

Pavement Surface Evaluation and Rating

PASER Concrete Roads Manual

RATING
10



RATING
7



RATING
4



RATING
1



Contents

Introduction	2
Rigid pavement performance	2
Pavement conditions and defects	3
Evaluation	4
Surface defects	4
Joints	7
Pavement cracks	9
Pavement deformation	12
Rating pavement surface condition	15
Rating system	16
Rating 10 & 9 — Excellent	17
Rating 8 — Very Good	18
Rating 7 — Good	19
Rating 6 — Good	20
Rating 5 — Fair	21
Rating 4 — Fair	23
Rating 3 — Poor	24
Rating 2 — Very Poor	25
Rating 1 — Failed	26
Practical advice on rating roads	27

This manual is intended to assist local officials in understanding and rating the surface condition of concrete pavements. It describes types and causes of distress and provides a simple system to visually rate pavement condition. The rating procedure can be used as condition data for the Wisconsin DOT local road inventory and as part of a computerized pavement management system like PASERWARE.

Produced by the T.I.C. with support from the Federal Highway Administration, the Wisconsin Department of Transportation, and the University of Wisconsin-Extension. The T.I.C., part of the nationwide Local Technical Assistance Program (LTAP), is a Center of the College of Engineering, Department of Engineering Professional Development, University of Wisconsin-Madison.

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Printed on recycled paper.

Pavement Surface Evaluation and Rating

PASER Concrete Roads Manual

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Pavement Surface Evaluation and Rating

Concrete PASER Manual

Many local agencies are responsible for maintaining roadways with concrete pavements. This manual offers useful information for planning maintenance and managing Portland Cement Concrete pavements. It discusses common problems and typical repairs and includes a visual system for evaluating and rating concrete pavements.

The Wisconsin Transportation Information Center has developed PASER manuals for other pavement types (see page 29). The rating systems are similar and compatible so that local road agencies can work with a comprehensive condition rating method. The rating procedure can be used as condition data for the Wisconsin DOT local road inventory (WISLR) and as part of a computerized pavement management system like PASERWARE.

Taking an organized approach to roadway management has many benefits. By documenting the actual conditions of roads you can set realistic budgets, make timely repairs, and set up cost effective maintenance procedures. Developing an overall plan for the roadway system lets local agencies develop budgets and plan for future needs. When detailed information is available, local officials can respond more effectively to questions from the public. A planned approach is easier to explain and receives greater public support.

Several key steps are necessary to develop a meaningful roadway management plan. First, you must inventory the existing condition. This is normally done by dividing the roadway into segments with similar conditions. During the inventory you collect information on construction history, roadway width, etc. Then you need some method for assessing the condition of the existing roadway. This *Concrete PASER Manual* uses a visual approach. Other information from material sampling, testing, and traffic counts can be useful when planning specific projects.

Another necessary step is setting priorities for roadway improvements. You can use roadway condition and the local importance of these roads to assign priorities. Then budgets can be developed based on cost estimates for the projected improvements. Since not all improvements can be made in one year, you can set up a 3-5 year budget and capital improvement plan. Normally this is updated annually.

Rigid pavement performance

Most concrete pavements on local roads are either plain (non-reinforced) or reinforced concrete. Reinforcement is usually provided by steel wire mesh placed approximately at mid slab depth. 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.

So-called 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 take higher edge loads. These higher edge loads can cause further cracking and deterioration along the joint or crack edges.

Some concrete pavements use joints that have load transfer dowels. These are smooth steel bars placed across the joint. They transfer traffic loads between adjacent concrete slabs while allowing opening and closing of the joint. These bars can rust and sometimes cause problems. The corrosion causes forces on the concrete which lead to spalling, cracking and general joint deterioration. Epoxy coated dowels are now commonly used.

Unsupported slab edges will deflect or bend under a load. If the supporting soil is saturated it can squirt 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 further under loads and joints deteriorate more.

Undoweled joints under heavy truck traffic may *fault*. This is when one slab edge is lower than the next slab. The downstream traffic slab will be lower than the upstream slab, creating a step. Faulting creates a poor ride.

You can often detect pumping by the soil stains around pavement joints or cracks. The resulting voids can be filled with grout. Slabs can be leveled by slab jacking or mud jacking. Obviously, sealing cracks and joints and improving drainage of the subsoils will help reduce pumping, faulting, and joint failures.

Pavement conditions and defects

It is helpful to separate various conditions common to concrete pavements. These are described individually in some detail. We also include causes for deterioration and common strategies for repair. Some defects are localized 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.

Surface defects

Wear and polishing, map cracking, pop-outs, scaling, shallow reinforcing, spalling.

Joints

Longitudinal joint, transverse joints.

Pavement cracks

Transverse slab cracks, D-cracking, corner cracks, meander cracks.

Pavement deformation

Blow ups; faulting; pavement settlement or heave; utility repairs, patches and potholes; manhole and inlet cracking; curb or shoulder deformation.

In reviewing the different defects it is important to consider both their severity and extent. Generally, conditions begin slowly and progressively become more serious. Slight defects may grow into moderate and then severe conditions. In addition, the defects might initially be indicated only in a few isolated cases. Examples in the rating section will help you identify how bad a condition is and how extensive it is.

