Palau Public Utilities Corporation

REQUEST FOR PROPOSAL
RFP PUCE19-002 SUPPLY OF PDD ELECTRIC POLES.

Issued on	:	**JANUARY 25, 2019**
Closed on	:	**FEBRUARY 15, 2019**
Request For Proposal No. (RFP No.)	:	**RFP-PUCE19-002**
Employer	:	**Palau Public Utility Corporation (PPUC)** PO Box 1372, Oldiais Building, Medalaii, Koror Republic of Palau 96940
Country	:	**Republic of Palau**

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1. PREFACE

This Request For Proposals (RFP) for the Supply of PDD Electric Poles has been prepared by Palau Public Utilities Corporation - Electric Power Operations (PPUC-EPO). PPUC-EPO wishes to receive Proposals from all interested persons or firms eligible to operate and with the capability to supply the services in the Republic of Palau.

2. BACKGROUND

Due to Power Distribution Department (PDD) New Installation, System Upgrade, Emergencies and Other Tasks Related to a Sustainable Electrical Power. Power Distribution Department (PDD) is in need to purchase this Electric Poles. In order for PDD to meet and perform the Expectation of Costumer and to fulfil the needs of the PDD Operation.

The Palau Public Utilities Corporation (PPUC) provides power, water and sewerage services to Koror and other areas in the Republic of Palau. In this RFP, Palau Public Utilities Corporation - Power Distribution Department (PPUC - PDD) intends to buy the needed Materials and Hardware to be Utilize by Power Distribution Department (PDD). PDD is located at Malakal, Koror Republic of Palau.

The Republic of Palau comprises of 350 tropical islands and islets located in the westernmost part of Micronesia about 600 miles (960 kilometers) East of Mindanao, Philippines and some 800 miles (1,280 kilometers) southwest of Guam. Palau lies between 8°10'N/3°N Latitude and 132°45'/134°25'E Longitude. The main group of Palau Islands is dominated by the 150 square mile (390 square kilometers) island of Babeldaob—Palau's largest land mass.

PPUC was created in 1994, the same year Palau gained independence as a sovereign nation. Since then, PPUC has been operating the national electric utility and the distribution facilities, which now covers about 47 linear miles of 34.5KV transmission and 114 linear miles of 13.8KV distribution lines.

Palau has a current real capacity of slightly over 28MW with power plants located at Malakal, Aimeliik, Peleliu, Angaur and Kayangel. Malakal and Aimeliik provide power to the central grid supplying Koror, and Babeldaob.

PPUC has grown from 1,500 connections while under national government management into a public utility serving over 6,800 customers comprised of 77% residential, 14% commercial, and 9% others. Last fiscal year's compiled data showed a total combined generation of 101,227 KW with the highest combined peak load recorded at 15,760 KW.

3. SCOPE OF WORKS

SCOPE OF SUPPLY:

ITEM	DESCRIPTION	QUANTITY	UNIT
1	**Concrete Pole 13M.** **301-7086-13M-19CM**	**50**	**PCS.**

2	**Concrete Pole 16M.** **301-7086-16-7-10**	**25**	**PCS.**
3	**Wooden Pole 39 Feet / Wood** **301-7086-39ft. Wood**	**25**	**PCS.**

For Sketch Plans & Specifications: See "Attachment A"

4. OBTAINING RFP

Electronic copies of the RFP may be obtained by emailing the nominated Contact Officer below, or from the PPUC website www.ppuc.com. All prospective bidders are requested to provide their contact details (company name and website, contact person, email and telephone number) to ensure they receive any updates to the RFP.

PPUC will also issue hard copies of the RFP on request at Palau Public Utilities Corporation (PPUC), Oldiais Building, Medalaii, Koror PO Box 1372, Republic of Palau 96940.

Contact Officer:

The contact officer for this RFP is:

Mr SOFRONIO B. MAHOR
Procurement Officer
PPUC
Oldiais Building, Medalaii, Koror
PO Box 1372,
Republic of Palau 96940
Telephone No.: 680-488-3870/3872
E-mail Address: ponz@ppuc.com

5. PROPOSAL REQUIREMENTS

The Proposer shall submit a written proposal which includes:

1. A Title Page identifying the RFP No. and the Works to be provided;
2. An appreciation of the scope of work and activities required, and the methods proposed to be used to complete the works;
3. Summary of experience in the Pacific Rim for the last three years.
4. Key Personnel or Contact Personnel;
5. Proposed time to start after notification of award
6. Fixed Lump Sum Price for works;
7. Other Proposal features which will contribute to the value of the offer.

6. SUBMISSION OF PROPOSALS

Interested Contractors may submit their sealed Proposal hardcopy to PPUC- Main Office, 2nd Floor, Oldiais Building, Medalaii, Koror, Palau 96940, or by email to the nominated Contact Officer. For inquiries regarding submission of quotations, please contact Mr. Mahor as noted above.

7. PAYMENT TERMS

A. Payment terms shall be determined as follows:

a. After evaluation per proposal

b. After negotiations with the winning offeror.

c. All payments shall be made after receipt of original invoice from contractor for each work phase, certified by a duly authorized PPUC representative

8. EVALUATION AND SELECTION PROCESS

All proposals received shall be evaluated by a specially convened committee. The following criteria (NOT Necessarily in Order) will be used to evaluate proposals:

A - Technical: 60%

1. Proposal compliance with all RFP requirements as stated in this document
2. Proposed Project Time-Frame
3. Familiarity and experience with this type of project for the last Three Years in the Pacific Rim.
4. Fast Records with PPUC Projects.
5. Meet the Required Specifications.

B - Financial: 40%

1. Proposed Project Cost.

9. GENERAL CONDITIONS

A. Suppliers are required to submit their proposals based upon the conditions expressed in these instructions

i. ***Assignment of Contract:*** The contract shall not be assigned to any party without prior written consent from PPUC.

ii. ***RFP Modification:*** This RFP does not commit PPUC to award a contract, to pay any costs incurred in the preparation of the proposal under this request, or to procure or contract for services. PPUC also reserves the right to accept or reject any or all proposals received under this request, to negotiate with qualified Bidder, or to cancel in whole or in part this RFP, if it is in the best interest of PPUC to do so. Prospective Bidder under this RFP may be required to participate in negotiations and to submit any price, or technical revisions to their proposals as may result from the negotiation process.

iii. ***Performance & Payment Bond:*** PPUC requires that all contractors with contracts in excess of $50,000 should acquire performance and payment bonds tendered in a manner and through a surety acceptable to the PPUC Chief Executive Officer / General Manager, which guarantees satisfactory completion of a project. The performance and payment bonds shall be in an amount equal to the total price specified in the contract. *(to be determined by PPUC)*

iv. ***Transfer of property:*** All proposals shall become PPUC property.

v. ***Conformity:*** The PPUC procurement regulations shall apply to all proposals and winning contractor shall be bound by them.

vi. ***Submission of the Proposal:***

1. A cover page with a table of contents
2. An executive summary page that summarizes the corporate history, contractor's ability to satisfy the requirements of this RFP, project cost and a synopsis of salient details required in this RFP.
3. The proposals shall be sealed in a package and should include:
   a. The Contractors information (i.e., Name, Address, and Contact) on the outside package
   b. The RFP# on the outside of the package that should be submitted NO LATER THAN 4:00 PM of CLOSING DATE-Palau Time.

