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Urban Concrete Roads Manual

Pavement Surface Condition Index

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Section 1: Introduction

A major function of an urban authority is to use public funds to provide a comfortable, safe and economical pavement surface on urban roads. This requires balancing priorities and making difficult decisions in order to manage pavements. Many urban pavement networks are often managed informally, based solely on the staff's judgment and experience. While this process is both important and functional, using a slightly more formalised technique can make it easier to manage pavements effectively.

Experience has shown that there are three especially useful steps in managing urban road pavements:

1. Inventory all urban roads.
2. Periodically evaluate the condition of all pavements.
3. Use the condition evaluations to set priorities for projects and select appropriate treatments.

A comprehensive pavement management system involves collecting data and assessing several road characteristics: roughness (ride), surface distress (condition), surface skid resistance and structure (pavement strength and deflection). Managers can combine this condition data with economic analysis to develop short-range and long-range plans for a variety of budget levels. However, many urban agencies lack the resources for such a full-scale system.

Many urban authorities are responsible for maintaining roadways with Portland Cement Concrete (PCC) pavements. Since surface condition is the most vital element in any pavement management system, urban authorities can use the simplified Pavement Surface Condition Index (PSCI) rating system presented in this Concrete Roads Manual to evaluate the condition of their concrete roads. The concrete roads ratings combined with other inventory data (construction history, width, length, shoulder, pavement type, etc.) can be very helpful in planning future budgets and priorities.

This Manual presents a system for evaluating and rating the condition of concrete pavements. The PSCI condition rating system has been designed with a number of objectives in mind. It should be simple to understand and implement by a wide range of survey personnel. No prior experience in pavement rating should be necessary to carry out the rating procedure. The PSCI rating system in Table 1 and Section 4 of this manual should be based only on visual concrete pavement distresses. The impact of surface defects, pavement deformation, cracks, joint seal damage and other defects on the overall rating system should be identified. The results of the rating system should be relatable to the maintenance treatment categories specified for use on concrete roads by the Department of Transport, Tourism and Sport (DTTAS). Table 2 in Section 6: Conclusions and Next Steps of this manual summarises the overall relationships between these factors.

This Manual is designed to improve the data collection and quality of visual surveying of urban concrete roads within the Republic of Ireland. Substantial use was made of the template provided by the Pavement Surface Evaluation and Rating (PASER) manuals produced by the Transportation Information Centre at the University of Wisconsin-Madison.

Section 2: Rigid Pavement Performance

Most concrete pavements on urban roads are either plain (non-reinforced) or reinforced concrete. Where concrete is reinforced, reinforcement is usually provided by steel wire mesh placed in the upper half of the slab. The reinforcement is intended to limit crack opening and movement in the concrete slab.

Since concrete slabs need to move (expand and contract) while curing and as temperature changes, pavements are constructed with contraction joints to control cracking. These are usually sawn into the pavement shortly after initial curing. This joint gives the slab a place to crack and makes a straight, well-formed groove to seal.

Expansion joints are occasionally provided. These are wider, full depth, and filled with a material to allow expansion. If used, they are placed adjacent to structures that cannot move with the pavement such as bridges, manholes, and other utility structures.

Rigid pavements (concrete) carry traffic loadings differently than flexible pavements (asphalt). Concrete pavements are designed to act like a beam and use the bending strength of the slabs to carry the load. Therefore load transfer across cracks and joints is important, especially on roads with heavy truck and bus traffic. Hairline and narrow cracks still have interlocked concrete aggregate and can effectively transfer loads. Because wide cracks and widely-spaced joints open up, they cannot transfer loads and must therefore carry higher edge loads. These higher edge loads can cause further cracking and deterioration along the joint or crack edges.

Unsupported slab edges will deflect or bend under a load. If the supporting soil is saturated it can squeeze up through joints or cracks when the slab bends. This is called pumping. Eventually the loss of supporting soil through pumping creates an empty space or void under the slab. The slabs may then crack under loading and joints further deteriorate. Pumping can often be detected by the soil stains around pavement joints or cracks.

Joints or cracks in concrete slabs may fault under heavy traffic loading. This is when one slab edge is lower than the next slab, creating a step. Faulting creates poor ride quality in the road pavement.

The voids under a slab can be filled with grout and slabs can be levelled by slab jacking. In addition, sealing cracks and joints and improving drainage of the subsoil will help reduce pumping, cracking, faulting, and joint failures.

