



# Bureau of Transportation Statistics

## Special Report

September 2007

### Highway Bridges in the United States—an Overview

by Jeffery Memmott, Ph.D.

Bridges are an integral part of the U.S. highway network, providing links across natural barriers, passage over railroads and highways, and freeway connections. The Federal Highway Administration (FHWA) maintains a database of our nation’s highway bridges—the National Bridge Inventory (NBI)—with detailed information on all public road bridges greater than 20 feet. This special report gives a brief synopsis of that inventory, including bridge condition and the resources spent for maintenance and upgrades.

#### Bridge Characteristics

Most highway bridges are owned by state and local entities. Table 1 gives a breakdown of bridge ownership over the period 1996 to 2006. Slightly more than 50 percent of bridges are owned by local agencies, with state agencies owning about 48 percent. The remaining 2 percent are owned by federal

agencies and private entities. Ownership is important because the owner of the bridge is responsible for the maintenance and operation of the structure, though in many cases agreements are made with other agencies to perform the actual maintenance and operation work.<sup>1</sup>

Most bridges are in rural areas, but urban bridges carry the most traffic (figures 1 and 2). Almost 77 percent of all bridges are located on rural highways, with 59 percent of those bridges in the two lowest highway type categories, rural collector and rural local roads (see box A). In contrast, most of the average daily traffic (ADT) is carried on urban bridges—about 73 percent of all traffic crossing bridges

in the United States. Urban interstate bridges, in particular, represent less than 5 percent of the total number of bridges but carry almost 35 percent of the traffic. At the other extreme, rural local roads have about 35 percent of the bridges but carry less than 2 percent of the traffic.

About 27 percent of the bridges in the United States were built between 1957 and 1971, reflecting increased bridge construction during the interstate construction era from the late 1950s through the early 1970s. However, a large number of bridges have been constructed in recent years; about 25 percent of the bridges are less than 20 years old. There are more than 9,900 bridges still in operation in the United States that are over 100 years old. Figure 3 shows the total number of bridges and the number of structurally deficient and functionally obsolete bridges by age.

<sup>1</sup> U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation’s Highways, Bridges, and Transit: Conditions and Performance*, p. 2-18. <http://www.fhwa.dot.gov/policy/2006cpr/pdfs/chap2.pdf>

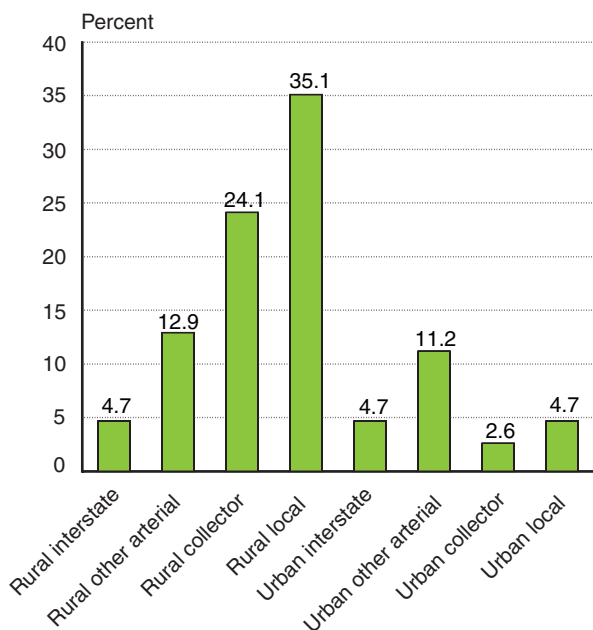
**Table 1: Number of Highway Bridges by Owner, 1996-2006**

Owner	1996	1998	2000	2002	2004	2006
Federal	6,250	7,452	8,010	9,049	8,425	8,355
State	273,247	274,263	277,076	280,216	282,527	284,668
Local	299,125	298,280	298,791	299,275	300,385	301,912
Private/railroad	2,382	2,283	2,275	1,501	1,479	1,490
Unknown/unclassified	484	441	415	400	397	375
<b>Total</b>	<b>581,488</b>	<b>582,719</b>	<b>586,567</b>	<b>590,441</b>	<b>593,213</b>	<b>596,800</b>

**NOTE:** Numbers include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Highway Bridges by Owner, various years. <http://www.fhwa.dot.gov/bridge/owner.htm> as of Aug. 14, 2007.