      [Note: The RFP # should be in big fonts.]
   c. The sealed package should include the One (1)*original plus Six (6) and One (1) USB Soft copies* of the proposal.

vii. ***Inquiries:*** Any inquiries, requests, clarification, or additional information pertaining to this RFP shall be made in writing, by email or fax through the contacts provided

10. CONTRACT CLAUSES

A. All contracts shall, at a minimum, contain the following clauses:

1. Governing Regulations
2. Penalties for Violation of Regulations
3. Contract Disputes
4. Gratuities
5. Kickbacks
6. Representation of Contractor Concerning Contingent Fees
7. Changes
8. Stop Work Order
9. Termination for Defaults or Convenience
10. Approvals, Certificates, Permits and Licenses
13. Commencement of Work
14. Liquidated Damages
15. Schedule
16. Clear Title
17. Taxes
18. Force Majeure
19. Relationship
20. Entire Agreement
21. Assignment
22. Subcontract

11. Laws and Regulations
12. PPUC's right to inspect
23. Contracting Officer

11. CONTACT DETAILS

Sofronio "Pons" Mahor
PPUC Contracting Officer
PPUC Procurement Division
Tel: (680) 488-5320 Fax: (680) 488-4499
Email: ponz@ppuc.com

Hilton Hideos
PDD Manager
PPUC Power Distribution Department
Tel: (680) 488-2413
Email: hilton@ppuc.com

APPENDIX 1- BID FORM

Letter of Quotation

Date: _____/_____/_____

RFP No.: **RFP-PUCE19-002**

Supply of PDD Electric Poles.

To: **The Chief Executive Officer / General Manager**
Palau Public Utilities Corporation

We, the undersigned, declare that:

(a) We have examined and have no reservations to the RFP, including Addenda issued in accordance (if any);

(b) The price of our Bid, excluding any discounts offered in item (d) below is the sum of: *[amount of local currency in words], [amount in figures]*

(c) Our bid shall be valid for a period of ..... days from the date fixed for the bid submission deadline in accordance with the RFP, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(e) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive; and

(f) We accept full responsibility for the health and safety of persons employed by us in completing the works under this Quotation.

Name .....

In the capacity of .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date.....

Appendix 2: Schedules of Rates and Prices

Price Schedules

General

1. The Request for Proposal will be a Lump Sum Quotation for completion of all specified works; Electric Poles.
2. The Schedules generally describe the works to be performed. Bidders shall be deemed to have read the RFP and visited the sites to ascertain the full scope of the requirements prior to filling in the price. The entered price shall be deemed to cover the full scope as aforesaid, including overheads and profit.
3. If bidders are unclear or uncertain as to any item, they shall seek clarification in writing prior to submitting their bid.

Pricing

4. Prices shall be entered in indelible ink, and any alterations necessary due to errors, etc., shall be initialled by the Bidder.
5. Bid prices shall be quoted in United States Dollars, in the manner indicated in the Bid Form of the RFP. For each item, bidders shall complete each appropriate column in the respective Schedules, giving the price breakdown as indicated in the Schedules.
6. Payments will be made to the Contractor in United States Dollars.
7. When requested by the Employer for the purposes of making payments or partial payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedules.

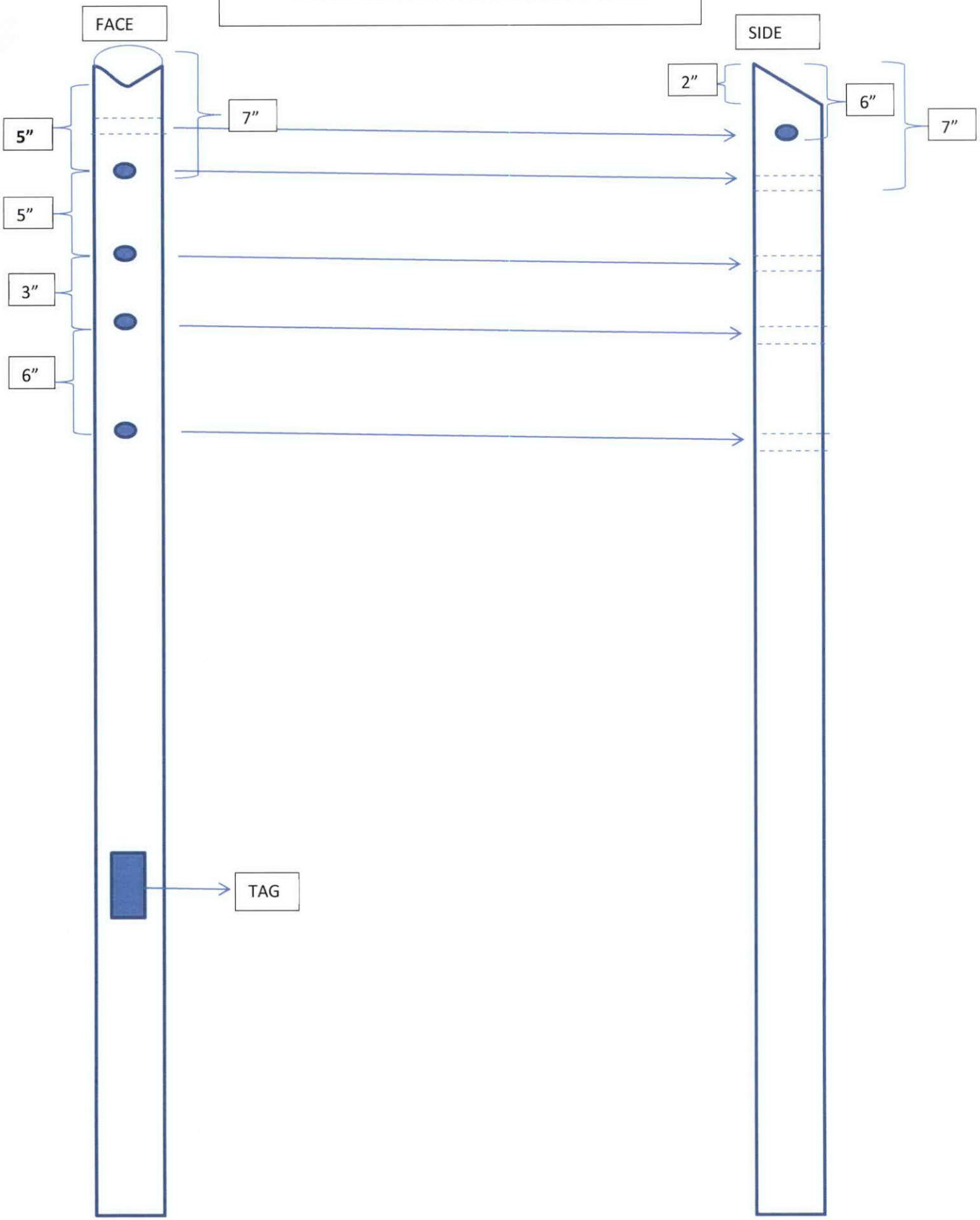
ITEM	DESCRIPTION OF WORKS	Price USD (Incl Taxes and Duties)
1	**Supply of Concrete Pole 13M**	
2	**Supply of Concrete Pole 16M**	
3	**Supply of Wooden Pole 39 Feet / Wood.**	
	TOTAL COST PROPOSAL	$_____

