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SFI GEC PALAKKAD

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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)

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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 (iii) Mechanical efficiency and (iv) Volumetric efficiency of an IC engine. (4)

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 15^0C and the pressure is 0.1MPa. Heat is added until the temperature at the end of constant pressure process is 1480^0C.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. Calculate discharge of the turbine if the overall efficiency is 80%. (4)

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)

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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, lift wells, ducts, toilets, electrical and airconditions, plant rooms etc.

For residential building: permissible FAR is 3.0. plot area is the area which is enclosed by the boundaries of the plot.

SL NO:	BOILDING USE	MAX COVERAGE %	MAX. PERMISSIBLE F.A.R
1.	Residential	60	15
2.	Educational	30	12
3	Commercial	60	20
4	Industrial	40	12
5.	offfice building	40	15
6.	Assembly	40	0.7

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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 attatched 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.

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* 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 prices 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 ~~finance~~ 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 supplies 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 further than putting all their focus and resources on one or a ~~few~~ few projects at a time.

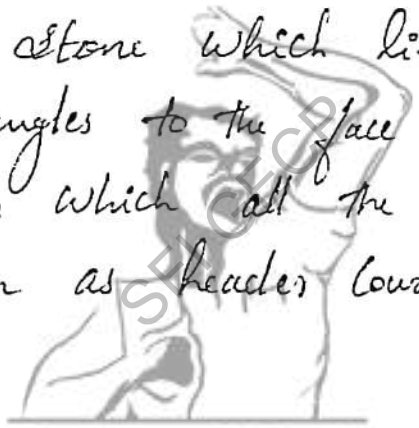
* Define (a) Stretcher (b) Headers (c) King closer (d) Queen Closer

- **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.

- **Header**

It is a brick or 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 portions of a brick obtained by cutting off the triangular piece between the ~~Center~~ Center of one end and the ~~Center~~ Center of one side.

- **Queen Closer**

It is the portion 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 ~~Sur~~ 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 then it is known as map.

- Primary divisions of Surveying:-

~~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 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 km^2) or 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 bricks 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.
- Colour 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 absoption Should not be greater then 20% for first class bricks and 22% of 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 Soundproof.
- 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 N/mm².

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 base floor is ready to apply floor covering.

In case of old 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 leveler. 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 sawdust. After 3 days these joints are rubbed with carborundum 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 base 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

adhesing 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 Manufacturers instructions. If possible grout small areas at a time. The grout is forced into the the joint with grout float held at approxiamately 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.

PREPERATION : 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 throught the joints to the surface. This oozed out cement grourst 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.

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

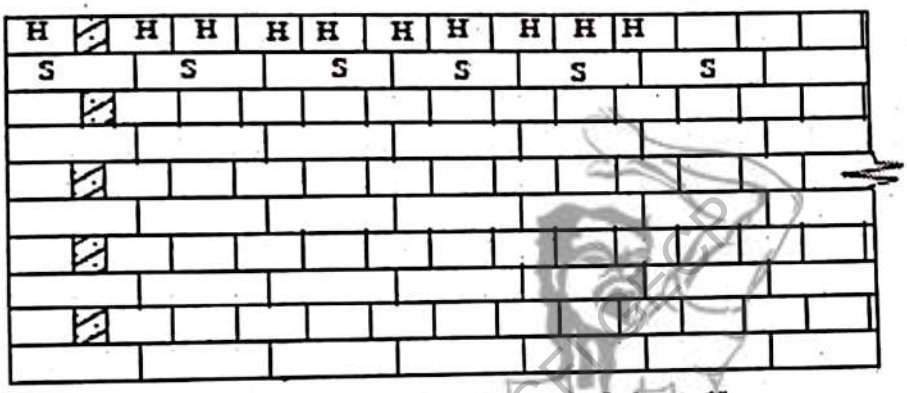
- concrete 20mm thick bedding mortar of 1:2 mix is spread under each individual slabs. The marble slabs is then laid over this mortar. Gently pressed with wooden mallet and leveled. The marble is then again lifted up and fresh mortar is added to the hollows of bedding mortar. The mortar is allowed to 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 expories and polyesters are used in terrazo floor in thinner layer, than in standard terrazo floor. The synthetic material replaces cement of the standard terrazo and they reduce the self weight of flooring. For the preperation 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.

