R.C.Patel College Of Engineering & Polytechnic, Shirpur

Department of Civil Engineering

Course Title- Highway Engineering **Course Code -** 313323

Programme Name -Civil Engineering **Semester-** Third

Unit	Title	COs	Learning hours	R Level	U Level	A Level	Total Marks
V	Road Drainage and maintenance	CO5	06	02	04	04	10

Unit 5: Road Drainage & Maintenance.

5.1 Drainage:

Definition: Drainage is the system used to remove and control rainwater and surface water from roads remains safe and durable.

Necessity of Drainage:

1) Prevents water from collecting on the road.
2) Protects pavement from damage.
3) Increases driving safety.
4) Reduces maintenance costs.
5) Increases road life.

Methods of drainage / Types of drainage:

1) surface drainage : a) side gutter b) catchwater drain.
2) Sub surface drainage: a) Longitudinal drains
   b) Cross drains.

1) surface drainage:

- Removes water from the road surface.
- Examples: side drains, gutters, catch pits.

2) Subsurface drainage:

- Removes water from below the pavement.
- Uses pipes and filter materials.

functions of surface drainage:

1) Surface drainage prevents the entry of surface water from the adjoining land.
2) Surface drains keep the surface of pavement dry thus helps to keep road in proper conditions.

A) side drains:

- Constructed along both sides of the road.
- Collect water flowing from the road surface.
- commonly used in rural and hill roads.

B) Gutter drainage

- used in urban roads
- Kerbs guide water into gutters.
- water is then carried to stormwater drains

C) catch water drains

- Constructed on the uphill side of hill roads.
- Intercepts water coming from higher ground before it reaches the road.

D) Cross drainage structures

- Allow water to pass across the road safely.

eg - Culverts, Bridges, Causeways.

Subsurface drainage

A) Longitudinal drains:

- Installed parallel to the road.
- collect groundwater and seepage water.
- Usually consist of perforated pipes surrounded by filter material.

B) French drains

- Trench filled with gravel and perforated pipe.
- collects and carries underground water away.

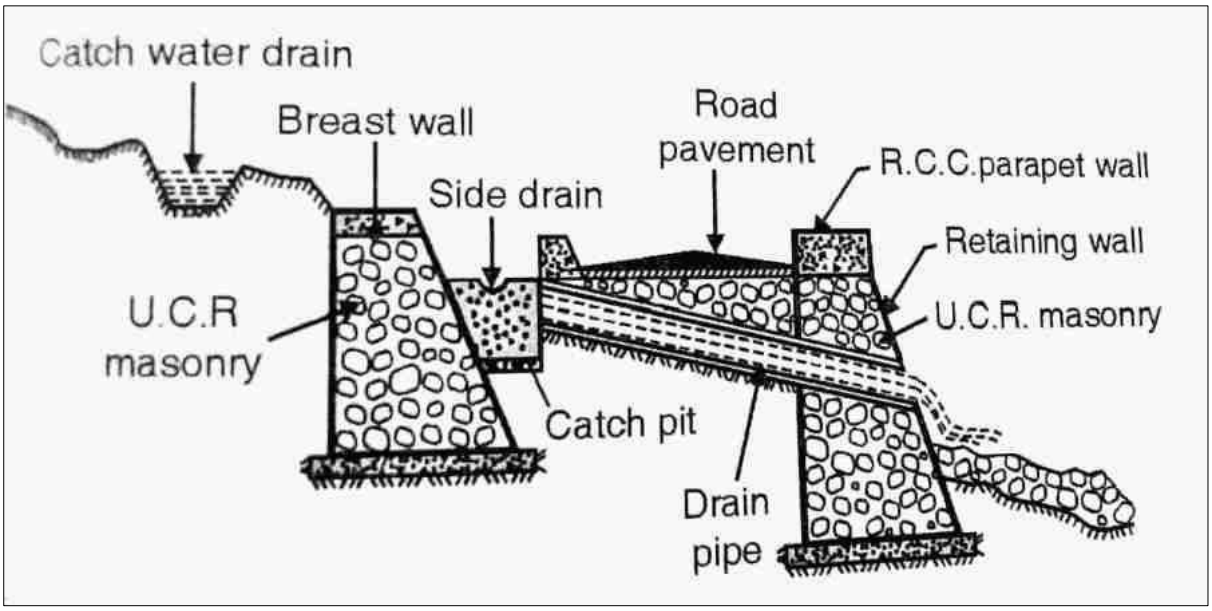
C) Edge drains

- Installed along the edges of pavement.
- Remove water from pavement layers.

