Department of Transport and Main Roads

Guide to the

Visual Assessment of Pavements

Engineering and Technology

Queensland Government

The *Guide to the Visual Assessment of Pavements* is provided as a pocket resource to assist in identifying:

- pavement performance issues
- possible causes and modes of pavement distress or failures.

The following factors may also have a bearing on the performance of the pavement:

- geology, topography and climate
- road geometry and cross-section
- site constraints
- drainage
- underground services
- inspection of sprayed seals.

Completing an assessment?

Don't forget:

- ☐ Defect mapping template
- ☐ Measuring wheel
- ☐ Straight edge
- ☐ Smart level
- ☐ Wedge (to measure ruts)
- ☐ Tape measure
- ☐ Camera
- ☐ Pencils

Work Safe, Home Safe

Out on site?
Consider the following:

Zeroharm atWork

- ☐ Project/site safety plan
- ☐ Risk assessments
- ☐ Work method statements
- ☐ Safety equipment
- ☐ PPE for day/night
- ☐ Traffic control crew
- ☐ Approval from relevant Region
- ☐ Approved traffic management plans
- ☐ Traffic managment centre notifications
- ☐ Induction/tool box talk
- ☐ Stop, Think, Go behaviours

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In this guide, pavement performance issues will be categorised as ‘cracks’ and ‘other defects.’

Bituminous surfaces

Cracks

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Other defects

Deck Wearing Surfaces

Cracks

Other defects

References

Block cracks (CB)

Multiple interconnected cracks that appear approximately rectangular in shape.

The respective size and shape of the blocks generally indicates the size of the joints within the base layer.

Assessment Criteria

- Predominant width of crack (mm)
- Area affected (m2)

Possible causes

- Reflective cracking due to joints in underlying layer (cemented materials).
- Shrinkage and cracking of the underlying bound (cemented) layer.
- Asphalt shrinkage and cracking due to its inability to expand and contract with daily temperature cycles.

Crescent shaped crack (CC)

Crescent shaped cracks that can commonly occur parallel to another in closely spaced groups.

Assessment Criteria

- Predominant width of cracks (mm)
- Area affected (m2)

Possible causes

- Wearing course has poor bond with underlying layers. Low modulus course layers.
- Insufficient wearing course thickness.
- Asphalt has been dragged by paver screed during laying.
- Turning, braking and / or acceleration movement induced stresses.

Crocodile crack (CR)

Generally small irregularly shaped polygons that resemble crocodile skin.

Begins as longitudinal cracks within the wheel path that progress with time and loads to a more branched, interconnected series of small polygons that are generally less than 150 mm in size.

Assessment Criteria

- Predominant width of crack (mm)
- Area affected (m2)

Possible causes

- Inadequate pavement layer thickness.
- Asphalt base or wearing course has become brittle with age.
- Weakness in the surface, base or sub-grade.
- Poor drainage.

Diagonal crack (CD)

Unconnected cracks that travel diagonally across the direction of traffic.

Assessment Criteria

- Predominant width of crack (mm)
- Length (m)
- Area affected (m2)

Possible causes

- Surface layer shrinkage.
- Reflection of shrinkage cracking from the underling bound layer.
- Differential settlements between embankments, cuts, structures, etc.
- Intrusion of tree roots.
- Installation of various services.

Longitudinal crack (CL)

Cracks that run longitudinally/parallel with the direction of traffic.

These cracks can occur as singular or as a series of parallel cracks.

Some branching may occur.

Assessment Criteria

- Width of dominant crack (mm)
- Length of dominant crack (m)
- Spacing (mm)
- Area affected (m2)

Possible causes

Occurring individually

- Reflection of a shrinkage crack or joint in an underlying cemented base.
- Incorrectly constructed joint in asphalt surfacing.
- Reflection of pavement joints associated with road widening.
- Displacement of joint at pavement widening.

Occurring as a series of almost parallel cracks

- Volume change of expansive clay subgrade.
- Cyclical weakening of pavement edge.
- Differential settlement between cut and fill.
- Reflection of cracks in underlying cemented sub-base.

Longitudinal cracking with differential settlement (CLDS)

Severe series of parallel longitudinal cracks.

Cracking gaps are commonly greater than 10 mm.

Commonly occurs on pavement on embankments that are greater than 5 m in height.

Assessment Criteria

- Predominant width of crack (mm)
- Length of crack (m)
- Area affected (m2)

Possible causes

- Slip failure of the embankment.
- Differential settlement at the joint between new and old embankment in pavement widening resulting in crack propagation.
- Weak fill or subgrade material.

Note

- For these type of failures, a Geotechnical Engineer should be consulted for recommendations.

Meandering crack (CM)

Singular, unconnected crack that varies in direction.

Assessment Criteria

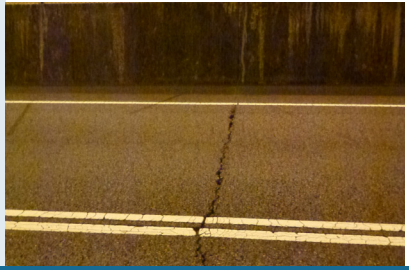
- Predominant width of crack (mm)
- Length of crack (m)
- Area affected (m2)

Possible causes

- Reflection of shrinkage cracks from underlying bound pavement base material.
- Differential settlement associated with embankments, cuts, adjacent structures and / or underground services.
- Intrusion of tree roots or moisture into the pavement.