Section 3: Pavement Distress – Concrete Pavements

This manual uses visual inspection to evaluate concrete pavement surface conditions. The key to a useful evaluation is identifying different types of pavement distress and linking them to a cause. Understanding the cause for current conditions is extremely important in selecting an appropriate maintenance or rehabilitation technique.

Deterioration has three general modes. These are

- Environmental deterioration due to weathering and aging
- Structural deterioration caused by repeated traffic loading
- Deterioration due to unsuitable materials (e.g. consolidation of subgrade, subsidence).

Pavement deterioration will result from contributions by one or more of these modes. It is important to try to determine the relative contributions in order to select the most effective rehabilitation techniques. The rate at which a concrete pavement deteriorates depends on its environment, traffic loading conditions, original construction quality and interim maintenance procedures. Poor quality materials or poor construction procedures can significantly reduce the life of a pavement. As a result, two pavements constructed at the same time may have significantly different lives, or certain portions of a pavement may deteriorate more rapidly than others. On the other hand, timely and effective maintenance can extend a pavement's life. Sealing cracks and joints can reduce the effect of moisture on weakening of concrete road pavements.

With all of these variables it is easy to see why pavements deteriorate at various rates and why we find them in various stages of disrepair. Recognising defects and understanding their causes helps us rate pavement condition and select cost-effective repairs. The pavement defects for concrete pavements shown on the following pages provide a background for this process. Some defects are localised while others indicate that problems may develop throughout the pavement. It is important to distinguish between local and widespread defects. Assessing the conditions of actual roadways also involves looking for combinations of these individual defects.

There are four major categories of common road surface defects for concrete pavements:

Surface Defects

Wear and Polishing
Pop-outs
Scaling

Pavement Deformation

Faulting
Utility repairs, Patches and Potholes
Manholes, Ironworks Defects

Cracks

Linear Cracking (longitudinal, transverse and meander cracks)
Corner Breaks
Shattered Slab

Joints

Joint Seal Damage (longitudinal joints, transverse joints)

Periodic inspection is necessary to provide current and useful evaluation data. It is recommended that Urban Concrete Road ratings be updated every two years, and an annual update is even better.

SURFACE DEFECTS

Wear and Polishing

A worn or polished surface may appear from traffic wearing off the surface mortar and skid resistant texture. Extensive wear may cause slight ruts where water can collect and cause hydroplaning. Sometimes traffic may polish aggregates smooth, causing the surface to be slippery. An asphalt overlay or grinding of the concrete surface can restore skid resistance and remove ruts.



Wearing and polishing of aggregate over the surface, corner break and joint damage also evident



Wearing and polishing of aggregate evident over surface of concrete slab

SURFACE DEFECTS

Pop-outs

Individual pieces of large aggregate may pop out of the surface. This is often caused by freeze-thaw action, combined with aggregate expansion, causing small pieces of concrete to break loose from the surface. Popouts usually range in diameter from approximately 25 to 100mm, and in depth from 12 to 50mm.

Surface patching can be done temporarily with asphalt. For severe areas, a more permanent partial depth concrete patch may be necessary.



Pop-outs on concrete slab

SURFACE DEFECTS

Scaling

Scaling is surface deterioration that causes loss of fine aggregate and mortar. More extensive scaling can result in loss of large aggregate. Scaling may be caused by de-icing salts, improper construction, freeze-thaw cycles and poor aggregate. Scaling can occur as a general condition over a large area or be isolated to locations of poor quality concrete. Traffic action may accelerate scaling in the wheel paths.

Grinding may remove poor quality surface concrete. Asphalt overlays or a bonded concrete resurfacing can prolong the life of the pavement. Partial depth patching of isolated areas may also be used.



Scaling on concrete slab resulting in loss of surface, joint seal damage also evident

PAVEMENT DEFORMATION

Faulting

Faulting is a difference in elevation across a joint or crack. Joints and cracks may fault or develop a step between adjacent slabs. Faulting can be caused by settlement due to soft foundations, pumping of subgrade soils and creation of voids under the slab. Unstable or poorly drained subgrade soils may cause pavements to settle after construction. Poorly compacted utility trenches may also settle. Heavy truck or bus traffic can rapidly accelerate faulting.