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.

▶ **Surface mortar worn away exposing larger aggregate. Accidents or friction testing may indicate a slippery surface in need of improved texture.**

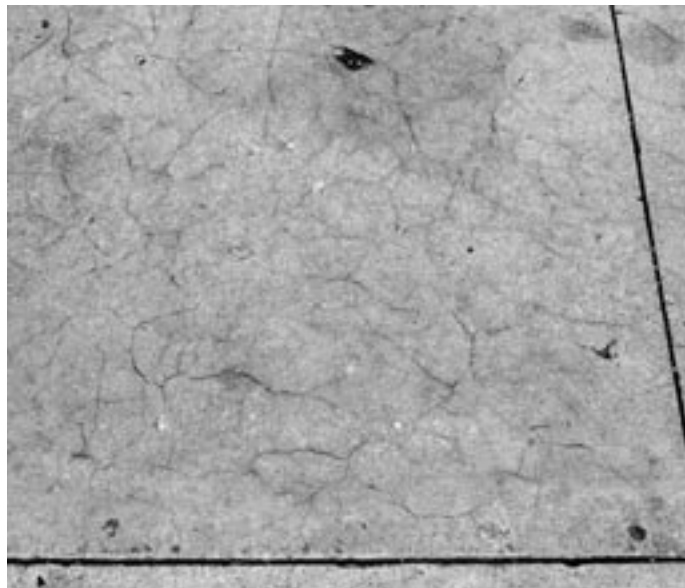


Map cracking

A pattern of fine cracks usually spaced within several inches is called map cracking. It usually develops into square or other geometrical patterns. Can be caused by improper cure or overworking the surface during finishing. If severe, cracks may spall or surface may scale. Repair is usually limited to very severe conditions. An asphalt overlay or partial depth patching may then be necessary.

Pop-outs

Individual pieces of large aggregate may pop out of the surface. This is often caused by chert or other absorbent aggregates that deteriorate under freeze-thaw conditions. Surface patching can be done temporarily with asphalt. For severe areas, a more permanent partial depth concrete patch may be necessary.



▲ **Close-up of a polished pavement surface.**

◀ **Hairline surface cracks, probably shallow in depth. May not cause any long term performance problems.**



◀ **Extensive pop-outs of large aggregate from surface. Pop-outs alone have not affected pavement serviceability.**

► Moderate surface scaling. Loss of mortar and fines from the surface beginning to expose larger aggregate.



► Severe scaling. Some larger aggregate is loose.



Reinforcing bar exposed. Shallow concrete cover caused large spall to develop around it. ▼



Scaling

Scaling is surface deterioration that causes loss of fine aggregate and mortar. More extensive scaling can result in loss of large aggregate. Often caused by using concrete which has not been air-entrained, the surface becomes susceptible to freeze-thaw damage. Scaling is also aggravated by the use of deicing chemicals.

Scaling can occur as a general condition over a large area or be isolated to locations where poor quality concrete or improper finishing techniques caused loss of air entrainment. In severe cases, deterioration can extend deep into the concrete. Traffic action may accelerate scaling in the wheel paths.

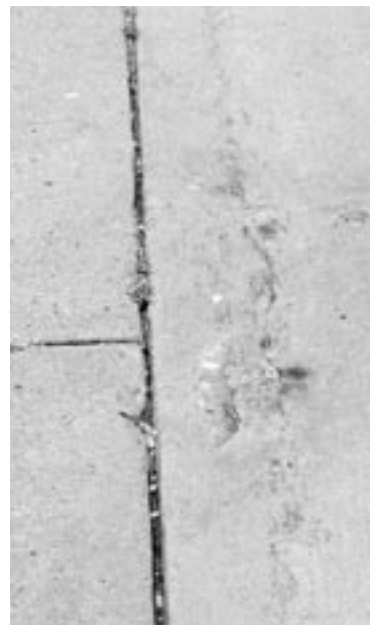
Grinding may remove poor quality surface concrete. Asphalt overlays or a bonded concrete resurfacing can prolong the life of the pavement. Partial depth patching of isolated areas may also be used.

Shallow reinforcing

If the steel reinforcing bar or mesh is placed too close to the concrete surface it will lead to concrete spalling. Corrosion of the steel creates forces that

break and dislodge the concrete. Often you can see rust stains in the surface cracks before spalling occurs. Can be temporarily patched with asphalt. Permanent repairs are difficult and usually involve replacing the steel and making a partial depth or full depth concrete repair.

◀ Surface stain parallel to joint. Indicates reinforcing steel too close to surface.



◀ Wire reinforcing mesh placed close to surface. Corrosion of the reinforcing steel causes the surface mortar to spall. Very difficult to patch and repair.

Spalling

Spalling is the loss of a piece of the concrete pavement from the surface or along the edges of cracks and joints. Cracking 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.

Repair will depend on the cause. Small spalled areas are often patched. Spalling at joints may require full depth joint repair.

▶
Small surface
spalls that
have been
patched.



▶
Spalling along
longitudinal
joints.



▼ A severely
spalled crack.



