Basic Civil Engineering (CV 105)

Model Answer Paper

Q. No.1

A) Describe the properties of good bricks used in building construction.

It is always desirable to use the best quality brick in constructions. The essential requirements for bricks are sufficient crushing strength, regularity in size and shape, less water absorptive, and a pleasing appearance. Generally good bricks should possess the following properties:

(i) Colour: The brick should have a uniform deep red or cherry colour as indicative of uniformity in chemical composition and thoroughness in the burning of the brick.

(ii) Shape: The bricks should have uniform size and plane, rectangular surfaces with parallel sides, sharp straight edges and true right angled corners.

(iii) Size: Bricks should be of standard sizes as prescribed by codes.

(iv) Texture: They should possess fine, dense and uniform texture. They should not possess fissures, cavities, loose grit and unburnt lime. At the same time the surfaces should not be too smooth to cause slipping of mortar.

(v) Soundness: When struck with hammer or with another brick, it should produce metallic sound.

(vi) Hardness: The brick should be so hard that when scratched by a finger nail no impression is made.

(vii) Strength: Crushing strength of brick should not be less than 3.5 N/mm^2. A field test for strength is that when dropped from a height of 0.9 m to 1.0 mm on a hard ground, the brick should not break into pieces.

(viii) Water Absorption: After immersing the brick in water for 24 hours, water absorption should not be more than 20 per cent by weight. For class-I works this limit is 15 per cent.

(ix) Efflorescence: Bricks should not show white patches when soaked in water for 24 hours and then allowed to dry in shade. White patches are due to the presence of sulphate of calcium, magnesium and potassium. They keep the masonry permanently in damp and wet conditions.

(x) Thermal Conductivity: Bricks should have low thermal conductivity, so that buildings built with them are cool in summer and warm in winter.

(xi) Sound Insulation: Heavier bricks are poor insulators of sound while light weight and hollow bricks provide good sound insulation.

(xii) Fire Resistance: Fire resistance of bricks is usually good. In fact bricks are used to encase steel columns to protect them from fire.

B) What is meant by cement concrete? Explain the functions of main ingredient of cement concrete.

Cement concrete is an intimate mixture of cement as binding material, fine aggregate, coarse aggregate and water. Concrete can be easily moulded to desired shape and size before it looses plasticity and hardens. It is strong in compression and weak in tension. There are four main ingredients of cement concrete:

1. Binding material (cement)

2. Fine aggregate (natural river sand, crushed stone sand)

3. Coarse aggregates (crushed stone)

4. Water.

Functions of various ingredients of cement concrete:

1. Cement: It is the binding material in cement concrete. When water is added, the cement hydrates and binds aggregates and the surrounding surfaces. Generally, richer mix (with more cement) gives more strength. Ordinary Portland Cement (OPC) is the most commonly used cement as a binding material for making concrete. In general, the initial setting time should be more than 30 minutes and final setting time should be less than 10 hours. Hence concrete should be laid in its mould before 30 minutes of mixing of water and should not be subjected to any external forces till final setting takes place.

2. Fine aggregate: The smaller size aggregates in concrete are known as fine aggregates. It consists of river sand or crushed stone sand. It prevents shrinkage of cement. When surrounded by cement it gains mobility enters the voids in coarse aggregates and binding of ingredients takes place. It adds density to concrete, since it fills the voids. Denser the concrete higher is its strength.

3. Coarse aggregate: Bigger sizes aggregates in concrete are known as coarse aggregates. It consists of crushed stones. It should be well graded. They should be clean, sharp, angular and hard. They give mass to the concrete and prevent shrinkage of cement.

4. Water: Water used for making concrete should be clean. It activates the hydration of cement and forms plastic mass. As it sets completely concrete becomes hard mass. Water gives workability to concrete which means water makes it possible to mix the concrete with ease and place it in final position. More the water better is the workability. However excess water reduces the strength of concrete.

