
Beaver

FLUORESCENT FIXTURES FOR OVERHEAD SIGN ILLUMINATION

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A Report on HPS Project 1(25)A to the
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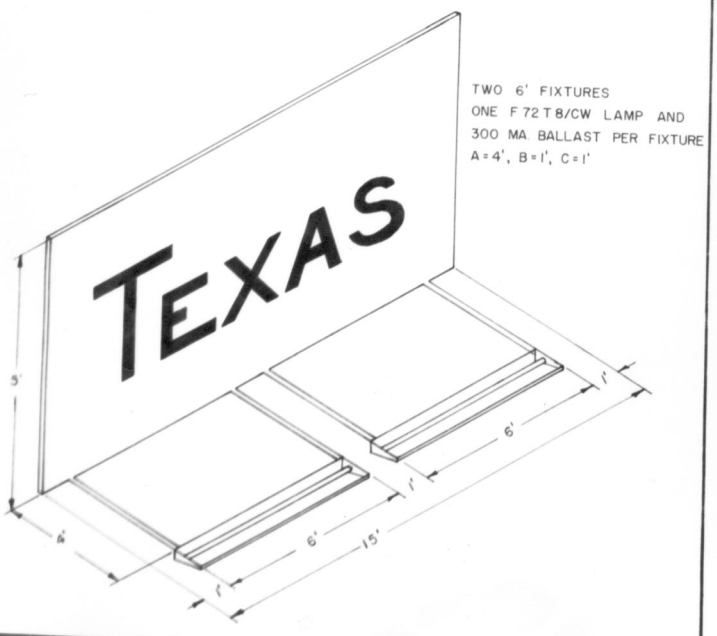
this report presents design information for fluorescent fixtures for overhead signs



TWO 6' FIXTURES
ONE F 72 T 8/CW LAMP AND
300 MA BALLAST PER FIXTURE
A = 4', B = 1', C = 1'

Fluorescent Fixtures for Overhead Sign Illumination

Introduction

Overhead signs are used on high type highways where it is necessary for the driver to make decisions and take action at high speeds. The Texas Highway Department has adopted the policy of illuminating all overhead signs with special fluorescent sign fixtures except at remote locations where power is not readily available. The Texas Transportation Institute, as a part of research project HPS 1(25)A, Intersection Illumination, sponsored by the Texas Highway Department and the Bureau of Public Roads conducted a study of fluorescent fixtures for overhead sign illumination. This report describes the results of this study. It contains the findings of the study and recommendations on the type and placement of fixtures, and lamps and ballasts recommended for signs of varying sizes.

The purpose of this study was to develop a set of charts to aid the designer, to compare the effectiveness of a special fixture and a typical commercial fixture, and to make appropriate recommendations.

The fixtures used in this study were the Standard Fixture adopted by the Texas Highway Department and developed by the California Division of Highways, and the General Electric "Fluoroflood" fixture. The first is referred to as the standard fixture and the latter as the commercial fixture in this report.

Illumination Standards

There are a number of requirements for the effective illumi-

nation of traffic signs. These are:

1. The brightness of the sign should be sufficient to stand out in contrast with its surroundings.
2. The brightness should be sufficiently uniform to provide equal legibility over the sign panel.
3. The illumination should not cause direct or objectionalbe reflected light to traffic approaching the sign.
4. The sign lighting fixture should not obstruct the reading of the sign at normal viewing distances.
5. The illumination unit should not produce daytime shadows reducing the legibility of the sign.
6. The equipment should require a minimum of maintenance and provide low annual operating costs.

The ability of a motorist to read an illuminated highway sign depends upon the amount of light reaching the sign (measured in foot candles), the reflective characteristics of the sign surface, and the environmental lighting located in the field of vision. It has been recommended that the optimum level of sign illumination for rural areas should range from an average illumination of 10 to 30 foot candles and from 20 to 100 foot candles in brightly lighted areas.* The Texas Highway Department has adopted a policy of illuminating overhead signs to an average of 30 foot candles. Design values developed in this report are based on the Texas Highway Department standard.

Within the average illumination requirements uniform lighting

*Report of Committee 7C on Sign Illumination Techniques, "Traffic Sign Illumination with External Fluorescent Fixtures", Institute of Traffic Engineers, Traffic Engineering, March 1960, pp 43-44.

over the face of the sign will provide maximum legibility and pleasing appearance. The illumination ratio is defined as the ratio of the maximum to the minimum illumination on the sign surface. A desirable ratio is 3 to 1 or less. A 5 to 1 ratio is considered the maximum allowable.* A 5 to 1 or less ratio was used as a standard in this study.

