DPOLE®
UTILITY POLES

Cml Middle East
سي ام ال الشرق الأوسط

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Past: a picture of Lorenzo Del Carlo spa in 1955

OUR ORIGINS

LDL is a conglomerate of four leading Italian companies in the fields of galvanization, industrial painting and the manufacturing of steel supports, with a total production area of 170,000 square meters.
The consolidated success of LDL results from a long tradition for excellence, as well as a proven track record of market success evidenced by the longevity of the group's first hot-dip galvanizing unit and pole production factory which trace their roots all the way back to 1950 and 1960 respectively. The affinities and the values of the individual companies have merged to create a global group which is at present supporting some the world's leading companies in the energy, telecommunication, railway and infrastructure sectors.

Present: a picture of CML srl in 2024

PRODUCTS AND SERVICES

Research and development

Design and sustainability: innovation starts here

LDL history is marked by innovation and intuition which come from continued investment in people and frameworks designed to enhance production processes and create unique cutting edge products.

The group's aim is to constantly evolve and maintain its growth trajectory in order to meet both global demand and anticipate clients' future needs.

Our new projects are designed to upgrade urban aesthetics and create advanced integrated systems for future smart cities leading to more efficient and functional lighting systems as well as new communication systems and energy transmission networks with wider reach.

Environment

Sustainable development for a better tomorrow

LDL has always been committed to the development of environmentally friendly products. Some concrete examples include reduced energy transmission towers, use of renewable energy to power lighting systems such as the 'stand alone' system powered by solar energy, optimization of supports for wind
power generation.

With a clean environment in mind, LDL ensures streamlined automated and manual production processes to minimize emmisions and maximize energy savings and efficiency, and manufacturing activities are fully certified to comply with the utmost demands of the market.

Values

Vision

Help to improve people's lives by bringing illumination to every part of the world, improving people's mobility.

Mission

To become a leading multinational Group in public lighting systems and steel structures for electricity lines and telecommunications grids developing new products for smart city that can improve people's mobility with structures for electrical cars and structures for sustainable mobility (metro in surface mobility).

We will accomplish this mission by:

- designing and manufacturing products with high standards in terms of quality, safety, design and innovation;
- pursuing efficiency, safety and sustainability in production processes.

Numbers

4 Plants in Italy:
2 Chiusi (SI), 1 Pegognaga (MN) 1 Uzzano (PT)

32,500 m^2 covered area

170,000 m^2 total area

200 employees

10 production lines

30,000 tons of steel processed per year

60,000 tons of hot - dip galvanized steel

OUR LOCATIONS:

Zincheria Toscana
LDL Holding
Via Provinciale Lucchese, 148
Fraz. S. Lucia 51010 Uzzano (PT) – Italy
T +39 0572 44711 - F +39 0572 447124
info@lorenzodelcarlo.it

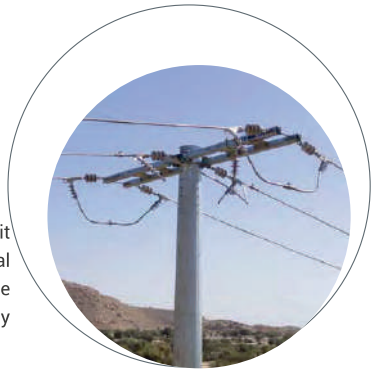
Cml
LDL Holding
Via della Bonifica, 9 - Loc. Le Biffe
53043 Chiusi (SI) - Italy
T +39 0578 850165 - F +39 0578 850166
info@cmlpali.it

Metalzinco
LDL Holding
Zona ind.le Loc. Le Biffe snc
53043 Chiusi Scalo (SI) – Italy
T +39 0578 20877 F +39 0578 224200
info@metalzinco.com

Macofer
LDL Holding
Via Provinciale Est, 52
46020 Pegognaga (MN) – Italy
T +39 0376 558414 - F +039 0376 558694
info@macofer.com

Cml Middle East
CML Middle East
PO BOX 2238, PC 133
Al Kuwair, Muscat
Sultanate of Oman

HOT - DIP GALVANIZED STEEL POLES



In the modern society the electric power has a crucial role, not only it defines the development of a Nation, but has become an essential element of our daily life or of our activities on the territory. A primary role for turning on the lights and the computer, but also and above all for every handicraft or industrial activity, is played by the distribution of the electric power, that needs a strong and reliable, as well as durable network. This primary role for the development and for the daily activity has to be played even with whims of the winds, agricultural fires, ice, floods and of the weather.

The galvanised steel distribution poles sustain the electric cables in a reliable and safe way maintaining the users safe, connected and productive granting the economic development.

The galvanised steel distribution poles take part at the construction of a network that is reliable, durable and economic, when and where necessary.

The galvanised steel distribution poles have a minor environmental impact (compared to wooden and concrete poles) and grant a 100% recycling.

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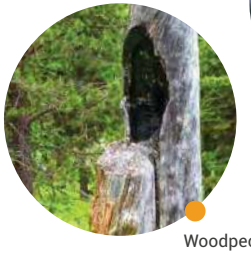
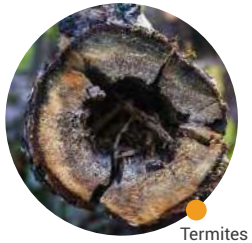
11 KEY POINTS OF GALVANIZED STEEL POLES COMPARED TO WOODEN OR CONCRETE POLES

1. Estimated lifespan of 60 years (6 times the one of a wooden pole and twice of the concrete poles)
2. 3 times lighter than a wooden pole and 7 times lighter than a concrete pole (cost reduction for transport and erection).
3. Reduction of the "domino" effect risk if a pole falls.
4. They do not burn (no risk with agricultural fires).
5. No maintenance requested (it is not necessary to tighten the assembly hardware, nor to treat them).
6. Resistant to attacks of insects, woodpeckers, rodents.
7. No toxic treatment with arsenic materials (forbidden in many countries) for public health reasons.
8. They are not porous, no infiltration is possible. They also do not break the effects of ice (or deflect with high humidity level).
9. Very economic alternative for head or corner poles. They can increase the lifespan by reducing the number of poles on the line.
10. They have a flexibility that allows to regain the imbalances within the lifespan rates (for example breaking of the cable due to freezing). This cannot be allowed by rigid supports such as concrete ones.
11. Limited environmental impact with a 100% recycling possibility (impossible for wooden poles because of the treatments, and for concrete poles _ both solutions have a major impact on the environment).

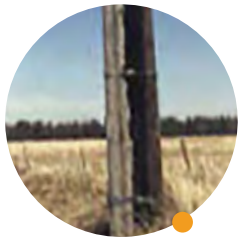
Disadvantages of the wooden and concrete poles



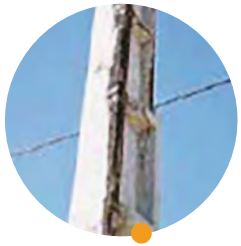
Woodpecker



Termites



Fire

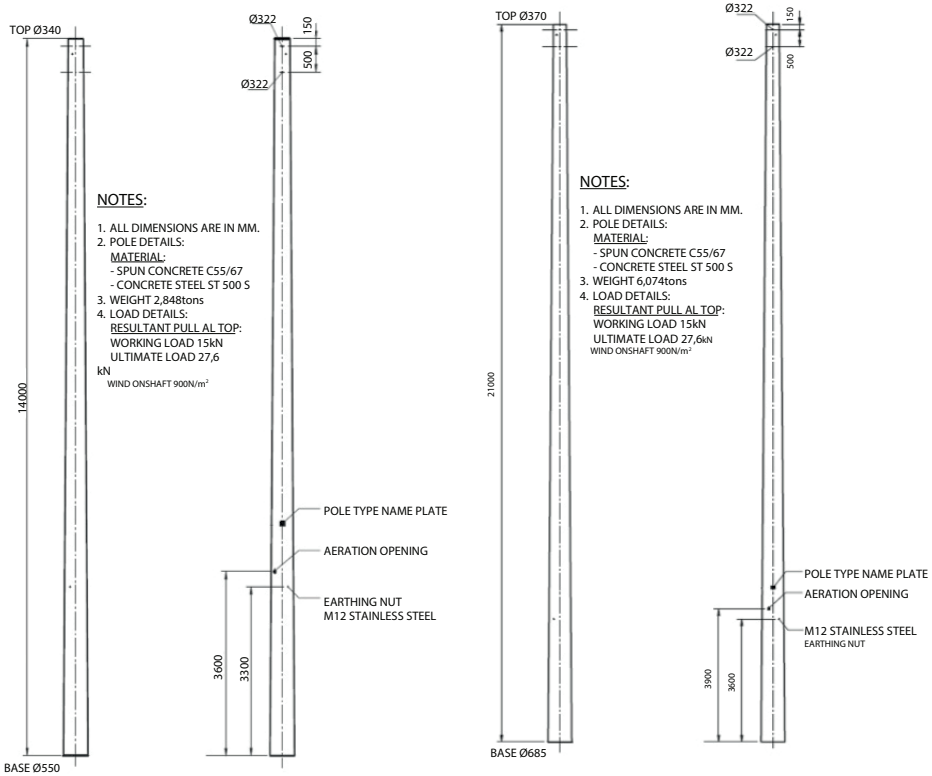


Corrosion

UTILITY POLES STEEL VS WOOD

	STEEL	CONCRETE	WOOD
Life forecast	**60 years**	30 years	10 years
Weight	**254 kg**	1350 kg	790 kg
Installation costs	**low**	Very high	high
Transport costs	**low**	Very high	high
Maintenance costs	**low**	low	Important
Remaining value (recycling)	**Positive**	Negative	Negative
Influence on the environment	**low**	high	Average

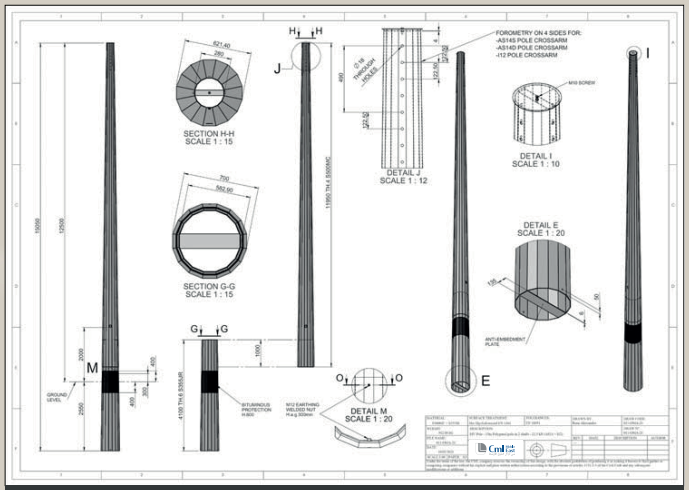
UTILITY POLES
STEEL VS CONCRETE



AS14 concrete pole
Ultimate load=27kN
Weight=2,8 ton

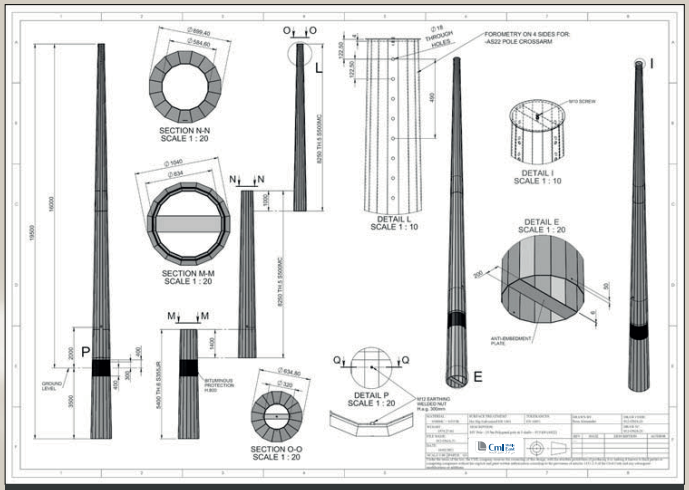
AS22 concrete pole
Ultimate load=27kN
Weight=6 ton

Making a comparison between steel and concrete poles (in the same range) it looks clear that steel poles are lighter than concretre one (even 3 times ligher in our case) so a small crane is more than enough for erection.



AS14 steel pole
Ultimate load=21kN - Weight=0,9 ton

(to be definied with customer)



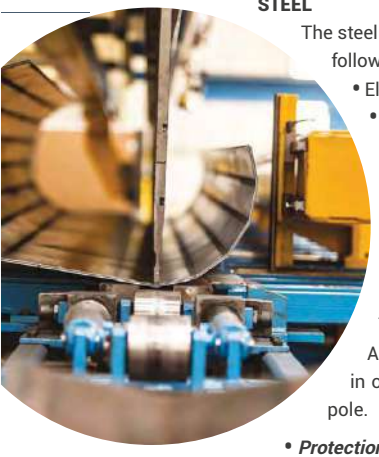
AS22 steel pole
Ultimate load=45kN - Weight=2 ton

Typical Label
(to be definied with customer)

TECHNICAL SPECIFICATIONS

MECHANICAL BEHAVIOUR

The metallic supports are dimensioned in order to resist to the nominal load F and on the wind pressure V applied at 0,25 m from the top. Under theses loads, the assured safety coefficient is significantly elevated and the pole resists to an elevated torque. Tests have shown that the destruction of the support occurred over a coefficient of 2.1. Moreover, the collapse of the support does not occur with a sudden break (as it is for the wooden or concrete poles) but through a plastic deformation or a local curvature of the connection section together with important deformations that allow the pole to still sustain part of the initial loads.



STEEL

The steel utilized is in accordance with the EN 10149 class I type S500MC and has the following features:

- Elastic limit Re = 500N/mm²
- Granted resistance at -20 C
- Suitable to be galvanized according to NFA 35503 class I.

Protection against corrosion

A product certificate of conformity can be supplied to the customer on request.

GALVANIZATION

- ***Hot - dip galvanization***

The distribution pole is hot dip galvanized according to EN 1461(or CEI 7-6 or ASTM A 123 or OES -1 or other standards depending from customer indication) in order to obtain an even zinc coating in both, the interior and exterior of the pole.

- ***Protection of the embedded part***

On request of the customer, the pole can be supplied with an additional bituminous protection (realised according to the customer's specifications).

Manufacturing tolerance

- Length of the elements: from 25 mm to + 75 mm
- Linearity: 2 mm per meter
- Torque: 1 grade for a length of 3 m
- Ovalisation: Max 3%
- Average diameter: +/- 0,5%
- Joint: +/_ 150mm

Standard accessories:

- Head cap
- Standard holes
- Data plate
- Earthing
- Bituminous protection

STANDARD FABRICATION DETAILS

The distribution poles are realised in a standard version with the following equipment or details:

- 5 pass through holes with a diameter of 18 mm and positioned regularly from the top.
- A M10 earthing nut positioned at 250 mm from the theoretical level of the ground.
- A top cap
- An identification plate showing: total height of the pole; the maximum eligible load with a coefficient 1; year of production; brand of the manufacturer (the plate can be customised according to the specifications /indictions of the customer).

The assembly of the poles on the ground is through embedment installation.

Over 12m the poles are realised in two sections.

As an option and on customer's request, the distribution poles can be supplied with:

- Specific identification plate
- Additional holes for the change of lighting fittings or additional accessories on the head.
- An additional earthing nut of the electrical fittings fixed on the head of the pole.
- An anti - embedment plate on the base of the pole.
- A bituminous protection of 800 mm (400 mm under the ground and 400 mm above) _ that can be modified according to the specifications/indications of the customer.
- Elements for the anchorage of the ladder or use of the climbing ladder.
- A series of removable rungs for access to the top.

GEOMETRY

The distribution pole has a regular polygonal section (8 or 12 or 16 sides) that offers resistance in all directions. The poles of up to 11,9 m are made by just one section, above 12 m they are built into two or more sections assembled on the construction site through coupling. The nominal retrieval height must be equal to 1,5 times the average diameter among the edges of the top section. The acceptable effective joint height realised on the site must be higher than 1,35 times the diameter among the edges of the top section.

MANUFACTURING

- **Longitudinal welding**

The longitudinal welding of the section is realised through the submerged welding following a qualified operational procedure and in accordance with standard ISO 15614-1.

- ***Quality***

The poles are manufactured on a site that is certified ISO 9001. The manufacturing and control procedures are clearly defined in the quality manual.

- ***Other***

The holes, the welding and other operations are realised before the galvanisation in order to ensure that the whole surface of the pole is protected from corrosion.

- ***Dimensions and eligible loads***

The eligible load is the one that leads the pole to the steel's minimum granted elastic limit with the wind, vertical load and variable safety coefficient. The application of a load due to the wind or the addition of accessories on the pole (vertical load), as well as taking into consideration a safety coefficient, complicate the selection procedure of a pole and needs a specific calculation.

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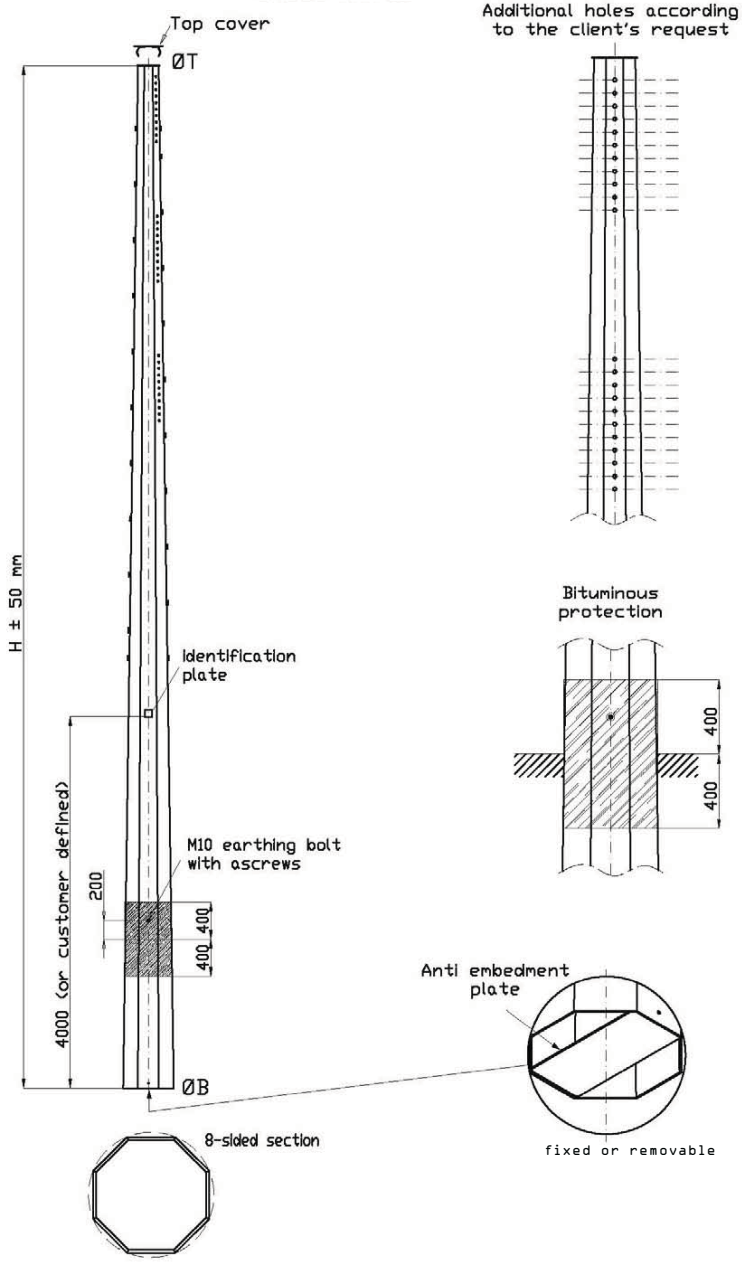
DISTRIBUTION DPOLE RANGE



OPTIONS

Additional holes according to the client's request

Bituminous protection

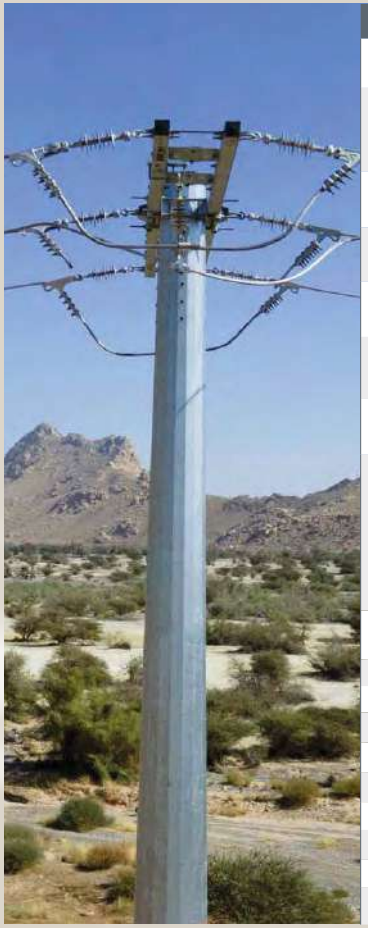
TECHNICAL SPECIFICATIONS

Manufacturing tolerance

Length of the elements from 25 mm to + 75 mm •
Linearity 2 mm per meter •
Torque 1 grade for a length of 3 m •
Ovalisation Max 3% •
Average diameter +/-0,5% •
Joint +/-150 mm •

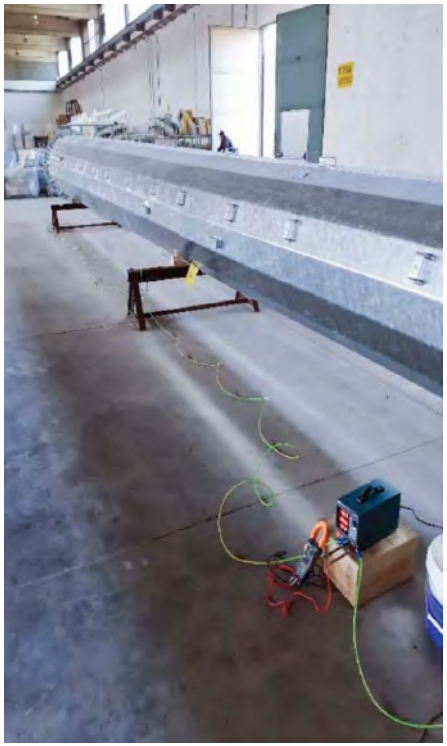
Standard accessories:

- head cap
- standard holes
- data plate
- earthing
- bituminous protection



S1	ITEEMS	REQUIREMENT
01	Standard	OES1/BS EN 1991/ASCE/SEI 48-2016 (as for OES 11 art. 0.05)
02	material	S500MC (according EN 10149) and S355J2 EN 10025-2 (suitable for galvanizatio)
03	Yield Strength	S500: > 500 MPa (according EN 10149) S355: > 355 MPa (according EN 10025)
04	Tensile Strength	S550: > 500-700 MPa (according EN 10149) S355: > 355-680 MPa (according EN 10025)
05	Temperature and Impact energy	S550: > -20°C /> 40J (according EN 10149) S335: > -20°C /> 27J (according EN 10025)
06	Total elongation (A%)	S550: > 15 (according EN 10149) S355: > 20 (according EN 10025)
07	Surface protection	Hot Dip Galvanization - min 127 µm According BS 729 or ASTM A123
08	Manufacure Tollerances	- Element length: 25 mm to + 75 mm - Linearity: 2 mm per meter - Torque: 1 grade for a lenght of 3 m - Ovalisation: Max 3% - Average diameter: +/- 0,5% - joint: +/- 150 mm
09	Type/Model	- Average diameter: +/- 0,5% - joint: +/- 150 mm
10	Heights	15.05, 15.05 and 19.50 meters
11	Weigts	900 kg, 900 kg and 2 tons
12	Diameters Base	700 mm, 700 mm and 1040 mm
13	Diameters Top	280 mm, 280 mm and 320 mm
14	Thickness	6 mm, 5 mm and 4 mm
15	Marking	Plate and danger plate as for OES-1
16	Ultimate Load	21 kN, 21 kN and 45 kN
17	Testing Lab	GeoConsultLab srl
18	Test Certificate	Attached

HOT DIP GALVANIZED POLES ARE A GOOD CONDUCTOR?