Q. No.2

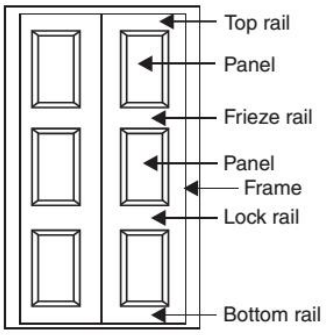
A) Write a short note on bearing capacity of soil.

All civil engineering structures whether they are buildings, dams, bridges etc. are built on soils. A foundation is required to transmit the load of the structure on a large area of soil. The foundation of the structure should be so designed that the soil below does not fail in shear nor there is the excessive settlement of the structure. The conventional method of foundation design is based on the concept of bearing capacity.

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. Soil properties like shear strength, density, permeability etc., affect the bearing capacity of soil. Dense sand will have more bearing capacity than loose sand as unit weight of dense sand is more than loose sand. If the bearing capacity of soil at shallow depth is sufficient to safely take the load of the structure, a shallow foundation is provided. Isolated footing, combined footing or strip footing are the option for the shallow foundation. Deep foundations are provided when soil immediately below the structure does not have the adequate bearing capacity. Pile, piers or well are the options for deep foundations. Mat or raft foundations are useful for soil which is subjected to differential settlement or where there is a wide variation in loading between adjacent columns.

OR

A) Draw a neat sketch of double shuttered panelled door and name the different parts.



Double shuttered panelled door

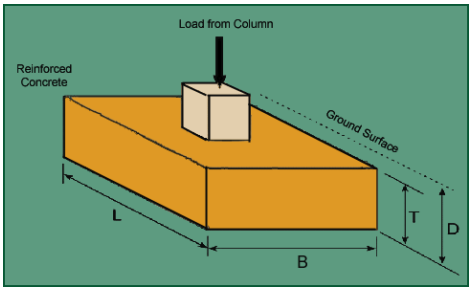
B) Explain with neat sketch the different types of shallow foundation.

Foundations are generally classified as shallow and deep foundations. According to Terzaghi, a foundation is shallow if its depth is equal to is less that its width. The shallow foundations are of the following types:

1. Spread Footing
2. Strap Footing
3. Strip/continuous footings
4. Combined Footing
5. Mat or Raft footings

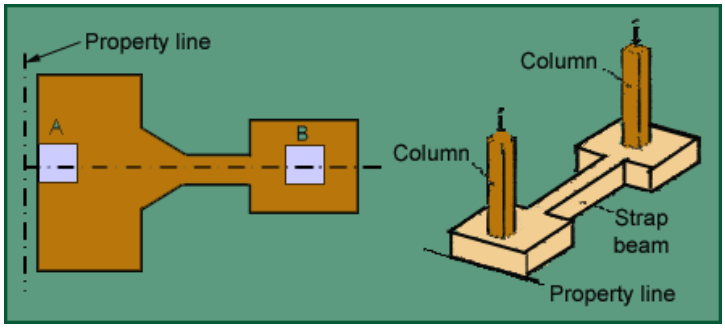
1. Spread Footing:

It is circular, square or rectangular slab of uniform thickness. Sometimes, it is stepped or haunched to spread the load over a larger area. When spread footing is provided to support an individual column, it is called "Isolated footing" as shown in fig.



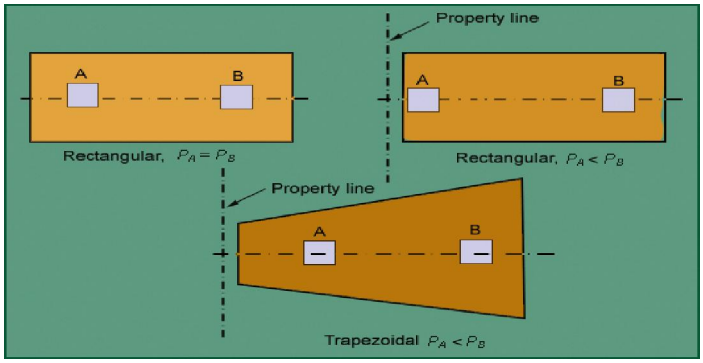
2. Strap Footing:

It consists of two isolated footings connected with a structural strap or a lever, as shown in fig. The strap connects the footing such that they behave as one unit. The strap simply acts as a connecting beam. A strap footing is more economical than a combined footing when the allowable soil pressure is relatively high and distance between the columns is large.



