Chapter 18: Joint Fillers and Sealers in Concrete Pavements

18.1 Introduction

Concrete pavements, despite their rigidity and high load-bearing capacity, are susceptible to cracking and damage due to temperature variations, shrinkage, and expansion. To control these movements and maintain structural integrity, **joints** are provided in concrete pavements. These joints must be adequately protected to prevent the ingress of water, debris, and incompressible materials that can lead to pavement deterioration.

Joint fillers and sealers serve as essential components in the performance and durability of concrete pavements. Fillers are used to **provide space for expansion**, while sealers **prevent entry of unwanted materials** and **ensure watertightness**. Proper design, material selection, and maintenance of joint fillers and sealers are crucial for long-lasting pavement performance.

18.2 Types of Joints in Concrete Pavements

Before understanding fillers and sealers, it's important to know the different types of joints in concrete pavements:

- **18.2.1 Expansion Joints**: Allow for thermal expansion of concrete.
- **18.2.2 Contraction Joints**: Control the location of cracking due to shrinkage.
- **18.2.3 Construction Joints**: Placed where construction is stopped and continued later.
- **18.2.4 Warping Joints**: Account for warping and curling of slabs due to temperature gradients.

18.3 Joint Fillers

18.3.1 Definition and Function

Joint fillers are **compressible materials** inserted in the joint gap to accommodate the **expansion of concrete slabs**. They remain in place throughout the pavement's life, absorbing compressive forces without disintegrating.

18.3.2 Desirable Properties of Joint Fillers

- High compressibility

- Recovery after compression
- Resistance to extrusion
- Durability under environmental conditions
- Non-absorbent or low water absorption
- Resistance to rot or biological degradation

18.3.3 Common Materials Used as Joint Fillers

- **Bituminous Premoulded Fillers**: Made from bitumen and fibers, common in India.
- **Cork**: Natural, compressible, and durable.
- **Sponge Rubber or Foam Sheets**: Light, easy to install, and highly compressible.
- **Cellulose Fiberboard**: Impregnated with bitumen for waterproofing.
- **Expanded Polystyrene (EPS)**: Lightweight and resilient.

18.3.4 Installation Techniques

- Should be placed vertically, flush with slab edges.
- Care must be taken to avoid gaps or misalignments.
- Should cover the full depth of slab (or as per design).
- Bond breakers may be used to avoid adhesion with concrete.

18.4 Joint Sealers

18.4.1 Purpose and Function

Joint sealers are applied to **seal the joint opening** and prevent the ingress of **water, fine particles, sand, and other debris**. They protect the joint from environmental attacks and mechanical damage.

18.4.2 Functions of Sealants

- Prevent water seepage into the sub-grade
- Allow joint movement due to temperature changes
- Resist ingress of incompressibles
- Minimize spalling at joint faces
- Reduce noise from joint impact

18.4.3 Classification of Joint Sealants

(a) Based on Application Type

- **Hot-poured Sealants**: Bitumen-based or rubberized asphalt, heated before application.
- **Cold-poured Sealants**: Polysulfide, silicone, polyurethane – applied without heating.

(b) Based on Material Behavior

- **Elastomeric Sealants**: Flexible, stretchable, and return to original shape.
- **Plastomeric Sealants**: Non-elastic but can deform under load.

18.5 Requirements of Ideal Joint Sealants

- Good adhesion to concrete
- High elasticity and extensibility
- Low modulus to accommodate joint movement
- Durability against UV rays, weather, oil, and chemicals
- Resistance to aging and embrittlement
- Easy to apply and maintain

18.6 Comparison: Hot-Poured vs Cold-Poured Sealants

Property	Hot-Poured Sealants	Cold-Poured Sealants
Application Temperature	High (150–200°C)	Ambient
Flexibility	Lower	High
Cure Time	Immediate after cooling	Requires curing (few hours)
Shelf Life	Short (once heated)	Long (pre-mixed in tubes)
Durability	Moderate	High
Cost	Low	Comparatively higher

18.7 Sealant Installation and Construction Practices

18.7.1 Joint Preparation

- Clean and dry joint faces using air blasting or sandblasting.
- Remove laitance and loose materials.
- Apply primer (if recommended by sealant manufacturer).

18.7.2 Backer Rod Placement

- A compressible backer rod (usually polyethylene foam) is inserted into the joint.
- Prevents sealant from bonding at the base.
- Controls sealant depth and provides correct geometry.

18.7.3 Sealant Application

- Ensure uniform depth and proper tooling.
- Avoid air entrapment.
- Follow manufacturer's temperature and humidity guidelines.

18.8 Design Considerations for Joint Sealing

- **Joint spacing and width**: Affects the movement range and sealant type.
- **Movement capacity**: Sealant must accommodate designed expansion/contraction.
- **Traffic load**: Heavy traffic demands more durable and elastic sealants.
- **Environmental exposure**: UV, water, and chemical exposure should be accounted for.

18.9 Failure of Joint Sealants: Causes and Remedies

18.9.1 Causes

- Poor joint surface preparation
- Incompatible sealant material
- Incorrect sealant depth/geometry
- Thermal or mechanical overloading
- Premature exposure to traffic

18.9.2 Remedies

- Replacing failed sealant after cleaning joint.
- Using correct backer rods and primer.
- Ensuring correct curing time before traffic opening.
- Periodic inspection and maintenance.

18.10 Recent Advances in Joint Sealants and Fillers

- **Polymeric sealants** with longer service lives.
- **Self-healing materials** that close minor cracks automatically.
- **Pre-formed compression seals** that don't require adhesives.
- **Nano-modified bituminous fillers** for better aging resistance.

18.11 Maintenance of Joint Seals in Concrete Pavements

- **Visual inspection** at regular intervals for cracking, debonding, or extrusion.
- **Cleaning and resealing** in case of deterioration.
- **Sealant replacement** after typical service life (5–10 years depending on traffic).
