WATER TREATMENT PLANT

Presented By:

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Introduction

- WATER:A principal element in the mineral and biological worlds
- It is also the preeminent vector of life and human activity. At present, the world's use of water, counting domestic, industrial and agricultural, totals an impressive 250 m3 per person per year.
- For better environment & upliftment of the people to sustain the economy of the area in particular and country in general, it is imperative to provide safe and adequate drinking water The quality of a water source cannot be overlooked in water supply development. In fact, virtually all sources of water require some form of treatment before potable use.
- Water treatment is the process of removing contaminants from raw water. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants.

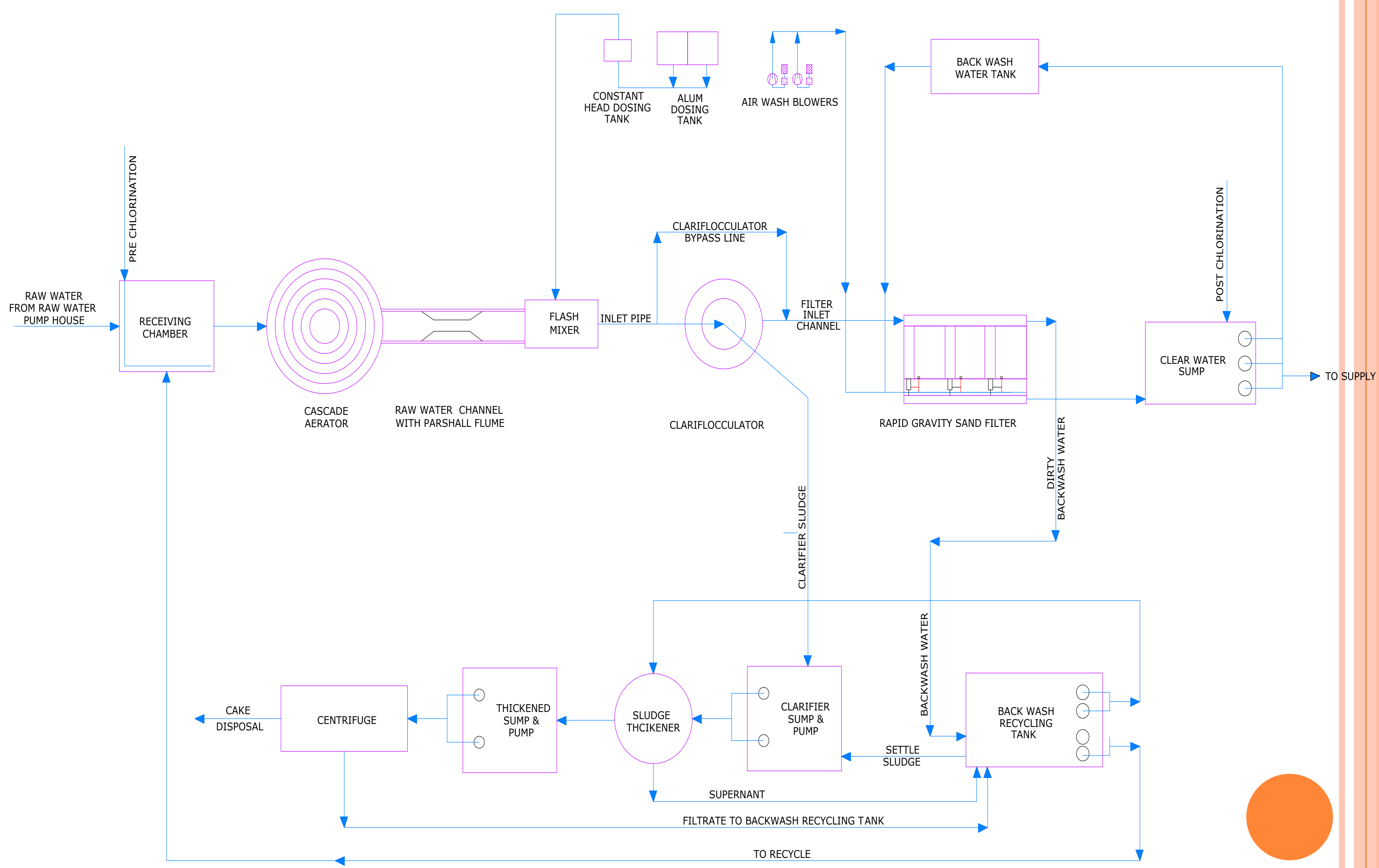
Raw Water Characteristics

Sr. no.	**Parameter**	**Unit**	**Value**
1.	pH		7.0 -8.5
2.	T.D.S.	mg/L	150 -250
3.	Turbidity	NTU	~ 15 to about 1000 (during monsoon)
4.	Chlorides	mg/L	40 -60
5.	Nitrates	mg/L	10 – 20
6.	Sulphates	mg/L	Nil
7.	Flourides	mg/L	0.62
8.	Total Alkalinity as $CaCO_3$	mg/L	150 -200

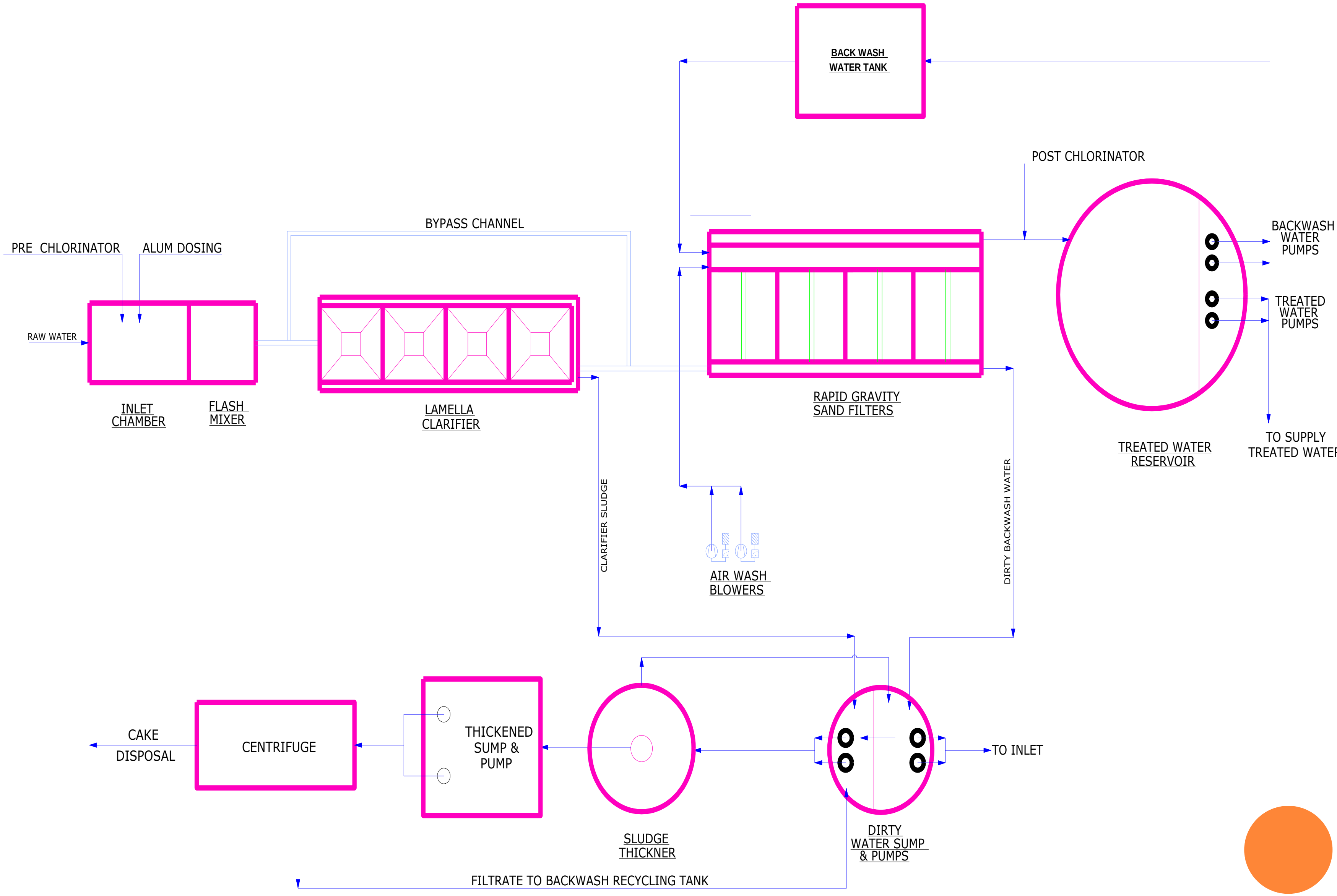
Treated Water Characteristics

Sr. no.	Parameters	Unit	Guaranteed Value
1.	pH		7.0 - 8.0 / 8.5
2.	Taste and odour		Unobjectionable
3.	Turbidity	NTU	< 1
4.	Colour	Pt-Co	< 5
5.	Bacterial quality	MPN /100 ml	Absent per 100ml sample. None of the samples should contain MPN of coliform exceeding 10 per 100 ml.
6.	Free Chlorine	mg/L	0.2 – 1.0

Process flow diagram for WTP With Clari-flocculator (with Recycling)



Process flow diagram for WTP With Lamella Clarifier



Receiving/ Inlet Chamber

- Description
- Raw water from raw water pump house is collected in inlet chamber for further treatment of the water.
- One or Two RCC baffle wall shall be provided at proper level and across the width of stilling chamber for effective pre-chlorination.
- The raw water from receiving chamber shall be led to flow measuring channels for flow measurement and control through cascade aerator as per requirement of water treatment.

Cascade Aerator

- **Description**
  - Raw water shall flow vertically up word to the top to increase dissolve oxygen of water and to get rid of unpleasant smell and taste. Then cascade readily over the steps .
  - After Aeration , Aerated raw water will get collected in the channel for further treatment.
  - The cascade aerator shall be a RCC structure with a lining of glazed tiles on all the water contact surfaces.
  - Removal of gas varies from 20-45% for CO2 and up to 35% for H2S
- **Design Criteria**
  - No of Steps :- 4 to 6
  - Head required:- 0.5 to 3.0 m
  - Space requirement :- 0.015 to 0.045 $m^2/m^3/hr$

Flow Measuring Channel & Parshall Flume

- The flow from the inlet unit shall receive in to flow measuring channel with parshall flume to measure the plant inlet flow.
- An ultrasonic flow meter with flow integrator and electronic display unit shall be provided at the flume.

Flash mixer

➢**Description:-**

- Flash Mixer shall be used for quick mixing of coagulant (Alum) added to enhance the formation of flocs of suspended solids causing the turbidity.
- The tank shall be provided with a turbine impeller type high speed mixer.
- The water from the flash mixer shall be then taken to the Clariflocculator.

Design Criteria for flash mixer

Sr. no.	**Parameter**	**Unit**	**Value**
1.	HRT	sec	20-60
2.	Velocity Gradient	Sec^{-1}	Greater than 300 s-1
3.	Ratio of tank height to diameter of tank	-	1:1 to 3:1
4.	Power Requirements	watts per m3/hr	1-3

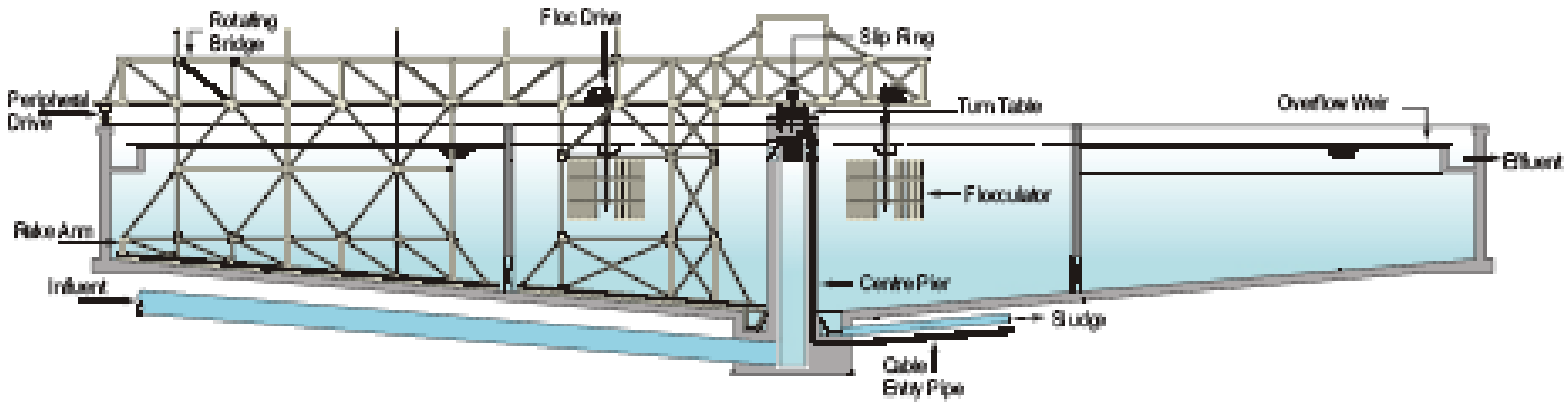
Velocity Gradient = Difference in flow velocity between the layers / distance between the layers.

Clariflocculator

- Description

- Clarification process is the removal of suspended solids from the raw water.
- The water from Flash mixer shall flow to the flocculation zone of Clariflocculator. The flocculation compartment shall be provided. The gentle mixing of the content (with help of slow moving flocculation paddles) shall form the flocs, which will be settled in the Clarifier zone by gravity. It shall remove the turbidity and precipitates of hard water formed in the flash mixer.
- The settled sludge shall be collected into the sludge pocket and then it shall be discharged off to the Clarifier Sludge Sump. The operation of sludge withdrawal will depend on the concentration of inlet turbidity of water.
- The over flows from the clarifier units shall be taken to the rapid sand filters through the filter inlet channel.

Clariflocculator

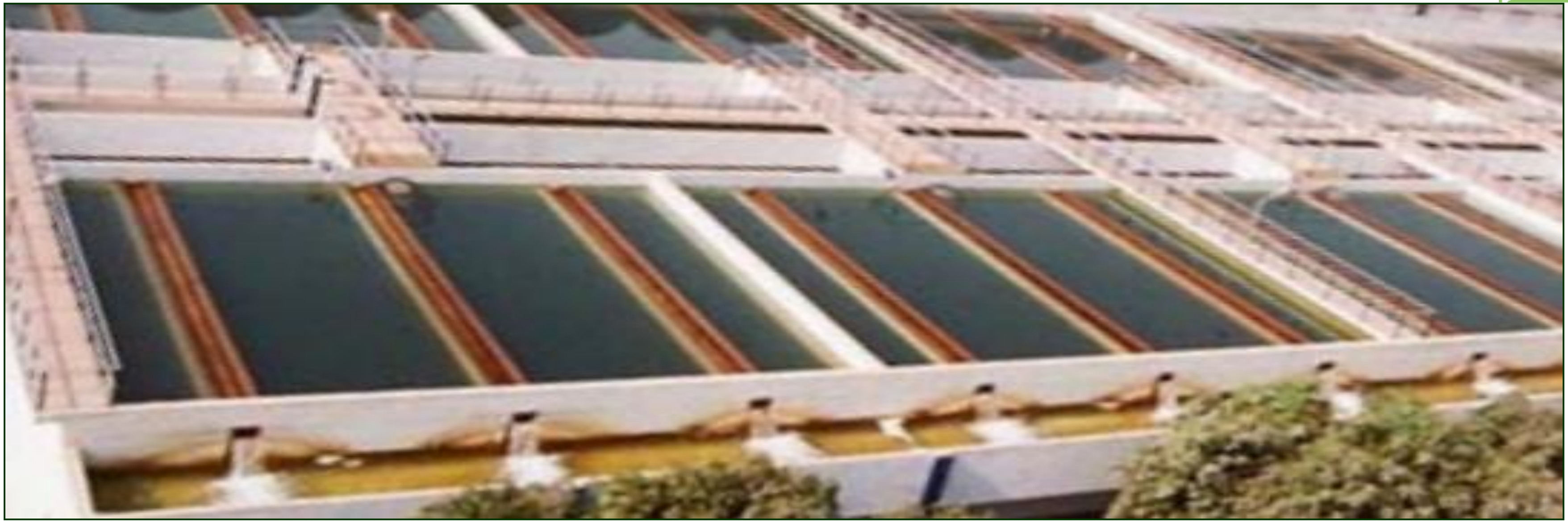


Clariflocculator - Peripheral Drive

Sr. no.	Design Parameter	Unit	Value
1.	Detention period in flocculator	min	20-30
2.	Detention period in clarifier zone	hr	2-2.5
3.	Surface overflow rate in clarifier	m3/m2/day	30-40
4.	Weir loading in clarifier	m3/m/day	300

Sr. no.	Design Parameter	Unit	Value
5.	SWD	m	3-4
6.	Floor Slope	-	1:12
7.	Max. diameter for circular tanks	m	60 Generally upto 50m

Lamella Clarifier

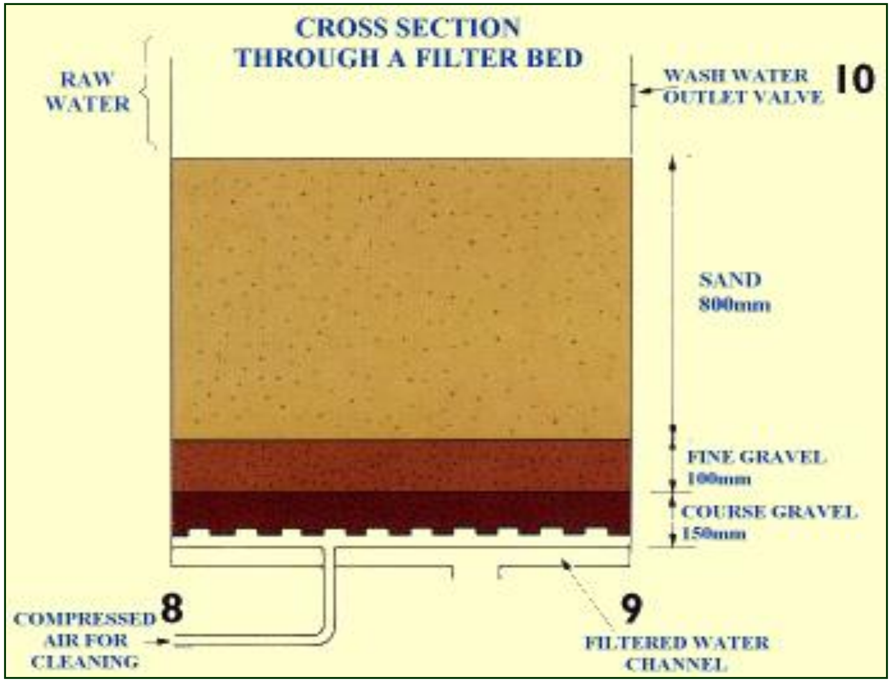


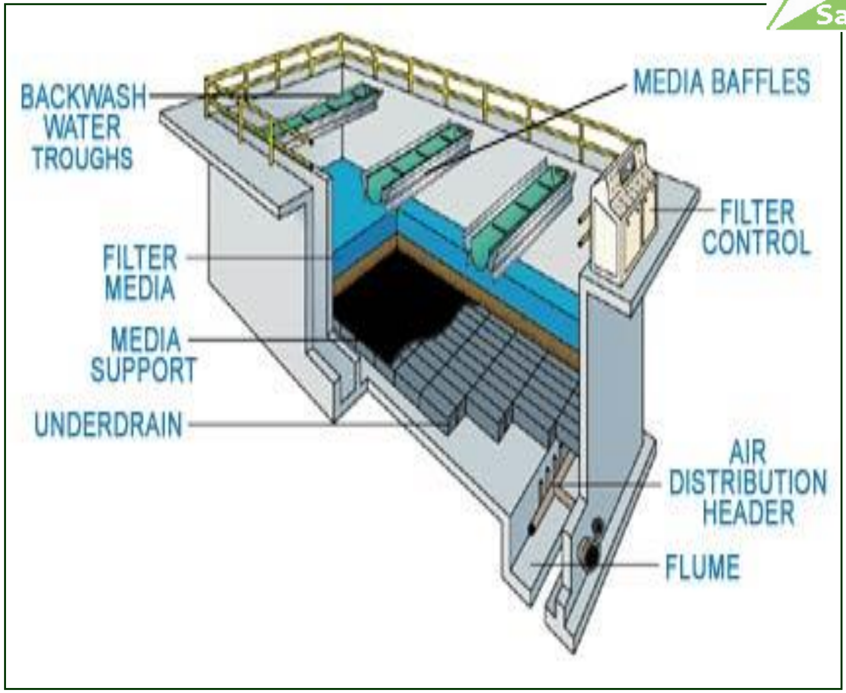
- Description
  - The raw water shall be taken to the sludge blanket lamella clarifier, for removal of turbidity due to suspended solids. In the lamella clarifier, the incoming water shall be delivered near the bottom of the tank through inlet piping/ distribution system.
  - The water rises at a steadily decreasing velocity through a blanket of suspended particles, which shall be allowed to accumulate in clarifier zone. This accumulation leads to the formation of the sludge blanket composed of particles which shall be capable of maintaining their position against the upper velocity of the water because they have been in the clarifier for a period during which their size has grown due to contact with other particles of coagulated matters moving upward with water and due to flocculation.
- Design Criteria :-
  - Surface loading rate :- 4.0- 6.0 m^3/m2/hr
  - Retention Time :- 40-60 min

