ROADSIDE SIGN LEGIBILITY AND ROADWAY ILLUMINATION

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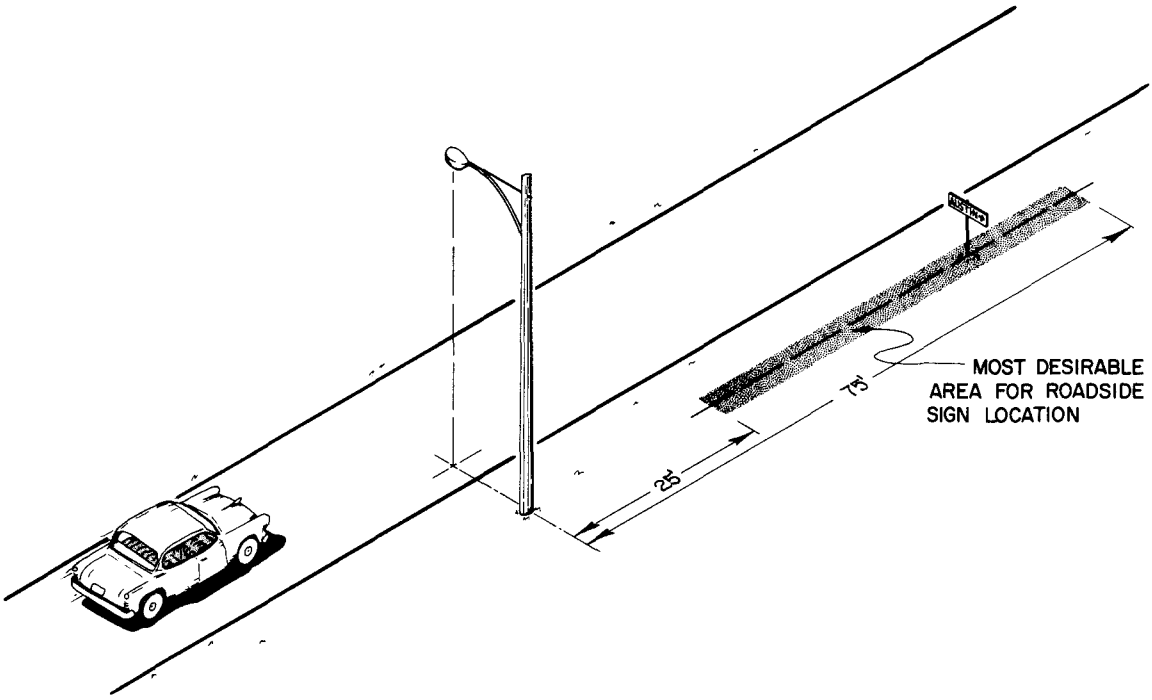
Roadside sign location and luminaire location should be coordinated at the design stage. Signs placed 25 to 75 feet behind a luminaire are legible at greater distances than signs placed ahead of a luminaire. In lateral placement, signs located approximately 10 feet to the right or "house" side of the luminaire have the greatest legibility.



ROADSIDE SIGN LEGIBILITY AND ROADSIDE ILLUMINATION

INTRODUCTION

Adequate signing is necessary to give today's driver help in taking full advantage of our ever improving highway system. Signs must be located to attract the driver's attention, to give him an adequate opportunity to read them, to command his obedience, and to provide time for proper response and action. The problem of sign location, recognition, and readability at night is of particular importance.

Numerous comprehensive studies of the target value and legibility of roadside signs have been conducted and reported previously. None of these studies has considered the effect on the legibility of signs caused by the presence and location of standard roadway lighting. It is generally known that placing signs so that roadway luminaires illuminate them increases their legibility, but there is no information that such improvement is great enough to warrant its consideration in roadway illumination and sign design.

