



**O N L I N E**

**LEARNING**

# **HIGHWAY DRAINAGE AND MAINTENANCE - Part 1**

**SKAA 2832 HIGHWAY ENGINEERING**

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# Content

- ✓ Highway Drainage System
- ✓ Highway Maintenance
- ✓ Pavement Rehabilitation
- ✓ Visual Assessment of Flexible Pavement Surface Conditions

# Highway Drainage System

✓ **Importance:**

1. **User safety – accumulated water caused hydroplaning, splash and spray, skidding**
2. **Pavement structure - reduce sub-grade strength, stripping problem, slope stability**

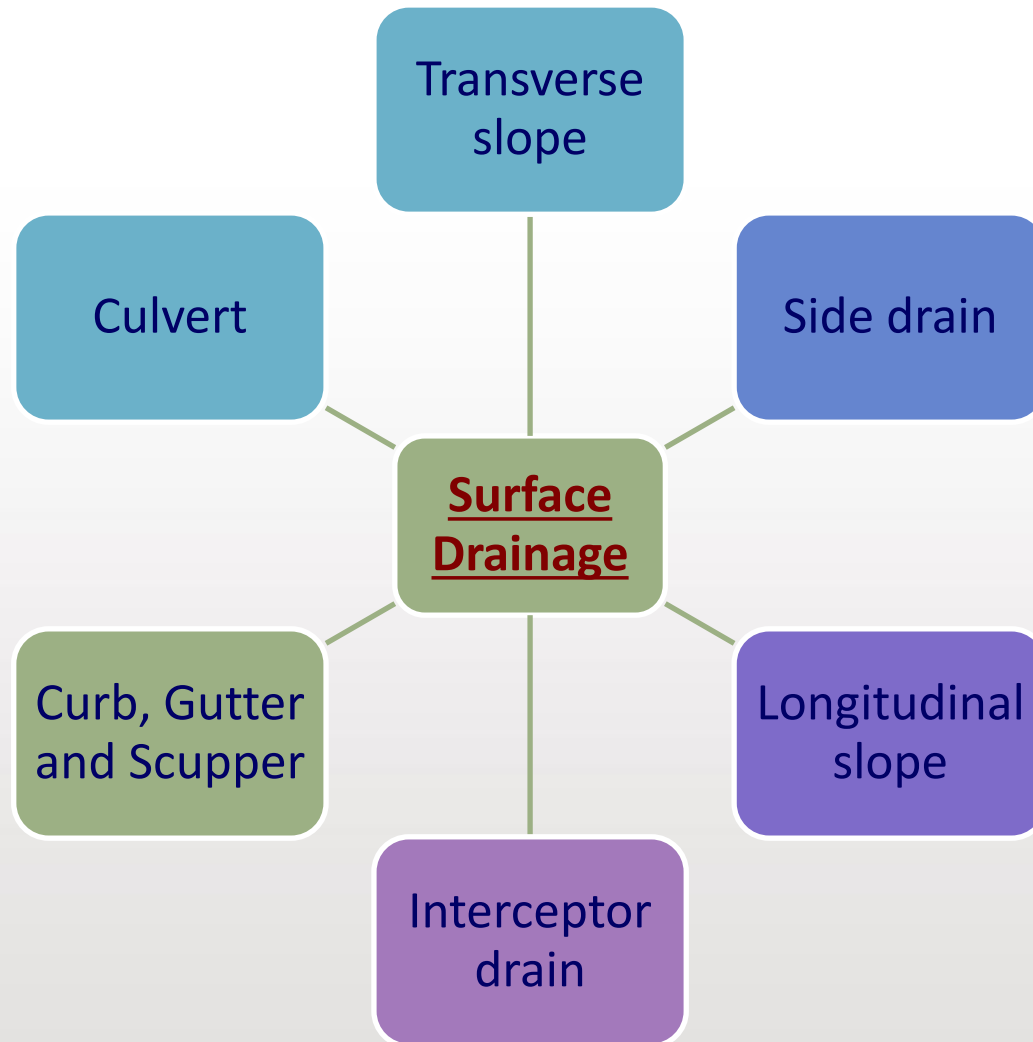
✓ **Two types of drainage:**

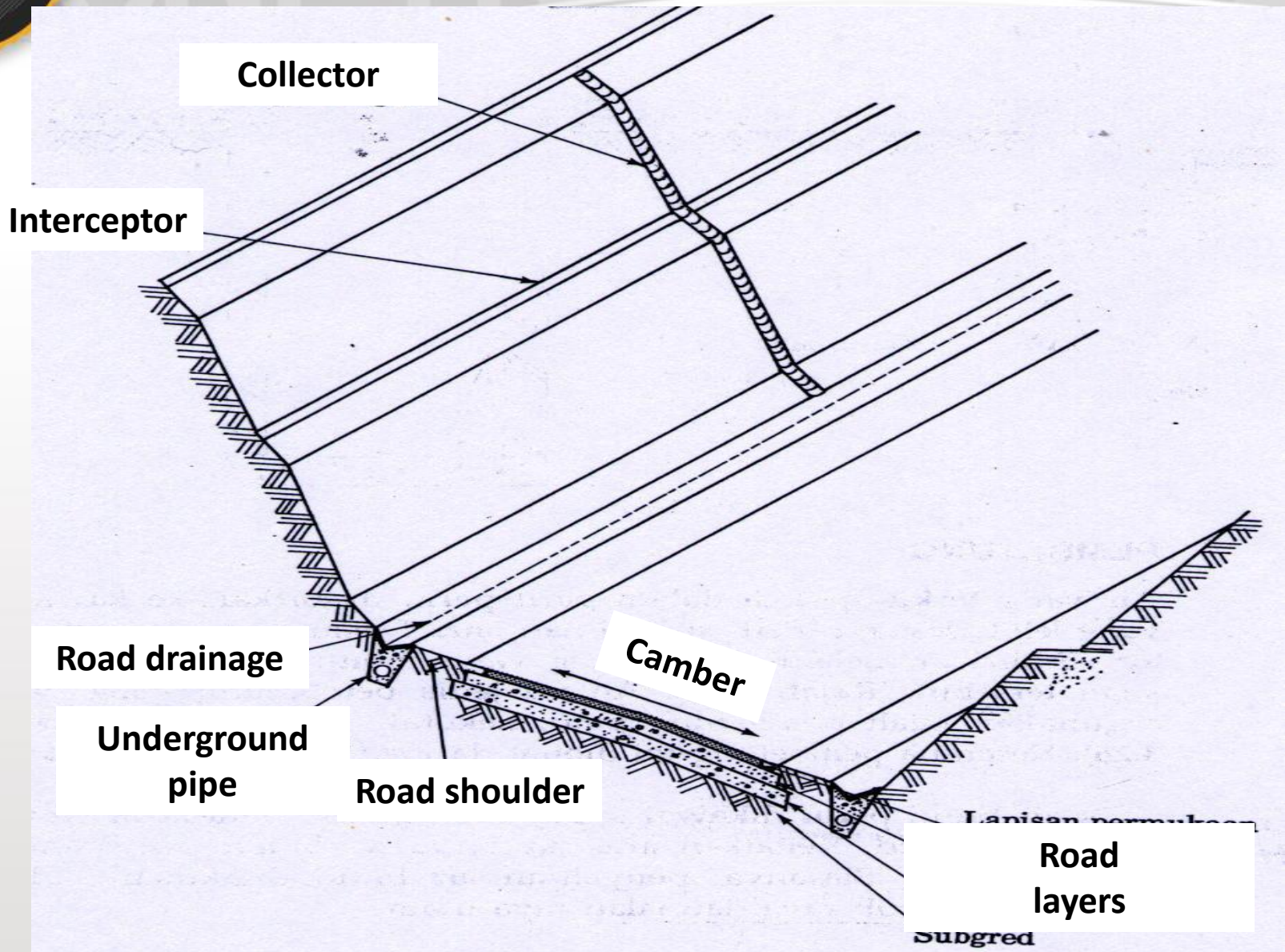
1. **Surface drainage – rain, snow, run-off water**
2. **Sub-surface drainage – cut/fill area, high water table**