Filter House

- The clarified water shall enter the declining type rapid gravity sand filters to remove the residual impurities like suspended solids & turbidity by filtration.
- The filter unit is contained with filter media, nozzel, pipes and necessary backwashing system. Each filter shall have central and lateral wash water troughs for equal withdrawal of the wash water during back-washing the filter.
- The filtered water from filters shall be taken to Clear water reservoir after disinfection

Filter House





Rapid Gravity Sand Filters: Residual solids / turbidity after clari-flocculator shall be removed in the gravity filters

Advantages of Rapid Gravity Sand Filter

- It has a much higher flow rate than a slow sand filter
- Requires relatively small area of land
- Is less sensitive to changes in raw water quality

Filter Bed

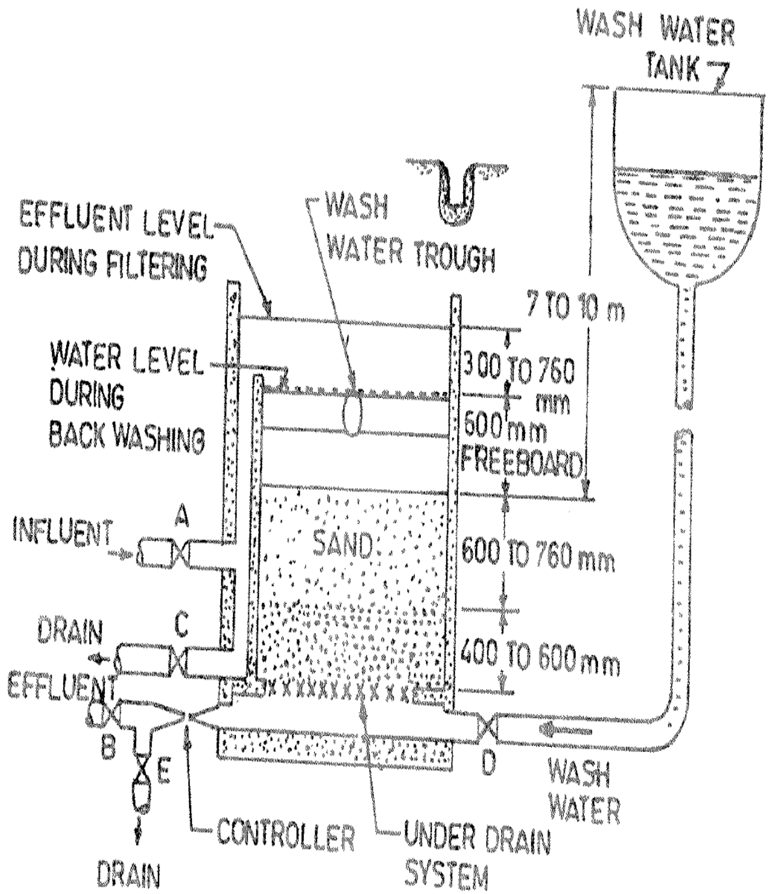


FIG. 7.17 DEFINITION SKETCH FOR OPERATION OF DOWNFLOW, GRANULAR–MEDIUM GRAVITY–FLOW FILTER

- **Design Criteria**
  - Rate of filtration : - 4.8 – 6.0 $m^3/m^2/hr$
  - Height of water over the filter bed :- 1.3 – 2.5 m
  - Rate of air backwash :- 36-54 $m^3/m^2/hr$
  - Rate of water backwash :- 24-36 $m^3/m^2/hr$
  - Duration of wash :- 5- 10 min (each for air & water)

Note - Ref. CPHEEO Manual for water treatment

Disinfection/ Chlorination

- The filtrated water from the gravity filter shall be collected in chlorine contact tank
- Post chlorination shall be carried out in chlorine contact tank.
- The filtered water flow from the chlorine contact tank shall be collected in Clear Water Reservoirs (CWR)

Sludge Thickener

- Description
- The main function of sludge thickener is to increase the concentration of solids by removing a portion of the liquid fraction from sludge; which is generated from clarification treatment.
- The concentration of sludge shall be increased from 1- 1.5 % up to 4 – 5 % by gravity settlement of the inlet solids.
- The conditioning polyelectrolyte shall be added to thickener for enhancing gravity separation with the help of polyelectrolyte dosing tank.
- The underflow of thickened sludge from thickener shall be fed to the Thickened sludge sump and the supernatant shall be taken to the backwash recycling tank.
- Design Criteria:
- Solid Loading rate :- 50-75 kg/m2/day (Normally 60 kg/m2/day)
- Inlet concentration :- 1 – 1.1 %
- Outlet concentration :- 4 -5 %
- Bottom Slope:- 1:8

Sludge Dewatering Unit

A. Centrifuge

- The objective of Centrifuge unit provided is to remove water from the sludge.
- The thickened sludge from the thickened sludge sump shall be pumped sludge dewatering units.
- It shall be solid bowl centrifuges designed to recover 90-95% solids of sludge collected in Thickened sludge sump. The dried sludge shall then be disposed off suitably. The centrate from the units shall be taken to the backwash recycling tank to be finally recycled to the measuring channel.

Dirty Water Collection /Backwash recyclingTank

- Backwash water recycling tank shall be provided to collect the back washed water flows from the rapid sand filters, supernatant flows from the gravity sludge thickeners and centrate flows from the sludge dewatering units/centrifuges.
- The collected flows then shall be recycled back to the plant / discharged safely.

THANKS

PRESENTATION ON PUMPS

FUNCTIONS,
PREVENTIVE MAINTENANCE & TROUBLESHOOTING

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- **Introduction**
- **Terminology**
- **Basic of Pump Engineering**
- **Classifications of Pumps**
- **Selection of Pumps & Prime Movers**
- **Piping & Plant Lay out**
- **Installation of Pumps**
- **Operation of Pumps**
- **Preventive Maintenance**
- **Trouble Shooting**

Introduction

In Water Supply System:

- Lifting water from source to purification plant or to service reservoir.
- Boosting water from source to low service areas and to OHT of multistoried buildings
- Transporting water through treatment plant, draining of settling tanks and other treatment units
- Withdrawing sludge
- Supplying water under pressure to operating equipment
- Pumping chemicals solutions to treatment units.

Introduction

In Sewage & Waste Water Handling System:

- Lifting sewage from collecting sump to distribution chamber of treatment plant
- Boosting sewage from intermediate pumping station to terminal pumping station or to discharge into another gravity sewer.
- Disposing leakages from dry well of pumping stations
- Transporting sewage through treatment plant, draining of settling tanks and other treatment units
- Transferring overflow or Excess sewage

TERMINOLOGY

- Pump
- Performance curve
- Head
- Capacity / Discharge / Flow
- Speed (in RPM)
- Efficiency
- Shut off head
- Run out head
- NPSH(R) & NPSH(A)
- Pump Input or BKW/BHP
- System head

What is Pump ?

It is a mechanical equipment adding energy to the fluid to move it from one point to another or raising its pressure or to transfer from a low pressure region to a high pressure region.

Head & Capacity

- What is Head ?

  HEAD - A height of a liquid column.

  Expressed in mt., kg / cm^2, psi, mlc

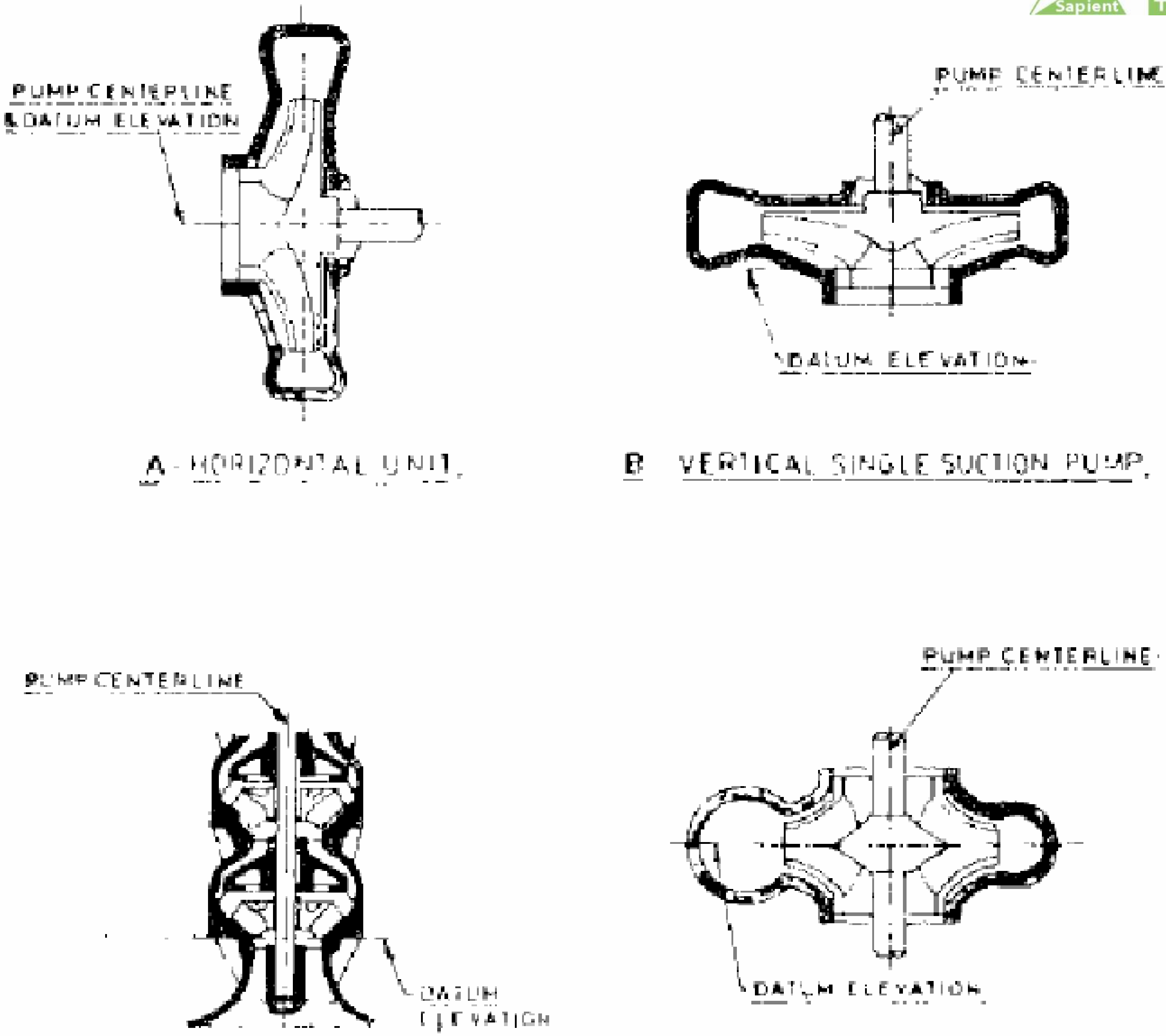
- Capacity / Discharge / Flow

  Quantum of liquid delivered by pump in specific time.

  Expressed in LPS, LPM, USGPM, IGPM, Cu.Mt / hr., Cusec

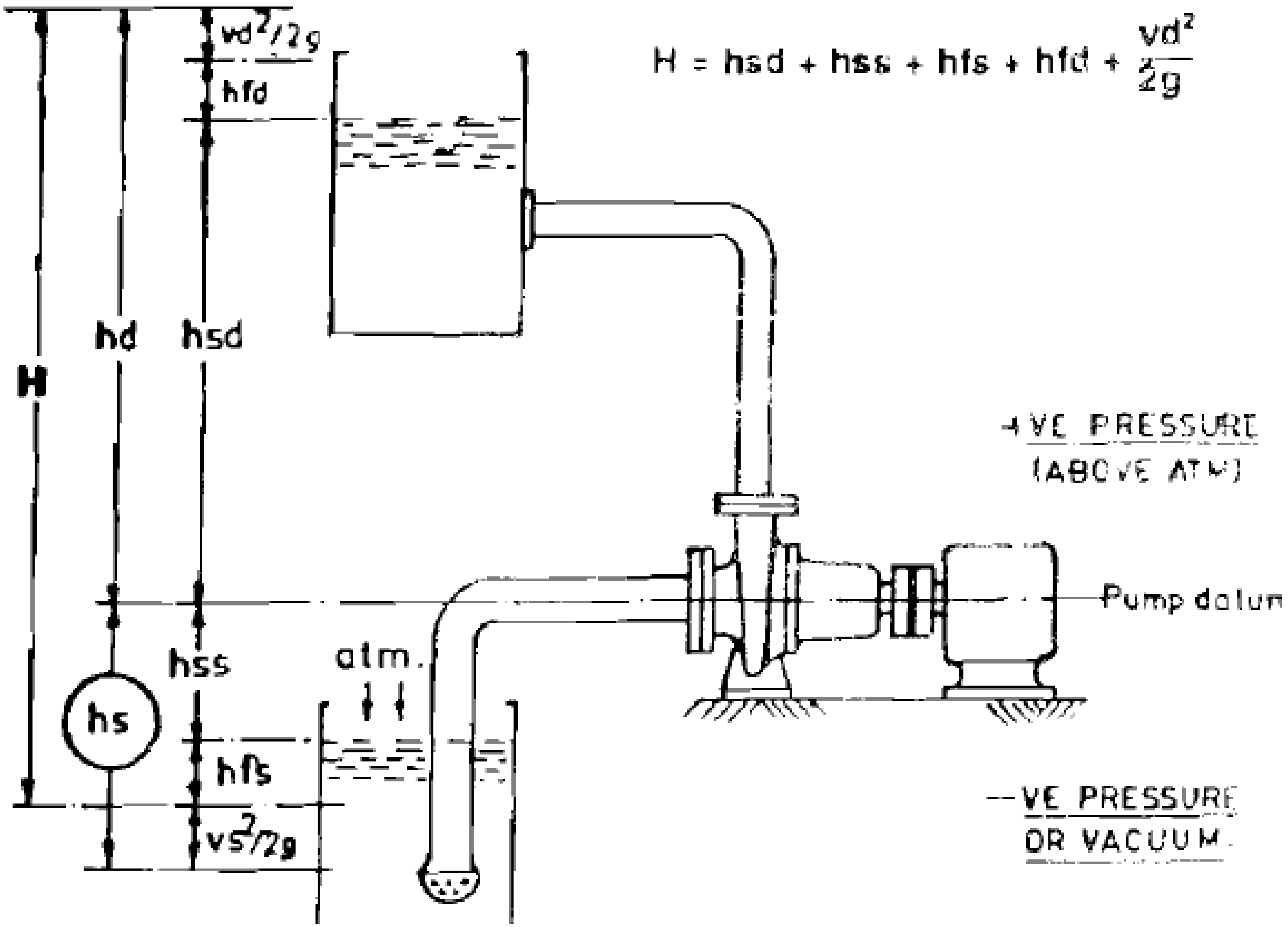
Total Head

- Total Static head: Static Delivery Head – Static Suc. Head.
- Suction head: Static Suc. Head (-ve in case of suc. Lift) - Fric. Head of Suc. side.
- Delivery head: Static Delivery Head + Fric. Head of Del. Side
- Velocity head: Vd^2/2g (termed as Residual Head)
- Frictional head: Friction losses in pipe, fittings, valves etc.
- Tot. Dyn. Head: Del. Head - Suc. Head + Velocity Head

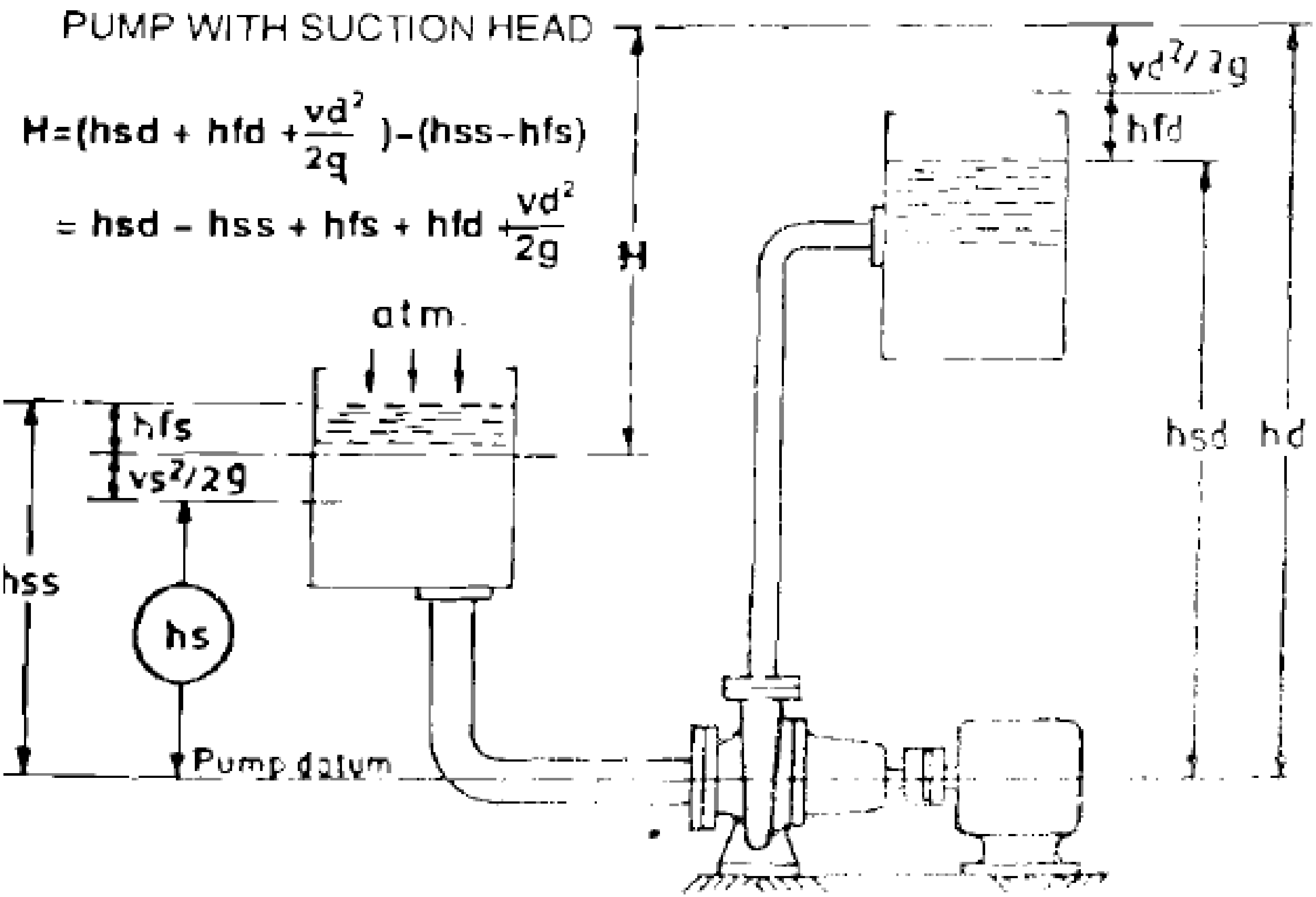


DATUM ELEVATION OF VARIOUS PUMP DESIGNS

Total Head Calculation with Lift



Total Head Calculation with Suction Head



NET POSITIVE SUCTION HEAD AVAILABLE (NPSH a)