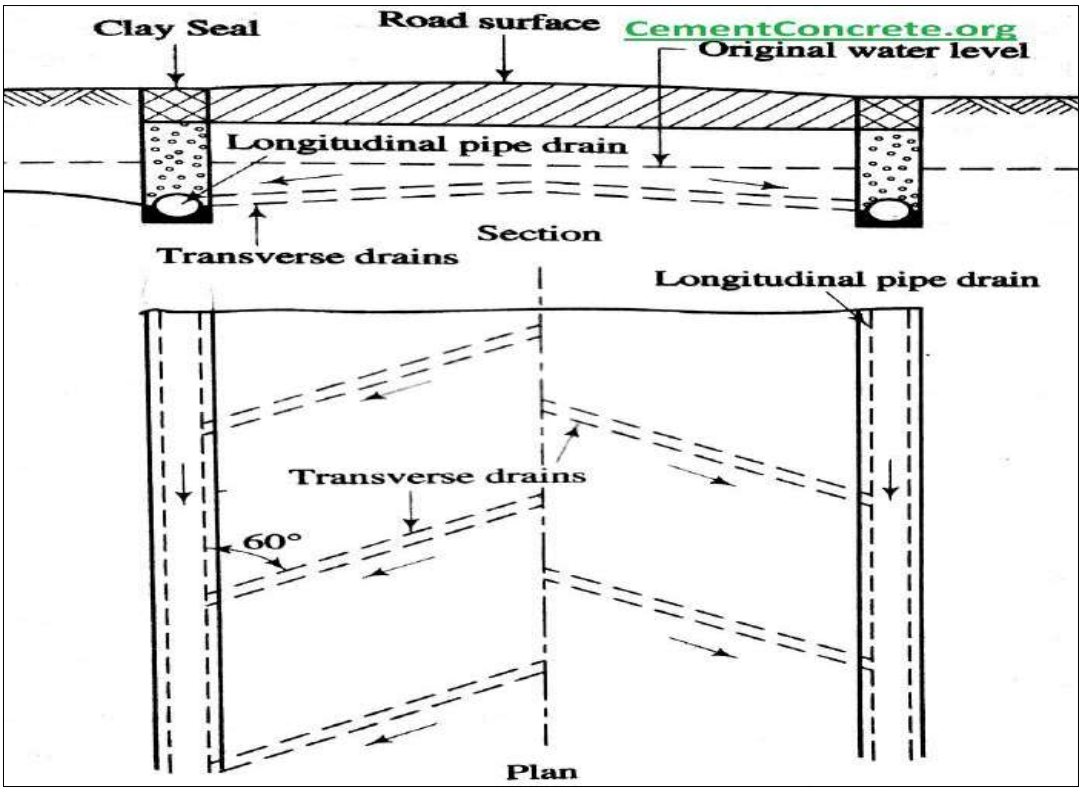
D) Under drains:

- pipes placed below the pavement structure.
- collect and discharge excess groundwater.

1. **Surface drainage**



2. **Sub Surface drainage**



5.2 Failure of flexible and Rigid pavement:

1) **Flexible pavement** → Flexible pavement is made of bituminous layers and transfers traffic load gradually to lower layers.

1. **Cracking** → cracks are breaks that develop on the pavement surface.

Causes →
- Repeated traffic loading
- Temperature changes.
- Ageing of bitumen.
- Weak pavement structure.

Preventive Measures →
- Use quality bitumen.
- Provide adequate pavement thickness
- seal cracks at an early stage.
- Maintain proper drainage.

2. **Rutting** → Rutting is the formation of longitudinal depressions or wheel track grooves on the road surface.

Causes →
- Heavy traffic loads.
- Poor compaction of pavement layers.
- Weak subgrade soil.
- Excess moisture in pavement.

