

Pavement Distress

- HMA and all other paving materials, is subject to a variety of distresses – A Usual phenomena
- As pavements approach their design life, distresses are expected to occur as a result of the environment and repeated traffic loads
- Causes of Distress identified e.g. Rutting could be occurred in a HMA surface due to:
 - unstable mixes
 - consolidation under traffic loading, or higher wheel loads or tire pressures than those considered in design
- Appearance of the problem at surface may be the same; however, the solution for each cause may be different.
- Cause of the problem must be identified for Effective Remedial action

Pavement Distress - Definitions

- **Distress** is a condition of the pavement structure that reduces serviceability or leads to a reduction in service life
- **Distress Manifestations** are the visible consequences of various distress mechanisms, which usually lead to a reduction in serviceability
- **Structural Failure** is a fracture or **Distortion** that may or may not cause an immediate reduction in serviceability but leads to a future loss of serviceability
- **Fracture** is the state of a pavement material that is breaking

Flexible Pavement Distresses



Alligator Cracking

(Chicken-wire cracking; Spiderweb cracking, etc.
Indicative of Fatigue Failure of Pavement)

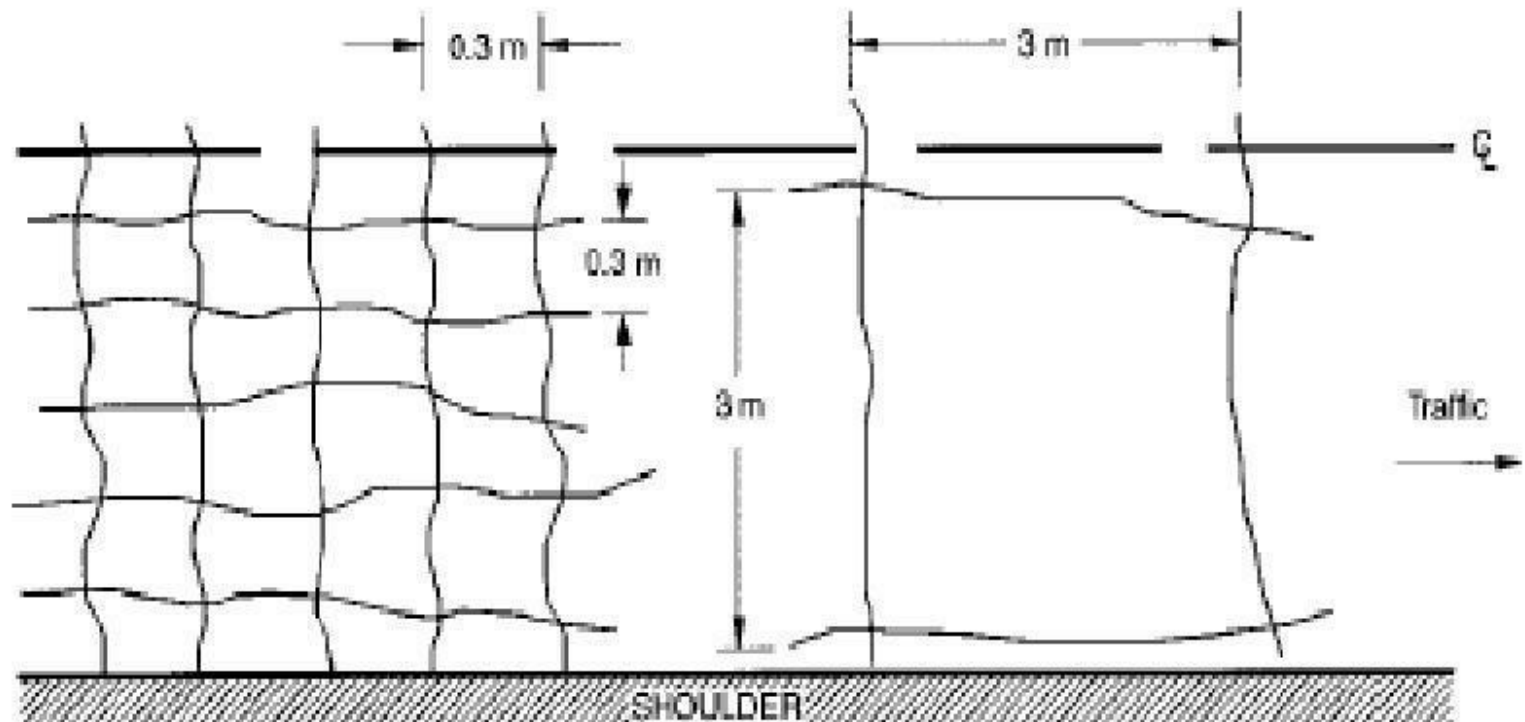
Flexible Pavement Distresses

- Pavement surface is divided into rectangular pieces with sides longer than one foot
- Possible causes: Shrinkage of asphalt



Block Cracking

Flexible Pavement Distresses



Block Cracking

Flexible Pavement Distresses



Reflection Cracking

Cracking of overlying AC layer due to PCC joint beneath

Flexible Pavement Distresses

- Cracking across the centerline, not due to reflection cracking
- Possible causes: Expansion and contraction of pavement material, roadbed settlement, poorly constructed paving joints

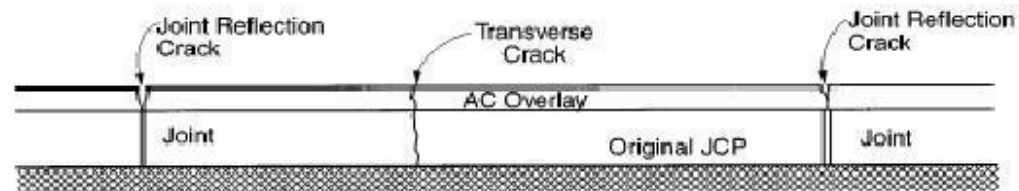


Transverse Cracking

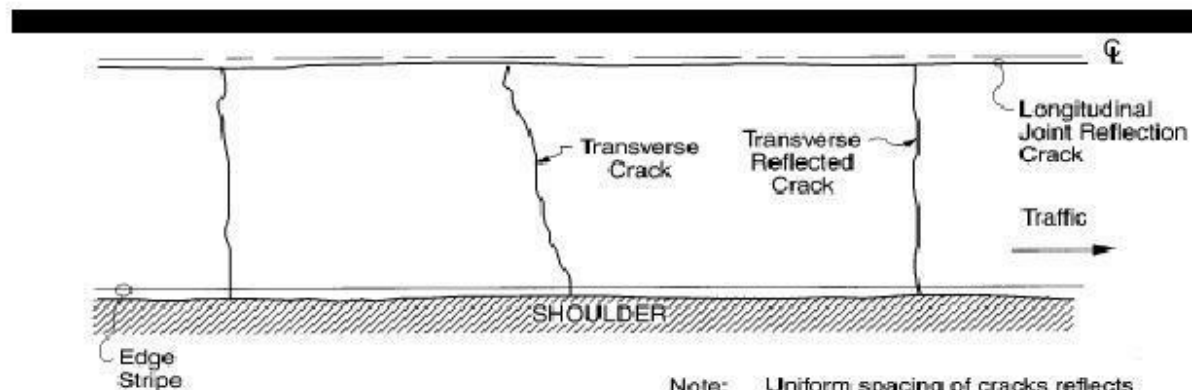
Cracking across the centerline, not due to reflection cracking

Flexible Pavement Distresses

Longitudinal section



Plan view



Note: Uniform spacing of cracks reflects the spacing of underlying joints.