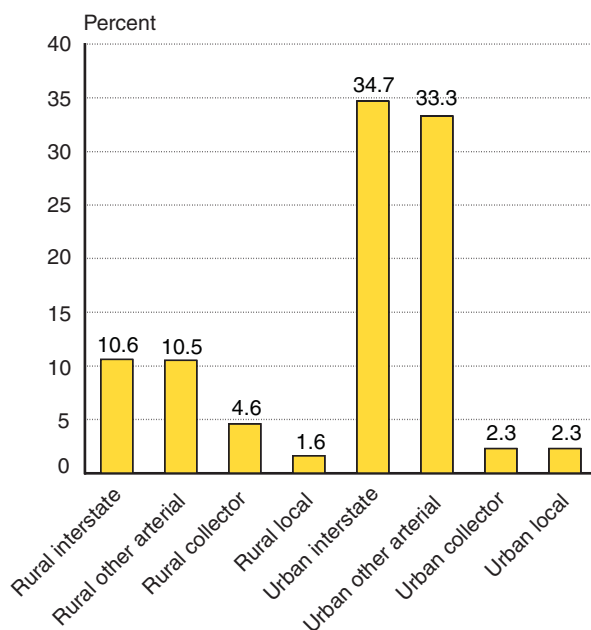
**Figure 1: Percent of Bridges by Highway Type**



**NOTE:** Percentages include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, Exhibit 2-16, p. 2-20, available at <http://www.fhwa.dot.gov/policy/2006cpr/pdfs/chap2.pdf>

**Figure 2: Percent of Average Daily Traffic on Bridges by Highway Type**



**NOTE:** Percentages include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, Exhibit 2-16, p. 2-20, available at <http://www.fhwa.dot.gov/policy/2006cpr/pdfs/chap2.pdf>

## Box A. Types of Highways

Highway bridges are located on all kinds of roads: the following terms are used to describe them, along with the functional classifications associated with each of the three major categories:

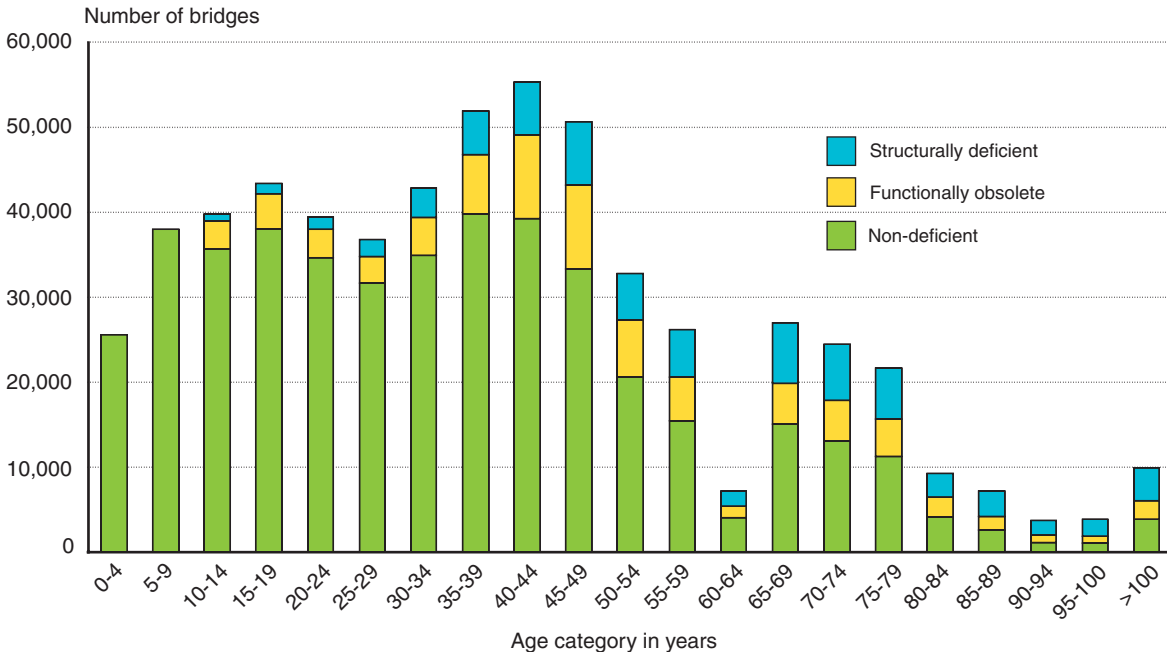
**Arterials** provide the highest level of mobility, at the highest speed, for long and uninterrupted travel. Arterials typically have higher design standards than other roads. They often include multiple lanes and have some degree of access control. The urban arterial system includes the functional classes interstate highways, other freeways and expressways, other principal arterials, and minor arterials. The rural network includes the functional classes interstate highways, other principal arterials, and minor arterials. In this report interstate highways are shown separately, and the other arterial functional classes are combined into the rural and urban other arterial categories.

