

# Urban Transportation System Characteristics, Condition, and Performance

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David F. Schulz, *Department of Civil Engineering, McCormick School of Engineering and Applied Science, Northwestern University*

Perhaps of more interest to conference participants than the contents of this paper is what is not contained in it. After considerable searching of literature sources and the Internet and contacts with government officials responsible for collecting and analyzing such information, the author was unable to develop credible comprehensive data on the differential condition of transportation infrastructure within urban areas, that is, the differences between central city and suburban facility condition and performance.

Whereas it is interesting to speculate on why this is so, it is probably sufficient to note that metropolitan planning organizations and state governments are simply not organizing and reporting their information along such lines, and in fact may be motivated not to do so. In any event, the fact that such data are not readily available is a useful finding in itself.

In the paper, therefore, the condition of “urban” transport infrastructure is reviewed, including all road and transit facilities in designated urbanized areas with population exceeding 50,000, along with small urban areas with population from 5,000 to 50,000, in comparison with their rural counterparts. Most of this discussion is derived from—and, frankly, extracted from—1997 *Status of the Nation’s Surface Transportation System: Condition and Performance (1)*, recently published by the Federal Highway Administration and the Federal Transit Administration.

## URBAN TRANSPORTATION SYSTEM CHARACTERISTICS

Any discussion of system condition and performance must begin with a brief review of its extent.

### Roads and Bridges

There were more than 3.91 million centerline- or route-mi (6.29 million route-km) of roads and streets in the United States in 1995 (21 percent “urban”), providing more than 8.2

million lane-mi (13.2 million lane-km) (22.6 percent “urban”). Urban centerline highway mileage increased 1.7 percent annually between 1985 and 1995. Whereas new construction was responsible for some of this increase, much of it was due to growing urban area boundaries as a result of the 1990 census, a factor that also contributed to a 0.3 percent annual decrease in rural mileage.

Roads in the United States are classified in a functional hierarchy, as shown in Figure 1. At the top of the hierarchy, Interstate highways carry the largest amount of traffic per lane-mile and the longest trips and operate at the highest speeds. Generally, trip length and speed decrease as one moves down the hierarchy until the local streets perform essentially a land access function in both urban and rural areas.

There were 581,862 bridges in the United States in 1996, 21.5 percent “urban.”

**Transit**

In 1995, 537 local public transit operators provided transit services in 316 urbanized areas, and 5,010 organizations provided transit services in rural and small urban areas. These systems used 135,564 vehicles, including 58,405 buses and 16,729 rail vehicles, with the remainder being small or special-purpose vehicles, including ferryboats.

The nation’s transit systems provided 1.6 billion equivalent vehicle-mi (2.6 billion vehicle-km) of rail service in 1995, an annualized increase of 2.5 percent since 1985, and 1.7 billion vehicle-mi (2.7 billion vehicle-km) of nonrail service, an annualized increase of 1.2 percent since 1985.

**Freight**

Freight in the United States is carried by a complex and increasingly intermodal system of trucking companies, railroads, waterborne shipping companies, pipelines, and air freight companies. Together, business and industry spent \$421 billion in 1994 to move 3.5 trillion tons (3.2 trillion metric tons) of freight over transportation networks totaling 2.3 million mi (3.7 million km).

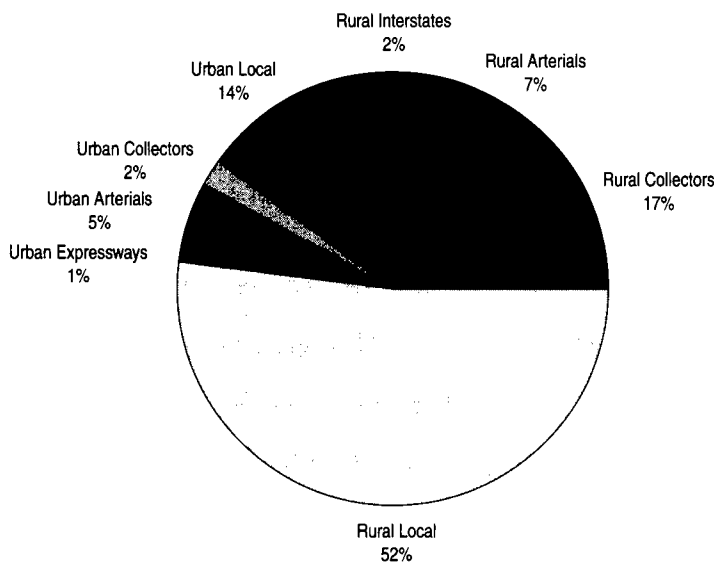


FIGURE 1 Functional classification of U.S. roads.

## PERFORMANCE

### Roadways

As indicated in Figure 2, urban expressways—Interstates, other freeways and tollways, and so-called “expressways”—carried 20.3 percent of the vehicle miles traveled in 1995 on only 1.4 percent of the lane miles. Urban arterials carried 27.4 percent of the vehicle miles of travel on only 5 percent of the lane miles.

Conversely, rural roads represent 77.4 percent of the lane miles of roads in the United States but carry only 38.5 percent of the vehicle miles of traffic.

As indicated in Figure 3, urban roadways also experienced higher traffic growth than their rural counterparts. Traffic on urban expressways grew at an annual rate of 4.7 percent in the 1985–1995 period.

