Highway surveys

Highway surveys or road surveys are the various stages of examination of an area for finalisation of alignment of a new road in economical manner.

1. Map study
2. Reconnaissance survey
3. Preliminary survey
4. Location survey

Topographic map

This is a map of an area in which general details of that such as building, hospitals, schools, road, railway etc. The other details like river, valleys, hills and contour lines are also show on the topographic map.

*. Map study

The process of making several possible alternative alignments of a road on the topographic map of an area is known as map study.

* Road alignment

The route along which the centre line of a road is located in the plan or on the ground is termed as road alignment.

The centre line of an road is located at site before it's actual construction. The cost of construction, maintenance,safey and ease ii travel etc.depend upon the alignment of road.

Requirements of an ideal road alignment

(a). Short -- It is desirable to have a shortest alignment between two terminal stations.

(B). Easy-- The alignment should be such that it is easy to construct and maintenance.

(C). Safe-- The alignment should be safe enough for construction and maintenance. It should have stable natural hill slopes, embankment and foundation.

(D). Economical-- The alignment should be such that the total life cycle cost that is sum of the initial cost, maintenance cost and vehicle operation cost is lowest.

(E). Utility -- The alignment should be such that it would offer maximum utility by servings maximum population per unit length of road.

Factors controlling alignment of a road in plan area

1. Obligatory points or control points
2. Traffic consideration
3. Geometric design considerations
4. Economic factors
5. Other considerations

Factors controlling alignment of a road in hilly area

1. Stability of hill side slopes
2. Drainage of surface and subsurface water flowing the hill side
3. special geometric standards for hill roads
4. Resisting length

Highway location

The process of marking the centre line of a road finally on the ground is called Highway location.

The object of these surveys is to locate the alignment of a road which provides maximum transportation facilities with minimum cost of construction and maintenance.

For location a highway the following engineering or field survey are undertaking

1.Reconnaissance survey

2. Preliminary survey

3. Location survey

Reconnaissance survey

A general examination of a fairly broad stretch of land between the terminal stations in the fild, along the proposed alternative alignments marked on the map is known as Reconnaissance survey. It is a rapid and rough survey of the area lying between the terminal stations.It is comparatively easier in plain than in hilly areas.

Details to be collected during reconnaissance survey

1.valleys ,ponds ,lakes ,marshy land ,ridge hills permanent structure and other obstruction along the route.

2. Approximate values of gradient, length of gradients and radius of curves of alternative alignments.

3. Number and type of cross drainage structure , maximum flood level and natural ground water level along the probable routes

4. Soil types along the routes

5. Source of construction materials and location of stone quarries

6. Obligatory points along the alternative routes.

Objectives of reconnaissance survey

1. It determines suitability of each alternative road alignment marked on the topographic map.
2. It also suggests any deviation of marked alignment due to ground realities.
3. It also helps to locate new suitable alignment on the. basic of preliminaly inspection of the region.
4. It helps in drafting a general report and working out estimate of probable cost. of road project.

Preliminary survey

The process of finding the details of alternative road alignment as recommendedby reconnaissance survey for final location survey is known as preliminary survey.

Objectives of preliminary survey

1. To survey the various alternative alignments found suitable during reconnaissance survey and to collect all necessary physical details.
2. To campare the different proposal in view of the requirements of a good road alignment.
3. To work out the cost of construction of roads along each alternative alignments of the road.
4. To finalise the best alignment from all considerations.

Method of conducting preliminary survey

HIGHWAY ENGINEERING

It is the branch of transportation engineering which deals with design,construction and maintenance of diff. types of roads is called highway engineering .

Importance of highway engineering

- **It helps in distribution on goods at diff. places .**

1. **It is cheaper transportation as compared to others .**
2. **It provide door to door transportation facility .**
3. **It helps in maintaining law and orders in country.**
4. **It distribute the agriculture product to the farmers .**
5. **It provide employment opportunities among in world .**
6. **It transport simply packaging of goods .**
7. **It plays an important role in country during war days .**
8. **It helps in distribution of medicine to the people which areinrural areas .**

IRC (Indian Road Congress)

It was established by central government in 1934. It was constitute to provide forum for maintenance and protection of national highway.

IMPORTANCE –

1. **It provide library service for studying related to highway .**
2. **It conducts periodically meeting to discuss technical problem .**
3. **It makes law and orders to protect the highway .**
4. **It promotes the use of standard specification and practise .**
5. **It provide suggestions for better method of design, construction, and maintenance of roads .**

CRRI (Central Road Research Institute)

Function Of Central Road Research Institute –

It was established by central government in 1950 for research work in highway .

1. **Carries basic and applied research for design, construction and maintenance of highway .**
2. **Carries research on traffic safey and transport economic .**
3. **Carries research on locally available material for construction and maintenance of road .**
4. **Resarch for development of new machine and tools**
5. **To provide technically advice in various organisation's.**

Ministry of Road Research Institute (MORIH)

It handles the matters related to highway .

1. **To control the fund approved bybcentral government for development of national highway .**
2. **To control central road fund .**
3. **To prepare plans for developnment and maintenance of national highway .**
4. **It develops standard specification for roads in country .**
5. **To administer matters regarding road research .**

National Highway Authority Of India (NHAI)

It was established by NHAI in 1988 for development and maintenance of national highway .

FUNCTION –

1. To collect fees on national highway for its proper maintenance .
2. To advice the central government on matters related to highway .
3. Regulate and control the plying vechiles on highway .
4. It provide facility for usres of highway .
5. Construct residensial building for its employees.

IRC has classified roads in india -

National highway - These are those road which connects the cpaital state to various states . It also connects the famous tourism of country .

State highway –These are those road which connect the capital state to district head quarter .

Major district road – These are those riad which connects the one district road to other .

Other district road – These are those road which connects the district road to main town or tehsil headquarters .

Village road – These are those road which connects the villages with each other with district road .

Road Drainage

Highway Drainage

- Highway drainage - the process of removing and controlling excess surface and subsurface water within the roadway or right of way.
- Types:

1.surface drainage(removal & diversion of surface water from the roadway & adjoining land)

2.subsurface drainage(diversion or removal of excess soil-water from subgrade)

Effects of drainage

- Excess moisture in soil subgrade causes lowering of its stability
- If any improper drainage system, flow of surface water across the road & shoulder and along slopes should cause erosion
- If stagnant of water, it causes diseases
- loss of money, human life

Maintenances of highway drainage

- The side drain should have sufficient capacity and longitudinal slope to carry away all the surface water collected from the roadway
- Lowering of moisture content of soil
- The pavement should be higher than water table
- To control the capillary rise

