Enhanced Crash Reporting to Explore Workzone Crash Patterns

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Abstract

This work analyzes patterns and factors in workzone crashes. In response to actual and suspected deficiencies in the quality of workzone crash reporting from standard police crash reports, an enhanced crash report form and procedure was developed and applied by police agencies in a small sample of workzones in Illinois. Analysis of 110 workzone crashes revealed differences between what the police were recording using enhanced and standard crash report forms. Most important was that workzone crashes appeared to be no more likely to produce injuries than those occurring on the same type of roadways when no workzone was present. The enhanced data provided better insight into the manner of collision and contributing factors of crashes occurring in various locations within the workzone. Approximately 40% of crashes recorded occurred outside the working area, in the taper and approach. Crashes in the working area usually involved more than two vehicles but most commonly resulted in property-damage-only. In the approach and taper portion, more than 30% were injury-producing and involved two vehicles. Approximately 40% of all crashes occurred when work was not in progress. Distraction from work in progress was an important contributor, but lack of escape was the leading contributing factor. Outside the working area, failure to yield and excessive speed were principal contributors (but speed was not a contributor inside the working area). Videotaping drivers approaching workzones provided visual evidence of actions which could lead to crashes. Most important was improper merging behavior in the approach portion, and drivers approaching queues at high speeds. Recommendations include moving enforcement outside the working area and concentrating on speeding and failure to yield, along with requiring alternate merging in areas of lane reductions.

Keywords: Accidents, Workzone, Driver Behavior, Types of Collision, Police Crash Reporting
Acknowledgments

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INTRODUCTION TO CRASH REPORTING IN WORKZONES

Research addressing crashes in workzones rarely has used the primary, detailed police crash reports to determine potential contributing factors; instead studies have been based on abstracted data from central crash reporting files. These abstracted data contain what the police officer elected to include in the objective components of the report and do not include narratives or diagrams. Moreover, for most crashes, police investigation is minimal. Attention is paid to completing the report rather than discovering (and eventually eliminating) causes. Police are reluctant to indicate contributing circumstances (1). As a result, data derived from these historic reports, may become a particular problem when attempts are made to analyze the patterns and causes of crashes in special-risk locations such as workzones, where abstracted data may be incomplete and misleading. This paper describes a recent effort to gather and analyze more detailed and descriptive data to explore where crashes are occurring in workzones and identify contributing factors.

As has been found in many crash reporting studies (1), (2), (3), (4), (5), significant variance exists in the quality of reports. Date, time, number of vehicles involved, and weather conditions are usually accurate. Level of severity, manner of collision, vehicular damage, and contributing circumstances are reported with substantially less accuracy. The locations of crashes are commonly reported in error. For a workzone, a mistake of 100 meters can place it in a different part of the zone, e.g., the work (construction) area rather than approach. As a result, researchers attempting to determine locations and possible causes of workzone crashes may have a poor basis for drawing conclusions, and thus the knowledge about the relationship between the workzone and the crash can be problematic.

The literature does contain significant efforts to identify causes of crashes based on the best available data (6), (7), (8). However, because of their dependency on the traditional crash report for “contributing circumstances,” especially vehicle speeds within the work area, these reports may lead to erroneous conclusions. As a result, Wang and others (9) have questioned the validity of interpretations of factors and patterns in workzone crashes. Nemeth (10), using the case study method, showed how review of the reports directly could lead to different causal factors than those derived from using historic files. One of his findings was that driver maneuvers rather than speed appeared to be the primary contributor to workzone crashes.

ILLINOIS WORKZONE CRASHES

Building on the work by Nemeth, we designed a short, check-off supplemental report to be completed when the police prepared a crash report (Figure 1). Reporting officers were asked to indicate where in the workzone the crash occurred using four locations: approach, taper, construction area, or exit. The officer also recorded the distance from the end of the taper, and environmental and driver actions which may have led to the
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Both the basic crash reports and supplemental forms provided the basis for the analysis reported in this section.

Several police agencies agreed to assist with the research by completing the supplemental forms in addition to the standard police crash report (PCR), and they provided the researchers with both reports for the sample crashes. Participating offers were trained to use this crash reporting procedure for workzone crashes. The researchers in conjunction with police management stressed the need for officers to collect data from all four portions of the workzone: approach, taper (or transition), construction area, and exit). Police were instructed to collect the data whether or not work actually was in progress.

