319

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RESEARCH PROBLEM STATEMENTS: HIGHWAY CAPACITY

mode
1 highway transportation

subject areas
21 facilities design
55 traffic flow, capacity, and measurements

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RESEARCH PROBLEM STATEMENTS: HIGHWAY CAPACITY

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FOREWORD

A3A10 RESEARCH PROBLEM STATEMENTS

A continuing function of committees within the Transportation Research Board is the identification of research needs. These needs are frequently described by committees in the form of research problem statements, which are then published in order to increase awareness of research that can be useful.

Even though recent years have seen the development and publication of the 1985 Highway Capacity Manual, TRB's Committee on Highway Capacity and Quality of Service has still had an ongoing activity to formulate research problem statements that address needs which are still unmet.

The appointed Subcommittee began this task under the chairmanship of Walter H. Kraft. Its work was completed under the chairmanship of Adolf D. May. Initially, about 100 possible topics were listed. These were reduced in number through the procedure of finalizing and prioritizing them into 29 research problem statements. The latter process involved the entire committee and prioritization across the committee's entire range of interest areas as well as within subject areas such as freeways, signalized intersections, arterials, and so on.

The twenty nine statements are grouped in the Circular by priority within each subject area. Listed below, in order of overall priority, are the top ten research needs identified by the Committee:

1. Capacity of Ramp-Freeway Junctions
2. Validation of Procedures for Calculating Signalized Intersection Delay
3. Levels of Service and Capacity of Weaving Areas
4. Shared/Permissive Lanes at Signalized Intersections
5. Adjustment Factors for Saturation Flow Rates at Signalized Intersections
6. Capacity Analysis Methods for Cross-Street Stop and Yield Controlled Intersections
7. LOS Criteria for Signalized Intersections at Near-Capacity Conditions
8. Evaluation of the Relationship between Levels of Service Computed for Unsignalized Intersections and Traffic Signal Warrants
9. Freeway Capacity Trends
10. Benefits of Operational Improvements Along Two-Lane Rural Highways.

A description of these top ten problem statements and all others will be found in the text that follows.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Capacity of Ramp-Freeway Junctions

Problem

Chapter 5 of the 1985 HCM is primarily based upon a Bureau of Public Roads study of lane distribution in the vicinity of merge and diverge areas conducted in the early 1960's. While the data from this study were reviewed, and the statistical correctness of the relationships developed from the study verified, the data represent operating characteristics which may no longer be valid on modern freeways.

Objectives

The following objectives provide a more detailed description of the needed research:

a. Select and observe operations at several representative merge and diverge areas. Data collected should include rates of flow, speeds, and standard deviation of speeds, as well as other potential performance parameters by lane summarized for short time periods not to exceed 15 minutes.

b. Evaluate the accuracy of current procedures for determining lane distribution in the vicinity of merge and diverge areas by type of vehicle.

c. Propose modifications of existing procedures (if necessary) to better predict lane distribution on modern freeways by type of vehicle. This may include the development of new approaches and/or models if deemed necessary.

d. Identify variables which may describe operational performance at merge and diverge areas. These should focus on turbulence and its propagation in the vicinity of the ramp. Develop candidate level of service criteria based upon these measures.

e. Investigate the impact of such geometric variables as merge/diverge angle, length and type of acceleration/deceleration lane, and relative ramp and freeway approach grades on operations and lane distribution.

f. Investigate the impact of ramp vehicle arrival patterns on capacity and level of service. As a minimum, study the difference between random arrivals, platoon arrivals, and ramp-metered arrivals.

g. Operational performances as influenced by trucks should also be studied.

h. Propose a revised methodology for analysis of merge and diverge areas on freeways.

i. Propose a full data collection scheme for calibration of the proposed methodology.

j. Implement the data collection scheme and calibrate an analysis methodology.

k. Write a replacement chapter for HCM Chapter 5, "Ramps and Ramp Junctions."

Key Words

Ramps, Ramp Junctions, Weaving

Related Work

Some data available from FHWA studies in the vicinity of a small number of freeway ramps. Also Ph.D dissertation "A Turbulence Approach at Ramp Junctions," by Nikos Theophilopoulis, Polytechnic University, Brooklyn NY, 1986. Ongoing related research includes NCHRP Project 3-35, "Speed Change Lanes".

Urgency/Priority

High

Cost

$500,000

User Community

Freeway Design, planning, and operations personnel.

Implementation

Replacement of Chapter 5 in the 1985 HCM.

Effectiveness

Improved accuracy in highway capacity analysis, and enhancement of highway cost effectiveness. Especially helpful in evaluating re-construction alternatives for freeway interchanges.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Levels of Service and Capacity of Weaving Areas

Problem

Several major studies involving weaving area operations have taken place since

1970, leading to a substantially revised analysis procedure appearing in the 1985 HCM. The final procedure of the 1985 HCM is, in effect, a compromise born of three procedures developed as the result of research studies -- the Polytechnic Method, published in TRB Circular 212, the Leisch Method, published in ITE Journal and several FHWA reports, and the JHK Method, published in FHWA reports. The three yield different results, with differences often being extreme.

The development of the three procedures relied upon data from three major studies. A 1963 data base collected by the then Bureau of Public Roads provided the largest amount of data; a data base collected by Polytechnic in 1973 provides significant data; a data base collected by JHK Associates in 1983 provides additional data. The three data bases cover a 20-year period over which substantial operational changes have been observed. Data from the three studies were not collected nor reduced in a fully consistent manner. The need exists to collect a significant modern data base with which to validate and recalibrate the various methodologies which have been proposed.

Objectives

The following objectives describe the purpose of the study in greater detail:

a. Develop a comprehensive data collection plan to provide an adequate data base to validate and re-calibrate weaving area analysis procedures without relying on 1963 or 1973 data. The plan should address: (1) the number of sites required to adequately span potential weaving area configurations, lengths, and widths, (2) the amount of data to be collected at each site to insure coverage of the full range in operating conditions, (3) the data collection and reduction techniques to be used, (4) the utility of data from other studies conducted since 1980, and (5) the use of data in calibration and validation.

b. Conduct a pilot study, testing and evaluating the collection, reduction, and analysis plan. Recommend revisions, if any are necessary.

c. Select sites to be studied in accord with the plan developed in Tasks a and b.

d. Collect data at the sites selected. For consistency with methodologies of HCM, data should be collected and summarized in short time intervals no longer than 15 minutes. This interval would be used for summarization of volumes, speeds, lane-changing parameters, and all other values observed.

e. Test the accuracy of the Polytechnic, Leisch, JHK, and 1985 HCM procedures against the new data base.

f. Recommend the format of an optimal analysis procedure for freeway weaving areas.

g. Calibrate the recommended format.

h. Write a replacement Chapter 4 for the 1985 Highway Capacity Manual.

