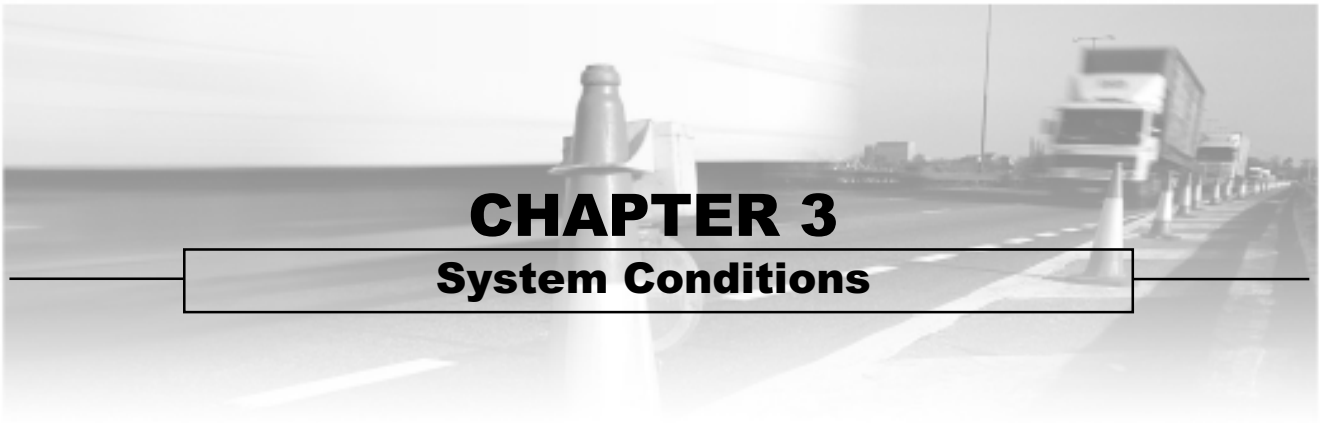


# CHAPTER 3
## System Conditions

### *Introduction*

The surface transportation system consists of a highway component and transit component. The condition of these two components is addressed in this chapter. The highway system assessment includes the status of roads and bridges. The transit system condition is based on the status of transit vehicles and facilities. Each element presented influences the overall condition of our transportation system. The data in this chapter will not only provide an evaluation of the transportation system, but can also help identify the future rehabilitation and replacement needs.

This chapter begins with a summary table comparing key highway and transit statistics with the values shown in the last report. This table is followed by a summary of the key points addressed in more depth later in the chapter.

The road conditions section of this chapter reviews pavement condition, alignment adequacy and lane widths. The pavement condition segment describes the measurement used, presents the overall pavement condition, and breaks down pavement conditions by location (rural/urban) and functional system. The alignment segment explains horizontal and vertical alignment, presents the rating system and evaluates the alignment adequacy in rural areas by functional system. The lane width segment describes current Interstate lane width requirements and presents lane widths by location and functional system. Where possible historical trends are illustrated.

The section of this chapter dealing with bridges includes bridge ratings and number of deficient bridges. Next, the number of deficient bridges is broken down by jurisdiction, location and functional system. The section concludes with a historical view of bridges on Interstates, other arterials, collectors and local functional systems.

The transit conditions section begins with a brief discussion of how transit conditions are measured; a more detailed discussion of the methodology is found in Appendix I. The section is broken down into three segments: urban bus conditions, rail conditions, and rural and specialized transit conditions. In the bus segment, information on the condition of bus vehicles is presented for different types of buses. Urban bus maintenance facility ages and conditions are also shown. In the rail segment, conditions for different types of vehicles are presented, followed by the conditions of different types of rail infrastructure. The rural and specialized transit segment contains information that is carried over from the previous report.

The data sources for the condition analysis include the Highway Performance Monitoring System (HPMS), the Nationwide Personal Travel Survey (NPTS), the National Bridge Inventory (NBI), the Transit Economic Requirements Model (TERM), the National Transit Database (NTD), the National Bus Condition Assessment (NBCA), and data provided by the Community Transportation Association of America (CTAA). The NBI covers all bridges on public roads and is collected biannually.

## *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 1997 C&P report, which were based on 1995 data. Where the 1995 data have been revised, updated values are shown in the second column. The third column contains comparable values, based on 1997 data.

**Exhibit 3-1**

**Comparison of the System Conditions Statistics with Those in the 1997 C&P Report**

| Statistic | 1995 Data | | 1997 Data |
|---|---|---|---|
| | 1997 Report | Revised | |
| Pavement in Good or Very Good Condition | 42.2% | --- | 41.3% |
| Pavement in Fair Condition | 38.9% | 39.0% | 41.6% |
| Pavement in Poor Condition | 6.4% | --- | 6.6% |
| Poor Pavement on Rural Interstates | 5.3% | --- | 3.7% |
| Poor Pavement on Urban Interstates | 9.8% | --- | 9.2% |
| Deficient Bridges | 31.4% | --- | 29.6% |
| Deficient Bridges on Interstates | 24.7% | --- | 21.6% |
| Deficient Bridges on Other Arterials | 27.6% | --- | 25.8% |
| Average urban bus condition rating | 3.8 | 3.0 | 3.1 |
| Average rail vehicle condition rating | 4.2 | --- | 4.0 |
| Poor/substandard urban bus maintenance facilities | 19% | --- | 23% |
| Good/excellent rail track mileage | 73% | --- | 73% |
| Good/excellent rail maintenance facilities | 64% | --- | 60% |
| Average small rural bus age | 4.9 yrs | --- | 4.9 yrs |

The pavement conditions reported in this chapter include all functional systems except rural minor collectors and local roads. The overall pavement conditions are presented based on the qualitative condition terms “very good,” “good,” “fair,” “mediocre” and “poor.” These ratings are derived from one of two measures: International Roughness Index (IRI) or Present Serviceability Rating (PSR). The definitions for IRI and PSR and the relationship between these two measures are discussed later in the chapter.

In 1997, 41.3 percent of measured roads were in “very good” or “good” condition, 52.1 percent were in “fair” or “mediocre” condition and 6.6 percent were in “poor” condition. Since 1995, there was a slight decrease in the percentage of miles rated “very good” or “good” and a slight increase in the percentage of miles rated “fair” or “mediocre” and “poor.” Pavement condition on the Interstate system improved since 1995. The percentage of “poor” pavement on rural and urban Interstates decreased while the percentage of “very good” or “good” pavement on both rural and urban Interstates increased. Based on the NHS “acceptable ride quality” standard, Interstate pavement condition improved in both rural and urban areas.

The common indicator used to evaluate the condition of our Nation's bridges is the number of deficient bridges. There are two types of deficient bridges: structurally deficient and functionally obsolete. In 1998, 29.6 percent of our Nation's bridges were deficient. Of the total number of bridges, 16.0 percent were structurally deficient while 13.6 percent were functionally obsolete. In urban areas, 32.5 percent of bridges were deficient, while in rural areas 28.8 percent were deficient. Over half of the deficient bridges are owned by local governments.

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.

## *Pavement Terminology & Measurements*

Pavement condition affects travel cost 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 the surface condition 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 cracks and spalling. |
| 2.0 - 3.0 | The riding qualities of pavements in this category are noticeably inferior to those of 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 in this group 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 speeds and considerable ride discomfort. Large potholes and deep cracks exist. Distress occurs over 75 percent or more of the surface. |

States are now expected to report IRI data for the Interstate system, other principal arterials, and rural minor arterials. IRI reporting is recommended for all other functional systems, but the majority of the data reported on rural major collectors, urban minor arterials, and urban collectors still uses PSR ratings. The FHWA adopted the IRI for the higher functional systems because this index uses a standardized procedure, is consistent across jurisdictions, is an objective measurement, and is

accepted as a worldwide pavement roughness measurement. The IRI system results in more consistent data for trend analyses and across jurisdictions.

Exhibit 3-3 contains a qualitative pavement condition term and corresponding quantitative PSR and IRI values. Interstate mileage has stricter guidelines than all other functional systems under both PSR and IRI. The translation between PSR and IRI is not exact. The IRI values are based on objective measurements of pavement roughness, while PSR is a more 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 2.5 on the PSR scale. Such a section would be rated as "Mediocre" based on its IRI, but would have been rated as "Poor" 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.

**Exhibit 3-3**

**Relationship Between IRI and PSR**

| Condition Term Categories | PSR Rating | | IRI Rating (inches/mile) | | Interstate & NHS Ride Quality |
|---|---|---|---|---|---|
| | Interstate | Other | Interstate | Other | |
| Very Good | ≥ 4.0 | ≥ 4.0 | < 60 | < 60 | |
| Good | 3.5 - 3.9 | 3.5 - 3.9 | 60 - 94 | 60 - 94 | Acceptable 0 - 170 |
| Fair | 3.1 - 3.4 | 2.6 - 3.4 | 95 - 119 | 95 - 170 | |
| Mediocre | 2.6 - 3.0 | 2.1 - 2.5 | 120 - 170 | 171 - 220 | Less than Acceptable > 170 |
| Poor | ≤ 2.5 | ≤ 2.0 | > 170 | > 220 | |

The *Federal Highway Administration 1998 National Strategic Plan* introduced a new descriptive term for pavement condition, "acceptable ride quality." The *Strategic Plan* stated that by 2008, 93 percent of the National Highway System (NHS) mileage should meet pavement standards for "acceptable ride quality." This goal is discussed in greater detail in Appendix B. In order to be rated "acceptable" pavement performance must have an IRI value of less than or equal to 170 inches per mile. The FHWA Strategic 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, so the PSR data are not used to determine "acceptable ride quality" in the *Strategic Plan* or related annual reports. This report uses the term "less than acceptable" (< Acceptable) to describe mileage that does not meet the "acceptable" threshold on the Interstate system.

In this chapter, overall pavement condition is presented based on the qualitative condition terms "very good," "good," "fair," "mediocre" and "poor" associated with the IRI or PSR system. Pavement conditions specific to the NHS are discussed in Appendix B.

**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 system. In order to continue to improve our pavement evaluation, FHWA has been working with AASHTO and the States to establish standards for measuring roughness, cracking, rutting and faulting.

## Overall Pavement Condition

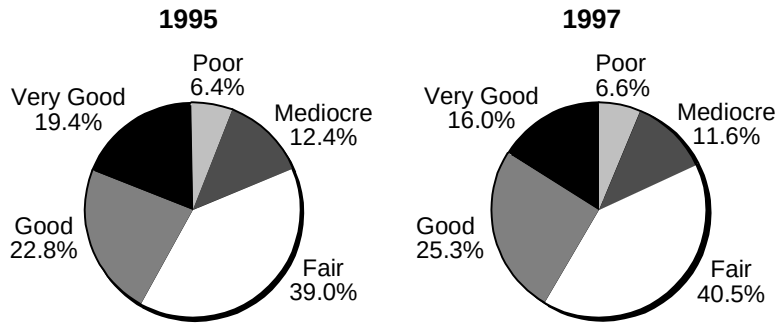
The highway systems covered in this chapter includes all mileage except rural minor collectors and local functional systems. Currently, 16.0 percent of our roads are in "very

good" condition and 25.3 percent are in "good" condition. Since 1995, the percentage of mileage in "very good" condition fell 3.4 percentage points while the percentage of mileage in "good" condition rose 3.0 percentage points. The percentage of "fair" pavement and "mediocre" pavement had a similar up and down trend.

The percentage of "fair" pavement increased from 39.0 percent to 40.5 percent while the percentage of "mediocre" pavement decreased from 12.4 percent to 11.6 percent. Finally, the percentage of "poor" pavement increased from 6.4 percent to 6.6 percent since 1995 [*See Exhibit 3-4*].