An extensive study of the legibility of roadside signs related to their position with regard to standard roadway illumination has been conducted by the Texas Transportation Institute, as a part of the research project on intersection illumination, jointly sponsored by the Texas Highway Department and the Bureau of Public Roads through the Highway Planning Survey program. The study is described in this report. Similar studies are being conducted on overhead signs and will be reported at a later date along with studies of overhead sign illumination.*

TEST PROCEDURE

The Texas Highway Department District 17 Sign Shop manufactured eight type D-1A destination signs for use in the studies. The signs were six feet by one foot with 7" black letters on a white beaded background. Real place names with similar letter characteristics were selected for use.

A standard 20,000-lumen type III G. E. mercury vapor luminaire with a H 400-E 1 G. E. mercury lamp was mounted thirty feet above the bituminous surfaced test location. The isolux readings recorded in the field for this luminaire are shown in Figure 5 in the Appendix. The test section provided more than one-fourth mile of constant grade in a nearly level approach to the luminaire and signs.

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*These studies were conceived by Mr. H. H. Bartel, Jr., Associate Professor of Civil Engineering at Southern Methodist University, and are a part of his research requirements for the Ph.D. degree at the A. & M. College of Texas. A complete report of these studies will be presented at a later date.

Preliminary study indicated that the longitudinal placement of signs with regard to the luminaire was more important than the lateral positioning. Figure 1 shows the plan of the main study designed to measure variations in legibility at different longitudinal locations. A test car with observer as passenger approached the signs from a distance of 0.5 mile at a speed of 5 miles per hour. The observer was in a position equivalent to that of the driver on a two-lane 24-foot pavement. The distance at which every letter of the wording on the test sign was read was recorded as the legibility distance. Six young male student observers participated in the studies and each observer made 64 passes. The luminaire was off for half these passes and on for half the passes; the 5040 sealed beam unit headlights of the test vehicle were on bright for half the observations and on dim for half the passes; a parked vehicle was located in the position of an opposing vehicle and in half the studies the headlights were on dim, and in the other half of the studies they were off.

The signs were mounted seven feet from the ground on line with the luminaire at six positions within 100 feet of the luminaire.

A confounded factorial experimental design was used that made it possible to assess the significance of and interrelationships among all major factors; i.e., differences between observers, test vehicle headlight settings, presence of opposing light source, effect of luminaire and differences between the six sign positions.

RESULTS

The most significant results of the study, derived from appropriate statistical tests, are shown in Figure 2. The reading distance for each observer has been reduced to a percent of the observer's reading distance maximum to eliminate differences in visual acuity. (Figure 7 in the appendix summarizes actual reading distances.) Each plotted point is the average of several readings for an observer.

The effect of the stationary opposing headlight source was so small that it has not been shown on the figure. As would be expected on a flat test course, when the luminaire was off the reading distance was constant regardless of the location of the luminaire.

When the test vehicle was operated on bright beams, there was a gradual increase in reading distance as the sign was moved past the luminaire and received more direct light from the distance.

Very significant results were found for the more typical operating condition--headlights dim. When the sign was in front of the luminaire it received no direct light from the luminaire and was readable at only 70 percent of the distance that it could be read at when the sign was 55 feet behind the light. The improvement in legibility distance exceeded 35 percent from a point 25 feet in back of the luminaire to a point 75 feet behind the light.