Interestingly, as indicated in Figure 4, congestion on urban roadways, as measured by peak-hour travel with volume to capacity ratios greater than 0.80, has been fairly constant during the 1985–1995 period. However, traffic volumes per lane mile have been increasing steadily, as indicated in Figure 5, with the largest increase on rural Interstates.

Whereas peak-hour congestion has been relatively steady and traffic volumes have been growing, fatality rates on both urban and rural roadways have been declining in the 1985–1995 period, as indicated in Figure 6, although there was a slight upturn in three of the six categories from 1993 to 1995. Despite their high traffic volumes, urban Interstates continue to be the safest facilities in terms of fatalities per 100 million vehicle-mi.

### Transit

As indicated in Figure 7, total transit ridership has been relatively stable during the 1985–1995 period, although rail ridership has grown at the expense of nonrail. Preliminary statistics from the American Public Transit Association indicate that in 1996 ridership grew more than 2.7 percent. Some systems, including the nation’s largest, the New York subway,

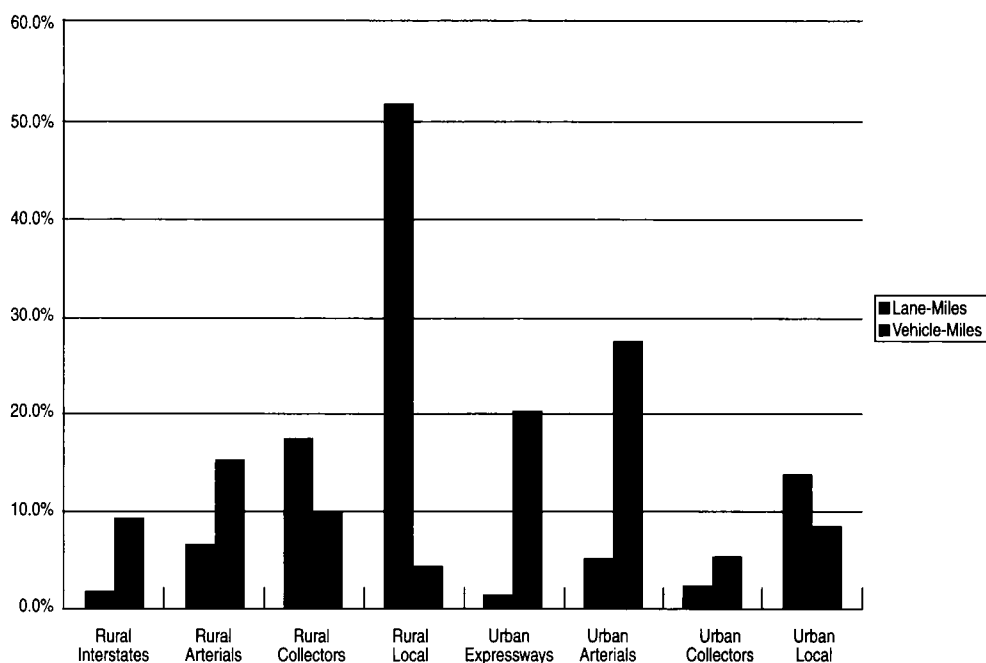


FIGURE 2 Proportions of lane miles and vehicle miles carried, by functional classification.

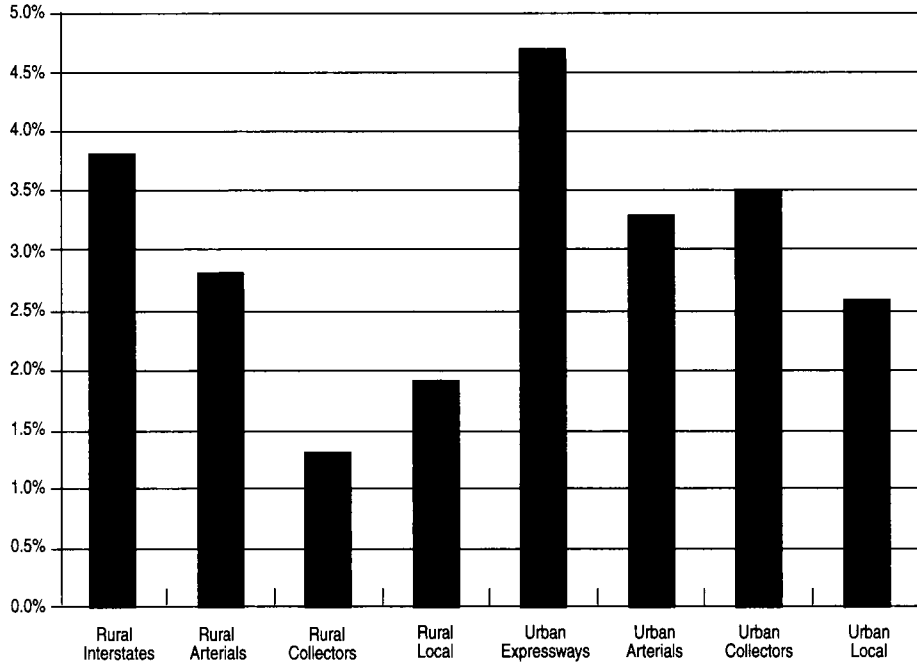


FIGURE 3 Annual rate of traffic growth by functional classification, 1985–1995.

