Chapter 3

System Conditions

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 column contains the values reported in the 1999 C&P report, based on 1997 data. Data revisions are shown in the second column. The third column provides comparable values based on 2000 data.

Exhibit 3-1

Comparison of System Conditions Statistics with Those in the 1999 Report

HIGHWAY

STATISTIC	CONDITION	1997 DATA 1999 REPORT	1997 DATA REVISED	2000 DATA
Total System Pavement	Good	n/a	43.2%	43.5%
	Acceptable	n/a	**86.6%**	**86.0%**
Rural Interstate Pavement	Good	n/a	56.9%	68.5%
	Acceptable	n/a	**97.6%**	**97.8%**
Small Urban Intestate Pavement	Good	n/a	51.4%	61.6%
	Acceptable	n/a	**95.8%**	**95.8%**
Urbanized Interstate Pavement	Good	n/a	39.3%	48.2%
	Acceptable	n/a	**90.0%**	**93.0%**
National Highway System Pavement	Good	n/a	46.1%	54.6%
	Acceptable	n/a	**91.8%**	**93.5%**

BRIDGE

STATISTIC	1998 DATA 1999 REPORT	1998 DATA REVISED	2000 DATA
Deficient Bridges	172,572	n/a	167,566
Deficient Bridges On Interstates	55,010	n/a	55,679
Deficient Bridges On Other Arterials	134,225	n/a	137,973

TRANSIT

STATISTIC		1998 DATA 1999 REPORT	1998 DATA REVISED	2000 DATA
Average Urban Bus Vehicle Condition *		3.1	2.96 **	3.07
Average Rail Vehicle Condition*		4.0	3.61***	3.55
Urban Bus Maintenance Facilities	Excellent	3%		9%
	Good	17%		8%
	Adequate	57%		54%
Rail Maintenance Facilities	Excellent	7%		0%
	Good	53%		21%
	Adequate	17%		43%
Rail Maintenance Yards	Excellent	0%		0%
	Good	63%		50%
	Adequate	37%		50%
Rail Stations	Excellent	11%		1%
	Good	46%		33%
	Adequate	15%		50%
Rail Track	Excellent	24%		26%
	Good	49%		45%
	Adequate	10%		12%

* Average Condition. Condtions are rated on ranking of 1 (poor) to 5 (excellent).
** Revised based on an improved methodology of applying data from the National Transit Database to estimated decay curves.
*** Revised based on new surveys of rail vehicle physical conditions and subsequent revision of decay curve function.

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, Small Urban Areas (population less than 50,000), and Urbanized (population greater than 50,000). In previous editions of this report the overall pavement conditions were presented based on the qualitative condition terms "very good," "good," "fair," "mediocre," and "poor." This edition adopts simplified terminology used in the annual 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 these two measures, and the relationship between the new categories are discussed later in the chapter.

In 2000, 86.0 percent of measured roads had acceptable ride quality including 43.5 percent that met the standard for good condition. Since 1997, there was a slight increase in the percentage of miles in the good category. There was also an increase in the percentage of miles in acceptable condition. Pavement condition on the Interstate system improved since 1997. The percentage of rural, small urban, and urbanized Interstates with acceptable ride quality increased by 0.4 percent to 96.6 percent between 1997 and 2000.

The common indicator used to evaluate the condition of the Nation's bridges was the number of deficient bridges. Under this metric, there were two types of deficient bridges: structurally deficient and functionally obsolete. In 1994, 32.5 percent of the Nation's bridges were deficient. In 2000, 28.5 percent of the Nation' bridges were deficient. Of the total number of bridges in 2000, 14.8 percent were structurally deficient while 13.8 percent were functionally obsolete. In urban areas, 31.9 percent of bridges were deficient, while in rural areas 27.6 percent were deficient. Local government agencies own over half of the deficient bridges.

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 29.6 percent. The percentage of deficient bridges on the Interstate system decreased from 24.7 percent to 21.6 percent while the percentage of deficient bridges on other arterials decreased from 27.6 percent to 25.8 percent.

A third indicator of bridge condition is deck area deficiency; this measure is increasingly used by engineers and policy analysts to describe bridge integrity. FHWA's FY 2002 Performance Plan, for example, includes an indicator on deck area deficiency for NHS and non-NHS bridges. As Exhibit 3-34 describes, the nationwide percentage of bridge deck area described as deficient dropped from 30.9 percent in 1996 to 27.9 percent in 2000. Bridges with unknown or unclassified ownership had the largest percentage of deficient deck area (42.8 percent in 2000), followed by privately owned bridges (33.8 percent). Federally owned bridges had the smallest percentage of deficient deck area (25.8 percent in 2000).

In 2000, 27.9 percent of the Nation's bridge deck area was considered deficient. The percentage of deficient bridge deck area decreased on every functional system from 1996 to 2000. Rural Interstate bridges had the smallest deficient deck area in 2000 (about 15 percent), while urban collector bridges had the largest deficient deck area (39.6 percent).

Transit Conditions

The condition of transit vehicles did not change significantly between 1997 and 2000. On a scale of 1 (poor) to 5 (excellent), bus vehicles had an average condition of 3.07 in 2000, up from 2.96 in 1997. The average condition of rail vehicles was 3.55 in 2000, down from 3.61 in 1997. Both the 1997 and 2000 ratings are lower than the 3.80 rating of rail vehicles reported in 1987. The average rail vehicle condition of 4.0 that was reported in the 1999 C& P Report for 1997 was subsequently revised downward to reflect a correction in the decay curve function for rail vehicles, excluding commuter rail. This revision was based on an updated and larger set of condition data collected by FTA in 1999, 2000, and 2001.

The percentage of bus maintenance facilities in adequate or better condition declined to 71 percent in 2000 from 77 percent in 1997. The percentage of rail maintenance facilities in adequate or better condition also fell from 77 percent in 1997 to 64 percent in 2000. The condition of yards has also declined. In 2000, 50 percent of all yards were in good condition and 50 percent were in adequate condition, compared with 63 percent in good condition and 37 percent in adequate condition in 1997. While the percentage of stations estimated to be in adequate or better condition has increased from 77 percent in 1997 to 84 percent in 2000, the percentage in good or better condition has declined from 54 percent in 1997 to 34 percent in 2000. These changes have resulted largely from the application of the newly estimated decay curve based on rail maintenance facility decay curves rather than in a change in the actual condition level of stations. Rail track conditions are estimated to have remained constant since 1997, with 83 percent of all track estimated to be in good or better condition in both 1997 and 2000.

Road Conditions

Pavement Terminology & Measurements

Pavement condition affects costs associated with travel, including vehicle operation, delay, and crash expenses. Poor road surfaces cause additional wear 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. Unexpected changes in surface conditions can lead to crashes, and inadequate road surfaces may reduce road friction, which affects the stopping ability and maneuverability of vehicles.

The pavement condition ratings in this section are derived from one of two measures: International Roughness Index (IRI), and 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 1 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.

States are required to report IRI data for the Interstate system, other principal arterials, rural minor arterials, and the National Highway System regardless of functional system. IRI reporting is recommended for all other functional classifications. The use of IRI data for reporting the status of rural major collectors and urban minor arterials has increased to 59 percent and 49 percent respectively of the miles for each. The total of urban collector miles reported using IRI data has risen to 34 percent. The procedure of reporting pavement condition status by IRI data for all functional classes is increasing.

The FHWA adopted the IRI for the higher functional classifications because this index uses a standardized procedure, is more consistent across jurisdictions, is an objective measurement, and is generally accepted as a worldwide 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, 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 data in this report only go back to 1993, when IRI data began to be collected. Caution should be used when making comparisons with older data from earlier editions of this report and when attempting to make comparisons between PSR and IRI data in general.

Q. Do other measures of pavement condition exist?

A. Other principal measures of pavement condition or distress such as rutting, cracking and faulting 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 has been working with AASHTO and States to establish standards for measuring roughness, cracking, rutting, and faulting.

Exhibit 3-3

Pavement Condition Criteria (Old - New)

	IRI RATING		PSR RATING	
OLD CONDITION TERM CATEGORIES	**INTERSTATE**	**OTHER**	**INTERSTATE**	**OTHER**
Very Good	< 60	< 60	≥ 4.0	≥ 4.0
Good	60 to 94	60 to 94	3.5 to 3.9	3.5 to 3.9
Fair	95 to 119	95 to 170	3.1 to 3.4	2.6 to 3.4
Mediocre	120 to 170	171 to 220	2.6 to 3.0	2.1 to 2.5
Poor	> 170	> 220	≤ 2.5	≤ 2.0

	All Functional Classifications	
NEW RIDE QUALITY TERMS*	**IRI RATING**	**PSR RATING**
Good	< 95	≥ 3.5
Acceptable	≤ 170	≥ 2.5

* The threshold for "Acceptable" ride quality used in the 2002 Conditions and Performance 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 meet to be classified as "Acceptable".

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 National Highway System (NHS) mileage should meet pavement standards for "acceptable ride quality." This goal was accomplished in 1999.

The FHWA has adopted a new metric based on the percent of vehicle miles traveled (VMT) on acceptable pavement. This metric of "Ride Quality" places more emphasis on the benefits of good pavements to the users instead of the physical condition of pavements. The *FHWA Fiscal Year 2003 Performance Plan* established the goal to have 92.5 percent of all VMT on the NHS to be on highways rated as acceptable or better ride quality by the year 2003. Exhibit 3-4 shows that in the year 2000, 91.0 percent of the VMT on the NHS were on pavements with acceptable ride quality. This is an increase of 0.4 percent over 1999. The NHS is discussed in more detail in Chapter 24.

Exhibit 3-4

Ride Quality on the National Highway System

	1993	1995	1997	1999	2000
Total VMT on NHS	2,323,656,218	2,773,719,086	3,033,033,380	3,241,301,356	3,312,944,220
Total VMT on NHS Acceptable Pavements	2,091,128,773	2,468,245,187	2,703,120,410	2,937,157,991	3,013,967,870
Total Miles of NHS	142,837	154,204	157,582	158,971	158,802
Total Miles of NHS with Acceptable Ride Quality	127,872	139,408	144,643	147,817	148,538
Percent VMT on NHS Acceptable Pavements	90.0%	89.0%	89.1%	90.5%	90.9%
Percent Miles of NHS Pavement with Acceptable Ride Quality	89.5%	90.4%	91.8%	93.0%	93.5%

Source: Highway Performance Monitoring System.

Please note that the remainder of this chapter retains the traditional approach of describing pavement condition in terms of miles, rather than in terms of VMT.

To be rated acceptable, pavement performance must have an IRI value of less than or equal to 170 inches per mile. Good pavements comprise a subset of acceptable pavements. For a pavement to be rated as good, the IRI value must be less than or equal to 95 inches per mile. The Fiscal Year 2003 Performance Plan applies the same ride quality standard to all NHS routes, including those off the Interstate system. IRI is required to be reported for all NHS routes and is the preferred measure to determine acceptable ride quality.

In this chapter, overall ride quality is presented based on the qualitative condition terms good, acceptable, and not acceptable. The correlation between these condition terms to the condition terms used in previous C&P reports and to the IRI or PSR system is presented in Exhibit 3-3.

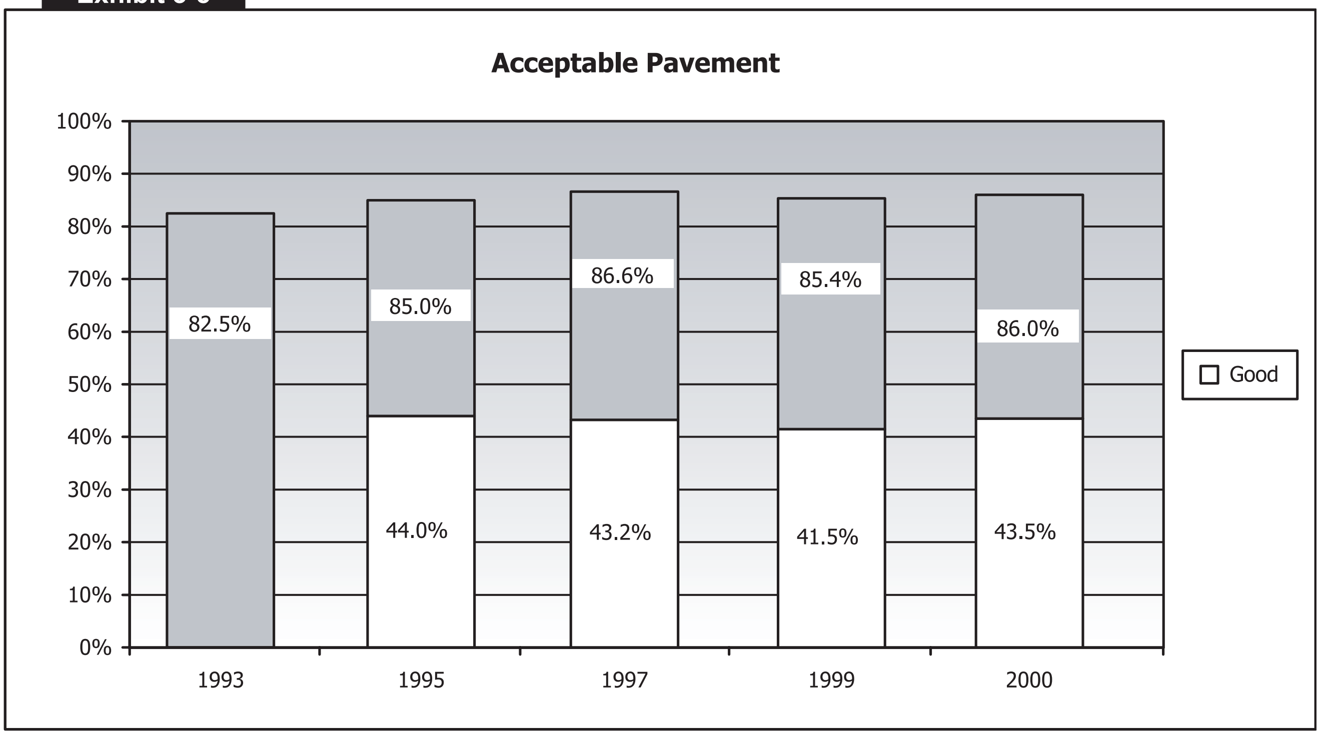
Overall Pavement Condition

The highway systems covered in this chapter include all mileage except rural minor collectors and local functional classifications. Based on the new metrics for ride quality, 86.0 percent of total road mileage evaluated was rated acceptable in 2000, including 43.5 percent that met the standard for good. *[See Exhibit 3-5].*

Q. Why isn't a percentage shown for the "Good" category in 1993?

A. In 1993, many States were in the process of converting from PSR to IRI reporting, and some anomalies in the overall data were observed. The percentage of pavement meeting the criteria to be classified as good was clearly inconsistent with that reported in subsequent years.

