BUREAU OF INDIAN STANDARDS

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भारतीय मानक **मसौदा**

सोलर फोटोवोल्टेइक वाटर पम्पिंग सिस्टम — विशिष्टि

भाग — 2 सकारात्मक विस्थापन पंप

DRAFT *Indian Standard*

Solar Photo Voltaic Water Pumping Systems — Specification

Part 2 — Positive Displacement Pumps

ICS 23.100.10

Pumps Sectional Committee, MED 20	Last date for receipt of comments is **12 July 2025**

FOREWORD
(*Formal clause will be added later on*)

This standard is primarily intended to introduce constructional, design, performance, safety features and testing requirements for Solar Photo Voltaic Water Pumping Systems utilizing Positive Displacement Technology and prescribes the method of measurement of performance and energy efficiency rating and testing for performance.

In the formulation of this standard, considerable assistance has been derived from the following Indian Standards for Piston Type Positive Displacement Pumps:

a) IS 17018 (Part 1) : 2022 'Solar photovoltaic water pumping systems Part 1 Centrifugal pumps — Specification'
b) IS 17429 : 2020 'Solar photovoltaic water pumping systems - Testing procedure - Guidelines'
c) IS 5120 : 1977 'Technical requirements for rotodynamic special purpose pumps (first revision)'
d) IS 10069: 2023 'Hydraulic fluid power Positive-Displacement pumps motors and integral transmissions methods of testing and Presenting Basic Steady State Performance'

In addition to the above Indian Standards, assistance has also been drawn from the following International Standards:

a) IEC 62253: 2011 Photovoltaic pumping system — Design qualification and performance measurements;
b) IEC 61730-1: 2023 Photovoltaic (PV) module safety qualification — Part 1:

		Requirements for construction;
c)	IEC 61730-2: 2023	Photovoltaic (PV) module safety qualification — Part 2: Requirements for testing; and
d)	IEC 60068-2-6: 2007	Environmental testing — Part 2 to Part 6: Tests — Test Fc: Vibration (sinusoidal)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (second revision)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT *Indian Standard*

SOLAR PHOTO VOLTAIC WATER PUMPING SYSTEMS — SPECIFICATION

PART 2 — POSITIVE DISPLACEMENT PUMPS

1 SCOPE

This Standard specifies the technical requirements for Solar Photo Voltaic Water Pumping Systems using positive displacement technology for handling clear cold water covering design qualifications and performance specifications. These pump sets can be installed on a suitable bore-well.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

In addition to the terminology specified in **3** of IS 17018 (Part 1), IS 5120 and IEC 62253, the following shall also apply.

3.1 Static Water Depth — It is the depth of water level below the ground level when the pump is not in operation.

3.2 Draw-Down — It is the elevation difference between the depth of static water level and the consistent standing water level in tube well during operation of pump set.

3.3 Shut-off Head (m) — The Shut off head of positive displacement pump set cannot be closed off under any circumstance. This may endanger the pump and the piping connected to it. A positive displacement pump set can guarantee performance per depth up to the maximum depth allowed.

3.4 Not to exceed Head (m) — The absolute depth that the pump can be installed and operated without causing damage to the pump mechanism.

3.5 Submergence — It is the minimum height of water level after drawdown above the pump suction casing.

3.6 Daily Water Output — It is the total water output on a clear sunny day with three times tracking Solar Photo Voltaic (PV) panel, under the "Average Daily Solar Radiation" condition of 7.15 KWh/m^2 on the surface of Photo Voltaic (PV) array [that is coplanar with the Photo Voltaic (PV) Modules].

3.7 Wire to Water Efficiency — It is the combined efficiency of Solar Photo Voltaic (PV) controller with inbuilt MPPT mechanism, pump set and piping. It can also be stated below:

Wire to Water Efficiency:

$$\eta = \frac{Flow\left(\frac{m^3}{s}\right) Head\ (m)\ Gravity\left(\frac{m}{s^2}\right) Density\left(\frac{kg}{m^3}\right)}{VI}$$

3.8 Clear Cold Water — Clear cold water shall mean, water having the characteristics specified below:

Sl No.	*Characteristics*	*Specified Value*
(1)	(2)	(3)
i)	Turbidity	50 ppm (silica scale), *Max*
ii)	Chlorides	500 ppm, *Max*

iii)	Total solids	3000 ppm, *Max*
iv)	pH value	6.5 to 8.5
v)	Temperature	33 °C, *Max*
vi)	Specific gravity	1.004, *Max*
vii)	Hardness (as $CaC0_3$) (drinking water)	300 mg, *Max*

NOTE — If any characteristics of the water differ from those specified above, the pump details shall have to be agreed between the manufacturer / supplier and user and shall be specified in the order.

3.9 Solar Photo Voltaic (SPV) Controller

The PV controller converts the DC voltage of the PV Array into a suitable DC voltage or Three phase AC. The Driver portion of the unit receives commands from a built-in control algorithm and uses the single or multiphase AC voltage to generate motor movements to match the desired stroke profile and speed.

NOTE — The PV controller may also include equipment for MPPT, monitoring, metering and for protection purposes.

3.9.1 Maximum Power Point Tracker (MPPT)

MPPT is an algorithm used for extracting maximum available power from Photo Voltaic (PV) module under certain conditions. The voltage at which Photo Voltaic (PV) module can produce maximum power is called 'maximum power point' (or peak power voltage).

4 CONSTRUCTION FEATURES

4.1 General

Positive Displacement SPV water pumping system uses the irradiance available through SPV array. The SPV array produces power, which can be utilized to drive a dc pump set using pump controller.

4.2 A SPV Positive Displacement water pumping system typically consists of:

a) Motor;
b) Pump Set;
c) Ground Module; and
d) SPV Pump Controller (*see* **3.9**).

NOTE — Some controllers can be inbuilt in the motors.

4.2.1 Provision for remote monitoring unit for the pumps shall be made in the pump controller using GSM/GPRS Gateway with Geo tagging and through an integral/external arrangement having following basic functions:

a) Controller shall be assigned with a unique serial number and its live status shall be observed remotely on online portal through login credentials;
b) Live status shall indicate whether controller is on/off;
c) The parameter that is, the water output, water flow rate, fault condition; array input voltage/current and power shall be logged at an interval of 10 minutes; and
d) Controller shall have a back up to store the data locally (at least for 1 year).

4.3 Solar Photo Voltaic (SPV) Array

4.3.1 SPV arrays contain specified number of same capacity, type and specification modules connected in series or parallel to obtain the required voltage or current output. The SPV water pumping system shall be operated with a PV array minimum capacity in the range of 3300 Watt peak to 4500 Watt peak, measured under Standard Test Conditions (STC). Sufficient number of modules in series and parallel could be used to

obtain the required voltage or current output. The power output of individual PV modules used in the PV array, under STC, shall be a minimum of 300 Watts peak, with adequate provision for measurement tolerances. Use of PV modules with higher power output is preferred.

4.3.2 Modules supplied with the SPV water pumping systems shall have certificate as per IS 14286/IEC 61215 specifications or equivalent National or International/Standards. STC performance data supplied with the modules shall not be more than one-year-old.