Reflection Cracking

Cracking of overlying AC layer due to PCC joint beneath

Flexible Pavement Distresses - Causes of Cracks

- Fatigue/ Surface Stresses
- Thermal
 - Concrete, flexible, and composite pavements
- Lack of bearing support
 - Under-design, poor drainage, or settlement
- Existing discontinuities
 - Cracks, joints, widening

Flexible Pavement Distresses



- Surface is wearing away from dislodging of aggregate particles (raveling), or traffic has abraded surface over a period of time (surface wear)
- Possible causes: Insufficient binder (Adhesion Problem), poor gradation (Cohesion Problem), topsize aggregate too large for layer thickness, poor compaction

Raveling

Flexible Pavement Distresses



- Bowl-shaped depressions in which pavement material has been broken up and removed
- Possible causes: Traffic loads over weakened spots in surface pavement or in underlying material

Pothole

Flexible Pavement Distresses



Pothole

Flexible Pavement Distresses



The Ultimate Pothole!

Flexible Pavement Distresses



or, ... Sinkhole!

Flexible Pavement Distresses



Flexible Pavement Distresses

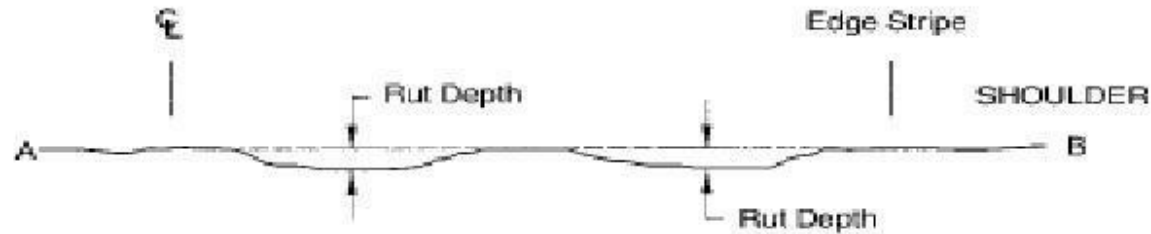


Pothole?

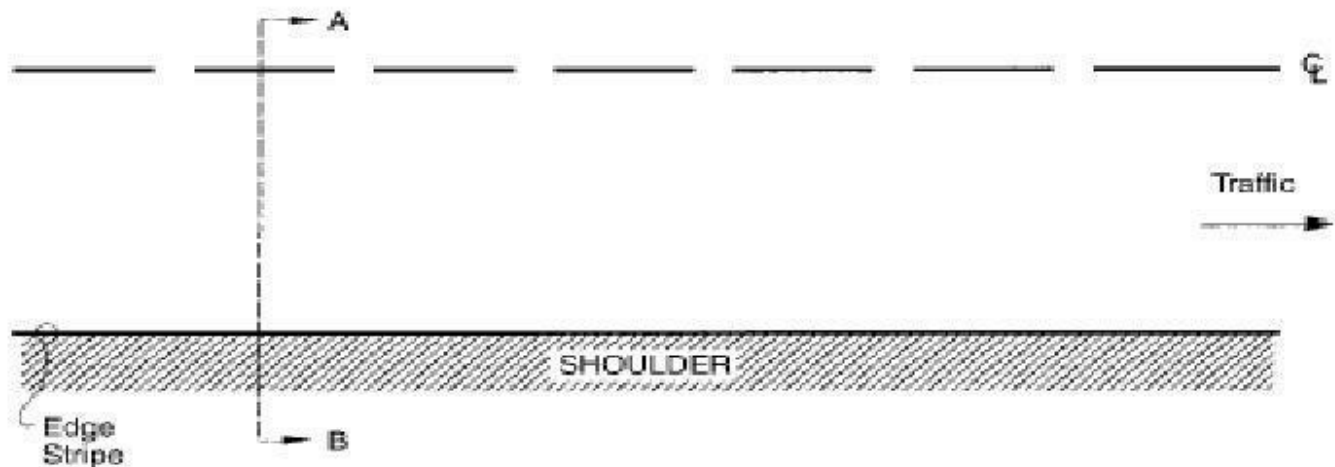
No. Just a speed reduction device!