Exhibit 3-5

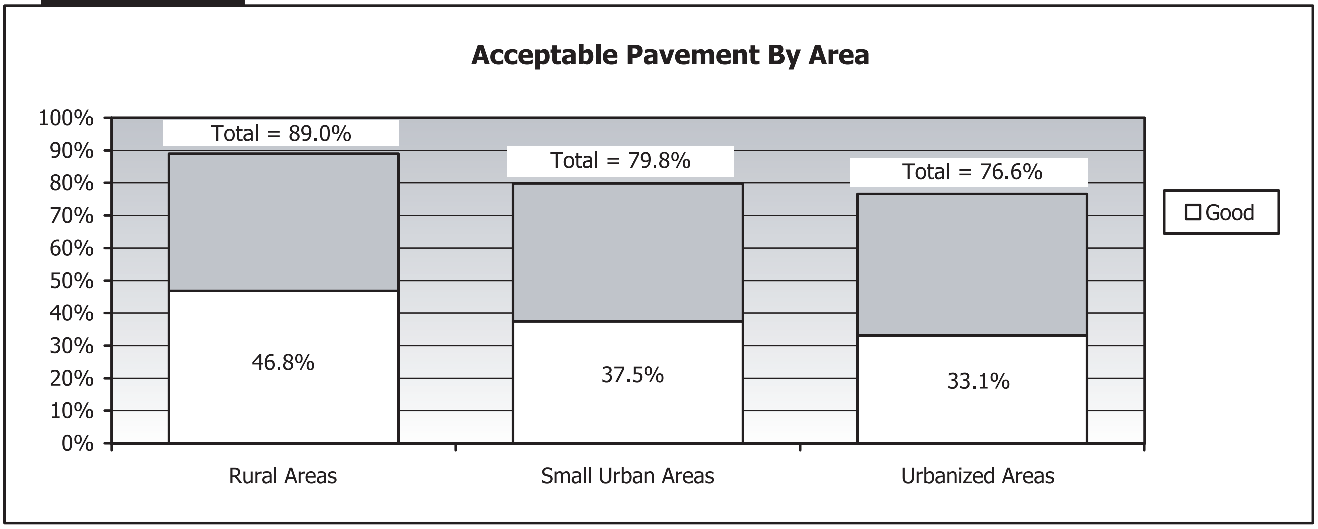


Source: Highway Performance Monitoring System.

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 78.2 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 2000 data, pavement conditions in rural areas are slightly better than those in small urban and urbanized areas. 89.0 percent of total road miles in rural areas are rated acceptable while 79.8 percent of road miles in small urban areas are rated acceptable and 76.6 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, 46.8 percent of rural miles, 37.5 percent of small urban miles, and 33.1 percent of urbanized miles. *[See Exhibit 3-6]*. Note that rural minor collectors and local functional system mileage are not included in these percentages.

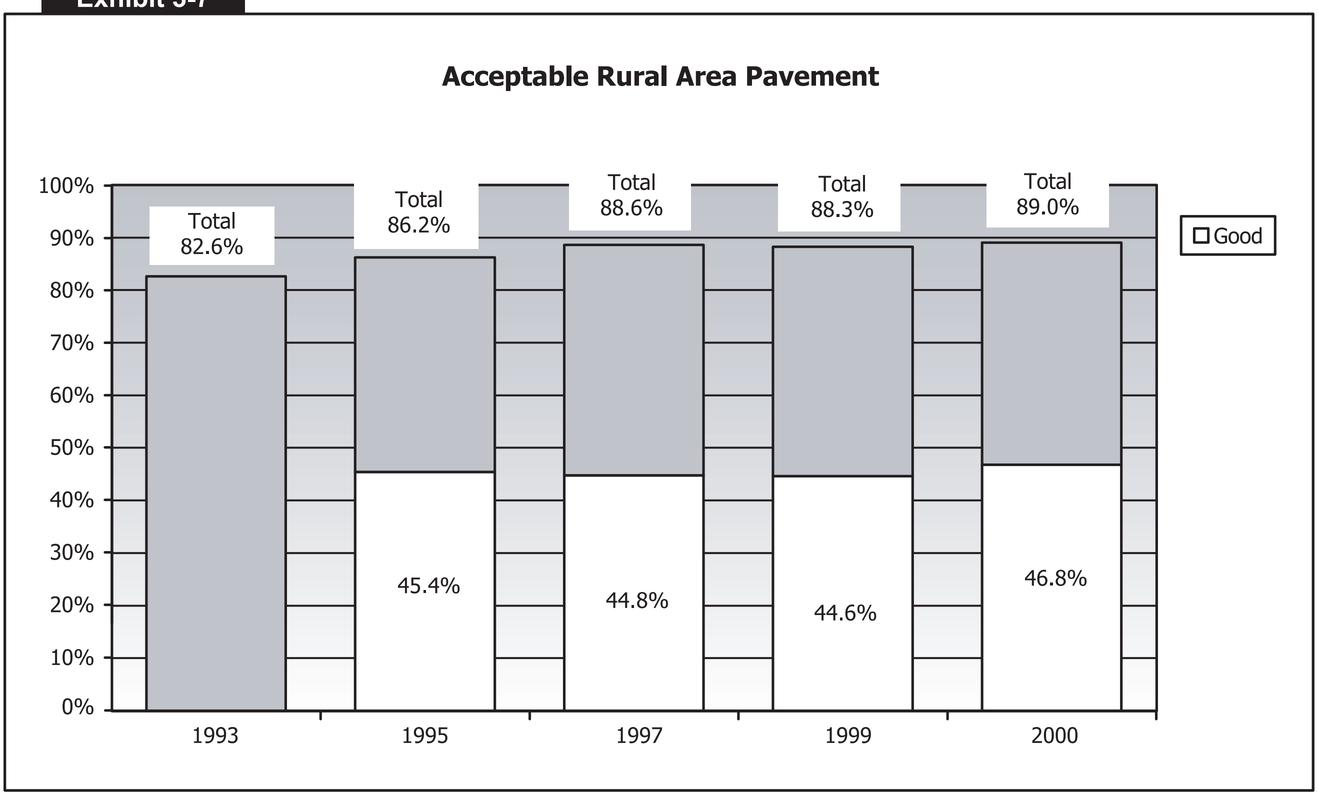
Exhibit 3-6



Source: Highway Performance Monitoring System.

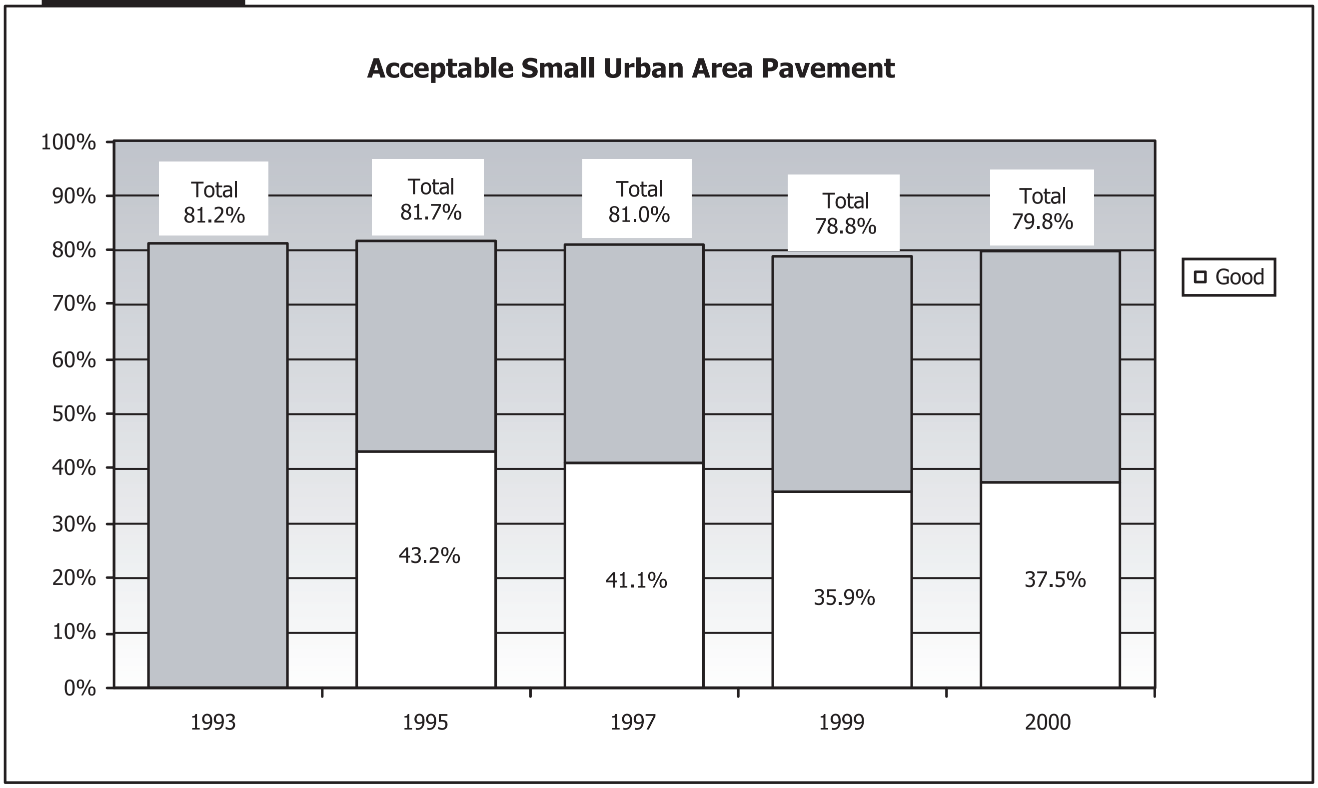
Pavement conditions in rural areas have generally been improving over time. Since 1993, the percentage of road miles in acceptable condition has increased from 82.7 percent to 89.0 percent in rural areas. However, both small urban and urbanized areas have experienced decreases in acceptable pavement miles from 81.2 percent to 79.8 percent and from 82.4 percent to 76.6 percent, respectively, since 1993. Comparable trends can be observed in the percentage of miles rated as good.
[See Exhibits 3-7, 3-8, & 3-9].

Exhibit 3-7



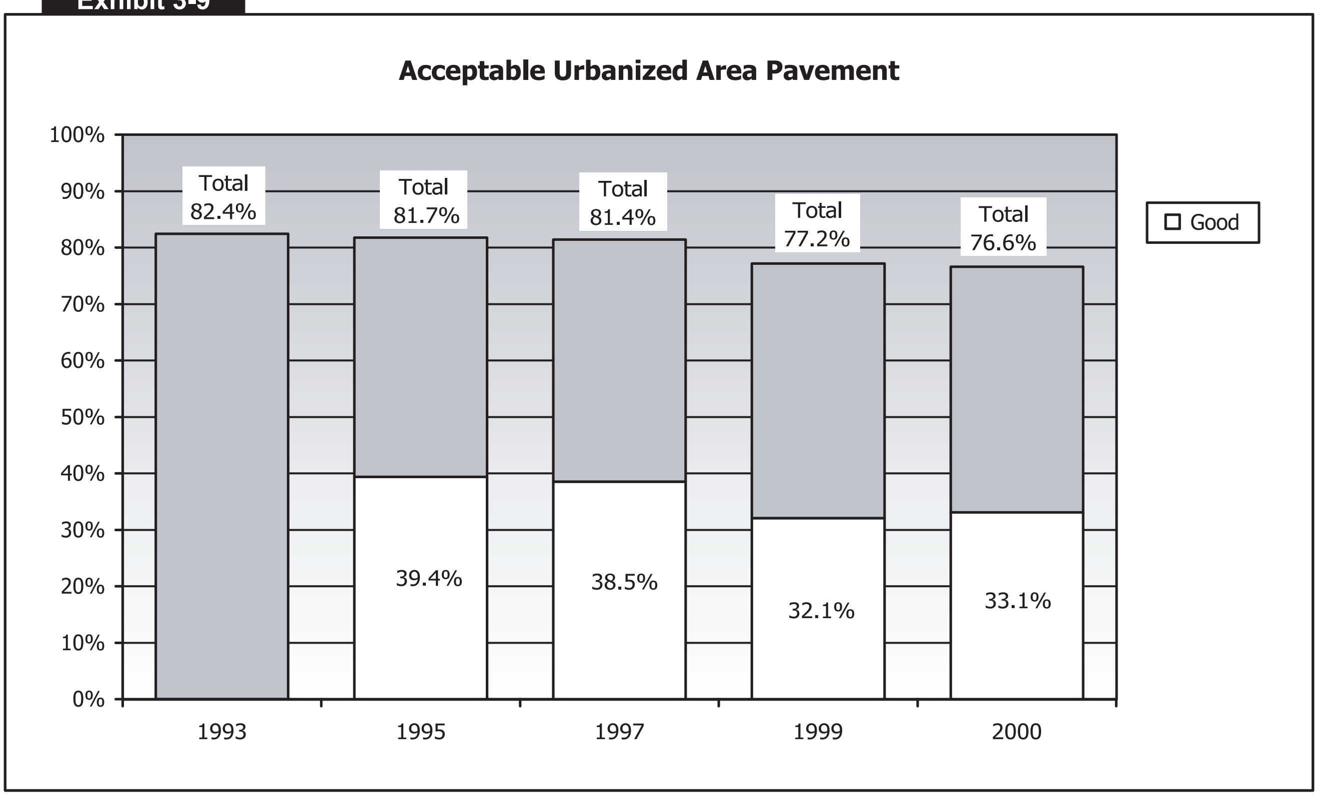
Source: Highway Performance Monitoring System.

Exhibit 3-8



Source: Highway Performance Monitoring System.

Exhibit 3-9



Source: Highway Performance Monitoring System.

Pavement Condition by Functional Classification

As stated in Chapter 2, the functional classification for approximately 68.8 percent of total mileage is "local." Nevertheless, roads classified as "Interstate" have the largest percentage of VMT, followed by other principal arterials, minor arterials, and major collectors. Therefore, ride quality on Interstate routes affects more users than ride quality on lower functional classifications. Interstate mileage in rural areas is 97.8 percent acceptable. In small urban areas, Interstate mileage is 95.6 percent acceptable. In urbanized areas, Interstate mileage is 93.0 percent acceptable.

For minor arterials, rural areas have a lower percentage of acceptable roads and a slightly higher percentage of miles of good roads than compared to urban areas. Urban areas also have a lower percentage of collector roads in acceptable condition and a lower percentage of collector roads miles in good condition when compared to rural 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 1993 to 2000 based on the revised ride quality standards incorporated in this report. The exhibit illustrates that pavement conditions have changed in a variety of ways. For example, since 1993, the percentage of Interstate miles in rural areas classified as acceptable has increased from 93.5 percent to 97.8 percent.

The percentage of Interstate miles in urbanized areas rated as acceptable has increased from 89.8 percent to 93.0 percent. However, during the same time period, the percentage of Other Principal Arterials in urbanized areas listed as acceptable has decreased from 79.3 percent to 67.8 percent.

Combining the rural, small urban, and urbanized Interstate data illustrates that, overall, Interstate pavement performance has improved since 1993. The percentage of all Interstate mileage with "acceptable ride quality" increased from 92.6 percent in 1993 to 96.6 percent in 2000.

One consistent trend is the faster rate of pavement condition improvement in rural areas versus small urban and urbanized areas. Since 1993, 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, two functional classifications—Interstate and Minor Arterials—have seen an increase in acceptable road miles, one functional class—Other Freeway and Expressway—has remained relatively stable, and two functional classes—Other Principal 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 have experienced declines in acceptable road miles—Other Principal Arterials, Minor Arterials, and Collectors. *[See Exhibit 3-10].*

Exhibit 3-10

Ride Quality by Functional System, For Selected Years 1993 - 2000

Percent Acceptable

FUNCTIONAL SYSTEM	1993	1995	1997	1999	2000
Rural Interstate	93.5%	94.5%	95.9%	97.6%	97.8%
Rural Principal Arterial	89.2%	91.4%	93.7%	95.5%	96.0%
Rural Minor Arterial	84.6%	85.1%	89.8%	92.0%	92.1%
Rural Major Collector	75.7%	82.5%	84.0%	79.7%	82.1%
Small Urban Interstate	93.5%	94.4%	95.8%	95.4%	95.8%
Small Urban Other Freeway & Expressway	93.7%	90.2%	91.2%	92.8%	93.7%
Small Urban Other Principal Arterial	85.8%	82.0%	80.5%	81.7%	82.9%
Small Urban Minor Arterial	77.7%	82.5%	82.2%	78.1%	80.0%
Small Urban Collector	74.0%	76.4%	75.9%	68.3%	68.9%
Urbanized Interstate	89.8%	90.0%	90.0%	92.2%	93.0%
Urbanized Other Freeway & Expressway	86.8%	87.6%	87.7%	88.8%	88.3%
Urbanized Other Principal Arterial	79.3%	75.9%	73.2%	67.6%	67.8%
Urbanized Minor Arterial	82.4%	82.1%	82.7%	78.5%	78.3%
Urbanized Collector	82.1%	84.4%	86.4%	80.3%	77.4%

Percent Good

FUNCTIONAL SYSTEM	1993	1995	1997	1999	2000
Rural Interstate		51.8%	56.9%	65.4%	68.5%
Rural Principal Arterial		41.3%	47.5%	54.0%	57.4%
Rural Minor Arterial		41.2%	45.5%	46.9%	47.8%
Rural Major Collector		48.8%	40.8%	33.2%	36.8%
Small Urban Interstate		49.8%	51.4%	58.2%	61.6%
Small Urban Other Freeway & Expressway		41.6%	35.8%	41.3%	43.8%
Small Urban Other Principal Arterial		36.8%	32.7%	33.7%	36.7%
Small Urban Minor Arterial		48.3%	46.5%	38.1%	38.9%
Small Urban Collector		44.3%	45.3%	30.3%	30.7%
Urbanized Interstate		41.4%	39.3%	45.0%	48.2%
Urbanized Other Freeway & Expressway		37.0%	31.4%	35.5%	38.0%
Urbanized Other Principal Arterial		29.3%	26.8%	23.7%	24.0%
Urbanized Minor Arterial		46.2%	46.0%	38.0%	38.4%
Urbanized Collector		45.5%	48.0%	31.5%	32.5%

Source: Highway Performance Monitoring System.