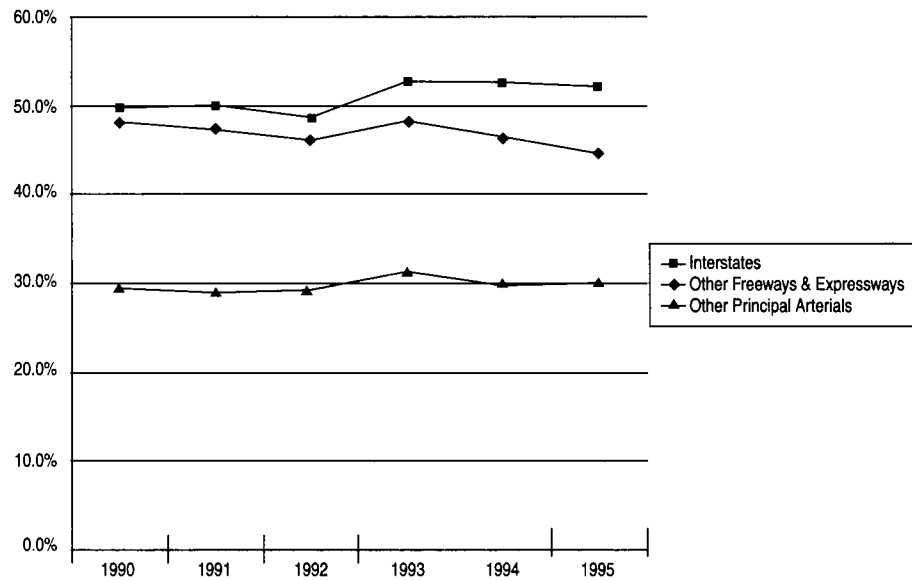


FIGURE 4 Congestion on urban roadways, as measured by peak-hour travel with volume to capacity ratios greater than 0.80.

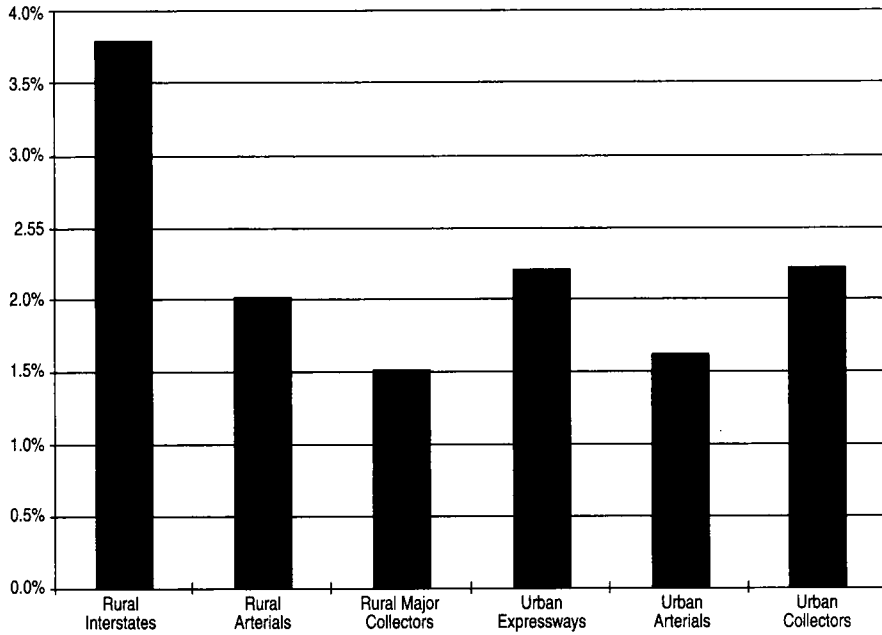


FIGURE 5 Annual rates of increase in traffic volume per lane mile, by functional classification.

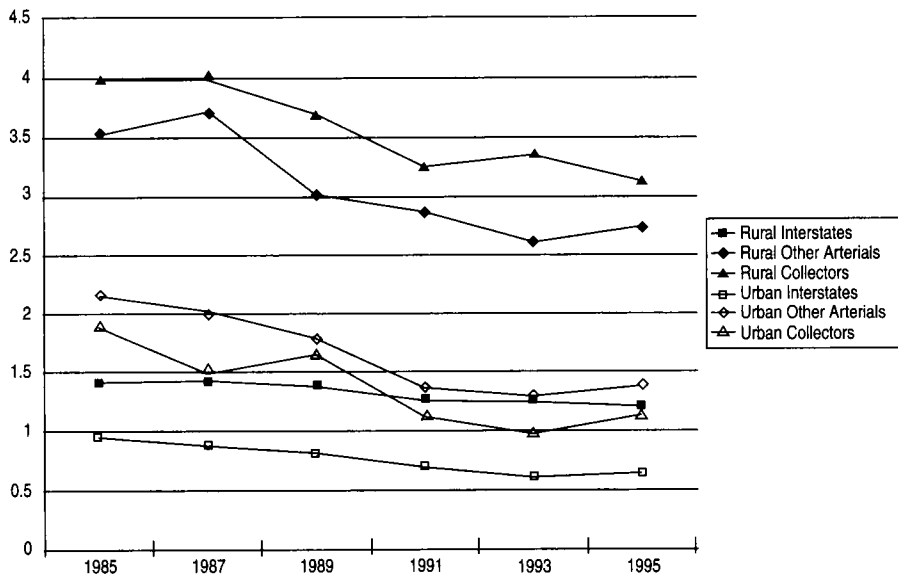


FIGURE 6 Fatality rates per 100 million vehicle-mi on U.S. roads, 1985-1995 (1 mi = 1.6 km).