Flexible Pavement Distresses

Longitudinal
cross section
A-A

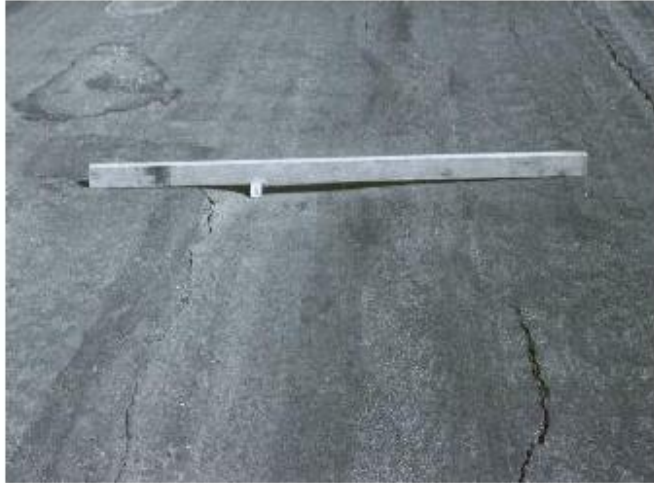


Plan view



Rutting

Flexible Pavement Distresses



- Depression in the wheel path of traveling vehicles
- Possible causes: Pavement base inadequate for maintaining traffic loads and/or the wearing away of surface material resulting from tire friction

Rutting

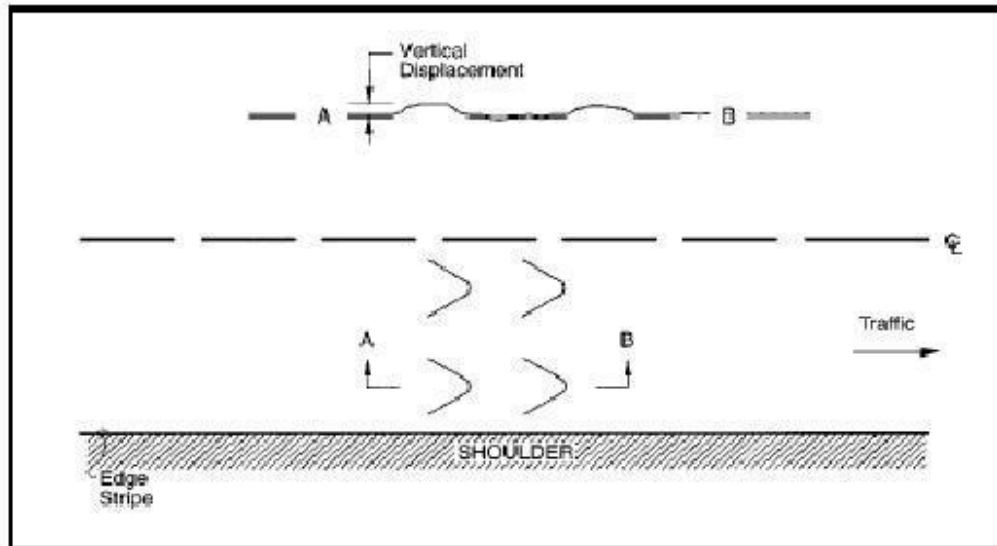
Flexible Pavement Distresses



Rutting

Standing water in rut troughs; Danger of Hydroplaning

Flexible Pavement Distresses



- Corrugations, Shoving, Slippage: Plastic movement typified by ripples across surface (corrugations), bumps formed on downstream side of traffic tire forces (shoving), and crescent- or half-moon- shaped cracks usually occurring at braking or turning locations (slippage)
- Possible causes: Surface course too soft or too weakly bonded with base to resist horizontal pressure of traffic moving across it, Unstable roadbed or subgrade. Frost heaves. Patching that is starting to deteriorate.

