Current State Practices and Recommendations for Improving Rail-Highway Grade Crossing Program

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The rail-highway crossing safety program is one of the most successful traffic safety initiatives in the United States. Since passage of the Highway Safety Act of 1973 it is estimated that 7,200 fatalities and 31,000 injuries have been prevented. Managing and conducting the rail-highway safety program within each state are more complex than managing and conducting typical traffic safety initiatives. This is primarily because of the diversity of expertise and agencies involved in conducting a successful program including the state, local roadway agency, FHWA, FRA, railroad companies, equipment suppliers, and private contractors. The complexity of effecting grade crossing improvements often results in a large amount of time between the identification of deficient crossings and the actual installation of the physical improvements. As state agencies gained experience with their programs many developed enhancements to increase program efficiency. These enhancements included different methods of identifying deficient crossings, corridor improvement programs, funding initiatives for off-system crossings, administrative enhancements, and improved cooperation and coordination with railroad agencies. The results of an effort conducted for the Alabama Highway Department to determine the structure, practices, and successful components of the rail-highway program of other states are summarized. This was accomplished by forwarding a survey to the rail-highway program coordinator of each state with the exception of Hawaii. A total of 41 responses were received. The results of that survey are summarized.

The rail-highway grade crossing safety program is one of the most successful traffic safety initiatives in the United States. Categorical funding for rail-highway crossing safety projects, Section 130 funds, have been available since passage of the Highway Safety Act of 1973. Since passage of the act, through fiscal year 1991 $2.65 billion in federal funds has been available to carry out this program. The benefit-cost ratio of these improvements is just a fraction lower than that achieved for all other highway safety projects. Evaluation of the rail-highway improvement program estimates that it has resulted in an 88 percent reduction in fatalities and a 62 percent reduction in injuries. These percentages indicate that 7,200 fatalities and 31,000 injuries were prevented by rail-highway grade crossing improvements (*1*). The 1973 act made the funds available, but it was the combined efforts of federal, state, local government, and railroad agencies that made it successful.

The primary responsibility for implementing the program was placed on the states. Each state was required to develop methods of identifying, prioritizing, inspecting, and developing countermeasures to correct deficient rail-highway grade crossings. To help ensure that program objectives were achieved FHWA, with FRA, established guidelines and specific program requirements. Each state was permitted to develop within the guidelines its own program to be compatible with the state's method of operation, record system, organizational structure, and anticipated program needs. The result is a wide variation among the states in the structure and procedures of the rail-highway grade crossing safety programs.

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Managing and conducting the rail-highway safety program within each state are more complex than managing and conducting typical traffic safety initiatives. This is primarily because of the diversity of expertise and agencies involved in conducting a successful program. The inventory is maintained by FRA and requires input from roadway agencies and operating railroads. Identifying deficient crossings requires information on train volumes and operating characteristics, traffic volume, type of roadway user, geometric crossing and approach characteristics, and quadrant sight availability. Conducting the site inspection requires input from the state and local governments, traffic safety, enforcement, and railroad signal engineering. Obtaining improvements in installation requires the development of plans, FHWA funding approval, roadway agency approval, railroad agreements, and for off-system crossings municipal cost sharing agreements.

The complexity of effecting grade crossing improvements often results in a large amount of time between the identification of deficient crossings and the actual installation of the physical improvements. As state agencies gained experience with their programs many developed enhancements to increase program efficiency and reduce implementation time. These enhancements included different methods of identifying deficient crossings, corridor improvement programs, funding initiatives for off-system crossings, administrative enhancements, and improved cooperation and coordination with railroad agencies.

This paper summarizes the results of an effort conducted for the Alabama Highway Department to determine the structure, practices, and successful components of the rail-highway programs of other states. This was accomplished by forwarding a survey to the rail-highway program coordinator of each state with the exception of Hawaii. A total of 41 responses were received. The survey consisted of 35 questions related to program administration, current practices, state policy, and planned enhancements. The remainder of this paper summarizes the survey results and concludes with a discussion of the survey findings.

SUMMARY OF SURVEY RESULTS

Crossing Responsibility

The organizational structure involved in the rail-highway crossing safety program is diverse among states. Although the department of

transportation (DOT) or highway department (HD) of each state deals with the broad topic of transportation safety, the grade crossing responsibilities are not the sole responsibility of DOT or HD. Sixteen states indicated that the public utility commission, department of rail and public transportation, commerce commission, safety commission, or other public agency has a rail office. The public utility commission of two states and DOT or HD of six states administer the program jointly with another state agency. The rail-highway program is administered solely by DOT or HD of 29 of the responding states.

