Teaming Up for Safe Design and Operation

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ABRIDGMENT

•HIGHWAY TRANSPORTATION is obviously a team operation. Planning, design, construction, maintenance and operations all figure in the quality of service and, therefore, in the safety on a highway system[1]. With the systematic kind of surveillance now in use, and with the obligation of funds to carry out improvement programs, everyone in the organization can do what is necessary to reduce accidents.

Planning

Proper planning can make a system of streets inherently safer. For example, residential areas with conventional gridiron street patterns have accident rates twice those of subdivisions with limited-access design; therefore, four-way intersections should be used only where noncontinuous streets intersect. At moderate to high traffic volumes, the accident rates at four-way intersections run from 3 or 4 to 14 or 15 times those at three-way. Multi-legged, jogged, acute angle, and Y-type intersections should also be avoided. Collector streets should exit into one major street only and should not run completely through the subdivision. Through traffic should be carried on major streets with access no more frequent than ¼-mile intervals. Along these streets, cul-de-sac, back-up or side-on treatment is preferable to a continuous service road, although service roads are safer than direct driveway connections (1, 2).

Design

Generosity and consistency are necessary in design. Substandard design features are consistently associated with higher than average accident rates. A substandard feature appearing in otherwise good alignment is doubly hazardous. The features characterizing freeways with lower than average accident rates are (a) generous width of lanes, shoulders and medians; (b) paved flush shoulders; (c) no curbs either right or left; (d) uniform cross-sections (number of lanes is constant over fairly long distances); (e) generous ramps, all on the right side; (f) good alignment, practically straight and level. Freeways in California with rates lower than the average have these features in common. Those with higher than average accident rates lack one or more of these characteristics (3).

Short acceleration and deceleration ramps are consistently the scene of high accident rates. Left-hand ramps are 3 or 4 times as accident prone as right-hand ramps. Accident rates increase at about 0.15 per degree of curve on conventional roads and about 0.3 to 0.4 per degree of curve on divided expressways. That is, curves over 5° have rates 4 times as great as tangents, and when they are combined with grades over 5 percent the rate is about 20 times that for straight and level alignment.

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[1] See Schoppert, statement to the meeting of the AASHO Committee on Traffic at Miami Beach, November 1962, which cites the roles of planning, design, construction, maintenance, and operations with examples of ways accidents can be reduced in each of these activities.

Construction

Construction specifications relating to mineral aggregates and pavement mixtures can keep accidents down if they are drawn so that the end result is a pavement with good skid-resisting and light-reflecting qualities. Skidding may be involved in as much as 40 percent of all accidents. In one state, skidding occurred before the brakes were applied in 10 to 15 percent of all accidents. On the Pennsylvania Turnpike, the accident rate is twice as high when the pavement is wet as when it is dry.

In Virginia, skidding rates for a certain region were twice those for the rest of the state. This difference was traced to the native mineral aggregates, used for paving in that region, which polished rapidly under traffic.

Skidding is more likely to occur at naturally hazardous places. An easy curve is twice as likely to be a skidding accident site as a straight stretch of road. Even easy to moderate grades can be 4 times as likely skidding accident sites as straight and level roads. When curves and grades come together, the risk of a skidding accident increases to something like 8 times that for straight and level roads.

Pavements good when they are laid will polish under traffic. Under light traffic or on straight and level roads, the polish is almost negligible, but it increases rapidly with the volume of traffic on curving stretches where skidding is most likely to be a problem. Elimination of this polish is one of the functions of maintenance.

Maintenance

Maintenance can keep accidents down by keeping sight distance unimpaired. When sight distance is less than 1,500 feet on 2-lane roads, the accident rate is twice that where it exceeds 2,500 feet. Even stretches of road with sight distances of 1,500 to 2,500 feet have about 1.5 times the accidents of those with unlimited sight distance. Where the obstructions occur infrequently, the accident rate is doubled.

Operation

The full and proper use of signs and markings at curves has reduced night and day accident rates as much as 50 and 55 percent, respectively. Setting up through streets and keeping through traffic off local streets by using stop signs to define through streets has reduced the accident rate on the through and the two parallel streets. In three such cases in San Francisco, the reductions ranged from 17 to 37 percent (based on studies by Shoaf in San Francisco).

A signalized intersection with both a left turn lane and a special turning phase will generally have only one-third as many accidents as one with the left turn lane only. Mast arms to get the signal indications out where they can be seen more readily will also bring the accidents down. In one urban area this resulted in reductions of 78 percent in angle collisions and 33 percent in pedestrian accidents. On a rural high-speed divided highway, the use of mast arms for additional indications decreased accidents about 45 percent (based on studies by Webb in California).

Recently, on approaching a major freeway-to-freeway interchange I noticed a driver making a U-turn, then proceeding back to the interchange and taking one of the ramps. On the next trip I saw a driver do exactly the same thing. On a third trip I saw a driver backing up one of the ramps and on a fourth trip I saw another driver making a U-turn across the median. I decided to look further into this and began to study the signs at this interchange. It seemed to me that almost without exception the signs tell people how to get to places they don't want to go. In the same general vein, I have noticed that about 5 percent of all fatalities on freeways involve vehicles driving on the wrong side of the median. Better signing and designs could reduce these occurrences.

On another occasion, a traffic engineer asked me how I would sign an interchange of two freeways which was ½ mile from an interchange of their common stem with an arterial street. We began to work something out, and then he said: "In the next fiscal year we plan to build another interchange 2,000 feet from the one serving the two freeways. How would you suggest we sign it?" Now, there are some things signing can do and there are others signing can't, and I submit that good teamwork takes into account

the limitations as well as the capabilities of each team member with no one being asked to perform beyond his capacity.

REFERENCES

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