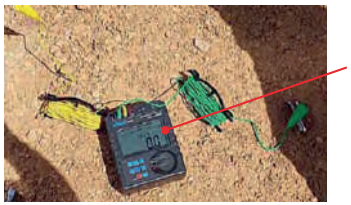
	Test I	Test II	Test III	Test IV	Test V	Test VI	Test VII	Test VIII	Test IX
voltage (V)	12	12	12	24	24	24	4	4	4
Current intensity (A)	0,2	0,5	1	1	0,5	0,2	0,2	0,5	1
ΔV (mV)	11,5	29,1	58,4	58,5	29,2	11,6	11,7	29,2	58,3
Theoretical resistance (Ω)	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Resistence value found (Ω)	0,057	0,058	0,058	0,058	0,058	0,058	0,058	0,058	0,058

The test was carried connecting the two ends of the pole (preliminary jointed _ slip on joint system) with copper cables of 6 sqmm, to the power supply; on the head, the cables were fixed to the equipotential bar, the other is connected to the gussets at the base of the tower where there is the predisposition for grounding. Same approach with the pole embedded. Subsequently the electrical current clamp has been connected to the laboratory power supply in order to record the voltage difference (ΔV) between the two ends of the tower; on the save side, the resistance of cables and the resistance of the bolted joints has been neglected.

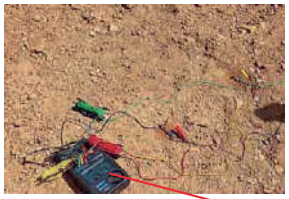
On the right you can read the data of the results obtained in the 9 tests carried out with voltage 4V 12V 24V and a current intensity of 0,2 A - 0,5 A - 1 A.

As shown in the table the resistance using the steel hot dip galvanized pole as a conductor for the earthing much less than to maximum resistance coming form specs (0,2 Ω). Is it also interesting to consider that the resistance of ground conductor used (6 sqmm) and the bolted connection (at the top and at the bottom side) is not considered and this is the greatest part of the 0,057 Ω measured ..... so the resistance of the pole is really minimal lower than the value (already low) measured.

EMBEDDED HDG STEEL POLES ARE GOOD FOR GROUND EARTHING?



2 Wires earth voltage test: result: 0 Volt



2 Wires resistance test result: 9,54 Ω

4 Wires soil resistivity test result: 692 Ωm

The following results has been obtained:
Earth voltage → 0 Volt
Soil resistivity → 692 Ωm
Earth resistance → 9,54 Ω
As reported, the performance of a hot dip galvanized steel pole directly embedded in ground without and insulation (concrete or layers on poles) is more than what it is possible to obtain (and this is physically correct if we consider that a HDG steel surface is a perfect conductor and that there are 7 sqm of external contact surface (the I18 pole is embedded in ground for 3m and the base diameter is 750mm) respect the 0,2 sqm of standard copper bar used for local earthing (and this is just considering the external surface of the pole). **The value of earth resistance are much lower than the 20 Ω internationally recognized as a reference for human body safety.**

Following test is about the earth resistance/resistivity measurements for embedded hot dip galvanized steel poles; these results confirm the possibility to NOT provide earthing on the poles, ONLY in case of direct installation into the ground (DIRECT EMBEDMENT) and not on concrete foundation or insulated installation.
The test was carried out in accordance with the international specifications using a earth resistance/soil resistivity tester (2/3/4 wires precision tester) and in particular the following methodology has been applied:
for the earth voltage measurement → 2 wires testing methodology
for the soil resistivity measurement → 4 wires testing methodology (Wenner methodology)
for the earth resistance measurement → 2 wires testing methodology (Volt-Amperometric)
A hot dip galvanized pole (as per below pictures) has been used as a conductor for grounding.
Note that the pole is a multi-bended (16 sides) steel plate longitudinally welded and made in two section jointed using slip on joint (friction) technique.

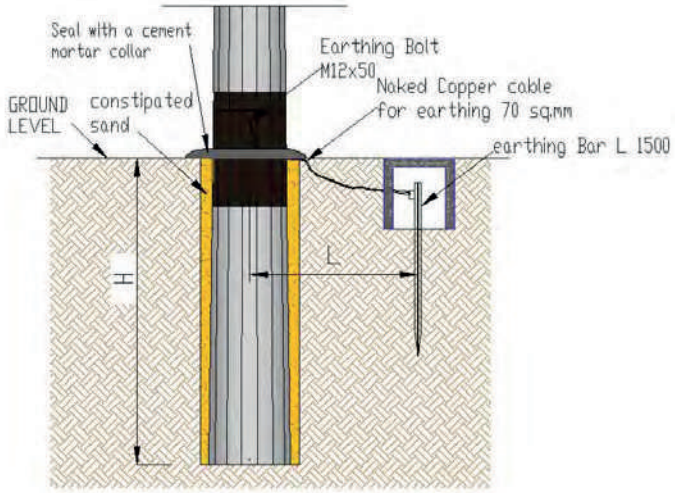
ADDITIONAL LOCAL EARTHING IS IT POSSIBLE?

All our steel poles are equipped with a welded nut for a local earthing as per below description. Local earthing is mandatory in case the pole is not directly embedded in ground (for example concrete embedment) and it is suggestd in any case every 2 km.

EARTHING INDICATIONS ARE REPORTED IN THE INSTALLATION PROCEDURE

Technical pole installation specifications:

Position	Description
H	Total height of the hole* 2550 mm
L	Distance of Earthing Bar 1500 mm

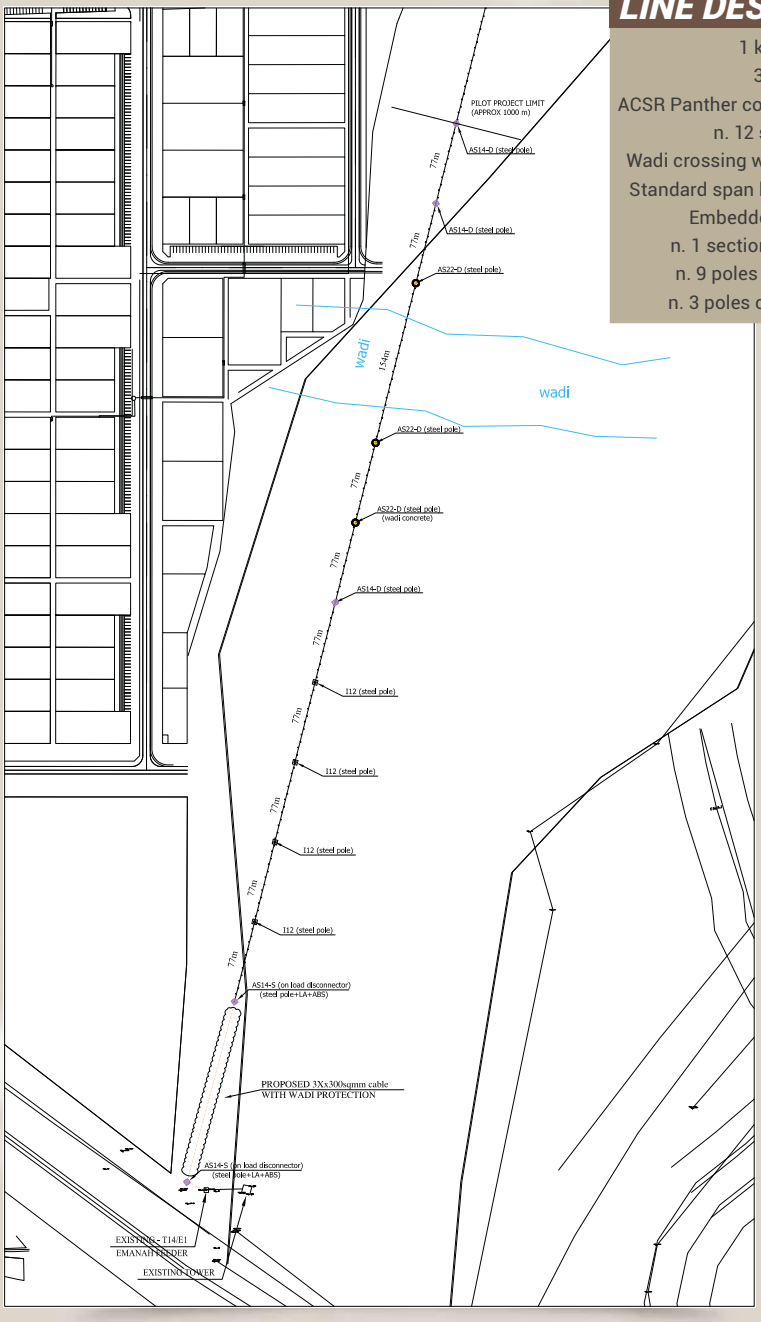


NIZWA PROJECT VIDEO

DPOLE PROJECT IN OMAN
NIZWA PROJECT

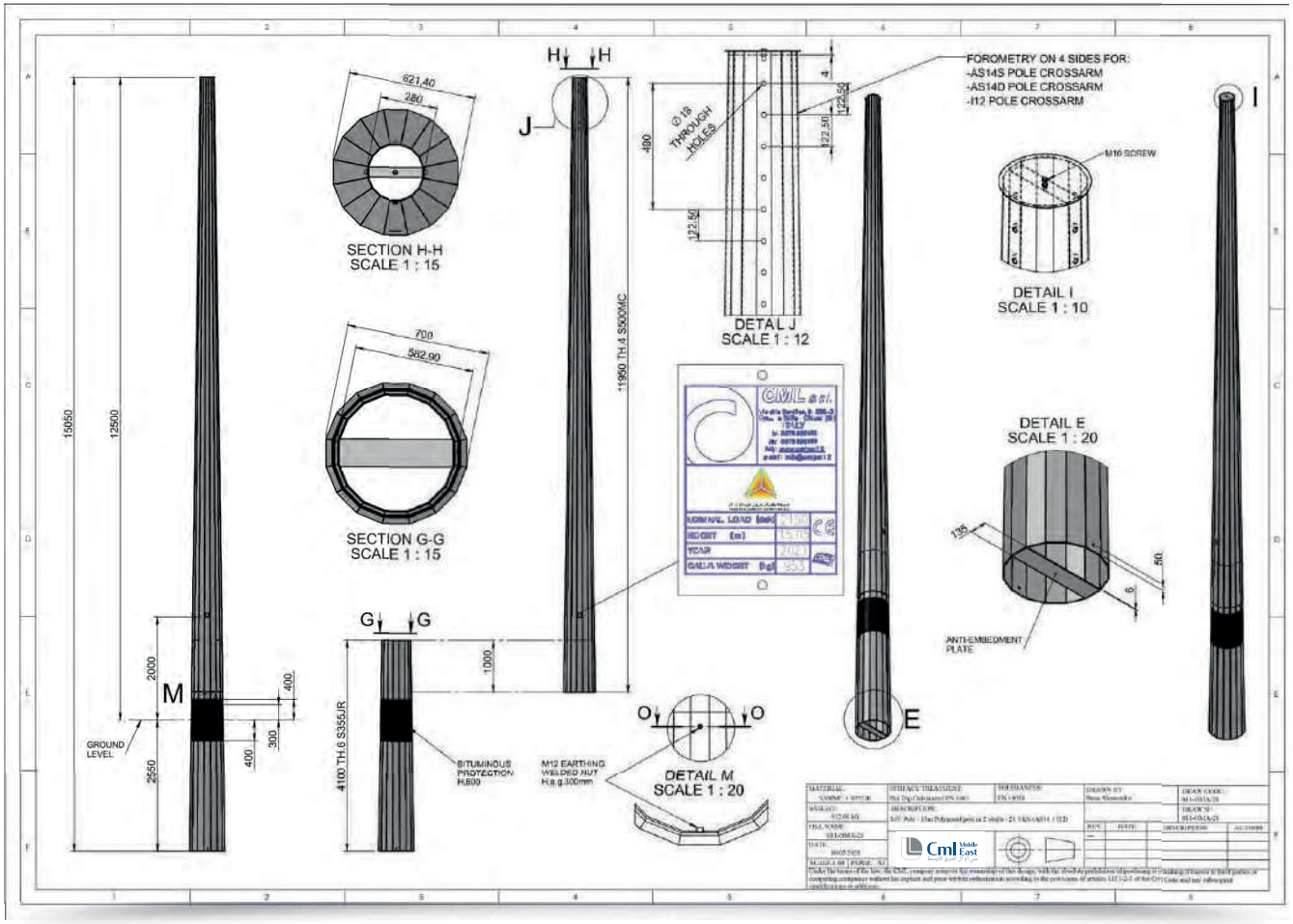
(1,5 km - 33 kV distribution line single circuit)

Site survey on July 29, 2021
(pilot project section 1 km)

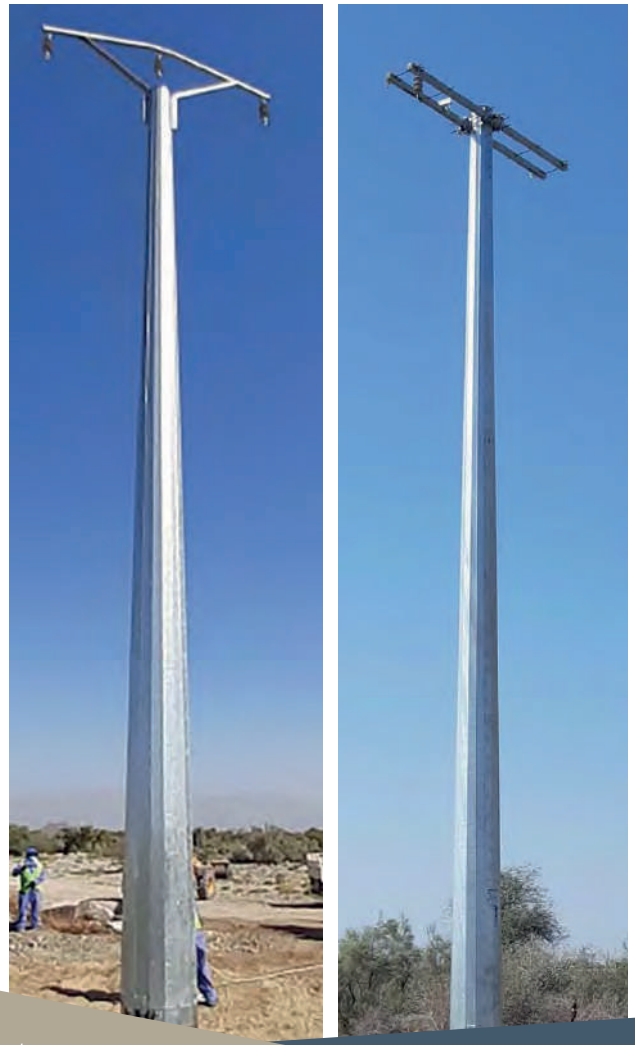


LINE DESCRIPTION:

1 km line
33 kV
ACSR Panther conductor (200 sqmm)
n. 12 steel pole
Wadi crossing with a span of 154 m
Standard span between poles 77m
Embedded in ground
n. 1 section underground
n. 9 poles of 15m height
n. 3 poles of 19,5m height

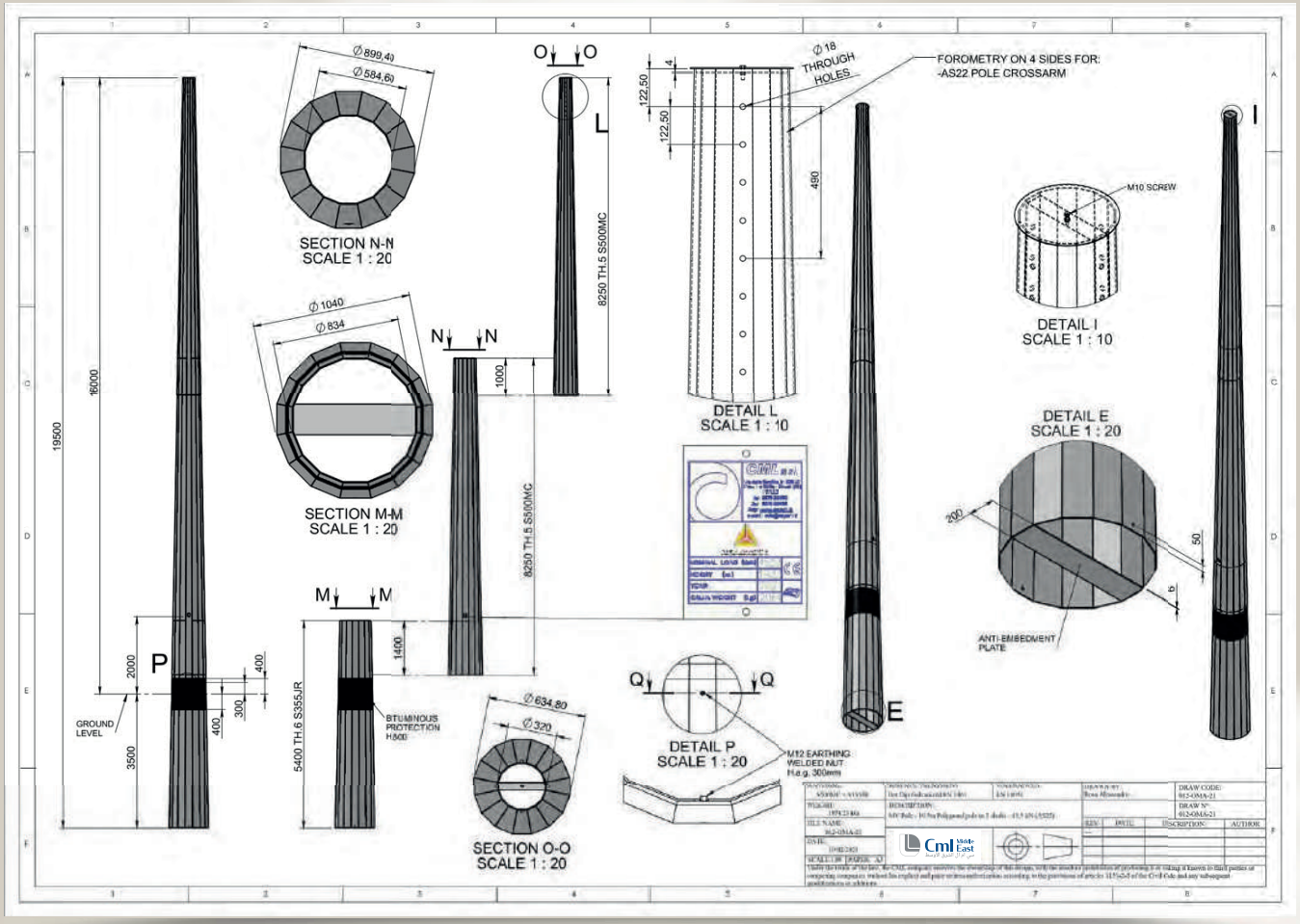


I12 AND AS14 STEEL POLE ULTIMATE LOAD=21kN WEIGHT=0,9 TON

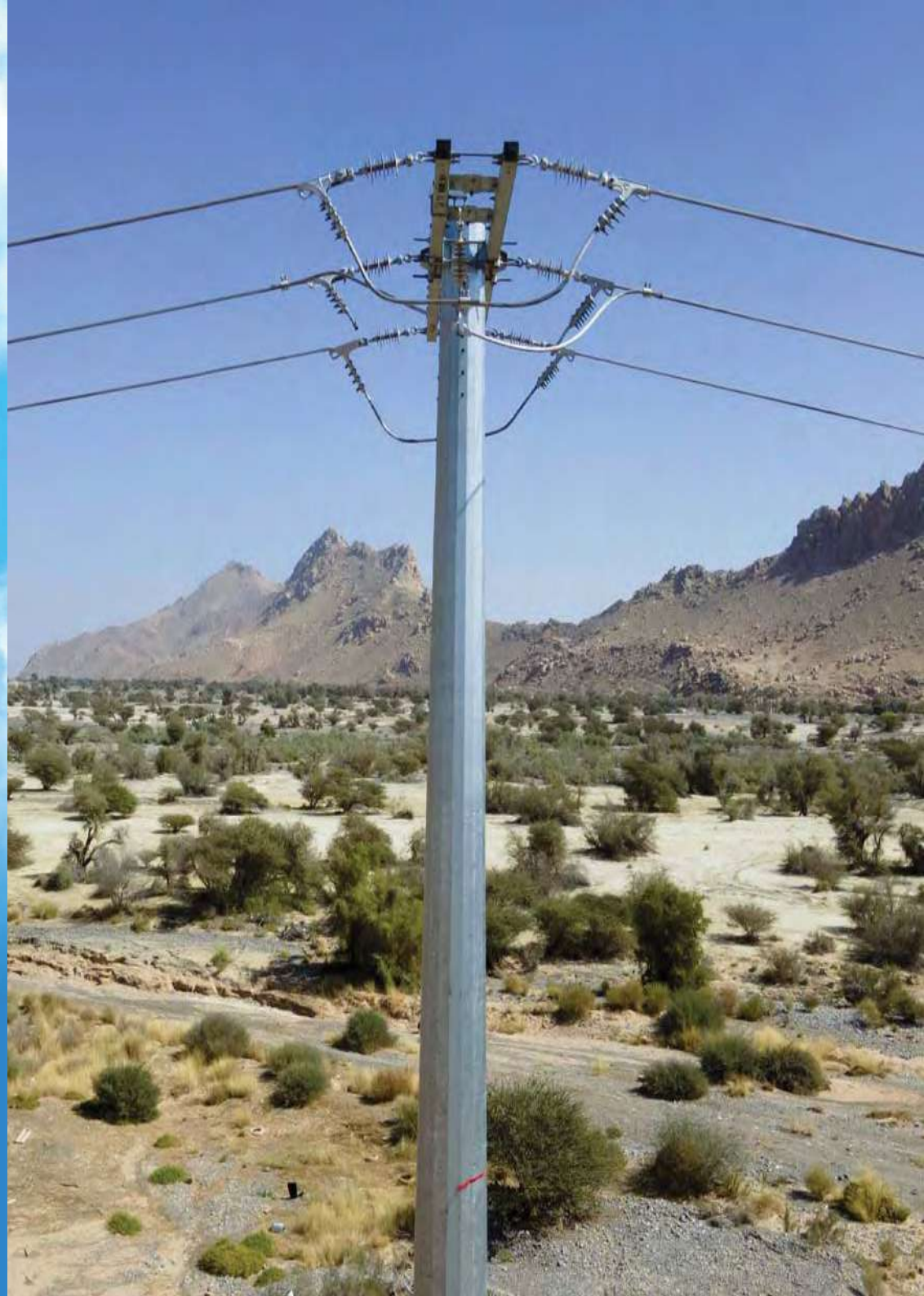


Embedment 2,5m _ pole diameter 0,8m - hole diameter needed 1m
(note that a slimmer AS14 pole it can be done in order to reduce hole diameter to 800mm)
For this project we used the AS14 poles also for the I12 but a specific intermediate pole is slim and lighter.

AS22 STEEL POLE
ULTIMATE LOAD=45kN
WEIGHT=2 TON



Embedment 3,5m - pole diameter 1m - hole diameter needed 1,2m
(note that a smaller AS22 pole in slim can be done in order to reduce hole diameter to 1000 mm)



CROSSARMS

AS14
TENSION
CROSSBAR

Double

Single

AS22
TENSION
CROSSBAR

Double

I12
SUSPENSION
CROSSBAR

DPOLE ACCESSORIES

POLE SUPPORTS

SURGE ARRESTERS SUPPORT

DISCONNECTOR SUPPORT

CABLE SUPPORT

DPOLE ASSEMBLY
SLIP ON JOINT

Slip on joint by hydraulic jacking system

Slip on joint by tirforts

DPOLE
POLE & SUPPORT
ASSEMBLY

POLE ASSEMBLY

SLIP ON JOINT DESIGN CALCULATION

SLIP ON JOINT DESIGN (MAX FORCE)		
N° sides of polygonal section:	16	
Taper:	0.02857	
Female shft tickness (S_p):	4	mm
Steel quality female section (S...):	500	5000
Slip on joint lenght:	1000	mm
Safety coefficient:	1.5	
Admissible load (σamm):	3333	kgf/cm²
Slip on joint max force (F_i):	10107	kgf

SLIP ON JOINT DESIGN (LENGHT)		
N° sides of polygonal section:	16	
Coefficient η:	3.040	
Friction coefficient μ (galvanized steel):	0.3	
Coefficient ξ* and safety coefficient K:	10.332	mm
F/F diameter of male shaft (Ds):	571.7	mm
Tapero (c):	0.02856	
Key of femal shaft (ds):	560.7	mm
Base material slip on joint lenghte (i_{min}):	752.2	mm
2ª class weiled material slip on joint lenght (i_{min}):	887.9	mm

Slip on joint max force - 10107 kgf

Minimun slip on joint on joint - 888 mm

SUPPORT ASSEMBLY

NIZWA PROJECT

CROSSARM ASSEMBLY

Pole will present a set of holes on each side in order to install the crossarm at different level on the top of the pole. This solution will help to level the conductor depending from ground condition. Un-used hale ae covered with PE or PVC caps.

