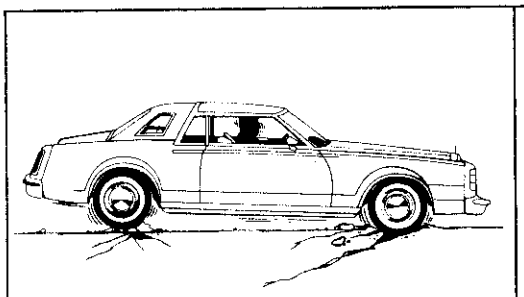
Highway Performance Monitoring System

Case Study Procedural Manual - Highway Improvement Unit Costs



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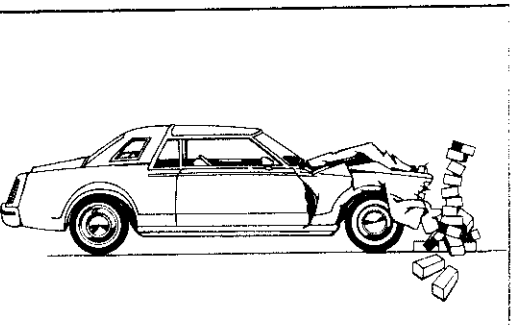

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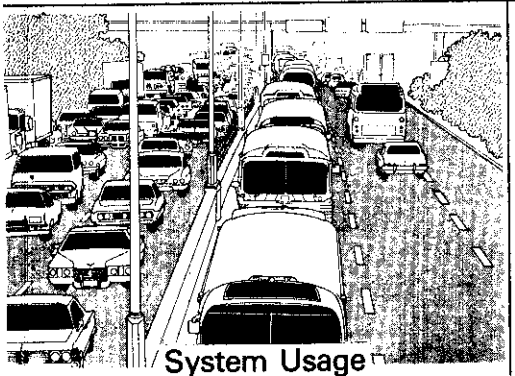

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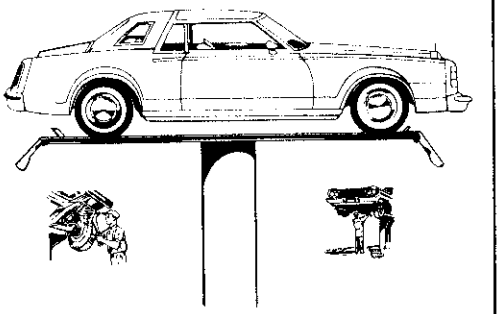

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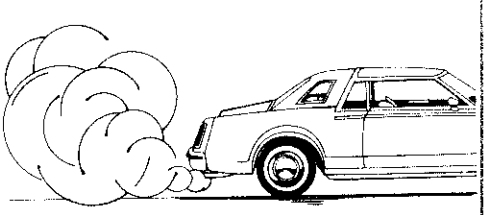

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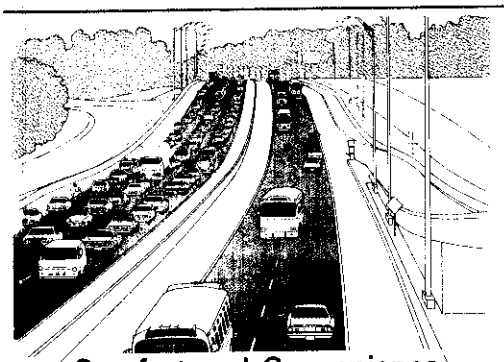

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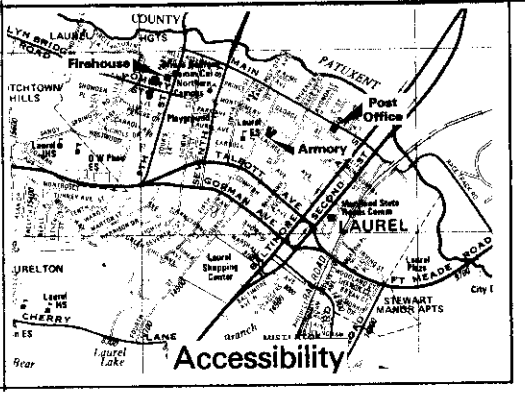

Accessibility

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

U.S. DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Program Management Division

June 1979

HIGHWAY PERFORMANCE MONITORING SYSTEM

Case Study

HIGHWAY IMPROVEMENT UNIT COSTS

June 1979

Highway Improvement Unit Costs

Introduction

Proper planning for highway improvement programs requires that alternative improvement strategies be evaluated in terms of the performance and benefits expected to be received relative to the amount of capital expenditures proposed. This is important at the national level as well as at the State and local levels. Capital improvement cost data is a necessary input to this evaluation process. The Federal Highway Administration (FHWA) is continually making such evaluations for its internal planning needs, and to provide information to other Federal agencies and to the Congress. The biennial highway needs report to Congress includes results from this type of analysis.