▶
Spalling over
shallow reinforcing.



JOINTS

Longitudinal joints

Longitudinal paving joints are 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 or raveling of the longitudinal joint. Settlement, instability, or pumping of the subgrade soil can cause longitudinal joints to fault. One common cause of cracks parallel to the longitudinal joints is waiting too long after the pour to saw the joint. Then, during initial cure the slab will crack roughly parallel (but not exactly) to the sawn joint.

Maintaining a tight joint seal can prevent intrusion of water and reduce freeze-thaw damage and pumping. Severe joint deterioration may require full depth patching and replacement of the joint.



▲ Joint open about 1/2".

◀ New, well-sealed longitudinal joint.



▲ Additional joint cracking, spalling, and broken pavement. Full depth repair is needed.



▲ Faulted longitudinal joint (over 1/2") with slight edge spalling.

Transverse joints

Transverse joints are constructed in concrete pavements to permit movement of the concrete slabs. Some joints are constructed with load transfer dowels. If the pavement has poor subsurface drainage, traffic may eventually create voids under the joints due to pumping and cause the slabs to settle or fault. Freeze-thaw deterioration at the joint can cause spalling and create additional cracks parallel to the joint. Load transfer bars may corrode, creating expansive forces that further deteriorate the concrete at the joint.

Occasionally, severe joint deterioration may develop from poor quality aggregate and so-called D-cracking. Joint sealing will help, but complete replacement is usually necessary.

Overall, lack of joint maintenance and rehabilitation is a common problem. Maintaining a tight, well sealed joint can reduce water intrusion and thereby reduce freeze-thaw damage, pumping, blow-ups, D-cracking, and spalling. Early repair of minor defects can often reduce the need for complete joint repair or replacement.

▼ **New, well-sealed transverse joint.**



▼ **Transverse joint has slight faulting and spalling.**



▶ **Severe spalling of a transverse joint.**



▶▶ **Cracks parallel to joint. Dark color next to transverse joint likely indicates D-cracking and additional deterioration. Full depth repair required.**



▶ **Severe spalling has required temporary patching. Complete joint replacement is necessary.**



PAVEMENT CRACKS

Transverse slab cracks

Transverse cracks may appear parallel to joints and can be caused by thermal stresses, poor subgrade support, or heavy loadings. They are sometimes related to slabs having joints spaced too widely. Joints spaced more than 15' apart commonly develop mid-slab transverse cracks.



**Transverse,
open crack.**



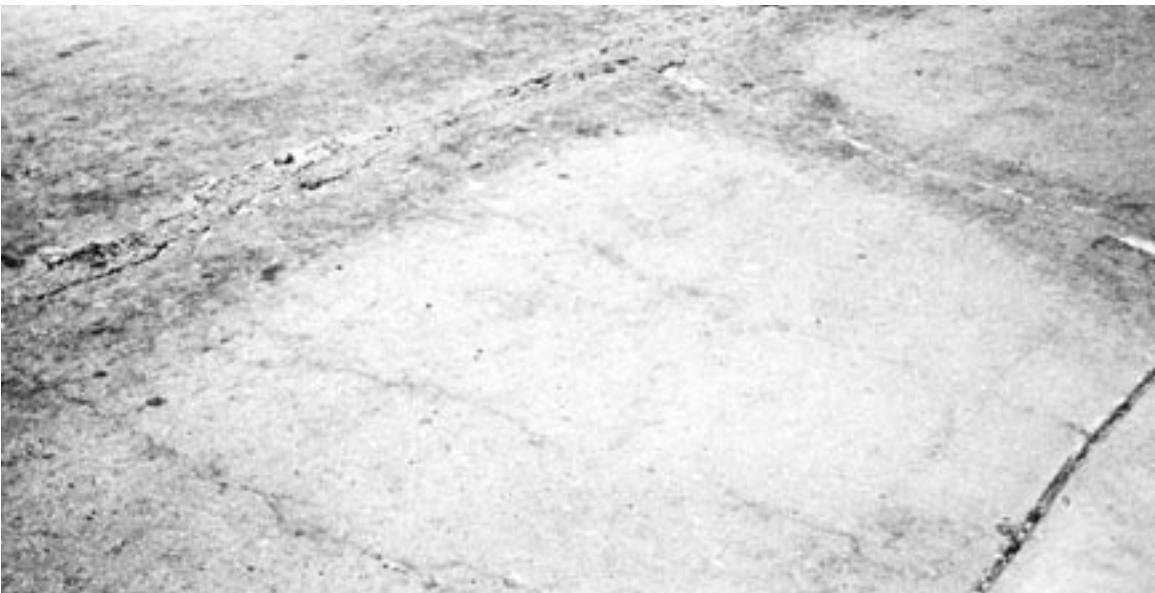
**Faulted transverse
crack with slight
edge spalling.**



As with joints, these cracks may deteriorate further if not sealed well. Slabs can fault at cracks which can spall and develop additional parallel cracking. Severe deterioration may require patching individual cracks. Multiple transverse cracks in individual slabs indicate further deterioration. Extensive transverse cracking indicates pavement failure and the need for complete replacement.



