

# The Economic Impacts of Prohibiting Coal Fly Ash Use in Transportation Infrastructure Construction



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# Executive Summary

## Fly Ash: A High-Return “Green” Building Material

Coal fly ash (hereafter referred to as “fly ash”) is a naturally-occurring product of the coal combustion process. It is nearly identical in composition to volcanic ash. When mixed with calcium hydroxide, it has many of the same properties as cement. Replacing a portion of the cement with fly ash creates a cementitious material that, when used as an input with aggregates, water and other compounds, produces a concrete mix that is well-suited to road, airport runway and bridge construction.

Fly ash concrete has a number of very significant, well-documented benefits that make it a mixture of choice for many state and local transportation departments and transportation engineers. It is more durable, yet less expensive than other traditional portland cement blends.

Fly ash concrete has also been praised for its environmental benefits as a “green” building material—putting to use an energy production byproduct that reduces the demand for carbon-intensive portland cement and requires less water in the hydration process.

## Use in the Transportation Construction Market

Concrete is a major transportation construction material in the United States. Twenty-five percent of the Interstate Highway System is paved in concrete. And it has been used to build 65 percent of the nation’s bridges.

Concrete represents about 15 percent of the total cost of building and maintaining transportation infrastructure in the U.S. each year. More than 75 percent of that concrete—\$9.9 billion worth—utilizes fly ash as a partial cement replacement blend. In some states, like California, Florida, Louisiana, New Mexico, Nevada, Utah and Texas, fly ash is used for virtually all of their concrete projects.

## Economic Impacts on Transportation Projects if Fly Ash is Unavailable

Despite the many established benefits of fly ash as a construction material and its widespread utilization, new proposed disposal regulations may limit or eliminate its availability. This study was conducted to forecast the potential economic impacts of the loss of fly ash availability in just one U.S. construction market—transportation infrastructure.

Our analysis has found that such an action would increase the average annual cost of building roads, runways and bridges in the United States by nearly \$5.23 billion. This includes a \$2.5 billion increase in the annual price of materials and an additional \$930 million each year in pavement repair work and \$1.8 billion in bridge work due to the shorter pavement life of portland cement concrete without fly ash. Over 20 years, the additional cost would be \$104.6 billion.

To put an excess \$5.23 billion in perspective, that is almost \$2 billion per year more than the federal government currently invests in the national Airport Improvement Program (AIP) and about 13 percent of the federal government’s current total annual aid to the states for highway and bridge work.

American taxpayers would bear the cost of such an action—either paying more for the same level of transportation improvements, or dealing with the consequences of a scaled back improvement program.

## Foregone “Opportunity Costs” and Savings on High Performance Pavements

In addition to these direct costs, limited or eliminated availability of fly ash use would have other potential economic ramifications for state transportation programs.

For example, the “opportunity cost” for state DOTs—in cost savings and/or delivery of additional projects that might be undertaken if fly ash concrete were widely used and concrete roads did not have to be repaved or reconstructed as often—would be estimated at \$4.5 billion per year.

Similarly, states would have to forego the potential additional benefits and savings derived by using fly ash in new, high performance concrete pavements. Fly ash is a key component of high performance concrete pavement designed for a lifespan of 30 to 60 years for concrete roads, compared to the current average of 20 to 25 years. If the transportation construction industry routinely used fly ash as a construction material in concrete to design pavements with an extended life span in mind, there would be significant savings because those roads would last longer and would not have to be repaved or reconstructed until later in their life cycle.

The estimated savings from the increased durability of various fly ash concrete life spans would be<sup>1</sup> :

- \$25 billion over 20 years (\$1.2 billion per year average) if all concrete roadways were designed with fly ash concrete materials to last 35 years, compared to the current national average of 22.5 years.
- \$33.5 billion over 20 years (\$1.7 billion per year) if all concrete roadway repair and reconstruction work used fly ash concrete with a 40-year life span.
- \$51.5 billion over 20 years (\$2.6 billion per year) if all concrete roadway repair and reconstruction work used fly ash concrete with a 50-year life span.
- \$65.4 billion over 20 years (\$3.2 billion per year) if all concrete roadway repair and reconstruction work used fly ash concrete with a 60-year life span.

Table 1: Cost of Banning Fly Ash Concrete (\$ Billions)

Additional annual cost of materials	\$2.5
Additional annual cost due to accelerated road & bridge repair needs	\$2.73
Total additional annual cost from fly ash ban	\$5.23
20-year total cost of fly ash ban	\$104.60

<sup>1</sup>This analysis, as described in the methodology, does not take into account that there could be additional costs associated with different fly ash mixes that would be required for higher performance pavement, such as finer aggregates for the final concrete blend. However, early estimates for the high performance pavement pilot program in California (as reported by FHWA) indicate that the cost differential between current concrete utilizing fly ash in California and the use of high performance concrete, designed for a 50 to 60 year life span, is about two to five percent. This model is simply taking into account that the fly ash concrete life span means a slower overall deterioration rate, and the need to reconstruct or repave a roadway is delayed.

## About the Authors & Methodology

This research was conducted by the American Road & Transportation Builders Association's (ARTBA) Economics & Research Team, led by ARTBA Vice President of Policy Alison Premo Black. Ms. Black is an economics doctoral candidate at The George Washington University in Washington, D.C. She earned her M.A. in International Economics & Latin American Studies at the Johns Hopkins School of Advanced International Studies (SAIS) and is a magna cum laude graduate of Syracuse University with multiple majors. Prior to joining ARTBA in 2000, she worked as analyst and researcher in the economic section of the Embassy of the Republic of Korea and as a researcher in the trade unit of the Organization of American States.

Ms. Black was assisted on this project by researcher/analysts Sarah Crane, Daniel Hadley and Nick Candela of the ARTBA staff. Caitrin Reed, ARTBA marketing and communications manager, was responsible for the design and layout of the publication.

The study utilized bid tab data from 48 states and Washington, D.C., collected and organized by Oman Systems, Inc., in Nashville, Tennessee. The same data are used by the Federal Highway Administration (FHWA) to calculate the National Highway Construction Cost Index. We also used transportation construction market data from the U.S. Census Bureau and conducted extensive surveys and personal interviews with state transportation department officials and fly ash supply company executives to determine state market shares and penetrations.

The FHWA Highway Economic Requirement System—State Version (HERS-ST) model was used for the long run analysis of the cost difference between repaving and reconstructing concrete pavements. HERS-ST estimates the investment that would be required to achieve specified highway system performance levels. The national version of this model is used by the FHWA to prepare its biennial reports to the U.S. Congress on the nation's highway and transit system's condition, performance and investment requirements.

ARTBA, founded in 1902 and headquartered in Washington, D.C., is the U.S. transportation construction industry's primary representative with the U.S. Congress, Executive Branch, federal agencies and courts, and national media.

# What Is Fly Ash?

Fly ash is one of the naturally-occurring products of the coal combustion process and is a residue that is nearly identical to volcanic ash. It is considered a pozzolanic material, which means that when mixed with calcium hydroxide, it has many of the same properties as cement. There are a number of well documented benefits from replacing a portion of the cement with fly ash to create a cementitious material that is then used along with aggregates, water and various other components, to produce concrete for roads and bridges.

Some of the benefits of using fly ash concrete include:

- **Fly ash concrete is stronger.** Over the long run, fly ash concrete has increased strength, which means there is less wear and tear on the roadway from heavy trucks and vehicle traffic.
- **Fly ash concrete is easier to work with.** The reduced temperatures of fly ash concrete and delayed setting time are two factors that make placing the concrete easier than other traditional portland cement blends. Fly ash concrete is also easier to pump and fills concrete forms with less effort than portland cement concrete.
- **Fly ash concrete lasts longer.** When water and chemicals are able to penetrate concrete, this causes the road or bridge to crack and deteriorate. Fly ash concrete has a lower permeability than traditional concrete, which means that less water and chemicals can enter the concrete. Therefore the fly ash concrete has a longer life span and does not need to be repaired or reconstructed as often.
- **Fly ash concrete costs less.** As noted later in this report, the cost of fly ash is an estimated 17 percent below the price for portland cement. FHWA notes that in some cases portland cement is twice as much as fly ash.
- **Some states must use fly ash concrete to prevent early deterioration.** Fly ash is used to mitigate a problem called alkali silica reaction, which is when concrete deteriorates early due to issues with aggregate quality. This is a major issue for some states, and fly ash is the most widely used product to combat this problem.
- **Using fly ash helps the environment.** Fly ash is a naturally occurring product from the coal-burning energy production process. Reusing it as a green building material both reduces the demand for carbon-intensive portland cement and requires less water in the setting process.



Photo courtesy of the American Coal Ash Association.

## How Long Has Fly Ash Been Used?

Humans have been blending volcanic ash and other pozzolanic materials with cement to make durable concrete for thousands of years. Experts believe that the use of these materials by the Roman Empire is one reason that so many of their structures, including the Pantheon and Coliseum, are still standing today.

Fly ash was recognized as a “suitable pozzolanic material” in the United States as early as 1914 (Aggarwal, et al. 2010). The first major domestic use of fly ash was the Hoover Dam Spillway Repair Project in 1942 (EPA, 2005). Fly ash addressed one of the challenges of building a structure so large – the internal heat generated by the concrete was causing the structure to crack. Engineers found that they were able to control the temperature and increase the overall strength of the Dam by replacing some of the portland cement with fly ash.

The next major application in the United States was also a large scale project. Over 120,000 metric tons of fly ash was used on the Hungry Horse Dam in Montana in 1948 (FHWA, 1999).

Throughout the 1970's and 1980's, the U.S. Environmental Protection Agency (EPA) issued guidelines on fly ash and encouraged its use as a green material. In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA), which established the federal procurement guidelines for cement and concrete containing fly ash and also granted EPA the power to determine which coal combustion residuals are considered hazardous materials. Since 1980, the beneficial use of fly ash has been protected under the Bevill Amendment to the RCRA. This legislation protects fly ash, among other materials, from regulation as a hazardous waste. In 1993 EPA published a Regulatory Determination, ruling that various coal ash products, including fly ash, are not hazardous waste. Then in 1999, the EPA published a second report to Congress once again upholding the Bevill Amendment for the following reasons; the “absence of identifiable damage cases, fixation of the waste in finished products which immobilizes the material, and/or low probability of human exposure to the material.” In 2000 the EPA issued a Final Regulatory Determination ruling that coal ash did not warrant regulation as a hazardous waste stating that the “limited risks posed by them (CCRs) and the existence of generally adequate State and Federal regulatory programs” made regulation under the RCRA inappropriate.



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<sup>2</sup> First published for review and comment on November 20, 1980, the guidelines were entered in the Federal Register on January 28, 1983. On January 4, 1985 the Deputy Administrator of the FHWA, in a memorandum to FHWA Regional Administrators, issued a statement ordering the removal of any discriminatory policies against the use of fly ash and declaring an expected “high level of compliance to the guideline.”



Despite the protection of the Beville Amendment, previous rulings, and the documented benefits of fly ash, from time to time, the EPA will consider proposals to regulate fly ash as a hazardous material. If fly ash were considered a hazardous material, this would have significant implications on the transportation construction industry, as detailed throughout this report.

Other developing countries recognize the benefits of using fly ash concrete in transportation construction. FHWA recently completed an international scanning tour looking at high performance concrete and long life pavement design in Europe and Canada (FHWA, 2007). While pavement design and concrete material choice in the United States is largely focused on short term pavement strength and cost, European countries design with a focus on the total life span of the pavement. The final FHWA report noted that “One key to long-lasting concrete pavements in Europe appears to be the great attention to cement and concrete mixture properties.” The report further notes that “the mixtures produce strong, dense, and durable concrete, despite the apparent widespread presence of reactive aggregates in western Europe . . . The careful consideration of cementitious materials used in the mix is one area that could yield benefits for the United States.”

Many European countries have effectively maintained pavements for 40 years, compared to the average U.S. lifespan of 20 to 25 years. Fly ash is an important component of most of the high performance, long life concrete mix designs in Europe and Canada.

## HISTORY OF FLY ASH IN THE UNITED STATES:

**1914:** Found suitable as pozzolanic material in the United States

**1932:** First referenced in academic literature

**1942:** First major use in the Hoover Dam

**1950:** Studied by the Bureau of Public Roads and found beneficial

**1976:** EPA passes the Resource Conservation and Recovery Act (RCRA) & establishes guidelines for fly ash

**1985:** FHWA statement “expecting” high compliance with guidelines

**1988:** EPA publishes a report to congress stating that fly ash does not have the characteristics of a hazardous material

**1993:** EPA publishes a regulatory determination that fly ash is not a hazardous waste.

**1999:** EPA publishes a second report to congress reiterating that fly ash does not have hazardous characteristics

**2000:** EPA issues a Final Regulatory Determination concluding that coal ash does not warrant regulation as hazardous

# How Is Fly Ash Used in Transportation Construction?

The most prevalent use of fly ash in transportation construction is adding it to concrete mixtures to replace various amounts of portland cement. Compared to portland cement concrete, fly ash concrete requires less energy and water to produce, has lower greenhouse gas emissions and saves money (Ladwig, 2009). This not only helps the environment, but provides a way for state DOTs and local governments to spend less money on concrete projects, thereby stretching their limited budgets even further. Huntzinger and Eatmon (2008) found that using pozzolans, such as fly ash, can reduce the cost of the cementitious material in concrete by 25 percent compared to portland cement concrete without fly ash.

Transportation construction uses what is called Class C and Class F fly ash. The difference between Class C and Class F is based on the type of coal that is burned by the power plant. Class F fly ash is a product of typically burning bituminous or lignite coal and is often used by states to mitigate what is called the alkali silica reaction, which results in the early deterioration of concrete.

Most state DOTs have specifications and regulations for both Class C and Class F fly ash. However, because of the availability of different types of coal and the local fly ash supplier, some states tend to use more of one type.

Fly ash has been used for the following transportation construction applications besides as a partial cement replacement (Roewer, Klein, 2003):

- **Mineral filler in asphalt production.** Not only is fly ash used in concrete, but it can be added to asphalt as well. Most asphalt requires a mineral filler, which helps the asphalt perform under heavy traffic conditions. Fly ash is a cost-effective filler that can make the hot mix asphalt more durable.
- **Structural fill.** Fill is frequently needed for a variety of purposes, including leveling work areas, filling in excavations and creating embankments. Fly ash can be combined with water and cement to create a fill that is highly workable and easily installed while wet, and extremely dense when dry. This fill requires no compaction, improves jobsite safety, and is easily excavated when no longer needed.
- **Road and sub-base stabilization.** Road base and sub-base stabilization is a crucial part of the road building process. These layers provide the foundation for the road and help maintain the road during periods of heavy use. When mixed with aggregates and lime, fly ash can create a low cost and durable base for roadways. Mixes can incorporate up to 14 percent fly ash. Studies by the Texas Transportation Institute have shown that using fly ash in the base of a roadway helps prevent deterioration and provides increased strength (Estakhri, 2004).
- **Soil modifier.** Soil around a work area frequently needs to be modified in order for work to proceed and the finished product to be structurally sound. Fly ash can also be added to soil for both chemical and mechanical stabilization. Fly ash can improve overly wet conditions and enhance the strength and plasticity of the soil.

## What Are Some Transportation Projects Using Fly Ash?

A number of landmark transportation projects across the United States have been built with fly ash concrete. The use of fly ash not only reduced the cost of these projects, but will help ensure that they last for decades to come.

**The Dallas/Fort Worth Airport** is a large-scale expansion project using fly ash in two ways. Not only is the fly ash being used in the concrete to provide increased workability and long term benefits, but fly ash is also being used in the soil stabilization of the airport's runway expansion.

The fly ash used in the **McGee Creek Aqueduct pipe bedding project** in Oklahoma resulted in 40 percent cost savings. This 1984 construction of the 16.6 mile aqueduct used 8,000 tons of recycled fly ash. Rather than compacted crushed stone as pipe bedding, engineers recommended a unique fly ash grout mix which exhibited less bleeding and shrinkage. The fly ash also caused the bedding to set significantly faster than the traditionally used cement grout.

The **San Francisco – Oakland Bay Bridge** was a California Department of Transportation (Caltrans) project that encompassed building a 2.2-mile bridge replacement of the previous 1936 structure. Caltrans has required that all concrete used in the project uses a minimum of 25 percent fly ash replacement. Even higher replacement rates of fly ash were used for the large footings and structural supports, up to 50 per cent. Caltrans experienced tremendous cost-savings from replacing large amounts of cement with fly ash.



Self-cementing, Class C fly ash was used as a drying agent to reduce soil moisture content by 30 percent before paving extended runways at Chicago's **O'Hare International Airport**. Fly ash was used to dry more than a million cubic yards of silty clay at the base of the runways. Its use as a drying agent was faster and cheaper than replacing existing soil or combining aggregates. Due to its physical and chemical properties, fly ash also acted as an excellent cementitious material to hold together pieces of pulverized asphalt, contributing to stronger, more durable, and longer-lasting runways.

The **Roosevelt Avenue Subway Station** in New York City replaced up to 15 percent of the cement in the concrete mix with fly ash. Now, the New York Metropolitan Transportation Authority mandates that all capital construction projects include fly ash as a replacement in thick concrete. This inexpensive incorporation of fly ash was considered a key project in the agency's fledgling "Green Building Program."

The use of fly ash in the reconstruction of the collapsed **I-35 Bridge** in Minneapolis, MN is using large amounts of fly ash to replace portland cement. While contributing to project cost-savings, the use of fly ash will also significantly increase the strength and durability of the concrete in the bridge. This major bridge transports 140,000 vehicles each day.

Fly ash has also since been used in other noteworthy projects such as the "Big Dig" in Boston, Tampa Bay's Sunshine Skyway Bridge, One World Trade Center in New York City, the Ronald Reagan Building and International Trade Center in Washington, D.C., and the District of Columbia subway system (EPA, 2005).

# How Much Concrete Is Used in Transportation Construction?

There are currently over 52,078 miles of concrete roadway in the United States, mostly on the federal aid highway system. This accounts for just over one percent of the 4 million miles of roadway across the country. Although this is a small percentage, concrete is used for 25 percent of the roads on the Interstate Highway System. Concrete is also an important part of the bridge network. There are 391,161 bridges in the United States made of some type of concrete material, representing 65 percent of all bridges.

Nationwide, concrete products are about 15 percent of total project costs. This value is estimated using detailed state DOT bid tabs for 2005-2010. When a state DOT has a project to award, it puts out a bid notice. Contractors will respond with detailed estimates of the project cost, including quantities and amounts for specific line items. The state DOT then opens all the bids and awards the contract to the lowest bidder. This detailed information in the bid tabs makes it possible to isolate all of the planned spending on concrete products by state DOTs.

Depending on the mix of projects and the number of concrete roads and bridges in the state, the total amount of spending on concrete products will vary significantly. For example, in Virginia, concrete products represented 23 percent of the total value of bid tabs in 2010. Other states with high concrete values in 2010 were California (23 percent), Nebraska (22 percent) and Iowa (20 percent).

States also use concrete for a variety of infrastructure projects – not just concrete roads. Nationwide, about 12 percent of concrete spending is on concrete pavements. Approximately 30 percent is for bridge related concrete products. Concrete is also used for storm pipe (6 percent of total concrete spending), drainage structures (5 percent of total concrete spending) and culverts (4 percent of total concrete spending). Nearly half of concrete products, 43 percent, fall outside of these classifications. This includes concrete used for curbs and barriers, sidewalks, light posts, guardrail anchors and concrete used for making repairs.

Based on extensive interviews with state DOT officials, our research shows that fly ash is used in 77 percent of all concrete products nationwide, although this amount will vary from state to state. Many state engineers interviewed for this study were unable to provide specific levels of fly ash concrete usage in their state. State usage of fly ash concrete varies due to local availability and state DOT material specifications. For example, Alaska and Hawaii use relatively little fly ash concrete due to limited availability and high transportation costs.

Table 2: Miles of Concrete Roadways by Type

	Rural	Urban	Total
Interstate	7,331	5,073	12,404
Other Freeways And Expressways	-	3,227	3,227
Principal Arterial Other	7,182	6,600	13,782
Minor Arterial	2,858	6,748	9,606
Major Collector	7,363	5,696	13,059
Total	24,734	27,344	52,078

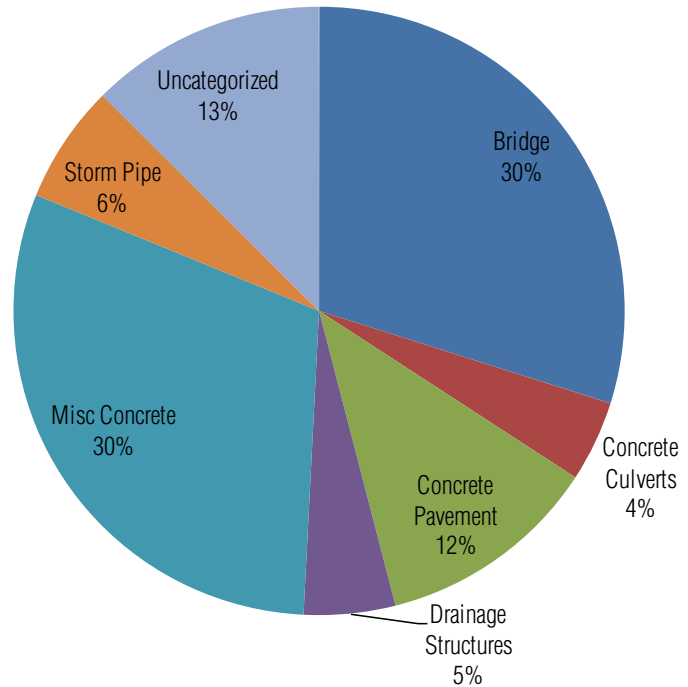
Source: FHWA Highway Statistics 2008, Table HM-12

Note: Mileage is for the federal-aid system and does not include any local roads. Includes all 50 states and Puerto Rico.

Many state engineers, including some working with the nation's largest transportation programs, affirmed very high usage of fly ash concrete. States such as California (100%), Louisiana (100%), New Mexico (100%), Nevada (100%), Utah (99%), and Florida (95%) told us that nearly all the concrete products used in their highway and bridge construction programs contain fly ash. If fly ash were to be regulated under a hazardous material designation, the increased costs to these programs would be significant and wide-ranging.

For those states that can identify the use of fly ash in their transportation construction markets, the total savings over the last five years from fly ash concrete has been approximately \$2.3 billion. That ranges from a savings of \$3 million in Maine, which has a very small percentage of fly ash concrete in the market, compared to approximately \$555.3 million in a state like California, which uses fly ash concrete exclusively.

## National Average Concrete Usage by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

Table 3: National Use of Concrete & Estimated Fly Ash (FA) Value (\$ Millions)

Year	Total value of concrete materials	Value of total bids	Concrete cost as % of total bids	Estimated FA concrete as % of total bids	Estimated value of FA concrete
2005	\$5,503	\$28,822	19.1%	15%	\$4,237.59
2006	\$6,201	\$33,284	18.6%	14%	\$4,774.61
2007	\$5,325	\$30,230	17.6%	14%	\$4,100.29
2008	\$5,043	\$28,120	17.9%	14%	\$3,883.41
2009	\$6,095	\$33,873	18.0%	14%	\$4,693.30
2010	\$6,628	\$31,717	20.9%	16%	\$5,103.41
Average	\$5,799	\$31,008	18.7%	14%	\$4,465.43

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

Note: This table assumes an average of 77 percent of all concrete utilizes fly ash.

Table 4: Estimated Cost Savings to State DOTs of Using Fly Ash (FA) Concrete (\$ Millions)

State	Percentage of concrete that includes fly ash	Total value of concrete products, 2005 to 2010	Total value of bids, 2005 to 2010	Estimated cost savings from using fly ash in concrete	Total estimated value of bid tabs without fly ash, 2005 to 2010
California	100%	\$3,266.6	\$16,871.0	\$555.3	\$17,426.3
Connecticut	50%	\$400.3	\$2,972.8	\$34.0	\$3,006.8
Florida	95%	\$983.9	\$10,300.6	\$158.9	\$10,459.5
Idaho	63%	\$185.2	\$1,686.2	\$19.8	\$1,706.0
Illinois	70%	\$1,306.2	\$9,648.5	\$155.4	\$9,803.9
Iowa	95%	\$1,021.7	\$4,394.7	\$165.0	\$4,559.7
Louisiana	100%	\$1,926.5	\$7,964.8	\$327.5	\$8,292.3
Maine	23%	\$79.6	\$1,155.1	\$3.0	\$1,158.1
Massachusetts	75%	\$167.7	\$3,417.3	\$21.4	\$3,438.7
Mississippi	100%	\$382.7	\$2,946.1	\$65.1	\$3,011.2
Montana	65%	\$113.4	\$1,686.5	\$12.5	\$1,699.0
Nebraska	100%	\$500.3	\$1,998.4	\$85.1	\$2,083.5
Nevada	100%	\$327.3	\$2,014.5	\$55.6	\$2,070.1
New Hampshire	95%	\$99.2	\$1,165.0	\$16.0	\$1,181.0
New Mexico	100%	\$309.6	\$2,868.7	\$52.6	\$2,921.3
New York	70%	\$682.9	\$8,164.2	\$81.3	\$8,245.5
Pennsylvania	70%	\$1,473.0	\$11,744.8	\$175.3	\$11,920.1
Rhode Island	33%	\$91.7	\$1,095.0	\$5.1	\$1,100.1
South Carolina	75%	\$309.6	\$2,895.5	\$39.5	\$2,935.0
Tennessee	80%	\$628.5	\$4,709.0	\$85.5	\$4,794.5
Utah	99%	\$277.9	\$2,298.9	\$46.8	\$2,345.7
Wisconsin	75%	\$1,244.6	\$5,678.0	\$158.7	\$5,836.7
Total		\$15,778.4	\$107,675.6	\$2,319.5	\$109,995.1

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. and state DOT interviews

Note: "Estimated Savings from Fly Ash" assumes a fly ash savings of 17 percent over portland cement. States shown could provide a specific estimate on the percentage use of fly ash in concrete.

# What Happens If Fly Ash Is Not Available For Roads and Bridges?

There are both immediate costs and long term ramifications for the nation's roads and bridges if fly ash is no longer available as a construction material in concrete that would average \$5.23 billion per year. There are also “opportunity costs” in the sense that because state DOTs and local governments would be spending more on repairing and replacing their concrete roadways, there are other projects that they would not be able to undertake. This lost opportunity cost is approximately \$4.5 billion per year.

## Short Run Impacts—Paying More for Concrete

If fly ash concrete were not available for highway and bridge projects, the cost of a portland cement concrete for highway and bridge projects in 2010 would have cost state DOTs and local governments an additional \$2.5 billion in material costs alone.

The total value of highway and bridge work in 2010 reached \$85.5 billion, of which an estimated 15 percent, or \$12.8 billion, was spent on various concrete products. If fly ash concrete accounted for 77 percent of that total, or \$9.9 billion in spending, the cost of using portland cement concrete would increase the value of that concrete by 17 percent, as noted below. This means state DOTs would have been spending \$14.4 billion to buy the same volume of concrete, a total cost increase of 11 percent.

Conversely, if all states were using 100 percent fly ash concrete, that would have saved state DOTs an estimated \$501.5 million in 2010 – extra funds that could have been spent on other projects.

Fly ash costs significantly less than portland cement. Although the specific costs of fly ash concrete will vary from state to state and will depend on the final mix proportions, on average, fly ash provides cost savings in the range of 17 percent.

According to data from the U.S. Geological Survey the average price of cement in 2010 was \$92 per ton, or five cents per pound. A survey of fly ash providers nationwide found the average price of a ton of fly ash is \$40, or two cents per pound. A typical mix of fly ash concrete will include approximately 390 pounds of portland cement and 150 pounds of fly ash. This is compared to a pure portland cement concrete, which contains about 564 pounds of pure cement.<sup>3</sup>

**Assuming that both the real value of highway and bridge work and inflation will both grow annually at two percent, replacing fly ash with a portland cement concrete would cost approximately \$50.3 billion over the next 20 years in material costs.**

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<sup>3</sup> To compare the cost of concrete with and without fly ash we have assumed that the ratios and prices of sand, gravel, water, and any other admixtures are constant. This approach is just modeling the difference in prices between a concrete with pure Portland cement and one with the addition of fly ash. This approach updates the methodology used by the Aberdeen Group (1985). The price differential calculated for the cementitious portion of concrete in this report is in line with the only other published account of such a price differential in Huntzinger and Eatmon (2008).

One other important consideration is that states that rely on fly ash concrete because of alkali-silica reaction (ASR) and chloride attack would not be able to use a straight portland cement concrete as an alternative. This would increase their short run material costs even more.

- ASR occurs when the cement, which is highly alkaline, reacts with silica contained in the aggregate materials used in the concrete. This reaction causes the aggregates chemical composition to be altered, and then causes it to expand as it absorbs water, leading to flaking and reduction in the strength of the concrete. Fly ash reduces the risk of ASR by reacting with the alkali in cement upon initial concrete mixing, to generate more cementitious compounds. This reaction then reduces the amount of alkali available later which can cause the ASR and damage the concrete. This problem often occurs in the South-west, which has highly siliceous aggregates which can cause considerable deterioration in the concrete once the ASR starts.
- Chloride attack occurs in concrete that is exposed to sea water or marine environments. Chloride ions penetrate the concrete and corrode the iron reinforcement within the structure. Fly ash also mitigates this problem, through its fine particle size and shape it causes the concrete to be more dense and less porous thereby reducing the extent to which chloride can enter the concrete.

ASR and chloride attack are key reasons why fly ash is a valuable resource for state DOTs that demand concrete that can perform well in harsh environments and under special conditions. States at risk for these conditions, such as California (ASR and chloride attack) and Florida (chloride attack), typically have very high usage of fly ash concrete. Officials from these state DOTs told us that 100 percent of the concrete used in California and 95 percent of the concrete in Florida contain fly ash.

Further adding to the short term costs incurred in any hazardous waste ruling would be the significant disposal costs for coal ash producers. In 2001, the approximately 450 coal-fired utility power plants in the United States produced 117.9 million tons of coal combustion residuals. This quantity represents the fourth largest (by volume) mineral resource produced in the United States (Roewer, Klein, 2003). An estimated 41 percent is reused or recycled in some way; this means that the rest, 59 percent (53 million Mg) is put into landfills (Carpenter, et al, 2007). If this vast amount of waste material was deemed hazardous, the future costs of disposal combined with the costs to mitigate already landfilled coal ash would be damaging to a variety of industries.

The EPA has estimated the average annual regulatory cost of declaring fly ash and other coal combustion residuals as hazardous materials would be \$2 billion, including the costs of industry compliance and government oversight.

If fly ash were no longer available to state DOTs, they would be compelled to use other mineral admixtures in their concrete. Other options could be blast furnace slag, silica fume, or rice husk ash. However, these options have undergone less research and testing and shorter periods of use than fly ash. According to FHWA, the first standard for silica fume use was established by the American Association of State Highway and Transportation Officials (AASHTO) in 1990 and the use of ground slag as a mixer with portland cement did not start until the 1970s. In addition, admixtures such as silica fume and rice husk ash actually increase water requirements, requiring additional resources to be expended in the production process. Fly ash is widely recognized as the most efficacious and readily available admixture in the United States and the effects of a lack of access, or even a restriction of access, would have wide-ranging and multifarious effects.



