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STUDY ON THE RELATIONSHIP BETWEEN VISIBILITY DISTANCE AND RETROREFLECTION OF CHEVRON SIGN

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ABSTRACT

Chevron sign is the visual guidance system to be installed at the location with poor sight distance to help the drivers clearly recognize the road alignment and curve day and night for safe driving. Thus should retroreflection performance of chevron sign fail to meet the requirements on foggy road, it's not able to provide the drivers with the information on alignment ahead. This paper hence is intended to analyze the retroreflection performance depending on visible distance at foggy condition. Consequently, the shorter the visible distance in foggy weather the less the retroreflection performance of chevron sign. Particularly it failed to satisfy the performance requirement when visible distance was 271m or less.

Keywords*: Chevron sign, Retroreflection, Illumination*

I. INTRODUCTION

Background And Goal Of The Study

The road is linked by combination of horizontal alignment and vertical alignment continuously and horizontal alignment comprises of the straight line, circular curve and transition curve to allow the vehicles to run at design speed. Particularly, the section combined by horizontal alignment and vertical downward slope is dangerous section requiring safety facilities to mind the drivers of the danger.

One of the typical facilities to enhance the running safety on curve is chevron sign which shall be provided to sharp horizontal curve or poor sight distance according to the Article 3 of the Road Act so as to help the driver recognize the alignment and curve ahead day and night as the visual guidance device [1]

But deviation from the road stiff occurs frequently which leads to fatal accident when the visibility is limited by fog. Should retroreflection performance of chevron sign fail to meet the requirements on foggy road, it's not able to provide the drivers with the information on alignment ahead, causing the accident. This paper hence is intended to analyze the retroreflection performance depending on visible distance at foggy condition.

II. INSTALLATION OF CHEVRON SIGN AND MEASURING GUIDLINE

Guideline For Installing Chevron Sign

According to Guideline for installation and management of road safety facility (MOLIT, 2008), chevron sign is the road appurtenance in the article 3 of Road Act and shall be installed on sharp horizontal curve or at the location with poor sight distance. And chevron sign is the visual guidance system to help the drivers clearly recognize the road alignment and curve day and night for safe driving. Installation of chevron sign is determined depending on horizontal curve radius and the standard size of the sign shall be 45cm x 60cm. The ground color of the sign shall be yellow and the sign shall be in black to be distinguishable and reflective performance shall be 470cd/(lx m3) to observation angle 0.2° and incidence angle -4° [1]

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Method Of Reflective Performance Test

The ground color of the sign shall be yellow and the sign shall be in black make it distinguishable by color combination. Chromaticity of reflector used for chevron sign shall be measur3ed according to KSA 3507 and 172,000lx LED lighting was used as light source.

Figure 1 shows the measurement of retoreflection of chevron sign. Reflective performance of the reflector shall be as Table 1 requiring 470cd/(lx m3) to observation angle 0.2° and incidence angle -4° [2]

