Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors

A New Tool for Rail Planners

ALLAN M. ZAREMBSKI AND JOHN F. CIKOTA, JR.

Zarembski is President, Zeta-Tech Associates, Inc., Cherry Hill, New Jersey; and Cikota is Senior Transportation Analyst, Federal Railroad Administration, Washington, D.C.

An increasingly attractive strategy for introducing high-speed passenger rail service begins by examining the freight corridors between well-populated cities. The corridors should offer the potential for improved passenger rail service that could be time-competitive with airplane and automobile for door-to-door trips in the range of 100 to 500 miles. The next task is to determine the upgrading necessary for the corridors to accommodate high-speed passenger operations in addition to the current freight traffic.

State agencies and other transportation planners investigating these options often need estimates of maintenance-of-way costs for the proposed high-speed rail routes. For example, the Mid-West Regional Railway Initiative (MWRRI), a consortium of states, recently wanted to examine projected maintenance-of-way costs for several proposed high-speed rail corridors in the Midwest, including Chicago to Detroit, Chicago to St. Louis, and Chicago–Milwaukee–St. Paul.

Problem

Future high-speed rail operations most likely will make use of track shared with freight trains. Because the experience in these corridors has been with freight-only traffic, transportation planners must determine the increase in the maintenance-of-way costs from the introduction of high-speed passenger traffic. These added costs reflect the increased track class and the tighter track requirements for the higher speeds of the passenger trains, as well as costs associated with the dynamic impacts of the higher-speed passenger trains and the increased traffic density, with correspondingly reduced opportunities for maintenance.

Because most railroad tracks in North America are privately owned, access agreements must be negotiated with the private owners. These agreements must specify how costs, such as for maintenance-of-way, are to be shared, or alternatively what access charges must be paid.

Solution

A recent Federal Railroad Administration (FRA) study looked at the maintenance-of-way costs associated with upgrading freight corridors for higher-speed operation—specifically the ongoing infrastructure maintenance costs for meeting varying traffic, track, and operating conditions. These ongoing or steady-state right-of-way maintenance costs included such cyclic capital costs as rail replacement, tie renewals, surfacing, ballast replacement, and the like, which are normally capitalized for accounting, as well as the maintenance costs for such tasks as inspections, spot repairs, and routine maintenance. Capital upgrade costs were excluded.

Costs were generated for three operating scenarios, covering a range of tonnage and traffic mix:

- Predominantly freight;
- Mixed traffic; and
- Predominantly passenger.

The costs were converted to total costs per track mile and included

- Maintenance-of-way operating expenses;
- Cyclic capital expenditures for track;
- Bridge and building costs (maintenance and capital); and
- Communications and signals costs (maintenance and capital).

Cost Models

To determine a range of right-of-way maintenance costs that included both the maintenance and the cyclic capital costs, two models were used:

- A model that calculates the level of work required to maintain a defined segment of track or territory, to estimate the noncapital track-maintenance expenditures for specific track segments and territories; and
- A model that calculates the cyclic capital costs from the standard service-lives and costs for track components, to estimate the future or steady-state spending required to replace components that wear out.

Minimum and maximum costs were developed for

Track Maintenance Cost Factors: Sample Case

Track Maintenance Cost Factors: Sample Case		Cost Per Track Mile ($1,000)				Cost Per Passenger Train Mile ($)			
		Total Tonnage (MGT)				*Total Tonnage (MGT)*			
Ratio of Passenger to Freight Trains	FRA Track Class	5 or fewer	5–15	15–30	30 or more	5 or fewer	5–15	15–30	30 or more
2 passenger: 1 freight	4	26.6	31.0	42.0	60.8	1.97	0.77	0.52	0.45
	5	29.2	34.4	46.8	68.8	3.41	1.39	0.96	0.89
	6	33.0	39.3	53.8	80.3	5.50	2.29	1.60	1.52
10 passenger: 1 freight	4	29.4	38.1	54.7	***	2.49	1.08	0.96	***
	5	31.5	41.5	59.9	***	2.95	1.32	1.20	***
	6	35.8	48.3	70.6	***	3.90	1.82	1.69	***
40 passenger: 1 freight	4	31.9	47.2	***	***	3.13	1.55	***	***
	5	34.4	52.1	***	***	3.48	1.77	***	***
	6	37.5	58.1	***	***	3.91	2.04	***	***

