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GOVERNMENT OF WEST BENGAL

IRRIGATION & WATERWAYS DEPARTMENT

MECHANICAL & ELECTRICAL DIRECTORATE

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USOR (M & E)

W.E.F May 10

2022

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GOVERNMENT OF WEST BENGAL

MECHANICAL & ELECTRICAL DIRECTORATE

UNIFIED SCHEDULE OF RATES (M&E)
(PART-A)

IRRIGATION & WATERWAYS DEPARTMENT
Jalasampad Bhawan
Bidhannagar
Kolkata- 700091

INDEX

(PART A)

For Unified Schedule of Rates (U.S.O.R M & E) under Irrigation & Waterways Department, Govt of West Bengal

Government of West Bengal
Irrigation& Waterways Directorate
Office of the chief Engineer (Mechanical & Electrical)
Jalasampad Bhawan, 2th Floor, Salt Lake City, Kolkata - 700 091

Preface

As per the Irrigation & Waterways Department Order no 04-(W)/2021-22 dt. 07th July 2021, a committee has been constituted in the Directorate level named as "Schedule of Rates Revision Committee (M&E)" for framing of "Unified Schedule of Rate for Mechanical & Electrical Works-USOR(M&E)". On initial submission of draft USOR (M&E) on 16.11.2021, the Secretary Irrigation & Waterways Department issued different directives in the ROD circulated vide no 353-IB-IW-14011(33)/5/2020-Section (IW) dt. 05.01. 2022.Here every attempt has been made to follow the Terms of Reference (TOR) stipulated in the initial stated order so that no items which has already covered in PWD (Elect) SOR & USOR (Civil) of I&W Deptt are repeated except mechanical portion of I&WD USOR(Civil) which has done as per the request of the Chairman of Schedule of Rates Revision Committee (Civil). Accordingly Mechanical portion SOR has been included in the USOR(M&E) and omitted in the recent submitted draft USOR(civil).

During formation of this SOR, an attempt has been made so that every items used by different Circles of this Directorate can be incorporated here. Tax structure has kept as per USOR (Civil) of this Department.

Details of recommendation of the committee have been separately attached based on Terms of Reference in stated Departmental Order & issued stated ROD.

USOR (M&E)-2022 has been prepared accommodating items which felt necessary as per the demand of new technology and past experience. All efforts have been made for making it a comprehensive and useful document for the I&W Directorate.

(S.K.Dey)
Chief Engineer (M&E)
I &W Directorate
Government of West Bengal

Chapter 1.1

Recommendation of the Schedule of Rates on the Terms of Reference for USOR (M&E)

Based on Terms of Reference Provided in the I&W Department order vide no. 04-(W)/2021-22 dt. 07.07.21 and the ROD issued by the Secretary, I & W Deptt. circulated vide no. 353-IB-IW-14011(33)/5/2020-Section (IW) dt 05.01.2022 on initial submission of Draft USOR on 16.11.2021, following recommendations have been made by the committee.

1. A Separate chapter of General Specifications for both Mechanical & Electrical has been introduced in this USOR as directed in the ROD,
2. Initially Wastage of Steel material @6% has been taken into consideration in this USOR which is to be ascertained as per the direction made in the stated ROD. A separate estimate in this respect has been framed as per actual dimension of steel material available in the market and found the wastage consideration is different for difference size of gate which is enclosed as "Sub-1". As the wastage has found from 8 to 22%, hence only 10% cutting wastage is only considered. Also the value of scrap material (10%) has been deducted from the final value.
3. Servicing of pumps have been notified for different ranges of pump capacity as directed in the ROD.
4. Procurement of new centrifugal pumps have been incorporated in this USOR.
5. All basic rates obtained from GEM portal have been verified with market Rate. It has found that Electrical & HVAC items rate are to be obtained from OEM Price list/Market rate to reach workable rate as directed in the ROD.
6. New labour rate to be applicable w.e.f. 01.01.22 has been directed in the ROD & complied in this USOR.
7. To ascertain hire charges of machineries to be used for mechanical works, this committed followed the CWC guidelines of River Valley Project 1988 & IS 11590:1995
8. Schedule of Rates for different works under M&E wings have been sub divided into following three group in Chapter 5.
   5.1- Hydraulic Gates/Hoist and allied works
   5.2- Drainage Pumping Stations
   5.3- Associated Electrical & Miscellaneous works
   5.4- Supply of portable pumps
9. Each and every item of the SOR has been analyzed based on standard format comprising of raw steel material, labour & machining. Standard format of machining has been taken from standard practice of manufacturing industries. Analysis of rate with supporting documents placed in chapter 6. The basis of analysis of rates of this USOR (M&E) are same as those adopted by PWD (Electrical) and other state Govt, like Karnataka, Andra Pradesh and Telegana.
10. Since some the items relating to gate manufacturer with hoisting arrangement, incorporated in the SOR are common to similar items, embodied in the USOR ,2018 (Civil). The same will be excluded from the upcoming USOR (Civil).
11. No repetition of Electrical Items has been made which are already described in the SOR of PWD (Elect.) But some of the electrical items which are regularly used by all working Divisions of this Wing have been incorporated as per clause 1.b of TOR. Intensive searching has been made to procure the basic rates of Electrical materials through GEM but found that rate is so poor that it cannot be considered as workable rate. Hence, OEM price list with due discount & market rate has been considered here.
12. This Committee has decided to analyze the rate after providing discount of 15% on all electrical items (leaving A.C. machine & L.T. accessories) described in the price list. Rate for repairing of HT & LT motors have been achieved through EOI and the lowest quoted price have been incorporated in the SOR. However a detailed analysis of rate has also been made and found justified.

13. Drawing of embedded parts of hydraulic gates/hoist & some basic data & technical features are incorporated as Annexure I & II respectively. Additional information for preparation of estimate also provided as Annexure III
14. Comparison of rates for old estimate & new estimate are enclosed in Sub-"2".

Now, as per the PWD(Elect.] SOR & SOR of MEC 2011, following District charge is recommended to be incorporated as extra as follows :—

1. Purba Medinipur, Purba Burdwan, Nadia except Kalyani:- @1% extra.
2. Paschim Medinipur, Paschim Burdwan, Birbhum, Bankura, Murshidabad, Purulia :-@2% extra
3. Malda and all district of North Bengal:- @3%

In latest PWD (Electrical] SOR, fixed overhead at @2.5% along with supervision charge @10% have been applied, Since those is no repetition of rate in the present USOR (M&E), overhead of 8% along with contractors profit @10% has been applied at the rates, as has been adopted in case of USORfCIVIL], I&W D, 2018, in terms of I & W Deptt. Memo. No.l40-IB dated 10.08.2018.

GST as applicable & Construction Labour Welfare Cess @1% are to be added with Schedule of Rates while arriving the estimated rates for preparation of estimate and BOQ as well.

This Committee recommends revision of this USOR after every three years.

02/03/2022
Junior Engineer
Durgapur Mechanical & Electrical Division

Assistant Engineer
Kangsabati Mechanical Division

02/03/22
Executive Engineer
Midnapore Mechanical & Electrical Division

02-03-2022
Executive Engineer
Metropolitan Drainage Mechanical Division

02/03/22
Executive Engineer
Mayurakshi Electrical & Mechanical Division

2/3/22
Project Manger (Hd. Quarter)
Suburban Embankment

02/03/2022
Superintending Engineer
Mechanical & Electrical Circle

02/03/22
Chief Engineer (M & E)
Irrigation & Waterways Directorate

2.0 GENERAL SPECIFICATION

2.1 Introduction:

This USOR (M & E) shall be a guide to Engineer Officers, Subordinates Officers, Contractors, in respect to preparation of estimates, drawing up schedule of works, execution of works and also settlement of additional item of works arising during execution.

Description of item in this USOR (M & E) shall be read in conjunction with this chapter alongwith drawing and appendices which provide further information and details. The rates in this USOR (M & E) are inclusive of cost of all materials, transportation and carriage of material up to works site, labour, plant and equipment, tools and tackles, safety gadgets, insurance, incidentals etc. but exclusive of applicable GST & labour CESS, as may be required for execution of a particular item/works or items /works which is/are to be read in conjunction with the specification.

Unless otherwise stated, the rates in this USOR (M & E) are inclusive of all type of overhead cost as listed below and no separate cost provision in this regard shall be kept in the estimate.

i) Items which cover both fabrication and erection shall include conveyance and delivery, handling, unloading, storing, hoisting and all labour for finishing to required shape and size.

ii) To establish, as per requirement, office at site with adequate space for contractor's personnel, inclusive of necessary furniture & furnishing, computers with printers, consumables etc., storage space for equipment, materials etc.

iii) To set up communication system as per requirement to be established at site (telephone, internet facilities etc.), vehicles including carriage vehicle for movement at site etc.

iv) Temporary power connections from electricity board, alternative power arrangement telephones, construction and drinking water etc.

v) General works such as setting out, clearance of site before setting out and clearance of works after completion.

vi) Material testing cost.

vii) All temporary works, formwork and false work.

viii) Cost of labour hutment

ix) Guarding of Material.

x) Cost for implementation of Quality Assurance Plan.

xi) Any other item of work (minor in nature) which could not be specifically provided in the estimate but which is/are necessary for complying the works.

2.2 Works entrusted with Mechanical& Electrical Wing:

Mechanical& Electrical Wing of Irrigation and Waterways Department is entrusted with the task of new project works including rehabilitation and up gradation of various vital functional assets, i. e., electromechanical components of dams, barrages, canal and pump house structures, electrical system & allied works, water supply and fire arrangement at offices, irrigation Colonies and Inspection Bungalows etc.

Brief description & broad specification of works under this USOR (M&E) are described below for guidance.

2.2.1 Gate systems.

Hydraulic Gates are structures or devices to control the flow of water as desired. These are essentially closure devices in which a leaf or a closure member is moved across the fluid way from an external position to control the flow of water.

Vertical lift gates, radial gates, Flap Gates, fall board gates are used in Dams, Barrage, canals, river, drainage channel etc under this department. Most of these gates are Low head Gates (Head of water is below 15m) and very few are medium head gate (Head of water ranging from above15m& below 30m).

Any gate system can be visualized as composed of following three parts:

A. Embedment and other fixed parts: It comprises of all those components of gate which are fixed and it includes first stage embedded parts, second stage embedded parts, sill beam, track plate, seal seats, liners, gate body, bonnets, gland stuffing box etc.

B. Gate Leaf: It is that portion of gate which moves across the fluid way in order to control it. It includes skin plate, vertical stiffeners, horizontal girder, end vertical girder or end arms, wheel / slide assembly, seal assembly etc.

C. Control Equipment: Screw Hoist, Rope Drum Hoist, Hydraulic Hoist, E.O.T. Crane, Gantry Crane etc.

Vertical lift Gate: As the name implies, these gates are fat and are operated in vertical direction. They consist of a flat plate called skin plate which is supported by a system of horizontal girders and vertical stiffeners which in turn are connected to end girders and wheels or sliding pads. These wheels (or sliding pads) transfer the load to concrete through tracks embedded in it.

This type of gates can be sliding, fixed wheeled, caterpillar etc, depending on the type of wheel provided. These could be used up to a span of 25m. Practically, span times (in meter) head is usually 105, i.e. Span (m) × head (m) = 105.

The advantages of vertical lift gates are:

- A short length of flume walls.
- Distribution of the gate water load.

The disadvantages are:

- The requirement of gate slots.
- Possibility of trash getting jammed in the wheels.
- Overhead structure.
- Wheels which have to rotate under water.

The majority of vertical-lift gates are counterbalanced to reduce the hoisting load. To prevent the counterbalance from entering the water when the gate is lifted, the counterbalance is reeved 2:1 so that it travels for only half the distance. This results in an additional load on the superstructure of the order of 2.7 times the mass of the gate, and requires a substantial support structure, adding to the cost of the gate installation.

Components of vertical Lift gate are explained below:

1. Skin Plate: A membrane which transfers the water load on the gate to other components.
2. Vertical Stiffeners: The structural vertical members used to divide the skin plate into panels.
3. Horizontal girder: Main structural member spanning horizontally to transfer the water pressure from skin plate and vertical stiffeners to the end vertical girder.
4. End vertical Girder: Main vertical structural members which take load from the horizontal girders.
5. Wheel Assembly / Slide Pads: Structural arrangements which take load from the end vertical girder and transfer it to the track plate.

Vertical lift gates can be subdivided into following type of gate.

(a) Slide type vertical gates.
(b) Fixed wheel type vertical gates.
(c) Stoney or roller gates.

Radial Gate:

Radial or tainter gate is in the form of a curved plate, storing water usually on convex side, having an arc of a circle as its main member which is supported on a system of steel framework which in turn transfers the thrust of water to concrete through another system of steel grillage or anchorages. Radial gates do not require grooves in the piers. They move on side guide plates which are in flush with the concrete surface.

For spillways, simplicity of operation and smooth flow pattern past the gate and avoidance of flow disturbance due to absence of grooves are positive features for radial gates.

1. Skin Plate: A membrane which transfers the water load on a radial gate to the other components.
2. Horizontal Girder: The main structural members of a radial gate, spanning horizontally to transfer the water pressure from skin plate and vertical stiffeners to end arms of the gate.
3. End Arms: Main structural members which carry the reactions from horizontal girder to the gate trunnion.

4. Trunnion Hub: A hub to which the converging arms of a radial gate are rigidly connected. It houses the trunnion bushing / bearing and rotates about the trunnion pin.
5. Trunnion Assembly: An assembly consisting of trunnion hub, trunnion bush or bearing. Trunnion pin and trunnion bracket.
6. Yoke or Trunnion Girder:A structural member supporting the trunnion bracket and held in place by load carrying anchors or tension members embedded in piers / abutments.
7. Anchor flats / Anchors: Structural tension members provided for transfer of water lad from trunnion girder of a radial gate to the piers / abutments.
8. Anchor Girder: An embedded structural member, transferring load from a radial gate to its surrounding structure.
9. Thrust Pad or Thrust Block; A structural member designed to transfer to the pier or abutment that component of water thrust on a radial gate caused by lateral force induced due to inclination of end arms.
10. Trunnion Tie: A structural member connecting the two trunnion assemblies of a radial gate to cater to the effects of lateral force induced due to inclination of end arms.
11. Wall Plate: A plate embedded flush in a pier / abutment to provide a track for the seal and guide rollers of the radial gate.

2.2.1.1 New Project Work of Gate System:

A) Criteria for Selection of Type of Gate.

It is difficult to give an exhaustive criterion for selection of type of gate in a Water Resources structure because every location is unique. Advances in manufacturing and design offer new efficient and economical solutions to old problems. However, following may be considered while making a selection of type of gate in a hydraulic structure with following criteria.

1. Discharge Capacity.
2. Discharge of floating debris.
3. Silt and bed load passage.
4. Headwater Pressure operation.
5. Loads on Concrete structure.
6. Absence of Vibration.
7. Hydraulic Regulation.
8. Automatic closure in emergency.

This criterion is achieved not only by selecting the proper gate type but also by arrangement of its components like placement of skin plate, seals, rollers etc. which makes the design even more interesting.

B) Design Criteria of Gate.

The general design consideration for all kinds of gate, lays down that

(a) The gate to be designed to withstand the unbalance hydrostatic & hydrodynamic load.

(b) The gate shall be self-closing type under its own weight.

(c) The gate shall be power operated or manually operated (if provided).

(d) In case of regulation requirement, the gate shall be capable of being held in partially open position without cavitations and under vibration.

(e) The gate should be reasonably water tight within the specified limits of 5 to 10 lit/minute/ meter length of seal.

Every gate is designed as per its operating conditions. A gate is generally designed to counteract following types of forces:

1. Hydrostatic head of water 2. Silt Pressure 3. Wave Effect 4. Seating load 5. Earthquake load 6. Hydrodynamic Load 7. Self-Weight (usually small in comparison to other forces)

Every gate is designed as per relevant codal provisions (a list of codes is given in 'BIS reference' Chapter) and on the basis of accepted design practices. Full discussions of design of all types of gates are not come under the scope of this chapter. However, some concepts are discussed as follows:

a) Permissible Mono-axial Stresses for structural components of Hydraulic Gates:

The permissible stresses for various components are taken as per dry and wet condition and further as per accessible and non-accessible conditions as per table given below:

Sl. No.	Material & Type	Wet condition		Dry condition	
		Accessible	Non-accesible	Accessible	Non-accesible
Structural steel					
i)	Direct Compression	0.45YP	0.40YP	0.55YP	0.45YP
ii)	Compression / Tension in Bending	0.45YP	0.40YP	0.55YP	0.45YP
iii)	Direct Tension	0.45YP	0.40YP	0.55YP	0.45YP
iv)	Shear stress	0.35YP	0.30YP	0.40YP	0.35YP
v)	Combined stress	0.60YP	0.50YP	0.75YP	0.60 YP
vi)	Bending Stress	0.65YP	0.45YP	0.75YP	0.65YP
Bronze/Brass					
i)	Bearing stress	0.035UTS	0.030UTS	0.040UTS	0.035UTS

YP stands for minimum guaranteed yield point stress and UTS stands for ultimate tensile strength. For materials which have no definite yield point, the yield point may be taken as 0.2 percent proof stress.

b) Co-acting width of skin plate with beam or stiffeners

For design of stiffeners and girders, the skin plate thickness is also taken into account. The co acting width of the skin plate in non panel construction is restricted by least of the following:

a. 40t + B where T = thickness of skin plate B = width of stiffness flange in contact

b. 0.11 times the span

c. Centre to centre distance of stiffener and girder (Hydrostatic force, Hydrodynamic forces, model studies also) For panel construction it is limited by the width = 2 V B where V= Reduction factor depending upon ratio of support length to the span of the plate and action of the moment as determined in the design codes viz IS 4622-2003. B= Half the span of the plate between two girders

However care should be taken that the width so calculated does not exceed limits set in IS 800¬1980.

c) Semi flexible Design

For the eventuality of one of the roller not in contact with the track plate and extreme loading conditions arising thereof, our IS codes have made a provision for designing the gate as semi flexible, fitted with number of elements with only two wheels on either side. The vertical girder in this case is discontinuous. While this features enables saving of steel in design of roller and tracks but at the same time care has to be taken to provide flexible joints between various elements at skin plate and end girder.

d) Hydrodynamic Loading

The gate is subjected to static water loading when the flow does not take place. When water flows past the gate at partial opening, hydrodynamic forces also occur which may be extreme in some cases causing vibrations, cavitations, non-operability and sometimes even failure of gate. The gate has to be designed carefully for following factors:

a. Gate Slot.
b. Gate lip.
c. Aeration (air demand).

Sometimes model studies become necessary to find out the amount of hydrodynamic forces and air demand. The problem of hydrodynamic loading becomes extreme at high head of water. Placement of sealing also plays a major role in the design of hydrodynamic loading.

e) Provision of Stop logs:

For maintenance of gates, Stop logs usually 10% of total number of spillway bays are kept. However care should be taken to ascertain the condition if the Stop logs are required to be lowered in flowing water. In such cases, provision of emergency bulkhead gate may be provided.

C) Brief description of design of vertical lift gate:

i) Skin Plate

Skin plate thickness is taken 1.5 mm more for account for corrosion. For non panel construction it is designed for bending across stiffeners or horizontal girder. For panel construction is designed for various end conditions as given in design code viz IS 4622-2003.

ii) Vertical Stiffeners / horizontal girder

Vertical stiffeners or horizontal girders are designed as simply supported or continuous beams depending upon framing adopted for the gate and take the load from the skin plate. The spacing between horizontal girders is adjusted in such a way that all the girders carry equal loading. The following methods may be used for this:

a. Trial and error method.
b. Analytical method.
c. Graphical method.

Care is also taken that the deflection of the gate does not exceed the permissible limit, especially so for the top seal gates.

iii) End vertical girder

The end vertical girder is designed as continuous beam resting on wheel contact point with concentrated loads coming from horizontal girders, at the points where they meet the end vertical girder. Torsional effects are also accounted for where applicable.

iv) Wheel Assembly:

Wheel assembly consists of Roller, wheel pin, Wheel bearing or bushing. Care should be taken to ensure the proper design for point contact or line contact loading. The wheel may have to be crowned for ensuring proper contact.

v) Wheel Track

The wheel track may be designed as beam resting on elastic foundation. Care should be taken that the bearing stress as well as shear stress in the concrete does not exceed the permissible stresses.

vi) Seal Assembly

Earlier wooden sealing or leather sealing was adopted for minor works. Nowadays sealing is generally of rubber. It should be as per IS 15466-2004 "Rubber Seals for Hydraulic gates - Specification" and it should be designed in accordance with IS 11855-2004 "Guidelines for Design and use of different types of Rubber seals for hydraulic gates". However care should be taken to take the friction coefficient of cladded seals in such a way that takes into account the wearing of cladded surface after repeated usage. Sometimes (for slide gates) metal seals are used which are generally of Brass or Bronze and are fixed to the gate leaf by countersunk screws of stainless steel or of same material.

D) Brief description of design of Radial gate:

Geometry of Gate:

i) Gate Sill Location

Gate sill is located downstream of crest and as close to the crest as possible to economise on the height of gate and size of pier. Placement of hoist and bridge etc should also be considered. As a general guideline sill may be placed at about 0.3 to 0.8 m below the crest.

ii) Radius of Gate

The radius of gate should be ideally between 1.0 times H to 1.25 times H. Where, H is the distance between top of gate and gate sill. However, this guideline is for crest radial gate. For top seal radial gate provided in sluices, consideration for placement of trunnion above water level and for minimum hoisting effort also needs to be taken into account.

iii) Gate Trunnion;

Trunnion is generally placed 1.5 m above the upper nappe of water along piers to prevent damage to trunnion due to floating debris and ice etc. However, this guideline is for crest

radial gate. For top seal radial gate provided in sluices, consideration for placement of trunnion above water level and for minimum hoisting effort also needs to be taken into account.

iv) Location of hoist.

If the radial gate is operated with rope drum hoist. The hoist may be located upstream or downstream. Upstream location of rope drum hoist involves less hoisting effort but its connection with gate becomes inaccessible and should be designed for extra safety. Downstream arrangement of hoisting involves more hoisting effort but the connection to gate is accessible and possible damage due to flowing debris etc is avoided.

A brief description of design of various components of Radial Gate is as follows:

a) Skin Plate

Skin plate thickness is taken 1.5 mm more for account for corrosion. For non panel construction it is designed for bending across stiffeners or horizontal girder. For panel construction is designed for various end conditions as given in design code viz IS 4623 2003.

b) Vertical Stiffeners or horizontal girders

These are designed in the same way as in vertical lift gates. However the effect of curvature in design of vertical stiffeners is taken into account. Sometimes horizontal stiffeners are also used. The total number of horizontal girders depends upon the gate height. But it should be kept minimum to simplify fabrication and maintenance as more horizontal girder implies more end arms which have to be accommodated in trunnion. As a general guidance the number of horizontal girders may be adopted as follows:

a) For height of gate upto 8.5 m - 2 Nos

b) For height of gate between 8.5 m to 12 m -3 Nos

c) For heights above 12 m - 4 or more

c) Bracing for Horizontal girder:

Bracing for horizontal girders are designed as per shear force shared by bracing panels at their locations.

d) End Arms:

End arms may be straight or inclined to economize on horizontal girder. But in case of inclined arms, lateral force has to be accounted for by provision of thrust block or trunnion tie beam. These are designed as columns for axial force and bending transmitted by horizontal girders.

e) Trunnion hubs:

Trunnion hubs are designed as thick or thin cylinders subjected to internal pressure generated by the resultant load on trunnion.

f) Trunnion bushing

Trunnion bushing should be of Aluminium bronze or self lubricating type. Overall economy is to be considered before selecting a type of bushing.

g) Anchorages;

The anchorage system of the radial gate is provided for the transfer of water load through the gate trunnion to the piers or abutments. These may be of following types:

i) Bonded anchorages.
ii) Unbonded Anchorage.
iii) Combined Anchorage.
iv) Pre stressed Anchorage.

In bonded anchorage the load transfer takes place in bond between the anchors and the concrete. In unbonded anchorage the transfer takes place in bearing between the anchor girder and concrete. For large size radial gates nowadays pre stressed anchorages are

E) Deflection of the gate:

Maximum deflection of the Horizontal girders/gate under normal conditions of loading shall be limited to:

1/800 of the span (c/c of the wheels) -Fixed wheel gate

1/800 of the span (c/c of the sliding track) -Low head slide gate

1/2000 of the span (c/c of the sliding track) -Medium and high head slide gate

F) Embedded parts.

Gate embedment are in the form of a steel track, guides, seal seat, seal base and sill beam and anchorages which are embedded in the concrete in the grooves. The minimum edge distance 'e' of the bearing flange plate shall in no case be less than 150mm.

Embedded parts play an important role in any Gate system. Quality of Gate functioning is largely affected by embedded parts. All the embedded parts for Gates & stop log gate in dams, barrages, should be made lined with corrosion resistance steel / Stainless steel. The BHN of S.S. for wheel track face shall be 50 points higher than the wheel. Length of different embedded parts shall be calculated as below:

Sl. No.	Embedded parts.	Length required
01.	Roller track	up to concrete pier top or 2 x Gate height +200 mm(whichever is less)
02.	Side seal path	Gate Height + 200
03.	Guide path/tee	up to concrete pier top + Gate height +200
04	Bottom Seal beam	same length of the skin plate

Anchor bolts shall be provided to hold the 2nd stage embedded parts. The anchor bolts shall be with double nuts and washers having suitable length and minimum diameter of 16mm. It is required to provide sufficient & skilled manpower along with all necessary T&P in time so that insert plates are installed during 1st stage concrete along with the progress of work of civil counterpart. It is required to give due attention and vigilance during concreting work (in both 1st stage and second stage) so as to ensure verticality of pier & designed size of

concrete block out. No bulging of concrete into the block out should happen. It will not only facilitate the fitting, fixing of 2nd stage embedded parts successfully but also provide free passage to the gate so as to move up & down freely.

Few Block out Diagram along with embedded parts for hydraulic Gates are attached as **Annexure -I**, which provide guidance only. Size of Block out as well as embedded parts shall be calculated as per design criteria.

G) Hoist support Structure.

Hoist Support structure consist of foundation bolts Assembly, base plates, trestle, Hoist Bridge, Railing and staircase. These shall be erected on the top of each pair and embankment on both sides. The height of the trestle shall be such that entire gate can be came out of the block out of the pair for proper maintenance. The width of the hoist bridge shall be adequate to accommodate the entire hoist mechanism, electrical panel and sufficient space for operation and maintenance. The hoist supporting structure and trestle shall be made of structural steel (weldable) conforming to I.S: 2062- 1992 and shall be designed to withstand the dead weight of the hoist, hoisting load as well as vibrations coming on the hoist, while in operation. Suitable anchorages for the hoist frame shall be provided to take the worst combinations of all loads under which the gates and hoists are under operation.

It is required to provide sufficient & skilled manpower for verifying size and position of block out at pier top during 1st stage concrete along with the progress of work of civil counterpart for successful installation of foundation bolt assy.

H) Catwalk Bridge:

Catwalk Bridge should be provided at downstream side besides& parallel to trestle bridge. It shall be used as a inspection path for gate. The height of the catwalk bridge shall be below the level of trestle bridge &close to gate position so that entire gate functioning can be easily inspected.

I) Hoist arrangement:

The gate shall be operated by independent fixed screw stem or rope drums type or chain hoist. The choice or selection of the hoist will be quite obvious in some cases but in other cases more than one feasible hoisting arrangement may be envisaged from the technical point of view but the ultimate selection is to be made on the basis of economy, simplicity of the arrangement or ease of maintenance.

1. Screw Hoist:

This is the very simple type of operating equipment used extensively earlier but at present due to its limitation in hoisting capacity and inefficiency, it is not finding much use for new installation. It is designed as per provisions of IS 11228- "Recommendations for design of screw hoists". It is operated either by hand or by electric motor. Sometimes even today, it is used for very low head installation where a positive downward thrust is desired for closure of gate. This type of Hoist generally used in gates at Canals, River etc.

2. Rope drum Hoist:

It is being extensively used these days where the downward positive thrust is not required for closure of gates and the gate is to close by its own weight. It is placed on a trestle whose height is determined by the height of gate and water level. Drums are designed to accommodate the required length of rope. It is designed as per provisions of IS 6938 - "Code of practice for design of rope drum hoist and chain hoist for hydraulic gates"

The operating equipment of rope drum type hoist shall comprise of electrically operated motor or manual to drive the rope drums through gearing, couplings. The rope drum assembly units, motor, brake and reduction units shall have minimum 3mm. thick MS sheet covers with flat/angle iron framework to protect it from dust, dirt and direct exposure to moisture. Suitable limit switch shall be provided on gate position indicator for automatically and positively stopping the drive motor during hoisting / lowering of the gate as soon as either end of the gate travel is reached. A manual / electrical interlock shall be provided in control circuit to cut off power supply to motor, while operating manual drive. Reduction gear unit shall be filled with gear oil of suitable grade. Provision shall be made for normal maintenance and repairs of hoist without disconnecting rope from hoist drum and with gate resting on sill (fully closed).

3. Chain Hoist:

Here sprocket and chain is used in place of drum and rope. This type of hoist is not being used extensively these days due to more maintenance requirement and operational problems.

J) Materials Standard:

In the manufacture of gates and appurtenances a great variety of materials, such as rolled, stainless, cast and forged steels, cast iron, bronze and its alloys, natural and synthetic rubber for seals and, in some cases, timber, is used. The wide range of types and the amount of materials available can satisfy all the needs and requirements of the gate designers, thus leading to an adequate and economic selection of the material. This selection must comply with sound criteria, in order to warrant reliable operation and long life for the equipment. Therefore, the designer should take into account not only the cost and availability of the material in the market but also its main characteristics such as the chemical composition, physical and mechanical properties (yield and tensile strength, elongation, toughness, hardness, weldability, machinability, heat treatment capability and the corrosion resistance. The material for various parts of gate leaf, embedded parts, hoist Support structure and hoist system is given below.

a) Gate leaf & Embedded parts.

Sl. No.	Components Parts	Recommended Material	Code Reference
i.	Structural parts of gate leaf including skin plate, stiffeners, horizontal girders, diaphragms, liners, seal clamp, Lifting lugs, structural parts of lifting beam, guide,Arms, Bracings, Anchor Girder, Yoke Girder, Load carrying Anchors etc.	Structural steel/ High strength structural steel	IS 2062
ii.	a. Load roller/Guide Roller b. Trunnion Hub and Bracket	Cast steel/ forged steel	IS1030 IS2062, IS210
	c. Wheel pins /Trunnion Pins	Corrosion resistant steel /SS 304	IS:1570(Part V) Cr. 13
	d. Retainers	Structural steel/ SS 304	IS: 2062
	e. Sleeves for pin (Distant piece)	Corrosion resistant steel	IS :1570 (Part- V) Gr.04Cr19Ni9

Sl. No.	Components Parts	Recommended Material	Code Reference
iii	a. Bushing	Self-lubricating bush/GM	IS305
		Al. Bronze (for lifting beam links)	IS: 305, Gr-AB-2 IS:318, Gr-LTB-1
iv.	Seals	Rubber	IS:11855
v.	Track & wall plate	Corrosion resistant	IS: 1570(Part- V) Gr.20
		Steel / Stainless Steel	Cr13 or Gr.30Cr13 or Gr.04Cr19Ni9 / AISI- 410/ 304
vi.	Seal seat	Stainless steel	IS:1570 Gr.04 Cr19 Ni9 / AISI 304
vii.	Lifting hooks (for lifting beam)	Forged steel/ Structural steel	IS: 2004 CI-V/IS: 2062
viii.	Lifting Pins	Corrosion resistant steel / Stainless Steel	IS:1570 (Part-V) Gr.20Cr.13 / AISI- 410/304

b) Material for Hoists System

Sl. No.	Components Parts	Recommended Material	Code Reference
i.	Wire rope	Steel Improved plough normally 6×36 construction	IS: 2266
ii.	Gears	Cast Steel/ Forged Steel	IS: 1030/IS: 2062/IS: 2707
iii.	Pinions	Cast Steel/Forged Steel	IS: 1570C40
		Forged Steel	IS: 2004CI.IV
iv.	Drums	Cast Steel/MS/CI	IS: 1030 / IS:2062
v.	Sheaves and Pulleys	Cast Steel/CI	IS:1030 / IS:2062
vi.	Shafts	Forged Steel/Rolled Steel	IS:2004CI.VI
vii.	Limit Switches, Proximity switch	Standard reputed Make / BCH / SIEMENS / SCHNEIDER / L&T	
viii.	Pins	Forged Steel/Carbon Steel	IS:2004/IS:1570-C40
ix.	Bushings	Bronze/Al-Bronze	IS:305/IS:318
x.	Threaded fasteners		IS:1363,IS:1367
xi	Base plate for Head stock assy.	Cast Steel/MS/CI	IS: 1030 / IS:2062
xii	Nut for head stock assy.	Cast Steel/CI/GM	IS:1030 / IS:2062/IS305

c) Material for Hoist Bridge, Hoist Support, Trestle, Walkways, Railing, Gantry Girder, Dogging, Device etc.

Sl. No.	Components Parts	Recommended Material	Code Reference
i.	Base Plate, Anchors, Columns, Stiffeners, bearings, lugs, girder etc.	Structural steel	IS: 2062 Rolled sections
ii.	Walkway	Chequered Plate	Standard / IS: 3502
iii.	Handrails & parts		IS: 1235 MS black medium duty or suitable structural section
iv	Lifting Pins	Corrosion resistance steel / stainless steel	IS: 1570 (Part V) Gr.20 Cr.13 / AISI-410 or 304

2.2.1.2 Manufacturing

Dimensional accuracy and maintaining tolerances play most vital role in successful commissioning of any hydro-mechanical work. Hence, most of the work shall be performed at workshop as per approved drawing. The only portions of work are to be left for doing at site, shall be based on erection methodology and ease of installation. Workshop must be equipped with all necessary machine tool such as Lathe Machine, Shaping Machine, drilling machine, gear cutting machine, Milling Machine, Shearing Machine, welding & Gas cutting facility etc and such machines should be run by highly skilled personnel. Such workshop shall have own in¬house quality control set up. Any machining work to be done within the permissible tolerance. Such tolerance shall be guided by fundamental tolerance limit that equal to 0.45D/3 +0.001D, where D is the geometric mean of diameter step and preferably H hole & d/e/f shaft combination. However, limit, fit and tolerances shall be guided by IS 919 latest revision. Sequences of activities in workshop usually are as under with a little variation.

A. Surface Cleaning:

Structural sections from the rolling mills may require surface cleaning to remove mill scale prior to fabrication and painting. Hand preparation, such as wire brushing, does not normally conform to the requirements of modern paint or surface protection system. However in some applications manual cleaning is used and depending on the quality of the cleaned surface they are categorized into Grade St-2 and Grade St-3. Blast cleaning is the accepted way of carrying out surface preparation in a well-run fabrication shop. Abrasive sand or steel particles are projected on to the surface of the steel at high speed by either compressed air or centrifugal impeller to remove rust and roughen the surface before applying the protective coating. Flame cleaning is another method of surface cleaning. In this method the surface is cleaned using an oxy-acetylene torch which works on the principle of differential thermal expansion between steel and mill scale. In another method the steel piece is immersed in a suitable acid and the scale and rust are removed.

B. Cutting and Machining:

Following surface preparation, dimensional marking & cutting to length is always the first process to be carried out. Cutting is done by any of the following methods:-

a) Shearing and cropping by Hydraulic shears.

b) Flame Cutting or Burning.

c) Arc Plasma Cutting.

d) Cold Sawing.

e) Punching and Drilling.

Most fabrication shops have a range of machines, which can form holes for connections in structural steel work. The traditional drilling machine is the radial drill, a manually operated machine, which drills individual holes in structural steelwork. But this method has become too slow for primary line production. Therefore, larger fabricators have installed NC (Numerically Controlled) tooling, which registers and drills in response to keyed in data. It is also possible to punch holes, and this is particularly useful where square holes are specified such as anchor plates for foundation bolts.

Rolled steel may get distorted after rolling due to cooling process. Further during transportation and handling operations, materials may bend or may even undergo distortion. This may also occur during punching operation. Therefore, before attempting further fabrication the material should be straightened. In current practice, either rolls or gag presses are used to straighten structural shapes.

Gag press is generally used for straightening beams, channels, angles, and heavy bars. This machine has a horizontal plunger or ram that applies pressure at points along the bend to bring it into alignment. Long plates, which are cambered out of alignment longitudinally, are frequently straightened by rollers. They are passed through a series of rollers that bend them back and forth with progressively diminishing deformation.

Misalignments in structural shapes are sometimes corrected by spot or pattern heating. When heat is applied to a small area of steel, the larger unheated portion of the surrounding material prevents expansion. Upon cooling, the subsequent shrinkage produces a shortening of the member, thus pulling it back into alignment. This method is commonly employed to remove buckles in girder webs between stiffeners and to straighten members. It is frequently used to produce camber in rolled beams. A press brake is used to form angular bends in wide sheets and plates to produce cold formed steel members.

C. Fitting and Reaming:

Before final assembly, the component parts of a member are fitted-up temporarily with rivets, bolts or small amount of welds. The fitting-up operation includes attachment of previously omitted splice plates and other fittings and the correction of minor defects found by the inspector. In riveted or bolted work, especially when done manually, some holes in the connecting material may not always be in perfect alignment and small amount of reaming may be required to permit insertion of fasteners. In this operation, the holes are punched, 4 to 6 mm smaller than final size, then after the pieces are assembled; the holes are reamed by electric or pneumatic reamers to the correct diameter, to produce well matched holes.

D Fastening Methods:

The strength of the entire structure depends upon the proper use of fastening methods. There are three methods of fastening namely bolting, riveting and welding. A few decades back, it was a common practice to assemble components in the workshop using bolts or rivets. Nowadays welding is the most common method of shop fabrication of steel structures. In addition to being simple to fabricate, welded connection considerably reduce the size of the joint and the additional fixtures and plates. However, there is still a demand for structural members to be bolted arising from a requirement to avoid welding because of the service

conditions of the member under consideration. These may be low temperature performance criteria, the need to avoid welding stresses and distortion or the requirement for the component to be taken apart during service e.g. bolts in crane rails or bolted crane rails.

E. Finishing:

Gate structural members like roller tracks/ thrust pads and thrust bearings whose ends must transmit loads by bearing against one another are usually finished to a smooth even surface. Finishing is performed by sawing, milling or other suitable means. Several types of sawing machines are available, which produce very satisfactory finished cuts. One type of milling machine employs a movable head fitted with one or more high-speed carbide tipped rotary cutters. The head moves over a bed, which securely holds the work piece in proper alignment during finishing operation. The term finish or mill is used on detail drawings to describe any operation that requires steel to be finished to a smooth even surface by milling, planning, sawing or other machines.

F. Quality control in fabrication:

Quality assurance during fabrication of gate components assumes utmost importance in ensuring that the completed gate assemblies behave in the manner envisaged during design stage. Any deviation from these design considerations as reflected in detail drawings may introduce additional stresses to the structure and affect its strength and durability. This may also affect the sealing performance of the gates. In order to ensure that the fabrication can be carried out in accordance with the drawings, it is necessary that inspection and checking is carried out in accordance with an agreed Quality Assurance Plan (QAP). The plan should elaborate on checks and inspections of the raw materials and also of the components as they are fabricated, joined etc. For fabrication activities being carried the absence of controlled environment (as in an organized workshop), the quality of workmanship of such fabrication is likely to suffer. It has, therefore, become all the more important to motivate the fabricators to appreciate the usefulness of Quality Assurance Plans and introduce the system in all their works and at site as well.

G. Painting:

The gates and hoist components are painted in accordance with provision of IS: 11477. Following gates and hoist components are painted to protect them against corrosion: -

- Embedded parts,
- Gate leaf,
- Hoists and its supporting structures

Paints are applied during manufacture and during maintenance.

a) Surface Preparation:

Surface preparation shall include through cleaning, smoothing, drying and similar operation that may be required to ensure that the primer and or paint is applied on suitable surfaces. Weld spatters or any other surface irregularities shall be removed by any suitable means before cleaning. All oil grease and dirt shall be removed from the surface by the use of clean material spirits, Xylol or white gasoline and clean wiping materials. Following the solvent cleaning, the surfaces to be painted shall be cleaned of all rust, mill scale and other lightly adhering objectionable substances by sand blasting. Surface of stainless steel, nickel, bronze and machined surface adjacent to metal work being cleaned or painted shall be protected

by making tape or by other suitable means during the cleaning and painting operations. Primers shall be applied as soon as the surface preparation is complete and prior to the development of surface rusting. In case there is considerable time gap, the surface shall be cleaned prior to priming.

b) Shop painting:

All embedded parts which come in contact with concrete shall be cleaned and given two coats of cement Latex to prevent rusting during the shipment while awaiting installation. Embedded parts which are not in contact with concrete and gate parts shall be given two coats of zinc rich primer with epoxy resin to obtain a dry film thickness of 75 microns, which shall be followed by two coats at an interval of 24 hours of coal tar blend epoxy resin part so as to get a dry film thickness of 80 microns in each coat. Total dry film thickness of paint shall be 300 microns.

The following surfaces are not to be painted unless or otherwise specified:

a) Machine finished or similar surface.
b) Surfaces which will be in contact with concrete.
c) Stainless steel overlay surfaces.
d) Surfaces in sliding or rolling contact.
e) Galvanized surfaces, brass and bronze surfaces.
f) Aluminium alloy surfaces.

All finished surfaces of ferrous metal including bolts, screw threads etc., that will expose during shipment or while awaiting installation shall be cleaned and given heavy uniform coating of gasoline soluble rust preventive compound or equivalent

c) Hoist and supporting structure:

i) Structural components: Primer coats of zinc phosphate primer shall be applied to give a dry film thickness of 40±5 microns. One coat of alkyd based micaceous iron oxide paint to give a dry film thickness of 65 ± 5 microns followed by two coats of synthetic enamel paint confirming to IS 2932 - 1974 to give a dry film thickness of 25 ± 5 microns per coat. The interval between each coat shall be 24hours.The total dry thickness of all coats of paint including the primary coat shall not be less than 175 microns.

ii) Machinery: Except machined surfaces all surfaces of machinery including gearing, housing, shafting, bearing pedestals etc., shall be given one coat of zinc phosphate priming paint to give minimum film thickness of 50 microns. Motors and other bought out items shall be painted if necessary. The finished paint shall consists of three coats of aluminium paint confirming to IS2339 - 1963 or synthetic enamel paint confirming to IS 2932 - 1977 to give a dry film thickness of 25±5 microns to obtain a minimum dry film thickness of 125 microns.

d) Inspection and testing of painting:

The following steps involved in inspection of painting are general inspection before and during painting

- Viscosity test of paints
- Thickness test - using Elcometer
- Inspection of general appearance of finished work.

The aim of inspection and testing is to ascertain whether the recommended practice is being employed during every stage of application and whether the final results fulfil the object of painting, inspection therefore means a close supervision while the work is in progress. Any test carried out should be non - destructive nature or, if of destructive nature, should be either restricted to areas which can be restored without marring the general appearances, or be such that it is possible to restore easily without necessitating a complete repetition of the work. When inspecting general painting work while in progress, it should be ensured:

- That painting follows immediately after pre cleaning or pre treatments; that any contamination which may occur in the interim period is removed, that special precautions are taken when painting after galvanizing;
- That no painting is carried out when there is danger of dew;
- That tools used are clean and not excessively worn;
- That the paint in the drums is thoroughly mixed prior to application; that drums are inspected to make sure that no sediment is left in them;
- That if paint has thickened because of long storage or because of the evaporation of the solvents, its viscosity is adjusted as recommended by the paint manufacturer;
- That each coat is allowed to dry sufficiently but not excessively before applying the following coat; that manufacturer's instructions for drying time are adhered to properly; and
- That every individual coat is properly applied, reasonably level and smooth and free from runs and 'holidays' (minute uncovered areas).

2.2.1.3 Erection:

General: Erection of gates, embedment and hoist machinery and structure is the process by which the fabricated structural members are assembled together to form the skeletal structure. The erection is normally carried out by the erection contractor. The erection process requires considerable planning in terms of material delivery, material handling, member assembly and member connection. Proper planning of material delivery would minimize storage requirement and additional handling from the site storage, particularly heavy items. Erection of structural steel work could be made safe and accurate if temporary support, false work, staging etc. are erected. Staging/scaffolding must be strong and rigid stiffened with necessary cross bracers and always decked and boarded on the sills with close boarded veiling and swings to prevent any injury to persons or materials

Before erection the fabricated materials should be verified at site with respect to mark numbers, key plan and shipping list. The structural components received for erection should be stacked in such a way that erection sequence is not affected due to improper storing. Care also should be taken so that steel structural components should not come in contact with earth or accumulated water. Stacking of the structures should be done in such a way that, erection marks and mark numbers on the components are visible easily and handling does not become difficult. It is emphasized that safe transportation of fabricated items to the site, their proper storage and subsequent handling are the pivotal processes for the success of fabrication of structural steel work As seen from the past executed projects, the accuracy and high quality of civil construction and erection of embedded metal parts plays predominant role in safe, satisfactory and trouble free erection and subsequent smooth operation of the hydro mechanical equipments.