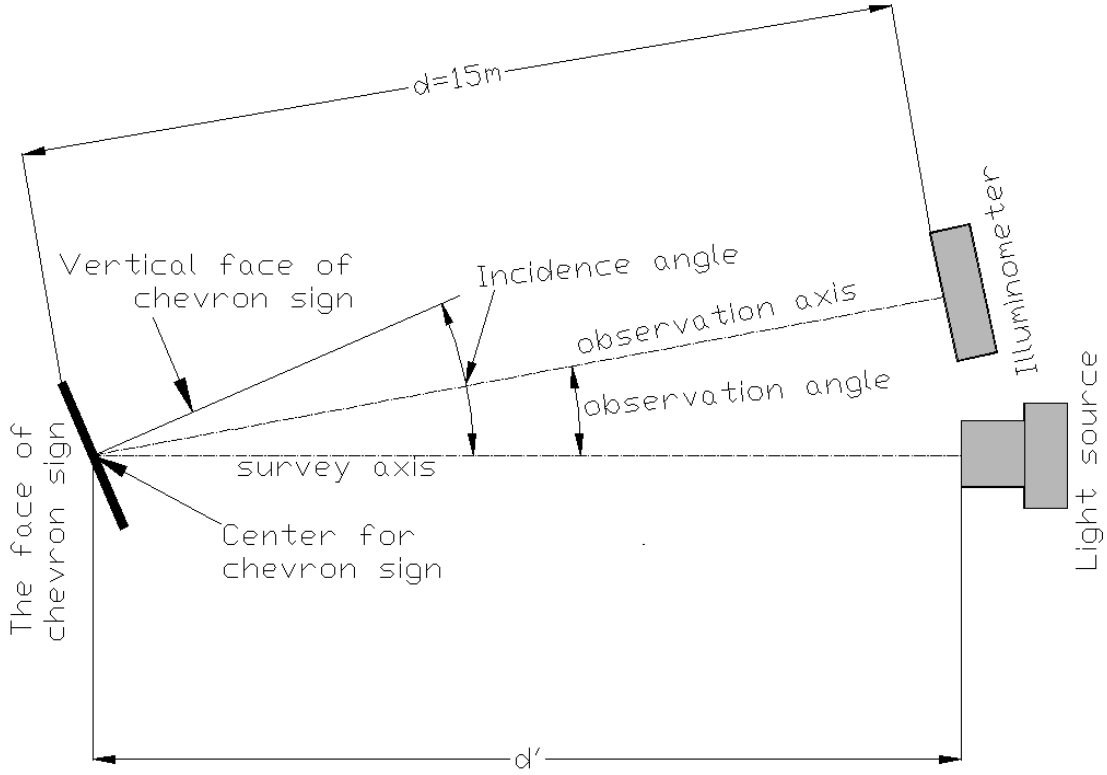

Figure 1 measurement of retroreflection of chevron sign

$R' = \frac{I}{E_s \cdot A}$

R' = Coefficient of retroreflection(cd/(lx · ㎡))

E_s= Illumination at the center of chevron sign (lx)

A= Area id chevron sign (㎡)

I= Light intensity at observation point (cd)

$I = E_r \cdot d^2$

E_r= Illuminance at observation point (lx)

d= Distance between observation points (m)

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Table 1 Retroflective performance

Observation angle	Observation angle	Retroreflective performance (cd/(lx m^3)
0.2°	-4°	470

III. EVALUATION OF VHEVRON SIGN IN FOGGY CONDITION

Table 2 shows the measuring result of retroreflector indicating that the shorter the visibility the less the illumination at observation point and greater the illumination at the center of chevron sign (Es)Such result indicated that the fog reduces the scattering and penetration, influencing on illumination.

Fig 1 shows the retroreflection coefficient depending on sight distance. Retroreflection coefficient without fog was 610cd/(lx m3) while the requirement was 470cd/(lx m3), indicating the superior performance. But when sight distance is reduced, retroreflection coefficient was reduced accordingly.

As a result of regression analysis, it failed to meet the requirement 470cd/(lx m3) when sight distance is 271m or less. Thus as seen above, the performance is not satisfactory on foggy road which leads to the failure of visual guidance on curve and thus the accident risk is heightened.

Table 2 Test results

Sight distance(m)	E_r(lx)	E_s(lx)	d(m)	A(㎡)	Retroreflection coefficient [cd/(lx·㎡)]	Reduction
2,000 (Normal)	4.1	5.6	225	0.27	610.1	0.0%
300	3.7	5.8	225	0.27	531.6	12.9%
290	3.7	5.9	225	0.27	522.6	14.3%
280	3.7	6.2	225	0.27	497.3	18.5%
270	3.7	6.3	225	0.27	489.4	19.8%
260	3.6	6.6	225	0.27	454.5	25.5%
250	3.6	7.1	225	0.27	422.5	30.7%
240	3.5	7.2	225	0.27	405.1	33.6%
230	3.5	7.4	225	0.27	394.1	35.4%
220	3.5	8.2	225	0.27	355.7	41.7%
200	3.4	9.1	225	0.27	311.4	49.0%
190	3.4	9.3	225	0.27	304.7	50.1%
180	3.4	9.0	225	0.27	314.8	48.4%
170	3.3	9.2	225	0.27	298.9	51.0%
160	3.2	9.6	225	0.27	277.8	54.5%
150	3.2	10.3	225	0.27	258.9	57.6%
140	3.2	11.1	225	0.27	240.2	60.6%
130	3.1	12.0	225	0.27	215.3	64.7%
120	3.1	12.0	225	0.27	215.3	64.7%
110	3.0	13.0	225	0.27	192.3	68.5%
100	2.9	14.3	225	0.27	169.0	72.3%