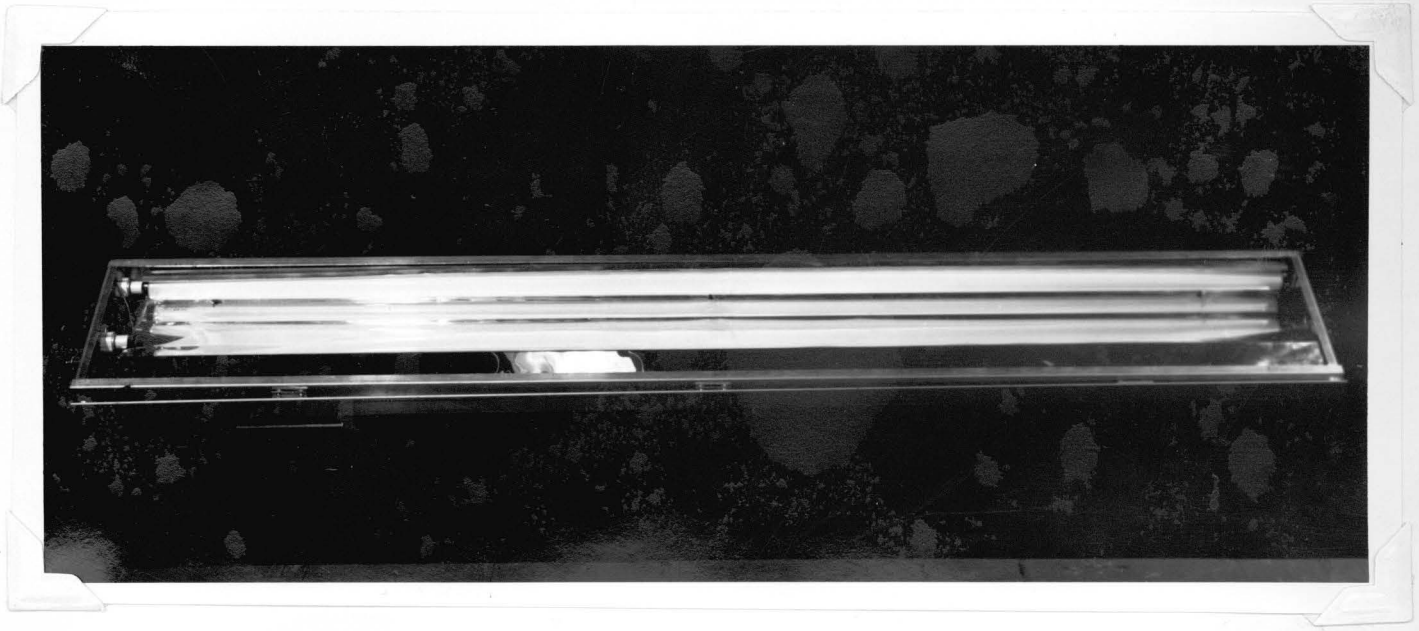
Bottom mounting of fixtures is recommended to eliminate daytime shadows on the sign face and to eliminate glare caused by a mirrored light source at night. This report develops design information for bottom mounted units.

The Study

There are several variables affecting the proper selection of a fluorescent sign fixture. The standard fixture is available in four foot and six foot lengths, and there are three different types of lamps and four different sized ballasts that can be used with it. The fixture can contain either one or two lamps. It can be tilted, and the distance from the sign and spacing between fixtures can be varied. The commercial fixture, a single lamp unit, is available in several lengths with different lamps and ballasts. This fixture can also be tilted with respect to the sign face. Figure 1 shows the standard and commercial fixtures used in this study.

Four lighting conditions for each fixture were used in the study. The standard fixture was also studied from angles other than the normal zero degree mounting (Fig. 2). Studies were made

*Report of Committee 7C on Sign Illumination Techniques, "Traffic Sign Illumination with External Fluorescent Fixtures", Institute of Traffic Engineers, Traffic Engineering, March 1960, pp 43-44.



