Effect of the Energy Crisis on Existing Design Standards

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An immediate reaction to the energy crisis by highway engineers was a proposal to summarily reduce design standards, especially design speed. This paper discusses why such a reduction should not be effected. Factors that should be considered before standards are reduced are (a) AASHTO definition of design speed, (b) possibility of 88-km/h (55-mph) speed limit being temporary, (c) the effect reducing design speed could have on multimodal corridors, (d) higher order of safety provided by higher design speeds, (e) increased use of smaller cars, (f) liability of highway engineers, and (g) current research on situational design criteria.

The energy crisis is one of many socioeconomic and political factors that have adversely affected the funds available for highway operation, both construction and maintenance. As an immediate reaction to the reduced availability of highway funds, some design engineers have proposed that geometric design standards be reduced. These proposals have, for the most part, centered on a reduction in the design speed to 88 km/h (55 mph), since that is the current maximum speed limit specified in the Federal-Aid Highway Act of 1974.

While it does not appear that the adoption of an 88-km/h (55-mph) design speed is an appropriate solution to the current problem of reduced highway funding capabilities, a brief discussion of the considerations involved in such a change is appropriate. A review of the various geometric design policies of the American Association of State Highway and Transportation Officials (1) indicates that there is nothing to prevent such a change since there are nine specific design speeds ranging from 32 to 129 km/h (20 to 80 mph). Although 88 km/h (55 mph) is not one of these, the geometric design requirements at this speed can be determined by interpolating between the values specified for the 80 and 97-km/h (50 and 60-mph) design speeds. However, there are several factors that should be considered before a policy of using an 88-km/h (55-mph) design speed is adopted.

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CONSIDERATIONS IN REDUCTION OF DESIGN STANDARDS

AASHTO Definition of Design Speed

AASHTO (1) defines design speed as "a speed determined for design and correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern." AASHTO also states (2) that design speed should be selected consistent with the terrain, type of highway, expected traffic volumes, and economic considerations. AASHTO policy indicates that "every effort should be made to use as high a design speed as practicable to attain a desired degree of safety, mobility and efficiency." The requirements for selecting design speed in urban areas (3) are consistent with those outlined in the earlier publication.

Thus, AASHTO policy, which is adopted by FHWA, is that a design speed should be higher than the anticipated operating speed. Table III-1 of the "blue book" (2) indicates that the assumed operating speed for wet pavements is between 94 and 80 percent of the design speed between 48 and 129 km/h (30 and 80 mph) respectively. To be consistent with this policy, a design speed of 105 km/h (65 mph) should appropriately be selected if an 88-km/h (55-mph) operating speed is to be maintained over a given section; and 105 km/h (65 mph) is specifically provided for in the "blue book." Further, a recent study of traffic speeds to determine the effect of the 88-km/h (55-mph) speed limit on operating speeds shows that, while there has been a definite decrease, only 53 percent of all vehicles on main rural roads conform to the 88-km/h (55 mph) speed limit.

88-km/h (55 mph) Speed Limit May Be Temporary

At hearings before the Senate Public Works Committee on increased truck size and weight, Senator Bentsen suggested that the 88-km/h (55-mph) restriction might be lifted in the future. Just as the maximum size and weight limitation on trucks has now been increased, so, too, could the current speed limit be increased by future legislation. In fact, a recent article (7) that listed congressional objectives with respect to automobile energy conservation did not include the maintenance of the 88-km/h (55-mph) speed limit in either short- or long-term objectives.

Throughout the years, highways have always been constructed by using the best available technology; as a result roads built in 1925 are in use today. This fact constitutes one of our major concerns: "How do we upgrade these older facilities to meet the safety standards in use today within the availability of highway funds?" By the same token, highways built today may well be in use in the year 2025; thus, it is imperative that engineers use the best standards available.

Although we do not know what the future automobile will look like, the technology available in the automobile industry will most probably produce vehicles with more efficient power plants and vehicles that are not so dependent on petroleum. Thus, the future safety and mobility demands placed on the highway may very likely be similar to those we know today.

Accordingly, highways should be designed with safety, mobility, and costs in mind. Where standards below those that have proved to provide a high degree of safety are proposed, a case to use these less-than-minimum designs should be made to the FHWA on a project-by-project basis.

Use of Highway Facilities as Multimodal Corridors

In some instances, the use of lower design speeds would seriously limit, if not prevent, the use of highway facilities as multimodal transportation corridors. Primarily, rail is the only other transportation mode that could jointly use a land corridor. The geometric requirements for rail are more restrictive than those for a highway facility in both horizontal and vertical alignment. However, by combining modes in a corridor, some of the costs can be shared, such as right-of-way acquisition and construction. For example, Metro, the 158-km (98-mile) rail transit system being built in the Washington, D.C., area, was proposed to use the I-66 median for rail lines. Because it now appears that I-66 will not be built, Metro wants to maintain control of sufficient right-of-way within the current highway corridor to build lines. California is now considering multimodal transportation corridors, particularly when new facilities are planned.