Shoving

Flexible Pavement Distresses



Shoving

Flexible Pavement Distresses



**Variety of
distresses**

Rigid Pavement Distresses



Cracking

Rigid Pavement Distresses

Durability cracking is series of closely spaced, crescent-shaped cracks near a joint, corner or crack

It is caused by freeze-thaw expansion of the large aggregate within the PCC slab
Some roughness, leads to spalling and eventual slab disintegration

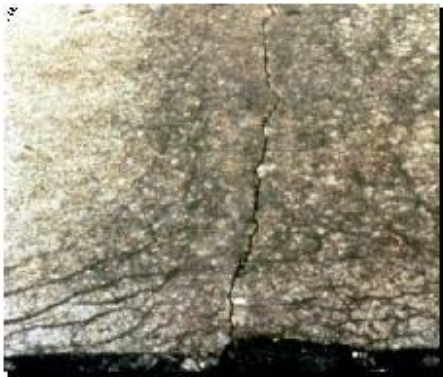
Possible Causes: Freeze-thaw susceptible aggregate.



D-cracking

D-Cracking

- Causes:
 - Poor quality aggregate
 - Freeze/thaw cycle
- Cures:
 - Temporary:
 - Partial depth asphalt patch
 - Permanent:
 - Full-depth repair



Transverse Cracking

■ Causes:

- Slab longer than 15'
 - Slab Curl
 - Curing

■ Cures:

- Crack Sealing
- Full-depth rigid repair
- Dowel bar retrofit



Longitudinal Cracking

- Causes:
 - Waiting too long to cut center joint
 - Subsoil settlement



- Cures
 - Joint Sealing
 - Full Depth replacement
 - Subsurface stabilization



Rigid Pavement Distresses

Popouts usually occur as a result of poor aggregate durability

Causes:

Poor aggregate freeze-thaw resistance

Alkali-aggregate reactions



Pop-outs

Rigid Pavement Distresses



Pothole

Rigid Pavement Distresses



Pothole

Shallow Reinforcing

■ Cause:

- Reinforcing Steel too close to surface

■ Cure:

- Asphalt overlay or patch
- Replacing steel & partial or full depth repair



Rigid Pavement Distresses

Crack intersects the PCC slab joints near the corner. Caused by high corner stresses

Roughness, moisture infiltration, severe corner breaks fault, spall and/ or even disintegrate

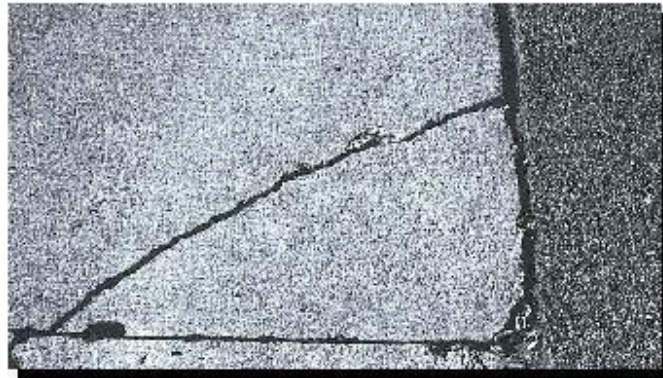
Possible Causes: Severe corner stresses caused by load repetitions combined with a loss of support, poor load transfer across the joint, moisture infiltration etc.



Corner Breaks

Corner Cracking

- Causes:
 - Insufficient soil support
 - Temperature related
- Cures:
 - Partial or full-depth patch
 - Replace slab
 - Stabilize subsurface



Rigid Pavement Distresses



A difference in elevation across a joint or crack usually associated with undoweled JPCP.

Faulting

Faulting

- Causes:
 - End-result of pumping
 - Eroded subsoil
- Cures:
 - Full-depth rigid repair
 - Undersealing
 - Dowel bar retrofit
 - Grinding



Rigid Pavement Distresses

Cracking, breaking or chipping of joint/crack edges.

Loose debris on the pavement due to Excessive stresses at the joint/crack caused by infiltration of incompressible materials and subsequent expansion

Caused when low quality PCC is used to fill in the last bit of slab volume or dowels are improperly inserted.

Misalignment or corroded dowel.