Key Words

Weaving Areas, Freeway, Freeway Capacity

Related Work

Key references include Chapter 4 of the 1985 HCM, and the studies referenced therein. The final report on NCHRP Project 3-28B will also be helpful. Two studies of weaving areas will be conducted by the California DOT, which will also provide useful data and analysis.

Urgency/Priority

High

Cost

$500,000

User Community

FHWA, State DOT's, Consultants. Highway design, planning, and operations analysts.

Implementation

Replacement or revision of Chapter 4 of the 1985 Highway Capacity Manual.

Effectiveness

Additional study will lead to more universally accepted design and analysis procedures based upon modern data base.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Freeway Capacity Trends

Problem

Freeway capacity may change over time as the mix of passenger cars on U.S. highways changes. There may also be regional differences in driver behavior that cause significant variation in capacity. Further, the issue of whether there is one value of capacity or two -- one when approached from stable flow, the other when approached from unstable flow -- is not resolved in the 1985 HCM.

Objectives

a. Select a nationwide sample of basic freeway section sites for study each three years over a period of 12 years. Between 15 and 30 sites should be selected.

b. Conduct a study of level of service (los) at each site during daylight hours covering a full range of levels of service, from A to F. Studies should include classified volumes, speeds, and headways summarized for each lane for 15-minute intervals of time.

c. For each study, conduct graphic and analytic curve-fitting analyses to determine the appropriate shape of speed-flow-density relationships, the existence of one or two values of capacity, and the numeric values of capacity.

d. Analyze each year's studies for shifts in the basic capacity value of 2,000 pcphpl, regional differences, and other trends.

e. When appropriate, recommend changes in the basic value of freeway lane capacity and the form of basic curves in the 1985 HCM.

f. Analyze yearly changes and trends, identifying, where possible, the causes of changes. Where possible, project these trends for potential future impacts.

g. Investigate the relation between capacity and percent occupancy. Suggest a technique to normalize occupancy to exclude the effect of hardware configuration.

Key Words

Freeway capacity.

Related Work

Many published works on capacity, speed-flow-density relationships, and uninterrupted traffic flow theory.

Urgency/Priority

High

Cost

$50,000/year.

User Community

FHWA, State DOT's, Consultants.

Freeway planners, designers, and operators.

Implementation

Periodic revision to basic values in the freeway-related chapters of the 1985 Highway Capacity Manual.

Effectiveness

Planners, designers, and analysts will be able to use the most up-to-date values for capacity. This will result in better designs and improved operations.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Lane and Shoulder Width Effects on Freeways

Problem

The factors for lane width and lateral clearance on freeways were calibrated in the early 1960's. The data used is no longer available, and no modern studies have been conducted.

Objectives

New data on the effects of lane widths, shoulder widths, and lateral obstructions must be collected and analyzed for freeway facilities. Shoulder widths and lateral clearance may or may not be separate factors affecting flow. Certain obstructing devices may have a greater impact on capacity and level of service than others, and procedures are needed to guide designers and analysts. The dependence of lane width impacts on heavy vehicle presence is another potential interaction requiring investigation.

The study would result in revised factors and/or a new methodology for considering the impact of restricted cross-sections on freeway operation and capacity.

Key Words

Lane width, shoulder width, lateral obstruction, freeway capacity.

Related Work

Lane width factor calibrations are being done as part of the NCHRP- sponsered study of multilane highways.

Urgency/Priority

High

Cost

$150,000

User Community

FHWA, State DOT's, Consultants.
Highway designers, planners, and analysts.

Implementation

Revision of lane width and lateral obstruction methodology in Chapter 3 of the 1985 HCM.

Effectiveness

Better understanding of these impacts will permit more informed design and planning decisions to be made, particularly in urban reconstruction projects.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Truck Factors for Freeways

Problem

Passenger car equivalents (pce) for trucks and other heavy vehicles are used to compute heavy vehicle adjustment factors in virtually every methodology of the 1985 HCM. Unfortunately, no consistent philosophy or approach was used to develop these. Various research efforts and methodologies use passenger car equivalent values with different meanings and interpretations. A comprehensive study of the available methods for calibrating passenger car equivalents and a comparative analysis is needed to allow the TRB Committee on Highway Capacity and Quality of Service to adopt a consistent philosophy for use within capacity analysis procedures for uninterrupted flow facilities.

Objectives

The research effort should be divided into two major phases. Phase 1 objectives would include:

a. Thoroughly review the literature, including research documents leading to the procedures in the 1985 HCM, to identify candidate methodologies for the calibration of passenger car equivalents on both general terrain and significant grade sections of uninterrupted flow facilities.

b. Compare and analyze the various methods for calibrating passenger car equivalents with respect to the meaning and interpretation of pce values, the impact on capacity and level of service computations, consistency with capacity and level of service concepts and computations, and the basic appropriateness of the pce concepts used.

c. Design and conduct a pilot study at two freeway sites, one a section of level terrain, the other a significant grade. Collect and reduce data at these sites to allow comparative computations of pce's using the various concepts and methods identified above for heavy vehicles of varying type and performance characteristics, and/or for a mix of heavy vehicles considered in a single pce value.

d. Recommend a consistent concept of passenger car equivalents which may be uniformly applied for all uninterrupted flow facilities covered by the 1985 HCM. Recommend a detailed procedure for calibrating pce's on such facilities.

The second major phase of the research would address the recalibration of pce values in Chapter 9 of the 1985 HCM:

e. Develop a data collection plan which will implement the proposed pce calibration for freeways. Identify candidate sites, and detail the amount and type of data to be collected. The plan should address both sections of general terrain, as well as specific upgrades. A small number of downgrades should also be included.

f. Implement the data collection plan of Task "e." Collect, reduce, and analyze data to yield recommended values for passenger car equivalents on freeways.

g. Prepare replacement pce tables and/or methodologies for inclusion in Chapter 3 of the 1985 HCM.

h. Discuss and analyze the applicability of the values calibrated to other types of uninterrupted flow facilities, including multilane and two-lane highways.