4.3.3 Modules must qualify to IS/IEC 61730 Part 1 and Part 2 for safety qualification testing.

4.3.4 The module efficiency shall be minimum16 percent and fill factor shall be more than 70 percent.

4.3.5 Modules must qualify to IS 17210 (Part 1) for the detection of potential-induced degradation Part 1 Crystalline silicon [mandatory in case the SPV array voltage is more than 600 V (dc)].

4.3.6 In case the SPV water pumping systems are intended for use in coastal areas the solar modules must qualify to IS/IEC 61701 for salt mist corrosion test.

4.3.7 The name plate of PV Module shall conform the IS 14286/IEC 61215.

4.3.8 Module to Module wattage mismatch in the SPV array mismatch shall be within ± 3 percent.

4.3.9 Any SPV array capacity above the specified array wattage for various models of solar pumping systems is allowed.

4.3.10 The PV modules must be warranted for output wattage, which shall not be less than 90 percent of the rated wattage at the end of 10 years and 80 percent of the rated wattage at the end of 25 years.

4.4 Motor-pump Set

4.4.1 The SPV Positive displacement water pumping systems may use the following type of motor pump sets:

Submersible motor-pump set with motor of the motor-pump set may be of the following type:

a) DC motor (brushless), BLDC

4.4.2 The "motor-pump set "shall have the following features:

a) The motor capacity ranging from 3.5 kW to 5.5 kW shall be dc; and
b) Submersible pumps could be used according to the dynamic head of the site at which the pump is to be used.

4.4.3 The pump and all external parts of motor used in submersible pump which are in contact with water shall conform to the requirement of relevant IS specification mentioned in IS 5120 and IS 14602 all the parts which are in contact with water should be of stainless steel grade (SS 304, 316, and 316 L) or higher as per IS 6911 and IS 3444 or brass or engg. plastic or elastomers

The motor pump set shall have 60 months guarantee and therefore, it is essential that the construction of the motor and pump shall be made using parts which have a much higher durability and do not need replacement or corrode for at least 60 months of operation after installation.

4.4.4 The suction/delivery pipe shall be of HDPE or uPVC column pipes of appropriate size. In case of HDPE pipes, the minimum pressure rating of 8 kg/cm^2 PE100 grade for pumps up to 3 HP, 10 kg/cm^2 PE100 grade for 5 HP pumps as per IS 10804 (Part 1) & IS 10804 (Part 2) and further higher minimum pressure rating for above 5 HP as appropriate shall be used.

4.5 Module Mounting Structures (MMS) and Tracking System

4.5.1 The PV modules shall be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The raw material usedand process for manufacturing of module mounting structure including welding of joints shall conform to

applicable IS 822. The module mounting structure shall be hot dip galvanized according to IS 4759. Zinc content in working area of the hot dip galvanizing bath shall notbe less than 99.5 percent by mass.

4.5.2 To enhance the performance of SPV water pumping systems arrangement for seasonal tilt angle adjustment and three times manual tracking in a day shallbe provided. In order to make structure rigid, the gap between telescopic pattern supports shall be minimal, further, for bearing of center load of whole structure only pins shall be used instead of threaded bolts.

4.5.3 The general hardware for structure fitment shall be either SS 304 or 8.8 Grade as per IS 6911. Modules shall be locked with antitheft bolts of SS 304 Grade. Foundation shall be as per the site condition, based on the properties of soil. Foundation can be done either withthe help of 'J Bolt' (*see* IS 5624 for foundation hardware)or direct pilling, it shall be decided asper the site and relevant IS that is, IS 6403/IS 456/IS 4091/IS 875 (Part 1 to 5) shallbe referred for foundation design.

4.5.4 Typical design of Module Mounting Structure (MMS) for different capacity of SPV pumps are attached at Annex B. The standards mentioned therein are to befollowed however any other proven designs may be used.

4.6 SPV Pump Controller

4.6.1 *Electronics*

The electronic module comprises of low power microprocessor driven logic circuits connected to a high voltage high current circuit connected directly to the motor coils. Since a feedback loop from the motor shaft is needed, it is desired to have the electronic module in close proximity to the motor to minimize electronic noise and interference.

4.6.2 The SPV pump controller must have IP (65) protection or shall be housed in a cabinet having at leastIP (65) protection in case of submergence.

4.6.3 Adequate protections shall be provided in the SPVpump controller to protect the solar powered pump set against the following:

a) Dry running; with/without sensor;
b) Open circuit;
c) Accidental output short circuit;
d) Under voltage;
e) Reverse polarity;
f) Surge protection to arrest high current surge; and
g) Over Temperature.

The system will have a minimum protection of reverse polarity and lightning. It is desirable to have additional overvoltage and over current protection either through the system software or directly by the hardware.

4.6.4 A dc. Switch as per IS/IEC 60947-3 or dc. circuitbreaker as per IS/IEC 60947-2 suitable for switching dc power on and off shall be provided in the SPV Positive displacement pumpcontroller.

4.6.5 All cables used shall be as per IS 694 orIS 9968 (Part 1). Suitable size of cable shall be used in sufficient length for inter-connection between the SPV array to SPV pump controller and the SPV pump controller to solar powered pump set. Selection of the cable shall be as per IS 14536.

4.7 Earthing Arrangement

4.7.1 Earthing of the motor shall be done as per IS 9283in accordance with the relevant provisions of IS 3043. Separate earthing shall be provided for controller, pump and SPV array.

4.7.2 For safety purposes, it shall be ensured during installation that the earthing is capable of taking care of leakage current.

4.7.3 In case of PVC/HDPE pipes used as discharge pipe, a separate non-corrosive, lower resistance conductor from motor earth terminal to control panel earth terminalshall be provided for earthing.

4.7.4 A lightening arrestor shall be provided with everySPV water pumping system.

5 PERFORMANCE REQUIREMENTS

5.1 Under the "Average Daily Solar Radiation" condition of 7.15 KWh/m^2 on the surface of PV array (that is coplanar with the PV Modules), the minimum water output from a Solar PV Water Pumping System at different "Total Dynamic Heads" should be as specified in Table 2.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

5.2 Material of Construction (MOC)

It is recognized that a number of materials of construction are available to meet the needs for pump set handling clear, cold water. A few typical materials are indicated in Table 1 - for Bore well submersible pump set.

NOTES

1. This is merely for the guidance of the manufacturers and the users.
2. The materials listed are to be considered as only typical and indicative of minimum requirements of the material properties. The use of materials having better properties is not prejudiced by the details above provided materials for components in bearing contact with each other do not entail galling, corrosion, magnetic induction, etc.

5.4 Deration Factor

Deration Factor can be aligned as per IS 14286 as temperature and irradiance corrections. It is defined in **10.2.3** and **10.4.3.1** (f) of IS 14286.Temperature and irradiance corrections can be made in accordance with IEC 60891.

6 TESTS FOR HYDRAULIC AND ELECTRICAL PERFORMANCE OF PUMPSET

6.1 The pumping set shall be tested independently for hydraulic and electrical performance to be tested as per IS 17429.

NOTE — Temperature effect (Temperature coefficients) of the solar modules must be considered while performing the testing with simulator (*see* **5.4**).

7 GUARANTEES AND TOLERANCES ON SOLAR PHOTO VOLTAIC POSITIVE DISPLACEMENT WATER PUMPING SYSTEMS PERFORMANCE

7.1 Guarantee of Workmanship and Material

The pumps shall be guaranteed by the manufacturer against the defects in material and workmanship under normal use and service for a period of at least 60 months from the date of commissioning.