Severe Scaling and Spalling

Rigid Pavement Distresses



Scaling

Scaling

- Causes:
 - Non-air-entrained concrete
 - De-icing chemicals
 - Improper finishing technique
- Cures:
 - Grinding
 - Asphalt overlay
 - Bonded resurfacing
 - Partial depth patch



Rigid Pavement Distresses

Description: Cracking, breaking or chipping of joint/crack edges. Usually occurs within about 0.6 m (2 ft.) of joint/crack edge

Problem: Loose debris on the pavement, roughness, generally an indicator of advanced joint/crack deterioration

Possible Causes:

- Excessive stresses at the joint/crack caused by infiltration of incompressible materials and subsequent expansion (can also cause blowups).
- Disintegration of the PCC from freeze-thaw action or "D"

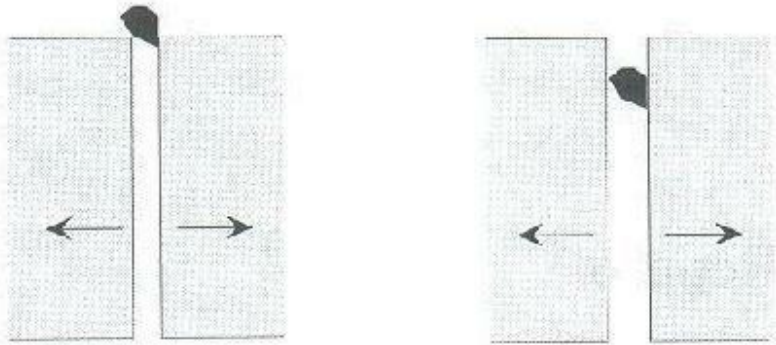


Spalling

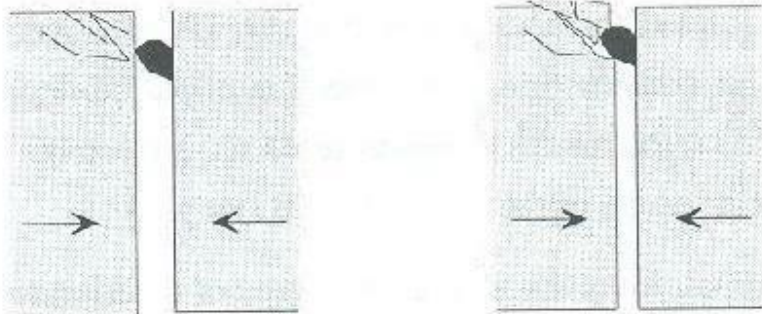
cracking.

- low quality PCC is used to fill in the last bit of slab volume or
- dowels are improperly inserted.
- Misalignment or corroded dowel.
- Heavy traffic loading.

Rigid Pavement Distresses



- a. Slabs contract during cooler temperatures, the joint expands, and incompressible materials enter the joint.



- b. Slabs expand during warmer temperatures and joint contracts. Incompressibles in the joint cause compressive stresses that result in cracking and spalling.

Spalling

Transverse Joint Spalling

- Causes:
 - Improper dowel alignment
 - Lack of joint seal
 - Incompressibles in joint
- Cures:
 - Crack & Joint Seal
 - Bonded Patching
 - Full-depth patching



Rigid Pavement Distresses



Decreased skid resistance



Causes: Repeated traffic applications. Generally, as a pavement ages the protruding rough, angular particles become polished. This can occur quicker if the aggregate is susceptible to abrasion or subject to excessive studded tire wear