Key Words

Freeway, Freeway Capacity, Grades, Climbing Lanes, Truck Speeds

Related Work

Related efforts include truck speed studies conducted by the California DOT, several TRB papers, including those by Cunagin and Messer, Roess and Messer, and Krammas and Crowley, NCHRP and FHWA studies relating to pce's, and the ongoing NCHRP study on multilane highways.

Urgency/Priority

Moderately high

Cost

$500,000

User Community

FHWA, State DOT's, Consultants

Highway design and operations analysts

Implementation

Results to lead to revisions in Chapter 3 to the HCM, with potential revisions to all uninterrupted flow-related chapters.

Effectiveness

New design criteria for freeway capacity and climbing lanes would be developed. These would be effective for projects designed after adoption of recommended criteria.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Tunnel and Bridge Capacity

Problem

Data on tunnel and bridge capacity is sparse in the 1985 HCM, and is limited to one or two locations at which maximum observed volumes may or may not represent capacity.

Objectives

Evaluate the capacity of bridges and tunnels using both data from published sources and operators of facilities and sampling of filed data obvservations. Studies should relate the type of facility and its basic vertical and horizontal alignment to capacity. The impact of general environmental, and the design of approach and departure roadways should be considered.

Key Words

Tunnel, Bridge, Viaduct, Capacity.

Related Work

A paper on the capacity of the Callahan Tunnel was published in TRR in 1985. In-house studies of the Port Authority of New York and New Jersey may provide additional insights.

Urgency/Priority

Moderate

Cost

$150,000

User Community

City and State DOT's, Toll Bridge and Tunnel Operators, FHWA. Planners, designers, and operators of tunnel and bridge facilities.

Implementations

Information would be added to Chapter 2 of the 1985 HCM.

Effectiveness

Information could help avoid designing capacity restrictions into a highway system in the form of a restrictive bridge, viaduct, or tunnel.

RESEARCH PROBLEM STATEMENT

FREEWAYS

Title

Toll Plaza Capacity and Level of Service

Problem

Current procedures in the 1985 HCM do not address toll plaza capacity or performance.

Objectives

Review current experience and data from toll authorities and other available sources. Evaluate capacity for various methods of toll collection and physical configurations. Establish reasonable level of service criteria for toll plazas.

Key Words

Capacity, Toll Plaza, Delay.

Related Work

Delay prediction techniques for signalized intersections. Studies and data from toll operating authorities.

Urgency/Priority

Moderately high

Cost

$75,000 - $100,000

User Community

State DOT's, Consultants, Toll Operating Authorities.
Operators, planners, and designers of toll facilities.

Implementation

Information may be added to Chapters 2, 3, and/or 6 of the 1985 Highway Capacity Manual.

Effectiveness

Improvements in toll plaza planning and design will result. These will, in turn, reduce delays at toll collection facilities.

RESEARCH PROBLEM STATEMENT

MULTI-LANE RURAL

Title

Consistency of Level of Service Criteria for Uninterrupted Flow

Problem

No method is explicitly provided to determine level of service on roadways with regulated travel speeds below 55 mph. Furthermore, there is a lack of consistency between two lane multilane highways as well as between freeways and multilane highways. For example the Level of Service criteria for two-lane highways (Table 8-1, Level Terrain, 60 mph) specify average travel speeds which at LOS D, are not consistent with those for multilane rural highways (Chapt. 7).

Objective

Research is needed to determine consistent level of service criteria for both two-lane and multilane for posted highway speeds between 35 mph and 55 mph. Specifically, research is needed to determine why the criteria for LOS D for two-lane highways (level terrain), is as high as 50-52 mph, whereas we can operate multilane highways as low as 40-50 mph and be in LOS D. These two ranges seem to be reversed -- drivers on a two-lane highway should be satisfied with a lower average speed range than when using a 70 mph multilane rural highway or freeway.

Approaches

Variations in volume and operating speed should be measured for different posted speeds. Perhaps level of service could be defined as a percent of posted speed rather than as simply an average speed. The research should examine the 5.0 sec. time delay criterion for two-lane highways. Perhaps a 3.5 sec. headway criterion (rather than 5.0 sec.) would reduce the LOS D average speed range for two-lane highways to a range more consistent with the speed criterion for multilane highways.

Research soon to be undertaken on multilane rural highways should look at this consistency problem.

(One temporary solution would be to omit LOS speed ranges from Table 8-1).

Key Word

Level of Service (LOS), Uninterrupted Flow, Highways

Related Work

N/A

Urgency/Priority

Medium

Cost

$75,000

User Community

N/A

Implementation

Updated factors to be incorporated in the revised Highway Capacity Manual.

Effectiveness

Improved accuracy in LOS criteria for uninterrupted flow.

RESEARCH PROBLEM STATEMENT

TWO-LANE RURAL

Title

Benefits of Operational Improvements Along Two-Lane Rural Highways

Problem

Most highway capacity techniques assume that traffic flow variables are in equilibrium along a homogeneous section of highway and traffic conditions. On multilane facilities, this is a reasonable assumption as lane changing permits platoons to rapidly dissipate. For two-lane highways, passing may not be possible due to no-passing zones and oncoming traffic. Congestion continues to build along a section of road until an opportunity to pass is provided. While present HCM methodology addresses this operational problem, it is not able to predict operational benefits of various improvements.

Objective

Develop analytical methods for identifying platooning and delay along two-lane highways as a function of section length, geometrics and traffic mix. The models must provide estimates of benefits of various improvements, such as passing lanes, as a function of section length and attributes.

Key Words

Two-Lane Highways, Rural Highways, Passing Lanes, Climbing Lanes

Related Work

Chapter 8 of HCM, NCHRP -33 and FHWA

Urgency

Very high

Cost

$500,000

User Community

Highway agencies in general

Implementation

Methodology added to Chapter 8 of HCM

Effectiveness

State highway departments need cost-effective strategies for improving operations along principal two-lane highways.

RESEARCH PROBLEM STATEMENT

TWO-LANE RURAL

Title

Adjustment Factors for Lane Width and Lateral Clearance on Two-Lane, Two-Way Highways

Problem

The influence of lane width and lateral clearance to roadside obstructions, combined into a single adjustment factor, is currently one of the two principal adjustment factors applied in two-lane, two-way capacity and level of service computations. The same adjustment factors have been in use over 30 years.

Objective

There is a need to develop new factors based on current driver expectancies, highway and vehicle characteristics, and future design trends.

