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# Visibility of Signs Functioning as Urban Disaster Prevention under the Jurisdiction of Administration - Field Survey on Higashiyama, Kyoto -

Yuki AKIZUKI*, Takeyoshi TANAKA, Michiko IWATA**

* COE Researcher, DPRI, Kyoto University
** Faculty of Engineering, Setsunan University, Japan

**Synopsis**

Based upon the field survey we conducted in Kyoto City, this paper examines the current situation and problems of signs functioning as urban disaster prevention under the jurisdiction of local government. Despite some important improvements, the signs are still poorly designed with regard to visibility, especially in the case of the leading signs to refuge. The signs do not have enough visibility especially in nighttime and electricity outage situations, and for the vulnerable persons such as foreign stranger and the aged. It is our proposal to review of signs' design, and to reorganize planning and management system within local government.

**Keywords**: Text Information, Sign under the jurisdiction of administration, Visibility Model, Evacuation Route, Stranger, Aged

## 1. Introduction

Contemporary urban life is increasingly vulnerable against disaster. There are three reasons for the city's vulnerability:

(1) Increasingly complex urban structure, congestion, and multistory buildings.
(2) More travelers across the city border.
(3) Advent of the super-aging society.

Under such circumstance, tools to assist to evacuate on one's own judgment are called for in the event of a disaster.

Generally, evacuation takes the following three steps. First, we try to understand the present location, assess the situation and decide whether to evacuate or stay. Next, we seek for safe area for refuge (Emergency Exit etc.). Finally, we evacuate once we find the routes for safer places. Text Information is crucial to these processes.

There are three kinds of signs useful for understanding the present location and evacuation route (the sign hereafter). The first is "Name of Place" sign to make people comprehend the present location like Emergency Exit Sign. The second is "Location Map" sign to guide those seeking for escape routes. The third is "Directional Route" sign for leading to the refuge area. In order for Text Information to function for evacuation properly, we need to ensure signs' visibility. For the visibility of Text Information, we have to consider not only sign's design but also affecting factors of environmental conditions surrounding signs.

In Japan, among these signs, only the Emergency Exit Sign has legal foundation (the Fire Services Act) to demand building owners and/or managers proper maintenance and installation management. For other types of signs, there is no such law, so there can be different degrees regarding implementation of administration or maintenance, which can limit the function of the signs (e.g. weatherworn signs lead to lower visibility, private parties put the signs as they please, eventually causing ineffective placement of the signs). For instance, we conducted a separate survey of leading signs to the refuges in Takayama City, Gifu Prefecture. Among the fourteen sample signs, these are left without any maintenance for more than eight years, and luminance contrast of eight signs drops to lower than 0.5 due to the deterioration by weathering. Ten out of the fourteen signs are inadequately placed (e.g. covered or absorbed by trees, plants, and other surroundings) because there is no direction issued by the City Government.

If a governmental authority is to administer these signs, the responsibility is clear so visibility expected to be more secured. Also, it enables effective placement and maintenance, so we can expect more effective guidance for the disaster-vulnerable people like sightseeing visitors, and more generally, higher degree of preparedness for disaster in the urban space.

This paper examines the actual conditions of the signs under the jurisdiction of city government, points out the current problems, and makes concrete proposal for improvement in a tourist-destination city. The case chosen is City of Kyoto, well known for its historical-tourist spots, and particularly within the city, focusing on the Higashiyama Ward, a downtown district in which important cultural assets are concentrated.

## 2. Signs for emergency situation

### 2.1 Outline of the sample city, Kyoto

The City of Kyoto has an area of 610.22km. Bounded by surrounding mountains, its terrain is a basin open to the south. Along the edge of the city is locates active faults such as Hanaore Fault and Obaku Fault. An inland earthquake is anticipated to cause M6.3-7.7 level of quake. The city sets up 66 refuges (total area 427.54ha; capacity 2,137,700 persons) and 379 temporary refuges (capacity 123,571) according to Kyoto City Disaster Prevention Plan.