**Exhibit 3-4**

**Pavement Condition, by Total Percent Miles, 1995 and 1997**

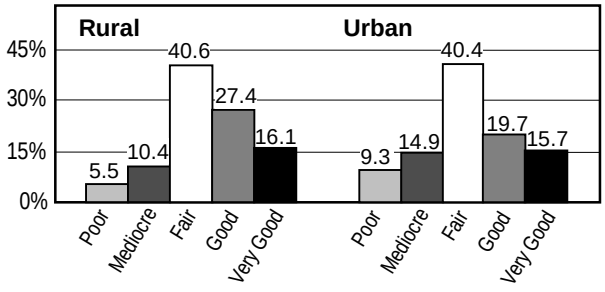



## *Rural and Urban Pavement Conditions*

When discussing pavement conditions, it is important to note the different travel characteristics between rural and urban areas. As mentioned in Chapter 2, rural areas contain 78.7 percent of road miles, but only 39.1 percent of annual VMT. In other words, although rural areas have a larger percentage of road miles, the majority of travel is occurring in the urban areas. According to 1997 data, pavement conditions in rural areas are slightly better than in urban areas. Only 5.5 percent of road miles in rural areas are rated "poor," while 9.3 percent of road miles in urban areas are rated "poor." Rural areas also have a larger percentage of "very good" and "good" roads. [*See Exhibit 3-5*]. When evaluating these percentages, please note that rural minor collectors and local functional system mileage are not included.

**Exhibit 3-5**

**Rural & Urban Pavement Conditions, 1997**

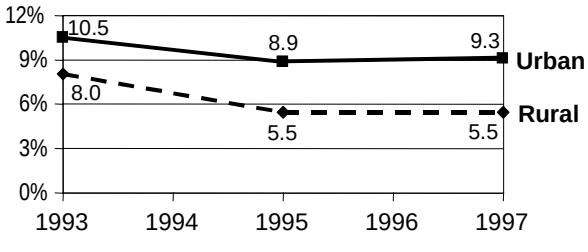



Source: June 1999 HPMS.

Pavement conditions in both rural and urban areas have generally been improving over time. Since 1993, the percentage of road miles in poor condition has decreased from 8.0 percent to 5.5 percent in rural areas and from 10.5 percent to 9.3 percent in urban areas. However, since 1995, the percent of urban miles in poor condition has increased. [*See Exhibit 3-6*].

**Exhibit 3-6**

**Poor Pavement - Percent Miles, 1993-1997**




Source: June 1999 HPMS.

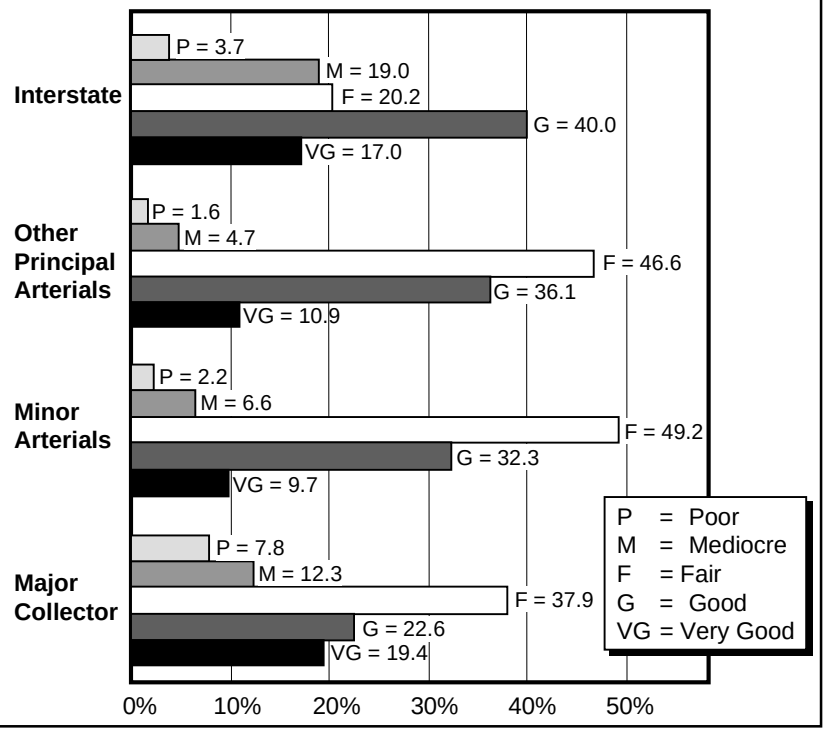
## *Pavement Condition by Functional System*

As was mentioned in Chapter 2, the functional system for approximately 68.9 percent of total mileage is "local." Nevertheless, roads classified as "Interstate" have the largest percentage of VMT, followed by minor arterials and major collectors. Therefore, ride quality on Interstate routes affects more users than ride quality on lower functional systems. Interstate mileage in rural areas is 57.0 percent "very good" or "good," 39.2 percent "mediocre" or "fair" and 3.7 percent "poor." In urban areas on the other hand, Interstate mileage is 40.5 percent "very good" or "good," 50.3 percent "mediocre" or "fair" and 9.2 percent "poor." Regarding minor arterials, rural areas have a slightly lower percentage of "poor" roads and a slightly higher percentage of "mediocre" or "fair" roads compared to urban areas. The urban areas also have a higher percentage of collector roads in "poor" condition and a lower percentage of collector roads in "very good" or "good" condition compared to rural areas. Exhibits 3-7 & 3-8 contain the portion of rural and urban pavement in the various condition categories, respectively.

A historical view helps clarify where pavement improvements are

**Exhibit 3-7**

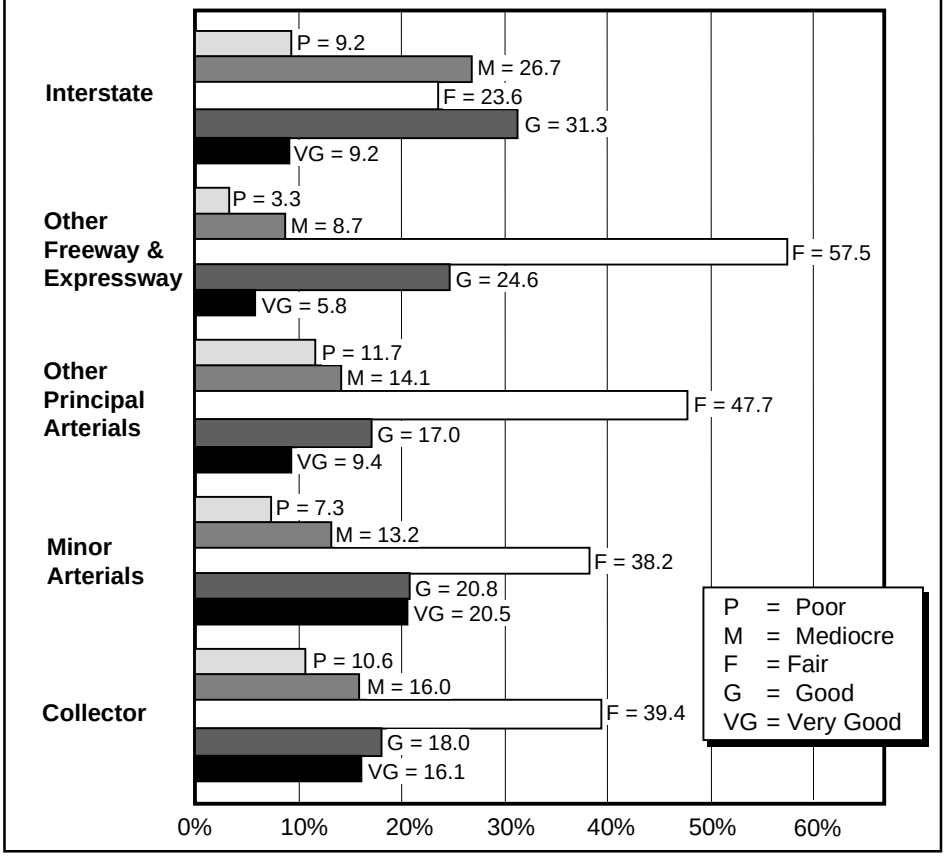
**Rural Pavement Condition, by Functional System, 1997**




Source: June 1999 HPMS.

**Exhibit 3-8**

**Urban Pavement Condition, by Functional System, 1997**

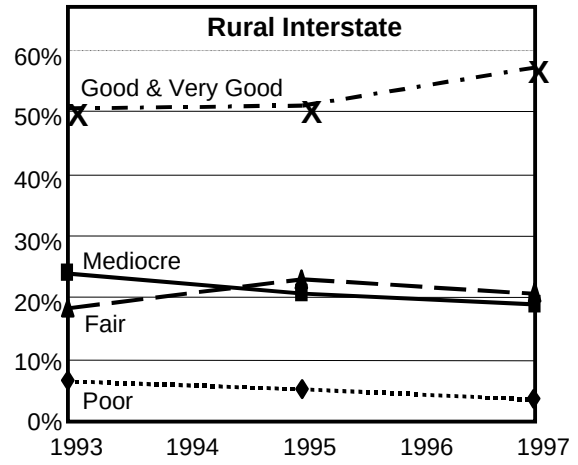



Source: June 1999 HPMS.

occurring and at what rate. Exhibits 3-9 and 3-10 list the pavement condition by category, functional system and location from 1993 to 1997. The data table and graphs illustrate that pavement conditions

**Exhibit 3-9**

**Rural Pavement Condition by Functional System, 1993-1997**



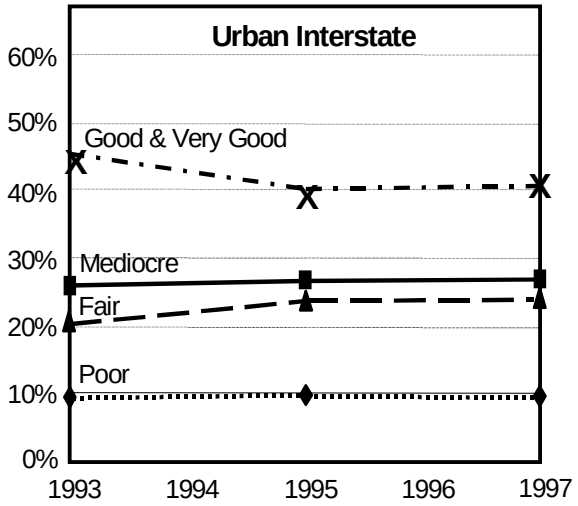

**Rural**

| | 1993 | 1995 | 1997 |
|---|---|---|---|
| **Interstate** | | | |
| *(Acceptable)** | *93.1%* | *94.7%* | *96.2%* |
| Good & Very Good | 50.7% | 51.3% | 57.0% |
| Fair | 18.4% | 22.8% | 20.2% |
| Mediocre | 24.0% | 20.6% | 19.0% |
| Poor | 6.9% | 5.3% | 3.7% |
| **Other Principal Arterials** | | | |
| Good & Very Good | 40.3% | 37.9% | 47.0% |
| Fair | 23.8% | 53.2% | 46.6% |
| Mediocre | 26.5% | 7.0% | 4.7% |
| Poor | 9.3% | 1.9% | 1.6% |
| **Minor Arterials** | | | |
| Good & Very Good | 37.9% | 35.3% | 42.0% |
| Fair | 29.1% | 53.3% | 49.2% |
| Mediocre | 22.0% | 8.9% | 6.6% |
| Poor | 11.0% | 2.6% | 2.2% |
| **Collectors** | | | |
| Good & Very Good | 32.2% | 48.2% | 42.0% |
| Fair | 37.7% | 31.9% | 37.9% |
| Mediocre | 12.4% | 12.7% | 12.3% |
| Poor | 6.8% | 7.3% | 7.8% |

