WEF component descriptions

Facility Component	Description
Crane platform and hardstand area	Crane platform and hardstand laydown for each turbine position.
Turbine Foundations	Reinforced Concrete Foundation. Depth: up to 3.5 m Diameter: up to 30 m per turbine Volume of concrete: up to 800 m^3 per turbine.
IPP Substation	33 kV to 132 kV collector substation to receive, convert and step-up electricity from the WEF to the 132 kV grid suitable supply. The substation's maximum height will be the Lightning Mast up to 25 m high. The facility will house control rooms and grid control yards for both Eskom and the IPP. Additional infrastructure includes parking, up to 2.8 m high fencing, stormwater channels and culverts, ablutions, water storage tanks, septic tanks, and boreholes.
Construction/office yard	This includes bunded fuel areas, oil storage areas, general stores (containers) and skips.
WTG component laydown area	Temporary laydown area.
On-site concrete batching plant	Temporary on-site concrete batching plant.
Primary Site Access Roads	Site access will, where possible, make use of existing farm roads that will be upgraded and maintained for the life of the WEF. The existing roads to be upgraded will be expanded to a width of up to 9 m. New roads will be constructed (in areas where there are no existing roads) with a final width of up to 9 m to the IPP substation and laydown areas. V-drains will run on both sides of the road. In certain areas of steep slopes, the constructed road will require cut and fill which will extend the final 12m total width of the road during operations.
Internal roads	Roads connecting the turbine positions will where possible make use of existing farm roads that will be upgraded and maintained for the life of the plant. The existing roads to be upgraded will be expanded to a width of up to 6 m. New roads will be constructed (in areas where there are no existing roads) with a width of up to 6 m and will connect all turbines. V-drains will run on both sides of the road. In certain areas of steep slopes, the constructed road will require cut and fill which will extend the final 9m total width of the road during operations.

Facility Component	Description
33 kV reticulation	A combination of 33 kV overhead lines and 33 kV underground cable (where technically feasible) will be used, aligned along the road network connecting each WTG position to the IPP substation.
Operations and maintenance (O&M) buildings	Includes other infrastructure such as parking, up to 2.8 m high fencing, stormwater channels and culverts, ablutions, water storage tanks, septic tanks, and boreholes.

WEF component footprints

Facility Component	Construction footprint	Final footprint after rehabilitation
Crane platform and hardstand area	Up to 0.8 ha per turbine	Up to 0.8 ha per turbine
Turbine foundations	Up to 0.07 ha per turbine (included in hardstand area).	Up to 0.07 ha per turbine (Included in hardstand area).
IPP substation	Up to 1 ha	Up to 1 ha
Construction/office yard	Up to 4 ha	0 ha
WTG component laydown area	Up to 4 ha	0 ha
On-site concrete batching plant	Up to 1 ha	0 ha
Temporary stockpiles	Up to 2 ha	0 ha
Primary site access road and reticulation	Total width of up to 15 m consisting of: • Up to 12 m wide area prepared for road and v-drain. • Up to 3 m width for underground 33 kV reticulation. Overhead lines to be used where underground cables are not technically feasible.	Total width of up to 12 m consisting of: • Up to 9 m wide road • Up to 1.5 m wide v-drain on either side of road 33 kV underground / overhead line reticulation and stockpile areas to be rehabilitated.
Internal roads and reticulation	Total width of up to 12 m consisting of: • Up to 9 m wide area prepared for road and v-drain.	Total width of up to 9 m consisting of: • Up to 6 m wide road

Facility Component	Construction footprint	Final footprint after rehabilitation
	• Up to 3 m wide area for underground 33 kV reticulation. Overhead lines to be used where underground cables are not technically feasible.	• Up to 1.5 m wide v-drain on either side of road 33 kV underground / overhead line reticulation and stockpile areas to be rehabilitated.
Operations and maintenance (O&M) buildings	Up to 0.5 ha	Up to 0.5 ha

Additional Information on Borehole and Water Requirements:

WATER

WRT boreholes, the anticipated locations are attached (we are exploring availability from the municipality).

WRT water storage on site please note that we will likely be utilizing temporary dams, during construction:

Details include:

- It will require some roadways around for trucks to pull up and fill up, and will likely be in the areas indicated for O&M.
- Typically you'd have a standpipe and pump to fill the truck (see image above).
- Typically requires no slab, probably some compaction and potentially importing of suitable layer works material for increased bearing capacity (but can depend on soil).

Water Requirements for Karoo WP (Phase 1)

Summary of requirements

Construction

	Annual	Total
Water (Kltr)	95,078	190,156
Refuse (m^3)	4,128	8,256
Sewerage (Kltr)	8,640	17,280

Operation

Water (Kltr)	558	
Refuse (m^3)	180	
Sewerage (Kltr)	438	

Water Requirements for Karoo WP 2 (Phase 2)

Summary of requirements

Construction

	Annual	Total
Water (Kltr)	93,418	186,836
Refuse (m^3)	4,176	8,352
Sewerage (Kltr)	8,640	17,280

Operation

Water (Kltr)	558	
Refuse (m^3)	180	
Sewerage (Kltr)	438	

Water Requirements for Karoo WP3 (Phase3)

Summary of requirements

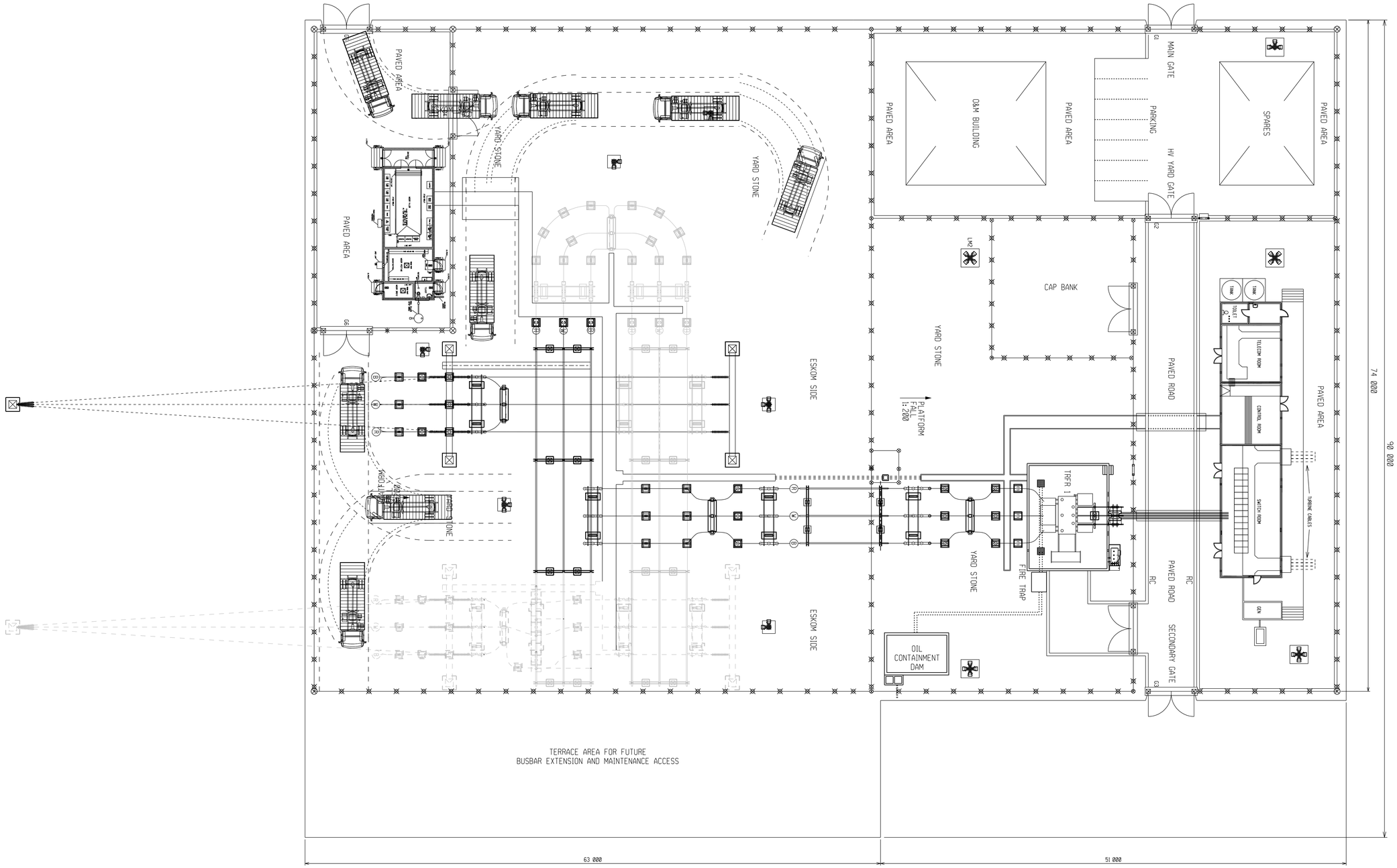
Construction

	Annual	Total
Water (Kltr)	45,803	91,606
Refuse (m^3)	2,640	5,280

Sewerage (Kltr)	5,760	11,520

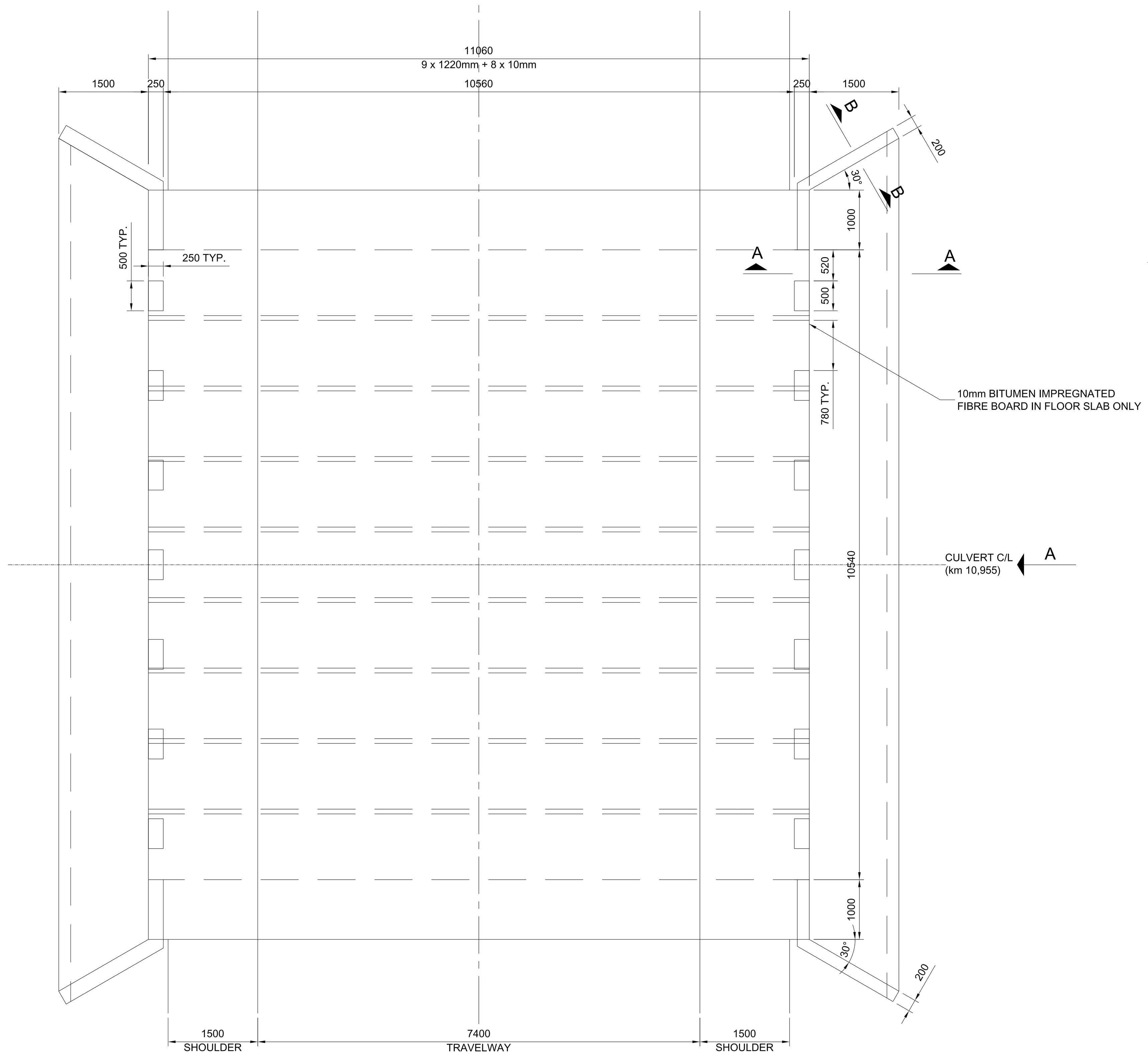
Operation

Water (Kltr)	412	
Refuse (m^3)	120	
Sewerage (Kltr)	292	



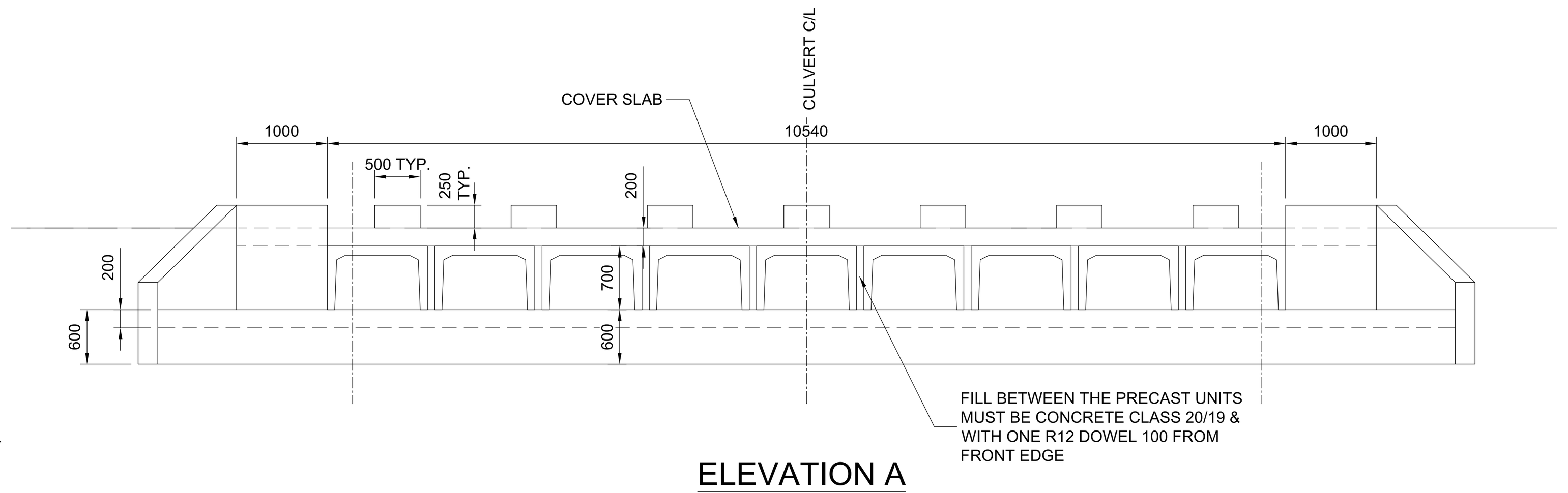
TYPICAL SUBSTATION LAYOUT

DWG. No. H371782-3100-220-260-0006



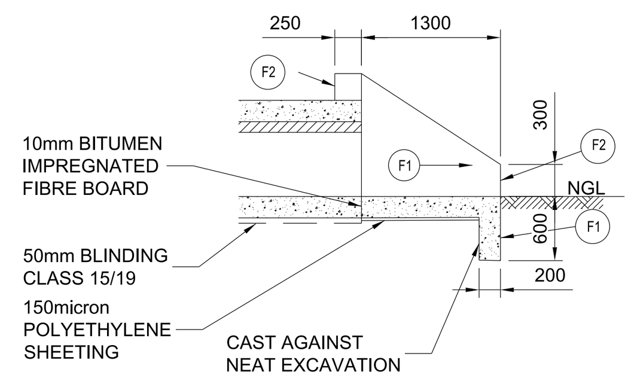
PLAN ON ROOF SLAB

SCALE 1:50



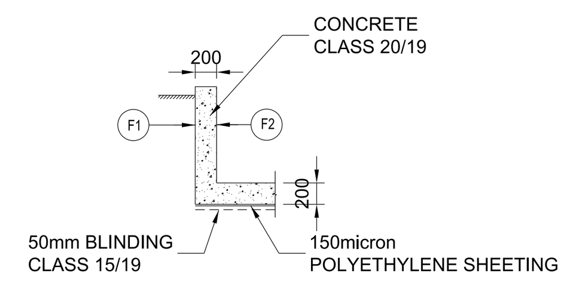
ELEVATION A

SCALE 1:50



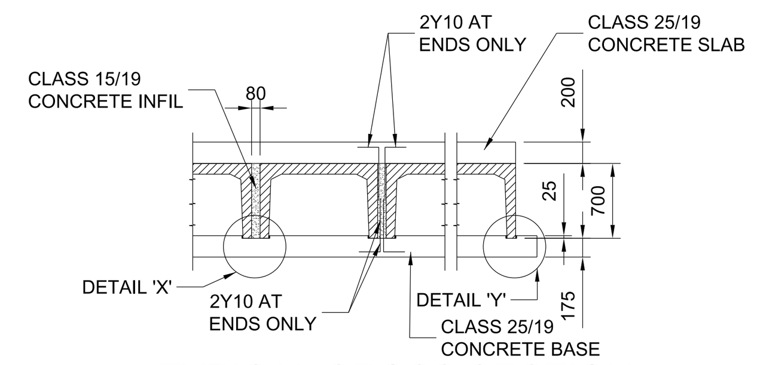
SECTION A-A

SCALE 1:50



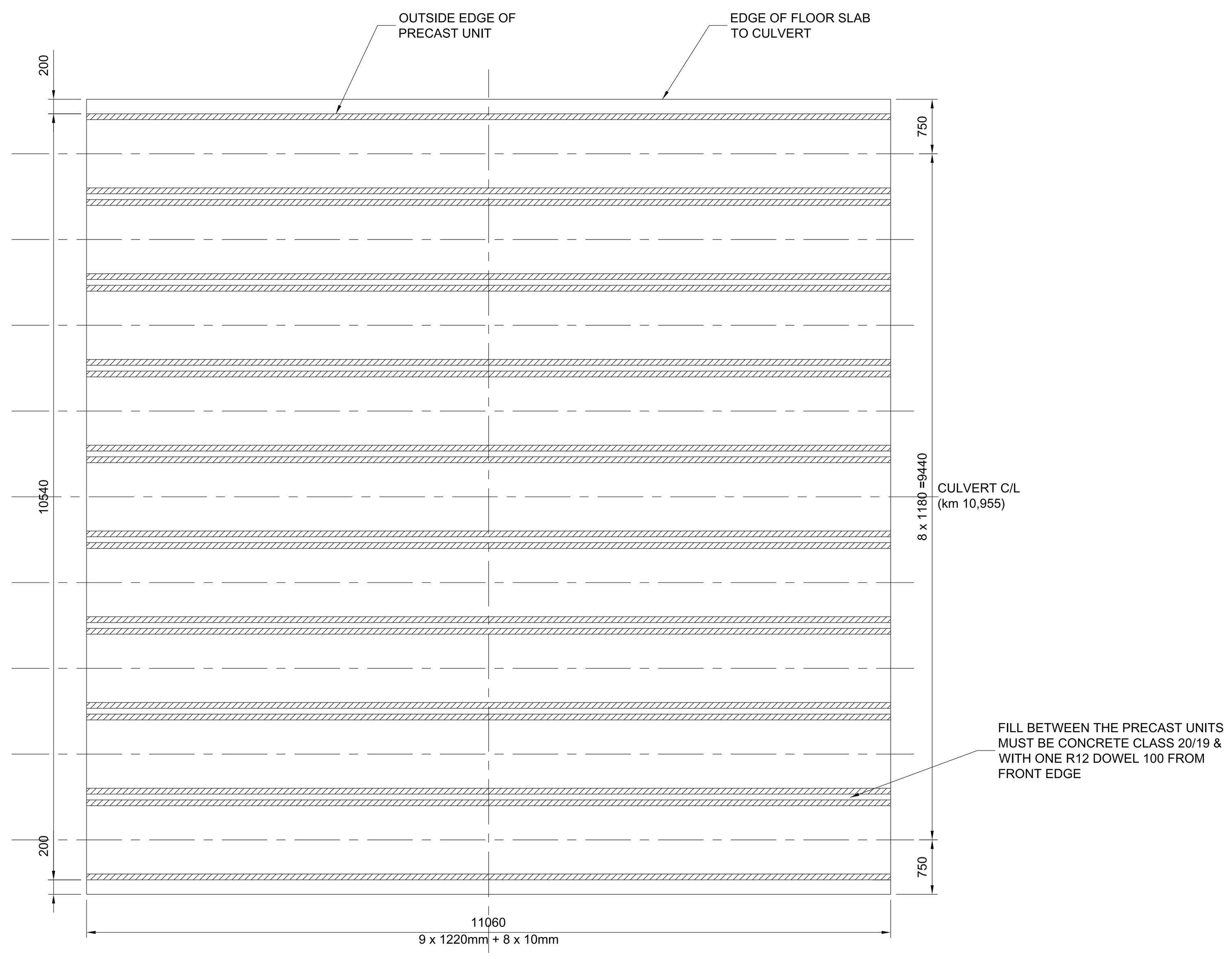
SECTION B-B

SCALE 1:50



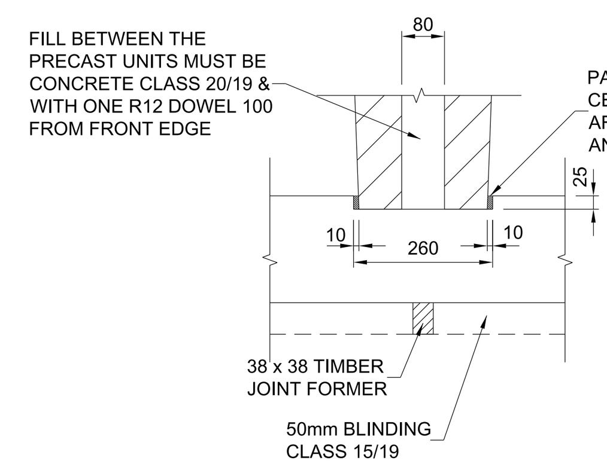
TYPICAL CROSS SECTION

SCALE 1:50



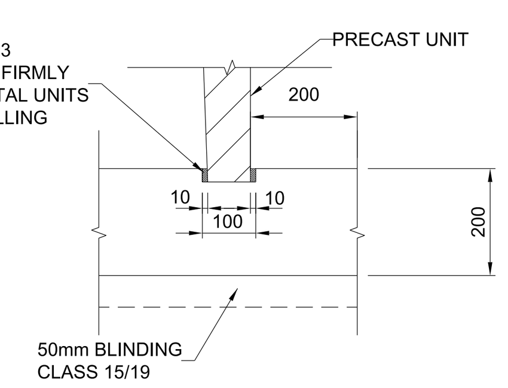
PLAN ON FLOOR SLAB

SCALE 1:50



DETAIL X

SCALE 1:10



DETAIL Y

SCALE 1:10

NOTES:

CONSTRUCTION

1. ALL EXPOSED CORNERS SHALL BE CHAMFERED 25 x 25
2. CONCRETE COVER TO REINFORCEMENT:-
   FLOOR SLAB & FOOTINGS = 50mm
   WINGWALLS = 40mm
3. CONCRETE FINISH:
   CONCEALED SURFACES = F1
   EXPOSED SURFACES = F2
4. POLYETHYLENE SHEET 0.15mm THICK SHALL BE PLACED UNDER ALL WINGWALL FOOTINGS AND INLET SLAB
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE COLTO STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE WORKS FOR STATE ROAD AUTHORITIES AS AMENDED TO DATE

MATERIAL SPECIFICATION:

1. INLET/OUTLET CONCRETE SLABS AND WINGWALLS - CLASS 20/19
   CHARACTERISTIC STRENGTH 20 MPa
   YOUNG'S MODULUS 28 000 MPa
2. REINFORCEMENT (SANS 920 - 1985)
   YIELD STRENGTH TYPE:
   MILD STEEL BARS 250 MPa
   HIGH TENSILE STEEL BARS 450 MPa
   WELDED STEEL FABRIC 450 MPa

DESIGN METHOD:

1. LIMIT STATE DESIGN ACCORDING TO TMH7 PART 3 AS AMENDED 1989
2. INLET AND OUTLET STRUCTURES ARE DESIGNED FOR LOADING SPECIFIED IN TMH7 PART 1 AND 2 AS AMENDED 1988 "CODE OF PRACTICE FOR THE DESIGN OF HIGHWAY BRIDGES AND CULVERTS IN S.A."
3. TYPE OF REINFORCEMENT AND SPACING ARE SHOWN ON THE DRAWINGS.
   THE CONTRACTOR MUST SUBMIT WORKING DRAWINGS AND BENDING SCHEDULES FOR APPROVAL.

FOUNDING MATERIAL:

1. MAX. CALCULATED GROUND PRESSURE - 100kPa
2. FOUNDING LEVEL TO BE APPROVED BY THE PROJECT MANAGER.

DRAWING No.	DRAWING TITLE
H371782-3100-230-272-004	UPGRADING OF ROAD 2938 - LAYOUT

REFERENCE DRAWINGS

REG. PROFESSIONAL

Reserved space for Issue Reason stamp applied by Document Control

No.	DESCRIPTION	BY	CHK'D	DATE
C	APPROVED FOR BID	JG	JE	2024-01-09
B	CLIENT REVIEW	JG	JE	2023-11-28
A	INTERNAL REVIEW	JG	JE	2023-11-06

REVISIONS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J. GOODWIN	NR	2023-09-28
DESIGNER	J. SADIE	NR	2023-09-28
CHECKER	J. ENGELBRECHT		
DESIGN COORD.	Simoes, Sergio		2024-01-15
RESP. ENG.	Bradley, Craig		2024-01-15
LEAD DISC. ENG.	J. ENGELBRECHT		
ENG. MANAGER	Azevedo, Fernando		2024-01-15
PROJ. MANAGER	Barnard, Andre	Barnard, Andre	2024-01-15
CLIENT	M McKINNEY		

DRAWING APPROVAL STATUS: Approved for Bid

ZIRCO ROODE HEUWEL (Pty) Ltd.

KAMIESBERG FEASIBILITY STUDY

UPGRADING OF ROAD D2938 GROEN RIVER CROSSING DETAILS

SCALE: AS SHOWN OR AS NOTED

DWG. No. H371782-3100-220-260-0006

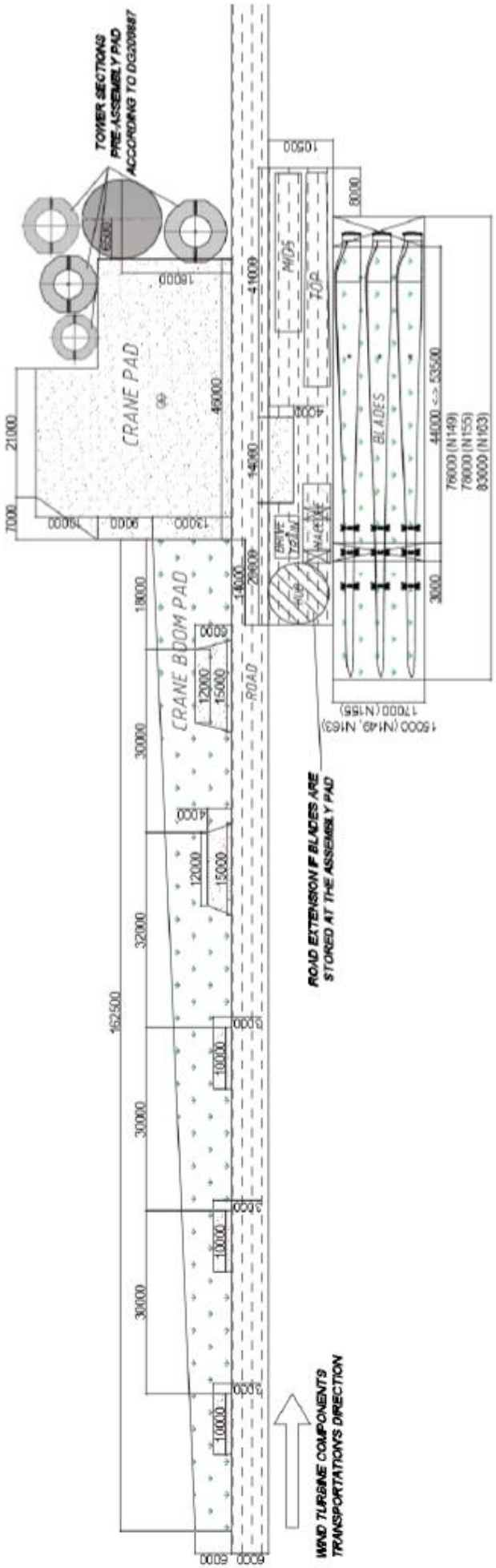
REV C

SHEET SIZE: A0

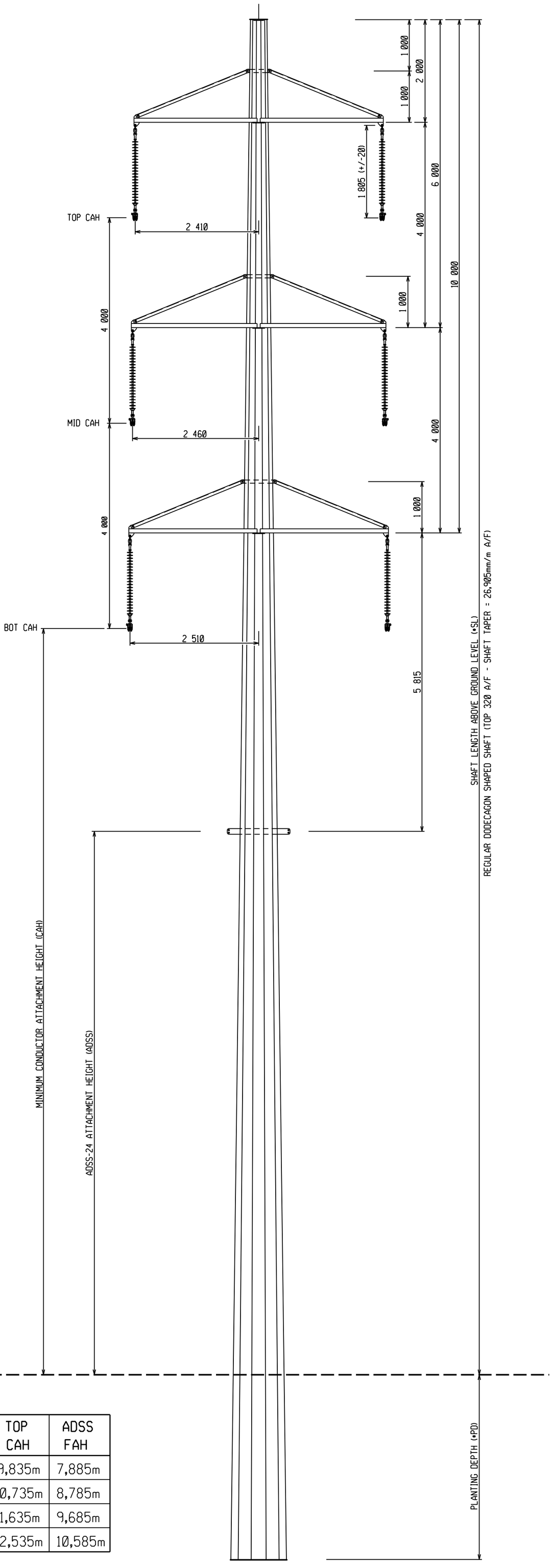
hatcpw15-pw-svc 10-JAN-2024 14:32
Zirco Roode Heuwel (Pty) Ltd\H371782\01_Work In Progress\220 - Civil\Drawings\H371782-3100-220-260-0006.dwg

"TYPICAL"

HARDSTAND LAYOUT



Final design will depend on OEM and turbine selected.

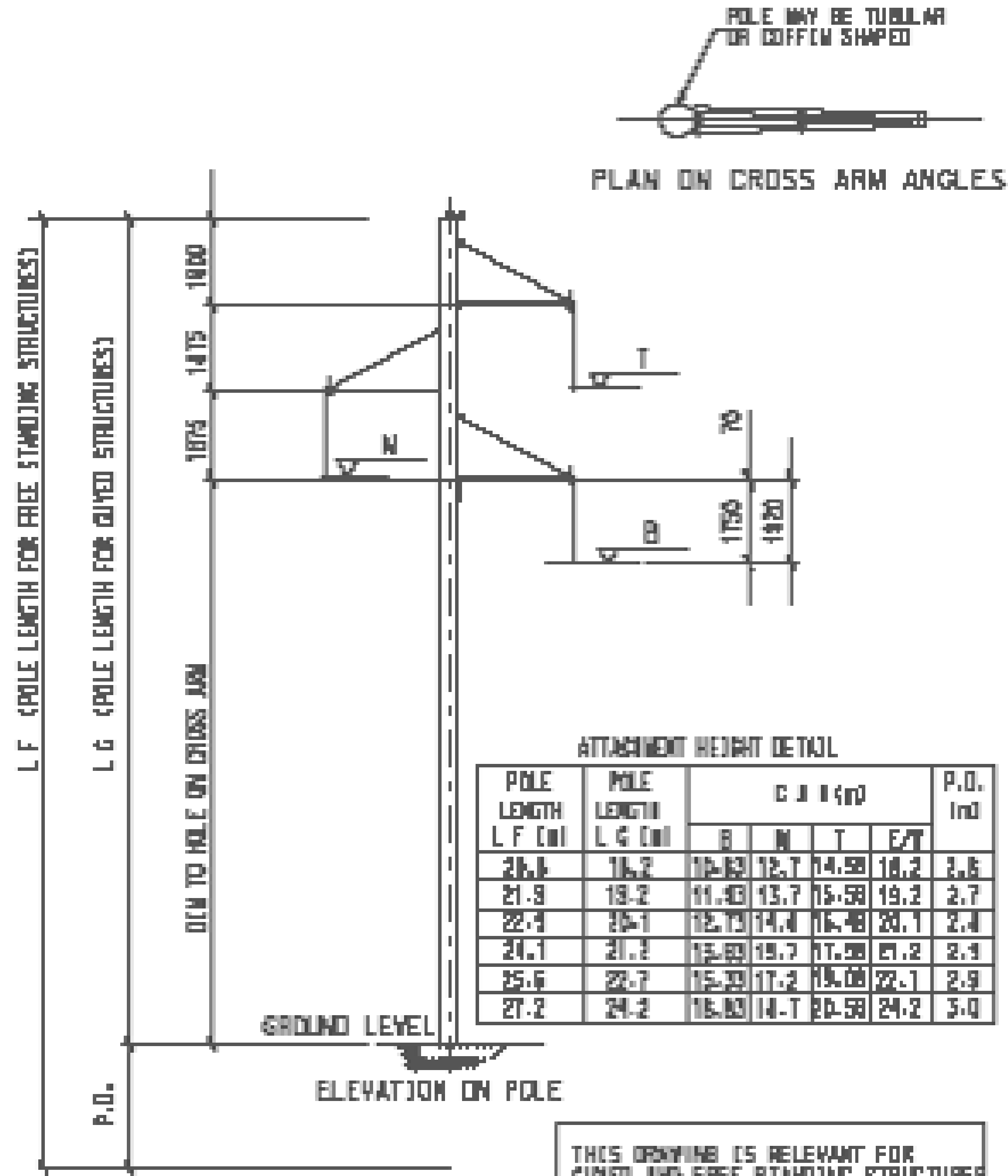


STRUCTURE LENGTH	•SL	•PD	BOT CAH	MID CAH	TOP CAH	ADSS FAH
27,0m	23,7m	3,3m	11,835m	15,835m	19,835m	7,885m
28,0m	24,6m	3,4m	12,735m	16,735m	20,735m	8,785m
29,0m	25,5m	3,5m	13,635m	17,635m	21,635m	9,685m
30,0m	26,4m	3,6m	14,535m	18,535m	22,535m	10,585m

50kN MONO-POLE DOUBLE CIRCUIT INTERMEDIATE SUSPENSION STRUCTURE

REGULAR DODECAGON (TWELVE-SIDED) SHAPED SHAFT

(6 x "TERN" ACSR PHASE CONDUCTORS; 1 X "KINGBIRD" ACSR SHIELD-WIRE; 1 X 24-CORE ADSS)



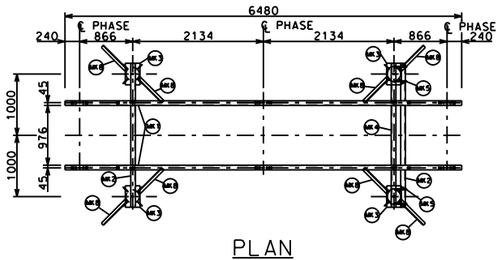
ATTACHMENT HEIGHT DETAIL

POLE LENGTH L F (m)	POLE LENGTH L G (m)	C J H (m)				P.O. (m)
		B	N	T	E/T	
20.6	16.2	10.83	12.7	14.58	18.2	2.6
21.9	19.2	11.83	13.7	15.58	19.2	2.7
22.9	20.1	12.73	14.4	16.48	20.1	2.8
24.1	21.2	13.83	15.7	17.58	21.2	2.9
25.6	22.7	15.33	17.2	19.08	22.1	2.9
27.2	24.2	16.83	18.7	20.58	24.2	3.0

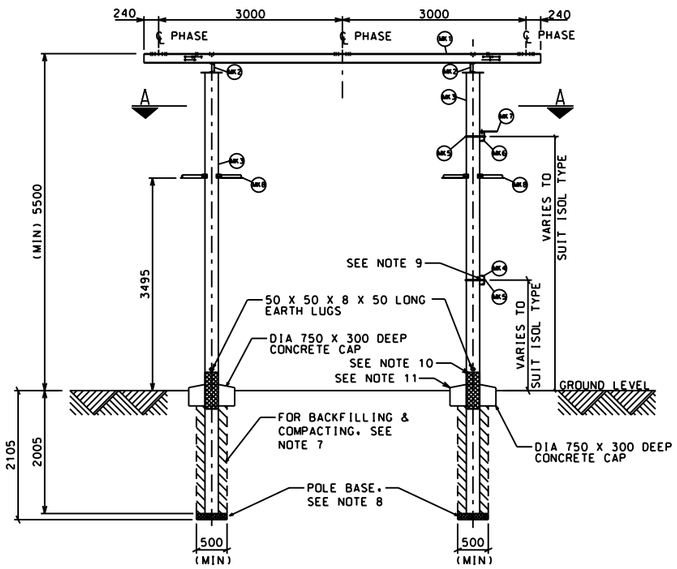
THIS DRAWING IS RELEVANT FOR GUYED AND FREE STANDING STRUCTURES

DISTRIBUTION TECHNOLOGY
132KV SUSPENSION X-ARM
GENERAL ARRANGEMENT FOR
SINGLE STEEL POLE STRUCTURE

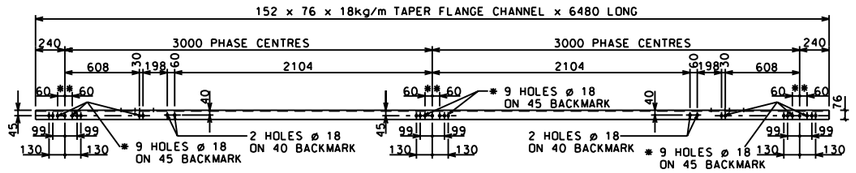
0



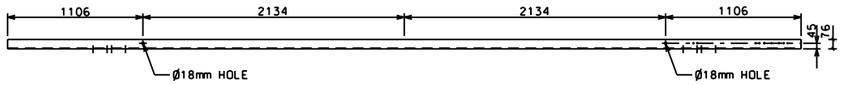
PLAN
SCALE 1:50



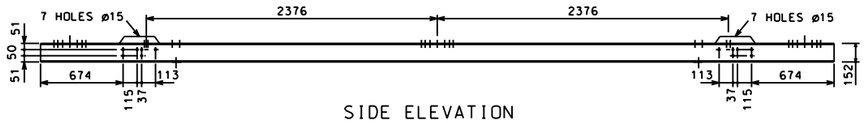
FRONT ELEVATION
SCALE 1:50



TOP ELEVATION
SCALE 1:25

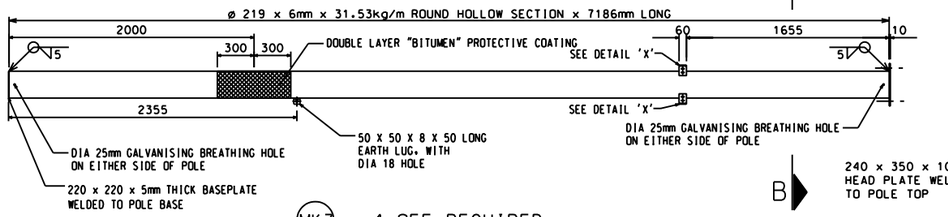


BOTTOM ELEVATION
SCALE 1:25



SIDE ELEVATION
SCALE 1:25

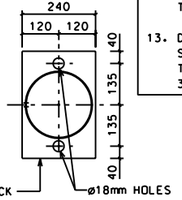
(MK1) - 2 OFF REQUIRED



(MK3) - 4 OFF REQUIRED
SCALE 1:25

B

B



240 x 350 x 10mm THICK HEAD PLATE WELDED TO POLE TOP

SECTION B-B
SCALE 1:10

NOTES:

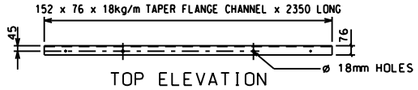
1. STEELWORK, BOLTS, NUTS & WASHERS TO BE HOT DIPPED GALVANISED AS PER SABS ISO 1461 & SABS 10240 1997.
2. ALL HOLES 18 DIA. FOR M16 BOLTS UNLESS OTHERWISE INDICATED.
3. MOUNTING BOLTS SECURING EQUIPMENT TO STRUCTURES, TO BE SUPPLIED BY ELECTRICAL EQUIPMENT CONTRACTOR/ERECTOR.
4. ANY SUPPORT STEELWORK REQUIRED ADDITIONAL TO WHAT IS SHOWN ON THIS DRAWING IS TO BE SUPPLIED BY ISOLATOR MANUFACTURER.
5. ALL STEELWORK FABRICATED, ERECTED & LEVELLED TO A TOLERANCE OF + 1,5mm
6. ALL PARTS TO BE CLEARLY STAMPED WITH ITEM MARK No. BEFORE GALVANISING.
7. HOLES FOR ISOLATOR SUPPORT STRUCTURE LEGS TO BE BACKFILLED WITH 8:1 SOIL/CEMENT MIXTURE, SLIGHTLY WATERED AND THOROUGHLY COMPACTED IN LAYERS NOT EXEEDING 300mm IN THICKNESS.
8. ISOLATOR SUPPORT STRUCTURE LEGS TO BE LEVELLED WITH DIA 500 x 100 THICK REINFORCED CONCRETE POLE BASIS TO DWG. 7.18/18481 REV 7. PROVIDED IN BOTTOM OF POLE HOLES.
9. ISOLATOR OPERATING HANDLE SUPPORT BRACKET ITEM MK4 TO BE DRILLED TO SUIT ISOLATOR TYPE TO BE INSTALLED.
10. STRUCTURE SUPPORT MK3 TO BE TREATED WITH A DOUBLE COAT BITUMIN CORROSION PROTECTION AT INDICATED POSITION.
11. DIA. 750 x 500mm DEEP, 15 MPa CONCRETE COLLARS TO BE CAST ARROUND STRUCTURE LEGS AS INDICATED. CONCRETE COLLAR TOPS TO BE BEVELLED MIN. 25mm.
12. 3 x 4mm CLASS 'A' HEAVY GALVANISED STRAIN WIRES TO BE STRAINED THROUGH ANTI-CLIMBING SUPPORT ANGLE SLOTS ALL ROUND.
13. DIA. 500mm COILS FLAT WRAP RAZOR WIRE TO BE TIED TO ANTI-CLIMBING STRAIN WIRE AT 400mm INTERVALS WITH 2mm CLASS 'A' GALVANISED WIRE TIES, WITH MIN. 3 TWITS AT EACH TIE. FLAT WRAP RAZOR COILS TO A MIN. 30% OVERLAP AT EACH COIL.

BOLT SCHEDULE

MK.	DIA.	LENGTH	No.OFF	WASHERS-No.OFF	MASS (kg)
A	M16	40	4	BEVELLED 16 OFF	0.667
B	M16	40	8	FLAT 8 OFF	1.078
C	M12	40	2	FLAT 2 OFF	1.078
D	M12	25	16	FLAT 16 OFF	0.73

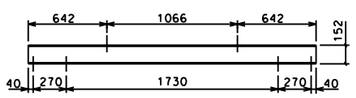
MASS (kg)

STRUCTURE	BOLTS	TOTAL
1336.99	8.31	1345.30
ZINC + 3.5%		46.08
TOTAL		1391.38



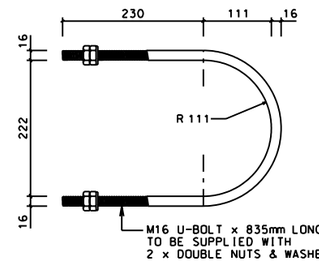
TOP ELEVATION
SCALE 1:25

BOTTOM ELEVATION
SCALE 1:25



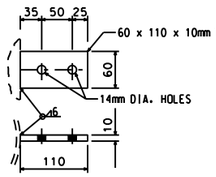
SIDE ELEVATION
SCALE 1:25

(MK2) - 2 OFF REQUIRED

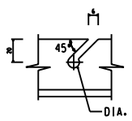


U-BOLT
SCALE 1:2.5

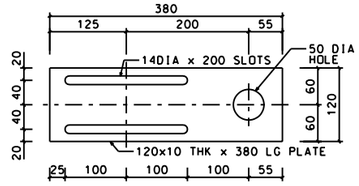
(MK5) - 4 OFF REQUIRED
MASS PER ITEM = 1,46kg



DETAIL 'X'
16 REQUIRED
SCALE 1:5

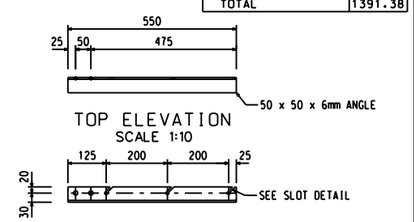


STRAIN WIRE SLOT DETAIL
N.T.S.



OPERATING HANDLE GUIDE
SCALE 1:2.5

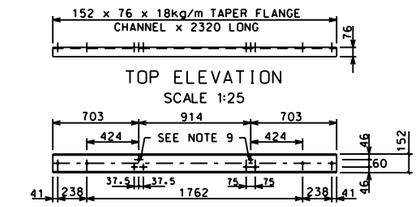
(MK7) - 1 OFF REQUIRED



TOP ELEVATION
SCALE 1:10

SIDE ELEVATION
SCALE 1:10

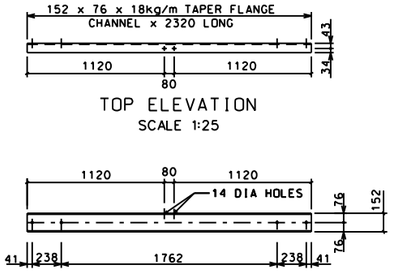
(MK8) - 8 OFF REQUIRED
MASS PER ITEM = 2.46kg



TOP ELEVATION
SCALE 1:25

SIDE ELEVATION
SCALE 1:25

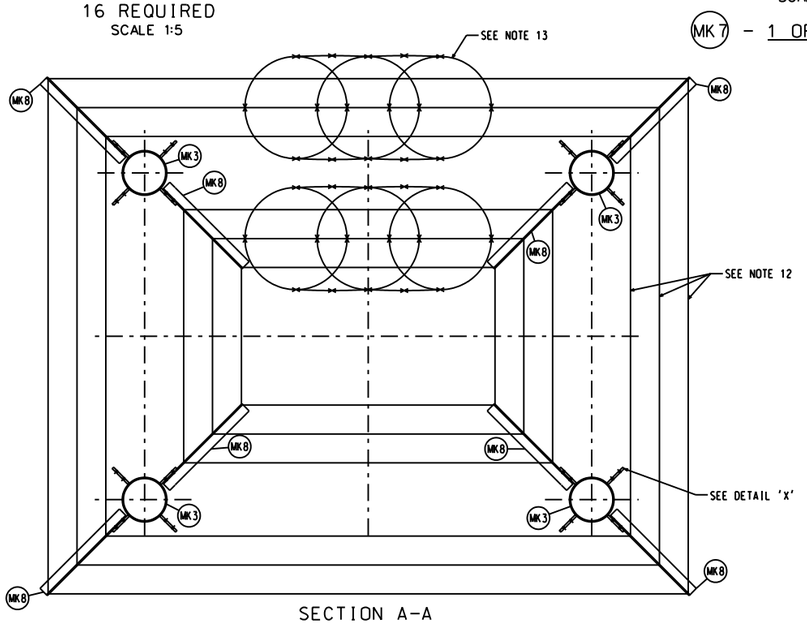
(MK4) - 1 OFF REQUIRED



TOP ELEVATION
SCALE 1:25

SIDE ELEVATION
SCALE 1:25

(MK6) - 1 OFF REQUIRED



SECTION A-A
SCALE 1:15

PRELIMINARY - AWAITING REVISION 5 APPROVAL

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
5	ANTI-CLIMBING SUPPORT & DETAIL ADDED	FDS	P v/d H		02/07/07	
4	ITEMS MK 4, MK 5, MK 6 & MK 7 DETAILS CORRECTED	FDS	P v/d H	R.L.	17/01/06	
3	EARTH LUGS, BITUMEN LAYER & CONCRETE CAPS ADDED	FDS	P v/d H	R.L.		
2	ITEMS 6 & 7 ADDED	IAN	P v/d H	R.L.	/ /	
1	DRAWING RENAMED AND CORRECTED	IAN	P v/d H	P.P.	/ /	

Eskom Distribution

NORTH WESTERN REGION

132kV SUB-TRANSMISSION LINES
5,5m LINE ISOLATOR SUPPORT MOUNTED ON POLES

AUTH:	P.PIETERSE
DATE:	28/01/2002
CHKD:	P. VD HEEVER
DATE:	28/01/2002
DRAWN:	PROPPIE
DATE:	AUG 2001

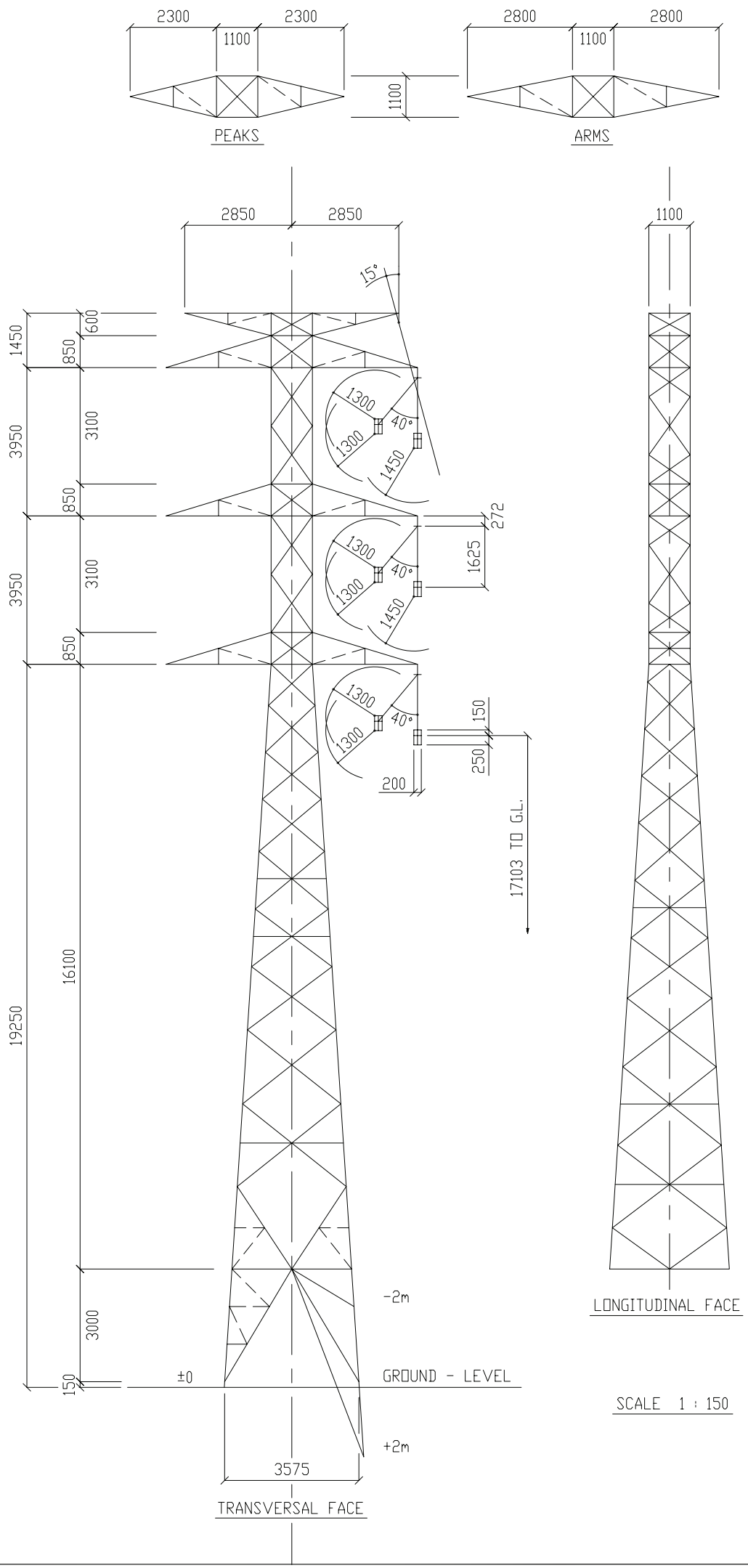
SCALE 1 : 50

THIS DRAWING IS THE PROPERTY OF ESKOM

D-FS-11757

SET	SHEET	REVISION
	Ø1	5

AIL



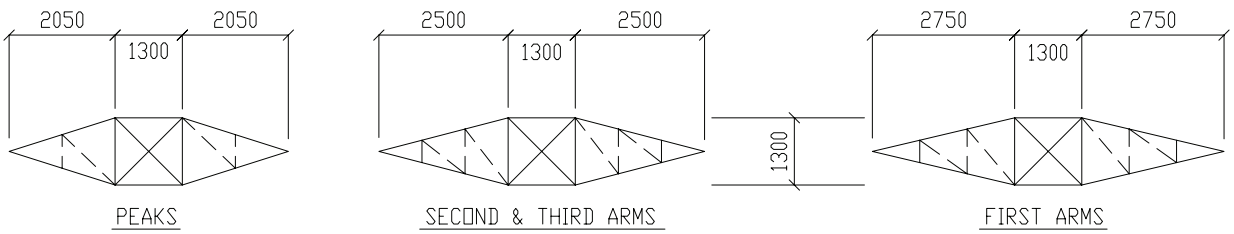
DATE:

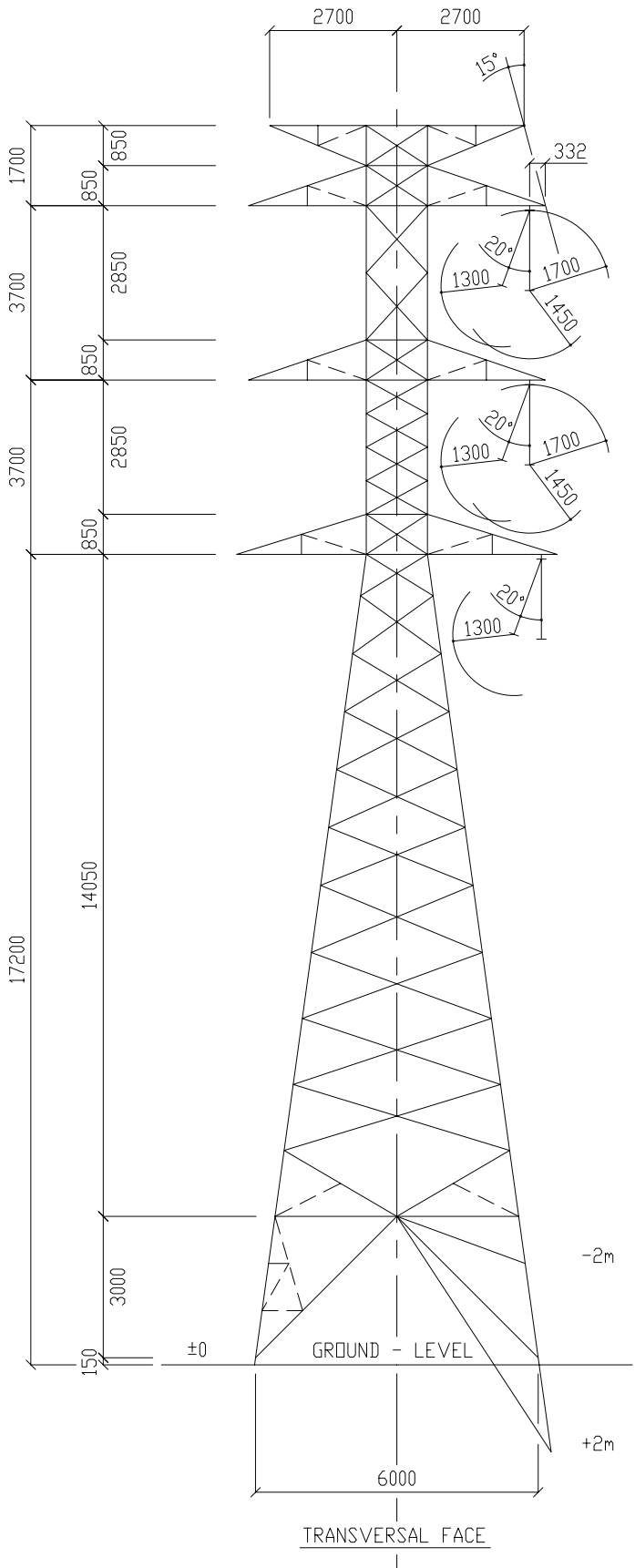
DWG. No 2036

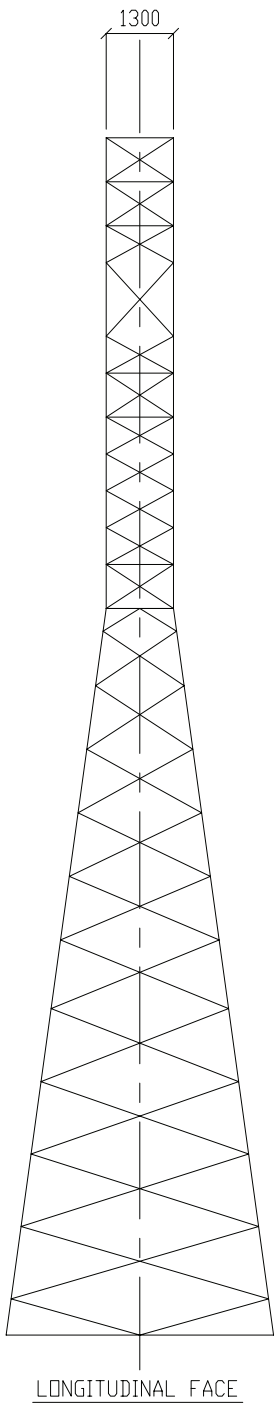
PROJECT: 132 KV. TRANSMISSION LINE

TITLE: SUSPENSION TOWER TYPE "245A"

Babcock Ntuthuko Powerlines







SCALE 1 : 150

DATE:

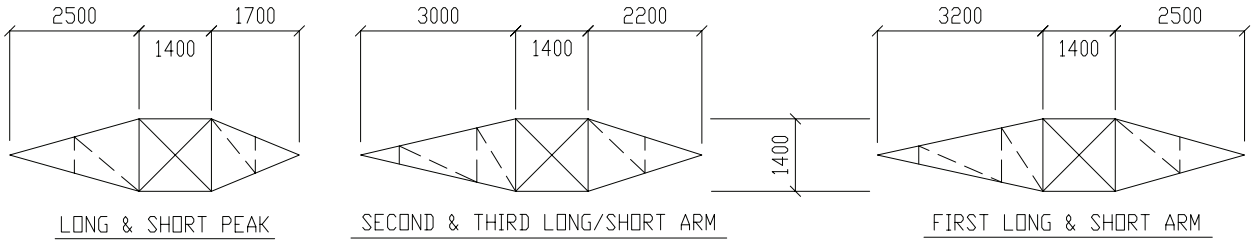
DWG. No 2037

PROJECT: 132 KV. TRANSMISSION LINE

TITLE: 0°–15° ANGLE STRAIN TOWER TYPE "245B"