Priority Ranking

A requirement of the *Federal-Aid Policy Guide* (2) is that each state maintain a priority schedule of crossing improvements. The priority schedule can be based on potential accident reduction, project cost, relative hazard, or other criteria appropriate for each state. There are several advantages to using hazard indexes and accident prediction formulae to rank crossings. These ranking methods remove subjectivity and are capable of being developed by computer, thereby facilitating the process. A previous report stated that the most commonly used formulae include the Peabody Dimmick Formula, the New Hampshire Index, the NCHRP Report 50 Formula (NCHRP 50), and the U.S. DOT Accident Prediction Formula, in addition to several methods developed by individual states (3). The survey results indicate that the ranking methods preferred by the states have changed. Of the states responding to the survey 13 indicated that they have developed their own formulas, 11 use the U.S. DOT Accident Prediction Formula, six use the New Hampshire Index, two use the Peabody Dimmick Formula, and one uses the NCHRP 50 Formula. Four states do not use a priority ranking method and rely on accident occurrence, public complaints, input from railroads, and field inspections to identify deficient crossings. The state that uses the NCHRP 50 Formula is planning to change to the U.S. DOT prediction method, and five states that use the New Hampshire Formula either have modified the method or are planning to change to the U.S. DOT prediction method. Some of the states, Oregon, for example, include a large number of variables in their prioritization methods.

Eighty-three percent of the states that use the U.S. DOT formula, 38 percent that use the New Hampshire Index, and 50 percent that use their own methods are satisfied with the procedures. The predominant comment regarding the U.S. DOT formula is that it does not consider quadrant sight distance or roadway approach characteristics and that it places too much weight on accident occurrence. A predominant complaint on each nonsubjective method was the accuracy of the FRA inventory.

Five states indicated that the available quadrant sight distance was included in the initial priority ranking step. Quadrant sight distance has not been a part of the FRA inventory, and these states did not indicate if sight distance information has been added to their state-maintained inventories. The numbers of buses, passenger trains, school buses, hazardous material transporters, and available sight distance are considered, often subjectively, after the initial prioritization and during the field inspection.

Implementation Time

The average time from identification to installation of appropriate countermeasures was indicated as 1 to 2 years by 19 states, 2 to 3 years by 17 states, and more than 4 years by four states. Twenty-four percent of the responses indicated that the primary cause of the delay was the amount of time that railroads take to return the plans, cost estimates, and agreements. Sixteen percent indicated that obtaining funding obligations from FHWA or a state or local agency was the primary cause of delay. Some indicated that the quarterly approval of projects by the FHWA because of the Intermodal Surface Transportation Efficiency Act (ISTEA) will result in additional delays.

Most states have initiated or are considering changes to their procedures to reduce the time to installation. These steps include developing master agreements with the railroads, using electronic billing, permitting advance material acquisition, and conducting meetings with the railroads to discuss the planned annual improvements. Ten states have established lump sum agreements, and at least one railroad and eight other states are considering lump sum agreements. Some states will not consider lump sum agreements, and one state tried it but found too many inconsistencies to continue its use.

Two states indicated that they had established a time frame with the railroads to expedite installation. In one state this is in the form of legislative action that has established 1 year after project authorization as the maximum time for installation or the railroad is required to perform the improvement without federal funds. The other state has a widely publicized verbal agreement that installation will take place within 1 year from the time that the initial plans are forwarded to the railroad.

Status Tracking

Eighty percent of the responding states have an established procedure for tracking the status of their rail-highway projects. Four states have used available software, such as Lotus, Paradox, D Base and SAS, whereas 15 agencies have developed their own programs. Manual systems, log books, and status boards are used by 12 agencies, whereas 7 agencies do not have a tracking system. Three of the agencies that do not have a system are in the process of developing a computerized system.