According to Kyoto City Yearbook 2002, the total population is 1,467,700, and 24.7% of them are considered vulnerable to disaster situation, such as senior citizens, infants, and disabled. Kyoto has many historical and cultural assets, including national treasures (20% of the nation's total) and cultural assets of national importance (14%). It annual receives more than 41 million sightseeing visitors annually. Daytime population is 1.09 times of the registered residents. Foreign residents account for 3.0% of total population, and foreign visitors 3.9 of total visitors staying at least one night. In total daytime population, 3.1% are foreigners, one third of which come from Asian nations such as Korea and China.

Higashiyama Ward has an area of 7.46km$^2$ and population of 243,987 (11,651 seniors, 1,073 registered foreign residents). As seen in Figure1, this ward has especially large number of historical assets, so daytime population ratio reaches to 1.383. There are two refuges located in the northern and southern parts and 25 temporary refuges.

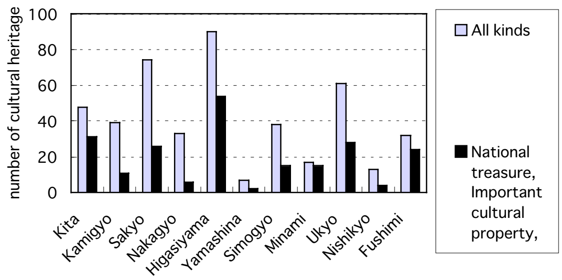


Figure 1: The cultural heritage in Kyoto City
Source: Kyoto City's Plan of Disaster Prevention

Three different departments of the City Government have jurisdiction over the signs in Kyoto; Fire Department, Industry and Tourism Department, and Construction Department. Each department keeps its own register book that contains code number they assign to individual sign, location or address, time of establishment, photo of the sign and other data.

### (1) Fire Department

The Fire Department (Disaster Section, Disaster Prevention Division) administers two kinds of signs related to the refuge that will play a crucial part in providing shelter to the evacuees（Photo1）. 250 signs are placed at gateway to the refuge throughout the City (Sign1).

Considering the significant foreigners population whose mother tongue is not Japanese, the City Government has started using the major foreign languages (English, Korean and Chinese) along with Japanese in the major signs since 1998. Leading sings to the refuge (Sign2) are placed around the site along the major roads, 158 throughout the City, but only printed in Japanese.



Left: Sign of refuge name (Sign 1)

Right: Sign leading to refuge (Sign 2)

Photo 1: Signs under the jurisdiction of Fire Department of Kyoto City.

### (2) Industry and Tourism Department

Industry and Tourism Department (Industrial Planning Section of the Tourism Division) administers three kinds of the sign (See Photo2). Sightseeing maps, 187 throughout the City (Sign3, Photo2) are printed in the four languages since 1999 and pictograms for the evacuation area have been added to the map since 2002.

Location maps totaling 804 in the City are donated by the Rotary Club since 1999 placed at elementary schools, police booths, and major tourist attractions (Sign4). Important parts of the information on these maps are printed in the four languages, but without pictograms.

The signs leading to the sight spot (Sign5) totaling 181 in the City are printed in Japanese and English. Some of this type are being removed as they become decrepit. Only this type of signs does not have standardized format.




Upper left:
Sightseeing map (Sign 3)

Lower left:
Location map (Sign 4)

Right: Sign leading sight spot (Sign 5)

Photo 2: Signs under the jurisdiction of Tourism Industry Department of Kyoto City.

### (3) Construction Department

Construction Department (Road Maintenance Section of Road Division) administers two kinds of the signs for roads. Sign of place name (Photo3, Sign6) indicates name of streets, avenues, and places. Directional arrow sign (Sign7) is designed to guide drivers and pedestrians to major destinations by arrows and road numbers. Since 1990 they have become bilingually printed (in English and Japanese).