Faulting creates a poor ride and may cause slab deterioration. Minor faulting ($\leq 25\text{mm}$) can be corrected by surface grinding. Improved drainage and stabilisation of subgrade soils are usually necessary. Voids can be filled with grout, or slabs jacked back to level position. Severe faulting ($> 25\text{mm}$) may require joint/slab replacement or pavement reconstruction.



Faulting of slabs

PAVEMENT DEFORMATION

Faulting



Faulting resulting in lip protruding from road surface



Severe Faulting (> 25mm) along joint

PAVEMENT DEFORMATION

Utility Repairs, Patches and Potholes

A patch is an area where the original pavement has been removed and replaced with new material. A utility cut is a patch that has replaced the original pavement to allow the installation or maintenance of underground utilities. Patches showing cracking, settlement, joint deterioration, or distress under continued traffic loading indicate underlying causes still remain.

Patches can be both small ($< 1 \text{ m}^2$) or large in size such as utility cut repairs. Patches may be in good condition and performing satisfactorily with little or no deterioration. Patches may be moderately deteriorating or badly deteriorating with other defects in the patched area and in need of replacement.

Localised failures of materials or subgrade soil can cause individual potholes. Surface spalling or other material defects may develop into localised potholes. Full depth patching is usually required.



New Patch in very good condition with good sealant

PAVEMENT DEFORMATION

Utility Repairs, Patches and Potholes



Deteriorated asphalt patching in poor condition on concrete surface



Moderately deteriorated asphalt patching in fair condition on concrete surface

PAVEMENT DEFORMATION

Utility Repairs, Patches and Potholes



Poor patching in area of shattered slab



Asphalt Utility patching in centre of concrete pavement

PAVEMENT DEFORMATION

Manhole, Ironworks Defects

Normal pavement movement due to frost heaving and movements due to changes in temperature often cannot be accommodated in the pavement adjacent to a manhole, ironworks or a storm sewer inlet. Cracks, blowups and faulting may develop and the concrete slab may deteriorate further. These are often localised defects that may not indicate a general pavement problem. Sealing and patching may slow the deterioration. Eventually full depth repairs may be required.



Cracking in vicinity of Manhole



Cracking in vicinity of Manhole with asphalt utility patching

Linear Cracking

Linear cracking includes longitudinal, transverse, meander and hairline cracks. Longitudinal or transverse cracks may appear parallel to joints and can be caused by repeat traffic loading, thermal stresses or poor subgrade support. They are sometimes related to slabs having joints spaced too widely. Joints spaced more than 4.5 metres apart commonly develop mid-slab transverse cracks.

Some pavement cracks appear to wander randomly. They may cross a slab diagonally or meander like a serpent. Meander cracks may be caused by settlement due to unstable subsoil or drainage problems, or by utility trench settlement. They are often local in nature and may not indicate general pavement problems.

Hairline cracks that are only a few hundred millimetres long and do not extend across the entire slab are rated as shrinkage cracks. They are formed during the setting or curing of the concrete, and usually do not extend through the depth of the slab.

As with joints, these types of linear cracks may deteriorate further if not sealed properly. Minor cracks may benefit from sealing to minimize water intrusion. Severe deterioration may require patching individual cracks.

Slabs can fault at cracks (faulting) which can spall and develop additional parallel cracking. Multiple linear cracks in individual slabs indicate further deterioration which may require sealing of cracks. Extensive and severe linear cracking indicates pavement failure and may require full depth patch or replacing the slab. Slabs divided into four or more pieces are rated as Shattered slabs.

Load transfer across cracks is important, especially on roads with heavy truck and bus traffic. Hairline and narrow cracks still have interlocked concrete aggregate and can effectively transfer loads. Because wide cracks and widely-spaced joints open up, they cannot transfer loads and must therefore carry higher edge loads. These higher edge loads can cause further cracking, spalling and deterioration along the crack edges.

Spalling is the loss of a piece of the concrete pavement from the surface or at corners, joints and along the edges of cracks. Cracking, traffic loadings or freeze-thaw action may break the concrete loose, or spalling may be caused by poor quality materials. Spalling may be limited to small pieces in isolated areas or be quite deep and extensive. Small spalled areas are often patched.

Linear cracks may be non-filled, may be filled with a sealant or may have faulting present. Non-filled narrow cracks (≤ 12 mm in width), filled cracks of any width where the sealant is in satisfactory condition, and cracks where no faulting exists would be considered to be at the lower end of deterioration. Non-filled wide cracks (> 12 mm in width), filled cracks of any width where the sealant is in poor condition, and cracks where faulting exists are classified as having severe deterioration.