*Acceptable: IRI<=170

**Exhibit 3-10**

**Urban Pavement Condition by Functional System, 1993-1997**




**Urban**

| | 1993 | 1995 | 1997 |
|---|---|---|---|
| **Interstate** | | | |
| *(Acceptable)** | *90.5%* | *90.2%* | *90.8%* |
| Good & Very Good | 45.3% | 40.0% | 40.5% |
| Fair | 20.3% | 23.7% | 23.6% |
| Mediocre | 24.9% | 26.5% | 26.7% |
| Poor | 9.5% | 9.8% | 9.2% |
| **Other Freeway & Expressway** | | | |
| Good & Very Good | 37.9% | 31.6% | 30.4% |
| Fair | 21.9% | 54.8% | 57.5% |
| Mediocre | 30.2% | 9.2% | 8.7% |
| Poor | 9.9% | 4.3% | 3.3% |
| **Other Principal Arterials** | | | |
| Good & Very Good | 35.2% | 25.9% | 26.4% |
| Fair | 23.5% | 47.8% | 47.7% |
| Mediocre | 26.4% | 14.5% | 14.1% |
| Poor | 15.0% | 11.8% | 11.7% |
| **Minor Arterials** | | | |
| Good & Very Good | 37.8% | 43.3% | 41.3% |
| Fair | 40.2% | 36.3% | 38.2% |
| Mediocre | 13.8% | 13.6% | 13.2% |
| Poor | 7.9% | 6.7% | 7.3% |
| **Collectors** | | | |
| Good & Very Good | 31.6% | 34.8% | 34.1% |
| Fair | 40.0% | 38.6% | 39.4% |
| Mediocre | 16.8% | 16.8% | 16.0% |
| Poor | 10.6% | 9.7% | 10.6% |

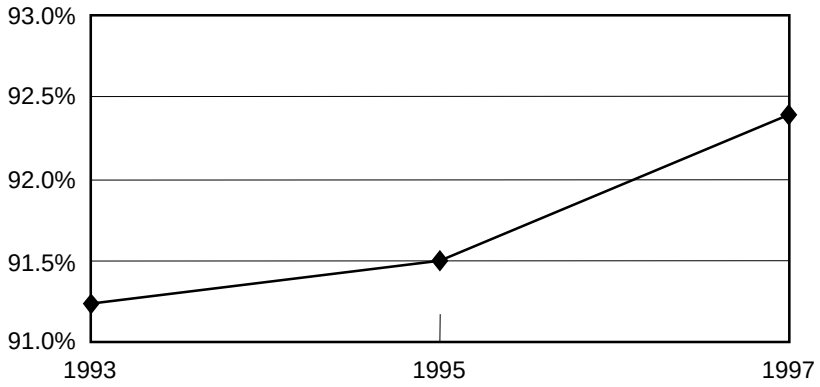
*Acceptable: IRI<=170

have changed in a variety of ways. For example, since 1993, the percentage of Interstate miles in rural areas characterized as "very good" and "good" has increased from 50.7 percent to 57.0 percent while the percentage characterized as "poor" has decreased from 6.9 percent to 3.7 percent. On the other hand, the percentage of Interstate miles in urban areas characterized as "very good" and "good" has decreased from 45.3 percent to 40.5 percent while the percentage characterized as "poor" has only slightly decreased from 9.5 percent to 9.2 percent. One consistent trend is the faster rate of pavement condition improvement in rural areas versus urban areas. For example, since 1993, the percentage of minor arterial miles in rural areas characterized as "poor" fell from 11.0 percent to 2.2 percent while the percentage in urban areas only fell from 7.9 percent to 7.3 percent. Exhibits 3-9 and 3-10 also identify the portion of Interstate pavements that meet the FHWA Strategic Plan standard for "acceptable ride quality" on the NHS.

Combining the rural and urban Interstate data illustrates that overall our Interstate pavement performance has improved since 1993. Exhibit 3-11 traces the percentage of Interstate miles in "acceptable ride quality." The percentage of all Interstate mileage with "acceptable ride quality" increased from 91.2 percent in 1993 to 92.4 percent in 1997.

**Exhibit 3-11**

**Percentage of Interstate Miles with Acceptable Ride Quality, 1997**




## *Roadway Alignment*

Alignment adequacy affects the level of service and safety of the highway system. There are two types: horizontal and vertical. Horizontal alignment affects speed and sight distance, while vertical alignment affects principally sight distance. Inadequate alignment may result in speed reductions (especially for trucks) as well as impaired sight distance. Alignment adequacy is evaluated on a scale from Code 1 (best) to Code 4 (worst). Exhibit 3-12 explains the alignment rating system.

**Exhibit 3-12**

**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 speeds 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 3-13 and 3-14 illustrate that more than 90 percent of the rural Interstate miles are classified as Code 1 for both vertical and horizontal alignment. A small portion of all roads is rated Code 4 (9.1 percent for horizontal alignment and 4.6 percent for vertical alignment). Roadway alignment continues to improve gradually as sections with poor alignment are reconstructed.

**Exhibit 3-13**

**Rural Horizontal Alignment Adequacy, 1997**

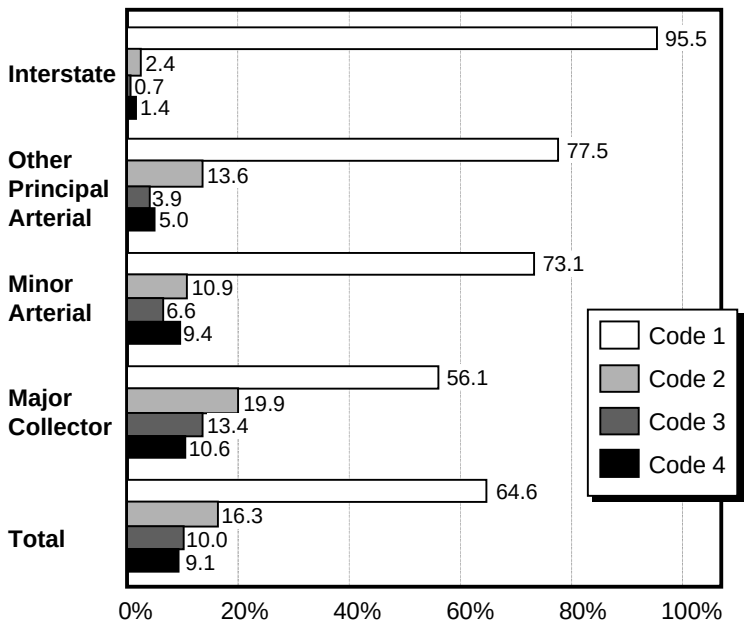
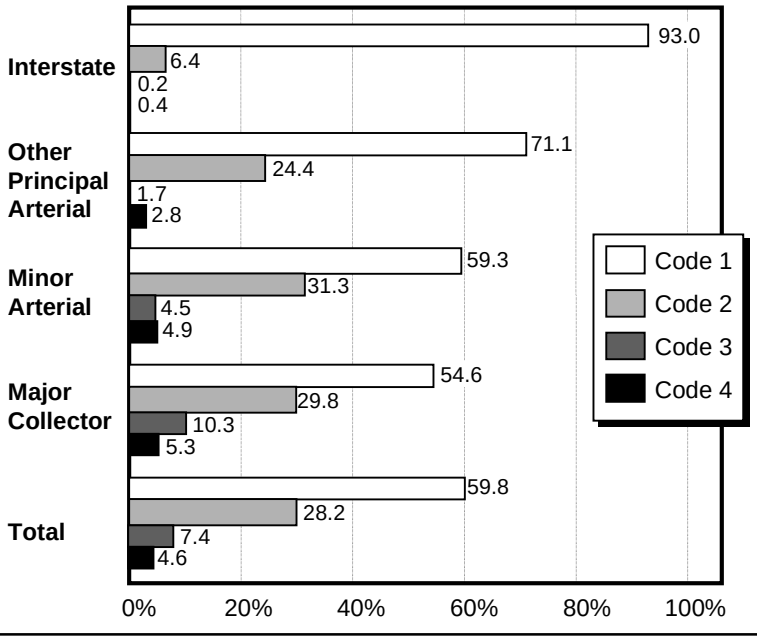



**Exhibit 3-14**

**Rural Vertical Alignment Adequacy, 1997**




## *Lane Width*

Lane width affects capacity and safety. For example, narrow lanes prevent a road from operating at capacity. As with roadway alignment, lane width is more crucial on functional systems with the higher travel volumes. Currently, high-type facilities (e.g. Interstates) are expected to have 12-foot lanes. Exhibits 3-15 and 3-16 illustrate that over 99 percent of the all Interstate miles meet the 12-foot standard. The percentage of 12+ foot lane widths decreases as the travel volume decreases. This relationship is seen on urban collectors and major rural collectors which have 51 percent and 36.8 percent respectively of 12+ foot lanes. The lanes that are less than 9 feet are mainly concentrated on the collector roads.

**Exhibit 3-15**

**Rural Lane Width, by Functional System, 1997**

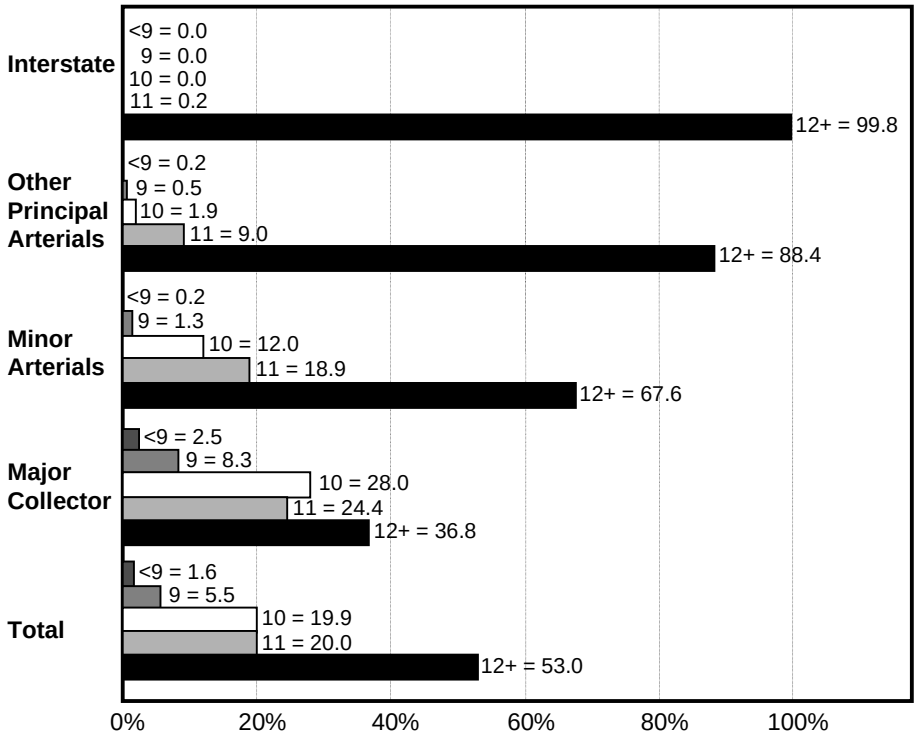
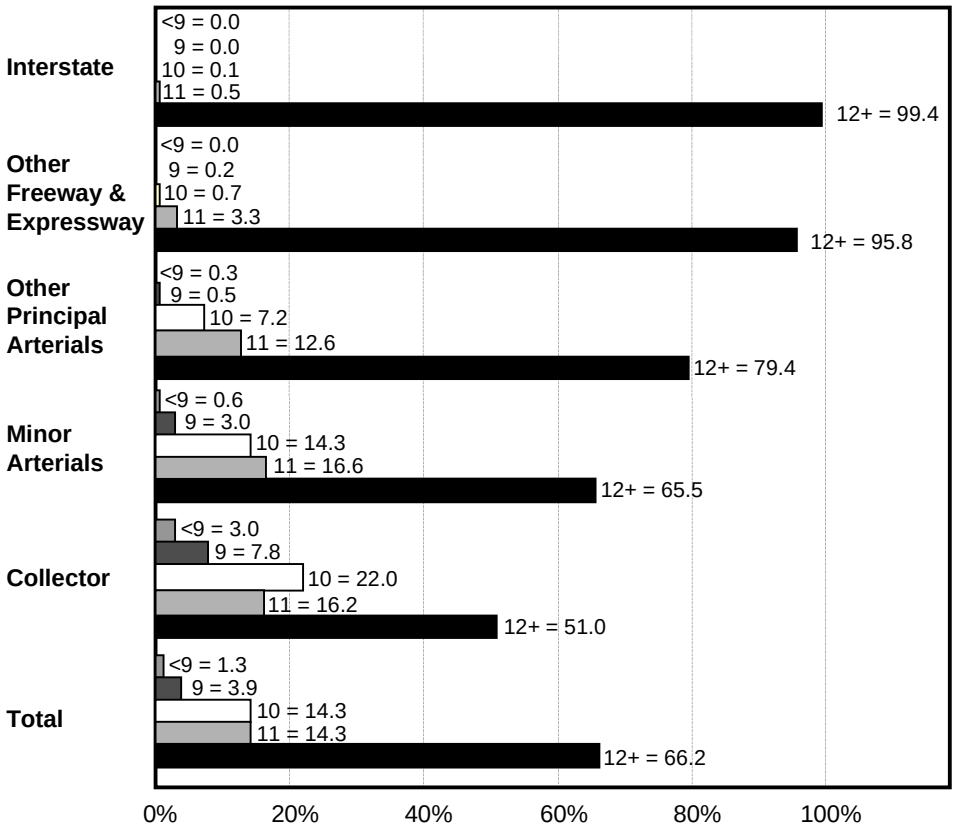