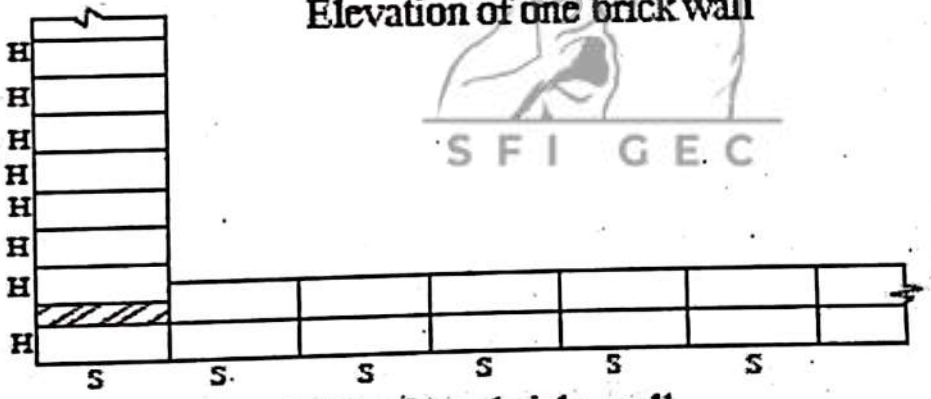
Agglomerated marble is another material used for flooring and its prepared by bonding granules of marble dust with synthetic resins under high pressure into slabs of different thickness colour and length. They can be installed over

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

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



Elevation of one brick wall



Plan of one brick wall

7)

FLOOR AREA	CARPET AREA
(a) • The built up covered area in all floors including basement floor. • It does not include the boundary walls but includes only the inner walls. • Basically it is the area covered under outer-to-outer walls of the house. • It is calculated by multiplying the outer-to-outer dimensions of floor.	• The covered area of the usable rooms at any floor level. • (Excluding the area of the walls) Area of staircase, lift wells, escalators, ducts etc are also excluded. • Calculated by subtracting the area occupied by the outer and the innerwalls of the house from the Total Floor Area.

(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, appartment 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 maintainance 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 wether 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 maintainance 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 Pyrogel.

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

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

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

OPC is classified into 3 grades - 33, 43, 53 grades denoted as C33, C43 and C53.

1) 33 grade cement (C33)
Obtained when 28 days compressive strength of cement is more than 33 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 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 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 transfered to undeerground 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

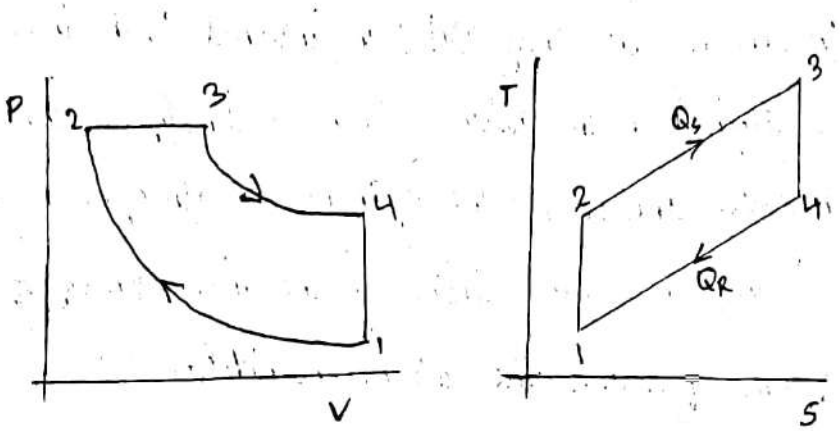
These piles are used where the foundation soil is very loose. They compact the soil and increase the load bearing capacity. Sand piles are used as compaction piles.

- End-bearing piles & Friction piles – LOAD BEARING PILES
- Compaction piles / Under reamed piles – NON-LOAD BEARING PILES

PART II: BASIC MECHANICAL ENGINEERING

PART-A

12)



1 → 2 Adiabatic Compression

2 → 3 Constant Pressure (P=C)

3 → 4 Adiabatic Expansion

4 → 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 (ip) and energy in fuel per second. ηith = ip (KJ/s) / energy in fuel per second (KJ/s) indicated power is defined as the sum of friction power and brake power.

