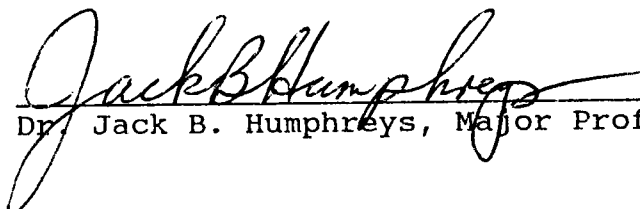
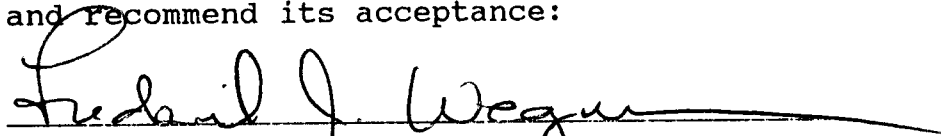
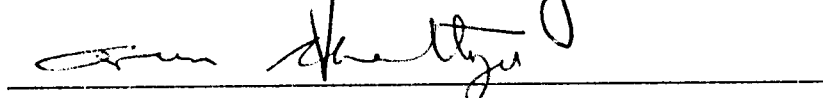


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TRAFFIC CONTROL CHANGES REQUIRING TRANSITION

A Thesis

Presented for the

Master of Science

Degree

University of Tennessee, Knoxville

William E. Cole

December, 1992

ABSTRACT

Transition to a new traffic control is needed for three reasons: safety, uniformity, and liability. Some transitions have been researched and had transition procedures developed, such as the installation or removal of a traffic signal and the reversal of Stop control at an intersection. However, no standardized transitions are documented in the Manual on Uniform Traffic Control Devices (MUTCD) and no standard transition nomenclature, similar to construction signing, exists at all.

This thesis explores transition in traffic control by reviewing published material on the subject, determining what types of control changes professionals in the field feel warrant transition and summarizing currently used policies and procedures. It introduces a set of model transition procedures using concepts found in the literature review and policies being used in the field. Then, by using some limited case studies and a final feedback questionnaire, these procedures are modified.

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CHAPTER 1

THE PROBLEM

Statement of the Problem

As traffic patterns change at specific locations in the roadway system, changes are also necessary in the operational procedures and devices that control those traffic patterns. A Two Way STOP may be changed to a Four Way STOP, a signal may be added at a previously unsignalized intersection, or a signal may be removed because it no longer meets warrants. Traffic control changes should be made as necessary, but they may cause safety problems if not carried out in a reasonable fashion. Unfortunately, no transition procedures are mentioned in the Manual on Uniform Traffic Control Devices (MUTCD), or the Institute of Transportation Engineer's (ITE) Transportation and Traffic Engineering Handbook. Some indepth research has been conducted on transitions related to signal installation and removal and changes in STOP control at intersections. The need for adequate and standardized changeover procedures for transitions is critical from three standpoints: uniformity, safety, and liability.

The purpose of this thesis is to: 1) identify those traffic operational changes that transportation engineering professionals feel require transition procedures, 2) determine procedures currently used by state and local agencies, 3) develop preliminary model transition procedures for those changes that transportation engineering professionals feel

require them, and 4) evaluate and modify these procedures to form a preliminary evaluation and adjustment of them.

Importance of the Problem

The need for the development of adequate and standardized changeover procedures is important from three standpoints: uniformity, safety, and liability.

Uniformity is defined by the MUTCD as using the same control devices to warn, regulate, or guide in the same or similar circumstances.

Uniformity of traffic control devices simplifies the task of the road user because it aids in recognition and understanding. It aids road users, police officers, and traffic courts by giving everyone the same interpretation. It aids public highway and traffic officials through economy in manufacture, installation, maintenance, and administration. (MUTCD, 1A-2)

Safety is generally defined as freedom from danger. In a driving situation this relates specifically to the driver's knowledge of the roadway, its geometrics, operational characteristics, and the requirements placed on the driver. If a change has been made that alters the requirements placed on the driver, adequate warning measures must be taken to modify driver expectancy and behavior. A driver that is familiar with the roadway and its traffic controls may be no longer informed, but misinformed. In order to reduce the probability of conflicts and accidents due to control changes,

a driver's expectancy must be modified. This expectancy typically does not involve a driver unfamiliar with the road who uses visual cues currently available to form an expectancy of what is ahead. Rather, it concerns a driver so familiar with a road that he/she no longer uses roadway signing to warn, regulate or inform him/her of roadway conditions. In these cases, those changes that are not accompanied by rather extreme measures to "deprogram" the driver may constitute a hazard for motorists. Transition procedures are needed to help inform motorists of changed traffic conditions so that their expectancy can be modified before arrival at the location where the change has occurred. Standardization in these transition procedures will facilitate motorist understanding of exactly what changes have been made. Such transition procedures should reduce driver surprise and improve safety overall.

The prime requisite of any traffic control modification procedure must be the minimization of hazards to the driving public. Consequently, any change in a control system which has been in effect for more than several months (other than temporary control such as involved in construction projects) must be preceded by a concerted information effort. Notice of the change can be disseminated through the local newspapers and radio stations, TV and utility bills. For broad scale modification programs involving numerous intersections, the local residents must be informed about the overall program, that is, the reasons, scope, stages, etc. Then as the various stages are implemented, a second news release is issued. Finally, a last effort is made to acquaint the public at

the site of the change using certain types of signs. Generally, traffic control system modifications are processed in three phases: preconversion, actual conversion, and post conversion. [Nebraska Intersection Control Procedure]

One of the many obligations of a public agency is to provide a safe and efficient transportation system for the public, given the constraints of their budgets and their political environments (i.e., citizen interference may veto a proposed control change). In the case of an accident resulting in legal claims against a responsible agency it is foreseeable that an operational change that is not accompanied by a prudent transition procedure could be interpreted as a breach of the responsible agency's duty to the public to make that facility safe.

Scope of the Study

A review of all articles published in the last twenty years listed in the Engineering Index relevant to the topic was conducted. Following the literature review, a questionnaire was developed to determine the perceived need for transition policies and procedures, and to obtain any policies or research by transportation agencies.

After a pilot study, the questionnaire was mailed to approximately 100 federal, state, and municipal transportation officials, as well as selected academic persons.

The transitions deemed necessary by 70 percent or more of

the responding officials were analyzed. Using concepts from written and unwritten policies and procedures received from the questionnaire respondents, a model transition procedure was developed for each type of necessary transition. These model transition procedures were documented in a paper which was sent with a second questionnaire to the original questionnaire respondents. Feedback from the respondents and some limited case studies were then used to modify those procedures.

CHAPTER 2

REVIEW OF THE LITERATURE

Analysis

The literature review consisted of an examination of all relevant articles listed for the last 20 years in the Engineering Index and any published material on the subject that the author was made aware of by his professors and colleagues. Three resources were uncovered that addressed traffic control transitions: 1) "SAFE CONVERSION OF UNWARRANTED MULTI-WAY STOP SIGNS" (Journal of Transportation Engineering, Vol III, No. 5, September 1985, ASCE), 2) "MULTI-WAY STOP SIGN REMOVAL PROCEDURES" (By Claude M. Ligon, Everett C. Carter, and Hugh W. McGee presented at the Annual Meeting of the Transportation Research Board, Washington, D.C., 1985), and 3) FHWA's "PROCEDURE FOR THE REMOVAL OF NOT NEEDED TRAFFIC SIGNALS" (November, 1980). These documents are summarized below.

1) "SAFE CONVERSIONS OF MULTIWAY STOP SIGNS" by Hemmat S. Chadda and Thomas E. Mulinazzi

In a paper published in the September 1985 ASCE Journal of Transportation Engineering, the authors based on a survey state that conversion procedures currently used are inconsistent and nonstandard, varying from one local political jurisdictions to another.

Conversions are never easy and involve many aspects of

concern (i.e., political, legal, safety). In spite of this the procedure should be "simple, easy to used and systematic." [1] Chadda's and Mulinazzi's paper discussed a conversion process graphically depicted in Figure 1.

There are two methods of Multiway STOP Conversion identified in the Chadda and Mulinazzi paper: 1) Simultaneous Conversions; or 2) Staggered Conversions. Simultaneous Conversion removed unwarranted STOP signs at all targeted locations the same day. Staggered Conversion removes unwarranted STOP signs one location at a time. The recommended conversion procedure is the same for each method. A "well conceived and implemented public relations campaign" is needed in both cases. [1] Strategies for such a campaign include: 1) Press Releases; 2) Informal Signing (see Figure 2); and 3) Advance Warning Signing (see Figure 3). Informal signs are installed before the change (30 days) and removed when the change is implemented. Warning signs are installed during changeover and removed sometime later (30 to 90 days). Chadda and Mulinazzi advice the following guidelines by used for the installation of warning signs:

1. "The volume; and speed of the cross street traffic does not convey the message that is does not stop."
2. The visibility of cross street traffic is obstructed.
3. The cross street's traffic volume is not clearly

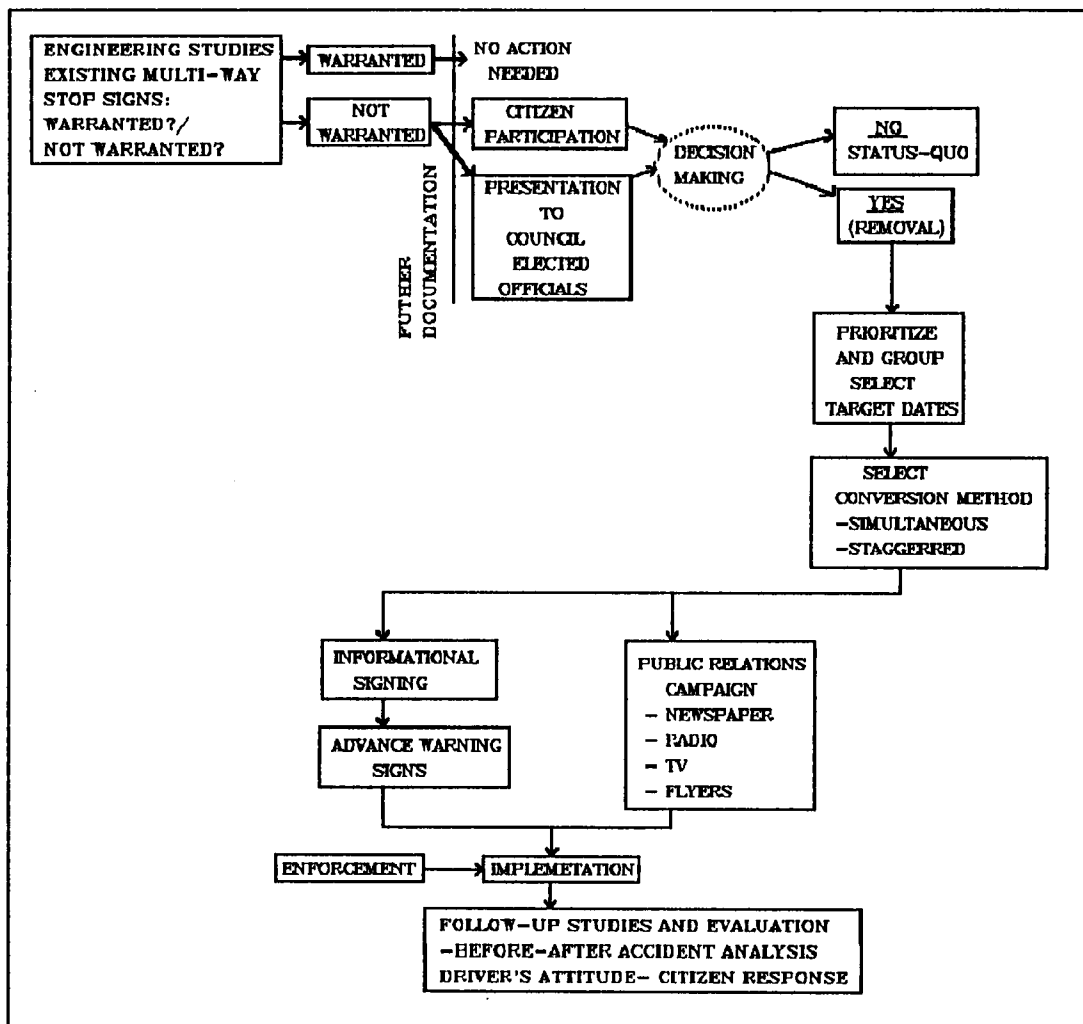


Figure 1 - Suggested Conversion Procedure
"SAFE CONVERSIONS OF UNWARRANTED MULTIWAY STOP SIGNS" by
 Hemmat S. Chadda and Thomas E. Mulinazzi

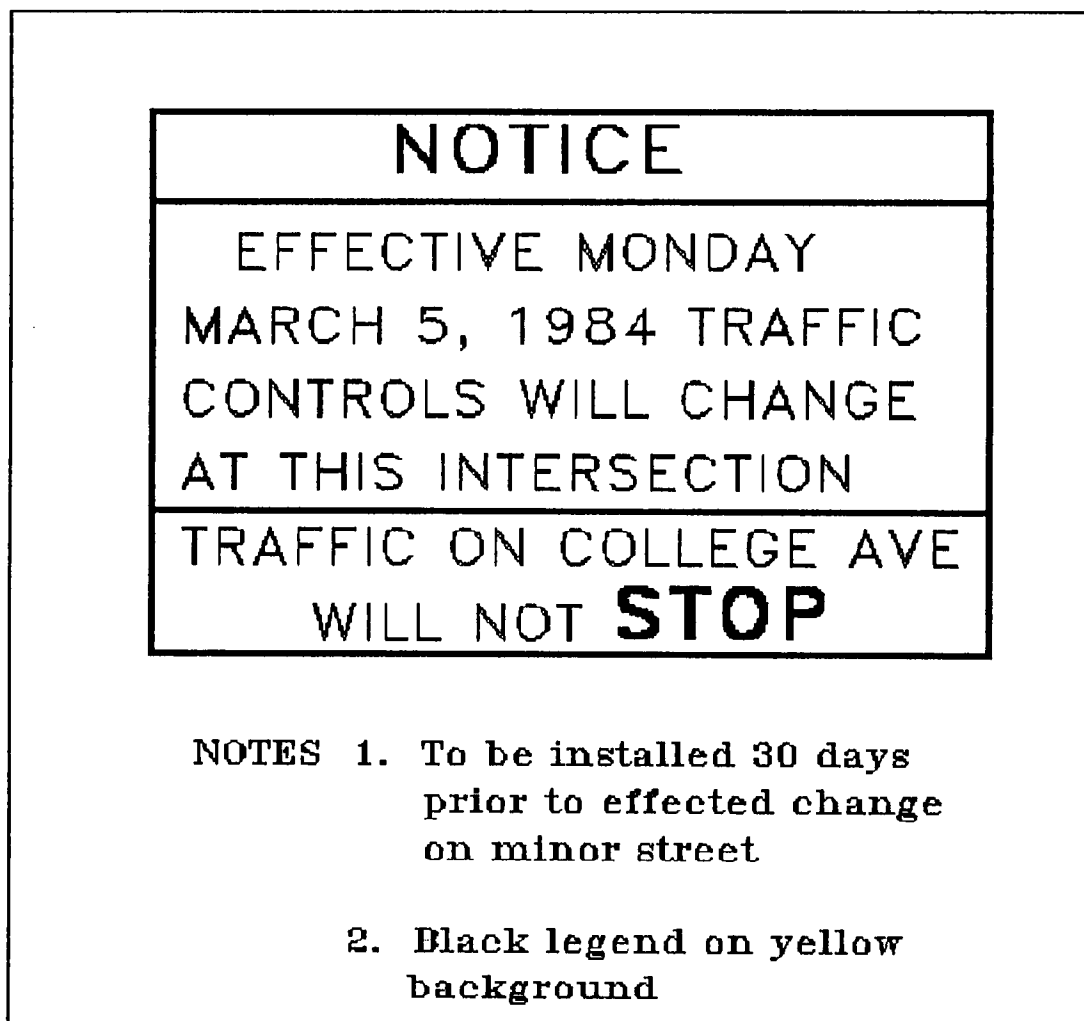


Figure 2 - Typical Informational Sign
"SAFE CONVERSIONS OF UNWARRANTED MULTIWAY STOP SIGNS" by
Hemmat S. Chadda and Thomas E. Mulinazzi

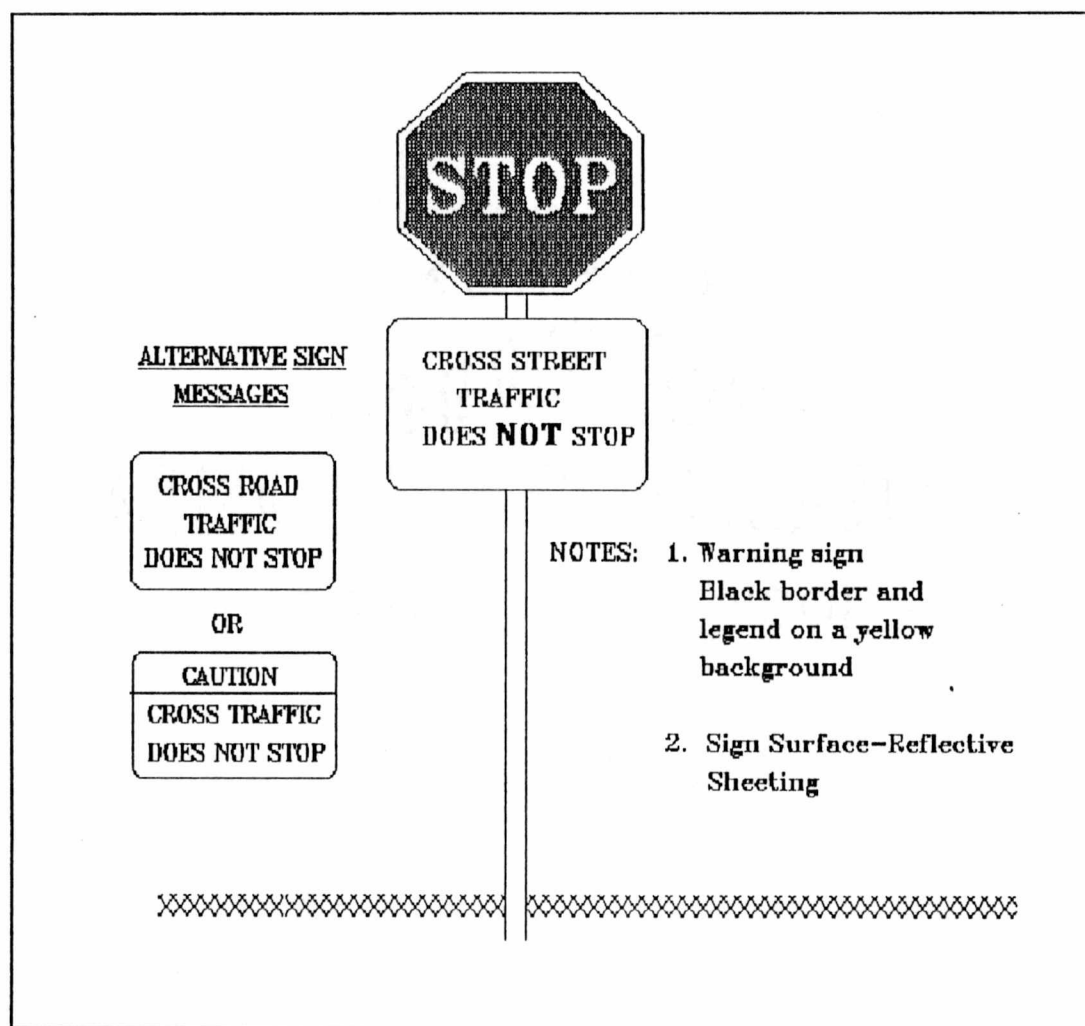


Figure 3 - Recommended Use of Warning Sign
"SAFE CONVERSION OF UNWARRANTED MULTIWAY STOP SIGNS" by Hemmat S. Chadda and Thomas E. Mulinazzi

greater than the STOP street.

