URBAN HIGHWAY ROUTE EVALUATION

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SYNOPSIS

The 1949 Washington Legislature, acting upon a recommendation of an Automotive Safety Foundation's state-wide transportation survey, gave the Department of Highways responsibility for construction and maintenance of highway-routes through cities. This paper presents a survey technique subsequently developed by the Traffic Engineering Division to analyze city-traffic problems by evaluating the adequacy or deficiency of urban-highway routes.

The evaluation process is centered around a practical application of research data contained in the *Highway Capacity Manual*. The survey procedure considered vehicle speeds, accidents, and anticipated thirtieth-highest-hour volumes of equal importance with capacity in rating traffic-carrying characteristics of a city street.

The Urban-Highway-Capacity Survey seeks to isolate the origin and causes of the traffic problem. It explores relatively inexpensive ways in which relief can be attained for the next 10- or 15-year period by the efficient use of existing street facilities. The proposals and recommendations of the survey report are intended only as temporary expedients for an interim period, while more permanent facilities are planned, financed, and constructed for the long-range solution to the local traffic problem.

Route evaluation procedure is not an exact science and must be kept flexible in its application. The results obtained, however, have proven to be a sound basis by which city councils can alleviate their local problems through the planning of traffic-improvement programs, and the factual data has assisted the Department of Highways in its municipal obligations by establishing priority in the programming of urban projects for improvement.

● THE STATE of Washington has experienced, during the past decade, a 37 percent growth in population, a 60 percent increase in motor vehicle registration, and an 80 percent greater use of the automobile as a means of transportation. The 1947 session of the state legislature was cognizant of this development and realized the need for a review of highway, road, and street requirements in Washington.

A joint fact-finding committee was created and directed to provide facts on automotive transportation needs to the 1949 session. The committee engaged a staff of highway engineering consultants from the Automotive Safety Foundation to conduct a statewide transportation study. The subsequent report, entitled "Highways in Washington's Future", presented the findings and recommendations of the A.S.F. Engineers.

The 1949 session of the legislature, acting upon the recommendations of the Automotive Safety Foundation's report, transferred from municipalities to the state certain responsibilities for the construction and maintenance of some 423 miles of state highway routes in urban areas.

NEED FOR URBAN-HIGHWAY-ROUTE EVALUATION

The routes of the state highways in the majority of the cities in Washington are directed over the principal arterial streets. The urban-highway route in the smaller towns, in many instances, is the only major traffic arterial. Relative to the other local streets, therefore, the traffic on the highway routes is heavy in both weight and volume, and generally constitutes the major traffic problem in the community.

The new legislation specifically obligated the Department of Highways to install, operate and maintain all traffic signals, signs, and control devices on the state system in cities below 15,000 in population, and to approve the installation and operation of such devices on urban highway routes in cities above that population class. Immediate municipal requests for traffic-control devices led to traffic engineering investigations by the Department of Highways.

The State Traffic Engineering Division thereby became involved in what generally proved to be the major traffic problems in Washington cities by attacking the difficulties

occurring on highway routes through the urban areas. A hasty investigation into the sources of urban-traffic information revealed an astounding lack of even basic volume data. Few municipalities had trained traffic-engineering staffs, and in the majority of the cities there was little uniformity in the application and operation of traffic-control devices. The existence of a definite need for an evaluation of the traffic-carrying capabilities of the urban extensions of the state highway system was realized immediately.

A special technical staff was established by the traffic engineer to devote full time to the solution of traffic problems on the urban highway routes. This staff was given the authority and responsibility to engage in the three functions: (1) the collection and assembly of information concerning the characteristics and patterns of motor vehicle operation in Washington cities, (2) The review or design of the installation and operation of urban traffic control devices in conformance with adopted uniform standards and established departmental policies, and (3) The development and employment of a traffic engineering procedure designed to measure the extent of the operational adequacy or deficiency of urban highway routes.

BASIC REQUIREMENTS FOR EVALUATION PROCEDURE

The State of Washington had started a program in 1946 of conducting origin-and-destination surveys of traffic in all cities over 5,000 population. These surveys are used to determine the long-range planning of state highway systems in the most important urban areas. Meanwhile, until facilities can be planned, financed, and constructed, there continually arises or exists certain deficiencies in the urban highway system which must be alleviated during the interim.