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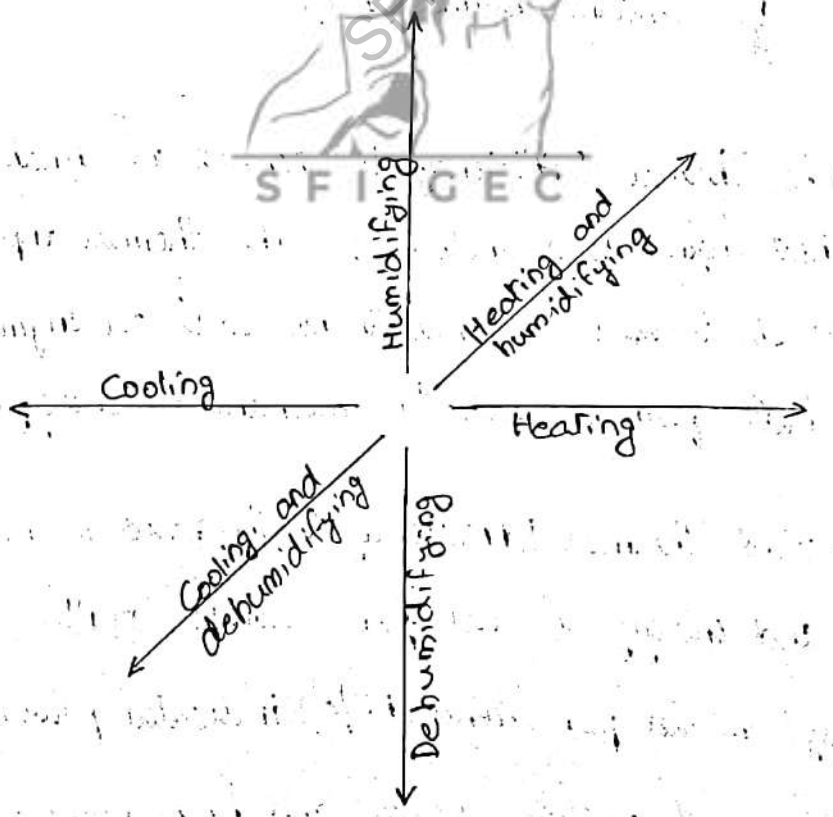
(iii) Mechanical efficiency is a dimensionless number that measures the effectiveness of a machine in transforming the power input to the device power output.

(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.



Various air-conditioning processes.

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 is attached to a hub which rotates along with the driven shaft and is free to slide axially on the driven shaft. During disenagement, 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, Turbines rings are rolling products.
- Extrusion : Extrusion is widely used in production of tubes & hollow pipes.

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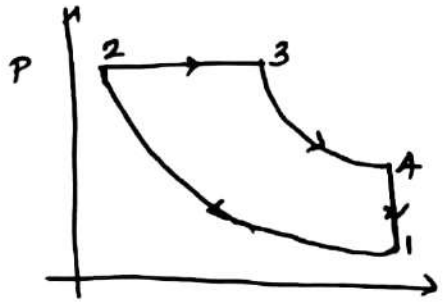
A)
17) $r_c = 16$, $T_1 = 15^\circ C = 288\,K$, $T_3 = 1480^\circ C = 1753\,K$ $P_1 = 0.1\,MPa$

$C_p = 1.005$ $C_v = 0.717$, $\gamma = 1.4$



process 1-2

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

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

(ii).

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

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

process 2-3

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

Cutt off Ratio, $\rho = \frac{T_3}{T_2} = \frac{1753}{872.93} = \underline{2.008}$

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Heat Rejected => $C_v(T_4 - T_1)$

Process 3-4

$T_4 = T_1 \rho^{\gamma} \Rightarrow 288 \times (2.008)^{1.4} = 288 \times 2.654$