# Surface Drainage





Collector

Interceptor

Road drainage

Underground pipe

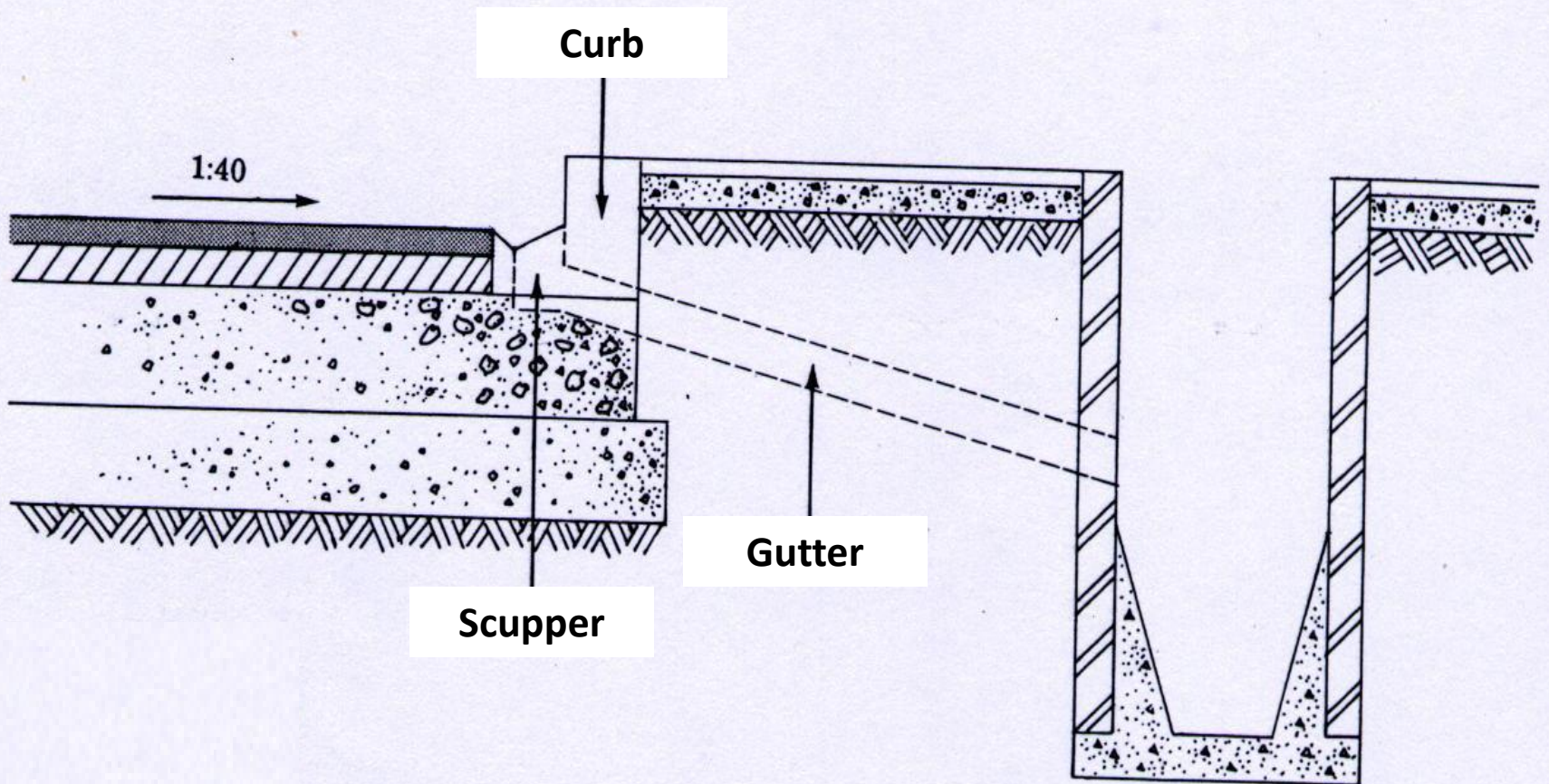
Road shoulder

Camber

Road layers

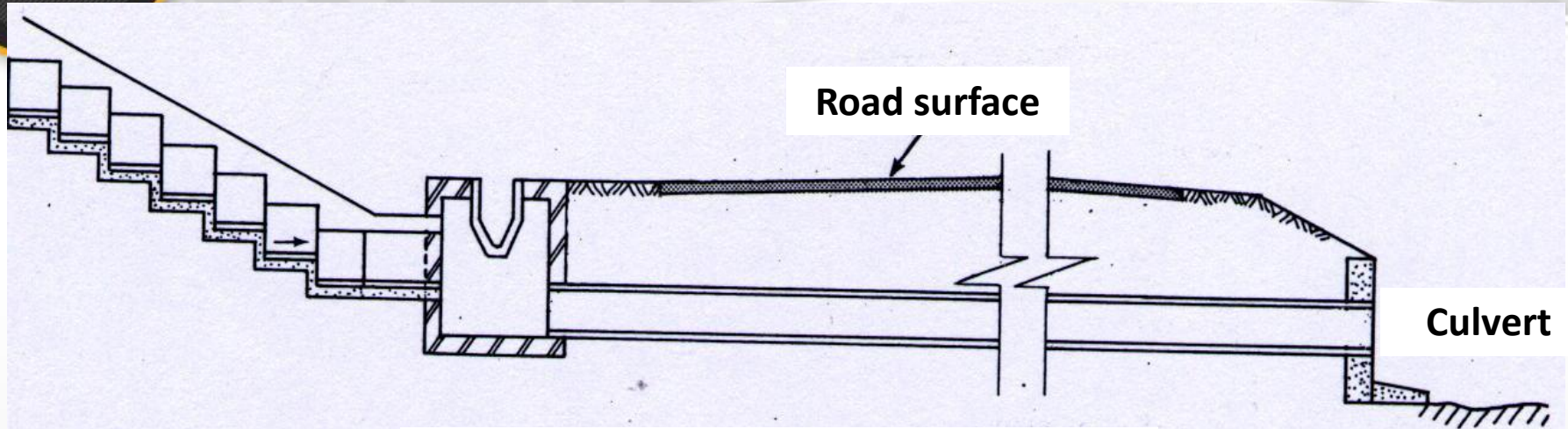
Subgrade

Lapisan permukaan

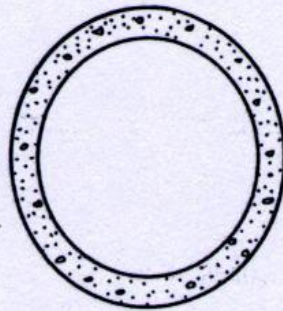