Municipal Agreements

An identified impediment to project installation is obtaining the municipal agreement. This agreement is used for crossings that are off the state system roadways and obligate local agencies to pay 10 percent of the improvement costs. The purpose of the municipal agreement is to commit the municipality to permit the installation of the traffic control devices on its street and to ensure enforcement as well as to commit funds. Ten states stated that it is desirable to have the local agencies sufficiently committed and supportive of the improvement that they are willing to contribute their 10 percent cost share. If the local agency was not able or willing to provide the cost share then they would attempt to have the railroad provide the share. If neither the railroad nor the local agency was willing to provide the 10 percent then the project was dropped. Two states that currently follow this practice are considering changing their policies to reduce the burden on the local agencies. Four states either make a special determination on a case-by-case basis or provide alternative local agency cost shares of 3 or 5 percent, with the state providing the matching funds because of the reduced percentage. Twenty-one states indicated that they require no cost share from the local agency. Four of these states indicate that special funds have been

appropriated by legislative action to provide the matching funds. Most respondents indicated that the 23 U.S.C. 120 (c) provision that permits 100 percent federal funding for certain types of safety projects is the primary reason for reducing the financial burden on the local agencies.

State Improvement Plans

The complexity of the crossing improvement plans forwarded to the railroads varies greatly. Seven states forward six or more sheets as part of their plans including a vicinity map (six of seven), legend sheet (five of seven), project notes (six of seven), project cross section (four of seven), summary of quantities (three of seven), railroad agreement (seven of seven), utility location layout (five of seven), installation plan (five of seven), traffic control plan (five of seven), paving layout (four of seven), and other sheets such as signal and sign standards. The plans of 11 states consist of three pages including a vicinity map (10 of 11), project notes (3 of 11), project cross section (2 of 11), summary of quantities (2 of 11), railroad agreement (8 of 11), utility location layout (1 of 11), installation plan (4 of 11), traffic control plan (1 of 11), and paving layout (2 of 11). Six states forward two sheets consisting of a location sheet (five of six), railroad agreement (five of six), installation plan (one of six), and diagnostic field report (one of six). Three states forward only the agreement. Twenty-three of the responding states develop to-scale engineering-quality drawings, 14 develop not-to-scale sketches, and 1 state provides no schematic of the planned improvements. Another state marks the planned improvements on an aerial photograph of the location.

Traffic Control

For on-state system improvements the responsibility for work zone traffic control is assumed by the state in most cases. Fourteen states vest the traffic control responsibility with the railroad, and six states work jointly with the railroad to ensure proper traffic control. Four states assume the traffic control responsibility for off-system crossings, but most off-system crossings are the responsibility of the railroad or local roadway agency. Only 13 of the states indicated that a traffic control plan was included in the plan packet forwarded to the railroads.

Diagnostic Reviews

Diagnostic reviews are conducted by all of the states, but the team members vary. Nine states do not have a representative from the office with railroad responsibility but have the state represented by district personnel. All but two states have or attempt to have a railroad representative present during the diagnostic inspection. These two states and eight others indicated that a railroad representative was not required during the diagnostic inspection. If problems were encountered or unusual conditions were present then railroad personnel would be requested for a follow-up inspection.

Gate Installation

The majority of respondents indicated that they used the guidelines of the *Railroad Highway Grade Crossing Handbook* (*3*) and *Traffic Control Devices Handbook* (*4*) for determining when to install automatic gates. The guidelines include the presence of multiple tracks, high train speed, high roadway speed and volumes, sight restrictions, special roadway users (such as school buses and hazardous material haulers), and the continuance of accidents after flashing light installation. States that have quantified some of these guidelines consider train speeds of 105 km/hr (72 km/hr for commuter trains) (65 and 45 mph, respectively) to be high, greater than 30 trains and 4,000 to 5,000 vehicles per day to be high train and roadway volumes, respectively, and greater than nine special roadway users per day to be high. Additional criteria considered to require gate installation are signalized intersections or intersections with large turning movements within 61 m (200 ft) of the crossing and accident prediction within the top 30 on the priority list. This last criterion, within the top 30 accident ranking, almost guarantees that most projects within the annual program will be recommended for gate installation. Five states indicated that they consider gates to be so much more effective than flashing lights that gates are always recommended. A number of states conducted corridor improvement initiatives that installed gates at all public crossings on passenger and high-volume rail lines. No states that installed traffic signals as the primary control device at grade crossings were identified. Any traffic signal installations that were identified at grade crossings were related to preemption strategies because of signalized intersections within 61 m (200 ft) of the crossing.

