AN ASSESSMENT OF CHANGES IN TRUCK DIMENSIONS ON HIGHWAY GEOMETRIC DESIGN PRINCIPLES AND PRACTICES

C. Michael Walton and
Ogilvie Gericke

SUMMARY REPORT 241-2(S)

SUMMARY OF

RESEARCH REPORT 241-2

PROJECT 3-8-78-241

CENTER FOR TRANSPORTATION RESEARCH
BUREAU OF ENGINEERING RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN
JUNE 1981

SUMMARY REPORT 241-2(S)

Introduction

A set of issues surrounding the legal limits to sizes and weights of motor vehicles has become a primary policy concern of government and the affected industry. Such concern is reflected by current Federal initiatives (stemming from the Surface Transportation Act of 1978), related study activities, and actions of several State transportation agencies.

Fuel shortages and rapidly increasing fuel prices have provided an impetus to resolve many of the problems associated with vehicle sizes and weights. The underlying notion is frequently reflected in the simple relationship — larger vehicles can carry more freight per unit of fuel. Fuel savings then become a means of effectiveness for the evaluation of changes permitting larger vehicles.

Although fuel conservation is important, it is only one of many measures that may be used in an analysis of the size and weight issues.

In Texas, a study is underway to evaluate some of the effects of operating larger and heavier vehicles on the highway system. Initial results, using a study technique modified from NCHRP Report 141, showed estimated pavement costs, bridge costs, truck operating cost savings, and fuel savings that would result from increases in axle and gross vehicle weight limits coupled with corresponding changes in vehicle unit lengths and width. No change in the height of vehicles or trailers is considered in this study. The work reported in Report 241-2 focuses on the costs of the geometric design and redesign requirements associated with increases in vehicle size (length and width) as well as height. A joint interim report, 231-Interim, "Economic Analysis of Effects of Heavy Trucks on Texas Highways," was published in September 1978.

Scope

As an initial assumption, four different vehicle combinations and two highway classification schemes are considered.

First, the three functional rural highway systems are considered in the analysis. This is a traditional approach which fits the Texas highway network of about 60,000 miles:

(1) the Interstate highway system,
(2) the U.S. and State highway system, and
(3) the farm-to-market road system.

Second, the following rural functional classes, or combination of classes, are considered in the analysis. This differentiates on the basis of road use:

(1) the Interstate highway system,
(2) the principal arterial systems (including Interstate), and
(3) a combination of "all classes" (Interstate, other principal arterials, minor arterials, major collectors, and minor collectors, excluding county roads that may be part of the above).

It was desirable to examine highway upgrading costs according to the above rural systems as the usage, design standards, and vehicle composition differ.

Note that urban, county, and local roads were excluded from the scope of this study. Subsequent activities are planned to include these streets and roads, which represent some 250,000 miles in Texas.

Four alternative scenarios were developed to provide a framework for analyzing a significant change in truck dimensions and weight patterns. Scenario A represents the current statuses and assumes that these weight and dimension limits will remain the same over the twenty-year analysis period. The other three scenarios represent an array of changes in gross vehicle weights, single axle weights, tandem axle weights, lengths, and widths.

Conclusions

Assuming that either one of scenarios B, C, and D is implemented and the reasoning and assumptions made to establish the effect of these scenarios on the design elements, cross section elements, and intersection design elements are reasonable, then the following can be expected.

Stopping Sight Distance

No change from the current policy is foreseen due to the ability of the 2-S1-2-2 and 3-S2-4 combinations to stop within the AASHTO braking distances.

Passing Sight Distance

Although the implementation of any one of scenarios B, C, and D will require additional sight

distance, the current pavement marking policy remains unaffected and no upgrading costs are required.

This element is only applicable to two-lane, two-way operations, and, if the current pavement marking practice is maintained, an adverse effect on safety can be expected.

Pavement Widening on Curves

Due to the increased offtracking characteristics of the 3-S2-4, additional pavement width will be needed if scenario C or D is implemented.

Critical Lengths of Grades

While the performance of today's trucks is superior to that of the AASHTO national representative truck, no adverse effect on the climbing ability of trucks is expected should either one of scenarios B, C, and D be implemented.

Lane Width

Although no change in the SDHPT policy is expected, a 6-inch increase in vehicle width will necessitate strict adherence to the current desirable standards. This will have a pronounced cost effect for either scenario B, C, or D. While this is the existing policy being strictly adhered to, the cost estimates should not be considered as over and above that for scenario A because the same costs will be necessary if the SDHPT road network is upgraded to the current policy.

Width of Shoulder

Here as for "Lane Width" no change in the current SDHPT policy is expected, but a strict adherence to this policy is recommended. This will be very costly for some of the road classes. This cost should not be considered as "over and above" that for scenario A, for the reason given in "Lane Width" above.

Minimum Design for the Sharpest Turns

Due to the increased offtracking characteristics and decreasing turning ability, especially for the 3-S2-4, additional pavement width will be needed in confined spaces to allow for the implementation of scenario C or D. While it is assumed that the existing intersections on all the road classes are designed to allow for the operation of scenario A, this is not so, especially for the Farm-to-Market roads. Estimates for all four of the intersection design elements are included because of the close relationships.

Width for Turning Roadways

As for "Minimum Design for Sharpest Turns" additional pavement width will be needed to accommodate the 3-S2-4 vehicle if either one of scenarios C and D is implemented.

Sight Distance for At-Grade Intersections

Additional sight distance will be needed because of the increase in truck length and the additional time required to cross an intersection. No cost estimate was made to allow for scenario C or D, because insufficient information was available on the existing sight distances or the restriction on sight distance at intersections.

Median Openings

Due to the increased offtracking characteristics of the vehicle combinations in scenarios C and D, additional pavement area will be needed to accommodate the 3-S2-4 and 2-S1-2-2 without undue encroachment on adjacent lanes.

Cost Estimates

Table 1 shows the total estimated cost to upgrade the different elements of the existing road network should either one of scenarios B, C, and D be implemented.

TABLE 1. SUMMARY OF COSTS TO ALLOW FOR SCENARIO B, C, OR D (IN THOUSANDS OF DOLLARS)

Item	Interstate Highways	U.S. and State Highways	Farm-to-Market Highways	Interstate Highways	All Principal Arterials	"All Systems"
Scenario B	939	1,068,212	1,791,562	939	329,139	2,860,713
Scenario C	1,908	1,073,727	1,964,388	1,908	336,581	3,040,023
Scenario D	1,908	1,073,727	1,964,388	1,908	336,581	3,040,023

Recommendations

Regarding the Efforts of This Study

If any one of scenarios B, C, and D is implemented, some alterations to the Texas highway network may be necessary.

While there is so little difference in cost of modifying the geometrics of the highway system between the implementation of scenario B, C, or D, other considerations such as pavement and bridge effects will have a bearing on the evaluation of changes in the legal size and weights of motor vehicles.

Regarding the Need for Future Research

The existing procedure used by AASHTO to calculate the required passing sight distance considers only the case of a passenger car overtaking a passenger car. Because of the serious safety implications, future research involving the relationship between passing sight distance and passing maneuvers which involve trucks and truck lengths needs more attention.

The performance of trucks on grades (acceleration and deceleration) needs attention because the current AASHTO standards are based on a 400:1 ratio while the proposed standards are based on a 300:1 ratio. If larger trucks are introduced there may be a shift back towards the 400:1 ratio and this will need future monitoring.

The question of lane width, safety, and vehicle width also needs additional attention in order to arrive at a definitive standard for lane width. A move towards a cost effective design can be accomplished only if additional safety implications are known and a cost assessment is made respective to the tradeoffs of safety and lane width.

As for lane width, a more conclusive study of shoulder width, safety, and vehicle width is needed.

This study represents one element of a broad set of issues surrounding the legal size and weights of motor vehicles, principally trucks. One concern has been the cost of redesign or modifications required to our existing highway network to accommodate a range of possible vehicle types, sizes, and configurations. It is intended that this study coupled with other ongoing studies in Texas and elsewhere will assist in developing the necessary data on which future decisions can be founded.

KEY WORDS: geometric design, truck/trailers, truck laws and regulations, rural highways, upgrading, cost analysis

The research reported here was conducted for the Texas State Department of Highways and Public Transportation.

The full text of Research Report 241-2 can be obtained from Mr. Phillip L. Wilson, State Planning Engineer, Transportation; Transportation Planning Division, File D-10R; State Department of Highways and Public Transportation; P. O. Box 5051; Austin, Texas 78763.