Babcock Ntuthuko Powerlines

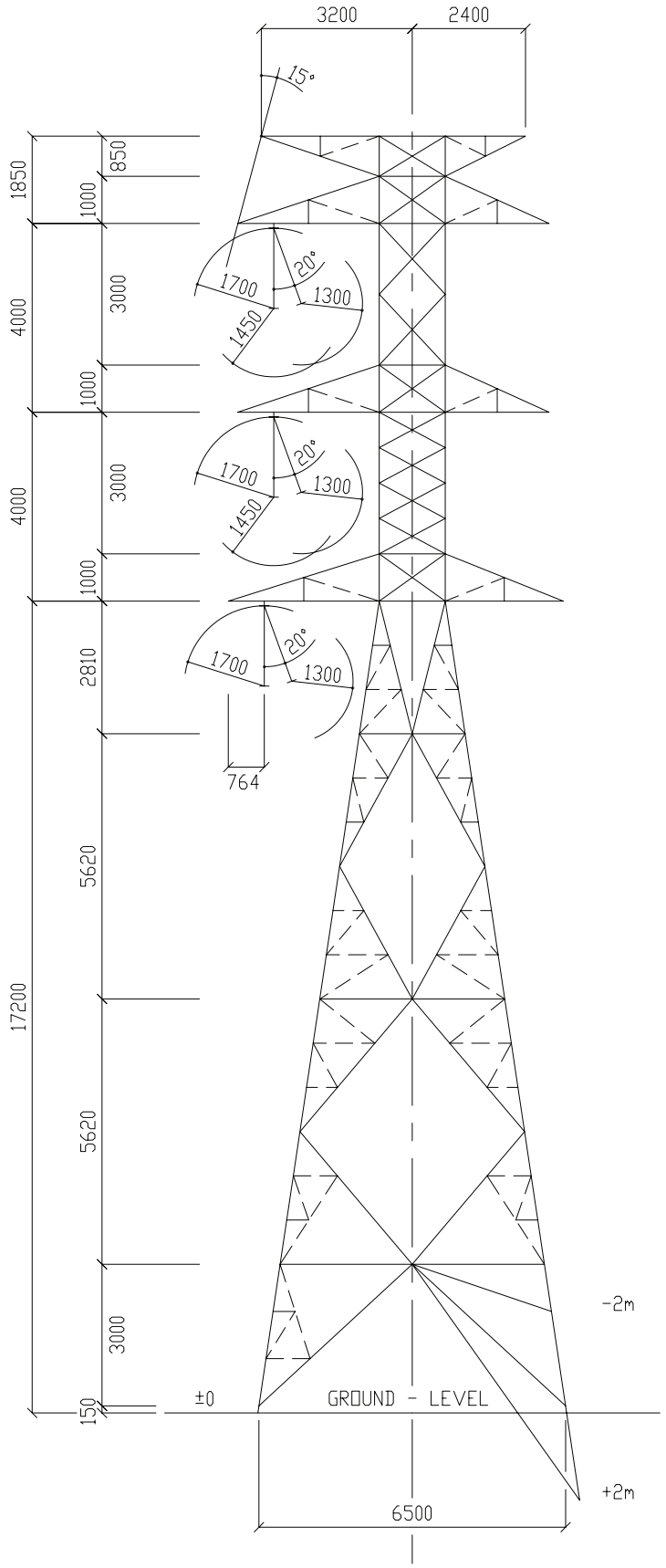
babcock



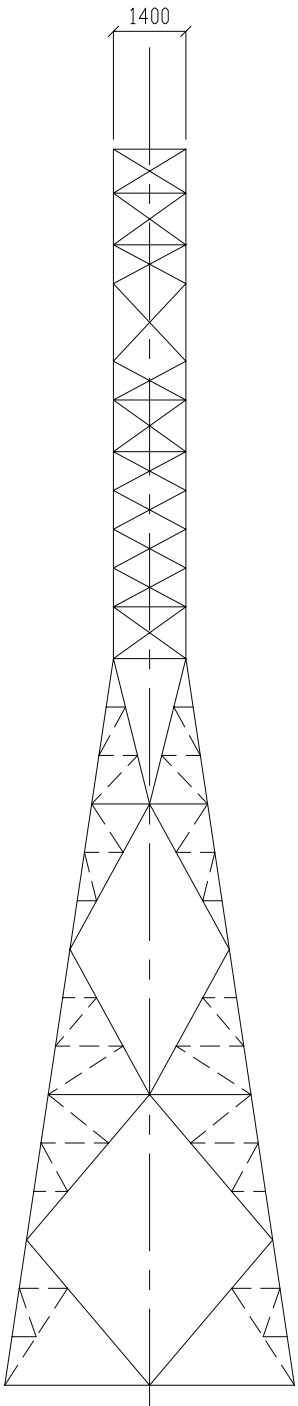
LONG & SHORT PEAK

SECOND & THIRD LONG/SHORT ARM

FIRST LONG & SHORT ARM



TRANSVERSAL FACE



LONGITUDINAL FACE

SCALE 1 : 150

DATE:

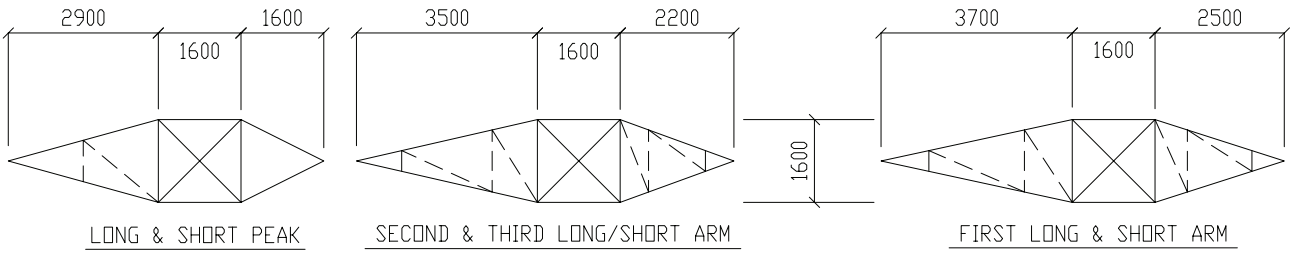
DWG. No 2038

PROJECT: 132 KV. TRANSMISSION LINE

TITLE: 15°–35° ANGLE STRAIN TOWER TYPE "245C"

Babcock Ntuthuko Powerlines

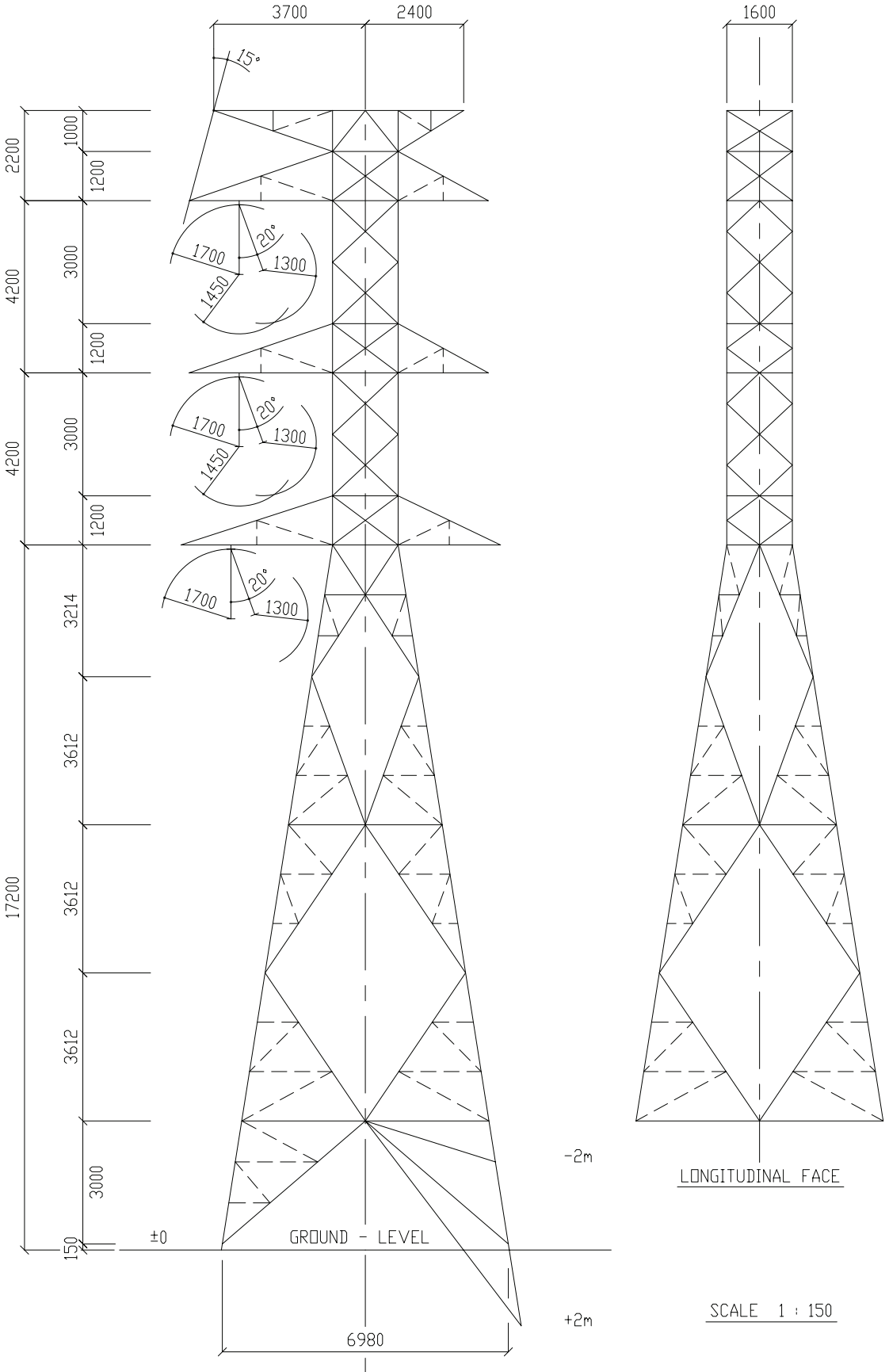
babcock



LONG & SHORT PEAK

SECOND & THIRD LONG/SHORT ARM

FIRST LONG & SHORT ARM



TRANSVERSAL FACE

LONGITUDINAL FACE

SCALE 1 : 150

DATE:

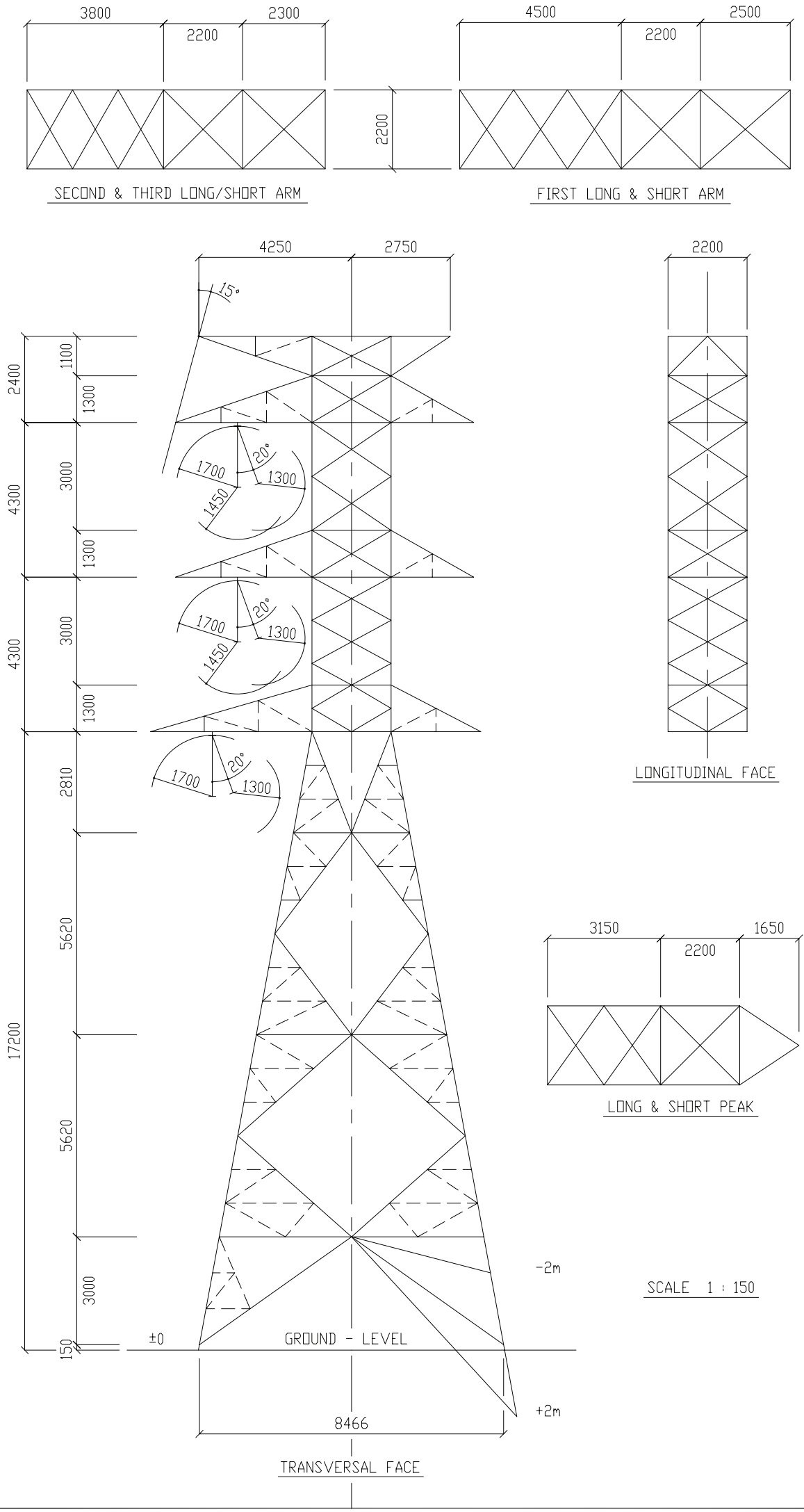
DWG. No 2039

PROJECT: 132 KV. TRANSMISSION LINE

TITLE: 35°-60° A/S & 0° TERM. TOWER TYPE "245D"

Babcock Ntuthuko Powerlines

babcock



DATE:

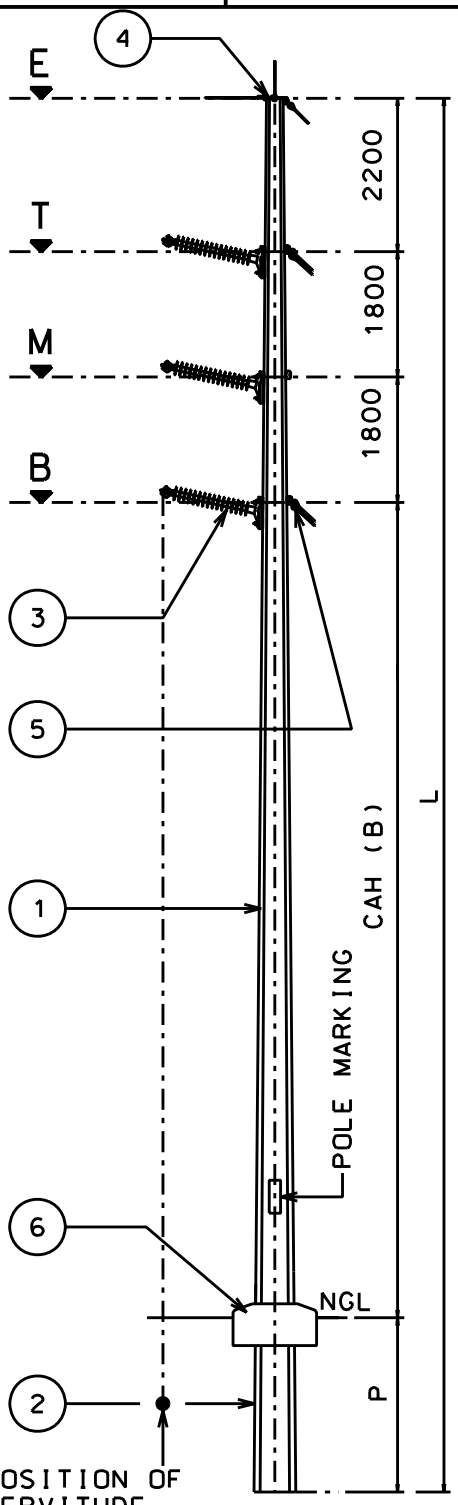
DWG. No 2040

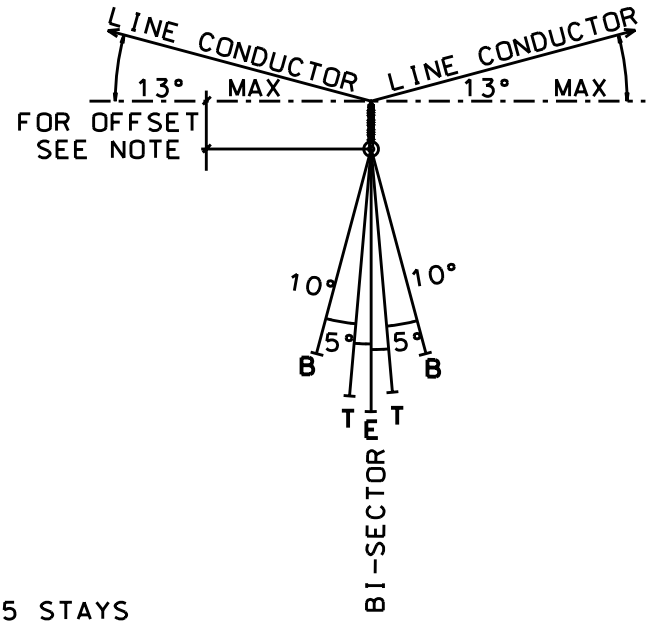
PROJECT: 132 KV. TRANSMISSION LINE

TITLE: 60°-90° A/S & 0°-35° TERM. TOWER TYPE "245E"

Babcock Ntuthuko Powerlines

babcock





5 STAYS
E) EARTH WIRE : 1 OFF
T) TOP PHASE : 2 OFF
B) BOTTOM PHASE: 2 OFF

TOP VIEW

STAY ARRANGEMENT FOR STAYED STRUCTURES

TIP LOAD = 23 kN

DESIGN REQUIREMENTS						
POLE LENGTH L	TIP LOAD (kN)	PLANTING DEPTH P	C A H (m AGL)			
			E	T	M	B
20	23	2.6	17.4	15.2	13.4	11.6
21	23	2.7	18.3	16.1	14.3	12.5
22	23	2.8	19.2	17.0	15.2	13.4
23	23	2.9	20.1	17.9	16.1	14.3
24	23	3.0	21.0	18.8	17.0	15.2

NOTE: POLE TO BE OFFSET 1500mm OUT OF LINE TOWARDS OUTSIDE OF BISECTOR AS SHOWN

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REV'D. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED INTERMEDIATE ANGLE STRUCTURE
GENERAL ARRANGEMENT (0-26°)

D-DT 7613	SET	SHEET	REVISION
	2	1	2

A4L

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ITEM NØ.	DESCRIPTION	D-DT NØ.
	STRUCTURE	
	TYPE 259B	D-DT 7613
	MANUFACTURER: STRUCTATECH	
	TYPE 261B	D-DT 7613
	MANUFACTURER: CIS	
1	POLE LENGTH (BODY)	
	20m STEEL	D-DT 7102
	21m STEEL	D-DT 7102
	22m STEEL	D-DT 7102
	23m STEEL	D-DT 7102
	24m STEEL	D-DT 7102
2	FOUNDATION	
	TYPE 1 (300kPa)	D-DT 7852 SHT 2
	TYPE 2 (150kPa)	D-DT 7852 SHT 3
	TYPE 3 (100kPa)	D-DT 7852 SHT 4
	TYPE 4 (50kPa)	D-DT 7852 SHT 5
	ROCK & SOFT ROCK	D-DT 7852 SHT 1
3	INSULATOR ASSEMBLY	
	INTERMEDIATE ASSEMBLY	D-DT 7321
4	EARTH WIRE ASSEMBLIES	
	NON INSULATED	D-DT 7323
	INSULATED	D-DT 7324
5	CONCRETE CAP AND	D-DT 7857
	EARTHING DETAILS	

