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It is a welcome opportunity to be permitted to appear before the American Railway Engineering Association to discuss matters of mutual interest which are constantly growing in importance.

The coordination of transportation in all its phases has been given the rank of both an ideal and a major objective of governmental responsibility. Much has been said concerning the ways and means of accomplishing this desirable coordination, but many of these advocated policies are directed toward existing conflicts and do not result in constructive effort since their foundation is in disagreements. There are so many constructive things that may be done where all transportation interests are in harmony that through these would seem to be a more productive approach, with the probability that when progress is made in these constructive phases many conflicts may automatically disappear or be materially mitigated.

The heritage of the past apparently imposes too strong restrictions upon our thinking into the future. Experience may be a great teacher, but only in the event that the precepts are sound. In a very few years the transportation world has changed in a degree beyond the expectation of any person, especially those who have been

most closely identified with the many and diverse developments.

Before the world went topsy-turvy and plunged civilization into a chaotic struggle where the wealth accumulated by nations was destroyed almost over night, the normal economic developments handicapped with insupportable burdens and the natural flow of trade and commerce painstakingly built through the generations wholly upset by artificial boundaries and customs reprisals, the principle was reasonably established that where transportation costs are lowest, wages are highest. Even under conditions today this principle seems to prevail with such exceptions as may be accounted for by influences growing out of the world conflict. If we accept this principle as ruling, all of us who have to do with transportation are given a charter that raises our efforts above the commonplace and endows them with a reflex upon the public welfare that becomes an incentive beyond the natural desire to do the day's work well. It is in this spirit that I am presenting some aspects of common interest to railway and highway transportation. It will doubtless be accepted that the more efficient transportation as a whole becomes, the greater asset the nation possesses, and the better position it occupies to compete with the world, while at the same time constantly raising the standards of living for our people generally.

There is a vast accumulation of laws, customs and attitudes of mind which are the product of the long years during which railway transportation as a nation-wide service, was in a major sense, a monopoly and which now greatly confuse the solution of transportation problems. This point is well illustrated by the State laws and traditions governing the payment of the cost of railroad-highway grade crossing eliminations. Although there is a wide discrepancy between the legal requirements in force in the different States, it is reasonable to estimate that the average minimum assessment upon the railroads is one-half of the cost of such improvements, but protection and warning devices are wholly the expense of the railroads.

Perhaps the first major recognition by the public of the changed conditions of transportation and the realization that the railroads are an asset to be conserved, rather than a monopoly to be curbed, came with the provision in the Federal highway legislation that permitted the construction costs of grade crossing improvements to be paid wholly from public funds. While it may be said that this departure from established custom grew out of the emergency necessity to provide employment of sound character, nevertheless its acceptance by the public without adverse criticism indicates the distance that public thought has traveled in its willingness to deal fairly, and as conditions now exist, with the railroads. In this, certainly the traditions

of the past have been denied by a recognition of actualities and a willingness on the part of the public to meet these fairly. If we can hold to the thought of efficient transportation in whatever form, as a national asset, the debate as to meticulous methods of assessing costs of improvements which add to the efficiency and safety of transportation, loses force. The important point to the public is that these improvements shall be made.

How much better the new plan is working is well attested by the actual results. From the time the Federal highway program was established in 1916 until 1933, a period of 17 years, there have been eliminated on the Federal aid highway system 6,000 grade crossings, and of these 4,650 have been accomplished through the relocation of the highways.

The first authority to carry the whole construction costs of such improvements from Federal funds was given in July 1933. Under the provisions of the National Recovery Act of 1933, 697 grade separations were constructed and 706 grade crossings were protected by automatic warning devices. In 1935 funds were made available specifically for work of this character and under this authorization a total of 854 grade crossings have been eliminated, 281 eliminations are under construction and 371 are programmed for construction, a total of 2106. In addition, 343 existing grade separation structures

are being rebuilt and protection with automatic warning devices of 120<sup>4</sup> crossings has been accomplished or provided for. Thus in a period of 3-1/2 years 3,146 crossings have been eliminated, including the rebuilding and reconstruction of the 343 obsolete and dangerous crossing structures, and a total of 1910 standard protection signals have been provided for or actually installed.

This achievement is notable in itself, but it should be of more importance that this program has brought together the railway and highway officials and engineers in a cooperative undertaking that has not only accomplished these immediate results, but has remarkably fine implications as to an intelligent and willing attack upon other problems of coordination in the future. Certainly the highway officials may be placed here upon record as desiring the most efficient railway transportation that can possibly be secured and are willing to devote generous efforts to this end.