**Closely spaced,
hairline transverse
cracks. Indicates slab
is broken
and in need of
replacement.**



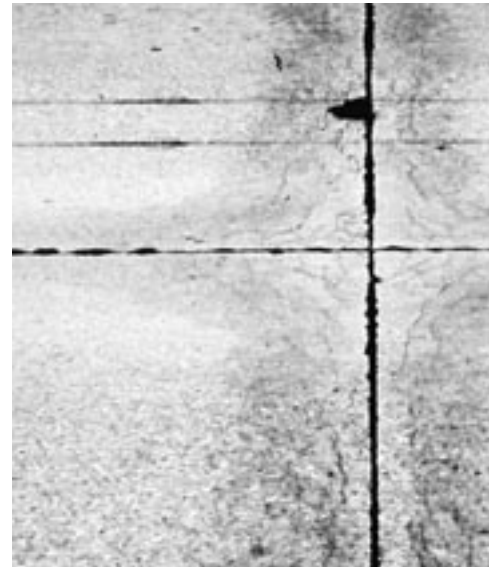
D-cracks

Occasionally, severe deterioration may develop from poor quality aggregate. So called D-cracking develops when the aggregate is able to absorb moisture. This causes the aggregate to break apart under freeze-thaw action which leads to deterioration. Usually, it starts at the bottom of the slab and moves upward.

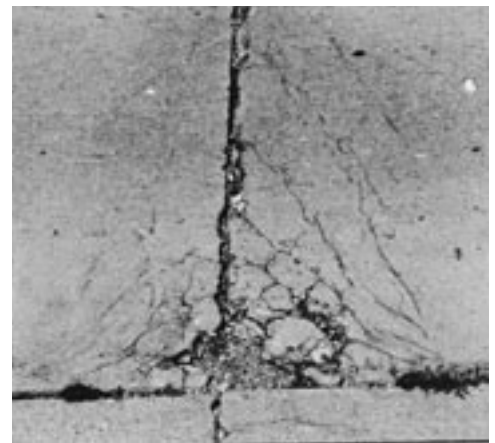
Fine cracking and a dark discoloration adjacent to the joint often indicate a D-cracking problem. Once this is visible on the surface the pavement material is usually severely deteriorated and complete replacement is required.

Joint or crack sealing helps slow D-cracking deterioration. This is a serious defect because it may indicate a material quality problem throughout the pavement.

Surface discoloration near joints and cracks indicates D-cracking and severe slab deterioration.



Multiple crack patterns adjacent to joints. Common D-cracking pattern.



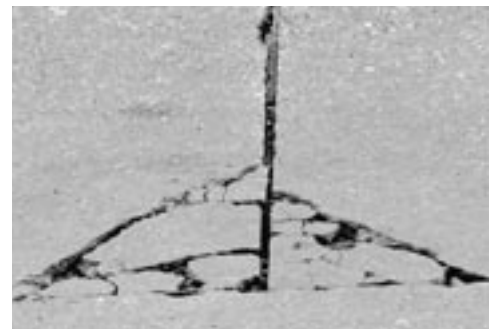
Corner cracks

Diagonal cracks near the corner of a concrete slab may develop, forming a triangle with a longitudinal and transverse joint. Usually these cracks are within one foot of the corner of the slab. They are caused by insufficient soil support or concentrated stress due to temperature related slab movement. The corner breaks under traffic loading. They may begin as hairline cracks.

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

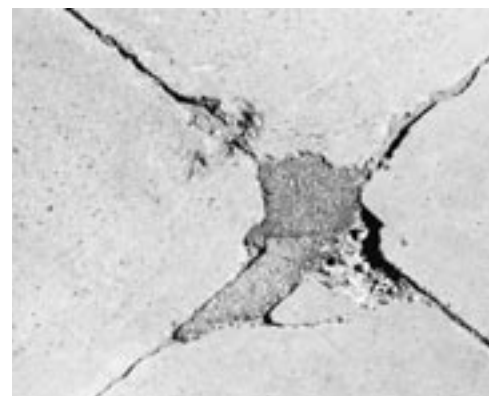
Partial or full depth concrete patching or full depth joint replacement may be necessary when corner cracking is extensive.

Corner cracking with broken concrete pieces.



First signs of corner cracking.

Severely spalled corner crack with missing pieces and patching.



Meander 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. Frost heave and spring thaw can also cause them. They are often local in nature and may not indicate general pavement problems.

Minor cracks may benefit from sealing to minimize water intrusion. Extensive or severe meander cracking may require replacing the slab, stabilizing the subsurface, or improving drainage.



Meander crack roughly parallel to longitudinal joint.



Meander crack caused by settlement. Lack of maintenance allows water to intrude and debris to collect in crack.



Faulting and spalling of a meander crack.

PAVEMENT DEFORMATION

Blowups

Concrete slabs may push up or be crushed at a transverse joint. This is caused by expansion of the concrete where incompressible materials (sand, etc.) have infiltrated into poorly sealed joints. As a result, there is no space to accommodate expansion. It is more common in older pavements with long joint spacing. Pressure relief joints can be installed and blowup areas must be patched or reconstructed.