Key Words

Level of Service, Capacity, Obstructions

Related Work

NCHRP Studies Two-Lane, Two-Way Highway Capacity

Urgency/Priority

High

Cost

$150,000

User Community

Highway agencies in general

Implementation

Updated factors to be incorporated in the revised Highway Capacity Manual

Effectiveness

Improved accuracy in highway capacity analysis, and consequently, enhancement of highway cost effectiveness

RESEARCH PROBLEM STATEMENT

TWO-LANE RURAL

Title

Overtaking and Platooning Behavior on Two-Lane Rural Highways

Problem

It is hypothesized that a driver perceives congestion on a two-lane rural highway as a function of inability to pass. Chapter 8 of the 1985 HCM recognizes this perception by drivers in the choice of traffic platooning (percent time delay) as the measure of service for two-lane highways. However, this measure of service is new and not well understood. Also, very little passing data are available for two-lane highways. There is a need for a fundamental study of the factors that cause platoons to build (through lack of passing opportunities) and to dissipate (through completed passes). The final result should be a simple model allowing better predictions of traffic platooning and passing rates on two-lane highways.

Objective

To obtain data and an understanding of overtaking and platooning behavior which may be used in quantifying Level of Service, to calibrate more accurately existing or new simulation models for two-lane highways, and for other engineering purposes.

Key Words

Rural Two-Lane Highways, Level of Service, Traffic Characteristics

Related Work

Some work has been undertaking in Alberta/Canada concerning supply and demand for overtaking and endeavoring to utilize the concept for determining the location and length of passing lanes. The work, however, needs to be broadened and expanded upon.

Urgency/Priority

The work is very relevant to two-lane rural highway operations and is an area that has received little attention but can now be addressed more easily with the availability of video camera and micro processor technology.

Cost

$200,000

User Community

Highway agencies, researchers

Implementation

The findings should be useful to develop or refine methodology related to operations and design.

Effectiveness

The results should lead to the development of more accurate procedures for the design and operation of two-lane highways.

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Shared/Permissive Lanes

Problem

The case of a shared left-turn/through lane at a signalized intersection with permissive phasing is one of the most complex in traffic engineering. Capacity procedures have been developed with only a highly approximate conception of several critical mechanisms affecting such lanes: (1) the equilibrium lane distribution of multilane approaches including such lanes, (2) the blockage of such lanes to through vehicles by left-turning vehicles unable to find a gap in the opposing traffic stream, and (3) the delay to vehicles in such lanes.

Objective

Develop more accurate estimators of saturation flow, capacity, and delay for shared lanes with permissive left-turns. A limited number of intersections with shared, permissive lanes should be studied in detail to quantify the blockage characteristics. The intersections studied should cover a range of geometric conditions. Each study should be lengthy enough to cover a range of volume conditions. Each study would observe and quantify the extent of shared-lane blockage by left-turners, and the impact of this on saturation flows, capacity, and delay. The effects of geometry on blockage would also be studied. Relationships/analytic models would be developed to describe the process, and a methodology consistent with the procedures of Chapter 9 of the new Highway Capacity Manual would be developed.

Key Words

Shared Lane, Permissive Phasing, Signalized Intersection, Capacity, Level of Service

Related Work

A verification and evaluation of the technique described in the Canadian Capacity Guide for Signalized Intersections which represents an improvement of the Australian application of turning factors can be used as a starting point.

Urgency/Priority

High

Cost

$125,000

User Community

Implementation

Updated factors to be incorporated in the revised Highway Capacity Manual

Effectiveness

Improved accuracy in signalized intersection capacity analysis

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Adjustment Factors for Saturation Flow Rates at Signalized Intersections

Problem

The ideal saturation flow rate and factors used to adjust it in the signalized intersection chapter of the 1985 Highway Capacity Manual have been taken from a number of different sources. Research is needed to determine the extent to which revisions in the factors are necessary.

Objective

The objective of this research would be to derive valid adjustment factors for the roadway, traffic, and environmental characteristics which affect saturation flow in signalized intersection operation.

Key Words

Such characteristics include lane widths, heavy vehicles, vertical grades, curb parking, local bus stop activity, area type, arterial classification, through lane utilization, turn lanes, pedestrian conflicts, metropolitan area size, one-way/two-way operation, and progressive traffic signal operation.

Related Work

Some of these adjustment factors were investigated as a part of the NCHRP research which predated the 1985 Highway Capacity Manual. However, the most critical factors (such as protected and permissive turn movement adjustments) were derived from theoretical assumptions. Others, such as metropolitan area size, arterial classification (Chapter 11), and one-way/two-way operation, need study also. Some of the methods described in the Canadian Capacity Guide for Signalized Intersections should be tested in a variety of U.S. conditions. Texas HPR Project 2397 "Effective Truck Operations on Signalized Intersections" is relevant.

Urgency/Priority

High

Cost

$200,000

User Community

The agencies in the user community which should receive this statement include AASHTO and FHWA.

Implementation

Findings which result from this research can be incorporated into revised versions of Chapter 9 of the 1985 HCM to provide more reliable guidance to the user community when conducting signalized intersection capacity analyses.

Effectiveness

The results of this research will promote a more accurate determination of signalized intersection operation and will encourage more cost-effective design decisions related to traffic signal operation and roadway lane allocations.

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Validation of Procedures for Calculating Signalized Intersection Delay

Problem

The 1985 HCM instituted new methods for calculating intersection delay based on extensive research and foreign experience. Application of the method in the U.S. should be studied to determine whether results meet practical needs for accuracy, ease of use, consistency, etc., or whether further refinement or simplification is justified.

Objective

To provide documentation on the newly approved method and a data base for further refinement is needed.

Key Words

Signalized Intersections, Highway Capacity, Delay, Level of Service

Related Work

NCHRP Project 3-28C on signal progression

Urgency/Priority

High - The method is beginning to be applied generally. Needed refinements should come as quickly as possible.

Cost

Unknown

User Community

Primarily urban highway design and operations personnel

Implementation

The Highway Capacity Manual has incorporated a means of systematic upgrading and revision on an annual basis.

Effectiveness

Even small improvements in means to analyze signalized intersection delay can produce large benefits in improved operations and increased intersection capacity.