Planning surveys are rapidly developing the information that will not only obtain the number but will enable an adequate classification of existing railway-highway grade crossings to be made.

It is only the repetition of axiomatic knowledge common to those in the railway and highway field, that we are certain to have for many years a very large number of grade crossings. That this statement may at once be understood by the public, it must be

emphasized here that numerically the crossings in the lower classifications as to combined traffic importance are greatly in excess of those in the higher classifications. Upon these latter of most importance, the available improvement funds must first be used. Since so many of these crossings will be continued in service, there must be better crossing protection devices which can be installed in large numbers and which must necessarily have a low cost range. There are promising developments in this field of simple, cheaply installed devices, in which the element of protection offered may be greatly increased over the standard cross-arm alternating light by providing in addition automatic gate arms.

In the European countries a very large number of the railway-highway intersections are at grade. Universally these are protected by gates, usually manually operated. The gates may be across the highway or across the railway, and quite generally each one seems to be in charge of a family which lives in a cottage at the site. The gates themselves are light and not strongly designed, but they have the essential quality of placing a barrier across the highway during the period of the passing of a train, and quite frequently for a considerable time before. I have had the experience in driving on a highway which intersected a railroad at frequent intervals

of not being able to make sufficient time between the crossings not to be stopped at each gate, even though the freight train was being operated at a slow rate up a fairly heavy grade.

Evidently the drivers on European highways accept the idea of waiting a reasonable time for the trains to cross, in contrast to the all-too-prevalent willingness in this country to risk life in a race for the crossing.

It is probably true that without significant exception the drivers, if the decision is definitely made by interposing a gate arm between the traveled way and the tracks, will not only obey but will have a great feeling of relief that they are driving safely. The interposing of a gate is of particular importance where there is more than one track, and by proper design of reflecting lights on the gate arm the hazards of night driving are materially reduced by the barrier of warning lights across the traffic lanes.

This discussion must not be construed to temper the determination to do away with all grade crossings by elimination as a goal, but rather to make more effective the protection of crossings that we know can not be reached for some time.

The planning surveys will serve another function of first importance by providing the data in definite form which, through careful study, will make possible the formulation of a program

of elimination of grade crossings on a scale more extensive than has yet been contemplated. The Interstate Commerce Commission reports at the end of 1935 234,000 existing grade crossings. At the rate of net elimination of the previous three years, approximating 1200 annually, it would require 190 years to wipe out grade crossings. It is apparent that an additional attack on an extensive scale and along new lines must be undertaken. For example, take the great Mississippi River basin in which there are hundreds of thousands of miles of highways that are crossed by the railroads, many of them of trans-continental importance. All who are familiar with the number of grade crossings in this area know that it will be possible by re-arrangement and by the building of short lines of roads parallel with the railroads, to concentrate a number of crossings at one point, which will justify an under or overpass. The application of careful planning will permit the closing of a large number of these grade crossings without serious handicap to the public and, through the greater safety provided, will amply justify this course.

The President has expressed the ideal of eliminating from these fast through rail lines all hazards due to grade crossings. To accomplish this on the extensive scale desirable, we must look to the intensive planning study which will be immediately possible, since these surveys are now rapidly maturing in a large number of



States. The actual possibilities inherent in a vigorous, intelligent attack on the problem of a very large number of existing crossings that is now practicable, will result in doing away with many of these crossings at a minimum of expense, provided only we can retain and extend the cooperative entente between the railway and the highway representatives.

The removal of each open crossing, however unimportant, must be a distinct gain to the railways in safety of operation for their fast trains, particularly those of the new light type, and as a corollary a decrease of hazards to the public, both for those who use the railways and for those who use the highways. The advantage to the railroads is only a concomitant to the public interest, which is the objective to be served. It may be repeated here that where this objective is accomplished, the exact division of costs becomes unimportant both in theory and in fact. Considerable attention is devoted in this paper to this problem of grade crossings which while important in itself, becomes more important if considered as the establishment of competent working relationships between the railways and the highways.

In this field of planning the grade crossing problem is only a start. When we consider the floods which have occurred during recent months in the Ohio River valley, and the interruption to transportation both rail and highway, and the cost of the rehabilitation and reconstruction of both railways and highways, it extends

the field of cooperative effort for the protection of transportation and the guarding against loss due to the same recurring causes to the whole field of flood protection. We have too long regarded the protection of highways and of railways against disastrous floods as separate problems. The destruction loss is always greatest in narrow valleys where the highways and railways occupy the same limited area, and where they frequently parallel each other for long distances.

