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SFI GEC PALAKKAD

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION(2019 scheme), DECEMBER 2019**

**Course Code: EST 120**

**Course Name: BASICS OF CIVIL & MECHANICAL ENGINEERING**

**PART I: BASIC CIVIL ENGINEERING**

(2019-Scheme)

Max. Marks: 50

Duration: 90 min

**PART A**

*Answer all questions, each carries 4 marks.*

- 1 Explain any two major disciplines of civil engineering.
- 2 What are the qualities of a good building stone?
- 3 Discuss the principles of surveying.
- 4 List out the criteria for the selection of a good roofing material.
- 5 Define bearing capacity of soil.

(5x4=20)

**PART B**

*Answer one full question from each module, each question carries 10 marks*

**Module-I**

- 6 a) Discuss the components of a residential building with a neat figure. (5)
- b) Explain the role of NBC, KBR and CRZ norms in building rules. (5)

**OR**

- 7 a) Discuss the requisites of a good site plan for a building. (5)
- b) List out any five major factors to be considered for the selection of a good site for a residential building. (5)

**Module-II**

- 8 a) Explain the types and uses of architectural glass as a construction material. (5)
- b) With sketches explain any five market forms of steel section and their uses. (5)

**OR**

- 9 a) List out any five major qualities of a good timber. (5)
- b) List out two uses of any five different types of cement. (5)

**Module-III**

- 10 a) With a neat sketch explain any two types of shallow foundation. (5)
- b) With neat sketches compare English bond and Flemish bond. (5)

**OR**

**D**

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**Pages:4**

- 11 a) Explain the water management and energy management in green buildings. (5)
- b) Discuss the civil engineering aspects of MEP and HVAC in a commercial building. (5)

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**PART II: BASIC MECHANICAL ENGINEERING**  
(2019-Scheme)

Max. Marks: 50

Duration: 90 min

**PART A**

*Answer all questions, each carries 4 marks.*

- 1 Draw the p-V diagram of a diesel cycle and define the terms (i) (4)  
Compression ratio, (ii) Expansion ratio, and (iii) Cut-off ratio related to the Diesel cycle.
- 2 With the help of a neat sketch show the important parts of an internal (4) combustion engine.
- 3 Define Cooling and Dehumidification .Also show the process in (4) psychrometric chart.
- 4 Differentiate between Impulse and Reaction turbine. Give examples for (4) each type.
- 5 Define the terms Rapid prototyping and Additive manufacturing. (4)

**PART B**

*Answer one full question from each module, each question carries 10 marks*

**Module-IV**

- 6 An engine working on Diesel cycle has diameter 150 mm and stroke 200 (10 ) mm. The clearance volume is 10 % of the swept volume. Determine the compression ratio and air standard efficiency of the engine if the cut-off takes place at 6 % of the stroke.

**OR**

- 7 a) Explain the MPFI system with block diagram. Also give its advantages (6)  
b) Give the concept of hybrid engines. (4)

**Module-V**

- 8 a) A centrifugal pump using 1kW of electric motor for pumping water against (5) 3m suction head and 7m delivery head. The discharge of the pump is 100 litters /minute. Find the efficiency of pump.
- b) Explain the open belt and cross belt drive in power transmission. Also give (5) the applications.

**D****NSA192007****OR****Pages:4**

- 9 a) A turbine is working at a head of 250 m and the discharge through the penstock is  $2 \text{ m}^3/\text{s}$ . If the efficiency of the turbine is 55 % , find the power developed by the turbine. (5)
- b) Explain the reversed Carnot cycle with PV Diagram. (5)

**Module-VI**

- 10 a) How the welding processes are classified? List out the different types of welding methods. (4)
- b) Explain the process of Arc welding with the help of a sketch. (6)

**OR**

- 11 Describe the working of a Milling machine. Draw the block diagram of a Milling machine and indicate its main parts. (10)

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Course Code: EST 120

# BASICS OF CIVIL & MECHANICAL ENGINEERING

## PART- 1: BASIC CIVIL ENGINEERING

(2019)  
Scheme

### PART- A

#### 1. ◦ Construction Engineering

As the name indicates construction engineering means execution of all designs and plans on the ground. The construction phase of a project represents the first tangible result of a design. Using technical and management skills, construction engineers turn designs into reality on time and with available resources.

#### ◦ Structural Engineering

Structural engineering is dealt with design of structures that supports their own weight and the loads they carry,

and that, i resist extreme forces from wind, earthquakes, bombings, temperature and others. Bridges, buildings, dams, towers and many other kind of projects are included within this specialty.

2.

- ① A good building stone should have a minimum crushing strength of  $100\text{N/mm}^2$
- ② It should have sufficient hardness (ie minimum coefficient of hardness of 14)
- ③ It should have high resistance to wear and tear
- ④ The specific gravity of good building stone should be greater than 2.7
- ⑤ It should have a high impact value
- ⑥ The % of water absorption after 24 hours should be less than 0.6.
- ⑦ It should have a suitable texture for carving and dressing.
- ⑧ It should have a good crystalline structure and better appearance.

3.

### ① Working from Whole to Part

The main principle of surveying is to work from whole to part. To achieve this on site, for a given land a set of primary central points are established with higher precision in and around the area. This is to prevent accumulate errors and to localize the minor errors. Later, inner control points are established in between those primary central points. The details are surveyed with the help of inner control points. This principle is called working from whole to part.

②

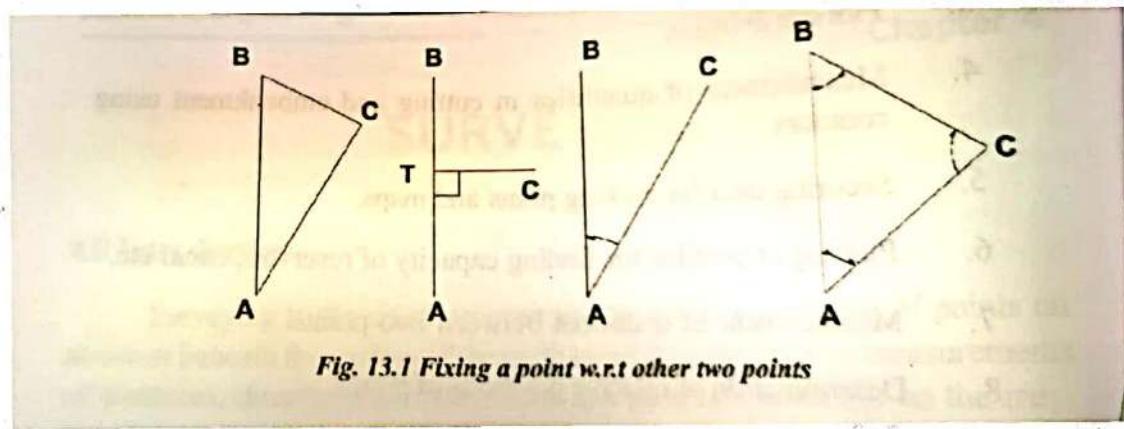


Fig. 13.1 Fixing a point w.r.t other two points

The relative position of a point can be fixed with reference to two other points by means of linear and angular measurements.