Following detailed drawing for each crossarm (provided) it will be installed on related pole. A top cap in hot dip glavanized steel will be also applied and all openings will be covered with PE o PVC caps.

POLES INSTALLATION
(DRILLING)

A common drilling rig has been used to perform the activity. In particular we used a Soilmec model T108 (with nominal torque of 100 kNm).

The drilling depth depend from soil characteristics and is calculated for each model of poles. In our case we had:

- For the I12 and AS14 poles → 2,55m depth
- For the AS22 → 3,5m depth

Base diameter for poles and auger dimension is reported:

- For the I12 and AS14 poles → 700mm and 1m auger
- For the AS22 → 1040mm and 1,2m auger

DPOLE INSTALLATION & ERECTION

1 HOLE DRILLING

2 HOLE CHECKING

3 SLINGING AND ERECTION

4 POLE LIFTING

5 HOLE APPROACH

6 HOLE CENTERING

7 GROUND EMBEDMENT

8 EMBEDMENT CHECKING

9 BACK FILLING

10 FINISHING

DPOLE BACK FILLING

BACK FILLING
ON CONCRETE

SAND + WATER BACK FILLING
(FOR POLES EMEBDDED
DIRECTLY IN GROUND)

DPOLE GROUND EMBEDMENT

POSITION	DESCRIPTION	POSITION	DESCRIPTION
(0.00)	Conventional indication of the ground level	A	Height of the earthing 300 mm
H	Total height of the hole* 3500 mm	C	Height heat-shrink sleeve 400 mm
B	Embedment heat-shrink sleeve 400 mm	Db	Hole diameter for the placement of the shaft= 1040 mm

** The depth shall be checked before of pole installation and in any case approved by the project manager.*

POSITION	DESCRIPTION	POSITION	DESCRIPTION
1	Anti - embedment plate	A	Foundation Hole
2	Base shaft of the pole	B	Ready shaft for the embedment
3	heat-shrink sleeve	C	Embedded and vertically placed shaft
4	sand with vibrating systems	D	Finishing with vibrated and compacted sand and Seal with a cement mortar collar

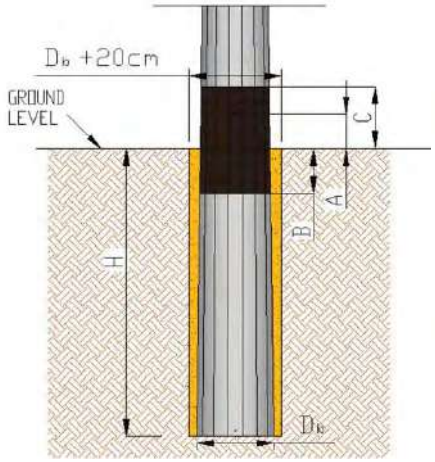


Figure: Reference quotes for the embedment

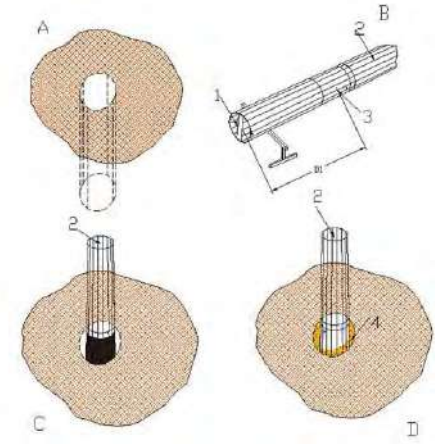
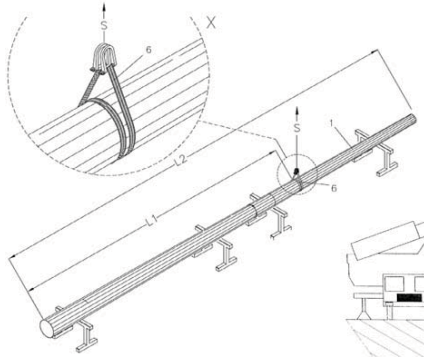
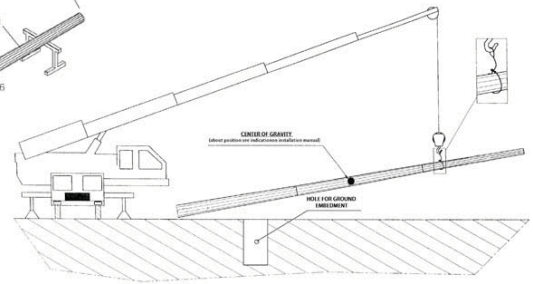


Figure: Embedment scheme of the pole shaft

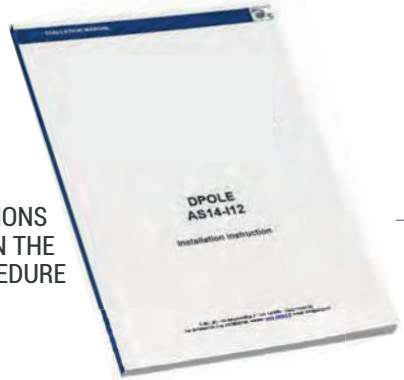




EARTHING

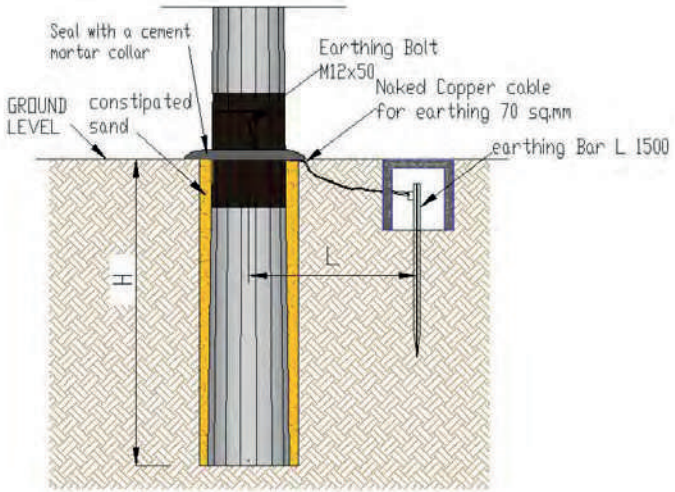
All our steel poles are equipped with a welded nut for a local earthing as per below description. Local earthing is mandatory in case the pole is not directly embedded in ground (for example concrete embedment) and it is suggestd in any case every 2 km.

EARTHING INDICATIONS ARE REPORTED IN THE INSTALLATION PROCEDURE



Technical pole installation specifications:

Position	Description
H	Total height of the hole* 2550 mm
L	Distance of Earthing Bar 1500 mm



CONDUCTOR STRINGING *(MATERIAL)*

TESMEC (tensioner)
Model. 611/675/10
Max tension 75 kN

TESMEC (puller)
Model. ARS 500

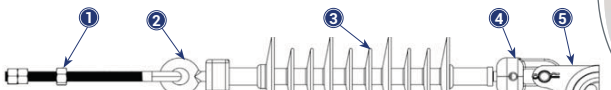
ACSR CONDUCTOR

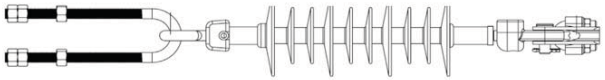
PANTHER
261 sqmm
210 mm DIA

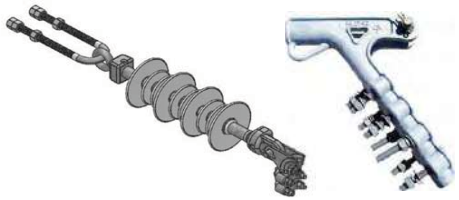
Team
(safety induction)

CONDUCTOR STRINGING CHAIN LINK

Tension chain link in composite 70kN composed of:



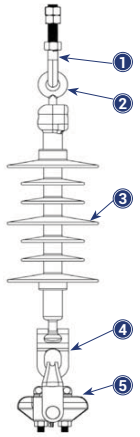


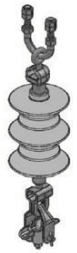


1. U bolt E16140
2. Eye Bolt OR70
3. Insulator ISI-TWE-A35-70SB
4. Ball socket BS70
5. Anchoring clamp GA1P

TENSION

Suspension chain link in composite 70kN composed of:





1. U bolt E16140
2. Eye Bolt OR70
3. Insulator ISI-TWE-A35-70SB
4. Ball socket BS70
5. Anchoring clamp SL1613ALM

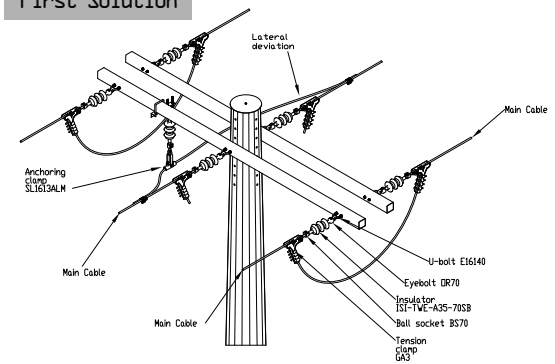
SUSPENSION

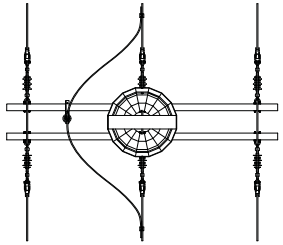
CONDUCTOR STRINGING TYPICAL CONDUCTOR INSTALLATION

NIZWA PROJECT

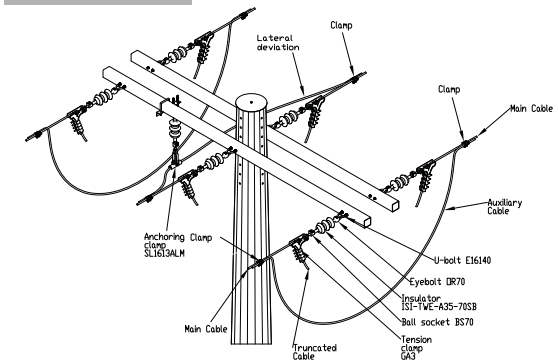
DPOLE CONDUCTORS STRINGING

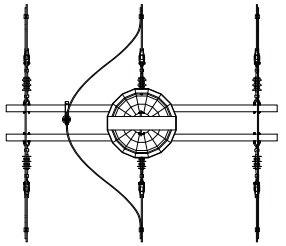
First Solution



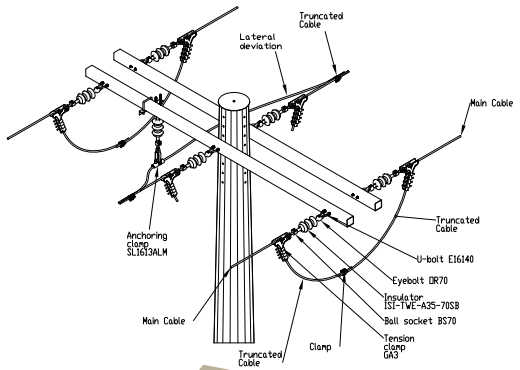


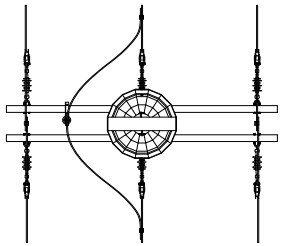
Second Solution





Third Solution





CONDUCTOR STRINGING
(CONDUCTOR PULLEY @ I12 AND AS14)

PULLEY @ 5 KN
SAG 3M
TENSIONER 1500 PSI
MAX SPAN = 80M

References:
1. NS220 Overhead Design Manual
2. AUS Bulletin 1724E-200
3. Overhead Power Line Design – E Kiessling, P Nefzger, JF Nolasco and U Kordyk
4. Principles of Power System – K Mehta

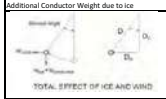
1. LINE CHARACTERISTICS

	Variable Symbol	Value	Unit	
Span Length (Ruling Span)	S	90	m	*Important: Creep is not considered in the calculation.*
Conductor Name		Panther		
Conductor Size		*516		
Stranding		*30/7 + 7/3		
Diameter	dia	0.021	m	
Cross-sectional Area	A	0.0002615	m^2	
Final Modulus of Elasticity	E	80000000000	N/m^2	
Coefficient of Linear Thermal Expansion	alpha	0.0000178	/deg C	
Unit Weight	W.1	9.84924	N/m	
Ultimate Tensile Strength	RTS	92250	N	

2. LOADING CONDITIONS

Initial Loading		*(These are the conditions when the conductor was first strung.)*		
Initial Horizontal Tension	H.1	3,100.00	N	
Initial Conductor Temperature	t.1	30	deg C	

Final Loading		*(These are the conditions where conductor will be subjected to wind, ice or max temperature.)*		
1. Thermal Load				
Conductor Temperature @ final loading	t.2	30	deg C	
2. Wind Load				
Wind Pressure	P	0	Pa (N/m^2)	*(Refer to applicable standards, NESC 2017 or ASCE.)*
Additional Conductor Weight due to wind	W.wind	0.000	N/m	
3.Ice Load				
Ice Thickness	t	0	m	*(Refer to applicable standards, NESC 2017 or ASCE.)*
Ice Density	density	915	kg/m^3	
Additional Conductor Weight due to ice	W.ice	0.000	N/m	



$$W_{ice} = \text{Volume} \times \text{density} = \rho_{ice} \cdot t(D + t)$$
$$W_{wind} = P_{wind}(D + 2t)$$
$$W_{total} = \sqrt{(W + W_{ice})^2 + (W_{wind})^2}$$

Resultant Conductor Weight	W.2	9.849	N/m		
Blowout Angle	theta	0.000	radians	0.000	degrees

30° C degree No wind *Pulley tension by calc. 3,1 kN*

3. CALCULATION OF FINAL HORIZONTAL TENSION — *AS14 - I12 POLE - Conductor load max 3,2 kN - UTS=92,25KN --> Safety Factor=28,8 (>6)*

CONDUCTOR STATE CHANGE EQUATION

$$H_2^3 + H_2^2\left(\frac{(W_1 S)^2 AE}{24H_1^2} - H_1 + (t_2 - t_1)\alpha AE\right) - \frac{(W_2 S)^2 AE}{24} = 0$$

ANOTHER FORM OF CSCE:

$$H_2^3 + A H_2^2 - B = 0 \quad \text{where} \quad B = (W_2 \cdot S \cdot C_2)^2 \quad C_2 = \alpha \cdot E \cdot A$$

$$A = C_2(t_2 - t_1) + \left(\frac{W_1 S \cdot C_2}{H_1}\right)^2 - H_1 \quad C_2 = \sqrt{\frac{EA}{24}}$$

Coefficients:

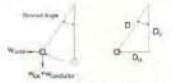
_A	68171.76436
B	6.84922E+11
_C1	933.6309049
_C2	372.376

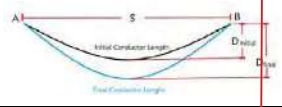
$H_2^3 + A H_2^2 - B = 0$		0	>>>>>>>>>>	*(Note: To solve the cubic equation, use the "goalseek" command of excel. See Manual.)*
Final Horizontal Tension	H.2	3,100.000	Newtons	

STOP! Do not proceed to "results summary" until "goalseek" have been performed.

RESULTS SUMMARY:

Sags:					
Initial Conductor Sag	D.1	3.222	m	Difference	*(Negative value represents Cold Uplift.)*
Final Conductor Sag	D.2	3.222	m	0	meters
Horizontal Sag	HD.1	0.000	m		
Vertical Sag	VD.2	3.222	m		
Conductor Lengths:					
Initial Conductor Length	L.1	90.307	m		
Final Conductor Length	L.2	90.307	m		
Tensions:					
Initial Horizontal Tension	H.1	3,100.00	Newtons		
Initial Tension @ supports	T.1	3,131.74	Newtons		
Final Horizontal Tension	H.2	3,100.00	Newtons		
Final Tension @ supports	T.2	3,131.74	Newtons		



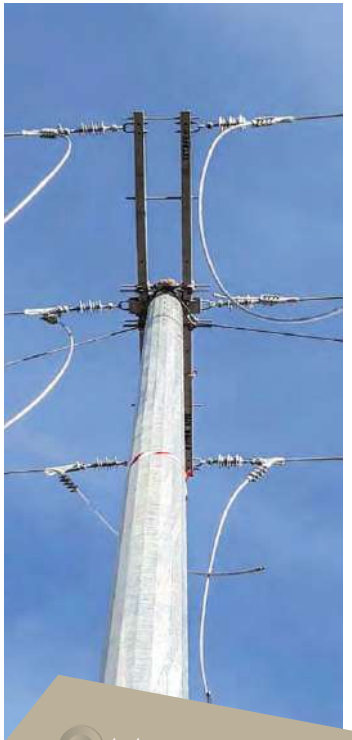


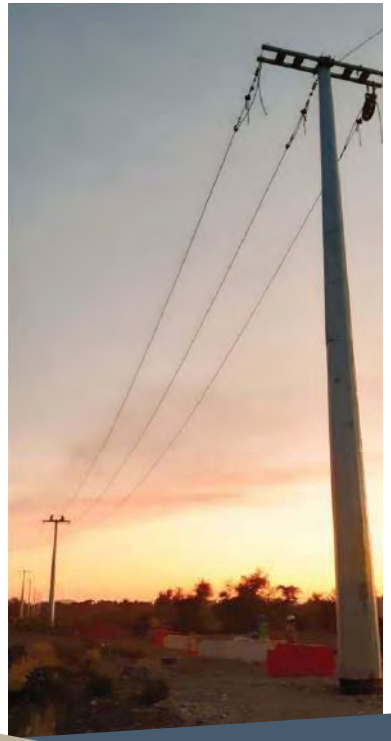
Cond. LENGTH: $L = S\left[1 + \frac{S^2 W^2}{24H^2}\right]$

$SAG: D = \frac{H}{W}\left[\cosh\frac{SW}{2H} - 1\right]$

$T_{average\ at\ supports\ (same\ level)} = H + WD$

Sag=3,2m





CONDUCTOR STRINGING
(CONDUCTOR PULLEY @ AS22)

1. MS100 Overhead Design Manual
2. IMS Bulletin 11 Jul 200
3. Overhead Power Line Design – T. Hanselig, P. Nefzger, J.F. Nicolaus and U. Kintzyk
4. Principles of Power System – V. Mehta

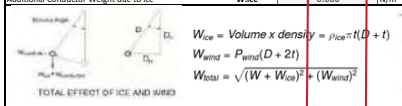
1. LINE CHARACTERISTICS

	Variable Symbol	Value	Unit	
Span Length (Ruling Span)	S	176	m	*Important: Creep is not considered in the calculation.*
Conductor Name		Panther		
Conductor Size		*516		
Stranding		*30/7 + 7/3		
Diameter	dia	0.021	m	
Cross-sectional Area	A	0.0002615	m^2	
Final Modulus of Elasticity	E	80000000000	N/m^2	
Coefficient of Linear Thermal Expansion	alpha	0.0000178	/deg C	
Unit Weight	W.1	9.84924	N/m	
Ultimate Tensile Strength	RTS	92250	N	

2. LOADING CONDITIONS

Initial Loading		*(These are the conditions when the conductor was first strung.)*		
Initial Horizontal Tension	H.1	6,850.00	N	
Initial Conductor Temperature	t.1	30	deg C	

Final Loading		*(These are the conditions where conductor will be subjected to wind, ice or max temperature.)*		
1. Thermal Load				
Conductor Temperature @ final loading	t.2	30	deg C	
2. Wind Load				
Wind Pressure	P	0	Pa (N/m^2)	*(Refer to applicable standards, NESC 2017 or ASCE.)*
Additional Conductor Weight due to wind	W.wind	0.000	N/m	
3.Ice Load				
Ice Thickness	t	0	m	*(Refer to applicable standards, NESC 2017 or ASCE.)*
Ice Density	density	915	kg/m^3	
Additional Conductor Weight due to ice	W.ice	0.000	N/m	



$$W_{ice} = Volume \times density = \rho_{ice} \pi t(D + t)$$
$$W_{wind} = P_{wind}(D + 2t)$$
$$W_{total} = \sqrt{(W + W_{ice})^2 + (W_{wind})^2}$$

Resultant Conductor Weight	W.2	9.849	N/m		
Blowout Angle	theta	0.000	radians	0.000	degrees

30° C degree No wind *Pulley tension by calc. 6,85 kN*

3. CALCULATION OF FINAL HORIZONTAL TENSION

AS22 POLE - Conductor load max 7 kN - UTS=92,25KN --> Safety Factor=13,17 (>6)

CONDUCTOR STATE CHANGE EQUATION

$$H_2^2 + H_2\left(\frac{(W_2 S)^2 AE}{24 H_1^2} - H_1 + (t_2 - t_1)\alpha AE\right) - \frac{(W_1 S)^2 AE}{24} = 0$$

ANOTHER FORM OF CSCE:

$$H_2^3 + A H_2^2 - B = 0$$

$$A = EA(t_2 - t_1) + \left(\frac{W_1 S C_1}{H_1}\right)^2 - H_1 \qquad C_1 = \sqrt{\frac{EA}{24}}$$

Coefficients:

_A	48971.31608
B	2.61928E+12
_C1	933.6309049
_C2	372.376

$H_2^3 + A H_2^2 - B = 0$ 0 >>>>>>>>>>

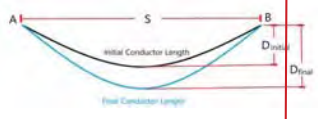
(Note: To solve the cubic equation, use the "goalseek" command of excel. See Manual.)

Final Horizontal Tension	H.2	6,850.000	Newtons

STOP! Do not proceed to "results summary" until "goalseek" have been performed.

