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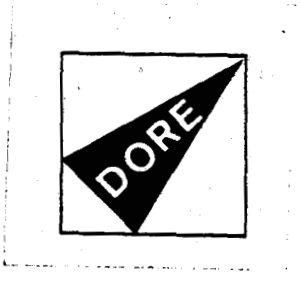
METHODS OF IDENTIFYING HAZARDOUS LOCATIONS



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METHODS OF IDENTIFYING HAZARDOUS LOCATIONS

THE NEW JERSEY DEPARTMENT OF TRANSPORTATION HAS SUCCEEDED IN ACCOMPLISHING THE FIRST MAJOR STEP TOWARD ACCIDENT PREVENTION--THAT BEING A SATISFACTORY METHOD OF ACCIDENT LOCATION. MILEPOST SIGNS ARE INSTALLED ON THE STATE HIGHWAY SYSTEM AND AFFORD AN ACCURATE ACCIDENT LOCATION METHOD. HOWEVER, THIS IS PREDICATED ON THE PREMISE THAT THE AGENCIES REPORTING ACCIDENTS (STATE POLICE, LOCAL POLICE, ETC.) AND THE AGENCY SUPPLYING ACCIDENT DATA TO THE TRANSPORTATION DEPARTMENT (DIVISION OF MOTOR VEHICLES) UTILIZE THE MILEPOST SYSTEM. ASSUMING THEY DO, THE NEXT LOGICAL STEP IS FOR THE TRANSPORTATION DEPARTMENT TO IDENTIFY THE HAZARDOUS LOCATIONS IN ORDER TO TAKE REMEDIAL ACTION.

THERE ARE NUMEROUS METHODS AVAILABLE AND UTILIZED BY OTHER STATES TO ACCOMPLISH THIS. NATURALLY, SOME METHODS ARE BETTER THAN OTHERS. HOWEVER, THE DECISION OF WHICH METHOD IS BEST FOR NEW JERSEY LIES WITH THE DIVISIONS WHOSE RESPONSIBILITY IT IS TO TAKE REMEDIAL ACTION.

IT IS, THEREFORE, THE PURPOSE OF THIS REPORT TO PRESENT SEVERAL OF THE MOST PROMISING METHODS AVAILABLE FOR IDENTIFYING HAZARDOUS LOCATIONS SO THAT THE DIVISIONS WHOSE RESPONSIBILITY IT IS TO TAKE REMEDIAL ACTION WILL HAVE SUFFICIENT INFORMATION TO SELECT THE BEST METHOD FOR NEW JERSEY.

A REPORT PREPARED BY ROY JORGENSEN AND ASSOCIATES AND WESTAT RESEARCH ANALYSTS, INC. FOR THE BUREAU OF PUBLIC ROADS, OFFICE OF HIGHWAY SAFETY, ENTITLED "EVALUATION OF CRITERIA FOR SAFETY IMPROVEMENTS ON THE HIGHWAYS" IS THE SOURCE FOR THE METHODS DISCUSSED IN THIS REPORT. THE JORGENSEN REPORT APPEARS TO BE AN EXCELLENT SUMMARY OF METHODS AVAILABLE AND IN USE BY OTHER AGENCIES RESPONSIBLE FOR HIGHWAY SAFETY.

A. DEFINITIONS AND REQUIRED DATA FOR IDENTIFICATION OF HAZARDOUS LOCATIONS

1. DEFINING HAZARD

HAZARD MAY BE DETERMINED EITHER BY JUDGMENT OR BY MEASURES OF ACCIDENT EXPERIENCE.

JUDGMENTAL DETERMINATIONS ARE THOSE THAT CAN BE MADE BASED UPON VISUAL OBSERVATION OF A SITE AND BY INTUITION. FOR EXAMPLE, AN UNLIGHTED INTERSECTION BY INTUITION IS MORE HAZARDOUS THAN A LIGHTED ONE; OR A STEEP FILL SLOPE MAY BE JUDGED HAZARDOUS BECAUSE A VEHICLE OUT OF CONTROL WOULD BE LIKELY TO TURN OVER.

USING JUDGMENT AND INTUITION HAS DEMONSTRABLE LIMITATIONS. HAZARDS THAT ARE OBVIOUSLY DANGEROUS, BY THEIR VERY NATURE, CREATE AN ATTITUDE OF CAUTION AND RESPECT ON THE PART OF DRIVERS RESULTING RATHER GENERALLY IN A GOOD SAFETY RECORD. FURTHERMORE, UNLESS PREDICTIONS OF

INCREASED SAFETY ARE SUPPORTED BY ACCIDENT DATA THERE IS NO MEASURE OF THE VALUE TO BE OBTAINED FOR A PARTICULAR IMPROVEMENT.