A. Sequence of Activities during Erection:

- Receiving material from the shop and temporarily stacking them, if necessary.
- Lifting and placing the member and temporarily holding in place.
- Temporarily bracing the system to ensure stability during erection.
- Aligning and permanently connecting the members by bolting or welding.
- Connecting cladding to the steel structural skeleton.
- Application of a final coat of painting.

2.2.1.4 Welding

Metal arc welding is the most widely used welding process for the fabrication, installation and erection of embedment, gate leaves and hoists. The main features of this process are as follows:

- Immediate heating.
- Depth of fusion and heating is fixed by electrode type size and current and can be controlled somewhat but not closely, by the operator.
- Nearly all metals can be welded.
- Welding can be carried out in all positions.
- Wide range of thickness can be welded.

The welding processes involve:

- Preheating: Reduces stress and distortion.
- Preparation for welding: Comprises cleaning the weld surface.
- Welding: Requirement of proper welding technique.
- Post heating: To reduce residual stresses in metal.

Precautions for quality welds:

Each bead and layer shall be thoroughly cleaned of all slag and spatter before the next bead or layer is deposited. Welds shall be free from cracks, tears and gross porosity. Defective welds shall be removed by gauging, chipping or grinding and the joint re-welded. Where complete penetration welds are to be welded from both sides, the root of the first side welded shall be gauged to sound metal before the second side is welded. When welding in the vertical position, the progression shall be upwards for all passes.

A. Welding defects, causes and types:

Normal welds always contain minute slag inclusions or porosity as revealed in non - destructive testing. Such small imperfections which cause some variations in the normal average properties of the weld - metal are called discontinuities. When discontinuity is large enough to affect the function of the joint, it is termed as defect and are caused due to:-

- Substandard welding consumables.
- Inefficient workman ship.
- Lack of cleanliness.
- Un-favourable properties of the base metal.
- Low ambient temperature and humid atmosphere.

Following defects are normally found:-

Incomplete Penetrations: - This defect occurs at the root of the joint when the weld metal fails to reach it or weld metal fails to fuse completely with the root faces of the joint. As a result, a void remains at the root zone which may contain slag, inclusions. In a fillet weld, poor penetrations at the root zone can give rise to cracking of single butt weld. In a weld adequate root penetration is ensured by size of electrode .sufficiently high current and directing the arc towards the root during deposition of the root pass..Rectification of this defect is a very costly proposition because it requires removal of the entire thickness of the weld and re welding.

Lack of Fusion:- Lack of fusion is the poor adhesion of the weld bead to the base metal and caused due to scale ((rusting), dirt, Oxide, slag and other non metallic substances which prevent the underlying metal from reaching metallic temperature. It can be prevented by Keeping the joint surface clean adequate welding current.

Undercut:- Undercutting is when the fillet weld reduces the cross-sectional thickness of the base metal, which reduces the strength of the weld and work pieces. This defect is usually caused by:

- Excessive welding current.
- Too high speed of arc travel.
- Wrong electrode angle or excessive side manipulation.
- Also causes due to damp or improperly formulated electrodes.

Note: In the case of statically loaded structures the presence of small and intermittent under cutting will reduce fatigue endurance of the welded joint and hence it should not be permitted.

The defect is rectified by filling up the undercut groove with weld pass. If under cut is deep and contains slag, it should be clipped away before re --welding. If the rectification is being carried out on thick joints and on high tensile steels, the welding procedure including pre heating should correspond to the recommended procedure for particular steel.

Overlap:-The defect occurs at the toes of weld and consists of weld - metal which has over flowed on the base metal surface without actually fusing to later. It can be isolated intermittent or continuous. It occurs more often in fillet welds and results in an apparent increase in the weld size.

Causes of overlap:

- It is occurred by an incorrect manipulation of the electrode, where by the weld metal flows away from the fusion zone.
- Use of too large an electrode in relation to the welding position, and excessive current coupled with a too low welding speed also promote its occurrence.
- When a single - pass fillet larger than 7.5mm in leg length is made in the horizontal position, the molten metal tends to sag and causes overlapping in at the toe of the horizontal member.

Rectification of overlap:

Slight and intermittent over lapping may be ignored in statically loaded structures, but it should not be permitted in dynamically loaded structure as over laps act as stress-raiser. Overlap is rectified by grinding, chipping or gouging out the excess infused weld metal. Care should be taken to leave the smooth surface.

Slag Inclusions:- Slag inclusions are detected by the normal non-destructive testing methods. While non - metallic inclusions are observed in the weld micro structure at high magnification. Non-metallic particles of comparatively large size entrapped in the weld metal are termed as slag inclusion. Slag inclusions usually occur in multi pass weld due to imperfect cleaning of the slag between the dispositions of successive passes. It may also be caused by heavy mill scale, loose rust, dirt, grit and other substances present on the surface of base metal. Slag trapped in under cuts or between uneven preceding runs may give rise to elongated lines of included slag when a subsequent weld pass is deposited. The melting characteristic of the welding consumables and particularly the viscosity of the rusting slag have an important bearing on inclusion. The molten slag should float freely to the surface of the weld pool and easily removable on solidification. It results in loss of strength and hair line cracks

Prevention of slag inclusion:

- Use proper welding consumables.
- Keep joint surfaces (especially gas cut surfaces) and bare filler wires perfectly clean and clean the base metal thoroughly before welding.
- Avoid under cuts and gaps between deposited perfectly clean and clean the base metal thoroughly before welding.
- Avoid under cuts and gaps between deposited passes.
- Clean the slag thoroughly between weld passes.

Porosity:- The presence of a group of gas pores in a weld caused by the entrapment of gas during solidification is termed as Porosity. The pores are in the form of small spherical cavities either clustered locally or scattered throughout the weld deposit. Sometimes entrapped gas gives rise to single large cavity, which is termed as a blow hole. In some rarer cases, elongated or tubular gas cavities are presented. These are referred to as piping or worm holes. The gases are evolved by the chemical reactions in the welding and these gases may have high solubility in the molten weld metal, but as the metal solidifies and cools, their solubility decreases rapidly and they are released from the metal. Sometimes if the weld metal solidification and cooling is too rapid, the gas gets entrapped in the form of Porosity.

Causes of porosity:

- Chemically imperfect welding consumables for example deficient in deoxidizers
- Faulty composition of the base metal or electrode wire for example, high sulphur content.
- Oil, grease moisture and mill scale on the joint surface.
- Excessive moisture in the electrode coating or submerged - are flux.
- Inadequate gas shielding or impure gas in a gas shielded process.
- Low welding current or too long an arc.
- Quick freezing of the weld deposit.

Puddling of the weld metal and use of preheat or higher current allow sufficient time for the dissolved gases to escape from the weld metal. Presence of small, finally dispersed porosity is normally not expected to affect the static and even dynamic properties of a welded joint. However excessive porosity blow holes or piping must be guarded against as they seriously impair these properties. Their presence is detected by the conventional NDT methods. The defective portions must be removed and re-welded.

Cracks:- Crack is defined as a discontinuity caused by the tearing of the metal while in a plastic condition (hot crack) or by fracturing of the metal when cold (cold crack). Hot cracks are those that occur at elevated temperatures and are usually solidification related. These cracks occur at temperatures above 540°C and when observed under the microscope are seen to have travelled across the boundaries between the grains (inter granular). If the cracks have extended to the surface, the fractured surface is found to be coated with the blue scale or possibly black scale. Cold cracks are those that occur after the weld metal has cooled to room temperature and may be hydrogen related. Most forms of cracking result from the shrinkage strains that occur as the weld metal cools. Cracking can occur in the weld metal, at the fusion line or in the base metal.

B. Post Weld Fabrication Difficulties:

Welding Distortions:

When laying a weld bead, filler metal is deposited at a high temperature above the melting point of material. This is approximately 1,370 deg C for steel. The weld wants to shrink as it cools to room temperature, but is restrained from doing so by the adjacent cold base metal. This restraint creates high-residual tensile stress that causes the weld to act like a stretched rubber band, with the work piece holding the ends. For this reason, when the clamps that hold the work piece are removed the base metal is allowed to move (or spring back) the part is distorted. Thinner material is more susceptible to this because it has less stiffness. Stainless steels are also more susceptible because they have greater thermal expansion and lower thermal conductivity than carbon steels.

How to manage fabrication distortions:

A full awareness of distortion is vital to all concerned with welding including the designer, detailer, factory foreman and the welders, as each in their actions could cause difficulties through lack of understanding and care. Weld sizes should be kept to the minimum required for the design in order to reduce distortional effects; in many cases, partial penetration welds can be used in preference to full penetration welds, deep penetration welds in preference to ordinary fillet welds. Some distortional effects can be corrected, but it is much more satisfactory to plan to avoid distortion and thereby avoid the difficulties and costs of straightening and flattening to achieve final acceptability.

Control of distortion:

These can be avoided by taking following:-

- Avoid over welding. The bigger the weld, the greater the shrinkage: correctly sizing a weld not only minimizes distortion, but also saves weld metal and time.
- Intermittent welding. Use intermittent welds instead of continuous welds where possible to minimize the amount of weld metal.
- Fewer weld passes. Because shrinkage accumulates from each weld pass, a fewer number of big passes results in less distortion than a greater number of small passes with small electrodes.
- Place welds near the neutral axis, or the centre of the part. Reduce warpage by providing less leverage for the shrinkage forces to pull the plates out of alignment.
- Balance welds around the neutral axis. Welding on both sides of the plate offsets one shrinkage force with another, to minimize warpage

- Use the back step welding technique. The general progression of welding in this technique may be left to right, but each bead segment is deposited from right to left.
- All members that are welded will shrink in their length, so each member will either be fabricated over-length or cut to length after welding, or an estimate of shrinkage will be added to anticipate the effect during the fabrication of the member.
- For the control of angular distortion and bowing, there are two methods of control that can be considered if the distortion is likely to be of significance :

Pre-setting: The section is bent in the opposite direction to that in which it is expected to distort and welding is then carried out under restraint. When cool, the clamps are removed and the section should spring straight. Trials and experience can determine the extent of pre-bend for any particular member.

Clamping: The units are held straight by clamps whilst the welding is carried out, which reduces the distortion to tolerable amounts.

- Thermal stress relieving. Another method for removing shrinkage forces is thermal stress relieving, i.e., the controlled heating of the weldment to an elevated temperature, followed by controlled cooling.
- Peening the weld bead stretches it and relieves the residual stresses. But peening must be used with care. For example, a root bead should never be peened because of the increased risk of concealing or causing crack.
- Peening on the final pass is not permitted because it can cover a crack and interfere with visual inspection.

C. Other Issues in Fabrication:

- Non availability of standard steel material The non-standard steel plates may be undersize (thickness-wise) , may lack sufficient carbon content, rendering the material dangerously brittle; and may fail in tension tests.
- Delay in importing items such as bearings etc. It occurs due to delay in order placement, items being non standard, strikes or traffic congestion at ports. It causes fitment delays in assemblies
- Inadequate or lack of facilities for stress relieving in the shop / site etc.
- Lack of machines of desired ratings and capabilities etc.
- Lack of Inspection and quality monitoring mechanism at shop floor.
- Strikes of labourers
- Lack of inspection or quality monitoring instrumentations at shop or site.
- Non availability of skilled man power.
- Outsourcing of job to other contractors resulting in comprise of quality.
- Change in design during the progress of work etc.

2.2.1.5 Operation and Maintenance Gates and Hoists

A) General

Proper maintenance of Hydraulic gates and hoists is very important for satisfactory operation of Gates and to achieve the envisaged benefits from the project. For systematic operation and maintenance of the gates and their operating equipment, the availability of comprehensive Operation and Maintenance manual for the equipment is essential.

B) O&M Manuals

The O&M Manuals for Hydraulic gates and hoists normally should include the following: -

- The design features of various components.
- Particulars of bought-out items and source of availability with addresses and phone Nos.
- Operating instructions.
- Type of lubrication oil and grease to be used and its availability.
- Schedule of maintenance and repairs.

The above are prepared for each hydraulic gate installation and the operation staff shall be made well conversant with them and trained for the job.

C) Need for Maintenance

Gated structures need regular maintenance with inspection and monitoring. If faithfully followed under competent management, structures can give totally reliable service long after their initial designed life cycle. For proper maintenance, the steel structures must be periodically inspected. .Failure of gates in most of the cases happens due to:

- Non-judicious choice of factor of safety at design stage to account for unforeseen forces.
- Loss of cross-section and strength of members due to near absence of preventive maintenance program.

Corrosion is the biggest culprit causing loss of cross-section of gate components and thereby reducing load carrying capacity of members. Corrosion implies destruction of metal by electro¬chemical or simple chemical action.

In order to prevent long term structural damage, corrosion must be controlled through a program of inspection, evaluation and preventive maintenance. Corrosion being the primary reason of gates failure shall be focus of preventive methods adopted to prolong the economic life of steel structural components. There are various detectors like ultrasonic equipment, magnetic crack detectors, nuclear flow detectors and X-Ray detectors which can show the depth of corrosion damage, but the extent to which the tensile strength has been reduced by corrosion could only be found by subjecting an existing piece to various laboratory tests. Rust is permeable to air and water, therefore the interior metallic iron beneath a rust layer will continues to corrode. Rust prevention thus requires coatings that preclude rust formation.

D) Operation and Maintenance of Gates and Hoists

Proper maintenance of Hydraulic gates and hoists is very important for satisfactory operation of gates and to achieve the envisaged benefits from the project. Operating personnel are required to be properly trained and sufficiently experienced so that they can use their initiative and judgment based on their past experience for situations which may arise during operation. Day to¬day experience on operation and difficulties if any, encountered should be faithfully recorded in the log book of gates so as to be available for studying the behaviour of various structures and equipment. Detailed instructions for inspection and normal maintenance and repairs of gate installation should be given in operation and maintenance manual. Inspection and maintenance experience are compiled in the form of History register of any installation so as to be useful for future designs, investigation of any failure, improper and unusual operation of gates. All such observations shall be recorded in the gates History register maintained for this purpose.

However, for carrying out special repairs of gates, if any, it is advisable to refer the matter to Experts.

IS: 10096 for Inspection of Radial Gates and Rope drum hoists and IS: 7718 Inspection of Vertical and slide gates are the Indian Standards issued by BIS which provides broad guidelines for inspection, testing and maintenance of gates and their hoists.

The list of parts involved in maintenance and operation of gates and hoists generally are as follows:

1. Vertical Lift Gates:

i. **Embedded parts:**

Sill beam assembly, Roller track, Seal seat / Upstream Guide, Top seal seat and side guide, Dogging arrangement

ii. **Gate Parts:**

Skin plate Assembly, End Verticals or End box, Horizontal girders, Vertical Stiffeners, Roller assembly, Seal Assembly, Side guide assembly iii. Lifting Arrangement

2. Radial Gates:

i. **Embedded Parts:**

Common anchorages (Bonded Anchorages): Sill beam Assembly, Wall plate Assembly, Horizontal Anchor Rods, Trunnion Girder, Trunnion girder chairs , Thrust block (If tie between trunnion is not used)

Independent anchorages (Un-bonded Anchorages) : Sill beam assembly, Wall plate assembly, Anchor girders Load Anchors / Tie flats, Yoke girders, Rest plate • Thrust block (If tie between trunnion is not used)

ii. **Gate Leaf**

Common anchorages (Bonded Anchorages) :

Skin plate,Side guide and seal assembly , Vertical stiffeners, Horizontal Girders, Horizontal Girder, Bracings , Arm Assembly, Trunnion, Trunnion pin, Trunnion Bush , Trunnion Bracket, Tie between trunnion or Thrust block Lifting Bracket

Independent anchorages (Un-bonded Anchorages) :

Skin plate,Side guide and seal assembly, Vertical stiffeners, Horizontal Girders, Horizontal Girder Bracings, Arm Assembly , Trunnion, Trunnion pin , Trunnion Bush , Trunnion Bracket , Tie between trunnion or Thrust block, Lifting Bracket

3. Rope drum Hoists:

i) For Vertical Lift Gates:

Drive Unit Assembly, Gear Box Assembly, Hoist Supporting structures etc. B.

ii) For Radial Gates:

Upstream Suspension:

Drive Unit Assembly, Gear box assembly, Hoist Bridge, Lifting arrangement Down Stream Suspension:

Drive unit assembly, Gear box assembly, fixed end support, Hoist chassis, Line shaft support girder, Dial and Dial Assembly etc.

E) Inspection prior to erection of gate:

a) Inspection of Embedded Parts:

i) The bottom sill beam shall be in true level and alignment with respect to the structure Axis.

ii) All other embedded parts i.e. Roller path, side seal path, 'T' guides; slide track, etc shall be fixed with respect to the bottom sill beam as per the drawing. The verticality and alignment shall be checked to ensure that all the embedded parts are truly vertical.

iii) Yoke girder, trunnion assembly etc are fixed as per drawing.

After setting of the embedded parts all the anchor bolts & nuts shall be put in position and welded with the 1ststage insert plates. The adjustment for the final alignment of the embedded parts shall be done with the help of anchor bolts. During 2nd stage of concreting all concrete mix shall be hand compacted. Compaction may be done by 20mm. rods. No mechanical vibrator should be used.

b) Inspection of gates and hoist:

i) The sub-assemblies of the gate shall be inspected in workshop.

ii) Checking of all dimensions of the gate shall be done after skeleton assembly of each gate is made and before final welding/riveting is allowed. This dimensional check shall be repeated after welding is done.

iii) Visual inspection of all weld sand bolt/rivets shall be made to the extent of 100 percent.

iv) Following critical dimensions shall be checked:

   a) Centre to centre distance between rollers and shoes.

   b) Centre to centre distance between the side seal and bases.

v) The seal bolts shall be tightened adequately and uniformly, and the rollers & guide wheels bechecked for free rotation.

vi) To check the effectiveness of the seals active seals interference shall be compared with that provided in the design because on this aspect will depend to a great extent the efficiency of sealing arrangement and easy operation of gate.

vii) Inspection of complete gate installation and hoists.

viii) Visualinspectionofallgatesandhoistsshallbecarriedoutasperthedetaileddrawing.Ithas to be ensured that the erection tolerances have been maintained during and after erection.

ix) In case of hoists following points shall be looked into:-

   a) Connections like shaft coupling, connections of wire ropes to drum and gate connections of hoist components to the base etc. have been properly made.

   b) Intermediate supports at required intervals are provided to permit free movement of shaft.

   c) The ends of the wire rope are properly looped and sufficient "U" / Drum clamps have been provided. The rope has been tightly wound over the drum and is properly lubricated.

   d) The wire ropes at both ends of the gate have equal initial tension.

   e) The hoist provided for the operation of the gate shall first be independently checked and tested when it is connected to the gate to ensure its satisfactory working.

x) It shall be ensured that the gate sill and other embedded parts are thoroughly cleaned, and no foreign matter is present to obstruct the movement of the gate.

xi) Before operation of the gate the following final checks shall be made:-

a) All bearings and wire ropes for proper greasing / cadmium compound.

b) All bolt of gear boxes, hoist drum and shaft couplings for tightness.

c) The oil level in gear reduction unit.

F) Inspection after erection of gate:

Once the gates have been erected, following precautions/ checks are to be taken before Dry-testing of Gates. The dry testing of the gates is normally done before the wet testing and during dry testing the gate is not subjected to any hydro static loading:

i) Checking of all critical dimensions and proper seating of gate over embedded parts is to be ensured. Record of readings may be maintained for future reference.

ii) Worm reducer, plumber blocks, trunnion pin, gate wheels and gear wheels should be lubricated.

iii) Removal of temporary supports if any.

iv) Checking of weld between horizontal girders, arms and trunnions, tees and horizontal girders, cross girders and hoist bridge girders, final welding of lifting bracket etc., and are to be welded if left over. A comprehensive check list is to be maintained.

v) Checking tightness of bolts between trunnion with arms and trunnion with horizontal girders, lock plate bolts of trunnion pin, wire rope clamp bolts and other bolts if used are to be tightened properly if loose.

vi) In case of unbounded anchorage one has to ensure the expansion of tie flats and yoke girder under load.

vii) The gates are to be inspected thoroughly for projections; temporary supports coming in the way of gate movement and excess concrete are to be removed if any.

viii) All the rubber seals are to be made wet before lowering the gate preferably with water to reduce heat generated between seal and seal seat and ensure fixing of all bolts and mouldings of site joints.

ix) Light test may be conducted for checking gap between seal and seal seat.

x) All weld tests are to be conducted.

G) Lubrication Schedule for Gates and Hoists :

Sl. No.	Parts to be lubricated	Mode of Lubrication	Lubricant	Lubricant Frequency
01	Trunnion pin bush bearing	Pressure grease gun	Servo gear - 20 or bearing grease	Once in three months as per site conditions
02	Gate Wheel bearings	Pressure grease gun	Servo Gear - 20 or Bearing Grease	Once in three months as per site conditions
03	Guide rollers	Pressure grease gun	Bearing Grease	Once in three months as per site conditions

Sl. No.	Parts to be lubricated	Mode of Lubrication	Lubricant	Lubricant Frequency
04	Hoisting wire rope	Hand applied	Servo Gear - 120 or Cordium Compound	Once in a year before monsoon sets in
05	Worm reducer	Oil bath	Servo HP - 30	Indicator level to be maintained always
06	Spur Gear Bearings	Pressure grease gun	Bearing Grease	Once in three months as per site conditions
07	Line shaft bearings	Pressure grease gun	Bearing Grease	Once in six months as per site conditions
08	Gear Wheels	Hand applied	Chassis Grease	Once in six months as per site conditions
09	Drum shaft	Pressure grease gun	Chassis Grease	Once in three months as per site conditions
10	Lifting Arrangement and buckles	Hand applied	M. P. Grease	Once in six months as per site conditions
11	Hand operation mechanism and other relating parts	Hand applied	Servolin - 140	Once in three months as per site conditions

H) Maintenance of Rope:

Maintenance of Wire Ropes means applying the cadmium compound every year prior to monsoon.

Lubrication:

In manufacture, wire ropes are fully lubricated (including fibre core and layers) to reduce internal abrasion, to exclude external moisture and delay corrosion. In service the initial lubricant will tend to dry out and therefore it is desirable to lubricate all ropes at regular intervals.

Lubricants:

The lubricant employed should be free from all harmful substances, such as acids and alkalis. It should be of a light grade that may penetrate between the wires and strands of the rope being wiped off or absorbed by surface dirt. Cadmium compound is recommended as a lubricant.

Application:

It is desirable that the rope be clean and dry. Jets of oil or wire brushing are some of the cleaning methods used preparatory to application of a lubricant. An easy and effective method of applying a lubricant is to brush the lubricant on the rope. The brush is dipped into the lubricant and applied. The lubricant may also be applied by hand with leather gloves. The

method is especially good where a heavy, non- flowing lubricant is applied. It is desirable to heat the lubricant to get a smoother and better application.

Inspection of Wire Rope:

The wire ropes should be inspected at regular intervals. Close examination will not only indicate, when it is time to put on a new rope, but it will also reveal many other things about the way the wire rope does it's work and whether it is suited to the job. It should be ensured that the end of the wire rope on the lifting bracket is positively held in socket filled by zinc.

Discarding a Wire Rope:

Generally a rope should be withdrawn from service, when it is considered that:

a) The loss of strength in the rope due to wear, corrosion or both is approaching one sixth of original strength.
b) The loss of strength due to fatigue, surface embrittlement or cracked and broken wires of any kind is approaching one tenth of original strength.
c) The outer wires have lost about one third of their depth as a result of any kind of deterioration. d) The outer wires are becoming loose and displaced for any reasons.
e) The rope has become kinked, distorted or damaged and a damaged piece cannot be removed.
f) Examination of rope leaves any doubt as to its safety for any reason whatsoever.

2.2.2 Pump System

Pumps are kinetic machines in which energy is continuously imparted to the pumped fluid by means of a rotating impeller, propeller or rotor.

Irrigation & Waterways department mainly uses waste water and storm water pumps in urban and metropolitan areas for drainage purpose and also to avoid flooding of low-lying areas during monsoon period. Due to increasing population and rapid urbanization the demand for water and sanitation increases constantly and thereby increase the amount of wastewater to handle. Waste water and storm runoff follows the gradient of the terrain in the drainage system. But in low lying areas with flatter slope where gravity flow condition may not be feasible and also where the water level of receiving water bodies is higher than the water level of the outfall, pumping arrangement has become necessary for efficient functioning of water drainage systems to avoid flooding and water logging. Also in coastal areas to overcome backflow of storm water during sea level rise suitable pumping systems with flap gates/check valves which only allow outflow and prevent back flow become necessary to minimize flooding during high tide periods. Well Point pumps are also used at construction site for dewatering during excavation and foundation work to keep the ground dry and stable during heavy rain and flooding conditions.

This department basically has two types of pumping station for the purpose of storm water and waste water pumping.

a) Wet pit pumping station: In wet pit system, the main pumping element i.e. bowel assembly is submerged under water connected with a drive shaft to an overhead electrical motor. Most of the existing high capacity pumping station in this department such as Chowbaga Pumping station, Uttarbhag Pumping station, Keorapukur pumping station, Bagjola Pumping station etc. has wet pit vertically suspended turbine pump and few pumping station has inclined installed turbine pump on canal bank.

b) **Dry pit pumping station:** In dry pit system, the horizontal centrifugal pump directly coupled with motor are installed on the floor of the dry pit with its suction pipe connected to the sump. Ranichak Pumping station has this type of pumps.

2.2.2.1 New pumping station:

Several important aspects are taken into consideration in planning and site selection for new pump station. The easy access necessary for safe operation, maintenance and emergency functions must be available at all times. Hydraulic conditions will have primary importance in site selection, but site appearance should be also considered. Foundation investigations are necessary and enough space must be provided in the area outside the station to accommodate parking as well as movements of large machinery. A dependable energy source is essential.

A) Terminology used for pump selection:

a) Capacity (Q) - Pump flow rate or capacity or discharge of a pump is the useful volume of fluid delivered to the pump discharge nozzle in a unit time.

b) Head (H) - Head of a pump is the useful mechanical energy transmitted by the pump to the fluid.

c) System head (H_{sys}) - Total head of the system is composed of the following four parts.

- H_{geo}- Geodetic head is the difference in height between the liquid level on the inlet and discharge sides.
- (Pa - Pe) / (p. g) - is the pressure head difference between the inlet and outlet tank.
- $(Va^2-Ve^2)/2g$ - is the difference in the velocity heads between the inlet and outlet tank.
- XHL - is the sum of the head losses (flow resistance in the piping, valves, fittings, etc in the suction and discharge lines as well as the entrance and exit losses.

d) Power (P) - The input power P of a pump (also called brake horsepower) is the mechanical power in kW or W taken by the shaft or coupling.

$$P = \frac{p.g.Q.H}{Effi}$$

B) Types of pump used.

a) Axial flow pump: Axial flow pumps deliver water parallel to the pump axis and drive shaft. They create pressure and velocity to liquids by lifting action of the impellers. They are suitable for low head and high discharge application.

(Sp. Speed range: 165-495(MKS, rpm, m3/s, m), 10000-20000(US, rpm, gpm, ft))

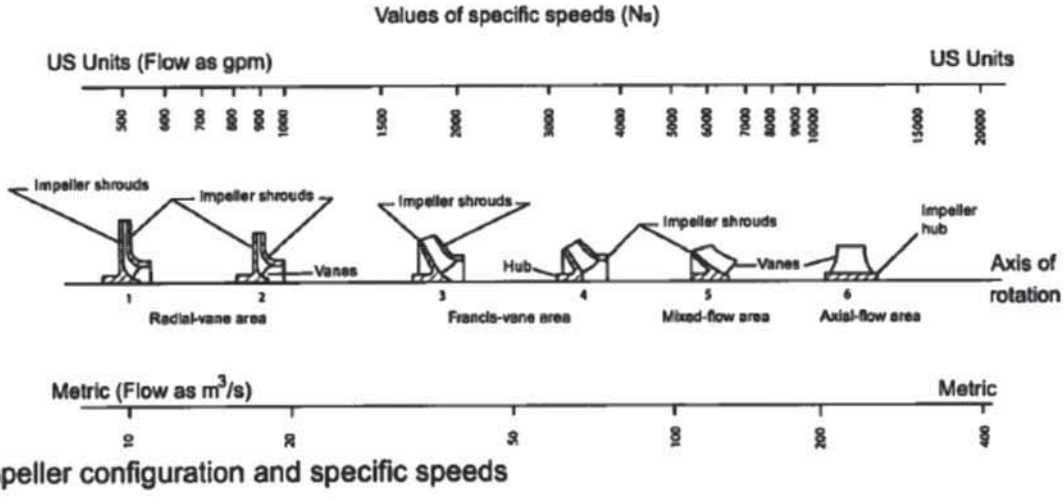
b) Mixed flow pump: Mixed flow pumps deliver water diagonal to the pump axis i.e. flow is partly axial and partly radial. They create pressure and velocity to liquids by both centrifugal & lifting action by the impellers/vanes. They are suitable for medium head and medium flow range application.

(Sp. Speed range: 82-165(MKS, rpm, m3/s, m), 4000-10000(US, rpm, gpm, ft))

c) Radial flow pump: Radial flow pump deliver water perpendicular to the axis of rotation of the pump. They create pressure & velocity to liquid by the centrifugal action of the impeller to deliver water. They are suitable for high to very high head and low to very low flow applications.

(Sp. Speed range: 10-82(MKS, rpm, m3/s, m), 500-4000(US, rpm, gpm, ft))

C) Impeller configuration and specific speeds:



Impeller configuration and specific speeds

D) Important aspect to be considered for new permanent pumping station:

While designing to install new permanent pumping stations, the following essential components that required to be considered are as follows:

i) Location of the pumping points.

ii) Details of space availability.

iii) Electrical Power source.

iv) Access to site.

v) Electrical & mechanical equipment.

vi) Estimation of design runoff at pumping station.

vii) Capacity of the pump sump i.e. the detention time in minutes pertaining to the peak of the Routed Hydrograph at the Drainage Pumping Node.

viii) Additional storage capacity if required.

ix) Numberof pumps including standby and operating point (Q Vs H) of pumps, determined from synchronization of pump characteristics (single or in parallel) & system head curve and authenticated through NPSH, as well as, discharge Vs power input curves and other typical elements related to pumping system.

x) Operation and maintenance requirement.

xi) Environment quality.

xii) Aesthetics.

E) Steps to consider when designing pumping stations.

Carefully calculation of the head and flow requirements. Check the expected minimum, average and peak flows. Also check if the head requirement varies; this will have a profound influence on the duty point of the pump.

- Check the site physically to confirm flow and head as many parameters may well have changed greatly since the station was first designed.
- Determine the number of pumps required from the specified flow and head requirements.
- Determine the pump type to be used.

a) Selection of Pump Type:

Generally axial flow propeller pumps used for low-head applications and mixed-flow pumps for medium-head applications. Installation of pumps in columns can have substantial advantages over other pump types, for turbine pumps, used in flood control applications.

These include:

- Reduced civil costs.
- No shaft alignment problems.
- Reduced installation time and cost.
- Takes up less floor space.
- Silent operation.
- Flood-proof.
- Fewer auxiliary elements required.
- Increased reliability.
- Reduced superstructure required.
- Reduced maintenance, including reduced maintenance costs.
- Greater flexibility.
- High efficiency.

b) Installation type:

The best choice of installation is ofjob-specific. However, column installation often offers scope for lower construction costs. The flexibility of column-type installation allows for everything from free outflow (above or below water level) to pressurised solutions. Column-type installations can also be inclined.

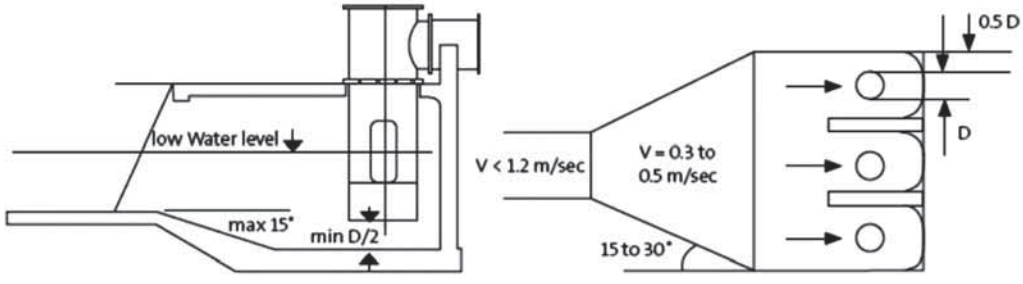
c) Sump design:

The sump design has a crucial impact on the pump's total lifespan. A less-than-optimal sump design could potentially result in poor performance and/or mechanical strain due to vibrations and cavitation at the inlet to the pump(s). A poor design can easily lead to sedimentation of sand and rags, which in turn can cause additional cavitation and vibration problems.

The main design requirement for a sump design is to provide optimal inlet conditions for the pumps. The flow being delivered to the pump units should be uniform, steady, and free of swirls or entrained air. Column-installed pumps are high-volume pumps, making them sensitive to suction chamber conditions; great care must be taken to ensure safe and long-lasting operation. The dividing walls - and the positioning of the pumps - must be done in a manner which avoids surface vortices, air ingestion and entrainment, and turbulence. The following factors should be considered:

- The velocity and distribution of the fluid in the inlet channel should be with a uniform flow. The angle of the bottom should have an inclination of 10 to 15 degrees.
- The velocity of the water in the inlet channel should be less than 1.2 m/s.
- The overall velocity of the water in the pumping station should be between 0.3 and 0.5 m/s.
- The effects of flow disturbances should be dissipated as far as possible from the pump intake.

- Stagnation regions should be avoided. If the design creates such stagnation regions, they should be filled with concrete before operation commences.
- Care should be taken to avoid suction vortices in connection with pump immersion. As a rule of thumb, the immersion of the pump should be between one to two times the pump diameters, depending on flow rate.
- The free distance between the pump and the sump bottom should never be less than half the pump diameter in order to avoid cavitations.
- The pump and column installation should be placed symmetrically in the pump sump while taking care that there is sufficient distance from the outer diameter of the pump to all walls of the sump. The distance should be at least half the pump diameter.
- With more pumps in parallel is it recommended to have separation walls between the pumps so that they are not influencing each other and the water is channelled uniform to the pump.
- The complete design should be subjected to careful analysis - this includes taking a careful look at screens and the possible need for a sludge pump.



d) Avoiding Cavitations:

Cavitation : and the noise and vibrations associated with this harmful process - can be prevented by fitting an anti-cavitation cone below the pump. When installed just beneath the suction bowl, the cone prevents cavitation - and can also prevent vortices and fluid separation.

e) Screen design:

Trash bar screen should be provided at the entrance to the pump sump to arrest large debris in the incoming storm water for smooth functioning of pumps. For storm water pumping station simple steel bar screens are used with bar spacing approximately 50 to 75 mm fabricated in modules to facilitate removal for maintenance.

Screens should be divided into several vertical panels and supported by vertical piers; they should never be supported horizontally. Observing this rule maximises the flow channel, thereby eliminating potential head increases and making it easy to clean and maintain the screens.

f) Using different pump sizes:

The pumps used in flood control applications are often called upon to operate under normal weather conditions - not just in extreme flood situations. At the same time, the pumping station must be able to cope with much higher peak flows in flood situations. To overcome

this challenge, the sump can be divided into two chambers - one for normal operation and another for peak flow situations. The two chambers of the sump must be divided by a low wall that allows the water to flow over into the second sump in flood situations. The pumps used for normal operation should be relatively small, whereas the peak flow pumps should be quite big, enabling them to cope with the extreme situation.

g) Monitoring and control:

Flood control pumps are big investments, and service and repair is relatively costly. Even when the system is designed well and the pumps used are of high quality, wear is inevitable - as is the risk of failure. Monitoring the condition of pumps helps lower the total lifecycle cost of the flood control application.

Proper monitoring and control will:

- protect expensive equipment
- help ensure optimum station operation
- reduce energy consumption
- help avoid overflow - and report any incident
- optimise service personnel schedules for preventative maintenance

h) Sensors:

When pumps are submerged, there is a greater risk of water entering the motor through the cable gland and shaft seal. For that reason in corporate an oil chamber with double sealing and also fit a range of sensors to protect the pumps. Typical sensors used in large pumps are -

- Bearing temperature sensors (lower and/ or upper)
- Motor temperature sensors
- Water-in-oil sensors monitoring the conditions of the shaft seal
- Terminal box moisture sensors
- Vibration sensor
- Winding isolation resistance

In addition to the above pump sensor, most applications also have a sensor to keep an eye on power consumption, voltage, operating hours, etc. Often, keeping an eye on changes in values is more important than responding to absolute values.

i) Service from the supplier:

A lot of know-how and experience is available from the pump supplier which can provide value to the design of future pumping stations for flood control. Today CFD simulations prove a useful tool. It enables the stakeholders to actually prove the chosen design, before carrying out the actual infrastructure investments. This makes it possible to evaluate, adjust and eliminate any risk.

j) Rotative speed limitation of water & waste water pumps:

The maximum operating speed is limited by the available NPSH in the system and the suction characteristics of the first stage. Excessive pump speed can result in unacceptable noise and vibration levels, abnormal wear, cavitations damage and pump failure.

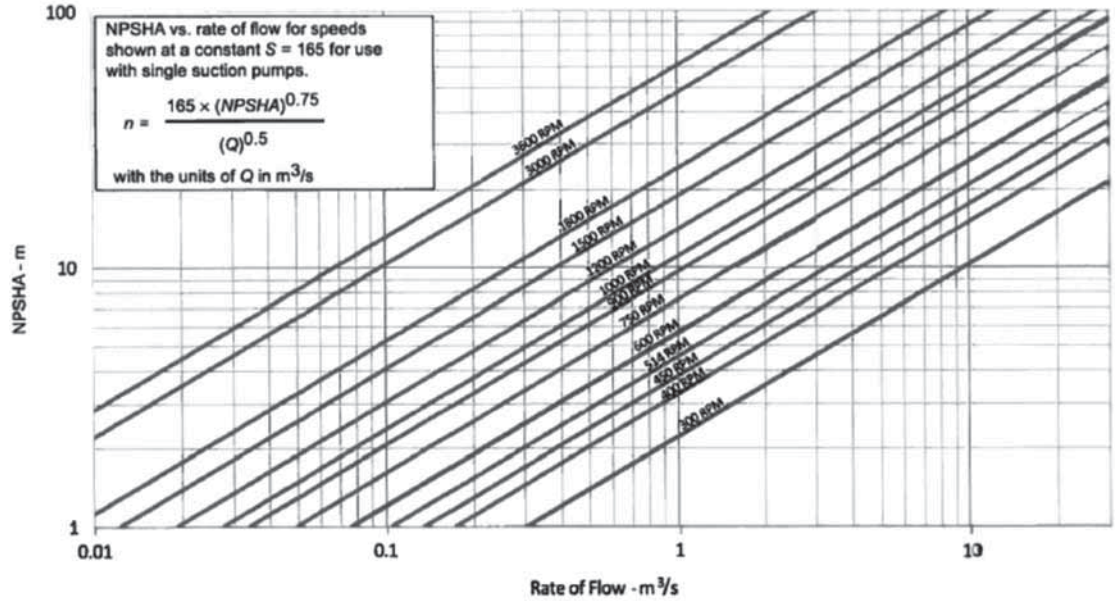
Municipal water and waste water pumps are frequently operated at flow rates above or below POR, to match the required demand. A conservative suction specific speed may be used to ensure an adequate margin on NPSH, to prevent damage due to wide operating range or the soft impeller material (bronze or cast iron impellers).

A S=165 (8500) value is generally used to set the maximum speed of rotation(n) that can allow for an acceptable pump life.

$$n = \frac{S(NPSHA)^{3/4}}{\sqrt{Q}}$$

n = rpm, S = Suction sp. Speed, Q = Flow rate per impeller eye (m^3/s)

Recommended maximum operating speed (metric) :



NPSH margin of water/waste water pumps :

Pump Type	Power (kW/stage)	POR NPSH Margin (1.0 m minimum)	AOR NPSH Margin (1.5 m minimum)
Wastewater (cast-iron impeller)	< 45	1.1 ratio	1.2 ratio
Wastewater (stainless-steel impeller)	< 45	1.05 ratio	1.1 ratio
Wastewater (cast-iron impeller)	≥ 45	1.2 ratio	1.3 ratio
Wastewater (stainless-steel impeller)	≥ 45	1.1 ratio	1.2 ratio
Water (stainless or aluminum-bronze impeller)	< 75	1.05 ratio	1.1 ratio
Water (stainless or aluminum-bronze impeller)	≤ 75	1.1 ratio	1.2 ratio

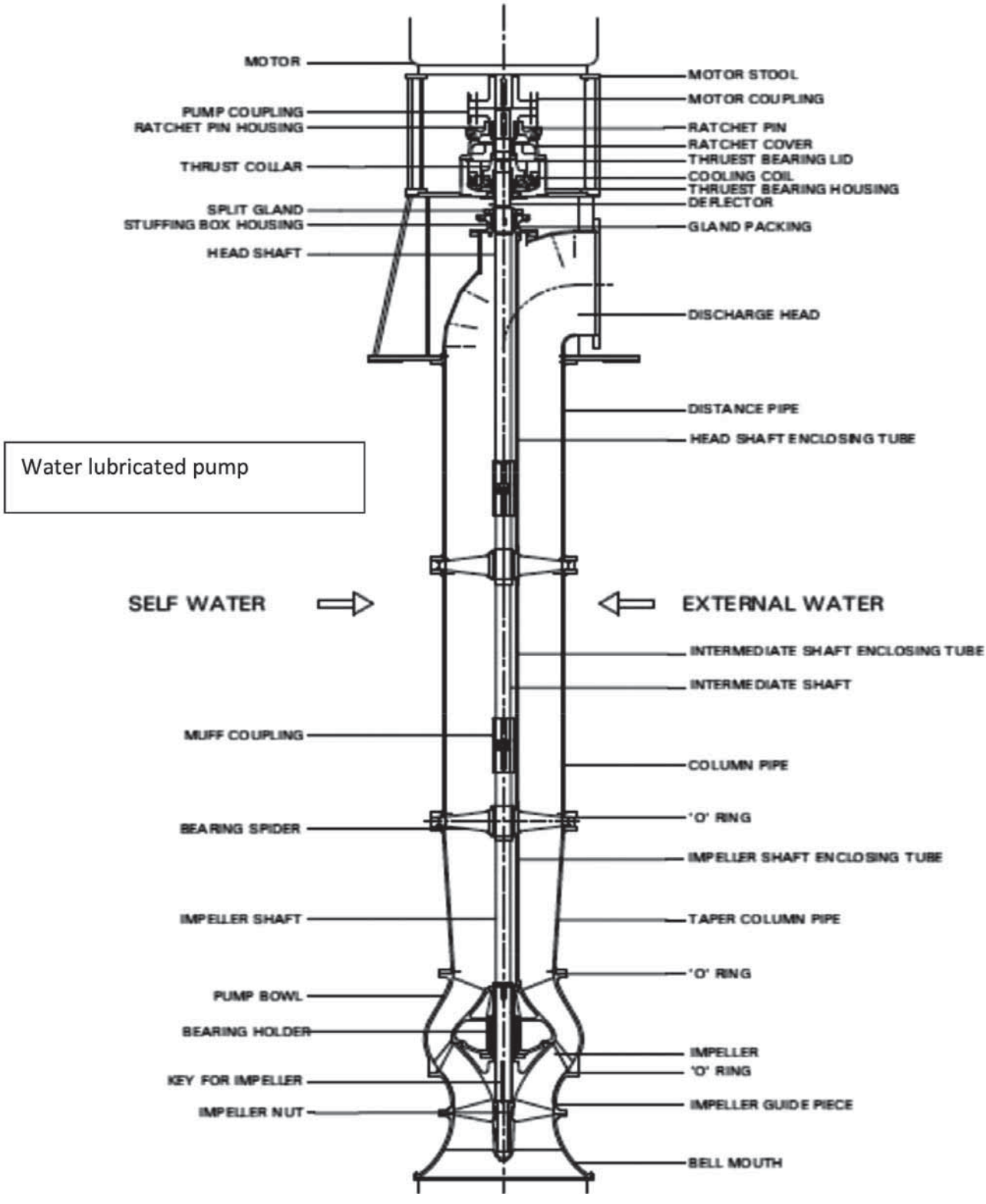
F) Major components of a Line shaft vertical pump:

Pumps comprising stages which accommodate rotating impellers and stationary bowls possessing guide vanes. The discharge from the pump unit is co-axial with the shaft and the pump unit is suspended by the column pipe containing a system of vertical shafting for

transmitting power to the impellers, the prime-mover being external to the flow stream. A typical vertical line shaft pump consists of the bowl assembly, column pipe assembly, head assembly, cooling system, lubricating system etc.

a) Suction umbrella: A formed piece attached to the suction bowl to reduce disturbance at pump inlet and reduce submergence required.
b) Suction bell: A flared tubular section for directing the flow of liquid into the pump. Designed for smooth inflow of water with minimum losses.
c) Discharge bowl: A diffuser with vanes cast integrally of an axial flow or mixed flow or turbine pump.
d) Impeller: The bladed member of the rotating assembly of the pump that imparts the principle force to the liquid pumped. Impellers are of Francis, Mixed flow, Semi-axial and Axial type; enclosed or semi-open.
e) Transmission Shaft: The line shaft transmits power from driver to impeller made of high tensile strength steel.
f) Column pipe: Either cast or fabricated, it houses line shaft bearings and directs water from bowl assembly to discharge head/elbow.
g) Transmission bearings: Cutless bearings are of natural / synthetic rubber / Elastomeric with outer shell of brass or suitable material. Lubrication by self/external clear water. Oil lubrication with bronze bearing is also used.
h) Thrust bearing: Michell Tilting Pad Type or Antifriction type for taking hydraulic axial thrust and weight of rotor assembly. Lubricated with oil or grease.
i) Discharge head/Discharge tee: To direct flow from column pipe to discharge pipe located above or below ground level.
j) Impeller nut-: A threaded piece used to fasten the impeller on the shaft.
k) Shaft adjusting nut- A threaded piece for altering the axial position of rotating assembly.
l) Shaft sleeve: A cylindrical piece fitted over the shaft to protect the shaft through the stuffing box, or seal chamber, or the line shaft bearings.
m) Stuffing box: A portion of the casing or casing cover through which the shaft extend and in which packing and a gland is placed to control leakage.
n) Shaft enclosing tube: A cylinder used to protect the drive shaft and to provide a means for mounting bearings.
o) Relief valve (air and vacuum): A means of releasing air during start-up and releasing vacuum during shut-down.
p) Bearing retainer: A device used to secure bearings when line shafting is used.
q) Non-reverse ratchet: To prevent reverse rotation of pump due to back flow of the water in case of it's tripping.
r) Motor stool: Fabricated rigid construction to ensure vibration-free operation of pump set.
s) Coupling: Between pump and prime mover flexible or rigid coupling used. For line shaft threaded barrel or muff type coupling used.
t) Sole plate: A metallic pad usually embedded in concrete on which the pump base is mounted.
u) Drive - Electric motor with vertical hollow/solid shaft.

