Development of a Traffic Control Devices and Pavement Markings Manual for Iowa's Cities and Counties with a Survey of Common Practices

Final Report

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Center for Transportation Research and Education

Iowa State University

CTRE's mission is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

DEVELOPMENT OF A TRAFFIC CONTROL DEVICES AND PAVEMENT MARKINGS MANUAL FOR IOWA'S CITIES AND COUNTIES WITH A SURVEY OF COMMON PRACTICES

FINAL REPORT

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EXECUTIVE SUMMARY

Local transportation agencies are responsible for a significant investment in traffic control devices and pavement markings. Thousands of signs and other inventory items, equipment, facilities, and staff are all dedicated to the installation and maintenance of devices and markings critical to the safety and convenience of the traveling public.

General requirements and responsibilities for these activities are contained in the *Manual for Uniform Traffic Control Devices* (*MUTCD*) and in the Code of Iowa. Further recommendations for the administration of traffic control devices and pavement markings at the local level are provided by the Iowa Department of Transportation and in many other documents from a variety of sources. However, no single reference or guidance manual exists for the common traffic control activities of local agencies in Iowa.

This research project (TR-441) was approved by the Iowa Highway Research Board in October 1999 to develop and distribute a manual that would provide local agencies with practical advice and guidance for traffic control devices and pavement markings installation and maintenance.

The project included seven tasks: (1) a review of available literature and references pertinent to traffic control, (2) the formation of an expert advisor guidance committee to recommend and assist in the development of a reference manual, (3) a survey of local agencies in Iowa to assess needs and concerns, (4) an investigation of strategies for inventory systems to assist local governments in the management of traffic control programs, (5) the development and distribution of the manual and operating statement, (6) the identification and production of miscellaneous outreach products to augment the research effort, and (7) the preparation of a project report to document the research activities.

The literature review, potential user survey, and advisory committee identified numerous topics of specific interest and potential benefit. These were included in the manual developed in this research, *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties*. The *MUTCD*, documents and manuals from the Iowa Department of Transportation, and selected references from several other states and organizations also provided invaluable technical references in the development of the manual.

The manual is printed in full color and presented in a three-ring-binder format that allows easy modification for specific local use and future updates. The document has been distributed to potential users in Iowa's local agencies.

In addition to identifying some topics for the reference manual, survey responses also provided useful information about common traffic control device and pavement marking practices followed by many rural and urban agencies in Iowa. These survey results, addressing over 40 applications of traffic control devices and pavement markings, were compiled, analyzed and are included in the final project report.

This final report also contains a discussion of inventory systems, conclusions, and recommendations, including suggested follow-up research. The manual and final report are complimentary documents, comprising the major products of this research project.

INTRODUCTION

Transportation agencies in Iowa are responsible for a significant public investment with the installation and maintenance of traffic control devices and pavement markings. Included in this investment are thousands of signs and other inventory items, equipment, facilities, and staff. The proper application of traffic control devices and pavement markings is critical to public safety on streets and highways, and local governments have a prescribed responsibility under the Code of Iowa to properly manage these assets. This research report addresses current traffic control and pavement marking application, maintenance, and management in Iowa.

Project Purpose and Need

Local transportation agencies have established and maintain a large number of traffic control devices and pavement markings. However, a single source reference manual to guide day-to-day activities in this major area of responsibility is not available. Many manuals and references have been published, but none addresses the full scope of topics. It is surmised that local agencies would benefit from an easy-to-understand guidance manual that addresses the broad range of important issues related to the management of traffic control devices and pavement marking assets and that is sufficiently adaptable to the needs of individual agencies.

It is often desirable to find information about a specific topic while working out of the office. Field crews need a resource that will provide a quick reference of suggested solutions for a specific topic or problem of interest. The purpose of this project was to provide such a resource. The manual is produced both in a printed, three-ring binder format, which allows easy updating and modification, and in a digital, computer-based form. The manual was also designed to withstand everyday long-term field use and includes additional references for more in-depth investigation. This research report should be considered a companion document to the manual.

A survey of the common practices and concerns of local agencies in Iowa was completed as part of this project, and a summary of the results is documented in this report. Survey responses helped identify the issues and needs addressed in the manual. These responses are presented and discussed in this report and indicate what traffic control practices are common in Iowa. The introduction of a common traffic control guide may produce even more consistent approaches to traffic control and pavement marking implementation/maintenance, inventory strategies, and inspection procedures throughout Iowa. It is anticipated that roadway safety will benefit and field crew efficiency will improve due to the information presented in this report and the accompanying manual, *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties*.

Project Background and Description

In October 1999, the Center for Transportation Research and Education (CTRE) presented a proposal to the Iowa Highway Research Board (IHRB) that suggested the development of a reference manual for local Iowa transportation agencies. This manual would address many

aspects of traffic control devices and pavement markings. The IHRB subsequently approved the proposed project.

This research project consisted of seven tasks. The first task involved the identification and review of literature pertinent to the research subject. Many current reference manuals that are used in other states were obtained. The literature review included a search of library databases, the Internet, and telephone discussions with transportation agencies throughout the United States.

The second task consisted of the formation of an advisory committee to provide guidance, advice, and recommendations on topics of specific interest that could be included in a traffic control manual and general operating statement. The committee met approximately monthly to offer invaluable assistance in authoring, reviewing, and commenting on topics that would be incorporated into the manual. Committee members represented potential users of the manual as well as knowledgeable and expert professionals from associated agencies, engineering consultation, and industry. Members of the advisory committee were

- Jerry Barnwell, 3M (retired)
- Alan Beddow, Engineering, Iowa Department of Transportation
- LeRoy Bergmann, Local Systems, Iowa Department of Transportation
- Tony Boes, Snyder & Associates
- Jim Brachtel, Iowa City and Federal Highway Administration
- Becky Hiatt, Federal Highway Administration
- Mark Nahra, Delaware County
- Blake Redfield, Council Bluffs
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- Randy Seibert, Dallas County
- Keith Knapp, Manager Traffic Engineering/Safety Programs, CTRE
- Tom McDonald, Safety Circuit Rider, CTRE
- Duane Smith, Associate Director for Outreach, CTRE

The third project task consisted of a survey to identify the needs, concerns, and common practices of local governments in Iowa and the Iowa Department of Transportation (Iowa DOT) with respect to traffic control devices and pavement markings. The results from this survey were invaluable and helped in identifying the topics to be addressed in the manual.

The fourth task of this project included the investigation and documentation of inventory strategies that are available to help transportation agencies manage traffic control devices and pavement markings programs. Results of this effort are briefly described in this report but are discussed in more detail in the manual.

Task five involved the development of an operating statement and a manual that address traffic control devices and pavement markings used by local agencies. This task and the resulting manual were the primary focus of this research project.

The sixth task of this project included the development of outreach products (e.g., articles, brochures, etc.) that could be used to present the results from the project and promote use of the manual.

The final task involved the preparation of a project report upon completion of all research activities.

A post-distribution survey of manual users will also be completed to determine the impacts of the reference manual on local traffic control device and pavement management programs.

Objectives

The objectives of the research project are listed below:

- Identify specific areas in traffic control device and pavement marking programs where a reference guide manual would be most beneficial for local government staff.
- Develop a single source manual to help administer the appropriate application of traffic control devices and pavement markings.
- Provide local governments and agencies with a summary of common practices with respect to traffic control devices and pavement markings in Iowa.
- Direct users to supplemental and current resources about traffic control and pavement marking issues.
- Investigate and describe various inventory methods and strategies for traffic control/pavement marking devices.
- Enhance traffic control/pavement marking program operating efficiencies, suggest improved management processes, establish long-term continuity of practice in local transportation agencies, and address liability exposure in the traffic control area of transportation safety.

Report Organization

This report is presented in five sections. Section 1 consists of the introduction. Section 2 summarizes the results of the literature search and review. Traffic control device and pavement marking designs and applications are addressed, and information about traffic control and pavement marking inspection procedures, inventory systems and strategies, maintenance practices, shop and stock management, and work zone use are included. Section 3 describes the common traffic control/pavement marking practices and concerns of local transportation agencies in Iowa. This information is summarized from the results of the project survey. A discussion of the survey development and distribution is included. Section 4 provides a description of the manual, *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties.* Sample topics from the manual are included and outreach opportunities

identified. Finally, section 5 presents the conclusions and recommendations of the project team based on information collected in the literature review and the survey responses.

LITERATURE REVIEW

Introduction

One of the initial tasks of this research project was the identification and review of related literature. A large number of manuals and other reference materials that address traffic control devices and pavement marking designs were identified, and these documents were used extensively.

The principal objective of the literature search was to collect, review, and compile the wealth of traffic control device and pavement marking information that exists and then to use that information to create a single source reference manual adapted for Iowa's specific needs.

The literature search for this project included a review of documents that discuss the design, placement, and management of traffic control devices and pavement markings. Some primary sources of information included the *Manual on Uniform Traffic Control Devices* (*MUTCD*), several Iowa DOT handbooks, Internet sources, and a number of national transportation libraries. A comprehensive search of the Transportation Research Information Services (TRIS) database was completed, and manuals/handbooks from various states and agencies, the American Association of State Highway and Transportation Officials (AASHTO), Institute of Transportation Engineers (ITE), Federal Highway Administration (FHWA), Transportation Research Board (TRB), and the Iowa Highway Research Board were obtained. In addition, individual states were also contacted for supplemental information.

Topics of Interest

The literature search for this research project focused on the following eight topics:

1. Traffic control device design and application,
2. Pavement marking design and application,
3. Inspection procedures,
4. Inventory systems and strategies,
5. Maintenance practices,
6. Shop and stock management,
7. Traffic control during operations, and
8. Miscellaneous topics of interest.

Relevant information about these topics was obtained and used to develop the manual for traffic control devices and pavement markings. More than one reference was obtained for each of the eight major topics of interest. However some of the references were used more extensively than others. These references are listed in the next section.

Extensively Used References

A large number of guide and reference manuals were obtained during the literature search, and all were reviewed for information related to the topics of interest. The following 12 reference documents, however, were utilized most extensively.

1. *Handbook of Traffic Control Practices for Low Volume Rural Roads.* 2d ed. Kansas County Engineers Association, Kansas Department of Transportation, 1991.

2. *Manual on Pavement Marking Program.* Office of Traffic Engineering, Engineering Division, Iowa Department of Transportation, Ames, Iowa, June 1996.

3. *Manual on Uniform Traffic Control Devices.* Millennium ed. Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 2000. http://mutcd.fhwa.dot.gov/. Jan. 2001.

4. *Manual on Uniform Traffic Control Devices for Iowa Streets and Highways.* Iowa State Highway Commission, Ames, Iowa, Jan. 1963.

5. *Manual on Uniform Traffic Control Devices for Streets and Highways.* Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 1988.

6. *Sign Crew Field Book: A Guide to Proper Location and Installation of Signs and Other Devices.* 2d ed. Traffic Operations Division, Texas Department of Transportation, Austin, Tex., April 1998.

7. *Sign Installation and Maintenance Guidelines.* Office of Traffic Engineering, Engineering Division, Iowa Department of Transportation, Ames, Iowa, Oct. 1999.

8. *Standard Highway Signs.* Rev. 2. Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 1978.

9. *Traffic Control Devices Handbook*. Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., 1983.

10. *Traffic Control Practices for Low Volume Roads.* South Dakota Transportation Technology Transfer Service, Brookings, S.D., and Division of Planning, Traffic and Safety Engineer's Office, South Dakota Department of Transportation, 1993.

11. *The Traffic Safety Toolbox: A Primer on Traffic Safety.* Institute of Transportation Engineers, Washington, D.C., 1999.

12. *Traffic Signing Handbook*. Institute of Transportation Engineers, Washington, D.C., 1997.

In addition to the references listed, many other resources were also used and provided valuable guidance. A complete list of the documents obtained during the literature search is in the bibliography at the end of this report.

SURVEY OF LOCAL TRAFFIC CONTROL/PAVEMENT MARKING COMMON PRACTICES AND CONCERNS

Survey Implementation

Development

A process was proposed to identify common Iowa practices in the application of traffic control devices and pavement markings. A relatively extensive survey of local agencies in Iowa was completed to determine their common traffic control/pavement marking practices and concerns. The survey questions focused on traffic control device and pavement marking design, applications, materials use, available staff and equipment, and suggested manual topics. The questions were designed to determine common practices. See Appendix A for a complete copy of the survey tool. The survey identified valuable information that was eventually used in the development of the Iowa manual for traffic control devices and pavement markings.

Distribution

In March 2000, the survey was mailed to 99 county engineers, 72 city administrators with populations greater than 5,000, and 202 cities with populations between 1,000 and 5,000. The survey was also sent to 18 Iowa Department of Transportation staff with specific traffic control responsibilities. A total of 391 surveys were distributed to local governments and the Iowa Department of Transportation.

Response

The survey responses received were catalogued and summarized to develop the common practice results documented in this report. Appendix B contains summaries listed in the same order as the questions in the survey.

The Center for Transportation Research and Education received a total of 120 responses to the survey, overall, a 30 percent response rate. The percent response from each group, relative to the number of surveys provided that group, is shown in Figure 1. County engineers had the highest response rate with 43 percent, followed by large cities (population over 5,000) with an approximate return rate of 35 percent. Figure 2 shows the number and percent of overall responses that were received from each survey group. The highest number of responses was received from counties and cities with populations between 1,000 and 5,000 (small cities).

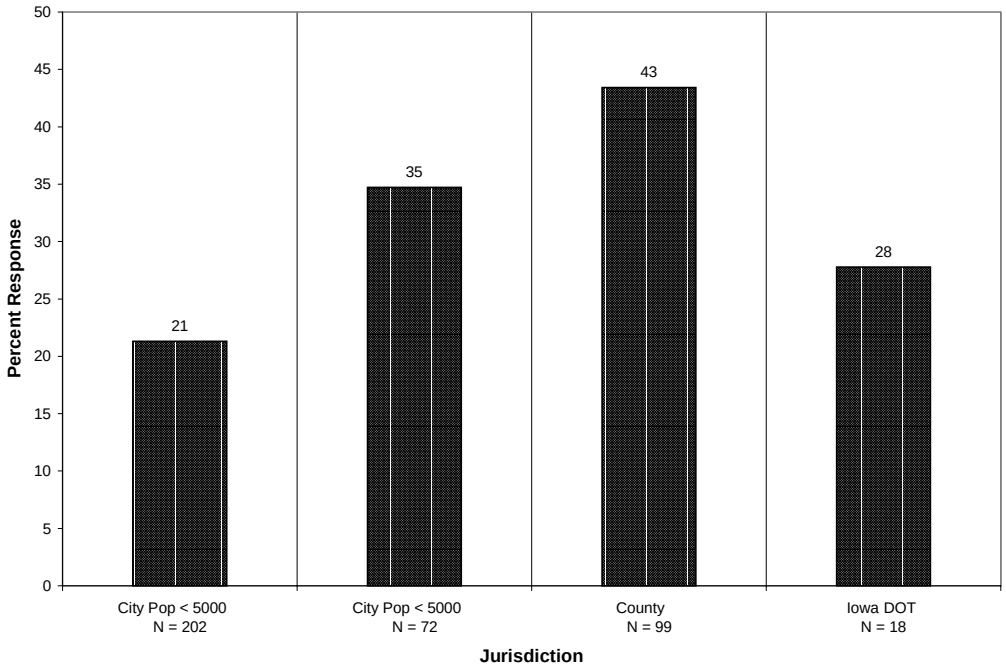


FIGURE 1 Return Percentage for Each Survey Group
(N is total surveys sent to each group)

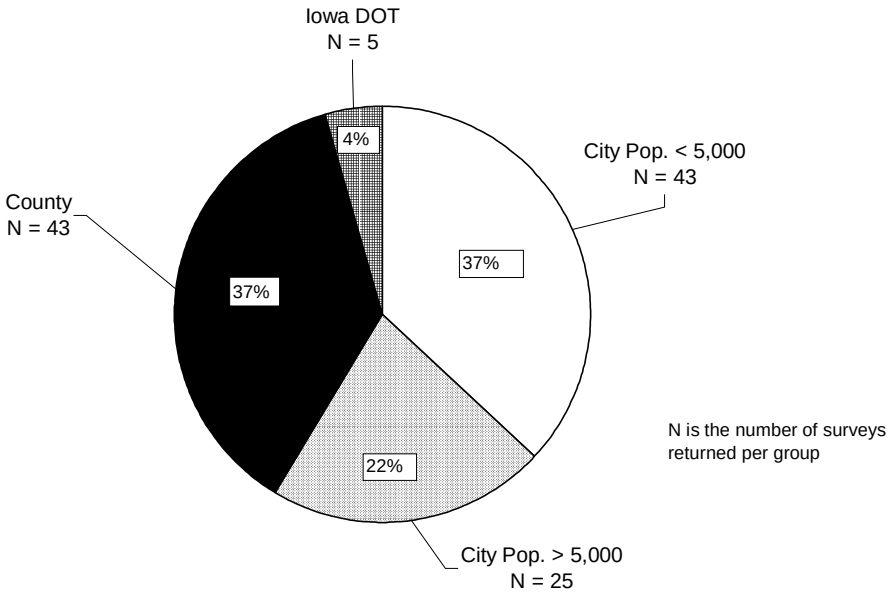


FIGURE 2 Group Responses as a Percent of Total Surveys Returned

Summary of Survey Responses

A database was developed to organize and analyze the information received from the survey. Bar charts were then created to visually portray a summary of the response data from each of the four survey groups, that is, cities with populations between 1,000 and 5,000 (small cities), cities with populations greater than 5,000 (large cities), counties, and Iowa DOT staff.

Appendix B contains summaries for each question, listed in the same numerical order as the survey (see Appendix A). All summaries in Appendix B are supplemented with an illustrative figure. For the discussion that follows, survey response summaries are grouped according to subject and thus do not appear in the same chronology as in the original survey.

In addition to the survey response discussion that follows, most survey questions included an opportunity for comments, and many were returned. These notes provided supplemental insight of common practices by State and local agencies. Many comments in particular were received regarding type of equipment used, question 5, use of fluorescent yellow-green sheeting, question 42, and replacement of pavement markings, question 43. Numerous comments were made on various other topics as well. Almost 50 suggestions were received for useful subjects to be addressed in the manual.

General Questions

The survey began with several general questions about demographics, procedures, staffing, equipment, and training. The demographics are summarized in Figure B.1 in Appendix B, and responses to questions 2 through 5 (see Appendix A) are summarized below.

Question 2 asked whether an agency used variable standards for traffic control devices and pavement markings on paved versus unpaved roads in rural areas, or on arterial versus collector streets in urban areas. Responses showed that a majority of all four groups do not vary standards for road or street characteristics, but approximately 25 to 30 percent of small cities and counties said they use different standards in recognition of road type. Only one large city said varying standards were followed. Four of the five responding Iowa DOT staff reported they did not use differing traffic control and pavement marking standards, regardless of road type. Refer to Figure B.4 in Appendix B for more detailed response information.

Question 3 asked whether an agency employed staff whose primary responsibility was the installation and maintenance of traffic control devices and pavement markings. Almost 90 percent of the small cities do not employ staff with these primary responsibilities, but more than half of the larger cities do. Overall, 80 percent of the responding counties and the Iowa DOT employ staff with these primary responsibilities. Refer to Figure B.5 in Appendix B for more detailed response information.

Question 4 asked about established training programs for staff with traffic control device and pavement marking responsibilities. An average of 81 percent of the cities and counties do not have training programs (see Figure 3). Three of the five Iowa DOT responses did indicate a training program was available in their agency, and about 15 percent of the responding cities and counties responded in a similar manner; training programs are provided for staff responsible for traffic control devices and pavement markings.

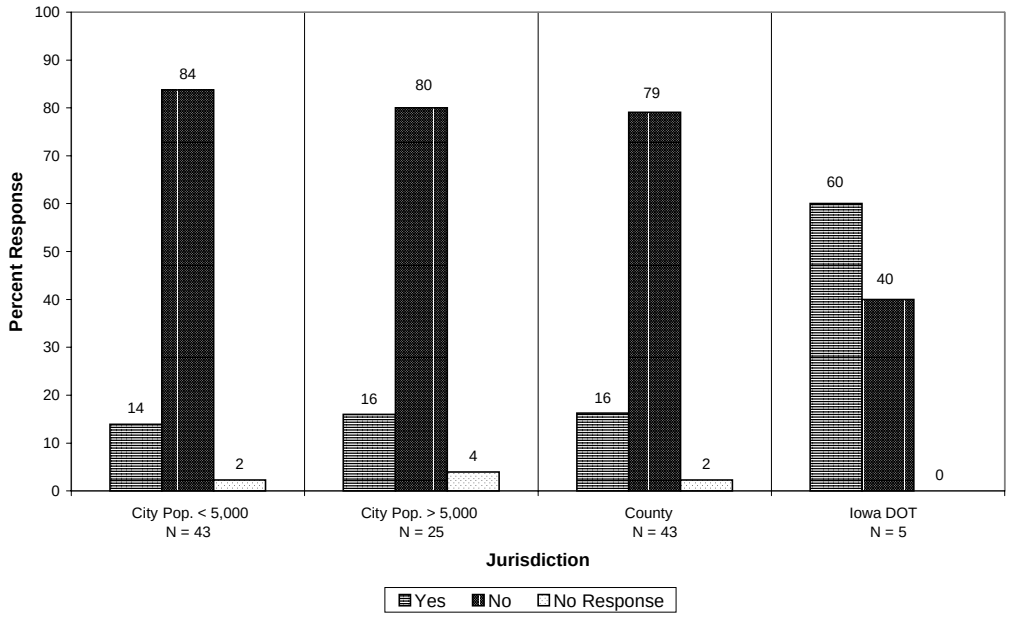


FIGURE 3 Agencies with Established Traffic Control Device and Pavement Marking Training Programs

Question 5 asked for information about trucks and other equipment (e.g., truck types and numbers) available for installing, repairing, or replacing traffic control devices and pavement markings. About half of small cities have a truck or a pickup dedicated to these activities, and 80 percent of the large cities and 91 percent of counties have between one and four trucks for traffic control. Refer to Figure B.7 in Appendix B for more detailed response information and Table B.1 in Appendix B for a list of trucks and other equipment dedicated to these activities.

Current Sign Practices

The survey also included several questions regarding current sign practices. These questions addressed issues related to regulatory, warning, and guide signs, special warning signs, and installation locations. Refer to Appendix A to view survey questions.

Regulatory Signs—Intersection Control Question 7 asked whether the agency used other guidelines in addition to the *MUTCD* when placing stop signs and/or yield signs. The survey results (see Figure 4) showed that responding large cities and counties follow similar practices; both use informal, unwritten guidelines to a much greater extent than formal, written guidelines. However, the smaller cities tend to follow written rather than informal guidelines. Four of the five responding Iowa DOT staff indicated that they follow formal, written guidelines for this application.

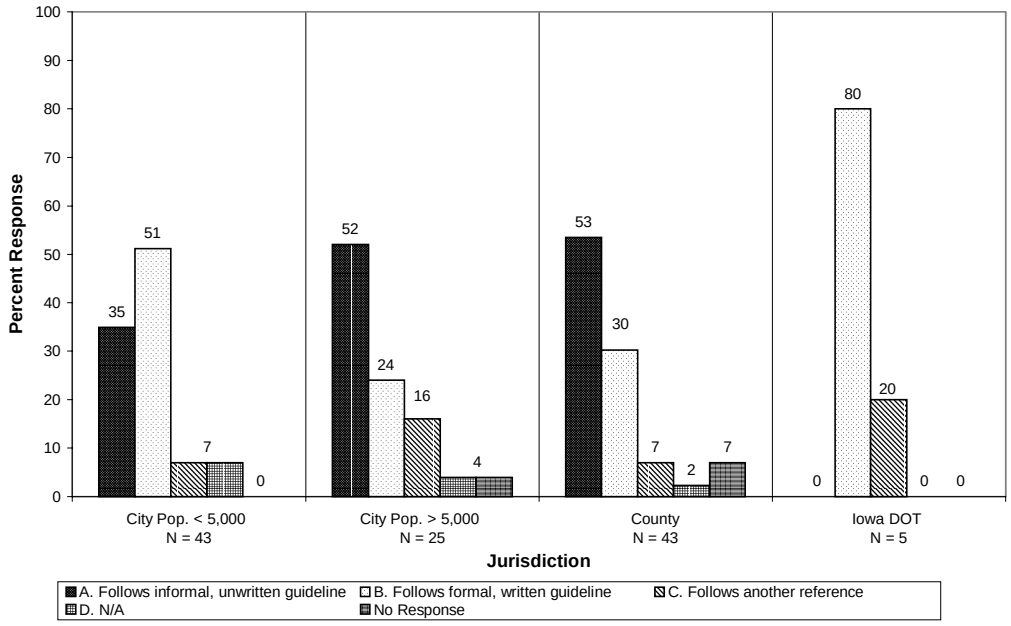


FIGURE 4 Supplements to the *MUTCD* When Placing Stop Signs and/or Yield Signs

Questions 33 and 41 gathered information on current signing practices at intersections. Question 33 asked whether the agency usually considered the use of yield signs for traffic control at intersections, and question 41 asked whether stop signs were routinely installed at rural, unpaved roadway intersections. The responses indicated that the use of stop signs at intersections along rural, unpaved roadways was routine for a slight majority of all the survey groups except small cities. The use of yield signs for traffic control at intersections, on the other hand, was not routinely considered by a majority of respondents. Figures B.37 and B.45 in Appendix B show the detailed response information for these two questions.

