

Under Washington state law, WSDOT is instructed to follow the lowest life-cycle cost methods in pavement management. Less durable pavements do not meet this legislative direction since they require more upkeep and are more expensive to maintain.

How Does a Shorter Lifecycle Affect Costs?

Shorter pavement lives increase the cost of replacing the pavement as well as the cost of inconveniencing the traveling public. On heavily traveled urban highways the indirect costs of traffic delays often overshadow the direct costs of paving the road.

A pavement that lasts only half as long can be more than twice as expensive as a more durable pavement, which makes pavement durability an important factor when choosing a type of pavement.

WSDOT operates the Washington State Pavement Management System, one of the most sophisticated pavement management systems in the world, to manage pavements under the lowest life cycle cost. This system measures pavement conditions on all state highways annually.

Any decrease in the life cycle of a particular type of pavement means that the budget must increase to maintain those pavements.

Next Steps

WSDOT is studying new generations of quieter pavements to determine not only initial noise reduction, but also long-term noise reduction performance, as well as to characterize the quieter pavement according to durability, smoothness and skid resistance.

There are several unanswered questions about quieter pavements including:

- How long does the initial noise reduction last?
- How durable is the pavement under Washington state climate and traffic conditions?

Concrete (PCC) Quieter Pavement Trial Projects

WSDOT is testing new PCC pavement textures that might increase pavement performance in high traffic corridors in Washington State, while also decreasing pavement noise:

- Southbound I-5 at 317th in Federal Way (begun in 2005)
- On I-90 in Spokane (begun in 2005)
- Northbound I-5 near Federal Way (2006)

Asphalt (HMA) Quieter Pavement Trial Project

WSDOT is planning on constructing two OGFC test sections (one modified with an asphalt rubber binder and the other modified with a polymer modified binder) on I-5 in Snohomish County from 52nd Avenue West to SR-526 (southbound). The test sections will include all lanes and shoulders of the southbound highway from milepost 187.29 to milepost 188.65. Work is scheduled to begin in Summer 2006.

Quieter Pavement Research Project

WSDOT will continue to investigate quieter pavement use nationwide, paying particular attention to pavement durability and life cycle costs.

Noise Measuring Equipment

WSDOT purchased additional equipment to directly measure the noise attributed to the tire/pavement interaction. This "sound intensity" measurement excludes engine and vehicle noise, measuring only the tire/pavement noise. Using this technology we will be able to compare the noise characteristics of different pavement surfaces no matter their geographic location.

WSDOT is working closely with the California Department of Transportation and the Federal Highway Administration to ensure uniformity in the data collection and measurement process.

For More Information

For more information on quieter pavement, please visit:
www.wsdot.wa.gov/biz/mats/pavement/QuieterPavements.htm

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Noise issues are a major concern for many residents in our heavily traveled urban areas and WSDOT is studying ways to reduce traffic noise.

Historically, the most effective method of reducing traffic noise has been the use of noise barriers, including noise walls and raised hillsides next to roadways. Yet noise barriers can be costly to install and are only practical in certain cases.

WSDOT is considering quieter pavement as a potential new method for designing pavements to reduce noise. Quieter pavements have some attractive characteristics such as reducing traffic noise and reducing the splash and spray from rainfall. However, quieter pavements also have some drawbacks, including decreased pavement durability and greater construction and maintenance expense.

Why Are We Looking at Quieter Pavements?

Noise is a common complaint along highways and many residents want solutions that will reduce traffic noise experienced at their homes.

Requests for noise reduction are increasing along several central Puget Sound highways including State Route 520, Interstate 90, Interstate 405, and Interstate 5.

The challenge is to design pavements that reduce noise, while still providing durable, smooth, and safe surfaces.

What are Quieter Pavements?

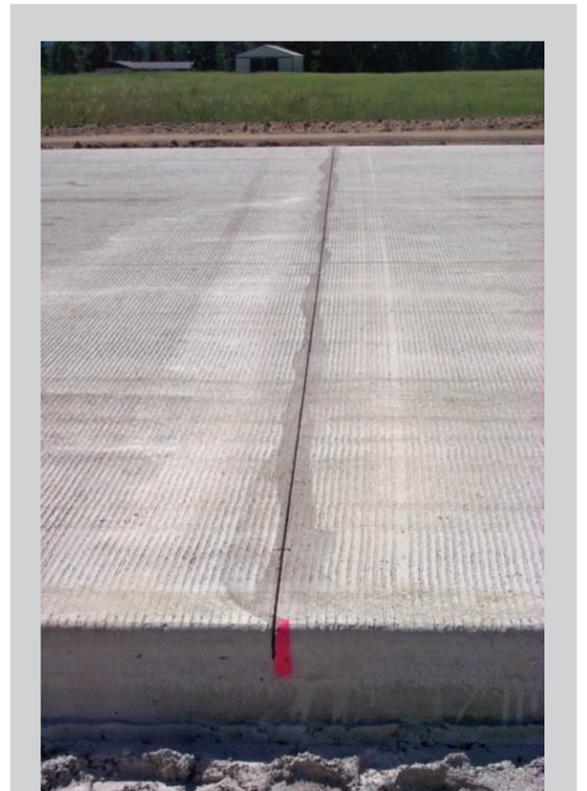
Quieter pavements initially reduce the noise created as a tire rolls along the pavement surface as compared to traditional pavements. Noise reduction primarily results from the type of surface texture used on the pavement.