Cross sectional view of a VT pump:



G) Materials of Construction:

Recommended materials for different component parts of pumps are as detailed below-

Sl No	Components Parts	Recommended Material
1	Bell mouth	CI / Ni CI / Brz / Stainless Steel / Duplex SS / Super Duplex SS
2	Impeller Guide Piece	CI / Ni CI / CS
3	Bowl	CI / Ni CI / Brz / Stainless Steel / Duplex SS / Super Duplex SS
4	Impeller	CI / Ni CI / Bronze / CS / Stainless Steel / Duplex SS / Super Duplex SS
5	Impeller Shaft	CS / Stainless Steel GRD- SS 304, SS 316, SS 410, SS 416 / K Monel / Duplex SS / Super Duplex SS
6	Intermediate Shaft	CS / Stainless Steel GRD- SS 304, SS 316, SS 410, SS 416 / K Monel / Duplex SS / Super Duplex SS
7	Head Shaft	CS / Stainless Steel SS GRD - 304, SS 316, SS 410, SS 416 / K Monel / Duplex SS / Super Duplex SS
8	Intermediate Shaft Sleeve	Brz /Stainless Steel GRD - SS 304, SS 316, SS 410, SS 416 / K Monel / Duplex SS / Super Duplex SS
9	Distance Sleeve	CI / Brz / Ni CI/ Stainless Steel / Duplex SS / Super Duplex SS
10	Column Pipe	MS / CI / Ni CI / SS
11	Shaft Enclosing Tube	MS / CI / Ni CI / SS
12	Discharge Head / Tee	MS / CI / Ni CI / SS
13	Intermediate Shaft coupling	CS / SS / K Monel
14	Intermediate shaft bearing	Neoprene Nitrile / Nitrile / Neoprene / LTB
15	Motor stool	MS / CI / Ni CI / SS
16	Pump and motor coupling	CI / CS- Forged
17	Gland	CI / Ni CI / Brz
NOTE: CI - Cast Iron, CS - Cast Steel, S S - Stainless Steel, Brz - Bronze, NiCI - CI with 1.5% Nickel.		

H) Material Standards:

All materials shall conform to the latest edition of relevant Indian standard or equivalent International standard VIZ. DIN, ASTM, or BS unless otherwise specified.

Material Type	Indian Standard (IS)	American standard (ASTM)	DIN
Cast Iron			
Cast Iron	IS 210 Gr. FG 260	ASTM A48 Class 40	(0.6025)DIN 1691 GG25
Spheroidal Graphite Cast Iron			
SG Iron (Ductile Iron)	IS 1865 Gr 400/15	A536, 60-40-18	(0.7040)DIN1693
GGG40			
SG Iron (Ductile Iron)	IS 1865 Gr 500/7	A536, 65-45-12	(0.7050)DIN1693 GGG50
Carbon steel			
Carbon steel (Wrought)	IS 1570 (part II)Gr. 40C8	ASTM A107 Gr. 1040	(1.1186)C40E/CK40
Carbon steel (Wrought)	IS 1570 (part II) Gr. 20C8	ASTM A107 Gr. 1020	(1.0402)C22
MS Steel	MS IS 2062 - Fe 410 WA	ASTM-A283 GR D	DIN 1700 GR ST4-2 FABRICATED STEEL44
Cast Steel Grades			
Cast steel		ASTMA 216 Gr. WCB	1.0619(GS-C25)
Cast Stainless Steel			
Stainless Steel CF8M	IS 3444 Gr. 4	ASTMA 351 Gr. CF8M	1.4408(GX5CrNiMo19 -11-2)
Stainless Steel CF8M	IS 3444 Gr. 4	ASTMA 743 Gr. CF8M	1.4408(GX5CrNiMo19 -11-2)
Stainless Steel CF3M	IS 3444 Gr. 16	ASTMA 351 Gr. CF3M	1.4409(GX2CrNiMo19 -11-2)
Stainless Steel CF3M	IS 3444 Gr. 16	ASTMA 743 Gr. CF3M	1.4409(GX2CrNiMo19 -11-2)
Stainless Steel CF8	IS 3444 Gr. 1	ASTMA 351 Gr. CF8	1.4301(X5CrNi18-10)
Stainless Steel CF3	IS 3444 Gr. 15	ASTMA 351 Gr. CF3	1.4306(X2CrNi19 11)
Cast Chromium Stainless Steel			
Stainless Steel CA15	IS 3444 Gr. 10	ASTMA 217 Gr. CA15	1.4106&1.448(DIN174 45 GX12Cr14)

Material Type	Indian Standard (IS)	American standard (ASTM)	DIN
Stainless Steel CA15	IS 3444 Gr. 10	ASTMA 743 Gr. CA15	1.4106&1.448(DIN17445 GX12Cr14)
Stainless Steel CA6NM	IS 3444 Gr. 24	ASTMA 487 Gr. CA6NM	1.4313&1.4317(GX5CrNiMo13-4)
Stainless Steel CA6NM	IS 3444 Gr. 24	ASTMA 743 Gr. CA6NM	1.4313&1.4317(GX5CrNiMo13-4)
Chromium Stainless Steel Round Bar Matterial			
Stainless steel 410	IS1570 (part V) Gr.X12Cr12	ASTMA 276 type 410	1.4006(X10Cr13)
Stainless steel 420	IS1570 (part V) Gr. X20Cr13	ASTMA 276 type 420	1.4021(X20Cr13)
Stainless steel 431	IS1570 (part V) Gr. X15Cr16Ni2	ASTMA 276 type 431	1.4057(X20CrNi17)
Stainless steel 316	IS1570 (part V) Gr.X04Cr17Ni12Mo2	ASTMA 276 type 316	1.4401(X5CrNiMo17122)
Stainless steel 316L	IS 1570 (part V) Gr. X02Cr17Ni12Mo2	ASTMA 276 type316L	1.4404(X2CrNiMo1810)
Cast Duplex Steel			
Duplex Steel 1A		ASTMA 890 Gr. CD4MCu	25Cr-5Ni-Mo-Cu
Duplex Steel 2A		ASTMA 890 Gr.CE8MN	24Cr-10Ni-Mo-N
Duplex Steel 3A		ASTMA 890 Gr.CD6MN2	5Cr-5Ni-Mo-N
Super Duplex steel 4A		ASTMA 890 Gr. CD3MN	25Cr-7Ni-Mo-N
Super Duplex steel 5A		ASTMA 890 Gr. CE3MN	24Cr-10Ni-Mo-N
Non Ferious Materials			
Bronze	IS 318 Gr. LTB2 (CuSn5Zn5Pb5C)	ASTMB 584 - C90500	DIN 1705 Rg 5
Phosphor Bronze	IS 28 Gr. 1 (CuSn11PC)		
Zinc Free Bronze	IS 28 Gr. 1 (CuSn10C)		

2.2.2.2 Erection of Pump:

Vertical turbine pumps are manufactured to close tolerances and rigid specifications hence proper erection and maintenance is important to ensure trouble free service.

A) Foundation:

The following factors should be accounted for, while designing.

- Dimensional requirements.
- Strength of foundation
- Levelling the foundation.
- Disturbances to the levelling.

i) Dimensional Requirement:

- The foundation opening should be large enough so that suction flare and rising pipe with outlet branch will pass easily through it.

ii) Strength of Foundation:

- The foundation should be substantial to take load of pump motor etc, to absorb any vibration and to form a permanent rigid support. The foundation and grouting should be done by the experienced, civil Engineering personnel.

iii) Levelling the foundation:

The guidelines about the grouting and levelling of sole plates are as under. Before pouring the concrete:

- It is essential to check the level of the sole plates individually and in combination.
- The top surfaces of the sole plates should be levelled to the accuracy of 0.05 mm/m sole plates should be levelled with help of straight edge and master level in two directions.
- For the pumps mounted on grinders, similar checks about individual and combined level should made before and after welding of the sole plates to the girders.
- If the sole plates are procured by the client directly at their end then ensure that sole plates are machined to close tolerances and polished.

B) Essential equipment's for erection of the pump.

- Over head crane.

  The crane should be ample capacity to the load. There should be a minimum clear height between the foundation and the top most position to the crane hook. This will facilitate easy erection.
- Chain and lifting hook.
- Jute ropes, crow bars and small pipes for leverage.
- Light but accurate straight edge.
- Master level having an accuracy of 0.02 mm/m
- Kerosene or thinner for cleaning of parts.
- Threading compound
- Feller gauge and shims for adjustment of levels.
- 'V' blocks and dial gauge with magnetic stand to check run out of shafts etc.
- Small wire brush for cleaning threads of shafts and coupling.

Besides the list given above, also following standard tools and equipment are essential for smooth erection.

- Files- Triangular, half round and flat of different cuts and sizes.
- Triangular scrapper
- Two sets of standard or ring spanners.
- Adjustable spanners, screw drivers of 300 mm (12") and150 mm (6").
- Sets of pipe wrenches and chain tang.
- Steel rule and measuring tape.
- Hand drill.
- Sets of taps and dies up to 25 mm (1")
- Chisel, machinist hammer, hack saw, vice etc.
- Emery paper, grease gun, thin rolled sheets of 0.03 to 0.05 mm thickness for shims.

C) Checking:

Though all critical parts are well packed while being dispatched from works, there is a possibility of shaft bending and damage to the threaded and machined portions during transit. The following checks should therefore be made.

- Threaded portions of shaft and couplings are not damaged.
- Shaft coupling fit properly on the shaft. They should not be too tight or loose on the shafts.
- All the shafts are checked for run out. The shaft run out should not exceed 0.125 mm at bearing portions.

D) Ensure proper fitting:

- While assembling, do not apply undue force.
- Avoid use of hammer.
- Ensure perfect matching of contact surfaces.
- Each part should be free from high points, burrs, dust, etc.
- Take care that no part is left out through over sight. Every single item even it is a small one has an important role in the proper functioning of the pump.
- Take care that no foreign substance is dropped or left inside. It may get stuck and cause jamming.
- While fitting rubber rings care should be taken not to twist or stress the joints. The rings prevent leakages and hence their none twisting is important. The following method of rubber ring will be found convenient. Hold one side of the joint in the hand and insert the opposite portion of the rings in the grove. Apply light tension along the rings by a gentle pull by fingers and place it in position around the periphery of the groove. The joint in the hand shall go in position last.
- All tools and equipment should be kept ready at hand before starting erection. Cross sectional drawing and instruction should always be referred to during erection.
- Erection should be done by specialised and experienced personnel.

E) Connection of delivery pipe and accessories to pump column:

- The delivery pipe and accessories such as sluice valve, reflux valve etc. should be supported and anchored independently near the discharge outlet so that when the bolts are tightened no strain will be transmitted to the pump column.
- Before connecting the flanges of delivery pipe and discharge outlet check that flanges match perfectly as regards the bolt hole position and parallelism. The clearances between the flanges should be to a minimum such that horizontal displacement of the pumping unit is avoided when tightening them together along with gasket in between.
- Expansion joints: If an expansion joint is installed in the piping between the pump and delivery pipe. Then anchor the delivery pipe in such way that so that delivery pipe line load should not be transmitted to pump column. If an expansion joint or non rigid coupling for pipe on delivery side is used, delivery pipe should be firmly anchored and pump discharge tee should be supported by means of thrust rod arrangement. If properly installed, this will eliminate the objectionable forces mentioned above.

2.2.2.3 Operation of Pumps:

Before starting the pump make sure that:

- The rotor assembly rotates freely by hand or lever.
- Minimum submergence is kept as specified.
- All air vents are open. (Shaft enclosing tube & column pipe)
- The cock of pressure gauge is closed.
- The supply voltage is all right.
- Before staring pump pre lubrication supply must be started (10minute before).
- Pump should be started at Delivery valve is in open condition.
- Check inlet pressure for external water lubrication pressure.
- Oil level in thrust bearing is sufficient

2.2.2.4 Inspection and Maintenance of Pumps:

Proper maintenance of pumps are very important for satisfactory operation and to achieve the envisaged benefit from the project. For systematic operation and maintenance of the pumping station and their operating equipment, the availability comprehensive operation and maintenance manual for the equipment is necessary.

Maintenance is also necessary to extend the useful life of all the installation by minimizing wear, tear and deterioration. The pride of installation of drainage pumping station cannot be fully appreciated unless conscious approach is towards operation al and maintenance. Proper maintenance of allied electro -mechanical components helps in minimizing / preventing unwarranted breakdown of equipments. Periodic/ preventive maintenance is normally followed to keep the equipment is in service for desired output. Therefore, for systematic maintenance of electro -mechanical components of drainage pumping stations, the availability of comprehensive maintenance manual is necessary.

Because of the wide variation in pump types, sizes, designs, and materials of construction, these comments on maintenance are restricted to those types of pumps most commonly encountered. The manufacturer's instruction books must be carefully studied before any attempt is made to service a particular pump.

A) Maintenance Management / Planning

This can be briefly described as below:

i) Asset / Equipment Register:

This register must contain the proper nomenclature of equipment, name of supplier, date of installation, special feature of the equipment. Thus the asset register is the information centre of the planned maintenance system.

ii) Complete drawings, manuals and spare parts catalogues:

Every maintenance unit must have with it a complete set of drawings of the pump & its components etc. including details of electrical installations and controls, manual and spare parts catalogue etc. The sub-divisional officers of these works shall be the safe custodian of all these records.

iii) Maintenance schedule:

A maintenance schedule has to be prepared for every unit adopting this manual. Maintenance schedule is pre-requisite for preventive maintenance system approach. By resorting to periodical maintenance, detect or wear and tear pattern of a particular item or component can be known. This may help in planning further repair & replacement and periodicity of a particular maintenance work.

iv) Maintenance of Records:

The most important work is that the inspection and maintenance experiences and repairs are compiled in the form of history sheet of the any installation in a chorological order for future guidance. These records should generally consist of:

- Date and time of commencement and completion of work.
- Details of job carried out like change/replacement of bearings, seals, nuts and bolts, welding repairs carried out etc. Even minor details like patch painting should also be recorded.
- Problems encountered if any during maintenance.
- Details of materials/items consumed during maintenance.
- Details of manpower deployed.
- Record of periodic inspection record.

The data should be recorded by the person responsible for maintenance.

B) Inspection:

When operators are on constant duty, hourly and daily inspections should be made and any irregularities in the operation of a pump should be recorded and reported immediately. This applies particularly to changes in sound of a running pump, abrupt changes in bearing temperatures, and seal chamber leakage. A check of pressure gages and of flow meters, if installed, and vibration should be made routinely during the fortnights. If recording instruments are provided, a daily check should be made to determine whether the current capacity, pressure, power consumption or vibration level indicates that further inspection is required. If these readings are taken electronically, trending charts should be produced to allow observation of changes as a function of time.

I) Daily inspections and check:

Perform following daily checks during routine maintenance activity:

i) Check and record pump operating parameters like discharge pressure gauge readings, bearing temperature, noise and vibrations. In case of increasing trend in vibration values, analyze cause and take corrective steps.

ii) Check amount of lubricant in respective chambers to ensure adequate lubrication of bearings and sleeves.

iii) Check dripping of lubricant from the lubricating line joints and take requisite corrective action.

iv) Check the pump and piping for leaks and rectify as necessary.

v) Check for adequate leakage of liquid from the stuffing box. Excessive leakage needs to be arrested.

II) Quarterly inspections:

Following checks during tri monthly maintenance activities are recommended:

i) Check that the foundation bolts and the hold-down bolts are tight.

ii) Check the shaft alignment, and realign as required.

iii) In case of Pumps supplied with Thrust Stand Assembly, ensure that the lubrication schedule described under relevant section is strictly adhered to.

iv) Change the lubricant every six months or after 2000 operating hours whichever is less.

v) Change the lubricant more often if the pumps are operating under adverse atmospheric or other conditions that might contaminate the lubricant.

vi) Under special situations, it may be necessary to partly dismantle the pump for attending to an adverse observation during any of the above inspection schedules.

III) Annual inspections:

A very thorough inspection should be performed once a year. In addition to the semi-annual procedure, the following items should be considered:

a) Check the thrust bearing and clean all components and rebuild bearing and fill with new lubricant oil.

b) Check the alignment of coupling and tighten all the holding down bolts.

c) Vibration trends should be reviewed. If the pump is trending toward unacceptable vibration levels,

(i) The bearings should be removed, cleaned, and examined for flaws and wear.

(ii) The bearing housings should be carefully cleaned.

(iii) Rolling element bearings should be examined for scratches and wear.

(iv) Immediately after cleaning, rolling element bearings that are considered acceptable for reinstallation should be coated with oil or grease.

Note: If there is any sign of damage, or if the bearings were damaged during removal, they should be replaced with new bearings of the correct size and type per the manufacturer's instruction book.

(v) The assembled rotor—or major rotor components if the rotor is not assembled of shrink-fit components—should be checked for balance prior to reassembly in the pump.

d) For pumps equipped with shaft packing, the packing should be removed and the shaft sleeves—or shaft, if no sleeves are used—should be examined for wear.

e) For pumps equipped with mechanical seals, if the seals were indicating signs of leaking, they should be removed and returned to the seal manufacturer for inspection, possible bench testing, and refurbishment.

f) When coupling halves are disconnected for an alignment check, the vertical shaft movement of a pump with sleeve (journal) bearings should be checked at both ends with packing or seals removed. Any movement exceeding 150% of the original design clearance should be investigated to determine the cause. End play allowed by the bearings should also be checked. If it exceeds that recommended by the manufacturer, the cause should be determined and corrected.

g) All auxiliary piping, such as drains, sealing water piping, and cooling water piping, should be checked flushed, as necessary. Auxiliary coolers should also be flushed and cleaned.

h) Pump equipped with stuffing boxes should be repacked, and the pump and driver should be realigned and reconnected.

(i) All instruments and flow-metering devices should be calibrated. The pump should be tested to determine whether proper performance is being obtained. If internal repairs are made, the pump should again be tested after completion of the repairs.

C) Overhauling:

It is difficult to make general rules about the frequency of complete pump overhauls as it depends on the pump service, the pump materials, the liquid handled, and the economic evaluation of overhaul costs versus the cost of power losses resulting from increased clearances or of unscheduled downtime. Some pumps on very severe service may need a complete overhaul monthly, whereas other applications require overhauls every one to four years or even less frequently.

A pump should not be opened for inspection unless either factual or circumstantial evidence indicates that overhaul is necessary. Factual evidence implies that the pump performance has fallen off significantly or that the noise or driver load indicates trouble. Circumstantial evidence refers to past experience with the pump in question or with similar equipment on similar service.

In order to ensure rapid restoration to service in the event of an unexpected overhaul, an adequate store of spare parts should be maintained at all times. The relative complexity of the repairs, the facilities available at the site and many other factors enter into the decision whether the necessary repairs will be carried out at the installation site or at the pump manufacturer's plant.

I) Pump disassembly guidelines:

While disassembling the pump tag number chit of the each pump components should be attached to the respective pump components.

i) Disconnect all cables/wires and cooling water pipe connections to the driver (if provided).

ii) Carefully remove the flush or lubricant connections and remove any associated piping that would interfere with the dismantling.

iii) The discharge valve in discharge line should be closed and pump relieved to atmospheric pressure. Then Remove all the auxiliary piping connections provided for pump.

iv) Dismantle the flange bolts at discharge side and remove the pipe immediately after the delivery flange in the Delivery piping.

v) After the discharge pipes are disconnected the next step shall be to drain off the oil from the bearing housing.

vi) Disconnect the motor end of coupling

vii) Disconnect the drive motor. Disconnect the motor stool from the pump base & remove the motor stool.

viii) Put the motor down taking care not to damage the motor coupling on drive end. Remove the fasteners in between.

ix) Pull-out the Pump coupling with the help of "puller pusher tool".

x) Take out the ratchet pin housing & ratchet cover.

xi) Remove the bearing nuts.

xii) Remove the thrust bearing lid.

xiii) Remove the journal bearing and journal bearing housing.

xiv) Remove the thrust collar. Take out the key for the thrust collar.

xv) Remove the thrust bearing carrier long with the oil retaining tube.

xvi) Take out the thrust bearing carrier from the lower stool.

xvii) Remove lower stool from pump base.

xviii) Lift the pump base by using slings and eye bolts. Place the erection clamp (I Beam section) on the foundation (Floor) such that the distance pipe resting pads rests on the clamp. Tighten the clamp by means of hex screws.

xix) Lift the head shaft enclosing tube by using eye bolts having male guide.

xx) Lift the head shaft enclosing tube by using eye bolts having female guide.

xxi) Dismantle the muff coupling joint between head shaft & intermediate shaft

xxii) Take out the head shaft, liquid deflector, clamping plate, split gland & gland packing.

xxiii) Lift the discharge tee by using slings and eye bolts. Place the erection clamp (I Beam section) on the foundation (Floor) such thazt the discharge tee resting pads rests on the clamp. Tighten the clamp by means of hex screws.

xxiv) Dismantle the discharge tee from the column pipe.

xxv) Dismantle the muff coupling & take out the intermediate shaft

xxvi) Lift the column pipe by using slings and eye bolts. Place the erection clamp (I Beam section) on the foundation (Floor) such that the taper column pipe resting pads rests on the clamp. Tighten the clamp by means of hex screws.

xxvii) Remove the intermediate shaft enclosing tube.

xxviii) Dismantle the column pipe from the column pipe which are placed one above the other for two numbers.

xxix) Lift the bearing spiders which are placed in two numbers.

xxx) Dismantle the intermediate shaft enclosing tube from the bearing spider which are placed one the other for two numbers. Remove cylindrical pins from bearing spider.

xxxi) Dismantle the muff coupling & take out the transmission shaft.

xxxii) Repeat same above procedure for two numbers of intermediate shafts.

xxxiii) Now lift all assembly along with taper column pipe from foundation opening & take it outside. Keep all assembly in vertical position on flat surface.

xxxiv) Fit a tailing strap around the bell mouth to control the pump when lowering the pump on ground in horizontal position. Give proper support to assembly wherever required. Centerline of pump unit assembly should be parallel with the ground line.

WARNING: Pump and components are heavy. Failure to properly lift and support equipment could result in serious physical injury or damage to pumps. Release the joint between pump bowl & taper column pipe.

xxxv) Remove the bearing spider & then impeller shaft enclosing tube. Remove 'O' rings & cylindrical pins in between.

xxxvi) Remove the bearing cover fitted on the bowl

xxxvii) Loosen the hexagonal nuts from tie rod. Remove the tie rods. Ensure that supports have been placed correctly.

xxxviii) Remove the bell mouth from liner. Then remove the liner from the bowl.

xxxix) Then remove the split ring. Remove the propeller nut from the propeller boss.

xl) With the help of puller for impeller shaft (supplied with special tool) remove propeller boss assembly from impeller shaft.

xli) Then draw impeller shaft from pump bowl.

xlii) Remove bearing holder from pump bowl.

xliii) Take the impeller shaft and keep it properly.

xliv) Collect all "O" rings and fasteners provided for each joining for easy accessibility while re-assembling the pump.

xlv) All the keys and retaining screws to be kipt properly to avoid problem in re¬assembly.

xlvi) All shafts to be kept properly to avoid damages and bending.

II) Checking the components after disassembly:

i) Wear and tear of shaft sleeves, Impellers, scratches marks which are observe.

ii) Remove the scratch mark and burr by files and scrappers.

iii) Hard particles which may come in contact with the pump parts like propeller, shaft sleeve and rubber bearings, can damage them because of rubbing action.

iv) Check the all cylindrical pins provided in between shaft bearing spider, sleeves & shafts.

v) Check the clearances between the bearings & shaft sleeves with the permissible values given in manual (technical data). Also check clearances in between propeller & liner.

vi) Check concentricity / run out of the shaft, shaft sleeve etc. If run out/ concentricity of above component is out of limit these parts may wear at one side portion only.

vii) For checking the run out and concentricity of the pump shaft pump shaft is clamped between centres of lathe or on "V" blocks and measures it by dial indicator.

viii) Check the propeller boss assembly is dynamically balanced. If the propeller is worn out, remove the scratch marks by files and scrapper. If the clearance between them is out of limit as specified replace it.

III) Repair/Replacement of dismantle parts:

i) Replace all the damaged parts' this applies in particular to wear ring (if applicable), shaft sleeve, radial bearing bushes etc.

ii) As a general rule, always fit a new 'O' rings, gaskets & other types of joints, making sure to maintain the same thickness as that of old components.

iii) If the impeller is worn out, remove the scratch marks by files and scrapper. If the clearance between them is out of limit as specified replace it.

iv) Remove rust and touch up damaged paints.

v) Replace any malfunctioning instruments.

vi) Remove the scratch mark and burr by files and scrappers.

vii) Remove if any run out in shaft.

viii) Restore all other parts of pump set properly.

2.2.3 Electrical System

M&E wing of Irrigation and Waterways Department have been dealt with several type of Electrical & other allied works. Electrical works can be sub-divided in following categories.

i) H.T. & L.T. motors for pump operation.

ii) 11 kV & 33 kV sub-stations for pump houses.

iii) Electrical wiring for offices, residential buildings, laboratories etc.

iv) Illumination of Dams, Barrages, Residential Complex, Office, Go down etc.

v) Electrical centrifugal and submersible pumps for water clogging and drinking water supply.

vi) Lifts in Offices & hoist mechanism of gates in Dam and Barrages and other regulator structures.

Other allied works are:

i) HVAC.

ii) Intercom & EPABX.

iii) Video conferencing.

iv) Fire protection and Alarm system.

So, from the above discussion, it can be revealed that M&E wing has been entrusted with versatile jobs in Electrical & other Allied works. This SOR undertaken only those items which are not covered in SOR of WBPWD (Elect.), but very essential for day-to-day work.

2.2.3.1 H.T., L.T. motors and transformer

H. T. & L.T. motor operation and maintenance once should be very conversant about the protection of motor. There are no of protections provided with the motors. But if anyone gives proper protections of the motor, the he must analyse the following characteristics curve.

i) Torque vs. Speed Curve.

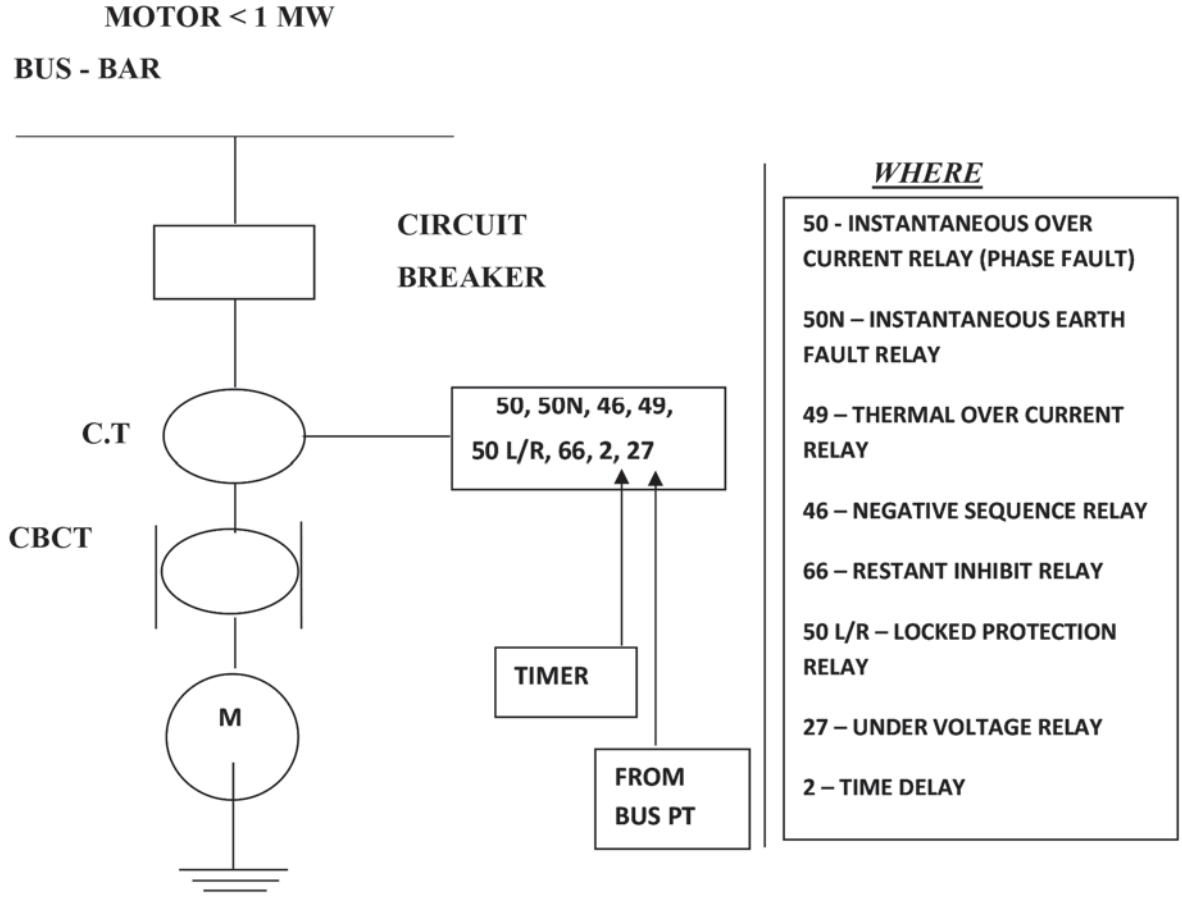
ii) Current vs. Speed Curve.

iii) Thermal withstand capability curve

iv) Negative sequence characteristics curve

As per above curves, we have to set the current for all protection Relay.

Normal protection relays of Motor less than 1 MW capacity have been shown below:



As we do not have motor more than 1 MW, hence protection for motor of >1 is not covered here. Relay setting is most vital part for protection. It is required to go through the motor characteristics before setting up the relay.

It will be half done, if we don't talk about Bus Bar is specified on following three factors: -

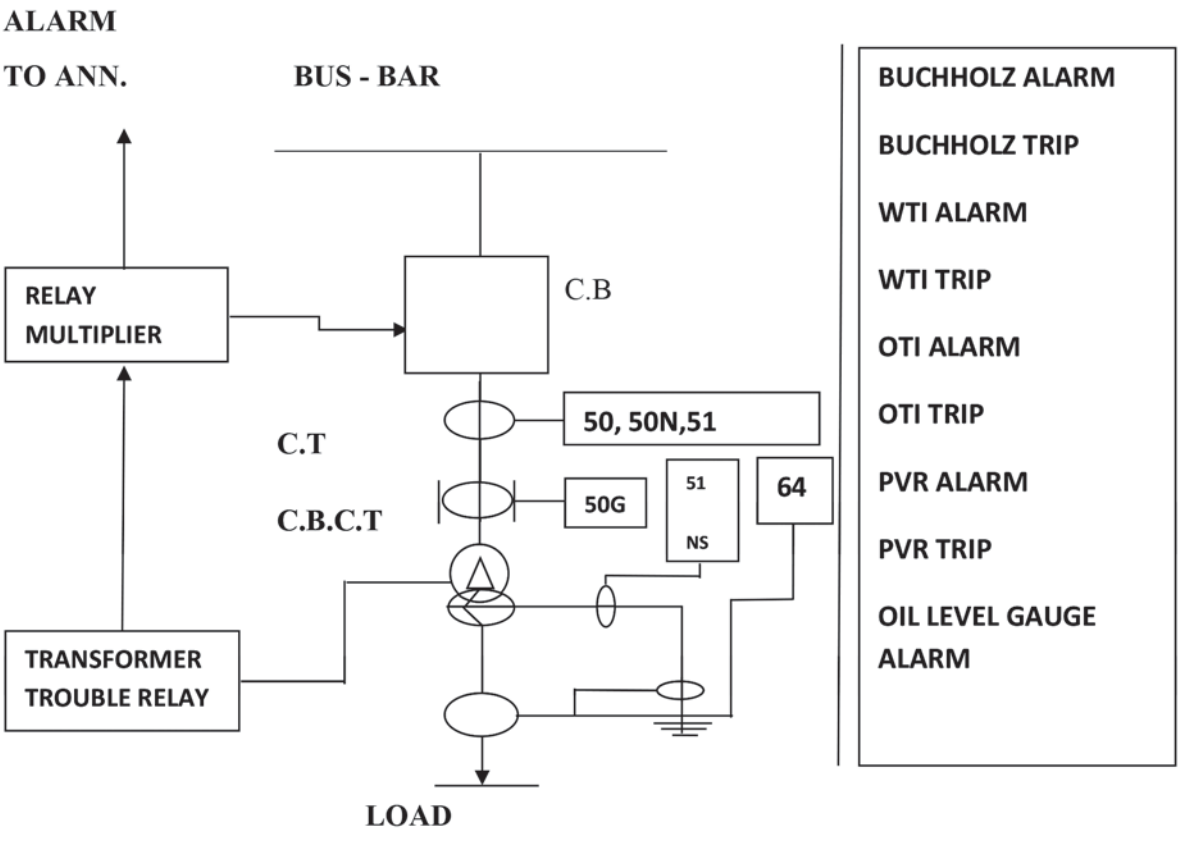
i) Voltage rating
ii) Continuous current rating
iii) Short circuit current rating

Based on current time curve of Bus Bar, protection relay of Bus Bar has been chosen. Normally, following three protections are provided for Bus Bar: -

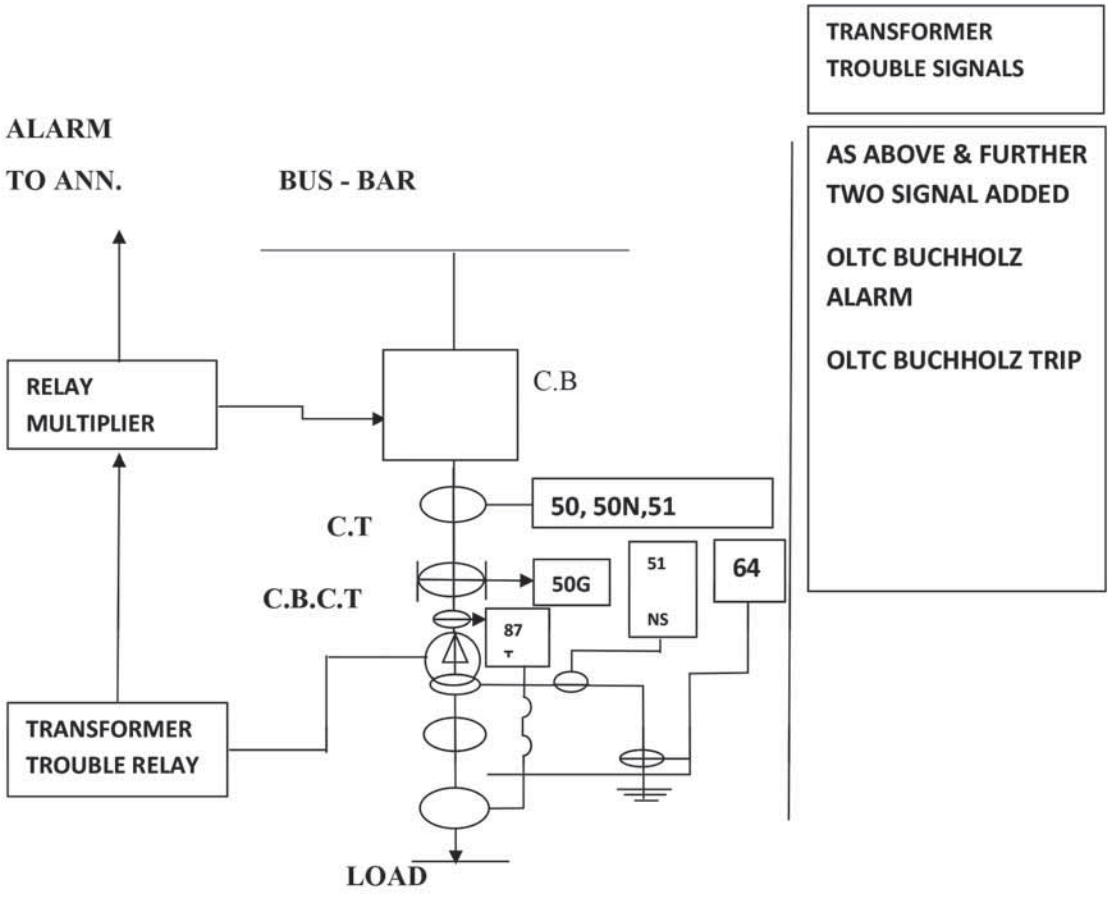
i) Over current and earth fault- IDMT.
ii) Bus Bar/Panel enclosure earth front protection.
iii) Bus Bar differential protection.

Now, before going into the brief description of the sub-station, please remember about earth fault current. Remember that earth fault could be severe fault for any machine having core e.g., transformer, motor, generator etc. Please note that since the core is laminated and laminations are separated by installing materials, very limited amount of earth fall current will occur and also the percentage of winding where the fault has occurred will also control the amount of fault current. Hence, it may be low to detect but adequate to damage the machine. So, please check the earth fault withstands capacity of the core. Below shown a

TRANSFORMER TROUBLE SIGNALS transformer rating up to 3.5 MVA.



For High Voltage Transformer one more relay (Differential) added & OLTC Alarm & Trip added as below: -



Here,

51 - IDMT over current relay
51 NS - Standby earth fault relay
87T - Transformer differential relay
50G - Sensitive earth fault relay
64 - Restricted earth fault relay
WTI - winding temperature index
OTI - Oil temperature index
PRV - Pressure release valve

Circuit Breaker:

At present, most circuit breakers are vacuum circuit breakers (VCB) and maintenance of which may be carried out as per OEM specification and guidelines.

2.2.3.2 Electrical wiring and Illumination:

This area has been covered under SOR of WBPWD (Elect.).General instruction, specification and material standard as described in PWD (Elect) Directorate SOR to be followed for LT works. However, topics regarding calculation of luminance are described below:

The average illuminance E(h) over a reference surface s can be calculated from the "lumen method" formula.

E(h)=F.n.N.LLF.UF(s)/ area of surface S

where:

- F - the initial bare lamp flux (lumens)
- n - the number of lamps per luminaire
- N - the number of luminaires
- LLF - the total light loss factor
- UF(s) - the utilization factor for the reference surface s of the chosen luminaire

Now the Three-dimensional modelling software is available in the market & can be used for Illumination. Please remember the glaring effect of human eye while designing illumination for Dam & Barrages.

2.2.3.3 Cable Sizing:

Cable sizing calculations depends on following three criteria's:

i) Short circuit criteria
ii) AMPACITY criteria
iii) Voltage drop criteria

Now, Short circuit criteria determines the minimum cross section required for the cable which depends on A=(IVt)/K, where A is area of cross section, I is fault current in Amp & t is the time to withstand fault current, K is the constant depends on materials(Conductor & Insulation).

Value of K

Conductor / Type of insulation	Copper	Aluminium
XLPE	143.08	94.48
PVC	115	76.03

Time will depend on calculation of fault time of relay connected in the circuit.

Now, AMPACITY criteria are the current carrying capacity (FLC) of the cable. Also, temperature and placing of cables in duct/tray. It is required to consider de-rating factor from the manufacturer's data.

For voltage drop criteria, following formula may be used:

% Vr= [{V3 X IFLC X (RCosθ + XSinθ) X L}/(1000 X no. of run X V_{rated})] X 100 % <3% of V_{rated}, here R & X are the resistance and reactance of cable in ohm/mtr., L is the length of the cable in mtr.

For motor, following formula may be used:

% Vst = [{V3 X 6IFLC x 1.2(RCosθst + XSinθst) X L}/(1000 X no. of run X V_{rated})] X 100 % <10¬15% of V_{rated},

Take Cosθst=0.25-0.3

2.2.3.4 General rule for electrical works:

It is obligatory under the IE Rules, that all Electrical Installation works shall be eXecuted under qualified Electrical Supervisor holding Electrical Supervisor's Certificate of Competency granted by the State Licensing Board. No layout shall be given by any Departmental officer, other than to a qualified licensed Engineer or Supervisor as stated above. If the Contractors fail to be represented by a Supervisor in the manner stated above or does not immediately apply for layout, the date and time of layout shall be fiXed by the Departmental Officer and intimated to the contractor.

2.2.3.5 Guidelines for operating personnel in the sub- station:

a) Breakers, CTs, PTs, Isolators, LAs, Batteries and Battery Charges, Station Transformers, Fire-fighting equipment, Capacitor banks etc., shall be made available in the control room. Also substation operating instructions record shall be made available in the control room for ready reference.

b) Should be familiar with various equipment available in the substation. Should be thorough about normal operations and emergency operations to be carried out.

   Battery charger operation - change from Float to boost and Boost to float rates changing in each mode.

c) CT available and adopted ratios relay settings meaning of relay indications on all circuit breakers shall be available.

d) Bucholz and differential relay indications. All annunciations and meaning and consequences of each.

e) Knowledge of all the relays and their functioning, purpose and shall be able to interpret correctly to decide whether the equipment can be charged again or to be kept isolated for further inspection/check-up by the concerned Maintenance/MRT personnel (especially when lockout relays, pressure relief relays, temperature relays, bucholtz relay sand differential relays operate) f) While taking over the shift duty, he shall go through the entire log of operation from time to time .last handed over to charge to know the important events happened, works done, condition othe equipment, line clears pending etc.

g) While taking over shift duty he has to check condition of communication equipment, lines, battery charger, batteries, feeders and transformers, breakers gas pressures, air pressures, healthy trip circuits, any relay indications not reset etc.

h) Whenever any feeder/equipment is loaded beyond normal load due to exigencies, such equipment shall be kept under close observation until normalcy is restored, temperature on transformers under such overloading conditions and cooler fans operation shall be constantly monitored.

i) In case of certain exigencies where operations started in particular shift are likely to be carried out during next shift, the personnel of both the shifts shall be available till the operations are completed and normalcy is restored. Shift duties should not be handed over to successor staff in the middle of an exigency.