**Exhibit 3-16**

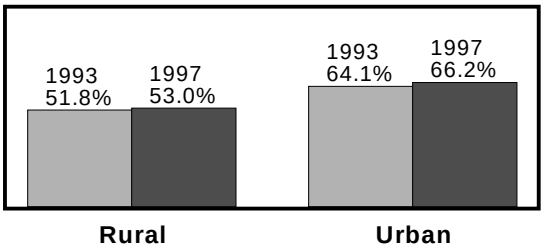
**Urban Lane Width, by Functional System, 1997**



Lanes have been widened over time through new construction, reconstruction, and widening projects. Since 1993, the rural mileage with lane width greater than or equal to 12 feet increased from 51.8 percent to 53.0 percent while the urban mileage with 12 foot+ lanes increased from 64.1 percent to 66.2 percent [*see Exhibit 3-17*].

**Exhibit 3-17**

**12+ Foot Lanes, Rural and Urban, 1993 and 1997**



# Bridge Conditions

This section uses two measures of bridge conditions: bridge component ratings, and the number of deficient bridges. The bridge component ratings provide a broader perspective on conditions, but the quantity of deficient bridges is a more widely used indicator. The bridge investment requirement analysis described later in this report focuses on bridge deficiencies. In addition, the *Federal Highway Administration 1998 National Strategic Plan* includes two goals related to percentage of deficient bridge. The target for NHS bridges is discussed in Appendix B. The target for all bridges is discussed later in this chapter.

## *Bridge Component Ratings*

The National Bridge Inventory (NBI) contains ratings on the conditions of three major bridge components: deck, superstructure, and substructure. Exhibit 3-18 contains a description of this rating system.

**Exhibit 3-18**

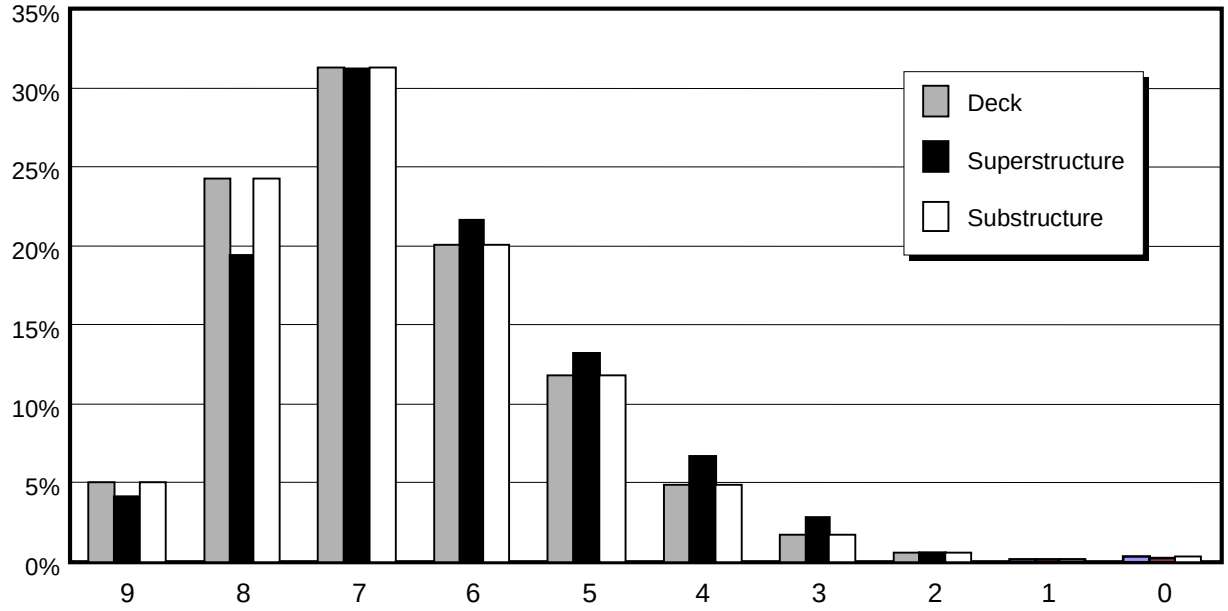
**Bridge Component Ratings**

| 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. Fatique 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. |

Exhibit 3-19 illustrates the distribution of bridge component ratings. The majority of bridge components are rated 7 or higher, indicating that they are in good, very good, or excellent condition. Approximately one-third are rated 5 or 6, indicating that they are considered fair or satisfactory. The remainder of bridge components are rated 4 or lower, indicating that they are in poor or worse condition. A component rating does not translate directly into an overall rating of a bridge's condition.

**Exhibit 3-19**

**Bridge Component Conditions, 1998**




## *Bridge Deficiencies*

The more common indicator used to evaluate the condition of our Nation's bridges is the number of deficient bridges. There are two types of deficient bridges: structurally deficient and functionally obsolete.

Exhibit 3-20 shows that in 1998 29.6 percent of our Nation's bridges were deficient. Of these deficient bridges, 16.0 percent of bridges were structurally deficient while 13.6 percent were functionally obsolete.

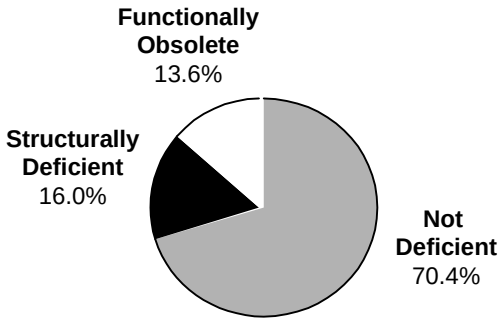
***Q.*** **How are "structurally deficient" and "functionally obsolete" bridges defined?**

***A.*** Bridges are structurally deficient if they have been restricted to light vehicles, require immediate rehabilitation to remain open, or are closed.

Bridges are functionally obsolete if they have deck geometry, load carrying capacity, clearance or approach roadway alignment that no longer meet the criteria for the system of which the bridge is a part.

**Exhibit 3-20**

**Deficiencies, All Bridges, 1998**




***Q.*** **Are all deficient bridges unsafe to cross?**

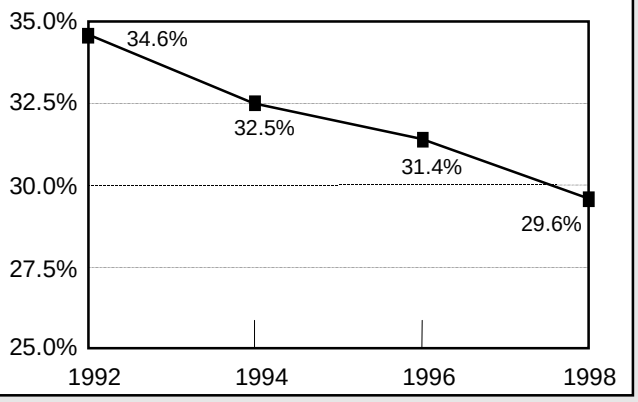
***A.*** No. A deficient bridge is not necessarily unsafe or one that requires special posting for speed or weight limitations. It does require significant maintenance, rehabilitation, or sometimes replacement. Some of these bridges are posted and may require trucks over a certain weight to take a longer route. For further information on the status of bridges, please refer to *The Status of the Nation's Highway Bridges: Highway Bridge Replacement and Rehabilitation Program and National Bridge Inventory*, Report to Congress dated May 1997.

**Q. How do recent deficient bridge data compare with the FHWA Strategic Plan target for deficient bridges in 2008?**

**A.** The Federal Highway Administration 1998 Strategic Plan stated that by 2008, less than 25 percent of our bridges should be classified as deficient. As Exhibit 3-21 illustrates, the percent of deficient bridges has been declining in recent years, from 34.6 percent in 1992 to 29.6 percent in 1998. The Strategic Plan also established a target for bridges on the NHS which is discussed in further detail in Appendix B.

**Exhibit 3-21**

**Percentage of Deficient Bridges, 1992-1998**



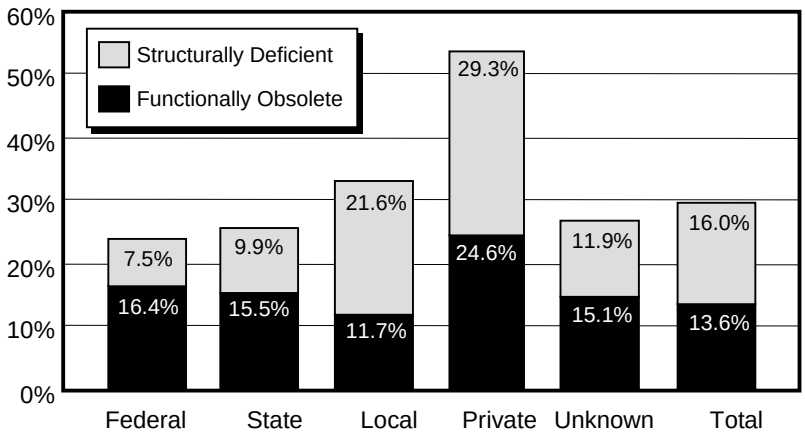

## Bridge Deficiencies by Jurisdiction

As Chapter 2 explained, ownership of bridges is divided among Federal, State, and local governments and private companies (including railroads). State and local governments own the majority of bridges, 46.9 percent and 51.2 percent respectively. The remaining 1.9 percent includes bridges owned by the Federal Government or private companies, and bridges for which ownership is unknown or not coded in the NBI.

Exhibit 3-22 shows there are significant differences in bridge deficiencies by level of government. Of the 298,222 bridges owned by local governments, 99,503 (33.4 percent) are deficient. This represents 57.7 percent of the total number of deficient bridges, 172,572. Although private companies own only

**Exhibit 3-22**

**Bridges: Percent Deficient, by Ownership, 1998**




| | Federal | State | Local | Private | Unknown | Total |
|---|---|---|---|---|---|---|
| Total Bridges | 7,448 | 273,897 | 298,222 | 2,278 | 1,131 | 582,976 |
| Total Deficient | 1,774 | 69,762 | 99,503 | 1,227 | 306 | 172,572 |
| Structurally Deficient | 555 | 27,196 | 64,519 | 667 | 135 | 93,072 |
| Functionally Obsolete | 1,219 | 42,566 | 34,984 | 560 | 171 | 79,500 |
| Percent Deficent | 23.8% | 25.5% | 33.4% | 53.9% | 27.1% | 29.6% |
| Percent Structurally Deficent | 7.5% | 9.9% | 21.6% | 29.3% | 11.9% | 16.0% |
| Percent Functionally Obsolete | 16.4% | 15.5% | 11.7% | 24.6% | 15.1% | 13.6% |

Source: National Bridge Inventory.

2,278 bridges, 0.4 percent of the total, 53.9 percent of these bridges are deficient. Of federally owned bridges, only 23.8 percent are deficient.