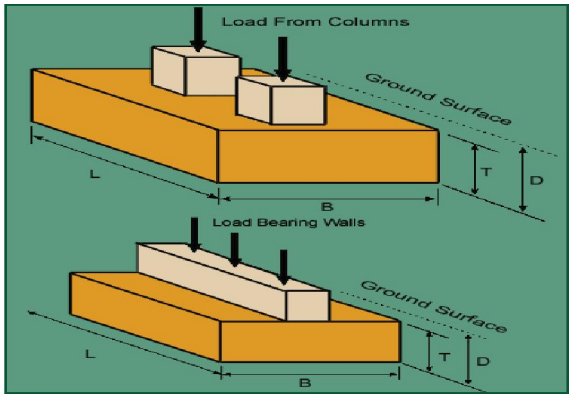
3. Combined Footing:

It supports two columns as shown in fig. It is used when the two columns are so close to each other that their individual footings would overlap. A combined footing is also provided when the property line is so close to one column that a spread footing would be eccentrically loaded when kept entirely within the property line. By combining it with that of an interior column, the load is evenly distributed. A combine footing may be rectangular or trapezoidal in plan. Trapezoidal footing is provided when the load on one of the columns is larger than the other column.



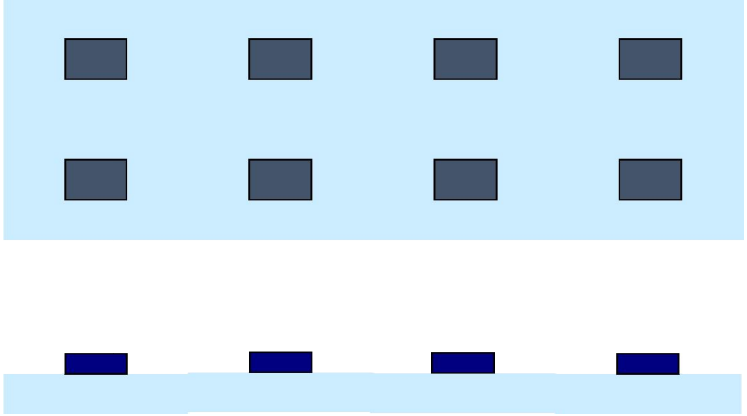
4. Strip/continuous footings

A strip footing is another type of spread footing which is provided for a load bearing wall. A strip footing can also be provided for a row of columns which are so closely spaced that their spread footings overlap or nearly touch each other. In such a case it is more economical to provide a strip footing than to provide a number of spread footings in one line. A strip footing is also known as "continuous footing". Refer fig



5. Mat or Raft footings:

It is a large slab supporting a number of columns and walls under entire structure or a large part of the structure. A mat is required when the allowable soil pressure is low or where the columns and walls are so close that individual footings would overlap or nearly touch each other. Mat foundations are useful in reducing the differential settlements on non-homogeneous soils or where there is large variation in the loads on individual columns.



Q. No.3

A) Differentiate between load bearing and framed structures.

Load bearing structure	Framed structure
• In load bearing structure, load transfer path is from slab/floor to walls and walls to footing.	• In framed structure, load transfer path is from slab/floor to beam, beam to column and column to footing.
• Load bearing walls can be of brick, stone, concrete block etc, and transfer structural loads.	• Walls can be of brick or concrete block and serve as enclosure or partitions and not to transfer structural loads.
• Limited storey buildings can be constructed.	• Multi storey buildings can be constructed.
• Less resistant to earthquake.	• More resistant to earthquake.
• Carpet area available is less.	• Carpet area available is more.
• Quantity of excavation is more.	• Quantity of excavation is less.
• It is more labour intensive.	• It is less labour intensive.
• The speed of construction is less.	• The speed of construction is more.
• It is more material intensive.	• It is less material intensive.
• Not flexible in design as one can't remove/ shift walls for modifications at a later date.	• Flexible in design as one can remove/shift walls for modifications at a later date.
• Room dimensions cannot be changed as walls have to be above walls.	• Room dimensions can be changed at different floors.
• Thickness of wall increases with increase in height.	• The thickness of wall remains same for all floors.
• Large span areas are not possible.	• Large span areas are possible.
• Limitations for openings in walls.	• No limitations for openings in walls.

