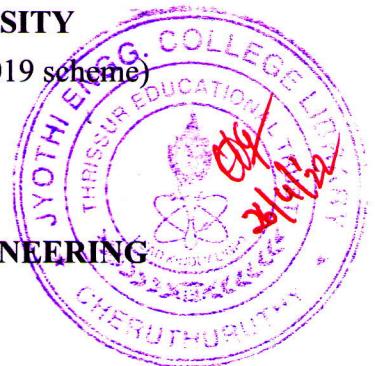


Reg No.: \_\_\_\_\_

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

First Semester B.Tech Degree Examination December 2021 (2019 scheme)

**Course Code: EST120****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 Discuss about Group A and Group C buildings as per NBC.
- 2 What are the major constituents of cement and what are its properties?
- 3 What are the properties and uses of first class bricks?
- 4 Define a) Pitch b) Ridge c) Wall plate d) Batten
- 5 What is the importance of green building? List out any four materials used in the construction of green building.

(5x4=20)

**PART B***Answer one full question from each module, each question carries 10 marks***Module-I**

- 6 a) Discuss the role of a civil engineer in the infra structural development of a country. (4)
- b) List out the different activities which are prohibited as per CRZ norms. (6)

**OR**

- 7 a) Discuss about the minimum size requirements of rooms for a residential building as per NBC. (4)
- b) With neat sketch explain the different components of a building. (6)

**Module-II**

- 8 a) What is rapid hardening cement? What are its advantages and uses? (4)
- b) Discuss about the primary classification of surveying. (6)

**OR**

- 9 a) Explain the different classifications of timber. (4)
- b) Explain the properties and uses of any two composite materials used in building construction (6)

**Module-III**

- 10 a) With neat sketch explain strap footing. (4)  
 b) Draw the plan and elevation of one brick thick wall with Flemish Bond. (6)

**OR**

- 11 a) What are the various aspects to be considered in fire safety of buildings? (4)  
 b) With neat sketch explain king post roof truss. (6)

\*\*\*

**PART II: BASIC MECHANICAL ENGINEERING**

(2019 Scheme)

Max. Marks:50

Duration: 90 min

**PART A***Answer all questions, each carries 4 marks.*

- 12 With the help of a block diagram explain the fuel system of CI engines. (4)  
 13 What is meant by priming of a pump? Why is it necessary in a centrifugal pump? (4)  
 14 Why gear drives are called positive drives, Whereas belt and rope drives are not considered positive? (4)  
 15 Compare CAD and CAM. (4)  
 16 Explain the advantages and disadvantages of rapid manufacturing systems. (4)

**PART B***Answer one full question from each module, each question carries 10 marks***Module-IV**

- 17 Calculate the ideal air standard thermal efficiency based on the Otto cycle for a petrol engine with a cylinder bore of 50mm and stroke of 75 mm and a clearance volume of  $21.3 \text{ cm}^3$ . (10)

**OR**

- 18 a) 1 kg of air at temperature of  $15^\circ\text{C}$  and pressure of 100 kPa is taken through a Diesel cycle .The compression ratio is 15 and the heat added is 1850 KJ Calculate the ideal cycle efficiency? (8)  
 b) Give the comparison between two stroke and four stroke engines. (2)

**Module-V**

- 19 a) With the help of a neat sketch, explain the working of a simple unitary air conditioning system. (6)  
b) Define humidity ratio and relative humidity. (4)

**OR**

- 20 Explain with a neat sketch, the working of a Pelton turbine (10)

**Module-VI**

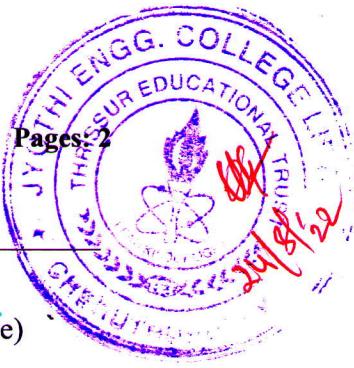
- 21 a) Explain the general procedure used in making a sand mould for the casting (4)  
b) Describe the direct extrusion and indirect extrusion with sketches (6)

**OR**

- 22 Discuss any four operations that can be performed on a lathe with simple sketches. (10)

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

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
 Second Semester B.Tech Degree Examination June 2022 (2019 scheme)

**Course Code: EST120**

**Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING  
 (2019 -Scheme)**

**PART 1: BASIC CIVIL ENGINEERING**

Max. Marks: 50

Duration: 90 min

**PART A**

*Answer all questions, each carries 4 marks*

Marks

- |   |  |     |
|---|--|-----|
| 1 | Explain relevance of civil engineering in the infrastructure development of a country. | (4) |
| 2 | Discuss the primary objectives of surveying.   | (4) |
| 3 | Distinguish between PCC and RCC.   | (4) |
| 4 | Explain the classification of pile based on load transfer.                             | (4) |
| 5 | Discuss any four factors considered for selection of flooring.                         | (4) |

**PART B**

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

**MODULE 1**

- |   |  |      |
|---|--|------|
| 6 | Explain basic elements of a residential building and its functions with the help of a neat sketch. | (10) |
|---|--|------|

**OR**

- |   |  |      |
|---|--|------|
| 7 | Explain the primary classification of CRZ. | (10) |
|---|--|------|

**MODULE 2**

- |   |  |      |
|---|--|------|
| 8 | Explain any 5 types of cement with its composition and uses. | (10) |
|---|--|------|

**OR**

- |   |   |      |
|---|---|------|
| 9 | Discuss any 5 rolled steel sections commonly available in market with its uses. Draw neat sketches of each. | (10) |
|---|---|------|

**MODULE 3**

- |      |  |     |
|------|--|-----|
| 10 a | Draw the elevation and plan of one brick thick wall with Flemish bond. | (5) |
| b    | Discuss any five types of roofing materials.                           | (5) |

**OR**

- |      |  |     |
|------|--|-----|
| 11 a | Explain the role of MEP and HVAC in a commercial building. | (5) |
| b    | Discuss the importance of green buildings.                 | (5) |

\*\*\*\*

**PART 2: BASIC MECHANICAL ENGINEERING**

Max. Marks: 50

Duration: 90 min

**PART A***Answer all questions, each carries 4 marks*

Marks

- 12 Why 2 stroke engines are not widely used in commercial vehicles nowadays? (4)
- 13 List any two merits and demerits of water cooling system over air cooling system. (4)
- 14 What is the unit used for specifying capacity of refrigeration? Define the unit (4)
- 15 List any two advantages and two disadvantages of belt drives (4)
- 16 List two products manufactured by casting and forging. (4)

**PART B***Answer one full question from each module, each question carries 10 marks.***MODULE 4**

- 17 With the help of a p-V and T-S diagram derive the air standard efficiency of a Diesel cycle (10)

**OR**

- 18 a With the help of a figure explain the working of a 4 stroke petrol engine. (6)  
b Explain any four merits and demerits of Petrol engine over Diesel engine. (4)

**MODULE 5**

- 19 Explain the basic components of Vopour compression refrigeration system with the help of neat sketch. Draw Pressure- Enthalpy and Temperature-Entropy diagrams of the same. (10)

**OR**

- 20 With neat sketch explain the working of Francis turbine (10)

**MODULE 6**

- 21 (a) Explain the arc welding process with a neat sketch (6)  
(b) Differentiate between soldering and brazing (4)

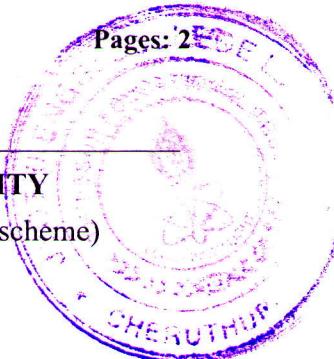
**OR**

- 22 (a) Define machining process. (2)  
(b) Explain the following machining operations (8)  
(i) Turning  
(ii) Drilling  
(iii) Milling and  
(iv) Grinding

\*\*\*\*

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

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



**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
 Second Semester B.Tech Degree Examination July 2021 (2019 scheme)

**Course Code: EST120**

**Course Name: BASICS OF CIVIL & MECHANICAL ENGINEERING**  
 (2019 Scheme)

**PART I: BASIC CIVIL ENGINEERING**

Max. Marks: 50

Duration: 90 min

**PART A**

*Answer all questions, each carries 4 marks.*

Marks

- |   |   |     |
|---|---|-----|
| 1 | What are the responsibilities of an engineer in ensuring the safety of built environment? | (4) |
| 2 | What are the principles of surveying?   | (4) |
| 3 | List out the different varieties of timber available in Kerala.                           | (4) |
| 4 | Differentiate between stretcher and header bond.  | (4) |
| 5 | Write a note on ramp.   | (4) |

**PART B**

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

**Module-I**

- |   |  |     |
|---|--|-----|
| 6 | a) Mention the factors to be considered while selecting the site for a building. | (5) |
|   | b) Draw a neat sketch showing important parts of a residential building.         | (5) |

**OR**

- |   |  |      |
|---|--|------|
| 7 | List out the major disciplines of civil engineering and explain their role in the infrastructural framework. | (10) |
|---|--|------|

**Module-II**

- |   |  |     |
|---|--|-----|
| 8 | a) Enumerate the physical and chemical properties of ordinary Portland cement. | (5) |
|   | b) Write a note on water proofing materials.                                   | (5) |

**OR**

- |   |   |      |
|---|---|------|
| 9 | List out the modern construction materials used for construction. Explain any four. | (10) |
|---|---|------|

**Module-III**

- |    |  |     |
|----|--|-----|
| 10 | a) Explain the circumstances where pile foundations are adopted. | (5) |
|    | b) Explain well foundation with neat sketch.                     | (5) |

**OR**

- |    |  |      |
|----|--|------|
| 11 | Explain various elements of a green building design. | (10) |
|----|--|------|

\*\*\*\*

**PART II: BASIC MECHANICAL ENGINEERING**

Max. Marks: 50

Duration:90 min

**PART A***Answer all questions, each carries 4 marks.*

Marks

- 12 What is meant by compression ratio? Why is it limited to 6 to 10 in petrol engines? (4)
- 13 With the help of a block diagram explain the CRDI system. (4)
- 14 Differentiate between comfort air conditioning and industrial air conditioning. (4)
- 15 Explain the concept of gear train ?Name important types of gear trains (4)
- 16 Explain how metals are joined in a village smithy shop. (4)

**PART B***Answer one full question from each module, each question carries 10 marks***Module-IV**

- 17 The minimum pressure and temperature in an Otto cycle are 100kPa and 300K. The compression ratio is 5 and the peak pressure is 2.1MPa Find out  
 (1) Heat supplied /kg of air (2) Heat rejected/kg of air (3) Work done /kg of air  
 (4) Theoretical thermal efficiency (5) Mean effective pressure (10)

**OR**

- 18 a) Explain the working of 4 stroke diesel engine with neat sketches. (6)  
 b) Give the comparison between CI and SI engines. (4)

**Module-V**

- 19 a) With the help of a neat sketch, explain the working of a vapour compression refrigeration system? Also show the process in p-h and T-S diagrams. (8)  
 b) Explain why Carnot refrigerator is not practically possible. (2)

**OR**

- 20 a) Differentiate between window air-conditioner and split air conditioner. (5)  
 b) Explain the working of Francis turbine, also give the field of application. (5)

**Module-VI**

- 21 a) With a block diagram explain the processes involved in a CNC system. (6)  
 b) How does welding differ from brazing and soldering processes? (4)

**OR**

- 22 Describe the working of a Drilling machine with the help of a block diagram and indicate its main parts. (10)

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KTU  
**NOTES**  
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**KTU STUDY MATERIALS | SYLLABUS | LIVE  
NOTIFICATIONS | SOLVED QUESTION PAPERS**

Reg No.: TCR19CE021Name: ANUPAMA JOY**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech S1 (Special Improvement) Examination January 2021 (2019 scheme)

**Course Code: EST 120**  
**Course Name: BASICS OF CIVIL & MECHANICAL ENGINEERING**  
**(2019-Scheme)**

**PART I: BASIC CIVIL ENGINEERING**

Max. Marks: 50

Duration: 90 min

**PART A***Answer all questions, each carries 4 marks.*

- 1 What is floor area ratio for a building as per KBR? What is its significance?
- 2 Explain the significance of initial and final setting time of cement.
- 3 Discuss the advantages of pre-fabricated construction.
- 4 Define (a) Stretcher (b) Header (c) King Closer (d) Queen Closer
- 5 List out any four different types of shallow foundation. (5x4=20)

**PART B***Answer one full question from each module, each question carries 10 marks***Module-I**

- 6 a) Explain any two classifications of buildings based on occupancy as per National Building Code. (4)
- b) Discuss the relevance of NBC and CRZ norms in building rules and regulations prevailing in our country. (6)

**OR**

- 7 a) Differentiate between floor area and carpet area. (4)
- b) Explain the responsibilities of an engineer in ensuring the safety of the built environment. (6)

**Module-II**

- 8 a) Discuss the objectives of surveying. (4)
- b) Discuss any six requirements of a good brick. (6)

**OR**

- 9 a) List out any four acoustic insulation and thermal insulation materials. (4)
- b) What are the different grades of OPC? Mention their uses and properties. (6)

**Module-III**

- 10 a) What is HVAC system? Explain any three types of HVAC system. (4)  
 b) What is pile foundation? List out the classification of piles based on its function. (6)

**OR**

- 11 a) List out the different floor covering materials. Explain the properties of any two. (4)  
 b) Draw the plan and elevation of one brick thick wall with English bond (6)

\*\*\*\*

**PART II: BASIC MECHANICAL ENGINEERING**

Max. Marks: 50

Duration:90 min

**PART A***Answer all questions, each carries 4 marks.*

- 12 Sketch the P-V and T-S diagram of diesel cycle and list the processes (4)  
 13 Define (i) Brake thermal efficiency (ii) Indicated thermal efficiency (4)  
     (iii) Mechanical efficiency and (iv) Volumetric efficiency of an IC engine.  
 14 Explain heating and Dehumidification process. Also show the process in psychrometric chart. (4)  
 15 Describe the working of a single plate clutch. (4)  
 16 List down the typical applications of the following processes. (4)  
     Casting, Forging, Rolling and Extrusion.