- NPSH a = Ps +/– Hst - Hfs - Vs^2/2g – Vp

- Where

Ps = Suction Pressure / Atm. Pressure

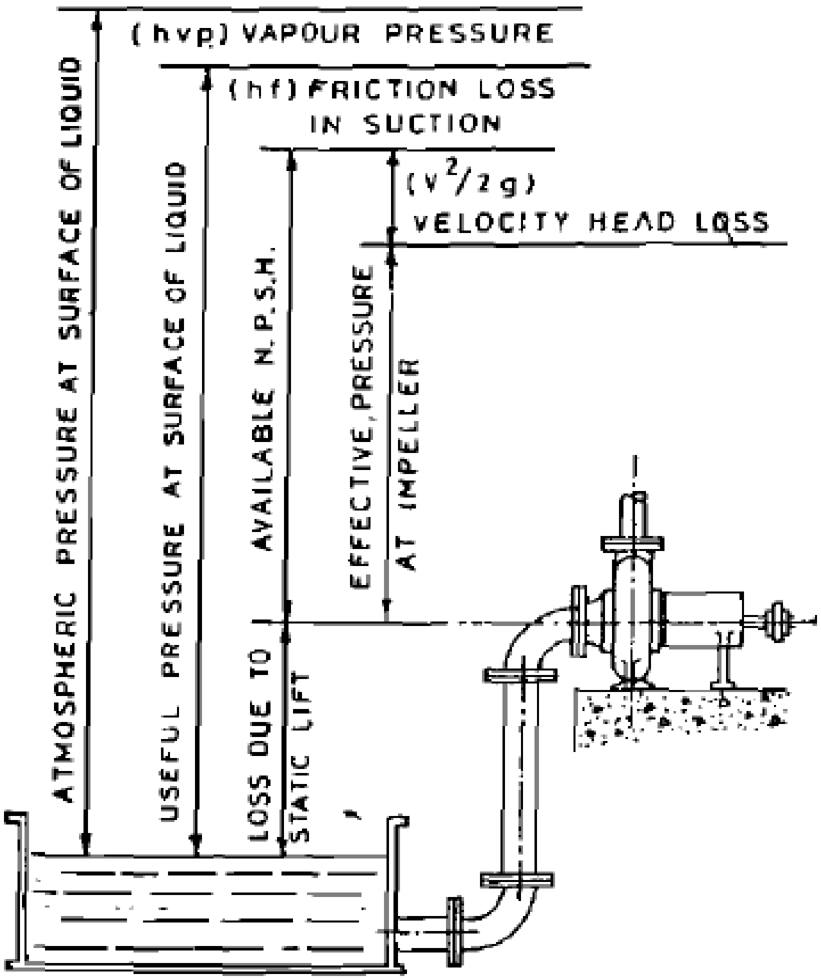
Hst. = Static Suc. Head +ve / -ve

Hfs = Friction losses in suction.

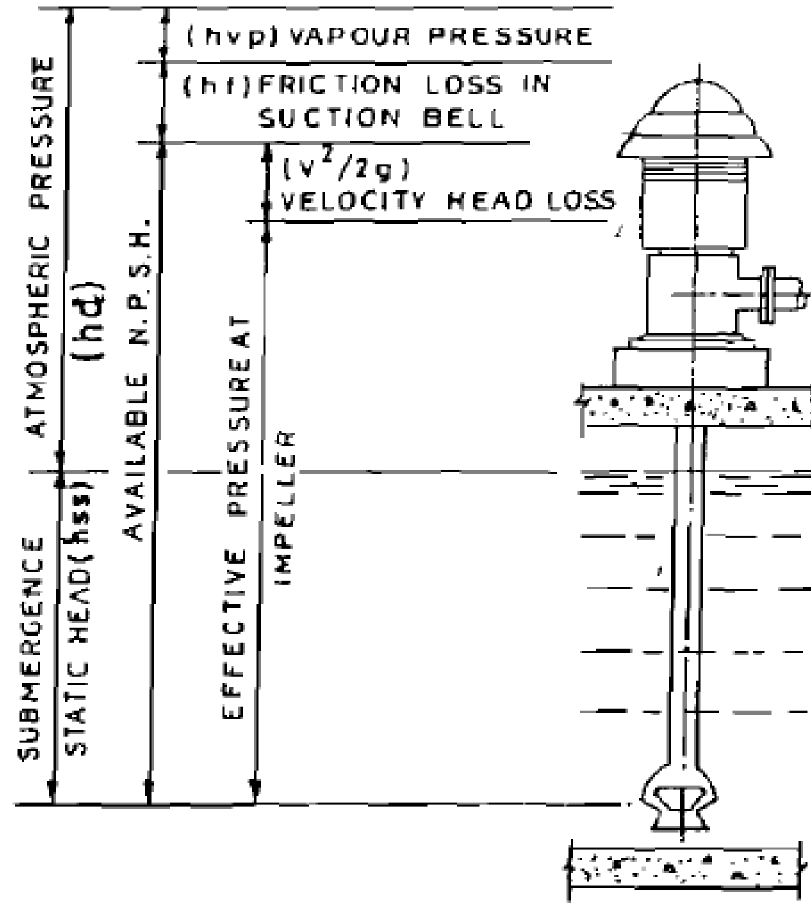
VS^2/2g = Velocity head at the suction face

Vp = Vapour Pressure of the liquid.

NET POSITIVE SUCTION HEAD AVAILABLE (NPSH a)

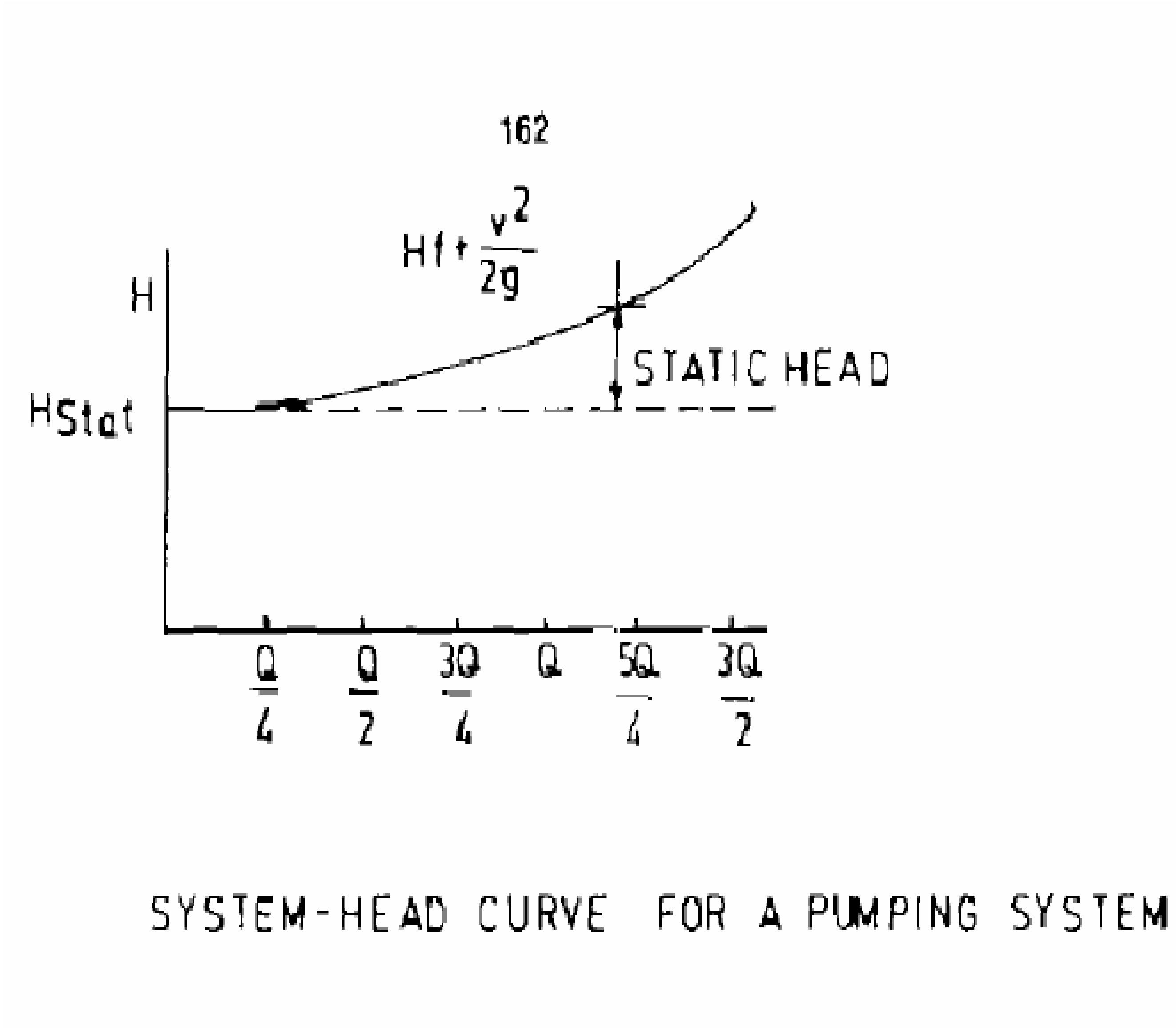


CENTRIFUGAL PUMP WITH LIFT

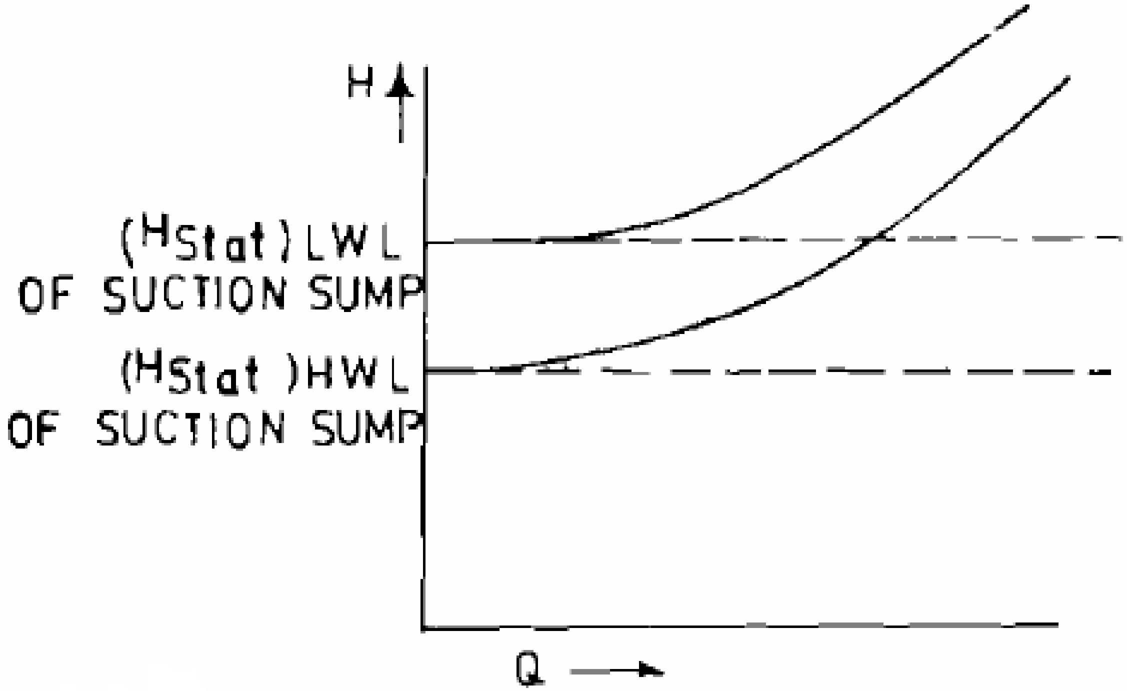


VERTICAL TURBINE TYPE PUMP

System Head

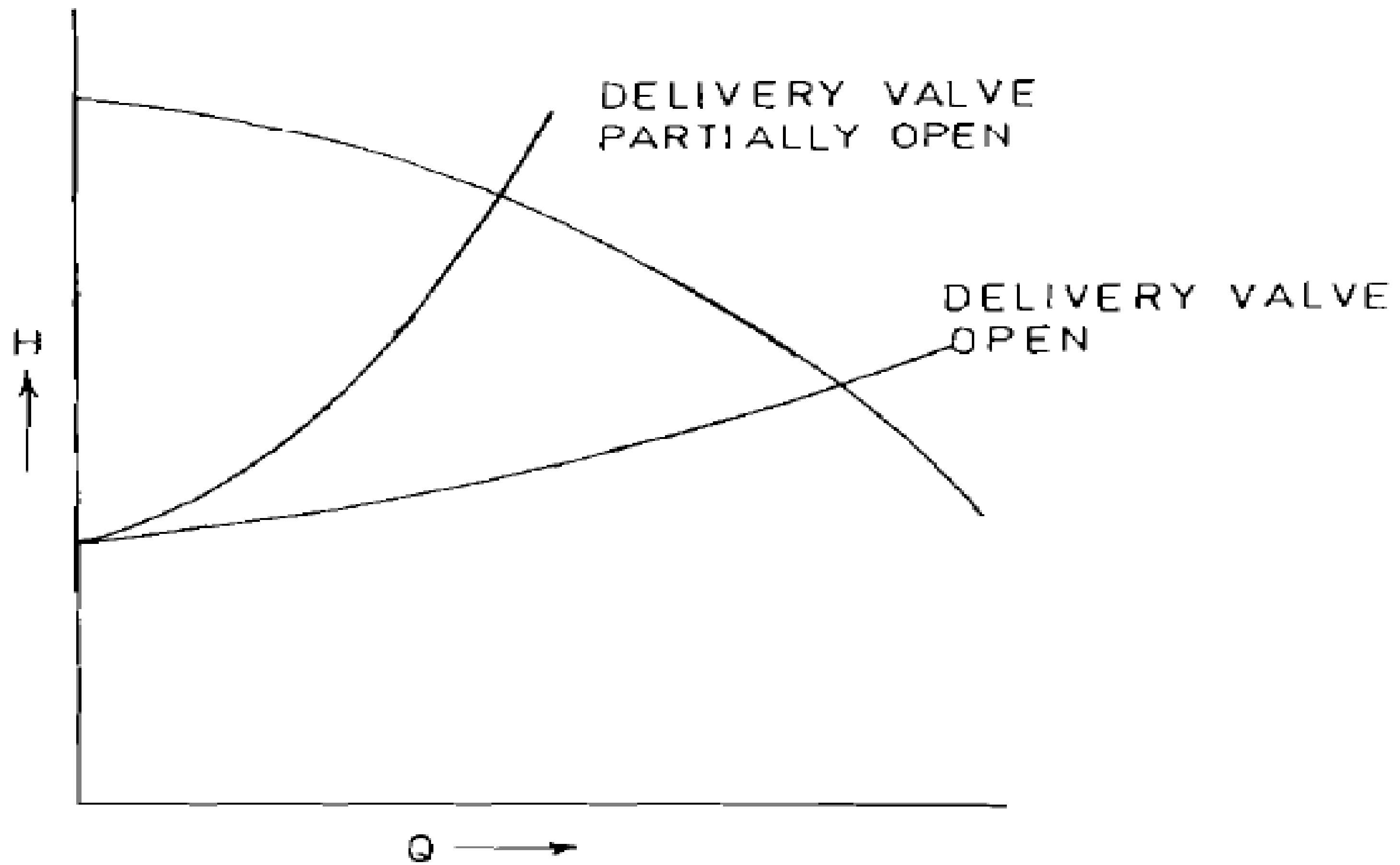

162
H
Hf + v²/2g
STATIC HEAD
HStat
Q/4
Q/2
3Q/4
Q
5Q/4
3Q/2
SYSTEM-HEAD CURVE FOR A PUMPING SYSTEM

System Head with Low level & High level in Suction Sump



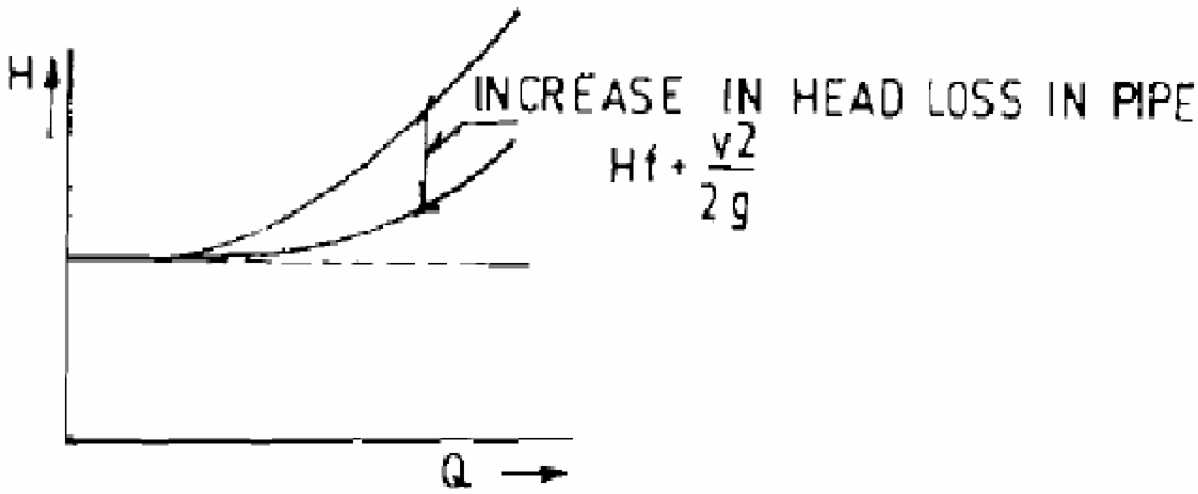
SYSTEM-HEAD CURVES FOR LWL & HWL IN SUCTION SUMP

