

Technical Report Documentation Page

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16. Abstract

The purpose of this project was to identify, from existing research on warning, regulatory, and symbol signs, where deficiencies in motorists' understanding may pose safety or operational problems and to define acceptable levels of motorists' comprehension. The study developed alternative designs to remedy the identified deficiencies. These proposed alternative were laboratory tested, and final sign designs were evaluated in a simulated highway environment. The results of the simulator evaluation were verified in closed field tests.

This volume, the third of three, is the appendices to the technical report. The first volume is an executive summary. The second volume is the technical report, which documents all the work conducted under this project.

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APPENDIX A
Problem Sign Identification Form
REGULATORY SIGNS

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
		Nine of the cases reviewed involved STOP signs. In four of the cases, a decision was rendered on behalf of the defendant government entity. In four cases judgments were made for individual plaintiffs. One case was to be retried. On those occasions where government agencies were found liable for damages, the problem involved placement of the sign or negligence in maintaining the sign properly.
 R1-1	Jones (1972)—70% of 54 subjects recognized a black and white version of this sign, without a legend, as a YIELD sign. Hulbert and Fowler (1980)—45% of 1661 respondents correctly identified the meaning of this sign. Nearly one-third of the subjects understood YIELD to mean, "look at the situation and proceed with caution." One out of every five interpreted it as "prepare to merge."	R1-2c (Maryland)—One contact felt this sign caused some motorist confusion.
 R1-2		
  R1-3 R1-4		Two cases involved a question of whether a 2-way or 4-way STOP was more appropriate as an intersection control. One court held for the defendant public agency and one decided in favor of the plaintiff individual.
 R2-1		One contact felt many new drivers are oblivious to this sign.



R2-5c



R3-1



R3-4

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Hostetter et al. (1982)—This sign has a potentially ambiguous message.</p>		
<p>Koppa and Gusman (1978)—91% of 416 subjects tested knew the correct meaning for this sign (R3-1) when used as part of an assembly with the ONE WAY (R6-1) sign.</p> <p>Hulbert, Beers, and Fowler (1979)—90% of 3137 subjects tested knew the correct meaning of this sign (R3-1).</p> <p>Jones (1972)—39% of 54 subjects could correctly identify this sign (R3-2) without a legend. 32% thought curve or turn ahead was indicated.</p> <p>Cole and Jacobs (1981)—For both R3-1 and R3-2, only 40% of 35 subjects could correctly identify these signs.</p>	<p>Five contacts expressed concern regarding R3-1 and R3-2. Most felt placement was a bigger problem than comprehension.</p>	
<p>Jones (1972)—67% of 63 subjects understood this sign without any legend. Nearly 20% identified this sign as a REVERSE CURVE warning.</p> <p>Hulbert, Beers, and Fowler (1979)—97% of 3148 subjects could correctly identify this sign.</p>		

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
	<p>One contact felt that with use of this sign, the adjacent lane becomes a turn lane as well.</p>	
<p>Koppa and Guseman (1978)—One test question places the subject driving down the street, wanting to turn left at the next intersection. Before reaching the intersection, he encounters this sign and is asked, 'Which lane should you be in to make your turn?' 66% of the 444 subjects tested said they could be in either lane, 28% said to use the left lane only.</p>		
	<p>Four contacts felt this sign and associated lane markings were not understood by the public.</p>	
<p>Pain et al. (1982)—HOV signing is comprehended adequately if it conforms to recommended designs. The diamond shape, however, has no inherent meaning to drivers.</p>	<p>Four contacts felt all special usage lane signing is not fully understood by motorists. One contact stressed there is too much information in very small print.</p>	



R4-1

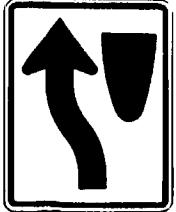


R4-2



R4-7

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
		<p>One case involving the use of this sign in a work zone application found the driver to be at fault and not the defendant highway department.</p>
		<p>One case was decided in favor of the plaintiff individual. The primary question was regarding proper placement of this sign.</p>
<p>Jones (1972)—76% of 62 subjects could state the proper maneuver which would be associated with this sign.</p> <p>Koppa and Guseman (1978)—74% of 429 subjects knew the correct meaning of this sign. However, when asked if this sign and the DIVIDED HIGHWAY sign (W6-1) meant the same thing, 51% said, "no," while 47% said, "yes."</p> <p>Hulbert and Fowler (1980)—35% of 1746 subjects correctly identified this sign as "traffic island ahead."</p> <p>Johnson (1980)—66% of 40 subjects tested correctly identified the Australian version of this sign.</p> <p>Cole and Jacobs (1980)—26% of 40 subjects tested identified the Australian warning version of this sign.</p>	<p>Three contacts felt this sign was not fully understood by drivers.</p>	<p>Two cases were cited where this sign was involved. In both instances, a highway work zone was the accident location. In one case a decision was rendered for the plaintiff individual when the defendant government agency failed to erect this sign, which was considered necessary. In the other case, the court ruled for the defendant highway department and found the driver to be negligent.</p>

	LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
			One case involved use of this sign. The court found that use of R4-8 without proper advance signing and cones fails to give adequate warning of a lane change/closure in a construction zone.
	<p>Jones (1972)—32% of 63 subjects could identify the symbol without legend.</p> <p>Johnson (1980)—36% of 121 subjects correctly identified this sign with and without the legend. (The results were pooled.)</p> <p>Cole and Jacobs (1981)—37% of 40 subjects tested correctly identified this sign without the word legend.</p> <p>Womack (1982)—67% of 375 subjects tested correctly identified this sign without the word message. 30% thought the sign was related to emergency facilities.</p>		
	<p>Jones (1972)—54% of 67 subjects correctly identified symbol without legend. 38% thought the symbol meant "Watch out for trucks."</p>		
	<p>Jones (1972)—30% correctly defined the meaning of this sign, but another 30% thought it meant, "Watch out for children on bicycles."</p>		

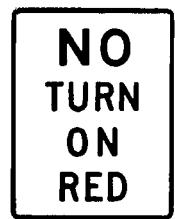
LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
Koppa and Guseman (1978)—93% of 434 subjects correctly defined this sign when presented in a roadway context.	Two contacts felt placement of this sign is critical in preventing "wrong-way" driving situations.	
	Two contacts felt that the "slash P" symbol is not understood when used on any parking sign.	
	Two contacts felt that there is a placement problem with this sign which may be associated with noticed compliance problems.	
Tidwell and Humphreys (1981)—71% of 829 drivers questioned correctly identified this sign as the crossing indicator and not as the advance warning.		Three cases involved the CROSSBUCK sign. One case was set for retrial. One case was partially remanded but a settlement was made to the plaintiff. One case was settled in favor of the defendant state highway department. None of the cases involved actual sign comprehension issues.



R6-1



R7-2a

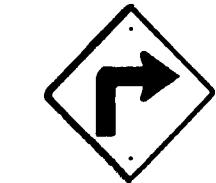


R10-11a



R15-1

WARNING SIGNS



W1-1R or 1L



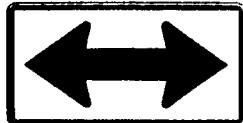
W1-2R or 2L



W1-4R or 4L



W1-5R or 5L

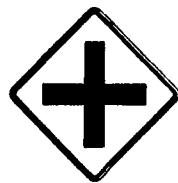


W1-7

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Koppa and Guseman (1978)—80% of 412 subjects tested stated that W1-1 and W1-2 were different signs, but 20% felt there was no difference between these signs. See W13-1.</p>		<p>Two cases were cited involving this sign. In one case it was found that the sign was erroneously placed and a decision was rendered in favor of the plaintiff. In the other case the court found in favor of the defendant government agency.</p>
<p>Jones (1972)—57% of 132 subjects could correctly identify this sign. See W1-1, W13-1.</p>		<p>Three cases involved CURVE signs. Two cases involved a question of whether a TURN sign might be more appropriate than the CURVE sign used. The court found for the defendants in both of these cases. One case involved an instance where a CURVE sign should have been placed and was not. The court found for the plaintiffs.</p>
	<p>One contact felt that the variables of initial left/initial right; speed/severity; and tangent/no tangent are items which should be addressed in examining these signs.</p>	<p>One case involved a potential miscomprehension problem, but legal technicalities had the State supreme court reversing a lower court decision which had been in favor of the plaintiff.</p>
<p>Jones (1972)—16% of 138 subjects defined this sign as "winding road." 68% defined it as "sharp, bad, extreme, dangerous, reverse, or S curve(s)."</p>	<p>Two contacts felt that drivers do not understand the right/left difference of this sign.</p>	
<p>Hostetter et al. (1982)—This sign requires supplementary navigational information.</p>		



W1-8



W2-1



W2-4

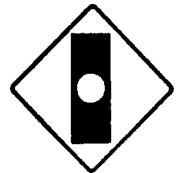


W3-1a

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Hulbert and Fowler (1980)—46% of 1745 subjects understood the significance of this sign.</p>		
<p>Jones (1972)—72% of 136 subjects correctly defined this sign.</p> <p>Cole and Jacobs (1981)—100% of 40 subjects correctly identified this sign.</p>	<p>Three contacts felt this sign could mislead motorists about the roadway alignment.</p>	<p>Two cases were cited involving this sign. In one case the sign was placed on all four legs of the intersection in conflict with the MUTCD standard. The court found for the plaintiff. In the other case it was determined that a CROSS ROAD sign should have been placed and was not; in this instance the court found for the plaintiff.</p>
		<p>One case was cited where the absence of this sign was cited as a proximate cause of the incident. The court found for the plaintiff.</p>
<p>Hulbert and Fowler (1980)—84% of 1738 subjects correctly identified this sign.</p> <p>Johnson (1980)—75% of 80 subjects correctly identified this sign.</p> <p>Womack (1982)—40% of 375 subjects correctly identified this sign. 23% interpreted this sign as "stop and go straight."</p>	<p>Five contacts felt this sign and W3-2a were not well understood. Some felt the signs were confused with actual STOP and YIELD signs. Others felt the straight arrow was misleading about the roadway alignment.</p>	<p>Five cases were cited where this sign was involved. In two instances the use of the sign was deemed adequate for the existing situation. In one case the STOP AHEAD sign was one of several signs cited as being the proximate cause of the accident. The court ruled that driver error was the cause. In two cases where judgments were made in favor of the plaintiff, it was shown that the sign was not placed in situations where it should have been.</p>



W3-2a

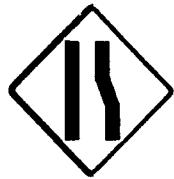


W3-3



W4-1

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Hulbert and Fowler (1980)—86% of 1717 subjects correctly identified this sign.</p> <p>Johnson (1980)—70% of 40 subjects identified this sign correctly.</p>	See W3-1a.	
<p>Jones (1972)—81% of 67 subjects correctly defined the meaning of this sign.</p> <p>Hulbert, Beers, and Fowler (1979)—94% of 3130 subjects attached a correct meaning to this sign.</p> <p>Cole and Jacobs (1981)—100% of 40 subjects correctly identified this sign.</p> <p>Wilson and Williams (1984)—82% of 198 subjects who were shown this sign correctly identified it. 92% had an "essentially correct" meaning. 81% of 248 subjects correctly identified this sign when it was shown as part of a highway scene. 88% had an "essentially correct" meaning.</p>		
<p>Koppa and Guseman (1978)—80% of 440 subjects defined the meaning of this sign correctly.</p>	<p>One contact felt many motorists are confused about right-of-way, especially when this sign is used on complex ramp terminals.</p>	



W4-2



W4-3



W5-2a

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Koppa and Guseman (1978)—61% of 438 subjects defined the meaning of this sign correctly. 20% defined it as "one lane traffic ahead." When asked if W4-2 and its "mirrored" counterpart (which would indicate a left side lane drop) were the same sign, 60% said "no," but 30% thought they meant the same thing.</p> <p>Hulbert, Beers, and Fowler (1979)—87% of 3138 subjects correctly identified this sign.</p> <p>Johnson (1980)—48% of 81 respondents correctly defined the meaning of this sign.</p> <p>Cole and Jacobs (1981)—80% of the subjects tested correctly identified the Australian version of this sign.</p>	<p>Four contacts felt that this sign and its implied message to merge are not fully understood by motorists.</p>	
<p>Hulbert and Fowler (1980)—In this test program, this sign had the poorest performance of all the signs tested. 7% of 1688 subjects tested correctly identified this sign; 59% thought it meant "merging traffic."</p>		
<p>Johnson (1980)—90% of 41 subjects correctly identified this sign.</p> <p>Wilson and Williams (1984)—51% of 198 subjects who were shown this sign correctly identified it. 84% had an "essentially correct" meaning. 67% of 248 subjects correctly identified this sign when it was shown as part of a highway scene. 93% had an "essentially correct" meaning.</p>	<p>Four contacts felt this sign is not understood. They were also quick to point out that the situation depicted is not true, since passing would never be allowed on a narrow bridge.</p>	

	LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
	<p>Jones (1972)—63% of 67 subjects correctly defined this sign. 10% confused this sign with DIVIDED HIGHWAY ENDS.</p> <p>Johnson (1980)—75% of 40 subjects tested correctly identified the Australian version of this sign.</p> <p>Cole and Jacobs (1981)—40% of 40 subjects correctly identified the Australian version of this sign. See R4-7.</p>	Two contacts felt this sign is not well understood by drivers.	
	<p>Jones (1972)—55% of 67 respondents correctly identified this sign. 10% defined this sign as "begin divided highway."</p> <p>Johnson (1980)—68% of 80 subjects correctly identified the Australian version of this sign.</p> <p>Cole and Jacobs (1981)—31% of 40 subjects tested identified the Australian version of this sign.</p>	One contact felt this sign is not well understood by motorists.	
	<p>Jones (1972)—78% of 67 subjects tested correctly identified this sign.</p> <p>Hulbert, Beers, and Fowler (1979)—93% of 3142 subjects chose the correct meaning for this sign.</p> <p>Johnson (1980)—100% of 40 subjects correctly identified the Australian version of this sign.</p>		<p>Two cases were cited which involved this sign. One case was decided in favor of the plaintiff where the evidence showed that the highway department used a non-conforming version of this sign. The other case found the proximate cause of the accident to be driver error and the decision was in favor of the defendant government agency.</p>
	<p>Jones (1972)—In this study the test version of this sign used the figure of an automobile instead of a truck. 57% of 67 subjects tested correctly identified the sign.</p> <p>Johnson (1980)—88% of 40 subjects tested correctly identified this sign. 95% correctly identified the sign when a car symbol was used in lieu of the truck.</p>	One contact felt this sign is interpreted as applying only to trucks.	<p>One case was cited involving this sign and other signs. The HILL sign did not play a significant role in the incident and the decision was rendered in favor of the defendant highway department.</p>



W8-3



W8-3a



W8-4



W8-5

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
Koppa and Guseman (1978)—84% of 428 subjects defined the meaning of this sign correctly. 12% defined it as "highway ends ahead; be prepared to exit."		
	Five contacts felt that this sign is not understood.	
Koppa and Guseman (1978)—88% of the subjects tested gave the correct definition for this sign.		
Jones (1972)—55% of 67 respondents correctly identified this sign. Koppa and Guseman (1978)—75% of 419 subjects tested correctly defined this sign. 20% defined it as "roadway winds or curves several times." Womack (1982)—Most commonly held interpretation of this sign is one associated with winding roads or curves ahead.	Four contacts felt this sign is not understood by drivers.	One case was cited involving this sign and a CURVE sign, but the case details centered around whether a CURVE or TURN sign was more appropriate for the existing situation and the use of this sign was not discussed in detail.



W8-9a



W9-1



W9-2

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Womack (1982)—High amount of confusion associated with this sign. Often confused with the UNEVEN PAVEMENT sign and other interpretations.</p> <p>Wilson and Williams (1984)—29% of 198 subjects who were shown the low shoulder sign correctly identified it. 76% had an "essentially correct" meaning. 39% of 248 subjects correctly identified this sign when it was shown as part of a highway scene. 73% had an "essentially correct" meaning.</p> <p>Wilson and Williams (1984)—14% of 198 subjects who were shown the uneven pavement sign correctly identified it. 77% had an "essentially correct" meaning. 15% of 248 subjects correctly identified this sign when it was shown as part of a highway scene. 70% had an "essentially correct" meaning.</p>	<p>Five contacts felt this sign was confused with the symbol sign used for uneven pavement sections. Most believe that neither is understood.</p>	
<p>Hostetter et al. (1982)—This sign is susceptible to left/right confusion; that is, some people fail to make the rapid decision, "if the right lane ends, I must move left."</p>		
<p>Hostetter et al. (1982)—Susceptible to left/right confusion.</p>		



W10-1



W11A-2



W11-3



W11-4

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
<p>Jones (1972)—When presented without the "RR" legend, 76% of 90 respondents correctly identified this sign as a railroad warning sign, but no differentiation was made as to whether or not this was an advance warning.</p> <p>Hulbert and Fowler (1980)—97% of 1702 subjects correctly identified this sign as a railroad crossing warning, but subjects were not asked to ascertain whether or not this was an advance warning.</p> <p>Tidwell and Humphreys (1981)—62% of 829 drivers correctly identified this sign as one located in advance of a railroad crossing. See R15-1.</p>	<p>One contact felt the advance warning was often confused with the CROSSBUCK.</p>	<p>One case was cited involving this sign. The plaintiff alleged that use of this sign and CROSSBUCK was not sufficient to warn bicycle riders of the hazard ahead. The court found signing to be in compliance with standards and found for the defendant highway department.</p>
<p>Jones (1972)—48% of 67 respondents correctly defined this sign.</p>	<p>Three contacts felt this sign was not understood as the actual location of a pedestrian crosswalk, or that it was confused with school signing.</p>	
<p>Jones (1972)—87% of 67 respondents understood the meaning of this sign.</p>		<p>One case involving this sign was cited. The plaintiff claimed that the highway department was liable for his collision with a deer in an area where this sign was not placed. The court upheld the highway department's discretionary non-use of this sign.</p>



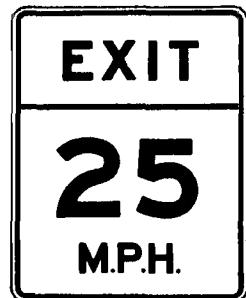
W12-1



W12-2

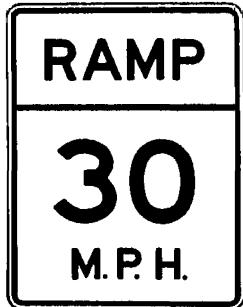


W13-1



W13-2

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
Hostetter et al. (1982)—This study found that this sign needs supplementary navigational information.		
Jones (1972)—76% of 67 respondents correctly defined this sign.		
Howard et al. (1972)—For advisory speeds 15-35 m.p.h., drivers consistently exceed the posted value. At higher speeds, 40-50 m.p.h., advisory and recorded speeds were more nearly equal. Both classes of sign, 15-35/40-50, cause different acceleration profiles by drivers.	Four contacts felt drivers do not know how to interpret the speed value, as an advisory speed or a speed limit.	
	One contact felt that drivers completely disregard this sign.	



W13-3



W14-1



W14-2



W14-3

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
	<p>One contact felt that drivers completely disregard this sign.</p>	
		<p>One case involving the use of this sign was cited. The defendant highway department used this sign and a CURVE sign to convey the idea the road ended. The court ruled that this treatment was not sufficient and ruled in favor of the plaintiff.</p>
	<p>Two contacts felt this sign was not as well understood as the DEAD END sign.</p>	
Jones (1972)—26% of 54 subjects could identify this sign without the legend.	<p>Two contacts felt this sign may have a placement problem.</p>	



LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
	<p>Three contacts felt this sign had no meaning for motorists.</p>	

**WARNING SIGNS USED FOR
STREET AND HIGHWAY CONSTRUCTION
AND MAINTENANCE OPERATIONS**



W20-2



W20-4



W20-5



W20-7a

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
		One case was cited involving this sign. The court ruled there was ample evidence of driver error and found for the defendant highway department.
	Hostetter et al. (1982)—This sign has a potentially ambiguous message.	
	Hostetter et al. (1982)—This sign is susceptible to left/right confusion.	
	Womack (1982)—This study found that most drivers recognized the fact that they were in a construction area, but failed to realize that they would receive flag signals ahead.	



W21-1a



S1-1



S2-1



S3-1

LITERATURE FINDINGS	PROFESSIONAL OPINIONS	LEGAL INVOLVEMENT
	<p>Four contacts felt that this symbol is not understood. A few mentioned that they had heard comments from motorists that the sign looked like "a man with a broken umbrella," or "a man feeding a whale."</p>	
<p>Koppa and Guseman (1978)—39% of 488 subjects distinguished the difference between the advance warning and the crossing sign. Most common misconception was to identify both as an advance warning (33%). 15% defined both signs as "pedestrian crossings."</p> <p>Hulbert, Beers, and Fowler (1979)—18% of 3122 subjects correctly identified the advance warning, while 45% correctly identified the crossing sign. 28% defined the signs as "pedestrian crossings."</p> <p>Womack (1982)—This study shows many drivers are unaware of the difference between these two signs and the pedestrian crossing sign.</p> <p>Wilson and Williams (1984)—21% of 198 subjects correctly identified this sign (S1-1) when shown only the sign. 42% identified this as S2-1. 31% identified this as a PEDESTRIAN CROSSING. 17% of 248 subjects correctly identified this sign as part of a street scene. 56% interpreted this sign as S2-1. 22% thought it was the PEDESTRIAN CROSSING sign.</p>	<p>Seven contacts felt motorists could not differentiate between these signs. Many thought both of these signs were confused with ADVANCE PEDESTRIAN and PEDESTRIAN CROSSING signs.</p>	
	<p>Two contacts felt that this sign is not understood by drivers. It was also mentioned that if the sign is understood, it is usually ignored because of its temporally dependent validity.</p>	

1

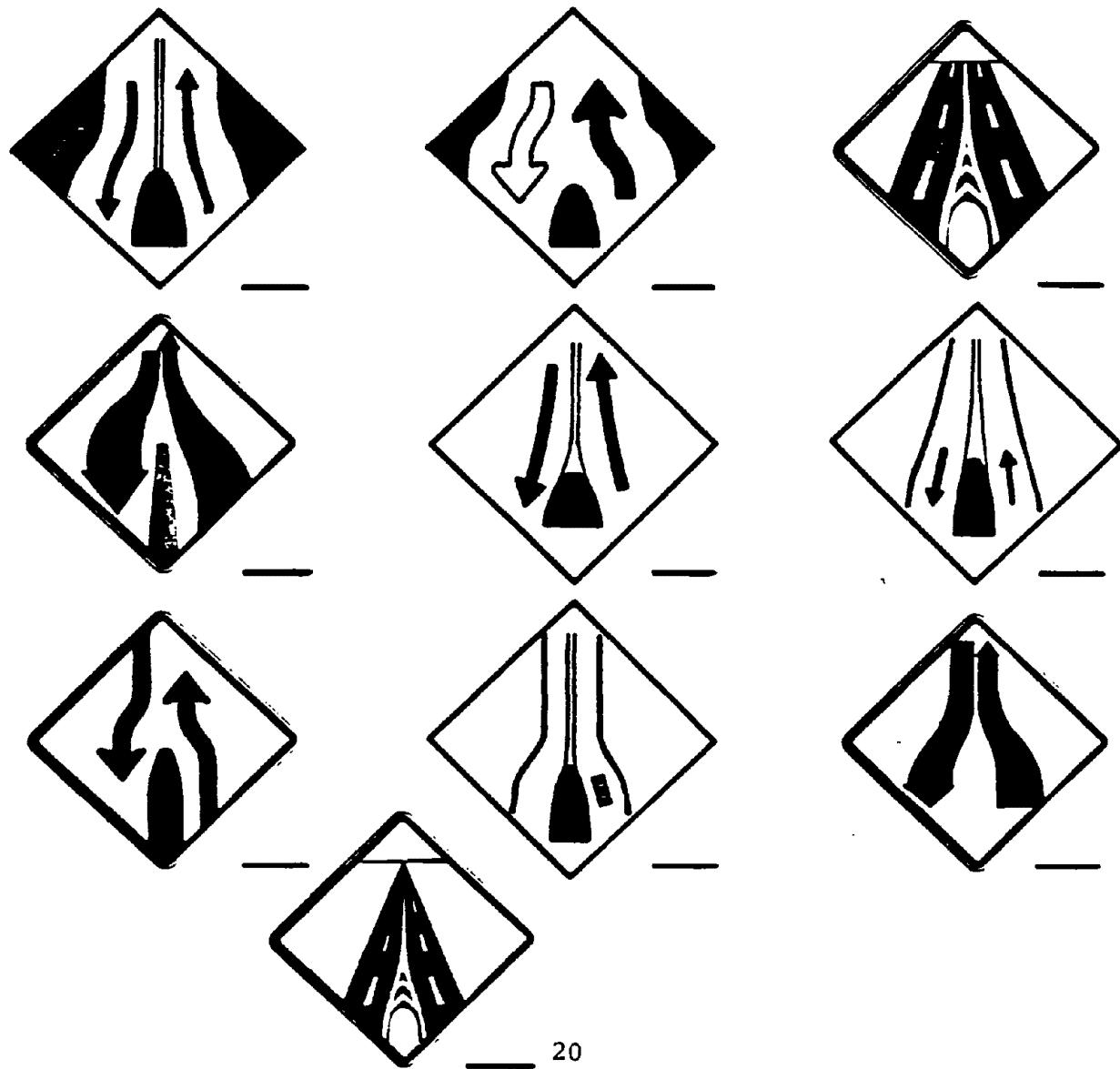
APPENDIX B
New Sign Design--Step 1



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W6-2 DIVIDED HIGHWAY ENDS SIGN.

This sign is often confused with its "opposite" W6-1, Divided Highway Begins Sign. This may be attributable to the fact that they are the exact same sign rotated 180° for each use.



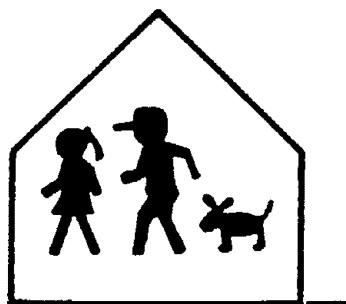
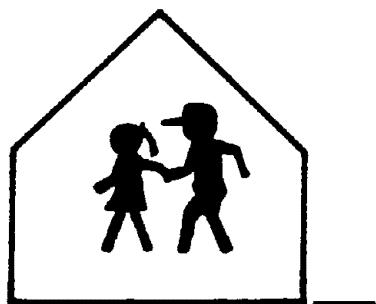
2



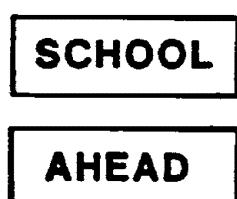
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

S1-1 SCHOOL ADVANCE SIGN.

This sign is intended to warn motorists that they are approaching a crosswalk used by school children. It is usually followed by S2-1, School Crossing Sign, which shows the actual location of the crosswalk. Most drivers understand the concept of pedestrians crossing the road, but fail to understand where the crossing actually is or that the pedestrians are school children. The addition of the crosswalk lines on the S2-1 sign seems to be too subtle a change for most drivers to catch. There is also a great amount of confusion between the S1-1 and S2-1 signs, and the W11-2, Pedestrian Advance Sign, and W11A-2, Pedestrian Crossing Sign. Again, the addition of the schoolbooks in the hands of the children on the S1-1 and S2-1 signs or the difference between the pentagon shape for the school sign and the diamond shape for the pedestrian sign may be too subtle for most people to notice.



or



}

Supplementary plaques
to go below sign



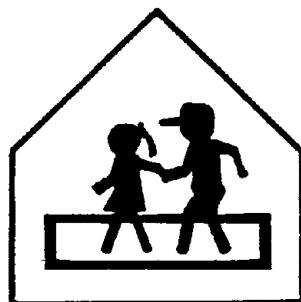
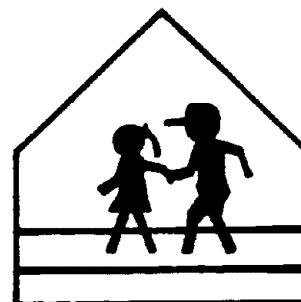
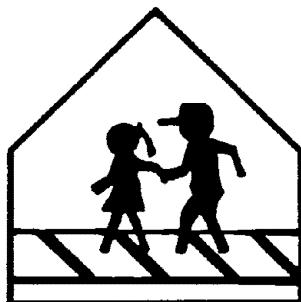
③



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

S2-1 SCHOOL CROSSING SIGN.

See S1-1, School Advance Sign.



X-ING

Supplementary plaque to go below sign

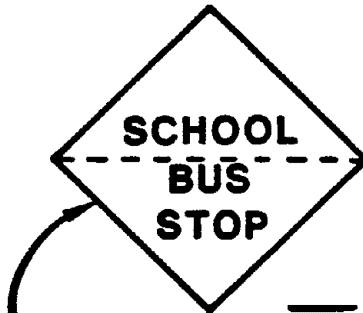
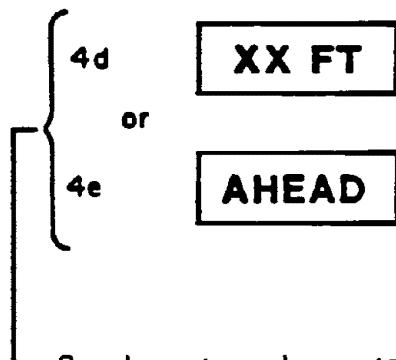
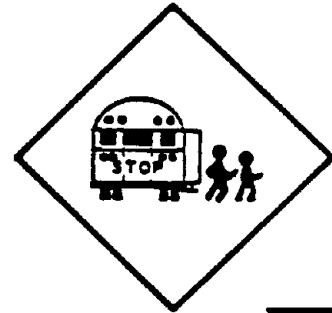
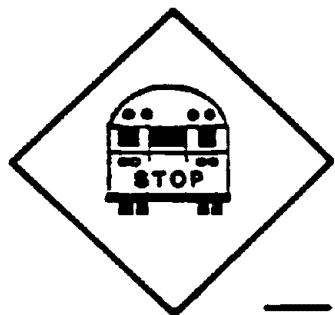
4



BLACK BORDER & MESSAGE,
YELLOW BACKGROUND

S3-1 SCHOOL BUS STOP AHEAD SIGN.

This sign is to be used in situations where a school bus stop is in an area where there are sight distance limitations. The word message is clearly understood, but the engineering concepts of sight distance and safe stopping distance are not. Some type of active command or supplementary plate (speed or distance) might help the problem. The temporal nature of the sign's applicability causes problems as well (i.e., Are school buses stopping ahead in June, July and August?).



Supplementary plaques to
go below sign

Hinge sign so message may be
concealed

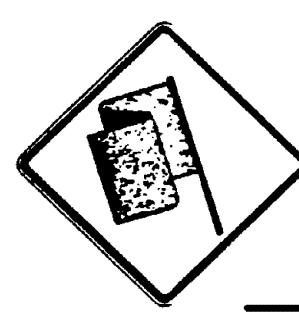
5



BLACK BORDER & SYMBOL,
ORANGE BACKGROUND

W20-7a ADVANCE FLAGGER SYMBOL SIGN.

This sign is usually recognized as being part of a construction or work zone, but many drivers fail to realize that they will be receiving traffic control directions from a flagger further down the road. Part of the problem may be an unfamiliarity with the flagging concept of controlling traffic over a one-lane section of road.



OBEY

Supplementary plaque to go
below sign

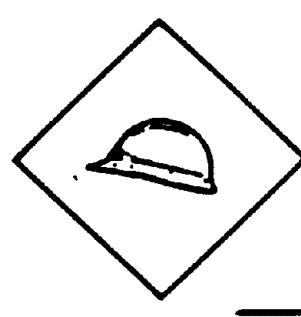
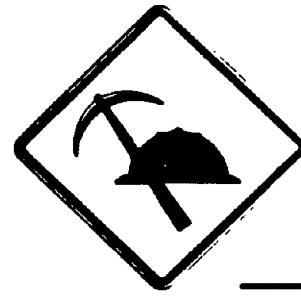
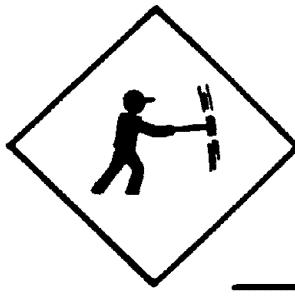
6



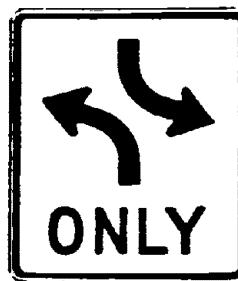
BLACK BORDER & SYMBOL,
ORANGE BACKGROUND

W21-1a WORKER SYMBOL SIGN.

The pictograph for this sign is probably the least understood by motorists. Interpretations have been "man with a broken umbrella," "man feeding a whale," and others.



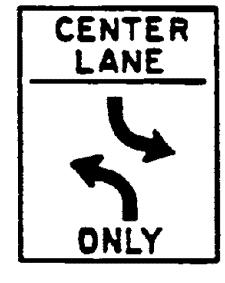
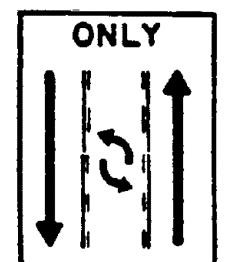
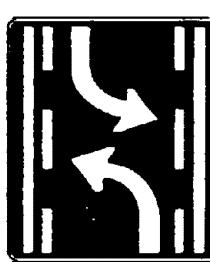
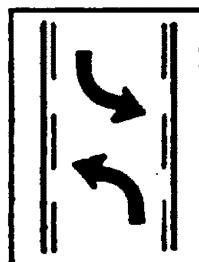
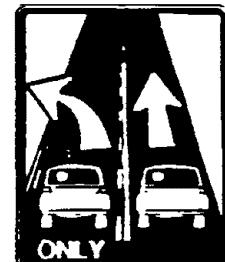
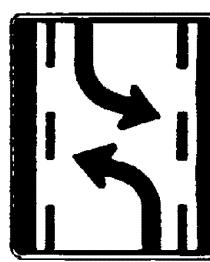
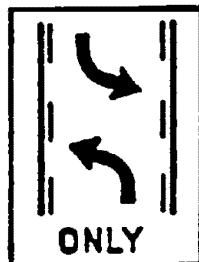
7



BLACK BORDER, SYMBOL
& MESSAGE, WHITE BACKGROUND

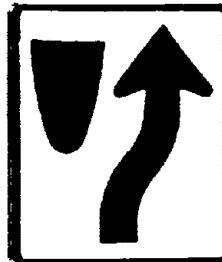
R3-9a TWO-WAY LEFT TURN ONLY SIGN.

This sign is one where the problem lies not only with the sign, but also with the public familiarity of the traffic engineering concept of two-way left turn lanes. The sign and associated pavement markings should work together to form the total concept.



NOTE: This is an existing sign
-R3-9b.

8

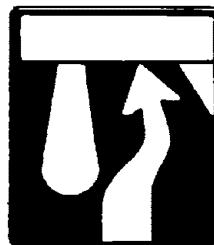
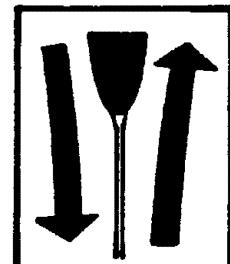
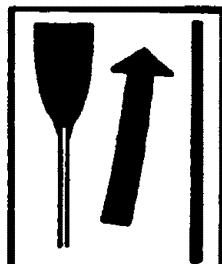
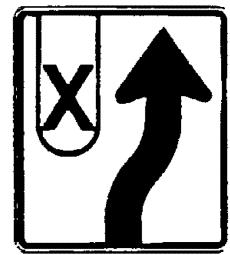
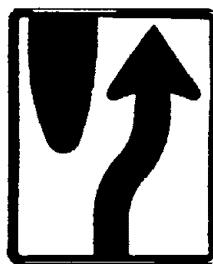


(18" x 24" PERMISSIBLE ON NARROW
MEDIAN AND AT MEDIAN OPENINGS,
36" x 48" FOR EXPRESSWAYS,
48" x 60" PRESCRIBED ON FREEWAYS
APPLIES TO R4-7 THROUGH R4-8)

BLACK BORDER & SYMBOL,
WHITE BACKGROUND

R4-7 KEEP RIGHT SYMBOL SIGN.

The curve of the arrow leads some motorists to believe that the alignment of the road is curved or winding ahead.



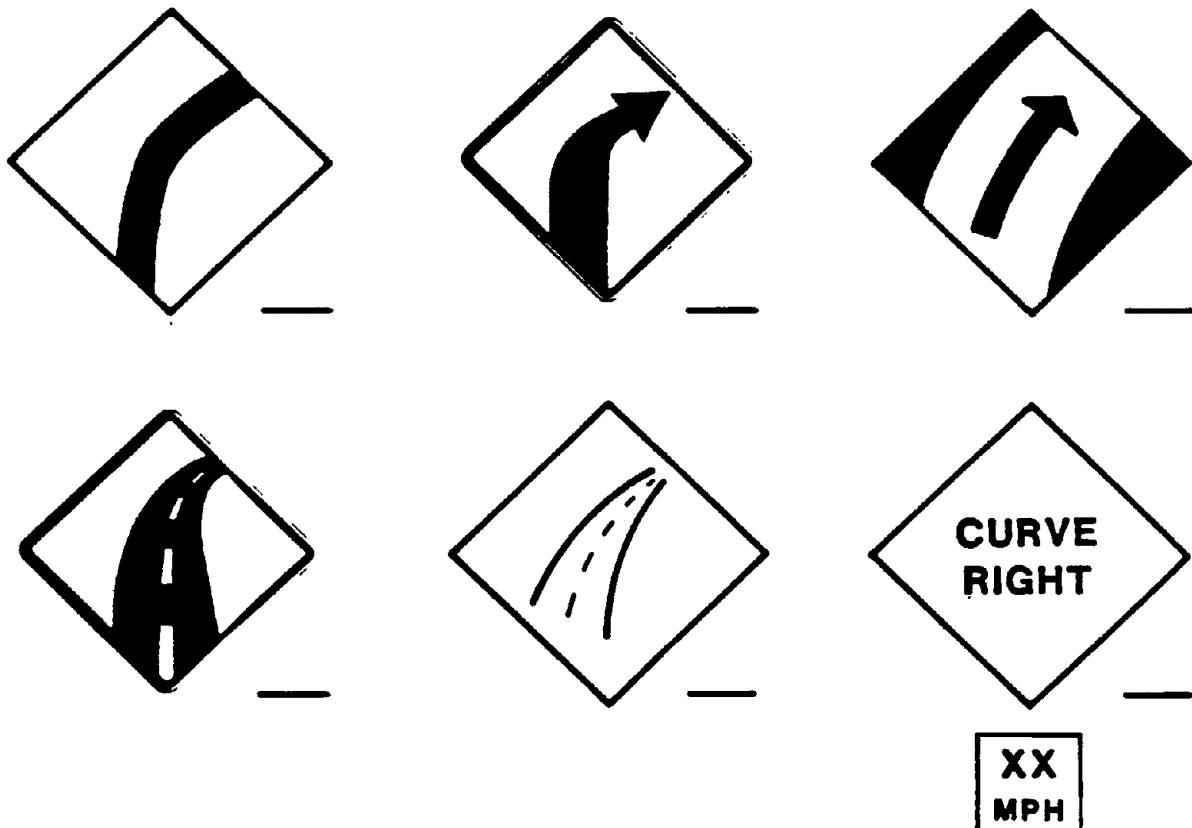
9



BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-2 CURVE SIGN.