**Collectors** provide a lower degree of mobility than arterials. They are designed for travel at lower speeds and for shorter distances. Generally, collectors are two-lane roads that collect travel from local roads and distribute it to the arterial system. The rural collector system includes the functional classes major collectors and minor collectors. In this report they have been combined into a single category. The urban collector system consists of a single functional class, urban collectors.

**Local** roads represent the largest element in the American public road network in terms of mileage. For rural and urban areas, all public road mileage below the collector system is considered local. Local roads provide basic access between residential and commercial properties, connecting with higher order highways. Both the urban and rural local road networks each consist of the lowest functional class, designated as the local functional class.

**SOURCE:** adapted from the U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* report to Congress, p.2-7

**Figure 3: Distribution of Highway Bridges by Age and Condition in 2006**



**NOTE:** Bridges that are both structurally deficient and functionally obsolete are classified as structurally deficient. Numbers include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Bridge by Year Built, 2006, available at <http://www.fhwa.dot.gov/bridge/structyr.htm> as of Aug. 8, 2007

## Bridge Ratings

Bridges are inspected and rated across a number of criteria, including load-carrying capacity, clearances, waterway adequacy, and approach roadway alignment. The FHWA reports that routine inspections are typically conducted every 24 months, with some bridges warranting more frequent inspections. With FHWA approval, a State may increase the inspection interval up to, but not to exceed, 48 months.<sup>2</sup> These bridges will be in very good condition and conform to a very stringent list of requirements. As a result of inspections and evaluation of NBI data, bridges are identified as not deficient, functionally obsolete, or structurally deficient. Structurally deficient takes precedence over functionally obsolete, so a bridge that is both structurally deficient and functionally obsolete would be classified as structurally deficient.<sup>3</sup> (see box B for definitions)

Older bridges are more likely to be structurally deficient and functionally obsolete than newer bridges. For example, the proportion of structurally deficient and functionally obsolete bridges is above 20 percent in the 35 to 39 years old category, over 40 percent in the 55 to 59 years old category, and over 50 percent in the 80 to 84 years old category.

<sup>2</sup> General guidelines are provided in FHWA Technical Advisory 5140.21.

<sup>3</sup> U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, p. 3-12. <http://www.fhwa.dot.gov/policy/2006cpr/pdfs/chap3.pdf>

The proportion of structurally deficient bridges is much lower than the proportion of functionally obsolete bridges for newer bridges, but rises much faster and is much higher for older bridges. For example, in the 15 to 19 years old category, about 3 percent of the bridges are structurally deficient, compared to almost 10 percent that are functionally obsolete. In contrast, in the 95 to 100 years old category, 53 percent are structurally deficient, compared to 21 percent that are functionally obsolete.

The percentage of structurally deficient bridges declined from 1992 to 2006, while the percentage of functionally obsolete bridges remained fairly constant over that time period. Of the bridges in the NBI database in 2006, 12.4 percent are listed as structurally deficient and 13.4 percent as functionally obsolete. Figure 4 shows the trends in bridge deficiencies from 1992 to 2006.

The total number of bridges classified as structurally deficient declined from 119,000 bridges in 1992 to 74,000 in 2006. The number of structurally deficient bridges over the period 1992 to 2006 is shown in figure 5.