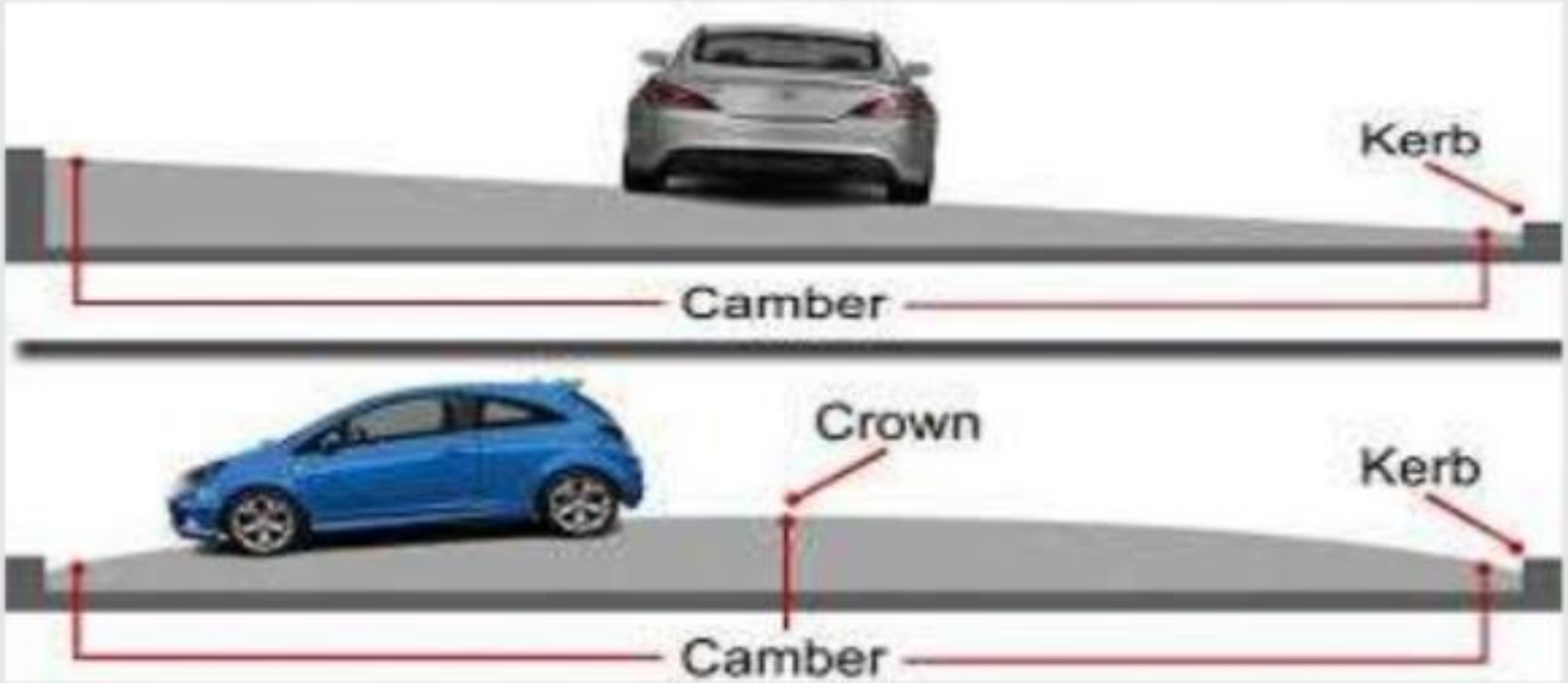
Components of surface drainage system

- Cross slope or camber
- The road side drains
- Cross drains

Cross slope or camber

- Water from the pavement surface & shoulders is first drained off within the help of cross slope or camber

Cross slope or Camber



Road side drains

- The road side drains of highways are generally open or unlined or kutcha drains of trapezoidal shape
- If provided to parallel to road alignment – longitudinal drains
- On plain terrain with embankment –provided on both sides of toe of embankment
- On sloping terrain(cross slope<4%)-provided on one side only.

Road Side Drains

Cross drains

- The water flowing along the road side drains are collected by suitable cross drains through cross drainage structures(CD structure)
- It is collected from natural valleys & streams and disposal off to the natural water course
- Different types of culverts(CD structure) : slab, box & pipe culvert
- If the width of river or stream > 6m – CD provided is called minor bridge
- If the width of river or stream > 60m- CD provided is called major bridge

Cross drains

Sub-surface Drainage

- to keep the variation of moisture in subgrade soil to a minimum
- Components:
  - Lowering of Water Tables
  - Control of Seepage Flow
  - Control of Capillary Rise

DITCHES

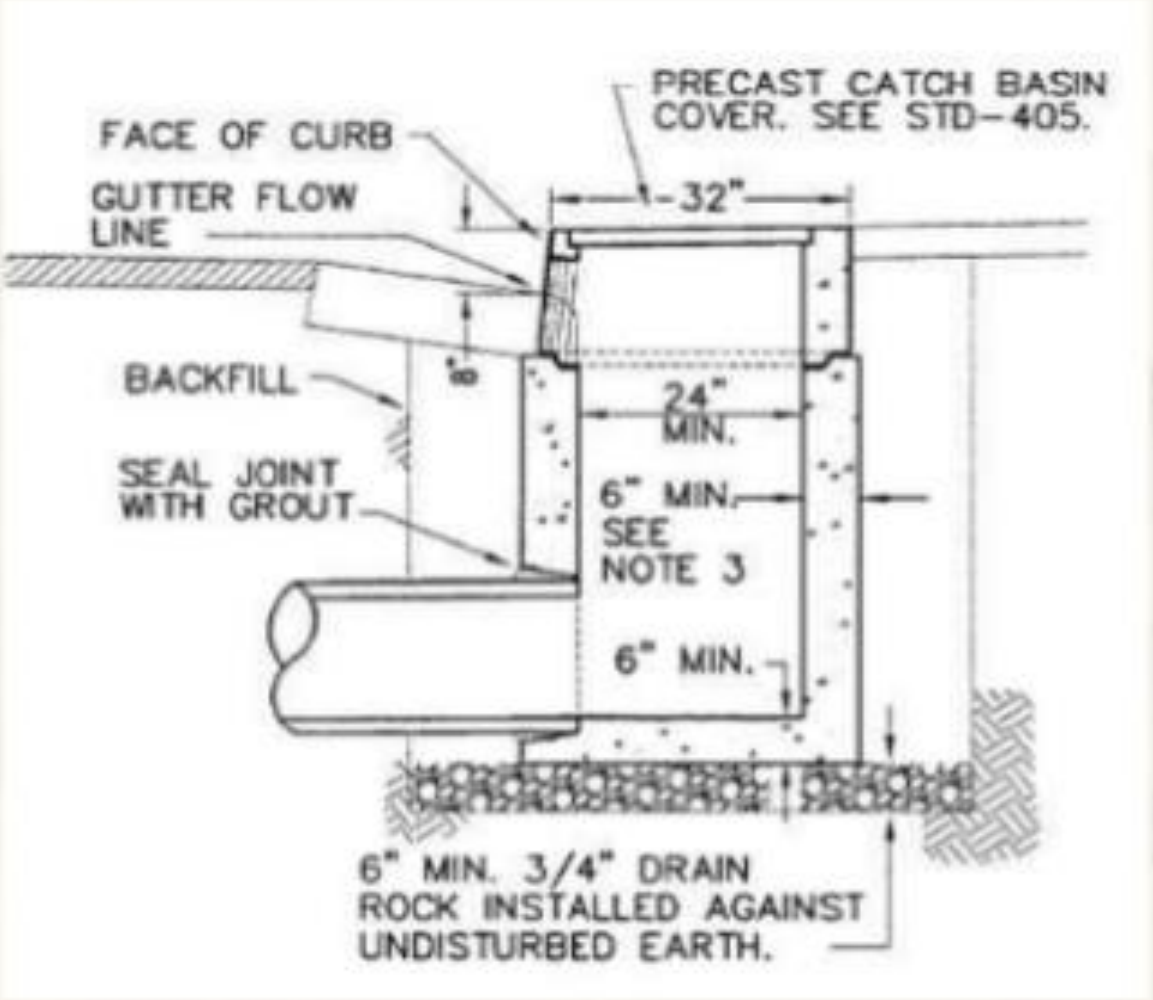
- A **ditch** is usually defined as a small to moderate depression created to channel water.
- A ditch can be used for drainage, to drain water from low-lying areas, alongside roadways or fields, or to channel water from a more distant source for plant irrigation. A trench is a long narrow ditch. Ditches are commonly seen around farmland especially in areas that have required drainage, such as The Fens in eastern England and the Netherlands.
- Roadside ditches may provide a hazard to motorists and cyclists, whose vehicles may crash into them and get damaged or stuck, especially in poor weather conditions, and in rural areas.

* A **culvert** is a drain or pipe that allows water to flow under a road, railroad, trail, or similar obstruction. Culverts differ from bridges mainly in size and construction.

* Culverts are generally smaller than bridges, ranging from 0.3-metre (1 ft) pipes to larger reinforced concrete structures. Culverts are typically surrounded by soil.

CULVERT

Catch Basin


PRECAST CATCH BASIN COVER. SEE STD-405.
FACE OF CURB
GUTTER FLOW LINE
32"
8"
BACKFILL
24" MIN.
SEAL JOINT WITH GROUT
6" MIN. SEE NOTE 3
6" MIN.
6" MIN. 3/4" DRAIN ROCK INSTALLED AGAINST UNDISTURBED EARTH.

A storm drain or storm sewer is designed to drain excess rain and ground Water from imprerivious surface is called catch basin .

ROAD GEOMETRICS

The proper planing , design and fixing of visible dimension for providing the safe comfertable and optimum movement of traffic

Factor Affecting Road Geometrics

1. Design speed :- The highest continuous speed at which vehicles can travel with safety on the road is known as design speed.

- It directly affect the site distance original curve and the length of vertical curve
- design speed should be selected such that it provide safety to all drivers 85% design speed is normally adopted

2. Topography:-

It is easy to construct Road with required standard for a plane terrain , Geometric design standard are different for different Terrain to keep the cost of construction and time of construction under control.

3. Vehicles :-

The dimensions , weight of vehicle influence the design aspects such that width of payment , radii of curve , parking etc.

4. Human :- The human factor influence the Geometric design are the physical , mental and psychological characteristics of driver.