This sign along with W1-1, Turn Sign, are a pair of signs which cause problems for many motorists because they look so similar. Along with W1-3, Reverse Turn Sign; W1-4, Reverse Curve Sign; and W1-5, Winding Road Sign, they all create similar comprehension difficulties for the motorist. Many motorists interpret these signs as actual diagrams of the roadway alignment ahead, while they are intended as representations only. This is especially true of the reverse turn and curve sign. The degree of curvature and distance between sequential curves is not communicated to the motorist. For example, the first curve may need a curve sign; the second may need a turn sign. Since they are close together, the reverse turn sign is used. A motorist slows his speed expecting two turns. He passes through the first curve at a speed he feels is too slow. He expects the next turn to be as gentle. He speeds up and enters the turn at an inappropriately high speed. Changing tangent distances between curves can cause problems as well.



Supplementary plaque to go
below all curve signs

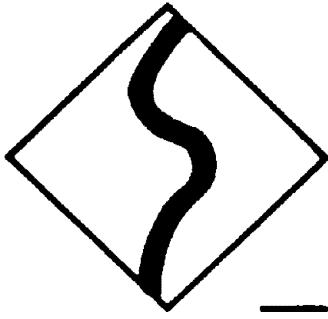
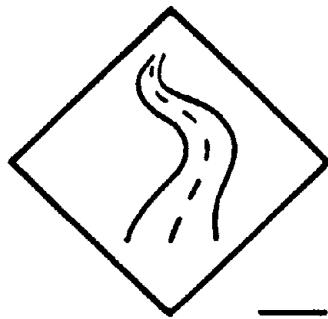
10



BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-5 WINDING ROAD SIGN.

See W1-2, Curve Sign.



NEXT
XX MILES

or

NEXT
XX FT

Supplementary plaques to
go below sign

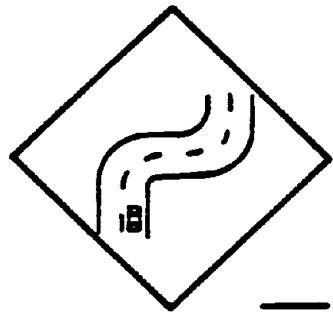
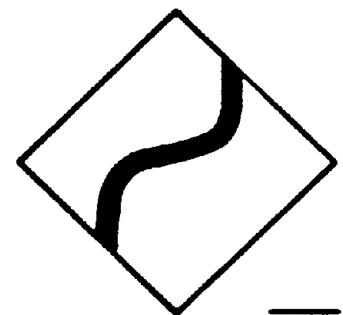
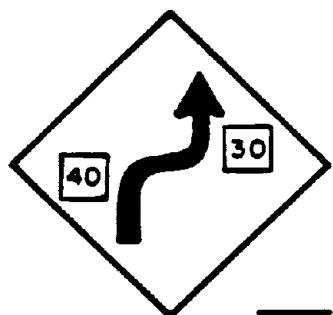
11



BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

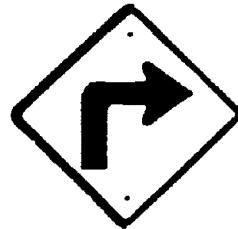
W1-3 REVERSE TURN SIGN.

See W1-2, Curve Sign.



Supplementary plaque
to go below sign

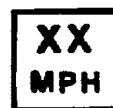
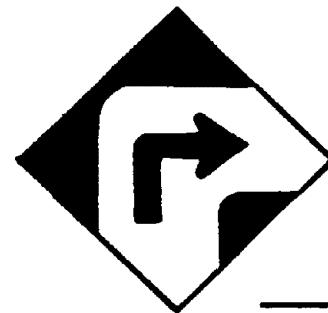
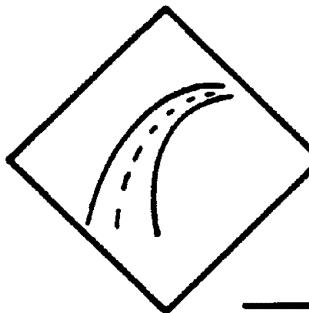
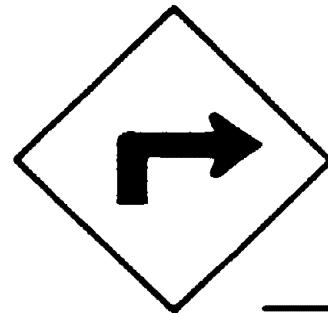
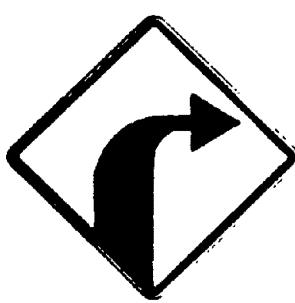
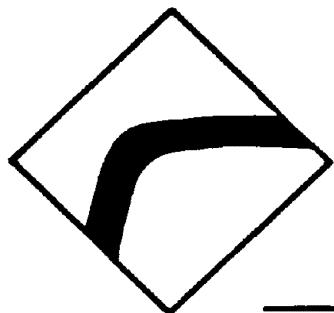
12



BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-1R/1L TURN SIGN.

See W1-2, Curve Sign.



Supplementary plaque
to go below sign

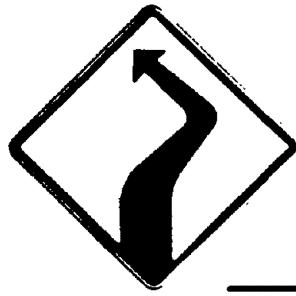
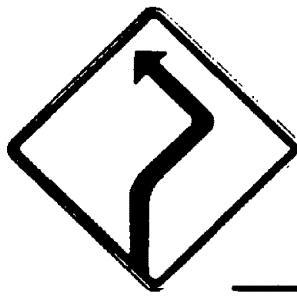
13

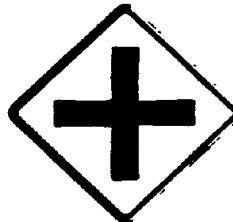


BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-4 REVERSE CURVE SIGN.

See W1-2, Curve Sign.

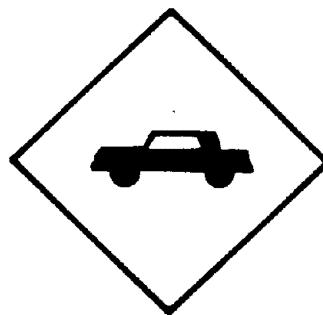
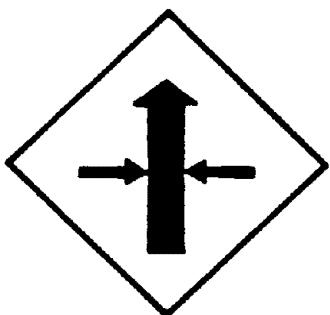
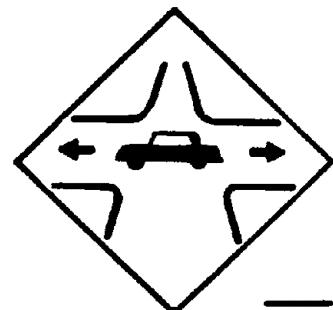
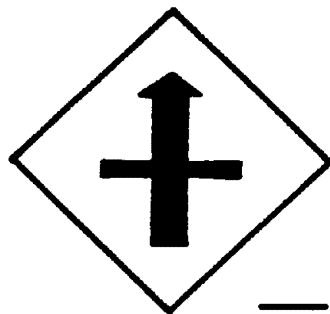




BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W2-1 CROSS ROAD SIGN.

Many drivers have a problem transferring this aerial or plan view to their point of view on the roadway. At times, it has been confused with the International Red Cross symbol, leading some people to believe it has something to do with hospitals.



**CROSS-STREET
NAME**

X-ING

Supplementary plaque
to go below sign

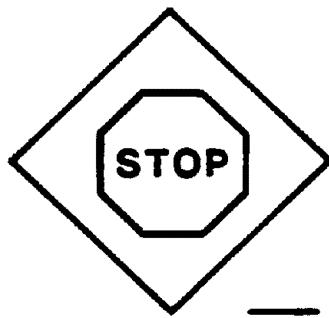
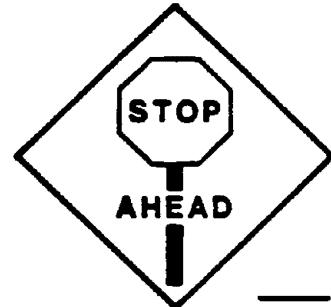
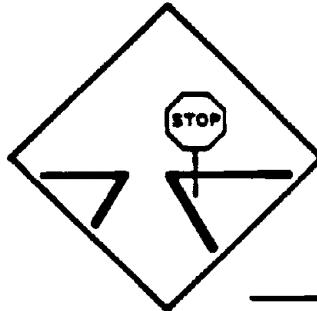
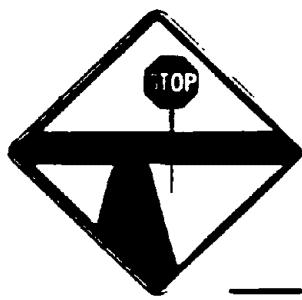
15



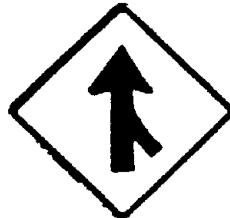
BLACK BORDER & ARROW,
RED "STOP" SIGN WITH WHITE BORDER,
YELLOW BACKGROUND

W3-1a STOP AHEAD SIGN.

The arrow on this sign sometimes misleads motorists about the alignment of the roadway ahead. Concern is expressed by some experts that the symbol could be interpreted as an actual Stop Sign.



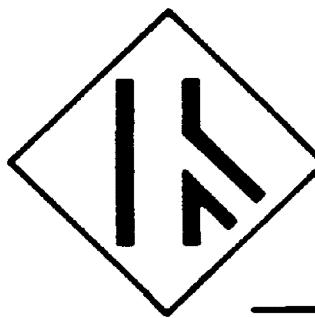
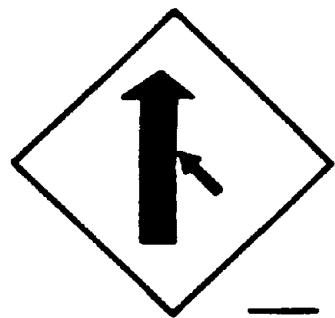
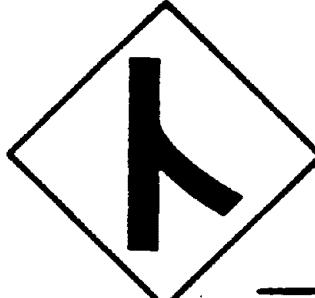
16



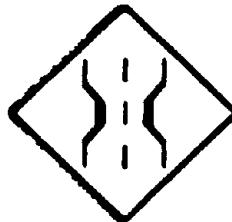
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W4-1 MERGE SIGN.

This sign causes some confusion as to which road is the major roadway. It is also confused with W4-3, Added Lane Sign.



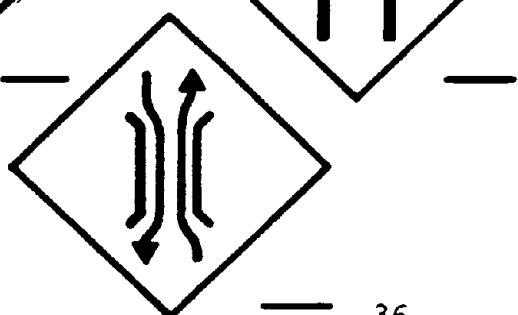
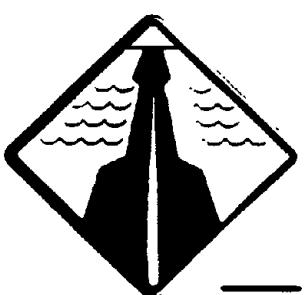
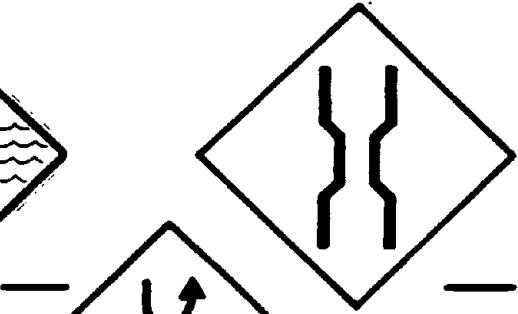
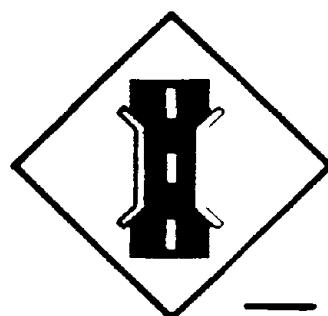
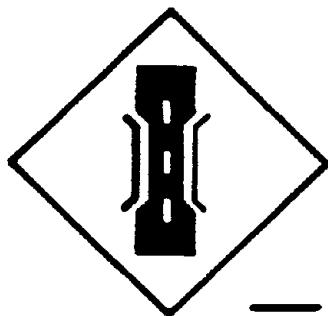
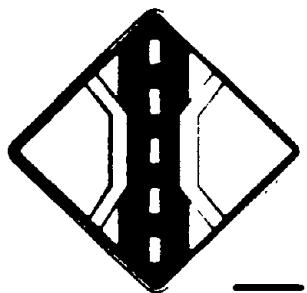
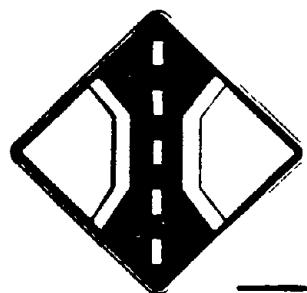
17



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W5-2a NARROW BRIDGE SIGN.

This use of the plan view of the road and the engineering symbol for a bridge does not allow any interpretation to be made by motorists for this sign.

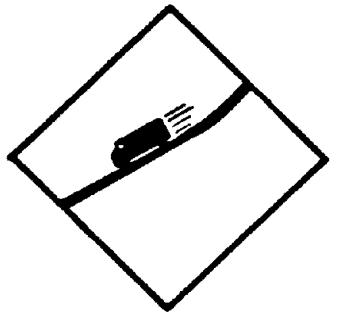
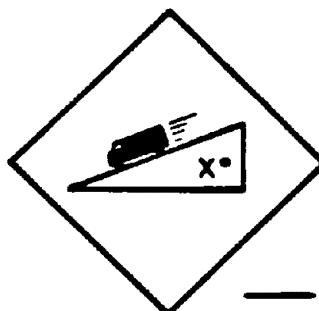
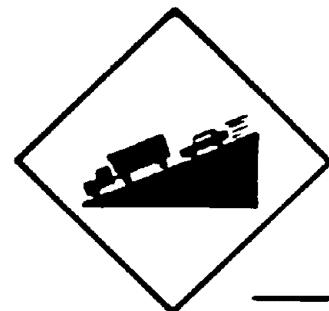
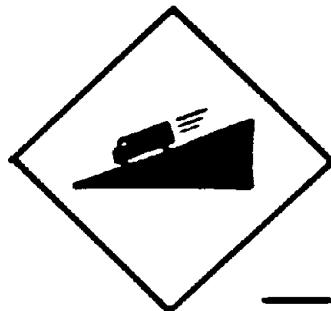




BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W7-1 HILL SIGN.

The truck symbol leads many motorists to think that the warning applies only to trucks.



HILL

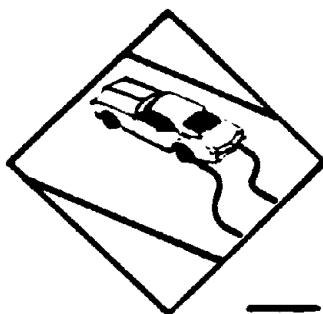
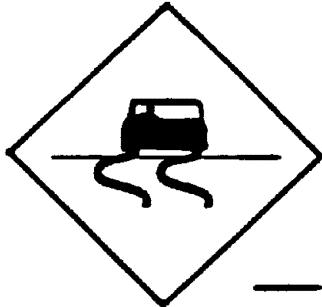
Supplementary plaque to
go below sign



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-5 SLIPPERY WHEN WET SIGN.

The concept of the road being wet/slippery is completely lost. Motorists interpret this sign as "sharp curve" or "drunk drivers ahead."



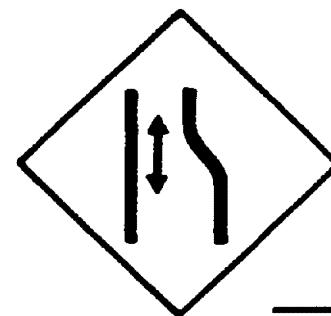
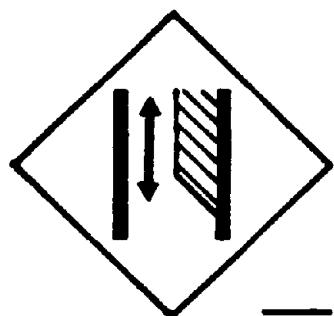
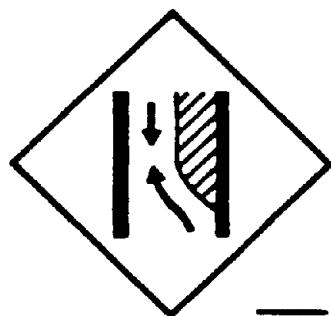
20



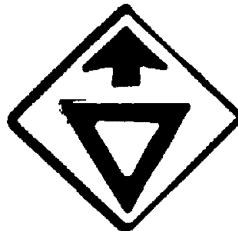
BLACK BORDER & MESSAGE,
ORANGE BACKGROUND

W20-4 ADVANCE ONE LANE ROAD SIGN.

The concept that one lane is being used for two-way traffic is not completely clear.



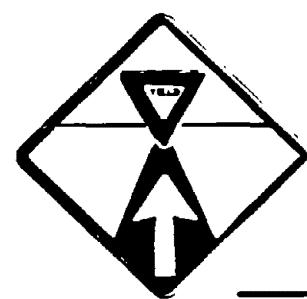
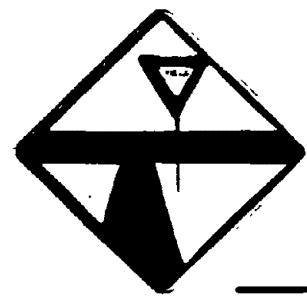
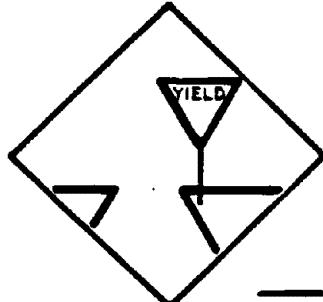
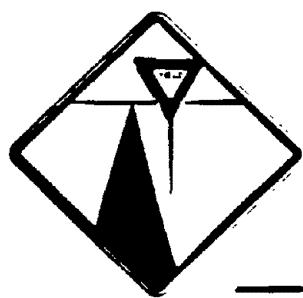
21



BLACK BORDER & ARROW,
RED & WHITE "YIELD" SIGN,
YELLOW BACKGROUND

W3-2a YIELD AHEAD SIGN.

The arrow on this sign sometimes misleads motorists about the alignment of the roadway ahead. Concern is expressed by some experts that the symbol could be interpreted as an actual Yield Sign.



XX FT

AHEAD

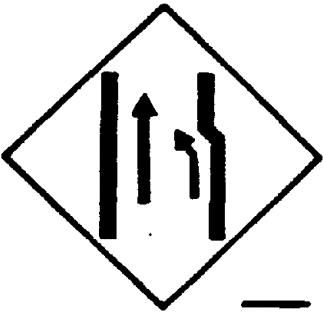
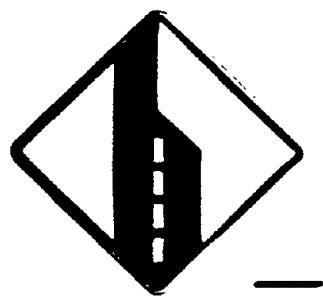
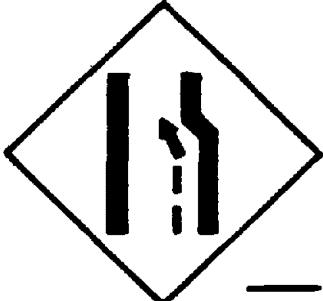
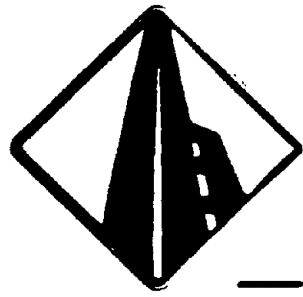
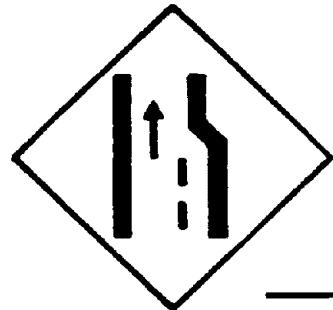
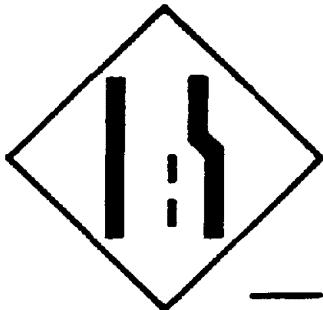
} Supplementary plaques
to go below sign



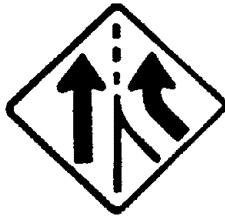
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W4-2 PAVEMENT WIDTH TRANSITION SIGN.

Difficult for motorists to differentiate between an actual lane drop and a narrowing of the pavement. Some motorists have difficulty differentiating between this sign and its "mirrored" opposite which signifies a left lane ending or closure.



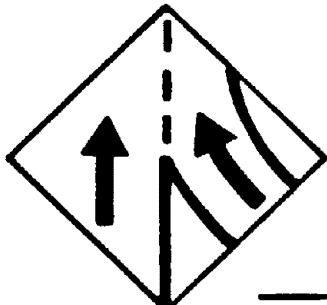
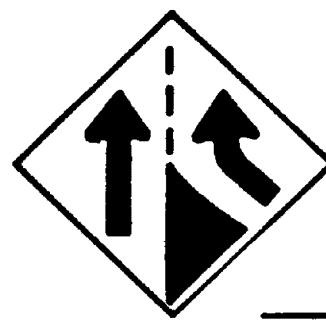
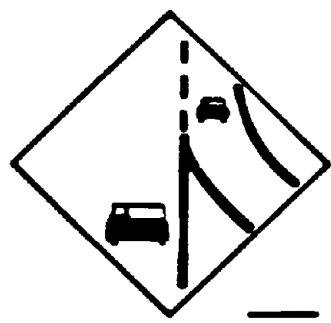
23



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W4-3 ADDED LANE SIGN.

See W4-1, Merge Sign.

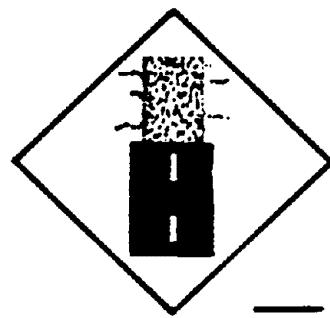




BLACK BORDER, BLACK SYMBOL
WITH YELLOW USED FOR
"ROAD STRIPE" & "UNPAVED ROAD"
DELINEATION, YELLOW BACKGROUND

W-83a PAVEMENT ENDS SYMBOL SIGN.

The symbol on this sign seems to be a bit vague to the driver. It has been interpreted as a gas pump.



XX FEET

or

AHEAD

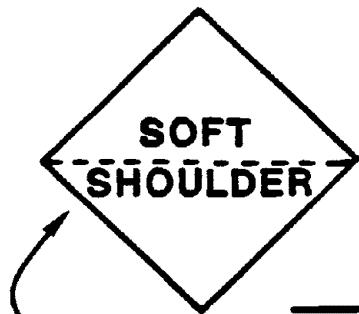
Supplementary plaques
to go below sign



BLACK BORDER & MESSAGE,
YELLOW BACKGROUND

W8-4 SOFT SHOULDER SIGN.

This sign does not have a completely understandable message. If the shoulders are soft, the motorist may ask, "How soft?"; "Do I need to stay off the shoulder?" Some positive command may help here. Some motorists do not understand what the shoulder area is.



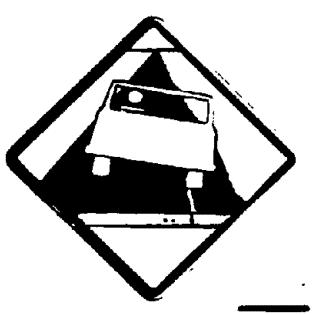
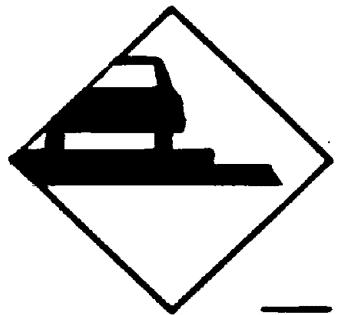
Hinge sign so message can be concealed when inappropriate



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-4b LOW SHOULDER SIGN.

This sign, similar to W8-4c, Uneven Pavement, fails to communicate to the driver the true nature of the hazard, steering/tracking problems. If the difference in pavement or shoulder height are extreme then larger vehicles might be easily overturned.

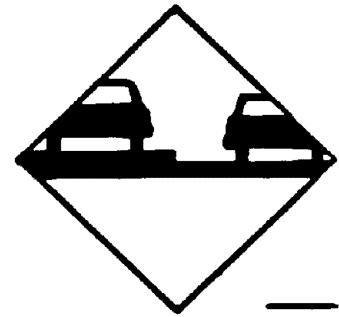
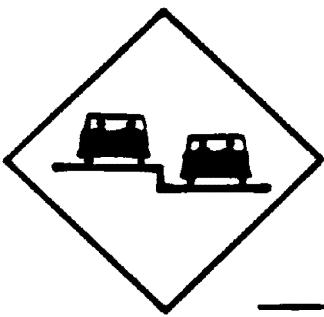
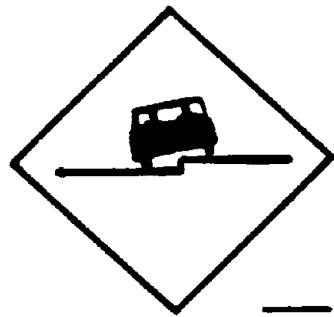




BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-4c UNEVEN PAVEMENT SIGN.

See W8-4b, Low Shoulder Sign.



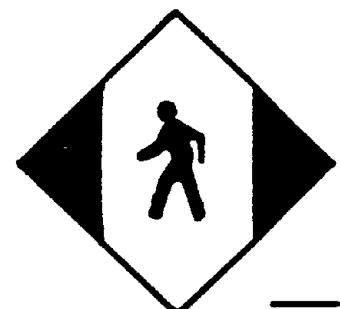
28



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W11-2 ADVANCE PEDESTRIAN CROSSING SIGN.

See S1-1, School Advance Sign.



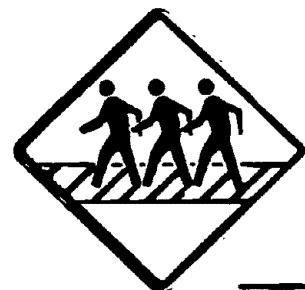
29



BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W11a-2 PEDESTRIAN CROSSING SIGN.

See S1-1, School Advance Sign.



X-ING

OR

X-WALK

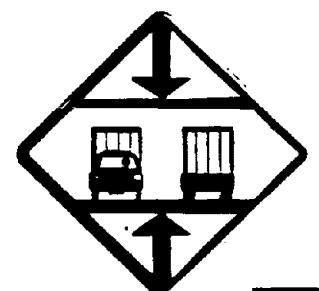
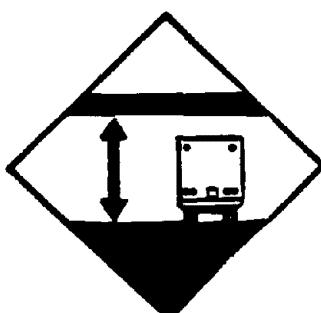
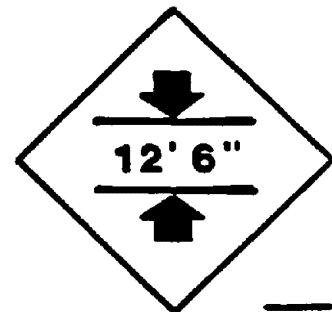
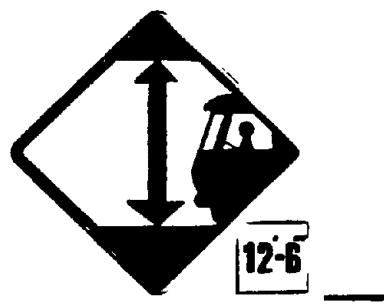
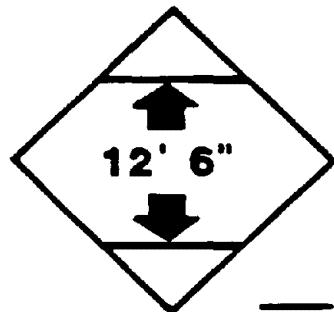
Supplementary plaques to go
below sign



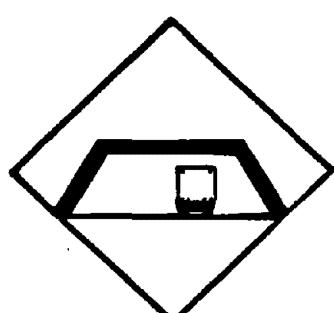
BLACK BORDER, SYMBOL, & MESSAGE,
YELLOW BACKGROUND

W12-2 LOW CLEARANCE SIGN.

Some motorists cannot attach any word meaning to this sign.



XX'X"



XX'X"

APPENDIX C
New Sign Design--Step 2

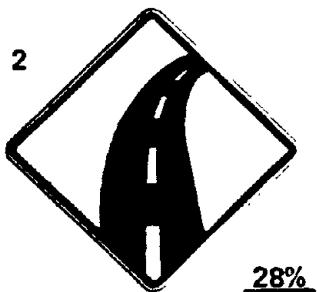


40%

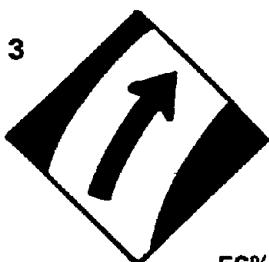
BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-2 CURVE SIGN.

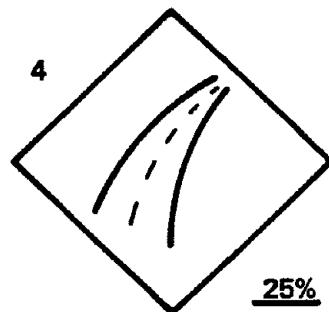
This sign along with W1-1, Turn Sign, are a pair of signs which cause problems for many motorists because they look so similar. Along with W1-3, Reverse Turn Sign; W1-4, Reverse Curve Sign; and W1-5, Winding Road Sign, they all create similar comprehension difficulties for the motorist. Many motorists interpret these signs as actual diagrams of the roadway alignment ahead, while they are intended as representations only. This is especially true of the reverse turn and curve sign. The degree of curvature and distance between sequential curves is not communicated to the motorist. For example, the first curve may need a curve sign; the second may need a turn sign. Since they are close together, the reverse turn sign is used. A motorist slows his speed expecting two turns. He passes through the first curve at a speed he feels is too slow. He expects the next turn to be as gentle. He speeds up and enters the turn at an inappropriately high speed. Changing tangent distances between curves can cause problems as well.



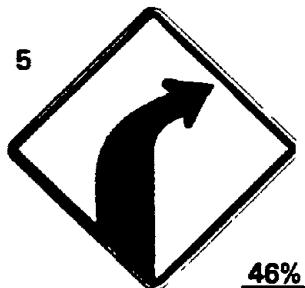
28%



56%



25%



46%

I-2.



6

68%

BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

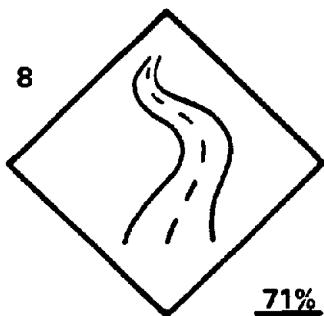
W1-5 WINDING ROAD SIGN.

See W1-2, Curve Sign.



7

76%



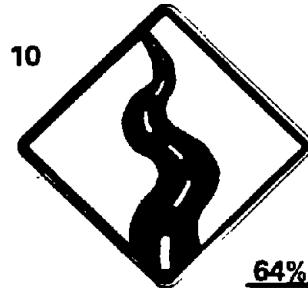
8

71%



9

86%



10

64%

I-3.

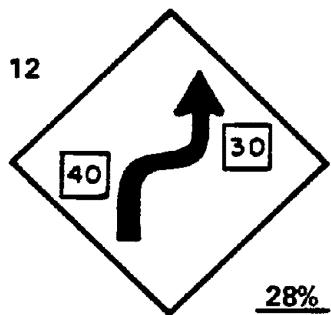


53%

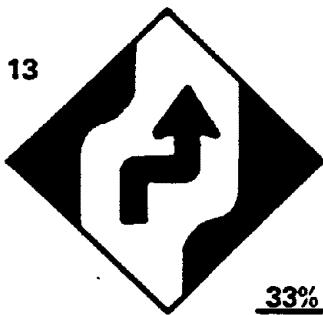
BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-3 REVERSE TURN SIGN.

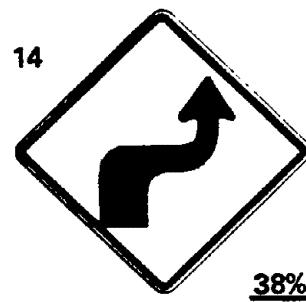
See W1-2, Curve Sign.



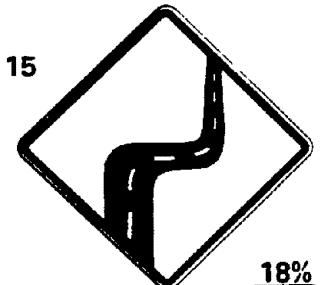
28%



33%

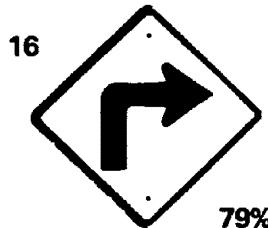


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18%

I-4.



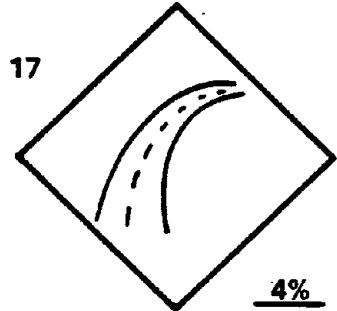
16

79%

BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

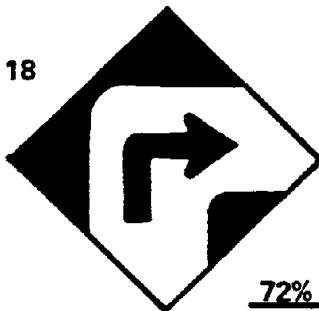
W1-1R/1L TURN SIGN.

See W1-2, Curve Sign.



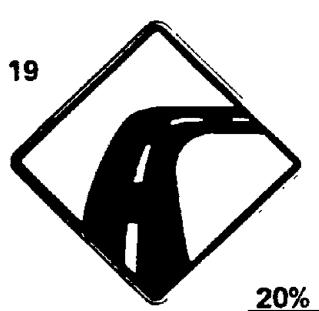
17

4%



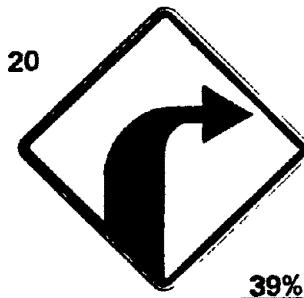
18

72%



19

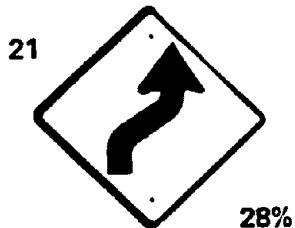
20%



20

39%

I-5.



21

28%

BLACK SYMBOL & BORDER,
YELLOW BACKGROUND

W1-4 REVERSE CURVE SIGN.

See W1-2, Curve Sign.