**PART B***Answer one full question from each module, each question carries 10 marks***Module-IV**

- 17 In an air standard Diesel cycle, the compression ratio is 16 and at the beginning of compression the temperature is  $15^{\circ}\text{C}$  and the pressure is 0.1MPa. Heat is added until the temperature at the end of constant pressure process is  $1480^{\circ}\text{C}$ . Calculate (1)The cut off ratio(2)The heat supplied per kg of air(3)The cycle efficiency (10)

**OR**

- 18 a) Explain the working of 2 stroke SI engine with neat sketches. (7)  
 b) Explain the fuel system for petrol engines. (3)

**Module-V**

- 19 With the help of a neat sketch explain the working of an air conditioning system for hot and humid outdoor conditions. (10)

**OR**

- 20 a) Describe the working of a Kaplan turbine with a suitable sketch. (6)  
b) A Pelton turbine with a head of 450m generates 13 MW at 450rpm. (4)  
Calculate discharge of the turbine if the overall efficiency is 80%.

**Module-VI**

- 21 a) Explain the arc welding process with a neat sketch showing the important parts. (6)  
b) Describe the additive manufacturing process. (4)

**OR**

- 22 Explain the working of a drilling machine with block diagram. (10)

\*\*\*\*

1. What is floor area ratio for a building as per KBR? What is its significance?

Ans) Floor Area Ratio (F.A.R) =  $\frac{\text{Covered area of all floors}}{\text{plot area}} \times 100$

Plot area is the area which is enclosed by the boundaries of the plot. Covered area is the maximum floor area of the building after excluding the cantilevered open balconies, garden, compound wall, gates, uncovered staircase etc.

Carpet area is the usable floor area excluding stair cases, loft wells, ducts, toilets, electrical and airconditioners, plant rooms etc.

For residential buildings permissible FAR is 3.0. Plot area is the area which is enclosed by the boundaries of the plot.

SL NO:	BUILDING USE	MAX COVERAGE %	MAX PERMISSIBLE FAR
1.	Residential	60	15
2.	Educational	30	12
3.	Commercial	60	20
4.	Industrial	40	12
5.	Office Building	40	15
6.	Assembly	40	0.7

2. Explain significance of initial and final setting time of cement?

Ans) Setting times :- This test is used for detecting the deterioration of cement due to storage. This test is carried out to find out.

(i) Initial setting time and (ii) Final setting time of cement.

(i) Initial setting time :-

For checking initial setting time of cement, take 300 gm of cement and it is mixed with percentage of water as determined from consistency test. This paste is filled in the Vicat mould. The square needle connected to the movable rod is allowed to penetrate in to the paste. In the beginning the needle penetrates completely. This process of penetration checked for another place in the same test paste at regular intervals till the needles doesn't penetrate completely. The needle should penetrate upto about 5 mm from the bottom of mould.

- The initial setting time is the interval b/w the addition of water to cement and the stage when needle ceases to penetrate completely.

• According to IS 269-1989 initial setting time of ordinary portland cement should not be less than 30 minutes.

(ii) Final setting Time :-

For checking final setting time prepare a cement paste and it is filled in the Vicat mould. The needle with annular collar attached to the movable rod is released gently. The time at which the sharp end of the needle makes an impression on test block and collar fails to do so is noted.

- The final setting time is the difference b/w the time at which  $H_2O$  was added to cement & time at which the needle fails to make an impression on test block.

\* Discuss the advantages of pre-fabricated construction.

- Financial Savings

One of the greatest advantages of prefabricated construction would be financial savings. Although the perception of custom made pieces may seem expensive, with prefabricated or modular construction, this is not the case. Modular construction targets all budgets and price points, creating an affordable option. Prefabrication manufacturers often receive bulk discounts from material suppliers which then trickles down to the cost of a construction project.

Modular construction also sidesteps the possibility of unreliable contractors and unproductive staff.

Additionally, the reduction in construction time can significantly save on construction financing costs.

- Flexibility

Modular construction can be easily be disassembled and relocated to different sites. This significantly reduces the demand for raw materials, minimizes expended energy and decreases time overall. Also,

modular construction allows for flexibility in the design of the structure allowing for a limitless number of opportunities. Since prefabricated construction units can be used in different spaces, its neutral aesthetics is able to blend in with almost any building type.

- Consistent Quality

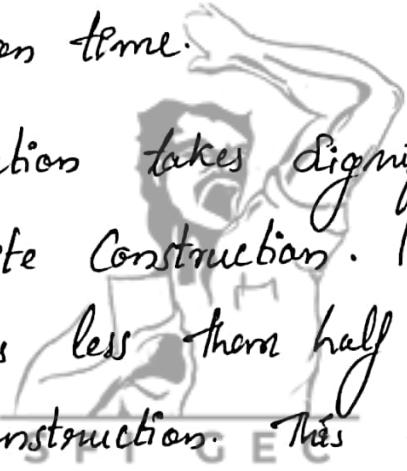
Since prefabricated construction occurs in a controlled manufacturing environment and follows specified standards, the sub-assemblies of the structure will be built to a uniform quality. Construction site-built structures are dependent upon varying skill levels and the schedules of independent contractors. These all contribute to the craftsmanship and overall quality of given structure. With prefabrication, each sub-assembly is built by an experienced crew in a weather-resistant factory, with multiple quality checks throughout the entire process. Some components of the building are constructed using precise machine equipment to ensure conformity to building code.

- Reduced Site Disruption

Since many components of a building are completed in

the factory , there is significantly less truck traffic, equipment and material suppliers around the final construction site. This limits the disruption of traditional jobsites that suffer from noise , pollution, waste and other common irritants . This streamlined approach to construction provides a far more efficient atmosphere for productivity, and eliminates unnecessary distractions and interference that are typical of construction sites.

- Shorter Construction time.



Portable construction takes significantly less time to built than on-site construction. In many instances, prefabrication takes less than half the time when compared to traditional construction. This is due to better upfront planning, elimination of on-site weather factor, subcontractor scheduling delays and quicker fabrication as multiple pieces can be constructed simultaneously. Shorter construction time allows construction companies to take on multiple projects at once, allowing businesses to grow rather than putting all their focus and resources on one or a few projects at a time.

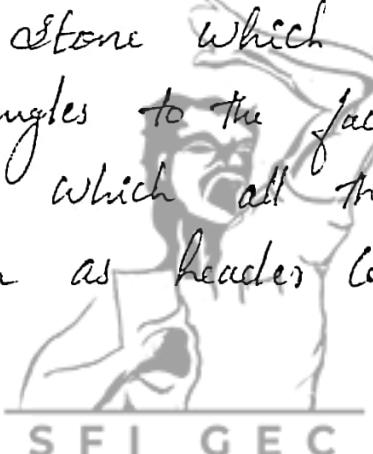
- \* Define (a) Stretcher (b) Headers (c) King closer  
(d) Queen closer

- Stretcher:

It is a brick or a stone which lies with its longest side parallel to the face of the work. The course of brick work in which all the bricks are laid as stretchers is known as Stretcher Course.

- Headers

It is a brick or a stone which lies with its greatest length at right angles to the face of the work. The course of brick work in which all the bricks are laid as headers is known as Header Course.



- King Closer

These are the positions of a brick obtained by cutting off the triangular piece between the center of one end and the center of one side.

- Queen Closer

It is the position of brick obtained by cutting a brick length wise into two portions.

\* List out any four different types of Shallow foundation.

- wall footing
- Isolated or column footing.
- Combined footing
- Cantilever footing
- Continuous footing
- Inverted arch footing
- Grillage foundation
- Raft or mat foundation
- Stepped foundation.



\* Discuss the objectives of Surveying.

- Surveying is the art of determining relative positions of objects on the surface of earth or above or beneath the surface of earth by means of measurement in the horizontal and vertical plane.
- Levelling: is the branch of Surveying which deals with the measurement of relative heights of different objects on the surface of earth.
- The primary object of any Survey is the preparation of plan or map. A plan may be defined as the projection of a ground and the features in it on a horizontal plane. Thus plan is the representation of an area and objects in it to some scale. If the selected area is very large and the scale adopted is very small thus it is known as map.
- Primary divisions of Surveying:-  
Surveying may be divided into two general classes,  
(i) Plane Surveying  
(ii) Geodetic Surveying.
- Plane Surveying  
Plane Surveying is the type of Surveying in which mean surface of earth is considered as plane and curvature

of the earth is neglected, as the Survey extend over small area. Surveys covering an area of  $200\text{km}^2$  may be considered as plane survey. In this Survey line connecting any two points on the earth surface are considered as straight line and angle between this lines as plane angle. Plane Survey is used for layout of canals, highways, railways, construction of bridges, dams, buildings etc.

### Geodetic Surveying

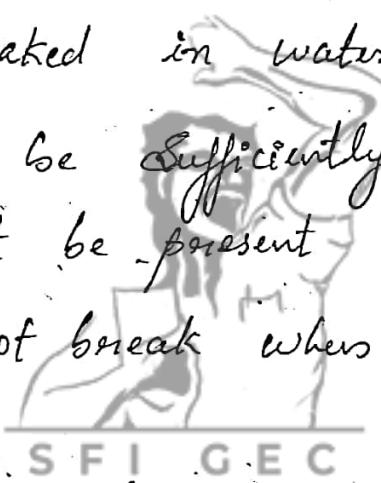
Geodetic Surveying is also called trigonometric Surveying. In this Survey it is necessary to take into account curvature of the earth. Geodetic Survey used when Survey extend over large area (greater than  $200\text{km}^2$ ). On accuracy of work required is great. In this Survey, line connecting any two points on the earth surface is curved or considered as an arc of a great circle.

\* Discuss any six requirements of a good brick.

Good brick should have the following properties:-

Brick should have perfect edges; well burnt in kilns, copper coloured, free from cracks with sharp and square edges.

- It should be uniform in shape and standard size.
- Colours should be uniform and bright.
- The brick when broken should show a bright homogeneous and uniform compact structure free from voids.
- It should produce clear ringing sound when struck with each other.
- Water absorption should not be greater than 20% for first class bricks and 22% for second class bricks when soaked in water for 24 hrs.
- Brick should be sufficiently hard i.e. no nail impression must be present when scratched.
- It should not break when dropped from a height of one metre
- It should have low thermal conductivity and should be sound proof.
- Good brick should not show any white or grey deposits of salts when immersed in water and dried, i.e. efflorescence.
- Good brick should not have less crushing strength below  $5.5 \text{ N/mm}^2$ .



- 11 a) List out the different floor covering materials. Explain properties of any two.
- b) Draw the plan and elevation of one brick thick wall with English bond.

1. MOSAIC FLOOR COVERING : Mosaic flooring consists of a base concrete and mosaic topping. This type of floor is widely used in theatres, temples and superior type of buildings.

Preparation : A 15cm sand cushion is provided over rammed and watered earthen surface. Over the sand cushion a base course of 10cm thick cement concrete using 1:5:10 mix is placed. The top surface of concrete is roughly finished to develop good bond b/w base and topping. Cure this concrete for 3 days, thus the base floor is ready to apply floor covering (flooring).

