

I said near the beginning that I wanted to discuss this question frankly. These are the frank views of one maintenance engineer who is charged with the responsibility of maintaining a system of highways that is rapidly expanding and on which the traffic demands are ever increasing and with much of the present system entirely inadequate to serve present needs. This also is an appeal to road design engineers to give more study to the design of a highway system along with their study of cross sectional design of one particular road. It is an appeal to road designers to alter their design standards so as to permit the use of available funds in such a way as to render the greatest amount of service to the greatest number of highway users. It is an appeal for improvement of a greater mileage of the system, even if the improvement is done on lower design standards, because I believe that maintenance costs can be reduced only by replacing or reconditioning the obsolete and overloaded portions of the road system.

DISCUSSION

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It is a pleasure to be on the program to discuss Mr. Johnson's excellent paper on the subject "Road Design to Reduce Maintenance Costs". After spending several years on maintenance, I can appreciate the present day serious problem of maintaining our great system of highways and streets, especially when a large percentage of the mileage was never constructed to withstand the punishment it is now receiving from heavy and fast traffic. The powerful position the United States occupies today was gained by the superb production of industry supplemented by unequalled systems of communication.

We are now living from the fat of our highway system. Cities, counties and states are falling behind rapidly in the construction and maintenance of adequate highway facilities. People want the benefits derived from the use of heavy trucks, the luxury and time saved by fast automobiles, a well connected road system built to modern standards, but they are unwilling to pay the cost. It is well known that many persons will do without some of the more necessary things in life in order to buy an automobile. If our highway departments were doing as well as the motor companies financially, the scales would be better balanced between the vehicle use and the road condition.

Mr. Johnson pointed out that the field of highway engineering is becoming more and more specialized as the department grows. The

matter of over specialization is of course a problem in most large business organizations. Serious thought must be given soon to some method of rotation of work so that we can develop engineers familiar with all phases of highway development. Relative to this particular subject, there is no doubt that a tour of maintenance duty should be a requisite for any construction or design engineer. I invite construction and design engineers to request maintenance duty for the betterment of themselves and the department. They will be thrown on their own resources and enjoy a certain freedom of action not usually experienced where the work is governed largely by specifications and standards.

Reaching to the heart of Mr. Johnson's remarks on maintenance and design, it will be well to briefly review modern methods of road design. In the early days the design of any particular section of new road was decided upon by a single engineer or a small group of engineers, and in many cases the design was influenced by local citizens. After several years it became apparent that the country was building a hedgepodge system of inadequate highways. Through the efforts of outstanding engineers of the AASHO and other organizations, design standards have been developed that insure a similar handling of the elements of highway design, not only in the state, but throughout the country. These standards are based on actual and *predicted* traffic. I call your attention to the use of *predicted* traffic in design. Many of our older roads become obsolete early because future traffic was not considered or methods had not been developed to predict traffic. These design standards are followed in general, however, there is enough flexibility to allow for extreme conditions of topography.

Mr. Johnson would prefer spreading the money available for construction over more miles of his 14,000 miles of maintenance by reducing the standards of a new construction project so that it would conform to older adjacent sections or fit into the overall road system by some slight improvement. From the highway administrator's standpoint it is imperative that some new construction be done in this manner, but it should be done only on roads where it is possible to obtain the greatest salvage without sacrificing the most important elements of modern design. Because of the high cost of new construction, we have been examining closely a number of the older and more heavily travelled roads in order to determine what can be done along this line. An illustration of the problem is that it is frequently possible to widen and strengthen an existing surface and obtain 100% salvage of the old pavement, but in most cases this would make the design engineer accept the responsibility for leaving in place such death traps as

narrow drainage structures, bad sight distances, heavy grades and stiff curvature. The end result would be that after a year or two the new wide surface alone would encourage increased speeds and cause many more accidents at the danger spots and there would be requests to have these removed by expensive piecemeal construction as the hazards became more apparent. Reference is made to point No. 4 made by Mr. Johnson. Is the proposed improvement so designed that it can be safely operated?

I would prefer to construct to modern standards short sections of road that would eliminate such hazards as one way or weak bridges and occasional bad curves. Then if in later years more construction money becomes available the large remainder of this section of highway could be constructed to proper standards and it would fit the short sections that were previously improved. There is a large field of this type of work in the state and much has been done along the line of improving short dangerous sections of road.

I think it should be known that the design engineers devote more thought and time in designing a road to help the construction and maintenance engineers than is properly credited to them. "How is this going to affect construction or maintenance" is a regular comment among the field location forces and in the drafting rooms. Better design and modern standards certainly reduce maintenance costs. Kentucky has never been in a position to indulge in the luxury refinements designed into the highways of some of the richer states, nor build new ones until it is a dire necessity.

Probably the largest maintenance expenditures are made on roads having inadequate bases and surfaces. It should be realized that a major portion of new construction funds are expended to obtain structurally sound surfaces. This is certainly not a luxury or something that can be chiseled on without maintenance having to suffer the consequence.

The design engineer is faced with problems directly affecting maintenance. The increasing burden placed on the highway system, if not anticipated to some extent in design, would aggravate the maintenance engineers present problems. It appears to me that our present standards are reasonable and not excessive when it is known that no real restrictions are placed on the development of cars and trucks. It would be a bridge or road designer's paradise if they could design with the assurance that truck load limits, widths and weights would not be increased or the speed and clearance of cars would be stabilized. Most of our old roads would be adequate and easily maintained if we

were using the vehicles of twenty years ago. Would you care to revert to that stage? As much as we would like to, this country cannot afford to stay motionless in the development of transportation, one of our great assets. The country's highways took a terrific beating during the last war and will continue to be abused in the present emergency. The five or six intervening years have not been sufficient to even approach adequacy with new construction. Think how much worse it could have been, if road design had been stabilized in the earlier years, if say the Model T. Ford.

Obsolescence and heavy maintenance is not peculiar to the highway industry. Railroads and airplanes are good examples of the fight to stay ahead in transportation. Industry is compelled to retire obsolete machinery and design plants and equipment to fit the overall expansion and progress now going on in the United States. We have advanced from powder to T.N.T. to atom bombs and are now preparing for the hydrogen bomb. Our army requires an equal advance in transportation to stay ahead. Speaking of the atom bomb, the Atomic Energy Commission is building a new plant near Paducah. One of the first operations must be the construction of roads to the area capable of serving 12,000 construction workmen.

Mr. Johnson's fine paper deserves more discussion commensurate with the importance of topic. The ideas advanced serve to keep the designer on his toes. We have been blessed by a cooperative maintenance division. Many improvements in design stem from suggestions given by maintenance engineers. Frequently maintenance has been the proving ground for design changes. The traffic division formerly a part of the maintenance division assists us in design. They never complain about high design standards, in fact, the traffic engineer wants wider surfaces and shoulders and other improvements beyond those now being used, because he knows that traffic moves faster and safer on a modern road.

Although the maintenance problem is great, I do not believe we can afford to lighten the burden by sacrificing in design. I believe it is the design engineer's duty to not only stay abreast of the times, but to anticipate the future. For the security of our country, which is so dependent on highways, the road designer must not go back, or stand still in design, but on the contrary he should advance our highway design in order to prevent wasting tax money on highways that will never fit the economy of a growing powerful nation.