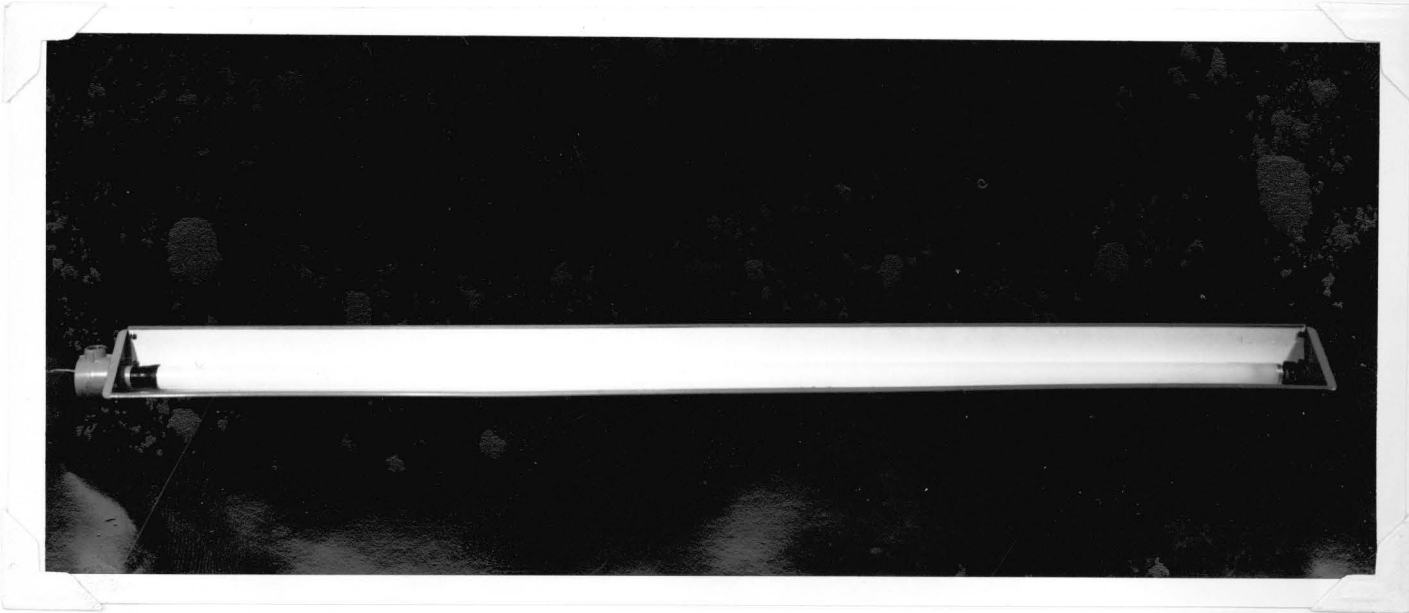
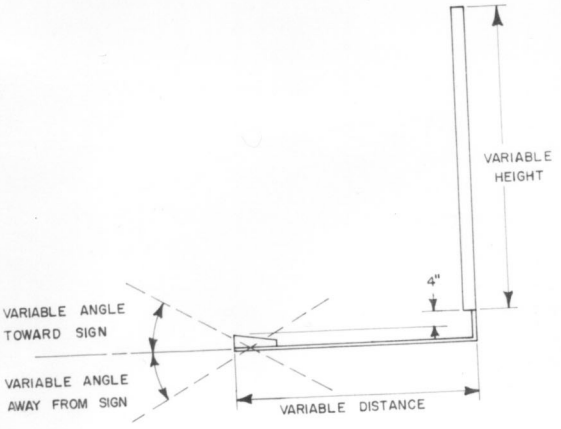
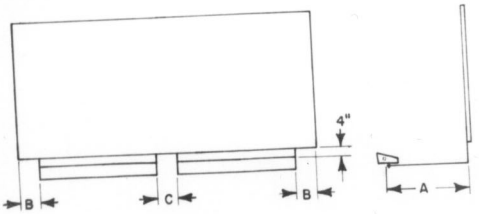


FIGURE 1





FIXTURE-SIGN RELATIONSHIP

FIGURE 4

of separation distances possible between fixtures and of proper location with respect to the sign and sign edge. The ballasts and lamps used in the study are shown in Table 1.

Test Procedure

The determination of photometric characteristics for the two fixtures was accomplished as follows. A suitable darkroom was used with the floor serving as the face of the sign. It was possible to test a maximum sign height of 15 feet. The fixtures were mounted on the wall with heights varying from 2 feet to 6 feet from the sign face. A one-foot grid was marked on the floor and suitably calibrated illumination meters used to obtain illumination readings. The illumination readings for each study were placed on a grid data sheet and illumination contours prepared as shown in Figure 3.

Results

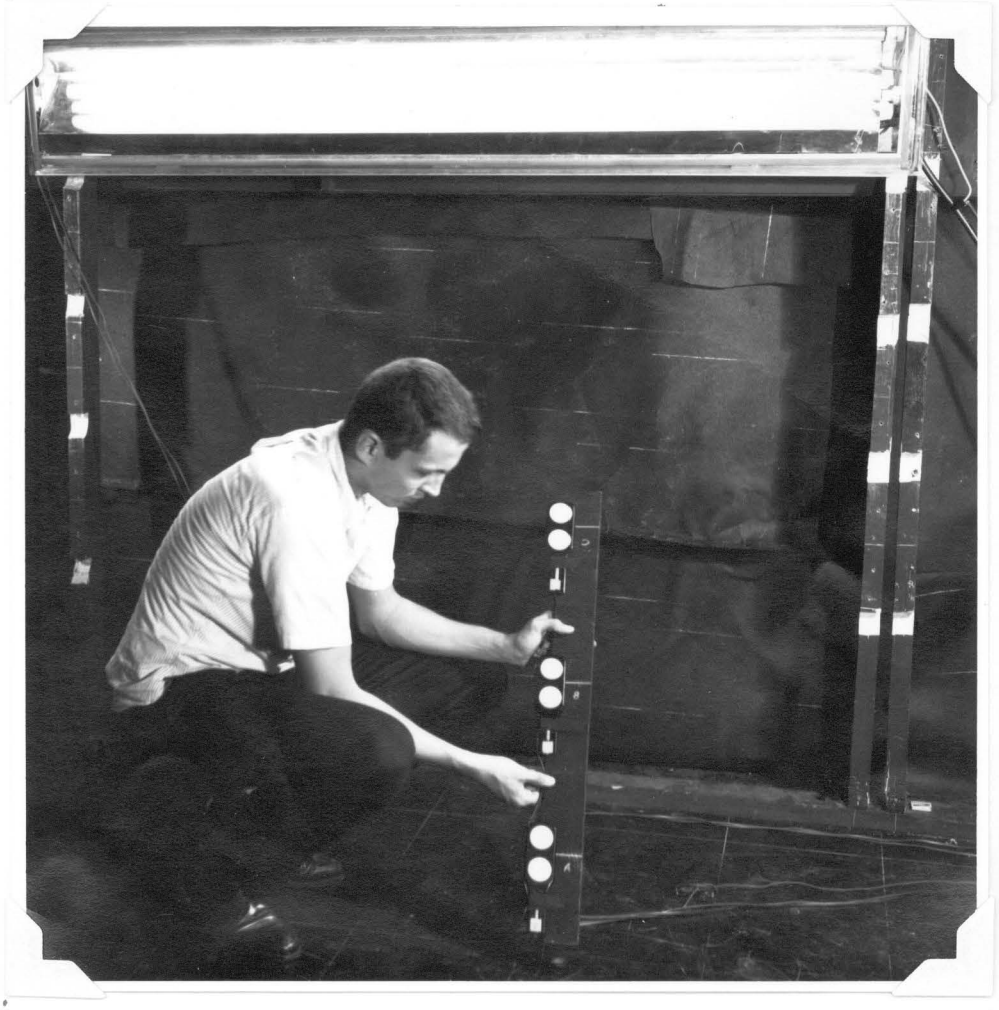
The study of the effect of tilt of the standard fixture on illumination shows two things. As the fixture is tilted toward the sign at increments of 5° the average sign illumination for fixtures mounted 3 feet to 4 feet from the sign increases 15 percent per 5° increase of tilt (Fig. 4-bottom). However, as the tilt is increased, the maximum height of sign that can be illuminated by the fixture is decreased from $\frac{1}{2}$ foot to 1 foot per 5° increase (Fig. 4-top). We therefore only considered the standard fixture at its normal position of 0° tilt.