Exhibit 3-22 also shows that the majority of deficiencies on bridges owned by local governments are structural. However, for State and federally owned bridges, the majority of the deficiencies are functional. Exhibits 3-23 and 3-24 clarify this difference. Local governments own 69.3 percent of structurally deficient bridges, but only 44.0 percent of functionally obsolete bridges. State governments own the majority (53.6 percent) of functionally obsolete bridges.

**Exhibit 3-23**

**Ownership of Structurally Deficient Bridges, 1998**

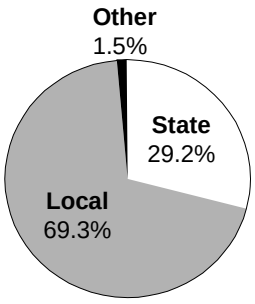
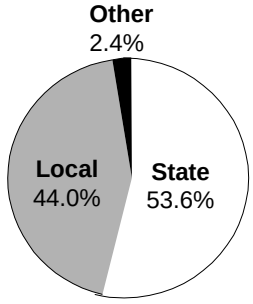



**Exhibit 3-24**

**Ownership of Functionally Obsolete Bridges, 1998**




## *Rural and Urban Bridges*

As indicated in Chapter 2, 78.0 percent of all bridges are located in rural areas. In 1998, 130,911 of the total 454,664 rural bridges (28.8 percent) were deficient. Bridges in urban areas are more likely to be deficient than those in rural areas. In 1998, 41,661 of the total 128,312 urban bridges (32.5 percent) were deficient. Exhibit 3-25 shows that deficient rural bridges are more likely to be structurally deficient, while deficient urban bridges are more likely to be functionally obsolete.

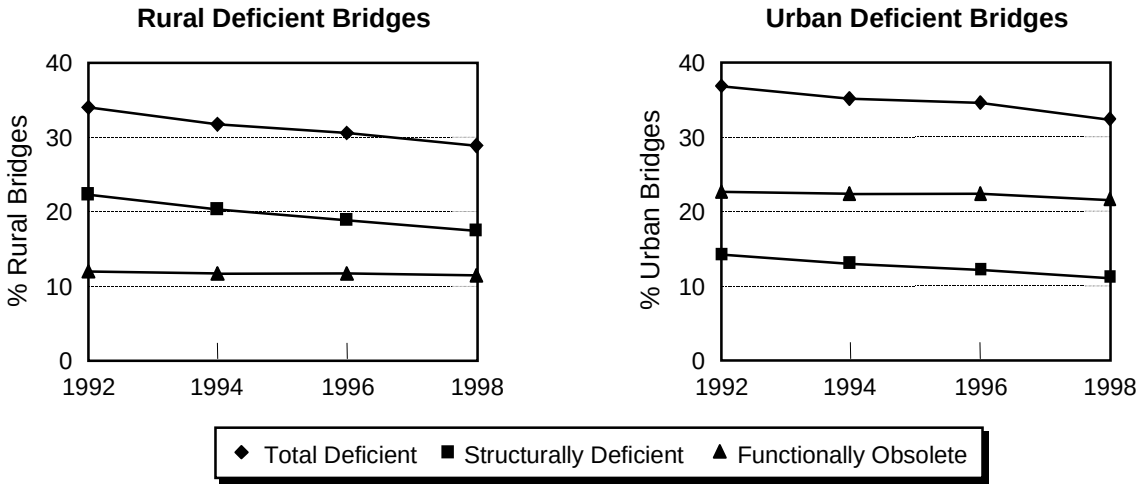
Bridge condition in both urban and rural areas has been improving in recent years. Exhibit 3-25 shows that the number of deficient rural bridges has declined from 156,863 (34.1 percent of the total) in 1992 to 130,911 (28.8 percent). The number of deficient urban bridges has declined from 42,489 (36.8 percent) in 1992 to 41,661 (32.5 percent) in 1998. The percentage of rural bridges that are structurally deficient has declined from 22.2 percent in 1992, to 17.4 percent in 1998, while the percentage of urban bridges that are structurally deficient declined from 14.1 percent to 11.0 percent over the same period. The number of urban bridges that are functionally obsolete grew from 26,228 to 27,588 over this 6-year period, though this represented a decline in percentage terms, from 22.7 percent to 21.5 percent. In summary, since 1992, the reduction in the number of structurally deficient bridges has been much more pronounced (20.6 percent to 16.0 percent) than the reduction in functionally obsolete bridges (14.0 percent to 13.6 percent).

## *Bridges by Functional System*

The general trend described in the previous section, where bridges in urban areas are more likely to be deficient, can also be seen in Exhibit 3-26. Bridges found on urban Interstates, urban other principal arterials and urban minor arterials have a higher percentage of deficient bridges than those on comparable rural functional systems. However, a larger percentage of bridges on local roads in rural areas are deficient (36.5 percent) compared to those in urban areas (32.6 percent).

**Exhibit 3-25**

**Rural and Urban Bridge Deficiencies, 1992-1998**




| | 1992 | | 1994 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Rural Bridges | 460,219 | | 455,319 | | 456,913 | | 454,664 | |
| Deficient Bridges | 156,863 | 34.1% | 144,799 | 31.8% | 139,545 | 30.5% | 130,911 | 28.8% |
| Structural | 102,292 | 22.2% | 91,991 | 20.2% | 86,424 | 18.9% | 78,999 | 17.4% |
| Functional | 54,571 | 11.9% | 52,808 | 11.6% | 53,121 | 11.6% | 51,912 | 11.4% |
| Urban Bridges | 115,364 | | 121,141 | | 124,949 | | 128,312 | |
| Deficient Bridges | 42,489 | 36.8% | 42,716 | 35.3% | 43,181 | 34.6% | 41,661 | 32.5% |
| Structural | 16,261 | 14.1% | 15,692 | 13.0% | 15,094 | 12.1% | 14,073 | 11.0% |
| Functional | 26,228 | 22.7% | 27,024 | 22.3% | 28,087 | 22.5% | 27,588 | 21.5% |
| Total Bridges | 575,583 | | 576,460 | | 581,862 | | 582,976 | |
| Deficient Bridges | 199,352 | 34.6% | 187,515 | 32.5% | 182,726 | 31.4% | 172,572 | 29.6% |
| Structural | 118,553 | 20.6% | 107,683 | 18.7% | 101,518 | 17.4% | 93,072 | 16.0% |
| Functional | 80,799 | 14.0% | 79,832 | 13.8% | 81,208 | 14.0% | 79,500 | 13.6% |

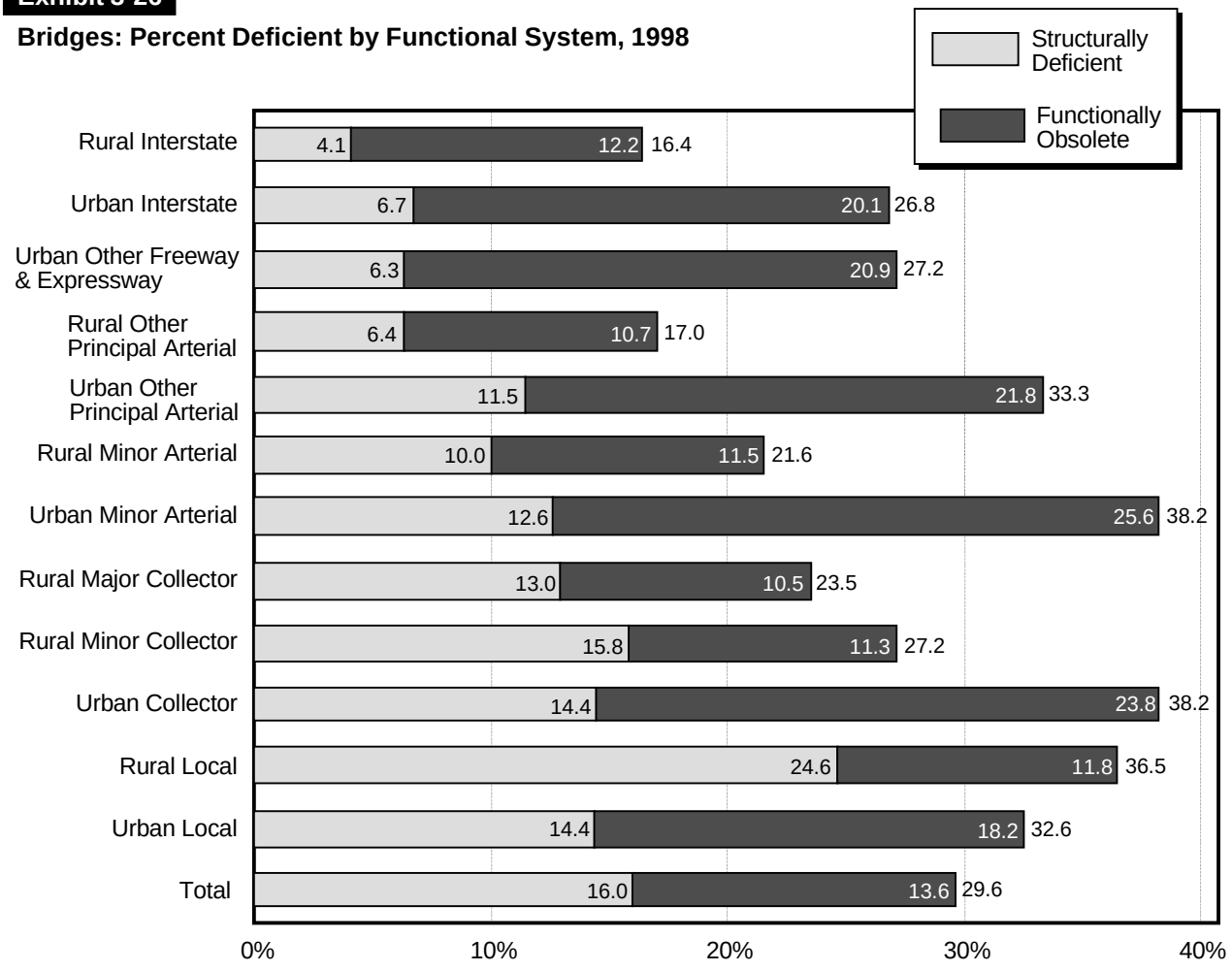
Source: National Bridge Inventory.

The proportion of structurally deficient and functionally obsolete bridges varies by functional system. Exhibit 3-26 highlights some of these differences. For the most part, the percentage of bridges that are deficient increases on lower functional systems. Bridges on the Interstate have the lowest percentage of deficient bridges (16.4 percent in rural areas and 26.8 percent in urban areas). The rural Interstate bridges also have the lowest percentage of structurally deficient bridges, 4.1 percent, of all functional systems in both areas. Other principal arterials, which like Interstates account for a large share of VMT, have a relatively small percentage of deficient bridges (17.0 percent in rural areas and 33.3 percent in urban areas).

Minor arterials have a larger percentage of deficient bridges than the higher functional systems. In urban areas, minor arterials are tied with collector roads for the highest percentage of deficient bridges (38.2 percent). This is the highest percentage of deficient bridges among all functional systems. Functionally obsolete bridges make up the largest portion of this percentage.

