TRANSPORTATION ENGINEERING – I (Highway Engineering)
Lecture – 5 & 6 (Unit – 1)

Topics to be covered:

- Types of Roads
- Various Road Patterns

PREPARED BY:

SHASHIKANT SRIVASTAVA
ASSISTANT PROFESSOR DEPARTMENT
OF CIVIL ENGINEERING
FACULTY OF ENGINEERING & TECHNOLOGY
RAMA UNIVERSITY UTTAR PRADESH, KANPUR (INDIA)

CLASSIFICATION OR TYPES OF ROADS :

A road is a way or route on land between two places that are paved or improved to permit travel by transportation means such as cars, motor vehicles, and horses. The roads can be classified based on many factors like:

a) Materials
b) Location & function
c) Traffic volume
d) Width
e) Economy
f) Traffic type
g) Rigidity
h Topograph

BASED ON MATERIALS : The roads can be classified on behalf of materials as:

1. Earthen roads
2. Gravel roads
3. Murrum roads
4. Kankar roads
5. WBM roads
6. Bituminous roads
7. Concrete roads

CLASSIFICATION OF ROADS BASED ON MATERIALS :

EARTHEN ROADS : Earthen roads are laid with soil. They are cheaper than all types of roads. This type of road is provided for fewer traffic areas or countryside areas. A good drainage system should be provided, which reflects excellent performance for a more extended period.



GRAVEL ROADS: Gravel roads are also low-quality roads, but they are better when compared with earthen roads. A compacted mixture of gravel and earth is used as pavement material in this case.



CLASSIFICATION OF ROADS BASED ON MATERIALS :

MORUM ROADS : Morum is a matter obtained from the disintegration of igneous rocks by weathering agencies. This is used to make roads called morum roads.



KANKAR ROADS : Kankar is an impure form of limestone. Kankar roads are provided where lime is available in a reasonable quantity. The Kankar roads are low quality and performance.



CLASSIFICATION OF ROADS BASED ON MATERIALS :

WBM ROADS: Water Bound Macadam (WBM) roads contain crushed stone aggregate in its base course. The aggregates are spread on the surface and rolled after sprinkling water. WBM roads provide better performance compared to earthen, gravel, murrum, and kankar roads. WBM roads are laid as layers of about 10cm thickness of each layer. They are very rough and may disintegrate immediately under traffic.



BITUMINOUS ROADS : Bituminous roads are prevalent roads around the world. They are the most used roads in the world. This road types are low in cost and suitable for driving conditions. The thickness of bituminous roads depends upon the subgrade soil conditions.



CLASSIFICATION OF ROADS BASED ON MATERIALS :

CONCRETE ROADS : Cement concrete is used to construct the pavements in case of concrete roads. These are very popular and costlier than all other types of roads. They are not flexible, so they require less maintenance. Concrete roads are suitable for high traffic areas. They are laid with joints and time of construction is more.



PLASTIC ROADS : Plastic roads are made entirely of plastic or of composites of plastic with other materials. Plastic roads are different from standard roads in the respect that standard roads are made from asphalt concrete, which consists of mineral aggregates and asphalt.

BASED ON LOCATION AND FUNCTION :

Based on Location and Function the roads can be classified as :

- ✓ Rural Roads
- ✓ Urban Roads

Rural Roads can further be classified as:

a) Expressways
b) National Highways
c) State Highways
d) Major District Roads
e) Other District Roads
f) Rural Roads or Village Roads

Urban Roads can further be classified as:

a) Arterial Roads
b) Sub-Arterial Roads
c) Collector Streets
d) Local Streets

RURAL ROADS :

EXPRESSWAYS : Expressways are the highest class of roads in India. In India, expressways are controlled-access highways where entrance and exit is controlled by the use of ramps that are incorporated into the design of the expressway, whereas National Highways are at-grade roads.