Table 5: 2010 State Comparison of Concrete Usage (\$ Millions)

State	Total value of concrete products	Value of total bids	% of total bids that are concrete	Miles of concrete roadway*	Concrete roadways as % of total mileage*
Alabama	\$81.9	\$703.3	9%	362	1.5%
Arizona	\$60.2	\$459.7	10%	272	2.1%
Arkansas	\$105.9	\$582.5	14%	329	1.5%
California	\$578.1	\$2,515.2	23%	2,356	4.3%
Colorado	\$46.0	\$323.8	11%	832	5.1%
Connecticut	\$84.0	\$585.0	7%	30	0.5%
Delaware	\$10.1	\$127.9	6%	122	8.0%
Florida	\$89.5	\$965.2	9%	44	0.2%
Georgia	\$81.3	\$670.6	9%	836	2.7%
Idaho	\$27.2	\$268.0	6%	149	1.6%
Illinois	\$255.7	\$2,427.4	8%	2,029	5.8%
Indiana	\$111.3	\$1,456.5	6%	1,320	5.9%
Iowa	\$165.3	\$651.7	20%	8,918	36.3%
Kansas	\$83.5	\$448.6	14%	1,335	5.4%
Kentucky	\$55.7	\$835.1	5%	443	3.3%
Louisiana	\$206.5	\$1,086.2	19%	1,734	13.1%
Maine	\$15.6	\$220.1	5%	10	0.2%
Maryland	\$25.5	\$416.5	5%	69	0.9%
Massachusetts	\$31.4	\$609.0	4%	26	0.2%
Michigan	\$195.0	\$1,231.8	12%	2,444	7.3%
Minnesota	\$124.9	\$698.0	14%	1,958	6.1%
Mississippi	\$65.3	\$533.2	9%	729	3.4%
Missouri	\$112.4	\$670.3	13%	2,874	9.5%
Montana	\$26.7	\$368.9	6%	108	0.9%
Nebraska	\$109.4	\$375.8	22%	1,916	12.2%
Nevada	\$36.1	\$286.6	13%	182	2.9%
New Hampshire	\$19.5	\$246.9	6%	0	0.0%

Table 5: 2010 State Comparison of Concrete Usage (\$ Millions)

State	Total value of concrete products	Value of total bids	% of total bids that are concrete	Miles of concrete roadway*	Concrete roadways as % of total mileage*
New Jersey	\$66.7	\$578.4	5%	122	1.2%
New Mexico	\$41.4	\$352.9	12%	43	0.4%
New York	\$108.5	\$1,271.7	6%	1,065	3.9%
North Carolina	\$60.4	\$824.0	6%	738	3.4%
North Dakota	\$43.7	\$454.9	7%	757	5.5%
Ohio	\$158.9	\$1,579.6	8%	748	2.6%
Oklahoma	\$171.4	\$847.3	16%	1,768	6.0%
Oregon	\$32.4	\$352.1	7%	182	1.1%
Pennsylvania	\$298.3	\$2,182.2	10%	1,230	4.3%
Rhode Island	\$9.2	\$168.2	2%	24	1.4%
South Carolina	\$48.4	\$650.7	6%	298	1.4%
South Dakota	\$23.8	\$376.9	5%	1,546	10.3%
Tennessee	\$132.8	\$952.0	11%	89	0.5%
Texas	\$662.4	\$3,641.6	14%	6,554	7.9%
Utah	\$62.1	\$1,694.3	4%	340	4.1%
Vermont	\$4.7	\$148.6	2%	5	0.1%
Virginia	\$278.9	\$952.7	23%	339	1.6%
Washington	\$134.1	\$2,174.3	5%	743	3.8%
West Virginia	\$54.7	\$498.4	8%	470	4.5%
Wisconsin	\$307.7	\$1,400.1	17%	2,602	9.2%
Wyoming	\$17.0	\$323.1	4%	304	3.9%
Total	\$5,521.3	\$41,188.2	13%	51,394	5.5%

Source: Analysis of State DOT bid tab data provided by Oman Systems Inc. and FHWA Highway Statistics, 2008

\*Mileage of concrete roadway and total mileage is for the federal-aid system and does not include any local roads.

## Long-Term Impacts—Repaving and Reconstructing Roads and Bridges More Often

A road paved with fly ash concrete will have a longer life span than a road paved with portland cement concrete and will deteriorate at a slower rate. Thus, a state DOT or local government that uses fly ash concrete should spend less in the long run on concrete repaving and reconstruction costs. The same is true for concrete bridges that include fly ash as a component of a high performance concrete mix—these structures are expected to last twice as long.

To test this theory for roads, we have created a model based on the FHWA Highway Economic Requirements System—State Version (HERS-ST). HERS-ST is a sophisticated software package that estimates the investment that would be required to achieve certain highway system performance levels. The nationwide version of HERS-ST is used by the U.S. Department of Transportation for the biennial report to Congress on the Status of the Nation's Highways and Bridges. The HERS-ST program includes a model for pavement deterioration, as detailed in the methodology section of this report, which we have updated with specific assumptions related to the performance of fly ash concrete.

The data for the model is from the Highway Performance Monitoring System (HPMS). HPMS data is submitted annually by state DOTs to FHWA, and includes detailed condition and travel information for roads across the country. HPMS data is designed to be used with the HERS-ST program. The latest data is from 2008, which is our base year.

We examined a sample of HPMS data for rigid and composite pavements.<sup>4</sup> We use our model to annually evaluate the condition of these roads over a 20-year period. We assume that a state DOT will repair a roadway once it reaches a deficient level, based on repair and reconstruction thresholds outlined by FHWA. Project costs, which are specific to a roadway's terrain, location and type, have been provided by FHWA as part of the HERS-ST model. We assume that project costs increase at a modest two percent a year. The pavement deterioration during each period is based on the forecasted travel on the roadway (part of the HPMS data), environmental conditions and the depth, age and other characteristics of the roadway. To reflect the benefits of fly ash, we have updated certain parameters of the model to slow the deterioration rate, depending on the projected lifespan of the fly ash concrete roadway.

In the initial baseline, we have randomly assigned 25 percent of the concrete roadways to a shorter life span of 22.5 years, which is the national average for portland cement concrete<sup>5</sup> (FHWA, 2007a). This is based on the fact that approximately 77 percent

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<sup>4</sup> Rigid pavements are defined as roads with concrete pavement and account for just under 18,000 miles of roadway in the sample. Composite pavements are a combination of hot mix asphalt and Portland cement concrete pavements. This could be a roadway that was either designed as a composite pavement, or may have been rehabilitated with either an asphalt or concrete overlay. Typically if a roadway has asphalt characteristics it will be classified as a flexible pavement. Therefore we have included all of the composite pavement roadways in the sample. Any major work on these roadways would likely include concrete material.

<sup>5</sup> The question arises: Are the final results from the model dependent on the initial random groupings of the projects? To address this issue, we actually created five different samples with different random groupings, and the results were nearly identical, indicating the initial groupings did not have an impact on the final results.

<sup>6</sup> There is no shortage of literature and material that notes one of the benefits of fly ash concrete is that it will last longer than traditional Portland cement concrete. However, there is very little information that quantifies that difference in life span. Therefore, recognizing that many of our nation's roadways have performed beyond their initial design service life of 20 to 25 years, and that the definition of long-term performance pavement has a life span of at least 40 years, we are using a life span estimate of 35 years for the current stock of concrete roadways in our sample that we estimate contain fly ash.

of the concrete used across the nation already contains fly ash. Those roads are assumed to have a life span of 35 years, with a slower deterioration rate.<sup>6</sup>

As detailed in the methodology, the final data includes 31,931 observations, or samples from roadways, that total 31,992 miles. The sample is limited to the Interstate and other highways, arterial roads and major collectors, and does not include local roadways or minor collectors.

The theory is that because roads with fly ash concrete have a longer life span, state DOTs and local governments would spend less money on repaving and reconstructing roads over the next 20 years.

What would be the additional cost of maintaining this same sample of roads if they were all made with portland cement concrete, and deteriorated at a faster rate with an expected life span of just 22.5 years?

The results show that state DOTs would spend \$394.6 billion over the next 20 years to repave and reconstruct concrete roadways as they reach a deficient level, given the assumption that approximately three-quarters of the roadways contain fly ash concrete and have an average life span of 35 years, compared to 22.5 years for portland cement concrete roads. These costs are just for repaving or reconstruction work – we assume that there is no additional widening, construction, realignment or safety-related components added to the project. A total of 77,470 separate repaving or reconstruction jobs would take place. This is an average of 3,873 projects per year at a cost of \$19.7 billion per year.

If all roadways were just made with portland cement concrete, and did not have the increased life span of the fly ash concrete, the cost of repaving and reconstructing this same sample of roadways would be \$413.3 billion over the next 20 years. State DOTs would be undertaking over 104,000 projects during the same time period, simply because roads were deteriorating faster and reaching the deficiency level sooner than in the case where fly ash concrete is used. That is an average of \$20.6 billion and 5,200 projects per year.

**All things being equal, the current use of fly ash concrete reduces cost of repaving and reconstructing concrete roadways by approximately \$900 million per year over the next 20 years, compared to a network of roadways made with portland cement concrete.**

For the bridge analysis, we use data from FHWA's National Bridge Inventory (NBI). The NBI has detailed information for over 709,500 bridges in the United States. The data set also provides an estimate of the current backlog of repairs that are needed for 417,300 bridges, including any bridge eligible for federal aid.

From this data we know that concrete bridges on average require either replacement, rehabilitation, widening, deck replacement or other work at an average age of 37 to 42 years, according to data submitted by the State DOTs for the NBI. We also use cost estimates submitted as part of the NBI to estimate the cost of bridge rehabilitation. The current cost of the backlog for concrete bridge work (not including associated road work) is \$79 billion.

The use of fly ash as part of a high performance concrete mix has the potential to double the service life of concrete bridges. In our analysis we assume that the current backlog of bridge projects is eliminated in the next 20 years and the updated structures

include fly ash. Eliminating the 20 year backlog is similar to the “maximum economic investment” scenario in FHWA’s 2008 Conditions and Performance Report.

The main economic benefit of a high performance concrete blend is that the extended service life of the bridge is that major bridge rehabilitation can be delayed while maintaining performance. This means that instead of requiring rehabilitation at an average age of 37 years for a bridge on the Interstate System, which is based on the current backlog, major work would not have to occur until 74 years of service life.

When we look at the next 50 years for the current stock of concrete bridges in the United States, the cost to rehabilitate, replace and repair those structures would be an estimated \$710 billion, assuming project costs increase a modest two percent a year. If state DOTs and local governments use high performance concrete blends to rehabilitate current structures and extend their service life, the cost of major work on those bridges over the 50 time horizon would be \$621 billion.

**Although most of these savings would be realized in future years, the total savings over the 50 year period of fewer bridge rehabilitation projects averages \$1.8 billion per year.**

## Additional Long-Term Benefits—Fly Ash in High Performance Concrete

The model also allows us to answer the question – what are the potential cost savings if roadways were designed for a longer life span?

According to FHWA, concrete pavements in the United State have routinely been designed and constructed “to provide low-maintenance service lives of 20 to 25 years.” (FHWA, 2007a) However, some state DOTs have begun considering pavement materials and designs with the focus on increasing the life span of concrete roadways to anywhere from 40 to 60 years of service life.

Long-life concrete pavement is defined as the following (Tayabji and Lim 2006):

- Pavements with a service life of at least 40 years
- Pavement that will not exhibit premature construction and materials-related distress
- Pavement that has a reduced potential for cracking, faulting and spalling
- Pavement that maintains desirable ride and surface texture characteristics with minimal intervention and only minor repairs



Photo courtesy of the American Coal Ash Association.

Although there are a number of specifications and procedures associated with high performance concrete, the use of fly ash is typically one of those requirements because of its beneficial properties. Several state DOTs currently have extended-life concrete pavement initiatives (FHWA, 2007a).

- Illinois has been investigating long-life concrete pavement options since the late 1990s and have changed their specifications to help prevent freeze-thaw and ASR-related damage. The design life of these roadways is 30 to 40 years, and includes the use of fly ash for addressing ASR issues. The typical Illinois long-life concrete mix design includes 135 to 145 pounds of fly ash and 430 to 490 pounds of type I cement (Minnesota DOT, 2009).
- Minnesota currently designs for long-life concrete pavements of 60 years for major high-volume urban highways. Fly ash is used to help mitigate any ASR-related concerns. The concrete mix design includes 175 pounds of fly ash and 410 pounds of cement (Minnesota DOT, 2009).
- Washington state is currently designing concrete roadways for a lifespan of 50 years. The concrete mix design specifications for the longer term performance concrete include a maximum of 35 percent Class F fly ash.

If all states adopted techniques and standards, including the use of fly ash concrete where possible, to extend the average service life of concrete pavements, how much would this save state DOTs and local governments in reconstruction and repair costs over the next 20 years?

The initial assumptions and modeling techniques for this analysis are the same as the original model for comparing the current mix of fly ash concrete roadways with roads only paved with portland cement concrete. State DOTs and local governments make necessary repairs or reconstruct the concrete roadways when they reach a certain deficiency rating. The only difference is that the concrete pavement has a slower deterioration rate and a longer service life.

- If all concrete roads had an average lifespan of 35 years, total spending to repave or reconstruct deficient roadways would be \$388.4 billion over the next 20 years, or an average of \$19.4 billion per year. This is compared to a scenario where it costs \$413.3 billion over the next 20 years to maintain the same concrete roadways without the benefits of fly ash.
- With an average life span of 40 years, the total cost falls to \$379.8 billion for necessary repaving and reconstruction, an average of \$19 billion per year.
- If roads were designed to last 50 years, the total cost for repaving and reconstruction over the next 20 years would be \$361.8 billion, or \$18.1 billion per year.
- Finally, with an expected lifespan of 60 years, concrete roadway repaving and reconstruction over the next 20 years would be \$347.9 billion, or an average of \$17.4 billion per year. This is an estimated savings of \$2.3 billion compared to the current use of fly ash and \$3.2 billion compared to a scenario where no fly ash is used.

## Opportunity Costs—What Project Opportunities Are States Missing?

If state DOTs were using fly ash as an input to concrete pavements that were designed to last for 40, 50 or 60 years, what sort of resources would be available for additional projects, and how would this impact state highway and bridge construction programs? **Our long run analysis estimates that this lost opportunity cost ranges from \$82.3 to \$99.4 billion over a 20 year period, with an average of \$4.5 billion per year.**

Beyond the additional material and life cycle cost of repaving and reconstructing concrete roadways if fly ash were not available, there is an opportunity cost if states are spending more of their resources on these activities. In other words, states may have to forego additional projects that would increase safety, add capacity, improve alignments or provide additional user benefits because they are spending more resources on basic repaving and reconstruction work.

In this second long run model, we look at the possible mix of projects that state DOTs, local governments and private entities may undertake over the next 20 years given some basic parameters. We use the full version of the FHWA HERS-ST model software for two scenarios.

The full version of HERS-ST estimates the total investment that would be required to achieve certain highway system performance levels. Given a set of highway sections, in this case concrete and mixed roadways, HERS-ST looks at each section and “decides whether an improvement is warranted, and, if so, what type of improvement.” HERS-ST takes into account various improvement alternatives, forecasted demand and the estimated impacts of the defined alternatives. The factors evaluated include predicted pavement conditions, vehicle speeds, capacity calculations, user safety costs, agency maintenance costs, vehicle operating costs, user travel time costs and emissions costs.



## Scenario One: Maintaining Current Performance Conditions

In the first scenario, we ask HERS-ST to select projects that will minimize total costs while maintaining current system conditions in terms of travel time, vehicle speed and pavement conditions. We assume that the concrete pavement life span is a maximum of 30 years for heavy concrete pavements, 25 years for medium pavements and 20 years for light pavements, which is the default in HERS-ST. Under this baseline scenario to maintain current conditions, total spending would be approximately \$373.8 billion in concrete related projects over the next 20 years, for an average of \$18.7 billion per year.

To derive the opportunity cost of using longer term fly ash pavements, we use the same model but assume that the concrete pavement will last twice as long and deteriorate at half the rate. Under this scenario, HERS-ST will select an entirely different set of projects while still minimizing investment levels and maintaining current performance. Some states will spend more on projects that could be more expensive, such as improving alignments, adding lanes or safety related improvements. Given the new set of parameters and the improvements in pavement life, HERS-ST selects an entirely different set of projects and improvements under the new criteria. Although some states spend more and some states spend less on projects, the total opportunity cost is approximately \$99.4 billion over 20 years, or an average of \$5 billion per year.<sup>7</sup>

## Scenario Two: Maximizing Economic Benefits

In the second scenario, HERS-ST selects project improvements based on the cost-benefit ratio. In this “economic efficiency” run, we assume that states undertake any project where the benefit-cost ratio is equal to one. In other words, if the benefits of the project equal the estimated cost, the state will undertake the project. In this case, the baseline scenario with existing pavement conditions and life span would total \$771 billion over 20 years, or \$38.6 billion per year.

Just as in the first scenario to maintain conditions, if we assume that concrete pavements are lasting longer and deteriorating at a slower rate, the model takes this into consideration and selects a different set of projects and improvements based on the new parameters. Some states would spend more on these new projects, and other would spend less. The total difference, including additional spending or savings, would be an opportunity cost of \$82.6 billion over 20 years, or approximately \$4 billion per year.

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<sup>7</sup>As noted, this estimate is only for concrete and mixed pavement roads. In the 2008 “Conditions and Performance Report” to Congress, FHWA estimated it would take an estimated \$67.2 billion in annual investment (2006\$) from all sources to maintain 2006 level average highway user costs under the HERS analysis. It is important to note that the investment level from this analysis and the “Conditions and Performance Report” are two separate derivations, although they are based on the same technique. The two numbers are not comparable. This is because our analysis only includes concrete roadways, and we are not asking the model to take into account other repairs or work that could occur on flexible pavements that may cost less than a concrete project. The final analysis by HERS is dependent on the total mix of projects. That being said, since many of the concrete roads across the country are on the Interstate system and major freeways/expressways, the value of work for these repair and reconstruction projects will be greater than may be suggested by the mileage.



# What Are the Environmental Benefits of Fly Ash?

Using fly ash to replace portland cement in concrete not only provides the benefit of recycling fly ash, but also reduces emissions and energy that would have been used to make the higher volume of cement.

Approximately 1.6 billion tons of cement are produced each year around the world, accounting for seven percent of global carbon dioxide emissions (Mehta, 2001). Using fly ash can reduce the total amount of energy needed to make concrete pavement (Kendall, 2008). One study (Huntzinger and Eatmon 2008) has even estimated that substituting pozzolans for cement clinker can reduce the most significant environmental impact of the manufacturing process by 22 percent.

Using fly ash as a partial replacement for cement also reduces the amount of water required in the concrete mixing process. Mehta (2001) estimated that the concrete industry uses one trillion liters of water every year in mixing alone. Mehta estimates that the mixing water required could be cut in half by using better aggregate grading practices and by expanding the use of mineral admixtures, including fly ash.

A number of studies have addressed environmental concerns about the leaching of fly ash residue. There is a substantial academic literature that shows that when fly ash is encapsulated in concrete there is a minimal risk of leaching.<sup>8</sup> Even fly ash used in gravel roads (not stabilized in concrete) has been proven to leach only trace amounts of minerals at stable and decreasing levels, well below state and EPA maximum containment levels (Edil & Benson, 2007).

The risk of potential leaching has been taken into consideration, carefully measured in laboratory tests, and monitored in real roadway tests in multiple life cycle analyses. Birgisdottir (2005) found that in terms of environmental impact “there was only a trivial difference. . . between a road with conventional materials and a road with bottom ash” when all aspects of the road construction process were taken into account. This slight difference is due to the significant environmental effects of production of new materials and construction of a road.

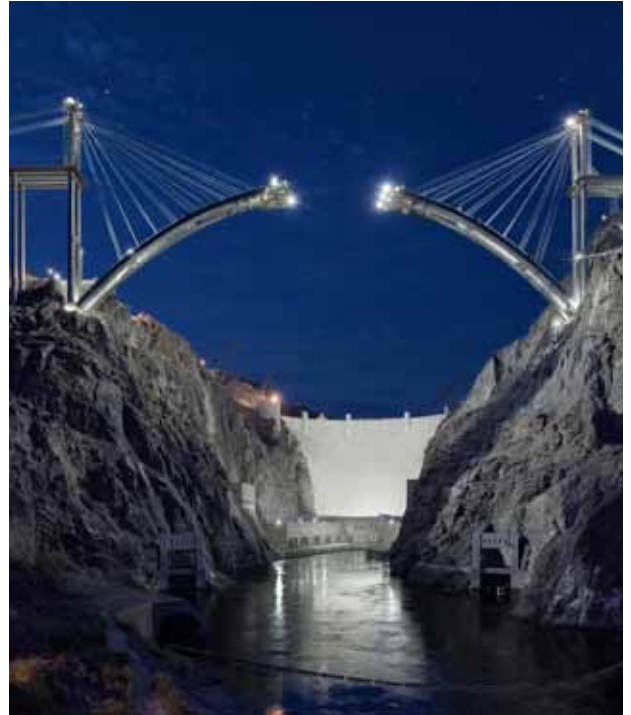


Photo courtesy of Jamey Stillings ([www.bridgeathooverdam.com](http://www.bridgeathooverdam.com)).

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<sup>8</sup> The EPA stated in March of 1999, “No significant risks to human health and the environment were identified or believed to exist for any beneficial uses of these wastes, with the possible exception of minefill and agricultural use . . .” (EPA, 1999).

## Methodology

The ARTBA Economics & Research team has used a variety of modeling techniques and data sources to provide an overall estimate of the cost of not using fly ash as an added material to concrete for highway and bridge construction.

To establish the baseline of current concrete consumption, we used bid tab data for 48 states and Washington, D.C., from Oman Systems, Inc. Data from Hawaii and Alaska is not included because of some issues with material classifications. The data from Oman Systems, Inc., is the same data used by FHWA to calculate the National Highway Construction Cost Index. We analyzed data on all concrete products used for highway and bridge projects, including concrete pipes and culverts, drainage, and bridge work. This allowed us to establish the value of concrete products as a percentage of total bid values. This ratio was then applied to the current value of construction work, from the U.S. Census Bureau, as a proxy for the value of concrete products being used in the highway and bridge construction market.

In order to determine the average price of fly ash, ARTBA distributed a web-based survey to 267 individuals at fly ash supply companies. Respondents were asked to list the average Freight On Board (FOB) price of fly ash (per ton) by state for 2010, in each of the states in which they operate. Aggregate prices were used in ARTBA's analysis.

The FHWA Highway Economic Requirements System – State Version (HERS-ST) model was used for the long run analysis of the cost difference between repaving and reconstructing concrete pavements. HERS-ST is a software package that estimates the investment that would be required to achieve certain highway system performance levels. Alternatively, the software can be used to estimate the highway system performance that would result given various investment levels. The HERS-ST model is a direct extension of the national-level HERS model. This model was developed by FHWA to examine the relationship between national investment levels and the condition and performance of the Nation's highways. FHWA uses the model to estimate future highway investment requirements under different scenarios. FHWA provides this information to the U.S. Congress in the biennial "Status of the nation's Highways, Bridges and Transit: Conditions and Performance Report to Congress."

For the long run analysis, ARTBA built upon the pavement deterioration model from HERS-ST v.2.0. Although there is an updated version of HERS-ST available, this earlier pavement deterioration model is easier to compute, and does not differ significantly from the later version.

The first step in the model is to calculate the total traffic for a section of roadway for the time period of interest from (to) to (tf):

$$TOTRAF = \frac{AADT_{to} + AADT_{tf}}{2} * 365 * (tf - to) \quad (1.1)$$

The next step is to calculate the ESALs for the time period:

$$ESALS = (TOTTRAF * PCAVSU * ELF_{SU} * LF) + (TOTTRAF * PCAVCM * ELF_{SM} * LF) \quad (1.2)$$

where:

- ESALS = ESALs accumulated during the time period;
- PCAVSU = average percentage of single-unit trucks during the time period;
- $ELF_{SU}$  = equivalent load factor for single unit trucks for this pavement type and functional class;
- PCAVCM = average percentage of combination trucks during the time period;
- $ELF_{CM}$  = equivalent load factor for combination trucks for pavement type and functional class;
- LF = lane load distribution factor

The lane load distribution factor and load factors were given by the HERS model and follow the AASHTO Pavement Design Guide.

The model determines present and future pavement conditions for a present serviceability rating (PSR). The initial number of ESALs that would cause the PSR to decline from the highest rating, 5.0, to its current base-year value is obtained through the following equation:

$$ESAL = 10^{LOGELA} \quad (1.3)$$

where:

$$LOGELA = XA + XG/XB \quad (1.4)$$

$$XA = 7.35 * \log(D+1) - 0.06 \quad (1.5)$$

$$XB = 1 + 16.24 * 10^6 / (D+1)^{8.46} \quad (1.6)$$

$$XG = \log((5 - PSRI) / 3.5) \quad (1.7)$$

and D is pavement thickness and PSRI is the PSR at the beginning of the year. The PSR at the end of the time period (PSRF) is obtained by adding the number of ESALs incurred during the time period to the initial value of ESALs, substituting the PSRF for PSRI in the above equation for XG and solving the system of equations for PSRF.

The final equation is:

$$PSRF = 5 - 3.5 * PDRAF * 10^{XG} \quad (1.8)$$

where PDRAF is a user specified pavement deterioration rate adjustment factor. In HERS-ST this adjustment factor is set to one, but FHWA notes that this can be altered to reflect the specific environment or materials used in the state.

The final step was to establish minimum and maximum PSR levels, based on the HERS-ST model, to reflect lower and upper limits on the actual PSR rating for a given section of roadway. At a minimum, pavement conditions will deteriorate due to environmental factors. The upper limit of a PSR (PSRMAX) during any given time period (t) is given by:

$$PSRMAX_t = PSRMAX_{t_0} * 0.3^{\left(\frac{t-t_0}{ML}\right)} \quad (1.9)$$

where (ML) is the maximum life of the section in years, and (t<sub>0</sub>) is the time at which the section was last improved, or six months before the beginning of the model run if that information is not known. The default assumption in HERS-ST is that rigid pavement has a maximum life value of 30 years for heavy pavement, 25 years for medium pavement and 20 years for light pavement.

The maximum value of the section's PSR at the end of the time period is the lesser of the PSRF calculated from the ESALs and impact of traffic, or the PSRMAX, which reflects roadway conditions from just environmental factors.

The minimum value of the PSR at the end of a time period is determined using the HERS-ST maximum deterioration rate. In this case, the default deterioration rate is 0.3 per year. This ensures that despite high levels of AADT and traffic, the value of the section's PSR will not decline by more than 0.3 a year. The minimum value of a section's PSR in a time period (t) is:

$$PSRMIN_t = 0.3 * (t - t_0) \quad (1.10)$$

The final PSR rating is then the larger of either the minimum PSR value, from equation 1.10, or the maximum value of the PSR, as determined from equations 1.9 and 1.8.

To account for the use of fly ash as a material in concrete, we adjusted both the maximum life assumption in the model and the rate of deterioration (PDRAF).

The ARTBA staff conducted extensive interviews with various experts from FHWA and state DOT's materials and engineering divisions. The state DOT experts interviewed were primarily chief engineers, structural engineers, materials experts, materials testers, and concrete engineers. We found that the contact's and their respective department's availability of fly ash related data and information varied.

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# Appendix A – State Profiles

## Introduction

For this study, ARTBA staff conducted extensive interviews with key engineering and materials personnel at FHWA and state DOTs.

Officials and technical experts at the FHWA expressed concern that fly ash might be designated as a “hazardous material.” They recounted the many proven structural and economic benefits of using fly ash blends for transportation infrastructure. One, in fact, expressed the opinion that it would be “catastrophic” if fly ash could no longer be used as a soil stabilizer and concrete additive.

This appendix provides a “snapshot” summary of pertinent state information on the fly ash issue, including relevant specifications, potential impacts of regulatory action, market penetration and use.

## The Use of Fly Ash in Alabama's Transportation Construction

Alabama currently has 23,988 miles of roadway in the Federal-aid Highway System, of which two percent is concrete. There are 1,201 bridges in the state, of which 33 percent or 394, contain primarily concrete. Approximately 10 percent of highway spending in Alabama is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

Alabama uses up to 20 percent of class F fly ash replacement of Portland cement and up to 30 percent class C fly ash in concrete mixes.

### How would a "hazardous building material" label affect your state?

Experts within the Alabama Department of Transportation (ALDOT) expect that if the EPA labels fly ash a "hazardous building material," Alabama would not continue to allow fly ash use in concrete. This, in turn, would result in an increase in the cost of projects, as alternative pozzolans are significantly more expensive. Fly ash has provided ALDOT with an incredible cost-savings, low long-term maintenance costs, and concrete that is superior in strength.

### How prevalent is fly ash in your transportation projects?

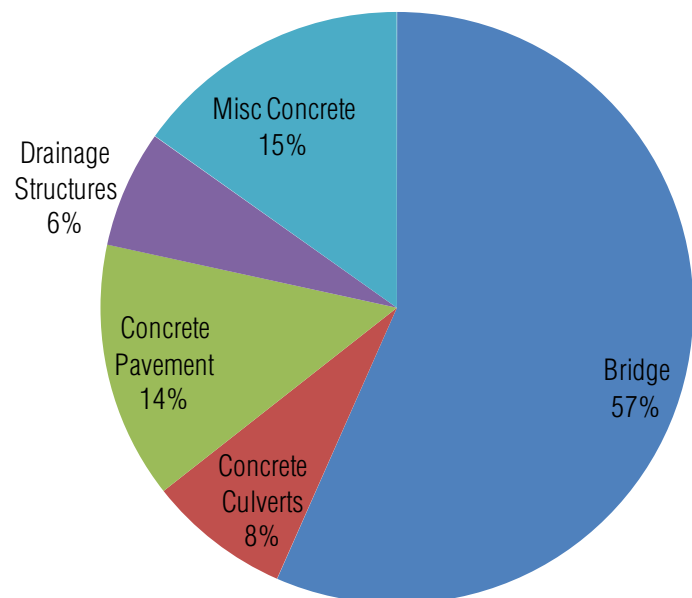
Fly ash is used extensively throughout the state. Engineers reported that the largest ready-mix concrete producer in the state provided an estimated 82,000 cubic yards of concrete. Each cubic yard of this concrete contained between 125 and 140 pounds of fly ash. Thus, its use is state-wide in Alabama.

### What are your state's sources of fly ash?

The only approved fly ash source in the state of Alabama are the Headwaters Resources facilities at power plants in Quinton and Wilsonville.



Average Alabama Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## Alabama Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete as % of Total Bids
2005	\$76.0	\$631.4	12.0%
2006	\$49.6	\$577.8	8.6%
2007	\$76.5	\$714.4	10.7%
2008	\$42.4	\$592.1	7.2%
2009	\$71.1	\$776.9	9.2%
2010	\$81.9	\$703.3	11.6%
Average	\$66.3	\$666.0	9.9%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Alabama Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$39.48	\$28.53	\$26.14	\$34.73	\$32.80	\$63.39
Concrete Culverts	\$14.53	\$1.62	\$3.67	\$4.40	\$1.85	\$4.86
Concrete Pavement	\$9.60	\$4.77	\$14.29	\$0.66	\$23.98	\$2.46
Drainage Structures	\$1.89	\$11.28	\$4.12	\$1.05	\$6.71	\$0.46
Misc. Concrete	\$10.51	\$3.43	\$28.31	\$1.55	\$5.78	\$10.71
Total	\$76.00	\$49.62	\$76.54	\$42.39	\$71.12	\$81.87

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Alaska's Transportation Construction

Alaska currently has 2,672 miles of roadway in the Federal-aid Highway System, of which there is no concrete mileage. There are 1,201 bridges in the state, of which 33 percent or 394, contain primarily concrete.

