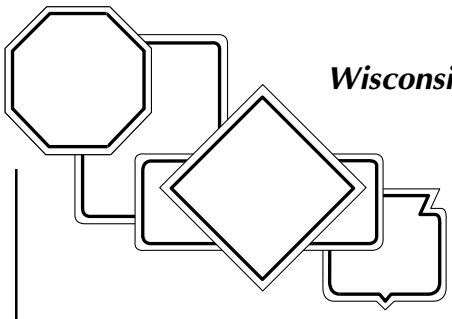


The Basics of a Good Road

We have known how to build good roads for a long time. Archaeologists have found ancient Egyptian roads that carried blocks to the pyramids in 4600 BCE. Later, the Romans built an extensive road system, using the same principles we use today. Some of these roads are still in service.

If you follow the basic concepts of road building, you will create a road that will last. The ten commandments of a good road are:

1. **Get water away from the road**
2. **Build on a firm foundation**
3. **Use the best materials**
4. **Compact all layers properly**
5. **Design for traffic loads and volumes**
6. **Design for maintenance**
7. **Pave only when ready**
8. **Build from the bottom up**
9. **Protect your investment**
10. **Keep good records**

1 Get water away from the road

We can't overemphasize the importance of good drainage. Engineers estimate that at least 90% of a road's problems can be related to excess water or to poor water drainage. Too much water in any layer of a road's structure can weaken that layer, leading to failure.

In the surface layer, water can cause cracks and potholes. In lower layers it undermines support, causing cracks and potholes. A common sign of water in an asphalt road surface is alligator cracking — an interconnected pattern of cracks forming small irregular shaped pieces that look like alligator skin. Edge cracking, frost heaves, and spring breakup of pavements also point to moisture problems.

To prevent these problems remember that water:

- flows downhill
- needs to flow someplace
- is a problem if it is not flowing

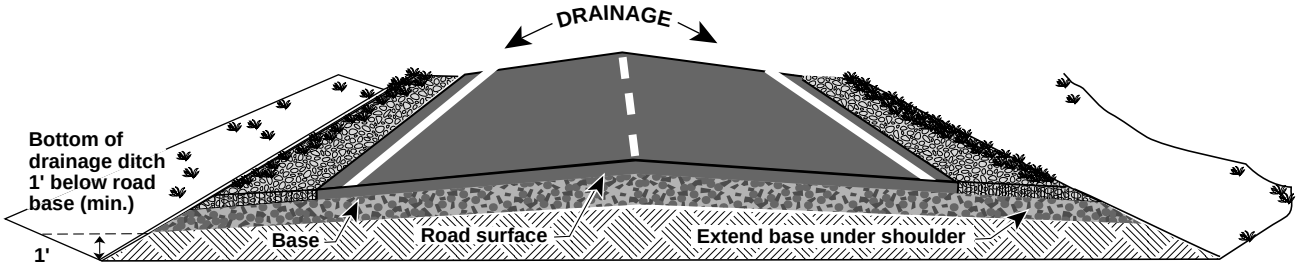
Effective drainage systems divert, drain and dispose of water. To do this they use interceptor ditches and slopes, road crowns, and ditch and culvert systems.

Divert — Interceptor ditches, located between the road and higher ground along the road, keep the water from reaching the roadway. These ditches must slope so they carry water away from the road.

Drain — Creating a crown in the road so it is higher along the centerline than at the edges encourages water to flow off the road. Typically a paved crown should be 1/4" higher than the shoulder for each foot of width from the centerline to the edge. For gravel surfaces the crown should be 1/2" higher per foot of width. For this flow path to work, the road surface must be relatively water tight. Road shoulders also must be sloped away from the road to continue carrying the flow away. Superelevations (banking) at the outside of curves will also help drain the road surface.

Dispose — A ditch and culvert system carries water away from the road structure. Ditches should be at least one foot lower than the bottom of the gravel road layer that drains the roadway. They must be kept clean and must be sloped to move water into natural drainage. If water stays in the ditches it can seep back into the road structure and undermine its strength. Ditches should also be protected from erosion by planting grass, or installing rock and other erosion control measures. Erosion can damage shoulders and ditches, clog culverts, undermine roadbeds, and contaminate nearby streams and lakes.

Evaluate your ditch and culvert system twice a year to ensure that it works. In the fall, clean out leaves and branches that can block flow. In spring, check for and remove silts from plowing and any dead plant material left from the fall.



Proper drainage keeps road surface hard.