**Exhibit 3-26**

**Bridges: Percent Deficient by Functional System, 1998**




| Functional Class | Total Bridges | Bridge Deficiencies | | | Percent Deficient | | |
|---|---|---|---|---|---|---|---|
| | | Structural | Functional | Total | Structural | Functional | Total |
| **Rural** | | | | | | | |
| Interstate | 27,530 | 1,135 | 3,369 | 4,504 | 4.1% | 12.2% | 16.4% |
| Other Principal Arterial | 35,302 | 2,252 | 3,765 | 6,017 | 6.4% | 10.7% | 17.0% |
| Minor Arterial | 38,022 | 3,808 | 4,391 | 8,199 | 10.0% | 11.5% | 21.6% |
| Major Collector | 95,830 | 12,426 | 10,097 | 22,523 | 13.0% | 10.5% | 23.5% |
| Minor Collector | 47,310 | 7,493 | 5,352 | 12,845 | 15.8% | 11.3% | 27.2% |
| Local | 210,670 | 51,885 | 24,938 | 76,823 | 24.6% | 11.8% | 36.5% |
| **Total Rural** | **454,664** | **78,999** | **51,912** | **130,911** | **17.4%** | **11.4%** | **28.8%** |
| **Urban** | | | | | | | |
| Interstate | 27,480 | 1,850 | 5,526 | 7,376 | 6.7% | 20.1% | 26.8% |
| Other Freeway & Expressway | 15,221 | 960 | 3,177 | 4,137 | 6.3% | 20.9% | 27.2% |
| Other Principal Arterial | 23,463 | 2,699 | 5,113 | 7,812 | 11.5% | 21.8% | 33.3% |
| Minor Arterial | 22,217 | 2,808 | 5,678 | 8,486 | 12.6% | 25.6% | 38.2% |
| Collector | 14,962 | 2,158 | 3,560 | 5,718 | 14.4% | 23.8% | 38.2% |
| Local | 24,969 | 3,598 | 4,534 | 8,132 | 14.4% | 18.2% | 32.6% |
| **Total Urban** | **128,312** | **14,073** | **27,588** | **41,661** | **11.0%** | **21.5%** | **32.5%** |
| **Total, Rural and Urban** | **582,976** | **93,072** | **79,500** | **172,572** | **16.0%** | **13.6%** | **29.6%** |

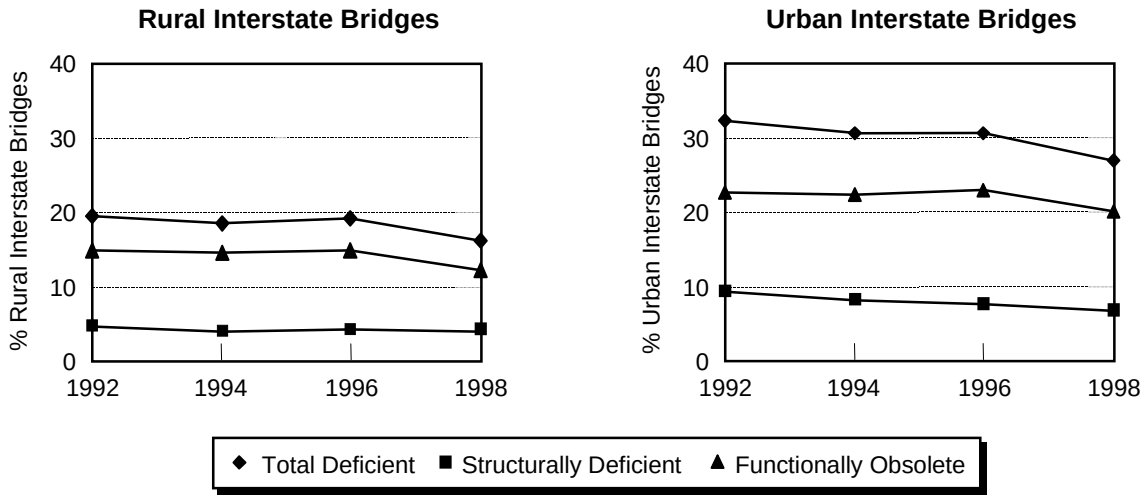
Source: National Bridge Inventory.

A high percentage of bridges functionally classified as local are deficient. In urban areas the percentage is 32.6 percent and in rural areas the percentage is 36.5 percent. The high percentage in rural areas is particularly significant because 36.1 percent of all bridges are on local rural roads. In addition, a large portion of the deficient bridges are structurally deficient.

Exhibit 3-27 through Exhibit 3-30 provide a historical perspective on bridge improvements. Since 1992, the percentage of deficient bridges on Interstates, other principal arterials, collectors and local roads have decreased in both rural and urban areas. However, there was an increase in the percentage of functionally deficient bridges from 1994 to 1996. This occurred on Interstates, other arterials and collectors in both rural and urban areas. In most cases, the increase was very small. The history of local functional system roads is mixed. Even though the percentage of total deficient bridges has decreased since 1992 there was a slight increase (up .4 percentage points) between 1996 and 1998.

**Exhibit 3-27**

**Interstate Bridge Deficiencies, 1992-1998**

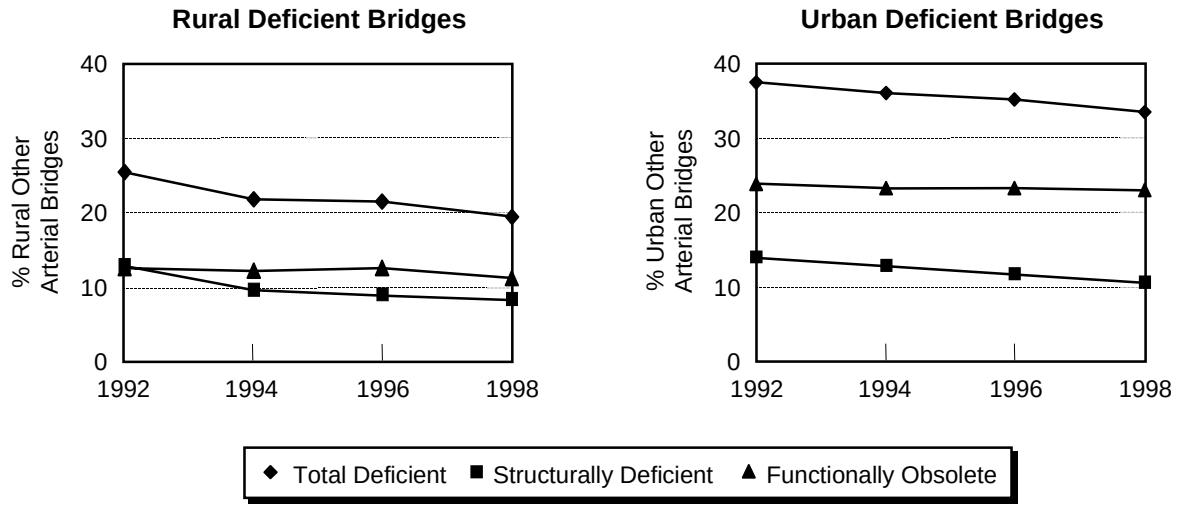



| | 1992 | | 1994 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| **Rural Bridges** | 29,148 | | 28,865 | | 28,638 | | 27,530 | |
| Deficient Bridges | 5,659 | 19.4% | 5,342 | 18.5% | 5,479 | 19.1% | 4,504 | 16.4% |
| Structural | 1,330 | 4.6% | 1,162 | 4.0% | 1,249 | 4.4% | 1,135 | 4.1% |
| Functional | 4,329 | 14.9% | 4,180 | 14.5% | 4,230 | 14.8% | 3,369 | 12.2% |
| **Urban Bridges** | 25,013 | | 25,861 | | 26,596 | | 27,480 | |
| Deficient Bridges | 8,066 | 32.2% | 7,920 | 30.6% | 8,181 | 30.8% | 7,376 | 26.8% |
| Structural | 2,367 | 9.5% | 2,141 | 8.3% | 2,070 | 7.8% | 1,850 | 6.7% |
| Functional | 5,699 | 22.8% | 5,779 | 22.3% | 6,111 | 23.0% | 5,526 | 20.1% |
| **Total Bridges** | 54,161 | | 54,726 | | 55,234 | | 55,010 | |
| Deficient Bridges | 13,725 | 25.3% | 13,262 | 24.2% | 13,660 | 24.7% | 11,880 | 21.6% |
| Structural | 3,697 | 6.8% | 3,303 | 6.0% | 3,319 | 6.0% | 2,985 | 5.4% |
| Functional | 10,028 | 18.5% | 9,959 | 18.2% | 10,341 | 18.7% | 8,895 | 16.2% |

Source: National Bridge Inventory.

**Exhibit 3-28**

**Other Arterial Bridge Deficiencies, 1992-1998**

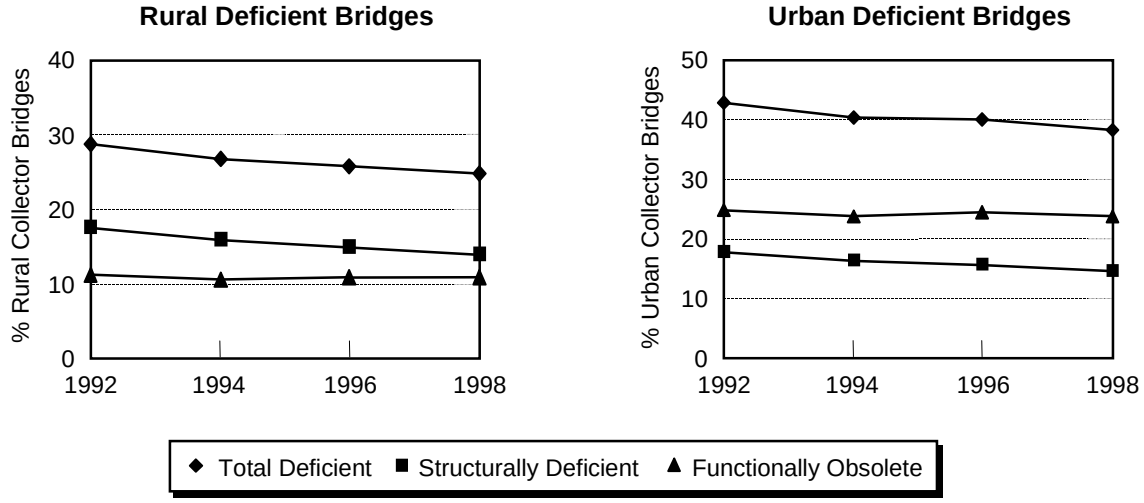



| | 1992 | | 1994 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| **Rural Bridges** | 78,123 | | 72,453 | | 72,970 | | 73,324 | |
| Deficient Bridges | 19,884 | 25.5% | 15,693 | 21.7% | 15,693 | 21.5% | 14,216 | 19.4% |
| Structural | 9,965 | 12.8% | 6,914 | 9.5% | 6,622 | 9.1% | 6,060 | 8.3% |
| Functional | 9,919 | 12.7% | 8,779 | 12.1% | 9,071 | 12.4% | 8,156 | 11.1% |
| **Urban Bridges** | 54,589 | | 57,012 | | 59,064 | | 60,901 | |
| Deficient Bridges | 20,481 | 37.5% | 20,506 | 36.0% | 20,710 | 35.1% | 20,435 | 33.6% |
| Structural | 7,544 | 13.8% | 7,247 | 12.7% | 6,902 | 11.7% | 6,467 | 10.6% |
| Functional | 12,937 | 23.7% | 13,259 | 23.3% | 13,808 | 23.4% | 13,968 | 22.9% |
| **Total Bridges** | 132,712 | | 129,465 | | 132,034 | | 134,225 | |
| Deficient Bridges | 40,365 | 30.4% | 36,199 | 28.0% | 36,403 | 27.6% | 34,651 | 25.8% |
| Structural | 17,509 | 13.2% | 14,161 | 10.9% | 13,524 | 10.2% | 12,527 | 9.3% |
| Functional | 22,856 | 17.2% | 22,038 | 17.0% | 22,879 | 17.3% | 22,124 | 16.5% |

Source: National Bridge Inventory.