5. Traffic :- It will be uneconomical to design the road for peak traffic flow.

Various element of road geometric

1. Right of way :- The total area of road acquire for road construction and for its future development is known as right of way.
2. Formation Width :- Top most finish layer of earth either in cutting or filling.

   carriageway + width of shoulder

Cross-Section of road & its elements :

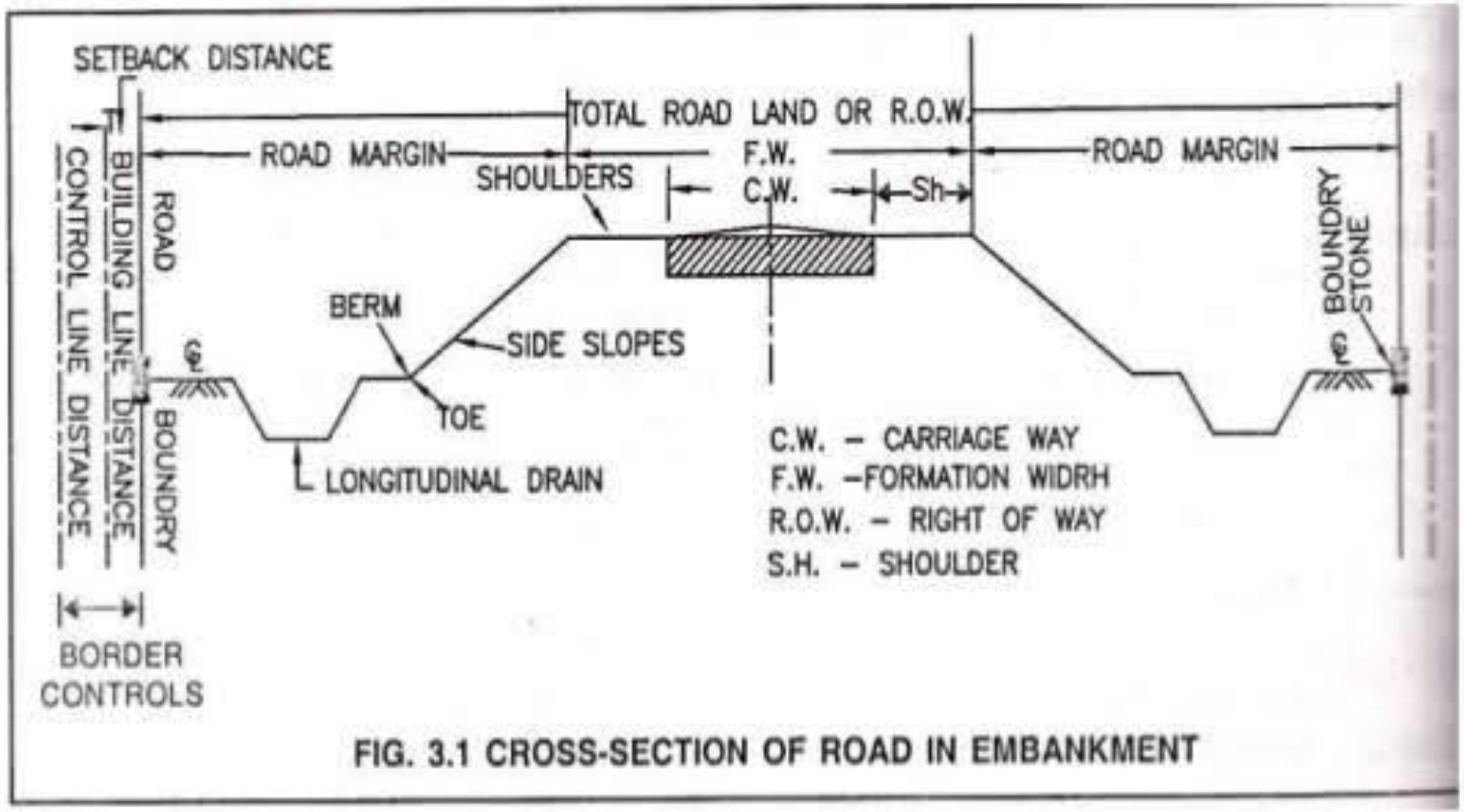
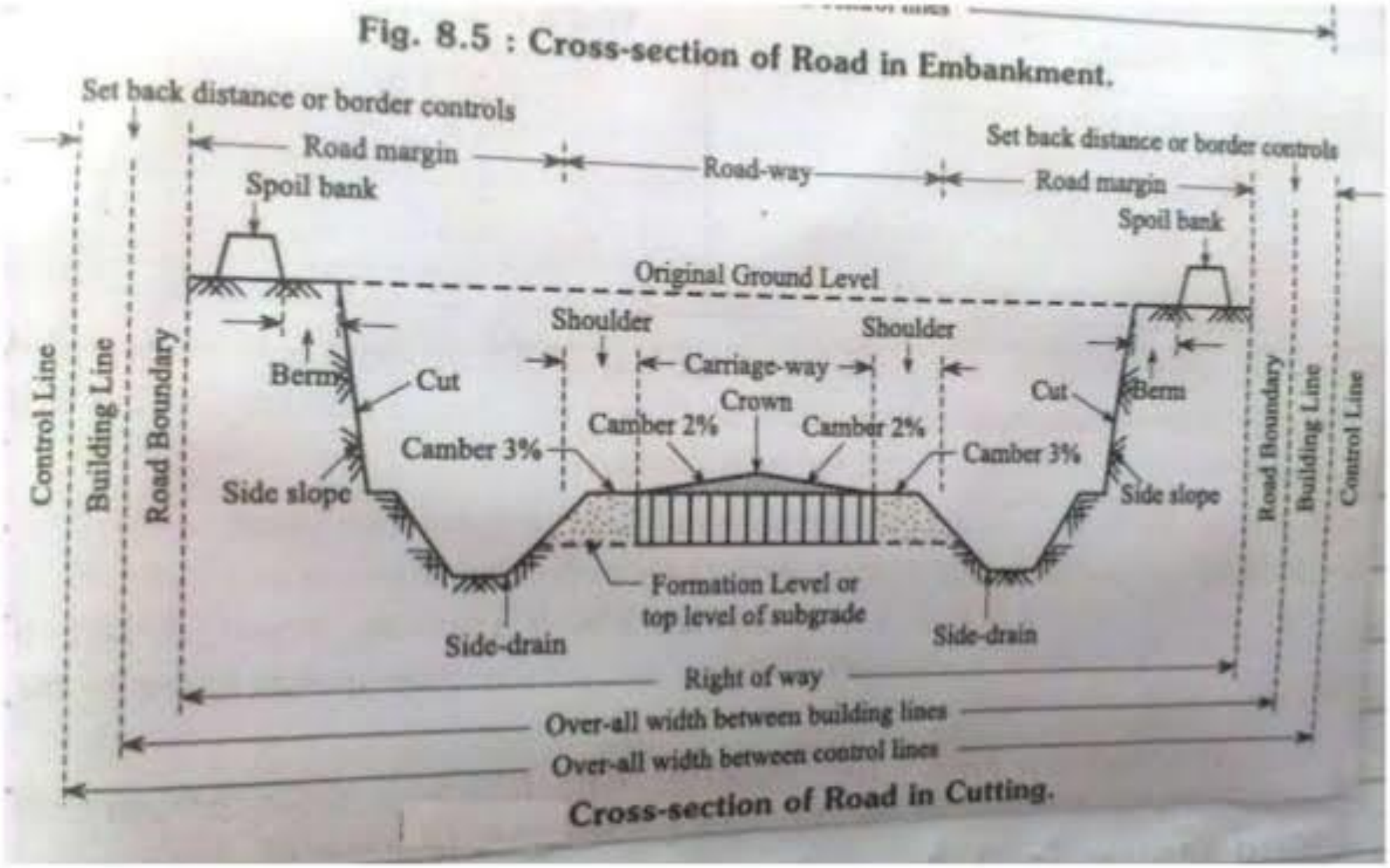


FIG. 3.1 CROSS-SECTION OF ROAD IN EMBANKMENT

CROSS SECTION OF ROAD



4. Road Margin :- The portion of land left for future road development at both side of the road after formation width.

5. Carriage Way :- The portion of the road where actual traffic is run.

5. Road Shoulder :- The portion at side of carriageway which is provided for the emergency use by traffic.

6. Side Slope :- The slope provided to the side of earth of road in embankment or in cutting for its suitability are called side slope .

