroll av leggene, ble ikke utført, da rengjøringen ikke var ferdig.

Bergen, 3. november 1975

Alfred Dahlberg

A. Dahlberg

FRIGG FIELD PHASE I

Perioden 17.2.76 - 24.2.76

Ordre nr. 601436

"Blue Whale"

Arbeid utført i perioden

"Blue Whale" lå nesten hele tiden for anker ved QP, og alt ble gjort klart til løfting av stiffleg kran.

Søndag 22.2. blåste det opp til styrke 10-11 med tung sjø. "Blue Whale" lå da med 8 anker ute ved QP.

Mandag 23.2. ca. kl. 0830 fallt bommen på stiffleg kranen ned og ble hengende over skutesiden. Kl. 1051 ble bargen truffet av ekstreme bølger som forårsaket 24° rulling till BB og 44° til styrebord. Dette forårsaket at bommen på 2000 tons American kranen slet wirer og løfteører på stiffleg kranen, mens bommen gikk i sjøen på styrbord side.

Kl. 1800 23.2. ble siste av de 8 ankerwirene kuttet, og vi forlot Friggfeltet.

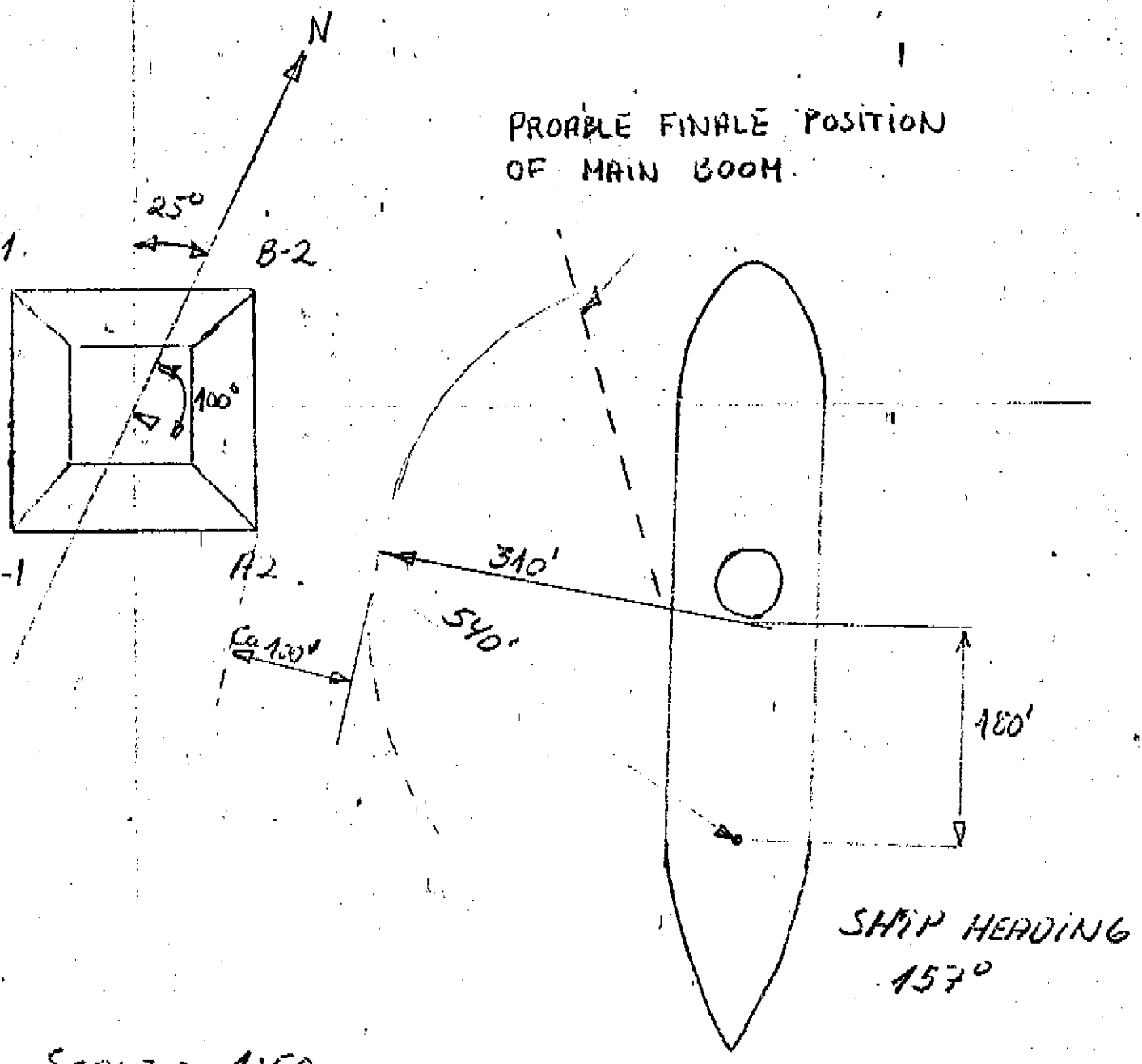
Undertegnede reiste til Bergen 24.2.

Bergen, 4. mars 1976

A. Dahlberg

vedlegg

POSITION OF BLUE WHALE RELATIVE TO SHIP WHEN MAIN BOOM COLLAPSED



SCALE ~ 1:50

F R I G G F I E L D

PHASE I

QP - Platform

Ordre nr. 60 14 36

Perioden 16.6. - 29.6. 1976

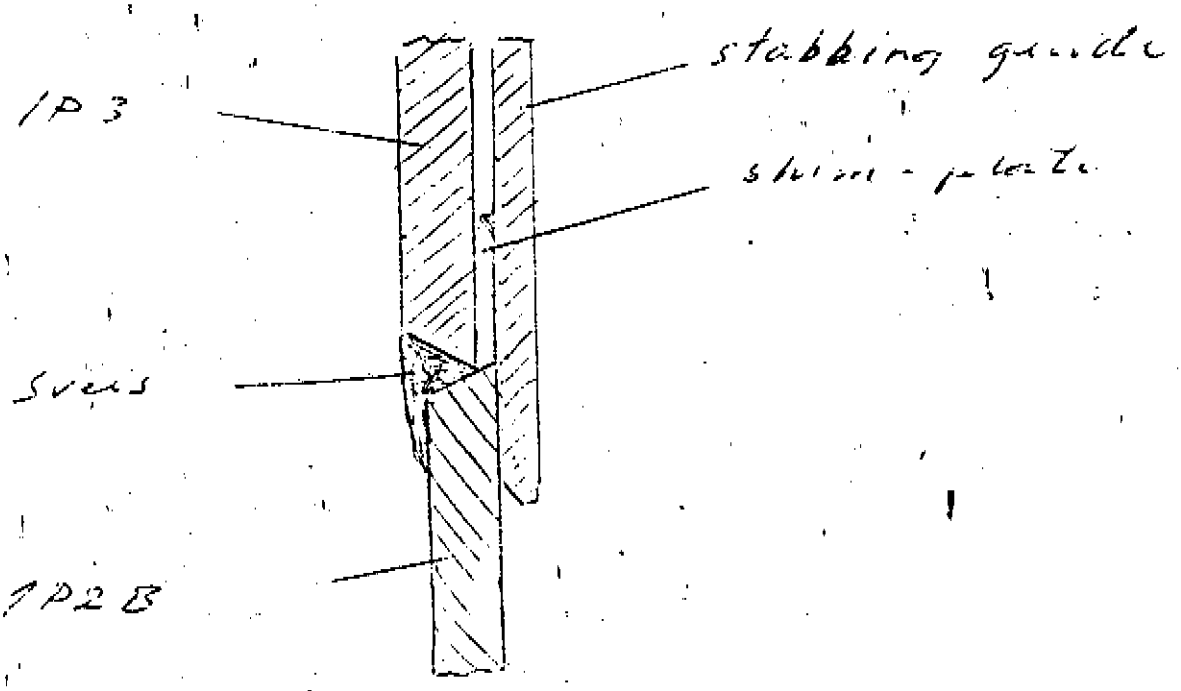
INSERT PILE:

Insert pile B 1-2 ble installert. Sveisene 100% ultralyd- og magnetpulverkontrollert.
Kontrollrapporter følger vedlagt.

Ved øverste butt-skjøt på insert pile (IP2B - IP3) var der en saksing i fugen på 7-8 mm over store deler av rørets omkrets. IP2B hadde for liten diameter.
For å bøte på denne saksingen, ble det sveist påleggssveis på IP2B fra nedre fugekant, og ca. 1" nedover røret.
Se vedlagte skisse samt foto.