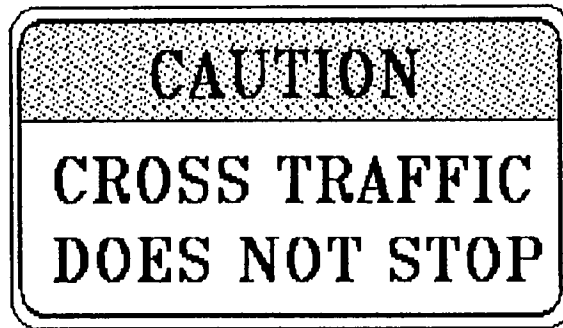
After all conversion related signing has been removed, several follow up studies are recommended including STOP observance, accident and approach speed studies, and an evaluation of citizen response.

2) "Multiway Stop Removal Procedures" by Claude M. Ligon, Everett C. Carter, and Hugh W. McGee.

This paper was presented to the 1985 Annual Meeting of the Transportation Research Board. A "wide variation" is noted in the conversion procedures of different government agencies based on survey and interviews conducted by the researches.

This study, initiated by FHWA, developed conversion procedures and attempted to document the safety effects of converting from All Way to Two Way STOP control. The first month immediately after conversion was identified as the "most critical period for accident increase." [2] Supplemental signing was the primary measure used to counteract this trend. After development of supplemental signs and a survey to determine motorist preference, the sign in Figure 4 was identified as the best candidate to promote safe removal of All Way STOPs.

Three phases in traffic control transition are identified for All Way STOP Removal: 1) Preconversion; 2) Actual Conversion; and Postconversion. Staggered or simultaneous removal strategies were proposed if a large number of



SPECIFICATIONS

1. Overall Sign Dimensions - 24" x 18"
2. Caution Band Dimensions - 24' x 6 "
3. Lettering Height - 4"
4. Colors - Black leters on yellow and
white backgrounds
5. Surface - Reflective Sheeting

Figure 4 - Caution sign for Approach still Required to Stop After Multiway Stop Intersection Conversion
"Multiway Stop Removal Procedures" by Claude M. Ligon, Everett C. Carter, and Hugh W. McGee

intersections were to be converted.

Staggered conversion was suggested if "an outpouring of political opposition was anticipated." [2] Several advantages of staggered removal were noted such as:

- a. Lessons learned at one location can be applied to succeeding locations
- b. Individual neighborhoods can be addressed regarding the stop sign removals as opposed to the entire municipality at once.
- c. Supplementary signs can be used during future conversions thereby reducing the inventory required.
- d. Work can be accomplished by existing crews without resorting to excessive amounts of overtime.
- e. Neighborhoods scheduled for future conversions can witness successful

actions elsewhere in town, thereby alleviating some of their fears.
f. Local approving officials may find this method more palatable.[2]

However, simultaneous removal was suggested if rental equipment would be needed to make the transition.

Ligon, everett and Carter suggest publicizing the conversions using: 1) Newspapers; 2) Radio; 3) Television; 4) Utility bills; 5) Flyers; 6) Letters and; 7) Neighborhood Newsletters. Signs similar to those shown in Figure 5 can also be used.1 In addition, if the intersection approaches are not properly signed and marked, the those approaches that will remain STOP controlled should be brought up to MUTCD guidelines. Intersection sight distance should be evaluated and, if necessary, improved. The following is the recommended conversion procedure:

The following sequence of events should occur prior to the beginning of the a.m. peak period on the day of the stop removals:

a. On minor approach, place supplementary plates(s) and sign in Figure 7 [sign similar to the one in Figure 5 stating "NOTICE CROSS TRAFFIC WILL NOT STOP EFFECTIVE AUG.8"] with caution sign in Figure 8 [Figure 4].

b. On major approach, after the action in a. above, remove the unwarranted stop sign(s), supplementary plate(s), and accompanying post(s) and notice sign(s) (Figure 6[Figure 5]).

c. Remove unnecessary "Stop Ahead" sign(s) including the post(s) on which they are mounted.

d. Replace 24-inch stop signs sign 30-inch stop signs for added emphasis. (This could be a temporary or permanent change.)

It is extremely important to convert the intersection prior to the morning peak period so as not to cause doubt in the motorist's minds concerning the previously publicized action.

The post conversion phase could involve a number of studies to evaluate the effectiveness of the new control. Those studies include: 1) volumes; 2) accident; 3) conflicts; 4) speed and; 5) stop observance. If speeding is observed, additional enforcement should be requested. Ninety days after the intersection is converted, the sign in Figure 4 should be removed. For the next twelve months accident and citizen comments should be used to evaluate the new control.

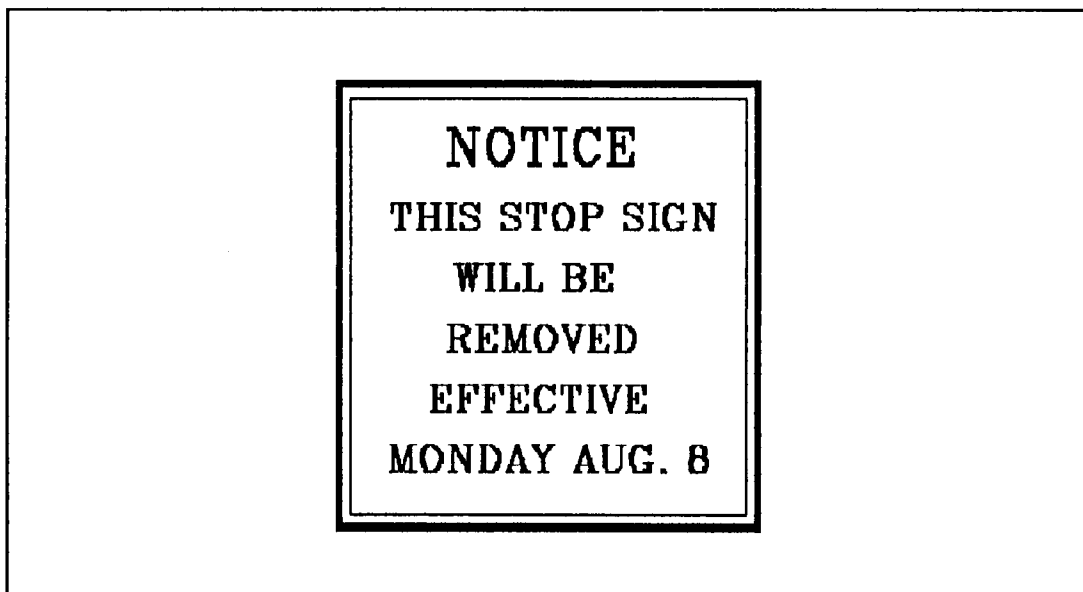


Figure 5 - Notice Sign for Major Approach "Multiway Stop Removal Procedures" by Claude M. Ligon, Everett C. Carter, and Hugh W. McGee

3) "User Guide for the Removal of Not Needed Traffic Signals" prepared for the FHWA by JHK and Associates and Wagner-McGee Association. Publication No. FHWA-8A-88-051.

...orderly procedures are necessary to carry out the actual implementation of the removal of signal hardware.[3]

These procedures should reduce hazards created by the drivers unfamiliarity with the change in control. They also inform the community that the removal will result in an improvement in safety and a reduction in vehicle delay.

Issues paramount to a successful conversion are: 1) public notification and/or approval; 2) transition methods and; 3) follow up studies and evaluation.

Public notification can be in several forms. The most common are news releases, letters, and signs. News releases can inform the most people however, the drivers of a particular intersection may not receive the information. A letter to residents and businesses in the immediate vicinity would get the information out however, the extensive cost involved might be prohibitive. A sign installed the same time that signal is placed on flash or hooded (see Figure 6) is a very effective and cost efficient way to inform the public.

Transition methods for signal removal in a great majority of agencies involve either putting the signal on flash or hooding the signal heads.

When the signals were flashed or bagged there was very little difference in the accident experience during the first month compared with the subsequent

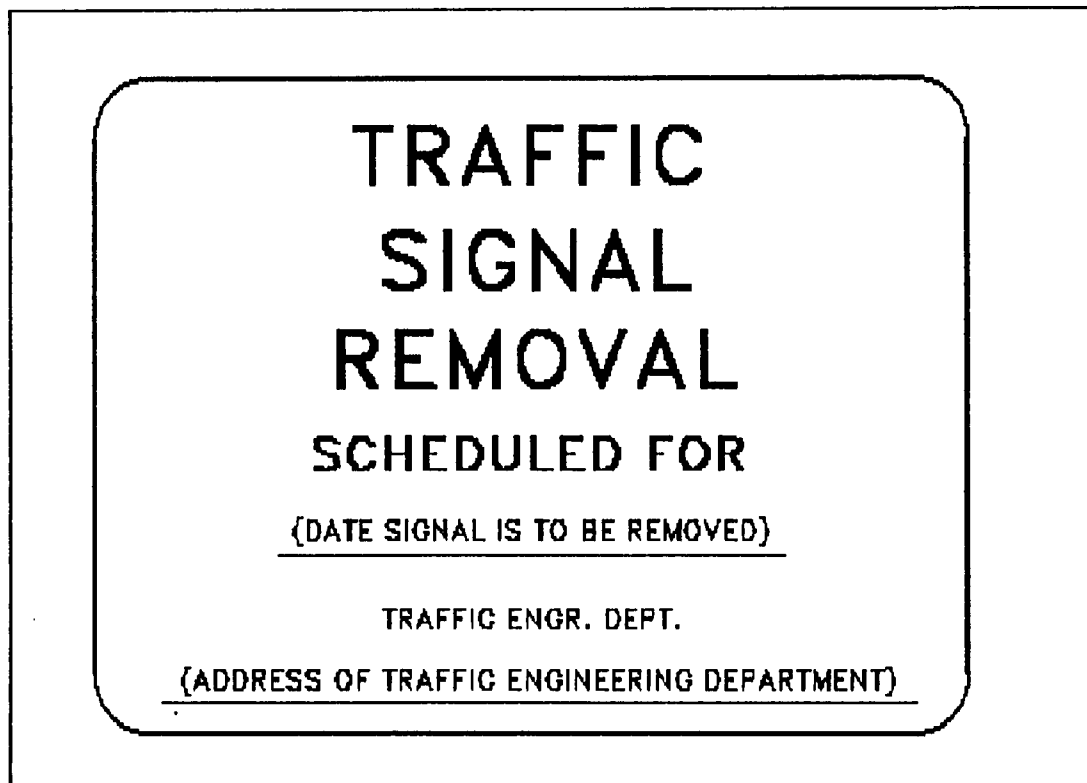


Figure 6 - Suggested Signal Removal Sign
"User Guide for the Removal of Not Needed Traffic Signals" Prepared for the FHWA by JHK and Associates and Wagner-McGee Association

period. This indicates that both of these interim control measures provide for a smooth transition. On the other hand with no transition control, the accident experience was 43 percent higher during the first critical month.[3]

Due to this finding it is strongly recommended that signals be flashed or hooded for at least 30 days prior to signal removal. In addition, signal removal should not be attempted during times of undue risk (i.e., inclement weather).

Increases in the accident rate, especially right angle accidents, during the interim control is not "sufficient

reason" to place the signal back in operation. However, if a significantly higher accident rate still persists several months after the signal has been in the interim control, then retention of the signal should be considered.

Summary

The three references in the literature review dealt with going from a stronger control to a weaker control (i.e., Four-way Stop to a Two-way Stop). Many other points are similar such as the need for a public relations campaign, the current assessment of "nonstandard" or varying conversion procedures, the belief that going from one control to another without transition is inadequate and the period of time that the conversion is the most critical: the first 30 days. In addition, the articles, in one way or another, divide the conversion process into before, during and after sections where study, decision making, and a public relations campaign are part of the "before" section, the placement and removal of appropriate signs and marking for conversion are in the "during" section, and the follow up study and post conversion monitoring are in the "after" section.

Of the two STOP Conversion articles, Ligon, Carter and McGee were more specific about the research and development of the conversion procedure, however, Chadda and Mulinazzi were more specific about the public relations campaign. Ligon, carter and McGee named several factors such as speed, volume,

sight distance, accident history, intersection geometrics, and community concern that were seen to effect the extent of transition needed. The research done by Ligon, Carter, and McGee as well as Chadda and Mulinazzi to determine the best conversion signing suggested the now common "CROSS TRAFFIC DOES NOT STOP" sign. Both articles also attempt to overcome driver expectancy with supplemental signs as well as the use of additional STOPS and/or flags/flashers to draw attention to the revised control of the intersection and identify simultaneous and staggered conversion strategies for a program removing many Four Way STOPS. The public relations campaign, seen as critical in both articles, lists a number of methods to inform the public but favors notification signing as the best alternative. Enforcement is recommended by Chadda and Mulinazzi during conversion.

The excerpt on signal removal from FHWA's "Procedure for the Removal of Not Needed Traffic Signals" also suggests a critical period of the first 30 days and recommends a public relations campaign as well as a follow up analysis of conditions after transition. This article does make two good points when it states that going back to former control should only be considered when the accident rate remains high several months after conversion and that conversions should not be attempted during periods of inclement weather due to obvious complications.

CHAPTER 3

THE STUDY PROCEDURE

Development of the Questionnaire

A questionnaire was drafted asking what conversion procedures each agency used and what traffic control changes warranted a staged transition. It also asked if the agency was aware of any research on the subject. After a first draft was compiled a pilot study of the questionnaire was undertaken by showing it to local professionals and altering the questionnaire according to their recommendations. The finished product is shown in Appendix C.

Development of the Mailing List

A mailing list was compiled subjectively using the ITE directory. One hundred potential respondents were selected, a great majority of which were municipal and state transportation officials however a few federal, consultant and academic professionals were also included. The number of potential state versus municipal respondents were approximately equal.

Questionnaire Response Rates

Of the 100 questionnaires mailed 46 were returned. These represented 28 states, 15 cities, two counties and one consultant. Seven respondents provided written conversion procedures, 24 respondents presented an unwritten conversion

procedure for at least one traffic control change and 16 respondents stated they had no conversion procedure for any traffic control change. A list of responding agencies is given in Appendix A.

CHAPTER 4

RESULTS FROM THE QUESTIONNAIRE

Changes that Require Transition

The first result of the questionnaire survey was a tabulation indicating what control changes professionals felt warranted a conversion procedure. Table 1 indicates what percentage of respondents felt that a conversion procedure was needed for each control type mentioned.

In order to reduce the research to a manageable size, it was decided to investigate and recommend transition procedures only for those transitions where 70 percent or more of the respondents felt transition is needed. All respondents feel that at least one of the control changes suggested warranted transition.

The traffic control changes requiring a conversion procedure according to at least 70 percent of the respondents were: 1.) Changing the intersection legs with STOP control (STOP Reversal), 2.) Four to Two Way STOP control, 3.) New Signals, 4.) Removal of Signals, and 5.) One Way street changes (One Way to Two Way, Two Way to One Way, and changing One Way direction).

Written Policies on Transition

Of the 46 respondents, seven had written procedures for some kind of traffic control or operational procedure change. The Nebraska Intersection Traffic Control

Table 1. Results from the Questionnaire

<u>Type of Change</u>	<u>Is Transition Necessary?</u>	
	<u>Yes (%)</u>	<u>No (%)</u>
<u>STOP signs</u>		
Initial Placement	46	54
Reversing STOPs	89	11
Change Yield to STOP	28	72
Two Way to Four Way STOP	54	46
Four Way to Two Way STOP	78	22
<u>Traffic Signals</u>		
New Signal Installation	89	11
Removal of Signal	72	28
Signal Timing/Phasing Changes	15	85
Addition/Removal of Left turn Phase	20	80
No Right turn on Red	9	91
<u>Miscellaneous</u>		
Lane Configuration Changes	26	74
Left turn Prohibition Changes	11	89
One Way Street Changes	87	13
Grooved Pavement Changes	9	91
Signs Other than STOP (i.e., Speed Limit, Parking Changes)	15	85

Modification Procedure has an excellent explanation of the purpose for transition procedures (see Appendix C).

The following is a technical review of the seven written procedures received. Several responding agencies stated in their written policies that the level of transition was dependent on factors such as speed of traffic, traffic volume, expectancy of change, and adequate sight distance. These agencies also stated in their policies that these factors assist in determining the type of warning device(s) required, the extent of public notification and the time frame for the transition. For the complete text of these written procedures see Appendix C.

Iowa DOT - Changes in STOP Conditions at Primary Highway Intersections

This procedure is divided up into three categories: 1)notification; 2)signing changes only and; 3)signing changes for intersection construction or reconstruction.

Notification - This portion sets up the procedure for particular offices in the IDOT organization. Basically, commission approval of each change in STOP conditions is given. At that time the news media is notified, a date is set for the actual change (two weeks after public notice is given), and the local law enforcement is informed of the

impending change.