Question 41 also asked the respondents to indicate their approximate percentage of stop sign usage at rural, unpaved roadway intersections. More than half of the city respondents indicated a 0 to 50 percent range, most likely due to a low number of rural unpaved roads in city jurisdictions. A majority of counties and Iowa DOT staff, on the other hand, responded that between 50 to 100 percent of rural, unpaved intersections included stop sign usage. Refer to Figure B.46 in Appendix B for more detailed response information.

Regulatory Signs—Speed Control Question 11 asked whether the agency followed other guidelines in addition to the *MUTCD* when establishing speed limits. The large cities and counties have similar responses; twice as many of these agencies follow informal, unwritten guides as follow formal, written procedures (see Figure 5). However, smaller cities tended to follow formal, written guidelines to a much greater degree. Four of the five responding Iowa DOT staff indicated that they follow written guidelines.

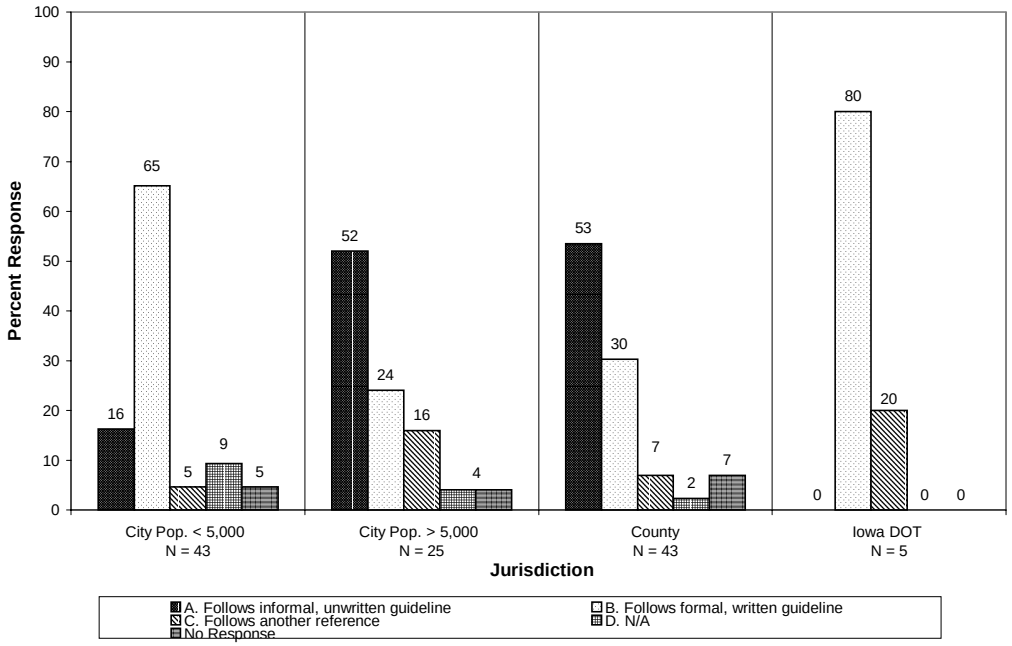


FIGURE 5 Supplements to the *MUTCD* When Establishing Speed Limits

Warning Signs Question 10 asked whether the agency followed other guidelines in addition to the *MUTCD* when placing curve and/or turn signs. Similar practices were found for large cities and counties. Twice as many of the respondents from these two groups followed informal, unwritten guidelines instead of written procedures. The sma ller cities responses were more mixed and had approximately 28 percent following informal, unwritten guidelines, approximately 33 percent using formal, written guidelines, and about 28 percent reporting the question was not applicable to their operations. Four of the five responding from the Iowa DOT followed formal, written guidelines. Refer to Figure B.12 in Appendix B for more detailed response information.

Question 12 asked about common practices for the establishment of no passing zones, and Question 16 addressed the placement of traffic control devices and pavement markings at narrow structures. These questions asked whether the agency followed guidelines in addition to the *MUTCD* when performing these activities. As expected, the survey responses suggested that counties established no passing zones and placed traffic control devices and pavement markings at narrow structures more frequently than cities. The responses also suggested that the majority of small cities probably did not routinely address these issues. In either case, the counties and large cities followed informal, unwritten guidelines more often than written procedures when completing either of these activities. Four of the five responding Iowa DOT staff also followed formal, written guidelines. Refer to Figures B.14 and B.18 in Appendix B for more detailed response information.

Question 39 addressed whether the agency routinely installed advisory speed plaques in conjunction with curve signs. The responses to this question varied greatly between the groups surveyed. While the Iowa DOT and county respondents favored routine use of advisory speed plaques, city groups did not. Small cities, in particular, did not use this sign, possibly due to a lower degree of experience with or need for curve signing in these communities. Approximately 80 percent of county responders said advisory speed signs were routinely used with curve signs, and similar results were received from responding Iowa DOT staff. Refer to Figure B.43 in Appendix B for more detailed response information.

Question 40 addressed the routine use of Double Arrow signs (*MUTCD* W1-7) at T-intersections. The survey showed that large cities use this sign more than smaller cities and that almost all counties routinely use these signs. Only one county that responded did not routinely use double arrow warning signs at T-intersections. All of the Iowa DOT staff indicated a routine use of these signs. Refer to Figure B.44 in Appendix B for more detailed response information.

Question 42 asked the responding agencies to indicate which of the following signs (with *MUTCD* IDs) were routinely installed with a fluorescent yellow-green color:

- Advance Bicycle Crossing (W11A-1)
- Bicycle Crossing (W11-1)
- Advance Pedestrian Crossing (W11-2)
- Pedestrian Crossing (W11A-2)
- Advance School (S1-1)
- School Crossing (S2-1)
- School Bus Stop Ahead (S3-1)
- School (S4-3)
- School Speed Limit (S5-1)

Small and large cities provided similar responses; both commonly used fluorescent yellow-green color for Advance School (S1-1) and School Crossing (S2-1) signs (see Figure 6). Large cities also used the fluorescent yellow-green color for Pedestrian Crossing (W11A-2) and Advance Pedestrian Crossing (W11-2) applications more frequently than smaller cities. This is probably the result of higher pedestrian volumes in larger communities and a greater need for these signs. Only a small percentage of cities routinely use the fluorescent yellow-green signs for any of the other applications.

The counties indicated a much lower routine use of fluorescent yellow-green signs for the listed applications. Participating counties however were more likely than cities to use fluorescent yellow-green signs for School Bus Stop Ahead (S3-1) signs. All of the responding Iowa DOT staff advised of the routine use of fluorescent yellow-green signs for all situations except School Speed Limit (S5-1) signs.

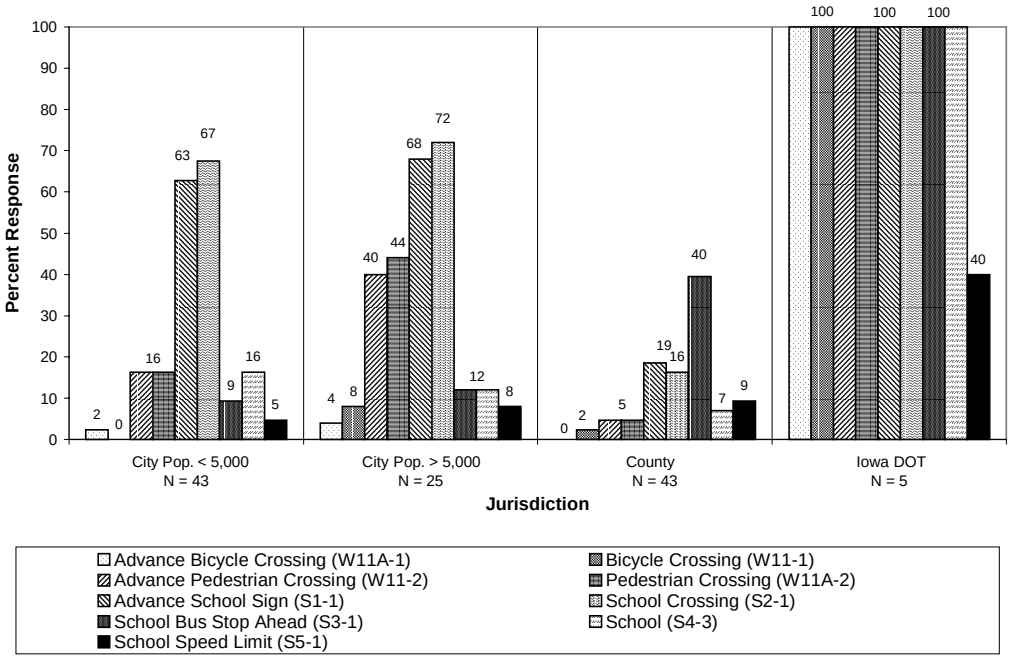


FIGURE 6 Use of Fluorescent Yellow-Green Warning Signs

Special Message Warning Signs The survey also included questions about the use and application of several specific warning signs. Of particular interest were School Bus Stop Ahead, Deer Crossing, Children Playing, and Deaf Child signs. Questions 25, 26, 27, and 28 asked whether the agency followed guidelines in addition to the *MUTCD* when installing these warning signs. The survey results showed that, although a significant number of local agencies do not use one or more of these signs, those that do typically follow informal, unwritten guidelines. However, the Iowa DOT staff that install these special warning signs follow formal, written guidelines. Refer to Figures B.27 through B.30 in Appendix B for more detailed response information.

Question 8 asked whether an agency followed guidelines in addition to the MUTCD when placing object markers and/or delineators. The cities and counties that use these devices indicated that they primarily follow informal, unwritten guidelines. In fact, 67 percent of the counties use unwritten guidelines for these activities. Approximately 25 percent of cities and the Iowa DOT indicated the use of written guidelines. Not surprisingly, the survey also showed that rural agencies use object markers and delineators more commonly than cities. Overall, about 12 percent of the large cities and 42 percent of the smaller communities indicated that the question did not apply to them. Refer to Figure B.10 in Appendix B for more detailed response information.

Sign Location Question 9 asked respondents whether their agency followed guidelines in addition to the *MUTCD* when locating traffic control devices longitudinally (parallel to the road or street) and laterally (perpendicular to the road or street). Survey responses were similar for all cities and counties. A majority of these agencies used informal, unwritten guidelines. All

responding Iowa DOT staff, on the other hand, followed formal, written guidelines when locating traffic control devices longitudinally and laterally. Refer to Figure B.11 in Appendix B for more detailed response information.

Pavement Marking Practices

The survey also included several questions that pertain to current pavement marking practice. Refer to Appendix A to view survey questions.

Question 17 asked about the methods used to place centerline markings on paved roads and streets, and question 18 addressed the placement of edge line markings. The intent of these questions was to determine whether agencies followed any guidelines in addition to the *MUTCD*. A majority of the responding counties and cities indicated that they follow informal, unwritten guidelines when performing these activities, but in most cases, the smaller communities judged this question not valid. As anticipated, the survey results also showed that counties placed substantially more edge line markings than cities. All responding Iowa DOT staff indicated that they follow formal, written guidelines for pavement marking practices. Refer to Figures B.19 and B.20 in Appendix B for more detailed response information.

Question 45 asked about the staff used by each agency to apply pavement markings. In-house staff applied pavement markings in approximately 70 percent of the cities and for all of the Iowa DOT. Pavement markings are applied by contract, on the other hand, in 95 percent of the counties. Refer to Figure B.50 in Appendix B for more detailed response information.

Sign and Pavement Marking Materials

The survey addressed several questions regarding common sign and pavement marking material use. Refer to Appendix A to view survey questions.

Question 31 asked the respondent to approximate the percentage of common sheeting types they used with stop, warning, and other signs. Question 32 asked about the size of signing that was typically used (i.e., more than 50 percent of the time) for these signs. The responses to these two questions were combined and summarized (see Figures 7 through 9). These summaries show several patterns about the sign sizes and sheeting types most commonly used in Iowa.

In general, a 30-inch, engineering-grade stop sign is used by most cities (see Figure 7). Most counties, on the other hand, use 30-inch, high-intensity stop signs. The Iowa DOT staff use either 30-inch or 36-inch high-intensity stop signs. A small number of the survey respondents use fluorescent and/or diamond sheeting, and a few indicated the use of 48-inch stop signs.

A 30-inch, engineering-grade warning sign was also the most commonly used size and sheeting by city agencies (see Figure 8). The counties also favored 30-inch warning signs but use high-intensity and engineering-grade sheeting about equally. Only one Iowa DOT staff member responded to this question and indicated the use of 36-inch high intensity or engineering grade sheeting for warning signs. The survey showed that very few agencies use fluorescent and/or diamond-grade sheeting for warning signs, but several use a 48-inch size.

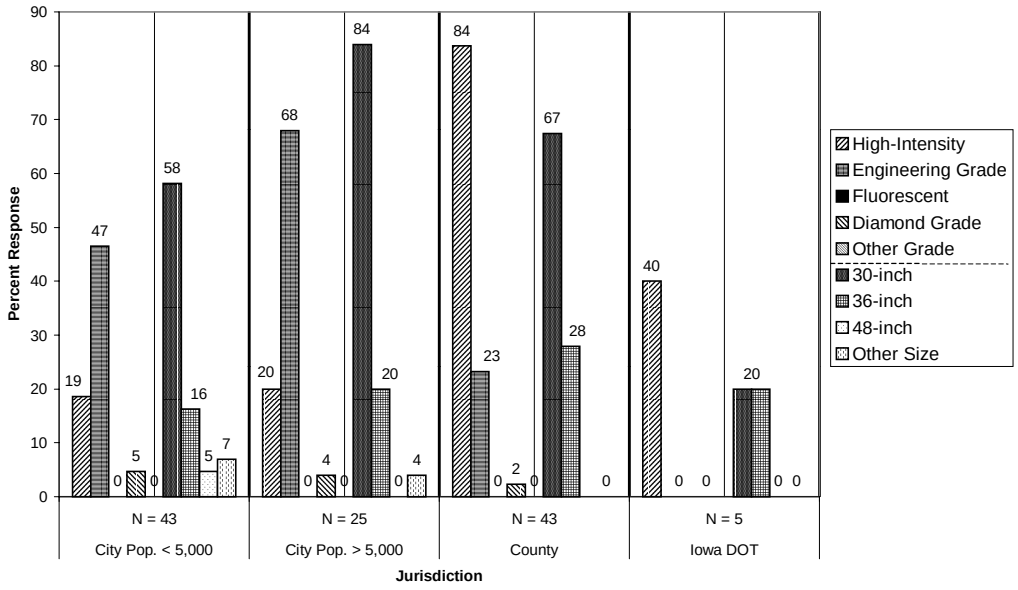


FIGURE 7 Stop Sign Sheeting Type and Size

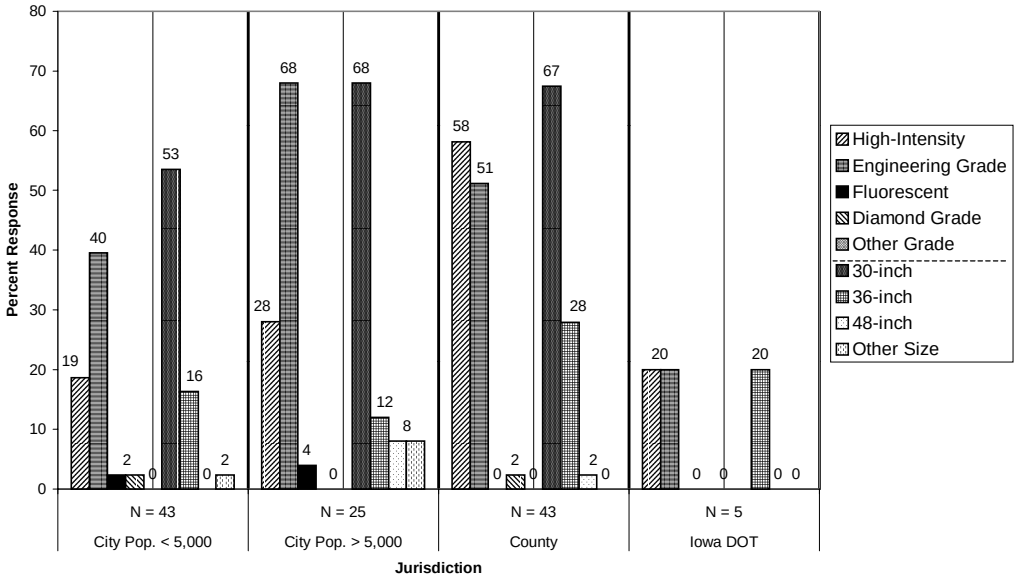


FIGURE 8 Warning Sign Sheeting Type and Size

Overall, a 30-inch, engineering-grade device is also used for other signs by most small and large cities (see Figure 9). The counties also use 30-inch signs but combined that with high-intensity and engineering-grade sheeting on an equal basis. The one response from the Iowa DOT indicated that agency uses engineering-grade sheeting for its other signs. Again, very few of the responding agencies use fluorescent and/or diamond grade sheeting for other signs, but a few use 48-inch signs and about 14 percent of the cities use other unspecified sign sizes.

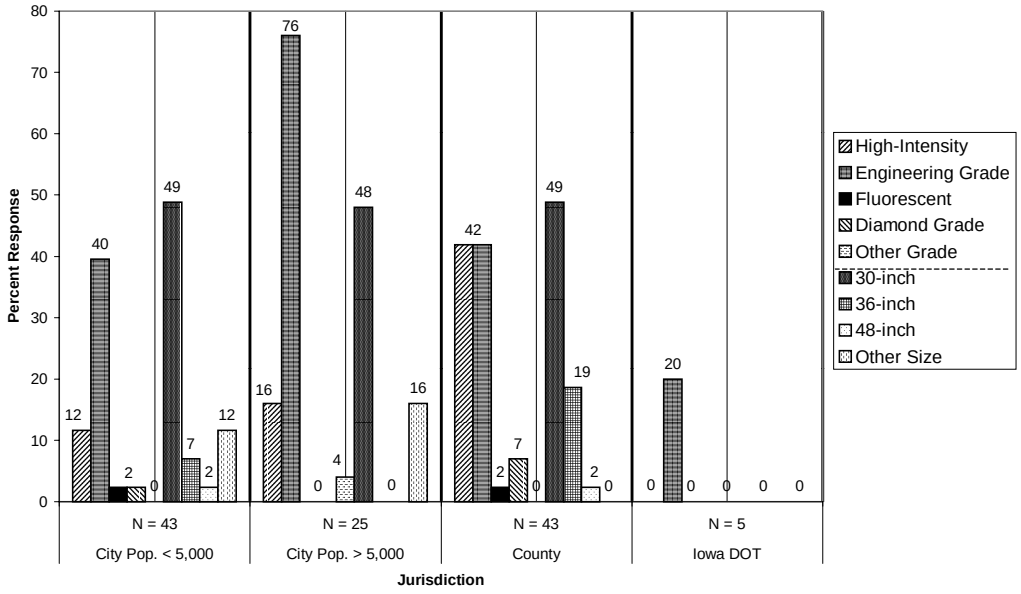


FIGURE 9 Sign Sheeting Type and Size for Other Signs

Question 34 asked about the type of sign support most commonly used (i.e., more than 50 percent of the time) in an agency. The shape of the steel sign supports was also investigated. The small and large cities that responded were similar in the sign support types that they use. Approximately half of the cities use 4-inch by 4-inch wood supports most commonly. The other half use steel supports and indicated that the most common shapes were U-channel or square. But, the square shape is used twice as much as the U-channel in most cites. Fifty-three percent of the counties on the other hand mostly use 4-inch by 4-inch wood supports and 26 percent use 4-inch by 6-inch wood supports. However, the counties that do use steel sign supports use a square shape most commonly. The Iowa DOT most commonly uses 4-inch by 6-inch wood supports. Refer to Figure 10 and Figure B.39 in Appendix B for more information.

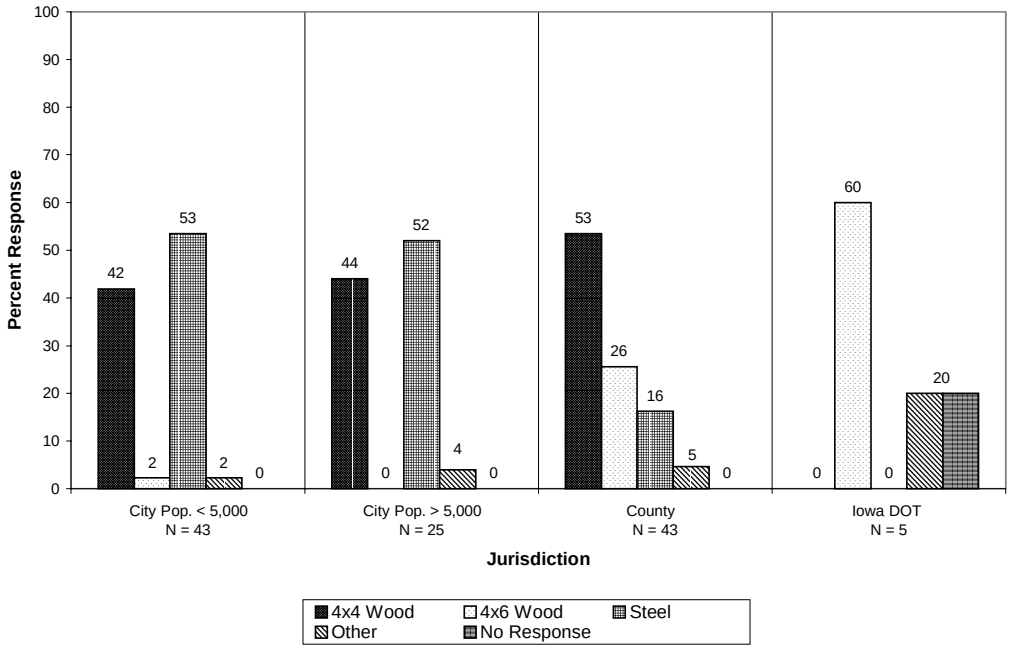


FIGURE 10 Sign Supports Most Commonly Used

Question 35 asked about the type of sign backing used most commonly (i.e., more than 50 percent of the time) in an agency. Overall, an average of 75 percent of the agencies use an aluminum sign backing, and an average of about 17 percent of the county and city staff use a steel backing. Refer Figure B.40 in Appendix B for more detailed response information.

Question 36 asked about street-name sign responsibilities, sizes, and materials. More specifically, each respondent was asked to indicate sign and lettering size, color, and type of reflectance used. All responding cities except one with a small population are responsible for street name signs. The cities typically use 6-inch or larger signs with a green background, 4-inch or larger white lettering, and engineering-grade sheeting. Two-thirds of the counties were also responsible for street-name signs, but they typically use an 8-inch or larger sign with 6-inch lettering on high intensity sheeting. Iowa DOT staff members are not responsible for street-name signs. Refer to Table B.2 in Appendix B for more detailed response information.

Question 44 asked about the types of pavement marking materials that an agency most commonly used (i.e., more than 50 percent of the time). The results showed that a water-based paint was used by more than 84 percent of the large cities, 90 percent of the counties, and all of the Iowa DOT respondents. Small cities typically use both water-based and alkyd-based paints. Very few groups appear to use tape, epoxy, thermoplastic, or any other type of pavement marking material on a regular basis. Refer to Figure B.49 in Appendix B for more detailed response information.

Inspection Procedures

The survey contained one question concerning inspection procedures of traffic control and pavement marking devices (see Appendix A).

Question 15 asked about guidelines used by an agency when inspecting (day and night) traffic control devices and pavement markings. An average of 64 percent of the cities and counties follow some unwritten guidelines for these procedures. In general, the survey results also suggest that cities probably perform this activity less than counties. About 23 percent of the cities that responded to the survey indicated that this question was not applicable to them, and only three counties answered in a similar manner. The Iowa DOT staff uses both written and unwritten guidelines. Refer to Figure B.17 in Appendix B for more detailed response information.

Inventory Practices

The survey asked one question dealing with inventory practices for traffic control devices and pavement markings (see Appendix A).

Question 29 asked about the implementation and maintenance of an inventory system for traffic control devices. Respondents were also asked about the type of inventory system that would be preferred if training was available. About 50 percent of the small cities that responded to the survey did not maintain an inventory system for traffic control devices (see Figure 11). Sixty per cent of large cities and 81 percent of the counties, on the other hand, did maintain a traffic control devices inventory system. Three of the five responding Iowa DOT staff also indicated that some DOT offices maintain an inventory system for traffic control devices.