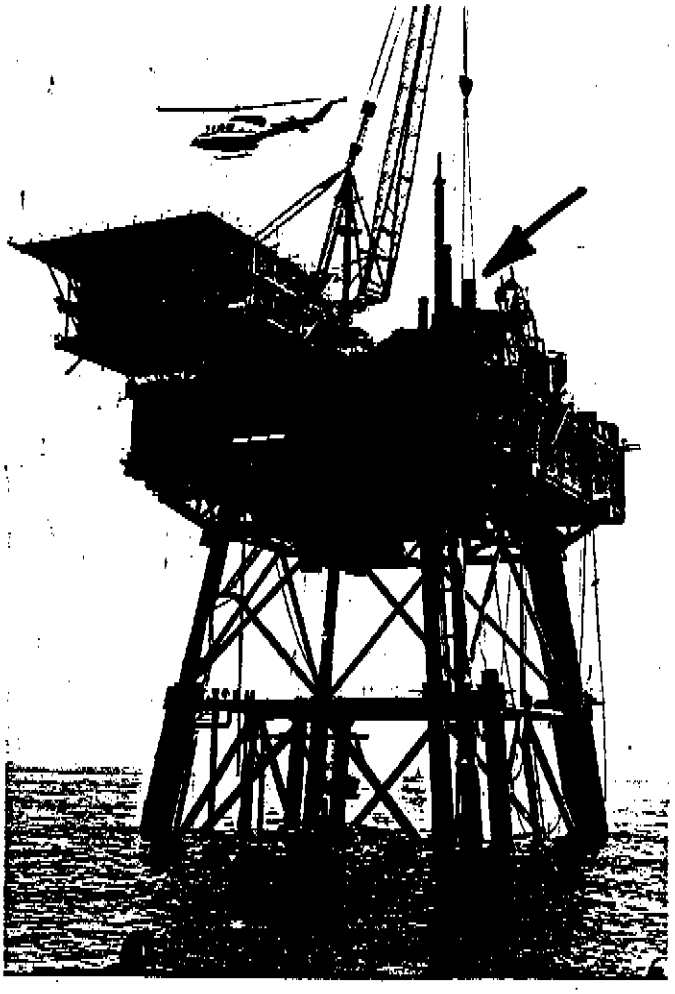
Bergen, 20. juli 1976

Erling Hakvåg



Snitt av sveise for bindelsen mellom IP2 B og IP3.

Sveise forbindelsen mellom
IP2B og IP3, pile B 1-2.
QP-plattform.



Fjerning
av follower
fra main-
pile B 1-2,
QP-plattform

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FRIGG FIELD PHASE I

PLATFORM: QP

SURVEYOR: A. DAHLBERG

PERIODEN: 29. JUNI - 20. JULI 1976

Arbeid utført i perioden:

1.0. Insert pile A 11

1.1. Det ble konstatert lekkasje i rockwell-koblingene på conductorene mens en boret med sjøvann ned mot enden av hovedpelen.

Mud ble holdt på et akseptabelt nivå over sjønivået under boringen p.g.a. lekkasjene som også ble observert fra ubåt.

1.2. Da conductorene skulle kobles fra hovedpelen mistet de verktøyet ned i hullet. Dette ble fisket opp, men en 7" rør, ca. 10 fot langt ble liggende igjen på bunnen av hullet.

1.3. Sveisingen av pelen gikk greitt, bortsett fra at det tok en del tid å få skjøtene tilpasset. Se vedlagte NDT rapporter.

1.4. Insert pilen ble senket ned i hullet med mud sirkulert foran enden.

Insert pilen stoppet ca. 9½ fot over maks. design dybde, (se pkt. 1.2.), hvor den ble cementert.

1.5. Under støping av insert pilen var det problemer å holde oppe egenvekten på diacemoil cementen som ble brukt.

Pelen ble støpt i to steg.

2.0. Insert pile B 11

2.1. Her var det også lekkasjer i rockwell-koblingene. Dette ble også bekreftet ved hjelp av ubåt.

2.2. Det var ingen spesielle problemer med sveisingen.

2.3. Insert pilen ble senket, som beskrevet i pkt. 1.4. Pelen ble hevet ca 2 ft. før cementering.

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2.4. Pelen ble cementert i to steg med diacemoil cement og ble stående ca. 0,5 fot under maks. design dybde.

3.0. Insert pile A 12

3.1. Etter boring med sjøvann som sirkulasjonsmedium ned til ca. 2 ft. over enden av hovedpelen ble det skiftet over til mud. Da enden av hovedpelen var passert med ca. 3 ft., sank mud nivået plutselig meget raskt.

Ubåtinspeksjon bekreftet lekkasjer i rockwell-koblingene, uten at disse kunne sies å være så stor at disse kunne være årsaken til ovennevnte mud tap.

Det var ikke mulig å konstatere om mud kom opp langs hovedpelen eller gjennom sjøbunnen, p.g.a. propelleren forstyrret sjøbunnen, og mud kom ned fra lekkasjene i rockwell-koblingene.

Det ble brukt "lost cirkulation" materiale i mud under resten av boringen, og mud nivået ble holdt så nær sjønivået som mulig. Til tross for dette ble det mistet en del mud i hullet.

3.2. Sveisingen av første sveis på insert pile ble påbegynt da jeg forlot plattformen.

4.0. Sveising

4.1. Ingen annen sveising enn på insert pile ble utført i perioden.

4.2. Prosedyreprøve ble sveist for K-fuge i forbindelse med sveising av stivere på support-frame før skidding av arbeidsmoduler.

Bergen, 4. oktober 1976

A. Dahlberg

A. Dahlberg

vedlegg: NDT-rapporter

Akt 191

FRIGG FIELD - PHASE I
PLATTFORM: QP
PROSJEKT NR.: 601436
PERIODEN: 21. august - 7. september 1976

I perioden er flyttingen av moduler for å installere insert-pile ved A 2 og B 2 leggene fullført.

Drilling av insert B 21 påbegynt.

Drilling stoppet ved ± 639 feet (fra false rotory table) på grunn av lekkasje langs main-pile. En sementplugg ble forsøkt støpt i hullet, men denne forsvant uventet ut i grunnen. Videre drilling / sementering ble stoppet i påvente av ekspertuttalelser.

Da jeg forlot feltet var, for meg kjent, intet videre program fastlagt.

Bergen, 10. september 1976

Jan Sulen

FRIGG FIELD - PHASE I
PLATFORM: QP
PROSJEKT NR.: 601436
SURVEYOR: A. DAHLBERG
PERIODEN: 17. NOVEMBER - 30. NOVEMBER 1976

Arbeid utført i perioden:

1.0. Generelt

1.1. Det arbeides med montering av varme og sanitærutstyr i modul B.

1.2. Brannlinjene kobles sammen med TPI.

2.0. Kraner

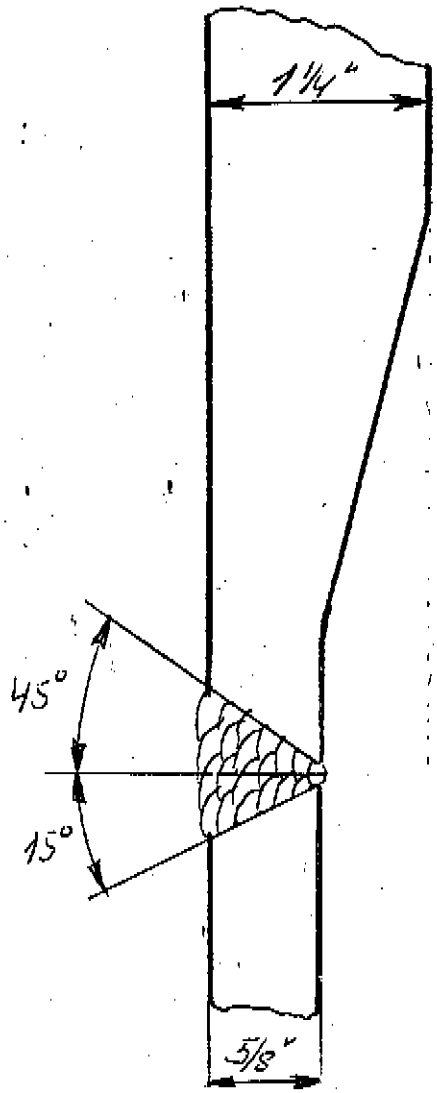
2.1. Sveisene på kran pedestalene som var i følge tegn. 2098, ark 320, detj. 4 rcv. 4, ble ultralydkontrollert.
Det ble ikke fremskaffet noen rapport på dette, men kilsveisene ble funnet å være så dårlige i roten at de kommer til å kutte pedestalene ned ca. 6" for å unngå problemer med sprekker.

2.2. Toppflensene på pedestalene vil ble maskinert ned, og sveisen sveist som på vedlagt skisse.

Bergen, 6. desember 1976

A. Dahlberg

vedlegg



KRAN PEDESTALER OP-FRIGG.