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REV'D. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES STAYED INTERMEDIATE ANGLE STRUCTURE REFERENCE TABLE (0-26°)

	SET	SHEET	REVISION
D-DT 7613	2	2	2

A4L

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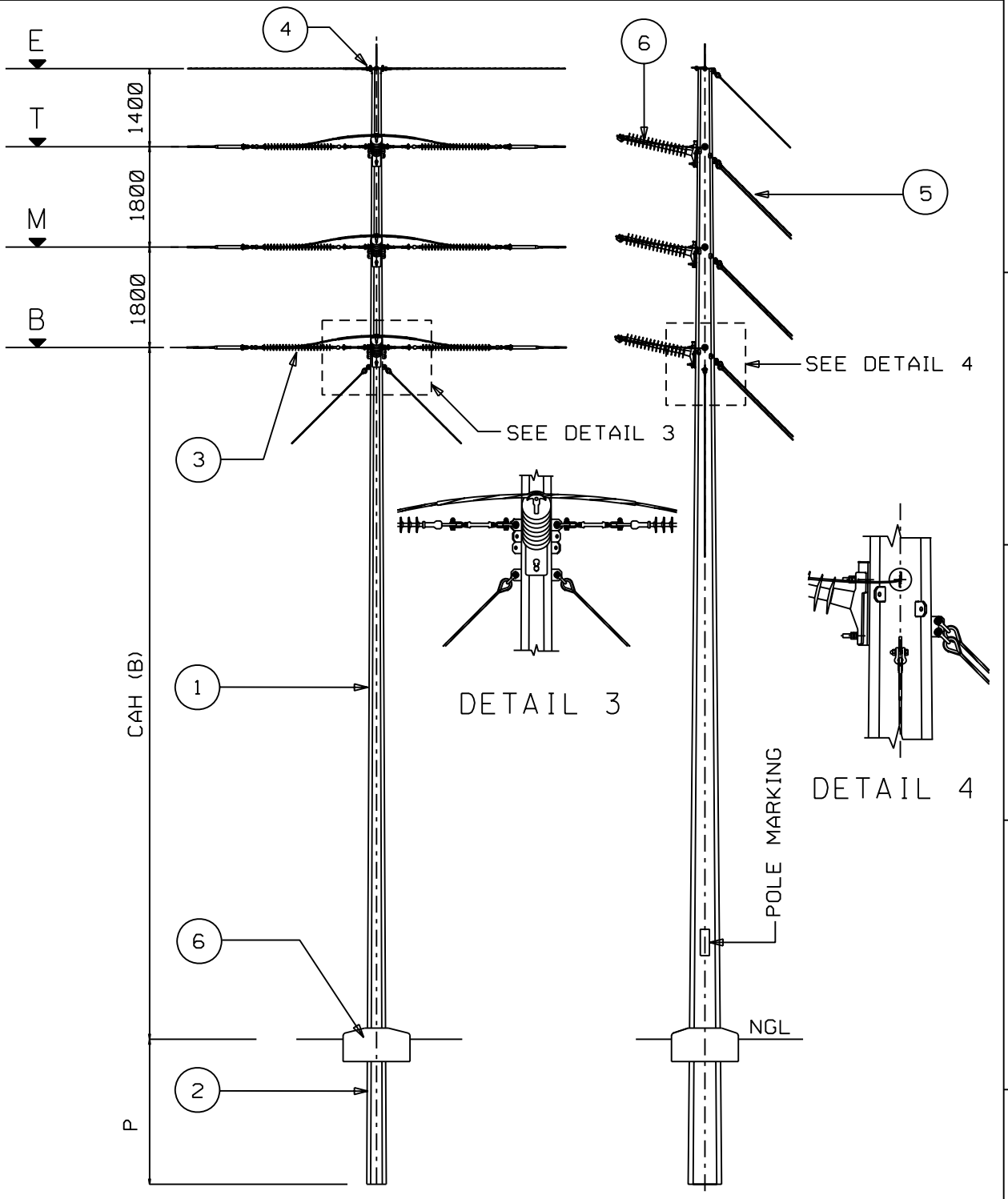

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
GENERAL ARRANGEMENT (0-90°)

	SET	SHEET	REVISION
D-DT 7615	3	1	2

A4L

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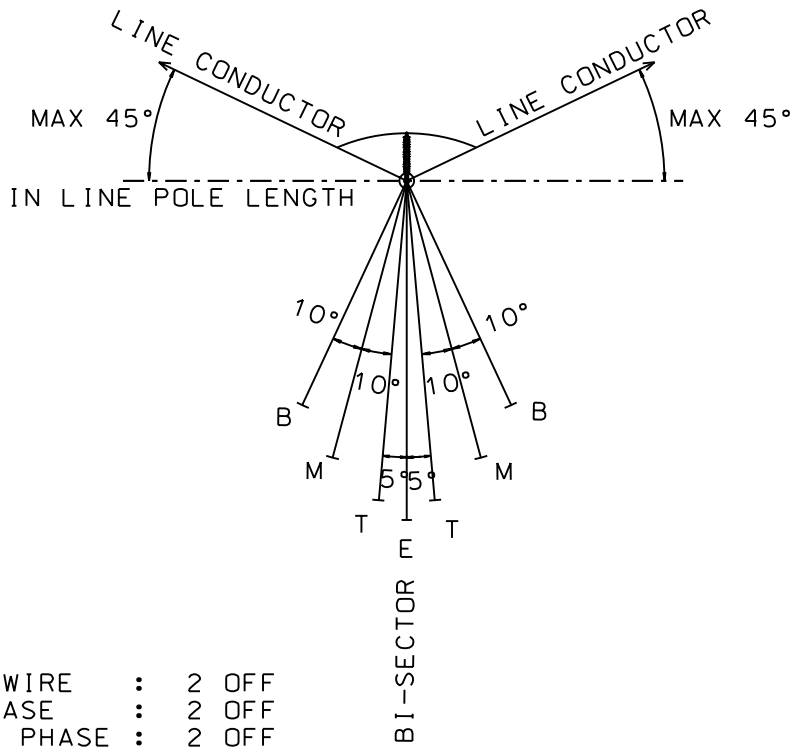

8 STAYS
E) EARTH WIRE : 2 OFF
T) TOP PHASE : 2 OFF
M) MIDDLE PHASE : 2 OFF
B) BOTTOM PHASE : 2 OFF

TOP VIEW

STAY ARRANGEMENT FOR STAYED STRUCTURES

SCHEDULE FOR CONDUCTOR ATTACHMENT HEIGHTS

DESIGN REQUIREMENTS			C A H (m AGL)			
POLE LENGTH L	TIP LOAD (kN)	PLANTING DEPTH P	E	T	M	B
18	23	2,0	16,0	14,6	12,8	11,0
19	23	2,0	17,0	15,6	13,8	12,0
20	23	2,0	18,0	16,6	14,8	13,0
21	23	2,0	19,0	17,6	15,8	14,0
22	23	2,0	20,0	18,6	16,8	15,0
23	23	2,0	21,0	19,6	17,8	16,0
24	23	2,0	22,0	20,6	18,8	17,0

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
DESIGN CRITERIA & STAYS (Ø-90°)

	SET	SHEET	REVISION
D-DT 7615	3	2	2

A4L

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ITEM NØ.	DESCRIPTION	D-DT NØ.
	STRUCTURE	
	TYPE 259D	D-DT 7615
	MANUFACTURER: STRUCTATECH	
	TYPE 261D	D-DT 7615
	MANUFACTURER: CIS	
1	POLE LENGTH (BODY)	
	18m STEEL	D-DT 7104
	19m STEEL	D-DT 7104
	20m STEEL	D-DT 7104
	21m STEEL	D-DT 7104
	22m STEEL	D-DT 7104
	23m STEEL	D-DT 7104
	24m STEEL	D-DT 7104
2	FOUNDATION	
	TYPE 1 (300kPa)	D-DT 7852 SHT 2
	TYPE 2 (150kPa)	D-DT 7852 SHT 3
	TYPE 3 (100kPa)	D-DT 7852 SHT 4
	TYPE 4 (50kPa)	D-DT 7852 SHT 5
	ROCK & SOFT ROCK	D-DT 7852 SHT 1
3	INSULATOR ASSEMBLY	
	STRAIN ASSEMBLY	D-DT 7311
4	EARTH WIRE ASSEMBLIES	
	STRAIN NON INSULATED	D-DT 7323
	STRAIN INSULATED	D-DT 7324
5	STAY ASSEMBLY/LOCATION	D-DT 7325/7346
6	JUMPER ASSEMBLY	D-DT 7321
7	CONCRETE CAP AND EARTHING	D-DT 7857

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
REFERENCE TABLE (Ø-90°)

	SET	SHEET	REVISION
D-DT 7615	3	3	2

A4L

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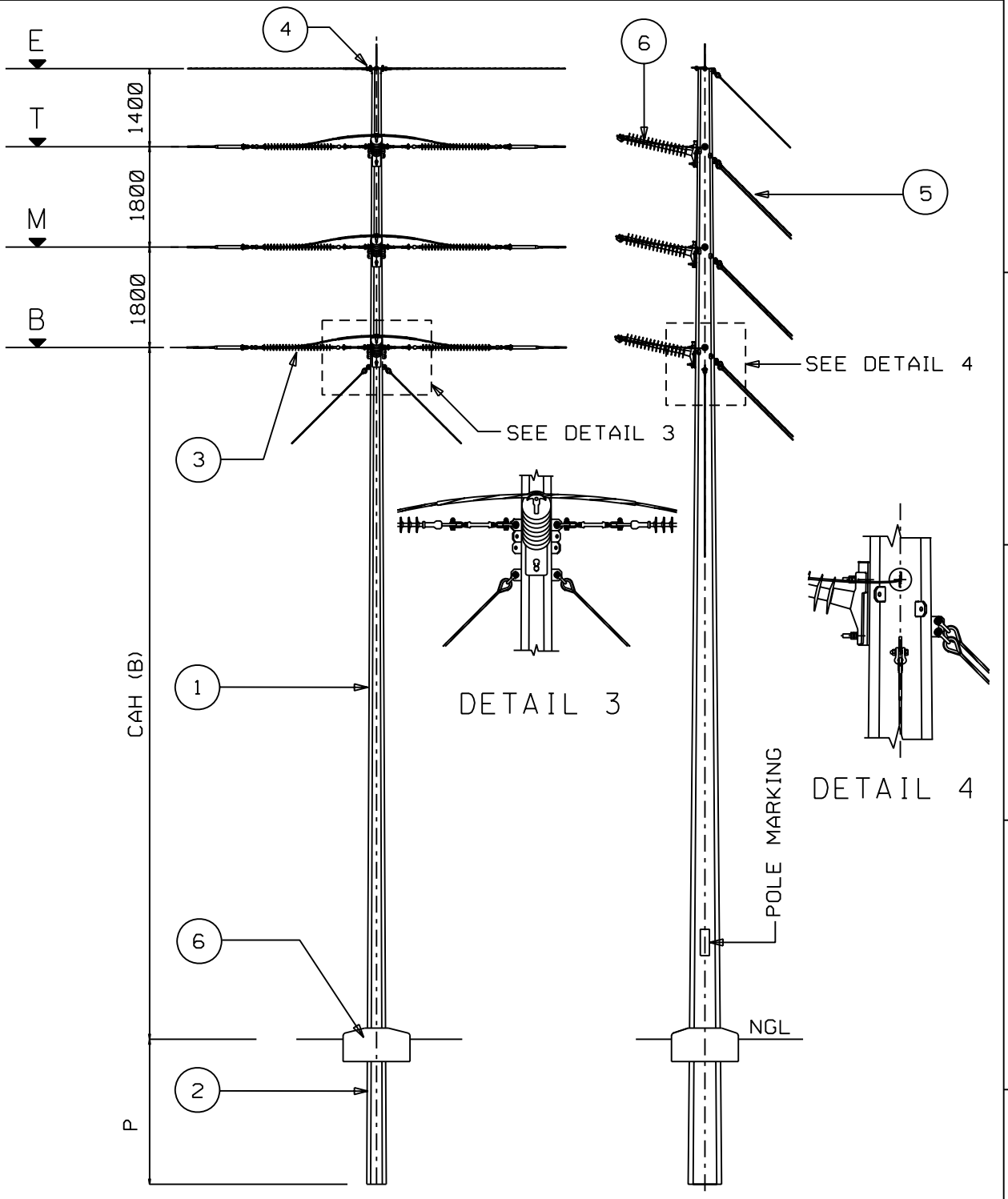

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
GENERAL ARRANGEMENT (0-90°)

	SET	SHEET	REVISION
D-DT 7615	3	1	2

A4L

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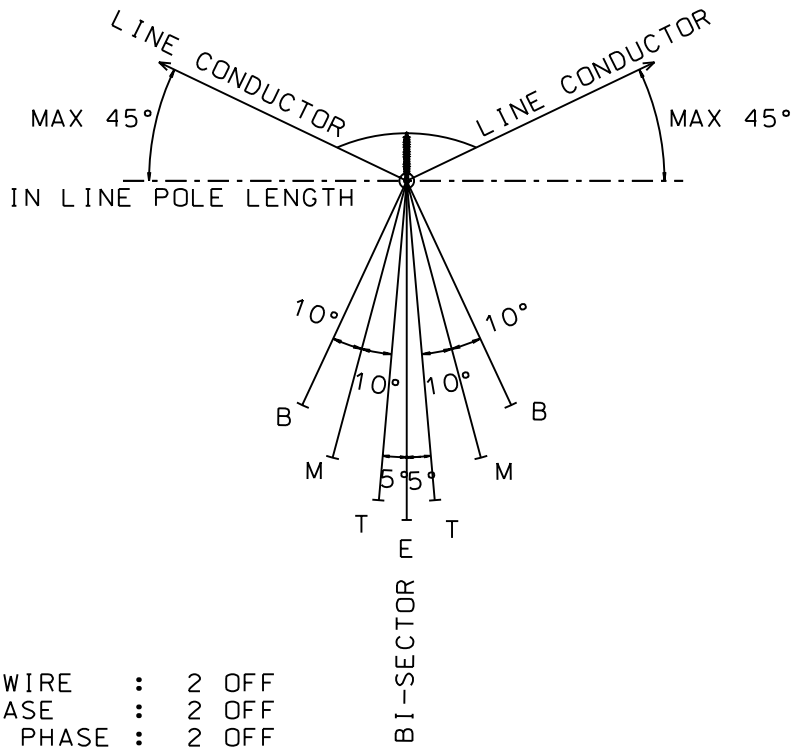

8 STAYS
E) EARTH WIRE : 2 OFF
T) TOP PHASE : 2 OFF
M) MIDDLE PHASE : 2 OFF
B) BOTTOM PHASE : 2 OFF

TOP VIEW

STAY ARRANGEMENT FOR STAYED STRUCTURES

SCHEDULE FOR CONDUCTOR ATTACHMENT HEIGHTS

DESIGN REQUIREMENTS			C A H (m AGL)			
POLE LENGTH L	TIP LOAD (kN)	PLANTING DEPTH P	E	T	M	B
18	23	2,0	16,0	14,6	12,8	11,0
19	23	2,0	17,0	15,6	13,8	12,0
20	23	2,0	18,0	16,6	14,8	13,0
21	23	2,0	19,0	17,6	15,8	14,0
22	23	2,0	20,0	18,6	16,8	15,0
23	23	2,0	21,0	19,6	17,8	16,0
24	23	2,0	22,0	20,6	18,8	17,0

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
DESIGN CRITERIA & STAYS (Ø-90°)

	SET	SHEET	REVISION
D-DT 7615	3	2	2

A4L

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ITEM NØ.	DESCRIPTION	D-DT NØ.
	STRUCTURE	
	TYPE 259D	D-DT 7615
	MANUFACTURER: STRUCTATECH	
	TYPE 261D	D-DT 7615
	MANUFACTURER: CIS	
1	POLE LENGTH (BODY)	
	18m STEEL	D-DT 7104
	19m STEEL	D-DT 7104
	20m STEEL	D-DT 7104
	21m STEEL	D-DT 7104
	22m STEEL	D-DT 7104
	23m STEEL	D-DT 7104
	24m STEEL	D-DT 7104
2	FOUNDATION	
	TYPE 1 (300kPa)	D-DT 7852 SHT 2
	TYPE 2 (150kPa)	D-DT 7852 SHT 3
	TYPE 3 (100kPa)	D-DT 7852 SHT 4
	TYPE 4 (50kPa)	D-DT 7852 SHT 5
	ROCK & SOFT ROCK	D-DT 7852 SHT 1
3	INSULATOR ASSEMBLY	
	STRAIN ASSEMBLY	D-DT 7311
4	EARTH WIRE ASSEMBLIES	
	STRAIN NON INSULATED	D-DT 7323
	STRAIN INSULATED	D-DT 7324
5	STAY ASSEMBLY/LOCATION	D-DT 7325/7346
6	JUMPER ASSEMBLY	D-DT 7321
7	CONCRETE CAP AND EARTHING	D-DT 7857

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
2	DRG SHT UPDATED. REFERENCES REVISED. GENERAL REVISION	SLR	RAB	AB	MARCH 2004	

Eskom Distribution

AUTH: A BEKKER
DATE: JAN 2004
CHKD: RAB
DATE: JAN 2004
DRAWN: LMP
DATE: NOV 1998

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
STAYED ANGLE STRAIN STRUCTURE
REFERENCE TABLE (Ø-90°)

	SET	SHEET	REVISION
D-DT 7615	3	3	2

A4L

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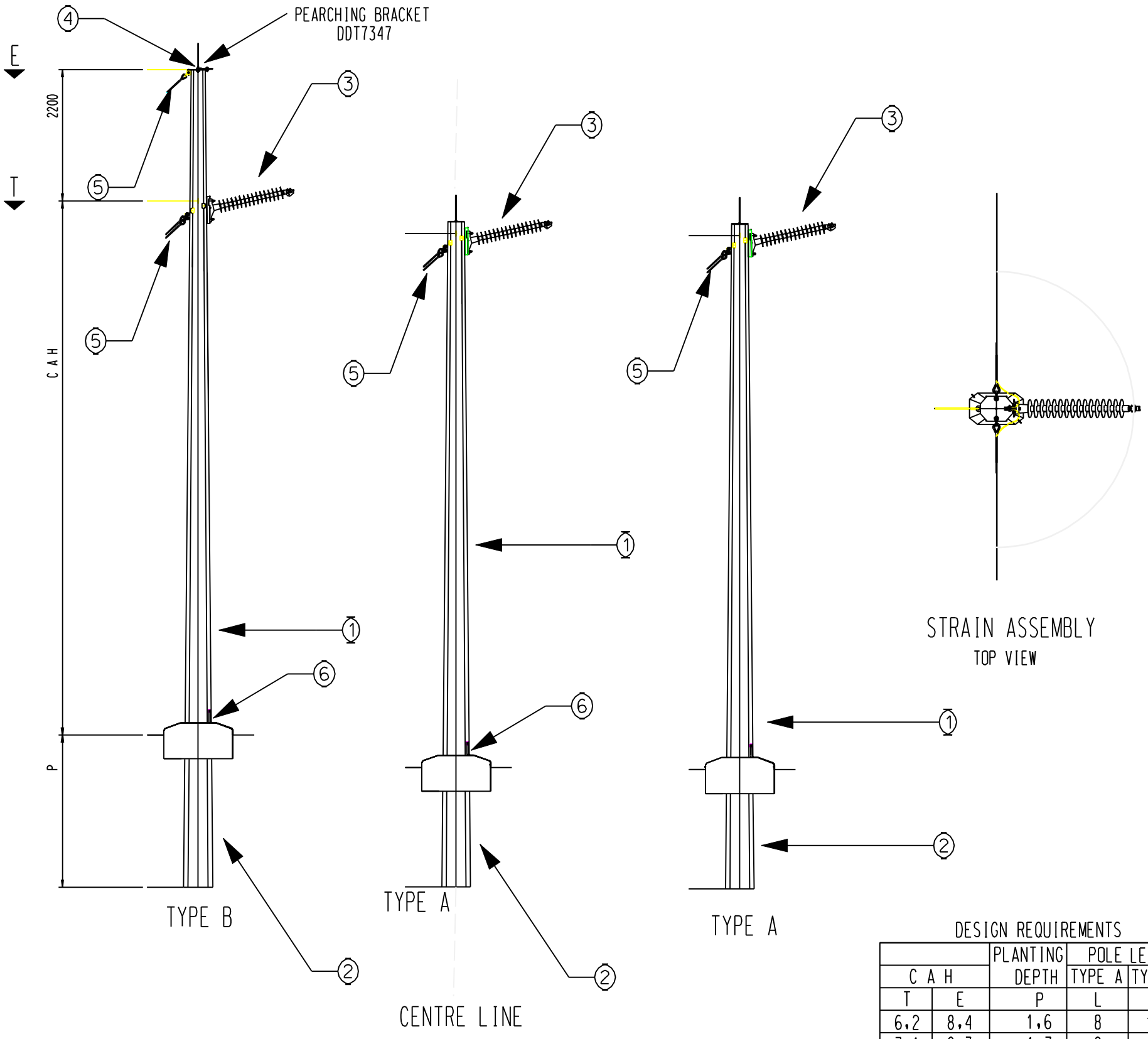


