A. G. Clary

For Want of a Nail

We are in the process of imperiling our total transportation investment by neglect of maintenance. Our railroads are in critical trouble because needed maintenance was deferred. A massive program of upgrading, resurfacing, and bridge replacement is needed for our highway system, yet there seems to be an almost irresistible pressure to divert available highway revenues for other useful purposes.

Increased truck and train weights are accelerating the failure of pavement, roadbeds, and bridges. Unless substantial capital investments are made soon, transportation costs must inevitably increase, raising the cost of nearly every service and product used in the United States.

Adequate attention is not being given to maintenance problems incidental to or caused by increases in transit construction programs. Our waterways are silting up because dredging funds are either inadequate or because environmental pressures limit dump sites for disposal of the dredged material. Increased funds need to be appropriated for improvement and maintenance of air traffic control installations.

Electric service, vital to rail electrification programs, rail transit, home heating, and highway operations, is becoming less reliable because adequate funds are not being made available to utilities in timely fashion to expand electric generating facilities and to perform adequate maintenance.

Solutions are being sought through imposition of additional federal regulations and controls on transportation rather than provision of intrinsically safe and efficient transportation facilities. Further regulations are being put forth by the federal government on the movement of hazardous cargoes, but available staff is inadequate to properly enforce the regulations.

We tend to overlook maintenance during the excitement and enthusiasm generated in the planning, design, and construction of giant transportation public works programs, whether rail, highway, air, or urban transit. We tend to forget that there is a hidden price on every capital investment: the maintenance and repair costs. That bill is usually delayed but inevitably becomes due and must be paid.

The Railroad Bill Has Now Been Tendered

An estimated 20 to 45 percent of the 200,000 miles of railroad tracks in the United States operate under some sort of slow order. Forty percent of Amtrak's trains now run on inadequately maintained track. The record of railroad accidents is worsening. Train accidents increased from 1972 to 1973 by 24.5 percent, the largest increase in the history of reported accidents. The calendar 1973 cost was 1,913 dead and 17,718 persons injured.

E. R. English, regional track engineer, Federal Railroad Administration, speaking to roadmasters, key individuals responsible for railroad track maintenance, at a meeting in Chicago reportedly stated:

As you know, we are required by the Federal Rail

The author is Engineer of Maintenance for the Transportation Research Board. The inferences and conclusions are those of the author and of those directly quoted. They have not been formally endorsed by the TRB or by the National Research Council. The article is published to draw attention to the critical existing situation that will probably worsen in the area of maintenance of transportation facilities and equipment.

> Safety Act of 1970 to establish and enforce safety standards on the nation's railroads. Our standards are, admittedly, quite flexible. We allow you to have a rather rotten railroad as long as speeds are kept to a minimum over bad stretches of track. Indeed, you need only one sound crosstie every eight feet and you can still limp along at 10 mph. In Indiana, however, we found 1329 separate instances where the track failed to meet even these minimum standards . . . and we had to order a "zero" speed limit until the track had been fixed.

Mr. English was speaking of the closing of 415 miles of Penn Central main track between Louisville, Kentucky, and Chicago, Illinois.

This crisis situation occurred because, as basic materials such as rail and ties reached the end of their inherent life in the late 1960s and 1970s, controlling maintenance of way budgets became increasingly difficult. Maintenance requirements became urgent, and deferral of maintenance began to have a critical impact on operations and service, yet overriding financial pressures drove railroads toward the operation of heavier cars and heavier trains, thus compounding the already critical problem.

Intense pressures still remain. Estimates are that each day 30-unit trains, weighing 10,000 tons loaded, must be added to the nation's coal-moving operations in the next 2 years to meet needs for energy. Essential improvements will require large investments to compensate for past maintenance-deferral policies of many railroads and to meet future demands for railroad service.