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Level of Service Criteria for Signalized Intersections at Near-Capacity Conditions

Problem

The 1985 Highway Capacity Manual computation procedure for signalized intersections poses a problem for lane groups which operate near capacity or are overloaded. In particular:

a. For lane groups with short lengths of red (due to short cycle lengths and/or long g/C ratios), the v/c ratios must often exceed 1.0 in order to produce enough delay to qualify for LOS B, C, D, or E. (Ref. 4)

b. No advice is given for overloaded conditions which exist for time periods longer or shorter than 15 minutes, or for situations with an overflow queue at the beginning of the analysis period. (Ref. 2 & 3)

c. Normal methods of counting discharge volumes can result in incorrect delay calculations when arrival volumes exceed capacity.

Objectives

To develop and validate adjustments or modifications for determining delays and levels of service which take into account time variations in overflow conditions. Specifically:

a. Provide guidance on methodology for obtaining arrival volumes. (Ref. 2)

b. Test the overflow delay formula for various congestion situations.

c. Devise techniques and procedures for computing more accurate overflow delay. (Ref. 4)

d. Develop and evaluate alternative criteria for LOS for overloaded or near-capacity conditions.

Key Words

Stopped Delay, Level of Service Overflow Delay

Related Work

Rothenberg (Ref. 1) has emphasized the need for using the duration of congestion (a time variable) in the determination of LOS.

Berry has a series of working papers which address different aspects of this problem of LOS at near-capacity conditions. (Ref. 2, 3, 4)

NCHRP 3-28-C is to gather data for overloaded approaches on a cycle-by-cycle basis for use in determining effects on delay of signal progression. Data from that research project should be useful in validating some of the alternatives set forth in the objective.

Cost

$100,000

Urgency/Priority

High

User Community

Users in areas where there is congestion now or expected in the future (when v/c ratios approach or exceed 1.0, and some approaches have congestion for more than 15 minutes).

References

1. Rothenberg, M.J., "Urban Congestion in the United States: What Does the Future Hold?," ITE Journal, July 1985.

2. Berry, D.S., "Volume Counting for Computing Delay at Signals," accepted by ITE Journal, April 1986.

3. Berry, D.S., "Duration of Overflow Delay at Signals," Working Paper, July 1986.

4. Berry, D.S., "Using v/c to Supplement Delay as Criteria for LOS at Signals," submitted to TRB Committee on Highway Capacity, May 18, 1986.

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Using Chapter 9 for Actuated Signals

Problem

The procedures outlined in Chapter 9 are based on the assumption that the signals operate in a fixed time cycle, i.e., green time, cycle time are considered constant. Moreover, no method is provided to determine the important timing parameters related to actuated signals such as minimum green and unit extensions.

Objectives

Determining cycle length and values of green given specific dial settings on controllers, location of detectors, etc.

Determining the extent to which overflow delay is reduced by variable green intervals.

Validation of delay calculations.

Key Words

Actuated Signals, Delay Computation

Relative Work

Relevant research is virtually non-existent

Urgency/Priority

Moderately high

Cost

$100,000

User Community

Users of the manual

Implementation

Add to manual

Effectiveness

Improved accuracy

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Capacity of Double Left Turn Lanes

Problem

Among other factors, e.g., increasing the length of the left turn lane, providing an exclusive left turn phase, and increasing the cycle length, it is sometimes necessary to use a double left turn lane to accommodate the demand. The draft report of Chapter 9 - Signalized Intersections suggests an adjustment factor of 0.90 be used, but no further discussion is given concerning the effects of intersection angle of skew or grade, which empirically appears to affect the capacity of double left turn lanes.

Objective

To develop an empirical basis for determining the capacity of double left turn lanes which consider the major factors that affect the capacity of this special intersection treatment.

Key Words

Intersection Angle, Approach Grade

Related Work

The use of double left turn lanes is mentioned in Chapter 9 - Signalized Intersections, however, there is no indication that the adjustment factor is refined to account for differences in the angle of intersection, approach grade, or other factors. Research has been conducted in Texas in various size communities at approaches with dual left turn lanes. The study results presented the framework for design of a more extensive nationwide study.

Urgency/Priority

Medium - While important in some urban areas, the use of double left turn lanes is not likely to be a major need to the majority of highway agencies. The research is important and perhaps should be considered for the HPR program.

Cost

The estimated cost is $75,000 including travel and time period is 18 months.

User Community

AASHTO and FHWA

Implementation

The findings would best be implemented through a revision in Chapter 9 of the Highway Capacity Manual. Initial findings should be presented in a TRB record.

Effectiveness

The overall societal impacts of the research may be small because double left turn lanes are not used in every community. In large urban centers, however, the associated operational benefits can be significant. Suggested measures of effectiveness include left turn volume, average delay per left turn vehicle, and number of intersection assidents.

RESEARCH PROBLEM STATEMENT

SIGNALIZED INTERSECTIONS

Title

Right Turn on Red After Stop at Signalized Intersections - Geometrics vs. Capacity

Problem

The number of vehicles that can make a right turn on a red signal indication depends upon (1) the geometrics of the curb; (2) sight distances and angle; (3) use of the right lane by through and right turning vehicles; (4) gap availability in the stream of traffic on the intersecting street; (5) operating speed on the intersecting street; and (6) gap acceptability of the right turning driver. The interrelation of these factors is unknown.

Objective

To obtain and analyze data on the operation of the right turn maneuver on red after a stop. Analysis should consider the full extent of possible conditions ranging from streets with and without parking, minimum and desirable curb returns, and large radius returns with and without islands.

Key Words

Gap Acceptability, RTOR, Channelization

Related Work

Unknown

Urgency/Priority

High

Cost

$50,000 - $75,000

User Community

Transportation Design Engineers, Capacity Analysts

Implementation

Inclusion in revised Highway Capacity Manual

Effectiveness

Improve realistic evaluation of signalized intersection capacity.

RESEARCH PROBLEM STATEMENT

UNSIGNALIZED INTERSECTIONS

Title

Capacity Analysis Methods for Cross-Street Stop and Yield Controlled Intersections

Problem

Chapter 10 of the 1985 Highway Capacity Manual describes a procedure for estimating capacity and level of service at an unsignalized intersection. The current method uses "reserve capacity," an analytically-defined variable that is not easily field-verified. This method has not been extensively validated or calibrated for U.S. conditions, nor does it estimate delay in quantitative terms. Other analysis methods for unsignalized intersections exist in the Swedish and Australian Highway Capacity Manuals. The German method upon which the 1985 HCM was originally based is also being revised. This research should evaluate the procedures, adjustment factors and measure of effectiveness for determining unsignalized intersection capacity.