Left: Sign of place name (Sign 6)
Upper: Cross-point name, Lower: Street name
Right: Directional arrow sign (Sign 7)

Photo 3: Signs under the jurisdiction of Construction Department of Kyoto City.

These signs are standardized by the Japan Road Association's Codebook for the Road Signs issued in 1986, so the same format is used everywhere in Japan. The Road Maintenance Section started centralized control over the road signs only several years ago (before that, individual field offices for road maintenance used their own register book) and complete follow-up of the removal is not yet available, so we have no definite total number for these road signs.

### (4) Non-governmental organization

The Kyoto City Government designates schools and large temples/shrines as temporary refuges. But as the administration is left to community-based voluntary disaster prevention groups, there is no centralized control and standardized design with regard to the signs attached to the temporary refuges (Sign8). The voluntary groups do not place leading signs to the sites in Kyoto.

## 3. Survey of the conditions of the signs

### 3.1 Outline of Survey

### (1) Sample

We select the signs under City Government's jurisdiction (Sign1 through Sign7) and the signs managed by voluntary groups (Sign8 at gateway of temporary refuges) as the research subject. They are located in the area between Gojo (5th) Avenue and Sanjo (3rd) avenue. This area is among the most heavily visited by tourists in Higashiyama Ward.

The selected area includes one refuge (Maruyama Park) and 11 temporary refuges. Table 1 shows the number of the signs in the selected area, Higashiyama Ward, and entire Kyoto City sorted by the sign's types.

Table 1: The number of the signs in the selected area.

| Jurisdiction Department | Type of sign | numbers of signs: Kyoto City | Higashiyama ward | survay area* |
|---|---|---|---|---|
| Fire Department | ① Sign of refuge name | 250 | 8 | 6 |
| | ② Sign leading to refuge | 158 | 5 | 3 |
| Tourism Industry Department | ③ Sightseeing map | 187 | 27 | 26 |
| | ④ Location map | 804 | 40 | 21 |
| | ⑤ Sign leading to the sight spot | 181 | 16 | 10 |
| Construction Department | ⑥ Sign of place name | unclear | 110 | 64 |
| | ⑦ Directional arrow sign | unclear | 27 | 16 |
| Other | ⑧ Sign attached to temporary refuge | 379 | 25 | 11 |

*Survay area is from Gojyo street to Sanjyo street at Higashiyama ward.

### (2) Survey item

We survey the sign's conditions based on the items from (a) to (c) considered in the sub-working meeting of Architectural Institute of Japan to research the effects of color on visibility.

#### (a) Placement of sign

Location, Height of placement, Light

intensity of sign's surroundings

**(b) Characteristics of sign**
Size of sign, Used color (Hue) of sign

**(c) Characteristics of characters**
Background/Character reflectance, Character size (height and width)

Measurement tools are the illuminance meter (TOPCON, IM-3) for the light intensity, the luminance meter (MINOLTA, LC-110) and the standard white board (reflectance=0.85) for background /character reflectance, and JIS color sheet (Nihon Sikiken) for grasping signs' hue.

**(3) Dates of survey**

The survey was conducted on December 3, 10, 11 and 17, 2003. The times of a day was daytime (clouded) between 9 :00 and 13:00, and between 18:30 and 21:00 after sunset and with no sunlight. It was cloudy all day, when we measured daytime intensity.

The daytime sunlight intensity of survey dates were measured by the pyrheliometer with shielding band (250mm in radius, and 50mm width) of direct sunlight at KYOTO IDMP Station whose position is in latitude 35 degrees and 2 minutes north, and in longitude 136 degrees 47minutes east. The results are shown in Figure2. It was cloudy with occasional rain on 2003/12/11, so there is a variation of sunlight intensity. However, it is considered that the diffused illuminance data from unobstructed sky was stabilized.