B) Draw a typical plan of a residential building using following data:

(Plan can be drawn using scale or with freehand sketching showing appropriate wall thickness, sufficient number of doors and windows and with internal room dimensions).

The minimum number of rooms and their sizes mentioned in bracket can be taken as:

Sit out (Verandah) - 01 (2.1m x 3m)

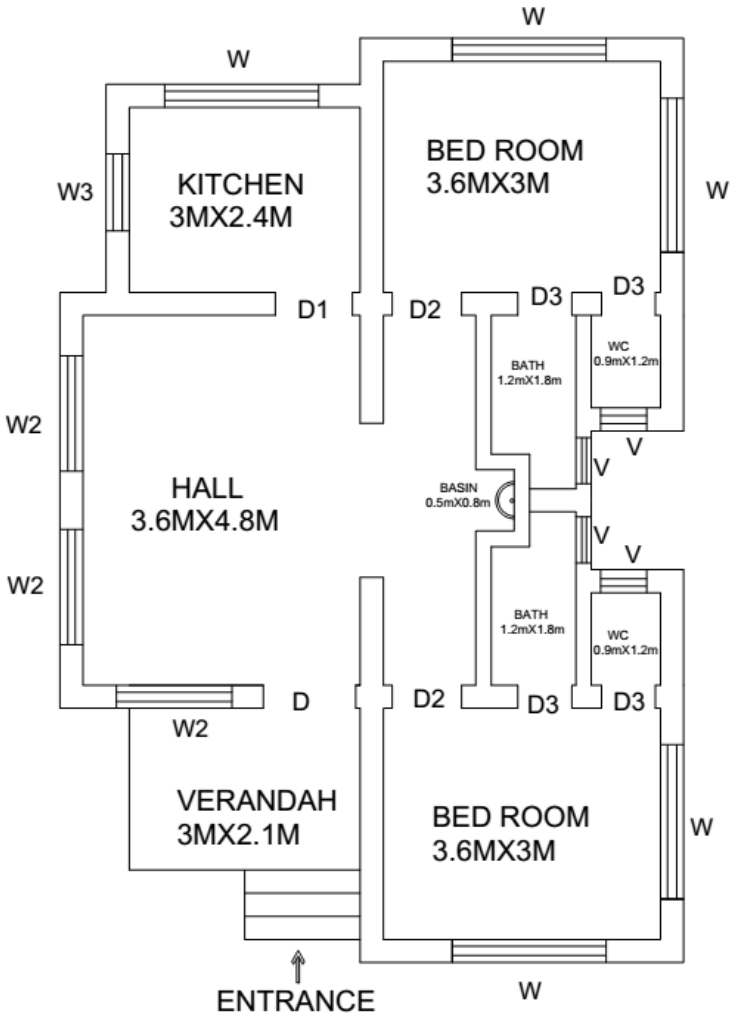
Living room (Hall) - 01 (3.6m x 4.8m)

Bed room - 02 (3m x 3.6m)

Kitchen - 01(2.4m x 3m)

Bath Room - 02(1.2m x 1.8m)

Water Closet - 02 (0.9m x 1.2m)



Q. No.4

A) List the necessary instruments used in plane table surveying.