NATIONAL HIGHWAYS: National highways are the main roads that connect all major cities to the capital of the country. They run throughout the length and breadth of the country. A minimum two-lane road is provided for national highways. The main highways running through the length and breadth of India, joining major parts, capital of states, foreign highways required for strategic movement for the defense of India are known as 'National highways'.

STATE HIGHWAYS : State highways are the second main roads that connect significant parts of the state within it. State highway ultimately connects to the national highways. The highways linking up with the National highways, district head quarters and important cities in states are known as 'State highways'. The geometric design specification and design speed for N.H. and S.H. are same. The responsibility of construction and maintenance – state government and central government gives grant for development..

MAJOR DISTRICT ROADS : Major district roads connect headquarters of the neighbouring district with main parts of the area while minor district roads are laid within the region. The important roads with a district connecting production and markets places with each other or with the main highways are known as 'Major District Roads'. The responsibility of construction and maintenance – district authorities and state government gives grant for development.

OTHER DISTRICT ROADS : The roads connecting market centres, tahsil head quarters, railway station in district known as other district roads. The design specification is low as compare to M.D.R.

VILLAGE ROADS (V.R.) : The roads connecting villages with each other or with nearest road are known as 'Village Roads'. These roads are very important from the rural area development point of view. The responsibility of construction and maintenance – local district authorities.

URBAN ROADS :

ARTERIAL STREETS :

- ✓ For the heavy/important traffic inside the city.
- ✓ Usually along the expressways serving as principal network of traffic flow.
- ✓ Join central business district with outside residential areas.
- ✓ Parking, loading, unloading prohibited.
- ✓ Pedestrians are allowed to cross only at intersections.

SUB-ARTERIAL STREETS :

- ✓ Less traffic than arterial streets.
- ✓ Pedestrians are allowed to cross only at intersections.
- ✓ Spacing varies from 0.5 km in central business areas to 3 to 5 km in residential area.
- ✓ Parking, loading, unloading usually restricted and controlled.

COLLECTOR'S STREETS :

- ✓ Meant for collecting the traffic from local streets to arterial streets.
- ✓ Full access allowed from properties alongside.
- ✓ Situated in residential, commercial, industrial areas.
- ✓ Few parking restrictions except for peak hours.

LOCAL STREETS :

- ✓ Open access from residents, business or other properties.
- ✓ Does not carry large volume of traffic.
- ✓ Unrestricted parking and pedestrians allowed

BASED ON TRAFFIC VOLUME, ECONOMY and TRAFFIC TYPE:

The roads according to the traffic volume can be classified as:

1. **Light Traffic Roads :** The roads which are carrying 400 vehicles daily on an average is called light traffic roads.
2. **Medium Traffic Roads :** If a road is carrying 400 to 1000 vehicles per day, then it is said to be a medium traffic road.
3. **High Traffic Roads :** If a road is carrying is more than 1000 vehicles per day then it is considered as high traffic road.

The roads according to economy can be classified as:

1. Low-cost roads
2. Medium cost roads
3 High cost roads

The economy depends upon the location and function of roads and also on the traffic analysis.

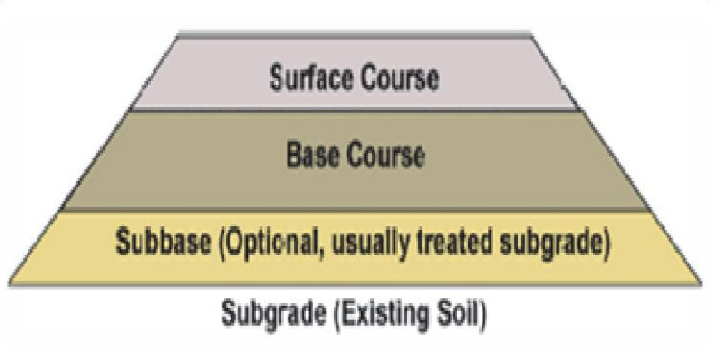
The roads according to traffic type can be classified as:

1. **Pedestrian Ways :** Pedestrian ways are exclusively built for pedestrians, and no vehicles are permitted in this way.
2. **Cycle Tracks :** Cycle tracks are provided on both sides of the pavement for cyclists; hence they can travel safely.
3. **Motorways :** Motorways are also known as expressways. Only a few vehicles are accessible to use this type of road. The cars which can move with high-speed acceleration are permitted in this way. Motorways makes travel quick and provides comfort for high-speed vehicles.

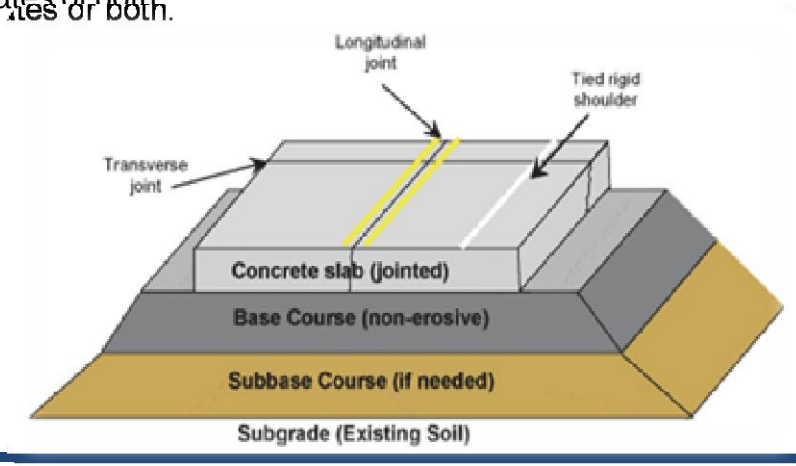
BASED ON RIGIDITY :

The road on the basis of rigidity can be classified as:

1. **FLEXIBLE ROADS :** A flexible pavement can be defined as a pavement layer comprising of a mixture of aggregates and bitumen, heated and mixed properly and then laid and compacted on a bed of granular layer. Flexible roads consist of a flexible layer as pavement surface, which requires proper maintenance, otherwise it can be disintegrated easily with heavy traffic. All types of roads except concrete roads fall under this category.



2. **RIGID ROADS :** Rigid pavements are non-flexible and cement concrete roads are fall under this category. Rigid pavements on the other hand, are made from cement concrete or reinforced concrete slabs, laid over a low strength concrete layer (Dry lean concrete, DLC) or on a well compacted layer of aggregates or both.



BASED ON TOPOGRAPHY :

1. PLAIN AREA ROAD : The roads constructed on levelled surface is known as plain area roads.

2. HILLY AREA ROADS : Roads constructed in hilly regions are called as hill area roads or ghat roads. Generally these are provided around the hill in a spiral shape.

Road Patterns :

Roadway patterns are very essential in the development of the settlements of a city. However, recent development in cities does not give importance to the study of the road patterns that give rise to numerous roads that are not interconnected, housing schemes and commercial developments built far away where roads are very distant from the centre of the town. The increasing distance between the residential and commercial hub of the city increases the dependency upon cars for the daily travel chores each household member makes frequently. The roadway patterns also increase the response time the emergency response vehicles take to reach a certain place. The main principle of the road pattern is to reduce the time and the distance that the vehicle takes to reach the destination place. It also focuses on interconnection of branch roads. Road Patterns also play vital role in traffic management of a region.

The various road patterns may be classified as:

- Rectangular or Block pattern
- Radial or star and block pattern
- Radial or star and circular pattern
- Radial or star and grid pattern
- Hexagonal pattern
- Minimum travel pattern

RECTANGULAR OR BLOCK PATTERN :

- In this pattern, the whole area is divided into rectangular blocks of plots, with streets intersecting at right angles.
- The main road which passes through the centre of the area should be sufficiently wide and other branch roads may be comparatively narrow.
- The main road is provided a direct approach to outside the city.
- Usually in this type of pattern the streets and roads are far away from each other and it takes a long time to reach the center of the area or city.
- This pattern is sufficiently easier to construct and maintain.
- This type of street pattern has a good aesthetic view and the road geometry is easier to understand.