Objective

The research would examine analysis methods, conduct limited validation studies, recommend a revised method, and calibrate the method. Specific tasks could include:

1. Compare and analyze the analytic basis for the methodologies in the Australian, Swedish and revised German methods.

2. Conduct field studies to validate the procedures. Data should be collected to include lane volumes and delays, gaps and gap acceptance, influence of metropolitan area size, impact of platooning due to the proximity of adjacent signalized intersections, and interruptions of main street flow. The data should be collected and reduced in such a way as to allow its further use in the calibration of revised procedures in later tasks.

3. Based on the results of tasks 1 and 2 above, recommend a method for a revised procedure. The method should contain a relationship between level of service and one or more operating characteristics of an unsignalized intersection that can be used in either an analytic or field investigation. If possible, the results obtained from this revised procedure should be compatible with the signalized intersection level of service and should also provide an overall intersection LOS.

4. Prepare a replacement for Chapter 10 of the new HCM.

Key Words

Cross-Street Stop Intersection Capacity, Stop Sign Control

Related Work

Gap acceptance data collected at three intersections in Illinois was reported in a 1983 graduate thesis at Northwestern University. No recent research regarding gap acceptance under heavy traffic demand or platooned flow conditions has been conducted. Relatively little other effort has been expended in the United States to validate the present methods or to consider alternative methods for evaluation of unsignalized intersections. Relevant research is being carried out at University of Bochum, Germany by W. Brilon.

Urgency/Priority

The resolution of these problems is a critical link in gaining the traffic engineering community's general acceptance and use of the unsignalized intersection analysis procedures. The importance of this work is further amplified by the substantial amount of interest that has been expressed in this topic by the current users of the Highway Capacity Manual, and by the large number of unsignalized intersections that exist and must be evaluated in order to adequately gauge the effects of operational and safety improvement project, new development proposals, etc. For these reasons, the urgency/priority of the proposed research is considered to be high.

Cost

$300,000

User Community

AASHTO, FHWA, NCHRP, ITE

Implementation

The findings of this research would most likely be used as the basis for a major revision to the level of service procedures described in Chapter 10 of the 1985 Highway Capacity Manual.

Effectiveness

The results of this research will play a major role in helping communities and developers to adequately assess the need for and effectiveness of various roadway operating and safety improvement projects. It is especially timely in light of the current level of interest in developing and implementing alternative access management techniques on arterials and other major regional transportation facilities.

RESEARCH PROBLEM STATEMENT

UNSIGNALIZED INTERSECTIONS

Title

Capacity and Levels of Service for All-Way Stop Sign Controlled Intersections

Problem

Chapter 10 of the 1985 Highway Capacity Manual contains a general discussion of all-way stop sign capacity. The capacity values shown are primarily taken from limited research conducted in the early 1960s. The manual does not currently provide a specific procedure for determining the capacity of all-way stop sign controlled intersections. This is considered to be a significant shortcoming of the HCM since intersections controlled by traffic signals or cross-street stop signs have specific procedures in the manual.

Objectives

The objective of this research would be to collect a statistically reliable amount of volume, queueing and delay data under various physical and operating conditions for both three-legged and four-legged all- way stop sign controlled intersections; recommend a method for calculating all-way stop sign capacity and levels of service on individual approaches, and to calibrate the method.

Key Words

All-Way Stop Intersection Capacity
Stop Sign Control

Related Work

No recent research in this area has been conducted in the United States that has been reported in the literature.

Urgency/Priority

All-way stop controlled intersections are prevalent in many parts of the country. The need to provide a valid technique for the user community is significant. The priority is high.

Cost

$100,000

User Community

AASHTO, NCHRP, FHWA, etc.

Effectiveness

Implementation

The findings of this study should be incorporated into revised versions of Chapter 10 of the 1985 HCM.

The results of this research will provide a consistent method for determining all-way stop sign intersection capacity.

RESEARCH PROBLEM STATEMENT

UNSIGNALIZED INTERSECTIONS

Title

Evaluation of the Relationship Between Levels of Service Computed for Unsignalized Intersections and Traffic Signal Warrants

Problem

When the unsignalized intersection procedures contained in Chapter 10 of the 1985 Highway Capacity Manual predict an unacceptable level of service (e.g., E or F) on one or more minor street approaches, the analyst is often interested in identifying appropriate mitigation measures. Possible mitigation measures may range from intersection channelization and turn prohibitions to the installation of a new traffic signal. Unfortunately, no formal guidance is currently available to the analyst for direction toward an effective and appropriate solution.

With respect to the installation of new traffic signals, the analyst may apply current MUTCD warrants for installing a new traffic signal, but there is no assurance that these analysis results will be consistent with the direction provided by the current Chapter 10 methodology. Therefore, there is an unfulfilled need for the Chapter 10 procedures to provide the analyst with a reasonable indication of the need for a traffic signal that is consistent with other existing techniques for evaluatingthe need for a new traffic signal.

Objective

To provide a set of guidelines for determining the relationship between the HCM unsignalized LOS procedures and the MUTCD. Specifically, if the HCM produces a low level of service and the MUTCD warrants do not justify a signal, what other control alternatives are possible at the intersection? Factors that should be considered during the research are aggregate intersection delay weighted by volume (for the design hour and on a daily basis), impact of additional turning lanes, and relative time-cost versus signal installation costs.

Key Words

Stop and Yield Signs

Traffic Signal Warrants

Related Work

Significant effort has been expended in preparing and certifying the MUTCD. Therefore, the results of this research should be as consistent as possible with the MUTCD warrants.

Urgency/Priority

The urgency of this effort relates to the credibility of the results of the HCM procedures. If the procedures produce results that are not consistent with the MCTCD, then they will not be as useful a tool for practicing traffic engineers and transportation planners.

Cost

$75,000

User Community

FHWA, AASHTO, ITE

Implementation

The results could be included as an appendix to Chapter 10 of the HCM.

Effectiveness

By further clarifying the procedures for determining the need for additional signals and promoting a safe and efficient street system the research should have high priority.

