RURAL ELECTRIFICATION AGENCY

CONSTRUCTION MANUAL

FOREWARD

The Rural Electrification Agency (REA) Construction Manual is a guideline to support the design and construction process of overhead and underground power distribution networks in Rural Electrification projects. It contains design parameters, key design specifications and standards for equipment and materials, and benchmark structural drawings for REA projects from the design stage through to the construction and commissioning stages; including service connections.

Anchored in the dictates of the Rural Electrification Strategy and Plan (RESP 2013-2022) for REA to adopt technical standards for all construction design, this manual is part of the Agency's efforts towards ensuring a 26% rural electrification access in an effective and efficient manner by 2020. In this regard, therefore, the manual aims to ensure good engineering designs and workmanships for rural power distribution networks for success in terms of: compliance with applicable regulations and standards; ensuring that the distribution network is developed with adequate safety and reliability; ensuring consistency across REA distribution networks, cost-effectiveness, ease of construction, and maintenance and operations.

I acknowledge the efforts that have been put into this process to produce working documents for better service delivery. This manual has been developed through a collective effort of a team of Engineers with vast experience in power distribution line design, construction and project management. In particular, I would like to thank the Project Development and Management Department for spearheading the initiative to develop this manual

It is my hope, therefore, that all field, technical and engineering staff (from the Agency, Contractors and Consultants) involved in the design, construction and supervision of REA power distribution networks will adhere to the guidelines herein to ensure effectiveness and efficiency as the Agency dedicates its work to socio-economic transformation, in an equitable and sustainable manner for rural development.

For God and My Country

Mr. Godfrey R. Turyahikayo

Executive Director

Rural Electrification Agency

REVISION RECORD

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ISSUE

For issue to all REA and Accredited Contractors' or Consultants' staff involved with the design, construction and supervision of overhead distribution lines and substations, and is for reference by field, technical and engineering staff.

Where this Manual is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

REA Manuals are subject to on-going review and therefore the information contained in this document may be amended by REA at any time. Inconsistencies may exist between standard documents. In such instances, the most recent REA Construction Manual shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Rural Electrification. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the Project manager, Engineering supervisor, Contractor, assured quality controller and the individuals involved to make sure that a safe system of work is employed and that statutory requirements are met.

REA disclaims any and all liability to any person or persons for any procedure, process or any other thing done or not done, as a result of this Manual.

INTERPRETATION

In the event that any user of this manual considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request REA to clarify the provision. REA's interpretation shall then apply as though it was included in the Manual.

Contents

1.0 PURPOSE

This Manual is to be used to support the design and construction process of overhead and underground power distribution lines including primary substations under rural electrification Projects.

This manual aims to ensure good engineering designs and workmanships for rural power distribution networks for success in terms of:

- Compliance with applicable regulations and standards
- Ensuring that the distribution network is developed with adequate safety and reliability
- Ensuring consistency across REA distribution networks
- Cost-effectiveness
- Ease of construction, maintenance and operations.

2.0 SCOPE

The document comprises an outline of acceptable design and construction standards for overhead and underground rural power distribution networks from 0.415kV to 33kV. Rural electrification projects are mainly limited to power distribution lines up to a maximum power capacity of 15MVA. Evacuation of Power greater than 15MVA may require different considerations outside the scope of this manual.

3.0 REFERENCES

The following referenced documents and standards are indispensable for the application of this document. This document shall be read in line with the relevant REA Manuals, and specifications for materials and Equipment.

3.1 Electricity Regulatory Authority (ERA) and National Documents

- The Electricity (Primary Grid Code) Regulations, 2003.
- The Electricity (Safety Code) Regulations, 2003
- The Electricity (Quality of Service) Regulations, 2003
- UETCL Uganda Grid Code protection Policy
- Uganda Electricity Board Engineering Memorandum (EM)

3.2 Rural Electrification Agency Documents

- REA Wooden Pole Manual 2015
- REA Concrete Pole Manual 2016
- REA Transformer Manual 2015

3.3 Other Standards and Documents

3.3.1 General standards

- International Electrotechnical Commissions (IEC) standards
- Institute of Electrical and Electronics Engineers (IEEE) standards
- Deutsches Institut für Normung -German Institute for Standardization (DIN)
- British Standards (BS) for overhead and underground power line construction
- British standards European Norm (BS EN)
- American Society of Testing and Materials Academic & Science (ASTM)
- American National Standards Institute (ANSI)
- AINSI American Iron and Steel Institute / Steel Products Manuals (AINSI)
- ISO International Organization for Standardization
- Near Field communication (NFC) Standards

3.3.2 Specific Standards

Standard	Description
IEC 60041	Instrument transformers
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60059	Standard current ratings
IEC 60071	Insulation co-ordination
IEC 60073	Basic and safety principles for man-machine interface, marking and identification
IEC 60083	Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC
IEC 60099	Surge arresters
IEC 60127	Miniature fuses
IEC 60129	Alternating current disconnectors and earthing switches
IEC 60137	Insulating bushings for alternating voltages above 1000 V
IEC 60168	Tests on indoor and outdoor post insulators of ceramic materials or glass

	for systems with nominal voltages higher than 1000 V
IEC 60173	Colours of the cores of flexible cables and cords
IEC 60186	Voltage transformers
IEC 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
IEC 60228	Conductors of insulated cables
IEC 60245	Rubber insulated cables of rated voltage up to and including 450/750 V
IEC 60255	Electrical relays
IEC 60269	Low-voltage fuses
IEC 60273	Characteristics of indoor and outdoor post insulators and post insulators units for systems with nominal voltages higher than 1000V
IEC 60309	Plugs, socket-outlets and couplers for industrial purposes
IEC 60364	Electrical installations of buildings
IEC 60439	Low-voltage switchgear and control gear assemblies
IEC 60529	Classification of degrees of protection provided by enclosures (IP CODE).
IEC 60840	Test of power cables of extruded insulation for rated voltage above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV)
DIN 48 201, BS EN 50182, IEC 61089, 62219, ASTM B399	AAAC 100 sq. mm Conductor
IEC 60885	Electrical test methods for electric cables
IEC 60947	Low-voltage switchgear and control gear. Parts 1-5.
IEC 61936	Power installations exceeding 1 kV AC
IEC 62271 -102	Alternating current disconnectors and earthing switches

IEC 60811, IEC 60228, VDE 0276, part 626 or equivalent. Accessories shall comply to European Standard HD 626, IEC 60228, IEC 60502, IEC 61238,	50 sq. mm Aluminium LV Aerial Bundled Cable
BS 4360, BS 183, BS 464 ESI 43-91, BS 4545, BS 729, ASTM A123, BS 443, BS 3643	Galvanised Low carbon mild steel. Stay rod, stay wire and earth wire, stay thimble
IEC 60282-2	Fuse Dropouts
IEC 60265-1 Ed. 2.0	Load Break Switch
IEC 60099	Surge Arrestors
IEC 62223	Long Rod/Dead End, Polymeric Tension Insulators, Pin Insulators, Stay Insulators
IEC 60720	Line Post Insulators
BS 137	LV Reel Insulators
ANSI C29.4 Class 54.4	LV and MV Stay Insulators
IEC 60076-1-2-3-4-5-10	Pole Mounted 3 phase Distribution Transformers 33/0.415/0.22kV
IEC 60076	Pole Mounted 3 phase Distribution Transformers11/0.433 kV Transformers
KS 02 – 94:1985	Specification for preservation of timber
SANS 752:2010	Eucalyptus poles, cross-arms and spacers for power distribution systems
SANS 1524-1	Electricity payment systems - Part 1: Prepayment meters
EAS 322: 2002	Wood Poles and Blocks for Power Line and Telecommunication – Specification
PIESA 1O18-4	Specification for Fitting and Accessories for Low Voltage Overhead Power Lines using Aerial Bundled Conductors. Part 4: Strain and Suspension Fittings for Aerial Service Cables.
PIESA 1018-5	Specification for Fitting and Accessories for Low Voltage Overhead Power Lines using Aerial Bundled Conductors. Part 5: Current-carrying Conductors and Joints.
ASTM A36, ASTM A123, BS 729, BS 4360 , BS 4848 Part 4, BS 4 Part 1, BS 5153	Low Carbon mild steel grade 43A for Cross-arms, Tension Plates, Half Clips, Fitting Straps, and Connecting Straps.
BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	Low carbon mild steel grade 43A. Bolts, ball ended hooks

BS 3288 Part 2, BS 1472, BS 729	Aluminium Alloy Hardware. Al. Alloy Suspension Clamp, Al. Alloy Bracket
NFC 33020, NFC 33021, NFC 33040, NFC 33041 & 042, BS EN 504832, NFC 20540, NFC 33040	Insulation Piercing Connectors, suspension clamps, anchor clamps, end caps and pre-insulated bimetallic lugs

4.0 DEFINITIONS

AAAC All Aluminium Alloy Conductor

ABC Aerial Bundled Conductor

Al Aluminium

Cu Copper

CUSTOMER A person or organisation that has applied for or receives electrical supply from the electricity network.

DNO Distribution Network Operator

EARTHING The process of connecting components of electricity supply networks to ground to prevent dangerous voltages occurring which may damage equipment or injure individuals coming into contact with them.

ERA Electricity regulatory Authority

EASEMENT A strip of land registered on the title deed in the office of the Registrar of Titles allowing access or other rights to a public body or party other than the owner of the parcel of land on which the easement exists.

HRC High Rapture Capacity

KV Kilo Volt

KW Kilo Watt

LV Low Voltage

MV Medium Voltage

MW Megawatt

NEMA National Environment Management Authority

NFA National Forest Authority

PIESA Power Institute of Eastern and Southern Africa

REA Rural Electrification Agency

SCADA Supervisory Control and Data Acquisition

SPAN A section of overhead conductor between two supporting poles or

	structures. The term may also refer to the horizontal distance between the two pole attachment points.
STAY	A steel wire that is used to support a pole when the tip load exceeds the pole capacity. The stay may be anchored in the ground or to another pole. Also known as a 'guy'.
TNO	Transmission Network Operator
UETCL	Uganda Electricity Transmission Company Ltd
UK	United Kingdom
UWA	Uganda Wildlife Authority
XLPE	Cross Linked Polyethylene

5.0 INTRODUCTION

This document is presented in two chapters:

Chapter one:

Discusses the preliminary Engineering design requirements and considerations that must be taken into account before actual works at site. It presents the minimum electrical and mechanical requirements or specifications that are acceptable on rural distribution networks. Furthermore, REA approved MV and LV pole support Structural drawings that are the minimum standard configuration for rural electrification projects are also presented in this section

Chapter two:

Presents the minimum engineering construction guidelines for works at site that should be followed by the relevant stakeholders.

CHAPTER ONE: POWER DISTRIBUTION NETWORK DESIGN CRITERIA AND CONSIDERATIONS

6.0 GENERAL DESIGN CRITERIA

6.1 Design Basis

The design basis for this manual utilises an empirical approach that utilises traditional factors of safety mirroring the UK BSI standards approach.

6.2 Average Site Conditions

Although weather conditions may vary in the various parts of Uganda, the following environmental data shall be taken as the design data for working conditions of equipment unless site specific data is provided.

Table 1: Average site conditions in Rural Uganda

Parameter	Unit	Value
Maximum ambient temperature	^{0}C	40
Minimum ambient temperature	^{0}C	10
Mean maximum daily temperature	^{0}C	35
Annual average temperature	^{0}C	25
Maximum solar radiation (worst case)	W/m^2	1,035
Keraunic level*		260
Seismic Acceleration	g	0.1
Design altitude above sea level	m	1500
Max. Wind speed • Height above ground 0 – 30m • Height above ground 30 – 50m	 m/s m/s	 34 45
Relative humidity, Maximum average Minimum	% rel.	 100 80 20
Average rainfall annually	mm/a	1,100
Hail	May occur during heavy storms	

*The keraunic level is a long-term average that describes the lightning and thunder activity in a given area. It is defined as the annual number of days where thunder can be heard.

6.3 General Design Parameter for Power Distribution Lines

Rural electrification power lines using AAAC100 conductor shall be designed to a maximum power carrying capacity of 15 MVA at Medium Voltage level (MV) of 33kV, and 5MVA at 11kV where the source/ maximum generating voltage is 11kV. The nominal low voltage level is 415/240 Volts.

Unless otherwise specified, the design of rural distribution networks shall be based on the following:

- System Frequency 50 Hertz
- Three phase MV overhead lines on wooden or pre-stressed spun concrete pole structures and only utilising underground MV powers cables under special circumstances such as crossing transmission lines, in Game parks, and interfaces with ground mounted distribution transformers.
- Bare conductors for MV lines and Aerial bundled cable for LV lines (at relevant sizes in section 7.6)
- Radial network configuration with normally open points complete with solid link isolators at every 10km of the MV line.
- Pole mounted transformers for capacity up to 315kVA and ground mounted transformers for capacities greater than 315kVA, unless the transformer's dimensions and weight considerations permit otherwise.
- All MV lines structures shall be constructed to 33kV standard regardless of voltage level with aerial earth unless otherwise specified.
- Maximum allowable voltage drop at rated voltage is plus or minus 6% for LV and 11kV, and plus or minus 10% for 33kV.
- Basic span length for MV lines 80-100m and 50m for LV lines; see Section 8.2.5 for maximum span lengths.
- 9m poles shall be used for LV networks and 12m and 14m poles for MV networks
- Earth resistance value shall not exceed; 5 ohms for both MV and LV.

7.0 ELECTRICAL DESIGN CONSIDERATIONS

7.1 General

This section discusses the major electrical considerations that must first be taken into account when designing feeder lines and selecting switchgear for rural power distribution networks.

7.2 Insulation coordination

Standard voltages are defined in IEC 60038. Standardised levels for the highest system voltages are according to IEC 60071-1. All test voltages for equipment are defined at sea level with altitude correction factors for dielectric strength according to the ANSI/IEEE Standard C57, 15-1986.

7.2.1 Insulation coordination for MV Switchgear

Table 2: Insulation coordination data at Medium Voltage and Low Voltage

Nominal system voltage between phases (kV)	**33**	**11**	**0.415**
Highest system voltage between phases (kV)	36	12	0.456
System frequency (Hz)	50	50	50
System earthing	Solid	Solid	Solid
System fault level (kA)	25	12.5	
Nominal voltages for:			
Circuit-breaker trip, auto-recloser auxiliary contactors and alarm circuits; V (dc)	110	110	
Circuit-breakers closing, spring charging and indication circuits; V (dc)	110	110	
Power line carrier equipment, & telephones; V (dc)			
Auxiliary equipment V (ac), 50Hz	400	400	

Unless specified otherwise all primary circuit components shall have ratings equivalent to the normal and short time rating of the associated auto-recloser as specified.

All equipment shall have the ratings specified when installed at site, within any housing or enclosure, which forms part of the plant or works and under the most onerous combination of site conditions specified.

7.2.2 Insulation coordination for Substation and Transmission line Equipment

Table 3: Substation and Transmission Line Equipment insulation coordination data

Nominal system voltage between phases (kV)	33	11	0.415
Peak Impulse withstand voltage (1.2/50 µs) (kV)	170	120	3
RMS Power frequency (1 minute) withstand voltage (kV)	85	28	2.5
Assumed highest switching surge (pu)	3.5	3.5	-
*Minimum substation clearances:			
Phase to earth (mm)	380	320	100
Phase to phase (mm)	430	400	150
Between terminals of the same phase	430	400	150

*Applicable to equipment not subject to impulse voltage test. The withstand voltage shall apply to outdoor insulators and bushings including support insulators and casings for circuit-breakers, post type current transformers, voltage transformers, main and auxiliary transformers, capacitor banks etc.

7.2.3 Insulation coordination for Insulators and Bushings

In accordance with IEC 60815, the creepage distance (minimum surface leakage distance measured from the metal cap to the base over the surface of the insulator shed) shall **not be less than 25 mm per highest system kV** between phases for general substation insulators.

The minimum protected surface leakage distance (that part of the insulator, which is protected against rain at right angles to the axis of the bushing) **shall not be less than thirty five percent of the total surface leakage distance.**

"Anti-fog" or "Anti-pollution" type or other insulators with very deep sheds or skirts will not be approved.

Insulators supplied shall be in accordance with IEC 62223, ANSI 54-4, ANSI C29.4 or equivalent and the following minimum characteristics shall apply:

Table 4: Minimum Parameters for Insulators

Characteristics	Unit	Tension Insulators	Pin insulators	Line post insulators	Stay insulator	Reel Insulator
System Voltage	kV	33	33	33	33	33
Cantilever Strength	kN	70	10	20	89	13.5
Minimum Nominal Creepage Distance	mm	1200	900	1200	76	40
Lightning withstand voltage (1.2/50µs)	kV	210	170	210	40	9
Min Flashover Voltage (Wet)	kV	70	70	95	23	

7.3 Power System Protection

7.3.1 General

Protection shall be arranged in zones which shall cover the power system completely, leaving no part unprotected. Thus the Contractor and Client shall work hand-in-hand with the TNO and DNO to ensure that the Auto-reclosers along the new line are set to the right parameters, such that the protection zones of all the circuit-breakers/ auto-reclosers from the substation to that auto-recloser overlap.

Protective systems in successive zones shall be graded in time, so that upon the occurrence of a fault only those relevant to the faulty zone trip.

According to the Uganda grid code protection policy, here below are some of the principles upon which protection schemes shall be coordinated:

a) The Ugandan Grid is largely solidly grounded, and therefore, all players shall implement protection schemes that effectively detect and subsequently remove/eliminate faults in solidly grounded networks.
b) On all ringed systems, directional relays shall be used to ensure effective discrimination.
c) Only unit protection schemes shall be allowed to operate 'instantaneously' at all Voltage levels.
d) For Impedance (distance) protection coordination between successive protection zones, a grading margin of not less than 0.3 seconds shall be allowed between protection devices of two or more players whose network(s) are adjacent to each other for static and numerical relays. Where electro-mechanical relays are used, such a margin shall not be less than 0.5 seconds.
e) Only authorized personnel shall have the leverage to edit relay settings in all protection devices. Any changes in relay settings must be communicated to the System Operator via a report detailing reason for change, time, and date and by whom.

7.3.2 Surge Arresters

Gapless Metal-Oxide type MV surge arrestors with composite housing of silicon polymer suitable for outdoor application shall be installed at each pole structure before switching equipment, at transformer structures and all terminal structures for protection against atmospheric over-voltages and switching surges.

Each Surge Arrester shall have a device for disconnecting it from the system in the event of arrester failure to prevent a persistent fault in the system and it shall give a visible indication when the arrester has failed.

Note that only one type of arrester shall be installed in the entire network.

Surge Arrester Selection:

Nominal System Voltage	11kV	33kV
Clearing time for earth fault	3s	3s
System Highest Voltage, Um	12kV	36kV
Temporary Over voltage: U_{TOV}	U_{TOV} ≤ (1.4 * Um / sqrt(3)) = 9.7 kV	U_{TOV} ≤ (1.4 * Um / sqrt(3)) = 29.1 kV
Maximum residual voltage at 10kA, 8/20 µs	35kV	110kV
Insulation withstand Levels Peak Lightening Impulse (1.2/50 µs) Power Frequency withstand voltage (wet)	 70kV 28kV	 170kV 70kV
Creepage Distance	300	900
Line Discharge Class	2	2

7.3.3 Dropout Fuse Isolators

Pole-mounted dropout fuse isolators (HRC) shall be installed at all transformers T-offs and the start of MV line T-offs shorter than 10km long from the main feeder. Long line T-Offs to the main MV line longer than 10km must also be equipped with manually *operatable* load break switches that also have SCADA communication and operation compatibilities. Beside the protection function this enables the sectionalizing of the network and easy localising or isolating of faults.

The Expulsion Fuse Cut-outs shall be of Class A as per IEC 60282-2. The Expulsion fuse shall be designed with a solid core, bird proof, one piece Porcelain Insulator and, it should be robust enough to withstand shocks due to frequent operations. The fuse carrier shall drop-out immediately following the blowing of the fuse.

Copper Arc Shortening rod shall be attached to the cap of the fuse tube to obtain higher interrupting rating. A removable button head type fuse link having M6x1 thread shall be able to fix to the arc shortening tube.

Drop out fuses shall be of the single phase type. In the event of the operation of one fuse on the three-phase system it is recommended that all three fuses be replaced. Fuse ratings shall be selected according the following formula.

$$\boldsymbol{I_{fr} \geq 1.5 \times \left(\frac{S}{\sqrt{3} \times V}\right)}$$

Where $\boldsymbol{I_{fr}}$ is the minimum available fuse rating per phase; $\boldsymbol{S}$ is kVA rating of the transformer; $\boldsymbol{V}$ is the 3-phase kV nominal voltage on the MV side. The factor 1.5 accounts for inrush currents.

7.3.4 Auto-Recloser

Medium voltage lines starting at the substations of power plants or high voltage / medium voltage transformer stations shall be equipped with auto-reclosers and related protection relays. Basically the following ANSI protection functions included in a single protection and monitoring unit (PMU) shall be implemented in each feeder: 51, 51N, 50, 67, 67N, 25, 79, 21 and 81.

Auto-reclosers shall be installed at the start of all new MV line extensions greater than 30km long from the main feeder and at all new line extensions introducing or foreseen to introduce a considerable load (or more than 5 distribution substation units) on the network in the future.

The auto-recloser shall meet the following minimum requirements:

- The recloser shall provide for directional earth fault, distance (impedance) protection and directional phase over current in accordance with ANSI standards. It shall be compatible to 67N and 67 requirements for directional earth fault and directional over current protection in addition to ANSI 50, 51, 51N, 81,and 79.
- Capability for communication of internal logic values to a remote relay or recloser control via serial communications. The unit shall have an EIA-232 and RS485 ports and DNP3 level 2 communication interface.
- An optional accessory for converting an EIA-232 serial port to encrypted and authenticated IEEE 802.11b wireless communication. Software shall be provided with this accessory to allow a personal Computer (PC) receive events or possibly send commands from or to the recloser.
- The control unit should be ready with the port IRIG-B time-code input
- The Auto-recloser shall be provided with manual tripping facility and lock out of the recloser locally.
- Remote *operatable* and SCADA Compatibility.

7.4 Earthing

The earthing or grounding of the rural power distribution network shall be according to the following minimum considerations:

- All structures having erection equipment such as transformers, disconnectors, cross arms, fuse cut-outs, surge arresters, cable sealing ends as well as line ends shall have a protection pole ground installed in order to get a low pole footing resistance less than 5Ω.
- MV lines shall be constructed with aerial earth wire/ shield wire (unless otherwise specified) and arcing horns installed on all distribution transformers for protection against lightening and gradual overvoltage respectively.
- The overhead shield wire shall be continuous and connected to ground on every other MV pole. The multi-grounded overheard earth wire for a primary distribution line is always connected to the substation grounding system where the circuit originates and is connected to all grounds along the length of the circuit.
- The grounding is performed by wounding the earth conductor at least six times around the pole butt prior to pole erection. No poles shall be erected without this installation.

- For wooden pole structures, the conductor is attached to the pole with 40mm steel U-nails at 500mm intervals and connected to the steel frame with bonding clips. Concrete "earth" poles should come prefabricated with connection points for grounding at the top, middle and bottom of the pole.
- Conductors for connecting poles to earthing shall be 3/2.64 galvanized low carbon mild steel wires with a total cross section of at least 25mm^2.
- Earthing rods shall be solid, copper clad steel rods with a minimum diameter of 16mm with provision for coupling together with a suitable clamp for connection of ground wire. The maximum height of coupled electrodes shall not exceed 4.5 m (3 rods). The copper coating shall have a minimum thickness of 0.3mm. "´Type "Copperweld" or equivalent.
- MV and LV transformer earthing system shall comprise of a minimum of four copper rods complete with an earth mat (1m^2) per earth pit.
- The pole ground lead shall extend above the top of the pole and shall be bonded to the surge arresters, overhead shield wire, plate bolts, tension insulator bolts, and in general all metallic supports installed on the structure.
- For horizontal construction without aerial earth, grounding shall be done every 5km through surge arrestors.
- Stay wires on MV lines at locations having pole grounds shall be solid and bonded to the pole ground. Otherwise stay wire on 33 kV lines shall be insulated with stay wire strain insulators.
- Switch handles must also be properly grounded.
- Cable armour and sheath must also be appropriately earthed.
- The earthing of distribution transformers shall comprise of a main MV earth electrode and a separate LV earth electrode, each with an independent earth mat arrangement consisting of at least four copper -plated earth spikes and 3/2.64 galvanized steel earth wire.
- The MV and LV earths shall be separated with the MV earthing on the transformer structure and LV earthing (permanent multiple earthing) on the first structures of the LV network, on LV terminals, LV section poles, LV poles with service connection and every other LV pole . All metal work, transformer tank and the MV surge arrestor shall be connected to the MV earth.
- The transformer neutral shall be directly connected to the LV earth.
- The following values of the earth resistance shall be expected:

  MV earth resistance : **< 5 ohms**

  LV earth resistance : **< 5 ohms**

- The above resistance values shall be maintained by periodic inspection and increasing the number of earth rods interconnected by copper earthing conductor to a maximum of 6 spaced at a minimum distance of 1.5m. Brine, ash or charcoal can also be used to improve earth values.
- The neutral conductor of the service to the customer must be connected to ground on the customer's premises at the service-entrance equipment.
- A metal water pipe provides a good ground. Care must be taken to avoid plastic, cement-lined, or earthenware piping.

- Driven grounds may be installed near the customer's service entrance to provide the required ground connection.
- All earth pits and ground wires must be covered up and out of sight for safety purposes. The maximum separation of interconnected remote earth pits for a given installation shall not be more than 30m with the connecting channel at a minimum depth of 0.8m.
- The size of the earth pit shall depend on soil type but shall not be less than 1.5m deep and cross section area of $1m^2$.

7.6 Conductors

7.6.1 Phase Configuration

The MV line phase configuration shall be red-yellow- blue from top to bottom for vertical configuration; but, red-yellow-blue from left to right as observed by the direction of power flow from the bulk supply point(BSP) to the load for horizontal configuration. This is also referred to as the "RED RIGHT REAR Rule" i.e., as one faces the direction of the load, the Red phase is on the right rear. In the case of staggered configuration the red phase is always alone on the left side. The phases shall be clearly labeled at all section structures and Line T-offs using phase indicators.

7.6.2 Selection of conductors

The following factors influence conductor selection:

- Load current
- Statutory requirements e.g., voltage drop and power loss
- whether the line is 'backbone' or a spur
- Fault levels
- Environmental conditions - vegetation, wildlife, pollution or salt spray
- Compatibility with existing adjacent electrical infrastructure
- Required span lengths and stringing tension.
- Future requirements of line planning

7.6.3 Overhead Bare Conductors

The size and type of conductor to be used shall depend on the results from the load flow studies. For an existing feeder line, considerations shall be made to assess the impact of the new MV line on the existing line.

In most cases, rural electrification MV distribution lines shall be constructed with AAAC100, the conductor shall comprise of 7 strands each of diameter 4.26mm (7/4.26) and shall be used along the main lines. AAAC50 (7strands each of diameter 3.02mm (7/3.02)) conductor shall be used along transformer T-offs, dead-ended spurs (less than 5km) and LV bare conductors.

The use of All Aluminium Alloy Conductor (AAAC) is attributed to its light weight and to the alloy being less useful after melting as compared to ACSR which is deemed optimal for rural electrifications considering the aspect of an increased risk of theft of material.

Vibration dampers, suitable for the particular conductor, shall be installed in spans of over 150 m.

7.6.4 Underground MV Power Cables

MV underground cables shall be used at crossings of transmission lines and connection to ground mounted transformers.

The cable shall consist of annealed copper wires or aluminium wires, stranded and compacted to a circular conductor. The conductor shall be in accordance with IEC 60228 and IEC 60502.

For transmission line crossings, the underground cable used shall be 185 sq. mm Single Core Aluminium Conductor, XLPE Insulated, Aluminium wire and with the following minimum electrical requirements:

Table 7: Minimum requirements for MV Power cables at 33kV, IEC 60502-2 standard

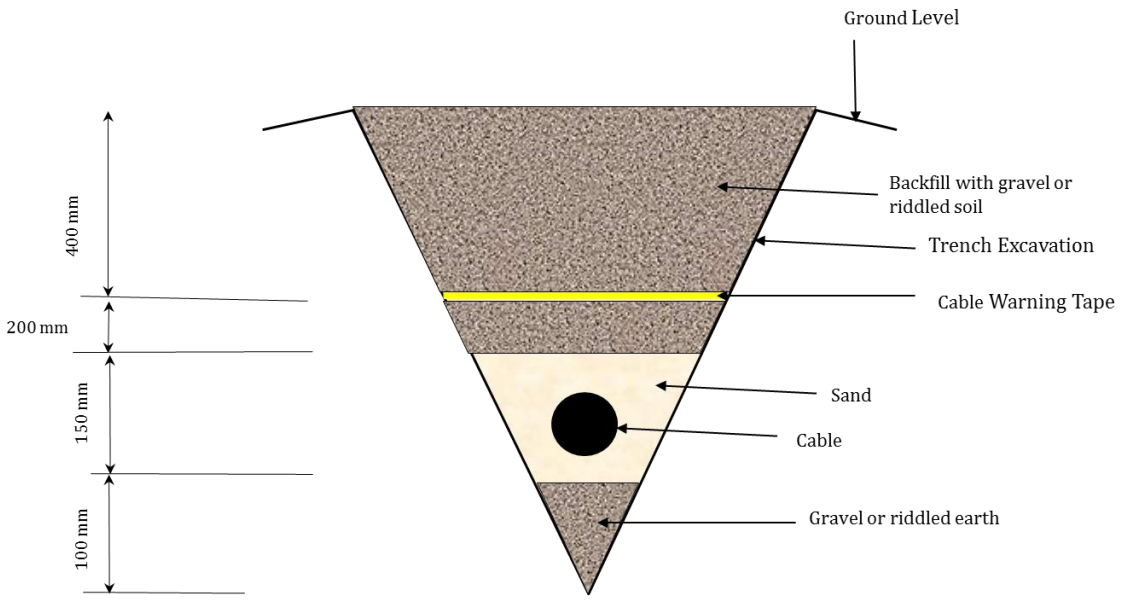
Particulars	Unit	Parameters
DC resistance for conductor at 20°C	Ω/km	0.164
AC resistance for conductor at 90°C	Ω/km	0.211
Impedance at 50 Hz	Ω/km	0.246
Short Circuit rating for 1 sec	kA	17.39
Current rating in Air, Laid in trefoil formation & ambient temp. = 30 °C	A	413
Current rating for cable Laid direct, ground temp. = 20 °C		309
Reactance at 50 Hz	Ω/km	0.127
DC resistance for Armour at 20 °C	Ω/km	0.155
AC resistance for Armour at 80 °C	Ω/km	0.192
Short Circuit rating of armour for 1 sec	kA	16.67

Table 8: Minimum requirements for MV Power cables at 11kV, IEC 60502-2 standard

Particulars	Unit	Parameters
DC resistance for conductor at 20°C	Ω/km	0.164
AC resistance for conductor at 90°C	Ω/km	0.211
Impedance at 50 Hz	Ω/km	0.246
Short Circuit rating of Conductor for 1 sec	kA	17.39
Current rating in Air, Laid in trefoil formation & ambient temp. = 30 °C	A	413
Current rating for cable Laid direct, ground temp. = 20 °C		309
Reactance at 50 Hz	Ω/km	0.109
DC resistance for Armour at 20 °C	Ω/km	0.270
AC resistance for Armour at 80 °C	Ω/km	0.335
Short Circuit rating of armour for 1 sec	kA	9.60

The following considerations shall apply while installing underground cables:

- All buried cable route drawings must submitted to REA and forwarded to local city or town planning authorities for approval prior to installation works.
- All cables shall be directly buried to the correct depth with a minimum of 600mm below the ground surface.
- Cables in the same pit shall be appropriately spaced to minimize physical contact.
- For cable trenches is rocky areas, backfilling shall be done using imported material such as laterite soils or murram, quarry dust or river sand.
- Prior to laying the cable one should ensure the trench bed is of soft soil so that the cable is not damaged when backfilling is done. Where necessary preferable material may be laid prior to installing the cable, such as red soil, murram, quarry dust or river sand, as appropriate.
- To ensure a good environment for underground cables buried directly in the ground, the refilling mass nearest to the cables shall mainly consists of sand of **a maximum grain size of 8 mm.**
- All cable routes crossing roads, railways, etc must be provided with ducts of the right size, dependent on the diameter of the cable, with a minimum of 150mm duct as standard. The ducts will be adequately protected with concrete.
- All joints and terminations shall be properly done to avoid breakdown of the insulation due to moisture and water ingress.
- The earthing of the cable armour shall be done on only one side.
- The cables shall be protected by Cable protection tape or a Stokbord cable covers.
- Cable routes shall be clearly marked, mapped and appropriate warning signs indicating the voltage level.
- MV cables on the main line shall be protected by surge diverters on both ends of the cable.



Cable Laying Detail Underground Cables

7.6.5 LV ABC

The bundled cable shall have 4 cores comprising of three phase conductors and one neutral messenger. The requirement is for ABC core sizes of 50mm^2 with a mechanical load bearing (min. 16.6kN) neutral messenger size of 54.6mm^2. The core Conductor shall be of multi-strand (7) round compacted hard drawn Aluminium conforming to IEC 61089 with XLPE insulation.

The following minimum electrical properties shall also apply:

Table 9: Minimum electrical requirements LV ABC

PARTICULARS	UNIT	Parameters
DC resistance at 20°C	Ω/km	0.6 (0.63 for neutral phase)
AC resistance at 90°C	Ω/km	0.8
Impedance	Ω/km	0.8
Current Rating	A	142
Short circuit ratings	kA	4.8
Insulation Minimum Thickness Voltage class	 mm kV	 1.4 0.65/1.1

7.6.6 LV customer Service cables

In rural areas LV service cables shall be to the following minimum specifications:

Table 10: Service cable sizes

LV Concentric/Twisted Cables	Use
Concentric Coax. 10 mm^2	AL XLPE Concentric Coax. (LV 1ph service 10 mm^2 connection)
Al 4 x 35 mm^2 XLPE	Al 4 x 35 mm^2 (LV 3ph service connection)

7.6.7 Transformer Wiring

Low voltage wiring between the transformer, fuse cut-outs and overhead line shall be by XLPE insulated 70sqmm stranded copper cable or XLPE insulated 120sqmm stranded aluminum (single core).

7.7 Distribution Transformers

Three-phase distribution transformers 33kV/415V shall be supplied in the following series of ratings: 25, 50, 100, 200, 315,500, and 630 kVA whereas single phase transformers shall be supplied in the following series of ratings: 7.5, 10, 12.5 and 15 KVA. The following minimum electrical requirements shall apply for distribution transformers;

Table 11: Minimum Electrical requirements for Distribution Transformers

Medium Voltage Characteristics		
Nominal Voltage (Rms)	**11kV**	**33kV**
Off load tapping (primary side)	-2.5%, -5%, 0%, +2.5%, +5%	
No. Of steps	5	
Insulator Creepage distance min (25mm/kV)	300mm	900mm
Vector group	Dyn11	
Short time withstand current duration (under three phase faults)	2 seconds	
Cooling	ONAN	

All transformers shall be hermetically sealed and suitable for both indoor and outdoor installation. All transformers shall be protected by dropout fuse isolators, arcing horns and surge arrestors. For each transformer, the maximum length any circuit shall run will not exceed 1km. The maximum loading on the transformer shall never exceed 80% of its rated capacity.

Each transformer shall have two outgoing LV circuits (one on either side of the transformer structure). Each circuit shall be protected by three sets of appropriately rated LV fuse cut-outs (HRC) or miniature circuit breakers (MCBs). To allow short overloads, a transformer fuse is typically selected to carry 150-300% of the transformer rated current. Fuse ratings shall be selected according the following formula:

$$I_{fr} \geq 1.5 \times \left(\frac{S \times 1000}{\sqrt{3} \times V \times n}\right)$$

Where I_{fr} is the minimum available fuse rating per phase; S is kVA rating of the transformer; V is the 3-phase nominal voltage on the LV side; n is the number of out-going circuits. The factor 1.5 accounts for inrush currents.

The transformers rating in kVA shall be stencilled in visible paint on the tank wall below the high voltage bushings in a clearly visible font size.

7.8 LV Network Design

Rural distribution networks (415/240V) shall be overhead lines of radial configuration mounted on wooden poles and/or concrete poles.

The maximum permitted voltage drop at the furthest consumer supply point **shall not exceed plus or minus 6%** of the nominal voltage.

The maximum LV span shall be 50m for both 3phase and single phase. The recommended pole height for LV networks shall be 9m or 10m where applicable. All loads connected to a given distribution transformer shall be properly categorised to ensure load balancing among the three phases.

An LV service connection shall consist of:

- Insulation piercing connectors
- Fully wired split type prepaid STS compliant meter
- Hook and tension clamp at the line pole
- Only 3 single phase or 2 three phase services connections shall be permitted per LV service pole. If this number of connections in to be exceeded then a distribution box is to be provided.
- Pole Top Box for up to 12 single phase connections or direct connection by piercing connector to the line.
- Overhead concentric service cable 10 mm^2 Cu for single phase consumers
- Self-supported twisted overhead cable 4 x 35 mm^2 Al for 3 phase consumers
- Kick poles, if necessary
- Hook and tension clamp at the consumer side
- Maximum horizontal distance of the customer supply point from the service pole shall be 35m

7.9 Metering

7.9.1 MV Metering

MV lines traversing more than one Service territory with different distribution network operators shall have MV metering units installed at the boundary of the two networks to record the energy dispatched.

The fully wired metering kiosk shall be supplied with a metering unit with a main and check energy meter.

The poly phase programmable stand-alone MV meter shall be able to be operated and controlled and have the following minimum features and capabilities:

- Licence fees-free programming software
- CT and VT operated. The 33kV CT metering unit shall be supplied with the multi-core CT's with range 200/100/50/25/1. The VT shall be 33 or 11kV/110V. The CT/VT will be a 3-phase 4-wire unit.
- Accuracy class 0.2 or better
- Data storage capability of 450 to 900 days of half hour data for one channel programmable integration period and
- Comprehensive tariff structure
- Instantaneous instrumentation
- Communication via optical port or communication module with an RS232 or RS422 interface; and 2G&3G communication network capabilities
- Internal clock and calendar with battery back up
- 2 element availability – three phase 3 wire meter
- 4 pulse relay outputs
- 2 line 16 character dot matrix liquid crystal display wide viewing angle
- The Energy meters supplied for the metering unit shall have an LCD display

7.9.2 Customer Supply Point Metering

Customer supply point metering shall be done through split type STS complaint pre-payment meters. The measurement control unit (MCU) shall be separated from the customer interface unit (CIU) and the mode of communication between them shall be by two core non-polarized pilot cable or inbuilt cable-less RF module or power line carrier (PLC) communication. The following minimum requirements shall also apply:

- Meters shall have both prepaid and post-paid capabilities interchangeable by a meter specific system generated token. Under the prepaid mode, the meter shall both support STS mode metering by power energy in kWh and cash mode metering by Time-of-use (ToU).
- The terminals shall be suitable for allowing at least 18mm long stripped bare conductor in diameter of at least 10mm for single phase and 23mm for three phase.
- The meter shall be provided with an anti-tamper cover, sealable with the meter body to secure the main power cable terminations. The use of these mechanical seals ensures that there will be visible signs of tampering if unauthorized entry to the system is attempted.
- The meter shall have a communication port for downloading tampering information to a PC or tablet.
- The meter shall have non-volatile memory with a minimum data retention time of 10 years.
- The meter shall be capable of "upstream" communication to a concentrator.
- Accuracy Class : 1.0

- Protection: High Resistance to short circuit, surge voltages, lightning etc.
- Short Circuit Current: 2.4 KA
- Electronic Board Withstand Voltage: 400 VAC for at least 48 Hrs.
- Impulse Withstand Voltage: Preferably greater than 6 KV
- Insulation Withstand Voltage: 2 KV per minute
- Service Life: Minimum 10 years
- Environmental protection IP54
- The meter shall have bypass detect function to compare phase line and neutral line.

8.0 MECHANICAL DESIGN CONSIDERATIONS

8.1 General Mechanical Design Approach

The two main technical aspects that shall be considered in the design of overhead distribution lines are:

- Ensuring that the mechanical load forces do not exceed the strength of the structures or other components, and
- Ensuring that there are adequate clearances - between the conductors and the ground or from other objects in the vicinity of the line, as well as between the various phase conductors and circuits themselves so that clashing does not occur.

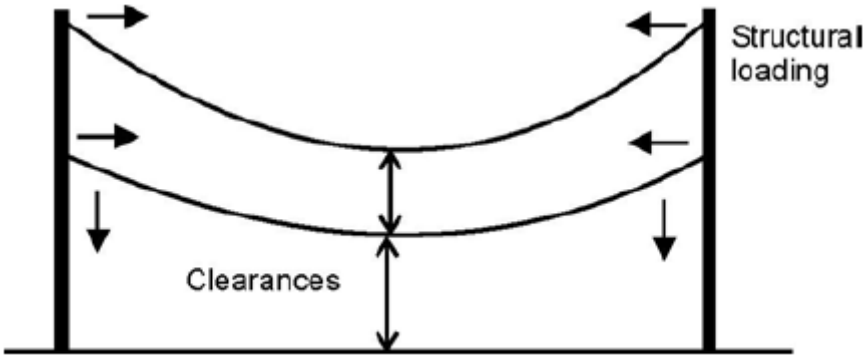
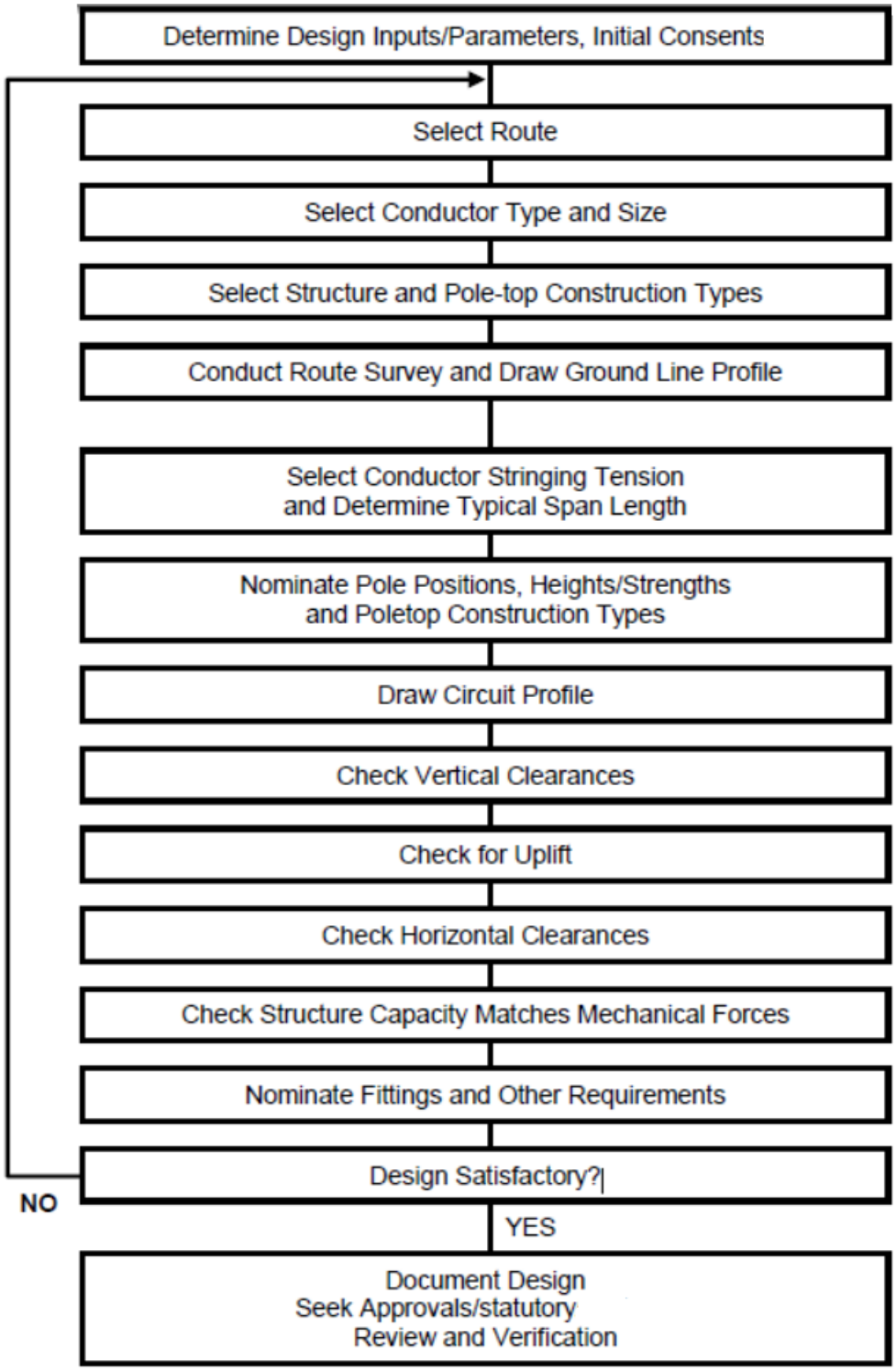


Illustration of Mechanical Considerations

8.2 Flowchart of Generalised Overhead Design Process

Typical steps in overhead distribution line design are shown below. The precise steps and their sequence will depend upon the project and the context in which the design is performed.

The process is *iterative*, with the designer making some initial assumptions, e.g. as to pole height and size, which may later need to be adjusted as the design is checked and gradually refined. The optimum arrangement that meets all constraints is required as the final outcome.



Flow Chart for Overhead Line Design Process

8.2.1 Determine Design Inputs/Parameters

Prior to commencing design, the Design Engineer shall collect and document all relevant design inputs such as:

- Preliminary planning reports, concept, specifications or customer request for supply initiating the project
- Load details
- Any special requirements of customers or stakeholders e.g., way-leaves consent
- REA planning requirements
- Possible future stages or adjacent developments, road widening or resumptions
- Relevant applicable standards or statutory ERA requirements
- Coordination with other utilities
- Survey plans or base maps
- Environmental assessments, Resettlement Action Plans (RAPs)
- Any site constraints identified.

The design should be 'traceable' back to a set of design inputs.

A REA Engineer should also be able to review the design and see why it was done a certain way.

8.2.2 Select Route

The following factors shall be taken into consideration when choosing a line route;

- Property issues, ease of acquisition of way-leaves over private lands
- Ease of obtaining approvals from statutory authorities e.g., NEMA, NFA, UWA
- Community acceptance
- Minimising vegetation clearing, environmental and visual impact, emf impact
- Access for construction, maintenance and operations
- For low voltage lines, ease of servicing all lots
- Compatibility with future development
- Suitable ground for excavation and pole foundations.
- Minimising terminations constructions

8.2.3 Select Overall Structure and Pole-Top Construction Types

Typical pole sizes are presented in Tables 12 and 13 with the applications for each class summarised in Tables 14 and 15 below.

Tables 14 and 15 below, also list the nominal maximum span lengths and deviation angles for various REA pole top MV Structure types using AAAC100 conductor.

Apart from spanning and angular limitations, the following shall be taken into account when selecting the construction type;

- Whole-of-Life cost
- Reliability
- Suitability for environment - vegetation, wildlife, salt and industrial pollution levels.

- Visual impact
- Ease of construction and maintenance.

Table 12: Sizes of Wooden Poles used for LV and MV lines

Pole Class	Pole Length	Min. Pole Top Diameter (150mm from top)	Max. Pole Top Diameter (150mm from top)	Theoretical Ground Line	Minimum Cantilever Strength at 55MPa	Minimum Mid-Point Strength at 55MPa
Unit	**m**	**mm**	**mm**	**m**	**kN**	**kN**
Light	9	130	140	1.5	3.05	7.44
	11	140	160	1.8	3.99	9.76
	12	140	160	2.0	5.23	13.00
Medium	9	144	170	1.5	4.37	11.03
	11	160	170	1.8	5.41	13.69
	12	160	180	2.0	6.85	17.55
	14	170	210	2.2	8.20	20.92
	15	200	220	2.5	8.00	20.09
	16	200	220	2.7	7.85	19.39
Stout	9	175	200	1.5	6.02	15.63
	11	180	220	1.8	7.13	18.55
	12	190	250	2.0	8.77	23.05
	14	195	250	2.2	10.22	26.73
	15	220	250	2.5	9.93	25.61
	16	220	250	2.7	9.71	24.65

Table 13: Sizes of Concrete poles used for LV and MV lines

Pole code name	Length (m)	Top Diameter (mm)	Taper Ratio	Working load (kN) applied 300mm from the tip	Ultimate load (kN) applied 300mm from the tip	Wall thickness (mm)	Depth Underground (m)	Maximum deflection of the tip at a load 10% beyond working load (mm)
9C1	9	150	1/75	2.05	3.30	40.00	1.50	180
9C2	9	190	1/75	3.00	4.80	40.00	1.50	180
9C3	9	190	1/75	3.90	6.25	50.00	1.50	180
10C1	10	150	1/75	2.15	3.45	40.00	1.60	200
10C2	10	190	1/75	3.10	5.00	40.00	1.60	200
10C3	10	190	1/75	3.90	6.25	50.00	1.60	200
11C1	11	150	1/75	2.50	4.00	40.00	1.80	220
11C2	11	190	1/75	3.70	5.90	50.00	1.80	220
11C3	11	190	1/75	4.70	7.50	50.00	1.80	220
12C1	12	190	1/75	2.60	4.15	40.00	2.00	240
12C2	12	190	1/75	3.75	6.00	50.00	2.00	240
12C3	12	190	1/75	4.85	7.75	50.00	2.00	240
14C1	14	190	1/75	3.40	5.45	50.00	2.20	350
14C3	14	190	1/75	5.00	8.00	50.00	2.20	350

8.2.4 Pole-Top Configurations

The more compact a pole-top construction is, the less visually obtrusive it is, although reduced phase separation means reduced spanning capability.

Designers shall aim to keep constructions reasonably consistent along a line. Not only is this more visually pleasing, but rolling from one style to another can reduce spanning capability and cause confusion with phasing.

The two overhead construction formations are Vertical Configuration and Horizontal Configuration.

8.2.4.1 Horizontal Pole-top Configuration

- Horizontal construction (Cross-arm) has the advantage of requiring minimal pole height, but at the expense of greater overall overhead line and easement width. Wooden cross-arms have the drawback of being prone to rot and weathering, leading to in-service failure. Wooden cross-arm shall not be used without Authorisation from REA.
- For strength needs in design, galvanised low carbon mild steel cross-arms (or any better Cross-arms) are the preferred choice.
- Horizontal constructions are preferred for spans in areas frequented by aquatic birds. For higher frequency risk spans, increased horizontal conductor separation can reduce bird impact conductor flashover, and bird diverters can be added to conductors to provide more effective visual warning to birds in flight.

8.2.4.2 Vertical Pole-Top Configuration

- Vertical construction is excellent for narrow easements or to reduce vegetation clearing, but requires additional pole height.
- Vertical Delta or Delta Pin construction provides both horizontal and vertical separation between phases, which helps reduce the incidence of conductor clashing.
- Pilot insulators for section structures shall be of composite material in order to accommodate the stress and strain forces imposed on the insulators.

8.2.5 Design Spans

The following functional types of poles shall be used with the specified maximum design spans [m] in 33 kV lines:

Table 14: MV wooden pole structures and their applications

No.	Structure Type	Use	No. Stays	Min.Span Length (m)	Max.Span Length (m)
	Single Member Structures				
1	Intermediate	• For supporting Conductors where the line deviation is 0^0	0	80	100
2	Pin / Light/Flying Angle	• For supporting Conductors where the line deviation is $5^0 \leq \Theta \leq 15^0$. • To be used upon approval	1	80	100
3	Vertical Angle Section	• For terminating Conductors • For line deviation of $15^0 \leq \Theta \leq 90^0$	3	80	100
	Two Member Structures				
1	Intermediate Support	• For supporting Conductors where the line deviation is 0^0 • For inter-spans greater than 100m • To strengthen the line against wind	0	100	180
2	Straight Section	• Used to sectionalize the line where the line deviation is 0^0 • Also used for switchgear support • For inter-spans greater than 100m • To strengthen the line against wind	4	100	180
3	Angle Section	• Used to sectionalize the line where the line deviation is $60^0 \leq \Theta \leq 90^0$	5	100	180
4	Tee-off	• interconnect a transformer • interconnect a new line	2	50 100	60 180
6	Transformer structure	• Support structure for the transformer • Orthogonal to the main line	2	30	100
7	Terminal	• Used at the point where the power line terminates.	2		100
	Three-Member Structures				
1	Straight Section	• For supporting Conductors where the line deviation is 0^0	6	180	250

		• For inter-spans greater than 180m • To strengthen the line against wind			
2	Angle Section	• For supporting Conductors where the line deviation is $60^0 \leq \Theta \leq 90^0$	7	250	300

Table 15: MV Concrete pole structures and their applications

	Structure name	Angle of Deviation	Recommended pole type	Ideal Span	Max span
	Single Member Structures				
1	Intermediate structure	0^0	11C1, 12C1, 14C1	0 to 100m	110m in preferable conditions
2	Single pole pin angle (light angle)	0^0 to 50^0	11C2, 12C2, 14C3	0 to 90m	100m in preferable conditions
3	single pole horizontal section (straight section)	0^0 to 60^0	11C2, 12C2, 14C3, 11C3, 12C3	0 to 90m	100m in preferable conditions
4	single pole vertical section	0^0 to 90^0	14C3, 12C3	0 to 90m	110m in preferable conditions
5	Single pole t-off structure	N/A	11C2, 12C2, 14C3, 11C3, 12C3	0 to 90m	100m in preferable conditions
	Double Pole Structures				
1	Double pole intermediate structure (support)	0^0	11C1, 12C1, 14C1	0 to 140m	160m in preferable conditions
2	33 kV double pole section	0^0 to 90^0	11C2, 12C2, 14C3, 11C3,	0 to 150m	180m in preferable

			12C3		conditions
3	Transformer equipment structure double pole	N/A	12C2	0 to 60m	
4	Double pole T off	N/A	11C2, 12C2, 14C3, 11C3, 12C3 + 9C2, 9C3	0 to 90m	110m in preferable conditions
5	Double pole terminal	N/A	11C2, 12C2, 14C3	0 to 100m	120m in preferable conditions
	Three Member Structures				
1	three member intermediate (support)	0^0	12C1, 14C1	100 to 250m	300m in preferable conditions
2	33 kV three member section	0^0 to 90^0	12C3, 14C3	100 to 250m	300m in preferable conditions
	LV Pole Structures				
1	LV intermediate	0^0	9C1, 10C1	0 to 40m	50m in preferable conditions
2	LV section	0^0 to 90^0	9C2, 9C3, 10C2, 10C3	0 to 40m	50m in preferable conditions
3	LV T-off				
4		N/A	9C2, 9C3, 10C2, 10C3	0 to 40m	50m in preferable conditions
5	LV terminal	N/A	9C2, 9C3, 10C2, 10C3	0 to 40m	50m in preferable conditions

- The average span shall amount to approximately 100m for the main lines. The mid span sag at a conductor temperature of 75°C is estimated at 0.223 m.

- Wide span structures for spans up to 250m may be realized by structures of three individual stayed tension poles. The distance between poles shall be selected depending on the span. Wide span sections may be used for crossing valleys.
- For three member structures with span greater than 300m approval has to be sought from REA.
- **The average ratio between Intermediate structures and H-pole structures shall be 10:1 in easy terrain, and 8:1 in more challenging terrain.**
- The spans for t-offs and inside the villages are shorter (70m), if necessary.
- Mixed MV/LV lines can be arranged with standard MV spans of 80 to 100m and additional LV poles in the middle of such spans (50m for LV). This shall only be permitted for horizontal pole-top configuration.
- Angle or Tension poles are stayed 14m poles.
- **For concrete pole Overhead lines with Aerial earth only 14m poles shall be used.**
- Section poles for long straight sections shall also be H type structures and have two stays in the in-line direction. They protect the line against cascading.
- The dead end pole structure shall be a stayed H wood/concrete structure with horizontal phase arrangement and cross-arms for fixing the phases, the cable sealing end as well as the lightning arresters.

8.2.6 Classification of Poles

All poles used in REA construction shall be colour coded and a visible ring painted at the theoretical ground level of the pole planting depth before dispatch from the pole plant. The colour coding shall facilitate size identification during handling and storage. The paint used for colour coding shall be indelible and in accordance with the Tables 16 and 17 below:

Table 16: Wooden Pole class and application

Pole Class	Pole Length	Min. Pole Top Diameter (150mm from top)	Max. Pole Top Diameter (150mm from top)	Application	Color Code
	m	**mm**	**mm**		
Light	9	130	140	LV Intermediates, light angles	Black
	11	140	160	MV Intermediates.	Pink
	12	140	170		
Medium	9	144	170	LV Heavy angles, T-off lay pole	Green
	11	150	170	MV intermediates	Navy Blue
	12	150	180	MV intermediates	Yellow

	14	170	210	MV intermediates, Flying Angles	Red
	15	200	220	MV Combined Constructions	
	16	200	220	MV Combined Constructions	
Stout	9	175	200		
	11	180	220	MV Heavy angles	Sky blue
	12	190	250	MV heavy angles	White
	14	195	250	MV heavy angles	Orange
	15	220	250	MV Combined Constructions	
	16	220	250	MV Combined Constructions	

Table 17: Concrete Pole Class and application

Pole type	Pole height	Plant Depth (m)	Colour code	Utilization
9C1	9 m	1.50	Black	LV intermediate, straight-line poles without angles
9C2	9 m	1.50	Green	LV Angles, sections, T offs and terminals
9C3	9 m	1.50	Two strips of green	LV structures which hold very long spans, heavy conductor, multiple way sections
10C1	10 m	1.60		LV intermediate, straight-line poles without angles
10C2	10 m	1.60		LV Angles, sections, T offs and terminals
10C3	10 m	1.60		LV structures which hold very long spans, heavy conductor, multiple way sections
11C1	11 m	1.80	Pink	MV intermediate, straight-line poles without angles

11C2	11 m	1.80	Navy Blue	MV Angles, sections, T offs and terminals
11C3	11 m	1.80	Sky Blue	MV structures which hold very long spans, heavy conductor and heavy angles
12C1	12 m	2.00	Two strips of red	MV intermediate, straight-line poles without angles
12C2	12 m	2.00	Red	MV Angles, sections, T offs and terminals
12C3	12 m	2.00	White	MV structures which hold very long spans, heavy conductor and heavy angles
14C1	14 m	2.20	Two strips of orange	MV Intermediates, Angles, sections, T offs and terminals
14C3	14 m	2.20	Orange	MV structures which hold very long spans, heavy conductor and heavy angles

8.2.7 Conduct route survey and Draw ground line profile

The line route is surveyed to determine:

- Proposed route for the new line
- Details of existing electricity infrastructure
- Terrain and site features, e.g. Trees, access tracks, fences, gullies.
- Ground line rise and fall along the route.

Ground line profiling may not be necessary for small community projects in rural areas where the ground is reasonably level or has a consistent slope throughout and there are no on site obstructions. This shall be determined at the discretion of the REA Contract manager. The designer can check ground clearances by simply deducting the sag in the span from the height of the supports at either end.

However, ground line profiling is essential where:

- Poles have to be positioned along an undulating traverse
- There is a 'hump' or change in gradient in the ground mid-span
- In rural areas where spans are comparatively long—say in excess of 100m
- The designer has doubts as to whether required clearances will be met (ground or inter-circuit or over some structure such as a streetlight column)
- Where uplift on poles is suspected.

The equipment used to obtain measurements will depend on complexity of project. For many distribution lines, a simple electronic distance measuring device and inclinometer are adequate. Elsewhere, use of a total station, a high-end GPS unit or LiDAR may be warranted.

Apart from the ground line, various features and stations must be shown—existing poles, gullies, fences, obstacles, roadways.

A clearance line is then drawn offset from the ground line, according to the minimum vertical clearances that apply (Table 18). This line shows the lowest level to which the line may sag under maximum load conditions. The clearance line height may vary along the route, according to the circumstances that apply e. g. whether along a footpath, over a highway or a non-trafficable area.

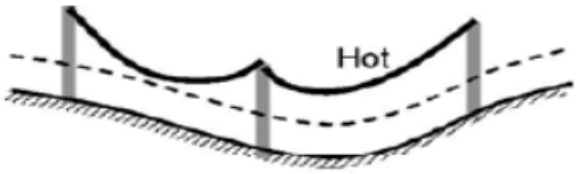


Table 18: Minimum Clearance Requirements

CONDITION	33kV
Running along:	
Urban street / road/railway	5.8m
Rural road	5.8m
Crossing Over	
Street/road	6.8m
Gazetted Highway	8.0m
Conductors of different circuits, communication lines, & cradles	1.8m
Buildings floors accessible to pedestrians only	4.6m
Building roofs accessible to pedestrians only	3.7m
Safety Clearance	
Phase to Electrical ground	0.5m
Phase to Phase	0.5m
33kV and 11kV	1.2m
MV and LV	1.2m
Connecting Jumpers above ground	4.3m
Width of line Clearance corridor	10m
Above ground not road	
Urban areas	5.0m
Rural areas	5.0m

Ground clearance can be checked by ensuring that the 'hot' curve does not fall below the clearance line offset from the ground line. If there is insufficient ground clearance, the designer may need to:

- reduce span length
- increase stringing tension
- increase pole height
- adjust pole positions to try to fit in better with the terrain.

Where there are long spans with a supercircuit and a subcircuit, intercircuit clearance should be checked. The supercircuit will be drawn at the maximum design temperature and the subcircuit at the 'cool' temperature, 15°C.

8.2.8 Select Conductor Stringing Tension and Determine Typical Span Length

Select a suitable stringing table which matches the typical span length along the route. For instance Table 19 below:

Table 19: Conductor Design Table for 100mm^2 "OAK" AAAC (Severe Weather Area)

Temp. (Deg. C)	Tension (Kgf)	Sag (m) for Span (m)								
		50	60	70	80	90	100	110	120	130
-6	736.6	0.14	0.20	0.27	0.36	0.45	0.56	0.67	0.80	0.94
0	651.2	0.16	0.23	0.31	0.40	0.51	0.63	0.76	0.90	1.06
5	583.9	0.18	0.25	0.34	0.45	0.57	0.70	0.85	1.01	1.18
10	521.0	0.20	0.28	0.38	0.50	0.64	0.79	0.95	1.13	1.33
15	463.7	0.22	0.32	0.43	0.56	0.71	0.88	1.07	1.27	1.49
20	412.9	0.25	0.36	0.49	0.63	0.80	0.99	1.20	1.43	1.67
25	368.9	0.28	0.40	0.54	0.71	0.90	1.11	1.34	1.60	1.87
30	331.7	0.31	0.44	0.60	0.79	1.00	1.23	1.49	1.78	2.08
35	300.6	0.34	0.49	0.67	0.87	1.10	1.36	1.65	1.96	2.30
40	274.7	0.37	0.54	0.73	0.95	1.21	1.49	1.80	2.14	2.52
45	253.2	0.40	0.58	0.79	1.03	1.31	1.62	1.95	2.33	2.73
50	235.2	0.43	0.63	0.85	1.11	1.41	1.74	2.10	2.50	2.94
55	219.9	0.47	0.67	0.91	1.19	1.51	1.86	2.25	2.68	3.14
60	207.0	0.49	0.71	0.97	1.27	1.60	1.98	2.39	2.85	3.34
65	195.8	0.52	0.75	1.02	1.34	1.69	2.09	2.53	3.01	3.53
70	186.0	0.55	0.79	1.08	1.41	1.78	2.20	2.66	3.17	3.72
75	177.5	0.58	0.83	1.13	1.48	1.87	2.31	2.79	3.32	3.90
80	169.9	0.60	0.87	1.18	1.54	1.95	2.41	2.91	3.47	4.07

8.3 Pole Foundation Design

The foundations shall be designed to resist uplift, overturning and vertical and horizontal pressure. Foundations shall also be able to withstand the stresses, which may be imposed upon them under erection and stringing operations. The following shall also be considered;

For normal soil (bearing capacity min. 300 kN at 2 m depth) conditions the treated wood poles shall be buried directly into the ground at a depth of minimum 1/6 of the total pole length or depths in Table 20 whichever prevails.

- Foundation design shall also take account of the rupturing capacity of the ground. In excavating foundation holes, the minimum amount of soil shall be disturbed in order to take advantage of the load bearing value of the virgin ground as far as possible. Back-filled soil shall be compacted using hand or mechanical compaction methods, not more than 150mm of loose soil shall be returned between each ramming operation.

- All structures shall have a minimum of one foundation block fitted at a minimum of 500mm below ground level. Where an angle of deviation exists the top foundation block shall be on the inside of the angle.
- In poor soil conditions i.e. clay or loose sand (bearing capacity min. 150 kN at 2m depth) the poles shall be reinforced by 2 pads mounted in line direction and connected to the pole at a depth of 0.80m with stud bolts (Use of baulks or kick blocks).The standard size of a baulk is 1300 × 250 × 125 mm. Baulks are used to support wood poles by increasing the surface area that is available for ground resistance to overturning or sinking.
- If the pole hole is not being dug by hand but is to be *augered* (large earth drill), then fitting of baulks (kick blocks) is not easy and instead increasing the pole planting depth or increasing the pole's effective diameter by backfilling the gap between the pole and the surrounding soil should be done; this can be done with concrete or a proprietary product that allows backfill to consolidate chemically (such as cement or marrum bands (laterite soils)).
- For soils in flooded areas the pole shall be fixed to a precast reinforced concrete stub which will be placed into the soil as to avoid submerging of the wooden material or use of marrum bands.
- All Foundations shall have a minimum factor of safety of 2.5 in a Non Severe Weather Environment and up to 3.5 in a Severe Weather Environment.

Table 20: Depth of Pits for Various Pole Heights

Length (m)	Depth of Pole (m)
9	1.5
10	1.6
11	1.8
12	2.0
14	2.3

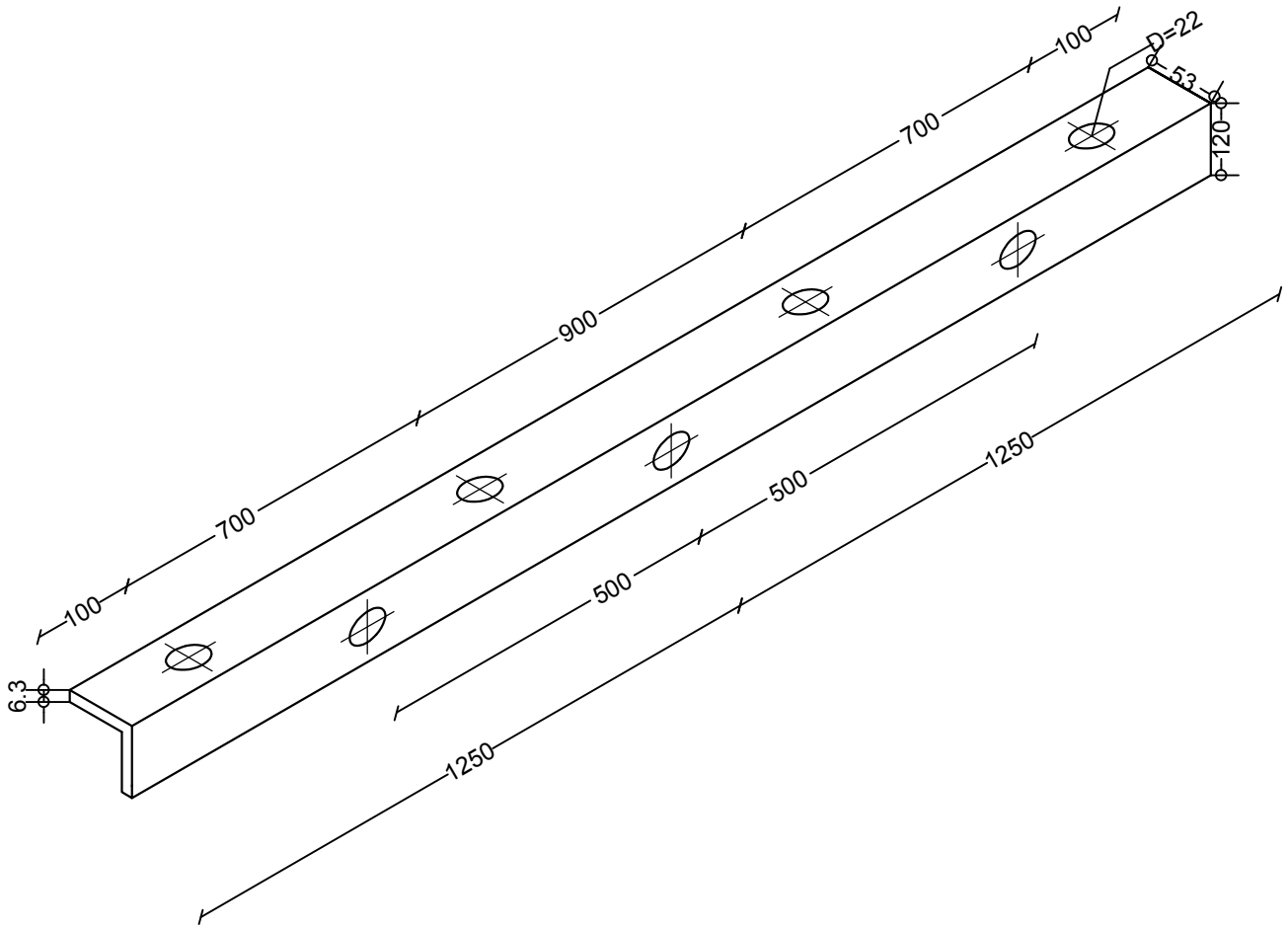
8.4 Cross-Arm Designs

The minimum requirements for all cross-arms shall be:

- Hot dip galvanized low carbon mild steel shall be used in the manufacture of cross arms in accordance with ASTM A123 and BS 729
- The structural steel used shall be **low carbon mild steel grade 43A** as specified in ASTM A36.
- The tensile strength and yield stress shall not be less than 430/510N/sq.mm and 255N/sq.mm respectively. Angle sections shall be as per BS 4848 while channel sections shall be as per BS 4.
- The thickness of all cross arms shall not be less than 9.5mm.
- The minimum dimension requirements for each structure type are as shown in Table 21 below.