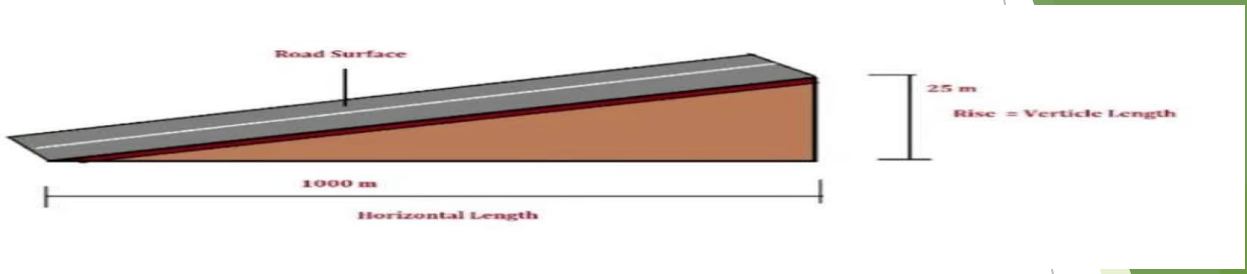
It helps in drainage of water from road

7. Kerb :- The boundary between carriageway and Shoulder of road.

8. Camber :- The Rise for convexity provided in the central portion of road

it is provided for divide the road into two lanes and for drain rain water.

9. Gradient :- The Rise and fall of road along its length



type of gradient

a.) Ruling Gradient :- The maximum gradient within which the designer attempt to design the vertical profile of a road

b.) Limiting Gradient :- The gradient steeper than ruling gradient and is adopted at place where topography of area compels to adopt a steeper gradient to avoid increase in cost.

c.) Exception Gradient :- The gradient steeper than the limiting gradient which may be used in short length of road only in extra ordinary situation.

d.) Minimum Gradient :- The minimum desirable slope essential for effective drainage of rainwater from the road .

For concrete drain 1:500 and for brick drain 1:200

objective of provide gradient

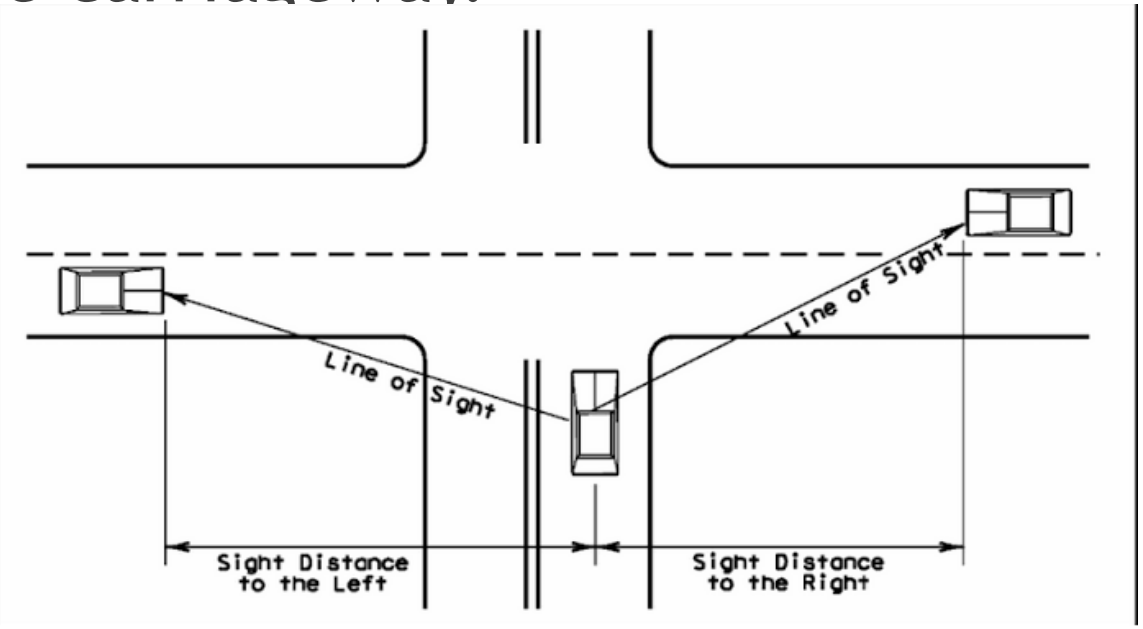
- To connect the terminal station situated at different vertical level
- To make the earth work of road Project economical by balancing the cutting and filling
- To provide drainage of rainwater falling over Road
- To reduce the maintenance cost of road surface

Design speed

- The maximum continuous speed at which most of the vehicle will move safely . It depend upon the following factor
- Type and physical condition of road surface.
- Nature type and intensity of traffic.
- Type of curve along Road.
- Sight distance.

Sight distance

The maximum clear distance along the centerline of the road at which a driver has visibility of an object stationary or moving at a specified height above the carriageway.



Sight distance at intersection of roads

Stopping sight distance SSD

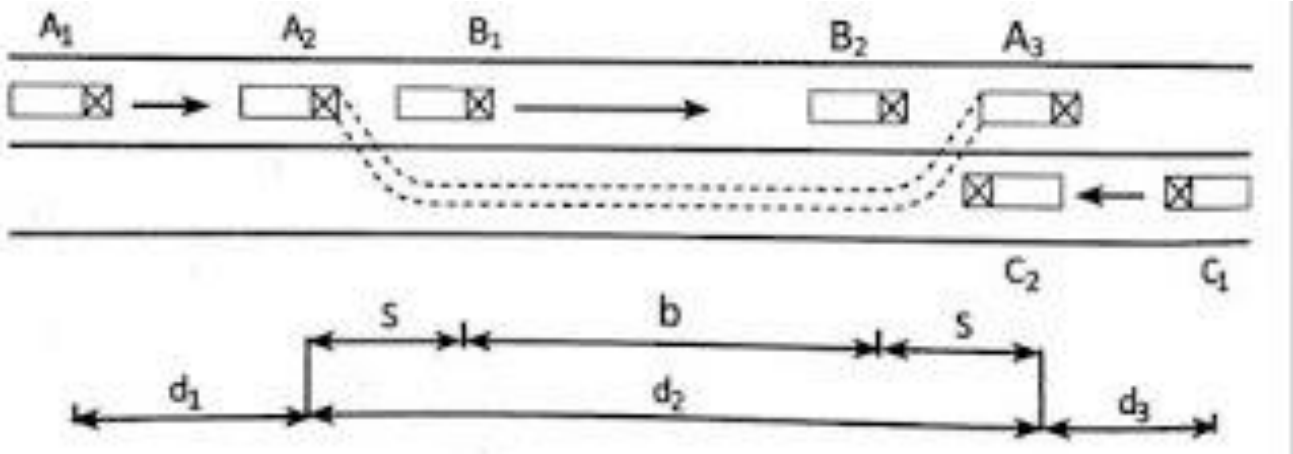
- Minimum distance ahead on the road required by a driver moving at a particular speed to bring his vehicle to the actual stop after seeing an object on the road

  it is depend upon

1. total reaction time of driver
2. speed of vehicle
3. efficiency of brake
4. friction resistance by road and tyre
5. gradient of road

Overtaking sight distance OSD

- Minimum length of road covered by old taking vehicle against a coming vehicle in opposite direction safely is known as overtaking sight distance . it depend upon
- Speed of overtaking vehicle.
- speed of overtaken vehicle.
- speed of vehicle coming from opposite direction.
- distance between over taking and overtaken vehicle.
- Skill and reaction time of driver.
- rate of acceleration of vehicle.
- gradient of road.



Curve The arc provide at the change in alignment or gradient of a road is known as curve

Necessity of providing curve

1. To lay the road according to topography of area.
2. To provide access to the particular place.
3. To avoid costly land to become part of a proposed new road.
4. To avoid excessive cutting or filling.
5. To avoid important structure to become part of road.
6. To make the use of existing bridge and right of way.

Type of curve

1. Horizontal curve :- The curve provide at turning point in horizontal alignment of a road are called original curve.

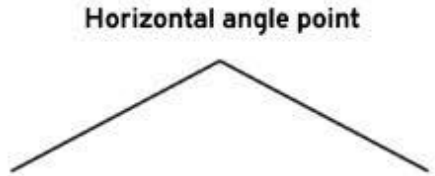
2. Vertical curve :- The curve provided at the change of gradient of a road are called vertical curve

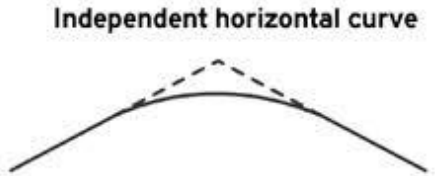
Types Of horizontal curve

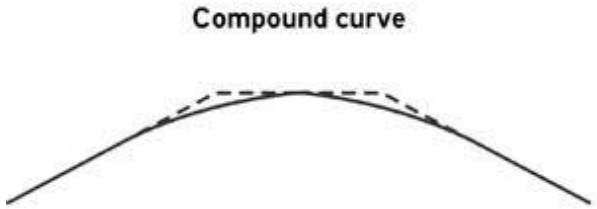
- Simple curve :- circular curve consisting of a single arc of uniform radius conecting two tangent is called simple curve.