Wet the surface of base concrete and apply a 20cm thick cement mortar of proportion 1:2. Glass pieces / marble pieces hammered into this mortar to get desired pattern. The inner area is filled with coloured pieces of mosaic chips. After this ordinary cement or coloured cement is sprinkled at the top and the surface is rolled using a stone roller till the surface is level. After 24 hrs surface is rubbed with pumic stone to get a smooth, level and polished surface. This polished surface is finally allowed to dry for some week before use.

2. MOSAIC TILE FLOORING : Mosaic tiles of different size and colour combinations are now available in market. This type of flooring is widely used in residential building, shop, theatres, temples and superior type of buildings.

**Preparation :** A 15 cm sand cushion is provided over rammed and watered earthen surface. Over the sand cushion a base course of 10cm thick cement concrete using 1:5:10 mix is placed. The top surface of concrete is roughly finished to develop good bond between the base and topping. Cure this concrete for 3 days, thus the bare floor is ready to apply floor covering.

In case of dd concrete base, thoroughly clean the concrete to remove dust and dirt. Use only water to mop the floor, and allow it to dry completely. Fill any dips or waves with a Portland cement based floor leveller. Over the concrete bedding, after a period of 2 to 3 days, a cement mortar layer of 1:1 mix is spread and over that tiles are arranged. A thin paste of cement is applied to their sides. Tiles are then slightly tapped till cement oozes out through joints to surface. This oozed out cement is immediately cleaned with sandbut. After 3 days these joints are rubbed with carbondum stone and then by pumic stone. Finally the surface is washed with a weak solution of soft soap in warm water.

**3. CERAMIC TILE FLOORING :** Ceramic tiles of different colour, size and quality are available in market.

**Preparation :** A 15cm sand cushion is provided over rammed and watered earthen surface. Over the sand cushion a base course of 10cm thick cement concrete using 1:5:10 mix is placed. The top surface of concrete is roughly finished to develop good bond between base and topping. Cure this concrete for 3 days, thus the bare floor is ready to apply floor covering.

Material commonly used for setting and grouting the tile are portland cement mortar, dry set or latex portland cement mortar, organic adhesive.

The grouts selected should be chemical-resistant, water cleanable and have good

adhering property. Apply a thin set mortar on the concrete base with the flat side of trowel to "key in" the mortar into thin concrete within lines. The trowel is held 45° to concrete and that angle is held uniformly throughout installation. The tile placed and lightly beaten in with a mallet. This is to ensure that tile is seated into mortar bed.

After beating, tiles are aligned with layout lines. Mix the grout according to Manufacturer's instructions. It's possible grout small areas at a time. The grout is forced into the the joint with grout float held at approximately 45° diagonally across the face of the tile. The sponge is used to "tool" the joints a smooth uniform depth. The sponge should be drawn across the tile face diagonally to joints. Do not overwork the joints and fill any pinholes or voids. This can be accomplished by thoroughly wringing out the sponge and by not applying excess pressure to sponge. The sponge should be drawn across the tile face diagonally to joints. Allow the mortar to set for 24 hours before walking over.

4. TILED FLOOR COVERING : clay tiles of different size shapes, thickness and colour are now available in market and are used as surface covering for floor.

PREPARATION : Over the concrete bedding, after a period of 2 to 3 days, a cement mortar layer of 1:1 mix is spread and over that tiles are arranged. A thin paste of cement is applied to their sides. Tiles are then slightly tapped till cement oozes out through the joints to the surface. This oozed out cement grout is immediately cleaned with sponge. After 2 or 3 days, the surface is washed with a weak solution of soft soap in warm water.

White glazed tiles used for flooring water closet, bathrooms, swimming pools etc. These tiles do not require polishing and keep excellent sanitary conditions. They are used for dadoing walls.

S F I G E C

Vitrified tiles are very commonly used for the flooring of A-class building, they have zero water absorption property, available in beautiful colour and design polished vitrified tiles like mirror stone, granamite and marogranite are cheaper than marble and granite.

5. MARBLE FLOOR COVERING : Marble flooring is commonly used for superior type of flooring construction. Marble slabs may be laid in different sizes, usually rectangular or square shapes. The base concrete is prepared as for tiled flooring. Over the base

- concrete 20mm thick bedding mortar of 1:2 mix is spread under each individual slabs. The marble slab is then laid over this mortar. Gently pressed with wooden mallet and leveled. The marble is then again lifted up and fresh mortar is added to the hollows of bedding mortar. The mortar is allowed to harden slightly, cement mortar is spread over it. The edges of already laid slabs are smeared with cement slurry paste, and then the marble slab is placed in position. It is gently pushed with wooden mallet so that cement paste oozes out from the joints, which should be as thin as possible. The oozed out cement is cleaned with sponge. The paved area is cured for a period of 7 days.

6. SYNTHETIC FLOORING : synthetic material like epoxies and polyesters are used in terrazzo floor in thinner layers, than in standard terrazzo floor. The synthetic material replaces cement of the standard terrazzo and they reduce the self weight of flooring. For the preparation of this floor, synthetic material and marble chips mixed with water to get a plastic paste. This mixture laid on the rough base already prepared. Grinding and polishing are performed after 16 to 48 hours.

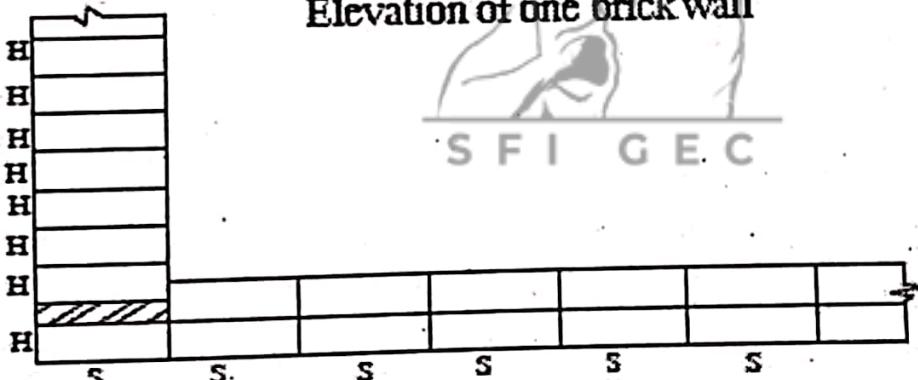
Agglomerated marble is another material used for flooring and its prepared by bonding granules of marble dust with synthetic resins under high pressure into slabs of different thickness, colour and length. They can be installed over

over existing floors even if the floors are deteriorated. These floors can have a nonskid surface and require no waxing.

Vinyl Tiles and Vinyl asbestos tiles of different colours, size and design are now available in market. These tiles can be fixed on the floor by spreading hot bitumen adhesive on the substrate and the surface is rolled with light roller.

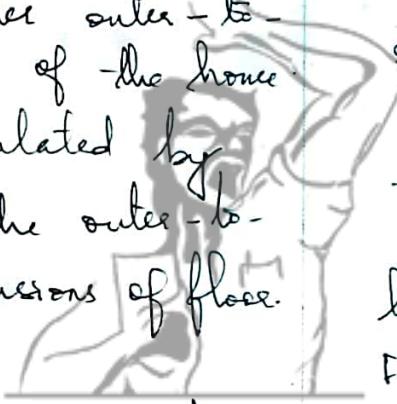


Elevation of one brick wall



Plan of one brick wall

7) FLOOR AREA	CARPET AREA
<p>(a)</p> <ul style="list-style-type: none"> <li>The built up covered area in all floors including basement floor.</li> <li>It does not include the boundary walls but includes only the inner walls.</li> <li>Basically it is -the area covered under outer-to-outer walls of the house.</li> <li>It is calculated by multiplying the outer-to-outer dimensions of floor.</li> </ul>	<p>The covered area of the usable rooms at any floor level.</p> <p>(Excluding the area of the walls)</p> <p>Area of staircase, lift wells, escalators, ducts etc are also excluded.</p> <p>Calculated by subtracting the <del>area</del> area occupied by the outer and the inner walls of the house from the Total Floor Area.</p>



(b) A built environment means the human-made space in which people live, work and recreate on a day-to-day basis. In Civil engineering context, it may be a single dwelling house, apartment complex, office building, educational building etc. During the construction phase, a construction safety document is to be prepared by the engineer and that is compiled and added to, on an ongoing basis throughout the life of the project. It is always handed over to the first occupier of the

building and it should contain details of maintenance and use of the building. It should also highlight any potential danger elements of that building and how the designer envisages it with safety. It should also contain details of machinery and its use of that building. Thus the responsibility of an engineer to ensure safety in built-up environment includes the following:

- 
- (i) After completion, ensure whether all the installations have met the safety standards.
  - (ii) Hand over all the documents of all installations in the building with specific safety remarks.
  - (iii) Identify all the safety - lapses.
  - (iv) Ensure that all warning instruction are displayed in place and is legible.
  - (v) Hand over the periodical maintenance schedule also.

9)

- (a) • Acoustic Insulating Materials are :-
- 1) Acoustic foam. Also called studio foam.
  - 2) Acoustic coatings : like Mass Loaded Vinyl (MLV)
  - 3) Acoustic fabrics.
  - 4) Sound insulation batts.
- Thermal Insulating - Materials are :-
- 1) Fibre glass.
  - 2) Mineral Wool.
  - 3) Cellulose.
  - 4) Aerogel and Pyrolyzed.

(b) Grades of Ordinary Portland Cement (OPC) :-

"Grade" is the 28 day strength when tested as per Indian Standards under standard conditions

Portland Cement or (OPC) is classified into various grades according to its compressive strength. Compressive strength is obtained by testing a cube of cement mortar cube of 1:3 ratios with face area  $50 \text{ cm}^2$  after 28 days of casting.

OPC is classified into 3 grades - 33, 43, 53 grades denoted as C<sub>33</sub>, C<sub>43</sub> and C<sub>53</sub>.

1) 33 grade cement (C33)

Obtained when 28 days compressive strength of cement is more than  $33 \text{ N/mm}^2$ .

This grade is conformed to I.S.269:1989 specifications.

2) 43 grade cement (C43)

Obtained when 28 days compressive strength of cement is more than  $43 \text{ N/mm}^2$ .

This grade is conformed to I.S.8112:1989 specifications.

3) 53 grade cement (C53)

Obtained when 28 days compressive strength of cement is more than  $53 \text{ N/mm}^2$ .

This cement is used for superior quality work. This grade is conformed to I.S.12269 : 1987 specifications.

10)

(a) HVAC system is a Heating, Ventilation, and Air - Conditioning system. This is a combination of systems used to provide a comfortable temperature in buildings and maintain high levels of air quality. The objective of HVAC is to keep the indoor environment both safe and comfortable for humans. Safety here mainly concerns with the Indoor Air Quality (IAQ) which demands the indoor air should have adequate oxygen and be free of toxic gases.

Types of HVAC systems :-

1) Split HVAC systems

The most common type of HVAC systems are the heating and cooling split system. It has 2 units — one for heating and one for cooling. This uses a traditional thermostat to manage temperature.

2) Hybrid Split HVAC systems.

It is a very energy efficient system. They have electric hybrid heater system.

3) Packaged HVAC systems.

Both heating and cooling unit all in one.

Usually installed in attic of a building.

Used in warmer climate. Heat is electrically

generated in this system.

- (b) When the load is to be transferred to underground strata due to poor bearing capacity of the surface soil, we take up a pile foundation. Pile is a slender structural member made of concrete, steel, timber or composite materials to transfer load.

Classification of 'piles' based on its function:

1) End bearing piles

These piles rest on hard strata and transmits load to it. These act as column/piers. Hard strata available at 10-15 m.

2) Friction piles

These piles generate sufficient load bearing capacity by friction. The frictional force is called 'skin force'.

3) Compaction piles

These piles are used where the foundation soil is very loose. They compact the soil and increase the load bearing capacity. Sand piles are used as compaction piles.

