Redesign and Evaluation of Selected Work Zone Sign Symbols

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A study of traffic sign symbols was completed recently at the FHWA Turner-Fairbank Highway Research Center in McLean, Va. As part of this research, four work zone traffic control warning signs (Pavement Width Transition, Flagger Ahead, Low Shoulder, and Uneven Pavement) were selected for redesign. Several alternatives for each sign were tested in a laboratory experiment. Legibility distance, comprehension, and preference data were collected for each alternative. The results of the study indicate that the current symbolic designs for Pavement Width Transition and Flagger Ahead are superior to the alternatives tested and should be retained. The current symbolic sign for low shoulders was found to be inadequate (22 percent comprehension), but an acceptable alternative was not found. Given the infrequent use of this sign and the difficulty of communicating this concept to the driver, the use of the alphabetic Low Shoulder sign is recommended. For the Uneven Pavement sign, an improved symbolic design was identified and is recommended.

In recent years symbolic designs have been used to improve the communication ability of traffic signs. Symbols have the advantage of being able to convey messages more concisely than traditional alphabetic signs. Most symbols have become well known and readily understood. However, certain symbols, because of their infrequent use or abstract meaning, do not serve their intended purpose. The FHWA receives and responds routinely to complaints from motorists about signs that are unsatisfactory.

A study of the legibility and comprehension of symbolic traffic signs was conducted at the FHWA Turner-Fairbank Highway Research Center (TFHRC) in McLean, Virginia. This paper discusses the results of the symbolic redesign portion of the research. In this part of the study, alternatives were tested for four work zone traffic control warning symbols identified as needing redesign. The four are the symbols for Pavement Width Transition, Flagger Ahead, Uneven Pavement, and Low Shoulder.

BACKGROUND

A brief review of the literature for each of the signs selected for redesign is presented below. The discussion includes an outline of the problems with the existing design, the findings from other research studies, and the alternatives that were included in this research study.

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Pavement Width Transition

The Pavement Width Transition sign is a symbolic sign currently included in the *Manual on Uniform Traffic Control Devices* (MUTCD) (*1*). Although this sign does not have a word alternative, the MUTCD does require that the Right [Left] Lane Ends alphabetic warning sign be used in advance of the Pavement Width Transition symbolic sign. Complaints received from motorists indicate that some drivers misinterpret the thick black lines on the sign as representing the lanes and not the edge of the road. On other signs, thick bold lines are used to represent the lanes.

Pietrucha and Knoblauch (*2*) studied this sign in their research on sign comprehension. The initial comprehension tests indicated that the sign shown in Figure 1—Alternative 1 outperformed the existing sign. However, subsequent simulator and controlled vehicle tests provided conflicting results. The authors recommended that additional research be conducted to resolve this conflict.

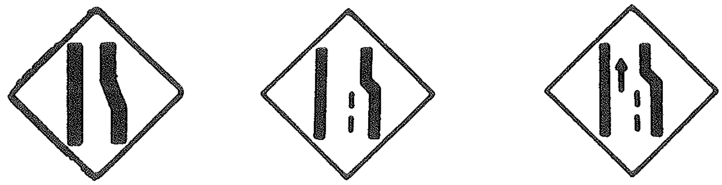
Other studies have also reported conflicting data on the effectiveness of the existing sign. A study by Hulbert et al. (*3*) on the understandability of traffic control devices found that 87 percent of the subjects questioned could correctly identify this sign, but a study by Koppa and Guseman (*4*) found only 65 percent comprehension.

Two of the more promising alternatives developed by Pietrucha and Knoblauch along with the existing design were selected for this experiment. These designs are shown in Figure 1.

Flagger Ahead

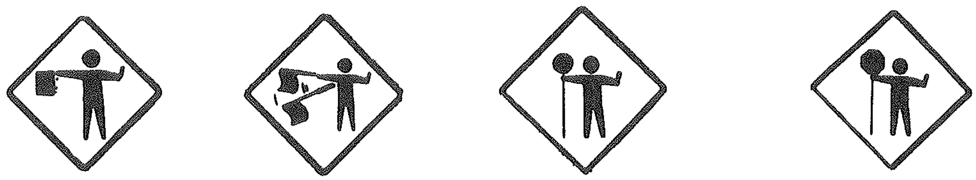
Currently, the MUTCD contains both alphabetic and symbolic versions of the Flagger Ahead sign. While both signs are fairly well understood by motorists, there has been some thought to modify the symbol to show the flagger holding a paddle instead of a flag. This is because Revision 4 of the MUTCD specifies the use of the STOP/SLOW sign paddle as the primary hand signaling device. The proposed version of the paddle sign is shown in Figure 2—Alternative 3.

