CHAPTER 3

System Conditions

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Summary

Exhibit 3-1 highlights the key highway and transit statistics discussed in this chapter, and compares them with the values from the last report. The first data column contains the values reported in the 2002 C&P report, based on 2000. Data revisions are shown in the next column.

Exhibit 3-1 *Comparison of System Conditions Statistics with Those in the 2002 C&P Report*

		2000 Data		
Statistic	**Condition**	**2002 C&P Report**	**Revised as of 12/23/04**	**2002 Data**
Total System Pavement	Good (% of miles)	43.5%	43.2%	46.6%
	Acceptable (% of miles)	**86.0%**		**87.4%**
Rural Interstate Pavement	Good (% of miles)	68.5%		71.9%
	Acceptable (% of miles)	**97.8%**		**97.8%**
Small Urban Intestate Pavement	Good (% of miles)	61.6%		64.9%
	Acceptable (% of miles)	**95.8%**	**95.7%**	**95.3%**
Urbanized Interstate Pavement	Good (% of miles)	48.2%		48.7%
	Acceptable (% of miles)	**93.0%**		**91.7%**
National Highway System Pavement	Good (% of miles)	54.6%	54.5%	57.4%
	Acceptable (% of miles)	**93.5%**		**93.7%**
Deficient Bridges		167,566		162,869
Deficient Bridges On Interstates		55,679		55,245
Deficient Bridges On Other Arterials		137,973		140,481
Average Urban Bus Vehicle Condition *		3.07	3.05 **	3.19 **
Average Rail Vehicle Condition*		3.55	3.77 **	3.72 **
Urban Bus Maintenance Facilities	Excellent	9%		7%
	Good	8%		6%
	Adequate	54%		55%
Rail Maintenance Facilities	Excellent	0%		3%
	Good	21%		41%
	Adequate	43%		43%
Rail Maintenance Yards	Excellent	0%		1%
	Good	50%		31%
	Adequate	50%		48%
Rail Stations	Excellent	1%	7%	3%
	Good	33%		22%
	Adequate	50%	17%	18%
Rail Track	Excellent	26%		40%
	Good	45%		34%
	Adequate	12%		12%

* Average Condition. Condtions are rated on ranking of 1 (poor) to 5 (excellent).

** New Condition Classification System.

Highway Conditions

The pavement conditions reported in this chapter include all functional classifications except rural minor collectors and local roads. Pavement conditions are presented for three population groupings: rural (population less than 5,000), small urban (population 5,000 to 50,000), and urbanized (population greater than 50,000). The overall pavement conditions are presented based on the terminology used in the annual Federal Highway Administration (FHWA) Performance Plan and other FHWA reports. Pavement is classified as having either "acceptable" or "not acceptable" ride quality; and, within the "acceptable" category, some pavement is classified as "good." These ratings are derived from one of two measures: International Roughness Index (IRI) or Present Serviceability Rating (PSR). The definitions for IRI and PSR, the relationship between them, and the ride quality ratings are discussed later in the chapter.

In 2002, 87.4 percent of measured road miles had acceptable ride quality, while 85.3 percent of the vehicle miles traveled (VMT) occurred on pavements in acceptable condition. Included within these figures are 46.6 percent of the miles of pavement that met the standard for good condition and 43.8 percent of the VMT that occurred on pavements in good condition. Since 2000, there has been an increase in the percentage of miles in the good category, as well as an increase in the percentage of VMT on pavements in good condition. There also has been an increase in the percentage of miles in acceptable condition, but a slight decrease in the percentage of VMT on pavements in acceptable condition. Pavement conditions on the Interstate System have varied since 2000. The percentage of miles of rural, small urban, and urbanized Interstates with acceptable ride quality decreased by 0.4 percentage points to 96.2 percent between 2000 and 2002, while the percentage of miles with good ride quality increased by 2.7 percentage points to 65.8 percent. The percentages based on VMT show changes in the same direction.

Bridge Conditions

The number of deficient bridges is the most common measure used to evaluate the condition of the Nation's bridges. This measure considers all bridges equivalently. Weighting bridges according to the average daily traffic incorporates traffic demands on the structure. Weighting bridges according to the total deck area includes the size of the structure in the analysis.

These metrics are used to evaluate structural deficiencies and functional obsolescence within the bridge network. Structural deficiencies result from deterioration of conditions and the reductions in load-carrying capacity appraisals. Functional obsolescence results from changing demands on the structure and includes appraisals on clearance adequacy, deck geometry, and alignment.

The number of deficient bridges on our highway system has been steadily declining. Since 1995, the percentage of deficient bridges decreased from 31.4 percent to 27.5 percent. Decreases have been seen on all other functional classes for all different owners. As demonstrated, the progress has occurred primarily due to reducing the percentage of structurally deficient bridges with little overall change in the percentage of functionally obsolete bridges.

Transit Conditions

The Federal Transit Administration (FTA) estimates conditions for transit vehicles, maintenance facilities, yards, stations, track, structures, and power systems using the Transit Economic Requirements Model (TERM) data collected through the National Transit Database (NTD) and special engineering surveys of transit assets. Since the 2002 C&P Report, condition information for approximately 70 percent of the Nation's transit assets has been updated in TERM.

The estimated condition of transit vehicles improved between 2000 and 2002, and the average age of transit vehicles declined. On a scale of 1 (poor) to 5 (excellent), bus vehicles had an average condition of 3.19 in 2002, up from 3.05 in 2000. The improvement in bus vehicle condition reflects a decrease in the average age of the bus vehicle fleet from 6.8 years in 2000 to 6.2 years in 2002. The average condition of the rail fleet increased from 3.38 in 2000 to 3.47 in 2002. The average age of rail vehicles declined from 21.8 years in 2000 to 20.4 years in 2002. Average rail vehicle age and condition are heavily influenced by the average age and condition of heavy rail vehicles, which account for 60 percent of the U.S. fleet. The average condition of commuter rail vehicles has been lowered since the 2002 report, based on engineering surveys that found that commuter rail vehicles deteriorate more rapidly in earlier years than previously estimated.

The average condition of bus and rail maintenance facilities was higher in 2002 than in 2000; however, about one-third of all bus and one-fifth of all rail maintenance facilities are in unacceptable condition. In addition to reflecting actual condition changes, these estimates reflect updated data on asset conditions collected from transit agencies. The average condition of urban bus maintenance facilities (including facilities for vans and demand response vehicles) improved, increasing from 3.23 in 2002 to 3.34 in 2002. In 2002, 55 percent of urban bus maintenance facilities was in adequate condition, 6 percent was in good condition, and 7 percent was in excellent condition, for a combined total of 68 percent in adequate or better condition. The conditions of rail maintenance facilities increased from 3.20 in 2000 to 3.56 in 2002. Eighty percent of all rail maintenance facilities are estimated to be in adequate or better condition and 20 percent in poor or substandard condition. Data collected since the last edition of this report revealed that a much larger percentage of rail facilities than previously estimated was 10 years old or less. In contrast to facilities, the condition of vehicle storage yards has declined. In 2002, 32 percent of all storage yards was estimated to be in good or excellent condition, compared with 50 percent in 2002.

About 46 percent of the nonvehicle data collected from earlier transit asset studies has been updated since the last report. This information revealed that the condition of stations was much worse than previously estimated. The condition of rail stations declined from 3.44 in 2000 to 2.99 in 2002. Nonrail stations are, on average, in better condition than rail stations. From 2000 to 2002, the conditions of track, substations, structures and third rail improved. The conditions of rail yards, overhead wire and stations declined. Changes in the condition of power systems are mixed, depending on the particular asset type. In 2002, power systems were, on average, estimated to be in good condition. These changes in conditions also reflect updated asset information.

Road Conditions

Pavement Terminology and Measurements

Pavement condition affects costs associated with travel, including vehicle operation, delay, and crash expenses. Poor road surfaces cause additional wear and tear on, or even damage to, vehicle suspensions, wheels, and tires. Delay occurs when vehicles slow for potholes or very rough pavement; in heavy traffic, such slowing can create significant queuing and subsequent delay. Inadequate road surfaces may reduce road friction, which affects the stopping ability and maneuverability of vehicles. This, and unexpected changes in surface conditions, may result in crashes.

The pavement condition ratings in this section are derived from one of two measures: the International Roughness Index (IRI) or the Present Serviceability Rating (PSR). The IRI measures the cumulative deviation from a smooth surface in inches per mile. The PSR is a subjective rating system based on a scale of 0 to 5. Prior to 1993, all pavement conditions were evaluated using PSR values. *Exhibit 3-2* contains a description of the PSR system.

Exhibit 3-2 *Present Serviceability Rating (PSR)*

PSR	Description
4.0 - 5.0	Only new (or nearly new) superior pavements are likely to be smooth enough and distress free (sufficiently free of cracks and patches) to qualify for this category. Most pavements constructed or resurfaced during the data year would normally be rated in this category.
3.0 - 4.0	Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any, visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracking and spalls.
2.0 - 3.0	The riding qualities of pavements in this category are noticeably inferior to those of the new pavements and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and extensive patching. Rigid pavements may have a few joint fractures, faulting and/or cracking, and some pumping.
1.0 - 2.0	Pavements have deteriorated to such an extent that they affect the speed of free-flow traffic. Flexible pavement may have large potholes and deep cracks. Distress includes raveling, cracking, and rutting and occurs over 50 percent or more of the surface. Rigid pavement distress includes joint spalling, faulting, patching, cracking, and scaling and may include pumping and faulting.
0.0 - 1.0	Pavements are in extremely deteriorated conditions. The facility is passable only at reduced speed and considerable ride discomfort. Large potholes and deep cracks exist. Distress occurs over 75 percent or more of the surface.

Q. Do other measures of pavement condition exist?

A. Other principal measures of pavement condition or distress such as rutting, cracking, and faulting exist, but are not reported in HPMS. States vary in the inventories of these distress measures for their highway systems. To continue improving our pavement evaluation, FHWA is undertaking an effort to determine which measures are commonly collected by most states. Adding such measures to FHWA's database would enable the agency to account for pavement needs nationwide more accurately.

States are required to report IRI data for the Interstate system, other principal arterials, rural minor arterials, and the National Highway System (NHS) regardless of functional classification. IRI reporting is recommended for all functional classifications. For those sections of rural major collectors for which ride quality data were reported, the use of IRI as the reporting method has decreased from 63.7 percent in 2000 to 62.7 percent in 2002. For every other functional classification for which a ride quality was reported, the percentage of miles for which it was reported in IRI increased between 2000 and 2002. The Federal Highway Association's (FHWA's) *Highway Performance Monitoring System (HPMS) Field Manual* requires rural roadway sample sections that are functionally classified higher than major collectors to have a ride quality reported in IRI. Compliance with this requirement varies from 99.75 percent on the Interstate to 99.47 percent on minor arterials. The *HPMS Field Manual* requires a ride quality of one form or another to be reported for all standard sample sections, including rural major collectors. A similar requirement exists within urban areas where roadway sections functionally classified higher than minor arterials are required to have a ride quality reported in IRI. Compliance in the urban areas varies from 99.10 percent on other freeways and expressways to 93.56 percent on other principal arterials. Reporting of ride quality in IRI drops to 53.91 percent for the urban minor arterials. The urban minor arterials and the rural major collectors classifications have increased their respective percentage of reporting using IRI between 2000 and 2002.

The FHWA adopted the IRI for the higher functional classifications because it is an objective measurement and is generally accepted worldwide as a pavement roughness measurement. The IRI system results in more consistent data for trend analyses and cross jurisdiction comparisons. *Exhibit 3-3* contains a description of qualitative pavement condition terms and corresponding quantitative PSR and IRI values. The translation between PSR and IRI is not exact; IRI values are based on objective measurements of pavement roughness, while PSR is a subjective evaluation of a broader range of pavement characteristics. For example, a given Interstate pavement section could have an IRI rating of 165, but might be rated a 2.4 on the PSR scale. Such a section would be rated as acceptable based on its IRI rating, but would not have been rated as acceptable had PSR been used. Thus, the mileage of any given pavement condition category may differ depending on the rating methodology. The historic pavement ride quality data in this report go back to 1995, while IRI data only began to be collected in 1993.

Exhibit 3-3 *Pavement Condition Criteria*

	All Functional Classifications	
Ride Quality Terms*	**IRI Rating**	**PSR Rating**
Good	< 95	≥ 3.5
Acceptable	≤ 170	≥ 2.5
Not Acceptable	> 170	< 2.5

* The threshold for "Acceptable" ride quality used in the 2004 C&P report is the 170 IRI value as set by the FHWA Performance Plan for the NHS. Some transportation agencies may use less stringent standards for lower functional classification highways to be classified as "Acceptable."

Since the translation between PSR and IRI is imprecise, caution should be used when making comparisons with older data from earlier editions of this report that relied more heavily on PSR data.

Q. What is FHWA's current target for NHS ride quality?

A. *The FHWA Fiscal Year 2005 Performance Plan* includes a goal to have 93.5 percent of all VMT on the NHS to be on pavements with acceptable ride quality. Additional details can be found in Chapter 17.

The *Federal Highway Administration 1998 National Strategic Plan* introduced a new descriptive term for pavement condition: "acceptable ride quality." That plan stated that, by 2008, 93 percent of the NHS mileage should meet pavement standards for "acceptable ride quality," which was defined as having an IRI value less than or equal to 170 inches per mile. This goal was accomplished in 1999. The FHWA subsequently revised this metric to be based on the percentage of vehicle miles traveled (VMT) on NHS pavements with acceptable ride quality. This revised metric places more emphasis on the benefits of ride quality to highway users and presents a more challenging performance target, since in recent years the percentage of VMT on NHS pavements with an IRI of less than or equal to 170 has been lower than the percentage of mileage meeting that standard. In 2002, while 93.7 percent of NHS pavements had an IRI of less than or equal to 170, only 90.6 percent of VMT on the NHS was on pavements with acceptable ride quality. The physical condition of the NHS is discussed in more detail in Chapter 17.

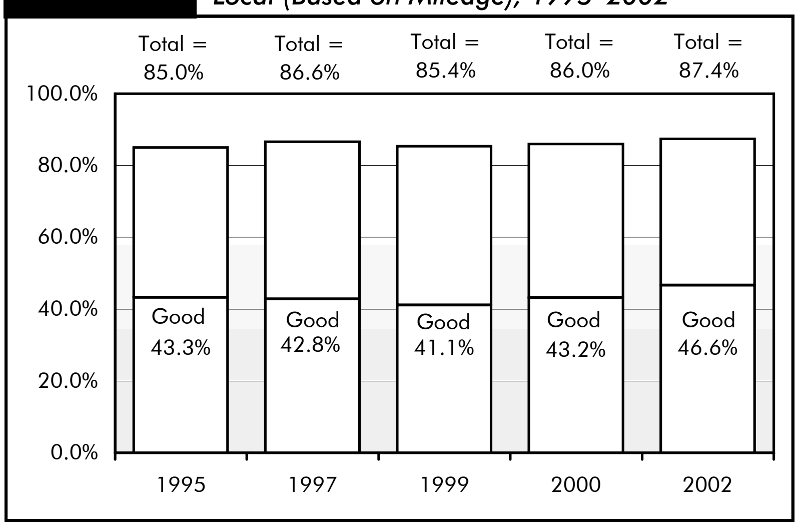
Some previous editions of the annual FHWA Performance plan also included targets for "good ride quality," which represented a subset of acceptable ride quality. For ride quality to be rated as good, it must occur on pavements with an IRI value of less than 95 inches per mile. In this chapter, overall ride quality is presented based on the qualitative condition terms: good, acceptable, and not acceptable.

Previous editions of the C&P report have focused mainly on pavement conditions in terms of mileage. This edition retains exhibits of that nature to maintain continuity, but also adds a number of parallel exhibits based on the percentage of VMT occurring on pavements with acceptable ride quality. This increased emphasis on the impacts of system conditions in highway conditions is intended to make this chapter more consistent with the approaches used in the operational performance and future investment requirement analyses included in Chapters 4 and 7, respectively. This approach is also intended to make this chapter more logically consistent with the revised NHS ride quality metric that has been adopted in the annual FHWA performance plans.

Overall Pavement Condition

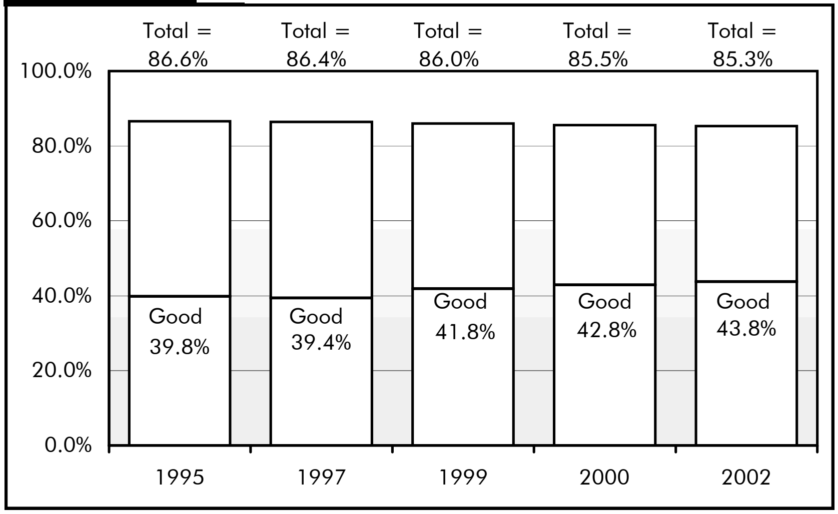
The highway systems covered in this chapter include all mileage except rural minor collectors and local functional classifications. In 2002, 87.4 percent of total road mileage evaluated was rated acceptable including 46.6 percent that met the standard for good [*Exhibit 3-4*], and 85.3 percent of VMT occurred on pavements rated acceptable, including 43.8 percent that occurred on pavements rated as good [*Exhibit 3-5*].

Exhibit 3-4 *Acceptable Pavement, All Functional Systems except Rural Minor Collectors and Local (Based on Mileage), 1995–2002*



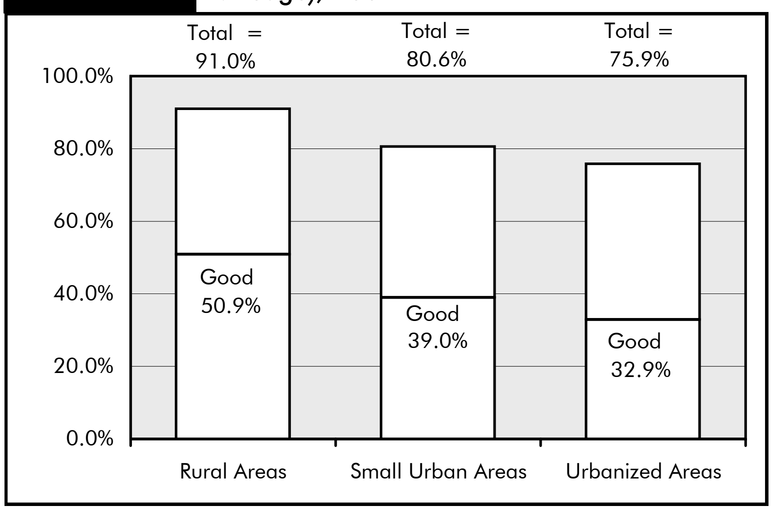
Source: Highway Performance Monitoring System.

Exhibit 3-5 *Acceptable Pavement, All Functional Systems except Rural Minor Collectors and Local (Based on Vehicle Miles Traveled), 1995–2002*



Source: Highway Performance Monitoring System.