Artificial Increase of Head



CHANGE IN OPERATING POINT BY OPERATION OF DELIVERY VALVE

System Head with change in pipe size

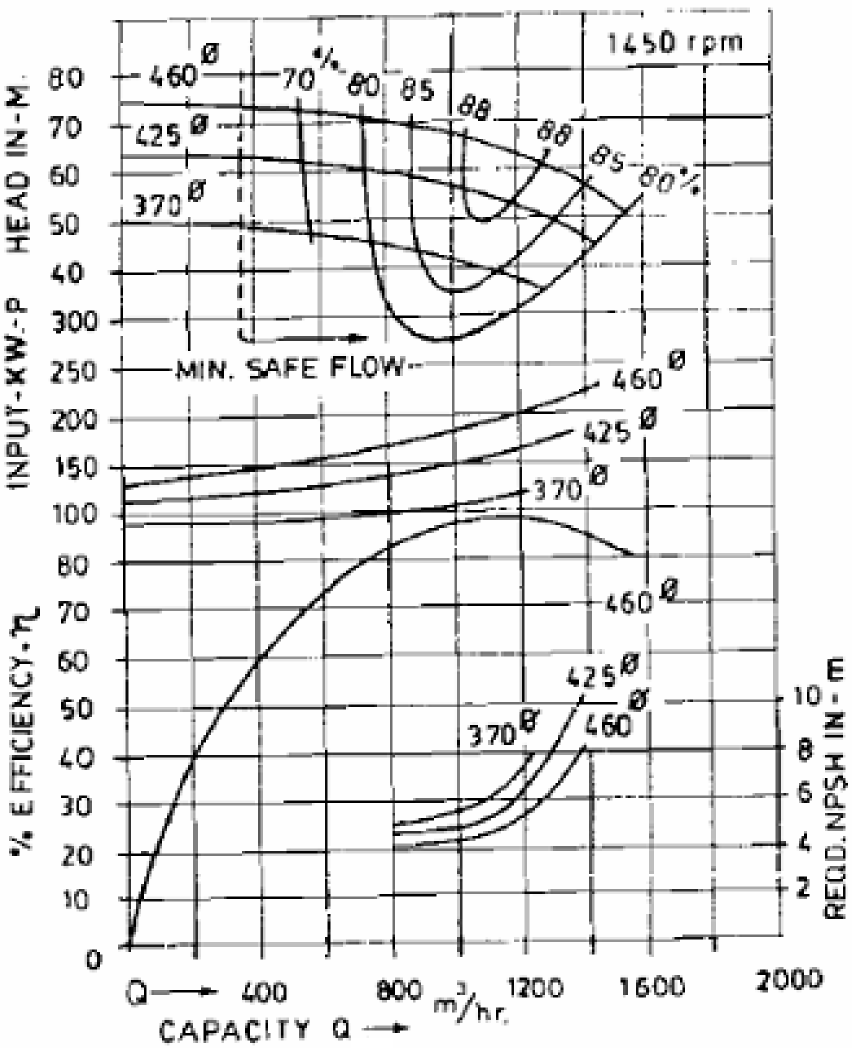


SYSTEM-HEAD CURVES WITH CHANGE IN PIPE - SIZES

Note: System Designer requires to carry out Cost-Benefit analysis to arrive at optimum pipe size evaluating capital cost of pipe v/s. operating / power cost

Performance Curve

- Capacity –Head
- Capacity –Power
- Capacity –Efficiency
- Capacity –NPSH-R



Iso- efficiency Curve

Calculation of Pump Input

Power required by pump to develop designed head and deliver designed flow :

$$\textbf{Pump input (BKW)} = \frac{H \times Q \times \text{Sp. Gravity} \times 100}{102 \times \text{pump } \eta.}$$

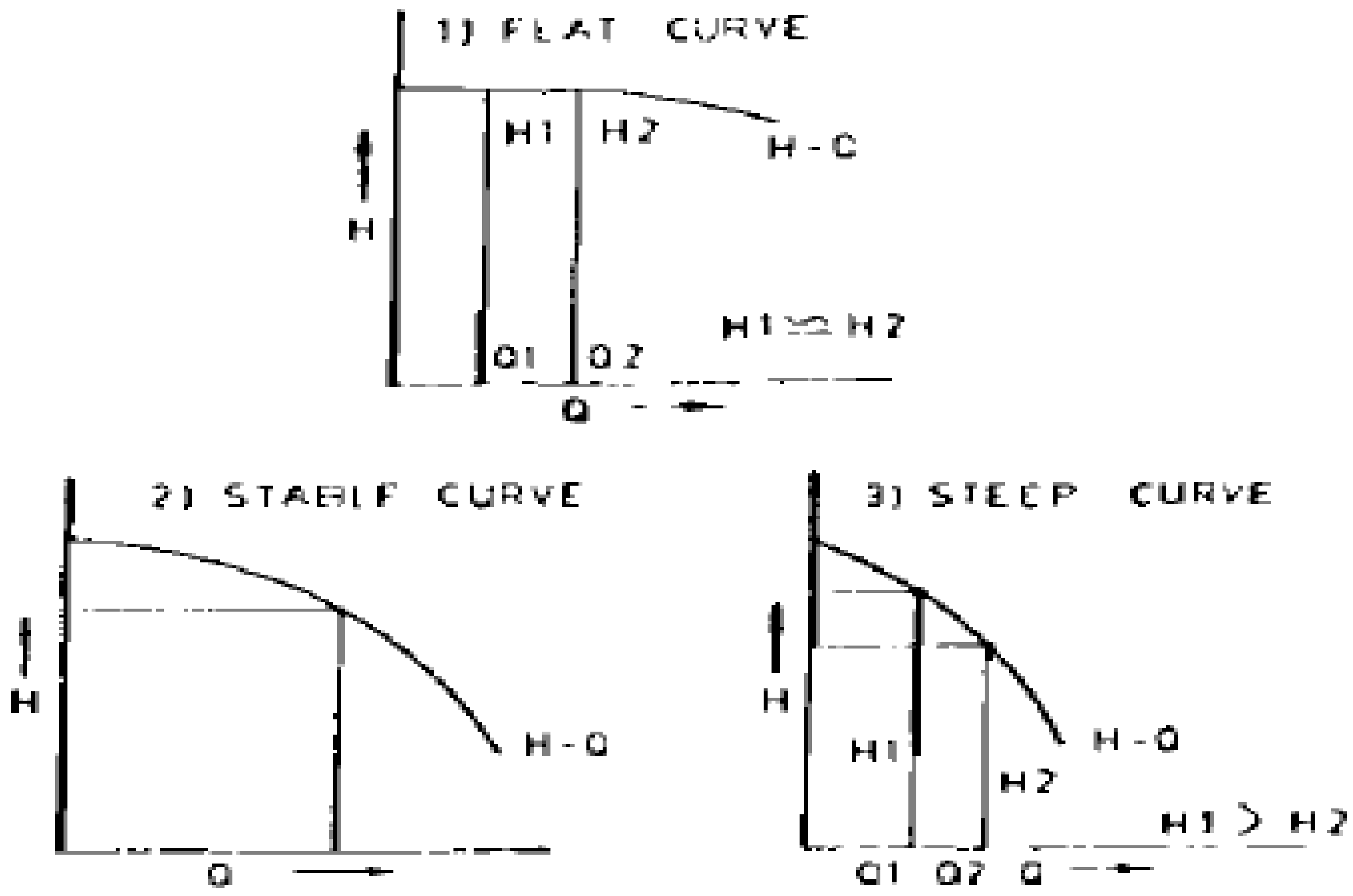
Where

BKW	=	in kw
H	=	Total Head in mlc
Q	=	Flow LPS
Sp. Gravity of liquid in kg/dm^ 3		
η	=	Pump Efficiency

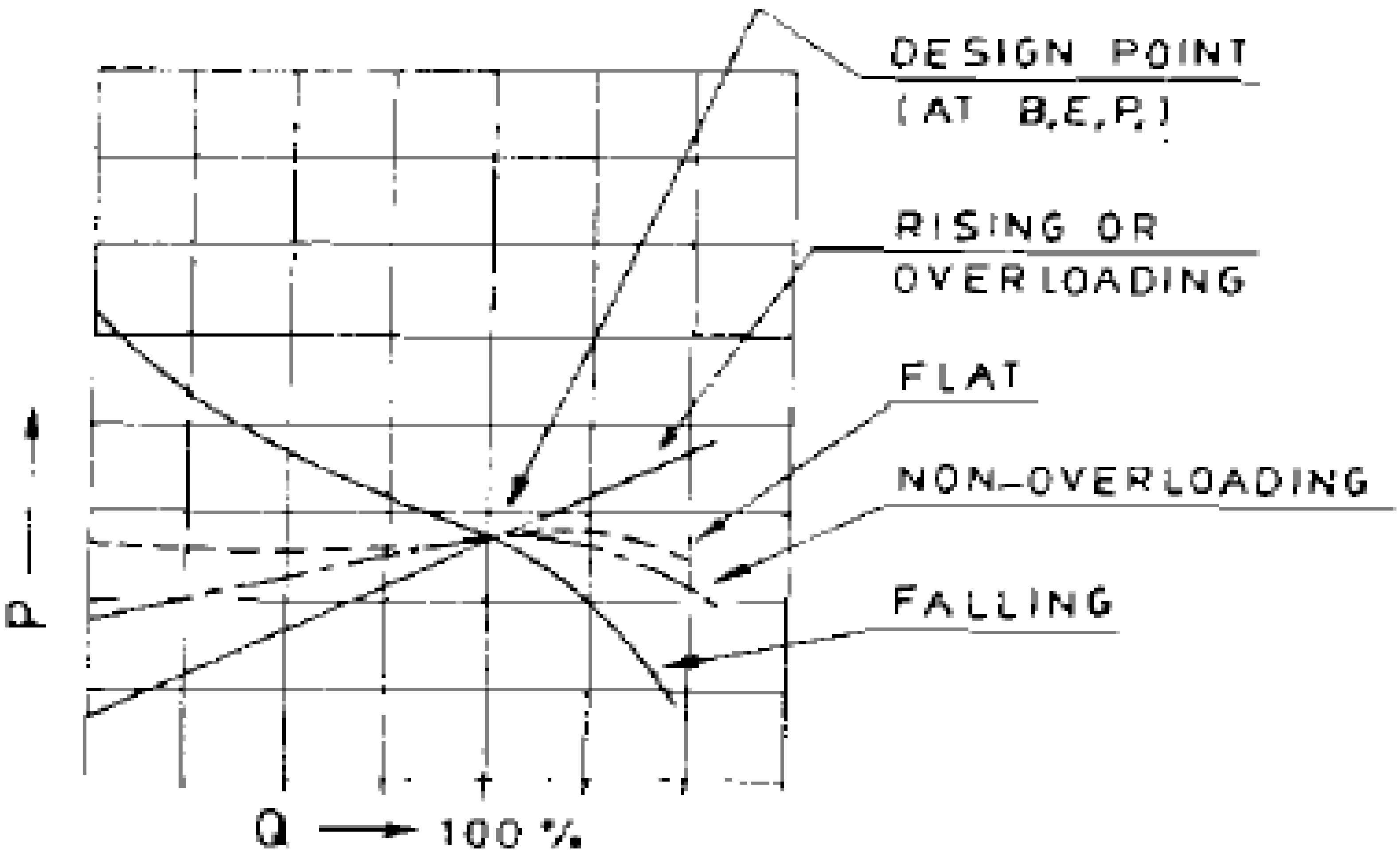
Overall efficiency of pump set:

$$\text{Motor input} = \frac{\text{Pump Input} \times 100}{\text{motor } \eta \text{ at rated load}}$$

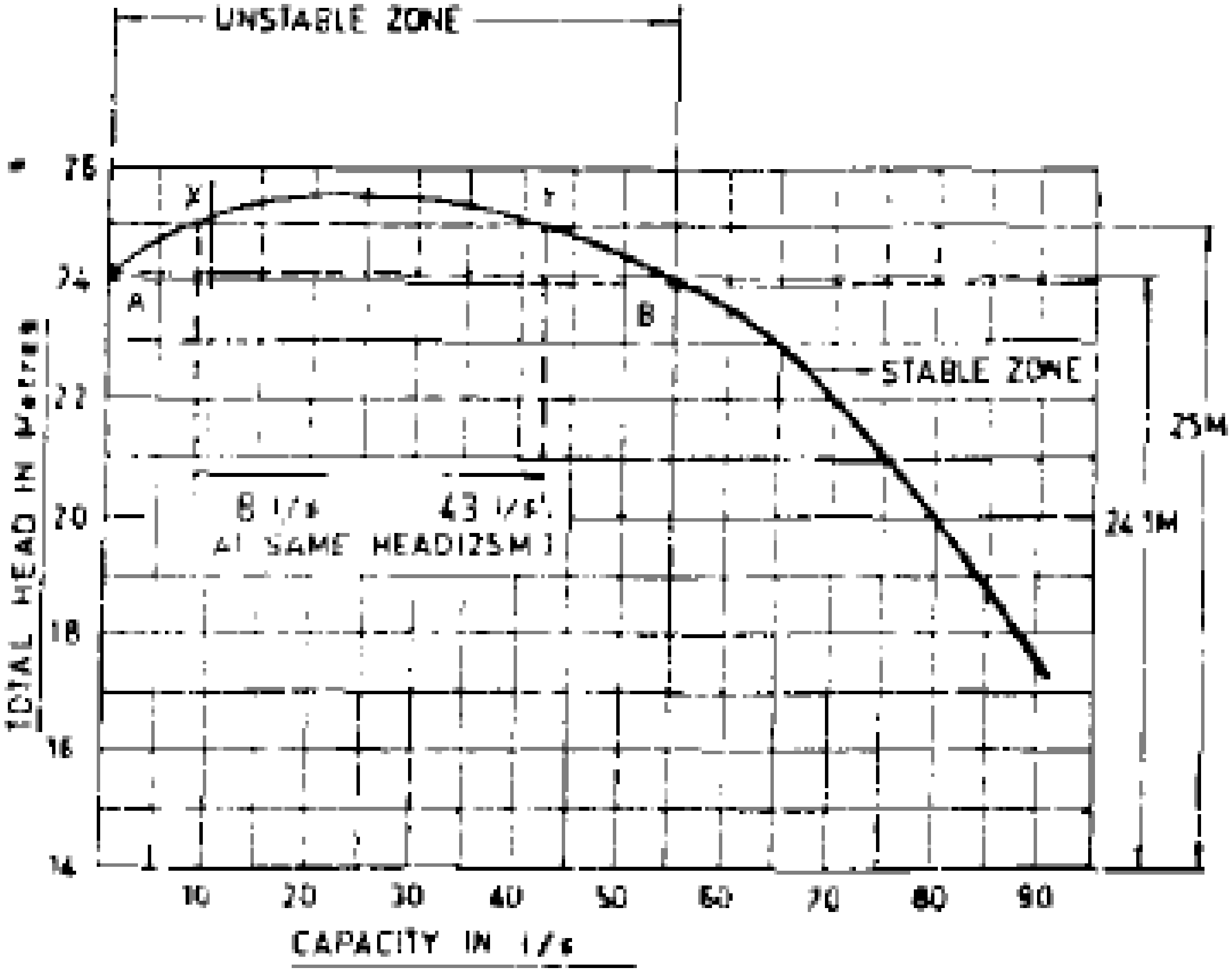
VARIOUS TYPE OF PERFORMANCE CURVE



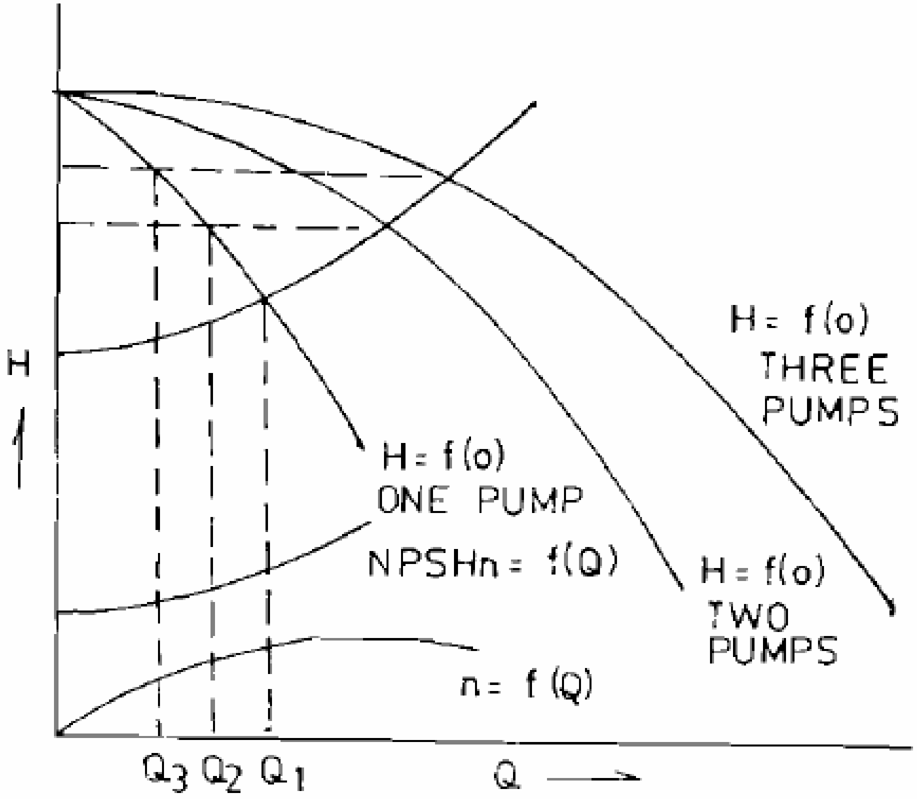
TYPE OF POWER CURVE



Drooping Characteristic



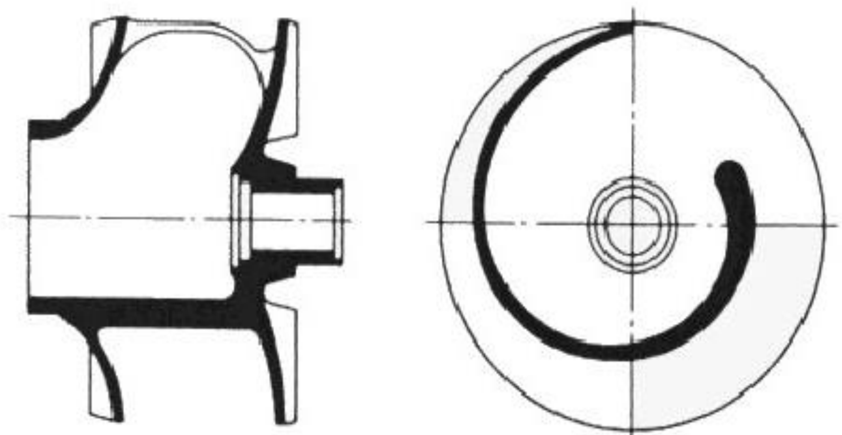
Pumps in Parallel Operation



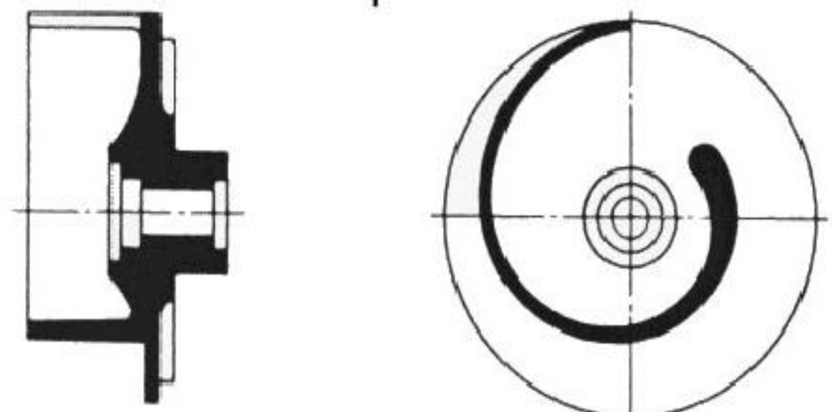
No. OF PUMPS IN OPERN.	FLOW OF EACH PUMP.
1	Q_1
2	Q_2
3	Q_3