2 Build on a firm foundation

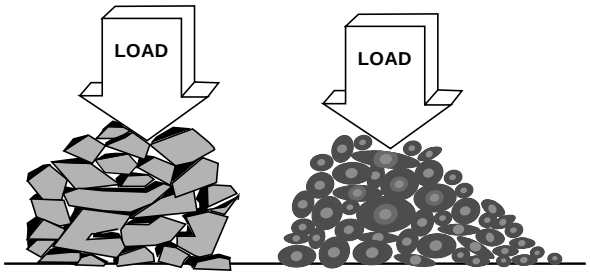
A road is only as good as its foundation. A highway wears out from the top down but falls apart from the bottom. The road base must carry the entire structure and the traffic that uses it.

To make a firm foundation you may need to stabilize the roadbed with chemical stabilizers, large stone called *breaker run,* or geotextile fabric. When you run into conditions where you suspect that the native soil is unstable, work with an engineer to investigate the situation and design an appropriate solution.

3 Use the best materials

With all road materials you "pay now or pay later." Inferior materials may require extensive maintenance throughout the road's life. They may also force you to replace the road prematurely.

Crushed aggregate is the best material for the base course. The sharp angles of the crushed material interlock when they are compacted. This supports the pavement and traffic by transmitting the load from particle to particle. By contrast, rounded particles act like ball bearings, moving under loads.



Angular particles are more stable than rounded particles.

Asphalt and concrete pavement materials must be of the highest quality, designed for the conditions, obtained from established firms, and tested to ensure it meets specifications.

4 Compact all layers

In general, the more densely a material is compacted, the stronger it is. Compaction also shrinks or eliminates open spaces (voids) between particles. This means that less water can enter the structure. Water in soil can weaken the structure or lead to frost heaves. This is especially important for unsurfaced (gravel) roads. Use gravel which has a mix of sizes (well-graded aggregate) so smaller particles can fill the voids between larger ones. Good compaction of asphalt pavement lengthens its life.

5 Design for traffic loads and volumes

Design for the highest anticipated load the road will carry. A road that has been designed only for cars will not stand up to trucks. One truck with 9 tons on a single rear axle does as much damage to a road as nearly 10,000 cars.

Rural roads may carry log trucks, milk trucks, fire department pumper trucks, or construction equipment. If you don't know what specific loads the road will carry, a good rule of thumb is to design for the largest piece of highway maintenance equipment that will be used on the road.

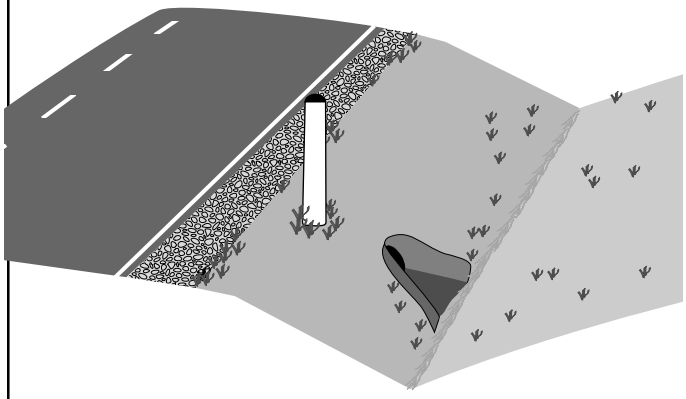
A well-constructed and maintained asphalt road should last 20 years without major repairs or reconstruction. In designing a road, use traffic counts that project numbers and sizes of vehicles 20 years into the future. These are only projections, at best, but they will allow you to plan for traffic loadings through a road's life.

6 Design for maintenance

Without maintenance a road will rapidly deteriorate and fail. Design your roads so they can be easily maintained. This means:

- adequate ditches that can be cleaned regularly
- culverts that are marked for easy locating in the spring
- enough space for snow after it is plowed off the road
- proper cross slopes for safety, maintenance and to avoid snow drifts
- roadsides that are planted or treated to prevent erosion
- roadsides that can be mowed safely

A rule of thumb for adequate road width is to make it wide enough for a snowplow to pass another vehicle without leaving the travelled way.



Mark culverts with a post so they can be located easily.

7 Pave only when ready

It is not necessary to pave all your roads immediately. There is nothing wrong with a well-built and well-maintained gravel road if traffic loads and volume do not require a paved surface. Three hundred vehicles per day is the recommended minimum to justify paving.

Don't assume that laying down asphalt will fix a gravel road that is failing. Before you pave, make sure you have an adequate crushed stone base that drains well and is properly compacted. The recommended minimum depth of crushed stone base is 10" depending on subgrade soils.