$= 764.29\ K$

Heat Rejected = ~~764.29K~~

$Q_R = 0.718\,(764.29 - 288)$

$= 341.97$

Cycle efficiency = $\frac{Q_S - Q_R}{Q_S} = \frac{884.47 - 341.97}{884.47}$

$= 0.6133 = 61.33\%$

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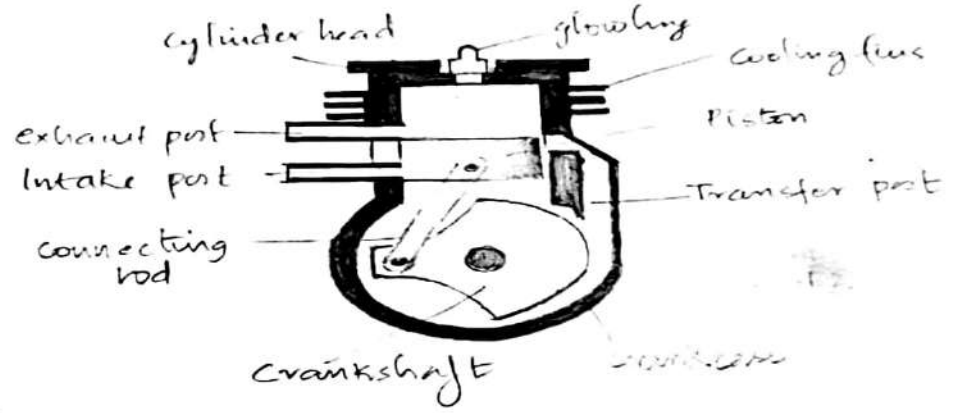
15)



- 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.

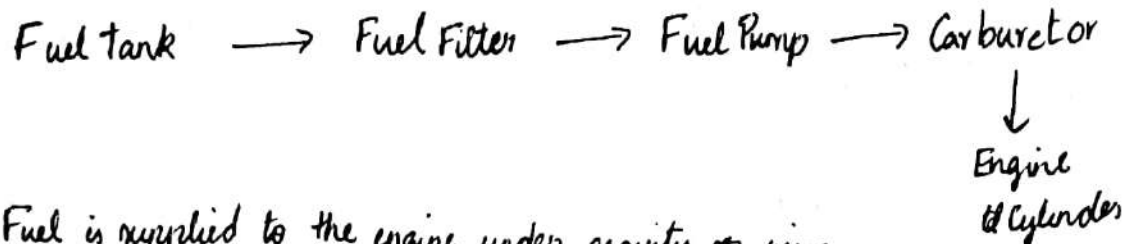
- Compression Stage

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.

b)



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 is 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.

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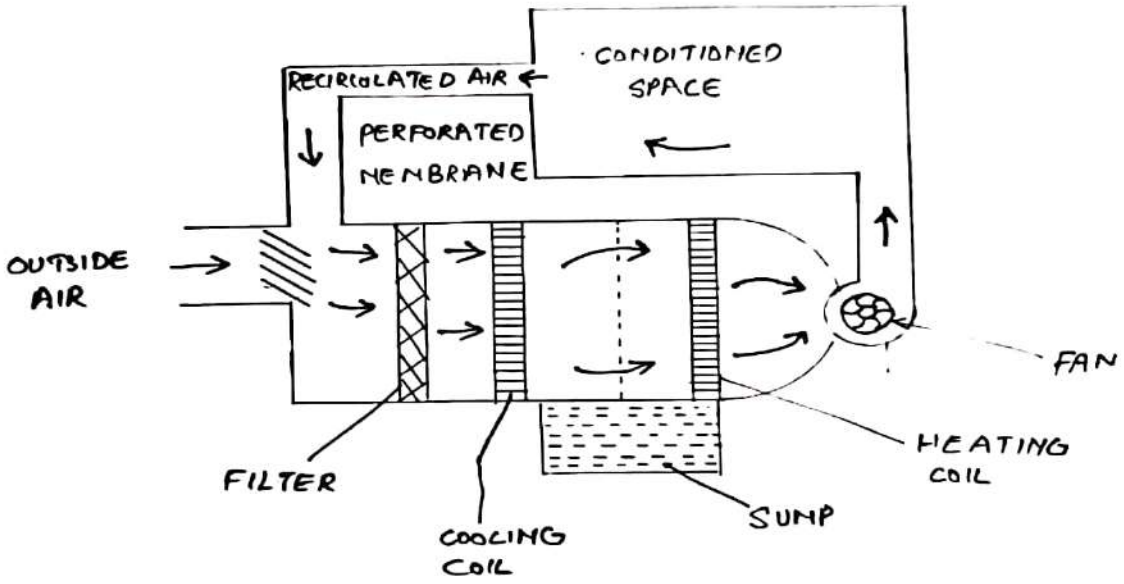

- Air is cooled and generally dehumidified
- Outside air flows through the damper, and mixes up with recirculated air (obtained from the conditioned space).
- The mixed air passes through a coil. The coil has a temperature much below the required dry bulb temperature of the air in the conditioned space.
- 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.