A writer in the January 1, 1975, issue of ***Railway Track and Structures*** stated:

> Most readers of this letter, especially those to whom it is specifically addressed, are familiar with the consulting engineer's conclusion that the tracks of all Class I railroads are harboring $5.7 billion in rail and tie deferments. Or the AAR study showing that an annual increase of $200 million is required in M/W expenses merely to prevent further track deterioration, and that, in addition, a minimum expenditure of $3 billion must be spent over a 10-year period to "catch up" on past deferrals.

The U.S. Railway Association (2) estimated that during ConRail's first 10 years $2.0 billion (uninflated) or $4.2 billion (inflated) will be needed for rehabilitation and capital improvement to track structure and facilities. Columnist George F. Will, in a March 14, 1975, column, published in the Washington Post, summarized the issue involved here:

> Some people think the government should buy the tracks of the bankrupt railroads and charge a user's fee to those who want to run trains on the rails. They note that the government builds the highways on which trucks roll; the government maintains, with a variety of electronic and planning services, "highways in the sky" for airlines; and the government maintains the system of inland waterways on which barges carry 16 percent of the nation's freight.

Wills went on to explain why he thought this was not the correct solution to the problem. Neither do I advocate greater federal control of transportation but, as a practical matter, I believe it to be the most likely outcome after a prolonged period of discussion and argument; therefore, we ought to prepare for the changes that will be wrought.

The Next Penn Central

Current loss of interest in highways among much of the nation's press and the American public indicates our next transportation disaster will involve the nation's highway system.

There are about 3.8 million miles of roads, including more than 600,000 miles of municipal roads and streets, in the United States. On much of this mileage, the pavement surface is nearing the end of its design life. In fact Nello Teer, apparently using U.S. Department of Transportation figures, stated 5 out of every 6 miles of arterial highways (only a small percentage of the total highway system) will need to be worked on before 1990: 285,000 miles will require resurfacing, 140,000 miles will need to be widened, and about 400,000 miles will need reconstruction or additional lanes or both. Thirty percent of the not-yet-completed Interstate Highway System already needs resurfacing.

There are approximately 600,000 highway bridges of various kinds in the United States, and more than half of those are more than 30 years old. Those aging bridges are worrisome because fatigue problems are beginning to appear, and the number of heavy vehicles using the structures is also increasing.

Norbert T. Tiemann, Federal Highway Administrator, testifying at hearings before the Subcommittee on Investigations and Review during June 12-14, 1973, said that, on the federal-aid primary system alone, 6000 bridges were 20 feet or less in width, 12,000 were structurally deficient, and 12,000 were functionally obsolete. He estimated the replacement costs would reach $1.2 billion.

The 1972 motor truck inventory was more than 20 million including 990,000 trailer and semitrailer hauling units. This represented a significant increase not only in numbers but in the average unit weight. According to the American Trucking Associations, the annual number of heavy highway vehicles entering the system rose from 62,000 in 1956 to 308,000 in 1972, while the annual number of medium-sized vehicles declined from 291,000 to 92,000 during the same period. Thus, although the maximum size and weight of trucks are limited by law, the trend has been toward a heavier average size.

Further complicating this situation is the rapidly upward spiraling cost of highway maintenance. In 1968 the AASHO Committee on Maintenance and Equipment estimated that maintenance costs by 1985 would be $3.6 billion or about 1½ times the then-expected expenditure in 1976 of $2.4 million. Actually, during the 15-year period (1960-1974) maintenance expenditures on the state-administered highways and street systems increased

174 percent, from $991 million to $2.72 billion, and by 1976 will certainly far exceed earlier estimates for that date.

I do not have an updated prediction for maintenance costs that reflect post-1972 inflation rates but note that the estimated yearly cost of highway maintenance (including systems not included in the preceding estimates) has reached $6.2 billion, up from about $5 billion in 1970, and is rising at a rate of about $300 million per year.

In addition, there is a large backlog of existing secondary highway deficiencies that have been deferred because of various limitations. These deferred maintenance costs, categorized as stop gap and second generation, have been estimated by the Federal Highway Administration to average about $2.25 billion per year over a 20-year period (1972-1992).

