

# New Perspectives on Closure of Railroad-Highway Grade Crossings as a System Improvement

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There are approximately 400 000 at-grade railroad-highway crossings in the United States; 219 000 are public at-grade crossings and roughly 166 440 of these have only crossbucks as warning devices. A conservative estimate is that it would cost more than \$6 billion to install automatic warning devices at all these crossings, and the money is not available. Low-cost alternative solutions must be found to reduce the potential for death and destruction at these sites. A study now in progress is described that includes library and field research to determine and document the pros and cons of considering the closing of a railroad-highway grade crossing as a viable alternative when crossings and community needs are assessed. The main objective is a set of guidelines so that community impacts (benefits and disbenefits) can be assessed and form the basis on which community leaders, local highway authorities, and railroad personnel can negotiate. The benefits of closure are not one-sided; i.e., they are not all railroad-related. There can be many community benefits, which are enumerated and fully discussed.

This paper is directed to highway and railroad safety professionals at all levels of government--state, city, or county--or to anyone else who has responsibility for improved safety on our railroad, road, and street systems. An often-controversial topic, the closure of unnecessary railroad-highway grade crossings, is presented and discussed.

The concept itself is not controversial. The disagreements arise in defining "unnecessary" grade crossings, particularly in small cities and rural areas. It appears to be impossible in some areas to close a crossing without making someone unhappy. Few authorities see any value in promoting controversial issues of this nature.

But there is value if one can look past the initial controversy and consider overall benefits. It is our thesis that there can be substantial benefits to local communities and that it is time for this issue to be considered and analyzed in this perspective.

No grade crossing should be closed when the facts indicate that it should not. The facts should determine the issue. As simple and straightforward as this sounds, it is exceptional to have the facts prevail in the case of grade-crossing closure. More often emotion and sometimes irrational opposition prevent a closure in spite of the facts.

The new perspective promoted here is simply to consider closure with an open mind. When there are benefits to the community, these should be considered. This in itself is a challenge to the highway professionals.

Consider that there are roughly 400 000 grade crossings in the United States. Of these, 219 000 are public at-grade crossings. Approximately 24 percent of the public at-grade crossings are equipped with automatic warning devices; the remaining approximately 166 440 public at-grade crossings have only crossbucks. It is estimated that it would cost more than \$6 billion to install automatic warning devices at all these crossings, and the funds are not available.

Complicating the situation is our current expansion of rail traffic in selected areas. Increased rail traffic at increased speeds plus a renewed interest in high-speed passenger transportation make it imperative that all avenues for improved safety be explored, particularly low-cost solutions. This is the present-day challenge that must be met in an atmosphere of cooperation and understanding.

The purpose of this paper is to describe a study of the issues involved in closure. This study is being conducted at Kansas State University under joint funding by the Federal Railroad Administration (FRA), Santa Fe Railroad, and the National Railroad Passenger Corporation (Amtrak).

## THE STUDY

The study may be described as library and field research to determine and document the pros and cons of considering the closing of a railroad-highway grade crossing as an alternative when crossings and community needs are assessed. The main objective, then, is a set of criteria and measures (guidelines) so that community impacts (benefits and disbenefits) can be assessed and form the basis on which community leaders, local highway authorities, and railroad personnel can negotiate on common ground on a rational basis.

The closure option has been neglected because in many cases it results in limited success. It raises strong emotions and contributes to misunderstandings and bad feelings between railroads and communities. The overall goal of the study is basically to develop some guidelines that will make it both easier and more productive for anyone interested in systematic improvement of grade-crossing problems to pursue the closure option. Even if the degree of success is not higher, at least there will be a methodology to estimate the probability of success prior to the attempt. Thus, a more-knowledgeable decision whether closure is a viable option in certain circumstances will be possible.

Early in the study, the political opposition usually generated when closure is discussed was displayed in telephone conversations and correspondence with a number of county commissioners and similar local officials; much insight was gained into local political attitudes. Officials would readily play "what-if" games with us. However, we were told in some areas that if word got around that we were actually promoting crossing closure, they would have to stop talking to us or at least show a less-cooperative attitude.