1. The Plane Table
2. The Alidade: a) Plain alidade b) Telescopic alidade
3. The Spirit level
4. Compass: a) The trough compass b) The circular box compass
5. U-fork or plumbing fork with plumb bob

B) Define

a) Back Sight (BS): This is the first staff reading taken in any set up of the instrument after the levelling has been perfectly done. This reading is always taken on a point of known reduced level (RL) i.e. on a bench mark or change point. It is also called as plus sight since this reading is added to the reduced level of the bench mark.

b) Fore Sight (FS): It is the last staff reading in any set up of the instrument, and indicates the shifting of the latter. It is also called as minus reading.

c) Change Point (CP): This point indicates the shifting of the instrument. At this point, a foresight (FS) is taken from one setting and a back sight (BS) from the next setting.

d) Bench Mark (BM): These are fixed point or marks of known reduced level (RL) determine with reference to the datum line.

OR

B) What are the fundamental principles of surveying? Explain briefly.

The fundamental principles of surveying are:

1. To work from the whole to the part, and

2. To locate a new station by at least two measurements (linear or angular) from fixed reference points.

1. According to the first principle, the whole area is first enclosed by main station (i.e. controlling station) and main survey lines (i.e. controlling lines). The area is then divided into a number of parts by forming well conditioned triangles. A nearly equilateral triangle is considered to be the best well-conditioned triangle. The main survey lines are measured very accurately with a standard chain. Then the sides of the triangles are measured. The purpose of working from whole to part is to localise the errors and to control the accumulation of errors. During this procedure if there is any error in measurement of any side of a triangle, then it will not affect the whole work. The error can always be detected and eliminated.

But if the reverse process (i.e. from the part to the whole) is followed, then the minor error in measurement will be magnified in the process of expansion and stage will come when these error will become absolutely uncontrollable.

2. According to the second principle, the new stations should always be fixed by at least two measurements (Linear and Angular) from fixed reference points. Linear measurement refers to horizontal distances measured by chain or tape. Angular measurement refers to magnetic bearing or horizontal angle taken by a prismatic compass or Theodolite.

Q. No.5

A) Write the classification of roads according to Nagpur road plan.

The Nagpur Road Plan classified the roads in India based on location and function into five categories as National highways (NH), State highways (SH), Major district roads (MDR), Other district roads (ODR) and Village roads (VR).

National highways: They are main highways running through the length and breadth of India connecting major ports, foreign highways, capitals of large states and large industrial and tourist centers including roads required for strategic movements. It was recommended by Jayakar committee that the National highways should be the frame on which the entire road communication should be based. All the national highways are assigned the respective numbers. For e.g. the highway connecting Delhi-Ambala-Amritsar is denoted as NH-1 (Delhi-Amritsar), where as a bifurcation of this highway beyond Fullundar to Srinagar and Uri is denoted as NH-1_A. They are constructed and maintained by CPWD. The total length of National highway in the country is 58,112 Km, and constitute about 2% of total road networks of India and carry 40% of total traffic.

State highways: They are the arterial roads of a state, connecting up with the national highways of adjacent states, district head quarters and important cities within the state. They also serve as main arteries to and from district roads. Total length of all SH in the country is 1,37,119 Km.

Major district roads: Important roads with in a district serving areas of production and markets, connecting those with each other or with the major highways. India has a total of 4,70,000 km of MDR.

Other district roads: Roads serving rural areas of production and providing them with outlet to market centers, taluka head quarters or other important roads like MDR or SH. They are of lower design specifications than MDR.

Village roads: They are roads connecting villages or group of villages with each other or to the nearest road of a higher category like ODR or MDR. India has 26,50,000 km of ODR+VR out of the total 33,15,231 km of all type of roads.

B) Draw a neat sketch of a general cross-section of a road.