Exhibit 3-6 *Acceptable Pavement by Area (Based on Mileage), 2002*



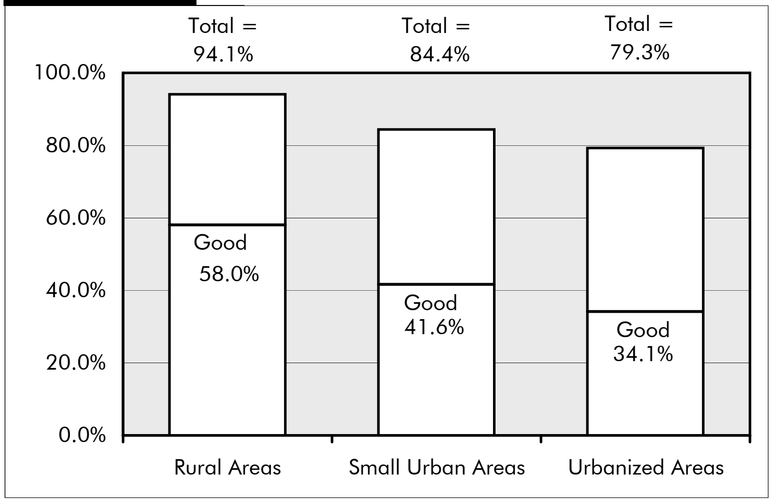
Source: Highway Performance Monitoring System.

Rural and Urban Pavement Conditions

When discussing pavement conditions, it is important to note the different travel characteristics between rural and urban areas. As noted in Chapter 2, rural areas contain 77.3 percent of road miles, but only 39.4 percent of annual VMT. In other words, although rural areas have a larger percentage of road miles, the majority of travel is occurring in urban areas. According to 2002 mileage data, pavement conditions in rural areas are slightly better than those in small urban and urbanized areas. *Exhibit 3-6* shows that 91.0 percent of total road miles in rural areas are rated acceptable, while 80.6 percent of road miles in small urban areas are rated acceptable, and 75.9 percent of the total road miles in urbanized areas are rated acceptable. The percentages shown as acceptable include mileage that also met the more stringent limit to be classified as good, 50.9 percent of rural miles, 39.0 percent of small urban miles, and 32.9 percent of urbanized miles. The rural and small urban percentages have increased in both categories between 2000 and 2002, while the urbanized percentages have decreased. The rural minor collector and local functional system mileages are not included in these percentages since those data are not collected in the HPMS on a universal basis.

According to the 2002 VMT data, ride quality in rural areas is better than in small urban and urbanized areas. *Exhibit 3-7* shows that 94.1 percent of VMT in rural areas is on pavements that are rated acceptable, while 84.4 percent of VMT in small urban areas is on pavements that are rated acceptable, and 79.3 percent of the VMT in urbanized areas is on pavements that are rated acceptable. These percentages also include VMT on pavements that met the more stringent limit to be classified as good, 58.0 percent for rural areas, 41.6 percent for small urban areas, and 34.1 percent for urbanized areas. Note that rural minor collector and local functional system routes also are not included in these percentages, for the same reason as given above.

Exhibit 3-7 *Acceptable Pavement by Area (Based on Vehicle Miles Traveled), 2002*



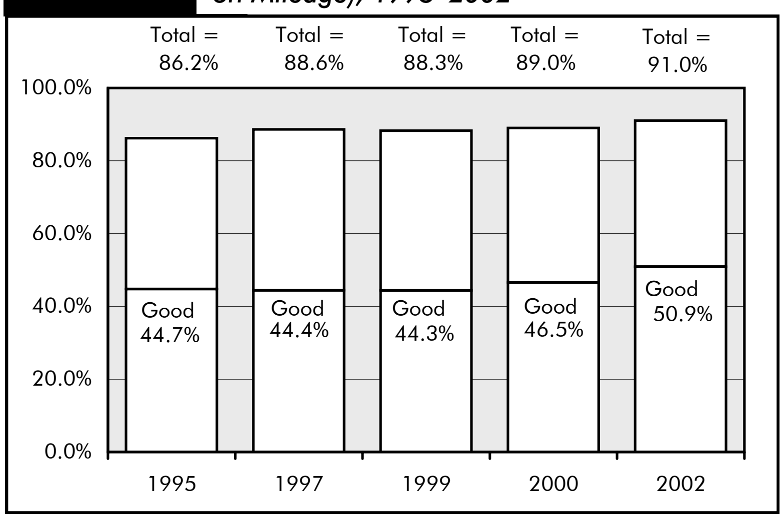
Source: Highway Performance Monitoring System.

Q. How can the percentage of mileage with acceptable pavement shown in Exhibit 3-4 logically be higher than the percentage of VMT on acceptable pavements shown in Exhibit 3-5 for all areas combined, while the opposite is true for rural, small urban and urbanized areas individually?

A. As shown in Exhibits 3-6 and 3-7, the percentage of acceptable pavement based on mileage is lower than the percentage of acceptable pavements based on VMT for rural areas, small urban areas, and urbanized areas. However, these exhibits also show that ride quality in rural areas is significantly better than in urbanized areas on either a mileage or VMT basis. Since a majority of mileage is in rural areas, while a majority of VMT is in urban areas, this means that the condition of rural roads has a much greater impact on a mileage-based measure (such as that shown in Exhibit 3-4) than it does on a VMT-weighted measure (such as that shown in Exhibit 3-5).

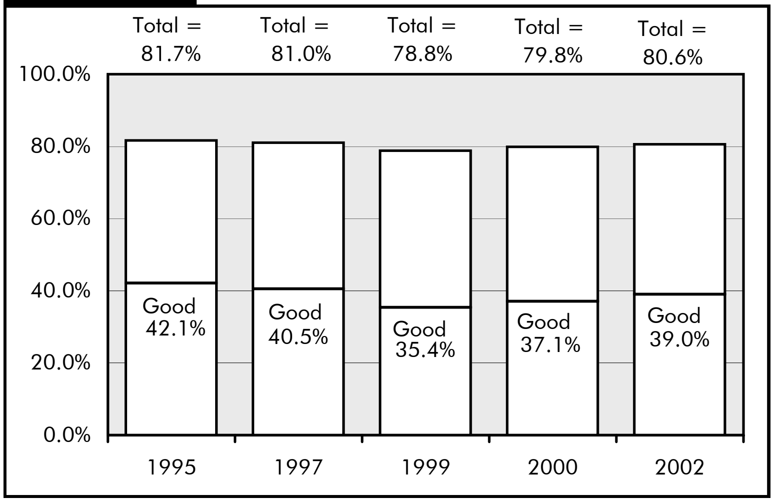
Pavement conditions based on mileage in rural areas have generally been improving over time. Since 1995, the percentage of road miles in acceptable condition has increased from 86.2 percent to 91.0 percent in rural areas [*Exhibit 3-8*]. However, both small urban and urbanized areas have experienced decreases in acceptable pavement miles, from 81.7 percent to 80.6 percent [*Exhibit 3-9*] and from 81.7 percent to 75.9 percent [*Exhibit 3-10*], respectively, between 1995 and 2002. Comparable trends can be observed in the percentage of miles rated as good.

Exhibit 3-8 *Acceptable Rural Area Pavement (Based on Mileage), 1995–2002*



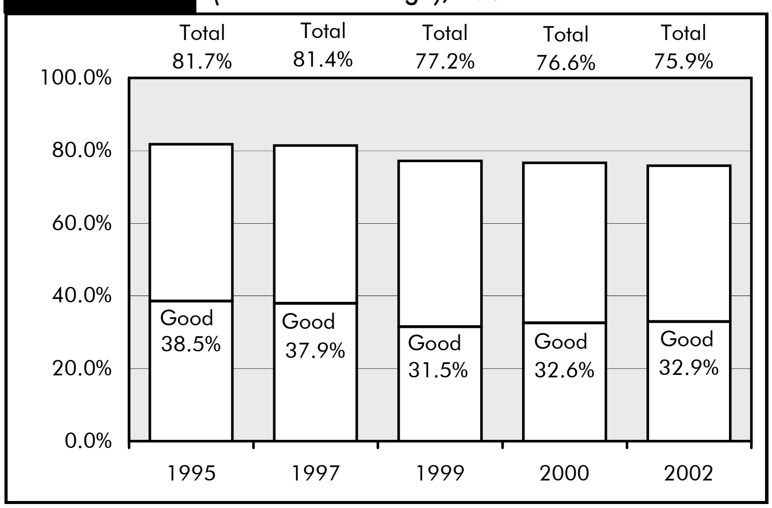
Source: Highway Performance Monitoring System.

Exhibit 3-9 *Acceptable Small Urban Area Pavement (Based on Mileage), 1995–2002*



Source: Highway Performance Monitoring System.

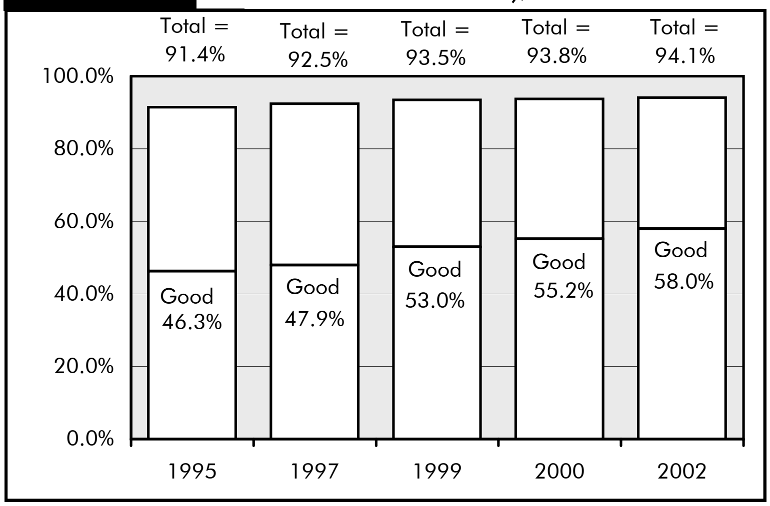
Exhibit 3-10 *Acceptable Urbanized Area Pavement (Based on Mileage), 1995–2002*



Source: Highway Performance Monitoring System.

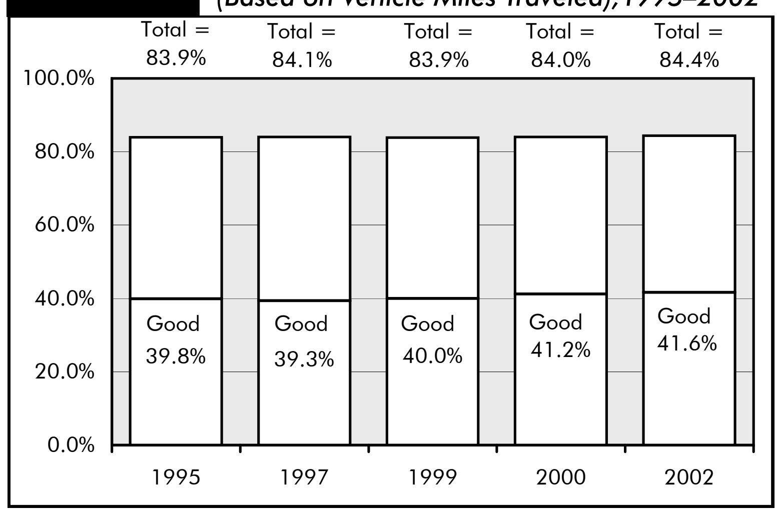
Ride quality based on VMT has followed a similar trend in rural and urbanized areas, and remained somewhat constant in small urban areas. Since 1995, the percentage of VMT on pavements rated in acceptable condition has increased from 91.4 percent to 94.1 percent in rural areas [*Exhibit 3-11*]. The percentage of VMT on pavements rated in acceptable condition in small urban areas has fluctuated from a low of 83.9 percent in 1995 and 1999 to a high of 84.4 percent in 2002 [*Exhibit 3-12*]. The percentage of VMT on pavements rated in acceptable condition has decreased from 83.5 percent to 79.3 percent in urbanized areas [*Exhibit 3-13*]. The percentage of VMT on pavements rated as good in rural areas has increased from 46.3 percent in 1995 to 58.0 percent in 2002. For small urban areas, the percentage increases very slightly over time. For urbanized areas, the percentage fluctuates, with a high of 35.2 percent in 1995 and a low of 34.1 percent in 1999 and 2002.

Exhibit 3-11 *Acceptable Rural Area Pavement (Based on Vehicle Miles Traveled), 1995–2002*



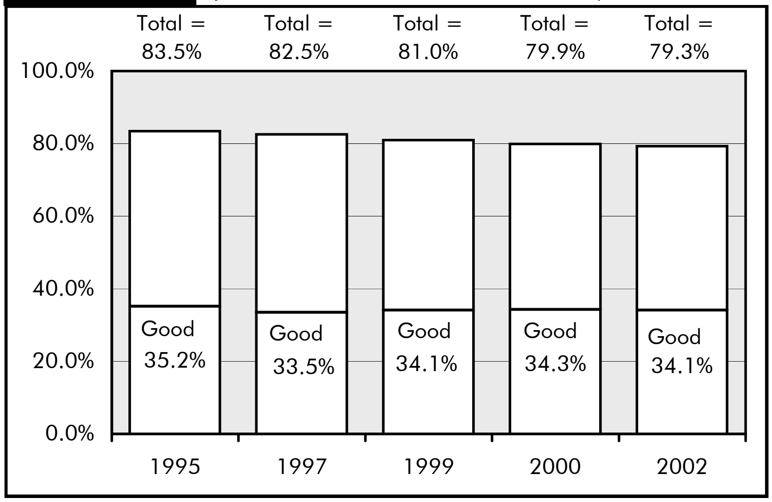
Source: Highway Performance Monitoring System.

Exhibit 3-12 *Acceptable Small Urban Area Pavement (Based on Vehicle Miles Traveled),1995–2002*



Source: Highway Performance Monitoring System.

Exhibit 3-13 *Acceptable Urbanized Area Pavement (Based on Vehicle Miles Traveled), 1995–2002*



Source: Highway Performance Monitoring System.

Pavement Condition by Functional Classification

As stated in Chapter 2, approximately 52.9 percent of the total mileage in the United States is functionally classified as local. Nevertheless, roads classified as Interstate have the largest percentage of VMT per lane mile, followed (in order) by other principal arterials, minor arterials, collectors, and locals. Therefore, improving ride quality on a mile of Interstate route affects more users than improving ride quality on a mile of road on a lower functional classification. Interstate mileage in rural areas is 97.8 percent acceptable. In small urban areas, Interstate mileage is 95.3 percent acceptable. In urbanized areas, Interstate mileage is 91.7 percent acceptable. The equivalent percentages based on VMT are 97.3, 94.6, and 89.3 percent, respectively. Ride quality on pavements rated as good follows the same order. For every functional classification, the same pattern as shown for Interstates is followed for each combination of population area and pavement rating, whether comparing based on mileage or VMT, with the exception that, based on mileage, collector routes in large urban areas are generally rated better than those in small urban areas.

A historical view helps clarify where pavement improvements are occurring and at what rate. *Exhibit 3-14* shows the pavement condition by category, functional classification, and location from 1995 to 2002 based on mileage. The exhibit illustrates that pavement conditions have changed in a variety of ways. For example, since 1995, the percentage of Interstate miles in rural areas classified as acceptable has increased from 94.5 percent to 97.8 percent.

The percentage of Interstate miles in urbanized areas rated as acceptable has increased from 90.0 percent to 91.7 percent. However, during the same time period, the percentage of other principal arterials in urbanized areas listed as acceptable has decreased from 75.9 percent to 67.5 percent.

Exhibit 3-14 *Ride Quality by Functional System (Based on Mileage), 1995–2002*

Functional System	1995	1997	1999	2000	2002
Percent Acceptable					
Rural Interstate	94.5%	95.9%	97.6%	97.8%	97.8%
Rural Other Principal Arterial	91.4%	93.7%	95.4%	96.0%	96.6%
Rural Minor Arterial	85.1%	89.8%	92.0%	92.0%	93.8%
Rural Major Collector	82.5%	84.0%	79.7%	82.1%	85.9%
Small Urban Interstate	94.4%	95.8%	95.4%	95.7%	95.3%
Small Urban Other Freeway & Expressway	90.2%	91.2%	92.8%	93.7%	94.8%
Small Urban Other Principal Arterial	82.0%	80.5%	81.7%	82.9%	83.0%
Small Urban Minor Arterial	82.5%	82.2%	78.1%	80.0%	81.3%
Small Urban Collector	76.4%	75.9%	68.3%	68.9%	70.8%
Urbanized Interstate	90.0%	90.0%	92.2%	93.0%	91.7%
Urbanized Other Freeway & Expressway	87.5%	87.7%	88.8%	88.3%	88.8%
Urbanized Other Principal Arterial	75.9%	73.2%	67.6%	67.7%	67.5%
Urbanized Minor Arterial	82.1%	82.6%	78.5%	78.3%	75.9%
Urbanized Collector	84.4%	86.4%	80.3%	77.4%	77.6%
Percent Good					
Rural Interstate	51.8%	56.9%	65.4%	68.5%	71.9%
Rural Other Principal Arterial	41.0%	47.5%	54.0%	57.4%	60.9%
Rural Minor Arterial	40.7%	45.3%	46.9%	47.7%	50.2%
Rural Major Collector	47.7%	40.1%	32.5%	36.2%	37.1%
Small Urban Interstate	49.8%	51.4%	58.2%	61.6%	64.9%
Small Urban Other Freeway & Expressway	41.2%	35.8%	41.3%	43.8%	49.7%
Small Urban Other Principal Arterial	36.3%	32.6%	33.7%	36.6%	35.4%
Small Urban Minor Arterial	46.8%	45.5%	37.2%	38.1%	42.1%
Small Urban Collector	43.4%	44.4%	29.3%	29.8%	33.1%
Urbanized Interstate	41.3%	39.3%	45.0%	48.2%	48.7%
Urbanized Other Freeway & Expressway	36.8%	31.4%	35.5%	37.9%	39.6%
Urbanized Other Principal Arterial	28.7%	26.6%	23.5%	23.9%	22.7%
Urbanized Minor Arterial	44.8%	45.2%	37.2%	37.6%	37.7%
Urbanized Collector	44.3%	46.6%	30.2%	31.4%	33.4%

Source: Highway Performance Monitoring System.

One consistent trend is the faster rate of pavement condition improvement in rural areas versus small urban and urbanized areas. Since 1995, the percent of total rural road miles classified as acceptable has increased in each of the four functional classes of rural roads. However, for the five functional classes of roads for small urban areas, three functional classifications—Interstate, other freeway and expressway, and other principal arterials—have seen an increase in acceptable road miles, while two functional classes—minor arterials and collectors—have experienced declines in acceptable road miles. For the five functional classes of roads for the urbanized areas, two functional classifications—Interstate and other freeway and expressway—have seen an increase in acceptable road miles, and three functional classes—other principal arterials, minor arterials, and collectors—have experienced declines in acceptable road miles.

Exhibit 3-15 shows the equivalent pavement condition by category, functional classification, and location from 1995 to 2002 based on VMT. The exhibit illustrates that pavement conditions based on VMT have generally mirrored those based on mileage. For example, since 1995, the percentage of Interstate VMT in rural areas on pavements classified as acceptable has increased from 94.5 percent to 97.3 percent.