RESULTS SUMMARY:

Sags:					
Initial Conductor Sag	D.1	5.575	m	Difference	*(Negative value represents Cold Uplift.)*
Final Conductor Sag	D.2	5.575	m	0	meters
Horizontal Sag	HD.1	0.000	m		
Vertical Sag	VD.2	5.575	m		
Conductor Lengths:					
Initial Conductor Length	L.1	176.470	m		
Final Conductor Length	L.2	176.470	m		
Tensions:					
Initial Horizontal Tension	H.1	6,850.00	Newtons		
Initial Tension @ supports	T.1	6,904.91	Newtons		
Final Horizontal Tension	H.2	6,850.00	Newtons		
Final Tension @ supports	T.2	6,904.91	Newtons		



$$\text{Cond. LENGTH: } L = S\left[1 + \frac{8}{3}\left(\frac{D}{S}\right)^2\right]$$
$$SAG: D = \frac{H}{W}\left[\cosh\frac{SW}{2H} - 1\right]$$
$$T_{average\ at\ supports\ (same\ level)} = H + WD$$

C.M.L. S.r.l.
Via della Bonifica, 9
53043 Frac. Le Biffe - Chiusi (SI)
Tel. 0578.514.50.64
Fax 0578.514.62.33
E-mail: info@cmlpali.it
Sito: www.cmlpali.it

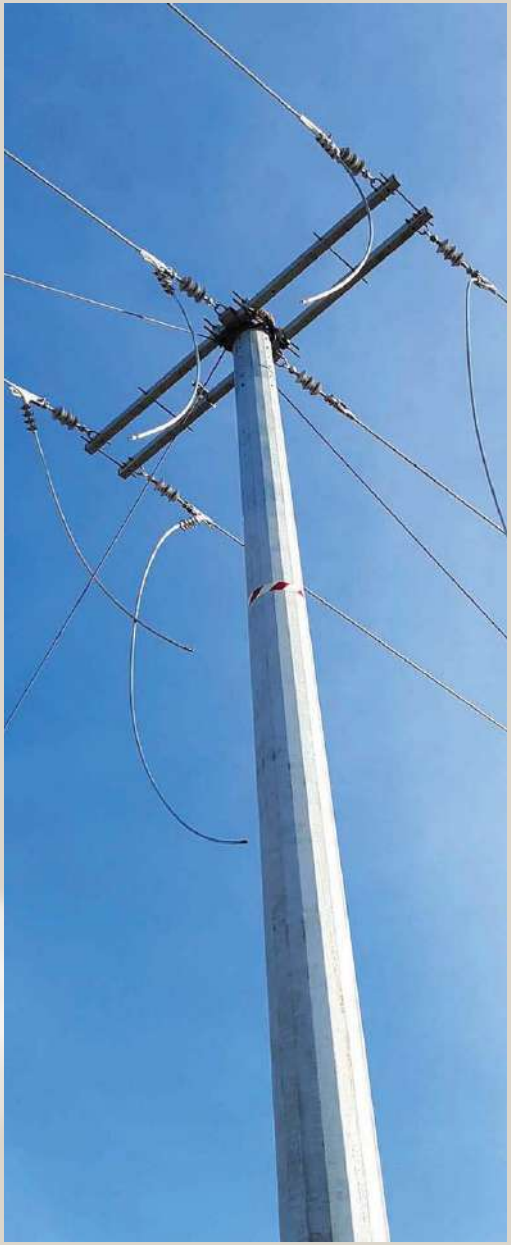
R.E.A. Siena N. SI-140982
Cod.Fisc. e Part. I.V.A. 01613810542
Cap. Soc. € 2.200.000,00
Soc. a cont.mento Lavoro dei Conf. SPA

SGS

Sag=5,5m

PULLEY @ 8 kN
SAG 4,5M
TENSIONER 4000 PSI
MAX SPAN=154M

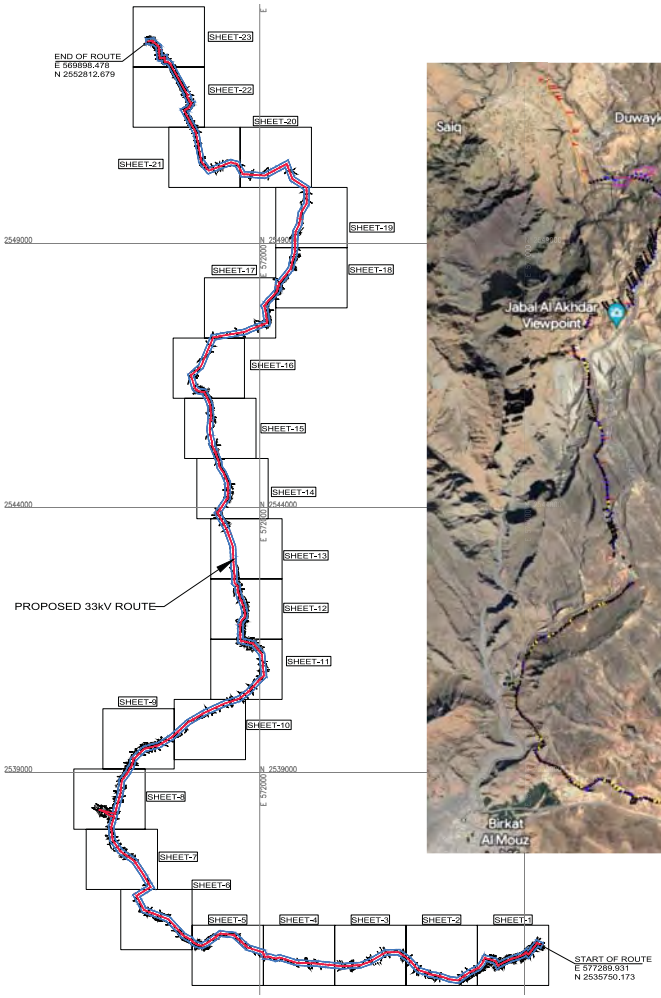
DPOLE CONDUCTOR STRINGING AND SAGGING



DPOLE PROJECT IN OMAN
JEBEL AKHDAR PROJECT

25 km - 33 kV distribution line
double circuit)

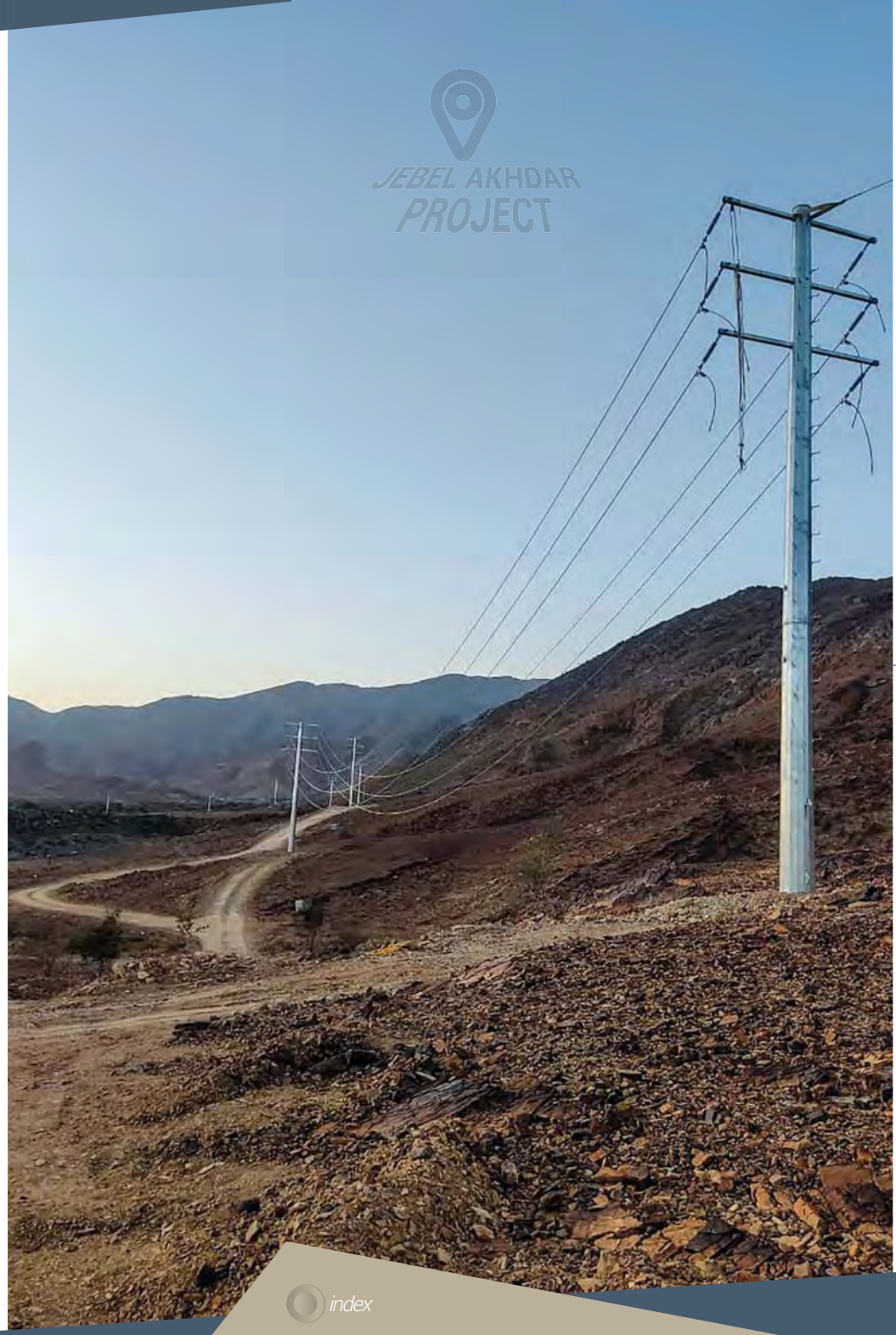
JEBEL AKHDAR VIDEO VIDEO



APPROVED ROUTE
(WITH STEEL POLE)

SITE SURVEY ON

JUNE
18-19
2022



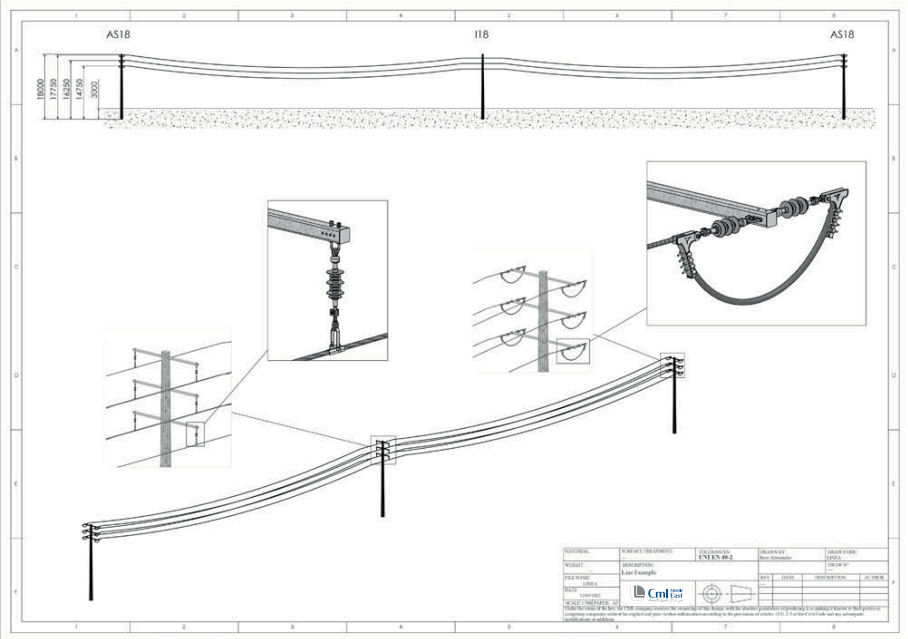
LINE DESCRIPTION:

Final customer: MAZOON ELECTRICITY COMPANY SAOC
Contractor: SCAN ELECTROMECHANICAL COMPANY

- Around 28,6 km of 33 kV double circuit line;
- ACSR 200 sqmmPanther Conductor;
- Around 2 km underground;
- Around 2,6 km on steel lattice towers;
- Around 24 km on HDG steel poles directly embedded in ground with n. 3 crossarms each suitable for a double circuit MV (33 kV) line;
- Line elevation: min (545m) -max (2121m);
- Max steel pole span 159m;
- Nominal steel poles span 120m;
- Total number of steel poles needed -> 262;
- N. 163 poles AS18 (Angle&Sectionwith 3 crossarms)
- N. 95 poles I18 (Intermediate with 3 crossarms)
- N. 4 poles I18s (Terminal poles with one crossarm)

PROJECT MILESTONES:

- Official PO received for steel poles → April 28th , 2022 ;
- From April to June 2022 steel poles engineering;
- Site survey 18 19 June 2022;
- Final design calculation and prototypes July 2022;
- FAT (with customer and contractor) 3 4 August 2022;
- Sag&tension file + elevation plan on September 2022;
- First shipment on site September 29th ,
- First pole installed on November 7th
- From November 7th up to today 150 poles installed;
- First stringing section February 6th , 2023
- From February 6 th up to today 40 sites stringing done.



JEBEL AKHDAR PROJECT

COMPARISON WITH LINE IN WOOD
(SINGLE CIRCUIT)

ORIGINA PROJECT (WOOD single circut)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	TOTAL	WODDEN POLES	STEEL WIRES
2H pole + 4 stay wires (intermediate)	3	21	17	19	20	27	23	13	9	18	9	4	16	14	12	11	5	8	8	15	2	**274**	548	1096
2H pole + 5 stay wires (angle)	1	9	3	7	6	3	4	4	5	3	3	15	4	6	7	1	8	8	4	3	0	**104**	208	520
2H pole + 2 stay wires (terminal)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**3**	6	6
3H pole + 6 stay wires (medium span)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	**3**	9	18
3H pole + 12 stay wires (long span)	0	0	0	0	4	0	0	3	4	3	0	0	0	3	1	0	4	0	3	0	2	**27**	81	324
3H pole + 13 stay wires (medium span + angle)	0	0	0	0	0	0	0	0	2	1	0	2	0	0	1	0	0	1	2	0	0	**9**	27	117
3T pole + 8 stay wires (right angle)	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	3	0	1	0	0	**8**	24	64
																			n° of site-->			**428**	**903**	**2145**

NEW PROJECT (STEEL- double circut)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	TOTAL	STEEL POLE	WIRES
AS18 monopole + 3 crossarms TRA4000-T	3	7	4	7	13	12	9	6	8	8	6	8	6	9	10	6	12	8	10	8	3	**163**	163	0
I18 monopole + 3 crossarms TRA4000-I	0	9	6	8	5	8	7	7	4	7	2	4	7	3	2	2	4	2	30	2	3	**95**	95	0
I18s monopole + 3 crossarms TRA4000-T	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	**4**	4	0
																			n° of site-->			**262**	**262**	**0**

Due to the resistance of these poles the lines has been revised removing a lot of intermediate wood poles (original project has been performed with a wooden pole solution on a single circuit line).
The average span has increased to approx 120 m, and no location has been changed, only removed.
The result is that now we have almost half of the site 262 locations instead of 428 for wood), with a consequent huge saving in material, work, accessories, preparation works, access roads, time in every phase of the activity on site.

- **Line in wood → single circuit 428 sites 903 poles**
- **Line in steel → double circuit 262 sites 262 poles**

Less number of sites it means:

- **Less holes**
- **Less trasportation cost**
- **Less installation cost**
- **Less cost for insulator and chain link**
- **Less time for the project exection**
- **Less cost**

NOTE:
*A better comparison between the steel solution and the wooden one needs to be done on 2-circuit base so in reality we have **262 steel poles against 1806 wooden poles**.*

COMPARISON WITH IN CONCRETE
(DOUBLE CIRCUIT)

Pole Type	Work Load (KN)	Length (m)	Ø Top (mm)	Ø Bottom (mm)	Weight (t)
IL-12	4.18	12	175	355	1.210
I-12	6	12	220	400	1.547
I-12+	7.3	12	220	400	1.625
I-13	6	13	220	415	1.757
I-14	6	14	220	445	1.96
I-15	6	15	220	445	2.172
I-16	6	16	220	460	2.396
I-17	6	17	220	475	2.631
A/S-12	15	12	340	520	2.315
A/S-14	15	14	340	550	2.848
A/S-16	15	16	370	610	3.881
A/S-18	15	18	370	640	4.577
A/S-18-18	18	18	370	640	4.865
A/S-18-22	22	18	415	685	5.93
A/S-20	15	20	370	670	5.657
A/S-20-18	18	20	370	670	6.134
A/S-21	15	21	370	685	6.074
A/S-22	15	22	370	700	6.506
A/S-24	15	24	370	730	7.23
T-12	30	12	460	640	3.462
T-13	30	13	460	655	3.831
T-14	30	14	460	670	4.213
T-16	30	16	460	700	5.316
T-18	40	18	516	840	7.750
G/P-18	10.5	18	310	580	3.960
DC-1610	10	16	250	490	2.900
DC-1618	18	16	370	610	4.100

Pic 1: Overview of concrete poles type

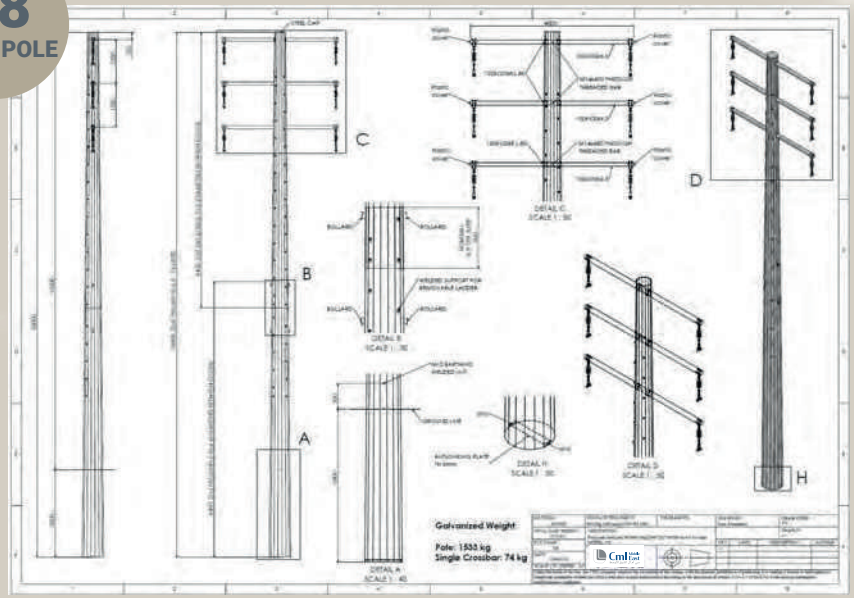
Making a comparison between steel and concrete poles (in the same comparable range):

- I18 comparable with n. 2 poles AS18-22 (globally we have 1,53 ton against 11,86 ton);
- AS18 comparable with n. 3 poles kind AS18-18 (globally we have 1,95 ton against 14,6 ton)

The concrete solution is 7,5 times more heavy
The number of poles needed is 683 against 262

I18
STEEL POLE

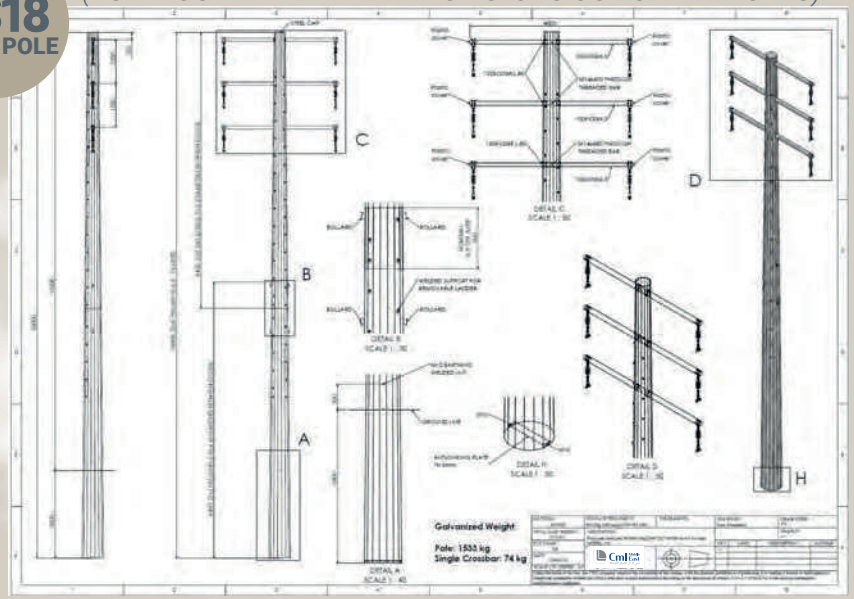
WORKING LOAD=45kN - WEIGHT=1,53 Ton TO BE COMPARED WITH N°2 AS18-22 CONCRETE POLES



Steel weight 1,53 Ton - concrete wight 11,86 ton

AS18
STEEL POLE

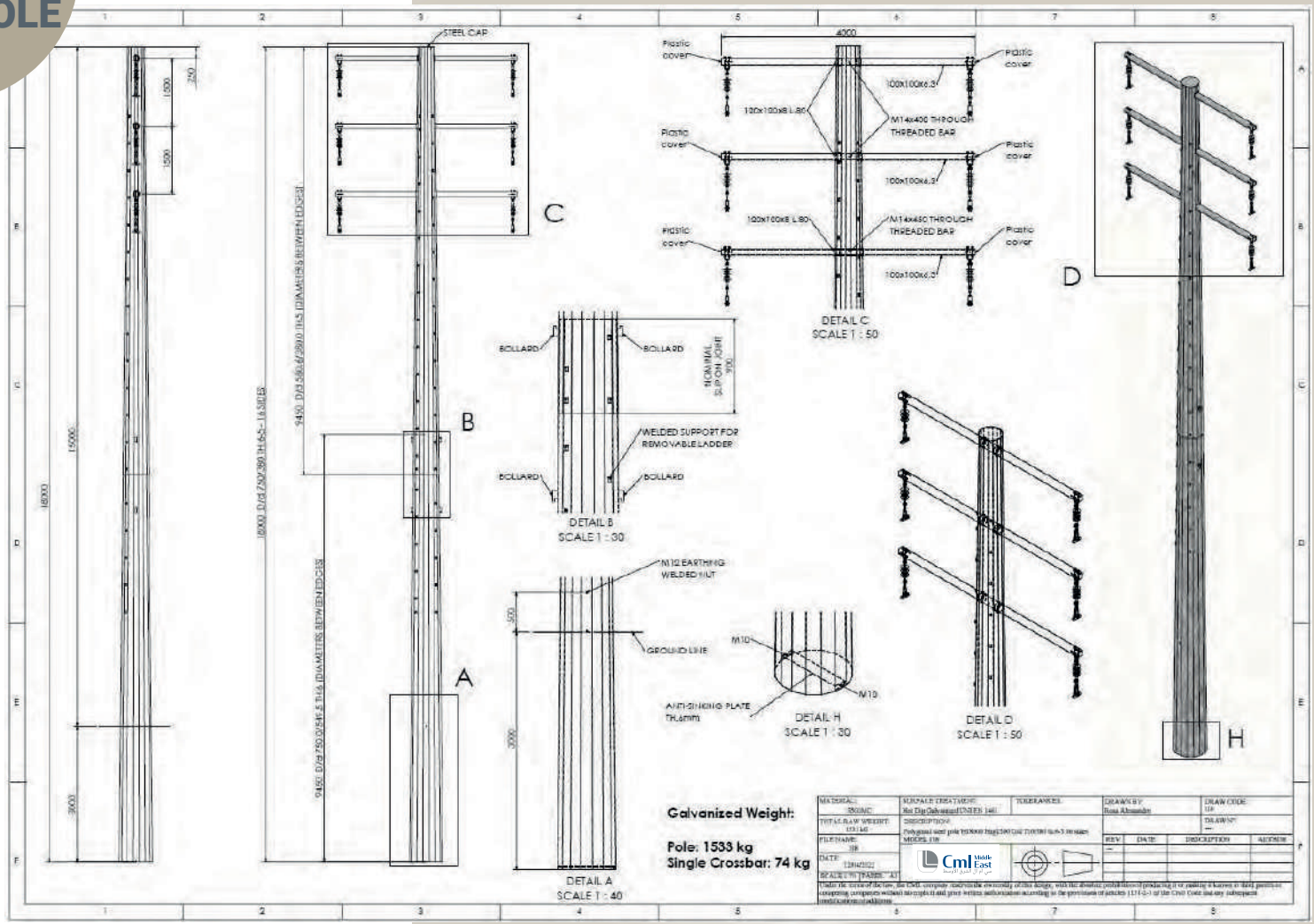
WORKING LOAD=60kN - WEIGHT=1,95 Ton (TO BE COMPARED WITH N°3 AS18-18 CONCRETE POLES)



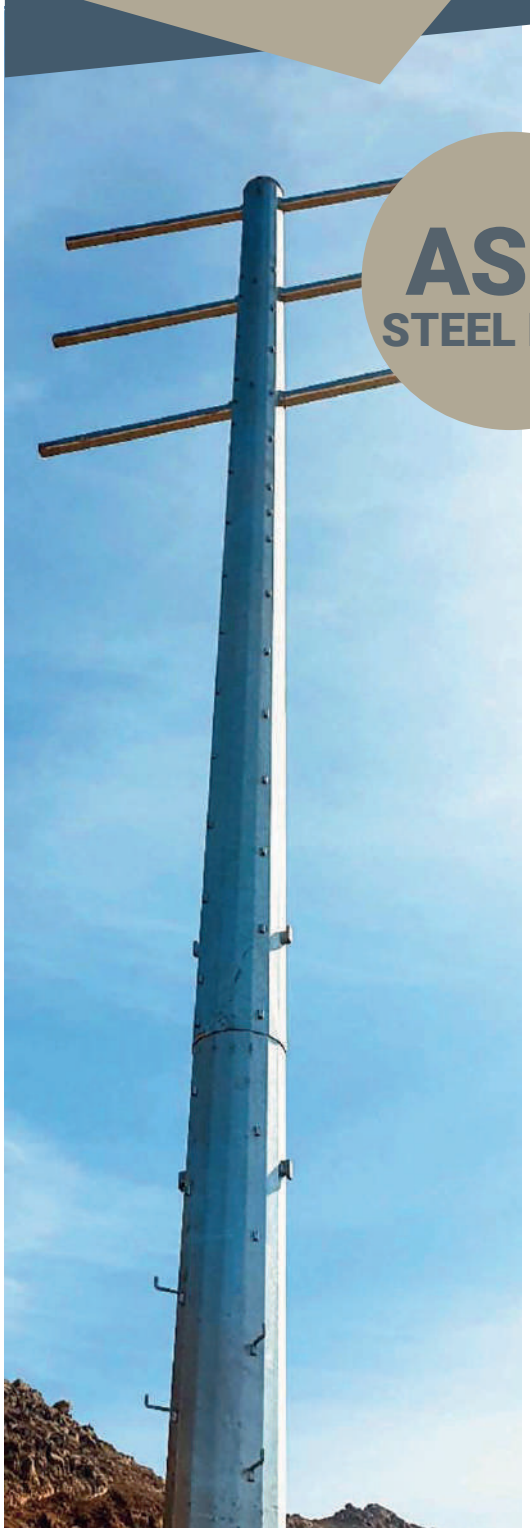
Steel weight 1,95 ton - concrete wight 14,6 ton