Four Quadrant Gates and Medians

Five states indicated that they installed four quadrant gates and 11 states have used medians to reduce gate violations. Only one state that has tried four quadrant gates in combination with medians for a wide roadway installation was identified. One state claimed to have a large number of quadrant gate locations, whereas the other users indicated only one such installation. Four states indicated that they were considering the use of four quadrant gates, and three were considering the use of medians to reduce violations.

The state that claimed a large number of four quadrant gate installations considered the installation of gates at existing median locations as a four quadrant gate installation. Although installations on the median, in addition to the roadside, result in four gates, this is not considered a four quadrant gate installation.

No state on the planned high-speed rail corridors (Section 1010) has definitely determined the type of warning device and traffic control that it will install. Some of the planning on four quadrant gates and medians was mentioned with reference to the Section 1010 corridors. The majority of responses for high-speed rail crossings identified flashing lights and gates with vague references to security barrier systems as possible high-speed rail warning devices.

Crossing Surfaces

Fifteen states indicated that they had guidelines for determining the type of crossing surface to be used. In most cases these guidelines were not quantitative but were based on a decision of the investigative team. When quantitative criteria were provided the high-type crossing surfaces were recommended on the basis of average daily traffic (ADT) and truck volume. Volumes greater than 1,000, 2,000, 3,000, and 5,000 vehicles per day were identified as requiring full-depth rubber or concrete crossing surfaces. Since maintaining the

crossing surface is usually the responsibility of the railroad many states allow the railroad to specify the type of crossing surface.

Crossing Closure and New Crossings

Fourteen states have adopted a formal policy, four states have an informal policy, and 18 states have no policy for effecting crossing closure. Three states are in the process of developing a closure policy, some of these with the assistance of a consultant. Nine of the states that have a formal closure policy also have the legislative authority to close crossings. Five additional states are planning to enact legislative authority for closure, and two have tried to pass closure legislation but the bill failed. A number of states indicated that their closure procedures provide the opportunity for public hearings.

A wide number of incentives have been used to help effect crossing closure for off-system crossings. These incentives include direct cash payments or payment in kind to the local agency by both the railroads and the state. For example, one state provides $5,000 and the railroad provides another $5,000 to the local agency, with the railroad paying the actual cost of each closure. Some railroads object in principle to direct payments to local agencies but will purchase $10,000 worth of computer hardware for the school system with each closure. Other incentives used by the railroads include paying the local government share for upgrading adjacent crossings for each closure, providing parallel roadways, landscaping, and roadway turnaround costs. One state will pay for safety improvements not related to grade crossings, such as off-system traffic signal installation, in exchange for crossing closure.

Inspecting only the average number of closures per year yields encouraging results. Twenty-three states claimed an active closure initiative that results in a weighted average of 4.6 crossing closures per year. When the closures of each state are considered with the number of new openings there is a net increase of 2.2 crossings per year. Thirty-one states indicated that they do not have formal thresholds or guidelines for determining when a new crossing is required. Those states that indicated that guidelines did exist did not provide any quantitative criteria. Decisions on new crossing needs are based on new roadway construction and subjective judgments of projected ADT and benefit to the public. Two states establish the need for a new crossing through a public hearing process.

The claims on the number of closures per year may be higher than what is actually occurring owing to any closure efforts. Some states include crossings that are closed because of rail abandonment in their closure estimates. Although these crossings are closed they are not the result of a closure initiative.

Private Crossings

In most cases a public agency has no authority over private crossings. Seven states have regulatory control vested in a public agency for opening, closure, and type of warning device present at private crossings. Three other states have the authority to stipulate what type of warning device should be displayed at private crossings. One state has a bill before the state legislature to give the public utility commission authority over private crossings on high-speed rail corridors. States that have jurisdiction over private crossings impose the same standards on the private crossings that are placed on the public crossings.

Metropolitan Planning Organization Requirements

Section 135 of ISTEA requires a state to develop and submit a statewide transportation improvement program before FHWA can authorize federal funds for rail-highway projects. In most cases this requires coordination with metropolitan planning organizations. Sixteen of the responding states stated that this requirement will result in additional delays in the installation of crossing improvements. Most respondents believed that this delay would be an additional 1 month to 1 year. A number of respondents commented that the new requirement creates extra work and red tape.