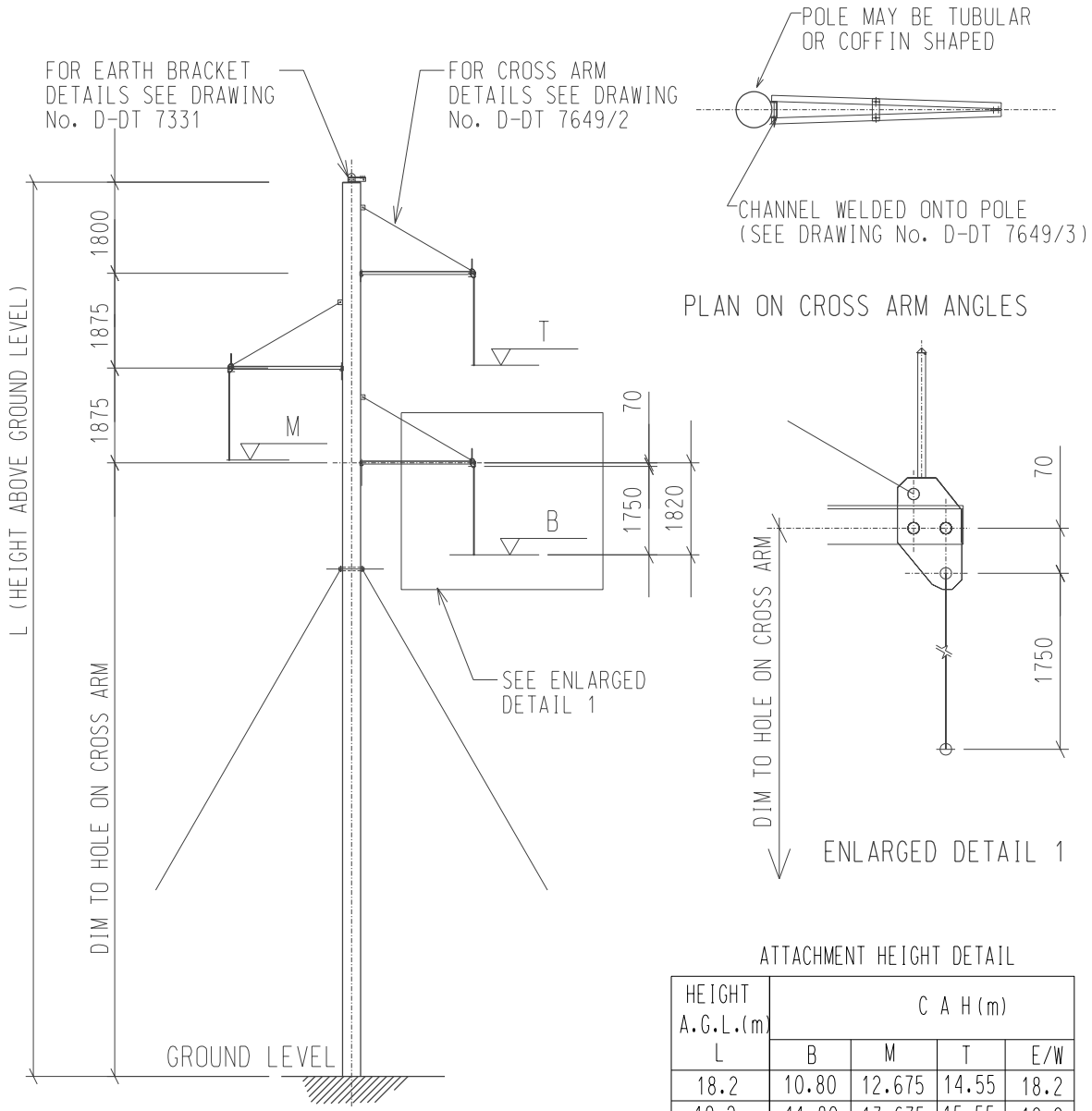
DESIGN REQUIREMENTS

C A H		PLANTING DEPTH	POLE LENGTH	
			TYPE A	TYPE B
T	E	P	L	L
6,2	8,4	1,6	8	10
7,1	9,3	1,7	9	11
8,0	10,2	1,8	10	12
8,9	11,1	1,9	11	13
9,8	12,0	2,0	12	14
10,7	12,9	2,1	13	15
11,6	13,8	2,2	14	16
12,5	14,7	2,3	15	17
13,4	15,6	2,4	16	18
14,3	16,5	2,5	17	19
15,2	17,4	2,6	18	20
16,1	18,3	2,7	19	21

NOTE:
1 THESE 3 POLES CAN BE USED AS AN UNSTAYED INTERMEDIATE STRUCTURE (0°) OR A STAYED INTERMEDIATE ANGLE STRUCTURE ($1\text{-}20^{\circ}$) OR A STAYED ANGLE STRAIN STRUCTURE ($0\text{-}90^{\circ}$).

REV	AUTH MAG	DATE DATUM	REVISION/REVISIES INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT- REFERENCE DRAWINGS

DRG.TEK REGISTR			ESKOM	DISTRIBUTION TECHNOLOGY 88/132kV STEEL POLE 3-POLE STRAIN STRUCTURE ($0\text{-}90^{\circ}$) GENERAL ARRANGEMENT	
CHKD NAGES					
DRAWN GETEKEN	LMP	22.11.1998	APPROVED	CAD.REF:	REV
SCALE SKAAL	NTS			FILE No.:	D-DT 7618 / 1



THIS DRAWING IS RELEVANT FOR
GUYED AND FREESTANDING STRUCTURES

ATTACHMENT HEIGHT DETAIL

HEIGHT A.G.L.(m) L	C A H (m)			
	B	M	T	E/W
18.2	10.80	12.675	14.55	18.2
19.2	11.80	13.675	15.55	19.2
20.1	12.70	14.575	16.45	20.1
21.2	13.80	15.675	17.55	21.2
22.7	15.30	17.175	19.05	22.7
24.2	16.80	18.675	20.55	24.2

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
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---	----------	-----	-----	-------	__/__/____	----------

Eskom Distribution

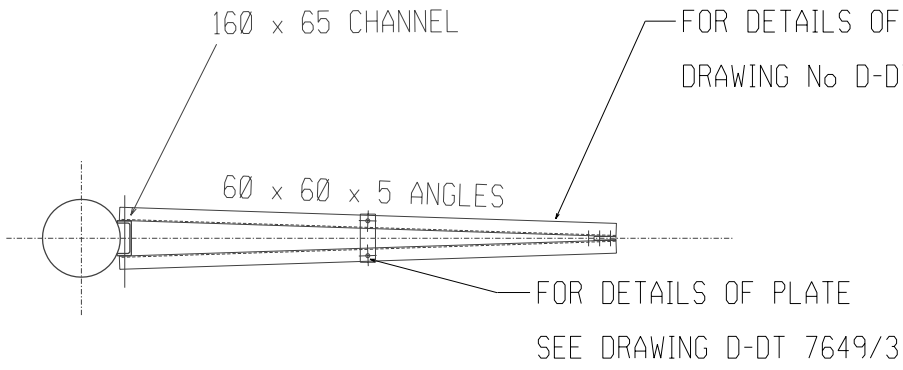
AUTH: A. BEKKER
DATE: JULY 2002
CHKD: B. BRANFIELD
DATE: JUNE 2002
DRAWN: S. LE ROUX
DATE: JUNE 2002

DISTRIBUTION TECHNOLOGY

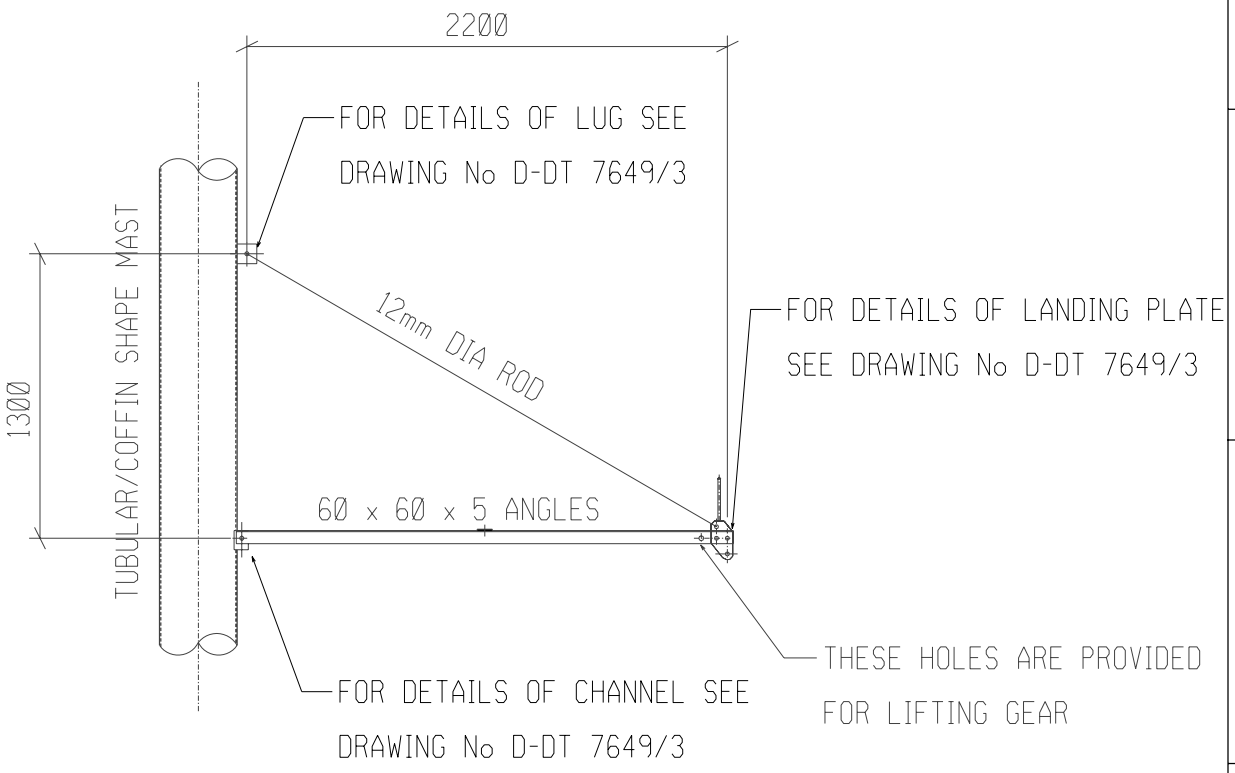
RETICULATION/SUB-TRANSMISSION LINES
SINGLE CIRCUIT GUYED INTERMEDIATE
STEEL POLE - GENERAL ARRANGEMENT

	SET	SHEET	REVISION
D-DT 7641	4	1	A

A4L



PLAN ON CROSS ARM ANGLES



ELEVATION ON CROSS ARM

NOTE:
ALL BOLTS USED TO BE
M16 GRADE 8.8 BOLTS

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
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Eskom Distribution

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
SINGLE CIRCUIT GUYED INTERMEDIATE
STEEL POLE - LAYOUT OF CROSS ARM

AUTH:	A. BEKKER
DATE:	JULY 2002
CHKD:	B. BRANFIELD
DATE:	JUNE 2002
DRAWN:	S. LE ROUX
DATE:	JUNE 2002

	SET	SHEET	REVISION
D-DT 7641	4	2	A

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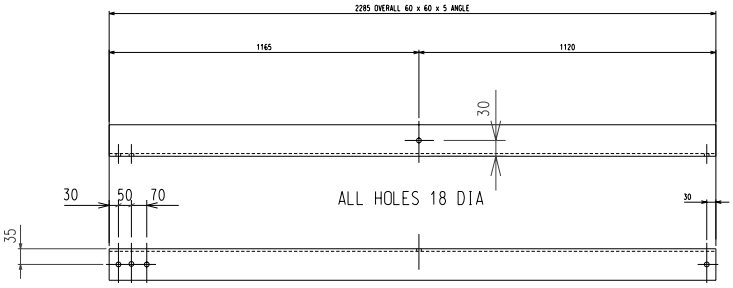
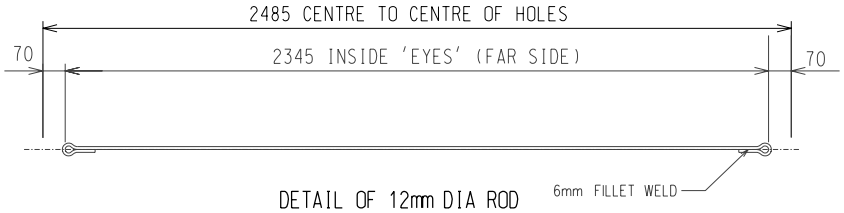
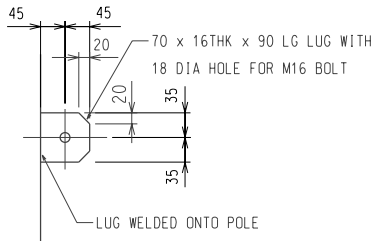


ONE ANGLE REQUIRED AS DRAWN
ONE ANGLE REQUIRED TO OPP HAND

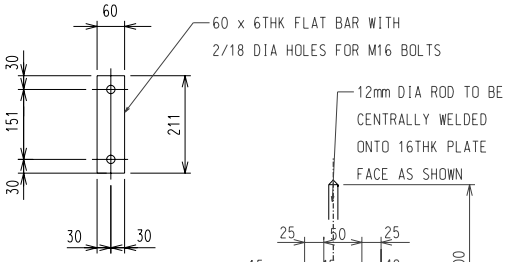
NOTE:
ALL BOLTS USED
TO BE M16 GRADE
8.8 BOLTS



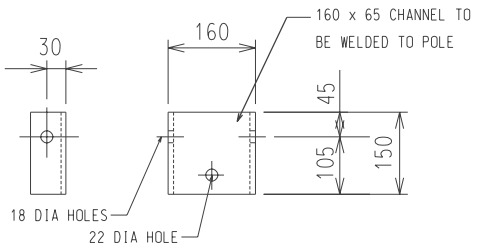
DETAIL OF 12mm DIA ROD



DETAIL OF LUG 'L1'



DETAIL OF PLATE 'P1'



DETAIL OF CHANNEL CONNECTION

DETAIL OF LANDING PLATE

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
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Eskom Distribution

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
SINGLE CIRCUIT GUYED INTERMEDIATE
STEEL POLE - X-ARM FABRICATION DRAWING

AUTH:	A. BEKKER
DATE:	JULY 2002
CHKD:	B. BRANFIELD
DATE:	JUNE 2002
DRAWN:	S. LE ROUX
DATE:	JUNE 2002

	SET	SHEET	REVISION
D-DT 7641	4	3	A

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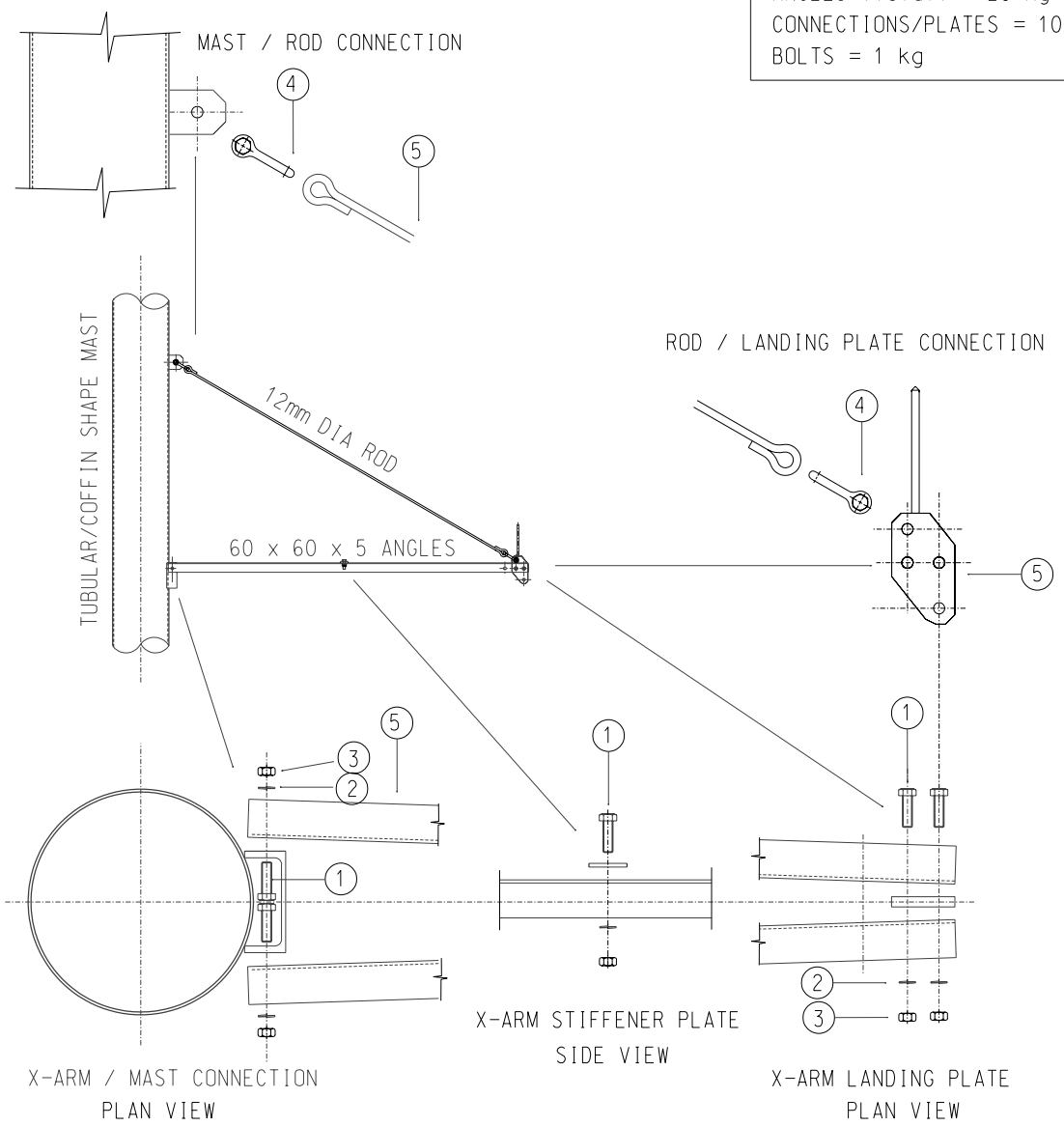
MASS OF CROSS ARM:
ANGLES (Total) = 20 kg
CONNECTIONS/PLATES = 10 kg
BOLTS = 1 kg



REF	DESCRIPTION	DRAWING NO.
1	SET SCREW, M16 x 50 LG GRADE 8.8	
2	WASHER, SPRING, M16	
3	NUT, M16	
4	SHACKLE, D 120KN	D-DT 7017
5	SUSP. ARM ASSEMB, 132KV	

REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE	PROJECT NO.
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Eskom Distribution