It has been found that the attitude described above is typical. Closure is a highly charged political issue in which emotional response often precludes a rational examination of the facts. This climate prevails particularly at the local level, at which understanding and cooperation are essential to achieve any closure. Nevertheless, there are in fact many community benefits to considering the closure option. It is time to explore these benefits for the overall public welfare. The main purpose of this paper is to get the reader to view closure in a new light and with a new perspective.

An essential part of the study was to gain insight into and analyze the attitudes and concerns of the public, the community, their leaders, etc., so that our guidelines will aid anyone in approaching those who have varied interests and varied community structures and in getting their cooperation.

The study, which is now in progress, will look at closure for two sets of general conditions--first, under existing conditions, i.e., the various state

and local options that exist; and second, in an ideal sense, i.e., the ideal set of state laws, policies, etc. A hypothetical 51st state will be used for which we will suggest legislation and policy that will improve the climate for closure.

There is an analogy between our Interstate system as it was designed in the 1960s and our major rail lines of today. When the Interstate system was constructed in the late 1950s and 1960s, many local roads were closed because money was not available to put an interchange at every crossing. This was done without much attention to local concurrence (in the early days) because it was in the best interest of the nation. There was a good deal of local opposition to this, but local opposition generally lost. It was not uncommon for a resident engineer on an Interstate project to bear the brunt of the frustrated farmers during the course of the project because they had no one else to berate.

The railroads are no less important to the country, particularly now that we are in an era of energy shortage. It would be in the best interest of the nation to promote high-speed barrier-free corridors to move goods and passengers across the country with the same type of enthusiasm that we used in building the Interstate system across the country to promote the free movement of highway vehicles.

In terms of uniformity, there is another analogy in relation to highways. In most cases, railroads have to deal with different laws and policies in dozens of states and literally hundreds of counties, townships, cities, and towns. Highway professionals long ago recognized the advantages of uniformity. This is evident in the Manual of Uniform Traffic Control Devices, which gives us uniform signs throughout the country. It is also evident in the Uniform Vehicle Code, which encourages uniform vehicle laws throughout the country. Many other aspects of street and highway design, construction, and operation are essentially standardized. Is it not time that we had a manual of uniform treatment of grade crossings that would go beyond the uniformity that we now have in the standard pavement markings and warning devices given in the Manual of Uniform Traffic Control Devices?

At this point, this situation is far from reality. More commonly, the railroads have to deal with 50 different sets of state laws, hundreds of different county commissioners, township trustees, and/or city and town councils. This is particularly true in the case of closure.

#### REVIEW OF THE PROBLEM

Very little has been formally presented or written on the subject of closure. A few years ago, Astle presented a paper that referred to selective closure--"the neglected option" (1). He addressed the cost of installation of automatic warning devices and their maintenance. With cost projections at an assumed inflation rate of 8 percent, he pointed out that in about 10 years the cost of flashing lights and gates could be in excess of \$100 000 and maintenance cost could be as high as \$5000/year. Further, in 20 years costs could very well be more than twice that amount. It is now apparent that the assumed 8 percent inflation rate was conservative and that, unless our economy changes soon, his projected cost may be upon us long in advance of the 20-year period he predicted at the time he wrote the paper.

Astle's point is that, in the future, active warning systems will become increasingly more expensive, whereas funding for installation of these systems may become less available. This is a strong economic argument to accelerate attempts to close

crossings adjacent to selected crossings that have automatic warning systems. The research described here will include a case study that will expand on this point.

In approaching problems such as closure, there are generally two options: consider individual crossings or use the systems approach.

There are times when considering an individual crossing is appropriate. On the other hand, in recent years, the systems approach has been recognized as desirable. At the last national conference on grade-crossing safety, in Salt Lake City, Sproles and Kirk presented a paper on the advantages of the rail-corridor systems approach (2). When one has to break the system down into hundreds of segments of subsystems of small units--i.e., each town, township, and county--many of the advantages of the systems approach are lost.