IT IS THEREFORE CONCLUDED THAT THE DEFINITION OF HAZARD FOR IDENTIFYING HAZARDOUS LOCATIONS MUST BE BASED ON THE INCIDENCE OF ACCIDENTS. THERE IS AMPLE EVIDENCE FROM THE CONCENTRATIONS OF NUMBERS OF ACCIDENTS AT SPECIFIC LOCATIONS, AND FROM ABNORMALLY HIGH RATES AT PARTICULAR POINTS OR OVER A LIMITED LENGTH OF HIGHWAY, THAT HAZARD CAN BE MEASURED BY THE INCIDENCE OF ACCIDENTS.

GOVERNMENT AGENCIES ARE CURRENTLY USING ACCIDENT DATA IN A NUMBER OF WAYS TO IDENTIFY HAZARDOUS LOCATIONS.

2. DEFINING LOCATIONS

A HAZARDOUS LOCATION AS USED HERE MAY APPLY TO A NUMBER OF DIFFERENT KINDS OF SITUATIONS. IT MAY BE (1) A POINT ON THE HIGHWAY SYSTEM, SUCH AS A NARROW BRIDGE, A DRIVEWAY ENTRANCE, OR A PLACE WHERE A FIXED OBJECT LIKE A TREE IS IMMEDIATELY ADJACENT TO THE ROAD PAVEMENT, OR (2) AN INTERSECTION WITH ANOTHER HIGHWAY, INCLUDING THE APPROACHES THERETO, OR (3) A LENGTH OF HIGHWAY WHERE ENVIRONMENTAL OR HIGHWAY CHARACTERISTICS CREATE HAZARD.

SO THE EVALUATION OF HAZARD PROCESS MUST BE DESIGNED TO RECOGNIZE THE SEVERAL TYPES OF HAZARD LOCATION--POINTS, INTERSECTIONS, AND HIGHWAY SECTIONS.

3. Required Accident Data

To make analyses of accident data for identifying hazardous locations, the accident data must be reported and stored in form adapted to computer analysis. Two important requirements are:

A. Individual accidents must be identified as to their location by road log mileage so groupings of accidents for individual locations or segments of the highway can readily be made. (The milepost location accomplishes this.)

B. Accident data must cover a sufficient period of time to give statistically valid data.

The required data mentioned above is available.

B. Alternate Methods

All methods analyzed in the Jorgensen report are not presented here. Only those that appear to be most readily adaptable and have proven adequate by previous use by other agencies are presented.

1. Description of Methods

A. Number Method - Accident data are analyzed to summarize the number of accidents for a spot location and number per mile for a section of highway. Locations having more than a defined minimum are classified

AS HAZARDOUS LOCATIONS FOR PURPOSES OF DETAILED EVALUATION AND IMPROVEMENT PLANNING.

B. Accident Rate Method - Accident data are analyzed to provide rates: accidents per vehicle for spot locations and accidents per vehicle mile for sections of highway. Criteria are established on the basis of rate to give the basis for classifying locations as hazardous.

C. Number-Rate Method - This is in effect a combination of methods 1 and 2. Minimum criteria are applied both for number and for rate.

D. Rate Quality-Control Methods - The same as method 2 except locations are eliminated if rates are not significantly greater than a mean accident rate.

2. Evaluation of Methods

A. Number Method

This method is based on the theory that spot improvement will be most productive in reducing hazard if improvement programs are directed toward the places where most accidents occur. Accident rate (hazard related to exposure) is, for all practical purposes, neglected.

THIS LACK OF CONSIDERATION OF EXPOSURE IS THE NUMBER METHOD'S PRIME DEFICIENCY. ILLUSTRATIVE OF THIS IS THE TABULATION IN TABLE 1 WHICH CONTAINS SOME ACCIDENT DATA ON CLUSTER LOCATIONS ABSTRACTED FROM A LISTING OF HAZARDOUS LOCATIONS.

TABLE 1

NUMBER OF ACCIDENTS AND ACCIDENT RATES BY CLUSTER LOCATIONS

Acc. Cluster	No. of Accidents in Cluster	Acc./MV Rate
1	21	1.85
2	7	.74
3	3	.33
4	7	.61
5	10	.87
6	14	1.04
7	3	3.95
8	13	1.01
9	4	2.19
10	3	1.12
11	11	.86
12	2	.85

ALTHOUGH LOW RELATIVE TO THE TOP PRIORITIES, ARE STILL WELL ABOVE THE STATE AVERAGES.

ASSUMING THAT ACCIDENT RATE IS AN INDICATION OF ACCIDENT REDUCIBILITY, AND USING THE STATE AVERAGE OF 5.0 ACC./MVM AS A COMMON DENOMINATOR, IT READILY CAN BE SEEN THAT THE TWO LOWER PRIORITY PROJECTS HAVE A POTENTIAL FOR ELIMINATING ABOUT 40 ACCIDENTS AS COMPARED WITH ABOUT 11 ACCIDENTS FOR ALL FOUR OF THE TOP PRIORITY PROJECTS.

