

Road User Cost Analysis

I-45 Gulf Freeway at Beltway 8 Interchange

CSJ #500-03-382

1994

Texas Transportation Institute

ROAD USER COST ANALYSIS

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The Texas Department of Transportation (TxDOT) is presently reconstructing the I-45 Gulf Freeway from Almeda-Genoa to Choate Road (CSJ #500-03-382). This effort provides for mainlane widening, extension of the HOV lane, ramp reversal, and signal installation. Construction is expected to be completed in late 1995.

TxDOT is presently negotiating a price with the construction contractor for the installation of four footings for direct connectors from I-45 to Beltway 8. Two scenarios have been submitted: 1) provides for a December 1995 completion; and 2) provides for a September 1995 completion and an increased cost of \$175,000. Completing the latter effort would allow TxDOT to open the HOV lane and the freeway mainlane improvements three to four months earlier than scheduled. The capacity of the freeway would be significantly increased due to an additional lane, 12-foot lane widths, and the addition of inside/outside shoulders. TxDOT has requested that the Texas Transportation Institute (TTI) complete a road user cost analysis associated with the proposed field change.

Delay Savings Estimates

Based upon the request from TxDOT, an assumption was made that the analysis was to concentrate on the I-45 Gulf Freeway at Beltway 8 interchange. The September 1995 completion date (as a result of the construction of the four footings for direct connectors) would allow for an earlier opening of the direct connections between the two roadways. As a result, TTI completed traffic studies within the interchange to complete the analysis. Subsequent conversations with TxDOT staff revealed that the user cost analysis should concentrate on benefits derived from completion of the entire project early and not only on those that would occur due to the early opening of the direct connectors. Therefore, a different approach to the analysis was taken using any previously available traffic data.

The limits of the construction effort (CSJ #500-03-382) extend from Almeda-Genoa Road to just north of Dixie Farm Road, a distance of 3.375 miles (5.431 kilometers). TTI completed traffic counts at all entrance and exit ramps as well as a mainlane count within the construction area in June 1993. This data is considered valid and sufficient to complete this analysis. Delays

estimated during the existing construction phase will be compared to those expected upon completion of the project; the corresponding difference will be applied to the current value of time and a daily monetary value will be determined.

In order to evaluate the impacts of the construction on the traffic on the freeway mainlane traffic, the FREQ10PC simulation model was used. The FREQ10PC model was used to simulate freeway operations for the construction project from Alameda-Genoa to FM 1959. The computer program allows simulation of freeway traffic operations for a given set of geometric and demand input parameters. It is based upon a macroscopic deterministic approach which assumes that freeway operations can be simulated by disregarding the actual randomness of traffic demand and the behavior of individual vehicles. Inputs to the model includes geometric and traffic demand data. Model outputs include freeway travel time, ramp delay, total freeway travel time, total travel distance, average speed, gasoline consumed, vehicle emissions, and mainlane delay. The latest version of the model (REL T91) was used for this analysis.

The model was set up for typical weekday traffic conditions for the freeway section between Alameda-Genoa and FM 1959 for a complete 24-hour period. The estimation of the capacity of the freeway sections has a major impact upon the results of the FREQ10PC simulation analysis. The capacity of the freeway mainlanes in the construction area will be reduced due to narrow travel lanes, reduced and/or no shoulders, and minimal clearances to lateral obstructions. Adjustment factors relating to these items were obtained from Table 3-2 of the *Highway Capacity Manual* and the reduced capacity for each phase evaluated was determined. The reduced capacity was then applied to the impacted freeway sections in the FREQ10PC model to estimate the traffic flow conditions.

The FREQ10PC model was used to simulate the traffic conditions within the construction area for both directions using ramp and mainlane volume data collected by TTI in June 1993. The model developed for the northbound direction indicates some congestion from 7:00 a.m. to 9:00 a.m. Total daily delay on the freeway mainlanes is estimated at 203 vehicle-hours/day. Congestion is also indicated for the southbound direction from 4:00 p.m. to 7:00 p.m. resulting in 512 vehicle-hours/day of daily delay on the freeway mainlanes. The delay for the southbound direction is higher due to the increased capacity of the upstream freeway section. The total daily delay on the freeway mainlanes attributable to the roadway construction is estimated at 715 vehicle-hours/day.

Completion of the roadway construction will result in an eight-lane freeway with an HOV lane located in the median. FREQ10PC models were also used to evaluate traffic conditions with the added capacity. The simulation analysis indicates no freeway congestion for either direction for 1993. The completion of the construction will reduce mainlane delay to the motoring public by the 715 vehicle-hours/day for typical weekday traffic.

Value of Time

Currently, the basis for determining the value of time is a TTI report "The Value of Travel Time: New Estimates Developed Using a Speed Choice Model," Research Report No. 396-2F. This study derived the value of time using a speed choice model assuming a rational driver chooses a speed so that the total driving costs are minimized. Total driving costs include value of time and vehicle operating costs, accident costs, and traffic violation costs. The study recommends the following values of time (in 1985 dollars):

- Drivers — \$ 8.03 per person-hour
- Passenger Car — \$10.04 per vehicle-hour (assumes 1.25 persons per vehicle)

The value of time may be adjusted using the current Consumer Price Index. Table 1 illustrates the CPI and value of time from 1985 to 1993. Current CPI values may be obtained from the *Wall Street Journal* or other economic publications.

Table 1. Value of Time, 1985 — 1993			
Year	CPI ¹	Value of Time	
		Drivers ²	Passenger Cars ^{2,3}
1985	322.2	\$ 8.03	\$10.04
1986	238.4	8.24	10.30
1987	240.4	8.48	10.60
1988	118.2 ⁴	8.82	11.03
1989	124.0 ⁴	9.26	11.58
1990	130.7 ⁴	9.76	12.20
1991	136.2 ⁴	10.17	12.71
1992	140.3 ⁴	10.47	13.09
1993	144.5 ⁴	10.78	13.48

Notes: ¹ CPI values are annual percentages.

² Costs represent only value of time.

³ Passenger car cost based on drivers value of time times vehicle occupancy rate of 1.25

⁴ CPI base was changed in 1988. A multiplication factor of 2.995566 must be used with CPI published after 1988.

User Cost Estimate

Using the estimated construction related vehicle delays (715 vehicle-hours/day) and the current value of time (\$13.48/vehicle-hour), a user cost estimate of \$9,638/day is attributable to the construction on I-45 Gulf Freeway (CSJ #500-03-382). Using the estimated additional construction cost of \$175,000 and daily user costs, the project becomes beneficial after nineteen working days. Since a time period of an estimated forty working days is saved, it is beneficial from road user cost estimate approach to pay the additional construction costs, which will assume completion of the construction by September 1995.