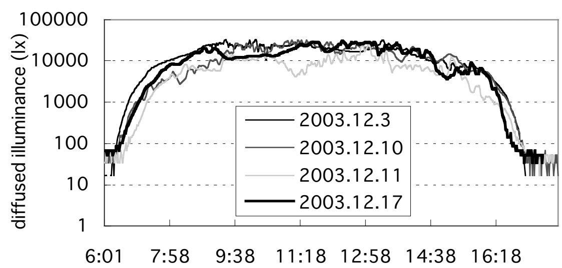


Figure 2: Diffused illuminance from unobstructed sky at latitude 35,02' north and longitude 136,47' east.

## 3.2 Placement

**(1)Surface placement**

The location of the signs is shown in Figures 3, 4 and 5 by jurisdiction. The map is prepared using ZENRIN electronic atlas Z Professional 2.

Fire Department's signs (Figure3) are related to refuges, but only handful of leading signs are placed alongside the major roads, with average interval of 310 meters. Interval is represented by average of the shortest distance between two signs. Figure 3 includes the temporary refuges but there is no leading sign to them.

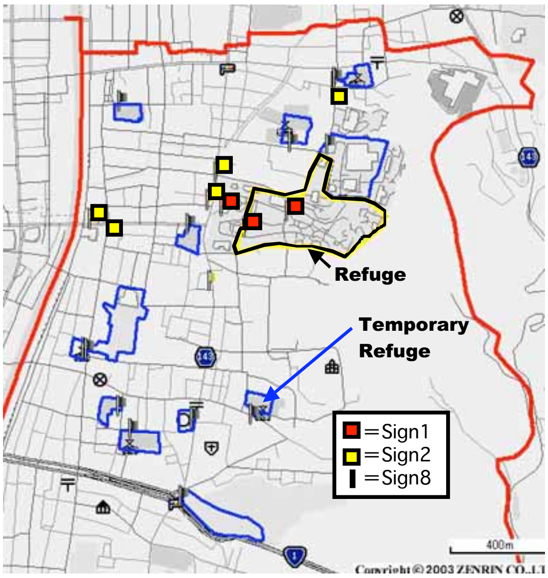


Figure 3: Site plans of related signs to refuge base and temporary shelter.

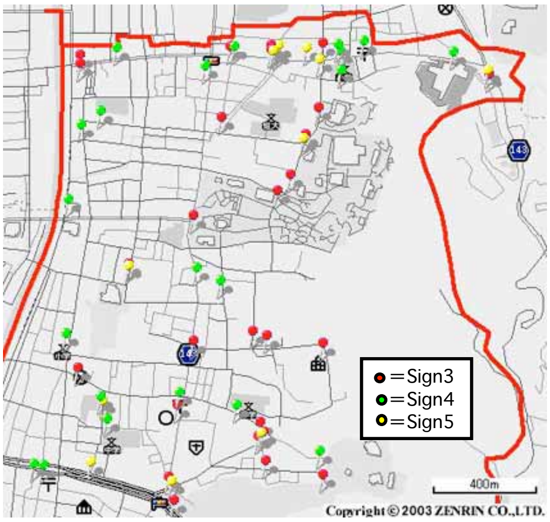


Figure 4: Site plans of related signs to Tourism Industry Department.

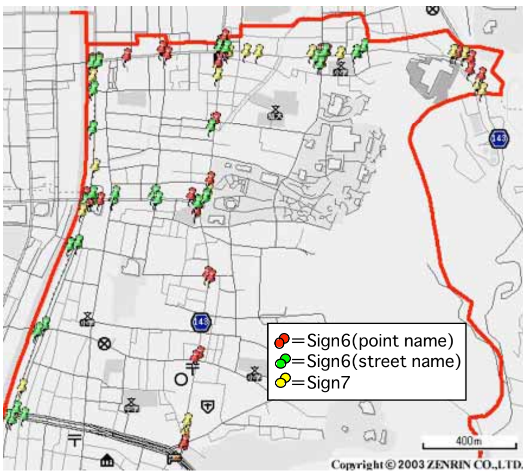


Figure 5: Site plans of related signs to Construction Department.