An FHWA in-house research study (Alicandri, Walker, and Roberts, unpublished data) used the FHWA driving simulator to evaluate the existing sign and the proposed paddle sign. In this study, 95 percent of the drivers who saw the flag sign remembered it, but only 45 percent of the drivers who saw the paddle sign remembered it. In questioning the subjects on the meaning of both signs, the authors found that



Existing Alternative 1 Alternative 2

FIGURE 1 Alternative signs for Pavement Width Transition.



Existing Alternative 1 Alternative 2 Alternative 3

FIGURE 2 Alternatives for Flagger Ahead sign.

the flag sign had 100 percent correct answers and the paddle sign had 42 percent correct. From the data, it appeared that many subjects identified the paddle sign as the sign held by school crossing guards and expected to see it near a school zone. The octagonal shape of the paddle led many subjects to respond that they expected a stop ahead.

Pietrucha and Knoblauch (*2*) also examined the design of the Flagger Ahead sign. They studied several alternatives for the sign, but the paddle sign was not among them. They found that the best alternative was one that showed apparent motion, Figure 2—Alternative 1, and recommended that further study of this design be undertaken for inclusion in the MUTCD.

The existing sign along with three alternatives was studied in this experiment. The first alternative was the paddle sign developed by Alicandri et al. The results of their research showed that drivers often interpreted the sign to mean Stop because of the Stop-sign-shaped paddle. As a way to address this problem, a second paddle sign (Figure 2—Alternative 2) was developed using a round paddle. Finally, the alternative recommended by Pietrucha and Knoblauch was included. The existing sign and the alternatives are shown in Figure 2.

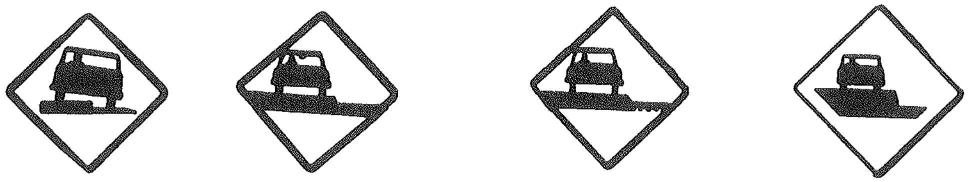
Low Shoulder

The MUTCD contains only an alphabetic version of the Low Shoulder sign. However, *Standard Highway Signs* (*5*) contains a symbolic version of the sign that is used widely. It is shown in Figure 3.

Pietrucha and Knoblauch (*2*) found a total lack of motorist understanding of this sign, as evidenced by only 4 percent correct responses. They tested a number of alternative designs with the best having 52 percent comprehension.

The existing Low Shoulder symbolic sign was also included in a research study by Wilson and Williams (*6*). They found that only 34 percent of the subjects could identify the sign correctly. The authors concluded that there was too much confusion with the Uneven Pavement symbolic sign and recommended that other alternatives be tested.

The development of an acceptable symbol for Low Shoulder is very difficult, as shown by results from previous studies. This study included a modification of Pietrucha and Knoblauch's best alternative (Figure 3—Alternative 2), which adds texture to the shoulder to denote a different surface. It is hypothesized that this will assist in differentiating the sign



Existing Alternative 1 Alternative 2 Alternative 3

FIGURE 3 Alternatives for Low Shoulder sign.

Alternative 1 Alternative 2 Alternative 3

FIGURE 4 Alternatives for Uneven Pavement sign.

from the Uneven Pavement symbolic sign and provide the driver with an added cue. A nontextured version of the sign (Figure 3—Alternative 1) was also included. A third alternative (Figure 3—Alternative 3), the design used currently in Texas for shoulder drop-off (*7*), was also included in the study.

Uneven Pavement

The MUTCD contains only an alphabetic version of the Uneven Pavement sign. While there is no symbolic version of the sign in the MUTCD, some states have developed one (Figure 4—Alternatives 1 and 3).