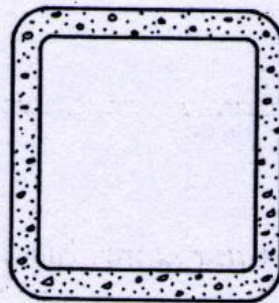
# Culvert



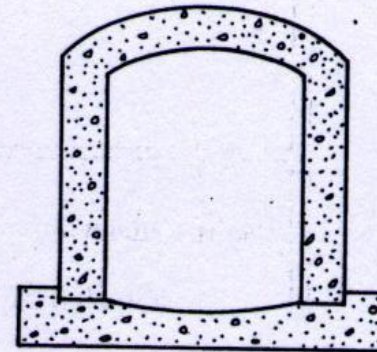
Road section



Pipe culvert



Box culvert



Arch culvert



# Side Drain







# Cascade



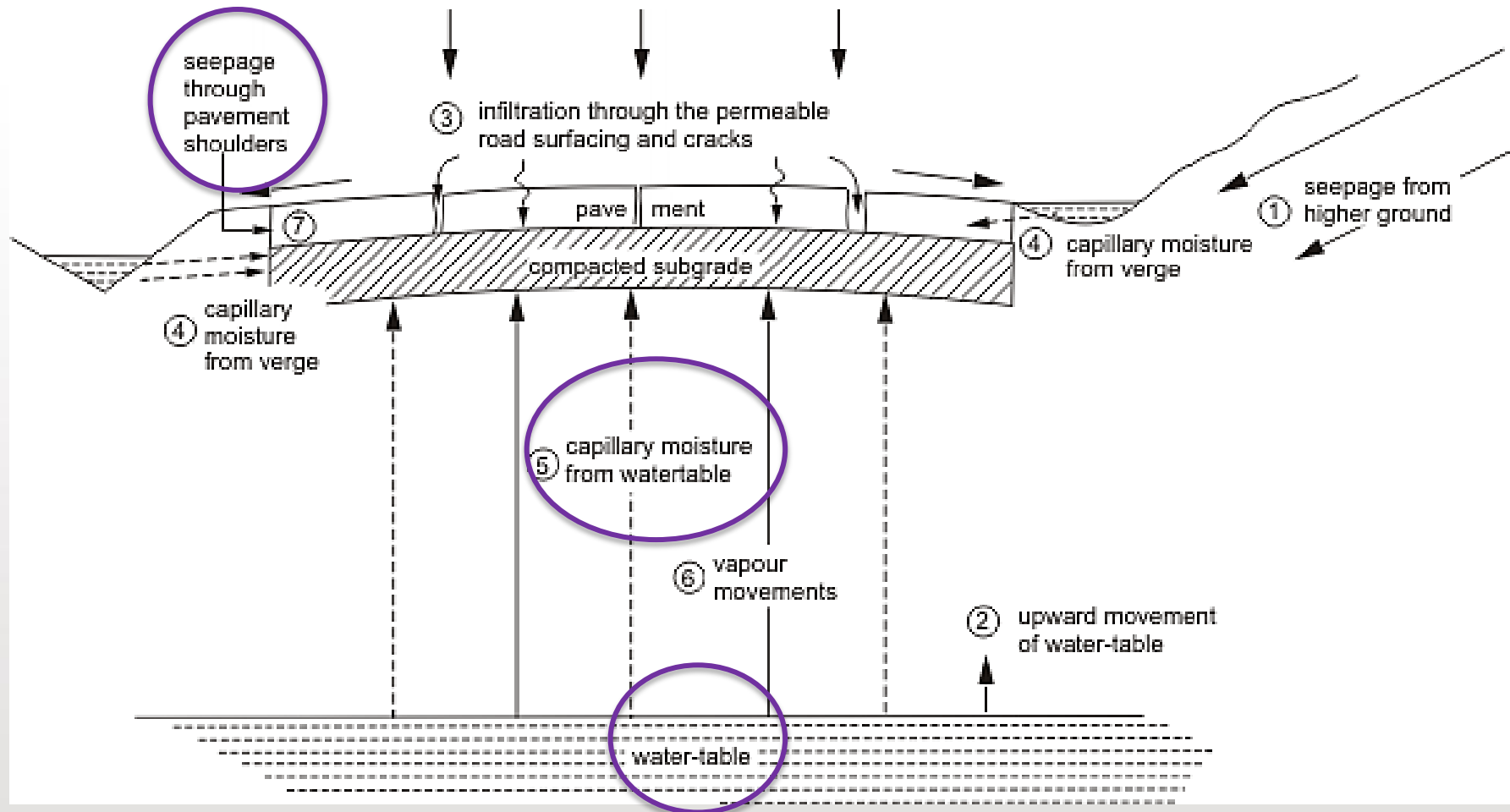