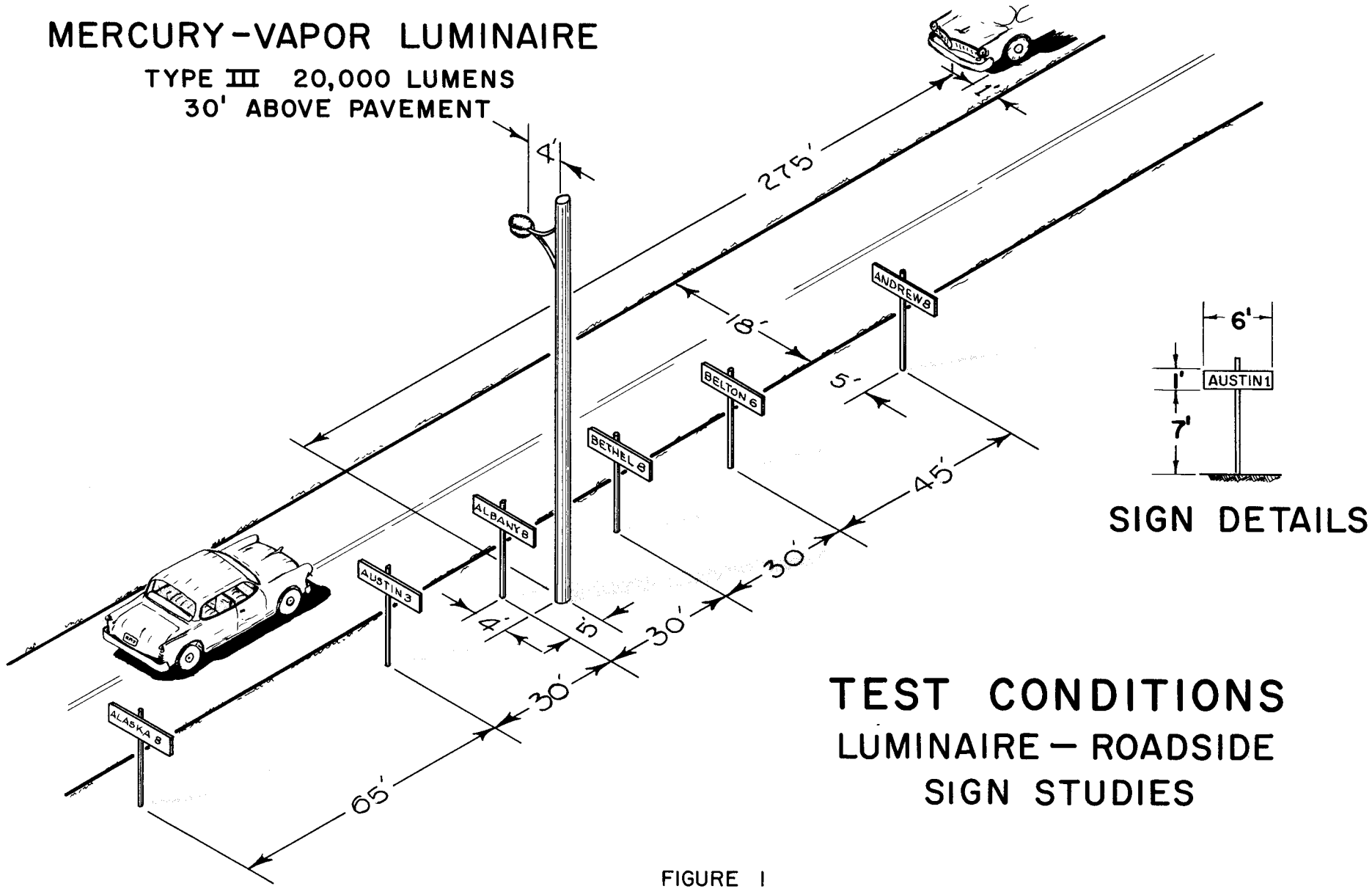