Signing changes only - When the number of STOP signs is reduced, red flags and signs indicating "HIGHWAY # _____ TRAFFIC DOES NOT STOP" are installed on the remaining STOPs and maintained for a minimum of 30 days. In addition, special warning signs "WATCH FOR CROSS TRAFFIC" are installed and maintained on the new through route for a minimum of three months. When the number of STOP signs is increased, red flags are installed above new Stop Ahead and STOP signs and maintained for 30 days or until rumble strips are installed. If approach speeds exceed 35 mph, 48 inch Stop Ahead signs are used and rumble strips are installed as soon as practicable. When STOP controls are used to reverse the through route, red flags are installed on new Stop Ahead and STOP signs and maintained to 30 days, signs will be installed below each STOP sign stating: "HIGHWAY # _____ TRAFFIC DOES NOT STOP" and special warning signs with the message "WATCH FOR CROSS TRAFFIC" are installed on the new through route and maintained there for three months. If the approach speeds exceed 35 mph, 48 inch STOP signs are used and rumble strips are installed as soon as practicable.

Signing changes for intersection construction or reconstruction - When a new STOP condition is imposed red flags are used on STOP and Stop Ahead signs and maintained for 30 days. If approach speeds exceed 35 mph, 48 inch Stop Ahead signs are used. When preexisting STOP conditions are

reestablished signs to that effect shall be replaced in the same location they occupied prior to intersection construction.

Discussion

This article lays out in language similar to the MUTCD (i.e., should, shall, may) guidelines for transition of STOP control at intersections. It establishes good criteria for oversize signs and time periods for transition. It also provides for good conspicuity of new signs by requiring flags to be installed on them.

However, no transitional Four Way STOP is recommended in the STOP reversal procedure, opting instead for rumble strips and additional signing. Signs with "...HIGHWAY #_____..." may be ineffective due to drivers not knowing a highway by that name or number (or even knowing the name at all), the paper work of communicating to the various agencies the "needed" information seems extreme, and even with this paper work in place no specific dates can be released to the media.

Warning signs are installed for the new through street to watch for vehicles on the old through street, and enforcement on the same day as transition may cause undue complaints. The common period of 30 to 90 days for transition are used in Iowa's procedures.

Oregon DOT

The Oregon DOT uses the sign shown in Figure 7 to alert drivers to a "recently and possibly unexpected change in traffic control." This sign is to be used in conjunction with other standardized signing and in no instance should remain longer than 30 days according to their procedures.

Discussion

This policy could be considered too generalized however, when combined with normal advance warning signs it might be an effective conversion procedure. No signing combinations are discussed and the transition period may need to be expanded.

Pennsylvania DOT

New Traffic Patterns Sign

The sign in Figure 8 is used to warn drivers of changes in travel lane configuration. The sign is to be placed a minimum of 775 feet in advance of the change and may state "ahead" if those changes cover only a short distance.

STOP Sign Removed From Side Street Sign (see Appendix C)

This sign is used to advise local drivers of changed conditions in STOP control. It should be removed after six weeks. In the event of STOP reversal, a six week All Way STOP is advisable for intersections of an average daily traffic of over 500 vehicles. After the original STOP signs are removed,



Figure 7 - Traffic Control Change Ahead Sign
Oregon Department of Transportation

the sign shall be authorized for six weeks beneath the remaining STOPS.

Discussion

The "CAUTION NEW TRAFFIC PATTERNS NEXT XXX MILES" sign in Figure 8 is the only attempt at warning of a change in lane configuration found in either the literature review or the questionnaire responses. However, no criteria is given for sign placement other than a single minimum distance. Speed at the site of transition may vary and so should the sign's distance from the changed lane configuration. The period of transition for this is only given as "temporary".

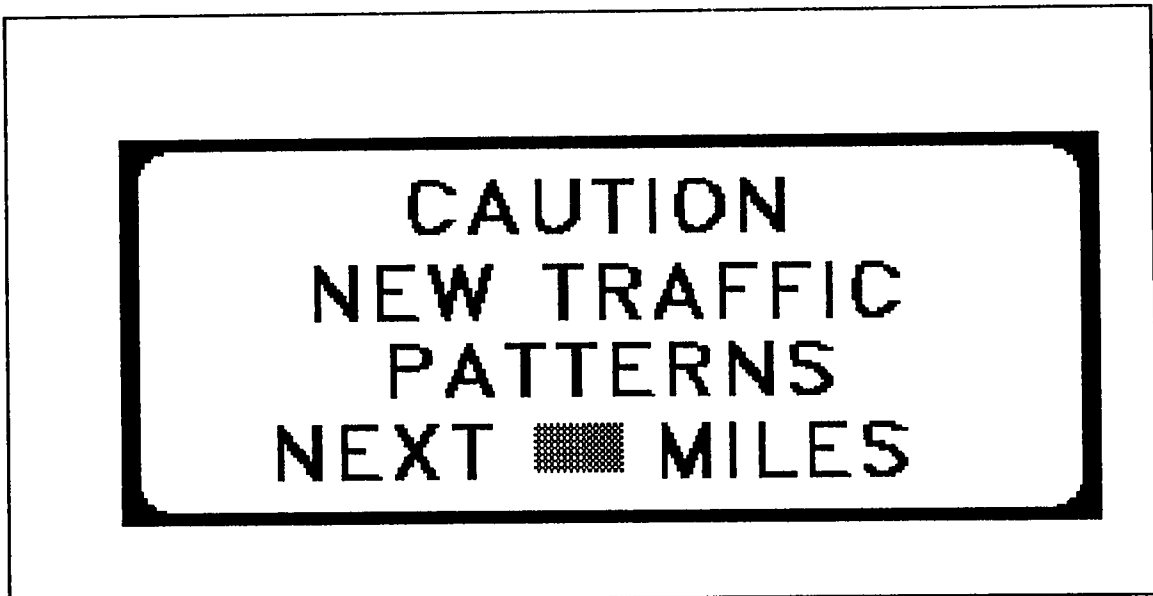


Figure 8 - Lane Configuration Change Sign
Pennsylvania Department of Transportation

The procedures for the Two to Four Way STOP or reversal of STOP signs uses the "STOP SIGN REMOVED FROM SIDE STREET" sign placed underneath the STOP. Transitional Four Way STOPs for STOP Reversal is authorized only for intersections with over 500 entering vehicles per day and mentions no other transition signing or pavement marking changes (i.e., Stop Ahead signing, Stop Lines). The transition period for Two to Four Way STOP and Four to Two Way STOP is six weeks.

City of Cedar Rapids, Colorado

Permissive to Protected Left Turn Phases

"Left turn on Green ball" when changing signal phasing from a permissive to protected left turn the existing R10-10 signs "LEFT TURN SIGNAL" will be removed and replaced by the R10-12 sign "LEFT TURN YIELD ON GREEN BALL". The R10-12 sign is used

as an interim control measure and after 30 days the R3-5 sign "LEFT TURN ONLY" replaces it.

Two Way to All Way STOP Conversion

After council approval, the following is undertaken. Public notification signs are placed on all approaches two weeks prior to the conversion. On the day of conversion, the signs are installed in the following order: 1) STOPS; 2) supplemental plates below STOPS; 3) temporary or permanent Stop Ahead signs.

All Way to Two Way STOP Conversion

If not already installed supplemental "ALL WAY" plates should be added 30 days before the conversion. Two weeks before the conversion, public notification signs are placed on all approaches. Pavement marking changes, intersection sight distance improvements and any parking restrictions are made before the day of conversion. On the day of conversion, the ALL WAY or FOUR WAY plate is removed, and another notification sign, "CROSS TRAFFIC DOES NOT STOP" is installed on remaining STOPS and maintained for 90 days or until "conditions" are considered satisfactory.

Two Way STOP Removal

The Cedar Rapids procedure refers back to the two previous procedures saying that the procedures are virtually the same

and only slight modifications are necessary.

Uncontrolled to Two Way STOP

Because this type of conversion involves an intersection with low traffic volumes and low vehicle speeds, no additional signing is necessary for this change.

Traffic Signal Installation

Public information signs are installed two weeks before turning the signals on, defining the date by identifying the month when the signal shall be turn on. Three days before the signal goes on normal operation the signal is placed on flash. "CROSS TRAFFIC DOES NOT STOP" signs are installed and the public notification signs are removed at that time. Just prior to turning the signal on to normal operation, the STOP signs are removed.

Signalized to Two Way STOP Control

Two weeks before signal removal, public notification signs are placed on all approaches. Hoods are simultaneously placed over all signal heads as STOP control is installed and "CROSS TRAFFIC DOES NOT STOP" signs or similar signing are also installed. The above is maintained for 30 days and conditions are evaluated. If satisfactory conditions exist at the end of the 30 day period the signal heads are removed but the "CROSS TRAFFIC DOES NOT STOP" signs are retained for another 60 days.

If satisfactory conditions do not exist, the interim control period should be extended and the signal removal should be reassessed.

Signalized to All Way STOP

Public notification signs are installed two weeks prior to actual conversion. Simultaneously, hoods are placed over all signal heads and the above control is maintained for 30 days. STOP signs are installed on all approaches, and public notification are removed. This control is maintained for 30 days and evaluated at the end of that period. With satisfactory conditions the signal heads are removed, but any temporary warning signs remain for another 60 days.

For All Cedar Rapids Procedures

In all the above changes it is recommended that the signing changes should be completed before the morning peak period and that all of the procedures in this documentation are subject to engineering judgement. However, any procedure modification should be documented in the files.

Discussion

The City of Cedar Rapids provided more traffic control conversion procedures than any agency participating in the survey. Left turn signals: permissive to protected phases, Two Way to All Way STOP, STOP Reversals, Uncontrolled to Two

Way STOP, Signal installation and Signal removal procedures were provided. Cedar Rapids procedures will be discussed individually.

The Permissive to Protected Left Turn Phases is the only procedure on changing from a permissive to a protected left turn phase at a signalized intersection. However, does it clearly communicate exactly what has changed? Perhaps the transition signing might be better with : "SIGNAL TIMING CHANGE --- LEFT TURN ON GREEN ARROW ONLY". A strobe in the signal or on the sign may also be desirable.

Many of the steps in other procedures for the Two Way to All Way STOP conversion are mentioned in the Cedar Rapid procedure however: 1.) Stop Ahead signing is uncovered/installed after the new STOP signs are installed and 2.) the transition period is 90 days rather than 30 days mentioned in other procedures. Oversize STOPs, Stop Bars flags, etc. are not mentioned. Public notice through signing two weeks prior to conversion and Stop Ahead signs are all that is required.

The All Way to Two Way STOP procedure is similar to the Two Way to All Way procedure in that it provides two weeks of public notice through signing, and a 90 day transition period. Removal of obsolete pavement markings, improvement of sight distance, if needed, is recommended before the day of conversion. Conversion before the morning peak hour is also recommended. The "CROSS TRAFFIC DOES NOT STOP" sign is recommended to stay until satisfactory conditions exist,

however no clarification of satisfactory is given.

STOP Reversal is not specifically covered, but the procedure refers to the previous topics stating only slight modification is necessary.

Uncontrolled to Two Way STOP apparently needs little or no transition by these procedures.

The Traffic Signal Installation process seems fairly comprehensive, however the short (three days) flashing period, and the assumption that a signal is installed at a Two Way STOP location should be qualified. The public notification signs are intended to serve as a warning as much or more than the flashing operation. This procedure leans heavily on the notification signs ability to get its message across.

In either of the procedures 1.) Signal to Two Way STOP and 2.) Signal to Four Way STOP, no flash period other than during the actual hooding of the signal heads is performed. Again this procedure relies heavily on public notification signs to warn drivers of changed conditions and a time table for the change. Signal heads are removed 30 days after the change and any additional warning signs are removed 60 days after. No definition of satisfactory is given in order to proceed from step 3 to step 4 in either case.

Nebraska DOT Intersection Traffic Control Modification Procedures

The state of Nebraska presents procedural details for:

1) Uncontrolled to Two Way STOP; 2) Two Way STOP to Uncontrolled; 3) Four to Two Way STOP; 4) STOP Reversal and; 5) traffic signal removal. A number of the steps are the same for all traffic control changes except for traffic signal removal.

Step one is to study and evaluate conditions and compare them with MUTCD criteria. All decisions must be backed up by measured and analyzed data. Step two is to publicize the change and the effective date. Step three is to make sure the change is made as publicized. Step four is to have all visibility sight obstructions corrected. At this point the transition procedures diverge.

Uncontrolled to Two Way STOP

Signs are installed per MUTCD standards and Stop Ahead signs with temporary red flags attached are installed on all controlled approaches.

Two Way STOP to Uncontrolled

A sign is placed below the STOP sign on the controlled streets two weeks before the STOP signs are removed stating: "NOTICE THIS STOP SIGN WILL BE REMOVED EFFECTIVE (date) ." An additional sign stating "NOTICE CROSS TRAFFIC WILL NOT STOP EFFECTIVE (date) " will be installed on the uncontrolled street in the normal position of a STOP sign. On the day of conversion, the STOP sign and the notice signs are removed and

a warning sign is placed in advance of the intersection on those approaches approximately 250 feet from the cross street stating "CROSS TRAFFIC DOES NOT STOP." On the approach that was and will remain uncontrolled, the "NOTICE CROSS TRAFFIC WILL NOT STOP EFFECTIVE (date)" sign is removed and replaced with a "CAUTION CROSS TRAFFIC DOES NOT STOP" warning sign. Red Flags are attached to each of the above mentioned signs.

Four to Two Way STOP

Thirty days prior to any change FOUR WAY plates (R1-3) are placed below all STOP signs. Signing is installed very similar to the Two Way STOP to Uncontrolled procedure. All approaches where STOP signs are to be removed have the "NOTICE THIS STOP SIGN WILL BE REMOVED EFFECTIVE (date)" sign installed two weeks prior to the change. In addition, on the approaches where the STOPs are to remain signs are installed stating "NOTICE CROSS TRAFFIC WILL NOT STOP EFFECTIVE (date)." On the day of conversion all signs are removed on the nonstop approaches and the minor street has a "CAUTION CROSS TRAFFIC DOES NOT STOP" sign installed 250 feet in advance of the intersection with red flags attached and the notification signs under the remaining STOPs are removed.

YIELD to Two Way STOP

Thirty inch STOP signs are installed and Stop Ahead signs are installed as well.

Evaluation of Signal Need

If a signal is not warranted, a program to remove the signal should begin by informing the local officials and the public. A time schedule should be included in this notification. The signal should be flashed for an unspecified length of time (yellow on major street, red on minor street). If flashing is not an option and the signal must be removed immediately, inform the public by all available news media for the reason of the removal. Thirty inch STOP and Stop Ahead signs should be installed on the minor approaches just prior to the signal being turned off and the signal being hooded.

III. Final Comment

Local officials should be advised not to become overly alarmed or overreact if an accident occurs after a change is made. Any incident should be thoroughly investigated to determine all causative factors and any preventative action that might be taken other than intersection control.

Changes in the kinds of traffic control discussed herein can be expected to generate some opposition and complaints. But, if the change is properly conceived and implemented, all aspects studied, and the basis for the change is well documented, opposition will be manageable. Any change should be allowed the test of time against any prophecy of doom. Local officials must resist the forces of the 4-P's- Personal opinions, Pressure groups, Petitions and Politics.[Nebraska Intersection Modification Procedure]

Discussion

Nebraska's intersection traffic control modification procedures cover some transitions not mentioned before, however many questions arise about the time table of these transitions. Most procedures follow the same general format for the first three steps:

1. Evaluate existing conditions and make decisions on any control based on MUTCD criteria and measured and analyzed data. This generally is the decision making and justification step.

2. Publicize the change and effective date and make sure the change is made as publicized. No further details are given on "publicize". Also, no official channels are mentioned. In addition, no mechanism for public input is mentioned.

3. Have all visibility sight obstructions corrected. This may not be possible in all cases. Many times buildings or road alignment (especially in Central Business Districts or mountainous situations) present a problem with sight distance that because of funding or political constraints is "unsolvable".

In going from Uncontrolled to a Two Way STOP or YIELD Control, the STOPs or YIELDS are installed before the Stop Ahead or Yield Ahead signs are installed. Warning signs should be installed before control signs. The installation of these warning signs first would make it clearer to motorists

that they should stop or yield during installation of the STOP or YIELD. The "Traffic Control Devices Handbook"(TCDH) procedures for the placement of channelizing devices for a work zone recommend that the work zone be laid out starting with the beginning. This supports the concept that warning signs should be installed before control signs.

The Two Way STOP control to no control procedure recommended appropriate signing, but no apparatus was available for public input and no time table is recommended to show how long these signs should stay up. The same is true of Nebraska's Four to Two Way transition procedure.

In the signal removal procedure three simple steps were used: 1) inform local governments and the public about the reasons for removal, 2) set the signal on flash and, 3) install STOP and Stop Ahead signs where needed and cover signal heads immediately. This may be a little too simple in many cases. No mechanism is available for public input. Also, it is unclear how the flashing mode is to be used, and for how long. Also, no notification signs are used. It seems that going from this control to a weaker control has less transition than any transition mentioned in the Nebraska Procedures.

In conclusion, in Nebraska's procedures little if any time table was given for a transition, notification and warning signs may need to be larger and public input was not mentioned in the process.

Illinois DOT

The state of Illinois procedures, given their comprehensiveness, were so brief that they are quoted here exactly.

TEMPORARY MEASURES TO ALERT MOTORISTS TO NEW TRAFFIC CONTROL DEVICES

The following temporary alerting measures, listed in ascending order of comprehensiveness, are intended to be used as appropriate to call motorists attention to new stop signs, traffic signals, and one way streets.

New Stop Sign Locations - Temporary Alerting Measures

1. Flags on Stop signs.
2. Flags on Stop and Stop Ahead signs.
3. Flags and Flashers (red and yellow) on Stop and Stop Ahead signs.

New Signal Locations - Temporary Alerting Measures

1. Flash signals for three to seven days
2. Flags on Signal Ahead signs.
Flash signals for up to one week.
- *3. Flags and yellow flashers on Signal Ahead signs. Flash signals up to one week.

New One-Way Street Intersections - Temporary Alerting Measures

1. Flags on One-Way Signs.
- *2. Flags and flashers on One Way signs; flags on No Left Turn signs.
- *3. Flags and flashers on One Way and No Left (Right) Turn signs.
*Flashers left in place until batteries go dead. (two or three weeks)

Agencies responsible for installation of traffic control devices should select a level of alerting measures based on :

1. Speed of traffic
2. Volume of traffic
3. Sign Distance
4. Unexpectancy of change (i.e., new street, major traffic pattern change, etc.)