Stop and Yield Signs

Section 1077 of ISTEA permits the installation of stop or yield signs, without an engineering study, at crossings that do not have automatic warning devices and two or more trains per day. Thirty-three responding states indicated that they plan to continue installing stop signs by the same policy used before ISTEA. A number of responses indicated that they do not plan on interfering with local agencies that decide to install stop signs without an engineering study. The survey identified no state agencies that plan to install stop signs at all crossings that met the ISTEA criteria. No respondents plan to install yield signs or stated that yield signs were a viable option at grade crossings.

Funding Options

The use of 100 percent federal funding for certain types of safety projects, including active and passive devices at rail-highway crossings, is permitted by 23 U.S.C. 120 (c). Twenty-four states indicated that they do not plan on changing their 90/10 percent funding procedure for crossings located off-system. Before ISTEA some states had already established 100 percent or 95 percent funding strategies by using state funds. Only four states have plans for using FTA funds for crossing improvements.

CONCLUSIONS AND RECOMMENDATIONS

Crossing Priority Ranking

Rail-highway grade crossing accidents are relatively rare. The infrequent train movements, even on lines with high train volumes result in difficulty in obtaining accurate and reliable accident predictions. Because accidents are random, the use of accident history alone for prioritization is not good practice. A crossing can exist for years with no accident and one accident involving a van with a large number of fatalities can result in a public outcry for improvement. Without consideration of other factors, however, this crossing could go forever without another accident. To accurately priority rank crossings for improvement it is necessary to have accurate accident, inventory, and roadway approach data.

Inventory Maintenance

The U.S. DOT/Association of American Railroads Crossing Inventory was developed in the early 1970s. It is maintained by FRA by

means of states and railroads voluntarily submitting update material. The inventory contains information on the crossing location, amount and type of highway and train traffic, traffic control devices, and other physical characteristics at the crossing. A frequent complaint received on the survey was the poor accuracy of data items in the inventory. This complaint is self-incriminating because it is the responsibility of the states and railroads to provide inventory updates. The initial update procedure recommended that the initiating agency (i.e., either state or railroad) complete an update form and forward it to the other party (i.e., either railroad or state). After notification and agreement of the changes by both agencies the state forwards the original copy of FRA for processing. This recommended procedure has the advantage of keeping all parties informed of changes. FRA procedures also allow for state or railroad submission of inventory data without those data first being confirmed by the other party. Although update procedures exist many data elements, such as ADT and train volume, are often so inaccurate that their use in quantitative formulas are guaranteed to give inaccurate results.

Updating the crossing inventory should become a prime concern of each program coordinator. The use of complicated and involved formulae to determine a hazard index or to predict accidents will yield unreliable results if the input data are inaccurate. Procedures need to be established within the state agency to update the ADT and to post items identified during the field investigations to the inventories. The FRA can provide the inventory to each state for updating on IBM compatible personal computers. The inventory can be forwarded on floppy disks and the disks include an update program to facilitate use and reduce errors. Further information on this update method, termed GX, can be obtained from FRA.

Sight distance along the roadway approach and within the quadrants is not part of the current inventory. The sight distance for the majority of crossings and safe approach speeds should be obtained during the field reviews and posted to at least the state-maintained inventory.

Accident Data

FRA requires the railroads to report any accident that involves the impact of a train with a roadway user, including pedestrians. These data, in conjunction with the inventory data, are used by FRA to develop annual accident summaries by state and crossing characteristics. The accident data are sufficient for determining statewide totals and national trends but should be closely inspected and augmented with other accident data before selecting countermeasures for individual sites. Many states do not inspect the accident descriptions, available from FRA, to determine the accident characteristics. This type of analysis considers all accidents as having the same cause, with no consideration to such factors as time of day, driver action, whether the vehicle was struck by or struck the train. Failure to consider these factors results in the potential failure to identify less expensive or additional countermeasures, such as crossing illumination, or to possibly realize that no physical countermeasure would be effective because of driver action. Similarly, data on accidents at or near a crossing but not involving a train can provide useful information on available sight distance and potential timing problems at adjacent signalized intersections. These accident data are not maintained by FRA and unfortunately are also not readily available to many states. Some states do not maintain a computerized data base for off-system accidents, and still more states cannot readily identify the mile points of crossings on their roadway systems.