Roadway Alignment

Alignment adequacy affects the level of service and safety of the highway system. There are two types of alignment: horizontal and vertical. Inadequate alignment may result in speed reductions and impaired sight distance. In particular, trucks are affected by inadequate roadway alignment with regard to speed. Alignment adequacy is evaluated on a scale from Code 1 (best) to Code 4 (worst). Exhibit 3-11 explains the alignment rating system.

Exhibit 3-11

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 only presents rural data. Exhibits 3-12 and 3-13 illustrate that 95.6 percent of rural Interstate miles are classified as Code 1 for horizontal alignment and 92.8 percent are classified as Code 1 for vertical alignment. The share of rural roads classified as Code 4 for horizontal alignment is 7.7 percent, and 6.3 percent are rated Code 4 for vertical alignment. Roadway alignment continues to improve gradually as sections with poor alignment are reconstructed.

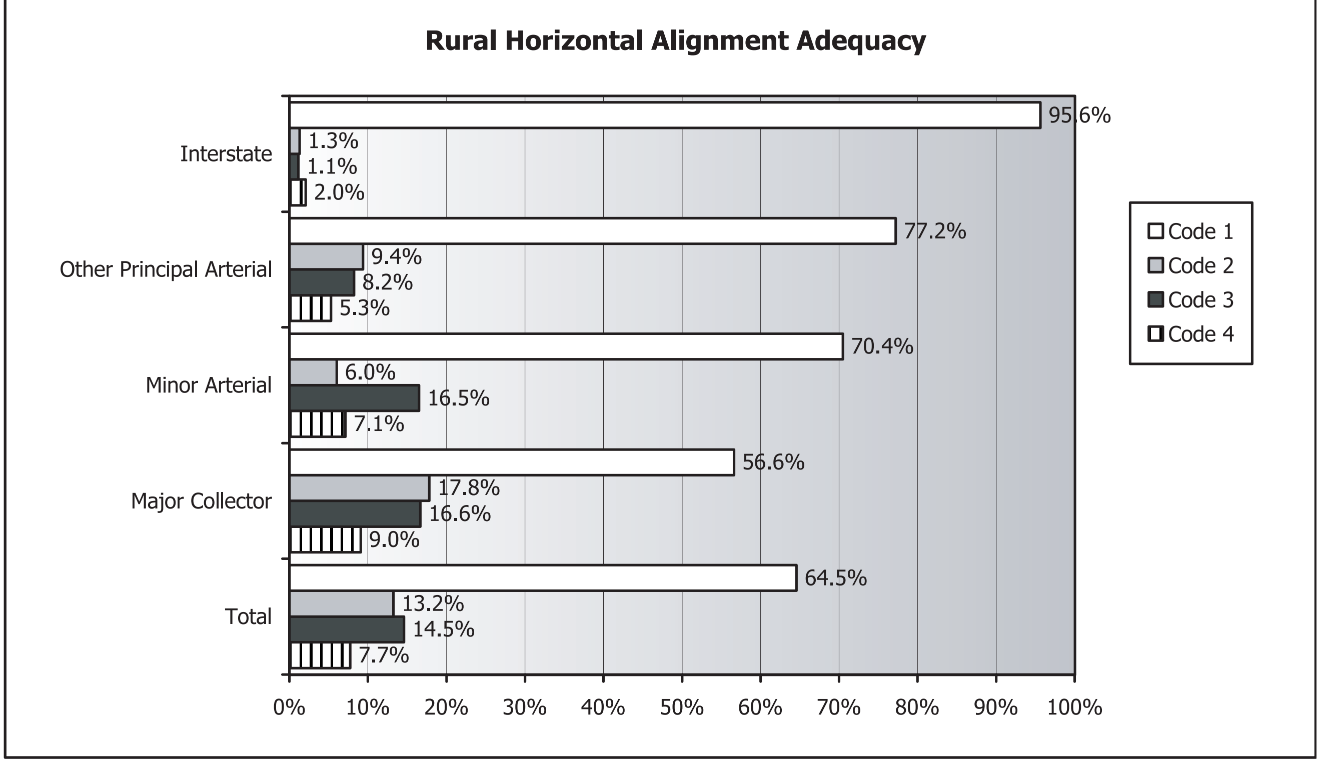
Lane Width

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 functional classifications with the higher travel volumes.

Currently, high-type facilities (e.g. Interstates) are expected to have 12-foot lanes. Exhibits 3-14 and 3-15 illustrate that over 97 percent of Interstate miles meet the 12-foot standard.
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. Since 1993, total rural mileage with lane width greater than or equal to 12 feet increased from 51.6 percent to 52.6 percent while the urban mileage with 12-foot-plus lanes decreased from 67.4 percent to 67.0 percent. Part of the urban decline may be attributable to the reclassification of roads from rural to urban as a result of population growth. [*See Exhibit 3-16*].

Exhibit 3-12



Source: Highway Performance Monitoring System.

Exhibit 3-13

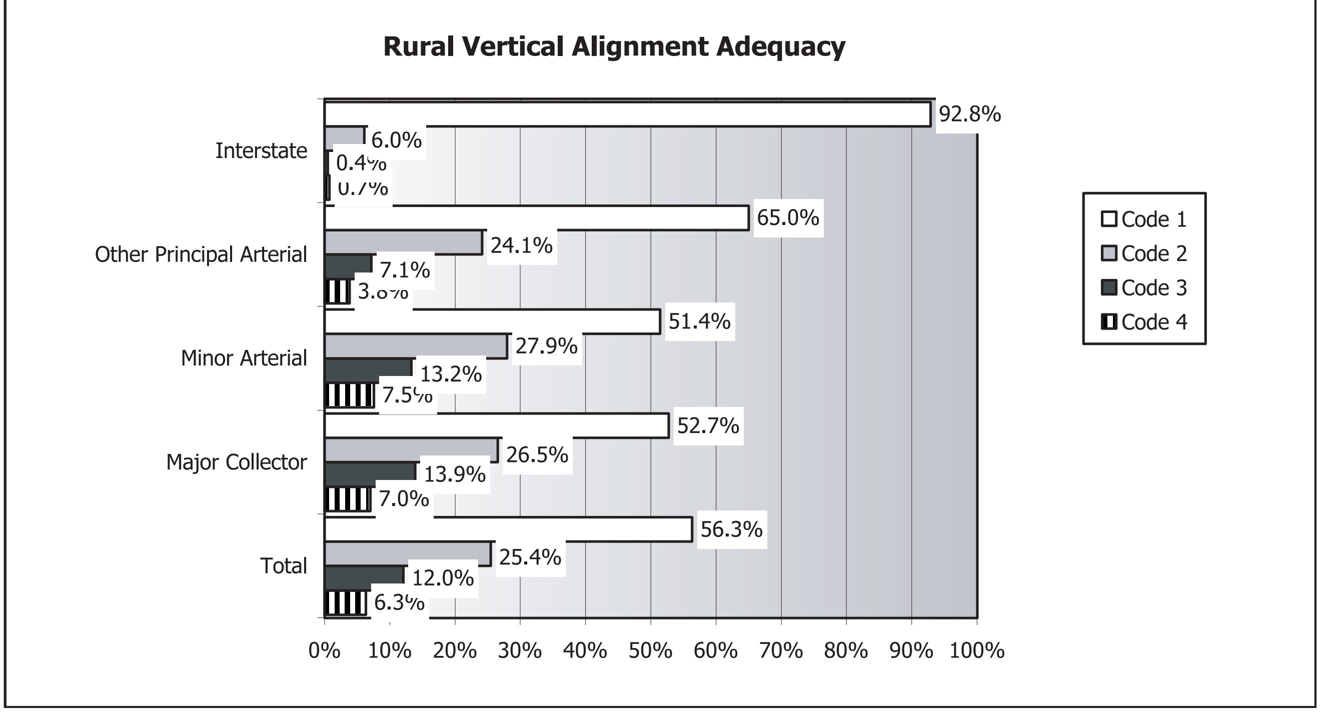
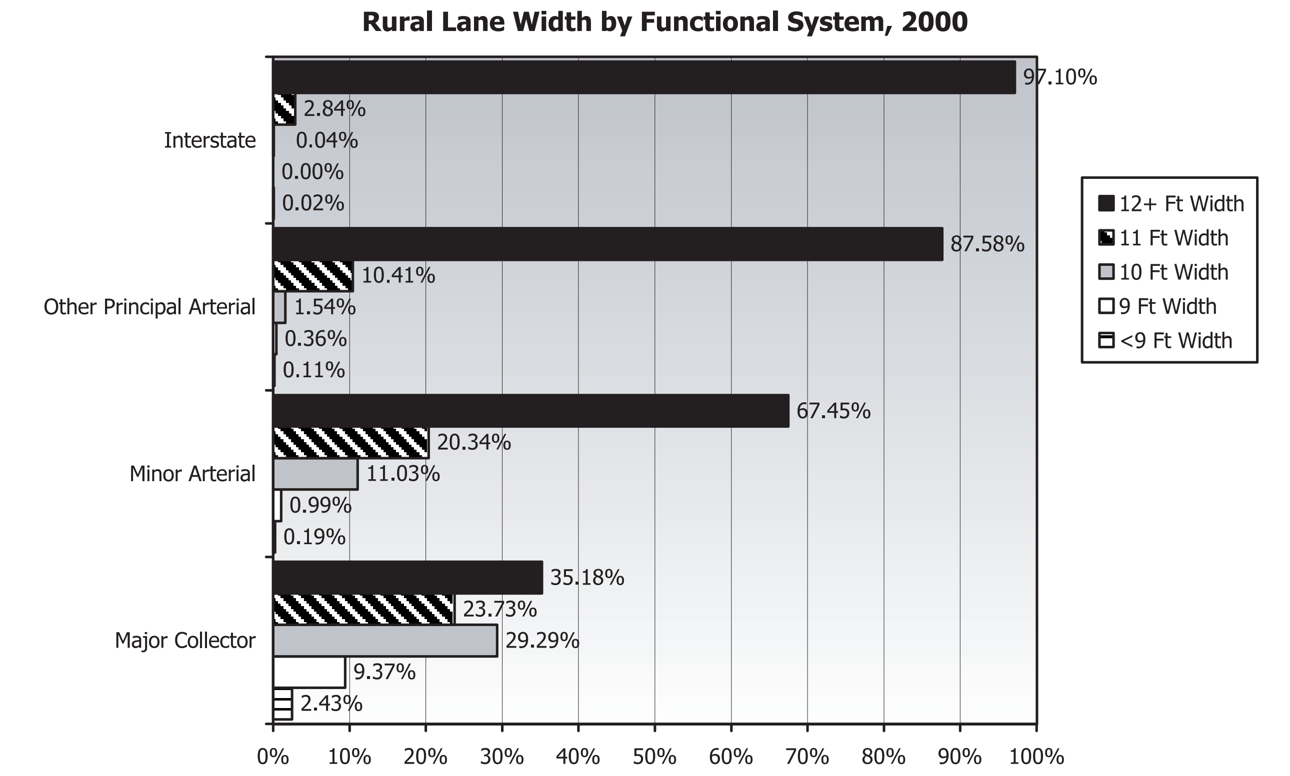
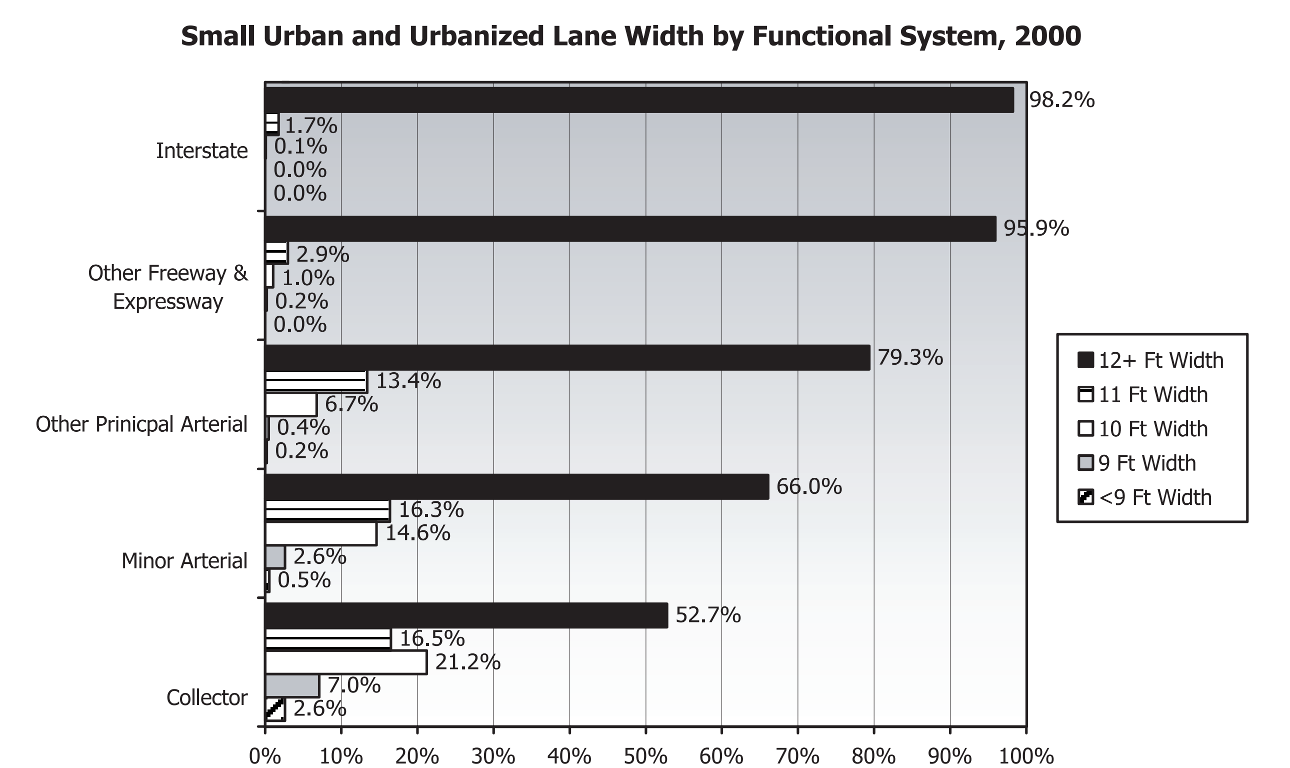