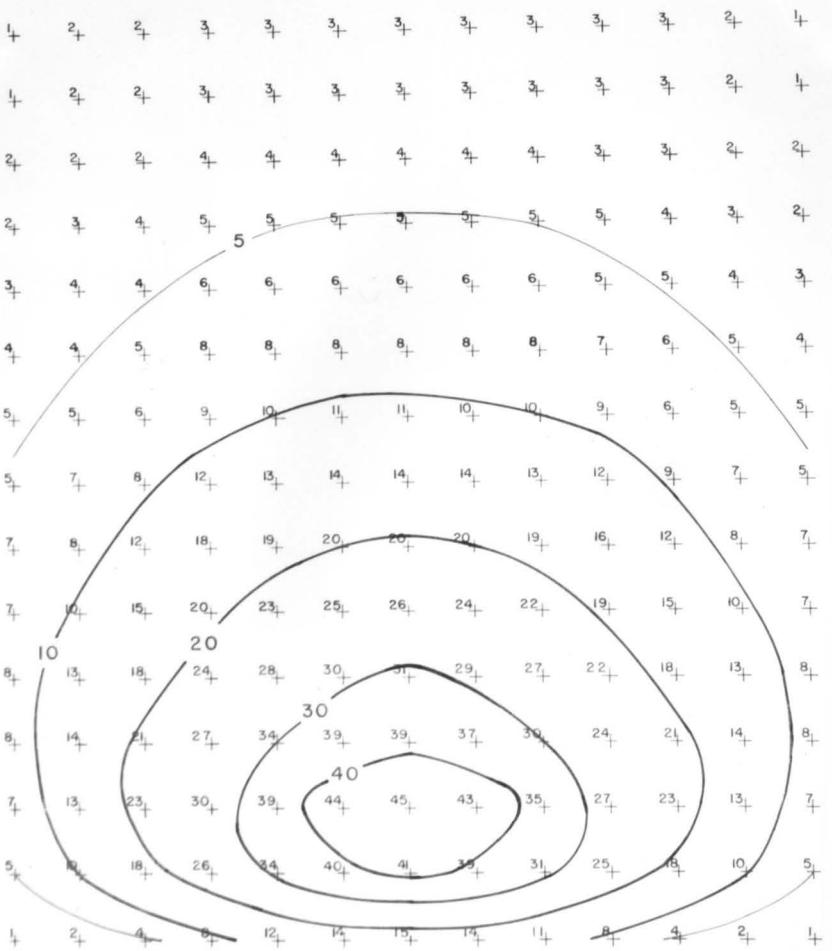
The separation study results in a chart listing the drop in average sign illumination per foot of separation (Fig. 5-top). It

Table 1

CONDITIONS TESTED

Standard Fixture				
No. of Fixtures	No. of Lamps	Tilt	Lamps	Ballast
1	1	none	F72T8/CW	300 ma
2	2	toward sign, 5°	F72T12/CW	425 ma
		10°	F72T12/CW/HO	800 ma
		away from sign, 5°	F72T12/CW/HO	1000 ma
Commercial Fixture				
1	1	22½°	F72T12/CW/HO	800 ma
2		45 °	F72T12/CW/HO	1000 ma
			F72PG17	1500 ma