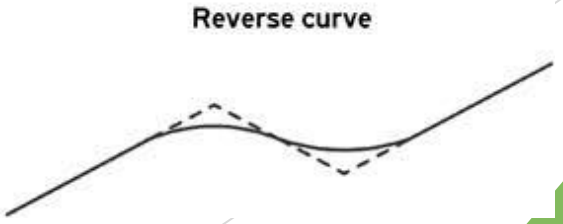
- Compound curve :- A circular curve consisting of two or more simple curve of different radii which turn in same direction

- Reverse curve :- A circular curve consisting of two or more simple curve of same or different radii having their centre in opposite direction .









- **Transition curve** :- The curve having its radius varying gradully from infinity at the tangent point to designed radius of circular curve .

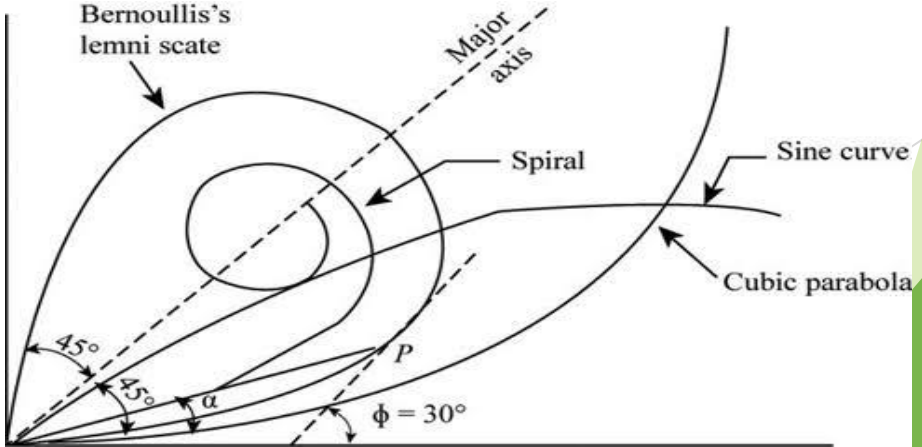
Objectives to provide transition curves

For the grdual introduction centrifugal force.

- To introduce superelevation gradually.
- To introduce extra widening gradually.
- To enhance aesthetics of highways.
- To improve design speed on horizontal curve .
- To prevent the overturning of vehicles on horizontal curve.

Types of Transition curves

1. Lemniscale
2. Spiral
3. Cubic parabola



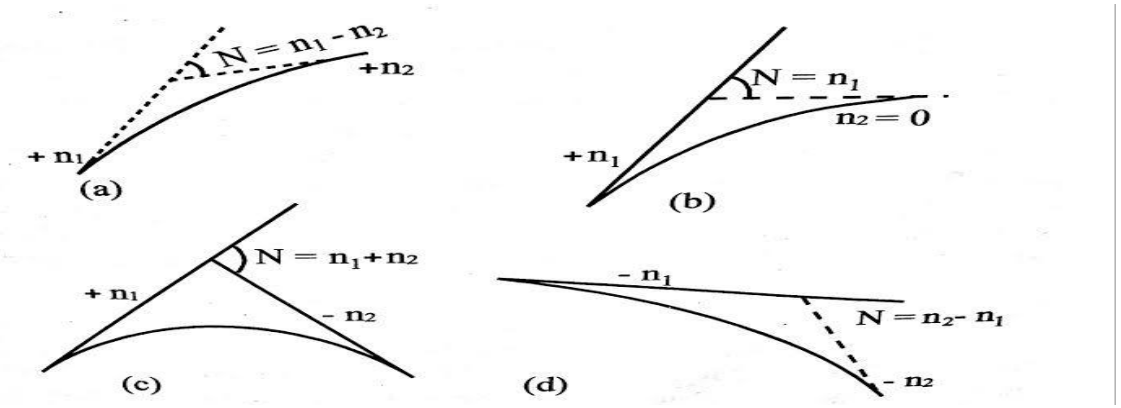
Vertical curve:- The curve provided at the change of gradient of a road are called vertical curve

Purpose of providing vertical curve

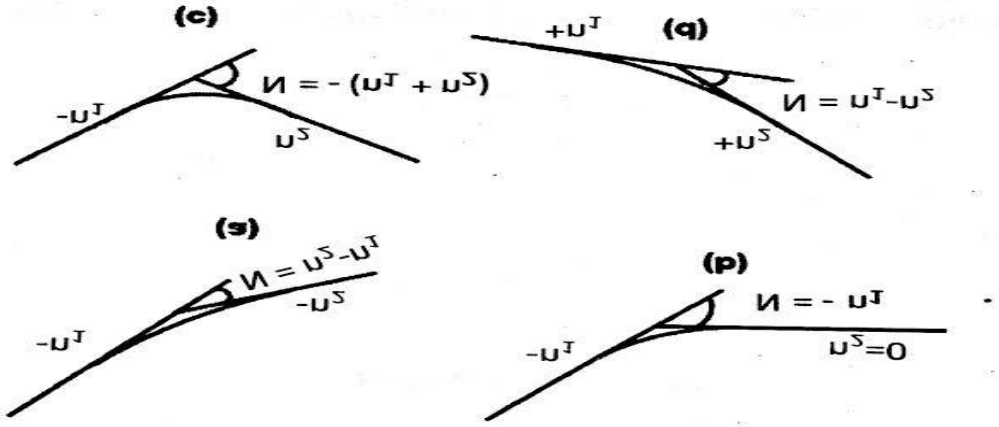
1. To provide gradual change in gradient .
2. To provide safety and adequate visibility to traffic .
3. To provide comfort to the passengers.

Type of vertical curve

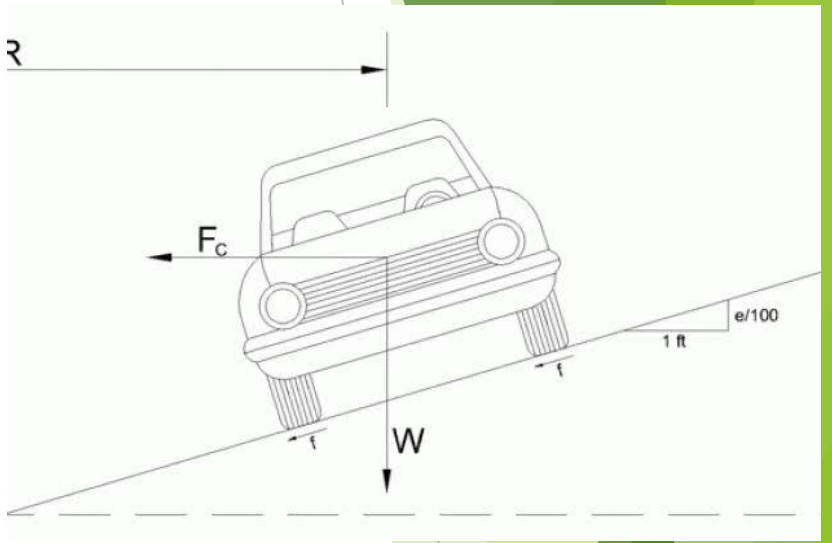
1. Summit curve :- The vertical curve having their convexity upward is called summit curve .



2. Valley curve :- The vertical curves having convexity downward are called valley curve .



Superelevation :- The invert inclination provide to the curved portion of road to prevent the vehicle to move in outward direction



Objectives of providing superelevation

1. To neutralize the effect of centrifugal forces.
2. To ensure safety of fast moving vehicle.
3. To prevent damage effect on road surface due to improper distribution of load.
4. To help fast moving vehicle to negotiate a curved path without overturning and sliding.

Road material

The different type of material is used for construction of road is called road material .