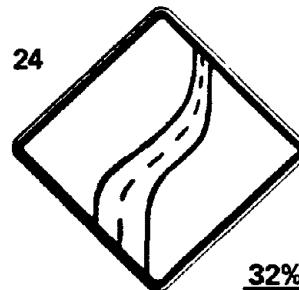
22

20%



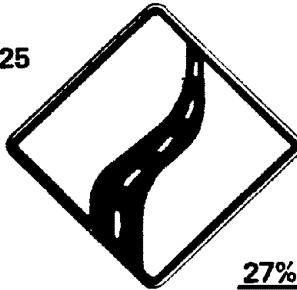
23

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24

32%



25

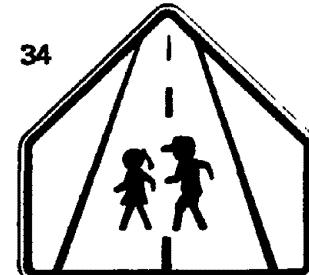
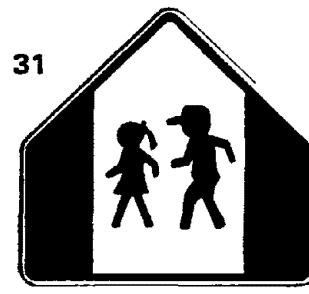
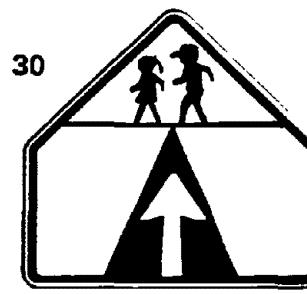
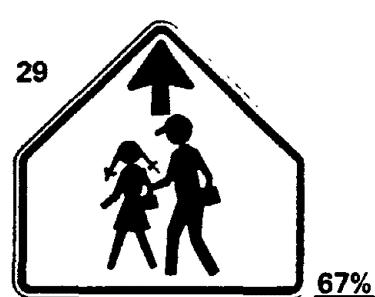
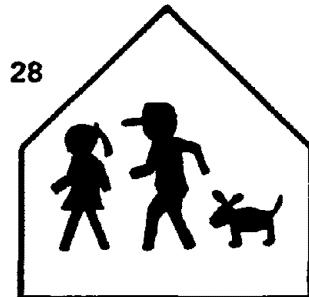
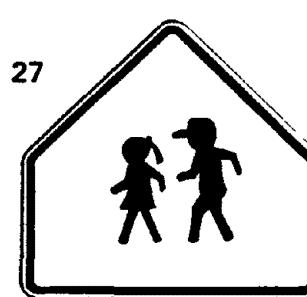
27%

II-6.



S1-1 SCHOOL ADVANCE SIGN.

This sign is intended to warn motorists that they are approaching a crosswalk used by school children. It is usually followed by S2-1, School Crossing Sign, which shows the actual location of the crosswalk. Most drivers understand the concept of pedestrians crossing the road, but fail to understand where the crossing actually is or that the pedestrians are school children. The addition of the crosswalk lines on the S2-1 sign seems to be too subtle a change for most drivers to catch. There is also a great amount of confusion between the S1-1 and S2-1 signs, and the W11-2, Pedestrian Advance Sign, and W11A-2, Pedestrian Crossing Sign. Again, the addition of the schoolbooks in the hands of the children on the S1-1 and S2-1 signs or the difference between the pentagon shape for the school sign and the diamond shape for the pedestrian sign may be too subtle for most people to notice.



II-7.



31%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

S2-1 SCHOOL CROSSING SIGN.

See S1-1, School Advance Sign.



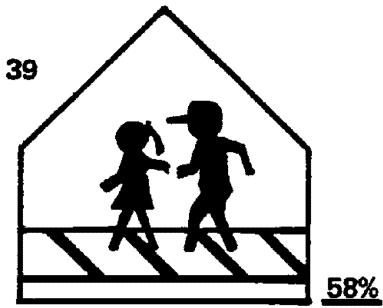
42%



58%



67%



58%

II-8.



40

SCHOOL
BUS STOP
AHEAD

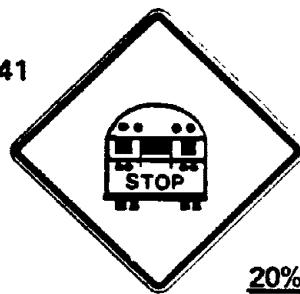
66%

BLACK BORDER & MESSAGE,
YELLOW BACKGROUND

S3-1 SCHOOL BUS STOP AHEAD SIGN.

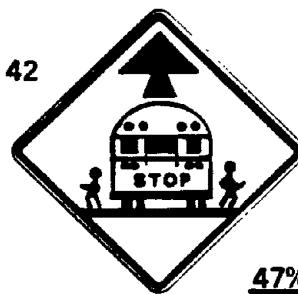
This sign is to be used in situations where a school bus stop is in an area where there are sight distance limitations. The word message is clearly understood, but the engineering concepts of sight distance and safe stopping distance are not. Some type of active command or supplementary plate (speed or distance) might help the problem. The temporal nature of the sign's applicability causes problems as well (i.e., Are school buses stopping ahead in June, July and August?).

41



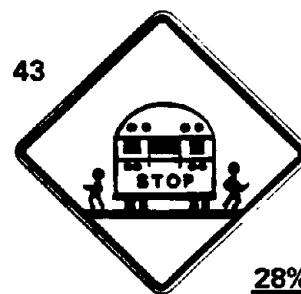
20%

42



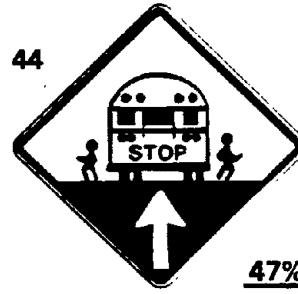
47%

43



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44



47%

II-9.



16%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W11-2 ADVANCE PEDESTRIAN CROSSING SIGN.

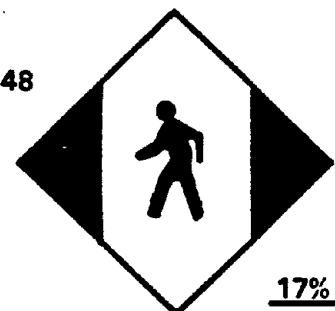
See S1-1, School Advance Sign.



38%



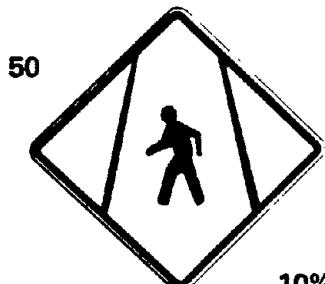
2%



17%



46%



10%



28%

II-10.



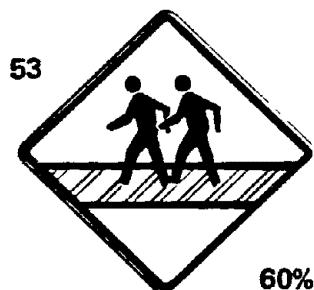
52

71%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W11a-2 PEDESTRIAN CROSSING SIGN.

See S1-1, School Advance Sign.



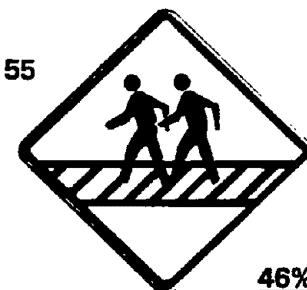
53

60%



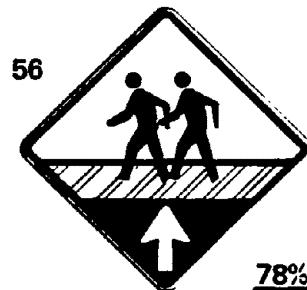
54

53%



55

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56

78%

III-11.

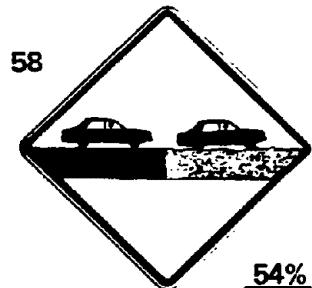


22%

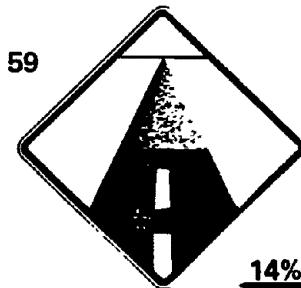
BLACK BORDER, BLACK SYMBOL
WITH YELLOW USED FOR
"ROAD STRIPE" & "UNPAVED ROAD"
DELINEATION, YELLOW BACKGROUND

W-83a PAVEMENT ENDS SYMBOL SIGN.

The symbol on this sign seems to be a bit vague to the driver. It has been interpreted as a gas pump.



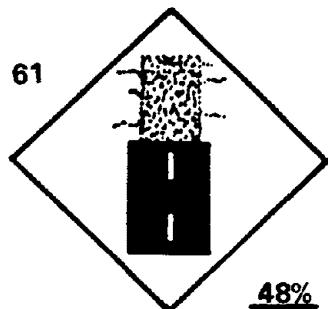
54%



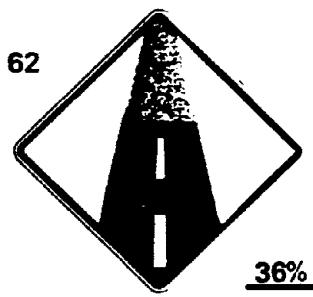
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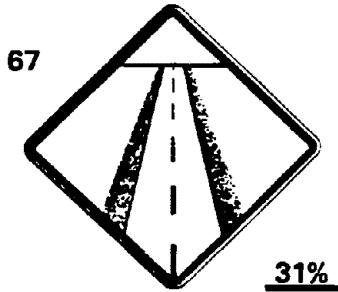
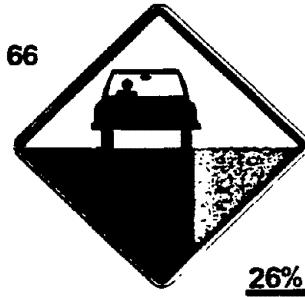
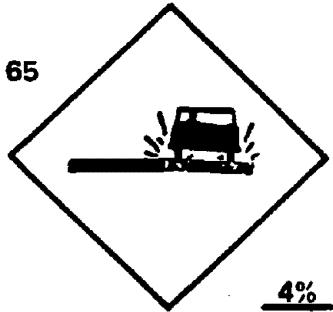
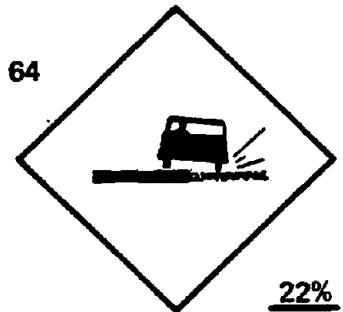
36%

III-12.

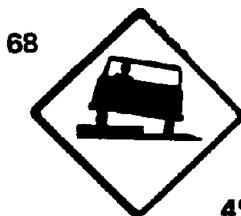


W8-4 SOFT SHOULDER SIGN.

This sign does not have a completely understandable message. If the shoulders are soft, the motorist may ask, "How soft?"; "Do I need to stay off the shoulder?" Some positive command may help here. Some motorists do not understand what the shoulder area is.



III-13.



4%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-4b LOW SHOULDER SIGN.

This sign, similar to W8-4c, Uneven Pavement, fails to communicate to the driver the true nature of the hazard, steering/tracking problems. If the difference in pavement or shoulder height are extreme then larger vehicles might be easily overturned.



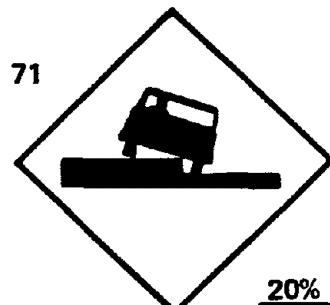
69

39%



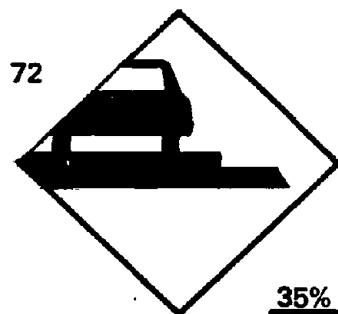
70

29%



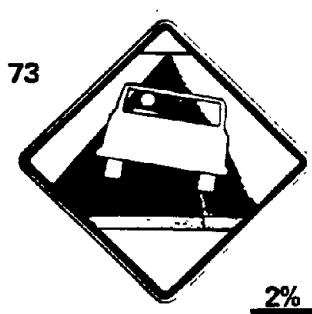
71

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72

35%



73

2%

III-14.

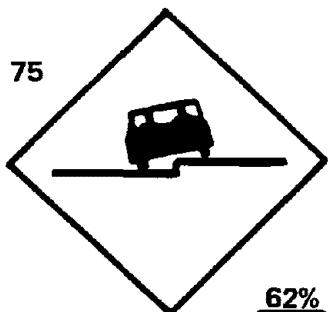


43%

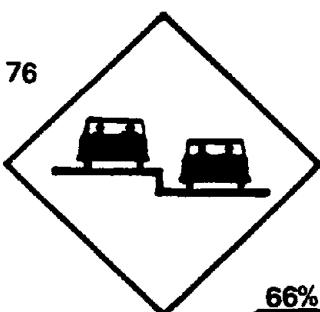
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-4c UNEVEN PAVEMENT SIGN.

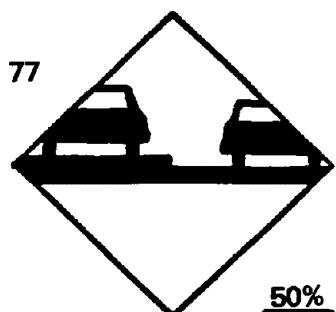
See W8-4b, Low Shoulder Sign.



62%



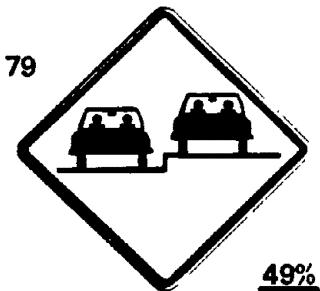
66%



50%

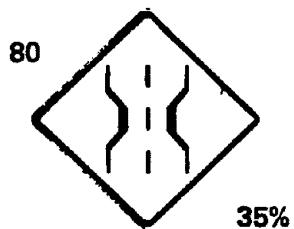


39%



49%

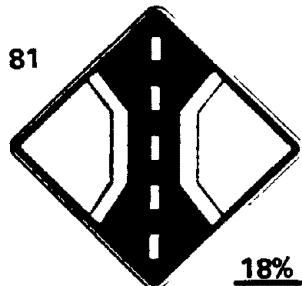
IV-15.



80 35%
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

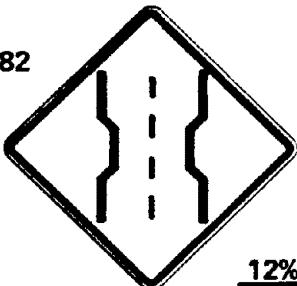
W5-2a NARROW BRIDGE SIGN.

This use of the plan view of the road and the engineering symbol for a bridge does not allow any interpretation to be made by motorists for this sign.



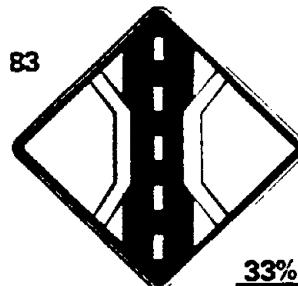
81

18%



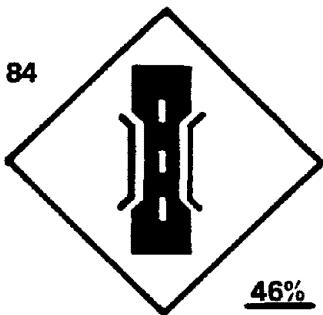
82

12%



83

33%



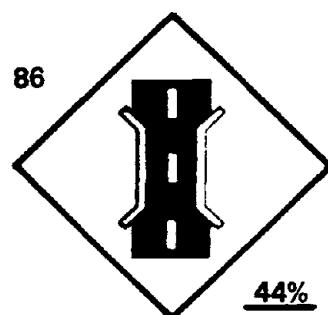
84

46%



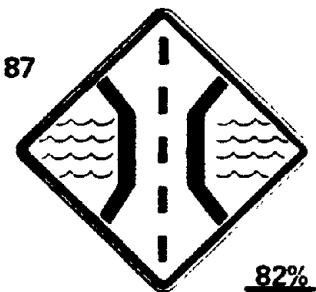
85

80%



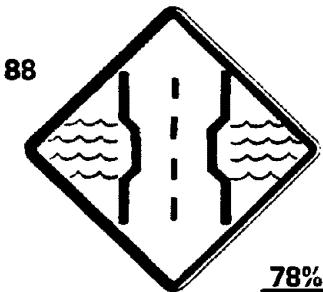
86

44%



87

82%



88

78%

IV-16.

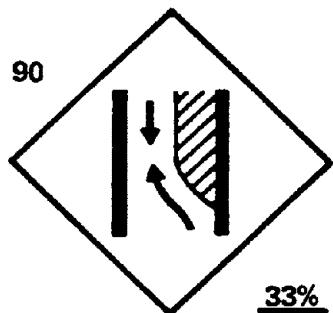


60%

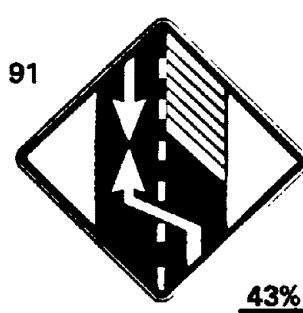
BLACK BORDER & MESSAGE,
ORANGE BACKGROUND

W20-4 ADVANCE ONE LANE ROAD SIGN.

The concept that one lane is being used for two-way traffic is not completely clear.



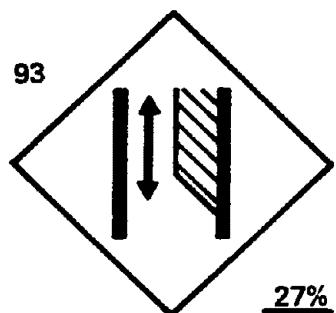
33%



43%



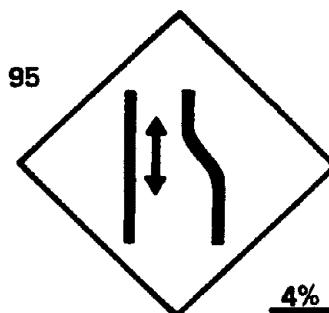
36%



27%

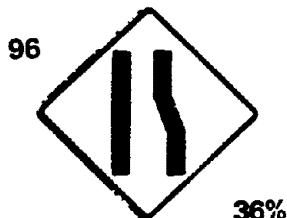


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IV-17.

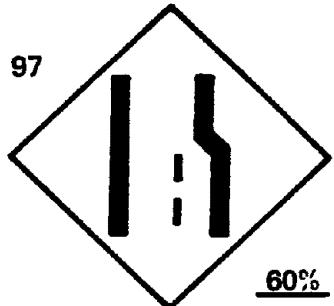


36%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

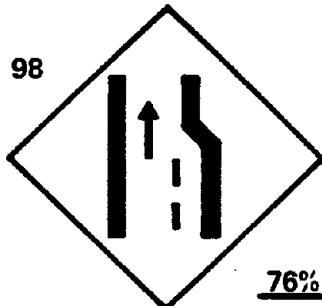
W4-2 PAVEMENT WIDTH TRANSITION SIGN.

Difficult for motorists to differentiate between an actual lane drop and a narrowing of the pavement. Some motorists have difficulty differentiating between this sign and its "mirrored" opposite which signifies a left lane ending or closure.



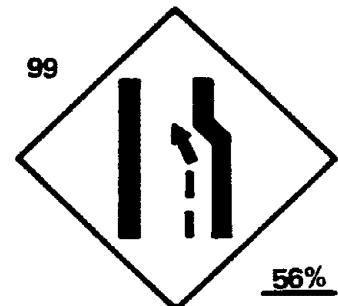
97

60%



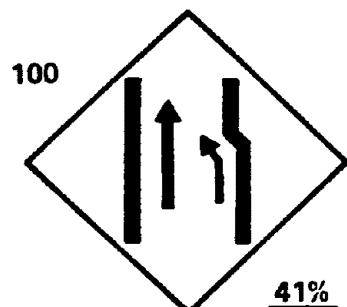
98

76%



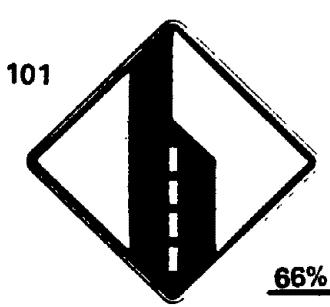
99

56%



100

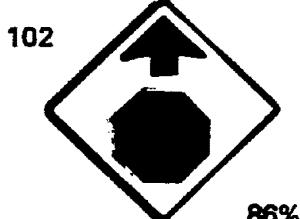
41%



101

66%

V-18.



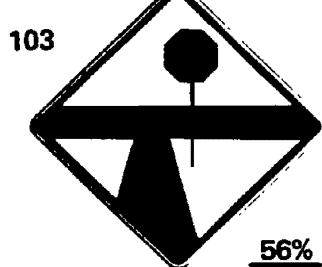
102

86%

BLACK BORDER & ARROW,
RED "STOP" SIGN WITH WHITE BORDER,
YELLOW BACKGROUND

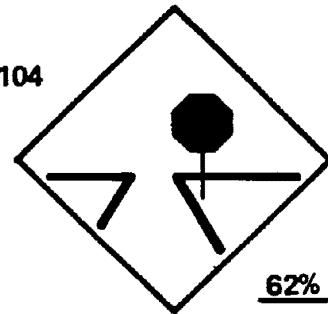
W3-1a STOP AHEAD SIGN.

The arrow on this sign sometimes misleads motorists about the alignment of the roadway ahead. Concern is expressed by some experts that the symbol could be interpreted as an actual Stop Sign.



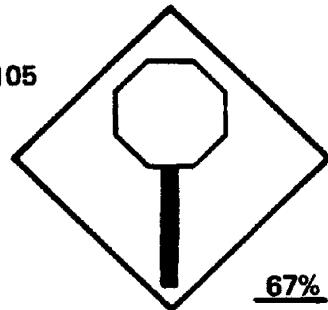
103

56%



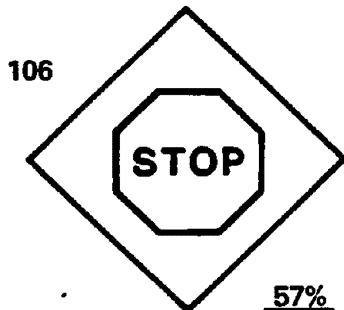
104

62%



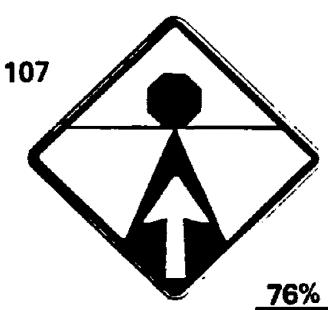
105

67%



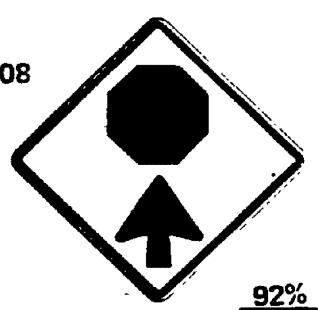
106

57%



107

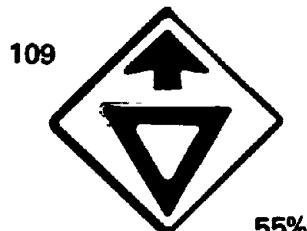
76%



108

92%

V-19.

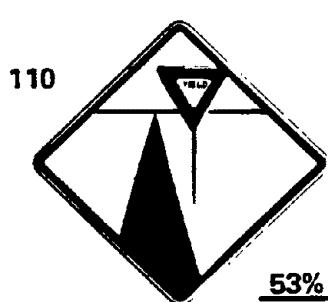


55%

BLACK BORDER & ARROW,
RED & WHITE "YIELD" SIGN,
YELLOW BACKGROUND

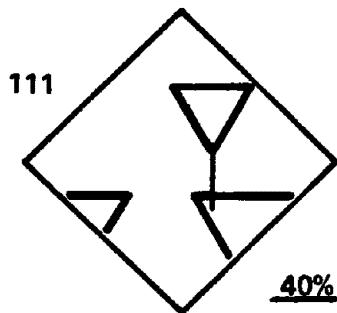
W3-2a YIELD AHEAD SIGN.

The arrow on this sign sometimes misleads motorists about the alignment of the roadway ahead. Concern is expressed by some experts that the symbol could be interpreted as an actual Yield Sign.



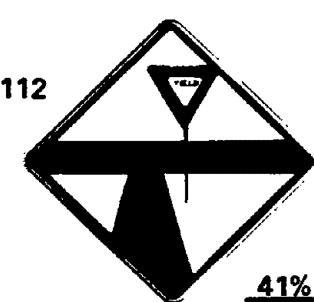
110

53%



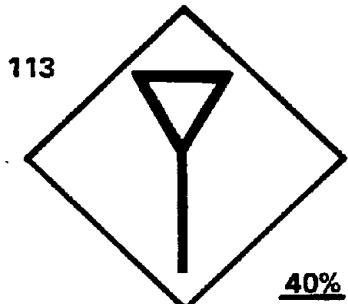
111

40%



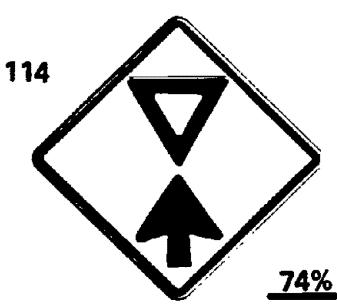
112

41%



113

40%



114

74%



115

55%

V-20.



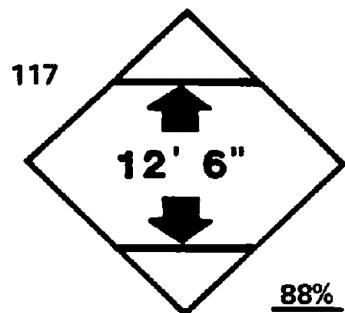
116

75%

BLACK BORDER, SYMBOL, & MESSAGE,
YELLOW BACKGROUND

W12-2 LOW CLEARANCE SIGN.

Some motorists cannot attach any word meaning to this sign.



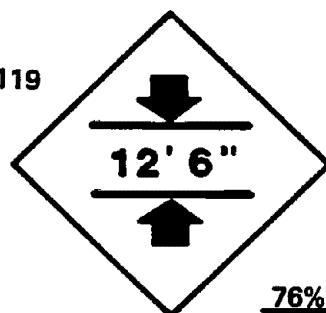
117

88%



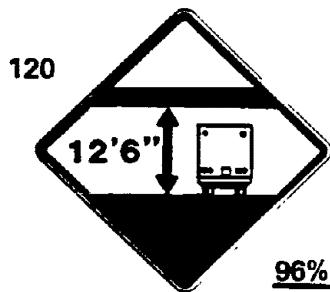
118

100%



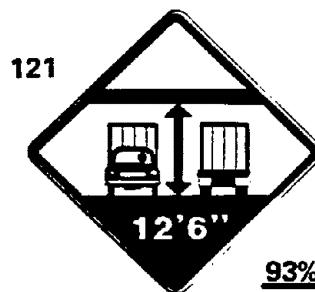
119

76%



120

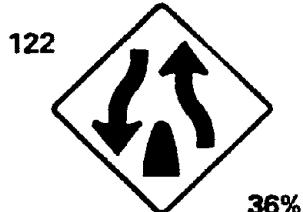
96%



121

93%

VI-21.



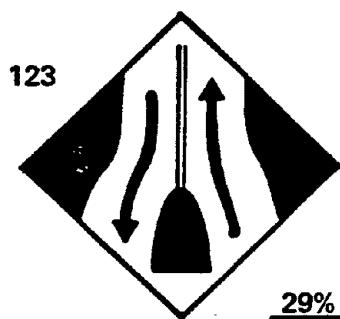
122

36%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

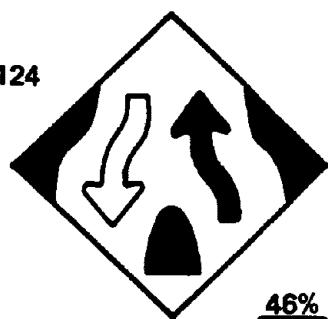
W6-2 DIVIDED HIGHWAY ENDS SIGN.

This sign is often confused with its "opposite" W6-1, Divided Highway Begins Sign. This may be attributable to the fact that they are the exact same sign rotated 180° for each use.



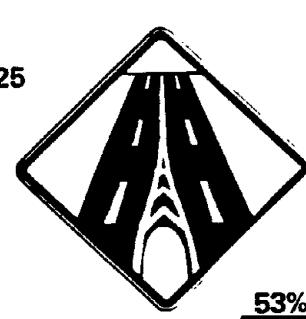
123

29%



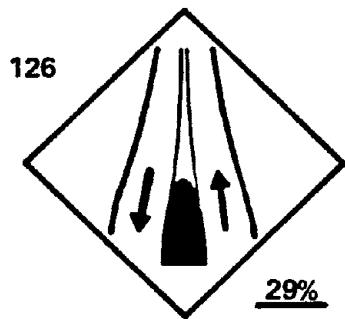
124

46%



125

53%



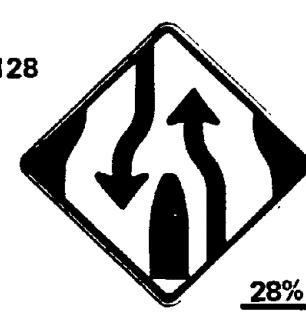
126

29%



127

37%



128

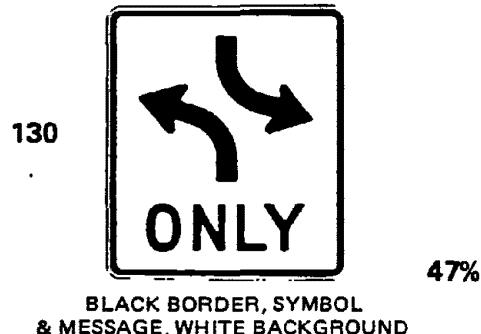
28%



129

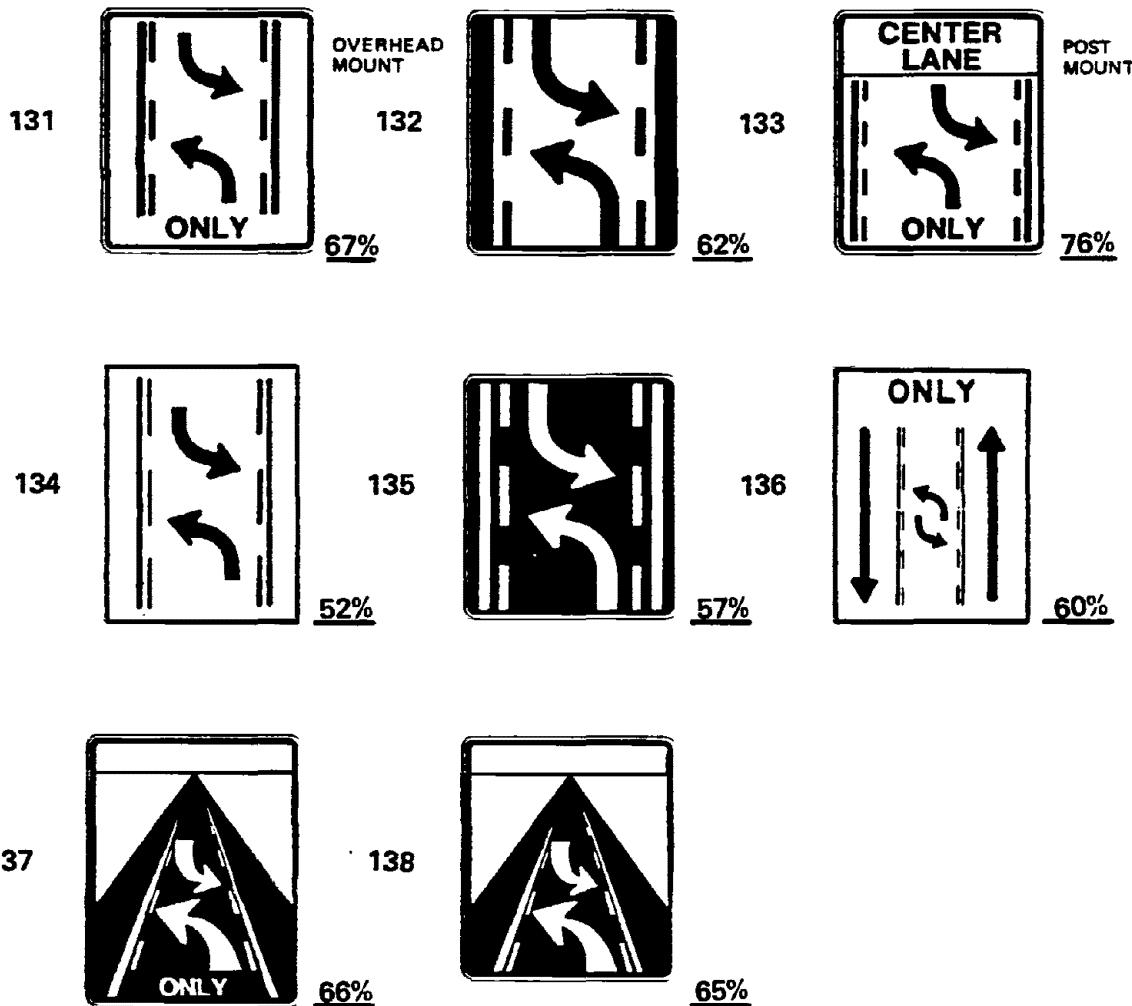
46%

VI-22.



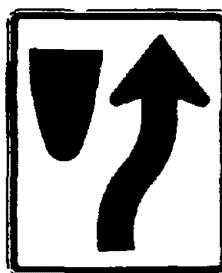
R3-9a TWO-WAY LEFT TURN ONLY SIGN.

This sign is one where the problem lies not only with the sign, but also with the public familiarity of the traffic engineering concept of two-way left turn lanes. The sign and associated pavement markings should work together to form the total concept.



VI-23.

139



73%

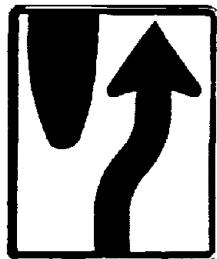
(18" x 24" PERMISSIBLE ON NARROW
MEDIAN AND AT MEDIAN OPENINGS,
36" x 48" FOR EXPRESSWAYS,
48" x 60" PRESCRIBED ON FREEWAYS
APPLIES TO R4-7 THROUGH R4-8)

BLACK BORDER & SYMBOL,
WHITE BACKGROUND

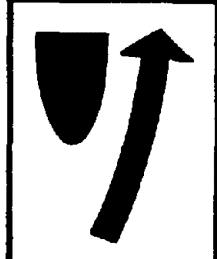
R4-7 KEEP RIGHT SYMBOL SIGN.

The curve of the arrow leads some motorists to believe that the alignment of the road is curved or winding ahead.

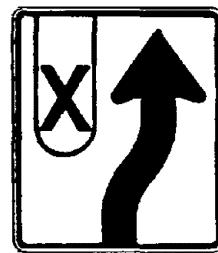
140



141

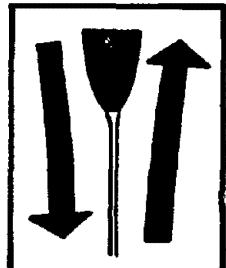


142

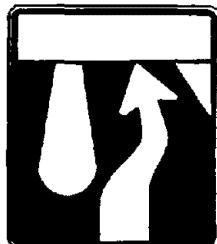


42%

143



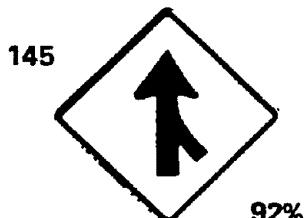
144



25%

63%

VII-24.

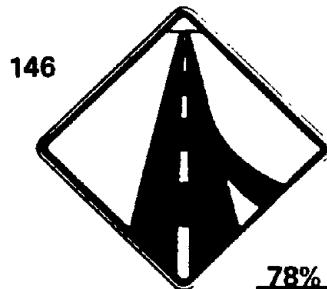


92%

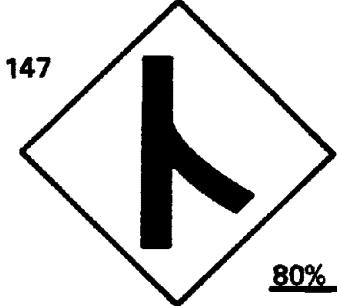
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W4-1 MERGE SIGN.

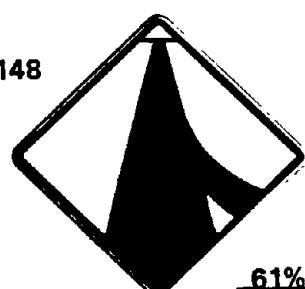
This sign causes some confusion as to which road is the major roadway. It is also confused with W4-3, Added Lane Sign.



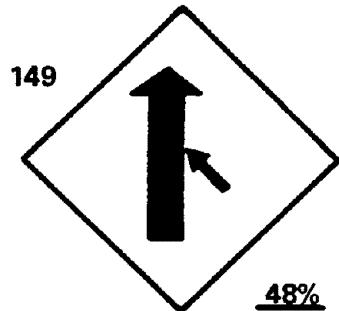
78%



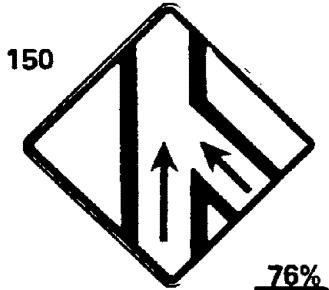
80%



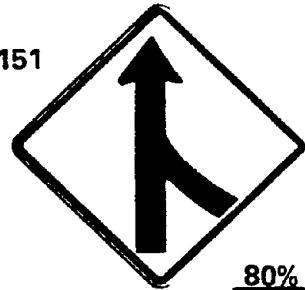
61%



48%

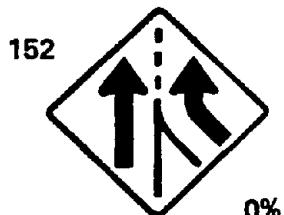


76%



80%

VII-25.