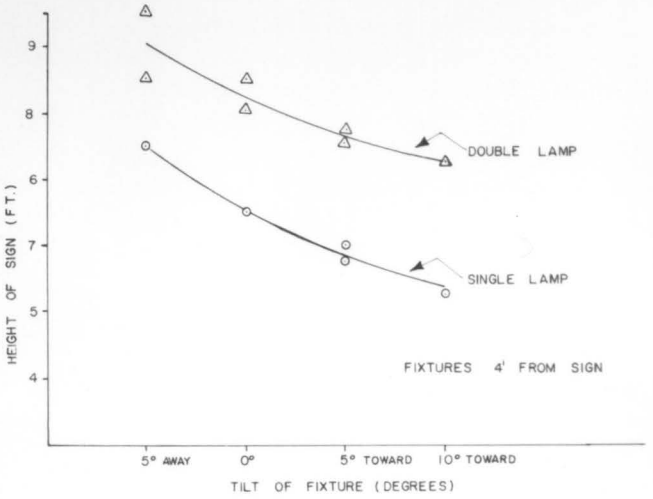




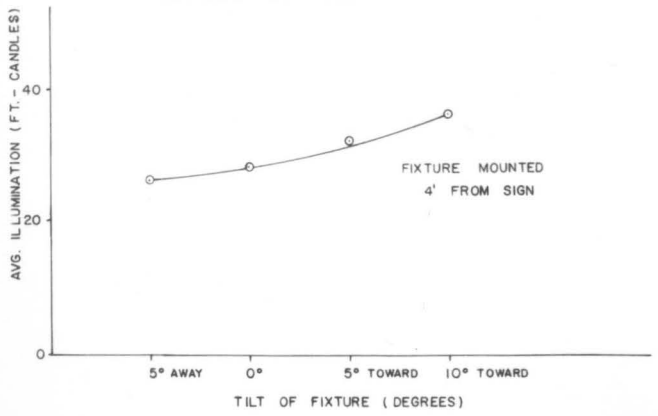
FIXTURE TYPE – STANDARD
LAMP TYPE – F72T12/C.W.
DISTANCE FROM SIGN – 4'
TILT OF FIXTURE – 0°
INVESTIGATOR – S.V.W.

NO. OF FIXTURES – 1 NO. OF LAMPS – 2
BALLAST – 425 M.A. BALLAST
BOTTOM OF SIGN IS 4" ABOVE FIXTURE
TEMPERATURE – 86.2°
DATE – 5/16/61

SAMPLE DATA
FIGURE 3



EFFECT OF TILT ON SIGN HEIGHT



EFFECT OF TILT ON AVERAGE ILLUMINATION

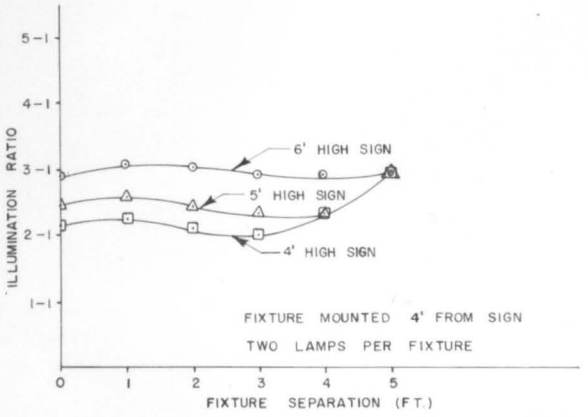
EFFECT OF TILT

FIGURE 4

NO. LAMPS PER FIXTURE	FIXTURE DISTANCE FROM SIGN	DROP IN AVERAGE ILLUMINATION (FT.– CANDLES) SEPARATION (FT.)				
		1	2	3	4	5
1 – LAMP	3'	1.5	2.5	3.5	4.5	6.0 *
2 – LAMPS	3'	2.0	4.5	6.5	8.5	10.0 **
1 – LAMP	4'	1.5	2.5	4.0	4.5 *	5.5 **
2 – LAMPS	4'	2.0	4.0	5.5	7.0 *	8.0 **
1 – LAMP	5'	0.5	1.5	2.5	3.5 **	4.5 ***
2 – LAMPS	5'	2.0	3.0	4.0	5.5 *	6.5 ***