Transverse crack (CT)

Unconnected cracks travelling perpendicular to the direction of traffic.



Assessment Criteria

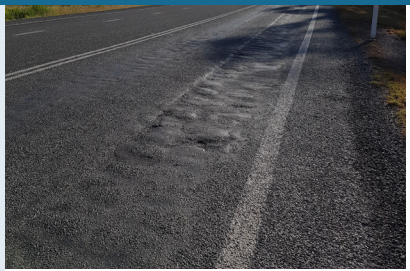
- Predominant crack width (mm)
- Spacing between parallel cracks(m)
- Length (m)
- Area affected (m2)

Possible causes

- Construction joint, contraction or shrinkage of the surfacing layer.
- Reflection of shrinkage cracks or joints from underlying bound pavement base material.
- Settlement due to underground structure or service.

Corrugations (DC)

Ripples – transverse undulations in the pavement surface or base, closely and regularly spaced, with wave lengths ranging between 0.3 m and 2 m.



Assessment Criteria

- Maximum depth under 1.2 m straight edge (mm)
- Crest to crest spacing (mm)
- Length of pavement affected (m)

Possible causes

- Inadequate quality of material to resist heavy vehicle loading.
- Irregular compaction of base and/or other defective work practices.
- Bonding between layers is poor.
- Inadequate stability of asphalt base or surfacing layer.

Delamination (SD)

The upper wearing surface has been stripped or removed and exposing the lower layer.

Assessment Criteria

- Thickness of layer(s) removed (mm)
- Area (typical) of individual defects (m2)
- Number of defects

Possible causes

- Insufficient cleaning or tack coat before installation of upper surfacing layer has resulted in poor bond between both the surfacing and lower layers.
- Traffic action and/or water seepage has weakened the bond between the surfacing layer and the lower layer.

Depressions (DD)

Localised depressions and concaving bulges along the pavement surface.

Depressions are not always located along wheel paths but can also extend along the entirety of a lane's width.

Can be clearly identified in wet weather, as depressions collect and fill with water.

Assessment Criteria

- Maximum depth under 1.2 m straight edge (mm)
- Area of depression (m2)

Possible causes

- Settlement of service and widening trenches.
- Isolated sections of soft or insufficiently compacted subgrade or embankment.
- Volume alteration of subgrade materials due to environmental influences (e.g. drying out due to trees or change in moisture content of expansive soil).
- Settlement of embankment or subgrade.

Edge Break (EB)

Edge of bituminous surface has become fretted, broken or irregular.

Assessment Criteria

- Maximum width of surfacing loss (mm)
- Length over which break occurs (m)

Possible causes

- The road alignment and/or pavement width are inadequate which results in vehicles travelling along the edge of the pavement.
- Shoulder has become eroded due to water and/or wind.
- Inadequate edge support.
- Loss of adhesion to base.
- Weak seal coat.

Edge Drop-off (ED)

The vertical distance from the surface of the seal at the edge, to the surface of the shoulder.

Not usually considered a defect if the drop-off is less than 10 to 15 mm.

Assessment Criteria

- Height of drop (mm)
- Length affected (m)

Possible causes

- The road alignment and/or pavement width are inadequate which encourages drivers to travel along the edge of the pavement.
- Shoulder material has insufficient erosion and abrasion resistance.
- The shoulder has not been resurfaced during resurfacing of the pavement.

Flushing (SF)

Pavement surface layer contains an excess amount of bitumen, which results in patches.

These patches have inadequate tyre-to-stone contact which lowers the skid resistance.

Assessment Criteria

- Area affected (m2)
- Percentage (by area) stone immersed (%)

Possible causes

- Excessive application rate of binder in regards to stone size.
- Excessive prime coat in the seal.
- Underlying patched or flushed area has excessive binder.
- Aggregate has penetrated into the soft surface of the base material.
- Inappropriate asphalt mix design (e.g low air voids, high binder content, or low stiffness for traffic conditions).

Patch (PA)

An area of pavement surface where the original has been replaced.

Expedient patches (PE) are identified as irregularly sided, usually small patches (a few square metres or less).

Reconstruction patches (PR) are usually straight sided.

Expedient Patch

Reconstruction Patch

Assessment Criteria

- Area of individual patch (m2)
- Number of patches in area under consideration

Possible causes of expedient patches (PE)

- Inadequate compaction may lead to further deformation and distress.
- Repair of surface deficiencies.

Possible causes of reconstruction patches (PR)

- Reconstruction of pavement deficiencies, within surface course, pavement or subgrade.
- Excavation required for services.

Polishing (SP)

The upper surface of the roadstone has become smoothed and rounded.

Usually occurs along the wheel paths.

Identified by the difference in texture and appearance of the trafficked and un-trafficked sections of the pavement.

Polished areas feel smooth and appear shiny.

Assessment Criteria

- Area affected (m2)

Possible causes

- Surface aggregates have poor resistance to polishing, especially in areas where heavy traffic movements occur.
- Naturally smooth and uncrushed aggregates (e.g. water-worn gravel) have been used.

Pothole (HO)

Varying sized, bowl-shaped cavity in the pavement surface that extends into wearing surface, base layers and/or subgrade layer.

The dynamic nature of heavy vehicle axles can often cause a rapid increase in the size of potholes, and/or create a series of potholes along a length of wheelpath.