The existing versions of the symbolic sign are often confused with Low Shoulder symbolic signs. Several research studies have examined alternatives for this sign. Pietrucha and Knoblauch (*2*) studied the comprehension of several alternatives for the Uneven Pavement symbolic sign. They found that two signs, Figure 4—Alternative 3 and Figure 4—Alternative 2, provided good levels of comprehension (76 percent and 73 percent, respectively). They concluded that further testing was warranted.

Wilson and Williams (*6*) evaluated the design shown in Figure 4—Alternative 1 and found that 14 percent of the subjects responded correctly, with an additional 63 percent close to the correct response. They also found a large number of different responses for this sign, which demonstrates serious misunderstanding, and considerable confusion with the Low Shoulder symbolic sign. They suggested that alternative symbolic designs be tested.

For this research study, the best alternative from the Pietrucha and Knoblauch study was included with the two other designs currently in use. These test alternatives are shown in Figure 4.

EXPERIMENTAL METHODOLOGY

Measures of Effectiveness

Many different studies involving a variety of techniques have evaluated symbol signs. Each of these techniques has its advantages and disadvantages and each provides different information about the sign. However, many of the studies use only one measure of effectiveness and examine only one aspect of the sign. In their review of methods for the evaluation of traffic signs, Dewar and Ells (*8*) state, "For the complete evaluation of traffic signs a single method will not be adequate. . . ." In a later paper on the same topic, Dewar and Ells (*9*) conclude that the development and evaluation of any symbol should include an assessment of comprehension, legibility distance, and preference.

These three measures of effectiveness were used in this study. The legibility data indicated which symbol can be discriminated most effectively by the driver, sign comprehension data indicated how easily the different symbols can be understood, and preference data measured driver satisfaction with the various alternatives.

Dewar (*10*) surveyed sign design experts and practicing traffic engineers to determine the relative importance they placed on the various criteria used to evaluate traffic sign symbols. Legibility distance and understandability or comprehension were two of the criteria included. Dewar found that understandability was judged as being more important than legibility distance. The findings from Dewar's research should be kept in mind when interpreting the results from this study.

Preference was not included in Dewar's study, but generally it is viewed as of low importance. It is most useful as a "tiebreaker" when the legibility distance and comprehension measures fail to discriminate between alternatives. Preference rating is also a way of generating feedback from the subjects.

Test Apparatus

A test apparatus was developed to collect legibility distance and comprehension data for a large number of symbol signs. The apparatus consisted of a zoom lens mounted on a MAST random access slide projector. The lens had a 10.5:1 ratio allowing slides to be projected on a rear projection screen as they would appear at distances ranging from 110 to 1,000 ft. At any given distance, the visual image on the retina from a projected sign corresponded to the image that would be formed by the same sign in an actual driving situation.

A Textronics development system controlled the system and allowed slides to be selected randomly. Computer controlled servos controlled the zoom ratio and zoom lens aperture. This allowed the apparent size of the image to be enlarged while maintaining proper sign brightness.

The experiment was conducted in the Human Factors Laboratory at the FHWA TFHRC. The test apparatus is shown in Figure 5.