NOTE: * – VALUE GOOD FOR 5' SIGN OR HIGHER
** – VALUE GOOD FOR 6' SIGN OR HIGHER
*** – VALUE GOOD FOR 7' SIGN OR HIGHER

THE EFFECT OF FIXTURE SEPARATION
ON AVERAGE ILLUMINATION



THE EFFECT OF FIXTURE SEPARATION
ON ILLUMINATION RATIO

THE EFFECT OF FIXTURE SEPARATION

FIGURE 5

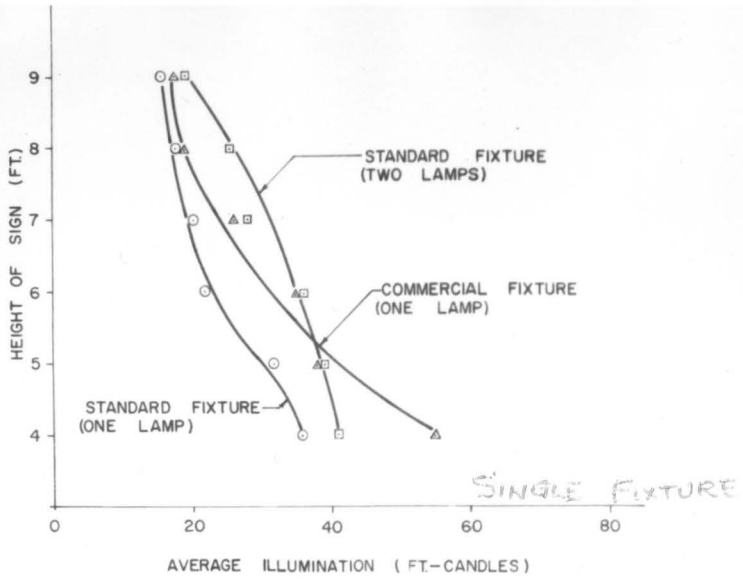
is found that the illumination ratio is constant or lowered slightly as the separation is increased (Fig. 5-bottom), and the ultimate separation is determined when the ratio begins to rise sharply.

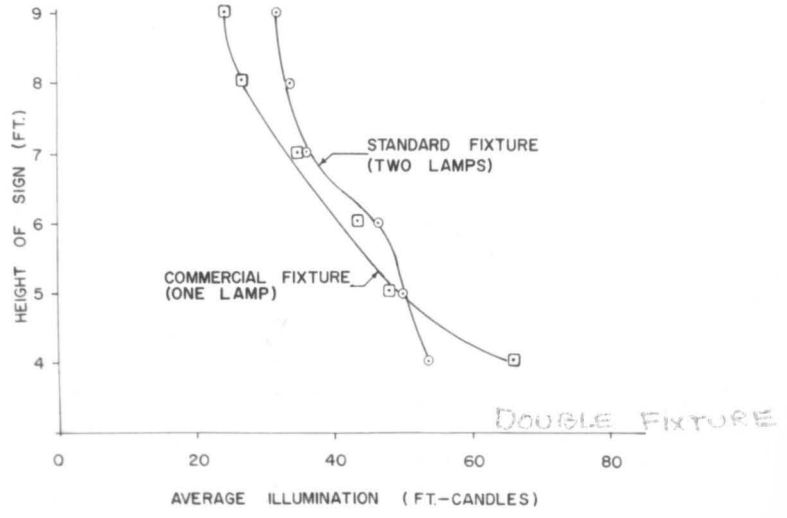
For an average illumination of 30 foot candles the standard fixture can illuminate sufficiently a 9 foot high sign where the commercial fixture is only able to reach 8 feet (Fig. 6). The maximum average illumination that can be produced by either fixture with a 5 to 1 maximum illumination ratio is compared and it is found that the standard fixture gives lower results for a 4 foot high sign and higher results for all signs higher than 4 feet (Fig. 6).

For a basis of design, charts were developed for the standard fixture for sign dimensions ranging from 4 feet to 9 feet in height (9 feet was the highest sign that could be illuminated with a 30 foot candle average illumination and a 5 to 1 illumination ratio) and 6 feet to 15 feet in width. These dimensions should include most of the signs used for overhead signing. The chart contains two possible selections of type of fixture, number and type of lamp, and the size of ballast needed for each sign dimension (Tables 2-7).

Example

If a designer wishes to determine the appropriate illumination design for an overhead sign 5 feet high and 15 feet wide, referring to Table 3 for a 5 foot sign, he would find that he would use two 6 foot fixtures with one F72T8/CW lamp in each fixture and two 300 ma ballasts. The fixtures are 4 feet from the face of the





AVERAGE SIGN ILLUMINATION

VS.

HEIGHT OF SIGN

FIGURE 6

Table 2

RECOMMENDED OVERHEAD SIGN ILLUMINATION
4 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	1	6'	1	F72T8/CW	300 ma	3'			1	4'	1	F48T12/CW	425 ma	3'	1'	
7	1	6'	1	F72T12/CW	425 ma	3'	6"		1	6'	2	F72T8/CW	300 ma	4'	6"	
8	1	6'	1	F72T12/CW	425 ma	3'	1'		2	4'	1	F48T12/CW	425 ma	3'		
9	2	4'	1	F48T12/CW	425 ma	3'		1'	2	4'	1	F48T12/CW	425 ma	4'		1'
10	2	4'	1	F48T12/CW	425 ma	3'		2'	1	6'	1	F72T12/CW	425 ma	3'		
									1	4'	1	F48T12/CW	425 ma			
11	2	4'	1	F48T12/CW	425 ma	3'		3'	1	6'	1	F72T12/CW	425 ma	3'		1'
									1	4'	1	F48T12/CW	425 ma			
12	2	6'	1	F72T8/CW	300 ma	3'			1	6'	1	F72T12/CW	425 ma	3'		2'
									1	4'	1	F48T12/CW	425 ma			
13	2	6'	1	F72T8/CW	300 ma	3'		1'	1	6'	1	F72T12/CW	425 ma	3'		3'
									1	4'	1	F48T12/CW	425 ma			
14	2	6'	1	F72T8/CW	300 ma	3'		2'	1	6'	1	F72T12/CW	425 ma	3'		4'
									1	4'	1	F48T12/CW	425 ma			
15	2	6'	1	F72T8/CW	300 ma	3'		3'	3	4'	1	F48T12/CW	425 ma	3'		1½'

