The American highway system: a case study in spending needs

by Richard Freeman

The United States has 3.9 million miles of roads and streets. Only half of these roads are paved. A large portion of them, including almost all of the most traveled portion of roads, will have to be resurfaced or rebuilt over the next 20 years.

Of these roads, 1.2 million miles or roughly 30%, represent the national "priority system," carrying 84% of the nation's traffic. This priority system is divided into major arteries and collector roads feeding into the major arteries, of which the most important components are:

42,000 miles of Interstate Highway System;

260,000 miles of major primary-system arterials;

400,000 miles of secondary-system rural collector roads; and

125,000 miles of urban-system collector roads.

Four-fifths of the nation's road mileage was in place as early as 1920, although not in its present form. Legislation in 1916 and 1923 began to knit the country's road system into a unified whole. In 1956, the Highway Trust Fund was created to give aid to most federal roads but especially to the Interstate Highway System, which, while only 1% of the nation's roads, handles one-fifth of all traffic and nearly half of all travel by combination trucks (mostly 18-wheel tractor-trailer trucks).

The Interstate System

As conceived, the Interstate System was to have been completed in 1972, well before the first cycle of major repairs was to begin. That goal was not met, but more than 96% of the system's planned 42,900 miles are now open to traffic, and the Congress has set a target date of 1990 for completion of the remaining 1,700 miles. The cost for completing the remaining miles, primarily
or $21.4 million per mile: High land costs and the confinement of urban construction space are responsible for the high cost. At current rates of repair, by 1990, 75% of the Interstate Highway System will have to be repaired or rebuilt.

Overall, capital spending for all major highways, inclusive of the Interstate System, began to plunge in the 1970s. Expenditures, measured in real dollars, declined steeply. Although the costs of driving on "poor" roads cannot be calculated precisely, one recent study by the Federal Highway Administration has found that operating costs on a road in poor condition may be 15% to 29% higher than the costs of using a road in good condition.

The heavy wear and tear of traffic destroys highways, but doing as much or more damage is the weather: water seepage, freeze-thaw cycles, and soil erosion. Highways succumb to chemicals used for de-icing purposes, chemicals interacting in the construction materials themselves, defects in construction, and drainage problems. As long as highways use concrete, which is ideal for its compressive strength—it can withstand much pressure—or conrete-asphalt mixtures, there will be such problems. Concrete has no tensile strength or "give," i.e., a bar of concrete two feet long and an inch square can be snapped over one's knee like a dry stick. When water gets in, the highway buckles, curls, scales, faults, and so forth.

Highway roads have a life expectancy of 20 to 25 years. It costs $125,000 per mile to resurface roads in "fair condition," i.e., tear off the top of the road and repour concrete, asphalt, etc.; it costs $600,000 to reconstruct or rebuild roads in "poor condition"—tear up from the roadbed, and replace or fix the road-bed, the base, the dividers, and the surface. It costs $1 million per mile to build a new road, including digging and rooting, grading and lining, and putting into place different layers as well as guard-rails, lights, and other items if necessary.

The Road Information Program (TRIP), a Washington, D.C.-based think-tank, estimated that in 1982, according to the engineering standards of the American Association of State Highway and Transportation Officials, 240,400 miles, or 12.3% of the nation's paved roads and streets were in "poor" or "very poor" condition. The TRIP group also estimated an additional 1,006,500 miles of road are only "fair"—also a substandard category, indicating serious problems with the road. The increase in road mileage in "fair" condition was 18% over the previous year's level; the increase in road mileage in "poor" condition was 30%. The accelerated rate of growth of poor or fair roads indicates the rapidity of depletion of the nation's highway system.

At the current rate, all of the nation's 1.2 million miles of priority highways are or will be over their useful life by the year 2000 and will need either resurfacing or rebuilding to stay in use.