In the above figure, let A and B are given points. C is the point which can be fixed in different ways as shown above.

Case 1. By measuring the distances AC and BC by drawing two arcs from A and B

Case 2. By dropping a perpendicular from C to AB

Case 3: By measuring distance AC and angle BAC

Case 4: By measuring the interior angles of the triangle ABC.

4.

- ① It should protect the building from weathering agencies like sun, rain, wind etc.
- ② It should be durable
- ③ Roof should be water proof with good drainage arrangements

- (4) It should be fire resistant
- (5) Should have adequate strength and stability
- (6) It should have thermal and sound insulation properties.

5.

In geotechnical engineering, bearing capacity is the capacity of soil to support the loads applied to the ground. The bearing capacity of soil is the maximum average contact pressure between the foundation and the soil which should not produce shear failure in the soil. Ultimate bearing capacity is the theoretical maximum pressure which can be supported without failure.

## PART-B

### Module - I

6.

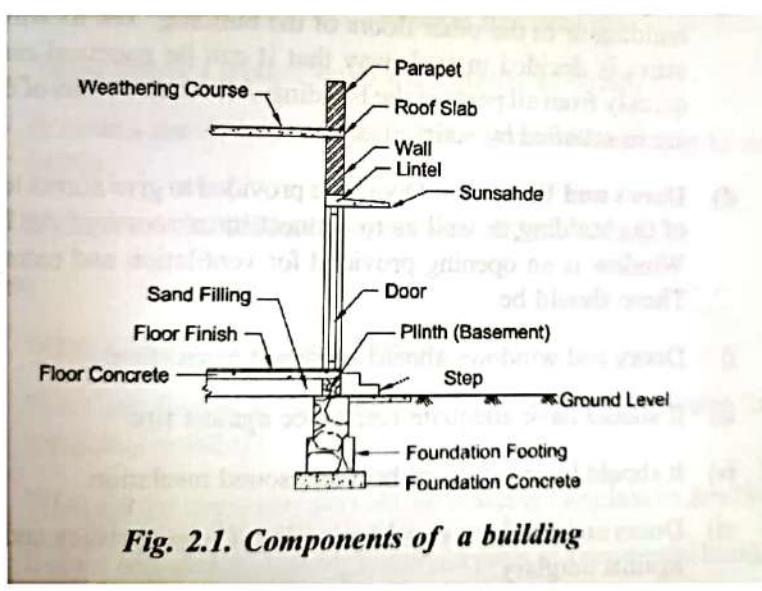
a. Components of buildings

1. Sub - Structure or Foundation
2. Plinth
3. Super Structure

① Sub-structure : is the portion of the building, below ground level, which transmits the load of super structure to the soil. It is the most critical part of the building which safeguards the building against the forces of wind, uplift, soil pressure etc.

② Plinth: is the middle part of building above the surface of the surrounding ground up to the surface of the floor. Sometimes it is also called a basement.

③ Super structure : is that component of the building which is constructed above the plinth levels. It includes walls, piers, floors, doors, windows, lintels, sunshades, roofs, steps, etc.



*Fig. 2.1. Components of a building*

7.

- ① Property Lines - Including property lines on your development site plan is one of the most important elements.
- ② Distance between Buildings and property Lines - understanding your site goes beyond staying inside your own property line. Surrounding infrastructure and buildings play an important role in shaping your design
- ③ Existing and proposed conditions - For officials and plan reviewers to grasp the full scope of your design, you'll want to present both existing and proposed conditions
- ④ Construction Limits and Lay Down Areas. This shows the areas of the property where construction take place. It also will delineate the area located on or near the site where the construction-related supplies, storage, and partial assembly takes place
- ⑤ Parking Area - Make sure to include parking diagram

b. National Building Code (NBC) controls ultimately all construction activities in our country. It provides guidelines for all regulation related to building construction. Information and mandatory practices are available in NBC related to Development and building planning, structural Design aspects, Construction and Asset / facility management., Building services, Plumbing services and solid waste management etc.

Kerala Building Rules - In our country, states and union territories have framed building rules and rules of fire fighting, solid waste management etc based NBC. In Kerala we follow KBR

Coastal Regulation Zone (CRZ).— Central government has declared the coastal stretches up to its territorial limit of our country excluding the islands of Andaman and Nicobar and Lakshadweep as Coastal Regulation Zones in order to ensure livelihood security to people residing in coastal area, to conserve and protect coastal stretches and to promote development through sustainable manner.

- b) ① The site should be fairly level with good quality soil.
- ② The location should be calm but reasonably developed.
- ③ It should be well connected by the roads and other smooth modes of transport.
- ④ It should have good communication facilities.
- ⑤ Electricity, water, sewer lines should be available.

8.

- a) ① Laminated Glass: It consists of two or more layers of glass with one or more layers of a transparent / pigmented and specially treated plastic Polyvinyl Butyral sandwiched between the glass layers. Used in majority of buildings and for high security places.
- ② Tempered or Toughened Glass: It is an extremely strong glass which is heat treated to a uniform temperature of approximately  $650^{\circ}\text{C}$  and rapidly cooled to induce compressive stresses of  $770 \text{ kg/m}^2$  to  $1462 \text{ kg/m}^2$  on the surfaces. It is used in commercial applications such as safety glazing, railings, fire knock-out windows etc.

③ Heat Strengthened Glass: Heat strengthened glass is a type of tempered glass which has been strengthened thermally by inducing a surface compression of 422 to  $658 \text{ kg/cm}^2$ . Used for spandrel and vision panels of curtain walls.

④ Reflective Glass: It is the glass on which a metallic coating is applied to one side in order to increase the amount of reflection by the glass of both the visible and infra-red range of electro magnetic spectrum. Used in office building, high-rise building, Entrance, privacy windows etc.

⑤ Insulating Glass: It is a prefabricated unit made of two or more glass panes, separated by a cavity and edges hermetically sealed together. Used in building with exceptionally high heating or cooling requirements.

## b) Channel Sections:

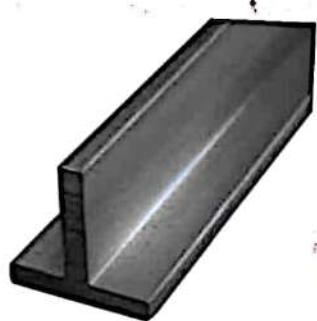
Channel sections have 2 equal flanges and a web. Channel sections are used in steel framed structures, grids and steel bridges.