7.2 Guarantee of Performance

The pump set shall be tested as per IS 17429 and guaranteed for their performance of the daily per day water output (Liters Per Day) at the guaranteed dynamic head as specified in **5.1** under the "Average Daily Solar Radiation" condition of 7.15 KWh/m^2 on the surface of Photo Voltaic (PV) array (that is coplanar with the Photo Voltaic (PV) Modules).

NOTE — The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

7.3 Pump sets used in the manufacture of Solar Photovoltaic Water Pumping systems shall be as per relevant Indian Standard Specification as applicable.

8 MARKING AND PARAMETERS TO BE DECLARED BY THE MANUFACTURER

The Solar Powered Pump set and Solar Photo Voltaic (PV) Controller shall be marked with the following parameters declared by the manufacturer:

8.1 Solar Photovoltaic Positive Displacement Pumping system:

a) Manufacturer's name, logo or trade-mark;
b) Type, Model, size and SI No of pump set;
c) Motor Rating (kW / HP); (Optional)
d) Recommended PV array power range;
e) Head Range (m), Discharge Range (lpm) TDH;
f) Capacity (LPD) at guaranteed head;
g) Operating head range, m;
h) Capacity range (LPD);
j) Maximum Current (A);
k) Maximum Voltage Range (V) and;
m) Photo Voltaic (PV) Array Rating in Watts peak (Wp) range; and
n) Overall Efficiency of the pump set.

NOTE — Since the PD Pump has a wider range of TDH, most of the performance parameters are also in range and will depend on the specific configuration chosen**.**

8.2 Solar Photo Voltaic Pump Controller:

a) Manufacturer's name, logo or trade-mark;
b) Model Number;
c) Serial Number;
d) Voltage Range;
e) Power Range in kW for Controller; and
f) Current rating (A)

9 BIS CERTIFICATION MARKING

9.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

Table 1 Material of construction of submersible positive displacement pump sets as per relevant Indian Standard specification

(*Clause* 5.2)

Sl No.	**Components**	**Bore well submersible Positive Displacement pump sets (Parts made of Casted / Molded / Sheet Metal fabricated process)**
(1)	(2)	(3)

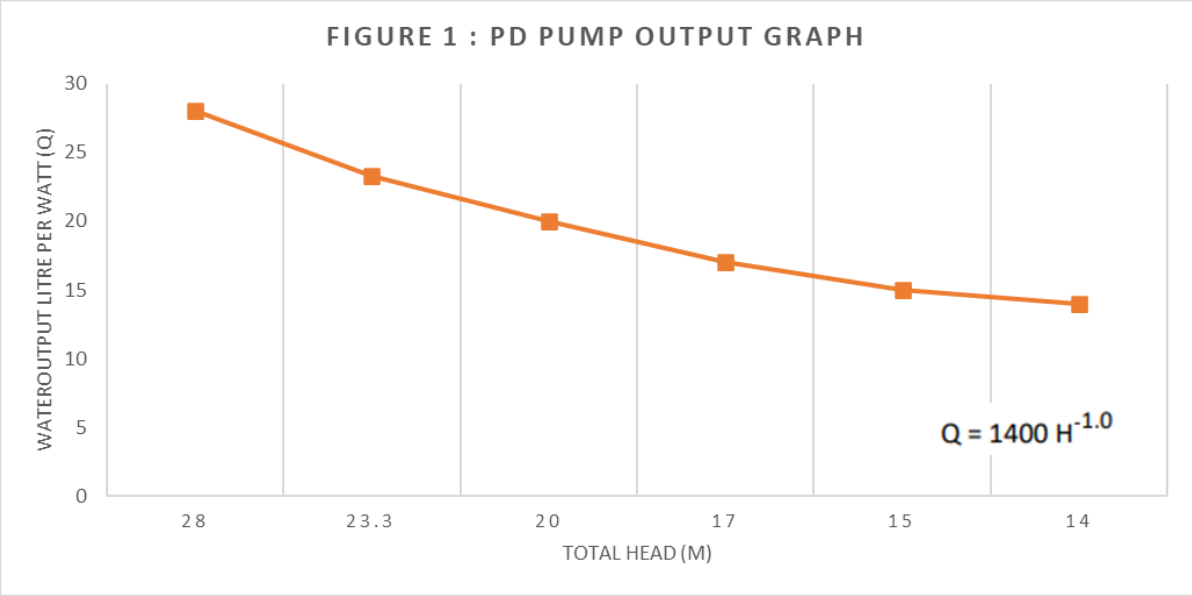
i)	Bearing inner sleeve	Bronze grade LTB 2, 3, 4 or 5 of IS 318 or 12 percent chromium steel grade X 04 Cr 12, X 12 Cr 12 and X 20 Cr 13, X04Cr19Ni-9/10, SAE 4140/4340 conforming to IS 6911 or IS 6603
ii)	Connecting Rod	AISI 4140 Hard Chrome plated
iii)	Bearing Lock nut	SAE 4340, Stainless steel X12 Cr 12 of IS 6911, X04Cr19Ni-9/10 of IS 6911
iv)	Non return valve	Stainless steel X12 Cr 12 of IS 6911, SAE 304/316 or Plastic/technopolymer or X04Cr19Ni-9/10 of IS 6911
v)	Piston	Stainless steel grade X 12 Cr 12 or X04Cr19Ni-9/10 of IS 6911 or IS 6603 or Plastic/techno polymer or Aluminum, SAE 304/316
vi)	Pump shaft	Stainless steel grade X 04 Cr 12, X 12 Cr 12 or X 20 Cr 13, X15Cr16Ni2 of IS 6603 or Mild steel EN19
vii)	Angular contact/Deep Groove Ball Bearing	Stainless steel versus Carbon polymer Composite or Stainless steel versus carbon or bronze-fiber or fiber-stainless steel
viii)	Suction	Stainless steel grade X 12 Cr 12 or X04Cr19Ni-9/10 of IS 6911 or IS 6603, SAE 304/316 or Plastic/techno polymer
ix)	Stator Casing	Stainless steel grade X 12 Cr 12 or X04Cr19Ni-9/10 of IS 6911 or IS 6603 or Bronze grade), SAE 304l
x)	Stator lamination	Electrical sheet steel as per IS 648
xi)	Winding Wire	Insulation: For water filled motors - Photo Voltaic (PV)C or poly wrap copper conductor as per IS 8783 For dry or encapsulated or oil filled or resin filled motor - Super enameled, Insulation details as per IS 13730 (Part 34), VPI with resin/varnish
xii)	Motor Shaft	Grade X 04 Cr 12, X 12 Cr 12, ISO-41cr4 or X 20 Cr 13 as per IS 1570 (Part 5)
xiii)	Cable	Electro grade copper insulating with Photo Voltaic (PV)C or with polymer and/or sheathing as per IS 694
xiv)	Cable gland	Nitrile rubber/Silicon Rubber/EPDM/Neoprene
xv)	Bearing Bush/inner ring	Leaded tin bronze Grade LTB3, LTB4 or LTB5 of IS 318 or resin bonded carbon metal-clad or rubber or rubber-lined, PTFE bonded carbon, SAE 4340
xvi)	Rotor Lamination	Electrical sheet steel as per IS 648
xvii)	Rotor conductor	Electro grade copper rods as per IS 613: 1984 or Die cast aluminum as per IS 4026
xviii)	PCB's	Conformal Coating (SKR-70/ Humiseal 1B31)
xix)	Controller PCB's Mounting Plate	Brass, Aluminum

Table 2 Minimum Requirement for Daily Flow
Indicative Technical Specifications of Solar Deep well (submersible) Positive Displacement Pumping Systems with D.C. Motor Pump Set with Brush Less D.C. (B.L.D.C.)
(*Clause* 5.1)

Sl No.	Array Wp/TDH	3300 Wp	4500 Wp
(1)	(2)	(3)	(4)
i)	70 m	69300	94500
ii)	100 m	49500	67500

Water output figures are on a clear sunny day with three times tracking of SPV panel, under the "Average Daily Solar Radiation" condition of 7.15 KWh/m^2 on the surface of PV array (that is coplanar with the PV Modules).