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90	2.7	14.0	225	0.27	160.7	73.7%
80	2.6	16.5	225	0.27	131.3	78.5%
70	2.5	18.4	225	0.27	113.2	81.4%
60	2.3	19.0	225	0.27	100.9	83.5%
50	2.1	20.8	225	0.27	84.1	86.2%
40	1.9	22.3	225	0.27	71.0	88.4%
30	1.7	25.7	225	0.27	55.1	91.0%
20	1.3	29.5	225	0.27	36.7	94.0%

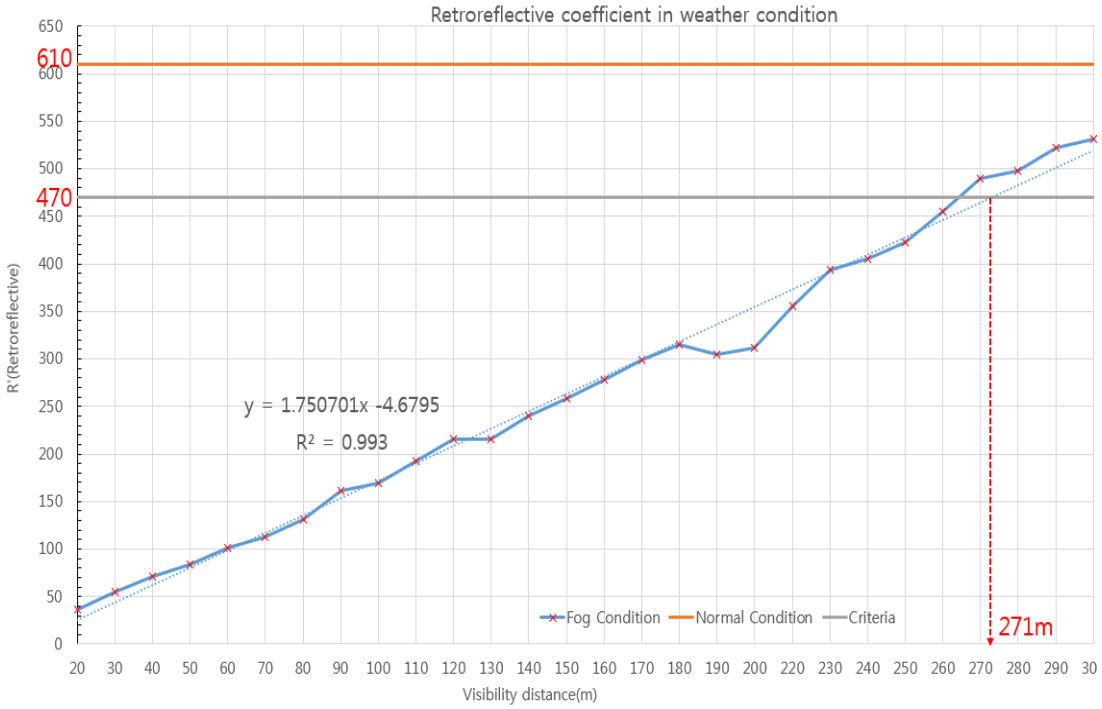

Figure 2 Retroreflection coefficient in foggy condition

IV. CONCLUSION AND FUTURE STUDY

This study is intended to analyze the reduction in retroreflective performance of chevron sign depending on fog density (sight distance or visibility) Consequently, retroreflection coefficient without fog was 610cd/(lx m3) which exceeds the requirement of reflector. But when the sight distance is reduced due in foggy condition, retroreflection coefficient was also reduced accordingly and as a result of regression analysis, it failed to meet the requirement when sight distance is 271m or less.

Recognizing the limit of retroreflective alignment guidance system on curve, preventive safety system to prevent the speeding vehicle from deviating or collision on curve shall be provided at the entrance to curve together with the road lighting that will help secure the visibility in inclement weather.

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