② I Sections: It's usually gullied. It is as rolled steel joists or beams and are used for floor beams, lintels, columns.



③ T Sections: It has a 'T' cross-section and are used in steel roof trusses, in built-up sections in steel water tanks and in chimneys and bridges.



④ Bars

- Square bars: for railing and grill work
- Round bars: in reinforced concrete and brick work.



⑤ Flats: These are plates with longer length and shorter width. width varies from 18 to 500mm and thickness from 3 to 8 mm. used in grill works and railings.



9

- a. ① It should be hard enough to resist deterioration.
- ② It should have sufficient strength to resist heavy structural loads.
- ③ It should have the property of elasticity so as to regain its original shape after removal of loads.
- ④ It should be able to resist attacks of fungi and worms and also atmospheric effects for a longer period of time.
- ⑤ It should have straight and closed fibres and compact medullary rays.

b.

### ① Rapid hardening Cement.

- ① In pre-fabricated constructions
- ② Road Repair works

### ② Coloured cement

- ① Floor finishing works
- ② Plastering of wall

### ③ Sulphate Resisting Cement

- ① For marine structures

④ For sewage treatment structures.

#### ④ White Cement

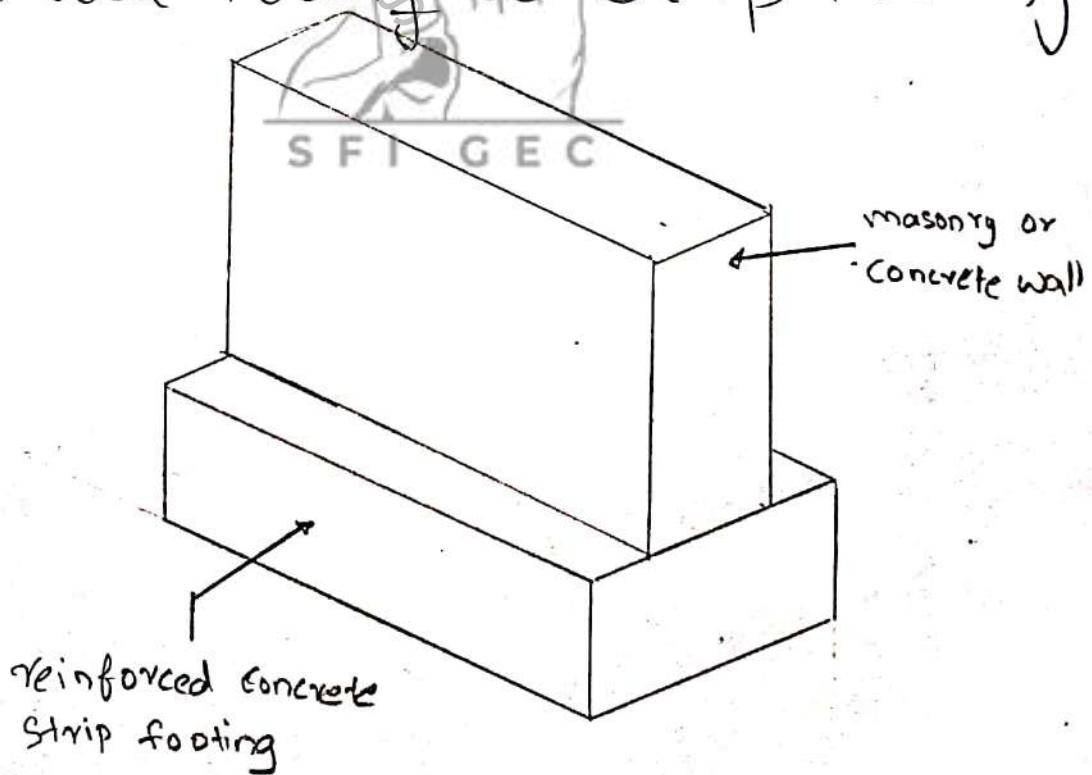
- ④ For white washing and plasterwork
- ④ For roads and bridge markings.

#### ⑤ Portland Pozzolana Cement

- ④ For marine structures
- ④ For sewers and sewage disposal works.

10.

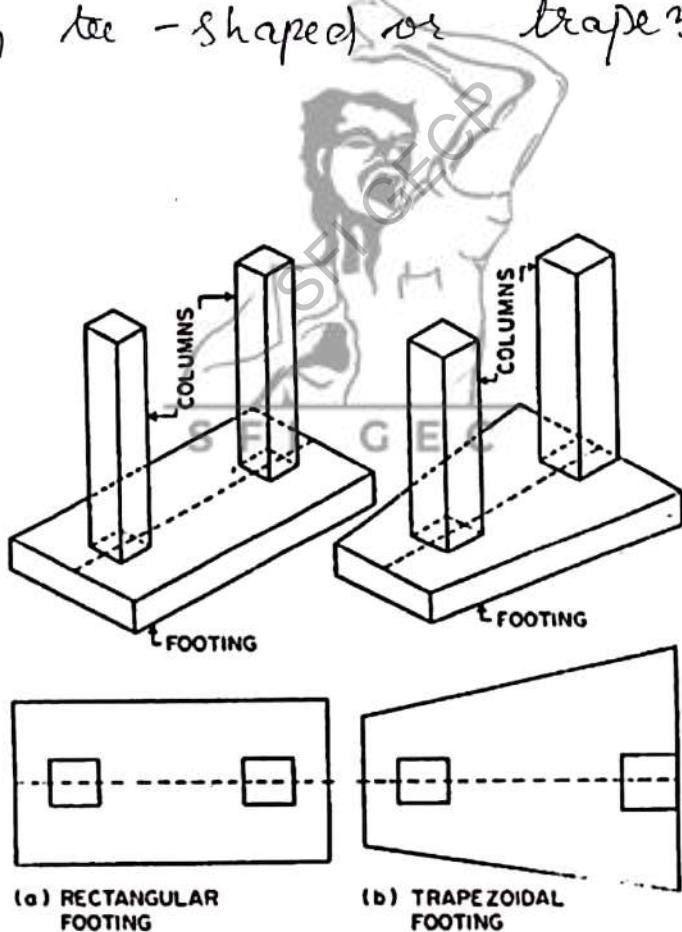
#### ① Wall Footing or Strip Footing



wall footing is also known as continuous footing. It runs along the direction of the wall. The width of the wall foundation is usually 2-3 times the width of the wall.