If both legislation and community acceptance were favorable, the systems-approach package of upgrading some crossings and closing others would be logical and feasible and superior to complete reliance on priority indices. This concept would lead to improvement packages that could be of great overall benefit to communities.

As an example, the study now under way includes documentation of a case in which five adjacent crossings are being upgraded because they are all high on the priority list. The preliminary analysis and conclusion indicate that three of these would have been good closure candidates. A system package would reasonably have led to upgrading two and closing three; the resulting system would have been safer, cheaper, and easier to maintain.

Also at the last national grade-crossing conference, Craven, from Illinois, mentioned closure in his presentation on a state's evaluation of the federally funded rail grade crossing safety program (3). Craven's comment was that the systems-corridor approach invariably leads to suggestions to close certain crossings. He also mentioned that what invariably follows is fierce public resistance.

In an article in *Railway Age*, Mulrenan (chief engineer, Chicago South Shore and South Bend Railroad) discussed the closure option and his railroad's approach to it in Indiana (4). He also noted that the option has not been much discussed or written about. Besides Astle's paper, Mulrenan's article appears to be only the second ever written for presentation or publication, although Berg presented a paper on a case study that resulted in several community benefits at the 1979 Annual Meeting of the Transportation Research Board (5).

Mulrenan found that when actual power for closure lies with the local political subdivision, closing of any crossing is politically sensitive. As he put it, "Even in a favorable environment, the effort can be messy." Other descriptive terms often used are "tedious," "time-consuming," and "costly in engineering and legal time." One of his main points was that, in spite of these negative connotations, closing of unnecessary crossings is in the public's interest as well as in the railroad's interest.

#### NEW PERSPECTIVES ON CLOSURE

Five general considerations became apparent early in the study:

1. If the railroad-highway intersection were treated like a highway-highway intersection, there would be fewer problems;
2. Systems and closure considerations would be enhanced with a new set of laws and policies in most states;
3. Under the current laws and policies that

exist in most states, local cooperation is essential;

4. These considerations, or problems, are parts of the bigger problem of community-railroad relationships, i.e., communication, cooperation, and understanding, which make good public relations extremely important; and

5. A uniform approach, based on uniform guidelines, along with good public relations should be able to counteract irrational, emotional resistance to any and all closures.

Nonrailroad professionals concerned with U.S. rural and small-town development are beginning to speak and write about having too many local roads and the benefits of closing some of these roads. This philosophy relates directly to consideration of grade-crossing closure.

A 1979 article on financing rural roads and bridges in Illinois includes recent data that clearly establish that higher-quality road surfaces result in substantially lower operating cost (6, pp. 41-56). The authors advocate closing many low-volume, poorly maintained roads and rerouting the traffic over a select system of fewer roads that can be better maintained as a result of the cost savings. They point out that the closing of some roads and bridges should at least be considered. To reinforce this idea, data are presented to show that the major cost of bringing local roads to adequate standards involves roads that have very low traffic volumes. The cost savings for vehicular operation on an asphalt surface compared with those for a gravel road in good condition are estimated at more than 90 percent.

It can be assumed that the savings would be greater in rerouting traffic from a deteriorated surface to a good surface. The main point is that these facts counterbalance the argument that all rerouting is costly to the affected public because of the extra miles. Up to some breakeven point, one could even expect a net saving.

The basic problem that resulted in too many rural roads and too many grade crossings is our 1-mile grid system. The objective of the 1-mile survey grid system adopted for most of the country almost 200 years ago was to open up the land. It served this purpose well but left us with a legacy of hundreds of thousands of miles of 1-mile grid pattern section line roads.

This road system served its purpose well for the 40- to 60-acre family-operated homestead of the 1900s. There are arguments for preserving this way of life, but it generally has given way to agribusiness partnerships and shared operations. This is the reality of today's agricultural operation.

Another paper along these lines, by Hartwig (7), sets forth a proposal to preserve agricultural land in Michigan by closing rural roads. According to Hartwig, the 1-mile grid may no longer be appropriate. If our goals and objectives are the preservation of agricultural land and increased agricultural productivity (which we often hear promoted), the 1-mile grid is inappropriate and may even be counterproductive (7).