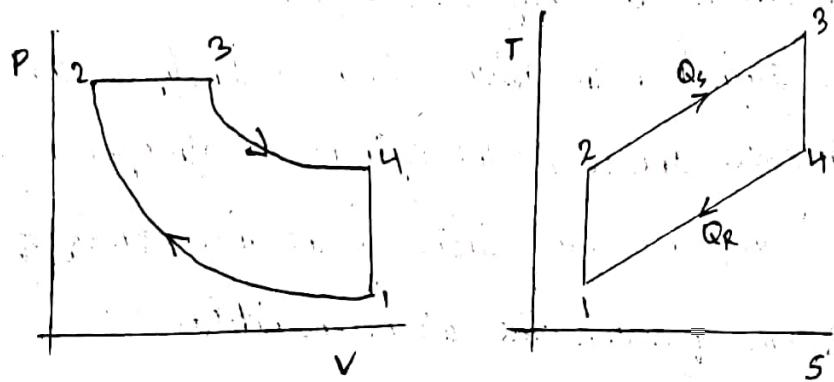
End-bearing piles & Friction piles - LOAD BEARING PILES

• Compaction piles / Under drained piles - NON-LOAD BEARING PILES

## PART II: BASIC MECHANICAL ENGINEERING

### PART-A

12)



$1 \rightarrow 2$  Adiabatic Compression

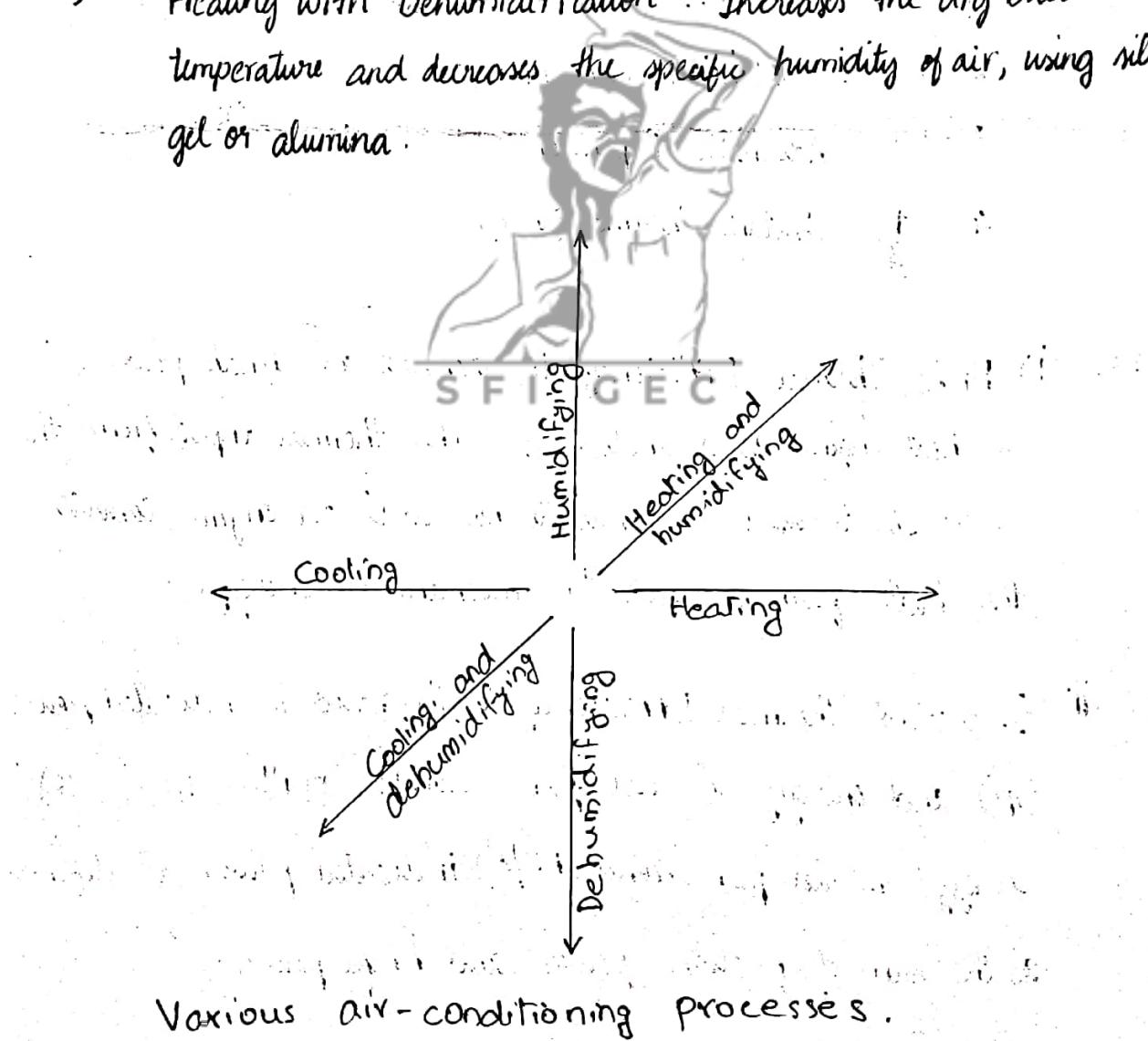
$2 \rightarrow 3$  Constant Pressure ( $P = C$ )

$3 \rightarrow 4$  Adiabatic Expansion

$4 \rightarrow 1$  Constant Volume ( $V = C$ )

- 13) (i) Brake Thermal Efficiency is defined as break power of a heat engine as a function of the thermal input from the fuel. It is used to evaluate how well an engine converts the heat from a fuel to mechanical energy.
- (ii) Indicated thermal Efficiency is the ratio of indicated power ( $i_p$ ) and energy in fuel per second.  $\eta_{ith} = i_p (kJ/s) /$  - energy in fuel per second ( $RJ/s$ ) indicated power is defined as the sum of friction power and brake power.

- (iii) Mechanical efficiency is a dimensionless number that measures the effectiveness of a machine in transforming the power input to the device power output.
- (iv) Volumetric efficiency (VE) in internal Combustion engine engineering is defined as the ratio of the mass density of the air fuel-making mixture drawn into the cylinder at atmospheric pressure (during the intake stroke) to the mass density of the same volume of air in the intake manifold.
- 14) Heating with Dehumidification : Increases the dry bulb temperature and decreases the specific humidity of air, using silica gel or alumina.



## 15) Single Plate Clutch

A clutch is a device used to connect a driving shaft to the driven shaft so that driven shaft may be started or stopped at will without stopping the driving shaft. Single Plate clutch is a friction clutch. It consists of a clutch plate made of steel and having frictional lining on each side. This clutch plate is attached to a hub which rotates along with the driven shaft and is free to slide axially on the driven shaft. During disengagement, a lever keeps the driven disk (clutch) away from the driving disk (flywheel). To engage the clutch, the lever is gradually released. The spring provides the required axial force to press the driven disk against the driver disk.

## 16)

**Casting :** Sand Casting is used for a variety of applications to produce a wide range of parts including : air compressor,

piston, bearings, blowers & impellers, bushing, cams

**Forging :** Components produced are Nails, Bolts, spanner,

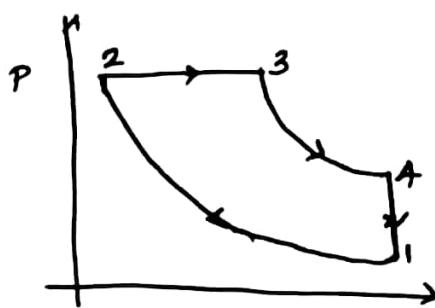
Crane hooks, Axles, Crankshafts, connecting rods etc.

**Rolling :** The rolling process is used to make plates, steel sheets, etc. Bearing, Turbine rings are rolling products.

**Extrusion :** Extrusion is widely used in production of tubes & hollow pipes.

A) 17)  $\gamma_c = 1.6$ ,  $T_1 = 15^\circ C = 288 K$ ,  $T_3 = 1480^\circ C = 1753 K$ ,  $P_1 = 0.1 \text{ MPa}$

 $C_p = 10.1005 \quad C_v = 0.717, \quad \gamma = 1.4$



process 1-2.

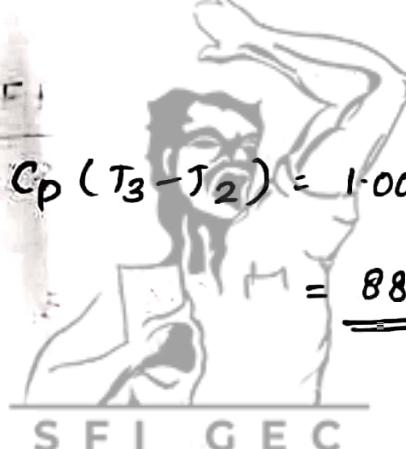
$$T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1} \Rightarrow T_2 = \left(\frac{V_1}{V_2}\right)^{\gamma-1} T_1 \Rightarrow T_2 = (\gamma_c)^{\frac{1.4-1}{\gamma}} T_1,$$

$$T_2 \Rightarrow (16)^{0.4} \times 288 \Rightarrow 3.031 \times 288 = \underline{\underline{872.93 \text{ K}}}$$

(ii).

~~Heat~~ Heat Supplied:  $C_p (T_3 - T_2) = 1.005 (1753 - 872.93)$

$= \underline{\underline{884.47 \text{ kJ/kg.}}}$



Process 2-3

$$\frac{V_2}{V_3} = \frac{T_2}{T_3} \Rightarrow \frac{V_3}{V_2} = g \text{ (Cut off Ratio).}$$

$$\text{Cut off Ratio, } g = \frac{T_3}{T_2} = \frac{1753}{872.93} = \underline{\underline{2.008}}$$

heat Rejected  $\Rightarrow C_v(T_4 - T_1)$

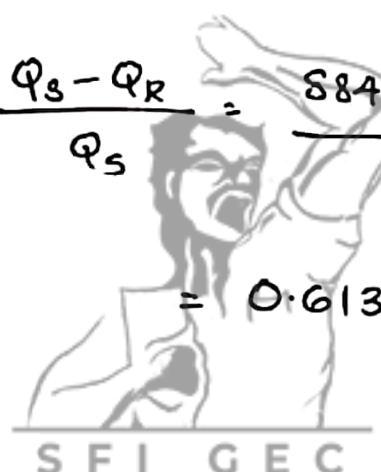
Process 3-4

$$T_4 = T_1 g^{\gamma} \Rightarrow 288 \times (2.008)^{1.4} = 288 \times 2.654 \\ = \underline{\underline{764.29 \text{ K}}}$$

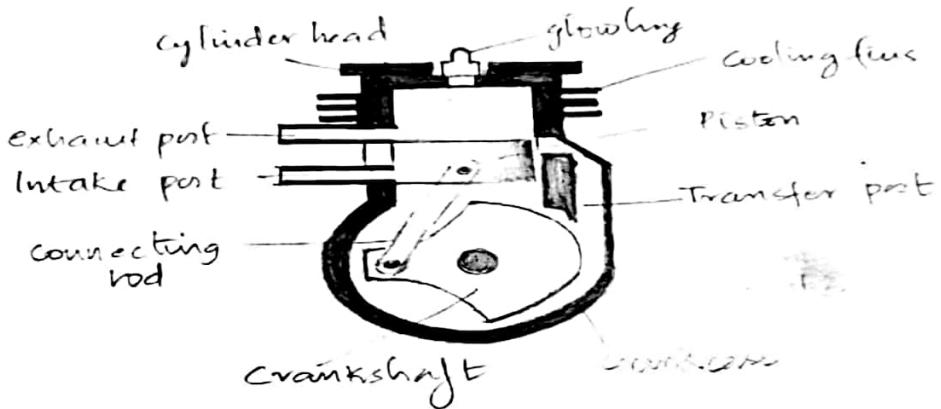
heat Rejected = 764.29 K

$$Q_R : 0.718 (764.29 - 288) \\ = \underline{\underline{341.97}}$$

Cycle efficiency = 
$$\frac{Q_s - Q_R}{Q_s} = \frac{884.47 - 341.97}{884.47} \\ = 0.6133 = \underline{\underline{61.33 \%}}$$



15)



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### Working Principle

Piston crown is used for controlling the movement of air-fuel mixture and emission.

### Suction stage

Piston going towards BDC, uncovers both the transfer port and the exhaust port while the inlet port remains closed. Fresh air-fuel mixture flows into the cylinder from the crank case due to the compression of charge by the lower side of the piston. Introduction of fresh charge pushes the burned gases out of cylinder.

### Compression Stage

Upward movement of piston, first cover the transfer port, and then the exhaust port. Air-fuel mixture is compressed due to the upward motion of piston. Also, in this stage, the inlet port opens and the fresh air-fuel mixture enters into the crank case through the port.

### Expansion stage

When piston reaches TDC, the charge is ignited with the help of a spark plug. Due to combustion, piston is pushed down, piston moves from TDC to BDC.