Bergen 6/12-76.
M. Dahlberg

FRIGG FIELD PHASE 1

Plattform QP

Prosjekt nr. 60 14 36

Surveyor : A. Dahlberg

Perioden 19. januar - 8. februar 1977

Arbeid utført i perioden:

1.0. Trykktesting.

1.1. Gass linjen fra broen til forbrenningsovnen testet. Trykket sank sakte, men ingen lekkasjer ble funnet. Se vedlegg. Komplett rapport arkivert på plattformen.

2.0. Kran pedestaler.

2.1. Disse blir forsterket med kneplater ned mot dekkfundamentet. Fundamentsplaten vil bli sjekket med UT for utrivningsbrudd/ laminering.

3.0. "Sabotasje?".

3.1. Det ble oppdaget i perioden at isolasjon var "skrapt" bort fra ledninger i kontrollromspanel. Dette medfører at alle berørte kretser må testes på nytt.

4.0. Fjerning av temporary modul.

4.1. Arbeidet med forberedelse for løfting av temporary boligkvarter, stiff leg krane og stiff leg sub struktur er påbegynt.

5.0. Rømmingsvei fra helikopter hangar tak.

5.1. Leider ned fra helikopterdekk mot M6A kranen kommer i veien for kranen. Denne ruten er lagt om med samme utgangspunkt fra helikopter hangartaket og via komunikasjonsmasten og ned.

Bergen, 15. februar 1977

Aksel Dahlberg

FRIGG FIELD - PHASE I

PLATTFORM: QP

PERIODEN: 13.06. - 21.06.77.

SURVEYOR: A. Dahlberg

PROSJEKT NR.: 601436

Arbeid utført i perioden.

1.0. Fjerning av pile-followers.

1.1. Arbeidet med fjerning av pile-followerne går svært godt. Opprenskingsarbeidet settes ikke igang før alt tungarbeid er ferdig.

2.0. Kraner.

2.1. Det ble funnet sprekker oppe på platene hvor bom-løfte-sylindrene kommer inn på kranhuset på kran M6B. Sveisen inneholdt porer og slag. Dette var sannsynligvis årsaken til sprekkene.

2.2. Begge sprekkene ble reparert. Se vedlagte rapport.

2.3. Det ble ikke funnet sprekker i kran M6A ved visuell kontroll av samme område.

Bergen, den 22. juni 1977.

A. Dahlberg

ELCN
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INSPECTION REPORT.

Company: Elf Norge A/S
Platform: QP/Frigg
Item: Crane M6B

This is to Certify that the undersigned surveyor to this society on the request of Elf Norge A/S has attended to the repair work on crane M6B/QP on the18th of June 1977.

Two cracks had been found, one on top of each landing plate for boom ram.

The cracks were ground out and the areas rewelded.

The repairs are considered as acceptable when MPI states that no cracks is present in the repaired area.

The underside of landing plate for crane pedestal M6B was vissualy inspected at the same time as far as accessable, nothing was found by this inspection.

Frigg, 18th of June 1977.

A. Dahlberg,
Surveyor.

Copy:
1 OIM/QP
1 Safty officer/QP
1 Maintenance/QP
1 Det norske Veritas/ Høvik.

ej/601/1kes/Tlc/Fig

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FRIGG FIELD - PHASE I
PLATTFORM: QP
PROSJEKT NR: 601436
SURVEYØR: A. DAHLBERG
PERIODEN: 19. MARS - 5. APRIL 1977

Arbeid utført i perioden:

1.0. Løft utført av ETPM 1601

1.1. A-modulen ble løftet på plass og skiddet i rett posisjon med henblikk på sammenkobling med B-modulen.

1.2. Batterirommet løftet opp.

1.3. Helikopterdekket løftet på plass og sveist ned. Røntgenkontroll av sveiser viste tilfredsstillende kvalitet.

2.0. Tilkobling av ferskvann på A-modulen

2.1. Ovennevnte system ble sagt å være trykktestet på land. Det viste seg imidlertid at tre sveiser ikke var sveist og et rør var sprukket.

2.2. Ovennevnte mangler medførte en del vannskader på A-modulen.

a) En del takpanel falt ned.
b) Våte senger og gulvtepper.
c) Telefonsystemet ute av drift over en kort periode.
d) Ingen elektriske kretser eller koblingsbokser tredde ut av funksjon, selv om disse tildels ble kraftig overrislet med ferskvann.

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3.0. "Boat bumper guides"

3.1. Pinnene for festing av "boat bumpere" på tre av hjørneleggene er forsvunnet.
Det ser ut som de er gått i sveiseforbindelsen ned mot platen, men dette må nærmere undersøkes av overflatedykkere.

4.0. Safety-, alarm-systemer

4.1. Det satses på å få safety-, alarm- og navigasjons systemene til å arbeide perfekt snarest.

Bergen, 18. april 1977

A. Dahlberg

FRIGG FIELD - PHASE I
PLATTFORM: QP
PERIODEN: 2. - 16. MAI 1977
SURVEYOR: JAN SULEN
PROSJEKT NR: 601436

Arbeid utført i perioden:

1. Det er utført trykktest av "Utillity Water" med 20 bars abs.

2. Prøver 4 sikkerhetsventiler for kompressor Q 10 på 140 psi.

3. I følge Mc. H. er det installert feile elektriske kabler for belysningen på QP. I stedenfor PWC - SWA - PWC 600/1000V er det installert PWC 600/1000V.

   Det er oppstått problem med fargekoden på det elektriske anlegget, da det et forskjell på fransk og engelsk kode.

4. Opprydding av strukturen på elv. + 20 er begynt og Wagley vil utføre arbeidet.

Bergen, 24. mai 1977

Jan Sulen

FRIGG FIELD - PHASE I
PLATFORM: QP
PROSJEKT NR: 601436
SURVEYOR: A. DAHLBERG
PERIODEN: 19. APRIL - 4. MAI 1977

Arbeid utført i perioden:

1.0. Uhell ved lossing av supply båt

1.1. Ën supply båt traff den 19. april pinnen hvor kaien på A 1 - A 2 skal festes. Denne pinnen står på vertikalen midt mellom A 1 og A 2, i havflatenivå. Det kunne ikke påvises andre skader enn den på pinnen og dens innfestningsplater. Nærmere inspeksjon bør foretaes av overflatedykker (Se tegn. Mc DH 2981 skect 127 1 of 3.)

2.0. "Fire pump diesel day-tank"

2.1. Ovennevnte tank er isolert med en isolasjon av ukjent merke som smelter lett, og må ansees som brannfarlig.

3.0. Generelt

3.1. Det arbeides på alle systemer for å få de operative. Helikopterdekket brukes som lagringsplass inntil videre.

3.2. Foreløpig er ikke mye utført av det som er nevnt i survey rapport fra 24. og 25. januar 1977.

Bergen, 9. mai 1977

A. Dahlberg

A. Dahlberg

EM.

p. 201
Kopi: Oldj. [illegible]
Sletten
[illegible]

16.54
16192b verit n
33386 elf n

| KOPI TIL |
| - 5 OKT. 1977 |
| ARKIVSIGN. |

stavanger 4/10/77
telex no: 15314 ju

to: dnv att: eri

cc: qp att: field superintendent
int.cc: de saint palais/bergsaker/lassailly/monnier/selnes/grinde/
nysted

from: elf aquitaine norge a/s stavanger

subject: frigg field qp reporting of damage.

---

according to offshore notices no 29 requirement, please be informed that on 2nd october 1977 at 10 o'clock p.m., the supply boat ''seaway jura'' bumped up against the southwest leg of the qp jacket.
the boat bumper was damaged and needs to be repaired. the upper connection with the leg of the jacket is broken.
there is no damage to the jacket.

regards
h. lye

tod.: 16h59
16192b verit n
33386 elf n

FRIGG FIELD - PHASE I
PLATTFORM : QP
PROSJEKT NR: 601436
SURVEYOR : AKSEL DAHLBERG
PERIODEN : 16.11.-23.11.77

Arbeid utført i perioden:

1.0. List of condition 2/1977

1.1. Følgende punkter funnet i orden:
C10, C11, C13, C14, C24 og D6.1.

1.2. Følgende punkter var ikke i orden:
C1, C3, C5, C12 og C23.
Egen survey rapport skrevet.

2.0. Inverter room

2.1. Temperaturen i rommet blir for høy. Dette medfører at døren til en hver tid står åpen.
Det ble avtalt at det skulle monteres en vifte for kjøling slik at døren kan holdes lukket.

2.2. Det ble opplyst at kjøler (air condition unit) var bestilt og at denne vil bli installert snarest mulig.

3.0. Boat Bumpers

3.1. Supply båten "Ben Viking" støtte kraftig i nordre boat bumper på nordøstre leg på QP kl. 2335 den 23.11.
Dette medførte at boatbumperen løsnet, men ble hengende.