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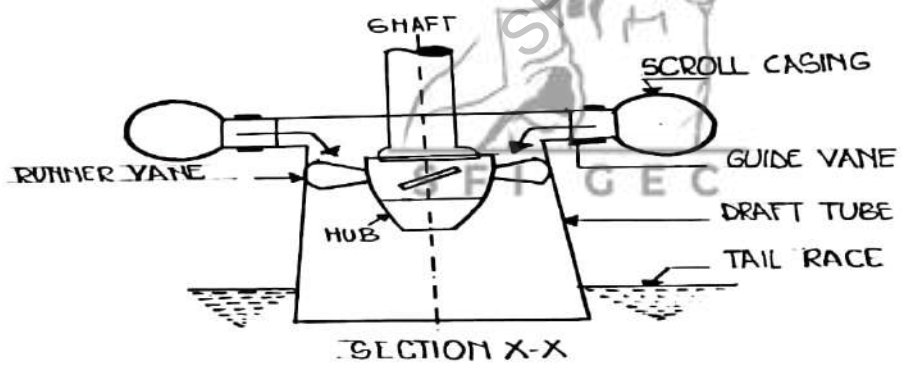
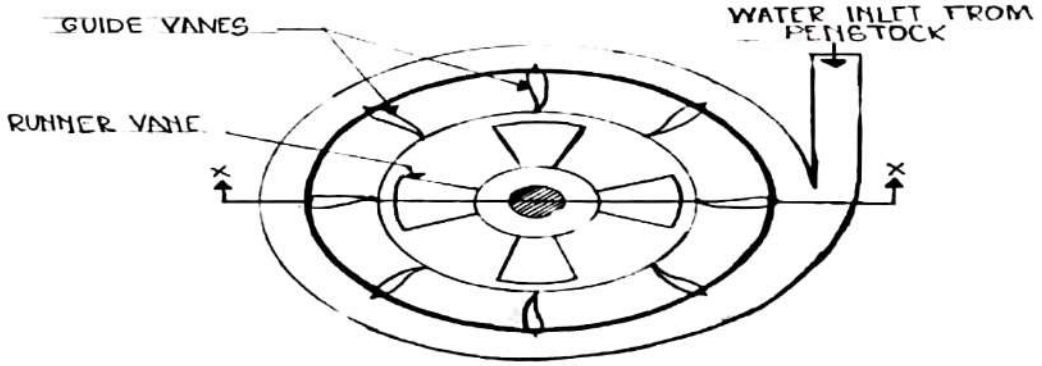
20

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.



SECTION X-X



KAPLAN TURBINE

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b) Head = $h = 450\ m$

$P = 13\ MW = 13 \times 10^6\ W$

efficiency = $\eta = 80\%$

$Q = ?$

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

Discharge of tube = $Q = 3.68\ m^3/s$.

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°C to 7000°C at the centre of the arc depending upon the electrode. Intense heat so produced

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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 sterevlithography (6L), 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~~ be