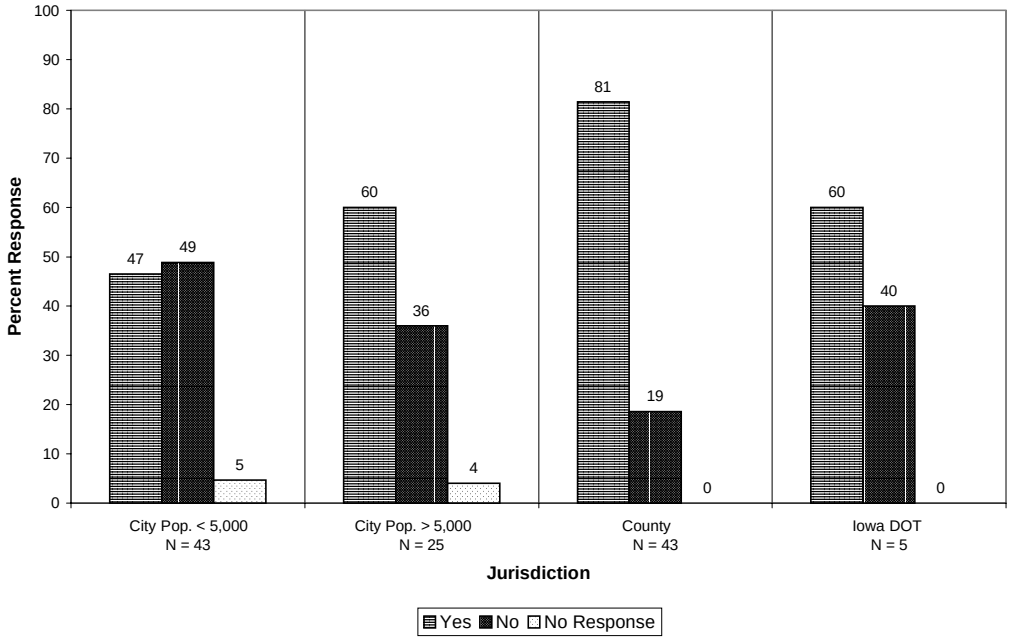


FIGURE 11 Agencies with an Established Traffic Control Device Inventory System

The survey results also showed that agencies without current traffic control inventory programs have different needs and desires regarding the type of system best for them, if training were provided. For example, almost 89 percent of the responding large cities would prefer a computerized system but a majority of the small city respondents seem to favor a manual system (see Figure 12). The county responses, on the other hand, were equally split between computerized and manual approaches.

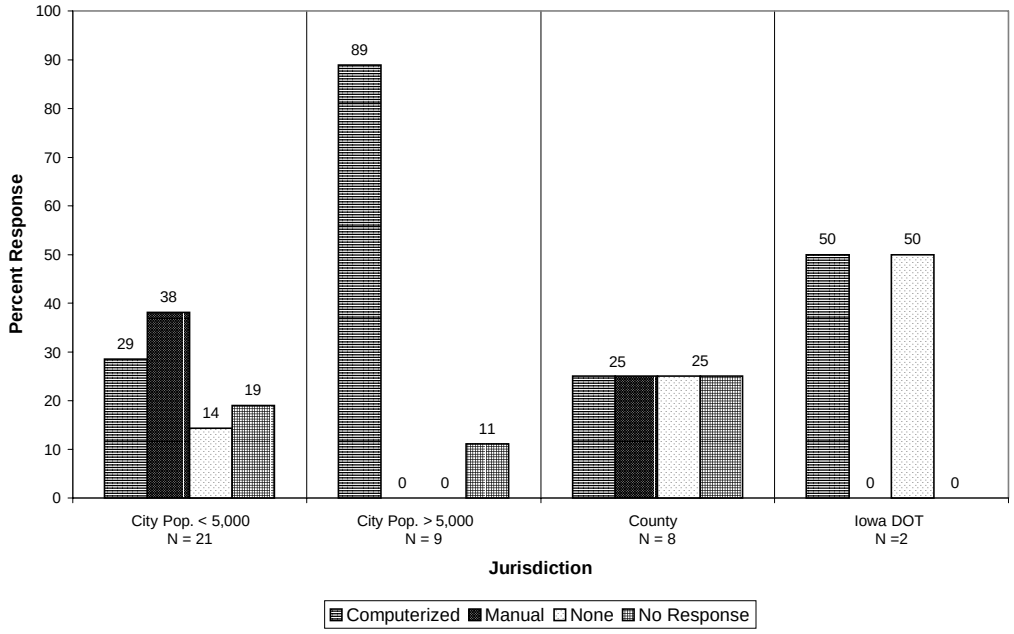


FIGURE 12 Traffic Control Device Inventory System Preferred if Training Is Available

Maintenance Practices

The following survey questions were concerned with maintenance practices for traffic control devices and pavement markings. Refer to Appendix A to view the questions in the survey.

Question 14 of the survey asked about guidelines followed for traffic control device or pavement marking theft and/or vandalism response. A majority of the counties and cities follow informal, unwritten guidelines when responding to theft and /or vandalism. About 84 percent of the counties, 64 percent of the large cities, and approximately one-half of the responding small cities gave this response. In general, more small cities follow formal guidelines than large city or county respondents. Four of the five Iowa DOT staff indicated they follow formal guidelines when responding to traffic control device or pavement marking theft and/or vandalism. Refer to Figure B.16 in Appendix B for more detailed response information.

Questions 30 and 43 asked about traffic control device and pavement marking replacement policies. An average of 94 percent of respondents replace traffic control devices on an as-needed basis in lieu of following a predetermined replacement schedule. See Figure B.33 in Appendix B.

Policies for replacement of pavement markings are more variable, however. While almost 70 percent of the responding small cities replace pavement markings on an as-needed basis, about the same percentage of large cites follow a predetermined replacement schedule for this activity. For pavement markings, counties use replacement on an as-needed basis about equally with predetermined replacement schedules. Responding Iowa DOT staff indicated following a predetermined replacement schedule. Refer to Figure B.48 in Appendix B for more detailed response information.

Management Applications

The survey contained two questions about certain management practices in the agencies (see Appendix A).

Question 6 asked about interagency (28E) agreements that address traffic control devices and/or pavement markings. An average of 74 percent of responding cities and counties do not have such an agreement in effect. However, three of the five responding Iowa DOT staff and an average of 24 percent of the responding city and county agencies are party to an interagency (28E) agreement that addresses traffic control devices and/or pavement markings. Refer to Figure B.8 in Appendix B for more detailed response information.

Question 37 asked whether signs were acquired by the responding agencies from outside vendors. More than 90 percent of the counties and small cities and 64 percent of the large city agencies acquire 76 to 100 percent of their signs from outside vendors (see Figure 13). Not surprisingly, four of the five responding Iowa DOT staff acquired only 0 to 25 percent of their signs from outside vendors.

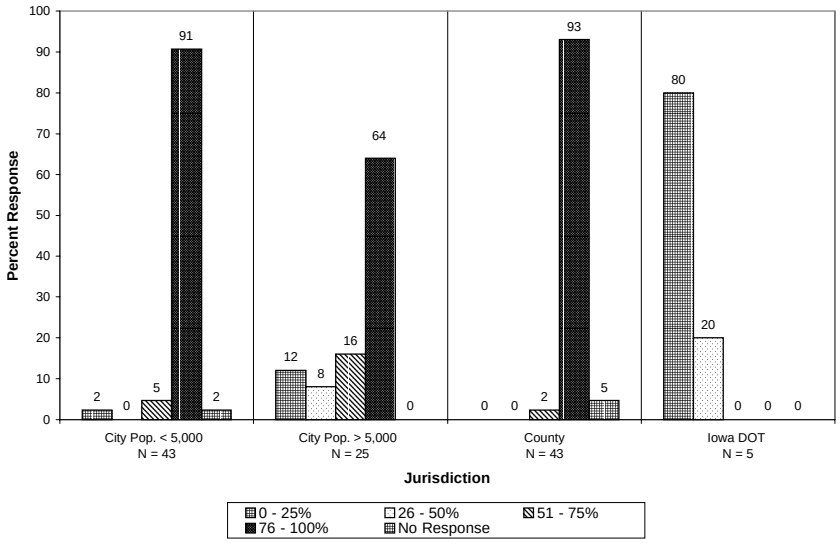


FIGURE 13 Percent of Signs Acquired from Outside Vendors

Traffic-Calming Devices

The survey contained five questions about the use of traffic-calming devices (see Appendix A). Generally these devices include rumble strips, speed bumps, speed humps, roundabouts, chokers, chicanes, bulb-outs, and other miscellaneous devices.

Questions 19, 21, 22, 23, and 24 asked what type of guidelines the agency follows when installing traffic-calming devices. The survey results suggest that more than 80 percent of the cities and counties do not install traffic-calming devices. The only exception to this pattern was installation of rumble strips. About 88 percent of the small cities and 64 percent of large cities do not perform this activity, but 84 percent of the responding counties do install rumble strips. For the counties that install rumble strips, more than 58 percent follow unwritten guidelines, as do 28 percent of the large cities. The Iowa DOT respondents typically follow written guidelines when installing rumble strips. Refer to Figures B.21 and B.23 through B.26 in Appendix B for more detailed response information.

Special Topics

Three special topic questions were also included in the survey (see Appendix A). These subjects addressed intersection lighting, use of roll-out stop signs, and the routine use of ball-bank indicators, or similar devices, to determine safe operating speeds for curves.

Question 13 asked what guidelines were followed by the agency when lighting intersections. An average of 37 percent of the responding cities and counties follow informal, unwritten guidelines (see Figure 14). However, an average of 21 percent of cities and counties use formal, written guidelines. Approximately 12 to 39 percent of these agencies indicated this question did not apply to them, implying that intersection lighting was not undertaken in those jurisdictions. The responding Iowa DOT staff follow both formal and informal guidelines.

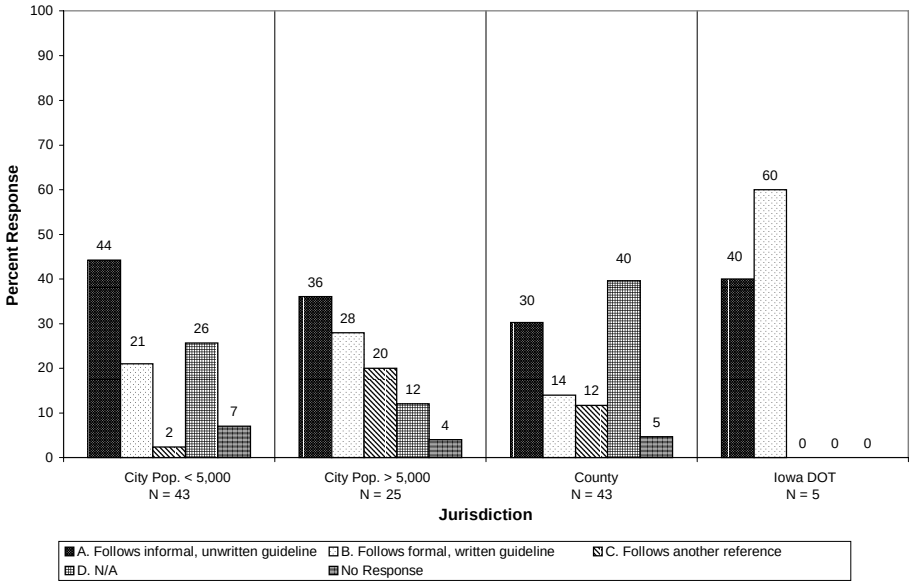


FIGURE 14 Guidelines Followed When Lighting Intersections

Question 20 asked what type of guidelines the agency follows when using roll-out stop signs. The survey results suggested that a majority of the counties and small cities do not use roll-out stop signs, but those that do favor informal, unwritten guidelines (see Figure 15). Larger cities seem to use roll-out stop signs more than the other responding jurisdictions, and 44 percent indicated using unwritten guidelines. Three of five responding Iowa DOT staff follow formal, written guidelines when approving use of a roll-out stop sign on primary roads.

Question 38 asked whether the agency routinely used a ball-bank indicator or similar device to determine safe operating speeds for curves. An average of 79 percent of the cities do not use a ball-bank indicator or similar device for this activity. This response is most likely due to a low number of curves in these cities where operating speed is a concern. Seventy-two percent of the counties, on the other hand, do use a ball-bank indicator or similar device to determine safe operating speeds for curves. Four of five Iowa DOT staff also routinely use a ball-bank indicator or similar device. Refer to Figure B.42 in Appendix B for more detailed response information.

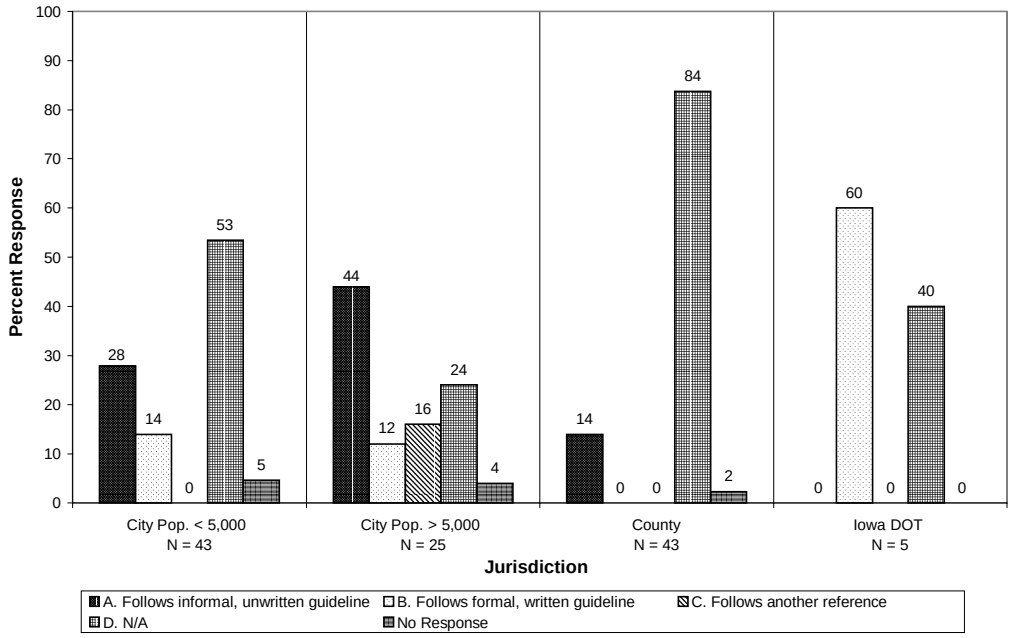


FIGURE 15 Guidelines Followed When Using Roll-Out Stop Signs

MANUAL FOR TRAFFIC CONTROL DEVICES AND PAVEMENT MARKINGS

The major objective of this research project was to develop and distribute an operating statement and manual for traffic control devices and pavement markings that would be useful to local agencies in Iowa. The following is a brief description of the manual produced as part of this project. The complete manual is a companion document to this report and is available separately.

Operating Statement

The operating statement contained in the manual *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties* (developed as part of this research) describes the general approach that the authors suggest be implemented and followed by transportation agencies in the administration and management of a program for traffic control devices and pavement markings. The operating statement included in the manual is as follows: "Decisions regarding establishment of traffic control in specific situations will be based on the precepts of the *Manual on Uniform Traffic Control Devices* and engineering studies considering factors such as traffic speed, volumes, sight restrictions, and crash history" (*MUTCD* references in the manual apply to the millennium edition).

Manual Overview

Contents

Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties is composed of the following 12 sections:

A. Introduction and a suggested operating statement
B. Quick reference section containing common conversion factors and references
C. Signs with several examples of frequent applications
D. Pavement markings, including materials and applications
E. Object markers, description and use
F. Delineators
F. Additional situations, with special applications of signing and pavement marking
H. Traffic studies, providing information for advisory curve speed determination, establishment of no passing zones, and speed limit studies
I. Operations; addressing inspection and maintenance practices, deficiency notices, shop and stock management, and vandalism response
J. Inventory systems for traffic control devices
K. Temporary traffic control for short term work zones
L. Appendix, with additional conversion factors, references, sample ordinances and policies, and tools for signing and marking

Description

The manual has a two-column format with color illustrations and is contained in a three-ring binder presentation. Revisions and modifications of the manual for procedures and approaches unique to the locality can be easily accomplished. A sample topic from the manual is shown on the following page.

Stop and Yield Signs

Sections 2B.04 through 2B.07 of the *MUTCD* describe Stop signs (R1-1), including applications and placement. Use of Stop signs is recommended for specific situations primarily involving high speeds, high traffic volumes, restricted views, and crash history.

In addition, the *MUTCD* discusses a few situations where Stop signs should not be used. The *MUTCD* also advises that less restrictive measures of traffic control be considered where a full stop is not required at all times.

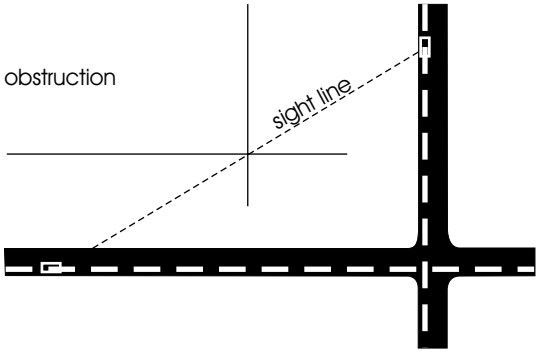
R1-1

MUTCD Sections 2B.08 through 2B.10 describe Yield signs (R1-2) along with applications and placement of these signs. This description includes locations and situations where Yield signs can be effectively installed. Primary factors to be considered when judging the appropriateness of Yield sign usage include traffic volumes, volume split, speeds, visibility, and crash history.

R1-2

Visibility and approach speed are important factors when selecting the most appropriate control for a given intersection. A sight triangle can aid in the analysis of these factors.

A minimum sight triangle will allow a sufficiently unobstructed sight distance along all approaches to an intersection, including across the corners, to allow approaching drivers to take necessary action— stop, slow, or accelerate— to avoid collision. Any object in the sight triangle high enough to restrict visibility (3 feet) should be removed or lowered, if possible. These objects could include cut slopes, vegetation, growing crops, or parked vehicles. An in-depth discussion of sight triangles can be found in AASHTO's *A Policy of Geometric Design of Highways and Streets*, 1990.



Sight triangle

When an approach to an intersection is not controlled by Stop signs, motorists should be able to see a potential hazard early enough to take appropriate action. The average driver requires an estimated minimum of three seconds to perceive and react to a hazard. The following table lists the distance a vehicle will travel in three seconds at various speeds.

Distance traveled by a vehicle in 3 seconds (not stopping distance)

Speed (mph)	Distance (feet)
10	45
15	70
20	90
25	110
30	130
35	155
40	180
50	220
60	260

Inventory Systems for Traffic Control Devices

Effective management of traffic control devices and pavement markings is dependent on a thorough knowledge of the location and condition of the many individual items. This information will help identify problem locations and needed maintenance, planning, budget control, and other agency responsibilities. Recognition of the importance of maintaining rapid access to accurate information has lead many local agencies to adopt an inventory system to identify and control the numerous assets in a traffic control system. Field inventory systems can take the form of paper files, maps, computerized databases, or a combination of these records. Properly established and maintained inventories can provide invaluable assistance in the following areas:

- Location of problem areas
- Providing a systematic replacement program
- Reducing potential liability with good documentation
- Planning and budgeting data
- Improving efficiency with prioritization capabilities

A well-maintained inventory should also allow transportation agencies to track signs and markings from acquisition, through installation, necessary maintenance, to final replacement. The observed condition of signs and pavement markings, particularly regarding retro-reflectivity standards compliance, can be documented in the inventory. Also any necessary maintenance, routine and emergency, can be easily recorded and this valuable data stored for future reference.

The initial establishment of a traffic control device and pavement markings inventory can be time consuming and costly, especially for small agencies. Inventory data can be collected with several methods that range from manual counting to video logging, but any method can result in a cost of several dollars per item of inventory. To lessen budget impacts, agencies can obtain initial data in stages, by addressing only specific areas or types of devices. For example, all regulatory signs may be inventoried in the first year, followed by warning signs later. Such a process would require a longer period to completely record the full inventory, but funding impacts could be extended over several budget periods.

Most inventory systems in use by local agencies in Iowa are computer-based, and several types of software are available, with varying degrees of sophistication and cost. Automated systems offer many advantages such as rapid condition analysis, report preparation, and budgeting assistance, and problem-area identification. However, small agencies can also gain considerable advantage from a low-cost, less sophisticated software program or even by using a simple paper file inventory. Advice and assistance in the development of an inventory system can be obtained from qualified consulting engineers, the Iowa DOT, and CTRE.

An effective inventory will provide a valuable tool for local agencies in managing the significant investment in traffic control devices and pavement markings, and improve the level of service and safety available for users of public roads and streets.

Outreach Opportunities

The potential benefits of this research project include development of a useful tool that local transportation agencies can use to more effectively apply, maintain, and manage the traffic control devices and pavement markings in their jurisdictions. The primary product of this research will be the manual, *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties*. This document will be described and promoted in technical publications, workshops and conferences, and on CTRE's web page. Interest in the manual from other states is also expected. Charts, pocket guides, and other products as identified by the advisory committee for this project, the Iowa Highway Research Board, and others may also be developed. One product being considered for development is a CD-ROM of the manual with word-search capability.

In addition, the initial proposal for this research included an evaluation of the beneficial impacts from the manual to local agencies undertaken approximately one year after initial distribution. CTRE staff will undertake this effort, and the resultant findings will be included in a supplemental report.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions are based on the literature search/review and survey results from this research project.

- Throughout the country, many manuals and reference documents have been developed that address a myriad of traffic control device and pavement marking topics. The data presented in these various resources, along with the results of the common practices survey completed in this research, allowed the production of a single source reference guide specific to Iowa. This document should assist and increase the efficiency of traffic control device/pavement marking managers and practitioners.

- The survey results described in this report provide valuable insight into the common practices, applications, and materials used by many jurisdictions in Iowa. This information was used to define the content of the manual developed as part of this project, and can also be used by local agencies to improve operations, efficiency, and uniformity of practice.

- The information presented in the manual (companion document to this report) provides specific suggestions for traffic control device and pavement marking applications not addressed in a detailed manner in the *MUTCD*. This information will supplement or replace unwritten guidelines now used by many Iowa transportation agencies.

- The common practice survey showed that small cities use both informal, unwritten procedures and formal guidelines in addition to the *MUTCD* when performing many routine traffic control and/or pavement marking activities. However, the survey also showed that larger cities and counties in Iowa were more inclined to rely on informal, unwritten guidelines in addition to the *MUTCD* when performing the same routine traffic control and/or pavement marking activities. Overall, Iowa DOT respondents typically used written guidelines to supplement *MUTCD* recommendations.

- The survey results show that two types of jurisdictional groups may follow similar practices for a specific activity but differ for many other practices. Small cities, for example, do not and, in many instances, cannot employ many of the same practices as larger cities and counties. Lower populations, less traffic, and funding priorities are all factors that impact the decisions and approaches used by different jurisdictions.

- While many agencies have adopted and maintain an inventory system for traffic control devices, many other agencies do not have such a management tool. Either a manual paper-based inventory or an automated computerized system would be beneficial depending on local requirements and resources.

Recommendations

The following recommendations are offered for consideration in traffic control device and pavement marking management programs:

- *Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties* is a comprehensive, single-source reference guide designed for field or office use. The manual should be used to improve traffic control device and pavement marking application, installation, and maintenance efficiency and consistency. In addition, the use of this manual should help agencies adopt similar and consistent practices related to traffic control devices and pavement markings. This uniformity should improve the operation and safety of Iowa roadways and streets.

- To expand the availability and usefulness of the manual developed in this research, a quick reference information system, such as a word-searchable CD-ROM, should be made available. This tool will improve access to specific recommendations and may be more efficient than the printed manual for office use.

- Section 3 of this report (Survey of Local Traffic Control/Pavement Marking Common Practices and Concerns) provides common practice comparisons of many transportation agencies in Iowa. The survey asked a variety of questions related to important traffic control topics. The survey respondents provided a great deal of interesting and beneficial information that should be reviewed and used by other agencies to assist in improving management decisions and actual traffic control device and pavement marking practice.

- The list of references in this report provides additional sources of detailed information on a wide variety of traffic control topics. These references should be consulted as needed if additional guidance on a specific topic is desired.

- Future surveys about traffic control devices and pavement markings topics should request more detailed information. For example, the response choice “N/A” (not applicable) in the survey designed for this type of research may have been confusing to respondents. More precise responses and survey results could be obtained with a survey design that included more thoroughly explained questions.

- It is recommended that agencies not currently using an active inventory system for traffic control devices should investigate and consider the potential benefits of this management tool.

- The manual developed in this research should be updated in a timely manner when needed in the future. This activity could be undertaken, when appropriate, as a supplemental research effort.

- The millennium edition of the *MUTCD* has been published by the Federal Highway Administration. For a more efficient and complete reference, agencies should include all or selected sections of the *MUTCD* in a common three-ring binder with the manual.