OPERATION OF PUMPS IN PARALLEL

Closed & Semi Open Single Vane Impeller

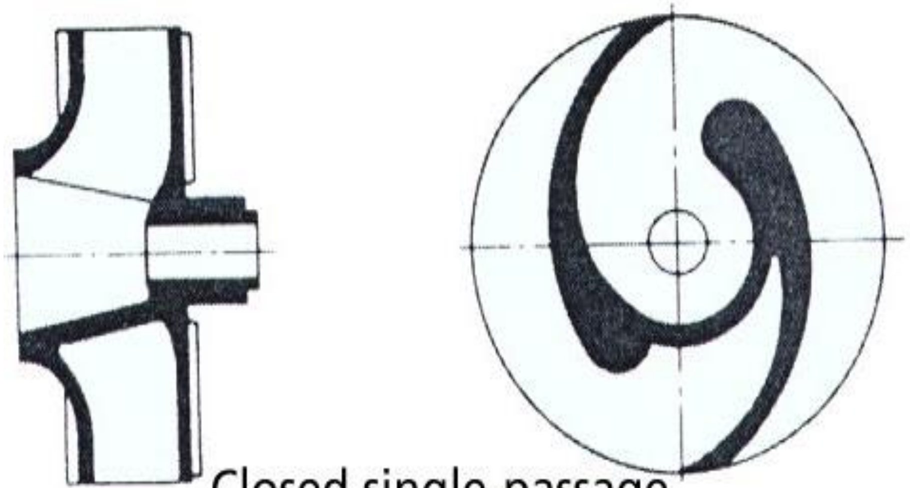


Closed single vane impeller
with front pate removed

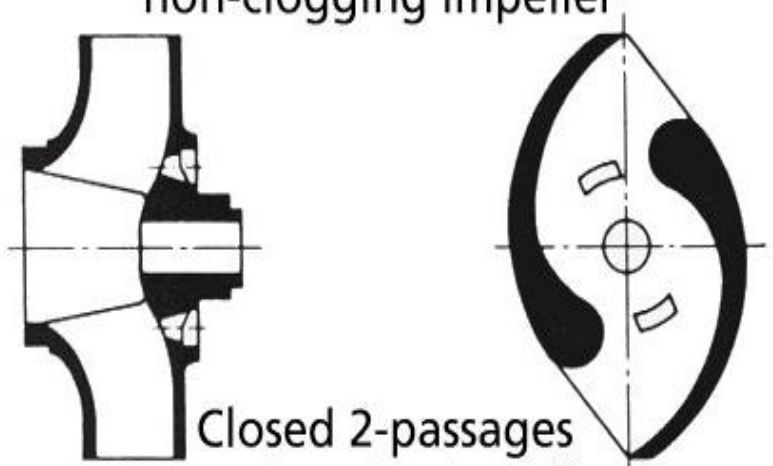


Open single vane impeller

Enclosed Single Vane & Two Vane Non Clog Impeller

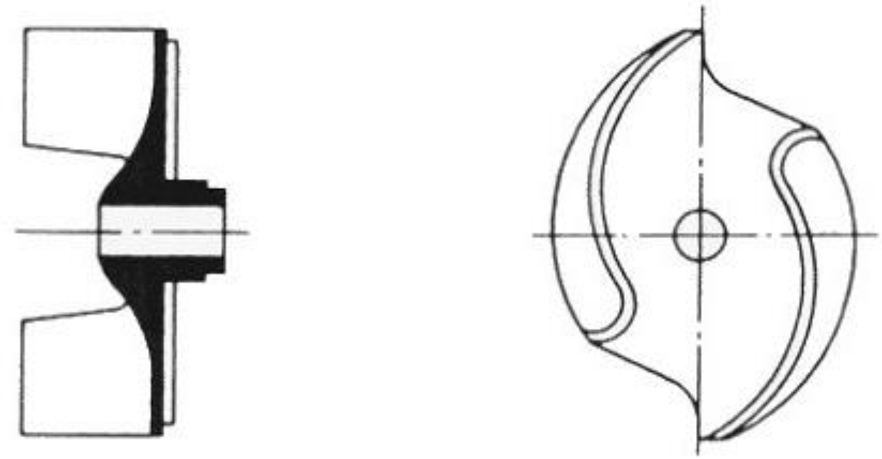


Closed single-passage non-clogging impeller

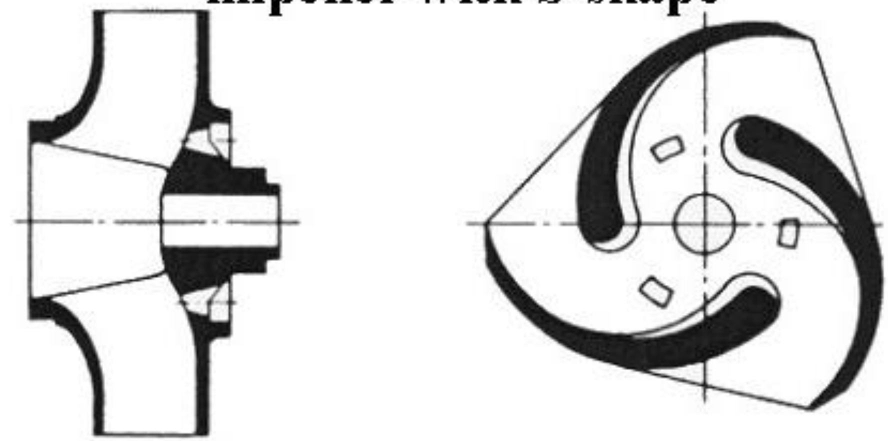


Closed 2-passages non-clogging impeller

‘S’ Type and Three Vanes Non Clog Impeller



Open 2 - passage non-clogging impeller with S-shape



3 passage non-clogging

Selection of Pump

- Considering Pump House construction
  - Wet well & Dry well
  - Wet well i.e. Sump or Jack well
  - Bore well
- Considering Nature of Liquid to be pumped
  - Water i.e. Raw or Treated
  - Chemicals i.e. Alum or Poly-Electrolyte Solution
  - Sewage i.e. Screened or Unscreened
  - Sludge
- Considering Type of Duty
  - Continuous
  - Intermittent
  - Cyclic

Selection of Pump

- Considering Present and Projected demand and pattern of change in demand
- Considering Head and Total Flow rate requirement
- Considering the efficiency of pump /s and consequent influence on power consumption and power cost
- Considering various options possible by permuting the parameters of the pumping system, including
  - -Capacity
  - -Number of pumps (working & Standbys)
  - -combining them in parallel or series
- Considering different modes of Installation in respect to
  - -cost of civil structure
  - -ease of operation and maintenance
  - -overall economics

Selection of Pump and Drive

- Consideration of head, discharge and speed
- Consideration of Suction head or Lift and calculation of NPSH available
- Consideration of System head curve for

  -constant static head

  -Variable static head (max. and min. sump liquid level)
- Consideration of Application Parameters and Suitability of Pump Features and piping layout in respect to

  -Horizontal / Vertical axis

  -Horizontal / Vertical Split Casing

  -Position of suction and Delivery Flanges

Selection of Pump and Drive

- Consideration of selection of Prime mover Type
  - -IC Engine
  - -Electric motor
- Consideration of selection of Prime mover and rating based on max. of
  - -BKW / BHP at duty parameter
  - -Max. power requirement for rated impeller
  - -Reserved power margin on BKW
- Consideration of necessary de-ration of prime mover rating for altitude, ambient temperature and humidity before finalising prime mover rating

Margin to decide Drive Rating

BKW required at the operating Point	% Margin over BKW to decide drive rating
upto 1.5 kw	50
1.5 to 3.7 kw	40
3.7 to 7.5 kw	30
7.5 to 15 kw	20
15 to 75 kw	15
75 kw and above	10

Piping layout - Pipes

Suction piping

- Keep as short and straight as possible
- Use long radius bends and elbows.
- Design suction pipe size considering 1.5 to 2.0 m/sec flow velocity.
- Use Only eccentric reducer with taper side below the c / l of pump.
- Use Suction strainer with net open area, minimum equal to three times c/s of suction pipes.
- Provide expansion bellows after valve.

Discharge piping

- Design delivery pipe size considering 2.5 m/s flow velocity
- Use radial tee or 30drg / 45drg. bend to connect discharge pipe with common manifold or header to minimise the frictional losses.
- Provide dismantling joint between pump and valves.
- Use duck Foot bend for vertical delivery pipes / Header.

Piping Layout - Valves

Suction valves

- **Use Foot valves up to 300mm pipe size when suction lift is encountered to facilitate priming**
- **For higher size suction pipe vacuum pump can be used for priming of pump.**
- **FV should be with sufficiently large strainer**
- **With positive suction condition, provide sluice valve or Butterfly valve or knife gate valve on suction to isolate pump**
- **Provide Expansion bellows between valve and pump**

Delivery valves

- **NRV near to the pump discharge flange single or multi door swing check or dual plate check valve to prevent reverse flow**
- **Sluice valve or BFV after NRV to isolate pump from common manifold or header**
- **Dismantling joints between pump & valves to facilitate easy removal during maintenance.**

Piping Layout - Valves

Header valve

- Wherever necessary, provide sluice / BF on header to isolate pumping system from Rising main during maintenance.
- In case of installing Flowmeter on Header, Isolation valve should be installed after flowmeter.
- Provide Expansion bellows between valve and Header.

Air valves

- Use air valves:

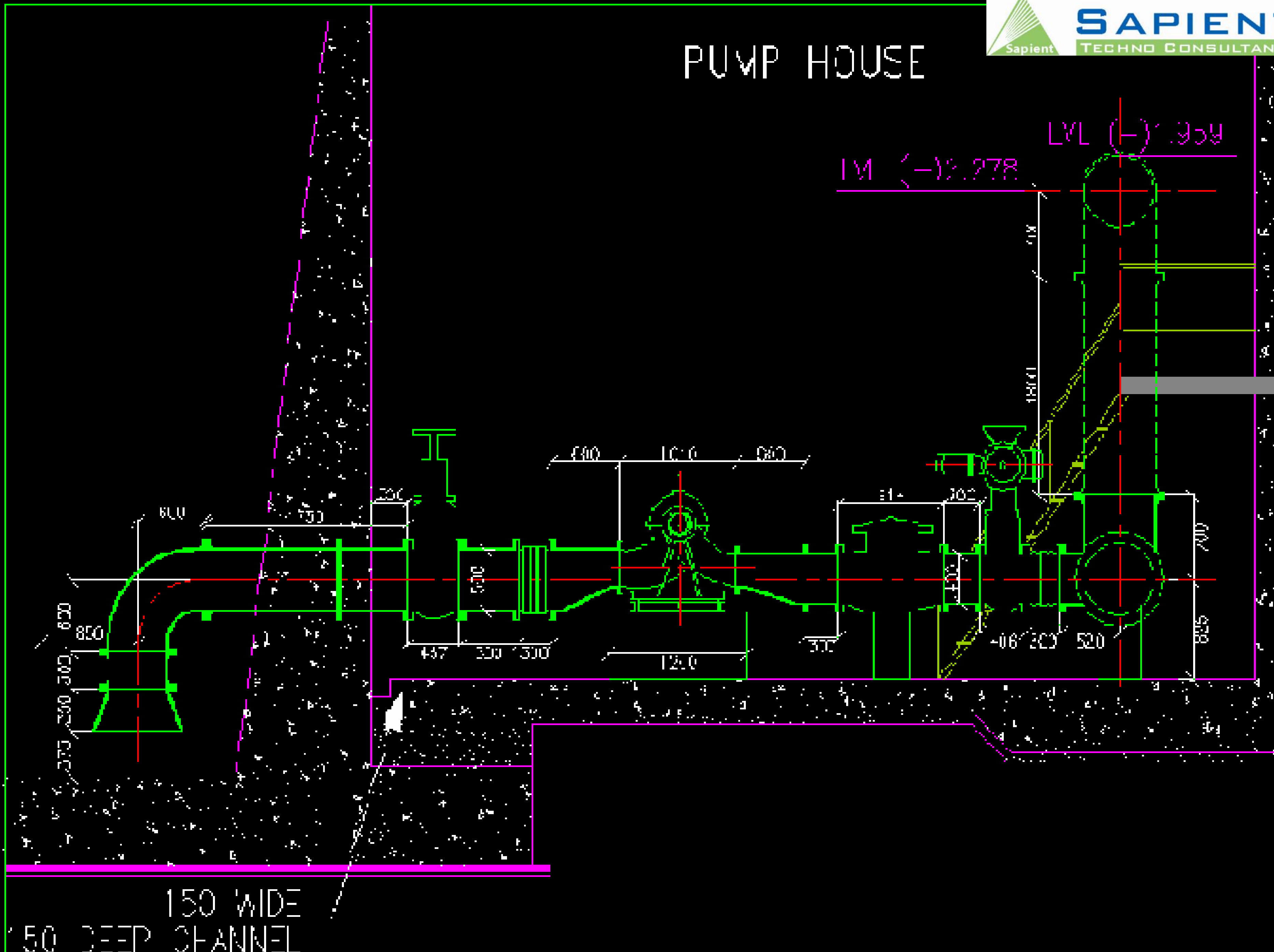
  to allow expulsion and filling of air from pipe whenever there are high points in the gradient of the pipeline, as compressed air develops high pressure and can cause bursting at the pipeline
- When pipeline is being emptied during shutdown, To permit air to enter in pipeline. Without air pipeline shall be under vacuum and it would generate undue stresses in pipes and pipe joints

Support

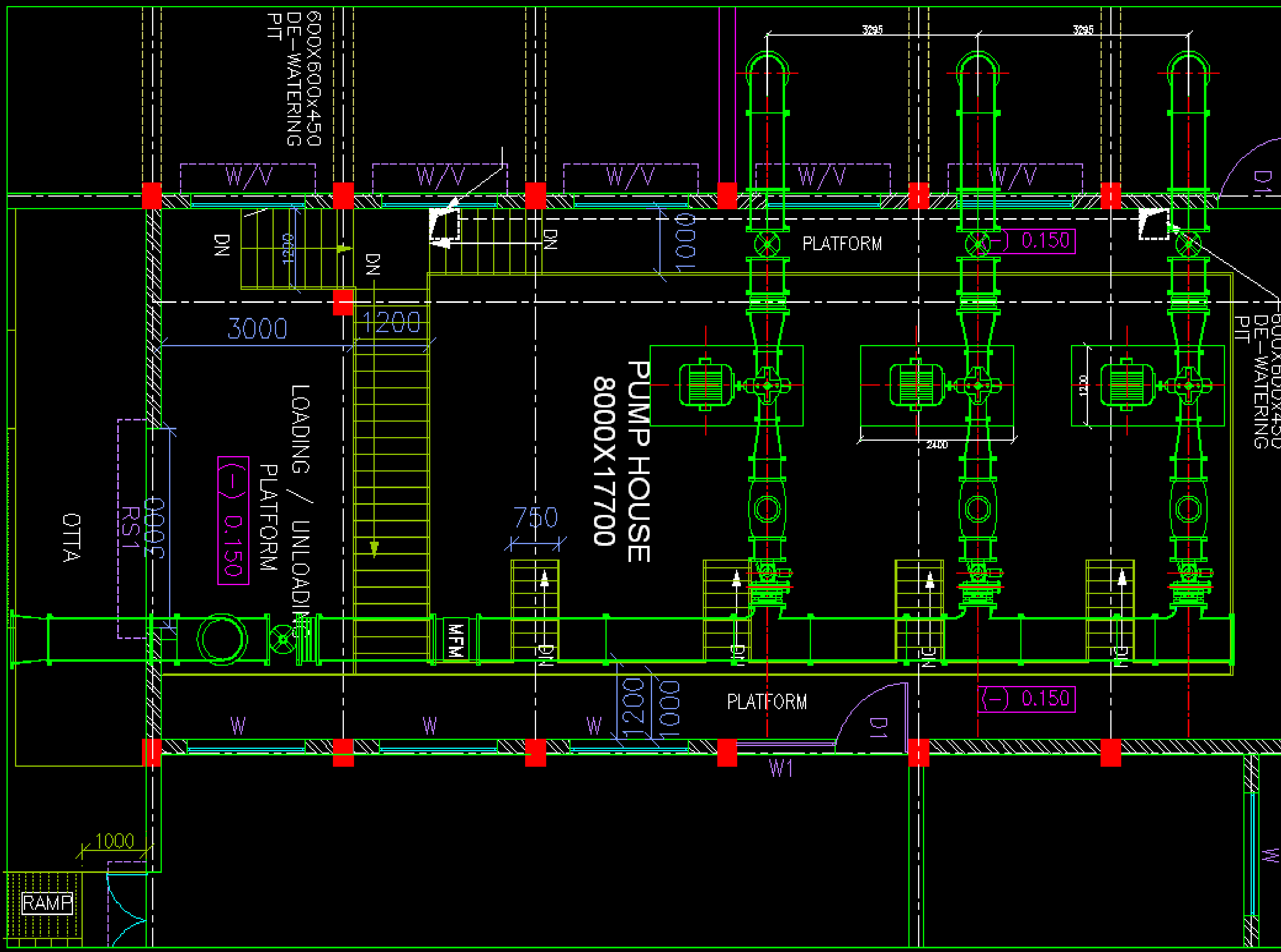
- Provide independent support to all valves
- Provide support to Header line at required interval of length.

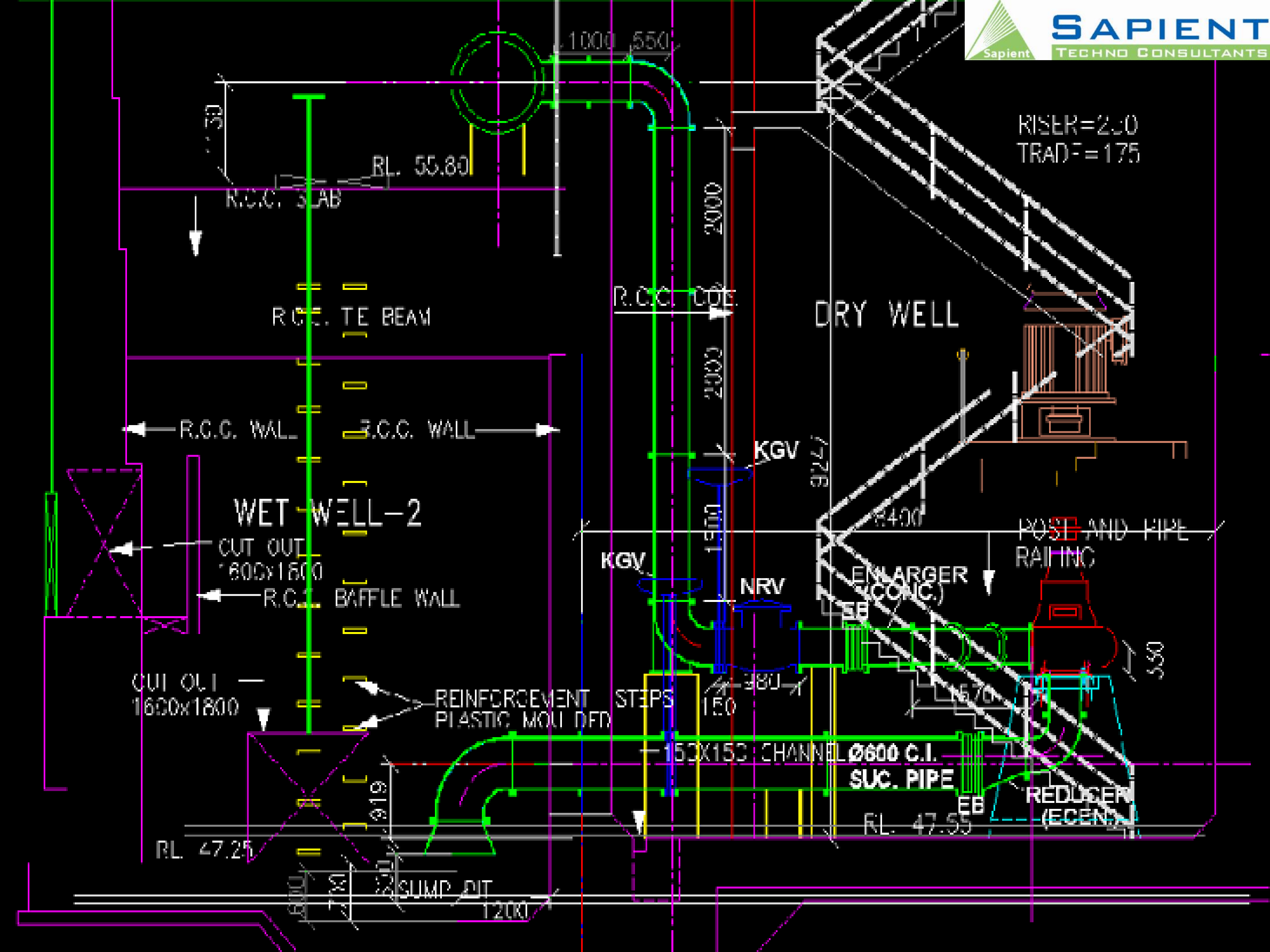
Layout Planning of Pumping System

- **Maintain min 0.6 to 1.0 mt space between adjoining pumps & motors depending upon small or medium or large units.**
- **Consider sufficient space to install pump, motor, suction and delivery pipes, fittings , valves, cables, cable trays etc. in the pump house.**
- **Make separate arrangement for control panel or construct separate MCC room.**
- **Maintain space and clearances from surrounded walls as per Indian Electricity rules.**
- **Provide service bay to accommodate the largest equipment for overhauling.**
- **Provide Ramp for loading / unloading bay.**
- **Take care of head room for crane / material handling tackles and deciding its capacity and traverse / movement.**