Bergen, 29.11.77

Jan Sulen
sen. surveyor

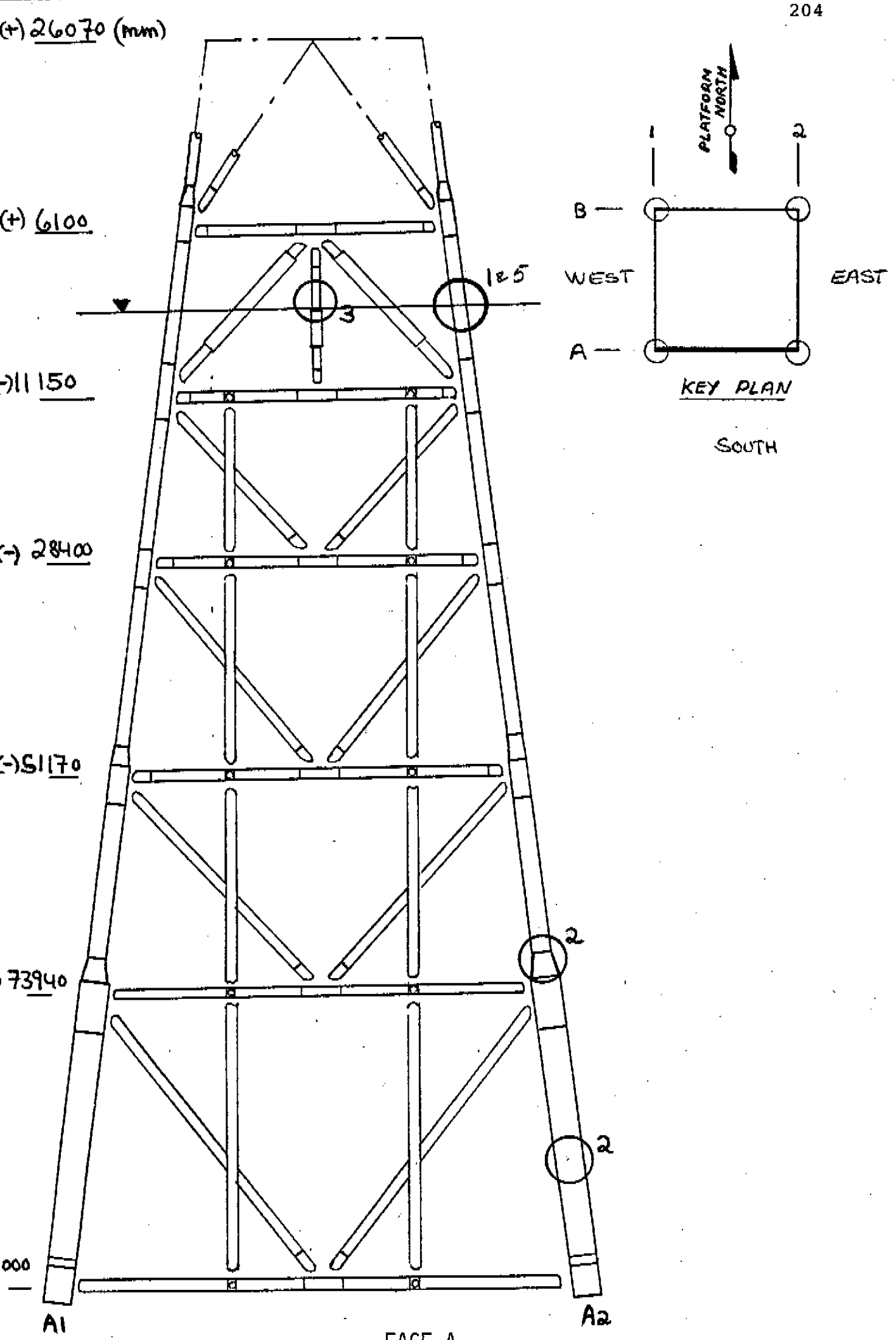
Aksel Dahlberg
surveyor

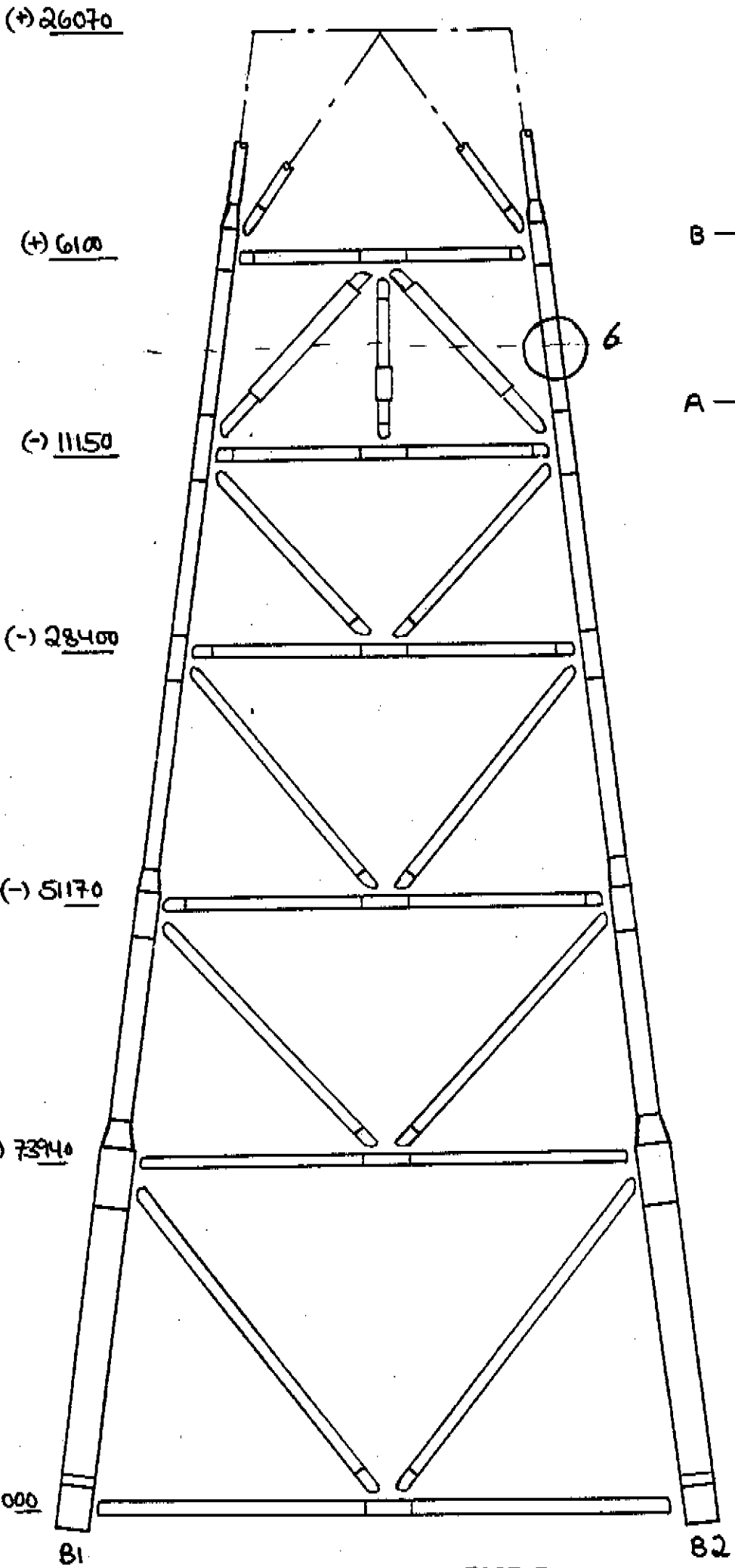
3.6 Damages and mishaps during and after installation

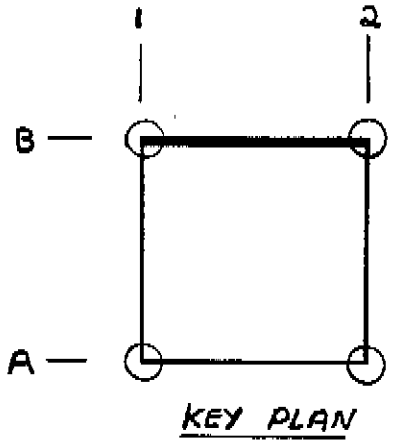
In the following figures those parts of the structure which have been subjected to accidental loadings are marked with a red ring ( ).
In general these areas have been repaired when found necessary.
Eg. the launch framing/horizontal framing which were damaged during onshore loadout were repaired by grouting of the damaged part of the member, a method which DnV considers satisfactory.
(telex no. 1907 22.7.75 lah/vwH/janb).

INDEX

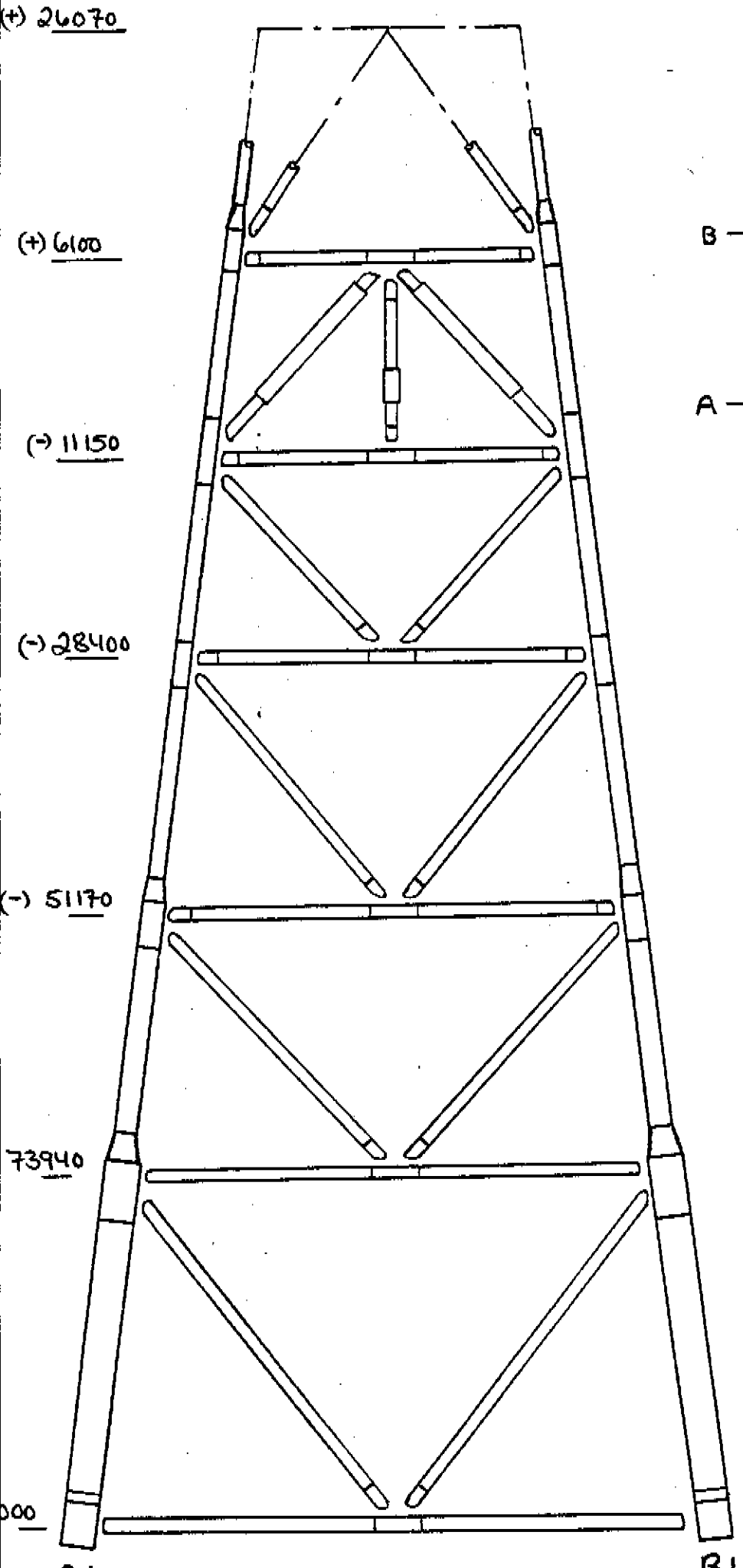
1. Collosion between supply ship ("Stad Breeze") and jacket, 17.10.76.
   Result: No visual damage.
2. Accident with anker-wire, end of July 1975.
   Result: Surface stripes.
3. Collosion between supply ship and jacket, 19.4.77.
   Result: local damage.
4. Misalignment of slipways during loadout onshore of jacket at UIE, June 1975.
   Result: Distortion of launchings/horizontal framing.
5. Collision between supply ship (seaway Jura) and southwest leg of jacket, 2.11.77.
   Result: Boat bumper damaged, upper connection with the jacket broken. No visual damage to jacket.
6. Collision between supply ship (Ben Viking) and boatbumper at northeast leg of QP Jacket, 23.11.77.
   Result: Boat bumper collapsed.


(+) 26070 (mm)
(+) 6100
1 & 5
3
-)11150
(-) 28400
(-)51170
73940
2
2
000
A1
A2
FACE A
PLATFORM NORTH
1
2
B
A
WEST
EAST
KEY PLAN
SOUTH

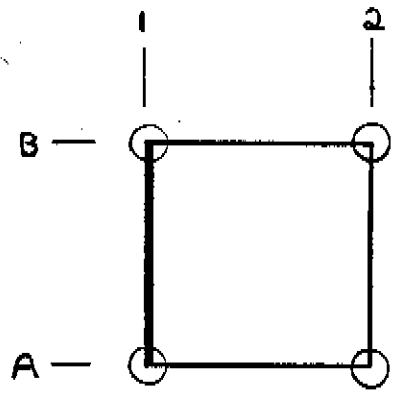




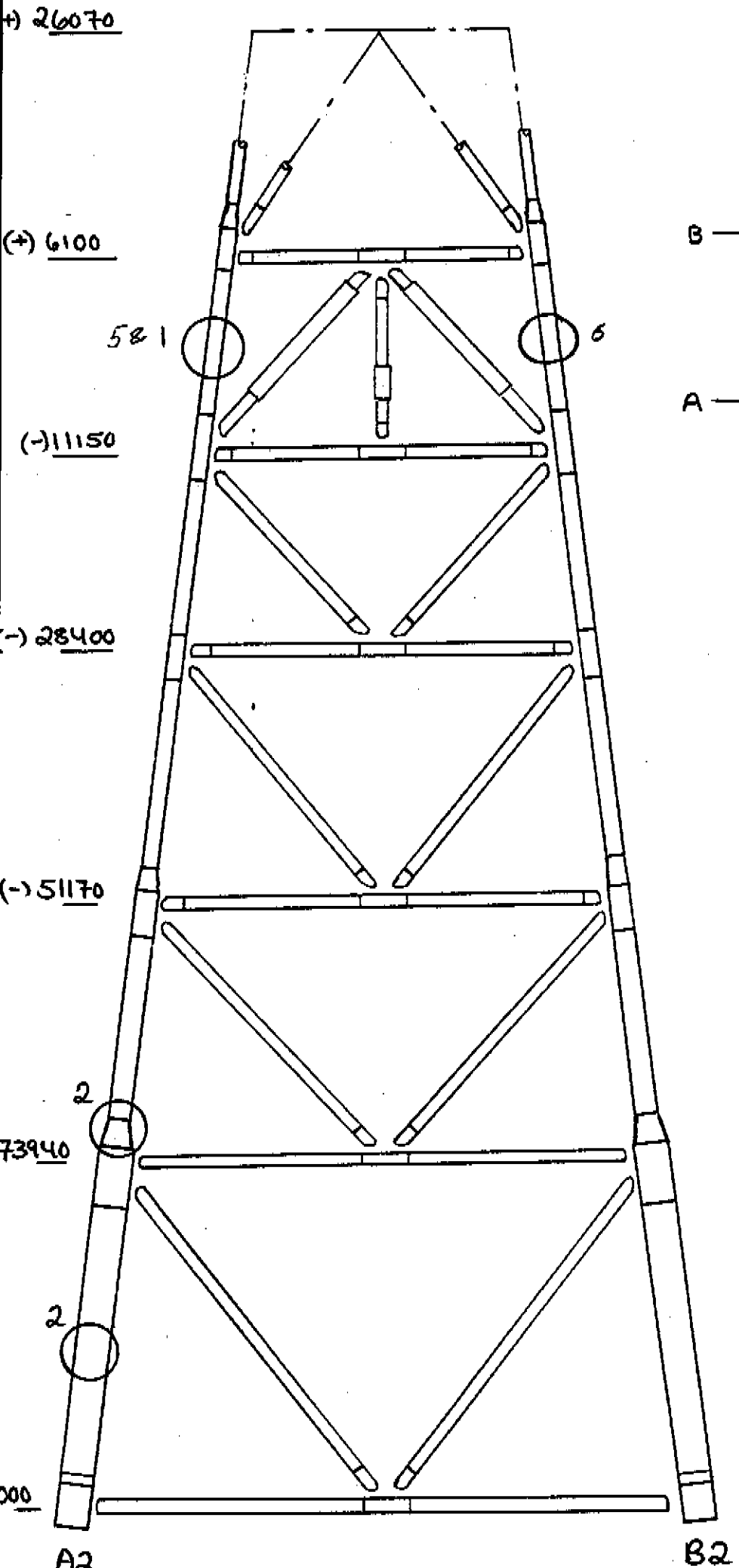
FACE B

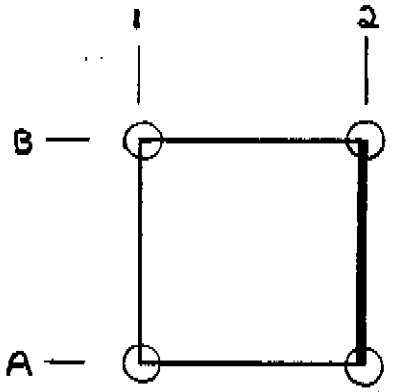


FACE 1



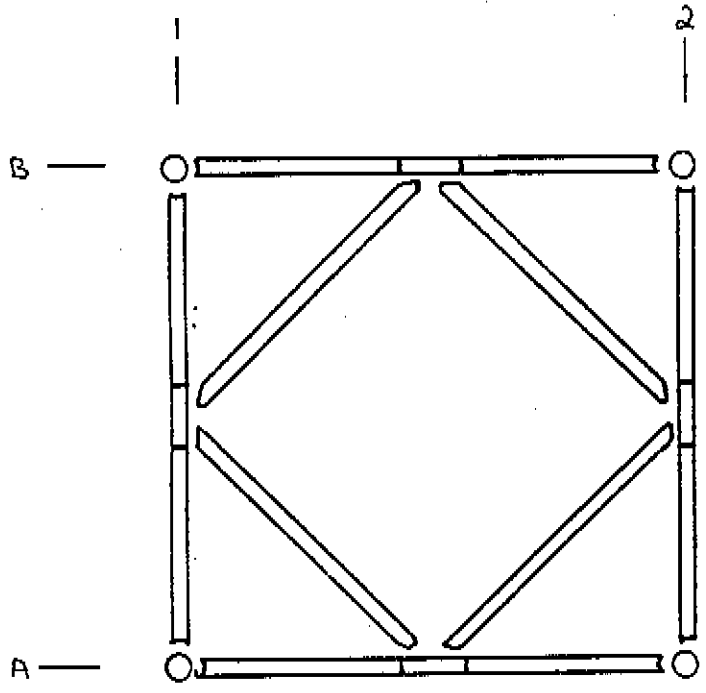
KEY PLAN



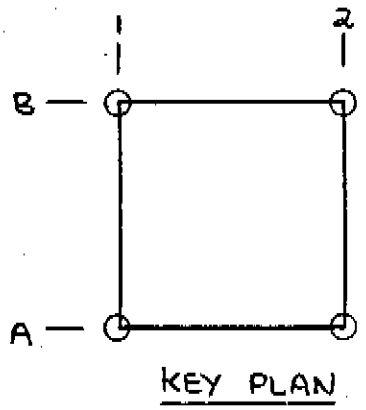


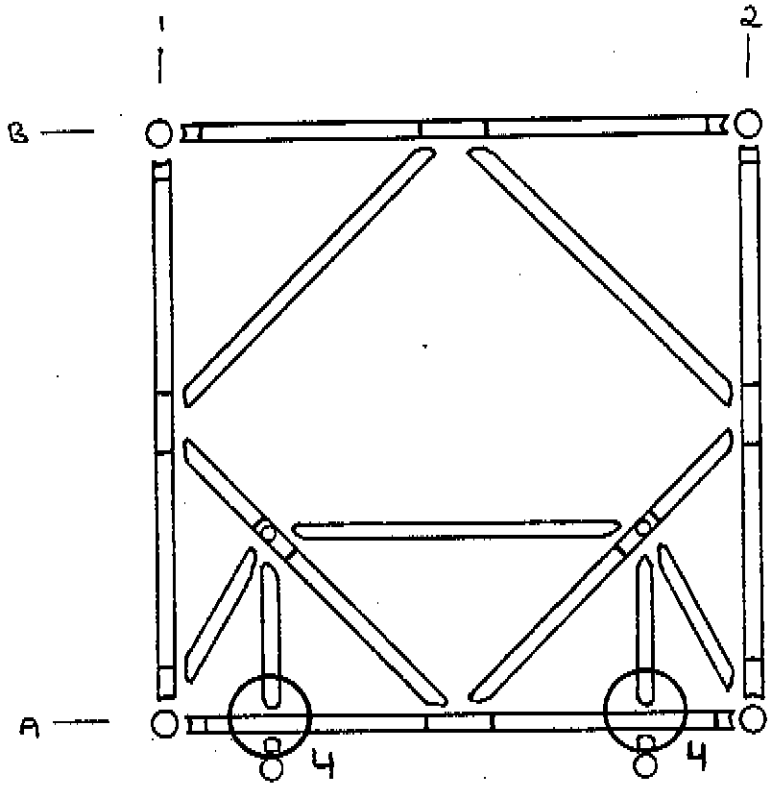
KEY PLAN

FACE 2



ELEVATION (+)6100





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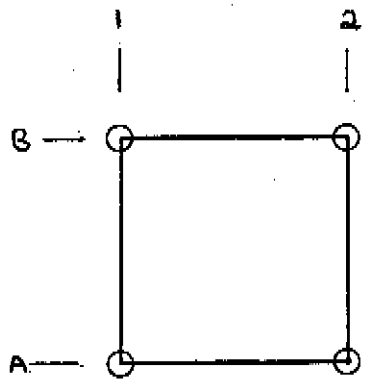