There are many uses for highway improvement unit cost information. Highway needs analysis models require improvement cost data as input. Investment - Performance models, which relate the level of highway capital investment to future highway performance, also must have this type of data as input. These models that estimate future highway performance based on a series of alternative levels of capital investment in highway facilities, or that relate future performance to the types of improvements proposed, are becoming more important as the funds for highway investment reach critically low levels in many jurisdictions.

Background

The National Highway Functional Classification and Needs Study (1970-1990) included cost data by type of improvements. These costs were furnished by the States for each sampled highway section for which a capital improvement was proposed within the study time frame. Costs were identified separately for right-of-way, grading and drainage, surface and base, other, and structures. These costs were aggregated by an FHWA computer program to form a national data base of typical highway improvement costs per mile in 1969 dollars. These costs have been used in subsequent years by applying an inflation factor derived from the composite construction bid price index.

In FHWA analyses, structure costs, except for sections with only structure improvement, have been aggregated with the other cost categories. Therefore, costs for each improvement type include the typical cost for structures associated with that type of improvement.

Since this data base is about 10 years old, current data are needed. Eventually, updating will be accomplished by analysis of improvement costs reported for HPMS capital improvements. However, an interim update

is needed to provide more recent cost data that can be used in the models that will be applied to the analysis for the 1980 report to the Congress. This is the reason for the request for improvement cost case studies to be done by several States at this time.

The cost tables furnished for your information and possibly as a help to you in doing this case study were developed from this 1969 data base.[1/] Individual 1969 State cost factors were applied to the cost data from each State to bring all data to a common base, the national level. These factors were derived by dividing each State composite construction bid price index by the national bid price index.

The construction and right-of-way costs were aggregated and multiplied by the inflation factor 2.3694, derived from the construction cost factors, to present the data in 1978 dollars. To furnish you with individual State cost tables, these 1978 national cost values were multiplied by the individual 1978 State cost factors, which were derived in the same manner as the 1969 factors.

Case Study Data Request

As we have already stated, the cost values we are furnishing you are based on updated 1969 values. One inflation factor has been applied uniformly to all costs in the data base, both to right-of-way and construction items. Probably, the cost relationships among these various items have changed during the past 10 years. To update the cost data we are asking case study participants to do the following:

1. Review highway capital improvement projects from 1977 to the present and select those for which the resulting improvement type can be related to those listed in the cost tables. If there are enough projects in 1978 to accomplish the purpose of this study (see 2. and 3. below), 1977 or 1979 need not be included. If 1977 or 1979 projects are included, factor the costs to 1978 dollars. These factors will be furnished for your use. Right-of-way costs and construction costs may be derived from different projects.

2. Using the projects identified in (1) above, calculate the capital improvement costs per mile to correspond with the cells in the cost tables furnished. Generally, do not complete a cell unless data from at least 3 or 4 projects are used in deriving the value.

   Costs may vary significantly in different areas of a State because of varying labor rates, materials prices, etc. The purpose of this study is to determine statewide average right-of-way and construction costs. Projects selected should be in the proper proportion to represent the statewide average. Otherwise, costs should be adjusted to the statewide average base.

1/ These tables will be furnished to those States that volunteer to undertake this case study.

3. Using the cost values derived in (2) above, complete the blank cost forms. It is not expected that every State will be able to enter a value in each cell. It is expected that each State participating in this study will be able to furnish values for a variety of improvement types, functional class or design types, numbers of lanes, and terrain or area development types.

   Note that all cost table values are in cost per mile except for urban major widening. These values are for cost per added lane mile. This is the cost per mile divided by the number of lanes added by the improvement project. All costs are in thousands of dollars.