TABLE 2

EXCERPT FROM PRIORITY LISTING

PRIORITY	ACCIDENT RATE NO./MILL. VEH. MILE	NO. OF ACCIDENTS
1	117.37	6
2	60.86	3
3	43.86	2
4	41.37	2
	SUB-TOTAL	13
38	14.90	17
39	14.70	44
	SUB-TOTAL	61

IT IS APPARENT THAT ACCIDENT RATE ALONE IS NOT A VALID BASIS FOR IDENTIFYING HAZARDOUS LOCATIONS.

c. Number-Rate Method

The first two methods as discussed have deficiencies which limit their effectiveness. On the other hand, if the criteria for these methods are combined so that both numbers of accidents and rate are considered, it would appear possible to eliminate or minimize the deficiencies.

Because of the promising character of this method, some detail regarding its use in one state - Ohio - is here presented. Ohio uses the Number-Rate Method with four variations to fit different situations.

The first situation is a "spot" such as a bridge, railroad crossing, intersection, etc. A "spot" is placed on the accident priority list if (1) the absolute number of accidents is equal to or more than 10 accidents/year and (2) the rate of accidents per million vehicles per year is 1.5 or more. The latter rate is the state average for so called "spot" locations.

The second situation is any section of highway. Highway sections in the State of Ohio are broken up by roadway characteristics and jurisdictional boundaries. A new section is started wherever these change. A section is placed on the accident priority

LIST IF (1) THE NUMBER OF ACCIDENTS PER MILE PER YEAR IS EQUAL TO OR EXCEEDS 5 AND (2) THE RATE PER MILLION VEHICLE MILES PER YEAR IS 2.8 OR MORE. SECTIONS ARE RANKED BY NUMBER OF ACCIDENTS PER MILE FOR EACH COUNTY.

THE THIRD SITUATION DEALS WITH THE NEED FOR SHOULDER (BERM) IMPROVEMENTS. THIS IS A SPECIAL CLASSIFICATION OF HAZARDOUS LOCATION AND AS SUCH HAS A THIRD CONDITION TO BE MET. THE THREE CONDITIONS ARE: (1) 4 OR MORE ACCIDENTS PER MILE PER YEAR, (2) 2.4 ACCIDENTS PER MILLION VEHICLE MILES PER YEAR AND (3) MORE THAN 45 PERCENT OF THE TOTAL ACCIDENTS ARE OF THE "RUN OFF ROAD," OR "HEAD-ON," TYPE OF ACCIDENT. FOR THE SECOND CONDITION CONSIDERATION IS BEING GIVEN TO RAISING THE FIGURE 2.4 ACC/MVM TO 2.8.

THE FOURTH SITUATION IS ALSO A SPECIALIZED ONE. IT DEALS WITH DE-SLICKING IMPROVEMENTS. THERE ARE THREE CONDITIONS TO BE MET. THE FIRST TWO ARE THE SAME: (1) 4 OR MORE ACCIDENTS PER MILE PER YEAR AND (2) 2.4 ACCIDENTS PER MILLION VEHICLE MILES PER YEAR. THE THIRD CONDITION IS RELATED TO THE PERCENT OF ACCIDENTS OCCURRING ON WET PAVEMENT. THE CRITERION IS THAT 27 PERCENT OF ACCIDENTS OCCUR ON WET PAVEMENT WITH PROVISION TO AMEND THIS PERCENTAGE UPWARD FOR LOW ACCIDENT NUMBERS.

THERE ARE MANY POSSIBLE ADAPTATIONS OF THE NUMBER-RATE METHOD. SOME SPECIFIC EXAMPLES WITH REGARD TO THE ORDER OF LISTING ARE:

(1) THE RATE-FOLLOWED-BY-NUMBER ALTERNATE WHERE AN INITIAL LIST OF LOCATIONS WITH ACCIDENT RATES EQUAL TO OR GREATER THAN AN ACCIDENT RATE CRITERIA IS SELECTED AND RE-ORDERED BY NUMBERS OF ACCIDENTS.

(2) THE NUMBER-FOLLOWED-BY-RATE ALTERNATE IS THE SAME AS THE ABOVE EXCEPT A NUMBER OF ACCIDENTS CRITERIA IS USED AND RE-ORDERING IS DONE BY RATE.