NOTE — For higher or lower head or in between various models; water output could be decided (that is performance specifications and requirements) based on the test reports.



10 PULSATION AND VIBRATION CONTROL REQUIREMENTS

For pulsation and vibration control requirements *see* 7.7 of ISO 13710.

11 OPERATION AND MAINTENANCE MANUAL

An operation and maintenance manual in English and the local language shall be provided with the solar PV pumping system. The manual shall have information about solar energy, photovoltaic modules, DC motors pump set, tracking system, mounting structures, electronics and switches. It shall also have clear information about mounting of PV module, Do's, Don'ts on regular maintenance and troubleshooting of the pumping system. Helpline number, name, address of the service center and contact number of authorized representative to be contacted in case of failure or complaint shall also be provided. A guarantee card for the modules and the motor pump set shall also be provided to the beneficiary.

ANNEX A

(*Clause* 2)

List of Referred Standards

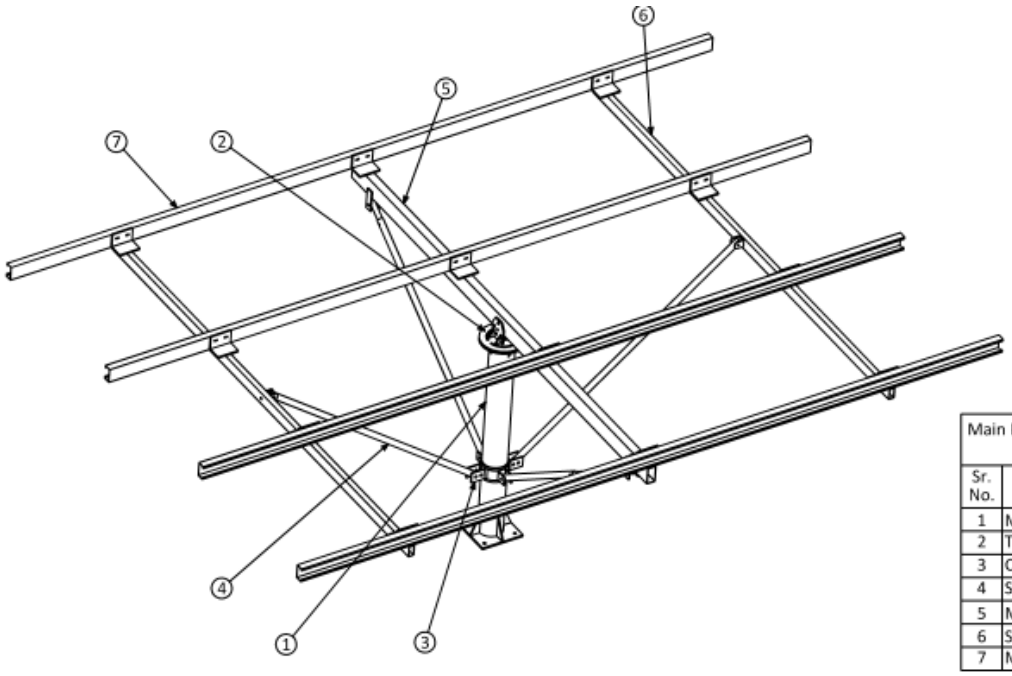
IS/ISO/IEC No.	*IS Title*
IS 210 : 2009	Grey iron castings — Specification (*fourth revision*)
IS 304 : 1981	High tensile brass ingots and castings (*second revision*)
IS 318 : 1981	Specification for leaded tin bronze ingots and castings (*second revision*)
IS 456 : 2000	Plain and reinforced concrete - Code of practice (Fourth Revision)
IS 613 : 2000	Copper rods and bars for electrical purposes — Specification (*third revision*)
IS 617 : 1994	Aluminum and aluminum alloy ingots and castings for general engineering purposes (*third revision*)
IS 648 : 2022	Cold rolled non-oriented electrical steel sheet and strip - Fully processed type - Specification (*Sixth Revision*)
IS 694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 1 100 V (*fourth revision*)
IS 811 : 1987	Specification for cold formed light gauge structural steel sections (Second Revision)
IS 822 : 1970	Code of procedure for inspection of welds
IS 875 (Part 1) : 1987	Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 1 dead loads - Unit weights of building materials and stored materials (Second Revision)
IS 875 (Part 2) : 1987	Code of practice for design loads (Other Than Earthquake) for buildings and structures: Part 2 imposed loads (Second Revision)
IS 875 (Part 3) : 2015	Design Loads (Other than Earthquake) for Buildings and Structures - Code of Practice Part 3 Wind Loads (Third Revision)
IS 875 (Part 4) : 2021	Design Loads (other than Earthquake) for Buildings and Structures - Code of Practice: Part 4 Snow Loads (Third Revision)
IS 875 (Part 5) : 1987	Design loads (Other Than Earthquake) for buildings and structures - Cod of practice for : Part 5 special loads and load combinations (Second Revision)
IS 1079 : 2017	Hot rolled carbon steel sheet, plate and strip - Specification (Seventh Revision)
IS 1161 : 2014	Steel tubes for structural purposes - Specification (Fifth Revision)
IS 1239 (Part 1) : 2004	Steel tubes, tubulars and other wrought steel fittings - Specification: Part 1 steel tubes (Sixth Revision)
IS 1239 (Part 2) : 2011	Steel tubes, tubulars and other steel fittings - Specification: Part 2 steel pipe fittings (Fifth Revision)
IS 1570 (Part 2/Sec 1) : 1979	Schedules for wrought steels: Part 2 Carbon steels (unalloyed steels), Section 1 Wrought products (other than wire) with specified chemical composition and related properties (*first revision*)
IS 2062 : 2011	Hot rolled medium and high tensile structural steel - Specification (Seventh Revision)
IS 2629 : 1985	Recommended practice for hot-dip galvanizing of iron and steel (First Revision)
IS 2633 : 1986	Method for testing uniformity of coating on zinc coated articles (Second Revision)
IS 3043 : 1987	Code of practice for earthing (*second revision*)
IS 3073 : 1967	Assessment of surface roughness
IS 3444 : 1999	Corrosion resistant high alloy steel and nickel base castings for general applications(*third revision*)
IS 4026 : 2023	Aluminum ingots billets and wire bars (EC grade) (*fourth revision*)
IS 4091 : 1979	Code of practice for design and construction of foundations for transmission line towers and poles (First Revision)
IS 4759 : 1996	Hot - Dip zinc coatings on structural steel and other allied products - Specification (*Third Revision*)