   For the Rural Improvement Cost Tables (Table UC-1), costs are stratified by functional system, terrain type, number of lanes (2- or 4-lane), and type of improvement. While the number of cells which can be completed by any State depends on the types of projects let during the time frame of this study, it is hoped that participating States will make an effort to complete cells in a wide range of categories. Each State should try to complete at least 150 cells each for construction and right-of-way portions of the Rural Improvement Cost Tables. (There are a total of 240 cells each for construction and ROW.)

4. For both the rural and urban cost tables, indicate the number of projects used to determine the costs for each cell. Separate forms are provided for this purpose.

5. Provide a reasonable estimate of the percentage of total cost attributed to each of the following subcategories: right-of-way, grading and drainage, surface and base, other, and structures. Percent Distribution Tables for Rural and Urban areas (Tables UC-5 and UC-6) are furnished for each State to complete. Each State should complete 10 tables, one table for each functional system in rural and urban areas. Each State should endeavor to complete as many cells as possible in these tables. All cells should be completed for each type of improvement and functional system for which information is available.

6. Provide rural and urban percentage distribution of the sources of right-of-way funds, Federal or non-Federal, for each functional class and improvement type reported in Tables UC-1 and UC-2. These tables, Tables UC-7 and UC-8, should be produced using the same projects that were used to produce Tables UC-1 and UC-2.

   As a part of the Cost Allocation Study, it will be necessary to project capital obligations by improvement type for one or more future years. Such information for the calendar years 1976 through 1978 is being reported as a part of the current HPMS effort and this information, or similar information for a later period, will serve as a base for the

required projections. For the purpose of assigning cost responsibility, both the current and future capital obligations by improvement type will be distributed among cost components using the percentage distributions of rural and urban costs by functional class and type of improvement (Tables UC-5 and UC-6) developed as a part of this case study. While this procedure is sufficient for distributing the capital obligations among the construction cost components, it is felt that the source of funding for right of way is much more variable than it is for the construction cost components. Of particular concern are the relative right-of-way costs on Federal-aid and non-Federal-aid projects and the portion of Federal funds invested in right of way. This information will be used to develop more realistic percentage distributions of costs among all cost components for both Federal-aid and non-Federal-aid projects.

7. Furnish a brief narrative report covering how the case study was conducted in your State. Any comments or caveats regarding the data furnished by the State should be included.

Each State should furnish the data requested by November 1, 1979. This data is needed by that time so that it may be analyzed and used to support a new cost data base for the 1980 report to the Congress.

Definitions

This section includes definitions of terms used on the data forms.

Urban Area Development Type

1. Built-up: Includes CBD and fringe areas. Predominant land uses are large and small business and commercial activity, light industry, warehouses, service activities, and high-density residential areas.

2. Outlying: Generally less intensively developed land uses than "Built-up." May include small business activities but is predominantly residential in character. May also include undeveloped areas within the urban area.

Urban Highway Design Type

1. Freeways and Expressways: Divided arterial highways for through traffic with full or partial control of access and with grade separations at all major intersections.

2. Other Divided: All streets or highways with a median separating traffic moving in opposite directions and not included in the definition of freeways and expressways.

3. Undivided: All streets without directional separation of traffic moving in opposite directions by a median. This includes all streets not included in the above two categories.

Terrain Type

1. Flat Terrain. That condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expenses.

2. Rolling Terrain. That condition where the natural slopes consistently rise above and fall below the highway grade line and where occasional steep slopes offer some restriction to normal highway horizontal and vertical alignment.

3. Mountainous Terrain. That condition where the longitudinal and transverse changes in the elevation of the ground with respect to the highway are abrupt and where the roadbed requires frequent benching or side hill excavation.

Type of Improvement

1. New Location - Complete construction on new alignment.

2. Reconstruct to Freeway - Complete reconstruction to freeway design standards on substantially the existing alignment.

3. Reconstruct to More Lanes - Complete reconstruction on substantially the same alignment with the addition of lanes to the existing section.

4. Reconstruct to Same Lanes - Complete reconstruction on substantially the same alignment with the same number of lanes as the existing section.

5. Major Widening (All Rural Facilities and Urban Freeways and Expressways) - The addition of lanes to an existing facility. While the existing pavement is at least to some degree salvageable, costs include resurfacing both the existing pavement and other minor improvements such as shoulder and drainage improvements.

6. Minor Widening (All Rural Facilities and Urban Freeways and Expressways) - Same as major widening except that added width does not add additional lanes.

