

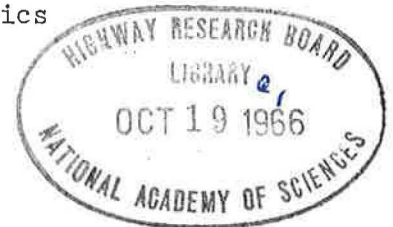
HIGHWAY RESEARCH CIRCULAR

Number 39

Subject Area: Traffic Control and Operations
Highway Design

September 1966

COMMITTEE ACTIVITY
Committee on Operational Effects of Geometrics
Department of Traffic and Operations
Highway Research Board



RESEARCH NEEDS

Research Problem Statements

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INTRODUCTION

The design of any transportation system is directed at improving traffic performance in terms of moving traffic efficiently and safely. Related to highways, the primary characteristics of traffic are concerned with the abilities, requirements, and performance of human beings as road users and highway vehicles. Together, these two components, the man and his vehicle, comprise a discrete traffic unit which, when observed in its environment, provides the foundation on which improvement of operations is founded.

Thus, nearly all aspects of geometric design, as related to traffic operations and safety, require additional study. Presently, however, the Committee proposes that research needed in this field be concentrated in three areas: shoulders, medians, and channelization. The scope of research required in each area as well as research problem statements typifying the work needed are presented.

PROBLEM AREAS

Shoulders

Research in this area should embrace all features of the shoulder problem in relation to the various functions of the shoulder. This includes considerations for the design, materials, construction, maintenance, economics, traffic operations and safety. It should also include the determination of shoulder usage by traffic or parked vehicles and the effectiveness of turnout areas.

Medians

In this area research should include the study of the width and height of highway medians with and without multiple curbs and physical barriers as well as the study of the effect of medians on traffic operations and highway safety.

Channelization

Research in this area should include the study of intersectional channelization and the operating characteristics of each of the several elements comprising the total design of intersections.

Specific problem statements illustrating the type of research needed in each of the above three areas follow.

RESEARCH PROBLEM STATEMENT

Title: Providing a Safe Refuge for Emergency Stops

PROBLEM: To establish the need, the criteria and desirable widths for left shoulders on multilane divided highways, particularly on three-lane directional highways. At present there is a wide variation practiced in left shoulder widths being provided on multilane highways, particularly on six- and eight-lane facilities. Very little reference is available on left shoulders. AASHO's policies on Geometric Design of Rural Highways and on Arterial Highways in Urban Areas offer only limited discussion on the subject.

PROBLEM AREA: Shoulders

OBJECTIVES: Research should be conducted to establish the need for left shoulders as related to the number of lanes. Influencing factors may be traffic volumes, type of facility, percent of commercial vehicles and operational conditions (free flow-weaving). To establish the desirable widths of left shoulders, the effectiveness of existing left shoulders of various widths should be analyzed and evaluated.

RESEARCH PROBLEM STATEMENT

Title: Protection of Physical Elements Adjacent to the Shoulder Area

PROBLEM: For proper operation of the highway, it is necessary to erect physical elements adjacent to the shoulder area such as sign supports, lighting, bridge abutments, and numerous other physical elements. Without proper protection these elements constitute a hazard to traffic which must use the shoulder area or traverse the shoulder area. Several agencies have developed standards for protection regarding a specific roadside element, but there is a need for a consolidated standard on this subject.

PROBLEM AREA: Shoulders.

OBJECTIVES: The objective of the proposed research would be to develop a standard or standards pertaining to proper protection of various types of physical elements. This standard should include the type of protection, its location with respect to the element protected, and, in general, detailed specification as to the proper protection to be provided. Research should include the study of curbing, both mountable and non-mountable, guardrail barriers, and concrete prows.

RESEARCH PROBLEM STATEMENT

Title: Structural Characteristics of Shoulders

- PROBLEM: Very little information is available on design standards or guides for structural characteristics of shoulders. Practice varies among the states, depending on conditions. Some related research has been done but is not directly applied to this problem.
- PROBLEM AREA: Shoulders.
- OBJECTIVES: Research should be conducted to determine the structural requirements of shoulders for the design traffic and to establish the relationship of the function of the shoulder structure to the through pavement structure. Factors such as drainage, safety, maintenance, edge support or protection to the through lane pavement and economy should be considered.

RESEARCH PROBLEM STATEMENT

Title: Shoulder Requirements

- PROBLEM: Shoulder design practices are non-uniform from the standpoint of width, surface type, texture and color, slope and stability. This reflects to some extent the lack of agreement as to basic needs. Thus, in what respect would standardization of shoulder design, based on criteria established for actual needs as against prevailing practice, affect construction, maintenance, highway operations, and highway economy?
- PROBLEM AREA: Shoulders.
- OBJECTIVES: To determine the requirements for shoulders on the Interstate system including ramps and other road systems and to develop facts and make recommendations regarding shoulder design criteria which will result in the lowest annual cost for capital improvement and maintenance and also satisfy the requirements for traffic volumes, traffic operations and safety, axle loads and other recognized design factors.