Linear Cracking (Longitudinal & Transverse)



Transverse cracks across carriageway open > 12mm and with poor sealant



Longitudinal open crack along concrete slab with no sealant

Linear Cracking (Longitudinal & Transverse)



Longitudinal and Transverse cracks



Longitudinal and Transverse wide open cracks

Linear Cracking (Meander)



Meander crack, open and with no sealant, and with spalling evident



Spalling along edge of wide crack resulting in loss of large pieces of concrete

Linear Cracking



Wide and Poorly sealed cracks showing severe deterioration



Very wide and Poorly sealed cracks showing severe deterioration

Corner Breaks

Corner Breaks caused by diagonal cracks may develop near the corner of a concrete slab, forming a triangle with a longitudinal and transverse joint. Usually these diagonal cracks are within 300mm of the corner of the slab. They are caused by insufficient soil support or concentrated stress due to temperature related slab movement. They may begin as hairline cracks but ultimately form corner breaks under repeated traffic loading.

Some corner cracks extend vertically through the full depth of the slab (corner break), while others start at the surface and angle down to intersect the joint (corner spall). With further deterioration, more cracking develops; eventually the entire broken area may come loose. This may be a localised failure or may point to widespread maintenance problems.

For minor corner breaks, sealing the cracks may be sufficient to repair. Partial or full depth concrete patching or full depth joint replacement may be necessary when corner breaks are extensive.



Corner Breaks on adjoining concrete slabs

Corner Breaks



Large Corner Break



Extensive Corner Breaks

CRACKS

Shattered Slab

Slabs divided into four or more pieces with severe damage/faulting/spalling along the crack edges due to overloading and/or inadequate support are rated as Shattered slabs. Complete slab replacement with subsurface stabilisation is usually required to repair the shattered slab condition.



Shattered slab with movement and severe Faulting resulting in failed road surface

Shattered Slab



Shattered slab over large area



Failed Pavement: Severely Shattered Slab with severe Spalling and Faulting (> 25mm)

Joint Seal Damage

Longitudinal and transverse joints in concrete pavements are constructed to permit movement of the concrete slabs. They are typically constructed to be narrow in width and usually well sealed. As pavements age and materials deteriorate, joints may open and further deteriorate. Cracks parallel to the initial joint may develop and accelerate into spalling of the joint. Spalling is the loss of a piece of the concrete pavement from the edges of joints. Spalling at joints may require full depth joint repair or patching. Settlement, instability, or pumping of the subgrade soil under traffic loading can cause joints to fault. Occasionally, severe joint deterioration may develop from poor quality aggregate.

Joint seal damage is any condition which enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering or spalling. A flexible joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab.

Typical types of joint seal damage are:

1. Stripping of joint sealant
2. Extrusion of joint sealant
3. Weed growth
4. Hardening of the filler (oxidation)
5. Loss of the bond to the slab edge
6. Lack or absence of sealant

Overall, lack of joint maintenance and rehabilitation is a more common problem. Maintaining a tight, well-sealed joint can reduce water intrusion and thereby reduce freeze-thaw damage, pumping, and spalling. The typical repair option for joint seal damage is to reseal the joints. Early repair of minor defects can often reduce the need for complete joint repair or replacement. Severe joint deterioration may require full depth patching or complete replacement of the joint.



Joint sealant in excellent condition

Joint Seal Damage



Wide Longitudinal joint with deteriorated joint sealing



Wide Longitudinal joint with deteriorated joint sealing

Joint Seal Damage



Joint seal damage with sealant almost completely removed



Severe Joint seal damage with joint eroded causing cracking and spalling

Section 4: Rating Pavement Surface Condition

Table 1 on the following page outlines the rating system for rating pavement condition. With an understanding of roadway conditions and distress, you can evaluate and rate concrete pavements. **Surface defects** comprise Wear and Polishing, Scaling, and Pop-Outs; **Pavement deformation** defects comprise Faulting, Utility Repairs, Patches and Potholes, and Manhole, ironworks and inlet cracks; **Crack defects** comprise Linear cracking, Corner cracks and Shattered slab; and **Joint Seal Damage** include damage to joint sealant.