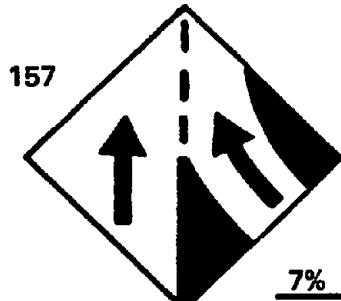
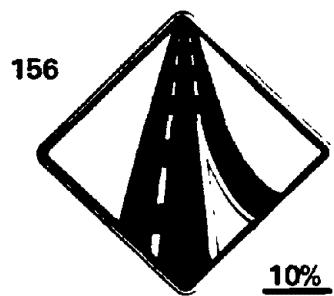
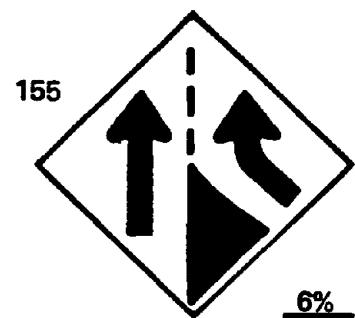
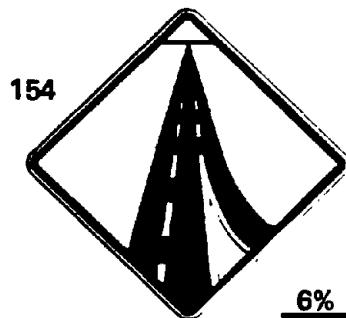
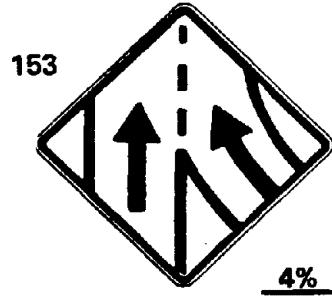


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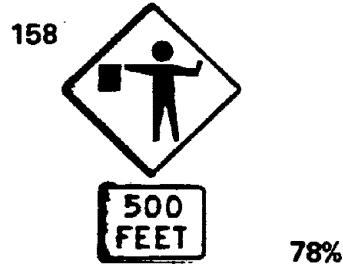
BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W4-3 ADDED LANE SIGN.

See W4-1, Merge Sign.



VIII- 26.

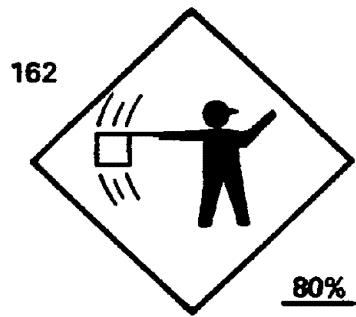


78%

BLACK BORDER & SYMBOL,
ORANGE BACKGROUND

W20-7a ADVANCE FLAGGER SYMBOL SIGN.

This sign is usually recognized as being part of a construction or work zone, but many drivers fail to realize that they will be receiving traffic control directions from a flagger further down the road. Part of the problem may be an unfamiliarity with the flagging concept of controlling traffic over a one-lane section of road.



VIII-27.

165



75%

BLACK BORDER & SYMBOL,
ORANGE BACKGROUND

W21-1a WORKER SYMBOL SIGN.

The pictograph for this sign is probably the least understood by motorists. Interpretations have been "man with a broken umbrella," "man feeding a whale," and others.

166



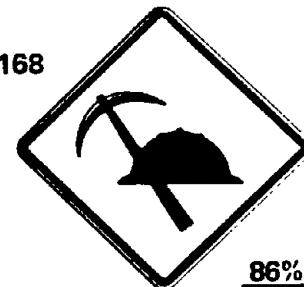
89%

167



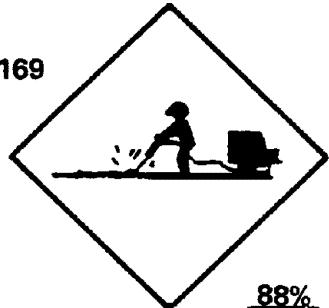
88%

168



86%

169



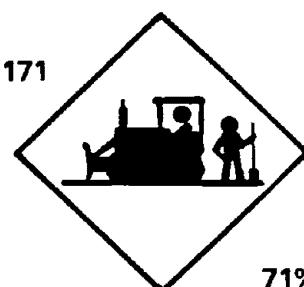
88%

170



88%

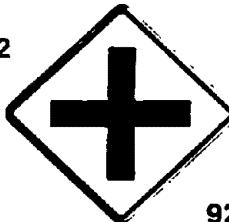
171



71%

IX-28.

172



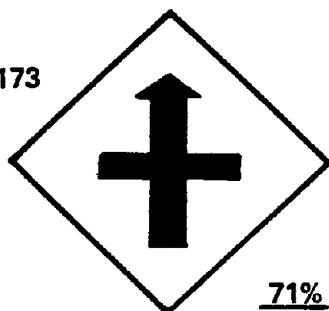
92%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W2-1 CROSS ROAD SIGN.

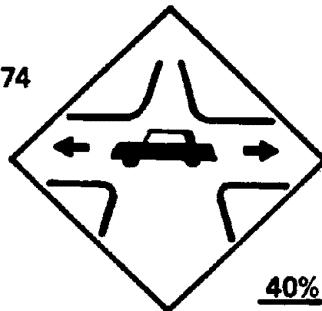
Many drivers have a problem transferring this aerial or plan view to their point of view on the roadway. At times, it has been confused with the International Red Cross symbol, leading some people to believe it has something to do with hospitals.

173



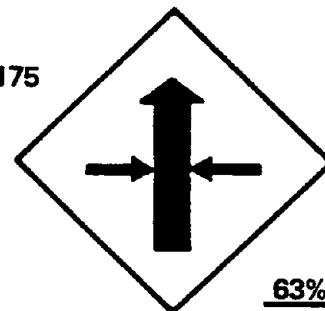
71%

174



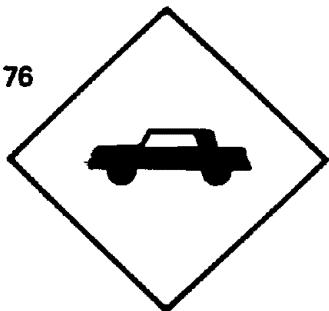
40%

175



63%

176



X-ING

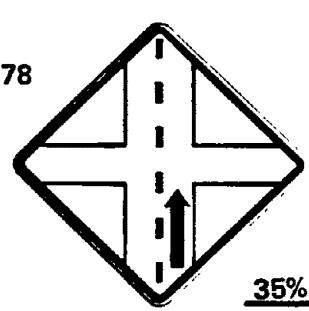
84%

177



64%

178



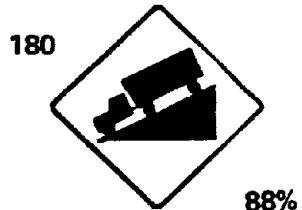
35%

179



85%

X-29.



88%

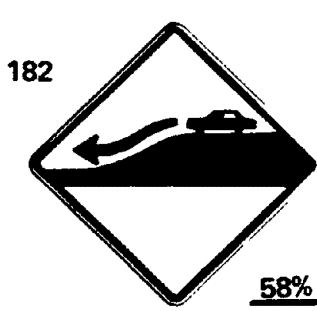
**BLACK BORDER & SYMBOL,
YELLOW BACKGROUND**

W7-1 HILL SIGN.

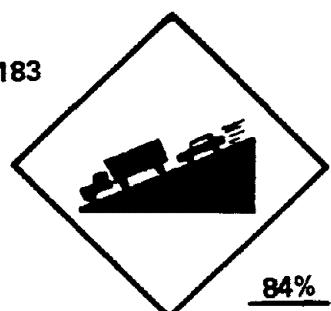
The truck symbol leads many motorists to think that the warning applies only to trucks.



98%



58%



84%



88%



78%



53%

XI-30.

187



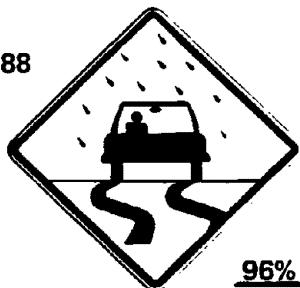
66%

BLACK BORDER & SYMBOL,
YELLOW BACKGROUND

W8-5 SLIPPERY WHEN WET SIGN.

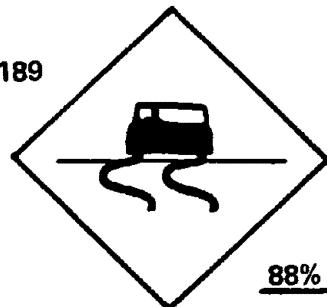
The concept of the road being wet/slippery is completely lost. Motorists interpret this sign as "sharp curve" or "drunk drivers ahead."

188



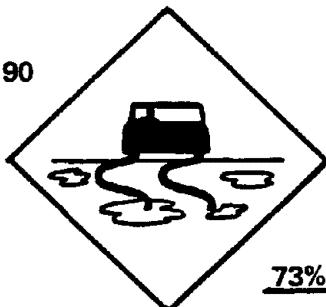
96%

189



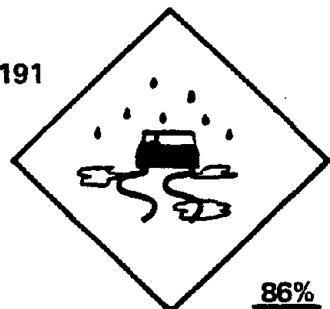
88%

190



73%

191



86%

192



80%

193



92%

APPENDIX D
Highway Driving Simulator

I. PURPOSE

This document (1) provides an introduction to HYSIM configuration, function, and general capabilities; (2) provides guidance for potential users to follow to obtain use of facility services; and (3) outlines user support available from the HYSIM facility staff. Interested persons may obtain additional information on HYSIM by contacting the Manager, Human Factors Laboratory, Systems Technology Division (HSR-10), Office of Safety and Traffic Operations R&D, Federal Highway Administration, Washington, D.C. 20590. (703) 285-2027.

II. HYSIM GENERIC DESCRIPTION

Figure 2 shows a floorplan of the HYSIM Laboratory.

The central feature of HYSIM is the car cab module (Fig. 1a). Except for engine and drive train, the car is complete and subjects participating in an experiment "drive" the car. All controls for velocity and heading - steering wheel, acceleration, and brake - are functional and the "feel" of the controls has been carefully maintained. Other ancillary controls - lights, horn, shift selector, fan switches, etc. - are also functional.

As the subject operates the car, he/she views a roadway scene projected on a curved screen located at the front of the car (Fig. 1b). The displayed roadway scene elements come from three sources; viz (1) roadway delineations and a few other scene elements are computer generated by special software and projected through the Roadway Project Module (Fig. 1c), (2) overhead and shoulder mounted signs are projected by four 35mm projectors (Fig. 1d), and (3) if a movie film is used, it is projected by the Cinematic Module (Fig. 1e). Typically, the computer generated roadway and sign projectors are used together. The cinematic display is normally used alone as an alternate projection media. All of the projection equipment and associated electronics are mounted on a gantry structure which spans the car cab near its midsection.

All of the above modules are computer controlled. Thus, the display scene responds appropriately and correctly to a subject's manipulations of the car controls; as the subject speeds up, elements in the roadway scene appear to move by more quickly, as the steering wheel is turned the scene shifts in azimuth to simulate a heading change, etc.

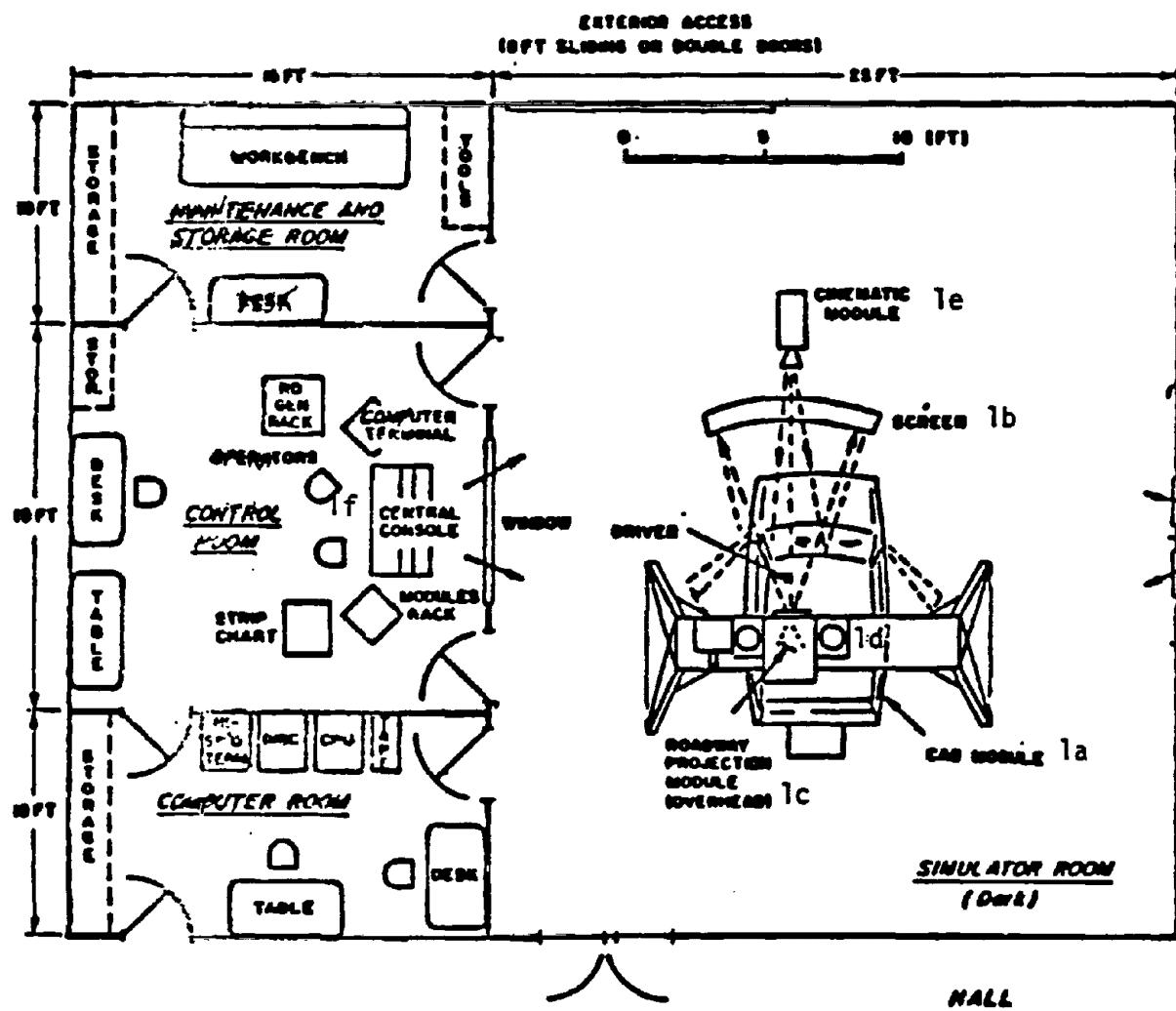


Figure 2. HYSIM Laboratory Floorplan

There is a central control console (Fig. 1f) where the simulator operator monitors simulator operation. The operator can also verify that the experiment is progressing according to plan, observe the driver, and check to assure data are being properly collected and recorded.

Typical data available are:

1. Speed
2. Distance travelled
3. Elapsed time
4. Steering wheel position
5. Brake application/pressure
6. Accelerator position
7. Lateral placement (either to the center line or to the road edge)
8. Discrete event occurrence (horn, turn signals, etc.)
9. Notation of specific events occurring in the experiment scenario (appearance of a certain sign, time with the subject responded to some event, etc.)
10. Various psychophysiological measures

Other HYSIM capabilities include simulation of (1) head and/or cross wind(s), (2) slippery or icy road surfaces, (3) several sets of vehicle dynamics, (4) fog, (5) wind and road noises and a siren sound activated when the subject exceeds a predetermined speed, and (6) Highway Advisory Radio messages.

Questions concerning which HYSIM modules are used during a simulation, what is displayed in the roadway scene, how many subjects participate, etc. are decided prior to the experiment. HYSIM is subsequently prepared and checked for conformance to experimental requirements before the experiment proper is conducted.

III. HYSIM USER SUPPORT SERVICES

When a study has been approved for HYSIM implementation, the Human Factors Laboratory Manager (HM) will provide consultations to the facility user. Consultations will include (1) a detailed review of the user's experimental design, (2) careful consideration of HYSIM capabilities to meet experimental requirements and any necessary experimental design tradeoffs, (3) thorough review of the independent and dependent variables used in the experiment, (4) a complete and detailed determination of the experimental scenario(s) requirements, (5) specification of the data to be acquired and (6) agreement on the number and type of subjects to participate in the experiment. After consultations are completed, the HM will work closely with the user and will direct the HYSIM facility staff in preparing the simulator for the experiment.

The user is responsible for supplying to the HM all artwork necessary to prepare Dyna-Sign slides for use in the study. The facility staff will subsequently prepare glass mounted 35mm slides properly scaled for the experiment. If cinematic operation is required, the user is responsible for supplying filmed scenes for the cinematic module. The facility staff will suitably modify the supplied film as appropriate for HYSIM use.

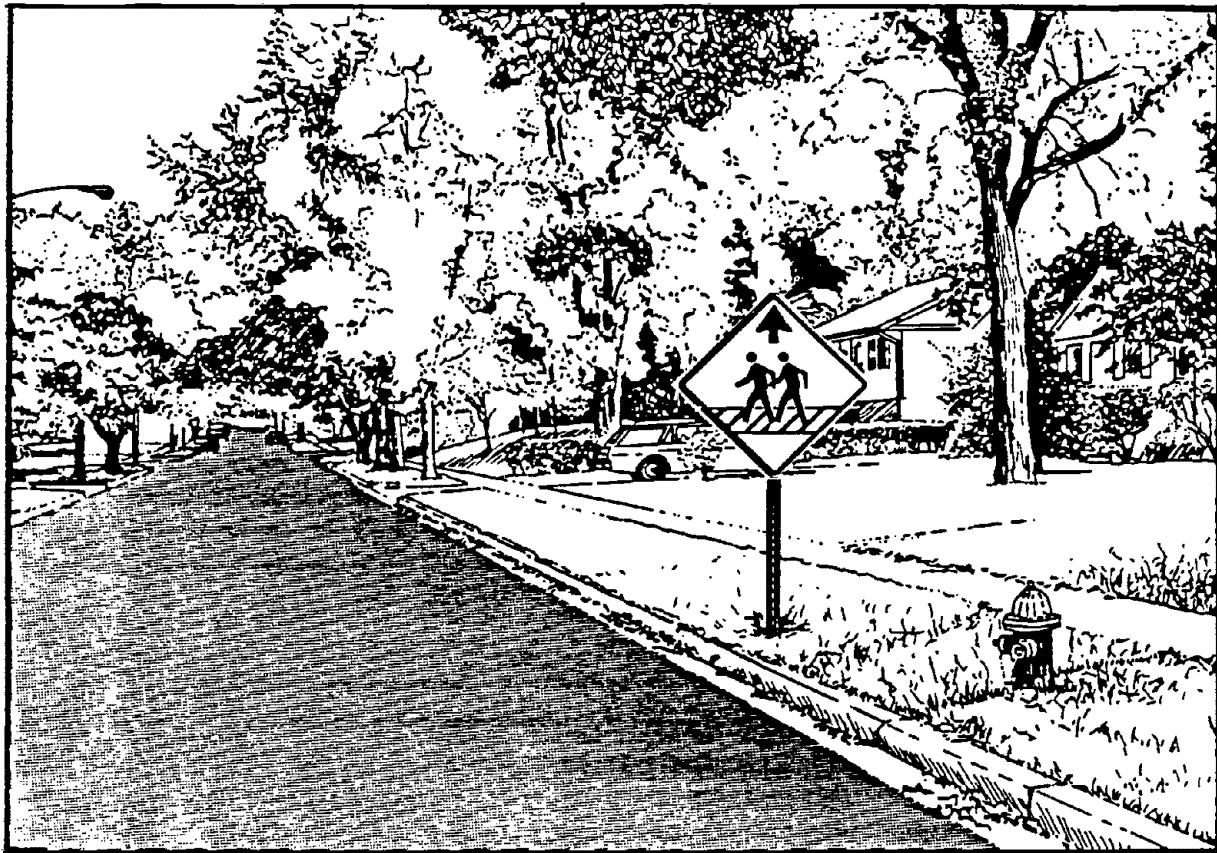
The user will attend the pilot and experiment runs for his/her study and is responsible for obtaining, scheduling, paying, and transporting all test subjects. Scheduling of subjects will be coordinated with the HM. The HM will provide consultation to the user regarding problems arising during the progress of the study and will correct any failures in machine function as quickly as possible so as to minimize slippage of the study schedule.

When the experiment data collection phase(s) is completed, the HM will supply the user with any of the following:

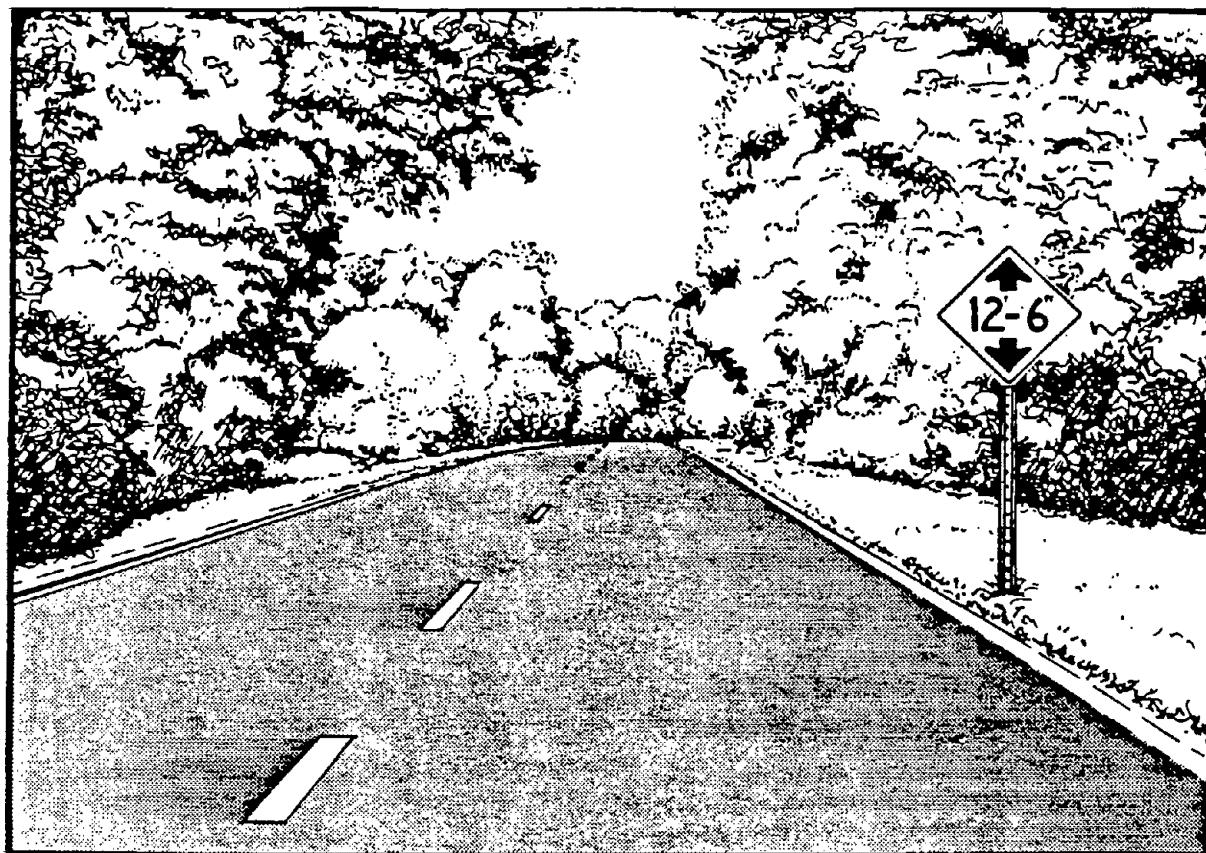
- a hard copy of all raw data
- selected summary statistics
- any strip-chart recordings made
- a magnetic tape containing all raw data

Users may subsequently arrange utilization of the DOT Transportation System Center's or other mainframe computer for complex data analyses. In selected cases, users may also arrange with the HM to analyze HYSIM data, using less complex analyses, on the HYSIM PDP 11/34 system.

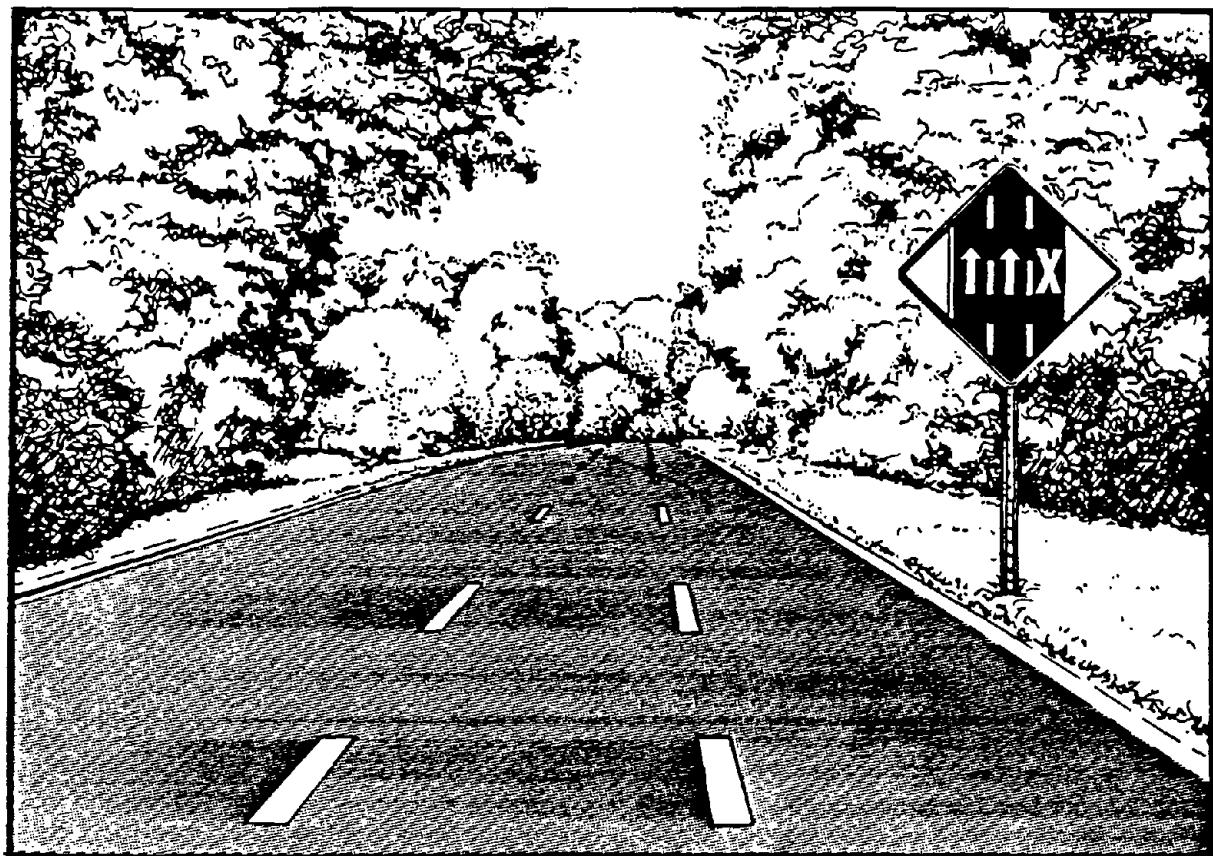
APPENDIX E
Screening Procedure Presentation Scenes



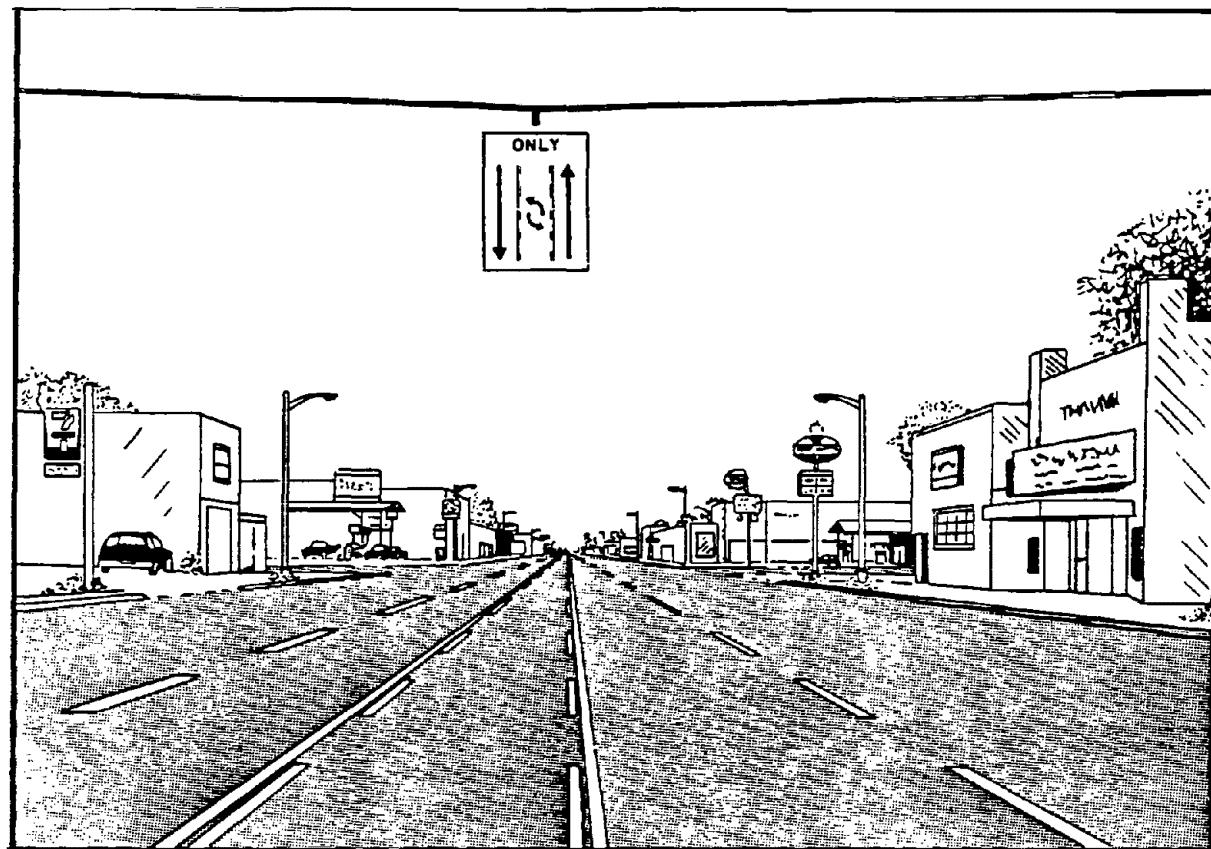
What do you think this sign means? _____



What do you think this sign means? _____



What do you think this sign means? _____



What do you think this sign means? _____

APPENDIX F
Subject Response Codes

I-1. #1-5 Curve Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Right Curve
10	Bears/Veers/Bends/Gradually Turns (Right)
(20)	Curve
21	Sharp Curve
22	Sharp Right Curve
25	(Right) Turn
26	Sharp (Right) Turn
30	Right Turn Only
31	Stay to Right
32	Slight Curves
33	Curvy Road
40	Blacktop on Curve
41	Road Bears Right, Reminder for Night Driving
42	Visibility
43	Turn Lanes
50	Uphill/Downhill
51	Narrows/Single Lane
52	Passing Allowed/Not Allowed
53	Stay Same/Straight Highway
54	Road Bends Right in 2 Lanes
60	Winding Road

I-1. #1-5 Curve Sign Continued

<u>Code #</u>	<u>Gist</u>
61	Two-Way Traffic
90	Immediate Turn
91	Long Curve
92	Single Highway
93	Road Warding Toward Right
99	Unknown

I-2. #6-10 Winding Road Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Winding/Windy _____
10	S Curves
11	Curving, Curve, Curved, Curvaceous Road/Multiple Curves
14	Curves
20	S Curve/Turn
21	Curve (in this Shape, Right/Left)
(22)	Crooked, Snake, Swerving, Twisting, Wigley, Zig-Zag Road
23	Double Curve
30	Curve
50	Passing/No Passing
51	Slippery When Wet With or Without Curves Mentioned
52	Narrows/Single Lane
53	Uphill/Downhill
60	Reverse Curve
90	Road Curves
99	Unknown

I-3. #11-15 Reverse Turn Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Reverse Turn
02	(Sharp/90 degrees) Right Turn (Curve) / Left Turn (Curve) (Ahead)
03	(Sharp/90 degrees) Turns/(Curves) (Ahead)
04	Offset/Jog Right
05	1st Curve-40 MPH-2nd Curve-30 MPH
10	(Bear) Right and Left (Turn) (Curve)
11	Jog/Offset/Zig-Zag/Double Turn/Double Sharp Curve/Curve in This Shape
12	S-Turn
14	Speed Changes in Curve
20	(Bad/90 degrees/Sharp)-(Curve/Turn/Bear/Curl)
21	Same as 20 With Right
23	Curves/Curved/Curvey/Curving
24	S Curve (Right)
26	Crooked/Twist
27	Curve-Slow Down
28	Sharp Right Turn then Straight
29	Slow to 30
70	Turns
30	Curve
31	Right Curve
32	S Curves

I-3. #11-15 Reverse Turn Sign Continued

<u>Code #</u>	<u>sist</u>
33	Bends Right Then Straight
34	Speed Limit Change in Curve
35	Detour
36	Merge
40	Road Construction and Curve
41	40 Left Lane/30 Right Lane
50	Uphill/Downhill/Dip
51	Narrows
52	Bends Left and Straightens
53	Passing/No Passing
54	Turn Off
55	Dip
56	Obstruction, Bear Right
57	Speed Limit Change After Curve
58	Numbers Have No Meaning
59	Speed Limit Change-No Curves Mentioned
71	Left/Right
60	Winding Road
61	Reverse Curve
62	Turn
90	Road Contoured Ahead
91	Roads Move Over
92	Follow Arrow
99	Unknown

I-4. #16-20 Turn Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Right Turn
02	Sharp/90 degrees Right
20	Turn
21	Sharp Curve
22	90 degrees/Right Angle
24	Bears, Bends, Goes, Veers (Right)
25	Curves, Curved, Curving
26	Right Curve/45 degrees
27	Curve (Ahead)
30	Mulitiple Curves Concept
31	Road Turns Off at Right
50	Uphill/Downhill
51	Passing/NO Passing
52	Narrows
53	Number of Lanes
54	Left
55	One-Way Traffic
56	Cross Traffic at Right

I-4. #16-20 Turn Sign Continued

<u>Code #</u>	<u>Gist</u>
60	Winding Road
61	Detour
62	Bridge
63	Right Turn Only
64	No Right Turn
90	Curve to Road at Right
99	Unknown

I-5. #21-25 Reverse Curve Sign .