### What are your state's fly ash specifications?

Alaska uses up to 20 percent of class F fly ash replacement of Portland cement and up to 30 percent class C fly ash in concrete mixes. Typically type C and F are used, depending on the mix design.

### How would a "hazardous building material" label affect your state?

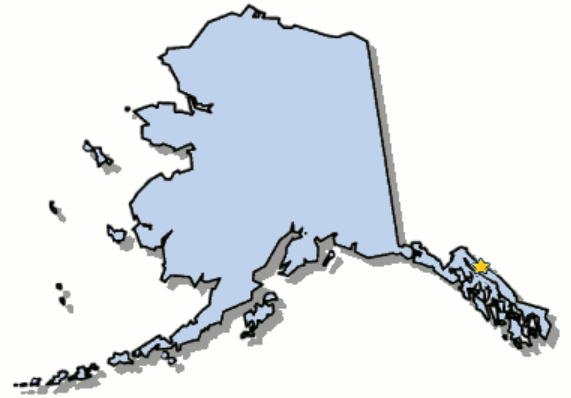
Alaskan Department of Transportation experts interviewed stated, "It is not in the best interest of the Department to have fly ash regulated as 'hazardous building material,' as it is recycled and has many cost-effective applications in the transportation construction industry." They recognize the importance of fly ash in counteracting alkali-silica reactions in concrete. Fly ash has also helped strengthen concrete structures against the extreme weather conditions experienced in Alaska.

### How prevalent is fly ash in your transportation projects?

Fly ash is imported, and thus very costly. It is used on an as-needed basis. The Department does not have information or records on fly ash usage.

### What are your state's sources of fly ash?

As previously stated, fly ash is imported. While Alaska does have coal-fired power plants, a higher quality fly ash is needed for transportation construction projects.



Editor's note: Data on concrete use profile from state transportation bid tabs is not available.

## The Use of Fly Ash in Arizona’s Transportation Construction

Arizona currently has 12,870 miles of roadway in the Federal-aid Highway System, of which two percent is concrete. There are 7,403 bridges in the state, of which 89 percent or 6,592, contain primarily concrete. Approximately 20 percent of highway spending in Arizona is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.

### What are your state’s fly ash specifications?

Fly ash replacement of Portland cement ranges from 20 to 35 percent or more, depending upon the geographic location. Arizona has excellent, high quality class F fly ash. Class C fly ash is used, but not as much as the class F.

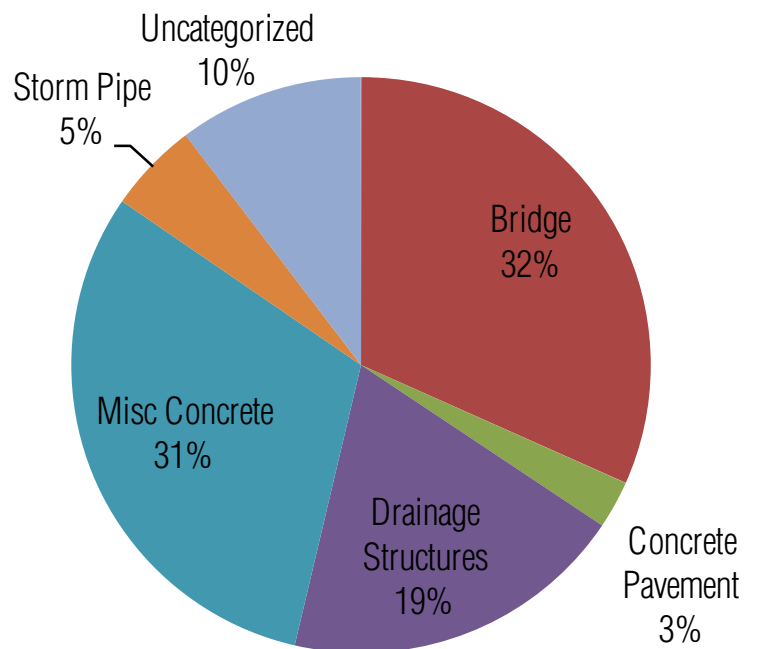


### How would a “hazardous building material” label affect your state?

As an expert within the state explained, “Reclassification of fly ash as a ‘hazardous waste material’ could put ADOT as well as other DOT’s throughout the United States in a very precarious position with the EPA, the United States Department of Transportation (USDOT), and Federal Highway Administration (FHWA), all of whom have been strongly advocating the use of fly ash, not only in concrete but in a wide variety of other uses for highway and bridge construction since the early 1970’s.” Furthermore, he explained that if the EPA reclassifies fly ash as a ‘hazardous material’ in any way, it is very likely that ADOT would not be allowed to use it in concrete or any other manner due to potential liability issues.

State experts also believe that if fly ash is reclassified as a ‘hazardous material’, most fly ash uses today would be prohibited. One coal fired power plant in Arizona recycles over 90 percent of the fly ash that it generates. There are several other power plants in Arizona that recycle similar amounts of fly ash material. As a result of any prohibition, these power plants would have to generate numerous additional fly ash retaining facilities to retain the 90 percent of the fly ash that is currently being recycled in Arizona and used in transportation projects. The official stated, “ADOT respectfully requests that the EPA does not regulate or reclassify coal combustion by products as hazardous materials.”

Average Arizona Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## How prevalent is fly ash in your transportation projects?

There is no information in the project bid tabs that delineates the amount of fly ash used in Arizona. The amount of fly ash used in place of Portland cement in concrete mix designs varies with every project, as well as within the half-dozen or more concrete mix designs in every project.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.azdot.gov/Highways/Materials/PDF/Materials\\_Source\\_List\\_FlyAsh.pdf](http://www.azdot.gov/Highways/Materials/PDF/Materials_Source_List_FlyAsh.pdf)

## Arizona Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$166.2	\$721.2	23.0%
2006	\$86.4	\$365.2	23.7%
2007	\$192.0	\$819.7	23.4%
2008	\$89.8	\$501.9	17.9%
2009	\$89.3	\$486.2	18.4%
2010	\$60.2	\$459.7	13.1%
Average	\$114.0	\$559.0	20.4%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Arizona Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$17.68	\$5.63	\$62.25	\$63.80	\$39.63	\$27.94
Concrete Pavement	\$3.82	\$0.94	\$2.45	\$3.95	\$6.45	\$0.63
Drainage Structures	\$75.09	\$7.01	\$34.18	\$4.00	\$12.22	\$0.00
Misc. Concrete	\$37.16	\$71.17	\$54.84	\$20.11	\$25.06	\$2.97
Storm Pipe	\$0.17	\$32.59	\$0.12	\$1.32	\$0.46	
Uncategorized	\$32.32	\$1.69	\$5.68	\$1.79	\$7.17	\$22.36
Total	\$166.25	\$119.04	\$159.53	\$94.95	\$90.98	\$53.90

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Arkansas' Transportation Construction

Arkansas currently has 21,513 miles of roadway in the Federal-aid Highway System, of which two percent is concrete. There are 12,542 bridges in the state, of which 58 percent or 7,307, contain primarily concrete. Approximately 15 percent of highway spending in Arkansas is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

Arkansas Department of Transportation standard specifications allow up to 20 percent replacement of Portland cement with classes C and F fly ash. Other amounts are treated on a job-by-job basis.

### How would a "hazardous building material" label affect your state?

Transportation experts interviewed feared the label could raise bids and increase the total cost of projects. However, since the state's total usage of fly ash was largely unknown, the possible ramifications were somewhat unclear. Nonetheless, experts do not support the possible labeling of fly ash as a "hazardous building material." Experts also pointed out the structural benefits of using fly ash in concrete as a means of achieving longer-lasting structures.

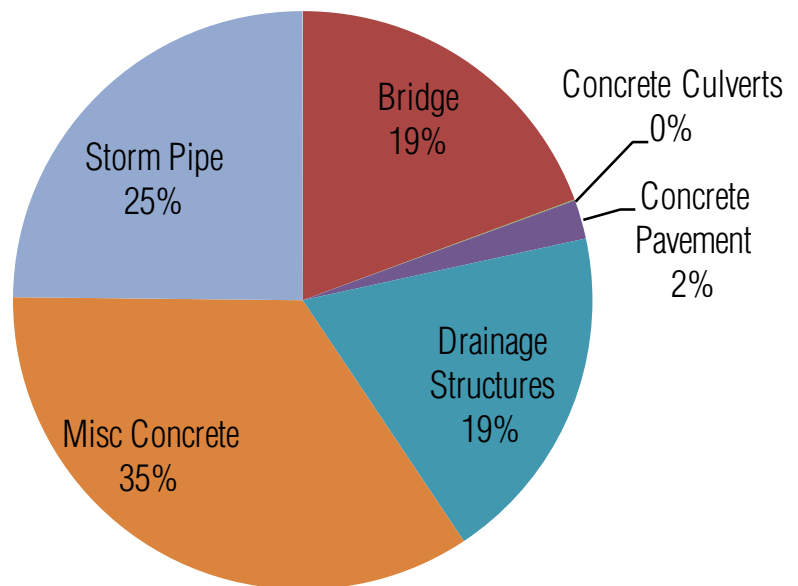
### How prevalent is fly ash in your transportation projects?

The Arkansas Department of Transportation, when interviewed, did not know the amount of fly ash used in their state. The Department has a set of state fly ash specifications and contractors must follow. Records of the amount of fly ash, or the specific Portland cement replacement percentages are not kept.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.arkansashighways.com/materials\\_division/Division%20500%20Portland%20Cement%20Concrete%20Pavement/50102%20Fly%20Ash.pdf](http://www.arkansashighways.com/materials_division/Division%20500%20Portland%20Cement%20Concrete%20Pavement/50102%20Fly%20Ash.pdf)

Average Arkansas Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Arkansas Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$57.3	\$394.0	14.5%
2006	\$42.0	\$386.3	10.9%
2007	\$47.6	\$376.4	12.6%
2008	\$56.9	\$387.1	14.7%
2009	\$77.9	\$507.6	15.4%
2010	\$105.9	\$582.5	18.2%
Average	\$64.6	\$439.0	14.7%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Arkansas Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$4.09	\$9.95	\$4.81	\$7.74	\$25.36	\$23.09
Concrete Culverts	\$0.09	\$0.12				
Concrete Pavement	\$2.21	\$0.08	\$0.45	\$3.06	\$2.20	\$0.53
Drainage Structures	\$19.88	\$2.91	\$17.25	\$6.71	\$5.05	\$22.14
Misc. Concrete	\$20.68	\$9.42	\$19.53	\$17.84	\$24.94	\$41.63
Storm Pipe	\$10.38	\$19.56	\$5.51	\$24.61	\$19.54	\$16.82
Total	\$57.32	\$42.04	\$47.55	\$59.96	\$77.09	\$104.22

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in California's Transportation Construction

California currently has 54,809 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 24,409 bridges in the state, of which 85 percent or 20,843, contain primarily concrete. Approximately 19 percent of highway spending in California is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

California uses 15 to 25 percent of class F fly ash replacement of Portland cement in mixes. Specifications sometimes allow for the use of other pozzolanic materials and ground granulated blast furnace slag, another type of coal ash.

### How would a "hazardous building material" label affect your state?

Experts within the California Department of Transportation (Caltrans) expressed their concerns with the EPA's proposed action, as their primary pozzolan in cement is fly ash. Furthermore, they emphasized the economic benefits of fly ash, and feared that a "hazardous building material" label would threaten its beneficial use. Caltrans uses fly ash extensively throughout the state, and contributes to significant cost-savings on projects.

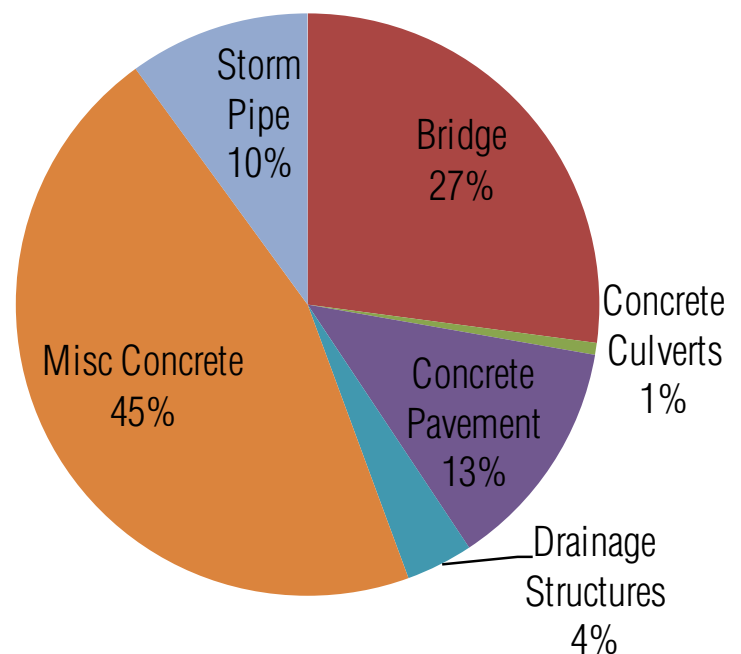
### How prevalent is fly ash in your transportation projects?

Fly ash is used in virtually all concrete supplied to Caltrans construction contracts. It has also been extensively used on private construction works.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

Average California Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## California Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$447.6	\$2,030.2	22.0%
2006	\$585.4	\$4,534.2	12.9%
2007	\$524.3	\$2,587.1	20.3%
2008	\$622.0	\$2,890.1	21.5%
2009	\$509.3	\$2,314.2	22.0%
2010	\$578.1	\$2,515.2	23.0%
Average	\$544.4	\$2,811.8	19.4%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in California Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$167.15	\$208.37	\$162.13	\$132.74	\$94.34	\$120.73
Concrete Culverts	\$0.18	\$2.54	\$15.00	\$3.54	\$0.28	
Concrete Pavement	\$103.90	\$23.78	\$45.85	\$83.84	\$17.11	\$147.57
Drainage Structures	\$17.53	\$4.47	\$35.54	\$45.15	\$16.77	\$1.68
Misc. Concrete	\$110.15	\$281.23	\$256.55	\$265.45	\$318.94	\$257.21
Storm Pipe	\$48.83	\$67.38	\$21.66	\$94.80	\$47.11	\$47.38
Total	\$447.75	\$587.77	\$536.72	\$625.52	\$494.56	\$574.57

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.



## The Use of Fly Ash in Colorado's Transportation Construction

Colorado currently has 16,424 miles of roadway in the Federal-aid Highway System, of which five percent is concrete. There are 8,408 bridges in the state, of which 57 percent or 4,807, contain primarily concrete. Approximately 16 percent of highway spending in Colorado is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

Fly ash is used to replace up to 30 percent of the Portland cement in concrete used by the Colorado Department of Transportation (CDOT). A typical cubic yard of concrete contains 600 lbs of cement, of which 180 lbs of fly ash could be substituted for Portland cement.

### How would a "hazardous building material" label affect your state?

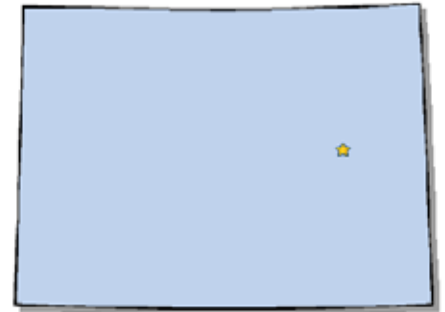
Experts interviewed from CDOT explained that fly ash is the most cost-effective mitigative measure for protecting concrete structures from a chemical reaction between the alkali in the Portland cement and the silica in aggregates. This alkali-silica reaction (ASR) creates an expansive gel that breaks apart concrete from the inside. Fly ash is extremely beneficial in mitigating ASR. Preventing ASR allows a structure to remain in service for its designed lifespan. Lastly, depending on the type of fly ash used, it is 20 to 50 percent less costly to use than Portland cement.

### How prevalent is fly ash in your transportation projects?

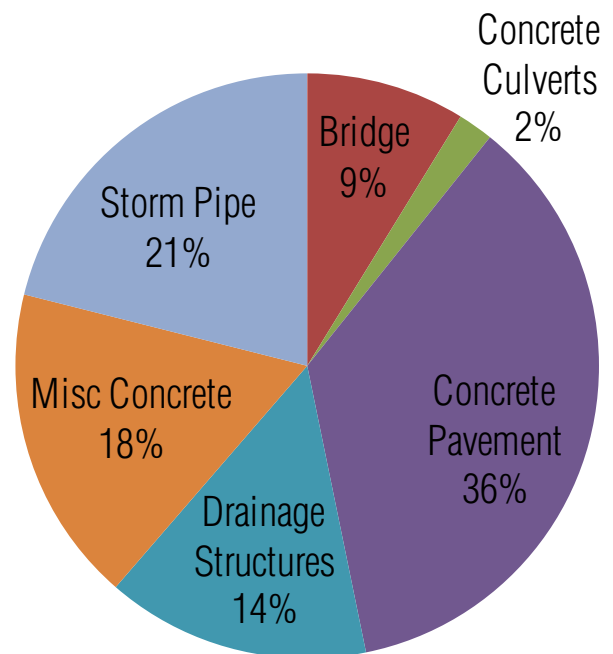
Currently, CDOT uses approximately 400,000 cubic yards of concrete in a typical year. On average, experts estimate that 20 percent of the Portland cement is replaced with fly ash. This results in a decreased Portland cement usage of about 25,000 tons, which equates to an equal reduction in CO<sub>2</sub>.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.coloradodot.info/programs/research/pdfs/2007/s50concrete.pdf/at\\_download/file](http://www.coloradodot.info/programs/research/pdfs/2007/s50concrete.pdf/at_download/file)



Average Colorado Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Colorado Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$28.3	\$240.0	11.8%
2006	\$76.6	\$450.2	17.0%
2007	\$59.6	\$348.0	17.1%
2008	\$66.5	\$450.2	14.8%
2009	\$69.2	\$325.4	21.3%
2010	\$46.0	\$323.8	14.2%
Average	\$57.7	\$356.3	16.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Colorado Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$3.86	\$2.63	\$6.51	\$4.13	\$9.68	\$3.53
Concrete Culverts	\$3.34	\$1.13	\$1.28	\$0.27	\$0.37	\$0.37
Concrete Pavement	\$5.87	\$27.65	\$18.55	\$31.39	\$28.46	\$12.93
Drainage Structures	\$9.82	\$0.49	\$20.07	\$14.54	\$2.50	\$3.01
Misc. Concrete	\$3.03	\$8.38	\$12.65	\$2.75	\$21.56	\$12.52
Storm Pipe	\$2.42	\$36.29	\$0.54	\$13.46	\$6.59	\$13.62
Total	\$28.35	\$76.56	\$59.60	\$66.55	\$69.16	\$45.97

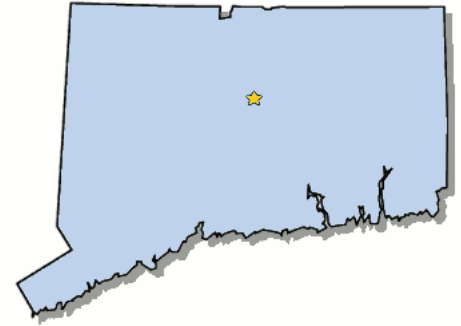
Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Connecticut's Transportation Construction

Connecticut currently has 6,082 miles of roadway in the Federal-aid Highway System, of which there is no concrete mileage. There are 4,180 bridges in the state, of which 43 percent or 1,812, contain primarily concrete. Approximately 14 percent of highway spending in Connecticut is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The Connecticut Department of Transportation (ConnDOT) has approved mix designs using 100 percent Portland cement, as well as alternative mix designs that use up to 15 percent replacement for each producer qualified by the department. Currently, the most common strengthening agent is class F fly ash.



### How would a "hazardous building material" label affect your state?

Most contractors in Connecticut maintain mix designs using fly ash. It is anticipated that ConnDOT specifications would be unchanged. However, since fly ash is the primary strengthening agent in concrete, ConnDOT would possibly need to identify more expensive alternatives. Thus, the potential "hazardous" label on fly ash is not supported by ConnDOT.

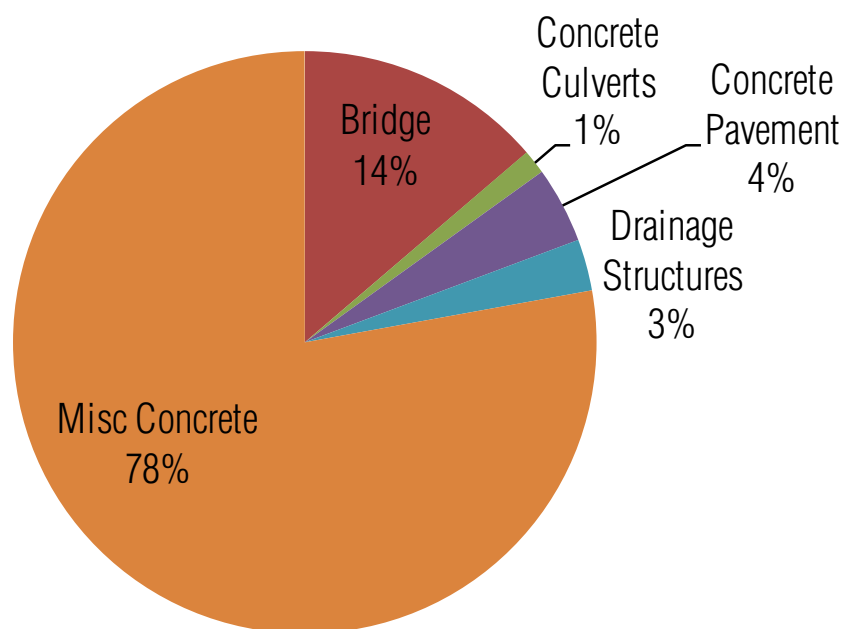
### How prevalent is fly ash in your transportation projects?

Based on the samples received, contractors use concrete with fly ash approximately 50 percent of the time. In the colder months, fly ash mixes are used less frequently.

### What are your state's sources of fly ash?

Suppliers of fly ash for Connecticut include: DTE energy, Separation Tech, MRT Corp, and Headwaters Resources.

Average Connecticut Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Connecticut Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$18.4	\$210.6	8.7%
2006	\$31.5	\$316.4	9.9%
2007	\$31.9	\$342.7	9.3%
2008	\$94.4	\$686.2	13.8%
2009	\$140.2	\$831.7	16.9%
2010	\$84.0	\$585.0	14.4%
Average	\$66.7	\$495.5	13.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Connecticut Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$1.88	\$2.05	\$10.07	\$32.78	\$6.75	\$1.39
Concrete Culverts	\$0.18	\$0.44	\$0.45	\$3.53	\$0.76	
Concrete Pavement	\$0.38	\$1.16	\$1.80	\$6.35	\$5.16	\$2.09
Drainage Structures	\$0.75	\$10.68				
Misc. Concrete	\$16.11	\$28.08	\$19.63	\$54.05	\$114.09	\$79.73
Total	\$19.30	\$42.41	\$31.94	\$96.71	\$126.76	\$83.21

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Delaware's Transportation Construction

Delaware currently has 1,526 miles of roadway in the Federal-aid Highway System, of which eight percent is concrete. There are 857 bridges in the state, of which 43 percent or 376, contain primarily concrete. Approximately eight percent of highway spending in Delaware is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The Delaware Department of Transportation (DELDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate up to 20 percent.

### How would a "hazardous building material" label affect your state?

Experts at DELDOT explained that they have used fly ash successfully in concrete and embankments as a cost-saving mechanism in projects. Furthermore, they recognize the importance of fly ash to counteract alkali-silica reactions in concrete. Experts are on record against the EPA's proposal to consider fly ash as a hazardous material. The use of alternative concrete strengthening agents, such as lithium, is possible. However, these are considerably more expensive than fly ash and would drive up the cost of projects.

### How prevalent is fly ash in your transportation projects?

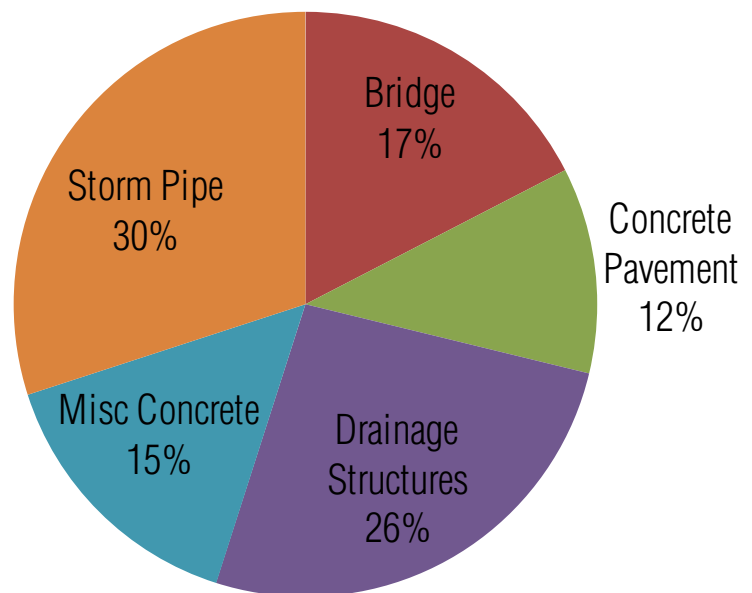
The use of fly ash is widespread in Delaware.

### What are your state's sources of fly ash?

Pioneer Concrete of Wilmington, Delaware is the primary supplier of concrete that has provided the state with fly ash. This fly ash is purchased from a company in Baltimore, Maryland named Separation Technologies Inc.



Average Delaware Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Delaware Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$10.9	\$144.2	7.6%
2006	\$4.1	\$78.3	5.2%
2007	\$18.9	\$203.2	9.3%
2008	\$9.6	\$131.0	7.3%
2009	\$4.9	\$97.1	5.0%
2010	\$10.1	\$127.9	7.9%
Average	\$9.7	\$130.3	7.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Delaware Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$3.06	\$0.64	\$1.54	\$1.03	\$2.07	\$1.83
Concrete Pavement	\$3.44	\$0.31	\$0.64	\$0.90	\$0.41	\$0.96
Drainage Structures	\$0.91	\$1.30	\$8.50	\$3.18	\$0.55	\$0.84
Misc. Concrete	\$1.45	\$1.00	\$3.01	\$2.20	\$0.56	\$0.57
Storm Pipe	\$2.03	\$0.80	\$5.23	\$2.27	\$1.31	\$5.90
Total	\$10.90	\$4.05	\$18.93	\$9.57	\$4.90	\$10.11

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Florida's Transportation Construction

Florida currently has 25,654 miles of roadway in the Federal-aid Highway System, of which there is less than one percent concrete mileage. There are 11,679 bridges in the state, of which 84 percent or 9,846, contain primarily concrete. Approximately 10 percent of highway spending in Florida is spent on concrete products each year, based on ARTBA analysis of bid tab data.



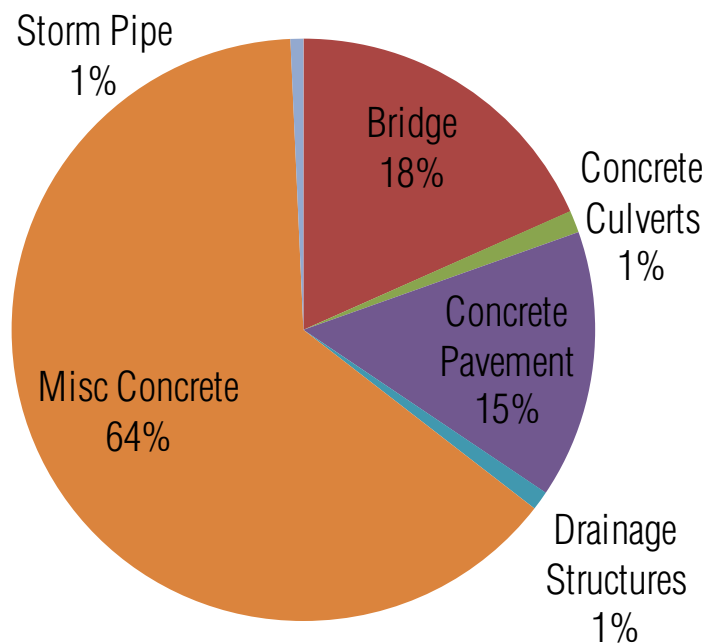
### What are your state's fly ash specifications?

Currently, the Florida Department of Transportation (FDOT) allows various rates of replacement of Portland cement with class C and F fly ash, although the class C fly ash is not formally approved. The state is currently evaluating class C fly ash in a cost-benefit analysis model to determine if it is cost-effective to use, seeing as how class F ash is available relatively cheaper. On average, the cost of fly ash ranges between \$20 and \$30 a ton. The cost of shipping was not included in that price.

### How would a "hazardous building material" label affect your state?

FDOT experts interviewed expressed their concern that an EPA regulation on fly ash could adversely affect the state's economic welfare. Florida is already facing financial turmoil, and the loss of a cost-saving mechanism in projects would prove to be detrimental to FDOT's ability to finance projects. Furthermore, FDOT published research papers and developed years of data supporting the qualities of class F fly ash in concrete exposed to marine and other "aggressive environments." According to one expert interviewed, "If class F ash is officially described as a hazardous material, my thoughts are that the material will not be available even though there would be ample supply simply because of the fear that the concrete facilities would or could be impacted if the material was handled incorrectly or a minor spillage occurred."

### Average Florida Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## How prevalent is fly ash in your transportation projects?

Currently, about 95 percent of mixes have fly ash or slag incorporated in them, with fly ash being the predominate material of choice. FDOT hopes that by next year all concrete projects will use fly ash.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/cementsource.pdf>

## Florida Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$237.0	\$2,171.1	10.9%
2006	\$186.1	\$2,167.3	8.6%
2007	\$194.2	\$1,929.1	10.1%
2008	\$89.7	\$1,427.1	6.3%
2009	\$187.5	\$1,640.8	11.4%
2010	\$89.5	\$965.2	9.3%
Average	\$164.0	\$1,716.8	9.6%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Florida Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$50.8	\$21.7	\$54.7	\$18.2	\$26.8	\$10.2
Concrete Culverts	\$0.7	\$0.2	\$7.0	\$1.2	\$2.2	\$0.8
Concrete Pavement	\$22.8	\$11.6	\$3.2	\$90.0	\$7.9	\$12.7
Drainage Structures	\$10.5	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Misc. Concrete	\$181.8	\$130.9	\$117.6	\$66.6	\$69.0	\$68.7
Storm Pipe	\$2.4	\$3.8	\$0.7	\$0.0	\$0.1	\$0.1
Total	\$269.1	\$168.1	\$183.3	\$176.0	\$106.0	\$92.5

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.