Reports received from the participating agencies were reviewed shortly after they were received and, when needed, we advised police managers of data collection problems. However, almost all of the reports were complete, and based on a comparison of narrative and diagram with the other reporting elements, the reports appeared reasonably accurate and precise. Feedback from the police agencies suggested that officers participating in the data collection had made a concerted effort to provide their best estimates based on at-scene observations and interviews.

Analyses using the special, two-part reporting procedure yielded different results than did studies based solely on the Illinois Department of Transportation historic data files, in part, because the historic data had many quality deficiencies.

These data were used to identify where within workzones crashes are most likely to occur, their severity, and most importantly, to examine contributing circumstances. These reports were supplemented with both on-site observations and videotaping to identify motorists’ behaviors which may have precipitated the crashes. The results of these behavioral observations are coupled with the findings from the crash reporting to produce our interpretations.

CHARACTERISTICS OF WORKZONE CRASHES

Number of Crashes Reported

This special reporting procedure provided data from 110 crashes in seven workzones located in the northern and western portions of Illinois during 1998 and 1999. However, in their opinion, the workzone played a role only in 103 of them. For the others, the police determined that the crash would have occurred even had there been no workzone.
Description of Crashes

Tabulations based on data from the 103 specially prepared reports were compared to those reported to the state in 1994 and 1995 (the latest complete set of data available at the time of the study). As shown in Table 1, crashes reported in workzones from the 1998 and 1999 special reporting had a lower percentage of injuries than those reported from the 1994 and 1995 statewide data. The 22% of the crashes reported as injury producing was similar to the historic percentage for crashes occurring when workzones were not present. With the exception of work by Hall and Lorentz (6) in New Mexico, all other studies of crash experience in workzones have shown them to be more severe than when the zone was not in place.

This difference in crash severity could have, in part, resulted from the fact that most of the crash reports related to construction on multi-lane suburban and rural highways where “Jersey” type barriers often were in place to separate traffic flows. However, during the research on the overall project related to workzone, and using 1994 crash data abstracted from the State of Illinois files, we found that police often failed to report crashes as “construction zone” even though a workzone was in place where the crash occurred. As discovered from the special reporting, this failure probably arose from two sources. First, if the crash did not occur within the actual working area, it was likely not to be coded as “construction zone.” Second, police often failed to use the “construction zone” code for property-damage-only (PDO) crashes. In this latter case, fewer PDO crashes would be reported, and crashes involving injuries would be over-represented.

In conjunction with other research being performed related to workzone safety, we examined all crashes at a sample of more than 20 sites with active workzones in 1994. The review showed that within the length of roadway and time that the workzone was in place, on the average 65% of crashes may have been miscoded. Adjusting crashes for this under-reporting yielded a result that showed workzone crashes in general to be no more likely to produce injuries than crashes outside the zones. Table 1 includes the 1994 percentages adjusted for observed under-reporting.

Further support for this finding came from an examination of the 103 crash reports submitted as part of the special reporting. For 47 crashes (46%), the reporting officer failed to use the code “construction zone.” Nine of these reports were for crashes occurring within the work area. More importantly, of the remaining 56 reports coded “construction zone,” 32% were for injury-producing crashes. When all crashes were used, only 22% resulted in injuries. Only these 56 reports which carried the “construction zone” code would have appeared in the state database as workzone crashes. The 32% of crashes producing injuries from the special reporting is very similar to the statewide injury crash for 1994 and 1995.

When crashes are examined across all parts of the workzone, not just the working area, differences in severity become evident. As shown in Table 2, 59% of the specially-reported crashes occurred in the work area, but only 18% were injury producing. The
injury percentage in the work area, even though obtained from a small sample, mirrors the injury percentage for 1994 and 1995 crashes statewide coded “outside workzone.” On the other hand, for crashes occurring in the approach or taper sections, 29% were injury producing (which for this sample was not significantly different from the work area percentage).