Exhibit 3-15 *Ride Quality by Functional System (Based on Vehicle Miles Traveled), 1995–2002*

Functional System	1995	1997	1999	2000	2002
Percent Acceptable					
Rural Interstate	94.5%	95.7%	97.4%	97.4%	97.3%
Rural Principal Arterial	92.9%	93.8%	95.5%	96.0%	96.2%
Rural Minor Arterial	91.2%	92.1%	93.2%	93.1%	93.8%
Rural Major Collector	86.4%	87.3%	86.1%	86.9%	87.6%
Small Urban Interstate	94.9%	96.1%	95.9%	95.3%	94.6%
Small Urban Other Freeway & Expressway	91.1%	92.6%	93.0%	94.4%	95.3%
Small Urban Other Principal Arterial	82.1%	80.6%	82.2%	83.3%	83.8%
Small Urban Minor Arterial	82.4%	84.0%	81.8%	81.7%	82.1%
Small Urban Collector	78.8%	78.7%	76.6%	74.3%	74.9%
Urbanized Interstate	88.8%	88.1%	90.4%	91.0%	89.3%
Urbanized Other Freeway & Expressway	87.8%	86.9%	87.6%	86.8%	87.4%
Urbanized Other Principal Arterial	76.4%	73.3%	68.3%	68.8%	68.8%
Urbanized Minor Arterial	83.4%	83.3%	80.2%	75.7%	75.4%
Urbanized Collector	82.1%	84.4%	80.1%	76.4%	74.5%
Percent Good					
Rural Interstate	53.3%	56.5%	66.8%	69.6%	72.2%
Rural Principal Arterial	43.6%	47.0%	54.3%	56.8%	60.2%
Rural Minor Arterial	42.8%	43.8%	47.2%	48.9%	51.0%
Rural Major Collector	43.9%	41.9%	38.6%	39.9%	42.4%
Small Urban Interstate	51.4%	52.9%	59.8%	62.5%	65.1%
Small Urban Other Freeway & Expressway	42.9%	38.2%	39.8%	41.6%	48.1%
Small Urban Other Principal Arterial	36.0%	32.9%	35.0%	38.0%	37.0%
Small Urban Minor Arterial	41.1%	43.6%	39.2%	38.2%	38.5%
Small Urban Collector	35.8%	36.6%	36.0%	34.1%	32.8%
Urbanized Interstate	39.1%	35.4%	39.7%	42.5%	43.8%
Urbanized Other Freeway & Expressway	34.1%	27.4%	31.3%	31.9%	32.8%
Urbanized Other Principal Arterial	27.3%	26.1%	24.2%	25.0%	23.8%
Urbanized Minor Arterial	39.9%	40.8%	37.8%	33.9%	33.4%
Urbanized Collector	35.8%	39.8%	39.9%	38.5%	35.9%

Source: Highway Performance Monitoring System.

Again, a consistent trend is the faster rate of pavement condition improvement in rural areas versus small urban and urbanized areas. Since 1995, the percent of total rural road VMT on pavements classified as acceptable has increased in each of the four functional classes of rural roads. However, for the five functional classes of roads for small urban areas, only two functional classifications—other freeway and expressway, and other principal arterials—have seen an increase in VMT on pavements rated as acceptable, while the other three functional classes—Interstate, minor arterials, and collectors—have experienced declines. For the five functional classes of roads for the urbanized areas, only one functional classification—Interstate— has seen an increase in VMT on pavements rated as acceptable, while the other four functional classes—other freeway and expressway, other principal arterials, minor arterials, and collectors—have experienced declines.

Since the statistics based on VMT track reasonably well with those based on mileage and since the FHWA has chosen to use the former as its measure of effectiveness for performance planning, future editions of this report are likely to scale back on the use of mileage-based statistics in favor of VMT-based statistics.

Roadway Alignment

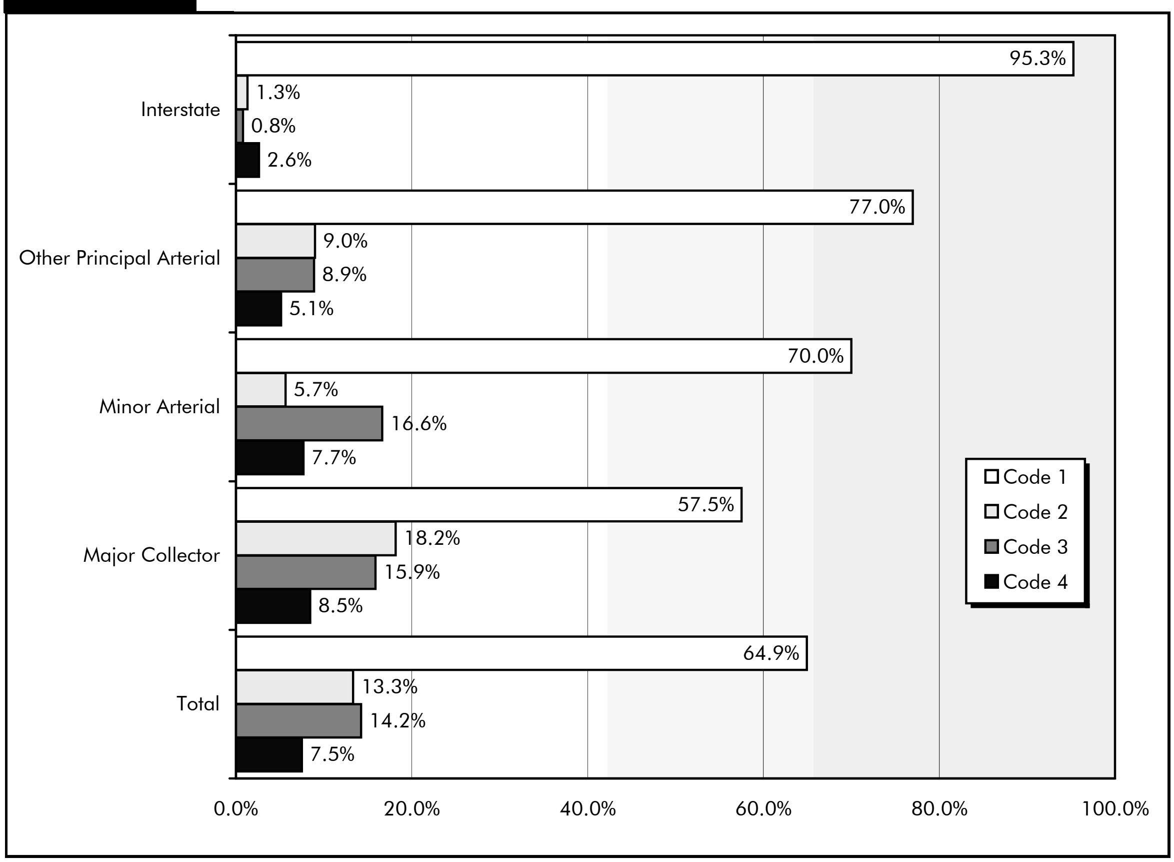
Alignment adequacy affects the level of service and safety of the highway system. There are two types of alignment: horizontal (curves) and vertical (grades). Inadequate alignment may result in speed reductions and impaired sight distance. In particular, excessive grades and/or curves may significantly affect the speeds at which trucks can safely operate. Alignment adequacy is evaluated on a scale from Code 1 (best) to Code 4 (worst). *Exhibit 3-16* explains the alignment rating system.

Exhibit 3-16 *Alignment Rating*

Rating	Description
Code 1	All curves and grades meet appropriate design standards.
Code 2	Some curves or grades are below design standards for new construction, but curves can be negotiated safely at prevailing speed limits. Truck speed is not substantially affected.
Code 3	Infrequent curves or grades occur that impair sight distance or severely affect truck speeds. May have reduced speed limits.
Code 4	Frequent grades occur that impair sight distance or severely affect truck speeds. Generally, curves are unsafe or uncomfortable at prevailing speed limit, or the speed limit is severely restricted due to the design speed limits of the curves.

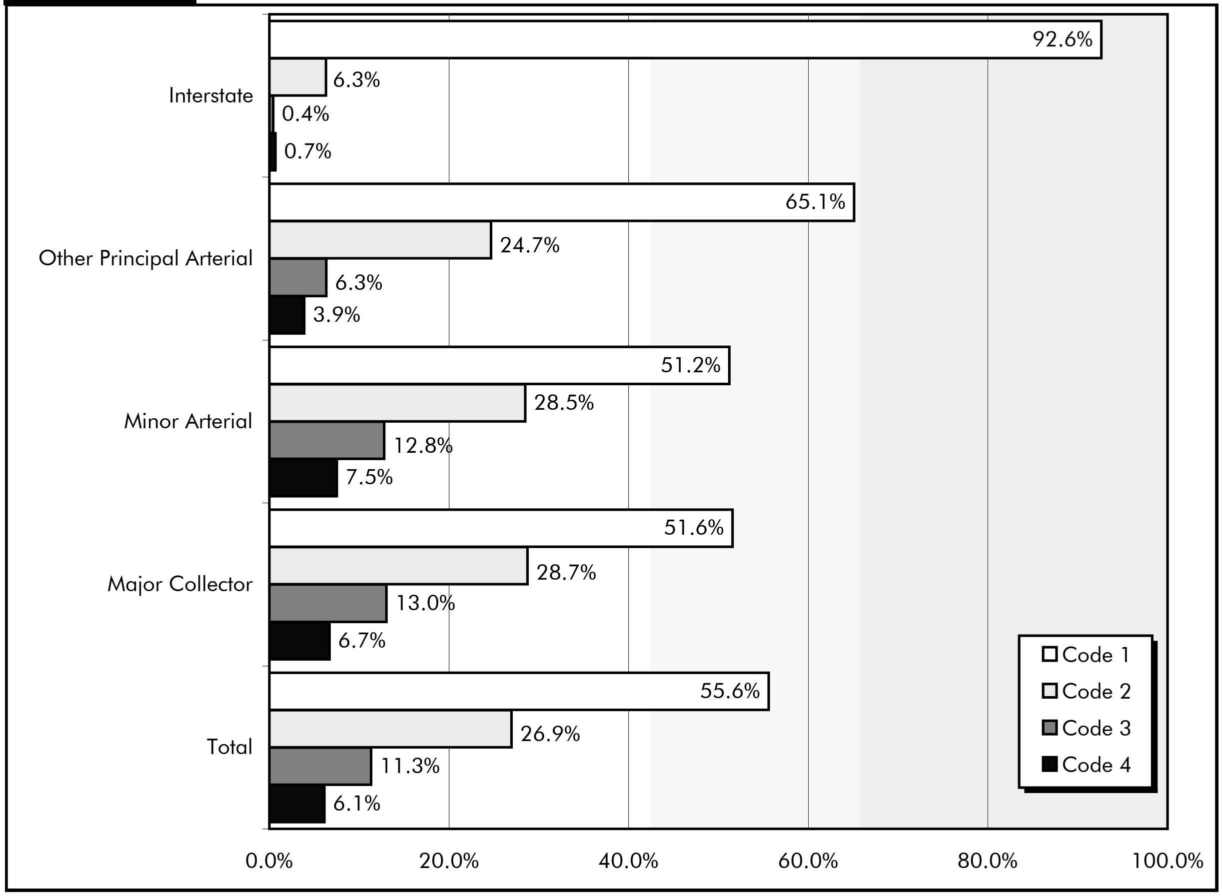
Adequate alignment is more important on roads with higher travel speeds and/or higher volumes (e.g., Interstates). Alignment is normally not an issue in urban areas; therefore, this section presents only rural data. *Exhibits 3-17* and *3-18* illustrate that 95.3 percent of rural Interstate miles are classified as Code 1 for horizontal alignment and 92.6 percent are classified as Code 1 for vertical alignment. The share of rural roads classified as Code 4 for horizontal alignment is 7.5 percent. For vertical alignment, 6.1 percent are rated Code 4. Roadway alignment continues to improve gradually as sections with poor alignment are reconstructed.

Exhibit 3-17 *Rural Horizontal Alignment Adequacy, 2002*



Source: Highway Performance Monitoring System.

Exhibit 3-18 *Rural Vertical Alignment Adequacy, 2002*



Source: Highway Performance Monitoring System.

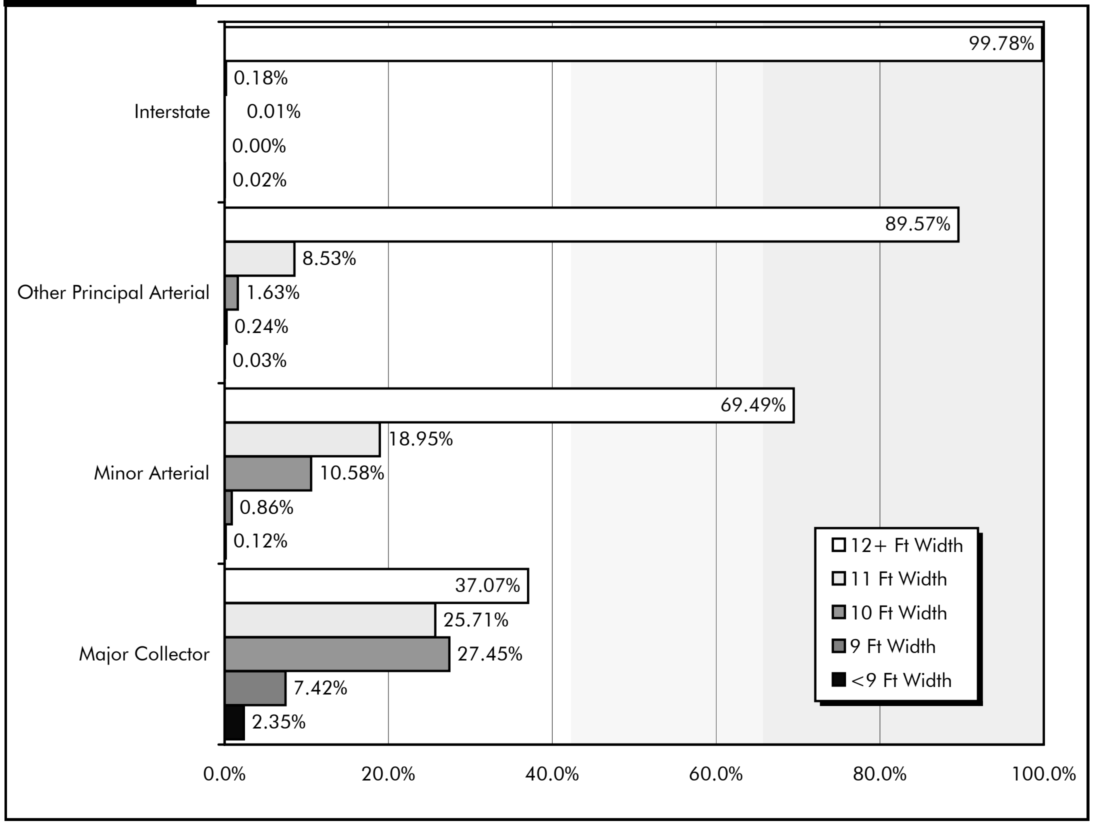
Lane Width

Lane width affects capacity and safety; narrow lanes prevent a road from operating at capacity. As with roadway alignment, lane width is more crucial on those functional classifications with higher travel volumes.

Currently, high-type facilities (e.g., Interstates) are expected to have 12-foot lanes. *Exhibits 3-19* and *3-20* illustrate that almost the entire Interstate System meets the 12-foot standard (less than one-quarter of 1 percent of the rural Interstate and only 1.5 percent of the urban Interstate do not). The percentage of miles with 12-foot-plus lane widths is lower on lower-type facilities that carry less traffic. Lanes that are less than 9 feet wide are mainly concentrated on the collector roads.

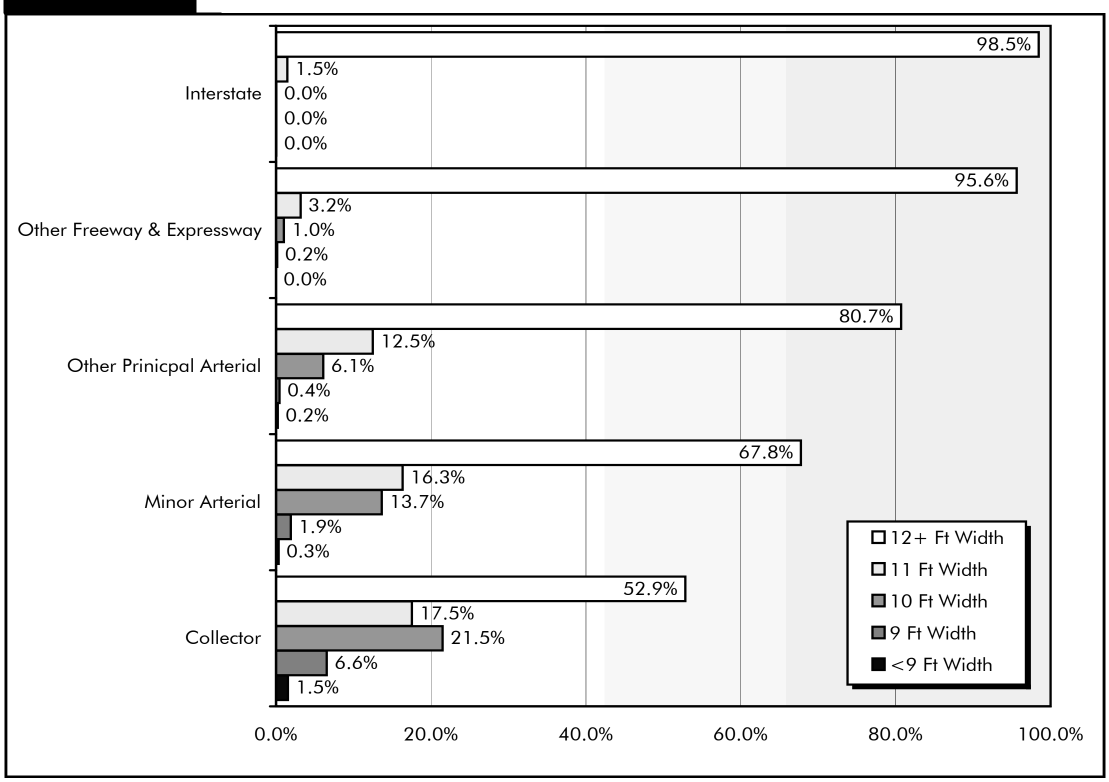
Lanes have been widened over time through new construction, reconstruction, and widening projects. Total rural mileage with lane width greater than or equal to 12 feet increased from 51.6 percent in 1993 to 53.8 percent in 2002. The urban mileage with 12-foot-plus lanes has fluctuated; but, in 2002, it was up to 67.9 percent from a low of 66.6 percent in 1995. Part of the reason for the urban fluctuation may be the reclassification of roads from rural to urban from time to time as a result of population growth [*Exhibit 3-21*].

Exhibit 3-19 *Rural Lane Width by Functional System, 2002*



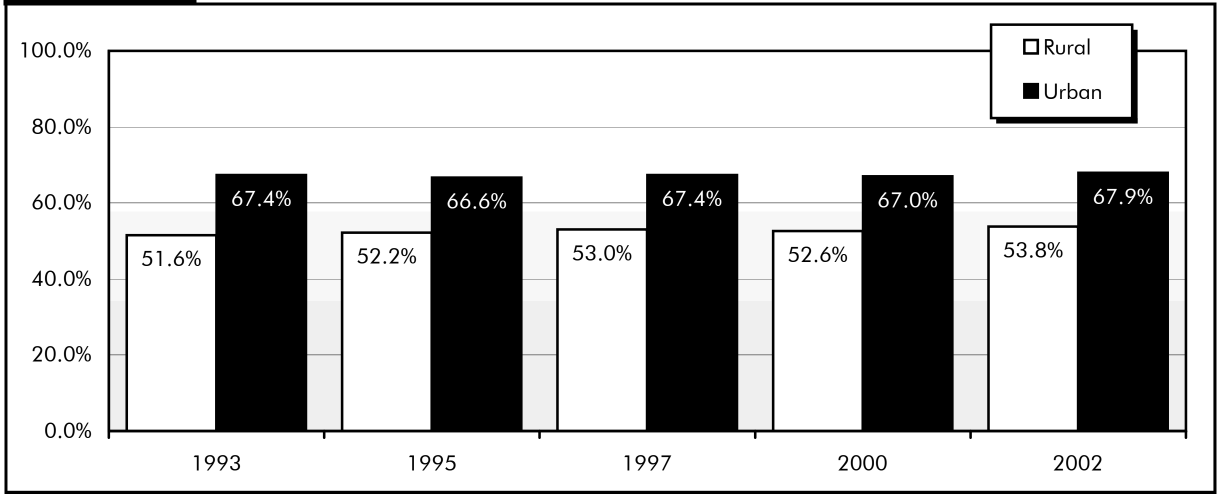
Source: Highway Performance Monitoring System.