Table 21: Cross-arm dimensions and applications

Item No.	Particulars	Cross-arm Dimensions (mm)	Application
	Single Member		
1	Intermediate	120x53x6.3mm-2500mm	Used at single member intermediate structures with a span of 80-100m.
	Two Member		
1	Intermediate	120x53x6.3mm-3000mm	Used at two member intermediate structures with a span of 100-180m.
2	Straight Section	150x100x10mm-3000mm	Used at two member section structures with a span of 100-180m.
3	Angle Section	150x100x10mm-3000mm	Two of these are used at two member angle section structures with a span of 100-180m.
4	Tee-off	150x100x10mm-3000mm	Used at the lay pole of the tee-off structure
5	Transformer Structure	150x100x10mm-3000mm	Used for terminal and pilot cross-arms
6	Switchgear	150x100x10mm-3000mm	Used at Auto-recloser, and LBS/ ABS structures.
7	Terminal	150x100x10mm-3000mm	Used at the terminal structure of the line.
	Three Member		
1	Straight Section	200x150x15mm-6000mm,70kN	Used at 3-member structures with a span of 180-250m
2	Angle Section	200x150x15mm-6000mm,70kN	Used at 3-member structures with a span of 250-300m
		250x200x15mm-9000mm, 100kN	Used for 3-member structures with a span greater than 300m



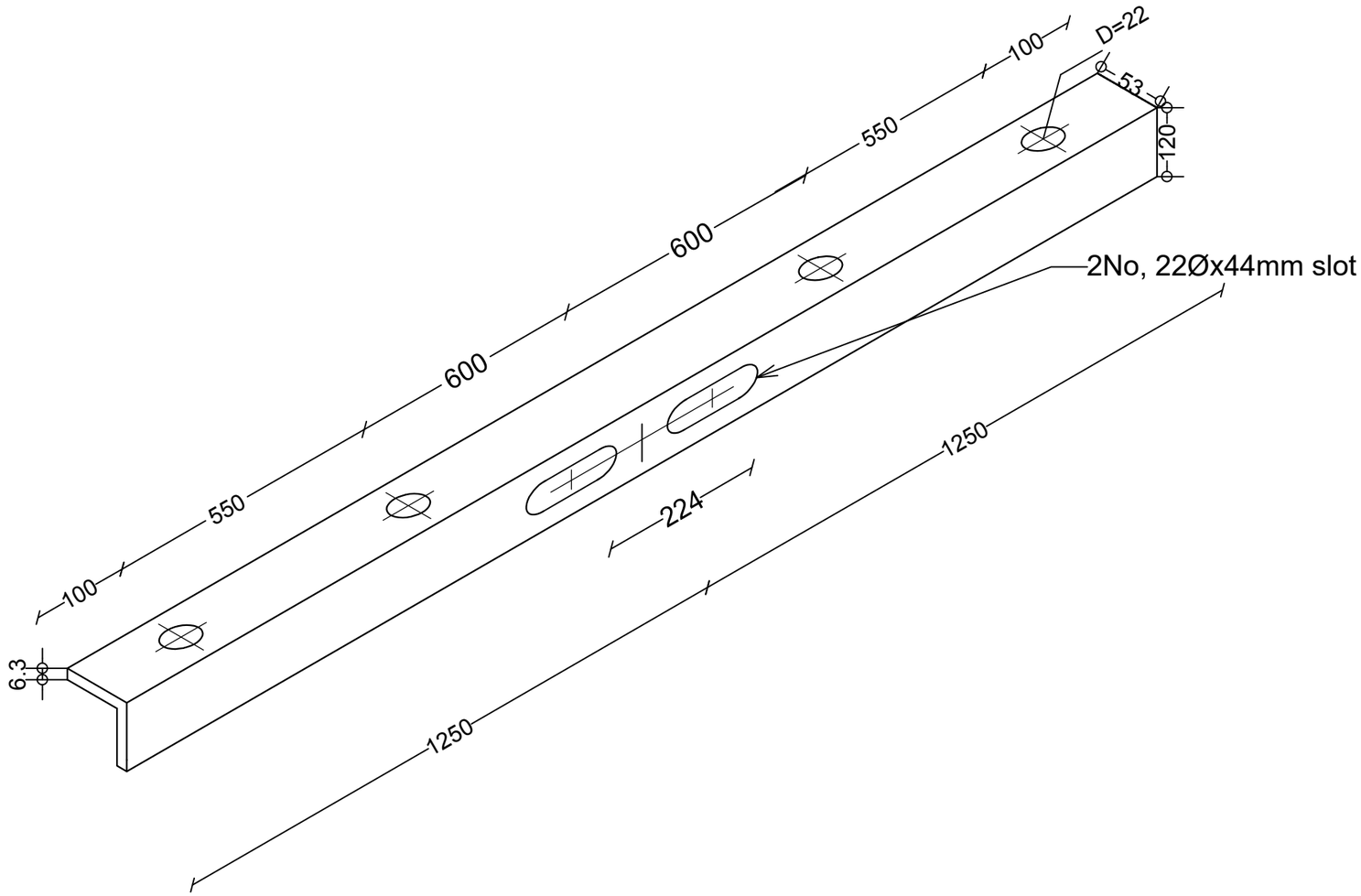
RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

MV SINGLE MEMBER CROSS ARM (2500MM)

APPROVED BY:	PRODUCED BY:	DRAWN BY:	
	CHECKED BY:	DATE:	
	SCALE:		
	DRW NO:		



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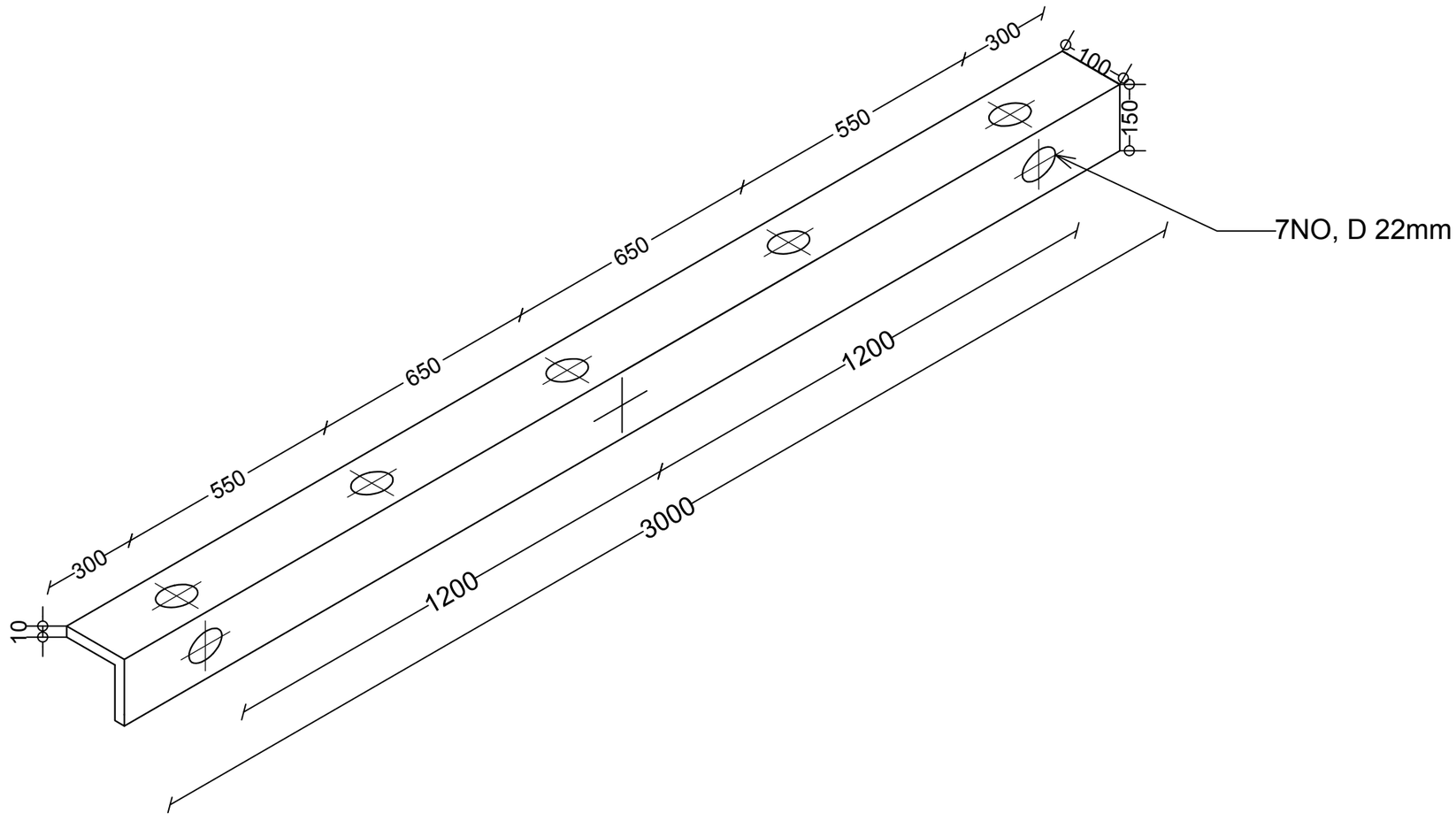
TEL:

"The Peoples Electricity Link"

TITLE:

INTERMEDIATE CROSS ARM- SINGLE POLE

APPROVED BY:	PRODUCED BY:	DRAWN BY:	
	CHECKED BY:	DATE:	
	SCALE:		
	DRW NO:		



NOTES:

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UGANDA

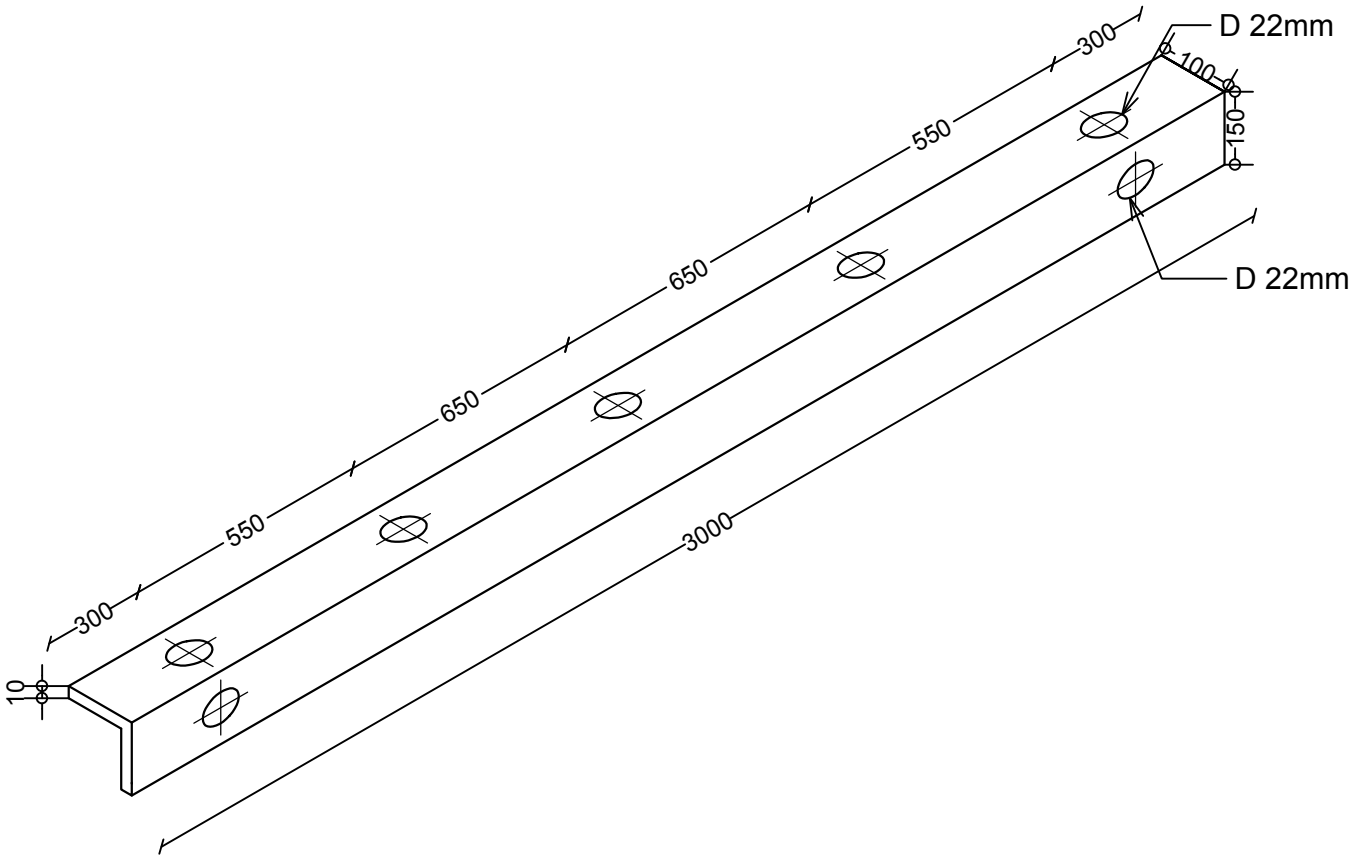
TEL:

"The Peoples Electricity Link"

TITLE:

MV TERMINAL/ LINE T-OFF CROSSARM

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



NOTES:

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			CHECKED BY: K.R	DATE:	
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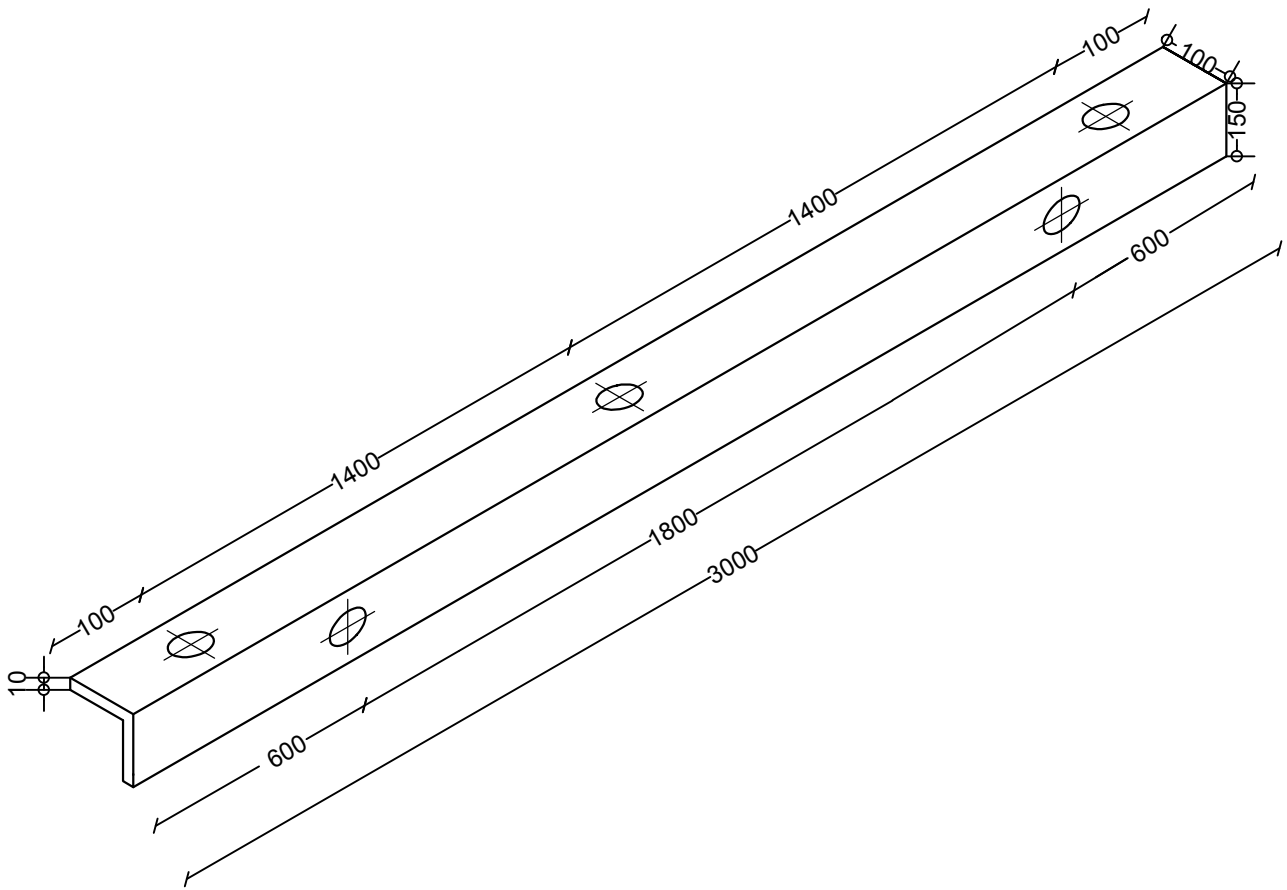

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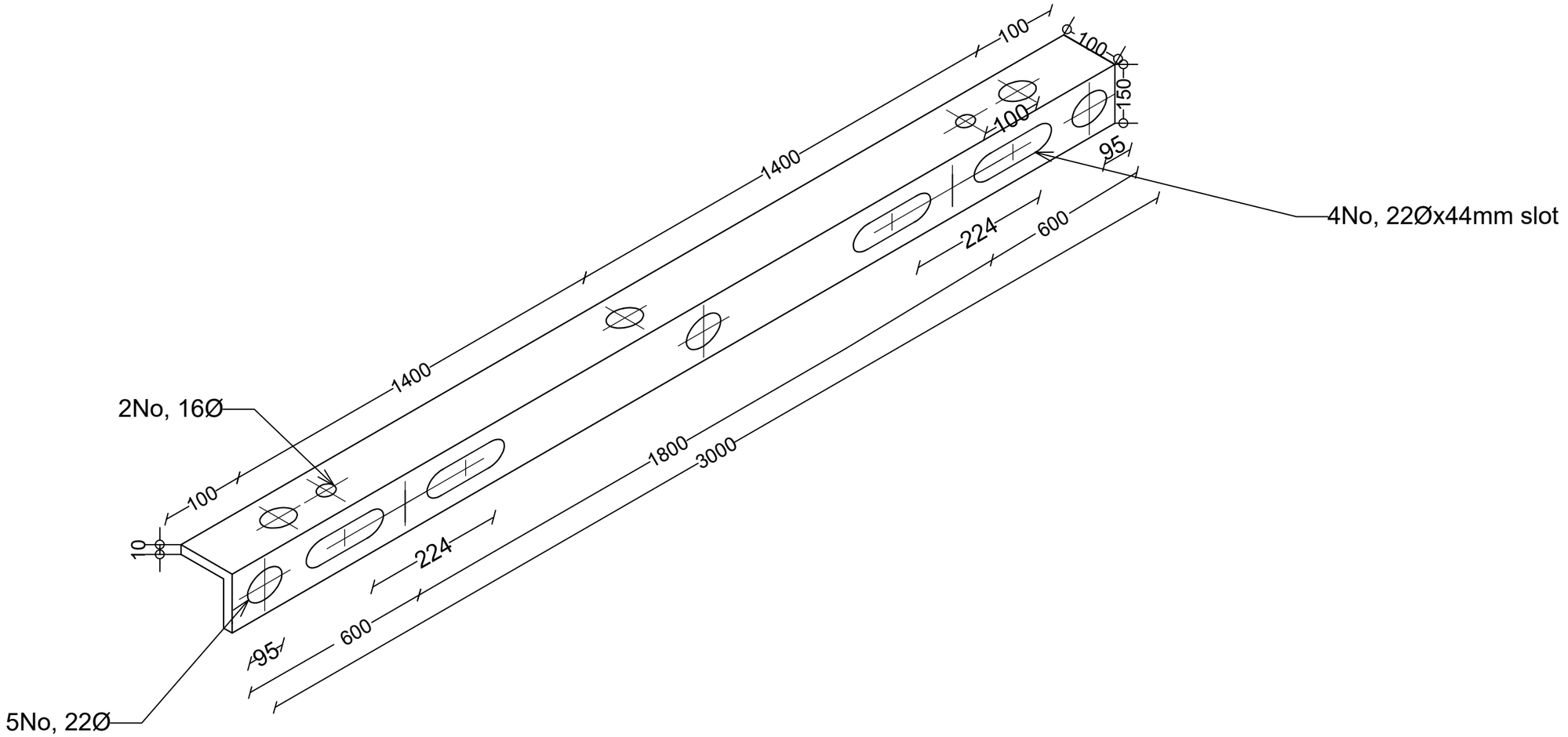
TEL:

TITLE:

MV TWO MEMBER CROSSARM (3000MM)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



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UGANDA

TEL:

"The Peoples Electricity Link"

TITLE:

MV INTERMEDIATE/SECTION TWO MEMBER CROSSARM

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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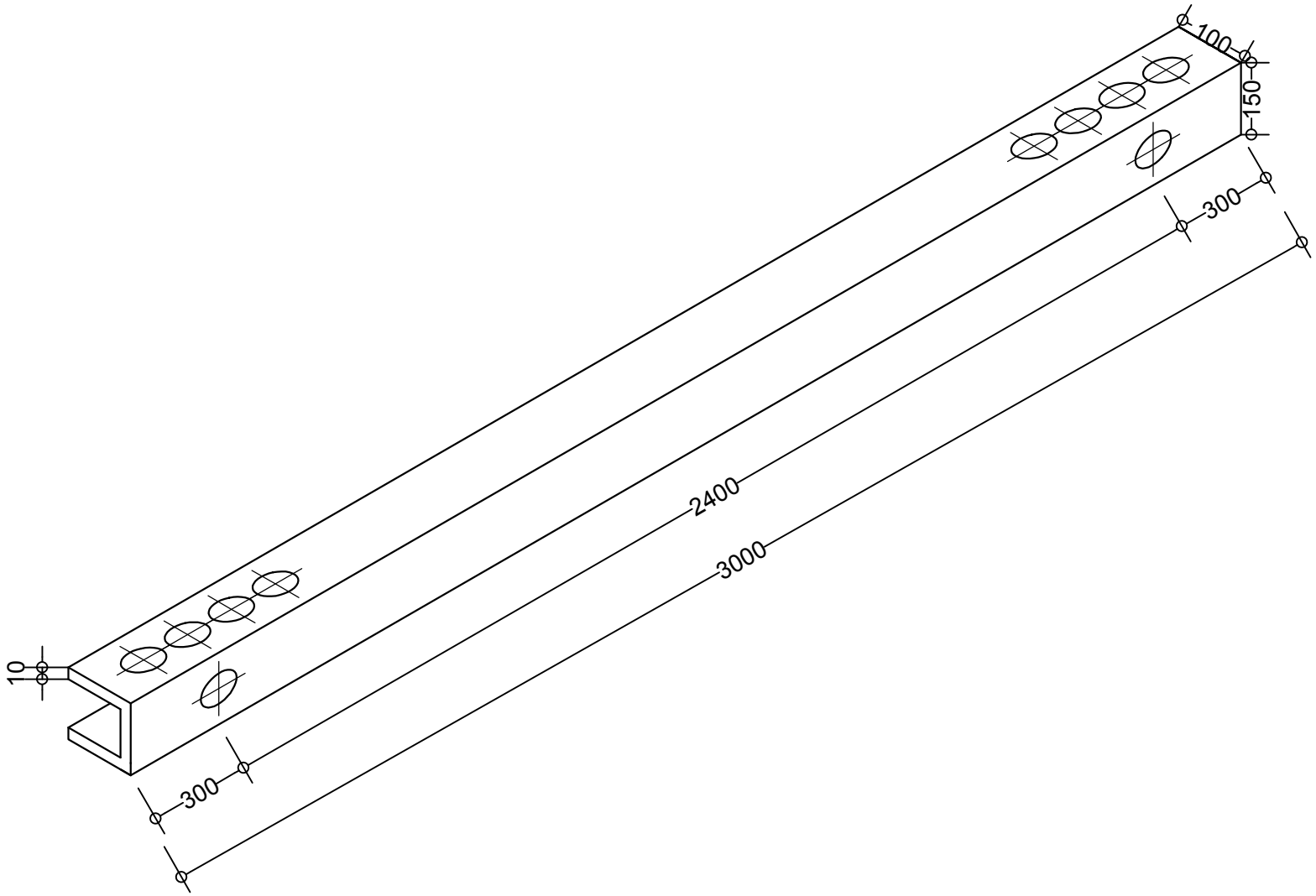
	DRW NO:		



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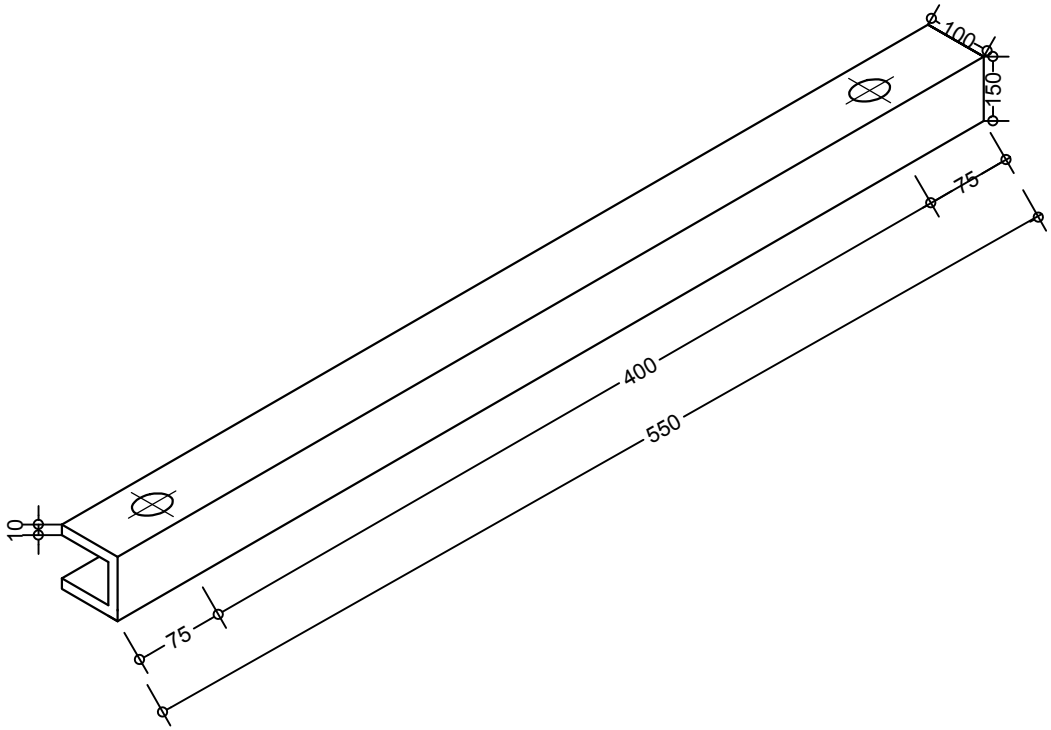
TEL:

TITLE:

TRANSFORMER U CHANNEL

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



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UGANDA

TEL:

TITLE:

TRANSFORMER PLATFORM U CHANNEL

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
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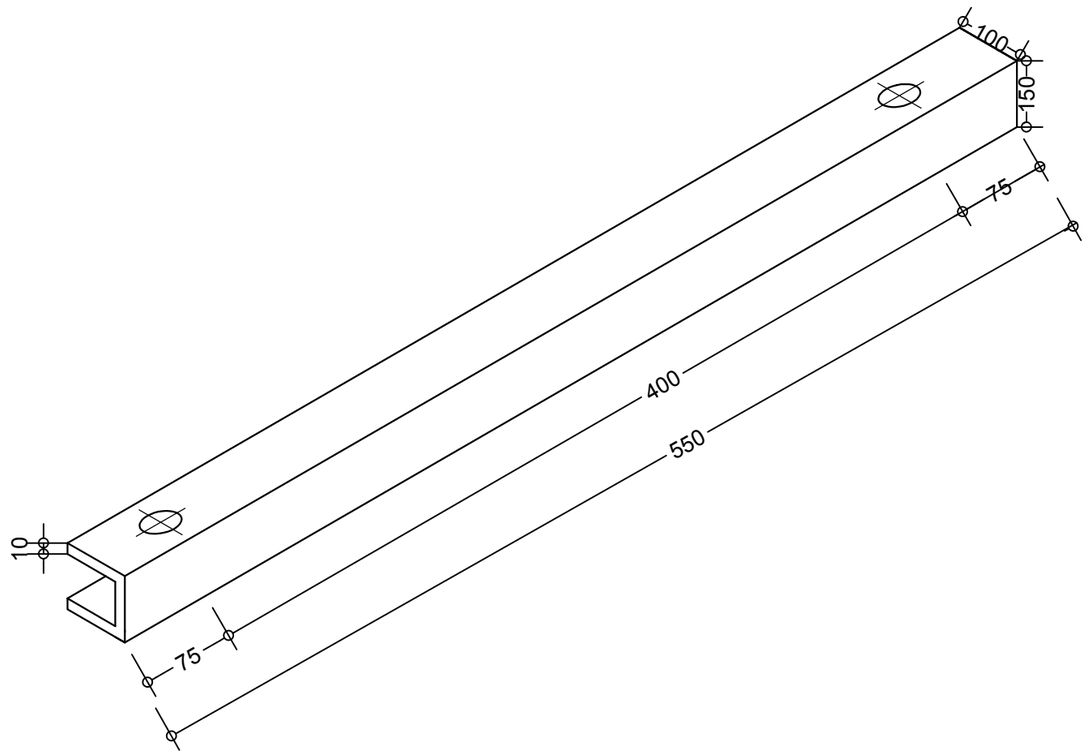

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TEL:

"The Peoples Electricity Link"

TITLE:

TRANSFORMER PLATFORM U CHANNEL

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
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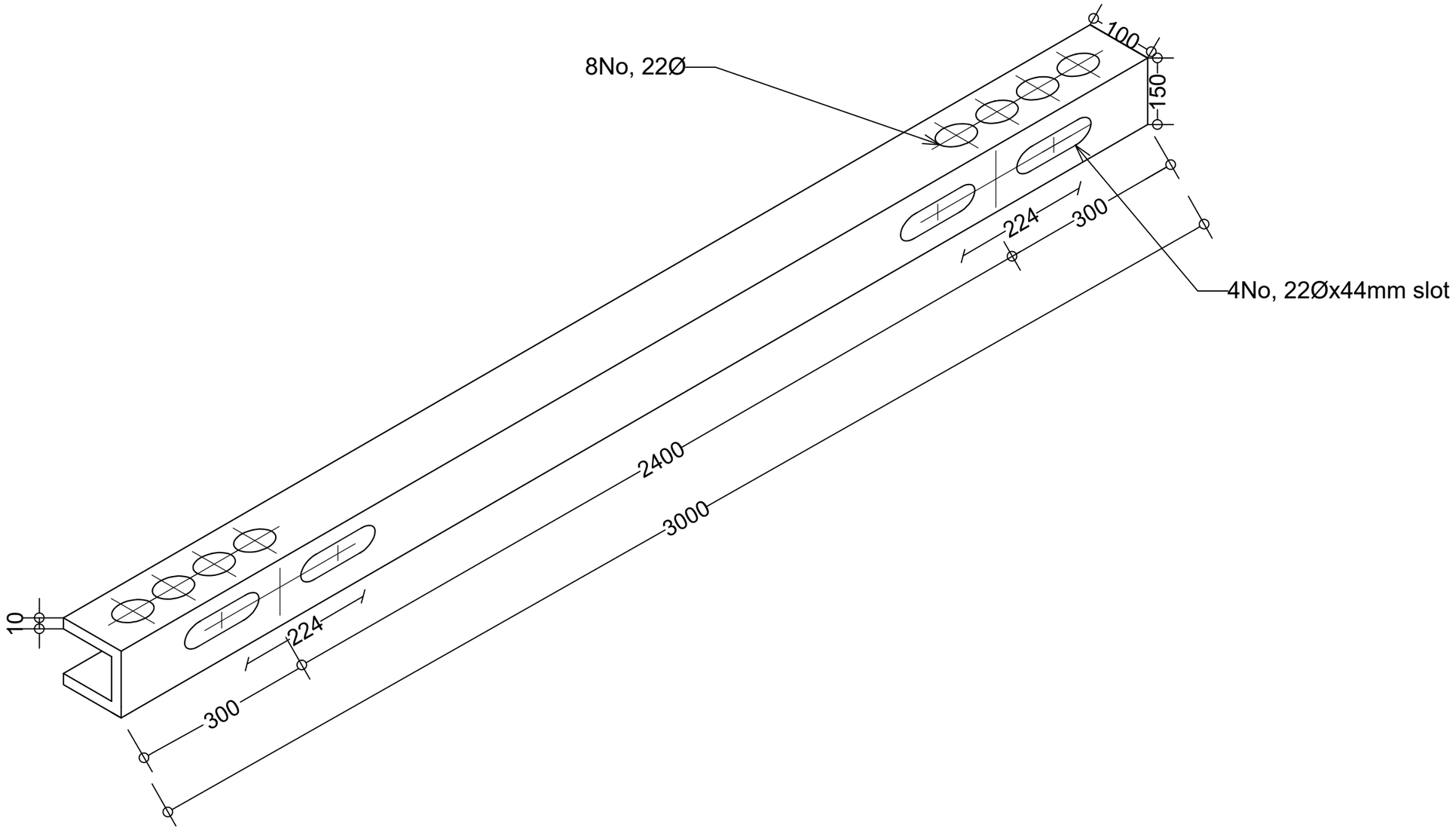

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KAMPALA
UGANDA

TEL:

"The Peoples Electricity Link"

TITLE:

TRANSFORMER U CHANNEL

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
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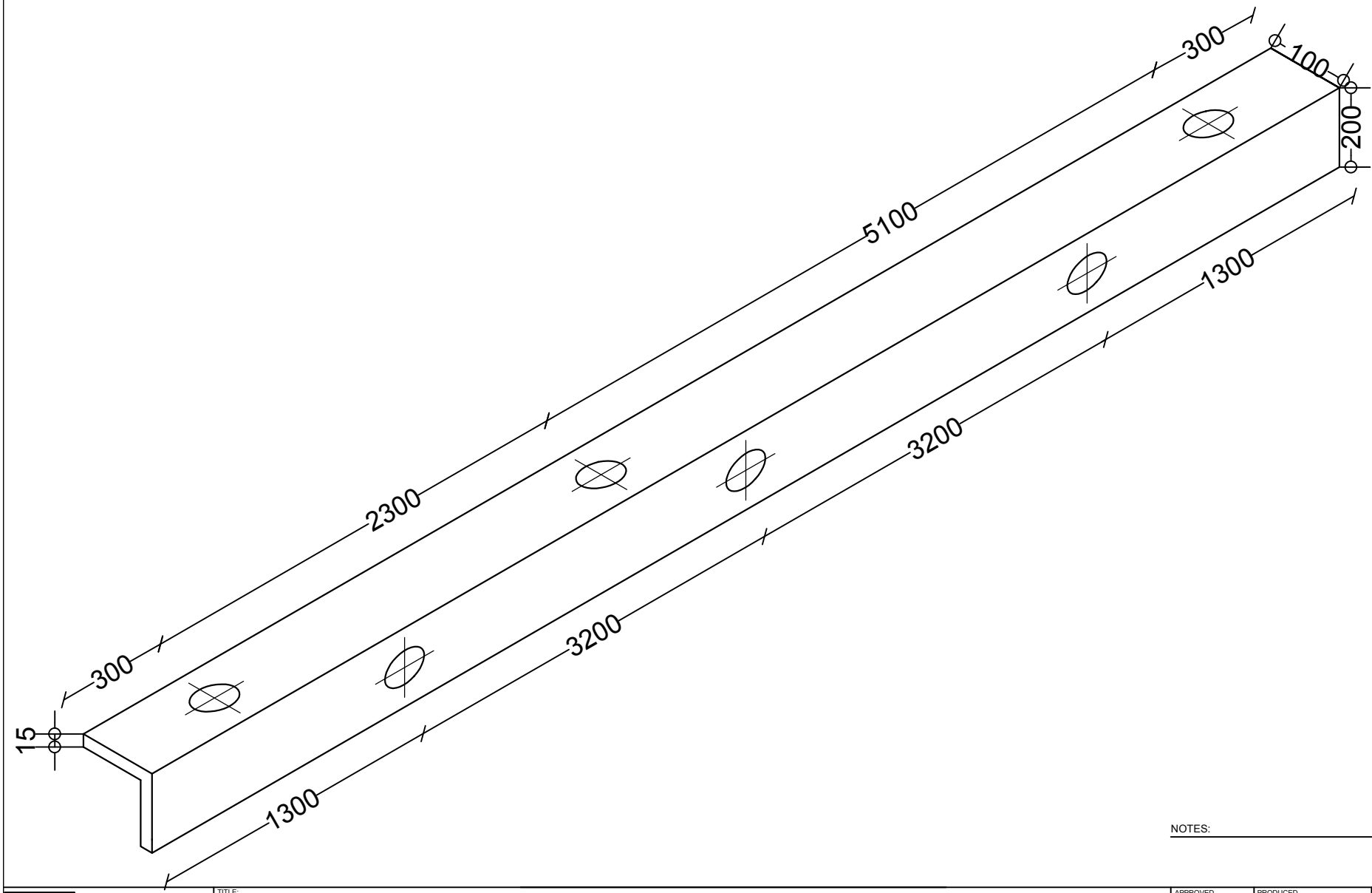

NOTES:

RURAL ELECTRIFICATION AGENCY
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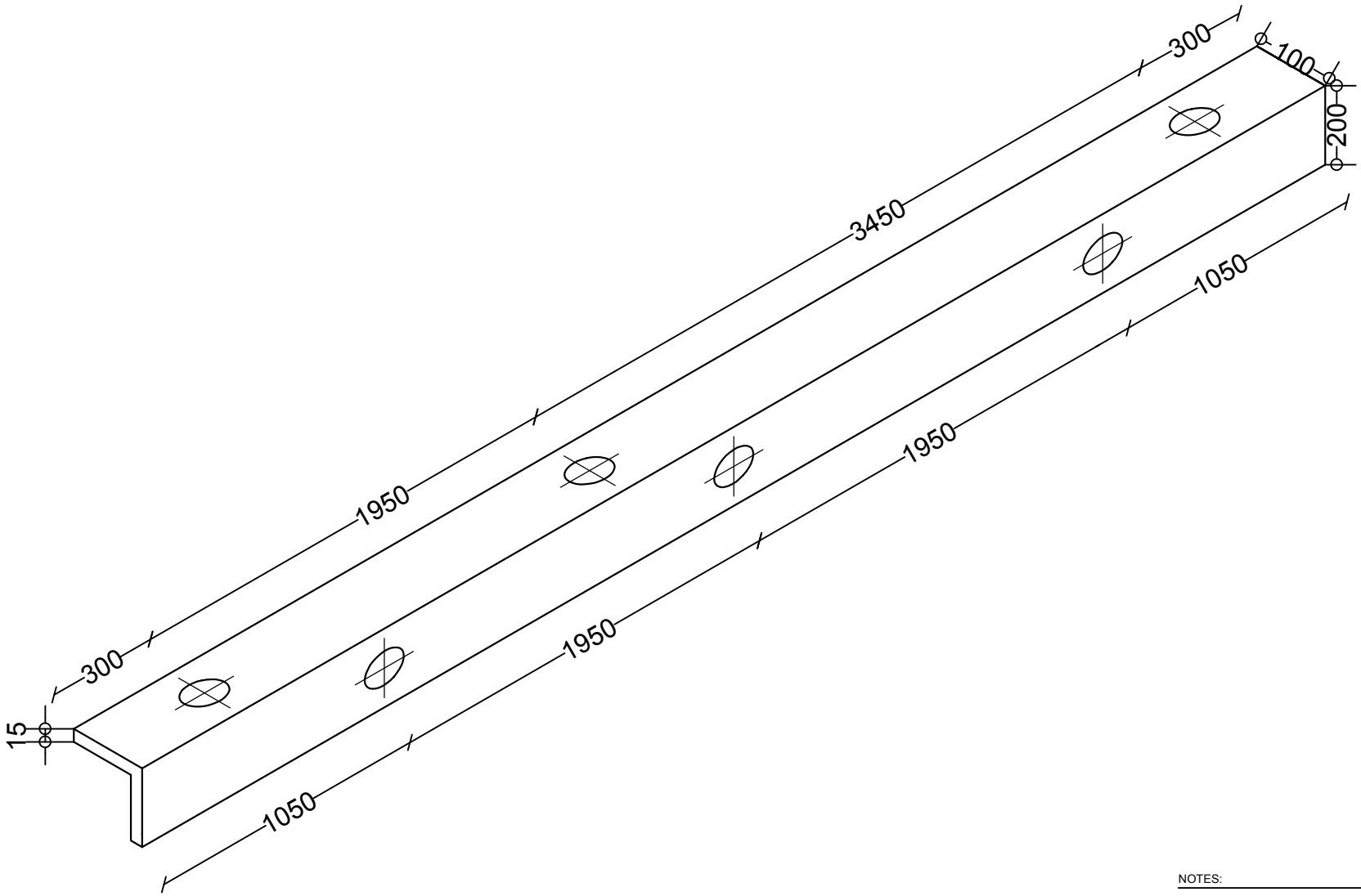
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

MV THREE MEMBER CROSSARM(9000MM)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



NOTES:

RURAL ELECTRIFICATION AGENCY PLOT 1, PLILKINGTON ROAD 10TH FLOOR, WORKERS HOUSE P.O.BOX 7317 KAMPALA UGANDA TEL:	TITLE: MV THREE MEMBER CROSSARM (6000MM)	APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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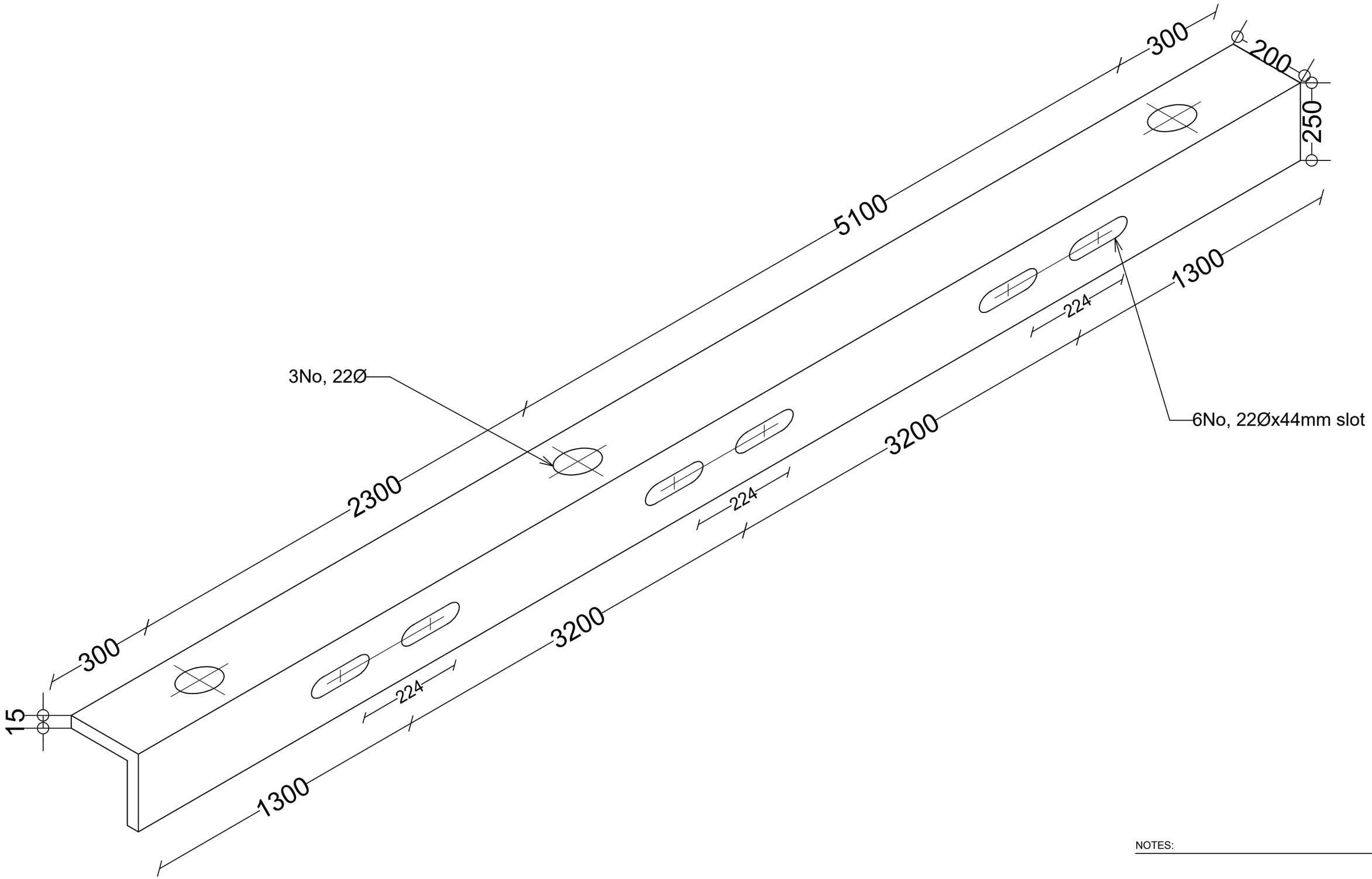

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10TH FLOOR, WORKERS HOUSE
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TEL:

TITLE:

INTERMEDIATE CROSS ARM- THREE MEMBER - NINE METER

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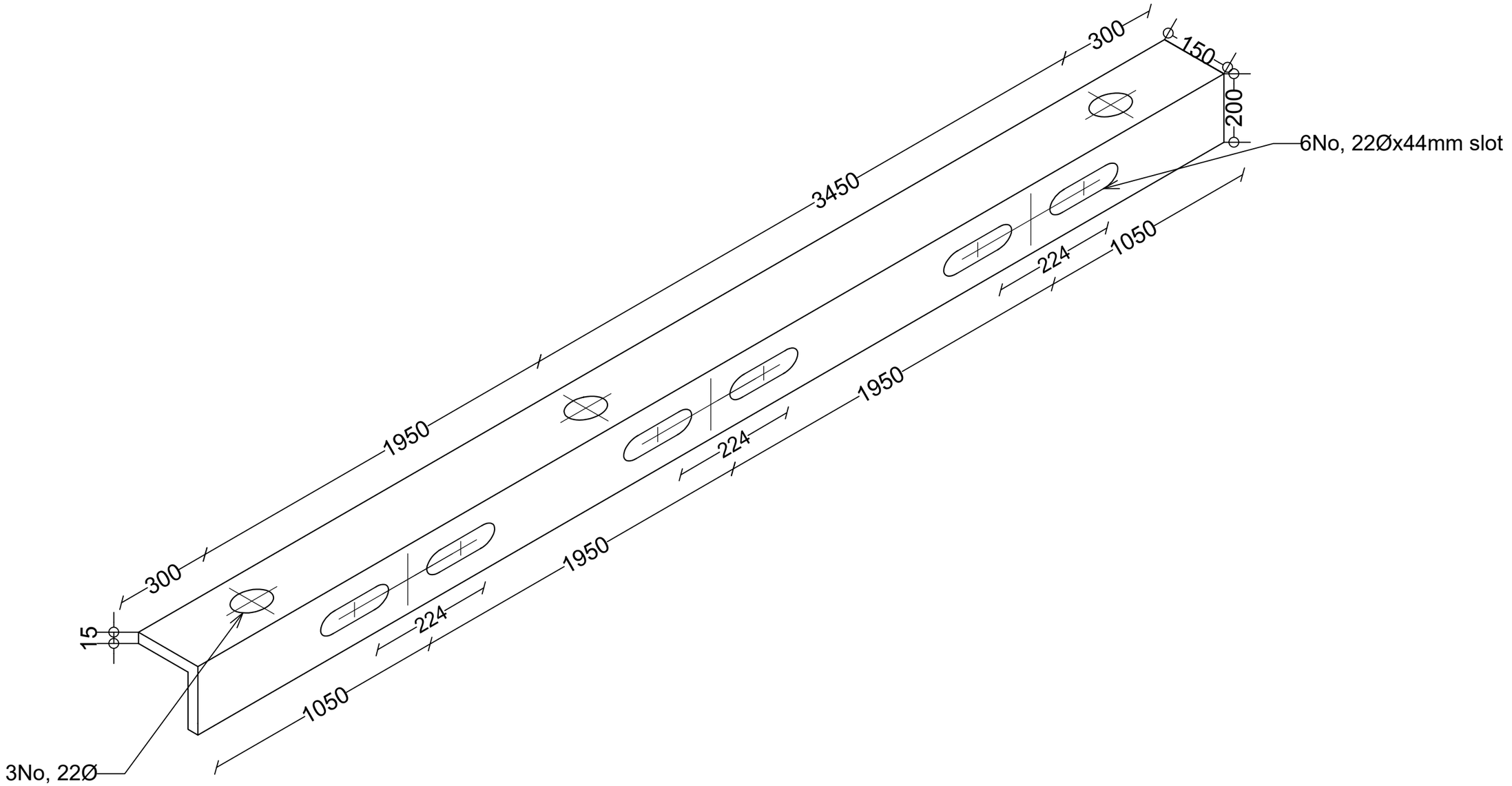

NOTES:

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TEL:

TITLE:

THREE MEMBER CROSSARM - SIX METER

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

8.5 Requirements for Line Accessories

8.5.1 Fittings for OHL

Design of hardware and accessories consisting of part assemblies like spacer dampers, dampers, suspension clamps, etc. shall cater for captive interconnection of as many parts as possible to ensure simple and safe mounting. This applies in particular to bolts, screws, washers and safety sheets.

All fittings shall be designed to facilitate hot line maintenance with appropriate tools.

The design of all conductor/insulator hardware and accessories shall avoid sharp corners or projections which would produce high electrical stress in normal working conditions. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service conditions.

8.5.2 Bolts, Nuts, Washers

- Bolts, threaded rods, nuts, and washers shall be supplied for the attachment of fittings to poles and must be of good quality low carbon mild steel grade 43A (ASTM A36) and hot-dip galvanized in accordance with the specifications in ASTM A123.
- All iron and steel parts such as mounting and support brackets, bolts and nuts, washers etc. shall be galvanized after processes such as sawing, shearing, drilling, punching, filling, bending and machining are completed.
- No bolt or stud shall project through its nut by more than l0 mm or four threads whichever is the less except for terminals and relay stems.

8.5.3 Pole Caps, Danger Plates, Phase plates, Circuit Labels

Pole Caps

- All poles erected shall be provided with pole caps fixed at the top of the pole to prevent water from oozing into the pole from the top.
- The caps shall be made from hot-dip galvanized steel and corrosion-resistant. They shall be fixed to the pole top with galvanized nails.
- They shall be of gauge 24 and shall be no less than 260mm in diameter, with a circular shape and fabricated in such a way that water just runs off it, when fixed to the pole.

Danger plates

- Danger plates shall be provided on each structure.
- The plates made from Iron sheet of gauge 16, approximately 210 mm long and 300 mm wide and mounted vertically and provided with fixing holes 8 mm diameter.
- The kind of paint used shall be 85 Micron Primer and the plates shall have red letters on a white background.

Number Plates

- Number plates shall be provided on each structure.
- The plates shall be made from Iron sheet of gauge 16, approximately 200 mm long and 150 mm wide and mounted vertically and provided with fixing holes 8 mm diameter.
- The kind of paint used shall be 85 Micron Primer and the plates shall have red letters on a white background.

Phase plates/ Indicators

- All H.V. dead-end and angle structures shall be provided with Red, Yellow and Blue colour phase plates to indicate the line conductors.
- The plates shall be made from Iron sheet of gauge 16, approximately 150 mm long and 150 mm wide mounted vertically and provided with fixing holes 8 mm diameter.
- The kind of paint used shall be 85 Micron Primer and the plates shall have red letters on a white background.

Circuit Labels

- Each structure on the double circuit line shall be clearly labelled with “CIRCUIT 1” and “CIRCUIT 2” to identify the two circuits. These labels which shall be of an approved design shall be fixed at least 500mm below the lower most phase conductor.

8.5.4 Bolts for Electrical Wiring

Bolts and studs for electrical wiring connections shall preferably be of brass M6 size. Size M5 may be used, but these must be of stainless steel, phosphor bronze or high tensile brass.

Nuts and pins shall be locked in position with lock-nuts or lock washers, or other devices if **approved.**

Lock washers shall not be used above M24 size except when a spring type is specially approved.

Bolts and studs which are subject to high temperatures and pressure shall be to an approved material specification with nuts of similar materials. All fasteners shall be suitably protected from corrosion at all stages until finish painting is carried out.

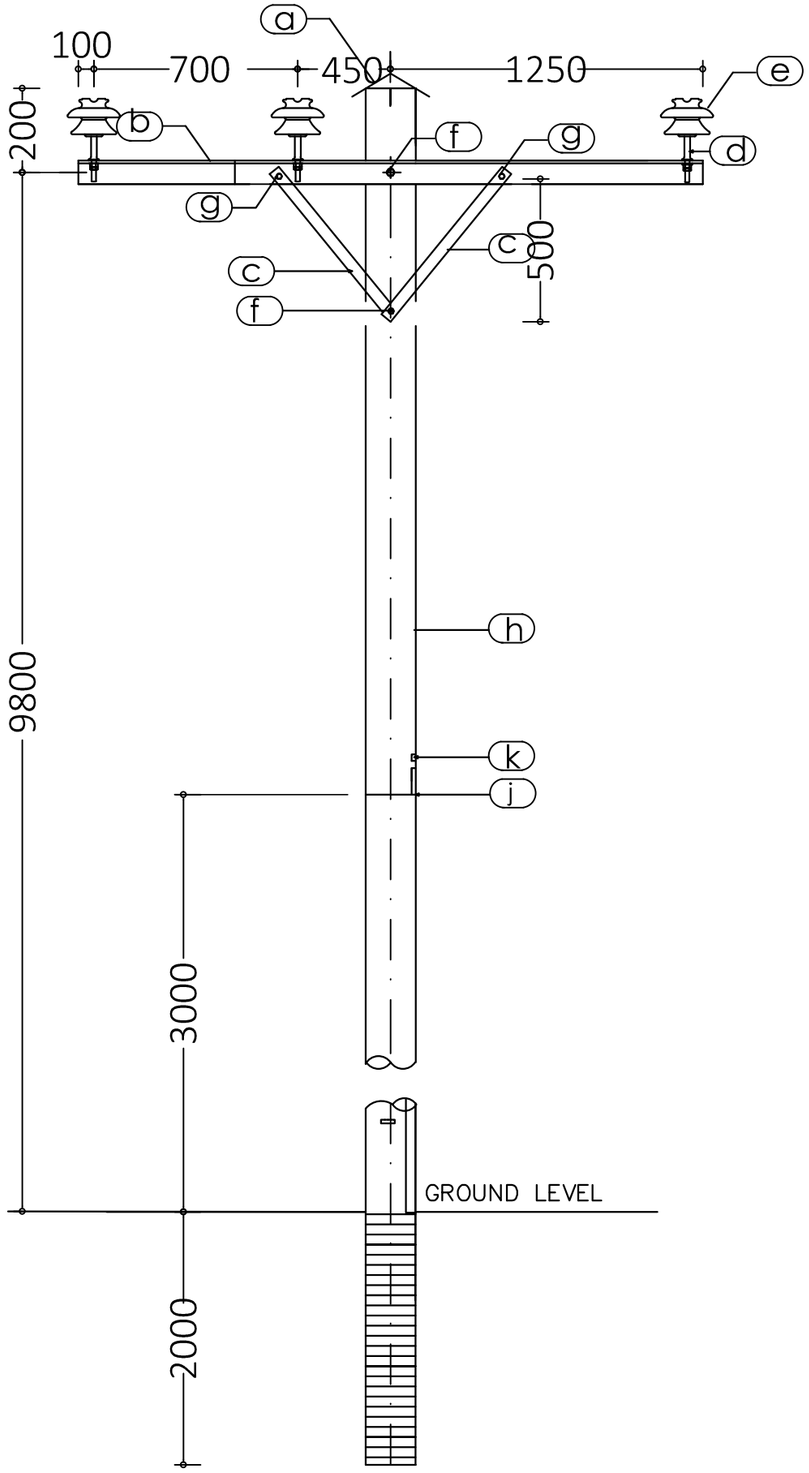
Suitable special spanners shall be provided for bolts and nuts which are not properly accessible by means of an ordinary spanner.

9.0 WOODEN POLE STRUCTURE TYPES AND DRAWINGS

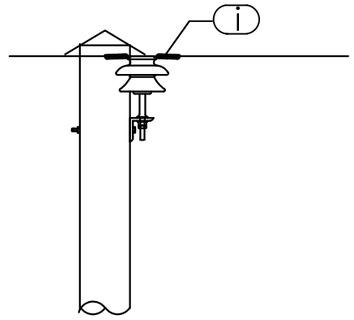
9.1 Single Wooden Pole Configurations

9.1.1 33kV Intermediate Structure, Horizontal Construction, (0^0)

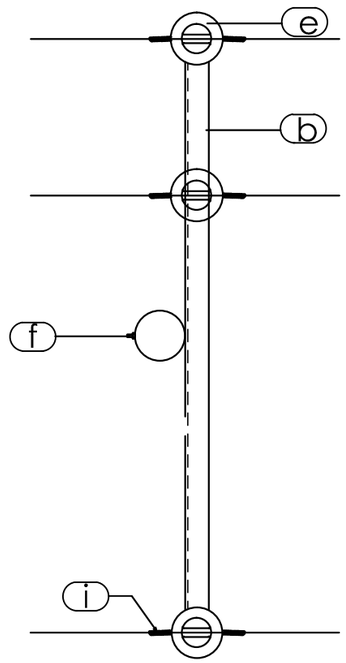
No.	Item	Item Specifications
1	Wooden Pole	• 12m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
4	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped L:120mm, W:53mm, THK: 6.3mm Total length: 2500mm • Diameter for holes: 22mm
5	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized low carbon mild steel; ASTM A36, ASTM A123. • Cross-Arm/Pole interface: M20x300mm bolts • Cross-arm Strut/pole interface: M20x300mmbolts • Struts/Cross arm interface: M20x50mm • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
6	Insulator Requirements	• Porcelain/polymeric pin insulators with spindles • Voltage: 33kV • Conform to IEC 62223 *Refer to Table 4 for the detailed insulator specifications.*
7	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface ***Refer to Table 4 for the detailed insulator specifications.*** Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
8	Danger/Name plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Holes for Nails: 8mm



FRONT VIEW



SIDE VIEW



PLAN VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP–STEEL GAUGE 24	1
b	120*53*6.3 THK –2500MM CROSS ARM	1
c	4MM THK CROSS ARM STRUT	2
d	300MM SPINDLE	3
e	10kN, 900MM, 110kV PIN INSULATOR	3
f	M20X300MM BOLT AND NUT	2
g	M20x50MM BOLT AND NUT	2
h	12M WOOD POLE	1
i	PREFORMS FOR BINDING	3
j	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
k	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

NOTES:

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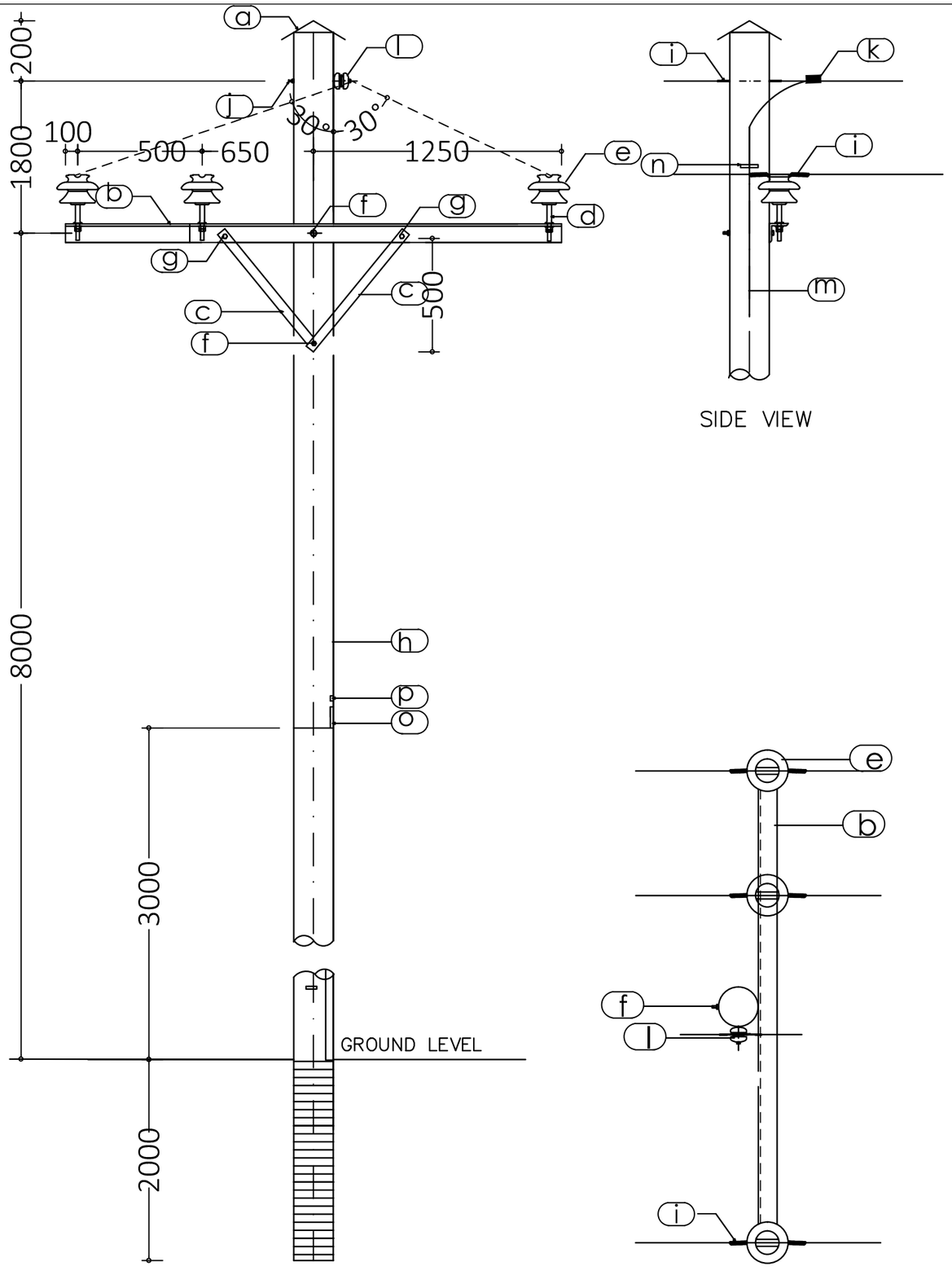
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

MV SINGLE POLE -INTERMEDIATE WITHOUT AERIAL EARTH 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



FRONT VIEW

SIDE VIEW

PLAN VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	120*53*6.3 THK –2500MM CROSS ARM	1
c	4MM THK CROSS ARM STRUT	2
d	300MM SPINDLE	3
e	10kN, 900MM, 110kV PIN INSULATOR	3
f	M20X300MM BOLT AND NUT	2
g	M20x50MM BOLT AND NUT	2
h	12M WOOD POLE	1
i	PREFORMS FOR BINDING	3
j	16X300MM BOLT AND NUT	1
k	25 X 25MM STEEL PG CLAMP	1
l	40MM, 9kV, 13.5kN REEL INSULATOR	1
m	3x2.64MM, 14M EARTH WIRE	1
n	STEEL U–NAILS AT 500MM INTERVAL	30
o	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
p	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

"The Peoples Electricity Link"

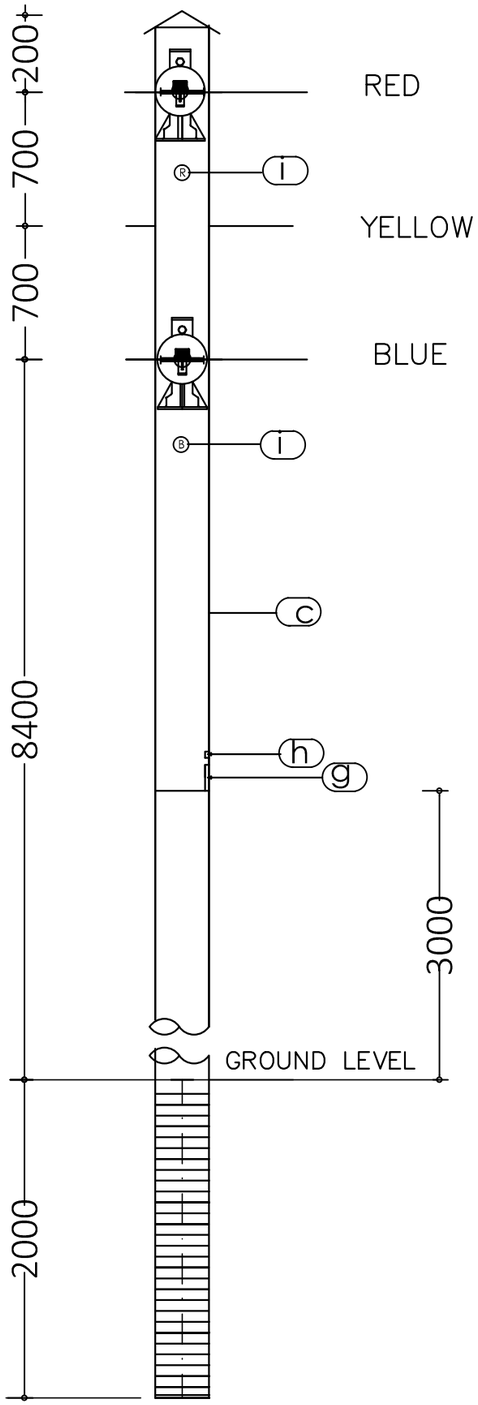
TITLE:

MV SINGLE POLE -INTERMEDIATE WITH AERIAL EARTH - 12M POLE

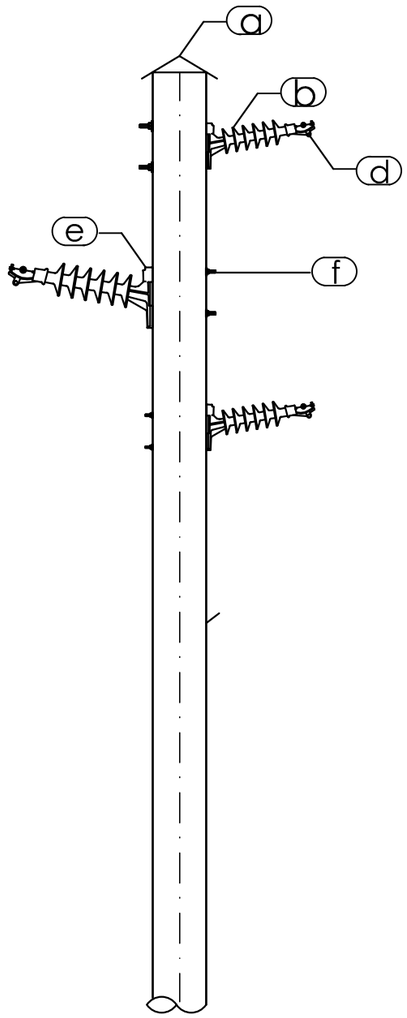
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.1.2 33kV Intermediate Structure, Vertical Construction (0^0)

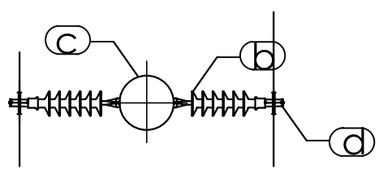
No.	Item	Item Specifications
1	Wooden Pole	• 12m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Insulator Requirements	• Porcelain/polymeric post insulators with spindles • Voltage: 33kV • Conform to IEC 62223 *Refer to Table 4 for the detailed insulator specifications.*
4	Insulator Accessories	• M20 bolts at the pole/insulator interface • Hot-dip galvanized steel; BS EN ISO 1461
5	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
6	Danger/Name/ phase indicator plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Phase Indicators: L:150 mm, W:150 mm • Holes for Nails: 8mm



SIDE VIEW



FRONT VIEW



PLAN

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP– STEEL GAUGE 24	1
b	1200MM, 95kV, 20kN, POST INSULATOR	3
c	12M STOUT WOODEN POLE	1
d	SIDE CLAMP	3
e	BASE CLAMP	3
f	M20 x 300MM BOLT AND NUT	6
g	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
h	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
i	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3

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TITLE:

MV SINGLE POLE - INTERMEDIATE VERTICAL CONSTRUCTION WITHOUT AERIAL EARTH - 12MPOLE

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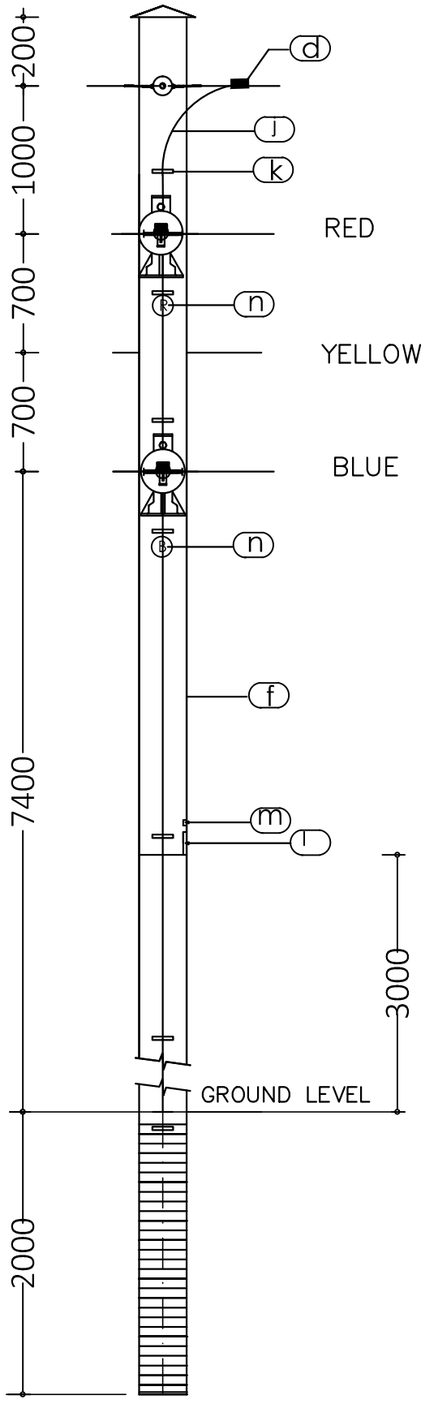
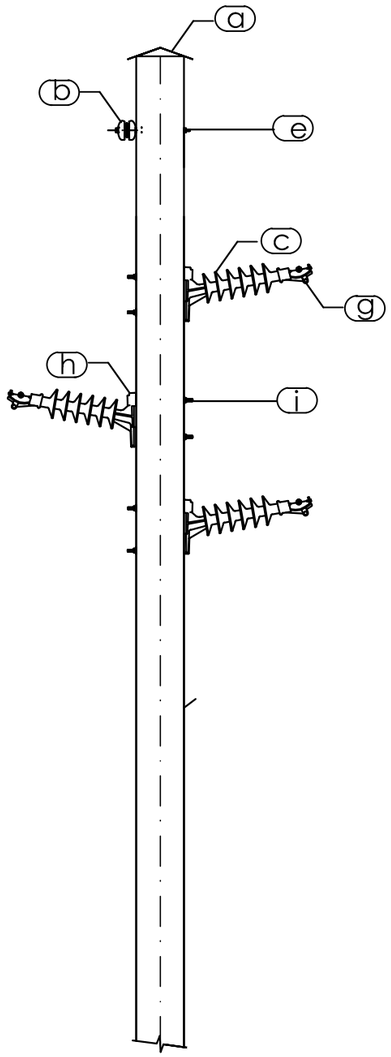
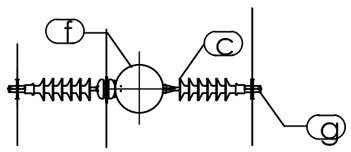


SIDE VIEW



FRONT VIEW



PLAN

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP– STEEL GAUGE 24	1
b	40MM, 9kV, 13.5kN REEL INSULATOR	1
c	1200MM, 95kV, 20kN, POST INSULATOR	3
d	25 X 25MM STEEL PG CLAMP	1
e	M16 x 300MM BOLT AND NUT	1
f	12M STOUT WOODEN POLE	1
g	SIDE CLAMP	3
h	BASE CLAMP	3
i	M20 x 300MM BOLT AND NUT	6
j	3x2.64MM, 16M EARTH WIRE	1
k	STEEL U–NAILS AT 500MM INTERVAL	30
l	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3

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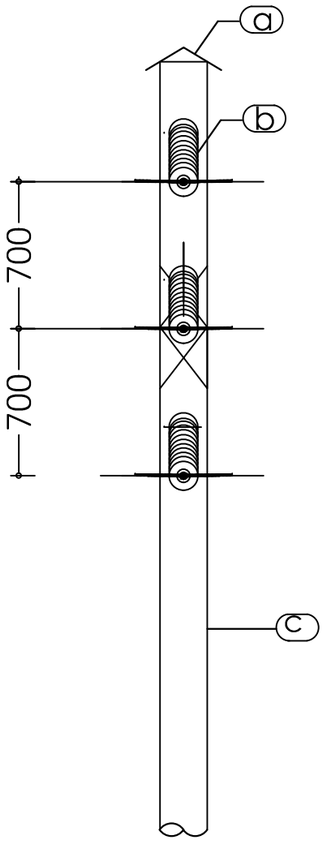
TITLE:

MV SINGLE POLE - INTERMEDIATE VERTICAL CONSTRUCTION WITH AERIAL EARTH - 12MPOLE

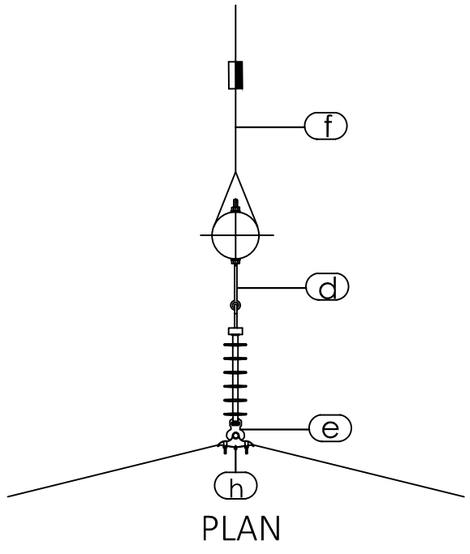
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.1.3 33kV Flying Angle Structure, ($5^0<\Theta<15^0$degrees)

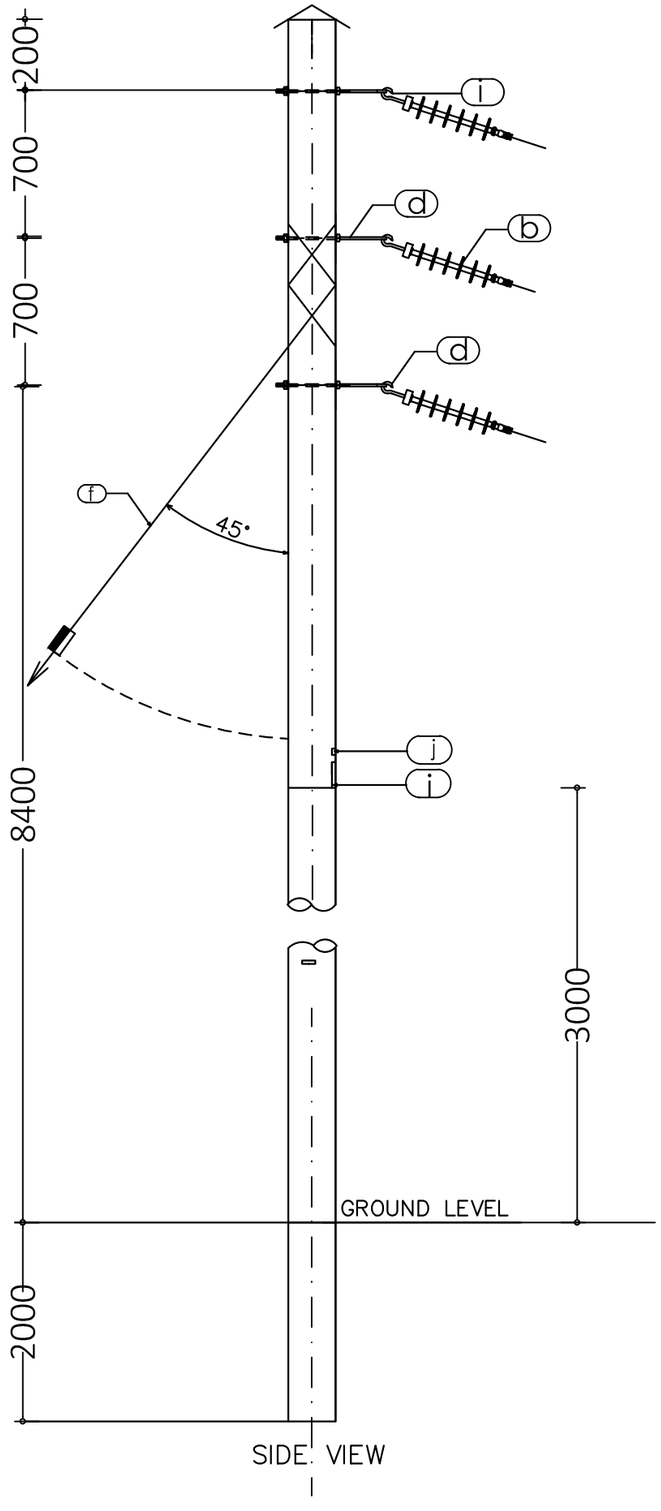
No.	Item	Item Specifications
1	Wooden Pole	• 12m pole: No shield wire • 14m pole: Overhead Earth wire configurations. *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Insulator Requirements	• Composite Strain insulators with hooks • Voltage: 33kV • Conform to IEC 62223 • M20x300mm bolts at the insulator-to-pole interface. *Refer to Table 4 for the detailed insulator specifications.*
4	Insulator Accessories	• M20x350 Eye bolts and Nut • Pig tail Hook • Hot-dip galvanized steel; BS EN ISO 1461
5	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
6	Danger/Name/ phase indicator plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Phase Indicators: L:150 mm, W:150 mm • Holes for Nails: 8mm



FRONT VIEW



PLAN



SIDE VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
c	12M MEDIUM, WOODEN POLE	1
d	M20X350MM EYE BOLT AND NUT	3
e	SOCKET TOUNGUE	3
f	STAY ASSEMBLY	1
g	M20 PIG TAIL HOOK	3
h	SUSPENSION CLAMP	3
i	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
j	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

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MV SINGLE POLE -FLYING ANGLE WITHOUT AERIAL EARTH 12MPOLE

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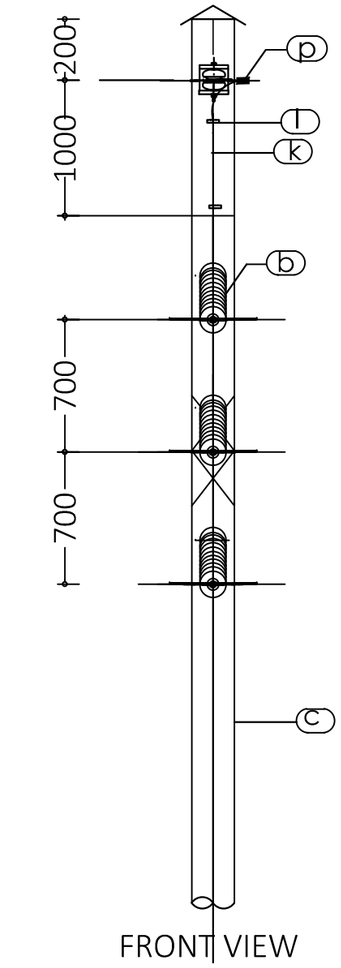
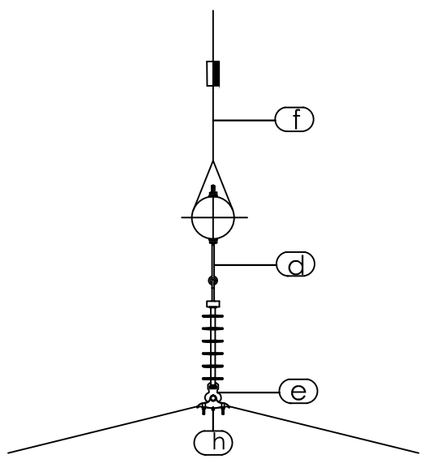


FRONT VIEW



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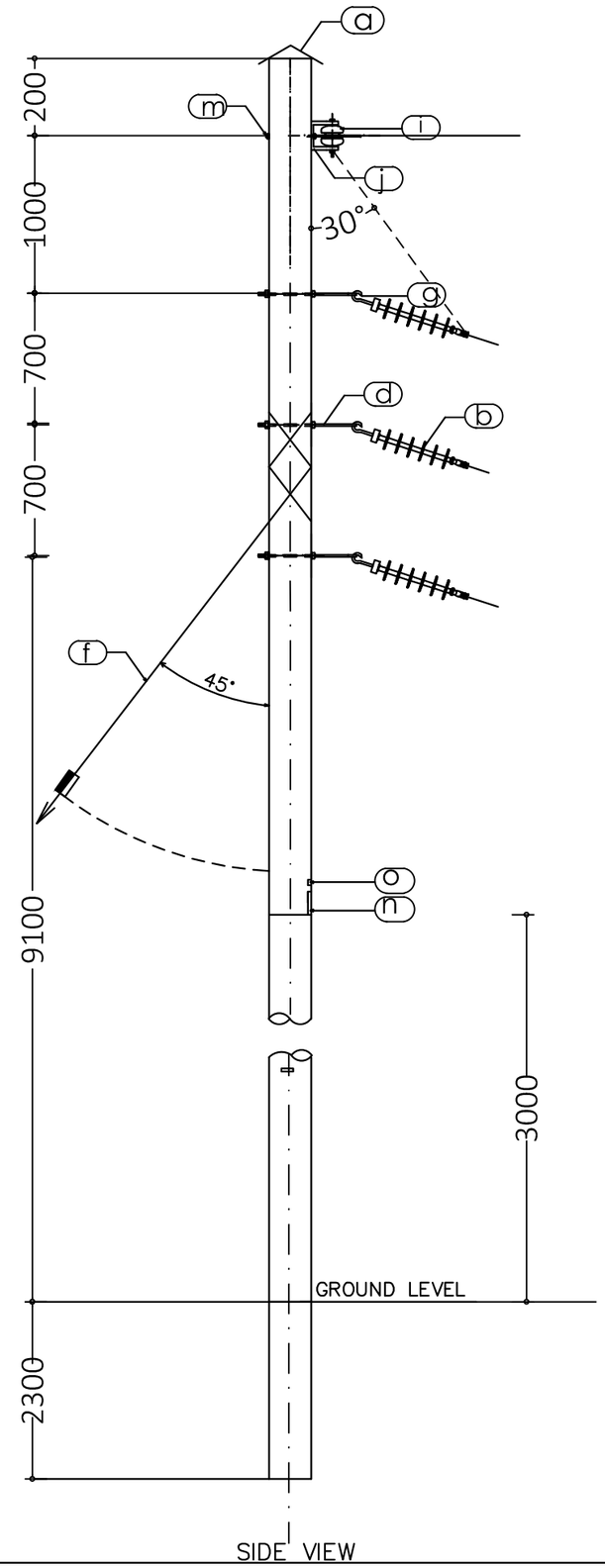