The most frequent manner of collision across all workzone locations was rear-end, followed by sideswipe with both vehicles traveling in the same direction. Rear-end collisions were more common (56%) than had been noted in the literature (6), (7), (8). Collisions with objects, on the other hand, were substantially lower (12%) than findings from other research, for example Nemeth (7) showed 25% and Hall (6), 15%.

Limitations to the sample, and the fact that it involved only four-lane, suburban or rural roadways without intersections affected the types of collisions we recorded. The lack of angle and turning collisions in the sample could have led to rear-end collisions representing a greater percentage.

Within the work area, 64% of the crashes were rear-end. Given the narrower lanes and concrete barriers, there was no escape. However, rear-end collisions also occurred approximately as frequently (63%) in the approach. Sudden and unexpected slowing of vehicles where a queue formed as a result of merging traffic probably was the most likely contributor.

In the taper, the most frequent crash type was same-direction sideswipe accounting for 13 of 18 crashes recorded (72%). Improper merging likely would account for most of the crashes recorded.

The ability to determine where within the workzone the collision occurred was important in this analysis. Because precise location of crashes within the workzone usually are not recorded in typical police reports, this is the first time distinctions can be drawn between the specific sections of the workzone.

**Contributing Factors**

**Work in Progress**

Reporting officers were asked to determine if work was in progress at the time of the crash. In 62 of the 103 reports (60%) work was in progress. An injury crash was slightly more likely to have been reported when work was in progress (Table 3). The higher percentage of crashes in the work area when work was in progress than at other times likely arose from drivers responding to distractions outside the vehicle. When police officers were asked to identify contributing factors (next section), distractions from construction activity frequently was noted as a contributor to the crash. The rear-end collision was the most frequent type of collision when work was in progress, as opposed to other manners of collision when there was no work.
Driving Environment

Reporting officers were asked to indicate, based on their assessment of the crash, which elements in the driving environment and driver actions may have contributed to the crash (see Figure 1). Officers could check more than one element and one action. The average number of environmental elements checked was 1.1; an average of 1.5 driver actions were indicated.

Lack of escape (see Table 4) was recorded as a environmental (external) factor in 27 (26%) of the 103 crashes. Next most frequently checked was interference (distraction) from the construction activity, accounting for 14 (14%) of the crashes. Almost all crashes with this contributing factor occurred within the work area. Interference from traffic control devices (TCD) accounted for 13% of the crashes; most of these were on the approach.

Driver Actions

Police identified 152 driver actions that contributed to the crash (Table 5). Stopping or sudden slowing was checked 38 times or 37% of all crashes (and even higher, 44%, of those crashes occurring inside the work area). Second most frequently identified was “following too closely,” occurring 24% of the time (also indicated more frequently for crashes within the work area). These interpretations correspond to the fact that 64% of the crashes were rear-end. Failure to yield and distractions from within the vehicle accounted for 18% and 17% of the crashes where these driver elements were checked. Both elements also were checked at a slightly higher rate in the approach and taper. On the other hand, excessive speed (above the speed limit) was checked only 5 times; once in the work area and four outside. This action represented 5% of all contributing driver actions and was substantially lower than reports from most other researchers except the case studies by Ha and Nemeth (11), who examined specific crashes in an Ohio workzone and found only one instance where speed (too fast for conditions) appeared to be a contributing factor.

There is a seeming paradox in that police officers cited 54 drivers in the 103 crashes for “speed too fast to avoid an accident” (ILCS 11-601a). When officers were specifically asked to indicate if speed in excess of the limit was a cause, they rarely did so.

Drivers and Vehicles

Police traditionally list the at-fault driver as the first driver on the crash report. In Illinois, most agencies, especially the State Police who prepared the largest number of the reports, follow this practice. Analysis based on data from the first-listed driver showed that male drivers were at fault in almost 70% of the workzone crashes. Statewide, only 56% of the at-fault drivers were male. Data from all crashes in Illinois show 42% of the at-fault drivers were between the ages of 26 to 65 as opposed to 52% of the at-fault
drivers in the workzone crashes. More importantly, this same age grouping was responsible for 52% of injury-producing crashes statewide, and 70% of the workzone injury crashes. Finally, drivers 66 and older were at fault 12% of the time in those collisions occurring in the approach and the taper as opposed to 9% for the entire workzone. The statewide overall rate of at-fault for drivers 66 and older is approximately 5%.