Hartwig concluded that a 3-mile grid would be advantageous to preserving agricultural land and enhancing agricultural productivity in Michigan. This concept means closing two out of three section roads and actually returning them to productive farmland.

Although there would be some disbenefits and some difficulty in implementation, Hartwig concluded that it is a desirable long-term goal. In addition to the overall advantage of preserving agricultural lands, some other benefits were discussed. The 1-mile grid generally results in a network of poorly maintained roads. This leads to a disproportion-

ately high accident rate, poor maintenance, and increased vehicle operating cost as a result of increased fuel consumption and vehicle wear.

Also, if closure reduces nonfarm development in an area, this should help stabilize the value of land, the assessed valuation, and thus the upward spiral of tax increases. Land previously used for road right-of-way could be converted to agricultural use (for example, a total of 95 acres in the 3-mile grid concept) and there would be larger continuous tracts without roads as barriers. Increased productivity per farm worker would result. With money saved from closed roads, reconstruction and improved maintenance on the remaining road system would enhance overall rural travel, decrease travel costs, and possibly decrease rural highway accidents.

In testimony on March 1980 before the Rural Transportation Advisory Task Force, as required by Public Law 95-580, J. Tierce of the Kansas Corporation Commission stated:

State officials, too, discussed the possibility of "making do" with available funds by prioritizing roads, devoting funds only to those roads that bear a high volume of traffic and abandoning others.

The importance here of studies and articles of this nature is that closure is no longer an idea invented by railroads solely for railroad benefit. There are community benefits. These benefits need to be studied and documented to counterbalance irrational argument against all proposed closures. Then, when closure really is in a community's best interest, this can be determined based on an analysis of the facts.

The Kansas State University (KSU) study now in progress calls for developing four case studies, two rural and two urban. The study corridor is the Santa Fe main line across Kansas, on which Amtrak operates. The existence of passenger trains in a corridor increases the potential for catastrophe at every grade crossing.

Of the two counties involved in the study, one is under a county-unit system of administration, which generally means that the county commissioners and the county engineer have jurisdiction over all roads not on the state system. The other type of administrative body in Kansas has townships as subunits within a county; roads are under the jurisdiction of township trustees. Two small-to-medium cities will be used in the same manner. At this point, one is being used to emphasize economic aspects and the other to emphasize the proper negotiations framework with small-town local officials.

The rural case-study approach will illustrate a methodology for determining potential for closure, probability of success, and guidelines to initiate and carry on the process. The problems with existing laws and policies will be documented and included in recommendations for improvement.

#### RATIONAL APPROACHES TO CLOSURE

##### General

Under the most-common state laws, cooperation of local officials and their constituents is essential. In most cases, if there is no cooperation, there will be no closure. Good public relations are extremely important, a fact that appears to be underrated by railroads. Communication with dozens of local officials by letter, by telephone, and in person has emphasized the importance of public relations over and over again during the first phases of the KSU study.

One part of the KSU study examined community and/or public attitudes toward closure. Approaches or programs to promote mutual understanding and cooperation are important and needed. The KSU study determined that railroad relations with local officials and the public could be improved.

The messages received over and over are "We don't have any closure candidates, but how can we keep the railroad from blocking our crossings at rush hour?" "I don't want to talk about closure, but why can't we get smoother crossings?" "...but why does it take so long to get things done?" and so forth.

One county engineer's comment was perhaps basic to a whole range of these complaints. He felt that if a railroad section supervisor or similar visible employee had more authority, that person could sit down and work things out. More personal contact prior to asking for cooperation on a matter such as closure cannot help but be beneficial. This should be true not only of closure but of all problems that arise between railroads and communities in which they operate.

Union Pacific (UP) railroad involves their public relations personnel in certain grade-crossing meetings and negotiations (8). A UP safety and security official has good personal contact with local police officials who are constantly on the lookout for safety problems. The railroads do need to consider using more personal contact for good public relations.