## The Use of Fly Ash in Georgia's Transportation Construction

Georgia currently has 30,822 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 14,578 bridges in the state, of which 70 percent or 10,245, contain primarily concrete. Approximately 17 percent of highway spending in Georgia is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The Georgia Department of Transportation (GDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate between 15 to 25 percent. Fly ash typically costs around \$28 per ton, delivered.

### How would a "hazardous building material" label affect your state?

GDOT engineers stated in interviews that if fly ash is designated as a "hazardous building material", it could make projects significantly more expensive and difficult to finance. The use of fly ash in Georgia has been largely successful in past decades, and experts were very apprehensive about the possibility of a "hazardous building material" designation. Experts interviewed also recognized its structural benefits in concrete, leading to longer-lasting, low-maintenance final products.

### How prevalent is fly ash in your transportation projects?

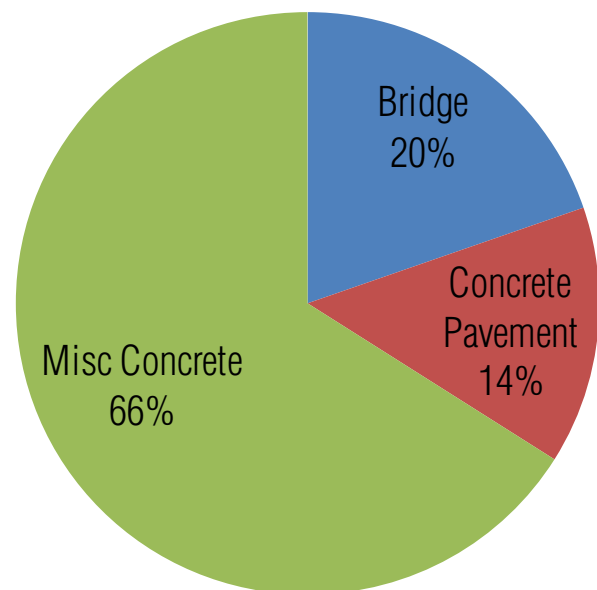
Fly ash has been used throughout the state in all classes of concrete since 1980.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://dot.ga.gov/doingbusiness/Materials/qpl/Documents/qpl30.pdf>



Average Georgia Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Georgia Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$248.8	\$1,445.1	17.2%
2006	\$547.9	\$2,371.6	23.1%
2007	\$358.2	\$2,089.9	17.1%
2008	\$63.6	\$628.3	10.1%
2009	\$82.5	\$816.2	10.1%
2010	\$81.3	\$670.6	12.1%
Average	\$230.4	\$1,337.0	17.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Georgia Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$66.15	\$116.68	\$67.92	\$16.55	\$2.90	\$1.74
Concrete Pavement	\$10.53	\$127.27	\$18.69	\$5.94	\$18.01	\$17.45
Misc. Concrete	\$172.11	\$303.95	\$271.57	\$41.15	\$61.55	\$62.11
Total	\$248.79	\$547.90	\$358.17	\$63.64	\$82.46	\$81.29

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Hawaii’s Transportation Construction

Hawaii currently has 1,549 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 1,125 bridges in the state, of which 86 percent or 971, contain primarily concrete.



### What are your state’s fly ash specifications?

The Hawaii Department of Transportation (HDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate up to 15 percent. A higher amount of fly ash may be allowed on a case-by-case basis.

### How would a “hazardous building material” label affect your state?

According to an expert interviewed within HDOT, fly ash has a wide variety of transportation infrastructure applications. In Hawaii, concrete is a major material used, and a potential “hazardous building material” label on fly ash would force HDOT to rely on other, more expensive, materials and practices to strengthen concrete. Furthermore, projects would become significantly more expensive, as fly ash is dramatically cheaper than alternative strengthening agents, such as lithium. A primary focus of fly ash in concrete is durability within marine environments. The possible labeling of fly ash could jeopardize the quality of projects completed.

### How prevalent is fly ash in your transportation projects?

Fly ash is prevalent in Hawaiian projects, but minimal use exists, due to the high cost of importing quality class F fly ash, approximately \$283 per ton delivered from China.

### What are your state’s sources of fly ash?

The class F fly ash that is currently being used in Hawaii has been imported from China by HDOT’s cement supplier, Hawaiian Cement. Hawaii does have a relatively small coal power plant, AES Hawaii Inc., but their fly ash does not meet class F or C requirements and has high sulfur content.

Editor’s note: Data on concrete use profile from state transportation bid tabs is not available.

## The Use of Fly Ash in Idaho's Transportation Construction

Idaho currently has 9,577 miles of roadway in the Federal-aid Highway System, of which two percent is concrete. There are 4,125 bridges in the state, of which 69 percent or 2,866, contain primarily concrete. Approximately 11 percent of highway spending in Idaho is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Idaho Transportation Department (ITD) typically uses around a 25 percent class F fly ash replacement of concrete in mixes. Technically, the specifications dictate use of only class F between 20 and 25 percent. Also, ITD does allow some not qualifying class F ashes as mineral filler.

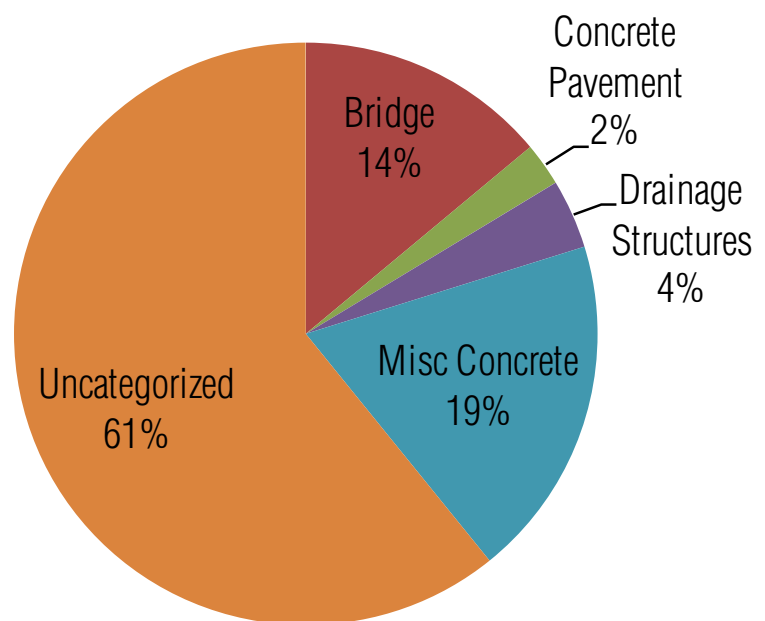
### How would a "hazardous building material" label affect your state?

ITD allows other strengthening agents in concrete, such as lithium, granulated blast furnace slag and silica fume. However, these alternatives are significantly more expensive than fly ash, and do not possess all of the beneficial attributes of fly ash. ITD experts interviewed emphasized the differences in workability and permeability properties. A "hazardous building material," according to experts at ITD, would be very detrimental to the infrastructure system and their ability to complete projects.

### How prevalent is fly ash in your transportation projects?

Roughly 60 to 65 percent of the ITD projects currently use fly ash. In the Boise area this year ITD is conducting four major concrete paving jobs, with another three underway in other parts of the state. Each of these projects uses fly ash in the concrete. Next year, two or three concrete paving projects are anticipated statewide, all using fly ash.

Average Idaho Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

Typically, vendors supply from the Navajo Power Plant and the ENX Corporation based in British Columbia. Several suppliers from the past no longer provide class F ash, such as Centralia in Washington.

## Idaho Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$18.1	\$225.0	8.0%
2006	\$13.7	\$157.9	8.7%
2007	\$13.1	\$220.5	5.9%
2008	\$45.1	\$393.1	11.5%
2009	\$68.1	\$421.6	16.2%
2010	\$27.2	\$268.0	10.1%
Average	\$30.9	\$281.0	11.0%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Idaho Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$1.10	\$1.59	\$0.76	\$3.47	\$11.28	\$7.68
Concrete Pavement	\$0.84	\$1.82	\$1.27	\$0.52		
Drainage Structures	\$5.17	\$1.02	\$0.71	\$0.23		
Misc. Concrete	\$3.20	\$3.94	\$6.59	\$9.66	\$8.71	\$3.20
Uncategorized	\$7.77	\$7.12	\$5.02	\$30.12	\$47.88	\$15.05
Total	\$18.09	\$15.49	\$14.35	\$43.99	\$67.88	\$25.93

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Illinois' Transportation Construction

Illinois currently has 34,727 miles of roadway in the Federal-aid Highway System, of which six percent is concrete. There are 26,077 bridges in the state, of which 72 percent or 18,757, contain primarily concrete. Approximately 14 percent of highway spending in Illinois is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

Illinois typically uses 15 percent Class F fly ash and 20 percent class C fly ash replacement of Portland cement in mixes. However, Illinois is currently in the process of allowing to up to 25 percent class F fly ash and 30 percent class C fly ash in mixes. The higher percentages are expected to reduce the cost of the mixture, lower the permeability of the concrete, further reduce the risk of alkali-silica reaction, and provide a more environmentally friendly mix.

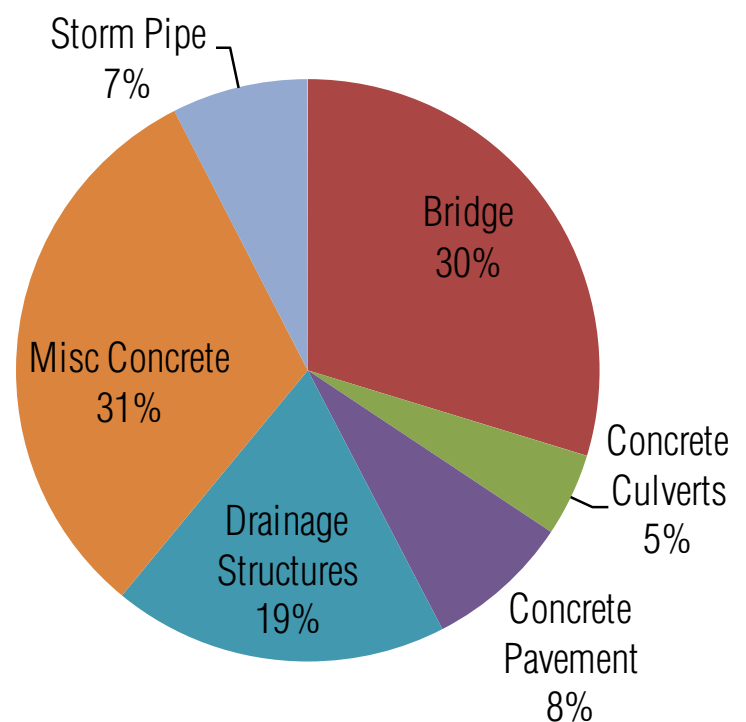
### How would a "hazardous building material" label affect your state?

According to an expert within the Illinois Department of Transportation (IDOT) interviewed, "Declaring the material 'hazardous' will most likely raise the cost and reduce or eliminate its availability for use." IDOT insiders fear having to use less durable concrete mixes that provide less protection against steel and damaging water. Fly ash is one of the most critical material components for ensuring a long life to infrastructure. IDOT has become very dependent on it, and hopes a reasonable solution can be obtained to ensure its continued use.

### How prevalent is fly ash in your transportation projects?

The use of fly ash depends on the area of the state. Some rural plants do not have a silo for fly ash. However, in the Chicago area it is used extensively. If a plant has a silo for fly ash, a great majority of the mixtures supplied will contain fly ash.

Average Illinois Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.dot.state.il.us/materials/finelydividedminerals.pdf>

## Illinois Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$236.5	\$1,244.8	19.0%
2006	\$261.7	\$1,391.1	18.8%
2007	\$161.3	\$1,157.2	13.9%
2008	\$167.1	\$1,259.9	13.3%
2009	\$223.9	\$2,168.1	10.3%
2010	\$255.7	\$2,427.4	10.5%
Average	\$217.7	\$1,608.1	13.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Illinois Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$30.97	\$77.66	\$62.96	\$60.38	\$74.33	\$82.18
Concrete Culverts	\$3.93	\$8.34	\$2.96	\$23.49	\$13.99	\$7.37
Concrete Pavement	\$17.23	\$17.88	\$16.91	\$15.65	\$13.86	\$23.54
Drainage Structures	\$55.00	\$25.80	\$25.92	\$15.25	\$49.87	\$70.93
Misc. Concrete	\$101.24	\$95.41	\$39.26	\$46.14	\$66.50	\$62.68
Storm Pipe	\$28.12	\$36.62	\$13.31	\$6.18	\$5.30	\$9.03
Total	\$236.49	\$261.71	\$161.31	\$167.09	\$223.86	\$255.73

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Indiana's Transportation Construction

Indiana currently has 22,333 miles of roadway in the Federal-aid Highway System, of which six percent is concrete. There are 18,543 bridges in the state, of which 66 percent or 12,149, contain primarily concrete. Approximately nine percent of highway spending in Indiana is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

Specifications dictate that the Indiana Department of Transportation can replace Portland cement at a rate between 20 to 25 percent for with both class C and F fly ash.

### How would a "hazardous building material" label affect your state?

Experts within the Indiana Department of Transportation were unavailable for interview.

### How prevalent is fly ash in your transportation projects?

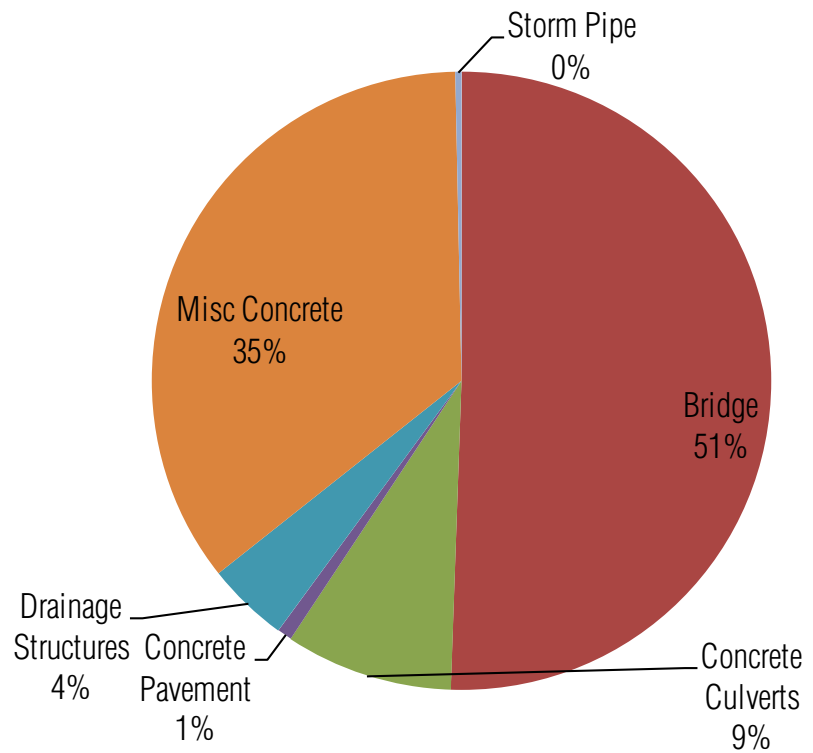
Outside experts speculate that Indiana uses fly ash extensively in its projects.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.in.gov/indot/div/M&T/appmat/pubs/apl27.pdf>



Average Indiana Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## Indiana Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$62.1	\$597.8	10.4%
2006	\$72.7	\$1,062.2	6.8%
2007	\$100.0	\$1,063.2	9.4%
2008	\$114.5	\$1,216.5	9.4%
2009	\$133.5	\$1,346.6	9.9%
2010	\$111.3	\$1,456.5	7.6%
Average	\$99.0	\$1,123.8	8.8%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Indiana Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$31.93	\$32.43	\$41.52	\$76.56	\$49.19	\$68.75
Concrete Culverts	\$4.69	\$5.44	\$14.15	\$3.56	\$14.19	\$9.98
Concrete Pavement	\$1.28	\$0.26	\$0.66	\$0.22	\$0.89	\$1.21
Drainage Structures	\$4.21	\$8.75	\$3.34	\$2.28	\$1.32	\$5.48
Misc. Concrete	\$19.71	\$25.44	\$40.05	\$31.80	\$67.18	\$25.91
Storm Pipe	\$0.32	\$0.43	\$0.30	\$0.09	\$0.76	\$0.02
Total	\$62.13	\$72.74	\$100.02	\$114.50	\$133.53	\$111.35

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Iowa's Transportation Construction

Iowa currently has 24,575 miles of roadway in the Federal-aid Highway System, of which 36 percent is concrete. There are 24,798 bridges in the state, of which 54 percent or 13,275, contain primarily concrete. Approximately 23 percent of highway spending in Iowa is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Iowa Department of Transportation (Iowa DOT) allows a 20 to 25 percent replacement rate of Portland cement with fly ash. Both class C and F fly ash are permitted, but the state typically only uses class F due to availability.

### How would a "hazardous building material" label affect your state?

Experts within Iowa DOT interviewed explained that if fly ash was labeled a "hazardous building material," waste restrictions would likely follow suit. This would make projects dramatically more expensive and the quality of the work would be compromised severely. This could be incredibly problematic for the Department, as fly ash is used in typically all concrete projects.

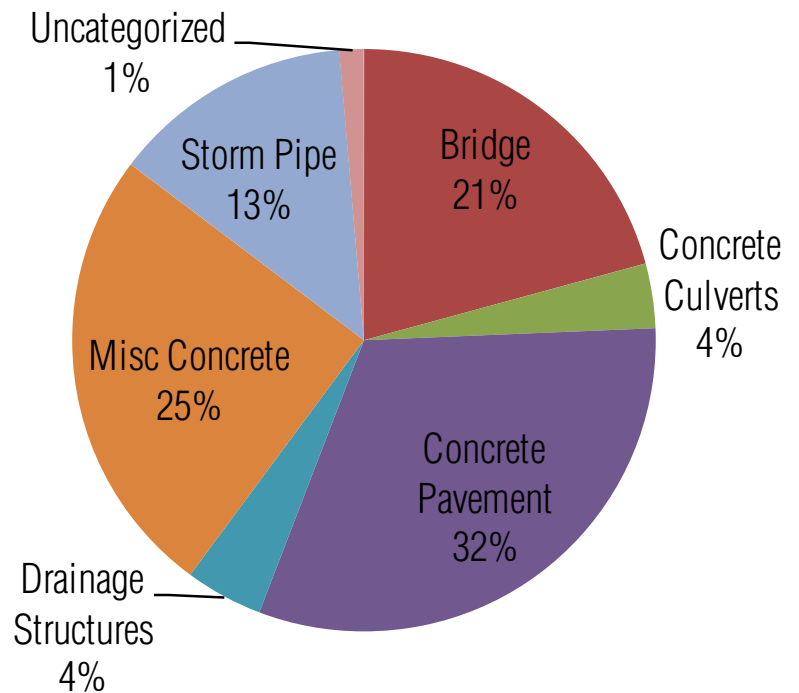
### How prevalent is fly ash in your transportation projects?

Typically all major infrastructure projects in the state, such as paved shoulders, bridges, and PCC Overlays, etc utilize fly ash. Most other minor projects, such as sidewalks, drives, curbs and gutters and precast items, etc also use fly ash with a 20 to 25 percent replacement.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.iowadot.gov/erl/archives/Oct\\_2007/IM/content/491.17aa.pdf](http://www.iowadot.gov/erl/archives/Oct_2007/IM/content/491.17aa.pdf)

Average Iowa Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Iowa Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$200.8	\$790.1	25.4%
2006	\$127.7	\$601.4	21.2%
2007	\$142.1	\$536.7	26.5%
2008	\$146.2	\$726.8	20.1%
2009	\$239.6	\$1,088.1	22.0%
2010	\$165.3	\$651.7	25.4%
Average	\$170.3	\$732.5	23.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Iowa Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$19.33	\$42.89	\$30.49	\$46.43	\$31.99	\$41.02
Concrete Culverts	\$4.32	\$4.68	\$8.30	\$5.48	\$7.84	\$6.12
Concrete Pavement	\$47.40	\$40.23	\$53.51	\$49.83	\$95.97	\$34.99
Drainage Structures	\$31.07	\$1.72	\$1.91	\$1.00	\$7.51	\$0.70
Misc. Concrete	\$26.69	\$28.08	\$40.33	\$35.88	\$78.93	\$47.53
Storm Pipe	\$71.96	\$6.15	\$7.58	\$7.43	\$17.10	\$26.17
Uncategorized	\$3.94	\$0.15	\$0.23	\$8.79	\$0.67	
Total	\$204.71	\$123.88	\$142.35	\$154.86	\$240.00	\$156.54

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Kansas' Transportation Construction

Kansas currently has 24,516 miles of roadway in the Federal-aid Highway System, of which five percent is concrete. There are 25,517 bridges in the state, of which 62 percent or 15,891, contain primarily concrete. Approximately 21 percent of highway spending in Kansas is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Kansas Transportation Cabinet (KDOT) specifications dictate that contractors can replace Portland cement at a rate up to 25 percent with fly ash.

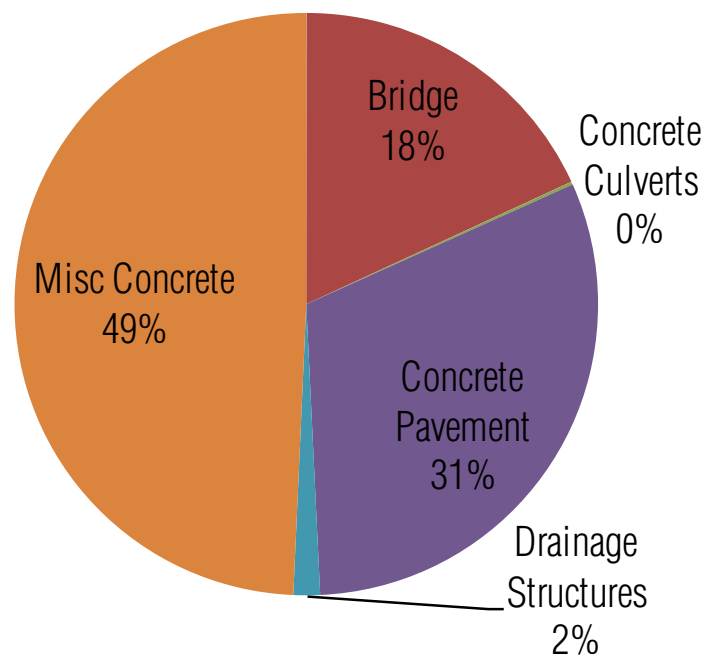
### How would a "hazardous building material" label affect your state?

According to a materials expert, KDOT uses fly ash throughout, and beyond the pavement process. It is used to stabilize or modify soil characteristics, fill voids beneath paving surfaces, and found extensively in concrete mixes. Within the past four years, KDOT has been working towards the use of concrete mixes which uses a portion of fly ash to create a tougher, less permeable concrete paste. Thus, the Department relies heavily on the use of fly ash and could expect some serious impacts if the EPA chooses to implement an aggressive oversight of the product.

### How prevalent is fly ash in your transportation projects?

The use of fly ash is wide spread throughout the state. KDOT has averaged using 50,000 tons of fly ash per year on its projects for the past 17 years. This does not include other governmental entities within Kansas, which rely on the use of KDOT specifications. Its use is widespread within the state.

Average Kansas Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.ksdot.org/burmatrres/pql/pql-07-03.pdf>

## Kansas Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$99.4	\$547.6	18.2%
2006	\$109.4	\$572.3	19.1%
2007	\$68.4	\$353.3	19.4%
2008	\$97.5	\$474.1	20.6%
2009	\$165.6	\$654.8	25.3%
2010	\$83.5	\$448.6	18.6%
Average	\$104.0	\$508.5	20.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

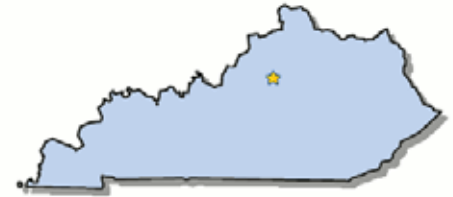
## Concrete Use by Type in Kansas Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$9.50	\$8.97	\$23.81	\$14.34	\$42.73	\$13.63
Concrete Culverts	\$0.82	\$0.21				
Concrete Pavement	\$26.96	\$33.43	\$23.07	\$34.45	\$41.48	\$33.74
Drainage Structures	\$1.49	\$2.60	\$0.64	\$0.83	\$1.53	\$2.13
Misc. Concrete	\$61.47	\$63.61	\$20.90	\$47.89	\$79.87	\$33.83
Total	\$100.24	\$108.82	\$68.42	\$97.52	\$165.60	\$83.33

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Kentucky's Transportation Construction

Kentucky currently has 13,623 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 13,632 bridges in the state, of which 81 percent or 10,979, contain primarily concrete. Based on our data, approximately six percent of highway spending in Kentucky is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Kentucky Transportation Cabinet (KTC) allows up to 30 percent replacement of Portland cement with class C fly ash and 20 percent replacement with class F fly ash.

### How would a "hazardous building material" label affect your state?

If fly ash were banned, insiders within KTC expected to see a rise in the cost of using concrete in general. All other alternative pozzolans are significantly more expensive. This increase in cost would be significant, as fly ash is used extensively state-wide.

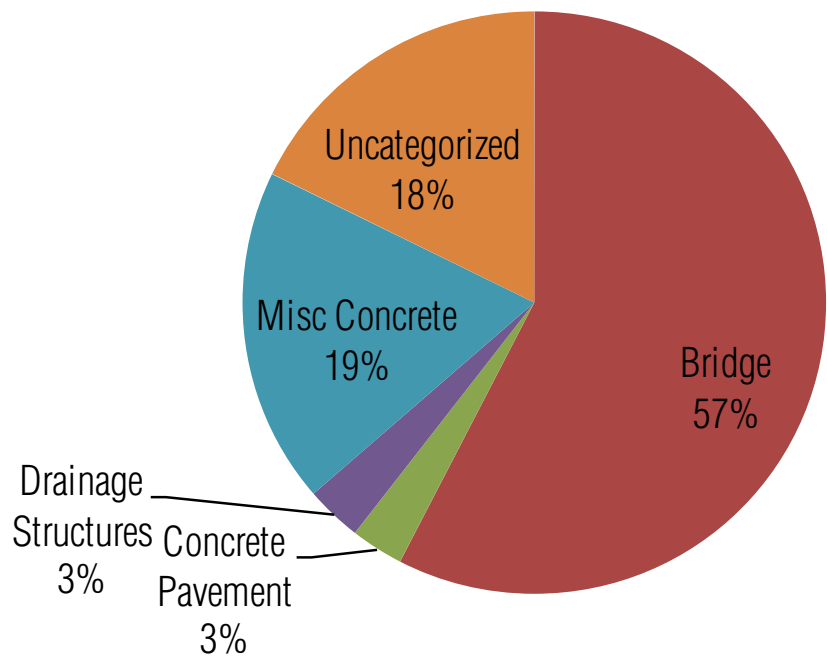
### How prevalent is fly ash in your transportation projects?

KTC does not keep accurate records of the amount of fly ash used in projects. However, experts believe that it is used frequently in state projects.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://transportation.ky.gov/materials/download/list%20of%20approved%20materials/lam.pdf> (pg. 54)

Average Kentucky Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Kentucky Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$49.6	\$834.8	5.9%
2006	\$64.3	\$1,125.6	5.7%
2007	\$83.0	\$1,440.2	5.8%
2008	\$27.3	\$452.8	6.0%
2009	\$64.6	\$888.7	7.3%
2010	\$55.7	\$835.1	6.7%
Average	\$57.4	\$929.5	6.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Kentucky Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$31.14	\$31.81	\$51.01	\$19.00	\$34.66	\$31.69
Concrete Pavement	\$0.78	\$3.66	\$1.96	\$0.02	\$3.27	\$0.40
Drainage Structures	\$2.68	\$3.23	\$3.33	\$1.51		
Misc. Concrete	\$10.24	\$18.84	\$10.97	\$1.04	\$13.26	\$10.15
Uncategorized	\$4.75	\$10.02	\$15.85	\$7.22	\$13.38	\$10.14
Total	\$49.60	\$67.56	\$83.12	\$28.79	\$64.57	\$52.38

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Louisiana's Transportation Construction

Louisiana currently has 13,189 miles of roadway in the Federal-aid Highway System, of which 13 percent is concrete. There are 12,320 bridges in the state, of which 70 percent, or 9,374, contain primarily concrete. Approximately 24 percent of highway spending in Louisiana is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Louisiana Department of Transportation and Development (DOTD) currently allows up to 25 percent fly ash replacement of cementitious material for pipe production, up to 20 percent fly ash for minor structures and pavement applications, and up to 15 percent fly ash for structural concrete. The replacement is on a pound for pound basis.

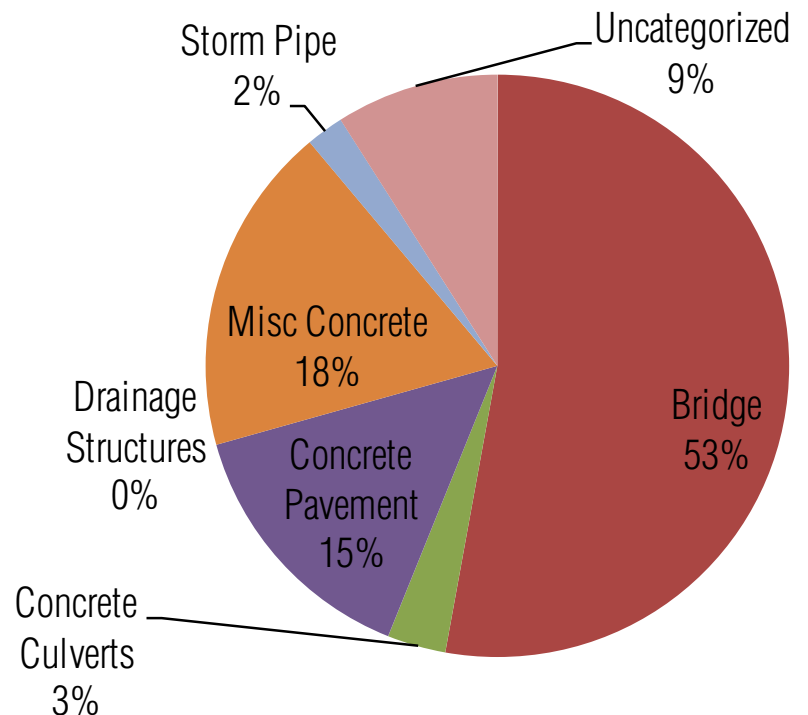
### How would a "hazardous building material" label affect your state?

An expert from DOTD interviewed stated that the possible "hazardous building material" label of fly ash would, "definitely raise the cost of doing business for DOTD considerably," as the strengthening agent is used extensively in the state. According to the expert, this potential change comes at an inconvenient time as they are "currently revising the standards and specifications and are planning on allowing ternary cementitious combinations that will significantly increase our use of fly ash for all concrete applications."

### How prevalent is fly ash in your transportation projects?

Nearly every pavement project has fly ash use incorporated into the bid prices. A great majority of the structural concrete does, as well. Its use is widespread throughout the state.