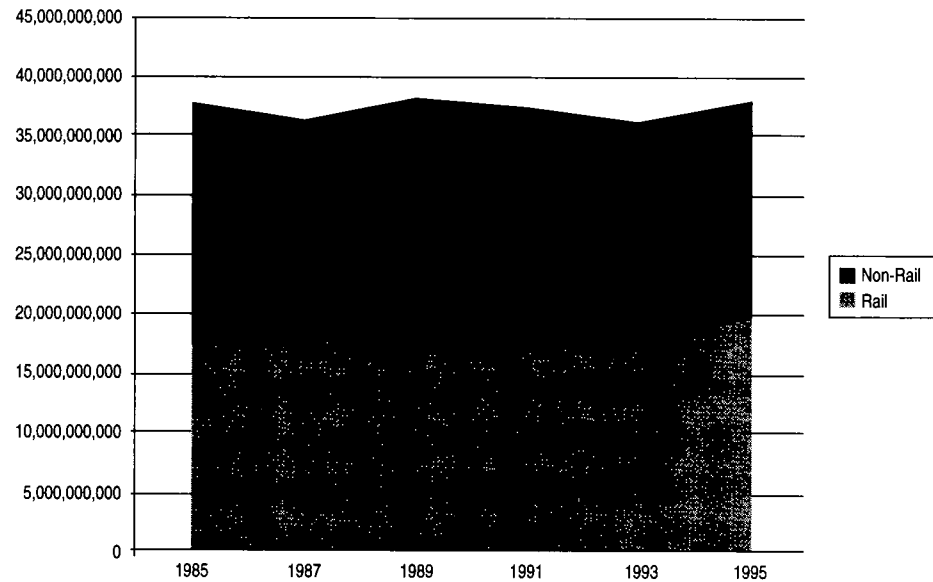


FIGURE 7 Transit ridership, 1985–1995.

are reporting substantially greater ridership increases. Unfortunately, other systems have fared worse, notably the Chicago Transit Authority, which lost 30 percent of its riders in the last decade.

Transit performance can also be judged by the rider experience. Passenger-weighted average speed rose 10.3 percent from 1985 to 1995. In 1995, 71 percent of transit riders had seats for their entire trip, and 9 percent more had seats for part of their trip. Fifty-nine percent of transit riders waited less than 5 min in 1995, and 80 percent waited less than 10 min. Fifty-one percent of riders had to make at least one transfer. Twenty-five percent of transit riders had a total trip time of less than 10 min in 1995, 57 percent less than 20 min, and 76 percent less than 30 min.

Much is made of the energy efficiency of transit, at least compared with the automobile. Yet, as indicated in Figure 8, when actual person miles of travel are compared with actual energy utilization, transit has almost the same energy efficiency as the automobile. Of course, “small trucks,” which include vans and sport-utility vehicles, fare much worse.

Whereas another resource paper is looking at the issue of finance, one aspect of performance is inescapable. Despite all the arguments about funding, fairness, and financial policy, one statistic is compelling: in 1995 each passenger mile of travel on the nation’s transit systems required 43.5 cents in public expenditure (27.0 cents per kilometer) (exclusive of fares), whereas each passenger mile of travel on the roadways required 3.25 cents (2.02 cents per kilometer)—91 percent of which was derived from highway user fees.

## CONDITION

### Roadways

Figure 9 presents the portion of “rough road”—defined as rated “poor” in pavement roughness—by functional classification from 1985 to 1995. Whereas there have been fluctuations primarily related to statistical measurement changes, the overall trend has been improving in most categories. At the other end of the spectrum, the proportion of pavements rated “good” or better has generally been increasing.

However, the numbers still appear to be intolerably high, with 36.3 percent of urban Interstate pavements rated “poor” or “mediocre” in 1995 and 26.3 percent of other urban

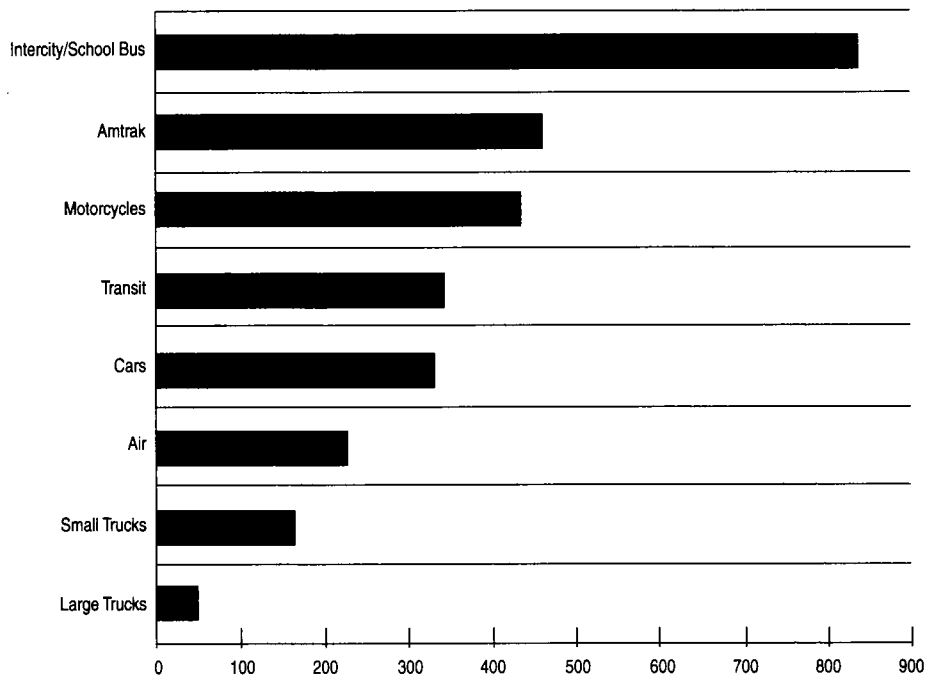


FIGURE 8 Comparison of energy efficiencies.