Another approach is the possibility of expanding the educational efforts of Operation Lifesaver along these lines. Once it is recognized that closure can yield benefits for communities and not just railroads, then some educational program addressing this issue would appear to be appropriate.

At this point it does not appear feasible to suggest a separate conference on the subject, but discussion of the concepts should be included wherever and whenever railroad and community leaders can be brought together. The recently completed joint U.S. Conference of Mayors--Association of American Railroads Urban Rail Conferences are the type of forum to improve and broaden railroad-city relationships. Not much from this conference series will seep down to small-town rural problems, but perhaps the concept could be adapted.

KSU is studying arguments beyond safety so that, when combined with safety, they will greatly strengthen the closure option as a viable alternative. Arguments collected from current practice and case studies have been valuable in this regard.

#### Summary of Responses

All the states, all Kansas counties, and several railroads were contacted. Most of the responses came from the railroads.

Seventy officials who represented all the major railroads in the United States were informed of the KSU closure study and given the opportunity to supply input on either guidelines they had or case studies of closure, whether successful or unsuccessful. Thirty-six officials who represented 25 railroads responded. Several provided us with valuable ideas, insight, and case studies.

The following discussion summarizes productive concepts that the KSU study has uncovered.

The two best sets of guidelines by the respondents were those given by the Atchison, Topeka and Santa Fe Railway Company and the Burlington Northern. Some responding railroads stated clearly that they had no guidelines or criteria for closure and treated each case as unique, generally after receiving a request from local or state officials. About half the responding railroads had procedures, al-

though not all were formalized guidelines.

Many railroads use the corridor or systems approach when considering closure. It was common to find a trade-off for closure by improving warning devices or making site improvements at adjacent crossings, i.e., improving sight distance or approach grades or angles.

A second point consistently mentioned as part of the criteria for closure was the existence of an adjacent crossing that had better warning devices and that required little additional vehicle travel. An important factor stressed was the average daily traffic (ADT) on the proposed closure. However, actual values were generally absent: No quantitative values were suggested for "low" ADT, "high" train speed, "high" number of trains, etc.

Although reduction of accidents can be used as an important incentive to gain closure, most railroads stressed the need for consent by local officials. Only where state agencies could act by authority of state statute without local consent could successful closure be achieved when the local community was opposed to it. This is definitely not the general case.

Criteria for closure (besides safety) most often mentioned were as follows:

1. Number, speed, and type of trains;
2. Construction of parallel roads on railroad right-of-way;
3. Distribution of population;
4. Location of nearest emergency service;
5. Financial considerations, particularly when local communities did not have to provide any money;
6. Purchase of private land when damage from closure might be claimed by local landowners; and
7. Continuous interruption of traffic (although this might also be a candidate for grade separation).

From the case studies of closure of the 25 responding railroads, criteria and considerations that were actually used could be determined. Of the 31 cases listed, 19 were successful and 12 either were failures or the action was unknown at the time. These statistics most likely do not reflect the true failure rate, however.

The major reasons that closure was proposed in these cases, in order of frequency, were as follows:

1. Minimal distance between crossings so that using the adjacent crossing would cause little additional travel for motorists,
2. Light ADT,
3. Inadequate sight distance,
4. Number and speed of trains, and
5. Acute crossing angle.

Other reasons, less frequently listed, were as follows:

1. Motorists were being caught on multiple tracks,
2. Road was a dead end on the other side of the tracks,
3. Time the crossing was blocked by train traffic was excessive,
4. Parallel road existed to the adjacent crossing, and
5. Railroad needed additional track for its yard operations.

Failure to get closure approval in many cases was due to local opposition that could not be overcome. One case failed because the agreement was made with a city, whereas county commissioners had actual authority over the road. Under the present mixture



of laws, ordinances, etc., procedures are at best confusing.