Name of Bidder _____

Signature of Bidder _____

"ATTACHMENT A"

DRILLING SPECIFICATION



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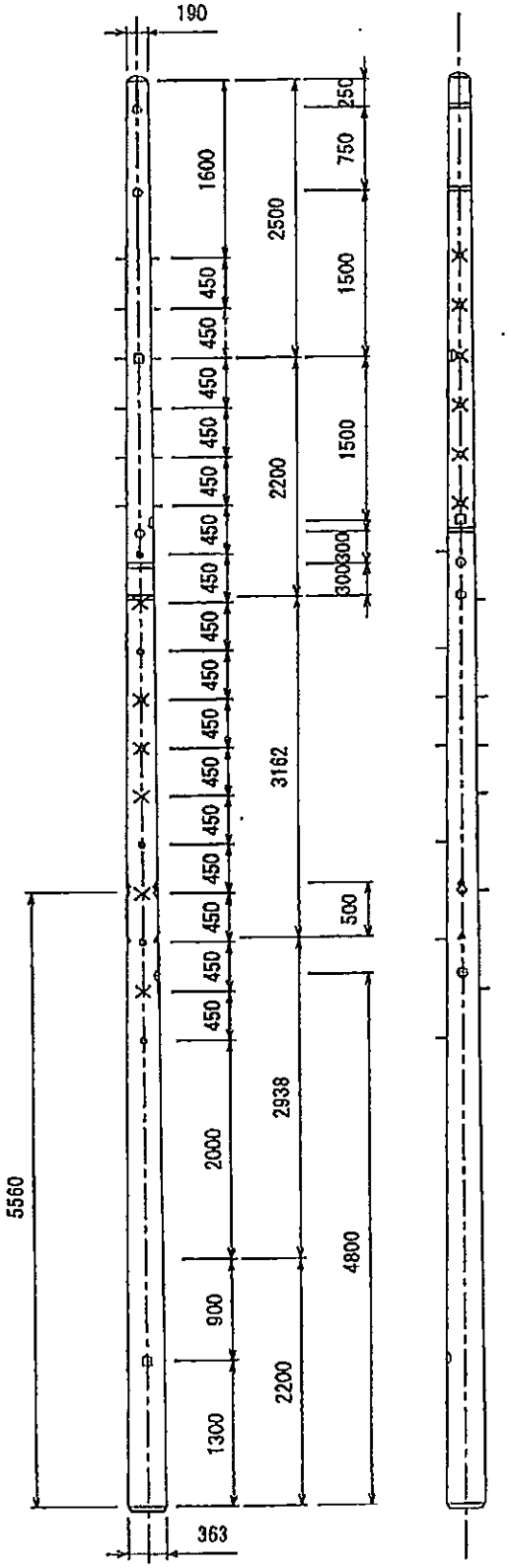
13－19－7.0



Φ18 Bolt Hole

○ ═	φ18ボルト孔
□ ▯	接地線引入口 Earth Wire Portal 接地線引出口 Earth Wire Exit
ー • ×	足場ボルト取付装置 Step Bolt Mounting Device
▲ ◭	番号札取付ビス受口 Sockets for Set Screws of Number Plates
◇ ◁	重心位置表示片 Display of Center of Gravity
⊕ ◖	磁器製銘板

Porcelain plates

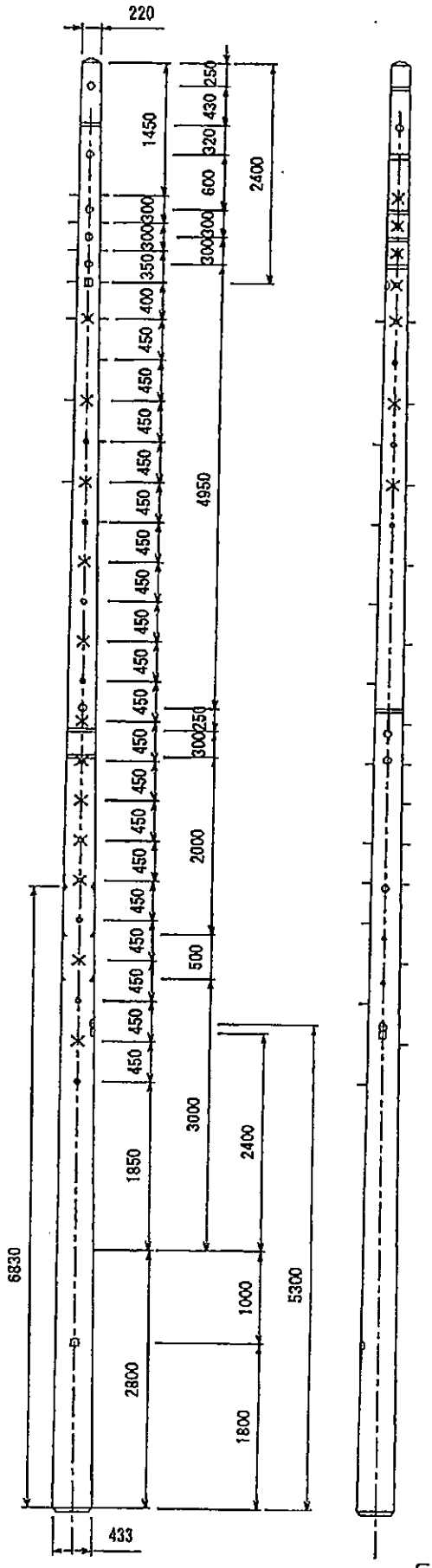
Step Bolt Mounting Device

足場ボルト取付装置	25
φ18ボルト孔	10

Φ18 Bolt Hole

(0909)

16－22－10



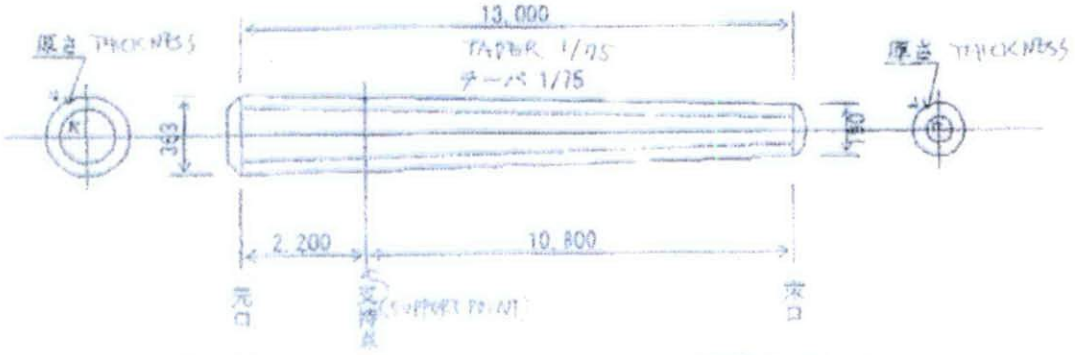
English translation same as "13-19-700"

○ ═	φ18ボルト孔
□ ▯	接地線引入口 接地線引出口
ー ◦ ×	足場ボルト取付装置
▲ ◢	番号札取付ビス受口
◇ ◁	重心位置表示片
⊕ ∈	磁器製銘板