Sightseeing maps (Sign3) are concentrated around The signs under the jurisdiction of Industry and Tourism Department are mainly for tourists from outside, so they tend to be located evenly across the area surveyed, with average interval of 140 meters (Figure4) upper Higashiyama area, while location maps (Sign4) are in downtown area.

Construction Department sets up signs alongside four major roads with more than 4 lanes, with average interval of 190 meters (Figure5).

Construction and Industry-Tourism Departments have more signs than Fire Department does in the area. If those non-fire-department signs include information with regard to refuges, the guidance to these refuges can be implemented more effectively.

### (2)Three-dimensional placement (Height of the signs)

Figure6 indicates the heights of center of the signs. Vertical axis is the cumulative ratio of each type of sign. Sign 3 and 4, both with map, are placed at eye height level, making them easy to see. Industry-Tourism's Sign5 and Sign8 for temporary refuges also are relatively low, but other types are placed at 2.0 meters or higher.

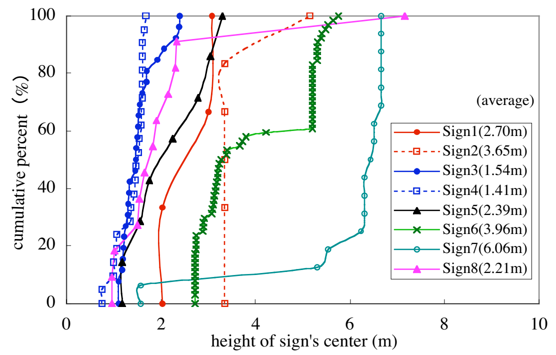


Figure 6: Distribution of height of sign's center.

### (3) Light intensity

We grasped the light intensity of sign's surroundings by measuring horizontal illuminance under the sign on the ground ($E_g$). Figure7 shows the relationship between the light intensity of sign's surroundings ($E_g$) and sunlight ($E_d$) in daytime. We used the diffused illuminance from unobstructed sky as the sunlight data. The broken line in Figure7-1 shows that the ratio values between $E_g$ and $E_d$ are 1/10 (under broken line) and 1/1 (upper broken line).

The plots over upper broken line occurred in including direction light in $E_d$, and these account for 36.5% of the all $E_d$ data. It is inappropriate to compare these data with $E_d$, therefore, in the next analysis as shown in Figure7-2, we compared $E_g$ and $E_d$ except these data.

Figure7-2 shows the effects of signs' surroundings on the sunlight to reach on the signs. The signs which $E_g$ are less than half of $E_d$ account for about 50% of valid data. Therefore, we know that there are many signs that are hard to ensure the sufficient light intensity in daytime.

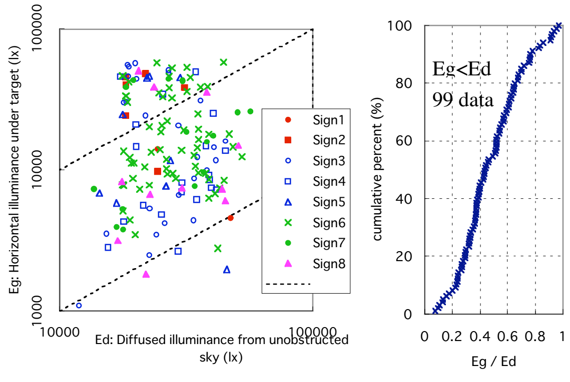


Figure 7-1: $E_d$ and $E_g$ Figure 7-2: $E_g/E_d$

Figure 7: Relationship between Daylight ($E_d$) and Horizontal illuminance under target ($E_g$).

We could measure the illuminance on the signs ($E_t$) whose height is less than 3.0 meters; those are Sign1, Sign3, Sing4, Sign5 and Sign8. Figure8 shows the relationship between $E_t$ and cumulative percent per type of sign.