◀ Internal pressure has partially raised slab at the joint. Complete replacement is required.

▼ A pavement blowup in progress. Concrete is crushed and slabs buckled.

Faulting

Joints and cracks may fault or develop a step between adjacent slabs. Faulting is caused by pumping of subgrade soils and creation of voids. Heavy truck or bus traffic can rapidly accelerate faulting. Longitudinal joints may fault due to settlement of an adjacent slab.

Faulting creates a poor ride and may cause slab deterioration. Minor faulting can be corrected by surface grinding. Voids can be subsealed, or slabs nudged back to level position. Severe cases may need joint replacement.



▲ Minor faulting of transverse joints. Aggravated by heavy traffic. Surface grinding will improve ride.



▲ Faulted longitudinal joint.



▶ Severely faulted joint. Slab jacking is necessary.

► Settlement caused meander crack with faulting.



Extensive cracking and patching caused by settlement. Pavement was built on unstable sub-grade soils.



Pavement settling or heave

Unstable or poorly drained subgrade soils may cause pavements to settle after construction. Poorly compacted utility trenches may also settle. This may be a gentle swale or a fairly severe dip.

Frost-susceptible soils and high water tables can cause pavements to heave during the winter months. Extensive pavement cracking and loss of strength during the spring can result in severe deterioration. Improved drainage and stabilization of subgrade soils are usually necessary, along with pavement reconstruction.

Utility repairs, patches and potholes

Replacement or repair of utilities will require cuts or utility openings. When repaired these pavement patches may show settlement, joint deterioration, or distress under continued traffic loading. Patches from previous repairs may perform like original pavement or experience joint deterioration or settlement.

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



▲ Utility repair or full depth joint repair. Very good condition.



▲ Asphalt patches. Poor (top) and fair (bottom) condition.



▲ Potholes caused by severe joint deterioration. Need repair.

Manhole and inlet cracks

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 or a storm sewer inlet. Cracks and faulting may develop and the concrete slab may deteriorate further. These are often localized defects that may not indicate a general pavement problem. Sealing and patching may slow the deterioration. Eventually full depth repairs may be required.

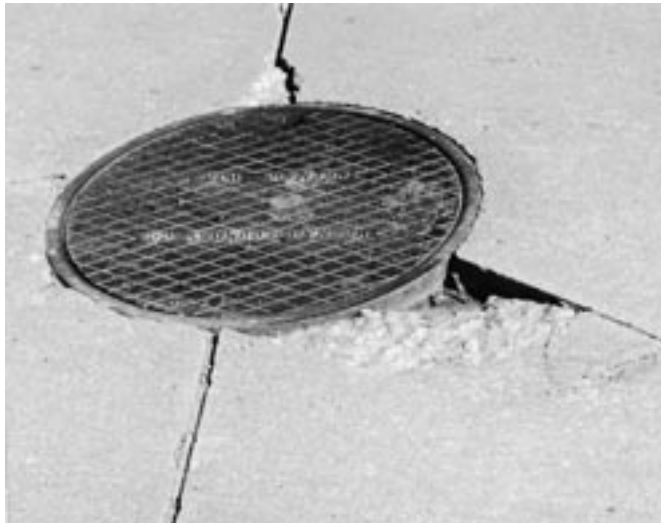
Curb or shoulder deformation

Concrete curb and gutter, or paved concrete shoulders, may separate from or settle along the main pavement. The longitudinal joints between the pavement and curb or shoulder may open, fault, or deteriorate like other longitudinal joints. When severe enough to disrupt drainage, the curb and gutter need to be replaced. Shoulder deterioration may require patching or replacement.

Settled gutter and joint filled with debris. Joint maintenance is needed. ▼



Extensive curb deterioration. Freeze-thaw damage to curb adjacent to inlet, and gutter is displaced. New curb and gutter are needed. ►



Two spalls at manhole in a new pavement. Partial depth patching would be beneficial. ◀



Extensive cracking and spalling at manhole requiring full depth repairs. ▼



Rating pavement surface condition

With an understanding of roadway conditions and distress, you can evaluate and rate concrete pavements. The rating scale ranges from **10—excellent** condition to **1—failed**. In general, most pavements will deteriorate through the phases listed in the rating scale. However, it is common for pavements to skip several levels when major defects appear or when the pavement is repaired. The time it takes to go from an excellent (10) to a very poor condition (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 pavements deteriorate rapidly. This is usually due to the combined effects of loading and 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 which follow and 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? In very poor condition and at the bottom of the scale? Or somewhere in between?

Next, think generally about the appropriate maintenance method.

Finally, review the individual pavement condition and distress and select the appropriate pavement rating. Remember that individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types. Use the categories in the table below and on page 16.

We have found that relating a normal maintenance or rehabilitation procedure to the surface rating scheme helps you

use the rating system. However, choosing an individual surface rating should not automatically dictate the final maintenance or rehabilitation technique.

You should consider safety, future traffic projections, original construction, and pavement strength since these may dictate a more comprehensive rehabilitation. On the other hand, it may be appropriate under special conditions to do nothing and let the pavement fully deteriorate and then rebuild when funds are available.