7. Widening (Urban Surface Arterials and Collectors ONLY) - All widening improvements including lane additions, regardless of the width added. The existing pavement is salvaged but costs include resurfacing the existing pavement--also include the cost of drainage and curb improvements.

8. Resurfacing and Shoulder Improvement - Overlay existing pavement plus grading to widen shoulders to design standards or complete reconstruction of shoulders to give additional strength.

9. Resurfacing - Overlay existing pavement plus adding material to bring shoulders up to grade. Also includes other minor associated improvements.

Cost Categories

Average costs per mile are to be developed for the following categories which are to include a prorated allowance for preliminary and construction engineering:

1. Right-of-Way and utility adjustments--Include all costs for acquisition of necessary rights-of-way and, where applicable, those for access control. Include costs for all lands acquired, including any developments thereon, easements including scenic, access rights and consequential damages, appraisals, legal fees, special engineering surveys, preparation of right-of-way plats, relocation payments, etc. Also include all costs which would normally be paid for all types of utility adjustments, private and public, within or to clear the right-of-way.

2. Grade and drain--Include costs for all items commonly covered in grade and drain construction contracts. Include all earthwork preparatory to roadside improvement such as channel changes, inlets, surface channels, flumes, dikes, underdrains, outfalls, and minor drainage structures, culverts and special fill treatment. Also include the same items for interchange and frontage roads. Include costs of storm sewer adjustment and all new major storm sewer lines and appurtenances such as pumping stations and equipment. Include all costs for demolishing buildings, moving fences, clearing and grubbing, etc.

3. Base and surface--Include costs of all base courses and surfacing, including shoulders, for the through roadway, interchanges, and frontage roads. Include all curbs and sidewalks.

4. Other--Include all roadway items not included in 1, 2, and 3 above. Include traffic control devices, roadside improvements (such as sodding, planting, roadside rests, etc.), lighting, guardfence, median barriers, railroad crossing protection (excluding separations). The cost of traffic control devices, signing, etc. should be included only when they are part of a large project such as widening or reconstruction.

5. Structure costs--Include the costs for all new structures and all structure improvements.

Submission of Forms

Forms to be submitted	Number of forms
Rural Improvement Costs (Table UC-1)	
One for each functional class	5
Interstate	
Other principal arterial	
Minor arterial	
Major collector	
Minor collector	
Urban Improvement Costs (Table UC-2)	
One for each design type and area type	6
Freeway and expressway	
Built-up	
Outlying	
Other divided	
Built-up	
Outlying	
Undivided	
Built-up	
Outlying	
Rural Number of Projects (Table UC-3)	
One for each functional class	5
Interstate	
Other principal arterial	
Minor Arterial	
Major collector	
Minor collector	
Urban Number of Projects (Table UC-4)	
One for each design type and area type	6
Freeway and expressway	
Built-up	
Outlying	
Other divided	
Built-up	
Outlying	
Undivided	
Built-up	
Outlying	

Forms to be submitted	Number of forms
Percentage of Rural Costs (Table UC-5)	
One for each functional class	5
Interstate	
Other principal arterial	
Minor arterial	
Major collector	
Minor collector	
Percentage of Urban Costs (Table UC-6)	
One for each functional class	5
Interstate	
Other freeway and expressway	
Other principal arterial	
Minor arterial	
Collector	
Percentage Distribution of Rural Right-of-Way Costs (Table UC-7)	
One for each functional class	5
Interstate	
Other principal arterial	
Minor arterial	
Major collector	
Minor collector	
Percentage Distribution of Urban Right-of-Way Costs (Table UC-8)	
One for each functional class	5
Interstate	
Other freeway and expressway	
Other principal arterial	
Minor arterial	
Collector	
Total number of forms	42

Table UC-1

Rural Improvement Costs ($000/Mile)

State Code _____ and Name _____

Functional Class:	Number of Lanes After Improvement					
	2			4		
	Flat	Roll.	Mt.	Flat	Roll.	Mt.
	Construction					
New Location						
Reconstruct to Freeway						
Reconstruct More Lanes						
Reconstruct Same Lanes						
Major Widening*						
Minor Widening						
Resurfacing and Shoulders						
Resurfacing						
	Right-of-Way					
New Location						
Reconstruct to Freeway						
Reconstruct More Lanes						
Reconstruct Same Lanes						
Major Widening*						
Minor Widening						
Resurfacing and Shoulders						
Resurfacing						