The rating scale ranges from 10 for a pavement in excellent condition to 1 for a pavement in failed condition. Most pavements will deteriorate through the phases listed in the rating scale. The time it takes to go from excellent condition (10) to complete failure (1) depends largely on the quality of the original construction and the amount of heavy traffic loading.

Once significant deterioration begins, it is common to see pavement decline rapidly. This is usually due to a combination of loading and the effects of additional moisture. As a pavement ages and additional cracking develops, more moisture can enter the pavement and accelerate the rate of deterioration.

Look at the photographs in this section to become familiar with the descriptions of the individual rating categories. To evaluate an individual pavement segment, first determine its general condition. Is it relatively new, toward the top end of the scale? Is it in very poor condition and at the bottom of the scale? Or somewhere in-between?

Finally, review the individual pavement distresses and using the primary rating indicators and secondary rating indicators given in Table 1, select the appropriate surface rating category for the pavement segment.

Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.

Table 1: The PSCI Rating System

Overall PSCI Rating	Primary Rating Indicators*	Secondary Rating Indicators*
10	No Visible Defects.	New pavement or recent concrete rehabilitation.
9	Minor Surface Defects¹ ($\leq 10\%$). Traffic Wear and Polishing in wheelpath. Slight Scaling or Pop-outs.	Recent concrete overlay or joint rehabilitation. Road surface in very good condition.
8	Moderate Surface Defects¹ (10% to 30%). Moderate Surface wear/Polishing, Pop-outs or Scaling Partial loss of joint sealant.	Little or No Other defects.
7	Extensive Surface Defects¹ ($> 30\%$). Extensive Surface Wear/Polishing, Pop-outs or Scaling. A few Linear Cracks ² or Corner Breaks, tight or well-sealed. Partial loss of joint sealant.	Little or No Other defects.
6	Moderate Other Pavement Defects³. Several Linear Cracks ² (some open) or Corner Breaks. Narrow Cracks (≤ 12 mm) or Open Joints with Joint Seal Damage. Patching in Good condition.	Surface defects ¹ may be present. Needs general joint and crack sealing.
5	Significant Other Pavement Defects³. More frequent open Linear Cracks ² (≤ 12 mm) and Corner Breaks, some with broken pieces. Significant Joint Seal Damage, minor faulting (≤ 25 mm) or spalling at joints or cracks. Patching in Fair condition.	Surface defects ¹ may be present. Manhole/ironworks defect may be present. Needs general joint and crack sealing.
4	Structural Distress Present⁴. Several slabs with wide (> 12 mm) Joints or Cracks, moderate spalling, or Faulting (> 25 mm). Corner Breaks with missing pieces or patches. Sealed Cracks in poor condition. Patching with signs of distress.	Other defects may be present. Joint sealant in poor condition.
3	Significant Areas of Structural Distress⁴. Many slabs with wide (≥ 12 mm) Joints, Cracks and Corner Breaks, severe Spalling or Faulting (≥ 25 mm). Shattered Slab where no Faulting exists. Patching in Poor condition.	Joints failed. Other defects may be present.
2	Large Areas of Structural Distress⁴. Extensive wide Cracks, severely spalled and patched. Shattered slab with severe Faulting (> 25 mm). Extensive Very Poor Patching.	Joints failed. May be difficult to drive on.
1	Extensive Structural Distress⁴. Pavement Failure. Severe Deterioration with many failed slabs. Extensive Failed Patching. Restricted speed.	Severe Deterioration. May be very difficult to drive on.

* Individual pavements will not have all of the types of distress listed for any particular rating.
They may have only one or two types.

Note 1: Surface Defects = Wear and Polishing, Scaling, and Pop-Outs.

Note 2: Linear Cracking = Longitudinal, Transverse and Meander Cracks.

Note 3: Other Pavement Defects = Narrow Open (≤ 12 mm) Linear Cracks, Corner Breaks and Joints, Manhole/ironworks defect, Minor Faulting (≤ 25 mm), Good/Fair Patching and Joint Seal Damage.

Note 4: Structural Distress = Shattered slab, Wide Open (> 12 mm) Linear Cracks, Corner Breaks and Joints, Severe Faulting (> 25 mm), Poorly Sealed Cracks and Joints, Potholes, and Poor/Failed Patching.

Rating 10

Excellent - No Maintenance

Rating 10 is for new concrete pavement with no visible defects. No maintenance required.



