Small City Traffic Improvements Developed from Accident Analysis

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INTRODUCTION

It is my opinion that the success or failure of our street operations can be measured in two ways. First is the effect on operations, which can be checked by travel time or delay studies at particular intersections. The second method is the use of accident data.

Examples of actual findings of traffic improvement needs, developed directly from accident report analysis, have been gathered from five cities in Illinois. These are in the small category, ranging from 6,500 to 60,000 population.

There are two broad categories of improvement needs that can be developed from accident analysis. One involves control devices, while the other involves physical changes.

TYPES OF TRAFFIC CONTROL DEVICES

The commonly accepted type of control devices are markings, signs and signals. They are utilized in three general areas.

First involves the control of moving traffic. This may use STOP signs, YIELD signs or traffic signals. It may involve the prohibition of turns, the attempted regulation of speed or direction of travel (one-way streets). Restriction of parking is another example. Control may also involve the guidance of traffic by lane lines, edge lines, centerlines, and symbol markings such as arrows.

A second area concerns warning devices. These can include pavement words and symbols, as in the case of railroad crossing identification. The markings may be placed directly on hazards, by using reflective paint or hash marks. Another way of identifying hazard is by use of conventional curve warning signs. Flashing beacons can be suspended over the road, or to draw attention to a special sign. The "bouncing ball" yellow beacon is a good example of this.

There are three kinds of control device applications: installation, modernization or revision, and (occasionally) removal.

SECURING ACCIDENT DATA

Before giving examples of how accident data can be used to determine needed improvements, it might be well to discuss how to secure the accident data.

My approach is to have the city police department copy all of their accident reports for a given period of time—three to five years, depending on city size. In an operating city engineer's office, it is a good idea to have the police routinely forward copies of all accident reports (actual written report describing the circumstances with the sketch showing what happened), as they are made up. Tabulations or summaries are of only limited value to the engineer.

Accident reports involving intersection conditions should be placed in files for the intersection, and those involving midblock conditions should be placed in separate files by street name. It is then possible to begin looking for the reasons people are getting into trouble at particular locations. Many times, there will be absolutely nothing that can be done to prevent the accidents. However, in a significant number of locations, patterns can be found. Some of these patterns can be strongly influenced by simple changes made by the engineer. If a certain pole is being struck repeatedly, perhaps it can be relocated or at least converted to a break-away type. If many of the accidents are occurring at night, the pole can be given reflective treatment. If an uncontrolled intersection shows a pattern of right angle accidents, these can normally be largely eliminated by installation of two-way YIELD or two-way STOP sign control. If a signalized intersection shows a heavy pattern of left turn type accidents, this may be greatly reduced by widening to provide for a left turn bay, or perhaps by revision in signal operation. The point is, needed changes cannot be determined without knowledge of problems the drivers are actually having.

Many dangerous appearing conditions do not actually result in accidents. If the hazard is obvious to the driver, he will often exercise that small amount of extra caution and usually avoid a collision. It is the more subtle conditions that produce accidents. Hence the need for an engineering analysis.

EXAMPLES OF ACCIDENTS INDICATING NEED FOR IMPROVED DEVICES

Examples involving need for installation of control devices have been drawn from a city of 30,000 population. In this town, two collector type roadways intersected in a residential neighborhood. The intersection had YIELD sign control, but the signs were of the old style—not reflectorized and not even well maintained. While there was no serious sight obstruction at the intersection, there had been seven right angle accidents in a two-year period. A check of traffic volumes during the evening rush hour showed about 300 cars per hour on one street and 50 cars per hour on the secondary street. With such a level, YIELD signs were totally inadequate, and the treatment was to replace these with proper STOP signs.

At another location in the same community, a collector street intersecting a major traffic route suffered 11 accidents in a three-year study period. However, checking the years in which these accidents occurred showed one in the first year of study, four in the second year, and six in the third year. This rapidly increasing frequency of accidents was produced by growth in the area and increased traffic volumes. The intersection was controlled by STOP signs facing the collector street, but the total entering volume during the evening rush hour was approaching 700 vehicles. These volumes were almost evenly divided between the two streets. Therefore, the installation of four-way STOP signs was made.

This illustration is not intended to imply that most situations can best be treated by four-way STOP control. In fact, thousands of such existing signs should be removed. Only occasionally does the four-way STOP represent the most desirable treatment.

In another community of 6,500 population, a collector roadway curves to go around a small lake. In a five-year study period, 12 accidents were identified. Seven involved cars leaving the roadway and either striking a tree or running into the lake. The remaining five accidents involved head-on collisions along the curve. Half of the accidents occurred at night. The improvements made at this location included repainting of the existing centerline, using reflectorized paint, with delineators installed directly in line with the approach roadway.

In a community of 19,000 population, an intersection of a collector roadway with a major traffic route was found. The collector street had STOP sign control, however 19 accidents had occurred during the four-year study period. Of these, 12 were of right angle type occurring in a three-year period. Such accidents can be reduced when treated by signal control. Checks of traffic volumes showed that the minimum volume warrant was met for three hours of the day and that the interruption for continuous traffic warrant was met for five hours on the major route and for the entire eight hours on the collector route. Under these conditions, the recommendation was for installation of traffic signal control.