In nighttime (Figure8-1), $E_t$ of signs related to refuge zone as Sign1 and Sign8 are less than that of signs related to location map as Sign3 and Sign4. The signs that those $E_t$ are less than 1.0 lux account for about 20% of the all signs, and those are hard to ensure the sufficient light intensity in nighttime. The average of $E_t$ of all signs in nighttime is about 10 lux.

In daytime (Figure8-2), the $E_t$ of Sign1 is far less than another signs. The average of $E_t$ of all signs in daytime is about 17000 lux.

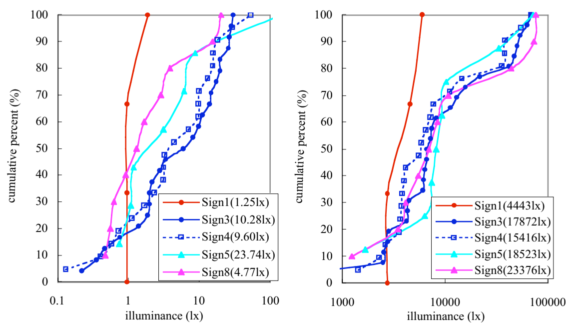


Figure 8-1: nighttime $E_t$ Figure 8-2: daytime $E_t$

Figure 8: Distribution of illuminance on signs ($E_t$).

## 3.3 Characteristics of the signs

### (1) Size

The cumulative size distributions of the signs are shown in Figure 9. Most of those under the City Government's authority (Sign1 through Sign7) are standardized, but the size of leading signs for the temporary refuge (Sign8) ranges from 0.09 to 3.1 $m^2$. Most of the signs except Sign1 and Sign7 are less than $1.0m^2$. Sign8 only contains the name of the temporary refuge, so the size of the sign and size of characters are proportionally related.

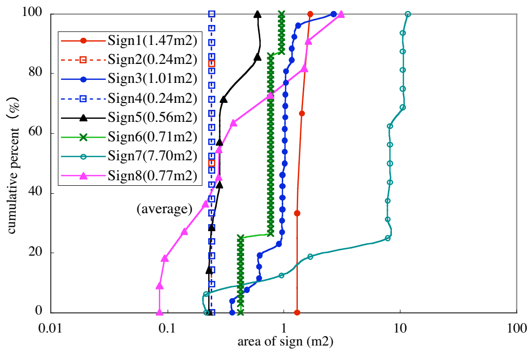


Figure 9: Cumulative percentage of sign's area.

### (2) Color

Most of the signs are colored. Only 3.8% of all signs are in monochrome, 5/6 of which are Sign8. The colour combination of characters and the background is shown in Table2 by jurisdiction.

The values in the table mean percentage against total characters printed in the signs of each department. Fire department tends to use black or white for background and/or character (72%), and for backgrounds it seldom uses any color. Construction's signs are dominated by PB-N combination (96%) as they are designated colors regulated by the code. Industry-tourism Department uses most varied colors .

Coloring has obvious advantage; enhancing distinction of contents and attracting people's attention. Caution however that coloring is without consideration of luminance contrast (brightness difference), may result in lower visibility.

Table 2: Used Color (Hue) of Sign.

| Jurisdiction Department | Background Hue | Character Hue R | Y | G | B | PB | P | N |
|---|---|---|---|---|---|---|---|---|
| Fire Department (Number of character N=1688) | R | | | | | | | 13.63% |
| | YR | | | | | | | 3.73% |
| | Y | | | | | | | 3.67% |
| | G | | | | | | | 3.55% |
| | B | | | | | | | 0.71% |
| | N | | | 0.71% | | 2.13% | | 71.86% |
| Tourism Industry Department (N=67723) | R | | | | | | | 3.11% |
| | YR | | | | | | | 30.30% |
| | Y | 0.04% | | | | 0.03% | | 17.32% |
| | GY | | | | | | | 0.33% |
| | G | | | 0.00% | | | | 15.44% |
| | BG | | | | | | | 0.02% |
| | B | 0.00% | | | | | | 9.34% |
| | PB | | | | | | | 0.04% |
| | P | | | | | | | 0.48% |
| | N | 0.20% | | 0.00% | 0.19% | 0.06% | 0.03% | 23.06% |
| Construction Department (N=1780) | G | | | | | | | 1.01% |
| | PB | | 0.45% | | | | | 38.48% |
| | N | 0.45% | | | | 57.47% | | 2.13% |
| Other (N=103) | Y | | | | | | | 8.74% |
| | G | | | 8.74% | | | | |
| | N | | 37.86% | | | | | 44.66% |