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 9 & 10	New pavement or recent concrete rehabilitation. No maintenance required.
Rating 7 & 8	First signs of wear, scaling, or cracking. Needs routine maintenance.
Rating 5 & 6	First signs of corner cracks, faulting, and joint or crack spalling. Requires surface repairs, sealing or partial depth patching.
Rating 3 & 4	Moderate to severe faulting, multiple slab cracking, and joint failure. Requires extensive slab or joint rehabilitation.
Rating 1 & 2	Pavement failure requiring complete reconstruction.

Rating system

Surface rating	Visible distress*	General condition/ treatment measures
10 Excellent	None.	New pavement. No maintenance required.
9 Excellent	Traffic wear in wheelpath. Slight map cracking or pop-outs.	Recent concrete overlay or joint rehabilitation. Like new condition. No maintenance required.
8 Very Good	Pop-outs, map cracking, or minor surface defects. Slight surface scaling. Partial loss of joint sealant. Isolated meander cracks, tight or well sealed. Isolated cracks at manholes, tight or well sealed.	More surface wear or slight defects. Little or no maintenance required.
7 Good	More extensive surface scaling. Some open joints. Isolated transverse or longitudinal cracks, tight or well sealed. Some manhole displacement and cracking. First utility patch, in good condition. First noticeable settlement or heave area.	First sign of transverse cracks (all tight); first utility patch. More extensive surface scaling. Seal open joints and other routine maintenance.
6 Good	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (1/4" wide) longitudinal or transverse joints and more frequent transverse cracks (some open 1/4").	First signs of shallow reinforcement or corner cracking. Needs general joint and crack sealing. Scaled areas could be overlaid.
5 Fair	Moderate to severe polishing or scaling over 25% of the surface. High reinforcing steel causing surface spalling. Some joints and cracks have begun spalling. First signs of joint or crack faulting (1/4"). Multiple corner cracks with broken pieces. Moderate settlement or frost heave areas. Patching showing distress.	First signs of joint or crack spalling or faulting. Grind to repair surface defects. Some partial depth patching or joint repairs needed.
4 Fair	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (1/2") with fair ride. Several slabs have multiple transverse or meander cracks with moderate spalling. Spalled area broken into several pieces. Corner cracks with missing pieces or patches. Pavement blowups.	Needs some full depth repairs, grinding, and/or asphalt overlay to correct surface defects.
3 Poor	Most joints and cracks are open, with multiple parallel cracks, severe spalling, or faulting. D-cracking is evident. Severe faulting (1") giving poor ride. Extensive patching in fair to poor condition. Many transverse and meander cracks, open and severely spalled.	Needs extensive full depth patching plus some full slab replacement.
2 Very Poor	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements or frost heaves.	Recycle and/or rebuild pavement.
1 Failed	Restricted speed. Extensive potholes. Almost total loss of pavement integrity.	Total reconstruction.

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



RATING 10 & 9

EXCELLENT —

No maintenance required

Rating 10 is for new pavement. Rating 9 is used for recent concrete rehabilitation or like-new condition. Some traffic wear. Slight map cracking or pop-outs. No maintenance required.



RATING 10
New pavement
with integral
curb.



RATING 9
Like new
condition.



RATING 9
Recent joint
rehabilitation.
Like new
condition.

RATING 8

VERY GOOD — Little or no maintenance required

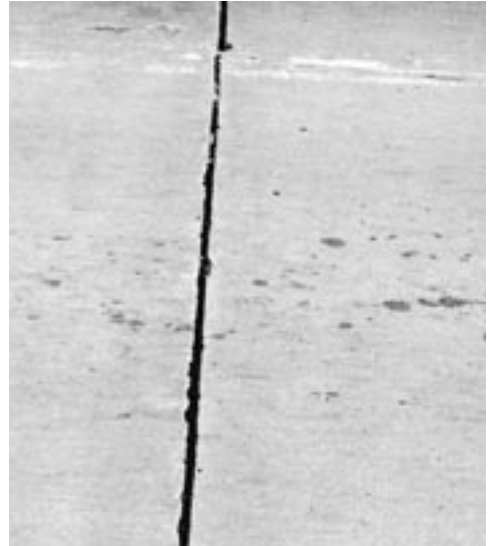
More surface wear, or slight defects showing in lanes. Pop-outs, slight surface scaling, partial loss of joint sealant, or isolated meander crack. Isolated manhole distress. Little or no maintenance required.



▶ Slight scaling.



▶ Isolated spall at manhole.



▲ Partial loss of joint sealant.



▶ Isolated meander crack, tight and well sealed.

RATING 7

GOOD — May require some routine sealing or maintenance

First signs of transverse cracking, patching or repair; more extensive pop-outs or scaling; some manhole displacement, isolated heave or settlement. May need some sealing or routine maintenance.

◀ **Residential street pavement in good condition after many years of service. May only need periodic joint sealing maintenance.**



◀ **Extensive pop-outs. Pavement is unsightly but still provides good level of service.**



◀ **Recent full depth pavement repair. In very good condition.**



◀ **Well sealed transverse crack. Joint repairs in good condition.**

◀ **Transverse crack. Tight, sound pavement.**

RATING 6

GOOD — Joint and crack sealing needed

First signs of corner cracking or shallow reinforcement. More frequent transverse cracks. Open (1/4") joints and cracks. Moderate scaling. Needs joint and crack sealing.