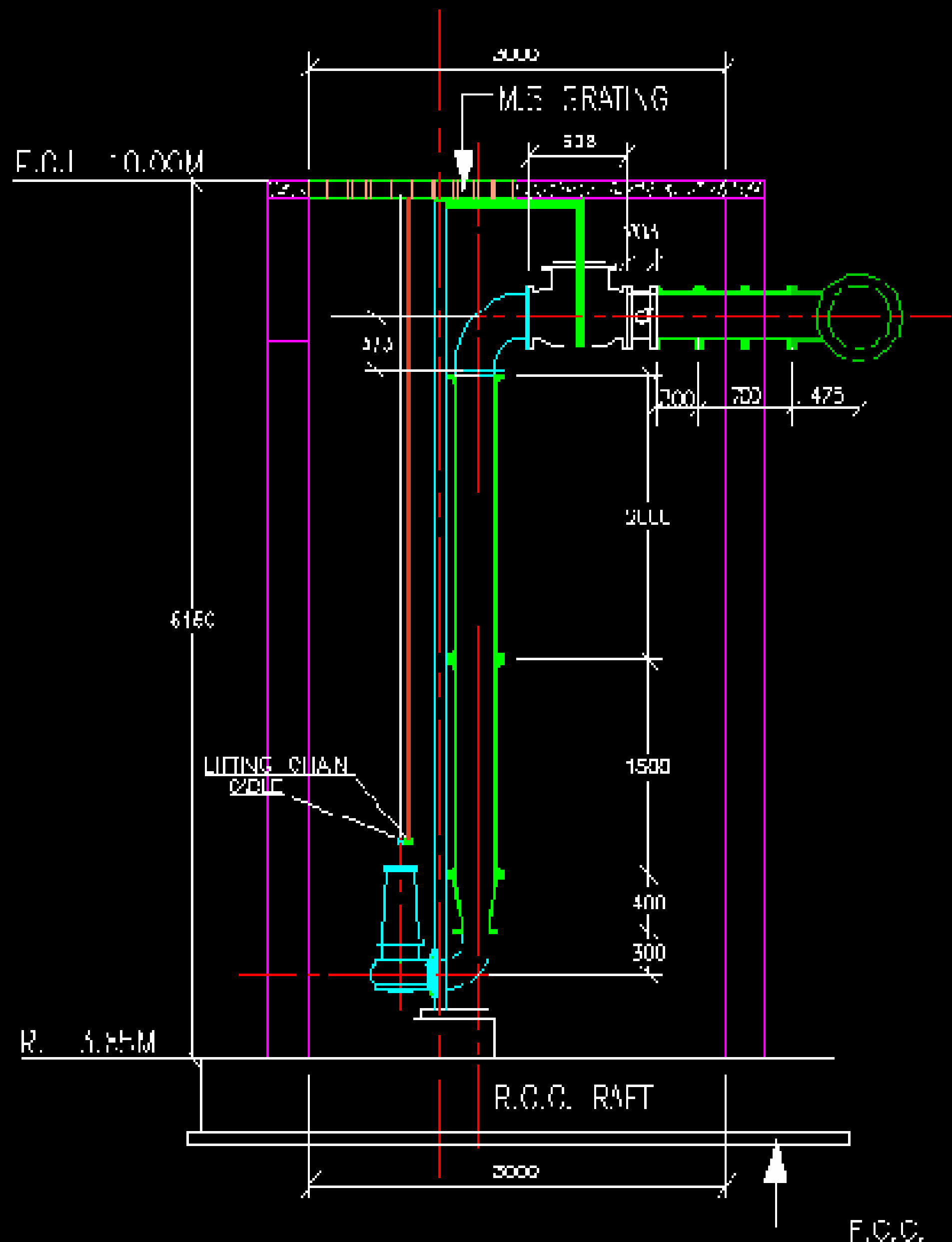

PUMP HOUSE
150 WIDE
150 DEEP CHANNEL

Sapient SAPIENT TECHNO CONSULTANTS





SAPIENT
TECHNO CONSULTANTS
1000
550
RL. 55.80
R.C.C. SLAB
R.C.C. TE BEAM
R.C.C. COL.
DRY WELL
RISER=2∪0
TRADE=175
2000
R.C.C. WALL
R.C.C. WALL
KGV
WET WELL-2
CUT OUT
1600x1800
R.C.C. BAFFLE WALL
KGV
NRV
POST AND PIPE
RAILING
ENLARGER
(CONC.)
EB
380
150
1570
CUT OUT
1600x1800
REINFORCEMENT STEPS
PLASTIC MOULDED
150X150 CHANNEL
Ø600 C.I.
SUC. PIPE
EB
REDUCER
(ECEN.)
RL. 47.55
RL. 47.25
SUMP PIT
1200



M.S. GRATING
LIFTING CHAIN
CABLE
R.C.C. RAFT
F.C.C.
3000
608
475
200
700
1500
400
300
6150
3000

Classification of Pumps

1. Based on Working Principles
2. Based on Energy input
3. Based on Method of coupling
4. Based on the position of the pump axis
5. Based on Applications
6. Based on Constructional Features

Based on Working Principles

- **-Centrifugal**
- **-Positive Displacement**
- **(Reciprocating-screw-gear, etc-lobe pump, vane pump)**

•Based on Energy input

- **-Hand pump**
- **-Engine pumpset**
- **-Electric pumpset**
- **-Steam Turbine driven**

•Based on Method of coupling

- **-Direct through Flex Couplings**
- **-Unibuilt**
- **-Belt driven**
- **-Variable speed arrangement**
- **-Right Angle Gear box driven**

- **Based on the position of the pump axis**
  - **Horizontal**
  - **Vertical** — **Vertical Turbine Pump**
    - **Bore well submersible**
    - **Volute type sump pump**
    - **Submersible Non clog.**

- **Based on Application**
  - **Water pump**
  - **Dewatering pump**
  - **Slurry pump**
  - **Sewage pump**
  - **Oil pump**
  - **Effluent pump**

- **Based on Constructional Features**

  -Type of casing

  Volute type

  Diffuser / Turbine type

  -Splitting of Casing

  Horizontal Split case

  Vertical Split Case

  Inclined split case

  -Type of Impeller

  Single suction or Double Suction

  Open, Semi - open or Enclosed

  Single vane or two vane or multi vane

  Radial or Mixed flow

  Non log

  Free Flow

  -Number of stages

  Single stage

  Double stage

  Multi stage

CENTRIFUGAL PUMP

- Horizontal Split Case
- Side Suction & Delivery Flange
- Dry Pit Horizontal axis
- Double suction Impeller

- Application :

  -Med. / High discharge

  & high head

  - Water & treated water

CENTRIFUGAL PUMP

- Horizontal Split Case
- Double stage pump
- Side Suction & Delivery Flange
- Dry Pit Horizontal axis
- Double suction Impeller

- Application :

  -Medium discharge high head

  -Water & treated water

CENTRIFUGAL PUMP

- Horizontal End Suction Non Clog
- Vertical Split Case Pump, Mixed Flow
- Dry Pit Horizontal axis

- Application :

  - Medium / high discharge & low head
  - Water & treated water
  - Storm Water
  -Sewage

CENTRIFUGAL VT PUMP

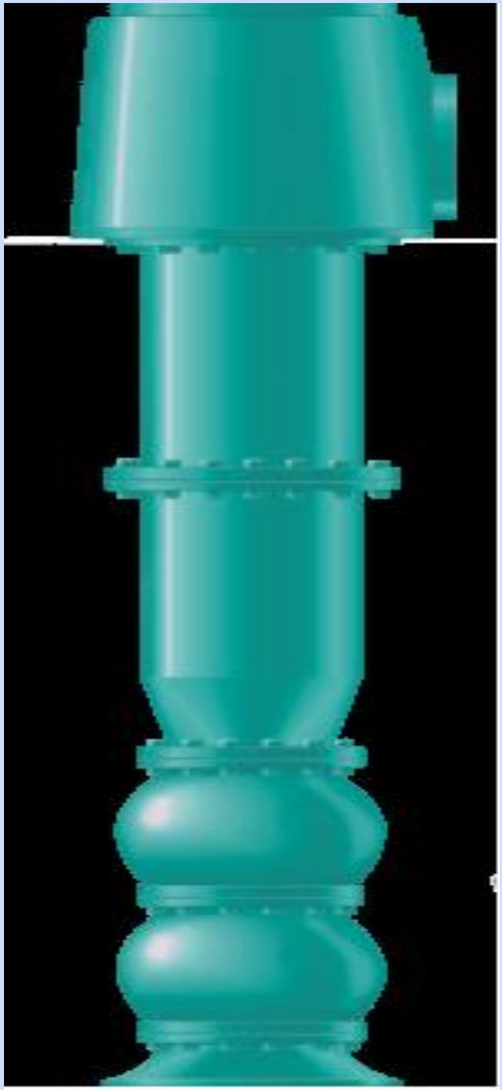
- Vertical Turbine
- Single / Multi stage pump
- Bottom Suction & Side Delivery Flange
- Wet Pit vertical shaft
- Mixed or axial flow Impeller

- Application :

  -Medium / high discharge

  and head

  -Raw Water & Water



CENTRIFUGAL PUMP

- Horizontal
- Non Clog Vertical split Case Pump,
- Dry Pit Horizontal axis

- Application :

  - Med. / High discharge & med. head
  - Sewage –screened and unscreened
  - Effluent
  - Storm water

CENTRIFUGAL PUMP SUBMERSIBLE NON CLOG

- Vertical Fixed Submersible pump
- Non Clog Vertical split Case Pump,
- Wet Pit Installation

- Application :

  - Medium & high discharge & medium head
  - Raw Water
  - Sewage –screened and unscreened
  - Effluent
  - Storm water

CENTRIFUGAL PUMP – SUBM.

- Vertical portable Submersible pump
- Non Clog Vertical split Case Pump,
- Wet Pit Installation

- Application :

  - Medium discharge & head

  - Raw Water

  - Sewage –screened and unscreened

  - Effluent

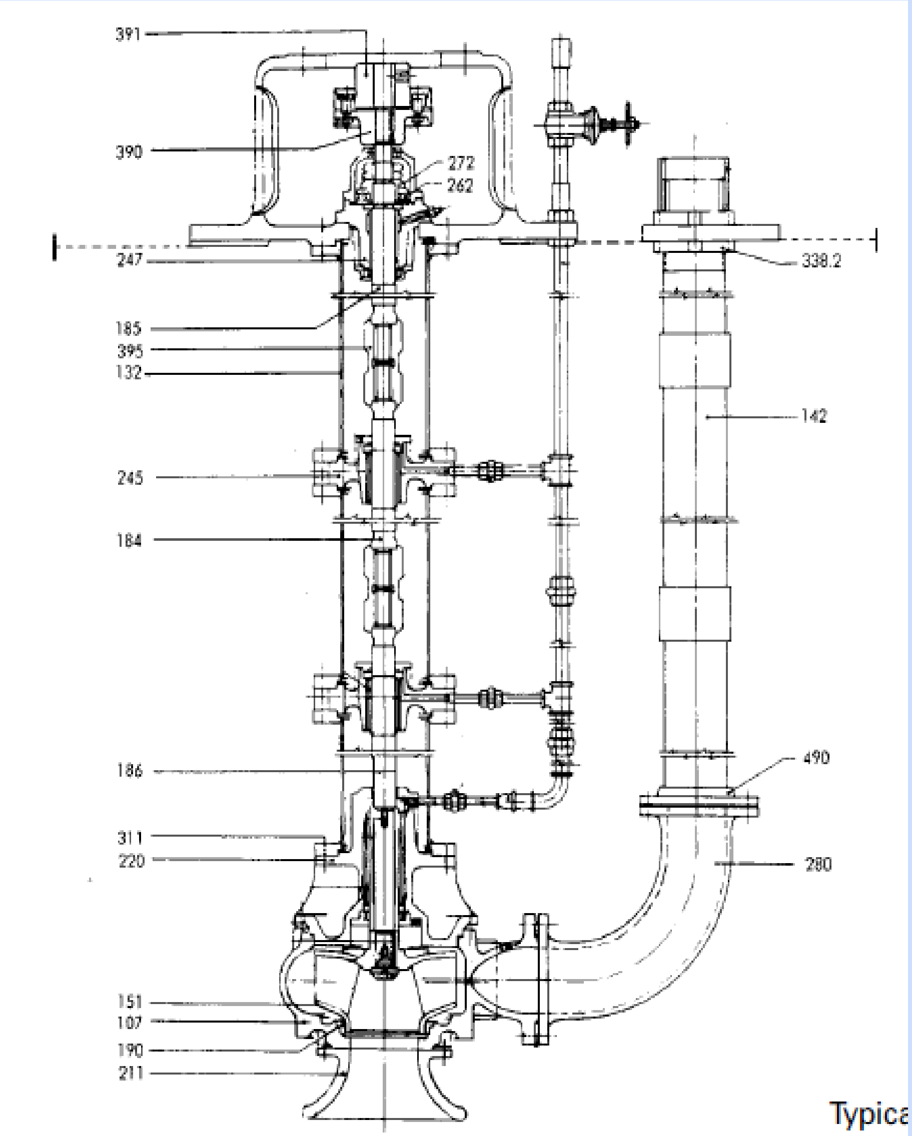
  -Storm water

CENTRIFUGAL PUMP

- Vertical Submerged pump
- Non Clog Vertical split Case
- Wet Pit Installation

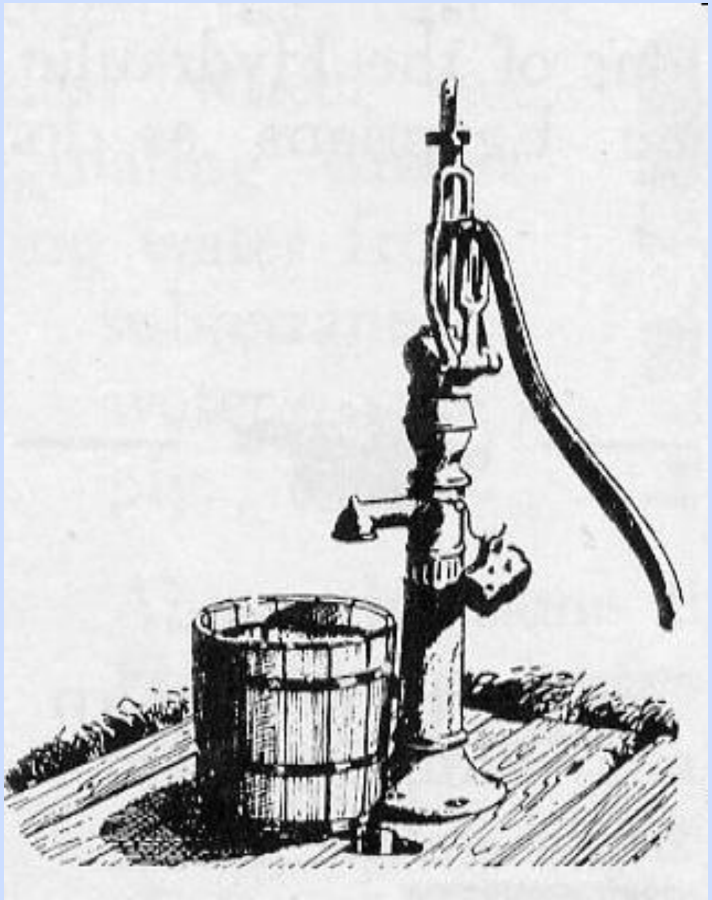
- Application :

  - Medium discharge & head
  - Raw Water
  - Sewage –screened and unscreened
  - Effluent
  - Storm water