- Approximately one year after distribution of the manual, a follow-up survey should be undertaken to determine extent of use, benefits of the manual, and obtain suggestions for future improvements and revisions.

ACKNOWLEDGMENTS

The principal investigators for this research project wish to thank the many individuals and institutions that provided support, assistance, and invaluable resources to this effort.

The members of the advisory committee contributed many hours attending meetings, suggesting and authoring topics, and reviewing draft articles for the manual. See the Introduction for a complete list of committee members.

The manuals and documents furnished by the staff of the Iowa Department of Transportation provided excellent resources for manual contents. Several other states and organizations also furnished resource documents. A complete list of these is presented in the References section of this report.

Editing and review by staff at the Center for Transportation Research and Education at Iowa State University contributed greatly to the successful culmination of this research.

Finally the support of the Iowa Highway Research Board was essential in the completion of this project, culminating in the development and publishing of a high-quality document and valuable user survey of common practices.

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Appendix A

Survey Tool

Center for Transportation
Research and Education

March 13, 2000

Dear Engineer or Administrator:

Staff in many of Iowa's city and county transportation agencies have expressed a desire for a single, convenient resource that addresses all the requirements, as well as good general practices, for using traffic control devices (TCDs) and pavement markings. To fill that need, the Center for Transportation Research and Education is developing a TCD/pavement markings guide and reference manual specifically for Iowa's local agencies.

In accordance with the *Manual on Uniform Traffic Control Devices*, the guide will address the use of permanent signs, markings, and devices placed on, over, and adjacent to public streets and roads. (Traffic signals will not be included.) The manual will provide a flexible framework for a TCD/pavement markings program that each agency can adapt to its own needs and practices. This project is being funded by the Iowa Highway Research Board (TR-441).

Before we can compile such a guide, we need to know about Iowa agencies' current practices and needs for information about TCDs and pavement markings. Please take a few minutes to complete the enclosed brief survey. The information and suggestions you provide will help us develop a useful resource for you and your staff.

Please return the survey to the address below as soon as possible. Thanks for participating.

Very truly yours,

Keith Knapp
Co-Principal Investigator
515-294-7082

Duane Smith
Co-Principal Investigator
515-294-8817

Tom McDonald
Co-Principal Investigator
515-294-6384

SURVEY about the use of permanent traffic control devices (TCDs) and pavement markings

For purposes of this survey
- we are *not* including devices or pavement markings used to control traffic in temporary situations like work zones.
- the term "pavement markings" includes both paint and durable markings.

General Questions

1. Do you serve a city or county jurisdiction?
   ❒ yes ❒ no

   If city, what is its population? _____

2. Does your agency use different traffic control and pavement markings standards (for example, for level, type, and size of signing, etc.) on paved versus unpaved roads in rural areas, or on arterial versus connector streets in urban areas?
   ❒ yes ❒ no

   If yes, what guidelines or references do you generally use to support your practices on
   paved roads? _____
   unpaved roads? _____
   or
   arterial streets? _____
   connector streets? _____

3. Does your agency employ staff whose primary responsibility is installing and maintaining TCDs and pavement markings?
   ❒ yes ❒ no

   If yes, how many? _____

   Comments? _____
   _____

4. Does your agency have an established training program for staff responsible for TCDs and pavement markings?
   ❒ yes ❒ no

   Comments? _____
   _____

5. Describe your agency's trucks and other equipment—types, numbers, etc.—dedicated to installing, repairing, or replacing TCDs and pavement markings. _____
   _____
   _____
   _____
   _____
   _____

6. Does your agency have any interagency (28E) agreements that include TCDs and/or pavements markings?
   ❒ yes ❒ no

   Comments? _____
   _____

Your Current Standard Procedures

For each activity numbered 7 through 28, circle **one** letter — A, B, C, or N/A—of the statement that is **most true** for your agency.

In addition to the MUTCD, my agency
- **A** follows an informal, unwritten guideline for this activity.
- **B** follows a formal, written guideline for this activity that we have developed or have adopted from another resource.
- **C** follows another reference for this activity.

N/A = My agency does not perform this activity.

7. Placing stop signs and/or yield signs **A B C N/A**

   Comments? _____
   _____

8. Placing object markers and delineators **A B C N/A**

   Comments? _____
   _____

9. Locating TCDs longitudinally (parallel to the road or street) and laterally (perpendicular to the road or street) **A B C N/A**

   Comments? _____
   _____

10. Placing curve and/or turn signs **A B C N/A**

    Comments? _____
    _____

11. Establishing speed limits **A B C N/A**

    Comments? _____
    _____

12. Establishing no passing zones **A B C N/A**

    Comments? _____
    _____

13. Lighting intersections **A B C N/A**

    Comments? _____
    _____

14. Responding to TCD or pavement markings theft and/or vandalism **A B C N/A**

Comments? _____

15. Inspecting (day and night) TCDs and pavement markings **A B C N/A**

Comments? _____

16. Placing TCDs and pavement markings at narrow structures **A B C N/A**

Comments? _____

17. Placing center line markings on paved roads and streets **A B C N/A**

Comments? _____

18. Placing edge line markings on paved roads and streets **A B C N/A**

Comments? _____

19. Installing rumble strips **A B C N/A**

Comments? _____

20. Using roll-out stop signs **A B C N/A**

Comments? _____

21. Installing speed bumps **A B C N/A**

Comments? _____

22. Installing speed humps **A B C N/A**

Comments? _____

23. Installing roundabouts **A B C N/A**

Comments? _____

24. Installing chokers, chicanes, bulb-outs, or other miscellaneous traffic calming devices **A B C N/A**

Comments? _____

25. Installing "School Bus Stop Ahead" signs **A B C N/A**

Comments? _____

26. Installing "Deer Crossing" signs **A B C N/A**

Comments? _____

27. Installing "Children Playing" signs **A B C N/A**

Comments? _____

28. Installing "Deaf Child" or other special-interest signs **A B C N/A**

Comments? _____

Traffic Control Devices (TCDs)

29. Does your agency have and maintain a sign inventory system?

❒ yes ❒ no

If no, would you like one if it were combined with training?

❒ yes (prefer: ❒ computerized ❒ manual)
❒ no

Comments? _____

30. Check the program that describes your agency's replacement policy for TCDs:

❒ follow a predetermined replacement schedule
❒ replace TCDs on an as-needed basis

Comments? _____

31. Indicate the approximate percent of sheeting used for the following sign categories. Fill in every blank:

	stop signs	warning signs	other signs
high-intensity	_____%	_____%	_____%
engineering grade	_____%	_____%	_____%
fluorescent	_____%	_____%	_____%
diamond-grade	_____%	_____%	_____%
other	_____%	_____%	_____%

Comments? _____

_____

32. What size sign does your agency *primarily* use (i.e., more than 50 percent of the time)? Check *one* size under each category:

	stop signs	warning signs	other signs
30-inch	_____%	_____%	_____%
36-inch	_____%	_____%	_____%
48-inch	_____%	_____%	_____%
other	_____%	_____%	_____%

Comments? _____

_____

33. Does your agency routinely consider the use of yield signs for traffic control at intersections?

❒ yes ❒ no

Comments? _____

_____

34. What type of sign supports does your agency *primarily* use (i.e., more than 50 percent of the time)?

❒ 4 x 4 wood
❒ 4 x 6 wood
❒ steel (describe shape) _____
❒ other _____

Comments? _____

_____

35. What type of sign backing does your agency *primarily* use (i.e., more than 50 percent of the time)?

❒ aluminum
❒ plywood
❒ steel
❒ other _____

Comments? _____

_____

36. Is your agency responsible for street-name signs?

❒ yes ❒ no

36. (continued)

If your agency is responsible for street-name signs, please indicate street name signs'

size _____
lettering size _____
color _____
reflectance ❒ high-intensity
❒ engineering grade
❒ other _____

Comments? _____

_____

37. What percent of all signs used by your agency is acquired from an outside vendor?

❒ 0–25%
❒ 26–50%
❒ 51–75%
❒ 76–100%

Comments? _____

_____

38. Does your agency routinely use a ball-bank indicator or similar device to determine safe operating speeds for curves?

❒ yes ❒ no

If no, how do you determine such speeds? _____

_____

_____

39. Does your agency routinely use advisory speed signs in conjunction with curve signs?

❒ yes ❒ no

Comments? _____

_____

40. Does your agency routinely use double arrows at T intersections?

❒ yes ❒ no

Comments? _____

_____

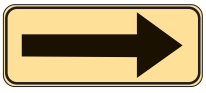
41. Does your agency routinely use stop signs at intersections on rural, unpaved roads?

❒ yes ❒ no

If yes, at approximately what percent of intersections on rural, unpaved roads? _____ %

Comments? _____

_____



42. Please check all of the following situations in which your agency routinely uses fluorescent yellow green signs:
- ❒ advance bicycle crossing (W11A-1)
- ❒ bicycle crossing (W11-1)
- ❒ advance pedestrian crossing (W11-2)
- ❒ pedestrian crossing (W11A-2)
- ❒ advance school sign (S1-1)
- ❒ school crossing (S2-1)
- ❒ school bus stop ahead (S3-1)
- ❒ school (S4-3)
- ❒ school speed limit (S5-1)

Comments? _____

_____

Pavement Markings

43. Check the statement that describes your agency's replacement policy for pavement markings:
- ❒ follow a predetermined replacement schedule
- ❒ replace markings on an as-needed basis

If you follow a predetermined schedule, please describe it briefly: _____

_____

_____

Comments? _____

_____

44. What type of pavement marking materials does your agency *primarily* use (i.e., more than 50 percent of the time)?
- ❒ water-based paint
- ❒ alkyd-based paint
- ❒ tape (indicate type of tape) _____
- ❒ epoxy
- ❒ thermoplastic
- ❒ other _____

Comments? _____

_____

45. Who *primarily* applies pavement markings in your jurisdiction?
- ❒ in-house staff
- ❒ contractors

Comments? _____

_____

Finally

46. What subjects would you want to find in a manual for local agencies regarding TCDs and pavement markings?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Optional

46. We may wish to contact you for additional information. For example, it might be helpful to learn more about guidelines your agency uses regarding TCDs and pavement markings. If we may contact you, please provide the following information:

Name: _____

Telephone number: _____

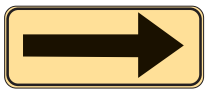
E-mail address: _____

If you prefer to be anonymous, remove the peel-off label from the address panel on the back before returning the survey.

Return the completed survey by **March 31, 2000.**

Thanks again!

Help us by completing the enclosed brief survey, and in turn we'll help you manage your traffic signs and pavement markings.



This study is sponsored by the
Iowa Department of Transportation.

CTRE
Center for Transportation Research and Education

IOWA STATE UNIVERSITY

Iowa Department of Transportation

Staple the pagss of the completed survey together, fold along the dotted lines so the return mail panel is on the outside, tape the survey shut, apply postage, and drop it in the mail.

TO: Center for Transportation Research and Education
TT Iowa State University Research Park
TT 2901 S. Loop Drive, Suite 3100
TT Ames, IA 50010-8632

Appendix B

Summary of Responses from Survey

Please note that due to rounding, not all response categories total 100 percent.

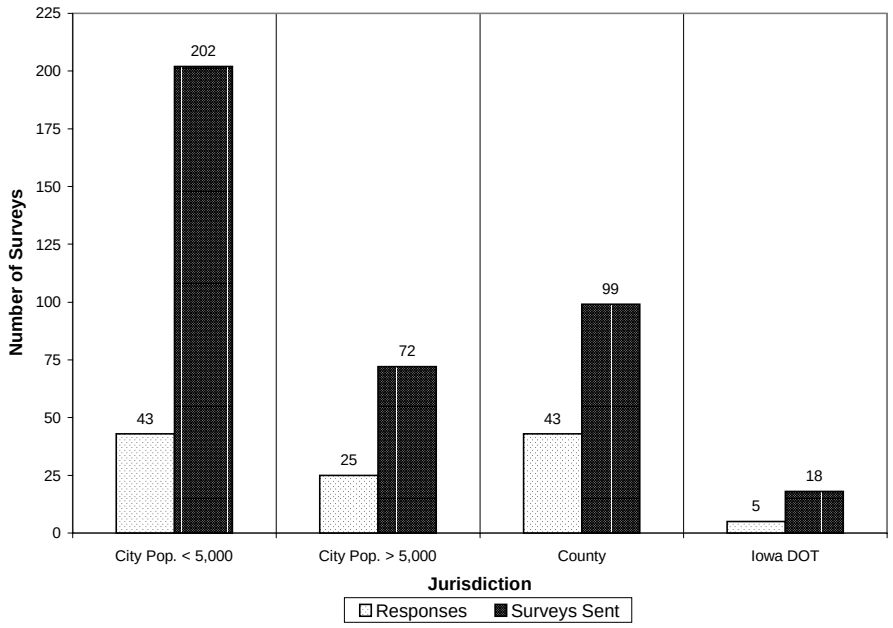


FIGURE B.1 Group Responses (Survey Question 1)

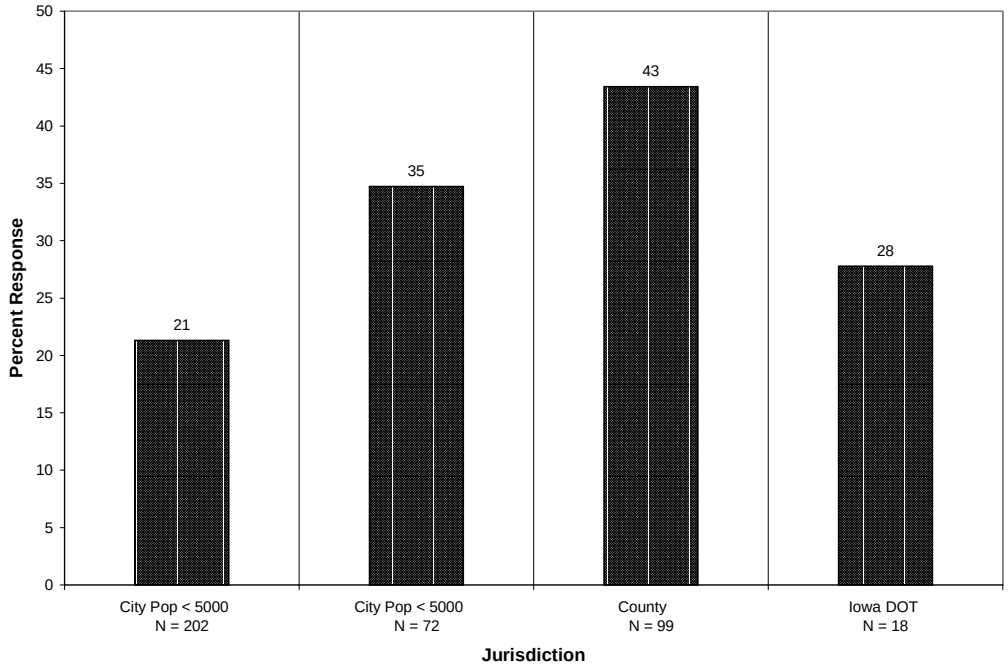


FIGURE B.2 Return Percentages for Each Survey Group (Survey Question 1)

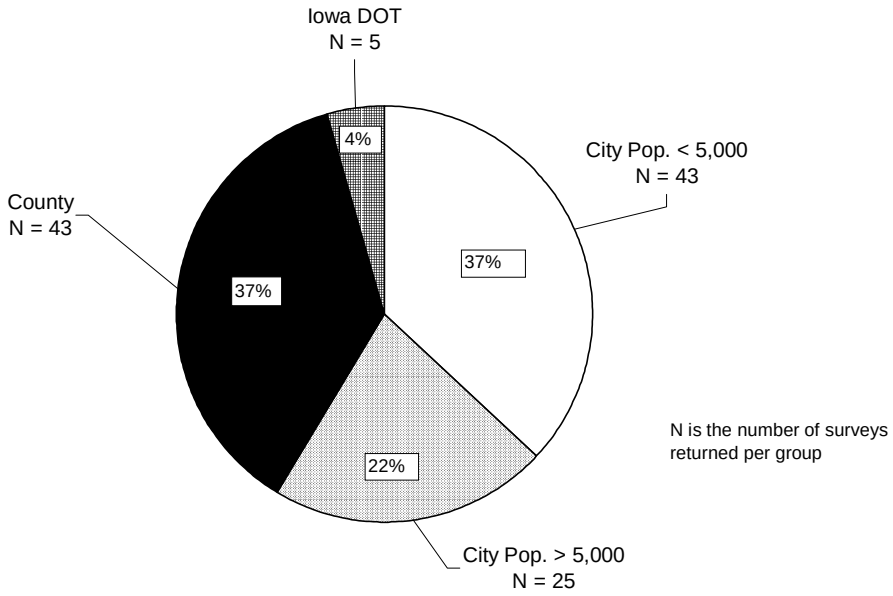


FIGURE B.3 Percent of Total Group Response (Survey Question 1)

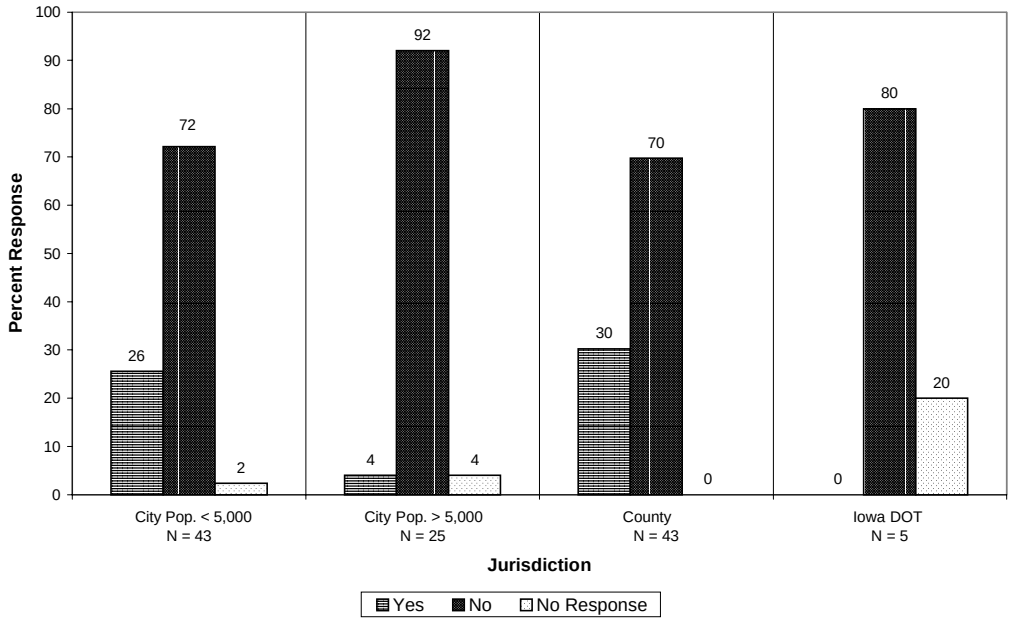


FIGURE B.4 Use of Variable Standards for Traffic Control and Pavement Markings on Paved versus Unpaved Roads in Rural Areas or on Arterial versus Collector Streets in Cities (Survey Question 2)

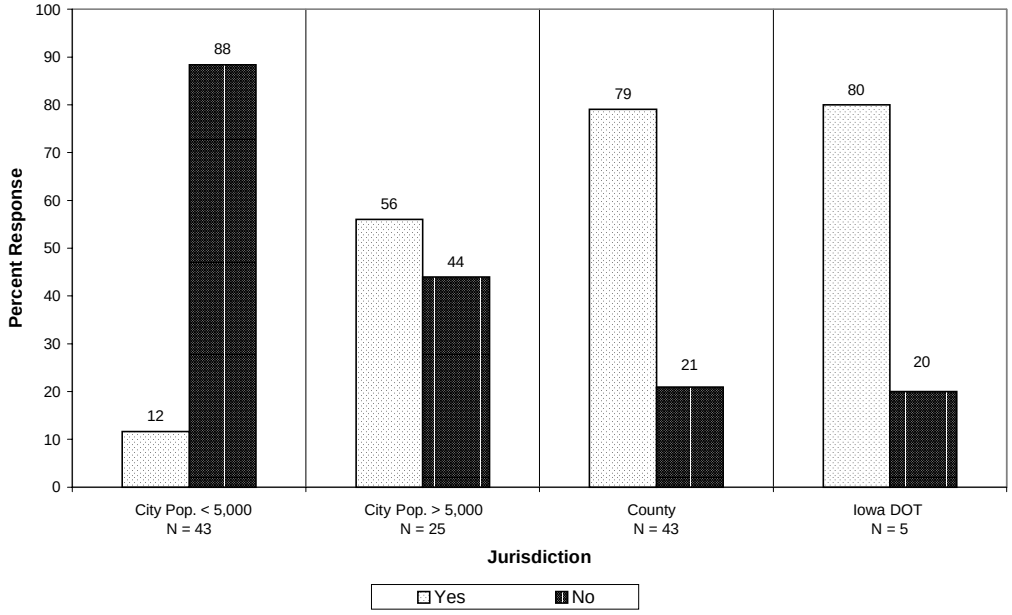


FIGURE B.5 Agencies That Employ Staff with Primary Responsibility of Installing and Maintaining Traffic Control Devices and Pavement Markings (Survey Question 3)

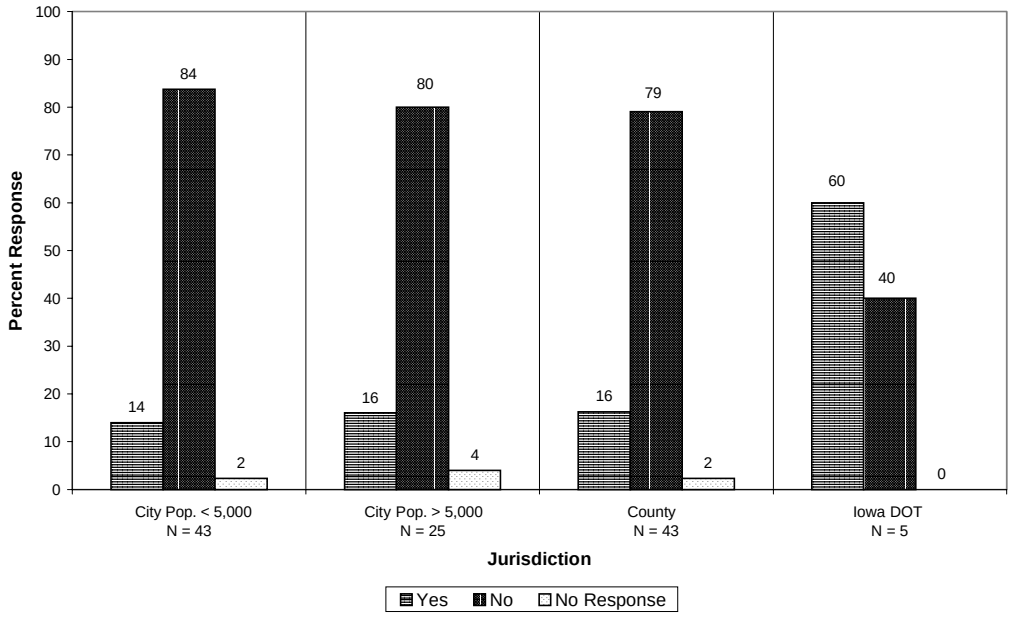


FIGURE B.6 Agencies with Established Traffic Control Device and Pavement Marking Training Programs (Survey Question 4)

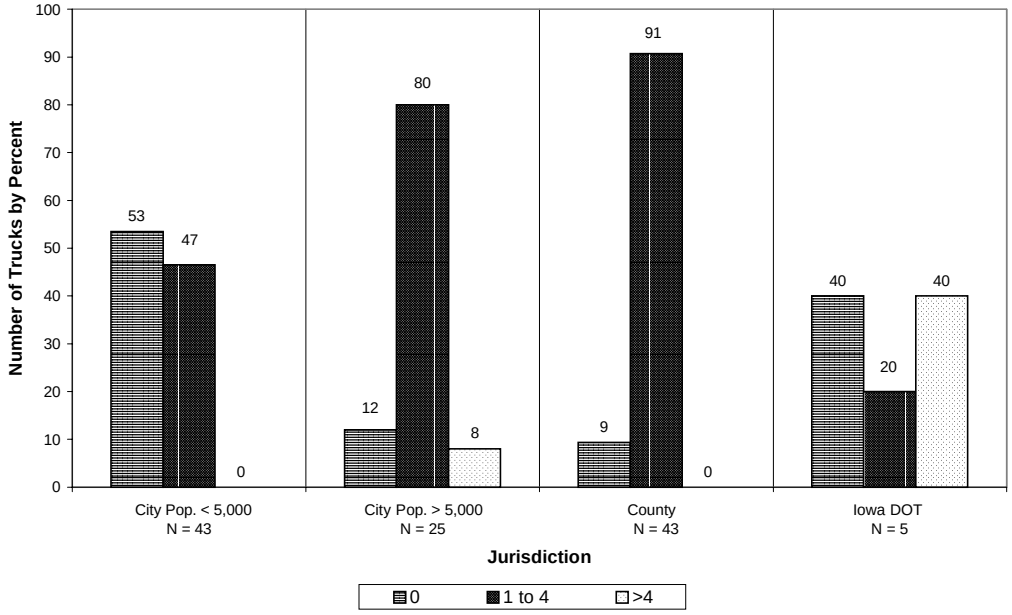


FIGURE B.7 Number of Trucks and/or Pickups per Agency Available for Traffic Control (Survey Question 5)

TABLE B.1 List of Equipment Used by Responding Agencies (Survey Question 5)

City Pop < 5000
- Boom truck with auger, Sweeper, Line painter
- 1 ton GMC, Backhoe
- 3/4 ton Dodge 4X4
- Usually a pickup with whatever equipment is needed
- Portable paint machine, Pickup trucks, Backhoe
- Shovels, Post hole digger
- Standard PWD trucks used for any and all purposes
- Pickup
- 1 ton truck, Load to push steel posts into ground, Walk behind paint machine - uses aerosol cans
- Pickup
- Pickup, Loader, Paint Machine
- Pickup, Post hole digger, Brushes and rollers for paint
- Paint striping machine
- Pickup, Steel post driver, Post hole digger, Rent paint stripping machine
- Pickup, Loader
- Pickup, Loader
- Pickup, Post hole auger, tractor

TABLE B.1 *Continued*

City Pop > 5000

- Paint stripping machine, Truck, Trailer
- 1-ton flatbed pickup with hydraulics and storage for sign installation/maintenance, and a 3/4 ton pickup with paint striping equip.
- 3 service trucks with service body, Walk behind airless striper with trailer
- 2 sign trucks, Centerline striper, Small truck for crosswalks, One-ton pickup for miscellaneous, Pavement markings, Walk behind striper, Stationary striper for turn arrows, etc.
- Skid mount paint machine, Boom truck 40' reach
- 1-ton pickup, Paint machine
- Pickup truck, Line eraser, Paint machine, 3M tape
- Pickup
- Truck mounted striping machine which can be removed and used as a walk behind unit
- Truck equiped with generator, Tool boxes, Welding equipment, etc.
- Manually controlled airless sprayer
- 1-ton pickup, Sign auger truck, Paint machine
- Walk behind paint machine
- Paint striping machine, Aerial lift truck
- 2 hand pushed paint machines, 2 sign trucks
- 3 pickups, 1 self contained paint machine
- Flatbed utility truck, Aerial bucket truck
- Signals - 2 pickups, Van w/ bucket lift, Truck mounted platform lift, Ttruck mounted 40' aerial lift, Digger derrick truck. Signs and Pav't Markings - 4 pickups, 1-ton barricade truck, 10T sign truck, Farmall M tractor, John Deere B tractor, Truck mounted lane striper, Small Paint striper
- Pickup, Trailer, Aerial truck, Post hole digger, Small paint machine for painting symbols, etc.