Average Louisiana Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.dotd.louisiana.gov/highways/construction/lab/qpl/qpl%2050%20fly%20ash.pdf>

## Louisiana Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$261.9	\$991.6	26.4%
2006	\$679.9	\$1,757.6	38.7%
2007	\$155.2	\$1,470.6	10.6%
2008	\$389.0	\$1,550.8	25.1%
2009	\$234.0	\$1,108.0	21.1%
2010	\$206.5	\$1,086.2	19.0%
Average	\$321.1	\$1,327.5	24.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Louisiana Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$163.16	\$529.43	\$58.66	\$114.01	\$109.50	\$43.63
Concrete Culverts	\$20.53	\$24.41	\$0.55	\$0.78	\$14.04	\$2.09
Concrete Pavement	\$14.92	\$40.26	\$21.59	\$79.65	\$31.09	\$92.40
Drainage Structures	\$0.03					
Misc. Concrete	\$24.41	\$44.41	\$17.35	\$178.31	\$58.10	\$29.41
Storm Pipe	\$8.23	\$10.43	\$16.65	\$0.80	\$3.13	\$0.72
Uncategorized	\$30.63	\$30.96	\$40.43	\$15.48	\$18.10	\$38.22
Total	\$261.91	\$679.90	\$155.23	\$389.02	\$233.97	\$206.47

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Maine's Transportation Construction

Maine currently has 6,323 miles of roadway in the Federal-aid Highway System, of which there is no concrete mileage. There are 2,392 bridges in the state, of which 37 percent or 876, contain primarily concrete. Approximately seven percent of highway spending in Maine is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The Maine Department of Transportation (MaineDOT) allows class F fly ash and the maximum allowed by specification is 30 percent by cement replacement. The typical amount used is 20 percent by weight of replacement.

### How would a "hazardous building material" label affect your state?

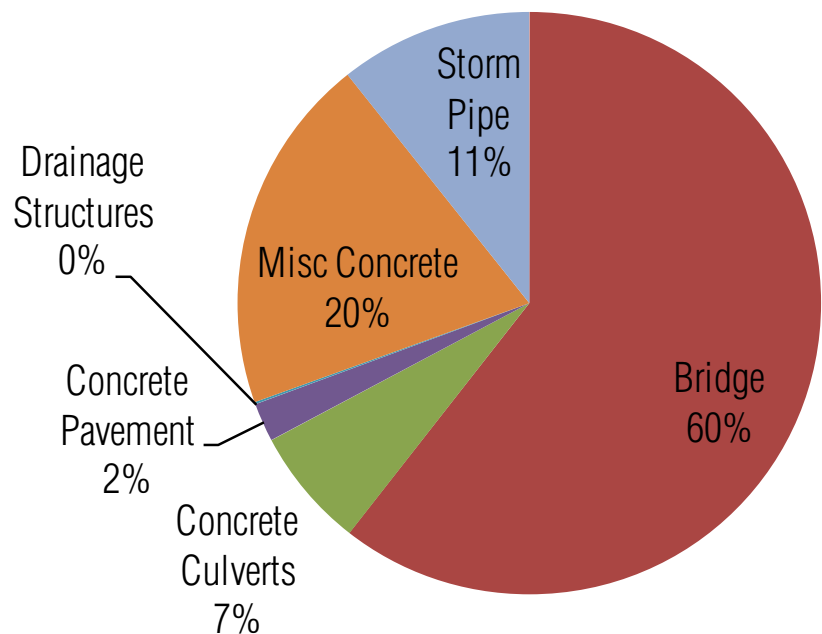
A MaineDOT expert interviewed declared such a designation "would not be in the Department's best interest." The concrete strengthening agent has been used successfully within the state to combat the damaging effects of chemical alkali silica reactions. Other alternatives are available, but class F fly ash is the most effective concrete additive to strengthen concrete, while still providing significant cost-savings. Furthermore, the insider added that "having it available as a tool to help provide long lasting durable concrete seems like a better choice than to have it sitting in a landfill for generations to come."

### How prevalent is fly ash in your transportation projects?

Fly ash is used in approximately 20 to 25 percent of all concrete projects.



Average Maine Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

Currently, all fly ash used in MaineDOT-approved mix designs is supplied by Headwaters Resources and originates from the Brayton Point power plant located in Somerset, Massachusetts.

## Maine Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$11.6	\$187.5	6.2%
2006	\$13.8	\$169.5	8.1%
2007	\$12.9	\$128.5	10.0%
2008	\$10.6	\$180.4	5.9%
2009	\$15.1	\$269.1	5.6%
2010	\$15.6	\$220.1	7.1%
Average	\$13.3	\$192.5	6.9%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Maine Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$8.14	\$3.82	\$6.69	\$7.23	\$11.38	\$10.91
Concrete Culverts	\$0.58	\$0.40	\$0.99	\$0.85	\$1.15	\$1.33
Concrete Pavement	\$0.52	\$1.19				
Drainage Structures	\$0.09					
Misc. Concrete	\$1.76	\$7.40	\$2.57	\$1.70	\$0.84	\$1.50
Storm Pipe	\$0.56	\$0.96	\$2.63	\$0.73	\$1.75	\$1.88
Total	\$11.65	\$13.78	\$12.88	\$10.51	\$15.11	\$15.63

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Maryland's Transportation Construction

Maryland currently has 7,766 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 5,168 bridges in the state, of which 34 percent or 1,754, contain primarily concrete. Approximately four percent of highway spending in Maryland is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

Specifications dictate that the Maryland Department of Transportation (MDOT) can replace Portland cement at a rate between 20-25 percent for with class F fly ash.

### How would a "hazardous building material" label affect your state?

MDOT experts were unavailable for comment.

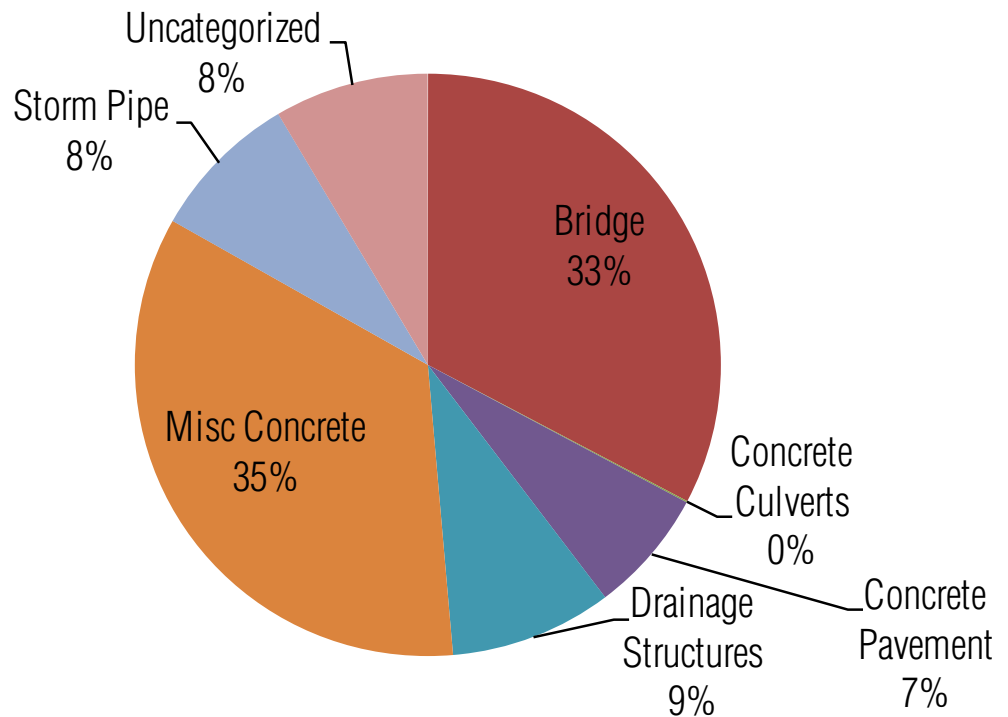
### How prevalent is fly ash in your transportation projects?

While experts from MDOT were unable for an interview, neighboring state's experts speculated that Maryland's usage of fly ash was extensive and state-wide.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.mde.state.md.us/programs/Land/SolidWaste/CoalCombustionByproducts/Documents/www.mde.state.md.us/assets/document/Fact-SheetCCBSites.pdf>

Average Maryland Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Maryland Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$58.1	\$630.0	9.2%
2006	\$23.7	\$982.7	2.4%
2007	\$24.4	\$1,083.8	2.2%
2008	\$36.5	\$1,074.0	3.4%
2009	\$25.8	\$515.9	5.0%
2010	\$25.5	\$416.5	6.1%
Average	\$32.3	\$783.8	4.1%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Maryland Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$24.72	\$8.25	\$5.64	\$14.32	\$3.54	\$6.97
Concrete Culverts	\$0.16					
Concrete Pavement	\$2.07	\$3.61	\$2.13	\$1.36	\$3.78	\$0.34
Drainage Structures	\$6.64	\$1.54	\$4.59	\$1.00	\$0.64	\$2.98
Misc. Concrete	\$23.50	\$5.70	\$7.70	\$10.27	\$8.76	\$11.12
Storm Pipe	\$1.17	\$3.95	\$2.66	\$4.02	\$2.41	\$1.81
Uncategorized	\$0.03	\$0.65	\$1.47	\$5.49	\$6.69	\$2.24
Total	\$58.29	\$23.70	\$24.20	\$36.47	\$25.82	\$25.46

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Massachusetts' Transportation Construction

Massachusetts currently has 10,787 miles of roadway in the Federal-aid Highway System, of which there is less than one percent concrete mileage. There are 5,042 bridges in the state, of which 35 percent or 1,788, contain primarily concrete. Approximately five percent of highway spending in Massachusetts is spent on concrete products each year, based on ARTBA analysis of bid tab data.



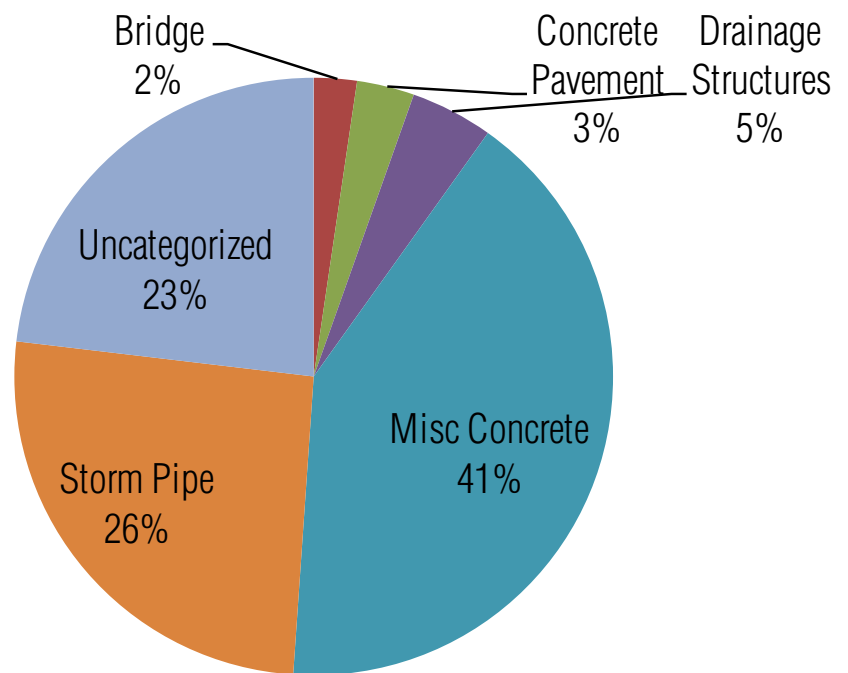
### What are your state's fly ash specifications?

The Massachusetts Department of Transportation (MassDOT) specifications allow concrete producers to replace 15 to 30 percent of portland cement with class F fly ash.

### How would a "hazardous building material" label affect your state?

Experts from MassDOT said they have recently been dealing with a shortage of fly ash due to a power plant shut-down. The lack of locally supplied fly ash has proven to be an expensive hurdle for projects. In the absence of fly ash, concrete producers will have to pursue other concrete strengthening agents. The labeling of fly ash as "hazardous" would have detrimental effects, experts believe. Based on this fly ash shortage within the last couple of weeks, MassDOT experts have experienced first-hand the economic benefits to fly ash in concrete.

Average Massachusetts Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## How prevalent is fly ash in your transportation projects?

Over the last few years, experts at the MassDOT have seen approximately 75 percent of approved concrete mix designs utilizing fly ash. Last year, projects utilized over 9 million pounds of fly ash in cement concrete products.

## What are your state's sources of fly ash?

Typically, the primary source of class F fly ash is from Headwaters Resources Inc. from the Brayton Point power station located in Somerset, Massachusetts.

## Massachusetts Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$25.2	\$466.5	5.4%
2006	\$15.0	\$334.7	4.5%
2007	\$17.3	\$511.8	3.4%
2008	\$52.3	\$839.0	6.2%
2009	\$26.4	\$656.1	4.0%
2010	\$31.4	\$609.0	5.2%
Average	\$27.9	\$569.5	4.9%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Massachusetts Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$0.30	\$1.92	\$1.24	\$0.26	\$0.19	
Concrete Pavement	\$1.56	\$0.07	\$0.35	\$0.59	\$0.23	\$2.41
Drainage Structures	\$1.79	\$0.40	\$0.07	\$2.40	\$1.36	\$1.44
Misc. Concrete	\$13.44	\$3.55	\$9.10	\$24.02	\$9.19	\$9.89
Storm Pipe	\$6.26	\$8.08	\$3.65	\$12.17	\$7.36	\$5.76
Uncategorized	\$1.90	\$2.86	\$4.08	\$11.24	\$7.07	\$11.67
Total	\$25.23	\$16.87	\$18.50	\$50.68	\$25.40	\$31.17

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Michigan's Transportation Construction

Michigan currently has 33,696 miles of roadway in the Federal-aid Highway System, of which seven percent is concrete. There are 10,937 bridges in the state, of which 49 percent or 5,371, contain primarily concrete. Approximately 16 percent of highway spending in Michigan is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The maximum percentage of fly ash and other concrete strengthening agents permitted into Portland cement mixtures is limited to 40 percent by weight substitution of the Portland cement. The Michigan Department of Transportation (MDOT) allows both class C and F fly ash.

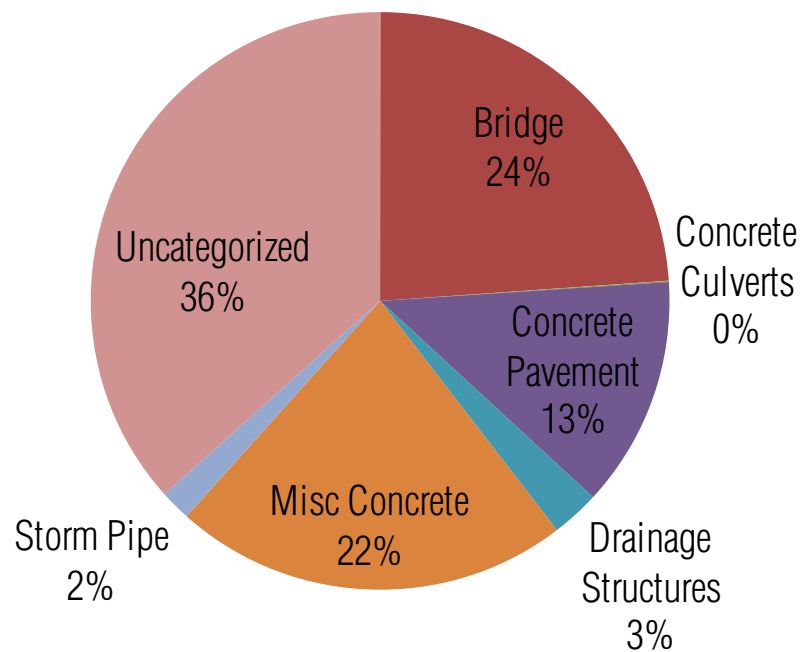
### How would a "hazardous building material" label affect your state?

MDOT experts interviewed cited the tremendous cost-savings provided by fly ash as "\$100,000 or more on a typical freeway reconstruction project." Experts also pointed out the structural benefits of using fly ash in concrete and feared that a "hazardous building material" label could jeopardize these advantages.

### How prevalent is fly ash in your transportation projects?

MDOT utilizes a significant amount of fly ash, as well as other supplemental cementitious materials in Portland cement. In addition, MDOT does permit its incorporation as a mineral filler for hot-mix asphalt applications, however this use is quite infrequent. Utilization of fly ash is solely at the option of the contractor.

Average Michigan Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.michigan.gov/documents/MDOT-Material\\_Source\\_Guide\\_Approved\\_Manufact\\_84760\\_7.pdf](http://www.michigan.gov/documents/MDOT-Material_Source_Guide_Approved_Manufact_84760_7.pdf)

## Michigan Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$193.0	\$1,154.2	16.7%
2006	\$292.3	\$1,576.5	18.5%
2007	\$202.2	\$1,346.0	15.0%
2008	\$205.6	\$1,240.7	16.6%
2009	\$203.3	\$1,350.0	15.1%
2010	\$195.0	\$1,231.8	15.8%
Average	\$215.2	\$1,316.5	16.3%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Michigan Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$18.33	\$53.70	\$53.54	\$50.38	\$70.19	\$62.36
Concrete Culverts	\$0.16	\$0.20	\$0.19	\$0.15	\$0.26	\$0.06
Concrete Pavement	\$37.40	\$21.65	\$23.54	\$45.31	\$16.26	\$22.37
Drainage Structures	\$9.10	\$13.58	\$6.98	\$1.29	\$0.81	\$3.08
Misc. Concrete	\$32.05	\$46.96	\$66.24	\$39.39	\$52.95	\$47.38
Storm Pipe	\$2.58	\$0.72	\$3.86	\$3.03	\$1.33	\$10.76
Uncategorized	\$93.37	\$155.45	\$47.87	\$66.01	\$61.53	\$49.00
Total	\$192.99	\$292.26	\$202.22	\$205.55	\$203.34	\$195.00

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Minnesota's Transportation Construction

Minnesota currently has 32,148 miles of roadway in the Federal-aid Highway System, of which six percent is concrete. There are 13,125 bridges in the state, of which 66 percent or 8,714, contain primarily concrete. Approximately 19 percent of highway spending in Minnesota is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Minnesota Department of Transportation (MnDOT) specifications allow up to 15 percent replacement of Portland cement with fly ash in pre-mixed concrete and 30 percent fly ash replacement in paving concrete.

### How would a "hazardous building material" label affect your state?

MnDOT experts interviewed anticipated that a "hazardous building material" would result in "increased costs, decreased performance characteristics, and a negative impact on project placement and finishing." Other alternatives as concrete strengthening agents were mentioned, but all significantly more expensive to use.

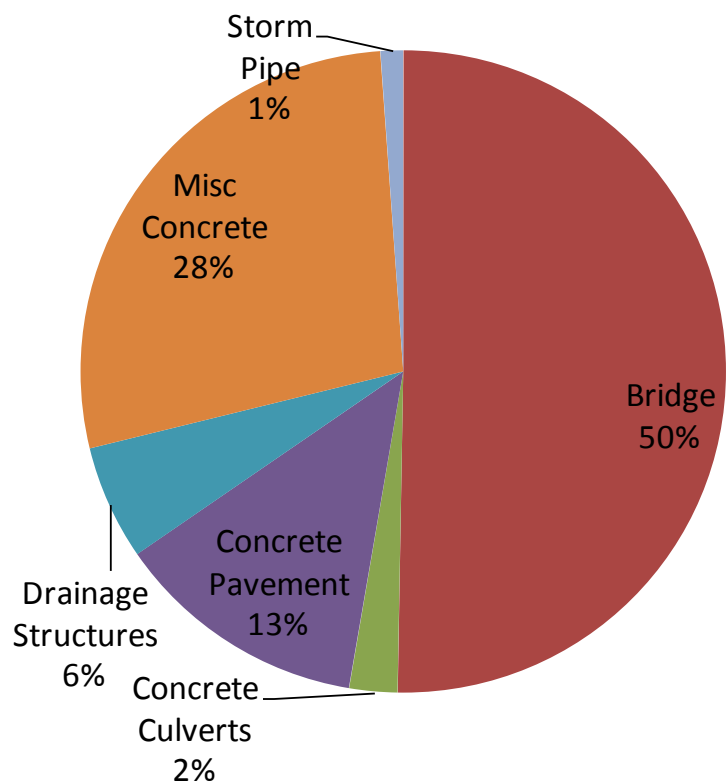
### How prevalent is fly ash in your transportation projects?

Virtually all concrete mixes in Minnesota contain fly ash. MnDOT annually purchases approximately 250,000 cubic yards of ready mix concrete, and in a typical year of paving uses 500,000 yards of paving concrete.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.dot.state.mn.us/products/concrete/certifiedflyash.html>

Average Minnesota Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Minnesota Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$72.0	\$444.6	16.2%
2006	\$51.1	\$382.5	13.4%
2007	\$163.4	\$634.5	25.8%
2008	\$86.3	\$457.1	18.9%
2009	\$125.4	\$639.9	19.6%
2010	\$124.9	\$698.0	17.9%
Average	\$103.8	\$542.8	19.1%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Minnesota Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$49.20	\$18.47	\$110.63	\$32.88	\$45.95	\$59.72
Concrete Culverts	\$10.04	\$1.11	\$0.30	\$0.08	\$2.57	\$1.10
Concrete Pavement	\$2.46	\$11.26	\$8.93	\$21.09	\$21.40	\$14.92
Drainage Structures	\$0.51	\$2.11	\$3.75	\$0.01	\$15.05	\$14.84
Misc. Concrete	\$9.83	\$18.12	\$39.76	\$32.23	\$40.40	\$34.22
Storm Pipe	\$0.00	\$0.03	\$0.01	\$0.02	\$0.05	\$7.07
Total	\$72.04	\$51.09	\$163.37	\$86.32	\$125.42	\$131.87

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Mississippi's Transportation Construction

Mississippi currently has 21,141 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 17,024 bridges in the state, of which 81 percent or 13,793, contain primarily concrete. Approximately 13 percent of highway spending in Mississippi is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

Currently The Mississippi Department of Transportation (MDOT) specifications allow up to 25 percent of either class F or class C fly ash replacement of cementitious material, however typical mixes utilize 20 percent class C ash.

### How would a "hazardous building material" label affect your state?

An expert interviewed within the Department informed us that "MDOT is very concerned as to the impact the potential labeling of fly as a 'hazardous building material' would have on our ability to provide economical concrete mix designs." Experts within MDOT feared that the label would result in the loss of the additive in concrete, which could come at the expense of the state's budget and the quality of the concrete structures state-wide.

### How prevalent is fly ash in your transportation projects?

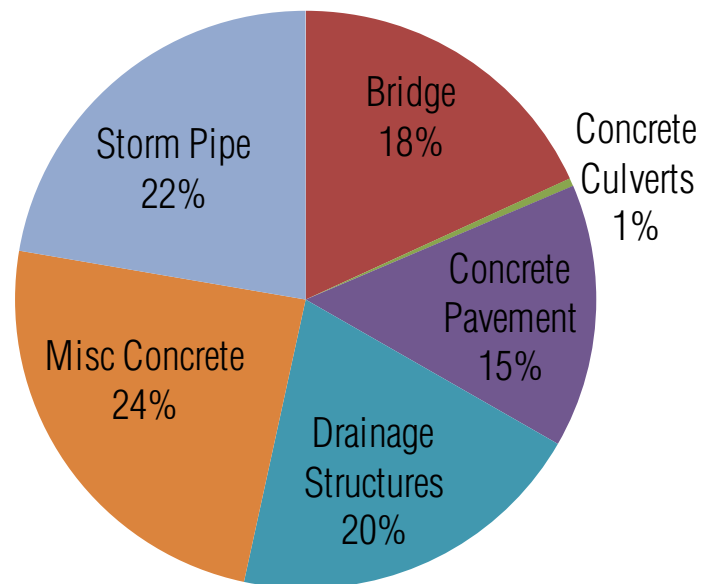
All concrete mixes utilize ash and approximately 5 to 10 percent of soil stabilization projects utilize fly ash in Mississippi.

### What are your state's sources of fly ash?

No sources were identified by MDOT.



Average Mississippi Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Mississippi Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$89.5	\$484.6	18.5%
2006	\$41.5	\$349.9	11.9%
2007	\$87.7	\$627.6	14.0%
2008	\$22.7	\$323.1	7.0%
2009	\$76.0	\$627.8	12.1%
2010	\$65.3	\$533.2	12.3%
Average	\$63.8	\$491.0	13.0%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Mississippi Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$3.42	\$15.26	\$21.86	\$0.59	\$17.68	\$10.60
Concrete Culverts	\$0.41	\$1.33				
Concrete Pavement	\$31.01	\$4.31	\$9.29	\$0.71	\$2.89	\$7.99
Drainage Structures	\$28.89	\$16.06	\$1.21	\$6.25	\$17.04	\$7.56
Misc. Concrete	\$7.62	\$4.35	\$34.22	\$6.03	\$18.02	\$22.67
Storm Pipe	\$18.12	\$1.50	\$21.08	\$9.16	\$20.34	\$15.19
Total	\$89.47	\$42.82	\$87.66	\$22.73	\$75.98	\$64.01

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Missouri's Transportation Construction

Missouri currently has 30,270 miles of roadway in the Federal-aid Highway System, of which nine percent is concrete. There are 24,204 bridges in the state, of which 49 percent or 11,829, contain primarily concrete. Approximately 19 percent of highway spending in Missouri is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Missouri Department of Transportation (MoDOT) specifications dictate that contractors can replace Portland cement at a rate between 20 to 25 percent for with both class C and F fly ash.

### How would a "hazardous building material" label affect your state?

Fly ash is between one-third and one-half the cost of cement in Missouri, which could substantially raise the price of concrete if fly ash were not available. MoDOT does not support the EPA's proposed legislation. In addition to the tremendous cost-savings experts interviewed also cited the structural benefits of using the fly ash to mitigate the harmful effects of water damage on concrete that lacks a strengthening agent.

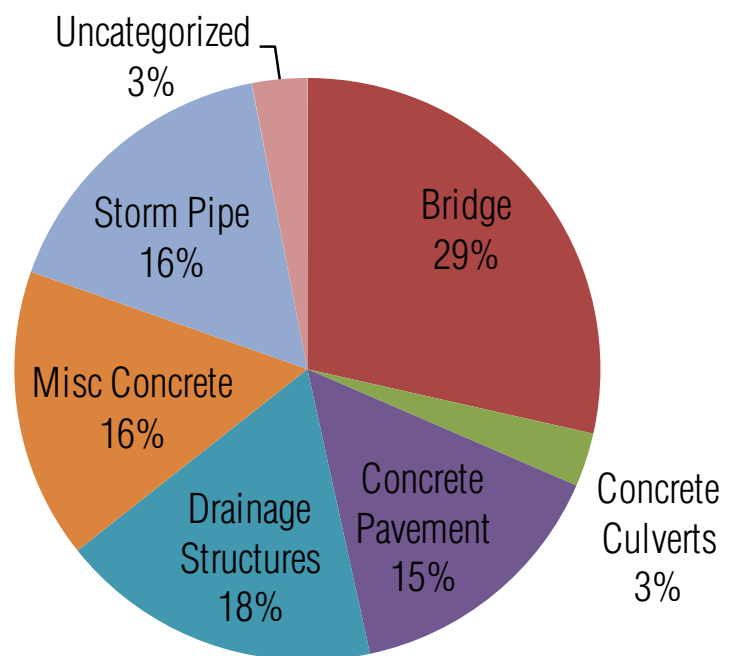
### How prevalent is fly ash in your transportation projects?

Fly ash is used extensively throughout the state. Contractors use an average of 75,000 tons of fly ash a year with 80 percent being used in concrete mixtures and the rest mainly used as mineral filler in hot mix asphalt.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://modot.mo.gov/business/materials/pdf/vol\\_1/FS1018T1.pdf](http://modot.mo.gov/business/materials/pdf/vol_1/FS1018T1.pdf)

Average Missouri Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Missouri Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$161.3	\$1,185.0	13.6%
2006	\$165.7	\$849.7	19.5%
2007	\$176.9	\$864.6	20.5%
2008	\$172.2	\$742.5	23.2%
2009	\$280.5	\$1,325.9	21.2%
2010	\$112.4	\$670.3	16.8%
Average	\$178.2	\$939.6	19.0%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Missouri Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$33.73	\$38.18	\$56.14	\$22.28	\$134.65	\$20.09
Concrete Culverts	\$1.09	\$17.43	\$0.51	\$0.01	\$12.61	\$0.10
Concrete Pavement	\$27.31	\$29.66	\$16.75	\$25.79	\$32.01	\$29.22
Drainage Structures	\$22.47	\$20.86	\$56.76	\$72.93	\$15.25	\$2.19
Misc. Concrete	\$44.11	\$26.33	\$12.95	\$15.40	\$41.46	\$31.27
Storm Pipe	\$32.53	\$23.59	\$28.88	\$34.41	\$38.09	\$19.13
Uncategorized	\$0.03	\$9.62	\$4.87	\$1.38	\$6.47	\$10.41
Total	\$161.27	\$165.68	\$176.86	\$172.22	\$280.55	\$112.40

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Montana's Transportation Construction

Montana currently has 12,705 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 4,969 bridges in the state, of which 48 percent or 2,398, contain primarily concrete. Approximately seven percent of highway spending in Montana is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Montana Department of Transportation (MDT) specifications allow up to 20 percent Class C replacement of cement with fly ash. Montana uses class C fly ash exclusively.

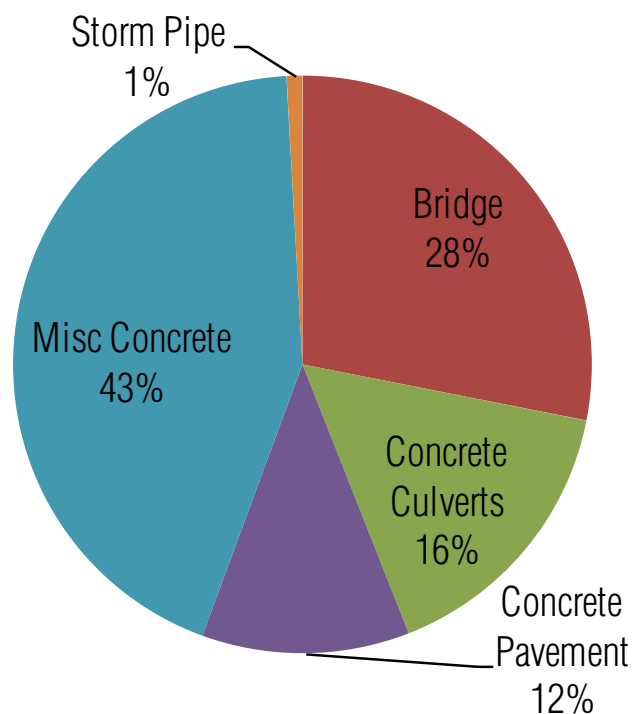
### How would a "hazardous building material" label affect your state?

Experts within MDT expressed their unhappiness with the proposed EPA labeling of fly ash as a "hazardous building material." One interviewee explained, "Banning fly ash would limit our supplier's options for producing low permeability and workable concrete. It will significantly affect the availability of cement once the economy gets going again. This will result in higher cement costs and more than likely lead to the use of more imported cements." MDT does not support the EPA's consideration of fly ash as a "hazardous building material."