Rating 10: New Pavement, no visible defects

Rating 9

Very Good - No Maintenance

Rating 9 is used for recent concrete rehabilitation or like new condition. Some traffic wear. Slight wear or polishing in wheelpaths. Slight Scaling or pop-outs. No maintenance required.



Rating 9: Small Patch in good condition, a few isolated tight Linear cracks present

Rating 8

Good - Routine Maintenance

Moderate surface wear visible, or slight defects showing in lanes. Pop-outs, surface wear/polishing or surface scaling from 10% to 30% of the road surface. Partial loss of joint sealant. Routine maintenance required.



Rating 8: Good condition, First isolated tight Linear crack evident, partial joint seal damage



Rating 8: Surface defects - Pop-outs over 10 to 30% of area

Rating 7

Good - Routine Maintenance

More extensive surface defects. Pop-outs, surface wear/polishing or surface scaling for greater than 30% of the road surface. First signs of well sealed linear cracking or corner breaks. Partial loss of joint sealant. May need some sealing or routine maintenance.



Rating 7: Greater than 30% Wear and Polishing present. Isolated utility cut in good condition



Rating 7: Good condition overall, a few isolated linear cracks (tight) present, partial joint seal damage

Rating 6

Fair – Surface Restoration

Several linear cracks or corner breaks visible. Cracks can be non-filled (≤ 12 mm), filled cracks with sealant in satisfactory condition or tight cracks where no faulting exists. Patching generally in good condition. Joint seal damage present. Surface defects may be present. Needs localised repairs, joint and crack sealing before surfacing.



Rating 6: Utility cut patching generally in good condition, some wear and polishing



Rating 6: Open Linear cracks and Corner breaks present, Patching and utility cut repairs in good condition



Rating 6: Transverse linear cracks (tight) with good patching and some wear



Rating 6: Transverse linear cracks of narrow width ($\leq 12\text{mm}$) and poor joint seal with grass growth

Rating 5

Fair – Surface Restoration

More frequent open linear cracks (≤ 12 mm) and corner breaks, some with broken pieces. Significant joint seal damage with minor faulting (≤ 25 mm) or spalling at joints or cracks. Patching in fair condition. Surface defects may be present. Requires localised repairs, grinding or joint/crack repairs before surfacing.



Rating 5: Corner breaks with minor faulting and spalling present, cracks are ≤ 12 mm wide



Rating 5: Multiple Corner breaks with broken pieces, crack width is narrow (≤ 12 mm)



Rating 5: Multiple Corner breaks and some linear cracking present, cracks are narrow in width



Rating 5: Fair patching, more frequent linear cracks and utility cracks (all narrow)



Rating 5: Large Patching in fair condition and linear narrow cracks present



Rating 5: Several slabs with Corner breaks, Linear cracking (non-filled $\leq 12\text{mm}$) and some spalling evident

Rating 4**Poor – Structural Rehabilitation**

Several slabs with wide (> 12 mm) Joints or Cracks, moderate spalling may also be visible at joints/cracks. Corner Breaks with missing pieces or patches. Sealed Cracks in poor condition. Patching showing signs of distress. Faulting of slabs less than 25mm may be present.

Severe surface distress with structural rehabilitation required. May require full bay slab replacement, or full depth repairs to correct defects. Some full depth joint or crack repair required.



Rating 4: Severe unsealed cracks greater than 12mm wide with spalling present



Rating 4: Multiple interconnecting linear cracks present with sealant in poor condition.



Rating 4: Extensive interconnecting linear cracking

Rating 3

Poor – Structural Rehabilitation

Many slabs with wide (> 12 mm) Joints, Cracks and Corner Breaks and severe Spalling or Faulting (> 25mm) may be visible. Shattered Slab where no Faulting exists. Patching in poor condition.

Full depth patching required plus some full slab replacement.



Rating 3: Extensive wide cracking (> 12mm) with spalling and very poor joint sealant



Rating 3: Shattered slab, wide cracks (>12mm) with very poor crack sealing



Rating 3: Severe faulting and surface deterioration present, very poor joints



Rating 3: Shattered slab with cracking >12mm

Rating 2

Very Poor – Road Reconstruction

Large areas of structural distress with extensive slab cracking that are severely spalled, patched or poorly sealed. Shattered slab may also be present with severe faulting ($> 25\text{mm}$) and patches in very poor condition. Road needs full depth reconstruction with extensive base repair.