Support for closure by local officials was usually obtained by acceptable trade-offs in which the railroad agreed to upgrade adjacent crossings and/or make similar improvements in exchange for closure. Some other trade-offs for closure were as follows:

1. Construction of a parallel road to the adjacent crossing on the railroad right-of-way,
2. Purchase of land by the railroad from a private landowner damaged by closure,
3. Installation of a fire alarm box at the railroad's expense,
4. Raising or leveling adjacent crossings, and
5. Relocation of track to a common right-of-way.

The Federal Highway Administration (FHWA) Railroad-Highway Grade Crossing Handbook has some suggested guidelines (9, pp. 98-100). Considerations included by the railroads but not mentioned in the FHWA handbook were as follows:

1. Construction of parallel road on railroad right-of-way;
2. Sharing cost of improvements, particularly by local communities;
3. Purchase of private land when damages from closure might be claimed by local landowners;
4. Elimination of potential for motorists to be caught on multiple tracks; and
5. Dealing with dead-end road on the other side of the tracks.

There are guidelines in the handbook that were not mentioned in the survey:

1. Retention of a pedestrian crossing when a crossing is closed to vehicular traffic;
2. Use of the crossing for necessary trips to schools, business establishments, and other public buildings; and
3. Growth trends and prospective development.

One lengthy case study (by J.R. Summers of Louisville and Nashville Railroad, June 11, 1979) involved a year-long concentrated effort to find alternatives to upgrading signals at almost every crossing along a 73-mile Gulf Coast line corridor. By June 1979 only nine crossings had been closed.

#### Road Geometrics

One of the study tasks was to look at road geometrics at and near grade crossings and document situations in which closure looked practical and desirable. For example, this may occur where tracks cut diagonally across roads near an intersection and form two crossings. With minor highway rerouting, one crossing could be closed.

But geometrics should go much farther than that. It is in everyone's best interest to have good geometric design criteria for grade crossings. Minimum standards of good geometric design on road approaches to grade crossings should be mandatory. Then if it is not possible to upgrade the road geometrics at a crossing to minimum standards and alternative routes are available, the crossing should be closed. If railroad-highway intersections were viewed with the same standards as any street or highway intersection, many of them would never have been constructed.

Again, consider good geometric practice for roads and streets. There are books of standards and accepted design criteria. Road and street intersections just do not get built by using basic geo-

metrics as bad as those often found in rural railroad-highway grade crossings. Commonly found are steep approach grades or humped crossings that have grades as high as 10-30 percent, poor sight distance from acute skew angles, tracks in a cut near the crossing, tracks on a curve near the crossing, or the road on a steep grade or curve. Field examinations discovered some rural crossings at which a driver would have to get out of the car to see as far down the track as would be considered safe sight distance at a highway intersection. One farm woman interviewed does just that when she drives loaded grain trucks across a crossing near her farm that has a steep road grade and poor sight distance. It scares her because she feels that if a train should appear just as her truck starts across, she will not have time to get out of the way. In this case, level approach road grades could remove the immediate danger.

Some states have addressed the geometric-design problem. Florida and Tennessee have established design criteria for grade crossings. Reasonable criteria or standards such as these should be more widely encouraged. For example, the following criteria are proposed by the Tennessee Department of Transportation for at-grade railroad crossings:

1. Crossings are to be treated as hazardous intersections;
2. Crossings should not be established where the railroad is in a cut or on a curve, where there are multiple tracks that can set up a trap condition, or near track switches;
3. For sight-distance considerations, the American Association of State Highway Officials publication (10, p. 384) should be consulted;
4. At-grade crossings should be no closer than 1500 ft in urban areas and 2500 ft in rural areas;
5. Crossings at angles of 90° should be aimed for, and in no case should the tracks be skewed less than 70° from the road center line; and
6. Approach grades should not exceed 7 percent (5 percent would be desirable); at 30 ft from the tracks, the roadway should be not more than 3 in higher or 6 in lower than the near rail.

The idea is to promote uniform design standards for crossings and to close those that cannot be upgraded to good standards and those near which reasonable alternative routes are available.

In closing, it is hoped that this paper has presented a few new ideas on the topic of closure, or at least some new insights into old ideas.

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