2.2.3.6 Checks & observations to be made in each month and a register should be maintained to keep records:

a) Voltages at all levels shall be observed and to be maintained nearest to the rated values by operation of tap changes of transformers, if applicable. After observing the supply voltage necessary tap change may be done with due consent of competent authority, to obtain desired operating voltage date and time should be recorded in register.

b) Healthy trips of all breakers shall be checked once in a month. If healthy trip fails, the breaker Shall immediately be hand tripped; fault in the healthy trip circuit shall be immediately attended and rectified. Only after ensuring DC supply, the breaker shall be closed. Healthy trip indicating lamps shall be in working condition date, time, trips result should be recorded in register.

c) Battery voltages, DC leakage, Charger condition, switch off AC supply to charger (once in a Shift) and observe any fall in DC battery voltage.

d) Check the loading on the transformers and capacitor banks. Load current in all the three phases and in neutral circuit (wherever available) to be checked. Any difference in phase currents shall be brought to the notice of maintenance staff and the concerned transformer or capacitor bank shall be cut off from service for detailed examination.

e) Note the oil and winding temperature and physically check-up by feeling the temperature of transformers by hand.

f) Note the oil levels in conservator tanks

g) Check up for any oil leaks and red hot spots.

h) Check-up dehydrating breathers of transformer.

i) Ensure that alarms and indications on annunciation panel are working.

j) Check the entire yard for any unusual sounds, sparks and red hots during evening shift.

k) Check oil levels and condition of breather if available for the MOCBs.

l) Check up for any sparking and flash over marks in the earth pits especially whenever feeders trip on faults.

m) Watering of earth pits to be done properly after vigil observation.

n) Ensure proper working of Energy meters on all CBs. If the energy meters are slow or not working, check the potential supply to the meters fuses etc.

o) Ensure the tripping of breakers on activation of relays whenever the LCs are issued on breakers.

p) Ensure that lightning arrestor's leakage current (micro) ammeter reading is in safe zone (Green).

q) Whenever feeders trip, find out the position of breakers at other end and note down relay indications if any at other end.

r) Check-up the marshalling boxes of breakers, CT junction boxes, PT junction boxes etc. and ensure that they are vermin proof.

s) Check up the batteries, exhaust fans in the battery room for proper operation once in every shift, and report any abnormalities to the maintenance staff immediately.

t) Ensure that hind doors of al control and relay panels are properly closed and the panels are properly sealed from the bottom and made vermin proof.

2.2.3.7 Safety precaution

Fundamental of Safety

I. Prevention of accidents requires whole-hearted co-operation of all members of the organization. A capable mentally alert employee will avoid accidents. However, an unsafe person is a liability. He is danger to himself, his fellow workers and to the equipment and organization.

II. Unsafe acts which may cause accidents:

   a. Operation on equipment without authority or warning.
   b. Operations or working without proper instructions.
   c. Making defective equipment or its improper use.
   d. Using defective equipment or its improper use.
   e. Working nearby dangerous or live electrical equipment which could otherwise be conveniently de-energised.

III. Unsafe conditions which may cause accidents are

   a. Ungrounded equipment.
   b. Defective material or equipment.
   c. Improper illumination.
   d. Non-standard design or construction.

   Accidents are the result of unsafe conditions or unsafe acts or combinations of both.

2.3 General rule for Designing& Drawing

Designing & drawing shall be mandatory in case of new project work and Major renovation & modernization work (which involve substantial changes in design).

The Works shall be designed, manufactured, arranged and installed to provide functional design and neat appearance. All parts of the Works shall be arranged to facilitate surveillance, maintenance and operation. All control sequences shall be simple and rational. The parts of the Works shall be designed and arranged so that they can be easily inspected, cleaned, erected, maintained and dismantled without involving large scale dismantling of other parts of the Works. They shall be designed and manufactured in accordance with the latest recognized rules of workmanship and modern engineering practice. All parts of the Works shall be suitable in every respect for continuous operation at maximum output under the climatic conditions and operating conditions prevailing at the Site.

Works, Materials and design are to be selected which are best suited for the operating conditions to which the parts in question will be subjected. Only such design and types of Works shall be offered which has confirmed its reliability in long-term continuous operation. All live, moving and rotating parts shall be designed so that same are adequately secured

in order to avoid danger to the operating staff. All electrical components shall be electrically earthed as per the latest practice.

When design and drawing work are outsourced, it is required to obtain working drawings (04 set) alongwith design detail for each activity. Lettering of the drawing shall be at least 3 mm high in block capitals. The sizes of drawings shall conform to International Organisation for Standardization (ISO) sizes. All drawings shall bear the mutually agreed title block and drawing number as per the coding and pattern available with the working Division. All drawings shall be drawn in accordance with Indian Standards, to scale, and shall be legible. Wording on drawings shall be in English. Symbols shall be in accordance with Indian Standards. it is also required to obtain design & drawings (soft copies) on good quality DVD/ Pen drive suitable for editing and printing.

2.4 Preparation of estimate

Assistant Engineer/Junior Engineer of respective working division shall conduct adequate and through site/field inspection prior to preparation of estimate to conceive the work in totality and all item shall be so styled as to fall within the scope of items incorporated in this USOR(M&E) hereafter called 'the Schedule items' as far as possible. But where it is necessary to incorporate one or more items not covered by this USOR(M&E), hereafter called 'Non-scheduled items' may be provided in the Schedule of Works for which the tender is to be invited, provided that rate of such items, incorporated in the estimate, are sanctioned by the Superintending Engineer prior to floating of tender. During preparation of such estimates of non schedule item, discount available in the market should be considered.

The quantities in the estimate shall be as far as possible on actual basis. In few eXceptional circumstances where it is difficult (if not impossible) to measure the actual quantity due to inaccessible site arising out of water logging, lack of clear front or any other reason , an eXcess quantity to the tune of 10% (MaXimum) may be added to the theoretical quantity so as to provide a common basis for bidding. The basis of payment will be on the actual quantities of work carried out by contractor. No allowance will be made for wastage of material. Requirement of scaffolding for erection of embedded parts, gates and hoisting components and electrical works etc shall not be considered separately as it is included in the rate of this USOR (M&E). Report of estimate shall mandatorily contain following in addition to other technical detail and works requirement:

i) Block PS and District of the concerned site supported by Google map.
ii) Site condition supported by coloured photographic view containing latitude and longitude.

Cost abstract of each estimate shall be followed by quantity analysis hereafter called 'Detailed Estimate' which contains detailed calculation of material/work quantities item wise.

In addition to that, Following Datasheet is to be annexed with the estimate.

ANNEXURE (Mechanical Work)

1. Name of Work:
2. Total nos of gate exist/to be installed with type (draw/radial/under sluice etc.) and size:
3. Nos of gate shutter is to be repaired:
4. Nos of gate shutter is to be replaced by new one:

5. Nos & type of hoisting arrangement to be repaired/installed:
6. Nos & type of hoisting arrangement to be replaced:
7. Total painting area of gates:
8. Area of gates to be painted:
9. Total painting area of the hoisting arrangement & stair, railing, motor cover, gear box etc:
10. Area of hoisting arrangement & stair etc to be painted. :
11. Total length of rubber seal present
    a) Top rubber seal (specification):
    b) Bottom rubber seal (specification):
    c) Side rubber seal (specification):
12. Total length of rubber seal to be replaced
    a) Top rubber seal (specification):
    b) Bottom rubber seal (specification):
    c) Side rubber seal (specification):
13. Last work done for maintenance or special repair completion date with tender no.:

ANNEXURE (Electrical Work)

1. Name of Work:
2. SLD for required work to be enclosed:.
3. Load calculation for choosing of cable/switch rating to be enclosed.
4. Drawing for panel to be submitted if it is required.
5. Schematic diagram showing the lux level of illumination is also required for road of boundary illumination.
6. Every attempt should be made to go for grid connected SPN power plant for the scheme if it is not possible state the reasons.
7. Last work done for maintenance or special repair completion date with tender no.

2.5 Measurement of work:

Mode of measurement shall be guided by Irrigation Code, 1957.Where irrigation code is silent on certain specific cases, and reference may be made to appropriate & relevant codes of practice published by the Bureau of Indian Standards (BIS).

While recording measurements for Electrical works, the MB shall be signed by the Contractor's Engineer or Supervisor, with his License No. noted therein, as a token not only of the acceptance of measurement but also of the execution of the work under his supervision.

2.6 BIS references.

All works shall be carried out according to technical specifications; the Indian Standard Code(s) of practice, Indian Electricity Act 1910, Indian Electricity Rule 1956 and Regulations framed there under, The Electricity Act 2003 and S.O.R (Electrical) of WBPWD. Any work not covered in the Indian Standard Code(s) & specification, it shall be carried out as per best practice adopted in this country and /or reference may be made to other appropriate & relevant ASTM, ASME, DIN, JIS or BS according to the direction and satisfaction of the

Engineer-in charge. Here are some relevant BIS references are included but not limited to the following:

A) GENERAL

IS 28 (1985): Phosphor bronze ingots and castings

IS 7814 (2005): Phosphor bronze sheet, strip AND Foil -specification

IS 305 (1981): Aluminum Bronze Ingots and Castings

IS 318 (1981): Leaded Tin Bronze Ingots and Castings

IS 800 (2007): General Construction In Steel - Code of Practice

IS : 816-1992 - Code of practice for use of metal are welding for general instruction in mild steel.

IS : 822-1991 - Code of practice for inspection of welds.

IS 3444 (1999): Corrosion Resistant High Alloy Steel And Nickel Base Castings for General Applications

IS 808 (1989): Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections

IS 919-1 (1993): ISO Systems of limits and fits, Part 1: Bases of tolerance, deviations and fits

IS 919-2 (1993): ISO systems of limits and fits, Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts

IS : 1023-1987 - Code of practice for OXygen- Acetylene welding for structural work in mild steel.

IS 1030 (1998): Carbon steel castings for general engineering purposes

IS 1200 (Part-8): Methods of measurement of building & civil engineering works (steel work & iron work)

IS 1367-3 (2002): Technical Supply Conditions for Threaded Steel Fasteners, Part 3: Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel - Bolts, Screws and Studs

IS 1570-2-1 (1979): Schedules for Wrought Steels, Part 2: Carbon Steels (Unalloyed Steels), Section 1: Wrought Products (Other Than Wires) With Specified Chemical Composition and Related Properties

IS 1570-4 (1988): Schedules for wrought steels, Part 4: Alloy steels (Alloy constructional and spring steels) with specified chemical composition and mechanical properties

IS 1570-5 (1985): Schedules for Wrought Steels, Part 5: Stainless and Heat-resisting Steels

IS 1732 (1989): Steel Bars round and square for structural and general engineering purposes

IS 2048 (1983): Parallel Keys and Keyways

IS 2062 (2011): Hot Rolled Medium and High Tensile Structural Steel

IS 2102-1 (1993): General tolerances, Part 1: Tolerances for linear and angular dimensions without individual tolerance indications

IS 2102-2 (1993): General tolerances, Part 2: Geometrical tolerances for features without individual tolerance indications

IS 2378 (1974): Code for designation of copper and copper Alloys IS : 2595-1991- Code of practice for radiographic testing.

IS 2629 (1985): Recommended Practice for Hot-Dip Galvanizing of Iron and Steel IS 2644 (1994): High tensile steel castings

IS 3589 (2001): Steel Pipes for Water and Sewage (168.3 to 2 540 mm outside Diameter)

IS 3823 (1988): Rolling bearings - Static load ratings

IS 3824-1 (1983): Method of Evaluating Dynamic Load Ratings of Rolling Berrings, Part 1: Radial Ball Bearings

IS 3824-2 (1983): Method of Evaluating Dynamic Load Ratings of Rolling Berrings, Part 2: Radial Roller Bearings

IS 3824-3 (1983): Method of Evaluating Dynamic Load Ratings of Rolling Berrings, Part 3: Thrust Ball Bearings

IS 3824-4 (1983): Method of Evaluating Dynamic Load Ratings of Rolling Berrings, Part 4: Thurst Roller Bearings

IS 3824 (2002): Rolling Bearings - Dynamic Load Ratings and Rating Life

IS 4137 (1985): Code of practice for heavy duty electric overhead travelling cranes including special service machines for use in steel work [MED 14: Cranes, Lifting Chains and Related Equipment]

IS 4432 (1988): Case hardening steels

IS 4460-1 to 3(1995): Gears - Spur and Helical Gears -Calculation of Load Capacity

IS 5312-1 (2004): Swing Check Type Reflux (Non-Return] Valves for Water Works Purposes, Part 1: Single-Door Pattern IS 5504 (1997): Spiral Welded Pipes

IS 6603 (2001): Stainless Steel Bars and Flats

IS 8830 (2007): Calculation of Load capacity of spur and helical gear - Application to marine gears

IS 10118-4 (1982): Code of practice for selection, installation and maintenance of switchgear and control gear, Part 4: Maintenance

IS 10742 (1983): Cast gun metal rods and bars

IS 14536 (1998): Selection, installation, operation and maintenance of submersible pump set - Code of practice

IS/ISO 1940-1 (2003): Mechanical vibration - Balance quality requirements for rotors in a constant (Rigid) state, Part 1: Specifications and verification of balance tolerances

B) HYDRAULIC GATES, HOIST, RUBBER SEAL, PAINTING & TRASH RACK

IS 13623 (1993): Criteria for choice of gates and hoists

IS 5620 (1985): Recommendations for Structural Design Criteria for Low Head Slide Gates

IS 9349 (2006): Recommendations for structural design of medium and high head slide gates

IS 4622 (2003): Recommendations for Structural Design of Fixed-Wheel Gates

IS 4623 (2000): Recommendations for Structural Design of Radial Gates

IS 13591 (1992): Criteria for design of lifting beams

IS 11228 (1985): Recommendations for design of screw hoists for hydraulic gates

IS 6938 (2005): Design of rope drum and chain hoists for hydraulic gates - Code of practice

IS 10210 (1993): Criteria for Design of Hydraulic Hoists for Gates

IS 11793 (1986): Guidelines for design of float-driven hoisting mechanism for automatic gated control

IS 7718 (1991): Recommendations for inspection, testing and maintenance of fixed wheel and slide gates

IS 10096-1-1 (1983): Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists, Part 1: Inspection, testing and assembly at the manufacturing stage, Section 1: Gates

IS 10096-1-2 (1986): Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists, Part 1: Inspection, testing and assembly at the manufacturing stage, Section 2: Rope Drum Hoists

IS 10096-2 (1983): Recommendations for inspection, testing and maintenance or radial gates and rope drum hoists, Part2: Inspection, testing and assembly at the time of erection

IS 10096-3 (2002): Recommendations for Inspection, Testing and Maintenance of Radial Gates and Rope Drum Hoists, Part3: After Erection

IS 13041 (1991): Recommendation for inspection, testing and maintenance of hydraulic hoist (After Erection)

IS 11855 (2004): Guidelines for Design and Use of Different Types of Rubber Seals for Hydraulic Gates

IS 15466 (2004): Rubber seals for hydraulic gates

IS 14177 (1994): Guidelines for painting system for hydraulic gates and hoists

IS 15509 (2004): Double-pitch precision roller chains and sprockets for transmission and conveyors

IS 2403 (1991): Short Pitch Transmission Precision Roller Chains and Chain Wheels

IS 2637 (2004): Steel roller chains Type S and C, Attachments and chain wheels

IS 11388 (2012): Recommendations for Design of Trash Racks for Intakes

IS 2266 (2002): Steel Wire Ropes for General Engineering Purposes

IS 2485 (1979): Drop Forged Sockets for Wire Ropes for General Engineering Purposes

IS 12959 (1990): Technical supply requirements for sprocket wheels for link chains

IS 6196 (1971): Dimensions for fitted half-couplings

IS 6280 (1971): sewage screens

IS 3832 (2005): Hand-Operated Chain Pulley Blocks

IS 3640 (1982): HeXagon Fit Bolts

IS 3734 (1983): Dimensions for worm gearing

IS 2693 (1989): Power Transmission - Bush Type FleXible Coupling

IS 3177 (1999): Code of Practice for Electric Overhead Travelling Cranes and Gantry Cranes other than Steel Work Cranes

C) PUMPS

IS 5600 (2002): Pumps - Sewage and Drainage

IS 1710 (1989): Pumps - Vertical Turbine MiXed and AXial Flow, for Clear Cold Water

IS 5120 (1977): Technical requirements for rotodynamic special purpose pumps

IS 13538 (1993): Centrifugal miXed flow and aXial pumps -Code for hydraulic performance tests - Precision class

IS 15310 (2003): Hydraulic Design of Pump Sumps and Intakes- Guidelines

IS 2951-1 (1965): Recommendation for Estimation of Flow of Liquids in Closed Conduits, Part I: Head Loss in Straight Pipes Due to Frictional Resistance

IS 2951-2 (1965): Recommendation for estimation of flow of liquids in closed conduits, Part 2: Head loss in valves and fittings

IS 10981 (1983): Class of acceptance test for centrifugal miXed flow and aXial pumps - Class B

IS 9137 (1978): Code for acceptance test for centrifugal, miXed flow and aXial pumps- Class C

IS 10805 (1986): Foot valves, refluX valves or non-return valves and bore valves to be used in suction lines of agricultural pumping systems

D) ANSI HI & ISO STANDARD

ANSI/ HI 1.3 - Rotodynamic Centrifugal Pumps for Design And Application

ANSI/ HI 2.3 - Rotodynamic Vertical Pumps of Radial, MiXed, and AXial Flow Types for Design and Application

ANSI/ HI 2.4 - Rotodynamic (Vertical) Pumps for Manuals Describing Installation, Operation and Maintenance

ANSI/ HI 9.8 - Intake Design for Rotodynamic Pumps

ANSI/ HI 9.6.1 - Rotodynamic Pumps Guideline for NPSH Margin

ANSI/ HI 9.6.3 - Centrifugal and Vertical Pumps for Allowable Operating Region

ANSI/ HI 9.6.4 - Rotodynamic (Centrifugal and Vertical) Pumps for Vibration Measurement and Allowable Values

ANSI/ HI 9.6.5 - Rotodynamic (Centrifugal and Vertical) Pumps for Condition Monitoring

ANSI/ HI 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

BS EN ISO 9906 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests Grade 1 & 2

For LT electrical work all IS code included in Directorate of WBPWD (Elect), S.O.R shall be followed.

2.7 Maintenance Register:

Recording of maintenance history is an important document to assess health of any mechanical and Electrical system comprising of gate system, drainage pump, sub-station etc. It not only helps in identification of problem in mechanical and Electrical system but also plays important role to avoid repetition of work in successive years. Thus, it provides a guidance to plan & prepare techno economically viable maintenance budget.

These records should generally consist of:

a) Date of completion of work / Date of final measurement.
b) Major works carried out.
c) Problems encountered if any during maintenance.
d) Reference Tender agreement no.

A register may be maintained in this regard and same shall be kept & maintained by concerned Assistant Engineer. Such maintenance details shall be recorded after completion of work and prior to submission final bill. Executive Engineer of concerned working Division shall satisfy himself before passing the final bill that necessary entries have been made in Maintenance Register.

A generalised format of maintenance Register at **Annexure-IV** has been provided.

2.8 Acceptable Makes of Bought out Items:

Makes of different bought out items play important role for better quality works. Hence, Selection of OEMs /brands have become necessary to maintain uniformity of works throughout the state and to encourage competitive environment between different OEMs. Here are some acceptable makes prescribed by committee of USOR (M&E) are included but not limited to the following.

Sl. No.	Item Description	List of Venders/Make	Country
1.	Structural steel	SAIL/TATA/ JINDAL/ Equivalent(approved by EIC)	India
2.	WireRope	UshaMartin/Bharat Wire Ropes/Fort William	India
3.	Brake	Electromag/BCH/Sterlingcontrol/Industries Syndicate	India
4.	ElectricMotor	Kirloskar/Crompton/GEC/ABB/Bharat Bijlee/SIEMENS	India
5.	GearBox	NewAllenberry/Elecon/Greeves	India
6.	PlummerBlocks	SKF/FAG/Equivalent(approved by EIC)	India
7.	Anti-frictional Bearings	SKF/FAG/Equivalent(approved by EIC)	India
8.	Paint	Berger/Asian Paints/Shalimar	India
9.	Welding Electrode	ESAB/D&H/ADOR/GEE/ L & T	Indian / Foreign
10.	GearOil	IOCL/BPCL/HPCL	India
11.	Cable & wire	Havels, Gloster, Finolex, Polycab, GEMescab, KEI or equivalent(approved by EIC)	India
12	LED Luminaries	PHILIPS, CROMPTON, PANASONIC, SURYA, NORDOX, LIGHTING TECHNOLOGY, BAJAJ, KLITE or equivalent(approved by EIC)	India
13	FAN	Crompton, Bajaj, Havels, Usha or equivalent(approved by EIC)	India
14	AC	Hitachi, Daikin, Voltas, Carrier, Panasonic or equivalent(approved by EIC)	Indian / Foreign
15	Poles	Calcutta Poles, Bajaj, Indian Pole, Utkarsh, /or Equivalent(approved by EIC)	Indian

2.9 Quality Assurance Plan:

Quality assurance plan (QAP) is required for effective execution for a particular work. The QA shall cover all stages of work such as setting out of works, selection of material, selection of method of works, selection of plant and equipment, deployment of staffs, quality control testing. The QA program shall cover as per standard documents such as relevant Indian Standard Codes including its Special Publications etc. These shall broadly cover the QA aspects of all services rendered, all items to be supplied and all activities to be performed including the temporary structures and equipment which will influence the quality of the completed works or the progress of the work. Hence, considering all these aspect QAP shall have to be designed and implemented to work at site. No separate cost provision in implementation of QAP shall be kept in the estimate as it is deemed included in the rate of USOR (M&E).

Chapter : 3
Labour Rates

RATE OF WAGES FOR DIFFERENT CATEGORY OF WORKERS Vide Circular No. 45/stat/2RW/32/94/LCS/JLC Dated 31.01.2022.

Sl. No.	Category of workers	Unit	Rate (Rs.)		
			Monthly Wages	Daily Wages	Hourly wages = Monthly wages x 12/1200 (As per CWC guide line)
1	Head Mason Grade -I	Each	11852.00	456.00	119.00
2	Ordinary Mason	Each	10775.00	414.00	108.00
3	Mazdoor (Male/Female)	Each	8904.00	342.00	89.00
4	Mazdoor (for night work)	Each	8904.00	342.00	89.00
5	Head Carpenter Grade -I	Each	11852.00	456.00	119.00
6	Ordinary Carpenter	Each	10775.00	414.00	108.00
7	Helper for Carpenter	Each	9795.00	377.00	98.00
8	Santras	Each	10775.00	414.00	108.00
9	Head Fitter /Head Mechanic	Each	11852.00	456.00	119.00
10	Ordinery Fitter / Mechanic	Each	10775.00	414.00	108.00
11	Helper for Fitter/Mechanic	Each	9795.00	377.00	98.00
12	Turner/Miller/Shaper	Each	11852.00	456.00	119.00
13	Helper for Turner/Miller/Shaper	Each	9795.00	377.00	98.00
14	Painter	Each	10775.00	414.00	108.00
15	Plumber	Each	10775.00	414.00	108.00
16	Helper for Plumber	Each	9795.00	377.00	98.00
17	Welder Grade -I	Each	11852.00	456.00	119.00
18	Ordidery Welder	Each	10775.00	414.00	108.00
19	Helper for Welder	Each	9795.00	377.00	98.00
20	Gas Cutter	Each	10775.00	414.00	108.00
21	Helper for Gas Cutter	Each	9795.00	377.00	98.00
22	Pump Operator	Each	9795.00	377.00	98.00
23	Sr. Electrician Grade-I	Each	11852.00	456.00	119.00
24	Electrician	Each	10775.00	414.00	108.00
25	Helper for Electrician	Each	9795.00	377.00	98.00
26	Generator Operator	Each	9795.00	377.00	98.00
27	Lift Operator	Each	9795.00	377.00	98.00
28	Spray Painter Grade-I	Each	11852.00	456.00	119.00
29	Ordinery Security Guard	Each	8904.00	342.00	89.00
30	Security Guard with Fire Arms	Each	10775.00	414.00	108.00

Note: Above labour rates do not include 10% Contractors' Profit, 8% Overhead Chrages & 1% Labour Welfare Cess

Chapter : 4.1
Basic Rate for Mechanical & Electrical Works
SUPPLY RATE OF FOLLOWING MATERIALS AS MENTIONED BELOW

Sl. No.	Category of workers	Unit	Basic Rate (Rs.)
1	M.S PLATE AS PER IS : 2062 -2011/Latest Revision, Make : SAIL/ TATA/JINDAL		
	a) Upto 2 mm thickness	Kg.	74.67
	b) Above 2 mm upto 10 mm thickness	Kg.	73.00
	c) Above 10 mm upto 20 mm thickness	Kg.	68.60
	d) Above 20 mm upto 50 mm thickness	Kg.	69.65
2	CHEQUERED PLATE 10mm thick Make : SAIL/TATA/JINDAL		
	a) Upto 4 mm thickness	Kg.	71.93
	b) Above 4mm thickness	Kg.	71.93
3	I.S.A as per IS : 2062 -2011/Latest Revision, Make : SAIL/TATA/JINDAL		
	a) Upto 100x100 x different thickness	Kg.	54.60
	b) Upto 200x200 x different thickness	Kg.	60.05
4	I.S.M.C as per IS : 2062 -2011/Latest Revision, Make : SAIL/TATA/JINDAL		54.60
	up to 200 x 75	Kg.	60.38
5	I.S.M.B as per IS : 2062 -2011/Latest Revision, Make : SAIL/TATA/JINDAL		
	a) Up to 200 x 100	Kg.	51.73
	b) Above 200 x 100 up to 300 x 140	Kg.	52.28
	c) Above 300 x 140	Kg.	62.48
6	M.S FLAT as per IS : 2062 -2011/Latest Revision, Make : SAIL/TATA/JINDAL		
	a) Upto 50 x different thickness	Kg.	56.65
	b) Above 50 upto 100 x different thickness	Kg.	59.74
	c) Above 100 upto 150 x different thickness	Kg.	61.80
7	Stainless Steel Flat (304)	Kg.	300.00
9	M.S Round (rolled) class 4 as per IS : 2004		
	a) upto dia 100 mm	Kg.	55.00
	b) Above 100 upto dia 150 mm	Kg.	62.00
10	M.S Round (forged) class 4 as per IS : 2004		
	a) upto dia 100 mm	Kg.	70.00
	b) Above 100 upto dia 150 mm	Kg.	75.00
11	EN-8/ 9 Round (rolled)		
	a) upto dia 100 mm	Kg.	60.00
	b) Above 100 upto dia 150 mm	Kg.	64.00
12	Stainless Steel Round as per AISI -410 (rolled)	Kg.	120.00
13	Stainless Steel Round as per AISI -304 (rolled)		270.00
14	Stainless Steel Round AISI -316 (rolled)		300.00

Sl. No.	Category of workers	Unit	Basic Rate (Rs.)
15	Welding rod (M.S) Make Advani/Esab/Ador	Kg.	120.00
16	Welding rod (S.S -304) Make Advani/Esab/Ador	Kg.	350.00
17	Acetylene Gas	Cum	370.00
18	Oxygen gas	Cum	52.00
19	LPG	Cum	175.00
20	Grinding wheel 4 inch	No	120.00
21	Structural M.S Bolt/Nut/Washer (Black)	Kg.	100.00
22	Structural M.S Bolt/Nut/Washer (Hot dipped Galvanised)	Kg.	115.00
23	Epilux 555HB coal tar epoxy	litre	196.50
24	Epilux zinc phosphate primer grey(610)	litre	217.50
25	Epilux 4HB MIO (155)	litre	
26	Alkyd MIO	litre	144.50
27	HB zinc phosphate primer (epoxy)	litre	196.00
28	Synthetic enemal paint (IS 2932)	litre	149.00
29	Inorganic Zinc silicate (IS 14946)	litre	492.00
30	Thinner	litre	124.50
31	Chemical for de-greasing / derusting / Phosphate Coating	litre	120.00
32	Wire Brush	No	30.00
33	Painting Brush	No	400.00

Chapter : 4.2
Hire Charges of Machinery

Analysis is done as per guide line of CWC - December 1988 & IS : 11590 :1995

Sl. No	Name of the Machine	Unit	Price	GeM/ Non GeM	Unit	Hire Charge	Unit	Hourly fuel/ energy charge	Unit	Machine crew/operators charges
	15 KVA Generator (Silent)	No	351500.00	GeM						
	a) Monthly Basis				hour	40.07				
1	b) Weekly Basis				hour	45.17	hour	334.59	Day	833.00
	c) Daily Basis				hour	50.26				
	d) Hourly Basis				hour	52.81				
	30 KVA Generator (Silent)	No	49000.00	GeM						
	a) Monthly Basis				hour	55.86				
2	b) Weekly Basis				hour	62.97	hour	669.19	Day	833.00
	c) Basily Basis				hour	70.07				
	d) Hourly Basis				hour	73.62				
	40 KVA Generator (Silent)	No	499999.00	GeM						
	a) Monthly Basis				hour	57.00				
3	b) Weekly Basis				hour	64.25	hour	892.25	Day	833.00
	c) Daily Basis				hour	71.50				
	d) Hourly Basis				hour	75.12				
	62.5 KVA Generator (Silent)	No	803000.00	GeM						
	a) Monthly Basis				hour	91.54				
4	b) Weekly Basis				hour	103.19	hour	1394.14	Day	833.00
	c) Daily Basis				hour	114.83				
	d) Hourly Basis				hour	120.65				
5	Portable Arc Welding Machine with cable (Monthly Basis)	No	37200.00	GeM	hour	8.48	hour	13.86	hour	249.90

Sl. No	Name of the Machine	Unit	Price	GeM/ Non GeM	Unit	Hire Charge	Unit	Hourly fuel/ energy charge	Unit	Machine crew/operators charges
6	MIG Welding Machine with cable (1.2mm wire) (Monthly Basis)	No	143600.00	GeM	hour	16.37	hour	606.38	hour	523.50
7	Pug cutting machine with pipe & nozzle (Monthly Basis)	No	105000.00	GeM	hour	11.97	hour	2.15	hour	523.50
8	Angle grinder machine (5 inch) (Monthly Basis)	No	4600.00	GeM	hour	2.10	hour	3.87	hour	249.90
9	Air less spray painting machine.	No	525000.00	Non GeM	hour	83.29	hour	8.66	hour	249.90
10	Drilling Machine 25 mm drilling capacity Lathe	No	59000.00	GeM	hour	6.73	hour	4.31	hour	249.90
11	Machine Heavy Duty 8.5' (Monthly Basis)	No	345000.00	Non GeM	hour	39.33	hour	21.54	hour	523.50
12	Lathe Machine Heavy Duty 20'	No	1800000.00	Non GeM	hour	205.20	hour	64.62	hour	523.50
13	Shapping Machine	No	215000.00	Non GeM	hour	24.51	hour	32.31	hour	523.50
14	5 Ton Capacity Chain Pulley Block	No	24300.00	GeM	hour	22.74	hour	0.00	hour	215.70
15	10 Ton Capacity Chain Pulley Block	No	35000.00	GeM	hour	29.68	hour	0.00	hour	215.70
16	Hydraulic Truck Crane 12 T (Hourly Basis)	No	1781000.00	GeM	hour	267.60	hour	749.49	hour	215.70
17	Hydraulic Truck Crane 16 T (Hourly Basis)	No	2123000.00	GeM	hour	318.98	hour	1030.00	hour	215.70
18	Sand Blasting Machine	No	85000.00	GeM	hour	12.77	hour	0.00	hour	719.00
19	Air Compressor 64 CFM	No	372000.00	GeM	hour	45.85	hour	80.85	hour	719.00

N.B : Above labour rates do not include 10% Contractors' Profit, 8% Overhead Chrages & 1% Labour Welfare Cess. Total charge will be Hire charge + energy/fuel charge+ Cost of Machine crew/operators

Chapter : 5

(A) Gates of Dams /Barrages			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.A-1	Fabrication , supply, erection and commissioning of embeded parts consisting of seal beam, slide track / roller track, side seal seats and guide path with all accessories for spillway vertical service gate / stoplog gate/ other vertical lift element of dams and barrages made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 - 2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting). Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly.	3	4
i)	Insert plate welded with J hook	Kg	175.00
ii)	Seal beam	Kg	161.00
iii)	Roller Track/ Slide Track/Side seal seat/ Guide Path	Kg	179.00
5.1.A-2	Fabrication , supply, erection and commissioning of embeded parts consisting of seal beam, roller track, side seal seats, and yoke grider etc. with all accessories for spillway Radial service gate of dams and barrages made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting). Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly		
i)	Insert plate welded with J hook	Kg	176.00
ii)	Seal beam	Kg	161.00
iii)	Roller Track/ Side seal seat/ Yoke Grider	Kg	192.00
5.1.A-3	Fabrication , Supply, erection and commissioning of embeded parts consisting of seal beam, slide track / roller track, side seal seats , top seal seats and guide path with all accessories for Head regulator vertical service gate / Emergency gate/ other vertical lift element of dams and barrages made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting). Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly		
i)	Insert plate welded with J hook	Kg	176.00
ii)	Seal beam	Kg	161.00
iii)	Roller Track/ Slide Track/Side seal seat/ Guide Path/Top seal seat	Kg	173.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.A-4	Fabrication , Supply, erraction and commissioning of embeded parts consisting of seal beam, slide track / roller track, side seal seats , top seal seats and guide path with all accessories for Head regulator radial service gate of dams and barrages made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting). Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly		
i)	Insert plate welded with J hook	Kg	176.00
ii)	Seal beam	Kg	161.00
iii)	Roller Track/ Side seal seat/ Yoke Grider/top seal seat	Kg	187.00
5.1.A-5	**Supply and fabrication of new stainless steel plate/flat (AISI - 304)** of suitable size on seal beam / roller track/ slide track/ side seal seats/ top seal seat by welding (SS) as per direction of the Engineer-in-charge including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification.	Kg	592.00
5.1.A-6	Fabrication , Supply, erection and commissioning of new fixed wheel type vertical lift spillway service gate/Emergency gate of Dams and Barrages as per IS: 4622 - 2003/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 - 2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).		
a)	Width of Gate shuteer size upto 12 metre	Kg	147.00
b)	Width of Gate shuteer above 12 metre upto 20 metre.	Kg	158.00
5.1.A-7	Fabrication , Supply, erection and commissioning of new Radial spillway service gate of Dams and Barrages as per IS: 4623 - 2000/ Latest Revision consisting of skin plate, vertical, horizantal grider, radial arm and stiffener, trinnion assemblies etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Bending, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	kg	161.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.A-8	Fabrication , Supply, erection and commissioning of new fixed wheel type vertical lift Head regulator service gate/Emergency gate of Dams and Barrages as per IS: 4622 - 2003/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 - 2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	144.00
5.1.A-9	Fabrication , Supply, erection and commissioning of new Radial Head Regulator service gate of Dams and Barrages as per IS: 4623 - 2000/Latest Revision consisting of skin plate, vertical, horizantal grider, radial arm and stiffener, trinnion assemblies etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Bending, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	156.00
5.1.A-10	Fabrication , Supply, erraction and commissioning of vertical lift stoplogs gate elements (all interchangeable) consisting of skin plate, vertical and horizontal girders, stiffeners, lifting brackets, ballast blocks etc., with all accessories for barrage/dam vent including cost of all materials, machinery, labour,welding ,aligning finishing seal fixing etc.with al lleads and lifts, complete as per specifications and approved drawings.	Kg	148.00
5.1.A-11	Design, drawing, fabrication, supply, erection, testing and commissioning of structural steel hoist bridge, Rail support Girder(for Gantry crane) & cat walk/walkway bridge on dam/ barrages and canal/rivers consisting of foundation bolt assembly, base plate, columns, beams, bracings, stiffeners, ties, chequered plate covering, hand railing, staircase etc., with all accessories including cost of all materials, machinery, labour, welding, finishing, etc., complete as per specifications and drawings with all leads and lifts (without painting).	Kg	153.00

(B) Maintenance & Repairing of Gates of Dam/Barrage			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.B-1	**Taking out old existing unservicable damaged gate shutter of dam /barrages** completely after disengaging from hoisting system completely for installation of new gate shutter. The work includes cutting of gates into suitable pieces by gas cutting, removing the same by mechanical means or suitable crane, stacking all the pieces at the suitable place or as directed by the Engineer in charge upto a lead of 1000 m. The cost includes cost of man power employed for dismantling and cost of consumables like oxygen, accetylene gas, welding rod, hire charges of machineries, like chain pulley block, gas set, grinding machine, welding set, tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading. The cost of complete dismantling of hoisting system & cost of old unservisable materials handed over to departmental godown including loading & unloading will be provided extra.		
a)	Gate shuteer size upto 10 Sq.m	Each	13549.00
b)	Gate shuteer size above 10 sq.m upto 20 Sq.m	Each	33649.00
c)	Gate shuteer size above 20 sq.m upto 50 Sq.m	Each	58790.00
d)	Gate shuteer size above 50 sq.m upto 70 Sq.m	Each	86552.00
e)	Gate shuteer size above 70 Sq.m	Each	124913.00
5.1.B-2	**Cost for arrangement of holding the Dam / Barrage gate and its counter weight** by special fixures, tools and tackles, chain pulley block and heavey scaffolding etc as per requirement for performing repairing works at the site. The cost includes cost of mampowers, hire charges of T&P, chain pulley blocks, scaffolding, and overhead cost etc to complete the job as per direction of Engineer in charge.		
a)	Gate shuteer size upto 10 Sq.m	Each	8569.00
b)	Gate shuteer size above 10 sq.m upto 20 Sq.m	Each	14964.00
c)	Gate shuteer size above 20 sq.m upto 50 Sq.m	Each	24677.00
d)	Gate shuteer size above 50 sq.m upto 70 Sq.m	Each	33668.00
e)	Gate shuteer size above 70 Sq.m	Each	47415.00
5.1.B-3	**Cost for repairing of vertical gate** shutter of Dam / Barrage including dismentling the damaged portion at lower part (skin plate, horizental/ vertical girder/stifner etc as per IS : 2062 - 2011 /latest revision) not more than 25% of gate hight from bottom by gas cutting and fitting, fixing and fabricated by welding as per direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without paintina)		
a)	Width of Gate shuteer size upto 12 metre	Kg	154.00
b)	Width of Gate shuteer above 12 metre upto 20 metre.	Kg	164.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.B-4	**Cost for repairing of radial gate** shutter of Dam / Barrage including dismentling the damaged portion at lower part (skin plate, horizental/ vertical girder/stifner etc as per IS : 2062 - 2011 /latest revision) not more than 25% of gate hight from bottom by gas cutting and fitting, fixing and fabricated by welding as per direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting)	Kg	172.00
5.1.B-5	Repairing/replacement/strengthening of damaged/heavily corrodeded portion of cross/horizontal/ vertical steel members, chequered plate, stair case, hand railing etc. of MS hoist tresstle bridge, catwalk/walkway bridge and other similar MS structure on dam/barrage and canal/rivers which includes dismantling of damaged portion of structural members and fabrication and finishing to the required shape & size as per direction. The Cost includes cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	154.00

(C) Main Canal & River Gates			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.C-1	Fabrication , supply, erection and commissioning of embeded parts consisting of seal beam, Guide channel with all accessories for vertical gate of canal/river made of MS material consisting of angle, channel, beam, plate, flat, etc. conforming to IS : 2062 - 2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting). Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly		
i)	Insert plate welded with J hook	Kg	160.00
ii)	Seal beam	Kg	142.00
iii)	Guide channel/Guide path/Top seal path	Kg	143.00
5.1.C-2	Fabrication , Supply, erraction and commissioning of embeded parts consisting of seal beam, side seal seats, and yoke grider etc. with all accessories for Radial gates of canal/river made of MS material consisting of angle , channel, beam, plate, fat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approveddrawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting) . Remarks: Cost for civil works to be taken from PWD (R) directorate seperatly		
i)	Insert plate welded with J hook	Kg	160.00
ii)	Seal beam	Kg	142.00
iii)	Side seal seat/ Yoke Grider/Top seal Path	Kg	146.00
5.1.C-3	Fabrication , Supply, erection and commissioning of new Slide type vertical lift regulator service gates of Canal/River as per IS: 5620 - 2000/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).		
i)	Width of Gate shuteer size upto 2 metre	Kg	130.00
ii)	Width of Gate shuteer size above 2 metre	Kg	134.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.C-4	Fabrication , Supply, erection and commissioning of new Radial Regulator service gate of Canal/River as per IS: 4623 - 2000/Latest Revision consisting of skin plate, vertical, horizantal grider, radial arm and stiffener, trinnion assemblies etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Bending, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).		
i)	Width of Gate shuteer size upto 4 metre	Kg	149.00
ii)	Width of Gate shuteer size above 4 metre	Kg	158.00
5.1.C-5	Fabrication , Supply, erection and commissioning of new Flap/Fall board shutter of Canal/River as per IS: 5620 - 2000/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).		
i)	Width of Gate shuteer size upto 4 metre	Kg	131.00
ii)	Width of Gate shuteer size above 4 metre	Kg	135.00

(D)Repairing and maintenance of Gates of Canal & River			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.D-1	Dismantling of damaged embeded part like guide channel/bottom seal beam/top seal beam of gates of canal/river from civil structure as directed by the Engineer-in- charge.The cost of man power employed for dismantling and hire charges of Tools and Plant, scaffolding charges etc. Payment will be made on actual length of Guide Channel.	RM	411.00
5.1.D-2	Taking out old existing unservicable damaged gate shutter of canal/ river completely after disengaging from hoisting system completely for installation of new gate shutter. The work includes cutting of gates into suitable pieces by gas cutting, removing the same by mechanical means or suitable crane, stacking all the pieces at the suitable place or as directed by the Engineer in charge upto a lead of 1000 m. The cost includes cost of man power employed for dismantling and cost of consumables like oxygen, accetylene gas, welding rod, hire charges of machineries, like chain pulley block, gas set, grinding machine, welding set, tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading. The cost of complete dismantling of hoisting system & cost of old unservisable materials handed over to departmental godown including loading & unloading will be provided extra.		
	a) Gate shuteer size upto 4.00 sq.m	Kg	5.88
	b) Gate shuteer size above 4.00 sq.m upto 8.00 sq.m	Kg	6.22
	c) Gate shuteer size above 8.00 sq.m	Kg	6.30
5.1.D-3	Cost for repairing of vertical/flap gate shutter of canal/river including dismantling the damaged portion at lower part (skin plate, horizental/ vertical girder/stifner etc as per IS : 2062 - 2011 /latest revision) not more than 25% of gate hight from bottom by gas cutting and fitting, fixing and fabricated by welding as per direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting)		
	Width of Gate shuteer size upto 2 metre	Kg	179.00
	Width of Gate shuteer size above 2 metre	Kg	182.00
5.1.D-4	Cost for repairing of radial gate shutter of canal/river including dismantling the damaged portion at lower part (skin plate, horizental/ vertical girder/stifner etc as per IS : 2062 - 2011 /latest revision) not more than 25% of gate hight from bottom by gas cutting and fitting, fixing and fabricated by welding as per direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting)		
	Width of Gate shuteer size upto 4 metre	Kg	193.00
	Width of Gate shuteer size above 4 metre	Kg	196.00
5.1.D-5	Cost for dismantling old unserviceable roller path / Guide Channel /seal path etc of gate shutter of River/Canal from existing civil structure for replacement as directed by the Engineer-in-charge.The cost includes cost of man power employed for dismantling. Payment will be made as per actual length of roller path / rubber seal path.	RM	474.00