REGARDLESS OF WHICH VARIATION TO THE NUMBER-RATE METHOD IS CHOSEN THE MAGNITUDE OF THE MINIMUM CRITERIA IS AN IMPORTANT FACTOR. IF THESE CRITERIA ARE TOO HIGH, IT IS CONCEIVABLE THAT MANY HAZARDOUS LOCATIONS WILL NOT BE IDENTIFIED FOR INVESTIGATION AND ANALYSIS. ON THE OTHER HAND IF THE CRITERIA ARE TOO LOW THE LISTING MAY IDENTIFY LOCATIONS THAT ARE NOT TRULY HAZARDOUS. FURTHERMORE, THE RELATIVE INFLUENCE OF RATE AND NUMBER OF ACCIDENTS ON THE COMPOSITION OF THE FINAL LIST OF LOCATIONS IS AFFECTED BY THE RESPECTIVE MAGNITUDES OF THE MINIMUM CRITERIA VALUES.

D. RATE QUALITY-CONTROL METHOD

THE RATE QUALITY-CONTROL METHOD USES THE RATE METHOD BUT GOES A STEP FARTHER AND APPLIES A

STATISTICAL TEST TO DETERMINE WHETHER OR NOT THE ACCIDENT RATE IS SIGNIFICANTLY ABNORMAL AS RELATED TO A PREDETERMINED MEAN ACCIDENT RATE FOR SECTIONS OR LOCATIONS OF LIKE CHARACTERISTICS. THE STATISTICAL TESTS APPLIED ARE BASED ON THE COMMONLY ACCEPTED ASSUMPTION THAT ACCIDENTS FIT THE POISSON DISTRIBUTION.

THE EFFECT IS TO ELIMINATE FROM CONSIDERATION THOSE LOCATIONS WHERE THE ACCIDENT RATE IS HIGH BUT EXPOSURE IS LOW.

C. DISCUSSION

DETAILED DESCRIPTIONS WERE OBVIOUSLY NOT GIVEN AS TO THE FINE DETAILS OF EACH METHOD. HOWEVER, IT IS FELT THAT THE ABOVE DESCRIPTIONS ARE ADEQUATE FOR SELECTION OF A PARTICULAR METHOD FOR USE IN NEW JERSEY. ALL METHODS CAN BE ADAPTED TO THE INFORMATION OBTAINED FROM THE DIVISION OF MOTOR VEHICLES AND FROM OUR DIVISION OF PLANNING. ALL METHODS ARE AMENABLE TO COMPUTER APPLICATION. IT SHOULD BE EMPHASIZED HERE THAT THESE METHODS WILL ONLY DEFINE HAZARDOUS LOCATIONS. IT DOES NOT GIVE SUFFICIENT INFORMATION THAT WILL ALLOW THE ENGINEER TO RECOMMEND REMEDIAL TREATMENT. ONCE THE HAZARDOUS LOCATIONS HAVE BEEN DETERMINED DETAILED ACCIDENT DATA MUST STILL BE OBTAINED FROM THE DIVISION OF MOTOR VEHICLES.

IN ESSENCE, THESE METHODS WILL PINPOINT THE HAZARDOUS LOCATIONS FOR FURTHER ANALYSIS. IT THEN BECOMES ESSENTIAL TO DETERMINE DETAILED ACCIDENT INFORMATION CONCERNING EACH

LOCATION SO THAT REMEDIAL TREATMENT CAN BE INITIATED.

AFTER THE ABOVE IS ACCOMPLISHED IT IS ADVISABLE TO PERFORM AN ECONOMIC ANALYSIS SUCH AS BENEFIT-COST, RATE OF RETURN, ETC. TO DETERMINE WHICH IMPROVEMENTS ARE ECONOMICALLY JUSTIFIABLE. IT IS POSSIBLE THAT THE COST OF NECESSARY IMPROVEMENT AT ONE LOCATION IS NOT JUSTIFIABLE IN RELATION TO THE POSSIBLE ACCIDENT REDUCTION POTENTIAL WHILE THE REVERSE MAY BE TRUE AT A SECOND LOCATION.

SHOULD WE BE SO FORTUNATE AS TO BE ABLE TO MAKE ALL NECESSARY IMPROVEMENTS AT ALL LOCATIONS THE ABOVE STEP WOULD BE UNNECESSARY. HOWEVER, SINCE WE ARE BOUND BY CERTAIN FISCAL RESTRAINTS IT IS ESSENTIAL THAT AN ECONOMIC ANALYSIS BE MADE SO AS TO ASSURE THAT WE MAXIMIZE BENEFITS IN RELATION TO MONIES ALLOCATED FOR SAFETY IMPROVEMENTS.

MEMBERS OF THE BUREAU OF SAFETY AND TRAFFIC (RESEARCH) WOULD BE MOST PLEASED TO FURTHER DISCUSS IN DETAIL ANY OF THE METHODS DESCRIBED IN THIS REPORT. ALSO ONCE A METHOD HAS BEEN SELECTED, WE WOULD, UPON REQUEST, PREPARE THE COMPUTER PROGRAMS REQUIRED TO FURNISH THE NECESSARY INFORMATION REQUIRED BY THE PARTICULAR METHOD.