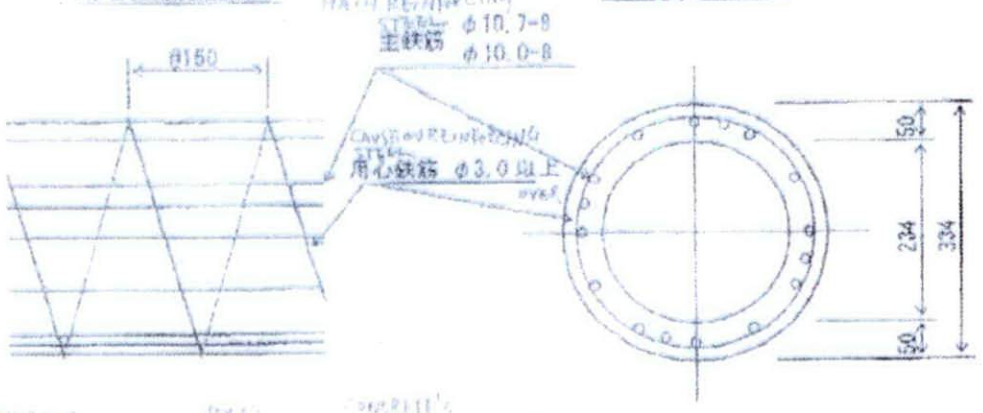
足場ボルト取付装置	38
φ18ボルト孔	18

Item #2

13－19－7.0 (0909) 1/2



用心鉄筋配筋図



支持点断面図

鉄筋重量 (kg)		ポール体積 (m^3)	コンクリート体積 (m^3)	ポール計算質量 (kg)	ひび割れ試験荷重 (kN)	支持点におけるひび割れ試験曲げモーメント (kN・m)
主鉄筋	用心鉄筋					
107.07	3.96	0.4628	0.4492	1200	7.0	73.85

Item # 2/2

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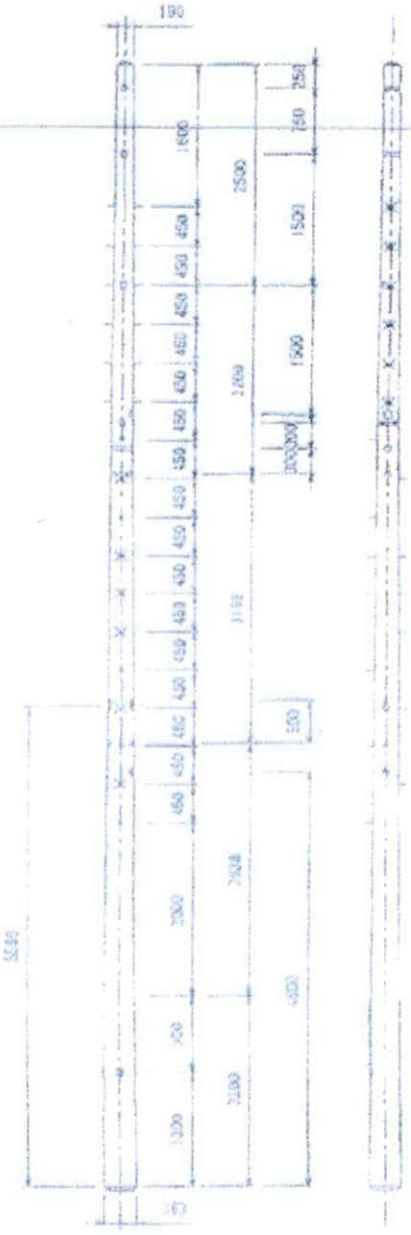
13－19－7.0

2/2



○ ＝	φ18ボルト孔	φ18 BOLT HOLE
□ 0	接地線引入口 接地線引出口	EARTHWIRE IN 〃 OUT
－ ・ ×	足場ボルト取付装置	SCAFFOLD BRACKET FIXTURE
▲ ◢	番号札取付ビス受口	NAMEPLATE SCREW HOLE
◇ ＜	重心位置表示片	CENTER OF GRAVITY
⊕ φ	銘器製銘板	NAMEPLATE

SCAFFOLD BRACKET FIXTURE

足場ボルト取付装置	25
φ18ボルト孔	10

φ18 BOLT HOLE

Confirmed By

Sylvester Nestor
PPUC Warehouse Clerk

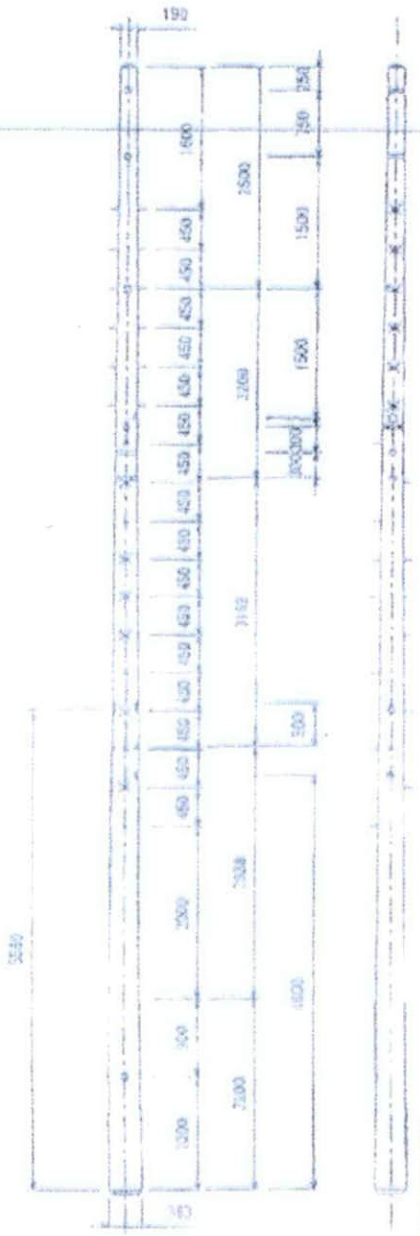
James Monpeult
PPUC PDO Manager

Item # 2/2

(0909)