## ② Combined Footing

The foundations which are made common to more than one column are called combined footings. They may be square, tee-shaped or trapezoidal.



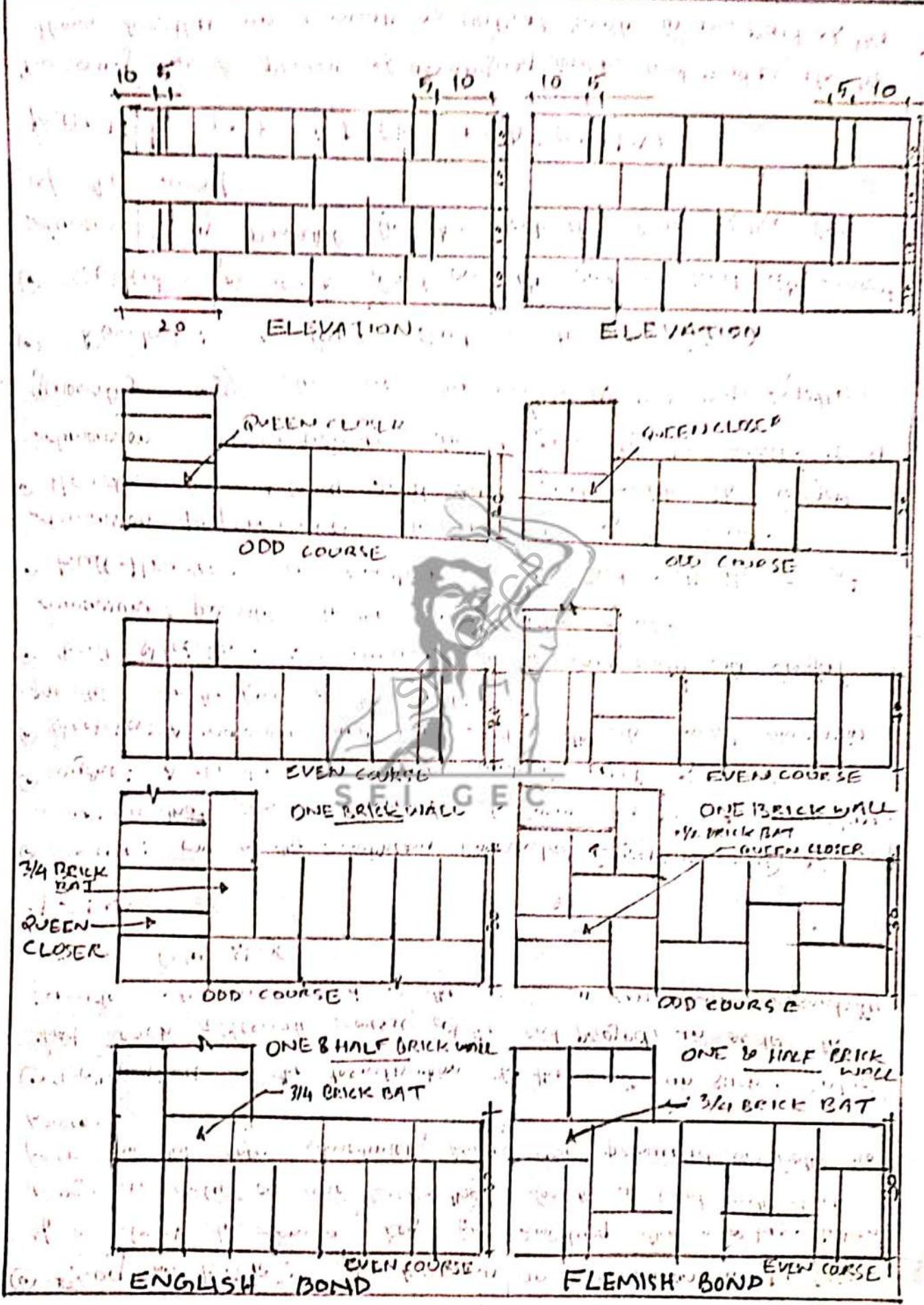
b.

## English bond

- ① Alternative courses are either headers or stretchers in elevation.
- ② There are no continuous vertical joints.
- ③ Every alternate header is centrally placed over a stretcher.
- ④ The facinging of each of the thicker walls consists only of headers.
- ⑤ When wall thickness is an even multiple of half bricks, present the same appearance on both faces.

## Flemish bond

- ⑥ Headers and stretchers placed alternately in each course. 
- ⑦ It has same appearance in the facing and backing of the wall in each course.
- ⑧ In walls with thickness equal to odd multiple of half bricks, half bats and three quarter bats are used, whereas no bats are required for walls with other thickness.



11.

## a. Water Management in Green Building

- ① Rain water harvesting facilities to utilize the water for the services of the building are provided with sufficient capacity.
- ② Plumbing arrangements are done in such a way that potable water is used for potable purpose only.
- ③ Dual plumbing system adopted one for potable and other for recycled/flush water.
- ④ The toilets shall be fitted with low water consuming flusher.

## Energy Management in Green Building

- ① The solar energy in a green building is harnessed to supplement the conventional energy. Use of photo voltaic cells convert solar energy.
- ② The natural light is allowed to enter in the intermediate floors to minimize the usage of electricity.

- ④ Sunlight is restricted by the high grown trees outside the lower floors of the building.
- ⑤ Installation of motion detectors for lighting control which makes light to glow only when area is occupied.

### b. MEP

Mechanical, electrical and plumbing (MEP) refers to these aspects of building design and construction.

① Mechanical : This systems most commonly relate to heating ventilation and air conditioning (HVAC) system, but they can also relate to transportation systems such as elevators, escalators, elements of infrastructure etc.

### ② Electrical :

Electrical system might include :

- power supply and distribution
- interior and exterior lighting
- control systems
- security and access systems

### ③ Plumbing .

This system might be used for .

- Water recovery and treatment systems.
- Heating and cooling
- waste removal
- Fuel gas piping.