The highest percentage of bridges classified as structurally deficient – 19 percent – are on local rural roads. Interstate highways have the lowest percent of structurally deficient bridges, with rural interstates at about 4 percent and urban interstates at about 6 percent. Functional obsolescence is much more prevalent in the urban functional categories. About 22 percent of all urban bridges are classified as

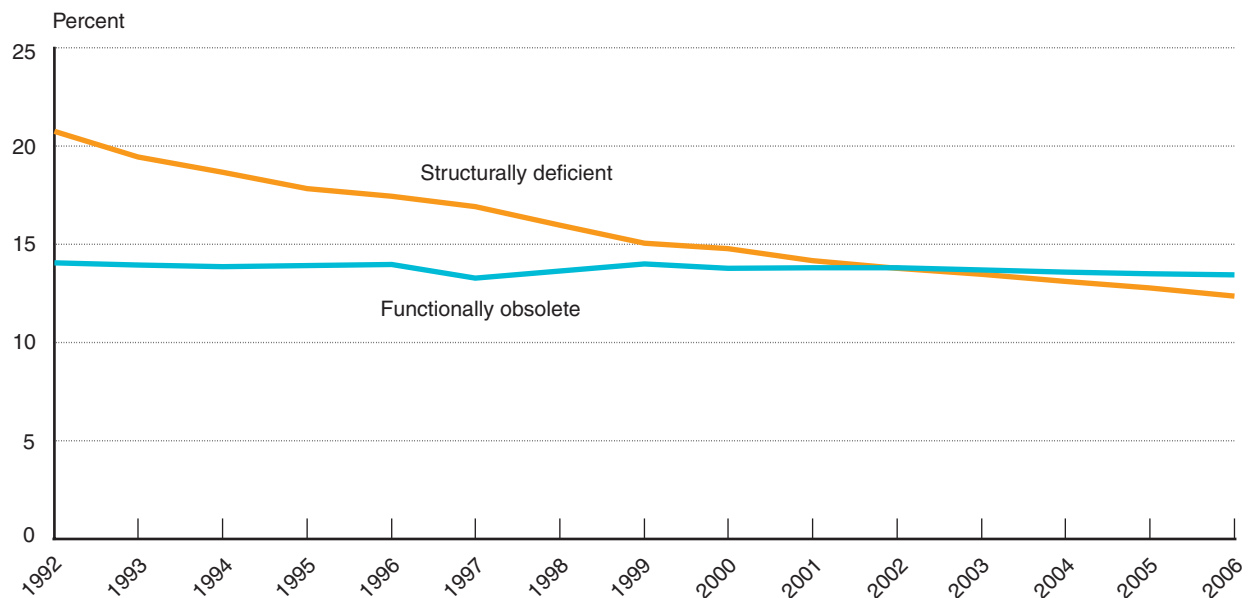
## Box B. Structurally Deficient and Obsolete Bridges as Defined by the FHWA

Bridges are considered **structurally deficient** if significant load-carrying elements are found to be in poor or worse condition due to deterioration and/or damage, or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to the point of causing intolerable traffic interruptions. The fact that a bridge is “deficient” does not immediately imply that it is likely to collapse or that it is unsafe. With hands-on inspection, unsafe conditions may be identified and, if the bridge is determined to be unsafe, the structure must be closed. A “deficient” bridge, when left open to traffic, typically requires significant maintenance and repair to remain in service and eventual rehabilitation or replacement to address deficiencies. To remain in service, structurally deficient bridges are often posted with weight limits to restrict the gross weight of vehicles using the bridges to less than the maximum weight typically allowed by statute.