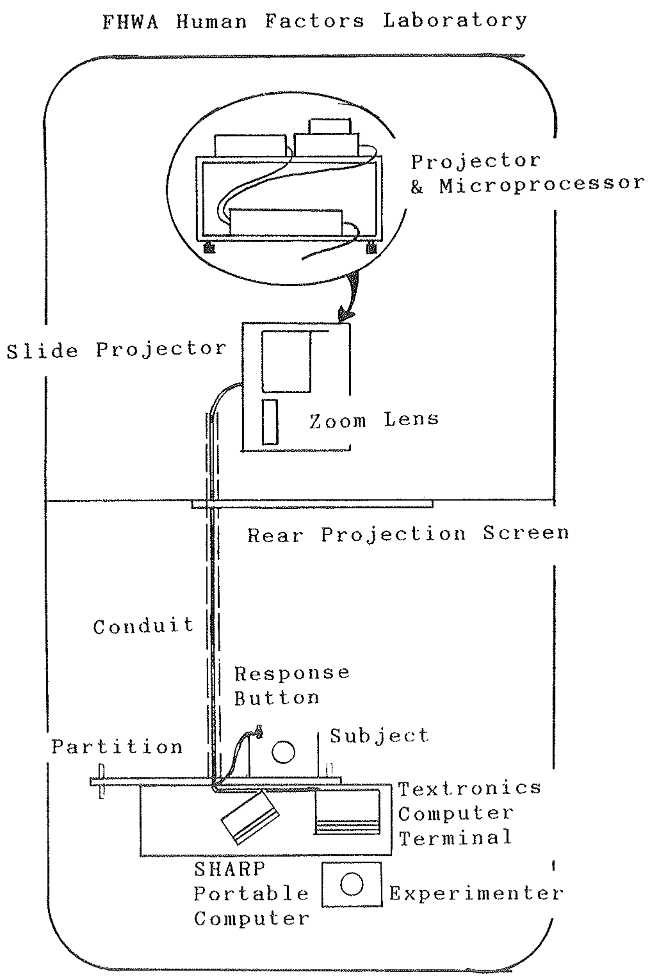


FIGURE 5 Test apparatus for laboratory experiment.

Test Stimuli

The stimuli consisted of slides of the sign images made using the FHWA graphics system. This system produces high quality graphics (resolution of 1,024 pixels × 780 pixels). An RGB camera recorded the graphic image, and the slides generated were reduced photographically to provide small images with high quality resolution.

Test Protocol

Briefing/Vision Screening

Before participating in this study, subjects were briefed on the requirements of the experiment and were given a far visual acuity test using the orthorater test instrument. A Snellen value of 20/40 was determined as the cutoff level for subject participation. This is the level that most states require for driver licensing.

Dynamic Legibility Test

A dynamic recognition distance test was developed to assess the legibility distance of the signs. This test consisted of presenting the subject with a randomly selected slide beginning at a simulated distance of 1,000 ft and moving forward at a rate equivalent to a driving speed of 44 ft/sec (30 mi/hr). The subject was given a handheld button and instructed to depress it when the symbol on the projected sign could be identified. Since the legibility distance of the sign was of interest, the subject was told to press the button when the features of the symbol could be described, even if the meaning was not clear.

When the button was pressed the slide was extinguished immediately and the subject was asked to describe the slide. If the response was correct, the distance was noted by the experimenter and the next trial was initiated. If the answer was incorrect, the trial resumed from the point of interruption.

An acceptable response was one that indicated that the essential features on the sign could be distinguished. For example, a typical acceptable answer for an Uneven Pavement sign might be "a car, on a road, tipped, with the lower side to the left." The response "a car on a road" would not be acceptable.

Comprehension Test

The symbolic signs were presented randomly to a subject, one at a time, to assess comprehension. The signs were displayed at a large size and for as long as the subject required to respond. Subject responses were classified into one of the following categories:

- *Correct:* The response demonstrated a clear understanding of the intended meaning of the sign;
- *Substantially Correct:* The response was not exact, but did indicate a reasonable understanding of the sign meaning; and
- *Incorrect:* The response demonstrated a lack of understanding of the intended meaning.

Preference/Debriefing

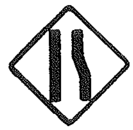
Subject preference data were collected at the conclusion of the study. Each subject was given the meaning of the four proposed symbol signs (Uneven Pavement, Low Shoulder, Flagger Ahead, and Right Lane Ends) and asked to rank the alternatives from best to worst.

Subject Group

Many of the changes that occur in driver behavior have been found to correlate negatively with age. This negative correlation is the result of deterioration in the physical capabilities of the eye, decreases in cognitive performance, and delay in the motor response functions. To study the effects of age, the subject population was stratified into two age brackets—under 45 and over 55. Each group contained 16 subjects of which half were male and half were female.

The test sample included 32 drivers from 20 years old to 68 years old with an average age of 47. The average age for the "old" group was 61 and for the "young" group was 33. The subjects were paid $30 for their participation in this study.

TABLE 1 PAVEMENT WIDTH TRANSITION DATA

			
Measure of Effectiveness	Exist	Alt-1	Alt-2
Mean Legibility Distance (ft.)	519	513	518
Comprehension - Correct	22%	38%	22%
- Sub/Correct	66%	59%	72%
- Incorrect	12%	6%	6%
Preference Rating	60	59	73

RESULTS AND ANALYSIS

Pavement Width Transition

The existing design and two alternative symbolic designs for the Pavement Width Transition sign were tested. The results are presented by measure of effectiveness in Table 1 and discussed below.