Discussion

The general approach in Illinois' procedure is unique in that it lists its procedures in "ascending order of comprehensiveness", and then lists parameters that would require a more "comprehensive" transition. Illinois gives simple, one step procedures. Increasing comprehensiveness usually meant flags and flashers on top of normal signing. No notification signing or other measures to inform the public were cited.

Unwritten Policies on Transition

Twenty-seven agencies returned some kind of unwritten or unofficial procedure for some traffic control change. Of these 18 were from states and nine were from cities or metropolitan areas.

Because these unwritten procedures are by nature less specific than their written counterparts, they will be analyzed differently. For each transition common practices for the conversion procedure will be listed and then unique practices for the conversion procedure will be listed. Each

practice and its variations will be analyzed individually in reference to the conversion procedure.

The following is a compilation of the unwritten policy responses received in this survey. The procedures are quoted in Appendix D.

Discussion of Unwritten Procedures

Initial Placement of STOP

Common Practice

1. Stop Ahead installed during transition period.
2. Notice to media.
3. One or more red flags or construction type flashers on STOPs and advance warning signs during transition period.

Uncommon Practices

1. Install one time stop bar and "STOP AHEAD" pavement markings and allow to wear out.
2. New STOP signs installed in barrels and placed in the center of the roadway.

The transition time ranged from one to seven weeks.

The notice to media practice is common for all transition types as well as flags or flashers to call attention to the new devices and advance warning signs.

However, one time pavement markings such as a Stop bar and "STOP AHEAD" markings may be an alternative to the above.

It puts the message right in front of the driver's eyes. This may be an expensive and time consuming step though. The STOP in a barrel put in the roadway would run a risk of being knocked down (by accident or on purpose) and might constitute a hazard and a perpetual maintenance problem during transition.

Reversing STOPs

Common Practice

1. Install a temporary Four Way STOP.
2. Install warning signs ahead of new STOPs.
3. Install "CROSS TRAFFIC DOES NOT STOP" signing on appropriate approaches.
4. Notice to the media.
5. Police officer control for the first eight hours.
6. Flashers and flags on signs.

Uncommon Practices

1. White on green educational sign "CROSS TRAFFIC DOES NOT STOP".
2. "RIGHT OF WAY TO BE REVERSED ON (DATE)" warning signs on all approaches - no transitional Four Way STOP.
3. "BE ALERT -- NEW TRAFFIC PATTERN AHEAD" warning signs on type III barricades.
4. "NOTICE - STOP SIGN ON ELM STREET WILL BE REMOVED (DATE)"; "NOTICE - STOP SIGN WILL BE PLACED ON 2ND STREET (DATE)" signs installed at intersection with

construction flashers - no transitional Four Way STOP.

All "common practice" ideas are usually found in other transitions except for the "CROSS TRAFFIC DOES NOT STOP" signing. This is common to appropriate changes in STOP control. The most unique practice was the use of notification signing of the reversal without a transitional Four Way STOP. This may be effective on low volume residential streets however, it is not recommended on collector or arterial streets.

Two to Four Way STOP

Common Practice

1. Install Stop Ahead signs in advance of new STOPs.
2. Double the STOPs (left and right intersection corners usually on a temporary basis for 2 to 6 weeks).
3. Flags or flashers on new STOPs.
4. Public Notice through the media.
5. Notification signs installed on all approaches stating "MULTIWAY STOP TO BE INSTALLED ON (DATE)" one week before new STOPs are installed.
6. Install Stop Bar.

Uncommon Practice

1. Warning Signs installed stating "BE ALERT -- NEW TRAFFIC PATTERN AHEAD" posted for two weeks.
2. STOPs installed in barrels and located in the center

of the roadway.

The common practices basically involve standard warning and notification signs or flag/flashers to call attention to them. The "... NEW TRAFFIC PATTERN..." signs may be too generalized in this instance however they may still fulfill their purpose.

Four to Two Way STOP

Common Practice

1. "CROSS TRAFFIC DOES NOT STOP" or related signing on appropriate approaches.
2. Public notice through the media.

Uncommon Practice

1. "BE ALERT -- NEW TRAFFIC PATTERN AHEAD" signs installed on all appropriate approaches.
2. "STOP SIGNS TO BE REMOVED XX/XX/XX" signs installed on appropriate approaches one week before removal.
3. "Very rarely done and not recommended".

Again the "...NEW TRAFFIC PATTERN..." sign is felt to be too generalized. STATE's recommendation (uncommon practice #3) may indicate that they have had safety and/or political problems with any Four Way STOP they have attempted to remove. It is very interesting that an official would come right out and say this about a commonly accepted control change.

New Signals

Common Practice

1. Place in flashing operation for 24 hours to two weeks before switching to operational mode.
2. Public notice through the media.

Uncommon Practice

1. New Signal Ahead sign with standard Signal Ahead symbol except on a white background plus the word "NEW" installed for three months.
2. Addressed at Public hearing.
3. Install temporary Signal Ahead warning signs even if they would normally not be required based on the circumstances.
4. "SIGNAL IN OPERATION" warning signs installed in the roadway on the centerline for two weeks.

The flashing operation practice is virtually universal; however the time flashed greatly varies. Public notice, as in all transitions, may not reach all of the affected drivers and may not change their driving habits on the site of the change.

The new Signal Ahead sign may be effective but the white background might not create any distinguishable difference to the driving public. The clarification for the warning signs cited in number three is reasonable and prudent. The "in road" signs may be effective but may create maintenance and accident hazard problems worse than the actual transition.

Removal of Signals

Common Practice

1. Signal placed in flashing operation for one week to six months before removal.

Uncommon Practice

1. Install notice signs such as : " NOTICE SIGNAL INDICATIONS TO BE REMOVED 1-20-88" and "NOTICE STOP SIGN WILL BE PLACED ON 2ND STREET 1-20-88".
2. Police to direct traffic while STOP signs are placed and signal indications are covered or removed.
3. Public meeting involving concerned citizens groups to explain what, why, etc.
4. Follow FHWA guide.
5. Hood signal heads and install at least two STOPs.

The most surprising thing was the lack of agencies that mentioned FHWA's "Procedure for the Removal of Not Needed Traffic Signals." Painfully absent is the "Public notice through media" practice. It is not recommended have the "at least two STOPs installed" rule of thumb because it might cause confusion in the case of a "T" intersection. The police direction during STOP sign installation and signal head hooding/removal is a good idea, but not always needed.

Lane Configuration Changes

Common Practice

1. Install signs stating "BE ALERT NEW TRAFFIC PATTERN

AHEAD". Install some on type III barricades.

2. Public notice through the media.

Uncommon Practice

1. More than the minimum sign requirements and in some locations police to help control traffic.

The "...NEW TRAFFIC PATTERN..." sign may finally have found it's place. Some modification may be needed to make the message clearer to motorists. More than minimum sign requirements should be installed (perhaps pavement markings allowed to wear out) but notice through the media alone is inadequate. The configuration changes may be too complex and/or subtle to expect a person to retain from an article or diagram to the transition site.

Left Turn Prohibition Changes

Common Practice

1. Public notice through the media.

Uncommon Practice

1. Install blazed orange target boards above the turn restriction signs to help identify the change.
2. Install warning signs and barricades.

Public notice through the media and an additional regulatory sign may be enough for this transition in some cases. The orange target boards may call attention to the signs, however not to the extent of flags or flashers. However, flags or flashers may not be appropriate at a

signalized intersection.

One Way Street Changes

Common Practice

1. Public notice through the media and direct mail to all abutting property owners.

Uncommon Practice

1. Install signs similar to "BE ALERT NEW TRAFFIC PATTERN AHEAD".
2. Use handouts and windshield notices on parked cars the day the changes are first made. (Commercial areas only).
3. Install "STREET TO BE MADE ONE WAY ON (DATE)" signs.
4. More than minimal regulatory signage is necessary and police used at major intersections during morning and evening rush hours will help.
5. Public hearings.
6. Installing Warning signs and barricades.

One Way street changes was one of the transitions with the highest percentages of respondents feeling transitions was necessary. It also was one of the most frequent unwritten procedures topics. However, practices varied greatly and about all that most could agree on was that the media should be notified. The notification and warning signs as well as the window notices were the most helpful. Barrels and barricades might be used in extreme circumstances.

CHAPTER 5

DEVELOPMENT OF THE MODEL TRANSITION PROCEDURES

General Concepts in Traffic Control Transition

Of the 46 respondents, seven had written procedures for some kind of traffic control or operational procedure change. The Nebraska Intersection Traffic Control Modification Procedure has an excellent explanation of the purpose for transition procedures (see Appendix C).

Throughout the author's evaluation of current procedures and the creating of model procedures, four questions about all conversion phase transitions came to mind:

1. What is the driver expecting?
2. What will the driver encounter?
3. What, if any, conflicts or accidents may develop because of the difference between that expected and that actually encountered?
4. How can the driver be warned so that conflicts and accidents are reduced?

Specific conflicts and accidents may be expected after specific control changes: (1) New Signals may increase the likelihood of rearends and running the signal causing angle accidents; (2) STOP Reversal may increase the likelihood of rearends at the new STOP or running of the new STOP causing angle accidents; (3) A Four Way to Two Way STOP may increase the likelihood of angle accidents; (4) One Way street changes may increase the likelihood of headon, sideswipe (opposite

direction), and angle accidents at intersections and; (5) Signal Removal may increase the likelihood of angle accidents. However, in the last case increased angle accidents may be a function of the change in control rather than the lack of appropriate transition measures to the new control.

In order to "deprogram" the driver and reduce the probability of accidents, the driver must: 1) take notice of a device that he or she normally wouldn't notice that informs him or her of a change, 2) understand what change has occurred and, 3) change his or her driving behavior because of that understanding. Warning signs (i.e., STOP AHEAD) and notification signs (i.e., "STOP SIGN TO BE REMOVED ON 9/7/89") have been used in the conversion phase of a transition.

In order to reduce the probability of conflicts and accidents due to control changes, a driver's expectancy must be modified. This modification typically does not involve a driver unfamiliar with the road who uses visual cues currently available to form an expectancy of what is ahead. Rather, it concerns a driver so familiar with a road that he/she no longer uses roadway signing to warn, regulate or inform him/her of roadway conditions. This driver must be "deprogrammed" and alerted to the changed conditions. In addition, the level of transition is dependent upon speed, traffic volume, expectancy of change, and sight distance.

In this section of this thesis conversion procedures are proposed where at least 70 percent of the questionnaire

respondents feel a transition is necessary. These changes are: 1) Reversing STOPs, 2) Four Way to Two Way STOP, 3) New Signal, 4) Signal Removal, and 5) One Way street changes. A model transition procedure developed by the author for each of these transition topics is presented below based on the concepts learned in the literature review, survey responses, and engineering experience.

STOP Reversal

Model Transition Procedure

Step 1. Install STOP AHEAD signs on non-controlled approaches at appropriate distances from the intersection. Each STOP AHEAD is to be augmented by an advisory plate with the word "NEW". These advisory plates should be black on yellow. A flasher (type A or type B) with yellow lens may be placed at the top of the assembly (see Figure 9). Flags may be used instead of flashers. Immediately following the placement of advance warning signs, STOPs are to be placed on the same approaches. A flasher (type A or type B) with red lens may be placed above the STOP, to be operated for one to two months. Next, a stop reversal sign should be installed below pre-existing STOPs stating "THIS STOP TO BE REMOVED ON --/--/--". Also, new STOPs

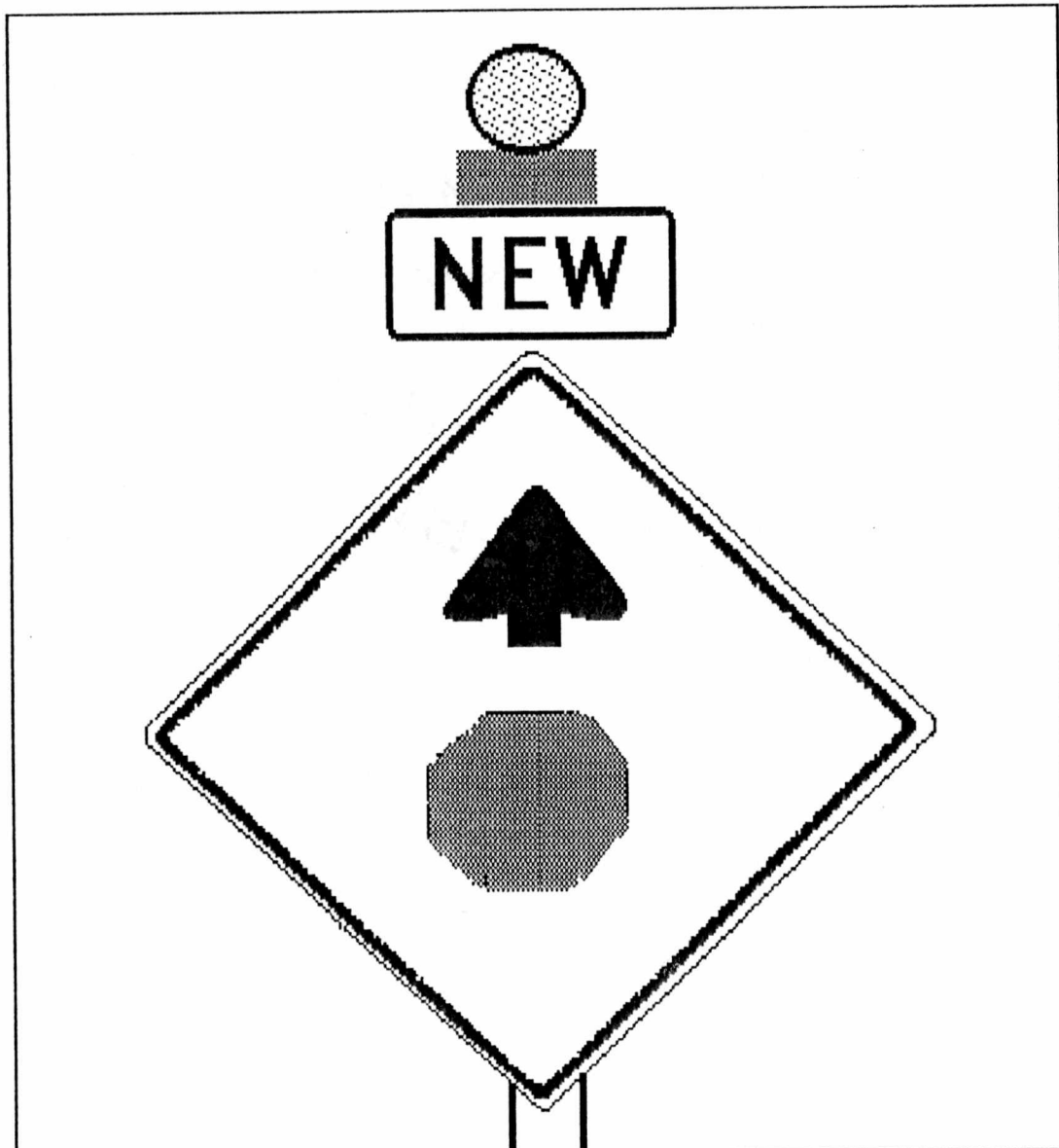


Figure 9 - Model STOP Reversal Sign

should have a stop reversal sign installed below them stating "CROSS STREET STOP TO BE REMOVED ON --/--/--" . "FOUR WAY" or "ALL WAY" plate should be installed in between the STOP and the stop reversal signs.

Note: Step 1 should be completed during nonpeak hours and on

a day other than a Friday or a day preceding a legal holiday.

Step 2. After a minimum of 30 days, the STOPs on the appropriate approaches should be removed. At the same time the "4 WAY" or "ALL WAY" plates should be removed on the remaining STOPs. Also, the "CROSS STREET STOP TO BE REMOVED ON --/--/--" signs should be replaced with "CROSS TRAFFIC DOES NOT STOP" signs on the remaining STOPs. In addition, the "NEW" plates on the "STOP AHEAD" should be removed along with any flags or flashers. It may be appropriate to reduce residential area transition times between Step 1 and Step 2 so that residents do not get "too used to" the transitional Four Way STOP.

Step 3. Remove "CROSS TRAFFIC DOES NOT STOP" and advance warning signs if no longer needed.

Note: Step 2 should occur during nonpeak hours on the day specified by the stop reversal sign.

Four Way to Two Way STOP

Model Transition Procedure

This transition is identical to the STOP Reversal procedure except for Step 1:

Step 1. A stop removal sign should be installed below the appropriate STOPs stating "THIS STOP TO BE REMOVED

ON --/--/--". Also, the other STOPS should have a stop removal sign installed below them stating "CROSS STREET STOP TO BE REMOVED ON --/--/--." An ALL WAY plate should be installed between each STOP and stop removal sign.

New Traffic Signal

Model Transition Procedure

- Step 1. Thirty days prior to the signal being placed in operation, signs should be installed on each approach to the intersection stating "NEW SIGNAL BE TO PLACED IN OPERATION --/--/--."
- Step 2. As signal heads are installed, hood or cover each head completely.
- Step 3. Approximately two weeks after Step 1, the signal heads should be installed and/or unhooded and immediately placed in a flashing operation that reflect past control conditions at the intersection. At this time, Signal Ahead signs with a "NEW" plate should be installed on the major (formerly non-stop) approaches. Flashers or flags may also be used with these warning signs. Stop Ahead signs, if installed at the intersection, should be replaced with Signal Ahead signs.
- Step 4. The signal is switched to operational mode

approximately two weeks after Step 3 and on the day specified on the signs in Step 1. Then the notification signs are removed. The STOPS on the minor street are removed simultaneously with the placement of the signal in the operational mode.

- Step 5. Approximately three months after the signal has been in operation, the flags, flashers and "NEW" signs should be removed. The Signal Ahead signs should also be removed unless otherwise needed.

Removal of Signals

Model Transition Procedure

- Step 1. Place "SIGNAL TO BE REMOVED ON --/--/--; COMMENTS XXX-XXXX" signs on all approaches to the intersection 30 days prior to its removal.
- Step 2. The signal should be placed on flash 24 hours a day for a minimum of two weeks prior to its removal. The flash should reflect future intersection control (i.e., all red for a Four Way STOP). STOP and Stop Ahead signs should be installed at this time.
- Step 3. Remove all signal heads on the date established in Step 1.
- Step 4. Remove Stop Ahead signs if no longer needed after Step 3.