▶
Several transverse cracks. Tight or well sealed.



▼
Surface rust stain. Indicates shallow reinforcing.

▶
Moderate scaling.



▲ **First signs of corner cracks.**



▲ **Isolated, tight meander crack. Several pop-outs. Remaining joints and cracks all tight and sound.**



RATING 5

FAIR — Partial depth patching and joint repairs may be needed

First signs of joint or crack spalling, or faulting. Multiple cracking at corners with broken pieces. Patching in fair condition. Surface texturing repairs may be necessary. Some partial depth patching and joint repairs may be needed.



Faulting at longitudinal joint and spalling along joint edge.



First signs of transverse joint faulting. Grinding will improve ride.



▲ **Open cracks with edge spalling. Corner crack and broken corner piece.**



▲ **Isolated manhole problems and joint spalling. Full depth repair required adjacent to manhole.**

RATING 5

FAIR — (continued)
Partial depth patching
and joint repairs may
be needed

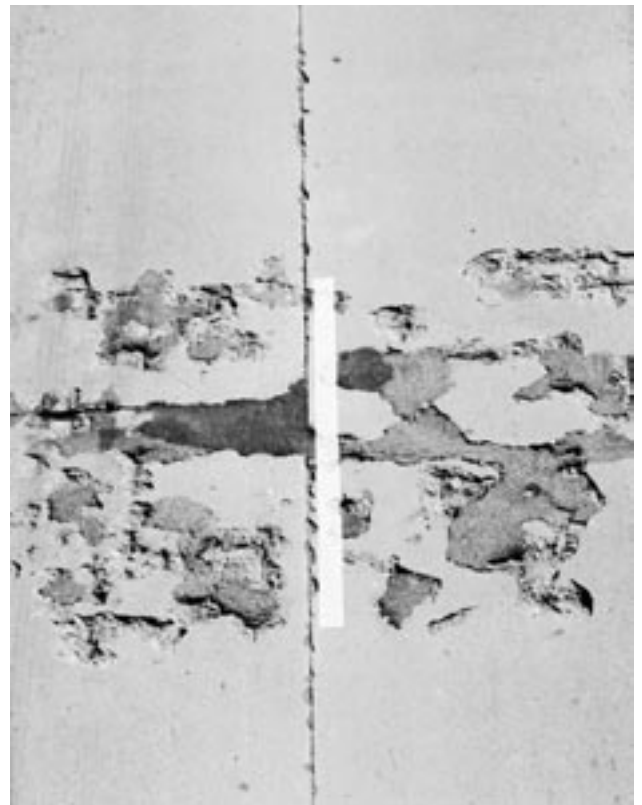
▶ Broken corner
pieces. Some
joint spalling.



Patching in
▼ fair condition.



▲ Severe scaling over extensive areas.
Patching or overlay needed.



▲ Spalling caused by shallow reinforcing steel.
Temporary patching needs to be followed
by extensive partial depth repairs.

Wide open meander crack (1") with edge spalling.
 ▼ Corner crack with spalling.



RATING 4

FAIR — Some full depth joint or crack repair required

Severe surface distress requires asphalt overlay or extensive surface texturing. Multiple transverse cracks with spalling and broken pieces. Corner cracking with potholes or patches. Blowups. Some full depth joint or crack repair required.

◀ All joints show some deterioration and spalling.



◀ Multiple open transverse cracks. Failed corner crack. Patches in fair condition.



▲ Corner cracking developed into small hole; moderate spalling of transverse crack.



◀ Moderate spalling at transverse joint.



◀ Moderate to severe longitudinal joint faulting. Transverse joint also has spalling.

RATING 3

POOR — Extensive full depth patching plus some full slab replacement required

Most joints and cracks are open (1"), spalled, or patched. D-cracking is evident. Severe (1") faulting. Extensive full depth patching required plus some full slab replacement.

▶
Joints and cracks badly spalled. Patching is failing. Full depth repairs required.



Multiple transverse cracks. Poor longitudinal joint with spalling.
▼



▶
D-cracking (discoloration) at transverse joint and corner cracking. Needs full-depth repair.



▶
Discoloration at joints indicates D-cracking. Slab replacement needed.



▶
Badly spalled joint and open crack. Slab or joint replacement needed.



▲ **Failed joint needs replacement.**



RATING 2

VERY POOR — Pavement recycling and reconstruction necessary

◀ Failed patches. Replace entire portion of lane.



▲ Remove and replace pavement around manhole and inlet.



◀ Closely spaced transverse cracks and poor longitudinal joint. Replace slab.



▲ Extensive joint failure. Major rehabilitation or complete replacement needed.

◀ Severe deterioration. Requires extensive reconstruction.

RATING 1

FAILED — Complete reconstruction necessary

▶
Slab and patch failure.



▶
Broken slabs require complete rebuilding.



▶
Total failure.