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
c	14M MEDIUM, WOODEN POLE	1
d	M20X350MM EYE BOLT AND NUT	3
e	SOCKET TOUNGUE	3
f	STAY ASSEMBLY	1
g	M20 PIG TAIL HOOK	3
h	SUSPENSION CLAMP	3
i	40MM, 9kV, 13.5kN REEL INSULATOR	1
j	D–IRON	1
k	3x2.64MM, 16M EARTH WIRE	1
l	STEEL U–NAILS AT 500MM INTERVAL	35
m	M16X300MM BOLT AND NUT	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
p	25 X 25MM STEEL PG CLAMP	1

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MV SINGLE POLE - FLYING ANGLE WITH AERIAL EARTH - 14MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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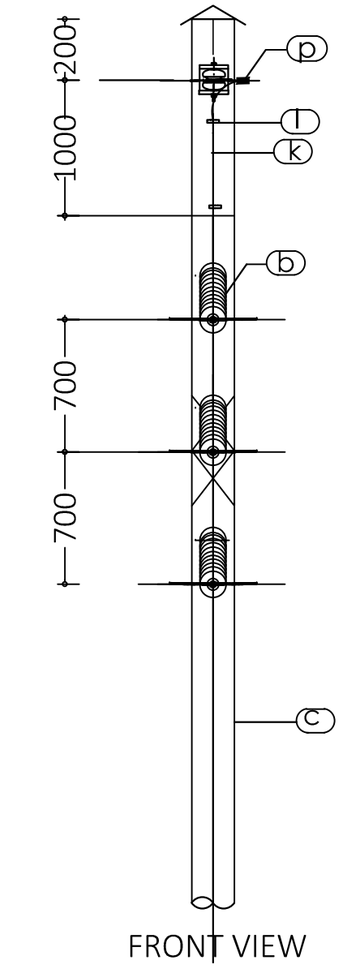
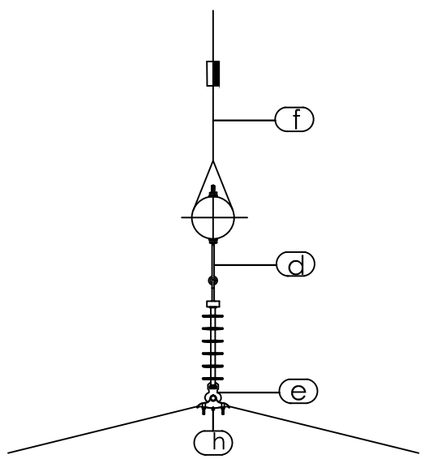


FRONT VIEW



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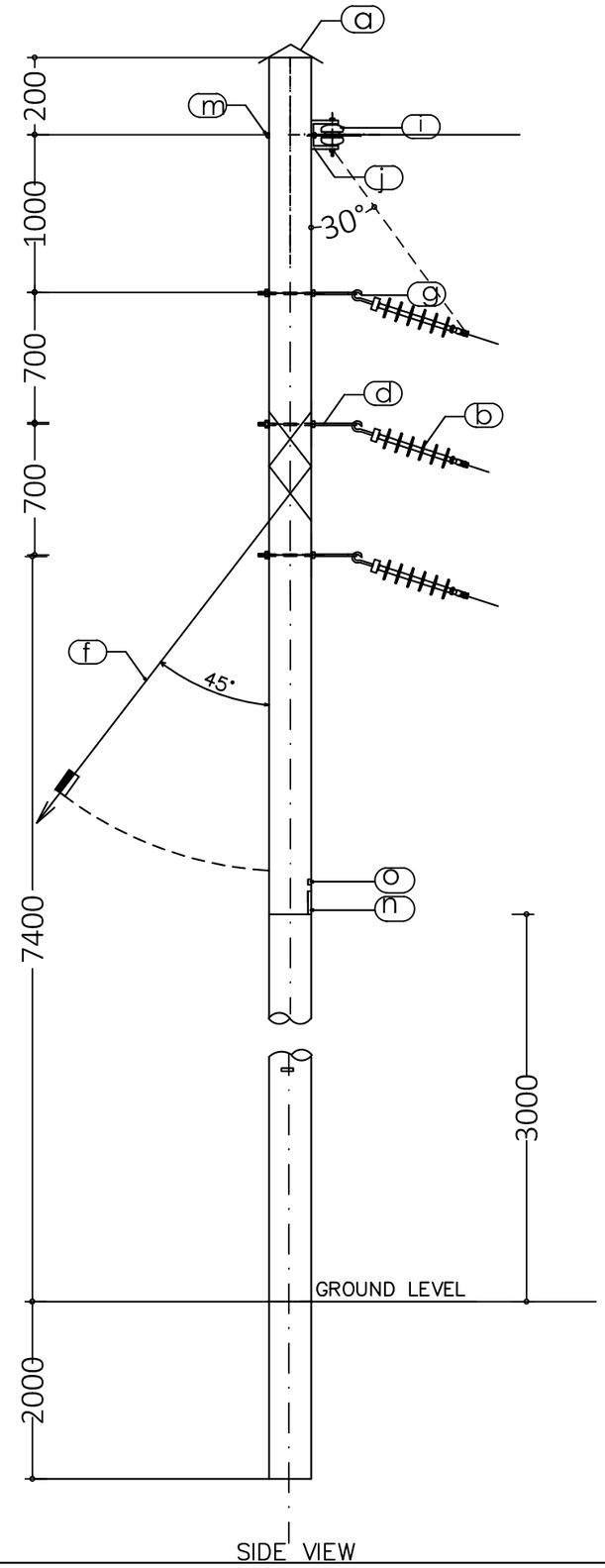

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
c	12M MEDIUM, WOODEN POLE	1
d	M20X350MM EYE BOLT AND NUT	3
e	SOCKET TOUNGUE	3
f	STAY ASSEMBLY	1
g	M20 PIG TAIL HOOK	3
h	SUSPENSION CLAMP	3
i	40MM, 9kV, 13.5kN REEL INSULATOR	1
j	D–IRON	1
k	3x2.64MM, 16M EARTH WIRE	1
l	STEEL U–NAILS AT 500MM INTERVAL	35
m	M16X300MM BOLT AND NUT	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
p	25 X 25MM STEEL PG CLAMP	1

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MV SINGLE POLE - FLYING ANGLE WITH AERIAL EARTH - 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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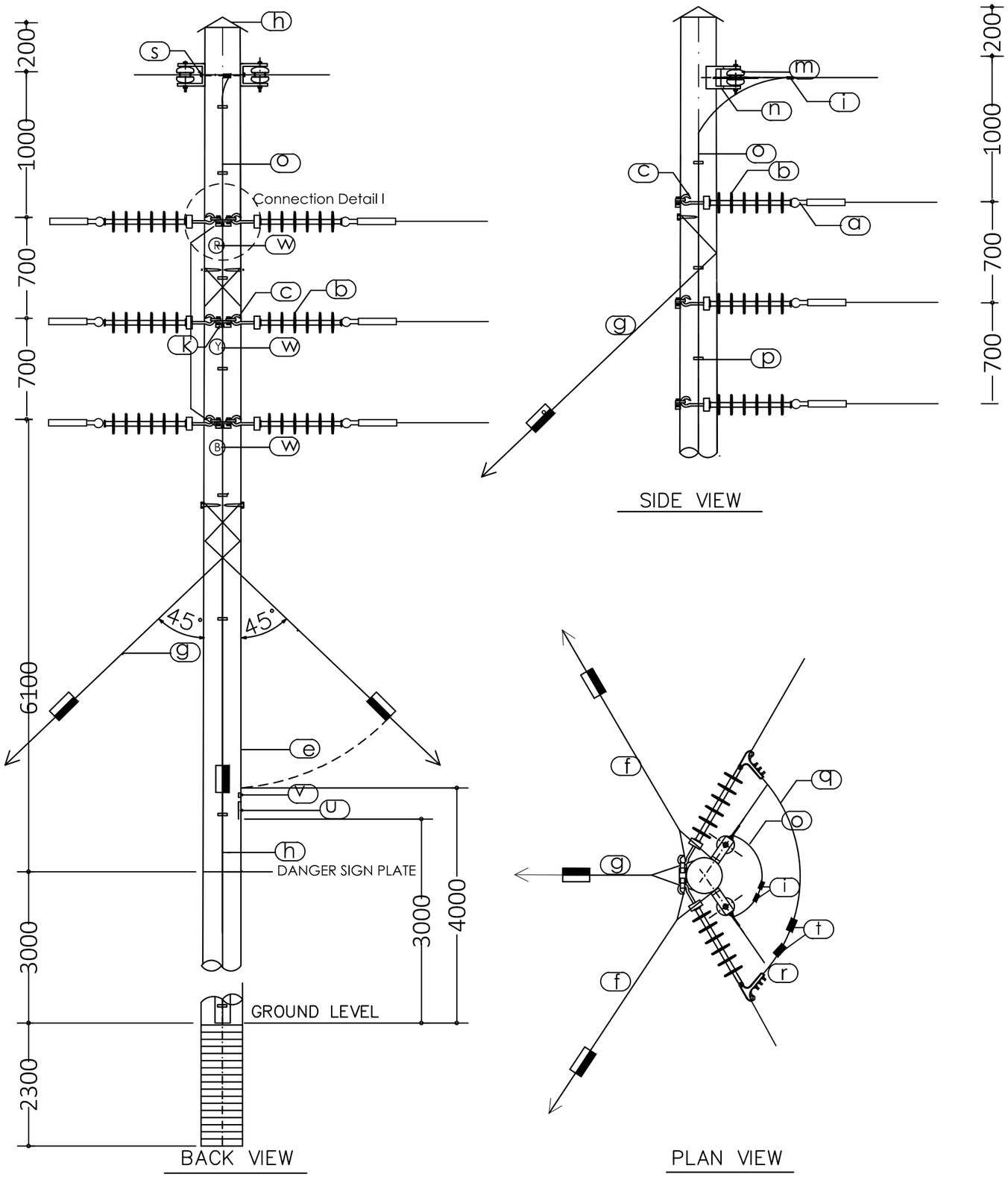
9.1.4 33kV Vertical Angle Section Structure, ($15^0<\theta<90^0$degrees)

No.	Item	Item Specifications
1	Wooden Pole	• 14m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Insulator Requirements	• Composite Strain insulators with hooks • Voltage: 33kV • Conform to IEC 62223 • M20x300mm bolts at the insulator-to-pole interface. *Refer to Table 4 for the detailed insulator specifications.* • Groove Clamps for holding conductor to insulator Tensile Strength: ≥ 300 N per sq mm
4	Jumpering Requirements	Jumpers/ connectors: • Aluminium to Aluminium • Material: AAAC100 Porcelain/ polymeric pin insulators for jumper supporting jumpers; 33kV. • PG clamps for terminating the conductor at the section
5	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
6	Danger/Name/ phase indicator plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Phase Indicators: L:150 mm, W:150 mm • Holes for Nails: 8mm

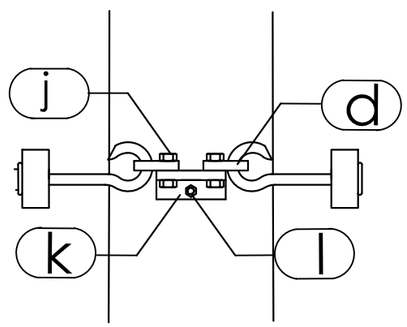


BACK VIEW

SIDE VIEW

PLAN VIEW

ITEM	DESCRIPTION	QTY
a	70kN ALUMINIUM ALLOY TENSION CLAMP	6
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
c	PIGTAIL HOOK	6
d	10MM THK STEEL TERMINATING STRAP	3
e	14M STOUT WOODEN POLE	1
f	INLINE STAY ASSEMBLY	2
g	BISECT STAY ASSEMBLY	1
h	260MM POLE CAP– STEEL GAUGE 24	1
i	25 X 25MM STEEL PG CLAMP	1
j	M20X50MM BOLT AND NUT	6
k	TOP CONDUCTOR FITTING	3
l	M20 x 300MM BOLT AND NUT	3
m	40MM, 9kV, 13.5kN REEL INSULATOR	2
n	D–IRON	2
o	3x2.64MM, 16M EARTH WIRE	1
p	STEEL U–NAILS AT 500MM INTERVAL	35
q	SUPPLY JUMPER CONDUCTOR	3
r	RECEIVER JUMPER CONDUCTOR	3
s	M16 X 300MM BOLT AND NUT	2
t	100X 100MM ALUMINIUM PG CLAMP	6
u	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
v	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
w	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3



Connection Detail I

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PLOT 1, PLILKINGTON ROAD
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MV SINGLE POLE - VERTICAL ANGLE SECTION WITH AERIAL EARTH -14M POLE (30-60 DEGREES)

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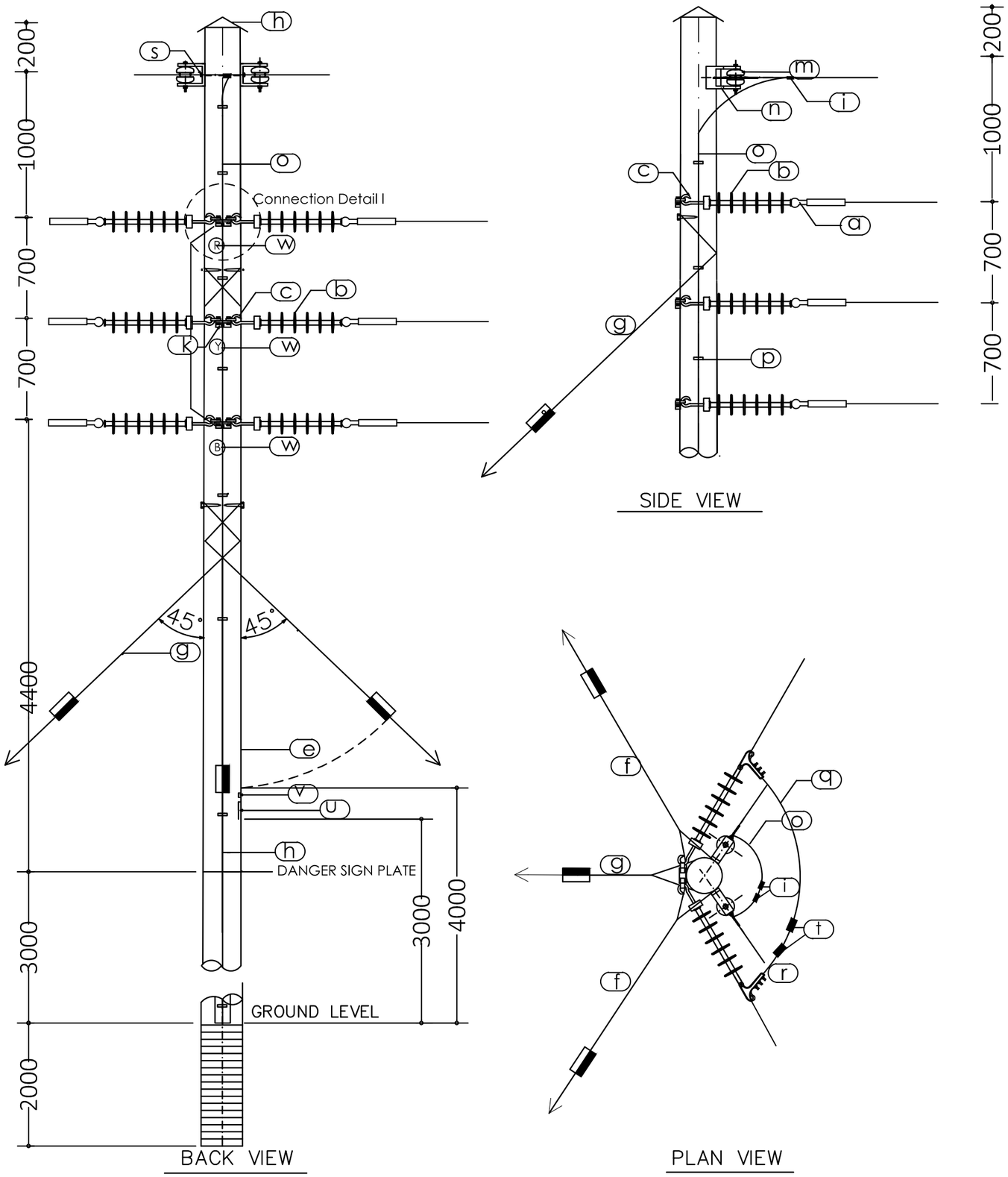
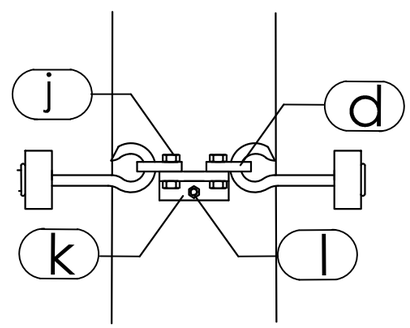


ITEM	DESCRIPTION	QTY
a	70kN ALUMINIUM ALLOY TENSION CLAMP	6
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
c	PIGTAIL HOOK	6
d	10MM THK STEEL TERMINATING STRAP	3
e	12M STOUT WOODEN POLE	1
f	INLINE STAY ASSEMBLY	2
g	BISECT STAY ASSEMBLY	1
h	260MM POLE CAP– STEEL GAUGE 24	1
i	25 X 25MM STEEL PG CLAMP	1
j	M20X50MM BOLT AND NUT	6
k	TOP CONDUCTOR FITTING	3
l	M20 x 300MM BOLT AND NUT	3
m	40MM, 9kV, 13.5kN REEL INSULATOR	2
n	D–IRON	2
o	3x2.64MM, 16M EARTH WIRE	1
p	STEEL U–NAILS AT 500MM INTERVAL	35
q	SUPPLY JUMPER CONDUCTOR	3
r	RECEIVER JUMPER CONDUCTOR	3
s	M16 X 300MM BOLT AND NUT	2
t	100X 100MM ALUMINIUM PG CLAMP	6
u	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
v	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
w	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3



Connection Detail I

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TITLE:

MV SINGLE POLE - VERTICAL ANGLE SECTION WITH AERIAL EARTH -12M POLE (30-60 DEGREES)

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	SCALE:		
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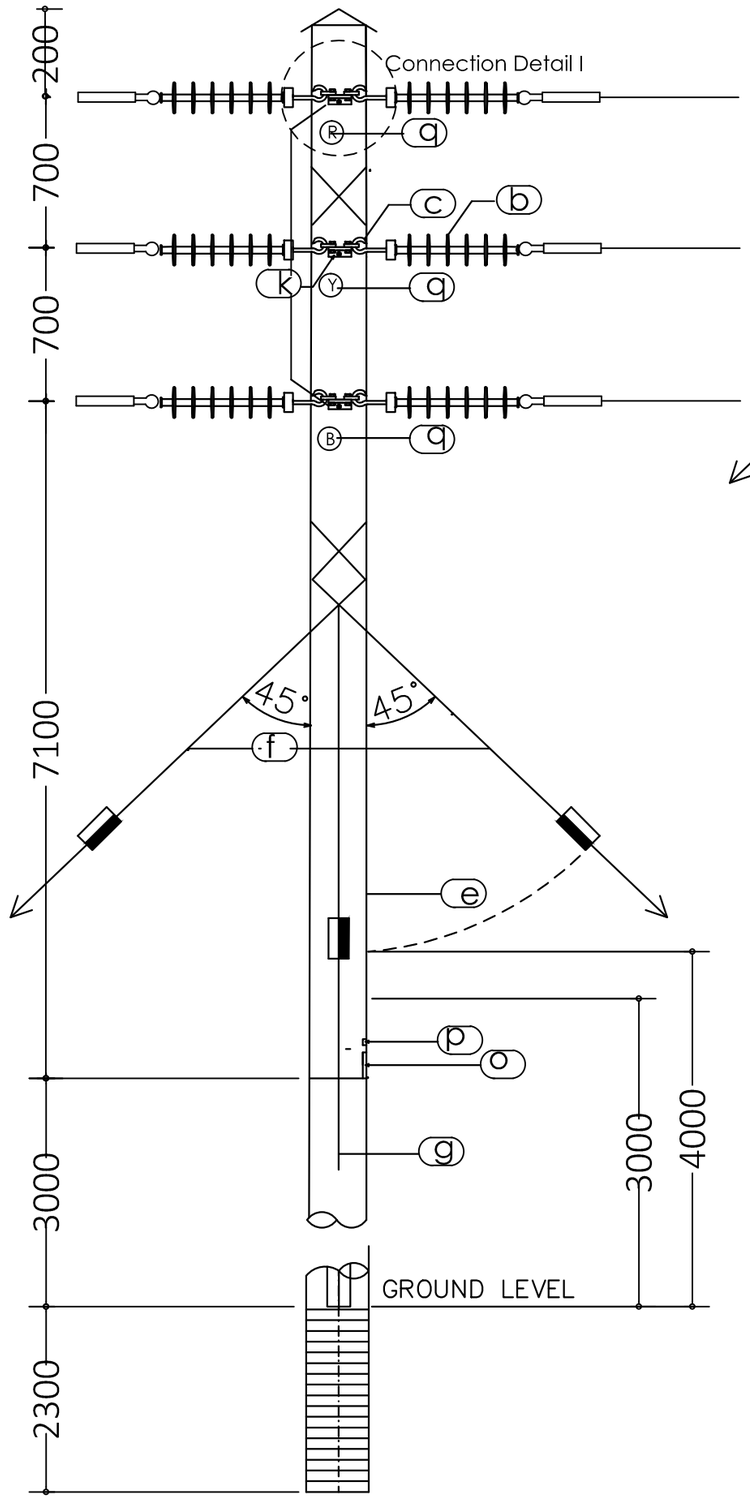
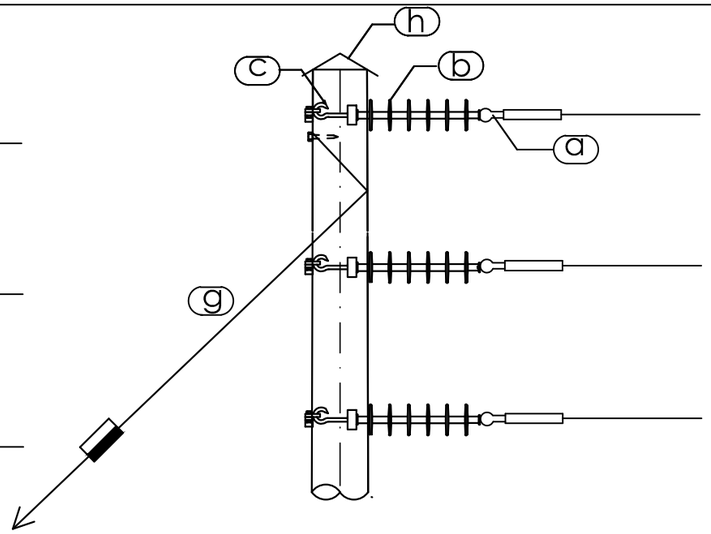
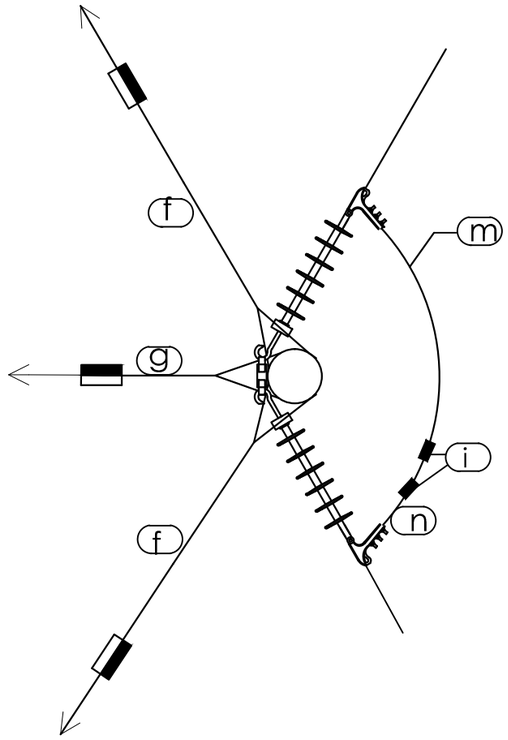


BACK VIEW

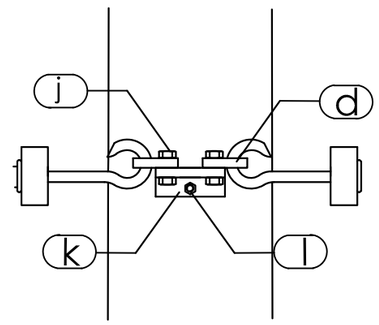


SIDE VIEW



PLAN VIEW

ITEM	DESCRIPTION	QTY
a	70kN ALUMINIUM ALLOY TENSION CLAMP	6
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
c	M20 PIGTAIL HOOK	6
d	10MM THK STEEL TERMINATING STRAP	3
e	14M STOUT WOODEN POLE	1
f	INLINE STAY ASSEMBLY	2
g	BISECT STAY ASSEMBLY	1
h	260MM POLE CAP– STEEL GAUGE 24	1
i	100 X 100MM STEEL PG CLAMP	6
j	M20X50MM BOLT AND NUT	6
k	TOP CONDUCTOR FITTING	1
l	M20 x 300MM BOLT AND NUT	3
m	SUPPLY JUMPER CONDUCTOR	3
n	RECEIVER JUMPER CONDUCTOR	3
o	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
p	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
q	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3



Connection Detail I

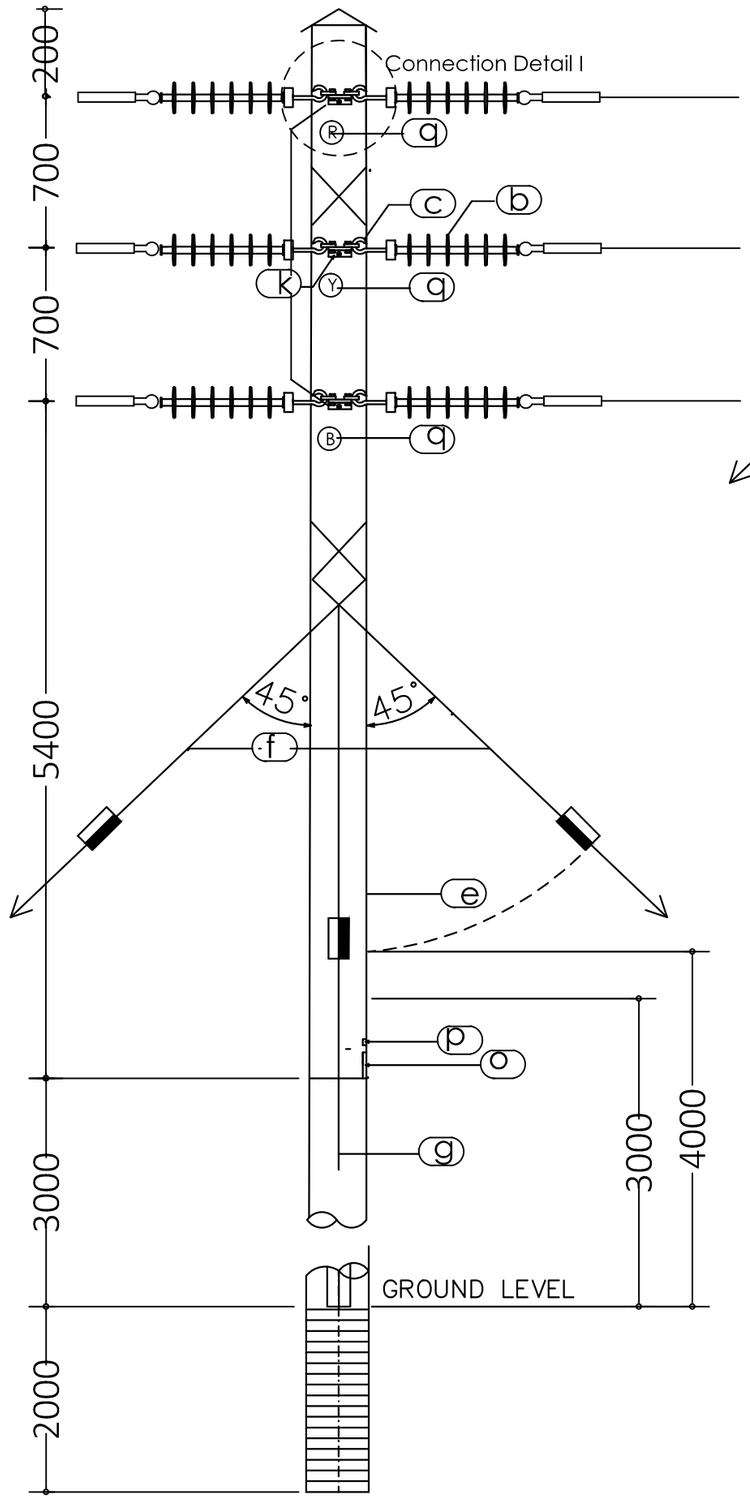
RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

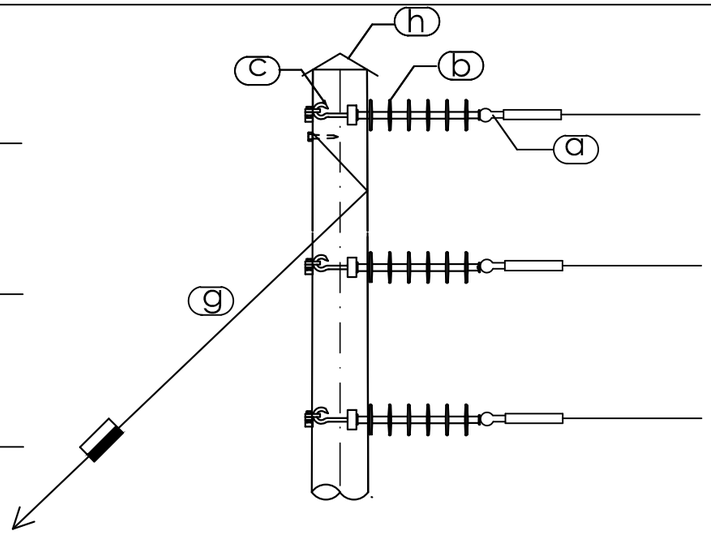
TITLE:

MV SINGLE POLE - VERTICAL ANGLE SECTION WITHOUT AERIAL EARTH - 14MPOLE

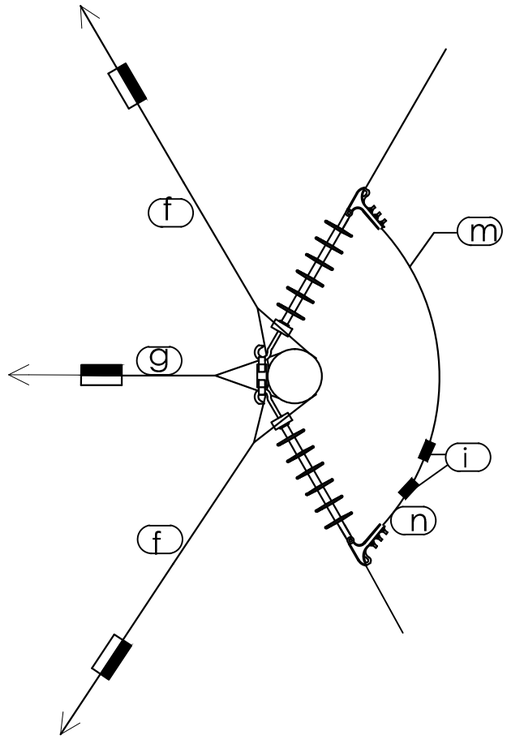
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



BACK VIEW

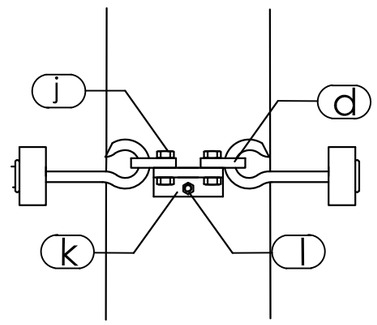


SIDE VIEW



PLAN VIEW

ITEM	DESCRIPTION	QTY
a	70kN ALUMINIUM ALLOY TENSION CLAMP	6
b	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
c	M20 PIGTAIL HOOK	6
d	10MM THK STEEL TERMINATING STRAP	3
e	12M STOUT WOODEN POLE	1
f	INLINE STAY ASSEMBLY	2
g	BISECT STAY ASSEMBLY	1
h	260MM POLE CAP– STEEL GAUGE 24	1
i	100 X 100MM STEEL PG CLAMP	6
j	M20X50MM BOLT AND NUT	6
k	TOP CONDUCTOR FITTING	1
l	M20 x 300MM BOLT AND NUT	3
m	SUPPLY JUMPER CONDUCTOR	3
n	RECEIVER JUMPER CONDUCTOR	3
o	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
p	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
q	150X150MM IRON SHEET GAUGE 16 PHASE IDENTIFIER, 85 MICRON PRIMER	3



Connection Detail I

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

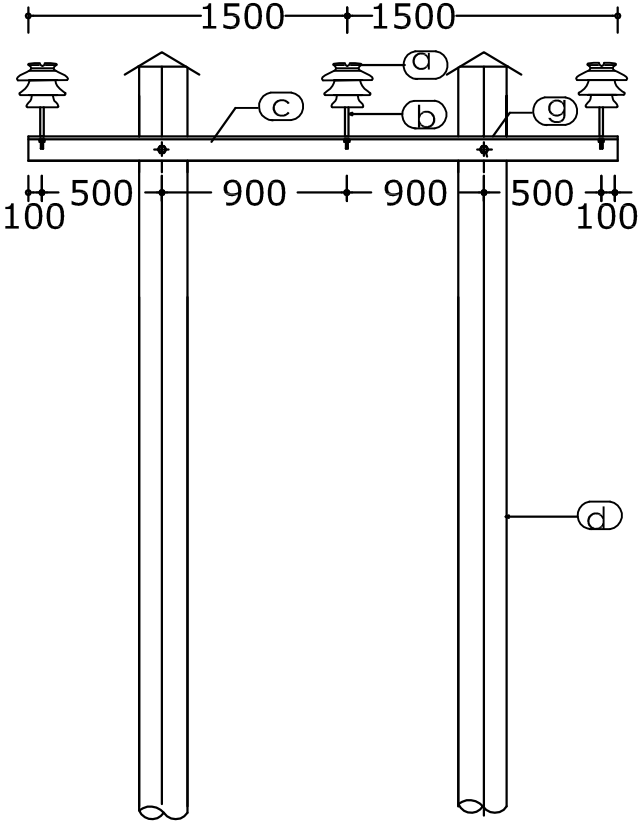
MV SINGLE POLE - VERTICAL ANGLE SECTION WITHOUT AERIAL EARTH - 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

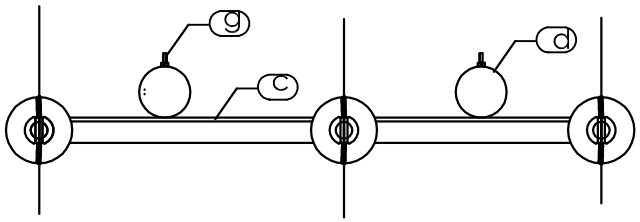
9.2 Double Wooden Pole Configurations

9.2.1 33kV Intermediate H-Support Structure; Horizontal Construction (0^0)

No.	Item	Item Specifications
1	Wooden Pole	• Two identical 14m poles for both earthed and unearthed configurations. *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
4	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped L:120mm, W:53mm, THK: 6.3mm; Total length: 3000mm Diameter for holes: 22mm
5	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized low carbon mild steel; ASTM A123. • Cross-arm/Pole interface: M20x300mm bolts • Cross-arm Strut/pole interface: M20x300mmbolts • Struts/Cross arm interface: M20x50mm • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
6	Insulator Requirements	• Porcelain/polymeric pin insulators with spindles • Voltage: 33kV • Conform to IEC 62223 *Refer to Table 4 for the detailed insulator specifications.*
7	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the poles • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
8	Danger/Name plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Holes for Nails: 8mm



FRONT VIEW



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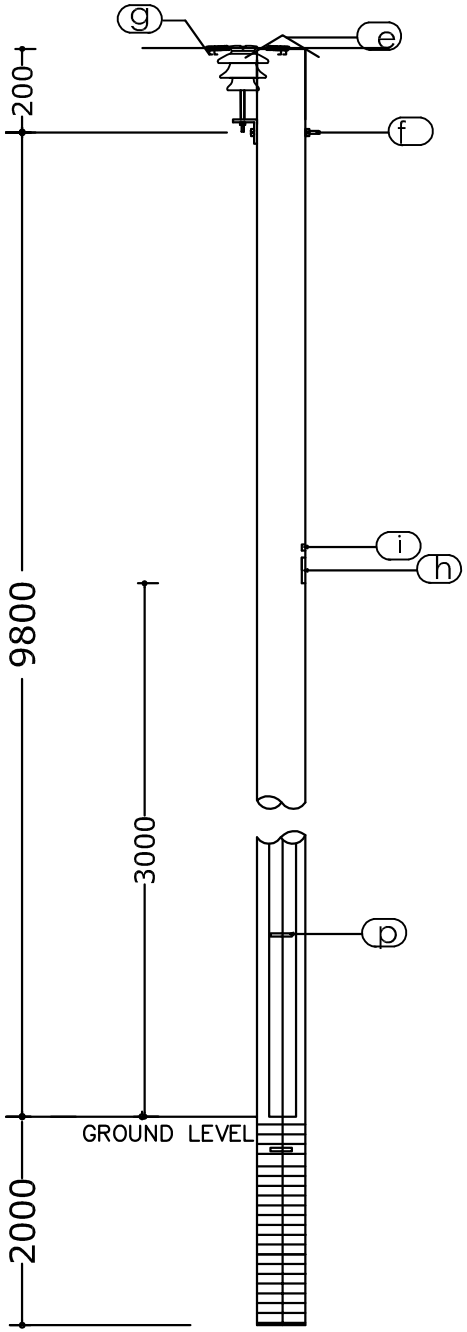

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	120*53*6.3 THK –3000MM CROSS ARM	1
d	12M STOUT WOODEN POLE	1
e	260 MM POLE CAP – STEEL GAUGE 24	2
f	M20X300MM BOLT AND NUT	2
g	PREFORMS FOR BINDING	3
h	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
i	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

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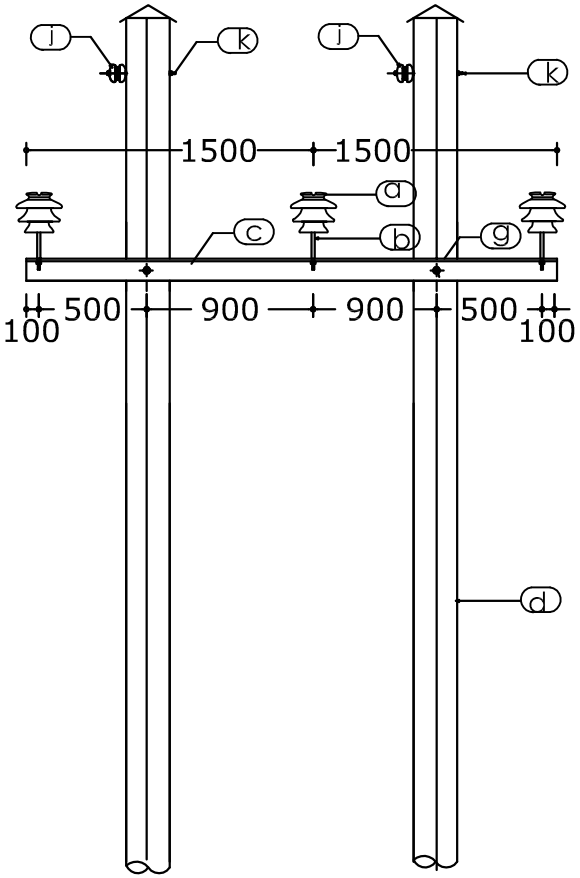
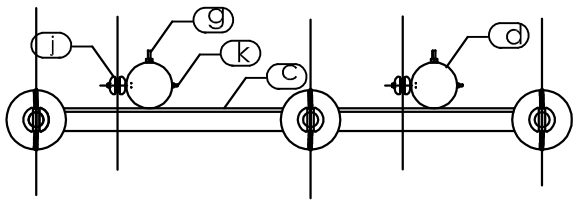
MV TWO MEMBER SUPPORT STRUCTURE WITHOUT AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K
	CHECKED BY: K.R	DATE:
	SCALE:	
	DRW NO:	



FRONT VIEW



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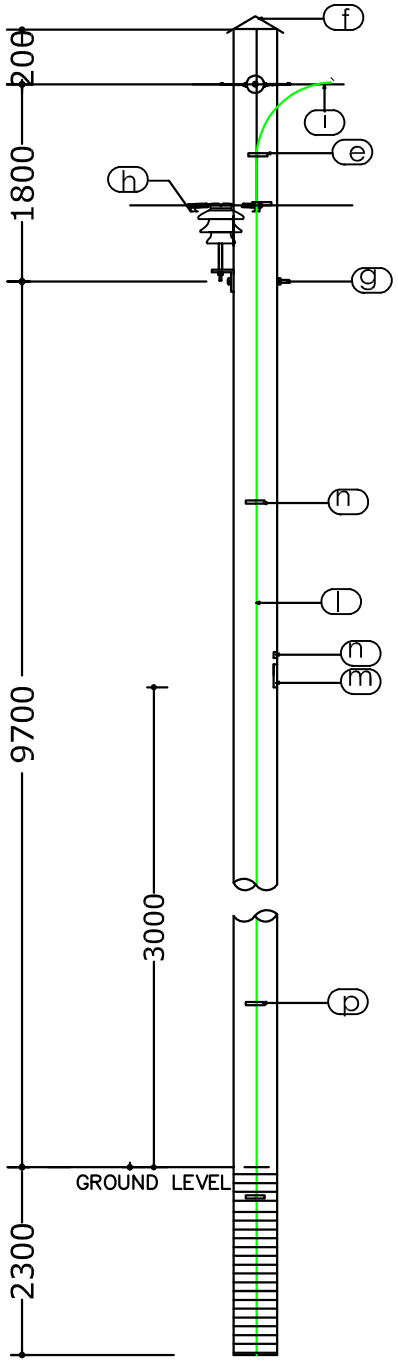

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	120*53*6.3 THK –3000MM CROSS ARM	1
d	14M STOUT WOODEN POLE	1
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260 MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	PREFORMS FOR BINDING	3
i	25 X 25MM STEEL PG CLAMP	2
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

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MV TWO MEMBER SUPPORT STRUCTURE WITH AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
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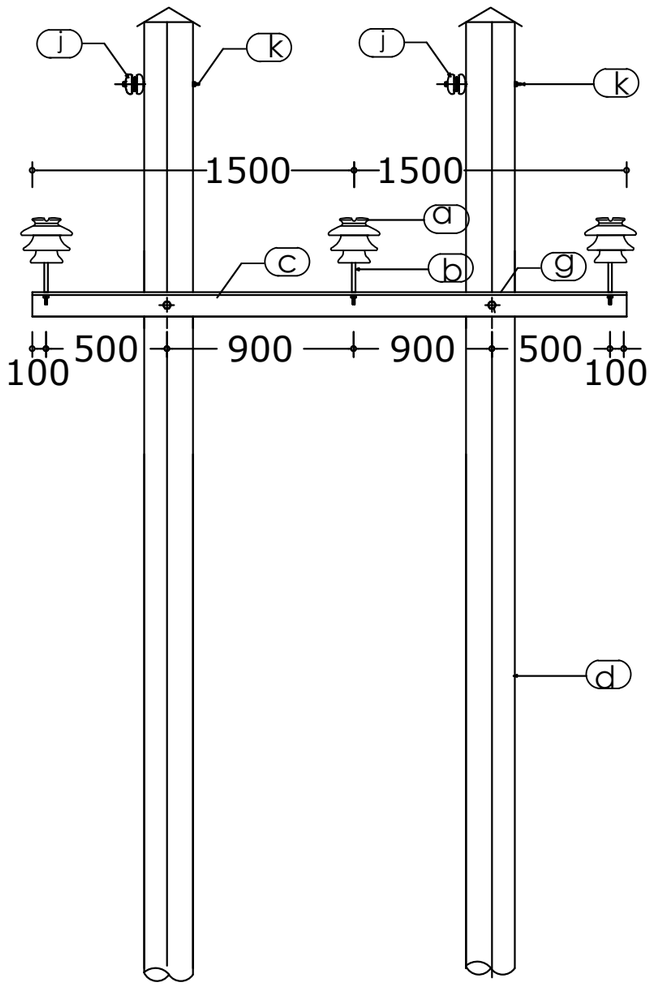
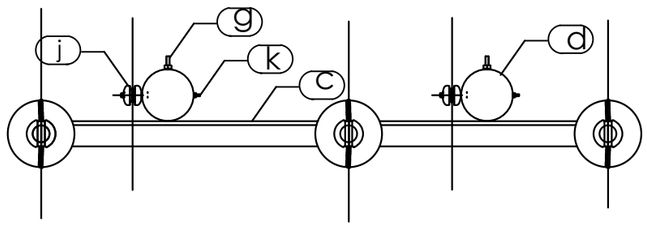


FRONT VIEW



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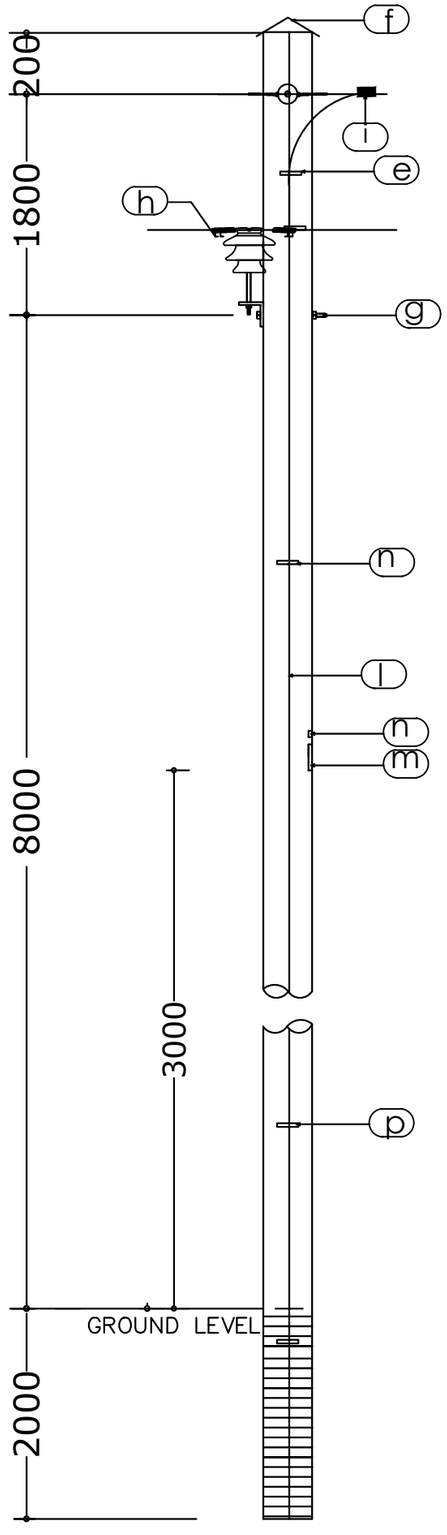

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	120*53*6.3 THK –3000MM CROSS ARM	1
d	12M STOUT WOODEN POLE	1
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260 MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	PREFORMS FOR BINDING	3
i	25 X 25MM STEEL PG CLAMP	2
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1

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TITLE:

MV TWO MEMBER SUPPORT STRUCTURE WITH AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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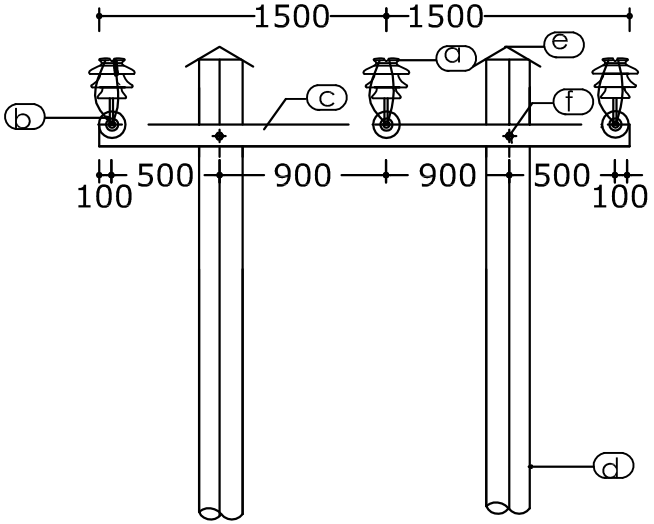
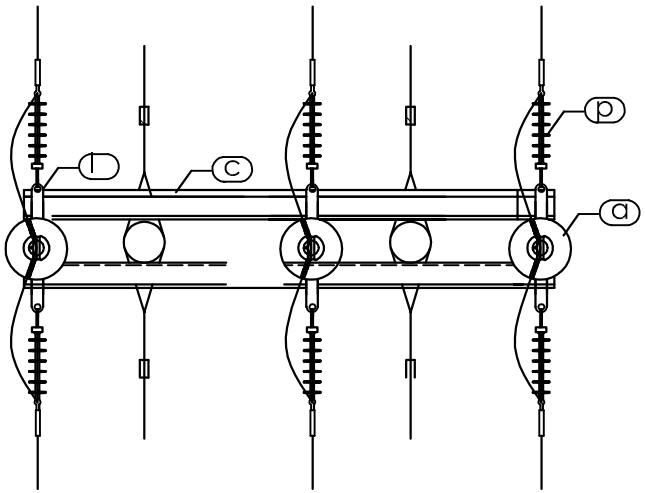
	SCALE:		
	DRW NO:		

9.2.2 33kV H-Section Structures, Horizontal Construction

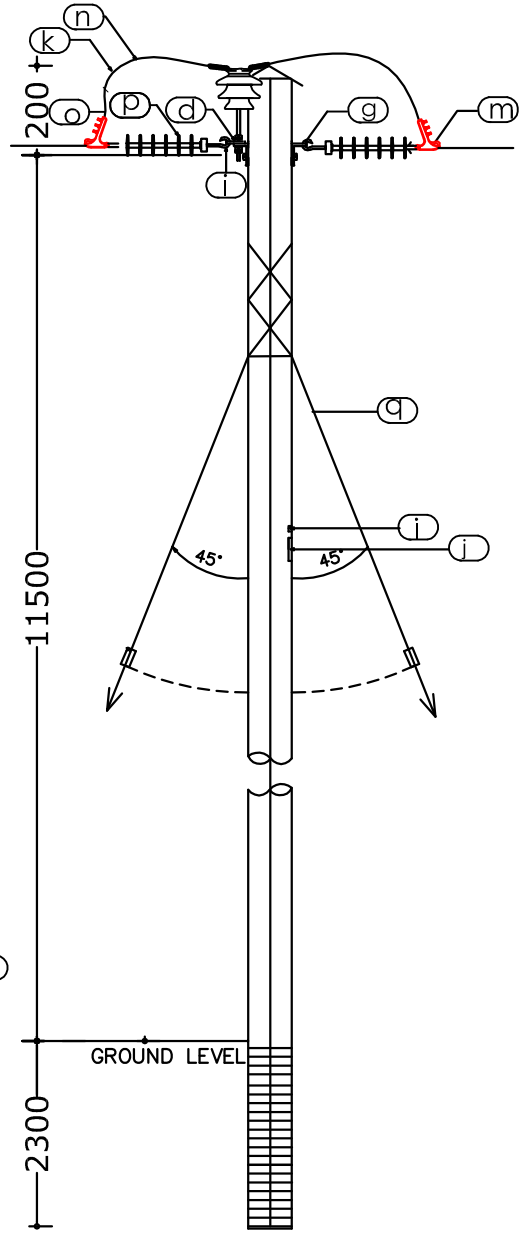
No.	Item	Item Specifications
1	Wooden Pole	• Two identical 14m poles for both earthed and unearthed configurations. *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped • Two cross-arms held by a steel connecting strap • Connecting strap: L: 50mm, W: 450mm; THK: 10mm • L:150mm, W:100mm, THK:10mm; Total length: 3000mm Diameter for holes: 22mm
4	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized steel; ASTM A123, ASTM A36. • Cross-arm/Pole interface: M20x300mm bolts • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
5	Insulator Requirements	• Composite strain insulators with hooks • Porcelain/ polymeric post insulators for supporting the jumpers at the cross-arm. • Voltage: 33kV • Conform to IEC 62223 *Refer to table 4 for the detailed insulator specifications.* • Groove Clamps for holding conductor to insulator; Tensile Strength: ≥ 300 N per sq mm
6	Jumpering Requirements	Jumpers/ connectors: • Aluminium to Aluminium • Material: AAAC100 Porcelain/ polymeric pin insulators for jumper supporting jumpers; 33kV. • PG clamps for terminating the conductor at the section
7	Earthing Requirements	Porcelain reel insulator; • Placed 200mm from the top of the pole

	(overhead earth)	• Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
8	Danger/Name/ phase indicator plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Phase Indicators: L:150 mm, W:150 mm • Holes for Nails: 8mm





AERIAL VIEW



SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	2
e	260MM POLE CAP – STEEL GAUGE 24	2
f	M20X300MM BOLT AND NUT	2
g	PIG TAIL HOOK	6
i	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
j	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
k	100 X 100MM ALUMINIUM PG CLAMP	6
l	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
m	70kN ALUMINIUM ALLOY TENSION CLAMP	6
n	RECIEVER JUMPER CONDUCTOR	3
o	SUPPLY JUMPER CONDUCTOR	3
p	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
q	INLINE STAY ASSEMBLY	4

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MV TWO MEMBER HORIZONTAL SECTION WITHOUT AERIAL EARTH - 14M POLE

APPROVED BY: MPDM

PRODUCED BY:

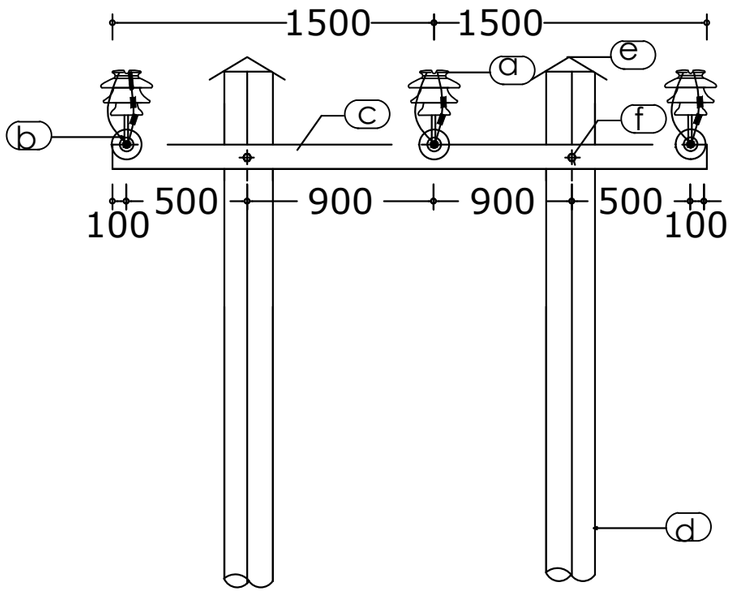
DRAWN BY: K.K

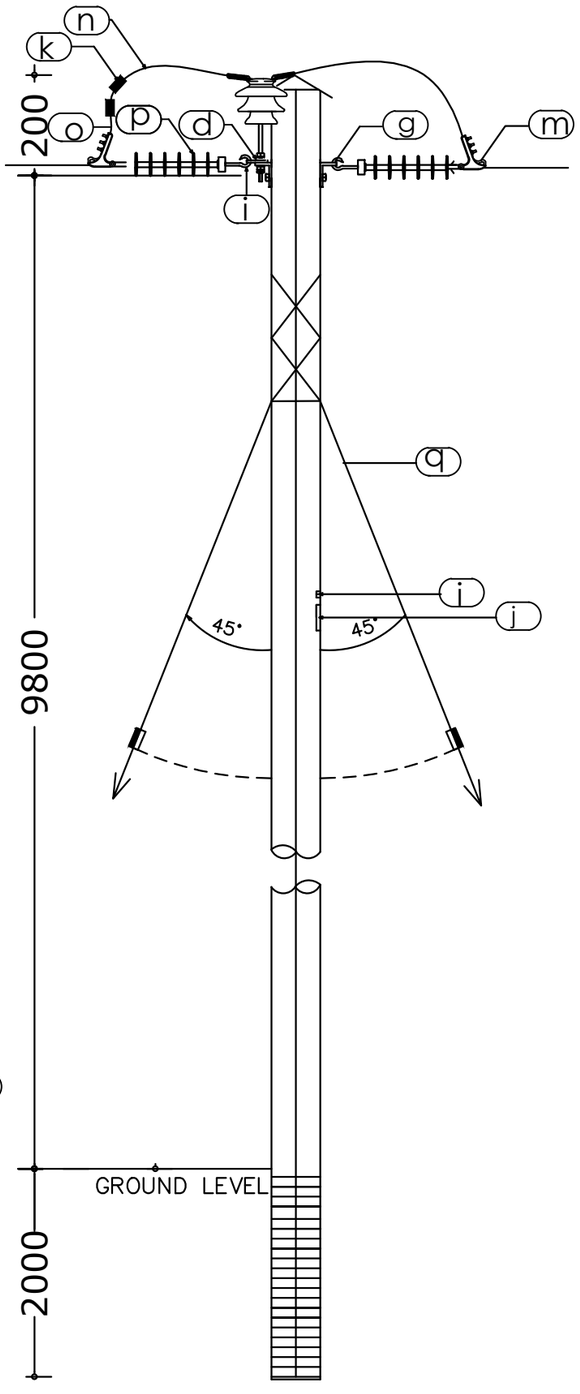
CHECKED BY: K.R

DATE:

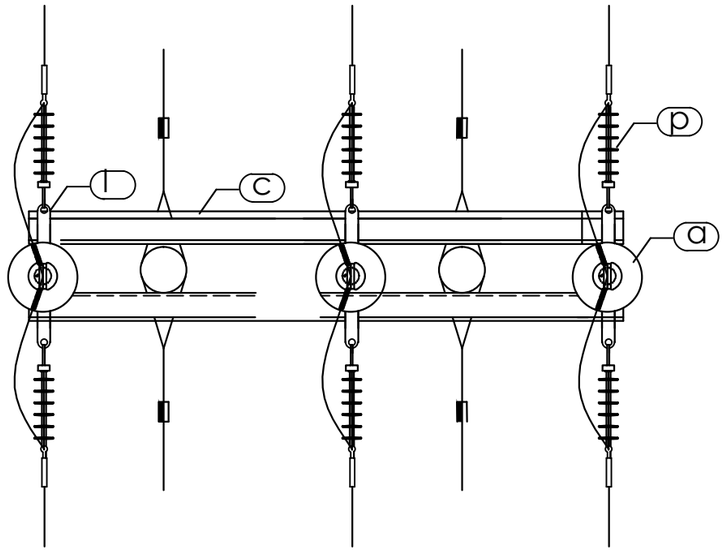
SCALE:

DRW NO:





ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	12M STOUT WOODEN POLE	2
e	260MM POLE CAP – STEEL GAUGE 24	2
f	M20X300MM BOLT AND NUT	2
g	PIG TAIL HOOK	6
i	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
j	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
k	100 X 100MM ALUMINIUM PG CLAMP	6
l	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
m	70kN ALUMINIUM ALLOY TENSION CLAMP	6
n	RECIEVER JUMPER CONDUCTOR	3
o	SUPPLY JUMPER CONDUCTOR	3
p	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
q	INLINE STAY ASSEMBLY	4



AERIAL VIEW

SIDE VIEW

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TITLE:

MV TWO MEMBER HORIZONTAL STRAIGHT SECTION WITHOUT AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
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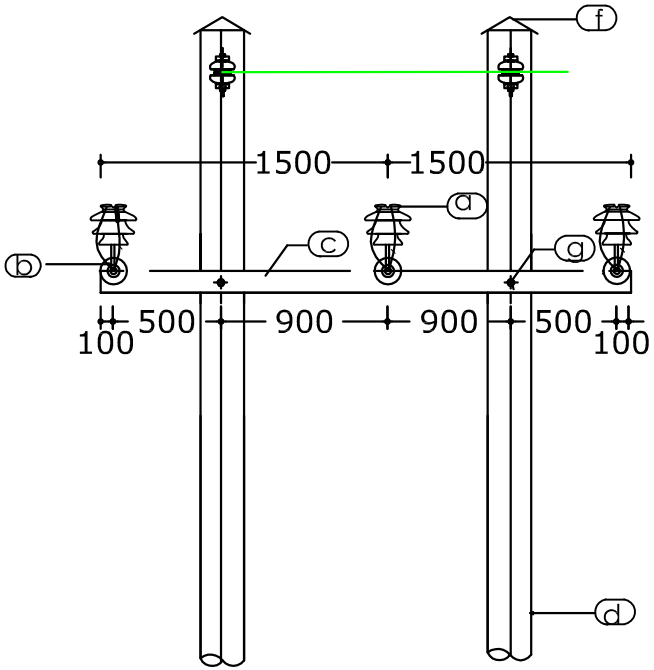
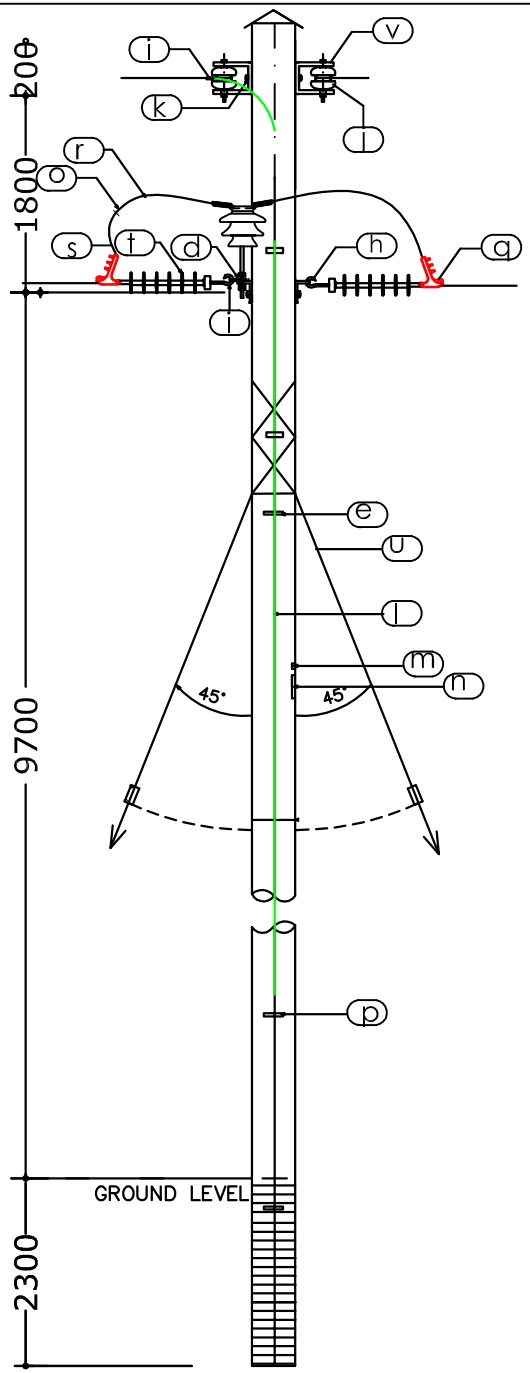
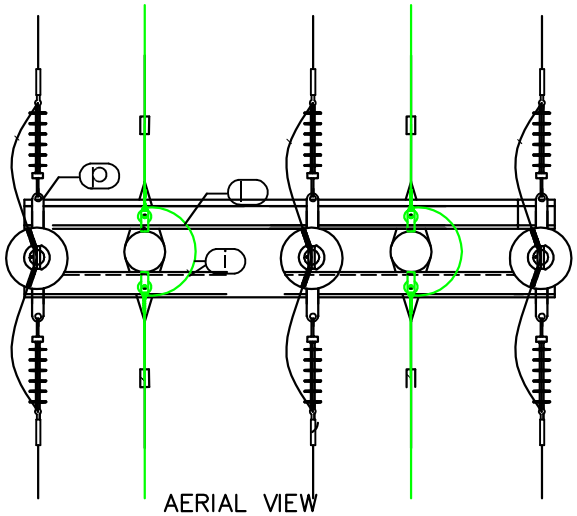




SIDE VIEW



AERIAL VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	2
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	PIG TAIL HOOK	6
i	25 X 25MM STEEL PG CLAMP	4
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	100 X 100MM ALUMINIUM PG CLAMP	6
p	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
q	70kN ALUMINIUM ALLOY TENSION CLAMP	6
r	RECIEVER JUMPER CONDUCTOR	3
s	SUPPLY JUMPER CONDUCTOR	3
t	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
u	INLINE STAY ASSEMBLY	4
v	D–IRON	2

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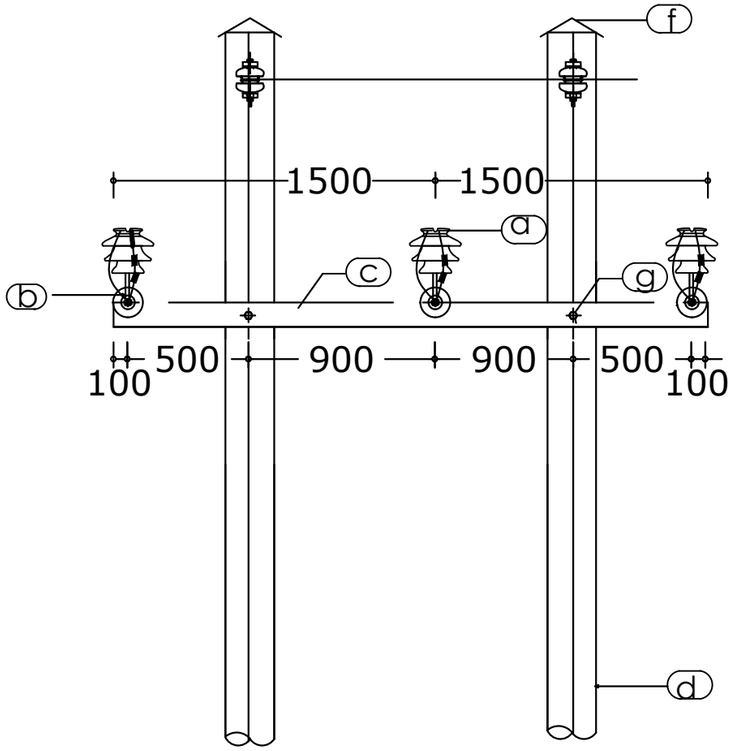
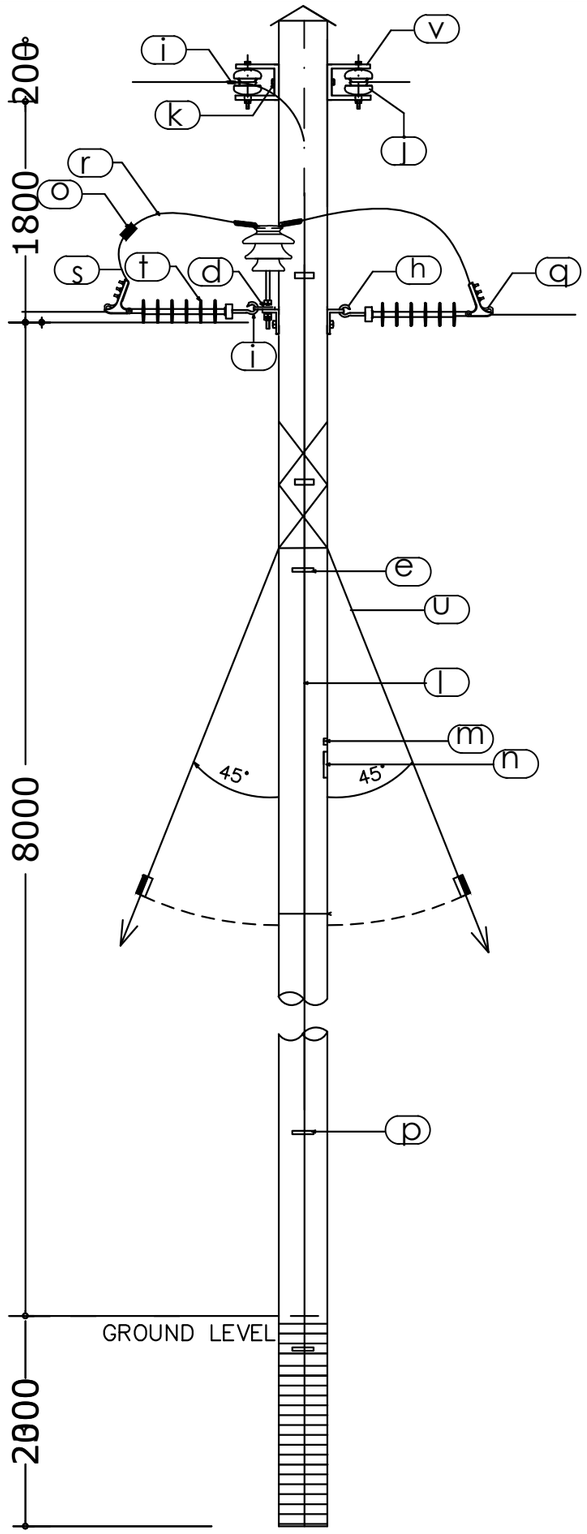
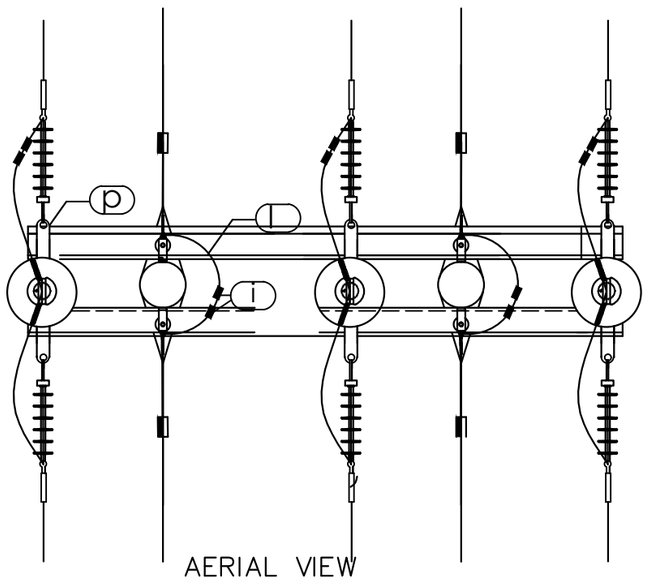
MV TWO MEMBER HORIZONTAL SECTION WITH AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		





SIDE VIEW



AERIAL VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	12M STOUT WOODEN POLE	2
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	PIG TAIL HOOK	6
i	25 X 25MM STEEL PG CLAMP	4
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	100 X 100MM ALUMINIUM PG CLAMP	6
p	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
q	70kN ALUMINIUM ALLOY TENSION CLAMP	6
r	RECIEVER JUMPER CONDUCTOR	3
s	SUPPLY JUMPER CONDUCTOR	3
t	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
u	INLINE STAY ASSEMBLY	4
v	D–IRON	2

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RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
1OTH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

MV TWO MEMBER HORIZONTAL SECTION WITH AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
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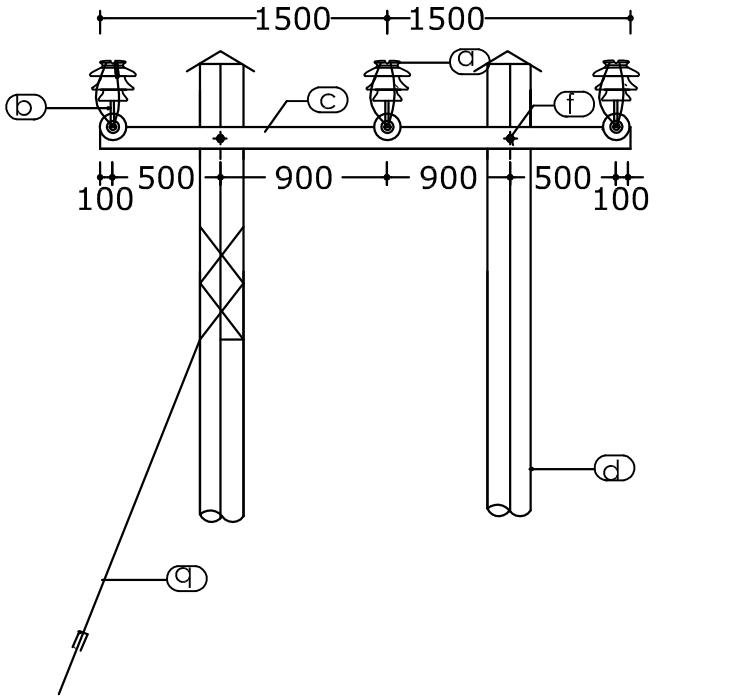
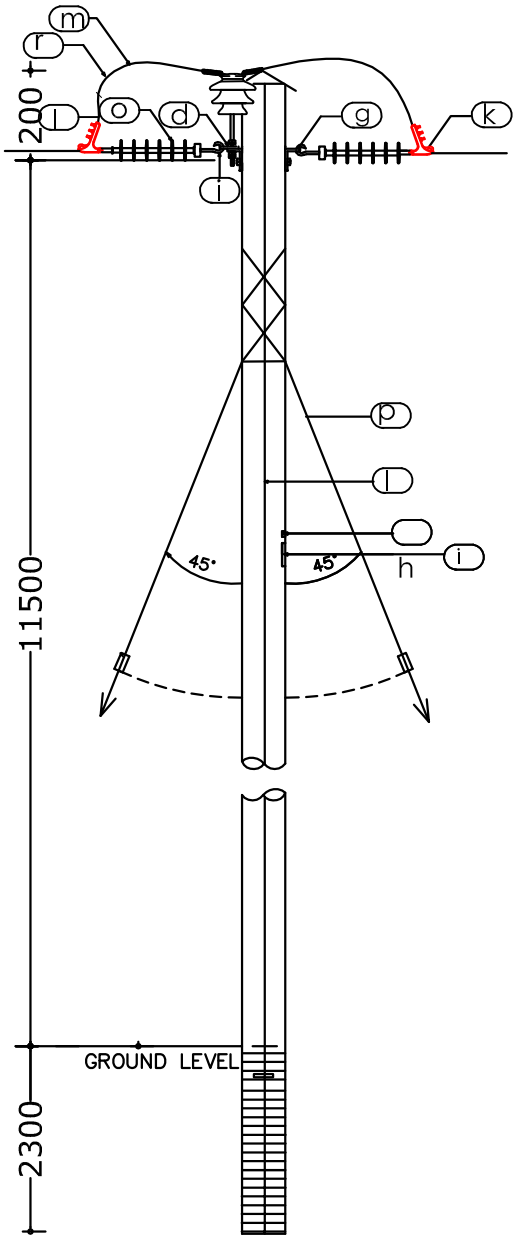
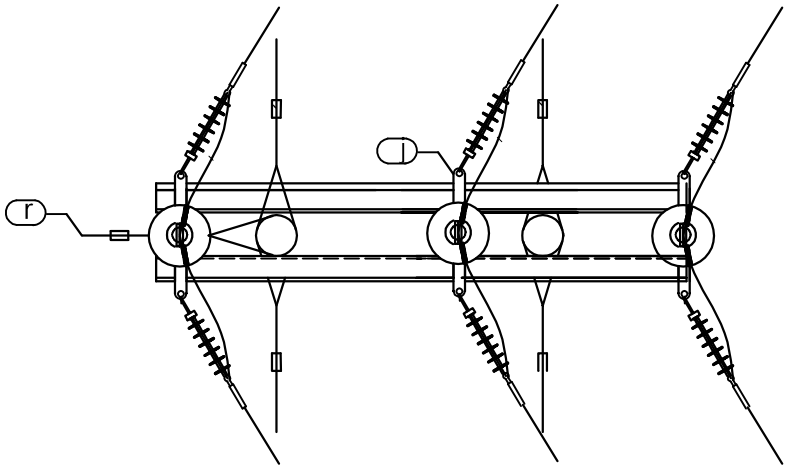
	DRW NO:		