I18
STEEL POLE

WORKING LOAD= 45 kN
WEIGHT= 1533 kg

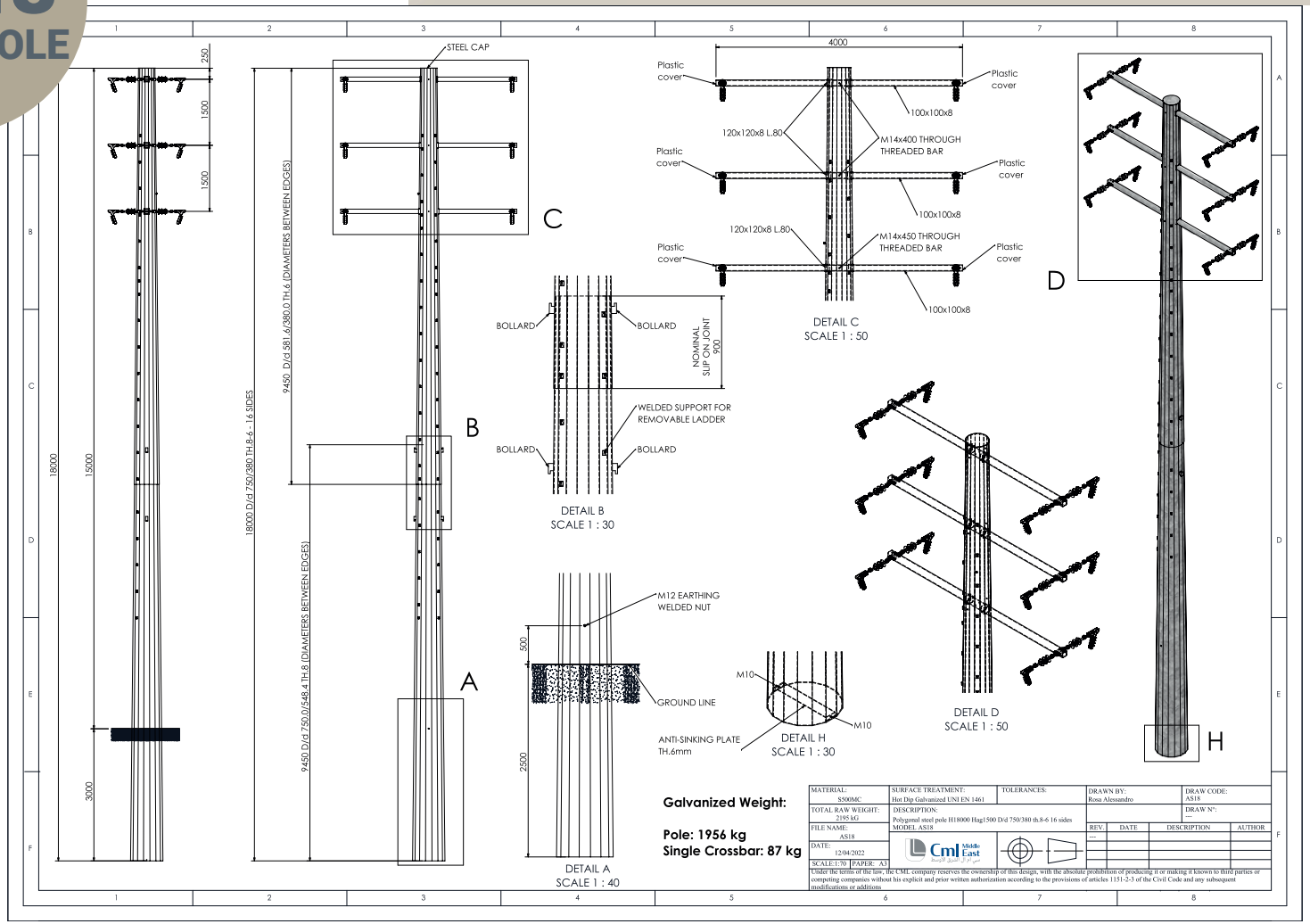


INTERMEDIATE POLE 15m a.g.
Embedment 3m
pole diameter 0,75m
hole diameter needed 1m



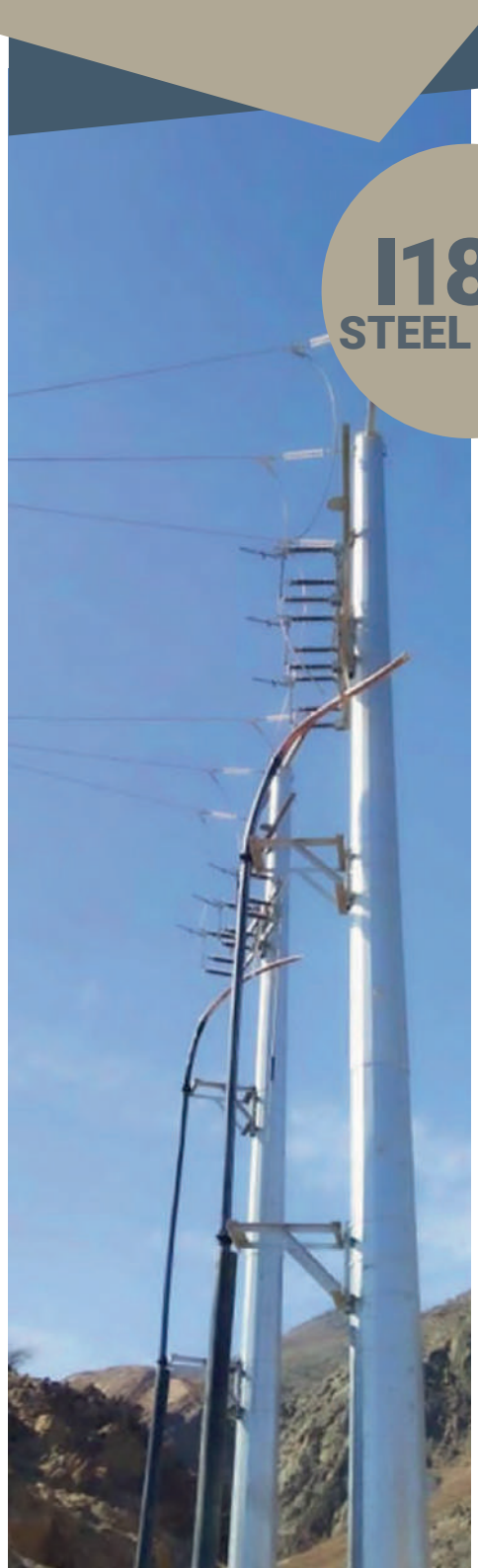
AS18
STEEL POLE

WORKING LOAD = 60 kN
WEIGHT = 1956 kg



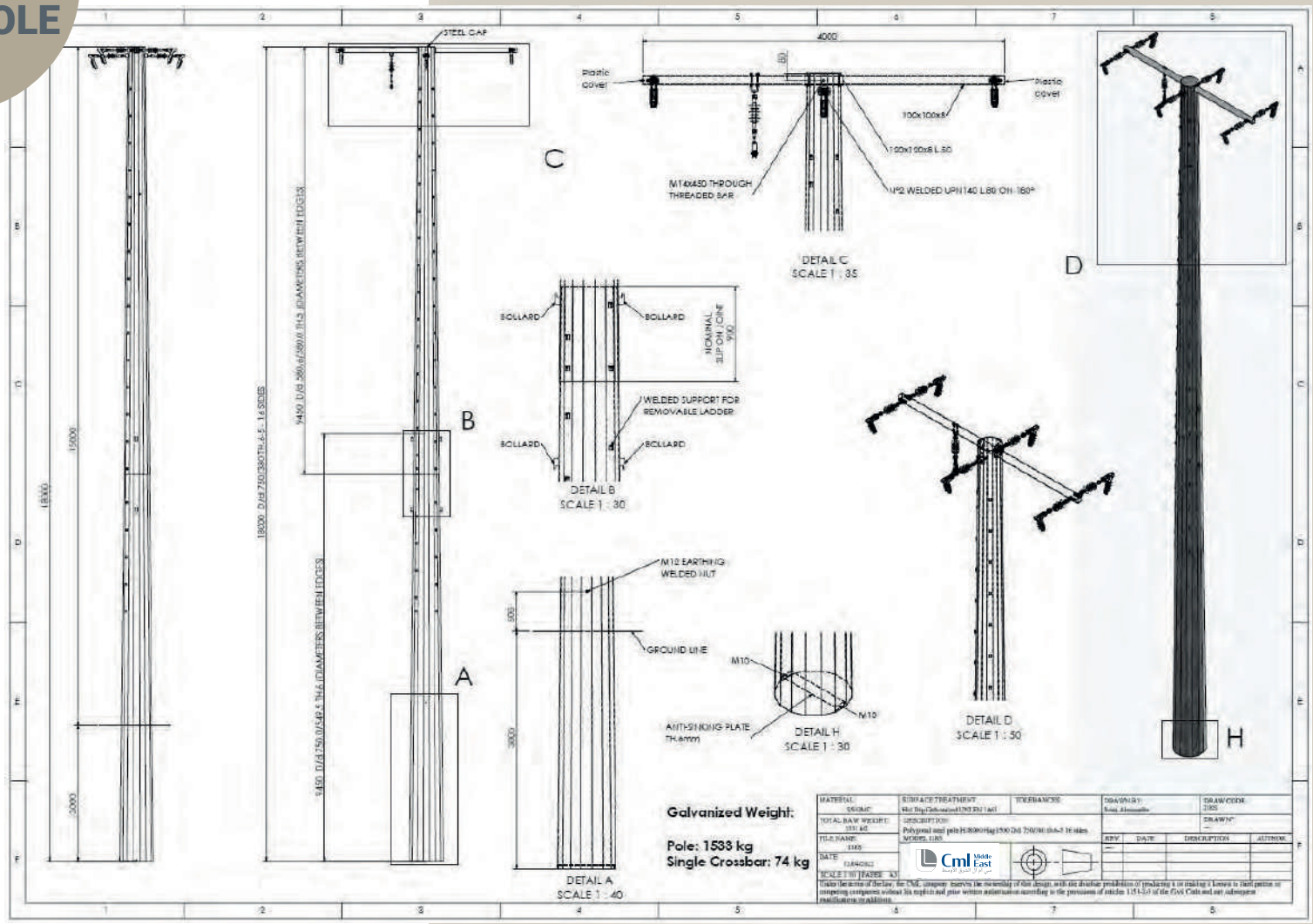
ANGLE/SECTION POLE 15m a.g.
Embedment 3m
pole diameter 0,75m
hole diameter needed 1m

index



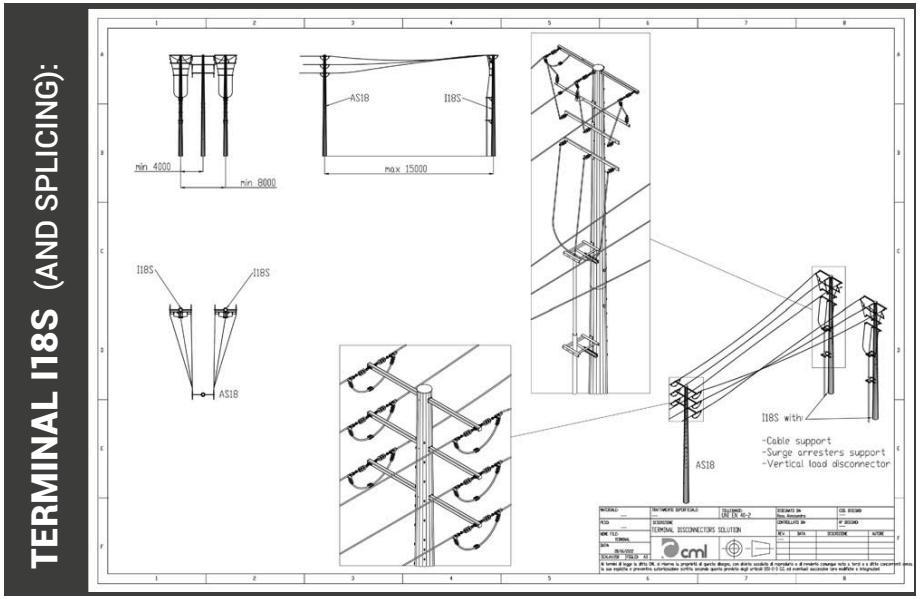
I18S
STEEL POLE

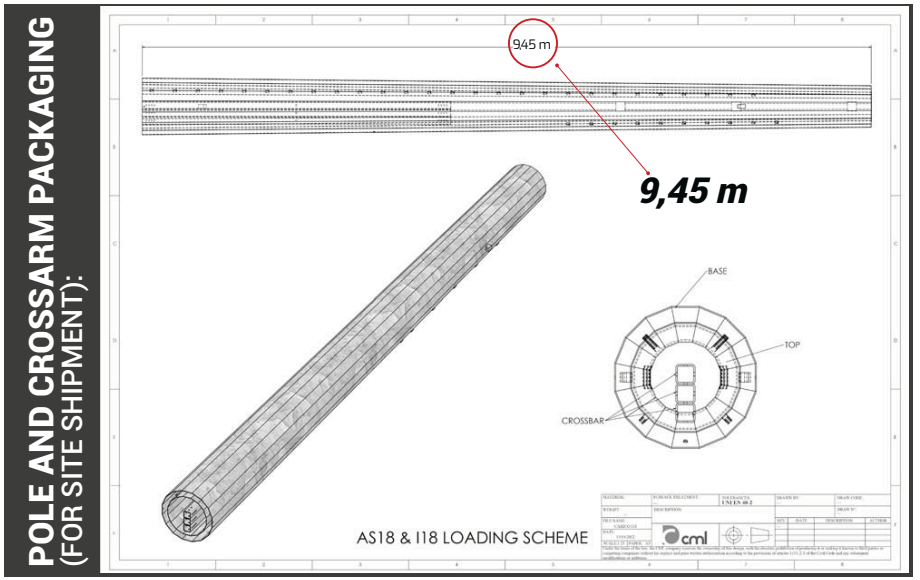
WORKING LOAD = 45 kN
WEIGHT = 1533 kg



TERMINAL POLE 15m a.g.
Embedment 3m
pole diameter 0,75m
hole diameter needed 1m

TERMINAL I18S (AND SPLICING):





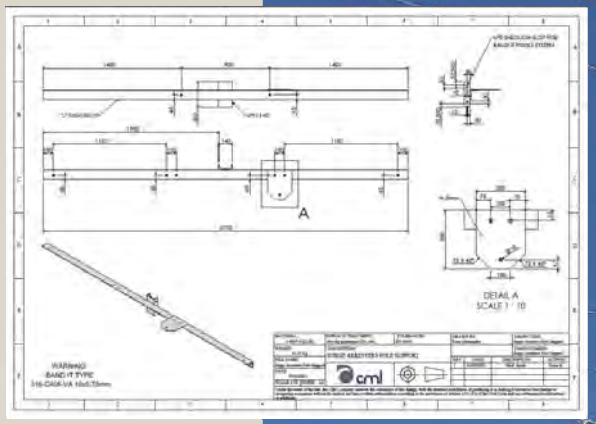
Smart packaging for storage and site delivery.
The poles and the crossarm are designed to take into account the shipment and the storage. As per drawings and pictures the complete pole is an item of 9,45x0,75m with the top shaft and the crossarm and all other material insert inside.
So the storage is really easy and simple to find the material and the transportation on site it can be done with a smal truck. A small crane for down loading is enough for the operation (the max weight of the package is 2 ton).

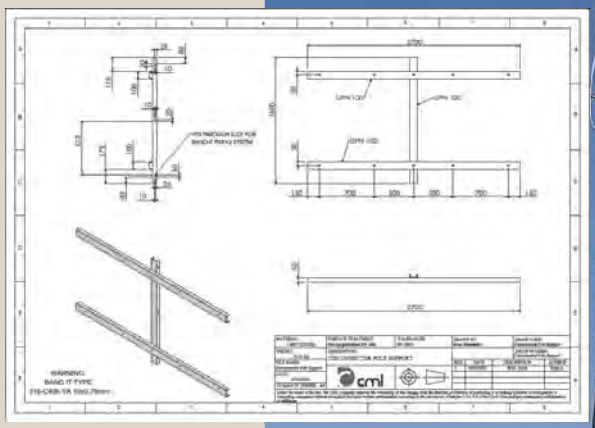
SUPPORTS ON POLE

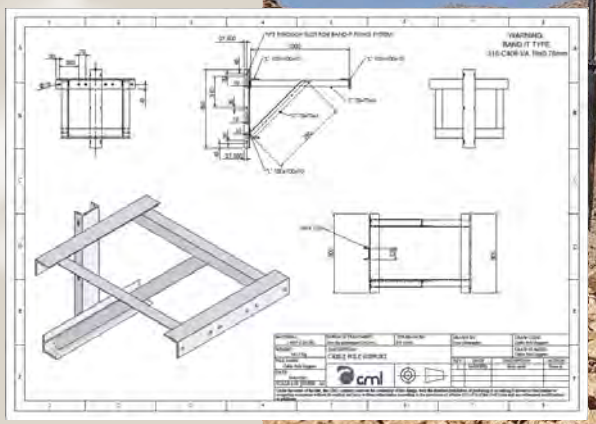
SURGE ARRESTERS SUPPORT

DISCONNECTOR SUPPORT

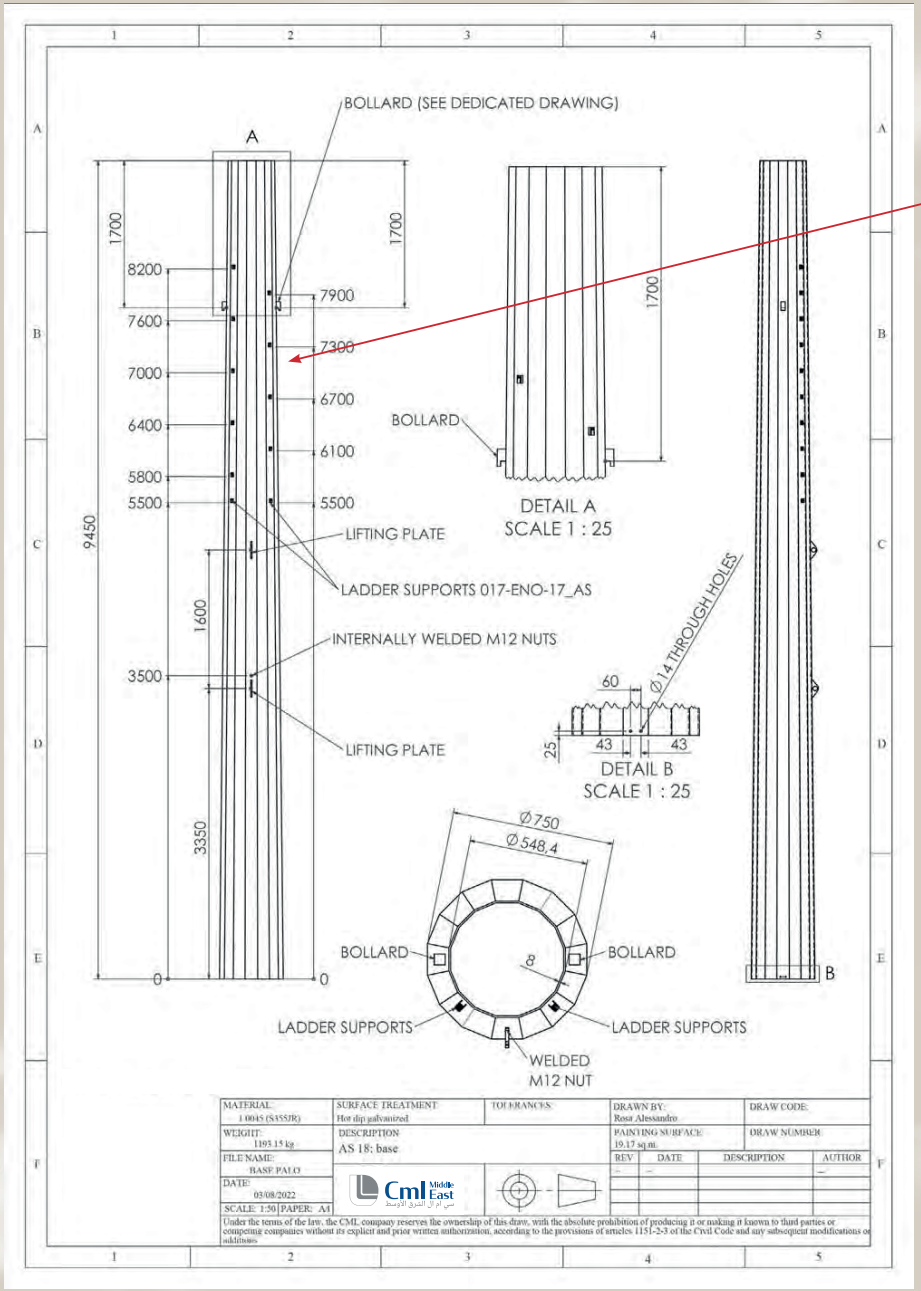
CABLE SUPPORT



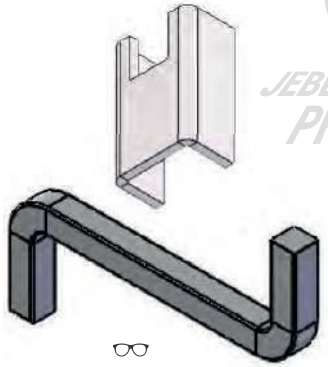




ADDITIONAL TOPICS ON STEEL POLES: LADDER

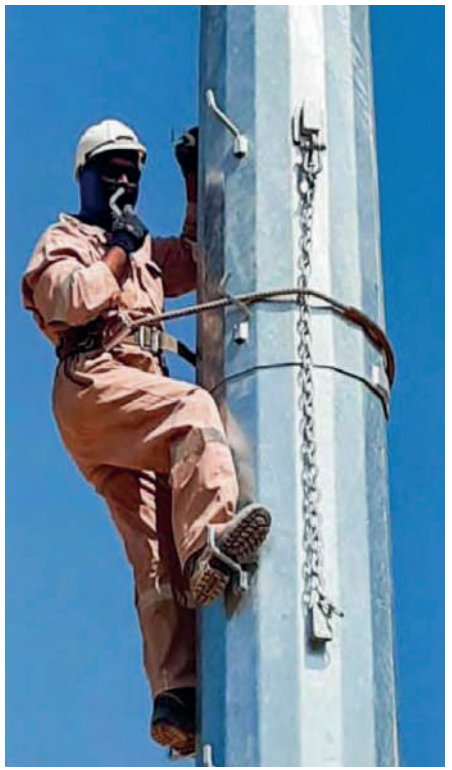


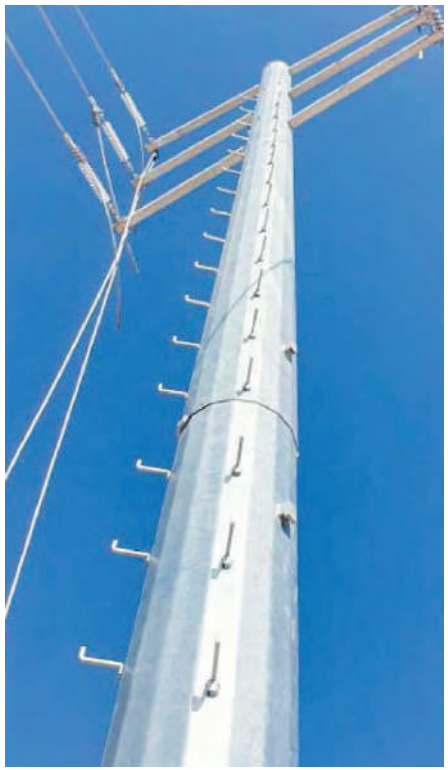
SOCKETS FOR REMOVEABLE STEEP LADDER



Very helpful during:

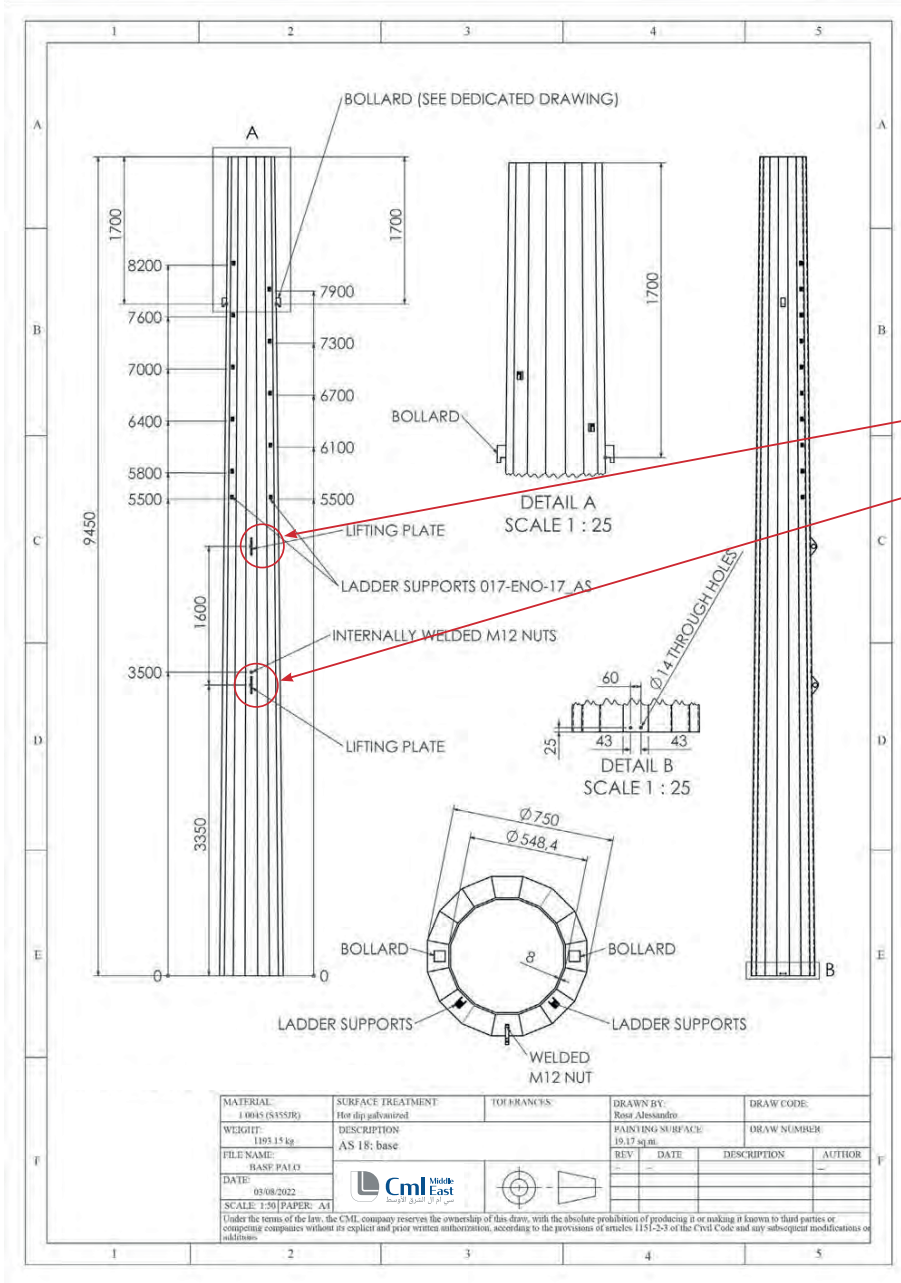
- Erection
- Stringing
- Maintenance





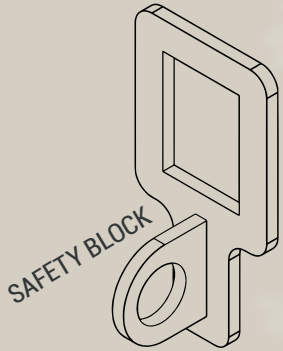
ADDITIONAL TOPICS ON STEEL POLES

ADDITIONAL TOPICS ON STEEL POLES: HOOKS

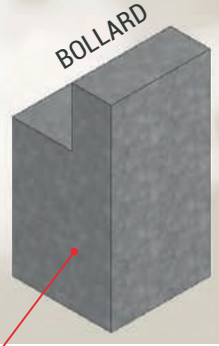


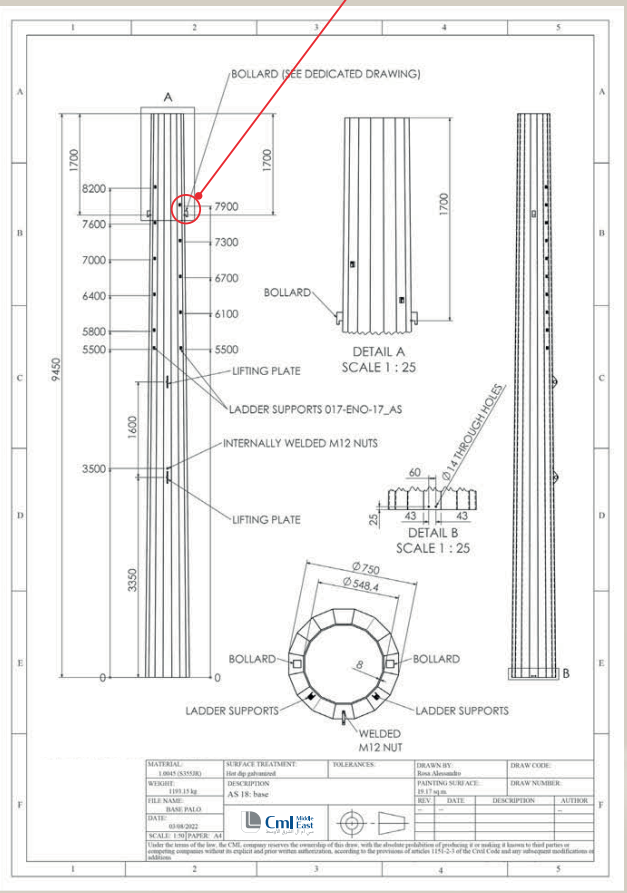
LIFTING + PULLEY HOOK

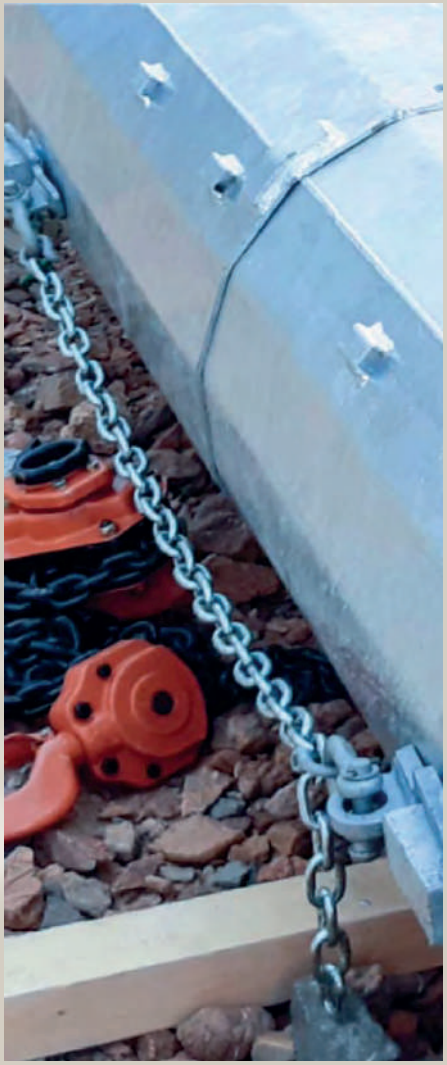
ADDITIONAL TOPICS ON STEEL POLES: BOLLARD



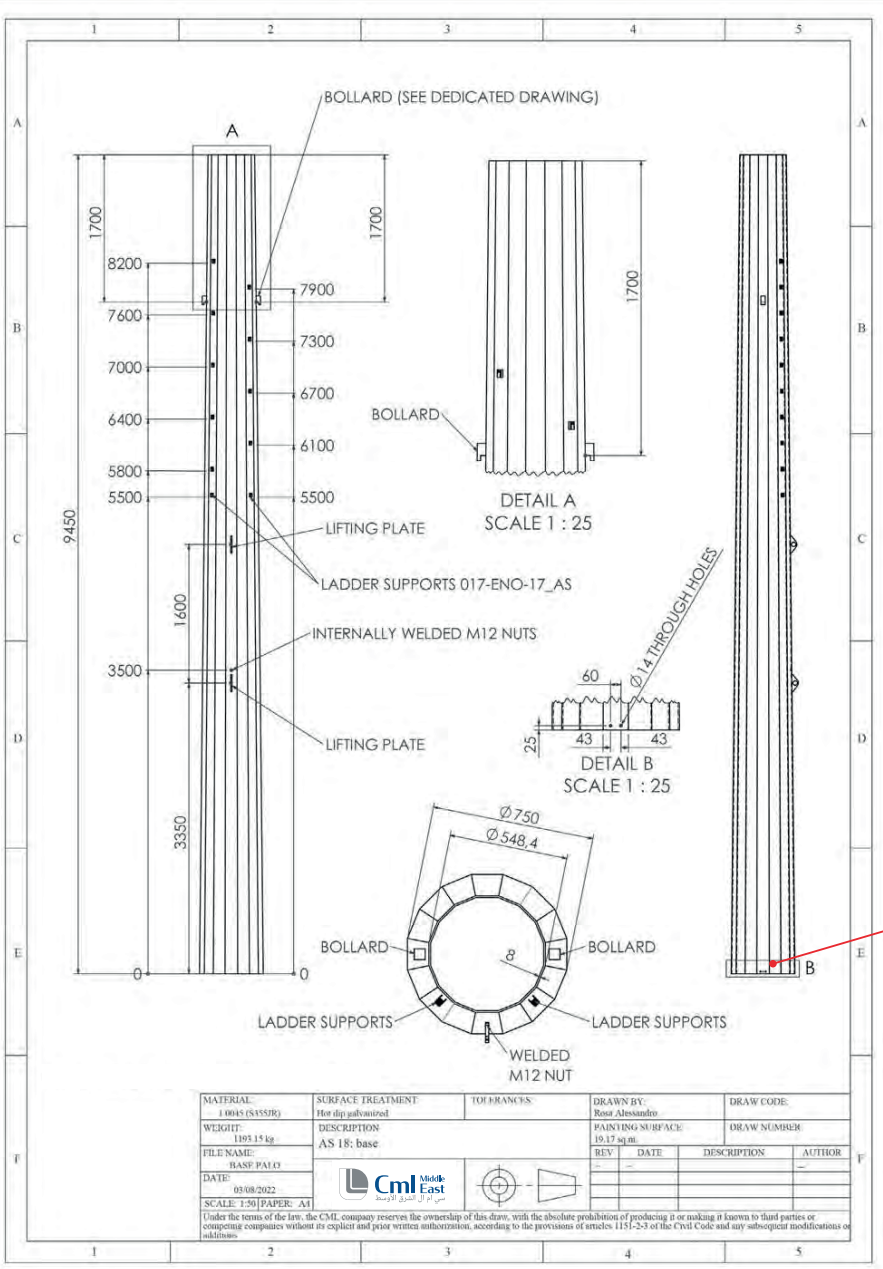
Device used for:
slip on joint phase for assembly
to install the removable
double safety chain
during erection



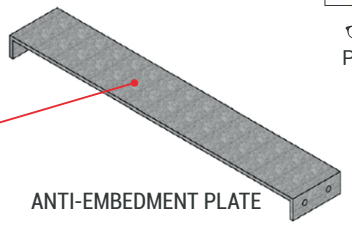




ADDITIONAL TOPICS ON STEEL POLES: PLATES



Method for danger plate installation on steel poles



ANTI-EMBEDMENT PLATE

Pole label in di-bond with danger plate included fixed by band-it in stainless steel 6,4x0,51 mm

DPOLE - ASSEMBLY PROCEDURE

A detailed assembly procedure with related drawing and slip on joint forces and leght is provided for each pole model

The «slip on joint» is a technology of conical poles (with a poligonal or circula section) assembly

A shaft is connected with the other by overlapping by the application of a force in order to guarantee the nominal lenght for the slip and absure the appropriate friction

The connection will be stable and the gravity after installation will improve friction between the two sections

JEBEL AKHDAR PROJECT

AS18 POLES:

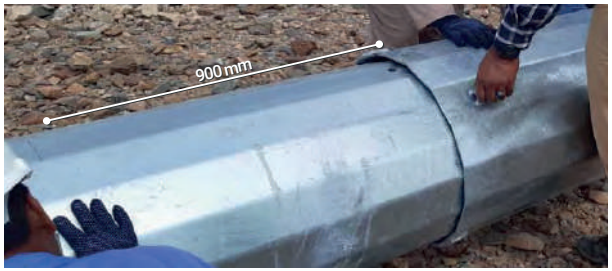
Slip on Joint design (max force)			Slip on Joint design (lenght)		
N° sides of polygonal section:	16		N° sides of polygonal section:	16	
Taper:	0.02133		Coefficient η:	3.040	
Female shft tickness (S₂):	6	mm	Friction coefficient μ (galvanized steel):	0.3	
Steel quality female section (S…):	500	N/mm²	Coefficient ξ° and safety coefficient K:	10.332	mm
Slip on joint lenght:	900	mm	F/F diameter of male shaft (Ds):	537.9	mm
Safety coefficient:	1.5		Tapero (c):	0.02133	
Admissible load (σ…):	3333	kgf/cm²	Key of femal shaft (ds):	527.5	mm
Slip on joint max force (F₁):	10188	kgf	Base material slip on joint lenghte (i…):	704.3	mm
			2ª class veiled material slip on joint lenght (i…):	830.7	mm

*Slip on joint max force = **10188** kgf* *Minimum slip on joint = **831** mm*

I18 + I18S POLES:

Slip on Joint design (max force)			Slip on Joint design (lenght)		
N° sides of polygonal section:	16		N° sides of polygonal section:	16	
Taper:	0.02123		Coefficient η:	3.040	
Female shft tickness (S₂):	5	mm	Friction coefficient μ (galvanized steel):	0.3	
Steel quality female section (S…):	500	N/mm²	Coefficient ξ° and safety coefficient K:	10.332	mm
Slip on joint lenght:	900	mm	F/F diameter of male shaft (Ds):	538.9	mm
Safety coefficient:	1.5		Tapero (c):	0.02122	
Admissible load (σ…):	3333	kgf/cm²	Key of femal shaft (ds):	528.6	mm
Slip on joint max force (F₁):	8448	kgf	Base material slip on joint lenghte (i…):	705.7	mm
			2ª class veiled material slip on joint lenght (i…):	832.3	mm

*Slip on joint max force = **8448** kgf* *Minimum slip on joint = **832** mm*



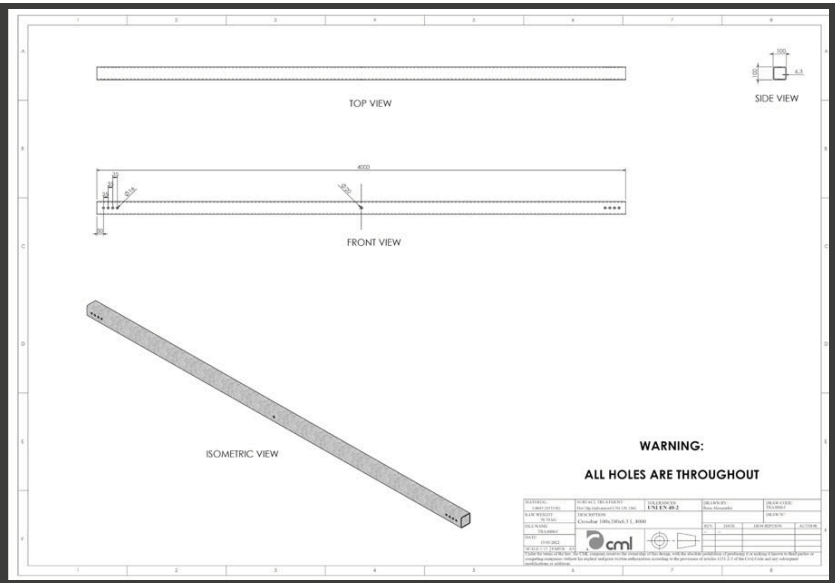
SIGN FOR DESIGNED SLIP ON JOINT (900 mm)

SIGN FOR MIN SLIP ON JOINT (831 mm)

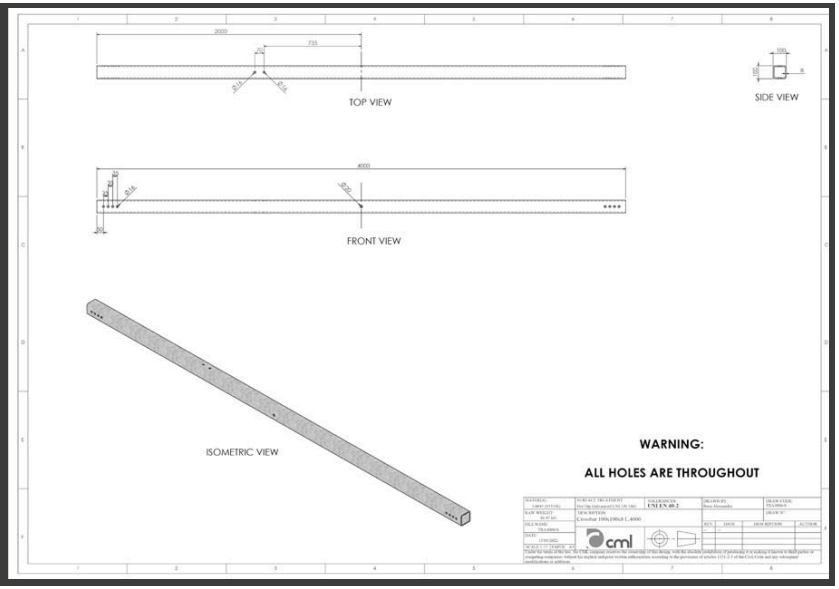
SEMI-BOLLARD
WELDED ON POLE TO PERFORM
THE SLIP ON JOINT

CROSSARM ASSEMBLY PROCEDURE

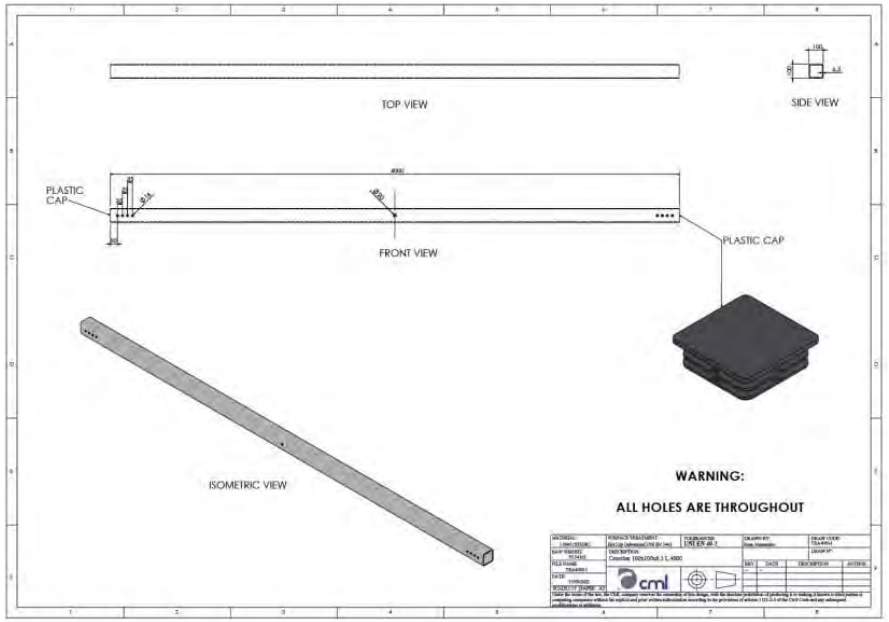
I18 CROSSBAR:



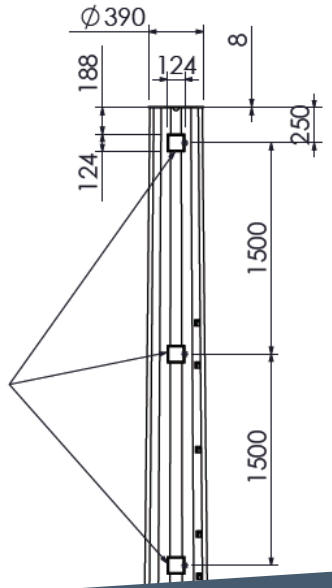
I18S+AS18 CROSSBAR:



Crossarms easy to be fixed
Just insert the crossarm on the reinforced pole opening and fix it by using a treaded bar M 14 x 500 mm with double nut



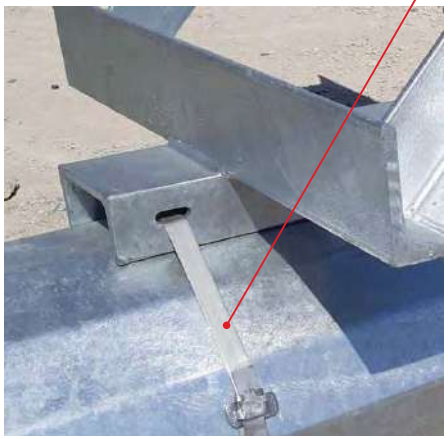
120x120x8 L.50
PROFILE
(SEE DETAILS ON
DEDICATED
DRAWING)



Easy installation for crossarms

The crossarm is just insert inside reinforced openings on the pole and fixed with a simple M 14 x 500 mm treaded bar Each crossarm is equipped with 2 PVC covers on the external side.

SUPPORTS ASSEMBLY PROCEDURE



CABLE SUPPORT
(SINGLE BAND-IT
TO BE USED)

SURGE ARRESTER (DOUBLE BAND IT TO BE USED)

FOLLOWING DETAILED DRAWING FOR EACH SUPPORT (DISCONNECTOR OR SURGE ARRESTER) IT WILL BE INSTALLED ON RELATED POLE THE CONNCETION OF ALL SUPPORTS WILL BE DONE BY BAND IT IN STAINLESS STEEL MODEL 316 C 406 VA 19 X 0 76 mm WILL BE USED THE USE OF SUCH TYPE OF CONNECTION WILL PROVIDE A HIGH LEVEL OF FLEXIBILITY ON POSITIONING OF THE SUPPORTS

POLE INSTALLATION PROCEDURE

A detailed installation procedure with related drawing and risk assestement manual is provided for each pole model.

Procedure for lifting, load, gravity centre, embedment lenght and back filling procedure is deeply explained in the manual. Embedment could be directly in ground or in concrete block (even solution with base plate and anchor cage are possibile).