SECTION -(E) GATES OF DISTRIBUTORIES / BRANCH CANAL/ MINOR CANAL/CHANNEL

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1 E-1	Fabrication , supply, erection and commissioning of embeded parts consisting of seal beam, Guide channel with all accessories for vertical gate of distributories/branch canal/minor canal/channel made of MS material consisting of angle, channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction of Engineer in charge. The Cost includes cost of Materials, hire charges of Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting).	Kg	143.00
5.1 E-2	Fabrication, supply, erection and commissioning of embeded parts consisting of hinge bracket with its accessories for vertical flap gate shutter of distributories/branch canal/minor canal/channel made of MS material consisting of angle, channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction of Engineer in charge. The cost includes cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting).	Kg	262.00
5.1 E-3	Fabrication , Supply, erection and commissioning of new Slide type vertical lift regulator service gates of Distributories /BranchCanal /Minor Canal/Channel as per IS: 5620 - 2000/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction of Engineer in charge. The Cost includes cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	130.00
5.1 E-4	Fabrication , Supply, erection and commissioning of new Mild steel flap type regulator service gates of Distributories /BranchCanal /Minor Canal/Channel as per IS: 5620 - 2000/Latest Revision consisting of skin plate, vertical and horizantal grider, stiffener etc. made of MS material consisting of angle , channel, beam, plate, flat, etc. conforming to IS : 2062 -2011/latest revision manufactured as per approved drawing and direction of Engineer in charge. The Cost includes cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	131.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1 E-5	Supplying, fitting and fixing at site Cast Iron flap shutter for hume pipe sluice with Cast Iron collar and other fittings etc. complete (as per drawing & direction of Engineer-in-charge)including casting the same, necessary drilling etc with carriage to site complete. The Cost includes cost of Materials, Machinaries , Manpower, Cutting, Aligning, drilling, Welding, Finishing, Consumables, Carriages and all overheads with all leads and lifts complete as per specification (without painting).	Kg	142.00
REPAIR MAINTENANCE & OPERATION OF GATES OF DISTRIBUTORIES / BRANCH CANAL/ MINOR CANAL/CHANNEL			
5.1 E-6	Dismantling of damaged embeded part like guide channel/bottom seal beam/top runner of gates of distributories/branch canal/minor canal/channel from civil structure as directed by the Engineer-in-charge.The cost of man power employed for dismantling and hire charges of Tools and Plant, scaffolding charges etc. Payment will be made on actual length of Guide Channel replaced.	RM	204.00
5.1 E-7	Taking out old existing unservicable damaged draw/flap gate shutter of distributories/ branch canal/minor canal/channel completely after disengaging from hoisting system completely for installation of new gate shutter. The work includes cutting of gates into suitable pieces by gas cutting, removing the same by mechanical means or suitable crane, stacking all the pieces at the suitable place or departmental godown or as directed by the Engineer in charge. The cost includes cost of man power employed for dismantling and cost of consumables like oxygen, accetylene gas, hire charges of machineries, like chain pulley block, gas set, tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading with all lead & lift.	Kg	5.71
5.1 E-8	Cost for repairing of vertical/flap gate shutter of distributories/branch canal/minor canal/channel including dismantling the damaged portion at lower part (skin plate, horizental/vertical girder/stifner etc as per IS : 2062 - 2011 /latest revision) not more than 25% of gate hight from bottom by gas cutting and fitting, fixing and fabricated by welding as per direction including cost of Materials, Machinaries , Manpower, Cutting, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting)	Kg	175.00
5.1 E-9	Oiling, cleaning & greasing the gate parts i.e guide channel, top runner, pedestal block, gear rods, wheel, fish plate etc. with sufficient lubricant as and when required for the regulator gates of distributories / branch canal/ minor canal/channel as per direction of the Engineer-in-charge including cost of all materials to site complete with all lead & lift.	EACH SET	473.00
5.1 E-10	Lifting draw shutters for feeding or drainage operation,as per direction of the Engineer-in-charge.	EACH	296.00
5.1 E-11	Lowering draw shutters after feeding or drainage operation,as per direction of the Engineer-in-charge.	EACH	296.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1 E-12	Lifting flap shutter on channel for feeding including tying with suitable galvanized wire to iron bracket to guard against falling down, as per direction of the Engineer-in-charge.		
	a) with galvanized wire rope	EACH	644.00
	b) with out supply of wire rope	EACH	244.00
5.1 E-13	Lowering flap shutter from channel after feeding operation, as per direction of the Engineer-in-charge.	EACH	183.00
5.1 E-14	Taking out screw gear rod including its head stock assembly by cutting nuts and bolts from draw shutter of distributories/branch canal/minor canal/channel for replacement/after feeding the canal and handed over to the section office or as directed by the Engineer in charge. The Cost includes cost of Manpower, Cutting, all overheads with all leads and lifts complete. The cost of carraige will be provided extra as per actual basis based on PWD Schedule of Rates.	EACH	413.00
5.1 E-15	Refitting the screw gear rod including its head stock assembly of draw type gate shutter of distributories/branch canal/minor canal/ channel for replacement/prior to feeding the canal after colleting from the section office. The Cost includes cost of Manpower, tools & Plants , all overheads with all leads and lifts complete. The cost of carraige will be provided extra as per actual basis based on PWD Schedule of Rates.	EACH	514.00

(F) HOISTING SYSTEM of GATES OF DAM/BARRAGE/RIVER/CANAL/Crane			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.F-1	Supply, installation, testing and commisioning of following items for hoisting system and gear box as mentioned below as per direction including cost of Materials, Machinaries , Manpower, Cutting, Machining, Aligning, Anchoring, Welding, Finishing, Consumables, Carriage and all overheads with all leads and lifts complete as per specification (without painting)		
i)	**Base frame (MS)**	kg	151.00
ii)	**MS cover for central drive unit and rope drum unit**	kg	154.00
iii)	**Guide Roller/Load Roller (C.S)**	Kg	219.00
iv)	**Rope Drum**		
	a. FG 200	Kg	203.00
	b. FG 400	Kg	229.00
	c. Cast Steel	Kg	266.00
v)	**Shaft /Pin with key ways made of**		
	a. Forged Steel	Kg	233.00
	b. EN8	Kg	184.00
	c. SS-304	Kg	817.00
vi)	**Plumber Block/Pillow Block/Bearing Housing (FG 400)**	Kg	616.00
vii)	**Coupling (Mat: C45)**	Kg	356.00
viii)	**Jaw/Clutch Coupling (Mat: C45)**	Kg	411.00
ix)	**TEFC SQUIRREL CAGE MOTOR : (3 phase crane duty, RPM :1000)**		
	a) 2 HP	Each	16187.00
	b) 3 HP	Each	20995.00
	c) 5HP	Each	24982.00
	d) 7.5 HP	Each	37719.00
	e) 10 HP	Each	40920.00
x)	**TEFC SLIPRING MOTOR : (3 phase crane duty, RPM :750)**		
	a) 3 HP	Each	128527.00
	b) 5 HP	Each	131811.00
	c) 7.5HP	Each	139198.00
	d) 10 HP	Each	173430.00
xi)	**Worm Reducer (Under driven/Over driven)**		
	a) Centre Distance 1-1/8"	Each	17223.00
	b) Centre Distance 3"	Each	41644.00
	c) Centre Distance 4"	Each	104560.00
	d) Centre Distance 5"	Each	134233.00
	e) Centre Distance 6"	Each	160847.00
	f) Centre Distance 8"	Each	244157.00
	g) Centre Distance 10"	Each	498878.00
	h) Centre Distance 12"	Each	778174.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
xii)	**Turn Buckle (MS)**	Kg	170.00
xiii)	**D-Shakle (forged MS)**	Kg	205.00
xiv)	**Sheve/Pulley(CS)**	Kg	176.00
xv)	**Rope Clamp(MS)**	Kg	340.00
xvi)	**Bush(GM)**	Kg	1353.00
xvii)	**Bush (C I)**	Kg	295.00
xviii)	**Self aligning ball Bearing (S.K.F) for shaft size**		
	a) Self aligning ball Bearing (S.K.F) for shaft size = 40 mm dia (1208 ETN-9)	Each	2260.00
	b) Self aligning ball Bearing (S.K.F) for shaft size = 50 mm dia (1210 ETN-9)	Each	2448.00
	c) Self aligning ball Bearing (S.K.F) for shaft size = 60 mm dia (1212 ETN-9)	Each	3327.00
	d) Self aligning ball Bearing (S.K.F) for shaft size = 70 mm dia (1214 ETN-9)	Each	5674.00
	e) Self aligning ball Bearing (S.K.F) for shaft size = 80 mm dia (1216 K)	Each	7011.00
	f) Self aligning ball Bearing (S.K.F) for shaft size = 90 mm dia (1218)	Each	9986.00
	g) Self aligning ball Bearing (S.K.F) for shaft size = 100 mm dia (1220)	Each	14394.00
xix)	Single row Roller Bearing (S.K.F) for shaft size		
	a) Single row cylindrical roller Bearing (S.K.F) for shaft size = 40 mm dia (N308ECP)	Each	5995.00
	b) Single row cylindrical roller Bearing (S.K.F) for shaft size = 50 mm dia (N210ECP)	Each	5944.00
	c) Single row cylindrical roller Bearing (S.K.F) for shaft size = 60 mm dia (N312ECP/C3)	Each	15080.00
	d) Single row cylindrical roller Bearing (S.K.F) for shaft size = 70 mm dia (N314 ECP)	Each	16116.00
	e) Single row cylindrical roller Bearing (S.K.F) for shaft size = 85 mm dia (N317ECP)	Each	22926.00
	f) Single row cylindrical roller Bearing (S.K.F) for shaft size = 90 mm dia(N318ECP)	Each	24110.00
xx)	Gear & Pinion (Cast steel)	kg	357.00
xxi)	Gear & Pinion (Forged steel)	kg	386.00
xxii)	a) Limit Switch Roller Lever type	each	2907.00
	b) Push Roller mini limit switch	each	1519.00
xxiii)	Rotary Limit switch	each	4866.00
xxiv)	Supply & fixing of AC solenoid Brake assembly , Type of brake - S-4, Wheel dia - 4", Max Torque - 13.6Nm, Duty - Continuous, AC Solenoid - pull type, type - B, Make BCHElectricLtd or eqv.	each	12681.00
xxv)	Supply & fixing of AC solinoid Brake assembly , Type of brake - S-5, Wheel dia - 5.5", Max Torque - 34.0 Nm, Duty - Continuous, AC Solenoid - pull type, Make BCH Electric Ltd or eqv.	each	17661.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
xxvi)	Supply & fixing of AC solinoid Brake assembly , Type of brake - S-7, Wheel dia - 7", Max Torque - 68.0 Nm, Duty - Continuous, AC Solenoid - pull type, Make BCH Electric Ltd oreqv.	each	20395.00
xxvii)	**Supply of brake lining for following sizes of AC Solenoid brake .**		
	a) Drum size 4", (make BCH or eqv.)	Each	1552.00
	b) Drum size 5.5", (make BCH or eqv.)	Each	2197.00
	c)Drum size 7", (make BCH or eqv.)	Each	2873.00
xxviii)	**Supply of brake shoe assembly for following sizes of AC Solenoid brake .**		
	a) Drum size 4", (make BCH or eqv.)	Each	3944.00
	b) Drum size 5.5", (make BCH or eqv.)	Each	5022.00
	c)Drum size 7", (make BCH or eqv.)	Each	8267.00
xxix)	**Supply of brake Coil Continuous for following sizes) of AC Solenoid brake .**		
	a) Drum size 4", (make BCH or eqv.)	Each	2142.00
	b) Drum size 5.5", (make BCH or eqv.)	Each	4054.00
	c)Drum size 7", (make BCH or eqv.)	Each	4054.00
xxx)	**Supply of brake Drum for following sizes of AC Solenoid brake .**		
	a) Drum size 4", (make BCH or eqv.)	Each	2002.00
	b) Drum size 5.5", (make BCH or eqv.)	Each	2678.00
xxxi)	**Position Indicator including its Coupling and Gearing**	Each	25074.00
xxxii)	**Poul Ratchet Locking Arrangement**	Each	3500.00
xxxiii)	**M.S Manual Operating handle.**	Kg	127.00
xxxiv)	**Manual operating mechanism**		
	a. chain	RM	569.85
	b. sprocket (Aloy Steel)	kg	556.76
	c. shaft/pin (SS -304)	kg	817.00
	d. Bush(GM)	kg	1353.00
	e. Plummer block(CI)	kg	616.00
	f. MS cover	kg	154.00
xxxv)	Supply & fitting fixing of round strand (steel core/fibre core) steel wire rope (ungalvanised, IWRC) of 6x36 construction of 1960 tensile designation as per IS-2266 (make: Usha Martin, Bharat Wire Ropes ltd or BIS approved makes), rope clamp with Dishakle and fitting fixing of said material with correct alignment and position inclusive of all cost of labour, T&P, scaffolding charges & all other incidental charges as necessary to complete the job in all respect upto the satisfaction of E.I.C.		
	a) 12 mm dia (steel core)	RM	238.00
	b) 12 mm dia (fibre core)	RM	218.00
	c) 14 mm dia (steel core)	RM	292.00
	d) 14 mm dia (fibre core)	RM	267.00
	e) 16 mm dia (steel core)	RM	327.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
xxxv)	f) 16 mm dia (fibre core)	RM	288.00
	g) 18 mm dia (steel core)	RM	423.00
	h) 18 mm dia (fibre core)	RM	311.00
	i) 20 mm dia (steel core)	RM	493.00
	k) 20 mm dia (fibre core)	RM	450.00
	l) 22 mm dia (steel core)	RM	577.00
	m) 22 mm dia (fibre core)	RM	528.00
	n) 24 mm dia (steel core)	RM	679.00
	o) 24 mm dia (fibre core)	RM	621.00
	p) 26 mm dia (steel core)	RM	785.00
	q) 26 mm dia (fibre core)	RM	715.00
	r) 28 mm dia (steel core)	RM	889.00
	s) 28 mm dia (fibre core)	RM	804.00
	t) 30 mm dia (steel core)	RM	1023.00
	u) 30 mm dia (fibre core)	RM	932.00
5.1.F-2	**Supplying, fitting & fixing of M.S fabricated pedestal stool** of suitable size, consisting of bottom plate, top plate, four nos legs etc febricated with suitable sizes m.s plate, m.s angle conforming to I.S 2062 of latest revision and as per approved drawing & direction of Engineer in charge. The cost includes cost of materials, man power employed for dismantling and fitting fixing, civil works consumables like cutting tools, gas, oxygen, welding rod, anchor bolt of required size, hire charges of machineries, like gas cutting set, welding set, tools & tackles etc including carriage loading & unloading.	Kg	139.00
5.1.F-3	**Supplying, fitting & fixing of cast iron pedestal stool** of suitable size, conforming to I.S 210 of latest revision and as per approved drawing, & direction of Engineer in charge. The cost includes cost of materials, man power employed for dismantling and fitting fixing, civil works consumables like cutting tools, anchor bolt of required size, hire charges of machineries, like lathe/shaping machine, grinding machine, drilling machine, tools & tackles etc including carriage loading & unloading.	Kg	145.00
5.1.F-4	**Supplying, fitting & fixing of winch machine** of suitable capacity having compound gear train comprising of open spur gears/pinions of required nos, plummer/ pillow block , CI bush, shafts, rope drum, MS frame, MS cover along with locking arrangement as per approved drawing & direction of Engineer in charge.		
	a) M.S Frame	Kg	151.00
	b) Cast Iron Rope Drum	Kg	203.00
	c) Cast Steel Rope Drum	Kg	266.00
	d) Plummer Block	Kg	616.00
	e) EN-8 Shaft	Kg	184.00
	f) C.I Bush	Kg	295.00
	g) Poul Ratchet Locking Arrangement	Each	3500.00
	h) Gears/Pinions	kg	357.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.F-5	**Supplying, fitting & fixing of screw hoisting arangement** made of **MS bottom plate, top plate, coller** with necessary holes on base plate and top plate to accomodate thrust bearing of suitable size as per approved drawing & design and as per direction of Engineer in charge. The cost includes cost of ms plate as per IS : 2062 -2011/ latest revision, man power employed for dismantling and fitting fixing, consumables like cutting tools, bolt & nuts of required size, hire charges of machineries, like lathe/shaping machine, grinding machine, drilling machine, tools & tackles etc including carriage loading & unloading but **excluding the cost of lifting Nut/Bush, thrust bearing & wheel supplied seperately.**	Kg	170.00
5.1.F-6	**Supplying, fitting & fixing of screw hoisting arangement** made of **C.I. bottom plate , top plate, coller** (free from any casting defects) with necessary holes on base plate and top plate to accomodate thrust bearing of suitable size as per approved drawing & design and as per direction of Engineer in charge. The cost includes cost of materials, man power employed for dismantling and fitting fixing, consumables like cutting tools, bolt & nuts of required size, hire charges of machineries, like lathe/shaping machine, grinding machine, drilling machine, tools & tackles etc including carriage loading & unloading but **excluding the cost of lifting Nut/Bush, thrust bearing & wheel supplied seperately.**	Kg	201.00
5.1.F-7	Supply of bearings		
a)	Bearing no.51108 (SKF)(Thrust bearing)	each	1330.00
b)	Bearing no.51109 (SKF)(Thrust bearing)	each	1483.00
c)	Bearing no.51111 (SKF)(Thrust bearing)	each	2054.00
d)	Bearing no.51211 (SKF)(Thrust bearing)	each	3832.00
e)	Bearing no.51112 (SKF)(Thrust bearing)	each	2254.00
f)	Bearing no.51213 (SKF)(Thrust bearing)	each	4570.00
g)	Bearing no.51214 (SKF)(Thrust bearing)	each	4958.00
h)	Bearing no.51215 (SKF)(Thrust bearing)	each	5300.00
i)	Bearing no.51216 (SKF)(Thrust bearing)	each	5917.00
j)	Bearing no.51217 (SKF)(Thrust bearing)	each	7800.00
5.1.F-8	**Supplying, fitting & fixing M.S fabricated wheel** in the screw hoisting system for lifting or lowering the draw shutter.The wheel consisting of suitable size ms hub to accomodate any size of G.M/C.I nut. The rim and four nos arm of wheel are made of 25mm. to 36mm. dia m.s rod complete as per direction of the Engineer-in-charge. The cost includes cost of materials, man power employed for dismantling and fitting fixing, consumables like cutting tools, welding rod, hire charges of machineries, like bending machine, lathe machine, grinding machine welding set, tools & tackles etc including carriage loading & unloading		
	(a) upto 60 cm dia. MS wheel.	Kg	136.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.F-9	**Supplying, fitting & fixing of C.I wheel** in the screw hoisting system for lifting or lowering the draw shutter.The wheel consisting of suitable size hub to accomodate any size of G.M/C.I nut, rim dia 32mm and four nos arm made of minor dia 30mm. & major dia 36mm rod complete or as per approved drawing & direction of the Engineer-in-charge.The cost includes cost of materials, man power employed for dismantling and fitting fixing, consumables like cutting tools, welding rod, hire charges of machineries, like lathe machine, grinding machine, tools & tackles etc including carriage loading & unloading.		
	(a) Upto 60 cm. dia. Cast Iron wheel	Kg	144.00
5.1.F-10	**Supplying, fitting & fixing of screw rod** having square thread of 1.5/2 T.P.I, Material bright steel [EN-8/EN9/forged Cl-4 (45C8) as per IS :1875 1992/latest Revision]. dia and thread length as required and providing with a drilled hole of required dia on the other end after flattened and supplying with one no. bolt and nut of required size and all other components as required as per direction of Engineer-In - Charge. The cost includes cost of material, man power employed, consumables like cutting tools, emery paper, cloths, , hire charges of machineries, tools & tackles, grease, mobil etc including carriage loading & unloading as per direction of Engineer in charge.		
	a) upto length 3 metre.	Kg	151.00
	b) upto lengthabove 3metre upto 5 metre.	Kg	155.00
	c) length above 5 metre.	Kg	161.00
5.1.F-11	**Supplying, fitting & fixing Gun Metal Nut** as per requirement having 1.5/2 T.P.I square thread for screw gearing arrangement, perfectly metting with the screw rod/gear rod for lifting the draw shutter as per direction of E.I.C. The cost includes cost of materials, man power employed, consumables like cutting tools, emery paper, cloths, , hire charges of machineries, tools & tackles etc including carriage loading & unloading.	Kg	1412.00
5.1.F-12	**Supplying, fitting & fixing Cast Iron Nut** as per requirement having 1.5/2 T.P.I square thread and fitting for screw gearing arrangement, parfectly metting with the screw rod/gear rod for lifting the draw shutter as per direction of Engineer In Charge. The cost includes cost of materials, man power employed, consumables like cutting tools, emery paper, cloths, hire charges of machineries, tools & tackles etc including carriage loading & unloading.	Kg	484.00
5.1.F-13	**Supplying, fitting & fixing of top runner** by supplying, fitting and fixing of new Mild Steel Channel conforming to IS : 2062 -2011/latest revision with necessary Mild Steel lugs of required length and size by making hole into top of the civil structure and fixing with necessry masonery work with maintaining proper line and level as directed by the Engineer- in-charge. The cost includes cost of materials, man power employed, cost ofm.s materials, cost of civil works along with two coats of epoxy paint over two coats of zinc rich primer.	Kg	118.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.F-14	**Design, drawing, fabrication, supply, erection, testing and commissioning of rail track (pair of rails) using 45 kg /m** standard rails on spillway bridge for movement of gantry crane for handling and operating spillway stoplog gate elements / river sluice / canal sluice emergency gate including cost of all materials, machinery, labour, aligning, anchoring, welding & finishing complete as per specifications (without painting).	RM	10240.00
5.1.F-15	**Design, drawing, fabrication, supply, erection, testing and commissioning of 25 tonne capacity Class- II type moving gantry crane** consisting of rail mounted gantry frame, top platform with hand railing, long / cross travel arrangements, rope drums, gear systems, electric motors, electromagnetic brake system, cabin, control panel, wire rope, ladder, motorised cable reeling drum etc., with all accessories for operating spillway stop log gate elements and river sluice / canal sluice emergency gates including cost of all materials, machinery, labour, etc.	Each	8741629.00
5.1.F-16	**Design, drawing, fabrication, supply, erection, testing and commissioning of automatic lifting beam** with all accessories for handling, lowering and lifting of spillway stop log gate elements including cost of all materials, machinery, labour, cutting, aligning, welding, finishing, etc., complete as per specifications and drawings with all leads and lifts. (without painting).	Tonne	165349.00
5.1.F-17	Supply of Gear Oil as per direction of Engineer in charge	Litre	212.00
5.1.E-18	Supply of Grease	Litre	247.00
5.1.F-19	Supply of Mobil Oil	Litre	220.00
5.1.F-20	Supply fitting Fixing of ss (AISI 304) bolts, nut & washer		
	i) dia 10 mm to 20 mm a) Length upto 75 mm	Kg	853.12
	b) Length above 75mm upto 150 mm	Kg	841.11
	c) Length above 150 mm	Kg	820.18
5.1.F-21	Supply fitting Fixing of ss (AISI 304) bolts, nut & washer		
	i) Dia above 20 mm a) Length upto 75 mm	Kg	1000.19
	b) Length above 75mm upto 150 mm	Kg	985.27
	c) Length above 150 mm	Kg	1006.56

(G) REPAIRING & MAINTENANCE OF HOISTING SYSTEM of GATES OF DAM/BARRAGE/RIVER/CANAL			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.G-1	**Dismentling rope drum hoisting system completely of Dam/ Barrage gate,** consisting of geared motor/motor, gear box, manual operating system, chain & sprocket, couplings, braking arrangement, power transmission shafts, spur gears, rope drum, rope, rope clamps, trunion etc part by part for repairing/replacement of gates and staking suitable place upto lead of 500 metre or as per direction of E.I.C. The cost includes cost of man power employed for dismantling of hoisting system, hire charges of mechanical devices for hanging the gate properly for repairing works, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading		
a)	Width of Gate shuteer size upto 12 metre	Each	7820.00
b)	Width of Gate shuteer above 12 metre upto 20 metre.	Each	13140.00
5.1.G-2	**Fitting fixing of rope drum hoisting system completely** of Dam/ Barrage gate, consisting of geared motor/motor, gear box, manual operating system, chain & sprocket, couplings, braking arrangement, power transmission shafts, spur gears, rope drum, rope, rope clamps, trunion etc part by part completely for trial run ofgateas per direction of E.I.C. The cost includes cost of man power employed for fitting fixing of hoisting system, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading, including cost of trial run but excluding supply of spares mentioned ealier.		
a)	Width of Gate shuteer size upto 12 metre	Each	8892.00
b)	Width of Gate shuteer above 12 metre upto 20 metre.	Each	13916.00
5.1.G-3	Dismantling of following items of rope drum hoisting system for replacement by new one as mentioned below as per direction including cost of Materials, Machinaries , Manpower, T & P and all overheads with all leads and lifts complete as per specification.		
i)	**Guide Roller**	Each	459.00
ii)	**Plumber Block**	Each	334.00
iii)	**Coupling**	Each	334.00
iv)	**Proximity switch/ Rotary/Limit Switch**	Each	211.00
v)	**Clutch Coupling (Mat: C45)**	Each	211.00
vi)	**Gate Position Indicator including its Coupling and Gearing**	Each	211.00
vii)	**Motor**	Each	334.00
viii)	**Turn Buckle**	Each	182.00
ix)	**Sheve/Pulley**	Each	182.00
x)	**Rope Clamp**	Each	182.00
xi)	**Bush**	Each	241.00
xii)	**Double Roller Bearing for shaft size**	Each	241.00
xiii)	**Gear & Pinion (Cast Iron)**	Each	301.00
xiv)	**Gear & Pinion (Cast steel)**	Each	301.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
xv)	**Shaft**	Each	301.00
xvi)	**EM Brake**	Each	182.00
xvii)	**Ratchet Poul Locking Arrangement**	Each	182.00
xviii)	**Manual Operating mechanism**	Each	304.00
xix)	**Rope**	Each	304.00
5.1.G-4	**Servicing of headstock assembly** i.e. opening the hand wheel from screw rod, including opening the thrust bearing from top and bottom thrust plate of bearing housing, nut, coller etc and cleaning all the components with the help of Kerosine and emery paper and re-fitting the same including changing necessary nuts & bolt after greasing the thrust bearing if Ok otherwise replaced by new one (excluding the cost of bearing, supplied separately) and fileing work if required for fixing to the pedestal upto the satisfaction of E.I.C. The cost includes cost of materials, man power employed, kerosene, grease, consumables like emery paper, cloths, blots & nuts, hire chargesof tools & tackles etc.	Each	1742.00
5.1.G-5	Oiling greasing of headstock assembly **(for screw hoist system) of regulator gates** of canal/ river by cleaning, checking, greasing, screw rod, G.M nut, Thrust bearing, guide channel, etc including all charges of man & materials which include refilling of gear oil, oiling greasing and fixing of missing nut & bolts & oil seals etc to complete the job as per direction o: EIC.	Each	722.00
5.1.G-6	**Servicing & maintenance of winch M/C** i.e. cleaning the gears, plummer block including bearings , rope drum etc with the help of Kerosine, jute, cloth, sand paper, emery paper etc, application of grease, mobil oil in the bearings of plummer blockfor proper lubricating and supply and fitting, fixing of **damaged oil seals &** missing Nut & Bolts etc. to complete the job at site as per direction of Engineer in charge.	Each	2335.00
5.1.G-7	**Dismentling of screw hoisting system** consisting of gear/ screw rod, padestal stool, top plate, bottom plate, G.M/C.I bush, operating wheel etc for repairing/replacement of gates and staking suitable place or as per direction of E.I.C. The cost includes cost of man power employed for dismantling, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading.	Each	1531.00
5.1.G-8	Oiling greasing of hoisting gear boxes (for rope drum and chain hoist) of dam /barrage gates and head regulator gates of dam/barrages by cleaning, checking, greasing /lubricating the gears, plummer bocks, bearings, manual drive etc including all charges of man & materials which include oiling, greasing, refilling of gear oil excluding supply of gear oil and grease and fixing of damaged oil seals & missing nut & bolts etc complete as per direction of EIC. (Gear oil & Grease provided extra.)		
a)	Width of Gate shutter size upto 9 metre	Each	1803.00
b)	Width of Gate shutter above 9 metre.	Each	2508.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.G-9	Oiling greasing of hoisting gear boxes (for rope drum and chain hoist) of **regulator gates of canal/rivers** by cleaning, checking, greasing /lubricating the gears, plummer bocks, bearings, manual drive etc including all charges of man & materials which include oiling, greasing, refilling of gear oil excluding supply of gear oil and grease and fixing of **damaged oil seals** & missing nut & bolts etc complete as per direction of EIC.(Gear oil & Grease provided extra.)	Each	1568.00
5.1.G-10	Oiling greasing of the **load roller and guide roller assembly of the barrage/dam gate and head regulator gates of dam/barragesby** cleaning, checking, greasing /lubricating etc including all charges of man & materials which include refilling of grease excluding supply of grease and fixing of damaged oil seals & missing nut & bolts, scafolding charges etc to complete the job as per direction of EIC. (Mobil oil & Grease provided extra.)		
a)	Width of Gate shutter size upto 9 metre	Each	1448.00
b)	Width of Gate shutter above 9 metre.	Each	2304.00
5.1.G-11	Oiling greasing of the **load roller and guide roller assembly of the regulator gates of canal/ rivers by** cleaning, checking, greasing / lubricating etc including all charges of man & materials which include refilling of grease excluding supply of grease and fixing of damaged oil seals & missing nut & bolts, scafolding charges etc to complete the job as per direction of EIC. (Mobil oil & Grease provided extra.)	Each	1214.00
5.1.G-12	Oiling greasing of the **trunion and guide roller assembly of the barrage/dam gates and regulator gates of canal/rivers by** cleaning, checking, greasing /lubricating etc including all charges of man & materials which include refilling of grease and fixing of damaged oil seals & missing nut & bolts, scafolding charges etc to complete the job as per direction of EIC. (Mobil oil & Grease provided extra.)	Each	1806.00
5.1.G-13	Dismantling and fixing only of **trunion assembly and guide roller assembly of radial gate of barrage/dam gate. The cost includes cost of manpowers, hire charges of T&P, chain pulley blocks, scaffolding, and overhead cost etc to complete the job as per direction of Engineer in charge.**	Each	2266.00
5.1.G-14	**Scraping, cleaning of wire rope, rope drum, pulley** and lubricating the wire rope with rope compound servo coat-140 or approved wire rope compound including setting the wire rope in proper alignment and position as necessary as per direction of EIC. The Cost includes cost of manpower employed, scaffolding charges, cost of kerosine, jute, wire brush, cloth, wire rope compound & all other incidental charges to complete the job in all respect.		
a)	12 mm dia	RM	45.00
b)	14 mm dia	RM	45.00
c)	16 mm dia	RM	45.00
d)	18 mm dia	RM	50.00
e)	20 mm dia	RM	50.00
f)	22 mm dia	RM	50.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
g)	24 mm dia	RM	61.00
h)	26 mm dia	RM	61.00
i)	28 mm dia	RM	70.00
j)	30 mm dia	RM	70.00
5.1.G-15	**Cost for maintenance of heavy duty gate lifting steel chain, sprocket, bearings** by scrapping, cleaning, washing with the help of wire brush, emery paper, jute, kerosine and greasing/ lubricating the steel chain with grease mobil including setting the steel chain in proper alignment and position as necessary as per direction of EIC.T h e Cost includes the cost of all man & materials which include grease, mobil, kerosene, jute wire brush, split pin if required etc, scaffolding cost & all other incidental charges to complete the job in all respect.		
a)	Width of Gate shutter size upto 9 metre	RM	446.00
b)	Width of Gate shutter above 9 metre.	RM	453.00
5.1.G-16	Servicing and overhauling of servo brake and refilling with transformer oil of avg. 01 ltr/servo brake incl. charges of dismantling, rewinding of coil if necessary, refixing. etc in complete as per direction of EIC.	Each	622.00
5.1.G-17	Servicing & overhauling of rotary type Limit switch including dismanlting, hire charges of T & P, cost of labour and testing & refixing the same after completion of work in complete as per direction of EIC.	Each	469.00
5.1.G-18	Servicing/ overhauling of Driving Motor 2HP/3HP, Heat burnishing ot achieve desire IR value with all rectifications/replacement of damaged bearings, alignment checking, connections and terminal wires as per the desired standard and to the satisfaction of E.I.C.	Each	1946.00
5.1.G-19	Inspection/checking, servicing and fitting fixing with correct alignment of the existing EM brake including all man and materials with suitable adjustment, alignment and trial run as per desired technical specifications and standard to the satisfaction of E.I.C.	Each	403.00
5.1.G-20	Inspection Checking/testing and servicing of the existing starter panel, all terminal connection, contactors, relays etc as per desired technical specification including man and minor materials for proper functioning as per direction of EIC.	Each	483.00

(H)RUBBER SEAL			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
	Cost for dismantling different types rubber seal from gate shutter as per direction of E.I.C. The cost includes cost of man power employed for dismantling, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading &		
5.1.H-1	a) Gate shuteer size upto 10 Sq.m	RM	202.00
	b) Gate shuteer size above 10 sq.m upto 20 Sq.m	RM	248.00
	c) Gate shuteer size above 20 sq.m upto 50 Sq.m	RM	427.00
	d) Gate shuteer size above 50 sq.m upto 70 Sq.m	RM	554.00
	e) Gate shuteer size above 70 Sq.m	RM	634.00
	Cost for supplying and fitting fixing of Flat rubber seal (Make : Universal Moulders & Engineer/Popular Rubber Works (Pvt) Ltd/ SAB Industries/Unique Polymer Works/equivelant approved make conforming to lS : 11855 -2011/Latest Revision) for different types of gate shutter as per direction of E.I.C. The cost includes cost of man power employed for fitting fixing, cost of rubber seal, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading but excluding supply of ms clamp/ flat plate, bolts, nuts and washer.		
S.1.H-2	a) 65mm x 6 mm.	RM	853.00
	b) 65mm x 8 mm.	RM	877.00
	c) 65mm x 10 mm.	RM	958.00
	d) 65mm x 12 mm.	RM	1048.00
	e) 100 x 12 mm	RM	1405.00
	f) 100 x 14 mm	RM	1710.00
	g) 100 x 20 mm	RM	1765.00
	h) 120 x 10 mm	RM	1359.00
	i) 125 x 12 mm	RM	1413.00
	j) 75 x 25 mm	RM	1580.00
	k) 140 x 20 mm	RM	1669.00
	l) 140 x 16 mm.	RM	2245.00
	Cost for supplying and fitting fixing of bulb/musical node/J- type rubber seal (Make : Universal Moulders & Engineer/Popular Rubber Works (Pvt) Ltd/SAB Industries/Unique Polymer Works/equivelant approved make conforming to lS : 11855 -2011/Latest Revision) for different types of gate as per direction of E.I.C. The cost includes cost of man power employed for fitting fixing, cost of rubber seal, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading but excluding supply of ms clamp/ flat plate, bolts, nuts and washer.		
S.1.H-3	a) solid bulb size- 40∅ 140 X 10 mm	RM	2074.00
	b) solid bulb: size- 40∅ 140 X 12 mm	RM	2228.00
	c) solid bulb : size- 40∅ 175mm x12mm	RM	2374.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.1.H-3	d) solid bulb: size- 40∅ 140x16mm	RM	2604.00
	e) hollow bulb : size- O.D 45∅, I.D 16∅ flat portion 100 X 12 mm	RM	1877.00
	f) hollow bulb : size- O.D 45∅, I.D 16∅ flat portion 100 X 14 mm	RM	1988.00
	g) hollow bulb: size- O.D 45∅, I.D 16∅ flat portion 100 X 16 mm	RM	2103.00
S.1.H-4	**Cost for supplying and fitting fixing of angle type rubber seal** (Make : Universal Moulders & Engineer/Popular Rubber Works (Pvt) Ltd/ SAB Industries/Unique Polymer Works/equivelant approved make conforming to lS : 11855 -2011/Latest Revision) for different types of gate as per direction of E.I.C. The cost includes cost of man power employed for dismantling & fitting fixing, cost of rubber seal, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading but excluding supply of ms clamp/ flat plate, bolts, nuts and washer.		
	a) size: (88mm+60mm+08mm) x 14mm(thick)	RM	1985.00
	b) size: (75 x 75mm) x14mm(thick)	RM	2234.00
5.1.H-5	**Cost for supplying and fitting fixing of corner rubber seal** (Make : Universal Moulders & Engineer/Popular Rubber Works (Pvt) Ltd/ SAB Industries/Unique Polymer Works/equivelant approved make conforming to lS : 11855 -2011/Latest Revision) for different types of gate as per direction of E.I.C. The cost includes cost of man power employed for dismantling & fitting fixing, cost of rubber seal, hire charges of tools & tackles, scaffolding and safety equipments etc including carriage loading & unloading but excluding supply of ms clamp/ flat plate, bolts, nuts and washer.		
	a) Rubber Corner Seal size 40∅ 140 X 10 mm	Each	2456.00
	b) Rubber Corner Seal size 40∅ 140 X 12 mm	Each	2465.00
	c) Rubber Corner Seal size 40∅ 175 X 12 mm	Each	2762.00
	d) Rubber Corner Seal size 40∅ 140 X 16 mm	Each	2881.00
S.1.H-6	Supplying of M.S flat for clamping Rubber seal with hole as per direction of EIC	Kg	113.00
S.1.H-7	Supplying of M.S bolts with nut for clamping Rubber seal as per direction of EIC	Kg	100.00

(I) Painting DAM/BARRAGE/MAIN CANAL /RIVER GATES & HOISTING SYSTEM			
Sl. No.	**Description of Item**	**Unit**	**Rate (Rs.)**
5.1.I-1	Cleaning gates / hoists / embedded parts/lifting beams etc, to expose fresh metal surface for painting by sand blasting method as per specifications including cost of all materials, labour, machinery, scaffolding, etc., complete with initial lead for sand upto 1 km and all lifts.	Sq.m	529.00
5.1.I-2	Surface cleaning of metal surfaces by chemical cleaners and then by hand with emary paper, wire brush and power tool cleaners and removing dust and preparation o f surface including cost of all materials, labour, machinery, scaffolding, etc., complete with initial lead for sand upto 1 km and all lifts.	Sq.m	64.00
5.1.I-3	Painting of embedded parts, all types of gates, stoplogs and barscreen/ gratings etc on prepared surfaces with one coat of inorganic zinc silicate primer (airless spray preferred)70+/ - 5 micron and two super coats with a total thickness of 300 microns (each 150+/- 5) of solventless coaltar epoxy paint each coat 150 microns (total 300 microns) including cost of all materials, labour, scaffolding etc., complete with all leads and all lifts.	Sq.m	407.00
5.1.I-4	Painting hoist structural components, tressle bridge ,crane, lifting beam, cat work bridge and other similar structure on prepared surfaces with two coats of zinc phosphate primer (airless spray preferred) 40 microns/coat and one coat 65+/-5 micron of alkyd based micaccous iron oxide paint followed by two coats of synthetic enamel paint 25 microns/coat including cost of all materials, labour, scaffolding etc., complete with all leads and all lifts.	Sq.m	348.00
5.1.I-5	Painting hoist structural components, tressle bridge ,crane, lifting beam, cat work bridge and other similar structure on prepared surfaces with two coats of zinc phosphate primer (airless spray preferred) 40 microns/coat and followed by two coats of synthetic enamel paint 25 microns/coat including cost of all materials, labour, scaffolding etc., complete with all leads and all lifts.	Sq.m	307.00
	Gates of Distributory/Branch/Minor canal/ Pump Coloum pipe/ Pump Discharge Pipe & other similar components		
5.1.I-6	Painting of Gates of Distributory/Branch/Minor canal/ Pump Coloum pipe/Pump Discharge Pipe & other similar components on prepared surfaces with one coats of zinc phosphate primer (airless spray preferred) 50microns/coat and one coal tar epoxy, 150 microns/coat including cost of all materials, labour, scaffolding etc., complete with all leads and all lifts.	Sq.m	169.00

CHAPTER 5.2
DRAINAGE PUMPING STATION

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.2.1	Maintenance and overhauling of **V.T. / inclined pumps** as per manufacturers instruction manual with all tools, tackles etc. This job includes labour charges, consumables like O - ring, sundry cleaning material etc. This job includes dismantling of all sub assemblies such as gear box, cooling pipes, bearing housing, stuffing box, discharge tee, muff couplings, shafts, column pipes, bowl assembly, bell mouth, strainer, line shaft enclosing tube etc. Reconditioning of all parts, inspection of all parts & replace these parts as per instructions (spares cost excluded) straighthening of shafts & refitting of all parts & sub assemblies with proper alignment including motor removing & refixing, test & trial for 24 hrs etc complete.		
i)	Capacity upto 05 cusec pump	each	21514.00
ii)	Capacity above 5 cusec and upto 25 cusec pump	each	50425.00
iii)	Capacity above 25 cusec and upto 50 cusec pump	each	68699.00
iv)	Capacity above 50 cusec and upto 100 cusec pump	each	76229.00
v)	Capacity above 100 cusec and upto 150 cusec pump	each	94529.00
vi)	Capacity above 150 cusec and upto 200 cusec pump	each	100773.00
vii)	Capacity above 200 cusec and upto 250 cusec pump	each	116944.00
5.2.2	Maintenance and overhauling of **Centrifugal Pump** as per manufacturers instruction manual with all tools, tackles etc. This job includes labour charges, consumables like O - ring, gland packing, sundry cleaning material etc. This job includes dismantling of all sub assemblies such as cooling pipes, bearing housing, stuffing box, shafts, bowl assembly, bell mouth, strainer etc. Reconditioning of all parts, inspection of all parts & replace these parts as per instructions (spares cost excluded) straighthening of shafts & refitting of all parts & sub assemblies with proper alignment. including motor removing & refixing, test & trial for 24 hrs. etc complete.		
i)	Capacity upto 2 cusec pump	each	9312.00
ii)	Capacity above 2 cusec and upto 5 cusec pump	each	11886.00
ii)	Capacity above 5 cusec and upto 20 cusec pump	each	18551.00
5.2.3	Cost of removing & refitting of motor of V.T. pump as per manufacturers manual & refitting it on pump with alignment with all tools, tackles & sundry material as per direction.		
i)	Up to 250 kw motor	each	4664.00
ii)	251 to 500 kw motor	each	6842.00
iii)	501 to 1000 kw motor	each	8608.00
5.2.4	Cost of replacement of damaged line shaft / cleaning of jammed impeller of V.T./ inclined pumps as per manufacturers instruction manual with all tools, tackles, consumables such as gland packing etc. This job includes dismatling of pump assembly parts by parts and replacement of damaged parts, refitting of all parts & sub assemblies with proper alignment including motor removing & refixing, test & trial for 24 hrs etc complete as per direction (spare cost excluded).		