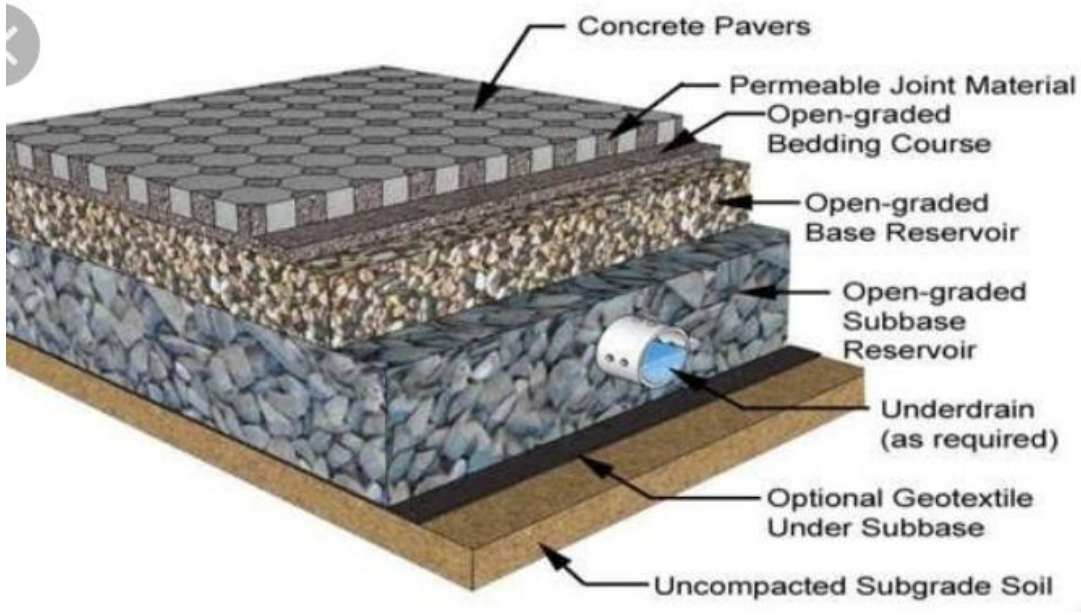
1. Soil
2. Binder
3. Aggregrate

Soil -

- The top layer of ground consisting of earthy material is called soil . It is available in different shape ,size and colour.

Types of soil –

1. **Clay**
2. **Silt**
3. **Loam**
4. **Shale**
5. **Marlae**



Subgrade soil -

The well compacted soil which act as a finished surface of earth work in which pavenment rest .

Characterdtics –

1. **It shold not deform under heavy load .**
2. **It sgoul have mini. Varition of volume under load .**
3. **During rolling it should be easily compact .**
4. **It should have good drain ability .**
5. **It should have high durability .**

Road aggregrate -

The material used for construction of road pavenment above the subgrade is called road aggregrate .

Properties –

1. **High strength**
2. **Hardness**
3. **Tughness**
4. **Adhesion with bitumen**
5. **Durability**

Types of aggregrate -

1. **Natural aggregrate (Sand ,Gravel ,Rock)**
2. **Artifucial aggregrate**

- **Broken bricks**
- **Air cooled slag**
- **Fly ash**

Binder -

The material used in road construction for binding aggregrate together to provide smooth surface for movement of vechiles .like Bitumen ,Tar ,Cement etc.

Function –

1. **They bind the surface particle together .**
2. **They make the road pavement durable and smooth .**
3. **They make the road surface impeemeable .**
4. **They act as cushion for raod surface .**

Bitumen -

It **is available in liquid or solid form . It is softend gradually when it is heated . It is available in black or brown colour . It is abtained by refinery process from petroleum.**

Bitumen material –

1. **Asphalt**
2. **Coaltar**
3. **Emulsion**
4. **Cutbacks**

Properties of bitumen -

1. It is available in liquid or solid form .
2. It should be durable .
3. It should be softened when heated .
4. It should be ductile and brittle .
5. It should not affected against wheathring attacks .
6. It should have low temperature suspectibility .

Tar -

It is obtained from destructive distillation of coal , wood and organic matters is called tar .

Emulsion – It is available in liquid form in which 50 to 60 % bitumen and 40% emulsifier is added to make the bitumen stabilized is called emulsion .

Function -

1. **It can be easily applied without heated .**
2. **It is used as a D.P.C.**
3. **It is used for stabilization of soil .**
4. **It is also used for pitch work and maintenance work .**

Cutbacks -

The **solution of bitumen in which a solvent added to reduce the consistency is called cutbacks . It contains 80% bitumen and 20% solvent .**

Function –

1. **It is easily applied on road without heated .**
2. **It increase the durability and wirkability of bitumen .**
3. **It can be used on all types of road .**
4. **It os used for stabilization of soil .**
5. **It is also used for dressing of surface .**

ROAD PAVEMENT

It may be defined as a structure consist of one or more layers of diff. material like gravel, earth, sand, cement, betumen etc and compacted to carry load of movement of vechile .

It have two types –

1. Flexible pavement –Those pavement which are surfaced with bitumen or asphalt material . These structure are less deformed under load . It can resist tensile stresses so it is called flexible pavement.

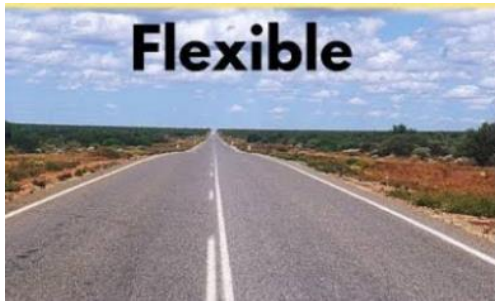
It consist of following components –

Subgrade

Sub base

Base

Surface course



Example – Bitumen road , Earth road , Gravel road

Rigid pavement -

Those pavement which are surfaced with cement concrete surface is called rigid pavement. It posses high flexural strength and deformed under heavy load . It consist of

1. Subgrade
2. Base course
3. C.C. slab

Advantages and disadvantages of flexural strength –

Advantages –

1. Initial cost is low .
2. These are elastic in behaviour .
3. Construction joint is not required .
4. No effect of temperature variation .
5. **I**t resist tensile stresses.
6. **Less** skilled labour required.
7. **It** is sitable for all types of traffic .

Disadvantage of flexible pavement

1. Flexural strength is less.
2. These are less durable .
3. High maintenance cost.
4. More slippery during rainy season .
5. Thichness is more as compared to rigid pavement .
6. It develop ruts and corrugations .

Advantages of rigid pavement –

1. More durable and long life .
2. Maintenance cost is low .
3. It can be laud on any sub grade .
4. These are dustless .
5. They do not develop rust and corrugation .
6. Flexural strength is more .

Disadvantage of rigid pavement -

1. Initial cost is high .
2. Construction joint is required .
3. Priduce heavy stresses due to temperature variation .
4. It required more skilled labour .
5. It causes noise under iron wheeled .
6. It require time to open for traffic after laying .

Function of various components of road pavement –

1. **Soil Subgrade-** A layer of natural soil to support the various components of pavement material is called soil subgrade .

FUNCTIONS -

1. To provide support to the road pavement.
2. To distribute to the large area .
3. To provide drainage facility .
5. To behave like a elasticity material .

2. SUB BASE COURSE –A layer of locally available material provide between sun grade and base course to increase the thickness of pavement is called sub base course

- **FUNCTION-**

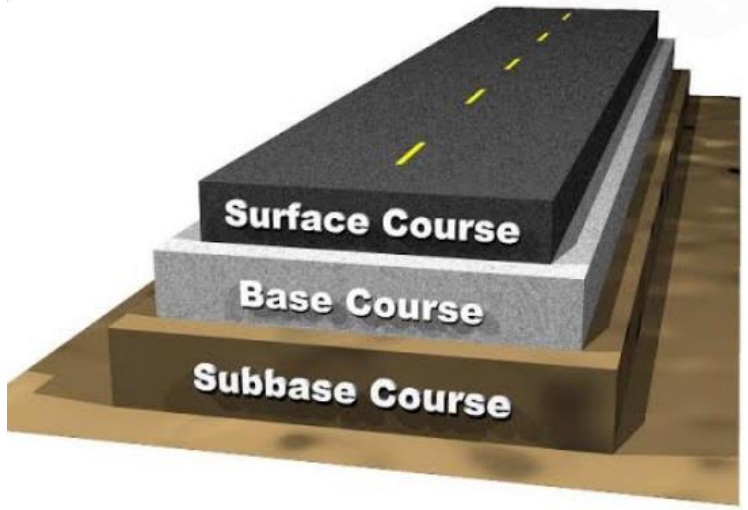
1. **T**o provide support to the base and wearing course.
2. **To improve the drainage condition**
3. It prevents the capillary rise of water .
4. It act as a filler material and increase the thickness of pavement.
5. To save the base and wearing course from poor quality of subgrade.