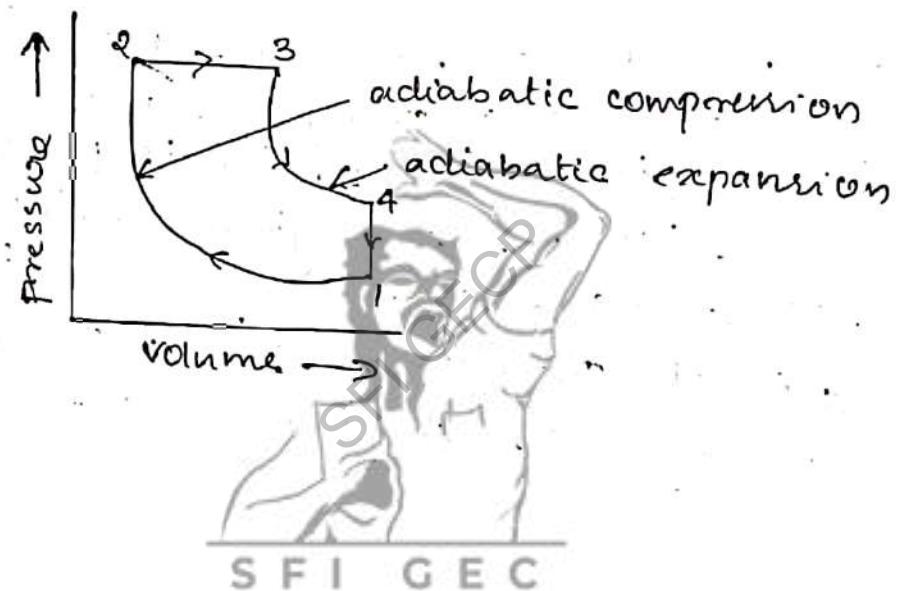
## HVAC

HVAC system is a Heating, Ventilation and Air-Conditioning systems. This is, the system or combination of system used to provide a comfortable temperature in buildings and maintain high levels of air quality. The objective of an HVAC system is to ensure that the indoor environment is both safe and comfortable for humans.

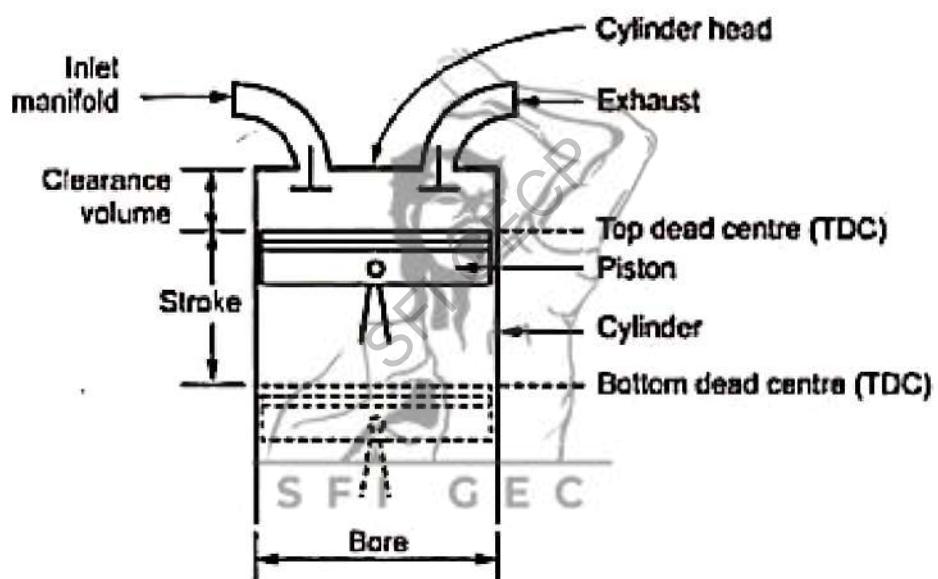


1 compression ratio is defined as the ratio of volume before compression to volume after compression.

cut off ratio is defined as the ratio of volume at the end of heat addition to the volume at the beginning of heat addition

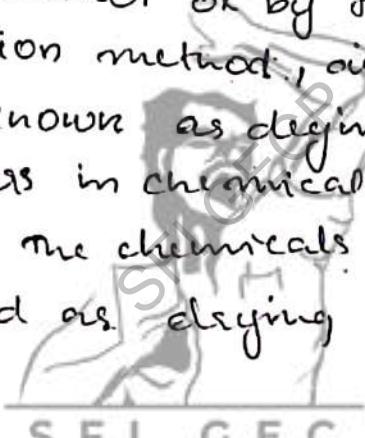


## 2) IC Engine terminology



3) cooling of air means lowering its dry bulb temperature. It can be attained by passing the air over evaporator coils of a refrigerating system. In a small room air conditioner the intake air is forced to flow over the evaporator coil directly. In such a case the relative humidity aspect is neglected or is of such order that it gets adjusted by itself. In most cases, an indirect evaporator system is used for cooling the air.

Dehumidification is the process of reducing water vapour content of air. It can be accomplished by the use of an air washer or by the use of absorbent. In the absorption method, air is passed through a chemical (known as drying agent). The moisture in the air enters in chemical combination with the drying agent. The chemicals like,  $H_2SO_4$  &  $NH_3$  are normally used as drying agents.



4

Differentiate between impulse and Reaction turbine. Give examples for each type.

Impulse turbine	Reaction turbine
The entire available energy of the water is first converted into kinetic energy.	The available energy of the water is not converted from one form to another.
The water flows through the nozzles and impinges on the buckets, which are fixed to the outer periphery of the wheel.	The water is guided by the guide blades to flow over the moving vane.
The water impinges on the buckets with KE.	The water glides over the moving vanes with PE.
The pressure of the flowing water remains unchanged and is equal to the atmospheric pressure.	The pressure of the flowing water is reduced after gliding over the vane.
It is not essential that the wheel should run full.	It is essential that the wheel should always run full and keep full of water.
It is possible to regulate the flow without loss.	It is not possible to regulate the flow without loss.
'Impulse' Turbine has more hydraulic efficiency.	Reaction Turbine has - relatively less efficiency.
Impulse turbine operates at high water heads.	Reaction turbine operates at low and medium heads.
Example of impulse turbine is pelton wheel	Examples of Reaction Turbines are Francis turbine, Kaplan and Propeller Turbine, Decca Turbine; Tubular Turbine, etc.

5 Rapid prototyping is the fast fabrication of a physical part, model or assembly using 3D computer aided design (CAD).

The creation of the part, model or assembly is usually completed using additive manufacturing or more commonly known as 3D printing.

Additive manufacturing (AM) refers to a process by which digital 3D design is used to build up a component in layers by depositing material.