Preventive Measures →
- Proper compaction during construction.
- Use strong pavement materials
- Improve subgrade strength.
- Ensure good drainage.

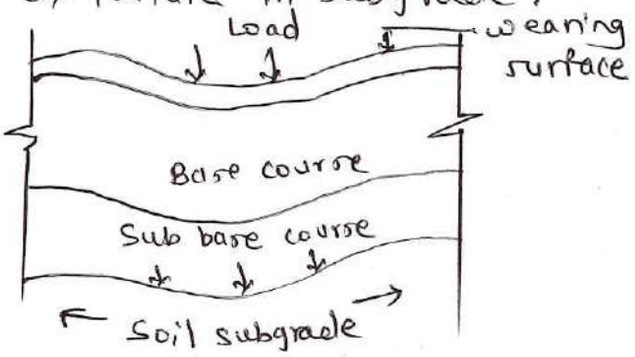
3. **Potholes** → Potholes are bowl-shaped holes formed on the pavement surface.

Causes →
- Water entering through cracks.
- Continuous traffic movement.
- Poor maintenance.

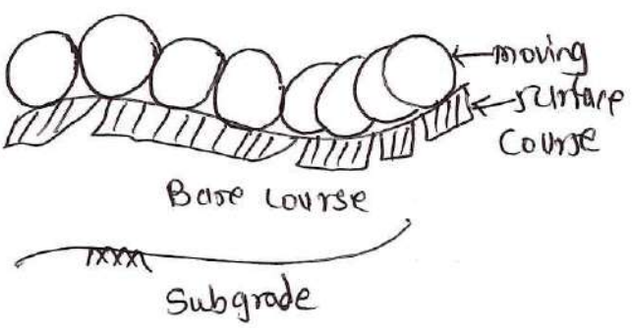
Preventive measures →
- Repair cracks immediately.
- Remove standing water.
- Use good quality construction materials.

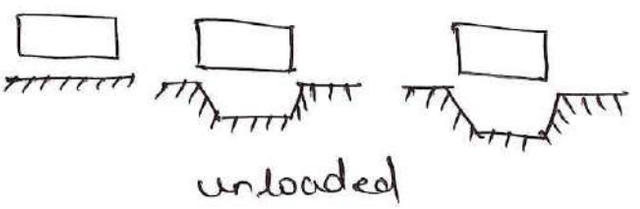
Causes of failure of flexible Pavement (WBM Road)

a) Failure in subgrade:

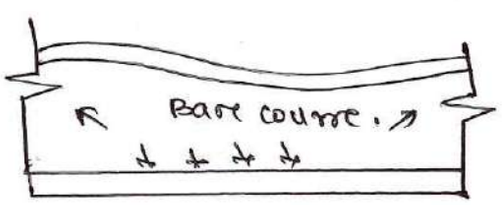


i) Inadequate stability
ii) Excessive stress application.



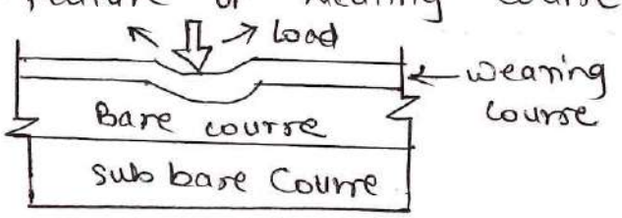


b) failure in Base course or sub base course.



- Inadequate stability or strength
- loss of binding action
- loss of base course material
- Use of inferior materials and Crushing of base course material.

c) failure of Wearing Course.



i) Shear failure
ii) Longitudinal cracking
iii) Reflection cracking

Remedial Measures for Pothole formation and Rut formation

i) Remedial measures for formation of pot holes in case of flexible pavements:

1) Cutting the defective area to rectangular shape and removing the loose stones up to the affected depth.

2) Filling up the prepared area with coarse aggregate of the same size.

ii) Remedial measures for formation of ruts in case of flexible pavements:

1) Cleaning the affected area and light watering.

2) Filling the rut using selected earth.

3) Watering and compaction by rolling.