Positive Displacement Pumps

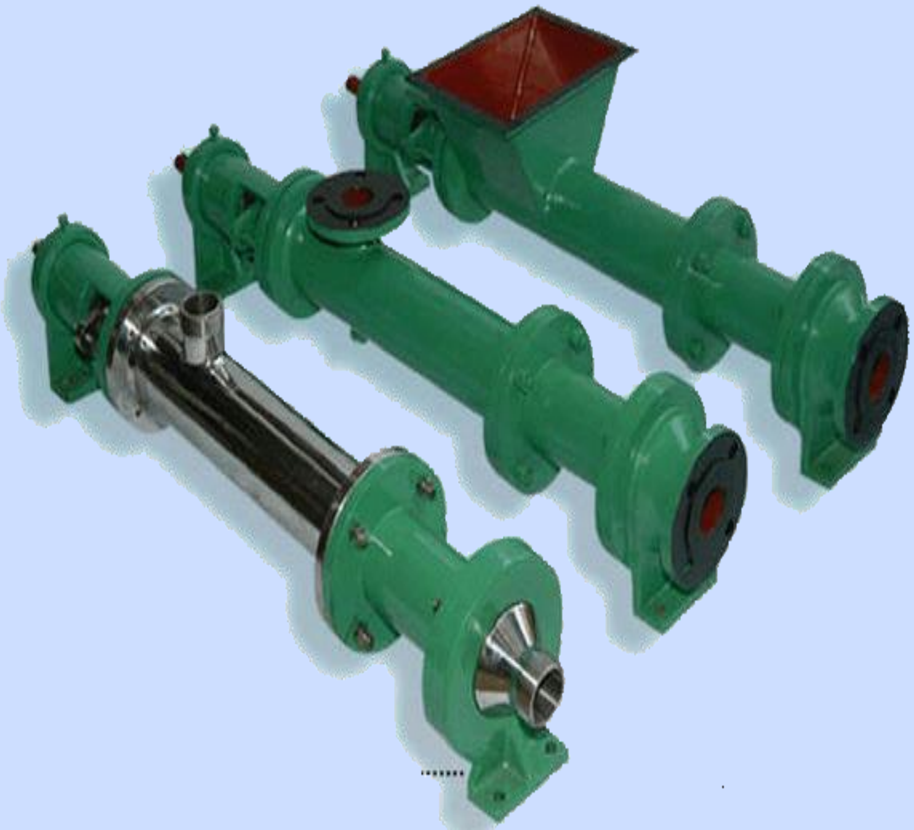
- Hand Pump



- Diaphragm Pump
  corrosive chemicals

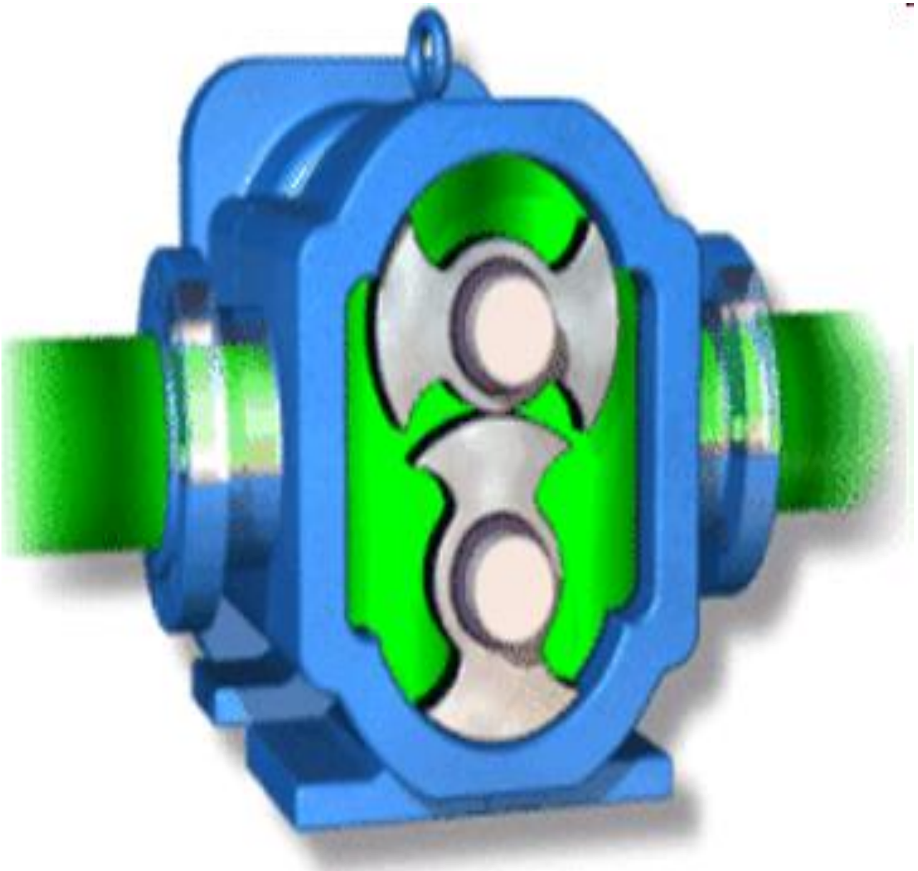
Positive Displacement Pumps

- Screw Pump for Sludge application
- Plunger Pump for Dosing application



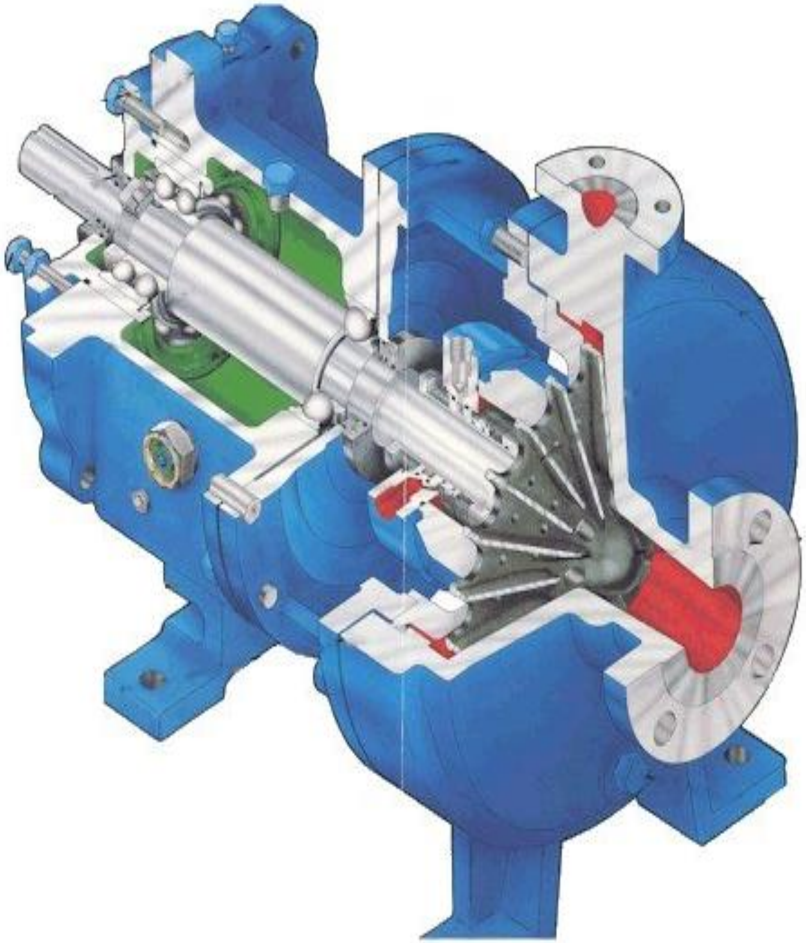
Positive Displacement Pumps

- Gear Pump
- Lobe Pump



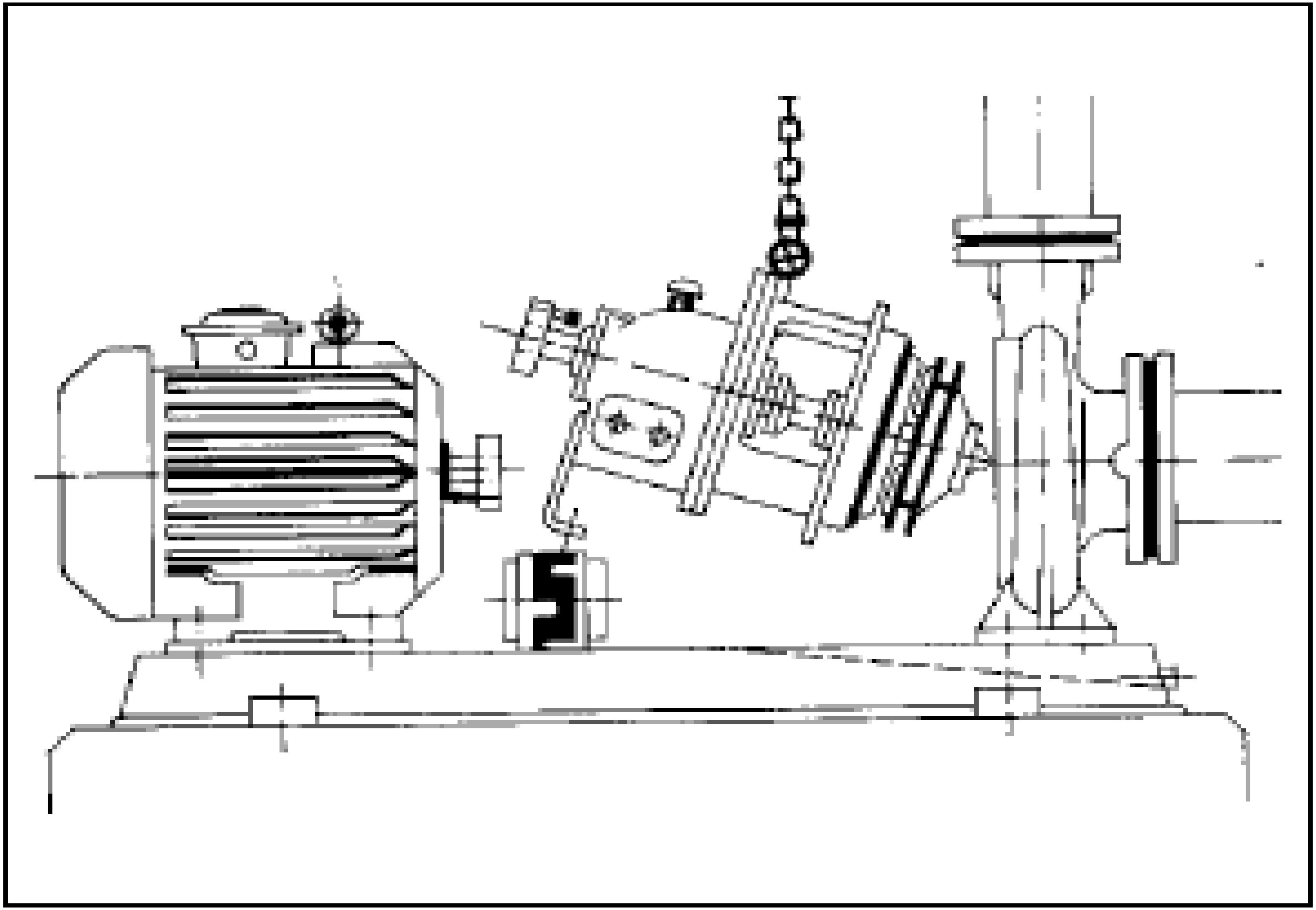
Positive Displacement Pumps

- Vane Pump



- Gear Pump

Back Pull Out Feature of End Suction Pump



INSTALLATION OF PUMPS

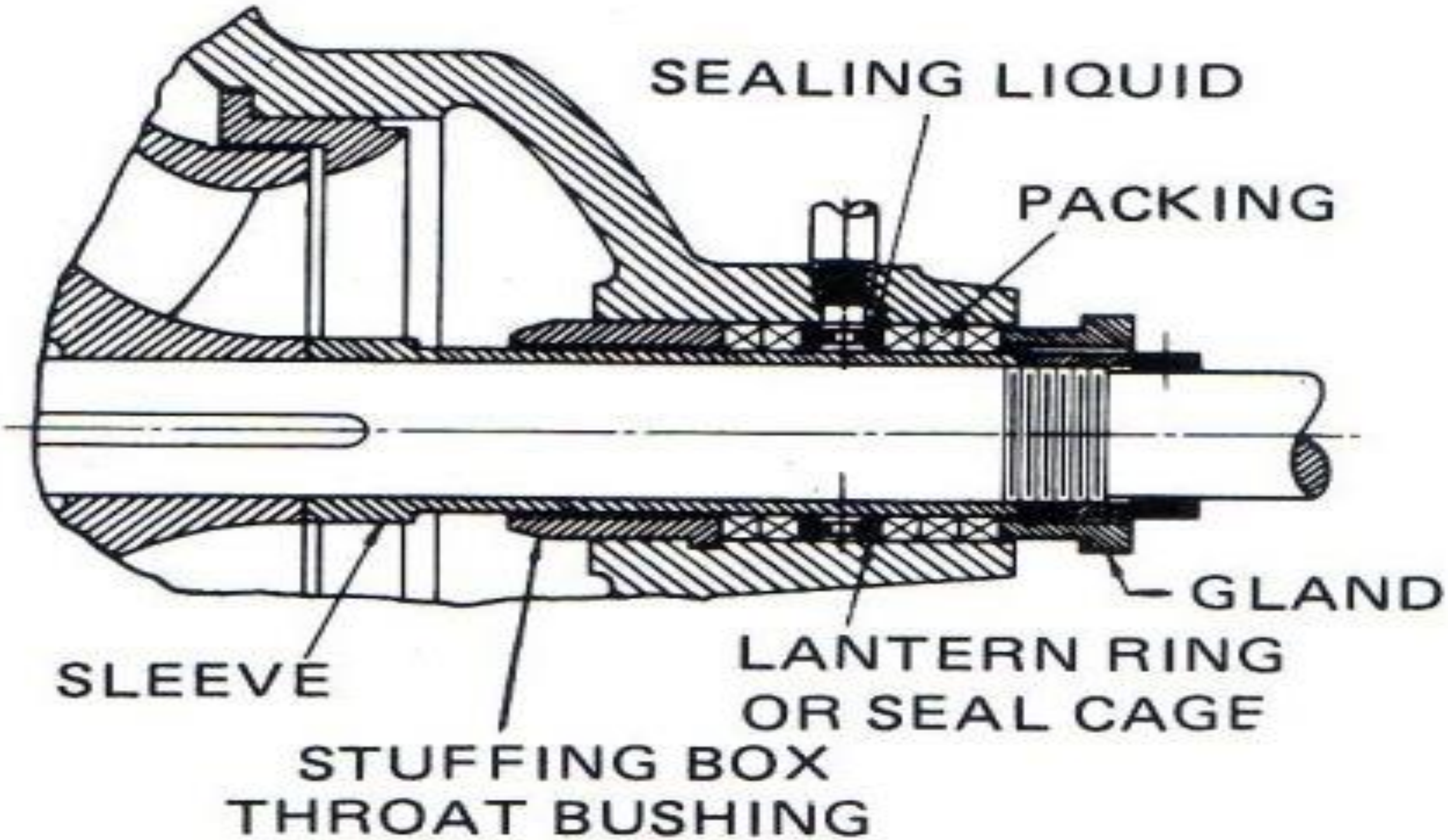
- Preparation of Foundation and fixing. Foundation bolts in pockets.
- Locating pump / base plate on foundation bolts.
- Leveling of base plate and pump set using leveling wedges.
- Grouting.
- Alignment.

Foundation

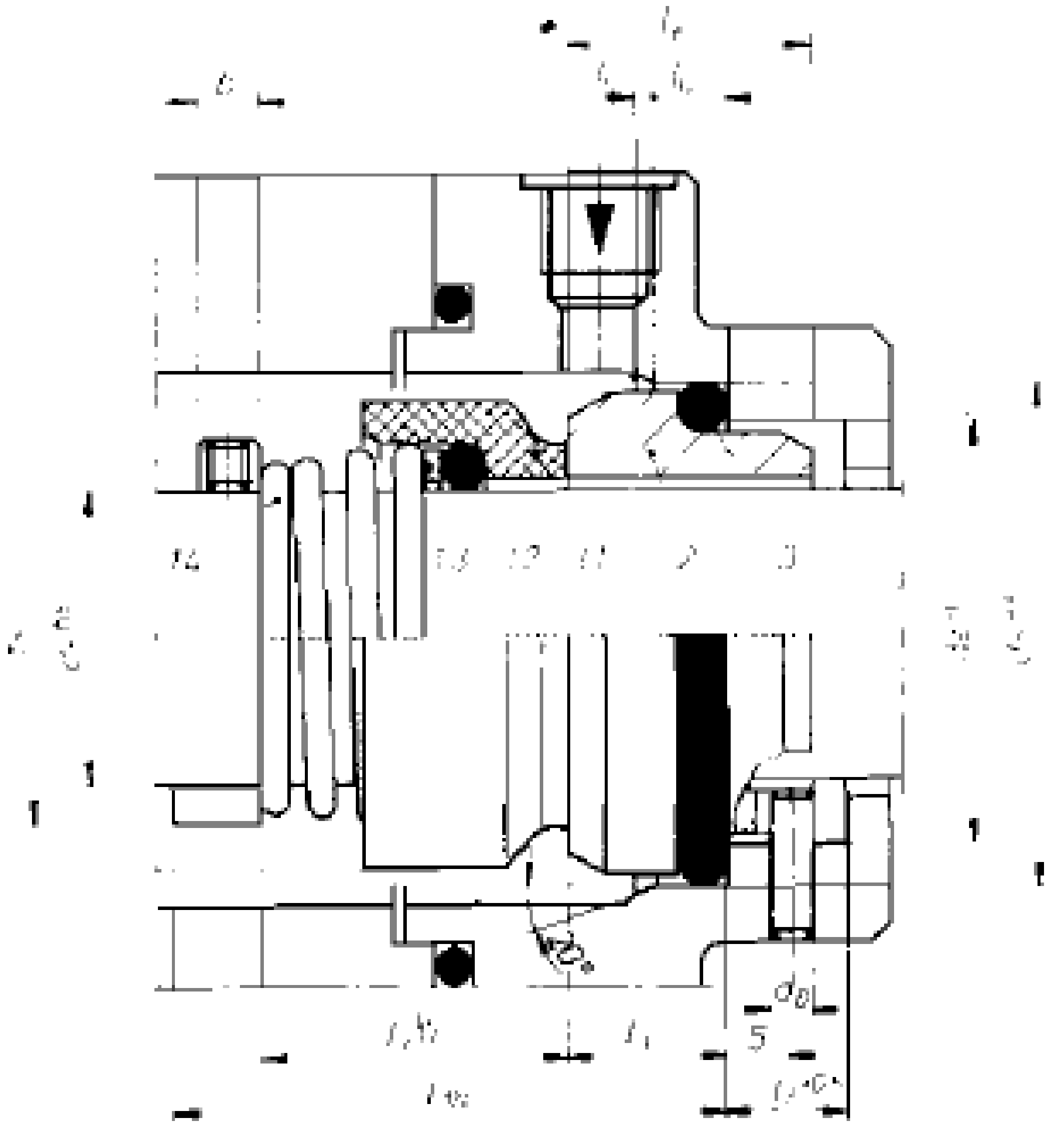
- Foundation should be sufficiently substantial to absorb vibrations and to form permanent, rigid support for the base plate.
- Capacity of the soil or supporting structure should be adequate to withstand the entire load of foundation & dynamic load of pump set
- A sole plate with machined face should be used as a bearing surface.
- Pumps, motors, coupling etc. should be thoroughly cleaned before installation.
- Submersible motors should be filled with water and installed.

Stuffing Box Packed Pump

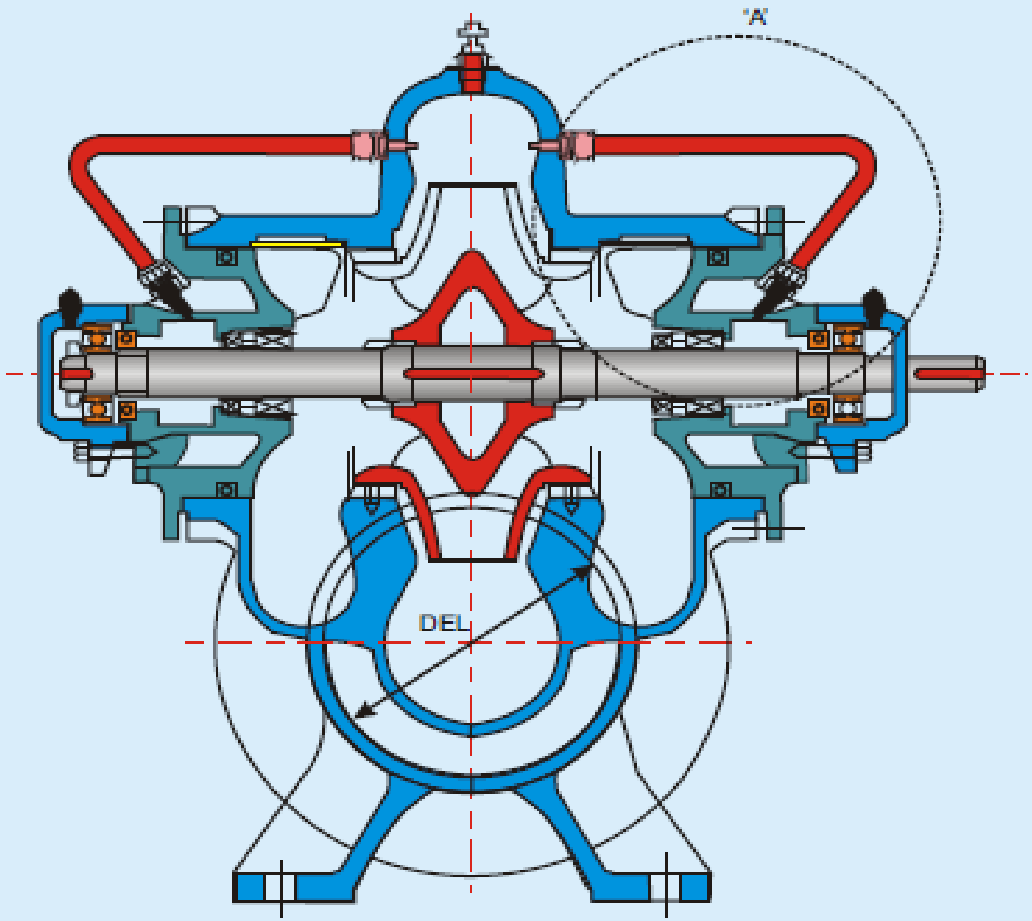
Stuffing Box Packed Pump with Lantern Ring

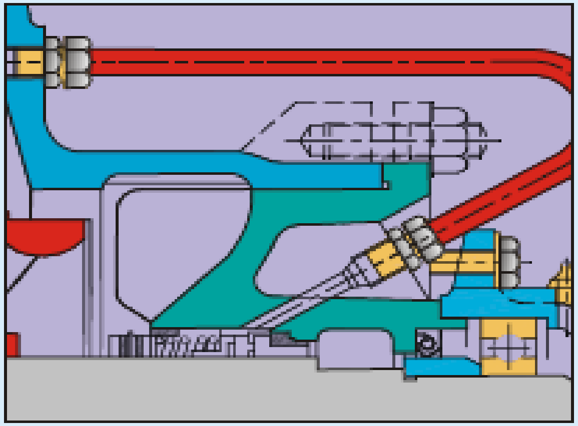


Mechanical Seal for shaft sealing



Stuffing Box sealing Connection





DETAILS AT - A

Operation

Prior to start:

- Rotate the coupling by hand .It should rotate freely.
- Ensure liquid level in suction sump.
- Check the electric supply for voltage, phases and frequency.
- Ensure suction valve open.
- Depending upon power characteristics of pump power curve, open or close the delivery valve.
- Start the water flow for stuffing box cooling or sealing or external flushing, if recommended.