## 3.4 Visibility of Sign

### (1) Visibility Model

Generally speaking, three factors are important to properly design visual environment. Those three factors are environmental conditions, visual object's conditions and human visual ability. The former two factors define visual stimulus, and the latter one defines visual sensitivity. Human visual ability consists of many functions like field of view and color sensitivity and so on, but usually the most important is visual acuity. Visual response, namely visibility depends on both visual stimulus and visual sensitivity. Figure10 shows the structure of this Visibility Model.

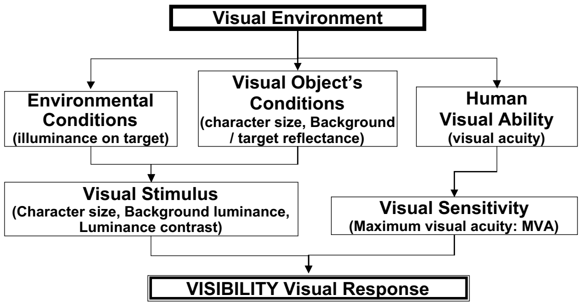


Figure 10: the structure of Visibility Model

Visual stimulus is represented by four elements, namely size of a visual target, background luminance, contrast between the visual target and background luminance, and viewing time. If the viewing time is more than 100 mill-seconds, the visibility becomes stable regardless of time. We can assume that observing time is longer than 100 seconds either in routine and non-routine situations. If sign's surface diffuses completely, background luminance is determined by illuminance on the sign and background reflectance.

There is a significant difference of visual acuity not only among age groups (Young / Aged) but also among individuals. However, it has been found that the environmental conditions at which maximum visual acuity (MVA) is attained are the same despite of differences of MVA. Therefore MVA can be an index for measuring human visual sensitivity.

Based on the results in Akizuki's report, Visibility Model of Text Information at steady state (the viewing time exceeding 100ms) can be constructed by five elements: character size (S), luminance contrast (C), background luminance ($L_b$), maximum visual acuity (MVA) and Visibility Level ($\alpha'$). Equation1 shows the Visibility Model of Text Information in the Steady State.

$$S = \frac{30 \times 10^{0.75\alpha'}}{MVA \times L_b^{0.23} \times C} \qquad (1)$$

where $S$ is character size (minute), $L_b$ is the adaptation background luminance and $L_t$ is the character luminance (cd/m$^2$), $C$ is the luminance contrast, $MVA$ is maximum visual acuity. $\alpha'$ shows Visibility Level that the rate to get more "Normal" legibility within the same MVA group. The validity ranges of Equation 1 are $10 \le S \le 100$, $0.35 < L_b < 1400$, $0.52 \le C \le 0.93$, $MVA \ge 0.1$, and $0.05 \le \alpha' \le 0.95$.

This Visibility Model was derived based on the experimental results that were carried out for 86 subjects under various visual stimulus conditions. The visual target was a monochromatic Japanese sentence typed in Ming font. Whichever value of $L_b$ and $L_t$ is higher the legibility did not change.

### (2) Risk indices about visibility of signs

In disaster situation, we should set three kinds of risk indices: Visibility Level, Age and the illuminance intensity on the signs. Risk indices are shown in Table3.

The necessary Visibility Level in disaster situations is assumed to be 0.80 in this paper.