Exhibit 3-20 *Small Urban and Urbanized Lane Width by Functional System, 2002*



Source: Highway Performance Monitoring System.

Exhibit 3-21 *Percentage of Roadways with 12+ Foot Lane Width, 1993–2002*



Source: Highway Performance Monitoring System.

Bridge System Conditions

The National Bridge Inspection Standards (NBIS), in place since the early 1970s, requires biennial safety inspections for bridges in excess of 6.1 meters in total length located on public roads. Information is collected documenting the conditions and composition of the structures. Baseline composition information is collected describing the functional characteristics, descriptions and location information, geometric data, ownership and maintenance responsibilities, etc. This information permits characterization of the system of bridges on a national level and permits analysis on the composition of the bridges. Safety, the primary purpose of the program, is ensured through periodic hands-on inspections and rating of the primary components of the bridge, such as the deck, superstructure, and substructure. This composition and condition information is maintained in the National Bridge Inventory (NBI) database maintained by FHWA. This database represents the most comprehensive source of information on bridges throughout the United States.

Q. How often are the bridges inspected?

A. Most bridges in the US Highway Bridge inventory are inspected once every two years. These inspections are performed by qualified inspectors. Where structures have advanced deterioration or other conditions warranting closer monitoring, inspections can be performed more frequently. Certain types of structures in very good condition may receive an exemption from the two-year inspection cycle. Inspections can be performed on these structures once every 4 years. Qualification for this extended inspection cycle is reevaluated depending on the conditions of the bridge. Eighty three percent (490,000 bridges) are inspected once every 2 years, twelve percent (71,000 bridges) are inspected annually, and five percent (28,000 bridges) are inspected on a 4-year cycle.

Classification of Bridge Deficiencies

From the information collected through the inspection process, assessments are performed to determine the adequacy of the structure to service the current demands for structural and functional purposes. Factors considered include the load-carrying capacity, clearances, waterway adequacy, and approach roadway alignment. Structural assessments together with condition ratings determine whether a bridge should be classified as **structurally deficient.** Functional adequacy is assessed by comparing the existing geometric configurations to current standards and demands. Disparities between the actual and desired configurations are used to determine whether a bridge should be classified as **functionally obsolete.** Structural deficiencies take precedence in the classification of deficiencies, so that a bridge suffering from a structural deficiency and functional obsolescence would be classified as structurally deficient.

Condition Rating Structural Deficiencies

The primary considerations in classifying structural deficiencies are the bridge component condition ratings. The NBI database contains ratings on the three primary components of a bridge: the deck, superstructure, and substructure. A bridge deck is the primary surface used for transportation. The deck is supported by the superstructure. This transfers the load of the deck and the traffic carried to the supports. Within the superstructure are the girders, stringers, and other structural elements. The substructure is the foundation of the bridge and transfers the loads of the structure to the ground. The superstructure is supported by the substructure elements, such as the abutments and piers.

Condition ratings are assigned for these primary components during periodic safety inspections. Condition ratings are also assigned for the channel and channel protective systems and for culvert designs. These structures do not have distinct deck, superstructure, or substructure elements. The ratings do not translate directly into an overall rating of a bridge's condition, but are good indicators of the quality of specific components. Condition ratings are either assigned directly by the bridge inspector or translated from more detailed element-level models employed in bridge management systems, such as Pontis, using the FHWA-provided translator.

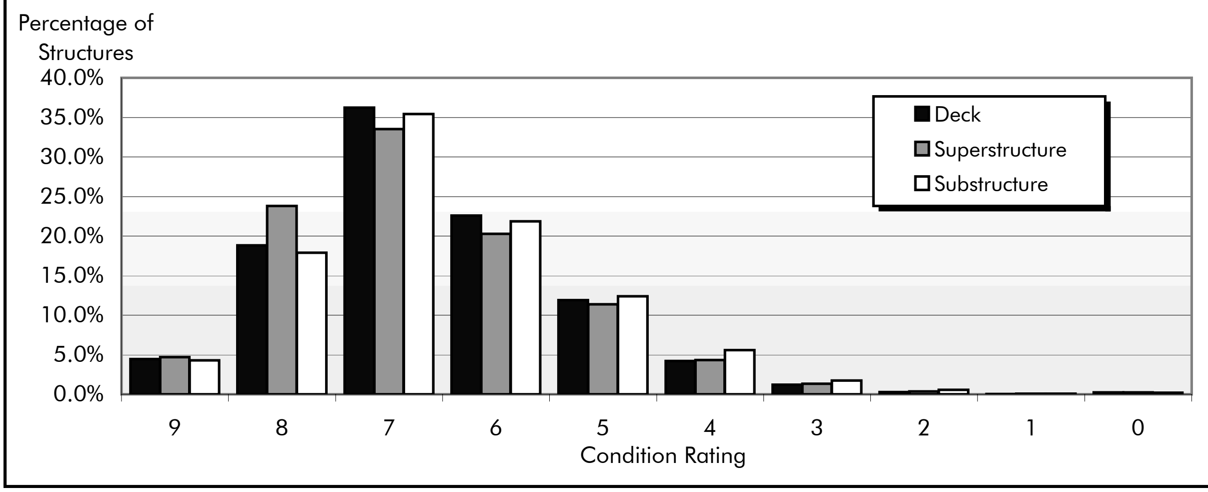
Condition ratings are used to describe the existing, in-place status of a component and not its as-built state. Rather, the existing condition is compared with an as-new condition. Bridge inspectors assign condition ratings by evaluating the severity of the deterioration or disrepair and the extent it has spread through the component being rated. They provide an overall characterization of the general condition of the entire component being rated and not an indication of localized conditions. *Exhibit 3-22* describes the bridge condition ratings in more detail.

Exhibit 3-22 *Bridge Condition Rating Categories*

Rating	Condition Category	Description
9	Excellent	
8	Very Good	
7	Good	No problems noted.
6	Satisfactory	Some minor problems.
5	Fair	All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	Poor	Advanced section loss, deterioration, spalling, or scour.
3	Serious	Loss of section, deterioration, spalling, or scour have seriously affected the primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may be removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
1	Imminent Failure	Major deterioration or section loss present in critical structural components, or obvious loss present in critical structural components, or obvious vertical or horizontal movement affecting structural stability. Bridge is closed to traffic, but corrective action may put back in light service.
0	Failed	Out of service; beyond corrective action.

Condition rating distributions are shown in *Exhibit 3-23* for the deck, superstructure, and substructure. Condition ratings of 4 and below indicate poor or worse conditions and result in structural deficiencies. Approximately 7 percent of all bridge decks are deficient based on condition rating, and 7 percent of all superstructures and 9% of all substructures are deficient. These classifications are not mutually exclusive, and an individual structure may have one or more than one deficient component.

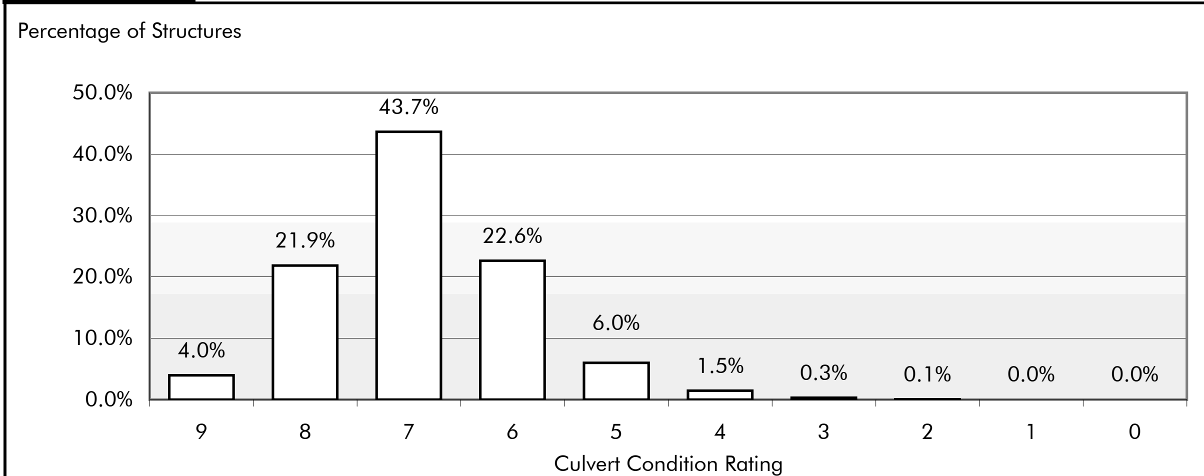
Exhibit 3-23 *Bridge Condition Ratings, 2002*



Source: National Bridge Inventory.

There are 118,394 culverts in the bridge inventory. These structures do not have a deck, superstructure, or substructure, but rather are self-contained units under roadway fill. Culverts are typically constructed of concrete or corrugated steel. Multiple pipes or boxes placed side-by-side are considered given that together they span a total length in excess of 6.1 meters and carry a public roadway. As these structures lack decks, superstructures, and substructures, individual ratings are provided to indicate the condition of the culvert as a whole. The distribution of culvert condition ratings is shown in *Exhibit 3-24*. Of all 118,394 culverts in the inventory, approximately 2 percent are classified as structurally deficient based on condition ratings less than or equal to 4 (poor conditions).

Exhibit 3-24 *Culvert Condition Ratings, 2002*



Source: National Bridge Inventory.

Structural Appraisal Ratings

Condition ratings are the primary criteria used in the classification of structural deficiencies; 80 percent of all structurally deficient bridges have condition rating deficiencies in their decks, superstructures, substructures, or culvert ratings. The remaining 20 percent of structural deficiencies are classified based on inadequate structural appraisal ratings and/or inadequate waterway adequacy ratings. These appraisal ratings evaluate a bridge in relation to the level of service it provides on the highway system on which it is located. The appraisal ratings compare the existing conditions with the current standards used for highway bridge design. *Exhibit 3-25* describes appraisal rating codes in more detail.

Exhibit 3-25 *Bridge Appraisal Rating Categories*

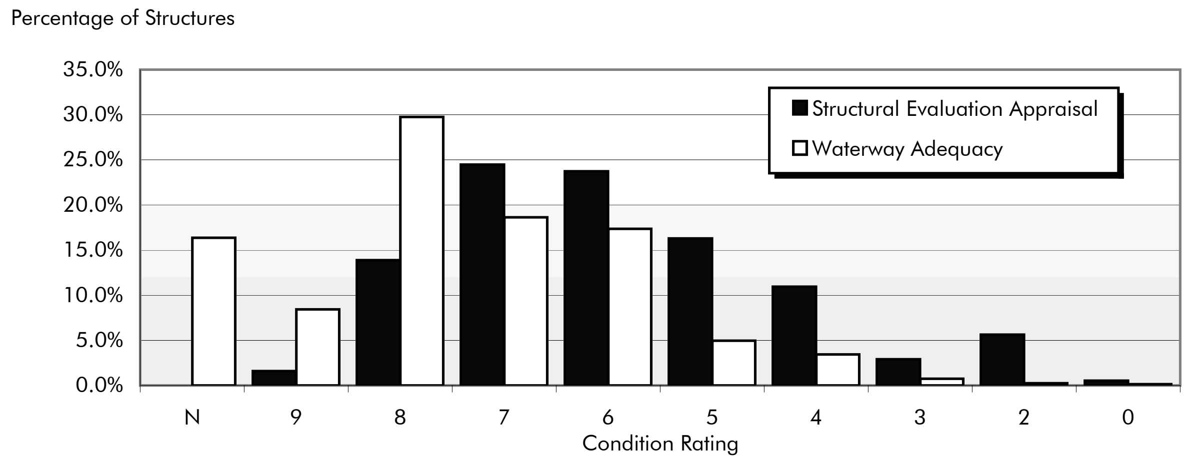
Rating	Description
N	Not applicable.
9	Superior to present desirable criteria.
8	Equal to present desirable criteria.
7	Better than present minimum criteria.
6	Equal to present minimum criteria.
5	Somewhat better than minimum adequacy to tolerate being left in place as is.
4	Meets minimum tolerable limits to be left in place as is.
3	Basically intolerable requiring a high priority of corrective action.
2	Basically intolerable requiring a high priority of replacement.
1	This value of rating code is not used.
0	Bridge closed.

Load-carrying capacity does not influence the assignment of the condition ratings, but it does factor into the structural evaluation appraisal rating. This is calculated according to the capacity ratings for various categories of traffic in terms of average daily traffic (ADT). A rating of 2 or less indicates the carrying capacity is too low and the structure should be replaced. In this case, the bridge is classified as structurally deficient.

The waterway adequacy appraisal rating assesses the opening of the structure with respect to the passage of flow through the bridge. This factor, which considers the potential for overtopping of the structure during a flood event and the potential inconvenience to the traveling public, is assigned based on criteria assigned by functional classification. Waterway adequacy appraisal ratings of 2 or less categorize a bridge as structurally deficient.

The distribution of structural evaluation appraisal and waterway adequacy ratings is shown in *Exhibit 3-26.* Roughly 6 percent of bridges are structurally deficient based on inadequate structural evaluation appraisal ratings, indicating the existing deficiencies require replacement of the structure. Waterway adequacy impacts a much smaller percentage of structures, with 0.3 percent of the bridges in the network classified as structurally deficient resulting from ratings of 2 or below.

Exhibit 3-26 *Structural Evaluation/Waterway Adequacy Ratings, 2002*



Source: National Bridge Inventory.

Appraisal Rating Functional Obsolescence

The primary considerations for functional obsolescence focus on functional- and geometric-based appraisal ratings. Ratings considered are the deck geometry appraisal rating, the underclearance appraisal rating, and/or the approach roadway alignment appraisal rating. For each of these appraisals, ratings are assigned based on the descriptions provided in Exhibit 3-25.

Deck geometry ratings consider the width of the bridge, the ADT, the number of lanes carried by the structure, whether two-way or one-way traffic is serviced, and functional classifications. The minimum desired width for the roadways is compared with the actual widths and used as a basis for appraisal rating assignment. Minimum vertical clearances are also considered by functional classification. Underclearance appraisals consider both the vertical and horizontal underclearances as measured from the through roadway to the nearest bridge component. The functional classification, federal-aid designation, and defense categorization are all considered for the underpassing route. Approach alignment ratings differ from the deck geometry and underclearance appraisal rating philosophy. Instead of comparing the approach

Q. How does a bridge become functionally obsolete?

A. 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.

alignment with current standards, the alignment of the approach roadway is compared with the alignment of the bridge spans. Deficiencies are identified where the bridge route does not function adequately because of alignment disparities.

The structural evaluation appraisal ratings, as mentioned, are used as a factor for determining whether a bridge has a structural deficiency. Descriptions of the ratings are given in Exhibit 3-25. A rating of 3 indicates the load-carrying capacity is too low; however, the situation can be mitigated through corrective action. In this case, the bridge is classified as functionally obsolete. Likewise, waterway adequacy appraisal ratings of 3 result in functional obsolescence. Ratings of 2 or below for either the structural evaluation or waterway adequacy appraisals result in structural deficiencies as these ratings typically are not correctable without replacement.

The distribution of structural evaluation appraisal and waterway adequacy ratings is shown in Exhibit 3-26. Approximately 3 percent of bridges are classified as functionally obsolete based on structural evaluation appraisal ratings. Waterway adequacy impacts a much smaller percentage of structures, with 0.7 percent of bridges classified as functionally obsolete resulting from a rating of 3, indicating corrective actions are required to mitigate the inadequate waterway capacities.

Functional obsolescence occurs primarily because of the deck geometry, underclearance, and approach alignment appraisals. Distributions of the number of structures classified as functionally obsolete by appraisal ratings are given for these factors in *Exhibit 3-27.*

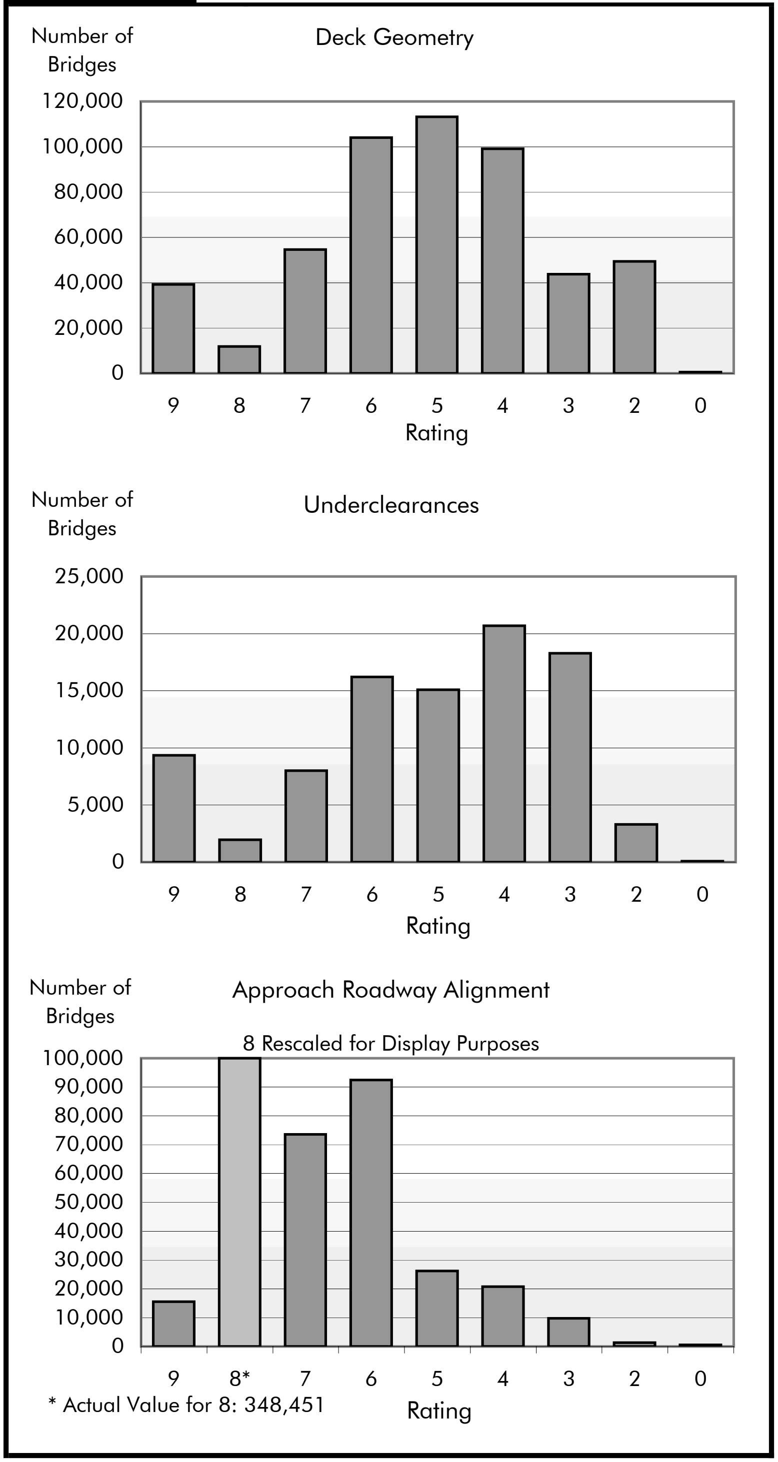
Number of Deficient Bridges

The most commonly cited indicator of bridge condition is the number of deficient bridges. Of the 591,707 bridges in the inventory, 162,869 are classified as deficient (27.5 percent), either for structural or functional causes. Of these, 81,304 are classified as structurally deficient and 81,565 are classified as functionally obsolete. Thus, roughly half of the deficiencies are structural and half are functional.