A procedure for the evaluation of a state highway route through an urban area should provide three types of basic information: first, the extent of the route deficiency under the conditions of existing operation; second, the possible methods by which the streets along the route of the urban highway may be more safely and economically used for automotive transportation; and third, the establishment of a definite time limit to show when normal traffic growth will exceed the best possible use of the street and a new or paralleling traffic facility will definitely be required.

The development of an evaluation process to achieve the desired results was centered around a practical application of research data contained in the *Highway Capacity Manual*,[1] prepared by a Highway Research Board committee. The evolving of a survey procedure considered that vehicle speeds, accidents, and anticipated thirtieth-highest-hour volumes are three factors of equal importance with street capacity in the rating of the traffic-carrying characteristics of an urban arterial. The combining of traffic-engineering studies of these four components of motor-vehicle operation ultimately developed into the Urban Highway Capacity Survey, as employed in Washington.

VOLUME STUDY

The primary objective of a motor-vehicular volume study is to determine the amount of peak-hour traffic for which the urban-highway route must be designed to carry. The thirtieth-highest hour is used as a practical criterion of needed capacity. Adequate records of the highest hours of traffic occurring over a period of one year, however, are seldom available in most urban areas of Washington. To offset this lack of information, mechanical-counter stations are located at strategic locations along the urban-highway routes to record as many of the peak hours of traffic occurring in the spring and summer months as can be attained. These highest-hour volumes are then plotted in numerical order and a "design hour," approximating the thirtieth-highest hour, is selected where the slope of the curve starts to change rapidly upward.

Once the design-hour volume has been established at the master-count stations, it is then obtained for all major intersections along the route by short peak-hour counts adjusted to the control-station patterns. The projection of the design-hour volume for 10 to 20 yr. into the future is based upon the natural trend of local motor-vehicle registration with adjustments being made for the normal increased rate of motor-vehicle use and anticipated area development.

[1] Prepared by the Committee on Highway Capacity, Department of Traffic and Operations, Highway Research Board. Available U. S Government Printing Office, Washington 25, D. C., 65 cents

ACCIDENT STUDY

Motor-vehicle accidents are symptoms of operational deficiency; therefore, the analysis of traffic-accident reports is considered to be one of the fundamental parts of the evaluation process. Accident diagrams are utilized to isolate high-accident-frequency locations for study and special treatment. Mileage and fatality-accident rates are employed to appraise the physical and economic loss due to motor-vehicle accidents on the route and to relate the severity of the local situation to average statewide statistics.

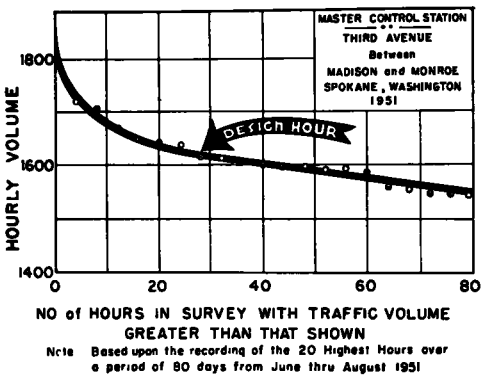

Figure 1. Selection of design-hour volume.

SPEED-AND-DELAY STUDY

Over-all peak-hour-traffic speeds which fall below a minimum urban optimum of from 15 to 20 mph. generally result in traffic volumes lower than the possible capacity, higher traffic densities, and a greater number of traffic accidents. The measurement of the over-all speed is, therefore, an important factor in the evaluation of an urban-highway route. This is achieved by "spot" and "cruising-car" speed checks to determine the operating speed and the location, type, and amount of operational delay in both the peak-hour and off-peak-hour traffic stream.

INTERSECTION-APPROACH CAPACITY STUDY

The signalized intersection has proven to be the most restrictive location along the route of the urban highway. The capacity of the least-efficient intersection determines to a great extent the amount of traffic an urban-highway route can carry. Capacity is, therefore, a major consideration in the evaluation process.

Intersection-approach capacities are calculated by the use of the research data contained in the *Highway Capacity Manual*. This is achieved with the aid of classification and turning-movement data obtained by the motor-vehicular volume study, and by a street inventory of: the geometrics of the intersection design, operation of traffic-control devices, extent of curb-parking restrictions, and the characteristics of bus-loading operations.