3. Base course -

A layer of broken stones and large size gravels provide between sunbase course and wearing course.

Functions –

1. To provide the stability to the riad pavement .
2. It transfer the traffic load to the sub base course
3. **It act as a** foundation fir road pavement.
4. **It withstand** against high shear stresses .



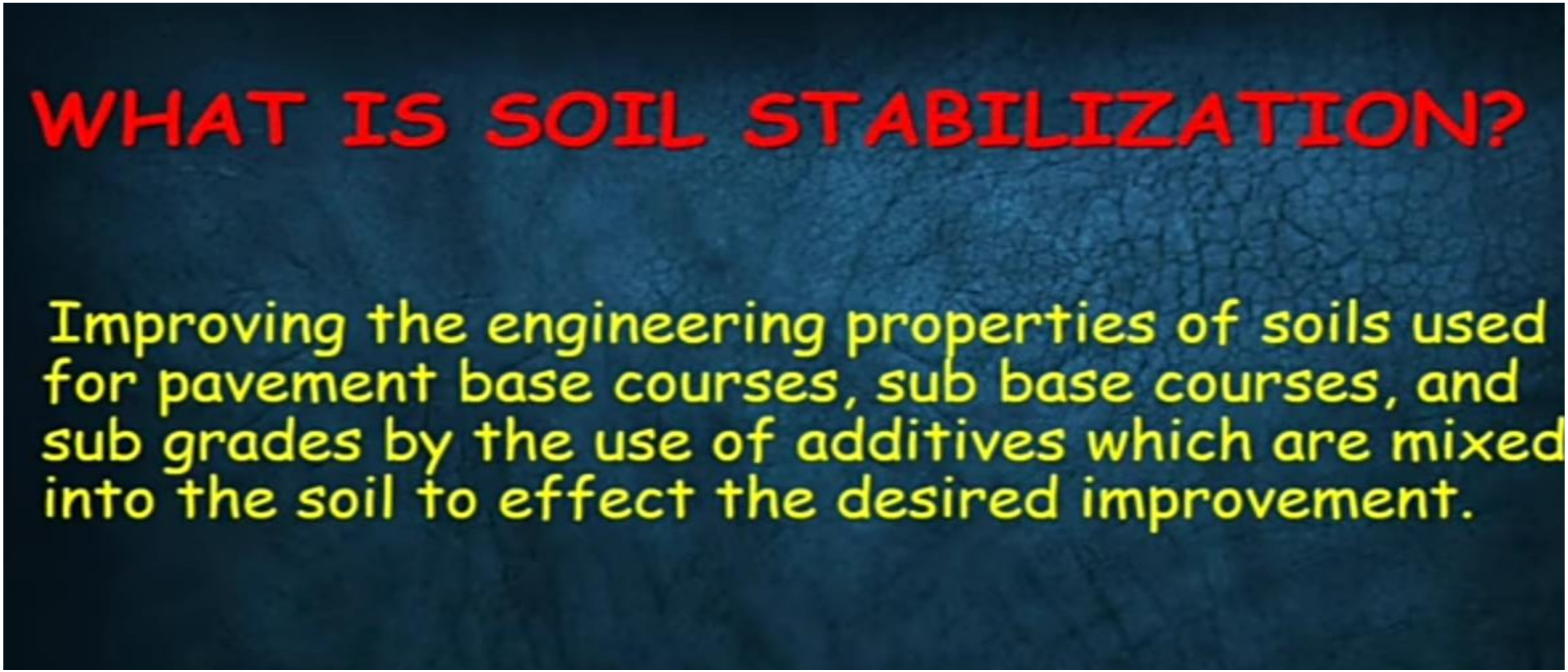
4. Wearing course -

It is the too most layer of road pavement which is in direct contact with wheels of vechiles . In flexible pavement bitumen surface is provide and in rigid pavement cement concrete surface is provide.

Functions –

1. It provide smooth surface for safe movement of traffic .
2. To reduce wear and tear of vechiles .
3. To provide water right layer against water infiltration .
4. To prevent dust and nuisance .
5. To transmit wheel load to the base course .
7. To resist abrasion pressure exerted by tyres .

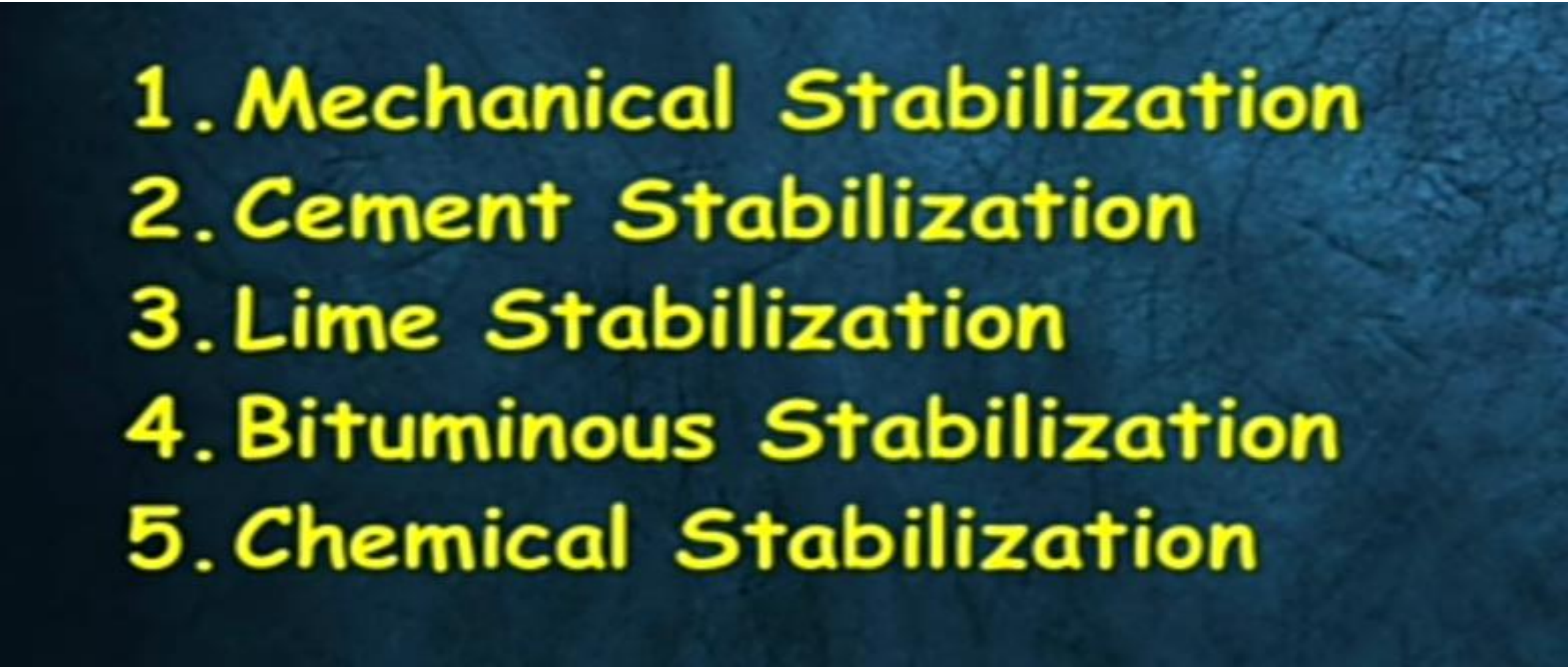
Soil Stabilization :-



Why soil stabilization is nedded :-

- Reduce permeability and compressibility of the soil
- To increase shear strength
- To enhance bearing capacity of soil
- Most importantly to improve natural soils for the construction
- Used to make area trafficable for emergency purposes.