### How prevalent is fly ash in your transportation projects?

While MDT does not keep specific track of the amount of fly ash that is used in projects, an expert from within the Department confirmed that it is used frequently in concrete and cement treated base. Experts estimate that fly ash accounts for roughly 10 percent of all the cementitious material used state-wide.

Average Montana Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## What are your state's sources of fly ash?

Most fly ash comes from Headwaters Resources Inc. and from other various Montana and Wyoming sources.

## Montana Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$9.0	\$216.9	4.2%
2006	\$16.2	\$301.3	5.4%
2007	\$21.1	\$198.6	10.6%
2008	\$20.5	\$264.0	7.8%
2009	\$19.9	\$336.8	5.9%
2010	\$26.7	\$368.9	7.2%
Average	\$18.9	\$281.1	6.7%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Montana Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$7.48	\$8.57	\$1.78	\$5.29	\$4.06	\$4.90
Concrete Culverts	\$0.11	\$11.04	\$0.78	\$2.32	\$3.17	\$0.75
Concrete Pavement	\$0.04	\$0.24	\$1.19	\$7.45	\$3.03	\$1.30
Misc. Concrete	\$1.52	\$7.27	\$7.12	\$6.85	\$9.83	\$17.07
Storm Pipe	\$0.15	\$0.61	\$0.26			
Total	\$9.29	\$27.71	\$11.13	\$21.91	\$20.09	\$24.02

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Nebraska's Transportation Construction

Nebraska currently has 15,759 miles of roadway in the Federal-aid Highway System, of which 12 percent is concrete. There are 15,471 bridges in the state, of which 42 percent or 6,463, contain primarily concrete. Approximately 25 percent of highway spending in Nebraska is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Nebraska Department of Roads (NDOR) specifications dictate that contractors can replace Portland cement at a rate at 25 percent for with both class F fly ash. Class C fly ash may be used at variable rates.

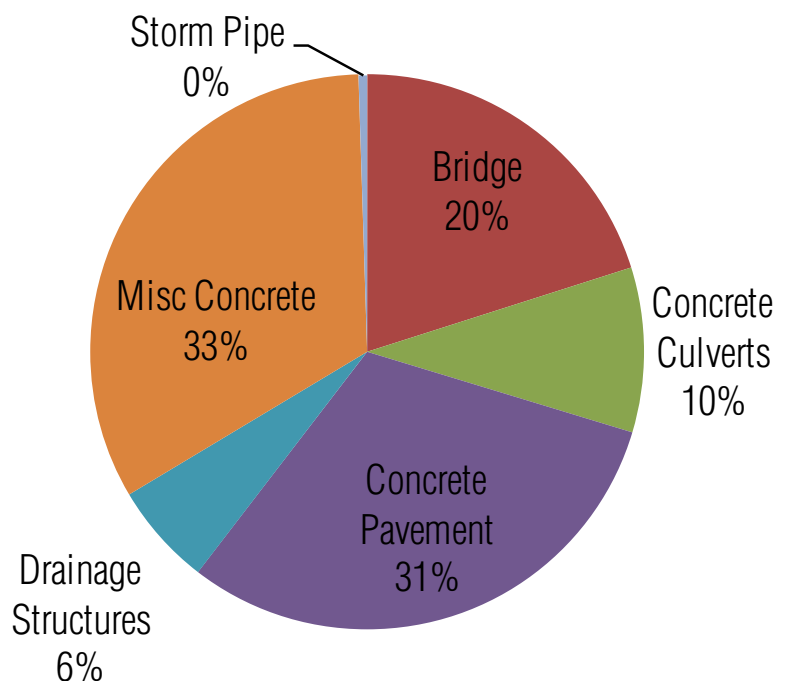
### How would a "hazardous building material" label affect your state?

Experts within NDOR explained that the inability to use fly ash would be extremely detrimental. Engineers view fly ash not as a waste product, but as an extremely useful and cost-effective concrete. They also recognize the importance of fly ash to counteract alkali-silica reactions in concrete. Furthermore, due to the climate in Nebraska, concrete structures are placed under more environmental stress than other geographic regions. The addition of fly ash in concrete mixes plays an enormous role in strengthening structures and ensuring a long-life for the concrete.

### How prevalent is fly ash in your transportation projects?

Over 417,314 cubic yards of concrete were placed in pavements, driveways, sidewalks and bridges. It is estimated that 141 lbs per cubic yard (25 percent class F fly ash) is added to each cubic yard to mitigate ASR. Based on that percentage, over 29,421 tons of class F ash is used in Nebraska each year.

Average Nebraska Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.nebraskatransportation.org/mat-n-tests/newapl/construction/concrete/flyash.pdf>

## Nebraska Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$111.5	\$363.5	30.7%
2006	\$41.4	\$251.5	16.5%
2007	\$95.5	\$401.4	23.8%
2008	\$40.4	\$189.6	21.3%
2009	\$102.0	\$416.6	24.5%
2010	\$109.4	\$375.8	29.1%
Average	\$83.4	\$333.1	25.0%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Nebraska Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$12.44	\$4.74	\$52.69	\$7.25	\$8.10	\$15.24
Concrete Culverts	\$6.58	\$18.05	\$1.04	\$0.65	\$2.51	\$19.31
Concrete Pavement	\$60.27	\$6.44	\$14.16	\$18.19	\$36.71	\$17.81
Drainage Structures	\$0.03	\$0.60	\$1.08	\$0.14	\$1.95	\$26.19
Misc. Concrete	\$32.18	\$11.58	\$26.58	\$14.18	\$51.92	\$29.26
Storm Pipe	\$0.86	\$1.62				
Total	\$112.37	\$43.03	\$95.54	\$40.40	\$101.19	\$107.82

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Nevada's Transportation Construction

Nevada currently has 6,291 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 1,735 bridges in the state, of which 85 percent or 1,481, contain primarily concrete. Approximately 16 percent of highway spending in Nevada is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Nevada Department of Transportation (NDOT) currently specifies a minimum of 20 percent replacement in all concrete. Class F fly ash is typically used, but more class N fly ash and some slag usage has emerged.

### How would a "hazardous building material" label affect your state?

Due to the prevalence of fly ash in virtually all concrete projects, experts at NDOT strongly support the continued usage of the concrete strengthening agent, as it is extremely cost effective, and benefits the structural properties of the projects.

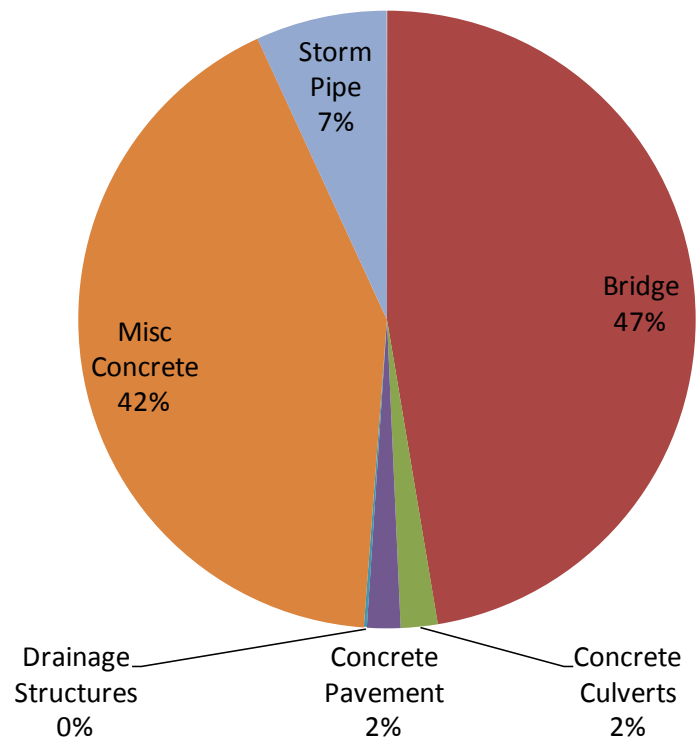
### How prevalent is fly ash in your transportation projects?

Fly ash is used extensively in Nevada. While NDOT does not specifically keep specific records of the amount of fly ash used, it is estimated that between 125 and 150 lbs of fly ash are used in every cubic yard of concrete.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [http://www.nevadadot.com/About\\_NDOT/NDOT\\_Divisions/Planning/Research/Qualified\\_Product\\_List\\_%28QPL%29.aspx](http://www.nevadadot.com/About_NDOT/NDOT_Divisions/Planning/Research/Qualified_Product_List_%28QPL%29.aspx)

Average Nevada Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Nevada Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$74.1	\$505.9	14.6%
2006	\$153.0	\$591.2	25.9%
2007	\$33.6	\$209.6	16.0%
2008	\$11.7	\$156.4	7.5%
2009	\$18.9	\$264.9	7.1%
2010	\$36.1	\$286.6	12.6%
Average	\$54.5	\$335.8	16.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Nevada Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$0.76	\$134.67	\$7.39	\$1.49	\$2.87	\$7.99
Concrete Culverts	\$6.28					
Concrete Pavement	\$0.56	\$3.11	\$0.63	\$1.10	\$0.32	
Drainage Structures	\$0.30	\$0.24				
Misc. Concrete	\$63.89	\$3.67	\$26.17	\$3.35	\$13.60	\$26.72
Storm Pipe	\$2.32	\$11.50	\$0.07	\$6.82	\$1.76	\$0.01
Total	\$74.10	\$153.19	\$34.27	\$12.76	\$18.56	\$34.73

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in New Hampshire's Transportation Construction

New Hampshire currently has 3,386 miles of roadway in the Federal-aid Highway System. There are 2,371 bridges in the state, of which 33 percent or 781, contain primarily concrete. Approximately nine percent of highway spending in New Hampshire is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

New Hampshire Department of Transportation (NHDOT) specifications allow for variable Portland cement replacement amounts. Typically class F fly ash is used, at a replacement rate of up to 40 percent.

### How would a "hazardous building material" label affect your state?

NHDOT experts interviewed explained that if fly ash were to be restricted or eliminated from use, it would most likely drive up the cost that they pay for concrete. In the absence of a cost-effective concrete-strengthening agent substitute experts predict increases in the life cycle cost of concrete structures.

### How prevalent is fly ash in your transportation projects?

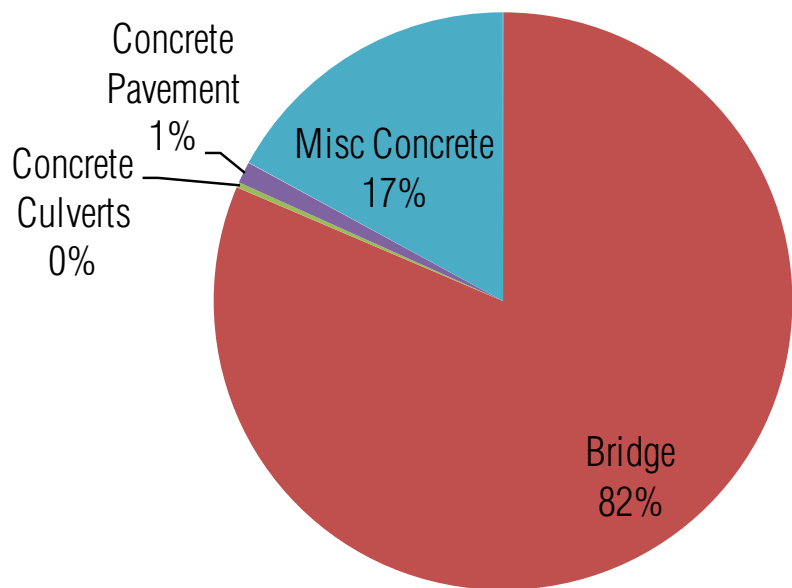
Experts within NHDOT do not specifically track fly ash usage, but believe that "most, if not all" concrete projects use it. Slag, another coal-burning byproduct, is also used.

### What are your state's sources of fly ash?

The primary source of fly ash in New Hampshire is the Brayton Point power plant in Massachusetts.



### Average New Hampshire Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## New Hampshire Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$15.4	\$170.2	9.1%
2006	\$6.4	\$119.4	5.3%
2007	\$22.2	\$182.7	12.1%
2008	\$12.8	\$172.1	7.5%
2009	\$22.9	\$273.7	8.4%
2010	\$19.5	\$246.9	7.9%
Average	\$16.5	\$194.2	8.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in New Hampshire Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$7.36	\$5.82	\$20.42	\$10.53	\$18.90	\$17.77
Concrete Culverts	\$0.21	\$0.08				
Concrete Pavement	\$1.14	\$0.03	\$0.03			
Misc. Concrete	\$8.06	\$0.55	\$0.40	\$2.32	\$3.97	\$1.62
Total	\$16.76	\$6.47	\$20.85	\$12.85	\$22.87	\$19.40

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in New Jersey's Transportation Construction

New Jersey currently has 10,183 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 6,474 bridges in the state, of which 39 percent or 2,536, contain primarily concrete. Approximately 18 percent of highway spending in New Jersey is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The New Jersey Department of Transportation (NJDOT) specifications dictate that contractors can replace Portland cement at a rate between 15 and 25 percent with class F fly ash.

### How would a "hazardous building material" label affect your state?

Experts within NJDOT predict that a, "hazardous building material," label on fly ash would result in an uptick in the price of concrete. Currently, fly ash provides NJDOT with significant cost-savings, and the increased amount of cement needed to be purchased would have serious financial implications.

### How prevalent is fly ash in your transportation projects?

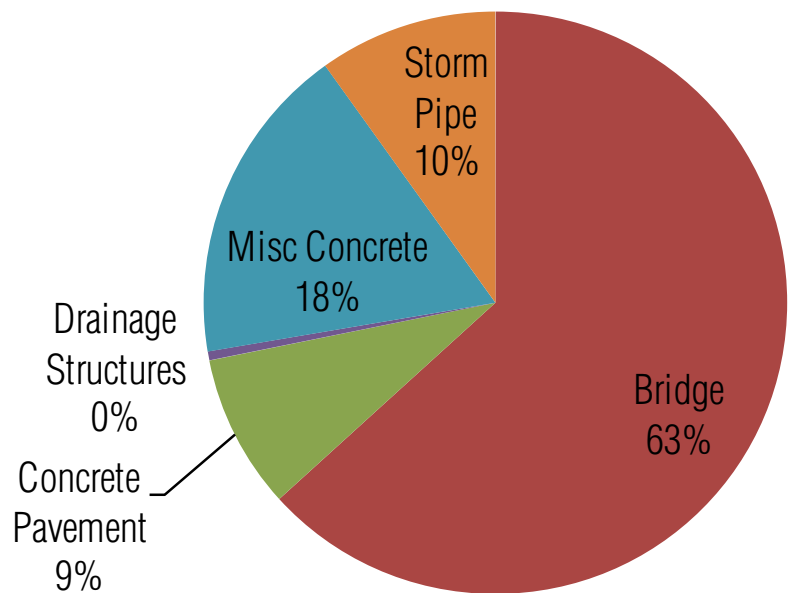
Approximately 45 percent of all projects containing concrete used fly ash last year. It is important to note that slag is also extensively used as a pozzolan in New Jersey.

### What are your state's sources of fly ash?

No sources were identified by NJDOT.



Average New Jersey Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## New Jersey Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2007	\$9.9	\$0.0	
2008	\$57.1	\$0.0	
2009	\$145.0	\$190.5	76.1%
2010	\$66.7	\$459.5	14.5%
2011	\$12.2	\$1,008.2	1.2%
Average	\$48.5	\$276.4	17.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

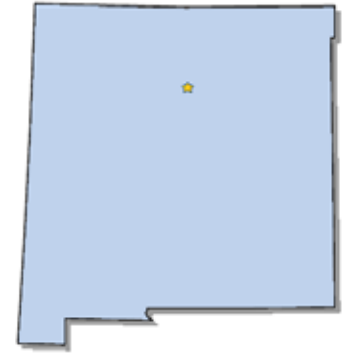
## Concrete Use by Type in New Jersey Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge			\$5.68	\$21.06	\$104.11	\$45.45
Concrete Pavement			\$0.61	\$10.32	\$12.00	\$0.99
Drainage Structures			\$0.09	\$1.30		
Misc. Concrete			\$3.26	\$16.23	\$13.80	\$16.24
Storm Pipe			\$0.31	\$9.50	\$15.08	\$2.71
Total			\$9.95	\$58.41	\$144.98	\$65.39

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in New Mexico's Transportation Construction

New Mexico currently has 10,711 miles of roadway in the Federal-aid Highway System, of which there is less than one percent concrete mileage. There are 3,865 bridges in the state, of which 79 percent or 3,049, contain primarily concrete. Approximately 11 percent of highway spending in New Mexico is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The New Mexico Department of Transportation (NMDOT) specifications dictate that contractors can replace Portland cement at a rate of at least 20 percent for class F fly ash. Class C fly ash replaces cement at a rate of at least 25 percent. There is no limit to the amount of fly ash that may be used in mixes. In fact, many mixes use 35 percent or more.

### How would a "hazardous building material" label affect your state?

Experts at NMDOT expressed their strong opposition to the possible hazardous label on fly ash. One source interviewed stated, "In essence, we would pay far more for concrete structures that also cost more to maintain and would need to be replaced sooner."

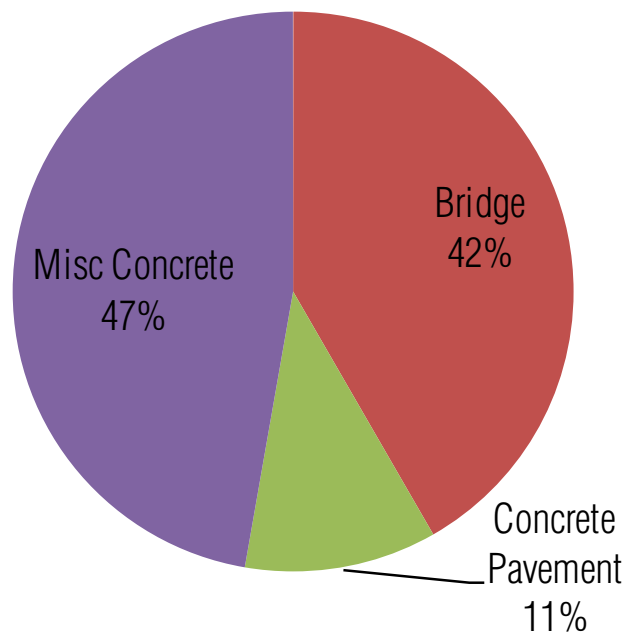
### How prevalent is fly ash in your transportation projects?

Fly ash is used in every concrete project in the state.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.nmshtd.state.nm.us/upload/images/Maintenance/apl.pdf>

Average New Mexico Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## New Mexico Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$47.5	\$393.9	12.1%
2006	\$29.3	\$458.4	6.4%
2007	\$20.8	\$325.7	6.4%
2008	\$68.2	\$726.8	9.4%
2009	\$102.4	\$611.1	16.8%
2010	\$41.4	\$352.9	11.7%
Average	\$51.6	\$478.1	10.8%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in New Mexico Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$20.15	\$14.85	\$7.81	\$18.41	\$35.11	\$32.71
Concrete Pavement	\$7.26	\$4.77	\$2.00	\$0.40	\$15.78	\$4.09
Misc. Concrete	\$20.09	\$9.72	\$11.01	\$49.35	\$51.50	\$4.56
Total	\$47.50	\$29.35	\$20.82	\$68.16	\$102.39	\$41.36

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in New York’s Transportation Construction

New York currently has 27,408 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 17,366 bridges in the state, of which 33 percent or 5,678, contain primarily concrete. Approximately eight percent of highway spending in New York is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state’s fly ash specifications?

The New York State Department of Transportation (NYSDOT) specifications dictate that contractors can replace Portland cement at a rate of up to 20 percent with class F fly ash.

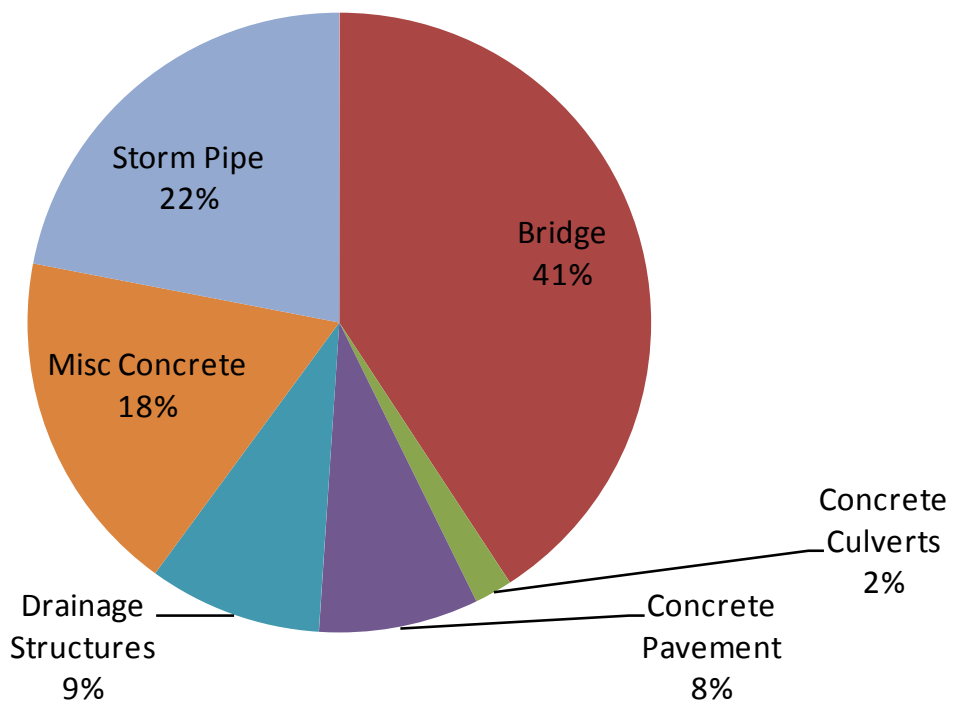
### How would a “hazardous building material” label affect your state?

Experts interviewed within NYSDOT weren’t sure of the effects, but expected that the state would use more expensive, alternative pozzolans that would decrease the cost-savings seen on each concrete project. Furthermore, sources recognized the importance of fly ash to counteract alkali-silica reactions in concrete, as its use in concrete leads to longer-lasting structures with lower long-term maintenance costs.

### How prevalent is fly ash in your transportation projects?

Pozzolan use is required in New York when there are reactive aggregates combined with high alkali cements. Fly ash usage varies geographically around the state. Typically pozzolans are used in about 70 percent of all the concrete produced for NYSDOT. From the last recorded summary of recycled materials use compiled in 2007, the fly ash use in concrete totaled about 8,100 tons per year.

Average New York Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at [https://www.nysdot.gov/divisions/engineering/technical-services/technical-services-repository/alme/con\\_min.html](https://www.nysdot.gov/divisions/engineering/technical-services/technical-services-repository/alme/con_min.html)

## New York Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$156.7	\$1,273.9	12.3%
2006	\$93.7	\$1,217.3	7.7%
2007	\$96.4	\$1,202.5	8.0%
2008	\$88.5	\$1,268.8	7.0%
2009	\$139.2	\$1,929.8	7.2%
2010	\$108.5	\$1,271.7	8.5%
Average	\$113.8	\$1,360.7	8.4%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

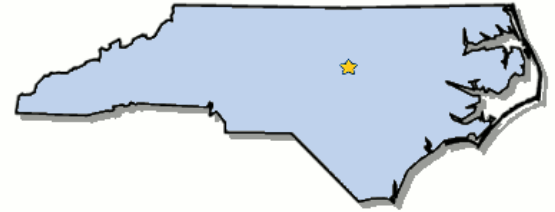
## Concrete Use by Type in New York Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$45.13	\$43.14	\$55.13	\$30.77	\$64.82	\$39.42
Concrete Culverts	\$4.24	\$0.84	\$2.48	\$2.31	\$2.05	\$1.49
Concrete Pavement	\$9.16	\$7.15	\$6.19	\$5.20	\$9.58	\$19.56
Drainage Structures	\$5.12	\$11.81	\$11.40	\$13.00	\$5.60	\$14.62
Misc. Concrete	\$12.92	\$17.10	\$12.00	\$28.20	\$32.85	\$19.73
Storm Pipe	\$80.15	\$13.63	\$9.15	\$9.06	\$24.31	\$13.65
Total	\$156.72	\$93.67	\$96.36	\$88.53	\$139.20	\$108.46

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in North Carolina's Transportation Construction

North Carolina currently has 21,682 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 17,884 bridges in the state, of which 43 percent or 7,745, contain primarily concrete. Approximately six percent of highway spending in North Carolina is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

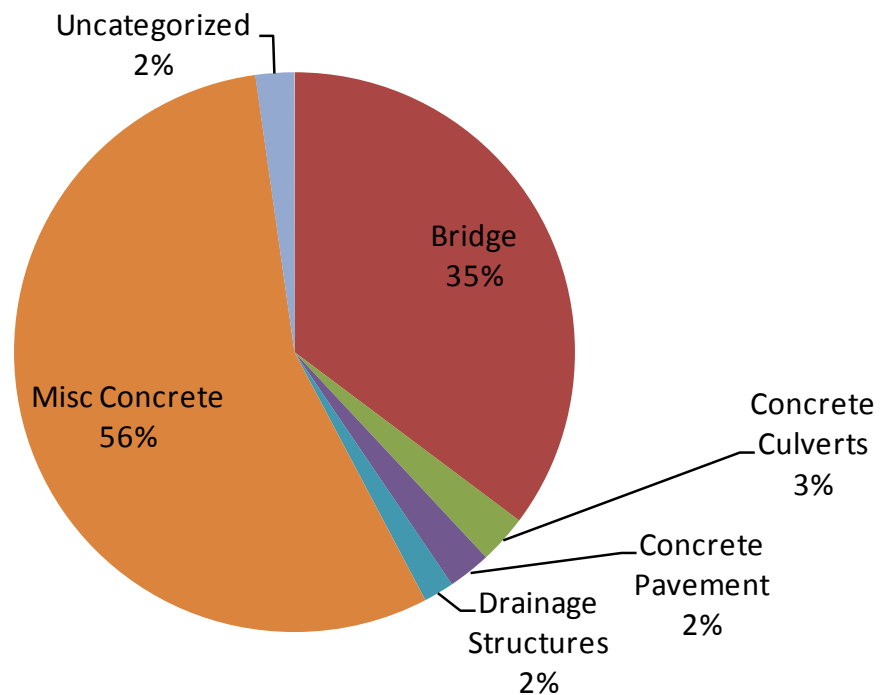
The North Carolina Department of Transportation (NCDOT) specifications dictate that contractors can replace Portland cement at a rate of up to 20 percent with both class C and class F fly ash.

### How would a "hazardous building material" label affect your state?

NCDOT experts interviewed anticipated that a hazardous building material label would result in significantly more expensive concrete projects. According to one source, "It would raise the cost of producing concrete, further tightening budgets for construction and maintenance." Fly ash has been beneficially incorporated into concrete mixes in North Carolina since 1983. The designs of concrete mixes with fly ash have improved the durability of structures and pavements by providing less permeable concrete. One expert highlighted fly ash's ability to counteract harmful alkali-silica reactions within the concrete, an advantage to its use within the state.

The use of fly ash reduces NCDOT's demand for Portland cement. Every ton of Portland cement produced creates approximately one ton of carbon dioxide emissions. For example, the use of 20 percent fly ash in a structure containing 500 cubic yards of concrete would reduce CO2 emissions by approximately 25 tons.

Average North Carolina Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## How prevalent is fly ash in your transportation projects?

NCDOT uses over 10,000 tons of fly ash in concrete every year. Its use in concrete is widespread in North Carolina.

## What are your state's sources of fly ash?

The main fly ash suppliers in North Carolina are: American Fly Ash, Separation Technologies, Southeastern Fly Ash, Cross Generating Station, McMeekin Station, Morgantown Station, and Wateree Station.

## North Carolina Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$38.8	\$509.1	7.6%
2006	\$14.8	\$446.0	3.3%
2007	\$41.9	\$803.0	5.2%
2008	\$64.4	\$848.8	7.6%
2009	\$57.4	\$884.1	6.5%
2010	\$60.4	\$824.0	7.3%
Average	\$46.3	\$719.2	6.4%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

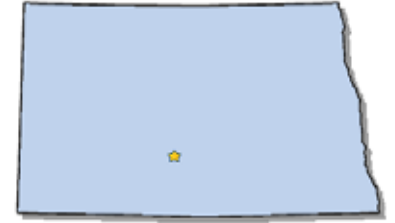
## Concrete Use by Type in North Carolina Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$7.71	\$2.87	\$13.99	\$22.60	\$22.33	\$28.62
Concrete Culverts	\$0.34	\$0.60	\$3.42	\$1.57	\$1.72	\$0.21
Concrete Pavement	\$0.43	\$2.52	\$0.15	\$3.75		
Drainage Structures	\$0.18	\$0.18	\$0.01	\$0.01	\$0.37	\$4.14
Misc. Concrete	\$30.41	\$11.12	\$24.06	\$37.67	\$32.88	\$18.33
Uncategorized	\$0.21	\$5.32	\$0.68			
Total	\$39.27	\$22.60	\$42.31	\$65.59	\$57.29	\$51.29

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in North Dakota's Transportation Construction

North Dakota currently has 13,831 miles of roadway in the Federal-aid Highway System, of which five percent is concrete. There are 4,451 bridges in the state, of which 58 percent or 2,580, contain primarily concrete. Approximately 12 percent of highway spending in North Dakota is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The North Dakota Department of Transportation (NDDOT) specifications dictate that contractors can replace Portland cement at a rate of up to 30 percent with both class C and class F fly ash.

### How would a "hazardous building material" label affect your state?

Experts interviewed within NDDOT reported that a hazardous building material label on fly ash would be detrimental to the state's ability to complete cost-effective projects, as the additive is used extensively throughout the state to combat damaging water permeability.

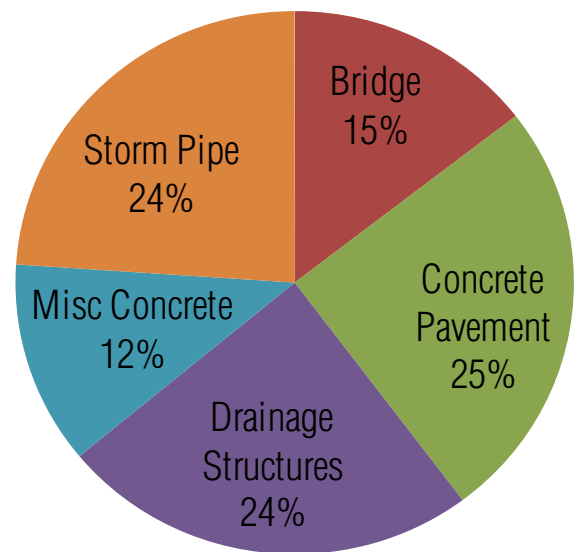
### How prevalent is fly ash in your transportation projects?

Fly ash is used extensively within NDDOT. Experts interviewed did not know the exact amount used, or percentage of concrete projects that utilized fly ash, but assured us that it was instrumental in concrete operations.

### What are your state's sources of fly ash?

None identified by NDDOT.