What Kind of Pavements are Used in Washington?

Pavements in urban areas of Washington State are made of either Portland Cement Concrete (PCC) or Hot Mixed Asphalt (HMA). Both can be made quieter, although often with trade-offs in performance.

What is Portland Cement Concrete?

PCC is most commonly found on the heavily traveled urban corridors because of its durability. Durable pavements require less maintenance and rehabilitation treatments, therefore reducing costs and construction impacts to the traveling public. To enhance skid resistance, Washington state traditionally uses concrete pavements with a textured surface, which have created one of the louder pavements types.



Shown above is a transversely tined PCC surface, one of the most durable but also one of the noisiest pavement types. Tining is created by dragging a mechanical or hand rake transversely across the freshly laid concrete to create shallow channels on an otherwise smooth surface.

What is Hot Mixed Asphalt?

HMA can either be dense or open graded.

Dense-graded HMA also has a long and successful history on heavily traveled urban pavements in Washington state. Unlike Open Graded Friction Course pavement (OGFC), dense-graded HMA pavements have relatively few voids which results in a tight surface that minimizes the ability of water to enter the pavement structure. Dense-graded HMA pavements have good durability and skid resistance, but also tend to be slightly noisier than OGFC pavements.

How Do We Make Road Surfaces Quieter?

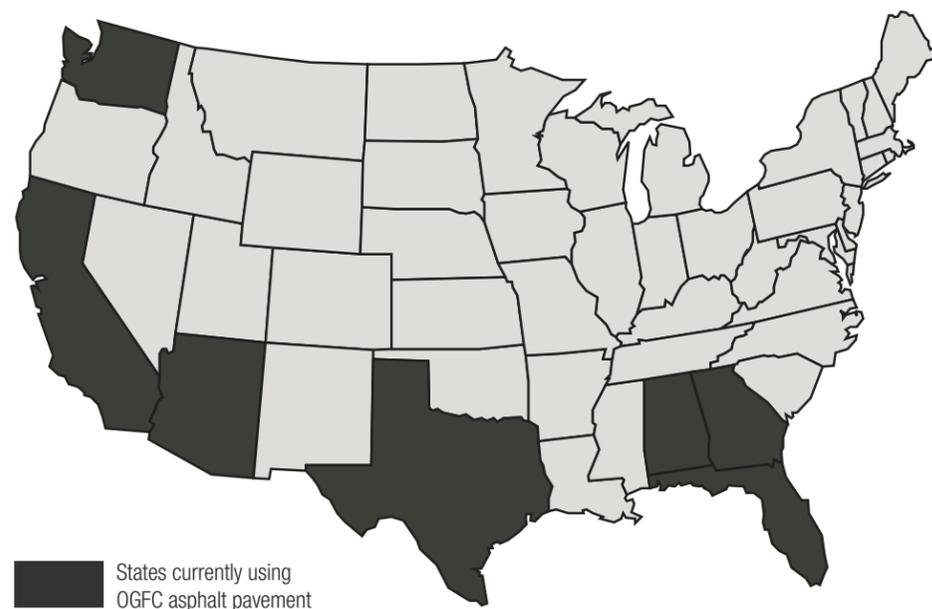
For any pavement type, the key is to make it as quiet as possible without reducing the pavement's durability, smoothness or skid resistance. Another important consideration is how long a pavement can maintain the lower noise levels.

How Do We Make Concrete Quieter?

Obtaining quieter Portland Cement Concrete (PCC) pavements depends on the pavement surface texture. Since the late 1970's, the Federal Highway Administration has required that PCC pavement textures provide skid resistant surfaces on all federally funded highway projects, which includes all interstate roadways. This resulted in the widespread use of transverse tining, which is now known to potentially be one of the loudest surface textures.

Currently there are several texturing alternatives (longitudinal tining, Astroturf drag and diamond grinding) that can provide a pavement surface that is just as safe as transverse tining, but which also result in a quieter surface.