IS 5120 : 1977	Technical requirements for rotodynamic special purpose pumps (*first revision*)
IS 5624 : 2021	Foundation Bolts — Specification (*Second Revision*)
Is 6403 : 1981	Determination of Bearing Capacity of Shallow Foundations — Code of Practice (*First Revision*)
IS 6603 : 2024	Stainless steel semi-finished products, bars, wire rods and bright bars — Specification (*second revision*)
IS 6745 : 1972	Methods for determination of mass of zinc coating on zinc coated iron and steel articles
IS 6911 : 2017	Stainless steel plate, sheet and strip — Specification (*second revision*)
IS 7215 : 1974	Tolerances for fabrication of steel structures
IS 8034 : 2018	Submersible pump sets — Specification (*third revision*)
IS 8783 (Part 4/Sec 1) : 1995	Winding wires for submersible motors - Part 4 : Individual wires – Section 1 : HR photo voltaic (PVC) insulated wires (*first revision*)
IS 9079 : 2018	Monoset pumps for clear, cold water for agricultural and water supply purposes — Specification (*third revision*)
IS 9283 : 2013	Motors for submersible pumpsets — Specification (*second revision*)
IS 9968 (Part 1) : 1988	Specification for elastomer insulated cables: Part 1 for working voltages up to and including 1 100 volts (*First Revision*)
IS 10572 : 1983	Methods of sampling for pumps
IS 10804 (Part 1) : 2018	Recommended pumping systems for agricultural purposes: Part 1 surface pumps (Third Revision)
IS 10804 (Part 2) : 2018	Recommended pumping systems for agricultural purposes: Part 2 submersible pump sets (Third Revision)
IS 11346 : 2002	Tests for agricultural and water supply pumps — Code of acceptance (*first revision*)
IS 13730 (Part 6) : 1994	Specification for particular types of winding wires: Part 6 oleo - Resinous enamelled round aluminium wire, class 105
IS 13730 (Part 34):2000/IEC 60317:1997	Specifications for particular types of winding wires - Part 34 : Polyester enameled round copper wire, class 130 L (*first revision*)
IS/ISO 21940-11 : 2016	Mechanical vibration - Rotor balancing: Part 11 procedures and tolerances for rotors with rigid behaviour
IS 15999 (Part 1) : 2021	Rotating electrical machines — Part 1 : Rating and performance
IS 17018 (Part 1) : 2022	Solar photovoltaic water pumping systems Part 1 Centrifugal pumps — Specification (*second revision*)
IS 17210 (Part 1) : 2019 IEC TS 62804-1 : 2015	Photovoltaic (PV) Modules - Test Methods for the Detection of Potential-Induced Degradation Part 1 Crystalline Silicon
IS 17429 : 2020	Solar Photovoltaic Water Pumping Systems - Testing Procedure - Guidelines
IS/IEC 61683:1999	Photovoltaic system-power conditioners — Procedure for measuring efficiency
IS 14286 : 2010 IEC 61215 : 2005	Crystalline silicon terrestrial photovoltaic (Photo Voltaic (PV)) modules - design qualification and type approval (*first revision*)
IS 14536 : 2018	Selection, installation, operation and maintenance of submersible pumpset - Code of practice (First Revision)
IS 14602 : 1999	Installation methods of positive displacement hydraulic pumps and motors – Guidelines
IS/IEC 61730-1 : 2016	Photovoltaic (PV) module safety qualification Part 1 Requirements for construction (*first revision*)

IS/IEC 61730-2 : 2019	Photovoltaic (PV) module safety qualification: Part 2 Requirements for testing (*first revision*)
IS/IEC 60947-3 : 2020	Low-Voltage Switchgear and Controlgear: Part 3 Switches Disconnectors Switch-Disconnectors and Fuse-Combination Units (second revision)
IS/IEC 60947-2 : 2016	Low - Voltage switchgear and controlgear: Part 2 circuit - Breakers (First Revision)
IS/IEC 61683:1999	Photovoltaic system-power conditioners — Procedure for measuring efficiency
IS/IEC 61701 : 2011	Salt mist corrosion testing of photovoltaic (PV) modules (first revision)
ISO 13710:2004	Petroleum, petrochemical and natural gas industries — Reciprocating positive displacement pumps
IEC 62253 : 2011	Photovoltaic pumping systems – Design qualification and performance measurements

ANNEX B
(*Clause*4.5.4)

SPECIFICATIONS FOR DUAL AXIS MANUAL TRACKING TYPE MODULE MOUNTING STRUCTURE (MMS) FOR SOLAR WATER PUMPING SYSTEM



Main Parts of MMS for Solar Water Pumping System		
Sr. No.	Part Name	Qty. / Set
1	Mian column	1
2	Top plate	1
3	Clamp with blade	2
4	Supporting pipe	6 / 8
5	Main tube	1
6	Side tube	2
7	Mounting purlin	4

For hot dip galvanizing of fabricated structure following shall be referred:

a) Minimum coating required shall be as per IS 4759;

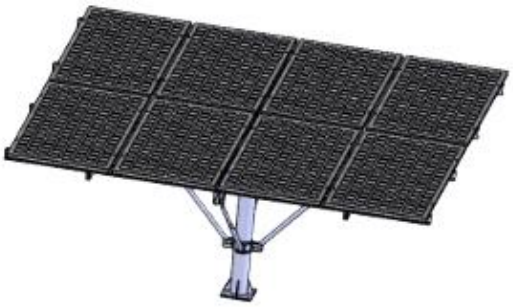
b) Preece test ($CuSO_4$ Dip test) as per IS 2633;

c) Mass of zinc (IS 6745 or IS 4759); and

d) Adhesion test (IS 2629).

4 Module MMS

6 Module MMS



8 Module MMS

10 Module MMS

B-1 STANDARD MMS FOR 4, 6, 8 AND 10 SOLAR MODULES HAVE BEEN SPECIFIED. THESE STANDARD MMS MAY BE USED IN COMBINATIONS FOR DIFFERENT CAPACITIES OF SOLAR WATER PUMPING SYSTEMS AS FOLLOWS

a) Standard MMS of 4 modules for 1 HP;
b) Standard MMS of 6 modules for 2 HP;
c) Standard MMS of 10modules or combination of standard MMS of 4 Modules and standard MMS 6 Modules for 3 HP;
d) Combination of two standard MMS of 8 modules or combination of standard MMS of 10modules and standard MMS 6 modules for 5 HP; and
e) Combination of three standard MMS of 8 modules or combination of twostandard MMS of 10 Modules and one standard MMS 6 modulesfor 7.5 HP and so on.

B-2 SPECIFICATIONS OF MAIN PARTS USED IN MMS ARE GIVEN BELOW

B-2.1 Centre Shaft

Centre shaft used in structure shall be of:

a) *For 4, 6 and 8 Modules Structure* —Minimum 139 OD with minimum thickness of 4 mm with base plate minimum 10 mm thickness if used and foundation hardware shall be as per IS 5624.

b) *For 10 Modules Structure* —Minimum 165 OD with minimum thickness of 4 mm with base plate minimum 20 mm thickness if used and foundation hardware shall be as per IS 5624.

For system without base plate that is, direct pilling is shall be as per the site condition based on the properties of Soil and refer (IS 6403 / 456 / 4091 / 875) for foundation design.

B-2.2 Rafters

The main and secondary rafter used in structure shall be of eitherSHS and RHS pipe sections.