2/2

13－19－7.0



○	═	φ18ボルト孔
□	8	接地線引入口 接地線引出口
−	×	足場ボルト取付装置
▲	4	番号札取付ビス受口
◇	∜	重心位置表示片
⊕	∜	銘器製銘板

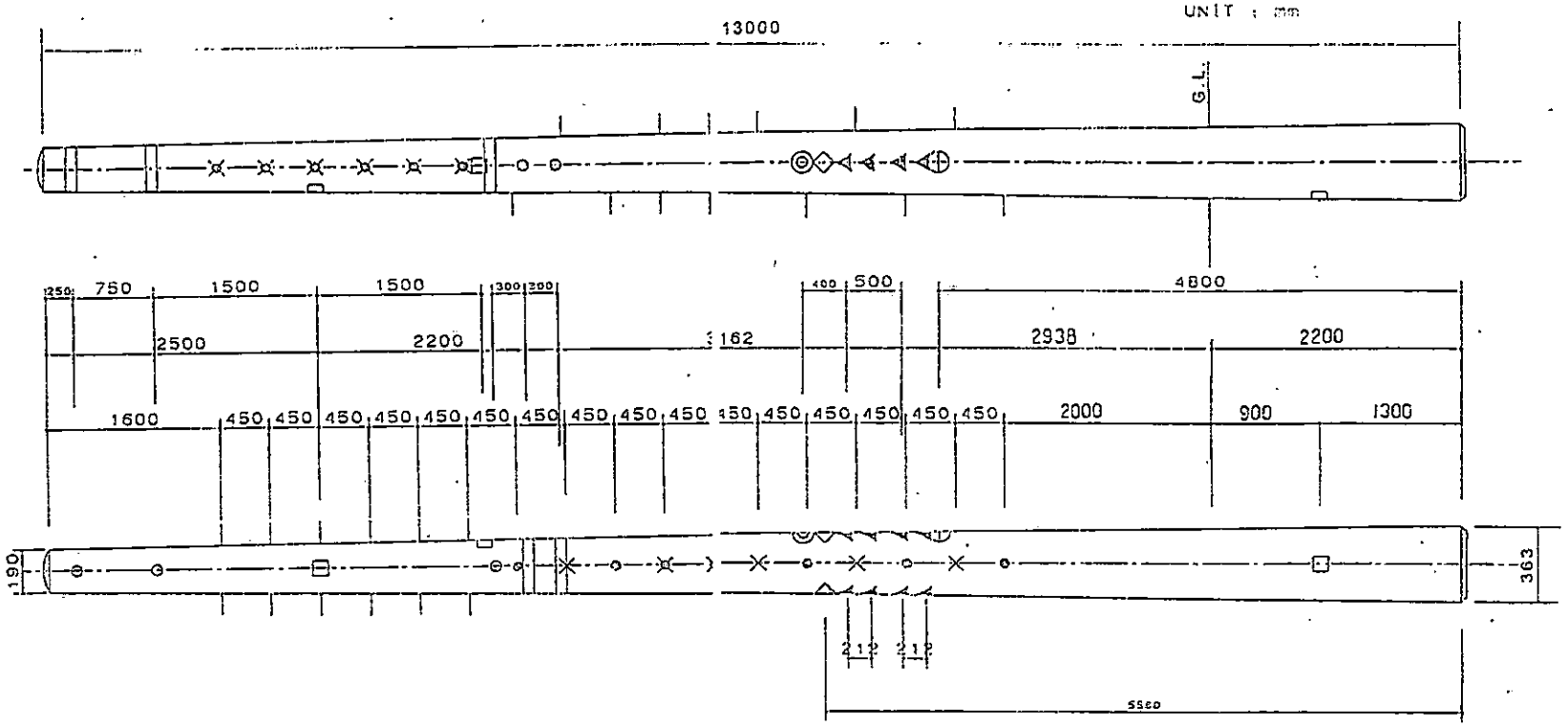
足場ボルト取付装置	25
φ18ボルト孔	10

Confirmed By:

Sylvester Nestor
PPUC Warehouse Clerk

James Mongeolt
PPUC POD Manager

UNIT : mm



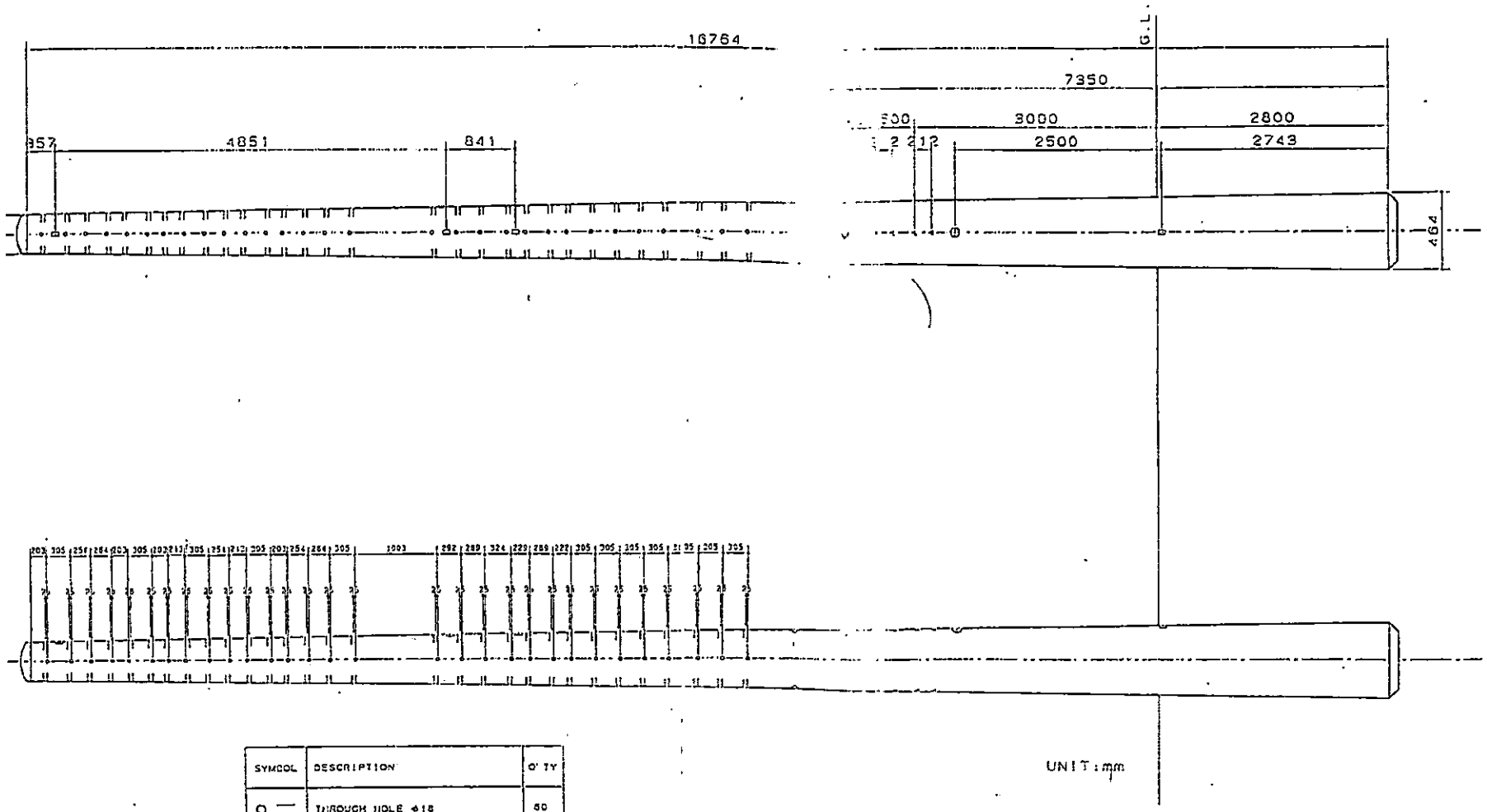
SYMBOL	DISCRIPTION	Q'TY
○ —	THROUGH HOLE φ18	5
□ ▯	INLET HOLE FOR ERATHING WIRE OUTLET HOLE FOR ERATHING WIRE	2 1
—o×	HOLE FOR STEP BOLT	25
◬ ◭	HOLE FOR NUMBER PLATE	8
◇ ▷	GRAVITY CENTER MARK	2
◎ ▷	BIRTH MARK	1
⊕ ▷	MANUFACTURER'S MARK	1

USAGE (REFER TO MATERI	LIST PD1ML001)
Concrete Pole	#4

No.	PART NAME	MATERIAL	SIZE	REQD	NOTE

YOSHIMOTO POLE CO., LTD.