RESEARCH PROBLEM STATEMENT

UNSIGNALIZED INTERSECTIONS

Title

Development of Design and Planning Methodologies for Unsignalized Intersections

Problem

Chapter 10, Unsignalized Intersections, does not address a methodology for analysis of either design or planning situations. The procedures in the manual are an operational technique with known lane configurations and traffic volumes. Procedures are required for design analysis to permit the determination of either lane configurations or acceptable traffic volumes given the other criteria and the required level of service (LOS). Also, procedures are required for planning analysis, which traditionally project traffic volumes and roadway conditions for a twenty year time frame. Therefore, analysis procedures are required for design, and simplified analysis procedures are required for planning. The incorporation of these two procedures would make Chapter 10 consistent with the format of the other chapters in the Highway Capacity Manual (HCM).

Objectives

The objective of this research is to develop procedures for design and planning analysis consistent with the data and operational procedures presently contained in the HCM. The proposed procedures for design analysis should account for all factors included in the operational analysis section. The proposed planning analysis procedures should be a simplification of the operational analysis procedures.

This developmental research will require considerable computational validation. If field collection of data is required due to the lack of sufficient available

data, the field work should be limited. Collection of field data may not be required because the design analysis is the reverse of the operational analysis; therefore, one analysis can be used to check the other analysis. The planning analysis procedures should produce results reasonably close to the operational analysis results, but must require considerably less time and effort. To accomplish this, specific factors of the operational analysis must be averaged or approximated. The work will be summarized in a manner suitable for insertion into the Highway Capacity Manual, Chapter 10.

Key Words

Chapter 10, Highway Capacity Manual

Related Work

none

Priority

The priority of this research is between high and middle. The work is required to complete the analysis procedures of the HCM chapter.

Cost

$25,000

User Community

ITE, Traffic Engineers, Planners

Implementation

The implementation of this work will be included as part of Chapter 10 of the HCM.

Effectiveness

This research will permit engineers to use Chapter 10 to design unsignalized intersections, and provide planners with a reliable tool for analysis of future conditions.

RESEARCH PROBLEM STATEMENT

ARTERIAL

Title

Arterial Class and Free Flow Speed: The Relationship to Arterial Parameters

Problem

The 1985 HCM has an arterial methodology in Chapter 11, which depends heavily upon the identification of arterial class by means of the free flow speed. The free flow speed is clearly a proxy for a number of factors, including parking activity, number of driveways, land use, side frictions, certain geometrics (e.g. divided facility or not) and possibly regional differences in driver behavior. It would be preferred that some of these proxies appear explicitly, or at least that the identification of free flow speed be made more precise.

Objectives

The objective of the proposed activity would be to develop a more specific set of rules for classifying arterials, rules which depend upon at least some of the cited factors. The work could be broadened to consider other factors.

Key Words

Arterial Class, Arterial Level of Service, Free Flow Speed.

Related Work

The original work which contributed to the present chapter exists. In addition, ongoing work related to evaluating the effects of quality of signal progression on delay is likely to provide relevant data and results.

Urgency/Priority

This research deals with a significant shortcoming of the current arterial analyses procedures described in Chapter 11 of the 1985 Highway Capacity Manual, which in turn has a direct influence on the overall validity and value of these procedures. Therefore, the priority for this research work is high.

Cost

$200,000

User Community

Users of the Highway Capacity Manual, and professionals concerned with traffic operations.

Implementation

This material will contribute to future enhancements of the Highway Capacity Manual.

Effectiveness

The results of this research will enhance the value of the Chapter 11 analytic procedures, and will advance the state of the art with respect to understanding arterial operating characteristics.

RESEARCH PROBLEM STATEMENT

ARTERIAL

Title

Level of Service of Roadways with Continuous Two-way Left-turn Median Lanes

Problem

Continuous, two-way left-turn lanes have been widely used on urban and suburban roadways during the past 30 years to reduce accidents and to accommodate land access needs. In determining the adequacy of this design for site-specific conditions, it is desirable to estimate the LOS of the proposed treatment. No specific procedures exist for determining the LOS of roadways with two-way left-turn median lanes.

Objectives

To develop a procedure for determining the LOS of three, five, and seven lane roadways where the center lane is used for two-way left-turn maneuvers. Regional differences in driver behavior may also be a significant factor to consider. Other factors to consider are roadway traffic volumes, the density of driveways served by the left turn lanes, the actual left turning volumes and signal spacing.

Key Words

Arterials median treatments.

Related Work

Transportation Research Circular 281, pg. 7-19 and Circular 284, pg. 8-20 mentions the use of two-way left-turn lanes, but does not provide a method for determining LOS. Report No. FHWA/RD - 85/028 and NCHRP Report 282 considered the effectiveness of two-way left-turn lanes but not in the depth required for inclusion in the HCM.

Urgency/Priority

As the use of two-way left-turn lane treatments is increasing, this research should be undertaken within the near term. Urgency/Priority for this research is moderate.

Cost

Estimated cost is $200,000 and a 24-month research period.

User Community

AASHTO, FHWA and local agencies

Implementation

Implementation should include revising the 1985 capacity manual and the course materials offered by the Traffic Institute and others. Publication of the results in a TRB Record would be desirable.

Effectiveness

By aiding in the decision to select a median treatment which reduces accidents and delay, direct long-term societal impacts can be expected. Measures of effectiveness include average delay per vehicle for left-turn and through vehicles, number of accidents per mile, and changes in left turn demand at adjacent intersections.

RESEARCH PROBLEM STATEMENT

ARTERIAL

Title

Effects of Volume on Running Times for Urban Signalized Arterials

Problem

Chapter 11 of the 1985 Highway Capacity Manual currently does not provide any adjustment factors for the effects of volume on running time between signals. All other chapters in the manual dealing with uninterrupted flow provide for lower speeds (and longer travel times) as volume increases. The possible need for adjustment factors as suggested in the PRC Voorhees draft report should be explored, particularly for longer-length arterial segments where midblock running time adjustments can have a significant effect on average travel speed.

Objectives

The objective of this research would be to use the same arterial test sections that are selected for the ongoing research entitled, "Effects of Quality of Signal Progression on Delay," and to measure travel times and delays between signalized intersections for different traffic volume conditions. Data would be gathered for arterial segments of different lengths and for different classes of urban and suburban arterial.

Key Words

Arterial Class, Arterial Level of Service, Running Time, Volume

Related Work

Related and recent work in this area include the project conducted by PRC Voorhees entilted "Quality of Flow in Urban Arterials," the ongoing research entitled, "Effects of Quality of Signal Progression on Delay," and the current

NCHRP work on multilane highways. This research would build upon the results and data bases developed under each of these earlier projects.