MGT = million gross tons
*** Elements of the matrix that represent unrealistic combinations of tonnage and high-speed passenger trains were intentionally omitted, including predominantly passenger operations with tonnage levels above 15 MGT and equal passenger-freight operations with tonnage levels above 30 MGT.
NOTE: maximum passenger speed is as follows: FRA Class 4, 80 mph; FRA Class 5, 90 mph; FRA Class 6, 110 mph.

each cell in the cost matrices. The minimum costs represented the typical Class I freight railroad practice, in which passenger trains operate on a freight railroad right-of-way; the maximum costs reflected maintenance practices on high-speed railroad track, such as Amtrak's Northeast Corridor.

The resulting costs were then calibrated to costs independently developed in a bottom-up cost study on two track segments in the Midwest:

- Buffington Harbor to Ft. Wayne, Indiana; and
- Watertown to Madison, Wisconsin.

The first segment would add high-speed passenger trains to a line with five freight trains per day, about 15 million gross tons (MGT) of traffic annually, and an operating speed of 40 mph. The second segment would add high-speed passenger trains to a line with two freight trains per day, less than 5 MGT, and an operating speed of 25 mph. Costs included activities to keep the railroad in safe condition for operations.

Allocating Costs

The resulting total costs per track mile were allocated between passenger and freight trains, allowing for the calculation of a cost per passenger train mile. An engineering-based cost allocation model divided the track maintenance costs among the different traffic types, including freight and passenger trains.

The model applies engineering damage equations to calculate the portion of track damage—or component life consumption—from each defined type of traffic operating on a specific track segment. The calculated relative damage is then used to allocate the track maintenance costs in an auditable and accountable way. The result is a set of cost matrices presenting total cost per track mile and cost per passenger train mile.

The table on page 30 presents the results of a sample analysis for three different mixes of passenger and freight trains—low, medium, and high percentage of passenger trains—and four different densities of total traffic. The results are presented for three different FRA track classes with maximum passenger train operating speeds: FRA Class 4 at 80 mph, FRA Class 5 at 90 mph, and FRA Class 6 at 110 mph. The total maintenance-of-way cost per track mile is presented, as well as the cost per passenger train mile—the commonly used measures for determining costs and access charges. The final methodology and tables were presented in an FRA technical monograph that will serve as a handbook for planners of new high-speed rail operations (*1*).

Benefits

The Rail Planner's Handbook will assist planners of high-speed rail service in estimating the costs of the right-of-way maintenance associated with the operation of high-speed passenger trains. The results are provided as matrices that allow planners to select the appropriate maintenance or capital cost for any segment of a proposed high-speed passenger railroad.

Illustration: J. Craig Thorpe, Commissioned by Cooper Consulting Co., Kirkland, Wash., for the Schiller Institute, Los Angeles, Calif.

Artist's rendering of high-speed rail on a freight corridor in California.

The handbook has been used to estimate future maintenance-of-way costs for several proposed rail corridors and for parts of the MWRRI consortium plan, which are investigating high-speed passenger operations on freight lines. The handbook is expected to become an indispensable aid in the planning of high-speed rail service throughout the United States.

In practice, the operation of publicly funded passenger trains on private freight railroads will require the negotiation of access charges, and the negotiated charges probably will not be the same as the costs shown in the matrices. The cost matrices, however, indicate the expected total spending that will be required on a steady-state basis and provide an example allocation of the costs.

For more information, contact Allan M. Zarembski, Zeta-Tech Associates, Inc., 900 Kings Highway North, Cherry Hill, NJ 08034; telephone 856-779-7795; e-mail Zarembski@zetatech.com.

Reference

1. *Technical Monograph: Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors*. Federal Railroad Administration, U.S. Department of Transportation, Washington, D.C., 2004.

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Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu).