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# Pothole Fact Sheet

## Why are they called potholes?

Pottery makers in 15th and 16th century England would take advantage of the ruts that wagon and coach wheels gouged into roads. Anxious for a cheap source of raw materials for making clay pots, the potters would dig into the deep ruts to reach clay deposits underneath. Teamsters driving wagons and coaches over those roads knew who and what caused these holes and referred to them as "potholes."

- Story attributed to the late trivia expert and syndicated columnist L. M. Boyd

The North American love of the open road is tested every late winter and spring when millions of pavement potholes suddenly appear seemingly everywhere. Mobility is increasingly integral to our way of life.

Did you know that 254 million registered vehicles travel nearly 3 trillion miles on more than 4 million miles of streets and highways in North America? An estimated 32% of our major roadways are rated in poor to mediocre condition, and driving on poor roads costs motorists \$67 billion in additional car operating and repair costs annually,

according to the American Society for Civil Engineers (ASCE) 2013 Reportcard on America's Infrastructure.

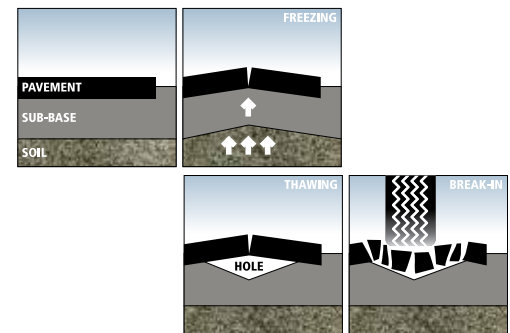
Driving over rough pavement affects travel costs for motorists in terms of vehicle operating costs, travel delays, and crash or accident costs. Motorists paid an extra \$444 a year in 2014 - a total of \$6.4 billion, according to AAA Mid-Atlantic, in vehicle repairs and operating costs. For municipalities, pothole repair expenses include personnel, equipment, and materials, and on a national basis equates to a multi-million dollar annual expenditure.

For example:

- Driving on roads in need of repair and full of potholes costs motorists in Washington, D.C. approximately \$833 per motorist, or \$311 million a year, according to the American Society of Civil Engineers Report Card for Infrastructure.
- In 2013, the City of San Diego, CA. filled over 30,000 potholes, spending \$1.3 million for pothole repair.
- In Oklahoma City, OK. The city spends \$1 million to make repairs to as many as 90,000 potholes each year.
- In 2012, Columbus, OH. spent \$175,578 for the hot and cold mix asphalt patch material to patch 130,397 potholes.

## What causes a pothole?

Potholes are created when the top layer of pavement and the material beneath—called the base or sub-base—cannot support the weight of the traffic. Two factors are always present in such a failure: TRAFFIC and WATER.



The "gestation period" for a pothole includes:

- 1) Snow-melt or rain seeps through cracks in the pavement and into the sub-base; if the moisture cannot adequately drain away from the sub-base and soil underneath, it becomes saturated and soft.
- 2) Trapped moisture is subjected to repeated freeze/thaw cycles—and with each occurrence the expanding ice lifts and cracks the pavement more. The passing traffic weakens the pavement, cracking it further.
- 3) As temperatures rise and the ice melts, a void is left under the pavement. This void collects more water, and during the next freeze, the void will enlarge.
- 4) Vehicles driving over the weakened pavement pound it until the surface breaks and collapses into the void below, thus creating a pothole.

## What affects pavement life?

Pavement life is influenced by many factors: vehicle loading (axle loads, tire pressure and gross vehicle weight [GVW]), traffic volume and mix, environmental conditions, topography, subgrade condition, initial pavement design and construction practices, maintenance activity and pavement age.

Traffic volume has increased significantly and this trend will continue—but few new lane-miles have been added to the nation's highway, road and street network and are not expected to keep pace with the increased demand.

The decision and capability to patch potholes is influenced by: current weather; traffic conditions; imminent scheduled roadway construction; major maintenance work or utility work in the roadway; availability of personnel, equipment, and materials, and the demands of the traveling public.

## How are potholes repaired?



Pothole patching is performed either as an emergency repair during harsh conditions, or as routine maintenance scheduled for warmer and drier periods. Typically, emergency repairs are done only when a pothole presents a substantial safety or traffic operational problem and must be urgently corrected. For example, a large pothole on a major arterial has contributed to collisions by causing drivers to swerve to avoid or lose control after hitting it. Or, one or more large potholes hinder the flow of traffic causing unusual slow-down and congestion. Potholes near activated traffic signals may expose embedded loop sensor wires, and when they break, the signals will not be responsive to traffic demands.

Emergency repairs usually are done in heavy traffic and can be a safety risk to maintenance workers. Repairs that are more permanent can be scheduled for times when weather and traffic are more conducive to safe operations.

The following are the standard pothole repair methods used for any asphalt paved street or road:

1. Cold-Patch ("Throw-and-roll") : Patching material is shoveled into the pothole—which may or may not be filled with water and debris—and compacted if possible, and crew moves on to next pothole. (This is considered superior to the more commonly used method of "throw-and-go", which does not compact the materials before leaving the site.) Cold patch repairs are quick, but temporary; they are an expedient fix performed when traffic, weather and general pavement conditions preclude a more permanent repair.
2. Hot-Patch Semi-Permanent: Water and debris are removed from the pothole; the sides of the patch area are "squared-up" until vertical sides exist in reasonably sound pavement. Tack oil is applied and then a heated asphalt mix is placed and compacted with a small, vibratory device. A slight crown for water dispersal is desirable. Although it raises the cost of the operation, this is considered one of the best methods for

repairing potholes, because it improves patch performance. Because this method is more labor and equipment intensive, it is usually done when traffic and weather conditions are more favorable.

3. Spray-Injection Devices: Water and debris are blown from the pothole; a tack coat of binder is sprayed on the sides and bottom of the pothole; asphalt and aggregate are blown into the pothole; the patch is covered with a layer of aggregate. This technique has higher equipment costs, but has a higher rate of productivity and lower material costs. Spray injection is faster than hot patch repairs and more permanent than cold patch; however, it is not as durable as or useful as hot patch for deeper potholes. The material is not compacted nor is the underlying base material corrected before filling.

4. Edge Seal as follow-up: Uses same method as throw-and-roll, but once repair section has dried, a second pass is made to place a ribbon of asphaltic tack material on top of the patch edge and pavement surfaces. A layer of sand is placed on the tack material to prevent tracking by tires, and the section is open to traffic as soon as workers and equipment are cleared from the area. (Although this requires a second pass, it can improve patch performance in older pavements with many cracks.)

Severely distressed spots that are much wider, or are substantially deeper, usually require base repairs at a later time. The affected area is removed back to or down to solid pavement or base and then new material placed. In some cases, under-drains may be installed to carry water away from the base and soil.

## How can we stop potholes from forming?

The success of pothole repairs depends predominantly on the timeliness of the repair and the quality of the materials and techniques used. Preventing potholes begins when the pavement is visibly cracked. Sealing the pavement to keep water from infiltrating into the sub-base is critical both for keeping potholes from forming and for extending the useful life of the pavement.

In reality, deferred maintenance can start communities on a downward path of deteriorating infrastructure and increasingly costly backlogs of required repairs. Experts conservatively estimate that for every \$1 spent to keep a road in good condition, it avoids \$6-\$14 needed later to rebuild the same road once it has deteriorated significantly, according to the American Association of State Highway and Transportation Officials (AASHTO) "Smart Growth America, Repair Priorities 2014."