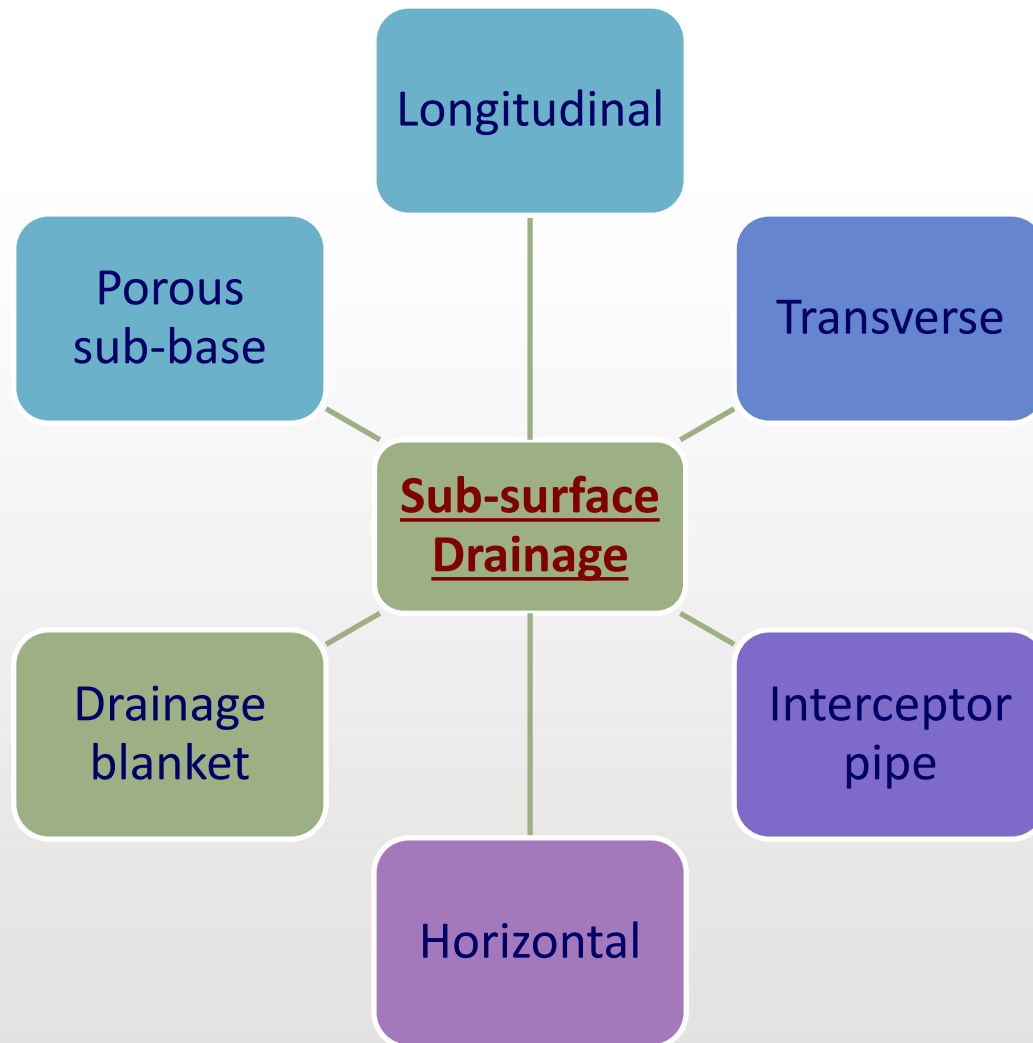


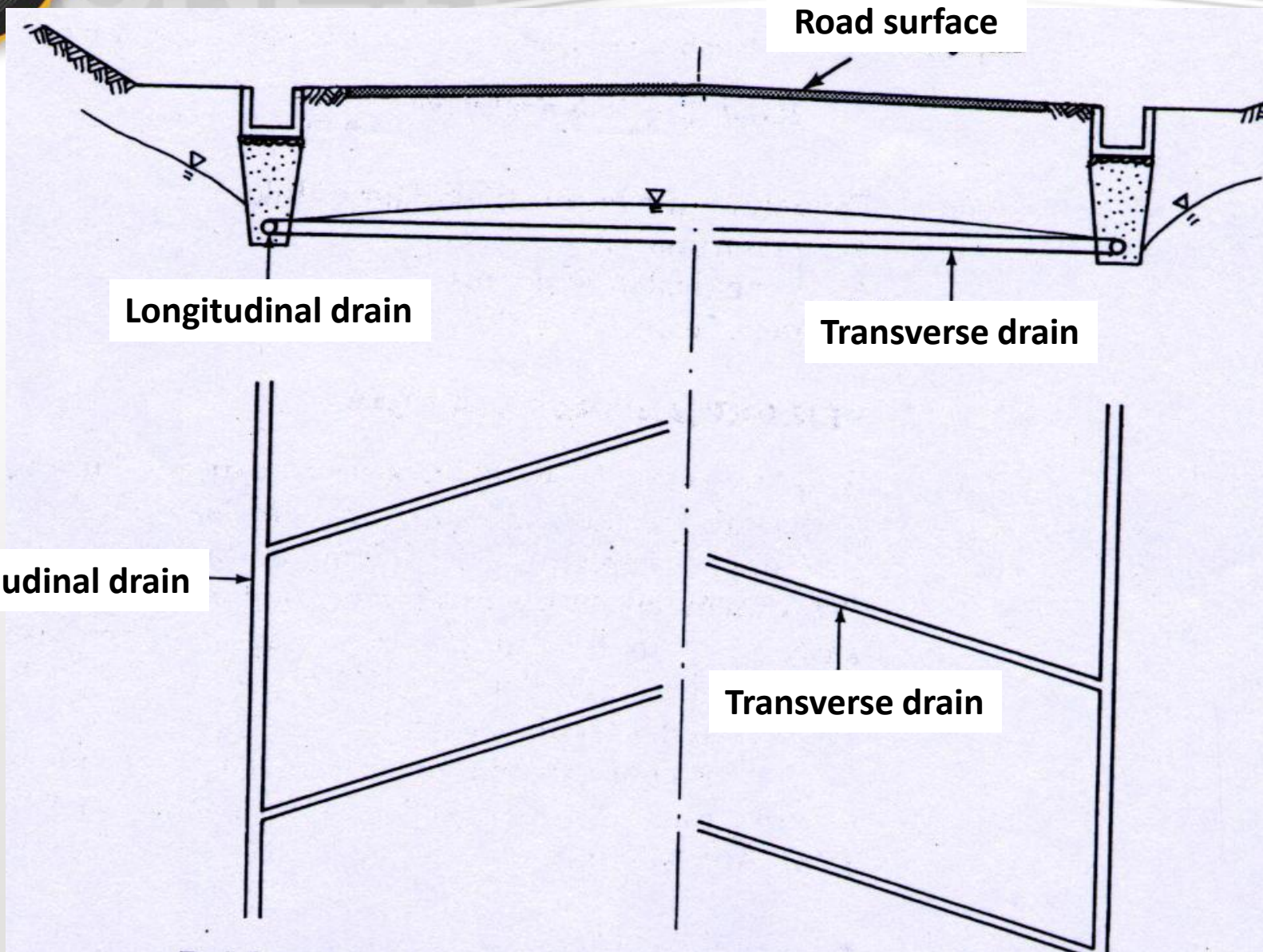
# Sub-surface Drainage

# Source of ground water









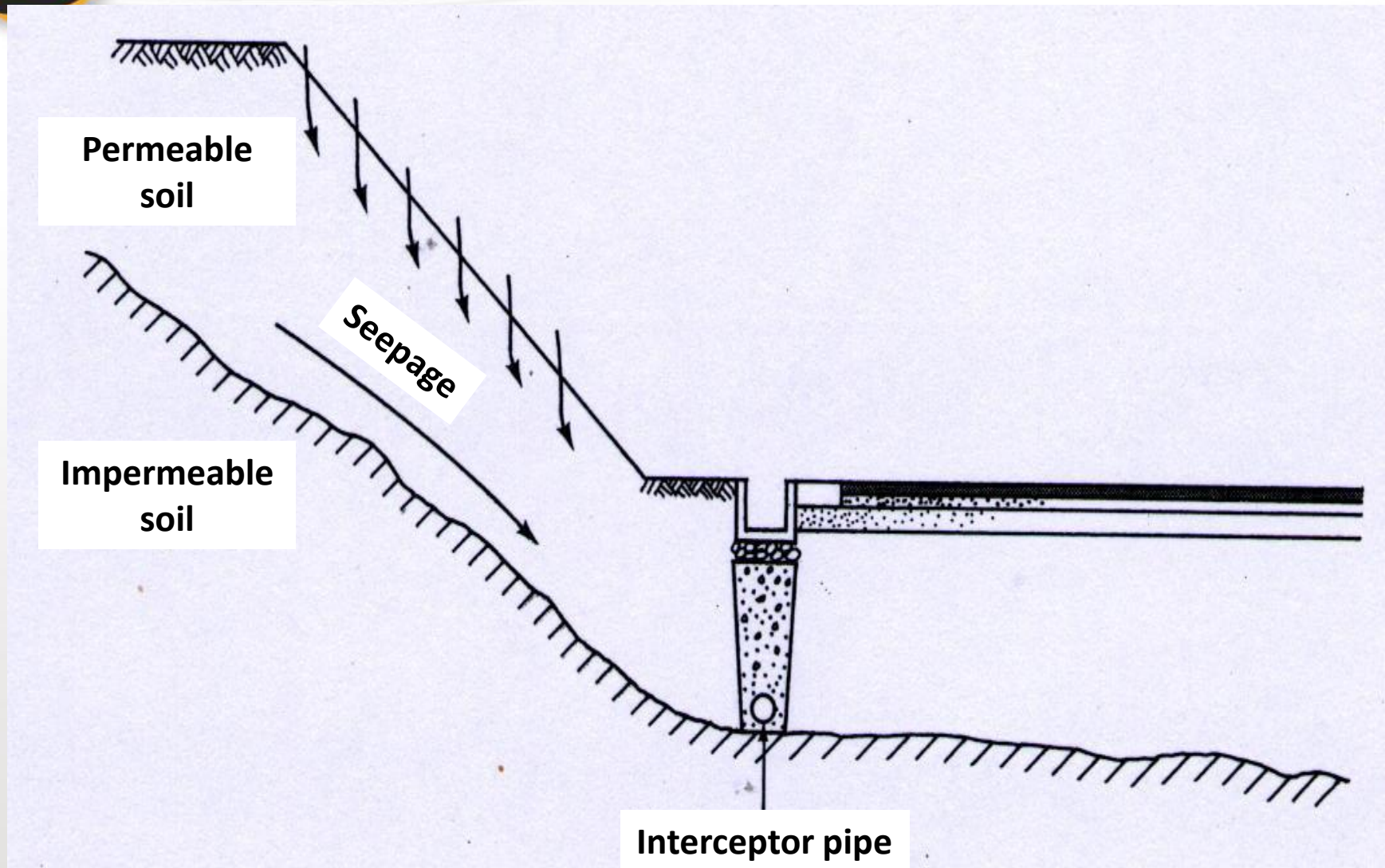
Longitudinal drain

Longitudinal drain

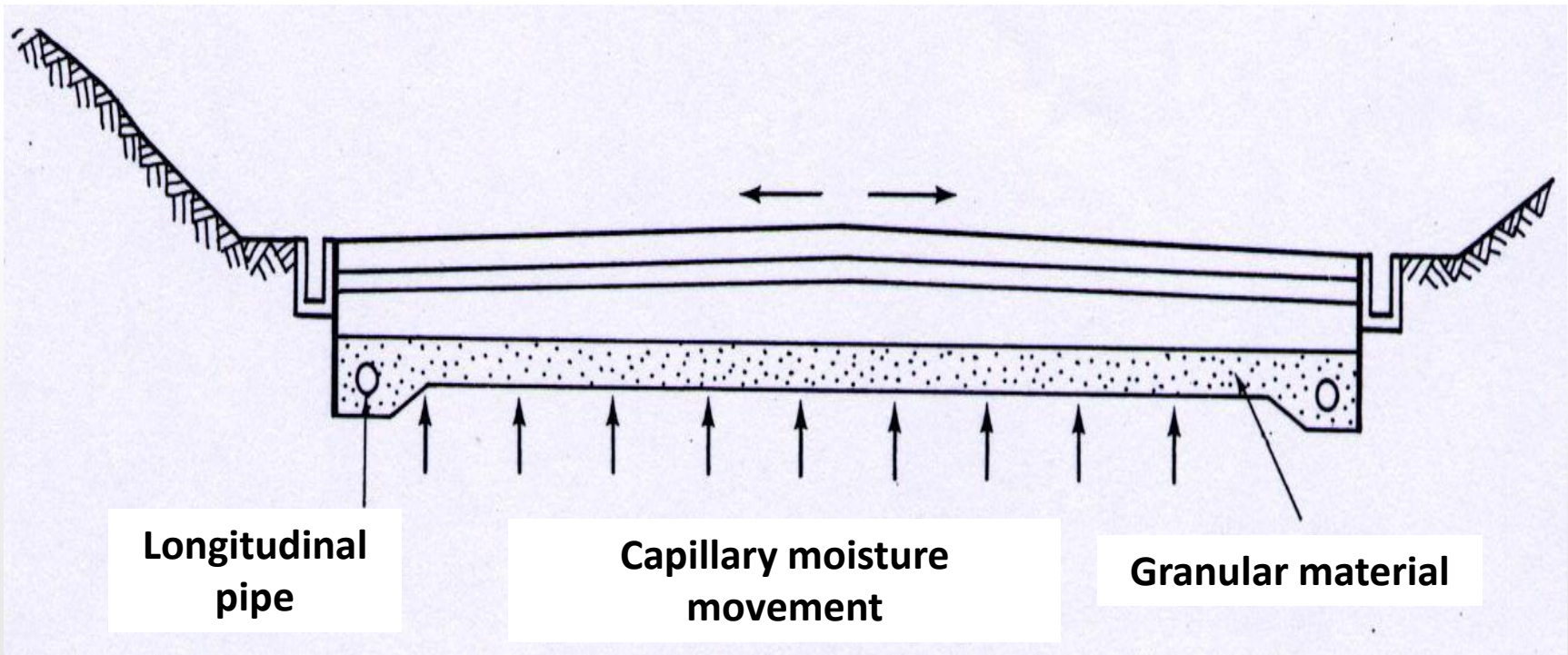