B-2.3 Purlin

Mounting purlins used in the structure shall be made of cold form steel section as per IS 1079 with minimum thickness of 2mm.

B-2.4 Provision for Seasonal Tilt

In one structure at least four telescopic supports (three may be used in MMS for 4 modules) either round hollow sections or square hollow section to be provided to support the mounting structure.

B-2.5 Provision for Daily Tracking

Provision for daily tracking shall be provided by the way of providing min. 8 mm thick metal sheet with precision cut grooves.

B-2.6 Module Locking System

Modules shall be locked with antitheft bolts of SS 304 Grade.

B-2.7 General Hardware for Structure Fitment

Either SS 304 or 8.8 grade hardware shall be used for fitment.

B-2.8 Hot Dip Galvanizing

All structure parts shall be hot dip galvanized according to IS 4759.

B-2.9 Tolerance for Fabrication

Tolerance for fabrication of steel structure shall as per IS 7215.

B-2.10 Welding

Welding shall be done as per IS 822 and grade of welding wire shall be (ER70S-6).

B-2.11 Raw Material Test Certificates (MTC)

MTC of all types of raw material used in dual axis manual tracking type MMS as per appropriate Indian Standard shall be submitted along with dispatch documents.

B-2.12 Tests to be performed on dual axis manual tracking type MMS for solar water pumping system.

B-2.12.1 For ascertaining proper welding of structure part following shall be referred:

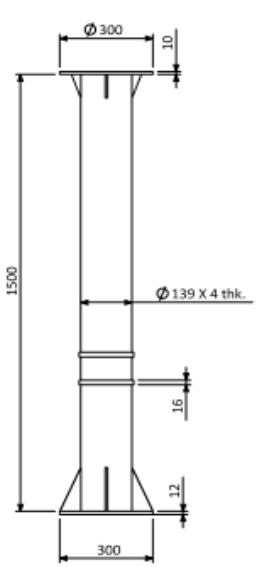
a) Weld wire grade shall be of grade (ER 70 S - 6); and
b) D.P. test (pin hole/crack) (IS 822).

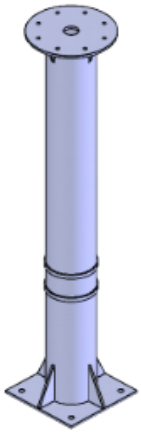
B-2.12.2 For ascertaining hot dip galvanizing of fabricated structure following shall be referred:

a) Min coating required shall be as per IS 4759;
b) Testing of galvanized material;
c) Preecetest (CuSO4 dip test) (IS 2633);
d) Mass of zinc (IS 6745 or IS 4759); and
e) Adhesion test(IS 2629).

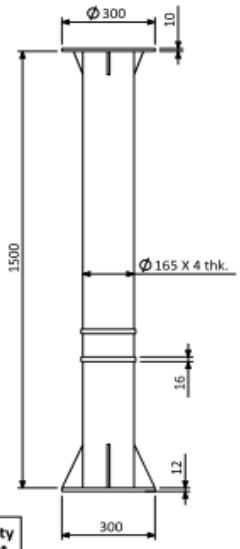
Part 1 Main Column

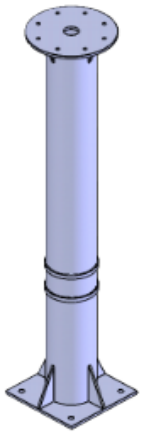
Common for 4, 6 & 8 MMS





For 10 MMS



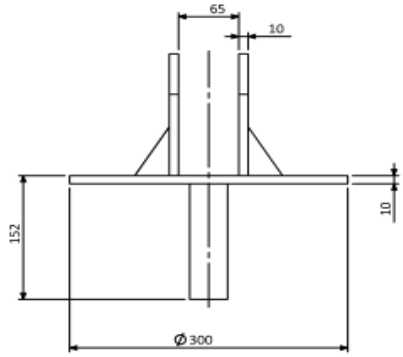


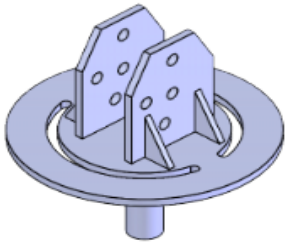
Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
1.	MAIN POLE			
	4,6 and 8 Modules	139 OD	1500	1
	10 Modules	165 OD	1500	1

Notes :
1. All dimensions are in mm.

Part 2 Top Plate

Common for 4, 6, 8 & 10 MMS



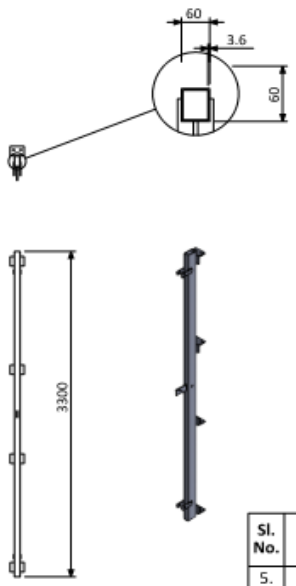


Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
2.	TOP PLATE (Common for all)	300 OD	--	1

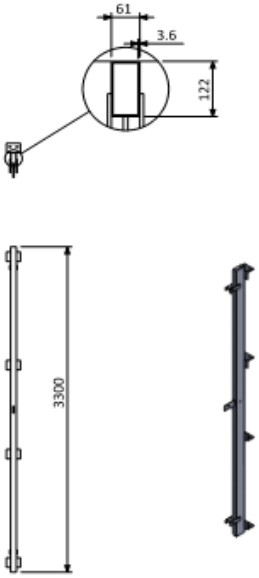
Notes :
1. All dimensions are in mm.

Part 3 Main Tube

Common for 4 & 6 MMS



Common for 8 & 10 MMS

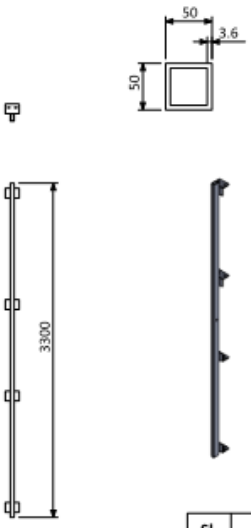


Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
5.	MAIN TUBE			
	4 and 6 Modules	60X60X3.6	3300	1
	8 and 10 Modules	112X61X3.6	3300	1

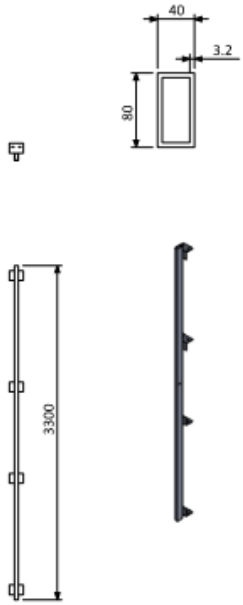
Notes :
1. All dimensions are in mm.