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, an actual 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 ratings decisions are likely to be more consistent because the roadway system is considered as a whole within a relatively short time.

An inspection also encourages a review of specific conditions important in roadway maintenance, such as drainage, adequate strength, and safety.

A simple written inventory is useful in making decisions where other people are involved. You do not have to trust your memory, and you can usually answer questions in more detail. Having a written record 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 your overall 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.

The Wisconsin DOT local road inventory (WISLR) is a valuable resource for managing your local roads. Adding PASER surface condition ratings is an important improvement.

Averaging and comparing sections

For evaluation, divide the local road system into individual segments which are similar in construction and condition. Rural segments may vary from ½ mile to a mile long, while sections in urban areas will likely be 1-4 blocks

long or more. If you are starting with the WISLR Inventory, the segments have already been established. You may want to review them for consistent road conditions. Obviously no roadway segment is entirely consistent. Also, individual pavements 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. It is useful to note special conditions on the inventory form so this information can be used in project design. For example, some spot repairs may be required.

Occasionally pavement conditions will vary significantly. For example, short sections of good condition may be followed by sections of poor pavement conditions. In this case, it is best to rate the pavement according to the worst conditions and note the variation on the form.

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 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 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 important and useful.

Assessing drainage conditions

Moisture and poor pavement drainage are significant factors in pavement deterioration. Some assessment of drainage conditions during pavement rating is highly recommended. While you should review drainage in detail at the project level, at this stage simply include an

▼ Urban drainage. **RATING: Excellent**



▲ Adequate rural ditch and good erosion control. **RATING: Good**

overview drainage evaluation at the same time as you evaluate surface condition.

Look at the roadway crown and check for low surface areas that permit ponding. Paved surfaces should have approximately a 2% cross slope or crown across the roadway. Rural

shoulders should have a greater slope to improve surface drainage.

Good drainage improves a pavement's ability to resist pumping, faulting and joint damage. Some new concrete pavements are being constructed with a special drainage layer and drain system to reduce water-related deterioration.

These systems require inspection and periodic maintenance.

You should also check curb and gutter, culverts, and storm drain systems. Storm drainage systems that are silted in, have a large accumulation of debris, or are in poor structural condition will also degrade pavement performance.

The T.I.C. publication, *Drainage Manual: Local Road Assessment and Improvement*, describes the elements of drainage systems, depicts them in detailed photographs,

and explains how to rate their condition. Copies are available from the T.I.C.

Planning annual maintenance and repair budgets

We have found that relating a normal maintenance or rehabilitation procedure to the surface rating scheme helps local officials use the rating system. However, an individual surface rating should not automatically dictate the final maintenance or rehabilitation technique.

You should consider safety, future traffic projections, original construction, and pavement strength since these may dictate a more comprehensive rehabilitation than the rating suggests. On the other hand, it may be appropriate under special conditions to do nothing and let the pavement fully deteriorate, then rebuild when funds are available.

Summary

Using local 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 concrete pavement surface condition rating procedure has proved effective in improving decision making and using roadway funds more efficiently. It can be used directly by local officials and staff. It may be combined with additional testing and data collection in a more comprehensive pavement management system.



▲ Reshape terrace behind curb to restore drainage and prevent damage to curb and street.

RATING: Fair



► Flooding. Curb and gutter need reconstruction.

RATING: Poor

**Transportation
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Publications**

Pavement Surface Evaluation and Rating (PASER) Manuals

Asphalt PASER Manual, 2002, 28 pp.

Brick and Block PASER Manual, 2001, 8 pp.

Concrete PASER Manual, 2002, 28 pp.

Gravel PASER Manual, 2002, 20 pp.

Sealcoat PASER Manual, 2000, 16 pp.

Unimproved Roads PASER Manual, 2001, 12 pp.

Drainage Manual

Local Road Assessment and Improvement, 2000, 16 pp.

SAFER Manual

Safety Evaluation for Roadways, 1996, 40 pp.

Flagger's Handbook (pocket-sized guide), 1998, 22 pp.

Work Zone Safety, Guidelines for Construction, Maintenance, and Utility Operations, (pocket-sized guide), 2002, 58 pp.

Wisconsin Transportation Bulletins

- #1 Understanding and Using Asphalt
- #2 How Vehicle Loads Affect Pavement Performance
- #3 LCC—Life Cycle Cost Analysis
- #4 Road Drainage
- #5 Gravel Roads
- #6 Using Salt and Sand for Winter Road Maintenance
- #7 Signing for Local Roads
- #8 Using Weight Limits to Protect Local Roads
- #9 Pavement Markings
- #10 Seal Coating and Other Asphalt Surface Treatments
- #11 Compaction Improves Pavement Performance
- #12 Roadway Safety and Guardrail
- #13 Dust Control on Unpaved Roads
- #14 Mailbox Safety
- #15 Culverts-Proper Use and Installation
- #16 Geotextiles in Road Construction/Maintenance and Erosion Control
- #17 Managing Utility Cuts
- #18 Roadway Management and Tort Liability in Wisconsin
- #19 The Basics of a Good Road
- #20 Using Recovered Materials in Highway Construction
- #21 Setting Speed Limits on Local Roads

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