Thus, required maintenance activities call for investments of $8 to $10 billion annually.

Our Overloaded Systems

The Federal Highway Administration report RD-73-67 states:

> While the sizes and weights report demonstrates a substantial economic benefit with higher weight limits, any substantial increase in legal loads without a massive program to update, monitor, and maintain the highway system would create disastrous effects in many states. Many pavements would need to be overlaid and bridges reinforced or posted for appropriate maximum loads.

Congress subsequently passed legislation in 1974 permitting an increase in truck weights on Interstate Highways. Companion measures providing financing to accomplish the massive upgrading of the highway system to accommodate these increased weights have not yet been provided.

The railroad companies similarly created a problem for themselves by upgrading their rolling stock with bigger cars, heavier engines, and unit trains that hammered away at the track structure and inevitably shortened track and track-support life. Then they often failed to adequately support these new demands with an increased track and structures investment. Figure 1 shows tie and rail deferrals. (Data in this figure were extracted from Federal Register, Vol. 40, No. 43, Pt. 2, March 4, 1975, p. 246.)

This deterioration in track structure can be related to rail profits and to increased maintenance of way and structures costs. Figure 2 shows the effect of rail car capacity on maintenance of way and structure costs. (This figure is a greatly modified version of a figure that appeared in a paper by Robert E. Ahlf, presented at the Regional AREA meeting in Kansas City, Missouri.) I believe the relationship that Ahlf derived, showing that costs for maintaining good track are lower than costs for maintaining poor track, could also be demonstrated for highway maintenance. Ahlf also commented:

> On the ICG we consider that roughly 53 percent of our total maintenance of way and structures expense and capital investment is incremental; that is, varies with tonnage moving over the railroad.

Figure 1

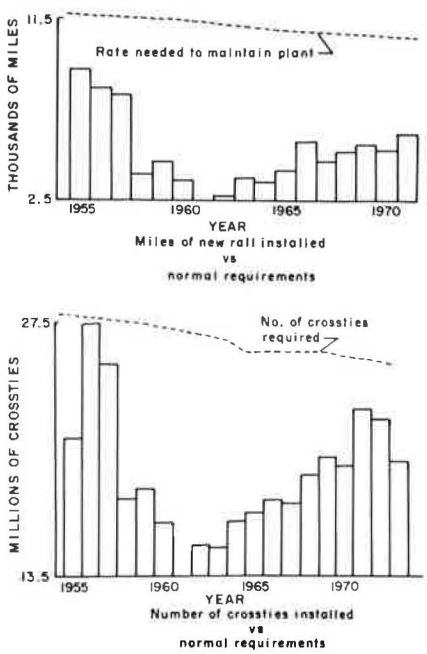
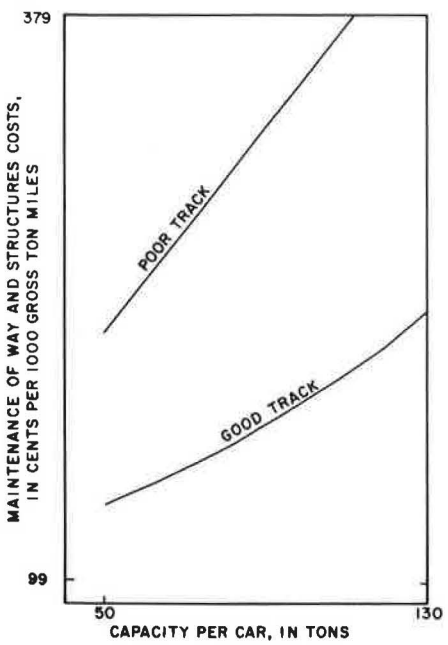


Figure 2



Charles River Associates (1) estimated that highway maintenance expenditures would decrease by 19 percent if there were a 25 percent reduction in intercity truck traffic. Battelle (1) allocated 17.8 percent of maintenance costs to trucks. These figures, crude as they are, provide a rough idea of load-related highway maintenance costs.