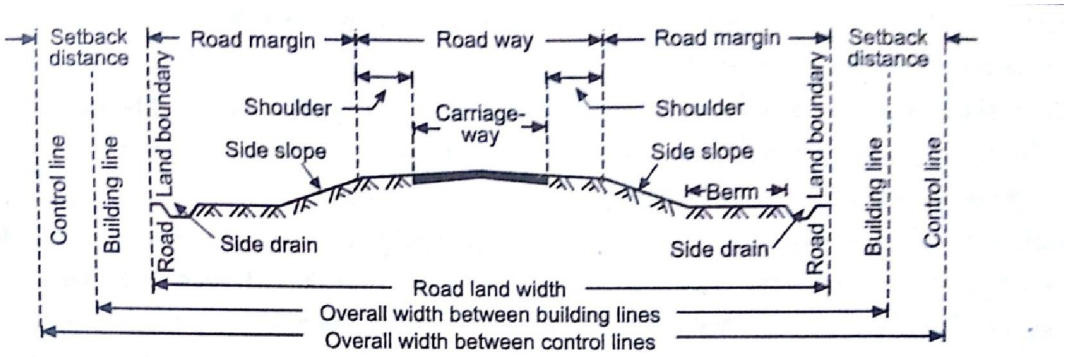
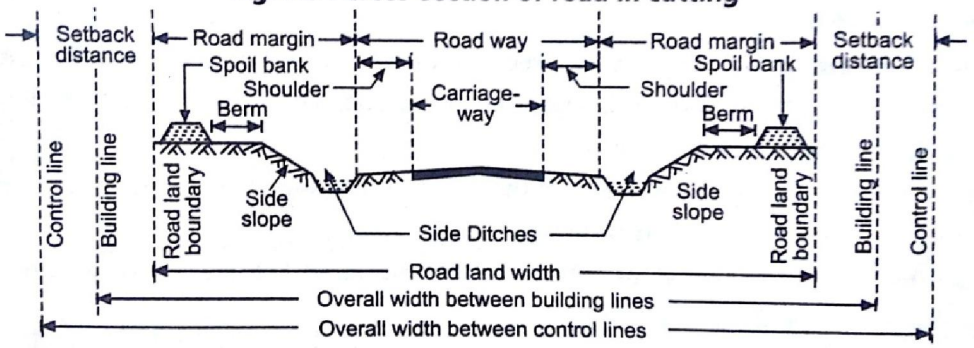


Fig. 5.5 : Cross-section of road in cutting



Q. No.6

A) Write a short note on rain water harvesting.

All sources of freshwater on earth originate from rainfall. As accumulated surface run-off, rains feed the flows of most of the non-perennial rivers. When the surface run-off infiltrates into subsoil, it forms groundwater. As the groundwater level increases, it oozes out as springs. Perennial springs are the fountainheads of many surface water bodies such as lakes, streams and perennial rivers. Rainwater harvesting (RWH) refers to collection of rain falling on earth surfaces for beneficial uses before it drains away as run-off. Rainwater harvesting is an important environment friendly approach - dubbed as a Green Practice which has double benefit in both keeping the groundwater table undisturbed and charging the aquifer. Collection and storage of rainwater in earthen tanks for domestic and agricultural uses is very common in India since historical times. The traditional knowledge and practice of RWH has largely been abandoned in many parts of India after the implementation of dam and irrigation projects. However, since the early 90s, there has been a renewed interest in RWH projects in India and elsewhere.

To aid towards the greater objective of water management and conservation and to increasing recharge of groundwater by capturing and storing rainwater, rainwater harvesting from rooftop run-offs and natural water bodies augment the community development. Rainwater harvesting can be done at individual household level and at community level in both urban as well as rural areas. At household level, harvesting can be done through roof catchments,

and at community level through ground catchments. Depending on the quantity, location and the intended use, harvested rainwater, it can be utilized immediately or after storage. Other than as a water supply, RWH can be practiced with the objectives of flood control and soil erosion control.

Components of RWH systems: A RWH system has three components:

• the catchment,

• the collection system, and

• the utilization system.

B) Write the Indian Standard specification for drinking water.

Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption. Drinking water shall comply with the following requirements apart from pesticide residues, radioactive substances, toxic substances, bacteriological parameters, and other harmful substances:

Sl. No.	Characteristic	Requirement (Acceptable limit)	Permissible limit in the absence of aletrnate source
i)	Colour, Hazen units, Max	5	15
ii)	Odour	Agreeable	Agreeable
iii)	pH value	6.5-8.5	No relaxation
iv)	Taste	Agreeable	Agreeable
v)	Turbidity, NTU, Max	1	5
vi)	Total dissolved solids, mg/l, Max	500	2000
vii)	E. coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample	No relaxation

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