Approximately 18% of the crashes involved three or more vehicles. This is 2.5 times the percentage of such crashes statewide. It also is 150% more than had been reported using the workzone crash reports contained on the IDOT database. The over representation of three-plus-vehicle crashes compared to statewide statistics can be explained by the fact that workzones with reduced lanes are more likely to be congested. When one driver suddenly changes speed, the lack of escape creates a situation where following drivers cannot avoid the crash. Three-vehicle crashes from the special reports exceeded the percentage from “workzone” crashes in the State database because of the pattern of failure to code crashes as occurring within workzones. On the other hand, single-vehicle crashes in workzones occurred at a substantially lower percentage than in statewide statistics.

**OBSERVATION OF DRIVER BEHAVIORS**

**Videotaping Drivers in Merging Locations**

Because 40% of workzone crashes occurred in the approach and transition, and these were more likely to be injury producing, we videotaped and interpreted driver behavior at this portion of the workzone to understand behaviors. Taping took place at three of the sites used for the special crash reporting. At each location the camera was located above the traffic either on a bridge over the roadway or on the roof of a nearby building. More than 4 hours of videotape were recorded when queuing was occurring.

Several classes of driver behavior were identified and counted from observations of the tapes. These behaviors were exhibited by merging drivers in both the closed lane and through (open) lanes. Five separate classifications were employed for the merging drivers:

a. Early merge (at a point early enough that no apparent slowing of traffic occurred); this was considered the normal or “safe” pattern
b. Mid merge (into the queue of the through lane, but not near the taper - at least 50 meters prior)
c. Late merge (immediately before or into the taper)
d. Forcing (more than one driver attempting to enter the same gap in the through lane)
e. Using shoulder (moving to the shoulder to pass others and then merging at a later point)
Four through-lane behaviors were observed:

a. Normal (allowed alternate merge when another driver attempted the merge)

b. Vigilante (the driver who blocks merging vehicles from moving to the head of the queue)

c. Failure to yield (failing to provide a gap for a merging vehicle)

d. Stopping in lane ( stopping to allow one or more drivers to merge)

Finally, one behavior applied to both the through and merging lanes. This was the driver who approached the end of the queue at a high rate of speed (relative to vehicles in the other lane). This action was noted more frequently in the through merging lane. Table 6 shows the relative frequency at which various behaviors were observed.

For discussion in this report only those actions which were considered directly contributory to safety are discussed. In the merging lane, this includes early, mid, and late merge, and forcing into a gap. In the through lanes, the actions are failure to yield and approaching the end of the queue too fast.

**Traffic in the Merging Lane**

*Early Merging*

An early merge was defined as a driver entering the traffic stream in the free flowing portion, or when a queue had formed, entering the stream prior to the queue. Such merging generally occurs without any noticeable interruption of the traffic flow. Under conditions where no queue exists (or at the minimum, the queue consists of one or two vehicles), most drivers were observed to merge early. These drivers appear to be reacting immediately to the warning sign indicating lane merger. In the videotaping, upwards of 50% of all drivers merged early, even though short queues had formed. However, as the traffic volume increased and queues lengthened, the percent merging early decreases. This reduction was most noticeable of the four-lane arterial roadway.

Because there is no apparent disruption to the traffic flow, and merging is done at the point where sufficient gaps exist, early merging is a safe behavior. Opportunities for vehicles to be involved in collisions are minimal.

*Mid Merge*

The term "mid merge" was given to drivers who merged into a queue but at a distance of several car lengths prior to the start of the taper. Gaps in the through stream were minimal. Therefore, when a driver merged, the driver of the vehicle in the through lane momentarily stopped. Frequently, the driver in the merging lane also slowed or stopped. As a result, stoppage often occurred in both lanes. The percentage of drivers merging into the queue prior to the taper decreased as the volume in both lanes
increased. Drivers in the merging lane either entered the through lane early or waited until the taper. The act of waiting until the taper was especially evident on the lower speed, four-lane arterial roadway where most drivers merged at the last possible moment.