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b)

Fuel Tank → Fuel Filter → Fuel Pump → Carburetor



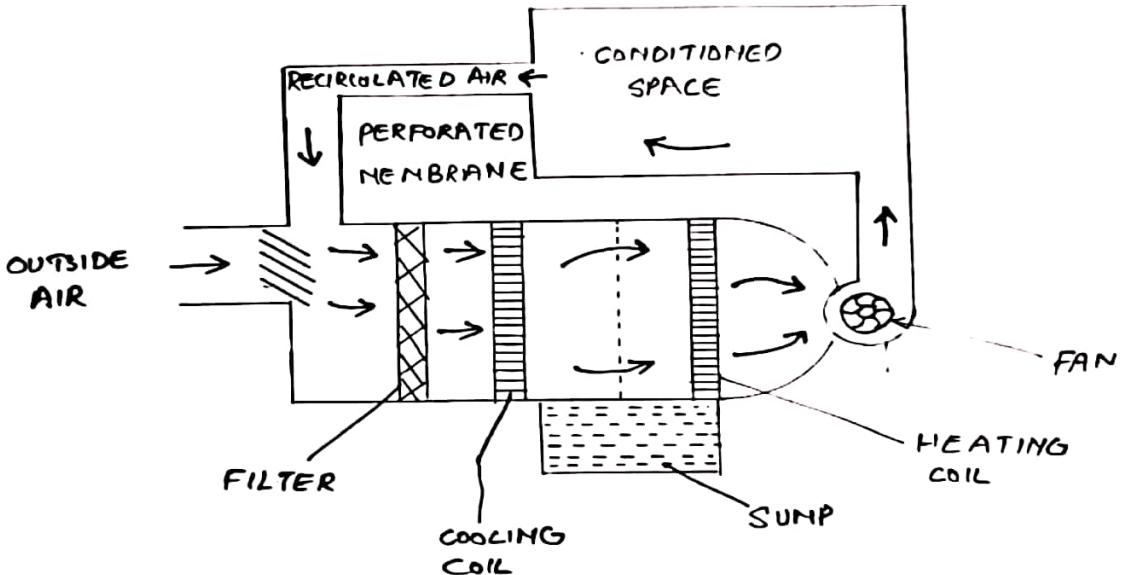
Engine  
& Cylinders

Fuel is supplied to the engine under gravity or using a fuel pump. Fuel system consists of fuel tank, fuel pump and carburetor.

#### 19) Summer Air Conditioning

In most of the places summer season is hot and humid. So required to supply cold and dry air. This requires systems where in the hot and humid air can be cooled to temperatures lower than the dew point temperature, so that the water vapour in air can be removed by condensation, and the resulting cold and dehumidified air supplied to the conditioned space in required quantity for providing thermal comfort. Thus it can be seen that a typical summer air conditioning system requires a refrigeration system that reduces the temperature of the air to temperatures much lower than the surroundings.

Water fed coil & coil coil



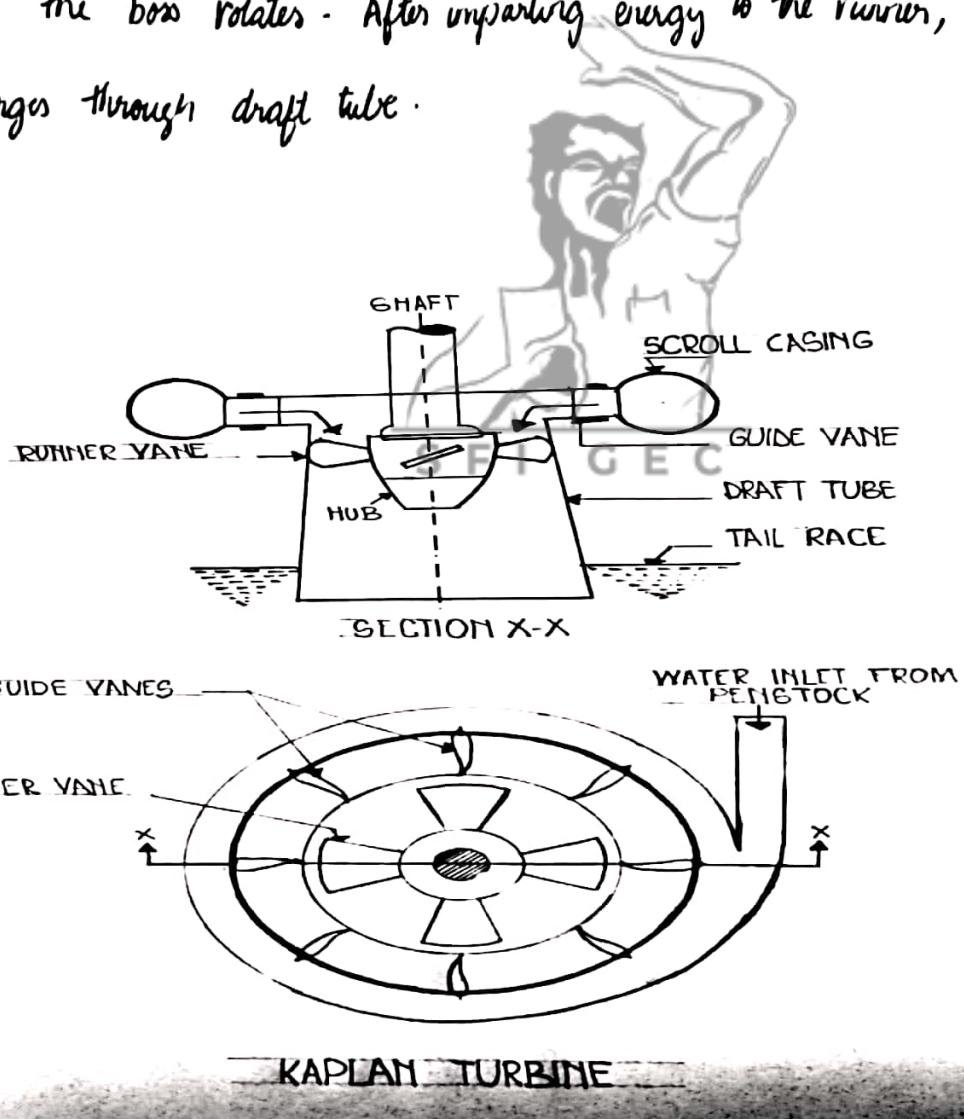
**CS** Scanned with CamScanner

- Air is cooled and generally dehumidified
- Outside air flows through the damper, and mixes up with recirculated air (obtained from the conditioned space)
- The mixed air passes through a coil. The coil has a temperature much below the required dry bulb temperature of the air in the conditioned space.
- The cooled air passes through a perforated membrane and loses its moisture in the condensed form which is collected in a sump
- Then air is heated by using a heating coil to bring the air to the designed room temperature

**CS** Scanned with CamScanner

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a) It is an axial flow reaction turbine where water enters and leaves the runner vanes parallel to the axis of the shaft. It is named after Viktor Kaplan. It is suited for low head and high discharge of water. Water from the penstock flows into a scroll casing surrounding the turbine runner. From the scroll casing water flows through the guiding mechanisms and makes 90° turn in the axial direction and enters the runner. The guide vanes pass water on to the runner smoothly. As a result the boss rotates. After imparting energy to the runner, the water discharges through draft tube.



b) Head =  $h$  = 450 m

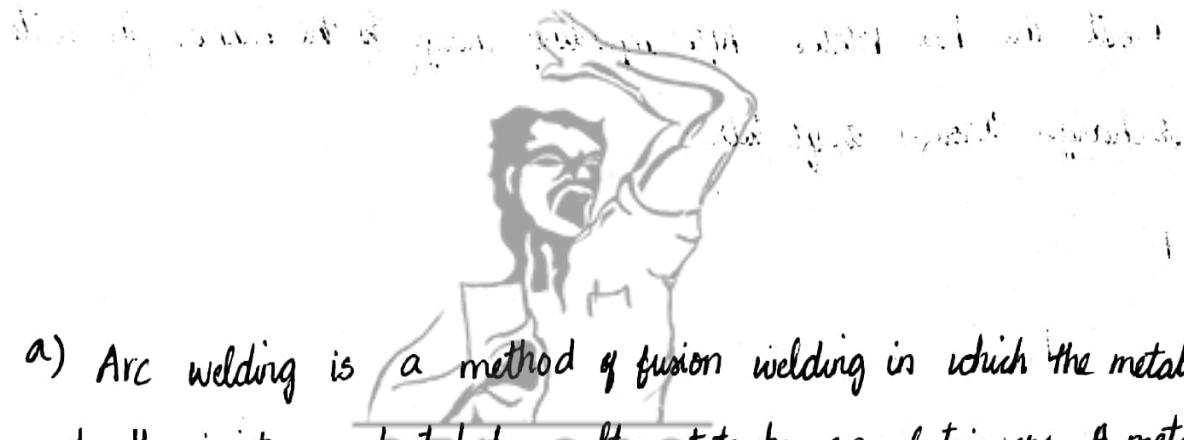
$$P = 13 \text{ MW} = 13 \times 10^6 \text{ W}$$

$$\text{efficiency} = \eta = 80\%$$

$$Q$$

$$n = \frac{P}{g \times Q \times h}, Q = \frac{P}{g \times h} = \frac{13 \times 10^6}{1000 \times 9.81 \times 450 \times 0.8}$$

Discharge of tube  $\equiv Q = 3.68 \text{ m}^3/\text{s}$



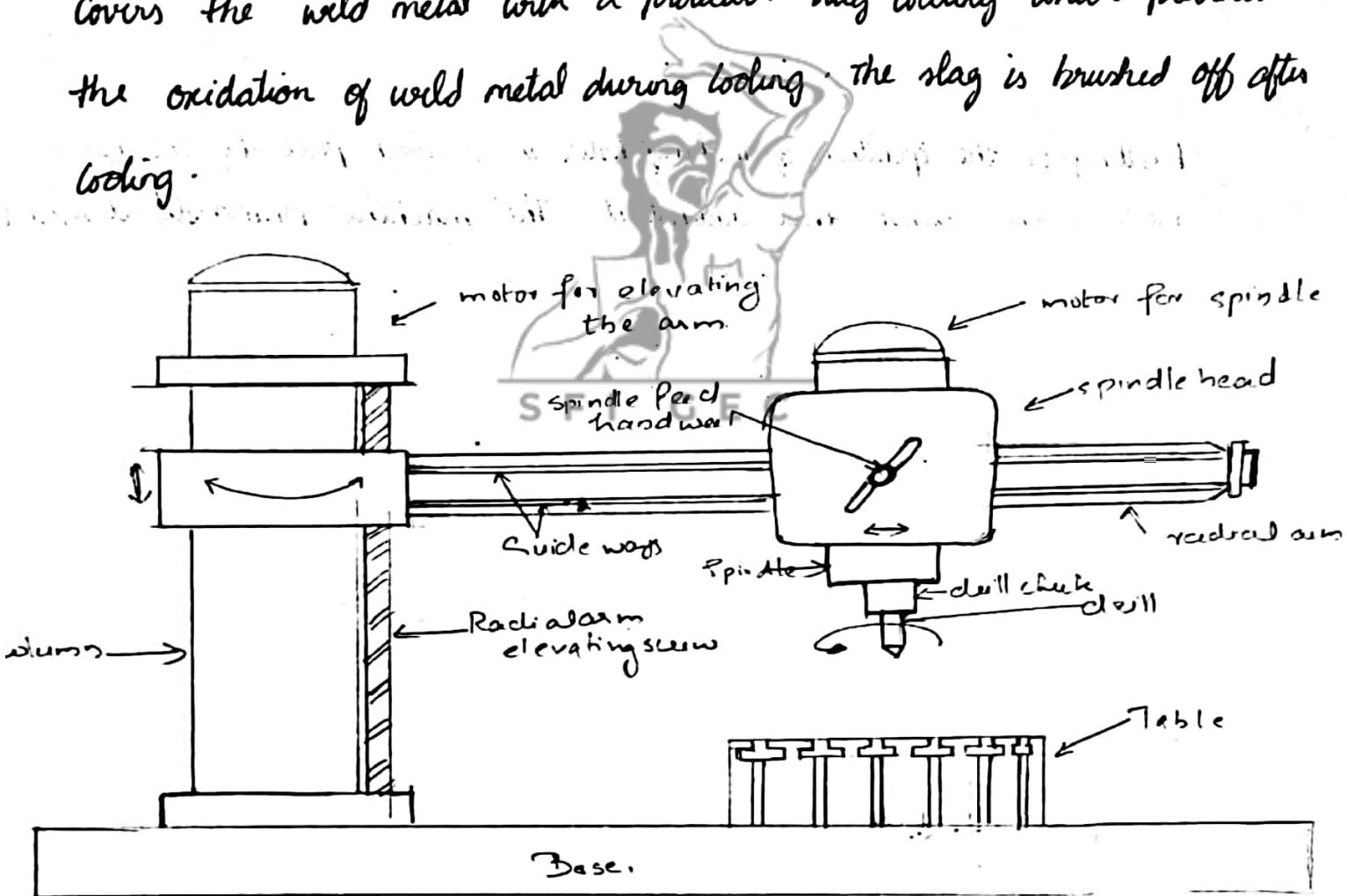
- 21) a) Arc welding is a method of fusion welding in which the metals at the joint are heated to molten state by an electric arc. A metal electrode is used for obtaining the arc between the metal parts to be joined and the electrode. Electric arc is provided by AC or DC power source. The electrode is allowed to touch the joint faces of the metal parts to be joined and is quickly removed to create a gap of 2 to 4 mm such that current continues to flow through a path of ionized particles called plasma. An electric arc is produced due to this and which may generate temperature upto  $6000^\circ\text{C}$  to  $7000^\circ\text{C}$  at the centre of the arc depending upon the electrode. Intense heat so produced

b) Rapid manufacturing or additive manufacturing are an alternative to subtractive processes. Additive manufacturing can typically produce models in a few hours, although it can vary widely depending on the type of machine being used and the size and number of models being produced simultaneously. Rapid and additive rapid manufacturing build parts in layers. Several rapid and additive rapid manufacturing techniques are being developed and commercially available such as stereolithography (SL), fused deposition modeling, selective laser sintering, laminated object manufacturing.