Prior to the direct application of the "Average Reported Intersection Capacity Curves,"

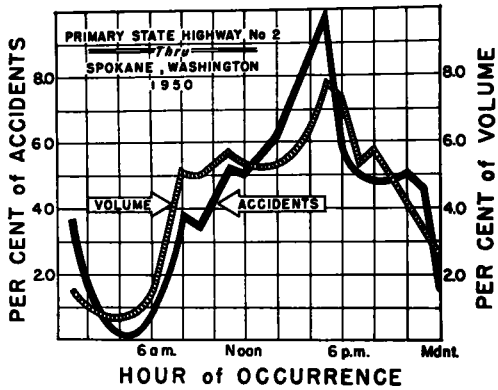

Figure 2. Relation between hourly traffic volume and time-of-accident occurrence.

contained in the manual, spot checks are made in each of the designated types of areas to observe traffic operating under defined "practical" or "possible" capacity conditions. Appreciable differences between the "calculated" and "observed" capacities leads to either a change in area classification, or an "area factor" being applied to the "curve" values.

URBAN-HIGHWAY ROUTE EVALUATION

The urban-highway-capacity survey is seldom applied in the same manner twice, inasmuch as it must be kept flexible to effectively cope with the varying nature of the traffic problems found in the different urban areas. For this reason, no definite evaluation procedure has been evolved whereby the relative efficiency of an urban-highway route could be judged by a percentage of indices such as 10 or 100. Rather the pertinent facts of the several studies are arrayed in analytical graphical form. Then it becomes a matter of interpreting

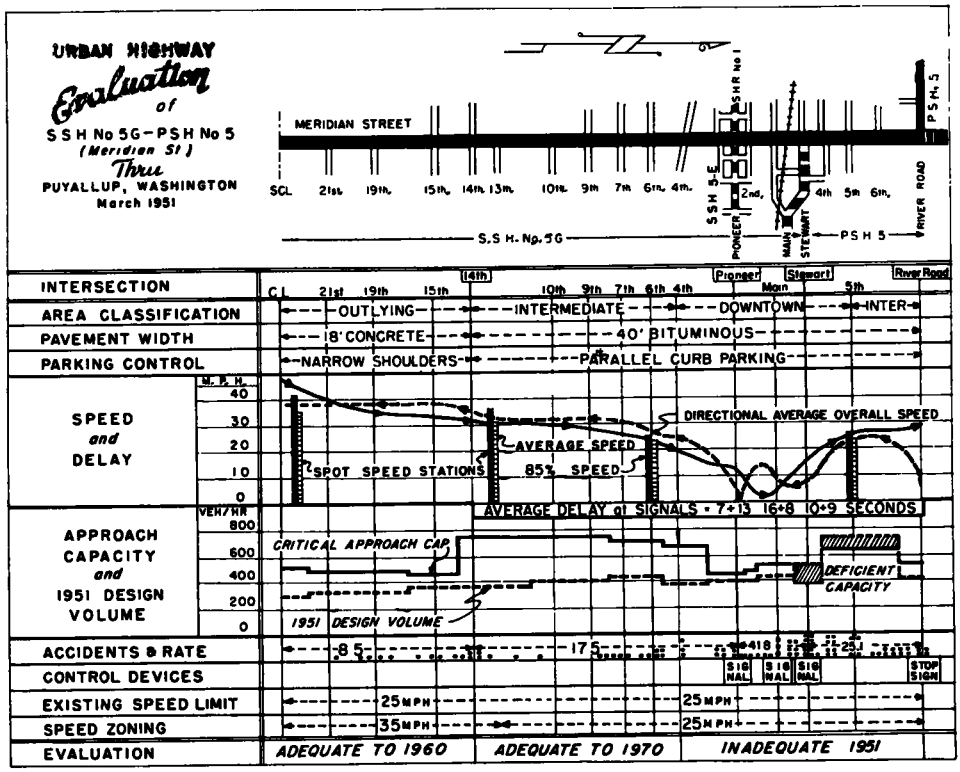

Figure 3. Urban-highway-route evaluation.