The New Charge Account

We are now undertaking the search for a solution to the urban transportation problem and, because the work is in its early stages, we have an opportunity to look ahead and to make provision now for necessary maintenance.

One can only speculate on the size of the maintenance problem, but I note that Milton Pikarsky, chairman of the Chicago Regional Transit Authority, called for quadrupling federal transit assistance to $6 billion a year by 1982. This compares closely with testimony at the subcommittee hearing (2) proposing that funding for urban transit equipment increase from the current $1 to $2 billion/year to $6.5 to $7 billion/year through the 1980s.

I suggest planners give a great deal of thought to maintenance as well as operating costs for these new and expensive systems. Highway maintenance costs already constitute about a third of highway expenditures and will surely rise; it is not unreasonable to expect that similar percentages should be considered in planning future transit systems. The experience of the Dallas airport people mover indicates that failure to include such planning can be irritating and costly. So far as I know a solution has not yet been found to the problem of icy conditions on the guideway system, for example.

In this regard, the effect of buses on local streets and roads should not be overlooked. The most common size of bus falls within the 19,500 to 26,000-lb class. One trip by a 24,000-lb bus will cause more pavement damage than 1300 trips by a 4000-lb automobile. At an average occupancy of 1.3 people/automobile and 50 people/bus, the automobile would carry about 34 times as many people. A study by the Institute for Defense Analysis suggested that about 14 percent of road operating and maintenance costs, for the specified conditions, could be charged to local transit buses.

This does not mean we should abandon the use of buses. Considerations of energy and air pollution must also be taken into account. The discussion is included here to emphasize that the effect of transit vehicles on existing road and street systems should be treated as a part of urban transportation costs and not a highway cost per se.

Waterways at Ebb Tide

In a session on inland waterways transportation at the TRB 54th Annual Meeting, an officer in the U.S. Army Corps of Engineers stated:

> The Corps' ability to dredge is declining, at least temporarily. . . . Vital harbors, ports, and inland waterways throughout our nation are adversely affected. In some cases, they face shutdown. Unless we can find ways to continue the maintenance of our waterways in the face of environmental, legal, and technical constraints, we could precipitate an economic situation which could adversely affect the entire economy.

Fly Me

The 1975 estimate for maintenance of air traffic control systems was $355,559,000, up $34,000,000 from 1974 estimate. Current strong interest in air safety and the "push" toward the installation of new navigational and control aids seems likely to result in a parallel need for additional funds for maintenance.

Blackouts Ahead

An uninterrupted supply of electric power is essential to the smooth operation of high-volume transportation facilities. Rail transit vehicles use electric power, and highways depend on electric power for operation of traffic control systems, ramp metering systems, safety lighting, and, in rare instances, pavement deicing.

Further, electrification offers the only feasible means to use coal or nuclear power for intercity train movement. see 6000 miles of railroad that ought to be electrified today, but the railroads are not in a position to finance major projects." Electrification will have to be contingent on the availability of reliable power sources.

There is good reason to doubt whether a continued uninterrupted supply of electric power for transportation can be ensured. More than half of the new homes now being constructed depend on electricity for heat and light. In a time of shortage, government officials will be hard pressed to allocate electricity between such essential services and other vital needs, yet regulatory agencies have been reluctant to permit rate increases in timely fashion for expansion of plant capacity. Utility bonds have been downgraded, and interest rates are at record high levels. But the future is not bright.

Chase Manhattan Bank, in recent advertisements, forecast that U.S. capital needs during the next 10 years may exceed $4.1 trillion. We will be lucky if as much as $2.6 trillion will be available for productive investment. Strident calls for an expanded public power system are heard.

The results of these pressures are predictable, and the future is indicated in an article in the Wall Street Journal on September 5, 1974, by Sanford L. Jacobs, who stated:

> Many utilities are putting off such routine maintenance work as tree trimming, replacement of aging wires and poles, and increase in the voltage-carrying capacity of power-delivery systems. The result will be an increased number of power outages.