RESEARCH PROBLEM STATEMENT

Title: Urban Expressway Median Design

- PROBLEM: Median barriers on much of the nation's urban expressways systems are a safety and maintenance problem. For example, narrow medians including light post, pedestrian fencing and guardrail are continually in need of repair to restore the barrier. The vast sums required for urban expressways makes economical use of right-of-way and minimizing of highway maintenance of high priority. There is a need then to determine the best design for medians on urban expressways where right-of-way is costly or otherwise limited.
- PROBLEM AREA: Medians.
- OBJECTIVES: To provide in a minimum width median a barrier that provides safety without reducing capacity. The barrier should require minimum maintenance under both normal conditions and those occurring after being struck by vehicles.

RESEARCH PROBLEM STATEMENT

Title: Intersection Design Efficiency

PROBLEM: There is a need to evaluate the relative efficiency of the various intersection designs so that comparisons can be made of various grade separated intersection designs, channelized intersection designs, and the detailed elements of each. The availability of such comparisons can help the designer in making decisions of good and bad design principles.

PROBLEM AREA: Channelization.

OBJECTIVES: To measure the relative merits of high speed inside loops and slow speed inside loops of a cloverleaf and to make other comparisons such as: inside loop vs. directional ramp vs. diamond type; left turn slots vs. jughandles; channelization vs. traffic circles.

RESEARCH PROBLEM STATEMENT

Title: Effect of Sight Distance on Traffic Operations in the Vicinity of Three-Way Tapp Terminals

PROBLEM: While merging maneuvers at on-ramp terminals with freeways have been studied with respect to design features such as approach angle, length of speed change lanes, etc., little is known about sight distance between ramp and freeway vehicles and its direct effect on the driver's ability to select a gap in main-line traffic. It can be hypothesized, particularly for locations where the design of acceleration lanes is sub-standard, that if the sight distance is unlimited, affording good visual contact between approaching vehicles, the merging maneuver can take place smoothly and safely with a minimum of speed change required. But, if the sight distance is highly restricted, preventing the ramp driver from selecting his gap before he reaches the ramp terminal, he must reduce his speed, stop entirely, or enter the main-line traffic stream without knowing whether or not an adequate gap exists. This could affect the capacity of both the shoulder lane of the freeway and ramp as well as the overall operational flow through the section.

PROBLEM AREA: Channelization (Merging Traffic).

OBJECTIVES: To determine the traffic operational effect of sight distance, especially restricted sight distance, between main-line and on-ramp vehicles upon the merging maneuver, the ramp and shoulder lane capacity, safety, and overall traffic flow. Geometric features such as ramp-main-line intersecting angle, length of acceleration lanes, and grades, in addition to obstructions which affect sight distance, must be considered and evaluated.

RESEARCH PROBLEM STATEMENT

Title: Operation of Interchange

- PROBLEM: The most complicated operational feature of freeway geometry is the interchange. The combination of diverse traffic movements results in the concentration of safety hazards at these locations. Under critical traffic flow the quality of operation at interchanges controls the capacity of the freeway proper. Basic to any geometric layout of interchanges must be the patterns of speeds through these areas: what are the speed patterns under ample design and what effects can result from confining and restricting layouts?
- PROBLEM AREA: Channelization (Interchanges).
- OBJECTIVES: To determine the characteristics of traffic flow through spacious interchanges and compare with similar characteristics where various confining geometrics exist. To arrive at optimum interchange design.

RESEARCH PROBLEM STATEMENT

Title: Operation of Intersections

- PROBLEM: A most important component of the surface street or highway is the cross street intersection. Modern engineering techniques generally require various forms of traffic channelization at these points based upon anticipated traffic movements. Right-of-way is usually most expensive and difficult to assemble at intersections and therefore, there is a need to determine the configurations of channelization which produce optimum operation combined with the minimum use of land.
- PROBLEM AREA: Channelization (Intersections).
- OBJECTIVES: To determine the premises upon which channelized intersections are being designed, to carefully study the operation of traffic flows through these geometrics when constructed, so as to determine whether the basic design premises are being fulfilled, whether the crossing is over-designed (and construction and right-of-way costs are excessive) or, on the other hand, under-designed thus resulting in undue restrictions to traffic flow, speed and capacity restraints and hazards. To arrive at a set of geometric standards to best satisfy various anticipated traffic conditions.

RESEARCH PROBLEM STATEMENT

Title: Operational Effects of Sign Placement

- PROBLEM: Under certain conditions of profile, alignment and roadway environment, drivers shy away from large signs adjacent to the edge of the shoulder on modern high speed freeways, causing friction within the traffic stream and frequent running off the pavement. Although some of the operational effects of roadside signs and sign placement have been examined and several research papers presented, there are insufficient field data available for a thorough analysis of the problem.
- PROBLEM AREA: Clearances for fixed objects.
- OBJECTIVES: To determine the frequency and nature of erratic vehicle movements on the pavement and on roadway areas beside the pavement in the vicinity of roadside and overhead signs; to evaluate these two basically different signing techniques with reference to:
- (1) effectiveness in providing information and instructions to drivers;
 - (2) effects of sign placement in relations to highway profile, alignment and other features of the roadway and driving environment; and
 - (3) sign construction and maintenance costs.

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*As of December 31, 1965