DRAWING TITLE: Concrete Pole 13-19-700	DRAWING NO. 940608-201
DRAWNED BY:	DESIGNED BY:
CHECKED BY:	APPROVED BY: SECTION No



SYMBOL	DESCRIPTION	Q'TY
○ —	THROUGH HOLE φ18	60
□ ▯	INLET HOLE FOR EARTHING WIRE OUTLET HOLE FOR EARTHING WIRE	3 1
⅄ L	HOLE FOR NUMBER PLATE	6
◇ ▷	GRAVITY CENTER MARK	12
◎ ▷	BIRTH MARK	1
⊕ ▷	MANUFACTURER'S MARK	1

USAGE (REFER TO MATERIAL LIST PD:ML001)	
Concrete Pole	#3

UNIT : mm

No.	PART NAME	MATERIAL	SIZE	REQD	NOTE

YOSHIMOTO POLE CO., LTD.

DRAWING TITLE: Concrete Pole 16.7-24-1000	DRAWING NO. 940608-301
DRAWNED BY:	DESIGNED BY:
CHECKED BY:	APPROVED BY: SECTION NO.

JOB# : A104580
DATE : DEC.21.'94

OWNER : MINISTRY OF RESOURCES AND DEVELOPMENT
REPUBLIC OF PALAU

PLANT : THE PROJECT FOR THE DEVELOPMENT OF ELECTRIC POWER SYSTEM

MINISTRY OF RESOURCES AND DEVELOPMENT
REPUBLIC OF PALAU

THE PROJECT
FOR
THE DEVELOPMENT OF ELECTRIC POWER SYSTEM

CONTRACTOR :

BELMAT

BUSSAN ELECTRIC MACHINERY TRADING CO., LTD.
TOKYO JAPAN

SUB CONTRACTOR :

TOSHIBA ENGINEERING CORPORATION
KAWASAKI JAPAN

FINAL

REV.MARK	DATE	CONTENTS	APPROVED BY	REV.MARK	DATE	CONTENTS	APPROVED BY
2	DEC.21.'94	FINAL					
1	NOV.25.'94	FOR APPROVAL	A.KODAKA				
0	AUG.05.'94	FOR APPROVAL	A.KODAKA				

DISTRIBUTION								
	CONSULTANT	3						
	BELMAT	1						

-	APPROVED BY	A.KODAKA	TITLE
SCALE -	CHECKED BY	N.SATO	CALCULATION FOR POLE STRENGTH
UNITS -	DESIGNED BY	N.SATO	
ISSUED BY	PLANT DIVISION		

TOSHIBA ENGINEERING CORPORATION
KAWASAKI JAPAN

DRAWING NO. PD1CL001

REV. MARK 2

Calculation for Pole Strength

Calculation of pole strength is based on Japan technical standards for electrical facilities "JEAC 70 11-1985, 22 (33) KV Distribution Standard."

1. Wind Load

Wind load is calculated by the following formula.

$$P=1/2\ \rho V^2 C$$

where P : Wind Load ($kg \cdot m^2$)

ρ : Air Density ($kg \cdot sec^2/m^4$)

ρ=0.115 (Atmospheric pressure : 720 mmHg
Temperature : 23°C)

V : Wind Velocity (m/sec)

V=40

C : Air Resistance Factor

C=1.0 (Conductor)

C=0.8 (Pole)

1-1 Wind Load of Conductor : Pw

$$Pw=1/2\ \rho V^2 C$$
$$=1/2 \times 0.115 \times 40^2 \times 1$$
$$=92 \quad (kg/m^2)$$

However, JEAC 7011 employs the following value as wind load of conductor for the calculation.

$$Pw=100$$

1-2 Wind Load of Pole : Pp

$$Pp=1/2\ \rho V^2 C$$
$$=1/2 \times 0.115 \times 40^2 \times 0.8$$
$$=74 \quad (kg/m^2)$$

2. Calculation of Pole Strength

Calculation of pole strength based on the wind pressure of a right angle to the transmission and distribution lines shall satisfy the following formula.

$$M \geq Mp+Mw$$

where M : Allowable Moment of Pole (kg·m)

Mp: Moment of Pole caused by Wind Pressure (kg·m)

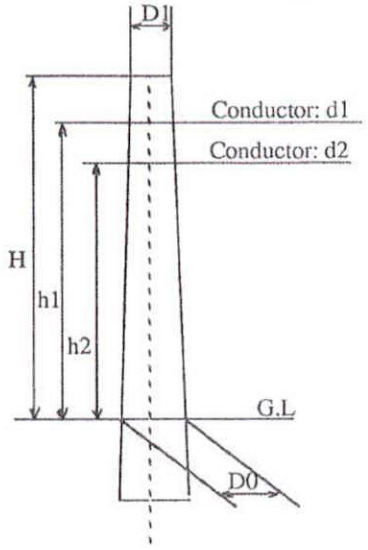
Mw: Moment of Conductors caused by Wind Pressure (kg·m)

$M=(H-0.25)\ Pc$

$Mp=Pp\ \{(2D_1+D_0)H^2\}/6$

$Mw=Pw\ S\ (\Sigma dh)$

where



Pc : Design Load of Pole (kg)
Pp : Wind Load of Pole (kg/m2)
Pp=74
Pw : Wind Load of Conductor (kg/m2)
Pw=100
D1 : Top Diameter of Pole (m)
D0 : Diameter of Pole at Ground Level (m)
H : Height of Pole above Ground Level (m)
S : Span Length (m)
d : Conductor Diameter (m)
h : Height of Conductor above Ground Level (m)

3. Results of Calculation

Calculation is carried out for each pole model which is applied for this project. The arrangement of each pole model is shown on the drawings ("Typical Pole Arrangement" PD1PA001).

Maximum allowable span for each pole model is as follows obtained from the attached computer output where M-(Mp+Mw) is more than zero.

1) Model 1 100m
2) Model 11 162m
3) Model 2 109m
4) Model 21 198m

PALAU : POLE STRENGTH - MODEL 1 & 11

2. POLE		MODEL 1	MODEL 1	MODEL 11	MODEL 11
L: Length	(m)	16.764	16.764	16.764	16.764
Pc: Strength	(kg)	1000	1000	1000	1000
D1: Top Dia.	(m)	0.240	0.240	0.240	0.240
D0: Dia. at GL	(m)	0.427	0.427	0.427	0.427
H: Height	(m)	13.964	13.964	13.964	13.964
S: Span	(m)	100	101	162	163

3. CONDUCTOR ARRANGEMENT		MODEL 1	MODEL 1	MODEL 11	MODEL 11
CONDUCTOR LEVEL-1					
Type	-	CU	CU	CU	CU
Size	(mm2)	38	38	38	38
d: Diameter	(m)	0.0078	0.0078	0.0078	0.0078
h: Height	(m)	13.714	13.714	13.714	13.714
No. of Cond.	-	1	1	1	1
CONDUCTOR LEVEL-2					
Type	-	AAC	AAC	AAC	AAC
Size	(mm2)	150	150	150	150
d: Diameter	(m)	0.016	0.016	0.016	0.016
h: Height	(m)	12.638	12.638	12.572	12.572
No. of Cond.	-	1	1	3	3
CONDUCTOR LEVEL-3					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	11.917	11.917		
No. of Cond.	-	1	1		
CONDUCTOR LEVEL-4					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	11.145	11.145		
No. of Cond.	-	1	1		
CONDUCTOR LEVEL-5					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	9.817	9.817		
No. of Cond.	-	3	3		