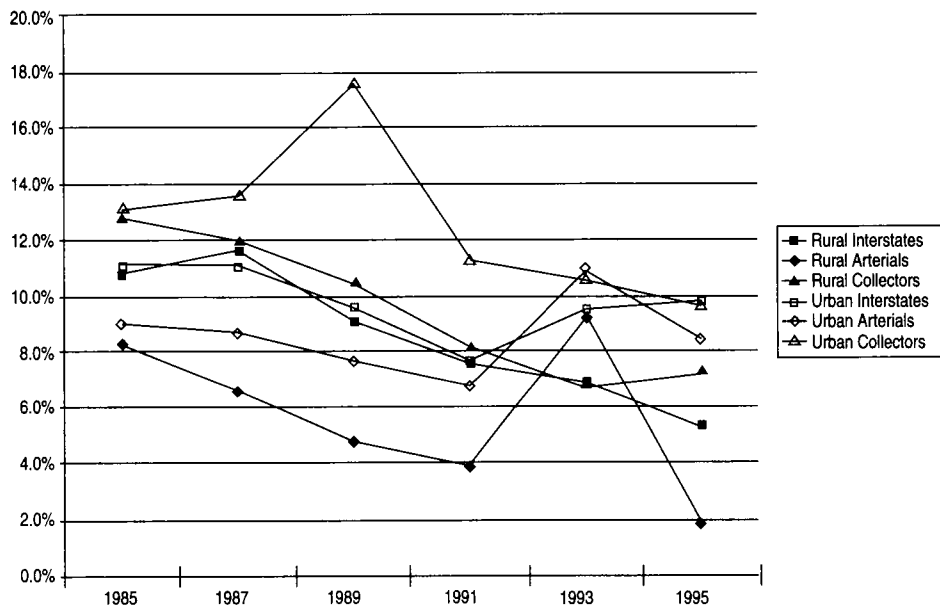


FIGURE 9 Proportion of "rough road" by functional classification, 1985-1995.

principal arterials in the same categories. These two roadway classifications account for almost half the vehicle miles traveled in the country.

### Bridges

Figure 10 presents deficient bridges by functional classification. There has been a steady reduction in the proportion of deficient bridges in all categories, reflecting substantial recent local, state, and federal reinvestment in bridges.

The deficient category includes both bridges that are “structurally deficient” and those that are “functionally obsolete.” Focusing on “structurally deficient” bridges, one finds 7.8 percent of urban Interstate bridges were so rated in 1995, along with 11.7 percent of other urban arterial bridges. This compares with 4.4 percent of rural Interstate bridges and 7.8 percent of other rural arterial bridges rated “structurally deficient” in 1995.

### Transit

Transit vehicles represent a wide range of vehicle types and styles. Whereas age was used as a surrogate for vehicle condition in the past, recently the U.S. Department of Transportation introduced the Transit Economic Requirements Model with a new methodology to report transit vehicle condition consistently over time. As shown in Figures 11 and 12, this system uses a 5-point rating scale. The figures indicate a steady decline in the condition of rail transit vehicles in the 1990s and the stabilization of bus condition, although at a level lower than that of rail vehicles. Given the increases in service volumes discussed previously, this represents a consistent aging of the rail vehicle fleet, presumably as retirements are deferred to accommodate service increases, whereas bus ages are relatively constant as new buses replace retirements.

With regard to the transit physical plant, 27 percent of elevated transit structures and 18 percent of underground structures were rated “bad” or “poor” in 1995, as were 27 percent of stations, 20 percent of maintenance facilities, and 20 percent of electrical substations. Nineteen percent of urban bus maintenance facilities were rated “substandard” or “poor” in 1995.

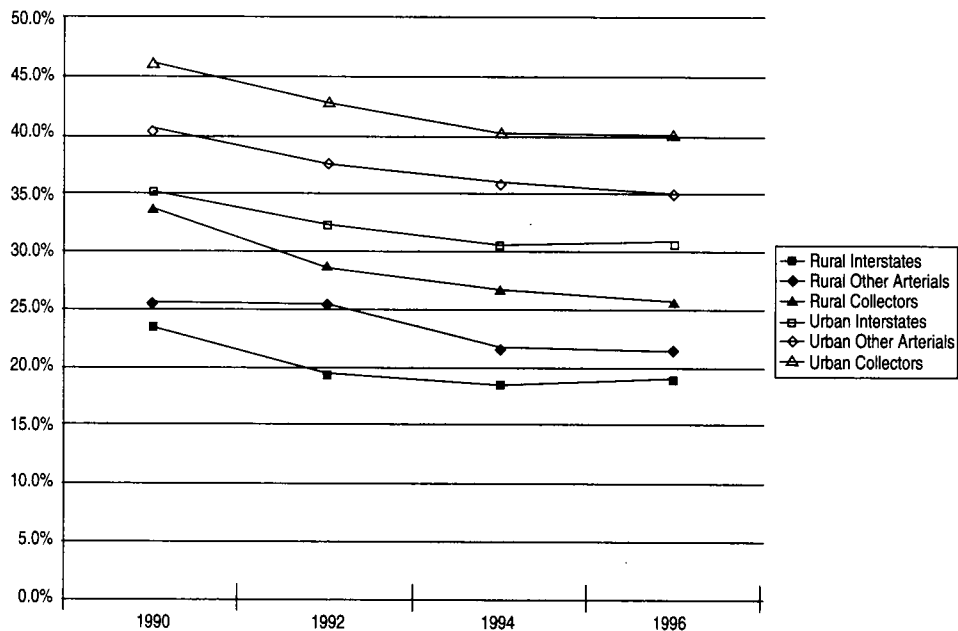


FIGURE 10 Percentage of deficient bridges, by functional classification.