22)

Drilling is the operation of making holes in a work-piece by forcing a rotating tool called drill against it. The machine primarily designed to make this operation is called drilling machine. A popularly used drilling machine called as radial drilling machine is shown in the figure. In a radial drilling machine, a radial arm allows the operator to position the spindle directly over the work piece rather than move the work-piece to the tool. The design of radial drill press gives it a great deal of versatility, especially on parts too large to position easily. Radial drill offer power feed on the spindle, as well as an automatic mechanism to raise or lower the radial arm. The principal parts of drilling machines are explained below

melts the faces of the prepared joint forming a pool of molten metal. The electrode is also melted and is transferred across the arc to the molten pool metal pool. The arc is maintained by uniformly moving the electrode across the work piece along the desired line of welding and keeping a constant gap between work piece and electrode. On solidification a weld is formed between two parent metals. Electrodes are coated with slagging or fluxing material. This provides a gas shield around the arc to prevent direct contact of air with the molten metal. It also covers the weld metal with a protective slag coating which prevents the oxidation of weld metal during cooling. The slag is brushed off after cooling.



**Base** - The base of the machine is a rectangular casting on which the column is mounted.

**Column** - The column is the vertical member of the machine which supports a table. The head supporting the motor and spindle is mounted on the top of the column.

**Table** - The table of the drilling machine supports the work piece or other work holding devices. It can be moved up and down on the column. Also it can be set in various positions in the horizontal plane.

**Drill head** - It is mounted on the top of the column and supports the spindle head and motor. The spindle head houses drill holding and rotating devices. A hand wheel is provided for holding the drill. The spindle receives power from the motor through belt and pulley arrangement. The speed of the spindle can be varied by shifting the belt on different steps of the lone pulley.

6) a)

(i) Institutional Buildings : These shall include any building or part thereof which is used for purposes such as medical or other treatments or care of persons suffering from physical or mental illness or diseases or infirmity, care of infants, convalescents of aged persons. Institution building ordinarily provide sleeping accommodations for the occupants. Examples of this type of building are hospital, sanatoria, nursing homes, orphanages, jail, prison, mental hospital etc.

(ii) Assembly Building : These shall include any building or part of a building, where groups of people assemble or gather for amusement, recreation, social, religious, patriotic, civil, travel and building for similar purposes etc. Examples of this type of building are Assembly hall, Theatres, auditorium, exhibition halls, gyms, restaurants, club rooms, museums, religious building like church, temple etc.

- b) Building Rules and bye laws are laid down by the Municipal or Town Planning Authorities for framing public or private building. Government of India has published National Building Code (NBC) for a reference for local bodies in framing building rules. Important rules and regulations of NBC are
- General requirement regarding plots
  - Exteriors or interiors open spaces.
  - Built up areas of building , coverage and floor area of building .
  - Where a building is newly erected, the building rules of KBMR shall apply to the designs and construction of the building .
  - Where the building is altered, the rules in KBMR shall apply to the altered portion of the building .
  - Where the occupancy or use of building is changed, these rules shall apply to all the parts of the building affected by the change .
  - Size, height and ventilation of rooms
  - Water supply, sanitation and rainwater harvesting

S F I G E C

General rules for Selection of building plot as per NBC

- 1) Building should not be constructed on any plot where there is deposit of refuse.
- 2) Building should not be constructed on a plot, which consists of big pit/quarry.
- 3) Building should not be constructed on a plot liable to flood or on a slope forming ~~as~~ an angle of more than 45 with horizontal.
- 4) Building construction or reconstruction in any area notified by the Government of India as a coastal regulation zone is restricted.
- 5) Building should not be constructed with a minimum clearance from the over head electric supply line. ~~as described to~~

#### COASTAL REGULATION ZONE (CRZ)

Coastal zone is the area of interaction between land and sea, which influenced by both terrestrial and marine environment. It includes the area between high tide and low tide up to 10 nautical miles towards the sea from the high tide and up to 20 km

from high tide line towards discharge of municipal sewage, industrial waste disposal leads to degradation of coastal ecosystems and an abrupt decrease in coastal resources.

For regulating developmental activities the coastal stretches within 500m of high tide line on the landward side are classified into the following four categories of Coastal Regulation Zone CRZ-1, CRZ-2, CRZ-3, CRZ-4

CRZ - 1 : The area that is ecologically sensitive and important / essential for maintaining the ecosystem of the coast. They lie between low and high tide line. Exploration of natural gas and extraction of salts are permitted.

CRZ - 2 : The areas that are already been developed up to and close to shore line. They are urban areas located in the coastal area with road network, water supply, sewage system and other infrastructure facility.

CRZ - 3 : The area that are already been developed up to and close to the shore line they are urban areas located in the coastal

CRZ - 3 : The area that are undisturbed under rural and urban localities which fall outside the 1 and 2 . Only certain activities related to agriculture even some public facilities are allowed in this zone .

CRZ - 4 : This area lies in Andaman Nicobar , Lakshadweep and are not included in CRZ 1,2 or 3 . Fishing and allied activities are permitted in this zone . Solid waste should be let off in this zone .





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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 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

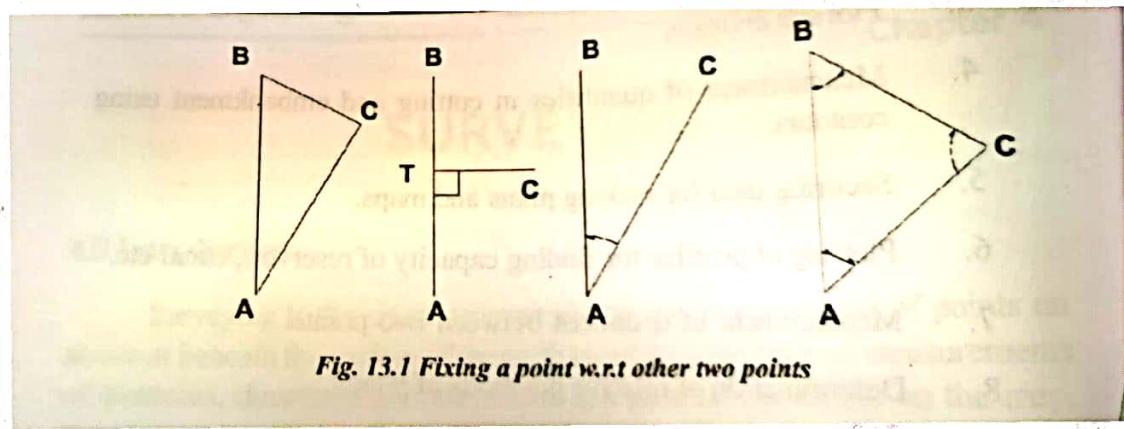


Fig. 13.1 Fixing a point w.r.t other two points

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.

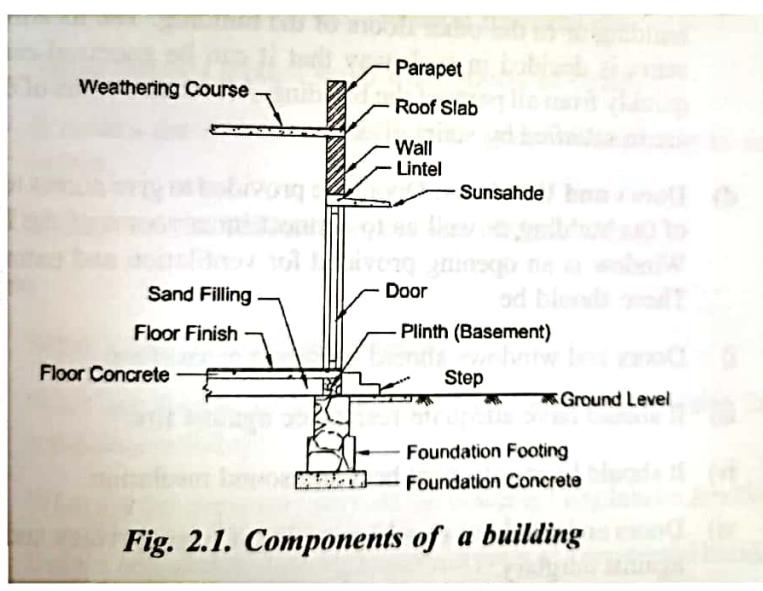


Fig. 2.1. Components of a building

7.

- a. 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 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.

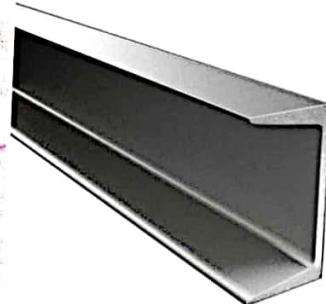
③ Heat Strengthened Glass: Heat strengthened glass is a type of tempered glass which has been strengthened thermally by inducing a surface compression of 422 to  $658 \text{ kg/cm}^2$ . Used for spandrel and vision panels of curtain walls.

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:

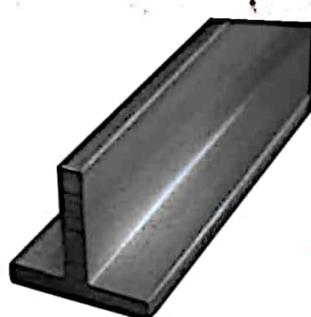
Channel sections have 2 equal flanges and a web. Channel sections are used in steel framed structures, girders and steel bridges.



② I Sections: It's usually gullied. It's 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 200mm 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

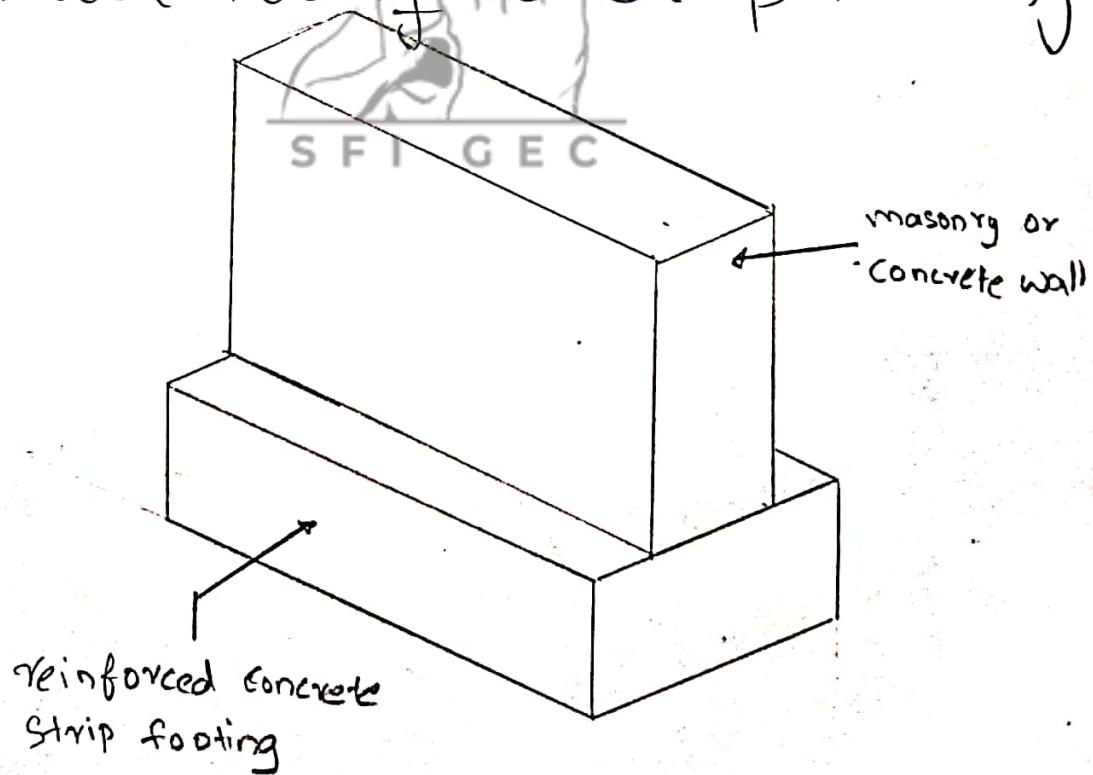
- ① For white washing and plasterwork
- ② For roads and bridge markings.