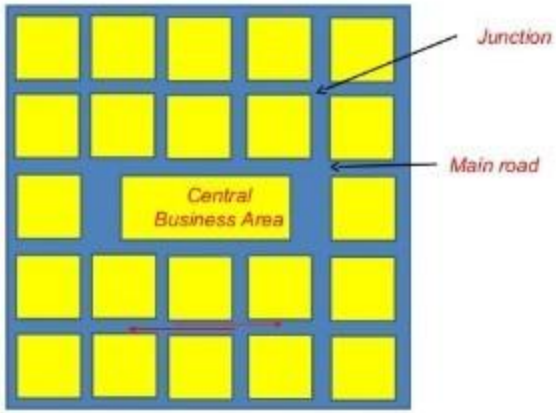
ADVANTAGES:

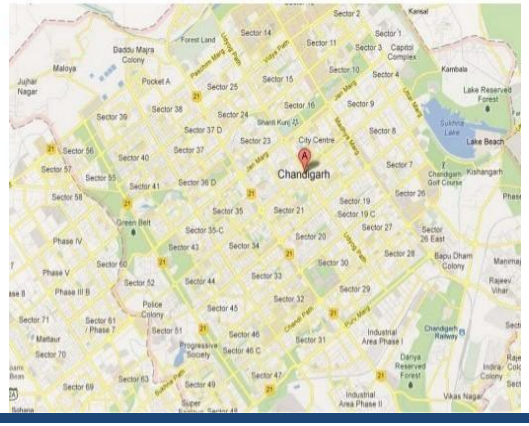
1.The rectangular plots may be further divided into small rectangular blocks for construction of buildings placed blocks to blocks having roads on their front.

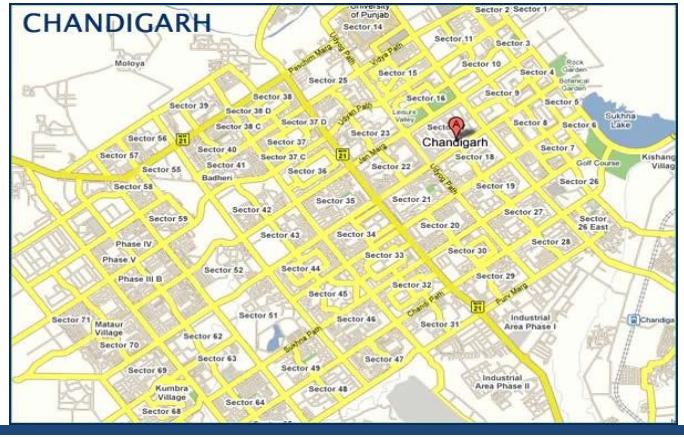
2. The construction and maintenance of roads of this pattern is comparatively easier.

LIMITATIONS:

1. This pattern is not very much convenient from traffic point of view, because at the intersections, the vehicles face each other.







RADIAL OR STAR AND BLOCK PATTERN :

This type of network is a combination of radial and block pattern. A radial network of roads radiate from the centre outwardly with block pattern network of roads in between the radial main streets.

In this pattern, the entire area is divided into a network of roads radiating from the business outwardly. In between radiating main roads, the built-up area may be planned with rectangular block.

Advantage:

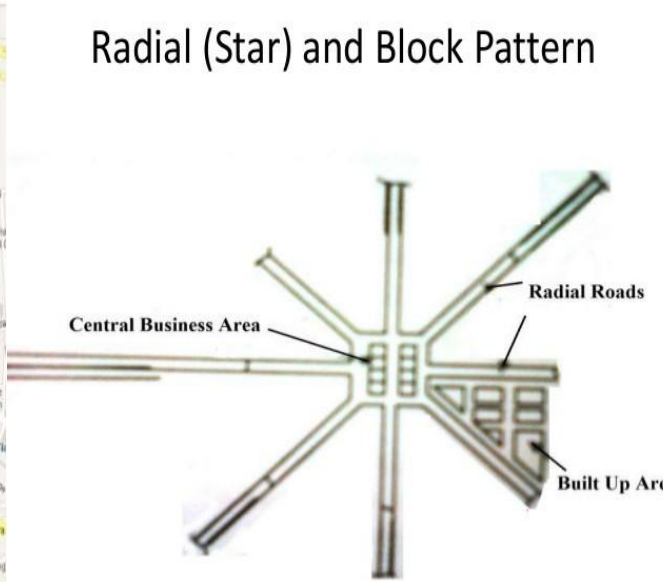
1) Reduces level of congestion at the primary bottleneck location.

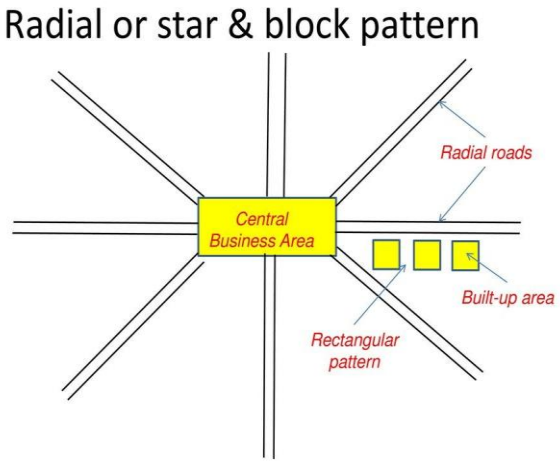
2) Prevents traffic from accessing local flow routes in the direction of the event venue that operate in favor of egress traffic flow.

3) If one is block then other side traffic can move.

Limitations:

1) Proves particularly effective if two lane ramp traffic does not have to merge at downstream end of ramp.





RADIAL OR STAR AND CIRCULAR PATTERN :

In this system, the main radial roads radiating from central business area are connected together with concentric roads. In these areas, boundary by adjacent radial roads and corresponding circular roads, the built-up area is planned with a curved block system.

Advantages:

1)At traditional intersections with stop signs or traffic signals, some of the most common types of crashes are right-angle, left-turn, and head-on collisions. These types of collisions can be severe because vehicles may be traveling through the intersection at high speeds. With circular pattern, these types of potentially serious crashes essentially are eliminated because vehicles travel in the same direction.

2) Installing circular pattern in place of traffic signals can also reduce the likelihood of rear-end crashes.

Limitations:

1)Approach roads should be sufficiently curved, far enough in advance of circular pattern, to reduce vehicle speeds of enterin drivers.

2)Traffic signs, pavement markings, and lighting should be adequate so that drivers are aware that they are approaching a roundabout and that they should reduce their travel speed.

RADIAL OR STAR AND GRID PATTERN :

Change in direction, and because street patterns are the most enduring physical element of any layout, it could potentially contribute to systematic site planning and, consequently, deserves a closer look. Though the network is entirely interconnected, north-south movement becomes circuitous, indirect, and inconvenient, making driving an unlikely choice and vividly illustrating that interconnections by itself is insufficient to facilitate movement.

Advantages:

1) Keep vehicular traffic safe with a high proportion of 3-way intersections.

2) Reduce cut-through traffic by similar or other means.

3) Improve traffic flow in both directions using Savannah's cellular structure.

4) Improve land use efficiency and unit density.

Limitations:

1) Islands separating the approach and exit lanes, known as splitter islands, should extend far enough.

2)Traffic signs, pavement markings, and lighting should be adequate so that drivers are aware that they should reduce their travel speed.

HEXAGONAL PATTERN :

This pattern is a network of roads that grow in such a manner in various directions forming hexagons.

In this pattern the entire area is provided with a network of roads formatting hexagonal figures. At each corner of the hexagon, three roads meet the built up area boundary by the sides of hexagons is further divided in suitable sizes.