Exhibit 3-14



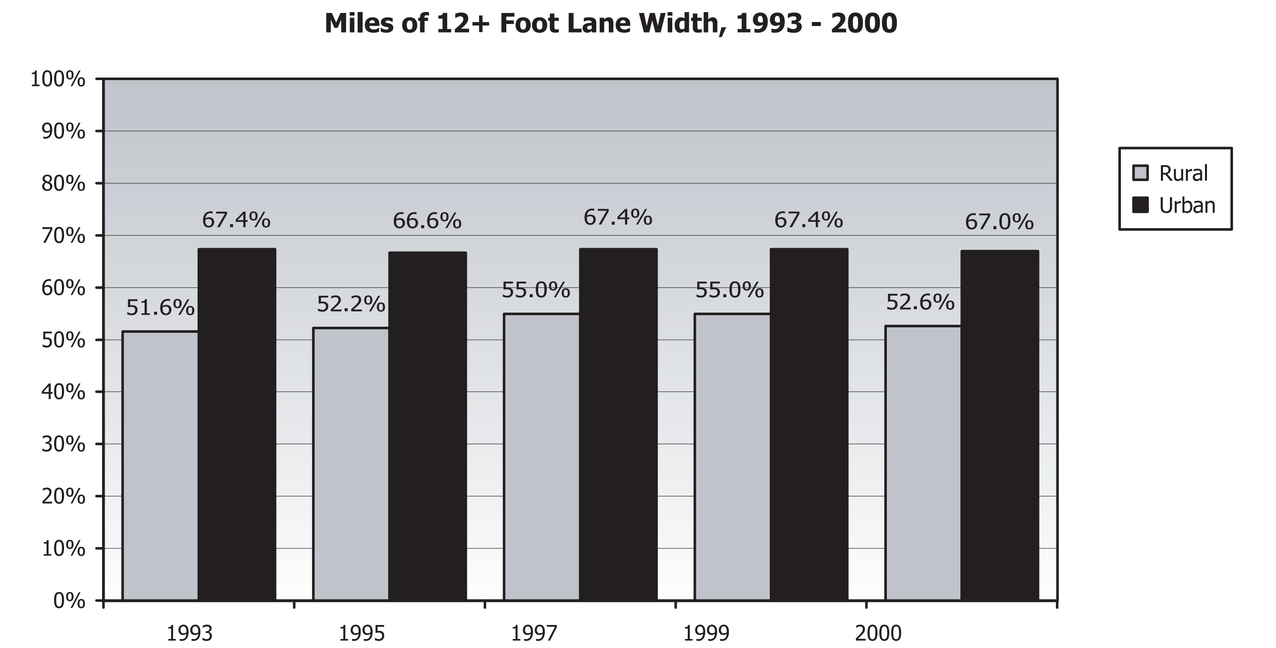
Source: Highway Performance Monitoring System.

Exhibit 3-15



Source: Highway Performance Monitoring System.

Exhibit 3-16



Source: Highway Performance Monitoring System.

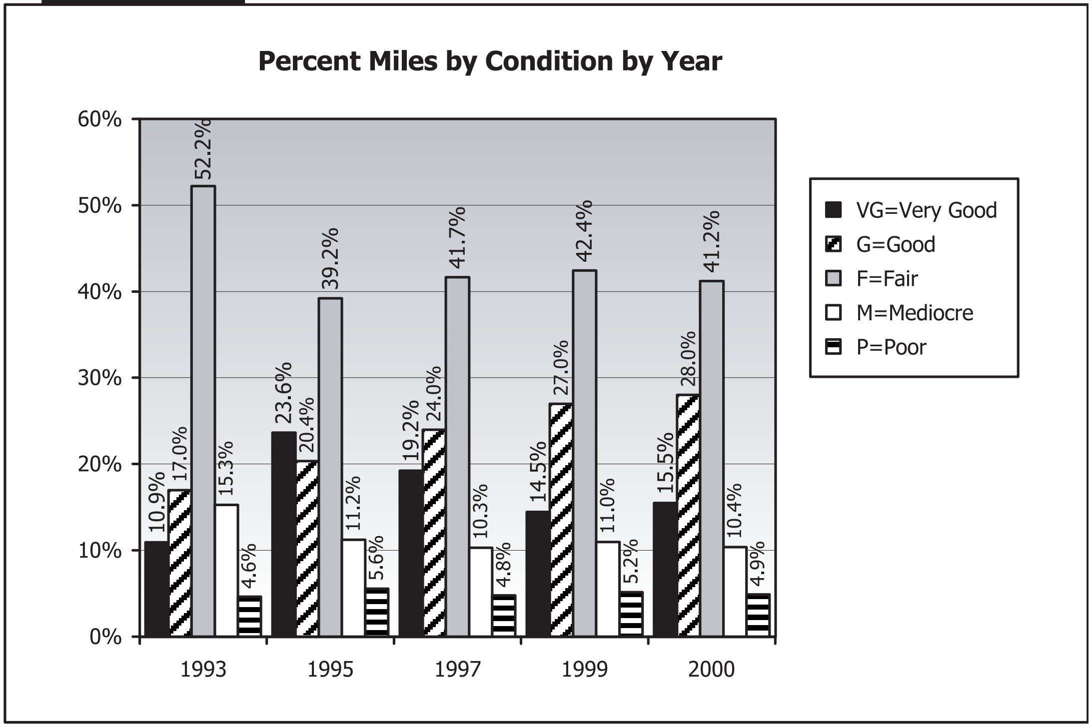
Pavement Condition Based on Old Classification System

In previous C&P reports, the condition of pavement was listed by very good, good, fair, mediocre, and poor. In order to provide reference and a bridge between the rating system in previous reports and the new system, the overall pavement condition based on 2000 HPMS data is shown in Exhibit 3-17.

Following the previous rating system, 15.5% of the miles are in very good condition and 28.0% are in good condition. Since 1997, the percentage of mileage in very good condition fell 1.0 percent while the percentage of mileage in good condition increased 1.0 percent. The percentage of fair pavement decreased from 42.4 percent to 41.2 percent while the percentage of mediocre pavement decreased slightly from 11.0 percent to 10.4 percent. Finally, the percentage of poor pavement decreased slightly from 5.1 percent to 4.9 percent since 1997.

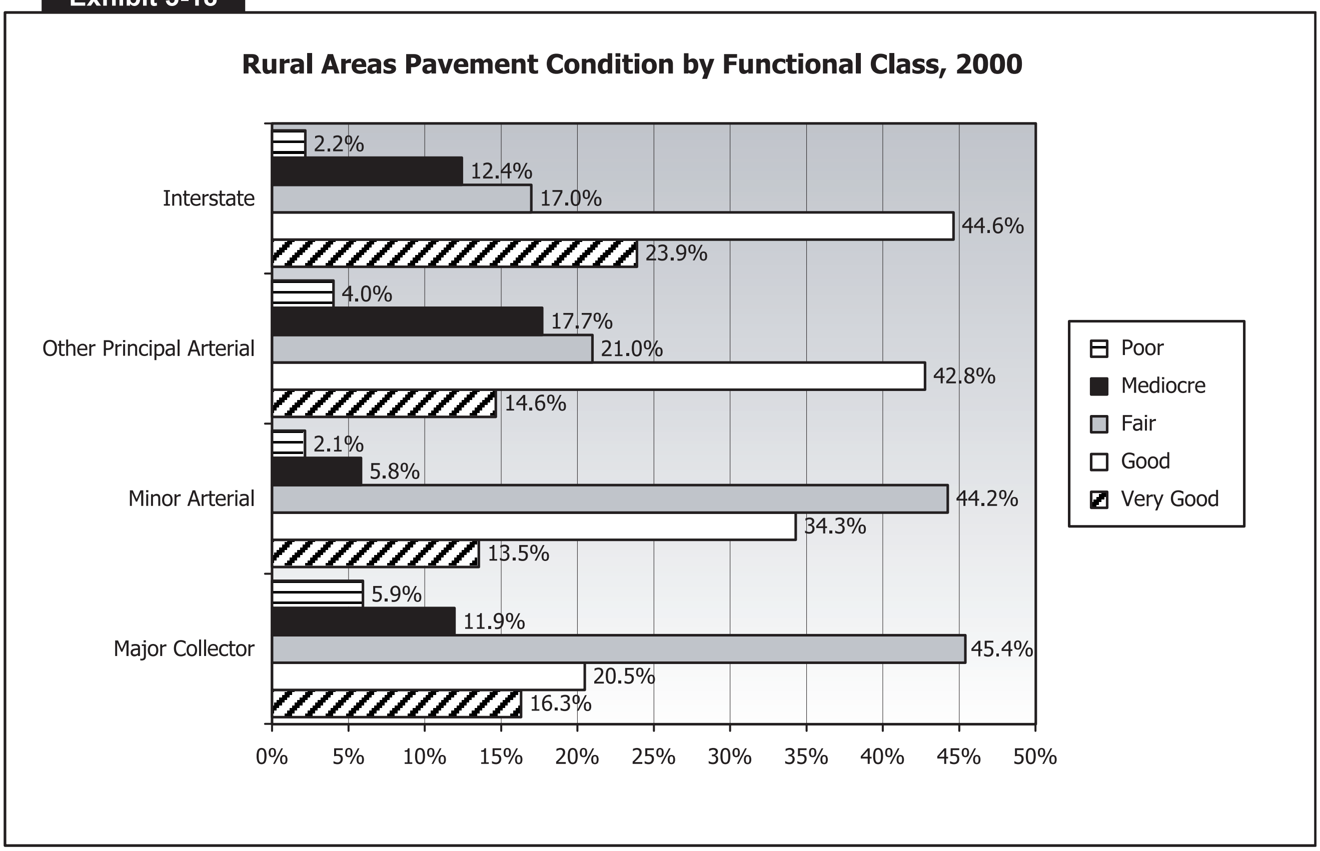
Exhibits 3-18, 3-19, and 3-20 contain the portion of rural, small urban, and urbanized area pavement in the various condition categories, respectively, based on ride quality standards prior to the implementation of the revised standards.

Exhibit 3-17



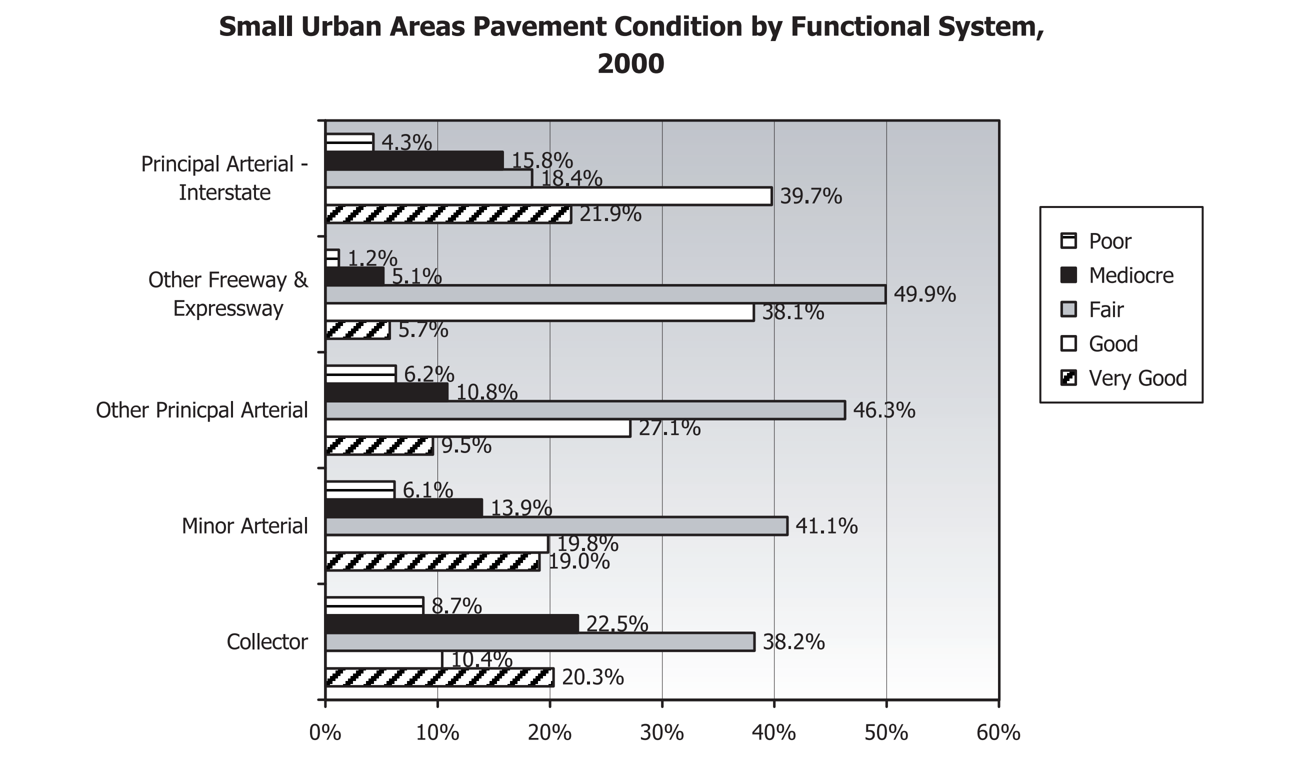
Source: Highway Performance Monitoring System.

Exhibit 3-18



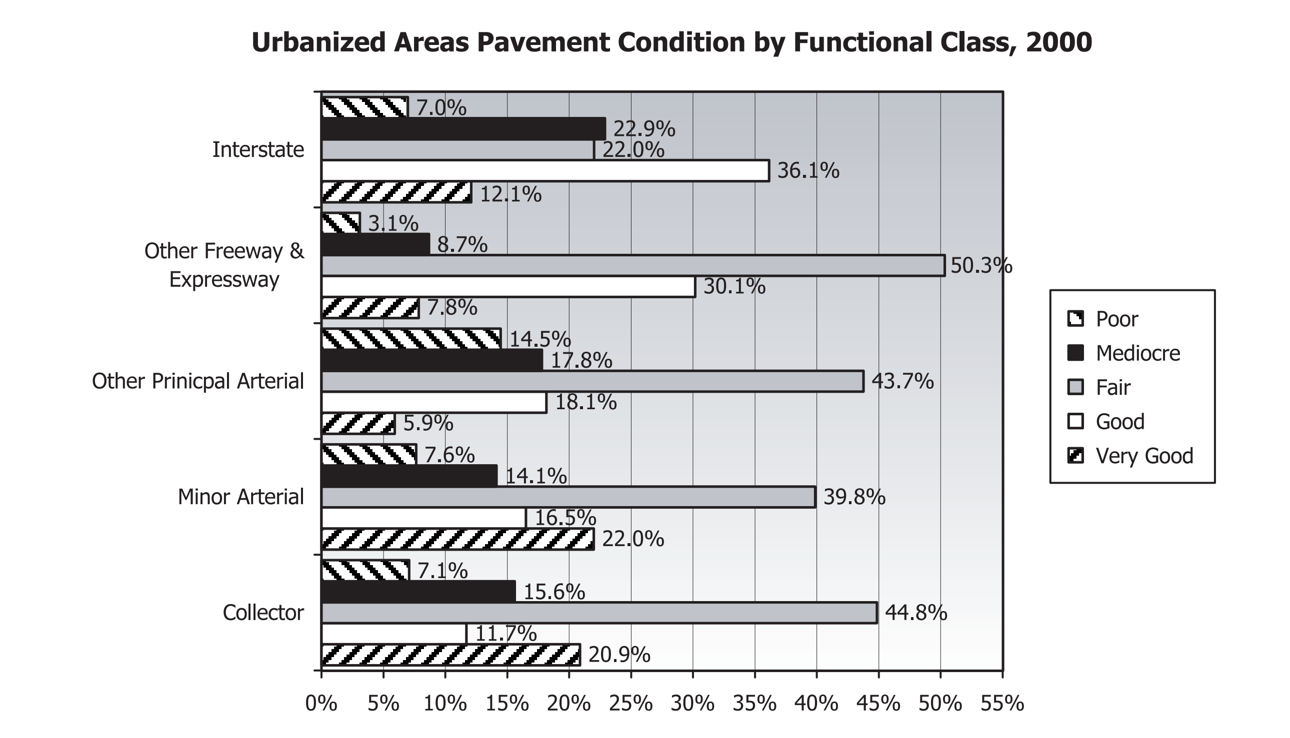
Source: Highway Performance Monitoring System.