4. MOMENT EVALUATION		MODEL 1	MODEL 1	MODEL 11	MODEL 11
M	(kg-m)	13,714	13,714	13,714	13,714
Mp	(kg-m)	2,175	2,175	2,175	2,175
Mw	(kg-m)	11,494	11,609	11,509	11,580
M-(Mp+Mw)	(kg-m)	45	-70	30	-41

PALAU : POLE STRENGTH - MODEL 2 & 21

1. WIND PRESSURE

TEMPERATURE	T=	23	(degree C)
AIR PRESSURE	H=	720	(mmHg)
AIR DENSITY	ρ =	(1.293*273)/(T+273)*H/760*1/9.8	
	=	0.115	(kg*sec2/m4)
WIND VELOCITY	V=	40	(m/sec)
AIR RESISTANCE	C=	0.8	(Pole)
	C=	1.0	(Wire)

WIND LOAD: P=1/2*ρ*V2*C

Pole:	Pp=	74	(kg/m2)	
Wire:	Pw=	100	(kg/m2)	Based on JEAC7011

PALAU : POLE STRENGTH - MODEL 2 & 21

2. POLE		MODEL 2	MODEL 2	MODEL 21	MODEL 21
L: Length	(m)	13	13	13	13
Pc: Strength	(kg)	700	700	700	700
Dl: Top Dia.	(m)	0.190	0.190	0.190	0.190
D0: Dia. at GL	(m)	0.334	0.334	0.334	0.334
H: Height	(m)	10.800	10.800	10.800	10.800
S: Span	(m)	109	110	198	199

3. CONDUCTOR ARRANGEMENT		MODEL 2	MODEL 2	MODEL 21	MODEL 21
CONDUCTOR LEVEL-1					
Type	-	AAC	AAC	CU	CU
Size	(mm2)	150	150	38	38
d: Diameter	(m)	0.016	0.016	0.0078	0.0078
h: Height	(m)	10.578	10.578	10.578	10.578
No. of Cond.	-	3	3	3	3
CONDUCTOR LEVEL-2					
Type	-	CU	CU	CU	CU
Size	(mm2)	38	38	38	38
d: Diameter	(m)	0.0078	0.0078	0.0078	0.0078
h: Height	(m)	9.4	9.4	9.4	9.4
No. of Cond.	-	1	1	1	1
CONDUCTOR LEVEL-3					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				
CONDUCTOR LEVEL-4					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				
CONDUCTOR LEVEL-5					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				

4. MOMENT EVALUATION		MODEL 2	MODEL 2	MODEL 21	MODEL 21
M	(kg-m)	7,385	7,385	7,385	7,385
Mp	(kg-m)	1,024	1,024	1,024	1,024
Mw	(kg-m)	6,334	6,392	6,353	6,385
M-(Mp+Mw)	(kg-m)	27	-31	8	-24

Calculation for Pole Strength

Calculation of pole strength is based on Japan technical standards for electrical facilities "JEAC 70 11-1985, 22 (33) KV Distribution Standard."

1. Wind Load

Wind load is calculated by the following formula.

$$P=1/2\ \rho V^2 C$$

where P : Wind Load ($kg \cdot m^2$)

ρ : Air Density ($kg \cdot sec^2/m^4$)

ρ=0.115 (Atmospheric pressure : 720 mmHg
Temperature : 23°C)

V : Wind Velocity (m/sec)

V=40

C : Air Resistance Factor

C=1.0 (Conductor)

C=0.8 (Pole)

1-1 Wind Load of Conductor : Pw

$$Pw=1/2\ \rho V^2 C$$
$$=1/2 \times 0.115 \times 40^2 \times 1$$
$$=92 \quad (kg/m^2)$$

However, JEAC 7011 employs the following value as wind load of conductor for the calculation.

Pw=100

1-2 Wind Load of Pole : Pp

$$Pp=1/2\ \rho V^2 C$$
$$=1/2 \times 0.115 \times 40^2 \times 0.8$$
$$=74 \quad (kg/m^2)$$

2. Calculation of Pole Strength

Calculation of pole strength based on the wind pressure of a right angle to the transmission and distribution lines shall satisfy the following formula.

$$M \geq Mp+Mw$$

where M : Allowable Moment of Pole (kg·m)

Mp: Moment of Pole caused by Wind Pressure (kg·m)

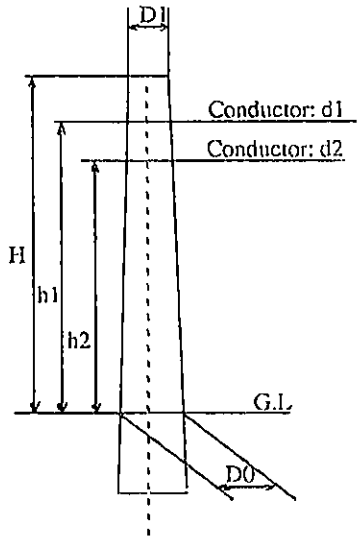
Mw: Moment of Conductors caused by Wind Pressure (kg·m)

$M=(H-0.25)\ Pc$

$Mp=Pp\ \{(2D_1+D_0)H^2\}/6$

$Mw=Pw\ S\ (\Sigma dh)$

where



Pc : Design Load of Pole (kg)
Pp : Wind Load of Pole (kg/m2)
Pp=74
Pw : Wind Load of Conductor (kg/m2)
Pw=100
D1 : Top Diameter of Pole (m)
D0 : Diameter of Pole at Ground Level (m)
H : Height of Pole above Ground Level (m)
S : Span Length (m)
d : Conductor Diameter (m)
h : Height of Conductor above Ground Level (m)

3. Results of Calculation

Calculation is carried out for each pole model which is applied for this project. The arrangement of each pole model is shown on the drawings ("Typical Pole Arrangement" PD1PA001).

Maximum allowable span for each pole model is as follows obtained from the attached computer output where M-(Mp+Mw) is more than zero.