There are many instances across the country in which right-of-way lines of a highway and a railroad abut each other; thus, both modes are using the same corridor.

Table 1. Accident rates on Interstate and federal-aid primary and secondary highway systems.

System	Fatalities	Injuries	Rate[a] Fatality	Injury
Interstate	4 946	169 225	2.31	78.92
Federal-aid primary				
Interstate	1 680	65 916	4.39	172.44
Other	18 681	750 852	4.79	192.42
Total	20 361	816 768	4.75	190.63
Federal-aid secondary				
State	9 262	283 493	6.31	193.13
Local	4 542	227 730	5.21	261.22
Total	13 804	511 223	5.90	218.50

[a]Per 62 million vehicle-km (100 million vehicle-miles) traveled.

Safety Features of Higher Design Speeds

Higher design speeds not only meet today's mobility demands but also generally provide a higher order of safety. Several research studies (4, 5) have shown that geometric elements such as longer sight distances, flatter horizontal curves, and flatter grades decrease accident experience. A comparison of the 1973 fatal and injury accident rates for the Interstate, federal-aid primary, and federal-aid secondary highway systems (Table 1) indicates generally that as design speed decreases the accident rate increases (10).

Recent research has shown that the flatter grades and flatter horizontal curves associated with the higher design speeds reduce fuel consumption (11). Thus, the use of a lower design speed to reduce construction costs will cause an increase in vehicle operating costs.

An issue related to the general safety implications of lower design speeds is the mixing of design speeds, e.g., a section having a 113-km/h (70-mph) design speed followed by a section with an 88-km/h (55-mph) design speed. An example of this is in Washington, D.C., where the Capitol Beltway (I-495) goes through Rock Creek Park. In the Rock Creek Park section, a lower design speed was imposed; however, in spite of the 80-km/h (50-mph) speed limit, the accident rate is higher in this section than in the two adjoining sections having higher design speeds. The accident rate through Rock Creek Park was 106/100 million vehicle-km (171/100 million vehicle-miles) as compared to 84/100 million vehicle-km (135/100 million vehicle-miles). Such situations violate driver expectancy (8); consequently, highway engineers have been accused of ignoring the human element in the design process.

Increase in the Use of Small Cars

The increasing use of small cars (compacts and subcompacts) is causing concern about whether the current sight distance requirements—1.14-m (3.75-ft) eye height and 0.15-m (0.5-ft) object height—are inadequate (9). New Jersey has indicated that inadequate sight distance may be a cause for the increase in small car accidents occurring in that state. Canada is also concerned that the eye height is inappropriate because of the increasing number of smaller cars on their highways; therefore, as part of their metrication effort, a 1.05-m (3.45-ft) eye height has been recommended as a change to Canadian geometric design standards. Should a lower eye height be accepted, a longer sight distance on crest vertical curves would be required.

Liability of Highway Engineers

The question of liability of highway engineers in negligence suits resulting from highway accidents should be considered. Paul W. Clark, former chief of litigation for the State Highway Commission of Kansas, pointed out that, in some instances, the courts have specified that the design be implemented when they believe the highway agency has not appropriately improved a highway feature in accordance with advanced state of the art in highway safety (6). Many states have given up their sovereign immunity and have thus opened the way for personal negligence suits against the highway engineer at all levels.

SUMMARY

An 88-km/h (55-mph) design speed or any other criterion should not be adopted as an immediate panacea to current fiscal problems without a good understanding of the implications of such decisions. Currently under way and planned is research that will provide a better understanding of the many unknowns of this situation. The objectives of one ongoing study (12) are to

1. Quantify the effect on accident frequency and severity of varying the magnitude, size, or dimension of each roadway and roadside design element and combinations of the elements,
2. Develop a methodology for measuring the cost effectiveness of these elements or combinations, and
3. Provide a readily usable design guide for the highway design engineer.

FHWA has plans to expand the work of Laughland and Schoon (12) so that most, if not all, of the geometric design elements or combinations recommended for further research will be investigated. The FHWA study will use the earlier work as a basis for beginning the FHWA research. Both a literature review and evaluation methodology will be used, and this research will only be done on those geometric elements or combinations that cannot be comprehensively evaluated in the earlier work.

Formal documentation of these studies will not be available until late in 1977; however, interim results of various investigations will be readily available from the progress reports required during the conduct of these research efforts.

Thus, the energy crisis should not be permitted to affect existing geometric design standards at least until ongoing or planned research is completed.

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