Note: In areas where political opposition is encountered it

may be necessary to prove that the signal is not needed. Over a period of six months or so a signal could be put on flash during late night hours, off peak hours, and finally 24 hours a day to gradually show that the signal is not needed. Then the transition procedure could begin.

One Way Street Changes: One Way to Two Way, Two Way to One Way or Reversal of Flow

Model Transition Procedure

Step 1. Notify the general public by news media, and abutting property owners by direct mail 30 days prior to Step 2. This is necessary of all three types of changes. Install notification signs (i.e., "SMITH STREET TO CHANGE TO ONE WAY SOUTHBOUND ON --/--/--"), locating them with both vehicles and pedestrians in mind.

Note: It is best to involve abutting property owners in the decision to make the change.

One Way to Two Way

- Step 2a. 1. Provide adequate sight distance at all intersections and driveways by removing parking, clearing vegetation, etc.
2. Prohibit parking with the driver's side door to the curb.
3. Remove One Way signs and change or install

pavement markings consistent with Two Way operation (consider straight arrow and turn arrow pavement markings on the main and cross streets).

4. Install warning signs stating or showing the new Two Way conditions on all cross street approaches, on the main street at the beginning/end of the Two Way section, and where major left turning movements occur.
5. Remove "DO NOT ENTER" signs
6. Remove Two Way warning signs approximately three months after Step 5.

Note: If only a section of the street is to be made Two Way, make the change at a signalized intersection, if possible, with overhead spanwire and/or mastarm-mounted "DO NOT ENTER" signs facing vehicles attempting to enter the One Way section the wrong way.

Two Way to One Way Changes

- Step 2b.
1. Install "WRONG WAY," "DO NOT ENTER," or "RIGHT/LEFT TURN ONLY" signs at cross street approaches and towards the cross street approaches on the main street, where appropriate.
 2. Block off the unused lane(s) with barrels

or barricades.

3. Revise existing pavement markings to show new One Way direction (consider straight arrows on pavement and turn arrows on pavement at cross streets).
4. Remove barrels or barricades and revise pavement markings again if necessary, about one month after Step 3.
5. Where appropriate, remove any "WRONG WAY," "DO NOT ENTER," or "RIGHT/LEFT TURN ONLY" signs one to three months after Step 4 .

Reversal of Flow Change

- Step 2c.
1. Improve sight distance at cross streets and driveways.
 2. Change One Way signing not only in direction but also in style (i.e., from R6-2 to a R6-1 or vice-versa). Install flags or flashers on signs if appropriate.
 3. Consider pavement markings to further illustrate the same point in Step 2 at the cross streets.
 4. Consider placing barrels and/or barricades at cross streets to discourage wrong way movements.

5. No transition measures are needed at former points of exit from the street other than normal signing.

Professional Feedback

A paper was written stating the model transition procedures and summarizing the data. In addition, a final questionnaire (see Appendix E) was sent to the 46 original questionnaire respondents. Five agencies responded to the final questionnaire: one City and four States.

STATE Department of Transportation

This agency stated that none of the procedures were inconsistent with current practices. However, the procedures were seen as too conservative. The cost of using these procedures was considered much too high because of: 1) additional sign making expense; and 2) additional field visits to install temporary signing. Also, the agency felt that transition periods, especially on the signal installation transition, were too long and recommended shortening them to one week.

STATE Department of Transportation

This state found the procedures to be reasonable and feasible. However, this agency specifically stated that the "NEW" signs were not needed.

STATE Department of Transportation

This agency found the procedures "very thorough" and made no recommendations for changing them. They did appear concerned about coordination between the media and dates on the public notice signs.

CITY Office of the Engineer

This agency felt that the signal installation notification signs were unnecessary and that motorists would most likely see the signal being built as opposed to additional signing. However, this agency said the procedures could and would be the transition guideline for that city with a few minor exceptions.

STATE Department of Highways and Public Transportation

This agency had procedures for STOP Reversal, Two to Four Way STOP, and Four to Two Way STOP. It was impressed with the new signal transition and intended to use it as its guideline.

Revisions to the Model Transition Procedures

Based on the Professional Feedback the following recommendations are made:

1. The signal installation notification signs be considered optional and used for locations typically needing longer transition periods (high traffic speeds, high traffic volumes, limited sight distance, or high accident potential)

CHAPTER 6

CASE STUDIES

Introduction

The following are a number of case studies undertaken by the City of Knoxville, Tennessee. While exact statistics on performance are not available in every instance, reaction by the public and any significant occurrences during transition are mentioned.

These proposed procedures were applied to relevant control changeovers that were not a planned part of this research but became necessary in the City of Knoxville during the course of this research.

Studies

Tennessee Avenue and Stonewall Street: Conversion from Multiway to Two Way STOP (see Figures 10 and 11)

This intersection was targeted for Four Way STOP removal because it was no longer used as a school crossing and Stonewall Street volumes were very low compared to Tennessee Avenue volumes. In addition, the north leg of the intersection had been closed and deeded by the city to the adjacent property owner, Florida Steel Cooperation, who used it as a driveway. This is a four way intersection with residential land use on the south side of Tennessee Avenue and industrial land use on the north side of Tennessee Avenue. Tennessee Avenue is a collector with approximately 2500 vehicles per day AADT. Stonewall Street is a local street and



Figure 10 - Tennessee Avenue looking east



Figure 11 - Stonewall Street looking north

its AADT is estimated to be between 200 and 400 vehicles per day. Speeds on Tennessee Avenue are between 30 and 40 mph. Both streets are straight, but the south leg of Stonewall Street is skewed and goes downhill towards Tennessee Avenue. The north leg of Stonewall Street likewise goes downhill away from Tennessee Avenue. Stonewall Street has parking on one side. Tennessee Avenue has parking on both sides with two traffic lanes over 12 feet wide. The signs were installed as shown in Figures 10 and 11 on December 17, 1990 and were removed as specified. "CROSS TRAFFIC DOES NOT STOP" signs were installed on the same day. This transition occurred without incident (i.e., no accidents occurred or citizen complaints were received).

Lake Avenue and Twenty-Second Street: Conversion to Multiway STOP (see Figures 12 through 15)

These are two One Way streets located very near the University of Tennessee Campus, Knoxville, Tennessee. Lake Avenue runs east and west (one way westbound) and Twenty-Second Street runs north and south (one way southbound). Both are residential/local streets, however Twenty-Second Street crosses a major arterial one block to the north. On the south west corner of the intersection is Thackston School, a kindergarten and day care facility. All other property is residential. Lake Avenue intersects a major collector, Volunteer Boulevard, one block west of the intersection. Lake



Figure 12 - Twenty-second Street looking south
approximately 400 feet from the STOP



Figure 13 - Twenty-second Street looking south
approximately 200 feet from the STOP



Figure 14 - Twenty-second Street looking south
approximately 100 feet from the STOP



Figure 15 - Twenty-second Street looking south
approximately 50 feet from the STOP

Avenue carries the majority of the traffic but stops for Twenty-Second Street due to a large earth bank on the north east corner of the intersection that causes a sight distance limitation. Twenty-Second St comes down a steep grade, intersects Lake Avenue, and then goes up a steep grade (8 percent or more). Both streets are about 30 feet wide with parking on both sides. Lake Avenue STOP regulations were stated with left and right corner 36" STOPs and a stop bar. The decision was made to go to an All Way STOP due to a relatively high number of right angle accidents. Left and right corner STOPs, Stop Ahead, and new signing was installed on April 31, 1991. A type A flasher was installed above the Stop Ahead assembly and parking was pulled back from the southbound STOPs to aid in their visibility on the same day. The flasher could not be seen flashing during the daylight hours. Also, since it was installed on a street light pole, it was not conspicuous in the evenings. The flasher and "NEW" sign were removed on June 3, 1991. The transition occurred without incident.

Central Street Jackson Avenue: Conversion from a Two Way to a Multiway STOP (see Figure 16 through 26)

Central Street is a Two Way street that runs north and south with metered parking on the west side of the south leg. Jackson Avenue runs east and west and is a two way street with parking on both sides, both legs of the intersection. The

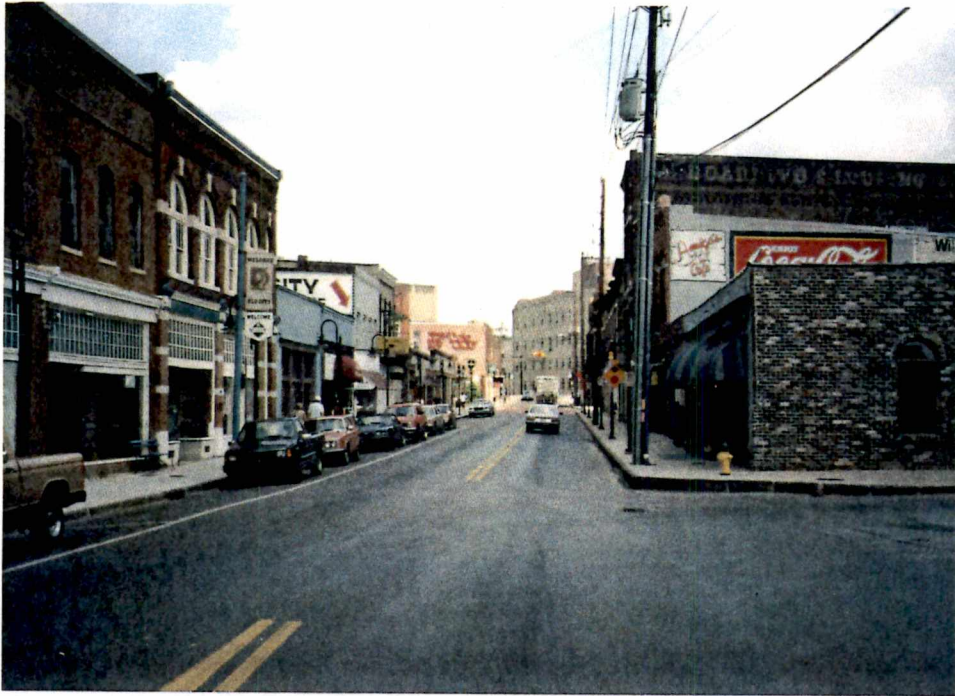


Figure 16 - Central Street looking north
approximately 400 feet from the STOP



Figure 17 - Central Street looking north
approximately 300 feet from the STOP



Figure 18 - Central Street looking north
approximately 200 feet from the STOP



Figure 19 - Central Street looking north
approximately 100 feet from the STOP



Figure 20 - Central Street looking north
at the STOP



Figure 21 - Central Street looking south
approximately 500 feet from the STOP



Figure 22 - Central Street looking south
approximately 400 feet from the STOP



Figure 23 - Central Street looking south
approximately 300 feet from the STOP



Figure 24 - Central Street looking south
approximately 200 feet from the STOP



Figure 25 - Central Street looking south
approximately 100 feet from the STOP



Figure 26 - Central Street looking south
at the STOP

intersection is located in a historic and recently restored part of Knoxville called "The Old City" and is surrounded by commercial land use (mostly antique shops and restaurants). Originally, Jackson Avenue stopped for Central Street. Recent construction by the city had repaved both streets, rebuilt the sidewalks, installed brick paving at the intersection and 50 feet back on all approaches, and relocated a large number of utilities at a considerable expense. The decision to go from a Two to a Four Way STOP was made based on delay and accident considerations. Four railroad tracks cross Central Street one half of a block north of the intersection about 5 to 10 feet above the normal grade of Central Street.

The same apparatus was installed here as at Lake Avenue and Twenty-Second Street on May 9, 1991 except no No Parking signs or stop bars were installed. The STOPs were installed approximately 50 feet back from the curb line of Jackson Avenue on Central Street to avoid damaging the city's aesthetic improvements.

Field observations revealed that northbound and southbound drivers were not observing the STOP and Jackson Avenue delay was said to increase rather than decrease because Jackson Avenue drivers waited to be sure north and southbound drivers stopped before proceeding through the intersection.

Flags were then installed on STOPs, but the problems continued until an overhead intersection control beacon was installed in June of 1991. A stop observance study was

conducted at this point. Approximately six percent of the north and southbound traffic was still not stopping. The city administration wants the beacon removed because the above ground utilities and the beacon's span wires are unattractive. The beacon was removed on June 5, 1992. Left corner STOP signs and stop bars were installed August 27, 1991.

Note in the photographs of this intersection, especially southbound, how the continuity of Central through and beyond the intersection might increase the chances for a motorist to overlook the STOP conditions.

Revisions to Model Transition Procedures

Based on the Case Studies the following recommendations are made:

- 1) The Type A flashers above the signs be replaced in all instances with flags because the Type A flashers are inconspicuous.
- 2) When changing STOP control or installing a new signal, stop bars be updated the same time as the new control is installed.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

The following is a summary of findings stated in this thesis:

- 1) Based on a questionnaire it was found that some agencies have a transition procedure for STOP conversion and/or signal installation. However, written guidelines on conversions are rare.
- 2) The original questionnaire verified that transition procedures vary among political jurisdictions in several ways.
 - a. Traffic control changes considered needing transition.
 - b. Level of transition needed for a change
 - c. Length of transition period
 - d. Specific traffic control devices and public relations campaigns used to carry out the change.
- 3) Based on a 70 percent approval rating from the questionnaire respondents, the following traffic control changes warrant a conversion procedure: a) STOP Reversal; b) Four to Two Way STOP; c) New Signal; d) Signal Removal; and e) One Way street changes.
- 4) According to the literature review, the level of transition is typically based on traffic speed, traffic

volume, available sight distance and accident history.

- 5) Traffic control conversion procedures are generally divided into three phases: preconversion, actual conversion and postconversion. Preconversion is when traffic data is used to decide if and when the change is to be made. Actual conversion is when the traffic control on the street is actually changed. Postconversion is when the new traffic control is evaluated.
- 6) When making the same traffic control changes at many intersections, simultaneous and staggered changover strategies were identified, according to the literature review.
- 7) The transition procedures developed in this thesis were found acceptable by most responding to the feedback questionnaire. They covered many elements of transition using procedures researched and field tested in state and local agencies.

No standardized transitions are currently listed in the MUTCD. Traffic Control practices not in the MUTCD are subject to great variation between agencies. The guideline that specifies warrants for the installation of traffic control should also specify procedures for transition. These procedures developed in this research have merit because they were derived from current field practices. However, before any such procedure is included in the MUTCD, further field

investigation is necessary. Specific needs are as follows:

1. Further research on what characteristics determine the need for, and level of, transition(i.e., traffic speed and volume)
2. Further field testing of a conversion procedure to verify it is prudent and cost effective.
3. Further professional feedback to insure that the procedures reduce, not increase, the citizen disapproaval of such changes and the way they are carried out.
4. Further research on liability and safety benefits of transition procedures.

LIST OF REFERENCES

LIST OF REFERENCES

- [1] Chadda, Hemmat S. and Mulinazzi, Thomas E., "SAFE CONVERSIONS OF UNWARRANTED MULTI-WAY STOP SIGNS", Journal of Transportation Engineering, Vol.111, No. 5, September, 1985.
- [2] Ligon, Claude M., Carter, Everett C., and McGee, Hugh W., "Multiway Stop Sign Removal Procedures", A paper Presented at the Annual Meeting of the Transportation Research Board, Washington, D.C., 1985.
- [3] FHWA, "Procedure For The Removal Of Not Needed Traffic Signals", FHWA Publication, 1980.
- [4] Transportation and Traffic Engineering Handbook, Institute of Transportation Engineers, Prentice-Hall International, Inc., 1982.
- [5] Manual on Uniform Traffic Control Devices for Streets and Highways, U.S. Department of Transportation, Federal Highway Administration, 1988.

APPENDIXES

APPENDIX A

AGENCIES RESPONDING TO THE QUESTIONNAIRE

State of Iowa
State of Oregon
State of Pennsylvania
City of Cedar Rapids
City of Allentown
State of Nebraska
State of Illinois
State of Delaware
State of Virginia
State of Colorado
County of Clackamas
City of Kansas City
City of Baton Rouge
City of Anchorage Alaska
State of Minnesota
City of Chicago
State of Oklahoma
State of New Mexico
City of Casper, Wyoming
State of New York
State of Wisconsin
State of Montana
City of Akron, Ohio
State of Indiana
State of West Virginia
State of Missouri
State of North Dakota
State of Florida
State of Texas
City of Albuquerque, New Mexico
State of New Hampshire
City of Provo, Utah
State of Wyoming
State of South Carolina
City of Helena, Montana
City of Green Bay, Wisconsin
City of Honolulu, Hawaii
City of Charleston, South Carolina
State of Arkansas
County of Broward, Florida
State of Maryland
Olin K. Dart, Consulting Engineers
City of Little Rock, Arkansas
State of Vermont
State of Alabama

APPENDIX B
STATE OF FLORIDA STATUTE

F.S. 1987

STATE UNIFORM TRAFFIC CONTROL

Ch. 316

(4) It shall be unlawful for any public body or official to purchase, or for anyone to sell, any traffic control signal or device unless it conforms with the manual and specifications published by the Department of Transportation and is certified to be of such conformance prior to sale. Any manufacturer or vendor who sells any traffic control signal, guide, or directional sign or device without such certification shall be ineligible to bid or furnish traffic control devices to any public body or official for such period of time as may be established by the Department of Transportation; however, such period of time shall be for not less than 1 year from the date of notification of such ineligibility.

(5) It is unlawful for any public body to manufacture for installation or placement any traffic control signal, guide, or directional sign or device unless it conforms to the uniform system of traffic control devices published by the Department of Transportation. It is unlawful for any public body to sell any traffic control signal, guide, or directional sign or device it manufactures to any nongovernmental entity or person.

(6) Any system of traffic control devices controlled and operated from a remote location by electronic computers or similar devices shall meet all requirements established for the uniform system and where such systems affect the movement of traffic on state roads the design of the system shall be reviewed and approved by the Department of Transportation.

(7) The Department of Transportation is authorized, after hearing pursuant to 14 days' notice, to direct the removal of any purported traffic control device wherever located which fails to meet the requirements of this section. The public agency erecting or installing the same shall immediately remove said device or signal upon the direction of the Department of Transportation and may not, for a period of 5 years, install any replacement or new traffic control devices paid for in part or in full with revenues raised by the state unless written prior approval is received from the Department of Transportation. Any additional violation by a public body or official shall be cause for the withholding of state funds for traffic control purposes until such public body or official demonstrates to the Department of Transportation that it is complying with this section.

(8) The Department of Transportation is authorized to permit traffic control devices not in conformity with the uniform system upon showing of good cause.