1) Model 1 100m
2) Model 11 162m
3) Model 2 109m
4) Model 21 198m

PALAU : POLE STRENGTH - MODEL I & II

2. POLE		MODEL I	MODEL I	MODEL II	MODEL II
L: Length	(m)	16.764	16.764	16.764	16.764
Pc: Strength	(kg)	1000	1000	1000	1000
Dt: Top Dia.	(m)	0.240	0.240	0.240	0.240
Db: Dia. at GL	(m)	0.427	0.427	0.427	0.427
H: Height	(m)	13.964	13.964	13.964	13.964
S: Span	(m)	100	101	162	163

3. CONDUCTOR ARRANGEMENT		MODEL I	MODEL I	MODEL II	MODEL II
CONDUCTOR LEVEL-1					
Type	-	CU	CU	CU	CU
Size	(mm2)	38	38	38	38
d: Diameter	(m)	0.0078	0.0078	0.0078	0.0078
h: Height	(m)	13.714	13.714	13.714	13.714
No. of Cond.	-	1	1	1	1
CONDUCTOR LEVEL-2					
Type	-	AAC	AAC	AAC	AAC
Size	(mm2)	150	150	150	150
d: Diameter	(m)	0.016	0.016	0.016	0.016
h: Height	(m)	12.638	12.638	12.572	12.572
No. of Cond.	-	1	1	3	3
CONDUCTOR LEVEL-3					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	11.917	11.917		
No. of Cond.	-	1	1		
CONDUCTOR LEVEL-4					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	11.145	11.145		
No. of Cond.	-	1	1		
CONDUCTOR LEVEL-5					
Type	-	AAC	AAC		
Size	(mm2)	150	150		
d: Diameter	(m)	0.016	0.016		
h: Height	(m)	9.817	9.817		
No. of Cond.	-	3	3		

4. MOMENT EVALUATION		MODEL I	MODEL I	MODEL II	MODEL II
M	(kg-m)	13.714	13.714	13.714	13.714
Mp	(kg-m)	2.175	2.175	2.175	2.175
Mw	(kg-m)	11.494	11.609	11.509	11.580
M-(Mp+Mw)	(kg-m)	45	-70	30	-41

PALAU : POLE STRENGTH - MODEL 2 & 21

1. WIND PRESSURE

TEMPERATURE	T=	23	(degree C)
AIR PRESSURE	H=	720	(mmHg)
AIR DENSITY	ρ=	(1.293*273)/(T+273)*H/760*1/9.8	
	=	0.115	(kg*sec2/m4)
WIND VELOCITY	V=	40	(m/sec)
AIR RESISTANCE	C=	0.8	(Pole)
	C=	1.0	(Wire)

WIND LOAD: P=1/2*ρ*V2*C

Pole:	Pp=	74	(kg/m2)	
Wire:	Pw=	100	(kg/m2)	Based on JEAC7011

PALAU : POLE STRENGTH - MODEL 2 & 21

2. POLE		MODEL 2	MODEL 2	MODEL 21	MODEL 21
L: Length	(m)	13	13	13	13
Pc: Strength	(kg)	700	700	700	700
Dt: Top Dia.	(m)	0.190	0.190	0.190	0.190
D0: Dia. at GL	(m)	0.334	0.334	0.334	0.334
H: Height	(m)	10.800	10.800	10.800	10.800
S: Span	(m)	109	110	198	199

3. CONDUCTOR ARRANGEMENT		MODEL 2	MODEL 2	MODEL 21	MODEL 21
CONDUCTOR LEVEL-1					
Type	-	AAC	AAC	CU	CU
Size	(mm2)	150	150	38	38
d: Diameter	(m)	0.016	0.016	0.0078	0.0078
h: Height	(m)	10.578	10.578	10.578	10.578
No. of Cond.	-	3	3	3	3
CONDUCTOR LEVEL-2					
Type	-	CU	CU	CU	CU
Size	(mm2)	38	38	38	38
d: Diameter	(m)	0.0078	0.0078	0.0078	0.0078
h: Height	(m)	9.4	9.4	9.4	9.4
No. of Cond.	-	1	1	1	1
CONDUCTOR LEVEL-3					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				
CONDUCTOR LEVEL-4					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				
CONDUCTOR LEVEL-5					
Type	-				
Size	(mm2)				
d: Diameter	(m)				
h: Height	(m)				
No. of Cond.	-				

4. MOMENT EVALUATION		MODEL 2	MODEL 2	MODEL 21	MODEL 21
M	(kg-m)	7,385	7,385	7,385	7,385
Mp	(kg-m)	1,024	1,024	1,024	1,024
Mc	(kg-m)	6,334	6,392	6,353	6,385
M-(Mp+Mc)	(kg-m)	27	-31	8	-24

PALAU : POLE STRENGTH - MODEL 1: FOR CIVIL(CAUSE WAY)

1. WIND PRESSURE

TEMPERATURE	T=	23	(degree C)
AIR PRESSURE	H=	720	(mmHg)
AIR DENSITY	ρ =	(1.293*273)/(T+273)*H/760*1/9.8	
	=	0.115	(kg*sec2/m4)
WIND VELOCITY	V=	40	(m/sec)
AIR RESISTANCE	C=	0.8	(Pole)
	C=	1.0	(Wire)

WIND LOAD: P=1/2*ρ*V2*C

Pole: Pp=	74	(kg/m2)	
Wire: Pw=	100	(kg/m2)	Based on JEAC7011

2. POLE

		MODEL 1	MODEL 1
L: Length	(m)	16.764	16.764
Pc: Strength	(kg)	1000	1000
D1: Top Dia.	(m)	0.240	0.240
D0: Dia. at GL	(m)	0.427	0.427
H: Height	(m)	13.964	13.964
S: Span	(m)	55	60

PALAU : POLE STRESS - MODEL 1: FOR CIVIL (CAUSE WAY)

3. CONDUCTOR ARRANGEMENT		MODEL 1	MODEL 1
CONDUCTOR LEVEL-1			
Type	-	CU	CU
Size	(mm2)	38	38
d: Diameter	(m)	0.0078	0.0078
h: Height	(m)	13.714	13.714
No. of Cond.	-	1	1
CONDUCTOR LEVEL-2			
Type	-	AAC	AAC
Size	(mm2)	150	150
d: Diameter	(m)	0.016	0.016
h: Height	(m)	12.638	12.638
No. of Cond.	-	1	1
CONDUCTOR LEVEL-3			
Type	-	AAC	AAC
Size	(mm2)	150	150
d: Diameter	(m)	0.016	0.016
h: Height	(m)	11.917	11.917
No. of Cond.	-	1	1
CONDUCTOR LEVEL-4			
Type	-	AAC	AAC
Size	(mm2)	150	150
d: Diameter	(m)	0.016	0.016
h: Height	(m)	11.145	11.145
No. of Cond.	-	1	1
CONDUCTOR LEVEL-5			
Type	-	AAC	AAC
Size	(mm2)	150	150
d: Diameter	(m)	0.016	0.016
h: Height	(m)	9.817	9.817
No. of Cond.	-	3	3

4. MOMENT EVALUATION		MODEL 1	MODEL 1
M	(kg-m)	13.714	13.714
Mp	(kg-m)	2.175	2.175
Mw	(kg-m)	6.322	6.896
Mp+Mw	(kg-m) (1)	8.496	9.071
M-(Mp+Mw)	(kg-m)	5.218	4.643
5. THRUST			
Tp	(kg)	343.6	343.6
Tw	(kg)	394.9	430.8
Tp+Tw	(kg) (2)	738.5	774.4

(1) overturning moment
8.496 tm → 8.6 tm

(2) horizontal force
738.5 kg → 0.8 t

ELECTRIC POLE

Item's Discription	Instock	On-Going Order	Unit Cost	Qty to be Ordered	Estimated Cost
Concrete Pole 13M					
301-7086-13M-19CM	0	100	1,651.30	50	82,565.00
Concrete Pole 15M					
301-7086-15M	0				
Concrete Pole 16M					
301-7086-16-7-10	0	50	2,719.30	25	67,982.50
Wooden Pole 34 Feet/ Wood					
301-7086-34 WOOD	12				
Wooden Pole 39 Feet/Wood					
301-7086-39FT WOOD	40		655.00	25	16,375.00
				ESTIMATED COST	**98,940.00**