Exhibit 3-19



Source: Highway Performance Monitoring System.

Exhibit 3-20



Source: Highway Performance Monitoring System.

Bridge Conditions

Three indicators are examined in this section: bridge condition ratings, the number of deficient bridges, and the percentage of deck area on deficient bridges. Each measure examines bridge conditions from a different perspective. Condition ratings provide a numerical evaluation of the condition of a bridge element. The number of deficient bridges is widely used by policymakers to describe bridge conditions nationwide, but it does not recognize the relative importance, from a mobility perspective, of an individual bridge's contribution to the overall transportation system. The final indicator—the percentage of deck area on bridges classified as deficient—is increasingly used to document the state of bridge conditions; for example, the FY 2002 FHWA Performance Plan includes this measure as its new indicator. This chapter describes deck area on deficient bridges by owner and functional system. Information on National Highway System (NHS) bridges is described in Chapter 24.

Bridge Condition Ratings

The National Bridge Inventory (NBI) contains ratings on the conditions of three major bridge components: the deck, superstructure, and substructure. A bridge deck is the primary surface used for transportation. The deck is supported by the superstructure, which carries the load of the deck and the traffic. 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 substructure elements, such as abutments and piers. Exhibit 3-21 describes bridge condition ratings in greater detail.

Condition ratings are used to describe the existing, in-place status of a component, not its as-built state. Engineers assign condition ratings by evaluating the severity of deterioration or disrepair and the extent to which it is widespread

Exhibit 3-21

Bridge Condition Ratings

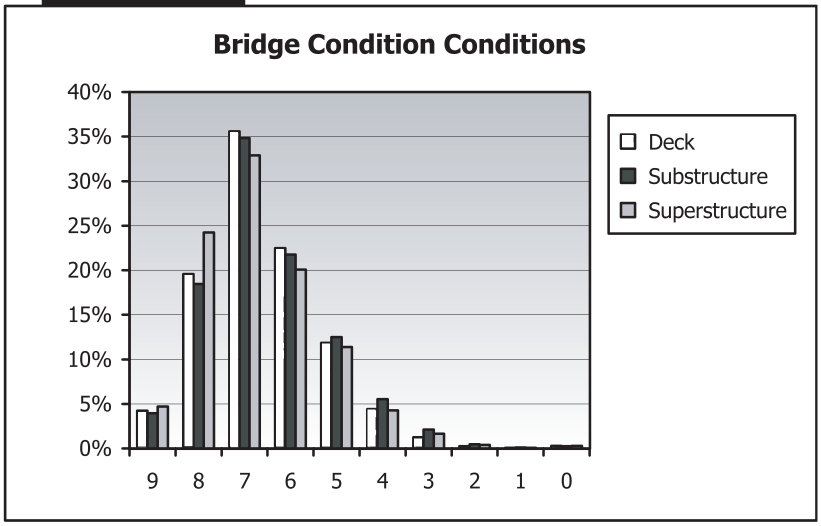
RATING	CATEGORY	DESCRIPTION
9	Excellent Condition	
8	Very Good Condition	
7	Good Condition	No problems noted.
6	Satisfactory Condition	Some minor problems.
5	Fair Condition	All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	Poor Condition	Advanced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

Source: "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges," December 1995.

throughout the component being rated. A condition rating does not translate directly into an overall rating of a bridge's condition, but it is a good indicator of the quality of specific elements.

Exhibit 3-22 illustrates the distribution of bridge condition ratings. Most bridge components are rated 7 or higher, indicating that they are in good, very good, or excellent condition. Another one-third of all bridge components are rated 5 or 6, indicating fair or satisfactory condition. The remainder of bridge components are rated 4 or lower, indicating a poor or worse condition.

Exhibit 3-22



Source: National Bridge Inventory.

Number of Deficient Bridges

The most commonly-cited indicator of bridge condition is the number of deficient bridges. There are two types of deficient bridges: structurally deficient and functionally obsolete. Bridges are considered structurally deficient if they are restricted to light vehicles, require immediate rehabilitation to remain open, or are closed. A deficient bridge may or may not be dangerous, but it does require significant maintenance, rehabilitation, or sometimes replacement. Bridges are considered functionally obsolete if they have deck geometry, load carrying capacity, clearance, or approach roadway alignment that no longer meets the criteria for the system of which the bridge is a part.

As shown by Exhibit 3-23, about 28.5 percent of the Nation's bridges were deficient in 2000. Of these deficient bridges, about 14.8 percent were structurally deficient and 13.8 percent were functionally obsolete.

The number of deficient bridges has steadily decreased over the past decade. In 1994, about 32.5 percent of the Nation's bridges were deficient, but that number had dropped by almost 4 percent by 2000. The long-term trend is consistent with expectations in the Federal Highway Administration's 1998 Strategic Plan, which stated that less than 25 percent of the Nation's bridges should be deficient by 2008. Exhibit 3-24 describes the trend data in more detail.

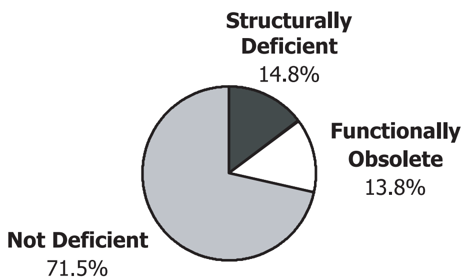
Q. When might a bridge be classified as functionally obsolete?

A. A bridge can become functionally obsolete because of highway improvements on the approaches to the bridge, such as lane additions or the widening of approaching roads. In other cases, a bridge may be classified as functionally obsolete through a redefinition of desired standards.

A more specific way of looking at the number of deficient bridges is by owner. As Chapter 2 explained, ownership of bridges is largely divided among State and local governments (47.2 and 50.9 percent, respectively). The remaining bridges, totaling 1.4 percent, are split among the Federal

Exhibit 3-23

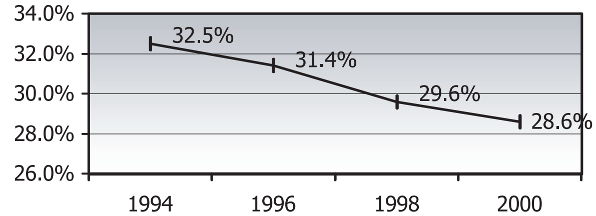
Deficiencies for All Bridges, 2000



Source: National Bridge Inventory.

Exhibit 3-24

Percentage of Deficient Bridges, 1994-2000



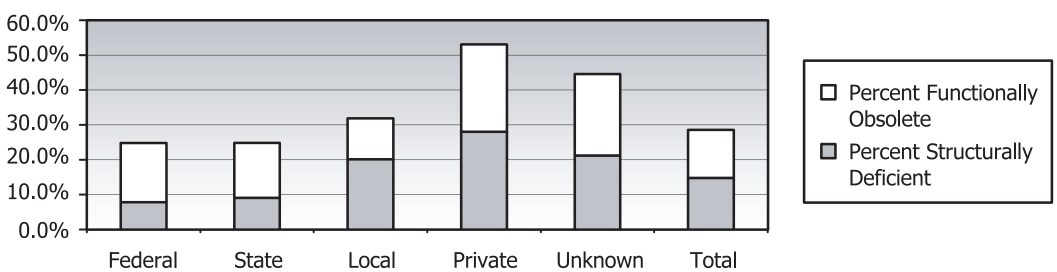
Source: National Bridge Inventory.

Government, private companies, and entities for which ownership is unknown or not coded in the National Bridge Inventory.

Exhibit 3-25 examines bridge deficiencies by owner. This exhibit shows substantial differences by level of government and type of owner. The Federal Government, for example, has the smallest percentage of deficient bridges (24.8 percent), but also owns a relatively small number of bridges (8,221). States have almost the same percentage of deficient bridges (24.9 percent), but have a much larger number of bridges (277,106). About 31.8 percent of the 298,889 bridges owned by local governments are deficient, while 53.1 percent of the Nation's 2,299 private bridges are deficient—the highest percentage of any owner type.

Exhibit 3-25

Bridges: Percent Deficient by Ownership, 2000



	FEDERAL	STATE	LOCAL	PRIVATE	UNKNOWN	TOTAL
Total Bridges	8,221	277,106	298,889	2,299	415	586,930
Total Deficient	2,038	68,832	95,291	1,220	185	167,566
Structurally Deficient	642	25,142	60,196	644	88	86,712
Functionally Obsolete	1,396	43,690	35,095	576	97	80,854
	FEDERAL	**STATE**	**LOCAL**	**PRIVATE**	**UNKNOWN**	**TOTAL**
Percent Structurally Deficient	7.8%	9.1%	20.1%	28.0%	21.2%	14.8%
Percent Functionally Obsolete	17.0%	15.8%	11.7%	25.1%	23.4%	13.8%
Total Deficient	24.8%	24.9%	31.8%	53.1%	44.6%	28.6%

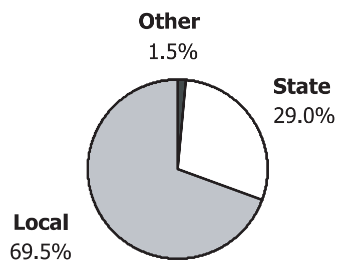
Source: National Bridge Inventory.

Most deficiencies on locally-owned bridges are structural, while most deficiencies on State and Federal bridges involve functional obsolescence. Exhibits 3-26 and 3-27 illustrate this phenomenon. About 69.5 percent of structurally deficient bridges were locally-owned, 29 percent were State-owned, and the remaining 1.5 percent were owned by the Federal Government, private companies, or other entities. Conversely, States owned about 54 percent of all functionally obsolete bridges. Local governments owned 43.4 percent of functionally obsolete bridges, and Federal, private, and other entities owned the remaining 2.6 percent.

Another way of looking at the number of deficient bridges is by rural and urban location. As Chapter 2 noted, 77.5 percent of bridges were in rural communities in 2000. About 27.6 percent of these rural bridges were deficient. At the same time, about 31.9 percent of the nation's urban bridges were deficient; therefore, urban bridges are more likely to be deficient than their rural counterparts.

Exhibit 3-26

Ownership of Structurally Deficient Bridges, 2000



Source: National Bridge Inventory.

Bridge condition in both urban and rural areas has steadily improved over the past decade. Exhibit 3-28 shows that the number of deficient rural bridges dropped from 31.8 percent in 1994 to 27.6 percent in 2000. More specifically, the number of structurally deficient rural bridges dropped from 20.2 percent in 1994 to 16.2 percent in 2000. The number of functionally obsolete rural bridges decreased less dramatically—from 11.6 percent in 1994 to 11.4 percent in 2000.

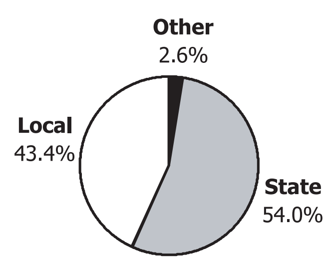
Exhibit 3-28 also shows that the number of deficient urban bridges dropped from 35.3 percent in 1994 to 31.9 percent in 2000. The number of structurally deficient urban bridges decreased from 13 percent in 1994 to 9.9 percent in 2000, while the number of functionally obsolete bridges diminished only slightly, from 22.3 percent in 1994 to 22 percent in 2000. The significant drop in urban bridge deficiency, therefore, can largely be attributed to improvements in the structural integrity of bridges in metropolitan areas.

Exhibit 3-29 elaborates on a central conclusion of the previous section: that bridges are more likely to be deficient in urban areas. Bridges on urban Interstates, urban principal arterials, and urban minor arterials have a higher percentage of deficiencies than those on comparable rural functional systems. Local functional class bridges represent a break from this pattern. A larger percentage of rural local functional class bridges are deficient (34.7 percent) than urban local functional class bridges (31.6 percent).

The proportion of structurally deficient and functionally obsolete bridges varies by functional system. Generally, the percentage of bridges that are deficient is greater on lower functional systems. Interstate bridges, for example, have the lowest percentage of deficient bridges (16 percent in rural areas and 27 percent in urban areas). Urban minor arterials

Exhibit 3-27

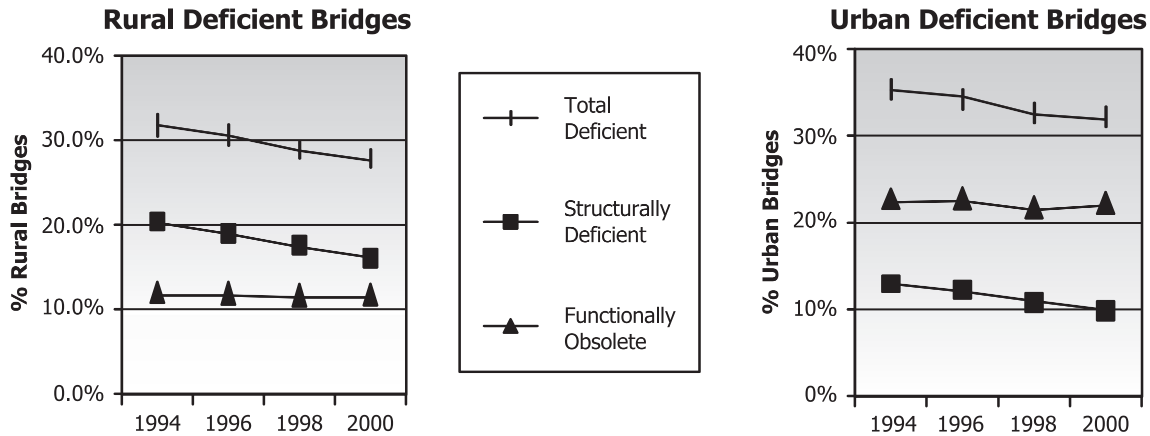
Ownership of Functionally Obsolete Bridges, 2000



Source: National Bridge Inventory.

