Accidents at Median Crossovers

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The purpose of this study was to examine the necessity for and the value of median crossovers on limited-access facilities. An accident analysis provided information on the frequency and nature of accidents at median crossovers. The type of and necessity for crossover usage by authorized personnel was determined from interviews with highway maintenance engineers and questionnaires completed by state police who patrol limited-access facilities. It was found that crossovers do cause frequent accidents in some locations, thus negating the positive benefits of having crossovers. Undesirable locations for crossovers include urban areas, interchange areas, and any location where use by the general public is likely. Applying more stringent controls to the location and use of median crossovers than now employed may result in a 5 percent reduction in accidents on limited-access facilities.

SAFETY IMPROVEMENTS are often controversial subjects, especially when the subject is highways. Judgments must be made weighing lives and injuries against the hard realities of financing the construction and maintaining the highway systems. Median crossovers on rural and urban freeways and expressways are controversial design features. State police and maintenance forces claim that median crossovers are necessary and essential for their work and that more frequent location of crossovers is desirable. Engineers involved with highway safety maintain that crossovers create accidents, are not necessary, and should be eliminated.

Crossovers are located on divided roadways so that emergency and maintenance vehicles can cross the median to change their direction of travel. However, motorists also find crossovers convenient for their use, even though the maneuver is illegal. This creates an accident-producing situation. Accidents at median crossovers involving U-turning vehicles accounted for nearly 25 percent of the total accidents on several road sections during some years investigated in this study. During a 4-year period an average of 5 percent of all accidents on the majority of toll and Interstate roads in Kentucky were caused by vehicles using median crossovers.

The purpose of this study was to analyze existing crossover locations, usage, and accidents and to develop criteria for use in determining the necessity for and the location of median crossovers. Primarily, 3 sources of information were used. An inventory of existing crossover locations was taken to determine the prevailing policy, if any, on crossover design and location. A comprehensive analysis of U-turn accidents at median crossovers was performed. Interviews were conducted with district highway engineers and questionnaires were given to all state police who patrol Interstate or toll roads in Kentucky. The questionnaire also provided an opportunity for the state police to express their opinions concerning the location and necessity for crossovers.

INVENTORY OF EXISTING CROSSOVER LOCATIONS

An inventory of existing crossover locations was performed by 2-man teams who traversed the roads selected for study. Crossovers, interchanges, or other features of significance were logged to the nearest tenth of a mile. These loggings were then plotted to

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TABLE 1  
CROSSOVER SPACING AND LOCATION

<table>
<thead>
<tr>
<th>Road</th>
<th>Average Distance Between Crossovers and Interchanges</th>
<th>Average Distance of Crossovers from Interchanges</th>
<th>Average Distance Between Interchanges</th>
<th>Average Number of Crossovers Between Interchanges</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-64 (Lexington to Morehead)</td>
<td>2.6</td>
<td>2.3</td>
<td>5.5</td>
<td>1.3</td>
</tr>
<tr>
<td>I-64 (Frankfort to Louisville)</td>
<td>2.1</td>
<td>1.8</td>
<td>5.0</td>
<td>1.4</td>
</tr>
<tr>
<td>I-65 (Cave City to Elizabethtown)</td>
<td>2.4</td>
<td>2.0</td>
<td>5.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Kentucky Turnpike</td>
<td>2.2</td>
<td>1.5</td>
<td>18.4</td>
<td>3.7</td>
</tr>
<tr>
<td>Blue Grass Parkway</td>
<td>2.3</td>
<td>1.9</td>
<td>14.8</td>
<td>5.4</td>
</tr>
<tr>
<td>Western Kentucky Parkway</td>
<td>2.2</td>
<td>0.6</td>
<td>14.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Mountain Parkway</td>
<td>1.7</td>
<td>0.6</td>
<td>8.4</td>
<td>3.3</td>
</tr>
<tr>
<td>US-41</td>
<td>1.0</td>
<td>0.7</td>
<td>2.7</td>
<td>1.5</td>
</tr>
</tbody>
</table>

scale and examined for similarities to see if any patterns in design governed. Kentucky's traffic guidance manual (2) provides no recommendations for crossover location. The Kentucky Department of Highways Standard Drawing 14.04c states: "Maintenance Crossovers shall be constructed one half to one mile from the end of the acceleration lane taper or de-acceleration lane taper whichever provides for the furthest spacing from the interchange." Although not stated, the locating of crossovers this close to interchange areas is assumed to be strictly a convenience for maintenance forces to conduct snow removal work. This philosophy is also reflected in the following statement that appeared in an ASCE publication (1): "Usually crossovers are needed at each end of an interchange area so snow and ice equipment may reverse direction quickly to clear all entrance and exit ramps."

The suggested pattern of crossover location is not consistently followed on any of the Interstate or toll roads in the state. Crossovers are commonly found as near as 0.1 mile and as far as 5.0 miles from interchange areas. The average distance between crossovers and interchanges varies from 0.6 mile on the Western Kentucky Parkway and Mountain Parkway to 2.3 miles on I-64 (Lexington to Morehead) (Table 1). Generally there is at least one crossover between exits when interchange spacing exceeds 3 miles. The average distance between crossovers and interchanges is about 2.2 miles, with the exception of US-41 in Hopkins County where no consistent spacing between consecutive crossovers or between an interchange and a crossover was found.

ACCIDENT ANALYSIS

Accident reports for a 4-year period were copied from original state police records for the following controlled-access roads: I-64, I-65, Bluegrass Parkway (3-year period), Western Kentucky Parkway, Mountain Parkway, Kentucky Turnpike, and US-41 (Madisonville Bypass, Hopkins County). All U-turn accidents at median crossovers were counted and analyzed. The

Figure 1. U-turn accident rate versus traffic volume.
following variables were found to affect the number of U-turn accidents on a given road:

1. Volume of traffic on the road,
2. Proximity to urban areas,
3. Presence of major interchanges between controlled-access facilities,
4. Number of crossovers,
5. Nearness of crossovers to interchanges,
6. Composition of the traffic stream,
7. Interchange spacing,
8. Width and type of median, and
9. All other roadway, weather, driver, and vehicle variables.

Of these variables, the first three are the most significant. Logically, as traffic volume increases, the probability of a U-turning vehicle coming in conflict with another vehicle increases (Fig. 1).

It is reasonable to assume that the drivers of U-turning vehicles are lost or confused, i.e., they may have made a wrong turn or missed a turn. More persons are likely to get confused in urban areas and in major interchange areas. Therefore, more U-turn accidents are likely to occur at such locations. This is verified by the U-turn accidents on the Kentucky Turnpike and US-41. There have been 34 U-turn accidents in a 4-year period involving southbound vehicles on the Kentucky Turnpike (Fig. 2). There were 16 at the first crossover south of Louisville, 8 at the second crossover south of Louisville, 4 at the third crossover south of Louisville, 2 at the fourth crossover south of Louisville, and 2 at other locations. In addition, 2 drivers involved in an accident admitted they were driving too slowly because they were looking for a crossover.

Ten accidents involved northbound vehicles on the Kentucky Turnpike (Fig. 3). All of these occurred after the opening of the Bluegrass Parkway in November 1965. There were 5 at the first crossover north of Elizabethtown, 2 at the second crossover north of

Figure 2. U-turn accidents on northern half of the Kentucky Turnpike.
of Elizabethtown, 1 at the third crossover north of Elizabethtown, and 2 at other locations. Many of these accidents were apparently caused by drivers who became lost or confused at the west end of the Bluegrass Parkway and were going north on the Kentucky Turnpike when they wanted to go south. Other situations where U-turn accidents occur near urban areas or major interchanges exist on I-65 and US-41 in Hopkins County. At the first crossover south of Elizabethtown on I-65, for example, there have been 13 accidents involving southbound U-turning vehicles in a 4-year period. The U-turn accidents
TABLE 2

<table>
<thead>
<tr>
<th>Type of Accident or Injury</th>
<th>Kentucky Turnpike</th>
<th>US-41</th>
<th>I-65 (South of Elizabethtown)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident</td>
<td>No.</td>
<td>Percent</td>
<td>No.</td>
<td>Percent</td>
</tr>
<tr>
<td>Right-angle</td>
<td>16</td>
<td>36</td>
<td>12</td>
<td>63</td>
</tr>
<tr>
<td>Oblique</td>
<td>17</td>
<td>38</td>
<td>7</td>
<td>37</td>
</tr>
<tr>
<td>Rear-end</td>
<td>11</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Injury^a</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Percent</td>
<td>No.</td>
<td>Percent</td>
<td>No.</td>
</tr>
<tr>
<td>12</td>
<td>27</td>
<td>5</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>4</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>53</td>
<td>10</td>
<td>53</td>
<td>8</td>
</tr>
</tbody>
</table>

^a Injury codes are as follows:
A—broken bones, visible cuts and lacerations, severe injuries, had to be carried from scene;
B—cuts and bruises of minor nature, need not be hospitalized;
C—complaint of injuries, none visible; and
O—no injuries.

on US-41 are clustered around the interchange with the Western Kentucky Parkway and the KY-85 interchange leading into Madisonville (Fig. 4).

Further evidence that driver uncertainty in traveling urban or interchange areas is a prime cause of U-turn accidents is supplied by the fact that 48 percent of the drivers of the vehicles making the U-turns were out-of-state drivers. Another 29 percent were in-state drivers but were out of their home county. Therefore, up to 80 percent of the drivers involved in accidents were probably unfamiliar with the roadway.

Other variables contribute to the accident problem in some locations. A study by Cribbins et al. (5) conclusively showed that for non-controlled-access facilities the accident rate increased with the number of openings in the median. An abnormally high number of crossovers on US-41 seems to contribute to the U-turn accident problem on that road.

The severity of U-turn accidents seems to depend roughly on the type of accident, i.e., right-angle, oblique, or rear-end collisions (Table 2). Right-angle collisions, which account for 39 percent of the total U-turn accidents, caused 59 percent of the severe injuries (Fig. 5). Less severe injuries resulted primarily from oblique and rear-end accidents. Overall, U-turn accidents are more prone to produce injury, as shown in Figure 6. In nearly all of the U-turn accidents studied, at least one innocent driver was involved.

Figure 5. Severe injuries (type A) by type of U-turn accident.

Figure 6. Injuries associated with U-turn accidents compared with injuries associated with all accidents.
MEDIAN Crossover Usage

An interview with the district engineers of several highway districts provided information on crossover usage by maintenance vehicles. Maintenance vehicles use crossovers primarily in winter during snow removal. The crossovers are convenient for clearing an interchange area and for turning around at county lines where maintenance responsibilities end. Other uses by maintenance vehicles are not readily predictable. As an example, when shoulder work is being performed, crossovers are used to lessen the distance for hauling materials. There are also special situations such as separate rest areas serving travelers in either direction of travel where usually one crew maintains both facilities.

Crossovers at each end of the rest areas enable the maintenance personnel to service both without undue inconvenience.

State troopers who patrol Interstate and toll roads completed a questionnaire and provided much information on state police use of and attitude toward median crossovers. The questionnaire was designed by the Division of Research in cooperation with the Kentucky State Police. A representative from the Division of Research visited each post and explained the questionnaire. Cooperation from state police personnel was excellent. There were 132 completed from approximately 95 percent of the troopers solicited.

State troopers use crossovers on a regular basis (Fig. 7). Eighty percent of the respondents reported using crossovers at least once a day. Eighty-two percent of the troopers admitted crossing the median at nondesignated locations (Fig. 8). Some 19 percent of these cross the medians at other locations more than they do at regular crossovers. When responding to an emergency and not being near a crossover, troopers will cut across the median wherever they happen to be. The only time this is not feasible is during periods of snowfall or heavy rain or where the median is difficult to cross, as for example on the Mountain Parkway.

There were several questions designed to evaluate trooper attitudes toward crossovers. When asked if crossovers were absolutely necessary for state police activities, 84 percent replied that they were necessary. Of the 16 percent who thought they were not absolutely necessary, the majority were troopers who patrol the Kentucky Turnpike and I-65 where U-turn accidents are more prevalent. Further evidence of a difference in attitude is reflected by responses given in Table 3. Among all troopers, there is an obvious majority who favor more frequent spacing of crossovers. On the Kentucky Turnpike and I-65, where there is an accident problem, attitudes shift toward more stringent control of crossover usage. The majority of troopers on the Kentucky Turnpike feel that crossovers should be eliminated entirely. This would seem to indicate a general attitude that, where crossovers frequently cause accidents, their necessity is to be questioned. A notable exception to this is US-41 in Hopkins County, which has a deeply depressed median. Here the troopers have difficulty crossing the median, and they take a more forceful stand for the necessity of median crossovers.
TABLE 3
ATTITUDES OF STATE TROOPERS TOWARD LOCATION OF CROSSES

<table>
<thead>
<tr>
<th>Responsea</th>
<th>Percent of All Troopers</th>
<th>Percent of Troopers on I-65</th>
<th>Percent of Troopers on Kentucky Turnpike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Located more frequently</td>
<td>65</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Located less frequently</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Eliminated entirely</td>
<td>7</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>Eliminated near interchanges and located very sparingly between interchanges</td>
<td>19</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

aThe responses were multiple choices to the question, if criteria were to be developed for the location of median openings or crossovers, do you feel that they should be . . . ?

**MEDIAN CROSSOVER LOCATION**

All evidence indicates that guidelines and restrictive measures on the location and use of median crossovers are in order. A summary of the reasons for this conclusion follows:

1. Median crossovers are prone to cause accidents.
2. Crossovers seem to be a convenience, not a necessity, for maintenance activities.
3. There is no consistent policy being followed for crossover locations.
4. Crossovers are a necessity for state police activities only during inclement weather and where the median is difficult to cross (92 percent of troopers cross the median at nondesignated locations).
5. When the accident-producing aspect of crossovers is obvious, state police tend to be opposed to crossovers.

Furthermore, the AASHO traffic safety committee concluded (3): "Any openings in the median can be the scene of unsafe driving, and should, therefore, be kept to a minimum." On several roads, accidents at median crossovers pose a special problem. These roads warrant separate discussion.

**Kentucky Turnpike**

The combination of narrow medians, relatively high traffic volumes, and confusing junctions makes the Kentucky Turnpike especially susceptible to U-turn accidents. Because of the accident problem and the corresponding negative attitude of the state police toward median crossovers, crossovers on this facility might well be permanently closed. Crossovers located between bridge piers (Fig. 9) may be an exception. There have not been any accidents at these crossovers. Retaining these crossovers on a conditional basis and noting whether they result in accidents could produce evidence on whether the hidden crossovers may be a solution to the problem in some locations.

**I-65 (South of Elizabethtown)**

Most crossover accidents on this road occur at one crossover. The first crossover south of Elizabethtown at milepost 87.3 has been the site of 13 U-turn accidents between 1965 and 1968. If this

Figure 9. Crossover located between bridge piers.
crossover were eliminated, drivers would have to travel a few more miles and turn around at an interchange.

US-41 (Hopkins County)

The occurrences of U-turn accidents on this road have been clustered around the Western Kentucky Parkway and KY-85 (at Madisonville) interchanges. Figure 4 shows that the crossovers are generally located very close to the interchanges. This close spacing contributes to the problem by requiring quick decisions from the driver making the U-turn. Sixty-three percent of the U-turn accidents are right-angle accidents caused by drivers turning from the outside lane into the path of another vehicle. To eliminate the abnormal number of U-turn accidents on this road, it would be desirable to eliminate all the crossovers. With interchanges spaced on the average only 2.75 miles apart, elimination of crossovers might be acceptable if it were not for the deeply depressed median that troopers find difficult to cross. An alternate solution would be to eliminate crossovers near interchanges and have only one crossover, at most, between any two interchanges.

Interstate Roads

In general, Interstate roads do not need many crossovers. Interchanges are spaced on the average about 5.5 miles apart, and the median can be easily crossed, if necessary. The present spacing is adequate for most purposes. There are, however, some exceptions. Crossovers near interchanges might be eliminated or at least moved. Interchanges and crossovers should be spaced so that there is a fairly uniform distance between two crossovers or an interchange and a crossover. Because crossovers are designed for convenience, the somewhat erratic spacing now found on many road sections can hardly be justified.

Toll Roads

The present spacing of crossovers on most toll roads, with the exception of the Kentucky Turnpike, presents few problems. Where the median can be easily crossed, crossovers spaced 5 miles apart would suffice. On toll roads with deeply depressed medians that cannot be easily crossed, closer spacing may be desirable.

Other Considerations

Among those who favor the use of median crossovers, there seem to be 2 different theories as to crossover locations. The first group maintains that crossovers are going to be used by the general public in any event. Therefore, crossovers should be located in prominent locations, have adequate sight distance, and be conspicuously signed. The second group says that crossovers should be hidden from the public eye and not signed. An article on operational problems on controlled-access facilities (1) stated: "Crossovers should be as inconspicuous as possible to prevent use by the public.... For enforcement purposes signs prohibiting public use are required, such as NO U-TURN—FOR OFFICIAL USE ONLY."

The policy to place crossovers in inconspicuous locations and then sign them seems contradictory. At the present little effort is made to make crossovers inconspicuous. However, on the Kentucky Turnpike, there have been no accidents at the crossovers located between the bridge piers during the 4 years of the study. This would indicate the desirability of using hidden crossovers.

Responses on the questionnaire indicated that there is some question as to the wording of the sign FOR EMERGENCY AND MAINTENANCE VEHICLES USE ONLY. Many troopers questioned the length and the message of the sign. It may be in order to study the contrasting effects at crossovers having the present sign, no sign at all, and a sign with a negative connotation like NO U-TURNS or U-TURNS ARE ILLEGAL. It is doubtful that signing changes are a solution, but the possibility should be investigated.

CONCLUSIONS

The purpose of this study was to examine median crossovers on controlled-access facilities in an attempt to determine the necessity for them. Although crossovers are
desirable and worthwhile for state police and maintenance uses, crossovers can only be considered as a convenience, not a necessity, and should be eliminated if an accident problem arises. Accident prevention was the foremost consideration in the development of the following criteria that appear to be warranted with respect to crossover location:

1. Median crossovers should not be located in or near urban areas, i.e., cities having populations of 10,000 or greater.
2. Median crossovers should not be located near major interchanges, i.e., the intersection of 2 controlled-access facilities. There should be no crossover between the interchange area and the next interchange on all connections, except on some toll roads where distances between interchanges may be extremely great.
3. Median crossovers should not be located within 2 or 3 miles of an interchange.
4. Any median crossover located so that the general public may be tempted to use it will cause accidents and should be eliminated.

Applying more stringent controls to the location and use of median crossovers than now employed may result in a 5 percent reduction in accidents on Interstate and toll roads.

REFERENCES