Figure legend:

Position	Description	Position	Description
(0.00)	Conventional indication of the ground level	A	Height of the earthing 300 mm
H	Total height of the hole* 3500 mm	C	Height heat-shrink sleeve 400 mm
B	Embedment hole-shrink sleeve 400 mm	D_b	Hole diameter for the placement of the shafts 1060 mm

*The depth shall be checked before of pole installation and in any case approved by the project manager

Figure: Reference quotes for the embedment

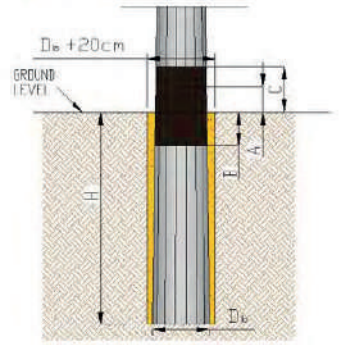
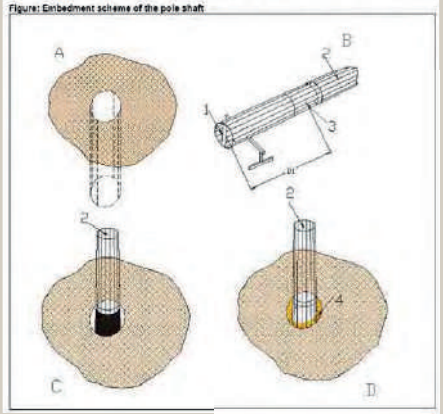
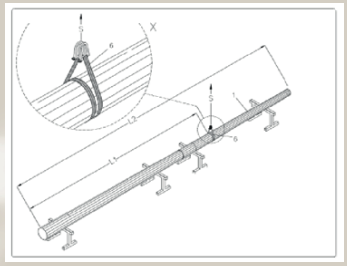


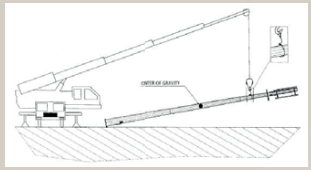
Figure legend:

Position	Description	Position	Description
1	Anti - embedment plate	A	Foundation Hole
2	Base shaft of the pole	B	Ready shaft for the embedment
3	heat-shrink sleeve	C	Embedded and vertically placed shaft
4	sand with vibrating systems	D	Finishing with vibrated and compacted sand and Best with a cement mortar collar

Figure: Embedment scheme of the pole shaft







POLES INSTALLATION
(ERECTION)

1 HOLE DRILLING

2 HOLE CHECKING

3 SLINGING AND ERECTION

4 POLE LIFTING

5 HOLE APPROACH

⚠ PLEASE NOTE THE USE OF A LIGHT CRANE FOR ALL ERECTION OPERATIONS

6 HOLE CENTERING

7 GROUND EMBEDMENT

8 EMBEDMENT CHECKING

9 BACK FILLING

10 FINISHING

⚠ NOTE THE USE OF A LIGHT CRANE FOR ALL ERECTION OPERATIONS

POLE INSTALLATION
(BACK FILLING)

CONDUCTOR STRINGING

Site IDs

Poles type

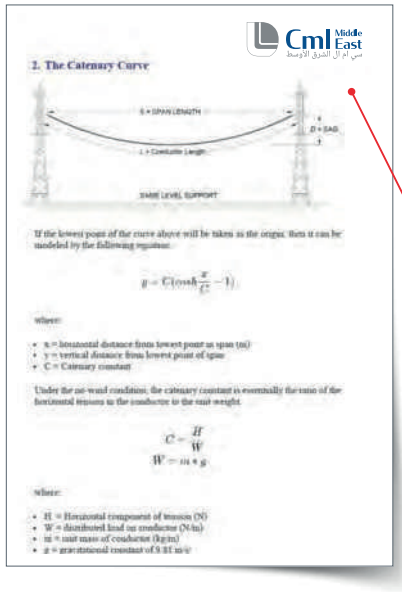
Span between the 2 sites

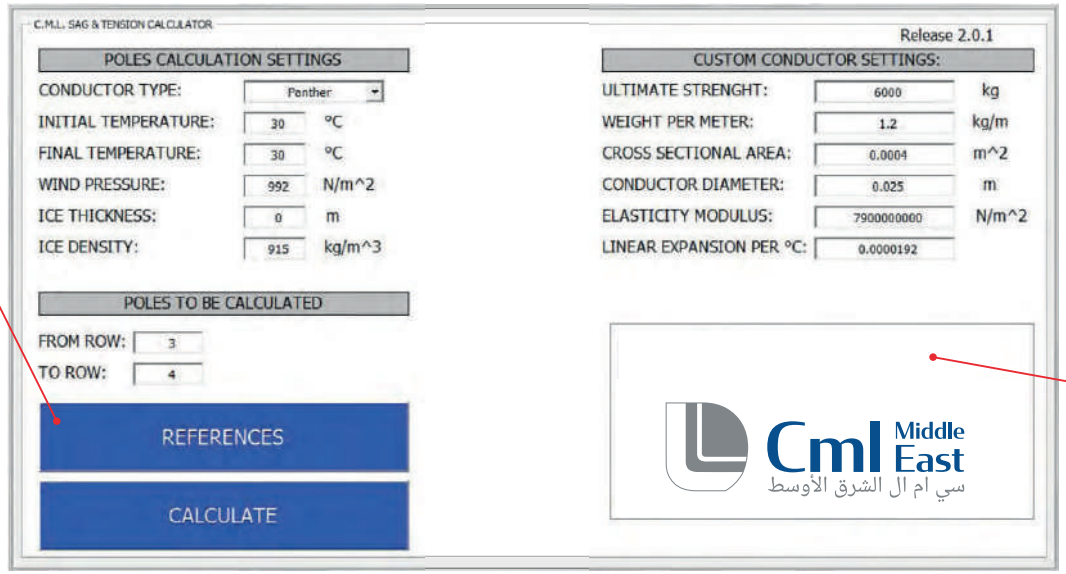
Start	End	Type St	Type End	Quota Palo	Quota Palo	Distance	Max Loa
1	2	I18S	I18S	585.7	585.7		7500
2	3	I18S	AS18	585.7	587.4	20.711	10000
3	4	AS18	AS18	587.4	606	112.271	10000
4	5	AS18	AS18	606	601	76.717	10000
5	6	AS18	AS18	601	571.5	109.021	10000
6	7	AS18	AS18	571.5	572.5	99.622	10000
7	8	AS18	I18	572.5	574.5	94.53	10000
8	9	I18	AS18	574.5	577	95.846	10000
9	10	AS18	I18	577	616	83.254	10000
10	11	I18	I18	616	619.5	23.97	7500
11	12	I18	I18	619.5	590	103.09	7500
12	13	I18	I18	590	578	77	7500

PRELOAD to be applied during stringing

CLEARANCE as per calculation

Max Sag	Preload	Final Load	Final Sag	Clearance	Note	OK Tir	OK Sag
		0.000	0.000	0.000		OK	OK
3.7488	500.00	1,167.105	1.062	9.686		OK	OK
10.0017	1,600.00	3,733.758	9.821	7.180		OK	OK
2.3448	1,200.00	5,000.000	2.263	7.050		OK	OK
11.5471	1,300.00	3,037.010	11.434	7.113		OK	OK
12.0929	1,100.00	2,570.804	11.306	7.787		OK	OK
3.4875	3,300.00	7,497.160	3.439	7.048		OK	OK
9.9844	1,200.00	2,803.322	9.562	7.423		OK	OK
6.0931	1,500.00	3,495.988	5.747	7.346		OK	OK
5.2769	500.00	1,167.781	1.424	10.853		OK	OK
5.9966	2,300.00	5,333.602	5.763	7.234		OK	OK
5.1597	1,500.00	3,493.761	4.914	7.245		OK	OK



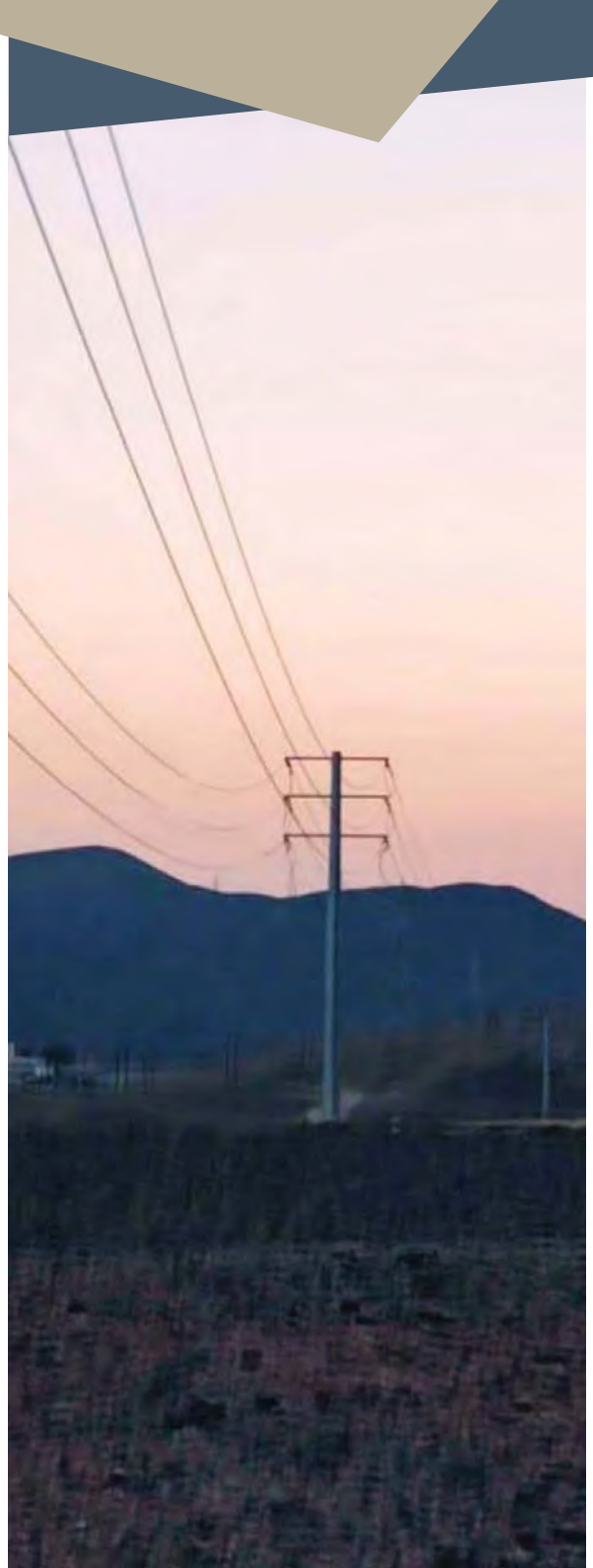


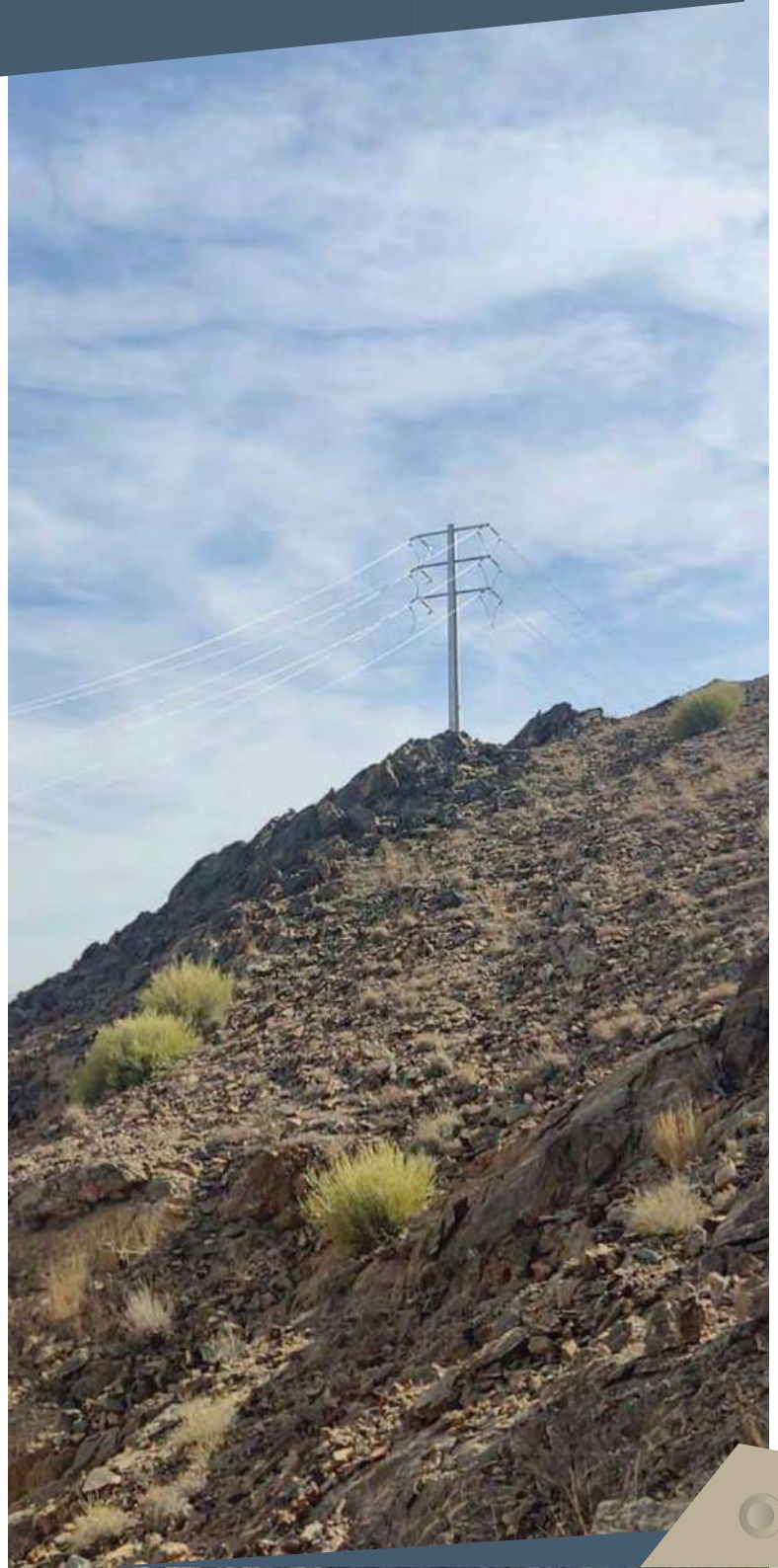
FOR STRINGING:
ALL INFORMATION WILL BE PROVIDED AND ON SITE PRELOAD NEEDS TO BE CHECKED AND THE FINAL CLEARANCE VERIFIED

CML SOFTWARE
FOR SAG & TENSION
FINAL CLEARANCE VERIFIED

DINAMOMETER
FOR PRELOAD CHECKING


JEBEL AKHDAR
PROJECT



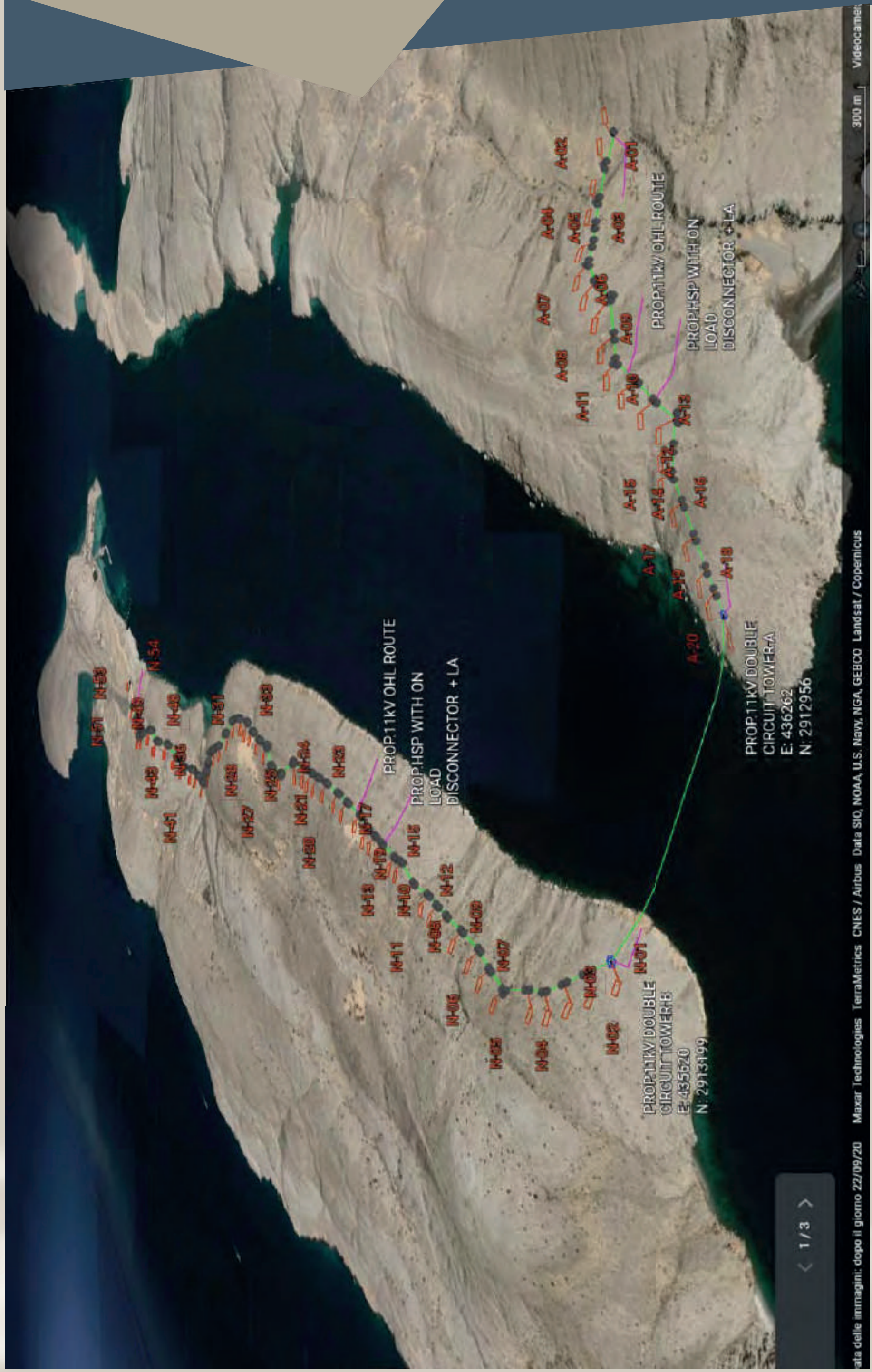


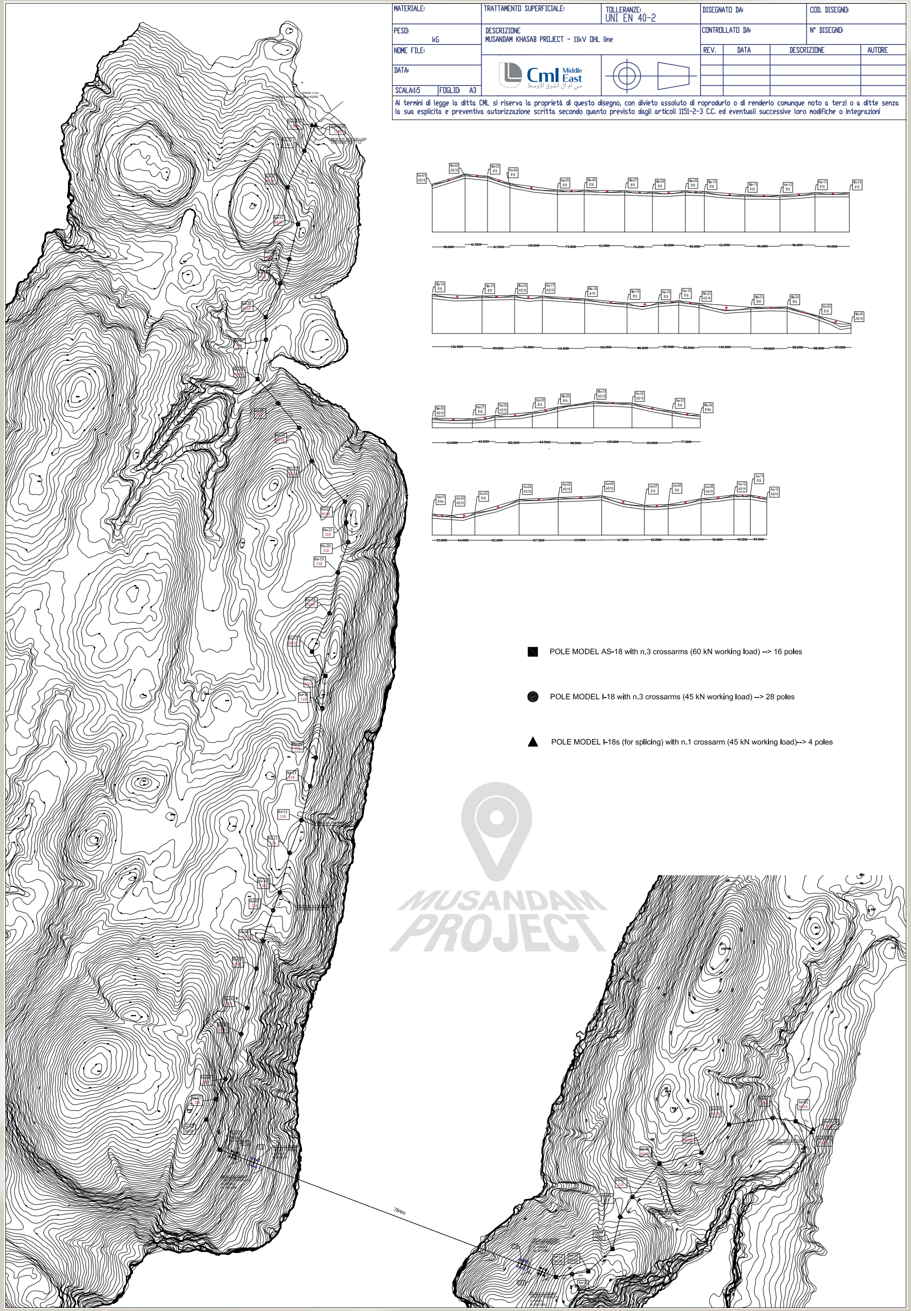

JEBEL AKHDAR
PROJECT

DPOLE PROJECT IN OMAN
MUSANDAM PROJECT

(5 km - 33 kV distribution line double circuit)

MUSANDAM PROJECT VIDEO


PROP11kV OHL ROUTE
PROP HSP WITH ON LOAD DISCONNECTOR + LA
PROP11kV DOUBLE CIRCUIT TOWER-A
E: 436262
N: 2912956
PROP11kV DOUBLE CIRCUIT TOWER-B
E: 435620
N: 2913199
Maxar Technologies TerraMetrics CNES / Airbus Data SIO, NOAA U.S. Navy, NGA, GEBCO Landsat / Copernicus
1/3


MUSANDAM KHASAB PROJECT - 11kV OHL line
UNI EN 40-2
Cml Middle East
POLE MODEL AS-18 with n.3 crossarms (60 kN working load) --> 16 poles
POLE MODEL I-18 with n.3 crossarms (45 kN working load) --> 28 poles
POLE MODEL I-18s (for splicing) with n.1 crossarm (45 kN working load)--> 4 poles
MUSANDAM PROJECT

COMPARISON BETWEEN LINE IN WOOD VS STEEL:

ORIGINAL PROJECT (WOOD - single circuit)

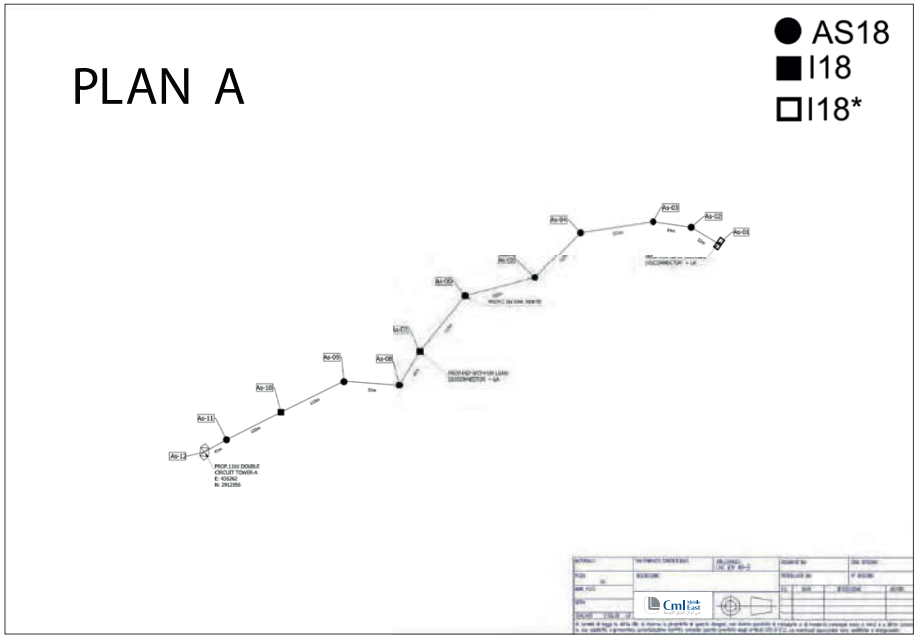
	A	N1	N2	N3	TOTAL	steel poles	wires
2H pole + 4 stay wires (intermediate)	11	17	14	13	**55**	110	220
2H pole + 5 stay wires (angle)	6	1	4	2	**13**	26	65
2H pole + 2 stay wires (terminal)	1	0	0	1	**2**	4	4
3T pole + 8 stay wires (right angle)	1	0	0	0	**1**	3	8
	19	**18**	**18**	**16**	**71**	**143**	**297**
Load disconnectors + ...	2	1	0	1	**4**		

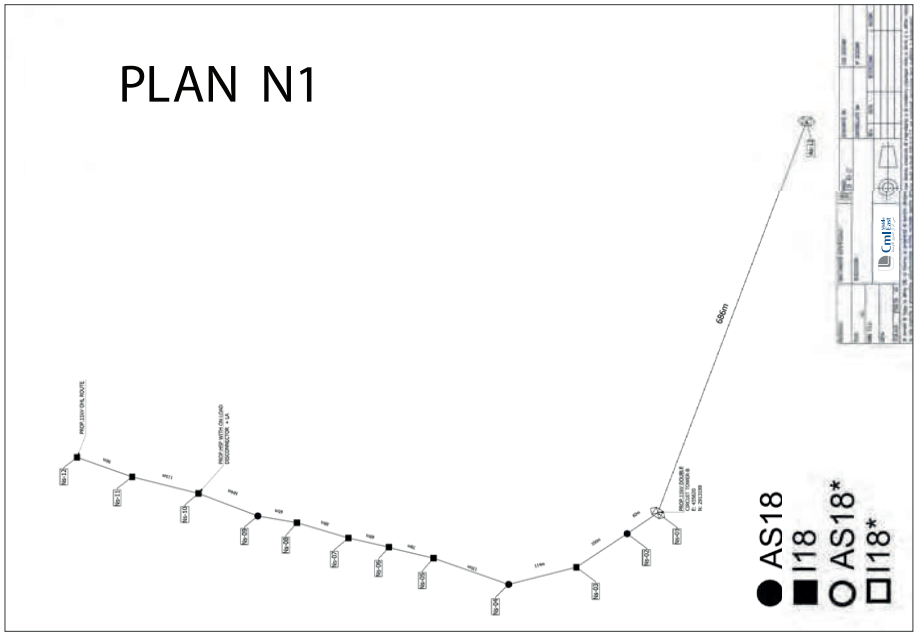
NEW PROJECT (STEEL)