Assessment Criteria

- Depth of pothole (mm)
- Area of pothole (m2)
- Number of potholes

Possible causes

- Loss of surface course as a result of cracking being left untreated.
- Cracked surface has allowed entrance of water into pavement layers.
- Heavy loading has disintegrated the base.
- Binder adhesion to tyres has damaged and/or lifted the surfacing layer.

Pumping water and stains (DR)

Seepage that has emerged through pavement cracks.

Fines have been carried from the base, subbase(s) and/ or subgrade to the pavement surface.

After the water has ceased the fines then stain the pavement, also known as pumping stains.

Pumping water

Pumping stains

Assessment Criteria

The severity of this defect cannot be determined by a visual inspection. Early intervention and testing are recommended to assess the severity of the issue.

Possible causes

- Underlying services (Water mains) have begun to leak.
- Water has infiltrated the pavement through wet subgrades, adjacent cuttings, poor pavement drainage, or cracked / permeable surfacing.
- Vehicle loading has induced a pumping affect which moves the pavement fines to the pavement surface using water as the medium.

Ravelling (SR)

Progressive disintegration of the pavement surface due to the loss of both binder and aggregates.

Assessment Criteria

- Area affected (m2)

Possible causes

- Poor adhesion between the asphalt and aggregate.
- The stone and/or binder has deteriorated.
- Dusty, hydrophilic, wet and/or dirty aggregates have been used.
- Inadequate asphalt mix design.
- Inadequate compaction.
- Construction during wet or cold weather.

Rutting (DR)

Channelised depressions that are located along wheel paths and commonly found in long sections.

Assessment Criteria

- Maximum depth (under a transverse 1.2 m straight edge) (mm)
- Length (m)

Possible causes

- Pavement age.
- Consistent overloaded vehicles and/or heavy vehicles.
- Inadequate pavement layer thickness.
- The surfacing or base layers have been incorrectly compacted.
- The surfacing or base layers have insufficient strength.

Shoving (DS)

Swells, bulges and horizontal deformations that have developed mainly in the direction of traffic where braking or acceleration movements occur.

Shoving can also occur in locations where there are high horizontal shear stresses i.e. roundabouts.

Assessment Criteria

- Maximum depth of bulge under 1.2 m straight edge from high point (mm)
- Area affected (m2)

Possible causes

- Poor compaction resulting in the surfacing and/or base layers to have inadequate strength.
- Inadequate pavement thickness.
- Poor bond between pavement layers.
- Pavement lacks containment/ waterproofing.
- Fuel/oil spillage has caused localised softening of asphalt binder.

Stripping (SS)

Scabbing, pop-outs, loss of coarse aggregate from a sprayed seal.

Can occur as loss of individual stones, or as the complete loss of stone in a localised area.

Loss of bond between aggregates and binder in lower asphalt layers (stripping in asphalt surface is refered as ravelling).

Assessment Criteria

- Area affected (m2)
- Percentage of stone throughout affected area (%)

Possible causes

- Low binder contents.
- Poor adhesion between cover aggregate and binder, due to dirty /dusty aggregate, wet aggregate, and/or insufficient precoating agent coverage on the aggregate.
- Aging or absorption of binder.
- Stone deterioration.
- Incorrect mix design.
- Inadequate rolling before opening the seal to traffic.

Block cracks (CB)

Multiple cracks that form a series of blocks.

Commonly distributed over the entire pavement.

Assessment Criteria

- Predominant crack width (mm)
- Area affected (m2)

Possible causes

- Combined effect of traffic loading and loss of support over time.
- The support within the sub-base or subgrade layer has been lost.
- Settlement of the subgrade.
- Insufficient slab thickness.

Corner crack (CN)

A singular crack that connects diagonally between a longitudinal edge and a transverse joint near the corner.

Assessment Criteria

- Crack width (mm)
- Crack length (m)
- Number of slabs affected

Possible causes

- Combined effect of traffic loading and loss of support overtime.
- Loss of subgrade or subbase support.
- Settlement of the subgrade.
- Insufficient slab thickness.

Diagonal crack (CD)

A singular, unconnected crack diagonally across a pavement/slab.

Assessment Criteria

- Crack width (mm)
- Crack length (m)
- Number of slabs affected

Possible causes

- During curing, the slab has shrunk due to excess length in the slab or the contraction joints have been sawn too late.
- Settlement.
- Insufficient slab thickness.
- The slab has been rocking.

Longitudinal crack (CL)

Cracks that run parallel with the direction of traffic.

These cracks can occur as singular cracks or as a series of parallel cracks.

Some branching may occur.

Assessment Criteria

- Crack width (mm)
- Crack spacing (mm)
- Crack length (m)
- Area affected (m2)

Possible causes

- Combined effect of traffic loading and loss of support.
- Differential settlement.
- Excessive slab width has caused lateral shrinkage.
- The longitudinal joints are located too close within the wheel paths.
- Insufficient slab thickness.

Plastic shrinkage crack (CP)

Individual or series of cracks that are spaced 50 – 500 mm apart.

The orientation of the cracks can be either transverse, diagonal or longitudinal.

Formed prior to concrete setting and are visible after the finishing of the concrete.