Traveling May Be Hazardous to Your Health

Some 30 billion shipments of hazardous materials are made each year. Government records show, for example, that in 1973 2.3 billion tons of hazardous commodities were shipped in the United States. The government estimates that by 1980 this figure will increase to 2.7 billion tons. There are 100,000 shippers and 40,000 motor carriers handling significant amounts of hazardous cargo. At some time during the transportation, these carriers use trucks to carry the load either across the country or on a short trip from manufacturer to rail head or airport for shipment.

The Environmental Protection Agency recently listed 300 hazardous substances as the first step in a regulatory process aimed at curbing chemical spills on waterways. The proposed rules could change chemical industry expansion plans and eliminate barge transportation of chemicals. Air transport of restricted articles (i.e., hazardous materials) is being sharply questioned. Members of the Air Line Pilot's Association formally refuse to carry certain materials on scheduled airlines.

In light of the foregoing, transportation of hazardous materials will necessarily be accomplished by train or truck. The accident record of trains, mentioned above, is likely to be matched by truck spills as the highway system falls into disrepair. The new urban transportation construction program will provide for almost none of the movement of hazardous cargo.

A recent study in Virginia reported that 3.6 percent of all trucks on Virginia highways carry hazardous materials; of these, 33.9 percent did not have placards required by regulations. However, there seems not to be unanimity of opinion about the value of placarding or even agreement on a placarding system to use. Federal regulatory agencies appear to be feuding over who will have the regulatory function over hazardous cargo movement.

Regulations are being issued by the federal government, but they are not rigidly enforced. No significant enforcement is being provided by the states. However, this situation is changing, and it would take only a few dramatic incidents, involving hazardous materials spilled in truck accidents in residential areas, to force a radical change.

Last year the Bureau of Motor Carrier Safety conducted 2600 inspections of shippers and carriers who handled hazardous commodities. This compares with 1500 inspections conducted in fiscal 1973. BMCS will increase its investment in labor and time toward regulating hazardous freight in 1975 by 100 percent. Air traffic control facilities are already operated by the Federal Aviation Administration.

Light at the End of the Tunnel?

We have a number of options to respond to these changes: for example, discontinue construction of new facilities and reallocate the resources to reconstruction and maintenance, allocate maintenance funds to more rational systems, and initiate planning and research to prepare for the changes that seem to be ahead. And we should probably recognize the possibility that one of the changes we may have to respond to is an effective decrease in the total funds available for transportation maintenance.

It seems likely that the federal government and state governments will eventually own and/or be responsible for funding maintenance of rail rights-of-way, electric utilities, highway systems, air traffic control systems, waterways, and transit facilities. In all probability, the transportation portion will be funded from a joint transportation fund that is allocated to cities and states.

The federal government recently set a precedent by permitting the use of federal funds for maintenance of urban transit facilities, and government regulations governing expenditure of federal highway revenues now permit funds for highway purposes that were heretofore defined as maintenance and are now defined as construction.

Although the disadvantages are real, I believe that we must start now to seek the benefits that might flow from common funding because it can permit programming transportation funds in a more rational manner, provide impetus to improved management to ensure a more nearly optimal expenditure of maintenance resources, result in the establishment of quality of service guidelines for all transportation modes, provide funds necessary to meet the guidelines, and force the integration of maintenance considerations into the preconstruction planning, design, and construction process.

There is, of course, no doubt that maintenance expenditures must be substantially increased; however, research could significantly reduce the amount of the increase. For example, we concluded in a recent study for the Federal Highway Administration that an investment of $10 million in research during the next 5 years, if successfully accomplished and implemented, could result in a reduction of more than $150 million/year in the amount that would need to be expended on highway maintenance if the research were not done.