Methods of soil stabilization :-



Mechanical stabilization:-

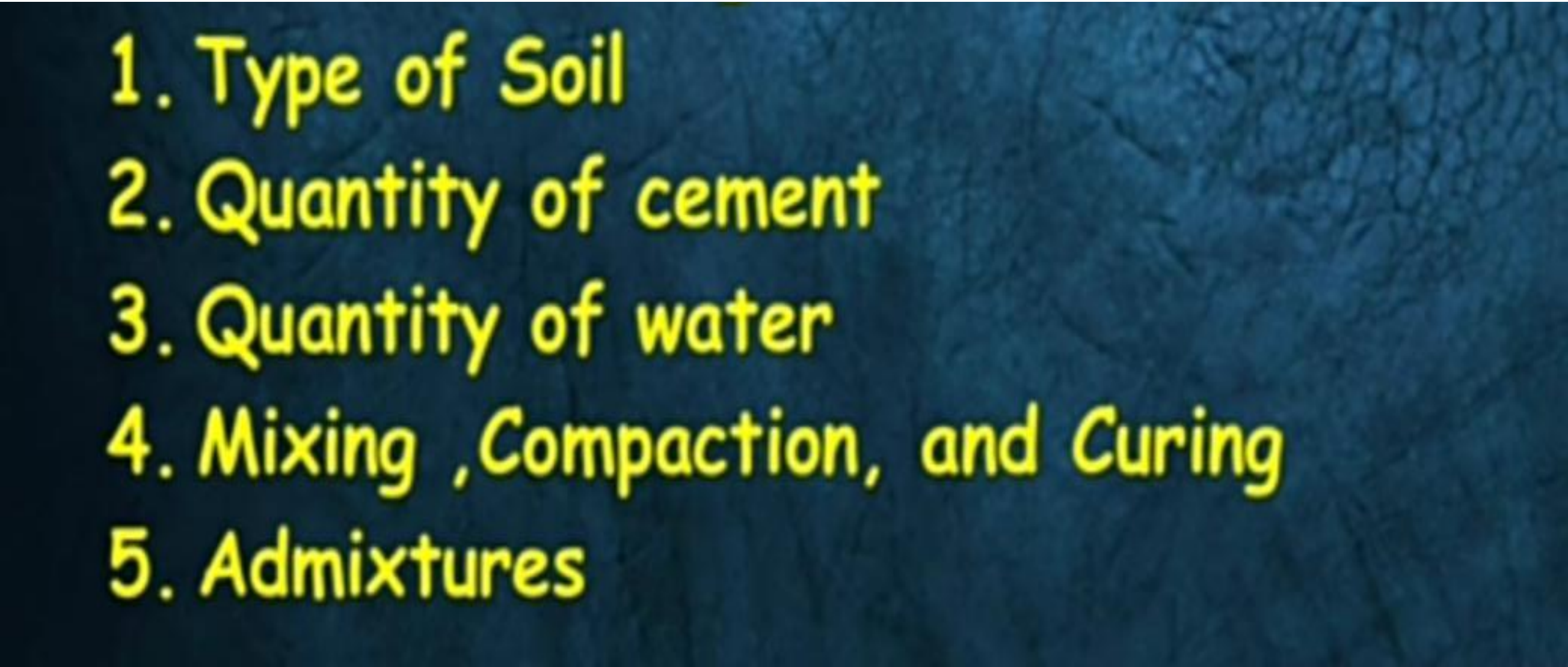
- Mechanical Stabilization is the process of improving the properties of the soil by changing its gradation.
- Two or more types of natural soils are mixed to obtain a composite material which is superior to any of its component.
- Also known as granular stabilisation.

Cement stabilization :-

- Cement Stabilization is done by mixing pulverized soil and Portland cement with water and compacting the mix to attain a strong material.
- Types of Cement Stabilization

1) Normal Soil-Cement
2) Plastic Soil-Cement
3) Cement-Modified Soil

Factors affecting cement stabilization :-



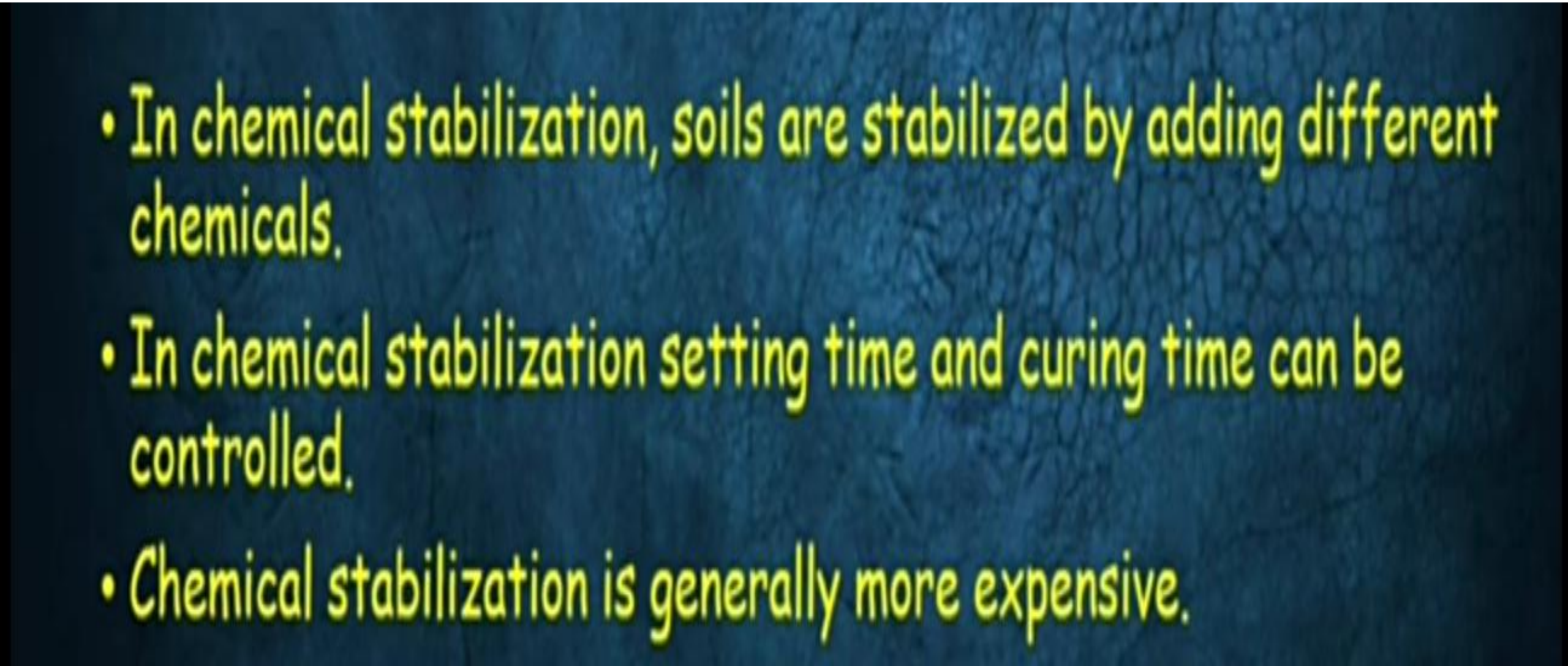
Lime stabilization :-

- Lime stabilization is done by adding lime to a soil, lime reacts with the soil and there is exchange of cations in the absorbed water layer and a decrease in the plasticity of the soil occurs .
- The resulting material is more friable than original clay and is therefore ,more suitable as sub grade.

Bitumenous stabilization :-

- Bituminous are non aqueous systems of hydrocarbon that are soluble in carbon di-sulphide.
- Any inorganic soil which can be mixed with asphalt is suitable for bituminous stabilization. In cohesionless soils ,asphalt binds the soil particles together and thus serves as a bonding or cementing agent.

Chemical stabilization :-



Prime coat -

It is a low viscocity liquid bitumenous material applied to the top road base of previous texture .

Function-

1. **To** seal the pores by penetrating into it .
2. **To waterproof the under laying layer .**
3. To provide adhesion between base and top layer
4. To coat and bond dust and loose layer .

Tack coat -

It is an application of binder to top road and surface to ensure a bond between new surface and old surface .

Function –

1. **T**o consolidate the existing surface .
2. **To** provide adhesion between new and old surface .
3. **To coat** and bond between loose materials

Seal coat -

- It is a final coat of bitumen material applied during construction pavement which are not impervious .

Function

1. **To** provide non skiiding surface .
2. **To seal the void of** existing surface .
3. **To repair** the top of existing surface

Construction step for laying of C.C slab -

1. **Preparation of subgrade**
2. **Preparartion of base course**
3. **Placing of form work**
4. **Watering of surface**
5. **Mixing and laying of concrete**
6. **Compaction and finishing**
7. **Curing**
8. **Opening to traffic**

Types of concrete joint -

- Expension joint – The joint constructed to allow for expension of road .
- Contraction joint – The joint constructed to allow shrinkage or contraction of road .
- Longitudinal joint- The joint provide along the length of road .
- Transverse joint –The joint provide perpendicular to the longitudinal joint .