Exhibit 3-28

Rural and Urban Bridge Deficiencies, 1994-2000



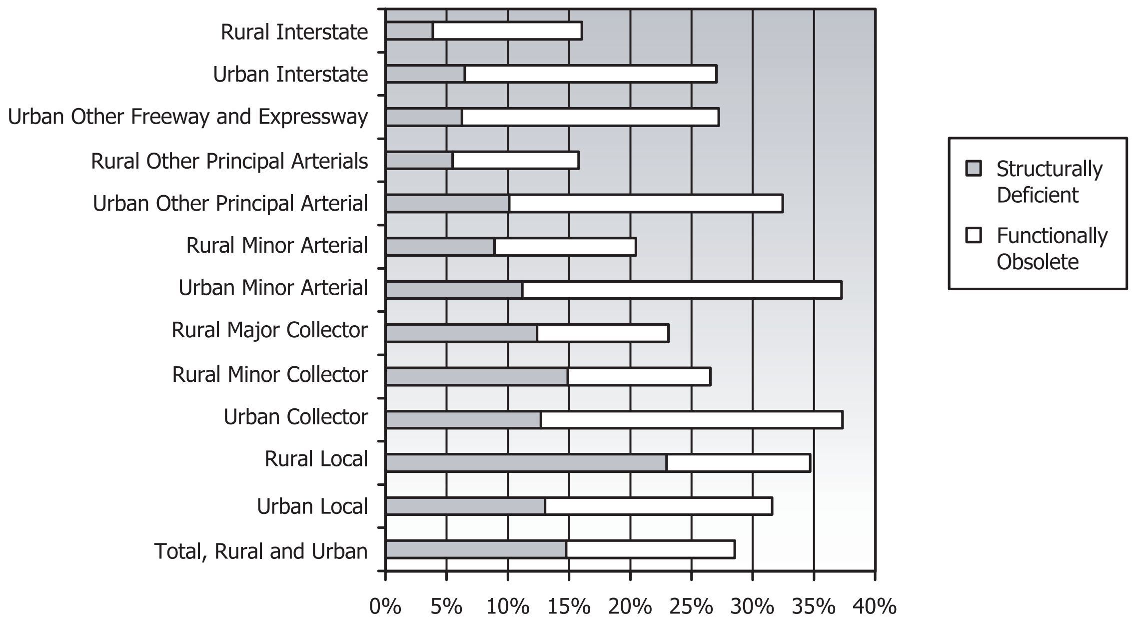
	1994		1996		1998		2000	
	NUMBER	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**
Rural Bridges	455,319		456,913		454,664		455,365	
Deficient Bridges	144,799	31.8%	139,545	30.5%	130,911	28.8%	125,523	27.6%
Structurally Deficient	91,991	20.2%	86,424	18.9%	78,999	17.4%	73,599	16.2%
Functionally Obsolete	52,808	11.6%	53,121	11.6%	51,912	11.4%	51,924	11.4%
Urban Bridges	121,141		124,949		128,312		131,781	
Deficient Bridges	42,716	35.3%	43,181	34.6%	41,661	32.5%	42,031	31.9%
Structurally Deficient	15,692	13.0%	15,094	12.1%	14,073	11.0%	13,079	9.9%
Functionally Obsolete	27,024	22.3%	28,087	22.5%	27,558	21.5%	28,952	22.0%
Total Bridges	**576,460**		**581,862**		**582,976**		**587,146**	
Deficient Bridges	187,515	32.5%	182,726	31.4%	172,572	29.6%	167,554	28.5%
Structurally Deficient	107,683	18.7%	101,518	17.4%	93,072	16.0%	86,678	14.8%
Functionally Obsolete	79,832	13.8%	81,208	14.0%	79,500	13.6%	80,876	13.8%

Source: National Bridge Inventory.

and urban collectors have the highest percentage of deficient bridges (37.3 percent for each system). The healthy condition of many higher-level bridges is striking, particularly since these account for a large share of VMT.

Exhibit 3-29

Bridges: Percent Deficient by Functional System, 2000



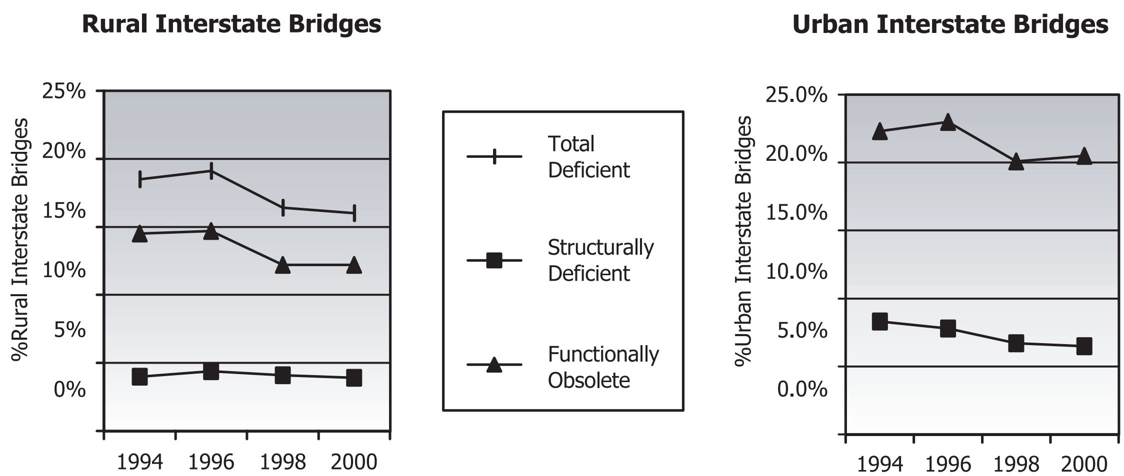
	TOTAL BRIDGES	BRIDGE DEFICIENCIES			PERCENT DEFICIENT		
		STRUCTURAL	FUNCTIONAL	TOTAL	STRUCTURAL	FUNCTIONAL	TOTAL
FUNCTIONAL CLASS							
Rural							
Interstate	27,797	1,076	3,384	4,460	3.9%	12.2%	16.0%
Other Principal Arterial	35,419	1,946	3,642	5,588	5.5%	10.3%	15.8%
Minor Arterial	39,377	3,509	4,551	8,060	8.9%	11.6%	20.5%
Major Collector	95,559	11,839	10,258	22,097	12.4%	10.7%	23.1%
Minor Collector	47,798	7,118	5,567	12,685	14.9%	11.6%	26.5%
Local	209,415	48,111	24,522	72,633	23.0%	11.7%	34.7%
Total Rural	**455,365**	**73,599**	**51,924**	**125,523**	**16.2%**	**11.4%**	**27.6%**
Urban							
Interstate	27,882	1,809	5,727	7,536	6.5%	20.5%	27.0%
Other Freeway and Expressway	16,011	1,000	3,358	4,358	6.2%	21.0%	27.2%
Other Principal Arterial	24,146	2,439	5,396	7,835	10.1%	22.3%	32.4%
Minor Arterial	23,020	2,574	6,002	8,576	11.2%	26.1%	37.3%
Collector	15,038	1,908	3,707	5,615	12.7%	24.7%	37.3%
Local	25,684	3,349	4,762	8,111	13.0%	18.5%	31.6%
Total Urban	**131,781**	**13,079**	**28,952**	**42,031**	**9.9%**	**22.0%**	**31.9%**
Total, Rural and Urban	**587,146**	**86,678**	**80,876**	**167,554**	**14.8%**	**13.8%**	**28.5%**

Source: National Bridge Inventory.

Exhibits 3-30 through 3-33 provide a historical perspective on the level of bridge deficiency by functional classification. Generally, bridge condition has improved on Interstates, other principal arterials, collectors, and local roads over the past decade. The greatest decline in deficiency occurred in the early to mid-1990s, particularly for Interstate bridges. Looking more specifically at the types of deficiency, structural deficiency consistently decreased on the systems profiled in Exhibits 3-30 through 3-33, while functional obsolescence either remained relatively constant or even increased slightly. On collectors, for instance, 16.1 percent of bridges were structurally deficient in 1994, but that number had dropped to 13.2 percent by 2000. At the same time, 11.9 percent of collector bridges were functionally obsolete in 1994, but that number had risen to 12.3 percent by 2000.

Exhibit 3-30

Interstate Bridge Deficiencies, 1994-2000

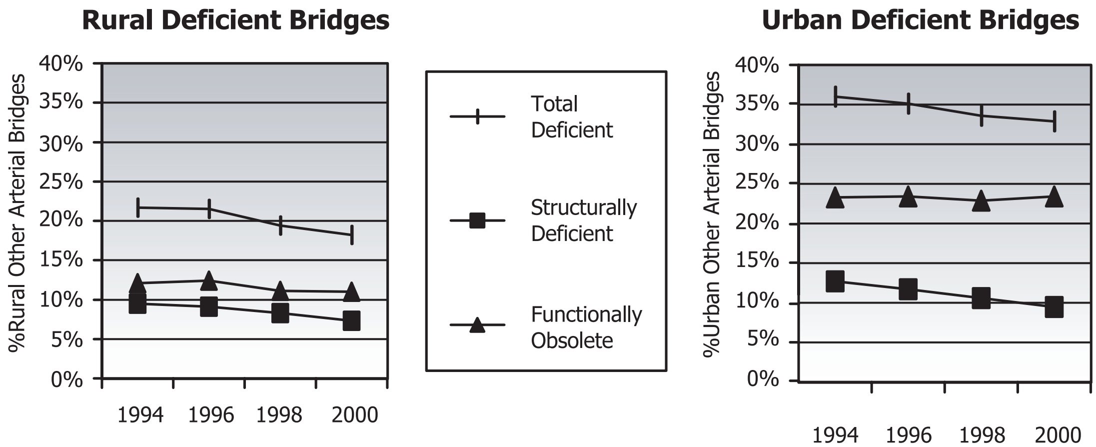


	1994		1996		1998		2000	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
Rural Bridges	28,865		28,683		27,530		27,797	
Deficient Bridges	5,342	18.5%	5,479	19.1%	4,504	16.4%	4,460	16.0%
Structurally Deficient	1,162	4.0%	1,249	4.4%	1,135	4.1%	1,076	3.9%
Functionally Obsolete	4,180	14.5%	4,230	14.7%	3,369	12.2%	3,384	12.2%
Urban Bridges	25,861		26,596		27,480		27,882	
Deficient Bridges	7,920	30.6%	8,181	30.8%	7,376	26.8%	7,536	27.0%
Structurally Deficient	2,141	8.3%	2,070	7.8%	1,850	6.7%	1,809	6.5%
Functionally Obsolete	5,779	22.3%	6,111	23.0%	5,526	20.1%	5,727	20.5%
Total Bridges	**54,726**		**55,234**		**55,010**		**55,679**	
Deficient Bridges	13,262	24.2%	13,660	24.7%	11,880	21.6%	11,996	21.5%
Structurally Deficient	3,303	6.0%	3,319	6.0%	2,985	5.4%	2,885	5.2%
Functionally Obsolete	9,959	18.2%	10,341	18.7%	8,895	16.2%	9,111	16.4%

Source: National Bridge Inventory.

Exhibit 3-31

Other Arterial Bridge Deficiencies, 1994-2000



	1994		1996		1998		2000	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
Rural Bridges	72,453		72,970		73,324		74,796	
Deficient Bridges	15,693	21.7%	15,693	21.5%	14,216	19.4%	13,648	18.2%
Structurally Deficient	6,914	9.5%	6,622	9.1%	6,060	8.3%	5,455	7.3%
Functionally Obsolete	8,779	12.1%	9,071	12.4%	8,156	11.1%	8,193	11.0%
Urban Bridges	57,012		59,064		60,901		63,177	
Deficient Bridges	20,506	36.0%	20,710	35.1%	20,435	33.6%	20,769	32.9%
Structurally Deficient	7,247	12.7%	6,902	11.7%	6,467	10.6%	6,013	9.5%
Functionally Obsolete	13,259	23.3%	13,808	23.4%	13,968	22.9%	14,756	23.4%
Total Bridges	**129,465**		**132,034**		**134,225**		**137,973**	
Deficient Bridges	36,199	28.0%	36,403	27.6%	34,651	25.8%	34,417	24.9%
Structurally Deficient	14,161	10.9%	13,524	10.2%	12,527	9.3%	11,468	8.3%
Functionally Obsolete	22,038	17.0%	22,879	17.3%	22,124	16.5%	22,949	16.6%

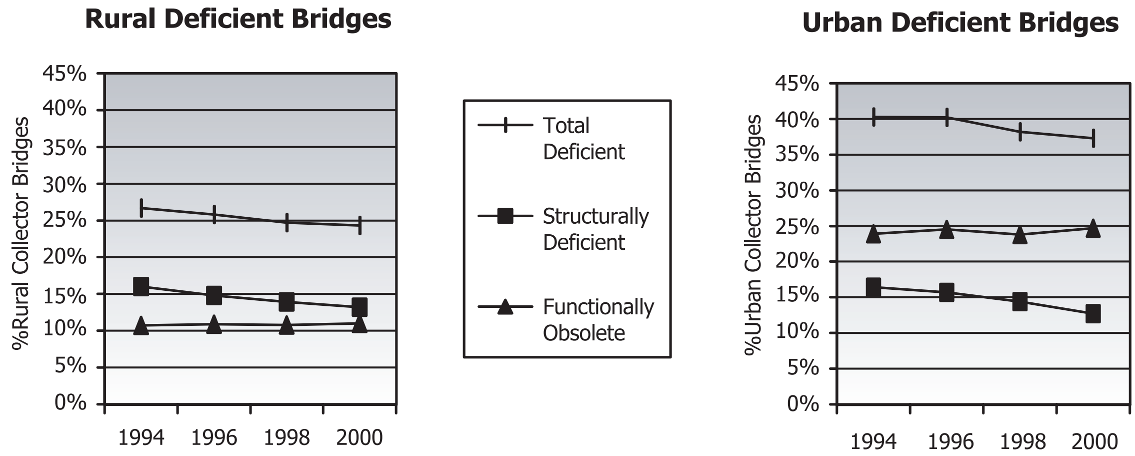
Source: National Bridge Inventory.

Q. Why has the percentage of functionally obsolete bridges not dropped in a similar manner as the percentage of structurally deficient bridges?

A. One reason may be the worsening performance of many systems. Since functional obsolescence indicates that a bridge cannot meet the capacity of the road it serves, increasing congestion would likely make many bridges functionally obsolete.

Exhibit 3-32

Collector Bridge Deficiencies, 1994-2000

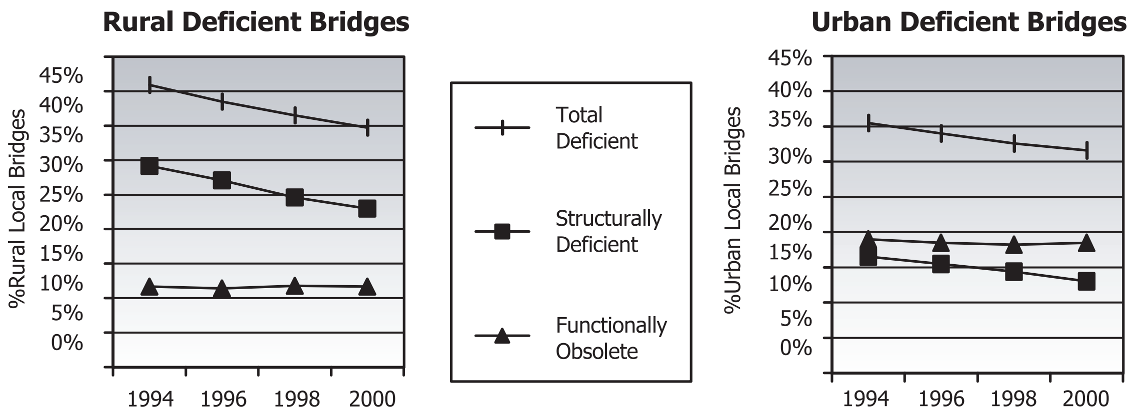


	1994		1996		1998		2000	
TOTAL BRIDGES	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**
Rural Bridges	147,612		144,246		143,140		143,357	
Deficient Bridges	39,398	26.7%	37,158	25.8%	35,368	24.7%	34,782	24.3%
Structurally Deficient	23,645	16.0%	21,375	14.8%	19,919	13.9%	18,957	13.2%
Functionally Obsolete	15,753	10.7%	15,783	10.9%	15,449	10.8%	15,825	11.0%
Urban Bridges	14,702		14,848		14,962		15,038	
Deficient Bridges	5,932	40.3%	5,976	40.2%	5,718	38.2%	5,615	37.3%
Structurally Deficient	2,415	16.4%	2,337	15.7%	2,158	14.4%	1,908	12.7%
Functionally Obsolete	3,517	23.9%	3,639	24.5%	3,560	23.8%	3,707	24.7%
Total Bridges	**162,314**		**159,094**		**158,102**		**158,395**	
Deficient Bridges	45,330	27.9%	43,134	27.1%	41,086	26.0%	40,397	25.5%
Structurally Deficient	26,060	16.1%	23,712	14.9%	22,077	14.0%	20,865	13.2%
Functionally Obsolete	19,270	11.9%	19,422	12.2%	19,009	12.0%	19,532	12.3%

Source: National Bridge Inventory.