Road surface

Transverse drain

Transverse drain



# Drainage blanket



Longitudinal pipe

Capillary moisture movement

Granular material

# Horizontal/slope drain

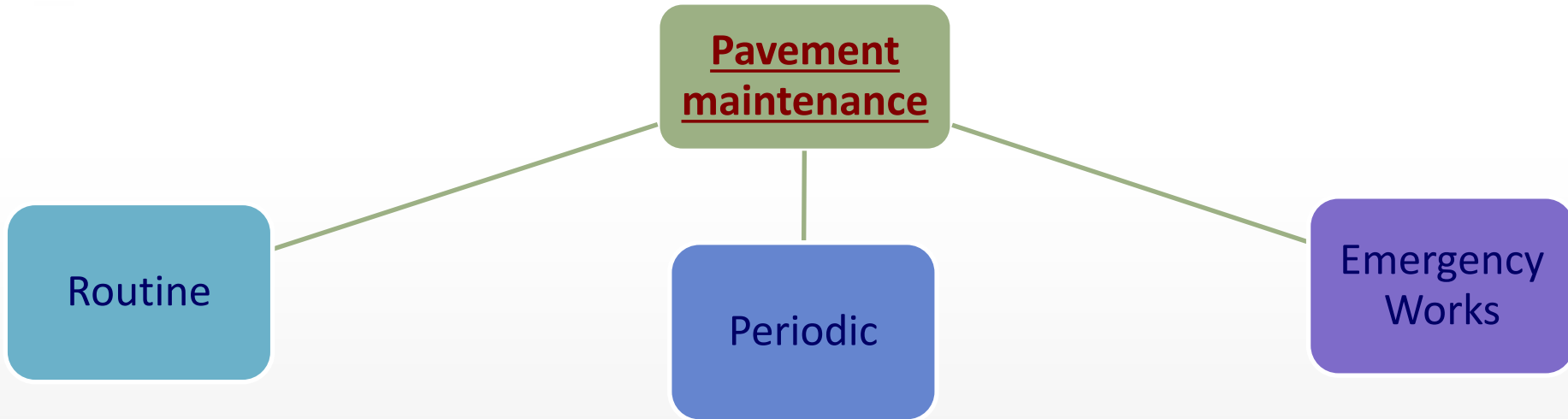




Granular material



# Pavement Maintenance



- ✓ Carried out on a regular basis
- ✓ Ex. grass cutting, landscaping, patching, shoulder, drainage, signage)

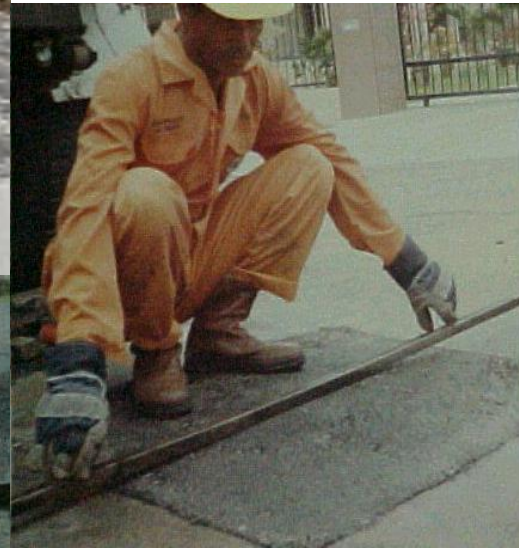
- ✓ Carried after once in a few years
- ✓ Normally large scale
- ✓ Ex. resurface, road marking