Assessment Criteria

- Crack width (mm)
- Crack depth (mm)
- Crack length (m)
- Number of slabs affected

Possible causes

- The shrinkage strains in the concrete exceeded the tensile strength during the hydration process.
- Concrete has been dragged by screeder during placement.
- Slight downhill movement on steeper crossfall or gradient.
- Poor reinforcing steel design.
- Improper curing technique.

Meandering crack (CM)

Irregularly winding crack that is unconnected and commonly singular.

Assessment Criteria

- Predominant width of crack (mm)
- Crack length (m)
- Number of slabs affected

Possible causes

- Shrinkage of slab during curing due to excess slab lengths or the contraction joints have been sawn too late.
- Insufficient slab thickness.
- Rocking of slab.
- Settlement.

Transverse crack (CT)

Unconnected crack travelling transversely across the slab.

Assessment Criteria

- Crack width (mm)
- Crack spacing (mm)
- Crack length (m)
- Area affected (m2)

Possible causes

- Shrinkage cracking.
- Shrinkage of slab during curing, associated with contraction joints being saw cut or due to excessive slab length.
- Insufficient slab thickness.
- Slab rocking.

Faulting (DF)

Differential residual vertical displacement of abutting slabs at joints and cracks creating a 'step' deformation.

Pumping of fines often occurs with faulting.

The pumping action may cause the approach slab to be higher in elevation than the departure slab.

Assessment Criteria

- Difference in elevation 9 mm across the joint or crack
- Number of slabs affected

Possible causes

- Slab settlement.
- Slabs have become warped, curled due to temperature changes.
- Insufficient subbase and subgrade support.
- Subgrade volume changes.
- Fines within the sub-base or subgrade have been lost as a result of pumping action.

Joint Seal defects (JD)

Loose material entering joints due to the loss, stripping and/or cracking of the joint's seal.

Assessment Criteria

- Percentage (by length) of joint affected

Possible causes

- Sealant has become aged and weathered.
- The sealant has been incorrectly prepared i.e. overheating of poured sealant and/or the sealant is poor quality.
- Poor adhesion of sealant to joint wall.
- Poor cyclic tension and compression properties.
- Joint contains an excess of sealant.
- The sealing joint is incorrectly shaped.
- Pumping.
- Rocking has ocured.

Patch (PA)

Localised area that has been replaced with new material for repair purposes.

Assessment Criteria

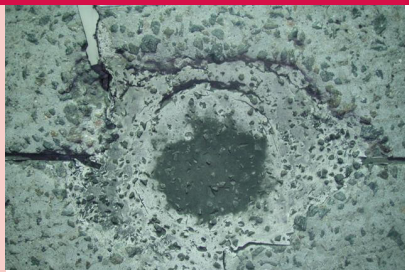
- Area of patch (m2)
- Number of patches (m)

Possible causes

- Repair of structural or surface deficiencies.
- Patched after excavations for services.
- Sections of deteriorated slab has been removed and patched.

Pothole (HO)

Depression or broken part of the slab that is roughly bowl shaped.



Assessment Criteria

- Depth of hole (mm)
- Area of pothole (m2)
- Number of potholes

Possible causes

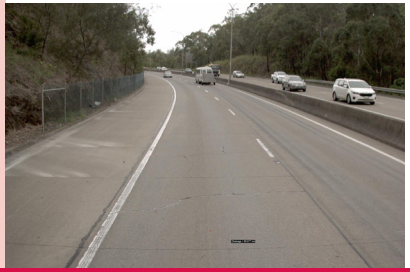
- Indication that the reinforcement has been placed too close to the surface.
- Moisture ingress into pavement cracks.
- Localised poor quality or disintegrated concrete.

Pumping water and stains (DP)

Seepage that emerges through pavement cracks.

Fines have been carried from the base, subbase(s) and/ or subgrade to the pavement surface.

After the water has ceased the carried fines stain the pavement, resulting in pumping stains.



Attributes

The severity of this defect cannot be determined by a visual inspection. At a later stage, voids or weak spots may develop within the granular or subgrade layers, as more fines are pumped out. This will affect the pavement strength and integrity. Early intervention and testing are recommended to assess the severity of the issue.

Possible causes

- Excessive moisture in sub-base (water infiltration through crack or joint or poor subsurface drainage) in combination with a water sensitive sub-base with a high fines content.

Rocking (DK)

Dynamic phenomenon where vertical movement occurs at a joint or crack due to live traffic loads.

Assessment Criteria

- Magnitude of movement caused by the passage of a standard axle – cannot usually be quantified

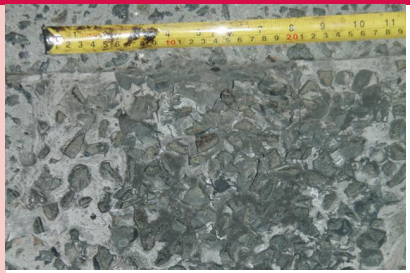
Possible causes

- Ingress of water and pumping of fines.
- Inadequate sub-base/subgrade support.
- Differential support under adjacent slabs.
- Excessive curling / warping of the slabs.

Skidding (SK)

Surface appears polished, rounded and glassy.

Inadequate skid resistance (micro texture) and surface roughness (macrotexture).



Assessment Criteria

- Length of road affected (m)

Possible causes

- Naturally polished aggregate.
- Spillages and detritus.
- Curing compound in microtexture.
- Poor construction finishing.
- Low-strength mortar worn from surface by traffic.