Exhibit 3-33

Local Bridge Deficiencies, 1994-2000



	1994		1996		1998		2000	
TOTAL BRIDGES	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**	**NUMBER**	**PERCENT**
Rural Bridges	206,389		211,059		210,670		209,415	
Deficient Bridges	84,366	40.9%	81,215	38.5%	76,823	36.5%	72,633	34.7%
Structurally Deficient	60,270	29.2%	57,178	27.1%	51,885	24.6%	48,111	23.0%
Functionally Obsolete	24,096	11.7%	24,037	11.4%	24,938	11.8%	24,522	11.7%
Urban Bridges	23,566		24,441		24,969		25,684	
Deficient Bridges	8,358	35.5%	8,314	34.0%	8,132	32.6%	8,111	31.6%
Structurally Deficient	3,889	16.5%	3,785	15.5%	3,598	14.4%	3,349	13.0%
Functionally Obsolete	4,469	19.0%	4,529	18.5%	4,534	18.2%	4,762	18.5%
Total Bridges	**229,955**		**235,500**		**235,639**		**235,099**	
Deficient Bridges	92,724	40.3%	89,529	38.0%	84,955	36.1%	80,744	34.3%
Structurally Deficient	64,159	27.9%	60,963	25.9%	55,483	23.5%	51,460	21.9%
Functionally Obsolete	28,565	12.4%	28,566	12.1%	29,472	12.5%	29,284	12.5%

Source: National Bridge Inventory.

Deck Area on Deficient Bridges

A third indicator of bridge condition is deck area on deficient bridges. Engineers and policy analysts are increasingly using this measure to describe the condition of the Nation's bridges. The Federal Highway Administration's FY 2002 Performance Plan, for example, includes this indicator for NHS and non-NHS bridges. This section examines the deck area on deficient bridges by owner and functional system.

As Exhibit 3-34 describes, the nationwide percentage of deck area on deficient bridges dropped from 30.9 percent in 1996 to 27.9 percent in 2000. Bridges with unknown or unclassified ownership had the largest percentage of deck area on deficient bridges (42.8 percent in 2000), followed by privately owned bridges (33.8 percent). Federally owned bridges had the smallest percentage of deck area on deficient bridges (25.8 percent in 2000).

Exhibit 3-35, describes this information by functional system. The percentage of deck area on bridges classified as deficient decreased on every functional system from 1996 to 2000. Urban Collector bridges had the largest percentage (39.6 percent). Using this indicator, the deck area on bridges classified as deficient was consistently larger for urban systems.

Exhibit 3-36 describes the percentage of deck area on deficient bridges in 2000, with data broken down by structural deficiency and functional obsolescence. On almost every functional system, the percentage of deck area on functionally obsolete bridges was far greater than the area for structurally deficient bridges. On urban Interstates, for example, 22.8 percent of the deck area on deficient bridges resulted from functionally obsolete bridges while 8.8 percent can be attributed to those bridges classified as structurally deficient.

Exhibit 3-34

Deficient Bridge Deck Area by Owner, 1996, 1998, and 2000

	Percentage of Deck Area		
FUNCTIONAL SYSTEM	**1996**	**1998**	**2000**
Federal	23.8%	26.4%	25.8%
State	29.4%	26.7%	26.4%
Local	35.2%	34.1%	32.8%
Private	38.1%	35.5%	33.8%
Unknown	49.0%	46.3%	42.8%
Total	**30.9%**	**28.5%**	**27.9%**

Source: National Bridge Inventory.

Exhibit 3-35

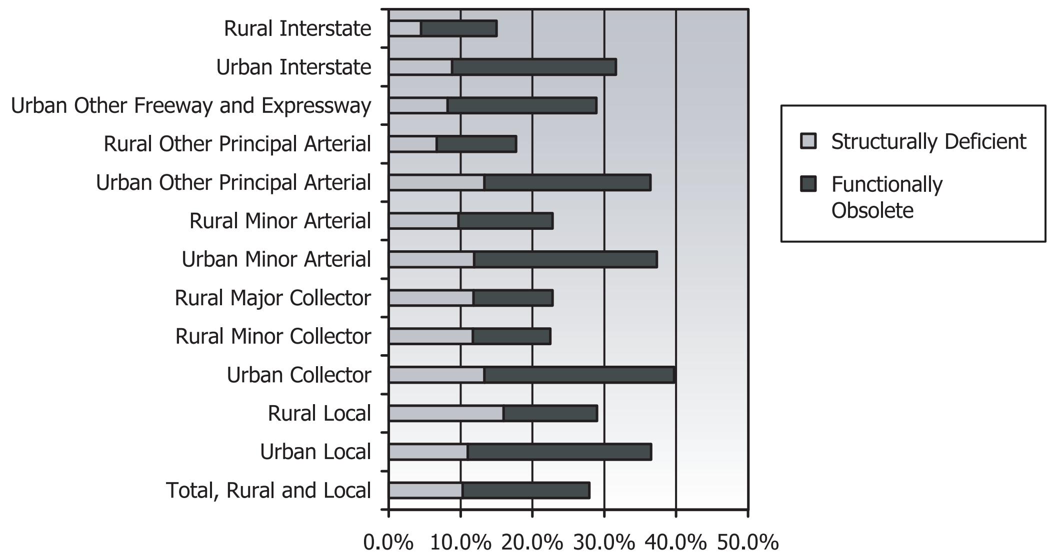
Deck Area on Deficient Bridges by Functional System, 1996, 1998, and 2000

	Percentage of Deck Area		
FUNCTIONAL SYSTEM	**1996**	**1998**	**2000**
Rural			
Interstate	17.9%	15.7%	15.0%
Other Principal Arterial	21.6%	19.0%	17.6%
Minor Arterial	26.1%	23.9%	22.9%
Major Collector	23.9%	22.9%	22.7%
Minor Collector	24.7%	23.2%	22.5%
Local	32.3%	30.3%	29.1%
Subtotal	**24.6%**	**22.7%**	**21.8%**
Urban			
Interstate	34.2%	30.9%	31.6%
Other Freeway and Expressway	32.4%	28.6%	28.9%
Other Principal Arterial	40.9%	38.3%	36.4%
Minor Arterial	40.3%	39.3%	37.3%
Collector	41.6%	39.3%	39.6%
Local	38.5%	36.7%	36.4%
Subtotal	**36.8%**	**34.0%**	**33.6%**
Bridge Total	**30.9%**	**28.5%**	**27.9%**

Source: National Bridge Inventory.

Exhibit 3-36

Deficient Bridge Deck Area by Functional Area, 2000



	Percentage of Deck Area		
	STRUCTURAL	**FUNCTIONAL**	**TOTAL**
Rural			
Interstate	4.5%	10.5%	15.0%
Other Principal Arterial	6.7%	11.0%	17.7%
Minor Arterial	9.7%	13.1%	22.8%
Major Collector	11.8%	11.0%	22.8%
Minor Collector	11.7%	10.8%	22.5%
Local	16.0%	13.0%	29.0%
Total Rural	**10.2%**	**11.6%**	**21.8%**
Urban			
Interstate	8.8%	22.8%	31.6%
Other Freeway and Expressway	8.2%	20.7%	28.9%
Other Principal Arterial	13.3%	23.1%	36.4%
Minor Arterial	11.9%	25.4%	37.3%
Collector	13.3%	26.4%	39.7%
Local	11.0%	25.5%	36.5%
Total Urban	**10.5%**	**23.2%**	**33.7%**
Total, Rural and Urban	**10.3%**	**17.6%**	**27.9%**

Source: National Bridge Inventory.

Transit System Conditions

U.S. transit system conditions can be analyzed by examining the aggregate number and type of transit vehicles in service, their average and condition, the physical condition and age of bus and rail maintenance facilities, and the condition of transit rail infrastructure components such as track, power systems, stations, and structures.

The National Transit Database (NTD) collects information from urban transit operators on fleet size, age distribution of vehicles, vehicle maintenance expenditures, and vehicle utilization, i.e., revenue miles traveled. The NTD data, however, does not provide information on the overall condition of vehicles. The Federal Transit Administration (FTA) has found the condition of vehicles of the same age can vary considerably, depending on factors such as the quality of vehicle maintenance and the geographic location in which the vehicles operate. Vehicles that are well maintained will generally be 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 also deteriorate more rapidly than vehicles that do not operate under those conditions.

FTA conducted extensive studies to estimate the mathematical relationship between the condition of a transit asset—a vehicle, facility, or rail track—and the age of the asset, its usage rate, and, when available, its maintenance history. Initial estimations of these relationships were based on extensive data collected by the Regional Transportation Authority of Northeastern Illinois and the Chicago Transit Authority in the 1990s and mid-1980s. This information was used to estimate the relationship between asset condition, age, and maintenance history over a ten-year period. The results of this study are available in a January 1996 FTA report, *The Estimation of Transit Asset Condition Ratings*.

Improvements to this estimation process have been and continue to be developed. As part of this effort, FTA has undertaken additional engineering surveys. In 1999, engineering assessments were made of the physical conditions of 77 bus maintenance facilities and 572 buses belonging to 31 transit operators. In 1999 and 2000, the physical conditions of 120 rail vehicles at ten different transit operators were also rated, with an emphasis on heavy rail vehicles and facilities. A subsequent survey of rail vehicles and facilities was undertaken in 2001, with inspections of the conditions of 36 rail facilities and 72 rail vehicles of 12 transit operators. This 2001 survey was split fairly evenly between heavy and light rail facilities and vehicles. The data collected by these studies have been used to refine the mathematical relationship used to estimate conditions for buses, heavy and light rail vehicles, facilities, and stations and to update the condition information that is presented in this chapter. No surveys of commuter rail vehicles or facilities were undertaken as a part of this effort. Commuter vehicles and facilities will be surveyed for the next version of this report.

Each vehicle and maintenance facility that was examined in an engineering assessment is assigned an overall level of condition based on a weighted average of the condition level assigned to the subcomponents of each vehicle and maintenance facility. For example, light rail vehicle subcomponents examined include the couplers, frame, bolster, gearbox, pneumatic piping, and the wiring and connections. Vehicles' exterior and interior subcomponents are also rated. Maintenance facility components that are evaluated include the roof structure, heating and ventilation systems, mechanical and plumbing systems, electrical equipment, specialty shops, and work bays. Subcomponents examined include—in the case of the roof structure—the exterior roofing frame, gutters and drainage system, and interior roof frame. In the case of specialty shops, the condition of each type of shop (e.g., machine shop, metal working shop) is evaluated separately. Condition ratings of bus vehicles and bus maintenance facilities are undertaken in a similar fashion.

Exhibit 3-37

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 physical condition of each asset is rated on a scale of 1 to 5 with 5 being the highest level of condition. This scale corresponds to the Present Serviceability Rating (PSR) formerly used by the Federal Highway Administration (FHWA) to evaluate pavement conditions. A rating level of 5, or "excellent," is synonymous with no visible defects, or nearly new condition. At the other end of the scale, a rating level of 1 indicates that the asset is in need of immediate repair and may have a seriously damaged component or components *[See Exhibit 3-37]*.

Bus Vehicle Conditions

The 1999 C & P Report revised bus vehicle conditions downwards based on survey information on the physical condition and age of bus vehicles collected by the National Bus Condition Assessment. This survey revealed that, on average, the condition of bus vehicles declined much more rapidly in the first five years of operation than was previously believed (from condition level 5 to about 3.25), after which the rate of decline was found to slow substantially with a condition level of 2.5 being reached after about 15 years, and 2.0 after 20 years.

Bus vehicle condition and age information is reported according to bus vehicle type for 1987-2000 in Exhibit 3-38. In 2000, the estimated average condition of the urban bus fleet was 3.07, up from 2.96 in 1997. Average bus vehicle age was reported to be 6.8 years, up slightly from an average age of 6.6 years in 1997. Since 1987, 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)*. Full size buses have consistently been operating at just below the adequate condition level.

Articulated buses have exhibited the most significant changes in condition levels, falling from a condition of 3.08 in 1987 to 2.49 in 1997, increasing to 3.33 in 2000. This fluctuation is most likely the result of a 12-year industry replacement policy and the fact that the bulk of *articulated buses* were purchased in 1983-84. This replacement cycle is also evidenced by a peak in the percentage of overage *articulated buses* at 61 percent in 1997, and subsequent decline to 29 percent in 2000. In all years, mid-sized buses have maintained an average condition above 3.0 and both small buses and vans have consistently maintained an average condition of more than 3.5.

Urban Bus Maintenance Facilities

Age

The estimated age distribution of urban bus maintenance facilities in 2000 is shown in Exhibit 3-39. This distribution is based on age information collected by the 1999 National Bus Condition Assessment, and applied to the 2000 national bus facility total as reported in the National Transit Database. Ninety-two

Exhibit 3-38

Urban Transit Bus Fleet Count, Age and Condition 1987-2000 (*)

YEAR	1987	1989	1991	1993	1995	1997	1999	2000
Articulated Buses								
Total Fleet	1,712	1,730	1,764	1,807	1,716	1,523	1,967	2,078
Percent Overage Vehicles	0%	0%	13%	16%	33%	61%	46%	29%
Average Age	4.9	6.7	8.2	9.5	10.7	11.8	8.7	6.9
Average Condition	3.08	3.08	2.98	2.88	2.66	2.49	3.10	3.33
Full-Size Buses								
Total Fleet	46,231	46,446	46,660	46,824	46,335	47,149	49,195	49,721
Percent Overage Vehicles	21%	22%	17%	20%	23%	25%	26%	25%
Average Age	8.2	8.4	8.0	8.5	8.6	8.2	8.7	8.5
Average Condition	2.93	2.83	2.93	2.82	2.83	2.86	2.90	2.93
Mid-Size Buses								
Total Fleet	2,821	2,928	3,268	3,598	3,879	5,328	6,807	7,643
Percent Overage Vehicles	10%	14%	23%	24%	23%	18%	14%	15%
Average Age	5.9	6.5	6.7	6.4	6.8	5.6	5.7	5.7
Average Condition	3.03	3.13	3.13	3.14	3.08	3.30	3.30	3.30
Small Buses								
Total Fleet	2,127	2,428	3,415	4,064	5,447	7,081	8,461	9,039
Percent Overage Vehicles	11%	15%	14%	13%	13%	13%	13%	12%
Average Age	3.9	4.1	4.0	4.0	4.0	3.7	4.0	4.2
Average Condition	3.56	3.56	3.56	3.48	3.55	3.56	3.51	3.47
Vans								
Total Fleet	3,241	3,288	6,261	8,353	11,969	13,796	14,539	14,893
Percent Overage Vehicles	30%	21%	22%	22%	21%	22%	5%	6%
Average Age	3.1	2.9	3.0	3.1	3.2	2.3	3.2	3.2
Average Condition	3.78	3.78	3.78	3.59	3.71	3.75	3.71	3.71
Weighted Average Condition	2.98	2.98	2.98	2.88	2.90	2.96	3.03	3.07
Weighted Average Age	7.5	7.7	7.2	7.4	7.3	6.6	7.0	6.8

(*) 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. Bus vehicle conditions have been revised based on an improved methodology of applying NTD data to estimated decay curves. These revisions are very small in magnitude.

Sources: Transit Economic Requirements Model and National Transit Database.

percent of bus maintenance facilities are estimated to be more than 10 years old and 31 percent are more than 30 years old. Individual facility ages may not relate well to condition, since substantive renovations are made to facilities at varying intervals over time.