### Average North Dakota Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## North Dakota Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$33.1	\$253.1	13.1%
2006	\$34.9	\$281.0	12.4%
2007	\$29.7	\$217.4	13.7%
2008	\$40.3	\$263.6	15.3%
2009	\$43.6	\$378.4	11.5%
2010	\$43.7	\$454.9	9.6%
Average	\$37.6	\$308.1	12.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in North Dakota Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$1.35	\$10.39	\$5.47	\$4.79	\$2.93	\$7.69
Concrete Pavement	\$0.33	\$2.89	\$3.65	\$6.78	\$22.41	\$20.97
Drainage Structures	\$7.58	\$9.37	\$6.30	\$16.65	\$10.33	\$4.25
Misc. Concrete	\$2.25	\$3.95	\$2.11	\$1.29	\$7.89	\$9.80
Storm Pipe	\$21.58	\$8.34	\$12.22	\$10.81	\$0.00	\$0.98
Total	\$33.10	\$34.94	\$29.74	\$40.32	\$43.57	\$43.70

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Ohio's Transportation Construction

Ohio currently has 28,886 miles of roadway in the Federal-aid Highway System, of which three percent is concrete. There are 28,066 bridges in the state, of which 52 percent or 14,500, contain primarily concrete. Approximately 14 percent of highway spending in Ohio is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Ohio Department of Transportation (ODOT) specifications dictate that contractors can replace Portland cement at a rate of up to 20 percent with any class of fly ash.

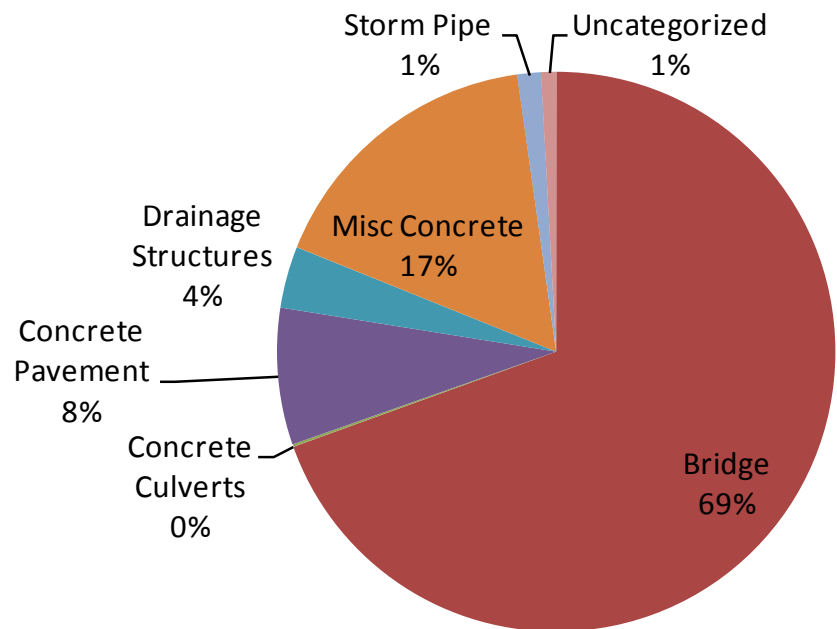
### How would a "hazardous building material" label affect your state?

One expert interviewed within ODOT explained, "Concrete producers use fly ash for a couple reasons: to lower costs and to meet specifications. Producers are not going to want to use or handle fly ash if it is considered a hazardous material, and they will find other ways to meet the specifications. The DOT's will see some monetary affect, but the environment will be the biggest loser. Instead of using this material for beneficial purposes, it will to be stuck in a landfill somewhere." ODOT does not support the EPA's possible labeling of fly ash as a "hazardous building material."

### How prevalent is fly ash in your transportation projects?

ODOT does not keep track of the amount of fly ash used in projects, or its prevalence.

Average Ohio Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.dot.state.oh.us/Divisions/ConstructionMgt/Specification%20Files/Final%20SS%20898%20Rev.%20012111.pdf>

## Ohio Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$182.5	\$1,092.9	16.7%
2006	\$259.9	\$1,531.7	17.0%
2007	\$203.4	\$1,187.2	17.1%
2008	\$119.8	\$1,074.1	11.2%
2009	\$206.2	\$1,479.6	13.9%
2010	\$158.9	\$1,579.6	10.1%
Average	\$188.5	\$1,324.2	14.2%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Ohio Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$102.45	\$208.14	\$154.53	\$80.44	\$158.23	\$81.77
Concrete Culverts	\$0.14	\$0.68	\$0.07	\$0.31	\$0.06	\$0.22
Concrete Pavement	\$29.34	\$9.77	\$11.50	\$11.79	\$11.07	\$16.19
Drainage Structures	\$8.57	\$2.38	\$7.69	\$0.96	\$18.61	\$2.19
Misc. Concrete	\$41.69	\$29.78	\$21.16	\$26.05	\$12.68	\$57.07
Storm Pipe	\$0.33	\$0.71	\$7.48	\$5.56	\$1.41	\$0.01
Uncategorized	\$8.46	\$0.98	\$0.28			
Total	\$190.97	\$252.45	\$202.71	\$125.11	\$202.07	\$157.46

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Oklahoma's Transportation Construction

Oklahoma currently has 29,355 miles of roadway in the Federal-aid Highway System, of which six percent is concrete. There are 23,591 bridges in the state, of which 57 percent or 13,545, contain primarily concrete. Approximately 21 percent of highway spending in Oklahoma is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Oklahoma Department of Transportation (ODOT) specifications dictate that contractors can replace Portland cement at a rate between 15 to 20 percent with class C or class F fly ash. Typically class C is used at 20 percent.

### How would a "hazardous building material" label affect your state?

According to ODOT experts, without fly ash the Department would have to consume 20 percent more cement, which could lead to higher prices for concrete and a shortage of cement. Furthermore, the source pointed out that the structural benefits of fly ash are second-to-none. While somewhat similar concrete additives exist, none can provide the strength at the extremely low cost that fly ash does.

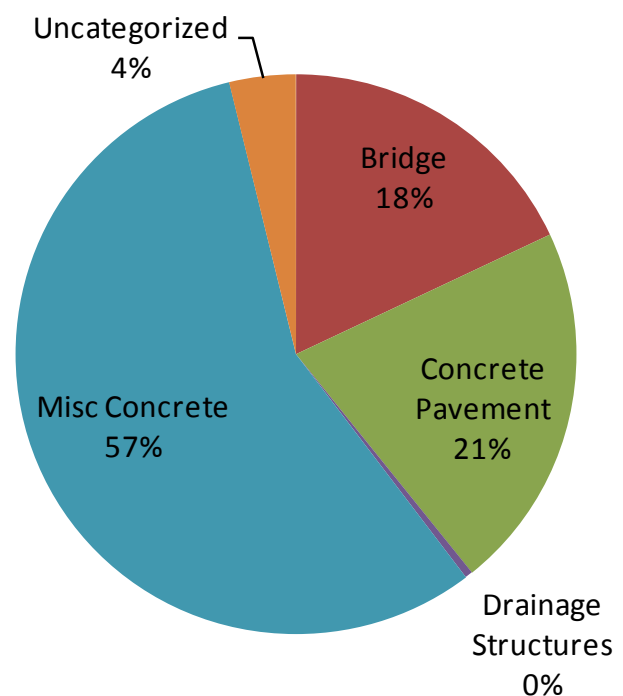
### How prevalent is fly ash in your transportation projects?

Almost all (approximately 95 percent) concrete projects within Oklahoma use class C fly ash at a replacement rate of 20 percent.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.okladot.state.ok.us/materials/htm-smap/11062p-FLY.htm>

### Average Oklahoma Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Oklahoma Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$70.0	\$374.1	18.7%
2006	\$116.8	\$594.1	19.7%
2007	\$120.6	\$622.1	19.4%
2008	\$136.2	\$683.9	19.9%
2009	\$280.3	\$1,252.9	22.4%
2010	\$171.4	\$847.3	20.2%
Average	\$149.2	\$729.0	20.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

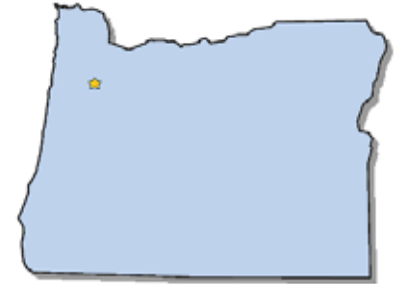
## Concrete Use by Type in Oklahoma Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$8.01	\$18.81	\$30.66	\$25.94	\$43.67	\$34.02
Concrete Pavement	\$16.80	\$22.22	\$17.93	\$31.17	\$65.30	\$36.61
Drainage Structures	\$0.01	\$2.26	\$1.41	\$0.26		
Misc. Concrete	\$45.24	\$75.79	\$66.91	\$57.87	\$159.73	\$100.52
Uncategorized	\$2.85	\$19.81	\$11.62			
Total	\$72.90	\$138.89	\$128.53	\$115.25	\$268.71	\$171.15

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Oregon's Transportation Construction

Oregon currently has 17,182 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 7,292 bridges in the state, of which 76 percent or 5,524, contain primarily concrete. Approximately 12 percent of highway spending in Oregon is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Oregon Department of Transportation (ODOT) specifications dictate that contractors can replace Portland cement at a rate up to 30 percent with class C, F, or N fly ash.

### How would a "hazardous building material" label affect your state?

ODOT is concerned about the availability of fly ash over the next decade as the traditional, long-standing sources go off line. Experts interviewed feared that if the EPA labeled fly ash as a "hazardous building material," this could accelerate the process. Furthermore, the extensive use of fly ash throughout Oregon makes this a large, state-wide issue.

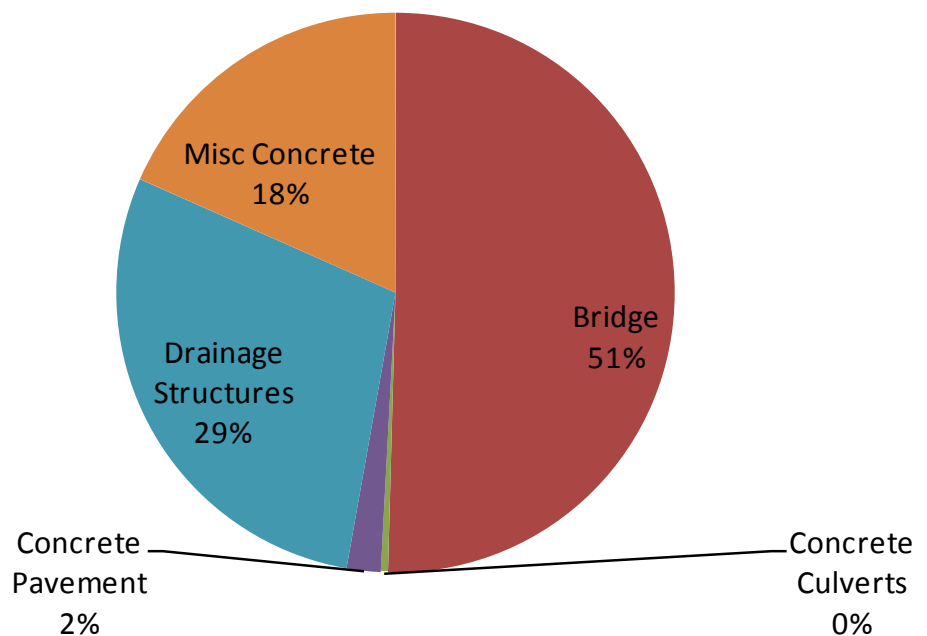
### How prevalent is fly ash in your transportation projects?

Fly ash is used extensively throughout the state.

### What are your state's sources of fly ash?

Oregon has two sources for the fly ash: Boardman, Oregon, which is shutting down in 2020 and Centralia, Washington, which is shutting down in 2025.

Average Oregon Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Oregon Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$44.5	\$332.5	13.4%
2006	\$64.2	\$426.6	15.0%
2007	\$49.0	\$356.0	13.8%
2008	\$32.5	\$314.5	10.3%
2009	\$35.6	\$437.8	8.1%
2010	\$32.4	\$352.1	9.2%
Average	\$43.0	\$369.9	11.6%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

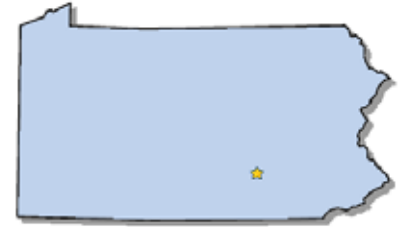
## Concrete Use by Type in Oregon Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$26.94	\$33.04	\$21.19	\$25.48	\$13.19	\$11.89
Concrete Culverts	\$0.14	\$0.14	\$0.22	\$0.42	\$0.15	
Concrete Pavement	\$0.49	\$0.77	\$0.18	\$0.58	\$3.08	
Drainage Structures	\$10.62	\$25.53	\$22.67	\$2.17	\$5.66	\$8.78
Misc. Concrete	\$6.31	\$4.67	\$4.95	\$4.82	\$16.11	\$11.02
Total	\$44.51	\$64.15	\$49.21	\$33.48	\$38.18	\$31.68

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Pennsylvania's Transportation Construction

Pennsylvania currently has 28,302 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 22,320 bridges in the state, of which 64 percent or 14,196, contain primarily concrete. Approximately 13 percent of highway spending in Pennsylvania is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Pennsylvania Department of Transportation (PennDOT) uses a quantity of fly ash equal to a minimum of 15 percent, by mass of the total cementitious material. If fly ash is added to reduce alkali-silica reactivity, a quantity of fly ash between 15 and 25 percent, by mass, of the total cementitious material is used.

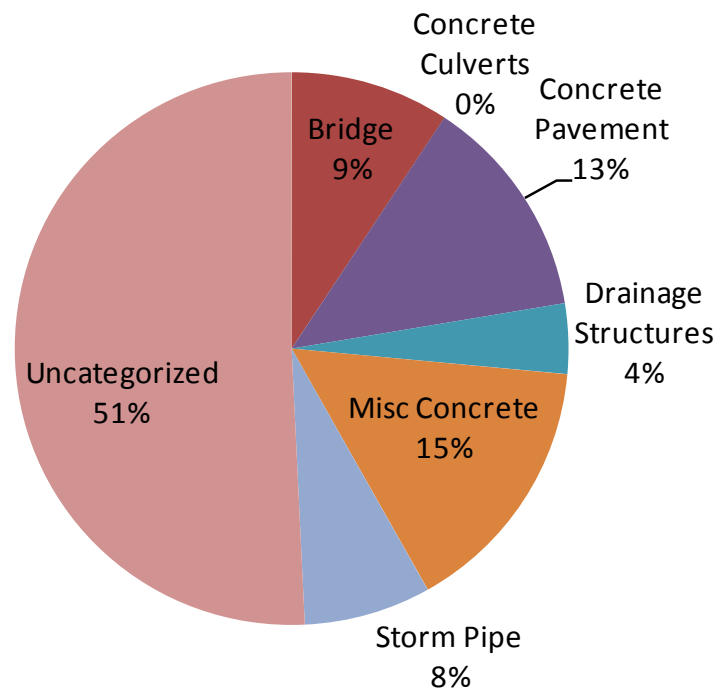
### How would a "hazardous building material" label affect your state?

PennDOT experts interviewed explained that the use of fly ash is a common method of strengthening concrete for transportation infrastructure. Insiders believe that either eliminating fly ash, or labeling it as a hazardous building material would very likely result in a corresponding increase in the cost of concrete. With the state's current budget challenges, this could be detrimental to the financial health of the Department. Furthermore, experts recognize the importance of fly ash to counteract damaging alkali-silica reactions in concrete, as its use leads to longer life-cycles with lower long-term maintenance costs.

### How prevalent is fly ash in your transportation projects?

PennDOT does not collect or maintain information on the amount of fly ash used in the state.

Average Pennsylvania Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## What are your state's sources of fly ash?

Pennsylvania's sources of fly ash include: Ash/Dell, Cinergy Corporation, Irvine Fly Ash, Headwaters Resources, Lafarge North America, Lehigh Portland Cement, Mineral Resources Technologies, Sinew, Separation Technologies, and VFL Technology.

## Pennsylvania Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$153.5	\$1,376.9	11.1%
2006	\$170.3	\$1,595.5	10.7%
2007	\$218.1	\$1,986.5	11.0%
2008	\$272.6	\$1,953.1	14.0%
2009	\$360.2	\$2,650.6	13.6%
2010	\$298.3	\$2,182.2	13.7%
Average	\$245.5	\$1,957.5	12.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Pennsylvania Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$11.57	\$22.97	\$28.78	\$18.16	\$26.93	\$28.41
Concrete Culverts	\$0.07	\$0.06				
Concrete Pavement	\$19.77	\$29.15	\$44.68	\$23.23	\$67.94	\$7.77
Drainage Structures	\$8.59	\$1.93	\$6.96	\$6.12	\$11.13	\$25.81
Misc. Concrete	\$27.22	\$22.25	\$24.89	\$48.92	\$60.95	\$42.01
Storm Pipe	\$11.65	\$15.98	\$8.69	\$20.72	\$12.40	\$39.51
Uncategorized	\$74.71	\$78.01	\$104.03	\$155.43	\$180.82	\$154.82
Total	\$153.59	\$170.33	\$218.03	\$272.57	\$360.18	\$298.33

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Rhode Island's Transportation Construction

Rhode Island currently has 1,704 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 741 bridges in the state, of which 313 percent or 42, contain primarily concrete. Approximately eight percent of highway spending in Rhode Island is spent on concrete products each year, based on ARTBA analysis of bid tab data.

### What are your state's fly ash specifications?

The Rhode Island Department of Transportation (RIDOT) specifications dictate that contractors can replace Portland cement at a rate up to 15 percent with various classes of fly ash.

### How would a "hazardous building material" label affect your state?

RIDOT engineers were very unsure of how the possible label would affect the Department. Furthermore, they cited the fact that there were "only a few, limited suppliers" of fly ash in the state. Contacts interviewed feared that such an EPA labeling would result in an increase in costs of concrete, which would undoubtedly drive up the costs of projects across the board.

### How prevalent is fly ash in your transportation projects?

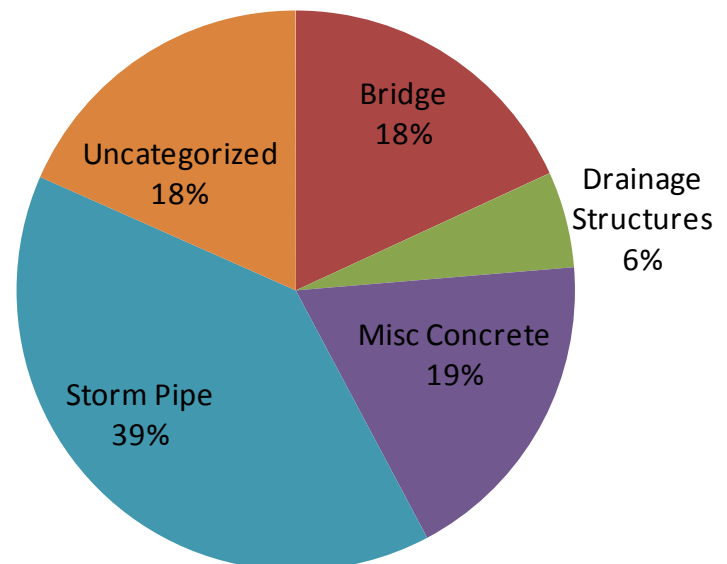
Experts interviewed reported that fly ash was used in approximately 33 percent of all concrete projects. It should be noted that other pozzolans, such as slag, are used more extensively in Rhode Island than in many other states.

### What are your state's sources of fly ash?

No sources were identified by RIDOT.



Average Rhode Island Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Rhode Island Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$47.3	\$279.2	16.9%
2006	\$3.4	\$49.8	6.8%
2007	\$12.4	\$89.4	13.8%
2008	\$2.0	\$45.7	4.5%
2009	\$17.4	\$462.7	3.8%
2010	\$9.2	\$168.2	5.5%
Average	\$15.3	\$182.5	8.4%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Rhode Island Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$11.90	\$0.53	\$0.74	\$0.78	\$1.56	\$1.33
Drainage Structures	\$0.72	\$1.94	\$0.70	\$0.10	\$1.61	\$0.11
Misc. Concrete	\$0.21	\$0.65	\$0.61	\$0.73	\$13.11	\$1.96
Storm Pipe	\$21.90	\$0.01	\$8.97	\$0.04	\$0.43	\$5.32
Uncategorized	\$12.53	\$0.28	\$2.08	\$0.43	\$1.50	\$0.25
Total	\$47.26	\$3.41	\$13.10	\$2.07	\$18.21	\$8.97

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in South Carolina's Transportation Construction

South Carolina currently has 20,798 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 9,221 bridges in the state, of which 84 percent or 7,746, contain primarily concrete. Approximately 11 percent of highway spending in South Carolina is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The South Carolina Department of Transportation (SCDOT) specifications dictate that contractors can replace Portland cement at a rate up to 20 percent with various classes of fly ash permitted.

### How would a "hazardous building material" label affect your state?

SCDOT experts interviewed see that the industry being greatly impacted by a potential restriction of using fly ash use, and consequently, the price of fly ash. The use of fly ash in concrete mixes is widespread in the state." Furthermore, the expressed concerns about the potential loss of the structural benefits that fly ash provides.

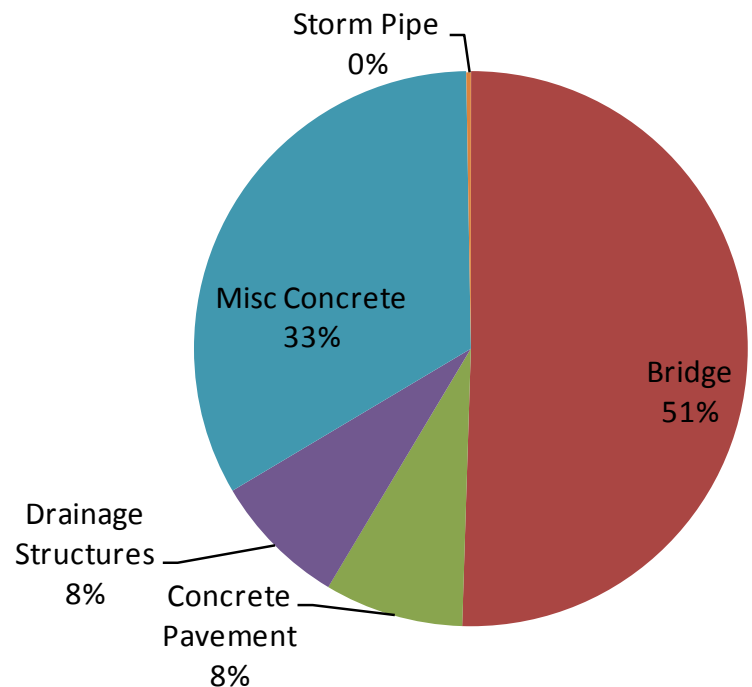
### How prevalent is fly ash in your transportation projects?

Approximately 75 percent of all concrete projects within the state use fly ash.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.scdot.org/doing/ConstructionDocs/pdfs/Materials/3%20QPL%20022811.pdf>

Average South Carolina Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## South Carolina Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$69.2	\$664.0	10.4%
2006	\$15.6	\$222.4	7.0%
2007	\$50.9	\$295.3	17.2%
2008	\$51.7	\$393.8	13.1%
2009	\$73.9	\$669.3	11.0%
2010	\$48.4	\$650.7	7.4%
Average	\$51.6	\$482.6	10.7%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in South Carolina Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$30.31	\$3.90	\$32.30	\$38.45	\$32.20	\$20.34
Concrete Pavement	\$4.52	\$3.02	\$6.37	\$5.57	\$3.42	\$2.30
Drainage Structures	\$5.41	\$1.17	\$3.50	\$0.24	\$8.50	\$5.72
Misc. Concrete	\$28.98	\$9.70	\$12.03	\$6.59	\$27.60	\$18.95
Storm Pipe	\$0.84					
Total	\$70.05	\$17.80	\$54.20	\$50.86	\$71.72	\$47.31

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in South Dakota's Transportation Construction

South Dakota currently has 14,994 miles of roadway in the Federal-aid Highway System, of which ten percent is concrete. There are 5,920 bridges in the state, of which 65 percent or 3,850, contain primarily concrete. Approximately six percent of highway spending in South Dakota is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The South Dakota Department of Transportation (SDDOT) specifications dictate that contractors can replace Portland cement at a rate between 15 to 20 percent with classes C and class F fly ash.

### How would a "hazardous building material" label affect your state?

Experts interviewed expressed their apprehension about labeling fly ash as a hazardous material. They said, "Trying to find an economical alternative to fly ash for mitigation alkali-silica reactions would be difficult." These alkali-silica reactions in concrete are damaging to the strength of the concrete and the overall structure. The addition of fly ash mitigates this and leads to longer life-cycles with lower long-term maintenance costs. SDDOT has not determined what other products might replace fly ash, or if more concrete would be placed with straight cement.

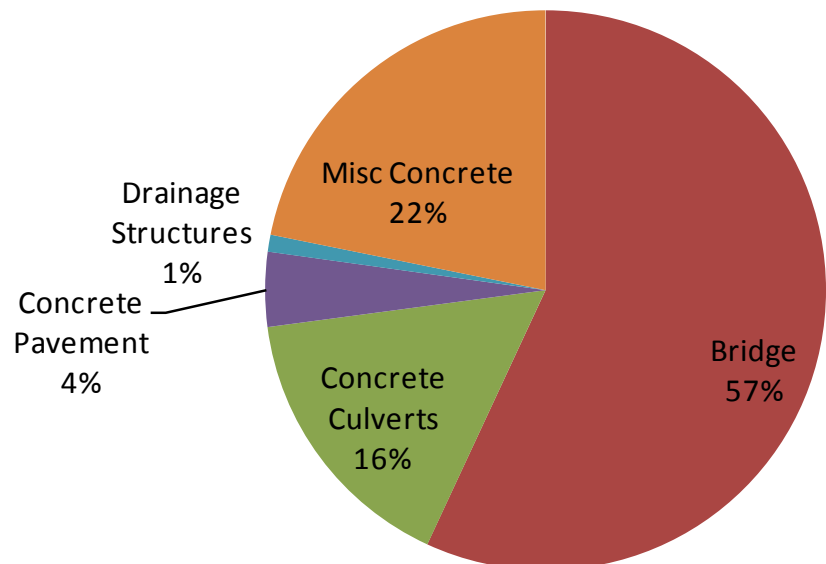
### How prevalent is fly ash in your transportation projects?

On average, experts estimate that the amount of fly ash used in the state accounts for 15 percent of the total amount of concrete.

### What are your state's sources of fly ash?

The primary source of class F fly ash comes from the Coal Creek, North Dakota.

Average South Dakota Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## South Dakota Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$12.6	\$207.7	6.1%
2006	\$13.9	\$228.7	6.1%
2007	\$15.3	\$211.9	7.2%
2008	\$15.1	\$242.4	6.2%
2009	\$19.0	\$368.0	5.2%
2010	\$23.8	\$376.9	6.3%
Average	\$16.6	\$272.6	6.1%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

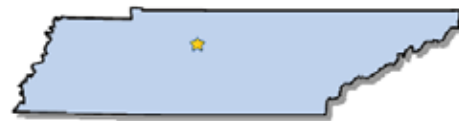
## Concrete Use by Type in South Dakota Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$7.81	\$6.88	\$9.60	\$8.02	\$11.39	\$13.05
Concrete Culverts	\$1.38	\$2.07	\$1.70	\$2.88	\$3.43	\$4.48
Concrete Pavement	\$1.06	\$0.08	\$0.78	\$0.29	\$0.35	\$1.73
Drainage Structures	\$0.12	\$0.16	\$0.29	\$0.01	\$0.41	\$0.01
Misc. Concrete	\$2.24	\$4.72	\$2.96	\$3.89	\$3.40	\$4.53
Total	\$12.62	\$13.92	\$15.32	\$15.09	\$18.98	\$23.79

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Tennessee's Transportation Construction

Tennessee currently has 17,589 miles of roadway in the Federal-aid Highway System, of which one percent is concrete. There are 19,880 bridges in the state, of which 84 percent or 16,792, contain primarily concrete. Approximately 13 percent of highway spending in Tennessee is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Tennessee Department of Transportation (TDOT) specifications dictate that contractors can replace Portland cement at a rate of 20 percent with class F fly ash, and 25 percent with class C fly ash.

### How would a "hazardous building material" label affect your state?

Experts within TDOT feared that a hazardous building material label on fly ash would significantly increase the cost of all concrete projects and compromise the strength of the structures. Experts pointed out that fly ash has been used extensively in the state, so the difference would be very noticeable. The quality of the concrete and the cost of projects would be dramatically different.

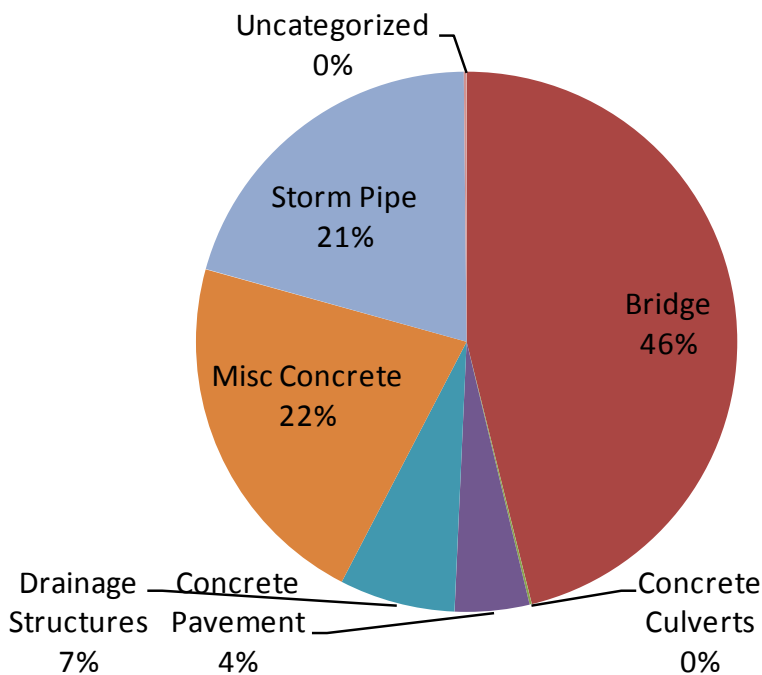
### How prevalent is fly ash in your transportation projects?

Approximately 80 percent of all concrete projects in Tennessee utilize fly ash.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.tdot.state.tn.us/materials/reseval/docs/qualprodlst.pdf>

Average Tennessee Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## Tennessee Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$90.9	\$629.3	14.4%
2006	\$97.2	\$715.2	13.6%
2007	\$71.3	\$579.5	12.3%
2008	\$104.8	\$740.4	14.2%
2009	\$131.6	\$1,092.7	12.0%
2010	\$132.8	\$952.0	14.0%
Average	\$104.8	\$784.8	13.3%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Tennessee Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$24.46	\$33.11	\$30.90	\$66.02	\$56.72	\$78.74
Concrete Culverts	\$0.10	\$0.13	\$0.57			
Concrete Pavement	\$1.30	\$5.86	\$3.67	\$7.84	\$3.03	\$6.31
Drainage Structures	\$0.89	\$6.88	\$19.83	\$1.84	\$8.63	\$5.28
Misc. Concrete	\$43.89	\$27.15	\$6.28	\$14.10	\$22.61	\$22.45
Storm Pipe	\$20.20	\$23.62	\$10.59	\$14.39	\$40.04	\$20.03
Uncategorized	\$0.44	\$0.61				
Total	\$91.29	\$97.35	\$71.84	\$104.20	\$131.03	\$132.81

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Texas' Transportation Construction

Texas currently has 82,454 miles of roadway in the Federal-aid Highway System, of which eight percent is concrete. There are 50,603 bridges in the state, of which 82 percent or 41,330, contain primarily concrete. Approximately 18 percent of highway spending in Texas is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Texas Department of Transportation (TxDOT) specifications dictate that contractors can replace Portland cement at various rates with fly ash, at the discretion of the contractor.