#### ⑤ Portland Pozzolana Cement

- ⑥ For marine structures
- ⑦ For sewers and sewage disposal works.

10.

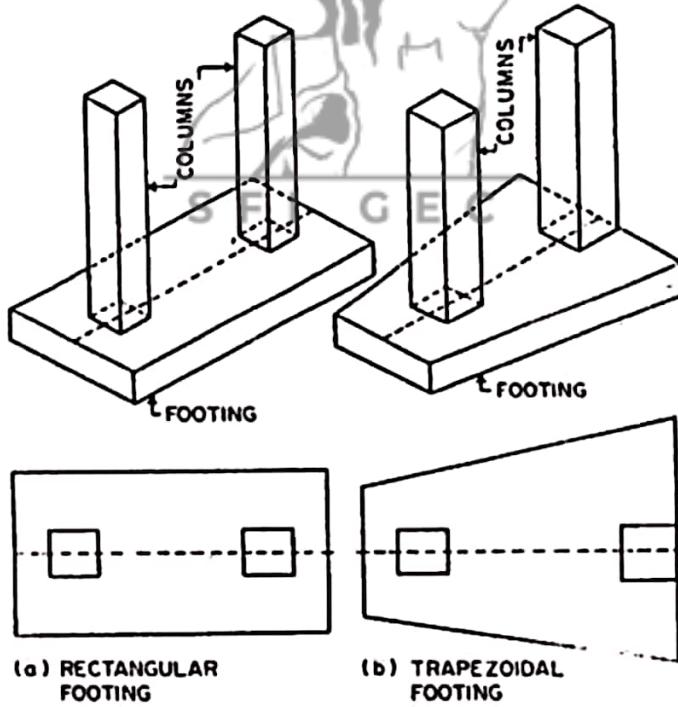
① Wall Footing or Strip Footing



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.



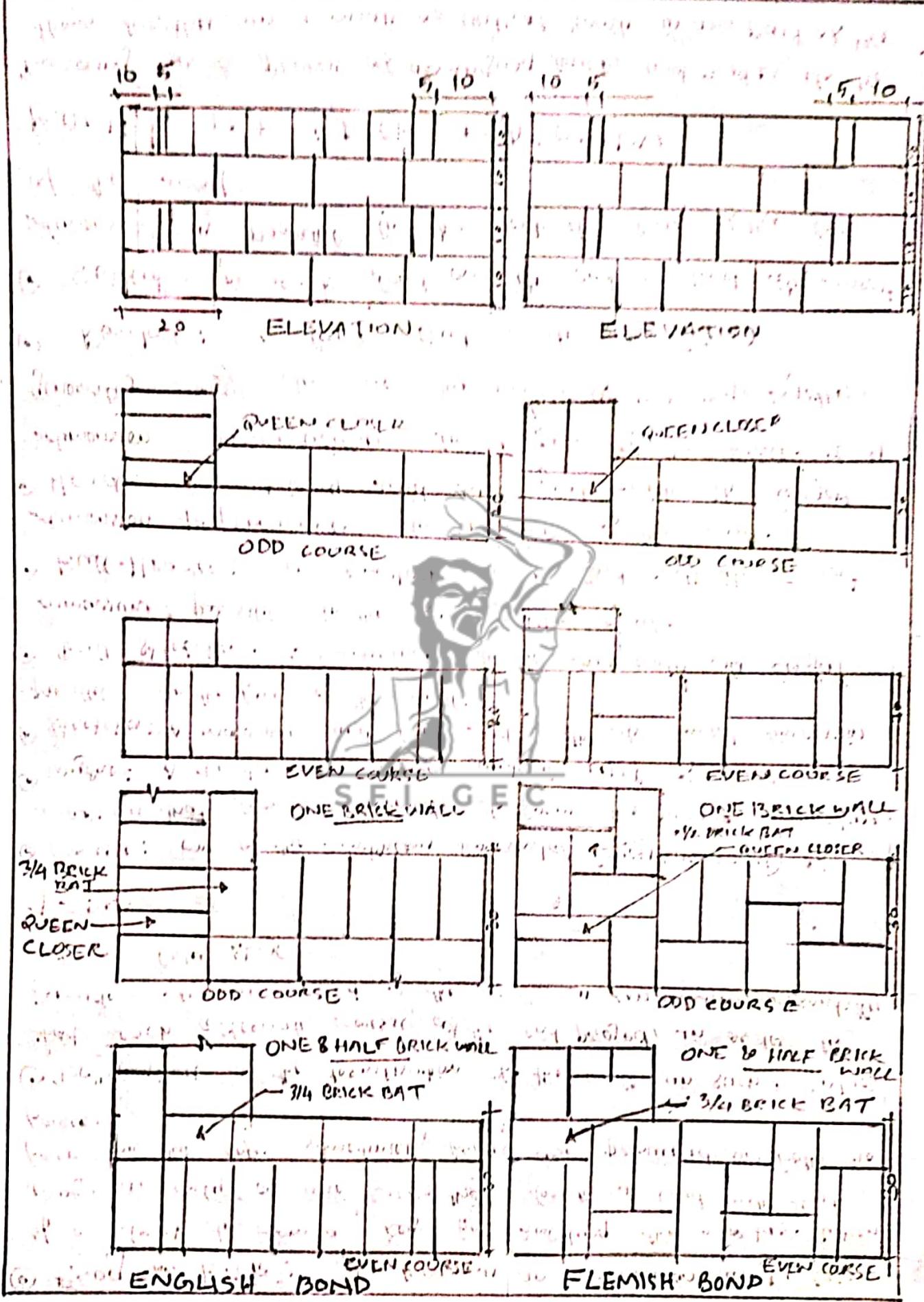
b.

## 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 facing 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

- ① Headers and stretchers placed alternately in each course.
- ② It has same appearance in the facing and backing of the wall in each course.
- ③ 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 on 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

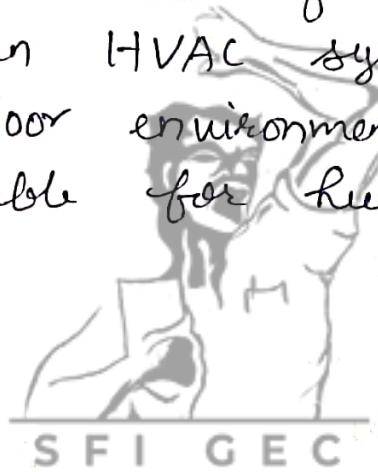
### ③ Plumbing .

This system might be used for .

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

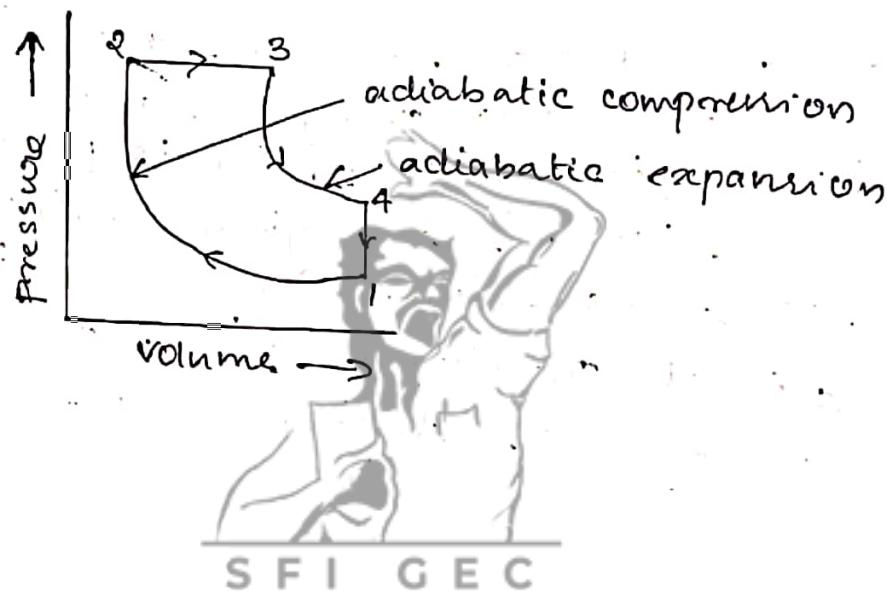
## HVAC

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.

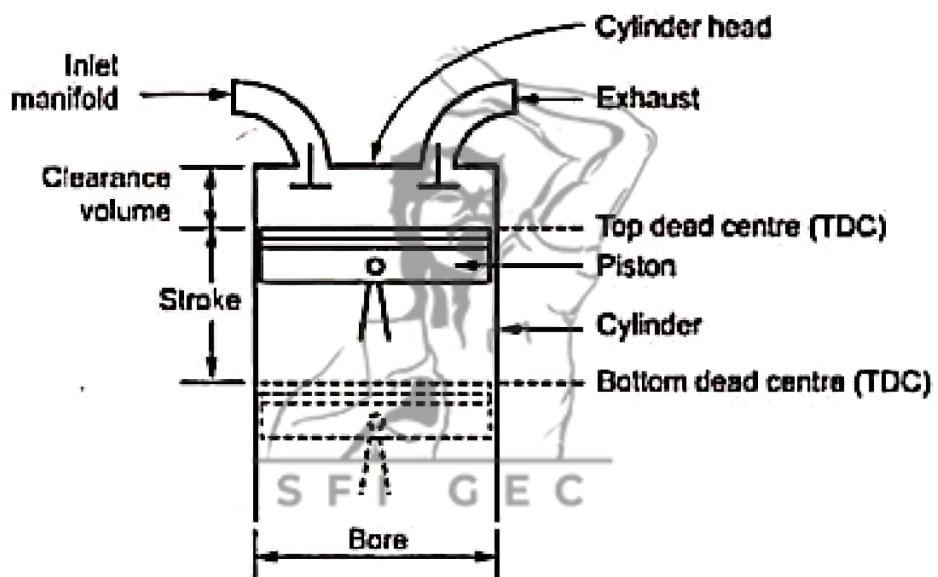


1 compression ratio is defined as the ratio of volume before compression to volume after compression.

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

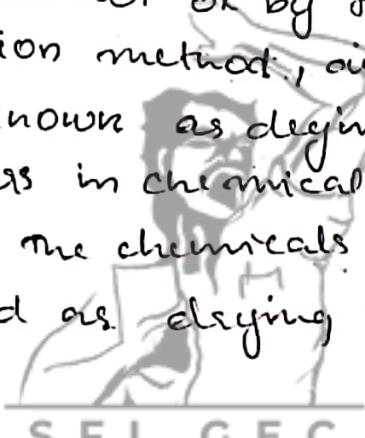


## 2) IC Engine terminology



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.

