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Movement of 14-Foot-Wide Manufactured Housing Units with Roof Eaves of 1 Foot or Less

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Abstract

This study was carried out in response to a request from the Virginia Manufactured Housing Association to be allowed by blanket permit to ship homes 14 feet wide at the base with roof eaves of up to 1 additional foot. In Virginia, the current maximum width allowed to be shipped under a blanket permit is 14 feet.

This two-part study included (1) a survey of the policies and practices of other states, and (2) an analysis of centerline and edgeline encroachment data obtained by videotaping test runs of one standard 14-foot-wide control unit and three 14-foot-wide experimental units with different 1-foot roof-eave configurations made available by the industry.

Forty-two states replied to the survey: 34 reported that movement of housing units more than 14 feet wide is permitted, and 23 reported that movement of units 16 feet wide, or wider, is permitted.

The pilot study identified four measures of risk to other travelers. From greatest to least potential risk, they were (1) wheels over the centerline, (2) side over the centerline, (3) wheels over the edgeline, and (4) side over the edgeline.

The encroachment data were analyzed by total trip and by trip segment, which was based on the number of lanes of travel. The portions of the total trip with two and three lanes of travel are equivalent to roads that require a single-trip permit, and the portions with four or more lanes are equivalent to most roads in the blanket permit network.

It was found that both for the total trip and for segments with four or more lanes of travel, the experimental units did not have more encroachment than the control unit for three measures of risk (wheels over centerline, side over centerline, and wheels over edgeline). Although the experimental units had statistically more encroachment than the control unit for the fourth measure (side over edgeline), most of the encroachment was on the four-lane divided segments and the actual differences were relatively small (less than 4% of the trip). The experimental units had more encroachment of the centerline (wheels and side) than the control on segments with two or three lanes but not more encroachment of the edgeline (wheels and side).

It was concluded that 14-foot-wide housing units with roof eaves up to 1 additional foot would create minimal additional safety risk to other motorists on roads with four or more lanes but have the potential to impose additional safety risks on roads with two or three lanes.

It is recommended that VDOT allow the industry to move 14-foot-wide housing units with roof eaves up to 1 foot on the blanket permit network. It is also recommended that the industry be required to maintain data on crashes, vehicle miles of travel (exposure), and route movements of these wider loads and furnish it to VDOT upon request. In addition, it is recommended that VDOT carefully evaluate requests to move these units on roads with two or three lanes to ensure there is sufficient roadway width and roadside clearance for a safe move. Finally, it is recommended that VDOT encourage AASHTO to undertake through the National Cooperative Highway Research Program a national study of all types of wideload movements so that uniform standards can be established for use by all states.

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TECHNICAL ASSISTANCE REPORT

MOVEMENT OF 14-FOOT-WIDE MANUFACTURED HOUSING UNITS WITH ROOF EAVES OF 1 FOOT OR LESS

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Transportation and the University of Virginia)

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EXECUTIVE SUMMARY

Background

In response to a request from the Virginia Manufactured Housing Association, the Virginia Department of Transportation (VDOT) asked the Virginia Transportation Research Council (VTRC) to conduct a brief examination of associated issues. The request was that "Virginia allow the construction and shipment of homes with eaves measuring 15 feet in width . . . under the current blanket permit used by all transporters of manufactured homes."

Since 1977, Virginia has permitted the movement of housing units up to 14 feet in width with a blanket permit. Housing units exceeding the 14-foot width limitation may be moved with a single-trip permit from the VDOT Permit Office if they meet the emergency, national defense, and short distance criteria spelled out in Section 5.0170 of the *Hauling Permit Manual.*

Because neither the time nor staff were available for an extensive study, such as the one VTRC conducted in 1976 regarding a proposal to increase the maximum width allowed from 12 feet to 14 feet, VTRC staff agreed to work with staff from VDOT's Traffic Engineering Division to generate data sufficient to make a decision on the request. Accordingly, it was determined that the two-part study should include (1) a survey of the policies and practices of other states, and (2) an analysis of centerline and edgeline encroachment data obtained from videotaping test runs of a standard 14-foot-wide control unit and three 14-foot-wide experimental units with different 1-foot roof-eave configurations made available by the industry. The experimental units were (1) a single-wide house with a 6-inch eave on each side (SW), (2) half of a double-wide house with a 1-foot eave on the edgeline side of the road (ELE), and (3) half of a double-wide house with a 1-foot eave on the centerline side of the road (CLE). The industry also provided an experienced driver for two complete days of test runs. The VDOT's Surface Transportation Assistance Act (STAA) study team videotaped the movements of the units. The four units each traveled the same 64.1-mile section of highway in the Danville, Virginia, area on August 7 and 8, 1991.

Survey of States

Forty-two states replied to a mailed survey: 34 reported that movement of housing units over 14 feet wide is permitted, and 23 reported that movement of units 16 feet or wider is permitted. Additionally, all of Virginia's border states, except West Virginia, permit the transport of housing units over 14 feet wide.

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Pilot Study

Loads more than 12 feet wide have the potential to create a safety risk for other highway users since they are wider than most traffic lanes in Virginia and, therefore, must encroach on the shoulder, an adjacent lane, or both. Although the degree of the safety risk created by 14-foot-wide housing units appears to depend also on three other factors (traffic volume, lane width, and roadside clearance), the nature of the data that could be obtained from the videotapes of the four trip movements allowed analysis only on the basis of type of housing unit, number of seconds of centerline and edgeline encroachment, and number of lanes of travel.

Four measures of risk were analyzed. From the greatest to least potential risk, they were (1) wheels over the centerline, (2) side over the centerline, (3) wheels over the edgeline, and (4) side over the edgeline.

As previously pointed out, this study was limited to transporting only four housing units over 64.1 miles of roadway by one industry-provided skilled driver. In addition, there were several factors that limited the collection of complete encroachment data. These factors included the occurrence of vehicles pulling between the camera van and the housing unit, the horizontal and vertical curvature of the roadway causing the housing unit to be out of the picture occasionally, video camera malfunction, and traffic conditions. When considering the data presented herein concerning statistical differences, the reader is cautioned to note that there were 1.2 total miles (1.9% of total miles) of two-lane roadway, 0.6 mile of three-lane roadway (0.9%), 1.7 miles of four-lane nondivided roadway (2.7%), 6.7 miles of five- lane roadway (10.4%), and 53.9 miles of four-lane divided roadway (84.1%). A small difference in the number of seconds of encroachment yields a large percentage difference on the short segments of the trip and could result in a statistical difference.

Total Trip

The total trip encroachment data in Table ES-1 suggested four important findings.

1. Encroachment over the centerline by the wheels is rare, and the results for all four units are quite similar. The only significant difference favors one of the experimental units.

Table ES-1
ENCROACHMENT BY TYPE OF UNIT AND MEASURE OF RISK ON ALL ROADS COMBINED (% of Trip)[a]

Criteria	Control	SW	ELE	CLE
Wheels over centerline	3.2	2.7	3.0	2.6*–
Side over centerline	36.6	34.9*–	34.7*–	33.2*–
Wheels over edgeline	3.0	3.7*+	3.0	2.8
Side over edgeline	68.2	73.4*+	73.9*+	73.5*+

[a] See Appendix D for seconds of encroachment.
* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

2. Although encroachment over the centerline by the side is frequent (the side of each unit is intruding into an adjacent travel lane roughly one-third of the time), the results again show great consistency. For this risk measure, however, the experimental units had statistically less encroachment than the control unit.

3. Encroachment over the edgeline by the wheels is also uncommon, and there is little difference in the results for the four units. The only significant difference favors the control unit.

4. Encroachment over the edgeline by the side is common (the side of each unit is intruding onto the shoulder of the roadway for more than two-thirds of the trip), but the results are also relatively consistent. Although there is almost no difference in edgeline encroachment among the experimental units, all three had statistically more encroachment than the control unit.

Trip Segment

The encroachment data were further evaluated according to trip segment based on the number of lanes of travel to determine if differences existed due to the unique attributes of each segment and, if so, if the differences might suggest a regulatory policy. The two- and three-lane segments are equivalent to roads that require the hauler to obtain a single-trip permit, use an escort vehicle, or do both. Segments with four or more lanes are equivalent to roads in the blanket permit network.