Part 4 Side Tube

Common for 4 & 6 MMS



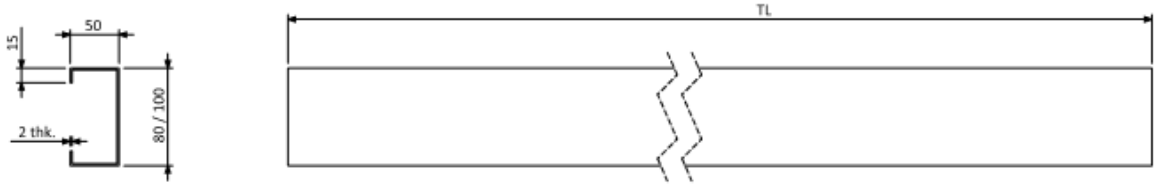
Common for 8 & 10 MMS



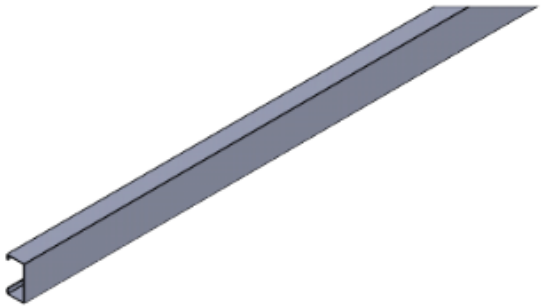
Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
6.	SIDE TUBE			
	4 and 6 Modules	50X50X3.6	3300	2
	8 and 10 Modules	80X40X3.2	3300	2

Notes :
1. All dimensions are in mm.

Part 5 Purlin



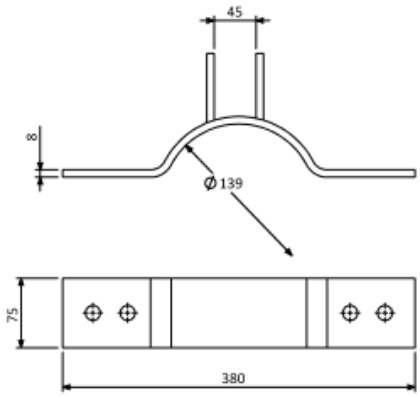
Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
7.	MOUNTING PURLIN			
	4 Modules	80X50X15X2	2050	4
	6 Modules	80X50X15X2	3100	4
	8 Modules	80X50X15X2	4150	4
	10 Modules	100X50X15X2	5200	4



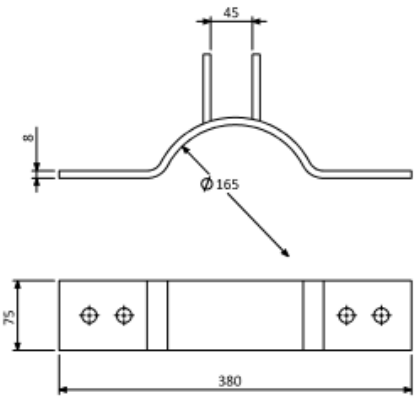
Notes :
1. All dimensions are in mm.

Part 6 Clamp with Blade

Common for 4, 6 & 8 MMS



For 10 MMS

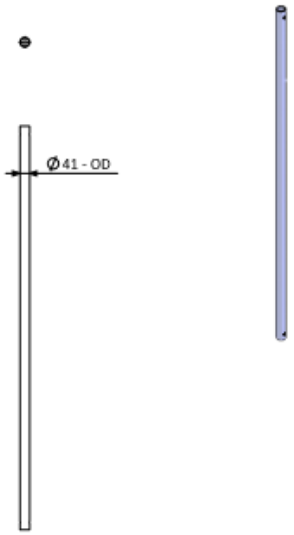


Sl. No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set
3.	CLAMP WITH BLADE			
	4,6 and 8 Modules (For 139 OD pole)	75x8	380	2
	10 Modules For 165 OD pole)	75x8	380	2

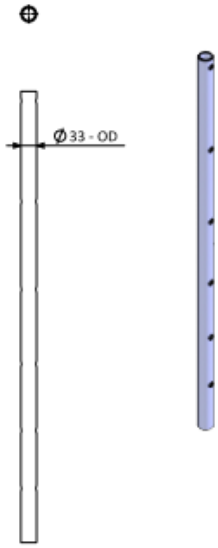
Notes :
1. All dimensions are in mm.

Part 7 Supporting Pipes

4A) Spporting Pipe - 4 nos / set
Common for 4, 6, 8 & 10 MMS



4B) Supporting Pipe - 2 nos / set
Common for 4, 6, 8 & 10 MMS



Notes :
1. All dimensions are in mm.

MainParts of MMS for Solar Water Pumping System

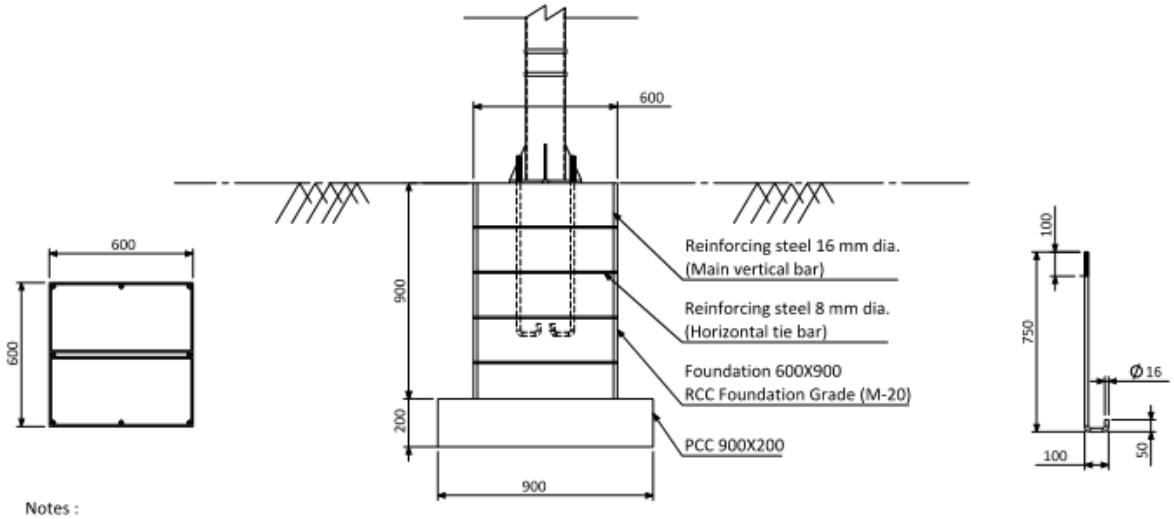
Sl No.	Part Name	Cross Section Detail	Length (mm)	Quantity Per Set	Material Grade
1.	**MAIN COLOUMN**				
	4, 6 and 8 Modules	139 OD	1500	1	YST – 240 as per IS 1161/IS 1239 (Part 1 & 2) and E250 as per IS 1079/IS 2062
	10 Modules	165 OD	1500	1	
2.	**TOP PLATE (Common for all)**				
		300 OD	--	1	YST – 240 as per IS 1161/IS 1239 (Part 1 & 2) and E250 as per IS 1079/IS 2062
3.	**MAIN TUBE**				
	4 and 6 Modules	60×60X3.6	3300	1	YST – 240 as per IS 1161/IS 1239 (Part 1 & 2) and E250 as per IS 1079/IS 2062
	8 and 10 Modules	122×61X3.6	3300	1	