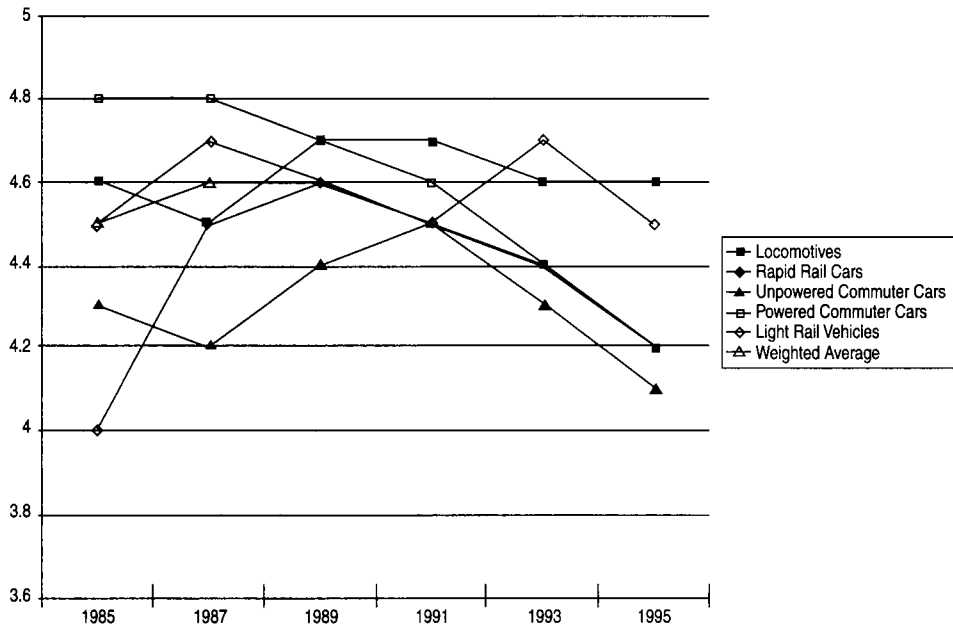


FIGURE 11 Transit vehicle condition—rail.

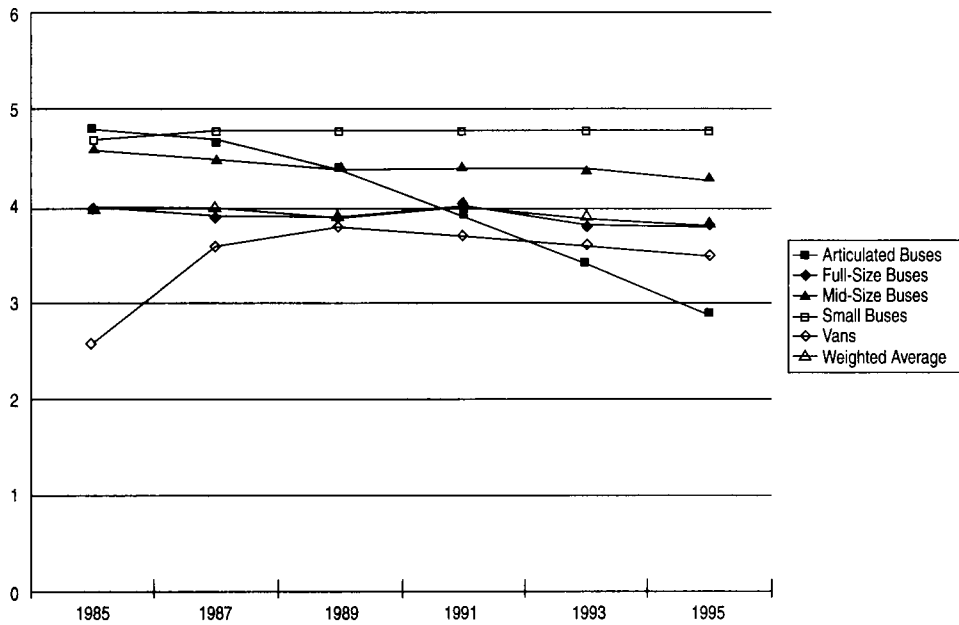


FIGURE 12 Transit vehicle condition—buses.

## Freight

Because virtually all the nation's freight is carried by private concerns, albeit with the largest single mode—motor truck—using public highways, statistics on freight transportation condition and performance are hard to find. Figure 13 shows the 1993 “mode split” for freight shipments by both value and volume. Of note is the predominance of trucks, the growth of intermodal, the resurgence of freight rail, and the important role of air freight in moving high-value cargo.