Sl. No.	Description of Item	Unit	Rate (Rs.)
i)	Capacity upto 05 cusec pump	each	8122.00
ii)	Capacity above 5 cusec and upto 25 cusec pump	each	22395.00
iii)	Capacity above 25 cusec and upto 50 cusec pump	each	26208.00
iv)	Capacity above 50 cusec and upto 100 cusec pump	each	31989.00
v)	Capacity above 100 cusec and upto 150 cusec pump	each	34761.00
vi)	Capacity above 150 cusec and upto 250 cusec pump	each	38672.00
5.2.5	Maintenance and overhauling of **cooling and lubricating system** as per manufacturers instruction manual with all tools, tackles etc. This job includes labour charges, sundry cleaning material etc. This job includes inspection, checking and cleaning of all parts and replacement of damaged parts as per instructions (spares cost excluded) and refitting of all parts& assemblies with proper alignment & test & trial for 24 hrs. etc complete as per direction.	each	13648.00
5.2.6	Maintenance and overhauling of **gear box unit** as per manufacturers instruction manual with all tools, tackles etc. This job includes labour charges, sundry cleaning material etc. This job includes dismantling of all sub assemblies such as opening the gearbox cover, unlocking of the lock nut, lifting of the pressure plate, gear, pinion including taking out of the five number of the bearing with the help of pusher and puller or any other suitable arragement . The job also inclusive of taking out of the thrust pad and bearing housing from the gearbox unit etc. Reconditioning of all parts, inspection of all parts & replace these parts as per instructions (spares cost excluded) & refitting of all parts & sub assemblies with proper alignment incuding motor removing & refixing, test & trial for 24 hrs. etc complete as per direction.		
	For 250 cusec pump	each	26719.00
5.2.7	Maintenance and overhauling of **thrust pad and inner housing of the Michell/hydrodynamic fluid film bearing** as per manufacturers instruction manual with all tools, tackles etc. This job includes reconditioning of all parts by depositing the suitable metal/white metal on the pad and housing and finishing complete with proper grooving and maching, polishing etc. and fitting fixing the same of as per direction.		
i)	For 50 cusec pump	each	8188.00
ii)	For 250 cusec pump	each	12379.00
5.2.8	Maintenance and overhauling of **reflux valve unit** as per manufacturers instruction manual with all tools, tackles etc. This job includes labour charges, sundry cleaning material etc. This job includes dismantling parts by parts from the delivery pipe for checking of the condition of all parts such as counter weight assembly, bearing, door pin hinges, pressure plate, rubber seal etc. Reconditioning of all parts & replace damaged parts as per instructions (spares cost excluded) & refitting of all parts & sub assemblies with proper alignment test & trial for 24 hrs. etc complete as per direction.		
	For 250 cusec pump	each	18805.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
5.2.9	Dismantalling and complete overhauling of the **grease pump** as per manufacturers instruction manual with all tools, tackles etc. This job includes dismantling part by part checking the conditions, servicing and cleaning and repairing and fitting fixing the same as per instruction (spares cost excluded).	each	7926.00
5.2.10	Maintenance and overhauling of **C.I. non-return** valve after dismantling it from delivery pipe line and checking part by part, cleaning, lubricating and thorough servicing the valve. This job includes labour charges, consumables like rubber gasket, sundry cleaning materials, lubricants & replace damaged parts as per instructions (spares cost excluded) & refitting of all parts with proper alignment as per direction.		
	For Valve dia. 300mm to 600 mm	each	11759.00
5.2.11	Maintenance and overhauling of **isolating sluice valve** after dismantling it from delivery pipe line and checking part by part, cleaning, lubricating and thorough servicing the valve. This job includes labour charges, consumables like rubber gasket, sundry cleaning material, lubricants & replace damaged parts as per instructions (spares cost excluded) & refitting of all parts with alignment.		
	For Valve dia. 300mm to 600 mm	each	11759.00
5.2.12	Maintenance and overhauling of **over head travelling crane** as per manufacturers instruction manual with all tools, tackles, cleaning materials etc. This job includes checking of all parts such as long travel & cross travel gear box, main hoist gear box, auxiliary hoist gear box, LT & CT travelling roller wheels, rope drum assembly, shank hook and block sheave/pulley assembly etc. by replacing / reconditioning defective parts (spares cost excluded) such as shaft, gears, pinions, reducing gears, bearings, plummer blocks, couplings and proper alignment with motor and changing of damaged oilseals and filling of gear oil, applying grease at all moving point for smooth and trouble free operation as per direction.		
i)	25/20 Tonne double girder EOT crane	each	47489.00
ii)	15 Tonne single girder EOT crane	each	36116.00
iii)	15 Tonne double/single girder manually operated crane	each	21808.00
iv)	10 Tonne single girder manually operated crane	each	17841.00
5.2.13	**Manufacture and supply of pump spares/components as per specification, drawing or existing one with proper tolerance and finish as per direction.**		
i)	Transmission Bearing/Bowl bearing/Rubber bearing (Material: Neo. Rubber LND BR 2 Shell)	kg	3314.00
ii)	Transmission Bearing (Material: GM Grade LTB 2&5 IS-318)	kg	1828.00
iii)	Bowl bush (Material: GM Grade LTB 2&5 IS-318)	kg	1828.00
iv)	Shaft sleeve/Gland sleeve (Material: ST ASTM 276-316 ANLD)	kg	2530.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
v)	Transmission shaft/head shaft/impeller shaft (Material: ST ASTM 276-316 ANLD)	kg	1752.00
vi)	Transmission shaft/head shaft/impeller shaft/valve shaft (Material: Forged steel C40, IS-1570)	kg	1383.00
vii)	Muff coupling with keyway (Material: .ST ASTM 276-316 ANLD)	kg	3079.00
viii)	Threaded shaft coupling (Material: C45, IS-1570)	kg	2558.00
ix)	Ratchet Housing / Ratchet cover (Material: CI FG200 IS-210)	kg	624.00
x)	Ratchet Housing / Ratchet cover (Material: CS 200-400W IS-1030)	kg	924.00
xi)	Thrust Bearing Housing/ Rubber Bearing Housing (Material: CI IS 210 FG200)	kg	611.00
xii)	Thrust Bearing Housing (Material: CS 200-400W IS-1030)	kg	877.00
xiii)	Thrust bearing holder /Thrust collar (Material: CI IS 210 FG200)	kg	600.00
xiv)	Coupling Pin (Mat. CS IS1570-40C8 HOT RLD) in motor coupling	each	1161.00
xv)	Suction bowl (Mat: CI FG 260 IS 210)	kg	399.00
xvi)	Discharge bowl (CI FG 260 IS 210)	kg	399.00
xvii)	Bearing Spider (Mat: CI FG 260 IS 210)	kg	578.00
xviii)	Impeller Lock nut /adjusting nut (Material: GM)	kg	1602.00
xix)	Impeller Lock nut /adjusting nut (Material: SS 410)	kg	1360.00
xx)	Impeller (Mat: CI FG 300 IS 210)	kg	1284.00
xxi)	Stuffing box (Mat: CI, IS-210, FG260)	kg	843.00
xxii)	Shaft enclosing tube (Material: SS-304)	kg	1105.00
xxiii)	Ratchet pin/pin (Mat: EN 24)	each	863.00
xxiv)	M.S. Column Pipe with flange on both side (IS-2062)	kg	243.00
xxv)	M.S. Discharge 'T Pipe with flange on three sides (IS-2062)	kg	248.00
xxvi)	Thrust pad of Mitchell/fluid film bearing. (Material- White metal)	kg	5530.00
xxvii)	MS Stand pipe with threaded socket complete (heavy Duty) main wall thickness 6mm (IS 2062).	kg	338.00
xxviii)	Gasket	kg	44.00
xxix)	cotton(hydraulic) gland packing	kg	1133.00
xxx)	Neoprene rubber bush	kg	658.00
5.2.14	**Supply of bearings (SKF MAKE)**		
i)	Bearing no 7322 (SKF)	each	53535.00
ii)	Bearing no 7318 BECBM (SKF)	each	36126.00
iii)	Bearing no 29322 E (SKF)	each	56934.00
iv)	Bearing no 29332 E (SKF)	each	102833.00
v)	Bearing no 16032 (SKF)	each	24771.00
vi)	Bearing no. 7319B (SKF)	each	45441.00
vii)	Bearing no. NU228ECML/C3 (SKF)	each	47913.00
viii)	Bearing no. NU226ECM (SKF)	each	32054.00
ix)	Bearing no. NU 321 ECML/C3B20 (SKF)	each	36912.00
x)	Bearing no. NU224 ECM (SKF)	each	29683.00

Sl. No.	Description of Item	Unit	Rate (Rs.)
xi)	Bearing no. 22216E (SKF)	each	10346.00
xii)	Bearing no - 1210 EKTN9 (SKF)	each	2126.00
xiii)	Bearing no - 6212 -2Z/C4(SKF)	each	2385.00
xiv)	Bearing no - 6216 (SKF)	each	3545.00
xv)	Bearing no - 51309 (SKF)	each	3617.00
xvi)	Bearing no - 3313A (SKF)	each	17132.00
xvii)	Bearing no - 3213A (SKF)	each	10216.00
5.2.15	Fabrication, supply, storing at site, installation & commissioning of trashrack/ bar screen/ grating conformong to relevent IS codes (IS:11388, IS:800, IS:2062) fabricated with structural steel sections such as ms flat, channels, angles etc. including cost of materials, machinary, labour, cutting, aliging, welding as per approved drawing including transportation charges as per direction.	kg	127.00
5.2.16	Lifting/lowering the displaced/damaged/normal inlet trashrack/bar screen/ gratings (up to 3 nos./pump bay) from intake channel pier grooves by Tripod, Chain pulley Block, rope etc. and stacking the same in suitable place at site as per direction.	p/ bay	4232.00

SECTION-A

SUPPLY OF LT AND HT CABLES

5.3. A.I. SUPPLYING OF FOLLOWING XLPE INSULATED ALUMINUM CONDUCTOR UNARMORED CABLES OF 1.1KV GRADE AS PER IS 7098 (PART 1) 1988 WITH UP TO DATE AMENDMENTS. (Rate in Rs. Per Mtr)

Conductor cross section in SQ MM	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300	400
1 CORE					70.00	109.00	133.00	172.00	227.00	299.00	358.00	430.00	528.00	624.00	777.00	976.00
2 CORE			99.00	138.00	151.00	196.00	270.00	329.00	453.00	561.00	686.00	818.00	988.00	1313.00	1604.00	2001.00
3 CORE			125.00	169.00	190.00	271.00	370.00	464.00	654.00	817.00	1000.00	1226.00	1505.00	1925.00	2385.00	2953.00
3.5 CORE						339.00	408.00	544.00	748.00	934.00	1199.00	1411.00	1779.00	2151.00	2733.00	3473.00
4 CORE			148.00	189.00	237.00	357.00	453.00	607.00	860.00	1025.00	1229.00	1550.00	1906.00	2481.00	2971.00	4022.00

5.3. A 2. SUPPLYING OF FOLLOWING XLPE INSULATED ALUMINUM CONDUCTOR ARMORED CABLES OF 1.1KV GRADE AS PER IS 7098 (PART 1) 1988 WITH UP TO DATE AMENDMENTS. (Rate in Rs. Per Mtr)

Conductor cross section in SQ MM	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300	400
1 CORE					127.00	167.00	197.00	239.00	305.00	339.00	410.00	482.00	590.00	749.00	923.00	1163.00
2 CORE			160.00	195.00	220.00	249.00	308.00	380.00	509.00	651.00	778.00	937.00	1132.00	1470.00	1791.00	2203.00
3 CORE			185.00	232.00	240.00	312.00	407.00	533.00	703.00	886.00	1055.00	1303.00	1598.00	2019.00	2525.00	3231.00
3.5 CORE						362.00	448.00	593.00	797.00	996.00	1239.00	1442.00	1826.00	2324.00	2827.00	3637.00
4 CORE			214.00	250.00	296.00	386.00	507.00	675.00	906.00	1112.00	1368.00	1655.00	2081.00	2605.00	3232.00	4193.00

5.3. A 3. SUPPLYING OF FOLLOWING THREE CORE HT POWER CABLE WITH STRANDED COMPACTCIRCULAR ALUMINIUM CONDUCTOR, CONDUCTOR SCREEN WITH EXTRUDED SEMI CONDUCTINGCOMPOUND, XLPE INSULATED, INSULATION SCREENING WITH EXTRUDED SEMI CONDUCTING COMPOUND IN COMBINATION WITH COPPER TAPE, CORES LAID UP, INNERSHEATH OF PVC, GALVANISED STEEL FLAT STRIP ARMOURED, AND OVERALL PVC SHEATHED CABLE CONFORMING TO IS 7098 (PART-2) 2011 WITH UP TO DATE AMENDMENTS.
(Rate in Rs. Per Mtr)

Cable Size in sq. mm	A2XFY							
	3.3 KV (UE)	6.6 KV (E)	6.6 KV (UE)/ 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)	33 KV (UE)	
35			1003.00					
50			1151.00					
70	1285.00	1285.00	1369.00					
95	1499.00	1499.00	1638.00	2187.00	2292.00	3030.00		
120	1766.00	1766.00	1890.00	2514.00	2593.00	3327.00		
150	2011.00	2011.00	2119.00	2769.00	2899.00	3673.00	4192.00	
185	2333.00	2333.00	2475.00	3143.00	3268.00	4069.00	4657.00	
240	2838.00	2838.00	2980.00	3702.00	3835.00	4639.00	5261.00	
300	3396.00	3396.00	3533.00	4279.00	4410.00	5238.00	5899.00	
400	4219.00	4219.00	4316.00	5069.00	5289.00	6095.00	6822.00	

ELECTRICAL SECTION			
SECTION- 5.3 B LAYING OF HT CABLES			
Sl. No.	**Description of Items**	**Unit**	**Rate (Rs.)**
5.3 B /1	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11 KV grade of following size direct in ground including excavation, sand cushioning, Brick protective covering and refilling the trench etc as required.		
(a)	Up to 120 sq. mm	Meter	384.00
(b)	Above 120 sq. mm and up to 400 sq. mm	Meter	422.00
5.3 B / 2	Laying of one number additional PVC insulated and PVC sheathed / XLPE power cable of 11 KV grade of following size direct in ground in the same trench in one tier horizontal formation including excavation, sand cushioning, Brick protective covering and refilling the trench etc as required.		
(a)	Up to 120 sq. mm	Meter	262.00
(b)	Above 120 sq. mm and up to 400 sq. mm	Meter	285.00
5.3 B / 3	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11 KV grade of following size in the existing RCC/HUME/ METAL pipe as required.		
(a)	Up to 120 sq. mm	Meter	36.00
(b)	Above 120 sq. mm and up to 400 sq. mm	Meter	63.00
5.3 B / 4	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 11 KV grade of following size in the existing masonry open duct as required.		
(a)	Up to 120 sq. mm	Meter	29.00
(b)	Above 120 sq. mm and up to 400 sq. mm	Meter	54.00

ELECTRICAL SECTION			
SECTION- 5.3 C JOINTING & END TERMINATION OF HT CABLES			
Sl. No.	**Description of Items**	**Unit**	**Rate (Rs.)**
5.3 C/1	**Supplying and making indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 11 KV grade as required :3M / Raychem make**		
(a)	up to 95sqmm	Each	13531.00
(b)	120 -185 sq. Mm	Each	15049.00
(c)	240 - 300 sq. mm.	Each	20066.00
(d)	400 - 500 sq. Mm	Each	27616.00
5.3 C/2	**Supplying and making outdoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 11 KV grade as required : 3M / Raychem make**		
(a)	up to 95sqmm	Each	20572.00
(b)	120 -185 sq. Mm	Each	23840.00
(c)	240 - 300 sq. mm.	Each	27245.00
(d)	400 - 500 sq. Mm	Each	33753.00
5.3 C/3	Supplying and making straight through cable jointing with heat shrinkable jointing kit complete with all accessories including ferrules suitable for following size of 3 core, XLPE aluminium conductor cable of 11 KV grade as required : 3M / Raychem make		
(a)	up to 95sqmm	Each	27320.00
(b)	120 -185 sq. Mm	Each	29881.00
(c)	240 - 300 sq. mm.	Each	36706.00
(d)	400 - 500 sq. Mm	Each	44829.00
5.3 C/4	**Supplying and making indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 33 KV grade as required : 3M / Raychem make.**		
(a)	95 - 150 sq. mm.	Each	24055.00
(b)	185 - 240 sq. mm.	Each	33194.00
(c)	300 - 400 sq. Mm	Each	37468.00
5.3 C/5	**Supplying and making outdoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for following size of 3 core, XLPE aluminium conductor cable of 33 KV grade as required : 3M / Raychem make.**		
(a)	95 - 150 sq. Mm	Each	34410.00
(b)	185-240 sq. Mm	Each	44654.00

ELECTRICAL SECTION

SECTION - 5.3D
LT PANELS AND ACCESSORIES

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 D 1	Supply, fixing, testing & commissioning wall/floor mounted LT panel primer coated with powder coated paint &provided with required gasket for dust/vermin proof with degree of protection IP42 suitable for 415Volt 3phase, 50 Hz, 4 wire system fabricated out of CRCA sheet up to 2 mm thick (1.6mm for doors) duly compartmentalized for incomer, bus section, outgoings, cable alleys & CT, PT Ampere , Volt , selector switches, frequency , phase indicating lamp, Energy complete including cost of busbar supports, detachable cable gland plates,2 earthing terminals, internal wiring &fixing of separately supplied MCBs, MCCBs, ACB, panel mounted changeover switch/SFUs, etc. as required but excluding cost of busbar strips, Ampere , Volt , selector switch as per approved design & specification	Kg	323.00
	Supply and fixing of LT panel accessories of approved make in existing LT panel including connections etc. as required as per specification.		
5.3 D 2	Supply of 3Ph LED Ammeter Cl 0.5	Each	1476.00
5.3 D 3	Supply of 3Ph LED Voltmeter Cl 0.5	Each	1476.00
5.3 D4	Supply of LED Freq meter Cl 0.2	Each	843.00
5.3 D5	Supply of copper busbar for electrical power distribution	Kg	767.00
5.3 D 6	Supply of aluminium busbar for electrical power distribution	Kg	240.00
5.3 D7	Supply of moving iron type analog AC ammeter (accuracy class 1.5), model-SMI-96 of following range		
5.3 D 7.1	0 to 30A	Each	398.00
5.3 D 7.2	0 to 100A	Each	465.00
5.3 D 7.3	0 to 200A	Each	561.00
5.3 D 8	Supply of 0 to 600V range moving iron type analog AC voltmeter (accuracy class 1.5), model-SMI-96	Each	465.00
5.3 D 9	Supply of ammeter selector switch Current in Each phase with OFF, 4 Pos. 90° angle of throw (OFF-R-Y-B)	Each	232.00
5.3 D10	Supply of voltmeter selector switch Votage between phases with OFF, 4 Pos. 90° angle of throw (OFF-RY-YB-BR)	ecah	174.00
5.3 D 11	Supply of 22.5 mm Hole Dia Mushroom Type Push Button switch	Each	140.00
5.3 D 12	Supply of 22.5 mm dia LED indicating lamps	Each	117.00
5.3 D 13	Supply of 240VAC analog time switch for ON-OFF control of street light	Each	2152.00
5.3 D 14	Supply of 3 pole power contactor type ML 1.5, 25A current rating	Each	3182.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 D 15	Supply of 3 pole power contactor type ML 2, 40A current rating	Each	5913.00
5.3 D 16	Supply of 3 pole power contactor type ML3, 40A current rating	Each	9775.00
5.3 D 17	Supply of 3 pole power contactor type ML12, 300A current rating	Each	57138.00
5.3 D 18	Supply of 3 pole power contactor type MNX18, 18A current rating	Each	1145.00
5.3 D 19	Supply of 3 pole power contactor type MNX22, 22A current rating	Each	1356.00
5.3 D 20	Supply of 3 pole power contactor type MNX25, 25A current rating	Each	1404.00
5.3 D 21	Supply of 3 pole power contactor type MNX140, 140A current rating	Each	24472.00
5.3 D 22	Supply of 3 pole power contactor type MNX185, 185A current rating	Each	28186.00
5.3 D 23	Supply of 3 pole power contactor type MNX225, 225A current rating	Each	31032.00
5.3 D 24	Supply of 3 pole power contactor type MNX250, 250A current rating	Each	35005.00
5.3 D 25	Supply of 3 pole power contactor type MNX300, 300A current rating	Each	42202.00
5.3 D 26	Supply of 3 pole Thermal over load Relay type MN-2, Relay range 0.9- 1.5A to 6-10A current rating	Each	1414.00
5.3 D 27	Supply of 3 pole Thermal over load Relay type MN-2, Relay range 9A to 15A current rating	Each	1418.00
5.3 D 28	Supply of 3 pole Thermal over load Relay type MN-2, Relay range 14A to 23A current rating	Each	1548.00
5.3 D 29	Supply of 3 pole Thermal over load Relay type MN-2, Relay range 20A to 33A current rating	Each	2281.00
5.3 D 30	Supply of 3 pole Thermal over load Relay type MN-5, Relay range 14A to 23A current rating	Each	2837.00
5.3 D 31	Supply of 3 pole Thermal over load Relay type MN-5, Relay range 20A to 33A current rating	Each	2861.00
5.3 D 32	Supply of 3 pole Thermal over load Relay type MN-5, Relay range 30A to 50A current rating	Each	3455.00
5.3 D 33	Supply of 3 pole Thermal over load Relay type MN-12L, Relay range 60A to100A current rating	Each	20116.00
5.3 D 34	Supply of 3 pole Thermal over load Relay type MN-12L, Relay range 90A to150A / 135-225A / 180-300A current rating	Each	20116.00
5.3 D 35	Supply of 3 pole MCCB Thermal Megnatic release type DN2-250 N, 125- 160A current rating	Each	20059.00
5.3 D 36	Supply of 3 pole MCCB Thermal Megnatic release type DN2-250 N, 160A -200A current rating	Each	21084.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 D 37	**Supply of 3 pole MCCB Thermal Megnatic release type** DN2-250 N, 200A - 250A current rating	Each	22809.00
5.3 D 38	**Supply of 3 pole MCCB Thermal Megnatic release type** DN3-400 N, 250A - 320A current rating	Each	28176.00
5.3 D 39	**Supply of 3 pole MCCB Thermal Megnatic release type** DN3-400 N, 320A - 400A current rating	Each	28176.00
5.3 D 40	**Supply of 3 pole MCCB Thermal Megnatic release type** DN3-630 N, 400A - 500A current rating	Each	**38584.00**
5.3 D 41	Supply of 1 pole Electronic Timer type ST100, 3-30 Second / 12-120 Second	Each	1692.00
5.3 D 42	Supply of 3-ph DOL Starter MN 16 DOL	Each	4011.00
5.3 D 43	**Supply of indoor tape insulated ring type low tension current transformer of following rating**		
5.3 D 43.1	60/5A, 5VA, Cl 0.5	Each	**383.00**
5.3 D 43.2	75/5A, 5VA, Cl 0.5	Each	**383.00**
5.3 D 43.3	100/5A 5VA, Cl 1.0	Each	**383.00**
5.3 D 43.4	100/5A 15VA, Cl 1.0	Each	1438.00
5.3 D 43.5	150/5A 5VA, Cl 1.0	Each	**383.00**
5.3 D 43.6	150/5A 15VA, Cl 1.0	Each	1246.00
5.3 D 43.7	200/5A 10VA, Cl 1.0	Each	**383.00**
5.3 D 43.8	200/5A 15VA, Cl 1.0	Each	767.00
5.3 D 43.9	250/5A 10VA, Cl 1.0	Each	479.00
5.3 D 43.1	250/5A 15VA, Cl 1.0	Each	767.00
5.3 D 43.11	300/5A 10VA, Cl 1.0	Each	527.00
5.3 D 43.12	300/5A 15VA, Cl 1.0	Each	671.00
5.3 D 43.13	400/5A 15VA, Cl 1.0	Each	**383.00**
5.3 D 43.14	500/5A 15VA, Cl 1.0	Each	**383.00**
5.3 D 43.15	600/5A 15VA, Cl 1.0	Each	**383.00**
5.3 D 43.16	800/5A 15VA, Cl 1.0	Each	479.00

ELECTRICAL SECTION

SECTION - 5.3 E.

OVERHEAD LINE POLES AND ACCESSORIES

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 E.1	**Supplying swaged and welded steel tubular pole of** following specifications as per IS 2317: 1980)		
5.3 E.1.1	7m length, 62Kg, 410-SP-01	Each	8319.00
5.3 E.1.2	7m length, 73Kg, 410-SP-02	Each	9795.00
5.3 E.1.3	7m length, 85Kg, 410-SP-03	Each	11405.00
5.3 E.1.4	8m length, 70Kg, 410-SP-10	Each	9392.00
5.3 E.1.5	8m length, 83Kg, 410-SP-11	Each	11136.00
5.3 E.1.6	8m length, 97Kg, 410-SP-12	Each	13015.00
5.3 E.1.7	8m length, 101Kg, 410-SP-13	Each	13551.00
5.3 E.1.8	8m length, 111Kg, 410-SP-14	Each	14893.00
5.3 E.1.9	8m length, 119Kg, 410-SP-15	Each	15967.00
5.3 E.1.1	9m length, 78Kg, 410-SP-25	Each	10465.00
5.3 E.1.11	9m length, 92Kg, 410-SP-26	Each	12344.00
5.3 E.1.12	9m length, 108Kg, 410-SP-27	Each	14491.00
5.3 E.1.13	9m length, 113Kg, 410-SP-28	Each	15161.00
5.3 E.1.14	9m length, 125Kg, 410-SP-29	Each	16772.00
5.3 E.1.15	9m length, 133Kg, 410-SP-30	Each	17845.00
5.3 E.1.16	9m length, 147Kg, 410-SP-31	Each	19723.00
5.3 E.1.17	9m length, 154Kg, 410-SP-32	Each	20663.00
5.3 E.1.18	9m length, 164Kg, 410-SP-33	Each	22004.00
5.3 E.1.19	11m length, 140Kg, 410-SP-49	Each	18784.00
5.3 E.1.2	11m length, 147Kg, 410-SP-50	Each	19723.00
5.3 E.1.21	11m length, 164Kg, 410-SP-51	Each	22004.00
5.3 E.1.22	11m length, 175Kg, 410-SP-52	Each	23480.00
5.3 E.1.23	11m length, 183Kg, 410-SP-53	Each	24554.00
5.3 E.1.24	11m length, 194Kg, 410-SP-54	Each	26029.00
5.3 E.1.25	11m length, 227Kg, 410-SP-55	Each	30457.00
5.3 E.1.26	11m length, 241Kg, 410-SP-56	Each	32336.00
5.3 E.1.27	11m length, 256Kg, 410-SP-57	Each	**34348.00**
5.3 E.1.28	12m length, 186Kg, 410-SP-58	Each	24956.00
5.3 E.1.29	12m length, 197Kg, 410-SP-59	Each	26432.00
5.3 E.1.30	12m length, 208Kg, 410-SP-60	Each	27908.00
5.3 E.1.31	12m length, 245Kg, 410-SP-61	Each	29039.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 E.1.32	12m length, 259Kg, 410-SP-62	Each	34751.00
5.3 E.1.33	12m length, 277Kg, 410-SP-63	Each	37166.00
5.3 E.1.34	12m length, 292Kg, 410-SP-64	Each	39178.00
5.3 E.1.35	12m length, 313Kg, 410-SP-65	Each	41996.00
5.3 E.1.36	12m length, 332Kg, 410-SP-66	Each	43204.00
5.3 E.2	Supply of CI base plate for overhead MS pole	Each	958.00
5.3 E.3	Supply of CI pole CAP for overhead MS pole	Each	575.00
5.3 E.4	Supply of single arm bracket made of 40mm dia 1.0 meter long	Each	1342.00
5.3 E.5	Supply of double arm bracket made of 40mm dia 1.0 meter long	Each	1725.00
5.3 E.6	Supply of single arm bracket made of 40mm dia 1.5 meter long	Each	1533.00
5.3 E.7	Supply of double arm bracket made of 40mm dia 1.5 meter long	Each	1725.00

ELECTRICAL SECTION

SECTION - 5.3 F.

LUMINARIES

Item No.	Description of Items	Unit	Rate (in Rs.)
	Supplying and fixing False Ceiling based Luminaries		
5.3 F.1	Supply and fixing of philips Soft Glow Office compliant fully diffused recessed mounted 2'X2' false ceiling based LED light including connection by 1.5 sq mm cu wire.		
5.3 F.1.0.1	Make : Philips 36 Watt	Each	5309.00
5.3 F.1.0.2	Make : Panasonic 36 Watt	Each	3912.00
5.3 F.1.0.3	Make : Bajaj, 36 Watt	Each	3235.00
5.3 F.2	Supply and fixing of philips Cirrus Surface Surface Mounted general purpose square shaped (2′ x 2′) luminaire 32Watt WH including connection by 1.5 sq mm cu wire.	Each	5118.00
5.3 F.3	Supply and fixing of philips Recessed Mounted Luminaires DaySpace is a unique 2'X2' LED luminaire suitable for grid ceiling including connection by 1.5 sq mm cu wire.	Each	
5.3 F.3.0.1	Philips, 30 Watt	Each	13155.00
5.3 F.3.0.2	Panasonic, 36W	Each	3271.00
5.3 F.3.0.3	Bajaj, 36W Neutral White	Each	4308.00
5.3 F.4	Supply and fixing of philips Smartbrite Xtra 4ft run length LED Batten Tube light, incl Fixing only fluorescent light fitting suspended 25 cm bellow the ceiling with 2 No. 20 mm dia EI conduit (14 SWG) supports incl. S&F EI conduit, ball socket/socket type ceiling plate and connecting the length of PVC insulated wire and painting etc. as required by 2x24/0.20 mm (1.5sqmm) flexible copper wire of 1.10 mt. length		
5.3 F.4.0.1	Philips make, 40 Watt	Each	1837.00
5.3 F.4.0.2	Crompton make, 18W	Each	1027.00
5.3 F.4.0.3	Panasonic make , 20W	Each	757.00
5.3 F.4.0.4	Make : Bajaj, 18 W Neutral White	Each	516.00
5.3 F.4.0.5	Make : Havells, 20 W LED	Each	985.00
5.3 F.5	Supply and fixing of philips Smartbrite Xtra 2ft run length LED Batten Tube light, 12 watt incl Fixing only fluorescent light fitting suspended 25 cm bellow the ceiling with 2 No. 20 mm dia EI conduit (14 SWG) supports incl. S&F EI conduit, ball socket/socket type ceiling plate and connecting the length of PVC insulated wire and painting etc. as required by 2x24/0.20 mm (1.5sqmm) flexible copper wire of 1.10 mt. length	Each	728.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 F.6	Supply and fixing of philips Sleek Surface Downlight, 16 watt WH, after cutting the ceiling or wall as reqd. and also mending good the damages to building works incl wiring and connection of the light by 1.5 sq mm cu wire complete.	Each	1683.00
5.3 F.7	Supply and fixing of GreenLED Ultima Square (6" x 6") , incl cutting the false ceiling in reqd dimensions also the wiring and connection of the light by 1.5 sq mm cu wire complete.		
5.3 F.7.0.1	Make : Philips, 10 watt square/ round	Each	1944.00
5.3 F.7.0.2	Make : Panasonic, 15W square/ round	Each	1083.00
5.3 F.7.0.3	Make : Crompton, 18 watt square/ round	Each	1015.00
5.3 F.7.0.4	Make : Bajaj, 15 watt square/ round	Each	1237.00
5.3 F.7.0.5	Make : Havells, 18 watt square/ round	Each	1060.00
5.3 F.8	Supply and fixing of philips Style State Track, Track & Spot Lights, ModelNo : ST916T LED20/940 PSU 1C MB BK IN also the wiring and connection of the light by 1.5 sq mm cu wire complete.	Each	13527.00
5.3 F.9	Supply and fixing of smart bright street light (36 Watt) complete with all accessories to be fixed /projected from the wall of the building or on pole incl. making holes/providing clamping arrangement & necy. GI reducer as required. S&F 40 mm GI pipe (ISI-Medium) quality 1.5 mts. average length having suitable bend S&F necy. length of 1.5 sqmm PVC insulated single core stranded annealed copper wire and making connections as required and mending good damages to wall incl. painting etc.		
5.3 F.9.0.1	Make : Philips, 36 watt	Each	5316.00
5.3 F.9.0.2	Make : Bajaj, 30 watt	Each	3016.00
5.3 F.9.0.3	Make : Crompton, 36 watt	Each	3512.00
5.3 F.9.0.4	Make : Panasonic, 30W	Each	2791.00
5.3 F.9.0.5	Make: Havells, 30 W LED	Each	5316.00
5.3 F.10	Supply and fixing of smart bright essential street light (70 Watt) complete with all accessories to be fixed /projected from the wall of the building or on pole incl. making holes/ providing clamping arrangement & necy. GI reducer as required. S&F 40 mm GI pipe (ISI-Medium) quality 1.5 mts. average length having suitable bend S&F necy. length of 1.5 sqmm PVC insulated single core stranded annealed copper wire and making connections as required and mending good damages to wall incl. painting etc.		
5.3 F.10.0.1	Make : Philips, 68 watt	Each	6218.00
5.3 F.10.0.2	Make : Panasonic, 70 watt	Each	8472.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 F.10.0.3	Make : Bajaj, 70 watt	Each	7841.00
5.3 F.10.0.4	Make : Crompton, 72 watt	Each	8021.00
5.3 F.11	Supply and fixing of greenline V2 street light (115 Watt) complete with all accessories to be fixed /projected from the wall of the building or on pole incl. making holes/providing clamping arrangement & necy. GI reducer as required. S&F 40 mm GI pipe (ISI-Medium) quality 1.5 mts. average length having suitable bend S&F necy. length of 1.5 sqmm PVC insulated single core stranded annealed copper wire and making connections as required and mending good damages to wall incl. painting etc.		
5.3 F.11.0.1	Make : Philips, 115 watt	Each	9284.00
5.3 F.11.0.2	Make : Panasonic, 120 watt	Each	12981.00
5.3 F.11.0.3	Make : Bajaj, 120 W LED	Each	11628.00
5.3 F.11.0.4	Make : Crompton, 120 watt	Each	13432.00
5.3 F.12	Supply and fixing of SkyCove LED Strip Light (5M length) with driver and necessary connection.		
5.3 F.12.0.1	Make : Philips , LED Strip SKYCove 5M WW with driver	Each	1428.00
5.3 F.12.0.2	Make : Havells, LED Strip SKYCove 5M WW with driver	Each	738.00
5.3 F.12.0.3	Make : Bajaj, LED Strip SKYCove 5M WW with driver	Each	2136.00
5.3 F.12.0.4	Make: Crompton, LED Strip SKYCove 5M WW with driver	Each	1708.00
5.3 F.13	Supply and fixing of Town Glow Post Top IP66/IK10 Post Top lantern with symmetric Light distribution complete with all accessories to be fixed on suitable pole incl. bolts and nuts incl making drilled holes etc to fixing up the landscape lighting pole complete.		
5.3 F.13.0.1	Make : Philips, 50 watt	Each	18471.00
5.3 F.13.0.2	Make: Havells, 50W LED	Each	13150.00
5.3 F.13.0.3	Make : Bajaj, 45W LED NW	Each	12005.00
5.3 F.13.0.4	Make : Crompton, Model no : 45 watt	Each	20274.00
5.3 F.14	Supply and fixing of LED Bollard (10watt) complete with all accessories		
5.3 F.14.0.1	Make : Philips, 10 watt	Each	11513.00
5.3 F.14.0.2	Make : Havells, 10 watt	Each	7996.00
5.3 F.14.0.3	Make ; Bajaj, 9 watt	Each	4813.00
5.3 F.14.0.4	Make : Crompton, 10 watt	Each	5381.00
5.3 F.15	Supply and fixing of EnduraLED Bulkhead Pressure Die cast housing LED bulkhead with IP66 Protection and IK09 impact resistance suitable for surface and wall mounting applications on ceiling fitting on wall /ceiling by screws etc.		

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 F.15.0.1	Make ; Philips, 6 watt NW	Each	1499.00
5.3 F.15.0.2	Make : Panasonic, 10W	Each	1161.00
5.3 F.15.0.3	Make ; Bajaj, 10W LED	Each	1544.00
5.3 F.15.0.4	Make: Havells, 10WLED	Each	1319.00
5.3 F.15.0.5	Make: Crompton, 10 watt LED	Each	1138.00
5.3 F.16	Supply and fixing of Havells Post top Luminaries with 4m pole and pole base cover, Luminaries model no : CORAL PT35WLED (35Watt) over the preinstalled muffing by grounting nuts and bolts complete including wiring from loop box to the light by 1.5 sq mm cu wire.	Each	35637.00
5.3 F.17	Supply and fixing of Havells Post top Luminaries with 6m pole and pole base cover, Luminaries model no : CORAL PT35WLED(35Watt) over the preinstalled muffing by grounting nuts and bolts complete including wiring from loop box to the light by 1.5 sq mm cu wire.	Each	44367.00
5.3 F.18	Supply and fixing of Havells Post top Luminaries model no : CORAL PT35WLED (35Watt) over the preinstalled GI Pipe over the gate structure or similar structure incl. connection by 1.5 sq mm cu wire from loop box to the light	Each	9731.00
5.3 F.19	Supply TMC501 Conventional industrial batten Philips LEDtube, model no : TMC 501 P 1xT-LED 22W P3241 with 1no Mas LEDtube 1200mm 18W865 T8 I - 2100lm including necessary connection.	Each	1172.00
5.3 F.20	Supply TMC501 Conventional industrial batten Philips LEDtube, model no : TMC 501 P 2xT-LED 22W P3242 with 2nos Mas LEDtube 1200mm 18W865 T8 I - 2100lm including necessary connection.	Each	1984.00
5.3 F.21	Supply TMC501 Conventional industrial batten Philips LEDtube, model no : TMC 501 P 2xT-LED 22W P3242	Each	541.00
5.3 F.22	Supply TMC501 Conventional industrial batten Philips LEDtube, model no : TMC 501 P 1xT-LED 22 W P3241	Each	451.00
5.3 F.23	Supply Philips LEDtube, model no : Mas LEDtube 1200mm 18W865 T8 I - 2100lm	Each	721.00
5.3 F.24	Supplying of different types of LED lamps (2.7/3W)		
5.3 F.24.1	Make : Philips, 2.7 Watt, Base B22/ E27, 230 Lm	Each	135.00
5.3 F.24.2	Make : Crompton, LED 3W - B22 - CDL	Each	108.00
5.3 F.24.3	Make : Havells, LED Adore 2.8 W B22 CDL Ball Lamp	Each	108.00
5.3 F.25	Supplying of different types of LED lamps (9W)		
5.3 F.25.1	Make : Philips, 9.0 Watt, Base B22/ E27, 825 Lm	Each	162.00
5.3 F.25.2	Crompton make, LED 9W - B22 - CDL	Each	271.00
5.3 F.25.3	Havells make, NU Bulb Plus 9 W 865 B22 3 Star	Each	131.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 F.26	Supplying of different types of LED lamps (12W)		
5.3 F.26.1	Make : Philips, 12.0 Watt, Base B22/ E27, 1200 Lm	Each	316.00
5.3 F.26.2	Make: Crompton, LED 12W - B22 - CDL	Each	316.00
5.3 F.26.3	Make: Havells, NU Bulb Plus 12 W 865 B22 2 Star	Each	248.00
5.3 F.27	Supplying of different types of LED lamps (17W)		
5.3 F.27.1	Make: Philips, 17.0 Watt, Base B22/ E27, 1700 Lm	Each	388.00
5.3 F.27.2	Make: Crompton, LED 18W - B22 - CDL	Each	406.00
5.3 F.27.3	Make: Havells, NU BULB Plus 18 W 865 B22 2 STAR	Each	352.00
5.3 F.28	Supplying of different types of LED lamps (20W)		
5.3 F.28.1	Make : Philips, 20.0 Watt, Base B22/ E27, 2000 Lm	Each	433.00
5.3 F.28.2	Make: Crompton, LED 23W - CDL	Each	374.00
5.3 F.28.3	Make: Havells, LED ADORE 20 W B22 CDL 2 STAR LED LAMP	Each	428.00
5.3 F.29	Supplying of different types of LED lamps (40W)		
5.3 F.29.1	Make : Philips, 40.0 Watt, Base B22/ E27, 4000 Lm	Each	947.00
5.3 F.29.2	Make: Crompton, LED 40W-B22-CDL	Each	1060.00

ELECTRICAL SECTION

SECTION - 5.3 G.

SUPPLYING AND REPAIRING OF FANS

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 G.1	**Supplying of approved make high speed ceiling fan (ISI marked) of following sizes having double ball bearing complete with standard down rod, canopy, hanging shackle, Aluminium blades, without regulator, A.C. 230-250 volts**		
5.3 G.1.1	900mm/ 1050mm/ 1200mm	Each	2297.00
5.3 G.2	**Supplying of approved make Pedestal fan oscillating type with base, blades, guard, speed regulator etc. AC 230-250 volts.**		
5.3 G.2.1	**500mm sweep**	Each	**4503.00**
5.3 G.2.2	**450mm sweep**	Each	4823.00
5.3 G.3	**Supplying of approved make cabin fan oscillating type with base, blades, guard, speed regulator etc. AC 230- 250 volts.**		
5.3 G.3.1	**400mm sweep**	Each	3917.00
5.3 G.4	**Supplying of approved make wall fan oscillating type with base, blades, guard, speed regulator etc. AC 230- 250 volts.**		
5.3 G.4.1	**450mm sweep**	Each	4402.00
5.3 G.4.2	**400mm sweep**	Each	**3368.00**
5.3 G.5	**Supplying of approved make exhaust fan heavy duty with mounting frame, blades AC 230-250.**		
5.3 G.5.1	150mm sweep RPM 900 / 1400 (6")	Each	1721.00
5.3 G.5.2	225mm sweep RPM 900 / 1400 (9")	Each	2151.00
5.3 G.5.3	300mm sweep RPM 900 / 1400 (12")	Each	2416.00
5.3 G.6	**Supplying of approved make plastic ventilating exhaust fan AC 230-250.**		
5.3 G.6.1	Ventilus 6" 150 Ivory, White, make : crompton	Each	1483.00
5.3 G.6.2	Ventilus 8" 200 Ivory, White, make : crompton	Each	1583.00
5.3 G.6.3	Ventilus 10" 250 Ivory, White, make : crompton	Each	1730.00
SERVICING AND REWINDINGS OF FAN			
5.3 G.7	Taking down the ceiling 900/1200/1400 mm sweep (GEC/ Crompton/Usha/Havells etc.) with necessary tools and tackles **from Ceiling.**	Each	**90.00**
5.3 G.8	Opening the Ceiling Fan 900/1200/1400 mm sweep (GEC/ Crompton/Usha/Havell's etc.) with necessary tools and tackles and testing, checking, servicing, overhauling including supplying 23/36 PVC Copper flexible wire up to length 1.0 Meter. And transportation charges etc. and re-fixing the ceiling **fan on its original position.**	Each	260.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 G.9	Opening the Ceiling fan testing, checking and Re-winding by supplying super enamelled copper wire of appropriate gauge, minilex paper, mica sheet, changing the loops, overhauling, backing, varnishing, re-fitting and using and measuring r.p.m. for ceiling fan above 36" sweep up to 60" sweep.	Each	1029.00
5.3 G.10	Taking down the heavy duty exhaust fan (1 Phase/3 Phase) 23 cm. sweep to 60 cm. sweep with necessary tools and tackles and arrangement from top of the wall.	Each	449.00
5.3 G.11	Opening the heavy duty following Exhaust fan/stand fan/cabin fan testing, checking, servicing and overhauling including supplying 1.5 sq.mm. PVC Copper flexible wire up to length 0.5 Meter. Including transportation charges etc. and refitting the same.		
5.3 G.11.1	Exhaust Fan/Stand Fan (24" or 60 cm. dia sweep)	Each	520.00
5.3 G.11.2	Cabin Fan (16" or 40 cm. dia sweep)	Each	272.00
5.3 G.12	Opening the following Exhaust fan (1 Phase/3 Phase) /Stand Fan/Cabin Fan testing, checking, Re-winding by supplying super enamelled copper wire of appropriate gauge, minalex paper, mica sheet, changing the loops, overhauling, becking, varnishing, re-fitting and testing and measuring r.p.m. etc.		
5.3 G.12.1	1-Ph Exhaust Fan (24" or 60 cm dia sweep)	Each	2233.00
5.3 G.12.2	3-Ph Exhaust Fan (24" or 60 cm dia sweep)	Each	2802.00
5.3 G.12.3	Cabin Fan (16" or 40 cm. dia sweep)	Each	1169.00
5.3 G.13	Supplying following sizes bearing:		
5.3 G.13.1	Bearing No. 6201 (SKF or Equivalent)	Each	78.00
5.3 G.13.2	Bearing No. 6202 (SKF or Equivalent)	Each	83.00
5.3 G.13.3	Bearing No. 6203 (SKF or Equivalent)	Each	101.00
5.3 G.13.4	Bearing No. 6204 (SKF or Equivalent)	Each	151.00
5.3 G.14	Supplying following sizes Capacitor of 250V rating:		
5.3 G.14.1	2.5 MFD Capacitor (Universal Make or equivalent)	Each	30.00
5.3 G.14.2	4 MFD Capacitor (Universal Make or equivalent)	Each	48.00
5.3 G.14.3	6 MFD Capacitor (Universal Make or equivalent)	Each	65.00
5.3 G.15	Supplying and fixing only 20 SWG MS Sheet Coul on wall with necessary nuts and bolts (6mm dia X 62 mm long) with necessary tools and tackles and arrangement for 24" or 60 cm sweep exhaust fan.	Each	1688.00
5.3 G.16	Painting of heavy duty Exhaust fan/Stand Fan/Cabin Fan in following sizes complete with 2 coats of paints with ready-mix paint/primer of approved make and brand including preparation of surface by sand paper/emery paper, cleaning etc. for receiving fresh coat of synthetic enamel paint.		
5.3 G.16.1	For 16" or 40 cm dia Cabin Fan	Each	392.00
5.3 G.16.2	For 24" or 60 cm dia Exhaust Fan	Each	582.00
5.3 G.16.3	For 24" or 60 cm dia Stand Fan	Each	726.00

ELECTRICAL SECTION			
SECTION - 5.3 H.			
SERVICING AND MAINTENANCE OF AC MACHINES			
Item No.	**Description of Items**	**Unit**	**Rate (in Rs.)**
5.3 H.1	Comprehensive Annual Maintenance and servicing of Air conditioning machine of following ratings		
5.3 H.1.1	1.0 Ton split type	Per Year	2967.00
5.3 H.1.2	1.5 Ton split & Cassette type both	Per Year	3687.00
5.3 H.1.3	2.0 Ton split & Cassette type both	Per Year	4347.00
5.3 H.1.4	1.5 / 2 Ton Window Type	Per Year	2998.00
5.3 H.1.5	5.5 Ton Duct Type	Per Year	8846.00
5.3 H.1.6	7.5 Ton Duct Type	Per Year	11366.00
5.3 H.2	Providing & Fixing of ISI marked (IS : 15778 - 2007) Rigid CPVC drain water piping 6 kg/ cm2 with fittings like elbow, socket, Tee etc& support with MS hanger on ceiling or recessed in wall with chasing & plastering with 6 mm thick closed cell elastomeric nitrile rubber insulation complete in all respect.		
	a) 20mm dia	Meter	186.00
	b) 25mm dia	Meter	231.00
5.3 H.3	Supply & fixing MS powder coated stand suitable for 1.0/1.5/ 2.0 Tr outdoor type of Split AC. All as per pre-approved by Engineer in charge.	kg	88.00
5.3 H.4	Supply, installation, testing & commissioning of suction/ discharge copper pipe line in split air conditioning unit 1.0/1.5 TR/2 TR/3 TR capacity including brazing, nitrile rubber insulation 6/9mm thick class 'O', etc complete as required.		
5.3 H.4.1	Copper tube 1/4"	Meter	319.00
5.3 H.4.2	Copper tube 3/8"	Meter	353.00
5.3 H.4.3	Copper tube 1/2"	Meter	464.00
5.3 H.4.4	Copper tube 5/8"	Meter	575.00
5.3 H.5	Gas charging (R410A/Eco Friendly Green Gas) of window/ split air conditioning unit including flushing of cooling & condensing units with nitrogen gas & rectification of leakage, replacement of filter, flair nut etc. if any.		
5.3 H.5.1	1.0 TR	Each	1410.00
5.3 H.5.2	1.5 TR	Each	1861.00
5.3 H.5.3	2.0 TR	Each	2416.00
5.3 H.6	Supply installation testing and commissioning of following capacity geyser 5 star rated storage water heater with advanced 3 level safety		
5.3 H.6.1	For 10L-capacity	Each	8332.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 H.6.2	For 15L-capacity	Each	9277.00
5.3 H.6.3	For 25L-capacity	Each	9749.00
5.3 H.7	Supply and Installationy of window type room air conditioning machine of following tonnage rating capacity) 3 star rating fitted with rotary crompresser and cooling capacity min. 6000 k cal/Hr., minimum discharge air flow 800cum mtr, 800EER (W/W) 2.7-2.89. (Rates are inclusive of extra refrigerant pipe drain pipe connecting cable) up to the satisfaction of the EIC.		
5.3 H.7.0.1	1.0 Ton (Make : Hitachi) 3 star non-inverter type	Each	27383.00
5.3 H.7.0.2	1.0 Ton (Make : Voltas) 3 star non-inverter type	Each	27022.00
5.3 H.7.0.3	1.5 Ton (Make : Hitachi) 3 star non-inverter type	Each	32307.00
5.3 H.7.0.4	1.5 Ton (Make : Voltas) 3 star non-inverter type	Each	30986.00
5.3 H.7.0.5	2.0 Ton (Make : Hitachi) 3 star non-inverter type	Each	36888.00
5.3 H.7.0.6	2.0 Ton (Make : Voltas) 3 star non-inverter type	Each	35478.00
5.3 H.8	Supply and Installationof Split type room air conditioning machine of following tonnage capacity 3 star rating fitted with rotary crompresser and cooling capacity min. 6000 k cal/Hr., minimum discharge air flow 800cum mtr, 800EER (W/W) 2.7-2.89. (Rates are inclusive of extra refrigerant pipe drain pipe connecting cable) up to the satisfaction of the EIC.		
5.3 H.8.0.1	1.0 Ton (Make : Hitachi) 3 star non-inverter type	Each	36677.00
5.3 H.8.0.2	1.0 Ton (Make : Voltas) 3 star non-inverter type	Each	41345.00
5.3 H.8.0.3	1.5 Ton (Make : Hitachi) 3 star non-inverter type	Each	43636.00
5.3 H.8.0.4	1.5 Ton (Make : Voltas) 3 star non-inverter type	Each	48656.00
5.3 H.8.0.5	2.0 Ton (Make : Hitachi) 3 star non-inverter type	Each	54265.00
5.3 H.8.0.6	2.0 Ton (Make : Voltas) 3 star non-inverter type	Each	64571.00
5.3 H.9	Supply and Installation of Cassette type room air conditioning machine of following tonnage capacity 3 star rating fitted with rotary crompresser and cooling capacity min. 6000 k cal/Hr., minimum discharge air flow 800cum mtr, 800EER (W/W) 2.7-2.89. (Rates are inclusive of extra refrigerant pipe drain pipe connecting cable) up to the satisfaction of the EIC.		
5.3 H.9.0.1	1.5 Ton Cassette AC Make : Hitachi	Each	65935.00
5.3 H.9.0.2	1.5 Ton Cassette AC Make : VOLTAS	Each	49639.00
5.3 H.9.0.3	2.0 Ton Cassette AC Make : Hitachi	Each	75184.00

ELECTRICAL SECTION

SECTION - 5.3 I.