- ✓ Beyond control
- ✓ Landslides, embankment failure, flooding, bridge collapse





# Patching





# Road Shoulder

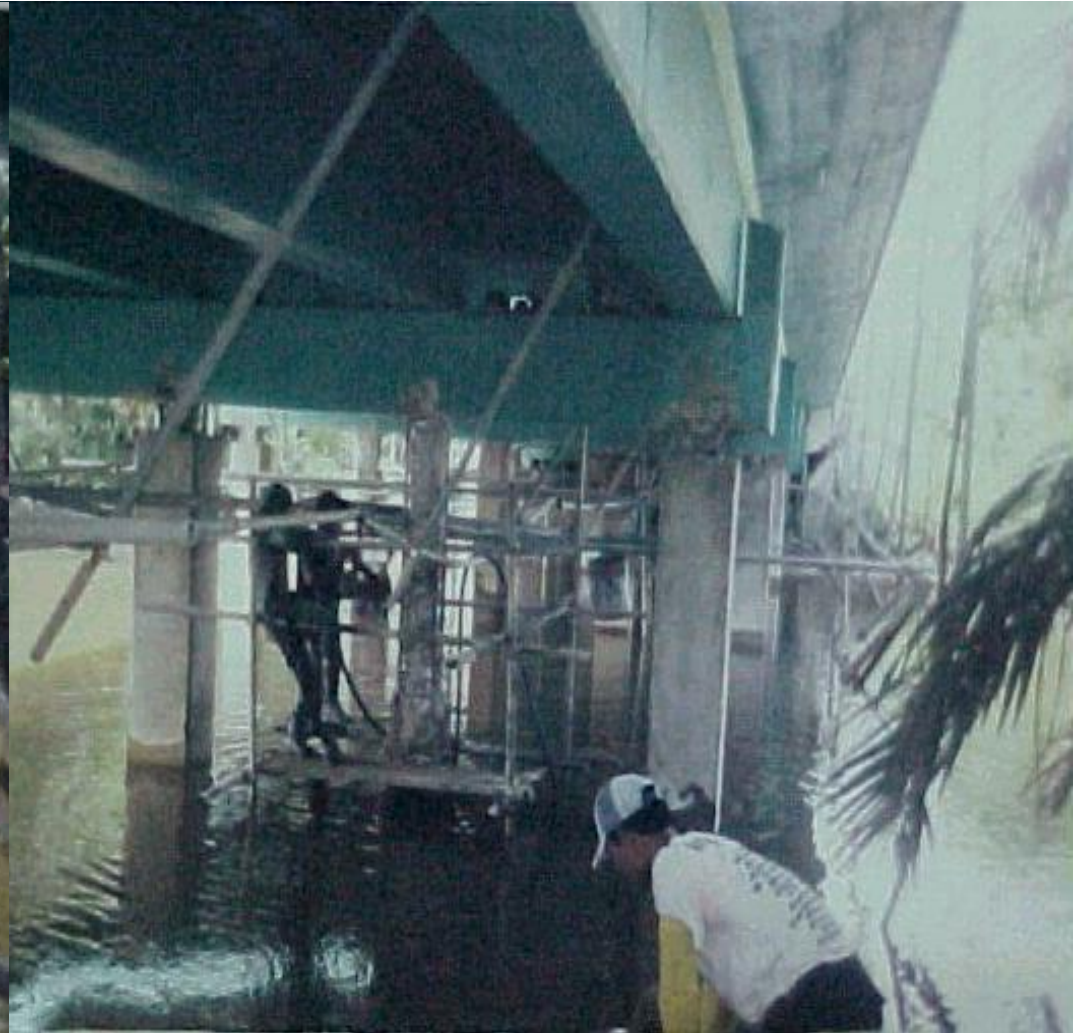




# Slope



# Bridge



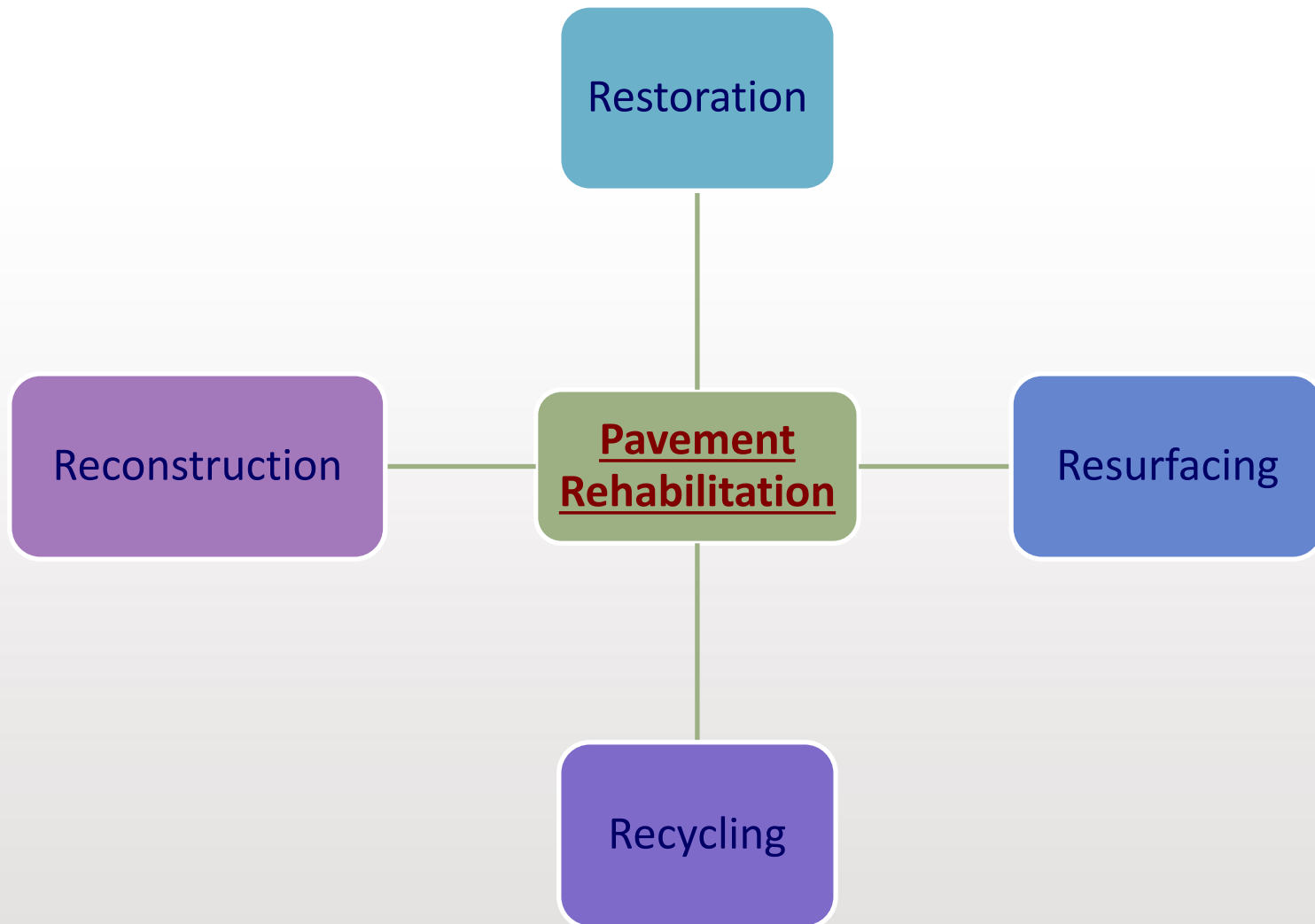


# Furniture, Landscape





# Pavement Rehabilitation





# Restoration

## Restoration techniques:

- ✓ Rejuvenating
- ✓ Crack sealing
- ✓ Cut and patch
- ✓ Thin bituminous overlay





# Rejuvenating



# Crack sealing





# Resurfacing

- ✓ Placement of fresh material
- ✓ improves riding quality and structural strength
- ✓ Need to properly design the overlay thickness
- ✓ Using thick asphalt overlay
- ✓ Pre-treatment required

# Resurfacing





# Recycling

## Types of recycling:

- ✓ Hot in-place recycling (HIPR)
- ✓ Cold in-place recycling (CIPR)
- ✓ Hot/Cold in-plant recycling



# Hot Recycling





# Cold Recycling





# Reconstruction

## Types of reconstruction:

- ✓ Hot recycling with overlay
- ✓ Cold recycling with overlay
- ✓ Construction/improvement of sub-surface drainage





# Reconstruction





# Thank You