## CONCLUSIONS AND OBSERVATIONS

1. Urban arterial roadways—Interstates, other freeways, tollways, and other arterials—carry almost half the nation's traffic on less than 6 percent of its lane miles. These highly congested facilities have pavements and bridges in demonstrably worse condition than their more lightly traveled rural counterparts. Traffic on them is growing substantially faster than our willingness or ability to expand them. Urban Interstates are truly the foundation of the American transportation system, and maintaining them in sound condition and improving them where warranted must be a top national transportation priority.

2. As the first- and second-generation Interstates reach the end of their useful lives, much greater recognition must be given that conventional highway funding formulas do not adequately address the extraordinary costs of rebuilding these truly nationally significant and vital transportation links “from the ground up.” Substantial amounts of the much derided “pork barreling” in the recent federal surface transportation legislation resulted from the necessity of rebuilding these vital facilities without completely draining the formula funding for National Highway System facilities in a number of states.

3. Also deserving special attention are arterial streets and highways, which together carry more traffic than Interstates, freeways, and tollways. Again, members of Congress saw the necessity to dedicate funding for desperately needed arterial improvements that otherwise could not be built because of inadequate formula funds.

4. Aside from the funding problems, urban Interstates especially, but also major arterials and key bridges, have emerged as irreplaceable transportation links. The severity of the effects of partially or totally shutting down these facilities for necessary repair and reconstruction cannot be overstated. Whereas much is being done to mitigate such effects, it is important for both transportation professionals and the general public to understand and support both the necessity to renew these facilities and the importance of doing everything possible to return them to service quickly and mitigate the effects of their disruption during construction.

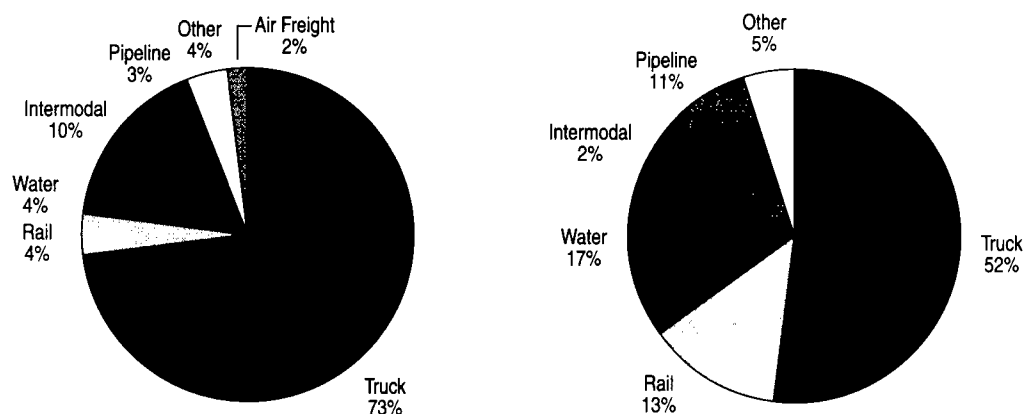


FIGURE 13 Mode split for freight shipments in 1993 by (left) value and (right) volume.

5. Rural roadways render important services not only to people who live, work, and do business in small-town and rural America, but as “the ties that bind” urban areas together—a reality reflected in the 3.8 percent annual traffic increase per lane mile they experienced from 1985 to 1995, the highest of any functional classification. With the rebound in population of small-town and rural areas reflected in the 1990 census and subsequent reports, there will be increasing pressure—and need—to reinvest in and upgrade the rural road network.

6. In a society dominated by the automobile, public transit continues to play a vitally important role of providing competitive mobility options in congested corridors and providing mobility to people who by virtue of age, income, disability, or choice do not drive a car. The United States has invested substantial resources in transit, and transit services have expanded over the last decade. Yet ridership has not kept pace with this expansion, and transit continues to lose market share.

7. Whereas New York and other cities have made some progress on backlogged transit capital investment needs, they share with Chicago and other transit systems the reality that deferred capital investment impinges on operating budgets not only through expensive emergency repairs and even unplanned shutdowns, but through generally more unreliable services that discourage riders. Even relatively new systems are not immune to the need for substantial capital reinvestment.

8. Concern must be expressed that the general decline in the condition of both buses and rail transit cars may reflect a set of decisions to, in effect, finance expanded transit services by deferring fleet and facility upgrading and replacement. One must also question whether an important factor in transit’s loss of market share is the decline in the condition of its infrastructure.

9. Conventional wisdom has it that transport infrastructure in older central cities is generally old, deteriorated, and inadequate, whereas counterparts in the suburbs are new, in good condition, and have at least adequate and possibly excessive capacity. Whereas this paper was not able to prove or disprove this hypothesis because of lack of data, a cautionary note is needed. Many older central cities have recognized and effectively taken action on the need to reinvest in their transportation infrastructure. New York has substantially upgraded its subway system. Chicago is systematically rebuilding both its freeways and its neighborhood streets. Los Angeles had, at least until recently, embarked on the nation’s most ambitious rail transit construction program. Boston has courageously chosen to remake its Central Artery. Smaller cities have done likewise. Meanwhile, many suburban areas find themselves with little or no transit and with highways that are not much more than “sprawled over” farm-to-market two-lane roads. Many new and expanded highways have been constructed in suburbs across the country, but other suburban areas experience some of the worst congestion in their urban areas and are unable because of policy, lack of funds, or NIMBY to proceed with needed road development. A policy of favoring reinvestment in existing transportation facilities and services in central cities and older ring suburbs may have a certain appeal, but there appears to be no readily available data to support the contention that such a policy would fulfill a more objectively important or necessary “need” than investment in transportation facilities in congested growing suburban areas. This, of course, does not address the role of such facilities in promoting sprawl or directing new development along desirable and efficient paths.