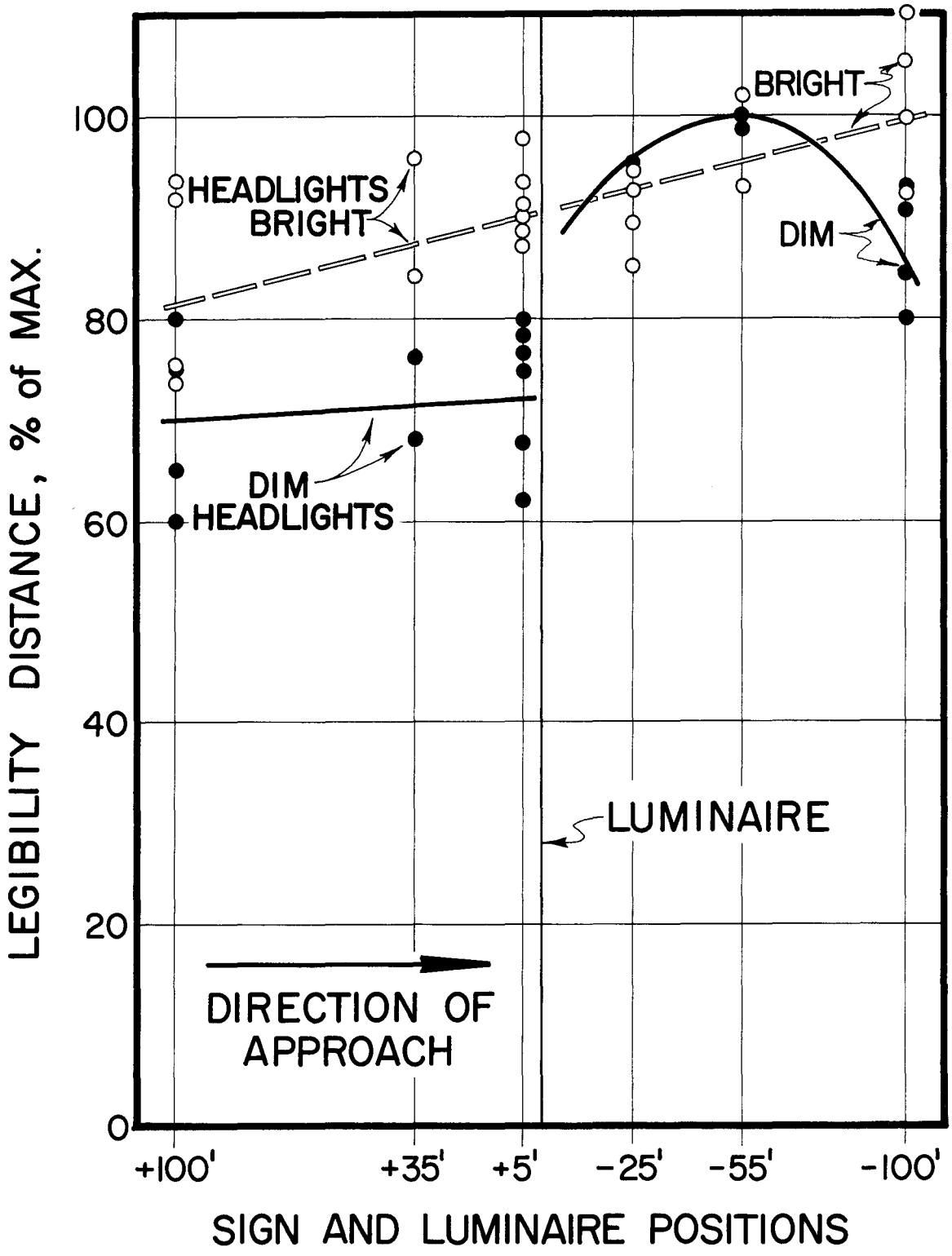