The trip segment encroachment data in Table ES-2 suggested three findings.

1. Encroachment over the centerline by the wheels occurred for a relatively small percentage of the time it took to travel the road segments with two or three lanes.

2. On the two-lane segments, two experimental units had statistically more centerline wheel encroachment than the control, and on the three-lane segment, one experimental unit had statistically more centerline wheel encroachment.

Table ES-2
ENCROACHMENT BY TYPE OF UNIT AND WHEELS OVER LINE ON ROADS WITH TWO OR THREE LANES (% of Trip)[a]

Criteria	No. Lanes	Control	SW	ELE	CLE
Wheels over centerline	2	2.2	2.6	9.8*+	6.8*+
	3	0.0	0.0	1.2	9.1*+
Wheels over edgeline	2	5.3	9.5*+	4.2	5.4
	3	0.0	5.2	1.2	0.0

[a] See Appendix D for seconds of encroachment.
* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

3. Encroachment over the edgeline by the wheels occurred for a relatively small percentage of the time it took to travel the two- and three-lane segments. The only statistical difference was for the two-lane segments. In this case, one experimental unit had more encroachment than the control.

The trip segment encroachment data in Table ES-3 suggested three findings.

1. Encroachment over the centerline by the wheels is rare on four-lane divided and five-lane segments. The experimental units had statistically less encroachment on the four-lane divided segments.

2. Encroachment over the centerline by the wheels was relatively common on the four-lane nondivided segments. The only significant difference favored one of the experimental units.

3. Encroachment over the edgeline by the wheels was rare. The only statistical difference was for the five-lane segments. In this case, one experimental unit had more encroachment than the control.

Table ES-3
ENCROACHMENT BY TYPE OF UNIT AND WHEELS OVER LINE ON ROADS WITH FOUR OR MORE LANES (% of Trip)[a]

Criteria	No. Lanes	Control	SW	ELE	CLE
Wheels over centerline	4 nondivided	23.8	23.3	25.0	9.9*–
	4 divided	3.1	1.8*–	2.2*–	2.1*–
	5	1.0	1.8	1.8	1.5
Wheels over edgeline	4 nondivided	0.0	0.0	0.0	0.0
	4 divided	3.6	4.3	3.4	3.4
	5	0.1	0.0	0.6*+	0.0

[a] See Appendix D for seconds of encroachment.
* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

Table ES-4
ENCROACHMENT BY TYPE OF UNIT AND SIDE OVER LINE ON ROADS WITH TWO OR THREE LANES (% of Trip)[a]

Criteria	No. Lanes	Control	SW	ELE	CLE
Side over centerline	2	22.5	36.8*+	20.0	17.6
	3	53.6	69.0*+	79.5*+	71.4*+
Side over edgeline	2	84.1	84.7	87.9	87.8
	3	84.5	70.7*–	72.3*–	75.3

[a] See Appendix D for seconds of encroachment.
* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

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Table ES-5
ENCROACHMENT BY TYPE OF UNIT AND SIDE OVER LINE ON ROADS WITH FOUR OR MORE LANES (% of Trip)[a]

Criteria	No. Lanes	Control	SW	ELE	CLE
Side over centerline	4 nondivided	84.9	89.0	93.4*+	90.8*+
	4 divided	24.7	22.5*–	23.9	19.9*–
	5	92.6	82.6*–	94.3	88.0*–
Side over edgeline	4 nondivided	19.8	20.7	13.8	16.2
	4 divided	79.6	83.3*+	82.8*+	83.3*+
	5	11.2	32.8*+	23.6*+	35.3*+

[a] See Appendix D for seconds of encroachment.
* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

The trip segment encroachment data in Table ES-4 suggested two findings.

1. Encroachment over the centerline by the side was common on the two- and three-lane segments. The experimental units had statistically more encroachment than the control on the three-lane segment, and one experimental unit had more encroachment on the two-lane segments.

2. Encroachment over the edgeline by the side was common on the two- and three-lane segments. Two of the experimental units had statistically less encroachment than the control on the three-lane segment.

The trip segment encroachment data in Table ES-5 suggested two findings.

1. Encroachment over the centerline by the side was common on four-lane nondivided and five-lane segments and relatively frequent on the four-lane divided segments. The four statistical differences for the four-lane divided and five-lane segments favored the experimental units. With both statistical differences for the four-lane nondivided segments, the experimental units had more encroachment than the control.

2. Encroachment over the edgeline by the side was common on the four-lane divided segments and relatively common on the four-lane nondivided and five-lane segments. The experimental units had statistically more edgeline encroachment on four-lane divided and five-lane segments.

Summary

The encroachment data showed that when considered on the basis of the entire trip, the experimental units had more encroachment in only one of the four measures of risk: side over the edgeline. For the other three measures, the encroachment data favored the experimental units.

On segments with four or more lanes, wheel encroachment over the centerline and edgeline generally favored the experimental units (i.e., less encroachment than the control). The experimental units generally had less encroachment over the centerline by the side on the four-lane divided and five-lane segments and generally more on the four-lane nondivided segments. Overall, the encroachment data for these three criteria (wheel over centerline, wheel over edgeline, and side over centerline) generally favored the experimental units. For the fourth criteria, the experimental units had more encroachment over the edgeline by the side on the four-lane divided and five-lane segments.

The encroachment data showed that the experimental units had more encroachment only for the side over the edgeline (the lowest level of potential risk), most of the encroachment was on the four-lane divided segments, and the *difference* in edgeline encroachment between the control unit and the experimental units was small (79.6% v 83.3%). Thus, the additional 1-foot roof eave overhanging the edgeline 10 feet above the ground should create minimal additional safety risk to other motorists since these wider roads generally have wide shoulders and/or clear zones.

On two- and three-lane segments, the experimental units generally had more encroachment over the centerline by the wheels, although the encroachment occurred for a relatively small percentage of segment travel time and exceeded 10 seconds in only one case. The data also showed that the experimental units generally had more encroachment over the centerline by the side. When there was encroachment over the edgeline by the wheels, the one statistical difference showed that an experimental unit had more encroachment. When there was encroachment over the edgeline by the side, both statistical differences favored the experimental units.

Because these data showed that the experimental units have more centerline encroachment on two- and three-lane roads (roads that require a single-trip permit), these increased encroachments have the potential to impose additional safety risks for other motorists.

Recommendations

1. In light of the encroachment data for roads with four or more lanes, VDOT should allow the manufactured housing industry to move 14-foot-wide units with eaves up to 1 foot on the blanket permit network of roads. However, the housing industry should also be required to maintain (and furnish upon state request) data relative to crashes, vehicle miles of travel (exposure), and route movements.

2. In light of the encroachment data on roads with two and three lanes of travel, VDOT should carefully evaluate all requests to move housing units with eaves on these roads to ensure that there is sufficient roadway width and roadside clearance for a safe move. VDOT should also consider requiring the hauler to use both a front and rear escort vehicle in transporting 14-foot-wide housing units with eaves on two- and three-lane roadways.

3. VDOT should seek a national study of all types of wideload movements (e.g., an NCHRP study) so that uniform standards can be established for use by all states.

TECHNICAL ASSISTANCE REPORT

MOVEMENT OF 14-FOOT-WIDE MANUFACTURED HOUSING UNITS WITH ROOF EAVES OF 1 FOOT OR LESS

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BACKGROUND

In September 1990, the Executive Director of the Virginia Manufactured Housing Association (VMHA) wrote the Virginia Department of Transportation's (VDOT) Permit and Truck Weight manager and formally requested that "Virginia allow the construction and shipment of homes with eaves measuring 15 feet in width . . . throughout the Commonwealth of Virginia under the current blanket permit used by all transporters of manufactured homes." The letter stated that North Carolina, Georgia, and other southern states already permitted the shipment of 14-foot-wide housing units with eaves of up to 1 foot. VMHA claimed that the 14-foot restriction put Virginia manufacturers at a competitive disadvantage compared to manufacturers in these other states because they were not able to build and ship units with wider dimensions. The letter further stated that "this change would allow for a more conventional look to manufactured housing and allow [the] . . . industry to be competitive with . . . site builders throughout the state."