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Reverse Curve
02	Right Curve/Bend, Left Curve/Bend
03	S Curve Right
10	Curved, Curvy, Curving, Curves, Crooked, Swervy, Twisting/in This Shape
13	Curves
20	Sharp Right/Left Turn/Curve
21	Right Turn Then Straight
22	Zig-Zag
23	Right Curve Then Straight
(24)	S Curve
25	S Turn
26	Sharp Curves
27	Turns
30	Curve Then Straight
31	Qualified Curve or Turn Then Straight
32	Detour Right
40	Dangerous Road
41	Road Curves - Pavement Ends
42	Change Lanes
43	Road Ends
50	Lane Moves to Right
51	Uphill/Downhill

I-5. #21-25 Reverse Curve Sign Continued

<u>Code #</u>	<u>Gist</u>
52	Passing/No Passing
53	Narrows
54	Left Then Right
60	Curve
61	Right Curve
62	Turn (including Qualified Curve)
63	Right Turn (including Qualified Curve)
64	Winding Road
65	Divided Highway
13	Road Curves
99	Unknown

II-6. #26-34 School Advance Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	School Crossing Ahead
02	School Zone/Area (Ahead); School Children in Area
10	Children Crossing Area
11	Children Crossing Ahead
20	School Crossing
22	Children Crossing
23	Children Ahead
24	Children
25	Pedestrians Crossing Ahead
26	Pedestrians Crossing
28	Pedestrians
29	Crosswalk Ahead
70	Crosswalk
71	Pedestrian Ahead
30	Residential/Populated/Children's Area
31	(Children) Playing Ahead
32	(Children) Playing
33	Children in Street
34	Pets/Animals
35	Playground
36	Pedestrians Walking in the Road
37	Children Walking in the Road

II-6. #26-34 School Advance Sign Continued

<u>Code #</u>	<u>Gist</u>
40	Mall Crossing
41	Bus Stop Ahead
42	Children Crossing at Corner
43	Children Playground - Hard to See
44	Children Might Cross
45	Children Crossing Not at Corner
50	Children Along Road (Not in Street)
51	One-Way Street
52	Road Narrows
90	Watch for Children in the Crossing on the Mid Striped Lane
99	Unknown

II-7. #35-39 School Crossing Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	School Crossing/Crosswalk
10	Children Crossing/Crosswalk
20	People/Pedestrian Crossing/Crosswalk
22	Downstream Children
23	Downstream Pedestrians
24	Children Crossing Ahead
30	(Children) Playing Ahead
31	(Children) Playing
32	Playground
33	Residential/Populated/Children's Area
34	Crosswalk Ahead
40	Women Crossing
41	Shopper Crossing
50	Children Along Road (Not in Street)
51	Children Crossing the Railroad
52	Children Walking Along Road
53	People Walking Along Road
60	School Advance Sign
61	School Crossing Ahead
62	Pedestrians Advance Sign
90	Children Walking
91	Safety Lane for Children
99	Unknown

II-8. #40-44 School Bus Stop Ahead Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	"School Bus Stop Ahead" (Verbatim Response to Word Sign)
02	Other Correct Responses to Word Sign
03	School Bus Stop Ahead (Correct Gist Response to Symbols)
10	Bus Stop Ahead
20	School Bus Stop
21	Bus Stop
22	School Bus
23	Downstream School Bus (Watch For/Be Alert For/Prepare to Stop For)
24	School Bus Stop Area
25	School Bus Route
30	Beware of Children
31	Slow Down
50	School Bus - STOP! (Action Response)
51	School Bus Stop (Straight Ahead)
60	School Ahead
90	School Crossing
91	School Stop Ahead (Question if Action is Implied)
92	Stop For School Bus (Question if Action is Implied)
93	Stop (Ahead)

II-8. #40-44 School Bus Stop Ahead Sign Continued

<u>Code #</u>	<u>Gist</u>
94	School Bus Stops
95	Bus Stops
99	Unknown

II-9. #45-51,56 Advance Pedestrian Crossing Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Pedestrian/People Crosswalk/Crossing (n.) Ahead
02	Crosswalk/Crossing (n.) Ahead
10	Pedestrian(s) Ahead
11	Be Alert/Watch for Pedestrian Crosswalk/Crossing (n.)
12	Pedestrian Crossing (n.) (in Area, Neighborhood, at Intersection)
20	Pedestrian(s)
21	Watch for Pedestrians (Crossing (vb.))
22	Pedestrian(s) Crossing (vb.)
23	Pedestrian/Residential Area
24	Crosswalk/Crossing (vb.)
25	Children Crossing
26	Pedestrian Crossing (n.)
30	Residential Neighborhood (No Mention of Pedestrians)
31	People Crossing Without Crosswalk (Jaywalking)
32	Children Playing/At Play
40	Jogging, Joggers/Hikers
41	Railroad
42	Wet Road or Street
43	Night
44	Construction
50	People/Pedestrians Walking (Not in Street)
51	Pedestrian Overpass

II-9. #45-51,56 Advance Pedestrian Crossing Sign Continued

<u>Code #</u>	<u>Gist</u>
52	Overhead
53	Children Walking (Not in Street)
54	Stop Sign
55	People Crossing on Hilltop
56	People Walking Along Street
60	School Crossing
61	School Ahead
62	Intersection Ahead
63	Wet
90	Mixed Directions About Pedestrian Crossing
91	Walkway Ahead
92	Pedestrian Crossing Straight Highway in Corner
99	Unknown

II-10. #52-55 Pedestrian Crossing Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Pedestrian Crosswalk/Crossing (n.) (including anything having to do with people in a crosswalk area.)
10	Crosswalk/Crossing (n.)
20	Pedestrian(s)
21	Watch for Pedestrians Crossing or Crossing Pedestrians
22	(People) Crossing (vb.) (the Street)
24	Pedestrians Crossing (vb.)
25	Pedestrian/Residential Area
30	Kids/Children (in Neighborhood)
40	Joggers, Jogging (Path)
41	Railroad
42	Person on Dock
43	Boys on Fence
44	Construction
50	People Walking (Not in Street)
51	People Walking in Street
60	(Pedestrian) Crossing (n.) Ahead
61	School Crossing
62	School Zone
90	Pedestrian Has Right to Cross Road
91	No Pedestrians
92	Sidewalk Crossing in Street
93	Men Working on Crossing
99	Unknown

III-11. #57-62 Pavement Ends

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Pavement Ends
02	Unpaved, Gravel, Dirt Road (Ahead)
10	Road Surface Changes, Different Pavement
(20)	Rough, Bumpy, Poor, Broken, Deteriorating, Soft Road (Ahead)
30	Road Under Construction
31	Road Closed/Lane Closed
32	Unmarked Pavement/Pavement Markings
33	Poor, Dark, Dangerous, Foggy Visibility
34	Debris in Highway
35	Bridge
36	Blacktop to Concrete
37	Right Side Problem
38	Road Blocked
40	No Tailgating
41	Heavy Traffic Road
42	Crossroads
43	Traffic Light Ahead
44	Drawbridge Ahead
50	Pass/No Pass
51	Narrows
52	Disabled Vehicle Ahead
53	Uphill/Downhill

III-11. #57-62 Pavement Ends Continued

<u>Code #</u>	<u>Gist</u>
60	Dead End
61	Slippery Pavement
62	Soft Shoulder
63	Falling Rocks
90	Unfinished Road
91	Road Ends (Ahead)
92	From Asphalt Going Into the Paved Lane
93	Single Lane
94	Road Ahead (?)
99	Unknown

III-12. #63-67 Soft Shoulder Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Soft Shoulder (Verbatim)
02	Other Soft Shoulder Response to Word Sign
03	Soft Shoulder (Correct Gist From Symbolic Sign)
10	Loose, Unpaved, Dirt, Grassy Shoulder
20	"Avoid" Shoulder
22	Rough/Bad/Dangerous Shoulder
30	Rough, Bumpy, Uneven, Rocky Road (Ahead)
31	Water (Road Damage)
32	Damaged, Poor, Bad, Tore Up, Broken, Potholed Road (Ahead)
33	Wet Road
34	Water (No Road Damage)
35	Debris in Highway
36	Shoulder
37	No/Narrow Shoulder
40	"Curb"
41	"Curves"
42	Flat Tire Changing Lane
43	Right Side of Road in Disrepair
44	Watch Out for Oncoming Traffic
45	Different Color Pavement Ahead

III-12. #63-67 Soft Shoulder Sign Continued

<u>Code #</u>	<u>Gist</u>
46	Two-Way
50	Long Straight Road
51	Passing
60	Low/Uneven Shoulders
61	Road is High in Center (Uneven Pavement)
62	Pavement Ends (Unpaved Roads)
63	Slippery (When Wet)
64	Road Ends/Dead End/Road Closed
90	Pavement Gone in Curb Lane
91	One-Way Turn Two-Way Up Road
99	Unknown

III-13. #68-73 Low Shoulder Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Low Shoulder
20	No Riding on Shoulder
21	Be Careful of Curb, Uneven Curb
22	No/Narrow/Unfinished Shoulder
25	Ditches, Deep Ditches
30	Bump/Pot Holes (Ahead)
31	Poor Road Conditions
32	Construction/Road Work (Ahead)
33	Road Surface Changes
34	Incline/Hill/Blind Hill (Ahead)
35	Oncoming Traffic, Two-Way Traffic
36	Passing/No Passing
37	Median Ends/No Median Strip
38	Car on Shoulder
39	High Shoulder
70	Raised Median
71	Stay Close Your Side
72	No Parking
73	Narrow/One Lane
74	Speed Bump Ahead
75	Banked, Angled, Graded Road
76	Gravel Shoulder

III-13. #68-73 Low Shoulder Sign Continued

<u>Code #</u>	<u>Gist</u>
77	No Guardrail
40	Watch for Flats Being Fixed, Cars Parked Off Road
41	Watch for Cars in Shadows
42	Visibility Problems
50	Parking ("in" Street)
51	Drive on Left, Opposite Side, Middle of Road
60	Uneven Pavement
61	Soft Shoulder
62	Joints, Pavement
63	Pavement Ends
90	Driver is Too Far to Left
91	High Lane(d)
92	Single Lane
93	Bad Curved
94	Raised Pavement
95	Graver Road
99	Unknown

III-14. #74-79 Uneven Pavement Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Uneven Pavement
10	(Half Lane) Raised/Dropped Roadway
20	Elevated, Unbalanced, Irregular, Graded, Slanted, Unlevel, Changed, Disruptive, Disjointed
30	Bumps, Wash-Out, Broken Up, Rough, Steel Plates
31	High Curb, Shoulders, Elevation Change Off Road
32	Banked Road
33	Emergency Stopping Only
34	Construction/Road Work
35	Curve
36	Medians- "Coming and Going"
37	Pass/No Pass
38	Speed Bump
39	Shoulder
70	Visibility
71	Hill
72	Lane Assignments
73	Uneven Road
74	Elevation Difference Between the Two Roadways
75	Two Lanes
40	Parking, Shoulder/Sidewalk
41	Parking Roadway
42	Disabled/Stopped Vehicle

III-14. #74-79 Uneven Pavement Sign Continued

<u>Code #</u>	<u>Gist</u>
43	Service Road (Ahead)
44	Mailman Delivering
60	Low Shoulder
90	Bad Paving
91	Road Offset on Right, Do Not Hit Curb
99	Unknown

IV-15. #80-88 Narrow Bridge Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Narrow Bridge
10	Bridge/Overpass
11	Bridge (Lane Reduction)
20	Road Narrows
23	Barricades/Guardrail
30	Lane Reduction (Specifically Mention "Lanes")
31	Fork
32	Narrowing and Construction
33	Avoid Shoulder
34	"Water" (Both Sides of Highway)
35	"Water" (On Road)
36	Side Street/Intersection - Closed/Construction
37	Two-Way Traffic
38	Construction
39	No Shoulder
40	Widens and Narrows
41	Rest Stop/Parking/No Parking
42	Signal Ahead
43	Pedestrian Crossing
44	Train Station
45	Slippery When Wet
50	Passing/No Passing

IV-15. #80-88 Narrow Bridge Sign Continued

<u>Code #</u>	<u>Gist</u>
51	Street Veers
52	On/Off Ramps (Interchange)
53	Intersection
54	Drive in Center
60	One Lane Bridge
61	Soft Shoulder
62	Low Shoulder
63	Divided Highway
64	Railroad Crossing
65	End Divided Highway
90	No Shoulder in Middle
91	Stop Both Coming and Going
92	Two-Way Lane
93	Low Bridge Ahead
94	Slides From Side of Road
95	Two Lane Traffic
99	Unknown

IV-16. #89-95 Advance One Lane Road Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Verbatim (to Word Sign)
02	Correct Gist (to Word Sign)
03	Correct Gist (to Symbolic Signs)
10	One Lane (With Some Warning, e.g., Enter at Own Risk, Stop, etc.)
11	Oncoming/Bidirectional Traffic Ahead
20	Follow the Arrows
21	Stop/Yield
23	Single Lane/One Lane (Traffic/Detour/Work Ahead)
25	One-Way Traffic
30	Two-Way Traffic
31	Right Lane Closed/Blocked/Obstructed - Merge Left
32	Merge Left
33	Right Lane Closed/Narrows/Blocked, etc.
34	Traffic Island
35	Dead End
36	No Passing
37	Curve
38	Bridge
39	Turning Lane
70	"Avoid" Shoulder
40	Left Lane Ends

IV-16. #89-95 Advance One Lane Road Sign Continued

<u>Code #</u>	<u>Gist</u>
41	Parking/No Parking (Fire Zone)
42	Sidewalk/Wall/Abutment/Shoulder Ahead
43	Train Crossing
50	Passing
51	Parking/With Two-Way Traffic
52	Uneven Grooves in Road - You May Change Lanes
53	Road Narrows - Retains Two Lane Traffic
54	Two Lanes Ahead
55	Straight Road Ahead
56	Ramp
57	Reversible Flow Lane
60	Wrong Way
61	Narrow Bridge
62	Low Shoulder
63	Divided Highway
64	One Lane Bridge
90	Collision Area
91	Head to Head
92	Double Road - Stay Off Shoulder
93	Two Single Lanes
94	Shoulder Road
95	One Lane - Right Curves
96	Turn in Road (Off)

IV-16. #89-95 Advance One Lane Road Sign Continued

<u>Code #</u>	<u>Gist</u>
97	Road for One Car Only
98	Mixed Up Sign
99	Unknown

IV-17. #96-101 Lane Reduction Transition Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Right Lane Ends
02	One Lane Ahead
03	Right Lane Merges/Merge Left
04	Two Lanes Into One Lane
10	Road Narrows - Move Left
20	Narrows
21	Merging Lane/Traffic
22	Construction in Right Lane
23	Lane Use
24	Lanes
30	Curve (in Various Forms)
31	Rough Road in Right Lane
32	Shoulder Ends/Narrows
33	Detour
34	Ramp/Interchange/Rest Area
35	Marked/Unmarked Pavement
36	Two Lanes Begin
40	Wet
41	Passing/No Passing
42	Three Lanes Into Two
43	Turn Lanes
44	Four Lanes Into Two
45	Bridge

IV-17. #96-101 Lane Reduction Transition Sign

<u>Code #</u>	<u>Gist</u>
50	Road Widens
51	Left Lane Ends
52	Stay in Lane Ahead
53	Can Pass On Right
54	Bear Right
60	Divided Highway
61	End Divided Highway
62	Hill
90	Right Lane Moves Toward Left Lane
91	Two Lane Traffic
92	Two Lane Highway
93	Road Bears to Left
94	Follow Lines on Road
95	Road Formation Changes
96	Two-Way Traffic
99	Unknown

V-18. #102-108 Stop Ahead Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Stop (Sign) Ahead
02	Stop (Sign) At Intersection (End of Street)
20	Four-Way Stop (Sign) Ahead
21	Stop (Sign) at "T" Intersection (Ahead)
22	Flashing Light (Ahead)
30	Rotary Ahead
31	Road Blocked/Ends
32	Prepare to Make Frequent Stops
33	Residential Section
34	Traffic Signal/Stop Light (Ahead)
40	No Parking
41	Stop Sign Overhead
42	Falling Rocks
43	Tree
44	Hydrant
45	Watch for Cars Backing Out of Driveways
46	Stop Ahead and Proceed (Straight)
50	Stop (Action Response)
51	One-Way Road (May Say Stop Sign)
52	Thru Street
53	Road Narrows at Stop Sign
60	Crossroads/Intersection
61	Clearance

V-18. #102-108 Stop Ahead Sign Continued

<u>Code #</u>	<u>Gist</u>
90	Stop Street Ahead
91	Stop-Right Turn Only
99	Unknown

V-19. #109-115 Yield Ahead Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Yield (Sign) Ahead
02	Yield at Intersection
20	Warning Sign Ahead
30	Fork in Road
31	Triangle-Island (Ahead)
32	One-Way Street
33	Slow/Residential/Caution/Yield to Driveways
34	Stop and Proceed with Caution
35	Obstruction (Bear Right or Left)
36	Merging Traffic Ahead
37	Danger Ahead/Caution
38	Road Stops/Dead Ends/Closed
39	Yield for Pedestrians/Bikes
70	Three-Way Intersection
71	Repaved Asphalt
72	Emergency Exit
73	Slow Moving Vehicle Ahead
74	Yield on Right
75	Signal Short
76	Yield at Top of Hill
40	Slow Moving Vehicle
50	Yield (Sign)
51	Yield (Sign) (Right or Left)

V-19. #109-115 Yield Ahead Sign Continued

<u>Code #</u>	<u>Gist</u>
52	Yield and Go Straight
53	Yield and Go Right
54	No Parking
55	Stop Sign
56	Yield and Narrows
57	Yield at "T"
58	Uphill/Downhill
60	Crossroads/Intersection
61	Signal Ahead
62	School Zone
63	Divided Highway
64	Stop Ahead
65	Dip
90	Yield to Highway
91	Yield to Passing Cars (Thru Traffic)
92	Caution Sign Ahead
93	Mixed
94	You Can Go No Further, Must Turn
95	Go Straight Ahead
99	Unknown

V-20. #116-121 Low Clearance Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Clearance 12'-6"
02	Clearance - Other Numbers
10	Clearance - No Height Specified
20	Bridge/Overpass (No Mention of Clearance/Height)
30	Road Width
31	Elevation
32	Road Not Wide Enough for Two Vehicles
33	Length of Road
34	Construction
40	High/Low Water
41	One Lane in Six Miles
42	Stay in Lane
43	Trucks Go to Low Gear
44	Truck Route
45	Truck Crossing
46	Vehicle Backing Up
47	Route 126
50	Passing/No Passing
60	Two-Way Traffic
61	Railroad Crossing
62	Hill
99	Unknown

VI-21. #122-129 Divided Highway Ends Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	End Divided Highway - Median Ends
10	Island Ends - Two-Way Traffic
20	Island Ends - Move Left
21	Road Narrows/Runs Together Ahead
22	Oncoming Traffic Keep Left - Right-Hand Traffic Keep Right
30	Narrows/Road Merges
31	Obstacle
32	Curve/Winding
33	Don't Cross Line/Stay in Lane
34	Two Lane Road/Traffic Circle/Pedestrian Center Spot
35	Fork
36	Merge Right and/or Left
37	Underpass/Bridge
38	Unmarked Pavement Ahead
39	Turning Lanes (Both Sides)
40	Dead End/Do Not Enter/Road Ends
41	Subterranean Concourse
42	Don't Cross Median
43	Center Lane Closed
44	Unfinished Road/Construction
45	Night/Darkness/Illumination
46	Pedestrian Walk Between Lanes

VI-21. #122-129 Divided Highway Ends Sign Continued

<u>Code #</u>	<u>Gist</u>
47	Do Not Drive on Left Side of Road
50	Bear Left and/or Right
60	Begin Divided Highway
61	Two-Way Traffic
62	Keep Right
63	One-Way
90	Single Lane/Dual/Double/Two Lane (Traffic) (Ahead)
91	Four Lane Highway/Three Lanes
92	Two-Way Intersection
93	Two-Way Traffic at Island
94	Yield to Ongoing Traffic or Light
99	Unknown

VI-22. #130-138 Two-Way Left Turn Only Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	(Center) Lane - (Left) Turn - Both Directions
10	Center Lane - (Left) Turn
11	Center Lane - (Left) Turn <u>Only</u>
12	Turns Only
20	Turn(ing) Lane(s)
21	Follow Arrows
22	Left Turn Lane(s)
30	Turning Allowed
31	Lanes for Turning Onto Other Street
32	Lanes for Turning at Intersection
33	Intersection Ahead
34	Do Not Use Center Lane
35	No Turning Allowed
36	Merging Traffic
37	Narrows
38	Left Turn From Lane #4
40	No Right Turn
41	Turn Left From Right Lanes Only
42	Two One-Way Roads Meet
43	Dead End - Turn Left
50	Left and Right Turns From Three Center Lanes
51	Passing Lane

VI-22. #130-138 Two-Way Left Turn Only Sign Continued

<u>Code #</u>	<u>Gist</u>
52	Reversible Flow Lane (Temporal Restriction)
53	Divided Highway
54	Right Turn From Center
55	Keep Left
60	Left Turn (Only)
61	Right Turn Only
90	Can't Understand
91	Left and/or Right Turns
92	Use Left Lane for Left Turn
93	Use Outer Lanes for Turns
94	Center Lane - Left and/or Right Turns (Only)
99	Unknown

VI-23. #139-144 Keep Right Symbol Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Keep Right
02	Island/Median (Ahead)
10	Keep Right - Divided Highway
11	Obstacle on Left
20	Road Merge Right
30	Slow Down
31	Curves/Jogs/Shifts/Zig-Zags/Bears
32	End of Highway - One-Way
33	Uphill/Downhill
34	Ramp/Entry
35	Construction
36	Change
37	Divided Highway (No Action Response)
40	Potholes in Left Lane
41	Railroad
42	Traffic Circle
43	Do Not Pass
50	Lane Drop
51	Narrows
52	Dead End
53	Median/Divided Highway Ends
60	One-Way

VI-23. #139-144 Keep Right Symbol Sign Continued

<u>Code #</u>	<u>Gist</u>
61	Soft Shoulder
62	Two-Way Traffic
63	Keep Left
90	Two Lane/One Lane
91	Some Kind of Clearance Sign
92	Road Off to Right
93	You Can Bypass
94	Use Right Lane
95	Road Separates
99	Unknown

VII-24. #145-151 Merge Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Merge (n. or adj.)
02	Right Lane Yield
10	Ramp/Road from Right/Interchange/Access Road/ Entrance/Incoming Traffic/Oncoming Traffic
20	Yielding Road
21	New/Extra/Added Lane
22	Side Road/Street
30	Intersection/Right Angle
31	Curve
32	Uphill/Downhill
33	Fork
34	Yield to Other Traffic
35	Obstruction
40	Turn On Lights
50	Dead End Street
51	Road Entering From Left
52	Narrows
90	One Lane/Two Lane
91	Intersection of Walk
92	Highway
93	Merge Left
94	Flowing Traffic
95	Road Goes Left
99	Unknown

VII-25. #152-157 Added Lane Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Added, Extra, Dedicated, Continued Lane
10	Added Third Lane
30	Merge/Merging Traffic/Lanes
31	Ramp/Traffic Entering/Joining/Coming In/Approaching/ Leading/Acceleration
32	Yield
33	Fork
34	Curve/Turn
35	Oncoming Traffic
36	Lose Curb Lane Ahead
40	Shoulder on Right Ahead
50	Passing/No Passing
60	End Divided Highway
61	Two-Way Traffic
90	Right Turn Only From Right and Straight
91	Begin Two Lane Highway
92	Stay on Right/Own Lane
93	Intersection Turns Off From/To Left
94	Use Only Part of Right Arrow for Driving
95	Road Merges on Left
96	Road Becoming One Ahead
99	Unknown

VIII-26. #158-164 Advance Flagger Symbol Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Flagman (Ahead)
10	Prepare to Stop/Stop
11	Signal (Ahead)
20	Construction/Workers
30	Railroad
40	Keep Right
41	Keep Left
42	Target Range Ahead
60	School...
61	Pedestrians Crossing
62	School Bus (Stop)
90	Road Repair Watch for Signal to Pass on Right
91	Obstruction Pass to Right
92	Road Work <u>Ends</u> 500' Ahead
99	Unknown

VIII-27. #165-171 Worker Symbol Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Men Working/Workers
02	Road Work/Construction
20	Men - Equipment
21	Equipment
30	Farm Equipment
31	Snow Removal
32	Children Playing
33	(Leaf) Clean-Up
34	Men Working - On Shoulder
35	Ditch Diggers
36	Sand Supply.
37	Grass Cutting/Gardener
38	Pothole Repair
39	Fire Station
70	Miners
71	Blasting Ahead
72	Farmland/Farm Equipment on Road
73	Chain Gang
40	Railroad
41	Slippery
42	No Dumping
43	Residential Neighborhood
60	Flagman Ahead
99	Unknown

IX-28. #172-179 Cross Road Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Crossroads/Intersection
10	Car Crossing (n.)
11	Cars Crossing (vb.)
20	Crossing, Four-Way Crossing
30	No Turns, Go Straight
31	Hospital
32	Dead End
33	(East-West) One-Way/Two-Way Street/Traffic
34	Narrows
35	No Parking
36	Overpass/Underpass
37	Unmarked Road
38	One Lane Traffic
39	(North-South) Two-Way Traffic
70	Do Not Cross Over the Line
40	"T" Intersection
41	Water Pump
42	Bumps Slow Entering Traffic
43	Divided Roadway
44	Church Ahead
50	(Four-Way) Stop
51	(North-South) One-Way Traffic Ahead
52	Intersection - Cross Traffic has ROW

IX-28. #172-179 Cross Road Sign Continued

<u>Code #</u>	<u>Gist</u>
53	Uncontrolled Intersection Ahead
54	Becomes Two-Way, Becomes Two Lane
60	Railroad Crossing
61	Keep Right
62	Crosswalk Ahead
90	Three-Way Intersection
91	No Stop Signs
92	Heavy Traffic
93	No Crossing
94	Right of Way
95	Thru Street
99	Unknown

X-29. #180-186 Hill Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Hill, Steep Grade, Steep Hill, Long Hill, Downgrade
10	Trucks - Hill
20	Dip/Bump/Hollow
21	Slope Ahead
30	No Trucks Allowed
31	Trucks Entering Road
32	Intersection (Profile Problem)
33	Narrows
34	Passing/No Passing
35	Slow Moving Trucks
36	Curve
37	Slow Down
40	Congested Traffic Area
41	Following Too Close
42	Steep Driveway
43	Mail Box
44	Weigh Station
50	Truck Blocking Road
51	Slight Hill
52	Truck Lane on Hill
90	Sharp Drop...
91	Trucks Moving...
99	Unknown

XI-30. #187-193 Slippery When Wet Sign

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Slippery When Wet
10	Slippery/Slick
11	Slippery When Precipitating
12	Slippery When Wet (At Night)
20	Slippery/Snow-Ice
21	Wet Road
30	Slippery/Curves
31	Curves
32	Mud
33	Oil/Gas
34	Potholes/Rough Road
35	Flood Area/Wash Out
40	Keep Right
41	Cattle Crossing
42	Truck Crossing
60	Hill
90	Bad Road Condition
99	Unknown

E-1. X Lane Closed

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Right Lane Closed
10	Right Lane Ends
11	Bear/Merge Left
20	Right Lane Traffic Restriction
21	Restricted Lane
22	Merge Left, Lane Use Unclear
23	Lane Patterns Change
30	Use Left Lane Only
31	On Ramp Ahead
32	Temporal Lane Restriction
33	One Way
34	Cross Street Ahead
40	Dip
41	Three Lane Traffic
90	Passing/No Passing
91	Proceed in Middle Lane
92	Two-Way Intersection
99	Unknown

E-2. Temporary Crossover

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Road Closed and Crossover
10	Move Over/Crossover/Stay Left (Right)
11	Two-Way Traffic Ahead
12	Lane(s) Blocked
13	Use One Lane Ahead
20	Detour/Road Closed
21	Two Lanes Ahead
30	Do Not Cross/Stay in Lane/No Crossing Median
31	Road Under Construction
32	Four Lane Road Ahead
33	No Passing, Do Not Cross Solid Line
34	Four Lane Road/Divided Highway Ends
35	Dangerous Intersection Ahead
36	Reversible Lane Turn Lane Confusion
37	Uphill/Downhill
38	Narrow
39	Sign Reads Top to Bottom
40	Death Trap Ahead
50	Passing
51	Move Left
60	Slippery Road
90	Four Lane - Two Any Given Time

E-2. Temporary Crossover Continued

<u>Code #</u>	<u>Gist</u>
91	No Bypassing
92	Double Lane
93	Entering Beltway
94	Divided Highway Ends
95	One-Way
96	No Stop On Lined Sign
99	Unknown

E-2. One Lane Road (EZ)

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Blockage - Move Left - <u>Share</u>
10	Blockage/Closure/Lane Close/Detour
20	One-Way
30	Unfinished Pavement
31	No Left Turn
32	Road Veers Left
33	Merge/Lane Change
34	Entering One-Way Street
90	High Buildings
91	Wreck
92	Impossible
99	Unknown

E-3. Street Closed - Do Not Enter

<u>Code #</u>	<u>Gist</u>
00	No Response/Don't Know
01	Do Not Enter/Road Closed/Dead End
02	Accident/Disabled Vehicle Ahead
03	One Way - Do Not Enter
10	Barricade Ahead
11	Police Controlling Traffic
12	Police Ahead
20	Police/Fire/Flashing Light
21	Road Closed at Dark
22	Stop (Ahead)
23	Center Right Lane(s) Closed
30	Yield
31	Tunnel Ahead
32	Blinding Sun/Glare/Light
33	Church/Cemetery/Monument
34	Scenic Area
35	Poor Visibility
36	Intersection/Crossing (Ahead)
37	Unmarked/Marked Pavement/Painting Crosswalk
38	No Passing
39	Stop Sign Ahead
71	Crosswalk/Crossing Guard
72	Dangerous Area/Accident Prone

E-3. Street Closed - Do Not Enter Continued

<u>Code #</u>	<u>Gist</u>
73	Shoulder Repairs/Parked Cars
74	Bumpy Road
75	Raise Hood in Case of Car Trouble/Instructions if "In Trouble"/Parking (On/Along) Road
76	Construction
77	Manhole
78	Do Not Enter - Intersection
40	Junk Yard Ahead
50	Stop Before Entering
60	Cross Roads
61	Railroad Crossing
62	Slippery When Wet
63	One Way Street
90	No Road Ahead
91	Auto Mechanics Stop Ahead
92	Don't Cross the Road
99	Unknown

APPENDIX G
EMERGENCY ZONE SIGN

One of the functions of a traffic control device (TCD) is to warn drivers of unexpected hazards in the trafficway. Usually these hazards are permanent features of the roadway or environment, but often they are temporary occurrences, as in the case of construction and maintenance operations. The construction and maintenance function has become so pervasive and viewed as so different a hazard, that a special class of TCD was developed for use in work zones. Now, attention is being focused on another on-street operation area which poses a hazard to the motoring public and the parties involved. This operation area is known as the emergency zone (EZ).

The emergency zone can be defined as an area in the trafficway where, due to some incident, a special hazard exists which necessitates the provision of emergency services such as those provided by police, fire, and emergency medical professionals. Traffic accidents, downed power lines, and building and automobile fires are a few examples of incidents in an emergency zone. These incidents can cause serious safety problems for those attending to the emergency situation and for motorists attempting to pass by or through the EZ. Even though most emergency vehicles are equipped with some type of vehicle lighting, it is felt the lighting devices alone do not give the motorist enough information to pass the EZ without causing additional problems. Therefore, it has been proposed that an emergency zone sign (Ezs) or family of signs, similar to the work zone signs, be developed for use by emergency personnel to control traffic in and around emergency zones. The objective of this task was to develop this new sign.

Literature Review

The literature contained many reports that deal with traffic control during emergencies. The Maryland Police Training Commission (1975) produced a nine-part instructional series for police trainees dealing with collision management procedures. One of these parts deals exclusively with controlling the accident scene. Flares, cones, and emergency vehicle lighting are all recommended as advance warning devices, but the use of signing of any type is not suggested. In a report prepared by Wilbur Smith and Associates (1972) for the Highway Safety Division of Virginia, use of flares, cones, lighting, and signing is advocated to aid in securing a traffic accident scene. Guidelines for placement of these devices are given, but there is no mention of what specific signing is to be used.

Although signing is usually mentioned as a traffic control alternative, use of vehicle lighting in emergency situations is cited most frequently. According to some state vehicle codes, the use of certain colors on certain types of vehicles at certain times constitutes a specific type of warning, but there appears to be no uniformity of these conventions from state to state (Post, 1978). Another problem cited is that it is often extremely difficult for the motorist to tell if an emergency vehicle is moving or stationary when its lights or light bars are being used. Recently, a study investigated the possibility of removing the roof mounted lighting devices from police vehicles for energy savings and improved surveillance capabilities (Stocia, 1983).

Changeable or variable message signs have long been recognized as an effective part of a freeway incident management system (Weckesser, 1979; Hanscom, 1981). Often the effectiveness of these systems is compromised by the fact that the information

displayed may not reflect the actual roadway conditions due to a time lag between a change in the status of the incident and change of the message to the driver.

This problem of time lags in the reporting system was addressed in a project done by 3M Company and the Minnesota Highway Patrol (Owen, 1973). A vehicle-mounted changeable message sign was developed by 3M Company and field tested by the Highway Patrol. The sign used a continuous scroll of eight different messages to warn motorists of various hazards. It was mounted flat on the roof of the vehicle and could be raised while the vehicle was still in motion. Use of this device reduced the time needed to attend to an incident and reduced the number of secondary collisions as well.

Since TCDs for emergency zones do not exist, there is no discussion of placement for such a device. Placement of many standard TCDs are based on prevailing speed and conditions as well as time necessary for the driver to comprehend and react to the TCD and alter his driving accordingly (USDOT, 1978). Methods for determining stopping sight distance and decision sight distance take these factors into consideration (McGee, Moore, Knapp, & Sanders, 1978), whereas for placement of flares or other warning devices presently used by police or other emergency personnel, distances are based on vehicle braking distances only (Maryland Police Training Commission, 1975).

Since this is a new type of device, not only can the message be novel, but the sign color and shape are not bound to presently used forms. There are several colors reserved for "future" uses in the MUTCD, as well as the standard colors already used (USDOT, 1978). One of the few studies of motorist understanding of traffic signing shape and color coding was done by the Virginia

Highway Research Council (Ferguson & Cook, 1967). The study showed that singular and combined uses of color and shape did not effectively communicate to drivers any indication of what type of message they were to receive from a sign. While much has been done on the recognizability and legibility of various sign shapes and colors (Markowitz et al., 1968), little has been done to study driver knowledge of the MUTCD color and shape coding conventions.

Emergency Zone Sign (Ezs) Development

The first step taken in developing the EZS was to determine the needs of the groups who would be using the device and the information requirements of motorists. In order to accomplish this, the aid of several public agencies was sought to provide information about "on the street" conditions. Project staff rode with county police traffic units (Montgomery County, Maryland), state trooper units (Maryland), and a large urban area fire and rescue crew (District of Columbia Fire Department). These experiences provided insight into the potential uses for an EZS, possible means of deployment, and the nature of the traffic such a device would have to control.

The choice of these emergency service agencies allowed observation of the wide range of activities and incidents that constitute emergency zones. Riding with the county police traffic units provided occasions to see accident and stopped vehicle situations in low to medium speed conditions on arterial streets, collectors, and rural country roads. While traveling with the state troopers, there were many opportunities to observe emergency situations on higher speed limited access facilities. Riding with fire and rescue squads in the District of Columbia allowed field personnel to experience many different emergency situations in an urban setting.

The major advantage of having the field personnel ride in the police and fire vehicles was their immediate arrival at the scene. This allowed them to make observations for the full time period in which an EZS would be deployed, used, and picked up. To facilitate the analysis of each incident, a videotape record of the emergency situation was made. The records were limited to views of the traffic approaching the emergency zone and verbal descriptions of the actual hazard.

In analyzing the videotapes, it became apparent that while the exact nature of every incident was different, there were several common elements among many of the situations. These elements were given generic names: recovery time, closure type, and control strategy.

Recovery time is the total time period from when the incident first occurs until trafficway conditions return to "normal." Recovery time has a great bearing on whether or not an EZS is to be used. If the time to deploy and take up the EZS is equivalent to or greater than the recovery time, it is impractical to use it. To assess the impact of the recovery time element, it was necessary to find the point at which the added risk of placing and retrieving the device is outweighed by the added protection afforded by the device. As one observer put it, "If the incident is something you can take care of quickly, why double the time your fanny has to be out in the traffic putting this thing out?" The question still to be answered was when does the break from liability to benefit take place? This was answered in the laboratory/field testing phase of the project.

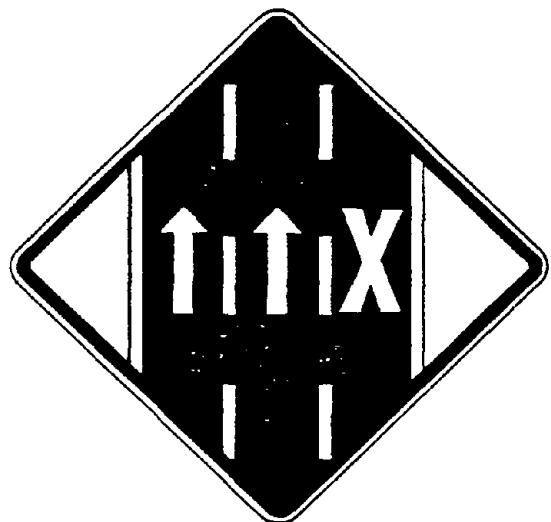
Closure type is a description of what part of the trafficway is no longer available to the motorist due to the occurrence of the incident. Based on the field observations, there were six

self-descriptive closure types: shoulder, single-lane undivided roadway, multiple-lane undivided roadway, single-lane divided roadway, multiple-lane divided roadway, and roadway closure. These closure types can be treated with specific control strategies.

Control strategy is the means of redirecting the traffic past the specific closure type. There are three basic control strategies. The first is to direct the traffic around a hazard utilizing the side of the road used by the affected motorist in his present direction of travel. The second is to direct the traffic around a hazard utilizing the side of the road opposite to the affected motorist's direction of travel. The third is to completely close off the area to traffic at the nearest junction point and begin to reroute the traffic. These control strategies were the basis for the design of the message to be used on the EZS.

The actual designs kept several things in mind. One was that symbolic messages seem to offer several advantages over word messages, and the current preference by the NCUTCD and FHWA is for the use of symbolic signing. Another is that emergency personnel cannot keep an entire sign shop in the trunks or equipment bays of their vehicles; therefore, a limited amount of designs with a wide variety of uses would be desirable. Lastly, it would be advantageous to use conceptual elements already in use on other TCDs in order to facilitate comprehension and learning of the new signs.

The first series of signs designed to execute the first control strategy, moving the traffic around a hazard using the same side of the road, was designated as the E1 series. These signs are shown in figure G-1. The design incorporates the use



E1-1



E1-2



E1-3



E1-4

Figure G-1. E1 series signs.

arrows for allowed through movements and X's for closed lanes. This follows the conventions used on many signs and lane use control signals. The signs would be fabricated so the arrows and X's could be moved from lane to lane to provide applicability for all situations. The perspective view used for Sign El-2 is a variation based on experimental issues raised in chapter 4. Signs using only word messages were also tested. These signs would be designed to allow the MERGE arrow to be placed right or left or to have Sign El-4 read RIGHT/LEFT LANE BLOCKED AHEAD.

The second series of signs is designated as the E2 series. They are to be used for moving traffic around a hazard using the opposing flow lanes, the second control strategy. These signs are shown in figure G-2. The designs again use the familiar arrows, X's, and merging elements of other TCDs. The signs could be modified to depict any situation. Within this series there are two types of signs. One shows the road condition for the driver approaching the hazard who would have to crossover to a contraflow lane (E21, 3, 7, 9). The other depicts the road condition for the driver who is approaching the contraflow situation and restricts this driver to a certain lane(s) (E22, 4, 6).

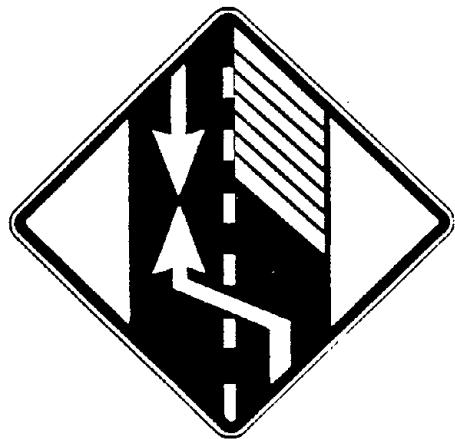
The third series of signs is to be used for roadway closures. They are designated as the E3 series. The signs use a variety of symbols, some familiar, some new, to communicate the idea of "no entry." These signs are shown in figure G-3. The symbols are uncomplicated and may be supplemented by a word message as part of a word/symbol hybrid sign (E3-1a).



Figure G-2. E2 series signs.