The analysis procedure for each crossing should include an inspection of the characteristics of each accident. As a minimum the individual accident summary, available through FRA, should be used. Ideally, this inspection should include all accidents at and in the vicinity of the crossing. In many states the ideal analysis would require changes in the state's accident data base or the establishment of the locational reference point of the crossing on the roadway system.

Program Scheduling

The survey indicates that the cause of delays from project identification to installation of the countermeasure is due to the FHWA, states, local agencies, railroads, and equipment suppliers. Because everyone is at fault each must realize the requirements and limitations that the other participants must operate under and review operations to determine how to increase efficiency. For example, railroads are reluctant to purchase equipment until the authorization to proceed is received from the state. States, in many cases by law, cannot commit funds for the purchase of equipment until an executed municipal agreement for off-system crossings is in hand and FHWA approval is obtained. Equipment suppliers require knowledge of the anticipated volume of hardware to enable purchases in quantities to maintain cost. Local governments, especially in rural counties and small cities, often do not have sufficient resources to pay their share of improvements. In those states that have elected to do so, FHWA will be approving projects on a quarterly basis instead of an individual project-by-project basis (i.e., for projects costing less than $1 million).

The states should meet with the railroads at least once a year to present the anticipated improvement program. This will enable the railroads to plan their workforces and notify suppliers of equipment needs. It will also enable distribution of the program into quarterly segments for FHWA approval.

Develop Status Tracking System

A status tracking system has the advantage of enabling the identification of impediments to program efficiency. A computerized system has the advantage of being able to determine the average turnaround time by division, local agency, and railroad. Such determinations can help identify what future actions can be taken, with individual railroads, for example, to prevent future delays. Computerizing the tracking system provides the ability to enhance the program, such as automatic highlighting of projects, delayed over a certain period of time in accord with the anticipated needs of each state.

Lump Sum Payments

Lump sum payments for typical installations have been met with mixed reaction by states and railroads. The advantages to lump sum payments are that they simplify the preparation of the improvement plans by the railroad and facilitate determining the 10 percent cost share required for off-system municipal agreements. There are a number of disadvantages to lump sum agreements. Because of the

different labor agreements and pay scales the cost of typical improvements will differ between railroads, and often between different parts of the state for the same railroad. Establishing the initial lump sum agreements requires careful review to ensure that the interests of the state and railroad are addressed. The lump sum agreements then need to be reviewed and updated on an annual basis.

Some states, instead of a lump sum and wishing to expedite the municipal agreements, have opted for a 10 percent over-under understanding. If the initial estimate provided by the railroad for an individual project is within 10 percent of the final cost then the initial estimate stands. This method necessitates monitoring to ensure that the initial estimate is not consistently higher or lower than actual cost.

State Force Work

Whenever a grade crossing is improved the pavement markings and advance warning signs, no-passing treatments, traffic signal preempt, and other roadway approach work should be performed. For on-system improvements this work is either performed or contracted for performance by state forces. For off-system crossings the approach work is often the responsibility of the local agency. In many instances the failure of the local agency to perform the roadway approach work in an expeditions and correct manner results in final approval delay. One remedy is to have the state forces perform the roadway approach work for both on- and off-system crossings. The cost of this work is a reimbursable project cost, and the use of state forces permits direct control on timely and correct application. One disadvantage to having the state forces perform work on the off-system approaches is increased potential liability.

Simplification of Plans

Developing comprehensive, to-scale plans for forwarding to the railroads can add a large amount of time to project implementation. This is especially true if the plans are prepared by division offices, which are frequently understaffed and where grade crossing improvements often are not high priority. Most railroads do not require an engineering-grade, to-scale diagram of the crossing or placement of the improvements. The necessary preliminary engineering work by the railroad to design the track circuitry and warning device upgrade will generate the drawings necessary for their force or contractor work. For the railroads to develop their detailed plans, a location sheet, description of the work to be performed, a not-to-scale sketch of the crossing, notes of special conditions, physical and operational conditions, and a supplemental agreement are all that should be required. The railroads can be directed in the master agreement to perform all work in accord with the standards of the Manual on Uniform Traffic Control Devices (MUTCD). This removes the necessity for placing the improvements on the sketch.