County

- 1-ton pickup
- 1-ton pickup with flat bed and hydraulic digger with 12" and 18" auger
- 1-ton pickup, Flanigan sign trailer
- 1991 Kodiak truck
- Pickup, 1/2 truck with commercial air compressor, Farm tractor with post hole digger
- Sign truck equipped with auger, post driver, slide-out platform, sign storage area, bolt and post storage areas, and misc.
- Truck with flannigan western sign bed, E-450 chassis. Currently re-equipping truck to improve efficiency and safety.
- Vehicle for signing, Contract painting
- 1-ton cabover flatbed truck with power auger & customized storage racks. Contract pavement markings
- One 2-ton sign truck with auger and boom basket, Sign earl applicator
- Sign truck with hydraulic auger
- Flannigan western flatbed, Auger, Work platform
- 1991 Ford F250 flatbed pickup, Trailer
- Pickup, Flatbed with auger
- One truck for installing signs (auger and post driver)
- Sign truck with platform and post driving boom. Sign making limited to 911 signs. Contract pavement markings.
- Single axle truck with 8" auger
- Pickup with top rack, Portable post driver (gas powered)
- Special design truck with utility type digger derricx
- Sign truck, Contract pavement markings
- Pickup, Boom truck with crane and auger
- 2 yr old straight truck with basket and auger drill and tool box. Old standby sign truck with auger and tool box. Sign trailer
- Flatbed truck with 8" auger
- Truck with hydraulic post auger/driver and operator extension platform
- Small bucket truck with auger
- 3/4 ton pickup with utility box, Electric post driver (steel posts and anchors), Electric aerial lift on trailer, Distance meter on vehicle
- Sign truck has auger and platform for employees and has signs and posts. All equip. to repair or replace signs. Contract pavement
- Straight truck with flatbed, boom, and auger. Has storage for post sign and tools.
  markings.
- Single axle sign truck
- Pickup with tools
- One - 2 ton truck with auger unit
- Sign trucks with auger, etc.
- 4 wheel drive pickup with sign trailer
- 1 truck - use square steel posts with electric driver
- DT 466 IHC truck
- Sign truck with auger and basket
- Sign truck equipped with hydraulic post pounder and platform, inventory of signs, posts, bolts, etc.

Iowa DOT

- One centerline truck, One curb truck per district
- Specialized trucks with booms for installations
- 6 large, 6 other

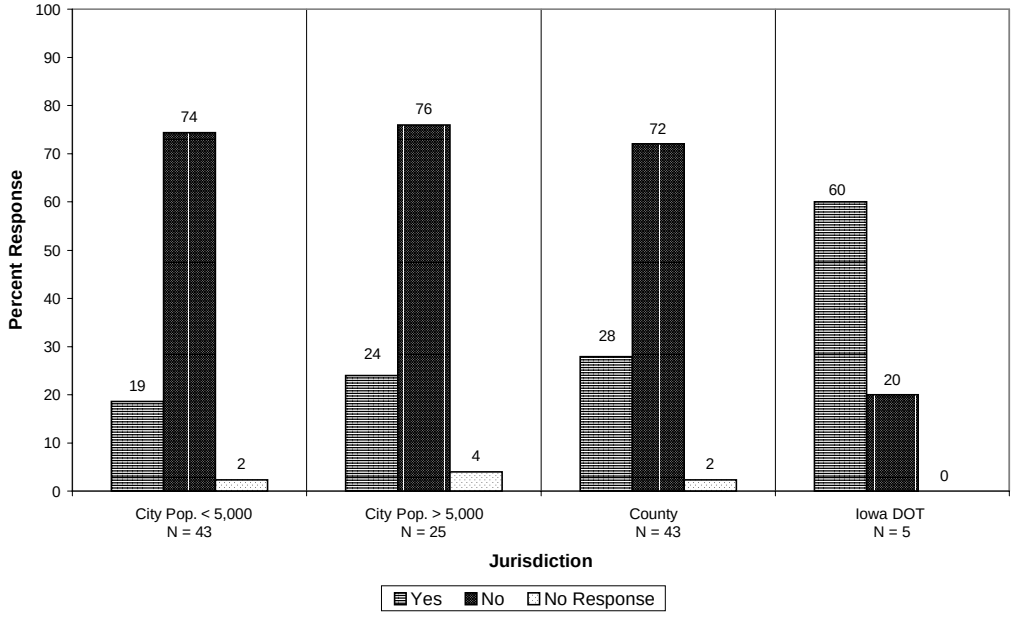


FIGURE B.8 Agencies with Interagency (28E) Agreements That Address Traffic Control Devices and/or Pavement Markings (Survey Question 6)

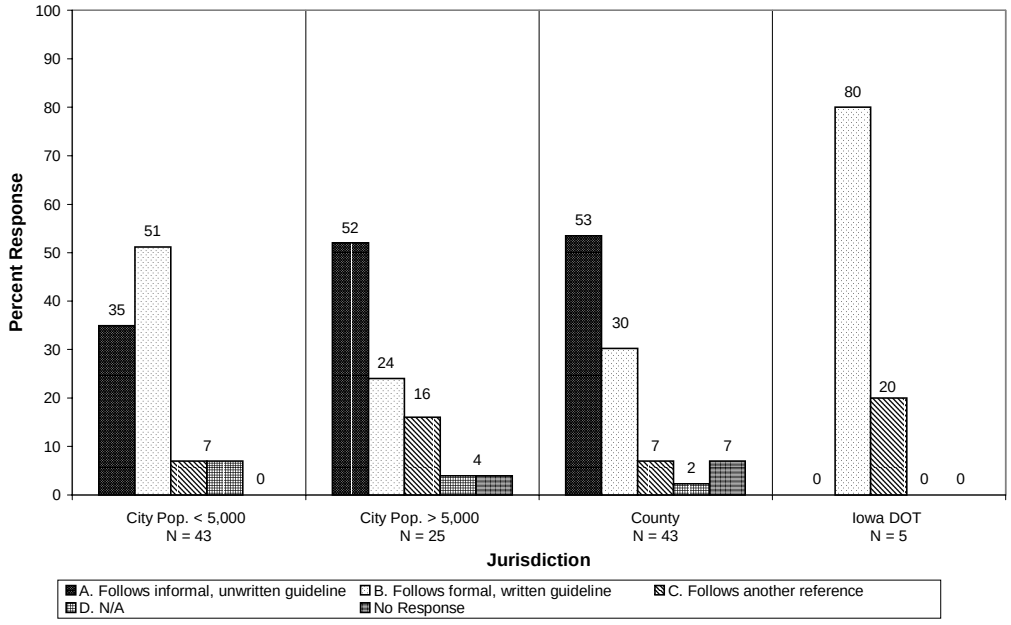


FIGURE B.9 Supplements to the *MUTCD* When Placing Stop Signs and/or Yield Signs (Survey Question 7)

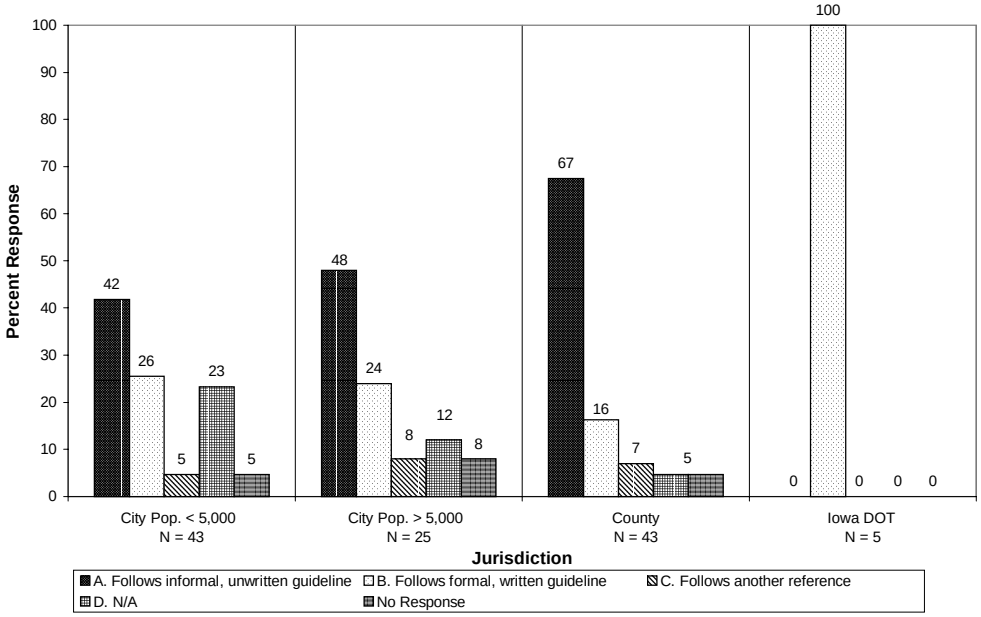


FIGURE B.10 Supplements to the *MUTCD* When Placing Object Markers or Delineators (Survey Question 8)

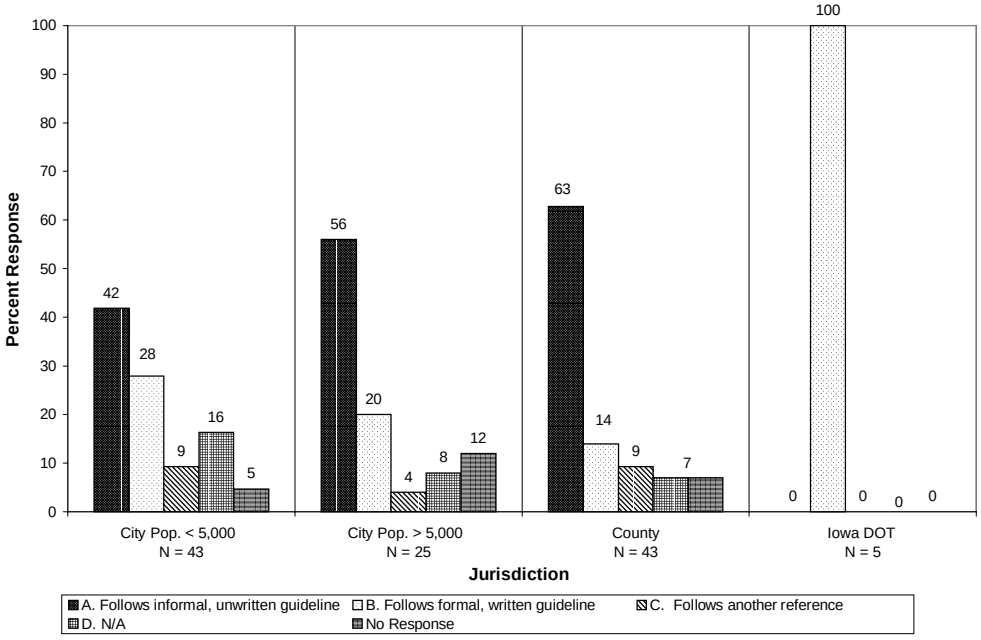


FIGURE B.11 Supplements to the *MUTCD* When Locating Traffic Control Devices Longitudinally (Parallel to the Road or Street) and Laterally (Perpendicular to the Road or Street) (Survey Question 9)

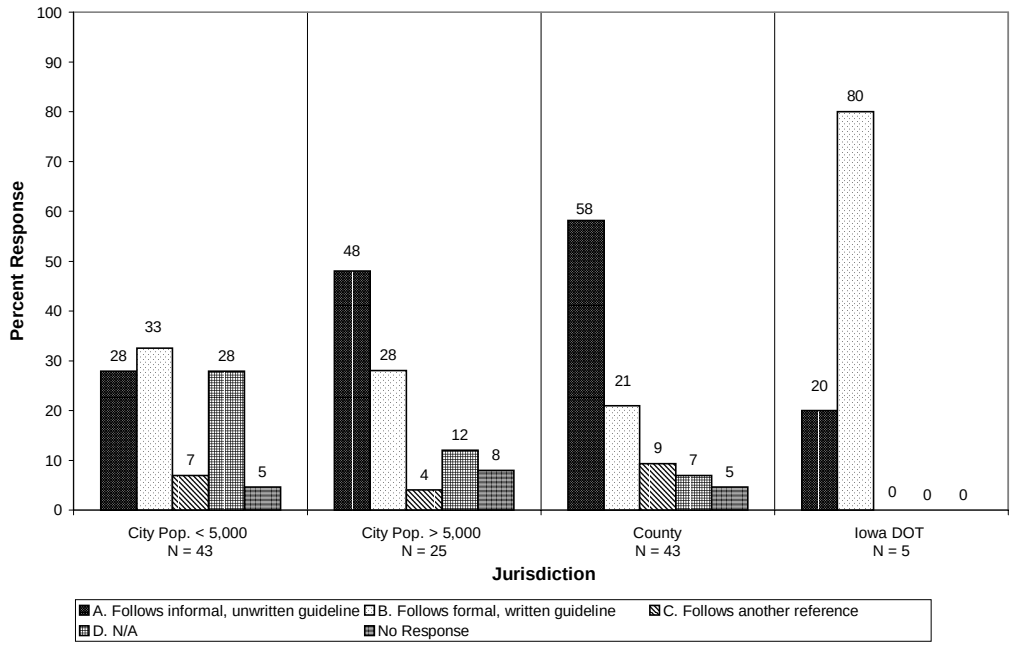


FIGURE B.12 Supplements to the *MUTCD* When Placing Curve and/or Turn Signs (Survey Question 10)

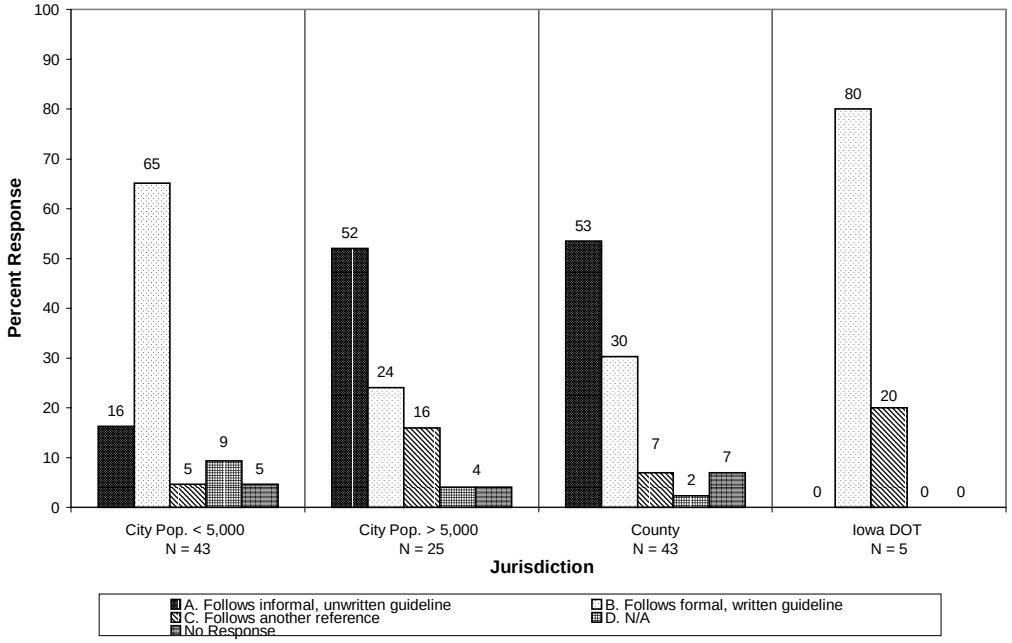


FIGURE B.13 Supplements to the *MUTCD* When Establishing Speed Limits (Survey Question 11)

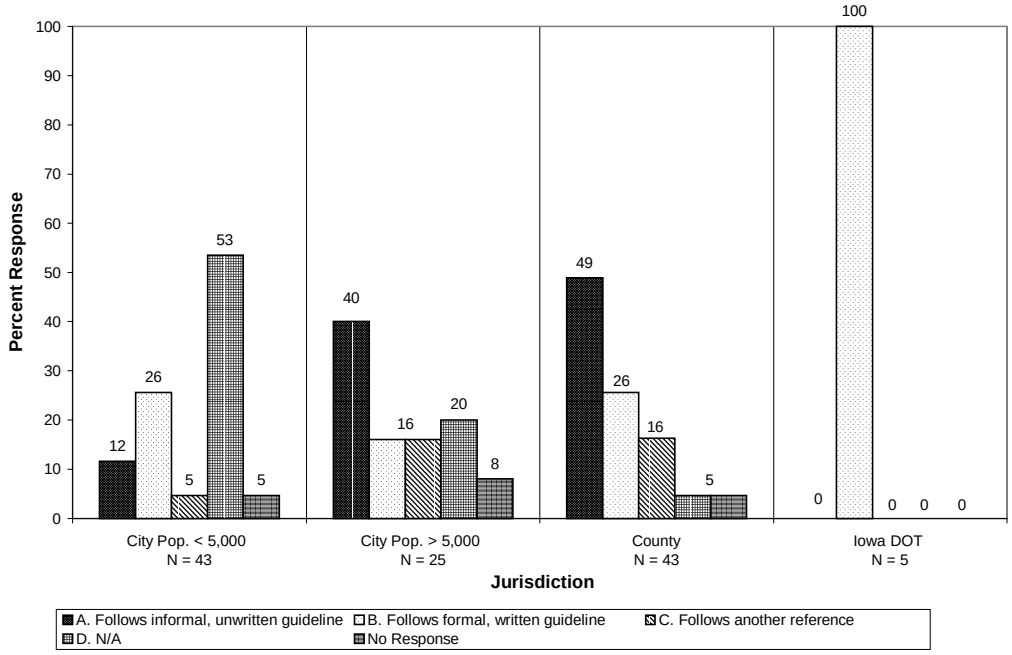


FIGURE B.14 Supplements to the *MUTCD* When Establishing No Passing Zones (Survey Question 12)

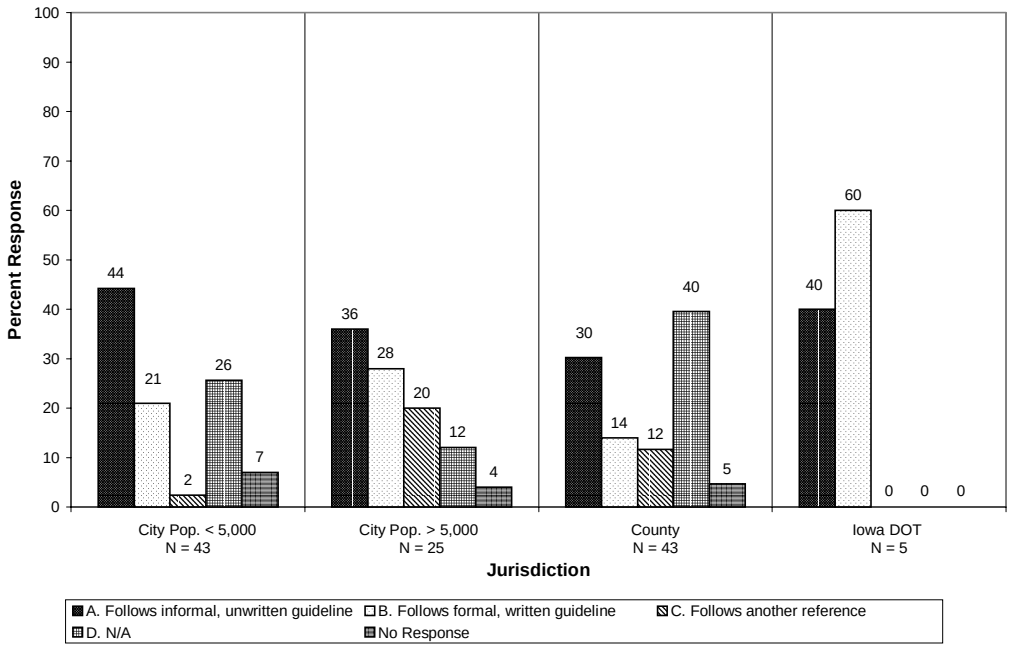


FIGURE B.15 Guidelines Followed When Lighting Intersections (Survey Question 13)

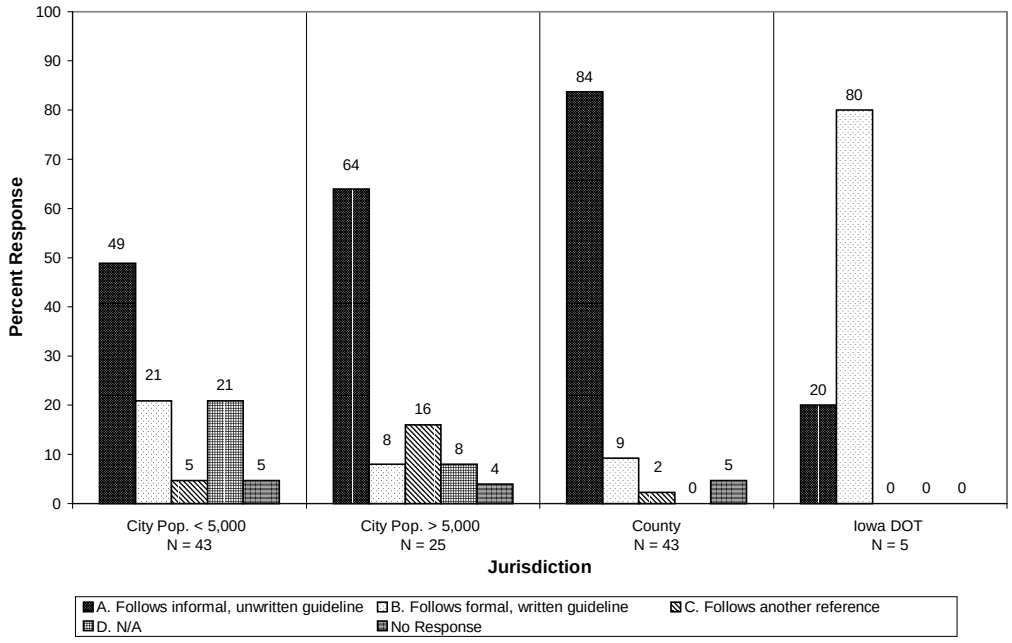


FIGURE B.16 Guidelines Followed When Responding to Traffic Control Device or Pavement Marking Theft and/or Vandalism (Survey Question 14)