E2-6

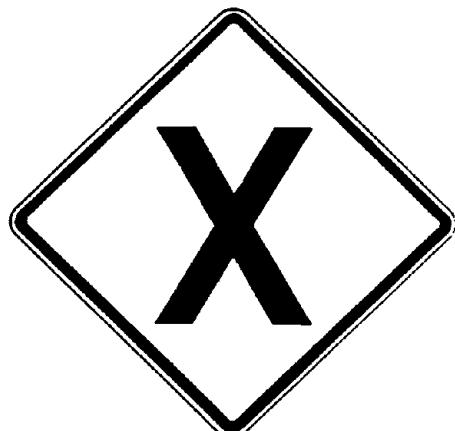


E2-7



E2-9

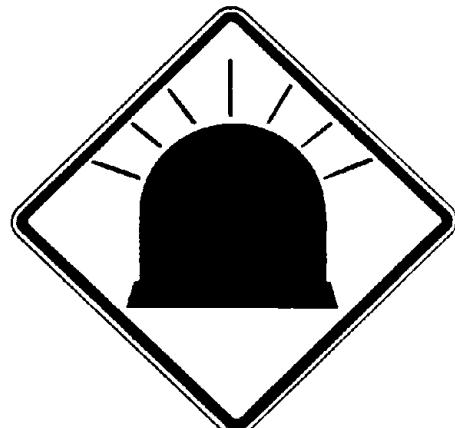
Figure G-2. E2 series signs (continued).



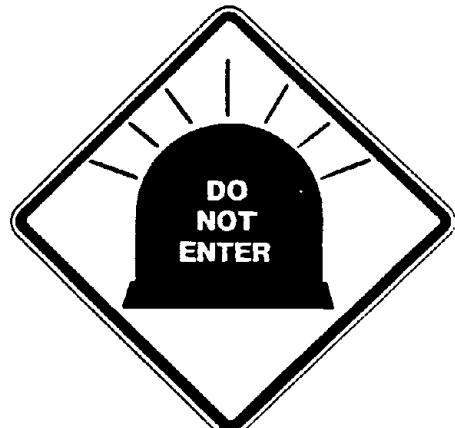
E3-1



E3-1a



E3-2

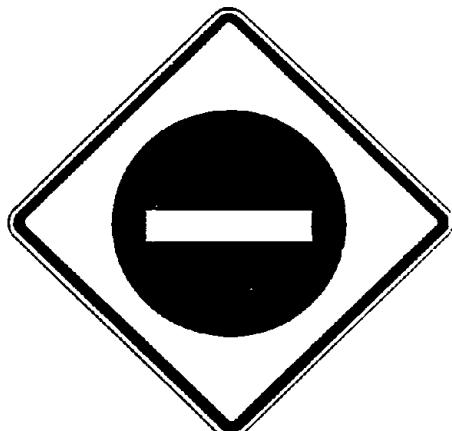


E3-2a



E3-2b

Figure G-3. E3 series signs.



E3-3



E3-3a



DO NOT
ENTER

E3-4a



E3-5



DO
NOT
ENTER

E3-5a

Figure G-3. E3 series signs (continued).

Laboratory Procedures

The EZ signs went through a two-phase laboratory test along with the problem signs and new candidates discussed in chapter 5. The EZ signs were included as part of the test booklets used for both the screening procedure and selection procedure.

The screening procedure resulted in the elimination of several of the originally designed EZ signs. Signs E1-1 and E-2 were the only E1 series of signs tested in the screening phase. It was thought that the word message signs (E1-3 and E1-4) would be fairly well understood, so they were defaulted to the selection procedure. A statistical analysis of the results showed the relationship between the signs and the subject responses was significant at the 0.05 level. Although Sign E1-2 was identified more often by the subjects (94% correct), it was decided to use Sign E1-1 (78% correct) for further testing because of the problems perspective view caused on other signs tested (see chapter 5). The large amount of black on Sign E1-1 also caused some concern about potential visibility problems, so a negative version of this sign was designed to be used in subsequent testing along with Signs E1-3 and E1-4.

In the E2 series of signs, or "crossover" signs, there were two subcategories of sign, the 4-lane crossover and the 2-lane crossover. The 2-lane crossover is the same situation as a one-lane road. Signs E2-7 and E2-9 were tested as part of the One Lane Road Sign (W20-4) candidates (see chapter 5). The results of the 4-lane crossover signs were not statistically significant. Again, for inexplicable reasons, the perspective signs (E2-3, E2-4, and E2-6) did better than the standard plan view signs (E2-1 and E2-2). The results were as follows:

<u>Sign #</u>	<u>% Correct</u>
E2-1	71
E2-2	58
E2-3	74
E2-4	71
E2-6	69

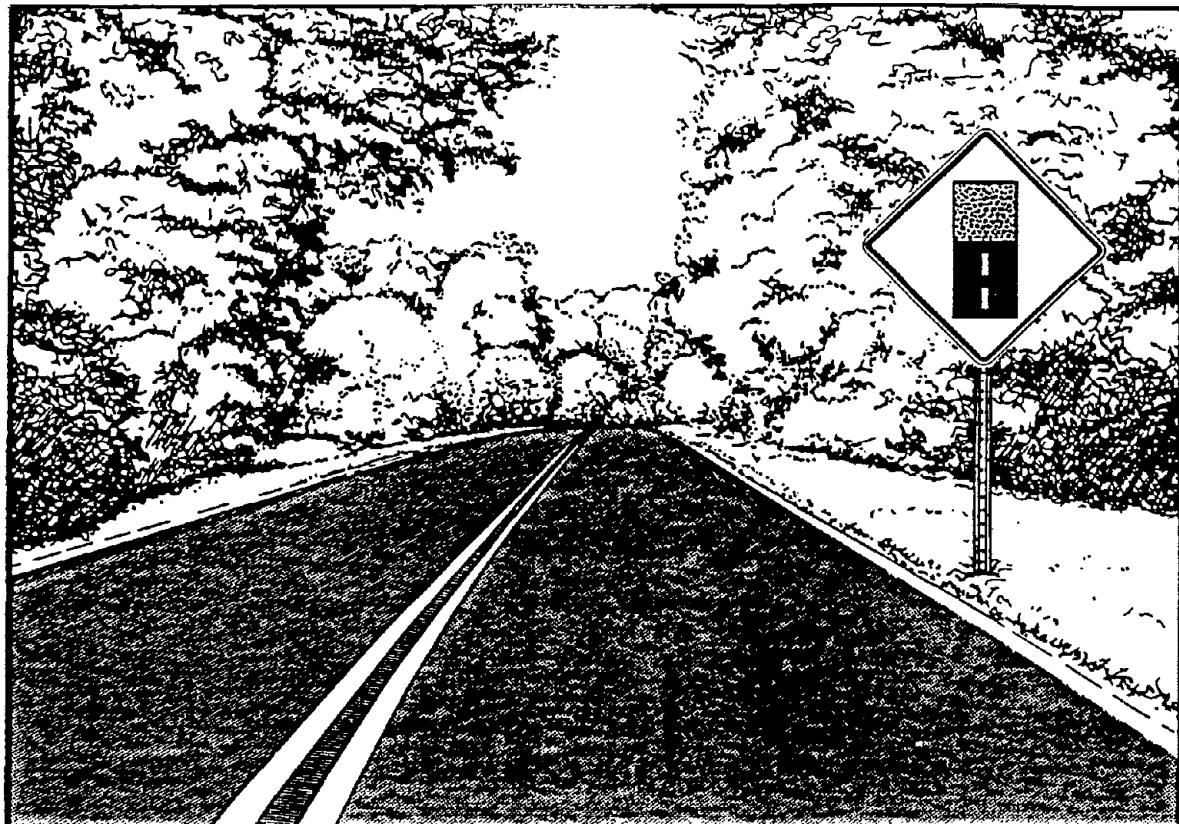
Since perspective has been shown to cause cognitive problems, Signs E2-3, E2-4, and E2-6 were eliminated from further testing. The potential visibility problems caused by the large amounts of black on Signs E2-1 and E2-2 necessitated a change to a negative version for these signs.

The E3 series of signs consisted of symbol only and word/symbol hybrid signs. It was decided to test only the symbol signs, since it was felt that the hybrid signs would be easily understood and the real interest was in seeing what responses the different symbols would elicit. The results for this group were statistically significant. The results were as follows:

<u>Sign #</u>	<u>% Correct</u>
E3-1	14
E3-2	0
E3-3	22
E3-4	51
E3-5	42

Although the "wrecked car" (E3-5) was the second most often correctly identified sign, it was decided to eliminate it from further testing because the E3 series sign is envisioned as being used at all types of street closures (e.g., fires, crime scenes) rather than just motor vehicle accidents. The police/fire dome light performed poorly and was eliminated from further testing. The remaining signs (E3-1, E3-3, and E3-4) were retained for testing in the next phase along with their hybrid counterparts (E3-1a, E3-3a, and E3-4a).

APPENDIX H
Selection Procedure Presentation Scenes



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

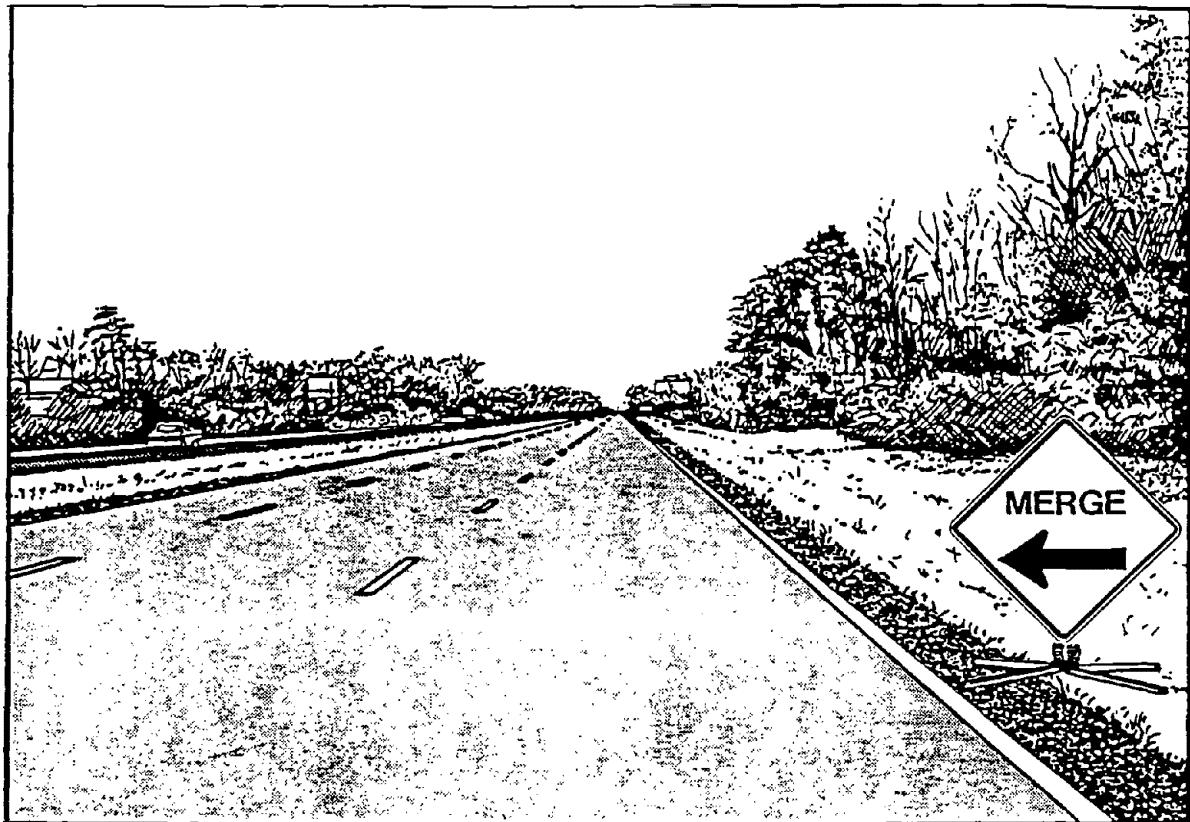
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

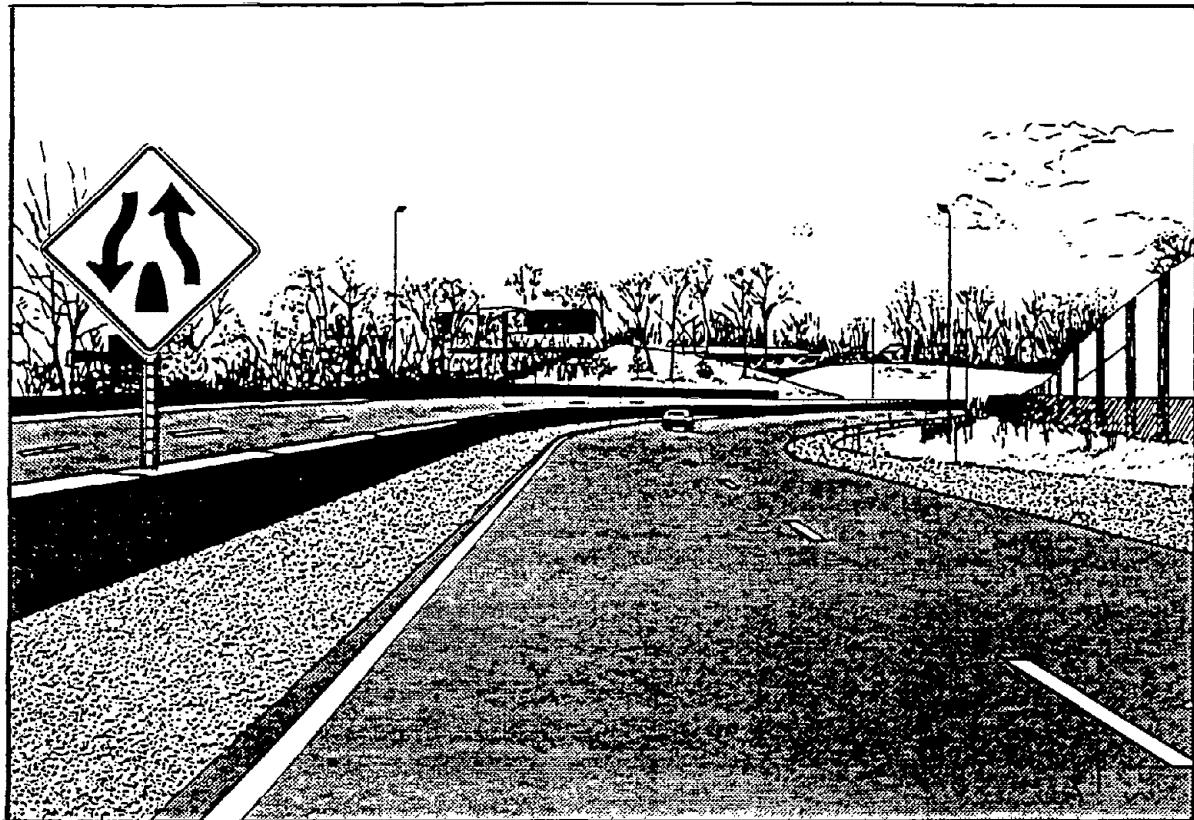
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

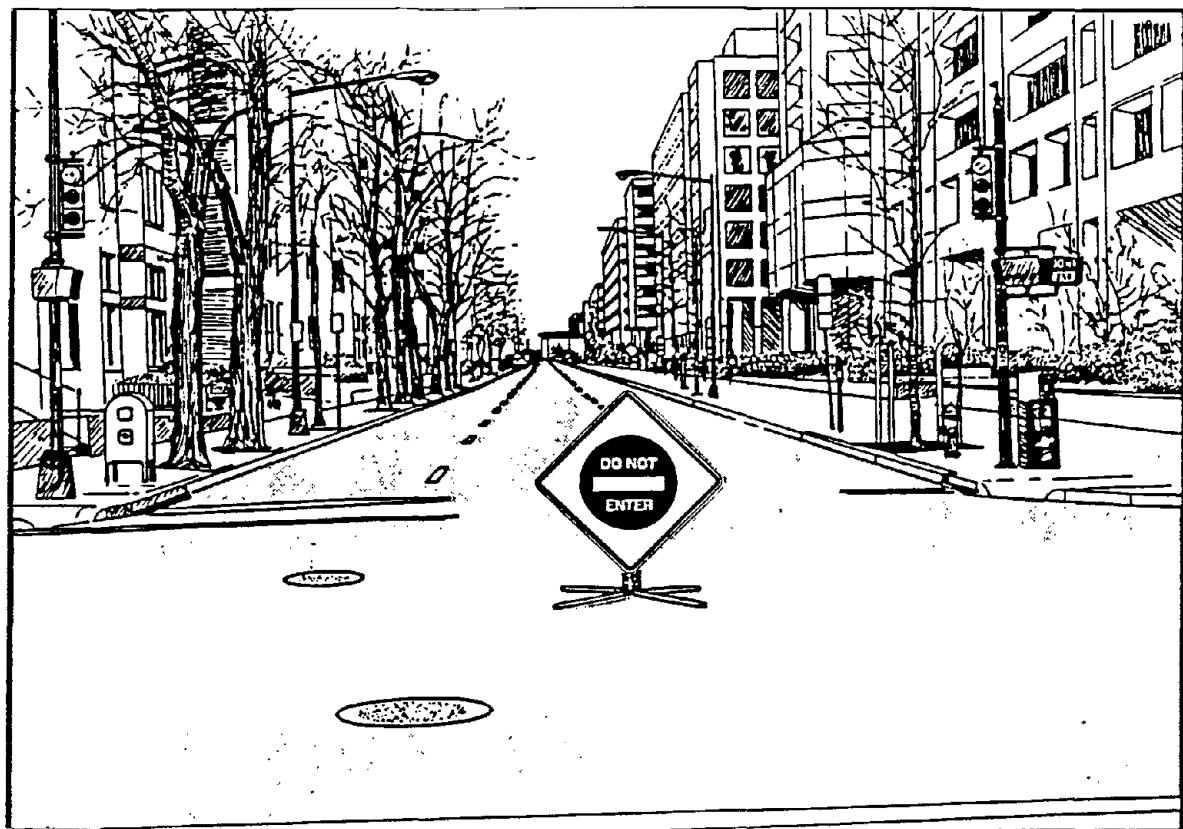
3

4

5

Not Very
Certain

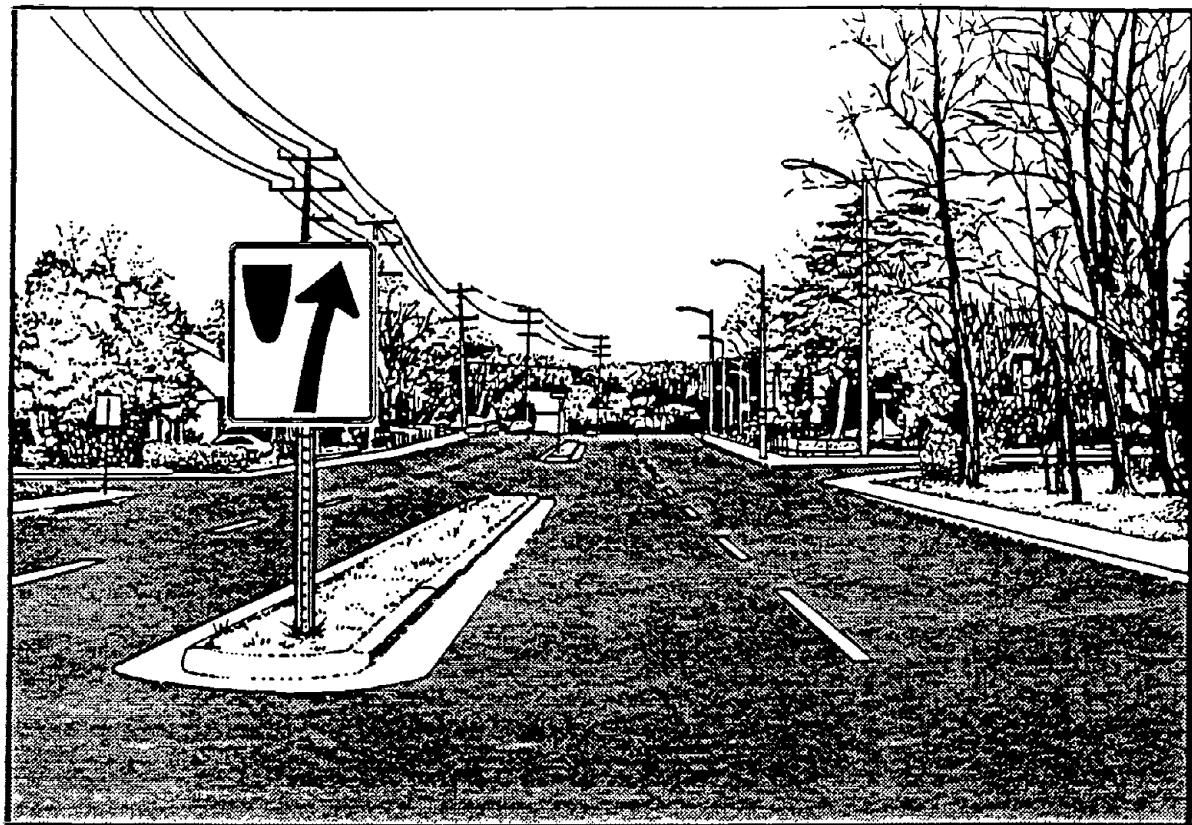
Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1	2	3	4	5
Not Very Certain				Very Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

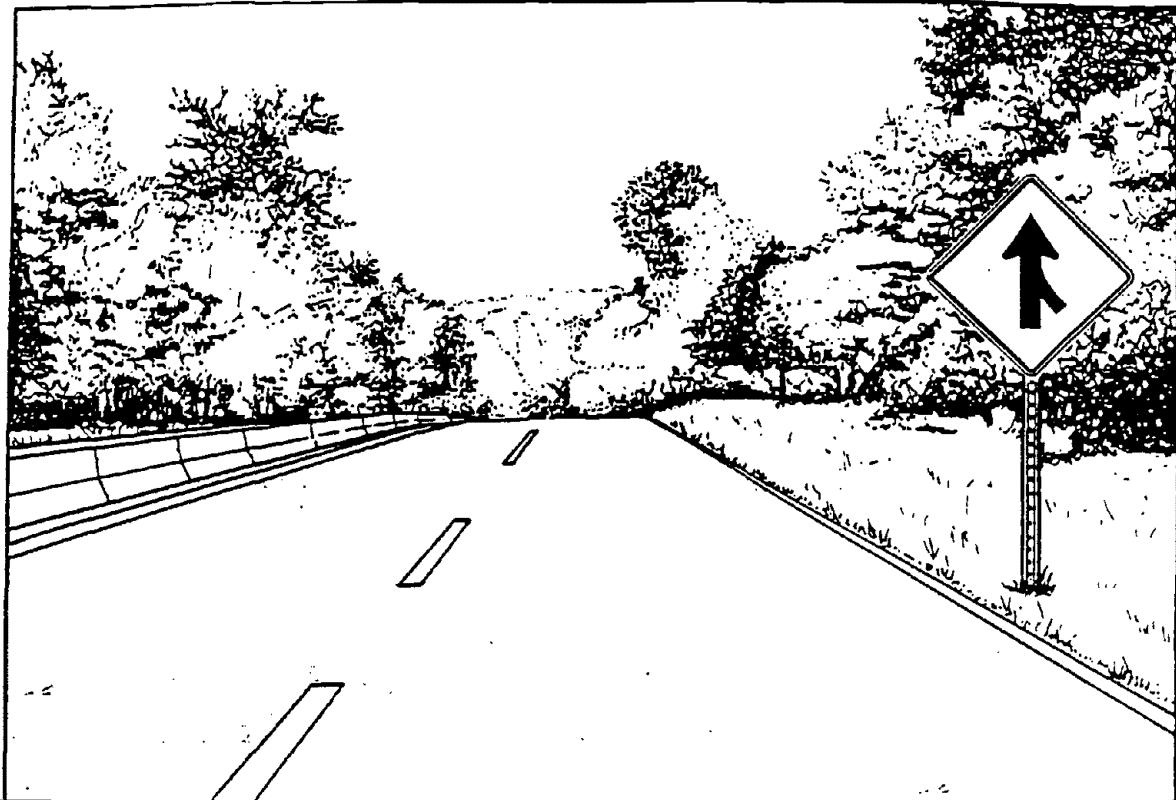
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

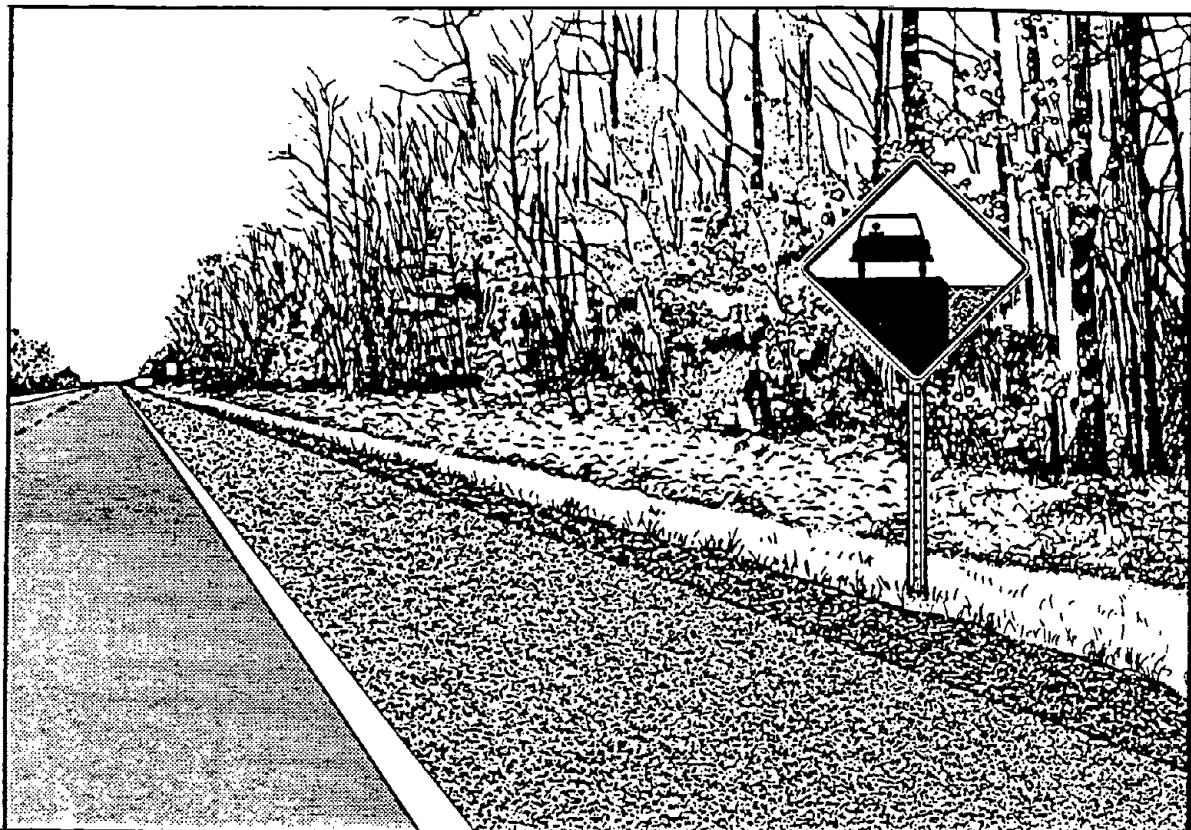
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

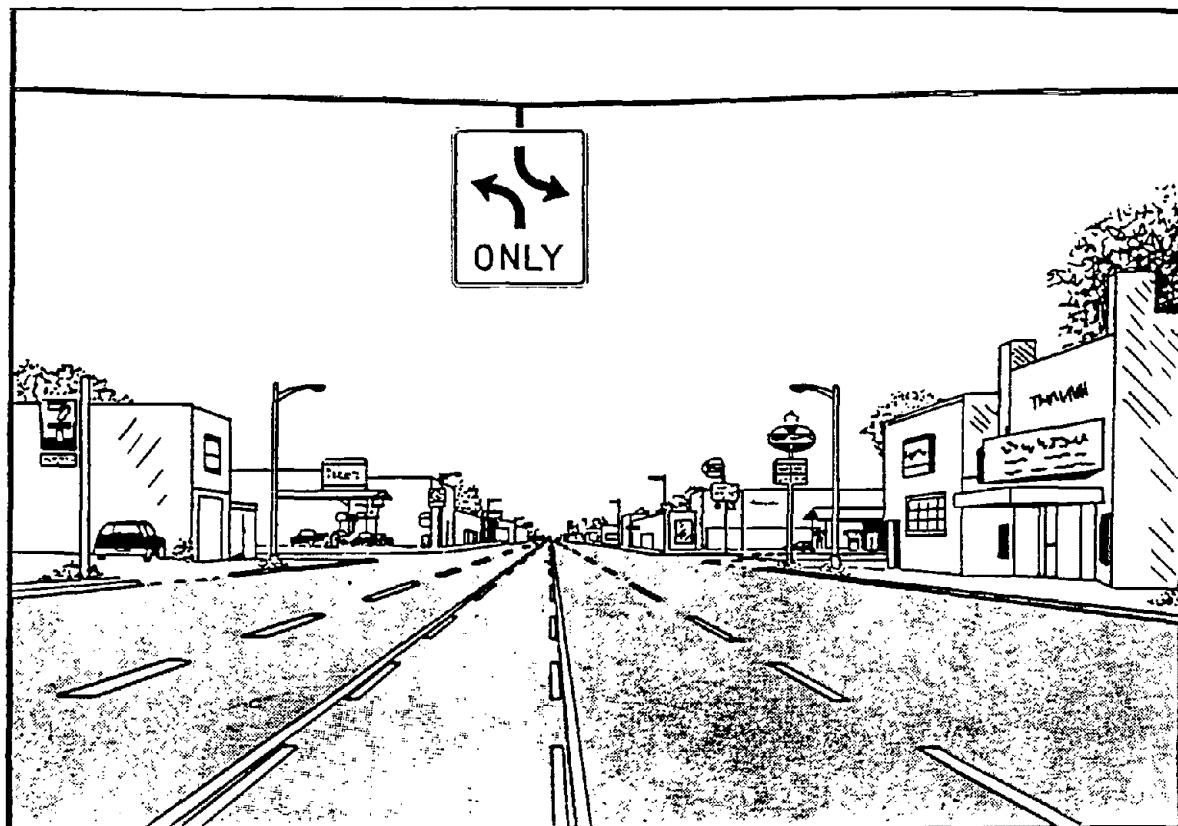
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

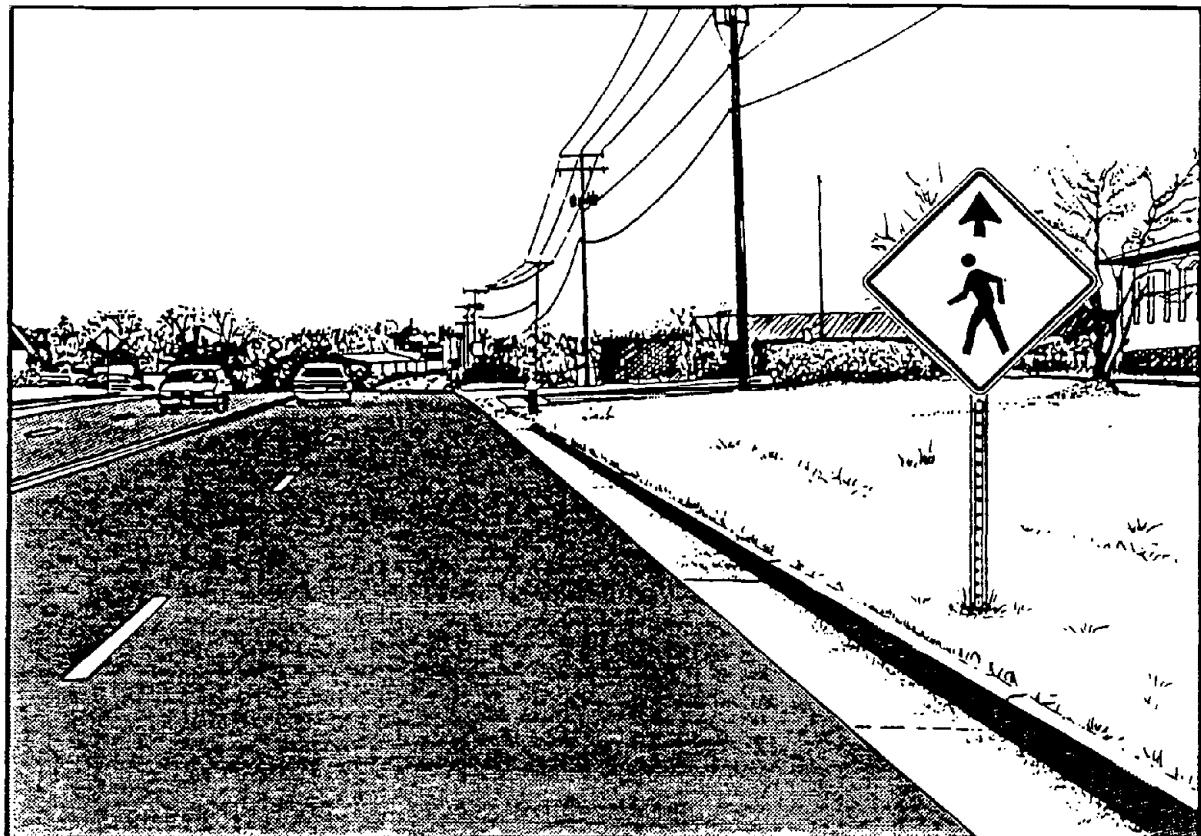
3

4

5

Not Very
Certain

Very
Certain



What do you think this sign means ?

Tell us on a scale from 1 to 5, how certain you are of your answer (circle number).