Spalling (LL)

Disintegration, breakdown, cracking or chipping at joint, or crack edges.

Assessment Criteria

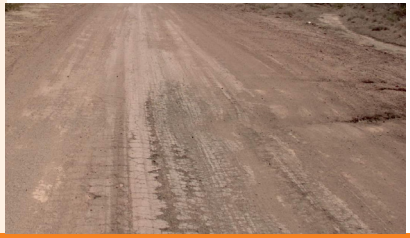
- Maximum depth of spall (mm)
- Length of joint or edge affected (m)

Possible causes

- Severe corner stresses have been created due to load repetition, combined with loss of support, and poor load transfer across the joint.
- Reinforcing and/or dowel bars have become corroded.
- Dowel bars are misaligned.
- Movement in the sub-base.
- Poor quality concrete aggregate.

Channel (DN)

Linear feature that is irregularly sided, steep and commonly occurs in the direction of wheel path or maximum slope.



Assessment Criteria

- Depth of channel (mm)
- Length of road affected (m)

Possible causes

- Surface materials have eroded.
- Rutting, corrugations or inadequate drainage system has allowed flowing water.

Coarse Texture (ST)

Pavement surface has course aggregate or rock (great than 75mm particle size) protruding the surface layer.

Can also contain loose material.

Assessment Criteria

- Projection of aggregate, proud of average pavement surface (mm)
- Area affected (m2)

Possible causes

- Erosion of fines from coarse pavement material.
- The rock subgrade has become exposed.

Corrugations (DC)

Closely and consistently spaced transverse undulations on the surface.

Assessment Criteria

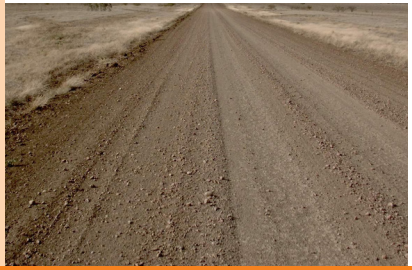
- Maximum depth under 1.2 m straight edge (mm)
- Crest-to-crest spacing (mm)
- Length of pavement affected (m)

Possible causes

- The quality of base material used, is insufficient for the local climate and traffic conditions. Common in dry conditions.

Loose materials (SL)

Surface contains unbound fine and/ or coarse aggregate materials.



Assessment Criteria

- Thickness of loose material (mm)
- Particle type (dust, sand, gravel)
- Length of affected pavement (m)

Possible causes

- Environmental or traffic actions have loosened weakly bound pavement materials.
- Materials have been transported onto or away from the roadway via wind or water.

Pothole (HO)

A cavity that penetrates the pavement layers and is bowl shaped or irregularly shaped.

Assessment Criteria

- Depth (mm)
- Area of pothole (m2)
- Number of potholes

Possible causes

- Collection and pooling of water.
- Moisture or traffic action has weakened the pavement.
- Insufficient initial compaction.

Rutting (DR)

Deformation located at wheel paths that is relatively smoothed and travels longitudinally.

Steep sided ruts are created due to local wet weather.

Assessment Criteria

- Maximum depth under a 1.2 m straight edge (mm)
- Length of pavement affected (m)

Possible causes

- The subgrade or pavement layer has insufficient moisture resistance/wet strength.
- Erosion of surface material.
- Excessive loose material.
- Traffic compaction of pavement or subgrade.

Shoving (DS)

Plastic bulging of surface associated with depression or rutting.

Assessment Criteria

- Depth from high point under a 1.2 m straight edge (mm)
- Area affected (m2)

Possible causes

- Plastic deformation of underlying subgrade.

Crocodile crack (CR)

Generally small irregularly shaped polygons that resemble crocodile skin.

The polygons are often confined to wheel paths and are generally less than 150 mm.

Begin as longitudinal cracks and develop over time into crocodile cracking.

Assessment Criteria

- Predominant width of crack (mm)
- Area affected (m2)

Possible causes

- Insufficient wearing surface thickness.
- Increased heavy vehicle loading has exceeded wearing surface load bearing capacity.
- Wearing course has become brittle with age.

Longitudinal crack (CL)

Cracks that run longitudinally with the direction of traffic.

These cracks can occur as singular or as a series of parallel cracks.

Some branching may occur.

Assessment Criteria

- Width of dominant crack (mm)
- Length of dominant crack (m)
- Spacing (mm)
- Area affected (m2)

Possible causes

- Reflection of a shrinkage crack or joint from an underlying concrete bridge deck unit.
- Incorrectly constructed joint in asphalt surfacing.

Meandering crack (CM)

Singular or group, cracks that vary in direction.

Assessment Criteria

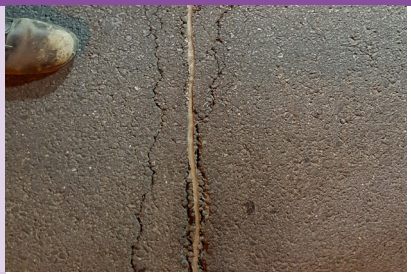
- Predominant width of crack (mm)
- Length of crack (m)
- Area affected (m2)

Possible causes

- Reflection cracking from the underlying pavement base material or concrete bridge deck unit.
- Ageing and brittle wearing surface.

Transverse crack at saw cut joint (CMTJ)

Multiple, commonly unconnected crack in transverse direction at bridge joints.