### How would a "hazardous building material" label affect your state?

As stated in two letters to EPA from TxDOT, the absence of fly ash would create a serious problem for the economy of transportation projects: both from an initial cost perspective, as well as a life-cycle cost perspective. The cost increase would vary dramatically across the state, based on each concrete plant's proximity to a coal-burning power plant and/or transportation delivery system.

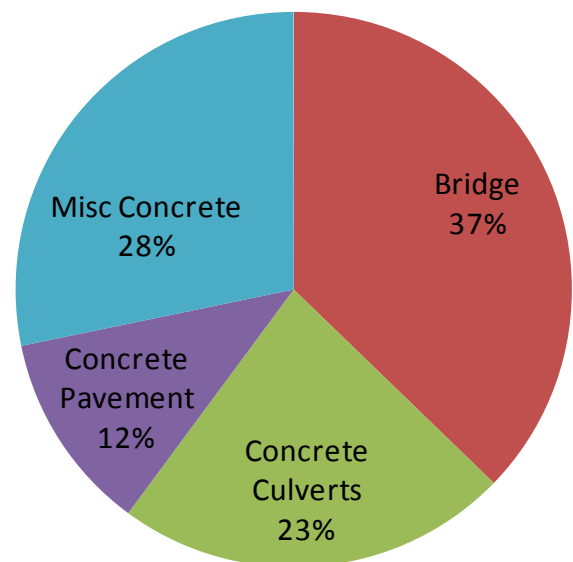
### How prevalent is fly ash in your transportation projects?

Fly ash is used in virtually all concrete in each of the 25 districts in Texas.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/flyash.pdf>

### Average Texas Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Texas Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$923.5	\$5,075.9	18.2%
2006	\$895.3	\$5,277.1	17.0%
2007	\$711.3	\$4,133.0	17.2%
2008	\$545.1	\$2,797.4	19.5%
2009	\$526.5	\$3,118.0	16.9%
2010	\$662.4	\$3,641.6	18.2%
Average	\$710.7	\$4,007.2	17.7%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

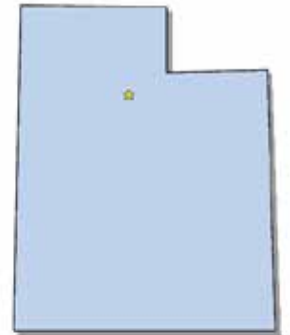
## Concrete Use by Type in Texas Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$293.0	\$429.9	\$218.9	\$181.4	\$216.0	\$249.4
Concrete Culverts	\$181.1	\$255.7	\$163.8	\$28.4	\$156.2	\$189.8
Concrete Pavement	\$140.1	\$45.8	\$78.6	\$121.1	\$24.4	\$86.1
Misc. Concrete	\$309.2	\$164.0	\$250.1	\$214.1	\$129.9	\$137.1
Total	\$923.5	\$895.3	\$711.3	\$545.1	\$526.5	\$662.4

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Utah's Transportation Construction

Utah currently has 8,214 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 2,847 bridges in the state, of which 67 percent or 1,914, contain primarily concrete. Approximately 39 percent of highway spending in Utah is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Utah Department of Transportation (UDOT) specifications dictate that contractors can replace Portland cement with class F fly ash at a rate between 20 to 30 percent.

### How would a "hazardous building material" label affect your state?

The use of fly ash in Utah is very widespread. UDOT experts believe that banning or restrictions of the use of fly ash would have serious consequences in regard to material availability, control of the damaging alkali-silica reactions in concrete, costs of mixes, and the change of processes required of our ready-mixers. Experts within UDOT interviewed stressed that they did not support the labeling fly ash as a hazardous building material.

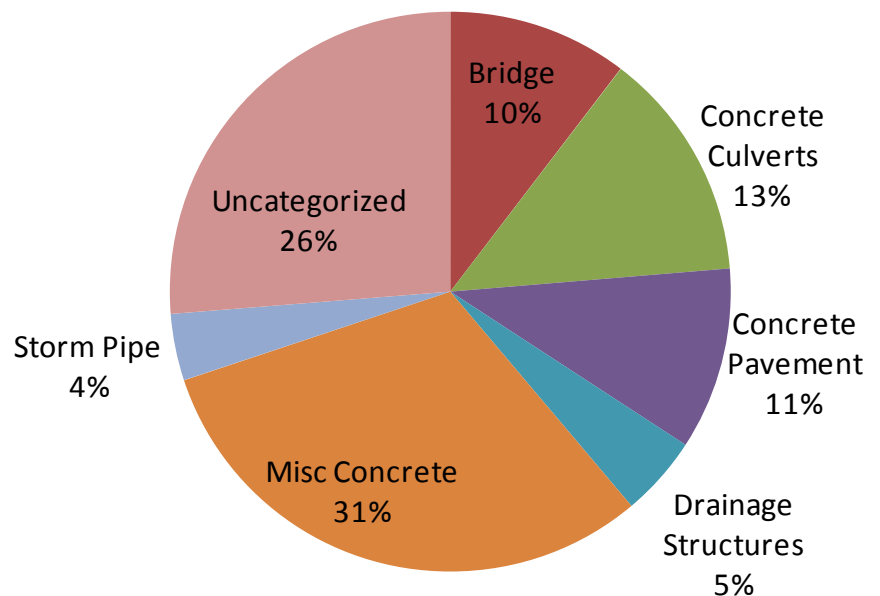
### How prevalent is fly ash in your transportation projects?

Experts interviewed report that Utah uses fly ash in approximately 99 percent of all concrete projects.

### What are your state's sources of fly ash?

The most common sources of fly ash used are from the Headwaters' Navajo and Bridger plants.

Average Utah Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Utah Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$25.2	\$243.2	10.4%
2006	\$76.8	\$556.4	13.8%
2007	\$18.4	\$261.3	7.0%
2008	\$45.5	\$345.2	13.2%
2009	\$50.0	\$454.9	11.0%
2010	\$62.1	\$438.0	14.2%
Average	\$46.3	\$383.2	12.1%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Utah Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$11.44	\$7.54	\$1.78	\$1.45	\$2.00	\$5.21
Concrete Culverts	\$0.10	\$0.11	\$1.73	\$0.33	\$0.59	\$34.86
Concrete Pavement	\$0.80	\$23.49	\$2.36	\$1.85	\$0.53	\$0.73
Drainage Structures	\$0.19	\$0.13	\$1.53	\$0.54	\$6.19	\$4.61
Misc. Concrete	\$11.59	\$33.66	\$3.54	\$9.28	\$22.49	\$7.36
Storm Pipe	\$0.31	\$1.01	\$3.27	\$5.57	\$0.58	\$0.17
Uncategorized	\$0.76	\$10.82	\$4.16	\$28.36	\$16.28	\$14.06
Total	\$25.18	\$76.76	\$18.37	\$47.39	\$48.66	\$67.01

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Vermont's Transportation Construction

Vermont currently has 3,842 miles of roadway in the Federal-aid Highway System, of which there is less than one percent concrete mileage. There are 2,715 bridges in the state, of which 32 percent or 877, contain primarily concrete. Approximately six percent of highway spending in Vermont is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The Vermont Agency of Transportation (VTrans) specifications dictate that contractors can replace Portland cement with class F, N, or C fly ash at a 20 percent rate.

### How would a "hazardous building material" label affect your state?

Experts interviewed within VTrans were unavailable for comment on this matter.

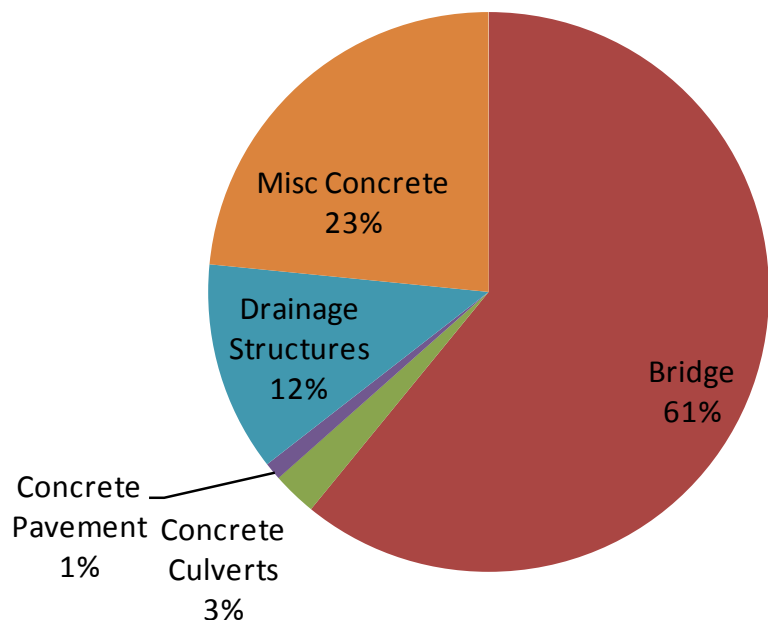
### How prevalent is fly ash in your transportation projects?

VTrans does not track fly ash usage in its state, and were unable to provide any data on its usage.

### What are your state's sources of fly ash?

VTrans was unable to identify any sources.

Average Vermont Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Vermont Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$9.4	\$96.8	9.7%
2006	\$7.1	\$75.1	9.4%
2007	\$6.8	\$120.8	5.6%
2008	\$6.9	\$109.0	6.3%
2009	\$9.0	\$198.8	4.5%
2010	\$4.7	\$148.6	3.2%
Average	\$7.3	\$124.8	5.8%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Vermont Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$7.96	\$3.99	\$2.38	\$4.90	\$5.51	\$2.24
Concrete Culverts	\$0.66	\$0.07	\$0.17	\$0.06	\$0.17	
Concrete Pavement	\$0.45					
Drainage Structures	\$0.15	\$0.17	\$3.68	\$0.25	\$0.76	\$0.35
Misc. Concrete	\$1.28	\$1.79	\$0.65	\$2.01	\$3.03	\$1.62
Total	\$10.50	\$6.02	\$6.89	\$7.22	\$9.47	\$4.21

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Virginia’s Transportation Construction

Virginia currently has 21,196 miles of roadway in the Federal-aid Highway System, of which two percent is concrete. There are 13,448 bridges in the state, of which 46 percent or 6,209, contain primarily concrete. Approximately 33 percent of highway spending in Virginia is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is the highest of all the states.



### What are your state’s fly ash specifications?

The Virginia Department of Transportation (VDOT) specifications dictate that contractors can replace Portland cement with class F or C fly ash at a minimum replacement rate of 20 percent. Class F fly ash is primarily used in Virginia.

### How would a “hazardous building material” label affect your state?

Eliminating or limiting the use of fly ash in Virginia would create a significant shortage of quality mineral admixtures. Currently, there is no “back-up” plan for the absence of fly ash. Experts interviewed explained that during the short-term VDOT’s ability to deliver projects on time and on budget, would be seriously impacted. Additionally, eliminating fly ash would escalate the cost of the remaining mineral admixtures available. Supplies of the remaining mineral admixtures are not sufficient to cover the demand. Another mineral admixture, silica fume, is available in smaller quantities than class F fly ash and slag, but is much more difficult to handle and is more expensive than fly ash. Contacts interviewed pointed out that it would certainly have a negative impact.

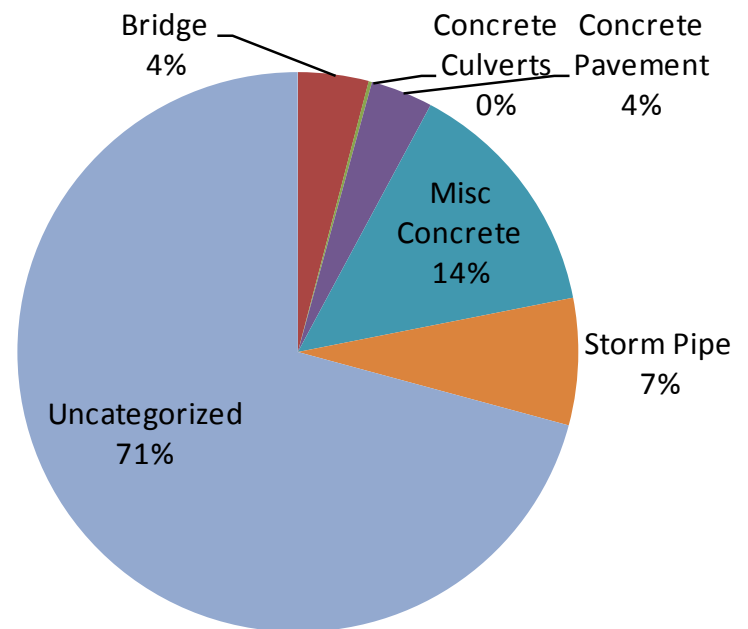
### How prevalent is fly ash in your transportation projects?

Experts within the VDOT estimate that fly ash is used in 60 to 70 percent of all concrete projects in the state.

### What are your state’s sources of fly ash?

Virginia receives its fly ash from Boral Material Technologies, Separation Technologies, and SEFA Group.

Average Virginia Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.



## Virginia Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$201.3	\$594.8	33.8%
2006	\$257.5	\$832.1	30.9%
2007	\$264.2	\$787.0	33.6%
2008	\$234.0	\$685.4	34.1%
2009	\$230.8	\$647.8	35.6%
2010	\$278.9	\$952.7	29.3%
Average	\$244.4	\$750.0	32.6%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Virginia Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$6.43	\$7.32	\$3.82	\$22.14	\$9.78	\$10.08
Concrete Culverts	\$0.56	\$0.04	\$0.84	\$0.85	\$0.66	
Concrete Pavement	\$2.73	\$0.60	\$1.61	\$15.55	\$5.78	\$26.01
Misc. Concrete	\$11.24	\$51.59	\$97.39	\$6.56	\$5.44	\$33.97
Storm Pipe	\$7.06	\$35.70	\$17.13	\$9.07	\$33.03	\$5.42
Uncategorized	\$173.23	\$162.26	\$143.39	\$179.85	\$176.08	\$203.44
Total	\$201.25	\$257.51	\$264.19	\$234.02	\$230.75	\$278.92

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Washington’s Transportation Construction

Washington currently has 19,415 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 7,681 bridges in the state, of which 80 percent or 6,161, contain primarily concrete. Approximately eight percent of highway spending in Washington is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state’s fly ash specifications?

The Washington State Department of Transportation (WSDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate up to 35 percent.

### How would a “hazardous building material” label affect your state?

WSDOT expects that more alternatives, such as lithium, could possibly be used as strengthening agents. This, however, would come at a great cost, as such alternatives can be extremely expensive. A bigger concern is the overall trends in rising highway materials costs in the last number of years across the board. This has affected asphalt binder, aggregate, concrete and steel, with additive higher cost of all materials effecting construction project costs. The labeling of fly ash as “hazardous” could exacerbate this issue.

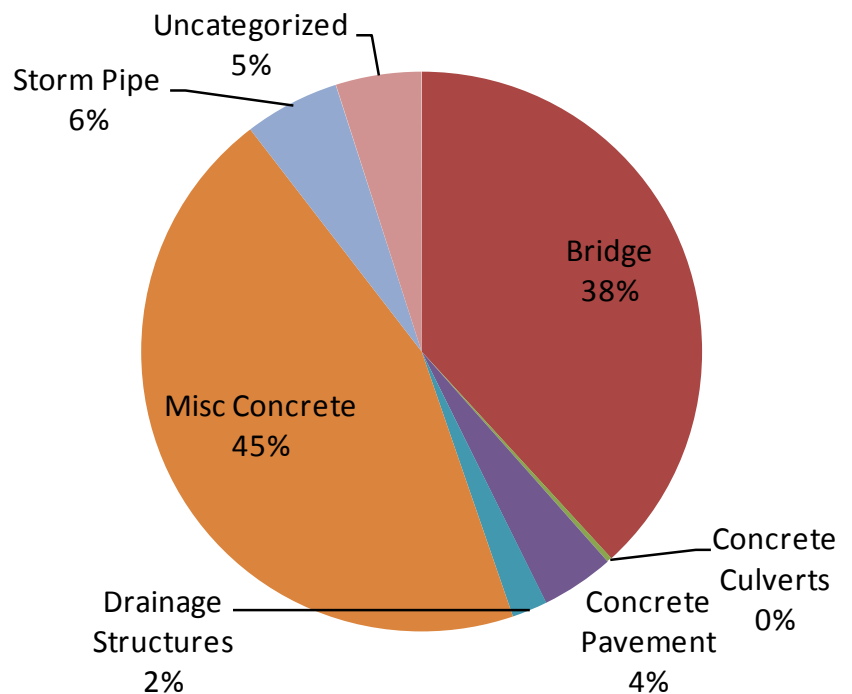
### How prevalent is fly ash in your transportation projects?

Many concrete suppliers chose to use either fly ash or slag in urban areas. It’s use varies in rural areas. Overall, fly ash usage occurs regularly on WSDOT projects that utilize concrete.

### What are your state’s sources of fly ash?

WSDOT receive fly ash from Lafarge North America, ENX, Boral Materials Technologies (Texas), and Headwaters resources.

Average Washington Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Washington Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$61.0	\$759.1	8.0%
2006	\$41.7	\$396.4	10.5%
2007	\$64.7	\$572.6	11.3%
2008	\$81.8	\$769.6	10.6%
2009	\$59.4	\$1,187.1	5.0%
2010	\$134.1	\$2,174.3	6.2%
Average	\$73.8	\$976.5	7.6%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

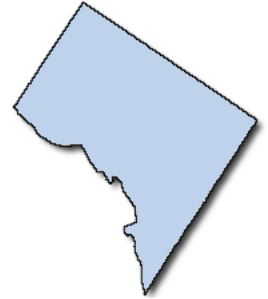
## Concrete Use by Type in Washington Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$21.40	\$5.84	\$7.22	\$32.87	\$30.76	\$71.20
Concrete Culverts	\$0.15	\$0.27	\$0.17	\$0.14	\$0.54	
Concrete Pavement	\$11.47	\$5.19	\$0.17	\$0.37	\$0.18	\$1.26
Drainage Structures	\$0.00	\$0.12	\$0.09	\$0.06	\$0.78	\$7.97
Misc. Concrete	\$24.55	\$27.44	\$38.27	\$42.35	\$17.73	\$48.38
Storm Pipe	\$2.64	\$2.79	\$3.46	\$2.23	\$8.19	\$5.04
Uncategorized	\$0.80	\$0.32	\$15.21	\$3.93	\$1.63	\$0.06
Total	\$61.01	\$41.98	\$64.61	\$81.97	\$59.81	\$133.92

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in the District of Columbia's Transportation Construction

The District of Columbia currently has 449 miles of roadway in the Federal-aid Highway System, of which six percent is concrete. There are 243 bridges in the state, of which 35 percent or 84, contain primarily concrete.



### What are your state's fly ash specifications?

The District of Columbia Department of Transportation (DDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate at 15 percent with class C and class F fly ash.

### How would a "hazardous building material" label affect your state?

Experts within DDOT declined all opportunities for an interview.

### How prevalent is fly ash in your transportation projects?

Outside experts speculate that the District of Columbia uses fly ash extensively in its projects.

### What are your state's sources of fly ash?

DDOT experts declined all opportunities for an interview.

Editor's note: Data on concrete use profile from state transportation bid tabs is not available.

## The Use of Fly Ash in West Virginia's Transportation Construction

West Virginia currently has 10,420 miles of roadway in the Federal-aid Highway System, of which five percent is concrete. There are 7,044 bridges in the state, of which 51 percent or 3,565, contain primarily concrete. Approximately 14 percent of highway spending in West Virginia is spent on concrete products each year, based on ARTBA analysis of bid tab data.



### What are your state's fly ash specifications?

The West Virginia Department of Transportation (WVDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate between 15 to 19 percent with class C and F fly ash.

### How would a "hazardous building material" label affect your state?

Experts interviewed stated that it would be detrimental to WVDOT if fly ash was not used in projects. In many areas of West Virginia, it is more cost effective to use fly ash rather than any other alternative pozzolan. The use of fly ash is very widespread in the state, and it is used more commonly than any other type of concrete-strengthening mechanism.

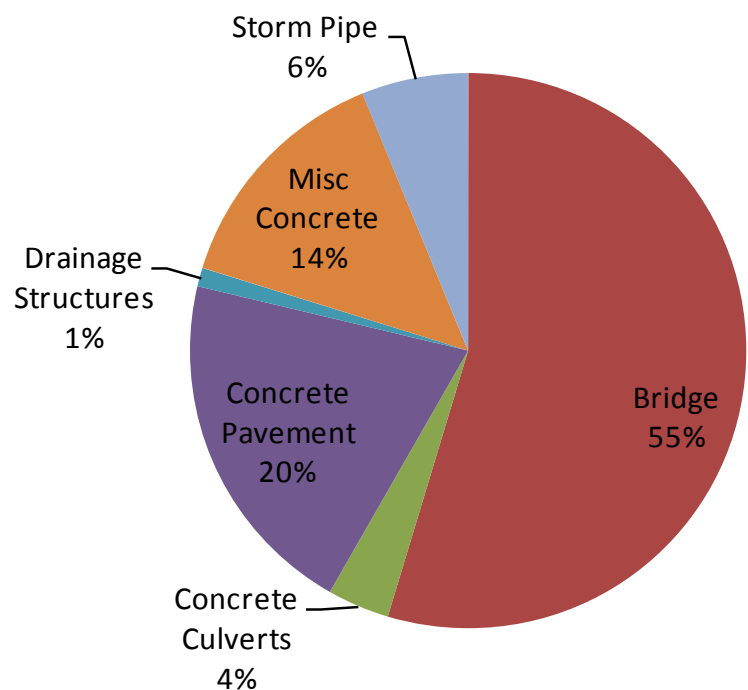
### How prevalent is fly ash in your transportation projects?

According to experts interviewed, West Virginia uses a significant amount of fly ash in concrete. Fly ash is used extensively in projects state-wide.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.transportation.wv.gov/highways/mcst/Pages/707.4pozzolansources.aspx>

Average West Virginia Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## West Virginia Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$40.2	\$387.6	10.4%
2006	\$72.3	\$505.6	14.3%
2007	\$84.0	\$459.5	18.3%
2008	\$86.6	\$609.5	14.2%
2009	\$56.7	\$455.5	12.4%
2010	\$54.7	\$498.4	11.0%
Average	\$65.7	\$486.0	13.5%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in West Virginia Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$13.78	\$41.47	\$61.08	\$36.54	\$29.19	\$33.67
Concrete Culverts	\$0.68	\$0.53	\$2.47	\$8.26	\$0.30	\$2.04
Concrete Pavement	\$17.18	\$8.36	\$1.51	\$31.31	\$13.96	\$8.39
Drainage Structures	\$0.09	\$0.04	\$1.27	\$0.67	\$2.01	\$0.23
Misc. Concrete	\$7.72	\$15.67	\$1.09	\$9.64	\$12.50	\$8.57
Storm Pipe	\$0.73	\$6.26	\$16.55	\$0.17	\$0.73	\$0.03
Total	\$40.18	\$72.33	\$83.96	\$86.59	\$58.68	\$52.92

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

## The Use of Fly Ash in Wisconsin's Transportation Construction

Wisconsin currently has 28,142 miles of roadway in the Federal-aid Highway System, of which nine percent is concrete. There are 13,831 bridges in the state, of which 67 percent or 9,269, contain primarily concrete. Approximately 22 percent of highway spending in Wisconsin is spent on concrete products each year, based on ARTBA analysis of bid tab data. This percentage is among the highest of all the states.



### What are your state's fly ash specifications?

The Wisconsin Department of Transportation (WisDOT) specifications dictate that contractors can replace Portland cement with fly ash at variable rates with both class C and F fly ash.

### How would a "hazardous building material" label affect your state?

One WisDOT expert interviewed expressed concerns about the impact that such a liability would have on project costs. He stated, "I would anticipate that our concrete bid prices would increase considerably and the performance of the material would decrease." Furthermore, the contacts interviewed praised the benefits of fly ash that the state has utilized for decades. The elimination or labeling of fly ash as a hazardous building material would be extremely detrimental to the WisDOT.

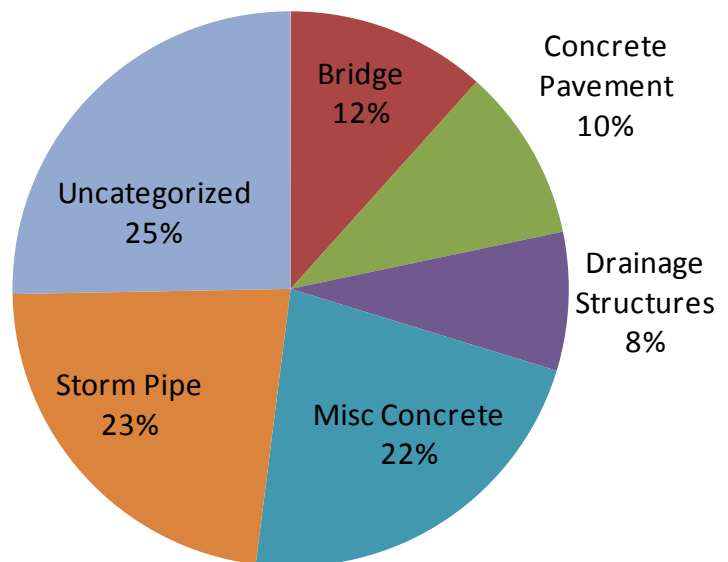
### How prevalent is fly ash in your transportation projects?

The majority of concrete in Wisconsin contains fly ash.

### What are your state's sources of fly ash?

A listing of the sources of fly ash can be found at <http://www.whrp.org/rfps-and-guidelines/downloads/RFPs%20PDF/Rigid/WHRP%20RFP%20-%20C%20vs%20F%20Fly%20Ash%20Study-FINAL.pdf>

### Average Wisconsin Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Wisconsin Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$241.7	\$997.3	24.2%
2006	\$151.7	\$675.5	22.5%
2007	\$136.3	\$624.2	21.8%
2008	\$167.1	\$833.7	20.0%
2009	\$240.1	\$1,147.3	20.9%
2010	\$307.7	\$1,400.1	22.0%
Average	\$207.4	\$946.3	21.9%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Wisconsin Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$17.92	\$27.86	\$17.44	\$25.02	\$24.18	\$32.23
Concrete Pavement	\$20.65	\$11.60	\$24.08	\$18.35	\$24.80	\$25.82
Drainage Structures	\$28.72	\$14.52	\$6.18	\$11.63	\$7.69	\$31.74
Misc. Concrete	\$39.92	\$47.12	\$48.00	\$44.04	\$50.12	\$47.52
Storm Pipe	\$118.69	\$22.64	\$16.37	\$33.53	\$35.69	\$55.72
Uncategorized	\$15.80	\$27.98	\$24.23	\$34.55	\$97.57	\$114.62
Total	\$241.69	\$151.72	\$136.30	\$167.13	\$240.06	\$307.65

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.



## The Use of Fly Ash in Wyoming's Transportation Construction

Wyoming currently has 7,819 miles of roadway in the Federal-aid Highway System, of which four percent is concrete. There are 3,033 bridges in the state, of which 49 percent or 1,496, contain primarily concrete.

### What are your state's fly ash specifications?

The Wyoming Department of Transportation (WYDOT) specifications dictate that contractors can replace Portland cement with fly ash with a replacement rate at a maximum of 20 percent on small concrete projects, and 20 to 25 percent replacement on larger-scale projects.

### How would a "hazardous building material" label affect your state?

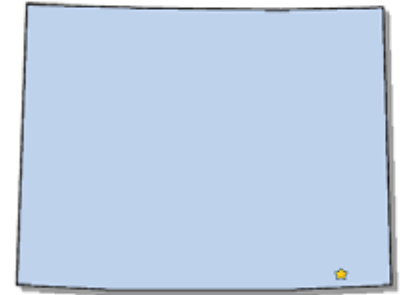
WYDOT experts interviewed felt the most detrimental part of fly ash restriction would be the potential loss of quality in concrete products. Several areas in Wyoming have aggregates that are highly reactive when exposed to the alkali in cement, causing the concrete to deteriorate quickly if the reaction is not mitigated. The chemical properties of fly ash in Wyoming's concrete provide excellent strengthening properties.

### How prevalent is fly ash in your transportation projects?

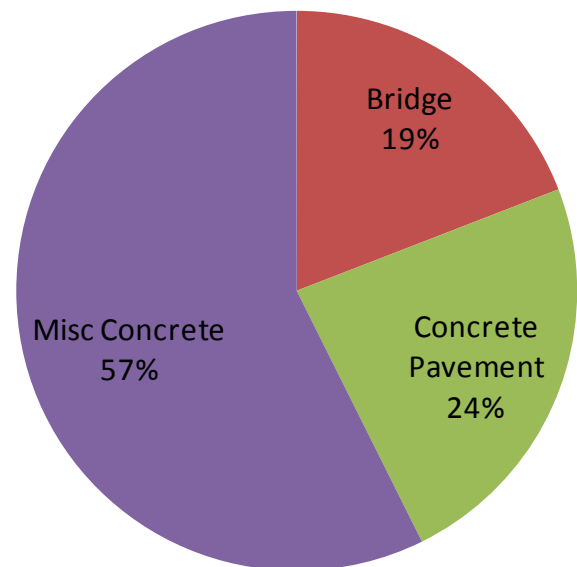
Fly ash is used extensively, state-wide throughout Wyoming.

### What are your state's sources of fly ash?

The sources of fly ash for Wyoming include the Headwaters and Boral power plants.



## Average Wisconsin Concrete Use by Type



Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Wyoming Annual Summary of Concrete Use in Bid Tabs (\$ Millions)

Year	Total Value of Concrete Materials	Value of Total Bids	Concrete Cost as % of Total Bids
2005	\$14.9	\$199.7	7.4%
2006	\$25.4	\$246.8	10.3%
2007	\$16.2	\$237.3	6.8%
2008	\$29.9	\$382.1	7.8%
2009	\$33.7	\$336.4	10.0%
2010	\$17.0	\$323.1	5.3%
Average	\$22.9	\$1,725.4	1.3%

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc.

## Concrete Use by Type in Wyoming Bid Tabs (\$ Millions)

Category Name	2005	2006	2007	2008	2009	2010
Bridge	\$2.76	\$1.68	\$0.35	\$9.73	\$6.47	\$5.21
Concrete Pavement	\$1.65	\$0.53	\$5.67	\$6.88	\$16.56	\$0.97
Misc. Concrete	\$10.47	\$23.20	\$10.21	\$13.27	\$10.69	\$10.81
Total	\$14.88	\$25.42	\$16.23	\$29.88	\$33.71	\$16.99

Source: Analysis of state DOT bid tab data provided by Oman Systems Inc. Misc. Concrete category includes concrete used for curbs and barriers, sidewalks, lightposts, guardrail anchors and concrete used for making repairs.

