Effect of Traffic Growth Projections upon Estimates of Highway Needs and Revenue

FRED B. FARRELL, Bureau of Public Roads

●ONE of the essential first steps in the making of a highway needs study is to estimate what future travel will be. It sets the stage for the measurement of needs, and it provides the framework for the development of financing structures.

Every projection of future travel is the composite of a number of assumptions. The resultant future trend (Figure 1) is generally one of three types: concave upwards, straight-line, or convex. Needs and revenue estimates will vary, and they will vary in different degrees, depending upon the type of projection or "forecast."

The purpose of this paper is not to discuss the merits of one type of forecast over another. The purpose is to show how, and to what extent, the type of forecast affects needs and revenue estimates. This progress report covers only straight-line forecasts. Analyses are currently under way for the curved-type of projections, and these will be covered in a future report.

Three straight-line forecasts were used, a 3-, 4-, and 5-percent annual increase over present traffic. The 4-percent rate, for example, means that there would be a 40-percent increase in travel in 10 years and an 80-percent increase in 20 years. For the 3- and 5-percent rates, the 20-year increase would be 60 and 100 percent, respectively. In some instances, these rates will be exceeded, but in general they fall within the range of future straight-line travel estimates found in a number of states.

Estimates of needs were then computed by the investment analysis approach (1). The investment data used for this purpose are a composite for primary rural state highway mileages in Missouri, Washington and West Virginia. Estimates of needs, thus derived, are illustrative only. A specific analysis for any given state would undoubtedly show somewhat different results due to such variables as construction costs, service lives, existing condition, and traffic density.

A straight-line traffic increase of 4 percent was used as a starting point. Needs were then computed for a 10-year catch-up period, a 20-year catch-up period, and a 30-year catch-up period. The 30-year catch-up period was included to show how much (or how little) effect the lengthening of the catch-up interval has upon the total cost over a long range period.

The cost of catching-up for each of these three periods is shown in Figure 2. Needs during a 10-year catch-up period are $500 million; for a 20-year catch-up period they are $850 million; and for a 30-year catch-up period they are $1,250 million. But this is only part of the picture, and the question can be asked: "What are the future needs after the 10- and 20-year catch-up periods, and how do the total 30-year costs compare for each catch-up program?" The answer to this is shown in Figure 3. The heavily outlined bars are the same as on Figure 2, but to the bar for the 10-year catch-up program has been added the cost of meeting needs during the second 10 years and the third 10 years. These added costs are those necessary to keep the highway system adequate, after adequacy is once attained.

The heavy bar for the 20-year catch-up program has been divided into two parts showing the relative needs during the first 10 years and the second 10 years. On top of the 20-year catch-up bar is shown the additional needs during the third decade which is the amount required to sustain adequacy once it is attained.

The heavy bar for the 30-year catch-up program has been divided into three parts to show the needs that should be met each 10-year period in an orderly schedule of catching up in 30 years.

The differences in 30-year total cost for each catch-up program are rather small. In fact, the difference between the 10-year and the 30-year catch-up programs is only 5 or 6 percent.

The significant difference between the 3 catch-up programs is not in their total 30-year cost; it is in the distribution of this total within the 30-year period. The relative

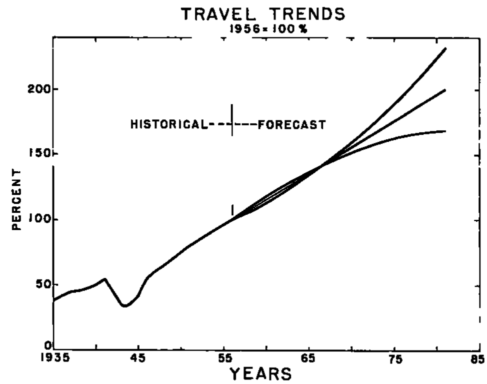

Figure 1.

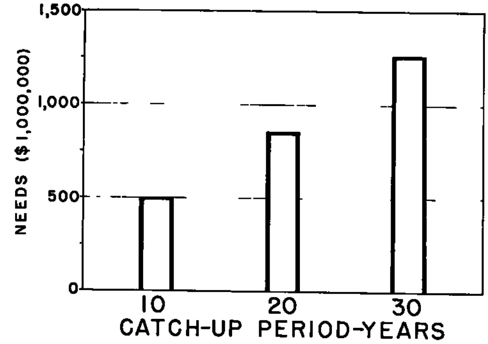

Figure 2. Cost of catch-up programs (4% straight line increase in traffic).

height of the bars for the first 10 years of each catch-up program shows, for example, that the cost during the first 10 years of the 10-year catch-up program is 50 percent greater than for the 30-year catch-up program but adequacy is reached in one-third the time.