**Exhibit 3-29**

**Collector Bridge Deficiencies, 1992-1998**

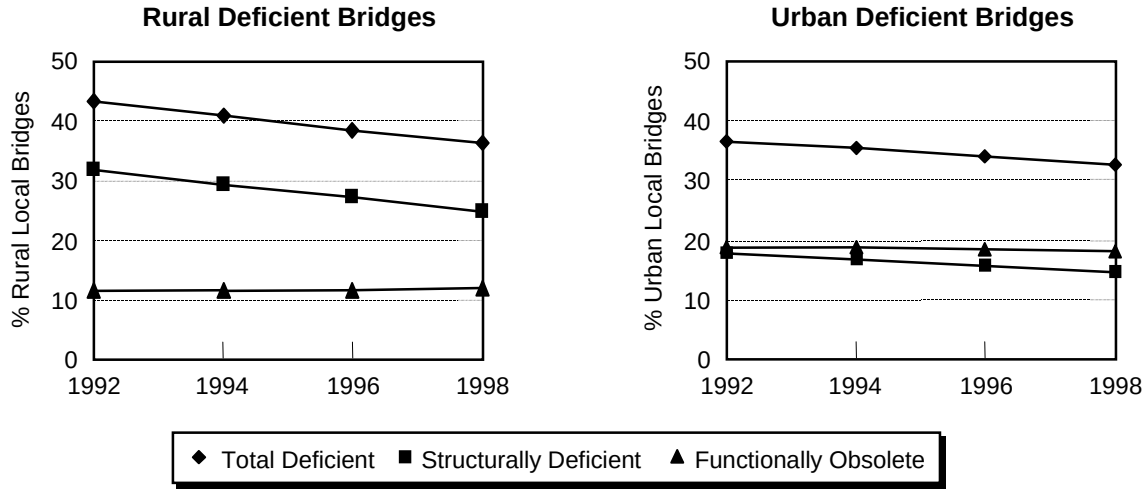



| | 1992 | | 1994 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| **Rural Bridges** | 147,148 | | 147,612 | | 144,246 | | 143,140 | |
| Deficient Bridges | 42,270 | 28.7% | 39,398 | 26.7% | 37,158 | 25.8% | 35,368 | 24.7% |
| Structural | 25,933 | 17.6% | 23,645 | 16.0% | 21,375 | 14.8% | 19,919 | 13.9% |
| Functional | 16,337 | 11.1% | 15,753 | 10.7% | 15,783 | 10.9% | 15,449 | 10.8% |
| **Urban Bridges** | 13,647 | | 14,702 | | 14,848 | | 14,962 | |
| Deficient Bridges | 5,847 | 42.8% | 5,932 | 40.3% | 5,976 | 40.2% | 5,718 | 38.2% |
| Structural | 2,440 | 17.9% | 2,415 | 16.4% | 2,337 | 15.7% | 2,158 | 14.4% |
| Functional | 3,407 | 25.0% | 3,517 | 23.9% | 3,639 | 24.5% | 3,560 | 23.8% |
| **Total Bridges** | 160,795 | | 162,314 | | 159,094 | | 158,102 | |
| Deficient Bridges | 48,117 | 29.9% | 45,330 | 27.9% | 43,134 | 27.1% | 41,086 | 26.0% |
| Structural | 28,373 | 17.6% | 26,060 | 16.1% | 23,712 | 14.9% | 22,077 | 14.0% |
| Functional | 19,744 | 12.3% | 19,270 | 11.9% | 19,422 | 12.2% | 19,009 | 12.0% |

Source: National Bridge Inventory.

**Exhibit 3-30**

**Local Bridge Deficiencies, 1992-1998**




| | 1992 | | 1994 | | 1996 | | 1998 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| **Rural Bridges** | 205,800 | | 206,389 | | 211,059 | | 210,670 | |
| Deficient Bridges | 89,050 | 43.3% | 84,366 | 40.9% | 81,215 | 38.5% | 76,823 | 36.5% |
| Structural | 65,064 | 31.6% | 60,270 | 29.2% | 57,178 | 27.1% | 51,885 | 24.6% |
| Functional | 23,986 | 11.7% | 24,096 | 11.7% | 24,037 | 11.4% | 24,938 | 11.8% |
| **Urban Bridges** | 22,115 | | 23,566 | | 24,441 | | 24,969 | |
| Deficient Bridges | 8,095 | 36.6% | 8,358 | 35.5% | 8,314 | 34.0% | 8,132 | 32.6% |
| Structural | 3,910 | 17.7% | 3,889 | 16.5% | 3,785 | 15.5% | 3,598 | 14.4% |
| Functional | 4,185 | 18.9% | 4,469 | 19.0% | 4,529 | 18.5% | 4,534 | 18.2% |
| **Total Bridges** | 227,915 | | 229,955 | | 235,500 | | 235,639 | |
| Deficient Bridges | 97,145 | 42.6% | 92,724 | 40.3% | 89,529 | 38.0% | 84,955 | 36.1% |
| Structural | 68,974 | 30.3% | 64,159 | 27.9% | 60,963 | 25.9% | 55,483 | 23.5% |
| Functional | 28,171 | 12.4% | 28,565 | 12.4% | 28,566 | 12.1% | 29,472 | 12.5% |

Source: National Bridge Inventory.

# Transit System Conditions

This report represents another step in a series of improvements that have been made in recent years to the calculation of public transit asset conditions, particularly in relating the age of assets to their actual physical condition. In particular, the data presented here on bus vehicle and maintenance facility conditions have been improved by input from the 1999 National Bus Condition Assessment. Such improvements are expected to continue in the future, as more data on conditions is collected and analyzed. For more information on the National Bus Condition Assessment and the methodology used to calculate conditions, see Appendix I.

## *Urban Bus Fleet*

Vehicle condition ratings are based on a scale from 1 (poor) to 5 (excellent) (Exhibit 3-31). The aging of the fleet can be described both by the average vehicle age and by the percentage of vehicles which are considered "overage," meaning that the vehicle's age exceeds FTA's minimum useful-life guidelines (Exhibit 3-32). Exhibit 3-33 shows the average ratings on this scale for different sizes of bus and demand response vehicles, as well as the average age and the overage percentage for each type of vehicle.

**Exhibit 3-31**

**Bus Fleet Condition Ratings Description**

| Rating | Condition Definition |
|---|---|
| 5.0 | Excellent |
| 4.0 | Good |
| 3.0 | Adequate |
| 2.0 | Substandard |
| 1.0 | Poor |

Source: Transit Economic Requirements Model (TERM).

The ratings shown here differ from those found in the 1997 Report in two significant ways:

- Estimated conditions are uniformly lower than reported in prior reports
- Average conditions for each asset type do not change as significantly over time

**Exhibit 3-32**

**FTA Minimum-Useful Life Guidelines**

| Vehicle Type | Age (years) |
|---|---|
| Full-Size Bus | 12 |
| Medium-Size Bus | 10 |
| Small Bus | 7 |
| Rail Vehicles | 25 |

Both of these features are primarily due to the updated relationship between bus vehicle condition and age determined by the National Bus Condition Assessment (Appendix I). The lower ratings result from the more rapid decline in asset condition that is exhibited by the new curves, and the more stable time series reflects in part the long period of slow decay.

The estimated average condition of the urban bus fleet in 1997 is 3.1, or adequate. This represents a slight improvement over the level of 3.0, which was attained in each of the previous 9 years. Conditions for large, articulated buses have declined over the previous decade, from 3.1 to 2.7, while conditions of vans have increased from 3.2 to 3.5.

This improvement in conditions reflects the slight change in average vehicle age over the decade from 7.5 years to 6.6 years. Decreases in the average ages of vans and small and mid-sized buses have been partially offset by the significant aging of the articulated bus fleet, where the average age has increased from 4.9 to 11.8 years, and over 60 percent of these vehicles can be considered overage.

**Exhibit 3-33**

**Urban Transit Bus Fleet Count, Age and Condition, 1987-1997**

| Year | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Articulated Buses** | | | | | | | | | | | |
| Total Fleet | 1,712 | 1,751 | 1,730 | 1,717 | 1,764 | 1,698 | 1,807 | 1,613 | 1,716 | 1,652 | 1,523 |
| Percent Overage Vehicles | 0% | 0% | 0% | 0% | 13% | 18% | 16% | 17% | 33% | 47% | 61% |
| Average Age | 4.9 | 5.9 | 6.7 | 7.6 | 8.2 | 9.1 | 9.5 | 10.1 | 10.7 | 10.6 | 11.8 |
| Average Condition | 3.1 | 3.1 | 3.1 | 3.0 | 3.0 | 2.9 | 2.9 | 2.8 | 2.8 | 2.8 | 2.7 |
| **Full-Size Buses** | | | | | | | | | | | |
| Total Fleet | 46,231 | 46,164 | 46,446 | 46,553 | 46,660 | 46,757 | 46,824 | 46,987 | 46,335 | 47,898 | 47,149 |
| Percent Overage Vehicles | 21% | 23% | 22% | 19% | 17% | 18% | 20% | 24% | 23% | 23% | 25% |
| Average Age | 8.2 | 8.2 | 8.4 | 8.2 | 8.0 | 8.3 | 8.5 | 8.7 | 8.6 | 8.3 | 8.2 |
| Average Condition | 3.0 | 3.0 | 2.9 | 3.0 | 3.0 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 3.0 |
| **Mid-Size Buses** | | | | | | | | | | | |
| Total Fleet | 2,821 | 3,002 | 2,928 | 3,106 | 3,268 | 3,204 | 3,598 | 3,693 | 3,879 | 4,434 | 5,328 |
| Percent Overage Vehicles | 10% | 14% | 14% | 18% | 23% | 26% | 24% | 24% | 23% | 20% | 18% |
| Average Age | 5.9 | 6.5 | 6.5 | 6.6 | 6.7 | 6.8 | 6.4 | 6.9 | 6.8 | 6.0 | 5.6 |
| Average Condition | 3.0 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 3.0 | 3.0 |
| **Small Buses** | | | | | | | | | | | |
| Total Fleet | 2,127 | 2,116 | 2,428 | 2,684 | 3,415 | 3,716 | 4,064 | 4,738 | 5,447 | 6,261 | 7,081 |
| Percent Overage Vehicles | 11% | 14% | 15% | 11% | 14% | 14% | 13% | 15% | 13% | 13% | 13% |
| Average Age | 3.9 | 4.2 | 4.1 | 3.9 | 4.0 | 4.1 | 4.0 | 4.1 | 4.0 | 3.8 | 3.7 |
| Average Condition | 3.3 | 3.0 | 3.0 | 3.3 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.3 | 3.4 |
| **Vans** | | | | | | | | | | | |
| Total Fleet | 3,241 | 3,243 | 3,288 | 3,778 | 6,261 | 7,028 | 8,353 | 10,785 | 11,969 | 12,317 | 13,796 |
| Percent Overage Vehicles | 30% | 29% | 21% | 22% | 22% | 15% | 22% | 19% | 21% | 23% | 22% |
| Average Age | 3.1 | 3.6 | 2.9 | 2.8 | 3.0 | 3.1 | 3.1 | 3.0 | 3.2 | 2.9 | 2.3 |
| Average Condition | 3.2 | 2.9 | 3.2 | 3.3 | 3.2 | 3.2 | 3.2 | 3.2 | 3.1 | 3.2 | 3.5 |
| Weighted Average Condition | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.1 |
| Weighted Average Age | 7.5 | 7.6 | 7.7 | 7.5 | 7.2 | 7.4 | 7.4 | 7.4 | 7.3 | 6.9 | 6.6 |

Source: Transit Economic Requirements Model, National Transit Database.

Note that the corresponding decay has not been nearly as dramatic, however, due to the relatively flat decay curve in the range from 5 to 12 years.

The average age of full-size buses, by far the most numerous bus type, is the same as it was in 1987 (8.2 years), but has decreased since 1994. Accordingly, the average condition of this predominant type remains at 3.0.

***Q.*** **Why was the average bus condition level for 1995 and prior years revised downward?**

***A.*** The revision reflects the improvement in the modeling of bus conditions that resulted from the 1999 National Bus Condition Assessment. See Appendix I for a description of this change in modeling procedure.

## *Urban Bus Maintenance Facilities*

Estimates of the condition of urban bus maintenance facilities come from the National Bus Condition Assessment. Exhibit 3-34 shows the age range of these facilities. Fifty-six percent of bus maintenance facilities are less than 20 years old, with most of these in the older half of that range. Nearly one-third of the facilities are over 30 years old.