Here again, there is no intent to imply that most traffic problems can be solved by traffic signals. As a matter of fact, the total number of accidents at an intersection usually goes up if traffic signals are installed.

An illustration where this did not occur involved the intersection of two major traffic routes in a town of about 33,000 population. In the 12 months prior to installation of signal control, there were 14 accidents at the intersection. There were no accidents during the first 19 months after signal installation. Perhaps one of the reasons for this dramatic change was the inclusion of throat widening and a left turn bay to reduce the probability of accidents. It should be noted that most of the accidents occurring under the two-way STOP control were of the right angle type. The problem that frequently develops is that signal installation results in a great increase in read-end accidents. Many of these can involve left turning movements, and by provision of separate bays for the turning movements, safety is enhanced.

EXAMPLES OF CONTROL DEVICE MODERNIZATION BY REMOVAL

Sometimes modernization or revision of controls include need for removal. As an example, a study in a town of 19,000 population found the need for many changes at intersections of local streets or local and collector streets. In all, there were a total of 18 four-way STOP controls that warranted change to two-way STOP. However, nine of these locations had sight obstructions (principally bushes), which required removal prior to change in the control. It was perfectly obvious that the excessive controls had been applied instead of the needed step of improving visibility for drivers approaching the intersection.

In the same study, STOP signs were found at two locations facing the wrong direction, forcing the heavier flow of traffic to stop. There were five intersections having no control, but where a YIELD or STOP was justified.

In most cases, intersections of low volume, residential streets require no controls.

Another example of improper control involved a four-way STOP sign that had been installed at the intersection of a low volume collector roadway and a high volume major traffic route. This was in a town of 60,000 population and had evidently been put in due to a heavy pedestrian crossing near a school. Even with the four-way STOP signs, children were being escorted across by an adult guard. There was a signalized major intersection only one block away, which was also a crossing point for children to the same school. Studies of the four-way STOP location found a high number of rear-end accidents occurring on the major traffic route due to drivers being forced to stop unnecessarily. Furthermore, comparatively large volumes of traffic were found to be bypassing the signalized intersection in order to break into the major traffic route via the four-way STOP signs. This added traffic was being moved along two side streets directly abutting the school.

The four-way STOP signs were removed, despite vigorous and vicious opposition by school board members and the PTA. A before-and-after study showed that intersection accidents were reduced to one-half; that no children were injured as a result of the change; and that traffic volumes adjacent to the school were substantially reduced. It is interesting to note that the most vocal school board member privately admitted he was wrong in objecting to the change, but refused to make a public apology on the grounds that it was "unpolitic."

TRAFFIC IMPROVEMENT OFTEN REQUIRES PHYSICAL CHANGES

There is, of course, a limit to the amount of improvement that can be gained by revisions in traffic control devices. Sometimes physical changes are necessary. These can be grouped into three general categories: one is hazard removal; a second is hazard attenuation; and a third involves geometric improvements or illumination.

Many fixed object hazards cannot be removed because they consist of structures supporting bridges, or they represent curbed islands necessary to channelize traffic. There are cases, however, where poles can be set back. Another treatment that can be placed in the category is the improvement of skid resistance on slippery pavements.

If the hazards cannot be eliminated, they can often at least be reduced in severity. So far as the fixed object is concerned, the use of guard rail or yield barriers and of break-away poles warrants improved consideration.

The subject of hazard attenuation is receiving increased attention. It has been a long time in coming, but gratifying attempts to reduce injury and death to the driving public are becoming more evident each day. Most of such needs are found on the higher speed roadways in outlying and rural areas. However, city engineers should keep themselves informed on progress in energy absorbing barriers, because they must occasionally deal with treatments for viaduct or bridge columns. These always seem to be located in the center of the road, or too close to the edges.

GEOMETRIC IMPROVEMENTS

Most engineers are interested in geometric improvements. It seems that our predecessors have built the streets too narrow or with too many curves. They also did a bad job of guessing how much traffic the streets would have to carry. Whatever the reasons, we have inherited the problems.

One step that is sometimes needed is the widening of narrow traffic lanes. In my opinion, it is desirable to have lanes at least 11 feet wide to handle city traffic. When they are less than this, sideswipe accidents are greater. If the pavements are a little slippery, and our car does not come to a stop in a perfectly straight line, the margin for error in a narrow traffic lane is inadequate.

On local residential streets, substandard widths can result in numerous accidents. One city of 19,000 population has constructed a large number of streets measuring only 19 to 20 feet in width. Nearly 15 miles of local streets in this community were paved to widths of less than 25 feet. In all, there were approximately 40 miles of local streets servicing single family residential homes. The study of the annual accident frequency per mile showed that streets *under* 25 feet in width had an accident frequency about 50 per cent higher than those *wider* than 25 feet.