1

2

3

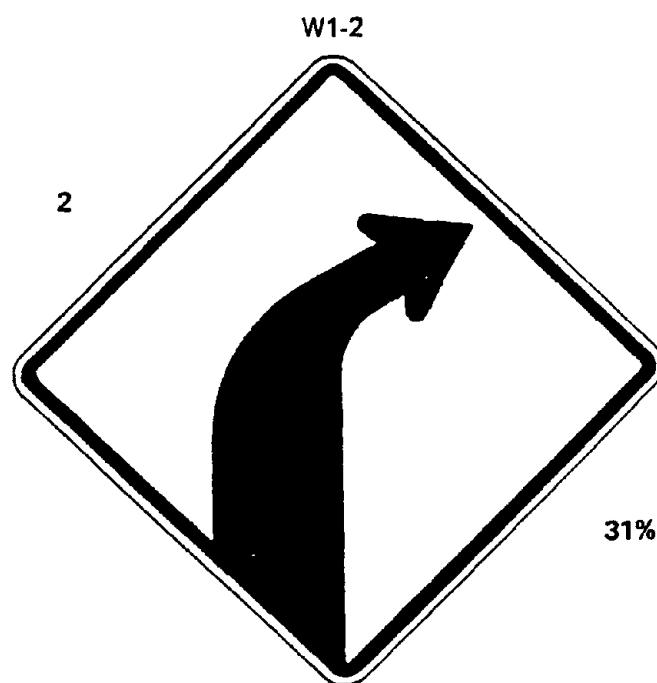
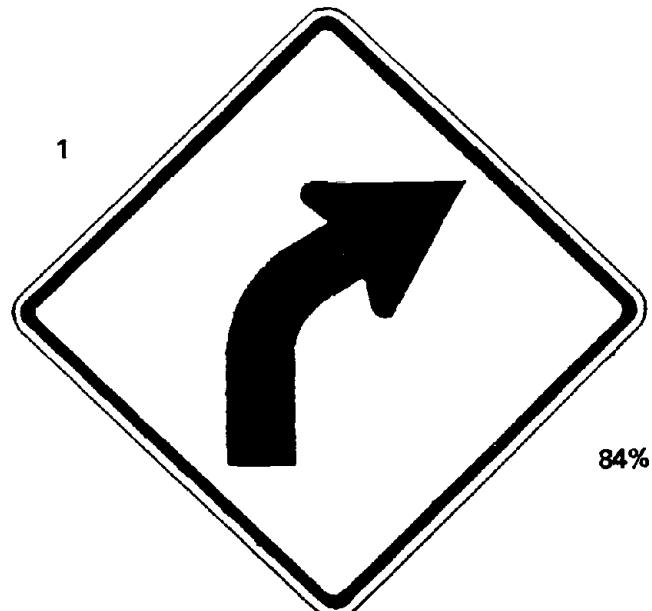
4

5

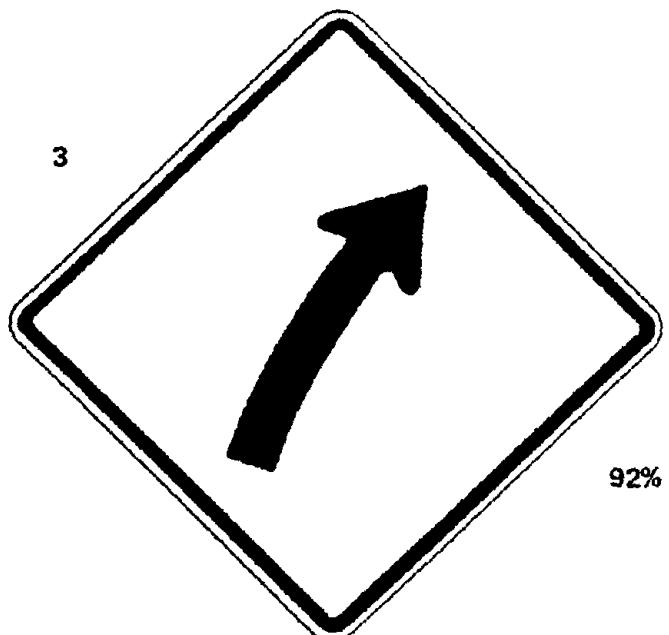
Not Very
Certain

Very
Certain

APPENDIX I
New Sign Design--Step 3

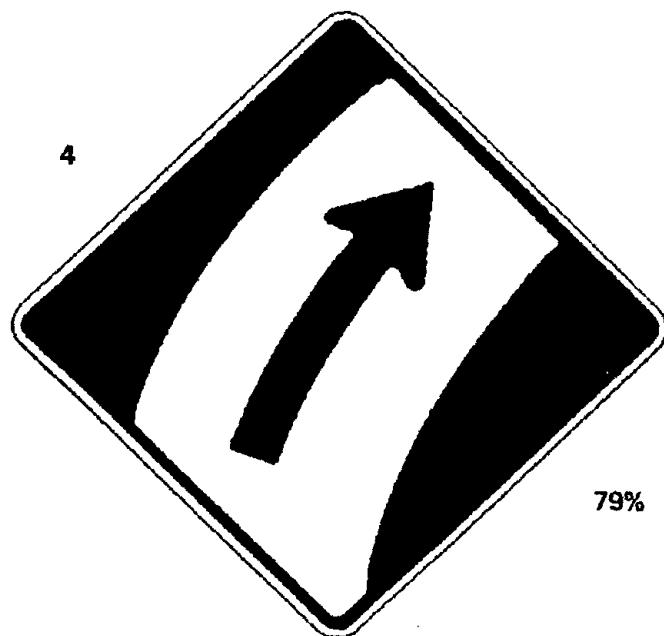


W1-2



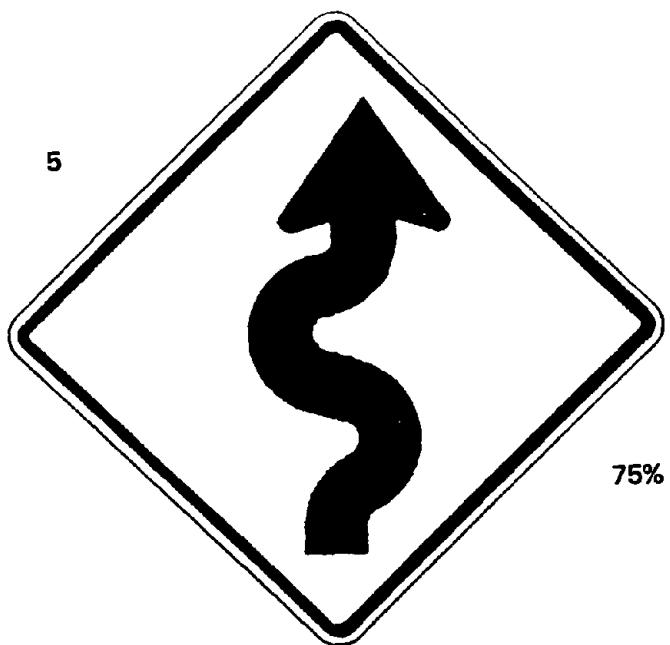
92%

W1-2

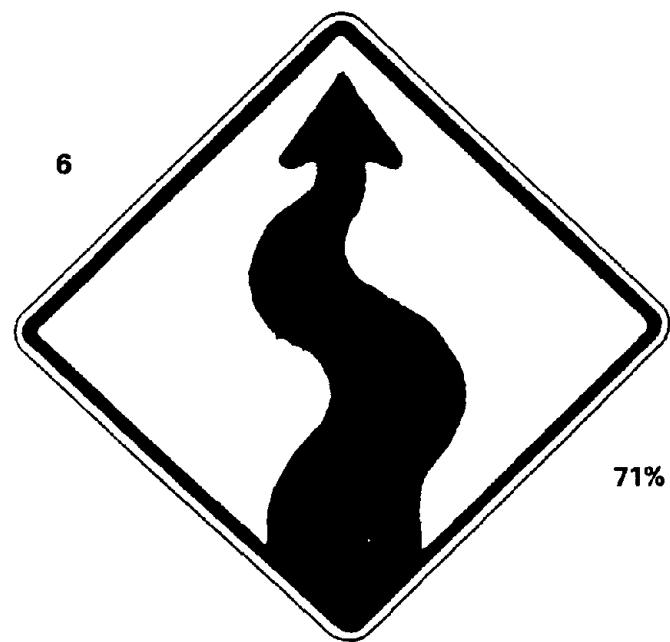


79%

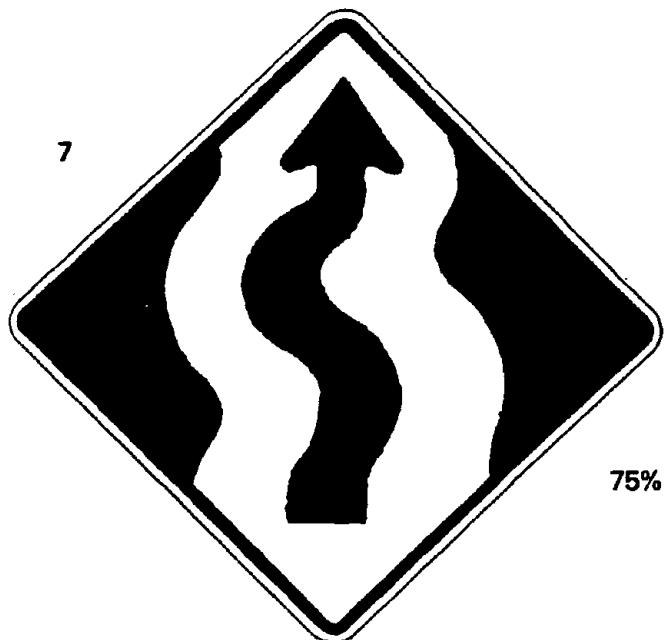
W1-2



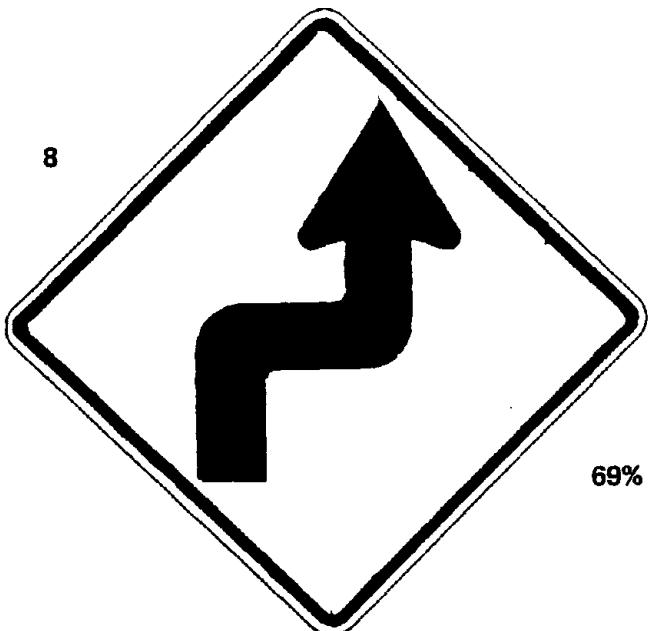
W1-5



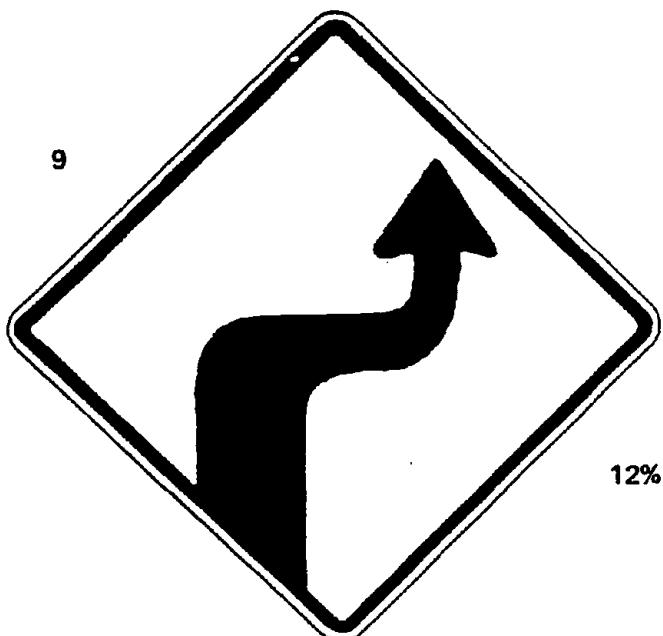
W1-5



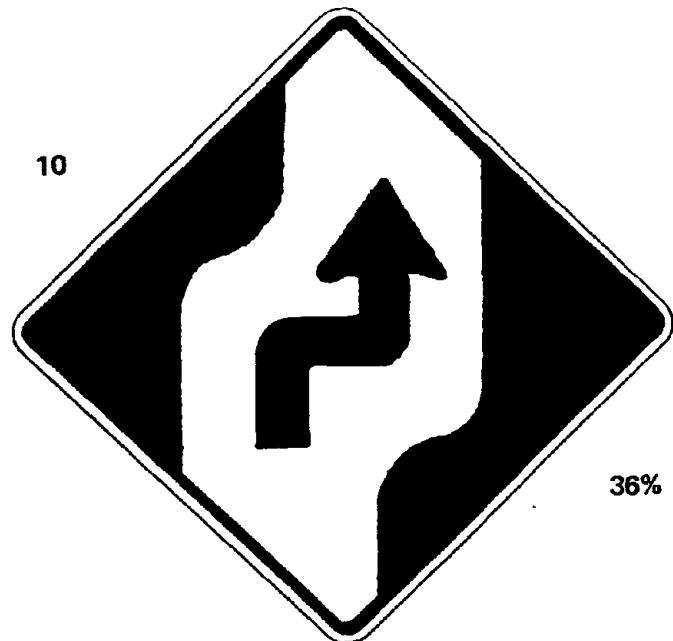
W1-5



W1-3

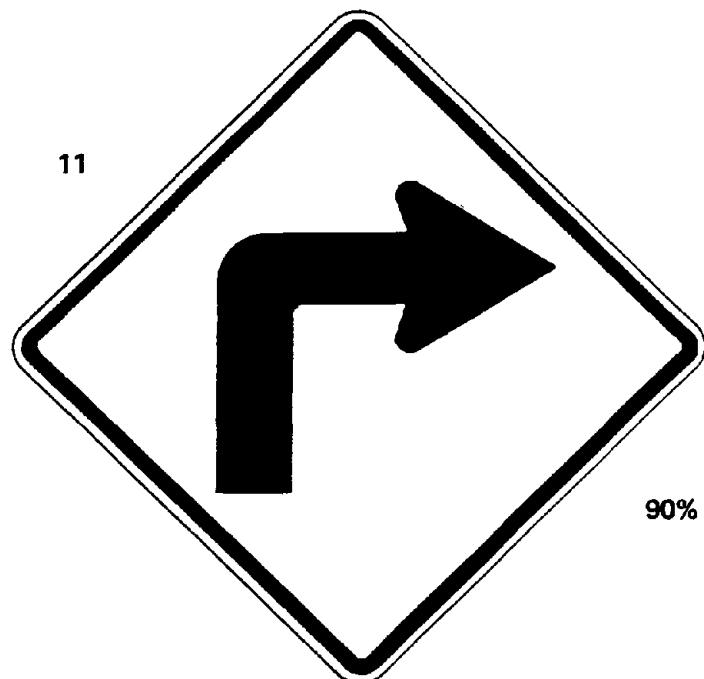


W1-3



W1-3

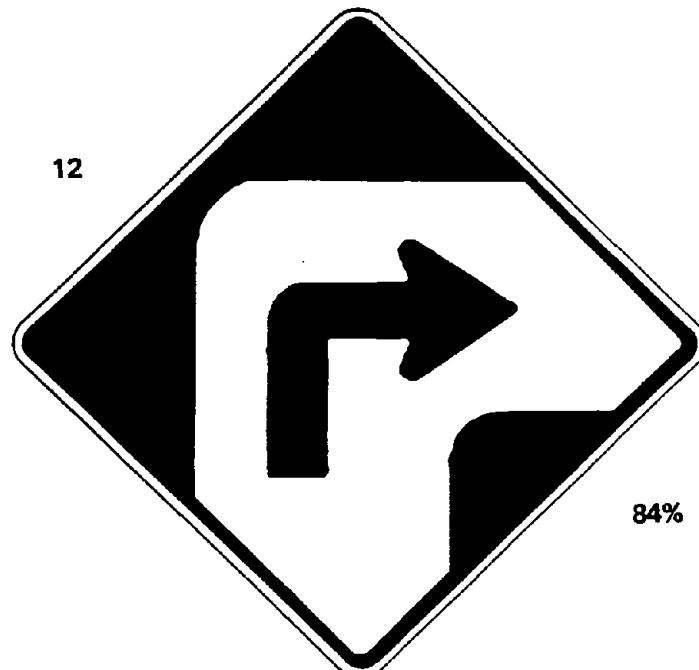
11



90%

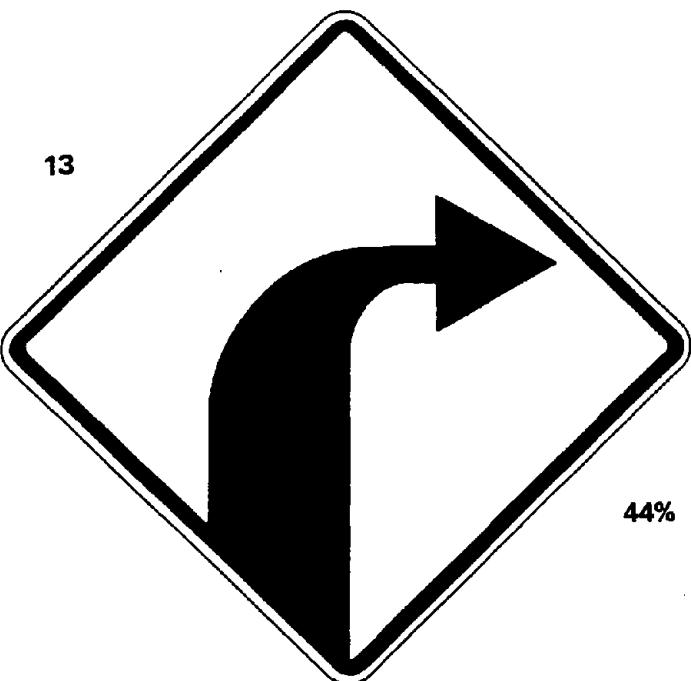
W1-1R/1L

12



84%

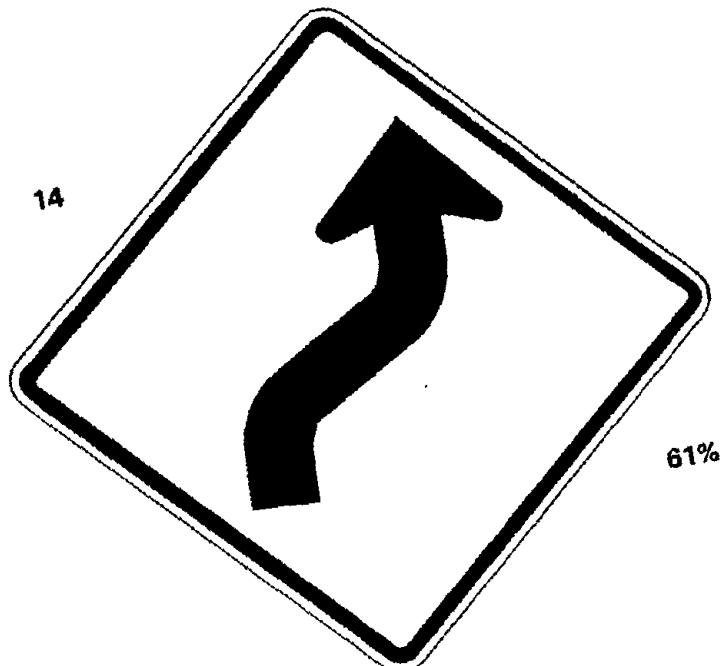
W1-1R/L



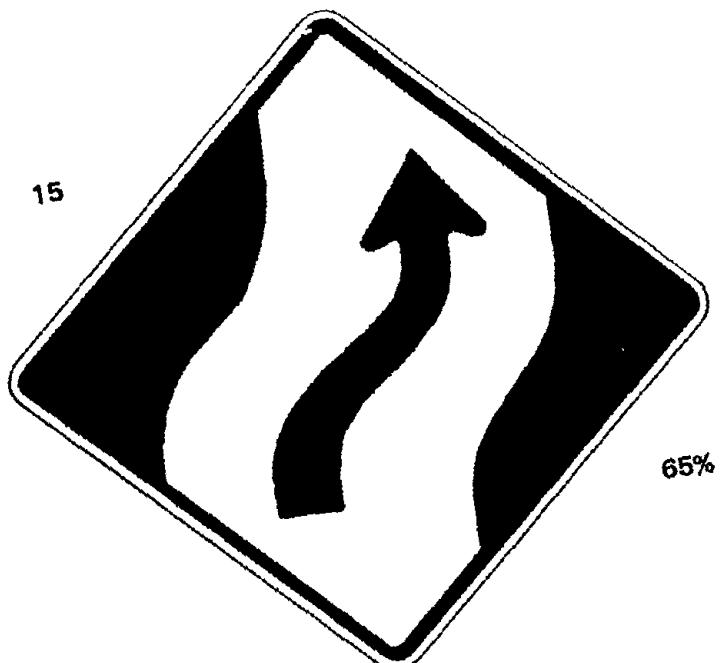
13

44%

W1-1R/L

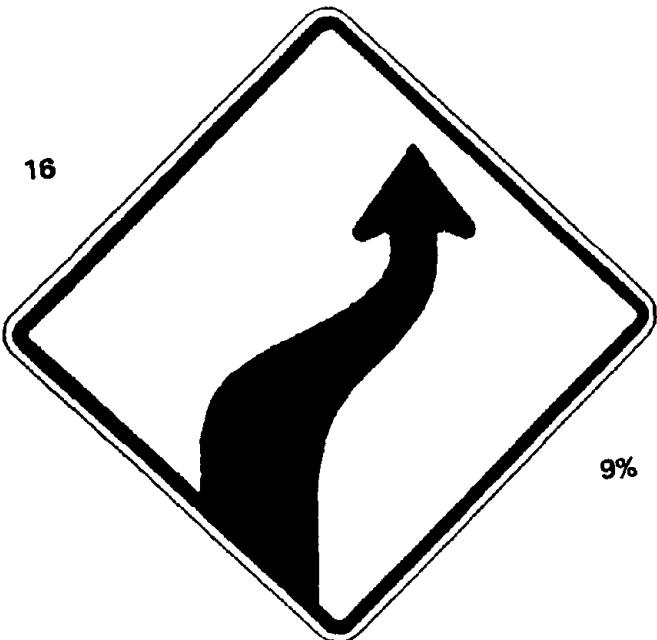


W1-4



W1-4

177



16

9%

W1-4

178

17



23%

S1-1

18



61%

S1-1

19



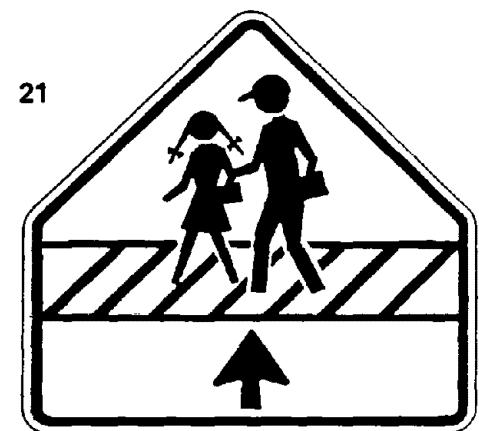
77%

S1-1



83%

S1-1



73%

S1-1



35%

S2-1



54%

S2-1

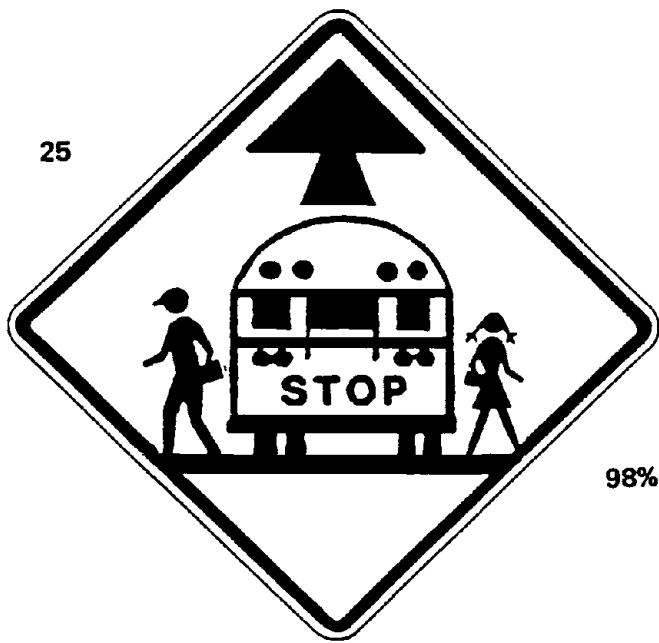
24



96%

S3-1

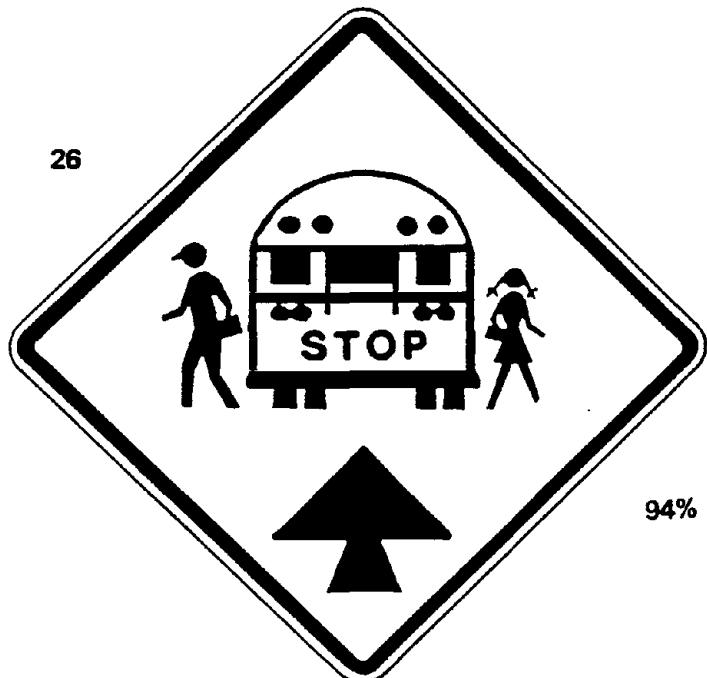
25



98%

S3-1

26



94%

S3-1

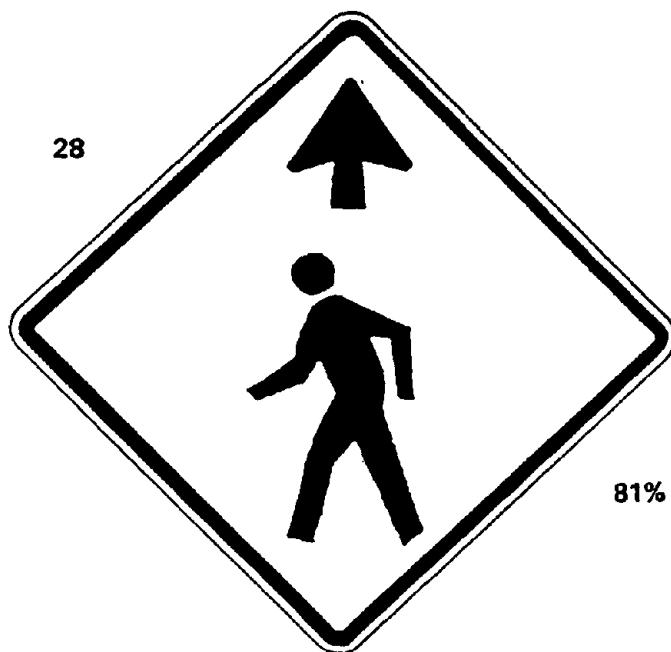
27



39%

W11-2

28



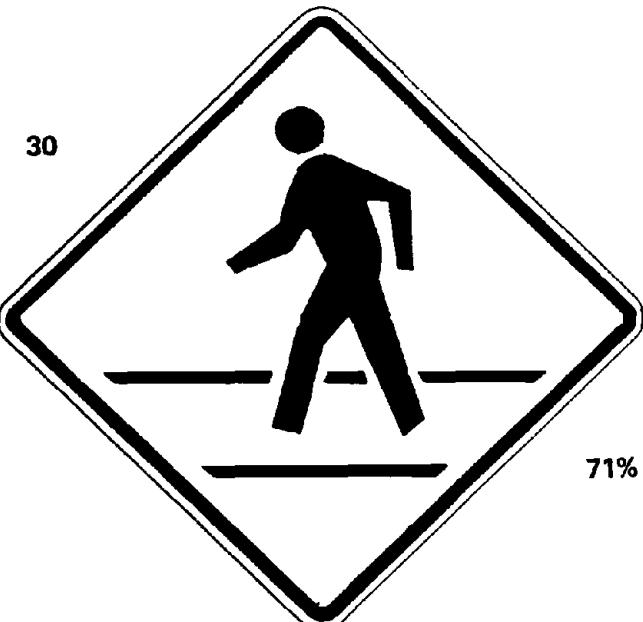
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W11-2

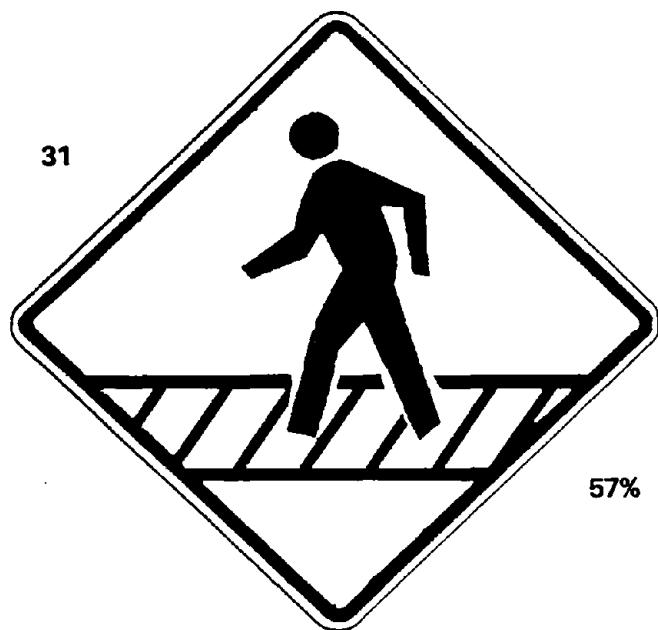
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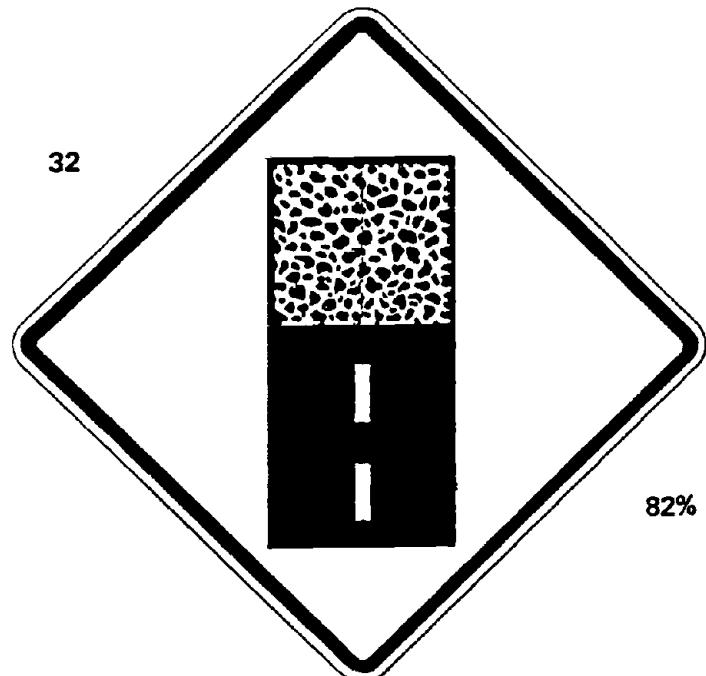
W11-2



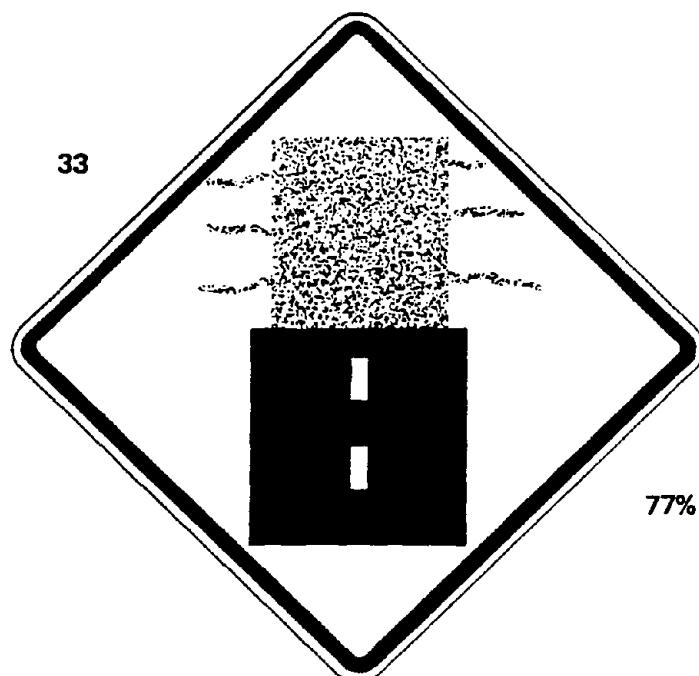
W11A-2



W11A-2

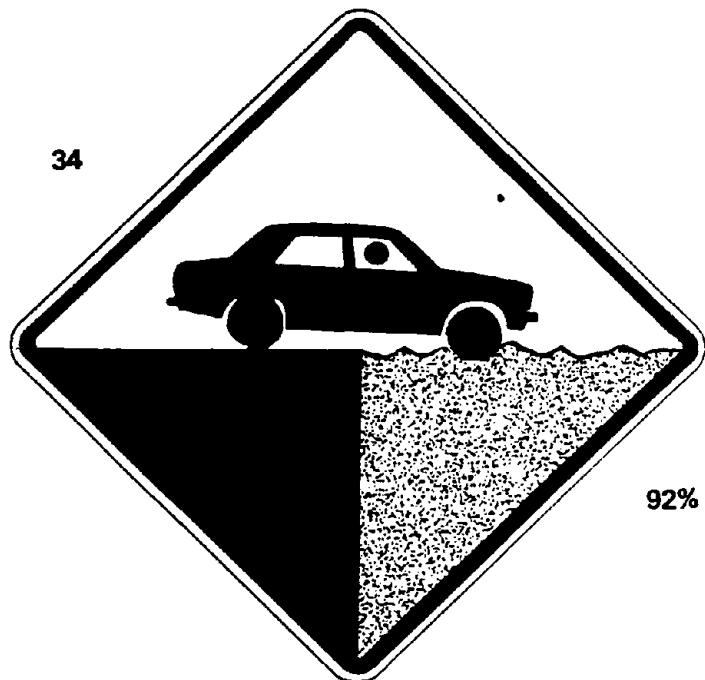


W8-3a

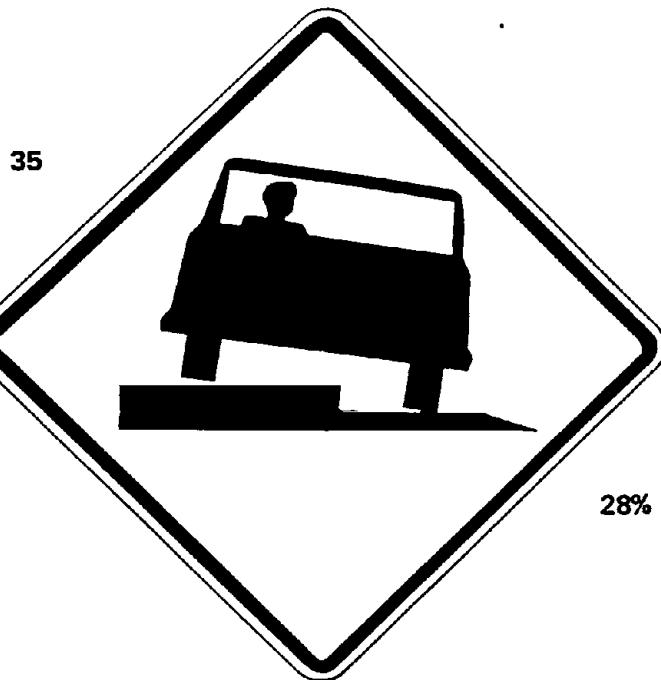


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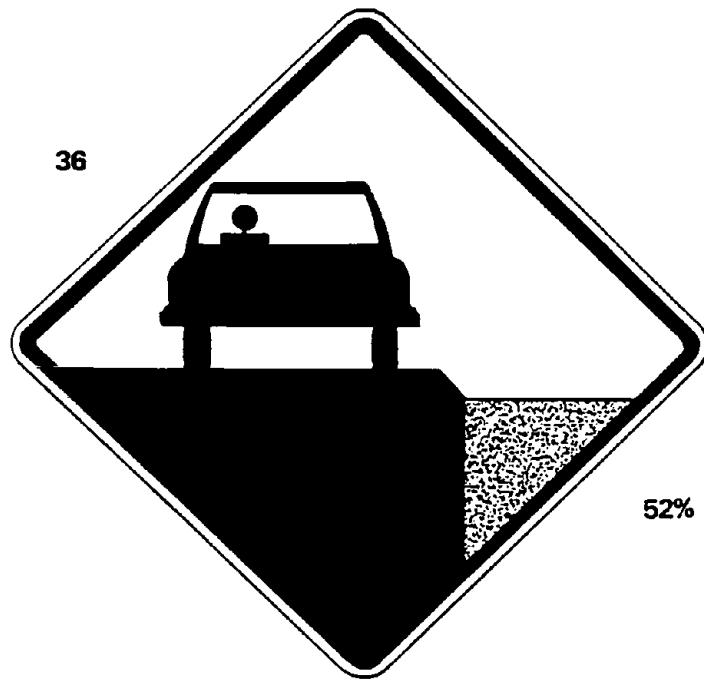
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W8-3a

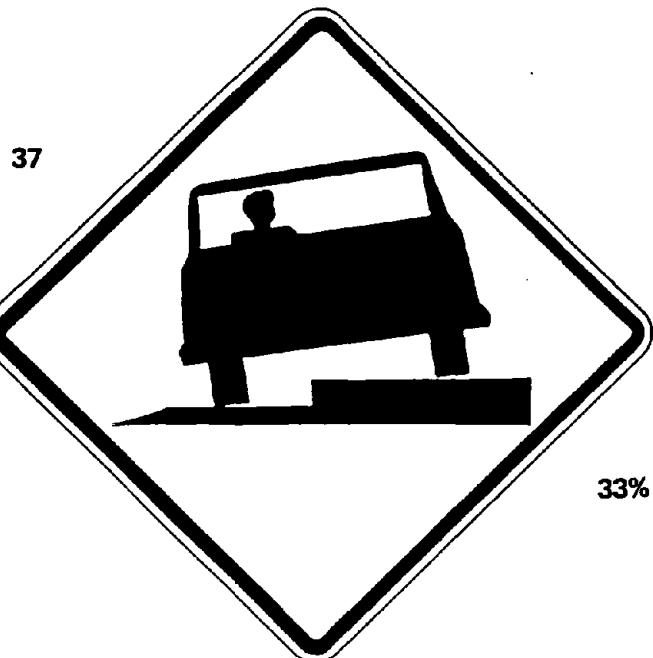


28%

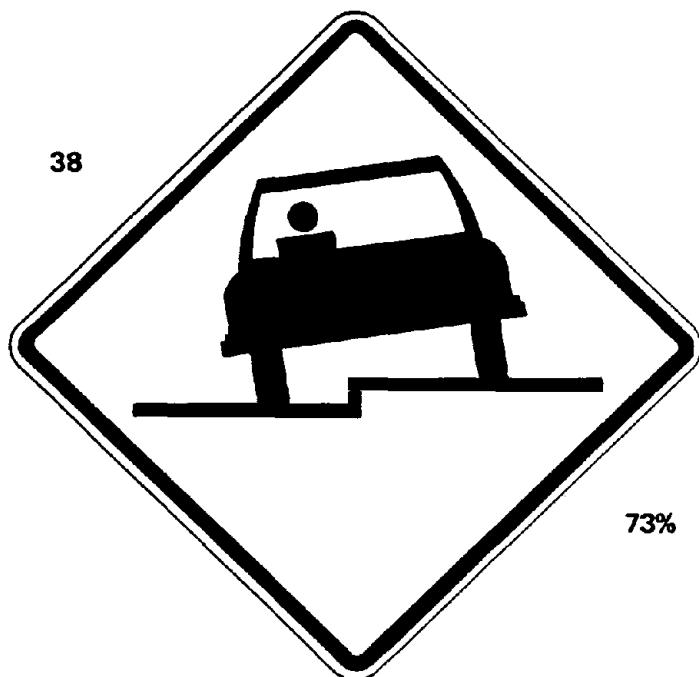


52%

W8-4b

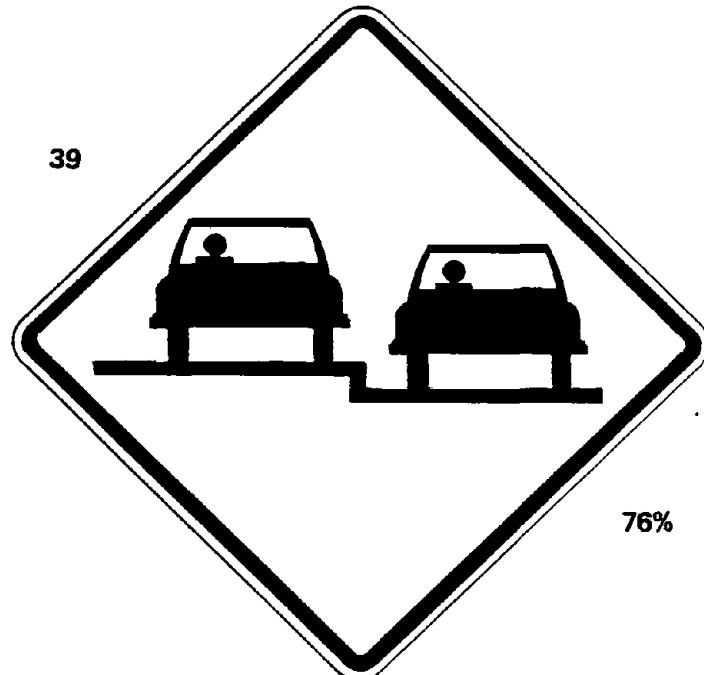


W8-4c



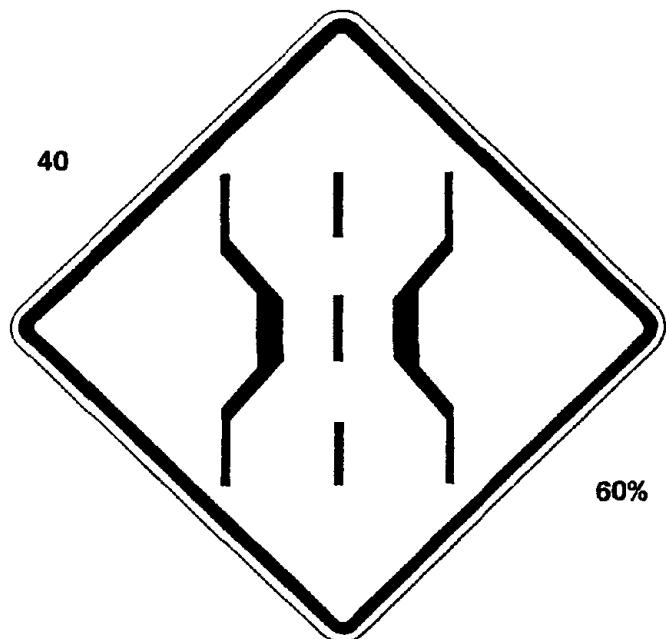
W8-4c

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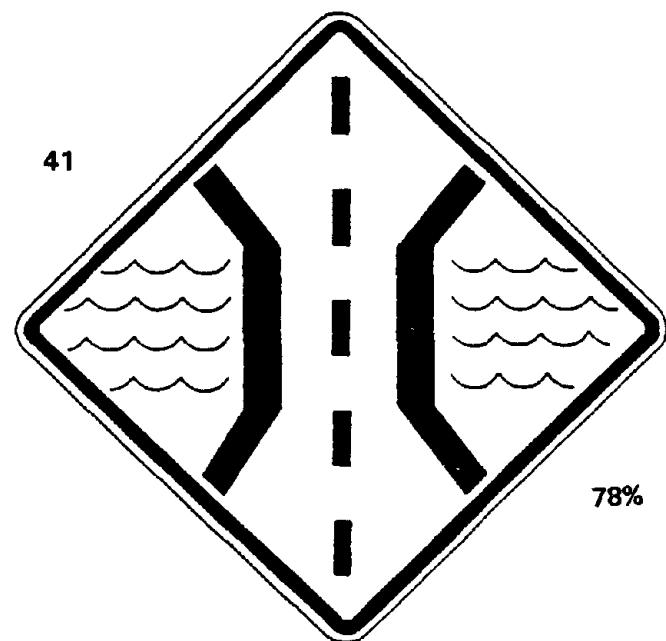