A blanket permit, also called an annual permit, must be carried in the truck while the oversized load is being transported. Under blanket permit provisions, the oversized load must be transported on a specifically designated network of roadways. Most of the road segments in this network have multiple lanes. Transport on any network road segment with fewer than four lanes requires the use of an escort vehicle for that portion of the trip. Transport of an oversized load on road segments off the network requires a single-trip permit, which is issued after VDOT has completed an analysis of the roads to be used, and also requires the use of an escort vehicle.

In order to investigate the feasibility of granting VMHA's request, and to estimate the level of risk associated with such a policy change, the state Maintenance Engineer requested that the Virginia Transportation Research Council (VTRC) assist VDOT in responding to the industry's request to amend Section 5.0170(4) of the state *Hauling Permit Manual*. Because neither the time nor staff were available for an extensive study, such as the one VTRC conducted in 1976 regarding a proposal to increase the maximum width allowed from 12 feet to 14 feet, VTRC staff agreed to work with staff from VDOT's Traffic Engineering Division to generate data sufficient to make a decision regarding the request. Accordingly, it was determined that a study should include (1) a survey of the policies and practices of other states, and (2) an analysis of centerline and edgeline encroachment data obtained from videotaping test runs of housing units.

DISCUSSION OF ISSUES

The movement of manufactured housing units occurs in a dynamic and changing traffic environment. During the pilot study reported herein, the driver of the housing unit used his CB radio to stay in contact with other trucks as they approached and varied his lateral placement within the travel lane as necessary. He stated that this was a common practice among professional truckers. As long as the wheels of a housing unit do not touch the line, the maximum encroachment by the side of a 14-foot-wide house over the line is 30 inches. On lanes 12 feet wide, a 30-inch centerline encroachment allows 9.5 feet (114 inches) of lane width for use by other motorists.

If a driver places the unit so as not to impede other motor vehicles, either those in an adjacent lane going in the same direction or those in an oncoming lane, he must, of necessity, move toward the shoulder of the highway and encroach the edgeline. If the wheels do not touch the edgeline, the side of the housing unit encroaches for a maximum of 30 inches. This is not to say that traveling in this manner is completely safe, because there is the possibility of colliding with objects along the shoulder. Of the four classifications of risk used in this study, traveling with the side of the housing unit encroaching the edgeline carries less potential safety risk to other motorists than encroaching the centerline.

Another issue to be considered involves the wheels of the housing unit being across the edgeline. Not all encroachment results in the wheels being off a paved surface, because in most instances, encroachment occurs when a driver gives way to other vehicles when he or she has room to do so. Room to move across the edgeline is available at exit and entrance ramps, at intersections, and at places where part of the shoulder is paved beyond the edgeline.

METHOD

The Surface Transportation Assistance Act (STAA) of 1982 increased the size (width and weight) of commercial trucks permitted on U.S. highways. Several states attempted to restrict the movement of these larger trucks on some highways outside the interstate system using a variety of safety arguments. Subsequent court cases established that the states must show that the larger trucks are more of a risk to the public than are other commercial vehicles currently permitted to travel. Although the current state requirements for the movement of manufactured housing are not an STAA issue, similar safety and legal arguments may apply. In light of this, the procedures used in this study were designed to determine whether housing units with roof eaves caused any additional safety risk to the motoring public when compared with a unit of the same width without eaves.

Survey of States

A questionnaire sent to the hauling permit office of each state requested information on their policies and practices in the movement of overwide manufactured housing units and requested any data or studies they had available on the movement of such units (see Appendix A).

Pilot Study

The pilot study of the movement of housing units included one 14-foot-wide unit without eaves, the largest currently permitted to be transported under blanket permit provisions, and three units with different configurations of roof-eave overhang. Each trip was videotaped by VDOT's STAA Analysis team. Figures B-1 through B-4 in Appendix B show the dimensions and features of each of the housing units. The four housing units were:

1. a 14-foot-wide half of a double-wide house without eaves (control)
2. a 14-foot-wide single-wide house with a 6-inch roof eave on each side (SW)
3. a 14-foot-wide half of a double-wide house with a 1-foot eave on the edgeline side of the roadway (ELE)
4. a 14-foot-wide half of a double-wide house with a 1-foot eave on the centerline side of the roadway (CLE).

The eaves of the experimental units were just over 10 feet above the paved surface of the roadway.

Each housing unit was transported over the same 64.1 miles of highway in the Danville area. The same industry-provided driver was used for the entire pilot study, a driver with obviously excellent skills. Each trip movement included two-lane (1.2 miles), three-lane (0.6 mile), four-lane nondivided (1.7 miles), four-lane divided (53.9 miles), and five-lane (6.7 miles) segments of roadway. The trips included travel through both urban and rural areas. When the data were categorized by the number of lanes of travel, each group (except for the three-lane segment) contains from two to four separate road segments. The data in Table 1 show that most of the road segments used in this demonstration had 12-foot lane widths. The two-lane segments had 11-foot lanes, and there was a 5.6-mile section of the four-lane divided roadway that had 10-foot lanes.

Four measures of potential risk to the motoring public were analyzed. Listed from greatest to least potential risk, the control unit was compared with each experimental unit in the percentage of the trip that:

1. the wheels of the housing unit encroached the centerline
2. the side of the housing unit encroached the centerline

Table 1
ROAD SEGMENT FEATURES

No. Lanes	No. Miles	Lane Width (ft)
2	1.2	11
3	0.6	12
4 nondivided	1.7	12
4 divided	5.6	10
4 divided	48.3	12
5	6.7	12
Total miles	64.1	

3. the wheels of the housing unit encroached the edgeline
4. the side of the housing unit encroached the edgeline.

There were several factors that limited the collection of complete encroachment data. These factors included the occurrence of vehicles pulling between the camera van and the housing unit, the horizontal and vertical curvature of the roadway causing the housing unit to be out of the picture occasionally, video camera malfunction, and traffic conditions.

The statistical test for the difference in proportions of independent samples was computed to determine whether the percentage of centerline or edgeline encroachment of the control unit and each of the experimental units differed at the $p < .05$ level. These comparisons were carried out for each roadway type separately and for all road sections combined for each of the four measures of potential risk. When considering the data presented herein concerning statistical differences, the reader is cautioned to note that a small difference in the number of seconds of encroachment on the short segments of the trip yields a large percentage difference and could result in a statistical difference.

There was one case involving the wheels across the centerline on the three-lane segment where a statistical test could not be computed because the control unit had 0 seconds of encroachment but the experimental unit encroached for 9.1% of the trip. In this case, 1 second of encroachment was assigned to the control unit so that computations could be performed. This is a conservative approach, because if a statistically significant difference is found for 1 second of encroachment by the control unit, it will also apply for the lesser actual encroachment of 0 seconds.

FINDINGS

Survey of States

Replies were received from 42 states (including Virginia): 34 stated that the movement of manufactured housing units wider than 14 feet is permitted (see

Table 2
ALLOWABLE HOUSING UNIT WIDTH

No. States	Maximum Width Stated (ft)
8	14
8	14 plus eaves
3	Greater than 14 but less than 16
15	16
8	Over 16
42	

Table 2), and 23 replied that movement of units of 16 feet or wider is permitted. In addition, all of Virginia's border states except West Virginia permit the movement of housing units in excess of 14 feet.

The data in Table 3 show responses to the question on how the decision to establish a maximum width for housing units was made. The responses fell primarily into three categories: department judgment (17), pressure by the industry (12), and legislative enactments (12).

Two questions dealt with the issue of research with regard to the movement of wide housing units. Only 10 states had performed any study of wide housing units: 4 had conducted informal studies and no report was available; 1 stated only that they had no information of a crash problem, and 5 (Michigan, Missouri, New Hampshire, North Carolina, and Virginia) had conducted a "study" of wide loads for which some written documentation was prepared. Only Virginia and Michigan had published a report; although the other 3 states had prepared written documentation, a report was not published. Colorado plans to conduct a study in the future.

The results of the five "studies" with written documentation can be summarized as follows.

1. Virginia recommended that the 14-foot-wide manufactured housing units under consideration be permitted to be moved.

Table 3
METHOD FOR ESTABLISHING MAXIMUM WIDTH

Decision Based on	States Allowing 14 ft+ Wide[a]	States Denying 14 ft+ Wide
Department judgment	17	5
Industry pressure	12	0
Legislative resolution	9	3
Research, experience, trial movements	4	0
Other	5	0

[a]Several states gave multiple responses.