Legibility Distance

An analysis of variance (ANOVA) with repeated measures was performed on the legibility data. This analysis showed a statistically significant difference between the age groups ($p = 0.02$), but did not indicate any differences between the sign alternatives ($p = 0.94$). A post-hoc test for multiple comparisons was performed to assess the difference between individual sign pairs. The Ryan-Elnot-Gabriel-Welsch (REGW) test was selected because it is considered one of the more powerful tests of this type. The results of the REGW test showed no statistically significant difference between any of the alternatives.

The short legibility distances for the three alternatives are not surprising if one considers their "long-distance" appearance. From far away, the signs appear the same. Subjects respond to the thick bold exterior lines when asked to describe the sign.

Comprehension

The comprehension data for the Pavement Width Transition sign were analyzed using the Cochran Q-test. This test is a nonparametric statistical test that determines whether three or more matched sets of frequencies differ significantly among themselves. To use this test the comprehension responses were reclassified as either correct or incorrect. The correct category included both correct and substantially correct responses. Performing the required computations resulted in $Q = 1.14$ and $p > 0.70$. This result indicates that the frequency of each response was the same except for chance differences.

The reason for testing different alternatives for the existing sign was to address the problem of drivers mistaking the heavy bold lines for the lanes instead of the edge of the road. From the responses given in this experiment, it appears that this confusion does exist with some drivers. The four incorrect responses given to the existing sign were all of this type. The alternatives tested helped somewhat, but they did not eliminate the problem. Both alternatives had two incorrect responses of the same type.

Preference

The preference rating was determined by summing the ranks for each alternative. The symbol with the lowest preference rating was the preferred alternative. Another nonparametric statistical test, the Friedman two-way analysis of variance by ranks test, was used to evaluate the preference data. The Friedman test resulted in a x^2 statistic of 3.81 giving a $p > 0.10$. This indicates that the preference ranking produced no statistically significant difference among alternatives.

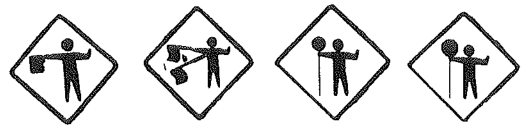
Flagger Ahead

For the Flagger Ahead sign, three alternative symbolic designs were tested along with the existing design. The results for each alternative are presented by measure of effectiveness in Table 2 and discussed below.

Legibility Distance

The ANOVA with repeated measures indicated a statistically significant difference between the age groups ($p = 0.003$) and among the sign alternatives ($p = 0.000$). The REGW post-hoc test for multiple comparisons was used to determine which sign pairs were statistically different. The results showed that

TABLE 2 FLAGGER AHEAD DATA



Measure of Effectiveness		Exist	Alt-1	Alt-2	Alt-3
Mean Legibility Distance (ft.)		532	367	460	448
Comprehension	- Correct	84%	63%	31%	47%
	- Sub/Correct	6%	22%	13%	22%
	- Incorrect	9%	16%	56%	31%
Preference Rating		61	79	84	96

at a level of confidence of 0.05, all the sign pairs were different except for Alternatives 3 and 4.

The legibility distance results indicated a clear difference among the three basic types of Flagger Ahead signs studied—the standard flagger sign, the flagger waving the flag, and the flagger holding a paddle. The legibility distance data did not show a statistically significant difference between the two types of paddle signs, round (Alternative 2) and octagonal (Alternative 3). The "long-distance" appearance of these signs is similar.

The reasons for the difference among the three basic types were evident during the testing. The standard sign was a familiar shape that was easily described at a far distance by the majority of the subjects. Alternatives 2 and 3 had shorter legibility distances because of the additional distance required by the subject to resolve the paddle. Alternative 1 had the shortest legibility distance because the sign had to be fairly large for the subject to discriminate the two flags used to depict motion.

Comprehension

The comprehension data for the Flagger Ahead sign were analyzed using the Cochran Q-test and resulted in $Q = 27.72$ and $p < 0.001$. This indicates that there is a statistically significant difference among alternatives.