76%

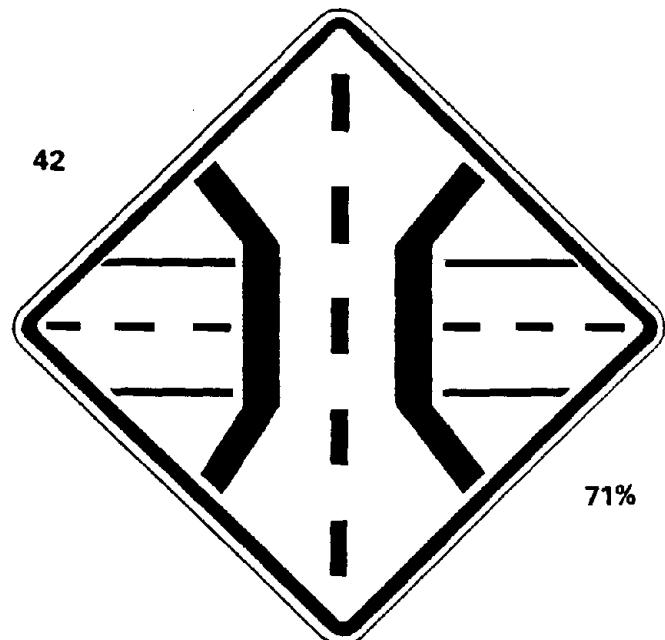
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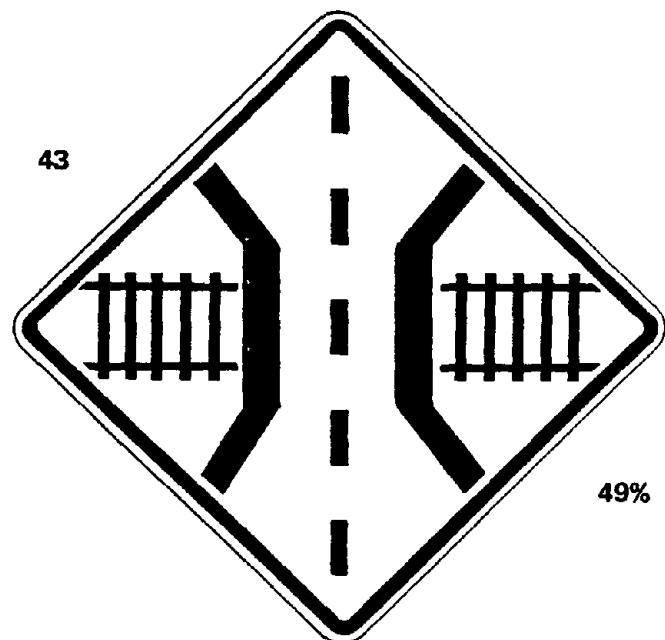
W5-2a



W5-2a



W5-2a



44

ONE LANE
ROAD

88%

W20-4

45

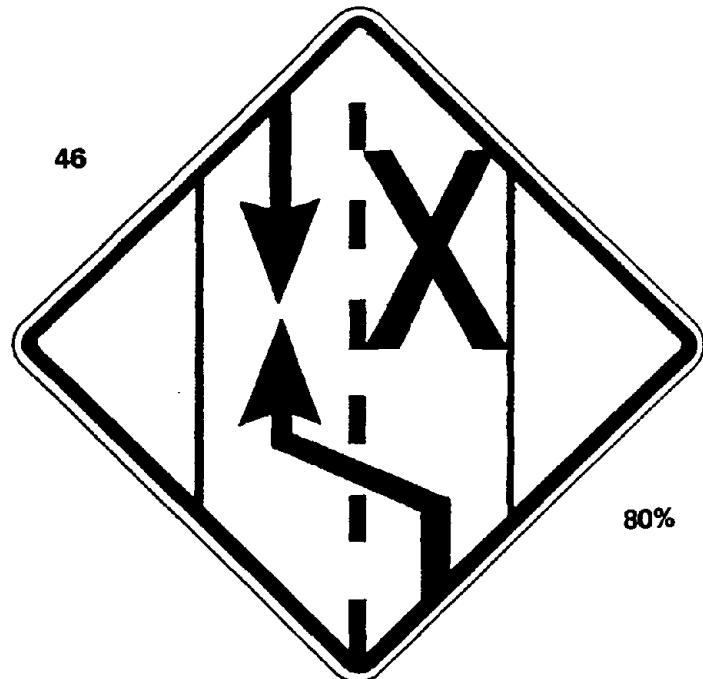


85%

W20-4

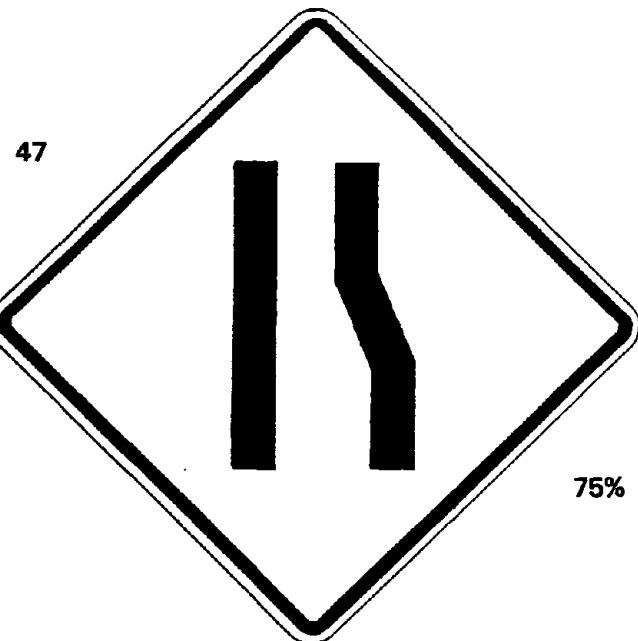
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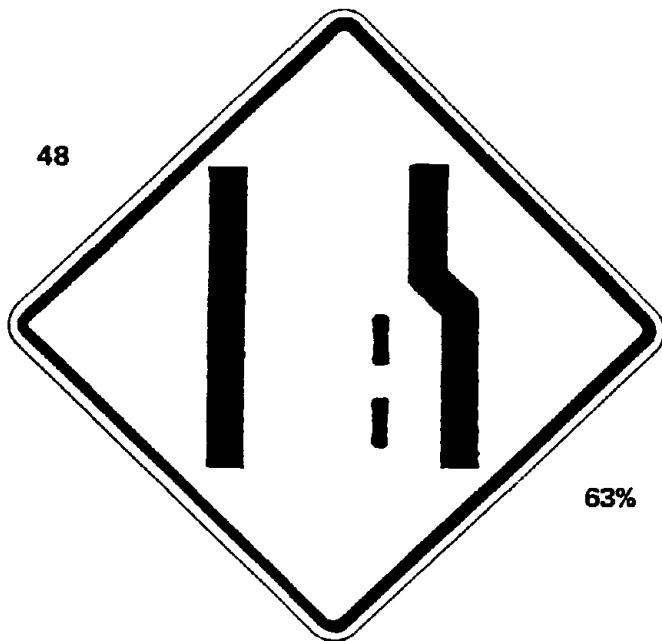
W20-4

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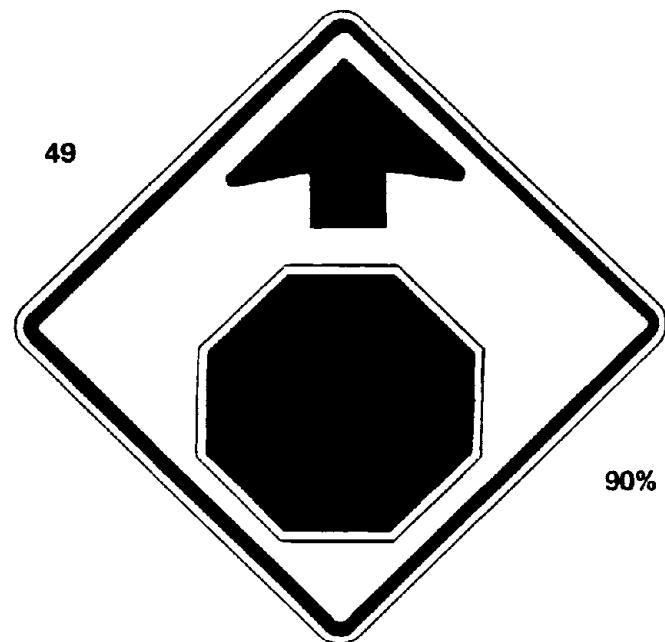
75%

W4-2



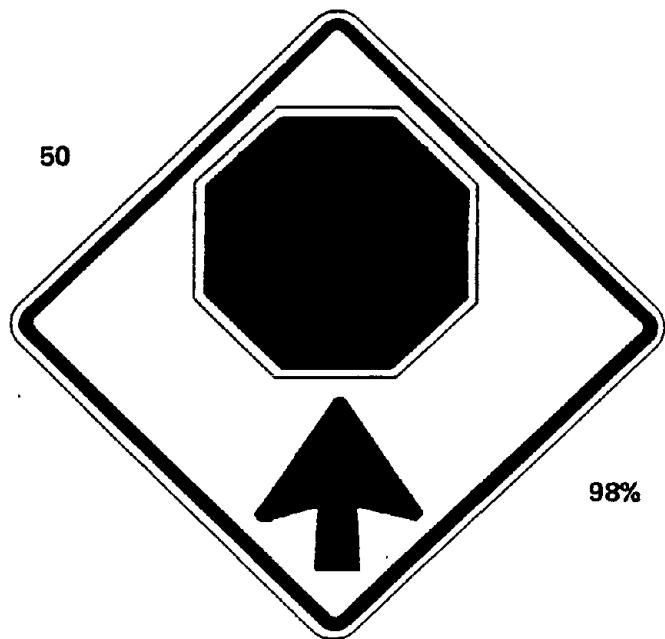
63%

W4-2



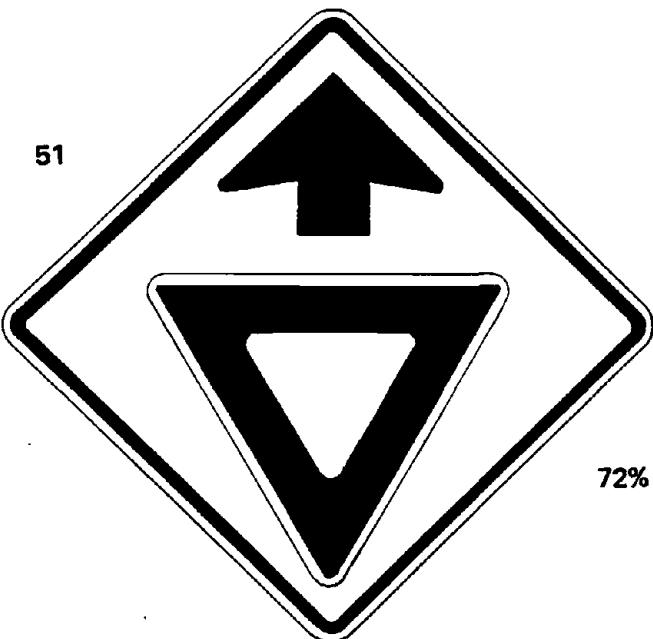
90%

W3-1a

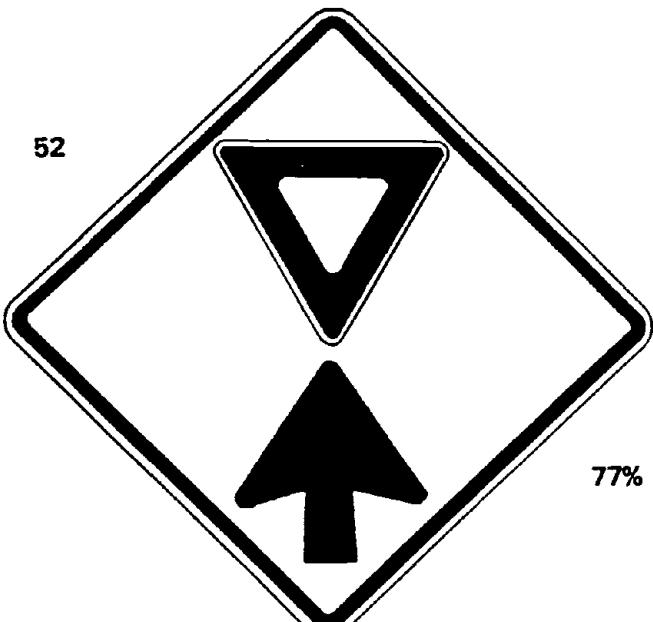


98%

W3-1a



W3-2a



W3-2a

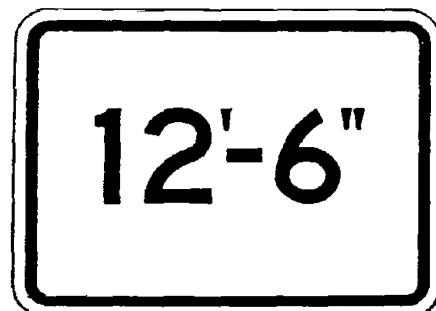


W12-2

54

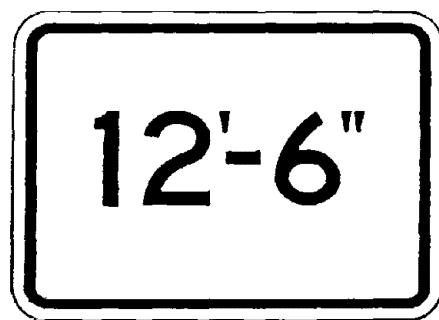
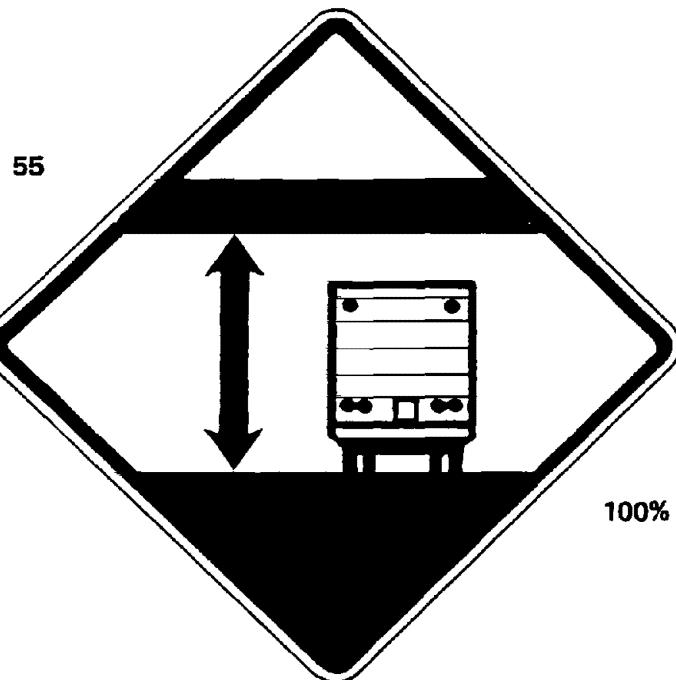


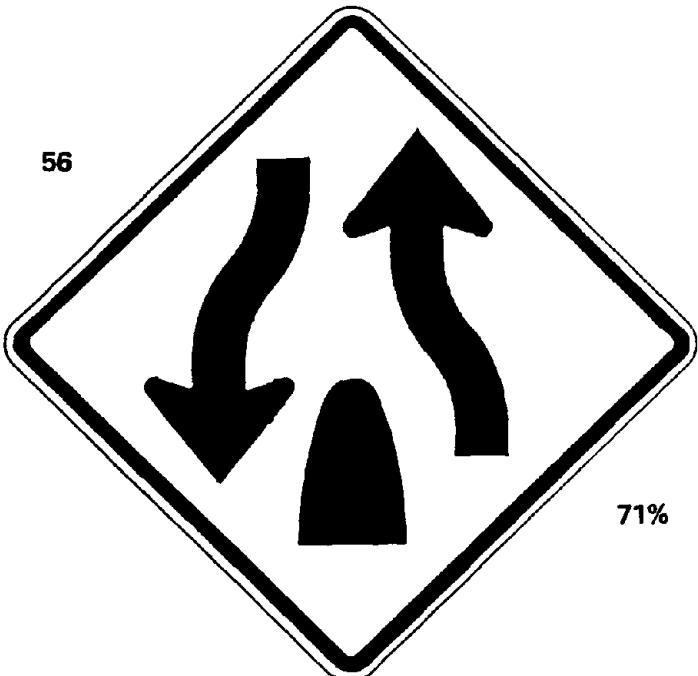
88%



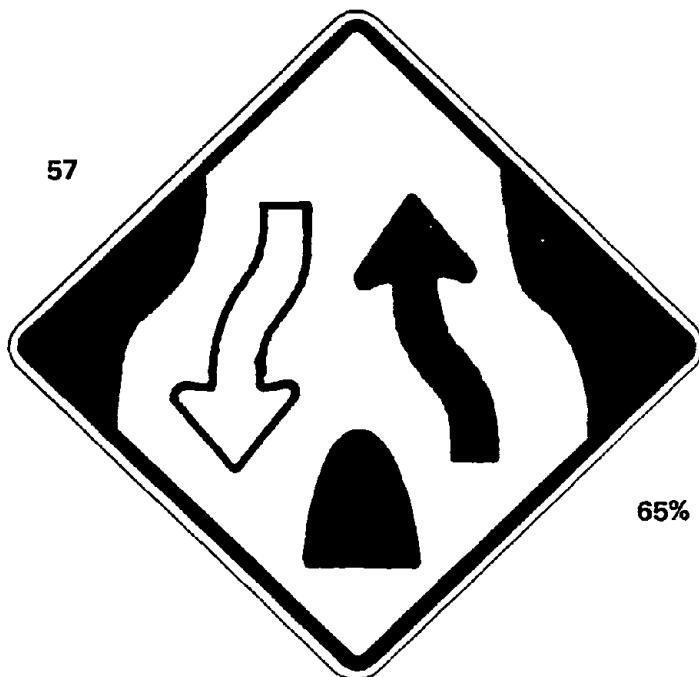
W12-2

200



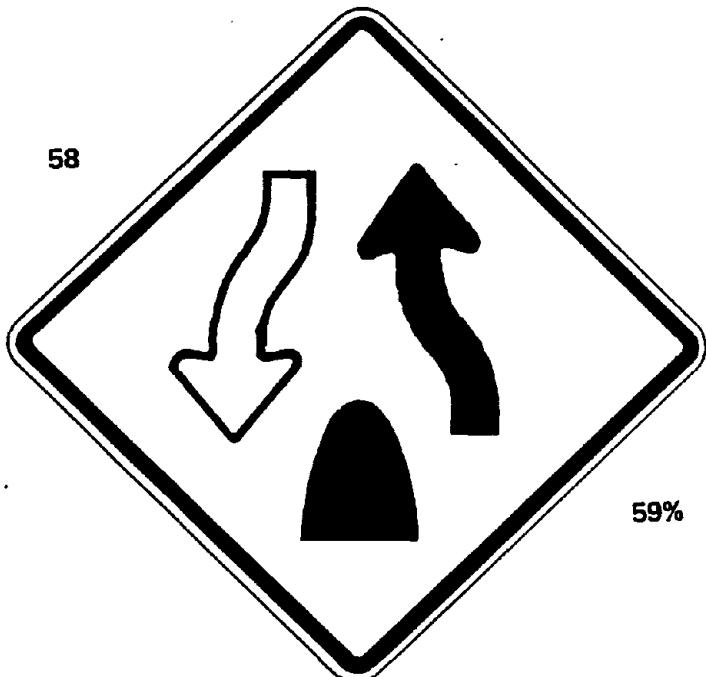


W6-2



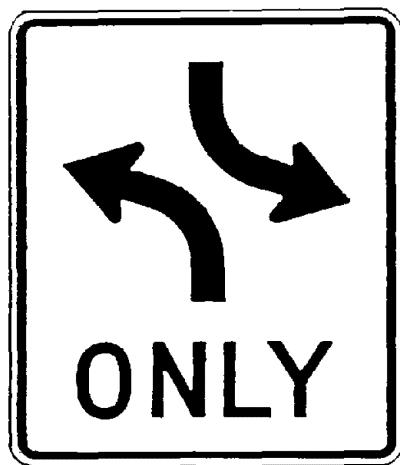
W6-2
202

58



W6-2

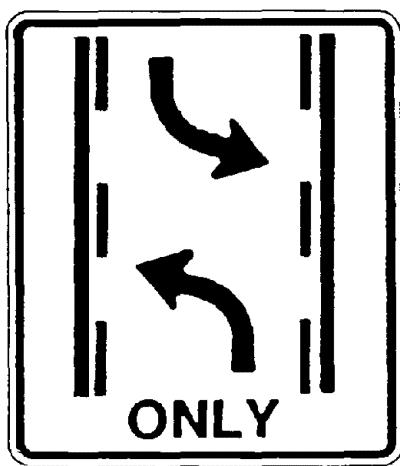
59



79%

R3-9a

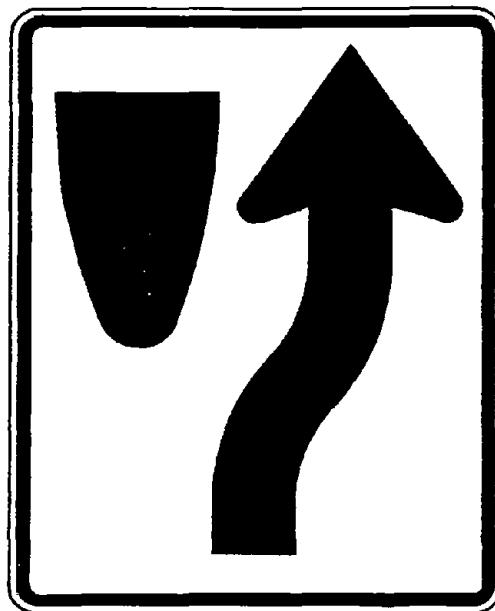
60



87%

R3-9a

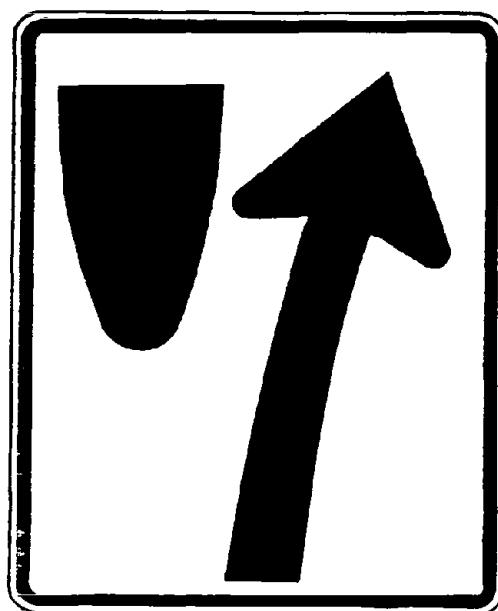
61



73%

R4-7

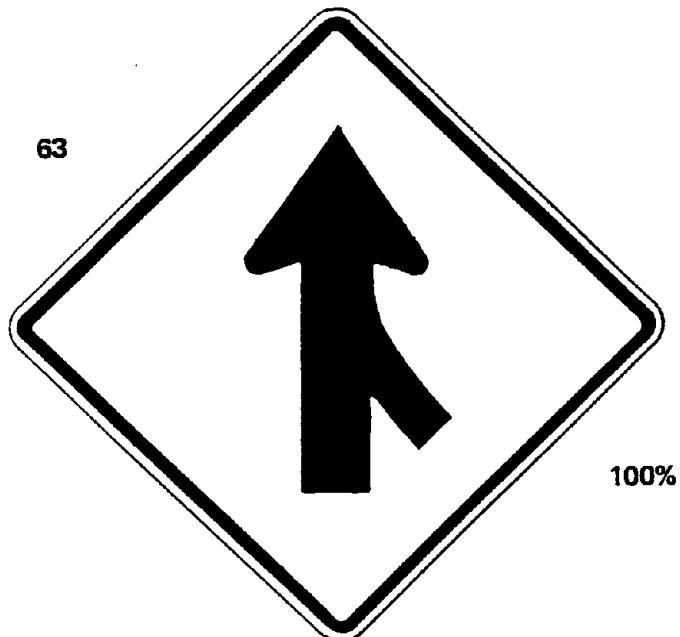
62



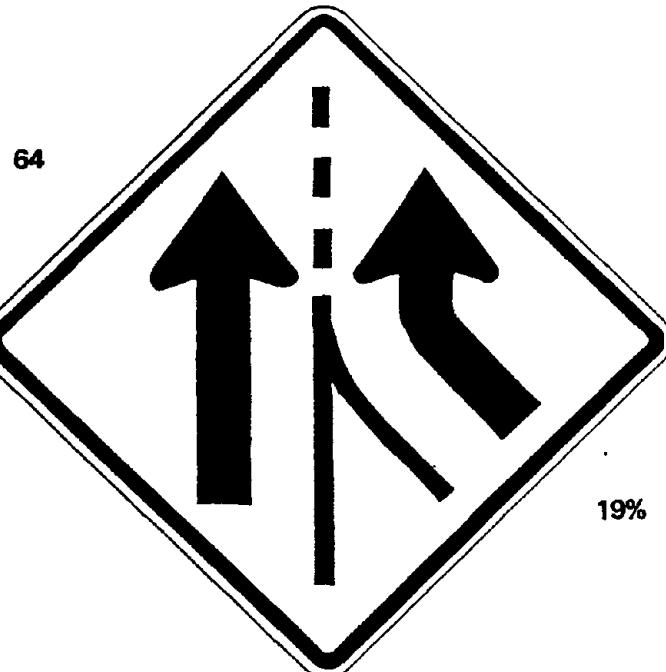
82%

R4-7

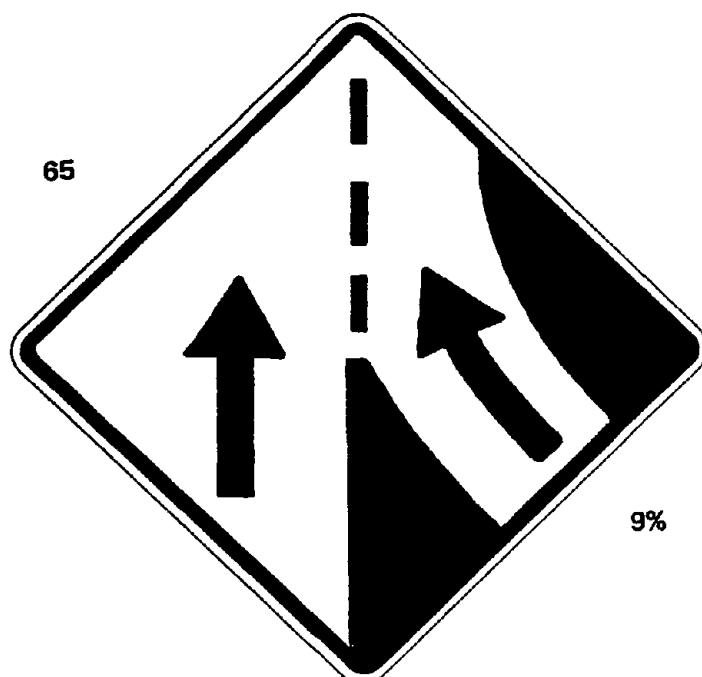
205



• W4-1

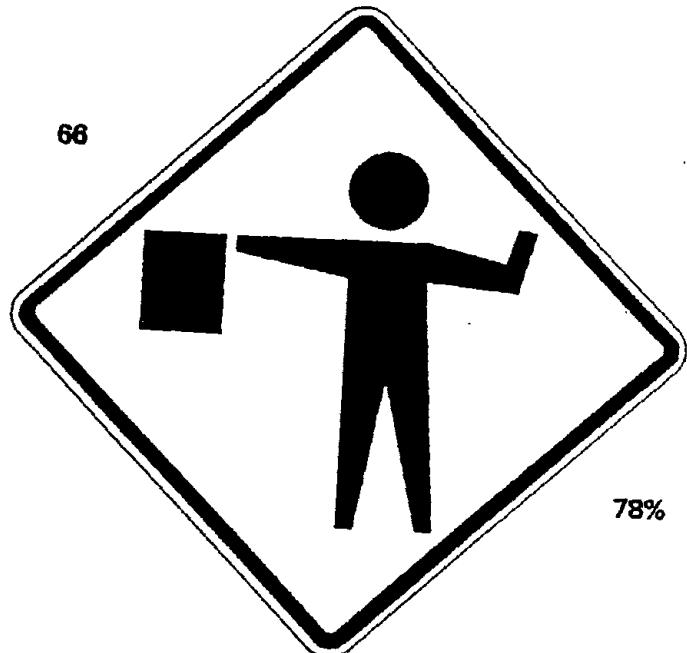


W4-3



W4-3

66



78%

W20-7a

67



98%

W20-7a

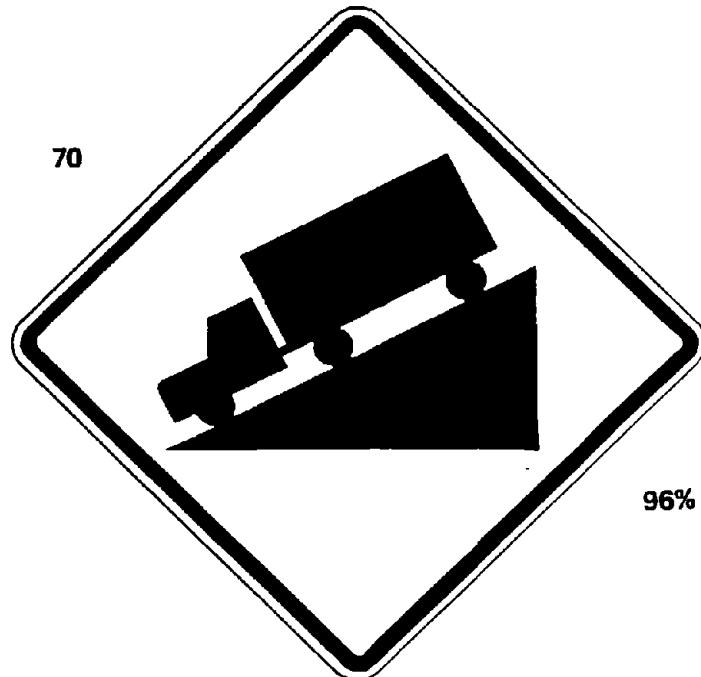
208



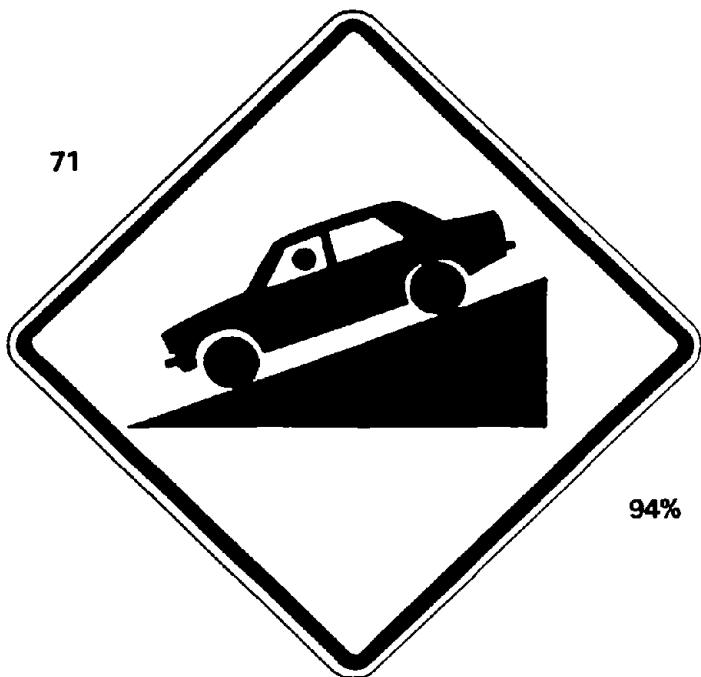
W21-1a



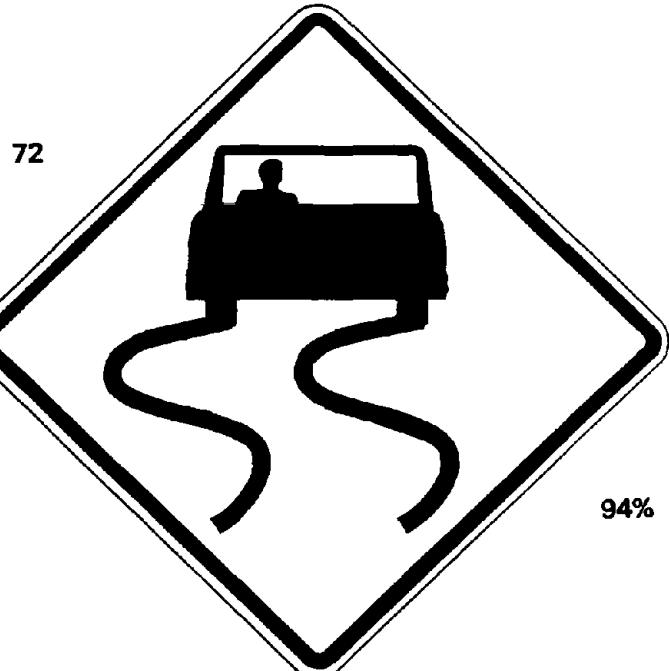
W21-1a



W7-1

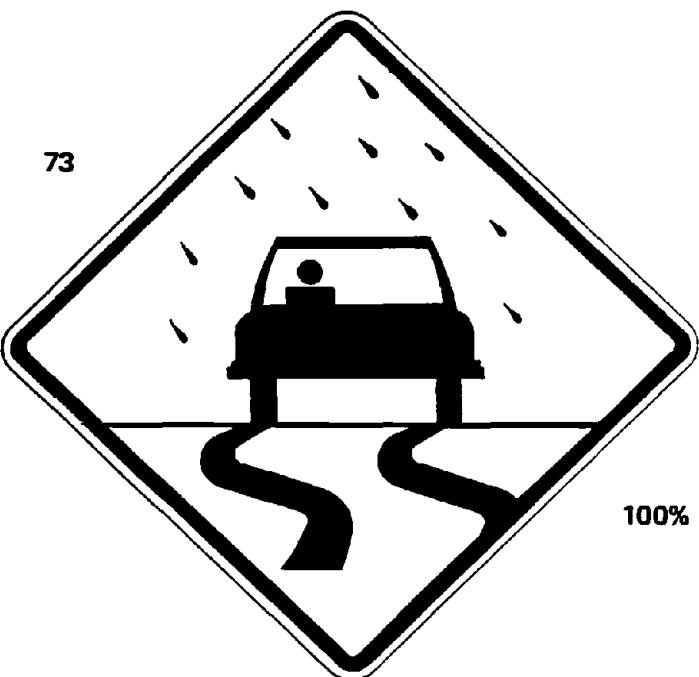


W7-1



94%

W8-5



100%

W8-5

211