2. Michigan (14 feet v. 16 feet) concluded that the wider load could be moved on multilane road segments in relative safety but safe movement on the two-lane segments would require a major upgrade of the shoulder.
3. Missouri (12 feet v. 14 feet) made no recommendation on whether to allow the movement of the wider load, but loads as wide as 16 feet are currently allowed due to legislative mandate.
4. New Hampshire recommended that loads more than 14 feet wide not be permitted, and this remains the policy in the state.
5. North Carolina (14 feet v. 14 feet with eaves) recommended that the wider load with eaves be permitted.

Only North Carolina and South Carolina had crash data available on manufactured housing units, and California has just begun collecting data. Only Florida had an estimate of vehicle miles traveled by manufactured housing units.

Pilot Study

Overview

Figures C-1 through C-4 in Appendix C show examples of the typical lateral placement of the housing units on the three-lane widths measured. These depictions are based on the encroachments observed on the road segments shown. Figure C-1 shows that on the 11-foot-wide two-lane segments, the encroachment occurred primarily on the edgeline. Figure C-2 shows that on the 12-foot-wide five-lane segments, mail boxes, telephone poles, and other objects at the edge of the roadway forced the housing units to encroach on the adjacent travel lane. On these sections of highway, it was common for vehicles to go out of their travel lane into the center turn lane when passing the housing unit. Figure C-3 shows that on the 10-foot-wide four-lane divided segments, the housing units encroached on both the edgeline and centerline and, in fact, impeded other vehicles from passing. Figure C-4 shows that on the 12-foot-wide four-lane divided segments, the encroachments were mainly over the edgeline. On these sections of highway, cars, single-unit trucks, tractor-trailers, and other towed vehicles (e.g., Airstream-type trailers) were able to pass easily without leaving their travel lane by moving over to the edgeline of the passing lane.

Loads more than 12 feet wide have the potential to create a safety risk for other highway users since they are wider than most traffic lanes in Virginia and, therefore, must encroach on the shoulder, an adjacent lane, or both. Although the degree of the safety risk created by 14-foot-wide housing units appears to depend also upon three other factors (traffic volume, lane width, and roadside clearance), the nature of the data that could be obtained from the videotapes of the four units allows analysis only on the basis of type of housing unit, seconds of centerline and edgeline encroachment, and number of travel lanes.

This section of the report discusses differences in centerline and edgeline encroachment between the control unit and the experimental units. Tables D-1 through D-5 in Appendix D show the time required to make each trip and the amount of time encroachment occurred.

Wheels Over the Centerline

Of the four encroachment measures used in this study, the wheels being over the centerline creates the greatest potential safety hazard for the motoring public. The data in Table 4 show that the control unit had the wheels over the centerline for 3.2% (3.1 minutes) of the total trip time (98.9 minutes.) The experimental units had a lower rate of total trip encroachment than did the control unit, and one had statistically less.

When the data were considered on the basis of number of lanes of travel, there were eight cases when no statistical difference was found, four cases when the experimental units had statistically less centerline wheel encroachment, and three cases when the experimental units had statistically more centerline wheel encroachment (see Table 5).

Table 4
CONTROL VERSUS EXPERIMENTAL UNITS—
PERCENTAGE OF TIME WHEELS OVER CENTERLINE

No. Lanes	Control	SW	ELE	CLE
2	2.2	2.6	9.8*+	6.8*+
3	0.0	0.0	1.2	9.1*+
4 nondivided	23.8	23.3	25.0	9.9*–
4 divided	3.1	1.8*–	2.2*–	2.1*–
5	1.0	1.8	1.8	1.5
All	3.2	2.7	3.0	2.6*–

* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

Table 5
CONTROL VERSUS EXPERIMENTAL UNITS—
STATISTICAL COMPARISON OF WHEELS OVER CENTERLINE

	Roads with 2 or 3 Lanes		Roads with 4 or More Lanes	
No. Comparisons Where	No.	%	No.	%
Experimental units had statistically more encroachment	3	50.0	0	—
Experimental units had statistically less encroachment	0	—	4	44.4
No statistical difference between units	3	50.0	5	55.6

The data on statistical differences were divided into two categories: those involving a wideload movement on two- and three-lane segments, and those involving a movement on four-or-more-lane segments. The two- and three-lane segments are equivalent to roads that require a single-trip permit, the use of an escort vehicle, or both. The four-or-more-lane segments are equivalent to most roads in the blanket permit network.

On the two- and three-lane segments, wheels encroached over the centerline for a relatively small percentage of the time it took to travel each segment. There were three comparisons (of six) where one of the experimental units had statistically more encroachment. Two of these three cases occurred on the two-lane segments: one experimental unit encroached for 9.8% (21 seconds), the other encroached for 6.8% (10 seconds), and the control encroached for 2.2% (5 seconds). The other case was on the three-lane segment where the experimental unit encroached for 9.1% (7 seconds) and there was no encroachment by the control unit.

On the four-lane divided and five-lane segments, encroachment over the centerline by the wheels was rare (1.0% to 3.1%). The experimental units had statistically less encroachment on the four-lane divided segments, and there was no statistically significant difference for the five-lane segments. Although encroachment over the centerline by the wheels was relatively common (9.9% to 25.0%) on the four-lane nondivided segments, the only statistical difference showed one experimental unit with less encroachment.

Side Over the Centerline

The second greatest potential safety hazard to the motoring public of this study's four encroachment measures occurs when the side of the manufactured housing unit is across the centerline. The data in Table 6 show that the side of the control unit was across the centerline for 36.6% (36.2 minutes) of the trip. The experimental units had statistically less encroachment than did the control unit.

When the data were considered on the basis of number of lanes of travel, there were five cases when no statistical difference was found, four cases when the side of the experimental units had statistically less centerline encroachment than

Table 6
CONTROL VERSUS EXPERIMENTAL UNITS—
PERCENTAGE OF TIME SIDE OVER CENTERLINE

No. Lanes	Control	SW	ELE	CLE
2	22.5	36.8*+	20.0	17.6
3	53.6	69.0*+	79.5*+	71.4*+
4 nondivided	84.9	89.0	93.4*+	90.8*+
4 divided	24.7	22.5*–	23.9	19.9*–
5	92.6	82.6*–	94.3	88.0*–
All	36.6	34.9*–	34.7*–	33.2*–

* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

Table 7
CONTROL VERSUS EXPERIMENTAL UNITS—
STATISTICAL COMPARISON OF SIDE OVER CENTERLINE

	Roads with 2 or 3 Lanes		Roads with 4 or More Lanes	
No. Comparisons Where	No.	%	No.	%
Experimental units had statistically more encroachment	4	66.7	2	22.2
Experimental units had statistically less encroachment	0	—	4	44.4
No statistical difference between units	2	33.3	3	33.3

the control, and six cases when the experimental units had statistically more encroachment than the control (see Table 7).

On the two- and three-lane segments, encroachment over the centerline by the side was common, and a statistical difference occurred in four of the six comparisons. One of these differences was on the two-lane segments and involved an encroachment of 36.8% (70 seconds) for the experimental unit and 22.5% (51 seconds) for the control unit. The experimental units had statistically more encroachment for all three comparisons on the three-lane segment. These involved encroachments of 69.0% (40 seconds), 71.4% (55 seconds), and 79.5% (66 seconds) for the experimental units and 53.6% (45 seconds) for the control.

On the segments with four or more lanes, encroachment over the centerline by the side was common on the four-lane nondivided and five-lane segments and relatively frequent on the four-lane divided segments. Two of the experimental units had statistically more encroachment on the four-lane nondivided segments, one for 90.8% (4.3 minutes) and the other for 93.4% (3.1 minutes), and the control unit encroached for 84.9% (1.8 minutes). Two of the experimental units had statistically less encroachment on the four-lane divided segments, and two had statistically less on the five-lane segments.

Wheels Over the Edgeline

When large-load vehicles use the shoulder of the roadway by placing the wheels over the edgeline, there may be an increased safety risk. The data in Table 8 show that the control unit had the wheels over the edgeline for 3.0% (3 minutes) of the total trip time (98.9 minutes). The experimental units had their wheels over the edgeline for between 2.8% (2.6 minutes) and 3.7% (3.4 minutes) for trips that took between 93.3 and 99.1 minutes to complete. One of the experimental units had statistically more encroachment.

Table 8
CONTROL VERSUS EXPERIMENTAL UNITS—
PERCENTAGE OF TIME WHEELS OVER EDGELINE

No. Lanes	Control	SW	ELE	CLE
2	5.3	9.5*+	4.2	5.4
3	0.0	5.2	1.2	0.0
4 nondivided	0.0	0.0	0.0	0.0
4 divided	3.6	4.3	3.4	3.4
5	0.1	0.0	0.6*+	0.0
All	3.0	3.7*+	3.0	2.8

* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

Table 9
CONTROL VERSUS EXPERIMENTAL UNITS—
STATISTICAL COMPARISON OF WHEELS OVER EDGELINE

	Roads with 2 or 3 Lanes		Roads with 4 or More Lanes	
No. Comparisons Where	No.	%	No.	%
Experimental units had statistically more encroachment	1	16.7	1	11.1
Experimental units had statistically less encroachment	0	—	0	—
No statistical difference between units	5	83.3	8	88.9

When the data were considered on the basis of number of lanes of travel, there were 13 cases when no statistical difference was found, 2 cases when the experimental units had statistically more wheel encroachment, and no case where the experimental units had statistically less wheel encroachment over the edgeline (see Table 9).

Encroachment over the edgeline by the wheels occurred for a relatively small percentage of the time it took to travel the two- and three-lane segments. The only statistical difference was for the two-lane segments. In this case, the experimental unit encroached for 9.5% (18 seconds) and the control unit encroached for 5.3% (12 seconds) of the trip.

Encroachment over the edgeline by the wheels was rare on the four-lane nondivided and five-lane segments and uncommon on the four-lane divided segments. The only statistical difference was on the five-lane segments. In this case, the experimental unit encroached for 0.6% (4 seconds) and the control unit encroached for 0.1% (1 second) of the trip.

Although two cases were found where the experimental units had a statistically greater percentage of wheel encroachment over the edgeline than did the control unit, the differences in encroachment time were so short as not to be a practical difference. In addition, while being over the edgeline, the wheels remained on a paved surface for the greater proportion of the encroachment.

Side Over the Edgeline

When considering these encroachment data, it should be kept in mind that even where a 12-foot-wide lane exists, a 14-foot-wide load will encroach either the centerline, the edgeline, or both. Of the four measures used in this study, the lateral placement of the load within a lane that would cause the least potential safety risk to the motoring public was for each unit to travel with the side of the house over the edgeline and not over the centerline. The data in Table 10 show that the side of the control unit was over the edgeline for 68.2% (67.4 minutes) of the entire trip. The experimental units had statistically more total trip edgeline encroachment than did the control. The side of the experimental units encroached the edgeline for 73.4% (68.4 minutes), 73.5% (69.9 minutes), and 73.9% (73.3 minutes) of the entire trip.

When the data were considered on the basis of number of lanes of travel, there were seven cases when no statistical difference was found, two cases when the experimental units had statistically less edgeline encroachment, and six cases when the experimental units had statistically more edgeline encroachment by the side of the house (see Table 11).

Encroachment over the edgeline by the side was common on the two-lane (84.1% to 87.9%) and three-lane (70.7% to 84.5%) segments. In both cases where a statistical difference was found, the experimental units had less encroachment than the control on the three-lane segment.

Encroachment over the edgeline by the side was common on the four-lane divided segments and relatively common on the four-lane nondivided and five-lane segments. The experimental units had statistically more edgeline encroachment on the four-lane divided and five-lane segments. On the four-lane divided segments, the control unit encroached the edgeline for 79.6% (61.0 minutes) of the trip and the experimental units encroached the edgeline for 82.8% (66.1 minutes), 83.3% (59.9

Table 10
CONTROL VERSUS EXPERIMENTAL UNITS—
PERCENTAGE OF TIME SIDE OVER EDGELINE

No. Lanes	Control	SW	ELE	CLE
2	84.1	84.7	87.9	87.8
3	84.5	70.7*–	72.3*–	75.3
4 nondivided	19.8	20.7	13.8	16.2
4 divided	79.6	83.3*+	82.8*+	83.3*+
5	11.2	32.8*+	23.6*+	35.3*+
All	68.2	73.4*+	73.9*+	73.5*+

* = $p < .05$; + = greater encroachment than control; – = less encroachment than control.

Table 11
CONTROL VERSUS EXPERIMENTAL UNITS—
STATISTICAL COMPARISON OF SIDE OVER EDGELINE

	Roads with 2 or 3 Lanes		Roads with 4 or More Lanes	
No. Comparisons Where	**No.**	**%**	**No.**	**%**
Experimental units had statistically more encroachment	0	—	6	66.7
Experimental units had statistically less encroachment	2	33.3	0	—
No statistical difference between units	4	66.7	3	33.3

minutes), and 83.3% (61.3 minutes). On the five-lane segments, the control unit encroached for 11.2% (1.7 minutes) of the trip and the experimental units encroached for 23.6% (2.6 minutes), 32.8% (4.4 minutes), and 35.3% (4.5 minutes).

Statistical Differences

When the data were considered on the basis of number of lanes of travel, the overall data showed that of the 60 comparisons carried out, no statistical difference occurred in 33 cases, the experimental units had statistically less encroachment in 10 cases, and the experimental units had statistically more encroachment in 17 cases (see Table 12).

Of these 17 cases, 8 were on roads with two or three lanes and 9 were on roads with four or more lanes. When these 17 cases were considered on the basis of the encroachment criteria, 6 involved the side of the housing unit over the centerline, 6 the side over the edgeline, 3 the wheels over the centerline, and 2 the wheels over the edgeline.

Table 12
SUMMARY OF STATISTICAL RESULTS

Result	Wheels/ Centerline	Side/ Centerline	Wheels/ Edgeline	Side/ Edgeline	Total
No difference	8	5	13	7	33
Experimental less	4	4	0	2	10
Experimental more	3	6	2	6	17
Segments where experimental units had more encroachment					
2-lane	2	1	1	0	4
3-lane	1	3	0	0	4
4-lane nondivided	0	2	0	0	2
4-lane divided	0	0	0	3	3
5-lane	0	0	1	3	4

Summary

1. The data show that when considered on the basis of the entire trip, the experimental units had more encroachment in only one of the four measures of risk: side over the edgeline. For the other three risk measures, the encroachment data favored the experimental units.

2. On the segments with four or more lanes, wheel encroachment over the centerline and edgeline generally favored the experimental units (i.e., less encroachment than control). The experimental units generally had less encroachment over the centerline by the side of a unit on the four-lane divided and five-lane segments and generally more centerline encroachment on the four-lane nondivided segments. Overall, the encroachment data for these three criteria (wheels over centerline, wheels over edgeline, and side over centerline) generally favored the experimental units. For the fourth criteria, the experimental units had more encroachment over the edgeline by the side of the unit on the four-lane divided and five-lane segments.

3. On the segments with two or three lanes, the experimental units generally had more encroachment over the centerline by the wheels, although the encroachment was for a relatively small percentage of segment travel time and exceeded 10 seconds in only one case. The experimental units generally had more encroachment over the centerline by the side. When there was encroachment over the edgeline by the wheels, the one statistical difference showed that an experimental unit had more encroachment. When there was encroachment over the edgeline by the side, both statistical differences favored the experimental units.

CONCLUSIONS

1. Virginia is one of the few states that restrict the movement of 14-foot-wide manufactured housing units with roof eaves.

2. Since the experimental units did not have more centerline and edgeline encroachment than the control for three of the four measures of risk, and the differences were relatively small (although statistically greater) for the fourth measure, the *overall* additional safety risk to other motorists by 14-foot-wide housing units with eaves is minimal.

3. On roads with four or more lanes of travel, the experimental units had more encroachment only over the edgeline by the wheels (the lowest level of potential risk), most of the encroachment was on the four-lane divided segments, and the *difference* in edgeline encroachment between the control unit and the experimental units was small (79.6% v 83.3%). Thus, the additional 1-foot roof eave overhanging the edgeline 10 feet above the ground should create a minimal amount of additional safety risk to other motorists since these wider roads generally have wide shoulders and/or clear zones.

4. Since the experimental units had more centerline encroachment on the roads with two or three lanes (roads that require a single-trip permit), these increased encroachments have the potential to impose additional safety risks to other motorists.

RECOMMENDATIONS

1. VDOT should allow the manufactured housing industry to move 14-foot-wide units with eaves up to 1-foot total on the blanket permit network of roads. However, the housing industry should also be required to maintain (and furnish upon state request) data relative to crashes, vehicle miles of travel (exposure), and route movements. These data would be useful if additional requests are received to increase the width of housing units permitted to be moved on Virginia highways.

2. VDOT should carefully evaluate all requests to move housing units with eaves on roads with two or three lanes to ensure that there is sufficient roadway width and roadside clearance for a safe move. VDOT should also consider requiring the hauler to use both a front and rear escort vehicle in transporting 14-foot-wide housing units with eaves on two- and three-lane roadways.

3. The manufactured housing industry has a pattern of making requests for changes in the hauling permit standards of the states on an "incremental basis." Relatively small changes in the length, weight, or width of housing units may not be discernable by the motoring public, and these variations may not be statistically different when a variety of characteristics are measured. Although small incremental changes may not show a difference, the sum of several of these changes could have a significant impact on the motoring public. In addition, once a change is granted by one state, this fact is used in approaching other states to obtain the same unit dimensions. Because Virginia does not have the resources to carry out a long-term, complex study of the movement of overdimensional loads, a request should be made through the National Cooperative Highway Research Program (NCHRP), or some other source, for a national study of the issues involving these movements so that uniform standards can be established for use by all states.

Appendix A

QUESTIONNAIRE SENT TO THE HAULING PERMIT OFFICE OF EACH STATE

DEPARTMENT OF TRANSPORTATION
RAY D. PETHTEL, COMMISSIONER
GARY R. ALLEN, PH.D.
RESEARCH DIRECTOR

UNIVERSITY OF VIRGINIA
JOHN CASTEEN, PRESIDENT
SCHOOL OF ENGINEERING & APPLIED SCIENCE
EDGAR A. STARKE, JR., DEAN
DEPARTMENT OF CIVIL ENGINEERING
FURMAN W. BARTON, CHAIRMAN

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
TRANSPORTATION RESEARCH COUNCIL
BOX 3817 UNIVERSITY STATION
CHARLOTTESVILLE, 22903

IN REPLY PLEASE
REFER TO FILE NO

RAY D. PETHTEL
COMMISSIONER

July 18, 1991

Dear Colleague:

The permit section of the Virginia Department of Transportation has requested the assistance of the Transportation Research Council in dealing with a request for a blanket permit provision. The Virginia Manufactured Housing Association has asked the state to allow the movement of 14-foot-wide units that have an additional 1-foot maximum roof overhang. The state has several major concerns with this request. The first involves the safety to the motoring public, and the second involves the passage of such units over the roadway without interfering with roadside structures and appurtenances.

In light of the implications of this request, we are seeking the assistance of the other states. Included is a short questionnaire with respect to this issue. Of prime concern is the way your state deals with loads over 14 feet wide and whether your state has any formal or informal research that can be shared with us on this issue.

Enclosed is a postage-paid self-addressed envelope that can be used if appropriate. It would be greatly appreciated if the questionnaire could be returned by August 5, 1991.

Thank you for your assistance.

Sincerely,

CBStoke

Charles B. Stoke
Research Scientist

CBS:sdc

Enclosure

cc: Mr. R. M. Ketner III
Mr. W. S. Ferguson
Mr. A. J. Norris

QUESTIONNAIRE

MOVEMENT OF MANUFACTURED HOUSING UNITS ON STATE HIGHWAYS

State ____________________

1. Is the movement of manufactured housing units (mobile and modular homes) wider than 14 feet permitted on your state's highways?

   ______ Yes
   ______ No

2. Was the decision to (allow) (deny) the movement of units wider than 14 feet based on:

   ______ No decision made
   ______ Legislative mandate
   ______ Research study
   ______ Departmental judgment
   ______ Successful experience in other states
   ______ Successful trial period in your state
   ______ Pressure from housing industry
   ______ Other (Please specify) ________________________________
   ____
   ____

3. Is the movement of units wider than 14 feet (allowed) (denied) on the basis of:

   ______ State law
   ______ Legislative resolution
   ______ Departmental policy
   ______ Other (please specify) ________________________________
   ____
   ____

4. What is the maximum width of housing units allowed on your state's highways?

   ____

5. Have any studies been conducted in your state concerning the travel of housing units 14 feet or wider:

   ______ Yes (Please furnish a copy of the report, no matter whether formal or informal)
   ______ No

6. Are any studies on this subject being conducted in your state or are any planned?

   ______ Yes ________________ Completion date
   ______ No

7. Have accident data on manufactured housing been compiled for your state?

   ______ Yes (Please enclose a copy of the figures)
   ______ No

8. Have data on vehicle miles of travel by manufactured housing units been compiled by your state?

   ______ Yes (Please enclose a copy of the figures)
   ______ No

9. What rules and regulations currently apply to the movement of manufactured housing units in your state? Please furnish a copy of these regulations. ______________________________
   ____
   ____
   ____

10. Additional comments and observations. ______________________________
   ____
   ____
   ____

Your Name ______________________________

Title ______________________________

Mailing Address ______________________________
____
____
____

Telephone (________) ____________________

Thank you for your cooperation and assistance. If you have any additional comments, or if you would like more information concerning the study, please contact:

Mr. Charles B. Stoke
Research Scientist
Virginia Transportation Research Council
Box 3817, University Station
Charlottesville, Virginia 22903

Telephone (804) 293-1900

Appendix B

FIGURES SHOWING DIMENSIONS OF HOUSING UNITS USED IN FIELD DEMONSTRATIONS

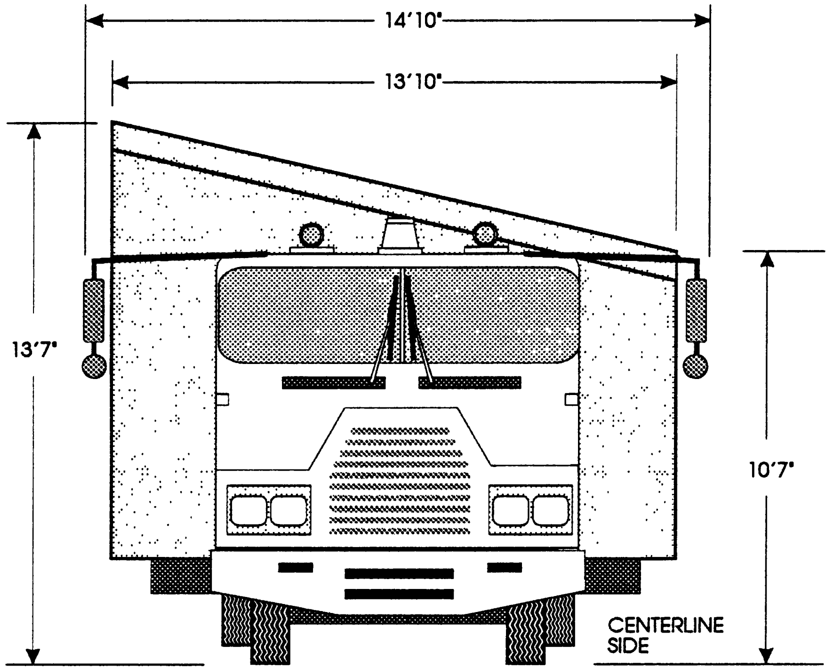

Figure B-1. 14 FEET WIDE W/O EAVES (CONTROL).