Rating 2: Large quantities of wide and open cracking with very poor sealant



Rating 2: Extensive wide interconnecting cracking with poor sealant



Rating 2: Extensive Shattered slab with no sealant present

Rating 1**Failed— Road Reconstruction**

Severe and extensive structural distress. Severe Deterioration with many failed slabs. Extensive patching in failed condition. Almost total loss of pavement integrity where speed is very restricted.

Road needs full depth reconstruction with extensive base repair.



Rating 1: Extensive very wide cracks, severely shattered slab with severe faulting (>25mm) and spalling



Rating 1: Shattered slab with spalling and grass growth, very wide cracks and very poor crack sealing



Rating 1: Failed slab with extensive cracking

Section 5: Practical Advice on Rating Roads

Inventory and Field Inspection

Most agencies routinely observe roadway conditions as a part of their normal work and travel. However, a road network inspection means looking at the entire roadway system as a whole and preparing a written summary of conditions. This inspection has many benefits over casual observations. It can be helpful to compare segments, and rating decisions are likely to be more consistent because the roadway system is considered as a whole within a relatively short time.

Having a written record and objective information also improves your credibility with the public. Finally a written inventory is very useful in documenting changing roadway conditions. Without records over several years it is impossible to know if road conditions are improving, holding their own, or declining. Annual budgets and long range planning are best done when based on actual needs as documented with a written inventory.

Averaging and Comparing Sections

For evaluation, divide the Urban road system into individual segments which are similar in construction and condition. Obviously, no roadway segment is entirely consistent. Also, surfaces in one section will not have all of the types of distress listed for any particular rating. They may have only one or two types. Therefore, some averaging is necessary.

The objective is to rate the condition that represents the majority of the roadway. Small or isolated conditions should not influence the rating. Occasionally surface conditions vary significantly within a short length along the road segment. For example, short sections of good condition may be followed by sections of poor surface conditions. In these cases, it is best to rate the segment according to the worst conditions. As a rough guide, a length of at least 20 metres is required to justify recording a change in road condition rating category.

The overall purpose of condition rating is to be able to compare each segment relative to all the other segments in your roadway system. On completion you should be able to look at any two pavement segments and find that the better surface has a higher rating.

Within a given PSCI rating, say 6, not all pavements will be exactly the same. However, they should all be considered to be in better condition than those with lower PSCI ratings, say 5. Sometimes it is helpful in rating a difficult segment to compare it to other previously rated segments. For example, if it is better than one you rated 5 and worse than a typical 7, then a rating of 6 is appropriate. Having all pavement segments rated in the proper relative order is most important and useful.

Section 6: Conclusions and Next Steps

Using Urban road funds most efficiently requires good planning and accurate identification of appropriate rehabilitation projects. Assessing roadway conditions is an essential first step in this process. This Pavement Surface Condition Index (PSCI) rating system in this Urban Concrete Roads Manual has been developed to improve the data collection and quality of visual surveying of non-national roads, and to improve decision making and use of road maintenance funds more efficiently. It can be used directly by urban authority officials and staff in the Republic of Ireland. It may be combined with additional pavement testing and data collection in a more comprehensive pavement management system in planning future budgets and priorities.

The PSCI rating system is based only on visual pavement defects. The impact of surface-related defects, structural-related defects and other defects is identified when applying the overall PSCI rating. The results of the rating system should be relatable to the maintenance treatment categories specified for use on Non-National roads by the Department of Transport, Tourism and Sport. Table 2 on the following page summarises the overall relationships between these factors.

Table 2: Treatment Measures

Overall PSCI Rating	Treatment Measures	Surface	Structure
10	No Maintenance Required	Excellent	
9		Very Good	
8	Routine Maintenance - Including sealing and overbanding of open joints and cracks	Fair	Good
7		Poor	
6	Surface Restoration — Requires localised surface repairs, scabbling/grinding to repair surface defects and minor faulting, joint or crack sealing/overbanding.	Fair	Fair
5		Poor	
4	Structural Rehabilitation - Extensive slab or joint rehabilitation, Requires full depth repairs/patching, and/or asphalt overlay to correct surface defects, or full bay slab removal and replacement.	Poor Overall	
3			
2	Road Reconstruction - Pavement failure requiring full depth reconstruction and extensive base repair.	Very Poor Overall	Failed Overall
1			

Section 7: Bibliography

1. PASER Concrete Roads Manual, Wisconsin Transportation Information Center, University of Wisconsin-Madison (2002).