	A	N1	N2	N3	TOTAL	wodeen poles	steel wires
AS18 monopole + TRA4000-T	8	3	10	9	**30**	30	0
AS18* monopole + TRA4000-T	0	0	0	0	**0**	0	0
I18* monopole + TRA4000-I	2	0	0	2	**4**	4	0
I18 monopole + TRA4000-I	2	8	3	1	**14**	14	0
	12	**11**	**13**	**12**	**48**	**48**	**0**
Load disconnectors + ...	2	1	0	1	**4**		

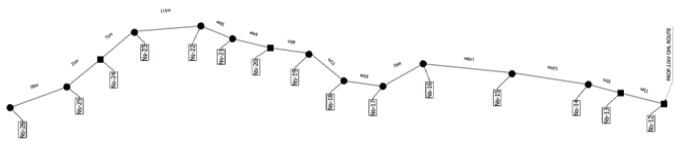
The comparison shows 48 steel poles against 143 wooden poles but we have to consider that the wooden one is single circuit and the steel one is double circuit.
So, for a real comparison we have to double the number of wooden peles... **we have 48 vs 286 around 6 times less in terms of number of poles.**

ROUTE AND PROFILING



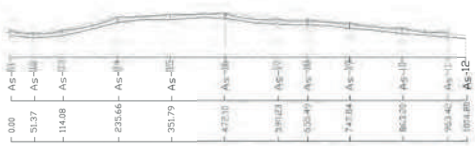


PLAN N2



● AS18
■ I18
○ AS18*
□ I18*

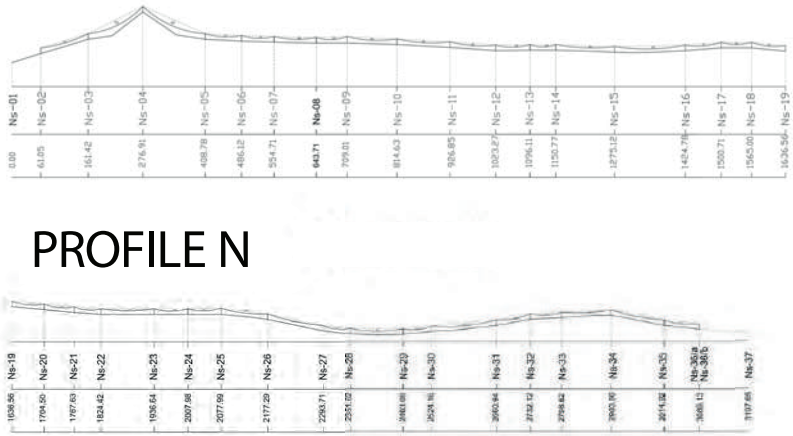
PROFILE A

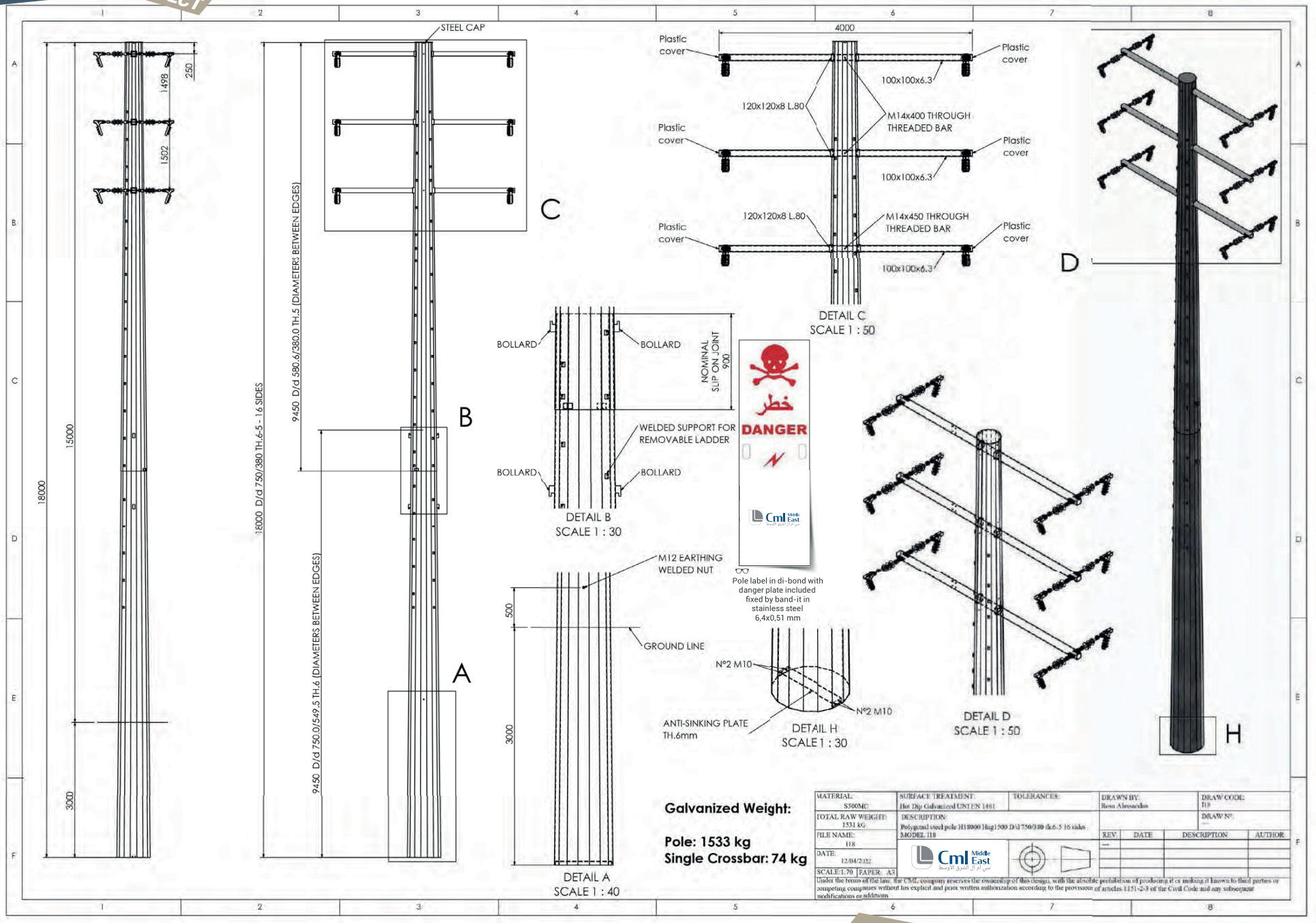


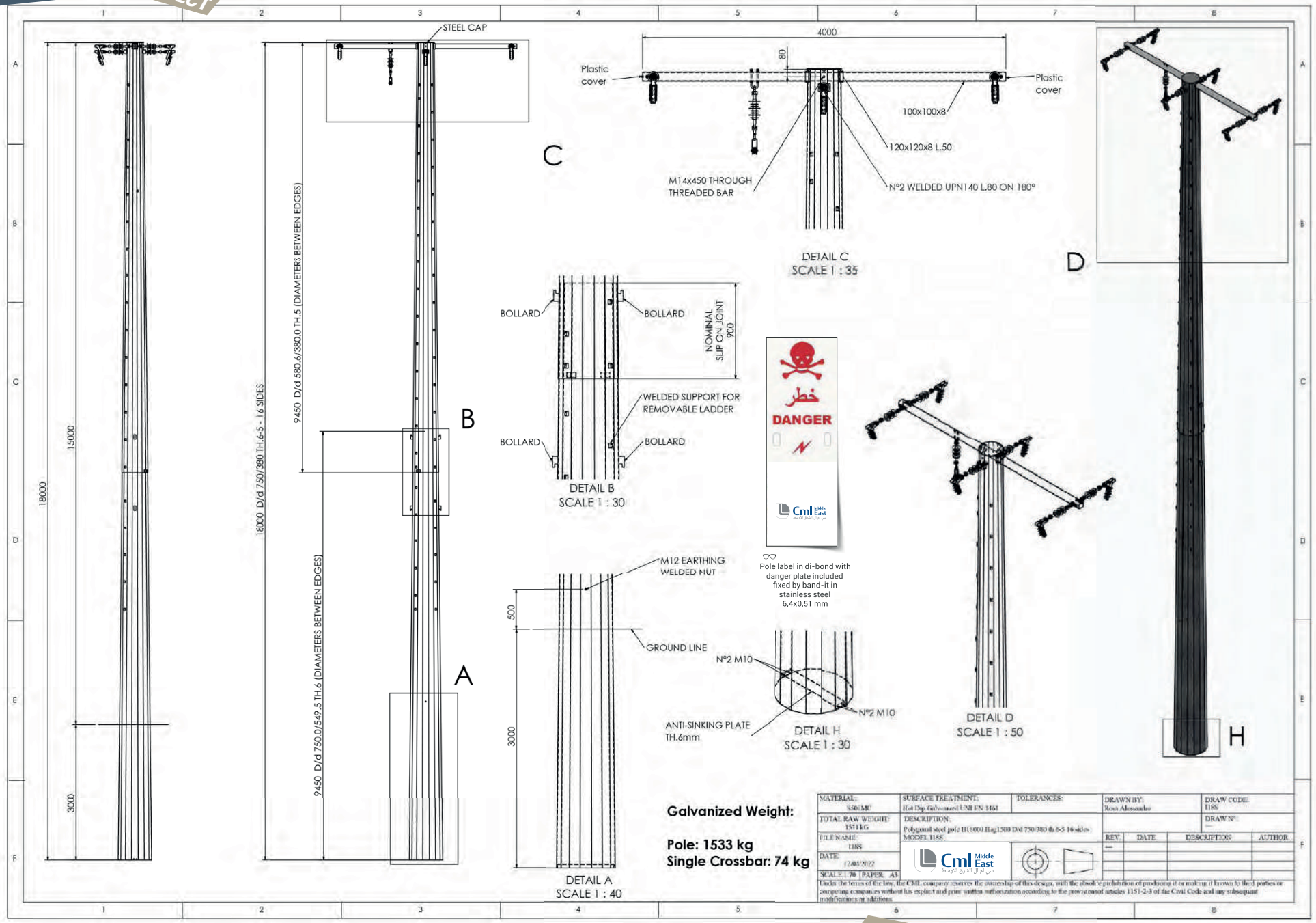
PLAN N3

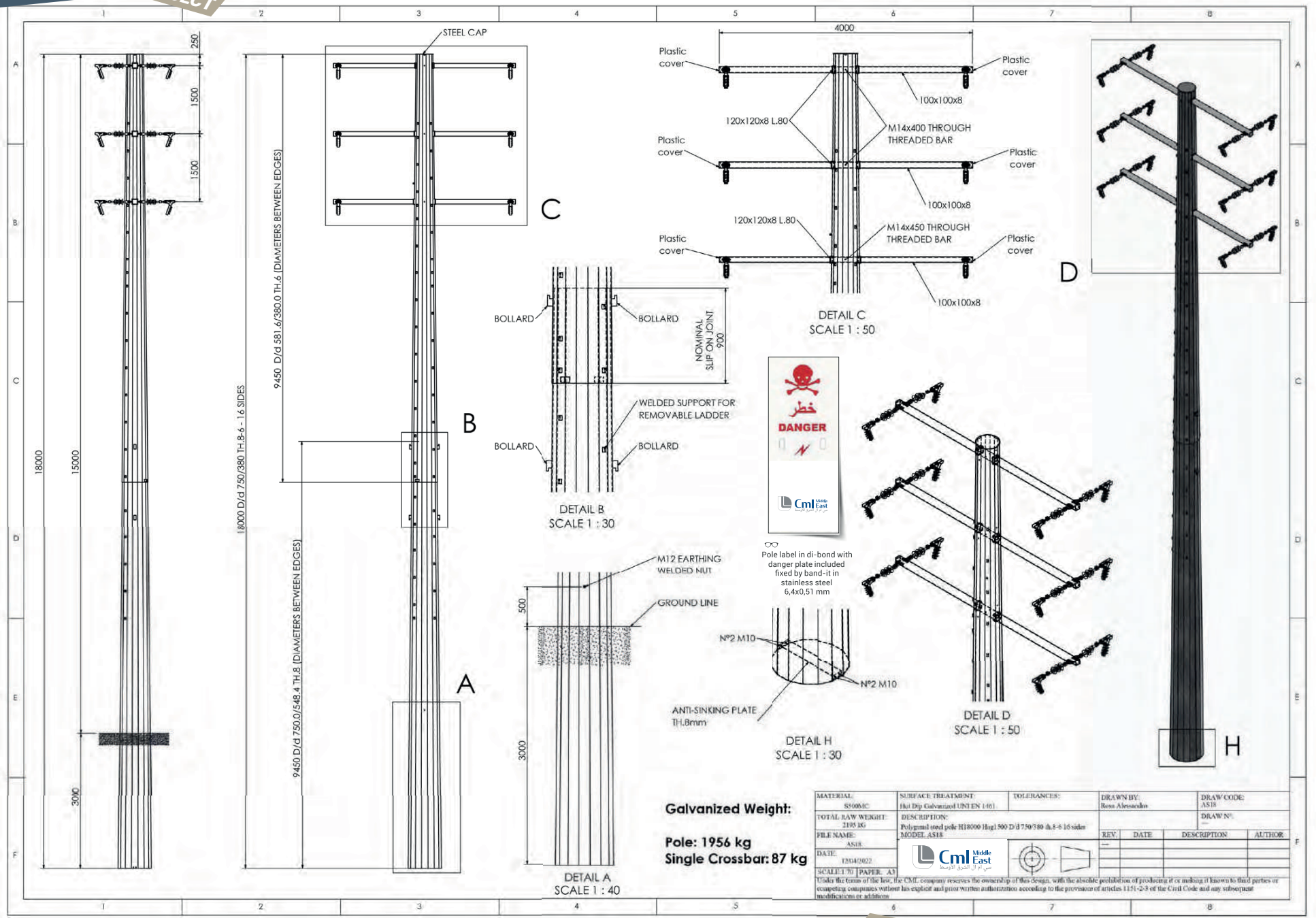
● AS18
■ I18
○ AS18*
□ I18*

PROFILE N




STEEL CAP
18000
15000
3000
1498
1502
250
9450 D/d 580.6/380.0 TH.5 (DIAMETERS BETWEEN EDGES)
18000 D/d 750/380 TH.6-5 - 16 SIDES
9450 D/d 750.0/549.5 TH.6 (DIAMETERS BETWEEN EDGES)
A
B
C
D
H
4000
Plastic cover
100x100x6.3
120x120x8 L.80
M14x400 THROUGH THREADED BAR
M14x450 THROUGH THREADED BAR
DETAIL C
SCALE 1 : 50
BOLLARD
NOMINAL SLIP ON JOINT 900
WELDED SUPPORT FOR REMOVABLE LADDER
DETAIL B
SCALE 1 : 30
خطر
DANGER
Pole label in di-bond with danger plate included fixed by band-it in stainless steel 6,4x0,51 mm
M12 EARTHING WELDED NUT
500
GROUND LINE
3000
DETAIL A
SCALE 1 : 40
N°2 M10
ANTI-SINKING PLATE TH.6mm
DETAIL H
SCALE 1 : 30
DETAIL D
SCALE 1 : 50
Galvanized Weight:
Pole: 1533 kg
Single Crossbar: 74 kg
MATERIAL: S500MC
SURFACE TREATMENT: Hot Dip Galvanized UNI EN 1461
TOLERANCES:
DRAWN BY: Rosa Alessandro
DRAW CODE: I18
TOTAL RAW WEIGHT: 1533 KG
DESCRIPTION: Polygonal steel pole H18000 Hsg1500 D/d 750/380 th.6-5 16 sides MODEL I18
DRAW N°:
FILE NAME: I18
REV. DATE DESCRIPTION AUTHOR
DATE: 12/04/2022
SCALE:1:70 PAPER: A3
Cml Middle East
Under the terms of the law, the CML company reserves the ownership of this design, with the absolute prohibition of producing it or making it known to third parties or competing companies without his explicit and prior written authorization according to the provisions of articles 1151-2-3 of the Civil Code and any subsequent modifications or additions


STEEL CAP
18000
15000
3000
9450 D/d 580.6/380.0 TH.5 (DIAMETERS BETWEEN EDGES)
16000 D/d 750/380 TH.6-5 - 16 SIDES
9450 D/d 750.0/549.5 TH.6 (DIAMETERS BETWEEN EDGES)
A
B
C
D
4000
80
Plastic cover
Plastic cover
100x100x8
120x120x8 L.50
M14x450 THROUGH THREADED BAR
N°2 WELDED UPN140 L.80 ON 180°
DETAIL C
SCALE 1 : 35
BOLLARD
BOLLARD
NOMINAL SLIP ON JOINT 900
WELDED SUPPORT FOR REMOVABLE LADDER
BOLLARD
BOLLARD
DETAIL B
SCALE 1 : 30
M12 EARTHING WELDED NUT
500
GROUND LINE
3000
DETAIL A
SCALE 1 : 40
خطر
DANGER
Pole label in di-bond with danger plate included fixed by band-it in stainless steel 6,4x0,51 mm
N°2 M10
N°2 M10
ANTI-SINKING PLATE TH.6mm
DETAIL H
SCALE 1 : 30
DETAIL D
SCALE 1 : 50
H
Galvanized Weight:
Pole: 1533 kg
Single Crossbar: 74 kg
MATERIAL: S500MC
SURFACE TREATMENT: Hot Dip Galvanized UNI EN 1461
TOLERANCES:
DRAWN BY: Rosa Alessandro
DRAW CODE: I18S
TOTAL RAW WEIGHT: 1511 KG
DESCRIPTION: Polygonal steel pole H18000 Hag1500 Dd 750/380 th.6-5 16 sides MODEL I18S
DRAW N°:
FILE NAME: I18S
REV. | DATE | DESCRIPTION | AUTHOR
DATE: 12/04/2022
SCALE 1:70 | PAPER: A3
Cml Middle East


STEEL CAP
250
1500
1500
18000
15000
3000
9450 D/d 581.6/380.0 TH.6 (DIAMETERS BETWEEN EDGES)
8000 D/d 750/380 TH.8-6 - 16 SIDES
9450 D/d 750.0/548.4 TH.8 (DIAMETERS BETWEEN EDGES)
A
B
C
D
H
4000
Plastic cover
100x100x8
120x120x8 L.80
M14x400 THROUGH THREADED BAR
M14x450 THROUGH THREADED BAR
DETAIL C
SCALE 1 : 50
BOLLARD
NOMINAL SLIP ON JOINT 900
WELDED SUPPORT FOR REMOVABLE LADDER
DETAIL B
SCALE 1 : 30
M12 EARTHING WELDED NUT
GROUND LINE
500
3000
DETAIL A
SCALE 1 : 40
خطر
DANGER
Pole label in di-bond with danger plate included fixed by band-it in stainless steel 6,4x0,51 mm
N°2 M10
ANTI-SINKING PLATE TH.8mm
DETAIL H
SCALE 1 : 30
DETAIL D
SCALE 1 : 50
Galvanized Weight:
Pole: 1956 kg
Single Crossbar: 87 kg
MATERIAL: S500MC
SURFACE TREATMENT: Hot Dip Galvanized UNI EN 1461
TOLERANCES:
DRAWN BY: Rosa Alessandro
DRAW CODE: AS18
TOTAL RAW WEIGHT: 2195 KG
DESCRIPTION: Polygonal steel pole H18000 Hsg1500 D/d 750/380 th.8-6 16 sides MODEL AS18
DRAW N°:
FILE NAME: AS18
REV. | DATE | DESCRIPTION | AUTHOR
DATE: 12/04/2022
SCALE 1:70 | PAPER: A3
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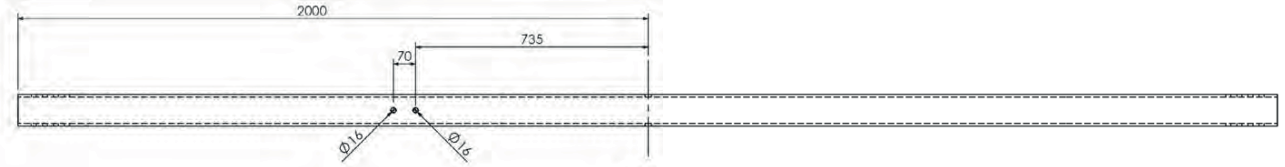
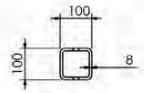
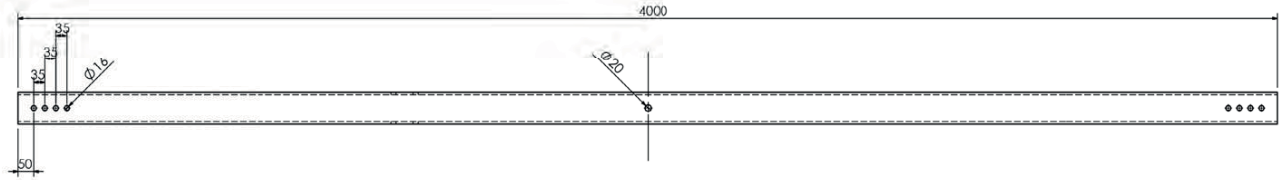


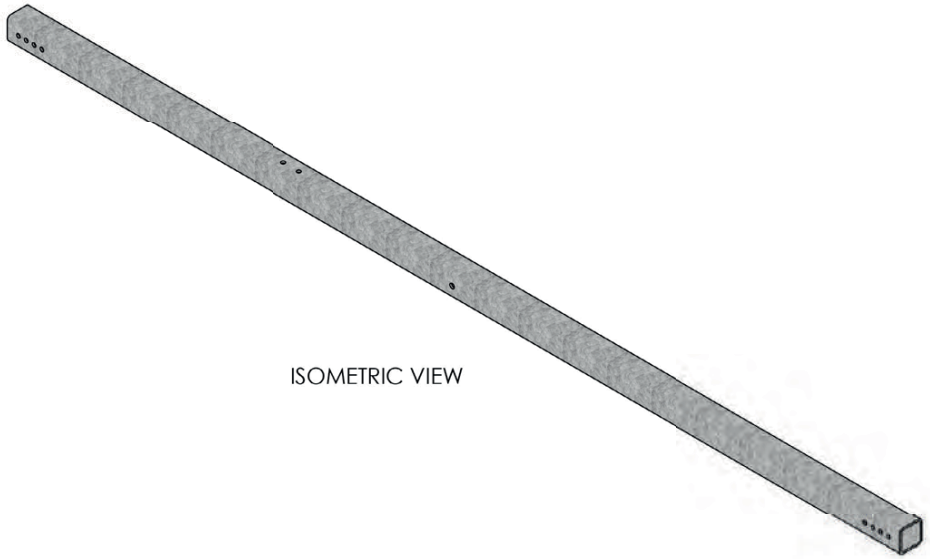
TOP VIEW



SIDE VIEW



FRONT VIEW



ISOMETRIC VIEW

WARNING:

ALL HOLES ARE THROUGHOUT

MATERIAL: 1.0345 (S355JR)	SURFACE TREATMENT: Hot Dip Galvanized UNI EN 1461	TOLERANCES: UNI EN 40-2	DRAWN BY: Rsia Alessandro	DRAW CODE: TRA4000-S
RAW WEIGHT: 86.97 kG	DESCRIPTION: Crossbar 100x100x8 L.4000			DRAW N°:
FILE NAME: TRA4000-S			REV. –	DATE – DESCRIPTION – AUTHOR
DATE: 15/03/2022				
SCALE: 1:15 | PAPER: A3				

Cml Middle East
سي ام ال الشرق الأوسط

CML MIDDLE EAST LLC

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AL KUWAIR, MUSCAT
SULTANATE OF OMAN

DPOLE video

COMPANY PROFILE

index