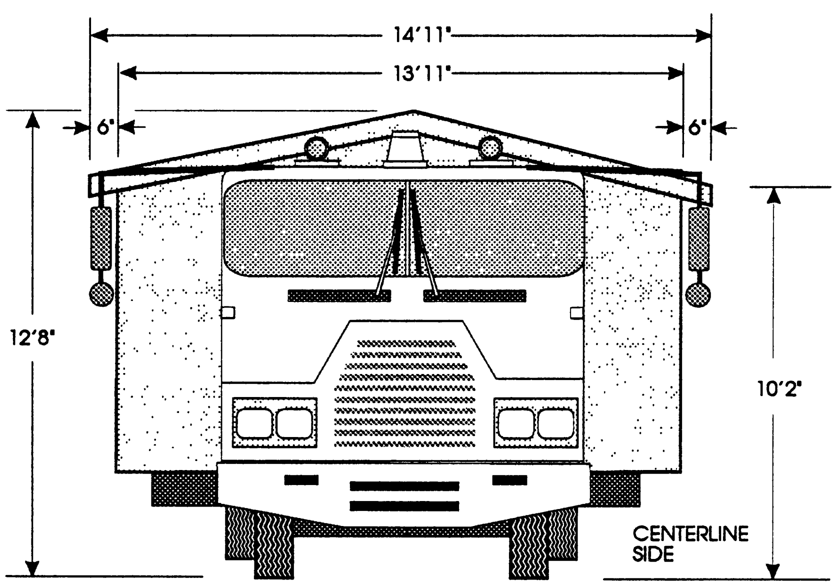

Figure B-2. 14 FEET WIDE W/EAVES (SW).

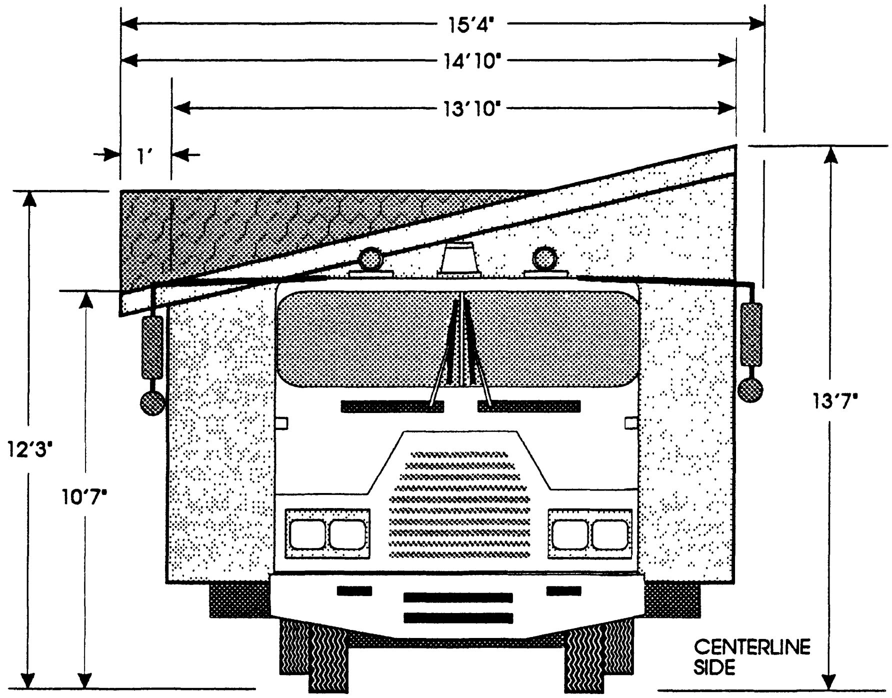

Figure B-3. 14 FEET WIDE W/EAVE ON EDGELINE SIDE (ELE).

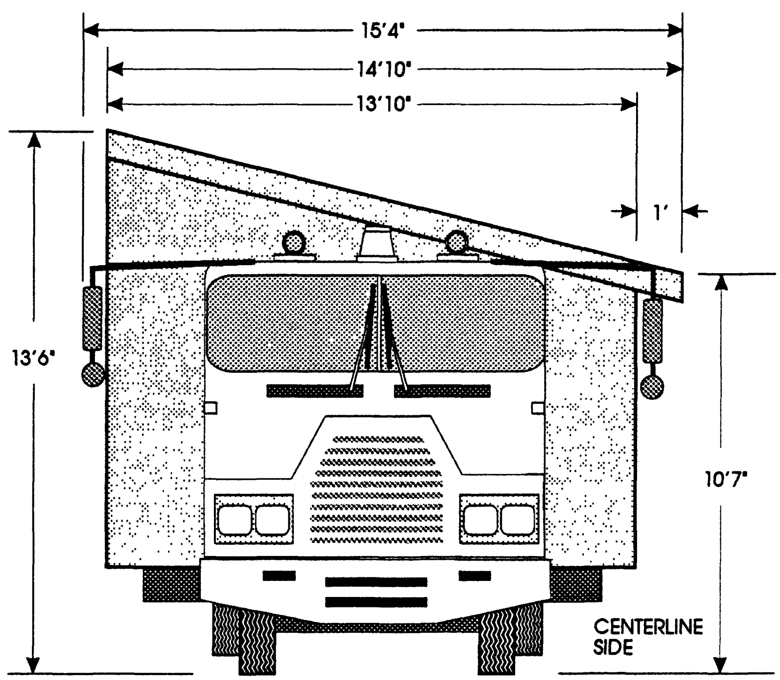

Figure B-4. 14 FEET WIDE W/EAVE ON CENTERLINE SIDE (CLE).