6

$$d = 150\text{mm} , L = V_1 - V_2 = 200\text{mm}$$

$$V_2 = 10\% (V_1 - V_2)$$

$$V_3 - V_2 = \frac{6}{100} (V_1 - V_2)$$

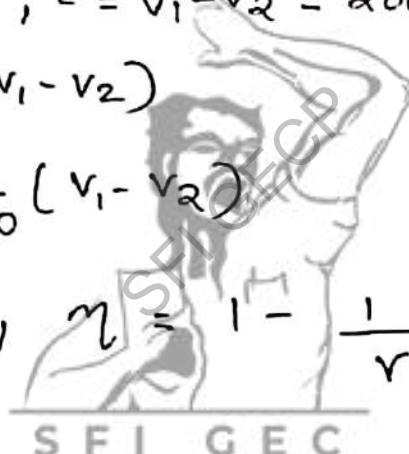
$$\gamma = \frac{V_1}{V_2} , \eta = 1 - \frac{1}{\gamma} \frac{(\rho^{\gamma} - 1)}{(\rho - 1)(\eta)^{\gamma-1}}$$

$$V_2 = \frac{10}{100} (V_1 - V_2)$$

$$10V_2 = V_1 - V_2$$

$$11V_2 = V_1$$

$$\frac{V_1}{V_2} = 11 \therefore \underline{\underline{\eta = 11}}$$



$$\rho = \frac{V_3}{V_2} =$$

$$V_3 - V_2 = \frac{6}{100} (V_1 - V_2)$$

$$100(V_3 - V_2) = 6(V_1 - V_2)$$

$$100V_3 - 100V_2 = 60V_2$$

$$100V_3 = 160V_2$$

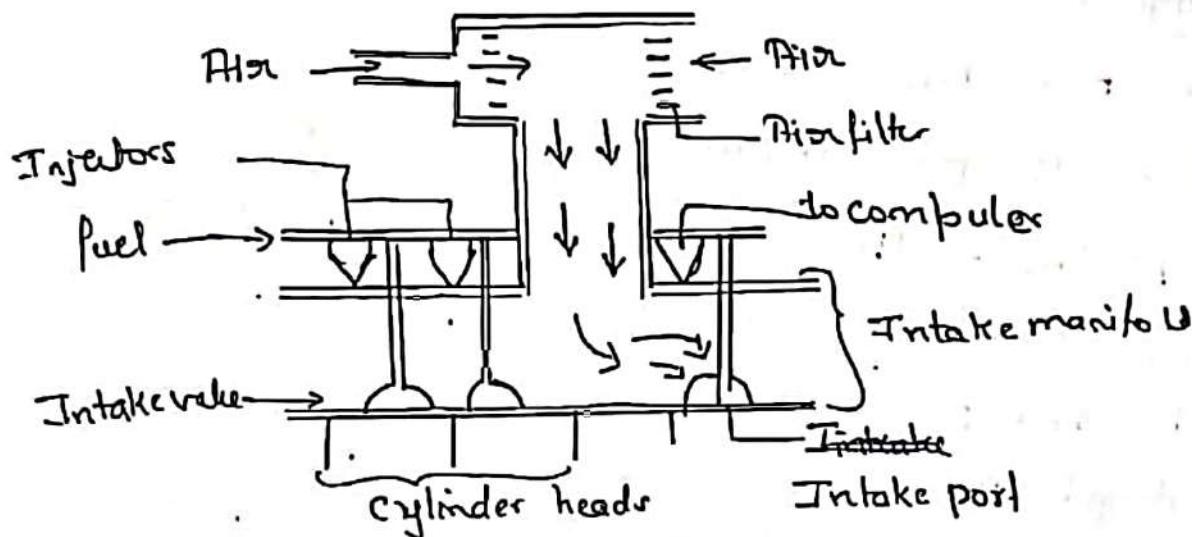
$$\frac{V_3}{V_2} = \frac{160}{100} = \underline{\underline{\frac{8}{5}}}$$

$$\begin{aligned}
 \eta &= 1 - \frac{1}{r} \left( \frac{(\rho^r - 1)}{(\rho - 1)(\alpha)^{r-1}} \right) \\
 &= 1 - \frac{1}{1.4} \cdot \frac{\left( \left( \frac{8}{5} \right)^{1.4} - 1 \right)}{\left( \frac{8}{5} - 1 \right) (11)^{1.4}} \\
 &\approx 1 - \frac{0.930936}{2.19197832} \\
 &= 0.5753 \approx \underline{57.53\%}
 \end{aligned}$$

89



## ⑦ a) Multipoint fuel injection (MPFI)



- In petrol vehicles carburetor is used for supplying air fuel mixture to the cylinder.
- In place of the carburetor MPFI system is used in vehicles.
- MPFI system injects fuel into individual cylinder based on commands from engine control module.
- MPFI have higher output, faster throttle response under varying driving condition.

MPFI consists of one fuel injector placed near every intake valve directed towards it, in the fuel intake manifold. Fuel is supplied to injector through a common rail. The amount of air decided by the car driver by pressing the gas pedal.

Scanned with CamScanner

The air mass sensor near throttle valve and oxygen sensor in exhaust sends signal to ECU.

- ~~the~~ ECU determine the air fuel ratio required hence the pulse width.

Depending on the signal from ECU the injector inject fuel into intake valve. The fuel sprayed at high pressure get atomized into fine particles and get mixed with air. The air fuel mixture is sucked into the engine cylinder and combustion takes place!

### Advantages of MPFI

1. Difference in power developed in each cylinder is minimum.
2. less vibration of engine
3. Fast response to acceleration & deceleration
4. Engine controller ECM, have more accurate amount of air fuel mixed mixture is supplied which lead to effective utilization of fuel & low emission level.
5. More mileage.

### 7(b) Hybrid Vehicles

Vehicles that use two distinct power sources are known as hybrid vehicles.

They usually come with ~~fuel~~ fuelled power source and an onboard rechargeable energy storage system for powering the vehicle.

Petroleum Hybrid Vehicles [PEHV] or Hybrid Electric Vehicles (HEV) generally use of an internal combustion engine and electric battery to provide the power to electric motor.



8

- a) A centrifugal pump using 1 kw of electrical motors for pumping water against 3 m suction head and 7 m delivery head. The discharge of the pump is  $100 \text{ liter}/\text{min}$ . Find the efficiency of pump.

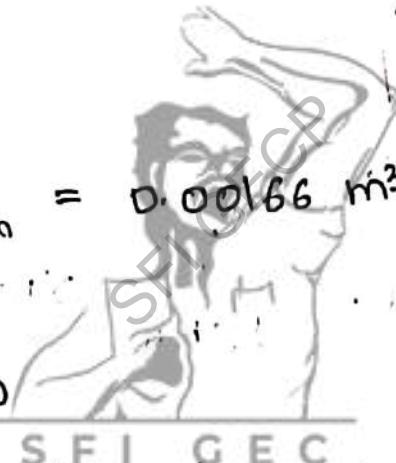
- b) Explain the open belt and cross belt drive in power transmission. Also give the applications.