Demineralization 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 turn 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

$$d = 150\text{mm} , L = v_1 - v_2 = 200\text{mm}$$

$$v_2 = 10\% (v_1 - v_2)$$

$$v_3 - v_2 = \frac{6}{100} (v_1 - v_2)$$

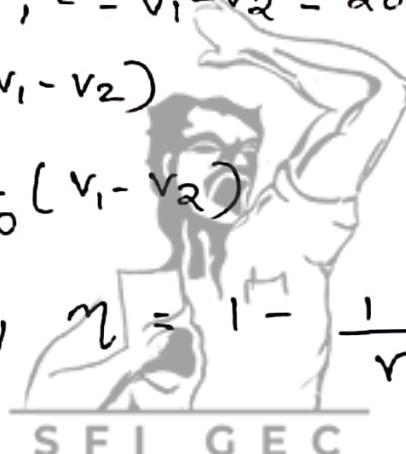
$$\gamma = \frac{v_1}{v_2} , \eta = 1 - \frac{1}{\gamma} \frac{(\rho^{\gamma} - 1)}{(\rho - 1)(\eta)^{\gamma-1}}$$

$$v_2 = \frac{10}{100} (v_1 - v_2)$$

$$10v_2 = v_1 - v_2$$

$$11v_2 = v_1$$

$$\frac{v_1}{v_2} = 11 \therefore \underline{\underline{\underline{v_1 = 11v_2}}}$$



$$\rho = \frac{v_3}{v_2} =$$

$$v_3 - v_2 = \frac{6}{100} (v_1 - v_2)$$

$$100(v_3 - v_2) = 6(v_1 - v_2)$$

$$100v_3 - 100v_2 = 60v_2$$

$$100v_3 = 160v_2$$

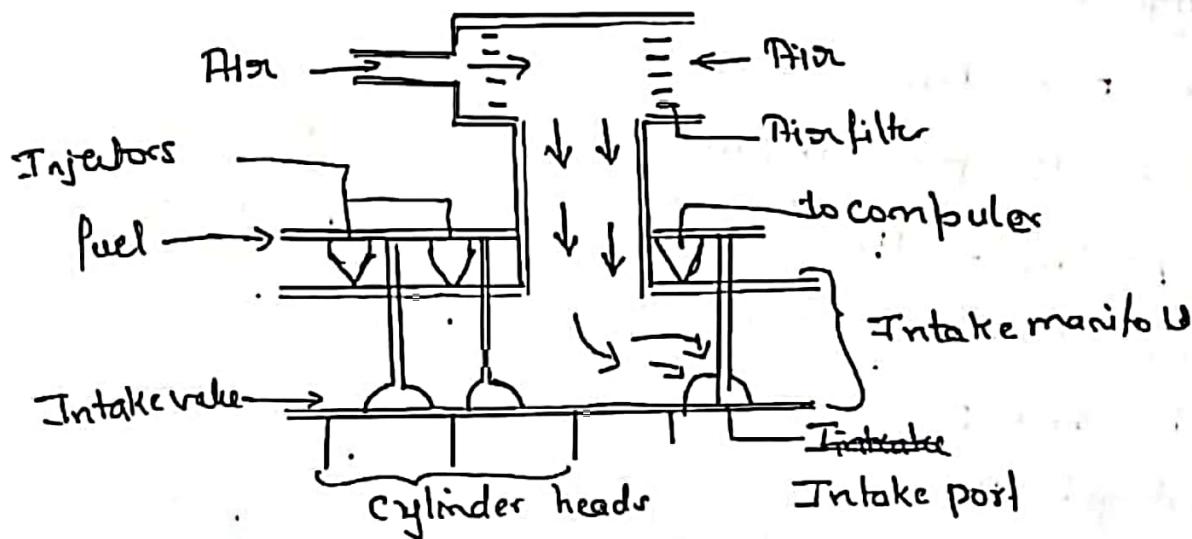
$$\frac{v_3}{v_2} = \frac{160}{100} = \underline{\underline{\underline{\frac{8}{5}}}}$$

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

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 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~~ fuel 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 l/min. Find the efficiency of pump.

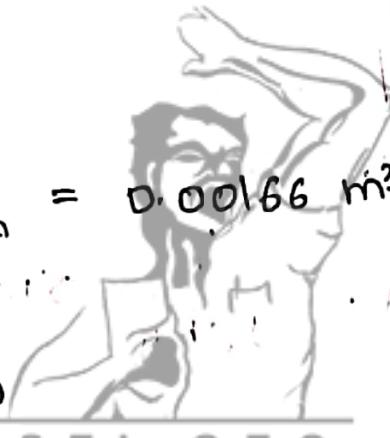
- b) Explain the open belt and cross belt drive in power transmission. Also give the applications.

Ans:-

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

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

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



$$H = h_d - h_s$$

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

$$(Pgh = P)$$

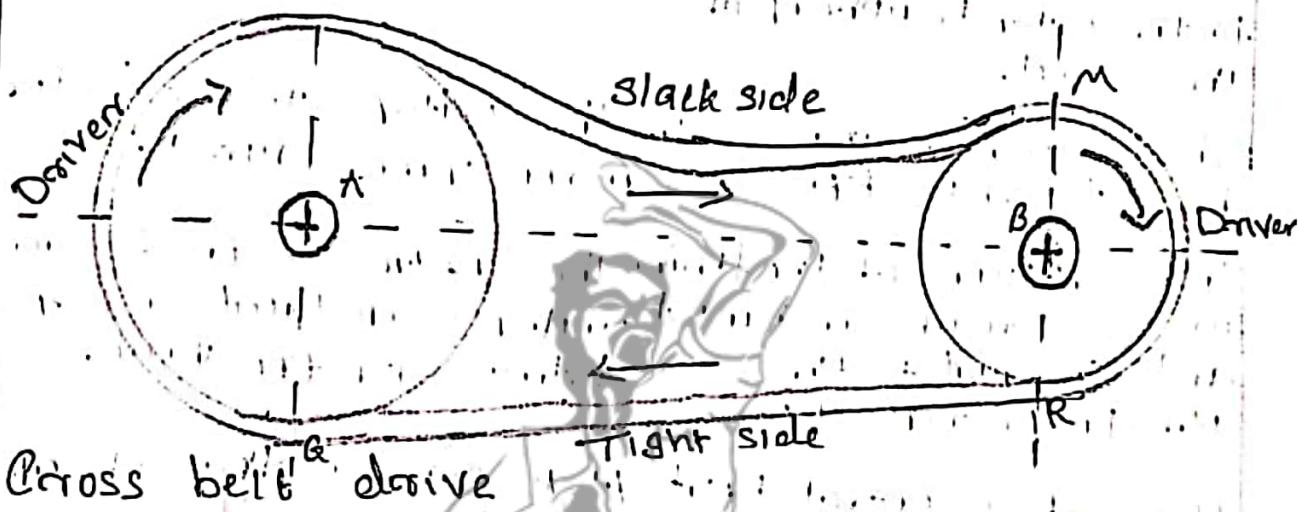
$$\eta_o = \frac{\rho Q g H}{P}$$

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

$$= 0.66\%$$

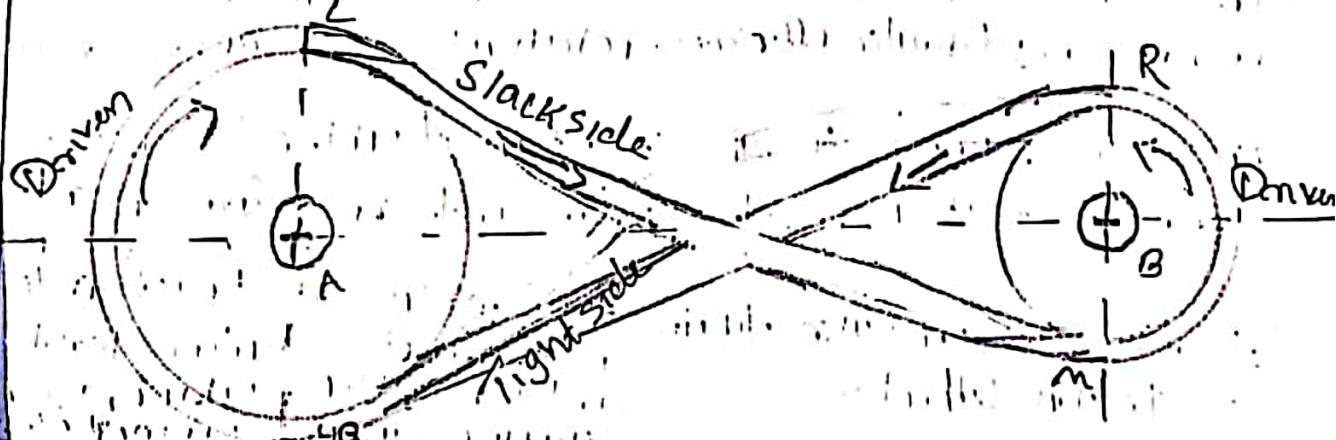
## 8 b) open belt drive

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

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

$\eta_0 = 55\%$

$P = ?$

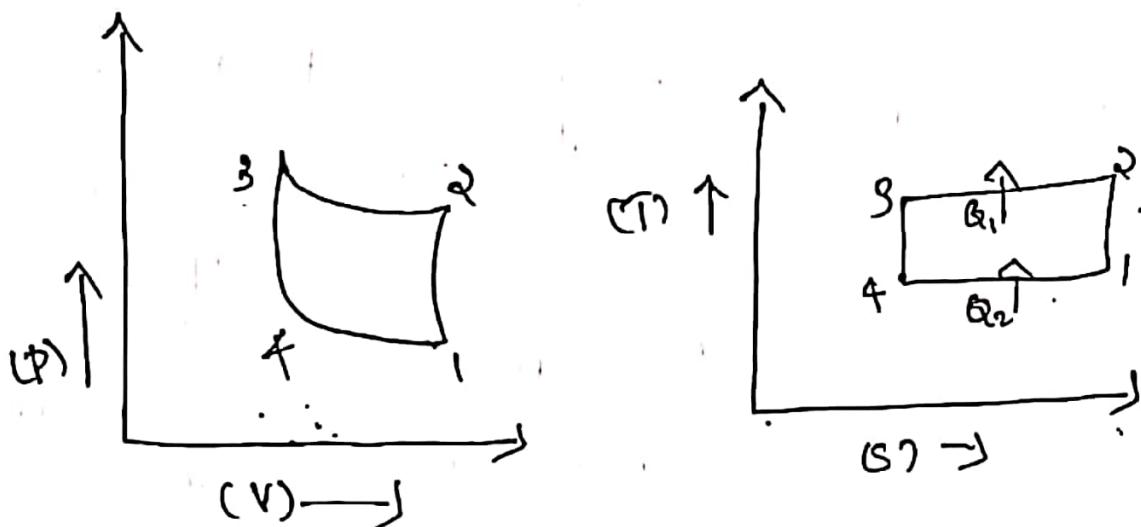
$$\eta_0 = \frac{P}{\rho g h Q} \times 1000$$

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

$$= 2691.7 \text{ W}$$

$$= \underline{\underline{2.6917 \text{ kW}}}$$

## 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 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

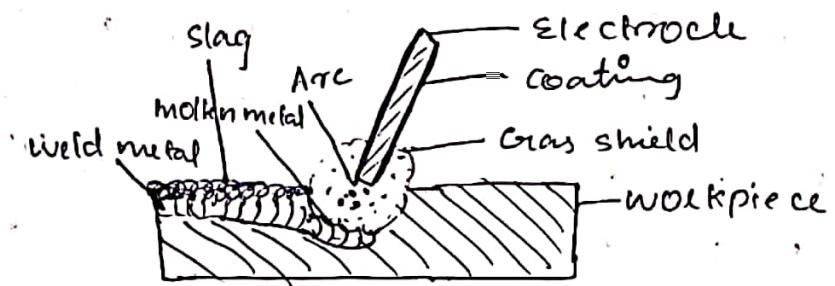
#### i) Electrical resistance welding.

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

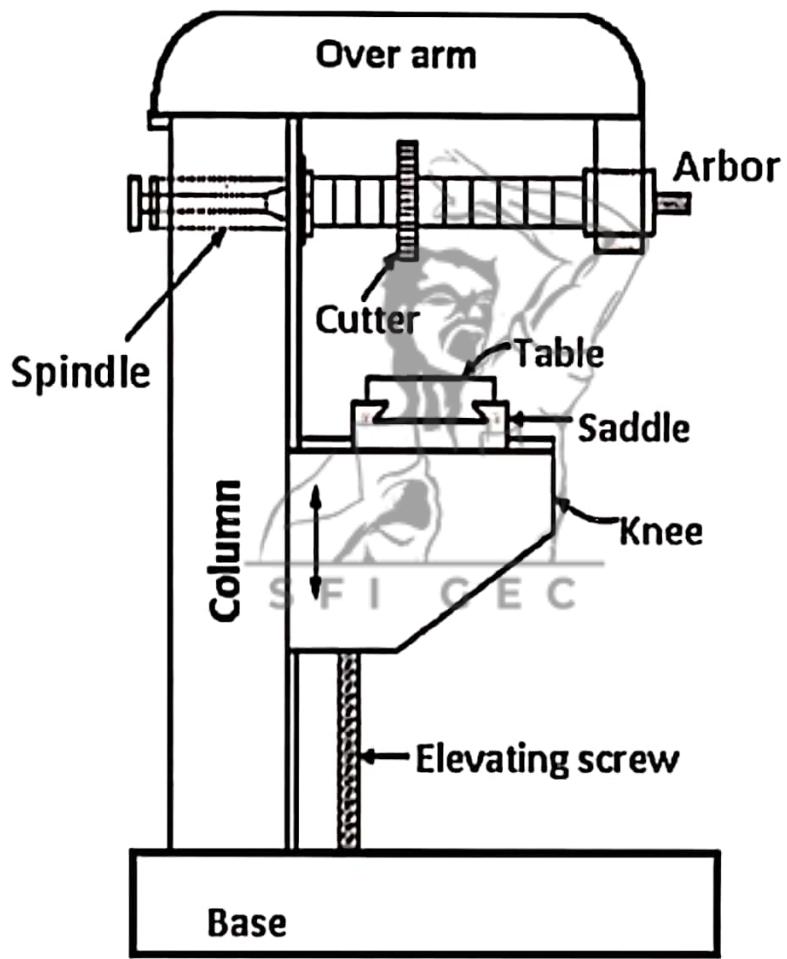
## b) Arc welding.



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 electrical 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 removal 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.