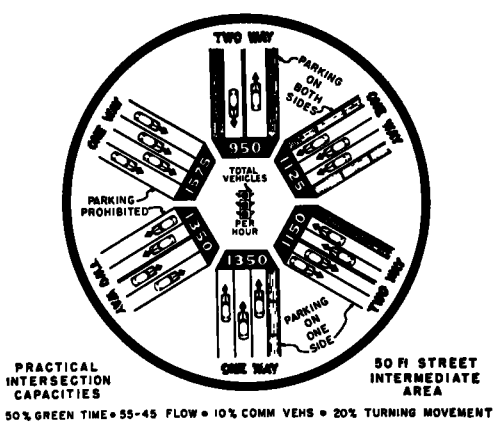

Figure 4. The capacity of a street depends upon its use.

Third Avenue – Spokane

DIRECTION of FLOW	PARKING	1950	1960	1970
TWO-WAY	*Both Sides*	–	–	–
ONE-WAY	*Both Sides*	+	–	–
TWO-WAY	*One Side*	+	–	–
ONE-WAY	*One Side*	+	+	–
TWO-WAY	*Prohibited*	+	+	–
ONE-WAY	*Prohibited*	+	+	+
+ Capacity Excess – Capacity Deficiency				

Figure 5. Useful time limit of various inexpensive solutions.

the facts and relying upon intelligent judgement to arrive at sound conclusions.

Past experience with this type of evaluation procedure has, however, developed one rule of thumb which has proven consistently true: Serious urban highway inadequacy can be considered to exist where there simultaneously occurs a high accident rate, a low over-all speed, and a calculated capacity deficiency.

APPLICATIONS OF EVALUATION

The urban-highway-capacity survey, in its evaluation process, seeks to isolate for inspection and understanding the origin and causes of the traffic problem. Then it explores relatively inexpensive ways in which relief can be

attained for the next 10- or 15-yr. period by the efficient use of the existing street facilities.

Recommendations based upon the conclusions of the evaluation of the urban-highway routes have been accepted by municipal governments as an action program which will, directly and indirectly, provide immediate reliefs to the transportation network deficiencies. Such progressive action has been taken by Washington cities as restriction of curb parking, prohibition of left and U-turns, revision of the arterial-street network, inauguration of one-way-street systems, application of the principles of speed zoning, provision of effective lane width, installation of pedestrian-protection devices less restrictive to vehicular movement than traffic signals, and the establishment and improvement of bypass routes. Other effective administrative steps taken by local officials towards solution of the traffic problem have been modernization of city traffic ordinances, centralizing all traffic-engineering functions in smaller towns under the office of city engineer, adoption of national sign standards, establishing standard school-safety-patrol practices and planning long-range-improvement programs.

The highway department's share in improving urban-highway-route deficiencies found by the evaluation process has been achieved by such engineering activities as: the designing and installation of progressive-signal systems, signing of one-way-street systems, the increasing of the capacity of two-way streets by prohibition of turns and revised signal timing where requests for one-way systems were found to be inappropriate, resurfacing of rough roadways, planning of alternate urban-highway routes, and cooperating with municipal officials on development of a master plan for the long-range construction of adequate traffic facilities.

The results of the urban-highway-route evaluation have, therefore, been effectively employed in two ways. First, they have provided a sound basis by which municipal officials can recognize the extent of their traffic problems and take steps to alleviate the conditions by planning traffic-improvement programs. Second, the evaluation process has provided the factual data necessary to assist the Department of Highways to fulfill its obligations in municipalities by establishing priority in the programming of urban projects for improvement.

EVALUATION OF TECHNIQUES FOR DETERMINING OVER-ALL TRAVEL TIME

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SYNOPSIS

AS A CONTINUATION of an earlier investigation (*1*), field tests were made on signalized streets in urban areas to compare techniques of determining over-all travel time through use of test cars. The techniques used in operating the test cars were: (1) The "floating-car" method, in which the driver is instructed to "float" with traffic, and to pass as many cars as pass him; and (2) "Average" test runs, in which the driver is instructed to travel at a speed which, in his opinion, is representative of the speed of all traffic at the time without reference to keeping a balance in the passings.

As an aid in evaluating the two different methods, the actual travel times of vehicles passing both ends of the test section were determined by recording vehicle-license numbers of each vehicle and the times they passed each end of the test section.

The results revealed that both of the test-car driving techniques produced average over-all travel times which were close to the average travel times as obtained through the license-check method. The average-test-run results for multilane streets showed somewhat less dispersion than the results for the floating-car method, indicating that the same reliability of results could be obtained with the average-test-run method through fewer test-car runs than with the floating-car method.