Any time a stoppage occurs, the “start-up delay” can be as much as three seconds (12). If mid-merging occurs frequently enough, significant lengthening of travel time may occur because of these delays. Also, because drivers stop, and because of relatively short headways in the queues, the opportunity for a rear-end collision increases. Moreover, if the merging vehicle forces the gap and the driver in the through lane is not expecting the maneuver, the opportunity for a sideswipe collision increases. The supplemental reporting showed that both types of collisions occurred frequently in the approach.

Late Merge

Late merge occurs in the taper. Either a sufficient gap existed to allow the driver in the merging lane to enter smoothly, or the merging driver partially moved into a gap and the driver in the through lane slowed or stopped, allowing the merge to proceed. If there was a sufficient gap for the merger, and the merging driver could continue without slowing, disruptions to the traffic flow appeared to be minimal. As long as stoppage did not occur, even under saturated conditions, the drivers in both lanes would experience shorter travel times through the taper than if either had to slow or stop. However, if a driver in the through lane did not provide a sufficient gap, the merging driver had one of two choices: force the vehicle into the available gap, causing the through-lane driver to stop; or stop and attempt to merge into the next gap. The latter action, because the merging driver was now starting from a stop, caused the driver in the through lane to stop. When an adequate gap was not available, vehicles in the through and merging lanes stopped.

Occasionally, two vehicles from the merging lane attempted to enter the same gap. This behavior was most noticeable at the taper, but it occurred occasionally in the middle of the queue. Every time two vehicles merged together into the through lane, traffic in both lanes stopped.

The effect of late merging, especially when drivers in the through lane are not providing adequate gaps, is similar to mid merge: delays increase, as do opportunities for rear-end and sideswipe collisions also increase.

However, if alternate merging is expected (and perhaps mandated), there may be a greater likelihood that drivers in the through lanes will provide an adequate gap. Pennsylvania has been experimenting with the alternate merge. Signs are posted encouraging drivers to stay in lane and merge alternately at the taper. In their evaluation of this concept, Pesti et al. (13) suggested that flow through the merge point
could be increased by as much as 300 vehicles per hour. This supported earlier findings for freeway construction zones by Orth-Rogers Associates (14). Further testing of the Pennsylvania approach is needed. Theoretical work also should be done to support the empirical findings.

**Traffic in the Through Lane**

*Failure to Yield*

Drivers in the through lane at the last merging point occasionally were observed closing the gap to prevent merging. This caused the driver in the merging lane to stop and wait for the next gap. However, the driver in the through lane also had to brake to avoid colliding with the vehicle in front. This latter action slowed or stopped the vehicles in the through lane as well. In such cases, failure to yield increases the delay to all vehicles in both lanes. More importantly, it increases the likelihood of a rear-end collision in both lanes. In the through lane, the accelerating driver might not have a sufficient gap to react to sudden slowing of the vehicle ahead. In the merging lane, the driver following the merging vehicle may not be prepared for the sudden stop if the merge cannot not occur.

Specifying alternate merging as a requirement might make drivers aware of the need to provide adequate gaps. Such a requirement also would allow the process to be supported through enforcement.

*Rapid Approach to End of Queue and to the Merge*

Occasionally we observed drivers who rapidly approached the end of the queue despite advanced warnings indicating construction ahead, merging lanes, and slowing traffic. Some of these drivers may not have been watching for the location of the end of the queue. In one video, approaching drivers were traveling so fast, they had to pull to the shoulder to avoid a collision. As shown in Table 6, these actions were observed at least 5% of the time.

Providing the drivers with visual information on the conditions ahead might encourage them to follow the recommendations from the warning signs. Where the end of the queue may not be visible, one method of alerting drivers would be to provide large video screens displaying the traffic ahead. Enhanced enforcement of speeds in the approach could be beneficial, especially if coupled with the use of variable speed limit signs. The latter are being used widely in Europe for congested conditions, especially on limited-access roads.
CONCLUSIONS FROM ANALYSIS OF CRASHES AND DRIVING BEHAVIOR

*Speed management*

The narratives in the crash reports suggested that excessive speed is a possible contributor to crashes occurring in the approach and taper. Although the driver may have been within a commonly accepted tolerance for the given speed limit, e.g., 10 km/h faster than that posted, the limit may have been too high for the approach. Observations from the videotape also showed more than 5% of drivers appeared to be approaching the queue at high rates of speed relative to the speed of vehicles in the queue. Given that approximately 40% of the crashes in this study occurred on the approach and taper, attention to approach speed is warranted. Reducing the speed limit without an external stimulus for the motorist to slow is not likely to result in speed reduction (15). Attention can be given to other speed management devices, including rumble strips, optical speed bars, and speed readout devices.

*Merge management*

The large number of sideswipe collisions during merger apparently resulted from failure to yield, especially when the number of acceptable gaps is not sufficient. Uncooperative driver behaviors such as failure to provide a gap or the attempt of two or more drivers to enter the same gap are contributing events. A more clearly established merge procedure in the approach and tape regions of workzones, along with appropriate legal backing, might reduce the likelihood of collisions. Without a clear strategy for approaching the work area, the actions of motorists (including those motorists who move from the through lane to block the merging lane) will continue to create crash risks. It may be possible to reduce collisions by encouraging alternate merging by: (1) educating drivers about the advantages of this procedure, (2) establishing a legal requirement, and (3) backing these steps with adequate enforcement.

*Enforcement*

Deployment of enforcement resources in the approach and taper seems to be desirable. When police patrols were observed during our visits to workzones, they were always inside the work area, apparently using radar to detect drivers exceeding the construction zone speed limits. Yet, as the special crash reporting indicated, only 60% of the crashes might be occurring at this location. These crashes were less severe and speed was less of a factor than for those crashes occurring in the approach and taper sections. Traffic violations contributing to crashes within the work area appeared to be more related to inattentive driving and following too closely rather than excessive speed. The approach and taper sections may offer more effective opportunities for controlling speed and failure to yield, and they present safer locations for making traffic stops while causing less delay to other drivers.
Crash reporting

This study has shown that workzone crashes are likely to occur more frequently than reported with standard procedures. Moreover, as many as 40% occur in the approach and taper sections. Most standard police crash reports do not encourage officers to report crashes occurring outside the working area as “workzone related.” The Minimum Uniform Crash Criteria (16) manual specifically defines the workzone on the basis of the presence of workers. Clearly this will not capture all of the important safety consequences of workzones. Broader definitions would capture a larger and more useful data set. Encouraging more detailed and more accurate coding of crash locations and characteristics will provide a better basis for improving workzone safety in the future.

REFERENCES


### Figure 1

**Supplemental Crash Reporting for Construction Zone Crashes**

*(To Be Completed for All Crashes Occurring within a Construction Zone Reported On-Scene)*

<table>
<thead>
<tr>
<th>Date: ___________________</th>
<th>Crash Report Nbr. ______________________</th>
</tr>
</thead>
</table>

1. Did the construction zone (as defined on the reverse side) contribute to the crash (did it occur because the construction zone was there)?
   - NO  **Do not complete the form**
   - YES  **Please continue with the form**

2. Based on the picture shown on the reverse side, where did the crash occur (check one)?
   - Advance area
   - Taper or crossover (to two-way traffic)
   - Work area
   - Exit

   Approximately how far from the point marking the end of the taper (or crossover) and start of the work area did the crash occur:
   
   ______ feet **BEFORE** or **AFTER** (circle one)

3. Which of the following elements related to the construction zone contributed to the crash? (check all that apply)
   - Interference with the driving lane from construction equipment or personnel.
   - Distraction resulting from activity in the work area.
   - Obstructed view of traffic by vehicles, signs, or activity in the work area.
   - Interference with the driving lane from traffic control devices (cones, barriers, etc.).
   - Missing, improperly placed, or ambiguous striping, cones, barriers, or traffic control devices.
   - Damaged pavement or unexpected changes in pavement levels.
   - Narrow lanes
   - Lack of adequate escape
   - Other - please specify: ____________________________

4. What actions of motorists or vehicle, including the at-fault driver, contributed to the crash? (check all that apply)
   - Stopping (stopped), sudden slowing, or driving at speed substantially below that of other traffic.
   - Driving outside/straddling the marked lane.
   - Unexpected lane change.
   - Failure to yield from on-ramp or merging at taper.
   - Driving in excess of the speed limit (indicate speed limit: _______ mph)
   - Rapid acceleration, high speed, or lane changes in the exit zone.
   - Following too closely.
   - Driving too rapidly or improper passing prior to the taper.
   - Distraction from within vehicle
   - Alcohol, drugs, or asleep
   - Vehicle defect
   - Other - please specify: ____________________________