MERCURY-VAPOR LUMINAIRE
TYPE III 20,000 LUMENS
30' ABOVE PAVEMENT
4'
275'
18'
5'
45'
30'
30'
30'
65'
4'
5'
ANDREW 8
BELTON 6
BETHEL 8
ALBANY 8
AUSTIN 3
ALASKA 8
6'
1'
AUSTIN 1
7'
SIGN DETAILS
TEST CONDITIONS
LUMINAIRE – ROADSIDE
SIGN STUDIES

FIGURE 1

FIGURE 2

ROADSIDE SIGN LEGIBILITY vs. LUMINAIRE LOCATION



This improvement in legibility averages over 100 feet, a significant value, equivalent to from one to two additional seconds of readability time at operating speeds, or nearly two extra inches of letter height.

In order to determine if this same effect is true for other lateral positions two additional studies were made. The results of a study of the amount of illumination from the luminaire on the center of the signs are presented in Figure 3. The peak illumination from the luminaire is at a point approximately 25 feet on the left or "road" side of the luminaire and falling off rapidly to a point approximately 10 feet on the right or "house" side of the luminaire. The vertical foot-candle contours shown on the isometric figure are also shown in Figure 6 of the Appendix.

A field study of the effect of lateral positions for signs receiving direct light from the luminaire was conducted using four additional observers. The results of this study are shown in Figure 4 and indicate that a sign approximately ten feet on the right or "house" side of the luminaire could be read from approximately ten to fifteen percent farther away than signs positioned either directly under the luminaire or twenty feet on the right or "house" side of it.

DISCUSSION

It is believed that the benefits in additional legibility distance warrant placing roadside signs from 25 to 75 feet past the luminaire. In many cases placing the signs as indicated would result in a sign being legible for a greater distance than if the sign were located ahead of the luminaire.

Other investigations have indicated that "static" legibility as measured in these studies does not give full attention to the real driving problem of "dynamic" visual acuity. A number of test runs conducted at typical operating speeds indicated that the improvements in reading distances noted at slow speeds exist at higher speeds also. The effect of moving opposing lights has not been considered in this study.

With respect to the lateralpplacement of signs, a location approximately ten feet on the right or "house" side of the luminaire appears to give best readability results. The improvements in legibility from best lateral positioning is not as great or as significant as that resulting from optimal longitudinal placement.

CONCLUSIONS

It is concluded that real and substantial improvements in night sign legibility will result when roadside sign location and luminaire location are coordinated at the design stage. It is concluded that signs should be placed from 25 to 75 feet "past" the luminaire. The lateral location of signs is not as critical as the longitudinal position, but the optimum placement is approximately 10 feet to the right of the luminaire.