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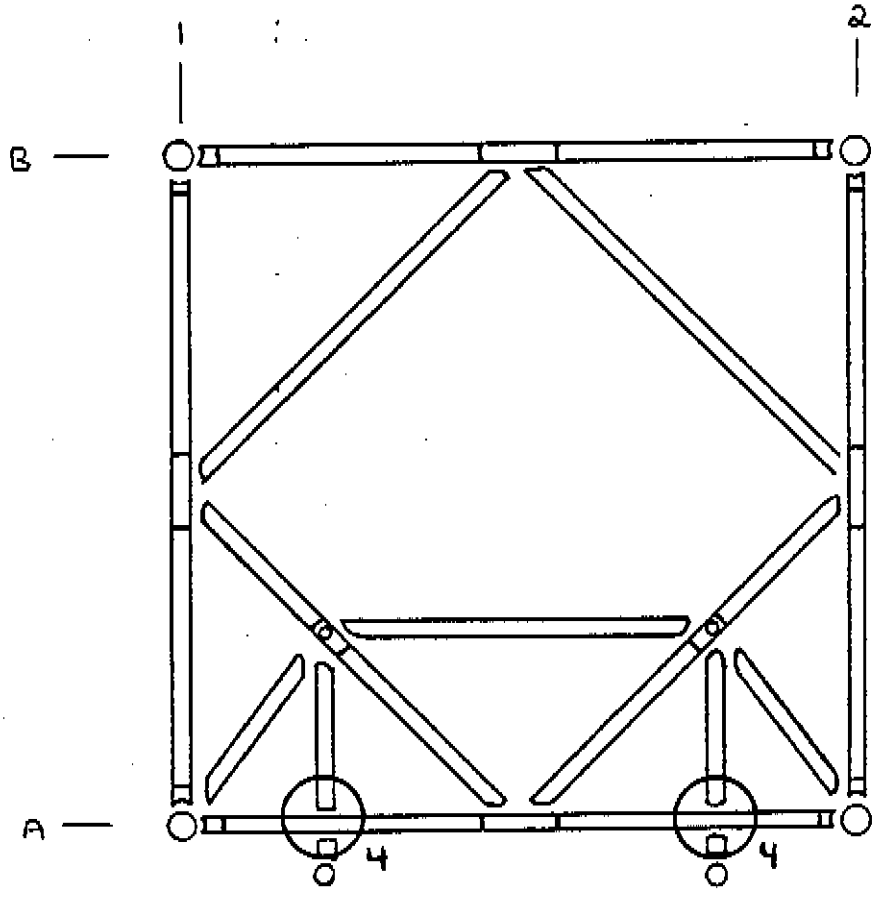
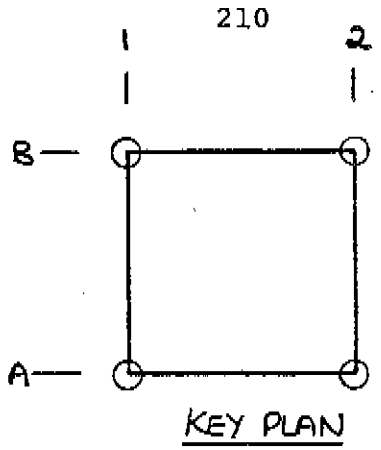
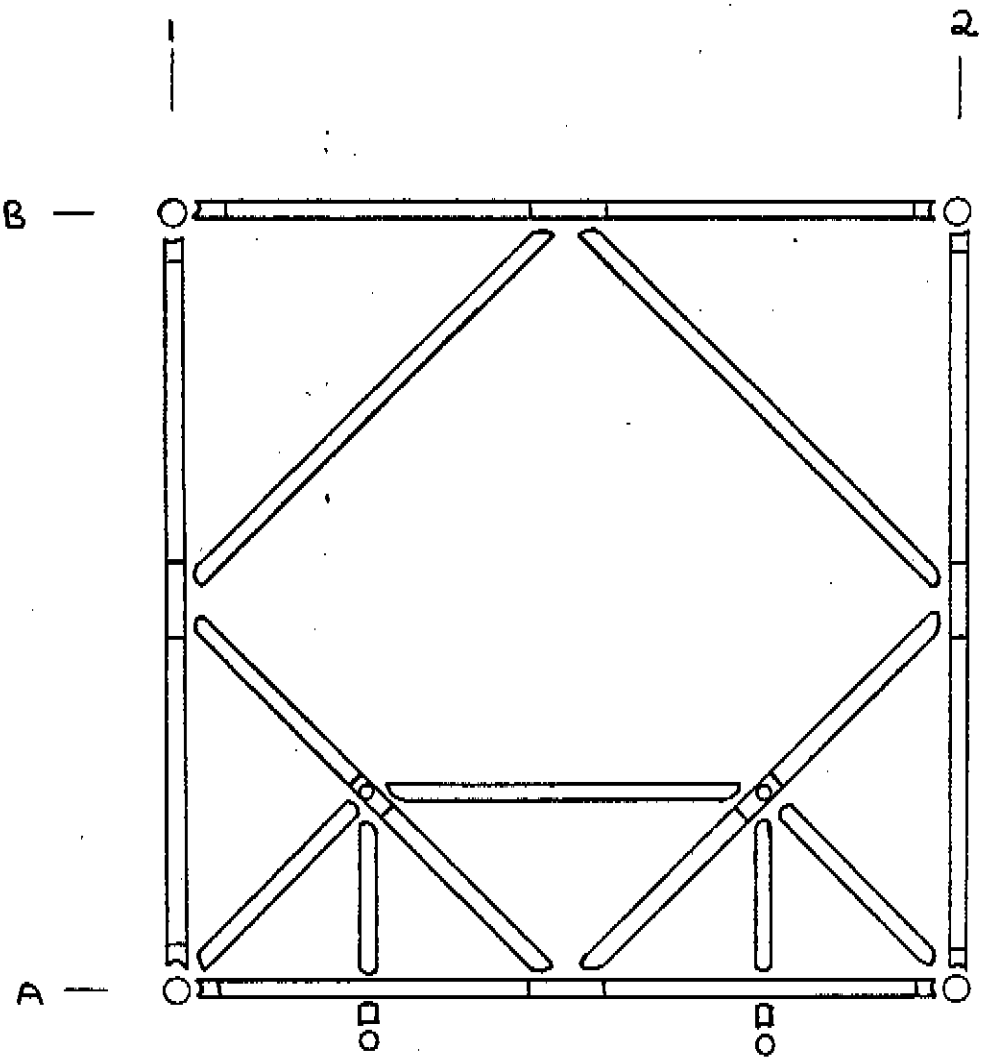


ELEVATION (-)28400



KEY PLAN



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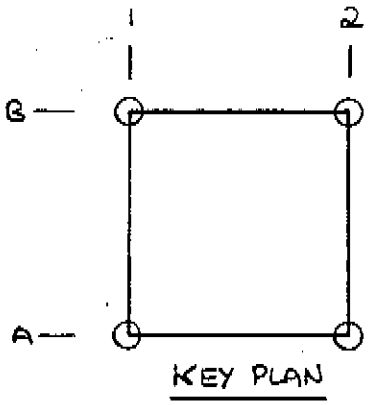

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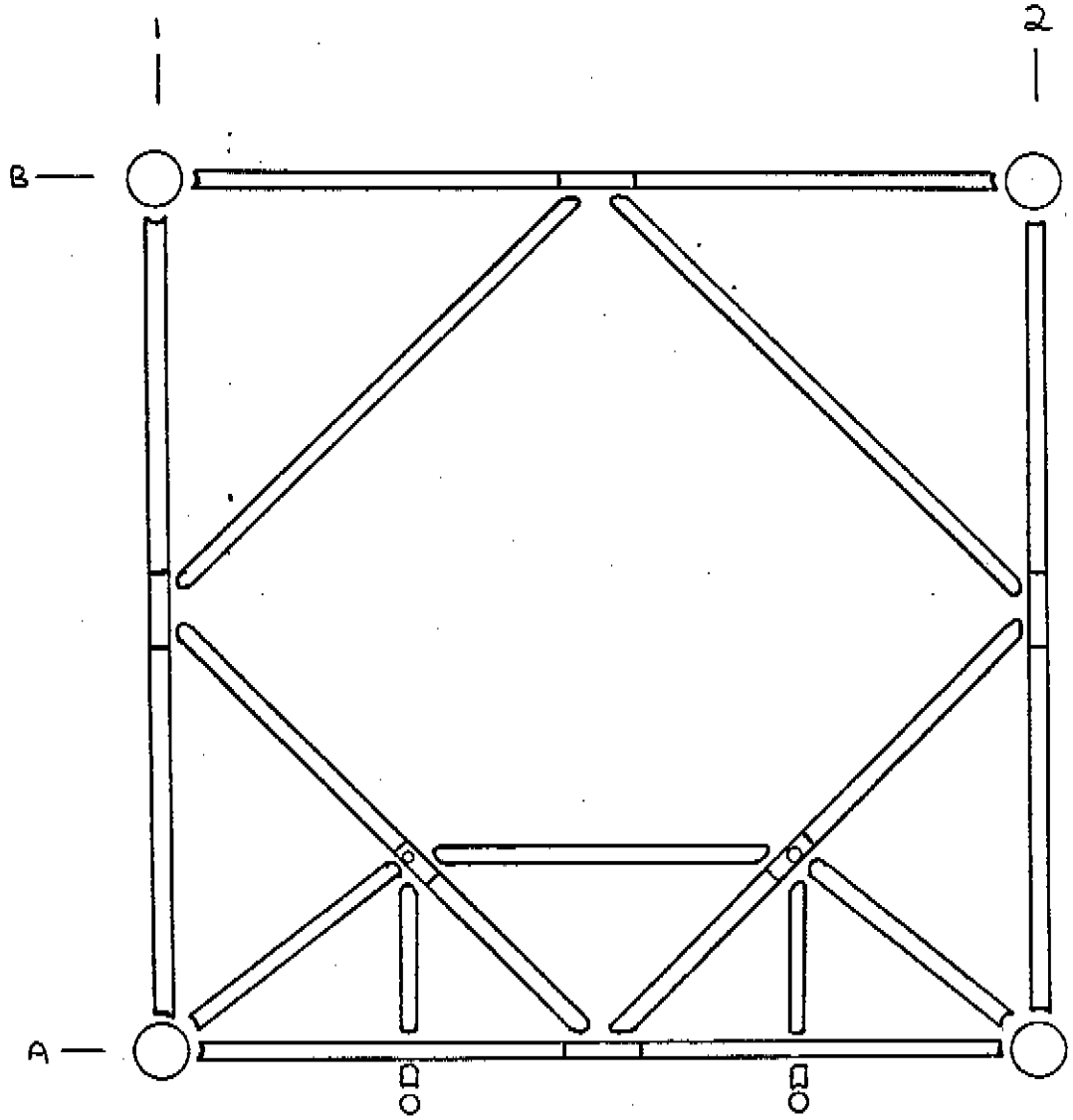
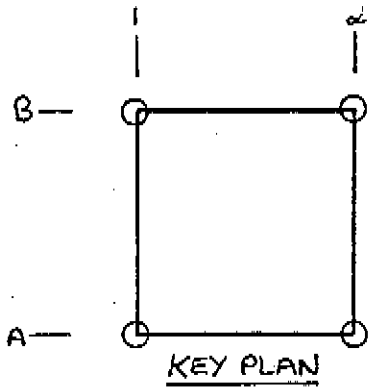
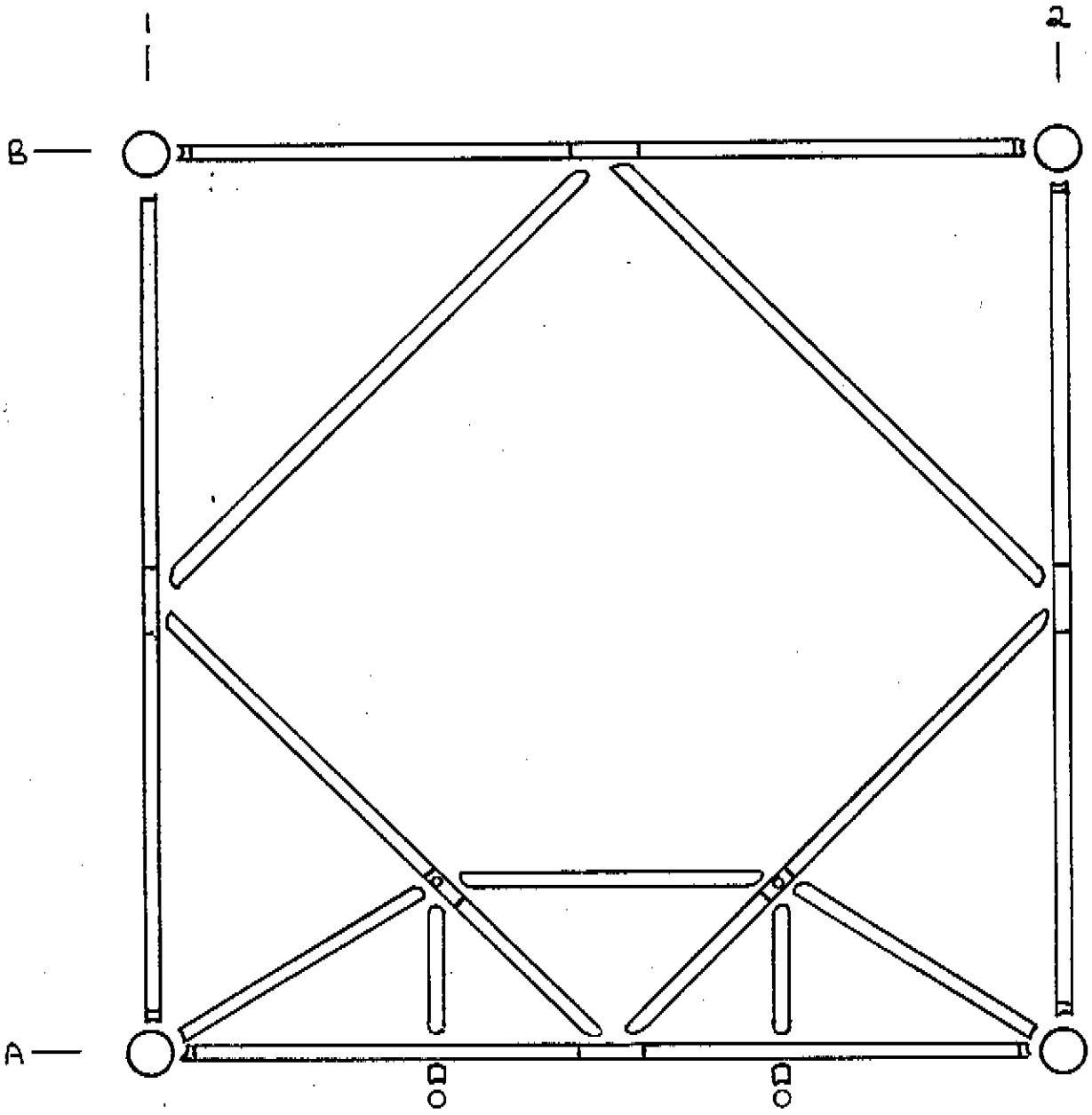