Urgency/Priority

Because of the efficiencies that could be obtained through coordination of this work with the ongoing research on quality of regional progression, the research should be undertaken within the near future and so urgency/priority is high.

Cost

Estimated cost is $100,000, and the project length is estimated to be 18 months.

User Community

AASHTO, FHWA, NCHRP, ITE and local agencies.

Implementation

The results of this research should be incorporated into the 1985 Highway Capacity Manual as a revised version of Chapter 11.

Effectiveness

The results of this research will enhance the value and validity of the Chapter 11 analytic procedures, and will advance the state of the art with respect to understanding arterial operating characteristics.

RESEARCH PROBLEM STATEMENT

ARTERIAL

Title

Effect of Arterial Weaving on Arterial Level of Service

Problem

The 1985 HCM addresses weaving sections, and arterial quality of flow, but it does not address the special problems induced on an arterial by ramps and closely spaced intersections which, by their nature and proximity, cause intense lane changing across the arterial in relatively short distances. The problem is often exacerbated by additional signalized intersections located between the major origin and destination points.

Examples of such configurations occur at airports, near major developments, and along arterials crossing freeways.

Objective

The objective would be to develop a logical and/or analytic method of treating this situation, develop a plan for compiling an appropriate data base, and calibrate and validate a procedure. The procedure would be sensitive to

configuration, distance, volumes, and intermediate signals. The measures of effectiveness to be considered include average travel speed(s).

Key Words

Arterial Weaving, Signals and Weaving, Surface and Weaving, Surface Street Weaving, Ramp to Freeway Interface.

Related Work

HCM Chapters 4, 11.

Urgency/Priority

High

Cost

$250,000

User Community

User of the Highway Capacity Manual, and professionals concerned with traffic operations.

Implementation

This material will contribute to future enhancements of the Highway Capacity Manual.

Effectiveness

The result of this research will be to improve arterial operations and design procedures and to address an important facet of arterial operation that is currently ignored by the 1985 Highway Capacity Manual.

RESEARCH PROBLEM STATEMENT

PEDESTRIANS/BICYCLES

Title

Bicycles at Signalized Intersections

Problem

The question that arises at the signalized intersection, with the increased number of conflicts produced by presence of bicycles, is how many motor vehicles can be accommodated. The accommodation of the bicycles may not be the problem since their service rate at a signalized intersection is high enough to accommodate very heavy demands.

Objectives

The objective is to analyze the effects of bicycle traffic within or outside separate lanes, upon the capacity of a signalized intersection to serve motor vehicle traffic. When bicycle lanes are placed on a street, the "bicycle keep right" rule is strongly encouraged. The bicycle traffic is thus separated from the motorized traffic. Under these conditions, capacity of the motor vehicle lanes(s) may be severely restricted. The degree of this restriction must be determined as it is affected by:

1. Motor vehicle lane configuration to include number of lanes, width, and turning designations;
2. Proportion of motor vehicles turning left, right, and proceeding straight;
3. Proportion of bicycles turning left, right and proceeding straight;
4. The signal settings or operation strategy; and
5. The presence of absence of a separate lane for bicycles.

Field observations, computer simulation, or a combination of the two approaches may be appropriate for the research.

Key Words

Capacity, level of Services, Bicycles, Intersections

Related Work

None

Urgency/Priority

High (no past work in U.S.A.)

Cost

$95,000

User Community

Cities, counties, state transportation departments, Federal Highway Administration, and consultants.

Implementation

1985 Highway Capacity Manual update of bicycle chapter and example in signalized intersection chapter.

Effectiveness

There is currently no method to include bicycle traffic in signalized intersection capacity-LOS determination. Bicycles do affect operation, especially near schools and colleges.

RESEARCH PROBLEM STATEMENT

PEDESTRIAN/BICYCLES

Title

Analysis of the Effect of Bicycle Use on Highway Capacity

Problem

In order to effectively utilize the bicycle as a method of transportation, the bicycle must be considered as one aspect of the total highway system. The increase in bicycles on the roads will affect highway congestion, and therefore, bicycles should be one factor considered in the future analysis of the highway capacity.

This will encourage the acceptance of bicycles by highway engineers and city planners as plans can then be rationally modified or developed to include the bicycle as an integral part of the transportation system; presently the bicycle is often seen as a problem-causer or nuisance. One factor that may add to congestion is the delay of motorists that an increased number of bicycles on the highway may cause. Furthermore, this is often a reason cited by other road users and by highway administrations to oppose cycling transportation.

Objectives

The objective of this study is to analyze motor vehicle-bicycle interaction and to qualify its effect on highway capacity. The study should include evaluations of midblock effects, intersectional effects, and interactions occuring on road-ways with varying widths, traffic volumes, terrain, and speeds. The study could be approached through observational data, including direct observation, and the use of photographs.

Key Words

Bicycles, Level of Service, Highway Capacity.

Related Work

None

Urgency/Priority

Medium

Cost

$100,000, depending upon scope.

User Community

Consultants, State Highway Departments, Federal Highway Administration.

Implementation

Procedures will be added to bicycle chapter of 1985 HCM

Effectiveness

N/A

RESEARCH PROBLEM STATEMENT

PEDESTRIANS/BICYCLES

Title

Pedestrian Volume/Density/Level of Service Relationships Problem

The relationship among level of service flow rate (volume) and space (inverse of density) specified in Chapter 13 (Pedestrians) of the 1985 Highway Capacity Manual appears to have been developed based on observations primarily made at very congested locations in New York City.

Objectives

There is a need to relate levels of service with more typical pedestrian volumes and densities which occur in representative mid-size and other large-size communities. This will provide community planners and engineers with a way to measure quality of pedestrian flow in a manner more consistent with quality of vehicular flow.

Key Words

Crosswalk Capacity, Sidewalk Capacity.

Related Work

No known surveys of pedestrian flows and levels of service are currently being conducted outside the major northeastern cities.

Urgency/Priority

High - Until walking speeds and the subjective measures for levels of service can be related to geographical area and community size, use of the 1985 HCM technique will not receive the widespread acceptance appropriate for this urban planning tool.

Cost

$100,000

User Community

The agencies in the user community which should receive this statement include AASHTO and FHWA.

Implementation

Findings which result from this research can be incorporated into revised versions of Chapter 13 of the 1985 HCM to provide more reliable guidance to the user community conducting sidewalk or crosswalk capacity analyses.

Effectiveness

The results of this research will ensure the more effective use of sidewalk space in urban environments.