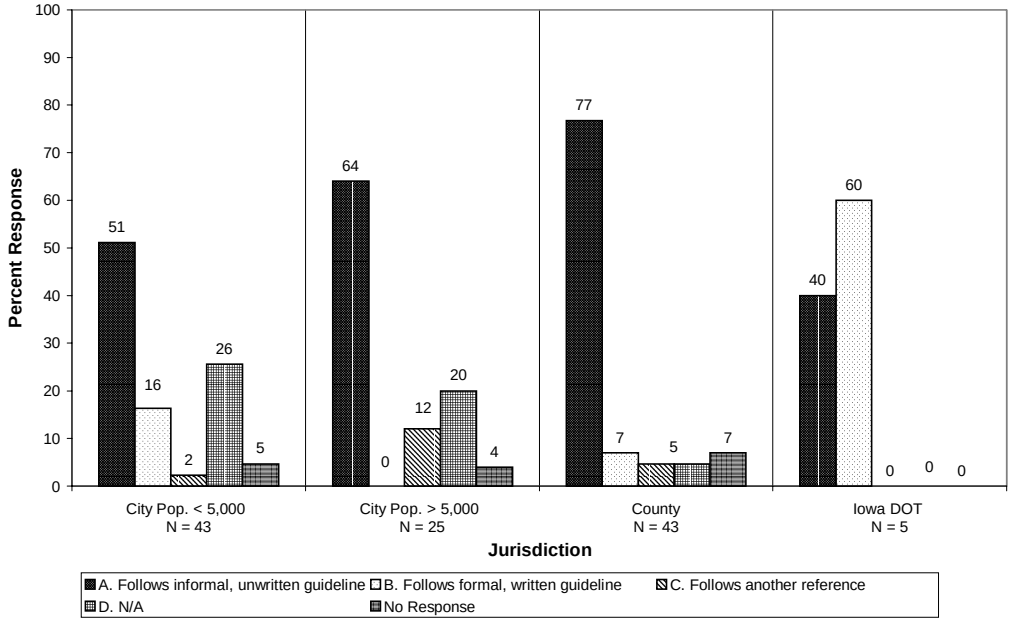


FIGURE B.17 Guidelines Followed When Inspecting (Day and Night) Traffic Control Devices and Pavement Markings (Survey Question 15)

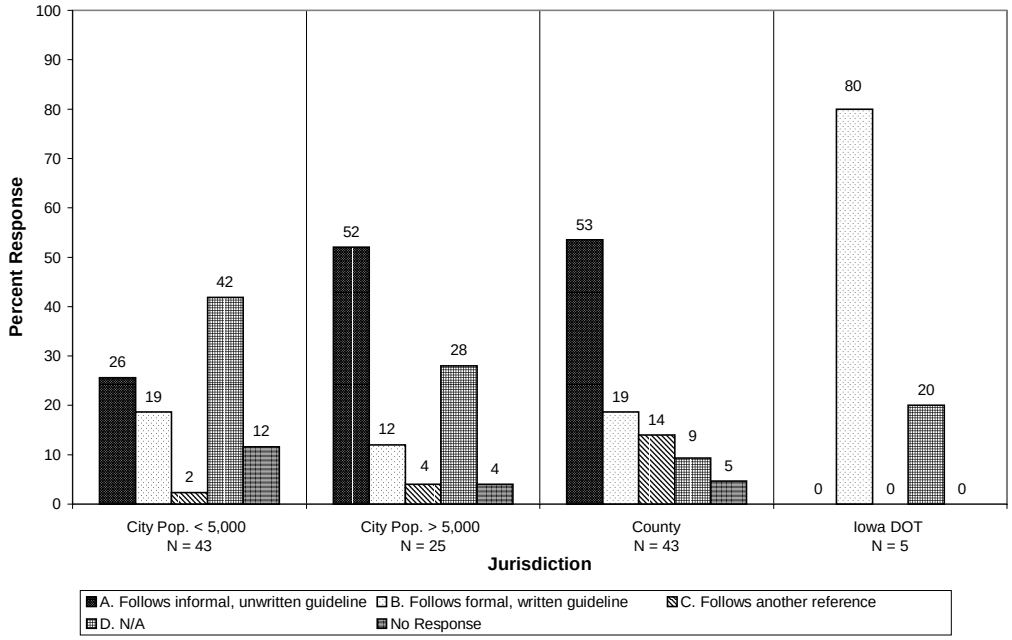


FIGURE B.18 Supplements to the *MUTCD* When Placing Traffic Control Devices and Pavement Markings at Narrow Structures (Survey Question 16)

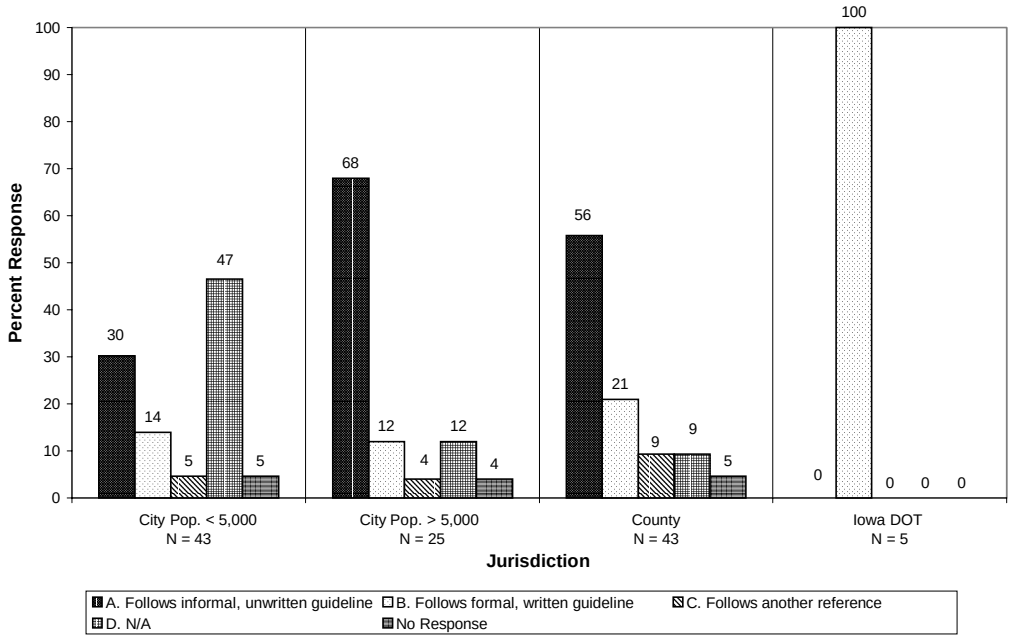


FIGURE B.19 Supplements to the *MUTCD* When Placing Center Line Markings (Survey Question 17)

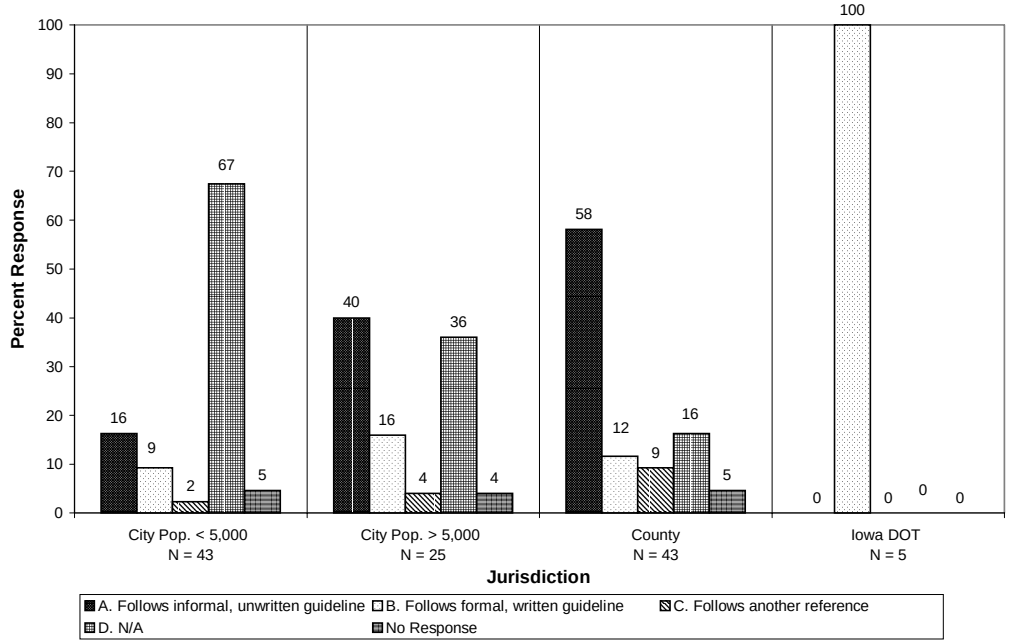


FIGURE B.20 Supplements to the *MUTCD* When Placing Edge Line Markings (Survey Question 18)

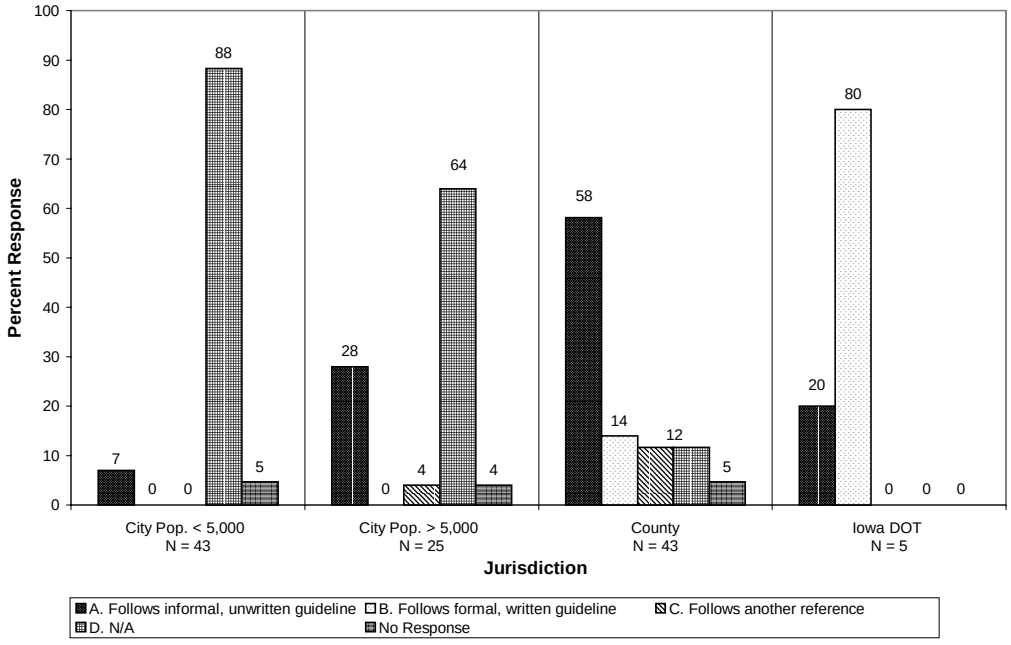


FIGURE B.21 Guidelines Followed When Installing Rumble Strips (Survey Question 19)

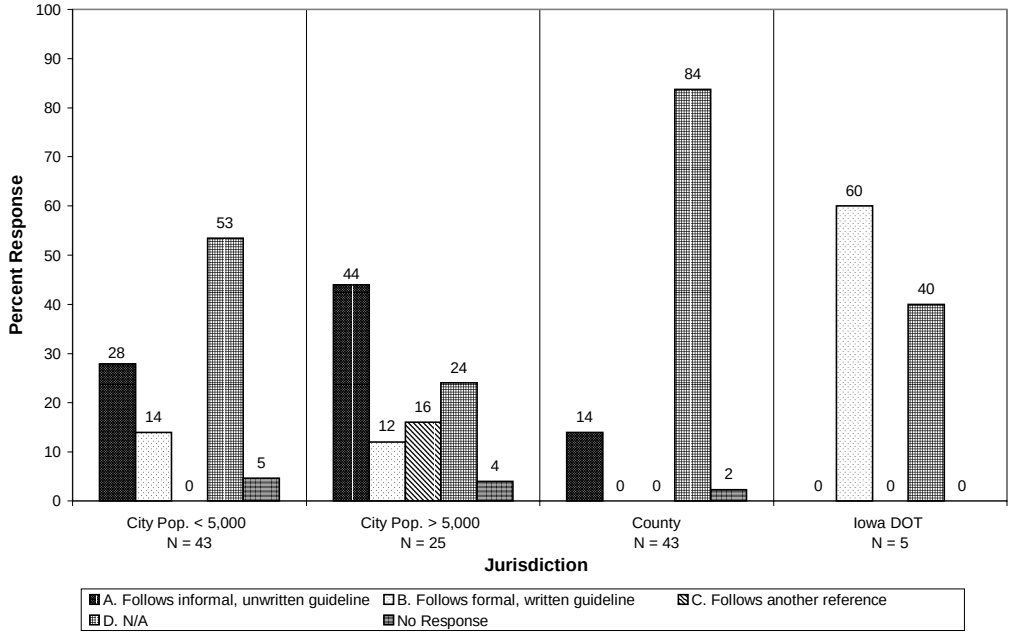


FIGURE B.22 Guidelines Followed When Using Roll-Out Stop Signs (Survey Question 20)

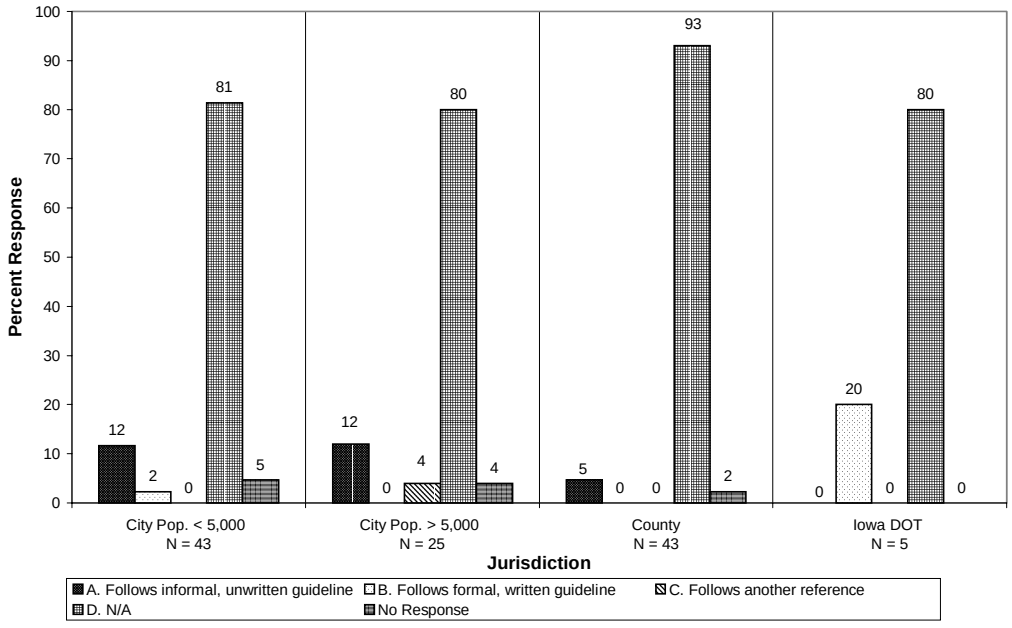


FIGURE B.23 Guidelines Followed When Installing Speed Bumps (Survey Question 21)

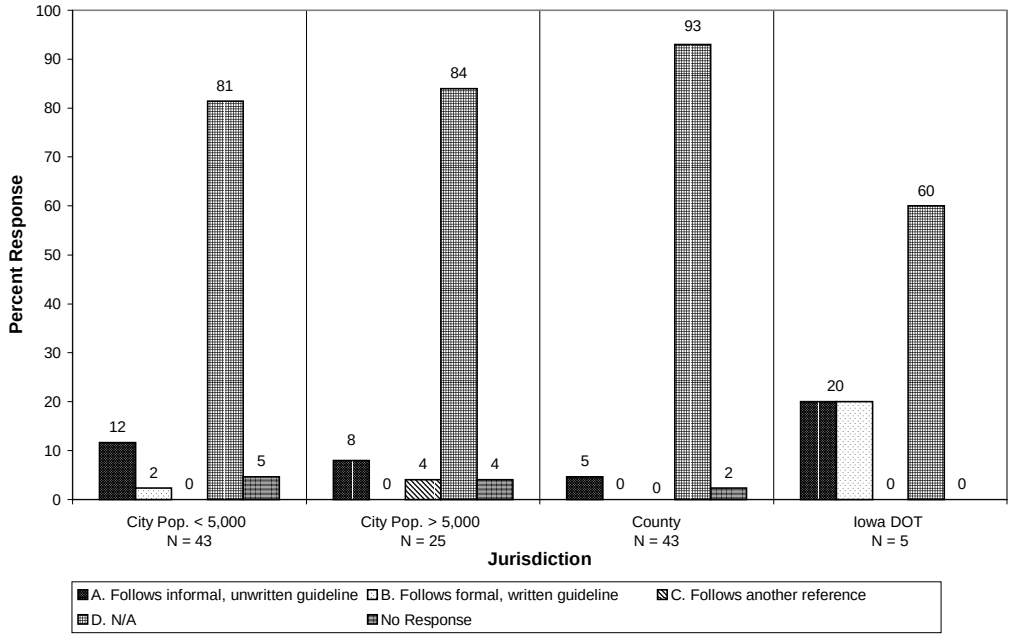


FIGURE B.24 Guidelines Followed When Installing Speed Humps (Survey Question 22)

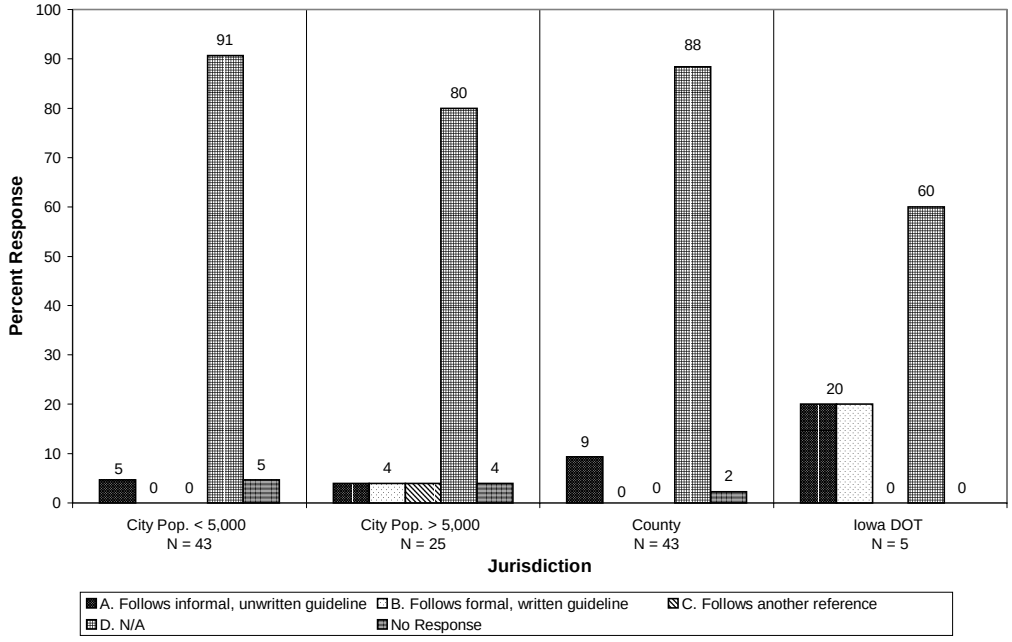


FIGURE B.25 Guidelines Followed When Installing Roundabouts (Survey Question 23)

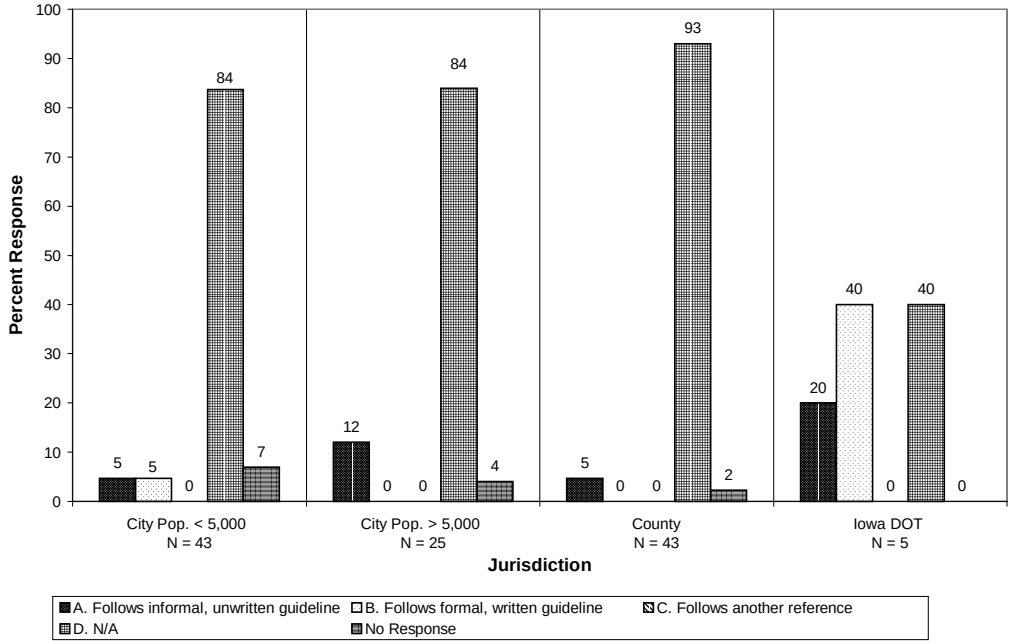


FIGURE B.26 Guidelines Followed When Installing Chokers, Chicanes, Bulb-Outs, or Other Miscellaneous Traffic Calming Devices (Survey Question 24)

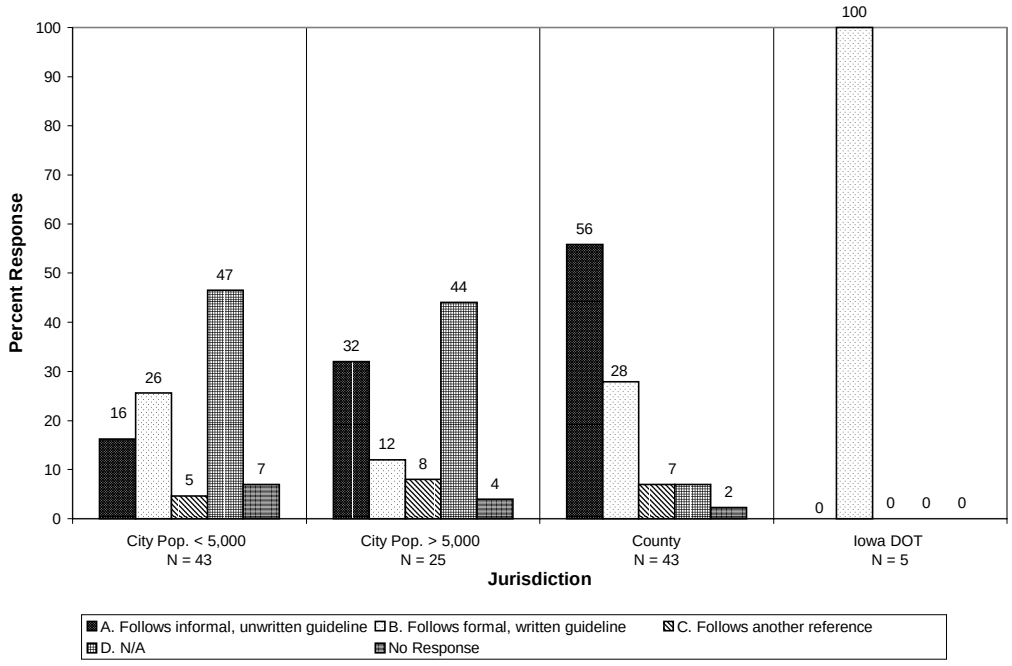


FIGURE B.27 Supplements to the *MUTCD* When Installing "School Bus Stop Ahead" Signs (Survey Question 25)

