INTRODUCTION

Working on or adjacent to roadways while traffic flows is dangerous. It is dangerous to the workmen who are constantly exposed to a stream of vehicular traffic. It is also dangerous to the motorist who may suddenly be forced into a situation that he did not or could not anticipate. The relatively high frequency and cost of accidents related to highway and utility construction and maintenance operations indicates a need for positive traffic control in areas where work is being performed.

Losses From Accidents at Construction Sites High

During 1969, 6,965 motorists and workers were involved in traffic-related accidents at road construction or maintenance sites in Illinois. Twenty people died as a result. These Illinois figures are typical of most other states.

The cost of these accidents in Illinois, in terms of medical bills, property damage, and lost work time, was an estimated $6,377,540. Much of this could have been avoided.

Where traffic must move through or around construction and maintenance operations, conditions are more dangerous and difficult to control because, to the motorist, they are unexpected and not in accord with the normal pattern of highway traffic.

Need for Sharp Separation of Traffic and Workers

The chances of an accident are reduced by clearly delineating a definite area for construction and maintenance operations and another area for the specific use of through traffic. Workers would rather be separated from traffic and the motorist wants and needs protection from the conditions and equipment in the work area.

Protection Arrangements Required Highly Variable

Obviously, no one standard sequence of signs or other control devices can be established as an inflexible arrangement for all situations.
Maintenance activities include such minor operations as roadside mowing, tree trimming, and ditch clearing. These activities normally require only that the motorist exercise a little extra care in driving, such as a reduction in speed to compensate for infrequent short term encroachments by men or equipment on the traveled way. At worst, more tangible interference to traffic in the form of standing or slowly moving equipment on the highway may exist for limited periods of time.

Pavement patching or culvert repair may close parts of the roadway for extended periods of time, while a major maintenance or construction project may reduce the traveled way to a single lane, requiring vehicles to move alternately in opposite directions. Where major repair or construction is required, a temporary detour over other highways may be provided for the safety of the motorist. Traffic control for this wide range of conditions can vary from the simplest installation of temporary warning signs to a complete road closure. Even for the same project, necessary protection may vary from hour to hour and from day to day and will definitely vary between day and night.

CONSIDERATIONS IN MAKING A TRAFFIC CONTROL PLAN

In some cases, consideration will have to be given to the coordination of traffic controls in overlapping construction contracts or utility work within the same general construction area. In cases such as these, a complete traffic control plan must be developed to insure safety for all activities. Operations of this type will often require that the traffic control plan be implemented in stages.

In deciding specifically what control devices are required, consideration must be given to the roadway type. Urban traffic conditions are characterized by relatively low speeds, high traffic volumes, limited maneuvering space, frequent turns, conflicting cross movements, and significant pedestrian movements. Traffic obstructions, particularly in the form of parked vehicles, are common. Construction and maintenance operations are more numerous and varied and include such diverse activities as pavement cuts for utility work, pavement patching, resurfacing, and even encroachments due to adjacent building construction. There is already ample conflict inherent in normal urban traffic movements and further conflict due to construction and maintenance operations should be kept to a minimum. Density of traffic on these facilities requires that traffic control procedures be designed and implemented only after detailed study of existing traffic conditions and the operation that is to be performed. On rural type highways, the primary problem is speed of vehicular travel.
ILLINOIS COMPLETES REVISION OF STANDARDS FOR TEMPORARY TRAFFIC CONTROL

In recent years, it has become apparent that improvement of traffic control during construction and maintenance operations is essential. Historically, the use of temporary motorist warning for work areas has been geared to legally required protection for workmen. Past methods and systems were developed when traffic was much less dense and moved much more slowly. Now we have a good opportunity to institute needed changes in the old, inadequate procedures due to current national attention to the problem and firm requirements for such things as steady-burning lights for delineation of work areas as required by the new national manual. Nearly two years ago, this impending national impetus generated recognition of the need for better practices, and traffic engineers in Illinois completed planning of a "major overhaul" of state standards related to temporary traffic control.

New Standards Developed Over Two-Year Period

While provisions were made to improve protection for workmen, concentrated consideration was also given to the danger existing for the motorist while traveling through or around a work area. In recognition of accepted practices concerning uniformity of traffic control devices, standardization of warning devices, and the need for protection methods to meet the requirements of traffic flow of the 1970's, several revisions or new traffic control device designs and systems of use were obviously necessary. Barricades, cones, and signs were standardized related to size, color, reflective material, and placement. From the initial planning to the finished product, the preparation and implementation of use of a new series of traffic control standards was a two-year job.

Many Areas of Highway Department Contribute

These new standards reflect the efforts of many offices of the State of Illinois Division of Highways who are all interested in improved safety for workmen and motorists. Needless to say, the final product still incorporates many compromises. The standards were prepared under the immediate direction of the Bureau of Traffic. Other persons were consulted for ideas and varied system designs were proposed by the Bureaus of Construction, Design, and Maintenance, the various district offices, and utility company representatives. The utility companies were represented throughout the planning process by members of the Utility Liaison Committee of the American Right-of-Way Association.
Standard “Cases” Cover Most Operations in R-O-W

Following many meetings of representatives of affected organizations a series of standard “cases” covering the major portion of all operations within the right-of-way were approved. The standards consist of 18 “cases” plus three additional standards covering details of traffic control devices. Three “cases” were also developed as recommended guides for use in urban areas. Due to the many varied conditions in traffic and road conditions in urban areas, it appeared impossible to develop a complete set of specific controls for urban areas but recommended guidelines were prepared that could be modified to fit most existing site conditions.

New System Approved by FHA

The new system, which has the approval of the Federal Highway Administration, represents an upgrading of traffic control requirements “across the board.” Directed toward improved safety for both workmen and motorists the new requirements are designed specifically to facilitate quick and easy passage of traffic through or around a construction or maintenance zone—either day or night—with a standardized system of warnings that is simple to understand and easily recognized.

Minimum Requirements of Standards May Often Need to be Exceeded

The standard sequence of traffic control devices that has been established for most rural locations may have to be modified to serve special rural locations. The minimum requirements of the standards will often need to be exceeded for particular conditions on high-speed access-controlled freeways or urban expressways. However, the same important basic consideration of uniformly applying the general principles should be followed on all facilities.

Consideration in Selecting Proper System for Traffic Control

To select a proper system of traffic control for any project, the engineer in charge must consider: (1) the type of work operation, (2) its physical location as related to moving traffic, (3) the type of roadway involved, (4) the normal speeds and density of traffic, (5) the length of time the job will take, (6) the time of day during which traffic will be affected, and (7) the environment of the area in the vicinity of the proposed project. The system selected must reduce the conflict between the motorist and the workmen to a minimum but the system may vary from a simple signing setup to a multiple series of signs, lights, barricades, pavement marking, and even a comprehensive preconstruction public information campaign. The use of flagmen may
be required to control the movement of motorists through the con­struction or maintenance area. Illinois statutes require contractors to provide two flagmen any time one-way traffic is necessary while men or equipment are working on the highway or street open to through traffic. Under certain conditions, temporary signals may be used in lieu of or in addition to flagmen.

Chapter of Uniform Traffic Control Devices—Construction—Updated

In connection with the new standards, the chapter of the Illinois Manual of Uniform Traffic Control Devices for Streets and Highways related to construction and maintenance operations has been updated and rewritten. This chapter contains detailed drawings of signs used for construction and maintenance warning signs, a complete set of the standards, and other related material. This chapter has been printed and assembled to be used as a separate document within itself. It has been filed with the Secretary of State, and thus has become the official policy governing all work on streets and highways in Illinois.

Many Notes per Standard

Here is a typical standard. Although those in the back of the room can't read the printing, you can at least see the many detailed notes contained on each such standard that could provoke a full day of dis­cussion. With this in mind, I will not discuss specific requirements on any individual standard.

Striped Barricades

The stripes on all barricades are to be alternating 6-inch widths of black and white at a 45 degree angle. The barricades must be striped on both sides with the back of the barricades striped in a manner similar to that described for the front portion. The striping on the reverse side of the barricades shall be placed in such a manner that by reversing the barricades the downward sloping angle of the striping will indicate traffic is to pass on the opposite side of the barricade posi­tion.

Orange 48-in. Diamond-Shaped Signs

The standards also prescribe the use of 48-inch by 48-inch diamond shaped signs on all rural highways and urban expressways that have normal posted speeds of 45 miles per hour or more. These signs are to have an orange reflectorized background with black border and legend. These orange signs were authorized for experimental use in Illinois by the American Association of State Highway Officials, with the con­currence of the federal highway administrator, for an evaluation of
their effectiveness. As most of you know, orange is the color that was finally selected by the National Joint Committee for use in the construction and maintenance portion of the revised *National Manual on Uniform Traffic Control Devices*. (Part VI)

**Flagman Signs**

Another addition to the Illinois standards is the new flagman traffic control sign. This is a 26-inch diameter sign that replaces the old hand-held paddle or red flag used by flagmen for directing traffic. One face of the new sign contains a standard 24-inch STOP face. On the opposite side is an orange and black diamond SLOW sign. These signs are mounted on a staff six feet in length. The use of this type of sign assures more motorists in the queue approaching the work area seeing and obeying the sign. This mounting design also assures that the traffic control sign will remain in a position to be seen by the motorist and not be placed in the flagman's pocket or used like a magic wand for wild waving and other inept attempts to direct traffic.

**Minimum Standards Set for each of 18 “Cases”—Operations in R-O-W**

The 18 “cases” included in the standards provide minimum standards for the majority of construction and maintenance operations within the right-of-way. These “cases” cover two-lane two-way roadways with provisions for day or night operations, as well as “cases” where the work is pursued during periods of time greater than one day. Provisions are also made for “cases” where the work is on or adjacent to a multilane divided or undivided highway for either day or night operations. I emphasize that these standards depict minimum traffic control and additional protection must be provided for special complex conditions or hazards that exist, particularly on high-speed expressway type facilities.

**Standards Include Work Area Limits**

The work areas shown on these standards include the limit of the area within which all construction and maintenance operations are being conducted, except for flagmen activities. In all cases, the vehicles, equipment, men and their activities involved in the construction and maintenance operations, are restricted to one side of the pavement unless otherwise authorized by the engineer. Due to specific field conditions that may arise in some locations, the longitudinal dimensions shown may be adjusted in order to provide the amount of protection intended. The standards make no provisions for a partial lane closure. When operations encroach on the roadway surface, a full lane shall be closed
with appropriate traffic control to be established. This is a particularly important aspect of proper control in these hazardous areas.

**Night Warning Signs**

Where warning signs are required at night, at least the first two signs of the series shall be supplemented by a high-intensity flashing amber light or torch during the period from sunset until sunrise.

**BACKGROUND FOR NEED OF STANDARDS**

**Study Shows Rear-End Accidents Most Frequent**

A review of construction site accidents that occurred in Illinois during 1969 indicated that the most common occurrence was rear-end collisions. Although a detailed study was not completed, it is estimated that approximately 80 percent of the accidents in these areas involved rear-end collisions. Accidents of this type that happen in work areas can be caused by several factors. First, the motorist fails to see the advance signs or other traffic control devices. Second, probably most common, the motorist disregards or forgets the message. Third, is the infrequent cases where the motorist does not understand the action required by the sign message.

**Overturn Off Road—Second Most Frequent Accidents**

The second most frequent type of accident occurring at construction and maintenance locations is described as “run off the road and overturn.” These usually occur because the driver fails to observe the advance warnings until he is required to suddenly apply his brakes or swerve to avoid a collision, which often leads to loss of control and overturning of the vehicle.

**Advance Warning Signs Found Lacking**

It is anticipated that the use of orange signs, which are distinctly different from any other type of warning sign, will serve as additional warning that there are workmen on the roadway. From a review of the traffic accidents and concurrent protection used on the roadway, it is clear that at least a share of the blame must fall on the workmen who install and then depend upon the protection devices. Too many accident reports state that the driver was surprised by a barricade across the road or a flagman stopping traffic with no advance signs. Advance signing is the best method we have of providing the motorist with the knowledge that there are workmen ahead on the road. In order for this warning to serve its purpose, some thought must be given to the location of the barricades and flagmen. If there is a crest vertical curve in the roadway or a horizontal curve, these devices must be
moved and positioned on the roadway so that the motorist will not be surprised as he rounds a curve or comes over the top of a hill.

One of the gross abuses of advance signing is the use of an inappropriate legend. How many times have you driven down the road and seen a MEN WORKING sign with no men in sight or a FLAG-MAN AHEAD sign when the flagman is either not present or at such a distance from the sign that when you reach him you have forgotten there was a sign announcing his presence?

False or Inaccurate Distance Message Signs Invite Contempt

A related problem is the use of signs incorporating distance messages. If a sign is erected on the roadway which says the lane is closed in 500 feet, then at a distance of 500 feet, the motorist would logically expect to see a barricade. If a sign message says something exists at a specific distance and the motorist doesn't see something at that distance, the next time he sees this same sign he will be inclined to ignore the message. Soon the motorists reach a state where they can't believe the signs that are put up on the roadway. Those who erect such signs have weakened the only protection that workmen have on the roadway.

Flagman in Poor Position

Let me relate some actual experiences from accident records that may illustrate what I have tried to say. First, a case in which some reasonable thought could have literally prevented a headache. A workman was working along the centerline with a jackhammer breaking out some pavement. A single flagman was stationed nearby directing one-way operations around the work area. As a car approached the work area, the flagman positioned himself on the left side of the open lane so that he was opposite the workmen. The accident report stated that the driver clearly saw the flagman and concentrated on missing him. As a result, a mirror on the right side of the vehicle struck the jackhammer operator in the head. While I suspect an attempt was being made to reduce costs by the use of only one flagman rather than the legally required two, the accident could still probably have been avoided if the flagman had properly positioned himself.

Cross Road Not Reckoned With

Another case involved a situation in which adequate warning signs were provided, barricades were properly in place, and flagmen were directing traffic in a one-way operation. As the traffic stream from the one direction approached and cleared, the flagman on the other end automatically released his stream of traffic to go through the work area but no one had considered traffic on a crossroad and a vehicle emerging
from the cross street collided with the stream of traffic that had been released by the flagman.

**Cone Markers Not Continuous**

Another example is the case where a substantial length of a multiline facility was being repaired and two lanes of traffic funneled into one lane through the work area. After traveling some distance, one motorist thought he had left the construction area because the centerline of cones was no longer present and his and other vehicles began to use both lanes. Suddenly the motorist leading the vehicle platoon in the left lane realized that there was again a line of cones along the centerline and that he should be in the right lane. These cones appeared with no taper or advance lane closed signs. The motorist in the lead car applied his brakes, causing a three-car chain reaction accident.

**CREATE SPECIAL JOB FOR TRAFFIC SAFETY IN CONSTRUCTION AREAS**

The need for improved highway safety and uniformity of practices in the control of traffic through these high hazard areas demands a strong policy covering preplanning of traffic control in construction and maintenance areas. This policy must also require a formal procedure for inspecting, evaluating, and reporting on the actual field installations used by public agency field forces, as well as those of contractors and utility companies. The policy must apply to all work involving any obstruction to the free flow of traffic in the normal traffic lanes, at any time on multilane highways, or work of sufficient duration that the obstruction will exist during hours of darkness on any other highway. A responsible engineering position reporting directly to a qualified traffic engineer should be created in appropriate sized offices for the overall supervision of activities related to construction and maintenance traffic control practices.

**Plan, Inspect, Evaluate and Report on Field Installations**

The policy should provide that a form similar to this one titled, "Traffic Control Authorization Requests" be submitted to the traffic engineer prior to starting any work covered under the standard conditions. Then, at least 72 hours before any work is begun, at a meeting with appropriate traffic engineering personnel, a traffic control plan should be established and reviewed for all phases of the proposed work. Once the work starts, a representative of the traffic engineer should inspect the initial traffic control installation within 24 hours of the time it is put in place. This same individual is then responsible for random
interval inspections, either day or night, not less than once per week during the entire period of operations.

A report similar to this one entitled “Traffic Control Inspection Report” should be prepared and filed in the traffic engineer's records, with one copy to be given to the individual responsible for the traffic control at the job site. This form covers a specific evaluation, as well as general comments or corrective measures recommended for such items of traffic control as: signs, lights, barricades, flagmen, pavement marking, traffic signals, channelizing devices. These devices should all be evaluated in relation to their condition, placement, night visibility, and general effectiveness. In this way, we not only have adequate plans and standards for traffic control devices on the highways, we also have a comprehensive inspection of every job site on our highways and an evaluation of the effectiveness of the actual installations.

**Inspection Reports Provide Records**

The inspection reports that are kept on file will become valuable records of the conditions at the time of work. These records will become increasingly useful to those responsible for the work and to the contractor's insurance companies where legal action is instituted as a result of a construction or maintenance site accident. Recent court decisions in many parts of the country seem to indicate neither a contractor, utility company, nor a governmental department can disclaim at least partial responsibility if an accident occurs at a highway work site where warning devices are not in compliance with those legally required.

**SUMMARY**

In summary, I would like to emphasize that if we are going to provide adequate guidance to the motorist and protection for the workman, we must do more than casual planning. We must not forget that to provide adequate safety we must consider the type of work being performed, its location as related to moving traffic, the type of roadway, and the hours of operation before we decide on the type of traffic control necessary. When we choose the type of traffic control, those devices used should conform to or follow a prescribed set of standards. The application of traffic control must always conform to the general requirements of the *Manual on Uniform Traffic Control Devices*. After all the parameters have been considered and the selection and installation accomplished, a procedure for inspecting and reporting must be implemented that will assure continued compliance until the project is completed.
As a final comment, I wish to assure you this new attention to an old problem is worth while. Based on experience for a full construction season, the accident rate in Illinois for accidents per job site decreased 33 percent as a result of the first year’s use of the new standards.

Fig. 1. Photo of tapered line of barricades closing a lane and clearly separating work area from traffic way.

Fig. 2. Photo of rural pavement intermittent patching.
Fig. 3. Photo of rural highway reconstruction by bituminous widening and resurfacing under traffic—note that traffic control must provide for oversize vehicles and loads.

Fig. 4. Photo of temporary crossover barricades during staged development of rural freeway.
Fig. 5. Photo at night of lane closure across small drainage structure—not recommended. Note bad centerline guidance.

Fig. 6. Photo of major rural freeway construction showing special barricades, pavement striping, and illumination.
Fig. 7. Photo showing temporary daylight freeway lane closure during installation of experimental louvered sign using cones rather than barricades.

Fig. 8. Photo showing use of temporary traffic signals during bridge deck reconstruction.
Fig. 9. Photo of typical standard drawing for minimum traffic control for a specific set of conditions on a two-lane rural highway.

Fig. 10. Photo of typical portable barricade providing maximum daylight contrast by use of black and white stripes.
Fig. 11. Photo showing “STOP” side of flagman traffic control sign. “SLOW” appears on back side of sign. (Figures 12 and 13 appear on pages 79 and 80)

Fig. 14. Photo showing night view of incorrectly placed barricades at a poorly maintained temporary runaround.
Fig. 12. Photo of Illinois form used for advance planning of temporary traffic control.
### Illinois Form: Record of Inspection of Temporary Traffic Control

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**Recommended Correction Measures**

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**Evaluate (Good, Fair, Not Acceptable)**

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**Report No.**

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**Inspected by**

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Fig. 13. Photo of Illinois form used for record of inspection of temporary traffic control.