4) Checking of camber for efficient drainage.

failure of Rigid Pavement

Rigid Pavement is made of cement concrete and high stiffness and strength.

1. Longitudinal cracks.
2. Transverse cracks.
3. Corner cracking.
4. Faulting
5. Spalling
6. Scaling.

failure in cement concrete Pavements.

-failure of cement concrete pavement

Failure due to two factors:

1) Dificiency of pavement materials

2) structural inadequacy of the pavement.

1) Deficiency of Pavement materials.

- soft aggregates
- Poor workmanship in joint construction.
- Poor joint filter and sealer material.
- Poor surface finish.

Various defects that creep in due to the above are:

i) Disintegration of cement concrete.
ii) formation of cracking
iii) spalling of joint
iv) Poor riding surface.
v) Mud pumping.
vi) structural track.

2) Structural Inadequacy of Pavement system.

- Inadequate subgrade support Pavement thickness would be a major cause of developing structural cracking in Pavements.

- from which causes of failure:

i) cracking of slab corners.
ii) Cracking of Pavements logitudinally.
iii) settlement of slabs.
iv) widening of joints.
v) Mud pumping.

5.3 Necessity of Maintenance of Road & its classification.

Road maintenance means keeping a road in good condition through regular inspection, repair and improvement work. Roads are continuously affected by traffic, rain, sunlight, floods, & other environmental conditions.

Necessity of Road Maintenance

1) To Ensure Road safety.
   - Damaged roads with potholes, cracks & uneven surfaces can cause accidents.
   - maintenance helps provide a smooth and safe road for all users.

2) To increase Road life.
   - Regular maintenance increase road life.

3) To improve Riding comfort
   - A well maintained road provides a smooth ride and reduces discomfort to drivers & passengers.

4) To Reduce vehicle operating cost.
   - Good road conditions reduce fuel consumption, tyre wear.

5) To protect the Road structure.
   - Timely repair and prevent from water entering Pavement

6) To maintain Efficient Traffic flow.
   - Proper traffic flow maintain and avoid traffic delays.

7) To Reduce future Repair Expenses.
   - Repairing small damaged early is much cheaper than reconstructing an entire road.

8) To improve Road Appearance.
   - clean and well-maintained roads create a better environment & improve the overall image of an area.

Classification of Road Maintenance.

1. Routine Maintenance.

It includes small repair works carried out regularly throughout the year to keep the road in serviceable condition.

- Filling small potholes
- Cleaning side drains
- Removing vegetation along roadsides
- Repairing road signs & markings
- Cleaning culverts and drainage structures.

2. Periodic Maintenance.

It is performed at fixed intervals to restore the condition of the road & improve its performance.

- Resurfacing of roads.
- Renewal of road markings.

3. Emergency Maintenance.

It is carried out immediately after unexpected events that damage the road.

- Repairing flood damaged roads.
- Removing landslide debris.
- Restoring damaged culverts.
- Repairing roads after accidents or storms.

4. Special Maintenance.

special maintenance involves major repair or rehabilitation work when the road has deteriorated significantly.

- Reconstruction of pavement.
- widening of roads.
- strengthening weak sections.
- Major rehabilitation works.

5. Preventive Maintenance.

It is includes actions taken before serious damage occurs.

27/06/25

Unit – V Road Drainage and maintenance

1. State the causes of failure of flexible road pavement with sketch.
2. Enlist the necessity of Highway Maintenance.
3. Draw neat labelled sketch of drain provided with grating.
4. Define Road Surface drainage.
5. Explain remedial measures for Pothole formation and Rut formation in case of flexible pavements.
6. Explain sub surface drainage of roads with its types and neat sketches.
7. State the sequential steps/procedure for repairing potholes in flexible pavement with sketch.
8. Explain subsurface drainage with side drains with suitable sketch.
9. Explain the necessity of drainage of roads.
10. State the types of drainage system.
11. State the functions of surface drainage and subsurface drainage.
12. Define catch water drain? Draw a neat sketch of catch water drain.
13. Differentiate between surface and subsurface drainage.
14. State the necessity and elaborate in detail, the special repairs of rigid pavements.
15. Draw neat sketch of subsurface drainage system with transverse drainage and longitudinal drains.