Examining the comprehension data for the four designs, the two paddle alternatives had a high percentage of incorrect responses (56 percent and 31 percent). This was because, in large part, subjects believed these signs represented a school crossing guard. The two flag alternatives gave much better comprehension results. The results for these two designs were comparable, with the existing sign getting slightly fewer incorrect responses and more completely correct responses.

Preference

Evaluating the preference data using the Friedman two-way analysis of variance by ranks test resulted in a x^2 statistic of 11.89 giving a $p < 0.01$. This result indicates a statistically significant difference among the alternatives. From the sum of the ranks, the existing sign was preferred over any of the other alternatives. Many subjects were confused with the two paddle alternatives and indicated that the motion alternative was more distracting than helpful. They believed the existing sign clearly indicated the presence of a flagger ahead.

When asked if they would prefer the use of a word sign instead of their highest ranked symbol, the subjects overwhelmingly (91 percent) preferred the use of a symbol. Conversations with subjects also indicated that the primary problem they had with this sign was not one of misunderstanding, but of misuse. The Flagger Ahead sign is too often displayed when there is no flagger or even any construction to be found.

Low Shoulder

Three alternative symbolic designs were tested along with the existing design. The results for each alternative are presented by measure of effectiveness in Table 3 and discussed below.

Legibility Distance

The ANOVA with repeated measures indicated a statistically significant difference among the age groups ($p = 0.004$). However, there was no statistically significant difference between the sign alternatives ($p = 0.824$). The REGW post-hoc test for multiple comparisons also showed that none of the alternatives was significantly different from another based on legibility distance.

The short legibility distances for this sign result from two factors: (a) the amount of detail that must be resolved, and (b) the complexity of the message. All of the alternatives required the subject to distinguish that one part of the road was lower than the other. Resolving detail of a small scale requires a fairly large image size. In addition, the concept of low shoulder is both unfamiliar and complex. This contributed to its short legibility distance.

TABLE 3 LOW SHOULDER DATA

				
Measure of Effectiveness	Exist	Alt-1	Alt-2	Alt-3
Mean Legibility Distance (ft.)	217	202	206	210
Comprehension - Correct	16%	25%	34%	34%
- Sub/Correct	6%	16%	25%	6%
- Incorrect	78%	59%	41%	59%
Preference Rating	93	87	62	78

Comprehension

The comprehension data for the Low Shoulder sign were analyzed using the Cochran Q-test and resulted in $Q = 13.50$ and $p < 0.01$. This indicates a statistically significant difference among alternatives.

The data clearly show that the Low Shoulder sign with the textured shoulder (Alternative 2) provided the best comprehension, while the existing design was the least understood alternative. The low comprehension for the current design is because drivers mistake it for the Uneven Pavement sign. Of the 25 incorrect responses to this sign, 19 (76 percent) were because of this confusion. Alternatives 1 and 3, while better than the existing design, still showed a significant amount of confusion between Uneven Pavement and Low Shoulder (10 and 6, respectively).

Alternative 2 had only one response of ". . . uneven pavement." The texturing of the shoulder is the main reason for the low amount of confusion. However, Alternative 2 still had more than 40 percent incorrect responses. Many of the incorrect responses to this sign involved a reference to the shoulder's being soft. While the subjects recognized the shoulder and understood that there was a hazard associated with it, they did not comprehend correctly the type of hazard.

Preference

Analyzing the preference data with the Friedman two-way analysis of variance by ranks test resulted in a x^2 statistic of 10.24 and a $p < 0.02$. This result indicates a statistically significant difference between the alternatives. The sum of the ranks demonstrated a preference for Alternative 2, the design with the textured shoulder. Many people indicated that the texturing gave them a cue that it was a shoulder and not a traveled lane.

The subjects also showed a strong dislike for the existing sign because of the Uneven Pavement/Low Shoulder confusion. Alternative 1 was ranked low because many people believed the drop-off to be too severe.

The problem of communicating the low shoulder concept was emphasized by the low percentage of drivers (34 percent) who said they preferred their highest-rated symbolic alternative to a word sign. Many subjects believed that the Low Shoulder symbolic sign would be seen too infrequently and they would be more comfortable with a word message.

Uneven Pavement

Three alternative symbolic designs for the Uneven Pavement sign were tested. There is no existing symbolic design in the MUTCD. The results for each alternative are presented by measure of effectiveness in Table 4 and discussed below.