The two kinds of accidents most affected by the narrower widths involved parked cars and pedestrians or bicycle riders being struck by moving traffic.

Another study in a town of 60,000 population covered 95 miles of local residential streets serving single family homes. These local streets had a broad range in widths, from less than 23 feet to as high as 40 feet. It was found that the extremely narrow streets had a relatively high acident frequency per mile, with the lowest frequency being found at a width of 32 feet. Interestingly enough, the streets wider than this showed a higher accident frequency. The engineer in this community concluded from these findings that the "standard" width of 34 feet was improper, and therefore revised the standards to 32 feet.

Another result of this particular study was confirmation of findings by others regarding the relative safety of 'T' intersections as compared with cross type. The cross types were found to have about three times as many accidents as the 'T' type, when related to similar abutting land uses.

It is impractical to talk about widening local residential streets that are too narrow. However, we can make accident studies and find out what widths are most appropriate for our communities. We can then revise our design standards to reflect the proper figures and not just rely on someone else's findings, or our own opinions.

LEFT TURN LANES AND ACCIDENTS

In most cities of all sizes, left turning vehicles along major traffic routes represent a troublesome interference with through traffic flow, and the added hazard is reflected in the accident statistics. Left turns are a problem at driveways, as well as at signalized intersections. The provision of a separate lane for left turning vehicles has many advantages. The principal type of left turn accident involves a rear-end collision. Often, one driver stops to make a left turn. The car immediately following him is also stopped safely; however, the third vehicle collides with the second car. It is extremely important that this type of accident be identified through careful examination of the accident report. If the accident is simply recorded as a "rear-end," then the value of a separate lane for left turns in preventing this type of accident will not be uncovered. This type of accident is usually not identified in a data processing system nor is it picked up by routine police coding or tabulation of accidents, but can be found from the police traffic accident report narrative statement.

The second type of left turn accident is more often tabulated, since it involves the left turning driver being struck by an opposing vehicle moving straight ahead. Even this type of accident can also be reduced by left turn bays, especially at signalized intersections. The condition is improved because the driver is placed in a better position to view oncoming traffic. If he is turning left adjacent to the centerline of a conventional street, opposing traffic can interfere with his vision of oncoming traffic.

Literally hundreds of examples could be cited of the need for left turn bay construction. In one town of 15,000 population, there were 119 accidents ocurring at four signalized intersections along a four-lane major route. During the four-year study period, these represented 70 per cent of all accidents in the section.

Of the intersection accidents, 43 per cent involved left turning movements from the major highway. Only 17 per cent were of right angle type, which might have been improved by signal modernization, with better placed, far-right signal heads.

The recommended improvements, in addition to signal modernization, were for throat widening and marking of exclusive left turn lanes on the major streets. The cost of improvements at the four intersections was estimated at $170,000.

At another location in the same community, the intersection of two major traffic routes produced 120 accidents in four years. Of these, about 27 per cent were of left turn type and largely preventable by a combination of left turn bays plus revised signal phasing. About ten per cent were of right angle type; some of which could likely be prevented by better located and larger signal indications.

Another intersection in the same community, and involving a major traffic route intersected by a low volume collector street, had 56 per cent of accidents involving left turns from the major route, plus 35 per cent of right angle type suspectible to correction by traffic signal control.

Improvements to both of these locations, together with extended route widening to provide improvement at intermediate intersections, was estimated at $400,000. Construction is being financed by TOPICS, state and city funds. Along the section of proposed improvement, there were 281 total accidents. It has been estimated that approximately one-third of all accidents in the improvement section will be eliminated by the proposed improvements.

CASE STUDIES OF ACCIDENTS AND IMPROVEMENT PROJECTS

These estimates of accident reductions are based upon detailed analysis of accident reports. Actual results from two improvement projects in another community of 60,000 population may be cited. One involved reconstruction of a six-legged intersection having two major routes plus a collector street all coming together at the same point. The work included relocation of the collector traffic to another point, and approximately two blocks of widening with construction of a barrier median. Recessed left turn bays were provided at the two basic intersections and at a major driveway. Traffic signal controls were added at two locations and a major revision in operation was accomplished at the third intersection. In the two years prior to the improvement, there was a total of 197 accidents at the intersections and midblock locations of the streets involved in the improvement. During the two year period after the improvement, there were 139 accidents, representing a 30 per cent reduction. Parking was prohibited as part of the project, and there were 22 fewer accidents of this type during the after period. In the area of barrier median construction, driveway accidents were reduced by 77 per cent.

At another location in the same community, a similar type of improvement was made involving widening, barrier median construction, left turn bays, and driveway controls. In the two years prior to this improvement, there were 151 accidents. The overall reduction, measured in the two years following the improvement, was 35 per cent.

Only a few of the available examples of safety improvement have been cited. The Highway Research Board's Special Report No. 93, titled, "Improved Street Utilization Through Traffic Engineering," lists many other examples.

Because of the great potential for improvement, every city traffic engineer is urged to delve into the accident records and learn from them the locations where reasonable improvements can be made.