History.—s. 1, ch. 71-135; s. 1, ch. 72-189; s. 1, ch. 73-310; s. 1, ch. 76-31; s. 1, ch. 77-140; s. 1, ch. 80-178.
Note.—Former s. 316.131.

316.0747 Sale or purchase of traffic control devices by nongovernmental entities; prohibitions.—

(1) It is unlawful for any nongovernmental entity to use any traffic control device at any place where the general public is invited, unless such device conforms to the uniform system of traffic control devices adopted by the Department of Transportation pursuant to this chapter.

(2) Any nonconforming traffic control device in use by a nongovernmental entity prior to January 1, 1980, may be used for the remainder of its useful life, after which any replacement device shall conform to the uniform system of traffic control devices adopted by the

Department of Transportation.
History.—s. 1, ch. 79-376.

316.075 Traffic control signal devices.—Except for automatic warning signal lights installed or to be installed at railroad crossings, whenever traffic, including municipal traffic, is controlled by traffic control signals exhibiting different colored lights, or colored lighted arrows, successively one at a time or in combination, only the colors green, red and yellow shall be used, except for special pedestrian signals carrying a word legend, and the lights shall indicate and apply to drivers of vehicles and pedestrians as follows:

(1) GREEN INDICATION.—

(a) Vehicular traffic facing a circular green signal may proceed cautiously straight through or turn right or left unless a sign at such place prohibits either such turn. But vehicular traffic, including vehicles turning right or left, shall yield the right-of-way to other vehicles and to pedestrians lawfully within the intersection or an adjacent crosswalk at the time such signal is exhibited.

(b) Vehicular traffic facing a green arrow signal, shown alone or in combination with another indication, as directed by the manual, may cautiously enter the intersection only to make the movement indicated by such arrow, or such other movement as is permitted by other indications shown at the same time. Such vehicular traffic shall yield the right-of-way to pedestrians lawfully within an adjacent crosswalk and to other traffic lawfully using the intersection.

(c) Unless otherwise directed by a pedestrian control signal as provided in s. 316.0755, pedestrians facing any green signal, except when the sole green signal is a turn arrow, may proceed across the roadway within any marked or unmarked crosswalk.

(2) STEADY YELLOW INDICATION.—

(a) Vehicular traffic facing a steady yellow signal is thereby warned that the related green movement is being terminated or that a red indication will be exhibited immediately thereafter when vehicular traffic shall not enter the intersection.

(b) Pedestrians facing a steady yellow signal, unless otherwise directed by a pedestrian control signal as provided in s. 316.0755, are thereby advised that there is insufficient time to cross the roadway before a red indication is shown and no pedestrian shall start to cross the roadway.

(3) STEADY RED INDICATION.—

(a) Vehicular traffic facing a steady red signal shall stop before entering the crosswalk on the near side of the intersection or, if none, then before entering the intersection and shall remain standing until a green indication is shown; however:

1. The driver of a vehicle which is stopped at a clearly marked stop line, but if none, before entering the crosswalk on the near side of the intersection, or, if none then at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection in obedience to a steady red signal may make a right turn, but shall yield the right-of-way to pedestrians and other traffic proceeding as directed by the signal at said intersection, except that municipal and county authorities

APPENDIX C - WRITTEN PROCEDURES ON TRAFFIC CONTROL TRANSITION

TRAFFIC CONTROL DEVICES AND OPERATIONAL PROCEDURES CHANGEOVER QUESTIONNAIRE

Name of Respondent _____
 Organization _____
 Department _____
 Official Title _____
 Years Experience _____

1. What kind of Traffic Control Device changes or Operational Procedure changes need a staged transition such as temporary warning signs, flashing signals, public notices, etc.

Yes	No	STOP SIGNS
_____	_____	initial placement
_____	_____	reversing stop conditions
_____	_____	changing yield to stop signs
_____	_____	two to four way stop
_____	_____	four to two way stop
_____	_____	other _____
		TRAFFIC SIGNALS
_____	_____	new traffic signal
_____	_____	removal of existing traffic signal
_____	_____	traffic signal timing/phasing changes (i.e. leading to lagging green for phasing, time allotment changes for timing)
_____	_____	addition or removal of left turn phase
_____	_____	no right turn on red
_____	_____	other

MISCELLANEOUS

___ ___ lane configuration changes

___ ___ left turn prohibition changes

___ ___ one way street changes (one way to two way
or vice versa, also directional changes)

___ ___ grooved pavement changes

___ ___ sign other than STOP signs (speed limit,
no parking)

___ ___ other _____

2. Does your agency have a written policy on changeovers for any Traffic Control Devices or Operational procedures? If so would you please mail us a copy with this questionnaire?
3. Has your agency done any research on changeovers? Do you have any data on this subject? Would you mail us a copies?
4. Are you aware of any research on this subject? If so would you give us a reference?
5. On the back of this questionnaire, please briefly outline the transition procedure of each type of changeover that you feel is necessary, but for which your organization has no written porcedure. Please include time frame and additional sheets if you find it necessary.

Please return completed questionnaire to:

Professor Jack B. Humphreys
Department of Civil Engineering
University of Tennessee
Knoxville, TN 37996-2010

Iowa Department of Transportation
Changes in Stop Conditions at Primary Highway
Intersections

Procedures:

A. Notification

1. After Commission approval of the change in stop conditions, the Office of Maintenance shall provide the News and Information office with all pertinent information including a sketch showing the signing changes.
2. The News and Information office shall prepare a news release describing the change and shall distribute it to local news media, the Office of Maintenance, the District Engineer, and the Resident Maintenance Engineer.
3. The Resident Maintenance Engineer shall establish the date for changing the signs, allowing a minimum of two weeks after public notice is given.
4. The Resident Maintenance Engineer shall inform local law enforcement official of the impending change in traffic controls at the intersection and the date it will be made.

B. Signing Changes Only

1. When the number of stop signs is reduced:
 - a. Red flags shall be installed above the remaining "STOP" signs and maintained there for a minimum of 30 days.
 - b. Signs shall be installed below the remaining stop signs indicating that "HIGHWAY # _____ TRAFFIC DOES NOT STOP."
 - c. Special warning signs with the message, "WATCH FOR CROSS TRAFFIC", shall be installed on the new through route and maintained there for a minimum of three months.
2. When the number of stop signs is increased:
 - a. Red flags shall be installed above the new "STOP AHEAD" and "STOP" signs and maintained there for a minimum of 30 days or until rumble strips are installed.

minimum of 30 days or until rumble strips are installed.

- b. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips are installed as soon as practicable.
3. When stop controls are changed to reverse the through route:
 - a. Red flags shall be installed above the new "STOP AHEAD" and "STOP" signs and maintained there for a minimum of 30 days or until the rumble strips are installed.
 - b. Signs shall be installed below each stop sign indicating that "HIGHWAY # _____ TRAFFIC DOES NOT STOP."
 - c. Special warning signs with the message "WATCH FOR CROSS TRAFFIC" shall be installed on the new through route and maintained there for a minimum of three months.
 - d. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips shall be installed as soon as practicable.

C. Signing Changes for Intersection Construction or Reconstruction

1. When a new stop condition is imposed:
 - a. Red flags shall be installed above the new "STOP AHEAD" and "STOP" signs and maintained there for a minimum of 30 days.
 - b. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips shall be installed.
2. When pre-existing stop conditions are reestablished, "STOP" and "STOP AHEAD" signs shall be replaced in the same locations or the same relative positions they occupied prior to intersection construction or reconstruction.
3. When the Office of Maintenance determines that special signing or warning is necessary, the devices shall be shown on

- b. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips are installed as soon as practicable.
- 3. When stop controls are changed to reverse the through route:
 - a. Red flags shall be installed above the new "STOP AHEAD" and "STOP" signs and maintained there for a minimum of 30 days or until the rumble strips are installed.
 - b. Signs shall be installed below each stop sign indicating that "HIGHWAY # _____ TRAFFIC DOES NOT STOP."
 - c. Special warning signs with the message "WATCH FOR CROSS TRAFFIC" shall be installed on the new through route and maintained there for a minimum of three months.
 - d. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips shall be installed as soon as practicable.

C. Signing Changes for Intersection Construction or Reconstruction

- 1. When a new stop condition is imposed:
 - a. Red flags shall be installed above the new "STOP AHEAD" and "STOP" signs and maintained there for a minimum of 30 days.
 - b. If the approach speed exceeds 35 miles per hour, the 48-inch "STOP AHEAD" signs shall be erected on both sides of the highway and rumble strips shall be installed.
- 2. When pre-existing stop conditions are reestablished, "STOP" and "STOP AHEAD" signs shall be replaced in the same locations or the same relative positions they occupied prior to intersection construction or reconstruction.
- 3. When the Office of Maintenance determines that special signing or warning is necessary, the devices shall be shown on the new intersection signing and marking plan.

Oregon Department of Transportation

A single sign is used to warn of any change in traffic control.

The TRAFFIC CONTROL CHANGE AHEAD sign may be used to alert drivers to a recently and possibly unexpected change in traffic control such as a new traffic signal, stop sign, or lane control. This sign shall be used only in addition to standard advance signing and shall remain in use only until regular traffic can be expected to have become familiar with the change, normally one week. In no instance shall the sign remain in use at a single site for longer than 30 days. (see Figure C-1)

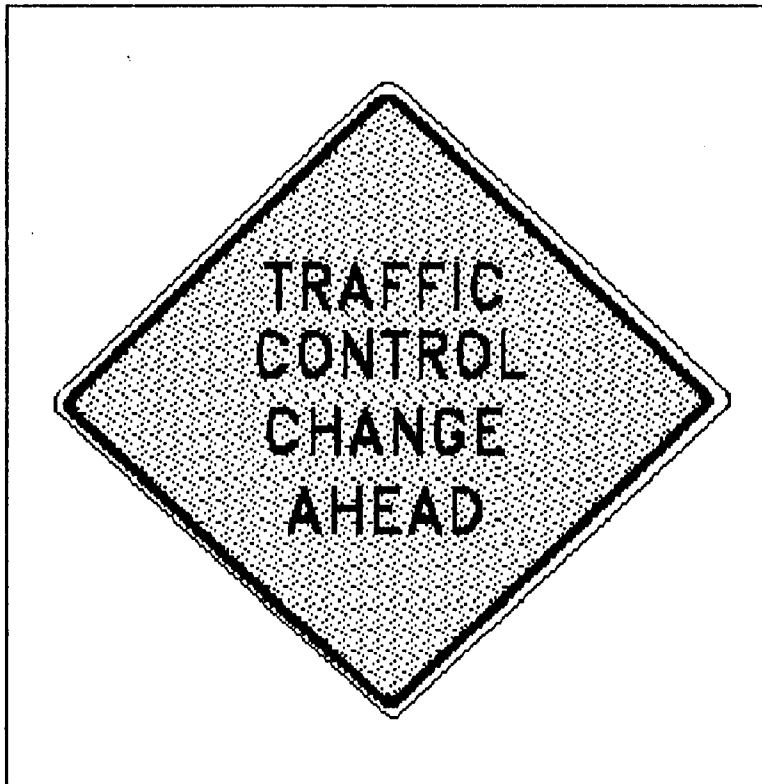


Figure C-1 - Traffic Control Change Ahead Sign

Pennsylvania Department of Transportation

The conversion procedures for this agency consist solely of two signs and a short paragraph for each's justification; One for lane change configurations and one for Four to Two way STOP conversions (see Figures C-2 and C-3). Allentown, PA gave the same procedure.

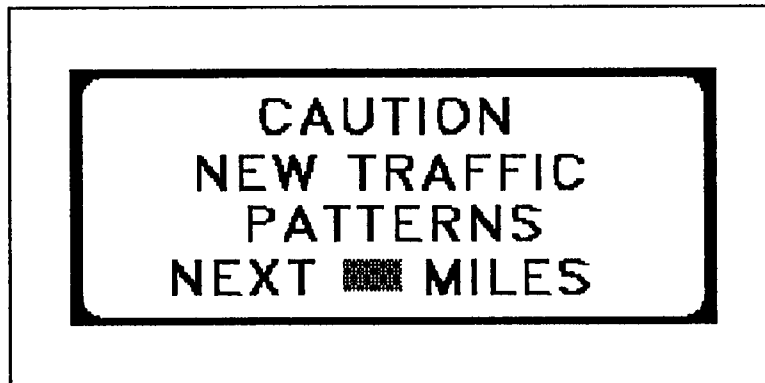


Figure C-2 - Lane Configuration Change Sign

New Traffic Patterns Sign, W14-8.

(a) Justification. The New Traffic Patterns Sign, W14-8 will be authorized for use as a temporary sign on expressways and freeways to warn drivers that the travel lanes have been revised. When the revision covers only a short distance, the last line on the W14-8 sign may be revised to state "AHEAD".

(b) Placement. When used, the W14-8 Sign should be placed a minimum of 775 feet in advance of the beginning of the section with revised travel lanes.

Stop Sign Removed from Side Street Sign, R1-4.

(a) Justification. Justification shall be as follows:

(1) The Stop Sign Removed from Side Street Sign, R1-4, shall be authorized for use to advise local

drivers that the stop sign on the side street has been removed. The R1-4 sign should be removed after six weeks.

(2) In the particular case when stop signs are to be reversed, a temporary multiway stop intersection should normally first be authorized for approximately six weeks for those intersections with a combined average daily traffic of 500 vehicles. After the original stop signs are removed, the R1-4 sign shall be authorized for six weeks beneath remaining stop signs.

(b) Placement. When used, the R1-4 sign shall be placed beneath appropriate stop signs for educational purposes.

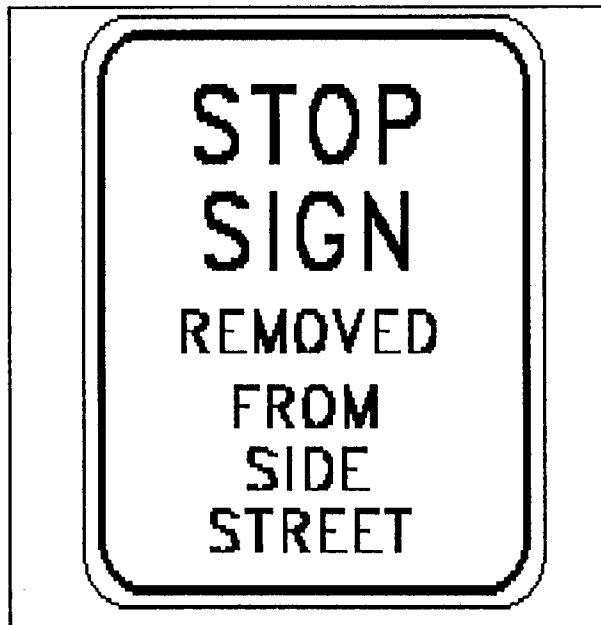


Figure C-3 - Four to Two Way STOP Conversion sign

City of Cedar Rapids

"LEFT TURN ON GREEN "

It will be the policy of the Department to install the R10-12 sign "LEFT TURN YEILD ON GREEN ", adjacent to all five

section protected/permissive left turn traffic signal heads. When the five section head is mounted on the end of the mast arm, the R10-12 sign will be mounted on the adjacent right side of the five section head. When the mast arm extends past the five section head, the R10-12 sign will be installed over the left turn lane, preferably on the end on the mast arm.

When the traffic signal operation is changed from protected left turns to permissive left turns, the R10-10 sign "LEFT TURN SIGNAL" will be removed and replaced with the R10-12 sign. The R10-12 sign is an interim control measure in this situation, and after 30 days the R10-12 sign will be removed and the R3-5 sign will be installed on the back to the mast arm.

EXISTING TWO-WAY STOP TO ALL-WAY STOP

After Council approval the following advisory procedure is established for stop sign conversion:

I. Existing Two-Way Stop to All Way Stop

1. Approximately two weeks prior to installation of the all-way stop place public notification signs on all approaches to the intersection. Legend for the signs will be "Notice "All-Way Stop Scheduled (day and date inserted)".
2. The signs listed below are to be installed or uncovered in the following sequence:
 - a.) Stop sign(s) on the uncontrolled approaches
 - b.) Supplemental plates below all stop signs
 - c.) Temporary or permanent Stop Ahead sign(s) on the uncontrolled approach(s)

If possible, the signs should be installed or uncovered before the morning peak period the day of conversion. Maintain the temporary "Stop

Ahead" signs for 90 days and then remove.

II. Existing All-Way Stop to Two-Way Stop

If supplemental plates are not in use at the intersection, then the supplemental plates should be added at least 30 days before the actual conversion.

1. Approximately two weeks prior to the actual conversion, place public notification signs on all approaches to the intersection. Legend for the proposed uncontrolled approaches will be "Notice this Stop Will Be Removed Effective (day and date inserted)". Legend for the proposed remaining stop sign controlled approach will be "Notice Cross Traffic Will Not Stop Effective (day and date inserted)".
2. Before the day of the conversion all pavement markings rendered obsolete by the change should be removed or obliterated. Also sight distance should be improved, if necessary, by (a) imposing parking restrictions, (b) pruning vegetation, or (c) adjusting location of the stop line.
3. Perform the conversion in the following sequence:
 - a.) On the proposed stop sign controlled approach replace the supplementary plate(s) and public notification sign(s) with temporary "Cross Traffic Does Not Stop" sign(s).
 - b.) On the proposed uncontrolled approach remove the unwarranted stop sign(s), supplementary plate(s), public notification sign(s), obsolete "Stop Ahead" signs and accompanying post(s).

If possible, the signing changes for the conversion should be completed before the morning peak period.

Maintain the temporary "Cross Traffic Does Not Stop" signs for 90 days. Evaluate the conditions at the intersection during this period. If conditions are not satisfactory, then the "Cross Traffic Does Not Stop" signs should remain for an additional period of time. At the end of the initial 90 day period with satisfactory conditions remove the "Cross Traffic Does Not Stop" signs.

III. Reassignment of Right of Way for Two-Way Stop

The above procedures may be applied with slight modifications where the right-of-way is reassigned at an intersection)i.e., stop sign reversals).

IV. Uncontrolled to Two-Way Stop

Uncontrolled intersections are located at the intersection of streets that are not "through" streets", have low traffic volumes, low speeds, and are located in residential areas servicing local traffic. Due to these conditions it will not be necessary to install other signs when installing the stop signs.

The procedures described in this PPM are subject to engineering judgement. Any modifications should be documented in the files.