4.	**SIDE TUBE**				
	4 and 6 Modules	50×50×3.6	3300	2	YST – 240 as per IS 1161/IS 1239 (Part 1 & 2) and E250 as per IS 1079/IS 2062
	8 and Modules	80×40×3.2	3300	2	
5.	**MOUNTING PURLIN**				
	4 Modules	80×50×15×2	2050	4	E250 as per IS 1079/IS 2062 and IS 811
	6 Modules	80×50×15×2	3100	4	
	8 Modules	80×50×15×2	4150	4	
	10 Modules	100×50×15×2	5200	4	
6.	**CLAMP WITH BLADE**				
	4, 6 and 8 Modules (for 139 OD pole)	75×8	380	2	As per IS 1079 and E250 as per IS 2062
	10 Modules(for 165 OD pole)	75×8	380	2	
7.	**SUPPORTING PIPES**				
	4, 6 and 8 Modules	41 OD and 33 OD	--	6	YST – 240 as per IS 1161/IS 1239 (Part 1 & 2) and E250 as per IS 1079/IS 2062
	10 Modules	41 OD and 33 OD	--	8	

Foundation Design for 4 /6 MMS

BOM for steel				
TMT Bar	Length	Unit Weight	Quantity	Total weight
16 mm	1000 mm	1.578 kg	8 pcs	12.6 kg
8 mm	2400 mm	0.950 kg	4 pcs	3.8 kg
8 mm	1250 mm	0.500 kg	4 pcs	2 kg

BOM for RCC and PCC				
Block	Width	Length	Height	Volume
RCC Column	0.600 M	0.600 M	0.900 M	0.324 CU.M
PCC	0.900 M	0.900 M	0.200 M	0.162 CU. M

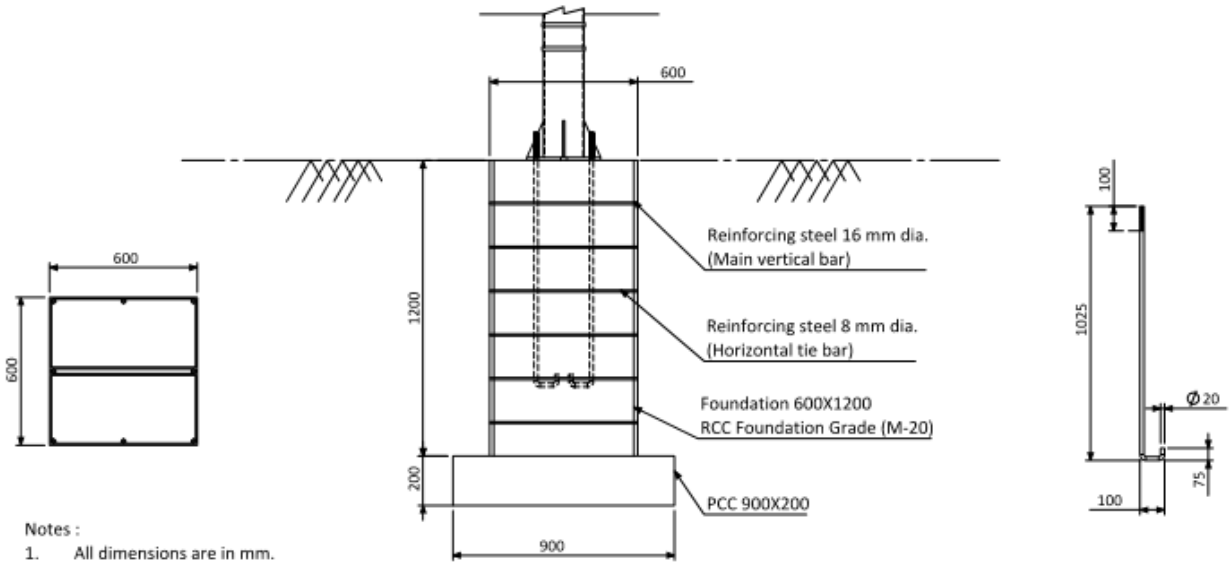


Notes :
1. All dimensions are in mm.

Foundation Design for 8 MMS

BOM for steel				
TMT Bar	Length	Unit Weight	Quantity	Total weight
16 mm	1300 mm	2.050 kg	8 pcs	16.4 kg
8 mm	2400 mm	0.950 kg	6 pcs	5.7 kg
8 mm	1250 mm	0.500 kg	6 pcs	3 kg

BOM for RCC and PCC				
Block	Width	Length	Height	Volume
RCC Column	0.600 M	0.600 M	1.20 M	0.432 CU.M
PCC	0.900 M	0.900 M	0.200 M	0.162 CU. M

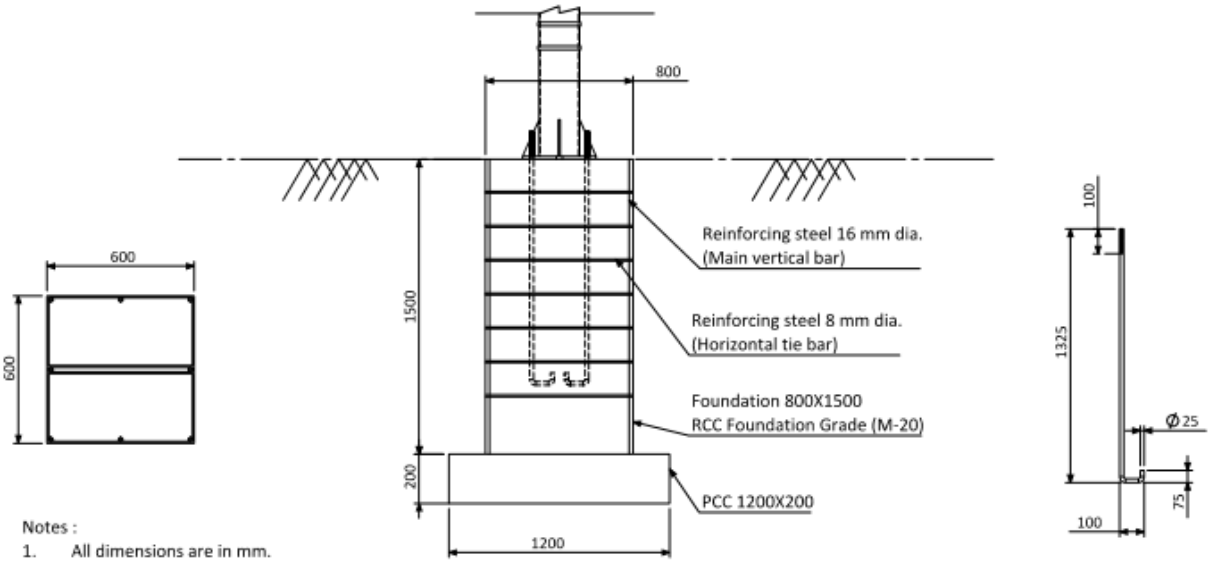


Notes :
1. All dimensions are in mm.

Foundation Design for 10 MMS

BOM for steel				
TMT Bar	Length	Unit Weight	Quantity	Total weight
16 mm	1800 mm	2.50 kg	8 pcs	20.0 kg
8 mm	3200 mm	1.25 kg	7 pcs	8.75 kg
8 mm	1650 mm	0.650 kg	7 pcs	4.55 kg

BOM for RCC and PCC				
Block	Width	Length	Height	Volume
RCC Column	0.800 M	0.800 M	1.50 M	0.960 CU.M
PCC	1.20 M	1.20 M	0.200 M	0.288 CU. M



Notes :
1. All dimensions are in mm.

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