The potential field for cooperation in matters of major import extends further. One of the problems which has ever confronted railway engineers is the maintenance of a smooth track under the impact of moving loads. The distortion of our modern railroad beds under the weight and speed of heavy locomotives has demanded constant increase in the weight of rails and the cost of the remainder of the track construction. The impact is directly affected by roughness, and after roughness develops its rate of increase is accelerated. The highway engineer has been faced with the same problem, but unfortunately it is a long and difficult operation to realign and bring to true grade a roadway surface. The problem has had to be attacked from the angle of prevention, and after a long, exhaustive study the influence of soils has been defined, and it may now be said soil control has been put upon a basis approaching real mastery. This final objective is not yet quite reached but it will be and within the limitations of practicable costs. The principles developed will be applicable to the

problems of the stabilization of the roadbeds under the rails as well as those under the highway surfaces.

As a comment upon some minor difficulties which have developed, it may be helpful to suggest the point of view of the public officials.

In the expenditure of all public funds there are a number of principles which must be observed that do not so unequivocally apply to the expenditure of private funds. One of these is that the terms of purchase proposals must be adjusted to provide competition and to permit all those who are reasonably in a position to supply either equipment or materials, or to undertake contracts, to submit bids.

There have developed some rather highly specialized fields in equipment and materials particularly for protective devices, in which the number of those who desire to compete is limited, and it might at this time be argued that only these are in a position to furnish the equipment or perform the services needed. This may be true, but it is necessary to fix the requirements of the proposals in such a way that they would not prevent others coming into the field. During the short period of operations under present legislation we have had widespread methods of taking bids, between proposals which specify the items in great detail and those for which only a lump sum bid was submitted.

The Bureau is now engaged upon a grouping or classification of materials which will enter into the grade crossing improvements for which bids will be required in sufficient detail to disclose intelligently the unit prices, which we hope will reasonably standardize current practice.

The decision of the Administration to continue the appropriations for grade crossing elimination on the same basis for the fiscal years 1938 and 1939, so far as we are able to determine, has met universal approval. The revised rules and regulations which were issued to cover the future program, while adhering largely to those previously in effect, have endeavored to cover such changes as experience has dictated to be desirable. Minor points requiring definition are covered in the instructions issued from time to time, rather than in the rules and regulations.

There is only one point upon which it seems desirable to make comment here. In the previous programs the division of the appropriations between the railroads in each State was based upon the relative miles of main line track. A number of situations arose where it was impossible to reach important crossings because of this division of the funds. It was also evident that if the same policy were continued the number of important crossings which could not be reached would be increased. For these reasons, while continuing in the main the division between the railroads upon the same mileage ratio, exceptions have been provided to make possible the use of funds for improvements having a high priority even though the allotment of funds to a particular railroad would be

increased. In a few cases previously there was vigorous insistence upon adhering to an exact division of the funds between the railroads. On the other hand, there were numerous instances of a most generous attitude on the part of the railroads, when it became evident that improvements in which they were particularly interested could not be immediately undertaken, in agreeing to important work elsewhere.

The remarkable results which already have been secured have been through the combined efforts of the railroads, the States and the Federal Government. We can confidently expect equally desirable results to come in other fields such as flood control where necessary to protect against losses and provide for continuity of operation of transportation lines. The field is open through cooperative effort to secure at minimum cost the elimination of a tremendous number of unimportant grade crossings by careful planning. In a large way this discussion is intended to point the way through practical undertakings to coordination of transportation agencies, and the eventual elimination of undesirable competition.

It would not be proper to close this paper without giving credit to the committee established by the railroads to cooperate with the States and the Bureau of Public Roads in the development of the grade crossing program. This committee, composed of Mr. R. E. Dougherty, Vice President of the New York Central Lines; Mr. W. D. Faucette, Chief Engineer of the Seaboard Air Line

Railroad; Mr. R. H. Ford, Assistant Chief Engineer of the Rock Island Railroad; Mr. G. F. Harris, Chief Engineer of the Santa Fe Railroad; Mr. R. J. Middleton of the Milwaukee Railroad; Mr. W. D. Higgins, Chief Engineer of the Pennsylvania Lines; and Mr. J. G. Brennan as contact engineer, have devoted generous time and intelligent application to every detail of the work, and are to be given full credit for suggestions based on their wide experience in meeting the problems of administration which have been handled with the minimum of friction and disagreement. The engineering departments of the railroads and the State highway departments have worked almost as one organization to produce results which are now becoming widely apparent as tangible assets contributing to the public's convenience and safety. I regard coordination of this character definite, large scale and accomplished with economy, as genuine coordination which we hope has only just begun.