TRAFFIC SIGNAL INSTALLATION PROCEDURE

The following advisory procedure is established for providing operation of new traffic signal installations:

1. Before turning the signals on normal operation, provide public notification signs on the intersection approaches. Legend for the signs will be

"Traffic Signal Operation Scheduled for (day and date inserted)". Depending on the project schedule the public notification sign may be installed several months in advance of the signal operation, but will only identify the month, and/or approximately two weeks before turning the signals on operation, the sign may in addition identify the specific day of signal operation.

2. Approximately three days before turning the signals on normal operation, place the signals in flashing operation. Concurrently, install "Cross Traffic Does Not Stop" signs, then turn the signal on normal operation. Remove the public notification signs.
3. Immediately prior to turning the signal on normal operation, remove the "Stop" signs, then turn the signal on normal operation. Remove the public notification signs.

The procedures described in this PPM are subject to engineering judgement. Any modifications should be documented in the files.

TRAFFIC SIGNAL REMOVAL PROCEDURE

After Council approval the following advisory procedure is established for removal of traffic signals:

Existing Signals Under Normal Operation With Proposed Two-Way Stops

1. Approximately two weeks prior to discontinuing normal operation of the traffic signal, place public notification signs on all approaches to the intersection. Legend for the signs will be "Traffic Signal Removal Scheduled for (day and date inserted)".

2. Simultaneously place hoods over all traffic signal heads and install stop signs on the minor street. Temporarily mount the appropriate "Cross Traffic Does Not Stop", "Traffic from Right Does Not Stop", or "Traffic from Left does Not Stop", signs below the stop signs. A short flash period will be required to simultaneously hood the traffic signal heads and install the signs. Remove the public notification signs.
3. Maintain the above traffic control for 30 days. Evaluate the conditions at the intersection during this period. If the conditions are not satisfactory, then the interim control in paragraph 2 should be extended during which time the signal removal should be reassessed.
4. At the end of the 30 day period without unsatisfactory conditions, remove the traffic signal heads. the temporary warning signs should remain for another 60 days and then be removed.

Exsiting Signals Under Normal Operation
With Proposed All Way Stops

1. Provide public notification signs as in paragraph 1 above.
2. Simultaneously place hoods over all traffic signal heads and install top signs on all approaches. Mount the appropriate supplementary plate below the stop signs. Remove the public notification signs.
3. Maintain the above traffic control for 30 days. Evaluate the conditions at the intersection during this period. If the conditions are not satisfactory the the interim traffic control in paragraph 2 should be reassessed.
4. At the end of the 30 day period without unsatisfactory conditions, remove the traffic signal heads. The temporary warning signs should remain for another 60 days and then be removed.

The procedures described in this PPM are subject to engineering judgement. Any modifications should be documented in the files.

State of Nebraska

INTERSECTION TRAFFIC CONTROL MODIFICATION PROCEDURES

Procedural Details for Specific Conversions - Refer Fig. 1 Attachment (Figure C-4)

A. Applying control at presently uncontrolled intersection.

Assume that control will be two-way either YIELD or STOP;

Study and evaluate site and conditions with reference to MUTCD criteria. Be sure that decisions made in determining type of control to be applied can be validated by measured and analyzed data.

Publicize change and effective date.

Make sure change is made as publicized.

Have all visibility sight obstructions corrected.

Position and install control signs as per MUTCD standards.

Install Yield Ahead or Stop Ahead warning signs on controlled approaches. Temporary red flags should be attached.

B.1 Removal of two-way STOP control at four-way intersections

Study and evaluate site and conditions with reference to MUTCD criteria. Be sure that decisions made in determining type of control to be applied can be validated by measured and analyzed data.

Publicize change and effective date.

Make sure change is made as publicized

Have all visibility sight distance obstructions corrected

Place Sign #1 below STOP signs on controlled street at least two weeks in advance of STOP sign removal.

Install Sign #2 on uncontrolled street in the normal position of a STOP sign.

On the conversion date, remove Sign#1 and STOP sign on the controlled street. Replace Sign #2 with Sign #3. Install Sign #4 on previously uncontrolled street approximately 200' to 250' in advance of intersections. Include red flag attachment to each sign.

B.2 Converting four-way control to two-way control

Study and evaluate site and conditions with reference to MUTCD criteria. Be sure that decisions made in determining type of control to be applied can be validated by measured and analyzed data.

Publicize change and effective date

Make sure change is made as publicized

Have all visibility sight obstructions corrected.

Make sure that 4-way panels (Type R1-3) are in place below all STOP signs at least 30 days prior to any change

On the publicized conversion date, remove Sign #1 and STOP sign 4-way panels on major street. Remove Sign #2 on minor street and replace them with Sign #3. Install Sign #4 on minor street approximately 250 feet

in advance of intersection. Include red flag attachments.

B.3 Shifting two-way control at a four-way intersection.

Study and evaluate site and conditions with reference to MUTCD criteria. Be sure that decisions made in determining type of control to be applied can be validated by measured and analyzed data.

Publicize change and effective date

Make sure change is made as publicized

Have all visibility sight obstructions corrected

When Changing from YIELD to STOP, install Stop Ahead at appropriate site in advance of STOP sign. At four-way intersection, if YIELD is on only one approach, it probably would be advisable to install a STOP sign on the opposite approach also. Install 30" STOP signs, not 24".

Supplemental signing is generally not needed when changing from STOP to YIELD. However, before changing, check for any sight obstructions caused by foliage or curb parking, and take any necessary remedial action.

D. Continuation or removal of traffic signal control

Make prescribed studies to evaluate prevailing traffic conditions. Test the results against the MUTCD warrants for signal control.

If signal control is warranted but existing system is obsolete, inefficient, or otherwise does not comply with MUTCD design and usage standards, a remodeling project should be developed.

If signal control is not warranted, develop removal program beginning with the dissemination of facts to local officials and the public. Include a time schedule.

Begin by setting signal control on flashing mode. (Flash yellow on major street and red on minor streets). If flashing is not possible, inform public by all available news media on reason for removal.

Install STOP (30") and STOP AHEAD signs on minor street approaches. Then turn off power and immediately cover the signal heads until removal can be completed.

III. Final Comment

Local officials should be advised not to become overly alarmed or overreact if an accident occurs after a change is made. Any incident should be thoroughly investigated to determine all causative factors and any preventative action that might be taken other than intersection control.

Changes in the kinds of traffic control discussed herein can be expected to generate some opposition and complaints. But, if the change is properly conceived and implemented, all aspects studied, and the basis for the change is well documented, opposition will be manageable. Any change should be allowed the test of time against any prophecy of doom. Local officials must resist the forces of the 4-P's- Personal opinions, Pressure groups, Petitions and Politics.

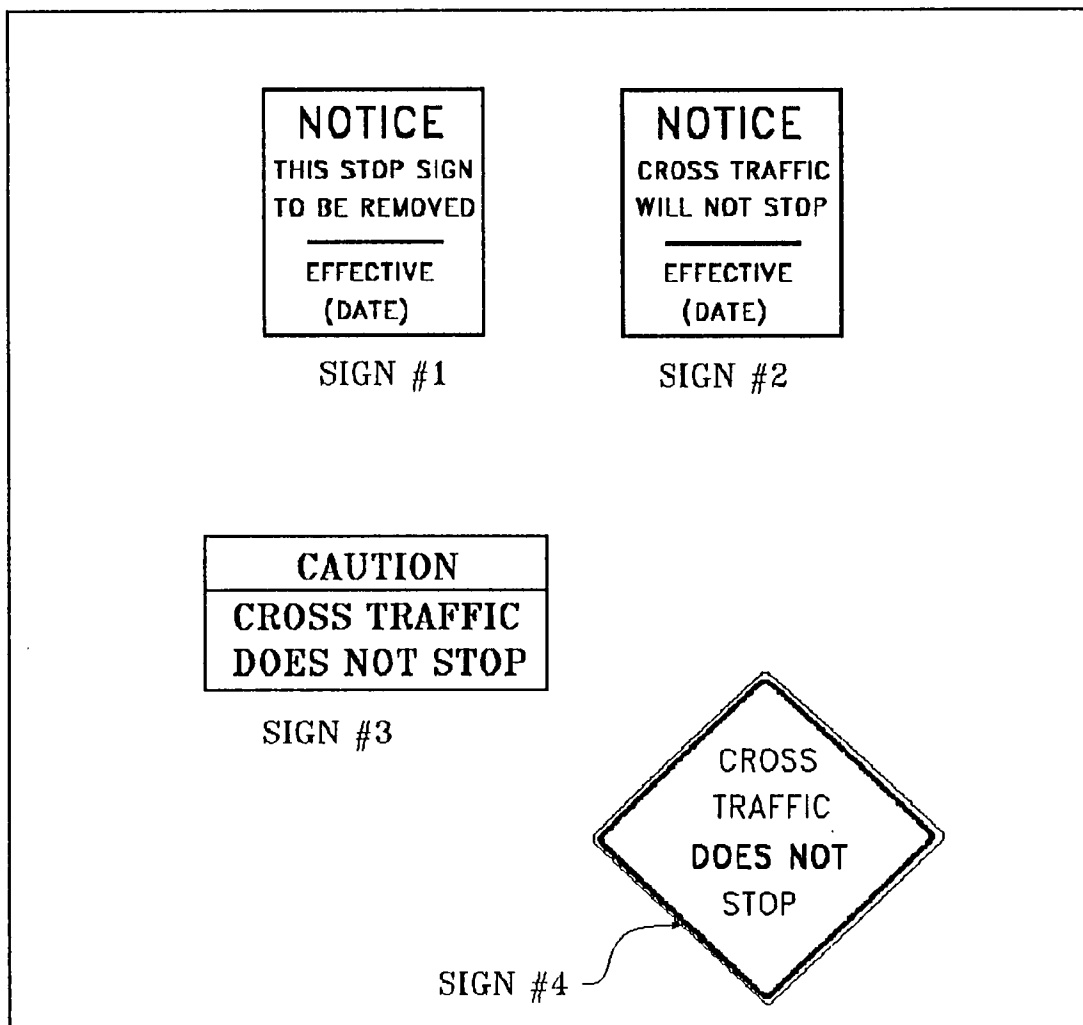


Figure C-4 - Nebraska's Conversion Signs

State of Illinois

TEMPORARY MEASURES TO ALERT MOTORISTS TO NEW TRAFFIC CONTROL DEVICES

The following temporary alerting measures, listed in ascending order of comprehensiveness, are intended to be used as appropriate to call motorists attention to new stop signs, traffic signals, and one way streets.

New Stop Sign Locations - Temporary Alerting Measures

1. Flags on Stop signs.
2. Flags on Stop and Stop Ahead signs.

3. Flags and Flashers (red and yellow) on Stop and Stop Ahead signs.

New Signal Locations - Temporary Alerting Measures

1. Flash signals for three to seven days
2. Flags on Signal Ahead signs. Flash signals for up to one week.
- *3. Flags and yellow flashers on Signal Ahead signs. Flash signals up to one week.

New One-Way Street Intersections - Temporary Alerting Measures

1. Flags on One-Way Signs.
- *2. Flags and flashers on One Way signs; flags on No Left Turn signs.
- *3. Flags and flashers on One Way and No Left (Right) Turn signs.
*Flashers left in place until batteries go dead. (two or three weeks)

Application

Agencies responsible for installation of traffic control devices should select a level of alerting measures based on :

1. Speed of traffic
2. Volume of traffic
3. Sign Distance
4. Unexpectancy of change (i.e., new street, major traffic pattern change, etc.)

APPENDIX D - UNWRITTEN POLICIES ON TRAFFIC CONTROL TRANSITION

STATE Department of Transportation

It is considered essential that public notice in the local news media be provided prior to changing control methods at intersections, (except as noted on the questionnaire) [STATE advocated transition for initial placement of stop, reversing of stops, two to four way stop, new signals and signal removal]. Where a change in control has occurred warning signs, for example, STOP AHEAD or SIGNAL AHEAD, should be temporarily used in advance of the intersection even if they would not normally be required based on the circumstances.

(a) When converting from a four-way stop, a sign "Crossing Traffic Does Not Stop" should be temporarily erected beneath the remaining stop signs.

(b) Traffic signals shall be operated in a flashing mode for one week prior to effecting "Stop and Go" operations and for 30 days prior to being removed.

(c) To change stop control from one street to another, the procedure is to advertise, erect stop control and advance warning on the crossing street thus establishing a four-way stop. Two weeks later the stop control may be removed from the street to be made "through", using method in (a) above.

(d) After about six months, unnecessary warning signs for instance, STOP AHEAD and SIGNAL AHEAD may be removed.

If a change from a two-way stop to a four-way stop is to be done for the purpose of eventually reversing stop control, it is essential that notice be given through press releases. A sign should be developed, also, to provide

notice to motorists on the street to which stop control is shifted.

STATE Department of Transportation

Reversing Stop Conditions -
Reversing stop conditions is done by using a four month period of full way stop.

Four Way to Two Way Stop - The placement of special signs on the stop approaches to inform drivers that all streets do not stop.

New Signals - A special "New Signals Ahead" sign - white in place of yellow background on the standard Signals Ahead sign plus the word "NEW." Place for three months.

Miscellaneous - Additional signs with flashing lights and/or flags. Depends upon magnitude of the change and the type of roadway.

STATE Department of Transportation STOP SIGNS

Initial Placement

Federal sign W3-1a should be installed in advance to the stop condition. Warning sign should remain in place for approximately two weeks.

Reversing Stop Conditions

Same as above.

Two to Four Way Stop

Same as above for the new approaches having stop signs.

TRAFFIC SIGNALS

New Traffic Signal

Signals should be placed in flashing condition for approximately four to seven days.

Lane Configuration Changes

Depending on the type of lane configuration changes, the installation of a sign having the message "BE ALERT NEW TRAFFIC PATTERN AHEAD" may be feasible.

One Way Street Changes

Same as Lane Configuration Changes with the addition of other warning signs designed to fit the circumstances.

Grooved Pavement Changes

Attached is a copy of the specs for the STATE standard sign which is placed in advance of grooved pavement [no copy was enclosed with survey response].

STATE Department of Highways

When reversing stop conditions, it is our policy to first install additional stop signs so as to create a four-way or multi-way stop. This condition is left for 30 days then the inappropriate signs are removed.

Prior to the start up of a new signal it is our policy to have that signal function in the "flash mode" for at least 24 hours. These signals are turned on between 9 a.m. and 2 p.m. and not turned on Fridays and days preceding a legal holiday.

CITY Transportation Department

When reversing or removing a STOP sign we use special educational sign for 30 - 60 days. The sign is green/white informational with legend:[see Figure D-1].

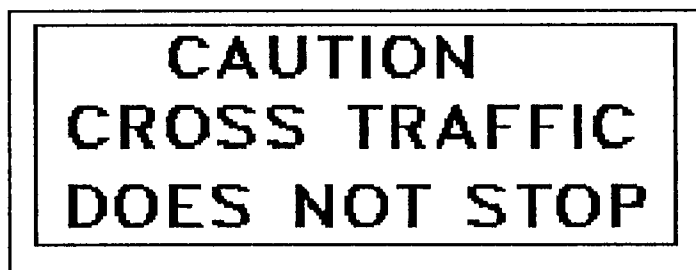


Figure D-1 - CITY's STOP conversion sign

One Way Streets are advertised by public news release and direct mail to all

abutting property owners. In most cases the property owners and tenants have already been involved and give advance opportunity to comment during study and discussion phase. In the past we have also used handouts or windshield notices on parked cars the day the changes are first made. This extra effort is only for commercial areas. For example, when we reversed two downtown streets covering an 18 block distance we placed windshield notices during first week.

CITY Department of Public Works

- 1.) 4 Way Stop installations - Warning signs one installed on all 4 approaches that indicate "Multiway Stop to be installed (date).". These signs are put up one week before that actual change. Stop signs are doubled (left and right sides) and stop ahead signs are installed on the street that did not previously stop.
- 2.) Two Way to One Way Operation - Warning signs are installed at key locations one week prior to the change that indicates "STREET TO BE MADE ONE WAY ON (DATE)."
- 3.) New Signal Installation - Signal put on flash 2 - 3 days prior to turning on stop and go operation.
- 4.) Removal of Signal Installation - Signal put on flash for 1 week prior to removal.
- 5.) Reversal of Right-of-Way (Stop signs) Warning signs are installed on all 4 approaches that indicate "intersection Right of Way to be reversed (date).". These signs are put up one week in advance of the change. Stop signs are doubled (left and right) and Stop Ahead signs are installed on the street that did not previously stop.

CITY Department of Public Works

For signing and lane control changes we post this sign [see Figure D-2] on barricades (type III) on all curbs and islands for approximately two weeks.



Figure D-2 - CITY's Lane Configuration Change Sign

New traffic signals are put on flash for 3 to 5 days before turning on.

For street conversions we use news papers for 2 weeks and

- notify all community groups with a presentation and graphics
- hang door hangers on all affected properties - twice
- notify Municipal Assembly
- distribute supporting studies

STATE Department of Transportation

- If a new stop condition for a high speed roadway will occur extra devices will be installed to bring these changes to the attention of the traveling public (e.g., temporary stop signs installed in barrels and placed in the center of the roadway - with or without flasher

depending on volume). These temporary signs or flashers are maintained for typically 2 - 6 weeks.

- For new turning restrictions, extra devices such as blazed orange target boards are placed above the turn restriction sign to help identify the change. These are also maintained for a period of two to six weeks.

- Naturally, the amount of additional temporary warning devices used is largely dependent on traffic volumes and speeds of the particular roadway. Higher volume, higher speed roadways require extra attention.

STATE Department of Transportation

We feel public notice in the media is required for any of the subjects shown as "Yes". This should start 7 - 10 days before it occurs and continue for at least the same period after it occurs [STOP - initial placement, reversing, two to four way. SIGNALS - new, addition or removal of left turn phase. MISCELLANEOUS - lane configuration changes, left turn prohibition changes one way street changes, other (construction zone)].

STATE Highway and Transportation Department

1. STOP SIGNS

A. Reversing stop conditions.

Place NOTICE signs, assume minor street is Elm and major street is 2nd.

Place the following notice sign on the minor street (Elm):

NOTICE / STOP SIGN ON ELM
STREET / WILL BE REMOVED/
1 - 20 - 88

Place the following notice on the major street (2nd):

NOTICE / STOP
SIGN WILL BE / PLACED ON
2ND STREET / 1 - 20 - 88

Notice signs should be in place for a minimum of 30 days.

Temporary construction flashers
to be placed on NOTICE signs.

On the day of implementation
(Change over of signing) The
intersection should be
controlled by a police officer
for at least 8 hours.