Exhibit 3-39

Age of Urban Bus Maintenance Facilities

	2000	
AGE (YEARS)	**NUMBER**	**PERCENT**
0-10	40	8%
11-20	202	41%
21-30	98	20%
31+	157	31%
Total	**497**	**100%**

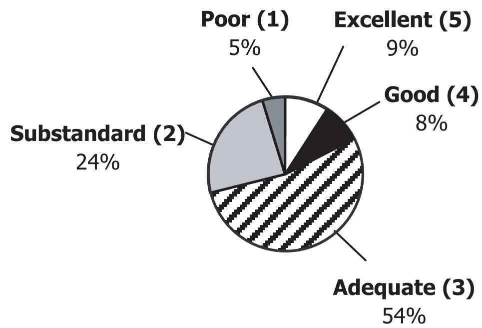
Source: National Bus Condition Assessment.

Condition

In 2000, the condition of bus maintenance facilities was estimated to be 3.23. Exhibit 3-40 provides the estimated condition level distribution of bus maintenance facilities. In 2000, 54 percent of all urban bus maintenance facilities were in adequate condition, 8 percent in good condition, and 9 percent in excellent condition, for a combined total of 71 percent in adequate-or-better condition (declining from 77 percent in 1997). Twenty-nine percent, however, are estimated to be in unacceptable condition—24 percent in substandard condition, and 5 percent in poor condition.

Exhibit 3-40

Percentage Distribution of Conditon of Urban Bus Maintenance Facilities, 2000



CONDITION	NUMBER	PERCENT
Excellent (5)	46	9%
Good (4)	41	8%
Adequate (3)	266	54%
Substandard (2)	121	24%
Poor (1)	23	5%
Total	**497**	**100%**

Source: National Bus Condition Assessment, Transit Economic Requirements Model and National Transit Database.

Rail Vehicle Conditions

The average condition of all rail vehicles except commuter rail has been re-estimated, based on engineering surveys of rail vehicle physical conditions undertaken between 1999-2001, following the completion of the 1999 C & P. The revision in rail vehicle conditions is similar to the one that occurred for bus vehicles in the 1999 Report. Analysis of the rail condition information collected in the survey revealed that rail decay curves follow a similar pattern as those for buses, i.e., rail vehicles decline rapidly during their first 5 years and more slowly thereafter. The conditions for commuter rail vehicles, for which the condition estimation procedures have not been reexamined, remain higher than for other rail vehicles. The conditions level for commuter rail vehicles reported here differs slightly from those in the 1999 C&P Report, based on the application of more comprehensive vehicle information.

In 2000, all rail vehicles were estimated to have an average condition of 3.55, down marginally from an average condition level of 3.71 in 1997. Condition levels in the 1999 Report for heavy and light rail vehicles have been revised downward by approximately one full point, from levels ranging from 4.0 to 4.7 to levels ranging from 3.25 to 3.64. Rail condition estimates are provided in Exhibit 3-41.

Rail vehicles have been, on average, in slightly better condition than bus vehicles between 1987 and 2000, with average condition levels consistently remaining above 3.5. Weighted-average rail vehicle age increased from 15.6 years in 1987, to 20.4 in 1997, to 21.8 years in 2000. The decline in average condition and increase in age has been driven by *commuter rail self-propelled passenger coaches* and *heavy rail vehicles.* The condition of *commuter rail self-propelled passenger coaches* has steadily declined from a condition of 5.0 in 1987 to 4.07 in 2000; the condition of heavy rail vehicles declined more gradually, from 3.59 in 1987 to 3.25 in 2000; the percentage of overage *commuter rail self-propelled passenger coaches* and *heavy rail vehicles* has also increased—for commuter rail self-propelled passenger coaches from 2 percent in 1987 to 61 percent in 2000, and for heavy rail vehicles from 15 percent in 1987 to 40 percent in 2000.

Conditions and ages for other rail vehicle types (*commuter rail locomotive, commuter rail passenger*

Exhibit 3-41

Urban Transit Rail Fleet Count (*), Age and Condition 1987-2000

YEAR	1987	1989	1991	1993	1995	1997	1999	2000
Commuter Rail Locomotives								
Total Fleet	491	451	467	556	570	586	644	591
Percent Overage Vehicles	30%	19%	17%	17%	21%	22%	17%	19%
Average Age	16.9	14.6	15.3	15.6	15.6	16.5	16.1	15.8
Average Condition	4.34	4.47	4.47	4.45	4.48	4.47	4.53	4.51
Commuter Rail Passenger Coaches								
Total Fleet	2,137	2,138	2,226	2,402	2,402	2,470	2,886	2,793
Percent Overage Vehicles	41%	32%	29%	29%	36%	33%	32%	29%
Average Age	19.6	18.0	17.3	18.6	20.1	19.8	18.5	17.7
Average Condition	4.23	4.36	4.36	4.20	4.12	4.09	4.21	4.28
Commuter Rail Self-Propelled Passengers Coaches								
Total Fleet	2,563	2,421	2,529	2,526	2,645	2,681	2,455	2,472
Percent Overage Vehicles	2%	5%	5%	6%	24%	25%	60%	61%
Average Age	13.3	15.0	16.5	18.2	19.7	22.0	24.3	25.2
Average Condition	5.00	4.88	4.74	4.65	4.54	4.36	4.18	4.07
Heavy Rail								
Total Fleet	10,344	10,246	10,170	10,074	10,157	10,173	10,366	10,375
Percent Overage Vehicles	15%	17%	29%	27%	37%	36%	40%	40%
Average Age	15.2	15.4	16.9	17.8	19.3	21.0	22.5	23.00
Average Condition	3.59	3.59	3.49	3.47	3.39	3.31	3.26	3.25
Light Rail								
Total Fleet	879	917	954	943	955	1,132	1,400	1,524
Percent Overage Vehicles	27%	20%	19%	10%	12%	10%	15%	13%
Average Age	17.2	15.6	16.6	14.9	14.8	14.6	18.9	18.4
Average Condition	3.60	3.71	3.60	3.64	3.55	3.63	3.62	3.63
Total Rail								
Weighted Average Condition	3.91	3.91	3.80	3.77	3.70	3.61	3.57	3.55
Weighted Average Age	15.6	15.7	16.8	17.7	19.1	20.4	21.6	21.8

(*) Includes vehicles that are not in active service. Rail fleets sizes reported here are slightly larger than those reported for active rail vehicles in Chapter 2.

Sources: Transit Economic Requirements Model and National Transit Database.

coaches, and *light rail vehicles*), which continue to account for a growing percentage of rail transit vehicles, have remained relatively constant and, in some cases, shown marginal improvement in condition and decrease in age between 1987 and 2000. The percentage of these rail vehicle types that are overage has also declined over this period. In 2000, the average age of *commuter rail locomotives* was 15.8 years and their average condition 4.51. Between 1987 and 2000, their average age fluctuated between 15.3 and 16.9 years and their average condition level between 4.34 and 4.53. The average age and condition of *commuter rail passenger coaches* have also remained relatively constant. Between 1987 and 2000, their average condition fluctuated between 4.09 and 4.36 and their average age between 17.3 and 20.1 years. In 2000, their average condition was 4.28 and average age 17.7 years. In the case of *light rail,* average vehicle condition ranged from 3.55 to 3.71 between 1987 and 2000. Their average age declined from 17.2 years in 1987 to 14.9 years in 1997, subsequently rising to 18.9 years in 1999. The industry standard replacement age for light rail vehicles is 25 years.

Urban Rail Maintenance Facilities

Urban rail maintenance facilities continue to age and their condition has continued to deteriorate, although the average condition remains adequate/ fair. In 2000, urban rail maintenance facilities had an average condition of 3.18. As shown in Exhibit 3-42, almost half of all urban rail maintenance facilities are more than 30 years old, and 85 percent are more than 10 years old. The condition of these facilities, updated based on engineering surveys of 36 rail facilities in 2000 and 2001, is lower than in 1997. About 75 percent of this decline was due to methodological revisions.

Exhibit 3-42

Age of Urban Rail Maintenance Facilities

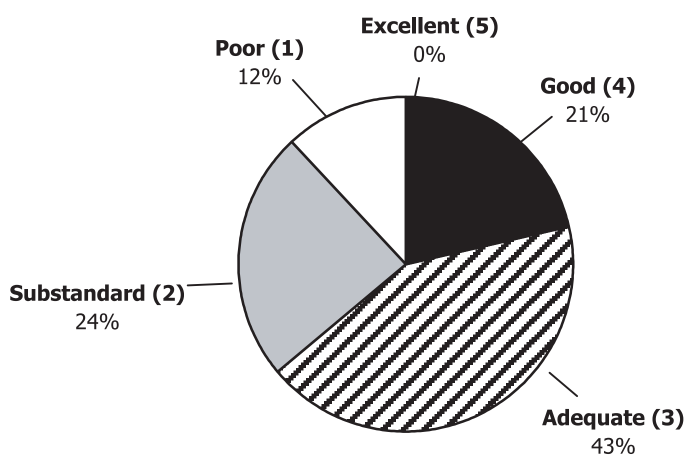
AGE OF FACILITY	2000 NUMBER	2000 PERCENT
0-10	22	15%
10-20	34	23%
21-30	23	15%
31+	71	48%
Total	**150**	**100%**

Source: National Rail Condition Assessment, 2000-2001.

The distribution of the conditions of urban rail maintenance facilities found in the most recent surveys are provided in Exhibits 3-43. Twenty-one percent of all urban rail maintenance facilities were found to be in good or better condition, and 64 percent in adequate or better condition. By comparison, the 1999 C & P Report stated that 60 percent of all urban rail maintenance facilities were in good or better condition and 77 percent in adequate or better condition. The percentage of facilities in substandard or worse condition was also found to have climbed to 36 percent in 2000 from 23 percent in 1997. Again, these changes, in part, reflect revisions to the decay curves and not solely deterioration in condition levels.

Exhibit 3-43

Percentage Distribution of Condition of Urban Rail Maintenance Facilities, 2000



CONDITION	2000 NUMBER	2000 PERCENT
Excellent (5)	0	0%
Good (4)	32	21%
Adequate (3)	64	43%
Substandard (2)	36	24%
Poor (1)	18	12%
Total	**150**	**100%**

Source: National Rail Condition Assessment, 2000-2001.

Other Urban Rail Infrastructure

The condition of urban rail infrastructure other than maintenance facilities and stations is estimated on the basis of decay curves relating condition to age, usage, and maintenance history. This information is based primarily on rail asset information collected by the Chicago Transit Authority (CTA) during the 1980s and 1990s for an Engineering Condition Assessment (ECA). Additional, but considerably more limited, asset condition data was provided by Metra and Pace, two transit operators in the Chicago area. The infrastructure data are based on the dollar amounts spent on different asset types (in constant dollars) rather than a numeric count of the assets. For this reason, condition results are displayed as percentages across condition levels rather than in units. The data collected were used to estimate decay curves for more than 40 different 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. These results supersede those from a previous survey of rail system asset conditions in nine metropolitan areas, *The Status of the Modernization of the Nation's Rail Transit Systems*, June 1992. Conditions results for 1992, reported in Exhibit 3-44, are based on the earlier survey and are, therefore, not entirely comparable to those reported for 1997 and 2000. The 1992 survey was considerably smaller in scope than the one conducted by CTA.

Exhibit 3-44

Physical Condition of U.S. Transit Rail Infrastructure -- Selected Years, 1992-2000

	CONDITION														
	1			2			3			4			5		
	POOR			SUBSTANDARD			ADEQUATE			GOOD			EXCELLENT		
	1992	1997	2000	1992	1997	2000	1992	1997	2000	1992	1997	2000	1992	1997	2000
Track	0%	7%	7%	5%	10%	10%	32%	10%	12%	49%	49%	45%	14%	24%	26%
Power Systems															
Substations	2%	12%	6%	19%	6%	6%	17%	10%	10%	56%	57%	58%	6%	15%	20%
Overhead Wire	0%	5%	6%	33%	11%	6%	10%	18%	11%	52%	34%	61%	5%	32%	16%
Third Rail	0%	14%	8%	21%	11%	8%	20%	15%	11%	53%	43%	48%	6%	17%	24%
Stations	0%	15%	0%	5%	13%	16%	29%	15%	50%	63%	46%	33%	3%	11%	1%
Structures															
Elevated Structure	na	1%	2%	na	29%	22%	na	12%	16%	na	59%	59%	na	0%	2%
Bridges	0%	na	na	11%	na	na	28%	na	na	54%	na	na	7%	na	na
Elevated Sections	0%	na	na	1%	na	na	72%	na	na	15%	na	na	12%	na	na
Underground Tunnels	0%	9%	12%	5%	19%	11%	34%	18%	19%	51%	47%	46%	10%	7%	12%
Maintenance															
Facilities	2%	6%	12%	34%	17%	24%	12%	17%	43%	35%	53%	21%	17%	7%	0%
Yards	2%	0%	0%	7%	0%	0%	26%	37%	50%	55%	63%	50%	9%	0%	0%

Note: 1997 and 2000 data are from TERM; 1992 data are from "The Status of the Modernization of the Nation's Rail Transit Systems."

Sources: Transit Economic Requirements Model (TERM),"Status of the Modernization of the Nation's Rail Transit Systems," FTA, June 1992.

Track conditions are estimated to have remained constant since 1997, with 83 percent of all track estimated to be in adequate or better condition in both 1997 and 2000. *[See Exhibit 3-44].* The average condition of *power systems* appears to have improved slightly since 1997. In 2000, 88 percent of substations and overhead wire (power system components) were estimated to be in adequate or better condition compared with 82 and 84 percent, respectively, in 1997. The condition of third rail, also a power system component, has improved even more dramatically, with 83 percent estimated to be in adequate or better condition in 2000, compared with 75 percent in 1997.

Station conditions in 2000 have been calculated on the basis of newly estimated decay curves for rail maintenance facilities. While the percentage of stations estimated to be in adequate or better condition has increased from 77 percent in 1997 to 84 percent in 2000, the percentage in good or better condition has declined from 54 percent in 1997 to 34 percent in 2000. These changes have resulted from the application of the newly estimated decay curve rather than in a change in the actual condition level of stations.

The conditions of *structures* (elevated structures and underground tunnels) have also improved. In 2000, 77 percent of this infrastructure was estimated to be in adequate or better condition, compared with 71 to 72 percent in 1997. The condition of *rail yards* has declined. In 2000, 50 percent of all yards were in good condition and 50 in adequate condition compared with 63 percent in good condition and 37 percent in adequate condition in 1997.

Rural Transit Vehicles and Facilities

Data on the conditions of rural vehicles and facilities is available from surveys funded by the Federal Transit Administration and conducted by the Community Transportation Association of America. Rural operators are defined as those operators outside urbanized areas, a different definition than used by the U.S. Census. Two surveys were conducted in 1997 and 2000, with a total of 158 rural transit operators responding. The data collected ranged from June 1997 to June 1999, but have been combined for the purposes of this analysis, as shown in Exhibit 3-45. Data from the last survey, conducted in 1994, was presented in the 1999 Conditions and Performance Report.

More than 50 percent of the rural transit fleet is overage. According to transit vehicle type, 41 percent of small buses, 34 percent of medium-size buses, 27 percent of full-size buses and 60 percent of vans and other vehicles are overage.

Exhibit 3-45

Number of Overage Vehicles and Average Vehicle Age in Rural Transit

	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.

The condition of rural bus maintenance facilities changed minimally between 1992 and 1999 [See Exhibit 3-46]. While the percentage of facilities in good or excellent condition declined marginally, from 82 to 80 percent, the percentage in very poor condition dropped from four percent in 1992 to one percent in 1999.

Special Service Vehicles

There is no current information available on the age and condition of special service vehicles. The last survey of special service vehicle ages was undertaken in 1994. This survey found that 19 percent of all medium buses were overage, 18 percent of all small buses and 43 percent of vans and other vehicles.

Exhibit 3-46

Condition of Rural Bus Maintenance Facilities

CONDITION	PERCENT	
	1999	1992
Excellent	30%	30%
Good	50%	52%
Poor	19%	14%
Very Poor	1%	4%
Total	**100%**	**100%**

Source: Community Transportation Association of America (CTAA).