ADVANTAGES:

1. Three roads meet the built up area boundary by the sides of hexagon.
2. The travel time and distance is minimized .
3. The issue of congestion can be addressed.

LIMITATIONS:

1. Traffic signs, pavement marking and lighting should be adequate so that drivers are aware that they should reduce their travel speed.

MINIMUM TRAVEL PATTERN :

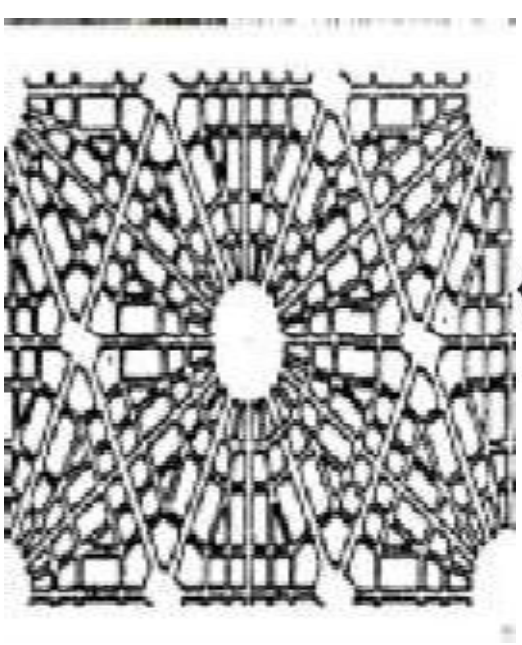
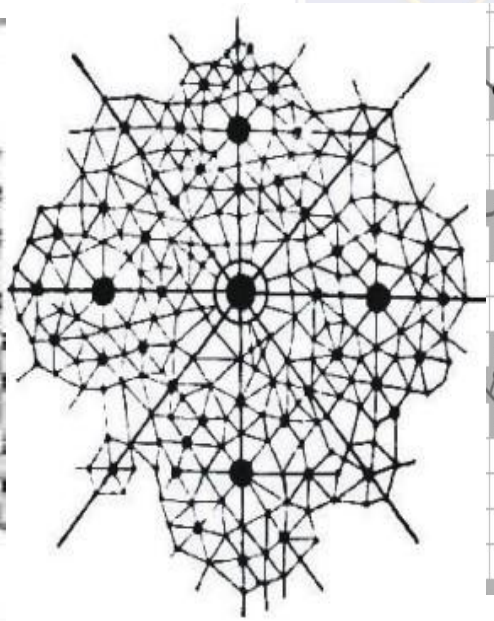
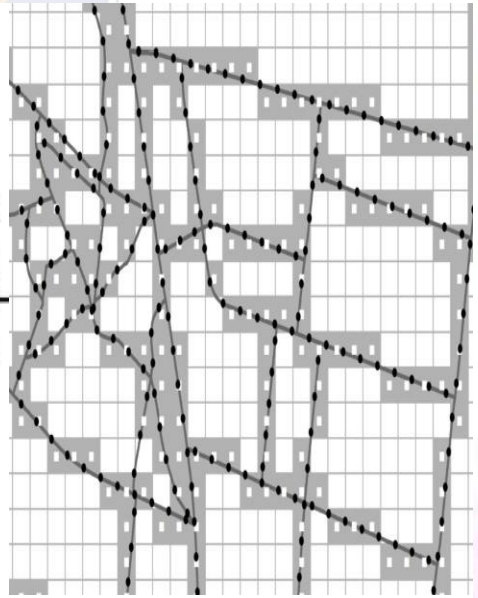
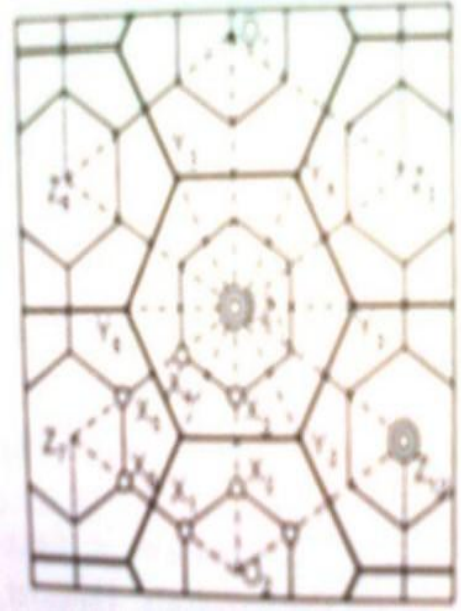
In this road pattern, city is contended by sector centre, sub urban centre and neighborhood centre by the road which require minimum distance to connect the city centre.