FIGURE 3

HIGHWAY SIGN ILLUMINATION FROM LUMINAIRE ONLY

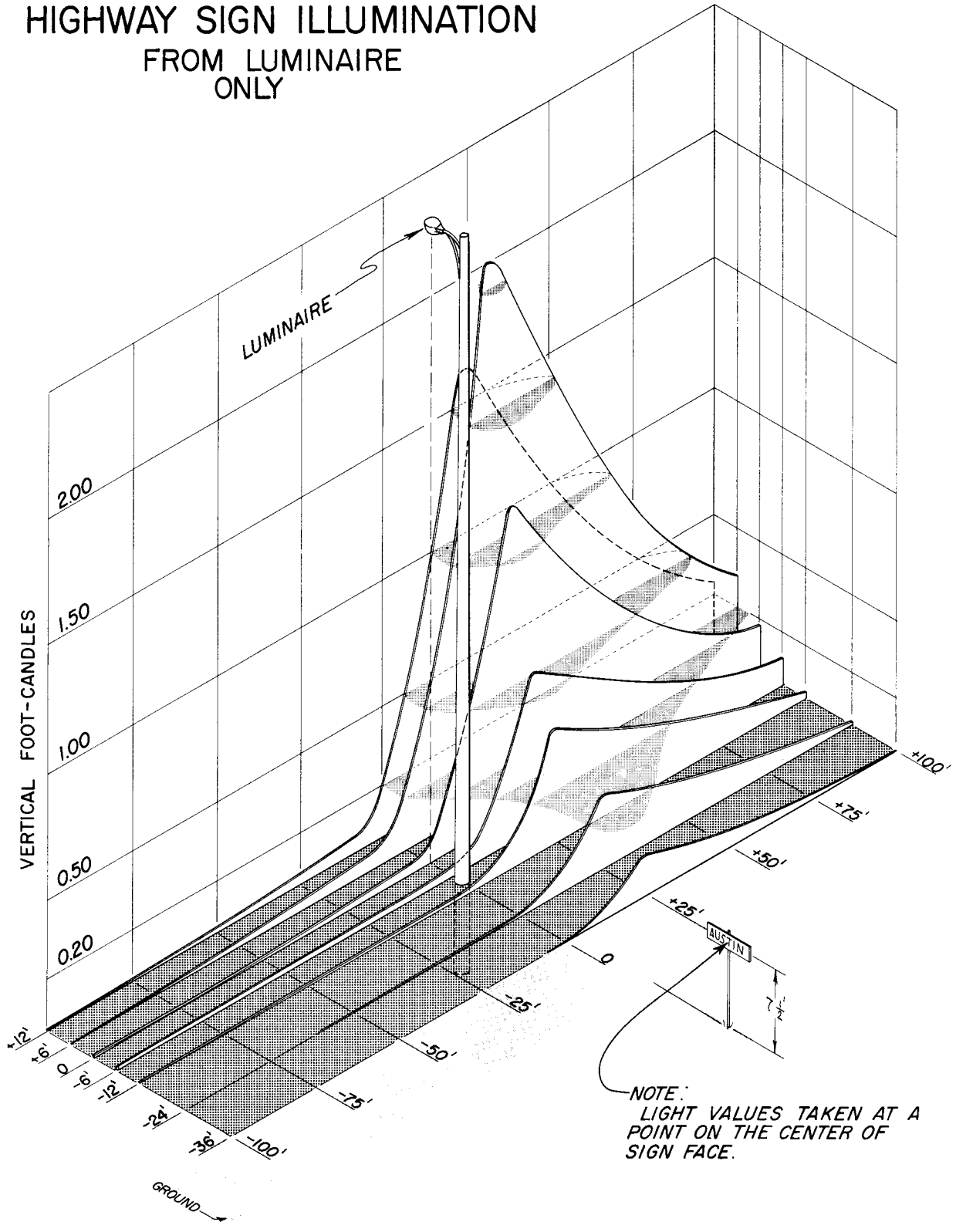
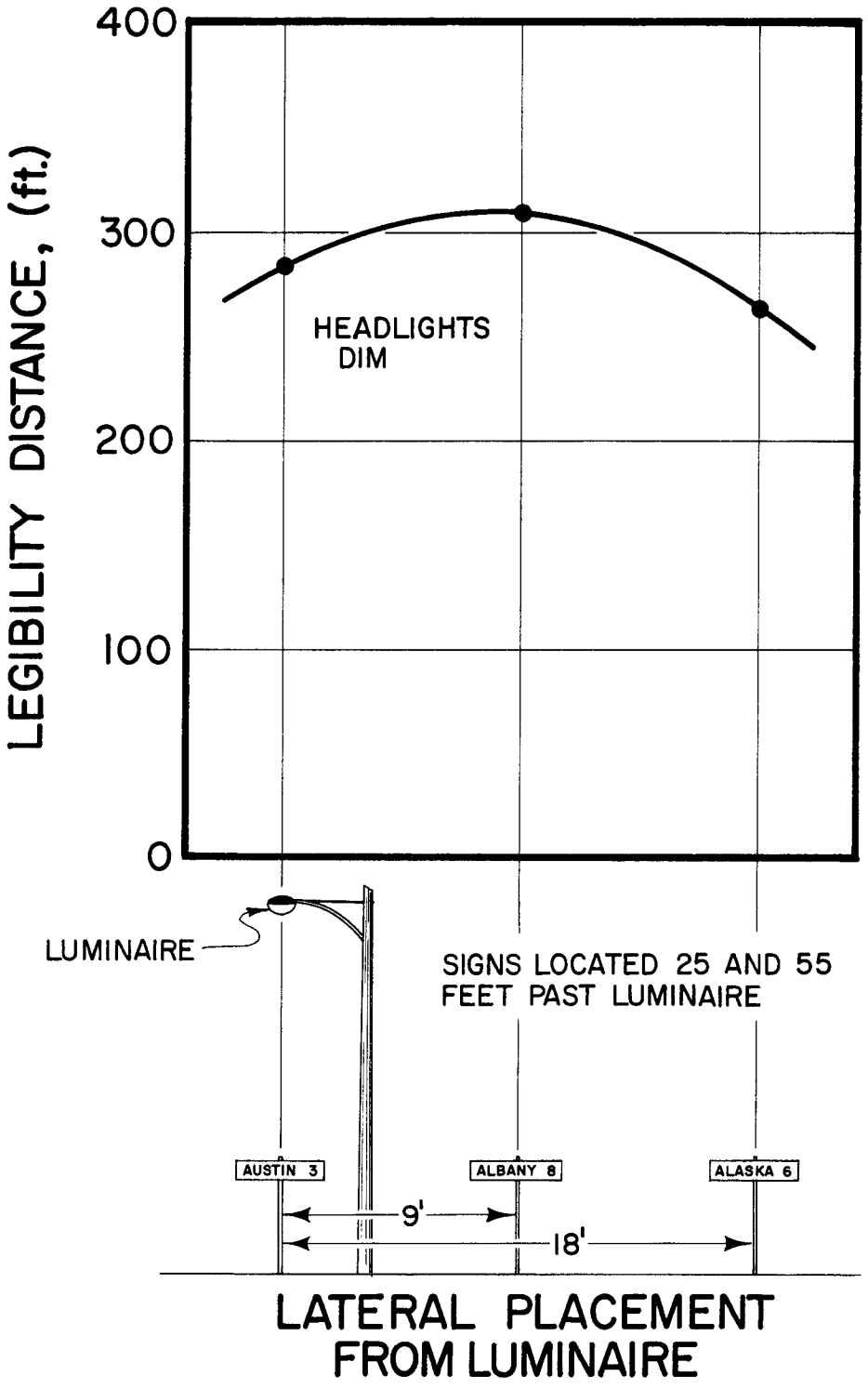