Exhibit 3-28 shows the trend of deficiency percentages from 1994 through 2002. Bridge deficiencies have been reduced primarily through reduction in the numbers of structurally deficient bridges. The percentage of functionally obsolete bridges has remained static over this time period.

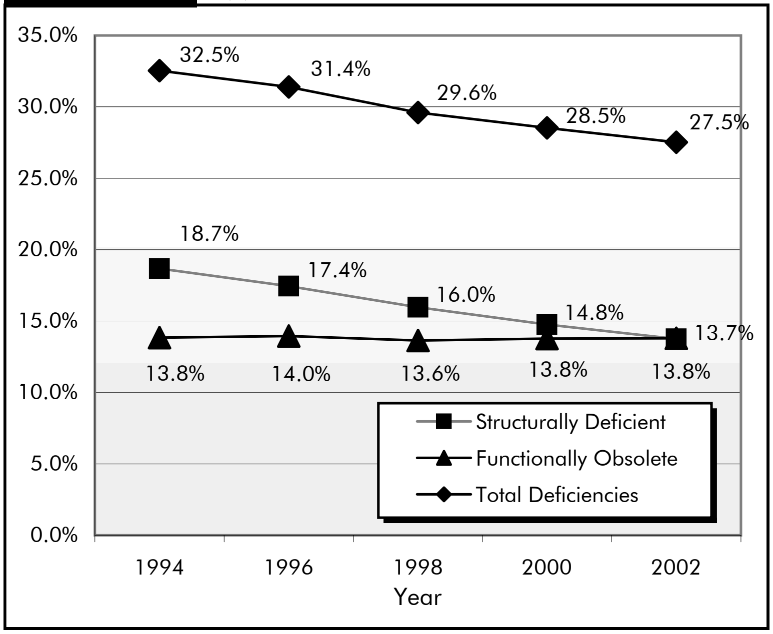
As indicated earlier, structural deficiencies and functional obsolescence are considered mutually exclusive, with structural deficiencies taking precedence where ratings classify a given bridge as both structurally deficient and functionally obsolete. Roughly half of the 81,304 structurally deficient bridges have no functional obsolescence issues and are deficient solely on the basis of structural safety and deteriorated bridge component conditions. The remaining structurally deficient bridges also have some type of functional obsolescence.

Exhibit 3-27 *Functional Obsolescence: Deck Geometry, Underclearance, and Approach Alignment Ratings, 2002*



Source: National Bridge Inventory.

Exhibit 3-28 *Bridge Deficiency Percentages, 1994–2002*



Source: National Bridge Inventory.

Deficient Bridges by Owner

Bridge deficiencies by ownership are examined in *Exhibit 3-29.* For Federally owned bridges, the number of bridges classified as functionally obsolete outweighs the number classified as structurally deficient by a 2 to 1 ratio. Similar percentages are seen for State-owned bridges. These bridges constitute a much more significant proportion of the overall inventory of structures, since State agencies own 47 percent of all bridges. Locally owned and private bridges have opposite trends, with the number of structurally deficient bridges outweighing the number of functionally obsolete bridges. These percentages have not changed significantly from those reported in the 2002 edition of the C&P report, based on year 2000 data.

Exhibit 3-29 *Bridge Deficiencies by Owner, 2002*

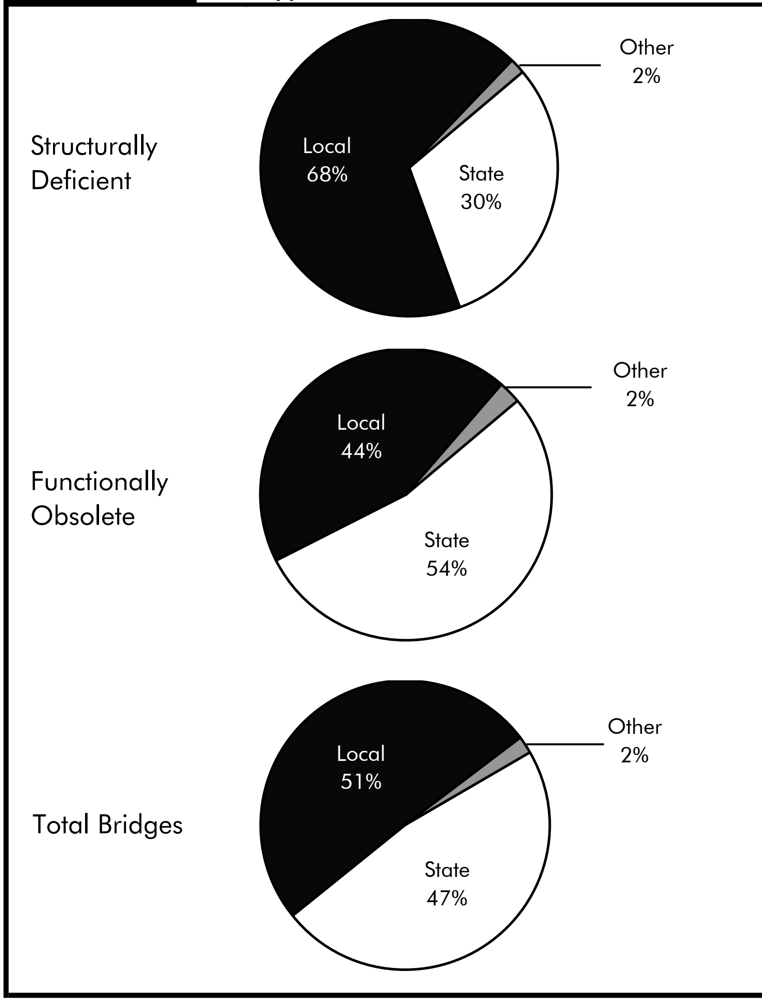
	Owner				
	Federal	State	Local	Private/Other	Total
Numbers					
Total Bridges	9,371	280,266	299,354	2,716	591,707
Total Deficient	2,216	68,472	90,981	1,200	162,869
Structurally Deficient	748	24,736	55,147	673	81,304
Functionally Obsolete	1,468	43,736	35,834	527	81,565
Percentages					
% of Total Inventory for Owner	2%	47%	51%	0%	100.0%
% Deficient	24%	24%	30%	44%	27.5%
% Structurally Deficient	8%	9%	18%	25%	13.7%
% Functionally Obsolete	16%	16%	12%	19%	13.8%

Source: National Bridge Inventory.

Examination of ownership percentages for structurally deficient and functionally obsolete bridges reveals the majority of structurally deficient bridges are owned by local agencies, while the majority of functionally obsolete bridges are owned by State agencies. These percentages can be contrasted with the ownership percentages for all bridges in *Exhibit 3-30.* The percentages are dominated by State and local ownership, with only small percentages of the total population of all structures attributable to Federal, private, and other owners.

As indicated earlier, the most commonly used criteria for measuring bridge deficiencies is the actual number of deficient structures. However, there are alternative measures available, such as accounting for traffic by weighting structures according to ADT or accounting for size of structures by weighting according to the bridge deck area. Deficiencies for all structures, regardless of owner, are compared using these alternative performance measures in *Exhibit 3-31.* Deficiency percentages using these alternative performance measures are compared for Federal, State, local, and other owners in *Exhibit 3-32.*

Exhibit 3-30 ***Bridge Deficiencies by Owner and Type, 2002***

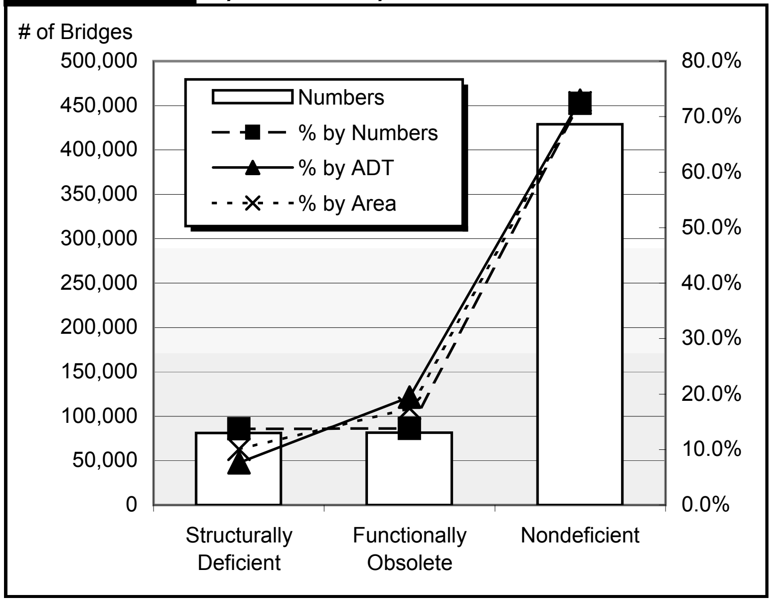


Source: National Bridge Inventory.

Q. What bridge deficiency criteria is used in the annual FHWA performance plan?

A. The *FHWA Fiscal Year 2005 Performance Plan* includes targets for the deck area on deficient bridges for NHS and non-NHS bridges. These measures are discussed in Chapter 17.

Exhibit 3-31 *Bridge Deficiencies by Numbers, by ADT, and by Deck Area*



Source: National Bridge Inventory.

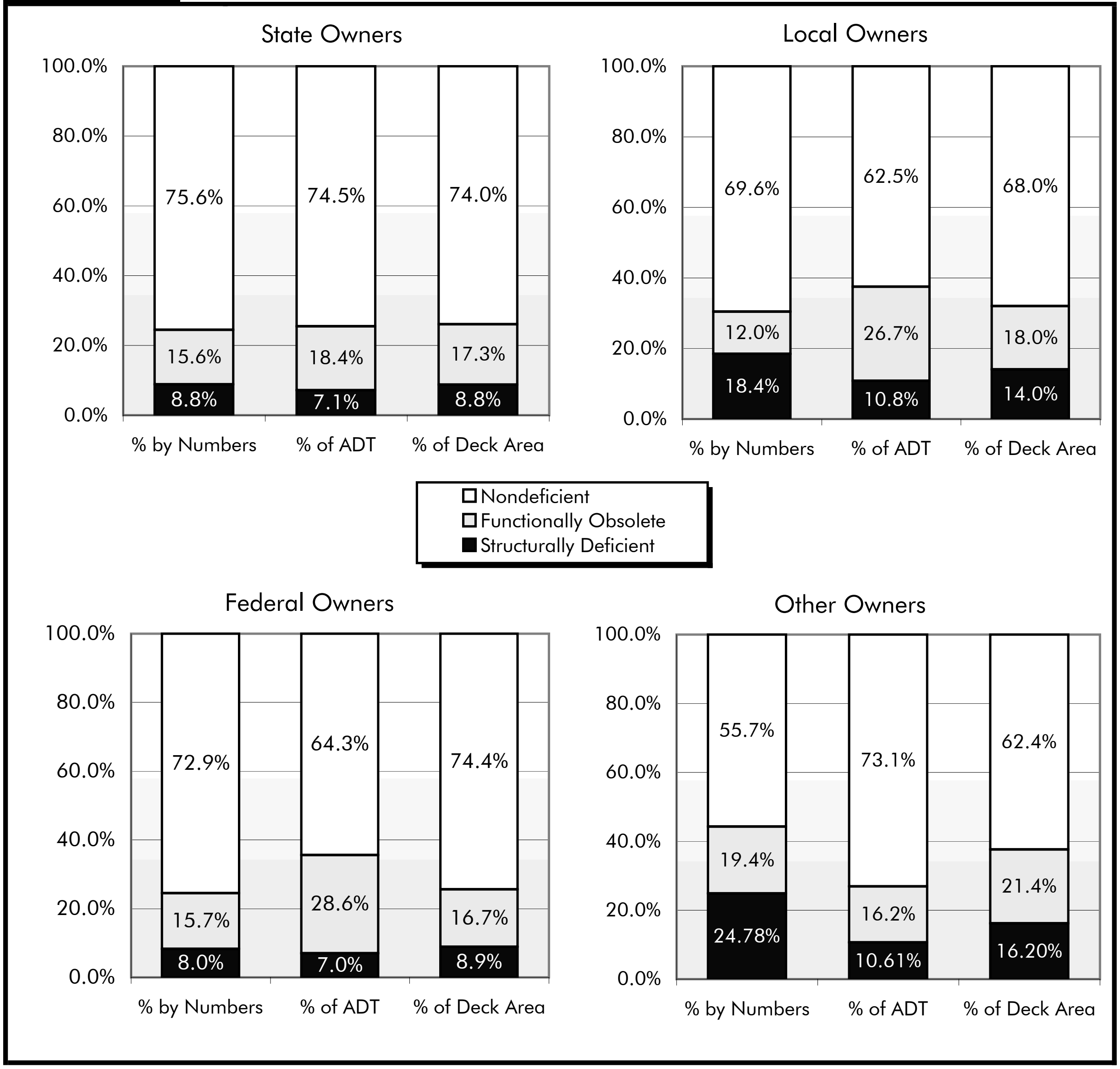
Deficient Bridges by Functional Classification

Functional classifications are maintained for each bridge recorded in the NBI. The functional classification codes designate whether the bridge carries Interstates or other principal arterials, minor arterials, collectors, or local roadways. The number of structurally deficient and functionally obsolete bridges are shown by functional classification in *Exhibit 3-33.*

The functional classification codes designate whether a structure is located in a rural or urban environment. As noted in Chapter 2 and as shown in Exhibit 3-33, the majority of bridges in terms of numbers are located in rural environments. With rural bridges, the number of structural deficiencies (15 percent) outweighs the number of bridges classified as functionally obsolete (11 percent). Urban roadways carry significantly higher volumes of traffic, as noted in Chapter 2. With urban bridges, the number of structurally deficient bridges (9 percent) is significantly lower than the number of functionally obsolete bridges (22 percent). Overall, a higher percentage of urban structures is classified as deficient (31 percent total); however, the majority of these deficiencies result from functional obsolescence. While the percentage of rural bridges classified as deficient is lower, the population and hence the number of deficiencies is larger. Structural deficiencies are more prevalent, in terms of percentages, in rural environments.

Bridge conditions in rural and urban areas have steadily improved over the past decade. As seen in *Exhibit 3-34,* overall deficiencies and structural deficiencies have both decreased. Functional obsolescence percentages, however, have not decreased but have remained static in both rural and urban environments. Exhibit 3-34 does not include structure records with unknown functional classification codes for any of the years depicted. Total numbers are thus slightly lower than the population figures presented in previous exhibits.

Exhibit 3-32 *Bridge Deficiencies by Owner, by Numbers, ADT, and Deck Area*



Source: National Bridge Inventory.

Exhibit 3-33 Bridge Deficiencies by Functional System, 2002

Functional Class	Total Number of Structures	Structurally Deficient	Functionally Obsolete	Total Deficiencies
Rural Interstate	27,316	1,104	3,210	4,314
Rural Other Principal Arterial	35,227	1,886	3,364	5,250
Rural Minor Arterial	39,587	3,407	4,451	7,858
Rural Major Collector	94,781	11,426	10,217	21,643
Rural Minor Collector	49,320	6,783	5,579	12,362
Rural Local	209,722	44,156	25,029	69,185
Total Rural	**455,953**	**68,762**	**51,850**	**120,612**
Urban Interstate	27,929	1,715	5,617	7,332
Urban Other Freeways of Expressway	16,844	1,025	3,431	4,456
Urban Other Principal Arterial	24,307	2,273	5,428	7,701
Urban Minor Arterial	24,516	2,605	6,402	9,007
Urban Collector	15,171	1,739	3,783	5,522
Urban Local	26,609	3,147	5,014	8,161
Total Urban	**135,376**	**12,504**	**29,675**	**42,179**
Total Identified by Functional Class	591,329	81,266	81,525	162,791
Rural and Urban Interstate	55,245	2,819	8,827	11,646
Rural and Urban Other Principal Arterial	64,103	6,012	10,853	16,865
Rural and Urban Minor Arterials	76,378	5,184	12,223	17,407
Rural and Urban Collectors	159,272	19,948	19,579	39,527
Rural and Urban Local	236,331	47,303	30,043	77,346
Unknown	378	38	40	78
Total, Including Unknown	**591,707**	**81,304**	**81,565**	**162,869**

Source: National Bridge Inventory.

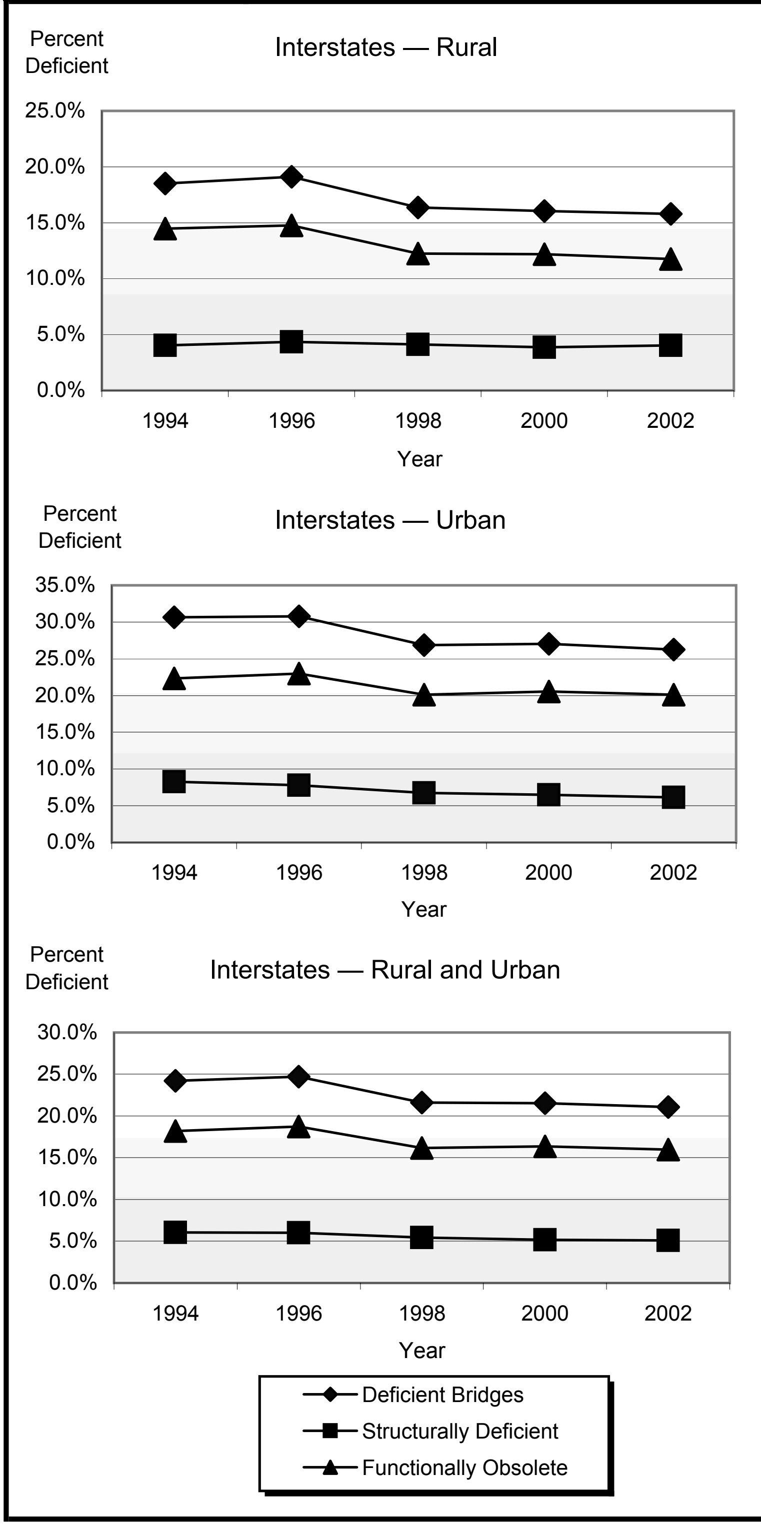
Exhibit 3-34 Rural and Urban Bridge Deficiencies, 1994–2002

Year	1994		1996		1998		2000		2002	
Rural Bridges	**455,319**		**456,958**		**454,664**		**455,365**		**455,953**	
Deficiencies	144,799	31.8%	139,545	30.5%	130,911	28.8%	125,523	27.6%	120,612	26.5%
Structurally Deficient	91,991	20.2%	86,424	18.9%	78,999	17.4%	73,599	16.2%	68,762	15.1%
Functionally Obsolete	52,808	11.6%	53,121	11.6%	51,912	11.4%	51,924	11.4%	51,850	11.4%
Urban Bridges	**121,141**		**124,949**		**128,312**		**131,780**		**135,376**	
Deficiencies	42,716	35.3%	43,181	34.6%	41,661	32.5%	42,031	31.9%	42,179	31.2%
Structurally Deficient	15,692	13.0%	15,094	12.1%	14,073	11.0%	13,079	9.9%	12,504	9.2%
Functionally Obsolete	27,024	22.3%	28,087	22.5%	27,588	21.5%	28,952	22.0%	29,675	21.9%
All Bridges	**576,460**		**581,907**		**582,976**		**587,145**		**591,329**	
Deficiencies	187,515	32.5%	182,726	31.4%	172,572	29.6%	167,554	28.5%	162,791	27.5%
Structurally Deficient	107,683	18.7%	101,518	17.4%	93,072	16.0%	86,678	14.8%	81,266	13.7%
Functionally Obsolete	79,832	13.8%	81,208	14.0%	79,500	13.6%	80,876	13.8%	81,525	13.8%

Source: National Bridge Inventory.