Assessment Criteria

- Predominant width of crack (mm)
- Length of crack (m)
- Area affected (m2)

Possible causes

- Bridge joint movements.
- Aged and damage DWS joint.
- Unsuitable DWS joint.
- Damaged underlying bridge deck concrete nosing.

Transverse crack (CT)

Unconnected crack travelling perpendicular to the direction of traffic.

Assessment Criteria

- Predominant crack width (mm)
- Spacing (mm)
- Length (m)
- Area affected (m2)

Possible causes

- Contraction and shrinkage of the underlying concrete bridge deck unit.

Abutment settlement (DAS)

Wearing surface on abutment and bridge deck is not even and in worse cases forming a step.

Possible causes

- Repetitive heavy vehicle loading has caused the abutment fill or subgrade to settle.
- Abutment erosion has created void under relieving slab.
- Inadequate compaction on the upper layer abutment.

Asphalt split (DSA)

A crescent shaped crack that is more severe and deeper than the standard crescent crack.

Possible causes

- Crescent cracks that have not been repaired and have continued to develop/deteriorate.

Asphalt Blister (DB)

Asphalt blisters or bubbles that appear on the freshly laid asphalt surface.

Possible causes

- Commonly occur on asphalt over liquid sprayed waterproofing membrane that has been installed in hot weather or summer.
- Chemical components of the waterproofing membrane may not be suitable for hot weather condition and require adjustments or alterations.
- When hot mixed asphalt is placed, excessive moisture on the concrete deck turns into steam. This steam is trapped underneath waterproofing membrane and when expanding it forms voids or bubbles that push up asphalt layer, creating asphalt blisters.

Corrugations (DC)

Transversely oriented undulations in the asphalt surface.

Possible causes

- Insufficient bonding between asphalt and waterproofing membrane.
- Substandard asphalt has become malleable due to hot climates.
- Asphalt has slipped/moved from the deck surface.

Damaged concrete bridge deck (DCBD)

Concrete cover of bridge deck has been reduced.

Reinforcing steel or post tensioned strands within concrete deck have become exposed or damaged.

Possible causes

- Asphalt profiler operator miscalculating the milling depth thus causing the profiler machine to mill too deep and damage concrete bridge deck.
- This damage may occur during removal of existing asphalt deck wearing surface or during texturing of the concrete bridge deck.

Damaged epoxy on bridge joint nosing (DDE)

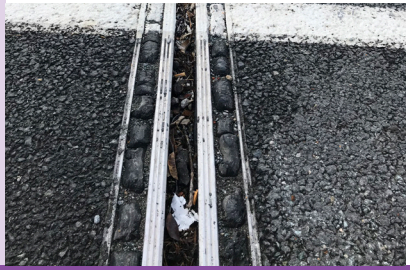
Epoxy on expansion joint nosing has begun to deteriorate (severe cracking, plugging off or peeling off).

Possible causes

- Ageing.
- Traffic loading.
- Extreme weather conditions.
- Incorrect installation.

Debris in expansion joint gap (DDEJ)

Expansion joint's gap above seal gland has filled with debris and loose materials.



Possible causes

- Accumulated road debris over the years.
- Lack of bridge joint maintenance.

Delamination (SD)

The wearing surface has peeled off.

Assessment Criteria

- Thickness of layer(s) removed (mm)
- Area (typical) of individual defects (m2)
- Number of defects

Possible causes

- Insufficient cleaning and surface preparation before installation of wearing surface layer has resulted in a poor bonding.
- Traffic action and/or water penetration have weakened the bond between wearing surfacing layer and the layer below.

Edge Fret (EF)

Edge of bituminous surface has become fretted, broken, absent or irregular.

Over the years, debris have accumulated along the bridge kerb and obstruct the scupper drains.

Assessment Criteria

- Maximum width of surfacing loss along the kerb (mm)
- Length over which break occurs (m)

Possible causes

- Shoulder has become eroded due to surface water flow or current.
- Resurfacing does not cover the entire bridge width but cease along the fog line.

Edge Lip (DEL)

The level of the asphalt at the edge of the deck wearing surface has not been properly compacted, therefore creating a step.

This lip then obstructs water from being able to drain through the scuppers.

Water will then pond on the wheel paths of the deck, resulting in potential aqua planning.

Possible causes

- The bridge railing prevents asphalt roller reaching bridge kerb due to inadequate compaction side clearance and therefore the drum of the roller could not compact the entire width of the asphalt.

Flushing (SF)

Pavement surface layer contains excess amount of bitumen which results in patches. These patches have inadequate tyre-to-stone contact which lowers the skid resistance.

Assessment Criteria

- Area affected (m2)
- Percentage (by area) stone immersed (%)

Possible causes

- Excessive rate of binder application with regards to stone size.
- Excessive prime coat (cutter) in the underlying seal.
- Underlying patches area or flushed area has excessive binder.
- Aggregate has penetrated the low strength.

Polishing (SP)

Deck wearing surface aggregates have become polished, smoothed, and appear shiny.

Assessment Criteria

- Area of pavement affected (m2)

Possible causes

- Surface aggregates have poor resistance to polishing especially in areas where heavy traffic movements occur.
- Smooth and uncrushed aggregates (e.g. water-worn gravel) have been used.

Pothole (HO)

Varying sized, bowl-shaped cavity in the pavement surface that extends into wearing surface, base layers and/or subgrade layer.