Utilities and Traffic Control

The location of underground and overhead utilities should be the responsibility of the railroad. The railroads' work will be performed on their rights-of-way (ROW), and locating hidden utilities should be the sole responsibility of the railroad. The railroads should be treated the same as a utility company with regard to traffic control responsibility. Because most of their work will be performed within their ROW, they can provide or contract for any required short-term traffic control. The state should provide assistance in establishing detours when necessary, such as for surface improvement work, but the prime responsibility for arranging traffic control should still be with the railroad. This responsibility, with reference to the MUTCD, should be made a part of the master agreement.

Local Cost Share

Beliefs among the states and railroads differ with regard to local participation in grade crossing improvements. Some states have reduced the percentage of local participation, established special fund pools, and allow 100 percent federal financing through the provisions of 23 U.S.C. 130. Other states try to get the railroad to contribute the local share. Still others believe that it should be a partnership, and if the local agency refuses to pay then the project is deleted from the safety program. One state forwards a letter explaining that the project will be deleted and warning of the potential liability for failure to participate if the local agency will not contribute.

Some small cities and rural agencies have such small operating budgets that contributing the 10 percent share can pose difficulties. If the crossing was identified from the statewide priority process as deficient, then the inability of the local agency to provide the 10 percent does not make the crossing any less deficient. To reduce grade crossing accidents emphasis must be placed on off-system crossings, which in 1991 accounted for over 84 percent of all at-grade crossings (*5*). States should consider strategies, such as 100 percent funding or closure of one crossing for upgrade of others, instead of dropping projects because of a lack of local participation. The feeling of partnership can be obtained by an agreement before upgrading that the local agency will maintain the pavement markings and traffic signing on the approaches.

Crossing Surface Work

Some states expend as much as 50 percent of their Section 130 funds on crossing surface improvements (*6*). Maintaining the crossing surface is the responsibility of the railroad, and the expenditure of Section 130 funds for crossing surfaces reduces the number of crossings that can receive upgraded warning devices. Surface improvements with Section 130 funds should be minimized as much as possible.

Diagnostic Team

Most survey responses indicate that the presence of railroad personnel on the diagnostic team is important. Some states and railroads do not think railroad personnel are necessary except in unusual circumstances. Some railroads state that, because their personnel will need to visit the site to develop the detailed plans, a visit with the diagnostic team is unnecessary. The presence of railroad personnel can, however, help identify unusual circumstances, provide updates or planned changes in train operations, and provide expertise generally not available at the state level. It is recommended that railroad personnel always be present at the diagnostic reviews and that the reviews be scheduled to cover as many daily inspections with each railroad representative as possible.

Stop and Yield Signs

None of the survey responses indicated plans to install stop or yield signs at crossings with two or more trains per day without an engineering study. Installing stop signs after a diagnostic review, as an interim measure until upgrade, and as a continuation of prior practice were the predominant responses. A number of railroads have stated that stop sign installation is a desirable and good countermeasure. This may, however, be prompted more by the relative low cost and reduction in possible liability resulting from stop sign installation than by actual effectiveness. The concerns of traffic engineers with stop sign installations at crossing locations stem from the probable loss of device viability at all placement locations. No respondents said that yield signs were a viable countermeasure.

Closure

The recent initiative of crossing closure has generated enthusiasm for the idea from state and railroad personnel. Although some states are experiencing success in closing crossings, the number of new crossings per year exceeds the number being closed. It can be expected that as more crossings are closed the candidates for closure will diminish. Simultaneously, as development continues the number of new crossings will continue to rise. Because railroads are required to maintain crossings they are presented with a scenario of ever-increasing operating costs. It is not known how many of the reported closures were because of closure efforts or abandonment of rail lines.

Private Crossings

Private crossings vary from crossings on driveways to industrial plants to crossings on farm field access roads. Some crossings, such as those to industrial plants, can carry roadway volumes that exceed the volume of public crossings. The terms of the agreements for these crossings often date from the establishment of the rail line and usually include a maintenance agreement. There are 115,425 private crossings in the United States, which experienced 495 accidents in 1991 (*5*). The survey identified only seven states that had guidelines or standards for private crossings. The high-speed rail initiative has resulted in increased concern for private crossings by FRA.

Safety Management

One requirement of ISTEA is that each state must develop and implement six management systems, one of which is highway safety. The purpose of the safety management concept is to increase traffic safety by establishing a multidisciplinary approach to the planning, design, and use of safety principles. FRA and state rail program coordinators should establish an active role in developing the safety management system to ensure that rail-highway crossing needs are properly addressed.

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