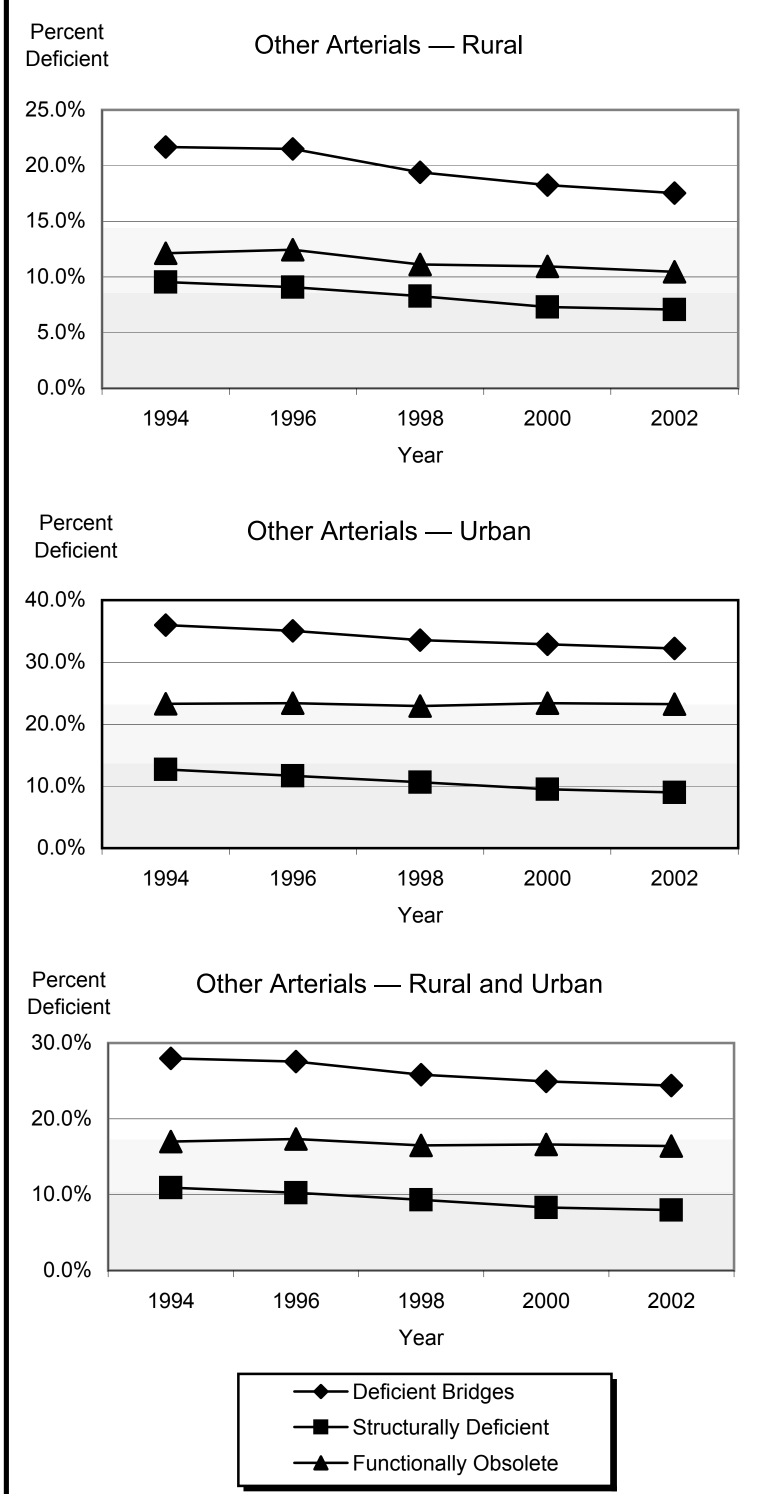
The trends for individual functional classifications can be examined. *Exhibits 3-35* through *3-38* show the trends for Interstate, other arterial, collector, and local bridges, respectively. Decreases in the number of structural deficiencies are exhibited for every functional classification, irrespective of the rural and urban designations. For Interstate bridges, decreases are also exhibited in the percentages of functionally obsolete bridges. For other functional classifications, there has been little change in the functionally obsolete percentages.

Exhibit 3-35 *Interstate Bridge Deficiencies, 1994–2002*



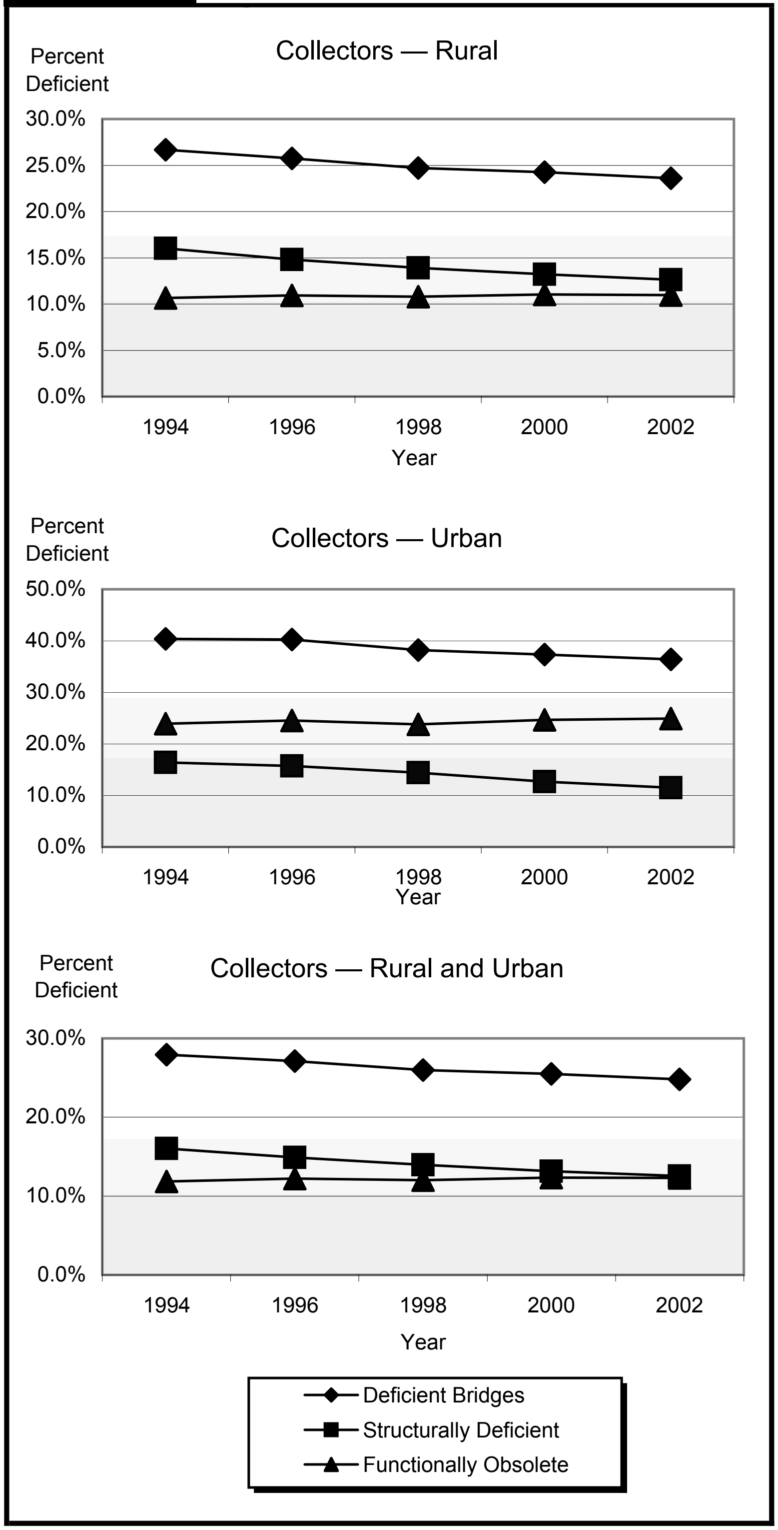
Source: National Bridge Inventory.

Exhibit 3-36 *Other Arterial Bridge Deficiencies, 1994–2002*



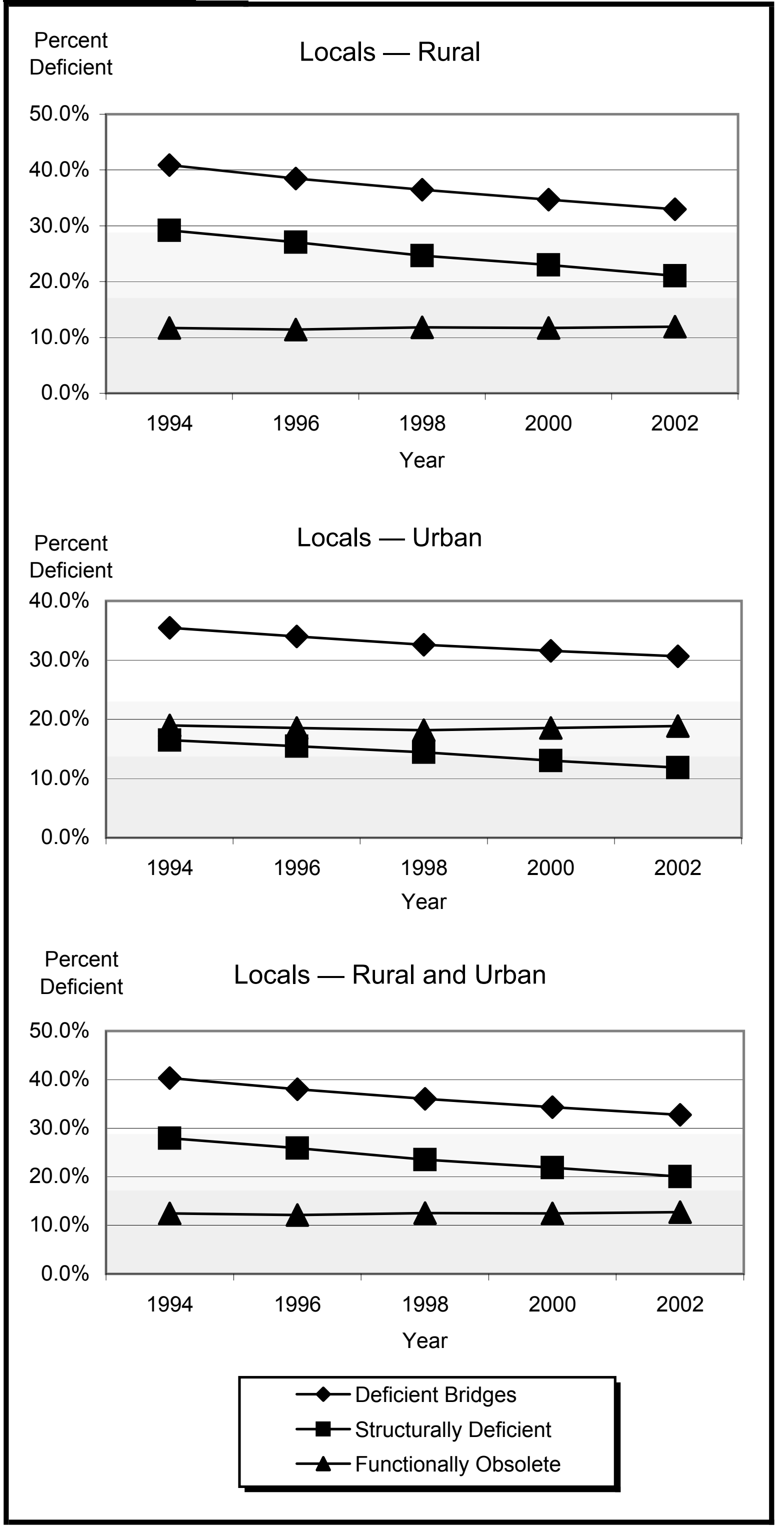
Source: National Bridge Inventory.

Exhibit 3-37 *Collector Bridge Deficiencies, 1994–2002*



Source: National Bridge Inventory.

Exhibit 3-38 *Local Bridge Deficiencies, 1994–2002*



Source: National Bridge Inventory.

Transit System Conditions

The condition of the U.S. transit infrastructure depends on the quantity, the age, and the physical condition of the assets that comprise it. This infrastructure includes vehicles in service, maintenance facilities and the equipment they contain, and other supporting infrastructure such as guideways, power systems, rail yards, stations, and structures such as bridges and tunnels.

The Federal Transit Administration (FTA) uses a numerical scale ranging from 1 to 5 to describe the condition of transit assets. This scale corresponds to the Present Serviceability Rating formerly used by the Federal Highway Administration to evaluate pavement conditions. A rating of 5, or "excellent," is synonymous with no visible defects or nearly new condition. At the other end of the scale, a rating of 1 indicates that the asset needs immediate repair and may have a seriously damaged component or components [*Exhibit 3-39*].

Exhibit 3-39 *Definitions of Transit Asset Condition*

Rating	Condition	Description
Excellent	5	No visible defects, near new condition.
Good	4	Some slightly defective or deteriorated components.
Fair	3	Moderately defective or deteriorated components
Marginal	2	Defective or deteriorated components in need of replacement.
Poor	1	Seriously damaged components in need of immediate repair.

The FTA uses the Transit Economic Requirements Model (TERM) to estimate the conditions of transit assets. This model comprises a database of transit assets and deterioration schedules that express asset conditions principally as a function of an asset's age and, in the case of vehicles, as a function of their estimated usage and maintenance history. The deterioration schedules used by TERM were initially estimated using data collected by the Regional Transportation Authority of Northeastern Illinois and the Chicago Transit Authority in the 1990s and mid-1980s and, to a lesser extent, on data collected by the Metropolitan Commuter Rail Authority (Metra) and the suburban bus authority (Pace) at the same time. A detailed description of these deterioration schedules is provided in a January 1996 FTA report, "The Estimation of Transit Asset Condition Ratings." The deterioration curves developed from the Chicago data continue to be used in TERM, with the exception of those for vehicles, maintenance facilities, and stations. The deterioration schedules for these assets have been re-estimated based on information collected from nationwide on-site engineering sample surveys.

The FTA has found that the condition of transit vehicles can vary considerably even if they are the same age. Vehicle conditions depend on how well vehicles are maintained and the location in which they operate. Vehicles that are well maintained are generally in better condition for their age than vehicles that are not. Vehicles that operate in coastal areas or in areas where salt is extensively used to melt ice during the winter deteriorate more rapidly than vehicles that do not operate under these conditions. Between 1999 and 2003, FTA conducted a large number of on-site inspections and collected information on the condition, age, and maintenance history of 1,179 transit vehicles. A total of 284 rail vehicles have been inspected: 88 commuter rail vehicles at 9 agencies, 94 heavy rail vehicles at 6 agencies, and 102 light rail vehicles at 11 agencies. A total of 895 bus vehicles have been inspected at 43 agencies. Fifty-eight articulated buses, 626 standard 40-foot buses, 84 low-floor 40-foot buses, 77 small buses (i.e., shorter than 40 feet), and 50 paratransit and vanpool vans were inspected [*Exhibit 3-40*].

Exhibit 3-40 *National Condition Assessments of Transit Vehicles*

	Vehicles	Number of Agencies
Buses	**895**	**43**
1999	572	31
2001-2002	323	12
Commuter Rail	**88**	**9**
2003	88	9
Heavy Rail	**94**	**6**
2000	92	5
2001	2	1
Light Rail	102	**11**
2000	28	5
2001	74	6
Total Number of Vehicles Inspected	**1,179**	

Source: National Condition Bus and Rail Assessments.

Each vehicle inspected was assigned an overall level of condition based on a weighted average of the condition of its subcomponents. For example, in the case of commuter rail, for which the most recent inspections were made, the subcomponents that were examined included the couplers, frame, bolster, gearbox, pneumatic piping, and wiring and connections. Vehicle exterior and interior subcomponents also were rated.

The FTA also has made a major effort to re-estimate the deterioration schedules for maintenance facilities. Between 1999 and 2003, 165 on-site maintenance facility surveys have been conducted at 45 rail and bus agencies. Facility conditions were determined by the conditions of a range of facility components and subcomponents. The components that were examined included the roof structure, heating and ventilation systems, mechanical and plumbing systems, electrical equipment, specialty shops, and work bays and their subcomponents. The condition of each type of specialty shop (e.g., machine shop, metal working shop) was evaluated separately. The condition of each component is estimated as an average of the condition of its subcomponents. For example, the condition of a roof structure is based on an average of the conditions of its roofing frames, its gutters, and its drainage system. Bus and rail facilities, on average, follow different deterioration schedules. While rail facilities are estimated to fall to a condition of 3.0 in just under 25 years, bus facilities take 40 years to reach this condition. Most of the decline in both rail and bus maintenance facility conditions takes place in the first 23 years. During this time, facilities undergo relatively little major rehabilitation. After 23 years, they begin to undergo periods of rehabilitation, which leads to a very gradual deterioration over the remaining years of their lives [*Exhibit 3-48* on page 3-44].

Since the 2002 edition of the C&P report, stations have used the same deterioration schedule as maintenance facilities. Prior to this report, stations used deterioration curves based on the relationship between station age and structure condition from data collected in Chicago. The decision to replace the station deterioration schedule based on Chicago data with the deterioration schedule for maintenance facilities was based on the premise that both stations and maintenance facilities are primarily structures, and the data collected for maintenance facilities were more recent and more accurate than the Chicago data. Engineering assessments of stations have recently been completed. Condition estimates based on newly estimated station deterioration curves will be provided in the 2006 edition of this report.