Assessment Criteria

- Depth of pothole (mm)
- Area of pothole (m2)
- Number of potholes

Possible causes

- Loss of deck wearing surface as a result of cracking being left untreated.
- Cracked deck wearing surface has allowed entrance of water into deck wearing surface.
- Heavy loading has deteriorated the asphalt deck wearing surface.

Rutting (DR)

Channelised depressions that are located along wheel paths.

Assessment Criteria

- Maximum depth (under a transverse 1.2 m straight edge) (mm)
- Length (m)

Possible causes

- Pavement age.
- Slow moving channelised heavy vehicle loading.
- Asphalt deck wearing surface has not been adequately compacted.
- Deck wearing surface has insufficient strength.

Shoving (DS)

Swells, bulges and horizontal deformations that have developed along the wheel path.

Swelling can also occur in locations where there are severe horizontal stresses i.e. roundabouts.

Assessment Criteria

- Maximum depth of bulge under 1.2 m straight edge from high point (mm)
- Area affected (m2)

Possible causes

- Asphalt deck wearing surface has not been adequately compacted.
- Poor bonding between the asphalt deck wearing surface and the concrete deck.
- Fuel/oil spillage has caused softening of asphalt materials.

Stripping (SS)

Scabbing, pop-outs, loss of bitumen, aggregate or filler from an spray seal layer.

Can happen as the loss of individual stones, or as the complete loss of stones within the layer.

Stripping can lead to development of potholes.

Assessment Criteria

- Area affected (m2)
- Percentage of stone throughout affected area (%)

Possible causes

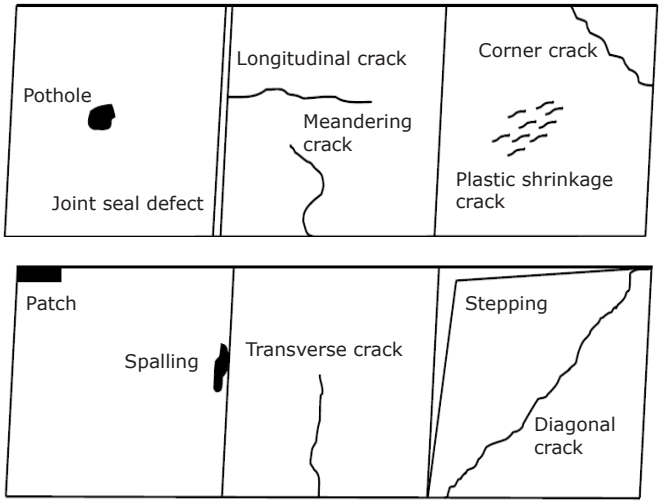
- Low binder contents.
- Poor adhesion between cover aggregate and binder, due to dirty/ dusty aggregate, wet aggregate, and/or insufficient precoating agent coverage on the aggregate.
- Aging or absorption of binder.
- Stone deterioration.
- Incorrect mix design.
- Inadequate rolling before opening the seal to traffic.

Visual Index

- *reference diagrams and charts to assist in indentifying pavement failures*

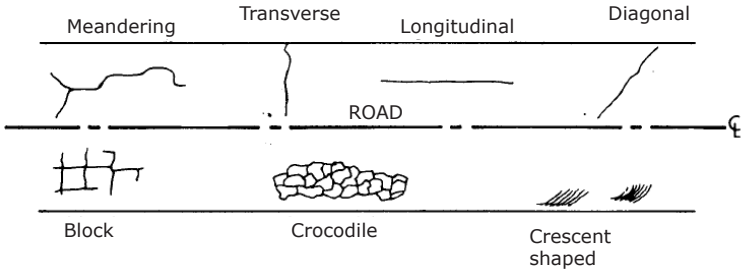
Visual index: concrete surfaces defects

Use these diagrams to assist in indentifying defects in concrete surfaces.



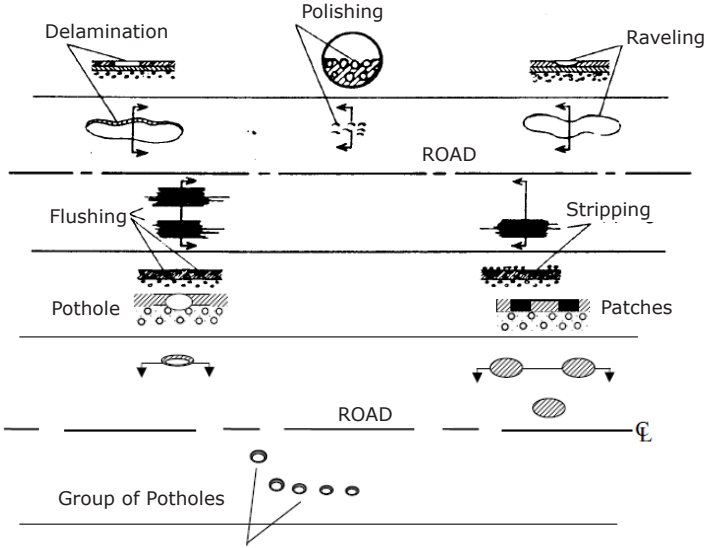
Visual index: bituminous surfaces defects – cracks