Exhibit 3-35 shows the condition of bus maintenance facilities. A majority of the facilities (57 percent) are found to be in adequate, middle-range condition. A slightly higher percentage of facilities are substandard/ poor (23 percent) than are good/excellent (20 percent). Less than 8 percent of facilities are in either extreme range (poor or excellent). Definitions of these condition levels are found in Exhibit 3-36.

**Exhibit 3-34**

**Age of Urban Bus Facilities, 1997**

| Age (years) | Number | Percent |
|---|---|---|
| 0-10 | 73 | 14% |
| 11-20 | 212 | 42% |
| 21-30 | 53 | 11% |
| 31+ | 165 | 33% |
| **Total** | **503** | 100% |

Source: National Bus Condition Assessment.

**Exhibit 3-35**

**Condition of Urban Bus Maintenance Facilities, 1997**

| Age (years) | Number | Percent |
|---|---|---|
| Excellent | 13 | 3% |
| Good | 86 | 17% |
| Adequate | 285 | 57% |
| Substandard | 93 | 18% |
| Poor | 26 | 5% |
| **Total** | **503** | 100% |

Source: National Bus Condition Assessment.

**Exhibit 3-36**

**Definitions of Urban Bus Maintenance Facility Conditions**

| Condition | Description |
|---|---|
| Excellent | The facility meets or exceeds most reasonable requirements of a transit bus maintenance program. |
| Good | The facility meets most reasonable requirements of a transit bus maintenance program but may have some less than optimum characteristics. |
| Adequate | The facility has shortcomings in its ability to support a transit bus maintenance program. While these shortcomings hinder the department's effectiveness or efficiency, they are not deemed to significantly impact performance. |
| Substandard | The facility has shortcomings in its ability to support a transit bus maintenance program, and these shortcomings are deemed to be below industry standards. The deficiencies adversely affect the efficiency and/or effectiveness of the operation. |
| Poor | The facility has significant shortcomings in its ability to support a transit bus maintenance program. |

Source: Transit Economic Requirements Model (TERM).

## *Rail Vehicles*

Conditions of the Nation's rail vehicle fleet are shown in Exhibit 3-37. While the ratings are based on the same 1 to 5 scale as was used for buses, the decay curves used to estimate conditions are of the logistic form discussed above, rather than the updated form used for buses.

**Exhibit 3-37**

**Rail Transit Vehicle Fleet Count, Age and Condition, 1987-1997**

| Year | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Locomotives** | | | | | | | | | | | |
| Total Fleet | 491 | 564 | 451 | 472 | 467 | 479 | 556 | 554 | 570 | 582 | 586 |
| Percent Overage | 30% | 23% | 19% | 20% | 17% | 17% | 17% | 28% | 21% | 22% | 22% |
| Average Age | 16.9 | 14.9 | 14.6 | 15.7 | 15.3 | 15.8 | 15.6 | 17.3 | 15.6 | 15.7 | 16.5 |
| Average Condition | 4.5 | 4.7 | 4.7 | 4.6 | 4.7 | 4.6 | 4.6 | 4.5 | 4.5 | 4.6 | 4.5 |
| **Unpowered Commuter Rail Cars** | | | | | | | | | | | |
| Total Fleet | 2,137 | 2,266 | 2,138 | 2,154 | 2,226 | 2,240 | 2,402 | 2,401 | 2,402 | 2,487 | 2,470 |
| Percent Overage | 41% | 32% | 32% | 29% | 29% | 35% | 29% | 35% | 36% | 35% | 33% |
| Average Age | 19.6 | 17.3 | 18.0 | 17.6 | 17.3 | 19.3 | 18.6 | 19.5 | 20.1 | 19.9 | 19.8 |
| Average Condition | 4.2 | 4.5 | 4.4 | 4.4 | 4.5 | 4.2 | 4.3 | 4.2 | 4.1 | 4.1 | 4.2 |
| **Powered Commuter Rail Cars** | | | | | | | | | | | |
| Total Fleet | 2,563 | 2,552 | 2,421 | 2,492 | 2,529 | 2,541 | 2,526 | 2,570 | 2,645 | 2,529 | 2,681 |
| Percent Overage | 2% | 4% | 5% | 5% | 5% | 5% | 6% | 7% | 24% | 25% | 25% |
| Average Age | 13.3 | 14.3 | 15.0 | 15.9 | 16.5 | 17.6 | 18.2 | 19.0 | 19.7 | 21.0 | 22.0 |
| Average Condition | 4.8 | 4.7 | 4.7 | 4.6 | 4.6 | 4.4 | 4.4 | 4.3 | 4.2 | 3.9 | 3.7 |
| **Heavy Rail Cars** | | | | | | | | | | | |
| Total Fleet | 10,344 | 10,419 | 10,246 | 10,325 | 10,170 | 10,161 | 10,074 | 10,153 | 10,157 | 10,154 | 10,173 |
| Percent Overage | 15% | 19% | 17% | 28% | 29% | 30% | 27% | 32% | 37% | 36% | 36% |
| Average Age | 15.2 | 15.2 | 15.4 | 16.2 | 16.9 | 17.7 | 17.8 | 18.7 | 19.3 | 19.9 | 21.0 |
| Average Condition | 4.7 | 4.7 | 4.6 | 4.6 | 4.5 | 4.4 | 4.4 | 4.3 | 4.2 | 4.1 | 3.9 |
| **Light Rail Vehicles** | | | | | | | | | | | |
| Total Fleet | 879 | 890 | 917 | 903 | 954 | 977 | 943 | 969 | 955 | 1,099 | 1,132 |
| Percent Overage | 27% | 30% | 20% | 18% | 19% | 19% | 10% | 10% | 12% | 10% | 10% |
| Average Age | 17.2 | 18.9 | 15.6 | 15.2 | 16.6 | 17.0 | 14.9 | 14.8 | 14.8 | 14.2 | 14.6 |
| Average Condition | 4.5 | 4.3 | 4.6 | 4.7 | 4.5 | 4.5 | 4.7 | 4.7 | 4.5 | 4.7 | 4.6 |
| Weighted Average Condition | 4.6 | 4.7 | 4.6 | 4.6 | 4.5 | 4.4 | 4.4 | 4.3 | 4.2 | 4.1 | 4.0 |
| Weighted Average Age | 15.6 | 15.5 | 15.7 | 16.3 | 16.8 | 17.8 | 17.7 | 18.6 | 19.1 | 19.5 | 20.4 |

Source: Transit Economic Requirements Model, National Transit Database.

The average condition of the rail vehicle fleet in 1997 was 4.0. While this corresponds to a condition rating of "good," it is significantly lower than the average condition of 4.6 for the fleet in 1987. This corresponds to an increase in the average age of the rail fleet from 15.6 to 20.4 years.

The decrease in condition is due primarily to the aging and declining condition of the heavy rail fleet, the most numerous rail vehicle type, which fell from 4.7 to 3.9, as the average age increased from

15.2 years to 21.0. Powered commuter rail cars also posted significant deterioration in average condition over the period, while other commuter rail vehicles were unchanged. Light rail vehicles improved slightly in condition, and their average age decreased from 17.2 to 14.6. This improvement resulted from the many new light rail systems that have come on line during the past decade. Definitions of rail vehicle condition ratings are found in Exhibit 3-38.

**Exhibit 3-38**

**Definitions of Rail Vehicle Condition**

| Condition | Description |
|---|---|
| Excellent | Brand new, no major problems exist, only routine preventive maintenance. |
| Good | Elements are in good working order, requiring only nominal or infrequent minor repairs (greater than six months between minor repairs). |
| Adequate | Requires frequent minor repairs (less than six months between repairs) or infrequent major repairs (more than six months between repairs). |
| Substandard | Requires frequent major repairs (less than six months between major repairs). |
| Poor | In sufficiently poor condition that continued use presents potential problems. |

Source: Transit Economic Requirements Model (TERM).

## *Rail Infrastructure and Maintenance Facilities*

Data on the conditions of rail infrastructure and facilities are presented in Exhibit 3-39. Data from 1984 and 1992 are derived from the Rail Modernization Study, while 1997 conditions data are calculated by TERM using unique decay curves for each asset type. It should be noted that the two approaches, while similar, are not perfectly comparable to one another.

**Exhibit 3-39**

**Physical Condition of U.S. Transit Rail Infrastructure, Selected Years, 1984-1997**

| | Condition | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Poor | | | Substandard | | | Adequate | | | Good | | | Excellent | | |
| | 1984 | 1992 | 1997 | 1984 | 1992 | 1997 | 1984 | 1992 | 1997 | 1984 | 1992 | 1997 | 1984 | 1992 | 1997 |
| **Track** | 0% | 0% | 7% | 7% | 5% | 10% | 49% | 32% | 10% | 31% | 49% | 49% | 12% | 14% | 24% |
| **Power Systems** | | | | | | | | | | | | | | | |
| Substations | 6% | 2% | 12% | 23% | 19% | 6% | 5% | 17% | 10% | 43% | 56% | 57% | 23% | 6% | 15% |
| Overhead | 20% | 0% | 5% | 12% | 33% | 11% | 27% | 10% | 18% | 36% | 52% | 34% | 5% | 5% | 32% |
| Third Rail | 13% | 0% | 14% | 26% | 21% | 11% | 19% | 20% | 15% | 36% | 53% | 43% | 6% | 6% | 17% |
| **Stations** | 0% | 0% | 15% | 15% | 5% | 13% | 56% | 29% | 15% | 23% | 63% | 46% | 6% | 3% | 11% |
| **Structures** | | | | | | | | | | | | | | | |
| Elevated Structure | na | na | 1% | na | na | 29% | na | na | 12% | na | na | 59% | na | na | 0% |
| Bridges | 1% | 0% | na | 16% | 11% | na | 51% | 28% | na | 28% | 54% | na | 4% | 7% | na |
| Elevated Sections | 0% | 0% | na | 1% | 1% | na | 80% | 72% | na | 3% | 15% | na | 16% | 12% | na |
| Underground | 0% | 0% | 9% | 5% | 5% | 19% | 49% | 34% | 18% | 35% | 51% | 47% | 11% | 10% | 7% |
| **Maintenance** | | | | | | | | | | | | | | | |
| Facilities | 4% | 2% | 6% | 54% | 34% | 17% | 14% | 12% | 17% | 24% | 35% | 53% | 4% | 17% | 7% |
| Yards | 4% | 2% | 2% | 53% | 7% | 12% | 26% | 26% | 7% | 16% | 55% | 30% | 1% | 9% | 49% |

The data show that most rail asset types have significantly improved in condition over the past 13 years, as much of the aging infrastructure has been rehabilitated and replaced. As a result, over half of the rail infrastructure is now in good or excellent condition for every asset type, whereas the same was true for only one asset type (power substations) in 1984. Among the asset types, track has shown the most significant improvement in condition. In 1984, just 43 percent of track mileage was in good or excellent condition; in 1997, the comparable figure was 73 percent.

## *Rural and Specialized Transit Vehicles and Facilities*

The available data on the condition of transit vehicles and facilities in non-urbanized areas has not been updated since the last report, though an effort to do so is currently under way. This older data is presented in Exhibits 3-40 (vehicles) and 3-41 (maintenance facilities).

**Exhibit 3-40**

**Number of Overage Vehicles and Average Vehicle Age in Rural and Special Service Transit, 1994**

| | Rural Operators | | | Special Service Operators | | |
|---|---|---|---|---|---|---|
| | Total Fleet | Average Age | Percent Overage | Total Fleet | Average Age | Percent Overage |
| Medium-Size Buses | 740 | 10.4 | 51% | 310 | 8.4 | 19% |
| Small Buses | 3,660 | 4.9 | 24% | 5,250 | 4.5 | 18% |
| Vans and Other | 8,050 | 4.5 | 44% | 23,770 | 4.4 | 43% |

Source: Community Transportation Association of America.

**Exhibit 3-41**

**Condition of Rural Bus Maintenance Facilities, 1992**

| Condition | Percent |
|---|---|
| Excellent | 30% |
| Good | 52% |
| Poor | 14% |
| Very Poor | 4% |
| **Total** | 100% |

Source: Community Transportation Association of America.