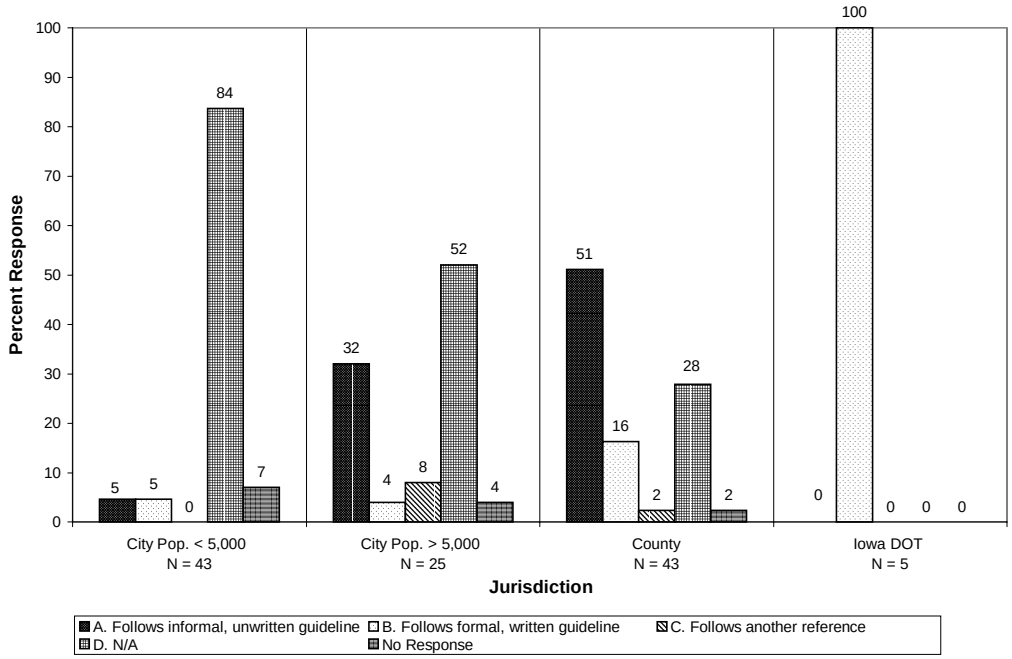


FIGURE B.28 Supplements to the *MUTCD* When Installing "Deer Crossing" Signs (Survey Question 26)

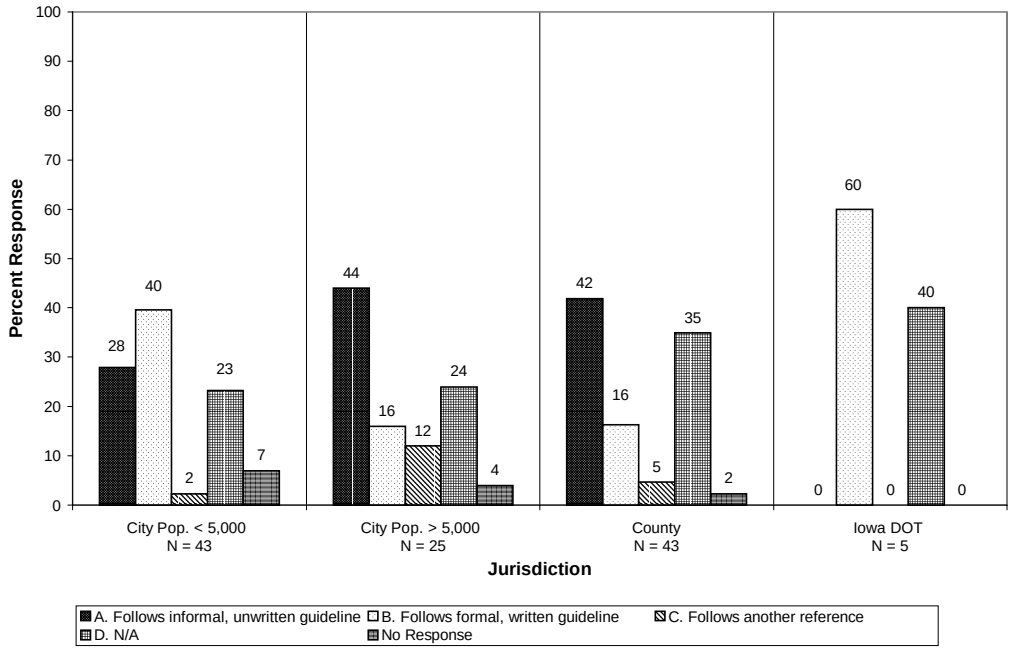


FIGURE B.29 Supplements to the *MUTCD* When Installing "Children Playing" Signs (Survey Question 27)

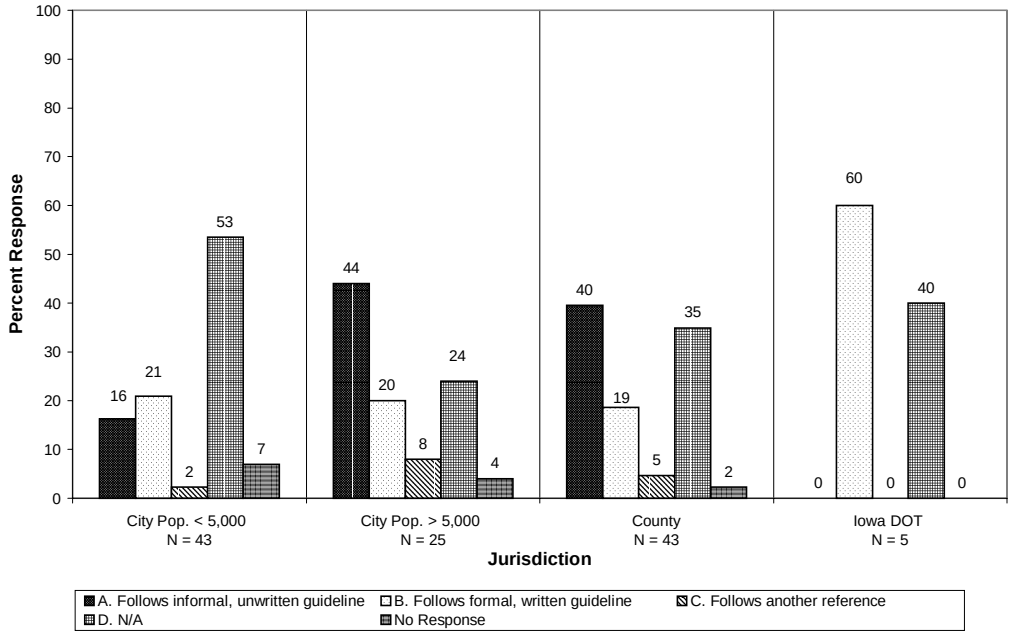


FIGURE B.30 Supplements to the *MUTCD* When Installing "Deaf Child" or Other Special-Interest Signs (Survey Question 28)

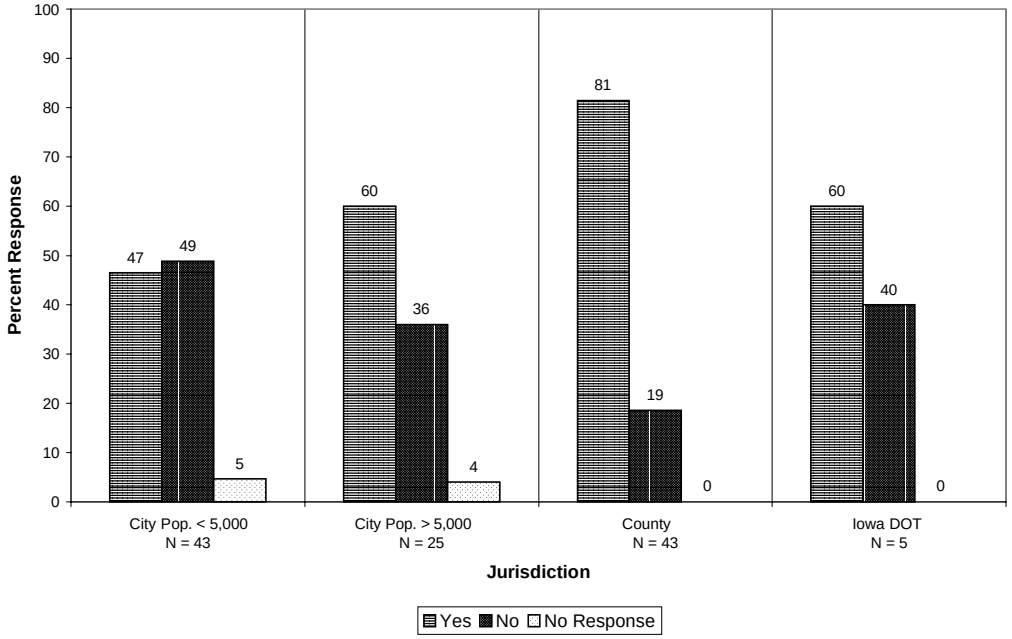


FIGURE B.31 Agencies with an Established Traffic Control Device Inventory System (Survey Question 29)

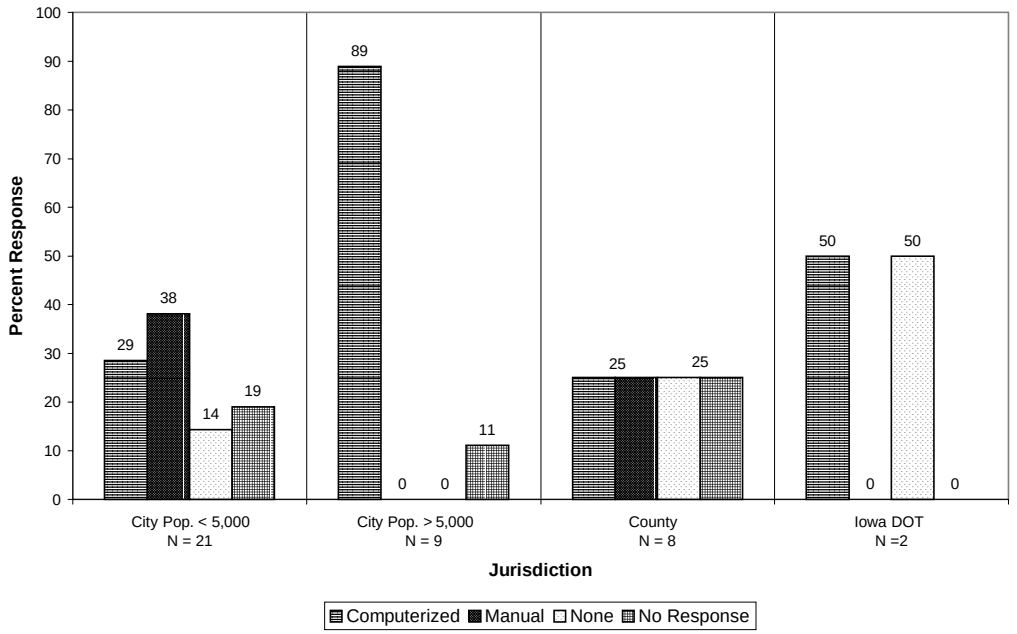


FIGURE B.32 Traffic Control Device Inventory System Preferred if Training is Available (Survey Question 29)

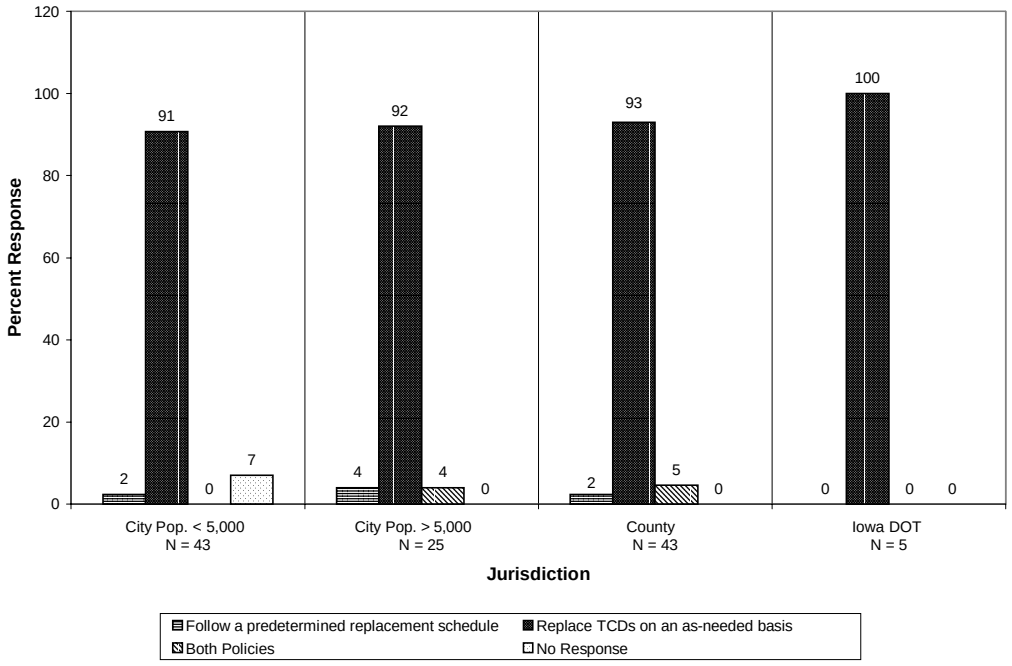


FIGURE B.33 Replacement Policies for Traffic Control Devices (Survey Question 30)

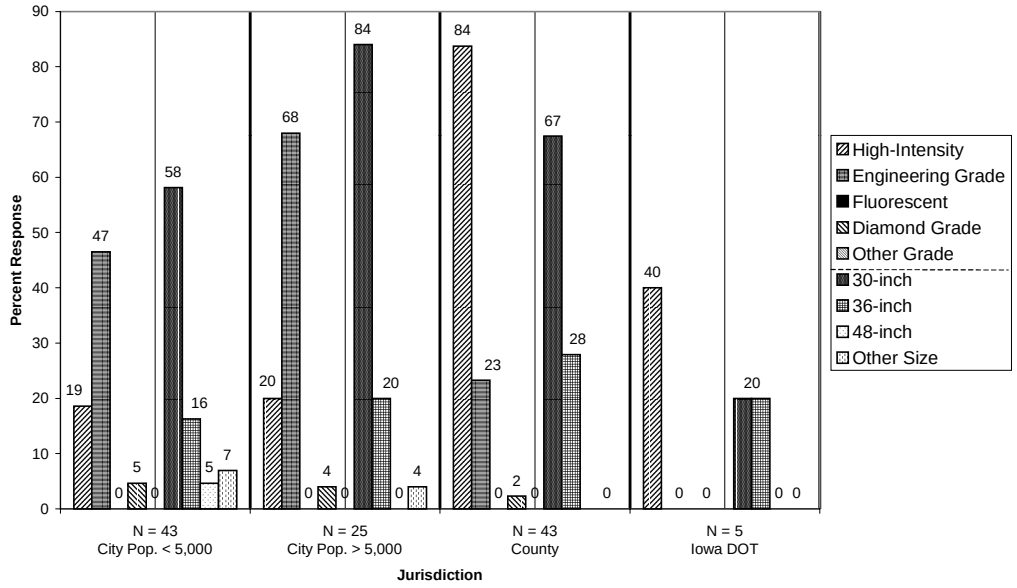


FIGURE B.34 Stop Sign Sheeting Type and Size (Survey Questions 31 and 32)

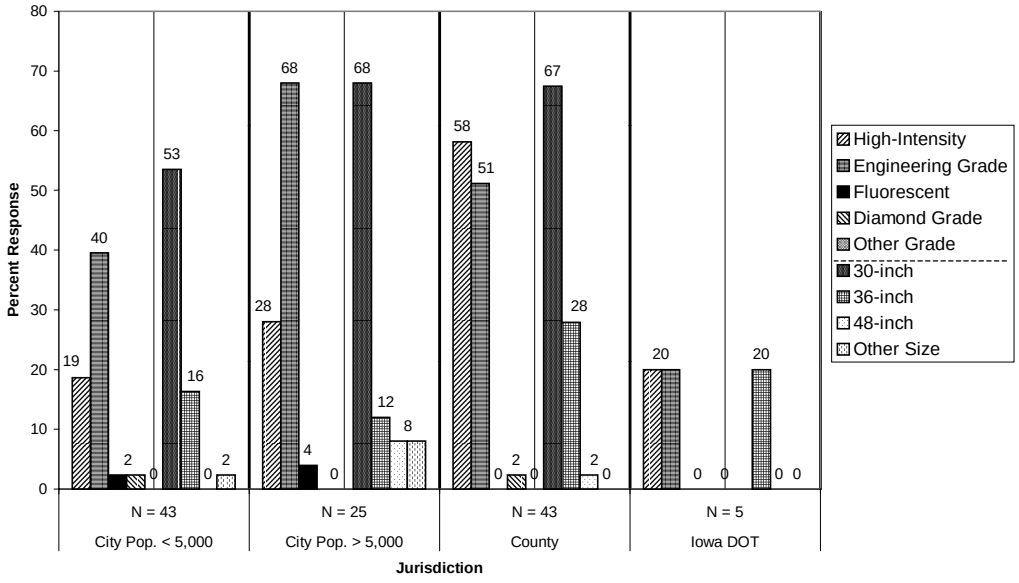


FIGURE B.35 Warning Sign Sheeting Type and Size (Survey Questions 31 and 32)

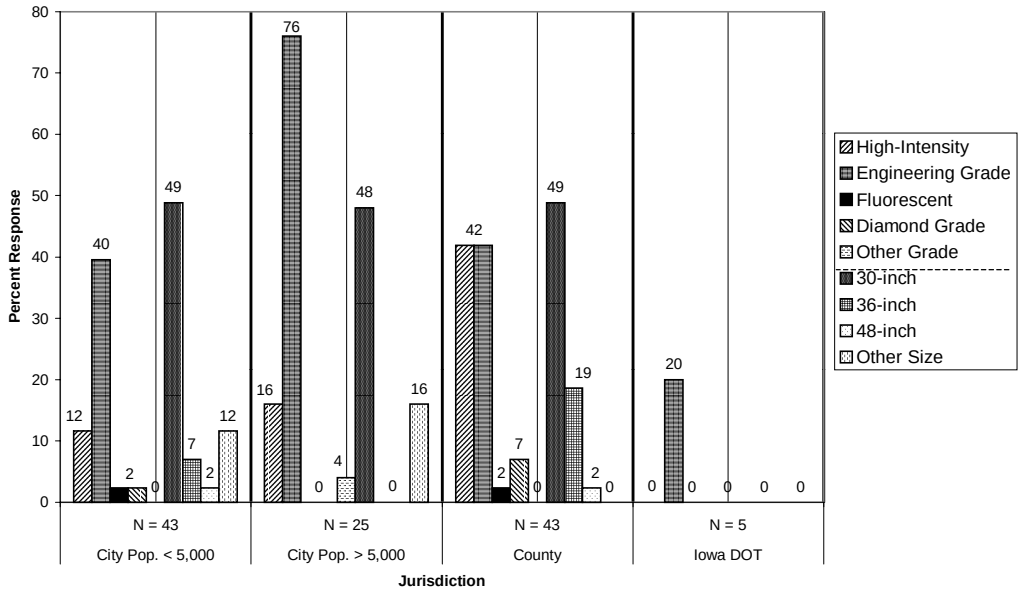


FIGURE B.36 Sign Sheeting Type and Size for Other Signs (Survey Questions 31 and 32)

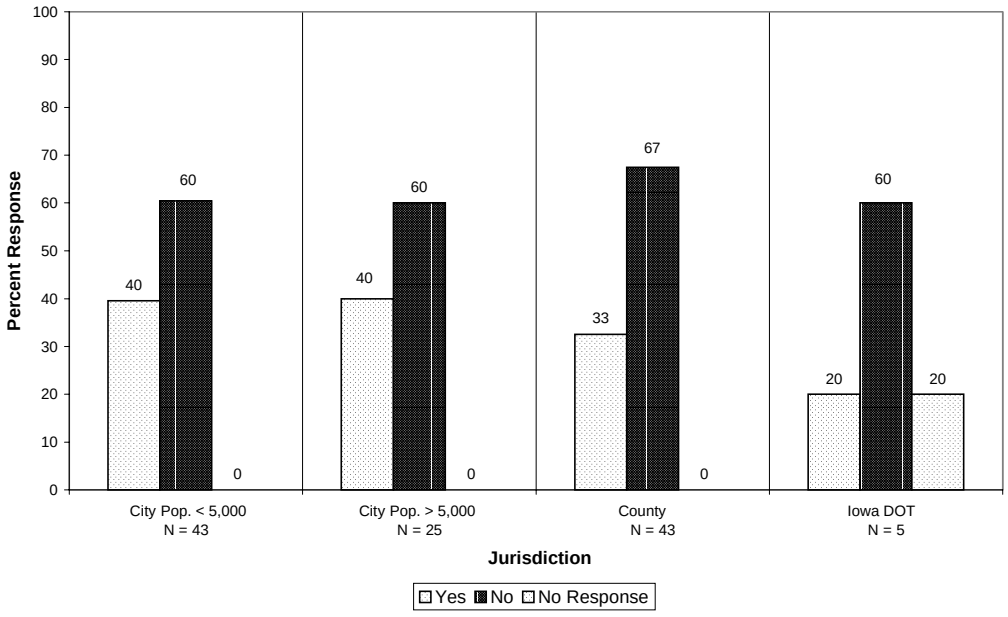


FIGURE B.37 Routine Consideration of Yield Signs for Traffic Control at Intersections (Survey Question 33)

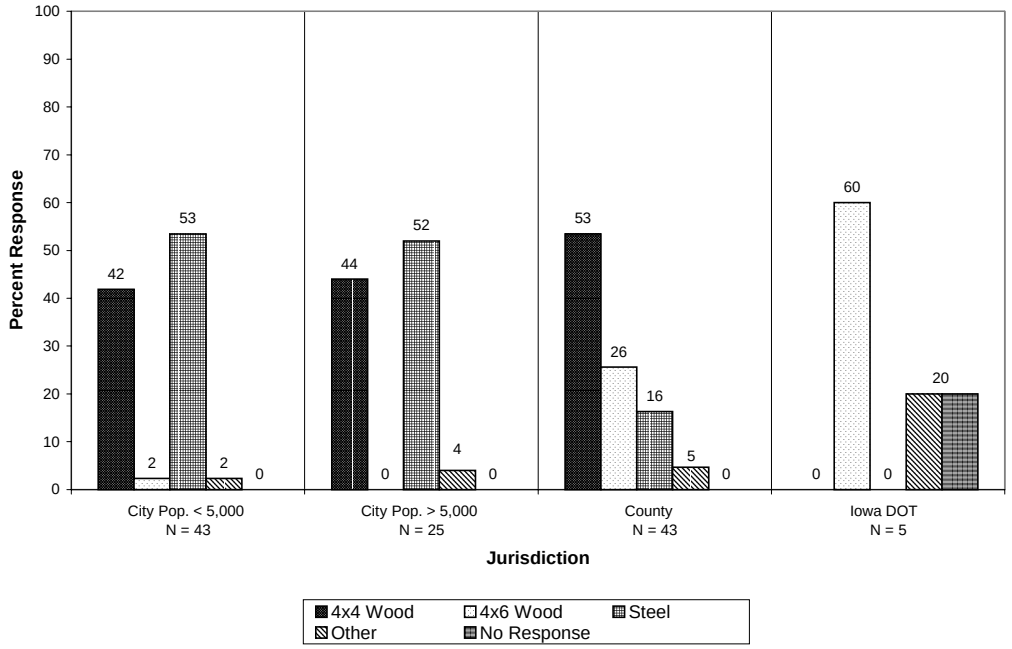


FIGURE B.38 Sign Supports Most Commonly Used (Survey Question 34)

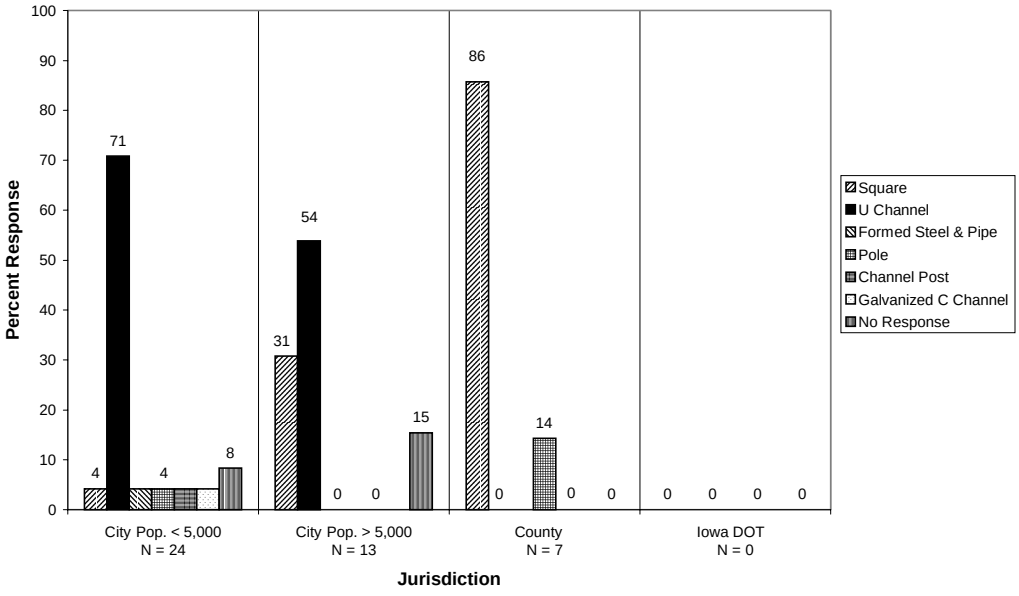


FIGURE B.39 Steel Support Shape Most Commonly Used (Survey Question 34)