AUTH: A. BEKKER
DATE: JULY 2002
CHKD: B. BRANFIELD
DATE: JUNE 2002
DRAWN: S. LE ROUX
DATE: JUNE 2002

DISTRIBUTION TECHNOLOGY

RETICULATION/SUB-TRANSMISSION LINES
SINGLE CIRCUIT GUYED INTERMEDIATE
STEEL POLE - X-ARM FABRICATION DRAWING

	SET	SHEET	REVISION
D-DT 7641	4	4	A

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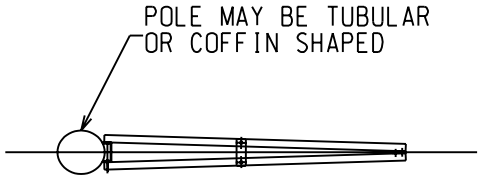
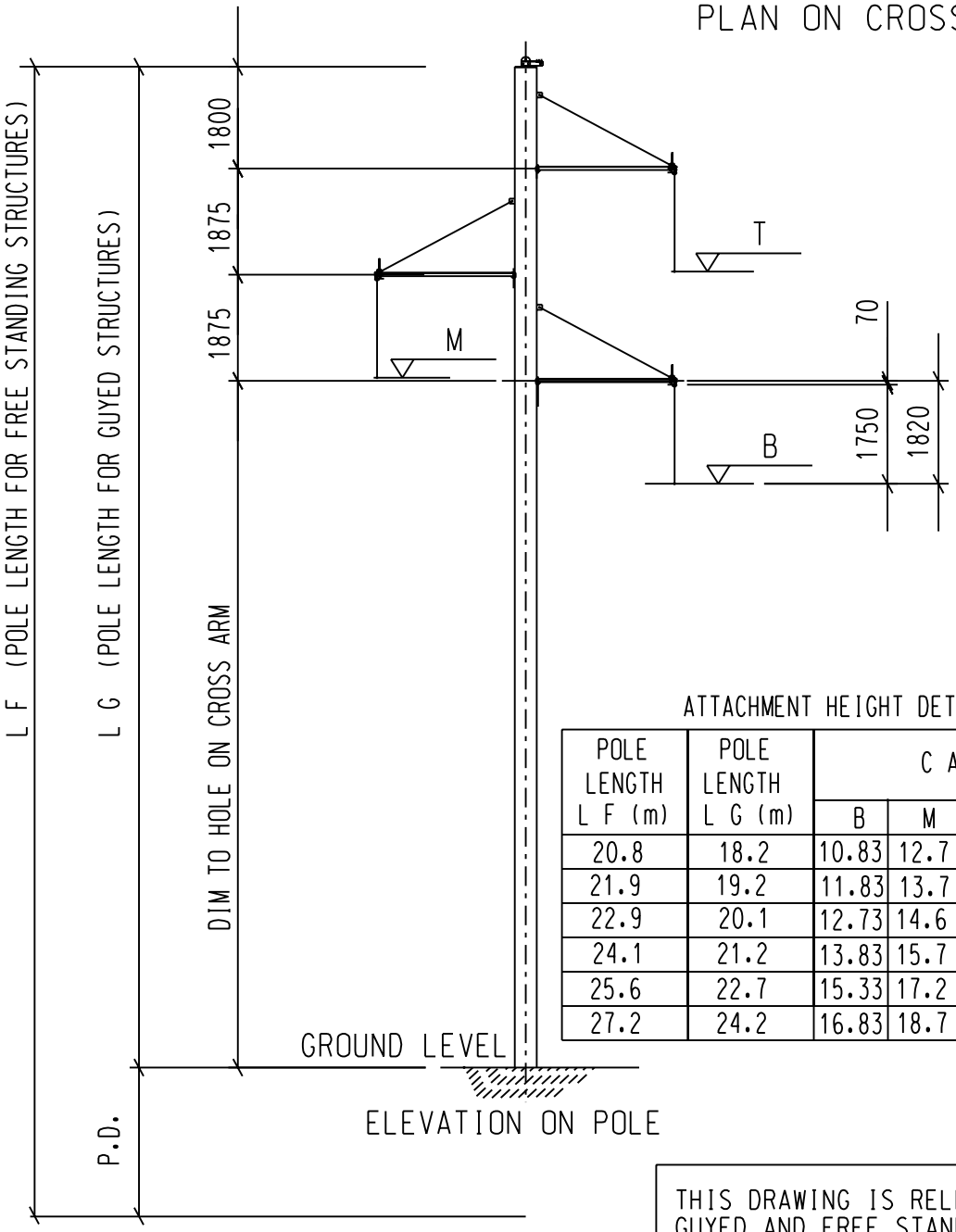


PLAN ON CROSS ARM ANGLES



ELEVATION ON POLE

ATTACHMENT HEIGHT DETAIL

POLE LENGTH L F (m)	POLE LENGTH L G (m)	C A H (m)				P.D. (m)
		B	M	T	E/W	
20.8	18.2	10.83	12.7	14.58	18.2	2.6
21.9	19.2	11.83	13.7	15.58	19.2	2.7
22.9	20.1	12.73	14.6	16.48	20.1	2.8
24.1	21.2	13.83	15.7	17.58	21.2	2.9
25.6	22.7	15.33	17.2	19.08	22.7	2.9
27.2	24.2	16.83	18.7	20.58	24.2	3.0

THIS DRAWING IS RELEVANT FOR GUYED AND FREE STANDING STRUCTURES

REV	AUTH MAG	DATE DATUM	REVISION/REVISIES / INDEX REF/INDEKSVERW	BY DEUR	CHKD NAGES	D-DT- REFERENCE DRAWINGS
0	AB	15.03 2002	FIRST ISSUE/EERSTE UITREIKING	SLR	RAB	

DISTRIBUTION TECHNOLOGY

132KV SUSPENSION X-ARM GENERAL ARRANGEMENT FOR SINGLE STEEL POLE STRUCTURE

DRG.TEK REGISTR				
CHKD NAGES	RAB	16.03 2002		
DRAWN GETEKEN	SLR	15.03 2002	APPROVED AB	CAD.REF:
SCALE SKAAL	NTS		26/04/2002	FILE No.:

REV 0

Eskom Distribution **GUIDE**

Document Classification: **Controlled Disclosure**

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COMPILED BY	APPROVED BY	FUNCTIONAL RESP	AUTHORISED BY
MM LE ROUX Land & Rights	**DR B VAN GEEMS** Land Development Study Committee	**V SINGH** for TESCOD	**MN BAILEY** CMDT for MD (Dx)
DATE: 15.02.2011	DATE: 15.7.2011	DATE: 21/2/11	DATE: 3.3.2011

Content

Foreword

The Land and Rights Work Group was established under the Land Development Study Committee for the purpose of compiling Standards, Procedures, Guidelines and training material for related engineering and construction practices within Eskom Distribution.

Revision history

This revision cancels and replaces revision no 0 of document no. **SCSAGAAW2**

Date	Rev.	Clause	Remarks
March 2011	0	-	**Compiled By:** MM Le Roux
			Option document was amended. Reference numbers changed. Agreement between Eskom and Telkom was removed.
		-	Draft watermark added
May 2004	0		**Compiled By:** V Constable, J C Greyling Document approved
Aug 2002	A		**Compiled By:** V Constable, J C Greyling Document compiled and numbered in accordance with the Eskom Documentation System

Authorisation

This document has been seen and accepted by:	
Name	**Designation**
MN Bailey	Corporate Manager Divisional Technology
V Singh	For TESCOD
DR B van Geems	Land Development Study Committee

This guide shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest

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Introduction

The question of the width of Eskom's power line servitudes on privately owned land is very sensitive and has legal, health and safety as well as emotional connotations attached to it. This is even more so in areas with high land values or where buildings are in close proximity to the selected route (the latter being the 'critical areas'). The final decision taken on the width of the servitude will ultimately determine how effectively Eskom can exercise its rights over the property in its effort to supply affordable electrical power. This while taking all health and safety precautions into account, as well as maintaining good relations with property owners.

The Electrical Machinery Regulations, promulgated under Section 43 of the Occupational Health and Safety Act 85 of 1993, and SANS 10280 provide for **statutory clearances.**

The current regulation 15(1) published in Government Gazette No 11458 of 12 August 1988. "The electric conductors and other wires" as set out in aforementioned regulation are not stationary and hang in catenary curves which vary by a considerable amount depending on a number of factors.

Eskom separation and tree and building restriction distances as currently being interpreted, are constant along the longitudinal length of the power line. These constant distances must therefore take into account the worst case distance condition, under normal circumstances at the mid-span point.

In many of the older servitudes the building restriction refers to the outside conductors of the power line. In most cases the figure of 30 feet was used as the distance from the outside conductor. The majority of the above servitudes refer to 88kV and lower voltage power lines so the figure of 11 metres can be used to describe the building restriction from the centre line in these cases. The outside conductor was usually less than 1,86 metres (6,1 feet) from the centre phase in these types of construction [9,14m + 1,86m = 11,00m]. This archaic practice causes difficulty in interpretation when the line is re-built on a different structure type, but can not be ignored.

Keywords

A guideline for building line restrictions, servitude widths, line separations and clearances from Power lines.

1 Scope

This document is intended to be used as a guideline for the determination of separation distances between parallel power lines, the tree and building restriction distances of various voltage power lines, as well as the height clearance of various voltage power lines over man-made and natural objects. Also included is a section on Underground Cables dealing with different voltage requirements as well as cable bending radii.

It is important to note that this document is not a specification or a standard, but rather a guideline as mentioned above.

2 Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this guide. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this guide are encouraged to investigate the possibility of applying the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from the Information Centre and Technology Standardization Department at Megawatt Park.

Advertising on Roads and Ribbon Development Act 21 of 1940

Eskom Conversion Act 13 of 2001

Electricity Regulation Act, Act 4 of 2006

Explosives Act 26 of 1956

SA National Roads Agency Limited and National Roads Act 7 of 1998.

Occupational Health and Safety Act 85 of 1993

National Railway Safety Regulator Act 16 of 2002

Telecommunications Act 103 of 1996

DST_34-1202, Rev.2, *Distribution Standard Part 6: Sub-transmission Lines, Section 1: General.*

DST_34-1191, Rev.0, *Distribution Standard Part 4: Medium Voltage Reticulation, Section 0: General information and requirements for overhead lines up 33kV with conductors up to HARE/OAK.*

DST_34-1192, Rev.0, *Distribution Standard Part 4: Medium Voltage Reticulation, Section 1: Light conductors - Particular requirements for overhead lines up to 33 kV with conductors up to Hare conductor*

DST_34-827: Rev.0, *Procedure for the approval of work where Eskom's rights might be encroached upon and/or services/assets placed at risk.*

DGL_34-363, Rev.4, *Guide for the co-use of Eskom Servitudes*

DGL_34-601, Rev.0, *Powerline Route selection as part of sustainable development.*

SANS 10280-1:2008

3 Definitions and abbreviations

3.1 Definitions

In this guide, unless the context indicates otherwise:

Power line: means an overhead line of whatever voltage, erected for the conducting of electricity.

Cable: means an underground service of whatever voltage, laid for the purpose of conducting electricity.

Tree and building restriction: means the horizontal distance measured perpendicularly from the centre line (on either side) within which no trees and buildings may encroach. Note that: use of the centre line, which is a visible physical feature to define the width of the building and tree restrictions in servitude and wayleave agreements, has been made here. The types of supporting structures and method of constructing Eskom power lines render the physical definition of the centre line of a power line easily recognisable.

Separation distance: means the horizontal distance between centre lines measured perpendicularly between any two power lines running parallel to each other. Due to the fact that a number of variables (such as the worst case weather conditions which are likely to be encountered) have to be considered, guidelines for distances only can be laid down. The present ruling in Eskom is that when two lines of dissimilar voltages are running parallel, the separation distance is determined by the separation requirements of the higher voltage line.

Clearance: means the radial distance from any electrical power transmission conductor and other wires of power lines. The Occupational Health and Safety Act 85 of 1993 and its regulations lay down the minimum clearances of electric conductors and other wires of power lines away from buildings and other structures. Non-compliance with the Act is non-negotiable.

Right: means the right to traverse or occupy land and includes inter alia servitudes, surface right permits, wayleaves, exercised options, licences and permissions to occupy. These are sometimes described as Rights-of-Way.

Wayleave agreement: means an unregistered personal contract conferring electric power transmission rights to Eskom, which is generally regarded as being binding on successors in the title who have knowledge of the right. Eskom's minor power lines, which are rural and urban reticulation lines, are covered by wayleave agreements. These are not secured by registration in the Deeds Office. Eskom's security relies largely on the fact that power supplies are or can be made available from these lines. No compensation is paid for these rights because their presence is generally regarded as being an advantage to the property.

Servitude: means a parcel of electric power transmission rights granted to Eskom over the immovable property of another and registered or to be registered against the title deed of the land in question and usually involves the payment of compensation.

3.2 Abbreviations

Not applicable

4 Requirements

4.1 Underground Cables

Underground power cables are not visible physical features and it is for this reason that area servitudes should be acquired. The reasons for an area servitude is the fact that the underground cables can not be installed in a straight line and tend to zigzag in the cable trench. It sometimes happens that Eskom's rights for an overhead power line provide for underground cables as well. The wording, for example, would be as follows: "*centre line of an Overhead Electric Power Transmission Line with Underground cables".* In such cases the requirements set down in this document for underground cables do not apply. Refer to Part 22 of the DT Web for detailed information.

4.2 Different voltages and requirements

The following apply as regards underground cables:

- Increased voltages for underground cables do not necessarily require larger tree and building restriction areas (servitude areas) than the normal minimum required for, say, an 11kV underground cable. Different depths for cables are as follow. For high voltage cables (66kV and above), the depth must be 1.2 metres; medium voltage cables (11kV and 22kV), the depth must be 1 metre and for low Voltage cables (4 core cables), the depth must be 800mm.
- Eskom has through the years maintained that *'no excavations may be effected within **1.5 metres** from any of its underground electric cables'*. Therefore, keeping servitude areas for underground cables at **minimum 3.00 metres wide** is preferable. Where multiple cables are laid next to each other, 300mm spacing apart from each other is preferable.
- No attempt should be made either in the Deed or the servitude diagram to limit the servitude area to the right of laying one cable only. This should be left open for any possible future cables that could be laid in the area with separation distance (that will not affect the cooling of the cables or the cable rating) permitting.

4.3 Cable bending radius

A cable bend at 90 degrees can never be achieved. Define a radius for the curve that would best suite the configuration at the bends. Furthermore, the 'area servitude' eliminates, to a great extent, the need to worry about what the cable does at the bends when precautionary measures are taken into consideration. In extreme cases, for example, breaking the curve into short cords would solve the problem – see figure below.

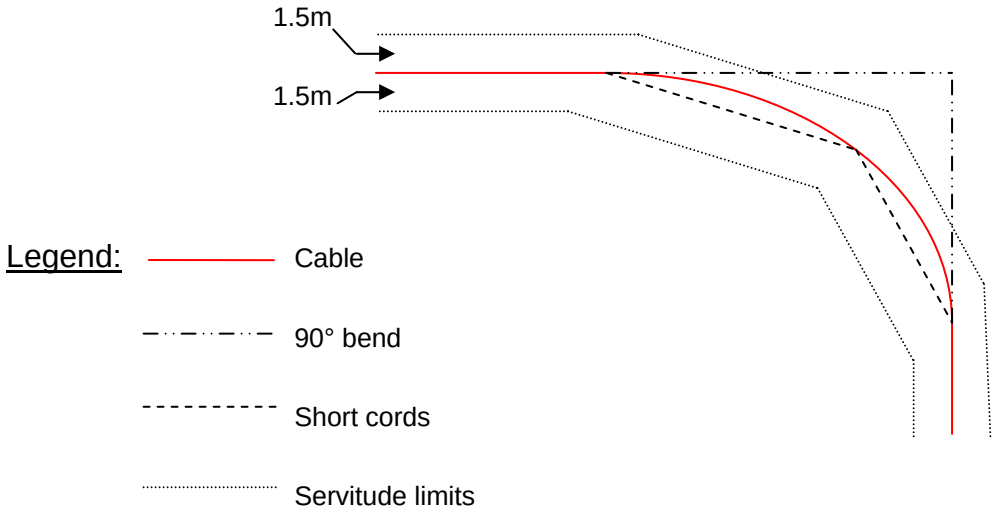


Figure 1

5 Overhead Lines

The question of servitude widths, and tree and building restriction distances have been central to long discussions and studies in the past and recently. Problems often arise due to stay positions of the angle strain structure at the bends falling outside the restriction area, commonly referred to as the "servitude area" in the Deed as well as the options. The problem occurs where stayed mono pole structures are utilised. Self supporting mono pole and lattice structures are recommended where an instance such as this could occur.

It is apparent from the studies that the tree and building restriction distance and parallel line separation distance will have to be obtained from the relevant Design Engineer for each individual project. Based on theoretical and practical principles, the servitude width is a function of the following:

- A = Horizontal conductor spacing at the structure (Generically a family of structures, e.g. self-supporting monopoles have roughly the same horizontal spacing between conductors for all types of structures; the standoff insulators are 1.2m long and the strain crossarms about the same).
- B = Conductor swing at 500Pa wind
- C = OHS Act Clearance to buildings, etc.

Therefore, required servitude width **= A + 2 x (B+C)**

This approach has been used very successfully in high-cost or critical areas (e.g. buildings close to proposed servitude). The best that has been achieved so far was where the land value was so high (through Stellenbosch vineyards) that, in that project, R700 000 in servitude costs were saved. This was achieved by using a single wood pole compact design over a comparatively short section of line, the reason being that, technically, the compact monopole 132kV lines can be accommodated on an even smaller servitude than 31.0m. The above equation can be used for any critical area where the applicable servitude width might not be achievable.

We can summarize the above by saying that one could have a scenario where your line servitude width changes depending on span length and cost of land. This means that it will depend on the span and the basic structure width (i.e. the horizontal conductor separation) that defines the servitude width, the other two (conductor and swing out span) being constant for a particular line. One could have shorter spans for narrower servitude width and balance the savings hereof against the cost of having more structures. It might be worthwhile to have more compact or alternative structures (which may have a cost implication) for such high land values.

The problem of stays extending beyond the servitude area can be eliminated, and should be negotiated and agreed upon with the landowner. From the Notarial Deeds of Servitudes as well as the Option documents it appears that Eskom's rights are only limited to activity within the servitude area except when it comes to the right of entry and the right to use existing roads. This is true since a 'servitude' gives only a limited right, which is also another reason why it is necessary to frame a servitude diagram in order to indicate the extent of these rights over the property concerned. Historical developments (Land Survey Manual: 8.17 Eskom's Consideration formula) also support this idea of a "restricted area". The normal clause in a deed for the rights acquired currently reads as follows:

1) The servitude/each of the servitudes shall include the following

a) the right to erect such structures and works on the property or to erect or lead such conductors, cables or appliances or other equipment on or over the property as may be necessary or convenient in exercising the right of servitude; and the right to erect such supporting mechanisms for structures and works with the possibility that it may reasonably extend beyond the servitude area as may be necessary or convenient to safely secure the structures or works.

b) the right to enter and be upon the property at any time in order to construct, erect, operate, use, maintain, repair, re-erect, alter or inspect the structures, works, appliances, conductors or cables on the property or in order to gain access to any adjacent property in the exercise of similar rights;

c) the right to use existing roads giving access to the property or roads running across the property and gates on the property and to erect in any fence such gates as may be necessary or convenient to gain access to or egress from the property and to gain access to any power line, telecommunication conductors, cables or accessory equipment;

2) the right to remove any trees, bush, material, grass or structures within the restricted area defined in clause 3 hereof and the right to cut or trim any tree in order to comply with the restrictions referred to in clause 3 hereof;

a) None of the above mentions 'supporting mechanisms', that is, stays. Sub-clauses 1.1 and 1.6 above come close to solving the problem but they could be interpreted to limit those rights within the servitude area only. It is for that reason that the standard clause 1.1 was changed in July 2002 to read as follows:

b) the right to erect such structures and works on the property or to erect or lead such conductors, cables or appliances or other equipment on or over the property as may be necessary or convenient in exercising the right of servitude; **and the right to erect such supporting mechanisms for structures and works with the possibility that it may reasonably extend beyond the servitude area as may be necessary or convenient to safely secure the structures or works.**

The above, will eliminate the problem of stays falling outside the servitude area. The need to register a servitude at the strain points for, say, a circle with a radius of 20m from the centre peg at the bends, will also not be necessary. This clause can be justified to the landowner by the **10% solatium** that is currently being paid as part of compensation. Should it be evident that stays falling outside the servitude area would adversely affect the property, and then an increase in solatium can be negotiated for during presentation for approval to the Land and Rights Tender Committee.

Over and above the rights mentioned above, the following restrictions are placed on the owner:

Extract from the official document.

c) With regards to the owner the following special restrictions are placed on the use of the property/ properties namely -

No building or structure may be erected or installed above or below the surface of the ground within metres of the centre line of any power line or within metres from any structure supporting mechanism.