The TERM includes a detailed inventory of the physical assets of transit agencies in urbanized areas that report to the National Transit Database (NTD). Assets are segmented by mode, asset type, and asset age. This asset inventory was initially based on FTA studies in the early 1990s, which collected the number, purchase price, and date of purchase of bus, light rail, and heavy rail assets. This information was updated and supplemented with data collected from Chicago (also used to estimate deterioration schedules) and subsequently, through special data collection efforts, directly from agencies. The TERM has internal checks, which are used to generate values for assets that are not reported by agencies or in cases where the quality of asset information reported to FTA is poor. Missing or incorrect assets are identified using relationships between agency-mode-dimensions and expected dimensions. For example, an agency with 20 miles of rail investment would be expected to have half the investment in train control equipment as an agency with 40 miles of investment. The TERM uses industry standard relationships like this to check that the asset inventory in TERM makes sense and makes adjustments to the industry data as required. Industry standard relationships are also used to estimate data where no data exist.

Transit asset condition estimates are updated with information collected from on-site assessments in each edition of the C&P report to reflect any revisions made to deterioration rates. This edition of the report uses newly estimated deterioration curves for bus vehicles and for commuter rail vehicles. Since the last edition of the report in 2002, 323 bus vehicles inspections were undertaken at 12 agencies. This bus sample included a mix of full-size, 40- to 60-foot buses; medium and small buses; and vans. In 2003, 88 commuter rail vehicle inspections were undertaken at 9 agencies.

Transit vehicle asset conditions also reflect the most recently available information on vehicle age, use, and level of maintenance from the NTD. The information used in this report is for 2002. Age information is available on a vehicle-by-vehicle basis from the NTD, but information on use and maintenance expenditures are not reported for each vehicle separately. However, average vehicle use, i.e., vehicle revenue miles per vehicle, is available by agency, by mode. Average maintenance expenditures per vehicle are also available on an agency and modal basis. For this reason, for the purpose of calculating conditions, average agency use and maintenance expenditures for a particular mode are assumed to be the same for all vehicles operated by an agency in that mode. Because maintenance levels may fluctuate from year to year, TERM uses a 5-year average.

Q. What is the Asset Conditions Reporting Module (ACM)?

A. The ACM is an effort, undertaken in 2002 through the NTD, to expand the collection of data on the Nation's transit asset infrastructure and its physical condition. Participation by agencies was voluntary. Several large operators opted not to participate, and not all agencies that participated submitted a complete set of information. The ACM data cover all asset types, excluding revenue vehicles. The ACM provided the following information, which is used to estimate transit asset conditions: (1) asset type, (2) asset age and quantity, (3) asset replacement cost, (4) the year in which the asset replacement cost is denominated, and (5) the percentage of the asset (e.g., facility) used by the reporting agency to provide transit services. In some cases, information reported to the ACM on the condition of an asset and its useful life was used to estimate the current age of the asset, which is used as input into TERM.

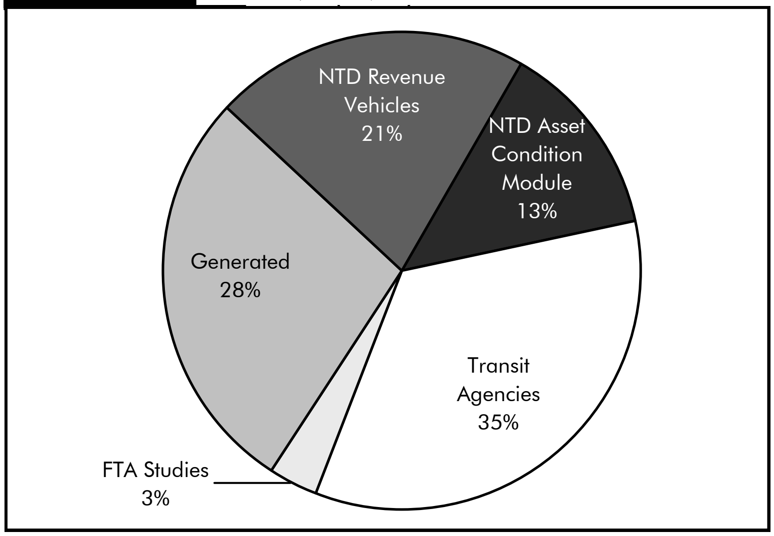
Condition estimates in each new edition of the C&P report are based on updated asset inventory information and reflect updates in TERM's asset inventory. Since the 2002 C&P report, conditions for approximately 70 percent of the Nation's transit assets have been updated. Vehicle data from the NTD was used to update 22 percent of the TERM data and data collected by the NTD Asset Conditions Reporting Module (ACM) was used to update approximately 15 percent. An additional 30 percent of TERM data was updated with inventory data provided by the New York Metropolitan Transportation Authority (MTA). Capital unit costs were updated for heavy and light rail based on FTA capital cost studies undertaken since the last edition of this report.

The ACM data included asset inventories for a few key major rail operators—including the Southeastern Pennsylvania Transit Authority and

Massachusetts Bay Transportation Authority—whose assets had previously been estimated within TERM. The ACM also provided real data for several recent light rail investments for which assets had previously been estimated, and more complete coverage on small- to medium-size bus operators than what was previously available. In general, the ACM asset records were more complete and often implicitly reported a higher total replacement value for an asset than what existed in TERM.

Since the MTA alone accounts for roughly one fourth of the Nation's transit assets in urbanized areas, the data received from the MTA were used to update more than 50 percent of all data obtained directly from transit operators.

Exhibit 3-41 *2002 Transit Economic Requirements Model (TERM) Data Sources*



Thirty-five percent of the TERM's existing asset inventory is currently based on asset information directly provided by transit agencies. Twenty-one percent is based on revenue vehicle data from the 2002 NTD, and 13 percent is based on asset data from the 2002 ACM. Three percent is based on information collected by asset studies undertaken by FTA in the early to mid- 1990s. Twenty-eight percent of the asset inventory in TERM is generated endogenously; 35 percent of the data was generated endogenously before the inventory was updated with asset information collected by the ACM and from the MTA. Asset quantities are converted to values with asset replacement cost information collected by FTA. [*Exhibit 3-41*].

Bus Conditions

As a result of the bus assessments completed since the last edition of this report, bus deterioration schedules have been revised to reflect the fact that bus conditions decline slightly more rapidly during the first three years of life than previously estimated, and slightly less rapidly after the age of 15. The study found that vans, paratransit vehicles, and small buses tend to decay more rapidly than full-size buses and their condition estimates, although included in the total average, is based on a decay curve that is different from the one used to estimate the conditions of mid-size, full-size, and articulated motor buses. Variations among the average age of agencies' fleets and maintenance practices created large differences in average fleet conditions. Vehicles that are rehabilitated have condition levels approximately 0.5 higher than vehicles that are not.

Bus vehicle age and condition information is reported according to bus vehicle type for 1993 to 2002 in *Exhibit 3-42.* These condition estimates are based on slightly revised deterioration schedules for buses based on engineering surveys undertaken since the last report. The allocation of buses among bus categories also has been revised since the last edition of this report. The 2002 NTD collected information on buses according to length and seating capacity. Previously bus information had been collected according to the number of seats only, except for articulated buses, which were reported separately. Two condition estimates

Exhibit 3-42 *Urban Transit Bus Fleet Count[1], Age, and Condition, 1993–2002*

Year	1993	1995	1997	1999	2000	2002	Revised Basis 2002
Articulated Buses							
Total Fleet	1,807	1,716	1,523	1,967	2,078	2,307	2,765
Percent Overage Vehicles	16%	33%	61%	46%	29%	15%	17%
Average Age	9.5	10.7	11.8	8.7	6.9	6.7	7.1
Average Condition	2.88	2.66	2.49	3.10	3.33	3.17	3.11
Full-Size Buses							
Total Fleet	46,824	46,335	47,149	49,195	49,721	50,294	46,685
Percent Overage Vehicles	20%	23%	25%	26%	25%	22%	19%
Average Age	8.5	8.6	8.2	8.7	8.5	7.7	7.5
Average Condition	2.82	2.83	2.86	2.90	2.93	2.99	3.02
Mid-Size Buses							
Total Fleet	3,598	3,879	5,328	6,807	7,643	8,914	7,304
Percent Overage Vehicles	24%	23%	18%	14%	15%	21%	34%
Average Age	6.4	6.8	5.6	5.7	5.7	5.6	8.1
Average Condition	3.14	3.08	3.30	3.30	3.30	3.30	2.93
Small Buses							
Total Fleet	4,064	5,447	7,081	8,461	9,039	10,096	14,857
Percent Overage Vehicles	13%	13%	13%	13%	12%	14%	18%
Average Age	4.0	4.0	3.7	4.0	4.2	4.1	4.5
Average Condition	3.48	3.55	3.56	3.51	3.47	3.53	3.39
Vans[2]							
Total Fleet	8,353	11,969	13,796	14,539	16,234	17,300	17,300
Percent Overage Vehicles	22%	21%	22%	5%	6%	11%	11%
Average Age	3.1	3.2	2.3	3.2	3.2	3.2	3.2
Average Condition	3.59	3.71	3.75	3.71	3.71	3.62	3.62
Total Fleet	64,646	69,346	74,877	80,969	84,715	88,911	88,911
Percent Overage Vehicles	20%	22%	24%	20%	19%	19%	19%
Weighted Average Age	7.4	7.3	6.6	7.0	6.8	6.2	6.2
Average Condition	2.87	2.88	2.94	3.01	3.05	3.21	3.19

[1] Includes vehicles that are not in active service. Bus vehicle fleets sizes reported here are slightly larger than those reported for active bus vehicles in Chapter 2.

[2]Vehicles used in for both demand response and vanpool services.

Sources: Transit Economic Requirements Mode and National Transit Database.

are reported in Exhibit 3-42 for 2002. The first column reports average conditions based on bus categories determined by seating capacity only (old classification system), and the second column reports conditions based on bus categories determined first by length, and when length was not available, by seating capacity (new classification system). The 2002 NTD data on length revealed that a larger percentage of buses were 45 feet or longer than was previously estimated. All buses 45 feet or longer must be articulated for structural reasons. Four hundred and fifty-eight vehicles were shifted from the full-size bus category to the articulated bus category. A considerable number of buses that were previously categorized as full-size and mid-size (4,761) have been reclassified as small. The number of articulated buses increased by 20 percent as a result of the reclassification, the number of full-size buses decreased by 7 percent, the number of mid-size buses decreased by 18 percent, and the number of small buses increased by 47 percent. Vans were not affected by the reclassification.

Conditions have gradually improved for all bus vehicle types since 1993. In 2002, the estimated average condition of the urban bus fleet was 3.21 (old classification) and 3.19 (new classification) compared with 3.05 in 2000 and 2.87 in 1993. [Note that all condition estimates prior to 2002 are based on the old classification system since information on length was not collected.] This improvement in conditions reflects a decrease in the average age of the bus vehicle fleet from 7.4 years in 1993, to 6.8 years in 2000, to 6.2 years in 2002. Since 1993, larger vehicles (*articulated, full-size, and mid-size buses*) have tended to have, on average, slightly lower-rated conditions than smaller vehicles (small buses, vans). Vans, paratransit vehicles, and small buses, in general, decay more rapidly than full-size buses. Vans typically reach a condition of 2.5 in 7 years, compared with 14 years, on average, for a 40-foot bus. Average bus fleet conditions vary considerably from agency to agency. Average bus fleet conditions ranged from 2.30 to 4.40 for the 31 agencies that participated in the most recent FTA bus vehicle conditions assessment.

Articulated buses experienced the largest fluctuations in conditions between 1993 and 2002, ranging from 2.49 in 1997 to 3.33 in 2000. In 2002, the average condition of articulated buses was 3.11 (new classification) and 3.17 (old classification). The fluctuations in articulated bus conditions are most likely the result of a 12-year industry replacement policy and the fact that the bulk of articulated buses were purchased between 1983 and 1984. This replacement cycle is evidenced by a peak in the percentage of articulated buses that were overage at 61 percent in 1997, and the subsequent decline in this percentage to 17 percent (new classification) in 2002. Mid-size buses have maintained an average condition above 3.0 in all years based on the old bus classification systems. However, based on the new classification system, their average condition fell from 3.30 in 2000 to 2.93 in 2002 as a considerable number of these vehicles in better-than-average condition for this category were reclassified as small buses. Both small buses and vans have consistently maintained an average condition of close to 3.5 or higher. Vehicles reclassified from the full and mid-size bus categories to the small bus category lowered the average conditions of small buses from 3.47 in 2000 to 3.39 in 2002. Full-size buses, which were on average consistently just below "adequate" condition between 1993 and 2000, reached an "adequate" average condition of 3.02 in 2002 under the new classification system.

Urban Bus Maintenance Facilities

Age

The estimated age distribution of urban maintenance facilities for bus, vanpool, and demand response systems in 2002 is shown in *Exhibit 3-43.* This distribution is based on age information collected by the 1999 and 2002 National Bus Condition Assessments and applied to the total national bus facilities in 2002 as reported in the NTD. The percentage of bus maintenance facilities less than 10 years old increased from 8 percent in 2000 to 12 percent in 2002, and the percentage more than 30 years old declined from 31 to 24 percent. The percentage of facilities aged 11 to 30 years remained about the same, increasing from 61 to 64 percent, but within this distribution the proportion of facilities aged 20 years to 30 years increased. Individual facility ages may not relate well to condition, since substantive renovations are made to facilities at varying intervals over time.

Exhibit 3-43 *Age of Maintenance Facilities for Urban Bus Vehicles*[1]

	2002	
Age (years)	**Number**	**Percent**
0-10	151	12%
11-20	406	33%
21-30	372	31%
31+	289	24%
Total	**1,219**	**100%**

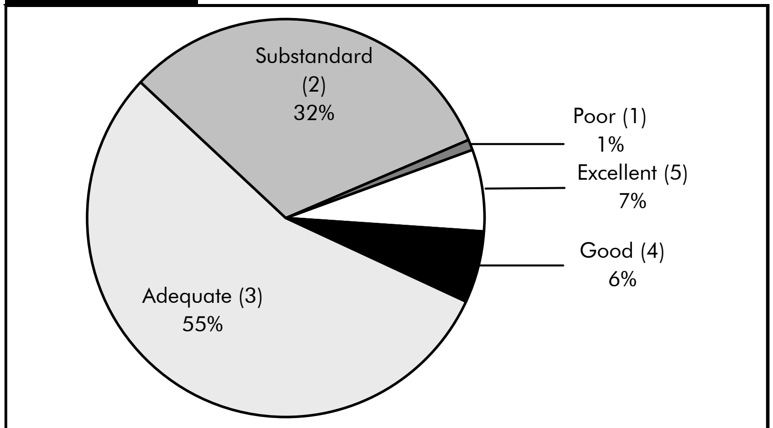
[1] Includes maintenance facilities for both directly operated and purchased transportation services. Exhibit 2-18 in Chapter 2 reports the number of maintenance facilities for directly operated services only.

Source: National Bus Condition Assessments, 1999 and 2001-2002, and 2002 NTD.

Condition

The average condition of maintenance facilities for buses, including vans and demand response vehicles, improved from 3.23 in 2000 to 3.34 in 2002. In 2002, 55 percent of all urban bus maintenance facilities were in adequate condition, 6 percent in good condition, and 7 percent in excellent condition, for a combined total of 68 percent in compared with 71 percent in adequate-or-better condition in 2000. Thirty-three percent of these facilities, however, are estimated to be in unacceptable condition—32 percent in substandard condition and 1 percent in poor condition. In 2000, 24 percent were in substandard condition and 5 percent in poor condition. [The average condition within each condition category increased, leading to an increase in average condition in spite of the slight decrease in the percentage of facilities in adequate or better condition.] [*Exhibit 3-44*]

Exhibit 3-44 *Distribution of Condition of Urban Bus Maintenance Facilities, 2002*



	2002	
Condition	**Number**	**Percent**
Excellent (5)	83	7%
Good (4)	68	6%
Adequate (3)	672	55%
Substandard (2)	387	32%
Poor (1)	10	1%
Total	**1,219**	**100%**

Source: Transit Economic Requirements Model.

Rail Vehicle Conditions

The average rail vehicle condition increased to 3.47 in 2002, from 3.38 in 2000, reflecting a decline in the average age from 21.8 years in 2000 to 20.4 years in 2002. By comparison, in 1993 the average rail vehicle condition was 3.54 and average age 17.7 years [*Exhibit 3-45*]. Average rail vehicle age and condition are heavily influenced by the average age and condition of heavy rail vehicles, which account for 60 percent of the total U.S. rail fleet. All rail vehicles combined have been, on average, in slightly better condition than all bus and bus-type vehicles. The condition of all rail vehicles combined averaged 3.45 for the years 1993 to 2002.

Changes in ages and conditions of all rail vehicles appear to fall within the range of normal depreciation, rehabilitation, and replacement cycles. In 2002, the average condition of each of the individual vehicle types was slightly lower or the same as in 1993, and the average age slightly higher except in the case of commuter rail self-propelled passenger coaches, which is significantly higher. In contrast with other rail vehicle types, the average age of commuter rail self-propelled vehicles has increased substantially, although the decline in their average condition has been more moderate, indicating that these vehicles have received a substantial amount of rehabilitation since 1993. (The percentage of overage commuter rail self-propelled passenger coaches increased from 6 percent in 1993 to 68 percent in 2002, their average age climbed from 18.2 to 27.1 years, and their condition declined from 3.69 to 3.50).

The average condition of commuter rail vehicles has been re-estimated based on engineering surveys of rail vehicle physical conditions undertaken in 2002. These new estimates are lower than those previously reported. This downward revision is similar to the one that occurred for heavy and light rail vehicles as a result of surveys made between 1999 and 2001 and reported in the 2002 edition of this report. It has led to a reduction in the commuter rail conditions, reported in earlier editions of this report, by about 15 percent. Analysis of the rail vehicle condition information collected by the engineering survey revealed that commuter rail vehicles decay more rapidly in early years than previously estimated. It was also revealed that the deterioration schedule of commuter rail vehicles differs from the deterioration schedule of heavy and light rail vehicles. Heavy and light rail vehicles deteriorate most rapidly in the first year of life, and then shift to a more gradual rate of constant decline for the remainder of their lives. By comparison, commuter rail vehicles deteriorate most rapidly in the first five years of their lives, at which point their conditions plateau until they reach approximately 22 years. After this, their condition starts to decline again albeit very gradually [*Exhibit 3-46*]. The conditions, shown in *Exhibit 3-46,* reflect these revisions and are not directly comparable to conditions reported in earlier editions of this report.