Legibility Distance

The ANOVA with repeated measures showed no statistically significant difference between the age groups ($p = 0.07$). However, there was a statistically significant difference among the sign alternatives ($p = 0.94$). The REGW post-hoc test for multiple comparisons indicated that this difference was between Alternative 3 and the other two alternatives. There was no statistically significant difference between Alternatives 1 and 2.

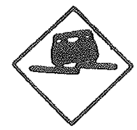
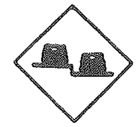
As with the Low Shoulder sign, the legibility distances for the Uneven Pavement alternatives are quite short. The problems associated with the two signs are similar.

The legibility distances for the Uneven Pavement Alternatives 1 and 2 were nearly identical, which is not surprising given their similar designs. The use of two cars in Alternative 3 seemed to contribute to its shorter legibility distance. The two cars did not accentuate the difference in pavement elevation; they only added more complexity to an already difficult sign.

Comprehension

The Cochran Q-statistic for the Uneven Pavement sign was $Q = 4.50$ resulting in a $p > 0.10$. This indicates that there

TABLE 4 UNEVEN PAVEMENT DATA

			
Measure of Effectiveness	Alt-1	Alt-2	Alt-3
Mean Legibility Distance (ft.)	216	222	151
Comprehension - Correct	50%	66%	41%
- Sub/Correct	19%	22%	28%
- Incorrect	31%	13%	31%
Preference Rating	56	58	78

was no difference in the frequency of responses among the three alternatives. However, the data for the three alternatives show that Alternative 2 had only four incorrect responses and Alternatives 1 and 3 had 10 incorrect responses. None of the alternatives had much confusion with the Low Shoulder sign.

Preference

The results of the Friedman two-way analysis of variance by ranks test indicated a statistically significant difference among alternatives. The x^2 value of 9.25 results in a $p < 0.01$. The rankings indicated a dislike for Alternative 3. Many of the subjects believed that this sign could represent an uneven road or it could just as easily be misinterpreted to mean ". . . use two lanes" or ". . . two-lane roadway ahead."

It appears that drivers prefer a symbolic sign as opposed to a word sign. Sixty-six percent of the subjects believed that their highest ranked symbolic sign was preferable to an alphabetic sign.

CONCLUSIONS AND RECOMMENDATIONS

Pavement Width Transition

No statistically significant difference was found among the three alternatives tested. While the number of incorrect responses was reduced with both of the new designs, the reduction was not statistically significant. The existing design had good comprehension, with 88 percent correct or essentially correct responses. Retention of the existing design is recommended.

Flagger Ahead

The existing flagger design performed significantly better than any of the alternative designs for all three measures of effectiveness. It was described correctly at longer legibility distances, had the highest comprehension (90 percent correct), and was clearly preferred by the subjects.

The results of this study indicate that there is nothing to be gained and much to be lost by switching from the current design to one showing a paddle instead of the flag. An effective symbol design must get the intended message to the driver clearly and concisely; the current design does just that.

Low Shoulder

The results of the legibility distance and comprehension tests illustrate the difficulties in symbolically representing the low shoulder concept. None of the alternatives tested performed adequately. The existing design had the lowest comprehension (22 percent correct) and the most confusions with the Uneven Pavement sign. Alternative 2 had the best comprehension (59 percent correct) and had few confusions with the Uneven Pavement sign, but still did not perform at an acceptable level. The preference data highlighted this fact. While Alternative 2 was the preferred design, the majority (66 percent) of the subjects said they preferred a word sign to any of the alternatives.

Given the infrequent use of this sign and the difficulty in communicating the Low Shoulder concept to the driver in a symbolic form, the current symbolic design should be withdrawn and only the word alternative used. Although the word sign was not included in this study, one can assume that the comprehension of this sign (at least by English-speaking, literate drivers) would be significantly higher than the 22 percent comprehension of the current symbolic design. As noted earlier, Dewar (*10*) found comprehension to be the most important evaluation criterion for traffic sign symbols.

Uneven Pavement

The results of this study indicate that Alternative 2 is the best choice. This alternative had the highest comprehension (88 percent correct) and the longest legibility distance. Contrary to the results for the Low Shoulder sign, the majority (66 percent) of the subjects preferred a symbol for this sign.

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