WSDOT, along with many other agencies, is testing newer designs and using new surface textures, to determine how much initial noise reduction can be achieved, as well as the long-term effects of maintaining a reduced noise level. Based on current PCC pavement performance, in conjunction with recent design modifications, WSDOT estimates that a PCC pavement can be designed and constructed so there are minimal future maintenance and rehabilitation treatment needs over a 50 year period.



Most of the states using Open Graded Friction Course (OGFC) pavements are located in the south, where the weather is warmer and studded tires are rarely—if ever—used.



Washington state has generally used “dense graded” HMA pavements, rather than “open graded.” Dense graded pavements have good durability and skid resistance, but also tend to be slightly noisier than OGFC pavements.

Pavement Texture

- The type of pavement texture determines the amount of noise created as a tire rolls along the surface. “Negative texture” refers to small holes in the pavement that capture noise.
- “Positive texture” refers to small bumps sticking up out of the pavement.

Pavement Types

- Dense graded hot mix asphalt (HMA) pavement
- Portland cement concrete (PCC) pavement
- Open graded friction course (OGFC) pavement



Close-up of an OGFC pavement. The texture includes holes or air voids which absorb sound.



An example of studded tire damage on an early generation OGFC pavement in Washington state. Note the ruts caused by studded tires.

What does Washington State Law say?

Titled “Priority Programming for Highway Development,” Section 47.05 of the Revised Code of Washington (RCW) directs WSDOT to manage a preservation program using “the most cost-effective pavement surfaces.”

Several factors need to be considered, including:

- (a) Life-cycle cost analysis
- (b) Traffic volume
- (c) Subgrade soil conditions
- (d) Environmental and weather conditions
- (e) Materials available; and
- (f) Construction factors

How Do We Make Asphalt Quieter?

Hot mixed asphalt (HMA) pavements can be designed to reduce noise by increasing the negative surface texture. In such cases, the pavement is built with a texture that contains many tiny air holes or voids. The air voids absorb and dissipate the sound generated at the tire-pavement interface. Such pavements are usually called open graded friction courses (OGFC) and are often referred to as the HMA version of quieter pavements.

In addition to reducing noise, these pavements also reduce splash and spray by draining water through the pavement, rather than across the pavement surface. OGFC also tends to have excellent skid resistance, improving the stopping distance of cars in wet weather. Yet, the downside of OGFC pavements is that they deteriorate more quickly than dense-graded HMA pavements.

WSDOT designs and constructs dense-graded HMA pavements for a 50 year design life, however, rehabilitation (typically an HMA overlay) cycles are required, approximately, every 16 years. Therefore, an HMA pavement will require at least three rehabilitation treatments over the 50 year period.

How Have Quieter Pavements Performed in Other States?

Other states using OGFC pavements report an initial reduction in noise of 3 to 5 decibels, compared to other pavements (concrete, dense-graded HMA). A 3-decibel change is roughly equivalent to cutting traffic volume in half, whether it be from 2000 to 1000 vehicles, or 200,000 to 100,000 vehicles.

California, Arizona, Texas, Georgia, Alabama and Florida, report an average OGFC pavement life of 8 to 10 years. This is about one-half of the 16-year pavement life of western Washington dense-graded HMA pavements.

What is WSDOT's Experience with OGFC Pavements?

Early designs of OGFC pavements were built in western Washington in the 1990s primarily for their better drainage properties. They have performed poorly.

WSDOT built three projects on I-5 in the 1990s that used the earlier generation of OGFC pavements. These projects rutted rapidly due to studded tire wear, trapping water in the ruts and increasing the risk of hydroplaning. The lifecycle of these pavements was one-third to one-half that of comparable dense-grade HMA, or five to eight years.

What are the Challenges?

Most states using OGFC pavements have much warmer climates than Washington State, a clear advantage in installing these pavements. According to the Arizona DOT specification, the temperature of the existing surface, prior to placement of the OGFC pavement, is required to be 85°F. Washington State urban pavements, placed at night to avoid traffic impacts, rarely reach this temperature during the available nighttime paving hours of 10 p.m. to 5 a.m.

What about Studded Tires?

Studded tires are legal in Washington state from November 1 to March 31. They have the potential to rapidly damage the OGFC pavement, resulting in raveling and rutting. States where the use of OGFC has been successful (California, Arizona, Texas, Georgia, Alabama and Florida) have little or no studded tire usage.

Why is WSDOT So Concerned about Pavement Durability?

The longer a pavement lasts, the less expensive it is.

The durability of OGFC pavements in the USA and around the world averages between 8 and 12 years, with most users reporting 8 to 10 year average pavement lives. Compared to an average pavement life of 16 years in western Washington for dense-graded HMA pavement, the shorter durability of the OGFC pavements is a significant concern.