**Functional obsolescence** is a function of the geometrics of the bridge in relation to the geometrics required by current design standards. While structural deficiencies are generally the result of deterioration of the conditions of the bridge components, functional obsolescence results from changing traffic demands on the structure. Facilities, including bridges, are designed to conform to the design standards in place at the time they are designed. Over time, improvements are made to the design requirements. As an example, a bridge designed in the 1930s would have shoulder widths in conformance with the design standards of the 1930s. However, the design standards have changed since the 1930s. Therefore, current design standards are based on different criteria and require wider bridge shoulders to meet current safety standards. The difference between the required, current-day shoulder width and the 1930s designed shoulder width represents a deficiency. The magnitude of these types of deficiencies determines whether the existing conditions cause the bridge to be classified as functionally obsolete.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation’s Highway, Bridges, and Transit: Conditions and Performance*, pp. 3-14, 3-15. <http://www.fhwa.dot.gov/policy/2006cpr/pdfs/chap2.pdf>

**Figure 4: Percentages of Highway Bridges with Deficiencies, 1992-2006**



**NOTE:** Bridges that are both structurally deficient and functionally obsolete are classified as structurally deficient. Numbers include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Deficient Bridges by State and Highway System, various years, available at <http://www.fhwa.dot.gov/bridge/britab.htm> as of Aug. 14, 2007.

functionally obsolete, compared to about 11 percent of rural bridges. The percentages of bridge deficiencies vary by highway type as shown in figure 6.

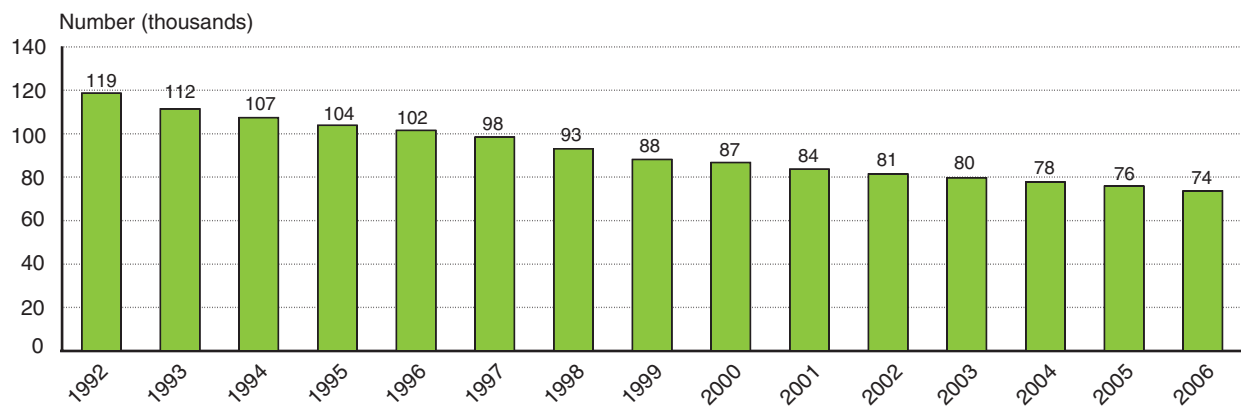
## Spending on Bridges

Table 2, taken from the FHWA's *Conditions and Performance Reports*, gives total bridge capital outlays for selected years. In 2004 capital outlays for bridge rehabilitation and replacement amounted to \$10.5 billion out of

a total capital outlay of \$12 billion (in 2004 dollars). The FHWA estimates future capital investment needs in biennial reports to Congress on highway, bridge, and transit conditions and performance. The most recent report, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, draws primarily on 2004 data.<sup>4</sup>

<sup>4</sup> U.S. Department of Transportation, Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, <http://www.fhwa.dot.gov/policy/2006cpr/pdfs.htm>

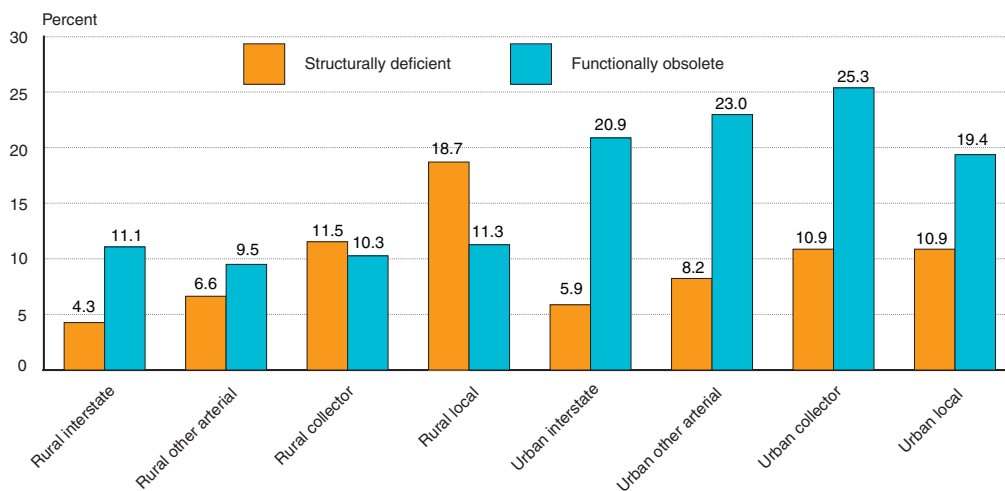
**Figure 5: Number of Highway Bridges Categorized as Structurally Deficient, 1992-2006**