ELEVATION (-)73940





ELEVATION (-)104000

4. SUMMARY OF SPECIAL AREAS FOR FUTURE INSPECTION

4.1 Jacket

The following figures point out those areas/items which based on design assumptions and DnV's inspection during fabrication and installation are considered important for future inspection

- The final survey has shown that the water depth is less than originally assumed for the corrosion allowance in the splash zone (i.e. MLW 100 m instead of 104 m as assumed).

  Special attention has to be paid to possible corrosion in this area.

- The marine growth assumed for QP is an increase in member diameter from el.+3.5 to -13 m from MWL, with no increase in hydrodynamic load coefficients for this area (see ch.1.4.5)It should be confirmed by regular survey that the marine growth do not exceed the assumed values.

- The areas exposed to impact loads from boats as reported in chapter 3.6 should be carefully inspected, especially the welds attaching boat landings and barge bumpers.

- The four repaired launch truss nodes (chapter 2.8) should be occasionally inspected.

- The butt weld at both ends of the conical section on the main legs (el. -72720 and el. -69975) should be inspected.

- The shear plates transfering the loads from the jacket corner legs into the piles are highly stressed in the upper and lower 5.0 m region. The void enclosed by the shear plates, the corner leg and the pile sleeve is

also filled with sea water. Although water is theoretically prevented from circulating in/out it is considered essential that the thickness of these plates be regularely measured. It is also important that the weld between the shear plates and pile sleeve as well as between shear plates and corner legs be regularely inspected in the upper and lower 5 m lengths. For the discontinuous shear plates at bottle B1, the weld between the shear plate pieces at the stiffeners should also be inspected.

- Generally, the joints between the horizontal bracings and the main legs at mudline is highly stressed. In addition may any irregularity in the modelling of the piles in the computer calculations greatly effect the stress level in these joints. Thus those joints should be inspected accordingly.

- All of the highly stressed joints/members marked with ◎ should be inspected.

- A scour depth of 2.0 m have been assumed in the calculations of piles. It should be regulary confirmed that this value is not exceeded.

4.2 Support frame

- The field welds between jacket and support frame should be inspected.

- Areas on top of the support frame where the support loads from module A and B is transferred into the structure is locally highly stressed and should be inspected accordingly.

- The external stiffener on the members in the support frame referred to in ch. 2.8 d should be regularly inspected.

- The allowable loads on the additional storage areas installed in the support frame should be clearly marked.

- The bridge landing was cutted off and welded on again offshore. All field welds should be regularly inspected.

- In order to support buoyancy tanks and later on guide the piles, pile guides were installed around each corner leg on elevation + 6100 and + 21500.

  These piles guides have been removed offshore, but in order to ascertain that no cracks develop at these locations, regular inspections should be conducted in an initial phase.

4.3 Modules

The inspection of the living modules should be concentrated on those areas supporting other structures like cranes, microwave lower and hanger. The substructure beams for those structure should be carefully inspected, as they also are highly stressed. This apply also for the joints in which those beams intersect.

4.4 Bridge QP - TP1

Field observation of the dynamic behaviour of the bridge should be conducted, and if large vibrations occur during any special environmental action this should be reported immediately and actions for preventing those vibrations taken..

Carefull inspection of the bridge support on QP should be conducted due to the erroneous fixation against rotations as explained in ch. 2.3.

4.5 Microwave tower

The support of the tower is the most critical area and should thus be inspected accordingly. In addition regular control of all the bolts in the tower should be conducted.

Stolt - Rockwater Joint Venture

Skogstøstraen 25 - PO Box 720 - N-4001 Stavanger, Norway
Tel.: 51 83 70 00 - Fax.: 51 83 83 83 - Direkte fax.: 51 83 72 52

Ba-Snw-CIT-00509
Contract no. C-215001
File: 54.1 Date: 19/8-98

NAME	COPY	ACTION	COMMENT
JOB		X	

Statoil
4035 STAVANGER

Att.: Jan Olav Berge / Tor Alm Elf Petroleum Norge A/S.

Your ref.:	Our ref.:	Date:
	1522/EIA	18.08.98

HYPERBARIC WELDING AND DIVING SERVICES/ CONTINGENCY
CONTRACT NO.: C-215001

SUBJECT: Norsk Hydro / Elf IMR. 1998.

Dear Sir.

During yearly inspection programs various volumes of reference material has been accumulated by the SCS inspection engineers.

In order to have this material available for future offshore projects it was decided to transfer the storage responsibility to one of Elf's sub sea engineers, Trond Hansen.

The following is a list of the reference material transmitted back to Elf;

1. Drawing Dossier for Frigg, North East Frigg and Heimdal fields. (2 x A3 copies).
2. DFI Resume for QP. Produced by DNV.
3. QP Sub sea as built file, volume 1.
4. QP Sub sea as built file, volume 4.
5. DFI Resume Heimdal Jacket, volume 1.
6. Heimdal, In-Service Inspection System Manual. Volume 3, chapter 5 – Structures, Risers & Pipelines.
7. DP2, In-Service Inspection System. Volume 5, chapter 5 – Structures and Risers.

Yours faithfully
for STOLT-ROCKWATER JOINT VENTURE

David Cooke
Project Manager

Eyolf Assersen
Intervention Team leader.