SERVICING AND MAINTENANCE OF HT EQUIPMENT

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 I.1	Dehydration & filtration of power transformer oil to raise the dielectric strength to the value specified in IS including submission of test result. The cost includs man, machinary, and tools & plant hire charges to complete the at site as per direction of the EIC.	Per Ltr	10.53
5.3 I.2	Taking out sample of oil and carrying out chemical test of oil in respect of its acidity test through reputed test house and submission of test result.	Per Test	1295.00
5.3 I.3	Taking out sample of oil from power/voltage transformer, OCB etc. & testing their dielectric strength according to specification and submission of test result.	Per Test	533.25
5.3 I.4	Opening the transformer breather and refitting the same after changing the silica gel including the supply of necessary gasket and silica gel.	Job	1370.00
5.3 I.5	Servicing and overhauling of 400 AMPS/ 500 AMPS/ 630 AMPS /1250 Amps ,11KV/ 6.6 KV. /3.3kv V.C.B./ V.C.U. dismantling the rack from the housing, opening the components, necessary cleaning of the component, carbonised portion, changing of rubber gasket, defective parts, cleaning of all mechanism parts and lubricating the mechanism, opening of C.T. & P.T.S., busbar spout assembly cleaning the same and insulated properly by supply of C.T.C. etc. and refitting all the parts to its original position by making all relevant electrical connection, panel wiring etc. for satisfactory & operation.	Each	11683.00
5.3 I.6	Servicing and overhauling of 1000/1250 AMPS , 33KV V.C.B. Panel dismantling the rack from the housing, opening the components, necessary cleaning of the component, carbonised portion, changing of rubber gasket, defective parts, cleaning of all mechanism parts and lubricating the mechanism, opening of C.T. & P.T.S., busbar spout assembly cleaning the same and insulated properly by supply of C.T.C. etc. and refitting all the parts to its original position by making all relevant electrical connection, panel wiring etc. for satisfactory & operation.	Each	14818.00
5.3 I.7	Servicing, cleaning and testing, calibration of following relay (for 6 KV Panel/11 KV Panel)		
5.3 I.7.i	For Incomer Feeder: Each relay set consists of following relays MICOM P110 /122/127/ 1 NO. CGL 14N/C- 1 NO VAX31 - 1 NO, VAA-33-1NO VAMP-31 - 1 NO, VAJH-13-1NO	Set	7231.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 I.7.ii	For motor protection: Each relay set consists of following relays Motor protection all relay and 1 NO. VAJH 13 - 1 NO.	Set	7231.00
5.3 I.8	Dismantling the 6KV HT motor after disconnection of the starter and rotor cable after opening bolts and nuts, with the help of overhead crane stacking the motor on wooden sleeper, with proper safety and care.	job	2369.00
5.3 I.9	Checking the dismantled 6 KV HT 630 HP slipring motor for its stud & opening all insulation like glass tape, insulating packing etc. & changing the same with new washer & packing while assembling including completing the taping and re- varnishing. Checking also to be done for slip ring etc. and re-fitting the motor in its original position including connection and testing as per diretion of E.I.C.	job	6329.00
5.3 I.10	Dismantling and overhauling the drum controller starter by transferring the transformer oil in a suitable container, taking out all copper contacts, checking and adjusting all other contacts and cleaning properly by means of emery cloth, petrol or carbon tetrachloride and checking repairing other internal parts and wiring, re-fitting the same and re-filling the transformer oil after proper cleaning, after fixing of all contacts and renewing contacts and complete wiring (contacts will be supplied by the Department).	set	4739.00
5.3 I.11	Taking out the P.T. (33 KV/110V) (11 KV/110V) (6 KV/110V) (3.3 KV/110V) HT VCB Panel and thorough cleaning, washing the interior portion with carbon tetachloride after taking out the from P.T. housing and re-fitting the same after attaining the desired IR. valve and re-fitting, re-fixing the P.T. complete and testing and commisining as per direction of E.I.C	job	4041.00
5.3 I.12	Dismantling, repairing, overhauling & calibration of C.T.M.M. Motor protection relay on out going (6 kv. Motor) panel and re-fitting the same after completion including testing as per direction of E.I.C.	job	7836.00
5.3 I.13	Opening the transformer breather & refitting the same after changing the silica gel including supply of necessary gasket and silica gel.	job	1016.00
5.3 I.14	Servicing and overhauling 2500 / 1600 /1250/1000 Amps A.C.B. after withdrawing the breaker from its track, complete servicing the breaker, cleaning, moving and fixed contacts and adjustment incl.mechanical lever, greasing, oiling etc. and disconnection of the armoured cable and cleaning the surface with carbon tetra chloride, marking cloth, emery papers and applying of petrolium jelly etc. to the socket terminals and taping with PVC tapes and re-connection of the same as per direction of E.I.C.	job	6116.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 I.15	Servicing and overhauling of 400 Amps Fuse & Switch unit (SIEMENS Make) by opening and cleaning all the parts and mechanical operating assembly with carbon tetra chloride, markin cloth etc. lightening the cable connections, fitting and fixing the moving and fixed contacts etc. as per direction of E.I.C.	job	906.00
5.3 I.16	Complete overhauling of Sart-Delta Starter for 75 -100 H.P. Motor checking mechanical & electrical accessories including cleaning of all contacts by carbon tetra chloride and checking all incoming and outfoing connections.	Each	1323.00
5.3 I.17	Dismantling all the terminals of the motor control panel and checking all the sockets on both side of panel, starter and capacitor bank including tapping as required and re-connections of the motor starter terminals after servicing of the panel and complete testing as per direction of E.I.C.	job	1241.00
5.3 I.18	Servicing and overhauling the Automatic star delta starter for 120 -180 HP Motor after opening all components, electric Timer, bi-metal relay etc. & fitting fixing the same after same plate servicing and overhauling testing as required as per direction of EIC (Spares will be supplied by Deptt.) (Spares will be supplied by Deptt.)	Each	2399.00
5.3 I.19	Complete servicing and overhauling and necessary repairing of DTH 250 Amps MCCB (L&T Make).	Each	742.00
5.3 I.20	Supply and fitting fixing of Aluminium tubular bus connector and stainless steel nut bolts & washer 10mmx50mm of the following type including dismantling of demand connector.		
5.3 I.20.i	Cost of pad connector for 33 KV isolator.	Each	1349.00
5.3 I.20.ii	Cost of tee conector.	Each	1344.00
5.3 I.20.iii	Cost of tee conector of dog connector.	Each	1270.00
5.3 I.21	Supplying and fitting fixing of Dog ACSR conductor in 33 KV sub station including dismanting of damage conductor	Each	511.00
5.3 I.22	Supplying and fitting fixing of 35sqmm ACSR conductor at 33 KV substation for Earth shedding	Each	420.00
5.3 I.23	Supplying and fitting fixing of 33 KV post isolator including dismantling of damage isolator from 33 KV gang operator isolator and other isolators.	Each	1553.00
5.3 I.24	Supplying and fixing of 15/16 mm dia turn buckle in 33 KV sub/ station Earth shidding with champs Nut bolts washer	Each	930.00
5.3 I.25	Supply and installation of SANDAS / WBSEDCL approve Make, 33KV Class, outdoor, oil insulated,Live tank,Pole mounting type, 1-phase, 50 Hz, current transformer ratio 30/1-1 A, core-1 20VA Cl.-1.0, core-2-15VA, Cl- 5P15,S.T.R-25KA for 1.0 sec, BIL-70/170KV & as per ISS2705(PartII-III)	Each	46101.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 I.26	Supplying and installtion of 42 kv lightning Arrester(type Gapless zing oxdie lightning arrester with insulating base and surge monitor- DC904 ,model no:- 9L12BNH042, HSN CODE 85354010) station clean, heavy duty, out door, self supporting, Nominal discharge current 10KA,discharge class-III as per attached drawing and specification.	Each	35354.00
5.3 I.27	Supply, Installation,testing and commissioning of MICOM 220 Numerical Relay for Motor Protection Feeder. (Make-SCHNEIDER)	Each	94123.00
5.3 I.28	Dismantling, Servicing, cleaning, testing, re-fitting and calibration of the Each feeder consist of Relay type- 2nos over current relay and one no earth fault relay (CDG 31 - 1No., VAX 31 - 1No. And VAMP 31 - 1No) For 3.3 /6.6/11/33 KV panel.	Each	6736.00
5.3 I.29	Dismantling, Servicing, cleaning, testing, re-fitting and calibration of Each feeder consist of over curren -2ns, under voltage - 2nos, over voltage 2nos (VDG 13 - 2Nos., VDG 11 - 2Nos., VDG 14 - 1No. & VDG 31 - 1 No.)For 3.3 /6.6/11/33 KV Bus P.T. Feeder.	Each	7286.00
5.3 I.30	Dismantling, Servicing, cleaning, testing, re-fitting and calibration of the Each Capacitor Feeder consist of over curren -1nos, under voltage - 1nos, over voltage 1nos (CDG 61 , VAX 31 & VAGH 13) For 3.3 /6.6 KV Capacitor Feeder	Each	6516.00
5.3 I.31	Dismantling, Servicing, cleaning, testing, re-fitting and calibration of the Each Bus Coupler Feeder / incommer feeder consist of over curren -2nos, Earth fault - 1no, mater trip- 1no and trip supervission relay 1nos (CDG 31, VAX 31 & VAJH 13) For 3.3 /6.6 KV / 11 KV Feeder		5746.00
5.3 I.32	Dismantling, Servicing, cleaning, testing, re-fitting and calibration of the 2500 KVA - 33kv/3.65kv & 500 KVA - 33kv/0.433kv Transformer consist of over curren-2nos , Earth fault - 1no, differential relay under voltage relay-1no , Transformer protection relay -3nos, master trip relay - 1nos (CDG 61, VAJH 13 & VAA 11, VAX 31, CAG 14) . for Each trans former.	Each	10036.00

ELECTRICAL SECTION

SECTION - 5.3 J.

SERVICING AND MAINTENANCE OF HT/LT MOTORS

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3/J/A	LT MOTORS (Squirrelcage IM)		
5.3 J.1	Taking out the L.T. sq. cage Induction Motor after disconnections of supply terminal connections including earthing terminal connection, from coupling end of 25/50 cusec vertical axial flow propeller pump after dismantling the same from the motor stool . The motor is to be kept on wooden sleeper at a suitable distance from the floor without damaging the earthing strips and cables etc. as per direction of E.I.C	Job	1478.00
5.3 J.2	Preliminary checking of the whole motor (LT sq. cage IM) and testing of I.R. value, load currents, leakage factor of stator & rotor, terminal lead joints of stator connection ends, insulation of glass fibre terminal bar, double cage rotor end rings and all of motor bars and bar joints, housing of D.E. & NDE shield bearing housing etc. before work to detect fault.	Job	4204.00
5.3 J.3	Complete servicing and heat varnishing of 415Volt, 3 Phase L.T. sq. cage induction motor after cleaning the stator and heating it up periodically and varnishing by Dr. Beck's graded insulating varnish to obtain stable IR value, cleaning up the rotor, including heating for demoisturisation, lacker coating on the surface of rotor stampings, cleaning and RO priming on the end shield covers, bearing housing and complete the necessary repairing works as per direction of E.I.C.		
5.3 J.3.1	Upto 75KW LT sq. cage IM	Job	17257.00
5.3 J.3.2	Above 75KW upto 180KW LT sq. cage IM	Job	18053.00
5.3 J.4	Replacing and jointing of new 1.1KV grade 70 sq.mm. fibre glass copper wire terminals leads by 100% solder (Eyre) compounded with Eyre-7 paste, (6 leads).		
5.3 J.4.1	Upto 75KW LT sq. cage IM	Job	11062.00
5.3 J.4.2	Above 75KW upto 180KW LT sq. cage IM	Job	11504.00
5.3 J.5	Finishing the end of terminal leads by S & F dowells copper sockets properly supplying tapes, petrollium jelly etc. 6 nos.		
5.3 J.5.1	Upto 75KW LT sq. cage IM	Job	1770.00
5.3 J.5.2	Above 75KW upto 180KW LT sq. cage IM	Job	1770.00
5.3 J.6	Cost of mechanical work viz. shaft truness, checking key way looping of holes grinding and polishing etc.		
5.3 J.6.1	Upto 75KW LT sq. cage IM	Job	885.00
5.3 J.6.2	Above 75KW upto 180KW LT sq. cage IM	Job	885.00
5.3 J.7	S & F of 395 mm. × 25 mm. × 25 mm. glass fibre bar for L.T.Induction motor terminal with Class-H insulations (Each motor consists of 2 nos. of bars).	Job	3097.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 J.8	Refitting the pump motor (LT sq. cage IM) set with all its necessary coupling and accessories to its original position including fitting fixing with bearing housing non-reversable rachet unit and pump shaft with proper tollerance and clearance and reconnection of terminal points the overhauling work i.e. cleaning of contracts sliping etc. (all connection strips, cable end are to be refitted in proper way including good damages of strip terminals) and satisfactory 2 hours trial run of the pump as per direction of E.I.C. for all pumping stations.	Job	2301.00
5.3 J.9	Positioning the motor from vertical to horizontal state by OH crane and manual labourer. Dismantling the motor by opening DE NDE shield covers, coil guard and taking out rotor from stator. Properly cleaning of the rotor including withdrawals of deposited sulpher sludge moistures from all the end ring bar joints neatly. Brazing of the double cage rotor bars with end rings by high skilled mechanics with silver brazing artical using silver brazing flux. Neatly surfacing of the newly brazed laminated rotor surface and installing the bar joints with Dr. Beak's graded insulations.		
5.3 J.9.1	Upto 75KW LT sq. cage IM	Job	6549.00
5.3 J.9.2	Above 75KW upto 180KW LT sq. cage IM	Job	6549.00
5.3 J.10	Properly checking of the motor, testing of developed IR value, load current factor, terminal lead joints, terminal bar etc. necessary repairing works.	Job	4425.00
5.3/J/B	HT MOTORS (Squirrelcage IM)		
5.3 J.1	Taking out the 3.3 KV /6.6 KV sq. cage induction Motor from coupling end of 100/150 cusec vertical axial flow propeller pump after dismantling all connection including earthing etc. The motor is to be kept on wooden sleeper at a suitable distance from he floor without damaging the earthing strips and cables etc. as per direction of E.I.C.	Job	6050.00
5.3 J.2	Preliminary checking and testing of IR value, insulation leakage of startor, cracks of porcelinbushings, conn. Terminal leads, fibre glass terminal blocks and rotor end ring joints etc, before to detect the fault for 3.3 KV /6.6 KV sq. cage induction Motor	Job	11239.00
5.3 J.3	Disassembling the motor end and opening of end shield covers, stator coil guard, taking out the rotor from the stator and placing it on the proper arrangement by hoisting mechanism. Thoroughly cleaning of the stator coil insulations, motor bearings, rotor core surface and end ring joints to demoisturishing of the deposited carbon with carbon tetrachloride and heating the stator by silicon heating elemenys periodicaly at a required temperature and covered with terpulin for heat protection along with the arrangement of compressedf air to blow the vapour moisture and to develop its IR value and varnishing with Dr. Beck's graded CLASS-H varnish including jel epoxy coatying tyo prevent from the moisture.		
5.3 J.3.1	Upto 225KW squirrelcage Induction motor of voltage rating 3.3KV	Job	58142.00
5.3 J.3.2	Upto 475KW squirrelcage Induction motor of voltage rating 6.6KV	Job	68504.00

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 J.4	S & F of 4m. Length of 95 sq.mm. /3.3 KV/6.6 KV grade H.T. glass copper leads with end finishing by 95 sq.mm. heavy duty dowells copper lug at STAR conn. Terminal leads including replacement of glass fibre terminal block and SS bolts etc.	Job	16504.00
5.3 J.5	Reassembling the 3.3 KV /6.6 KV sq. cage induction Motor including placing the rotor into the stator, refixing the coil guard, prefixing the motor covers, terminal leads, terminal blocks, cable entry box, terminal box aftetr completion of repairing works.		
5.3 J.5.1	Upto 225KW squirrelcage Induction motor of voltage rating 3.3KV	Job	22544.00
5.3 J.5.2	Upto 475KW squirrelcage Induction motor of voltage rating 6.6KV	Job	33310.00
5.3 J.6	Refitting the pump motor (3.3 KV /6.6 KV sq. cage induction Motor) set with all its necessary coupling accessories to its original position including fitting fixing with bearing housing, non-reversable ratched unit and pump shaft with proper tolerance and clearance and reconnection of terminal points of the completion of necessary work and satisfactory 2 hours trial run of the pump as per direction of E.I.C.	Job	6991.00
5.3 J.7	Properly cheeking, testing of developed IR value of the motor, leakage factor of bushings, terminal shortings, IR value of G.F.blocks etc. after the necessary repairing works for 3.3 KV /6.6 KV sq. cage induction Motor	Job	11265.00
5.3 J.8	DRIVING END HOUSING Under cut of damaged DE side bearing housing portion, metal deposition on die under cut surface, machining, turning & polishing with proper tolerance according to the size of bearing outer. Work should be completed in all respects up to the satisfaction of E.I.C.	Job	18850.00
5.3 J.9	NON DRIVING END HOUSING Under cut of damaged N DE side bearing housing portion, metal deposition on the under cut surface, machining, turning & polishing with proper tolerance according to the size of bearing outer. Work should be completed in all respects up to the satisfaction of E, I.C.	Job	18850.00
5.3 J.10	DRIVING END SHAFT JOURNAL Under cut of damaged DE s ide bearing journal portion, metal deposition on the under cut surface, machining, turning & polishing with proper tolerance according to the size of bearing bore. Work should be completed in al| respects up to the satisfaction of E.I.C.	Job	19602.00
5.3 J.11	NON DRIVING END SHAFT JOURNAL Under cut of damaged DDE side hearing journal portion, metal deposition on the under cut surface, machining, turning & polishing with proper tolerance according to the size of bearing bore. Work shoul d be completed in all respects up to the satisfaction of E.1.C .	Job	19602.00
5.3 J.12	DYNAMIC BALANCING Trueness check ing & dynamic balancing of rotor. (Certificate is to be Pro vided to Authority)	Job	17920.00

ELECTRICAL SECTION

SECTION - 5.3 K.

SERVICING AND OVERHAULING OF 33KV SUB-STATION EQUIPMENTS

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 / K.1	Preliminary checking, testing and overhauling of 33 KV M.O.C.B. reassembling the loose components, greasing where necessary, removing all dust and cleaning woth carbon tetrachloride, painting where necessary including supplying and replacing petty spares, nuts, bolts, wire etc. as per direction of E.I.C.	Job	14829.00
5.3 / K.2	Preliminary checking, testing servicing and overhauling of 415V. 3200 amps Air Circuit Breaker (L&T Make) complete re-assembling the loose components, inter connection properly, checking all instruments including all wornout/missing spares, screws, nuts, bolts, wires etc. greasing where necessary as per direction of E.I.C.	Job	3586.00
5.3 / K.3	Preliminary checking, testing, servicing and overhauling of M.C.C.B. panel consisting of 13 nos. 200 amps M.C.C.B., 2 nos. 100 amps, M.C.C.B. re-assembling the loose components, making all interconnection, checking all instruments, including supplying all and replacing all wornout/missing petty spares, nuts, bolts etc. greasing and tapplings where necessary as per direction of E.I.C.	job	1098.00
5.3 / K.4	Servicing and overhauling the auto star- delta starter (Siemens Make) after opening all the components from its original position, checking the contractors, timer bi- metal relay etc. and fitting fixing the same in original position after completion of pverhauling, testing, heating the timer etc. as required at site as per direction of E.I.C.	set	1529.00
5.3 / K.5	Servicing and overhauling of 250 A, fuse switch unit (Siemens Make) opening, cleaning all the parts and mechanical operation assembly with C.T.C. marking cloths etc. hightening the cable connection, fitting the moving and fixed contact etc.	Each	717.00
5.3 / K.6	Servicing, overhauling and cleaning of following 33-KV outdoor equipments cleaning the carbonized of knife contact, fixed contact, oiling and greasing for smooth operation includng changing of petty spares, nuts, bolts springs etc.		
5.3 / K.6.1	33 - KV gang operated isolator.	Set	2648.00
5.3 / K.6.2	33-KV drop out fuse.	set	2648.00
5.3 / K.7	Servicing and cleaning of 33-KV outdoor sub-stations aluminium high level bus and low level bus cleaning all post insulator, after opening from support clamps, cleaning of petty spares like Ampere tape, nuts, bolts, spring etc. refixing the same after greasing as per direction of E.I.C.	Job	7149.00
5.3 / K.8	Making necessary arrangement to improve insulation resistance of 3 phase induction motor (100 h.p) upto the value satisfying I.F rules & relevant I.S. code disengaging from pump including testing, checking insulation by approprite Megger & re-engagement the motor with pump & complete the job as per direction of E.I.C	Job	4912.00

ELECTRICAL SECTION

SECTION - 5.3 L.

LED GLOW SIGN BOARD

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 L.1	Supply and installation of Polyvinylidene Fluoride coated Aluminium Composite Panel board (3mm) of Aludecor / Alstone size (as per drawing)to be made such a manner that it can be opened towards up direction for taking maintenance.	Sq. ft	186.00
5.3 L.2	S&F of Acrylic letter scripted in English/Bengali. size and matter of letter as per approved drawing by EIC, front side of the letter to be made 6mm thick imported (White- 0.40) uv stabilized excellent to self display. Make- Acast, Mitsubishi, all letter will be raised minimum 2" to be fixed by special type of solution. (total sqm of Each letter is to be measused based on its front surface area)	Sq. m	11488.00
5.3 L.3	S&F LED lamp incl. best quality LED lighting arrangement to be fixed by proper arrangement with complete connection. (1 module contain 3 nos LED, 0.5 W Each)	module	53.00
5.3 L.4	S&F Water proof power supply system IP65, output volatge : 12V/24V DC, 50/60Hz frequency, 108 to 305 VAC power supply, >.95 power factor for LED lamp. (Make : Meanwell)	Each	
5.3 L.4.1	75 Watt, Model ELG 75	Each	3408.00
5.3 L.4.2	100 Watt, Model ELG 100	Each	4087.00
5.3 L.4.3	150 Watt, Model ELG 150	Each	4693.00
5.3 L.4.4	200 Watt, Model ELG 200	Each	5014.00
5.3 L.4.5	240 Watt, Model ELG 240	Each	5840.00
5.3 L.4.6	300 Watt, Model ELG 300	Each	7035.00
5.3 L.5	26 Gauge Galvanized iron sheet for back panel with one coating of white paint, Make - Aarti / Bansal / Jindal	Sq. ft	127.00

ELECTRICAL SECTION

SECTION - 5.3 M.

OFFICE COMPATIBLE EPABX SYSTEM

Item No.	Description of Items	Unit	Rate (in Rs.)
5.3 M.1	Supply and installation of SYNTEL make EPABX SYSTEM model no : 4S (4+0+16) with LCC16 W/O CPU, configuration: 4CO+0D+16E	Set	26687.00
5.3 M.2	Supply and installation of SYNTEL make EPABX SYSTEM model no : GSM4S (2+0+8) with 2PGSM & LCC8, configuration: GSM 4 + 8 AE	Set	40525.00
5.3 M.3	Supply and installation of SYNTEL make EPABX SYSTEM model no : GSM6S (0+0+16) with PRI with 4P GSM & LCC 16 W/O CPU, configuration: 4 GSM +16E + PRI	Set	59679.00
5.3 M.4	Supply and installation of 2W CPU with KTS Card, Make : SYNTEL	Set	10066.00
5.3 M.5	Supply and installation of KTS 24 (4 Wire), Make : SYNTEL	Set	9205.00
5.3 M.6	Supply of Beetel Telephone set, Model no : C11	Set	672.00
5.3 M.7	Supply of Beetel Telephone set, Model no : M56 (CLI/ Two Way Speaker)	Set	1223.00
5.3 M.8	Supply of Beetel Telephone set, Model no : B77, (Telewin Basic)	Set	3549.00
5.3 M.9	Supply of Beetel Telephone set, Model no : M78 (Telewin Speaker CLI)	Set	4450.00
5.3 M.10	Supplying of polythelene insulated solid annealed 1 pair zelli filled Telephone cable	Set	10.00
5.3 M.11	Supplying of polythelene insulated solid annealed 5 pair zelli filled Telephone cable	Set	40.00
5.3 M.12	Supplying of polythelene insulated solid annealed 10 pair zelli filled Telephone cable	Set	78.00
5.3 M.13	Supplying of Beetel make coil cord	Set	34.00
5.3 M.14	Supplying of beetel make M78/ B77 coil cord	Set	51.00
5.3 M.15	Supplying of Beetel make M78/B77 Rossette Box	Set	60.00

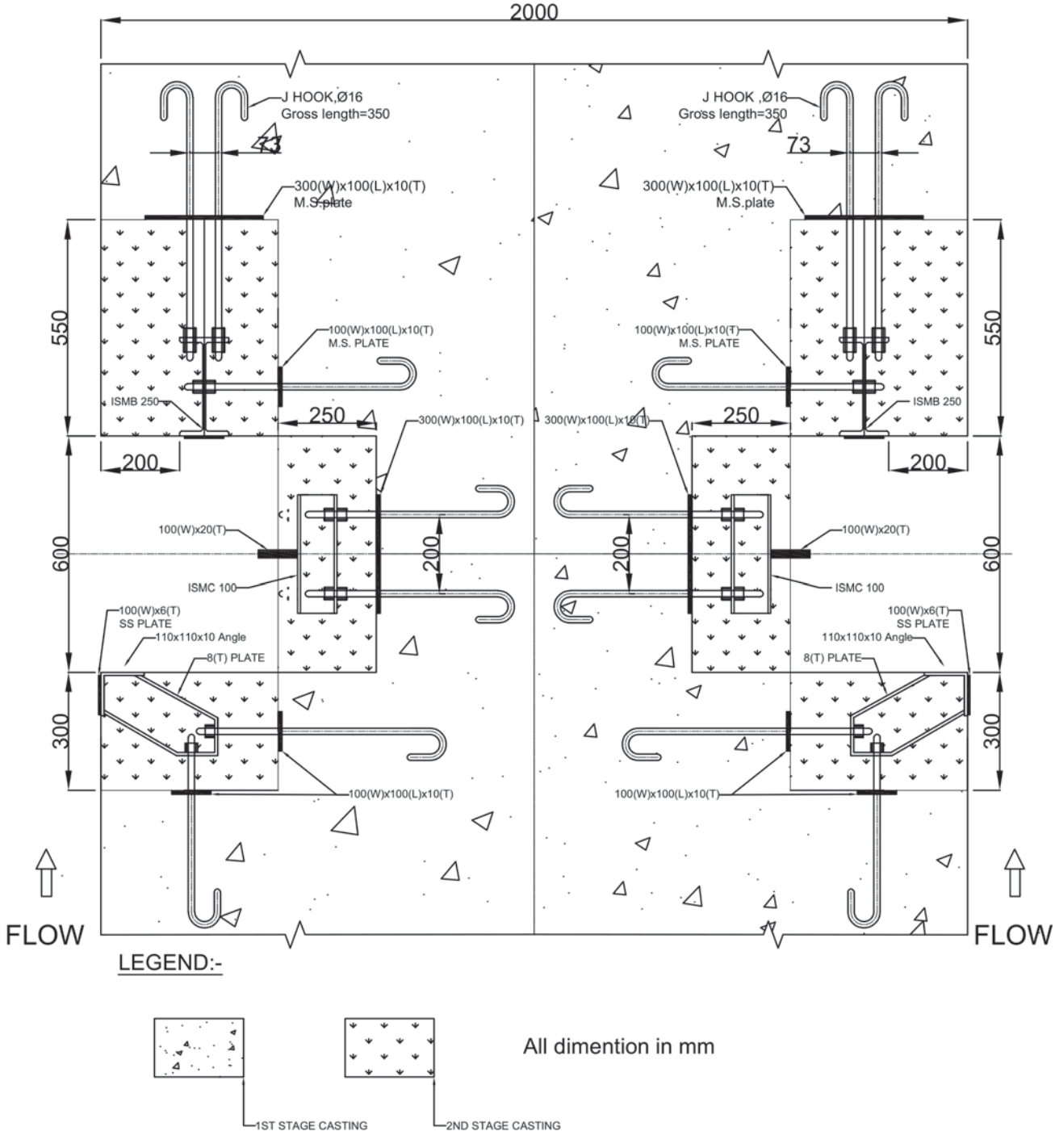
Chapter : 5.4
SUPPLY OF PORTABLE PUMPS

Sl. No.	Description of Items	Unit	Rate (Rs.)
5.4.1	Supply and Delivery at departmental Godown of trolley mounted self priming type, horizontal, single stage **disel engine driven** centrigugal pump set of power rating-12-14 H.P., suction & delivery size- 100mm x 100mm, operational speed-1500-1800 rpm, minimum discharge 35LPS at 12 mtr head, casing & impeller-CI, coupled with diesel engine along with common base frame, coupling etc as per specification and as per direction of EIC.	Each	356555.00
5.4.2	Supply and Delivery at departmental Godown of self priming type, horizontal, single stage **electric motor driven** centrigugal pump set of power rating-12-14 H.P., suction & delivery size- 100mm x 100mm, operational speed-1500 rpm, minimum discharge 35LPS at 12 mtr head, casing & impeller- CI, coupled with electric motor along with common base frame, coupling etc as per specification and as per direction of EIC.	Each	143472.00
5.4.3	Supply & fixing of accessories comprising of 1 Roll(15 Mtr) 4" Suction super quality pipe, 15 Mtr 4" canvas heavy delivery pipe, 1 no 4" heavy duty GI bend, 2 nos GI tail pieces(out), 1 no CI tail pieces(In), 3 nos clamps, 1 no 4"Ø CI foot valve.	Set	19820.00
5.4.4	Supply and Delivery at departmental Godown of self priming type, horizontal, single stage **electric motor driven** centrigugal pump set of power rating-20 H.P., suction & delivery size- 150mm x 150mm, operational speed-1500 rpm, minimum discharge 60 LPS at 12 mtr head, casing & impeller- CI, coupled with electric motor along with base plate, coupling etc as per detailed specification and as per direction of EIC.	Each	215667.00
5.4.5	Supply and Delivery at departmental Godown of trolley mounted self priming type, horizontal, single stage **disel engine driven** centrigugal pump set of power rating-24-27 H.P., suction & delivery size-150mm x 150mm, operational speed-1500-1800 rpm, minimum discharge 70 LPS at 12 mtr head, casing & impeller-CI, coupled with diesel engine along with common base frame, coupling etc as per specification and as per direction of EIC.	Each	713677.00
5.4.6	Supply and Delivery at departmental Godown of self priming type, horizontal, single stage **electric motor driven** centrigugal pump set of power rating-24-27 H.P., suction & delivery size- 150mm x 150mm, operational speed-1500 rpm , minimum discharge 70 LPS at 12 mtr head, casing & impeller-CI, coupled with electric motor along with common base frame, coupling etc as per specification and as per direction of EIC.	each	267059.00
5.4.7	Supply & fixing of accessories comprising of 1 Roll(15 Mtr) 6" Suction super quality pipe, 15 Mtr 6" canvas heavy delivery pipe, 1 no 6" heavy duty GI bend, 2 nos GI tail pieces(out), 1 no CI tail pieces(In), 3 nos clamps, 1 no 6" CI foot valve.	per Job	38735.00

ANNEXURE - I

Drg. No. : USOR/EP/01/01/(03)

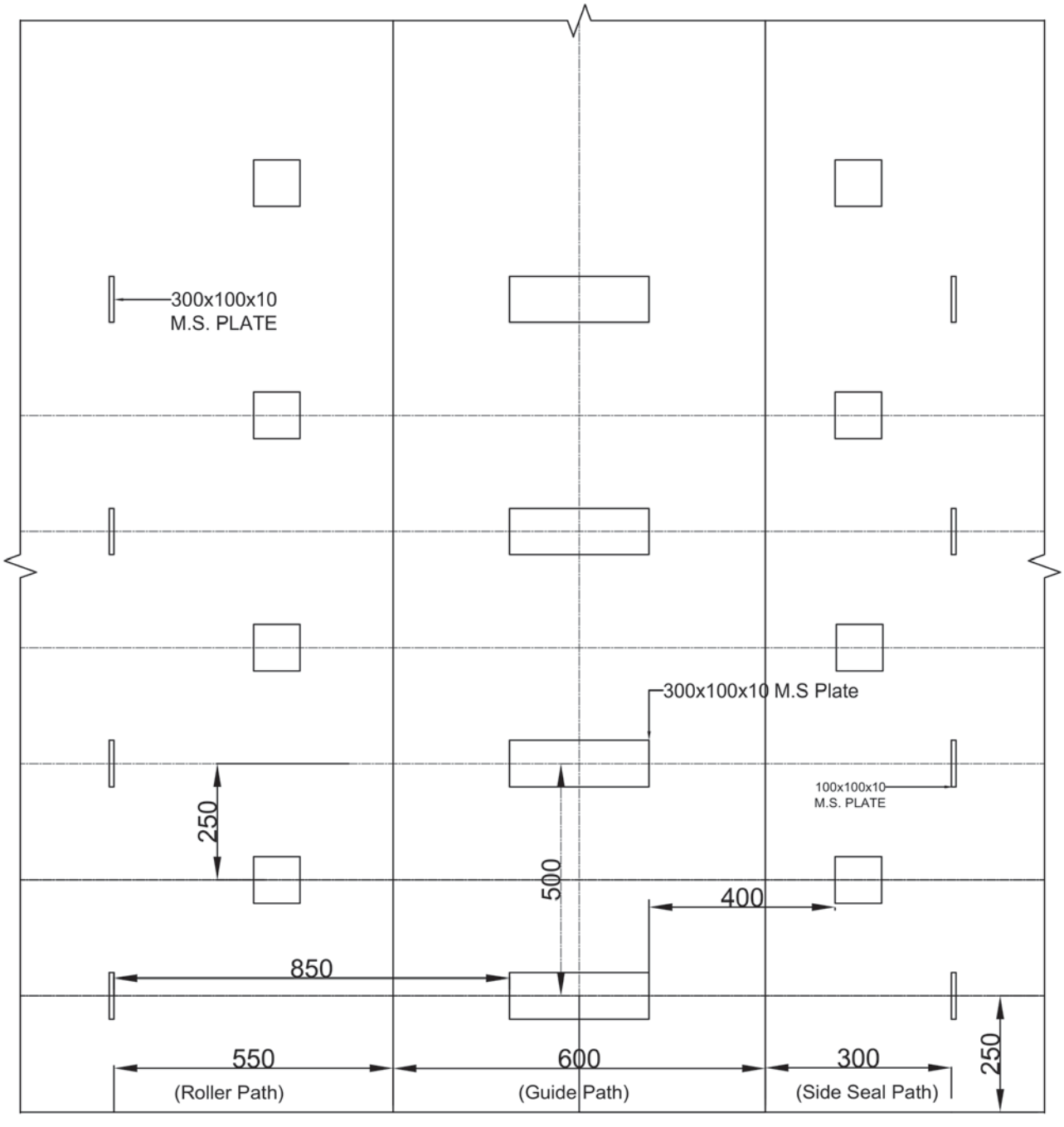
Model Block out Diagram at plan for fixing Embedded parts on pier (Roller Path,Side Seal Path, Guide Path) for vertical Gate of Dam /Barrage of Size (width) above 2m upto 10m.



ANNEXURE - I

Drg. No. : USOR/EP/01/02/(03)

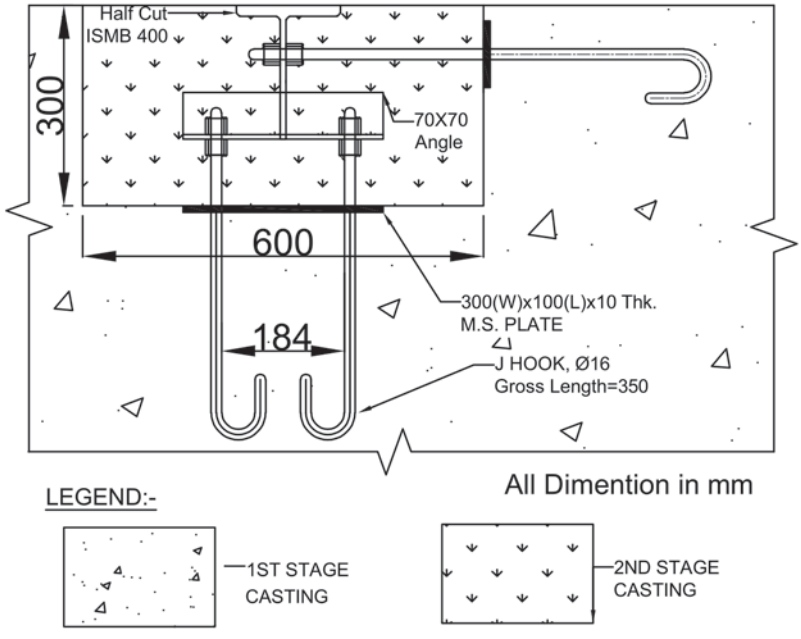
Model Layout of insert plate at elevation on pier Gate size (Width) above 2M to 10M.



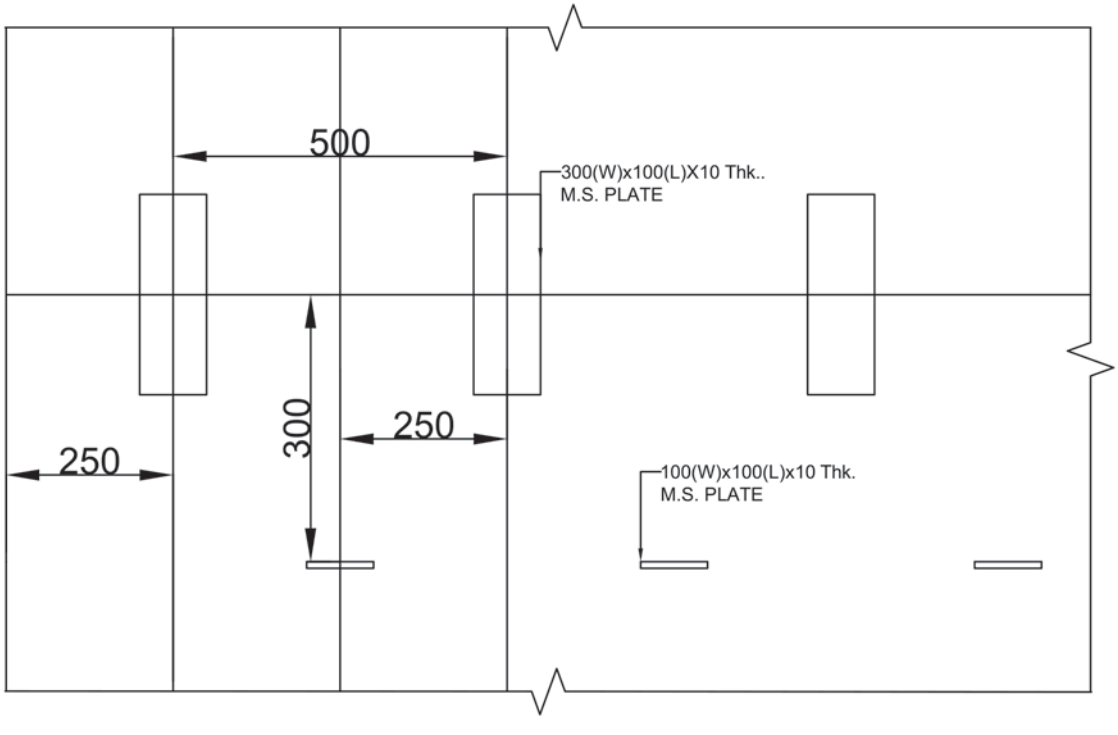
ANNEXURE - I

Drg. No. : USOR/EP/01/03/(03)

Model Block out Diagram at elevation for bottom seal beam for vertical/ Radial Gate of Dam / Barrage upto size(W) above 2m to10m.