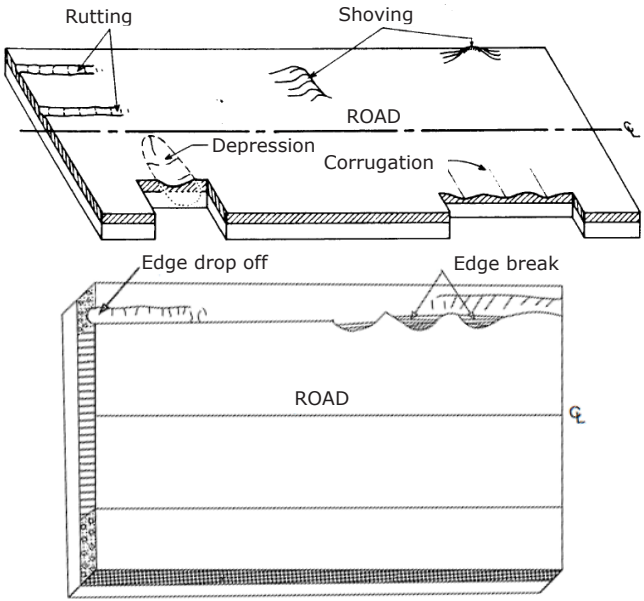
Use these diagrams to assist in indentifying cracks in bituminous surfaces.



Visual index: bituminous surfaces defects

Use these diagrams to assist in indentifying defects in bituminous surfaces.

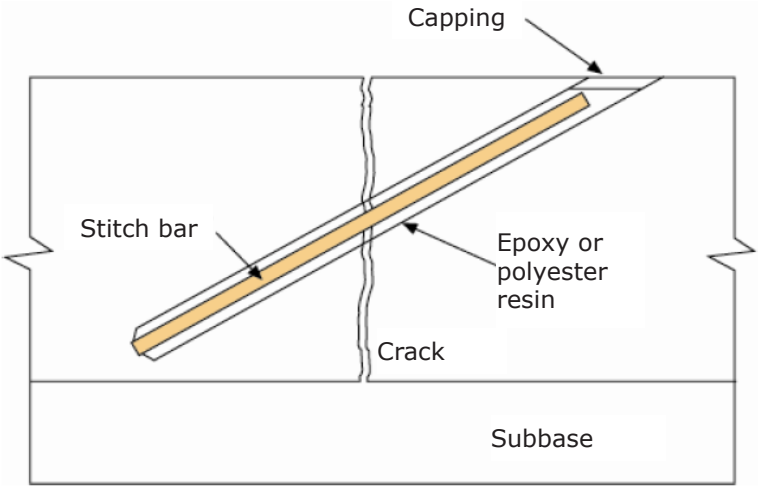



Rutting
Shoving
ROAD
Depression
Corrugation
Edge drop off
Edge break
ROAD

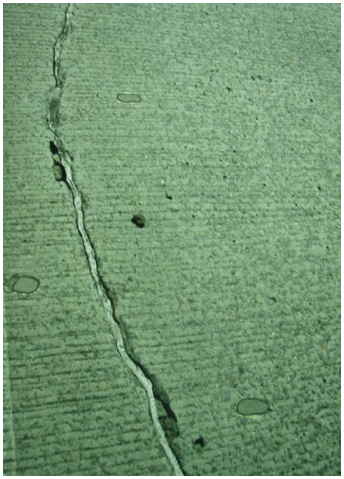
Visual index: concrete slab cross stitching

This process is to retain aggregate interlock across joints/cracks, to maximise shear load transfer at concrete joints or cracks, which are considered to have the potential to open under environmental effects and traffic loading.

This process is applicable to joints/cracks which have corroded and for tying kerbs to the pavement.



These photos demonstrate concrete surface longitudinal crack repairs using cross stitching.



Cross stitched crack
The dotted marks are reinforcement bars.

Cross stitching concrete surface repair

Photos supplied courtesy of Department of Transport and Main Roads.

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The information provided in this resource has been developed as an in-house pocket reference guide for use in training and conducting field investigations.

Content is taken from the NAASRA publication, A guide to the visual assessment of pavement condition, 1987; Austroads Guide to Pavement Technology, Part 5: Pavement evaluation and treatment design, March 2009, 2nd Edition; TMR Pavement Rehabilitation Manual, April 2012; TMR Routine Maintenance Guidelines, November 2017; Draft BCC Pavement Rehabilitation Manual, April 2011; Techniques to use on roads by salinity, Australian Stabilitsation Industry Association, 2005; Interim Guide to the Maintenance of Concrete Pavements, Road Traffic Authority, 2000; Construction and Material Tips, Part 1 Shrinkage Cracking, Texas Department of Transportation 2006; and Data Sheet: Plastic Shrinkage Cracking, Cement Concrete and Aggregates Australia, 2005.

This guide is not an exhaustive reference in identifying all possible pavement defects. For more information refer to the appropriate Department of Transport and Main Roads and AUSTROADS technical publications.

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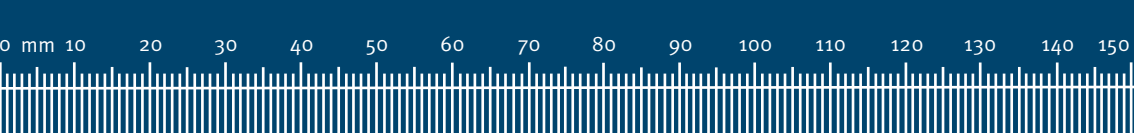

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