SIDE VIEW



AERIAL VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	2
e	260MM POLE CAP – STEEL GAUGE 24	2
f	M20X300MM BOLT AND NUT	2
g	M20 PIG TAIL HOOK	6
h	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
i	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
j	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
k	70kN ALUMINIUM ALLOY TENSION CLAMP	6
l	RECIEVER JUMPER CONDUCTOR	3
m	SUPPLY JUMPER CONDUCTOR	3
o	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
p	INLINE STAY ASSEMBLY	4
q	BISECT STAY ASSEMBLY	1
r	100 X 100MM ALUMINIUM PG CLAMP	6

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TEL:

TITLE:

MV TWO MEMBER ANGLE WITHOUT AERIAL EARTH 14MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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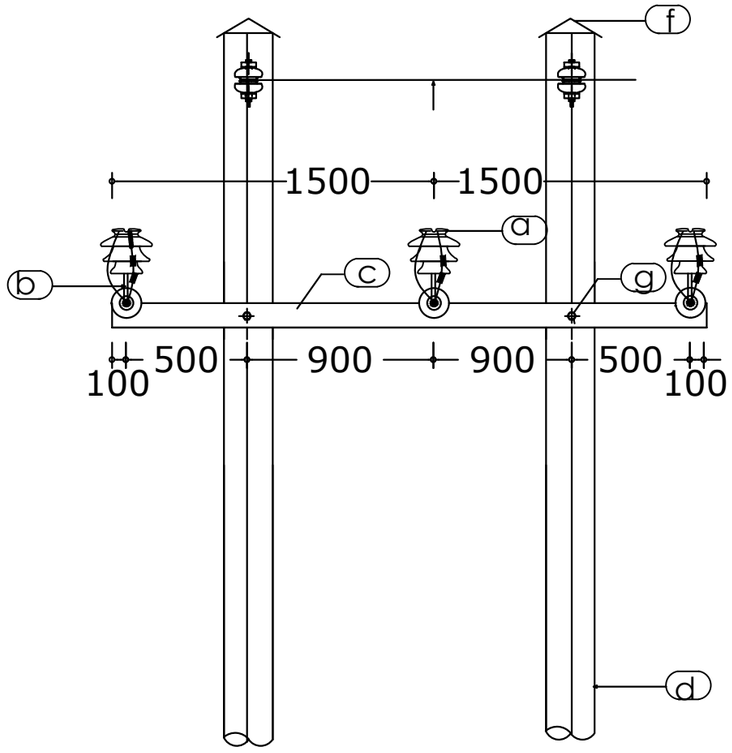
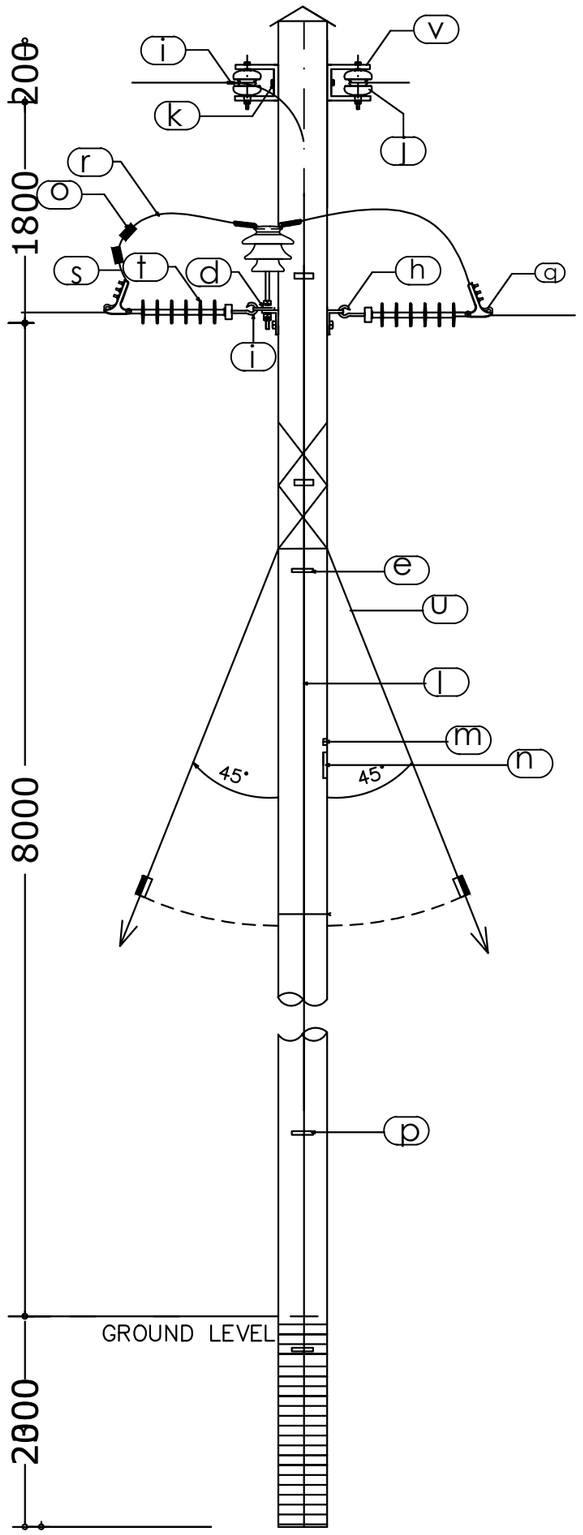
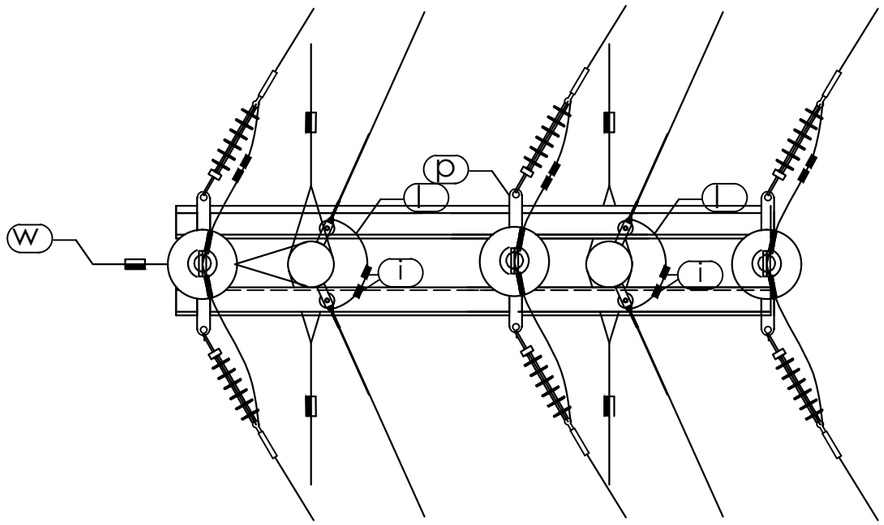
	SCALE:		
	DRW NO:		







SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	12M STOUT WOODEN POLE	2
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	M20 PIG TAIL HOOK	6
i	25 X 25MM STEEL PG CLAMP	4
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	100 X 100MM ALUMINIUM PG CLAMP	6
p	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
q	70kN ALUMINIUM ALLOY TENSION CLAMP	6
r	RECIEVER JUMPER CONDUCTOR	3
s	SUPPLY JUMPER CONDUCTOR	3
t	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
u	INLINE STAY ASSEMBLY	4
v	D–IRON	2
w	BISECT STAY ASSEMBLY	

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RURAL ELECTRIFICATION AGENCY
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1OTH FLOOR, WORKERS HOUSE
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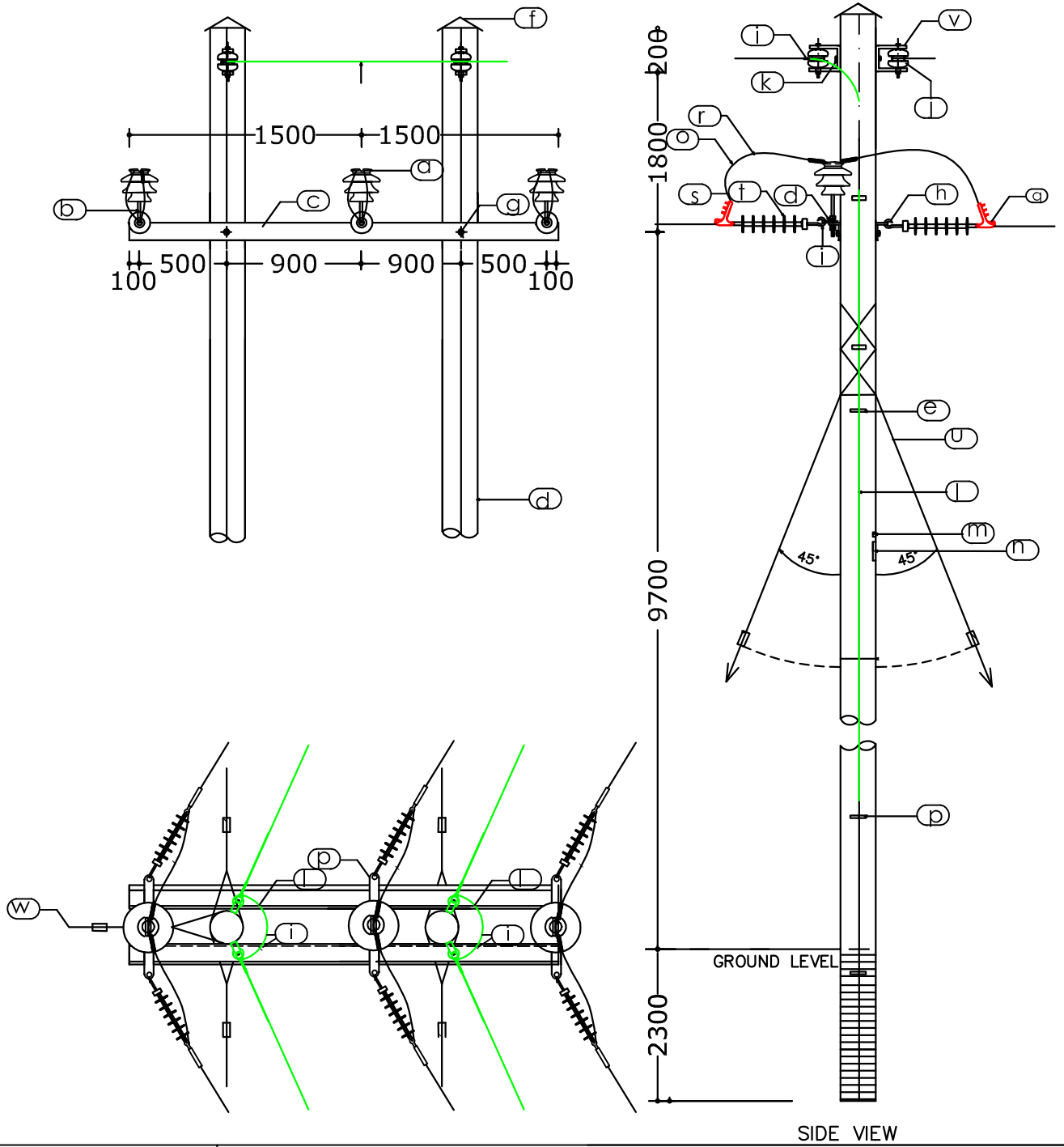
TEL:

TITLE:

MV TWO MEMBER ANGLE WITH AERIAL EARTH - 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	2
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	2
g	M20X300MM BOLT AND NUT	2
h	M20 PIG TAIL HOOK	6
i	25 X 25MM STEEL PG CLAMP	4
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	100 X 100MM ALUMINIUM PG CLAMP	6
p	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
q	70kN ALUMINIUM ALLOY TENSION CLAMP	6
r	RECIEVER JUMPER CONDUCTOR	3
s	SUPPLY JUMPER CONDUCTOR	3
t	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
u	INLINE STAY ASSEMBLY	4
v	D–IRON	2
w	BISECT STAY ASSEMBLY	

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PLOT 1, PLILKINGTON ROAD
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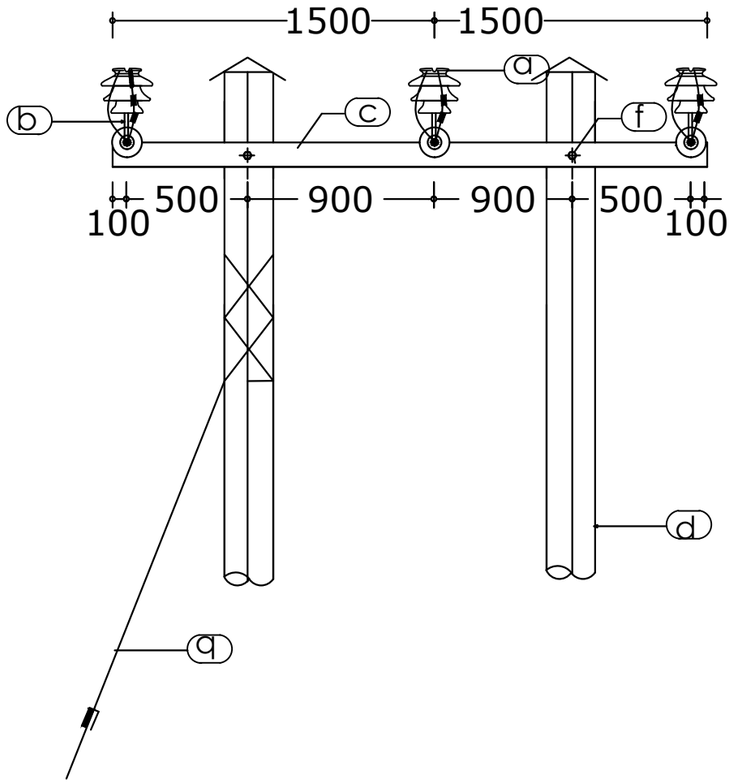
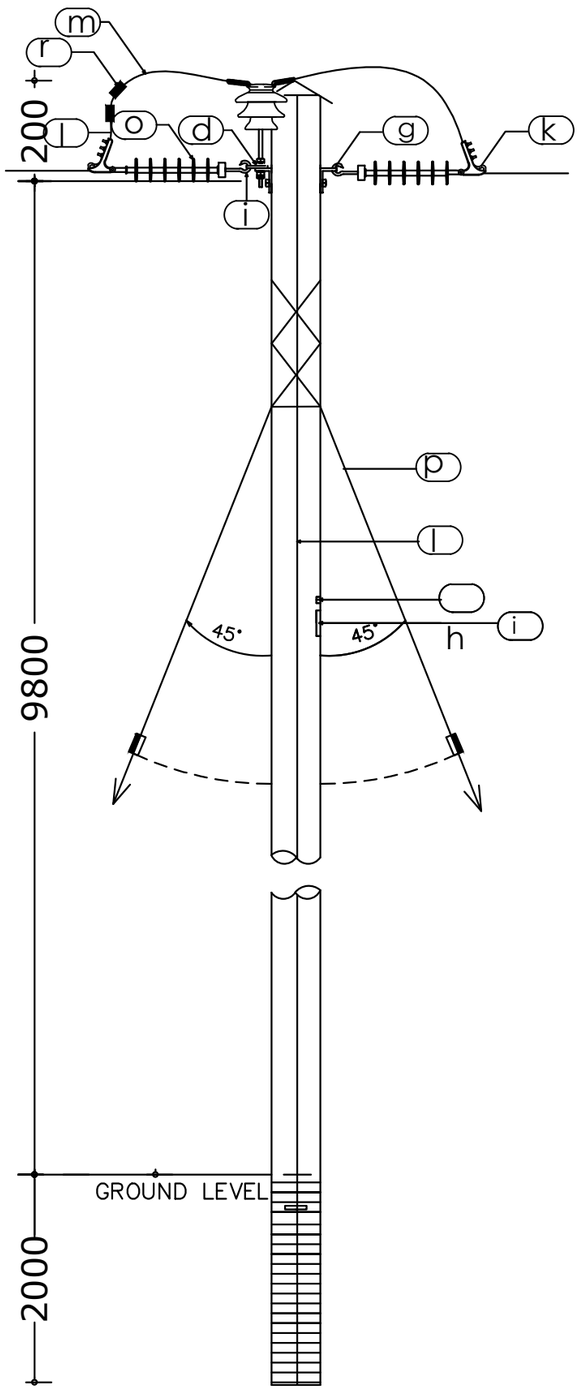
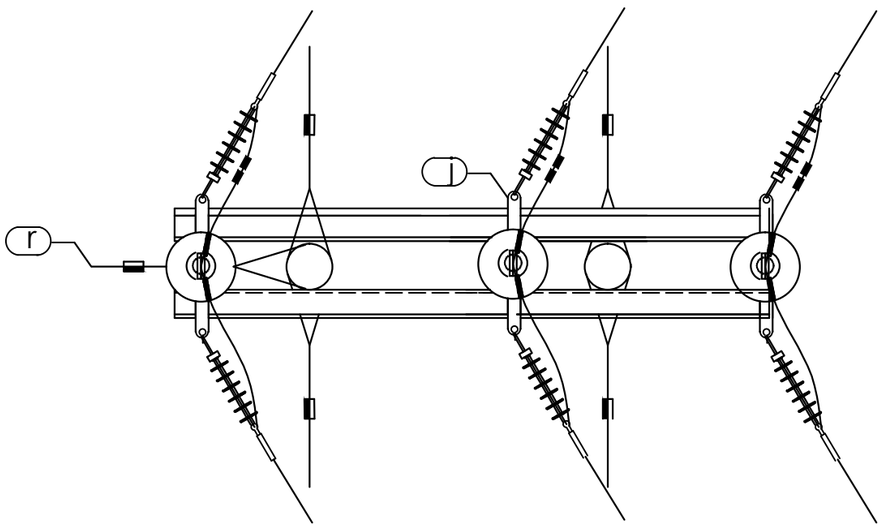
MV TWO MEMBER ANGLE WITH AERIAL EARTH - 14MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K
	CHECKED BY: K.R	DATE:
	SCALE:	
	DRW NO:	





SIDE VIEW



AERIAL VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	150*100*10 THK –3000MM CROSS ARM	2
d	12M STOUT WOODEN POLE	2
e	260MM POLE CAP – STEEL GAUGE 24	2
f	M20X300MM BOLT AND NUT	2
g	M20 PIG TAIL HOOK	6
h	200X150MM IRON SHEET GAUGE 16 POLE NUMBER, 85 MICRON PRIMER	1
i	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
j	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
k	70kN ALUMINIUM ALLOY TENSION CLAMP	6
l	RECIEVER JUMPER CONDUCTOR	3
m	SUPPLY JUMPER CONDUCTOR	3
o	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
p	INLINE STAY ASSEMBLY	4
q	BISECT STAY ASSEMBLY	1
r	100 X 100MM ALUMINIUM PG CLAMP	6

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TITLE:

MV TWO MEMBER ANGLE WITHOUT AERIAL EARTH 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
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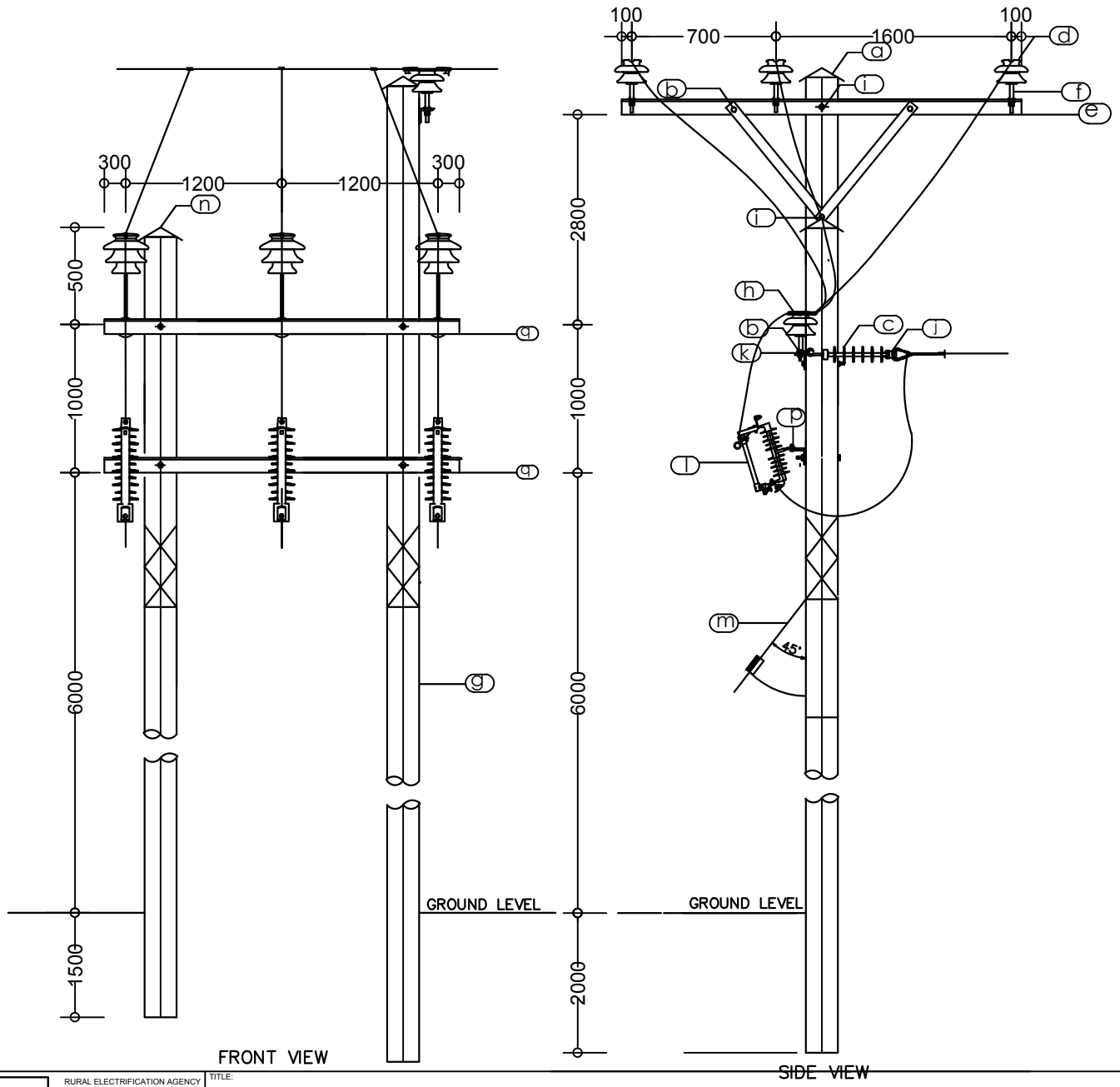
9.2.3 33kV Tee-off Structure

No.	Item	Item Specifications
1	Wooden Pole	• 12m pole • 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped • Two cross-arms with the dimensions; L:150mm, W:100mm, THK: 10 mm; Total length: 3000mm L:150mm, W:100mm, THK: 10mm; Total length: 3000mm • Diameter for holes: 22mm
3(a)	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized steel; BS EN ISO 1461. • Cross-arm/Pole interface: M20x300mm bolts • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
4	Insulator Requirements	• Porcelain/ polymeric post insulators with spindles shall be used at the cross-arm of the 12m pole. • Composite strain insulators with hooks shall be used at cross-arm of the lay (9m) pole. • Voltage: 33kV • Conform to IEC 62223 *Refer to table 4 for the detailed insulator specifications.*
5	Jumpering Requirements	Jumpers/ connectors: • Aluminium to Aluminium • Material: AAAC100
6	Drop-out fuse requirements	• Anchorage clamps shall be used to support the dropout fuse holders at the cross-arm.
7	Danger/Name plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Holes for Nails: 8mm



ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	M20X250MM BOLT AND NUT	2
c	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
d	10kN, 900MM, 110kV PIN INSULATOR	3
e	150*100*10 THK –2500MM CROSS ARM	1
f	300MM SPINDLE	6
g	12M WOODEN POLE	2
h	CONDUCTOTR BINDING	3
i	M20X300MM BOLT AND NUT	6
j	SOCKET THIMBLE	3
k	TERMINATING STRAP	3
l	DROP OUT FUSE	3
m	TERMINAL STAY ASSEMBLY	2
n	200MM POLE CAP – STEEL GAUGE 24	1
o	9M LAY POLE	1
p	M20X5M BOLT AND NUT	1
q	150*100*10 THK –3000MM CROSS ARM	2

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
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TEL:

TITLE:

MV TWO MEMBER T-OFF STRUCTURE

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	CHECKED BY: K.R	DATE:	
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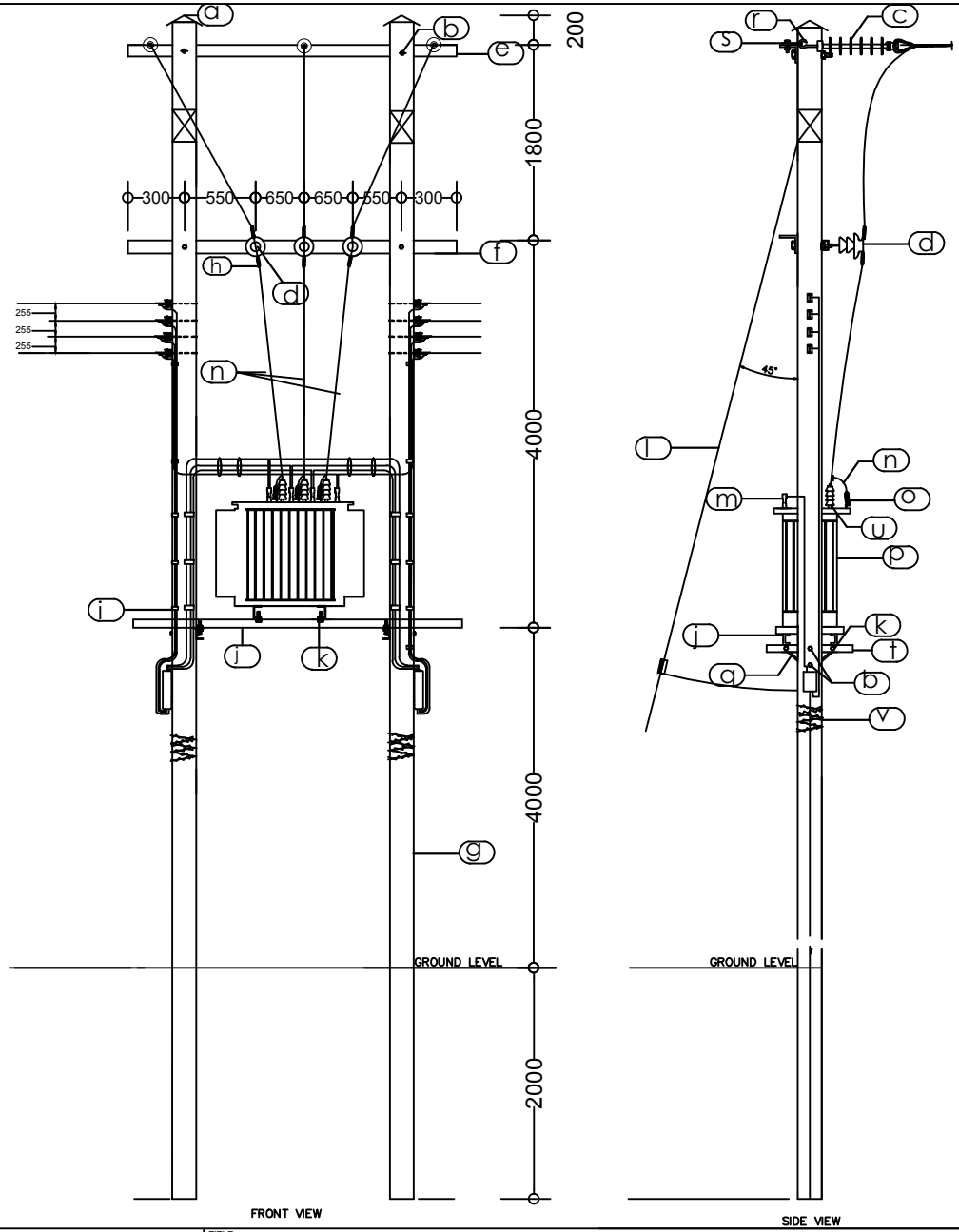
9.2.4 33kV Transformer Structure

No.	Item	Item Specifications
1	Wooden Pole	• Two 12m identical poles *Refer to Table 12 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped terminal and pilot support cross-arms L:150mm, W:100mm, THK: 10mm; Total length: 3000mm Diameter for holes: 22mm In case drop-out fuses are installed; a cross-arm with the above mentioned dimensions shall be installed below the pilot cross-arm.
4	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized steel; ASTM A123 and ASTM A36 • Cross-arm/Pole interface: M20x300mm bolts • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
5	Insulator Requirements	• Composite strain insulators with hooks at the terminating cross-arm; 33kV. • Polymeric pin insulators with spindles at the pilot cross-arm to support the jumpers/ connectors • Voltage: 33kV • Conform to IEC 62223 *Refer to table 4 for the detailed insulator specifications.*
6	Jumpering Requirements	Jumpers/ connectors: • Aluminium to Copper • Material: AAAC50
7	Drop-out fuse requirements	• Incase drop-out fuses are installed at transformer structure, anchorage clamps shall be used to support the dropout fuse holders at the cross-arm.
8	Protection Requirements	• Lighting/ surge arrestors installed either at the terminal cross-arm or at the MV side of the transformer.
9	Earthing Requirements	MV earthing; 4 copper rods • Hard-drawn high conductivity copper with hardened steel driving caps and tips • diameter: > or equal 19mm 2 earth mats

10	Transformer Platform	• Two Long U-channels L:150X100X10mm-3000mm • Four Short U-channels L150X100X10mm-550mm • Four Transformer platform braces; 4mm thick • M20x300mm bolts for Short U-channels/ pole interface • M20x300mm bolts for brace/ pole interface
11	Danger/Name plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Holes for Nails: 8mm



ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	2
b	M20X300MM BOLT AND NUT	8
c	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
d	JUMPER SUPPORT(PILOT INSULATOR)	3
e	150*100*10 THK –3000MM CROSS ARM	1
f	150*100*10 THK –3000MM CROSS ARM	1
g	12M WOODEN POLE	1
h	CONDUCTOTR BINDING	3
i	CABLE SADDLE	
j	150*100*10 THK –3000MM U–CHANNEL	2
k	M20X50MM BOLT AND NUT	12
l	TERMINAL STAY ASSEMBLY	2
m	SECONDARY BUSHING	3
n	SURGE ARRESTOR CONNECTION	3
o	SURGE ARRESTOR	3
p	TRANSFORMER	2
q	4MM THK ARM BRACES	4
r	M20 PIG TAIL HOOK	3
s	TERMINATING STRAP	3
t	150*100*10 THK –550MM U–CHANNEL	4
u	PRIMARY BUSHING	3
v	ANTI CLIMBING	

NOTES:

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PLOT 1, PLILKINGTON ROAD
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TEL:

TITLE:

MV TWO MEMBER TRANSFORMER STRUCTURE

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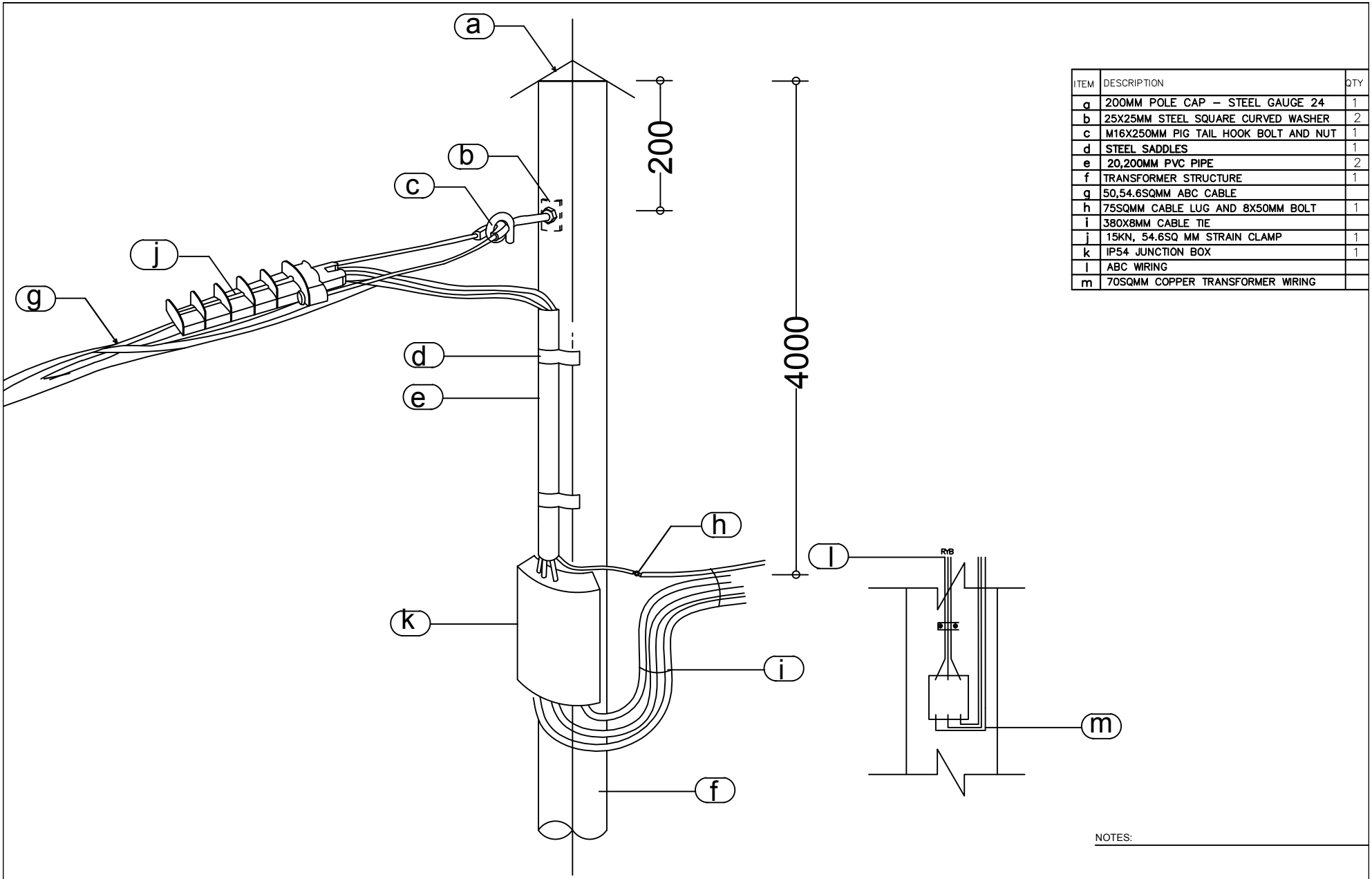
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	1
d	STEEL SADDLES	1
e	20,200MM PVC PIPE	2
f	TRANSFORMER STRUCTURE	1
g	50,54.6SQMM ABC CABLE	
h	75SQMM CABLE LUG AND 8X50MM BOLT	1
i	380X8MM CABLE TIE	
j	15KN, 54.6SQ MM STRAIN CLAMP	1
k	IP54 JUNCTION BOX	1
l	ABC WIRING	
m	70SQMM COPPER TRANSFORMER WIRING	

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
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TEL:

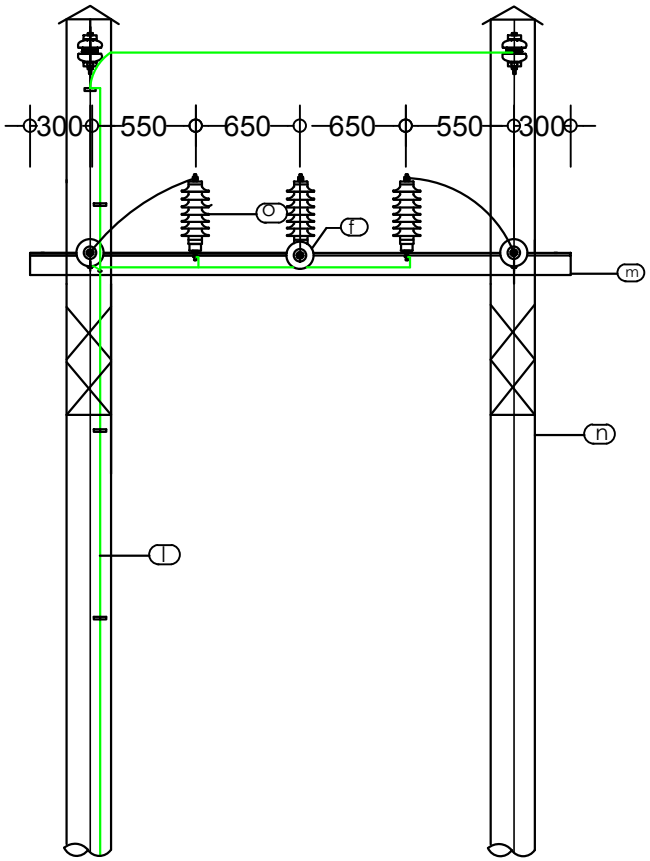
TITLE:

ABC LV TERMINATION AT TRANSFORMER STRUCTURE

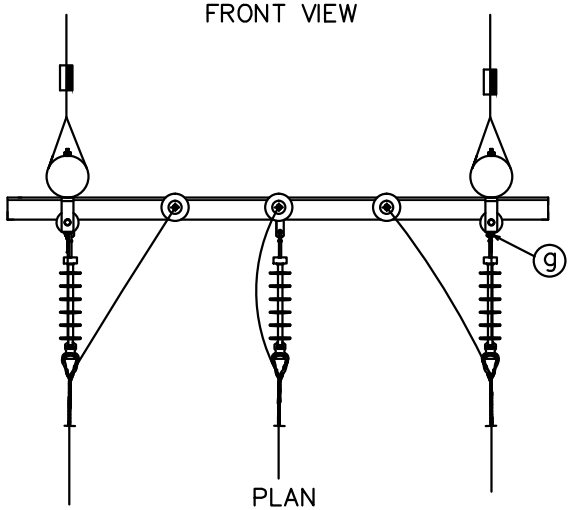
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.2.5 33kV Terminal Structure

No.	Item	Item Specifications
1	Wooden Pole	• Two 12m identical poles *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
4	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped L:150mm, W:100mm, THK: 10mm; Total length: 3000mm Diameter for holes: 22mm
5	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized steel; ASTM A123, ASTM A36. • Cross-arm/Pole interface: M20x300mm bolts • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
6	Insulator Requirements	• Composite strain insulators with hooks at the terminating crossarm; 33kV. • Voltage: 33kV • Conform to IEC 62223 *Refer to Table 4 for the detailed insulator specifications.*
7	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.* Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
8	Danger/Name plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Holes for Nails: 8mm



FRONT VIEW



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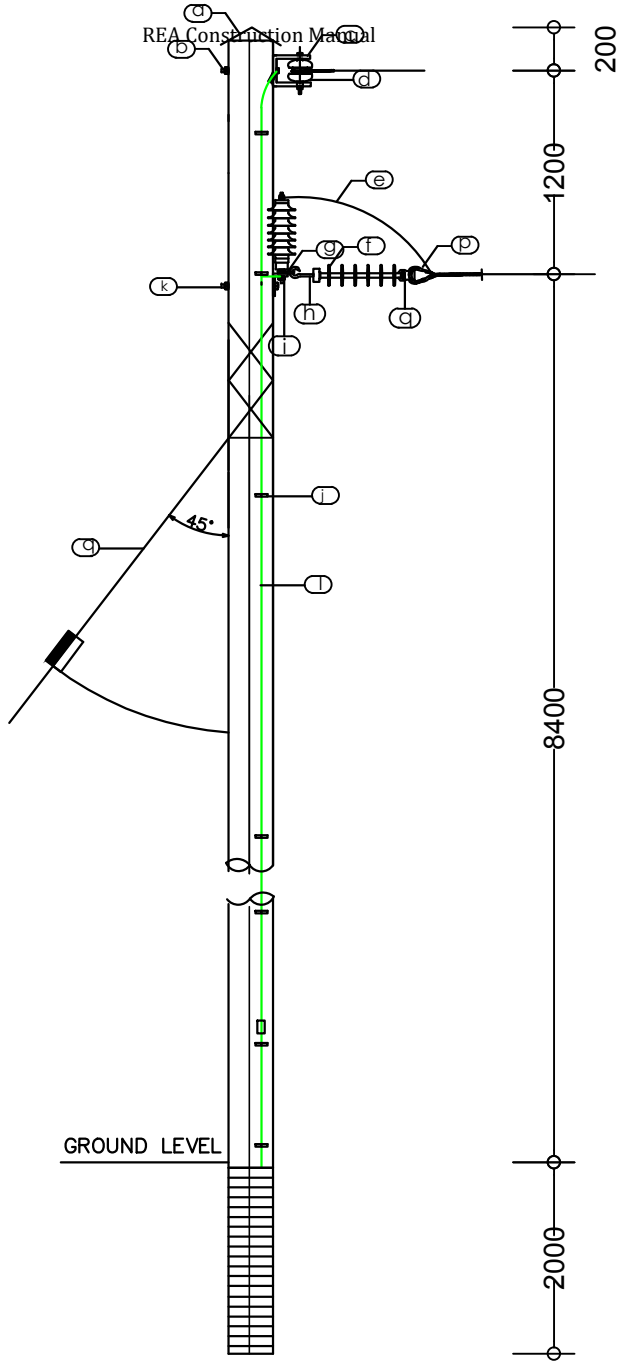

SIDE VIEW

ITEM	DESCRIPTION	QTY
a	260MM POLE CAP – STEEL GAUGE 24	1
b	M16X300MM BOLT AND NUT	1
c	D–IRON	1
d	40MM, 9kV, 13.5kN REEL INSULATOR	1
e	JUMPER CONDUCTOR	
f	1200MM, 210kV, 70kN, STRAIN INSULATOR	3
g	TERMINATING STRAP	3
h	M20 PIG TAIL HOOK	3
i	M20X50MM BOLT AND NUT	3
j	STEEL U–NAILS AT 500MM INTERVAL	30
k	M20X300MM BOLT AND NUT	3
l	3x2.64MM, 16M EARTH WIRE	1
m	150*100*10 THK –3000MM CROSS ARM	1
n	12M STOUT WOODEN POLE	1
o	SURGE ARRESTOR	3
p	PREFORMED DEAD END	3
q	SOCKET THIMBLE	3

NOTES:

RURAL ELECTRIFICATION AGENCY
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TEL:

TITLE:

MV TWO MEMBER TERMINAL STRUCTURE - 12M

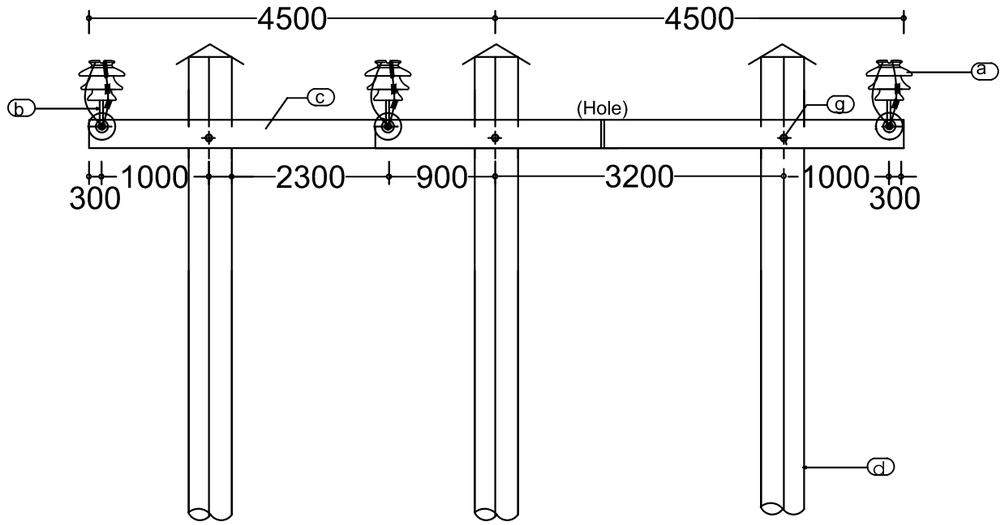
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

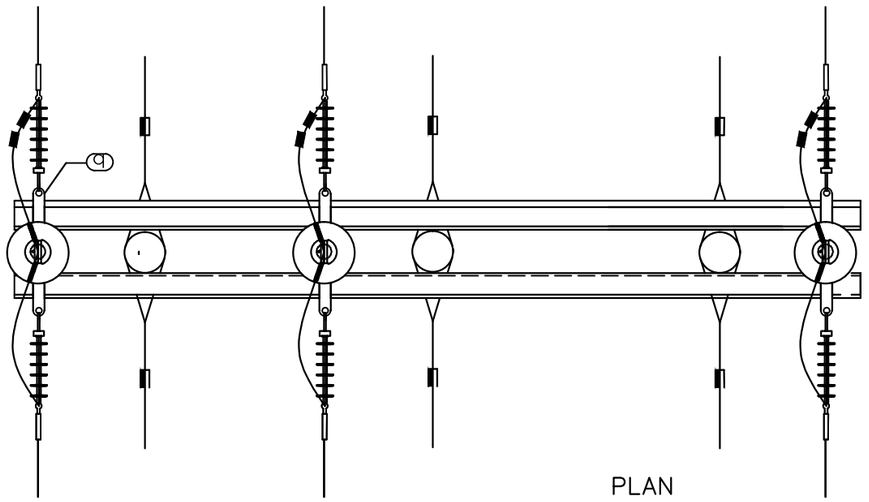
9.3 Three Member Wooden Pole Configurations

33kV Three Member Section Structure, Horizontal construction, ($60^0<\theta<90^0$)

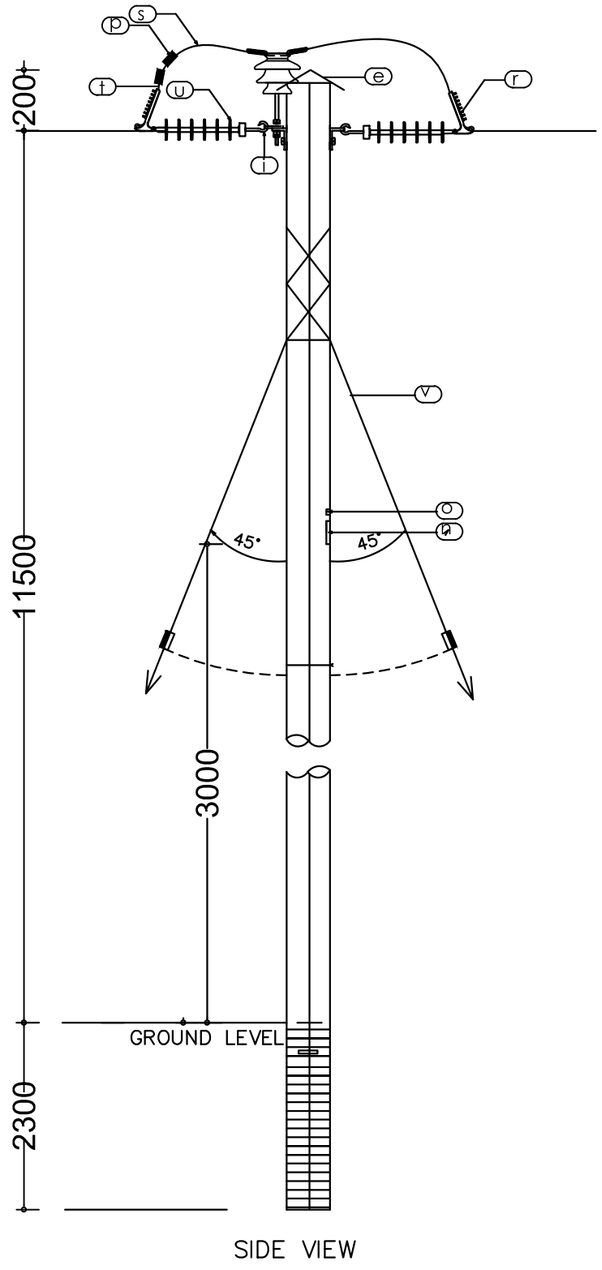
No.	Item	Item Specifications
1	Wooden Pole	• Three identical 14m poles *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 260mm • Thickness: Gauge-24
3	Galvanized Steel Cross-arm	• Hot dip galvanized steel: ASTM A123 • Low carbon mild steel grade 43A; ASTM A36 • L-shaped L:200/250mm, W:150/200mm, THK: 15mm; Total length: 6000mm or 9000mm Diameter for holes: 22mm
4	Cross-arm accessories	• All struts, braces, bolts, nuts, washers shall be made from hot-dip galvanized steel;ASTM A136 and ASTM A36. • Cross-arm/Pole interface: M20x300mm bolts • Square curved washers: L:50mm, W:50mm THK:2.5mm; Diameter : 22mm.
5	Insulator Requirements	• Polymeric pin insulators with spindles at the pilot cross-arm to support the jumpers/ connectors • Voltage: 33kV • Conform to IEC 62223 *Refer to table 4 for the detailed insulator specifications.* • Groove Clamps for holding conductor to insulator; Tensile Strength: ≥ 300 N per sq. mm
6	Jumpering Requirements	Jumpers/ connectors: • Aluminium to Aluminium • Material: AAAC100 Porcelain/ polymeric pin insulators for jumper supporting jumpers; 33kV. • PG clamps for terminating the conductor at the section
7	Earthing Requirements (overhead earth)	Porcelain reel insulator; • Placed 200mm from the top of the pole • Conform to IEC 62223 • M16x300mm bolts at reel insulator/ pole interface *Refer to Table 4 for the detailed insulator specifications.*

		Aerial Earth; • Galvanized steel wire • 3 strands, each of 2.64mm diameter (3/2.64). • Earthing shall be done every after one pole. • Construction conform to IEC 888, BS 183 and BS 443 • Weight of Zinc Coating (kg/m2): 0.24 • Ultimate Tensile Strength (kN): 5.4
8	Danger/Name/ phase indicator plates	• Gauge 16, Iron sheet plates of 85 Micron Primer • Danger plate: L:210 mm, W:300 mm • Number plate: L:200 mm, W:150 mm • Phase Indicators: L:150 mm, W:150 mm • Holes for Nails: 8mm





SIDE VIEW



SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	250*200*15 THK –9000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	3
g	20X300MM BOLT AND NUT	3
h	PREFORMS FOR BINDING	N/A
i	PIG TAIL HOOK	6
j	25 X 25MM STEEL PG CLAMP	N/A
k	40MM, 9kV, 13.5kN REEL INSULATOR	N/A
l	16X300MM BOLT AND NUT	N/A
m	3x2.64MM, 16M EARTH WIRE	N/A
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
p	100 X 100MM STEEL PG CLAMP	6
q	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
r	100kN ALUMINIUM ALLOY TENSION CLAMP	6
s	RECIEVER JUMPER CONDUCTOR	3
t	SUPPLY JUMPER CONDUCTOR	3
u	1200MM, 210kV, 100kN, STRAIN INSULATOR	6
v	INLINE STAY ASSEMBLY	4
w	D–IRON	N/A

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
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UGANDA

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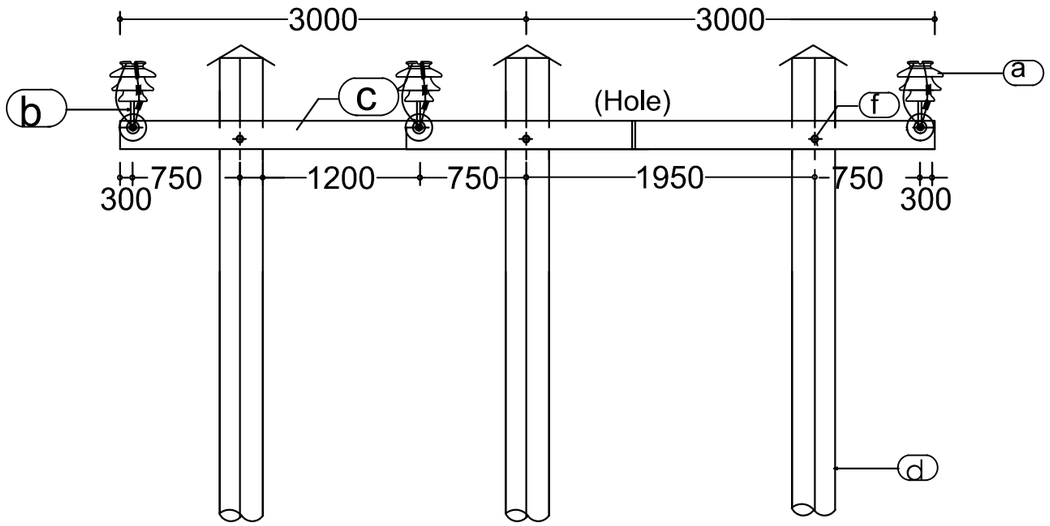
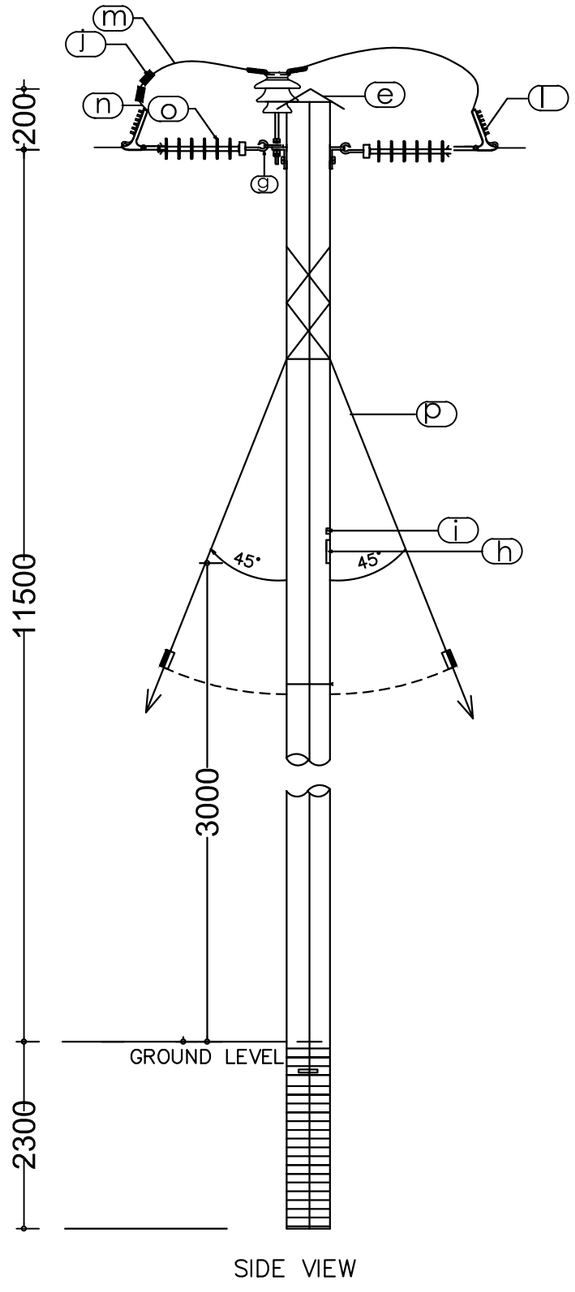
TITLE:

MV THREE MEMBER SECTION WITHOUT AERIAL EARTH (NINE METER CROSS ARM)

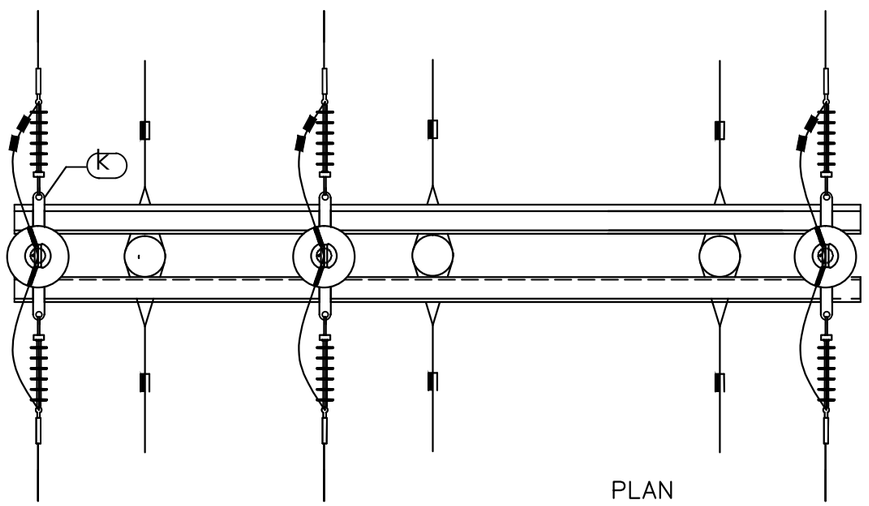
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		





SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	200*150*15 THK –6000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	260MM POLE CAP – STEEL GAUGE 24	3
f	M20X300MM BOLT AND NUT	3
g	M20 PIG TAIL HOOK	6
h	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
i	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
j	100 X 100MM ALUMINIUM PG CLAMP	6
k	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
l	70kN ALUMINIUM ALLOY TENSION CLAMP	6
m	RECIEVER JUMPER CONDUCTOR	3
n	SUPPLY JUMPER CONDUCTOR	3
o	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
p	INLINE STAY ASSEMBLY	4



PLAN

SIDE VIEW

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PLOT 1, PLILKINGTON ROAD
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TITLE:

MV THREE MEMBER STRAIGHT SECTION WITHOUT AERIAL EARTH (SIX METER CROSS ARM)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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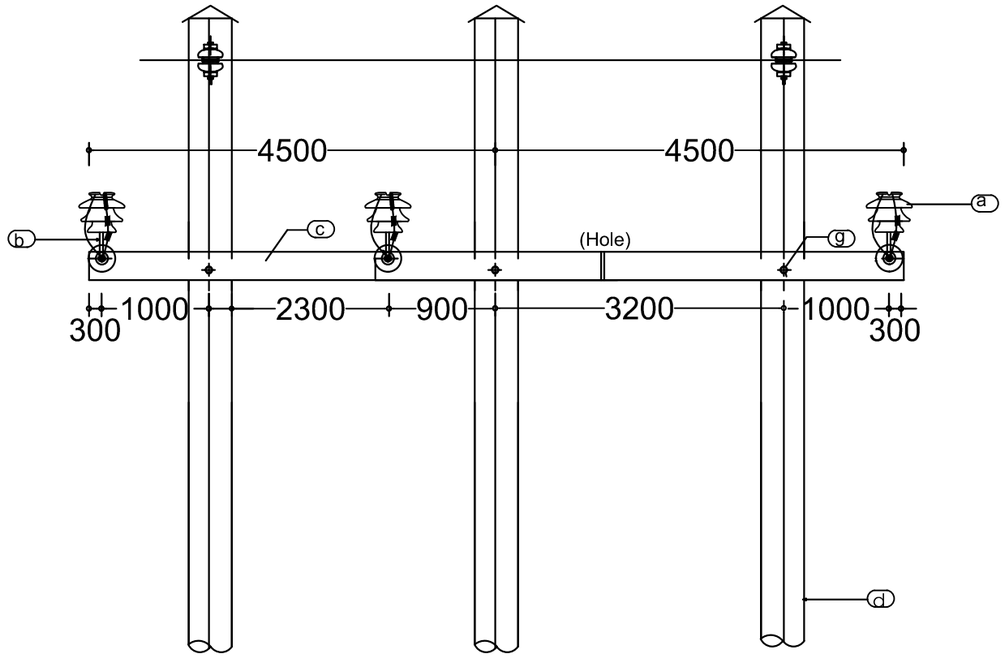
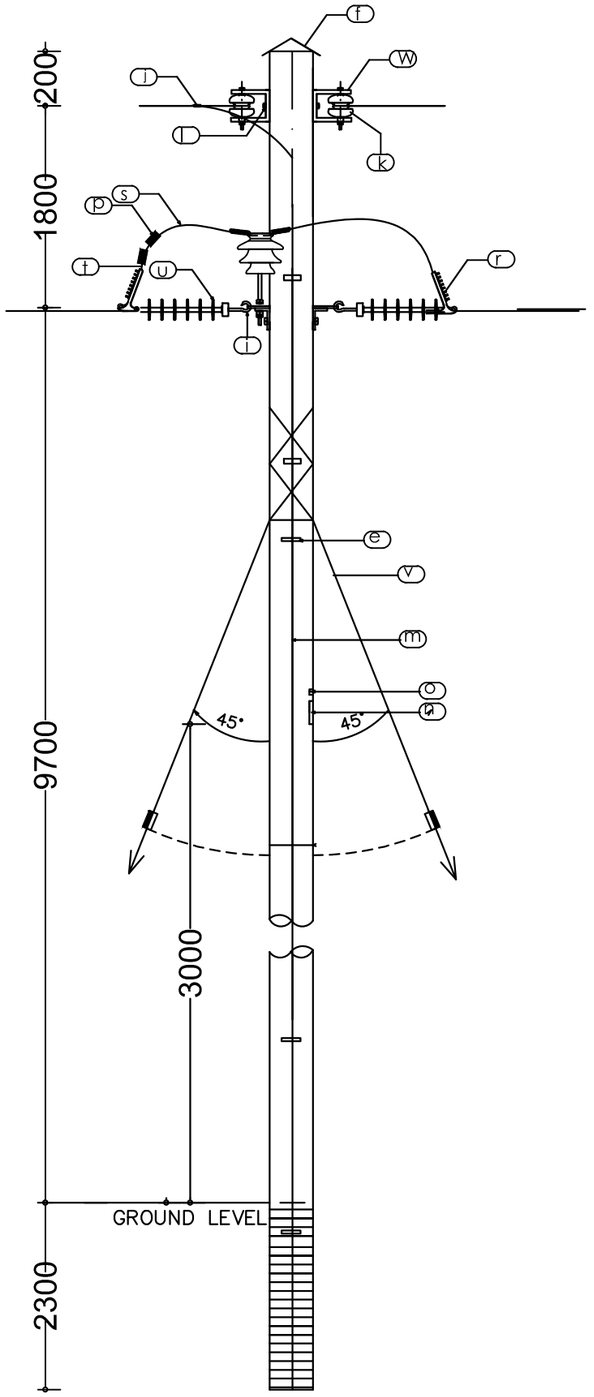


PLAN



SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	250*200*15 THK –9000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	3
g	20X300MM BOLT AND NUT	3
h	PREFORMS FOR BINDING	N/A
i	PIG TAIL HOOK	6
j	25 X 25MM STEEL PG CLAMP	2
k	40MM, 9kV, 13.5kN REEL INSULATOR	2
l	16X300MM BOLT AND NUT	2
m	3x2.64MM, 16M EARTH WIRE	2
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
p	100 X 100MM STEEL PG CLAMP	6
q	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
r	PREFORMED DEAD END	6
s	RECIEVER JUMPER CONDUCTOR	3
t	SUPPLY JUMPER CONDUCTOR	3
u	1200MM, 210kV, 100kN, STRAIN INSULATOR	6
v	INLINE STAY ASSEMBLY	4
w	D–IRON	2

SIDE VIEW

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MV THREE MEMBER SECTION WITH AERIAL EARTH (NINE METER CROSS ARM)

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	CHECKED BY: K.R	DATE:	
	SCALE:		
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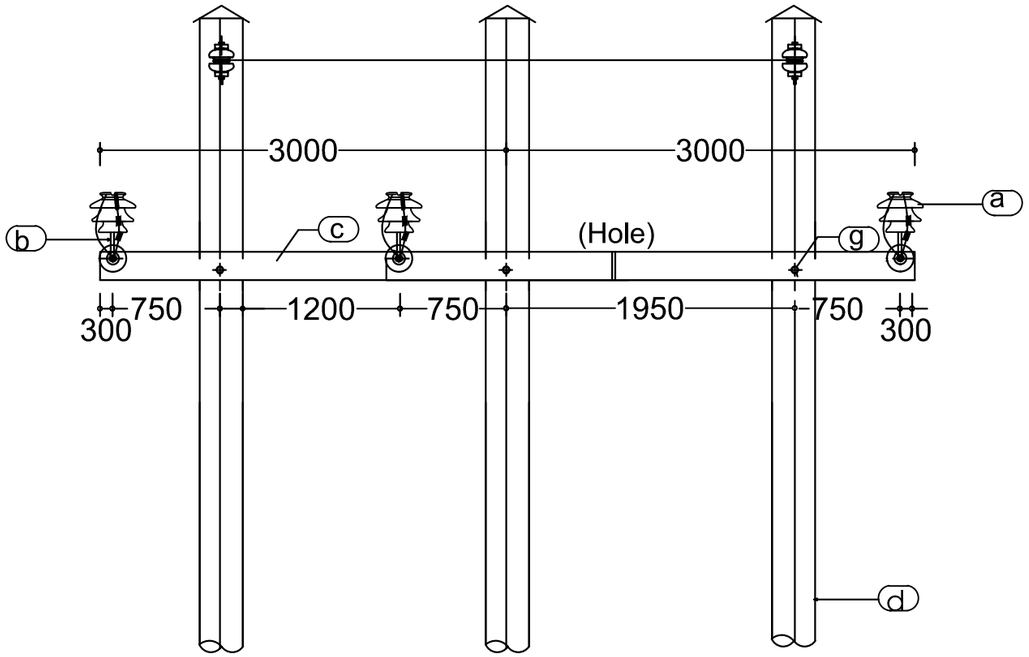
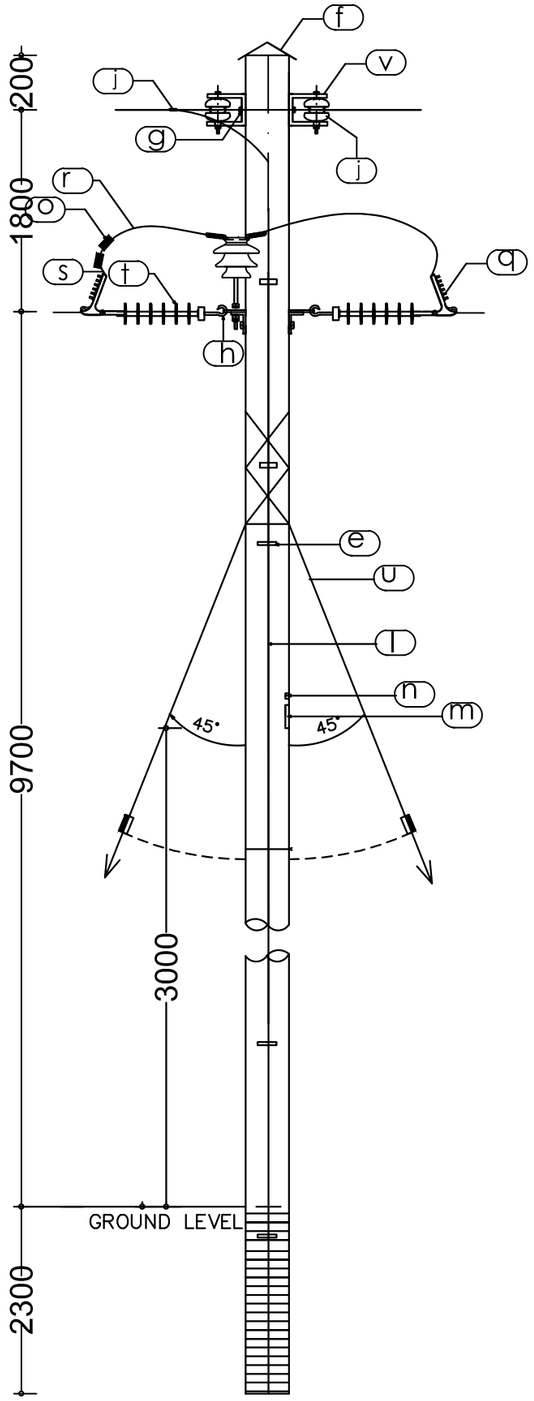


PLAN

SIDE VIEW



SIDE VIEW

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	200*150*15 THK –6000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	3
g	M20X300MM BOLT AND NUT	3
h	M20 PIG TAIL HOOK	6
i	25 X 25MM STEEL PG CLAMP	2
j	40MM, 9kV, 13.5kN REEL INSULATOR	2
k	M16X300MM BOLT AND NUT	2
l	3x2.64MM, 16M EARTH WIRE	2
m	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
n	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
o	100 X 100MM ALUMINIUM PG CLAMP	6
p	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
q	70kN ALUMINIUM ALLOY TENSION CLAMP	6
r	RECIEVER JUMPER CONDUCTOR	3
s	SUPPLY JUMPER CONDUCTOR	3
t	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
u	INLINE STAY ASSEMBLY	4
v	D–IRON	2

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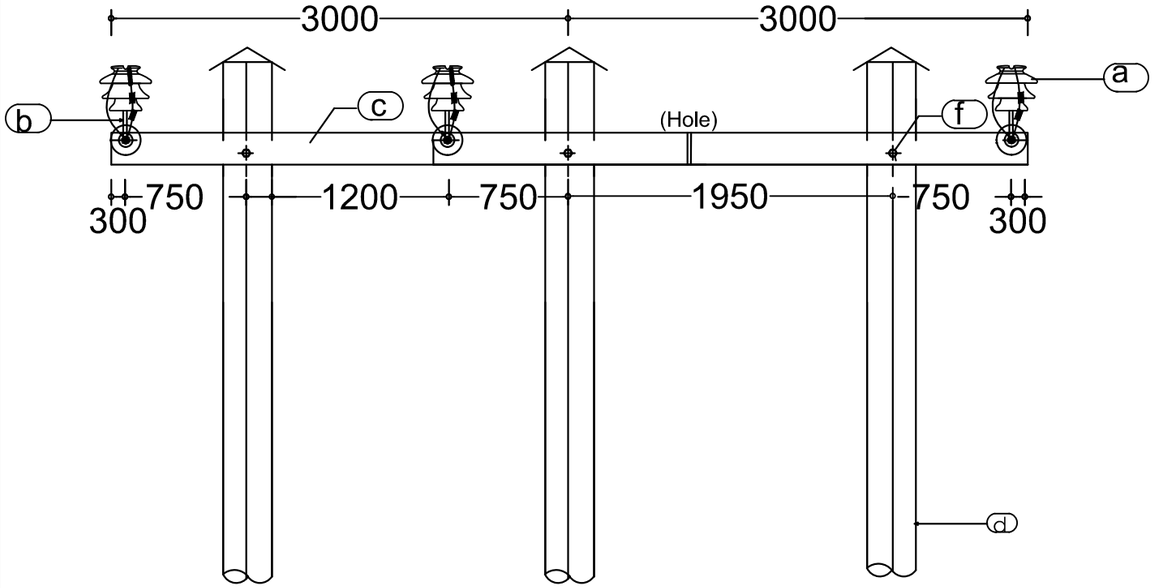

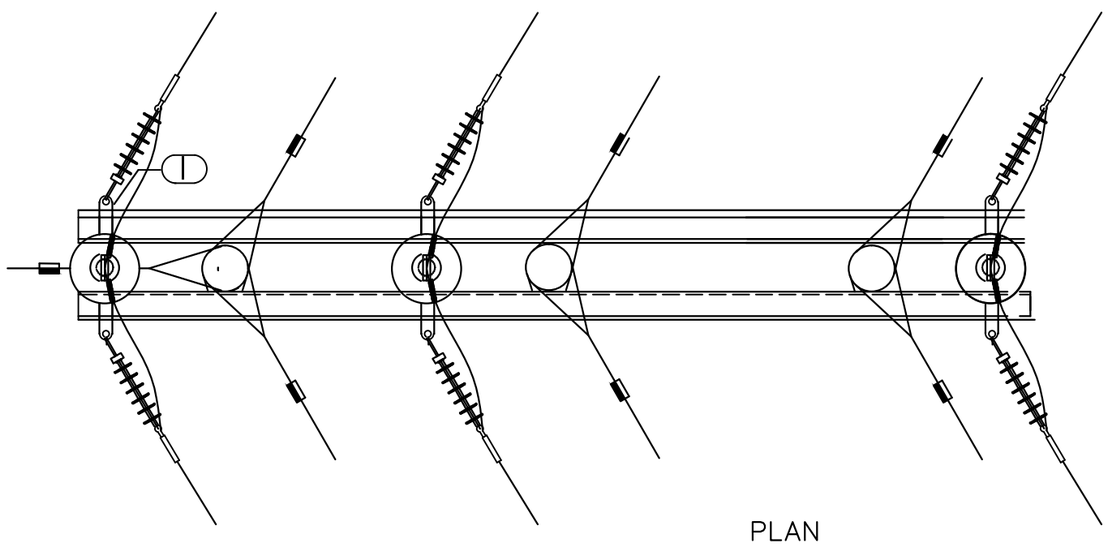

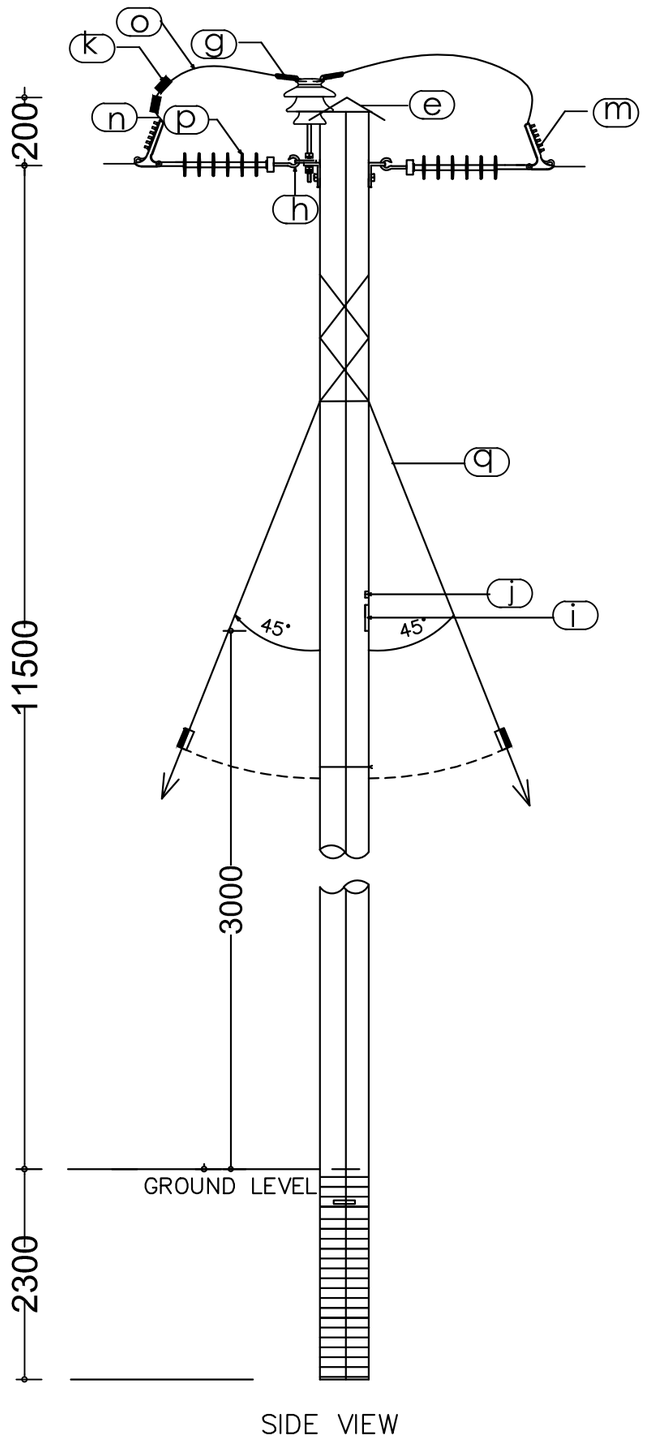

ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	200*150*15 THK –6000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	260MM POLE CAP – STEEL GAUGE 24	3
f	20X300MM BOLT AND NUT	3
g	PREFORMS FOR BINDING	
h	M20 PIG TAIL HOOK	6
i	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
j	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
k	100 X 100MM ALUMINIUM PG CLAMP	6
l	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
m	70kN ALUMINIUM ALLOY TENSION CLAMP	6
n	RECIEVER JUMPER CONDUCTOR	3
o	SUPPLY JUMPER CONDUCTOR	3
p	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
q	INLINE STAY ASSEMBLY	4