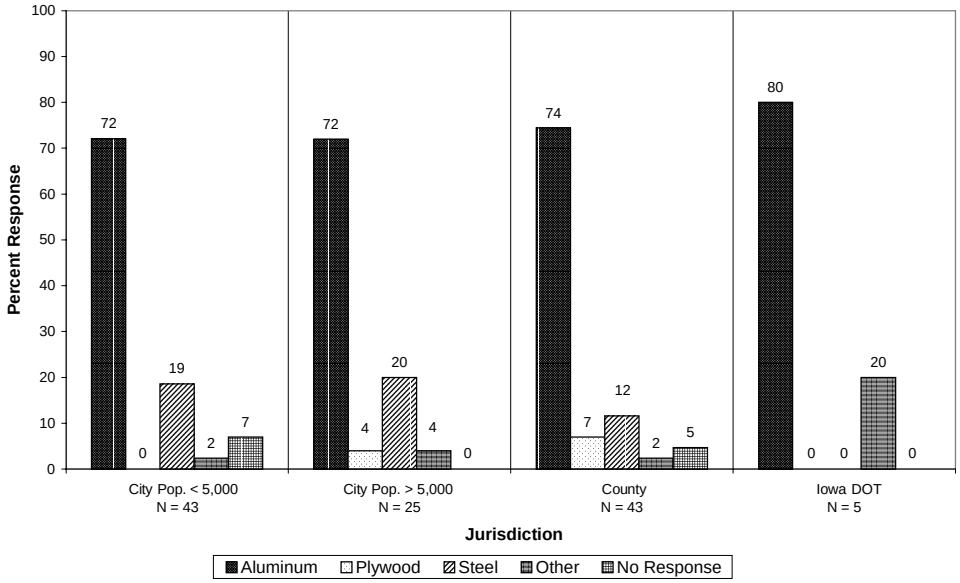


FIGURE B.40 Sign Backing Most Commonly Used (Survey Question 35)

TABLE B.2 Street-Name Sign Responsibilities and Most Common Practices (Survey Question 36)

Response	City Pop. < 5,000 N = 43	City Pop. > 5,000 N = 25	County N = 43	Iowa DOT N = 5
	(%)	(%)	(%)	(%)
Yes	98	100	70	0
No	2	0	30	100

Sign Height of those answering yes

	N = 42	N = 25	N = 29	N = 0
	(%)	(%)	(%)	(%)
6-Inch	55	36	17	0
8-Inch	7	16	33	0
9-Inch	0	16	23	0
Other	10	20	3	0
No Response	29	12	23	0

Letter Height of those answering yes

	N = 42	N = 25	N = 29	N = 0
	(%)	(%)	(%)	(%)
3-Inch	12	4	3	0
4-Inch	50	36	13	0
6-Inch	17	32	43	0
Other	2	20	17	0
No Response	19	8	23	0

Sign/Letter Color of those answering yes

	N = 42	N = 25	N = 29	N = 0
	(%)	(%)	(%)	(%)
Green/White Letters	50	88	83	0
Other	31	8	0	0
No Response	19	4	17	0

Reflectance of those answering yes

	N = 42	N = 25	N = 29	N = 0
	(%)	(%)	(%)	(%)
High-Intensity	19	16	57	0
Engineering Grade	62	68	10	0
Other	5	12	13	0
No Response	14	4	20	0

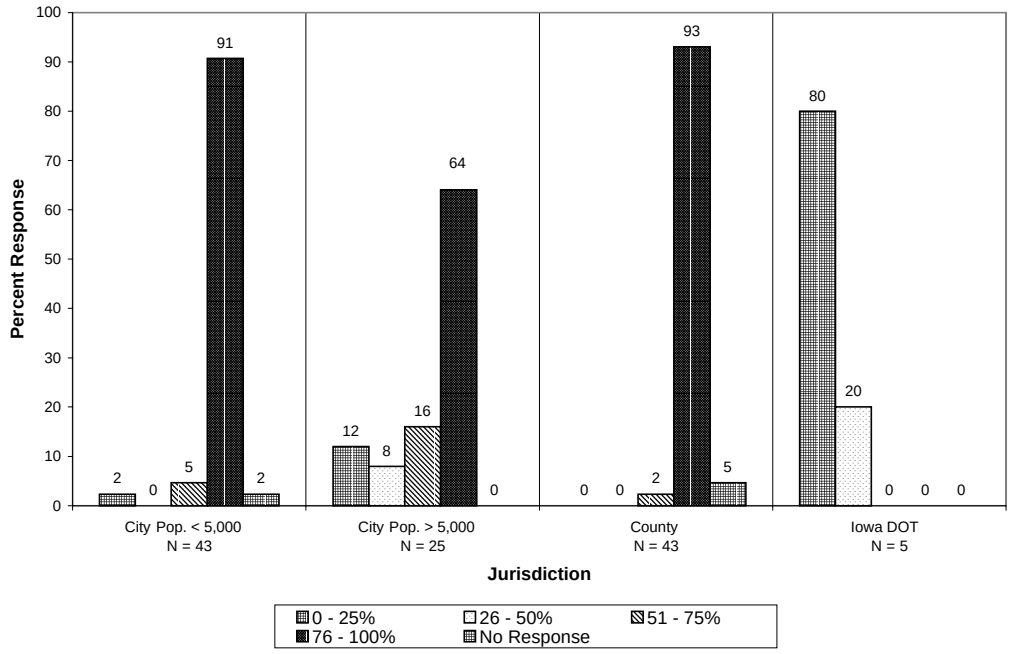


FIGURE B.41 Percent of Signs Acquired from Outside Vendors (Survey Question 37)

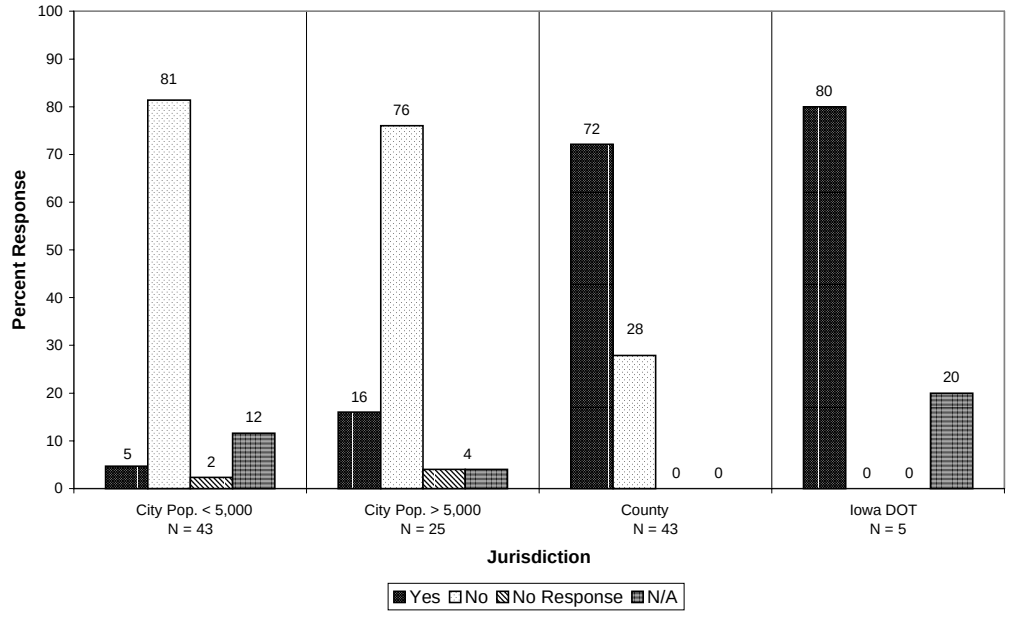


FIGURE B.42 Use of Ball-Bank Indicator or Similar Device to Determine Safe Operating Speeds for Curves (Survey Question 38)

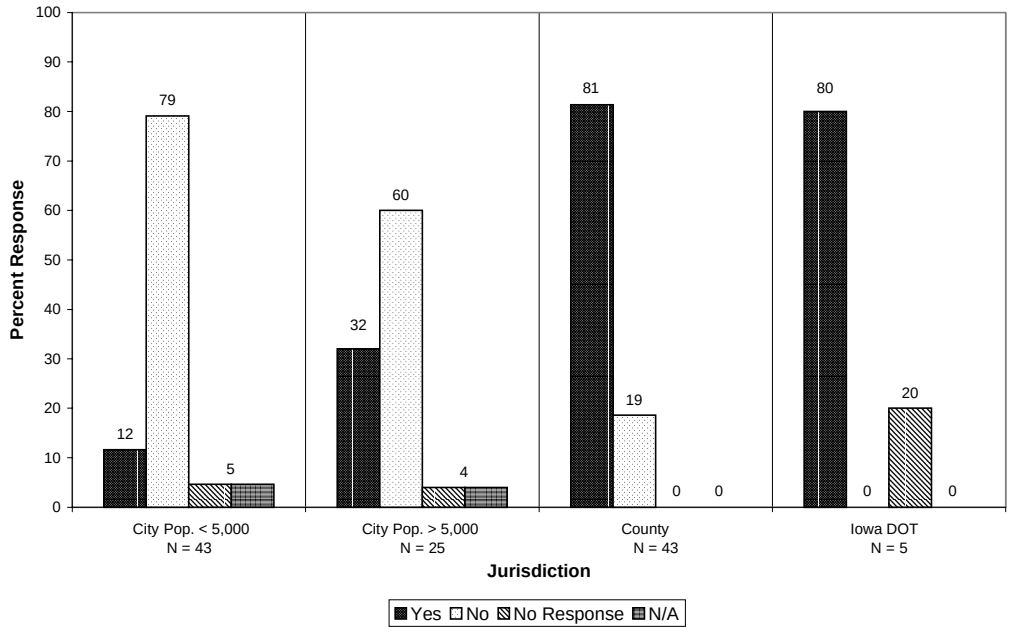


FIGURE B.43 Use of Advisory Speed Plaques with Curve Signs (Survey Question 39)

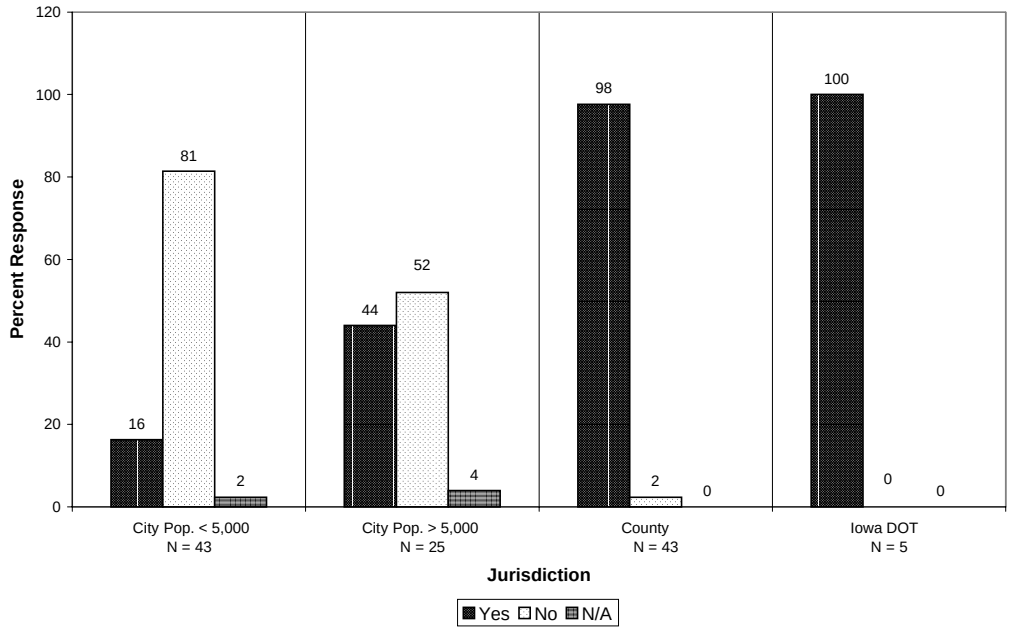


FIGURE B.44 Use of Double Arrow (W1-7) Signs at T-Intersections (Survey Question 40)

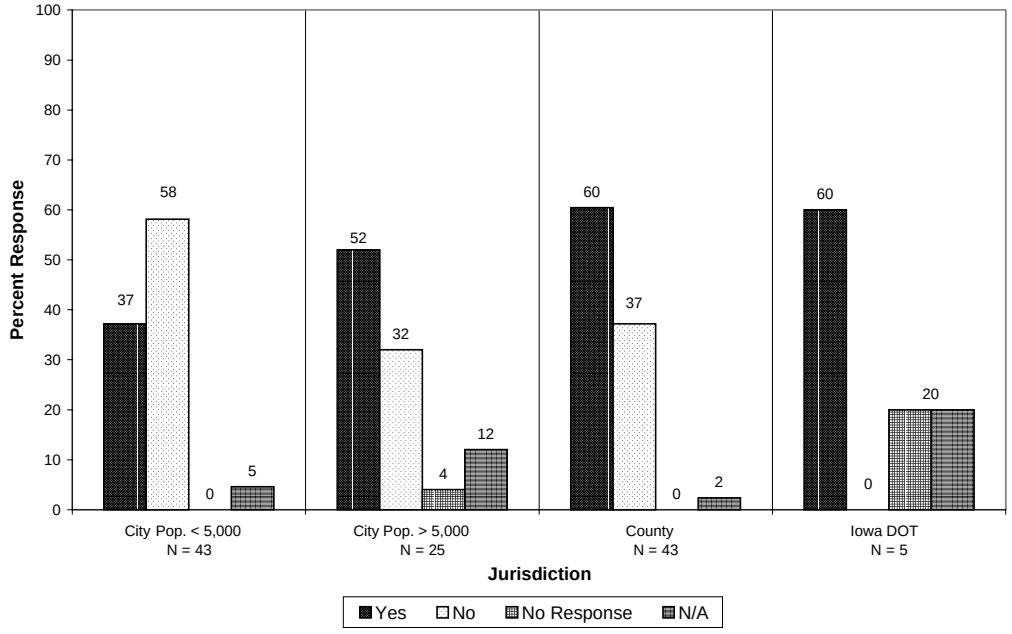


FIGURE B.45 Routine Use of Stop Signs at Intersections on Rural, Unpaved Roads (Survey Question 41)

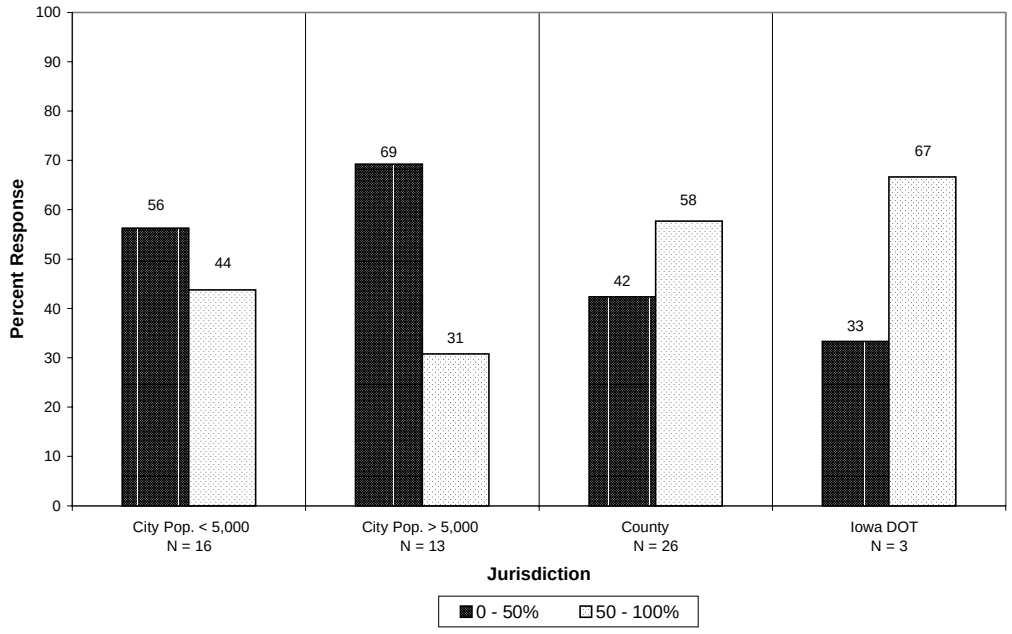


FIGURE B.46 Approximate Percentage of Stop Sign Use at Rural, Unpaved Road Intersections (Survey Question 41)

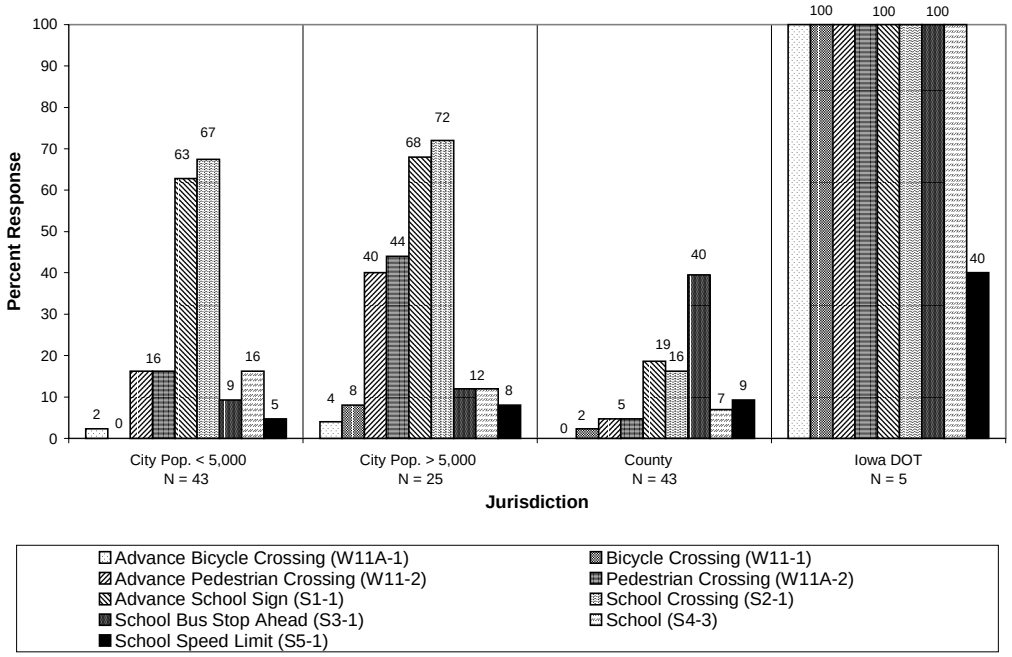


FIGURE B.47 Use of Fluorescent Yellow-Green Warning Signs (Survey Question 42)

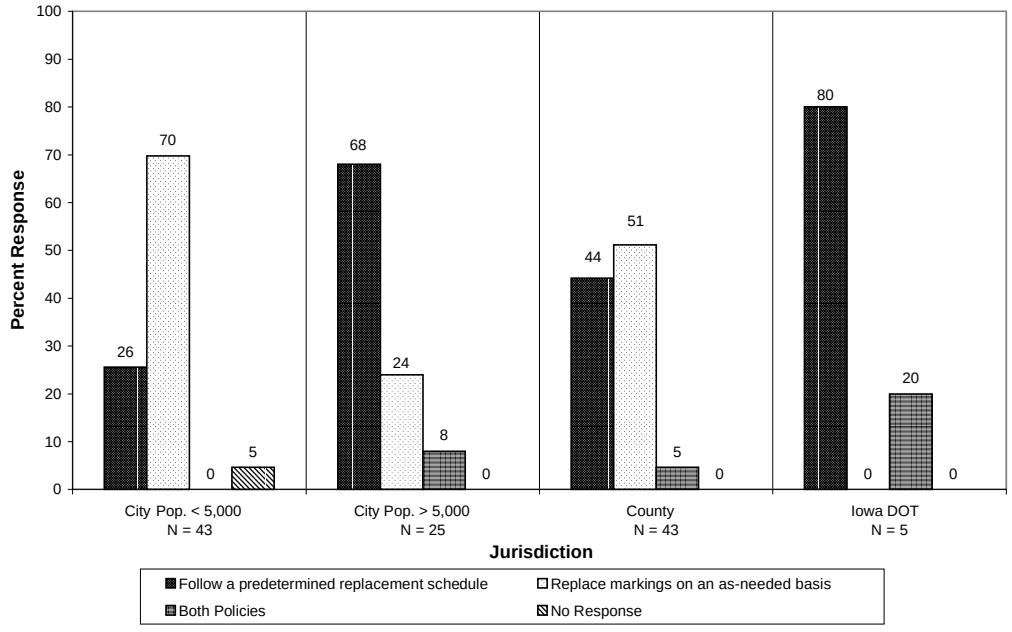


FIGURE B.48 Replacement Policies for Pavement Markings (Survey Question 43)

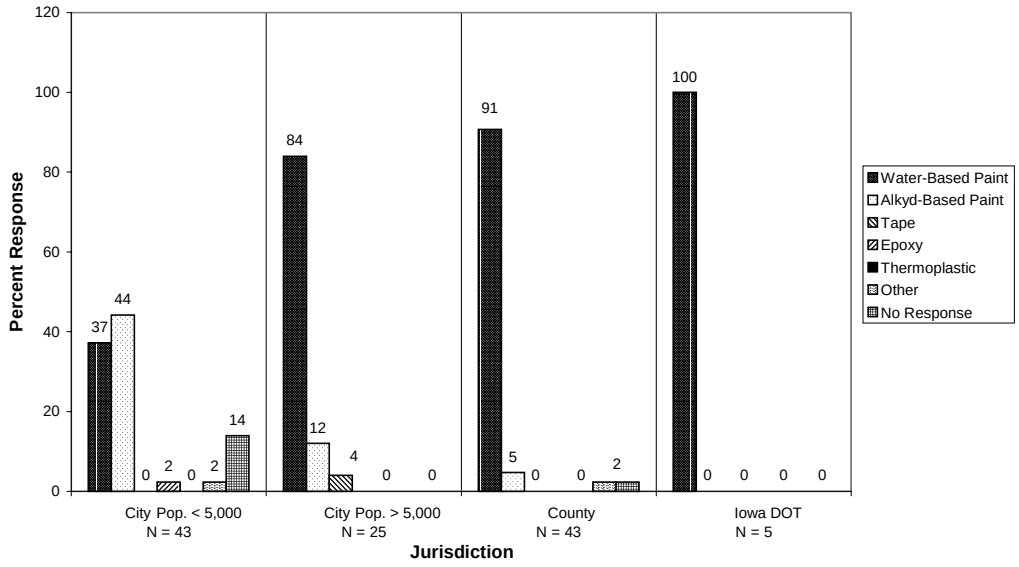


FIGURE B.49 Pavement Marking Materials Most Commonly Used (Survey Question 44)

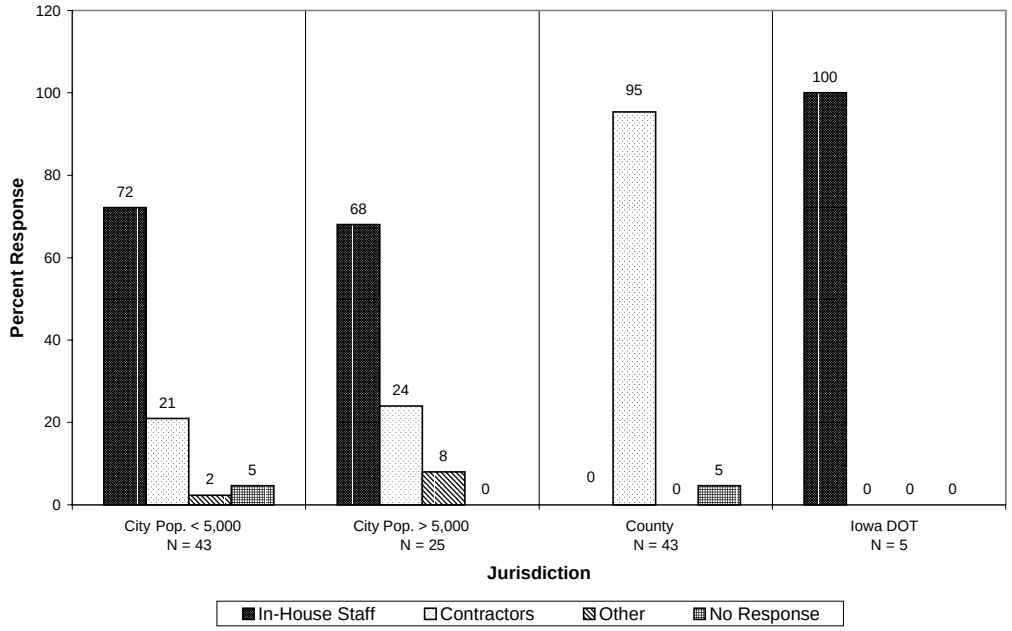


FIGURE B.50 Pavement Marking Applicators Most Commonly Used (Survey Question 45)