The needs shown in Figure 3 are based on 4 percent straight-line traffic increase. Figure 4 shows how they compare with needs based on 3- and 5-percent straight-line traffic increases.

The middle bars for each of the three groups in Figure 4 are the same as those in Figure 3. To either side have been added the bars for the 3 percent and 5 percent traffic increases.

Traffic has a noticeable affect upon costs. Within each catch-up program, the total height of the bars shows a spread of about 30 percent between the 3- and the 5-percent forecasts. This 30 percent spread is about the same as the spread in total traffic which is 190 percent (in 30 years) for the 3-percent forecast and 250 percent (in 30 years) for the 5-percent forecast. This preliminary finding suggests, therefore, that for a 30-year period, the total cost of any given catch-up program will vary in direct proportion to the total travel on the system at the end of the 30-year period. This relation does not, however, hold for shorter periods than 30 years.

Figure 5 shows the relation between revenue and needs for a 4-percent straight-line traffic forecast. The revenue bar, to the left, is based on the assumption that the income designed to meet needs over a 30-year period will follow the travel trend. Under this assumption, 25 percent of the income will be obtained during the first 10 years, another 33 percent during the second 10 years, and the remaining 42 percent during the third 10 years. For the 30-year catch-up program, these percentages by 10-year periods are almost identical. Therefore, based on the assumption that revenue follows

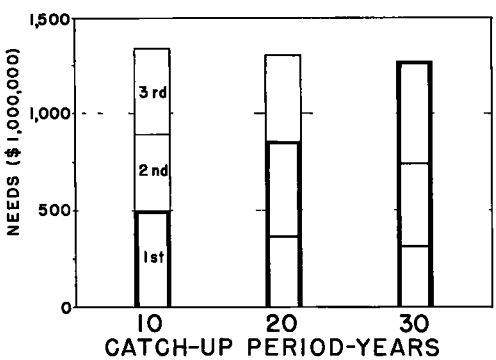

Figure 3. Cost of programs by decades (4% straight line increase in traffic).

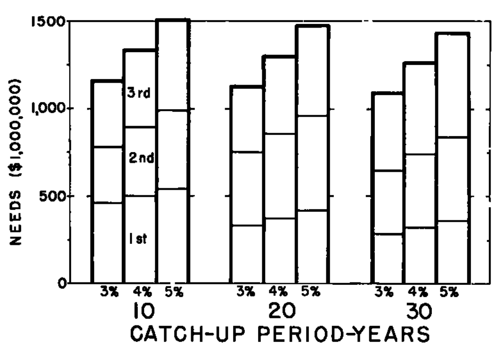

Figure 4. Cost of programs by decades (3, 4, and 5% straight line increases in traffic).

the travel trend, a revenue structure can be designed on a pay-as-you-go basis which will produce the required income to meet scheduled needs in a 30-year catch-up program. But for the 10- and 20-year catch-up programs the total height of the bars for the first 10 and 20 years is greater than the revenue. Therefore, supplemental sources of revenue should be obtained to make up the difference. If it is made up by borrowing, such borrowing should take place in the early years and be repaid in the later years when the revenue exceeds needs. At a 3½-percent interest rate on borrowed money, the total revenue requirements would be increased by 8⅛ percent in the case of the 10-year catch-up program and 5 percent for the 20-year catch-up program. These increases would be somewhat lower if based on a 3-percent straight-line traffic forecast and somewhat higher for a 5-percent forecast.

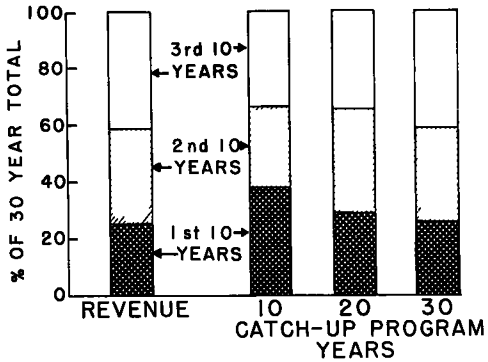

Figure 5. Distribution of revenue and needs (based on 4% straight line traffic increase).

The foregoing findings are preliminary. It is expected that, upon completion of this study, a better understanding will be gained as to the influence of travel forecasts upon needs and revenue estimates. This will serve to bring closer together the engineering and financial phases of highway needs studies.

REFERENCE

1. Fred B. Farrell, "The Investment Analysis Approach to Estimating Highway Needs." Proceedings, Highway Research Board, Vol. 35 (1956).