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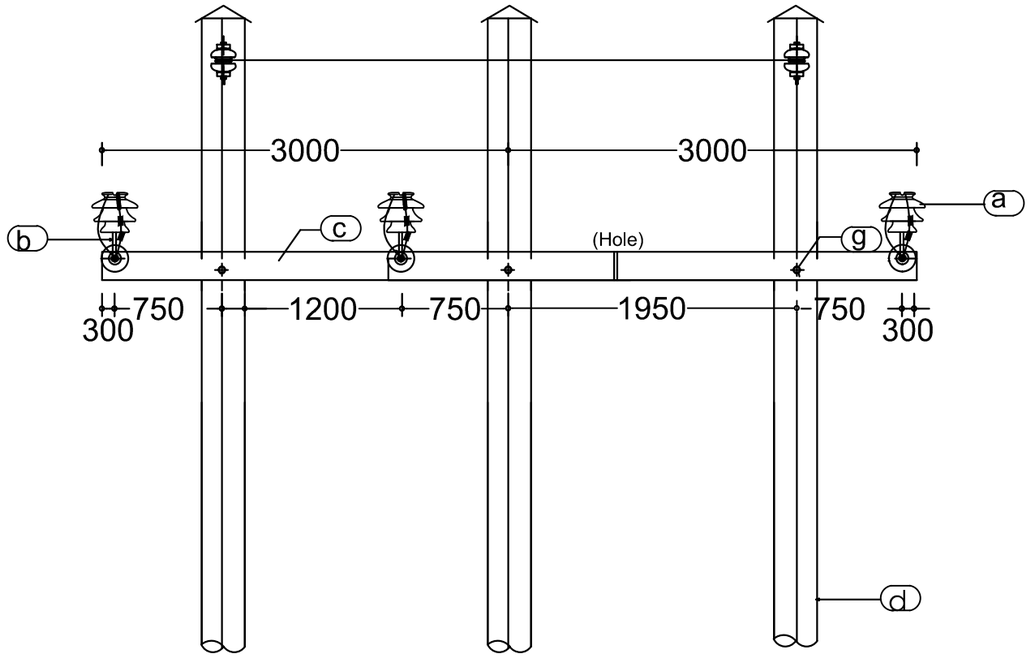
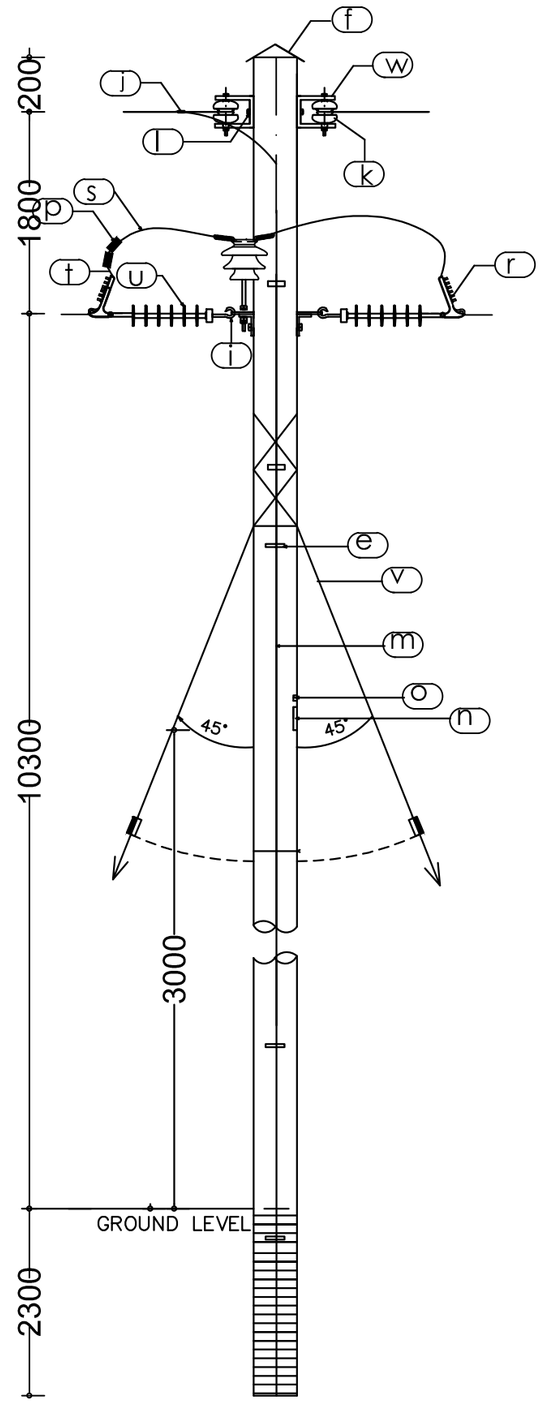
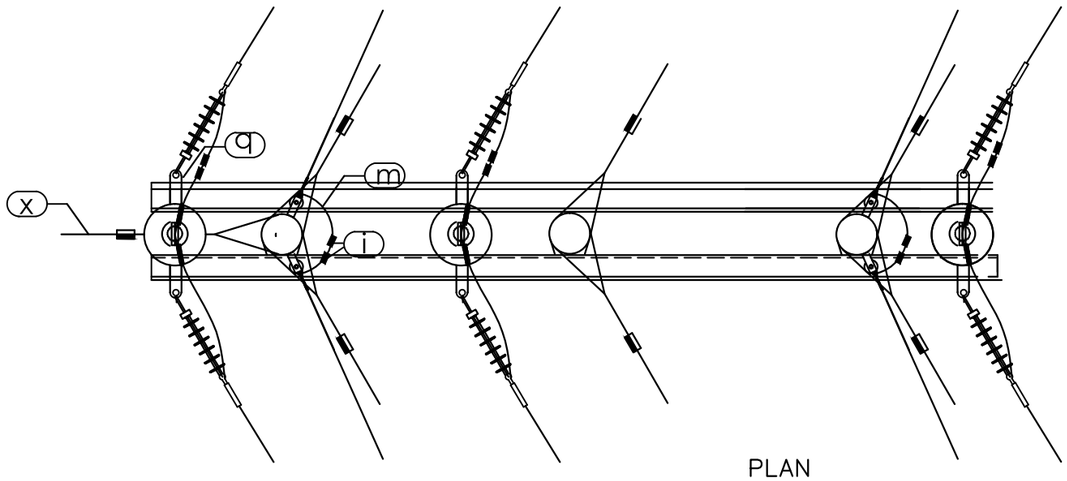
MV THREE MEMBER ANGLE STRUCTURE WITHOUT AERIAL EARTH (SIX METER CROSS ARM)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		





ITEM	DESCRIPTION	QTY
a	10kN, 900MM, 110kV PIN INSULATOR	3
b	300MM SPINDLE	3
c	200*150*15 THK –6000MM CROSS ARM	2
d	14M STOUT WOODEN POLE	3
e	STEEL U–NAILS AT 500MM INTERVAL	70
f	260MM POLE CAP – STEEL GAUGE 24	3
g	M20X300MM BOLT AND NUT	3
h	PREFORMS FOR BINDING	N/A
i	M20 PIG TAIL HOOK	6
j	25 X 25MM STEEL PG CLAMP	2
k	40MM, 9kV, 13.5kN REEL INSULATOR	2
l	16X300MM BOLT AND NUT	2
m	3x2.64MM, 16M EARTH WIRE	2
n	210X300MM IRON SHEET GAUGE 16 DANGER PLATE, 85 MICRON PRIMER	1
o	200X150MM IRON SHEET GAUGE 16 POLE NUMER, 85 MICRON PRIMER	1
p	100 X 100MM ALUMINIUM PG CLAMP	6
q	50X450MM, 10MM THK STEEL CONNECTING STRAP	3
r	70kN ALUMINIUM ALLOY TENSION CLAMP	6
s	RECIEVER JUMPER CONDUCTOR	3
t	SUPPLY JUMPER CONDUCTOR	3
u	1200MM, 210kV, 70kN, STRAIN INSULATOR	6
v	INLINE STAY ASSEMBLY	4
w	D–IRON	2
x	BISECT STAY ASSEMBLY	1



PLAN

SIDE VIEW

SIDE VIEW

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
1OTH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

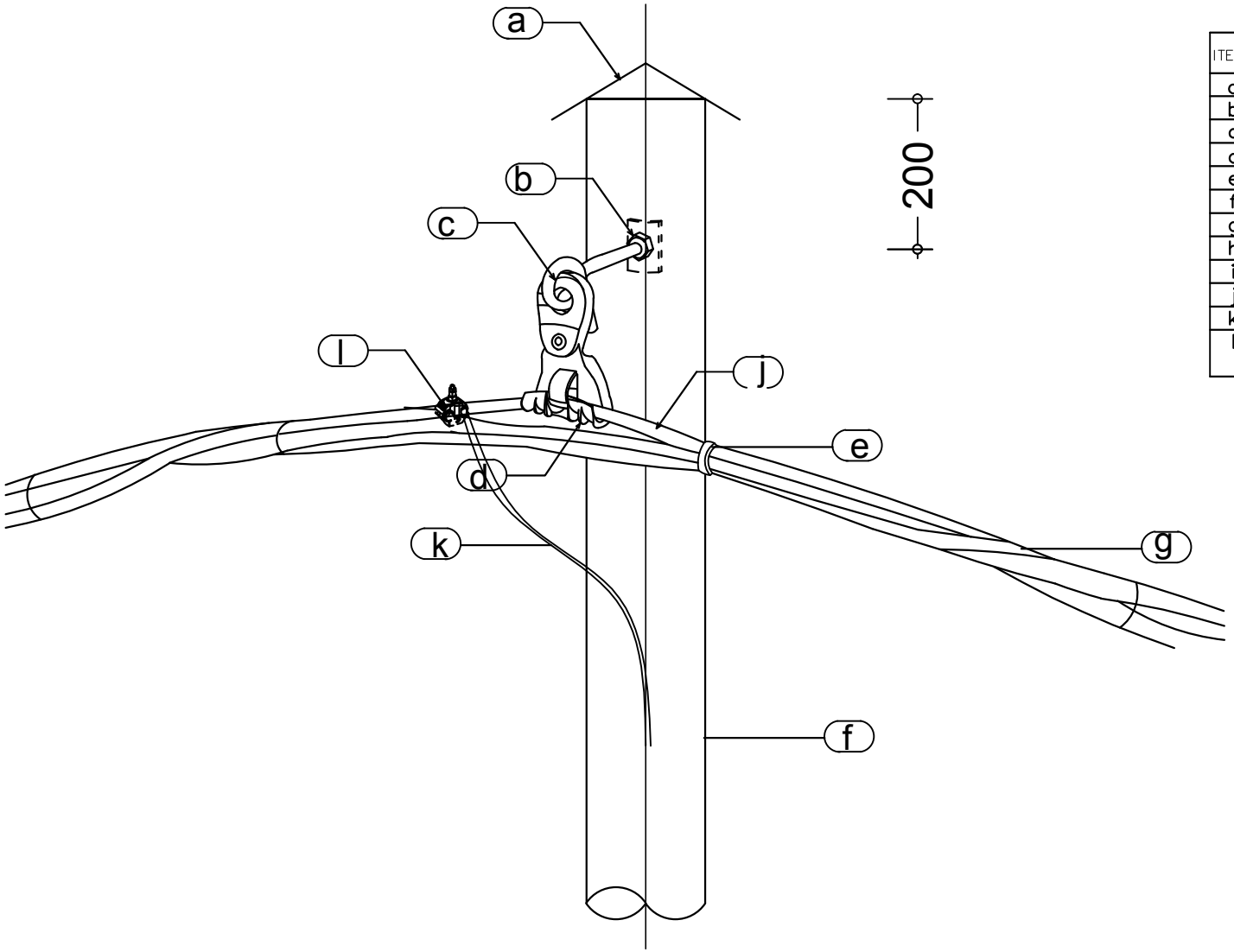
MV THREE MEMBER ANGLE STRUCTURE WITH AERIAL EARTH (SIX METER CROSS ARM)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4 LV Wooden Pole Structures

9.4.1 ABC suspension Assembly, $0^0<\Theta<30^0$

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
6	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	1
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	1
d	12KN, 54.6SQ MM SUSPENSION CLAMP	1
e	380X8MM CABLE TIE	
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	INLINE STAY ASSEMBLY	1
i	380X8MM CABLE TIE	
j	54.6SQ MM XLPE AL, MESSENGER	
k	3x2.64MM, 16M EARTH WIRE	
l	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	1

NOTES:

RURAL ELECTRIFICATION AGENCY
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10TH FLOOR, WORKERS HOUSE
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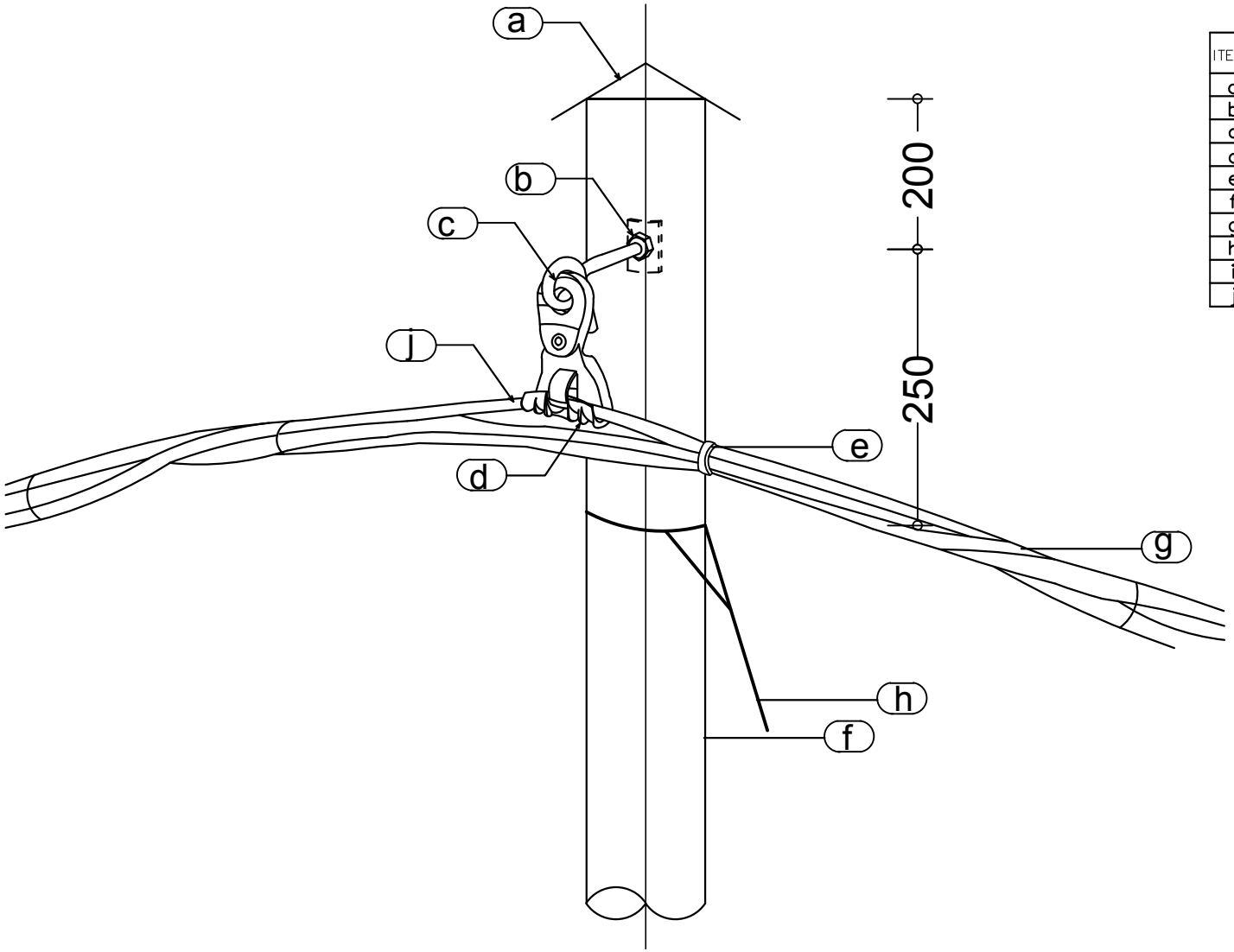
KAMPALA
UGANDA

TEL:

TITLE:

ABC LV SUSPESION STRUCTURE WITH EARTHING

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	1
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	1
d	12KN, 54.6SQ MM SUSPENSION CLAMP	1
e	380X8MM CABLE TIE	
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	INLINE STAY ASSEMBLY	1
i	380X8MM CABLE TIE	
j	54.6SQ MM XLPE AL, MESSENGER	

NOTES:

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TEL:

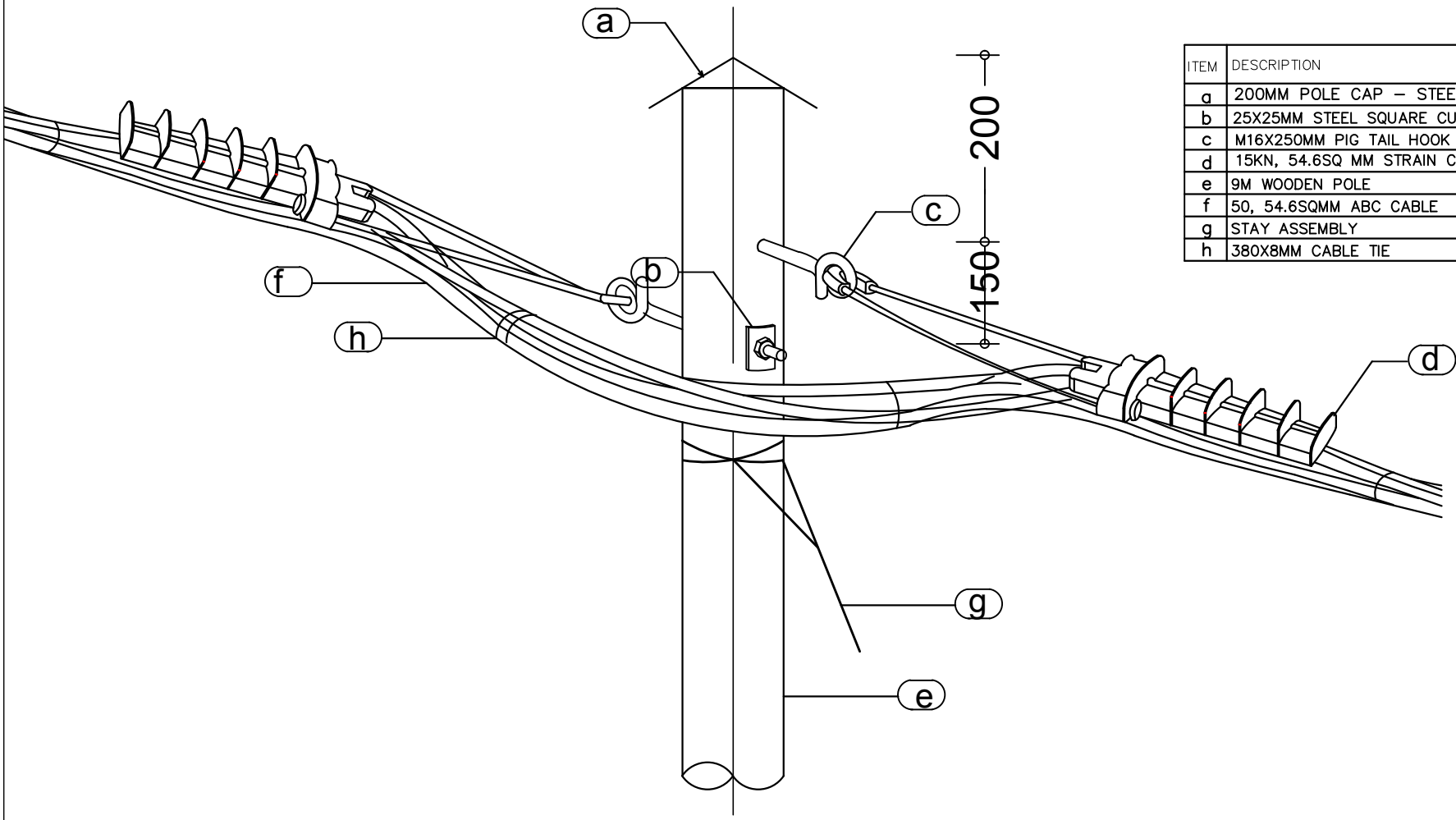
TITLE:

ABC LV SUSPESION STRUCTURE 5-30 DEGREES

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.2 ABC Angle Strain Assembly, ($30^0 \leq \theta \leq 60^0$)

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
5	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
6	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	2
d	15KN, 54.6SQ MM STRAIN CLAMP	2
e	9M WOODEN POLE	1
f	50, 54.6SQMM ABC CABLE	
g	STAY ASSEMBLY	1
h	380X8MM CABLE TIE	

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

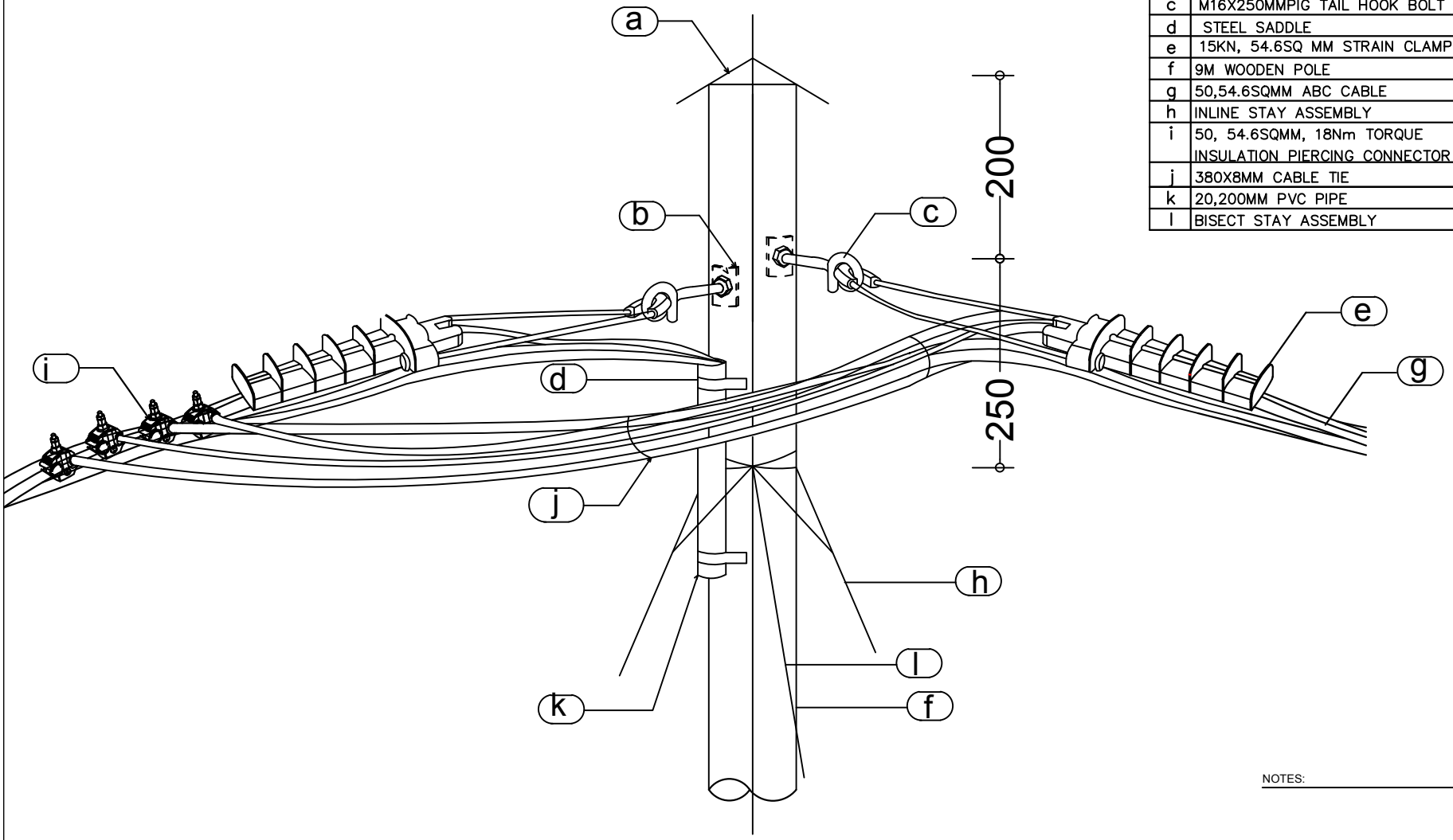
ABC LV STRAIN STRUCTURE (30-60 DEGREES)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.3 ABC Angle Strain Assembly, ($60^0 \leq \theta \leq 90^0$)

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
5	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 50sqmm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
6	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
7	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089

ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MMPIG TAIL HOOK BOLT AND NUT	2
d	STEEL SADDLE	1
e	15KN, 54.6SQ MM STRAIN CLAMP	2
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	INLINE STAY ASSEMBLY	2
i	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	4
j	380X8MM CABLE TIE	
k	20,200MM PVC PIPE	
l	BISECT STAY ASSEMBLY	2



NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

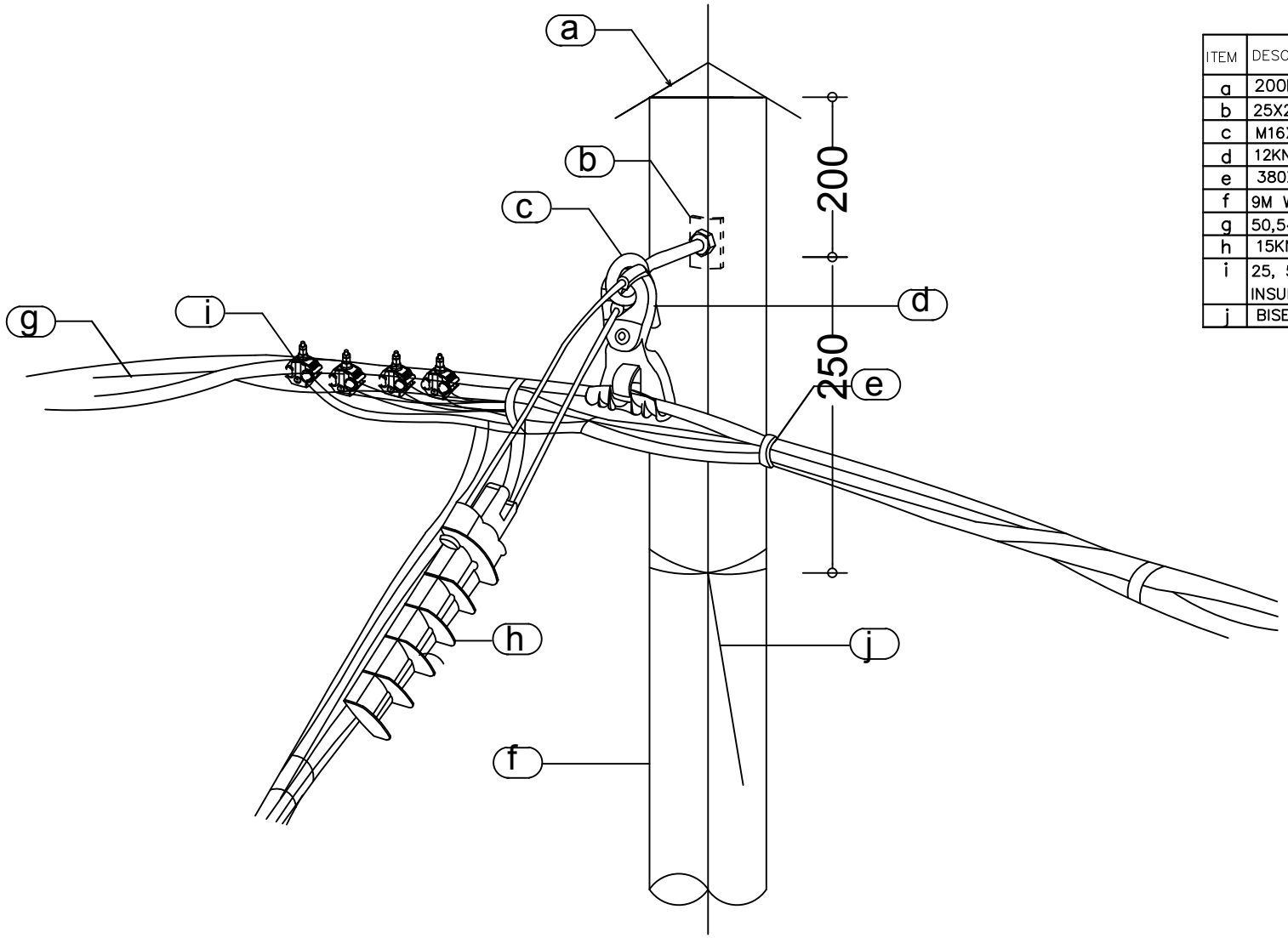
TITLE:

ABC LV STRAIN STRUCTURE (60-90 DEGREES)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.4 ABC Tee-off from intermediate structure

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ATM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
6	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 50sqmm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
7	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
8	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	1
c	M16X250MMPIG TAIL HOOK BOLT AND"NUT	1
d	12KN, 54.6SQ MM SUSPENSION CLAMP	1
e	380X8MM CABLE TIE	
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	15KN, 54.6SQ MM STRAIN CLAMP	1
i	25, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	4
j	BISECT STAY ASSEMBLY	1

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

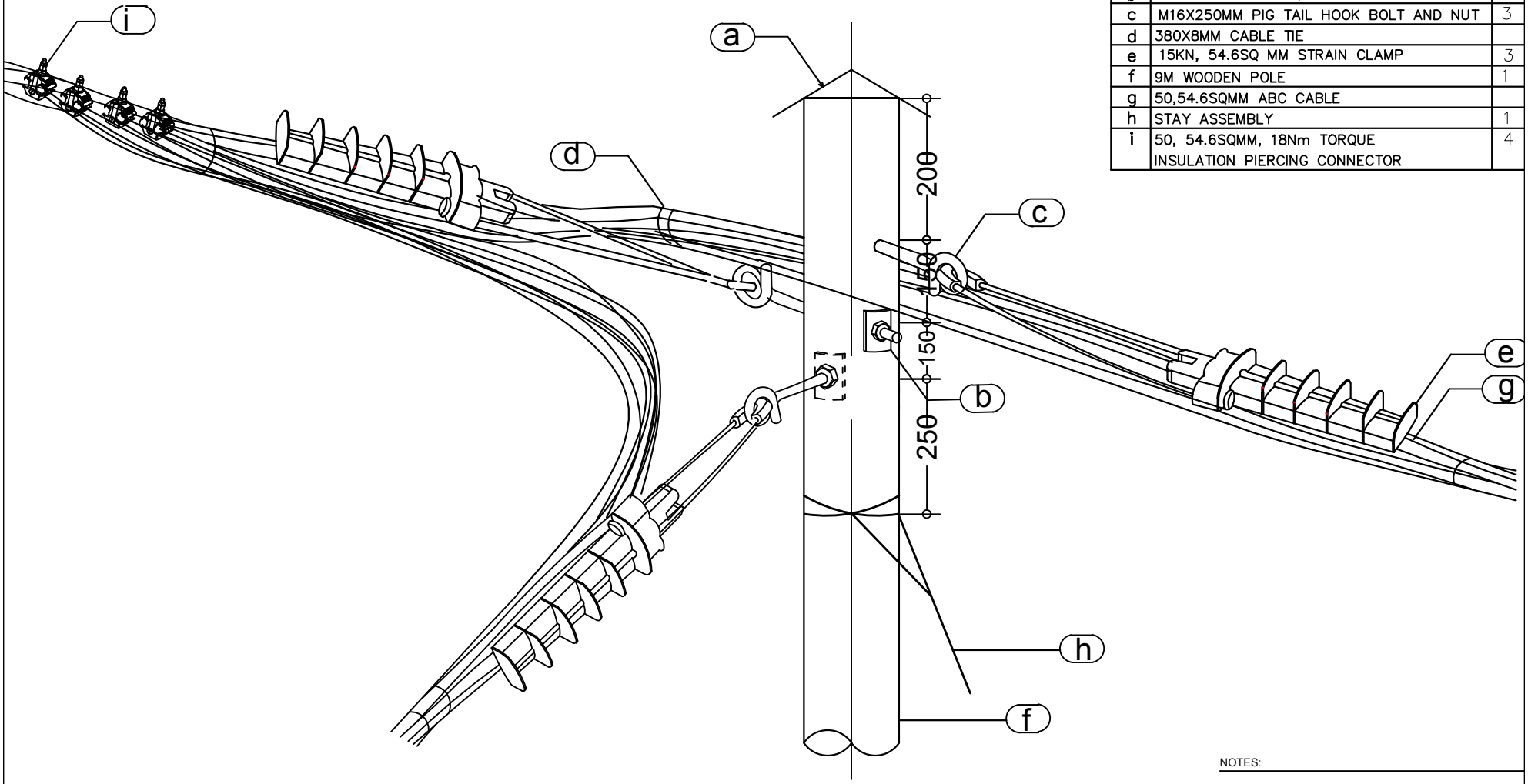
ABC LV TEE FROM INTERMEDIATE STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.5 ABC Tee-off from Strain Assembly

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
6	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 50sqmm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
7	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
8	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089

ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	3
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	3
d	380X8MM CABLE TIE	
e	15KN, 54.6SQ MM STRAIN CLAMP	3
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	STAY ASSEMBLY	1
i	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	4



NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

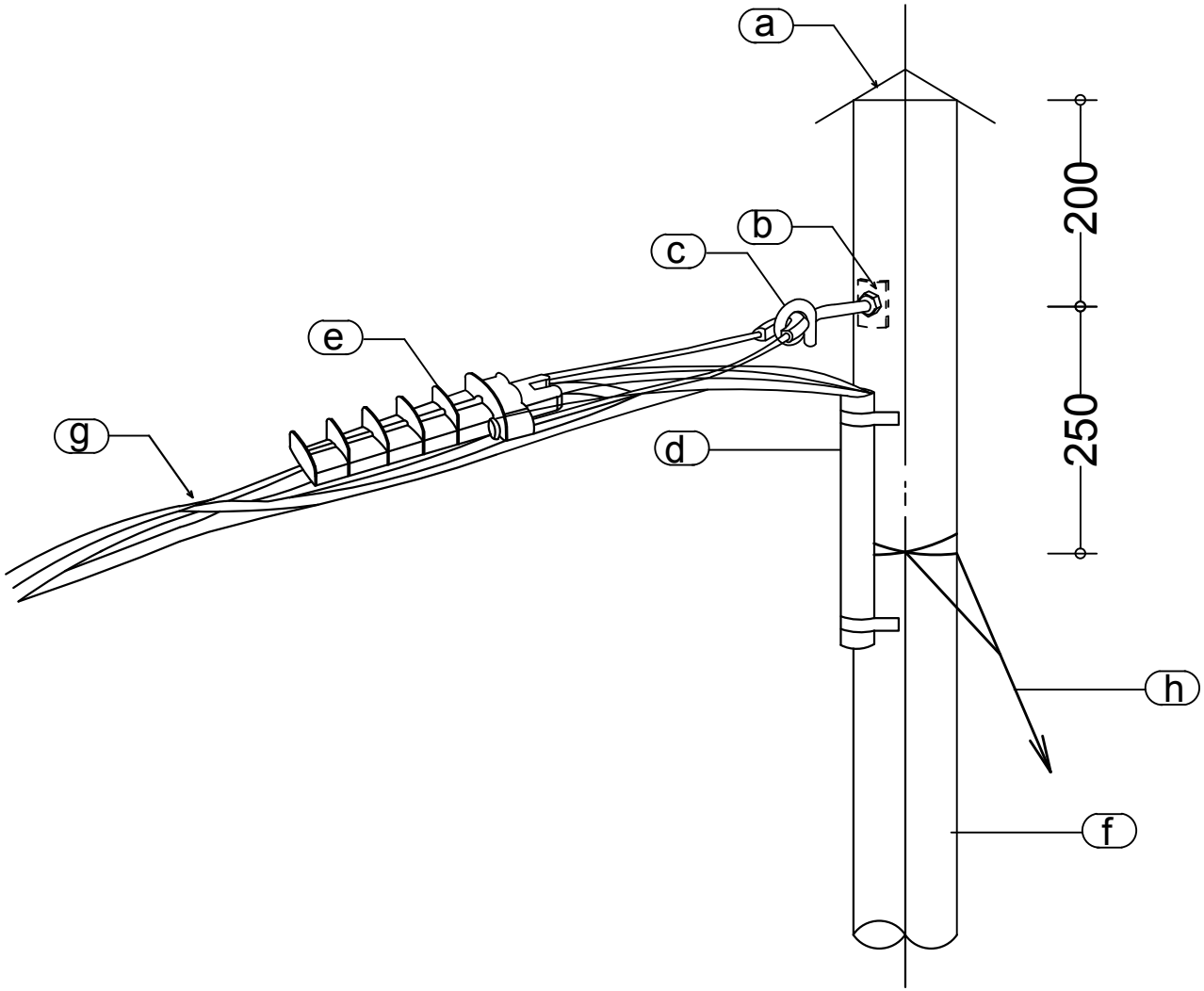
TITLE:

ABC LV TEE FROM STRAIN STRUCTURE (30-60 DEGREES)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.6 ABC terminal assembly

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
4	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
5	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
6	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
7	PVC pipe	PVC pipe for cable termination L: 4m
8	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	1
c	M16X250MMPIG TAIL HOOK BOLT AND NUT	1
d	20,200MM PVC PIPE	1
e	15KN, 54.6SQ MM STRAIN CLAMP	1
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	INLINE STAY ASSEMBLY	1

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

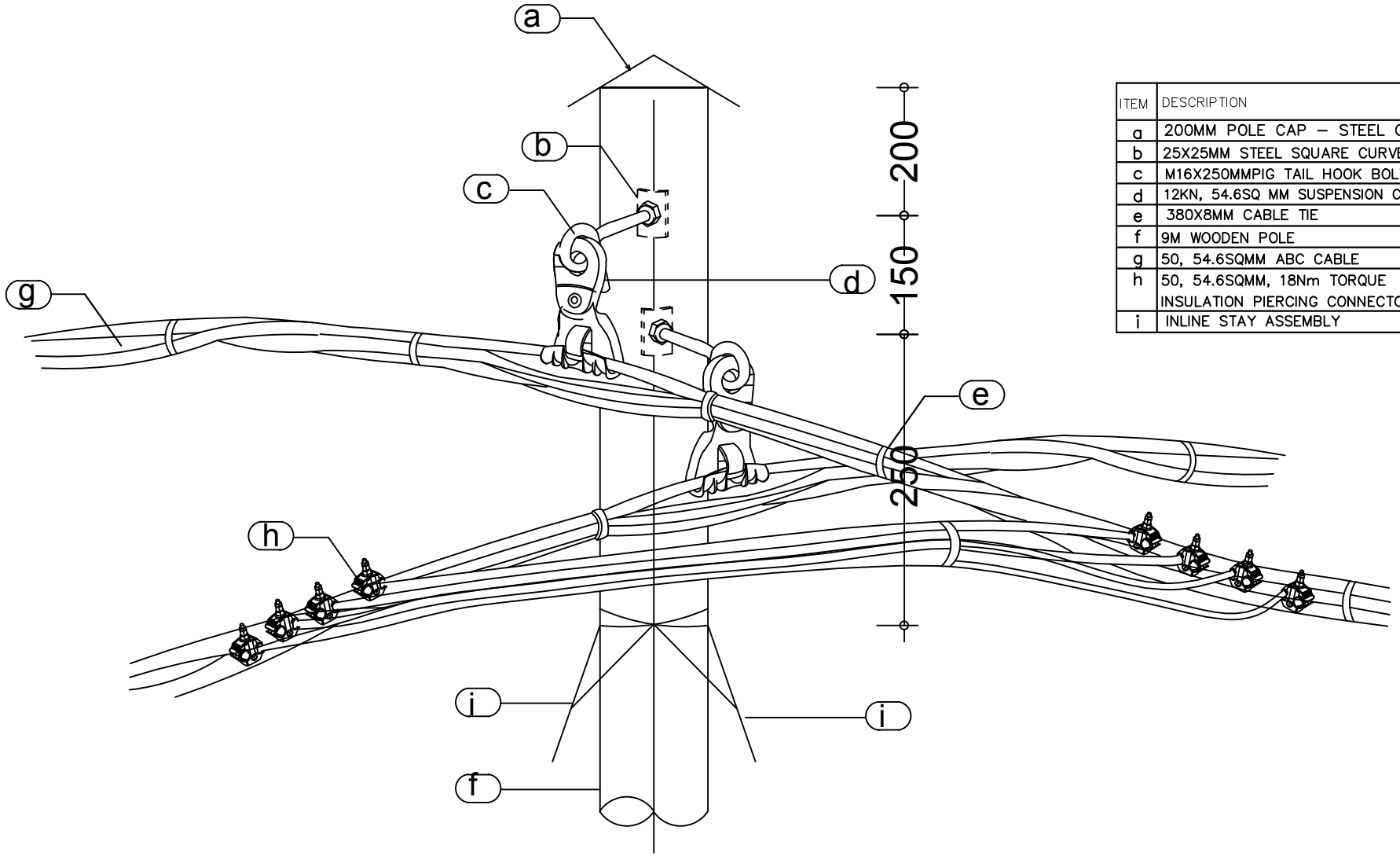
TITLE:

ABC LV TERMINAL STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.7 ABC Cross Intermediate-Intermediate Assembly

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 50sqmm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
6	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
7	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MMPIG TAIL HOOK BOLT AND NUT	2
d	12KN, 54.6SQ MM SUSPENSION CLAMP	2
e	380X8MM CABLE TIE	
f	9M WOODEN POLE	1
g	50, 54.6SQMM ABC CABLE	
h	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	8
i	INLINE STAY ASSEMBLY	2

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

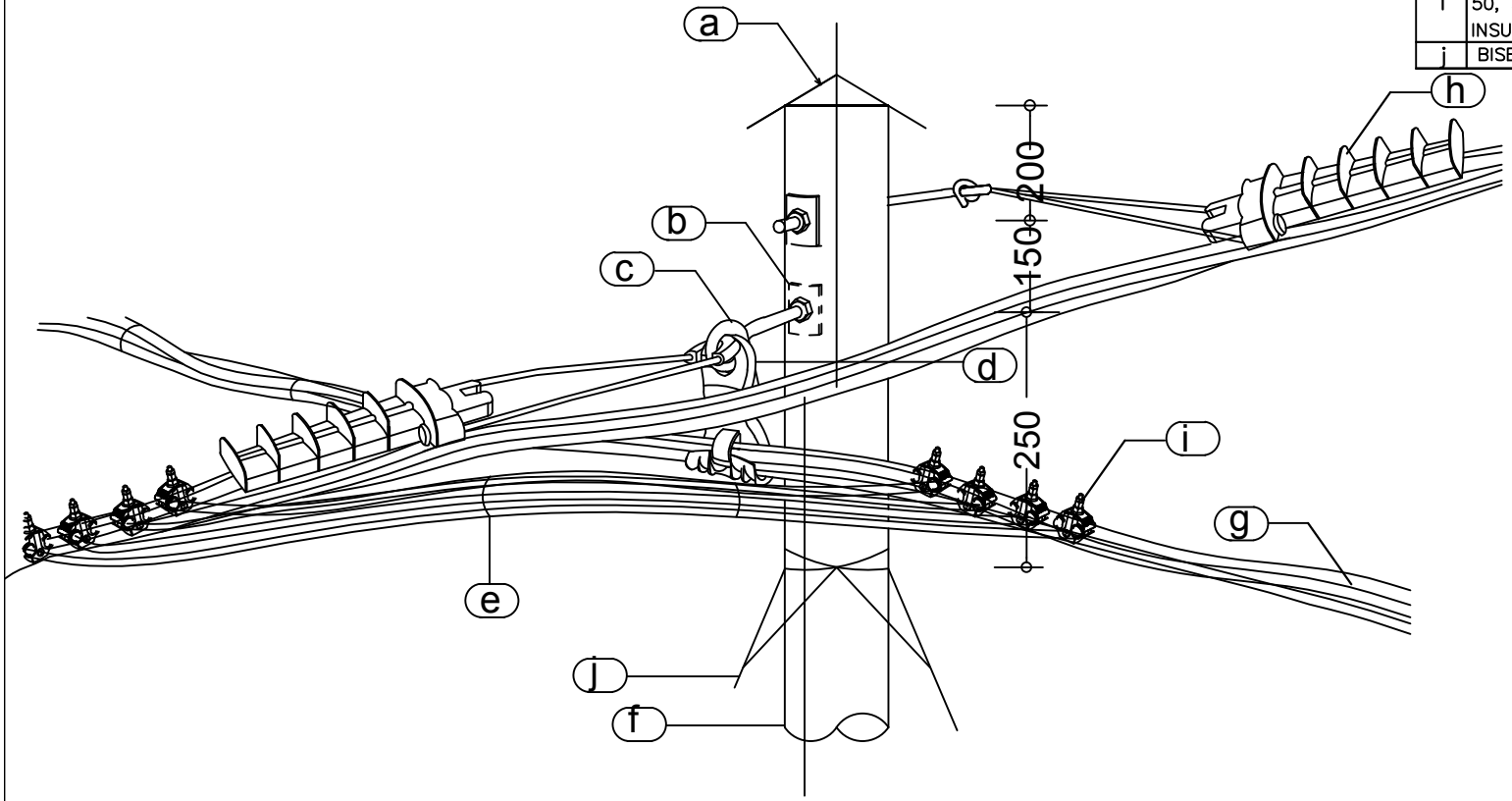
ABC LV CROSS INTERMEDIATE - INTERMEDIATE STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.8 ABC Cross Intermediate-Strain Assembly

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
6	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 50sqmm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
7	Cable ties	• Material: Polyamide, colored black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
8	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089

ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MM PIG TAIL HOOK BOLT AND NUT	2
d	12KN, 54.6SQ MM SUSPENSION CLAMP	2
e	380X8MM CABLE TIE	
f	9M WOODEN POLE	1
g	50, 54.6SQMM ABC CABLE	
h	15KN, 54.6SQ MM STRAIN CLAMP	2
i	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	8
j	BISECT STAY ASSEMBLY	2



NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

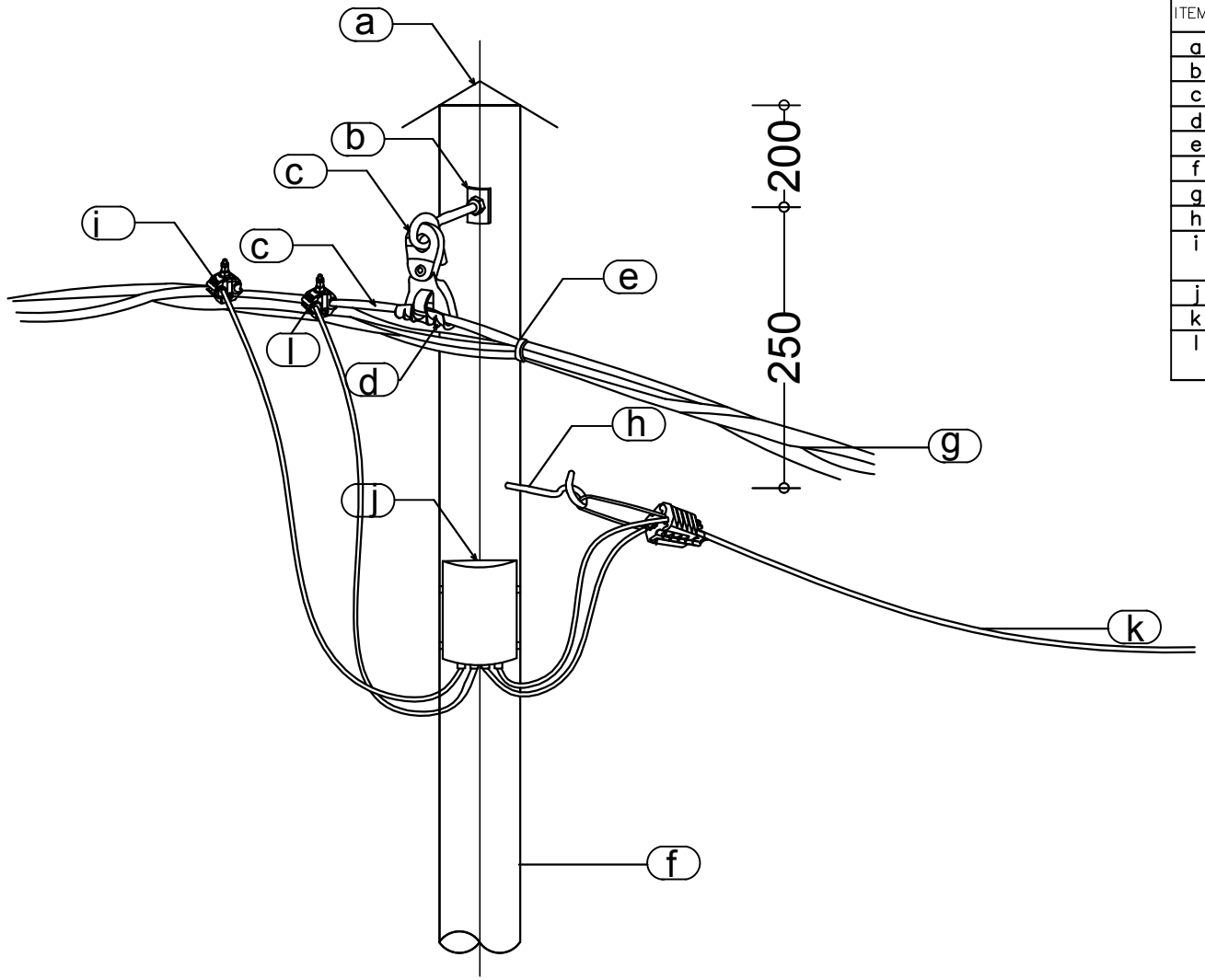
TITLE:

ABC LV CROSS INTERMEDIATE - STRAIN STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

9.4.9 ABC Service Cable Connection

No.	Item	Item Specifications
1	Wooden Pole	• 9m pole *Refer to section 8.2.6 for the required pole diameters.*
2	Pole Cap	• Hot-dip Galvanized steel; ASTM A153 • Diameter: 200mm • Thickness: Gauge-24
3	Pig tail hook bolt	• M16x250mm • Galvanized low carbon mild steel; ASTM A123
4	Suspension clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm • Min. Breaking load: 12kN • Conform to: NF C 33 040 or EN 50 483-3
5	Strain clamp	• Material: XPLE Aluminium Alloy • Capacity: 54.6sqmm Min. Breaking load: 15kN • Conform to PIESA 1018-4:2004
6	Piercing connector	• Material: XPLE Aluminium Alloy • Capacity: Three 10 or 16 sq.mm conductors and one 54.6sqmm XPLE Aluminium Alloy • Nominal breaking Torque: 18Nm • PIESA 1018-5:2004
7	Cable ties	• Material: Polyamide, black, weather-stabilized and corrosion resistant. • Width: ≤ 9mm • L:380mm, W:8mm • Conform to: PIESA 1020:2004
8	ABC cable	• Multi-strand round compacted hard drawn Aluminium with XLPE insulation • Conductor Diameter: 50sqmm • Messenger phase: • Diameter: 54.6sqmm • Conforming to IEC 61089
9	Service cable	• Copper conductor • Single phase connection: 10sq.mm • Three phase connection: 35sq.mm 4-core • Conforming to PIESA 1062:2004



ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	1
c	M16X250MMPIG TAIL HOOK BOLT "AND NUT	1
d	12KN, 54.6SQ MM SUSPENSION CLAMP	1
e	380X8MM CABLE TIE	2
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	COACH SCREW	1
i	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	2
j	CUSTOMER PREPAID METER POINT	1
k	10 OR 16SQMM SINGLE CORE COPPER CABLE	
l	10 OR 16, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	1

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

ABC LV SINGLE PHASE CUSTOMER SERVICE CABLE CONNECTION

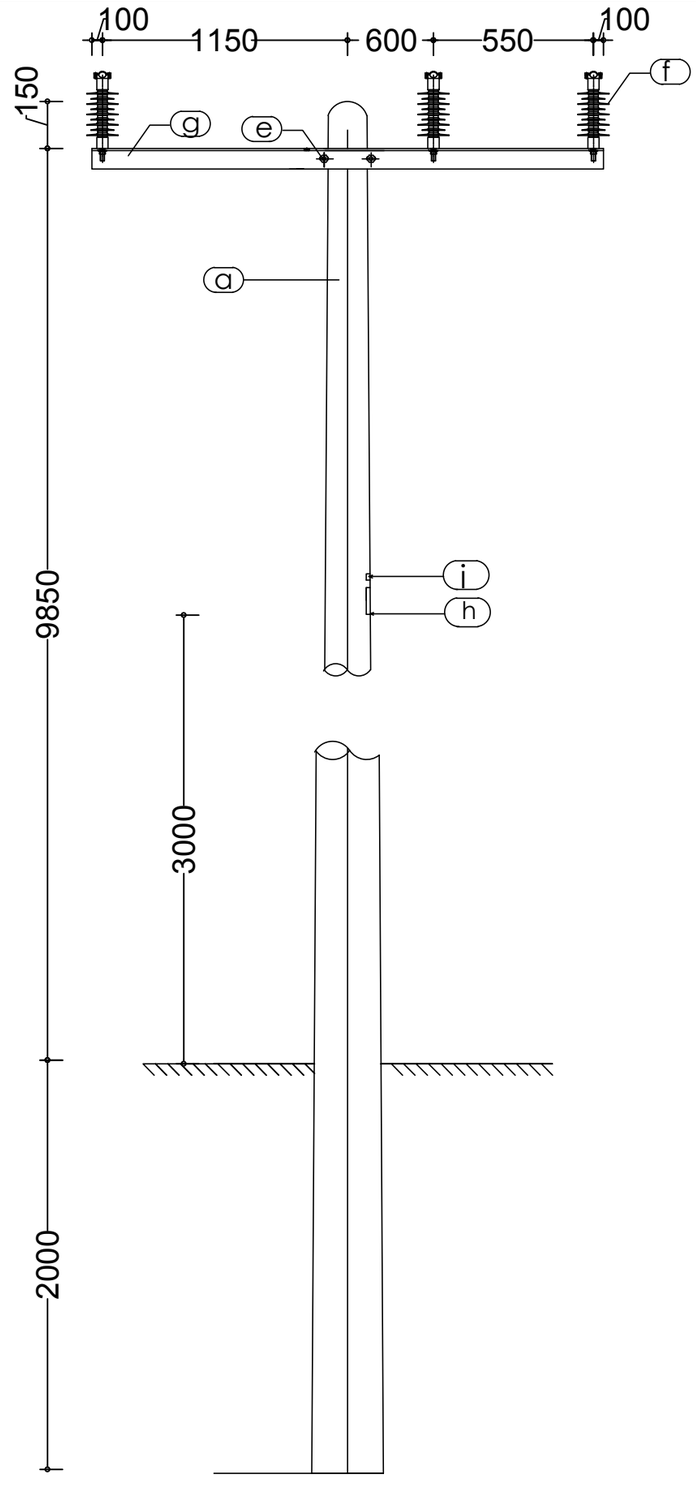
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

10.0 CONCRETE POLE STRUCTURE TYPES AND DRAWINGS

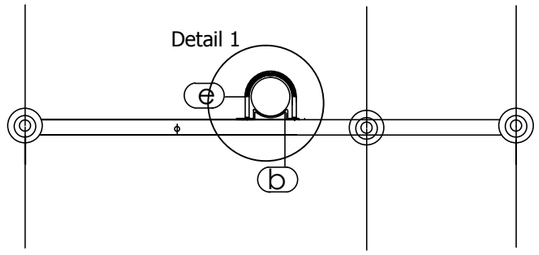
10.1 Single Concrete Pole Configurations

33kV Intermediate Structure, Horizontal Construction, (0^0)

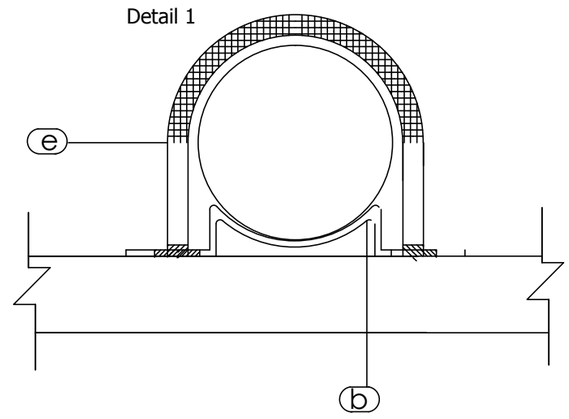
Structure Type	Material	Specification	Standard	Qty
Intermediate	Concrete pole 12C1	Ultimate tensile strength 4.17kN or 5.47kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	Low carbon mild steel grade 43A. 33kV cross arm.	L 120×53×6. 3 ×2500 Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	BS 4360, galvanisation BS EN 1501461, BS 729, ASTM A36, ASTM A123.	1
	Low carbon mild steel grade 43A. Tension Plate/clamp for cross arm.	L330×75×6×R103 Fixing Holes: 2, diameter 22mm	BS 4360, galvanisation BS EN 1501461, BS 729, ASTM A36, ASTM A123.	1
	Low carbon mild steel grade 43A. Bolt, Washer and Nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Low carbon mild steel grade 43A. U-bolt, Washers and Nuts for cross arm	M20*R105*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	1
	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	BS 137, BS 729, IEC 62223, IEC 61109, IEC 61952	3
	Preformed top tie			3
	Danger plate	4 holes, 210*300mm. *Refer to section 8.5.3*		1
	Structure number plate	200*150mm (*Refer to section 8.5.3)*		1



ELEVATION



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C1	Ultimate tensile strength 4.17kN Concrete grade 50	1
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	1
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm	2
d	Preformed top tie		3
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	1
f	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
g	Intermediate pole cross arm.	Low carbon mild steel grade 43A. L 120X53x6.3X2500 Fixing Holes: 2, Diameter 22mm. tensile strength 430kgf/sq.mm	1
h	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
i	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1



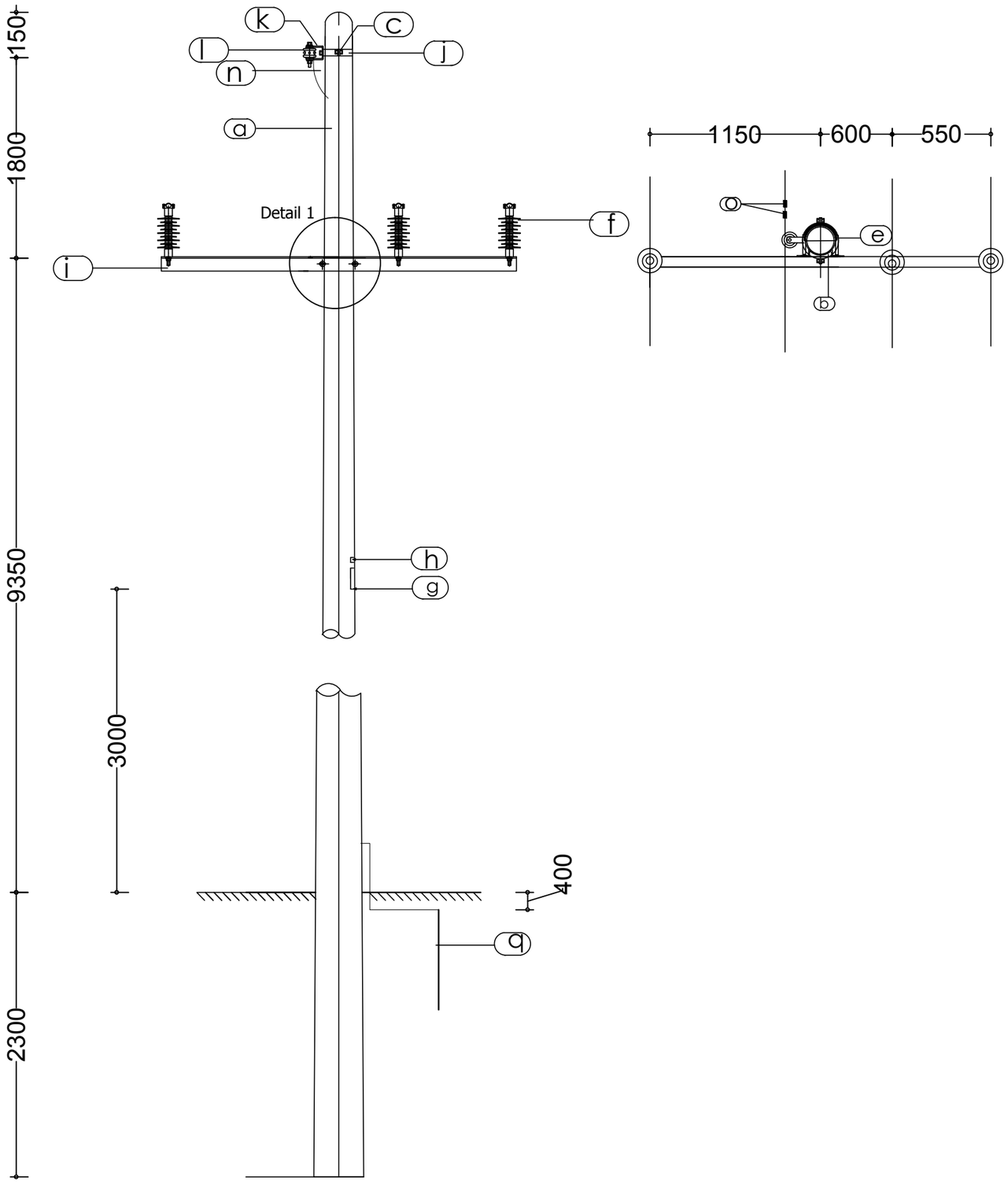
NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
1OTH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

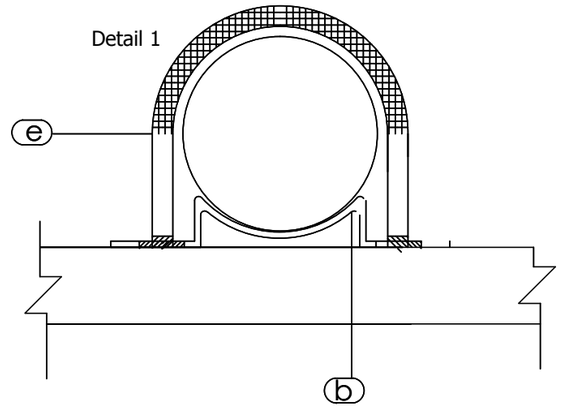
TITLE:

MV SINGLE POLE -INTERMEDIATE WITHOUT AERIAL EARTH 12MPOLE

APPROVED BY: MPDM	**PRODUCED BY:**	**DRAWN BY: K.K**	
	CHECKED BY: O.J	**DATE:**	
	SCALE:		
	DRW NO:		



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C1 PME	Ultimate tensile strength 5.47kN Concrete grade 50	1
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	1
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	3
d	Preformed top tie	Aluminium	3
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	1
f	33kV Pin insulator	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
g	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
h	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
i	Intermediate pole crossarm	Low carbon mild steel grade 42A L 120X53X6.3X2500, Fixing Holes: 2, diameter 22mm, tensile strength 430kgf/sqmm	1
j	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm W: 30mm, R: 96mm	2
k	D-Iron With Bolt	Low carbon mild steel grade 43A	1
l	Reel Insulator	Power frequency Voltage, dry 20kV, wet 9kV, failing load 9kN	1
m	Binding Wire	Aluminium	0.5m
n	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	5m
o	PG Clamp	Galvanised steel PG Clamp 25,25	2
p	Lugs for earth wire	25sq mm, aluminium	2
q	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	1
r	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	2



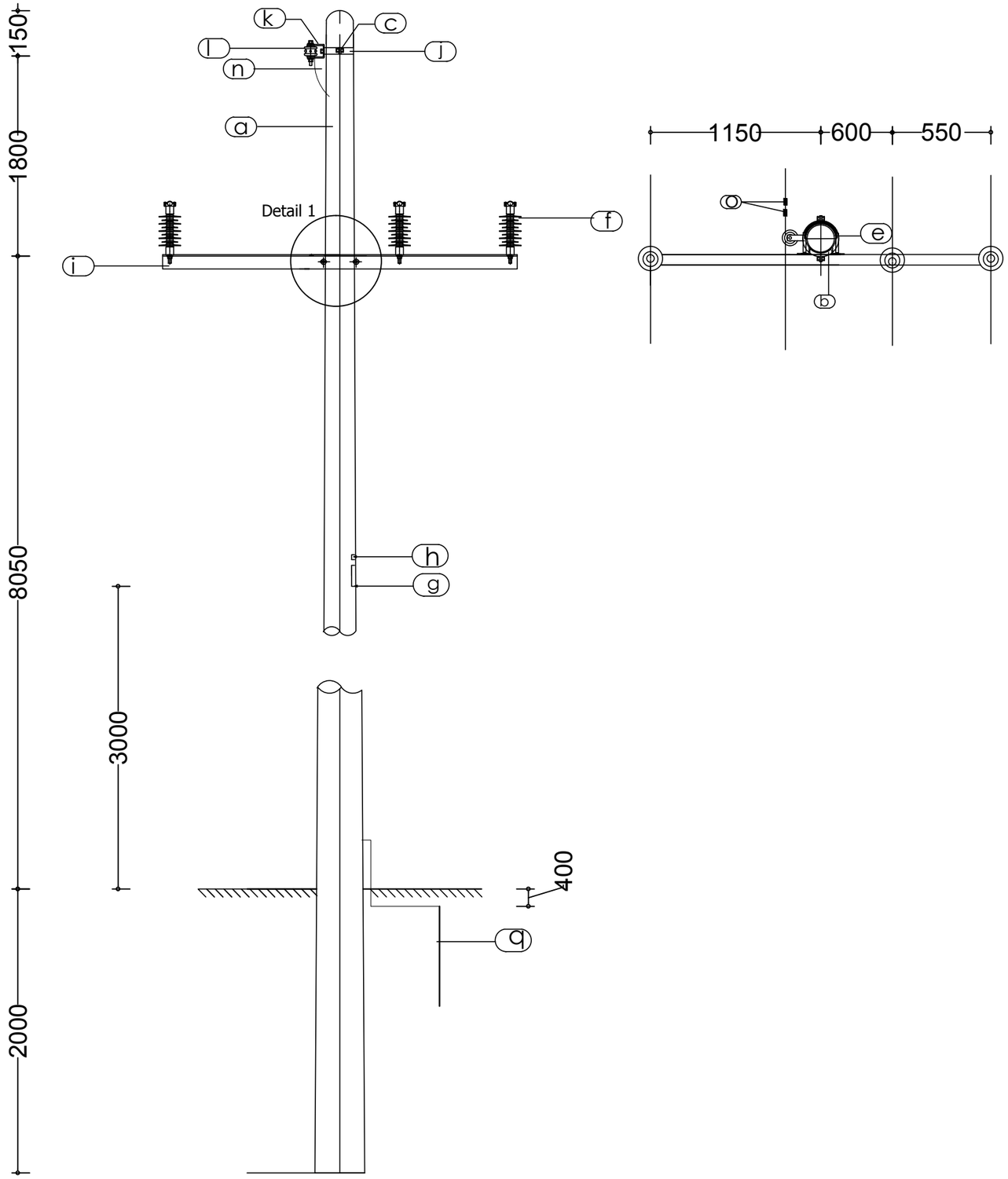
NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

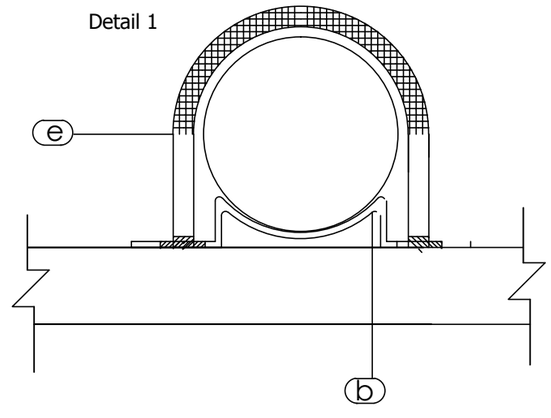
MV SINGLE POLE -INTERMEDIATE WITH AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	**PRODUCED BY:**	**DRAWN BY: K.K**	
	CHECKED BY: O.J	**DATE:**	
	SCALE:		
	DRW NO:		



ELEVATION

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C1 PME	Ultimate tensile strength 5.47kN Concrete grade 50	1
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	1
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	3
d	Preformed top tie	Aluminium	3
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	1
f	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
g	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
h	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
i	Intermediate pole crossarm	Low carbon mild steel grade 42A L 120X53X6.3X2500, Fixing Holes: 2, diameter 22mm, tensile strength 430kgf/sqmm	1
j	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm W: 30mm, R: 96mm	2
k	D-Iron With Bolt	Low carbon mild steel grade 43A	1
l	Reel Insulator	Power frequency Voltage, dry 20kV, wet 9kV, failing load 9kN	1
m	Binding Wire	Aluminium	0.5m
n	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	5m
o	PG Clamp	Galvanised steel PG Clamp 25,25 failing load 9kN	2
p	Lugs for earth wire	25sq mm, aluminium	2
q	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	1
r	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	2



NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
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P.O.BOX 7317
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

MV SINGLE POLE -INTERMEDIATE WITH AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	**PRODUCED BY:**	**DRAWN BY: K.K**	
	CHECKED BY: O.J	**DATE:**	
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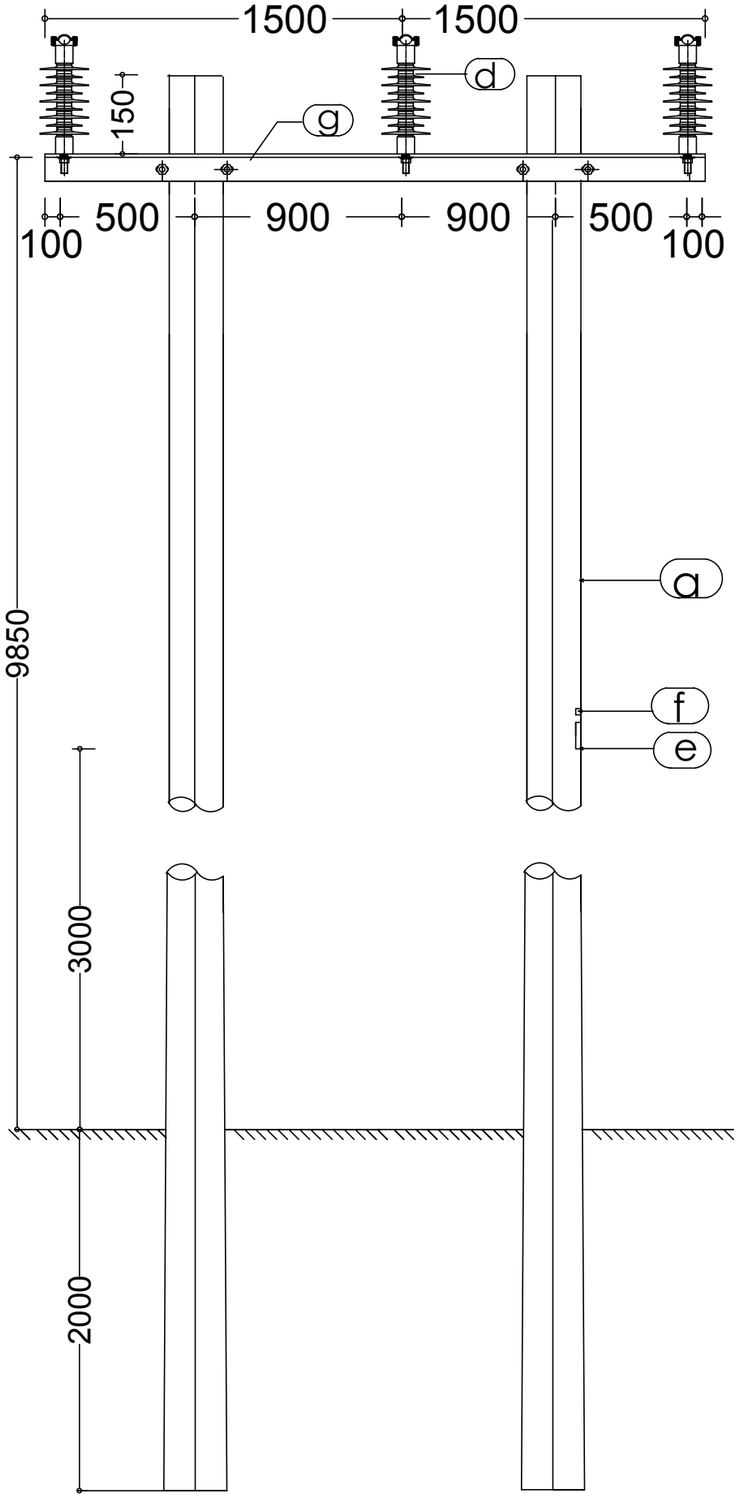
	DRW NO:		

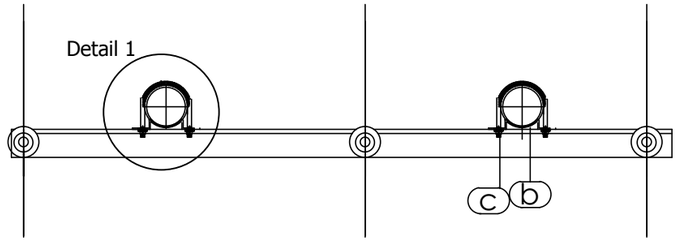
10.2 Double Concrete Pole Configurations

10.2.1 33kV H-Pole Support Structure

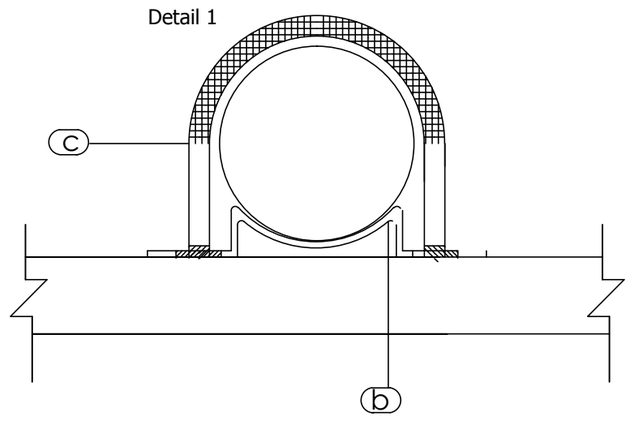
Structure Type	Material	Specification	Standard	Qty
H- pole support	Concrete pole 12C2 or 14C2	Ultimate tensile strength 6.03kN or 8.00kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	2
	Low carbon mild steel grade 43A. H-pole support cross arm	3000*120*53*6.3	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	1
	Tension plate for cross arm	L330×75×6×R103 Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	2
	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	BS 137, BS 729, IEC 62223, IEC 61109, IEC 61952	3
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	4
	Low carbon mild steel grade 43A. U-bolt for cross arm	M20*R105*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Danger plate,	4 holes, 210*300mm (Refer to section 8.5.3)		1
	Structure number plate	200*150mm (Refer to section 8.5.3)		1



ELEVATION



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	2
c	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	2
d	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
e	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
f	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
g	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000,	1
h	Bolt, washer and nut	Low carbon mild steel grade 43A. M20*50mm	4



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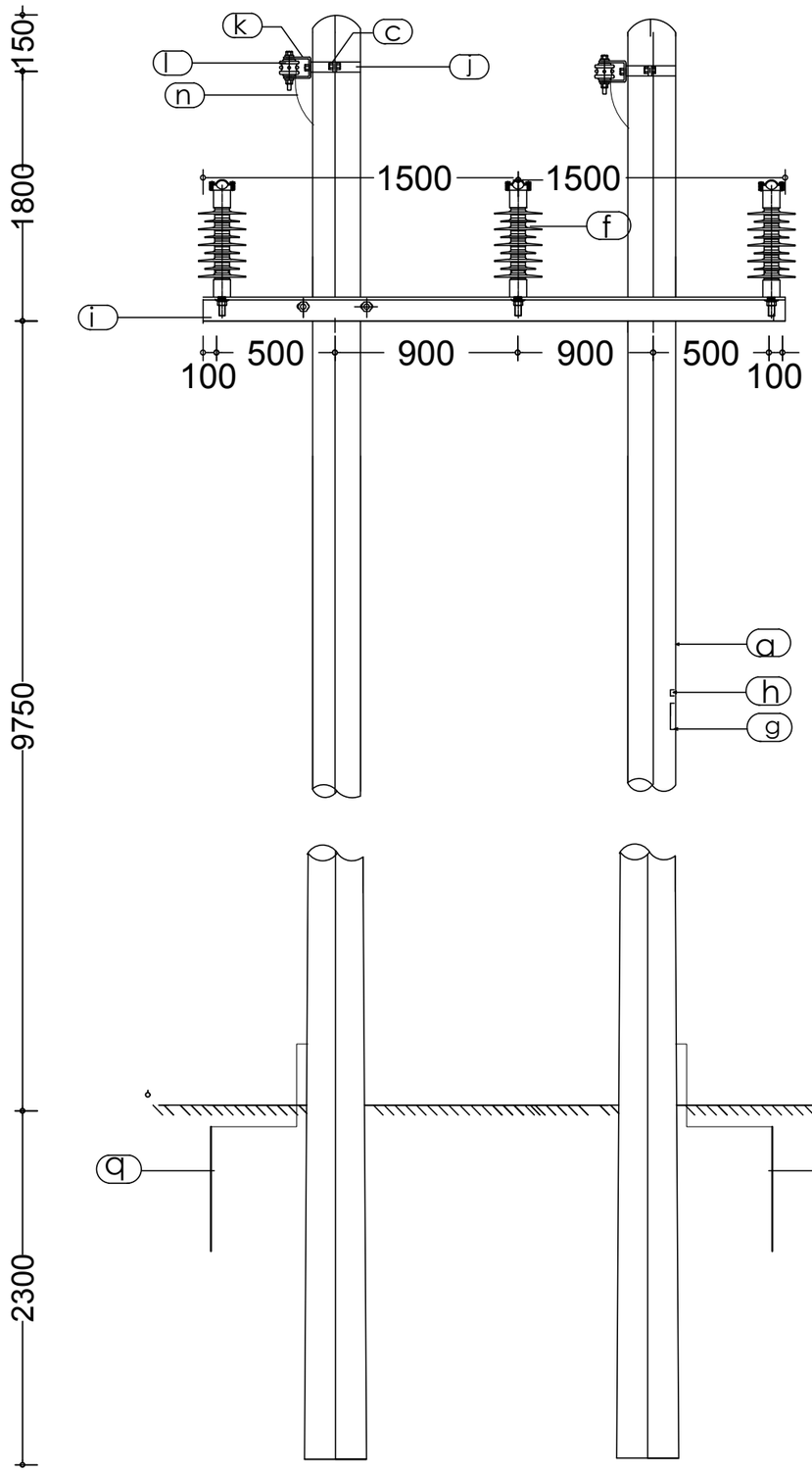
TITLE:

MV TWO MEMBER SUPPORT STRUCTURE WITHOUT AERIAL EARTH - 12M POLE

APPROVED BY: MPDM MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		



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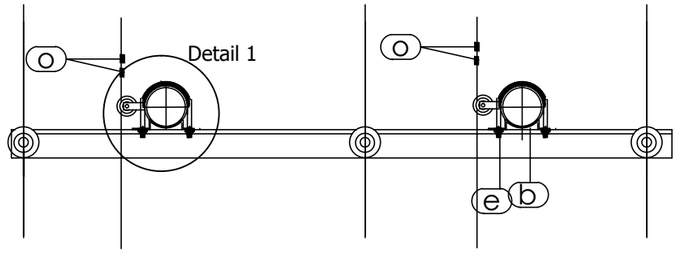

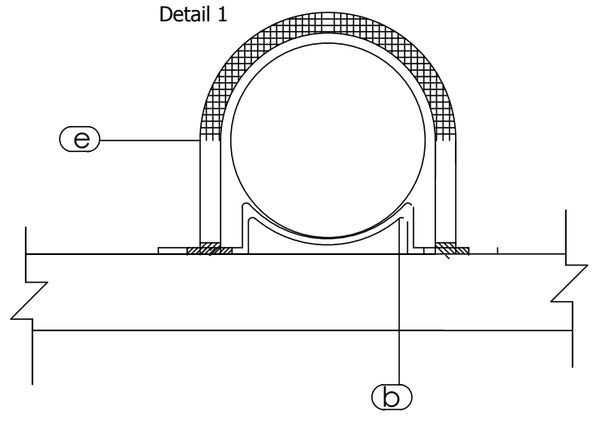

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C1 PME	Ultimate tensile strength 5.47 kN Concrete grade 50	1
b	Tension Plate type 1.	Low carbon mild steel grade 43A. L 150X53 FX6.3X2500, Fixing Holes: 2, diameter 22mm tensile strength 430kgf/sq.mm	2
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	4
d	Preformed top tie	Aluminium	2
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	2
f	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
g	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
h	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
i	Intermediate pole crossarm	Low carbon mild steel grade 42A L 150X100X10X3000, diameter 22mm, tensile strength 430kgf/sqmm	1
j	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm W: 30mm, R: 96mm	4
k	D-Iron With Bolt	Low carbon mild steel grade 43A	2
l	Reel Insulator	Power frequency Voltage, dry 20kV, wet 9kV, failing load 9kN	2
m	Binding Wire	Aluminium	1m
n	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	10m
o	PG Clamp	Galvanised steel PG Clamp 25,25 failing load 9kN	4
p	Lugs for earth wire	25sq mm, aluminium	4
q	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
r	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	2

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MV TWO MEMBER SUPPORT STRUCTURE WITH AERIAL EARTH - 14M POLE

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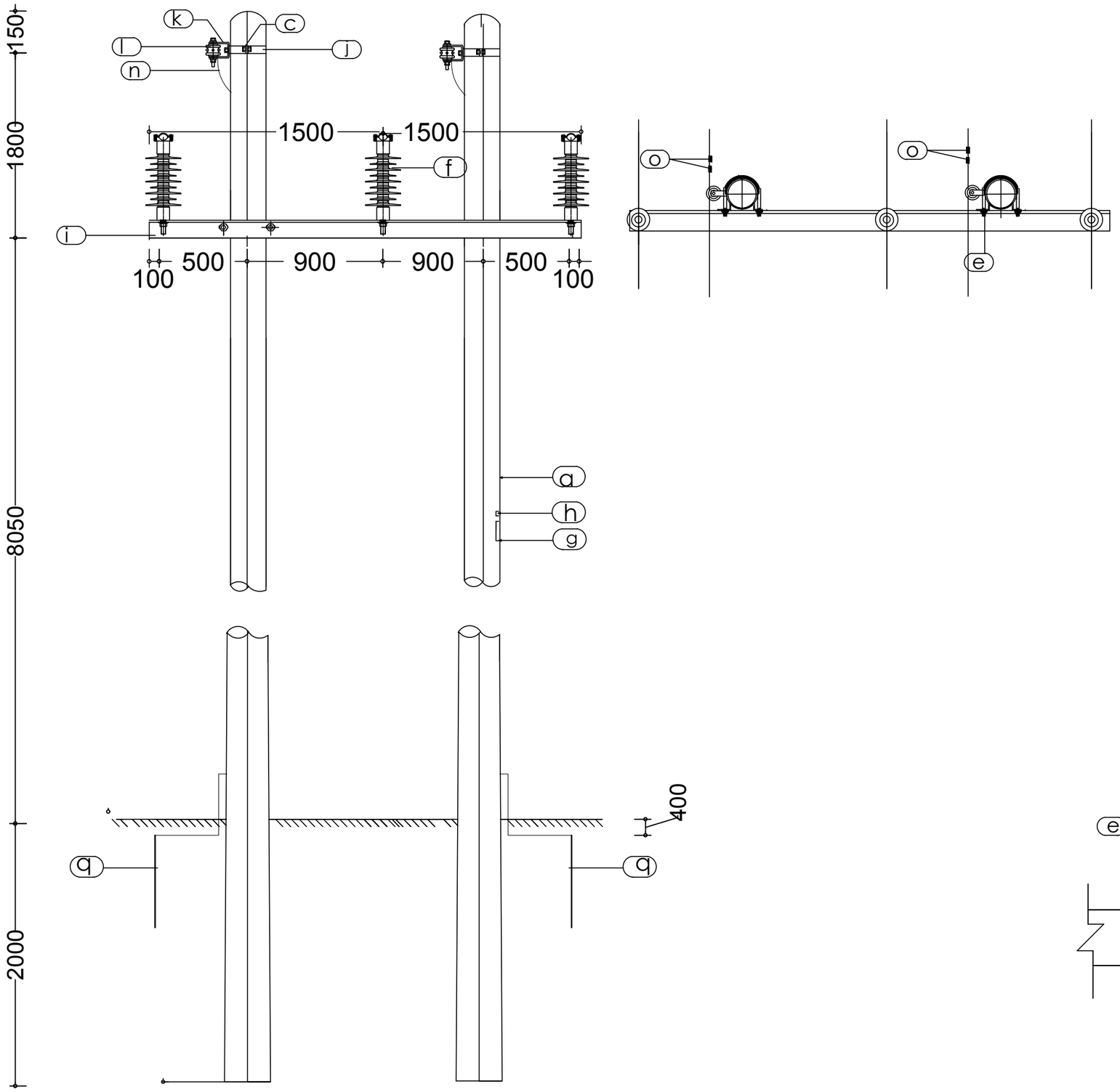
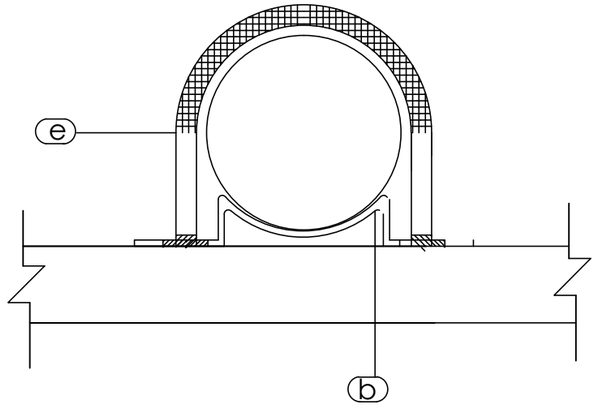
	DRW NO:		



ELEVATION

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C1 PME	Ultimate tensile strength 5.47 kN Concrete grade 50	1
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	2
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	4
d	Preformed top tie	Aluminium	2
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	2
f	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
g	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
h	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
i	Intermediate pole crossarm	Low carbon mild steel grade 42A L 150X100X10X3000, diameter 22mm, tensile strength 430kgf/sqmm	1
j	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm W: 30mm, R: 96mm	4
k	D-Iron With Bolt	Low carbon mild steel grade 43A	2
l	Reel Insulator	Power frequency Voltage, dry 20kV, wet 9kV, failing load 9kN	2
m	Binding Wire	Aluminium	1m
n	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	10m
o	PG Clamp	Galvanised steel PG Clamp 25,25 failing load 9kN	4
p	Lugs for earth wire	25sq mm, aluminium	4
q	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
r	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	2



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KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

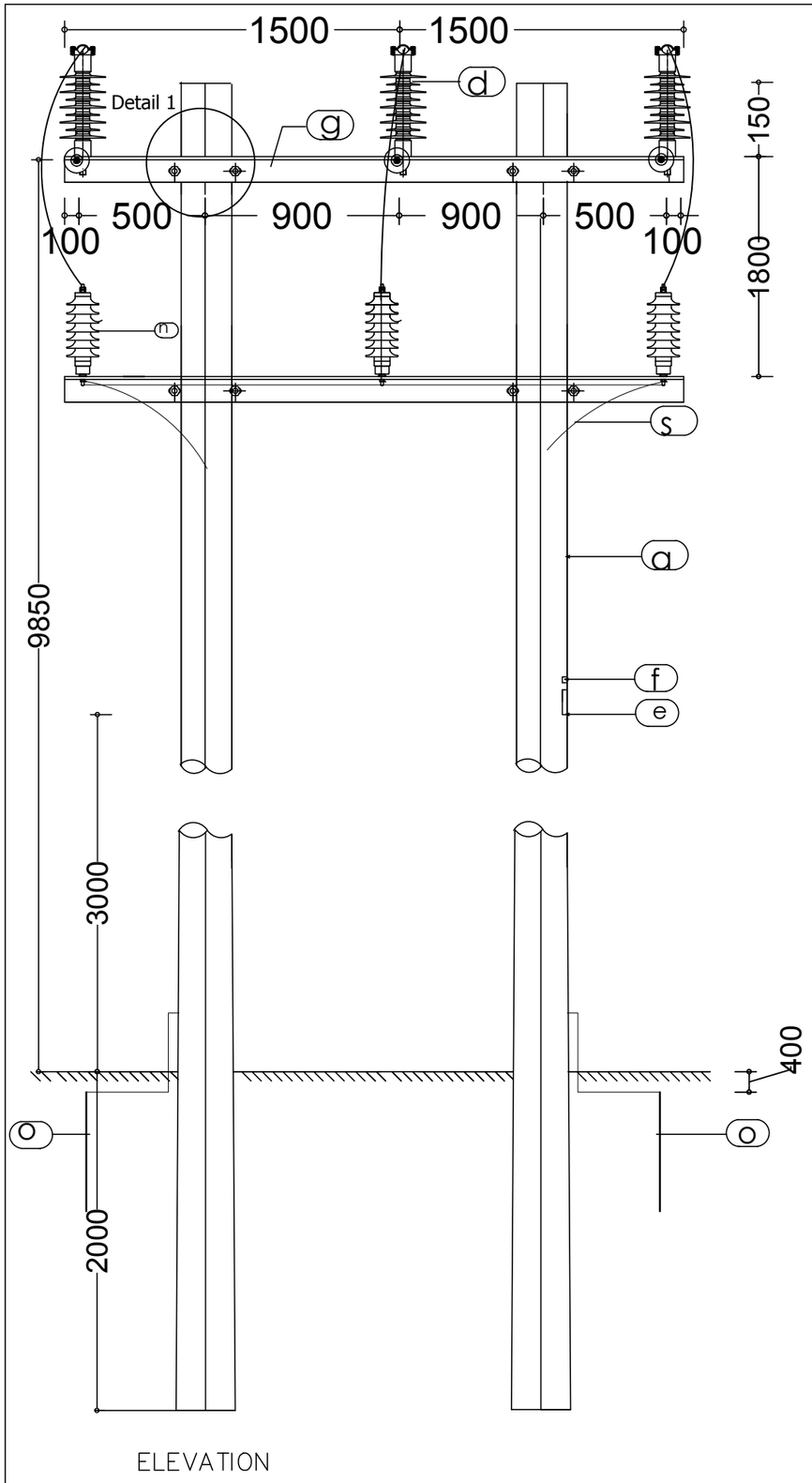
MV TWO MEMBER SUPPORT STRUCTURE WITH AERIAL EARTH - 12M POLE

APPROVED BY: MPDM MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.2.2 33kV H-Pole Section Structure

Structure Type	Material	Specification	Standard	Qty
H-pole section	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN or 8.00kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	2
	Low carbon mild steel grade 43A. H-pole section cross arm	3000*150*100*10	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	3
	Tension plate for cross arm	L330×75×6×R103 Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	6
	Connecting strap	Galvanised Low carbon Mild steel grade 43A : 541*75*6	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	3
	Fitting straps	Galvanised Low carbon mild steel grade 43A: L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	6
	Ball ended Hooks	Ball and shank 16mm2	BS 3288 Part 2, BS 729	6
	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	BS 1472, bolts &nuts to BS 916	6
	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	IEC 62223, IEC 61109, IEC 61952	6
	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	BS 137, BS 729, IEC 62223, IEC 61109, IEC 61952	3

	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	16
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*300mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	4
	Low carbon mild steel grade 43A. U-bolt for cross arm	M20*R105*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Aluminium PG clamps	100-100mm2, 50-50mm2		6
	Danger plate,	4 holes, 210*300mm		1
	Structure number plate	200*150mm		1
	Phase label	150*150		3
	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 preferred.	IEC 60099-4	3
	Aluminium lugs for earthing,	50mm2, 100mm2		3
	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	5m
	Lugs for earth wire	25mm2, aluminium		5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	Copper clad rods BS 2874, Steel BS 4360	2
	Stay Assembly			4 or 5



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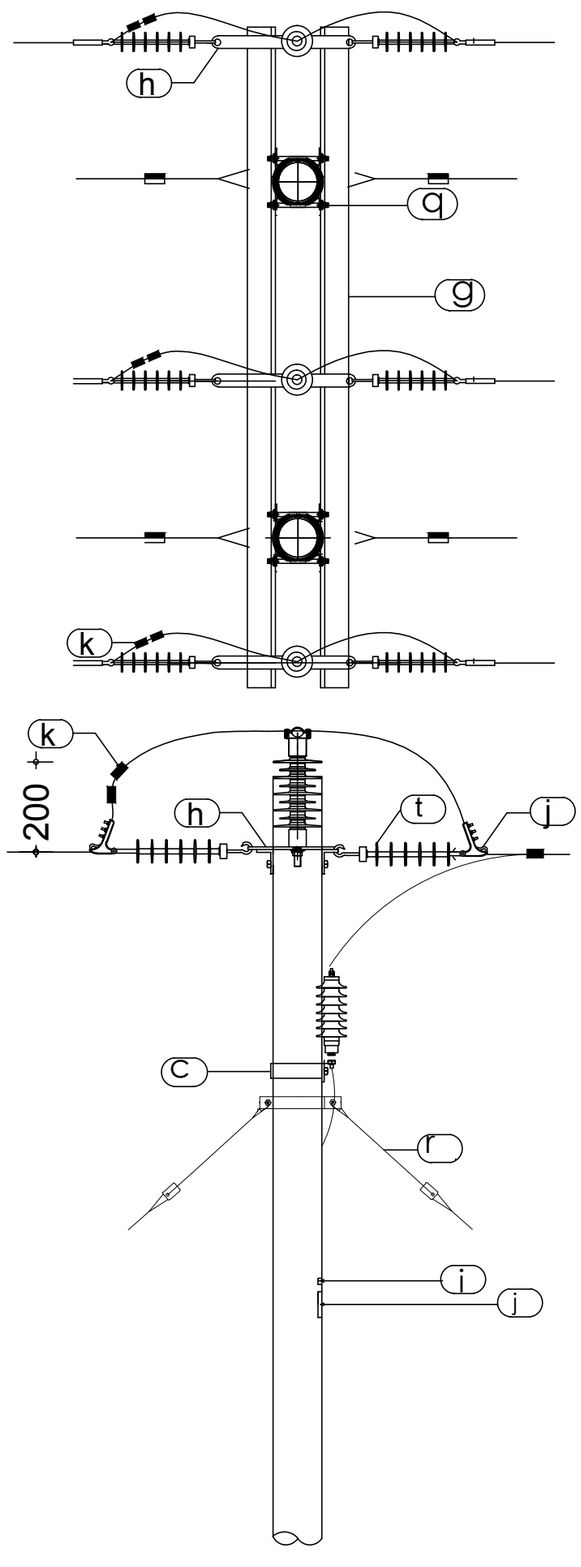
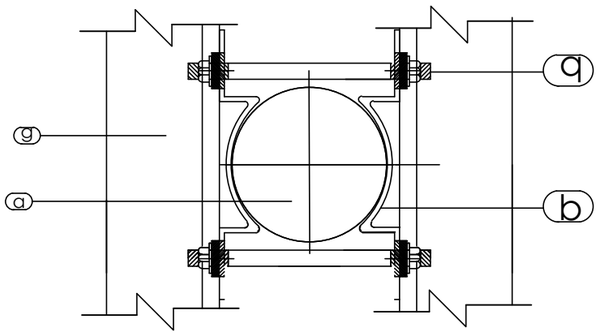


ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	6
c	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	2
d	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
e	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
f	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
g	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	3
h	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
i	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	6
j	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	6
k	Aluminium PG Clamps	100-100mm2, 50-50mm2	12
l	Aluminium lugs for earthing,	50mm2, 100mm2	3
m	Lugs for earth wire	25mm2, aluminium	5
n	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 .	3
o	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
p	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	16
q	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
r	Stay Assembly		4-5
s	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5,8kN	10m
t	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3

Detail 1



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P.O.BOX 7317
KAMPALA
UGANDA
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TITLE:

MV TWO MEMBER STRAIGHT SECTION STRUCTURE WITHOUT EARTH 12m

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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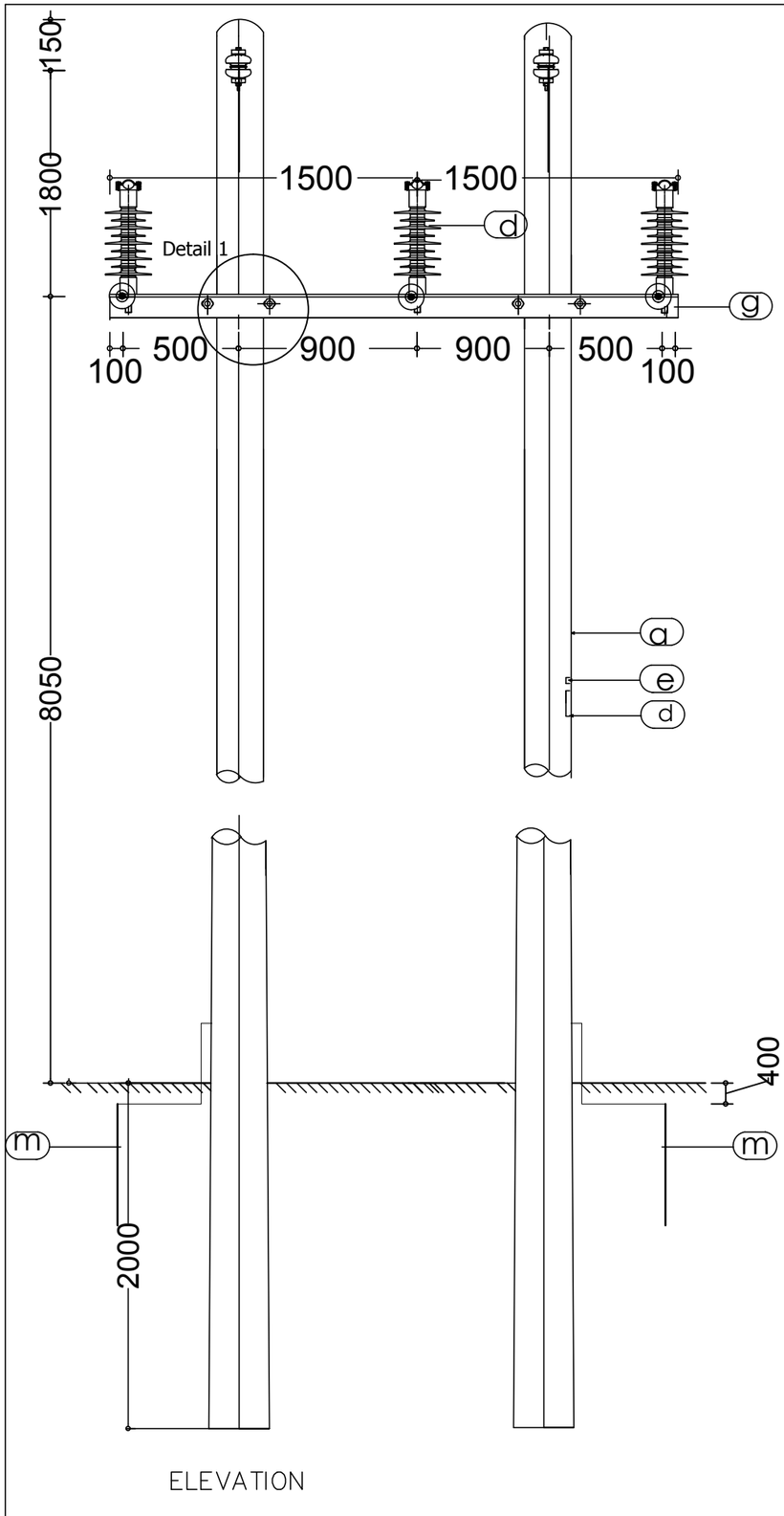

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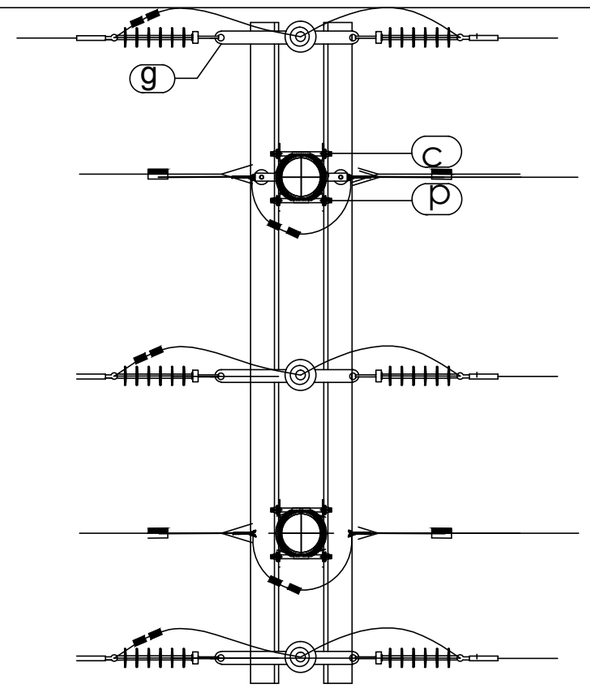
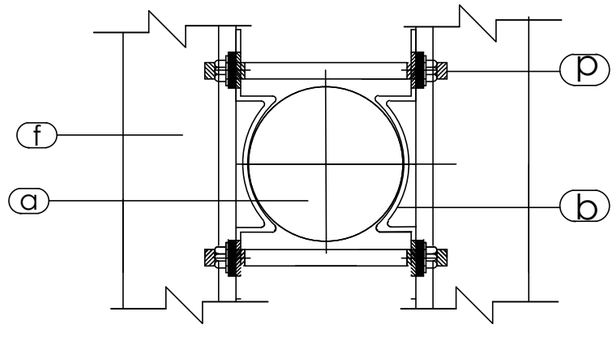


ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	6
c	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
d	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
e	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
f	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	2
g	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
h	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	6
i	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	6
j	Aluminium PG Clamps	100−100mm2, 50−50mm2	12
k	Aluminium lugs for earthing,	50mm2, 100mm2	3
l	Lugs for earth wire	25mm2, aluminium	5
m	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
n	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	18
o	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	4
p	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
q	Stay Assembly		4−5
r	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5,8kN	10m
s	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
t	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
u	D−Iron With Bolt	Low carbon mild steel grade 43A	3
v	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	3



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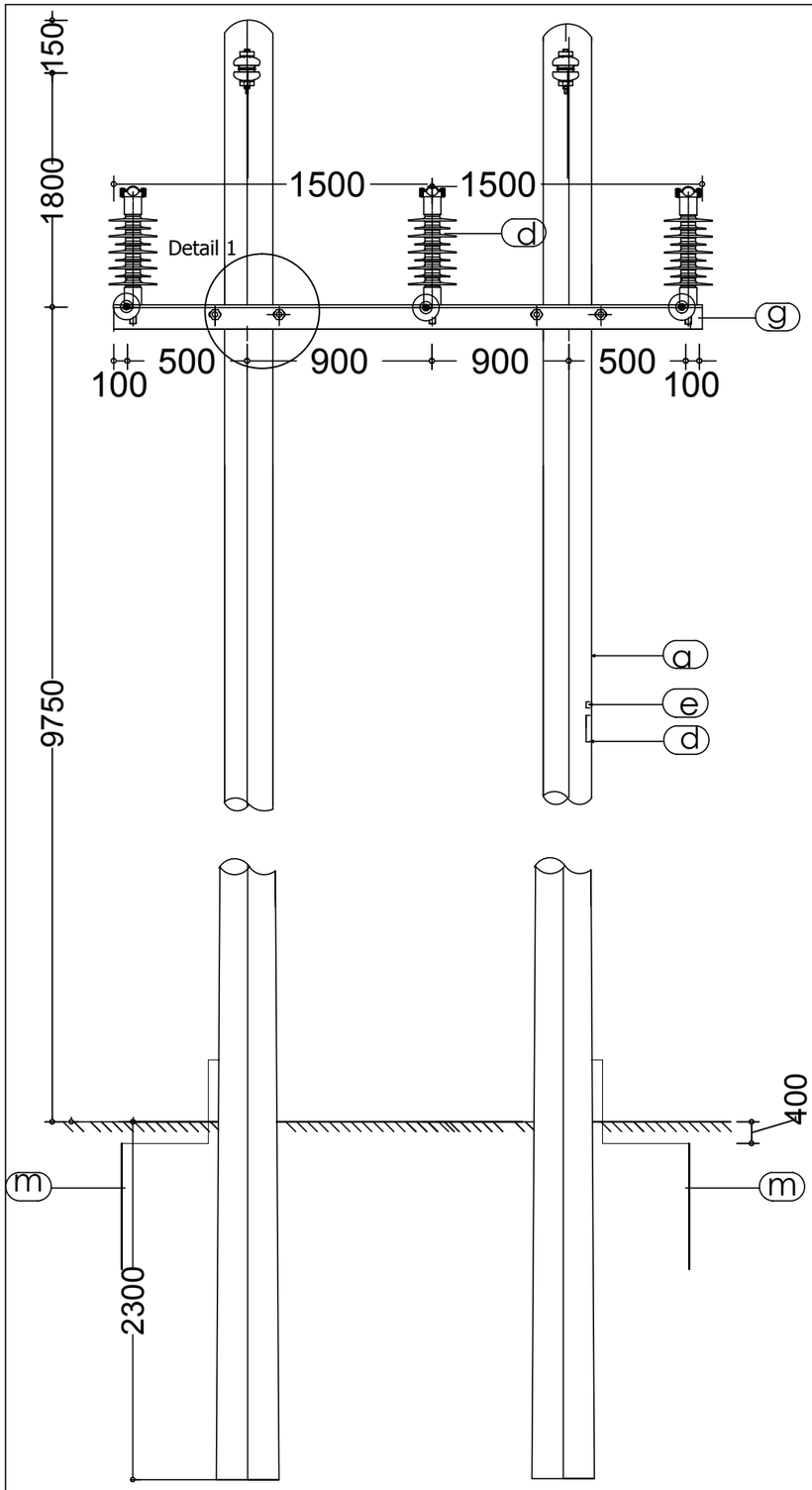
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

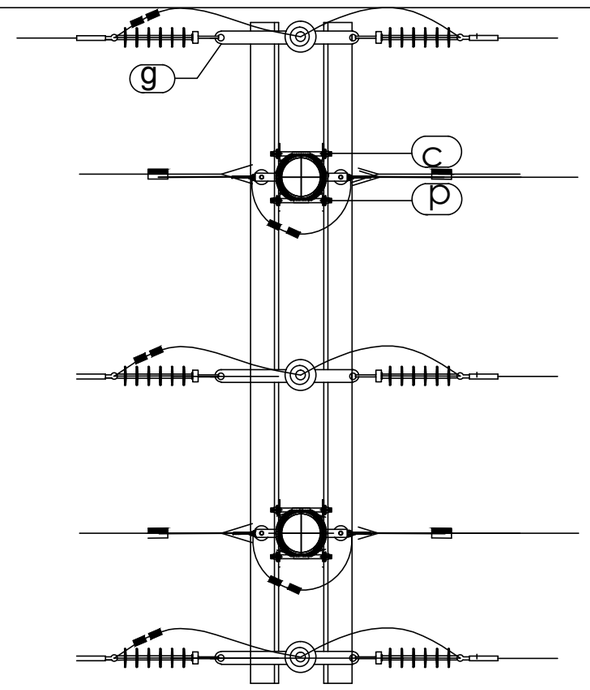
TITLE:

MV TWO MEMBER SECTION STRUCTURE WITH AERIAL EARTH - 12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

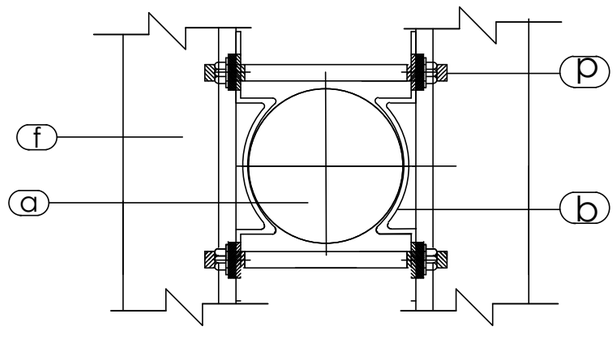


ELEVATION



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	6
c	33kV composite polymeric	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
d	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
e	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
f	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	2
g	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
h	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	6
i	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	6
j	Aluminium PG Clamps	100−100mm2, 50−50mm2	12
k	Aluminium lugs for earthing,	50mm2, 100mm2	3
l	Lugs for earth wire	25mm2, aluminium	5
m	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
n	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	18
o	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	4
p	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
q	Stay Assembly		4−5
r	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5,8kN	10m
s	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
t	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
u	D−Iron With Bolt	Low carbon mild steel grade 43A	3
v	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	3

Detail 1



RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
1OTH FLOOR, WORKERS HOUSE
P.O.BOX 7317
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UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

MV TWO MEMBER SECTION STRUCTURE WITH AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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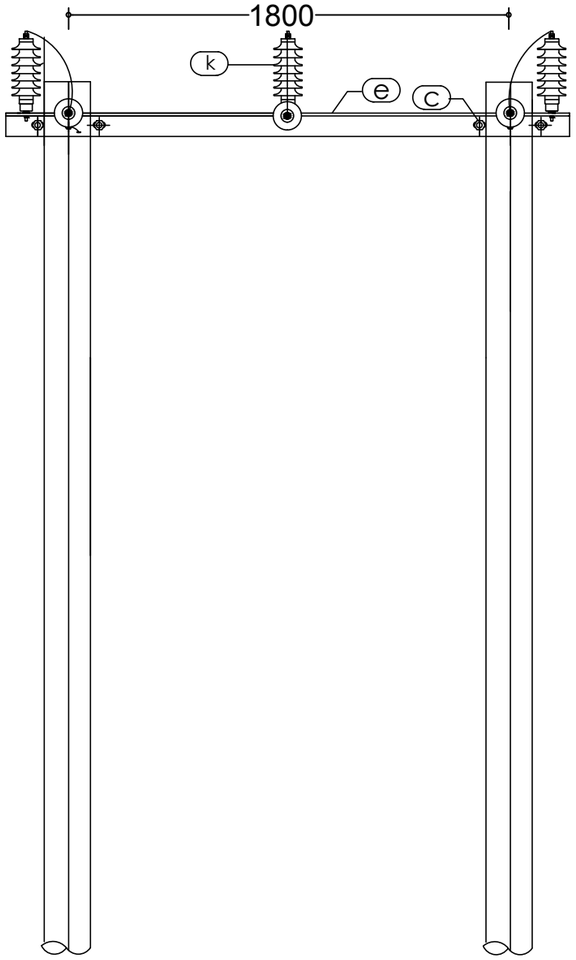
	SCALE:		
	DRW NO:		

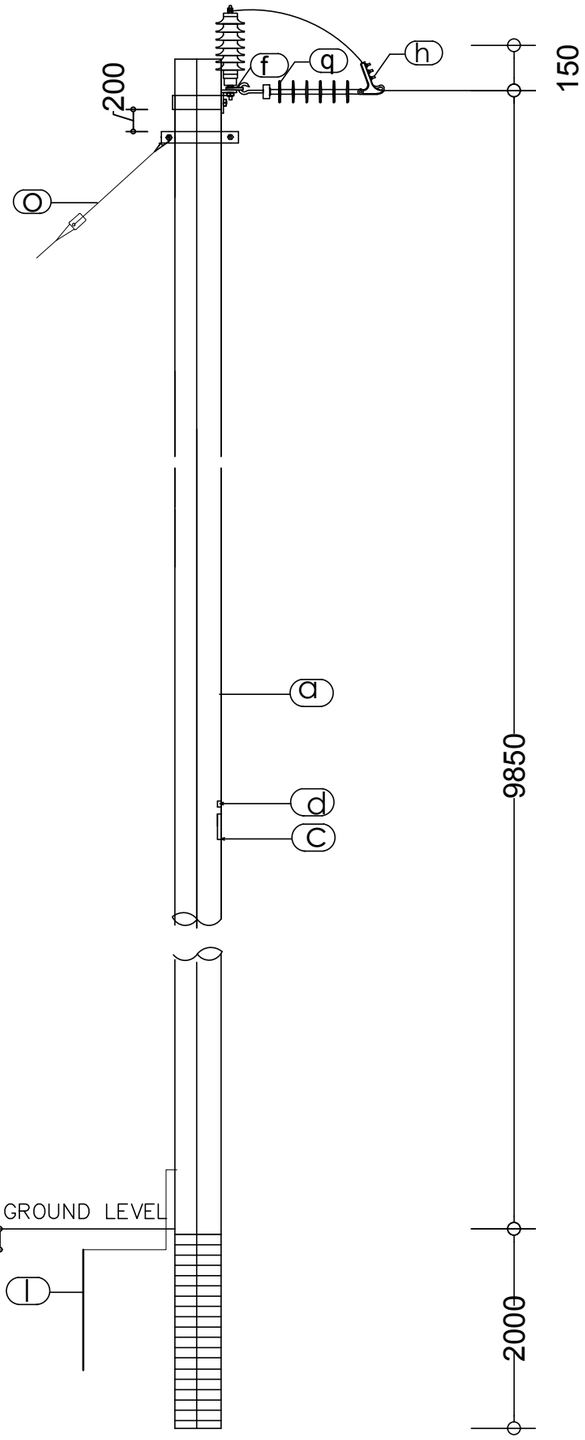
10.2.3 33kV H-Pole Terminal Structure

Structure Type	Material	Specification	Standard	Quantity
H-pole terminal	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN or 8.00kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	2
	Low carbon mild steel grade 43A. H-pole terminal cross arm	Low carbon steel grade 43A, 3000*150*100*10. Tensile strength 430Kgf/sq.mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	2
	Low carbon mild steel grade 43A. Tension plate for cross arm	Low carbon steel grade 43A L330×75×6×R103 Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	4
	Low carbon mild steel grade 43A. Connecting strap	Low carbon steel grade 43A 541*75*6	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	3
	Low carbon mild steel grade 43A. Fitting straps	Low carbon steel grade 43A L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123.	3
	Ball ended Hooks	Ball and shank 16mm^2	BS 3288 Part 2, BS 729	3
	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	BS 1472, bolts &nuts to BS 916	3
	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	IEC 62223, IEC 61109, IEC 61952	3

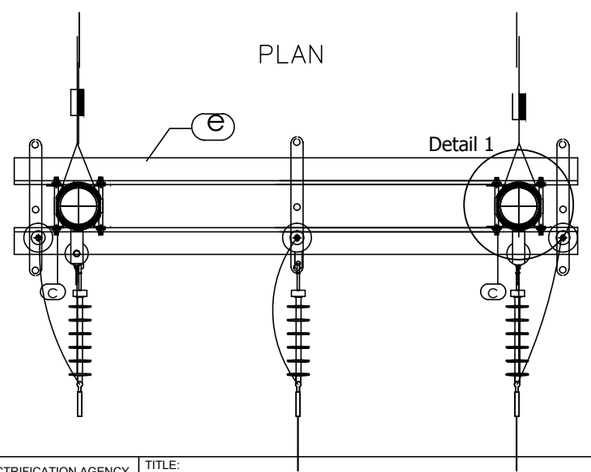
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	11
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*300mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	4
	Danger plate,	4 holes, 210*300mm		1
	Structure number plate	200*150mm		1
	Phase label	150*150		3
	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. **Class 2 preferred.**	IEC 60099-4	3
	Aluminium lugs	100 – 50mm^2		3
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	5m
	Lugs for earth wire			5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	2
	Stays			2



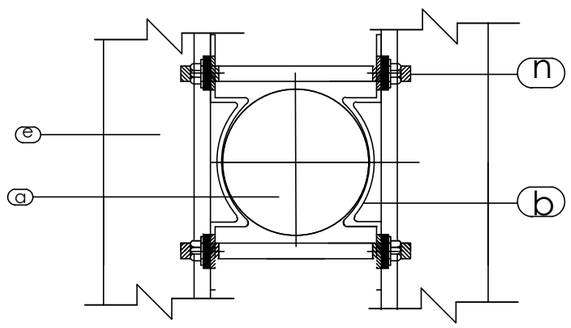
FRONT VIEW



SIDE VIEW



Detail 1



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	4
c	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
d	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
e	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	1
f	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	3
g	Connecting Straps	Low carbon mild steel grade 43A. 420*50*6 3 Holes 22mm and 38mm	3
h	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
i	Aluminium lugs for earthing,	50mm2, 100mm2	3
j	Lugs for earth wire	25mm2, aluminium	5
k	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2.	3
l	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
m	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	16
n	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
o	Stay Assembly	Low carbon mild steel grade 43A.	2
p	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	10
q	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3

NOTES:

RURAL ELECTRIFICATION AGENCY
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MV TWO MEMBER TERMINAL STRUCTURE WITHOUT AERIAL EARTH - 12M

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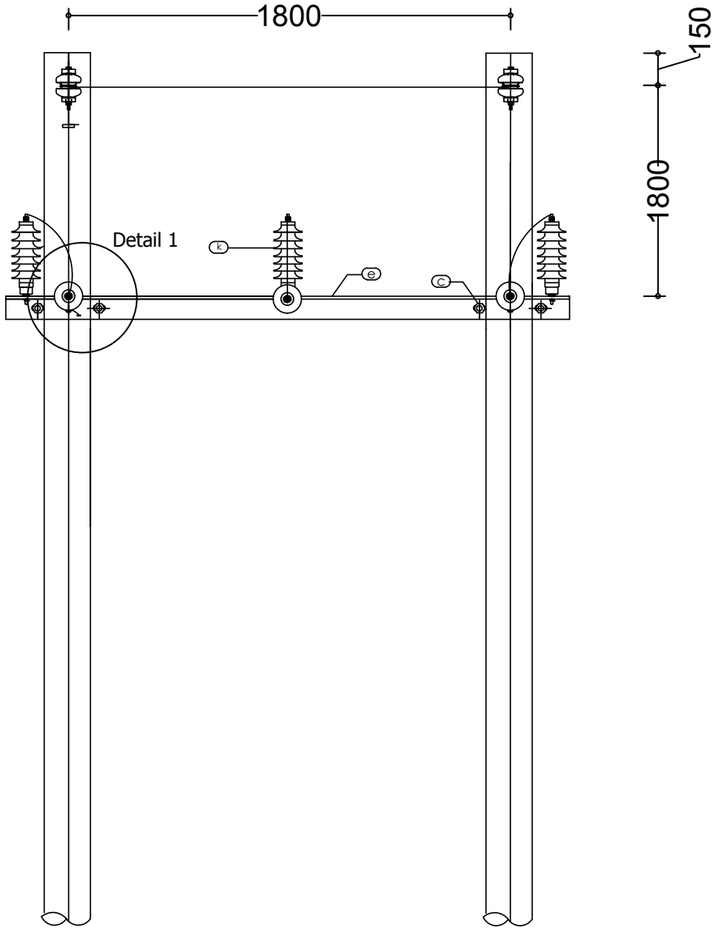
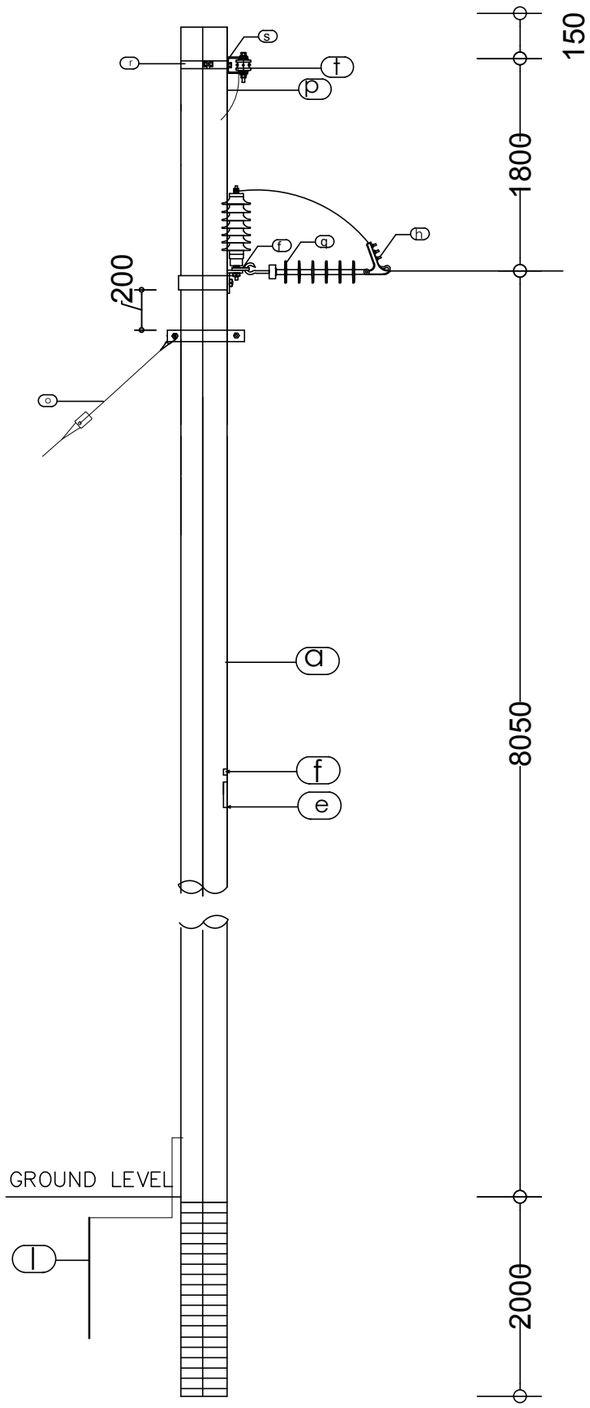
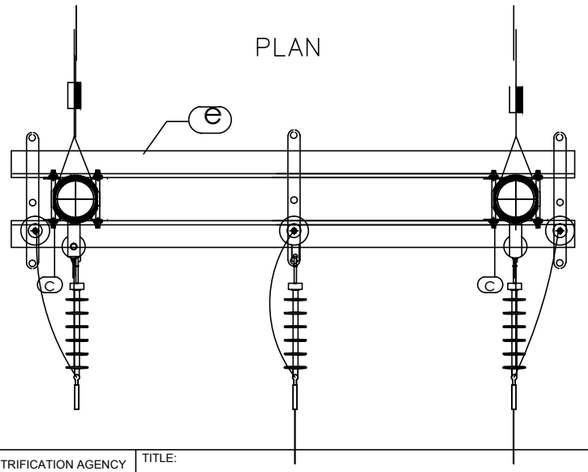


FRONT VIEW

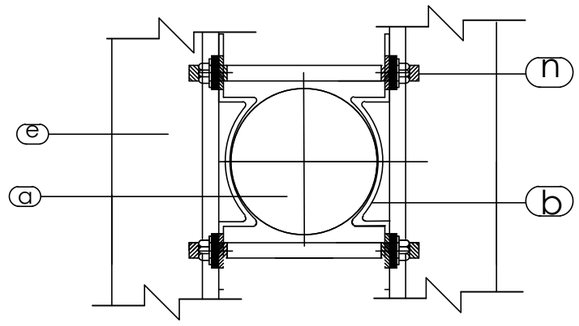


SIDE VIEW



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	4
c	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
d	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
e	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	1
f	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	3
g	Connecting Straps	Low carbon mild steel grade 43A. 420*50*6 3 Holes 22mm and 38mm	3
h	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
i	Aluminium lugs for earthing,	50mm2, 100mm2	3
j	Lugs for earth wire	25mm2, aluminium	5
k	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 .	3
l	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
m	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	16
n	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
o	Stay Assembly	Low carbon mild steel grade 43A.	2
p	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	10
q	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
r	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
s	D−Iron With Bolt	Low carbon mild steel grade 43A	2
t	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	2

Detail 1



NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

MV TWO MEMBER TERMINAL STRUCTURE WITH AERIAL EARTH - 12M

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
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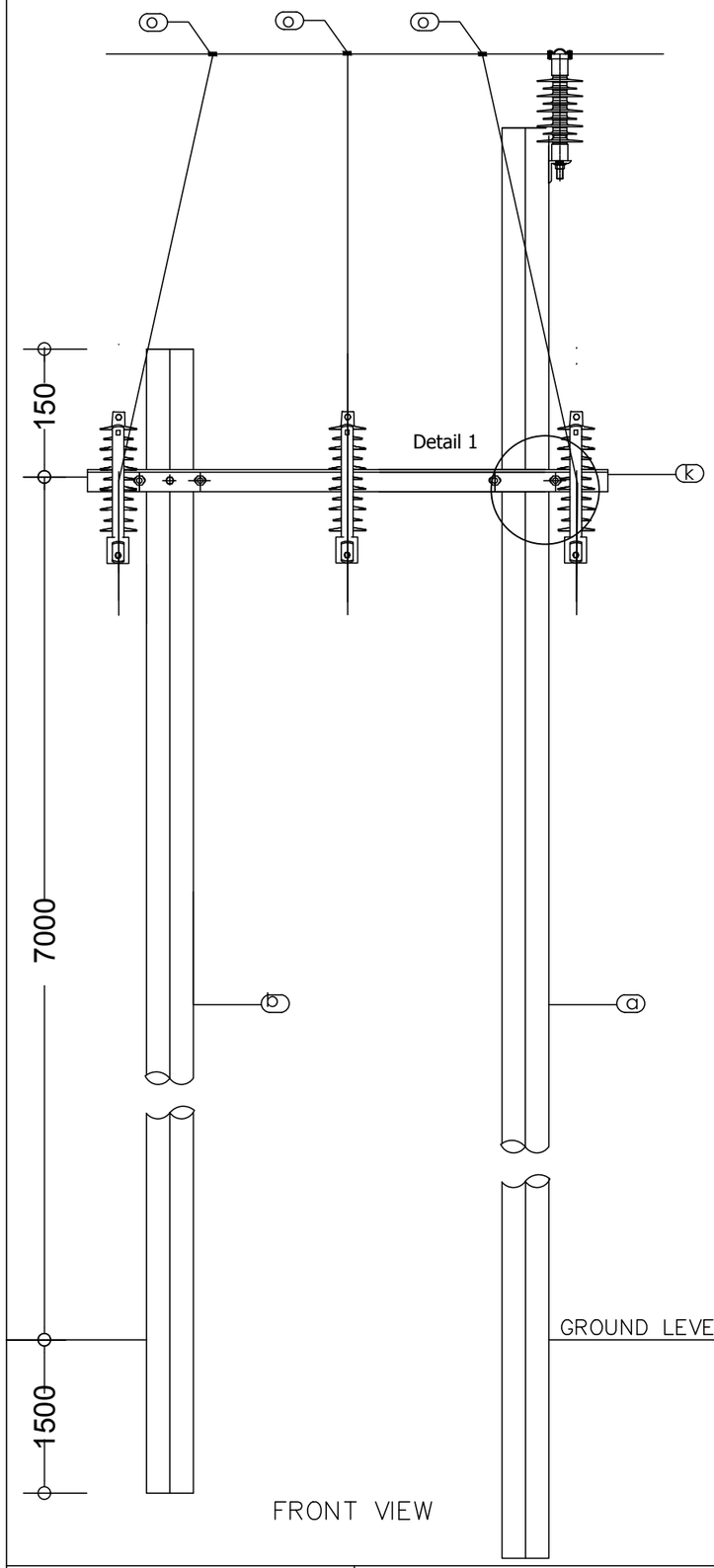
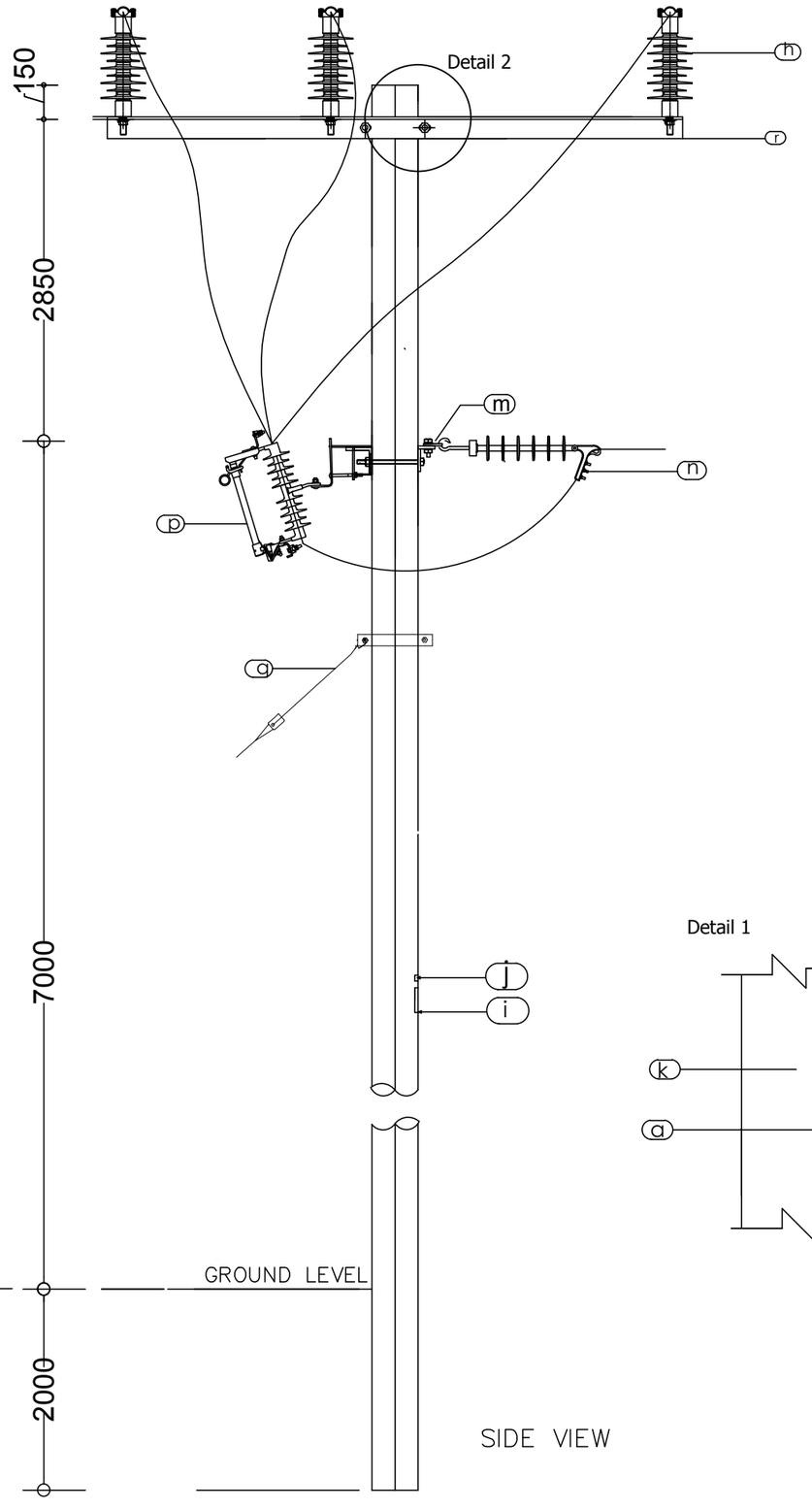
	DRW NO:		

10.2.4 33kV H-Pole T-off Structure

Structure Type	Material	Specification	Quantity
H-pole T-off	Concrete pole 12C2 or 14C2		1
	Low carbon mild steel grade 43A. H-pole cross arm	3000*150*100*10	2
	Low carbon mild steel grade 43A. Tension plate for cross arm	L330×75×6×R103 Fixing Holes: 2, diameter 22mm	4
	Connecting strap	Mild steel 541*75*6	3
	Fitting straps	Low carbon mild steel L173*75*10, 2 Holes 22mm and 38mm	3
	Hooks		3
	Groove clamps		3
	Tension insulators		3
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*50mm	11
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*300mm	4
	Low carbon mild steel grade 43A. U-bolt for cross arm	4 holes, 210*300mm	1
	Structure number plate	200*150mm	1
	Phase label	150*150	3
	Surge arresters		3
	Aluminum lugs for earthing, 50 OR 100		3
	Earth wire	Low carbon mild steel, 2.64*25mm 3core	5m
	Lugs for earth wire		5
	Earth rod		2
	Stays		2



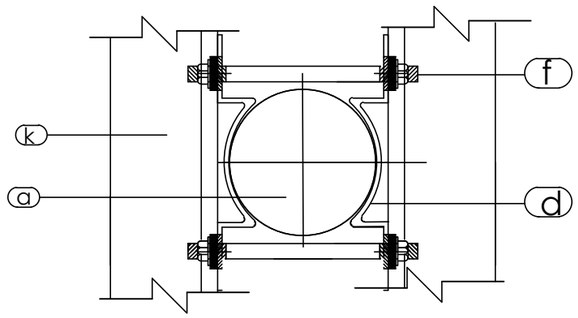


FRONT VIEW

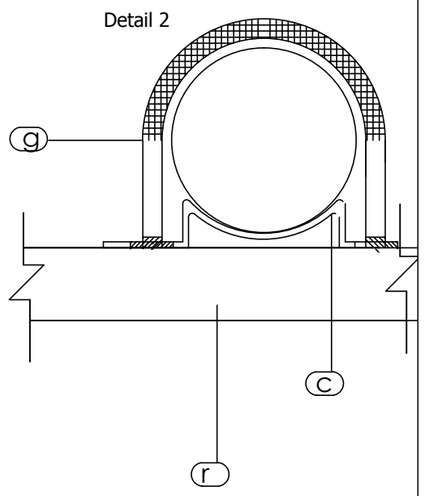
SIDE VIEW

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C1	Ultimate tensile strength 4.17kN, concrete grade 50	1
b	Concrete pole 9C2	Ultimate tensile strength 4.83kN, concrete grade 50	1
c	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	3
d	Tension Plate type 2.	Low carbon mild steel grade 43A	2
e	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	2
f	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*350mm	2
g	U–bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	1
h	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (–) 200kV and 210kV	6
i	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
j	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
k	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	2
	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
m	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (–) 200kV and 210kV	3
n	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
o	Aluminium PG clamps	100–100mm2, 50–50mm2	3
p	Explusion Fuse Set	33kV or 11kV expulsion fuse set appropriately rated	1
q	Stay Assembly	Low carbon mild steel grade 43A. M20*300mm	2
r	Intermediate pole cross arm.	Low carbon mild steel grade 43A. L 150X53x6.3X2500 Fixing Holes: 2, Diameter 22mm. tensile strength 430kgf/sq.mm	1

Detail 1



Detail 2



NOTES:

RURAL ELECTRIFICATION AGENCY
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10TH FLOOR, WORKERS HOUSE
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TEL:

TITLE:

MV TWO MEMBER T-OFF STRUCTURE WITHOUT AERIAL EARTH - 12MPOLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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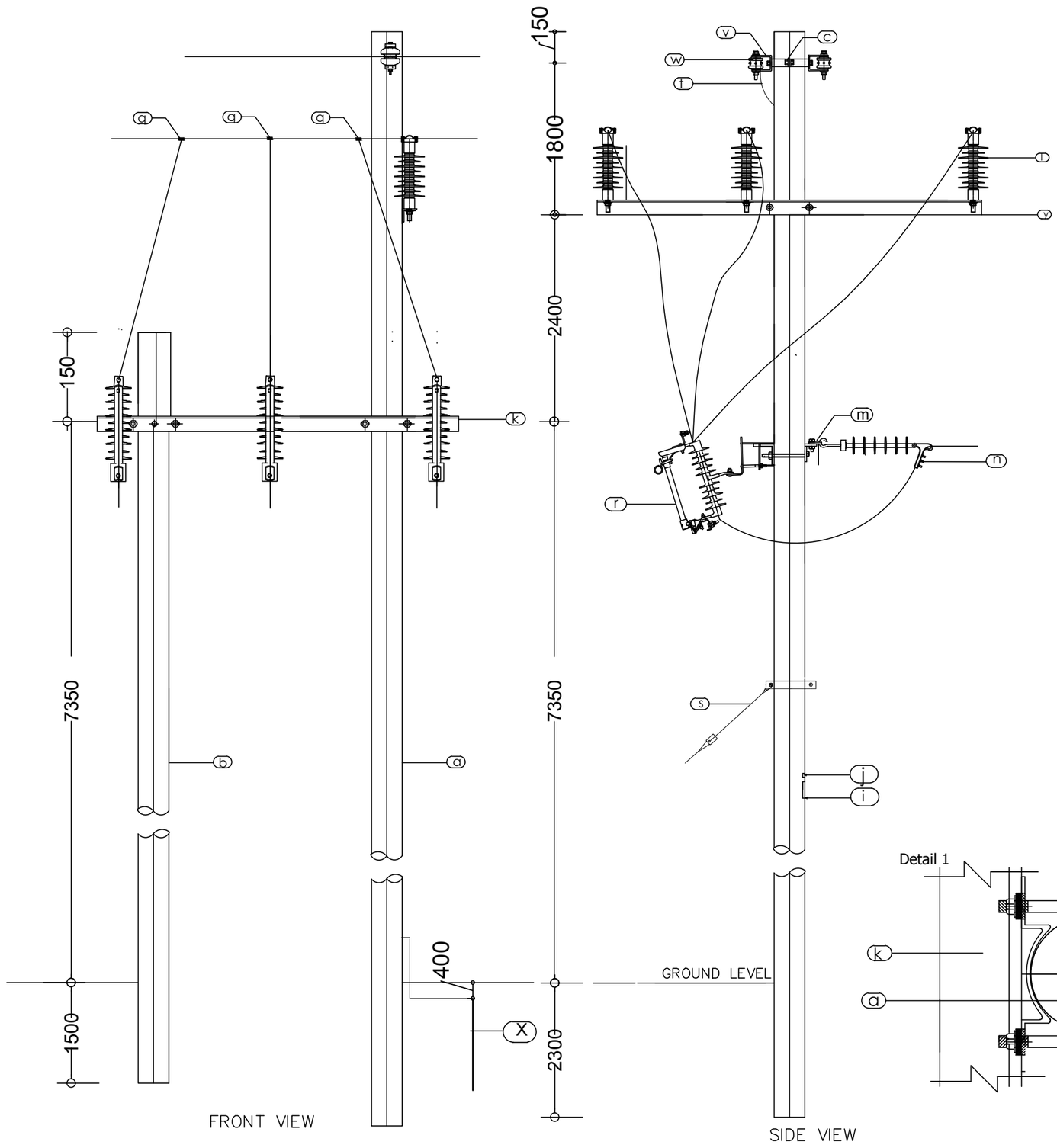
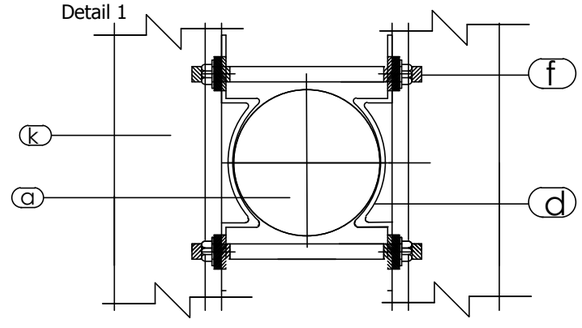
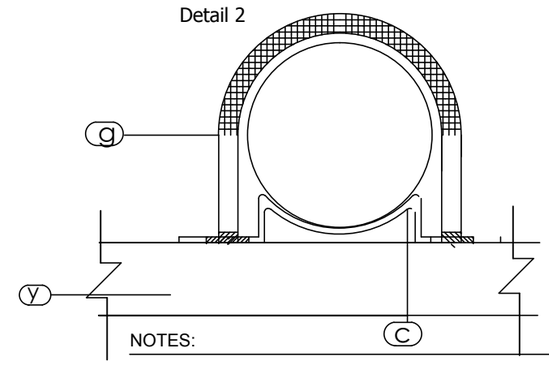


ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C1 (PME)	Ultimate tensile strength 5.4kN, concrete grade 50	1
b	Concrete pole 9C2	Ultimate tensile strength 4.83kN, concrete grade 50	1
c	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	4
d	Tension Plate type 2.	Low carbon mild steel grade 43A	3
e	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	2
f	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*350mm	2
g	U–bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	3
h	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (–) 200kV and 210kV	6
i	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
j	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
k	H pole crossarm	Low carbon mild steel grade 43A L 150X100X10X3000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	3
l	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
m	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (–) 200kV and 210kV	3
n	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
o	Aluminium lugs for earthing,	50mm2, 100mm2	6
p	Lugs for earth wire	25mm2, aluminium	5
q	Aluminium PG clamps	100–100mm2, 50–50mm2	3
r	Explusion Fuse Set	33kV or 11kV expulsion fuse set appropriately rated	1
s	Stay Assembly	Low carbon mild steel grade 43A. M20*300mm	2
t	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	10m
u	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
v	D–Iron With Bolt	Low carbon mild steel grade 43A	2
w	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	2
x	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	1
y	Intermediate pole cross arm.	Low carbon mild steel grade 43A. L 150X53x6.3X2500 Fixing Holes: 2, Diameter 22mm. tensile strength 430kgf/sq.mm	1

Detail 1



Detail 2



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KAMPALA
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MV TWO MEMBER T-OFF STRUCTURE WITH AERIAL EARTH -14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

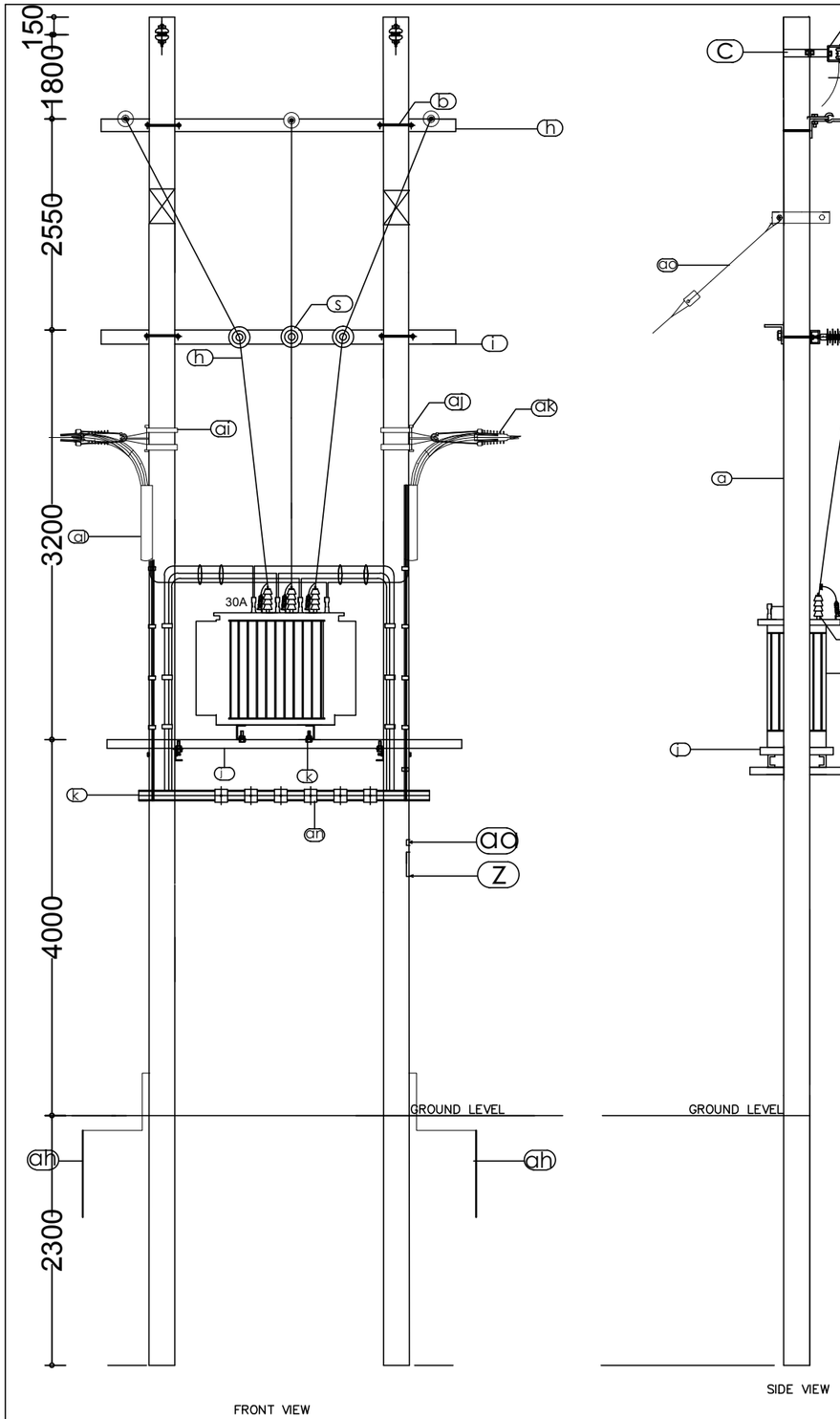
10.2.5 Concrete Pole Transformer Structure

Structure Type	Material	Specification	Standard	Qty
Transformer structure.	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN or 8.00kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	2
	Low carbon mild steel grade 43A. H-pole section cross arm	Low carbon steel grade 43A, 3000*150*100*10	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Low carbon mild steel grade 43A. Upper steady bar for pilot pin insulators	Low carbon steel grade 43A, 3000*150*100*10	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Low carbon mild steel grade 43A. Transformer plate form	Low carbon steel grade 43A, 3000*150*100*10	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	2
	Low carbon mild steel grade 43A. LV fuse steady bar		BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Low carbon mild steel grade 43A. Tension plate for cross arm	Low carbon steel grade 43A, L330×75×6×R103. Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	2
	Low carbon mild steel grade 43A. Tension plate for upper steady bar	Low carbon steel grade 43A, 340×75×6×R104. Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	2
	Low carbon mild steel grade 43A. Tension plate for transformer platform		BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	6

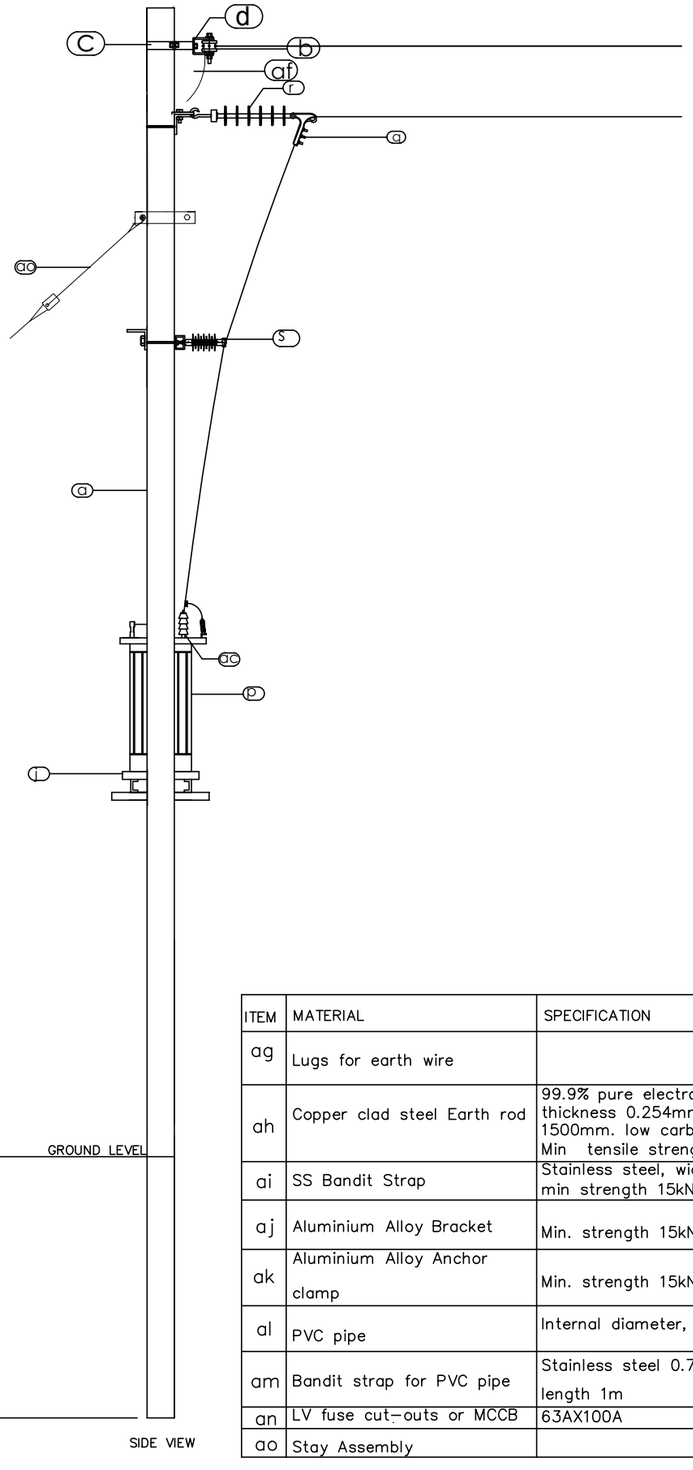
	Low carbon mild steel grade 43A. Fitting straps	Low carbon steel grade 43A L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Ball ended Hooks	Ball and shank 16mm^2	BS 3288 Part 2, BS 729	3
	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	BS 1472, bolts &nuts to BS 916	3
	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	IEC 62223, IEC 61109, IEC 61952	3
	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	BS 137, BS 729, IEC 62223, IEC 61109, IEC 61952	3
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	25
	Low carbon mild steel grade 43A. Bolt, washer and nut	M20*350mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	8
	Low carbon mild steel grade 43A. U-bolt for cross arm	M20*R105*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Low carbon mild steel grade 43A. U-bolt for upper steady bar	M20*R120*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Low carbon mild steel grade 43A. U-bolt for LV fuse	M20*R120*L170	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2

	steady bar			
	Danger plate,	4 holes, 210*300mm, Gauge 16 and Iron composition		1
	Structure number plate	200*150mm, Gauge 16 and Iron composition		1
	Phase label	150*150, Gauge 16 and Iron composition		3
	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. **Class 2 preferred.**	IEC 60099-4	3
	Bimetallic lugs	100 – 50mm^2		3
	Pre-insulated Bimetallic lugs	50mm^2, Aluminium 99.5%	NFC33-021	8
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	15m
	Lugs for earth wire			5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	8
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		1 set
	Aluminium Alloy Bracket	Min. strength 12kN	BS 1472	1
	Aluminium Alloy Anchor clamp	Min. strength 15kN	BS 1472	1
	PVC pipe	Internal diameter, 60mm,		2

		length 0.8m		
	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m		10
	LV fuse cut-outs or MCCB	63A – 100A		6
	Stays			2



FRONT VIEW



SIDE VIEW

ITEM	MATERIAL	SPECIFICATION	QTY
ag	Lugs for earth wire		5
ah	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	8
ai	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN	1 set
aj	Aluminium Alloy Bracket	Min. strength 15kN	1
ak	Aluminium Alloy Anchor clamp	Min. strength 15kN	1
al	PVC pipe	Internal diameter, 60mm, length 0.8m	2
am	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m	10
an	LV fuse cut-outs or MCCB	63AX100A	6
ao	Stay Assembly		2

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2 (PME)	Ultimate tensile strength 6.03kN, concrete grade 50	2
b	Reel Insulator	Power frequency Voltage, dry 20kV, wet 9kV, failing load 9kN	2
c	Galvanised steel clamp for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	4
d	D-Iron complete with the bolt	Low carbon mild steel grade 43A.	2
e	Preformed termination for earth wire	Galvanised Steel	2
f	PG Clamp	Steel PG Clamp 25, 25	2
g	Lugs for earth wire	25mm2, aluminium	8
h	H-pole cross arm	Low carbon mild steel grade 43A. 3000*150*100*10	1
i	Upper steady bar for pilot pin insulators	Low carbon mild steel grade 43A. 3000*150*100*10	1
j	Transformer plate form	Low carbon mild steel grade 43A. U-type 3000*150*100*10	2
k	LV fuse steady bar	Low carbon mild steel grade 43A. 3000*150*100*10	1
l	Tension plate type 1	Low carbon mild steel grade 43A. L330?75?6?R103. Fixing Holes: 2, diameter 22mm	2
m	Tension plate for upper steady bar	Low carbon mild steel grade 43A 340x75x6xR104. Fixing Holes: 2, diameter 22mm	2
n	Tension plate for transformer platform	Low carbon mild steel grade 43A.	6
o	Fitting straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	3
p	Ball ended Hooks	Ball and shank 16mm2	3
q	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
r	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
s	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
t	Bolt, washer and nut	Low carbon mild steel grade 43A M20*50mm	27
u	Bolt, washer and nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	4
v	Bolt, washer and nut	Low carbon mild steel grade 43A. M20*350mm	8
w	U-bolt for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	4
x	U-bolt for upper steady bar	Low carbon mild steel grade 43A. M20*R120*L170	2
y	U-bolt for LV fuse steady bar	Low carbon mild steel grade 43A. M20*R120*L170	2
z	Danger plate,	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm,W: 300mm	1
aa	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W:150mm	1
ab	Phase label/ Identifiers	150*150mm Iron sheet gauge 16, 85 micron primer	3
ac	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 preferred.	3
ad	Bimetallic lugs	100 ? 50mm2	3
ae	Pre-insulated Bimetallic lugs	50mm2	8
af	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	15m

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TITLE:

TRANSFORMER STRUCTURE WITH AERIAL EARTH -14M POLE

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	CHECKED BY: O.J	DATE:	
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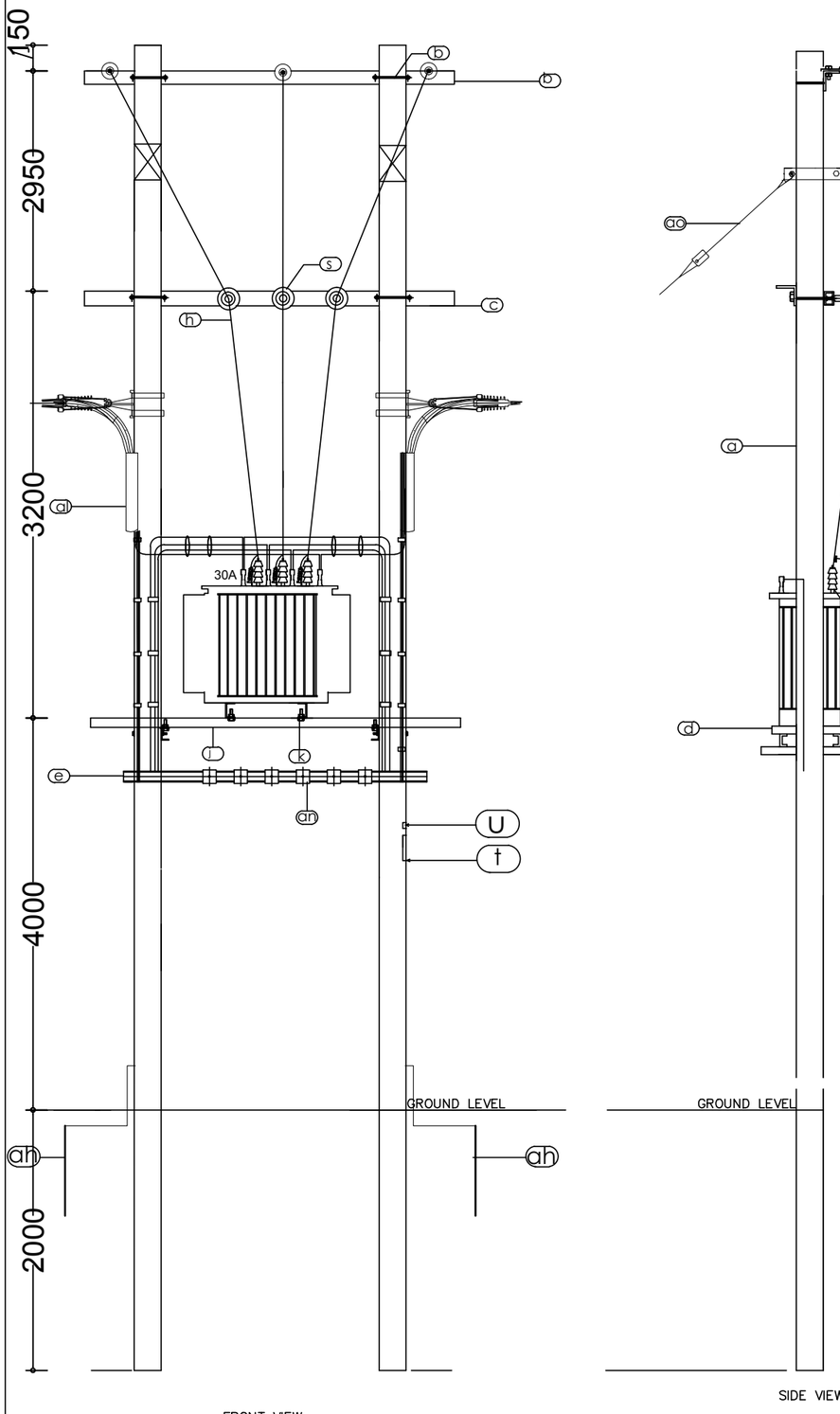

ITEM	MATERIAL	SPECIFICATION	QTY
an	LV fuse cut-outs or MCCB	63AX100A	6
ao	Stay Assembly		2

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 12C2 (PME)	Ultimate tensile strength 6.03kN, concrete grade 50	2
b	H-pole cross arm	Low carbon mild steel grade 43A. 3000*150*100*10	1
c	Upper steady bar for pilot pin insulators	Low carbon mild steel grade 43A. 3000*150*100*10	1
d	Transformer plate form	Low carbon mild steel grade 43A. 3000*150*100*10	2
e	LV fuse steady bar	Low carbon mild steel grade 43A. 3000*150*100*10	1
f	Tension plate type 1	Low carbon mild steel grade 43A. L330?75?6?R103. Fixing Holes: 2, diameter 22mm	2
g	Tension plate for upper steady bar	Low carbon mild steel grade 43A 340x75x6xR104. Fixing Holes: 2, diameter 22mm	2
h	Tension plate for transformer platform	Low carbon mild steel grade 43A.	6
i	Fitting straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	3
j	Ball ended Hooks	Ball and shank 16mm2	3
k	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	3
l	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
m	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
n	Bolt, washer and nut	Low carbon mild steel grade 43A M20*50mm	27
o	Bolt, washer and nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	4
p	Bolt, washer and nut	Low carbon mild steel grade 43A. M20*350mm	8
q	U-bolt for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	4
r	U-bolt for upper steady bar	Low carbon mild steel grade 43A. M20*R120*L170	2
s	U-bolt for LV fuse steady bar	Low carbon mild steel grade 43A. M20*R120*L170	2
t	Danger plate,	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm,W: 300mm	1
u	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
v	Phase label/ Identifiers	150*150mm Iron sheet gauge 16, 85 micron primer	3
w	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 preferred.	3
x	Bimetallic lugs	100 ? 50mm2	3
y	Pre-insulated Bimetallic lugs	50mm2	8
z	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	15m
ag	Lugs for earth wire		5
ah	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	8
ai	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN	1 set
aj	Aluminium Alloy Bracket	Min. strength 15kN	1
ak	Aluminium Alloy Anchor clamp	Min. strength 15kN	1
al	PVC pipe	Internal diameter, 60mm, length 0.8m	2
am	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m	10

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TITLE:

TRANSFORMER STRUCTURE WITHOUT AERIAL EARTH -12M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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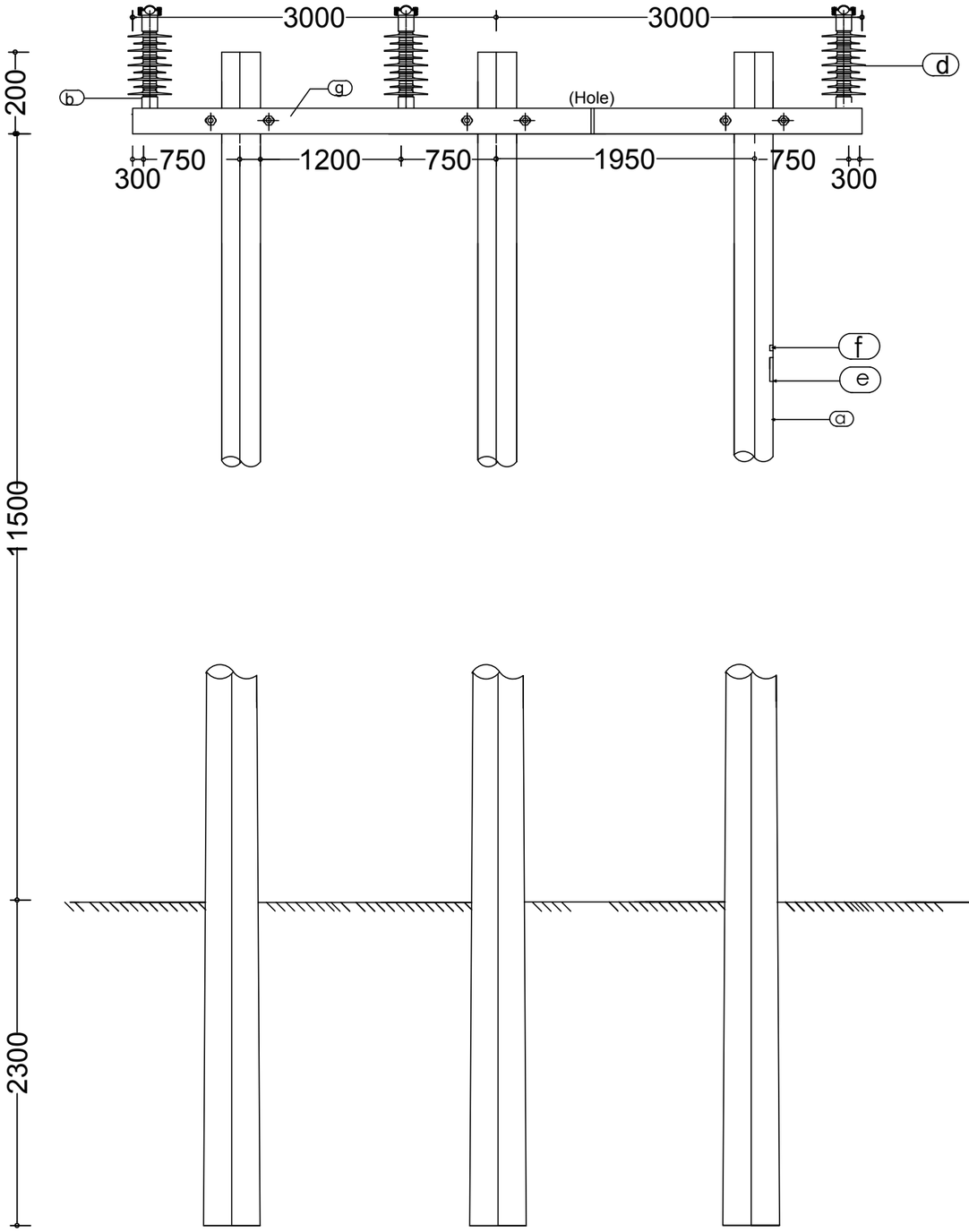
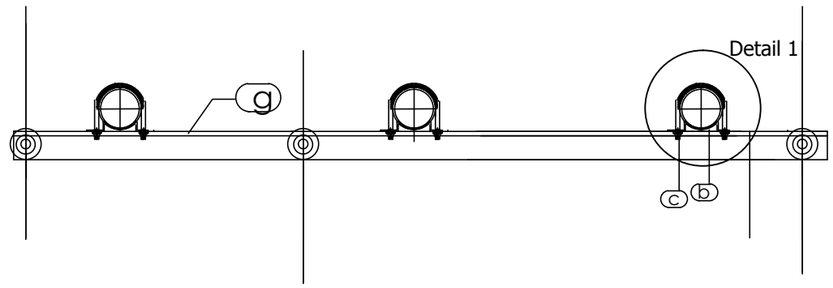
10.3 Three Member Concrete Pole Configurations

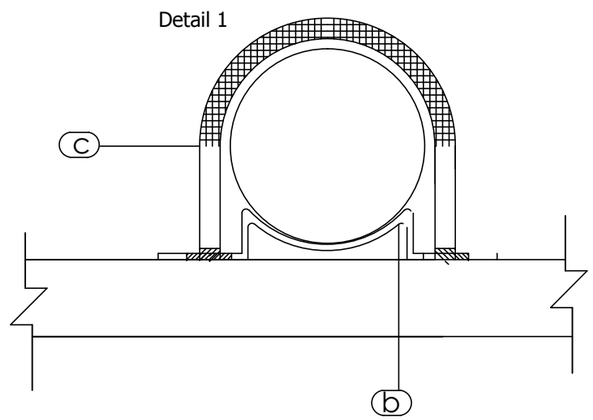
33kV 3-Member Section Structure

Structure Type	Material	Specification	Standard	Qty
3M Section	Concrete pole 14C2 (PME)	Ultimate tensile strength 6.03kN or 8.00kN, concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	3
	Low carbon steel grade 43A. 3m cross arm type 1	6000*200*150*15. (for Spans 160 – 300m)	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Low carbon steel grade 43A. 3m cross arm type 2	9000*250*200*15. (for Spans above 300m)	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Low carbon steel grade 43A. Connecting strap	541*75*6.	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Low carbon steel grade 43A. Tension plate for cross arm	L330×75×6×R103, Fixing Holes: 2, diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	8
	Low carbon steel grade 43A. Fitting straps	L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	6
	Ball ended Hooks	Ball and shank 16mm^2	BS 3288 Part 2, BS 729	6
	Groove clamps	Tensile strength 70kN, 6 bolts, aluminium alloy	BS 1472, bolts &nuts to BS 916	6
	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 1200mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	IEC 62223, IEC 61109, IEC 61952	3
	33kV composite polymeric Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	BS 137, BS 729, IEC 62223, IEC 61109, IEC 61952	3
	Low carbon steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	20
	Low carbon steel grade 43A. Bolt, washer and nut	M20*300mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	6
	Low carbon steel grade	M20*R105*L170	BS 916, BS 4360,	2

	43A. U-bolt for cross arm		BS 3288 Part 2, BS 729, ASTM A123	
	Danger plate,	4 holes, 210*300mm		1
	Structure number plate	200*150mm		1
	Phase label	150*150		3
	Aluminium Alloy PG Clamp complete with bolts	100 – 100 or 50 – 50mm^2	BS 1472, bolt to BS 3288 Part 2, BS 729	3
	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. **Class 2 preferred.**	IEC 60099	3
	Aluminium lugs for earthing	, 50 or 100		3
	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	6m
	Lugs for earth wire			5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	2
	Stay Assembly			6 or 7







ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2	Ultimate tensile strength 6.03kN, Concrete grade 50	3
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	3
c	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	3
d	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
e	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
f	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
g	H pole crossarm	Low carbon mild steel grade 42A L 200X150X15X3000, Fixing Holes: 4	1

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MV THREE MEMBER SUPPORT STRUCTURE WITHOUT AERIAL EARTH - 14M POLE

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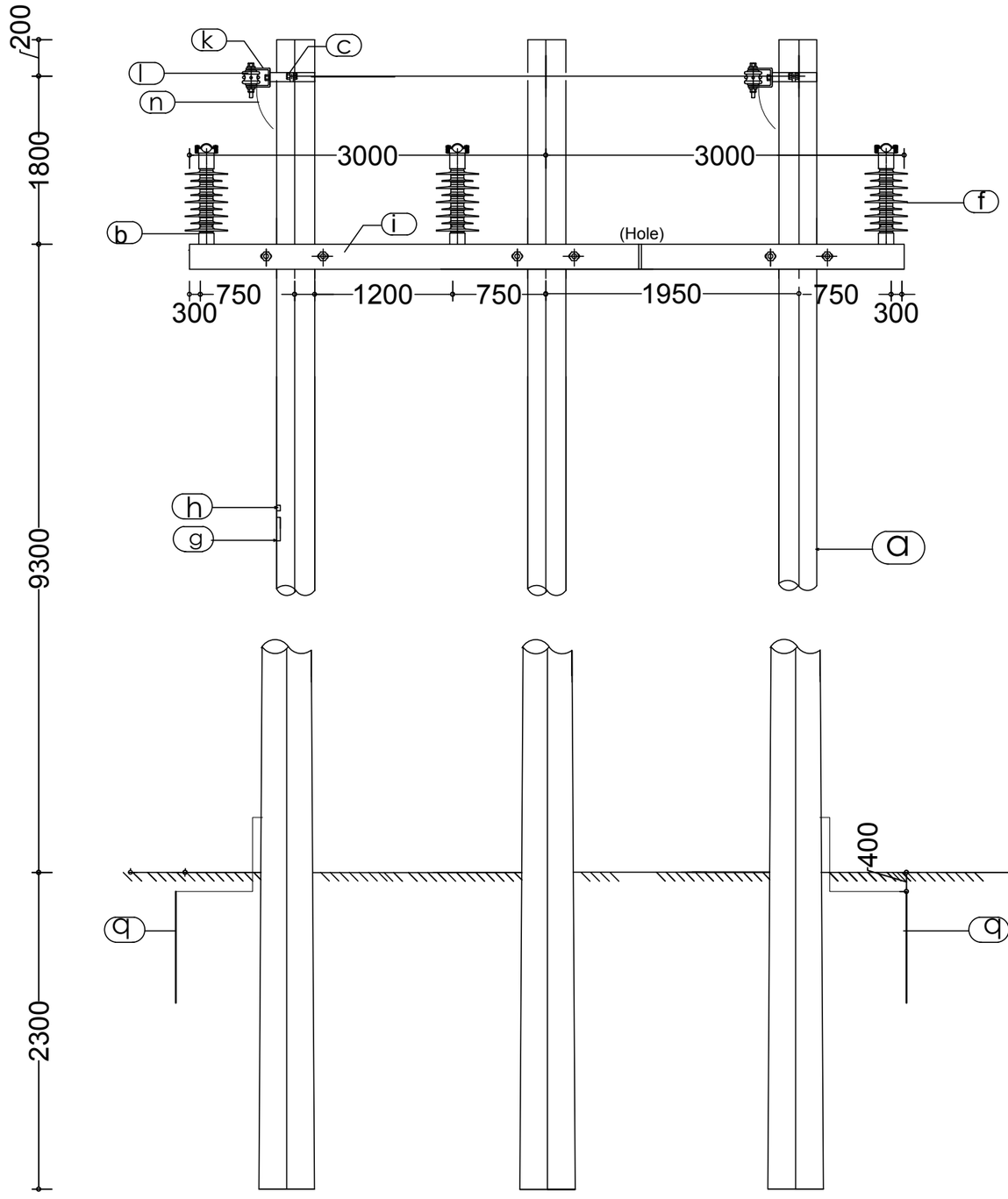

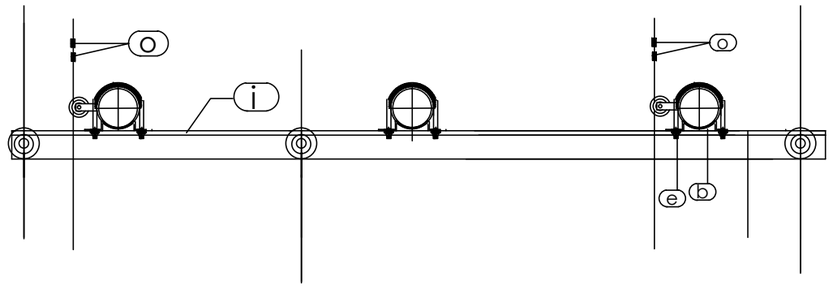

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2	Ultimate tensile strength 6.03kN, Concrete grade 50	3
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	3
c	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm	12
d	Preformed top tie	Aluminium	3
e	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	1
f	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
g	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
h	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
i	H pole crossarm	Low carbon mild steel grade 42A L 200X150X15X6000, Fixing Holes: 4	
j	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
k	D-Iron With Bolt	Low carbon mild steel grade 43A	2
l	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	2
m	Binding Wire	Aluminium	1.5m
n	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strenght 5,8kN	15m
o	PG Clamp	Galvanised steel PG Clamp 25,25 failing load 9kN	2
p	Lugs for earth wire	25sq mm, aluminium	2
q	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	1

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MV THREE MEMBER SUPPORT WITH AERIAL EARTH

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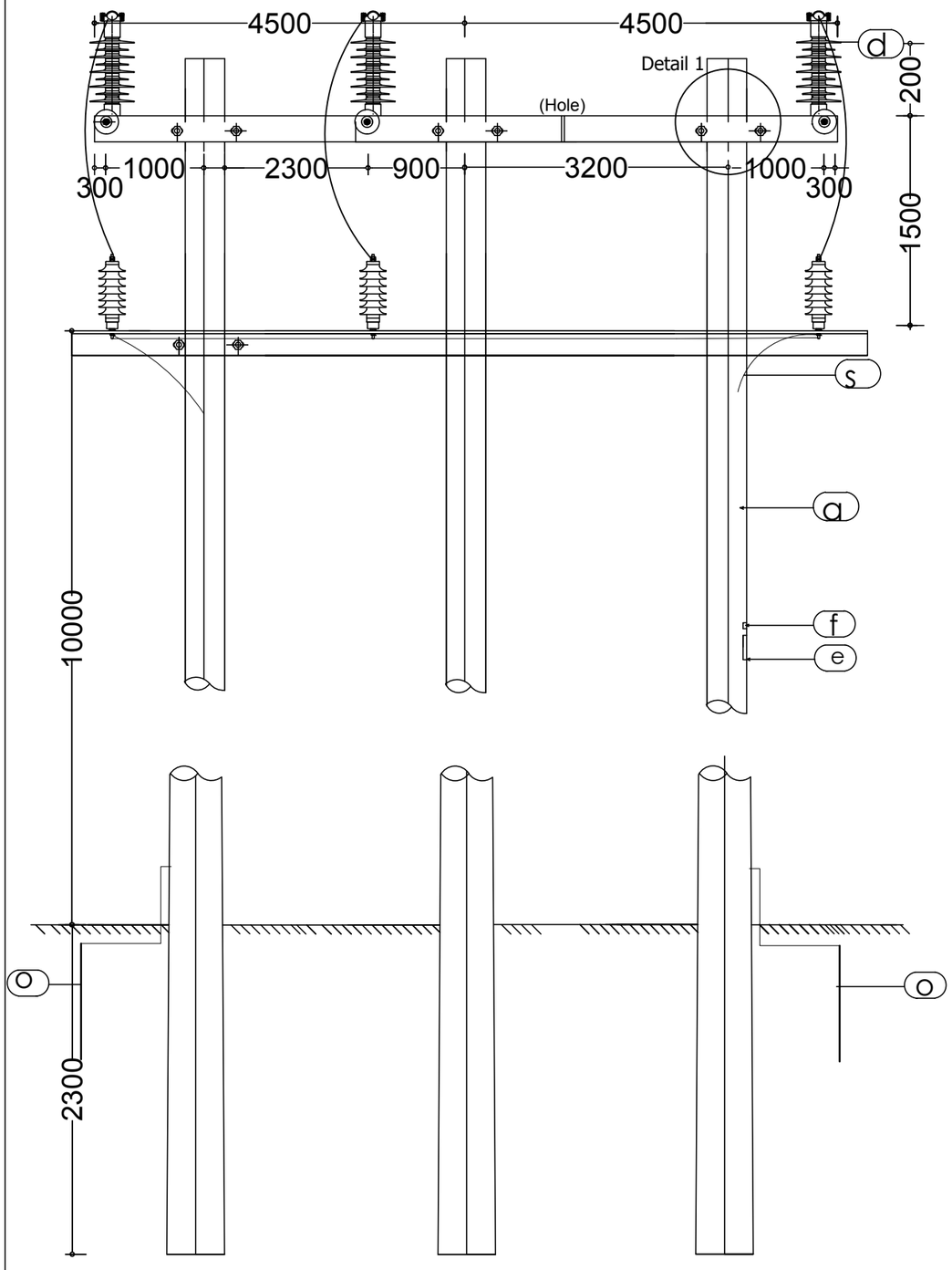
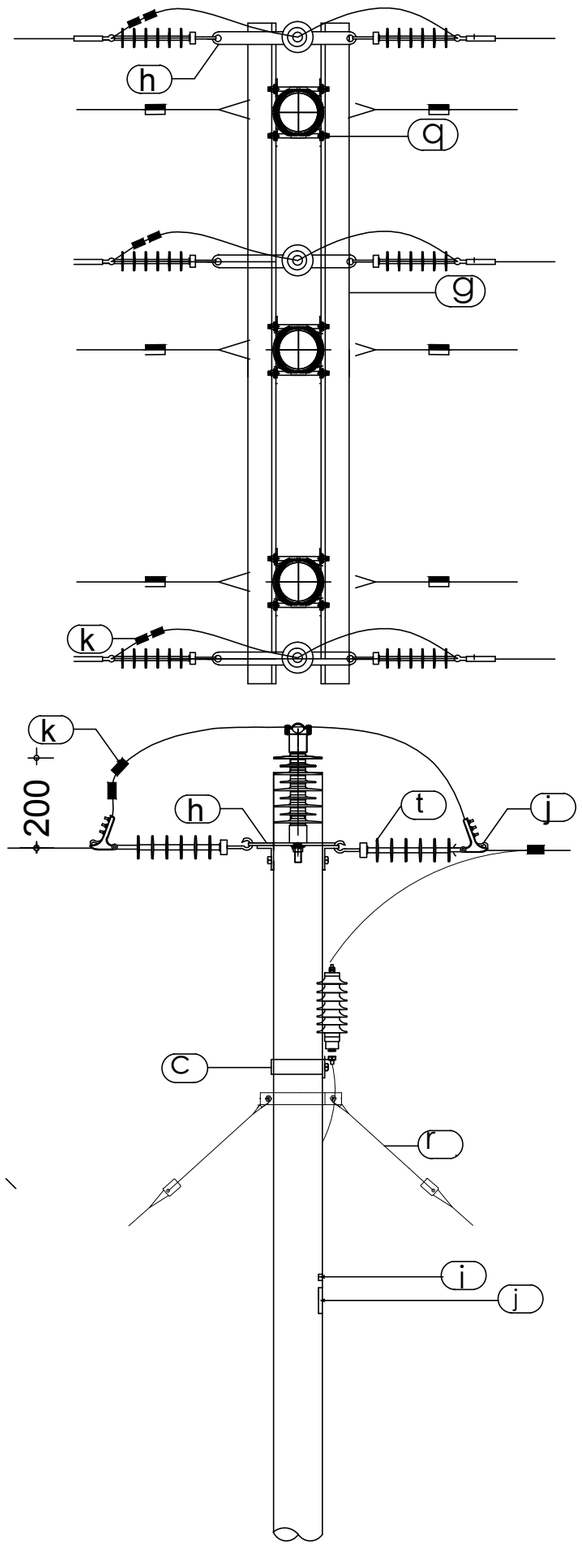
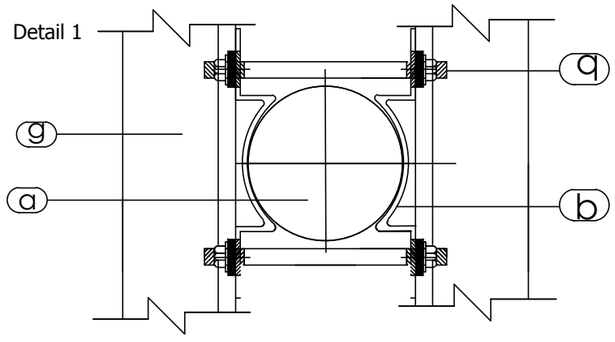




ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	3
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	6
c	U-bolt, Washers and Nuts for cross arm	Low carbon mild steel grade 43A. M20*R105*L170	2
d	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3
e	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
f	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
g	H pole crossarm	Low carbon mild steel grade 43A L 250X200X15X9000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	3
h	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
i	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	6
j	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	6
k	Aluminium PG Clamps	100-100mm2, 50-50mm2	12
l	Aluminium lugs for earthing,	50mm2, 100mm2	3
m	Lugs for earth wire	25mm2, aluminium	5
n	33kV Surge arresters	Nominal discharge current 10kA, impulse withstand current 100kA, creepage 900mm. Class 2 preferred.	3
o	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
p	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	16
q	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
r	Stay Assembly		4-5
s	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5,8kN	10m
t	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (-) 200kV and 210kV	3



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TITLE:

MV THREE MEMBER SECTION STRUCTURE WITHOUT AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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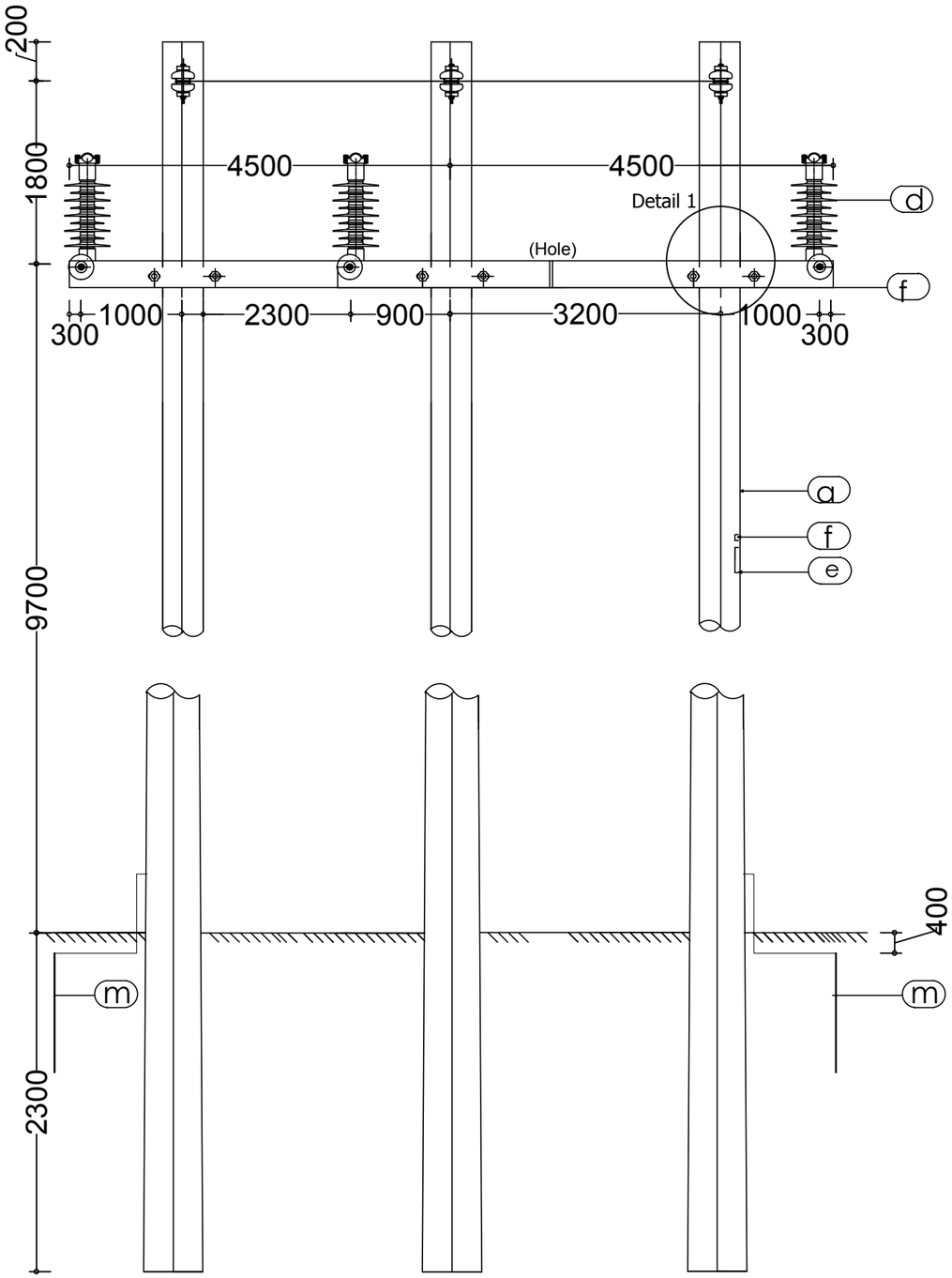
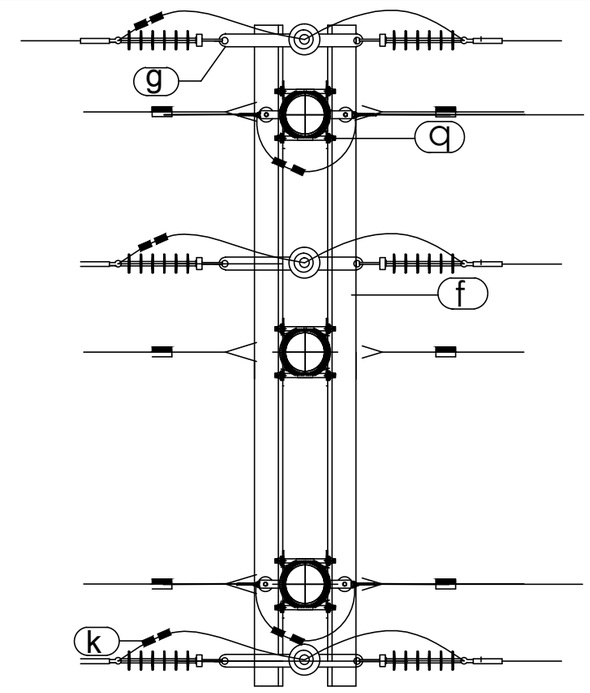
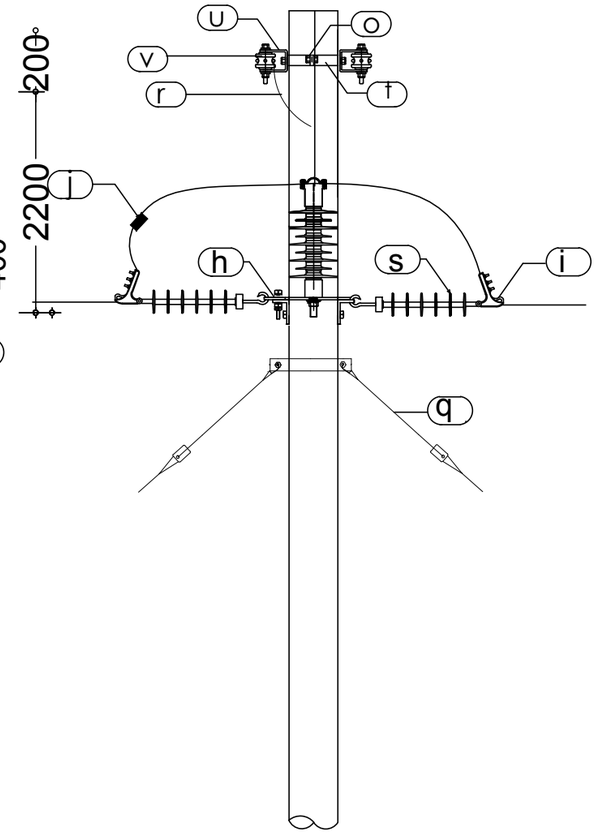
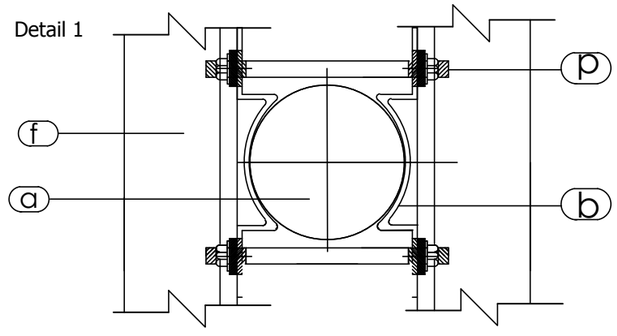






ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 14C2 (PME)	Ultimate tensile strength 6.03kN, Concrete grade 50	2
b	Tension Plate type 1.	Low carbon mild steel grade 43A L330X75X6XR103. Fixing Holes: 2, diameter 22mm	6
c	33kV Pin insulators	Mechanical failing load 10kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
d	Danger plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 210mm, W: 300mm	1
e	Structure number plate	Gauge 16 iron sheet, 85 micron primer, 4 holes, L: 200mm, W: 150mm	1
f	H pole crossarm	Low carbon mild steel grade 43A L 250X200X15X9000. Fixing Holes: 2, diameter 22mm. tensile strength 430kgf/sq.mm	2
g	Connecting Straps	Low carbon mild steel grade 43A. 541*75*6	3
h	Fitting Straps	Low carbon mild steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	6
i	Groove clamps	Tensile strength 70kN, 3 bolts, aluminium alloy	6
j	Aluminium PG Clamps	100−100mm2, 50−50mm2	12
k	Aluminium lugs for earthing,	50mm2, 100mm2	3
l	Lugs for earth wire	25mm2, aluminium	5
m	Copper clad steel Earth rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	2
n	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*50mm (Fully threaded)	18
o	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*70mm (Fully threaded)	4
p	Bolt, Washer and Nut	Low carbon mild steel grade 43A. M20*300mm	4
q	Stay Assembly		4−5
r	Earth Wire	Galvanised steel 3X2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5,8kN	10m
s	33kV composite polymeric Tension insulators	Mechanical failing load 70kN, creepage 900mm, dry & wet flashover voltage 120kV & 70kV. Impulsive withstand (+) and (−) 200kV and 210kV	3
t	Galvanised steel Clamp	Low carbon mild steel grade 43A. Thickness 6mm	4
u	D−Iron With Bolt	Low carbon mild steel grade 43A	3
v	Reel Insulator	Power frequency Voltage, dry 20kV, wet 8kV, failing load 9kN	3



RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
10TH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA
"The Peoples Electricity Link" TEL:

TITLE:

MV THREE MEMBER SECTION STRUCTURE WITH AERIAL EARTH - 14M POLE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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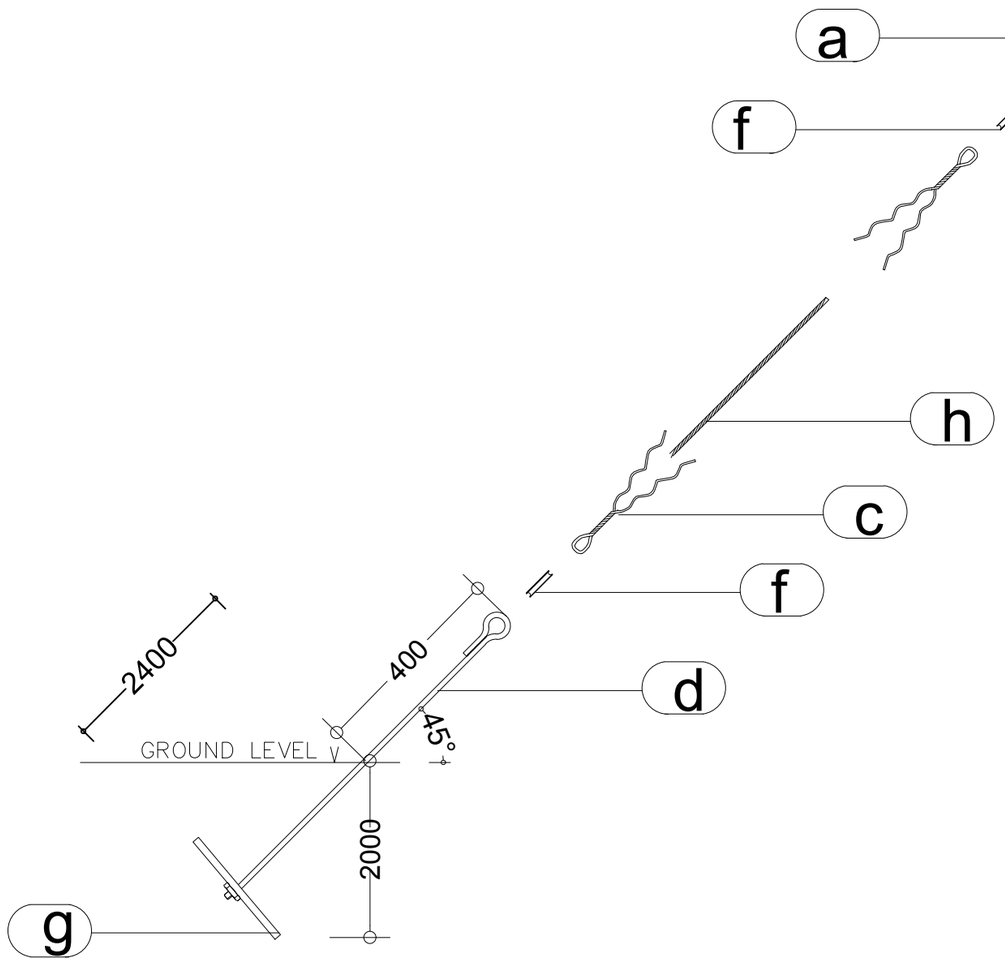
10.4 MV Stay Assemblies for Concrete Pole Structures

10.4.1 Conventional MV Stay Assembly (concrete)

Structure Type	Material	Specification	Standard	Qty
MV Conventional Stay Assembly	Low carbon steel grade 43A. Half clip type 1, 2 or 3	L360*75*6*R98, 2 Holes diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Low carbon steel grade 43A. Fitting strap	L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Low carbon steel grade 43A. Stay thimble	Groove Radius 7.5mm, Thickness 20mm and length 78mm	BS 464, BS 4360, BS 729, ASTM A123	2
	33kV Stay insulator	Creepage 76mm, dry flashover voltage 40kV, wet 23kV, mechanical failing load 89kN	ANSI 54-4, ANSI C29.4, IEC 62223	1
	Low carbon steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Preformed guy wire	Ultimate tensile strength 101kN.	IEC 888, BS 183 and BS 443, BS 729	4
	Low carbon steel grade 43A. Stay rod	2440 x 19 mm, threaded part 305mm	BS 1320, BS 4360, ASTM A36, BS 729, ASTM A123	1
	Concrete stay stab	660*480*60mm, failing load 65kN, concrete grade 40	IS 5820, BS 2484, BS 4483, KS 02-95	1
	Stay washer for concrete stab	Hot dip galvanized steel grade 43 A: 180x 144x 5mm	ASTM A36, ASTM A123	1
	Stay wire	Ultimate tensile strength 101kN	IEC 888, BS 183 and BS 443, BS 729	15m

ITEM	MATERIAL	SPECIFICATION	QTY
a	Half clip type 1	Low carbon steel grade 43A. L360*75*6*R98 2 Holes diameter 22mm	1
b	Fitting strap	Low carbon steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	1
c	Preformed guy wire	Ultimate tensile strength 44kN.	4
d	Stay rod	Low carbon steel grade 43A. 1800 x 16 mm, threaded part 305mm, min ultimate strength 44kN	1
e	Bolt, washer and nut	Low carbon steel grade 43A. M20*50mm	2
f	Stay thimble connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	2
g	Concrete stay stab	500*380*50mm, failing load 45Kn. Concrete grade 40.	1
h	Stay wire	Ultimate tensile strength 44kN, thickness of galvanisation 0.24kg/m	10M



NOTES:

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TEL:

TITLE:

MV STAY ASSEMBLY

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: K.R	DATE:	
	SCALE:		
	DRW NO:		

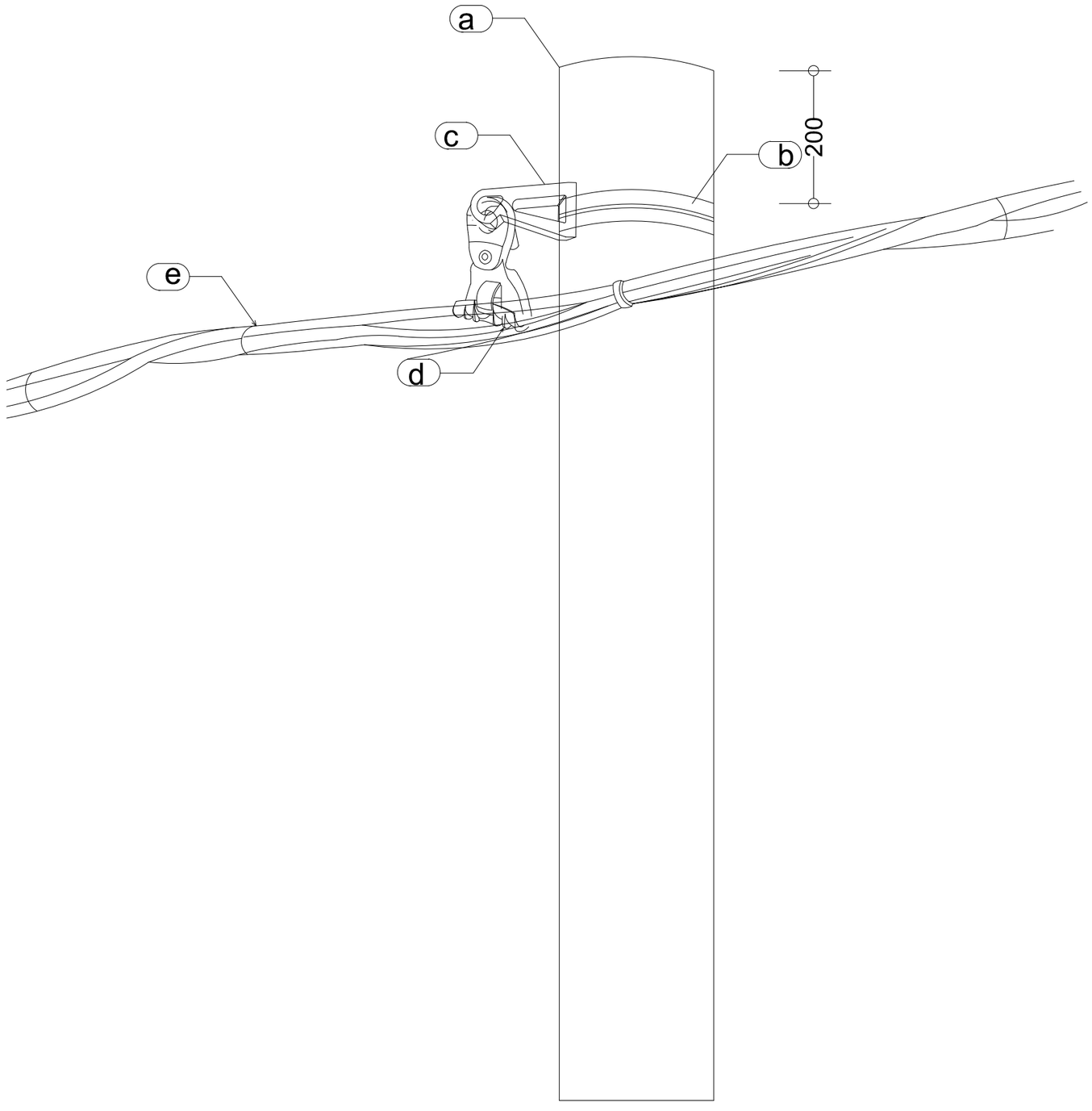
10.4. 2 MV Flying Stay Assembly (concrete)

Structure Type	Material	Specification	Standard	Qty
MV Flying Stay Assembly	Concrete pole 9C1	Min ultimate tensile strength 3.33kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	Low carbon steel grade 43A. Half clip type 1	L360*75*6*R98, 2 Holes diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	2
	Low carbon steel grade 43A. Fitting strap	L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Low carbon steel grade 43A. Stay thimble	Groove Raduis 7.5mm, Thickness 20mm and length 78mm	BS 464, BS 4360, BS 729, ASTM A123	2
	33kV Stay insulator	Creepage 76mm, dry flashover voltage 40kV, wet 23kV, min mechanical failing load 89kN	ANSI 54-4, ANSI C29.4, IEC 62223	1
	Low carbon steel grade 43A. Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	4
	Preformed guy wire	Ultimate tensile strength 101kN.	IEC 888, BS 183 and BS 443, BS 729	4
	Low carbon steel grade 43A. Stay rod	2440 x 19 mm, threaded part 305mm	BS 1320, BS 4360, ASTM A36, BS 729, ASTM A123	1
	Concrete stay stab	660*480*60mm, failing load 65kN, concrete grade 40	IS 5820, BS 2484, BS 4483, KS 02-95	1
	Stay washer for concrete stab	Hot dip galvanized steel grade 43 A: 180x 144x 5mm	ASTM A36, ASTM A123	1
	Stay wire	Ultimate tensile strength 101kN	IEC 888, BS 183 and BS 443, BS 729	25m

10.5 LV Concrete Pole Structures

10.5.1 ABC Intermediate Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
Intermediate	Concrete pole 9C1	Min ultimate tensile strength 3.33kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.75mm min strength 15kN		1 set
	Aluminium Alloy Bracket	Min strength 12kN, preferred 15kN		1
	Suspension clamp	Min groove dia 54.6sqmm XPLE Aluminium Alloy Min. Breaking load: 12kN	NFC 33040, BS EN 50483-2	1
	PVC Cable tie	380x8mm	NFC 33040, BS EN 50483-2	6



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C1	Min ultimate tensile strength 3.33kN. Concrete grade 50	1
b	Galvanized steel clamp LV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	2
c	Aluminium Alloy Bracket	Min strength 12kN	1
d	Suspension clamp	Min groove dia 54.6sqmm. Breaking load: 12kN	1
e	PVC Cable tie	380x8mm cable ties	6

NOTES:

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TITLE:

ABC LV INTERMEDIATE CONCRETE STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
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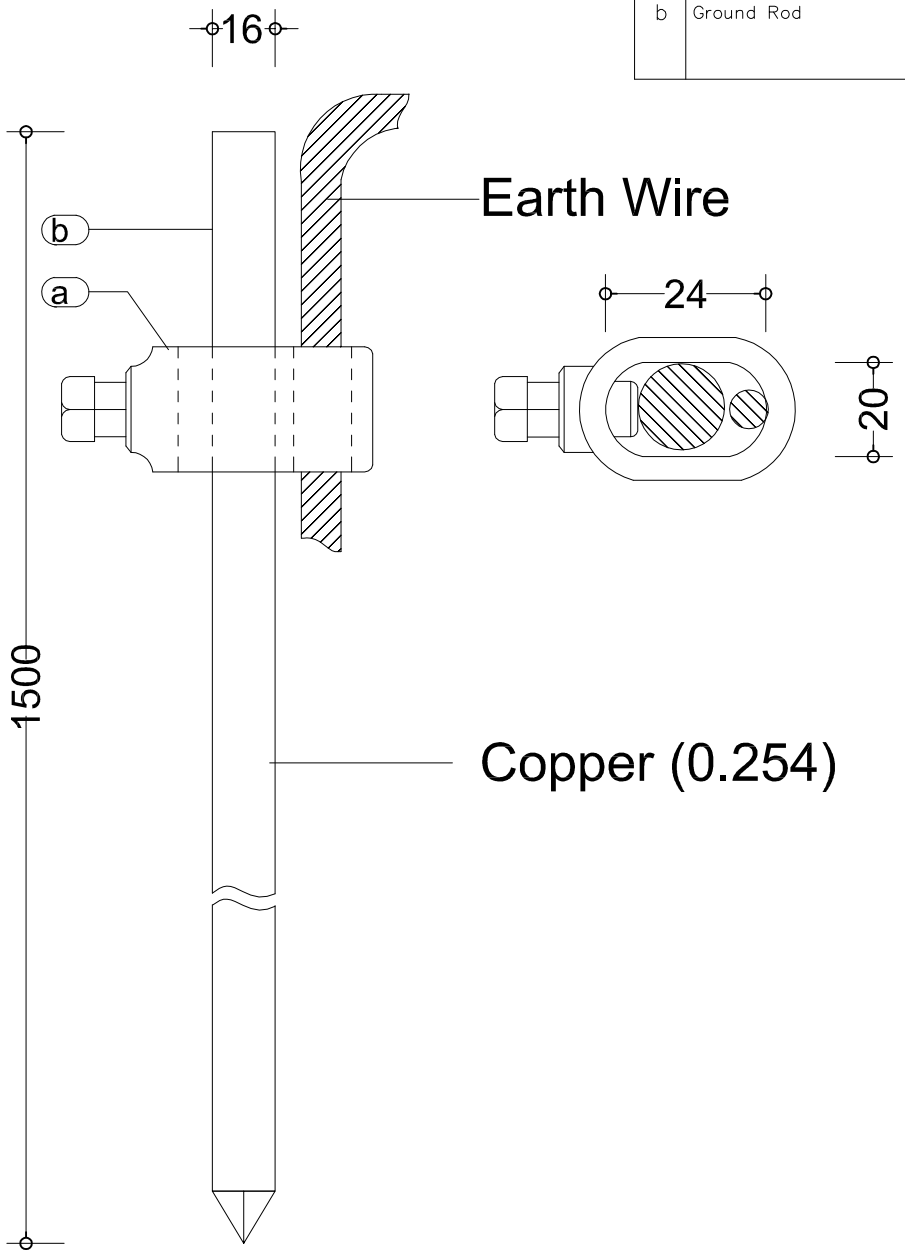
ITEM	MATERIAL	SPECIFICATION	QTY
a	Clamp to connect Earth Wire to Rod	Brassing	1
b	Ground Rod	99.9% pure electrolytic copper min coating thickness 0,254mm. Diameter 16mm length 1500mm Low carbon steel grade 43A. Min tensile strength 600N/m2	1



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TEL:

TITLE:

EARTH ROAD CONNECTION

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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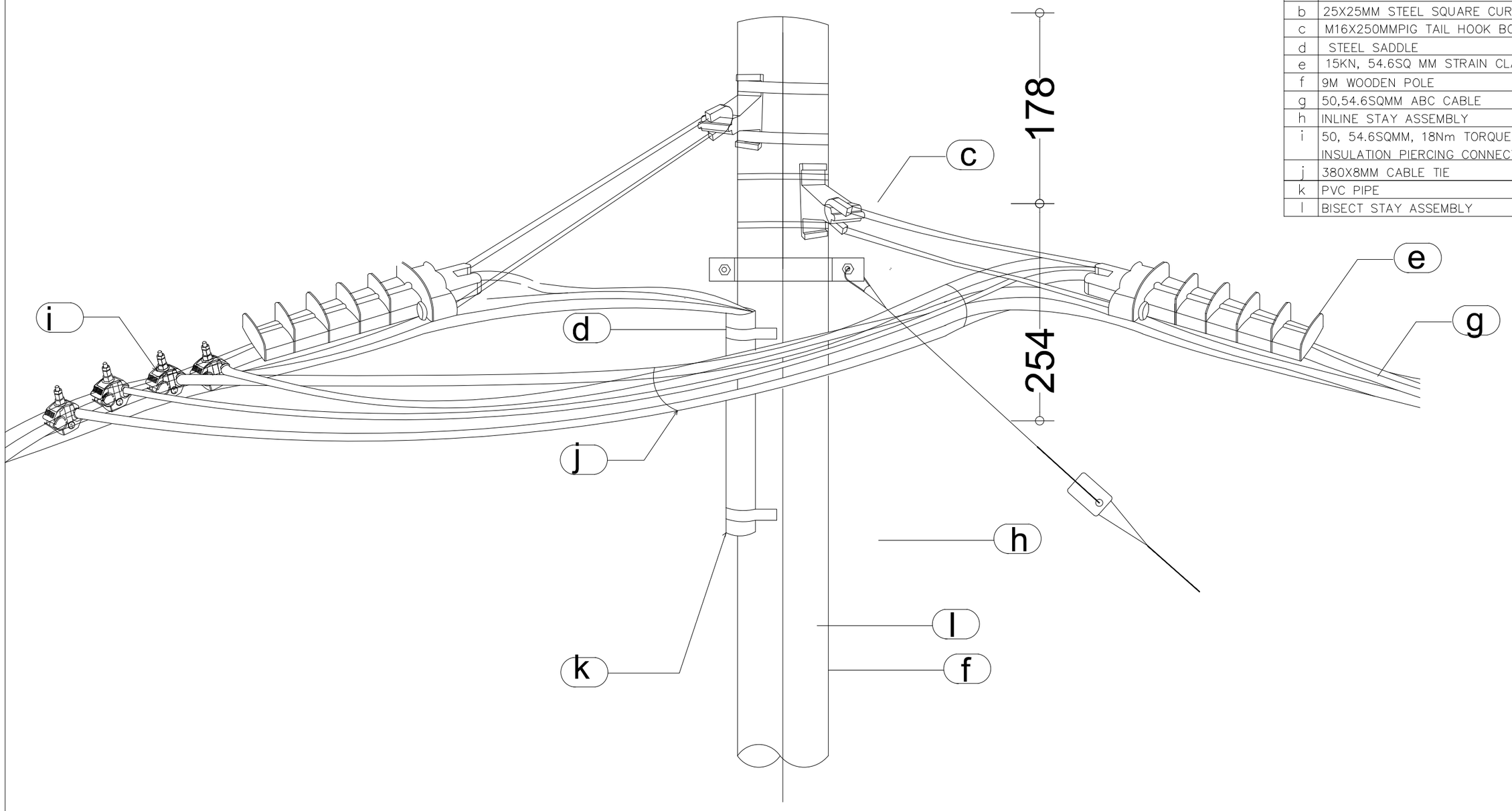
	DRW NO:		

10.5.2 ABC Strain Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
ABC Strain	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		2 sets
	Aluminium Alloy Bracket	Min strength 12kN		2
	Anchor clamp	Capacity: 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 15kN	NFC 33041, BS EN 50483-2	2
	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	NFC 33020, BS EN 50483-2	1
	PVC Cable tie	380x8mm	BS EN 50483-2	8
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	6M
	Lugs for earth wire	Aluminium lugs 25mm^2		5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	2
	Stay			1, 2 or 3

ITEM	DESCRIPTION	QTY
a	200MM POLE CAP – STEEL GAUGE 24	1
b	25X25MM STEEL SQUARE CURVED WASHER	2
c	M16X250MMPIG TAIL HOOK BOLT AND NUT	2
d	STEEL SADDLE	1
e	15KN, 54.6SQ MM STRAIN CLAMP	2
f	9M WOODEN POLE	1
g	50,54.6SQMM ABC CABLE	
h	INLINE STAY ASSEMBLY	2
i	50, 54.6SQMM, 18Nm TORQUE INSULATION PIERCING CONNECTOR	4
j	380X8MM CABLE TIE	
k	PVC PIPE	
l	BISECT STAY ASSEMBLY	2



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TITLE:

ABC LV STRAIN STRUCTURE (60-90 DEGREES)

APPROVED BY:	PRODUCED BY:	DRAWN BY:	
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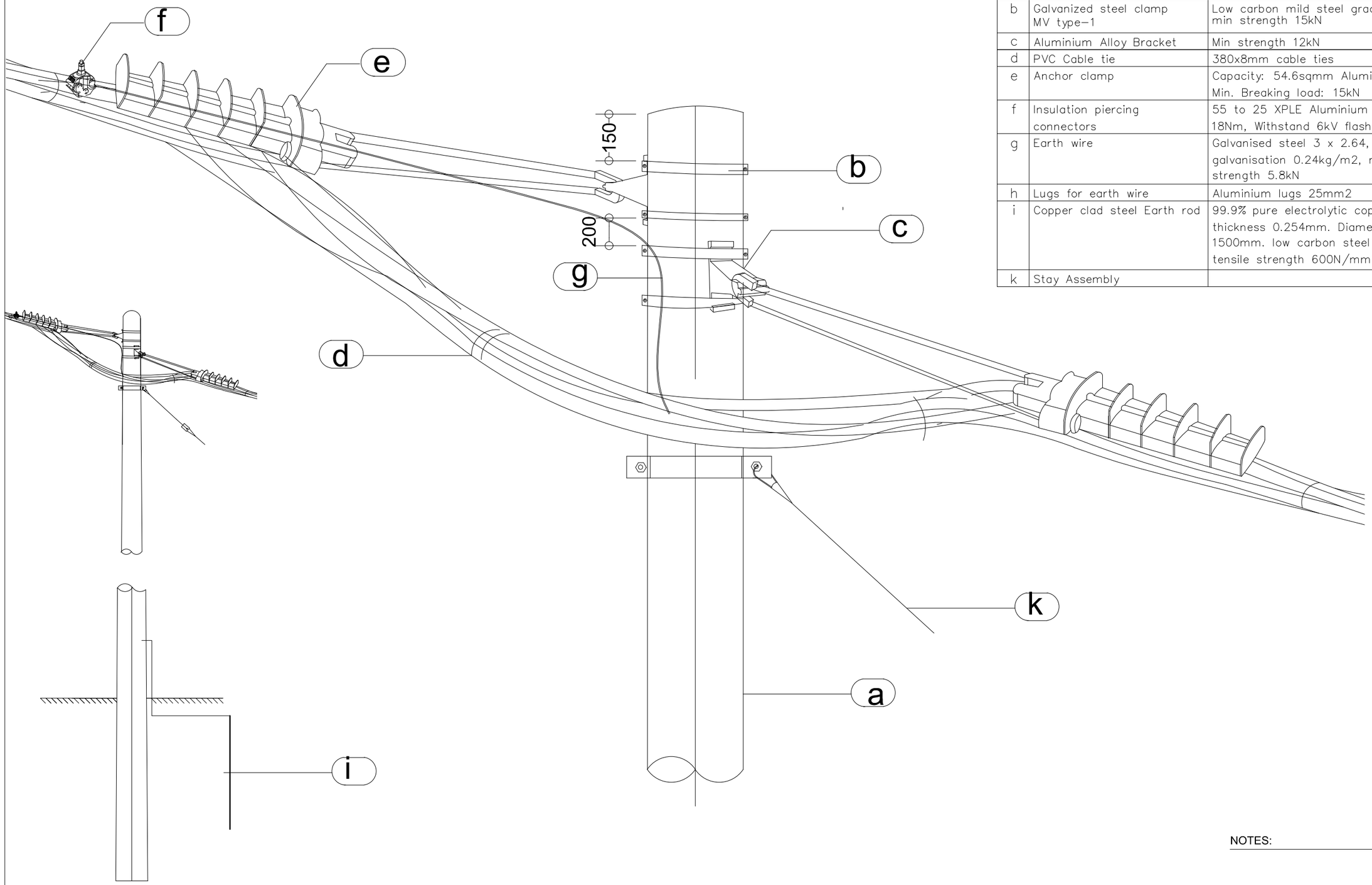

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN Concrete grade 50	1
b	Galvanized steel clamp MV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	4
c	Aluminium Alloy Bracket	Min strength 12kN	2
d	PVC Cable tie	380x8mm cable ties	8
e	Anchor clamp	Capacity: 54.6sqmm Aluminium Alloy. Min. Breaking load: 15kN	2
f	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	1
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	5
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	1
k	Stay Assembly		1–3

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TITLE:

ABC LV STRAIN STRUCTURE (30-60 DEGREES)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
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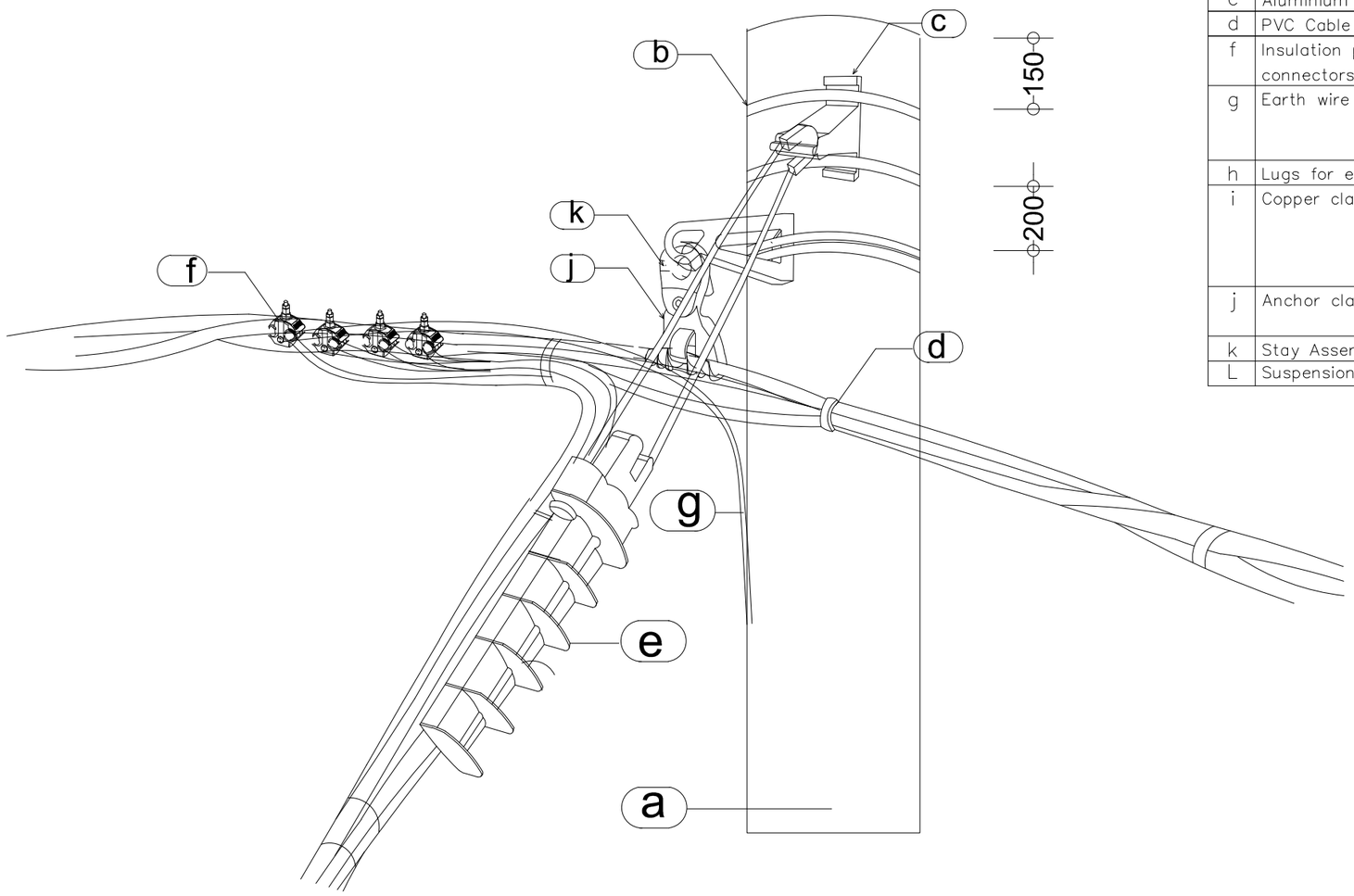
	DRW NO:		

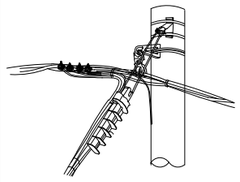
10.5.3 ABC T-off from Intermediate Concrete Pole Structure

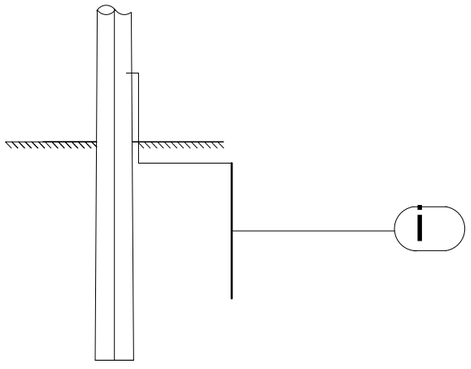
Structure Type	Material	Specification	Standard	Qty
T-off from Intermediate	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.75mm min strength 15kN		2 sets
	Aluminium Alloy Bracket	Min strength 12kN		2
	Suspension clamp	Dia 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 12kN	NFC 33040, BS EN 50483-2	1
	Anchor clamp	Capacity: 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 15kN	NFC 33041, BS EN 50483-2	1
	PVC Cable tie	380x8mm		8
	Insulation piercing connectors	Three 50sqmm, one 54.6sqmm XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	4
	End caps	Rubber end caps 50 – 70mm^2, 0.6/1kV, UV resistant material	NFC 33020	4
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	6M
	Lugs for earth wire	Aluminium lug 25mm^2		5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length	Copper clad rods *BS 2874,* Steel BS 4360	2

		1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2		
	PVC pipe	Internal diameter 60mm, 0.5m length		2
	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m		3
	Stay			1

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN Concrete grade 50	1
b	Galvanized steel clamp MV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	4
c	Aluminium Alloy Bracket	Min strength 15kN	2
d	PVC Cable tie	380x8mm cable ties	8
f	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	4
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	2
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	1
j	Anchor clamp	Dia 54.6sqmm Aluminium Alloy. Min. Breaking load: 12kN	1
k	Stay Assembly		1
L	Suspension Clamp	Min groove dia 54.6sqmm. Breaking load: 12kN	1







NOTES:

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TEL:
"The Peoples Electricity Link"

TITLE:

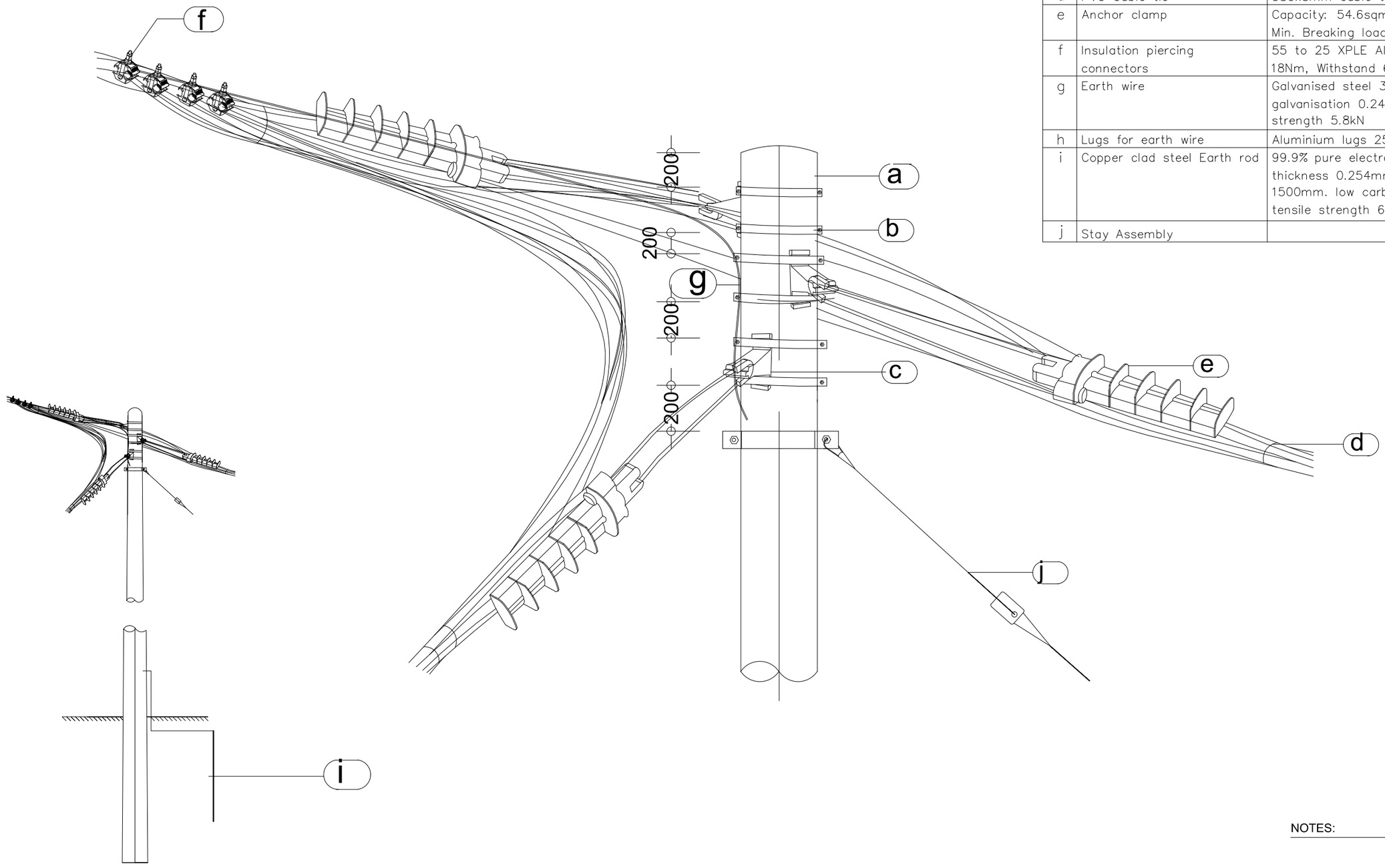
ABC TEE FROM SUSPENSION

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.5.4 ABC T-off from Strain Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
T-off from Strain	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		3 sets
	Aluminium Alloy Bracket	Min strength 12kN		3
	Anchor clamp	Capacity: 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 15kN	NFC 33041, BS EN 50483-2	3
	PVC Cable tie	380x8mm		12
	Insulation piercing connectors	Three 50sqmm, one 54.6sqmm XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	4
	Insulation piercing connectors	55, 25 XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	1
	End caps	Rubber end caps 50 – 70mm^2, 0.6/1kV, UV resistant material	NFC 33020	4
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	6M
	Lugs for earth wire	Aluminium lug 25mm^2		5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile	Copper clad rods *BS 2874,* Steel BS 4360	2

		strength 600N/mm^2		
	PVC pipe	Internal diameter 60mm, 0.5m length		2
	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m		3
	Stay assembly			3



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN Concrete grade 50	1
b	Galvanized steel clamp MV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	6
c	Aluminium Alloy Bracket	Min strength 12kN	2
d	PVC Cable tie	380x8mm cable ties	8
e	Anchor clamp	Capacity: 54.6sqmm Aluminium Alloy. Min. Breaking load: 15kN	3
f	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	9
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	2
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	1
j	Stay Assembly		1

NOTES:

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10TH FLOOR, WORKERS HOUSE
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TEL:

TITLE:

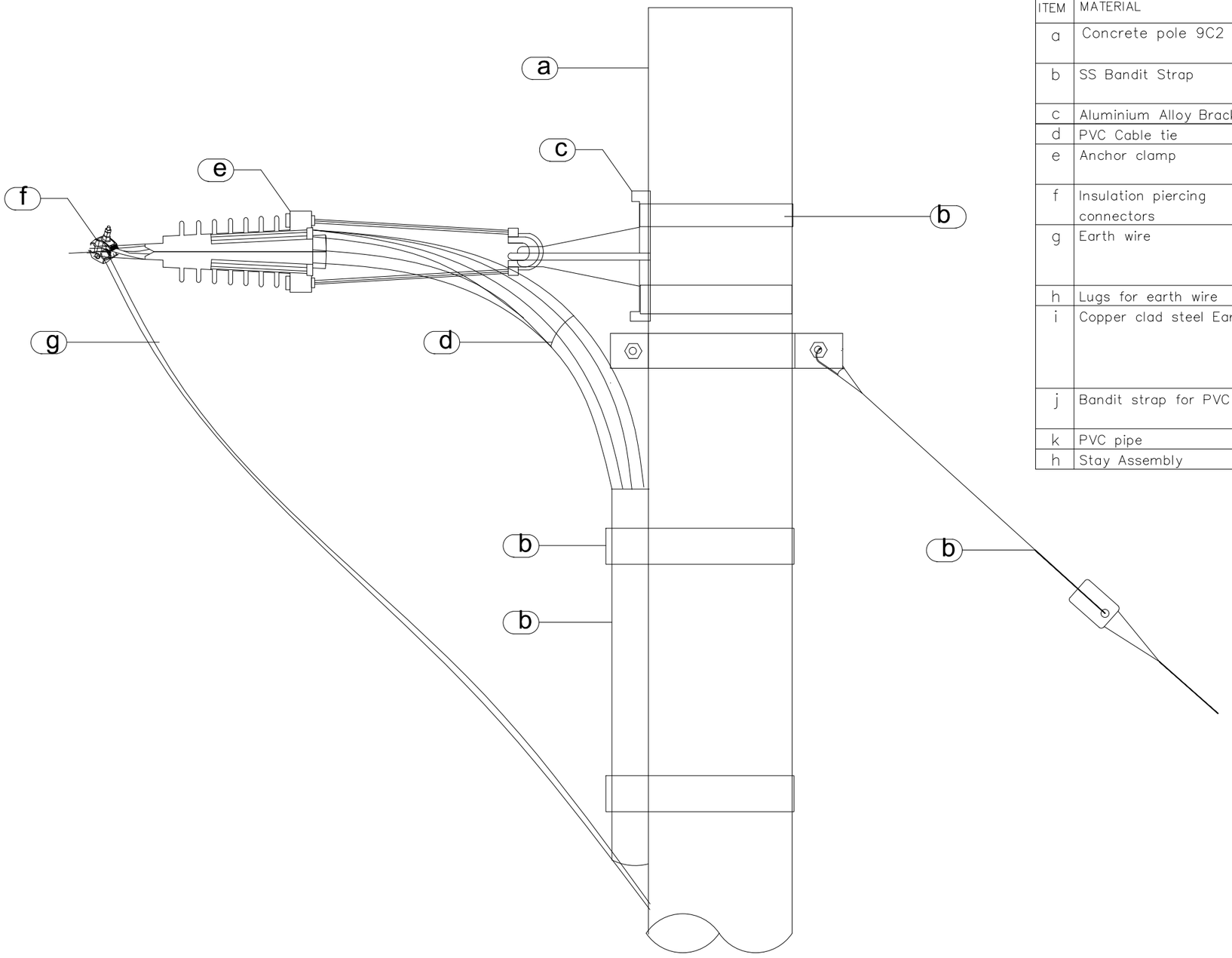
ABC LV TEE FROM STRAIN STRUCTURE (30-60 DEGREES)

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.5.5 ABC Terminal Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
Terminal	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		1 set
	Aluminium Alloy Bracket	Min strength 12kN		1
	Anchor clamp	Capacity: 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 15kN	NFC 33041, BS EN 50483-2	1
	PVC Cable tie	380x8mm cable ties		4
	Insulation piercing connectors	55, 25 XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	1
	End caps	Rubber end caps 50 – 70mm^2, 0.6/1kV, UV resistant material	NFC 33020	4
	Earth wire	Low carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443, BS 729	6M
	Lugs for earth wire			5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	2
	PVC pipe	Internal dia, 60mm, 0.5m length		2

	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m		3
	Stay assembly			1



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	1
b	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN	2 Set
c	Aluminium Alloy Bracket	Min strength 12kN	2
d	PVC Cable tie	380x8mm cable ties	8
e	Anchor clamp	Capacity: 54.6sqmm Aluminium Alloy. Min. Breaking load: 15kN	2
f	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	4
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	5
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	2
j	Bandit strap for PVC pipe	Stainless steel 0.7mm thick, width 20mm, length 1m	1
k	PVC pipe	Internal dia, 60mm, 0.5m length	1
h	Stay Assembly		1

NOTES:

RURAL ELECTRIFICATION AGENCY
PLOT 1, PLILKINGTON ROAD
1OTH FLOOR, WORKERS HOUSE
P.O.BOX 7317
KAMPALA
UGANDA

TEL:

TITLE:

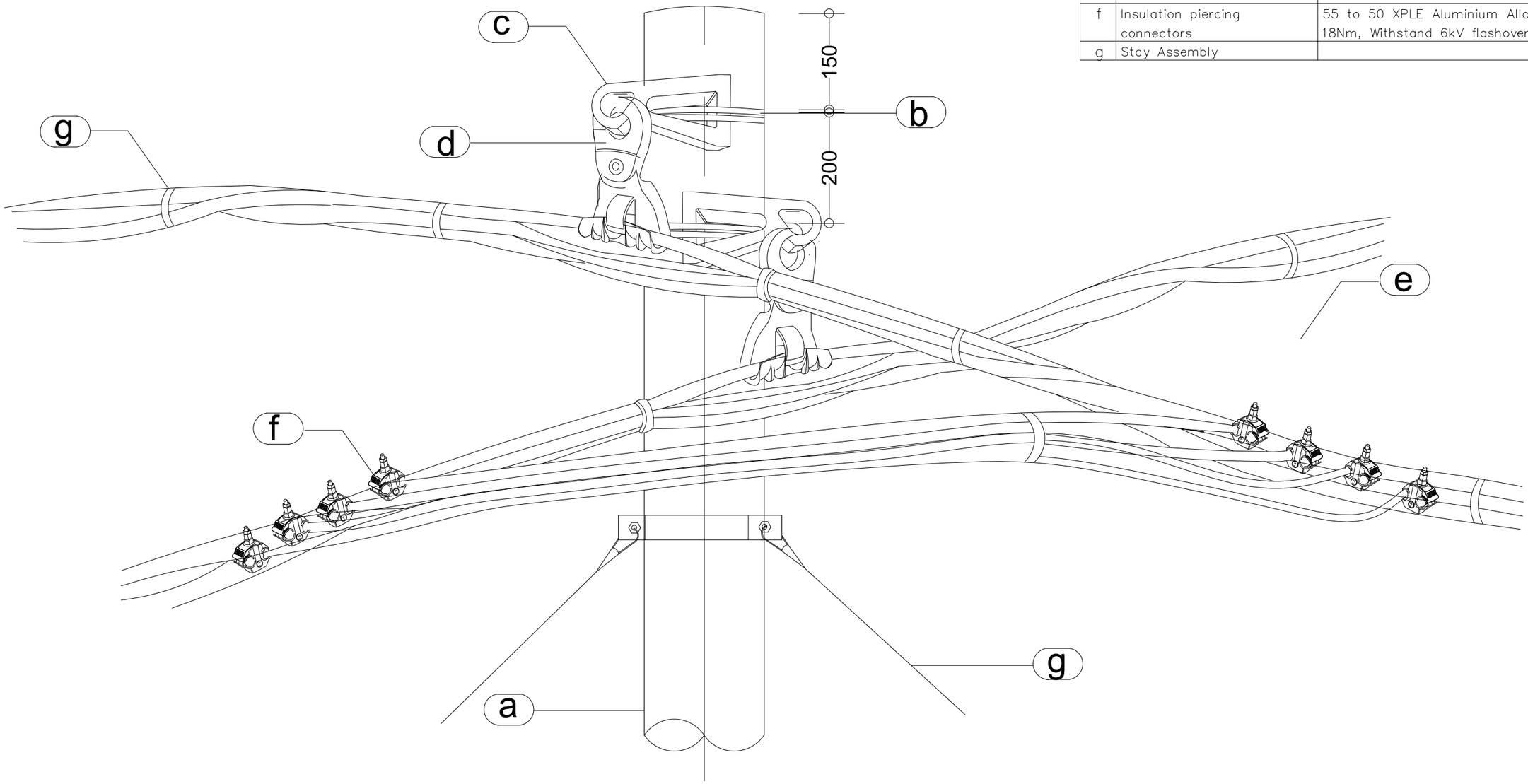
ABC LV TERMINAL STRUCTURE

APPROVED BY:	PRODUCED BY:	DRAWN BY:	
	CHECKED BY:	DATE:	
	SCALE:		
	DRW NO:		

10.5.6 ABC X-Intermediate Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
ABC X – Intermediate	Concrete pole 9C2	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		2 set
	Aluminium Alloy Bracket	Min strength 12kN		2
	Suspension clamp	Min groove dia 54.6sqmm XPLE Aluminium Alloy Min. Breaking load: 12kN	NFC 33040, BS EN 50483-2	2
	PVC Cable tie	380x8mm cable ties		12
	Insulation piercing connectors	55, 55 XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	8
	End caps	Rubber end caps 50 – 70mm^2, 0.6/1kV, UV resistant material	NFC 33020	8

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C1	Min ultimate tensile strength 3.33kN. Concrete grade 50	1
b	Galvanized steel clamp LV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	4
c	Aluminium Alloy Bracket	Min strength 12kN	1
d	Suspension clamp	Min groove dia 54.6sqmm. Breaking load: 12kN	2
e	PVC Cable tie	380x8mm cable ties	6
f	Insulation piercing connectors	55 to 50 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	8
g	Stay Assembly		2



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KAMPALA
UGANDA

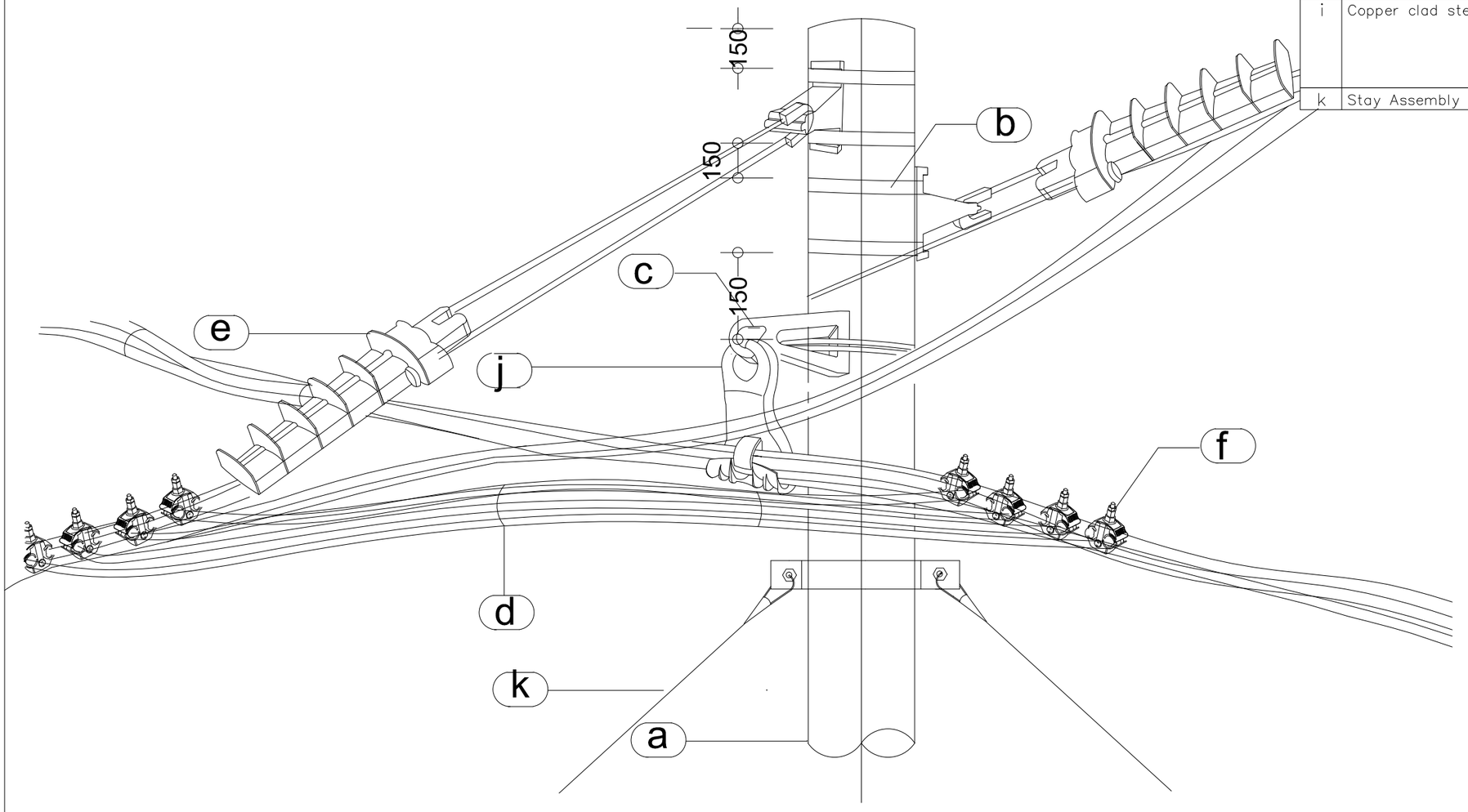
TEL:

TITLE:

ABC LV CROSS INTERMEDIATE - INTERMEDIATE STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN Concrete grade 50	1
b	Galvanized steel clamp MV type–1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	6
c	Aluminium Alloy Bracket	Min strength 12kN	3
d	PVC Cable tie	380x8mm cable ties	9
e	Anchor clamp	Capacity: 54.6sqmm Aluminium Alloy. Min. Breaking load: 15kN	4
f	Insulation piercing connectors	55 to 55 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	9
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	2
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	1
k	Stay Assembly		1



NOTES:

RURAL ELECTRIFICATION AGENCY
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KAMPALA
UGANDA

TEL:

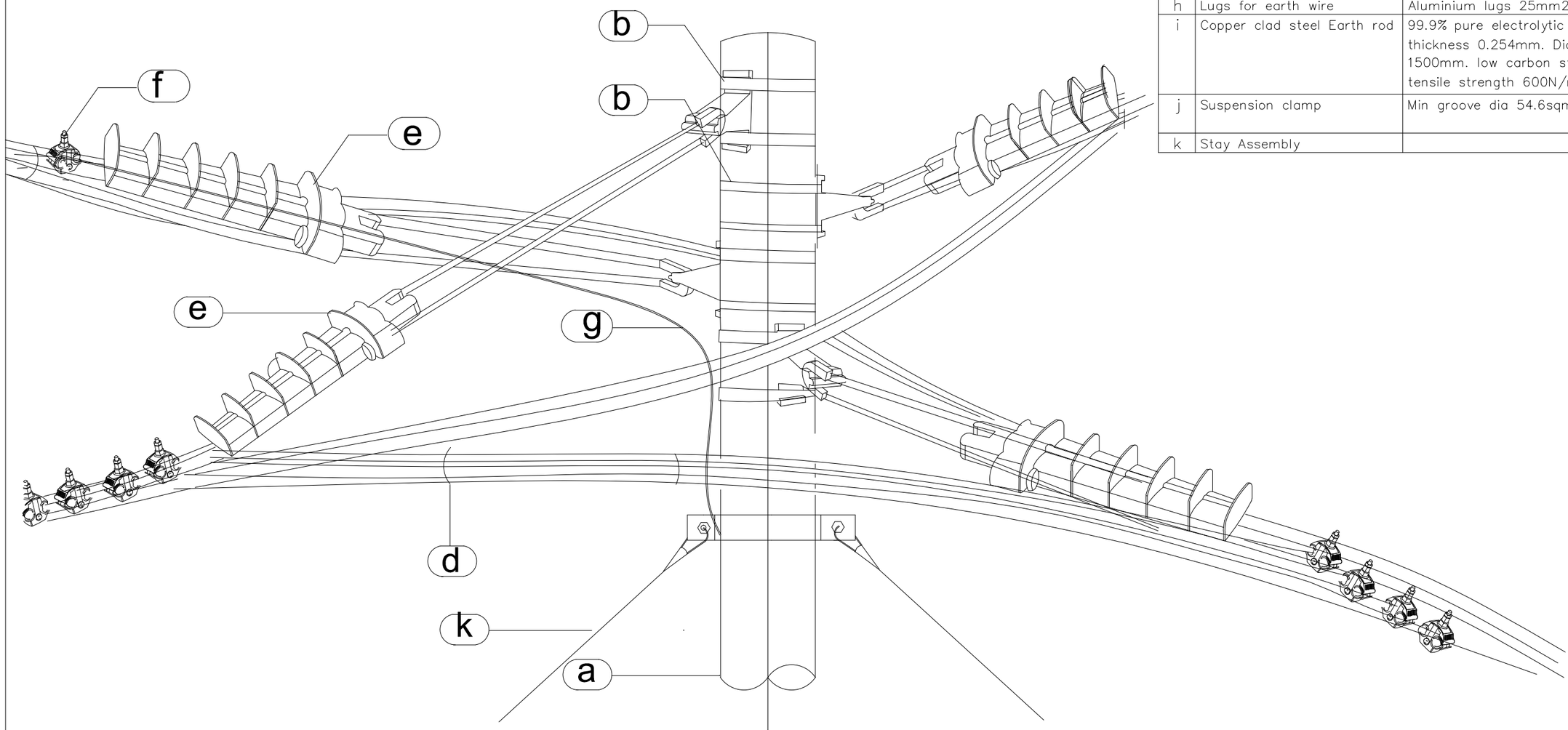
TITLE:

ABC LV CROSS INTERMEDIATE - STRAIN STRUCTURE

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.5.7 ABC X-Strain Concrete Pole Structure

Structure Type	Material	Specification	Standard	Qty
ABC X – from strain	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	BS 8110, IS 1678, AS 4065, BS 5328 Part 4, IS 7321	1
	SS Bandit Strap	Stainless steel, width 20mm, thickness 0.7mm min strength 15kN		4 sets
	Aluminium Alloy Bracket	Min strength 12kN		4
	Anchor clamp	Capacity: 54.6sqmm XPLE Aluminium Alloy. Min. Breaking load: 15kN	NFC 33041, BS EN 50483-2	4
	Insulation piercing connectors	55 to 55 XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	4
	Insulation piercing connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm	NFC 33020, BS EN 50483-2	1
	PVC Cable tie	380x8mm		16
	Earth wire	Low Carbon mild steel 3 x 2.64, thickness of galvanisation 0.24kg/m^2, min ultimate tensile strength 5.8kN	IEC 888, BS 183 and BS 443	6M
	Lugs for earth wire	Inner diameter 25mm^2, aluminium		5
	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm^2	Copper clad rods *BS 2874,* Steel BS 4360	2
	Stay			1, 2 or 3



ITEM	MATERIAL	SPECIFICATION	QTY
a	Concrete pole 9C2 (PME)	Min ultimate tensile strength 4.83kN or 5.03kN. Concrete grade 50	1
b	Galvanized steel clamp MV type-1	Low carbon mild steel grade 43A, 40x6THK flat min strength 15kN	6 Set
c	Aluminium Alloy Bracket	Min strength 12kN	2
d	PVC Cable tie	380x8mm cable ties	8
e	Anchor clamp	Capacity: 54.6sqmm Aluminium Alloy. Min. Breaking load: 15kN	2
f	Insulation piercing connectors	55 to 55 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	4
g	Earth wire	Galvanised steel 3 x 2.64, thickness of galvanisation 0.24kg/m2, min ultimate tensile strength 5.8kN	6M
h	Lugs for earth wire	Aluminium lugs 25mm2	5
i	Copper clad steel Earth rod	99.9% pure electrolytic copper, min coating thickness 0.254mm. Diameter 16mm, length 1500mm. low carbon steel grade 43A. Min tensile strength 600N/mm2	2
j	Suspension clamp	Min groove dia 54.6sqmm. Breaking load: 12kN	1
k	Stay Assembly		1

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KAMPALA
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TEL:

TITLE:

ABC LV CROSS - STRAIN STRUCTURE

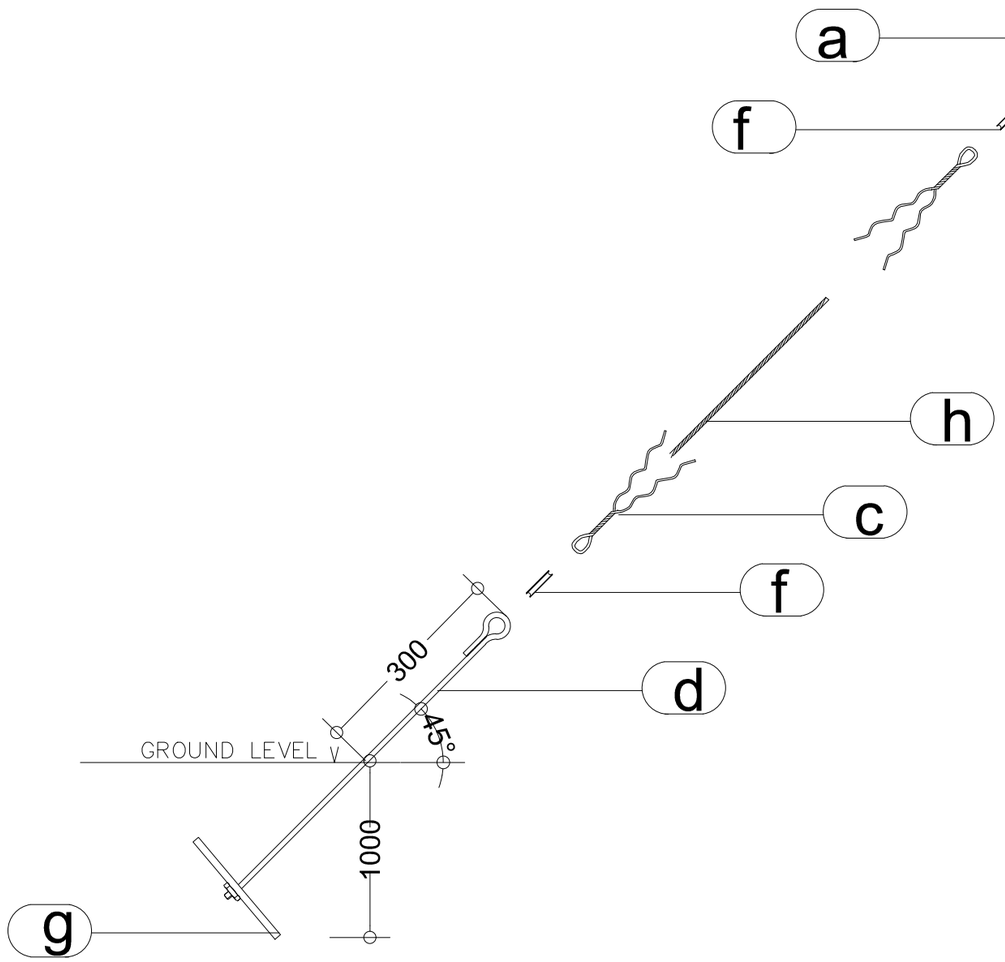
APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.7 LV Stay Assemblies for Concrete Pole Structures

10.7.1 LV Conventional Stay (Concrete)

Structure Type	Material	Specification	Standard	Qty
LV Conventional Stay Assembly	LV Half clip type 1	Galvanised low carbon mild steel, grade 43A L360*75*6*R98, 2 Holes diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Fitting strap	Galvanised low carbon mild steel, grade 43A L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	1
	Stay thimble	Groove Radius 7.5mm, Thickness 20mm and length 78mm	BS 464, BS 4360, BS 729, ASTM A123	2
	Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	2
	Preformed guy wire	Ultimate tensile strength 44kN.	IEC 888, BS 183 and BS 443, BS 729	4
	Stay rod	1800 x 16 mm, threaded part 305mm, min ultimate strength 44kN	BS 1320, BS 4360, ASTM A36, BS 729, ASTM A123	1
	Concrete stay stab	500*380*50mm, failing load 45kN. Concrete grade 40.	IS 5820, BS 2484, BS 4483, KS 02-95	1
	Stay washer for concrete stab	Hot dip galvanized steel grade 43 A: 180x 144x 5mm	ASTM A36, ASTM A123	1
	Stay wire	Ultimate tensile strength 44kN, thickness of galvanisation 0.24kg/m	IEC 888, BS 183 and BS 443, BS 729, BS 4545	10 m

ITEM	MATERIAL	SPECIFICATION	QTY
a	Half clip type 1	Low carbon steel grade 43A. L360*75*6*R98 2 Holes diameter 22mm	1
b	Fitting strap	Low carbon steel grade 43A. L173*75*10, 2 Holes 22mm and 38mm	1
c	Preformed guy wire	Ultimate tensile strength 44kN.	4
d	Stay rod	Low carbon steel grade 43A. 1800 x 16 mm, threaded part 305mm, min ultimate strength 44kN	1
e	Bolt, washer and nut	Low carbon steel grade 43A. M20*50mm	2
f	Stay thimble connectors	55 to 25 XPLE Aluminium Alloy. breaking Torque: 18Nm, Withstand 6kV flashover in water	2
g	Concrete stay stab	500*380*50mm, failing load 45Kn. Concrete grade 40.	1
h	Stay wire	Ultimate tensile strength 44kN, thickness of galvanisation 0.24kg/m	10M



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PLOT 1, PLILKINGTON ROAD
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UGANDA

TEL:

TITLE:

LV STAY ASSEMBLY

APPROVED BY: MPDM	PRODUCED BY:	DRAWN BY: K.K	
	CHECKED BY: O.J	DATE:	
	SCALE:		
	DRW NO:		

10.7.2 LV Flying Stay (Concrete)

Structure Type	Material	Specification	Standard	Qty
LV Flying Stay Assembly	Half clip type 1	Galvanised low carbon mild steel, grade 43A L360*75*6*R98, 2 Holes diameter 22mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	2 sets
	Fitting strap	Galvanised low carbon mild steel, grade 43A L173*75*10, 2 Holes 22mm and 38mm	BS 4360, BS EN 1501461, BS 729, ASTM A36, ASTM A123	3
	Stay thimble	Groove Radius 7.5mm, Thickness 20mm and length 78mm	BS 464, galvanisation BS EN 150146, BS 729	2
	Bolt, washer and nut	M20*50mm	BS 916, BS 4360, BS 3288 Part 2, BS 729, ASTM A123	4
	Preformed guy wire	Ultimate tensile strength 44kN.	IEC 888, BS 183 and BS 443, BS 729	6
	Stay rod	1800 x 16 mm, threaded part 305mm	BS 1320, BS 4360, ASTM A36, BS 729, ASTM A123	1
	Concrete stay stab	500*380*50mm, failing load 45kN, Concrete grade 40	IS 5820, BS 2484, BS 4483, KS 02-95	1
	Stay washer for concrete stab	Hot dip galvanized steel grade 43 A: 180x 144x 5mm	ASTM A36, ASTM A123	1
	Stay wire	Ultimate tensile strength 44kN, thickness of galvanisation 0.24kg/m	IEC 888, BS 183 and BS 443, BS 729, BS4545	15m

11.0 DOCUMENTATION

11.1 General

The sizes of all documents and drawings shall conform to the ISO standard, and be of size A1, A2, A3 or A4. Larger sizes than A1 shall be avoided. All documents in size A3 and A4 shall be bound in hard covers. Maps, schematic diagrams, and apparatus lists shall have a size of A3 or A4. Scales to be used on the drawings shall be 1:10, 1:20, 1:40, 1:50 and multiples of this series. All text in the documentation shall be in English language.

All measurements shall be given in mm.

The Contractor shall during the total project time maintain a List of Documentation to be updated by him whenever needed. The List of Documentation shall include the date of original issue of each document submitted as well as the dates of every revision. The List of Documentation shall also include a time schedule for the submittal of the documentation.

11.2 Documentation for Design and Manufacture

During the design period full documentation on all equipment shall be supplied to the Engineer for review and approval. All drawings prepared by the Contractor shall be submitted in three sets to the Engineer for review and approval. All documentation shall have such information or instructions related to the drawings and the design as may be necessary

Drawings marked **RETURNED FOR CORRECTION** shall be corrected by the Contractor and sent to the Engineer for further review. When a drawing is marked **REVIEWED** or **REVIEWED AS AMENDED**, the Contractor will be allowed to use the drawing for manufacture and erection. The Contractor shall, however, make corrections according to the remarks given by the Engineer. Manufacturing starting prior to receipt of "Reviewed" drawing is done at the Contractor's own responsibility.

The Engineer’s approval does not in any way relive the Contractor of his full responsibility for the correctness of his documentation and the proper functioning, quality and compliance with the Specifications of all plant and equipment supplied by him.

11.3 As-Built Documentation

11.3.1 General

Immediately before commissioning and the Taking-Over Certificate has been issued, the Contractor shall update all final documents in accordance with the modifications made. When a document contains all modifications, it shall be marked **AS-BUILT**. AS-BUILT documentation in hard copy form shall be submitted to the Employer in five sets and to the Engineer in one set, latest two months after Taking-Over Certificate has been issued. The documentation shall also be submitted in digital form in the same amount of sets. All text shall be in Acrobat Reader format and all drawings in AutoCAD 2010 (.dwg) and GIS (georeferenced ARC 1960 UTM) format. For drawings, A3 size and larger, one of the sets issued to the Employer shall be of reproducible transparent material (PVC). The supply of AS-BUILT documents shall comprise but

not be limited to all drawings for construction and installation, maps, calculations, instructions for operation, maintenance, repair and adjustment, apparatus lists, spare parts lists containing information needed for ordering for all equipment supplied under the Contract.

11.3.1.2 General Manuals

The following general manuals, covering the whole project, shall be delivered.

- A general description of the equipment in this contract.
- The manuals shall include spare part lists and description of any special tools needed for service of the equipment.
- All other drawings or manuals which are not mentioned, but are deemed necessary for a safe and proper handling of the delivered equipment.

11.3.3 Network Design Documentation

The following documents shall be delivered.

- All layouts, construction and installation drawings
- All calculations regarding civil, electrical and mechanical design.
- Apparatus lists including all apparatus installed, subdivided into MV and transformer areas, for MV and LV network, respectively. Lists shall include technical data, order number and reference to schematic diagrams.
- For MV, geographical maps showing the location of the lines, switches and distribution substations.
- For LV network, geographical maps showing the location of the lines, poles, service connections and luminaries
- Single-line diagrams covering the MV network. The diagrams shall contain apparatus designations, cross-sectional areas and type of conductors.
- Single-line diagrams covering the LV network fed from each substation. The diagrams shall contain apparatus designations, cross-sectional areas and type of conductors.

11.3.4 Material Documentation

Documents for approval shall be delivered before the work is started but shall also be included in the as-built documentation as follows.

- Data specifications.
- Routine test certificates.
- Data lists with by the Engineer required amendments incorporated. The contents of the lists shall correspond to the schedules of this document. Data lists will be regarded as binding for the manufacturer.

- Dimension drawings. They shall be regarded as binding for the manufacturer and shall contain measures, weights and features of the apparatus.
- Detail drawings as required by the Engineer.
- List of components and details on the apparatus. They may preferably be included in the dimension sketch.

In case of alterations, agreed upon by all parties, new documents shall be issued.

CHAPTER TWO: DISTRIBUTION LINE CONSTRUCTION

12.0 SURVEY

12.1 Line Route Survey

The Contractor shall carry out the line routing by instrument survey, based on the preliminary line route drawing(s) where provided. Owing to the large scale factor of these drawings, they are of rather general nature and need to be superseded by more detailed line route maps in an approved scale. They shall contain comprehensive information on the route area, noting **UTM co-ordinates (ARC 1960)** of angle points, and all relevant particulars on crossed/approximated trees, structures, over- and underground services, etc.

Due consideration shall be given for the following factors when selecting MV Line Route and support positions.

- Access for construction and future maintenance work
- Environmental and Aesthetic considerations
- Swampy ground and areas liable for flooding to be avoided
- Amount of tree cutting to be minimized
- Inconvenience caused to the other services to be minimized
- Construction of MV Lines in parallel with telephone lines/ railway lines to be avoided
- Crossing of probable building sites, Lands with valuable vegetation, Road Widening Reservations, Play grounds etc. to be avoided
- Support positions near canals, drainage lines, water pipes, side drains, culverts, marshy lands etc. to be avoided.
- Heavy Angles of deviations to be minimal
- Construction of tension points at uplifts to be avoided
- Cost of construction shall be kept to minimum
- Overall route length shall be kept to minimum

The following details and information within the 30 m band of 15m to each side of the center line shall be included on the line route strip plans in 1:2000 horizontal scales.

- The visual nature of the ground
- All buildings and high obstructions (with their height) shall be indicated

- Voltage, Height of Lower, Upper Conductor and Earth wire of all power lines shall be indicated
- Details of all Telecommunication lines shall be indicated
- Details of all roads, pathways, rivers, canals and drains (with their widths) shall be indicated, Roads names should be included
- Angle of deviation, sketch of the measurement to re-establish any missing peg, shall be indicated
- Affected valuable tress, plants etc. shall be indicated.

In addition to the above 1:50000 map marked with the final line route shall also be submitted. It will be necessary to obtain GPS Coordinates along the line route.

The contractor shall make arrangement to set out angle and terminal support positions based on the final line route approved by the project manager. The Contractor shall then establish preliminary line by instrument survey between angle points with an adequate number of intermediate line pegs with necessary adjustment to meet guidelines given above.

The contractor shall record the positions of angle and terminal pegs on sketches related to existing permanent features nearby or to additional pegs placed off line, in such a way that the angle and terminal pegs can be conveniently replaced in an event of loss.

The preliminary route shall then be offered for inspection by the project manager's representative. If the Engineer decides that it is necessary to change the route, the Contractor shall set out new angle points as directed by the engineer and shall establish new preliminary lines between them and shall re-submit for approval.

The preliminary route drawings and other diagrams shall be drawn in AutoCAD 2010 or higher versions. The format and the notation shall be subjected to the approval of the client. The preliminary route drawings, line route marked on the 1:50000 maps and other related drawings should be submitted with soft copies in a CD and in hard copies.

Hard copies of drawings submitted shall be on high quality, durable paper of thickness less than 80 GSM

Based on the final line route drawing approved after site visits, the contractor shall mark all angle positions at site with adequate tie measurements to relocate any missing pegs. All such tie measurements and detail sketches, separately in A4 size papers, shall be submitted with final line route drawings. GPS Co –ordinates of the all such angle positions shall also be indicated.

12.2 Line Profile Survey

The topographical line survey shall be carried out along the approved line route. The theodolites used and measuring techniques applied shall be state of the art, employing digital recording techniques. The survey shall be carried out to a minimum accuracy of 1 in 2.000 for distance and 1 minute for angular measurements.

Strip plans and longitudinal sections shall be prepared by the Contractor for each complete line at scales of **1:2000 horizontal and 1:200 vertical**. The distribution line will run in a straight line between the defined angle points.

The use of PLS CAD or other approved software is mandatory for the design, establishment of the profile drawings and pole spotting.

The following details and information are to be included on the profile drawings:

- All Buildings, or high obstructions within 30m band of 15m to each side of the centerline shall be shown dotted at their measured height with the distance left or right of line indicated and places where other existing line run parallel with proposed line within 100m shall be marked.
- At each angle position and intermediate Structure position a "tie-in" sketch shall be provided on the profile sheet. This sketch shall show clearly the location of the support, using as reference, points, which can be located on the ground. The direction of the line and angle of deviation are to be shown stating also whether the deviation is left or right.
- Where ground slope across the line route exceeds 1in 25 level of the ground left and right of the centerline shall be recorded at an offset distance of 10m. The offset levels shall be indicated on the profile as broken and/or chain dotted lines and the distance off-line stated. All within this 35m band shall be shown.
- The profile shall show all changes of level of 300 mm or more along the route centerline and along the offset lines. All features such as hedges, fences, ditches, roads, railways, rivers, canals, buildings, telegraph, power and pipe lines shall be shown. Route numbers of roads shall be stated or, in if unclassified, destination, similarly for railways.
- The cumulative distance is to be shown at each 300m.
- Ordinance datum stating the basic for all levels shall be shown at 10m vertical intervals at the beginning and end of each section and profile sheet. Levels shall be shown at each paper on line and at ever obstruction or geographical feature.
- The visual nature of the ground shall be noted, whether arable, pasture, etc., with special reference to paddy fields, marshy, soft ground or instability, avalanche paths and seismic disturbance, scrubs, cultivation with name eg. Pine , eucalyptus … or forest
- Where the ground contour rises steeply the ground line shall be terminated a minimum of 100mm for the top if the sheet and continued with and overlap of 300m of line route.
- The following details shall be shown for crossing of power line.
    - Voltage and type of construction.
    - Ground levels at point of crossing and support structures.
    - Height of the top conductor / earth wire at point of crossing and support structures.

- Distance of crossing point to support the structures along route of line to be crossed and the angle of crossing.
- Temperature and time when the levels taken.
- Support structures numbers of both upper and lower lines.

- Along the bottom of the profile sheet shall be drown, to the same scale as the horizontal scale of the profile, a route map showing all relevant details, within a distance of 30m each side of the route centerline.

The results of the survey shall be presented in the form of **a survey report** including the combined line route surveyed marked on the 1:50,000 scale maps.

The profile drawings and other diagrams shall be drawn in AutoCAD 2010 or higher versions. The format and the notation shall be subjected to the approval of the project manager. The Profile drawing, line route marked on the 1:50,000 maps and other related drawings shall be submitted with soft copies in a CD.

13.0 PEGGING

a) Pegging shall be as per the approved survey drawings and pole structure drawings. Care should be taken to ensure span lengths, structure positioning of the route map are adhered to

b) Pegs used shall be strong and coloured in a bright water proof paint.

c) The pegs shall be at least 2 feet tall with 1 foot buried securely in the ground

d) Demarcation of visible land marks e.g. trees and rocks shall be done to enable easy future identification of pegs. Demarcation may be in form of water proof painted arrows on the land marks.

e) All pegs or other marks shall be preserved until their removal is authorised by the Engineer.

14.0 ROUTE CLEARANCE

a) After Site mobilization, local team shall be engaged to clear the line route as per the pegged lines of all bushes or a tree along the way-leaves trace.

b) Route clearance shall be conducted on the approved line route and shall be done to achieve right of way during construction.

c) Any crop/plant/structure damages shall be coordinated with Engineer's representative nominated way leaves officer as per the employer's laid down Resettlement Action Plan (RAP) and in line with the approved environmental management plan

d) Before line clearance is conducted, ensure that adequate community sensitization has been conducted

e) Ensure that the property owners sign consent forms before clearance is conducted. Obtain way leaves consent forms from REA way leaves office and return filled forms to REA.

f) The bush clearance shall be done by use of Machetes or power saw for big trucked trees. All trees, snags, stumps, shrubbery, ant hills and undergrowth exceeding 2 meters in height as measured on the downhill site shall be cut to a maximum stump of 20 cm along the right-of-way.

g) All trees adjacent to the right-of-way which could fall across the conductors or against the towers shall be cut, this criterion shall apply with the conductors displaced 53° from the vertical in either direction.

h) Engage the services of the local leadership (e.g. LC) during the line clearance activity

i) The route clearance shall be done up to a radius of 5m on either side of the line. In cases where trees are located beyond the 5m only the braches shall be trimmed.

j) The heavy branches / bushes shall be carefully stacked outside the right-of-way for title land owners to collect as directed by respective officials, but kept from interfering with vehicle movements or being a hindrance to road traffic. The Contractor shall remove and dispose of any felled trees and waste material such as useless packaging material to the satisfaction of the Engineer.

k) Safety measures for all personnel working at height shall be religiously adhered to always to eliminate any accidents. These measures are not limited to donning safety gear such as wearing protective helmets, suitable gloves and overalls and goggles.

15.0 MATERIALS HANDLING & TRANSPORTATION (LOCAL)

15.1 Pole Handling and Transportation

a) All ready poles for REA projects shall be stacked separately with wooden spacers between poles.

b) Individual poles shall be clearly branded at the butt with a distinctive paint mark for ease of tracking.

c) Poles shall be marked at the: 2 meter point from the butt for 12m poles, 1.5 meters for 9m poles and 2.2 meters for 14m poles. This is to ensure that the poles are erected at the proper pit depths.

d) The manufacturer shall have the necessary trucks to transport these poles.

e) At dispatch, the poles shall not be handled with equipment that damages the poles. Cant hooks, pole tongs, or other pointed tools shall not be applied to the ground line section of any pole. A bell logger/log turner shall be used to handle the pole while loading onto/ offloading from the truck.

f) At dispatch, a REA representative shall be on hand to ensure that the right REA stacks are loaded and dispatched.

g) The poles shall be transported on a suitable vehicle supported full length. Poles shall not be dragged along the ground.The pre-stressed concrete poles shall be carried on the proper transport vehicles with a bed long enough to take the atleast 85% of the concrete pole length as shown below

Length of the Vehicle Bed for Transportation of Pre-stressed Concrete Pole

h) Each truck shall adequately carry: Between 90-100 9m wooden poles; 50-70 12m wooden poles; and 35-45 12m wooden poles.

i) A delivery notice (including the quantity and specifications of the poles) shall be provided from the pole plant for the transportation truck for signature by the driver at dispatch and receipt in the project area.

j) At delivery to the project area, the poles shall be offloaded without damage. The contractor shall use a crane or any appropriate technology to ensure that poles are safely unloaded.

k) Under conditions where these are unavailable, appropriate slings shall be used by well trained personnel to ensure that the poles are offloaded without damage.

l) At the project area, the poles shall be offloaded at a central location and stacked in heaps.

m) The clerk of works in the project area shall check for the distinctive paint mark at the butt, the delivered quantities and specifications to ensure that the received poles were as dispatched.

n) Poles will be stacked in heaps above the ground. They should be placed on even ground. For poles stored for longer periods, they should shaded to avoid the effects of direct sunlight

15.2 Delivery to site and Handling of Transformers and MV Switchgear

a) On delivery, the client and the contractor shall carry out a thorough external inspection of the transformer or switchgear unit before it is offloaded from the truck. The following checks shall be carried out;

   i. *Check for signs of damage on the packing or on the transformer that may have occurred during the transportation.*

   ii. *The characteristics of the transformer detailed on the rating plate must correspond to those of the shipping documents and with those of the test report, which is attached to the transformer.*

   iii. *Check if each transformer is complete with the accessories foreseen in the contract*

b) If there is evidence of damage and/or indication of rough handling in transit, an inspector representing the carrier should be requested and the manufacturer immediately notified.

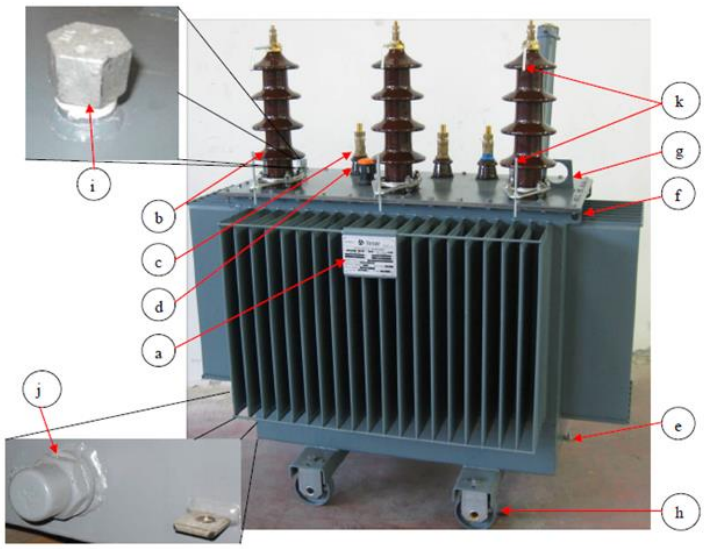
c) An internal inspection shall only be necessary only if internal damage is suspected because of external indications of rough handling.

d) The unit shall always be handled in the normal upright position to prevent overturning and spilling of oil, unless information from the manufacturer indicates that it can be handled otherwise.

e) To ensure this, only the special lifting eyes and tow attachments shall be used during transport or handling. In addition, the ropes shall be arranged so as not to interfere with the radiators or cooling fins.

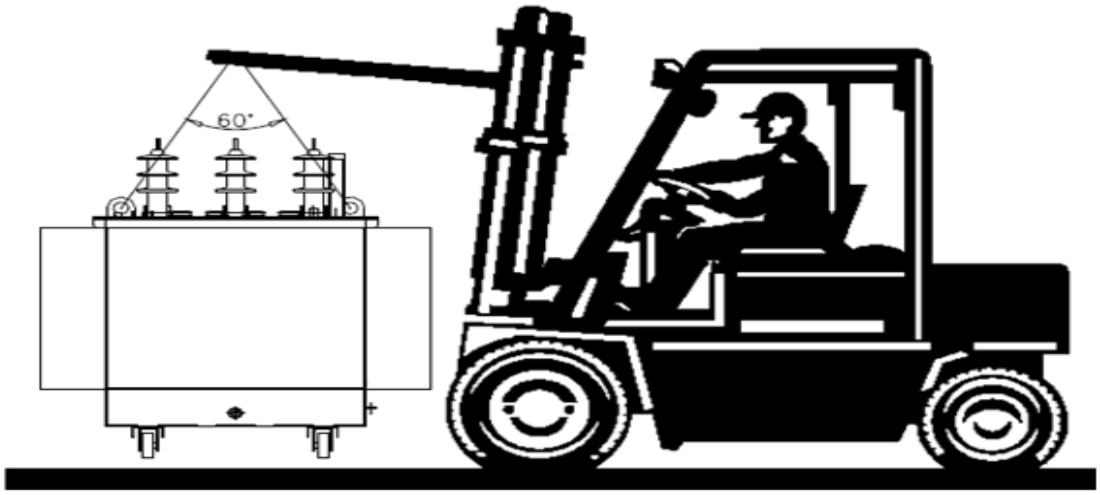
f) Where a crane or a self-loader of sufficient capacity is not available, a transformer unit may be skidded or moved on rollers onto a jack of sufficient capacity.

g) The Contractor should note that use of any under-capacity lifting mechanism could result in severe damage to the transformer, lifting equipment, or personnel involved in handling the transformer.

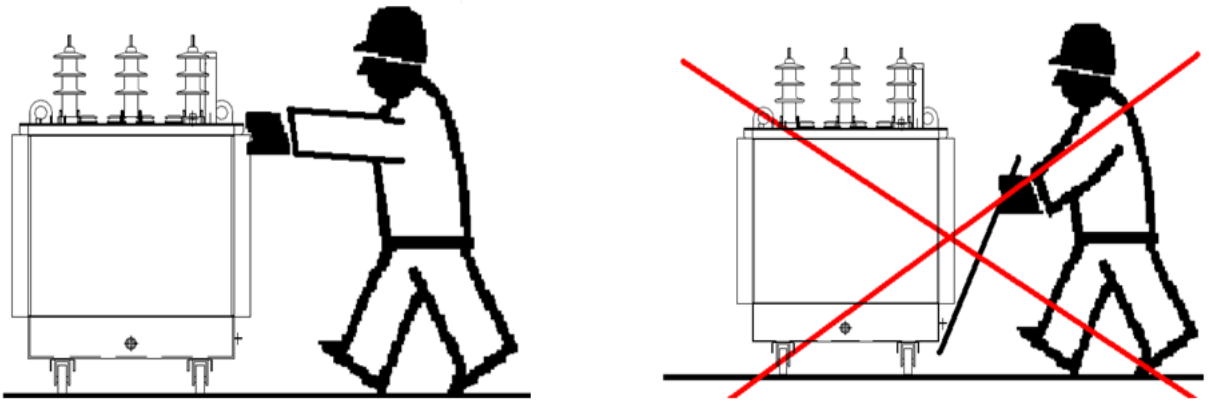


a. Rating plate
b. HV porcelain bushing
c. LV porcelain bushing
d. Off-load tap-changer
e. N°2 earthing terminals
f. Tow attachment
g. Lifting eyes
h. Truck with rollers for lengthways or sideway travel
i. Thermometer pocket
j. Drain valve
k. Arcing horns on HV porcelain bushing, for transformer without HV cable box

Parts External Parts of a distribution transformer



Handling by Bridge Crane or Forklift truck



Manual Handling

15.3 Storage of MV Switchgear and Transformers

a) The unit shall be completely assembled prior to storage. If the transformer is not completely assembled, then separate parts shall be left in their original shipping containers and stored in a clean, dry place or as per the manufacturer's instructions.
b) If an oil-filled, indoor-type transformer is stored outdoors it should be thoroughly covered to keep out rain.
c) An outdoor transformer may be stored outdoor until the time of installation, although this poses a risk of vandalism.
d) The unit shall not be stored or operated in the presence of corrosive vapors or gases, such as chlorine.
e) The storage room shall be well accessible to ease inspection and also well ventilated so that heated air can escape readily.
f) The following procedures shall be performed before storage and on a monthly basis while the unit is in storage in order to ensure that no damage or changes in condition have occurred:
    i. Inspect unit for any damage
    ii. Inspect space heaters for proper operation
    iii. Record fluid level and pressure readings
    iv. Measure and record ambient temperature

g) For indoor installation, the Contractor shall ensure that the active components of the transformer are protected during stage by the either filling the tank with dry air, dry nitrogen, or dry oil depending on the duration of storage.

The three time periods to determine the form of protection during storage shall be as follow;

i. Less than three months. This requires storage in dry air or dry nitrogen.
ii. Three to Six months. This requires storage in dry nitrogen or oil.
iii. Longer than six months. This requires filling the transformer with oil filling.

15.3.1 Storage—Less than three months

The transformer must be kept under positive pressure between 3 to 5 psi at all times while in storage.

- A reserve air supply >10 bar (150 psi) is required to be coupled with a pressure vacuum regulator.

- An elevated pressure should initially be applied for several hours, and the unit checked for leaks. Both the reserve air supply and the tank pressure should be monitored and recorded daily during the first week or two, as required by the manufacturer. These readings should be taken at approximately the same time each day, and the time and temperature should also be recorded.
- *If the pressures remain stable, then the interval between readings may be slightly extended.*

Oil Storage—Transformers received from the factory filled with oil may be stored without further attention.

15.3.2 Storage—Three to Six Months

- An unassembled transformer can be vacuum-filled with oil to its proper level and the space above the oil pressurized with dry air or nitrogen.
- An elevated pressure should be applied for several hours, and the tank checked for leaks. Both the cylinder pressure and the tank pressure should be monitored and recorded daily during the first couple of weeks. These readings should be taken at approximately the same time each day, and the time and temperature should also be recorded.
- If the pressures remain stable, the interval between readings may then be extended.
- Alternatively, the transformer may be fully assembled, vacuum filled with oil, and made operationally ready. If the transformer is equipped with pumps, periodically one half of the pumps should be run for thirty minutes, followed by operation of the other half for thirty minutes. Otherwise, the transformer should be tested and maintained as though operational.

15.3.3 Storage Check List

- Fill with nitrogen or dry air (high purity nitrogen ONLY if being stored more than 90 days) at 3 p.s.i. (-50 degrees centigrade; -58 degrees Fahrenheit dew point, or lower)
- Check for leaks all round with soap and water
- Make sure all bushings are stored in proper upright position
- Make sure all items/accessories are accounted for
- Make sure all steel components (radiators, conservator tank (if any), etc.) have blanking plates installed
- Check proper operation of nitrogen equipment, if applicable

- Activate the periodic pressure recording form, and place it inside the nitrogen equipment cabinet
- Stop the impact recorder and sign off on time, date, and location

However, regardless of the storage period, the best method of storage is to fully assemble the transformer on its permanent foundation and vacuum fill it with oil. It should be recognized that while a transformer sits without being filled with oil, the impregnated insulation is draining oil. This is the major limitation in prolonged storage in dry gas.

- When a transformer stored in dry gas is installed, a minimum of 72 hours should be allowed between oil filling and energizing, to allow for oil impregnation of the insulation that drained during storage.

16.0 POLE POSITION AND PIT EXCAVATION

a) Pole pits shall be excavated to the right depths and widths as per the REA pole manuals. Warning tape (coloured ribbons) shall be used around open pits so as to mitigate accidents.
b) Pole pits should not stay open for long, Pole erection should commence immediately after excavation.

c) Pit excavation shall immediately follow the pegging activity to avoid errors due to lost pegs.

d) The pole holes shall be dug to the recommended depths (1/6 of the pole height) in Table 20 of this document

e) Appropriate tools and adequate safety wear shall be provided to workers to reduce the risk of accidents

f) Compressors shall be used in rocky areas and the contractor shall inform REA project engineer on this. Casual labourers shall not be forced to dig rocky grounds in order to reduce risk of injuries.

g) H-pole, 3member structures and transformer structures should be properly set out before excavating pits.

h) Pits should be dug straight down to the standard depth of the pole height without tamper. The Hole digging activity shall be done to ensure that overall alignment of the structures along the line route is not lost.

i) Appropriate transportation (on carrier trucks) shall be used to deliver poles for erection.

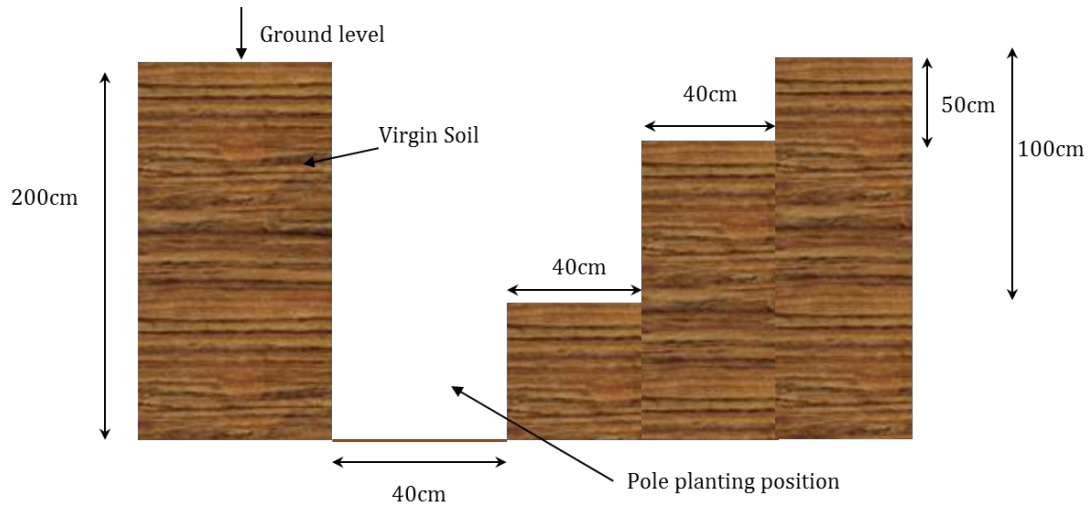
j) For Concrete Poles, Pole pit excavation, erection and backfilling shall be done by using a pole planter with a hydraulic grabber. The pole planter shall simultaneously be able to

load and move poles, excavate pole pit, erect and back fill the pole at one go. The pole planter shall be able to handle poles from diameters 150mm to 580mm. the diameter of the auger for drilling pole pits shall not exceed 400mm. Special augers for drilling pits in hard soils such rocky areas shall be in place to handle such difficult grounds.

k) Poles positioned in the work area shall not be left on the ground for a period of more than 2 days before erection.

l) Concrete or wooden Poles shall NOT be dragged during positioning.

m) Pits for intermediate single pole structures shall be stepped as shown in the figure below where as pits for angle and intermediate structures shall be dug straight down to full pole planting depth.



Pit Excavation for an Intermediate Structure

17.0 POLE ERECTION

a) Poles shall be erected plumb with a tolerance on vertical deviation not exceeding 3 mm/m. This must be checked with a plumb bob.

b) Poles shall be assembled in accordance with the approved Contractor's drawings and erected by any suitable method which will not overstrain structural members or their foundations. The method of erection shall not interfere with adjacent or intersecting line and/or other improvements.

c) Unless otherwise specified, straight line poles shall be installed so as to have the cross-arm at right angles to the line direction, and angle structures to have the cross-arms bisecting the line deviation angle.

d) Upon pole erection, back-fill soil shall be rammed into the hole to cover a minimum depth of 400mm from ground level. The ramming while pouring an adequate amount of water for compactness shall be done at depths 60cm intervals. This ensures the stability of the pole. In swampy and boggy areas, poles shall be adequately back-filled with murram bands (in metallic cylindrical drums) and planted with kick-blocks.

e) During MV pole erection, grounding should be done on every other pole, and all section structures. For LV poles, grounding is also done at every other pole and at the LV terminal.

f) For wooden poles, the grounding is done by wounding the earth conductor at least six times around the pole butt. The conductor is attached to the pole with u-nails at 500mm intervals.

g) For concrete Poles; Transformers and other equipment structures shall comprise of protective multiple earthing (PME) concrete poles. Where MV construction design has continuous aerial earthing, PME poles shall be planted after every alternate pole and the terminals. On LV side PME poles shall also be planted after every alternate pole and at all terminals.

h) The earthing of all PME poles shall consist of a lug for connecting the three strand 25mm.sq. galvanised low carbon mild steel wire to the lower end of the pole. The earth wire shall be connected to a minimum of two steel plated copper earth rod. The earth wire shall be firmly connected to the earth rod and if considered necessary, an earth-mat may be used along with steel plated copper earth rod. The aluminium lug shall be 12mm.sq.

i) On the upper side of the PME pole, the same 25mm.sq. galvanised low carbon mild steel earth wire shall be connected to the neutral of the conductor, surge arrester, etc. for system earthing or to both of the equipment and the hardware of the structure.

18.0 POLE DRESSING

18.1 Mounting Cross-Arms and Insulators

a) Cross-arms assemblies should be carefully erected according to the general arrangement drawings.

b) Cross-arms are erected true and square to the pole and be braced in all cases.

c) The pole through bolts, cross arms bolts and all other equipment mounting bolts shall be long enough in order to fully engage the nut and washer.

d) The Insulators shall be transported and assembled at site. Insulator shall be bright and the metal portion free of dirt and corrosion or other damages to the galvanizing. Cracked, chipped or otherwise damaged insulators shall not be used. Similarly, hardware with Galvanizing defects or partly corroded shall also not be used. If insulators are dirty, they are cleaned with cloth whenever necessary. No other material i.e. any type of oil shall not be used for cleaning purpose. The assembled insulators will be hoisted with the help of a winch carefully avoiding any damage during hoisting. Before lifting the string of assembled insulators from the ground, proper checking will be made to check whether the insulator string is fixed with all the relevant hardware as per the approved drawing.

18.2 Guiding principles Pole dressing

The following guiding principles shall be followed:

a) The Contractor shall take into consideration that power line shall be of 33kV construction type while selecting line accessories for dressing.

b) The Contractor shall seek approval from the REA project Engineer before dressing stage. All towers shall be inspected by the Engineer accompanied by the Contractor before the stringing operation. The Contractor shall notify the Engineer 3 weeks before the stringing operation so that the associated erected poles are ready for inspection. The Client and the Contractor shall inspect the all line accessories such as insulators, cross arms, danger plates, pole caps to ensure that they comply with REA construction standards and specifications.

c) A pole cap shall be fitted at all times or pole top cut at 45^0 (at the factory) to protect the pole top from rotting due to ingress by water.

d) The Contractor shall ensure that care is taken not to damage or injure galvanized steel surfaces and insulators.

e) M20 bolts shall be used for MV structures. An exception is made for the earthing system accessories where M16 bolts and nuts shall be used.

f) M16 bolts shall be used for LV structures.

g) Each bolt should have a washer behind the nut and, where possible and should be positioned so that the potential shear forces act on the shank of the bolt rather than the threaded part.

Table 22: Tools required for pole dressing

No.	Tool	Use
1	12M Extensible Ladders	For ascending and descending the pole
2	Lines Man Safety Belt	For securing linesman around the pole
3	Climbing Shoes	For ascending or descending the poles without sliding
4	Crowbar, Hand Hoe, Pick Axe, Shovel, Pole Pike, Spades	For excavating the pole and stay holes
5	10-22 Ring And Flat Spanners	For tightening and loosening of bolts and nuts
6	Earth Rammer	For compacting the soil as you backfill the excavations
7	3 Ton. Snatch Block	Forms part of pulley system to transport materials and tools up and down the pole
8	1/2 Inch. & 1 Inch. Ropes of 30m each (Nylon or Manila)	For transporting tools/ materials up and down the pole and for pole alignment
9	3/4 Inch.5/8 Inch Augers	For drilling holes in the wood poles
10	18 Inch. & 36 Inch Bolt Cutters	For cutting conductor and stay wires to desired length
11	100m Tape Measure	For measuring recommended depth and length
12	Drum Jack	For supporting the conductor drum above the ground to ease conductor removal
13	Spirit Level	For aligning cross arm and transformer platform
14	Set of Screw Drivers (Flat)	For tightening and loosening screws
15	1/2 Kg Claw Hammer, Ball Peen Hammer	For driving and removing nails in and out of wood poles
16	Bow Saw, Panga, Power Saw, Axe	For carrying our line clearance. For making stay stubs.
17	Lines man Pliers	For gripping, pulling and cutting material

18	Linesman Tool Box	For keeping tools before and after use
19	Linesman Tool Bag	For securing tools when at work position
20	Tirfor (Complete with wire rope and handle)	For manual lifting and lowering of heavy equipment
21	Crimp Tool	For compressing lugs and ferrules tightly onto conductors
22	D Shackle	For giving support to anchoring ropes and chains
23	Filing Tool	For sharpening cutting tools and climbing iron gaffs
24	Roller	Ease Movement of conductor when pulling up cross arms and stringing conductor
25	Earthing kit	For connecting isolated equipment to ground to create safe passage of charges.

19.0 GUYS AND STAY WORK

a) Only Low carbon mild steel grade 43A stay wire of minimum dimensions 7 / 2.64mm for LV works and 7/4.00mm for MV works shall be used unless otherwise specified.

b) The stay rods supplied shall be of hot dipped galvanized steel and the design shall be in accordance with BS 1320. They shall be threaded for a length of 305 mm and shall be complete with turnbuckle, nuts and bearing plate. The rods shall also be complete with a thimble suitable for preformed stay terminations.

c) Stay rods shall be for installation on LV and MV lines and the minimum dimensions shall be as follows:

- LV Stay rods: 1800 x 16 mm
- MV Stay rods: 2440 x 19 mm

d) The depth of the stay pit shall be 1/6 of the height of the pole. Stay pits shall be rectangular, of depth 2m or 1/6 of the pole height, width 0.6m and length 1.2m and with an undercut at the bottom where the stay stub is properly secured.

e) The distance of the stay pit from the pole shall be 2/3 of the pole height.

f) However, in case of space constraints like in trading centers, towns, and other support types such as the outrigger stay, guy pole and flying stay shall be used.

g) The position of the pole top make-off of the stay assembly shall vary depending on the structure type. However, the Contractor shall ensure that the forces acting on the pole are countered by the stay.

h) Care shall be taken when fitting stay tops, as these should be positioned so that the weight is taken on the pole and not on the tie straps of the cross-arm. Thus one strand shall be taken out of the pole top stay fitting to be bonded to the steelwork (only on MV).

i) Stays shall not be sited too close to the pole by making a large enough stay top angle; that is, 45^{o} in order to prevent crippling effect from occurring on the pole.

j) Where two stays are required, they can be installed either splayed or in tandem. When splayed, they shall be a minimum of 3m apart at ground level. When in tandem, the stay blocks shall be in separate holes with at least 3m undisturbed ground between them. Tandem Stays are not permitted when the structure is designated as a failure containment structure such as a tension structure.

k) Stays shall be fitted with insulators at a distance not less than 10ft measured vertically from ground. The stay insulators shall be of the approved standard as specified in the list of tables. Stay insulators shall be installed in all stays, regardless of whether the conductors are insulated or bare.

l) The stay insulator shall be positioned **no lower than 3m** and no higher than would allow any jumper or dropper to touch below the insulator, should that jumper or dropper break loose at any point.

m) The stay shall be anchored firm in the ground by installing a stay rod and stub in the stay pit. **The stay stub shall be concrete with dimensions 660 x 480 x 60mm, concrete grade 40, and minimum failing load 65kN.**

n) The stay wire shall be jointed to the pole top, insulators and stay anchors using helically preformed fittings that are easy to use.

o) Two Wind stay supports shall be installed to MV intermediate poles planted in areas vulnerable to storms and swamps

p) All stays are to be installed such that the stay wire is left tight under normal working conditions, with the stay load equally proportioned between the stays where multiple stays are employed.

q) Where guying is not possible, strut or brace the pole with another pole but this shall only be done with REA approval.

20.0 CONDUCTOR STRINGING, TENSIONING AND SAGGING

20.1 General

The Contractor shall join, string and sag the conductors only after preparation of his initial sag and tension tables for use in field operations. The initial sag and tension tables are subject to approval by the Engineer.

During the stringing operation and before sagging is completed the Contractor shall ascertain that all clearances would conform to drawings and that the limiting requirements for clearances between the lowest conductor and various features at maximum sag would be met.

If the above requirements are not found possible in particular cases, the Contractor shall bring the attention of the Engineer to the conditions and propose means to improve the condition.

20.2 Stringing

a) The conductors and earth wires shall be installed by tension stringing

b) The Contractor shall submit in writing for approval a complete and detailed description of the stringing equipment, stringing and sagging procedure intended for use.

c) Planning shall be carried out before conductor stringing. That is; observing the possible hazards, like roads, railways, buildings and doing clearance to ensure that no trees or vegetation lies within the line corridor.

d) The Contractor should ensure that the type and dimensions of the conductor to be strung shall comply with the REA specifications.

e) The Contractor shall ensure that the conductor cable drums are to be kept securely at an angle on drum jacks which are kept on a firm foundation.

f) Rollers shall be installed at every pole and conductors pulled by hand with the help of lead pulling wire or rope which has previously been passed over each roller.

g) The Contractor shall supply all necessary tools and stringing equipment which shall be subject to the approval of the Engineer. Under no circumstances shall the conductors and earthwires be allowed to contact the ground or any other obstacle. Refer to Table for other tools required in stringing.

h) The stringing equipment and operation shall be such as to avoid overstressing pole structures or foundations. Any damage to poles or foundations occurring in such an operation shall be made good at the expense of the Contractor. Non-metallic lagging shall be used to protect any part of any structure which may be subject to abrasion by the pulling line or which may damage conductor or earthwire passing over it.

i) Earthwires may be strung either in advance of conductor stringing or at the same time, at the Contractor's convenience. If both conductors and earthwires strung simultaneously proper precautions shall be exercised against the earthwire and conductors abrading each other.

j) Care should be taken while stringing/ running out conductor to avoid kinking, twisting or abrading the conductor in any manner. Bends of less than the minimum-bending radius of 18 times the cable diameter will not be permitted. Jumper loops shall be made up between terminal fittings and formed into such a shape as will afford the minimum clearance specified on the tower outline drawings and so that the jumper insulator string, if any supplied, is not deflected from plumb alignment. Any damage to conductors shall be reported immediately to the Engineer who will decide whether or not the conductor is damaged enough to warrant repair or replacement at the Contractor's expense.

k) While stringing, care should be taken to protect the conductor from being trampled on, run over by vehicle or dragged over the ground.

l) Special care should be taken, when running out conductors near existing live lines, road crossing.

20.3 Tensioning and Sagging

a) The conductor shall be tensioned using approved tensioning equipment and wire grips designed to prevent damage to the conductor during tensioning

b) Stringing the conductors shall thus be done with precision to ensure that the correct ground clearance and tension are attained.

c) The acceptable clearance values for the conductors were as shown in Table 18 (section 8.2.7).

d) The correct conductor sag length shall be obtained by use of a sagging chart, on obtaining information on the conductor size, span length and temperature in order to avoid infringing the ground clearance and over tensioning the structure/ conductor.

e) The conductor design sags/ tensions chart shall be provided by the conductor manufacturer. Table 24 shows a sample conductor erection sags/ tensions chart

f) While stringing, the linesmen shall use sag boards nailed to the poles at a measured distance below the conductors while the conductor is pulled to ensure that the dip in the conductor is level with the top of the boards.

g) Alternatively, to obtain correct sag, a dynamometer positioned on the middle conductor shall be used to measure the tension in the middle conductor while the other two conductors are pulled to match.

h) In order to dissipate the initial torsion energy conductors or earth wires shall be left in the sheaves for at least 48 hours after sagging before clipping-in.

i) Before finally terminating the conductors, the pole at either end of the section shall be checked for plumb, and the stays adjusted accordingly. Temporary backstays and conductors shall also be adjusted accordingly.

j) Once sagging is complete and the stays adjusted, the conductors shall be terminated while paying careful attention to accuracy.

k) Checks shall be made to ensure that the pole position to judge whether the pole is plumb both longitudinally and transversely.

l) Cross-arms shall be checked for *squareness* with the line.

m) For lines that require earth wire, the Ground Wire shall be strung at the topmost of the three conductors.

n) Earthing shall be done every other pole for both MV and LV.

o) Full tension splices shall preferably be made with pre-formed line splices or alternatively compression joints.

p) When damage to a conductor does not exceed three aluminium strands, either broken or nicked deeper than one-third of their diameter a repair splice or sleeve shall be installed and where this limit is exceeded the damaged section of the conductor shall be cut out and spliced with the abovementioned preformed line splice or compression joint.

q) A maximum of one splice per conductor or earth wire cable will be allowed in any phase in any span. No splices shall be located in any span crossing main roads, major rivers, major communication or power lines.

r) **Craddle guards shall be installed on MV lines crossing Railways, Roads and densely populated people settlements.**

Table 23: Tools required for Conductor Stringing

No.	Tool	Use
1	12M Extensible Ladders	For ascending and descending the pole
2	Lines Man Safety Belt	For securing linesman around the pole
3	Climbing Shoes	For ascending or descending the poles without sliding
5	10-22 Ring And Flat Spanners	For tightening and loosening of bolts and nuts
6	3 Ton & 1.5 Ton Pull Lifts	For stringing/ tensioning of conductors and stays
7	Come-Along (Universal)	For gripping conductors/ stay wires while stringing or tensioning
12	1/2 Inch & 1 Inch. Ropes (Manila)	Used while running out conductors
14	18 Inch. & 36 Inch Bolt Cutters	For cutting conductors and stay wires to desired length
15	100m Tape Measure	For measuring recommended depth and length
16	Drum Jack	For supporting the conductor drum above the ground to ease conductor removal
18	Set of Screw Drivers (Flat)	For tightening and loosening screws
20	Bow Saw, Panga, Power Saw, Axe	For carrying our line clearance
21	Lines man Pliers	For gripping, pulling and cutting material
22	Linesman Tool Box	For keeping tools before and after use
23	Linesman Tool Bag	For securing tools when at work positon

25	Tirfor (Complete with wire rope and handle)	Used while surging/ tensioning conductor
26	Crimp Tool	For compressing lugs and ferrules tightly onto conductors
27	D Shackle	For giving support to anchoring ropes and chains
30	Pull Lift, Sealing, Conductor Grip	Used when surging/ tensioning conductors
35	Roller	Ease Movement of conductor when pulling up cross-arms and stringing conductor
36	Sagging Chart	Used to determine conductor sag value
37	Sag Board	For aiding the lines man to obtain a correct sag while sagging

Table 24: Sample Conductor Erection Table for 100mm2 "OAK" AAAC (Severe Weather Area)

Temp. (Deg. C)	Tension (Kgf)	Sag (m) for Span (m)								
		50	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
-6	796.9	0.13	0.18	0.25	0.33	0.42	0.51	0.62	0.74	0.87
0	709.0	0.14	0.21	0.28	0.37	0.47	0.58	0.70	0.83	0.98
5	638.6	0.16	0.23	0.31	0.41	0.52	0.64	0.78	0.92	1.08
10	572.0	0.18	0.26	0.35	0.46	0.58	0.72	0.87	1.03	1.21
15	510.1	0.20	0.29	0.39	0.51	0.65	0.80	0.97	1.15	1.36
20	453.9	0.23	0.32	0.44	0.58	0.73	0.90	1.09	1.30	1.52
25	404.4	0.25	0.36	0.50	0.65	0.82	1.01	1.22	1.46	1.71
30	361.7	0.28	0.41	0.55	0.72	0.92	1.13	1.37	1.63	1.91
35	325.6	0.31	0.45	0.62	0.80	1.02	1.26	1.52	1.81	2.12
40	295.5	0.35	0.50	0.68	0.89	1.12	1.38	1.68	1.99	2.34
45	270.5	0.38	0.54	0.74	0.97	1.23	1.51	1.83	2.18	2.56
50	249.7	0.41	0.59	0.80	1.05	1.33	1.64	1.98	2.36	2.77

55	232.2	0.44	0.63	0.86	1.13	1.43	1.76	2.13	2.54	2.98
60	217.4	0.47	0.68	0.92	1.20	1.52	1.88	2.28	2.71	3.18
65	204.8	0.50	0.72	0.98	1.28	1.62	2.00	2.42	2.88	3.38
70	193.9	0.53	0.76	1.03	1.35	1.71	2.11	2.55	3.04	3.57
75	184.4	0.55	0.80	1.09	1.42	1.80	2.22	2.69	3.20	3.75
80	176.0	0.58	0.84	1.14	1.49	1.88	2.32	2.81	3.35	3.93

21.0 INSTALLATION OF POWER DISTRIBUTION TRANSFORMERS

Transformers of 315kVA and below shall be pole mounted; and 500kVA and above shall be plinth mounted. However, this may change depending on the dimensions and weight of the Transformer. In such cases guidance shall be sought from REA or the authorised Engineer.

The mounting plinth shall be on compacted ground made of hard core re-enforced with round steel bars with 1000mm above the ground. A lockable metal cage, painted aluminium shall surround the plinth and transformer.

All poled mounted transformers shall be placed on H-pole structures in line with REA standards. The transformer platform shall be at least 3.65m above the ground level.

For 33kV or 11kV transformers shall be installed as T-offs from the main line to allow for maintenance and easy of isolation.

Each Transformer Substation shall consist of the following components:

- Tee – off structure arrangement
- Terminal structure arrangement
- One set of fused drop-out links
- One set of surge arrestors.
- The conductor for all transformer substations T-offs shall be able to carry the maximum current of the transformer (50mmsq AAAC for this contract).
- A transformer-mounting platform shall be fabricated from galvanized, 10mm steel channels.
- The MV isolator support shall be at least 1.2m above the pilot cross-arm.
- Each outgoing low voltage phase from the transformer shall be protected with a fuse cut-out which is able to carry the maximum current output. Depending on the number of circuits

22.0 PRE-COMMISSIONING AND COMMISSIONING

22.1 Pre-commissioning Tests

- Among other factors, the line shall be considered safe for energizing after passing the pre-commissioning tests.
- Pre-commissioning tests shall be carried out by the Contractor supervised by the Engineer.
- The Contractor shall ensure to carry out a thorough inspection of the line to ensure proper line clearances before inviting REA for the pre-commissioning activity.

The pre-commissioning tests to be carried out shall not be limited to the following;

No.	Test	Purpose for the Test	Safety Measure	Equipment to be tested	Expected Values	Tools Required	Tool Specifications
1	Insulation Resistance Test	For measuring the level of insulation of the equipment	The line should be de-energized and isolated	Lightening arrestor, Load/ Air Break Switch, Fuse cutout switch, Distribution transformers	Resistance Value above 2000 MΩ	Digital Insulation Resistance Tester (Megger)	Variable test voltage of at least 5kV
2	Earth Resistance Test	For determining the Earth Resistance Value of the equipment	The equipment should be de-energized	Load/ Air Break Switch, Distribution Transformer	MV Value: <5Ω, LV Value: <10Ω	Earth/ Ground Resistance Tester (Fluke)	Variable test voltage of at least 3.7kV

- Equipment that does not pass the Insulation resistance test shall be replaced.
- Earthing shall be improved for equipment whose earth resistance values do not lie within the acceptable values.

22.2 Final Inspection

a) The final line inspection shall be carried out at the end of the works in the presence of both the Contractor and the Engineer. The line inspection shall be carried out as **a foot patrol.**

b) Pole pit ramming and backfilling which should be properly done

c) Poles should be properly plumbed and the line properly aligned

d) Poles should not be interfered with by cutting to make up for shallow pits.

e) Pole caps, structure number plates, anti-split plates and Danger/Hatari plates are fitted and at correct heights and locations.

f) Check if murram bands have been used for all pole structures in swampy areas and that the murram bands are at an appropriate height and width

g) Nuts are complete with washers, cross arms are properly aligned and straight, conductor spacing are as per approved design drawings and spans are as per survey route design.

h) Check Insulators for cracks and any other physical damage.

i) Check that tensioned and sagged conductor does not have waves, frays, kinks and conductor strands are not disintegrated/opened

j) Check that all ground and phase clearances are met and 33/11kV and LV combined construction clearances are met as well

k) Ensure that conductor terminations, binding and jumpers are neatly done

l) Bush clearance is as per specification

m) For stays, ensure that support point is in-relation to load on the pole, all materials used are as per specification, stay insulators are installed at the right height, guy grips hold the stay wire without slippage and are neatly finished and stay wire well tensioned. Stay holes done as per specification and the distance of stay hole from the pole is as per specification

n) LBSs, ABSs, dropout fuses and MCBs or LV fuse cut-outs should be installed as per specification. Their operation should also be checked. For Dropout fuse, the height at which they are installed should be checked so that it is not way above the length of operating rods

o) Ensure that all earthing and bonding connections are correctly in place and the connections tight.

p) For distribution transformers;

    i. Ensure poles are properly erected, cross arms properly dressed, MV and LV fuses installed at correct heights, surge arresters installed and properly earthed with the cross arms and body of the transformer. Hatari/danger board installed and the transformer neatly wired with the specified material. The number of LV circuits is as per survey design drawings. LV earth done one span away from the transformer and the transformer body does not have any damage, leakage or damaged insulators

    ii. Ensure that the oil drain valve is closed, and the drain-plug in place. Inspect for signs of oil leakage, especially around bolt-on type radiators, and switchgear/cable box flanges.

iii. Check the transformer oil level is visible in the sight glass, allowing for the ambient temperature. The level should correspond to the marked 15°C point.

iv. Ensure the transit cap has been removed from the breather pipe. (In rare instances, a dryer may be fitted, check or fill with dry silica gel as applicable).

v. Check free movement of the tap change handle, set to required position (1 - 5, nominally position 2 or +2.5% MV volts). With system voltage applied to the primary side, check open circuit secondary voltage (250/415/433V ± 1.25%, or as noted in the project file) and adjust if necessary.

vi. Prove phase rotation, and phase-in with adjacent low voltage network.

Note: Any change of tapping position is to be made with the transformer **not energised.**

q) Ensure that all the approved REA test forms for all equipment have been filled.

22.3 Commissioning Tests

a) Upon completion of the pre-commissioning tests and Final inspection, the Contractor shall make all the necessary adjustments where required.

b) The Contractor shall then write formally requesting REA, *two weeks in advance*, to schedule the commissioning exercise, with the following documents attached;

i. As-built drawings of the line (both in hard copy and soft copy with GPS referenced coordinates)

ii. Operations & Maintenance manuals for the Transformers and Switchgear

iii. Pre-commissioning test reports

c) The following tests shall be carried out during commissioning for the different equipment;

No.	Equipment	Test to be Carried Out	Expected Result	Tool to be Used
1	Load Break Switch	Insulation Resistance Test	Resistance Value above 2000 MΩ	Digital Insulation Resistance Tester
2	Load Break Switch	Earth Resistance Test	Resistance Value less than 5Ω	Earth/ Ground Resistance Tester (Fluke)
3	Distribution Transformer	Insulation Resistance Test	Resistance Value above 2000 MΩ	Digital Insulation Resistance Tester
4	Distribution Transformer	Earth Resistance Test	MV Value: <5Ω, LV Value: <10Ω	Earth/ Ground Resistance Tester

				(Fluke)
5	Distribution Transformer	Line-Line voltage, Line-phase voltage	L-L: 415V, L-phase: 240V	Digital Clamp Multimeter
6	Distribution Transformer	Voltage and Phase Rotation Check	Phase Rotation; R-Y-B	Digital Multimeter, Phase Rotation Meter
7	Metering Unit	CT Ratio	CT Ratio as per Name Plate Reading	CT Analyser + Diesel Generator
8	Metering Unit	VT Ratio	CT Ratio as per Name Plate Reading	CT Analyser + Diesel Generator
9	Metering Unit	Wiring and Programming Main and Check Meter	N/A	CT Analyser + Diesel Generator
10	Auto Recloser	Inputting Protection Settings	Fault Detection	n/a

d) During commissioning, the Serial Numbers of the equipment tested shall be recorded.

e) For all equipment tested and commissioned, the personnel present shall fill commissioning forms provided by REA and sign off with comments.

f) The Auto-recloser protection settings shall be calculated from the main substation to ensure that the protection zones are well coordinated.