5. Was construction in progress at the time the crash occurred?
   - YES
   - NO

6. In your opinion, could changes have been made in design, marking, or other aspects of the construction zone that might have helped prevent the collision?
   - YES
   - NO

Specify: __________________________________________

__________________________________________

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*The Traffic Institute, 405 Church Street, Evanston, IL 60204, attn: Richard A. Raub, Research Scientist*
Construction Zone with One-lane Reduction

- Exit
- Actual Activity
- Work Area
- Division between the Taper and Workzone
- Taper (transition)
- Advance Area*

*Note: the advance area can vary in length depending upon traffic, but always should include the 1/2 mile preceding the work area.
### Table 1
Differences in Severity of Workzone Crashes, State Database and Special Reporting

<table>
<thead>
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<th></th>
<th></th>
<th></th>
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<tr>
<td></td>
<td></td>
<td>Outside Workzone</td>
<td>Workzone</td>
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<tr>
<td>Fatal</td>
<td>0.0%</td>
<td>0.3%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Injury</td>
<td>22.3%</td>
<td>21.6%</td>
<td>32.7%</td>
</tr>
<tr>
<td>PDO</td>
<td>77.7%</td>
<td>78.1%</td>
<td>67.0%</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td>900,964</td>
<td>13,955</td>
</tr>
</tbody>
</table>

### Table 2
1998/99 Workzone Crashes (Special Reporting) by Severity and Manner of Collision

<table>
<thead>
<tr>
<th>Location in Workzone</th>
<th>Severity</th>
<th>Injury</th>
<th>PDO</th>
<th>Percent of All Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach</td>
<td></td>
<td>7</td>
<td>16</td>
<td>30.4%</td>
</tr>
<tr>
<td>Taper</td>
<td></td>
<td>5</td>
<td>13</td>
<td>27.8%</td>
</tr>
<tr>
<td>Work Area</td>
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<td>11</td>
<td>50</td>
<td>18.0%</td>
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<tr>
<td>Exit</td>
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<td>0.0%</td>
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<tr>
<td>Total</td>
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<td>23</td>
<td>80</td>
<td>22.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location in Workzone</th>
<th>Manner of Collision (selected)</th>
<th>Pedestrian</th>
<th>Object</th>
<th>Rear-end</th>
<th>Sideswipe</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach</td>
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<td>1</td>
<td>1</td>
<td>15</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Taper</td>
<td></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Work Area</td>
<td></td>
<td>0</td>
<td>10</td>
<td>39</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Exit</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1</td>
<td>12</td>
<td>58</td>
<td>26</td>
<td>6</td>
</tr>
</tbody>
</table>

| Percent of Crashes   | 1.0% | 11.7% | 56.3% | 25.2% | 5.8% |
| All IDOT 94/95 Workzone Crashes (%) | 2.2% | 15.8% | 33.1% | 8.0% | 16.7% |
Table 3
Crashes and Work in Progress

<table>
<thead>
<tr>
<th>Work in Progress</th>
<th>Severity PDO</th>
<th>Severity Injury</th>
<th>All Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>74.2%</td>
<td>25.8%</td>
<td>62</td>
</tr>
<tr>
<td>No</td>
<td>82.9%</td>
<td>17.1%</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work in Location in Workzone</th>
<th>Approach PDO</th>
<th>Taper PDO</th>
<th>Work Area PDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>22.6%</td>
<td>11.3%</td>
<td>66.1%</td>
</tr>
<tr>
<td>No</td>
<td>22.0%</td>
<td>26.8%</td>
<td>48.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work in Manner of Collision</th>
<th>Rear-end PDO</th>
<th>Sideswipe PDO</th>
<th>Object PDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>69.4%</td>
<td>21.0%</td>
<td>3.2%</td>
</tr>
<tr>
<td>No</td>
<td>36.6%</td>
<td>31.7%</td>
<td>24.4%</td>
</tr>
</tbody>
</table>