Table 3

RECOMMENDED OVERHEAD SIGN ILLUMINATION
5 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	1	6'	1	F72T12/CW	425 ma	3'			1	4'	2	F48T12/CW	425 ma	3'	1'	
7	1	6'	2	F72T8/CW	300 ma	3'	6"		1	6'	2	F72T12/CW	425 ma	4'	6"	
8	1	6'	2	F72T8/CW	300 ma	3'	1'		1	6'	2	F72T12/CW	425 ma	3'	1'	
9	2	4'	1	F48T12/CW	425 ma	3'		1'	2	4'	1	F48T12/CW	425 ma	3'		1'
10	2	4'	1	F48T12/CW	425 ma	3'	1'		1	6'	1	F72T12/CW	425 ma	3'		
									1	4'	1	F48T12/CW				
11	2	4'	1	F48T12/CW	425 ma	4'	1'	1'	1	6'	1	F72T12/CW	425 ma	3'		1'
									1	4'	1	F48T12/CW				
12	2	6'	1	F72T8/CW	300 ma	3'			1	6'	1	F72T12/CW	425 ma	3'	1'	
									1	4'	1	F48T12/CW				
13	2	6'	1	F72T8/CW	300 ma	3'		1'	1	6'	1	F72T12/CW	425 ma	4'	1'	1'
									1	4'	1	F48T12/CW				
14	2	6'	1	F72T8/CW	300 ma	3'		1'	2	6'	1	F72T12/CW	425 ma	3'		4'
15	2	6'	1	F72T8/CW	300 ma	4'	1'	1'	3	4'	1	F48T12/CW	425 ma	3'		1½'

Table 4

RECOMMENDED OVERHEAD SIGN ILLUMINATION
6 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	1	6'	2	F72T8/CW	300 ma	3'			1	6'	2	F72T12/CW	425 ma	3'		
7	1	6'	2	F72T8/CW	300 ma	3'	6"		1	6'	2	F72T12/CW	425 ma	3'	6"	
8	1	6'	2	F72T8/CW	300 ma	3'	1'		1	6'	2	F48T12/CW	425 ma	3'	1'	
9	2	4'	2	F48T12/CW	425 ma	4'	6"		2	4'	2	F48T12/CW	425 ma	4'	6"	
10	2	4'	2	F48T12/CW	425 ma	4'	1'	1'	1	6'	2	F72T12/CW	425 ma	4'		
									1	4'	2	F48T12/CW				
11	2	4'	2	F48T12/CW	425 ma	4'	1'	1½'	1	6'	2	F72T12/CW	425 ma	4'	6"	
									1	4'	2	F48T12/CW				
12	2	6'	2	F72T8/CW	300 ma	4'			1	6'	2	F72T12/CW	425 ma	4'	1'	
									1	4'	2	F48T12/CW				
13	2	6'	2	F72T8/CW	300 ma	4'	6"		1	6'	2	F72T12/CW	425 ma	3'		3'
									1	4'	2	F48T12/CW				
14	2	6'	2	F72T8/CW	300 ma	4'	1'		2	6'	2	F72T8/CW	300 ma	3'		2'
15	2	6'	2	F72T8/CW	300 ma	3'		3'	2	6'	2	F72T12/CW	425 ma	4'	1'	1'

Table 5

RECOMMENDED OVERHEAD SIGN ILLUMINATION
7 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	1	6'	2	F72T12/CW/HO	800 ma	4'			1	6'	2	F72T12/CW/HO	1000 ma	4'		
7	1	6'	2	F72T12/CW/HO	1000 ma	4'	6"		2	4'	2	F48T12/CW	425 ma	4'		
8	2	4'	2	F48T12/CW	425 ma	4'			2	4'	2	F48T12/CW	425 ma	4'		
9	2	4'	2	F48T12/CW	425 ma	4'	6"		2	4'	2	F48T12/CW	425 ma	4'	6"	
10	2	4'	2	F48T12/CW	425 ma	4'	1'		1	6'	2	F12T12/CW	425 ma	4'		
									1	4'	2	F48T12/CW				
11	1	6'	2	F72T12/CW	425 ma	4'	6"		1	6'	2	F72T12/CW	425 ma	4'	6"	
	1	4'	2	F48T12/CW					1	4'	2	F48T12/CW				
12	2	6'	2	F72T8/CW	300 ma	4'			1	6'	2	F72T12/CW	425 ma	4'	1'	
									1	4'	2	F48T12/CW				
13	2	6'	2	F72T8/CW	300 ma	4'	6"		2	6'	2	F72T12/CW	425 ma	4'	6"	
14	2	6'	2	F72T12/CW	425 ma	4'	1'		2	6'	2	72T12/HO/CW	800 ma	4'	1'	
15	2	6'	2	F72T12/CW/HO	800 ma	4'	1'	1'	2	6'	2	F72T12/CW/HO	1000 ma	4'	1'	1'