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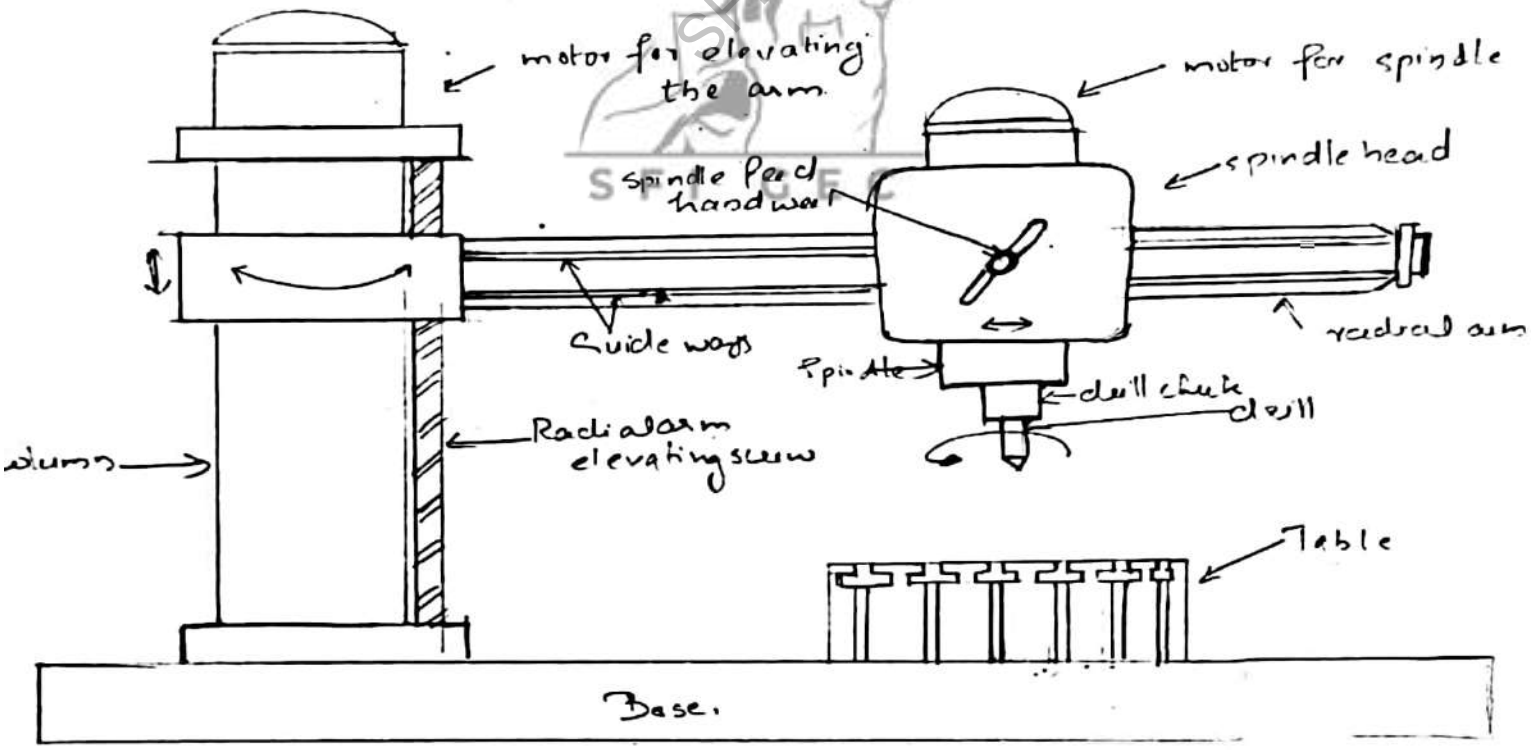
melts the faces of the prepared joint forming a pool of molten metal. The electrode is also melted and is transferred across the arc to the molten pool metal pool. The arc is maintained by uniformly moving the electrode across the work piece along the desired line of welding and keeping a constant gap between work piece and electrode. On solidification a weld is formed between two parent metals. Electrods 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.



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

Column – The column is the vertical number 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 cone pulley.

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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 accomodations 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, recreation, social, religious, patriotic, civil, travel and ~~and~~ building for similar purposes etc. Example of this type of building are Assembly hall, Theatres, auditorium, exhibition halls, gymnasiums, restaurants, club rooms, museums, religious building like church, temple etc.

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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

a) General requirement regarding plots
b) Exterior or interior open spaces.
c) Built up areas of building, coverage and floor area of building.
d) Where a building is newly erected, the building rules of KBMR shall apply to the designs and construction of the building.
e) Where the building is altered, the rules in KBMR shall apply to the altered portion of the building.
f) Where the occupancy or use of building is changed, these rules shall apply to all the parts of the building affected by the change.
g) Size, height and ventilation of rooms
h) Water supply, sanitation and rainwater harvesting

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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 ~~ang~~ 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 be~~

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 nautic miles towards the sea from the high tide and up to 20 kms

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

For egulating developmental activities the coastal stretches within 500m of hightide 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 area 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 faulity.

~~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~~

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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, Lakshdweep 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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