FIGURE 4

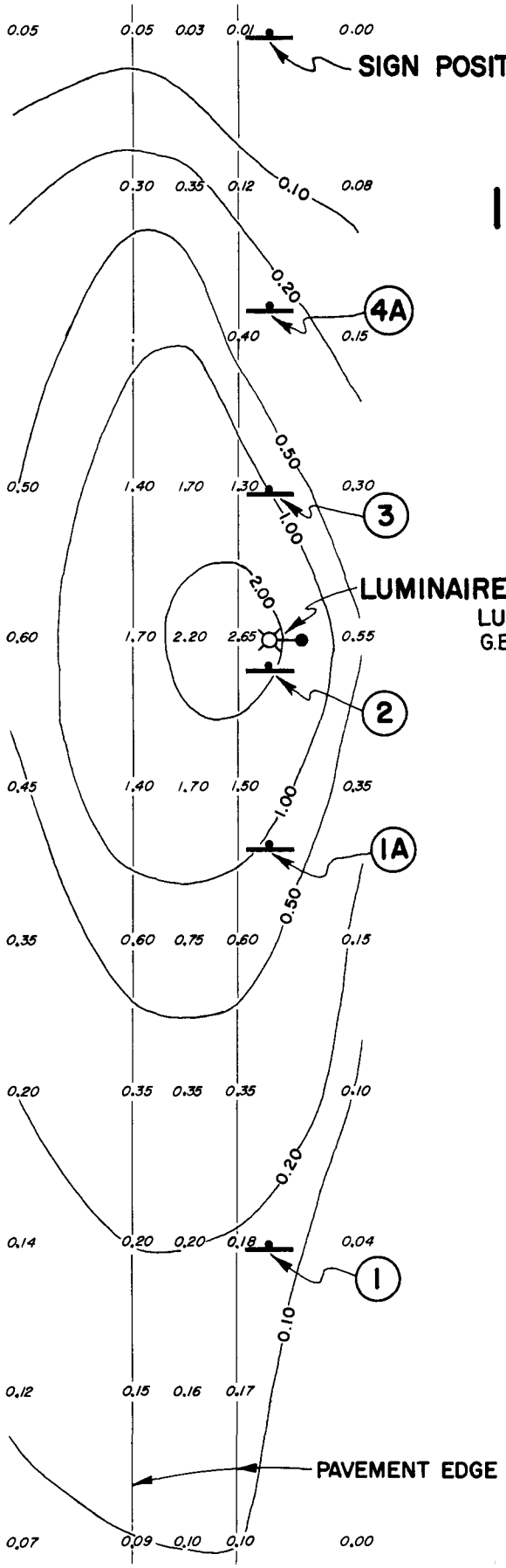
ROADSIDE SIGN LATERAL PLACEMENT VS. LEGIBILITY DISTANCE



APPENDIX

FIGURE 5

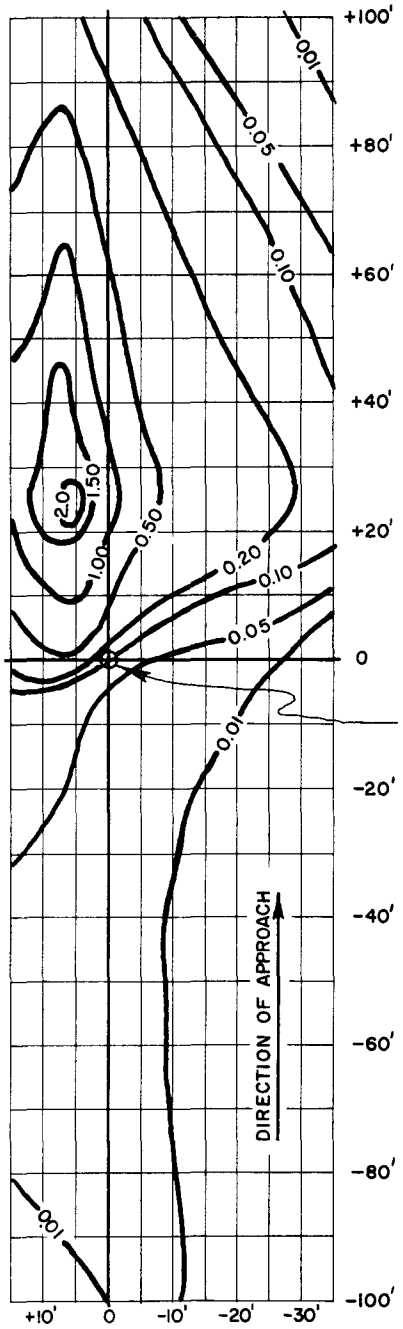
ISOLUX PATTERN OF LUMINAIRE USED FOR ROADSIDE SIGN TESTS



NOTE: ALL VALUES GIVEN IN FOOT-CANDLES AT ROAD SURFACE.

FIGURE 6

HIGHWAY SIGN ILLUMINATION
RELATED TO
LUMINAIRE POSITION



NOTE:
LIGHT VALUES, (VERTICAL FOOT-CANDLES), TAKEN ON CENTER OF SIGN FACE — 7.5 FEET ABOVE GROUND.

LUMINAIRE — MERCURY VAPOR TYPE III., G.E., 20,000 LUMENS, 30 FEET ABOVE GROUND, 400 WATT.

FIGURE 7

ROADSIDE SIGN LEGIBILITY VS. LUMINAIRE LOCATION