Table 6

RECOMMENDED OVERHEAD SIGN ILLUMINATION
8 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	2	4'	2	F48T12/CW	425 ma	4'										
7	2	4'	2	F48T12/CW	425 ma	4'										
8	2	4'	2	F48T12/CW	425 ma	4'			2	4'	2	F48T12/CW/HO	800 ma	4'		
9	2	4'	2	F48T12/CW	425 ma	4'	6"		2	4'	2	F48T12/CW/HO	800 ma	4'	6"	
10	2	4'	2	F48T12/CW	425 ma	4'	1'		1	6'	2	F72T12/CW	425 ma	4'		
									1	4'	2	F48T12/CW				
11	1	6'	2	F72T12/CW	425 ma	4'	6"		1	6'	2	F72T12/CW/HO	800 ma	4'	6"	
	1	4'	2	F48T12/CW					1	4'	2	F48T12/CW/HO				
12	2	6'	2	F72T8/CW	300 ma	4'			1	6'	2	F72T12/CW	425 ma	4'	1'	
									1	4'	2	F48T12/CW				
13	2	6'	2	F72T12/CW	425 ma	4'	6"		2	6'	2	F72T12/CW/HO	800 ma	4'	6"	
14	2	6'	2	F72T12/CW	425 ma	4'	1'		2	6'	2	F72T12/CW/HO	800 ma	4'	1'	
15	2	6'	2	F72T12/CW/HO	800 ma	4'	1'	1'	2	6'	2	F72T12/CW/HO	1000 ma	4'	1'	1'

Table 7

RECOMMENDED OVERHEAD SIGN ILLUMINATION
9 FOOT SIGNS

Width of Sign (Feet)	First Choice								Second Choice							
	Fixture		Lamp		Ballast	Placement			Fixture		Lamp		Ballast	Placement		
	No.	Length	No.	Type		A	B	C	No.	Length	No.	Type		A	B	C
6	2	4'	2	F48T12/CW	425 ma	4'										
7	2	4'	2	F48T12/CW	425 ma	4'										
8	2	4'	2	F48T12/CW	425 ma	4'			2	4'	2	F48T12/CW/HO	800 ma	4'		
9	2	4'	2	F48T12/CW/HO	800 ma	4'		1'	2	4'	2	F48T12/CW/HO	1000 ma	4'		1'
10	1	6'	2	F72T12/CW	425 ma	4'			1	6'	2	F72T12/CW/HO	800 ma	4'		
	1	4'	2	F48T12/CW					1	4'	2	F48T12/CW/HO				
11	1	6'	2	F72T12/CW/HO	800 ma	4'		1'	1	6'	2	F72T12/CW/HO	1000 ma	4'		1'
	1	4'	2	F48T12/CW/HO					1	4'	2	F48T12/CW/HO				
12	2	6'	2	F72T12/CW	425 ma	4'			2	6'	2	F72T12/CW/HO	800 ma	4'		
13	2	6'	2	F72T12/CW/HO	800 ma	4'		1'	2	6'	2	F72T12/CW/HO	1000 ma	4'		1'
14	2	6'	2	F72T12/CW/HO	1000 ma	4'		2'	3	4'	2	F72T12/CW/HO	800 ma	4'		1'
15	3	4'	2	F48T12/CW/HO	1000 ma	4'		1½'	1	6'	2	F72T12/CW/HO	800 ma	4'		6"
									2	4'	2	F48T12/CW/HO				

sign (A), 1 foot apart (B), and are 1 foot from the end of the sign (C), as a first choice. As a second choice, use three 4 foot fixtures with 1 F48T12/CW lamp in each fixture and three 300 ma ballasts. The fixtures are $1\frac{1}{2}$ feet apart with the outside fixtures coming to the end of the sign and the fixture is 3 feet from the sign. This example is shown on the frontispiece.

Conclusions

1. The standard fluorescent sign lighting units are most effective at distances from the sign ranging from 40 percent to 60 percent of the sign height.

2. The use of F72T8/CW, F72T12/CW, F72T12/CW/HO, F48T12/CW and F48T12/CW/HO lamps is appropriate to illuminate signs efficiently.

3. Fixtures with two lamps are required for all signs more than 5 feet high.

4. Two fixtures are needed when sign height exceeds 7 feet.

5. The maximum height sign which can be illuminated from below with standard fixtures to an average of 30 foot candles with a maximum illumination ratio of 5 to 1 is 9 feet.

6. A maximum inter-fixture spacing is 5 feet.

7. An efficient end spacing of fixtures is 1 foot.

8. On the basis of average sign illumination only, the standard fixture gives a higher average illumination than the commercial fixture for all signs greater than 4 feet high and adequately illuminates 9 foot high signs to the 30 foot candle design level. The commercial fixture will only illuminate an 8 foot sign.

9. For practical purposes the standard fixture gives as satisfactory a lighting pattern at no tilt as it would at any other angle.

Recommendation

It is recommended that a study be made at new installations to evaluate the effect of environmental lighting conditions on the average illumination needed on the sign. It is believed that average illumination other than 30 foot candles may be appropriate in certain areas depending upon surrounding light and glare.