*Costs are per added lane mile for Major Widening only

Table UC-2
Urban Improvement Costs ($000/mile)

State Code _____ and Name _____

Design Type (check one) Freeway & Expy. ____ Other Divided ____ Undivided ____	Number of Lanes After Improvement			
	2	4	6	> 6
Area Type (check one) Built-up ____ Outlying ____	Construction			
New Location				
Reconstruct to Freeway				
Reconstruct to More Lanes				
Reconstruct to Same Lanes				
Major Widening*				
Minor Widening				
Widening				
Resurfacing and Shoulders				
Resurfacing				
	Right-of-Way			
New Location				
Reconstruct to Freeway				
Reconstruct to More Lanes				
Reconstruct to Same Lanes				
Major Widening*				
Minor Widening				
Widening				
Resurfacing and Shoulders				
Resurfacing				

*Costs are per added lane mile for Major Widening only

Table UC-3

Rural Number of Projects

State Code _____ and Name _____

Functional Class:	Number of Lanes After Improvement					
	2			4		
	Flat	Roll.	Mt.	Flat	Roll.	Mt.
	Construction					
New Location						
Reconstruct to Freeway						
Reconstruct More Lanes						
Reconstruct Same Lanes						
Major Widening						
Minor Widening						
Resurfacing and Shoulders						
Resurfacing						
	Right-of-Way					
New Location						
Reconstruct to Freeway						
Reconstruct More Lanes						
Reconstruct Same Lanes						
Major Widening						
Minor Widening						
Resurfacing and Shoulders						
Resurfacing						

Table UC-4
Urban Number of Projects

State Code _____ and Name _____

Design Type (check one) Freeway & Expy. ____ Other Divided ____ Undivided ____	Number of Lanes After Improvement			
	2	4	6	> 8
Area Type (check one) Built-up ____ Outlying ____	Construction			
New Location				
Reconstruct to Freeway				
Reconstruct to More Lanes				
Reconstruct to Same Lanes				
Major Widening				
Minor Widening				
Widening				
Resurfacing and Shoulders				
Resurfacing				
	Right-of-Way			
New Location				
Reconstruct to Freeway				
Reconstruct to More Lanes				
Reconstruct to Same Lanes				
Major Widening				
Minor Widening				
Widening				
Resurfacing and Shoulders				
Resurfacing				

Table UC-5

Percentage Distribution of Rural Costs by
Functional Class and Type of Improvement

State Code _____ and Name _____

Functional Class:	Right of Way	Grade and Drain	Surface and Base	Other	Structures	Total
New Location						100
Reconstruct to Freeway						100
Reconstruct to More Lanes						100
Reconstruct to Same Lanes						100
Major Widening						100
Minor Widening						100
Resurfacing and Shoulders						100
Resurfacing						100

Table UC-6

Percentage Distribution of Urban Costs by
Functional Class and Type of Improvement

State Code_____ and Name _____

Functional Class:	Right of Way	Grade and Drain	Surface and Base	Other	Structures	Total
New Location						100
Reconstruct to Freeway						100
Reconstruct to More Lanes						100
Reconstruct to Same Lanes						100
Major Widening						100
Minor Widening						100
Widening						100
Resurfacing and Shoulders						100
Resurfacing						100

Table UC-7

Percentage Distribution of Rural Right-of-Way Costs

State Code _____ and Name _____

Functional Class:	Federal-aid Projects		Non-Federal-Aid Projects	Total Percent	Total Dollars
	Federal Funds	Other Funds			
New Location				100	
Reconstruct to Freeway				100	
Reconstruct to More Lanes				100	
Reconstruct to Same Lanes				100	
Major Widening				100	
Minor Widening				100	
Resurfacing and Shoulders				100	
Resurfacing				100	
	a	b	c		

$a + b + c = 100$

Table UC-8

Percentage Distribution of Urban Right-of-Way Costs

State Code _____ and Name _____

Functional Class:	Federal- aid Projects		Non-Federal-Aid Projects	Total Percent	Total Dollars
	Federal Funds	Other Funds			
New Location				100	
Reconstruct to Freeway				100	
Reconstruct to More Lanes				100	
Reconstruct to Same Lanes				100	
Major Widening				100	
Minor Widening				100	
Widening				100	
Resurfacing and Shoulders				100	
Resurfacing				100	
	a	b	c		

$$a + b + c = 100$$