**NOTE:** Bridges that are both structurally deficient and functionally obsolete are classified as structurally deficient. Numbers include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Deficient Bridges by State and Highway System, various years, available at <http://www.fhwa.dot.gov/bridge/britab.htm> as of Aug. 14, 2007.

**Figure 6: Percentages of Highway Bridges with Deficiencies by Highway Type in 2006**



**NOTE:** Bridges that are both structurally deficient and functionally obsolete are classified as structurally deficient. Percentages include the 50 U.S. states, the District of Columbia, and Puerto Rico.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Count, Area, Length of Bridges by Highway System, 2006, available at <http://www.fhwa.dot.gov/bridge/fc.htm> as of Aug. 14, 2007.

**Table 2: Bridge Capital Outlays, Selected Years**  
(billions of current dollars)

Year	Bridge rehabilitation and replacement	Bridges for new highway construction	Total
2004	10.5	1.6	12.0
2002	11.3	1.1	12.4
2000	7.6	1.2	8.8
1999	6.1	1.0	7.0

**NOTE:** Numbers may not add to totals due to rounding.

**SOURCE:** U.S. Department of Transportation, Federal Highway Administration, *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, Years 1999, 2002, 2004, and 2006, Exhibit 6-13.

## Conclusion

Bridges play a critical role within the highway network and the overall transportation system in the United States. There are more than 590,000 highway bridges in the United States, and most are owned by state or local government entities. Most bridges are located on rural collector and rural local roads, but urban interstates and other urban arterial highways carry most of the traffic. The highest proportion of bridges were built during the peak interstate construction period from the late 1950s through the early 1970s, but there are many older bridges still in use. A large number of bridges have also been built in recent years. The number of structurally deficient bridges has been

declining continuously since 1992. The number of functionally obsolete bridges has stayed relatively constant since 1992. Almost 26 percent (12.4 percent structurally deficient and 13.4 percent functionally obsolete) of the bridges in the United States are currently classified as either structurally deficient or functionally obsolete. Bridges on rural local highways have the highest percentage of structurally deficient bridges, with rural and urban interstates the lowest. The bridges with the highest traffic volumes—urban interstates and urban other arterials—have low percentages of structurally deficient bridges. Spending on bridge rehabilitation and replacement has generally been rising in recent years, accounting for \$10.5 billion out of \$12 billion in total bridge capital outlays in 2004. 🔄

### About this Report

This report was prepared by Jeffery L. Memmott, Transportation Specialist, of the Bureau of Transportation Statistics (BTS). BTS is a component of USDOT's Research and Innovative Technology Administration. The estimates in this report were developed from a variety of data sources and reviewed by staff in the Federal Highway Administration.

The principal data sources are:

U.S. Department of Transportation, Federal Highway Administration, *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance, 2002, 2004, and 2006*. <http://www.fhwa.dot.gov/policy/2006cpr>

U.S. Department of Transportation, Federal Highway Administration, National Bridge Inventory, Tables of Frequently Requested NBI Information. <http://www.fhwa.dot.gov/bridge/nbi.htm>

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#### Data —

- **Commodity Flow Survey**—survey reporting value, weight, and ton-miles by commodity, mode, origin, and destination.
- **National Household Travel Survey** – survey of daily and long-distance passenger travel in the United States, 2001.

#### Publications —

- *Transportation Statistics Annual Report 2006*
- *Government Transportation Financial Statistics Report 2003*
- *National Transportation Statistics*
- *State Transportation Statistics*