A road paved only when it is ready will far outperform one that is constructed too quickly.

8 Build from the bottom up

This commandment may seem obvious, but it means that you shouldn't top dress or resurface a road if the problem is in an underlying layer. Before you do any road improvement, locate the cause of any surface problems. Choose an improvement technique that will address the problem. This may mean recycling or removing all road materials down to the native soil and rebuilding everything. Doing any work that doesn't solve the problem is a waste of money and effort.

9 Protect your investment

The road system can be your municipality's biggest investment. Just as a home needs painting or a new roof, a road must be maintained. Wisconsin's severe climate requires more road maintenance than in milder places.

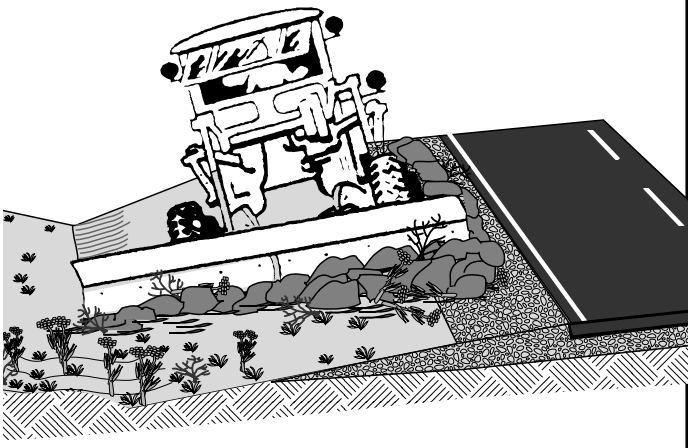
Do these important maintenance activities:

Surface — grade, shape, patch, seal cracks, control dust, remove snow and ice

Drainage — clean and repair ditches and culverts; remove all excess material

Roadside — cut brush, trim trees and roadside plantings, control erosion

Traffic service — clean and repair or replace signs



Design roads with adequate ditches so they can be maintained with a motor grader. Clean and grade ditches to maintain proper pitch and peak efficiency. After grading, remove all excess material from the shoulder.

10 Keep good records

Your maintenance will be more efficient with good records. Knowing the road's construction, life, and repair history makes it much easier to plan and budget its future repairs. Records can also help you evaluate the effectiveness of the repair methods and materials you used.

Good record keeping starts with an inventory of the system. It should include the history and surface condition of the roadway, identify and evaluate culverts and bridges, note ditch conditions, shoulders, signs, and such structures as retaining walls and guardrails.

Update your inventory each year or when you repair or change a road section. A formal pavement management system can help use these records and plan and budget road improvements.

Resources

The Basics of a Good Road #17649, UW-Madison, 15 min. videotape. Presents the Ten Commandments of a Good Road. Videotapes are loaned free through County Extension offices.

Asphalt PASER Manual (39 pp), **Concrete PASER Manual** (48 pp), **Gravel PASER Manual** (32 pp). These booklets contain extensive photos and descriptions of road surfaces to help you understand types of distress conditions and their causes. A simple procedure for rating the condition helps you manage your pavements and plan repairs.

Roadware, a computer program which stores and reports pavement condition information. Developed by the Transportation Information Center and enhanced by the Wisconsin Department of Transportation, it uses the PASER rating system to provide five-year cost budgets and roadway repair/reconstruction priority lists.

Wisconsin Transportation Bulletin factsheets, available from the Transportation Information Center (T.I.C.).

Road Drainage, No. 4. Describes drainage for roadways, shoulders, ditches, and culverts.

Gravel Roads, No. 5. Discusses the characteristics of a gravel road and how to maintain one.

Using Salt and Sand for Winter Road Maintenance, No. 6. Basic information and practical tips on how to use de-icing chemicals and sand.

Culverts—Proper Use and Installation, No. 15. Selecting and sizing culverts, designing, installing and maintaining them.

Geotextiles in Road Construction/Maintenance and Erosion Control, No. 16. Definitions and common applications of geotextiles on roadways and for erosion control.

T.I.C. workshops are offered at locations around the state.

Crossroads, an 8-page quarterly newsletter published by the T.I.C. carries helpful articles, workshop information, and resource lists.

For more information on any of these materials, contact the T.I.C. at 800/442-4615.

This fact sheet was written by Thomas Nelson to accompany the videotape, ***The Basics of a Good Road.*** *It is based on a fact sheet produced by the Vermont Local Road Program.*

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