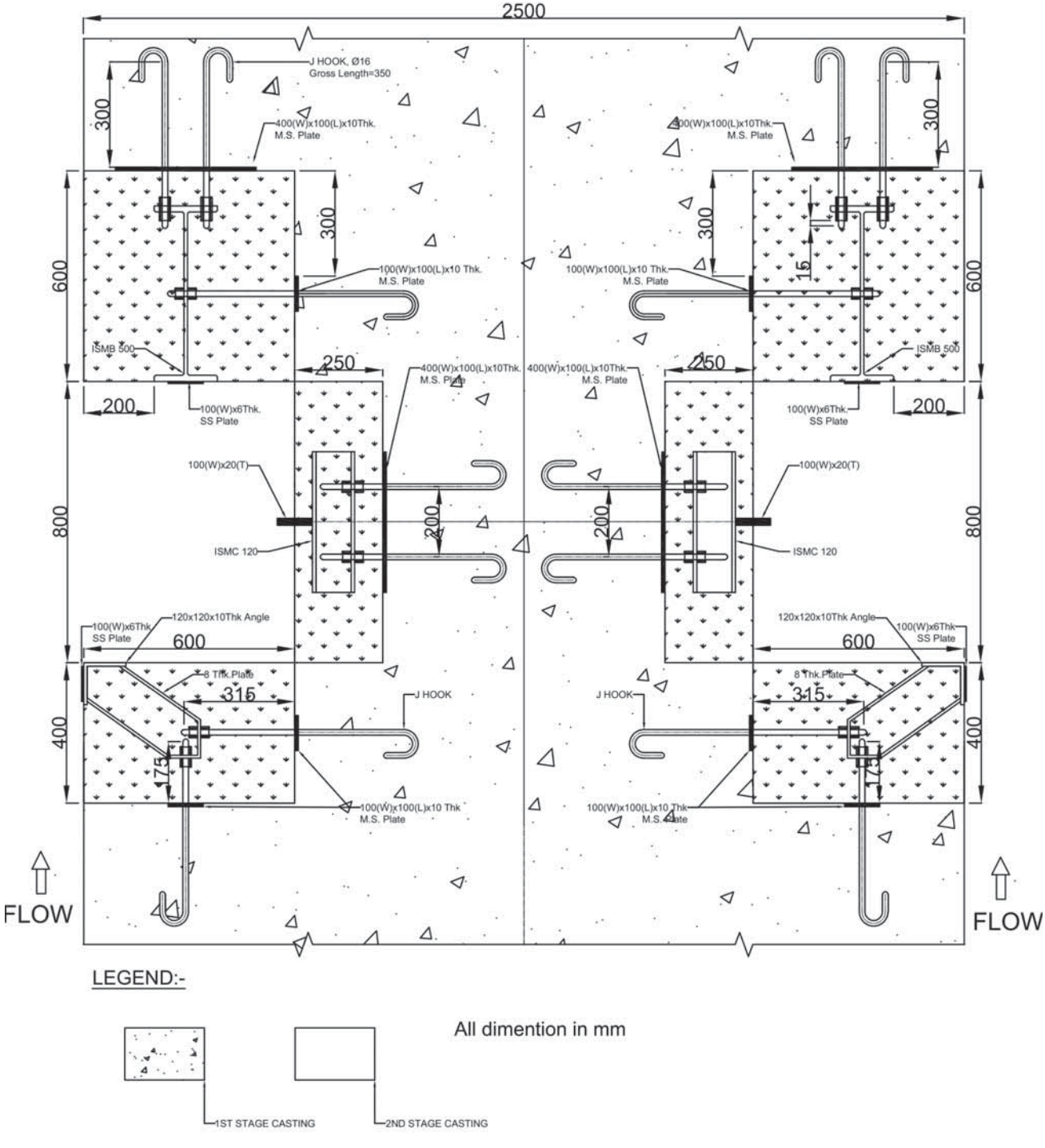
Model Layout of insert plate at Plan on Weir top.Gate size (Width) above 2M to 10M



ANNEXURE - I

Drg. No. : USOR/EP/02/01/(03)

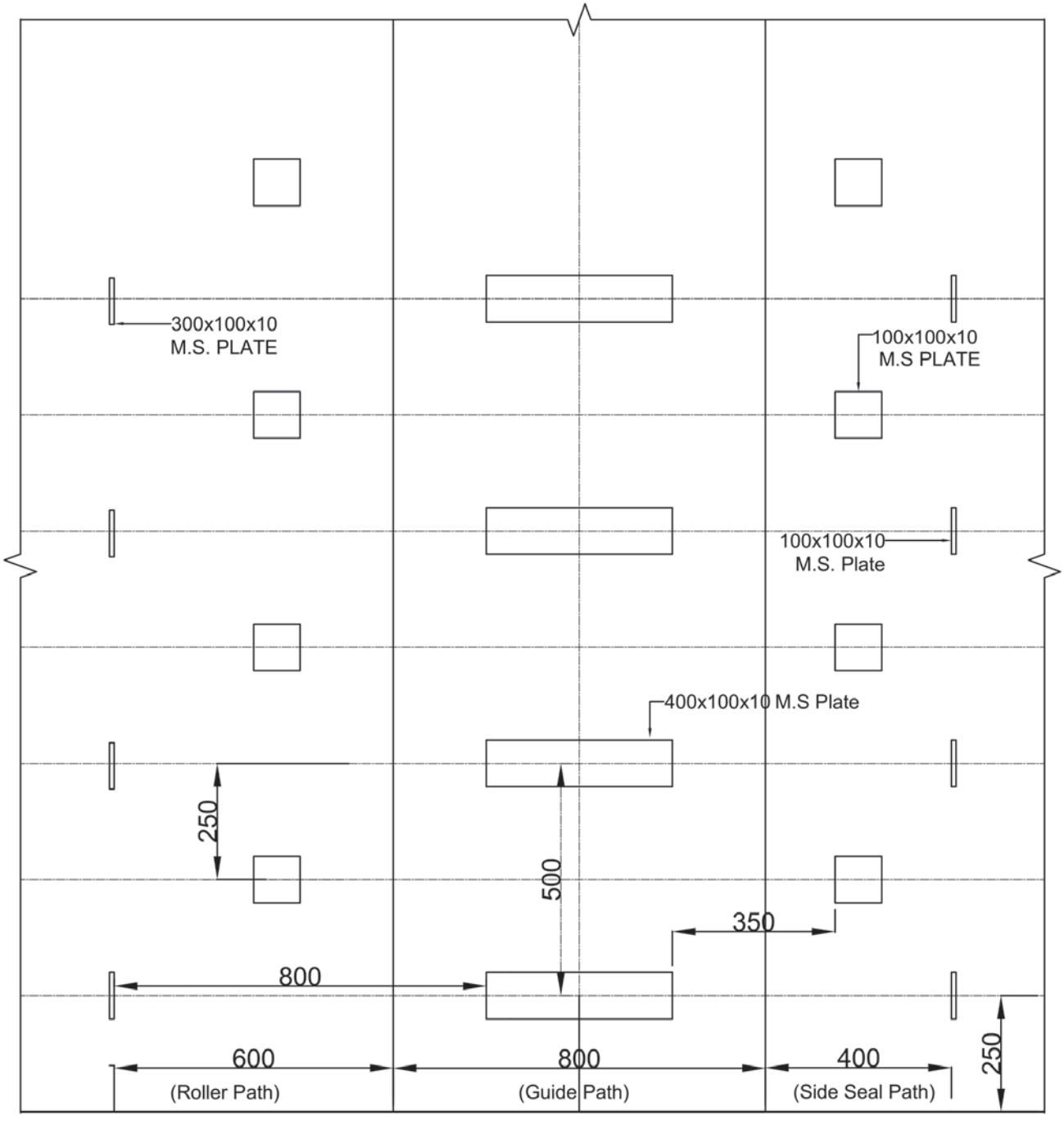
Model Block out Diagram at plan for fixing Embedded parts on pier (Roller Path, Side Seal Path,Guide Path) for vertical Gate of Dam /Barrage of Size (width) above 10m upto 20m.



ANNEXURE - I

Drg. No. : USOR/EP/02/02/(03)

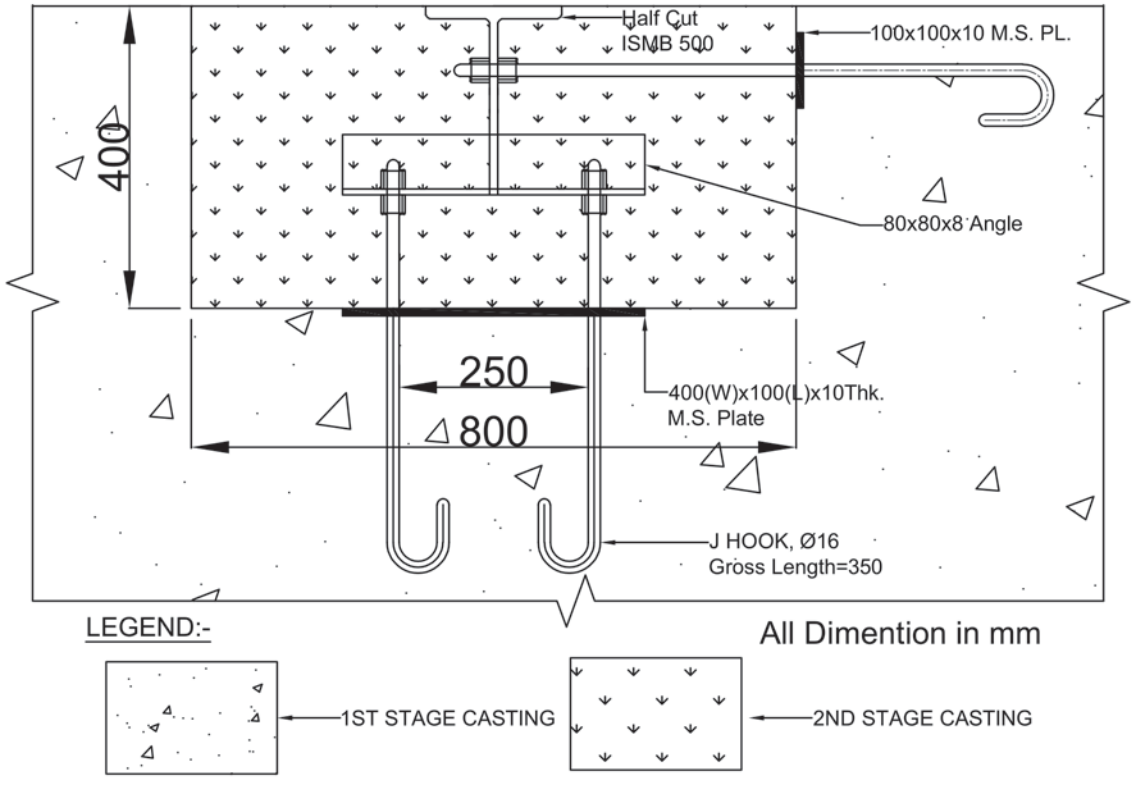
Model Layout of insert plate at elevation on pier Gate size (Width) above 10M to 20M



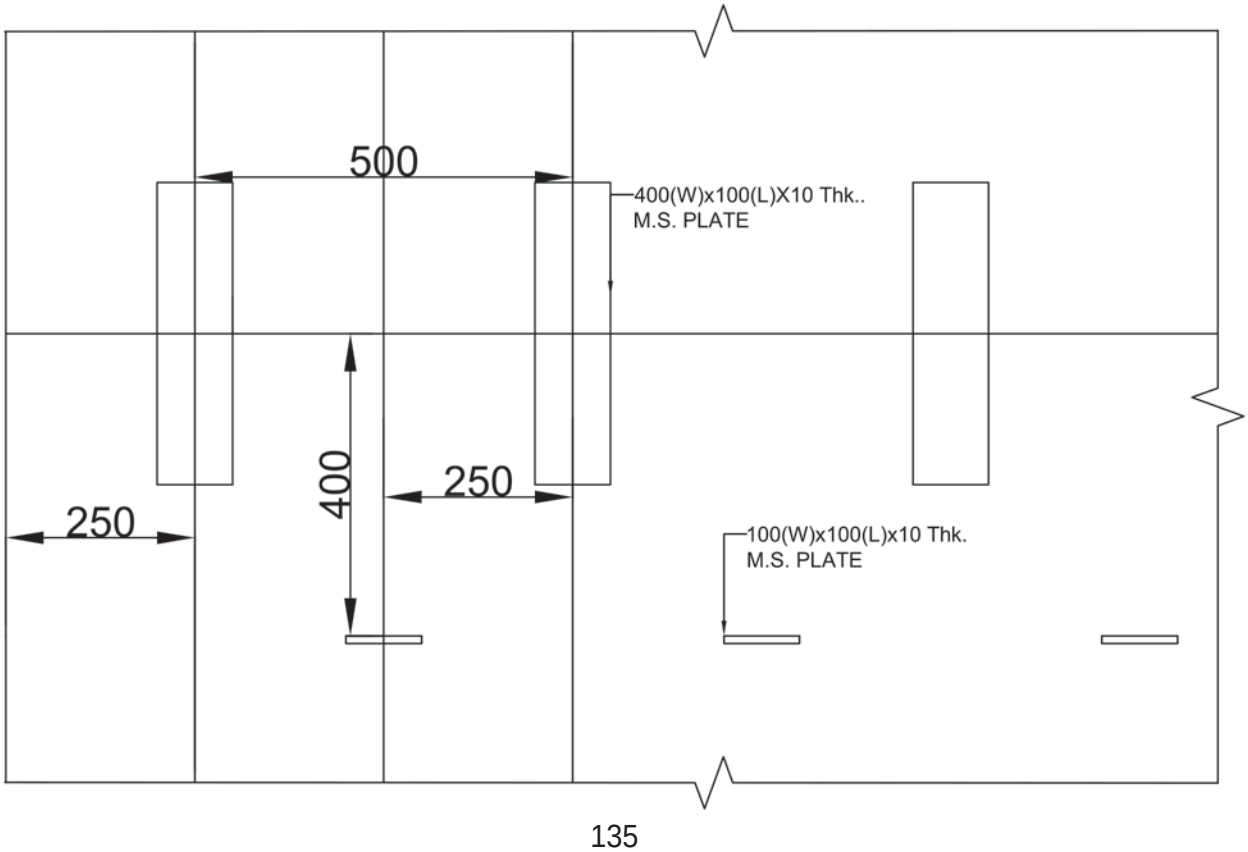
ANNEXURE - I

Drg. No. : USOR/EP/02/03/(03)

Model Block out Diagram at elevation for bottom seal beam for vertical / Radial Gate of Dam / Barrage upto size(W) above 10m to 20m.



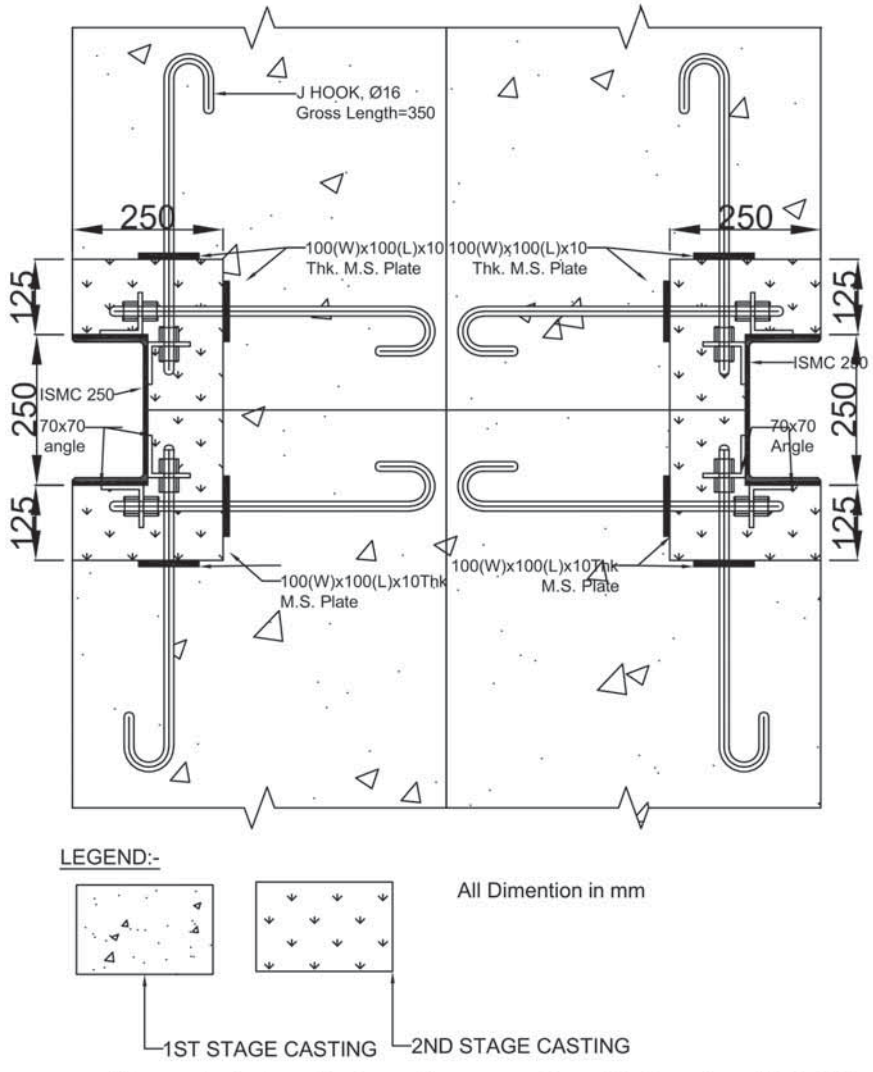
Model Layout of insert plate at Plan on Weir top.Gate size (Width) above 10M to 20M



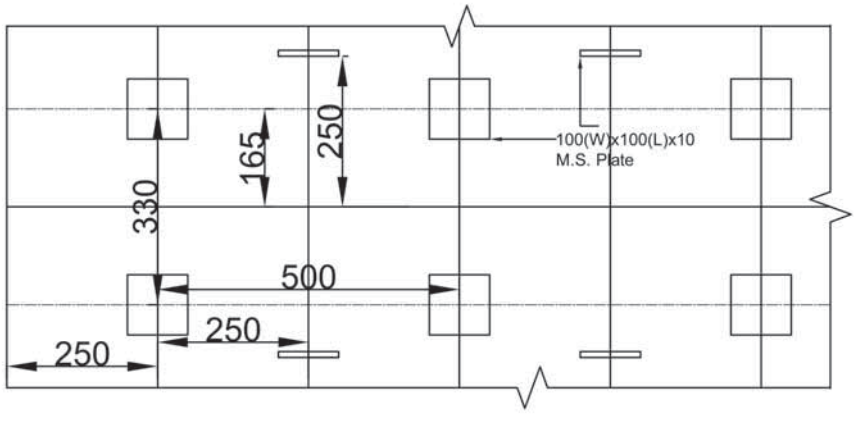
ANNEXURE - I

Drg. No. : USOR/EP/03/01/(03)

Model Block out Diagram at plan for fixing embedded parts on pier for vertical Head regulator (fixed wheel type) Gate of Barrage/Main canal etc. upto size(W)=2M



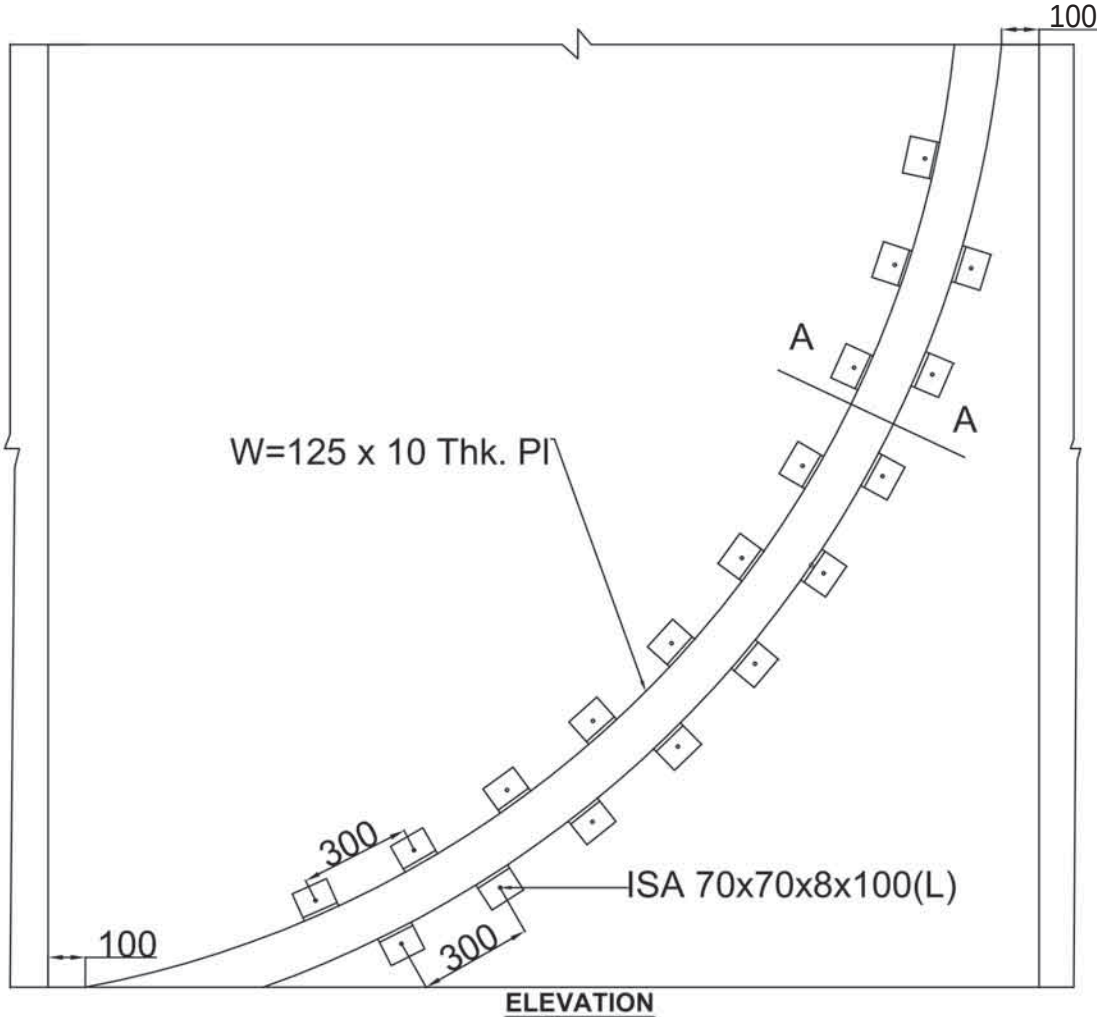
Model Layout of insert plate at elevation on pier. Gate size (Width) upto 2m



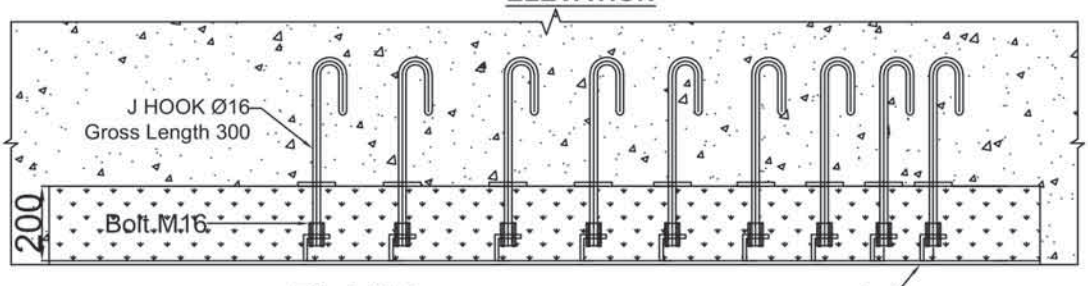
ANNEXURE - I

Drg. No. : USOR/EM/4/1/(1)

Block out Details of side seal path of radial gates

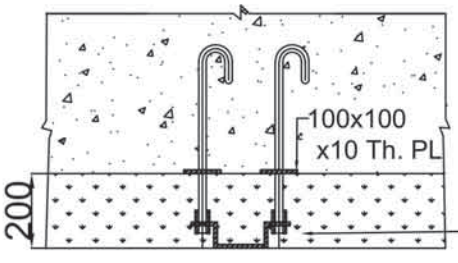


ELEVATION



PLAN (ALL J- HOOK & INSERT PLATE NOT SHOWN)

125X10 Th. Pl.



LEGEND:-

1ST STAGE CASTING

2ND STAGE CASTING

All Dimention in mm

Section A-A

N.B: Block out for Guide path shall as like as side seal path and its concentric & smaller radius

Annexture-II

Some Technical features on Barrage Gates & Drainage and storm water Pumps

A) Hoist Mechanism of Gates :

General :

Hoist are provided for operation of gates, which are used to regulate flow of water from reservoir or Dam for the purpose of flood control, irrigation, power generation etc.

Depending upon the hoist capacity and operating conditions mainly two different types of hoists are used.

1) Rope drum or chain sprocket hoist.
2) Screw type hoist.

1) Rope drum or chain sprocket hoist :

This is most common type of hoist used for gates of barrage and dam because it enables to operate wide gate being suspended at the two ends, with a common driving unit at the centre ends. This type of hoist is also used for sluice and penstock gates, when there are of self closing type and there is no huge vibration of the gate. Vibration of the gate decrease the life of rope. These can be operated either manually or electrically depending upon hoist capacity, period taken for opening and closing the gate and other operating conditions.

In case of electrically operated gates, the gates can be operated not only more quickly than manually operated gates but also additional electrical and electronic gadgets can be possible to be incorporated in operating mechanism of the gates to facilitate to operate the gates from remote location. Gate position & corresponding water discharge from reservoir or dam can also be visualized in computer screen at flood control centers using sensor and decoder.

In extreme danger flood situation and in extreme adverse climatic condition when it becomes very difficult for operators to reach operating platform i.e. hoist bridge of barrage gates, auto-operation system of the gates from a nearby control room can be made possible to be started.

Opening and closing position of gates as well as corresponding discharge of water from reservoir and dam can be visualized in computer screens at flood control centers which will help in monitoring the gate operation more effectively.

2) Screw-lift hoist :

This type of hoist is used when positive thrust is required to close the gate, though efficiency of this hoist is low. This can be used for high-head gates provided the gate does not vibrate. Vibration may damage teeth of screw-rod. As the gates are being lifted in such type of hoisting system through single point suspension, this method of lifting of gates applied generally in small gate or narrow ones like sluice gates.

In small capacity of gates, gates are operated manually and in high capacity of gates electrical operation should be applied.

Brief description of Rope Drum Hoist:

1) General:

Two drums are installed in hoist bridge at two suspension point of the gate and gate is connected to the drum through wire-ropes. If the capacity is very low, one rope may be provided for each side. A turn- buckle is provided on one side to adjust the lengths of the rope to equalize the tension in ropes on two sides. If the capacity of hoist is not low, a pair of ropes is provided in each side.

The drums are coupled to an end reduction unit, housing the sets of gear-pinion.

Drum shaft may be fixed or rotating. In case of fixed shaft, bronze bushings are used at the two ends of the drum so that it rotates freely on the shaft. In case of rotating shaft, the drum is keyed to the shaft, which is supported on roller or ball bearings at the two ends. The gears are lubricated by grease or oil bath.

The gear unit is connected to the worm reducer through a shaft and worm reducer is coupled with electric motor which is connected with electromagnetic brake through brake-drum. One end of motor shaft will be connected to manual operation mechanism through a clutch. Electromagnetic brake will then free provided with hand release.

Dial indicator is provided for each gate to indicate gate position in lowering or hoisting.

Hoist limit switch or proximity switch is provided for automating stopping of the hoist mechanism when the gate is fully closed or open.

2) Capacity of Hoist :

To deter mine the capacity of hoist all forces acting to the gate are to be considered.

Following forces mainly act on the gate :-

i) Gates own weight,

ii) Wheel friction: This consists of rolling friction of wheel or track and also the friction at the bearing for the axle.

Wheel friction F = It is the combination of rolling friction of wheel or track and also the friction at the bearing for the axle.

$$\text{Wheel Friction } F = \frac{\text{Water Pr against gate}}{\text{Radius of gate}} \times (\mu_R + \mu_A \times \text{Radius of axle})$$

Where, μ_R = co-efficient of rolling friction & μ_A = co-efficient of axle friction.

iii) Seal friction : This is common for all types of gates and is caused by sliding seals on seal seat

Seal friction = Water load on seal × Co-efficient of seal friction.

Co-efficient. of friction = 1.2 for rubber on steel.
& 0.6 for bronze on steel.

Capacity of Hoist = 1.2 (Gates own wt. + wheel friction + seal friction)

(20% reserve capacity may be considered as a safety factor)

3) Selection of rope :

One of the most suitable type of rope is of 6 x 37 construction. Flexibility of rope of this construction increases its life. Improve plow steel ropes are preferred because these have higher breaking strength as compared to ,mild plow steel ropes. Ropes are to be selected for 60% of the hoist capacity, as it is assumed load will be shared by two sides at 40% & 60% Gears shall also be designed for the load of 60%.

4) Rope Drum :

A value of (20 × rope dia) is found suitable as Drum Dia.

Drum can be of cast iron or can be fabricated from structural steel. Cast iron is cheaper & preferable. Drum is designed to resist crushing as well as to be enough strong to resist bending.

To design rope drum combined stress for crushing and bending to be considered.

The combined stress should not exceed 6000 psi and bending stress should not exceed 3000 psi for ordinary cast iron.

Number of grooves required depend on lift of the gate. In addition to the turns provided for lift, 2 more grooves are provided to reduce the tension on the rope where clamped to the drum. Dia of grooves in drums should be slightly larger the rope dia to avoid pinching and binding of strands and to permit the rope to adjust itself to the radius of curvature.

5) Lifting Speed :

Lifting speed may be taken between 0.3 mt. to 0.5 mt. per minute for electrically operated gates.

High starting torque duty squirrel cage induction motor generally used.

$$\text{Horse power of motor} = \frac{\text{Hoist load(in kg.)} \times \text{lifting speed (in mt.)}}{4500 \times \text{overall efficiency}}$$

Overall efficiency generally comes as 45% to 55%.

6) Reducer :

After knowing drum r.p.m. from lifting speed of the gate and knowing the speed of the motor total reduction required may be worked out. This reduction can be obtained either by gears or worm reducer and gears combined to gather. The gears can be designed by Lewis formula and their sizes are selected to give an economical design.

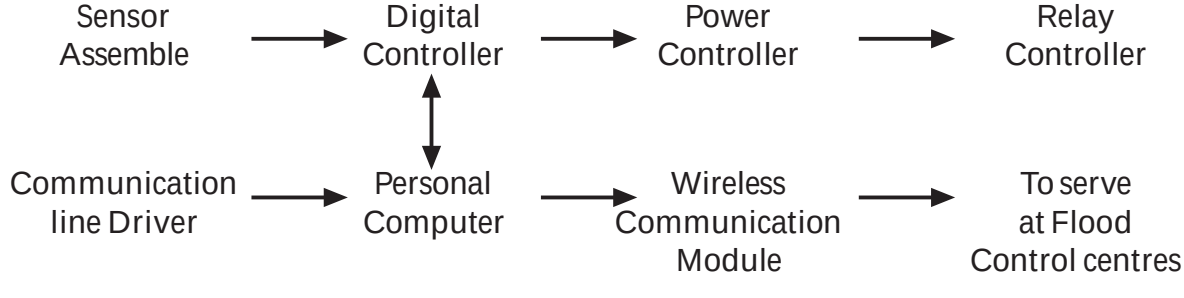
$$\text{Lewis Formula : } s = \frac{LP}{FY}$$

Where, S = Stress in ton/Sq. inch.
L = Load on tooth in tons.
P = Diametral pitch
F = Face width in inches.
Y = Strength factor.

7) Shaft :

The shafts are to be designed according to type and load coming on it. The shafts may be in simple bending, pure torsion or under combined influence of bending and torsion. The stresses shall not exceed the permissible limits of shear or tensile under equivalent bending and equivalent twisting moments.

8) Remote monitoring and control of gates using sensor, decoder & P.C.:



The sensor assembly is connected to gate drive mechanism. The digital controller decodes gate position data from sensor and sends it to the control P.C. in barrage office through communication cable. Head quarters in Kolkata is connected to Barrage Office through wireless communication using GSM network. Gate data of control P.C. is also uploaded to the web server.

Digital controller also drives the power controller, which generates necessary signals to drive the relay contractors for gate movement.

B) Drainage & Storm Water pumps :

1) General :

Axial or mixed flow vertical type wet. Pit pumps are extensively used in disposing the drainage and storm water after accumulation in inlet pond or sump.

This type of pump is low head pumps and most pumping in drainage and irrigation is low head.

2) Selection of number of pumps :

Number of pumps in a pumping station are being selected in such a way that in normal rainfall condition or in disposing sewerage water during non-monsoon period. Pumping Station can be utilized effectively operating minimum number of pumps and thus operating cost can be minimized. Stand by unit is generally provided for un-interrupted operation of pumping station in full capacity even a pump becomes out of service for maintenance.

3) Head of the Pumps :

It is algebraic difference of total discharge head and total suction head. In drainage pumps total suction head can easily be determined but this is not the case of total discharge head. The losses in the discharge system are to be determined.

4) Standard codes for pumps :

i) For specification pumps - vertical turbine and mixed flow pump - IS 1710 :1989 (Reaffirmed 1994)

ii) For technical requirement for rotodynamic pumps - IS 5120.

iii) For intake design for vertical turbine pumps

a) Hydraulic Institute/ANSI

b) IS Code : 15310 - 2003.

5) **Motor :** Induction motors are used as a prime-movers.

6) **Selection of Horse power of pumps :**

$$H.P = \frac{\eta WQH}{75\eta}$$

W = Wt. of water in kg./cu.mt. = 1000, η = Efficiency of pump set.

Q = Pump discharge in cu. mec., H = total dynamic head in Mt.

In addition 20% may be kept as reserve capacity

TABLE -I

Materials components for construction of gates :

Sl. No:	Component parts	Recommended materials	Ref. to IS Code
1	Gate leaf	a) Cast Iron b) Structural Steel c) Cast Steel	IS 210 : 1993 IS 226 : 1975 IS 2062 : 1999 IS 8500 : 1991 IS 1030 : 1998
2	Gate frame	a) Cast Iron b) Structural Steel	IS 210 : 1993 IS 226 : 1975 IS 2062 : 1999 IS 8500 : 1991
3	Seal Plate/Seals	a) Bronze b) Brass c) Stainless Steel d) Rubber	IS 306 : 1968 IS 318 : 1962 IS 1458 : 1965 IS 291 : 1977 IS 1570 : 1985 IS 6911 : 1972 IS 4622 (Appendix B) IS 11855 : 1986
4	Seal Seats/Bearing Plate	a) Bronze b) Brass c) Steel d) Cast Iron e) Stain steel or stain steel clad plate.	IS 306 : 1968 IS 318 : 1962 IS 1458 : 1958 IS 291 : 1977 IS 226 : 1975 IS 2062 : 1999 IS 8500 : 1991 IS 210 : 1993 IS 1570 : 1985 IS 6911 : 1972
5	Guides	a) Structural Steel b) Corrosion resistance Steel	IS 226 : 1975 IS 2062 : 1999 IS 8500 : 1991 IS 6603 : 1972

TABLE -II

Unit weight & properties of Hot-Rolled Steel Sections

ISA - HOT-ROLLED STEEL EQUAL ANGLES

Description	Size (mm × mm)	Thickness (mm)	Weight per metre (in kg.)	$I_x = I_y$ ($Cm.^4$)	I_u (Max.) ($Cm.^4$)	I_v (Min.) ($Cm.^4$)
ISA 2020	20 × 20	3 4	0.9 1.1	0.4 0.5	0.6 0.8	0.2 0.2
ISA 2525	25 × 25	3 4 5	1.1 1.4 1.8	0.8 1.0 1.2	1.2 1.6 1.8	0.3 0.4 0.5
ISA 3030	30 × 30	3 4 5	1.4 1.8 2.1	1.4 1.8 2.1	2.2 2.8 3.4	0.6 0.7 0.9

Description	Size (mm × mm)	Thickness (mm)	Weight per metre (in kg.)	$I_x = I_y$ ($Cm.^4$)	I_u (Max.) ($Cm.^4$)	I_v (Min.) ($Cm.^4$)
ISA 3535	35 × 35	3	1.6	2.3	3.6	0.9
		4	2.1	2.9	4.7	1.2
		5	2.6	3.5	5.6	1.5
		6	3.0	4.1	6.5	1.7
ISA 4040	40 × 40	3	1.8	3.4	5.5	1.4
		4	2.4	4.5	7.1	1.8
		5	3.0	5.4	8.6	2.2
		6	3.5	6.3	10.0	2.6
ISA 4545	45 × 45	3	2.1	5.0	8.0	2.0
		4	2.7	6.5	10.4	2.6
		5	3.4	7.9	12.6	3.2
		6	4.0	9.2	14.6	3.8
ISA 5050	50 × 50	3	2.3	6.9	11.1	2.8
		4	3.0	9.1	14.5	3.6
		5	3.8	11.0	17.6	4.5
		6	4.5	12.9	20.6	5.3
		7	5.15	-	-	-
		8	5.82	-	-	-
ISA 5555	55 × 55	5	4.1	14.7	23.5	5.9
		6	4.9	17.3	27.5	7.0
		8	6.4	22.0	34.9	9.1
		10	7.9	26.3	41.5	11.2
ISA 6060	60 × 60	4	3.7	-	-	-
		5	4.5	19.2	30.6	7.7
		6	5.4	22.6	36.0	9.1
		8	7.0	29.0	46.0	11.9
		10	8.6	34.8	54.9	14.6
ISA 6565	65 × 65	5	4.9	24.7	39.4	9.9
		6	5.8	29.1	46.5	11.7
		8	7.7	37.4	59.5	15.3
		10	9.4	45.0	71.3	18.8
ISA 7070	70 × 70	5	5.3	31.1	49.8	12.5
		6	6.3	36.8	58.8	14.8
		7	7.38	-	-	-
		8	8.3	47.4	75.5	19.3
		10	10.2	57.2	90.7	23.7
ISA 7575	75 × 75	5	5.7	38.7	61.9	15.5
		6	6.8	45.7	73.1	18.4
		8	8.9	59.0	94.1	24.0
		10	11.0	71.4	113.0	29.4
ISA 8080	80 × 80	6	7.3	56.0	89.6	22.5
		8	9.6	72.5	116.0	29.4
		10	11.8	87.7	139.0	36.0
		12	14.0	102.0	161.0	42.4
ISA 9090	90 × 90	6	8.2	80.1	128.0	32.0
		8	10.8	104.0	166.0	42.0
		10	13.4	127.0	202.0	51.6
		12	15.8	148.0	235.0	60.9

Description	Size (mm × mm)	Thickness (mm)	Weight per metre (in kg.)	$I_x = I_y$ ($Cm.^4$)	I_u (Max.) ($Cm.^4$)	I_v (Min.) ($Cm.^4$)
ISA 100100	100 × 100	6 6.5 8 10 12 15	9.2 9.99 12.1 14.9 17.7 21.9	111.0 - 145.0 177.0 207.0 -	178.0 - 232.0 282.0 329.0 -	44.5 - 58.4 71.8 84.7 -
ISA 110110	110 × 110	8 10 12 16	13.4 16.6 19.7 25.7	197.0 240.0 281.0 357.0	313.0 381.0 446.0 560.0	81.0 98.9 116.0 150.0
ISA 120120	120 × 120	8 10 12 15	14.7 18.2 21.6 26.6	- - - -	- - - -	- - - -
ISA 130130	130 × 130	8 10 12 16	15.9 19.7 23.5 30.7	331.0 405.0 476.0 609.0	526.0 640.0 757.0 966.0	136.0 166.0 196.0 250.0
ISA 150150	150 × 150	10 12 15 16 18 20	22.9 27.3 33. 35.8 40.1 44.1	634.0 746.0 - 959.0 1160.0 -	1010.0 1190.0 - 1520.0 1830.0 -	260.0 306.0 - 395.0 481.0 -
ISA 180180	180 × 180	15 18 20	40.9 48.6 53.7	- - -	- - -	- - -
ISA 200200	200 × 200	12 16 20 24 25	36.9 48.5 60.0 71.1 73.9	1830.0 2370.0 2880.0 - 3470.0	2910.0 3760.0 4570.0 - 5500.0	747.0 968.0 1180.0 - 1440.0

TABLE -III

ISA - HOT-ROLLED STEEL UN-EQUAL ANGLES

Description	Size (mm x mm)	Thickness (mm)	Weight per metre (in kg.)
ISA 3020	30 × 20	3 4 5	1.1 1.4 1.8
ISA 4025	40 × 25	3 4 5 6	1.5 1.9 2.4 2.8
ISA 4530	45 × 30	3 4 5 6	1.7 2.2 2.8 3.3

Description	Size (mm x mm)	Thickness (mm)	Weight per metre (in kg.)
ISA 5030	50 × 50	3 4 5 6	1.8 2.4 3.0 3.5
ISA 6040	60 × 40	5 6 8	3.7 4.4 5.8
ISA 6545	65 × 45	5 6 8	4.1 4.9 6.4
ISA 7045	70 × 45	5 6 8 10	4.3 5.2 6.7 8.3
ISA 7550	75 × 50	5 6 8 10	4.7 5.6 7.4 9.0
ISA 8050	80 × 50	5 6 8 10	4.9 5.9 7.7 9.4
ISA 9060	90 × 60	6 6 8 10	6.8 8.9 11.0 13.0
ISA 10065	100 × 65	6 8 10	7.5 9.9 12.2
ISA 10075	100 × 75	6 6 8 10	8.0 10.5 13 0 15.4
ISA 12575	125 × 75	6 8 10	9.2 12.1 14.9
ISA 12595	125 × 95	6 8 10 12	10.1 13.4 16.5 19.7
ISA 15075	150 × 75	8 10 12	13.7 17.0 20.2
ISA 150115	150 × 115	8 10 12 16	16.3 20.1 24.0 31.4
ISA 200100	200 × 100	10 12 16	22.9 27.3 25.8
ISA 200150	200 × 150	10 12 16 20	26.9 32.1 42.2 52.0

TABLE -IV

ISMC - HOT ROLLED STEEL SECTION - MEDIUM CHANNELS

Description	Weight per mtr. (in kg.)	Width of Flange (mm)	Thickness of flange (mm)	Thickness of web (mm)	I_x ($Cm.^4$)	I_y ($Cm.^4$)
ISMC 75	7.14	40	7.5	4.8	78.5	12.9
ISMC 100	9.56	50	7.7	5.0	192	26.7
ISMC 125	13.1	65	8.2	5.3	425	61.1
ISMC 125+	13.7	66	8.1	6.0	435	64.4
ISMC 150	16.8	75	9.0	5.7	788	103
ISMC 150+	17.7	76	9.0	6.5	813	110
ISMC 175	19.6	75	10.2	6.0	1240	122
ISMC 175+	22.7	76	10.2	7.5	1310	136
ISMC 200	22.3	75	11.4	6.2	1830	141
ISMC 200 +	24.3	76	11.4	7.5	1910	151
ISMC 225	26.1	80	12.4	6.5	2710	188
ISMC 225 +	30.7	82	12.4	9.0	2960	219
ISMC 250	30.6	80	14.1	7.2	3880	211
ISMC 250 +	34.2	82	14.1	9.0	4080	244
ISMC 250 ++	38.1	83	14.1	11.0	4340	268
ISMC 300	36.3	90	13.6	7.8	6420	313
ISMC 300 +	41.5	92	13.6	10.0	6900	345
ISMC 300 ++	46.2	93	13.6	12.0	7350	375
ISMC 350	42.7	100	13.5	8.3	10000	434
ISMC 400	50.1	100	15.3	8.8	15200	508

TABLE -V

TABLE - V ISMB - HOT ROLLED STEEL SECTION - MEDIUM WEIGHT BEAMS

Description	Weight per mtr. (in kg.)	Width of Flange (mm)	Thickness of flange (mm)	Thickness of web (mm)	I_x ($Cm.^4$)	I_y ($Cm.^4$)
ISMB 100	11.5	70	7.2	4.0	183	12.9
ISMB 125	13.0	70	7.6	4.4	445	38.5
ISMB 150	14.9	75	7.6	4.8	718	46.8
ISMB 175	19.3	85	8.6	5.5	1260	76.7
ISMB 200	25.4	100	10.8	5.7	2120	137.0
ISMB 225	31.2	110	11.8	6.5	3440	218.0
ISMB 250	37.3	125	12.5	6.9	5130	335.0
ISMB 300	44.2	140	12.4	7.5	8990	486.0
ISMB 350	52.4	140	14.2	8.1	13600	538.0
ISMB 400	61.6	140	16.0	8.9	20500	622.0
ISMB 450	72.4	150	17.4	9.4	30400	834.0
ISMB 500	86.9	180	17.2	10.2	45200	1370.0
ISMB 550	103.7	190	19.3	11.2	64900	1830.0
ISMB 600	122.6	210	20.8	12.0	91800	2650.0

ANNEXURE -III

Additional information to be submitted along with the report of estimate.

A. For Mechanical Work:

1. Name of Work:
2. Total nos of gate exist/to be installed with type (draw/radial/under sluice etc.) and size:
3. Nosofgate shutter is to be repaired:
4. Nos ofgate shutter is to be replaced by new one:
5. Nos& type of hoisting arrangement to be repaired/installed:
6. Nos& type of hoisting arrangement to be replaced:
7. Total painting area of gates:
8. Area ofgates to be painted:
9. Total painting area of the hoisting arrangement & stair, railing, motor cover, gear box etc:
10. Area of hoisting arrangement & stair etc to be painted. :
11. Total length of rubber seal present
    a) Top rubber seal (specification):
    b) Bottom rubber seal (specification):
    c) Side rubber seal (specification):
12. Total length ofrubber seal to be replaced
    a) Top rubber seal (specification):
    b) Bottom rubber seal (specification):
    c) Side rubber seal (specification):
13. Last work done for maintenance or special repair completion date with tender no.:

B. For Electrical Work:

1. Name of Work:
2. SLD for required work to be enclosed:.
3. Load calculation for choosing of cable/switch rating to be enclosed.
4. Drawing for panel to be submitted if it is required.
5. Schematic diagram showing the lux level of illumination is also required for road of boundary illumination.
6. Every attempt should be made to go for grid connected SPN power plant for the scheme if it is not possible state the reasons.
7. Last work done for maintenance or special repair completion date with tender no.

ANNEXURE -IV

REGISTER OF MECHANICAL & ELECTRICAL MAINTENANCE

Name : Block : P.S.: Type of Gate/Pump: No of Gate/Pump: Size of Gate leaf: Type of Gate Hoist: Capacity of Pump:	Technical Detail of Each Gate system/Pump System	
	Brief technical details of Gate /Pump	
	Brief technical details of Hoist system/Pump operation system	

Sl. No.	Date of work	Major works taken up	Tender Agreement No.	Sig. of concerned A.E



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