Ans:-

$$\text{a) } Q = 1000 \text{ l/min} = 0.00166 \text{ m}^3/\text{s}$$

$$h_s = 3 \text{ m}$$

$$h_d = 7 \text{ m}$$



$$H = h_d - h_s$$

$$= 7 - 3 = 4 \text{ m}$$

$$(\rho g H = P)$$

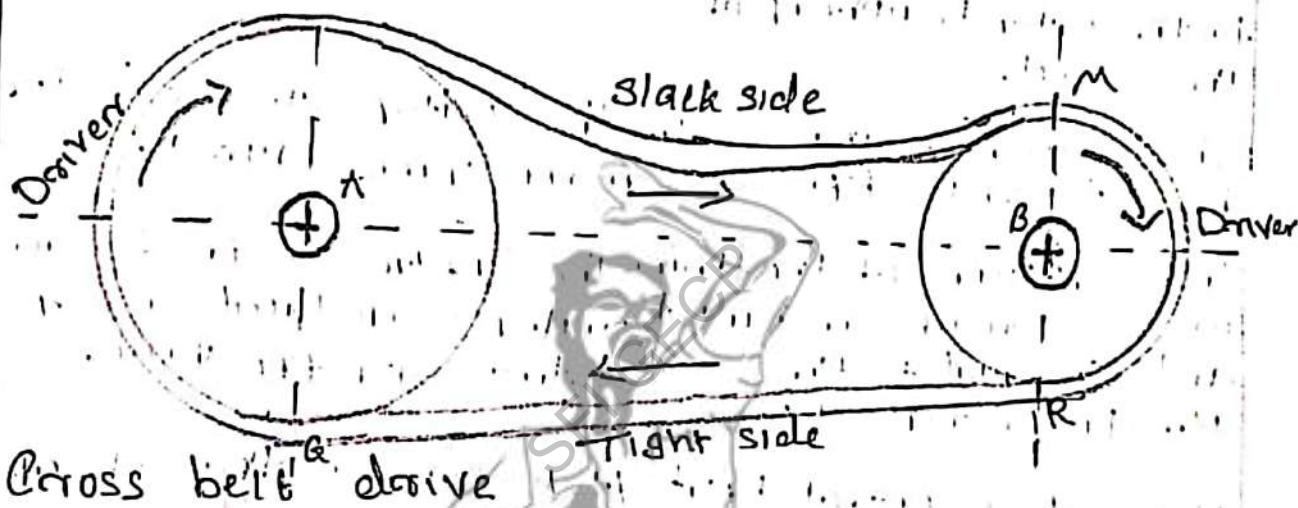
$$n_o = \frac{\rho Q g H}{P}$$

$$= \frac{1000 \times 0.00166 \times 4}{1000} = 0.00664$$

$$= 0.66\%$$

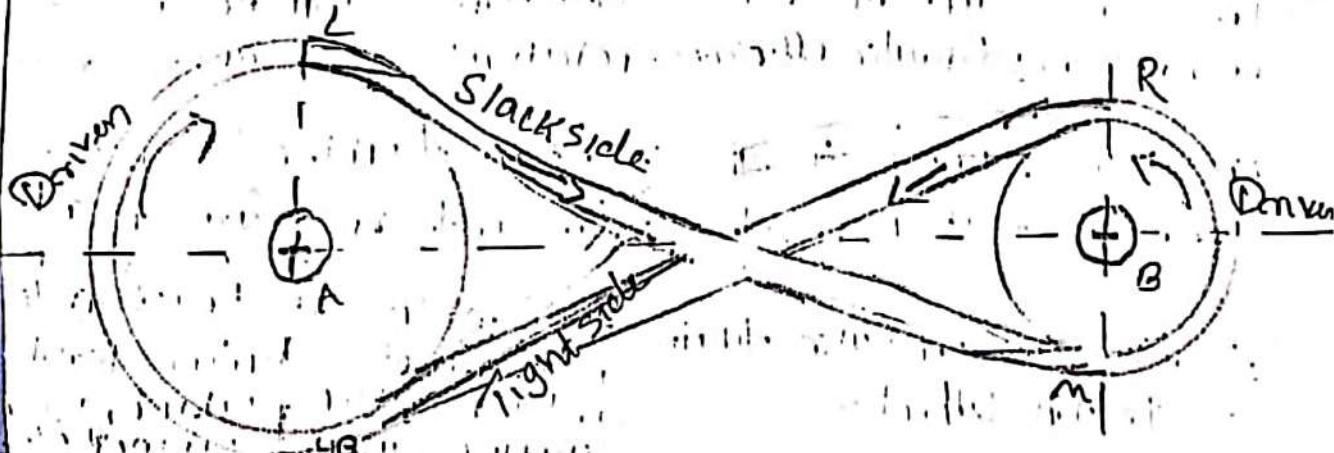
## 8 b) open belt drive

- Open belt drives are used to rotate the driven pulley in the same direction as the driver pulley.
- When motion occurs, this belt drive occurs, one side of the pulley is more tightened compared to the other.



## Cross belt drive

- Cross belt drives rotate the driven pulley in opposite direction to the driving pulley.
- The wrap around the kind of drive must be great for more power to be transmitted when compared to open belt drives.



- 9) a) A turbine is working at a head of 250m and the discharge through the Penstock is  $2 \text{ m}^3/\text{s}$ . If the efficiency of the turbine is 55%. find the Power developed by the turbine.
- (b) Explain the reversed Carnot cycle with P-V diagrams.

Ans:

a)  $H = 250 \text{ m}$

$Q = 2 \text{ m}^3/\text{s}$

$\eta_o = 55\%$

$P = ?$

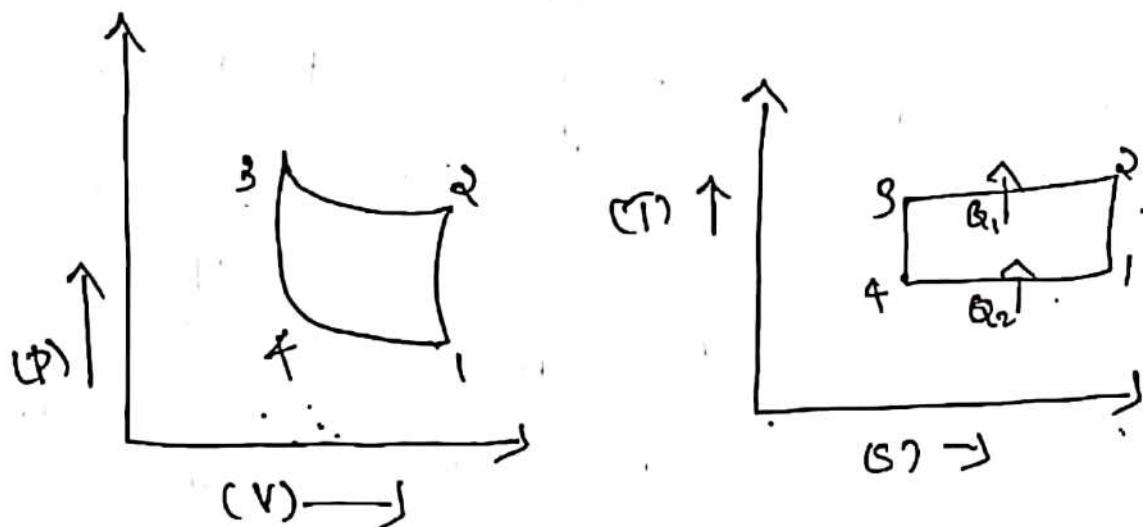
$$\eta_o = \frac{P}{\rho g h Q} \times 1000$$