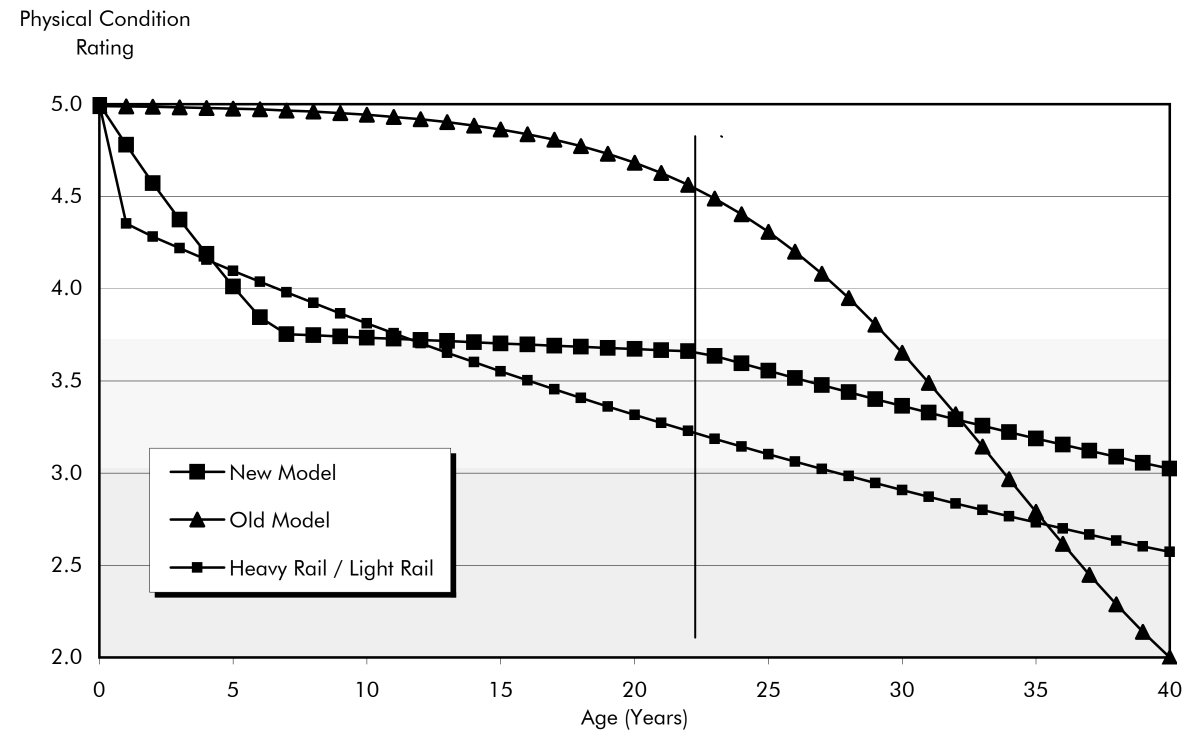
Exhibit 3-45 *Urban Transit Rail Fleet Count, Age, and Condition[1], 1993–2002*

Year	1993	1995	1997	1999	2000	2002
Commuter Rail Locomotives						
Total Fleet	556	570	586	644	591	709
Percent Overage Vehicles	17%	21%	22%	17%	19%	23%
Average Age	15.6	15.6	16.5	16.1	15.8	16.9
Average Condition	3.77	3.77	3.70	3.82	3.77	3.72
Commuter Rail Passenger Coaches						
Total Fleet	2,402	2,402	2,470	2,886	2,793	2,985
Percent Overage Vehicles	29%	36%	33%	32%	29%	34%
Average Age	18.6	20.1	19.8	18.5	17.7	19.0
Average Condition	3.68	3.63	3.68	3.74	3.76	3.68
Commuter Rail Self-Propelled Passengers Coaches						
Total Fleet	2,526	2,645	2,681	2,455	2,472	2,389
Percent Overage Vehicles	6%	24%	25%	60%	61%	68%
Average Age	18.2	19.7	22.0	24.3	25.2	27.1
Average Condition	3.69	3.68	3.62	3.57	3.55	3.50
Heavy Rail						
Total Fleet	10,074	10,157	10,173	10,366	10,375	11,093
Percent Overage Vehicles	27%	37%	36%	40%	40%	36%
Average Age	17.8	19.3	21.0	22.5	23.0	20.0
Average Condition	3.47	3.39	3.31	3.26	3.25	3.41
Light Rail						
Total Fleet	943	955	1,132	1,400	1,524	1,637
Percent Overage Vehicles	10%	12%	10%	15%	13%	14%
Average Age	14.9	14.8	14.6	18.9	18.4	16.1
Average Condition	3.64	3.55	3.63	3.62	3.63	3.61
Total Rail						
Total Fleet	16,501	16,729	17,042	17,751	17,755	18,813
Percent Overage Vehicles	23%	33%	32%	39%	38%	37%
Weighted Average Age	17.7	19.1	20.4	21.6	21.8	20.4
Weighted Average Condition	3.54	3.48	3.42	3.40	3.38	3.47

[1] Rail conditions for commuter rail vehicles have been revised downward based on revised deterioration schedules. Average conditions for the rail fleet are therefore also lower than reported in earlier reports.

Sources: Transit Economic Requirements Model and National Transit Database.

Exhibit 3-46 *Commuter Rail Vehicle Condition Versus Age*



Urban Rail Maintenance Facilities

Age

Data collected since the last edition of this report through the ACM reveal that a much larger percentage of rail maintenance facilities are less than 10 years old and a much smaller percentage are more than 30 years old than was previously estimated. In 2002, 30 percent of all rail facilities were estimated to be 10 years old or less (compared with 15 percent in 2000), and 33 percent were estimated to be more than 30 years old (compared with 48 percent in 2000) [*Exhibit 3-47*].

Exhibit 3-47 *Rail Maintenance Facility Ages*

Age of Facility	Number	Percent
0-10	47	30%
11-20	38	24%
21-30	19	12%
31+	52	33%
Total	**156**	**100%**

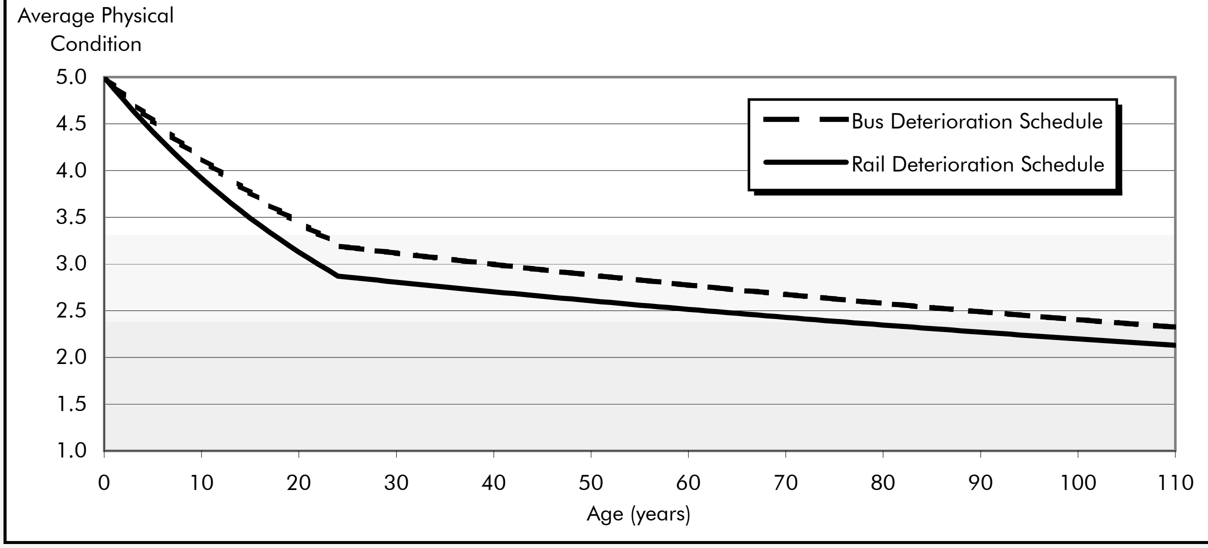
Source: National Rail Assessment.

Note: Includes Alaska Rail and Inclined Plane.

Q. Do rail and bus maintenance facilities follow the same deterioration schedules?

A. Bus and rail maintenance facilities have similar, but not identical, deterioration schedules. Bus maintenance facilities are, on average, in slightly better condition than rail maintenance facilities of the same age [*Exhibit 3-48*].

Exhibit 3-48 *Bus and Rail Maintenance Facilities Average Conditions and Age*

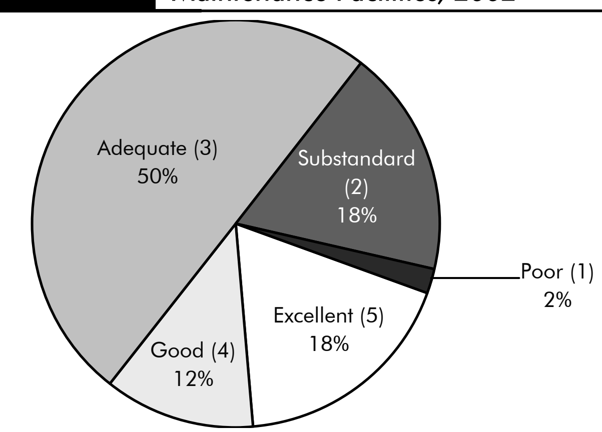


Source: National Bus and Rail Condition Assessments.

Condition

In 2002, the average condition of urban rail maintenance facilities was estimated to be 3.56, compared with 3.20 in 2000. The estimated condition improved largely due to expanded information on facilities ages collected by the ACM. As *Exhibit 3-49* shows, in 2000, 30 percent of all rail maintenance facilities were estimated to be in good or excellent condition and 80 percent in adequate or better condition. Twenty percent, however, are believed to be in poor or substandard condition and have immediate capital investment needs.

Exhibit 3-49 *Distribution of Condition of Urban Rail Maintenance Facilities, 2002*



Condition	2002 Number	2002 Percent
Excellent (5)	27	18%
Good (4)	18	12%
Adequate (3)	76	50%
Substandard (2)	27	18%
Poor (1)	3	2%
Total	**152**	**100%**

Source: Transit Economic Requirements Model.

Note: Excludes Alaska Rail and Inclined Plane.

Other Rail Urban Infrastructure

The condition of rail urban infrastructure other than maintenance facilities and stations is estimated on the basis of decay curves principally relating condition to age, although the conditions a few nonvehicle assets are also estimated on the basis of usage and maintenance history. This information is based primarily on rail asset information collected by the Chicago Transit Authority during the 1980s and 1990s for an Engineering Condition Assessment. Additional, but considerably more limited, asset condition data were provided by Metra and Pace, two transit operators in the Chicago area at that time. The data collected were used to estimate decay curves for more than 40 types of transit assets and averaged into a smaller number of aggregate decay curves, according to each asset's contribution to the total replacement cost for the group of assets into which it was averaged. As a part of the validation process, industry experts reviewed the results and assessed whether they accurately captured the dynamics of transit asset decay. The results were published in *The Estimation of Transit Asset Condition Ratings, Heavy Rail Systems,* January 1996.

Infrastructure data are based on the dollar amounts spent on different asset types (in constant dollars) rather than a numeric count of the assets. Earlier versions of this report, therefore, only provided condition results for these assets displayed as percentages across condition levels. This information is believed to be more accurate than average condition estimates. Bearing this in mind, however, this edition of the report also provides estimates of average condition by asset type [*Exhibit 3-50*].

Exhibit 3-50 *Physical Condition of U.S. Transit Rail Infrastructure—Selected Years, 1997–2002*

	CONDITION ESTIMATES		Distribution of Assets by Condition														
			1 POOR			2 SUBSTANDARD			3 ADEQUATE			4 GOOD			5 EXCELLENT		
	2000	2002	1997	2000	2002	1997	2000	2002	1997	2000	2002	1997	2000	2002	1997	2000	2002
Maintenance																	
Facilities	3.20	3.56	6%	12%	2%	17%	24%	18%	17%	43%	50%	53%	21%	12%	7%	0%	18%
Yards	4.00	3.64	0%	0%	0%	0%	0%	20%	37%	50%	48%	63%	50%	31%	0%	0%	1%
Power Systems																	
Substations	4.17	4.33	12%	6%	4%	6%	6%	2%	10%	10%	12%	57%	58%	51%	15%	20%	31%
Overhead Wire	4.00	3.93	5%	6%	8%	11%	6%	11%	18%	11%	16%	34%	61%	46%	32%	16%	19%
Third Rail	4.05	4.10	14%	8%	7%	11%	8%	7%	15%	11%	13%	43%	48%	50%	17%	24%	23%
Track	4.06	4.17	7%	7%	6%	10%	10%	9%	10%	12%	12%	49%	45%	34%	24%	26%	40%
Structures																	
Elevated Structure	4.02	4.27	1%	2%	2%	29%	22%	7%	12%	16%	3%	59%	59%	83%	0%	2%	5%
Underground Tunnels	3.75	4.09	9%	12%	8%	19%	11%	9%	18%	19%	13%	47%	46%	37%	7%	12%	34%
Stations	3.44	2.99	15%	0%	30%	13%	16%	26%	15%	50%	18%	46%	33%	22%	11%	1%	3%

Sources: Transit Economic Requirements Model (TERM).

Information collected by ACM and directly from MTA has replaced 46 percent of the nonvehicle data collected from these earlier studies, which was used in the last edition of this report. The nonvehicle asset condition levels for 2002 provided in Exhibit 3-50 reflect these updates to the asset inventory information and new information provided to the NTD. The decay curves used to estimate conditions are the same as used in previous editions of this report. Conditions for 1992, reported in the 2000 edition of this report, have been dropped from Exhibit 3-50. These condition estimates were based on earlier surveys and are not fully comparable with estimates for subsequent years.

As discussed earlier, rail maintenance facilities are in better condition than previously estimated. By comparison, the condition of maintenance *yards* (vehicle storage yards) has declined. In 2002, 32 percent of all yards were in good or excellent condition, compared with 50 percent in 2000. The percentage in substandard condition increased from 0 percent in 2000 to 20 percent in 2002. No yards were reported as being in poor condition in either 2000 or 2002.

Power systems are on average in good condition. Changes in the conditions of power systems are mixed, depending on the particular asset type. The estimated condition of substations increased from 4.17 in 2000 to 4.33 in 2002. The percentage of substations in excellent condition increased from 20 percent in 2000 to 31 percent in 2002. The condition of overhead wire declined slightly from 4.00 in 2000 to 3.93 in 2002. In 2002, 65 percent of overhead wire was reported to be in good or excellent condition compared with 77 percent in 2000. The estimated conditions of third rail increased very slightly from 4.05 to 4.10. There were only very minor changes in the distribution of third rail according to condition.

Track conditions are estimated to have improved slightly from an average condition of 4.06 in 2000 to an average condition of 4.17 in 2002, principally on the basis of updated information. The percentage of track in excellent condition increased from 26 percent in 2000 to 40 percent in 2002, and the percentage in good condition declined from 45 to 34 percent. The percentage of track in substandard or poor condition was relatively unchanged, falling from 17 to 15 percent.

The estimated conditions of *structures* also improved. The average condition of *elevated structures* increased from 4.02 in 2000 to 4.27 in 2002. The percentage of elevated structures in good or excellent condition increased from 59 percent in 2000 to 83 percent in 2002, and the percent in excellent condition increased from two to five percent over the same period. The average condition of *underground tunnels* increased from 3.75 to 4.09. The percentage of underground tunnels in excellent condition increased from 12 percent in 2000 to 34 percent in 2002, largely due to a shift out of the good to the excellent condition category. The percentage of underground tunnels in substandard and poor condition decreased from 23 percent in 2000 to 17 percent in 2002.

The condition of *rail stations* is estimated to have declined from 3.53 to 2.87. Although the percentage of all stations in excellent condition increased from 1 percent in 2000 to 3 percent in 2002, the percentage in good condition fell from 33 to 22 percent and the percentage in substandard or poor condition increased from 42 percent in 2000 to 56 percent in 2002. FTA will be undertaking physical inspections of a sample of stations in 2004. The results of these inspections will be included in the 2006 edition of this report.

Q. How does the condition of nonrail stations compare with the condition of rail stations?

A. Nonrail stations are in better condition than rail stations. The condition of nonrail stations is estimated to have declined from 4.65 in 2000 to 4.37 in 2002. The condition of *stations* for all modes combined declined from 3.44 in 2000 to 2.99 in 2002.

The Value of U.S. Transit Assets

The value of the transit infrastructure in the United States is estimated to be $347.7 billion in 2002 dollars based on the information contained in TERM and on data collected through the NTD and the other data collection efforts discussed in this chapter. It excludes the value of assets that belong to rural and special service operators that do not report to the NTD. The reader should bear in mind that this is a very preliminary estimate, which will be subject to revision as more information is collected. Rail assets are estimated to be $264.6 billion, nonrail assets are estimated to be $66.7 billion, and systems are estimated to be $16.4 billion [*Exhibit 3-51*]. The systems category comprises assets that serve more than one mode within a single agency. Systems investments include administrative facilities, the external structure and furniture and equipment within, intermodal transfer centers, agency communications systems (such as PBX, radios, and computer networks), and vehicles used by agency management (such vans and autos).

Exhibit 3-51 *Estimated Valuation of the Nation's Transit Assets, 2002*

(Billions of current dollars)

	Nonrail	Rail	Systems	Total
Maintenance Facilities	$38.0	$6.4	$4.4	$48.9
Guideway Elements	$2.5	$130.9	$0.6	$134.0
Stations	$1.4	$42.9	$9.0	$53.3
Power Systems	$0.6	$33.6	$1.5	$35.6
Vehicles	$24.3	$50.7	$0.9	$75.9
Grand Total	$66.7	$264.6	$16.4	$347.7

Source: Transit Economic Requirements Model.

Rural Transit Vehicles and Facilities

Data on the conditions of rural vehicles and facilities have not been updated since the 2002 edition of the report. The most recent data available were collected from surveys funded by the FTA and conducted by the Community Transportation Association of America. The information was collected between June 1997 and June 1999. The responses of the 158 rural operators that responded to these surveys have been combined. Note that for the purpose of these surveys, rural operators are defined as those operators outside urbanized areas, a different definition than used by the U.S. Census. These surveys found that more than 50 percent of the rural transit fleet was over age. Forty-one percent of small buses, 34 percent of medium-size buses, 27 percent of full-size buses, and 60 percent of vans and other vehicles were found to be overage [*Exhibit 3-52*]. Small buses more than 7 years old, medium buses more than 10 years old, large buses more than 12 years old, and vans more than 5 years old were categorized as over age.

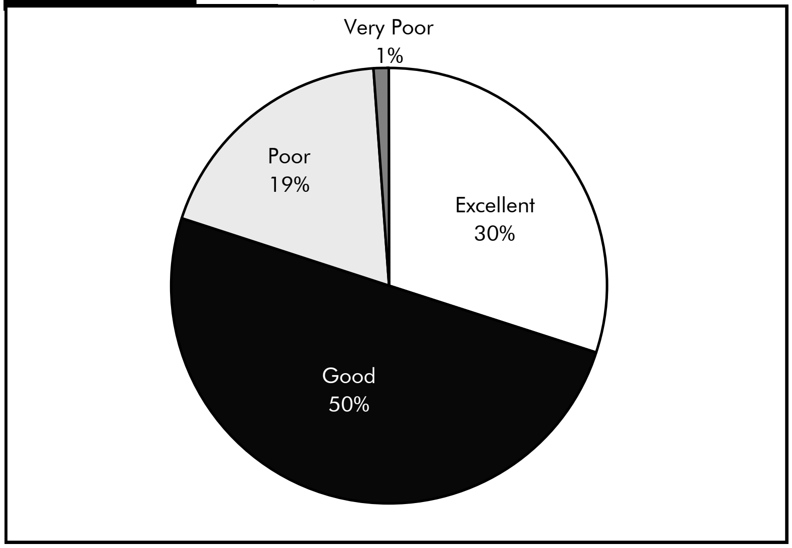
Exhibit 3-52 *Number of Overage Vehicles and Average Vehicle Age in Rural Transit*

1997–1999	Total Fleet	Average Age	Percent Overage
Full-Size buses	767	7.8	27%
Medium-Size Buses	1,727	7.6	34%
Small Buses	4,413	5.7	41%
Vans and Other	11,991	7.0	60%
Total	**18,898**	**6.8**	**52%**

Source: Community Transportation Association of America.

These surveys also found that 30 percent of bus rural maintenance facilities were in excellent condition, 50 percent in good condition, 19 percent in poor condition, and 1 percent in very poor condition [*Exhibit 3-53*].

Exhibit 3-53 *The Condition of Rural Bus Maintenance Facilities, 1997–1999*



Special Service Vehicles

No information is available on the age and condition of special service vehicles. FTA estimated that in 2002 nearly 60 percent of special service vehicles were more than 5 years old.