- B. Use similar notice signing time
frames and police officers to
change from 4-way to 2-way.

2. TRAFFIC SIGNALS

- A. New Traffic signals should be
put on flash for at least 24
hrs. prior to normal operation.

- B. Removal of existing traffic
signal. Signals should be put
on flash operation during which
time the following notice signs
should be placed on all
approaches:

NOTICE / SIGNAL
INDICATIONS / TO BE
REMOVED / 1 - 20 - 88

NOTICE / STOP SIGN WILL
BE / PLACED ON 2ND
STREET / 1 - 20 - 88

Police to direct traffic while
stop signs are placed and
signal indications are covered or
removed.

3. MISCELLANEOUS

One way street changes to be handled
similar to that shown above.

CITY Office of the Engineer

Stop Signs

Information signs are placed on the
approaches where stop signs are to
be added or removed. These
information signs

"STOP SIGN TO " STOP SIGN TO
BE REMOVED or BE INSTALLED
XX/XX/XX" XX/XX/XX"
date (1 week notice)

Signals

For a signal removal, a sign is placed on each approach that states:

"SIGNAL
TO BE
REMOVED
BY XX/XX/XX
COMMENTS XXX-
XXXX"
Date (2 weeks)
Phone #

The signal is placed on flash the last week before removal. The other signal issues would probably be delt with best in the local paper.

Miscellaneous

If public notification is necessary, the news paper is probably the best way to approach it.

STATE Department of Transportation

Signing changes - recommend one or more red flags on sign and on advance warning sign. Leave up for several weeks. Could also use a barricade flasher until batteries wear out, then remove.

Signals - new signal installation should be put on flash for several days.

Street changes - should be in local paper

STATE Department of Highways

Reversing stop conditions - flags on signs, public notice

Four to two way stop - public notice

New traffic signal - place on flash for several days

Removal of existing signal - flash for 30 days

One way street changes - public notice

CITY Traffic Engineering Division

Stop sign reversal - usually go to 4 way briefly (2 weeks) then remove old signs, adding (see Figure D-3).

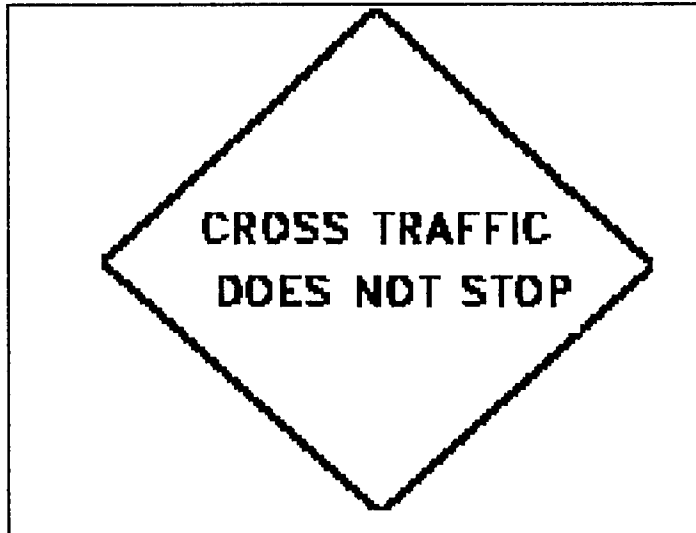


Figure D-3 - CITY's Four to Two Way STOP Change Sign

4 to 2 way - use sign (see Figure D-3) if wholesale (one nearby community had to removal all of their 4 way stops under court order) - newspaper publicity and some more personal notice such as a flyer with the water bill and the warning signs above.

Signal installation

1st - flash red on minor - yellow on major street for a week or so.

2nd - in operation plus (see Figure D-4) signs on each approach on a structure in the roadway (on centerline) for about 2 weeks more -- if there hasn't been anything serious, its o.k.

Signal out

Warning sign ahead of time - "Signal to be removed - Dec 15th"

If there are any known groups that might be interested (feel they own the signal) - a notice to them to attend some meeting to explain what, why, etc.

STATE Department of Highways

It is beneficial for all types of changes

in traffic control, to be publicized in a local newspaper. Those marked as needing a staged transition should be publicized in the local newspapers. The majority of items denoted as needing staged transition would also need other actions based upon sight distance, prevailing speeds and traffic volumes. (Indiana)

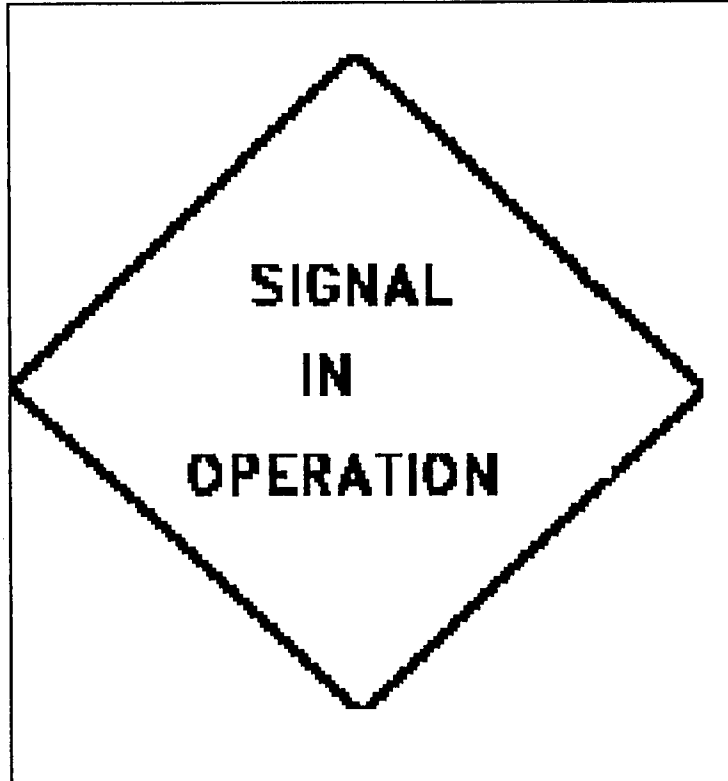


Figure D-4 - CITY's Signal Installation Sign

Reversing "stop" conditions should probably be staged through a 4 way stop with "Stop Ahead" signs (as needed), then revert to two way stop, thus completing the transition.

Two to four way stop would probably require stop ahead signs on the previous preferential route. If geometry, approach speeds and general character of the area indicate, the prewarning signs could be supplemented with flashing beacons.

Four to two way stop should be preceded by several notices in the local newspapers and finally implemented. Upon

implementation, a special warning sign should advise the motorist on the stop approaches that the crossing approach does not stop.

New traffic signal should be placed on flash operation for a few days before being placed in signal mode. Signal mode should not be implemented on a Friday or weekend.

Removal of existing traffic signal should be transitioned by placing the signal to red - amber flash (amber to mainline) for approximately 6 months before final removal.

Lane configuration changes and one way street changes should have more than minimal regulatory signage at the major points or areas of conflict. In some instances, in larger metropolitan areas, police are used at major intersections during morning and evening rush hours to provide reinforcement of the regulatory sign for each lane configuration or one-way operation.

STATE Highway and Transportaion
Department

New "Stop" sign locations may need a one time stop bar painted or a temporary "stop ahead" sign installed.

New traffic signal is flashed for a minimum of 24 hours prior to turn on and is never put in operation on a Friday to monday for turn on that day.

STATE Highway Department
STOP SIGNS

1. [initial placement] No transition period.
2. [reversing stops] Article in newspapers for the affected area - advance signing stop ahead for transition period.
3. [yield to stop] Article in newspaper for the affected area - advance signing stop ahead for transition period.
4. [two to four way stop] Article in

newspaper and advance signing stop ahead signs for transition period.

5. [four to two way stop] Four-way to two-way stop has not been a problem

TRAFFIC SIGNALS

New signals are addressed at public hearings and may be addressed by newspaper or other media.

Removal of existing traffic signals. The Users Guide for Removal of Not Needed Traffic Signals.

Implementation page FHWA-IP-80-12, Nov. 1980, is used as a guide.

STATE Department of Transportation

STOP SIGNS

1. Initial Placement - pre-stop condition warning signs installed two weeks prior. Public notification through media one week prior.

2. Reversing Stop Conditions - same as 1, with cross street does not stop message.

3. Two to Four Way - same as 1.

4. Four to Two-Way - same, with message cross street traffic does not stop. Removal subject to provisions of STATE state statute 316.0745 (7) [see appendix B]

TRAFFIC SIGNALS

1. Removal of Existing Signal - subject to provisions of Statute 316.0745(7). - public involvement if part of a larger project.

2. Traffic Signal Timing/Phasing - public notification of timing changes not necessary but revising lead/lag operations requires notification through media, etc.

3. Travel Speed of Coordinated Systems - inform public of signal system project and travel speed limit to gain benefits. One week prior is sufficient.

MISCELLANEOUS

1. Lane Configuration Changes - media notification one week prior.

2. Left Turn Prohibition Change - public involvement two weeks prior. Media notification one week prior.

3. One Way Street Changes - same as 2.
4. No Parking Signs - same as 2.

Although no written policy or procedure exists, we conduct an extensive public involvement campaign with our median revision projects. Safety concerns dictate that the existing median configuration on divided arterials (left turn lane tapers, storage lengths, and median opening spacing) must be revised to accommodate increased traffic volumes. Businesses and residences (usually through civic groups or homeowners associations) that are subject to revised access (no left turns into or out of) are notified by letter, with plans, and asked to attend a public information meeting two weeks later to discuss potential impacts. This process is usually held during the conceptual design stage of the project, although for projects with plans available but construction is some time later, actual design plans are used.

STATE Department of Highways and Public Transportation

Reversing Stop Conditions

Two week switch to all-way stop before reversing.

Four to Two-Way Stop

Very rarely done and not recommended. Special temporary signs would be needed to tell drivers still stopping that the cross street traffic does not stop. Recommend two months for temporary signs.

New Traffic Signal

Flash for two weeks.

Removal of Existing Traffic Signal

Flash for six months to gauge public reaction to removal. If there aren't too many complaints, take it out. The flashing period serves as the transition.

One-Way Street Changes

Requires full public hearings and notices. Regular signing and markings should then be used.

CITY Public Works Department

When reversing stop signs, we post 4 way

for 4 - 6 weeks then remove the first stops and add sign "CROSS STREET TRAFFIC DOES NOT STOP" for 6 weeks when stop signs are installed on major street, paint stop ahead on pavement, and allow to wear out.

STATE Department of Transportation

Reversing stops - temporary multiway stop.

New Signal - place on "flash" at least 2 weekdays and weekend.

CITY Department of Engineering

New Traffic Signal - flashing operation for 24 hours.

Removal of existing traffic signal - cover signal, hood and install at least 2 stop signs.

Left turn prohibition changes - warning signs, barricades, public notice.

One Way Street Changes - warning signs, barricades, public notice.

STATE Highway Department

Signals must be flashed for 24 hours prior to initial turn on.

On most significant changes we will use the local media via press releases to inform the public on major changes but we have no formal policies on this.

**APPENDIX E - RESONSES TO THE FINAL
QUESTIONNAIRE**

**Final Questionnaire
for feedback on Model Transition
Procedure**

1. Do any of the procedures seem inconsistent with your current practices and/or past research? If so how?
2. Do any of the procedures appear infeasible to your agency due to the amount of manpower and materials required?
3. Do any of the procedures fall short of their objectives?
4. What problems can you see in implementing these measures in the field?
5. Has this paper changed or reinforced your opinion on the subject?
6. Would you consider making these procedures guidelines for your agency? If not, why?
7. Please state any comments or objections to the model transition procedures as written.

Please Return to:

Mr. William E. Cole
1400 Loraine Street
Knoxville, TN 37921

STATE Department of Transportation

FINAL QUESTIONNAIRE RESPONSES FOR
FEEDBACK ON MODEL TRANSITION PROCEDURE

General Comment from our December 12,
1988 survey:

Normally, we do not take any special measures when installing a new stop sign, yield sign, speed zone, etc. Although some special action might be necessary in the case of reversing of stop conditions (a rare occurrence on State highways). In the case of new signals, the usual procedure is to place the signal in flashing operation. Flashing beacons and/or red flags on a signal ahead warning sign are often used for a period of time while motorists adjust to the new operation. Other than this, we do not use "changeover" signing except for in unusual situations.

Answers to Specific Questions:

1. None of the procedures seem inconsistent with current practices and/or past research. Although we do not implement some of the procedures, we have seen research and actual field use that would support all of the procedures.

2. It appears that the stop sign conversion would be a time consuming effort. From our experience, most municipalities in (our state) do not have the manpower to perform a stop sign conversion in the suggested manner. It also becomes costly as temporary supplemental signs have to be made and erected. Therefore, when conversions are made, the usual method of transition is notification through a newspaper article. In cases whereby the changeover is controversial, a long transition can result in the rallying of the opponents of the change.

As to the addition of a new traffic signal, we do not feel that the month long transition period is necessary. One week of flashing operation supplemented by temporary signal ahead signs with

flags is sufficient to warn motorists of the new signal.

3. Basically, the procedures accomplish their objectives in a conservative, inefficient, and costly manner. It is our contention that some of these procedures are overkill and will lead to greater manpower requirements and higher costs.

4. Potential field problems while implementing these procedures can be expected. Some of the procedures require additional field visits to make temporary changes. With budget constraints, the manpower may not always be available thus causing delays in implementing various phases. We also anticipate that because additional temporary signs will be required for certain changeovers, there will be additional costs involved.

5. This paper has not changed or reinforced our opinion on the subject. Because traffic engineering functions vary between State and municipal agencies, it would have been nice to see the results segmented by the different type of respondents. For example, we noted that as a State agency we are rarely involved with stop sign reversals. The same is also true in regard to establishing one way street flow. While only a low state priority, these two activities are often high priority functions for city traffic engineers. Similarly, a rural county highway superintendent will be fortunate to have a traffic signal, never mind being concerned about his transition policies for installing or removing a signal. The acceptance of the various procedures will be somewhat dependent upon the type of agency and whether it operates in a rural or urban environment. It is realized that you attempted to account for this by considering procedures for those categories in which at least 70% of the respondents agreed that some transition is necessary. However, while the majority is in agreement on the general subject, there may be wide disagreement over how much transition is required.

Taking into consideration the various environments, the procedures are not a panacea for all.

6. We would not at this time consider making these procedures as guidelines for our agency because of the manpower and economic impacts involved. Additionally, it is our opinion that some of the procedures are too conservative and could be performed in a more efficient manner without sacrificing safety.

7. As noted in #6, we have reservations about the model because of the stated factors.

STATE Department of Transportation

1. Do any of the procedures seem inconsistent with your current practices and/or past research? If so how? No

2. Do any of the procedures appear infeasible to your agency due to the amount of manpower and materials required? No

3. Do any of the procedures fall short of their objectives? No

4. What problems can you see in implementing these measures in the field? None

5. Has this paper changed or reinforced your opinion on the subject? Reinforced

6. Would you consider making these procedures guidelines for your agency? If not, why? Yes, with minor modifications.

7. Please state any comments or objections to the model transition procedures as written.

A. We believe the NEW sign used in the model transition procedures supplementing the STOP AHEAD and SIGNAL AHEAD signs is unnecessary. Since the advance warning signs themselves are new and will draw attention, we believe that installing the

NEW supplemental panel and removing it in later steps is unnecessary.

B. Step 3 of the New Traffic Signal Model Transition Procedure indicates two (2) weeks after the signal heads are installed that the singals be uncovered and placed on flash. We believe that this time should be reduced.

STATE Department of Transportation

Question 1. Do any of the procedures seem inconsistent with your current practices and/or past research? If so how? Yes, we do not use signs to inform the public of the date the change in control is to be effective. We generally rely on media releases.

Question 2. Do any of the procedures appear infeasible to your agency due to the amount of manpower and materials required? No, for the most part we are currently following the same procedures as those in your paper.

Question 3. Do any of the procedures fall short of their objectives? No, the procedures are very thorough.

Question 4. What problems can you see in implementing these measures in the field? Coodination between media releaswes and the dates posted on the signs will need to be watched closely to ensure the same date for the change is being publicized. Along with this, the changes must be made on the publicized date or a credibility problem may develop.

Question 5. Has this paper changed or reinforced your opinion on the subject? It has reinforced by opinion.

Question 6. Would you consider making these procedures guidelines for your agency? If not, why? Our current procedures are similar to those in the paper.

Question 7. Please state any comments or objections to the model transition

procedures as written. No Comments

CITY Office of the Engineer

1. The procedure for installing a new signal seems to be a little bit of an overkill. Installing signs indicating the date that a signal will be set into operation is unnecessary and a bit risky. Motorists are more likely to see a signal being built than they are to read another sign. Tyhis is especially true if the motorists normally travel on the side street rather than the main street. This type of signing may be risky because it is difficult to predict when the construction of a signal will be complete.

I question how effective media publicity would be when some of these changes are made. If the media chose to cover a change in traffic control, would the targeted motorists pay attention?

2. None of the procedures appear to be too loabor or material intensive to prevent the City of (xxxx) from using them.

3. All of the procedures appear to be suffiecient to achieve their objective.

4. I do not see any problems in implementing thwese procedures.

5. The paper stresses a uniform method for changing traffic control. Uniformity is important in the traffic business.

6. These procedures will be guidelines with a few minor exceptions.

7. I do not have any further comments.

STATE Department of Highways and Transportation

1. Do any of the procedures seem inconsistent with your current practices and/or past research? If so

how? We follow similar practices on REVERSING STOPS, TWO WAY TO FOUR WAY STOP & FOUR WAY TO TWO WAY STOP. There is no written policy on others.

2. Do any of the procedures appear infeasible to your agency due to the amount of manpower and materials required? No

3. Do any of the procedures fall short of their objectives? No

4. What problems can you see in implementing these measures in the field? None

5. Has this paper changed or reinforced your opinion on the subject? It reinforced our opinion that more consistency is needed in methods for making control changes, particularly new signals.

6. Would you consider making these procedures guidelines for your agency? If not, why? Yes, particularly signal installations.

7. Please state any comments or objections to the model transition procedures as written. None

VITA

William E. Cole was raised in Knoxville, Tennessee and attended the University of Tennessee from summer of 1983 until spring of 1988 attaining his Bachelor of Science in Civil Engineering. He is currently employed by the City of Knoxville Engineering Department, supervising the Operations and Investigations Section of the Traffic Engineering Division. He is an associate member of the Institute of Transportation Engineers and is a member of its Tennessee section.