Polished Aggregate

Wear & Polishing

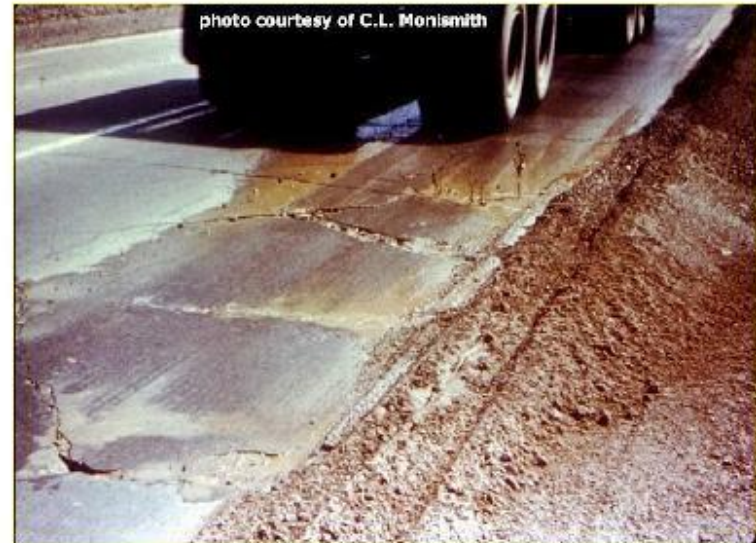
- Causes:
 - Traffic wears off surface aggregate
- Cures:
 - Grinding
 - Asphalt Overlay



Rigid Pavement Distresses

Movement of material underneath the slab or ejection of material from underneath the slab as a result of water pressure

Move from underneath one slab to underneath an adjacent slab. This type of movement leads to faulting.



Pumping

Pumping

- Causes:
 - Water
 - Fines
 - Lack of load transfer
 - Loading
- Cures
 - Under sealing
 - Dowel bar retrofit
 - Full depth rigid repair
 - Concrete pavement grinding



Rigid Pavement Distresses

Blow-ups



are caused by expansion of concrete to the point where the stress causes the concrete to be raised. This can result in a problem ranging from a small bump to a shattering of concrete as if an explosion occurred

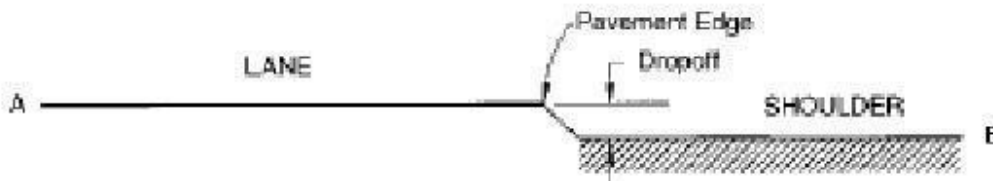


Blowups

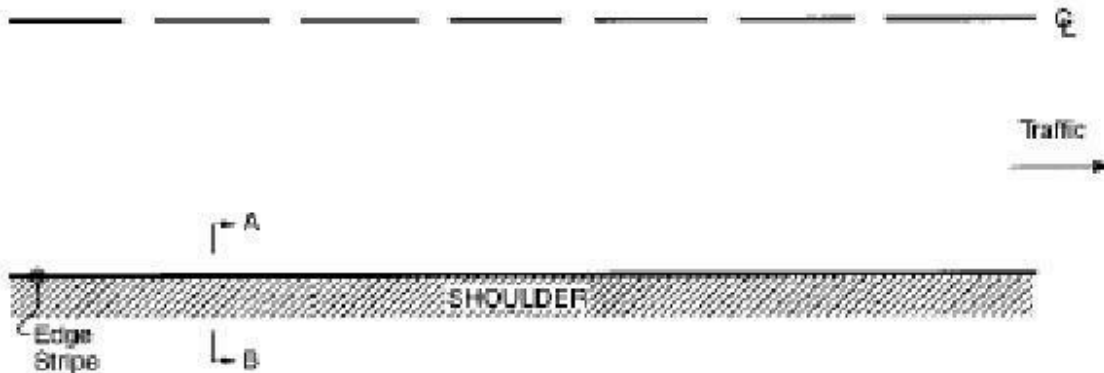
- Causes:
 - Expansion of concrete
 - Poorly sealed joints
 - Hot weather
- Cures:
 - Pressure relief joints to prevent
 - Patch or reconstruction after occurrence



Distresses Common to All Pavement Types



Longitudinal cross section



Plan view

Lane-to-Shoulder Drop Off