$$P = 0.55 \times 9.81 \times 2 \times 250$$

$$= 2697.4 \text{ W}$$

$$= \underline{\underline{2.697 \text{ kW}}}$$

b) Reversed Carnot cycle



1-2 → Adiabatic compression

2-3 → Isothermal compression

3-4 → Adiabatic expansion

4-1 → Isothermal expansion

→ Here in adiabatic compression work has to be supplied and here the temperature rises.

→ In isothermal compression (2-3) Process

→ In isothermal compression heat is rejected keeping the high temp constant.

→ In adiabatic expansion (3-4) the temperature falls to the initial state

→ In isothermal expansion (4-1) Process the heat is absorbed at low temp from the space being cooled.

10 a) welding is done with the help of a welding machine. The welding machine rises the temperature of the required portions of the work pieces so that it can fuse them. Depending upon the type of heat production welding processes are classified as i) electrical resistance welding ii) arc welding iii) gas welding & iv) thermit welding

#### 1) Electrical resistance welding.

In this process the work piece to be joined are held together and a strong electric current of low voltage (6 - 10V) and high amperage (60 to 4000 amperes) is passed through them. When the current passes through the metal, the high resistance at the point of contact raises the temperature at the junction. The mechanical pressure applied at this moment completes the weld.

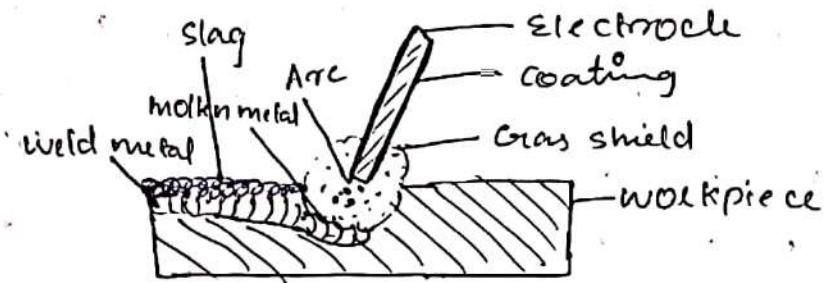
This further divided into  
a) spot welding b) butt welding c) flash welding d) seam welding

2) Gas welding

3) arc welding

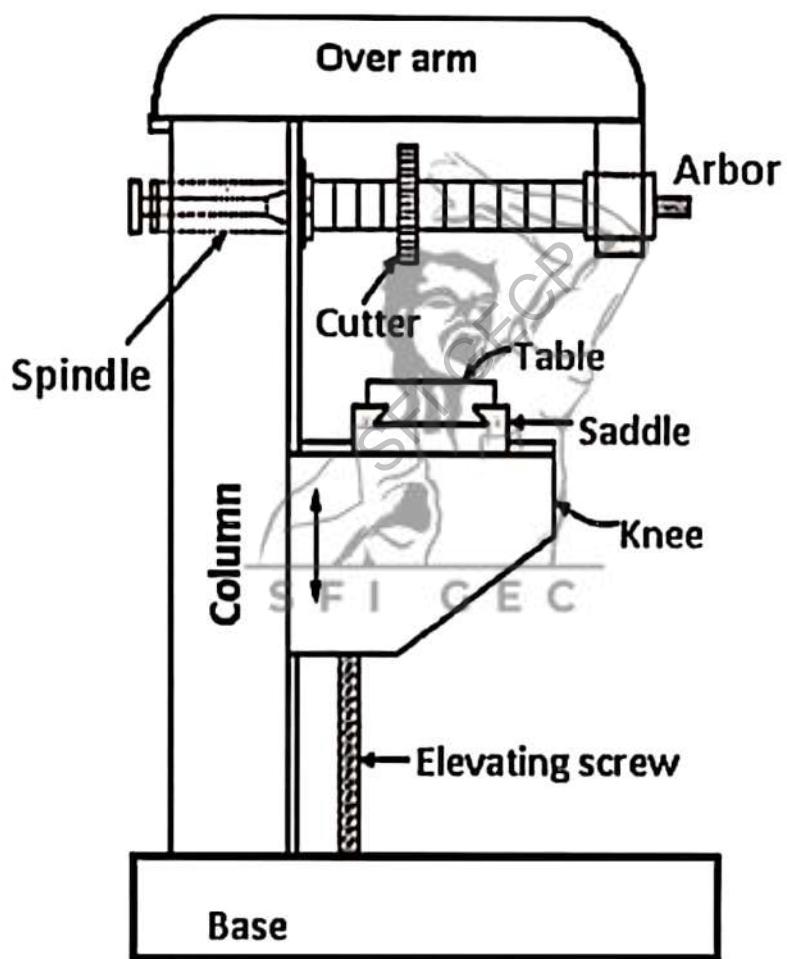
4) Thermit welding

b) Arc welding



In this the surfaces to be joined are fused by the heat produced from an electric arc. A metal electrode is used for obtaining the electric arc. Between the work piece & the electrode, together an electric current is established. Separating electrode from the workpiece by a short distance an electric arc is formed in which the electric energy is converted into heat. The intense heat so produced melts the work piece under the arc forming a pool of molten metal which is forced out of the pool by the blast from the arc as shown in fig.

# 11) Milling Machine



## WORKING

Milling is the process of removing metal by feeding the workpiece against a rotating multipoint cutter. As the cutter rotates, each cutting edge removes a small amount of material from the advancing workpiece for each rotation of the cutter. The rate of metal removed is rapid as the cutter rotates at very high speed and has many cutting edges. The difference of milling and other machining processes are interrupted cutting, relatively small size of chips and variation of chip thickness in a single chip itself.

Based on the direction of the cutter motion and workpiece fed, milling can be classified into conventional milling or up milling and climb milling or down milling. In up milling, the work piece is mounted on a table is fed in the opposite direction of that of the rotating cutter. In down milling the work piece which is mounted on the table is fed in the same direction of that of the rotating cutter. Down milling produces surface of higher quality because the cutting process keeps the work piece firmly pressed against the table.