ADVANTAGES :

1. The potentially serious crashes are essentially eliminated.

LIMITATIONS :

1. Traffic signs, pavement marking and lighting should be adequate so that drivers are aware that they should reduce their travel speed.
2. Intersections can be challenging specially for older drivers.

1. The width of different roads as recommended in Nagpur plan by the Indian Road Conference for hilly region, is :

(A) Same for National Highways

(B) Different for National Highways

(C) Same for State Highways

(D) Same for Major District roads

2. Border Roads Organisation for hilly regions, was formed in

A.1947

B.1954

C.1958

D.1960

3. The main objective of transportation is?

a) Economical transport of goods

b) Economical transport of passengers

c) To generate revenue

d) Safe economical and efficient transport of goods and passengers

4. The factors influencing the cost of transportation are?

a) Supply

b) Demand

c) Both supply and demand

d) Cost of land

5. Which is the most flexible type of transportation available?

a) Roadway

b) Railway

c) Waterway

d) Airway

6. The transportation system that requires a low initial investment among the following is?

a) Roadway

b) Railway

c) Harbour

d) Airport

7. The PMGSY was launched in the year?

   a) 2000

   b) 2002

   c) 2003

   d) 2004

8. The current highway development works in India are undertaken by?

   a) NHAI

   b) Govt. of India

   c) State governments

   d) NHDP

9. The main features of the roman road do not include the following?
   a) They were built straight
   b) They were strong
   c) They excavated soft soil till hard strata was obtained
   d) The total thickness was 0.75m to 1.2m
10. The tresaguet method of laying roads was developed in the year?
   a) 1764
   b) 1774
   c) 1800
   d) 1796
11. The cross slopes provided for drainage water under Macadam's construction road is?
   a) 1 in 10
   b) 1 in 20
   c) 1 in 36
   d) 1 in 40
12. The Indian Roads Congress was formed in the year?
   a) 1928
   b) 1934
   c) 1929
   d) 1930

13. A research organisation that was formed for the research and development organisation works related to roads was?
    a) Indian Roads Congress
    b) Central Research Institute
    c) Central road found
    d) NHAI
14. The first 20 year development plan is also called as?
    a) Nagpur road plan
    b) Lucknow road plan
    c) Bombay road plan
    d) Delhi road plan
15. Primary system of roads consists of?
    a) National highway
    b) Expressway
    c) National highway and Expressway
    d) State highway
16. The phases of highway planning do not include the following?
    a) Assessment of road length requirement
    b) Preparation of master plan
    c) Showing the phasing of a plan in five year plan
    d) Financing

17. The Nagpur plan classified the roads based on _____
    a) Location
    b) Function
    c) Location and function
    d) Annual daily traffic
18. The arterial roads are a classification of which type of roads?
    a) Rural roads
    b) Urban Rods
    c) National highway
    d) State highwa
19. The rectangular pattern of roads has been adopted in which Indian city?
    a) New Delhi
    b) Chandigarh
    c) Hyderabad
    d) Mumbai
20. The Nagpur plan formulae assumed which type of pattern?
    a) Star and grid
    b) Star and circular
    c) Hexagonal
    d) Circular

"Thank you"

Have Any Query ?

Ask us @ shashikant.fet@ramauniversity.ac.in or shashikantchitransh3@gmail.com