In conclusion, I cite a statement in FORTUNE by Herman G. Roseman, an economist with National Economic Research Associates: ". . . bring to . . . mind the declining days of the Roman Empire. . . the roads overgrown, the aqueducts not working, the public baths not fully operative." Let us not permit a decline in the quality of maintenance of transportation facilities to serve as evidence of the declining days of our Republic.

References

1. Hearings before the Subcommittee on U.S. Department of Transportation and Related Agencies Appropriations, Committee on Appropriations, House of Representatives, 93rd Congress.
2. Preliminary System Plan for Restructuring Railroads in the Northeast and Midwest Region Pursuant to the Regional Rail Reorganization Act of 1973. U.S. Railway Association, Vol. 1, February 26, 1975.

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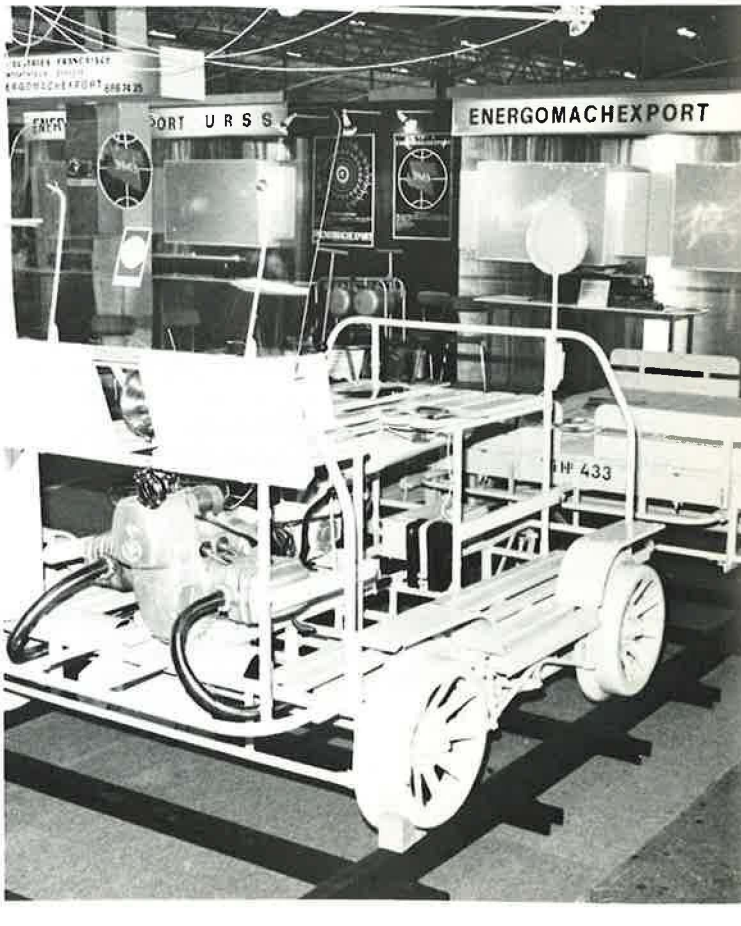

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1 The VEC transportation system carried passengers from the parking lot to the TRANSPORT-EXPO facilities. Passive cabs traveled on a 6-second minimum headway at 10 to 20 miles per hour.

2 A track-keeping device exhibited by Zweiweg Fahrzeug GmbH makes it possible for a standard Unimog truck to be used as a derailment-proof rail vehicle. Manufacturers claim that this truck has the pulling power of a 20-ton locomotive during shunting operations and can haul a trailer load of 650 tons on a level stretch of rails.

3 Steyr-Daimler-Puch of Austria exhibited this propane-powered city bus, with a capacity of 10 seated passengers and 10 standing. The 15-foot length and short turning radius makes the bus ideal for use in restricted areas. It is also intended for demand-responsive, park-and ride, and airport use.

4 From Russia comes this gasoline-truck intended for maintenance work on railroads. The vehicle, exhibited by Energomachexport, featured an extremely high standard of coach-building in its largely wooden body.