Putting pump in operation:

- Start the pump. Let the motor pick up full speed.
- Open the delivery valve, if closed before starting, gradually till the current taken by motor reaches the full load or valve gets full open.
- See that motor is not getting over loaded.

Check During running:

- Check vibrations and noise .Vibrations of vertical motor should be checked at top.
- Stop the pump if abnormal noise & vibrations are observed.
- Find the cause and eliminate. Restart the pump.
- Take the temperature of bearing holder.
- Ensure stuffing box gland leaks at 60 to 90 drop per minutes or as recommended by manufacturer, if stuffing box is self sealed.
- Check if gland plate gets heated up. It should remain at normal temperature.
- In case of parallel system, Start other pumps one by one this way and observe the head and capacity developed by the pump is as designed and specified in the pump name plate.

Centrifugal Pump’s Parts

- Casing
- Impeller
- Suction cover & casing cover
- Wear Rings (Impeller / Casing)
- Shaft
- Shaft sleeve
- Impeller Nut
- Stuffing Box Housing
- Lantern Ring & gland Packing / Mech. Seal
- Water deflector
- Bearing Housing

Preventive Maintenance of Pumps

Maintenance schedules

- **Daily Observations:**

  -Operation timings of each pump.

  -Stuffing box leakage condition

  -Pump & motor bearing temperatures

  -Undue noise or vibrations, if observed

  -pressure, flow meter, voltmeter & current readings.

Preventive Maintenance of Pumps

- **Half Yearly Inspection**

-Check of free movement of stuffing box gland,

-Cleaning and oiling of gland bolts,

-Inspection of the packing and repacking , if necessary,

-vibration of pump & motor.

-alignment of pump and motor,

-cleaning of oil lubricated bearings and replenishing fresh oil as recommended by manufacturer,

-checking of grease lubricated bearings and replenish grease to correct quantity, if needed.

-Check if grease / Lubricating oil overheat the bearings after re-fill.

-Calibration of instruments.

Overhauling

- Overhaul pump after 10,000 working hours by specialised / trained fitter.
- Order required spares giving complete name plate detail of equipment.
- Keep sufficient stock of fast moving spares parts and consumables like ,gland packing, grease, lubricating oil, coupling rubber cushions, Liquid level oiler cup for oil lubricating pump.

Pump Troubles and Care

CHECK-CHART FOR CENTRIFUGAL PUMP AND ITS TROUBLES:

Sr. No.	Symptoms	Possible Cause of trouble (explanation of Nos. given below)	Sr. No.	Symptoms	Possible Cause of trouble (explanation of Nos. given below)
1	Pump does not deliver	1 , 2 , 3 , 4 , 6 , 11, 14, 16, 17, 22, 23	6	Packing has short life	12, 13, 24, 26, 28, 32, 33, 34, 35, 36, 38, 39, 40
2	Insufficient capacity delivered	2 , 3 , 4 , 5 , 6 , 7 , 8 , 9 , 10 , 11, 14 , 17 , 20 , 22, 23 , 29 , 30	7	Pump vibrates or is noisey	2 , 3 , 4 , 9, 10 , 11 , 21 , 22, 29 , 30,31
3	Pump loses priming after starting	2 , 3 , 5 , 6 , 7 , 8 , 11, 12 , 13	8	Insufficient pressure developed	5 , 14 ,16 , 17, 20 , 22 , 29 , 30 , 31
4	Pump requires excessive power	15 , 16 , 17 , 18 , 19 , 20 , 23 , 24 , 26 , 27 , 29 , 33 , 34 , 37	9	Bearing have short lift	24 , 26 , 27 , 28, 35 , 36 , 41 , 42, 43, 44 , 45 , 46 ,47
5	Stuffing Box leaks successively	13 , 14 , 26 , 32 , 33 , 34 , 35 , 36 , 38 , 39 , 40	10	Pump overheats and seizes	1 ,4 , 21 , 22, 24 , 27 , 28 , 35 , 36 ,41

Possible Causes of Troubles

Suction Troubles:

1. Pump not primed
2. Pump or suction pipe not completely filled with liquid
3. Suction lift too high
4. Insufficient margin between suction pressure and vapour pressure, i.e insufficient NPSHa
5. Excessive amount of air or gas in liquid
6. Air pocket in suction line
7. Air leaks in suction line
8. Air leaks in pump through stuffing box
9. Foot valve too small
10. Foot valve partially clogged.
11. Inlet of suction pipe insufficiently submerged.
12. Water – Seal pipe plugged
13. Seal cage improperly located in stuffing box preventing sealing fluid entering space to form the seal

Possible Causes of Troubles

Mechanical Troubles:

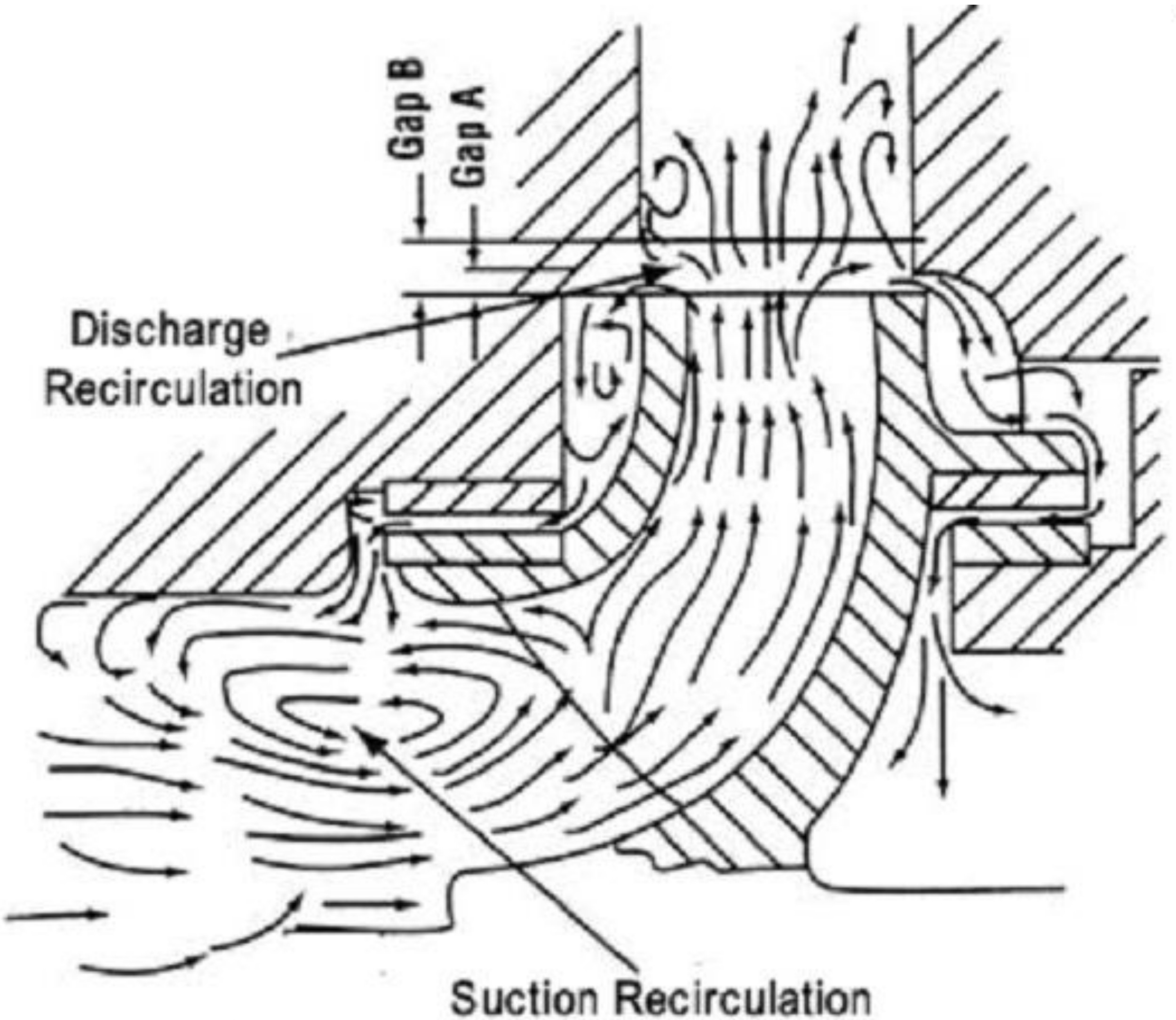
23. Foreign material in impeller
24. Misalignment
25. Foundation not Rigid
26. Shaft bent
27. Rotating part rubbing on stationary part
28. Bearing worn
29. Wearing rings worn
30. Impeller damaged
31. Casing gasket defective permitting internal leakage.
32. Shaft sleeves worn or scored at the packing
33. Packing improperly installed
34. Incorrect type of packings for operating conditions.
35. Shaft running off center because of worn bearings or misalignment

Possible Causes of Troubles

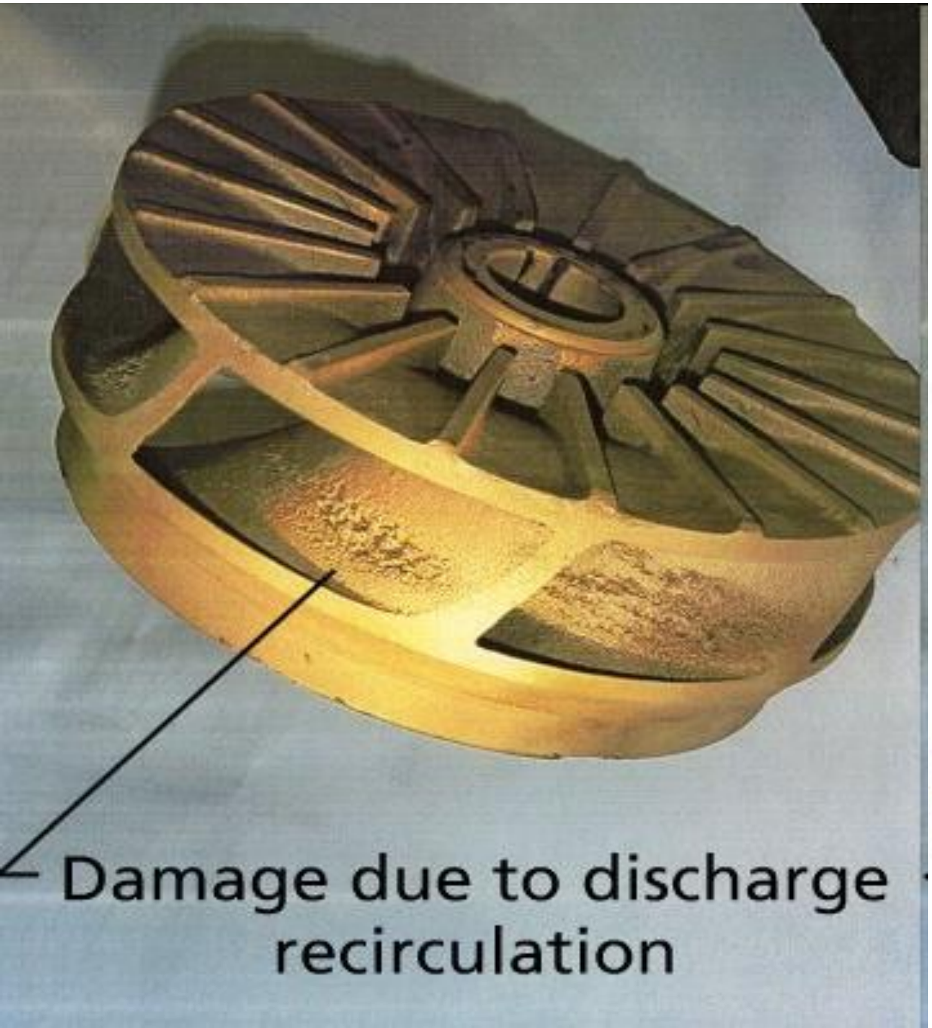
Mechanical Troubles (continue):

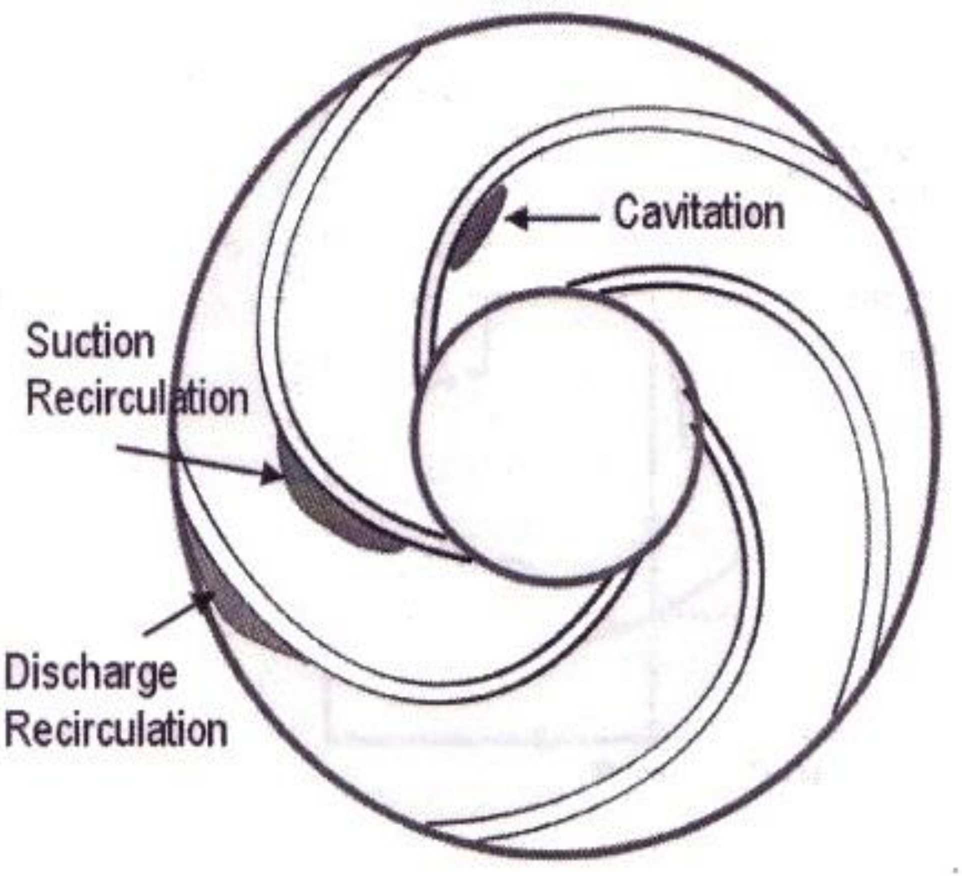
36. Rotor out of balance resulting in vibration
37. Gland too tight resulting in no flow of liquid to lubricate packings.
38. Failure to provide cooling liquid to water cooled stuffing boxes.
39. Excessive clearance at bottom of stuffing box between shaft and casing, causing packing to be forced into pump interior.
40. Dirt or grit in sealing liquid, leading to scoring of shaft and shaft sleeve.
41. Excessive thrust caused by a mechanical failure inside the pump or by the failure of the hydraulic balancing device, if any.
42. Excessive grease or oil in antifriction bearing housing or lack of cooling causing excessive bearing temperature.
43. Lack of lubrication
44. Improper installation of antifriction bearings (damage during assembly, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, etc)
45. Dirt getting into bearings.
46. Rusting of bearings due to water getting into housing
47. Excessive cooling of water –cooled bearing resulting in condensation in the bearing housing of moisture from the atmosphere.

Recirculation of fluid

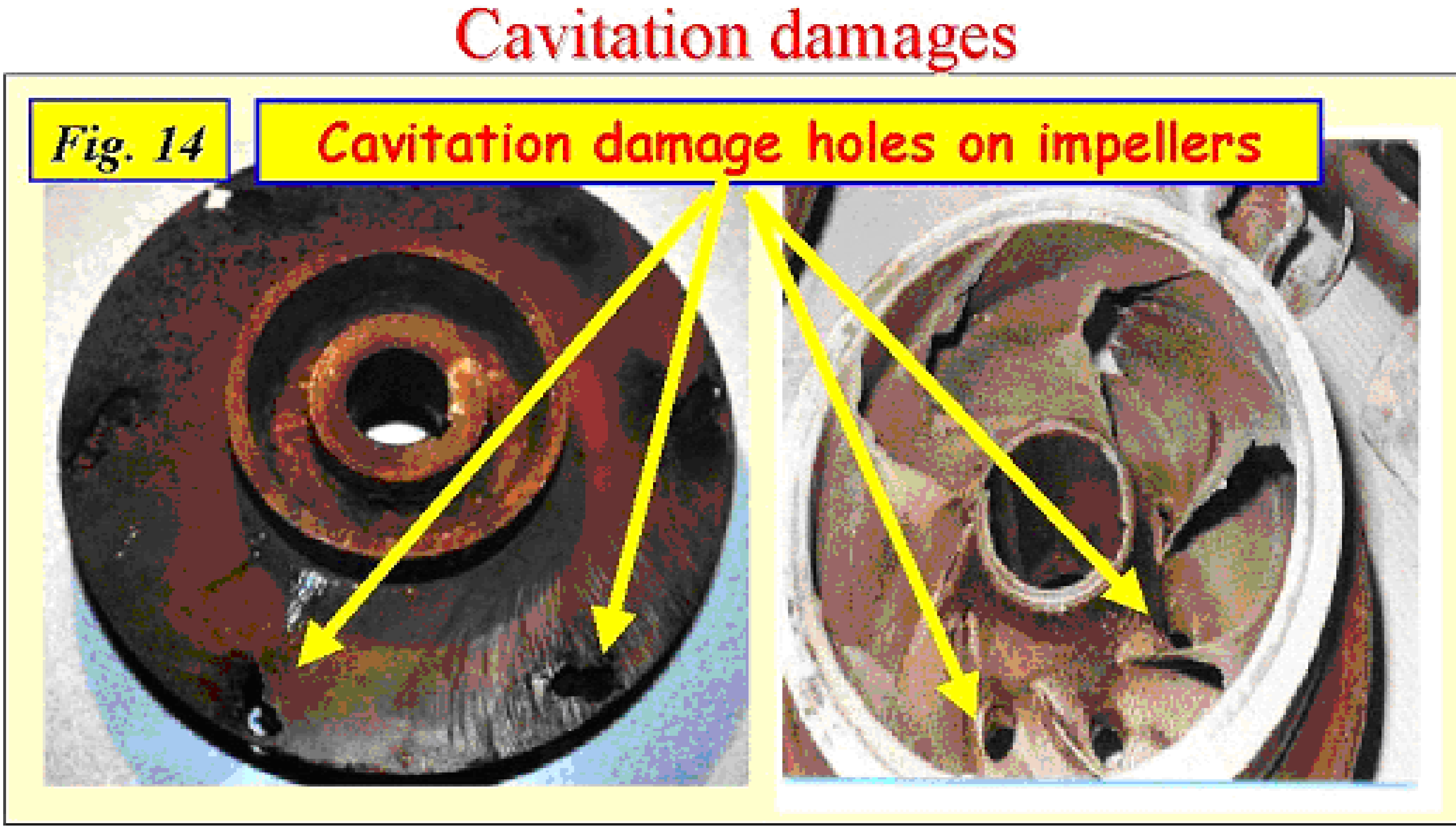


Damage due to Suction & Discharge Recirculation





Damage due to Cavitation



TEN DON'TS FOR PUMP

For getting maximum service from the Pump selected for certain Duty parameters and Operating conditions

DO NOT RUN THE PUMP

1. Outside the recommended range.
2. Without lubricating the bearings with grease or oil.
3. With liquid other than specified
4. With less NPSH than recommended
5. With delivery valve fully shut for longer period.
6. When misaligned
7. Without lubricant to the stuffing box either external or internal
8. Unless periodically checked as suggested.
9. With undue weight on suction and delivery pipe flanges,
10. When strainer is removed from suction.

Thank You