Table 4
Contributing Roadway Elements to Crashes (External)

<table>
<thead>
<tr>
<th>Contributing Elements(^1)</th>
<th>All Crashes</th>
<th>Location in Workzone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent of Crashes</td>
</tr>
<tr>
<td>Interference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>13</td>
<td>11%</td>
</tr>
<tr>
<td>Activity</td>
<td>14</td>
<td>14%</td>
</tr>
<tr>
<td>Construction</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Obstructed View</td>
<td>7</td>
<td>6%</td>
</tr>
<tr>
<td>TCD Problem</td>
<td>6</td>
<td>5%</td>
</tr>
<tr>
<td>Pavement</td>
<td>6</td>
<td>5%</td>
</tr>
<tr>
<td>Narrow Lanes</td>
<td>14</td>
<td>14%</td>
</tr>
<tr>
<td>No Escape</td>
<td>27</td>
<td>24%</td>
</tr>
<tr>
<td>Other</td>
<td>22</td>
<td>19%</td>
</tr>
<tr>
<td>Total</td>
<td>114</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^1\) Police could check one or more contributing elements
### Table 5
**Contributing Driver Actions to Crashes**

<table>
<thead>
<tr>
<th>Driver Actions</th>
<th>All Crashes</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Sudden</td>
<td>38</td>
<td>25%</td>
</tr>
<tr>
<td>Driving Outside</td>
<td>9</td>
<td>6%</td>
</tr>
<tr>
<td>Improper Lane</td>
<td>13</td>
<td>9%</td>
</tr>
<tr>
<td>Failure to Yield</td>
<td>19</td>
<td>13%</td>
</tr>
<tr>
<td>Exceed Speed Limit</td>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>Exit Behavior</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Following Too</td>
<td>25</td>
<td>15%</td>
</tr>
<tr>
<td>Improper Approach</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Distract Inside</td>
<td>17</td>
<td>11%</td>
</tr>
<tr>
<td>Alcohol/Drugs</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Vehicle Defect</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>19</td>
<td>13%</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td></td>
</tr>
</tbody>
</table>

1 Police could check one or more contributing elements

### Table 6
**Driver Behavior Classification**

<table>
<thead>
<tr>
<th>Behavior Type</th>
<th>IL 120 – 1st Visit</th>
<th>IL 120 – 2nd Visit</th>
<th>Interstate 94</th>
<th>Dundee Rd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Merging Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Est. Merging Volume (%)</td>
<td>19.9%</td>
<td>16.5%</td>
<td>47.8%</td>
<td>30.3%</td>
</tr>
<tr>
<td>a. Early</td>
<td>48.7%</td>
<td>55.6%</td>
<td>53.7%</td>
<td>17.1%</td>
</tr>
<tr>
<td>b. Mid Merge</td>
<td>41.7%</td>
<td>29.0%</td>
<td>5.8%</td>
<td>12.2%</td>
</tr>
<tr>
<td>c. Late Merge</td>
<td>9.2%</td>
<td>14.5%</td>
<td>40.3%</td>
<td>65.8%</td>
</tr>
<tr>
<td>d. Forcing Merge</td>
<td>0.4%</td>
<td>0.9%</td>
<td>0.2%</td>
<td>4.9%</td>
</tr>
<tr>
<td>e. Using Shoulder</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Through Lane</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Normal Behavior</td>
<td>98.2%</td>
<td>97.1%</td>
<td>90.9%</td>
<td>94.6%</td>
</tr>
<tr>
<td>b. Vigilante</td>
<td>0.6%</td>
<td>2.9%</td>
<td>2.7%</td>
<td>1.8%</td>
</tr>
<tr>
<td>c. Failure to Yield</td>
<td>1.2%</td>
<td>0.0%</td>
<td>6.4%</td>
<td>3.3%</td>
</tr>
<tr>
<td>d. Stopping in Lane</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Rapid Approach to the</td>
<td>0.9%</td>
<td>4.8%</td>
<td>4.9%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Flow (vph)</td>
<td>1300</td>
<td>1300</td>
<td>1800</td>
<td>1800</td>
</tr>
</tbody>
</table>

* Percent of all vehicles approaching merge