No tree shall be planted within the servitude area.

No tree which will grow to a height in excess of the horizontal distance of that tree from the nearest conductor of any power line shall be planted within the vicinity of the power line.

No material which may in the opinion of Eskom endanger the safety of any power line shall be placed within metres of the centre line of any power line.

No mining activities or blasting operations shall be carried out within 500 metres of the centre line of any power line, without the prior written permission of Eskom.

5.1 Different voltages and requirements

As illustrated in the foregoing discussion on overhead lines, the following applies:

- For a number of reasons, one of which is that the clearance distance to a building in mid-span of power line would be different to the distance near a support structure due to conductor swing, Eskom has laid down servitude widths in excess of those required by the OHS Act.
- These building restrictions are constant throughout the length of power line of any particular voltage - conductor size, type of construction and route permitting. These may be reduced in accordance with the above where land values are very high.

Current practice within Eskom is that each region has its own standard building restrictions, which are applicable throughout that region. The guidelines given below are generally being used in the majority of the regions while the minority do not differ by more than 1 – 2 metres.

Table 1 below gives the building line restriction distances that should be used as guidelines. It is intended to lay down standard building restrictions that will be applicable to all regions within Eskom. The building restriction distances given are perpendicular from the centreline of the power line to the edge of the building restriction on one side of the power line. In order to obtain the total building restriction of a single power line the figures should be multiplied by two.

Separation distances between power lines that run parallel to each other are necessary in order to avoid excessive induction. The separation distance between two parallel lines is measured perpendicularly from the centre of the one line to the centre of the other line. Applicable separation distances for different operating voltages are also shown in Table 1.

Table 1 – Guidelines for different voltages and requirements

Voltage	Building restriction on each side of centre line	Separation distance between parallel lines
1) All voltages below 22kV	9 metres	12 metres
2) 22kV	9 metres	12 metres
3) 33kV	11 metres	14 metres
4) 44kV	11 metres	14 metres
5) 66kV	11 metres	14 metres
6) 88kV	11 metres	14 to 15 metres
7) 132kV and Delta construction 275kV	18 metres (15.5 - 20)	15 metres (21 - 24)
8) 220kV	23.5 metres (19.5 - 21.0)	32 metres (25m)
9) 275kV (Horizontal)	23.5 metres	32 metres
10) 400kV	27.5 metres (Stayed) (23.5 m Self-supportting)	35 metres
11) 765kV	40 metres	46 metres

Note: The information above is quoted from the *Rights of Way Manual (Module 15979)* and the information in brackets, where the two are different and inconsistent, is quoted from *the Land Survey Manual*.

Furthermore, it is strongly advised that the restriction distances for a particular voltage line not be assumed to be as given above, but that the question be discussed prior to commencing with route planning. Furthermore, in the context of this document, the following classification applies to the operating voltages shown in Table 1 above:

- 1 to 3 are classified as Distribution Lines (MV),
- 4 to 7 are classified as Sub-transmission Lines (HV) , and
- 8 to 11 are classified as Transmission Lines (HV).

Note also that the ruling in Eskom is that when two lines of dissimilar voltages are running parallel, the separation distance be defined by the requirement of the higher voltage of the two lines.

The separation distance between **parallel lines for 132kv lines** of 15m will not be a problem when two monopole 132kv lines run parallel to each other, but could become a problem when a monopole 132kv line runs parallel to a lattice 132kv line.

It should therefore be considered that the **15m separation distance** only apply to monopole type construction lines running adjacent to each other.

Where monopoles are planned to run adjacent to lattice type structures, each line needs to be looked at individually, since each lattice line has its own variables. These variables, as shown below, will need to be determined prior to a separation distance being decided on.

a) The cross-arm length of the lattice suspension structure.

b) The insulator length

c) The type of conductor, conductor thickness and conductor mass

d) The longest span between two suspension structures

e) The maximum sag

The last four variables will have a major impact on the perpendicular distance that the conductor will swing out under heavy wind conditions. Once this has been calculated the formula to calculate the separation distance would then be as follows:

Line Separation = I + S1 + M + C + L + S2

Where: I = Length of stand off insulator from monopole

S1 = Swing out distance of conductor from monopole stand off insulator

M = Minimum safety distance as per the OHS Act

C = Length from centre of structure to insulator

S2 = Swing out distance of insulator and conductor from lattice structure

6 Line clearances

6.1 The Occupational Health and Safety Act 85 of 1993

The Occupational Health and Safety Act 85 of 1993 (the OHS Act), as mentioned previously, provides for **statutory clearances** – see Annex A (informative) on page 15 for details. Eskom and a number of other authorities (Roads Department, Transnet Telkom, etc.) have laid down minimum clearances to their works, which are in excess of those required by the OHS Act.

6.2 Various clearances

Table 2 below gives the minimum clearances as adopted and used for various operating voltages:

- 1 to 3 are classified as Distribution Lines (MV),
- 4 to 7 are classified as Sub-transmission Lines (HV) , and
- 8 to 11 are classified as Transmission Lines (HV).

Table 2 – Clearances (all distances are given in metres)

Description of Service		Distribution				Sub-Transmission				Transmission				
		6.6kV	11kV	22kV	33kV	44kV	66kV	88kV	132kV	220kV	275kV	400kV	533kV	765kV
Outdoor earth: minimum safety clearance		0.2	0.2	0.3	0.4	0.5	0.8	1.0	1.5	1.9	2.4	3.2	3.7	5.5
Phase to phase		0.2	0.3	0.4	0.6	0.7	1.0	1.2	1.7	2.3	3.0	4.0	N/A	6.1
Ground clearnce inside and outside townships	in	5.5	5.5	5.5	5.5	5.7	5.9	6.3	6.7	6.7	7.2	8.1	8.6	15.0
	out	5.0	5.1	5.2	5.3									
Building structures not part of power line		3.0	3.0	3.0	3.0	3.0	3.2	3.4	3.8	4.2	4.7	5.6	6.1	10.0
Transnet walkways and foot bridges		4.7	4.8	4.9	5.0	5.1	5.3	5.6	6.0	6.6	6.9	7.8	8.3	15.0
Powerlines other than Transnet		0.7	0.8	0.9	1.0	1.1	1.4	1.6	2.0	2.4	2.9	3.8	4.3	7.5
Transnet electrification wires and track earth wires		2.0	2.1	2.2	2.3	2.4	2.6	2.8	3.3	3.7	4.2	5.0	5.5	7.5
Above roads in townships, proclaimed roads including Transnet		6.2	6.3	6.4	6.5	6.6	6.9	7.1	7.5	7.9	8.4	9.3	9.8	15.0
Telkom telephone lines (Eskom requirement)		1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.0	2.4	3.0	3.9	4.3	7.5
Transnet telephone lines		1.4	1.4	1.5	1.7	1.8	2.0	2.2	2.7	3.2	3.6	4.5	4.9	7.5
Spoornet tracks		9.6	9.7	9.8	9.9	10.0	10.2	10.4	10.9	11.4	11.8	12.7	13.2	
Spoornet electrification structures		3.0	3.0	3.0	3.0	3.0	3.2	3.4	3.8	4.3	4.8	5.6		
Transnet power lines		1.4	1.4	1.5	1.7	1.8	2.0	2.2	2.7	3.2	3.6	4.5		
Natal & Transvaal (TVL): abnormal load routes and TVL freeways: minimum		7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5					
National roads and Natal: minimum		6.5	6.5	6.5	6.5									

As regards to other clearances the following applies:

- **Timber restrictions:**

The distance at which a single tree or a row of trees may grow in the vicinity of a power line is set out in the servitude agreements signed by each landowner. This distance is dependent on the height of the tree, the extent of foliage and the manner in which the tree grows. The main purpose of the clause in the servitude agreement is to preclude any danger to the power line.

When power lines are planned and constructed through known forestry areas i.e. an area designated for the commercial production of timber, the servitude area is increased to the figures given in Table 3 below.

Table 3 – Timber areas (all distances are given in metres)

Voltage	Tree restriction distance on each side of the centre line	Total servitude width paid for at 100%
1) 11, 22 and 33kV	25	50
2) 42 and 66kV	33	66
3) 88kV	33.5	67
4) 132kV	36	72
5) 275kV	38.5	77
6) 400kV	40	80

No trees should be permitted within the servitude area given above. Existing firebreaks in the timber areas should be used as far as possible to mitigate costs.

- **Explosive magazines**

Power Lines must not be constructed in the close proximity of explosive magazines.

Regulation 7.3 of the Explosives Act 26 of 1956 lays down that no power line shall be erected or alternatively no magazine may be erected unless the following minimum horizontal distances are adhered to:

Table 4 – Explosive magazines (all distances are given in metres)

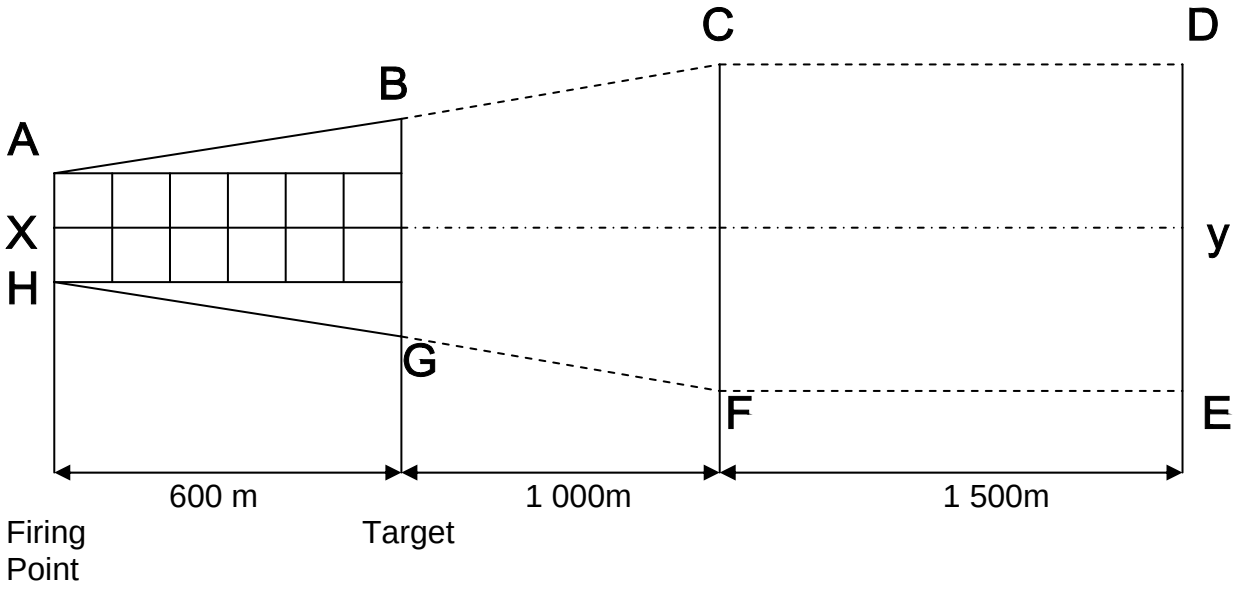
Length of power line span	Clearance to magazine
1) Under 30metres	15 metres
2) 30 – 150 metres	20 metres
3) Over 150 metres	30 metres

The distances given above are not only to the centre line but rather to any part of the power line.

- **Rifle ranges**

Power lines should not be routed across or within the areas defined as "danger zones" of rifle ranges as stray bullets may damage the conductor or insulators. The requirement for the planning of a power line in the vicinity of one of the South African National Defence Force ranges is set out in *Planning of Power Lines in the vicinity of Rifle Ranges*. This standard sets out the procedure to be followed in the case where a power line is planned within or near the danger zone of a South Africa National Defence Force rifle range.

The sketch below illustrates the danger zone of a rifle range of 12 targets.



Note:
BG = 384m
CF = 824m
DE = 824m

Figure 2: Proximity to rifle ranges

It will be noted that the danger zone extends for 2 500 meters behind the target area. This area can be reduced for local conditions e.g. such as a hill 60m high behind the targets.

- **Vertical clearances over navigable waters**

Generally, normal ground clearances should be provided to the normal summer water level of a river and the spillway level of a dam. Care should be taken not to place support structures of transmission and distribution lines in the 50 and 100-year flood plains.

If crossings are proposed over rivers, dams or lakes (which are or could be used as navigable, particularly by yachts or boats with high masts) then a clearance of 2,5 metres plus the relevant minimum outdoor clearance should be provided over the tallest mast likely to be encountered on such water under conditions of spillway level and maximum conductor sag. The tallest mast likely to be encountered on inland waters should not exceed 15 metres (measured from the water level).

Finally, regulation 15(1)(b) of the Electrical Machinery Regulation states that: the clearances of conductors and other wires over the normal high-water level of power lines crossing over water shall not be less than the values for power lines above the ground outside townships, with the provision that if the owner of the land on which the water is situated requires a greater clearance and no agreement can be reached, the dispute shall be referred to the chief inspector for a decision.

- **Other structures**

Boreholes and Windmills should be treated in the same manner as a building. The sweep of the tail of the windmill should not be closer that the building restriction distances set out in Table 2.

Although swimming pools do not normally protrude above the ground surface they should be treated in the same manner as a building is.

- **Clearances as per agreement with Telkom**

Where an overhead non insulated electrical supply line (except overhead service mains) crosses an existing or projected overhead telecommunications line, the electricity supplier or user must provide minimum clearances as follows:

a) In accordance with the regulations in terms of the Occupational Health and Safety Act 85 of 1993, see Table Annex A.

6.3 High load roads/routes

The requirements of the Occupational Health and Safety Act (OHS Act) 85 of 1993 must be strictly adhered to when crossing over high load roads or routes. Table 2 (under 'abnormal load routes') on page 11 gives the clearances as adopted and used in this regard.

The following are some of the standard conditions for clearances that are applicable to power lines and/or cables that cross or are parallel to national roads:

(i) No tower, pole, stay, pipe nor cable shall be erected or laid within a distance of 20 or 60 metres as applicable, measured from the national road reserve boundary, if such tower, pole or stay, pipe or cable is erected or laid parallel to the national road.

(ii) No tower, pole or stay shall be erected within a distance of 20 or 60 metres as applicable, measured from the national road reserve boundary, if such tower, pole or stay is erected for the purpose of establishing a power line across the national road.

(iii) No manhole shall be constructed within a distance of 20 metres, measured from the national road reserve boundary, if such a manhole is constructed for the purpose of laying an underground cable underneath the national road, unless an alternative position for the manhole has been previously determined in consultation with the Regional Engineer

(iv) A vertical clearance of not less than 6.5 metres, measured from the crown of the national road to the lowest wire, shall be observed for lines operating at a phase voltage of 33kV and below.

(v) The underground cable pipe shall be laid inside a sleeve pipe, which shall extend across the full width of the national road reserve, the top convex of which shall be at least one metre below the surface of the national road and the natural ground level. ESKOM shall ensure that in the process of laying an underground cable or sleeve pipe across the national road, the surface of the road shall not be interfered with.

(vi) ESKOM shall undertake to maintain any tower, pole, stay or overhead wire, cable or pipe at all times, at its own cost and to take all necessary precautions to ensure the safety of road users.

(vii) ESKOM shall undertake to shift or relocate, at its own cost and without compensation, any overhead power line or underground cable at the intersection of such power line with the existing national road, if such shifting or relocation becomes necessary as a result of road widening work, road construction work or road maintenance work, provided that such widening, construction or maintenance shall not involve any re-routing of the national road.

Another standard condition of importance to remember is that: *No permanent entrance to or exit from a National Road shall be permitted.*

The 20 metres referred to in clauses (i) and (ii) is applicable to those power lines of voltage below 40kV. The 60 metres distance refers to power lines whose voltages are 40kV or higher.

The clearance given in clause (iv) is a minimum for road purposes only. The Occupational Health and Safety Act 85 of 1993 require clearances in excess of 6,5 metres for all voltages above 40kV, and these additional clearances must be abided by.

The SA National Roads Agency Limited and National Roads Act 7 of 1998 require that no crossing should be within 500 metres of the point of intersection at a junction but this restriction may be waived with special application with motivation. No fee is payable for any application to National Roads.

As regards Provincial roads the following applies: the Provinces use clauses in the Advertising on Roads and Ribbon Development Act 21 of 1940 to impose building restrictions for a distance outside the road reserve boundaries. The clauses in the Advertising on Roads and Ribbon Development Act preclude without approval, any building or structure within 300 Cape feet each side of the centre line of any proclaimed building restriction road. By common usage the 300 Cape feet has been converted to 95 metres.

The jurisdiction of any provincial roads department does not extend beyond the 190 metre wide strip whose centre line is the centre line of the proclaimed road reserve. Eskom has agreed to apply to the relevant provincial road authority for all new Eskom services so that Eskom can be advised of future road plans and other special conditions that must be observed.

Annex A - Electrical machinery regulations

(Informative)

		Minimum clearance in metres				
Maximum voltage for which insulation is designed. kV rms phase-phase	Minimum safety clearance	Above ground ouside townships	Above ground in townships	Above roads in townships, proclaimed roads outside townships and tramways	To telecommunication lines or between power lines and cradles	To buildings, poles and structures not forming part of power lines
1.1 or less……	—	4.9	5.5	6.1	0.6	3.0
7,2……..	0.15	5.0	5.5	6.2	0.7	3.0
12……..	0.20	5.1	5.5	6.3	0.8	3.0
24……..	0.32	5.2	5.5	6.4	0.9	3.0
36……..	0.43	5.3	5.5	6.5	1.0	3.0
48……..	0.54	5.4	5.5	6.6	1.1	3.0
72……..	0.77	5.7	5.7	6.9	1.4	3.2
100……	1.00	5.9	5.9	7.1	1.6	3.4
145……	1.45	6.3	6.3	7.5	2.0	3.8
245……	1.85	6.7	6.7	7.9	2.4	4.2
300……	2.35	7.2	7.2	8.4	2.9	4.7
362……	2.90	7.8	7.8	9.0	3.5	5.3
420……	3.20	8.1	8.1	9.3	3.8	5.6
800……	5.50	10.4	10.4	11.6	6.1	8.5
533kV d.c.* ……	3.70	8.6	8.6	9.8	4.3	6.1

* Maximum voltage to earth for which insulation is designed.

Provided that these figures are based on the assumption that clearances shall be determined for a minimum conductor temperature of 50 ºC and a swing angle corresponding to a wind pressure of 500 Pa: Provided further that where under normal conditions power line conductors operate at a temperature above 50 ºC, the clearance at a higher temperature at which the conductors operate shall be in accordance with the clearance indicated in the table.

Annex B – Impact Assessment

(Normative)

Impact assessment form to be completed for all documents.

1 Guidelines

- All comments must be completed.
- Motivate why items are N/A (not applicable)
- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

2 Critical points

2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

Comment: Document Revisions

2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: n/a

2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: n/a

2.4 When will new stock be available?

Comment: n/a

2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?

Comment: n/a

2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

Comment: n/a

2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: (N/A during commenting phase)

Annex B
(continued)

3 Implementation timeframe

3.1 Time period for implementation of requirements.

Comment: Immediately

3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: n/a

4 Buyers Guide and Power Office

4.1 Does the Buyers Guide or Buyers List need updating?

Comment: n/a

4.2 What Buyer's Guides or items have been created?

Comment: n/a

4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: n/a

4.4 If the implementation of this document requires assessment by CAP, provide details under 5

4.5 Which Power Office packages have been created, modified or removed?

Comment: n/a

5 CAP / LAP Pre-Qualification Process related impacts

5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment: n/a

5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment: n/a

5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment: n/a

Annex B
(continued)

5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: n/a

5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: n/a

5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Comment: n/a

5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: n/a

5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: n/a

6 Training or communication

6.1 Is training required?

Comment: Yes

6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

Comment: On Job

6.3 State designations of personnel that will require training.

Comment: Survey staff and Land & Rights Practitioners

6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: Workgroup/Development Team

6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

Comment:

Annex B
(continued)

6.6 Was Technical Training Section consulted w.r.t module development process?

Comment: n/a

6.7 State communications channels to be used to inform target audience.

Comment: n/a

7 Special tools, equipment, software

7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: n/a

7.2 Are there stock numbers available for the new equipment?

Comment: n/a

7.3 What will be the costs of these special tools, equipment, software? n/a

8 Finances

8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

Comment:

……

……

……

Impact assessment completed by:

Name: Magda Le Roux_____

Designation: Land and Rights_____