10. Before any generalized policy decision is made to favor central city over suburban infrastructure investment, there is a need for a national study of the physical condition and operational performance of central city versus suburban transportation infrastructure.

11. At the millennium, the United States finds itself as a “hegemon,” an economically, culturally, and militarily world-dominant superpower. Yet to maintain this position and the quality of life it confers on most—but certainly not all—Americans, there is a need to take steps now to ensure that the United States can continue to compete effectively in an increasingly competitive world marketplace. An important component of that competitiveness is the ability to quickly and efficiently transport raw materials and finished products between and within American cities. Concern must be expressed that “just-in-time”

manufacturing techniques place critical importance on reliable freight transportation at a time when the largest freight mode—the truck—is beset by urban and suburban traffic congestion. Of special interest are the difficulties trucks have in navigating much of the urban road network because of both congestion and physical deficiencies such as low bridge clearances, low bridge load limits, inadequate turning radii, insufficient loading areas, and poor pavements.

12. Railroads are not immune to central city congestion. The Union Pacific Railroad fiasco in Houston is a cautionary tale to those familiar with the “hubbing” problems of rail and intermodal interchanges in Chicago, Los Angeles, New York, and elsewhere. Happily, there is a much-touted “urban renaissance” in many American central cities, where advantages of proximity, culture, education, communications, and worker availability are promoting business growth. How ironic it would be if this renaissance either did not reach its full potential or, worse, was choked off because of the inability of urban road and rail systems to efficiently move freight.

13. After a decade or more of concern about a lack of jobs, it is sobering to confront the reality that the United States is running out of people—at least skilled people—to fuel its continued economic growth. And because of the movement of jobs to the suburbs, particularly low- to medium-skill manufacturing jobs, the problem is both a skills and a spatial mismatch. This problem is, of course, an opportunity to deal with the largest social problem facing the country, the stubbornly disproportionately high minority unemployment in certain parts of the central cities. Whereas in the long run “bringing the jobs to the people” (central city economic development) and “bringing the people to the jobs” (opening up low- and moderate-income housing opportunities in the suburbs) together with job training are undoubtedly the answer, in the short run the transportation system must bridge the gap through innovative reverse commute facilities and services.

14. It is important to recognize that the increasingly competitive world economy emphasizes the importance of good long-distance air transport services. Continuing air travel growth is stretching the capacity of many airports to provide reliable service, particularly access to and from the airports. Yet airports find themselves constrained by surrounding development, funding shortages, and the concerns of neighboring communities from expanding their physical plants. Many cities are seeing proposals to build ever-larger new airports at great distances from the central city. Although it is questionable whether either building new airports or substantially expanding existing ones can realistically be accomplished in the current environment, those concerned with the health of central cities must also concern themselves with ensuring that existing airports remain viable and competitive well into the new century.

15. Connecting existing airports, central cities, and nearby [up to 400 mi (644 km)] cities with high-speed rail is an attractive option not only for deferring and perhaps eliminating the need for airport expansion or new airport development, but also for strengthening the economy of the central cities themselves.

16. Since the enactment of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, the existence of transportation enhancement funds and the emphasis on multimodal transportation have brought into prominence the importance of bicycle facilities. It is no coincidence that bicycle sales in the United States have increased from 6.9 million in 1970 to an estimated 12 million in 1995, after peaking at 13 million in 1993. This is a substantially greater increase than any other vehicle type except motor trucks. Whereas many cities and suburbs had previously developed recreational bicycle trail systems and many states had used abandoned rail rights-of-way for long-distance trails, the ISTEA initiatives prompted many areas to consider bicycles more seriously as a work commuter mode. The barriers to such use are well known: inadequate secure storage, prohibitions against bicycles on transit vehicles or in elevators, safety concerns when sharing streets with motor vehicles, and lack of locker and shower facilities at workplaces. Yet bicyclists and their advocates have persevered, and today many cities are identifying work trip bicycle routes with special signage and, where possible, dedicated space, as well as incorporating bicycle paths in new or rebuilt facilities. Clearly, the assault on the bicycle barriers needs to continue.

17. After decades of trying to segregate pedestrians from vehicles in downtowns and neighborhood business areas, central cities are increasingly recognizing that projects such as pedestrian malls can rob mixed-use and commercial centers of cities of much of their vitality. Yet the concerns for safety and convenience that drove the original malling remain. It is not clear whether there are as yet a complete set of technological or urban design “fixes” for encouraging pedestrian movement within city centers while facilitating automobile and transit access to them.

18. Everyone concerned with transport infrastructure—road or transit; central city, suburban, or rural—must be troubled by the increasing paralysis of our society in building new infrastructure and substantially renovating existing facilities. A litany of problems including funding shortages, environmental concerns, construction disruption, NIMBY, highway-transit disputes, and byzantine legal requirements, to mention only the most prominent, have made building almost any large project—road, transit, airport—extremely problematic in America today. Yet as we contemplate a new century, and indeed a new millennium, we only have to look back at the great urban infrastructure projects of this century—the great waterways, railroads, urban transit systems, highways, and international airports—and try to imagine our economy and society without them. Before it is too late, we must recognize that we are effectively losing our capacity to build big infrastructure, we are going to have to build some in the future, and it is therefore important that we halt the slide.

## REFERENCE

1. *1997 Status of the Nation's Surface Transportation System: Condition and Performance*. Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, Dec. 1997.