Appendix C

FIGURES SHOWING TYPICAL LATERAL PLACEMENT OF HOUSING UNITS ON VARIOUS ROAD SEGMENTS

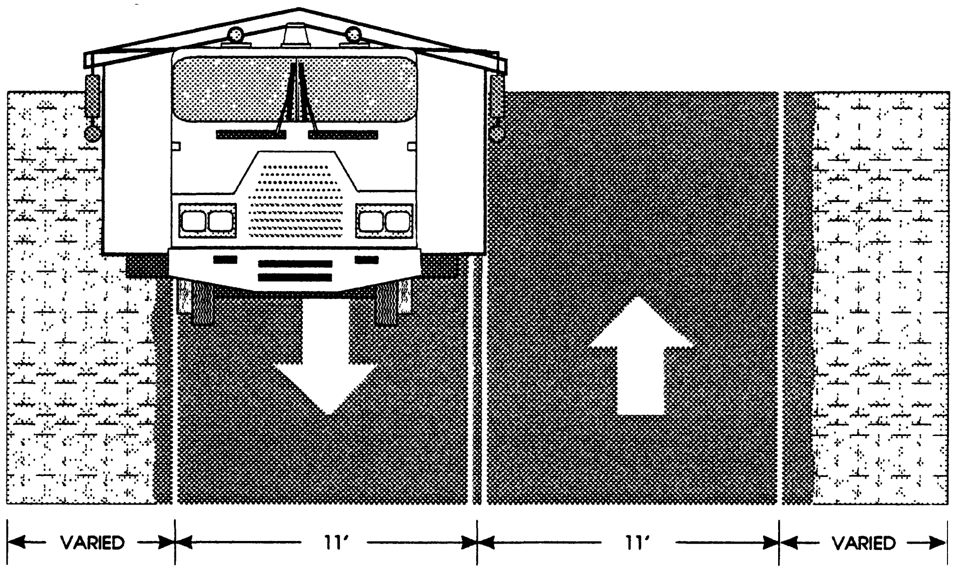

Figure C-1. **HOUSING UNIT ON TWO-LANE ROAD SHOWING EDGELINE ENCROACHMENT.**

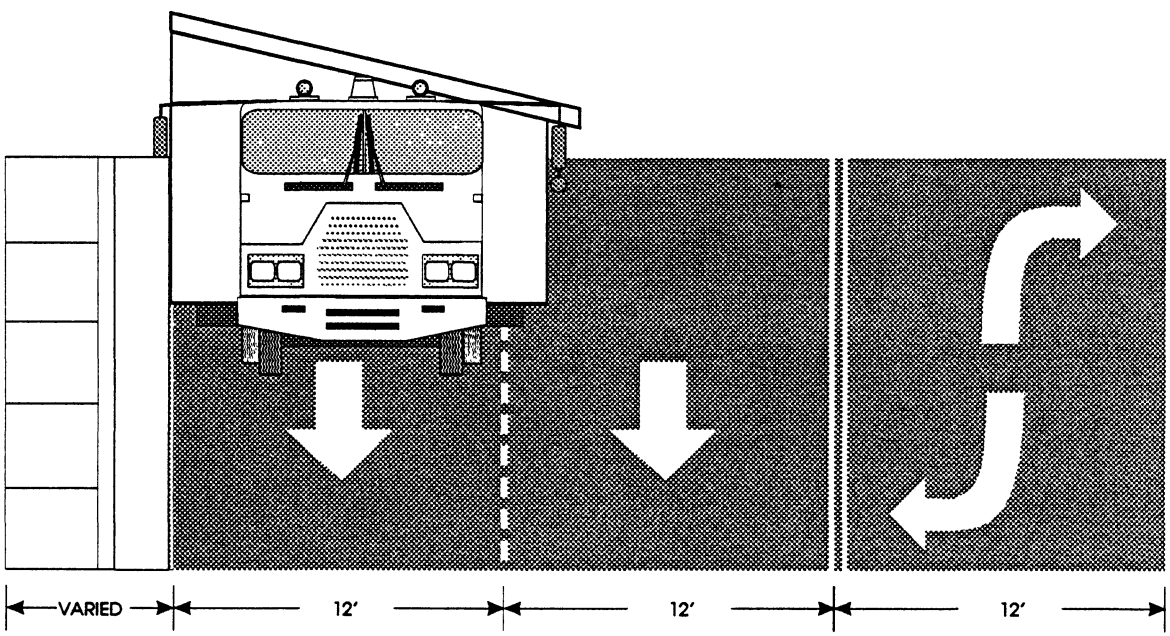

Figure C-2. **HOUSING UNIT ON FIVE-LANE ROAD SHOWING CENTERLINE ENCROACHMENT.**

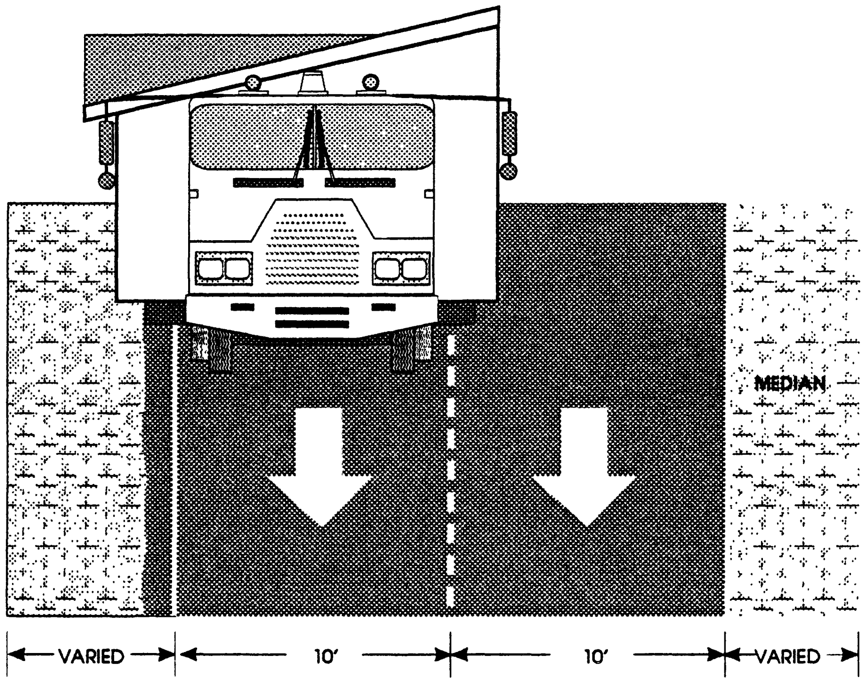

Figure C-3. HOUSING UNIT ON 10-FOOT-WIDE LANE SECTION OF FOUR-LANE DIVIDED ROAD SHOWING BOTH EDGELINE AND CENTERLINE ENCROACHMENT.

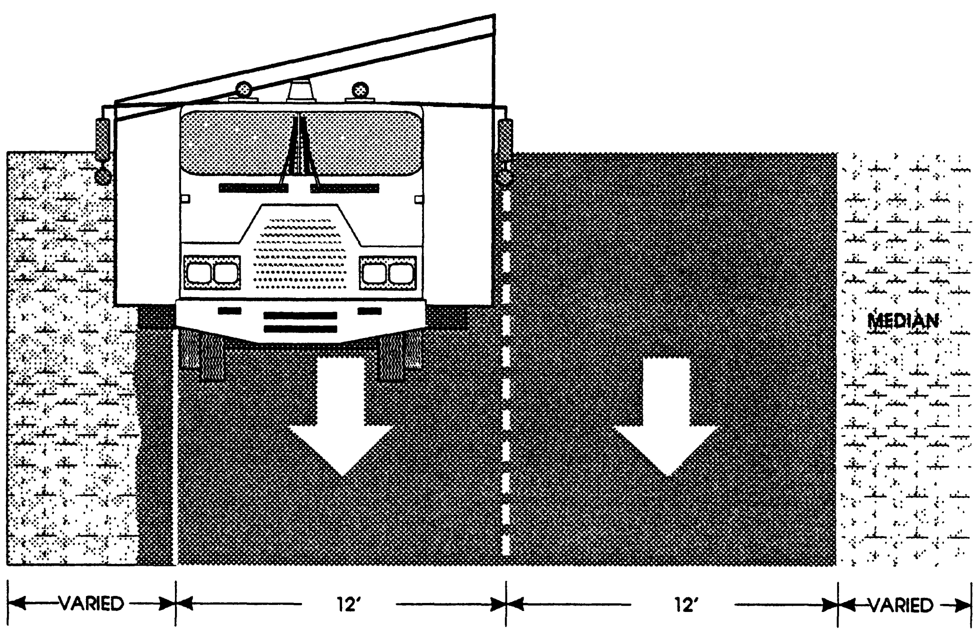

Figure C-4. HOUSING UNIT ON 12-FOOT-WIDE LANE SECTION OF FOUR-LANE DIVIDED ROAD SHOWING EDGELINE ENCROACHMENT.

Appendix D

TRIP LENGTH AND ENCROACHMENT TIMES BY NUMBER OF LANES AND TYPE OF HOUSING UNIT

Table D-1
TRIP LENGTH BY NUMBER OF LANES AND TYPE OF UNIT (Seconds)

No. Lanes	Control	SW	ELE	CLE
2	227	190	215	148
3	84	58	83	77
4 nondivided	126	227	196	284
4 divided	4,596	4,310	4,790	4,417
5	900	811	664	759
All	5,933	5,596	5,948	5,685

[a]All trip lengths are not of same duration due to variations in traffic conditions, video camera malfunctions, and/or the photographers inability to capture every moment of each trip faithfully.

Table D-2
ENCROACHMENT OVER CENTERLINE BY WHEELS BY NUMBER OF LANES AND TYPE OF UNIT (Seconds)

No. Lanes	Control	SW	ELE	CLE
2	5	5	21	10
3	0	0	1	7
4 nondivided	30	53	49	28
4 divided	144	78	98	94
5	9	15	12	11
All	188	151	181	150

Table D-3
ENCROACHMENT OVER CENTERLINE BY SIDE BY NUMBER OF LANES AND TYPE OF UNIT (Seconds)

No. Lanes	Control	SW	ELE	CLE
2	51	70	43	26
3	45	40	66	55
4 nondivided	107	202	183	258
4 divided	1,137	970	1,143	881
5	833	670	626	668
All	2,173	1,952	2,061	1,888

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Table D-4
ENCROACHMENT OVER EDGELINE BY WHEELS
BY NUMBER OF LANES AND TYPE OF UNIT (Seconds)

No. Lanes	Control	SW	ELE	CLE
2	12	18	9	8
3	0	3	1	0
4 nondivided	0	0	0	0
4 divided	167	184	162	149
5	1	0	4	0
All	180	205	176	157

Table D-5
ENCROACHMENT OVER EDGELINE BY SIDE
BY NUMBER OF LANES AND TYPE OF UNIT (Seconds)

No. Lanes	Control	SW	ELE	CLE
2	191	161	189	130
3	71	41	60	58
4 nondivided	25	47	27	46
4 divided	3,657	3,591	3,964	3,679
5	101	266	157	268
All	4,045	4,106	4,397	4,181

REPORTS