The cost of putting the 1.2 million miles of priority roads in working order—rebuilding and repairing where necessary—is $576 billion over 20 years (all figures in 1982 constant dollars). Another $200 billion will be required for repair of the nearly 2.7 million miles of non-priority rural roads and urban streets, three-quarters of which are unpaved. Total expense, which includes nearly $30 billion to complete the remaining 1,300 miles of the Interstate Highway System, is $776 billion, or $38.8 billion per year.

This figure, however, is premised on the assumption that the U.S. road system will need no expansion. The stagnation in freight tonnage, economic growth, and population growth characteristic of the United States for the past 5 to 10 years has led every agency that works on this problem, from the Association of General Contractors, to the Federal Highway Administration, to The Road Information Program to assume *virtually no growth in the road system in the future*. The Department of Transportation's National Transportation Policy Study Commission took a novel approach in its final report of June 1979, assuming a moderate level of growth, and coming up with a road repair and expansion program that would cost $1.239 trillion dollars if adjusted to the period 1984-2004, or $61.9 billion per year (all figures in 1982 constant dollars). This pro-growth policy assumption was made before Paul Volcker's appointment to head the Federal Reserve System persuaded most groups that growth is impossible.

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If the specified critical parameters for population, shift in labor force, and energy are applied, real product output will be 4 to 10 times larger in 2004 than in 1984. The highway system, or at least its most crucial 1.2 million mile priority system, will have to be expanded at the rate of 3% to 4% annually. However, we must assume that the U.S. priority road system will have to expand at the *minimal rate of between 1% and 2% per year for the next two decades*, and that the cost of constructing a new mile of road for this priority system is $1 million per mile: According to the Federal Highway Administration, the cost of building one mile of new road varies from a low of $275,000 for one mile of two-lane secondary road over flat terrain, to $31.6 million for one mile of four-lane, urban Interstate highway. The priority system of roads will expand by 264,000 miles if the system expands at the rate of 1% per year, and by 583,000 miles if the system expands at the rate of 2% per year. At $1 million per mile, the cost of new road construction, just for the priority system, will thus range between $264 and $583 billion.

Adding the deficit of $876 billion to the cost of expansion, the total cost of highway repair *and* expansion will vary between $1,140 billion to $1,459 billion over the next 20 years, depending on whether a 1% or 2% rate of growth of the road system is planned. The total highway expense is $52 to $68 billion per year.

The cost of the system will be much larger when inflation is added in, running from $2.75 trillion to $3.61 trillion when an average inflation rate of 5% is assumed for the 20 years from 1984-2004. In nominal dollars which account for inflation, the United States will have to spend between **$138 billion and $181 billion per year for 20 years.**

Bridges

Obviously, even the finest highway system is not a reliable means of transporting goods or people if the bridges that system spans threaten to collapse at any time. And in fact, at present, sections of cities are dysfunctional, shut down to traffic by the closing of bridges, or by their collapse. Two-thirds of the nation's 557,516 bridges have been classified by a report from TRIP as "either structurally deficient or obsolete." Of these officially "deficient" bridges, 126,655 are so unsafe as to be restricted by federal law to light vehicles—no trucks, buses, truck trailers, or fire engines—or closed to traffic altogether pending rehabilitation. A bridge near Toledo is weight-restricted and heavy commercial traffic faces a 23-mile detour into the city. Consumers pay the increased costs for goods.

At the rate the nation is repairing its bridges, it would take 287 years to catch up with existing problems.

According to a report of the Federal Highway Administration on the "Highway Bridge Replacement and Rehabilitation Program" (issued March 1982), it will cost approximately $14.7 billion to rehabilitate, and $32.9 billion to replace all of the eligible deficient bridges in the country, for a total estimated cost of $47.6 billion in 1980 dollars, or $55.5 billion in 1982 dollars. This figure only repesents *current* deficiencies and does not take into consideration the bridges that will become deficient in the future. This will cost $10 billion, bringing the total 20 year expenditure bill to $65.5 billion.

Finally, the 50 new cities one must take into account as a requirement will entail bridge construction at a cost of approximately $30 billion.

Total bridge construction cost: **$95.5 billion.**