The average MVA of the aged is about 1.0, and that of the young is about 2.0. In the survey report on physical measurement of Japanese people (Japanese Body Size Data, 1992-1994), the average of eye height of the aged is about 1.49, and that of the young is about 1.58.

The light intensity is set to three levels. Daytime and nighttime levels are represented by average value of measured illuminance on the sign, considering the environmental conditions such as surrounding buildings and artificial lighting. On the electric outage, we also set the level of no-light-but-moonlight situation (moonlight hereafter).

Table 3: Risk indices about visibility of signs

(1) Necessary of Visibility Level

| | |
|---|---|
| Visibility Level | $\alpha' = 0.8$ |

(2) Age

| | visual acuity | eye height (m) |
|---|---|---|
| the Young | 2.0 | 1.58 |
| the Aged | 1.0 | 1.49 |

(3) Illuminance intensity on sign

| | average (lx) | maximum (lx) | minimum (lx) |
|---|---|---|---|
| daytime | 17000 | 76221 | 450 |
| nighttime | 10 | 145 | 0.13 |
| just moon light | 0.2 | | |

### (3) Calculation of Visible Distance

We quantify the visibility of signs to convert it into Visible Distance $D$ at which an observer can read the Text Information of Signs easily. Figure11 shows the physical characteristics for which calculation of $D$ is needed. $D$ is computed by the coupling Equations3 based upon the Visibility Model in the Steady State. This $D$ represents the performance of the sign.

$$\left.\begin{aligned} D &= \sqrt{V^2 + (H-h)^2} \\ V &= \cos\delta \times (S'/2) / \left[ tan\{S/(2\times 60)\} \right] \\ \cos\delta &= D/V \\ S &= 10^{0.75\alpha'} \times 30 / \{ MVA \times L_b^{\ 0.23} \times C \} \end{aligned}\right\} \quad (2)$$

where $V$ (m) is the distance between target (i.e. character of Text Information) and observer's eyes. $H$ (m) is the height of the sign's character and $h$(m) is the height of the observer's eye. $\delta$(degree) is the angle of center of the character and vertical direction. $S'$ is the original size of character.

If an observer cannot read target's characters easily because the visual stimulus of the characters is in bad conditions: the character size is very small and/or their contrast is low, then we cannot calculate $D$ of it.

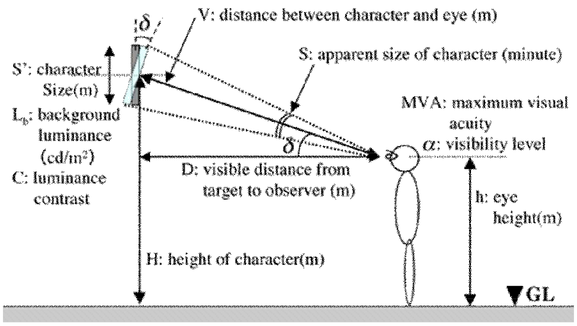


Figure11 the structure of Visibility Model

### (4) Visibility of Sign

Equation 3 expresses the average of a sign's Visible Distance $D_{ave}$ per one character. If an observer cannot read target's characters easily, we set $D = 0$.

$$D_{ave} = \frac{\sum D_n}{n} \quad (3)$$

where $D_n$ is a Visible Distance (minute), $n$ is the number of characters in a sign.

Figure12 shows the $D_{ave}$ results according to the risk indices about visibility of signs. The visibility of some signs is too low to calculate visible distance. In that case no entry in the figure. $D_{ave}$ of Sign1 at refuge is short; 2.6 meters for the young and 0.64 meters for the aged. $D_{ave}$ of some signs is less than 1.0 meter in daytime for the aged. In the moonlight, only Sign8's $D_{ave}$ for the young exceeds 1.0 meter.

In addition, the difference between $D_{ave}$ of Sign6 and that of Sign7 in the nighttime / moonlight depends on the difference of background reflectance (character size and contrast about the same). If background reflectance is higher than character reflectance, $D_{ave}$ value of the sign tends to be longer.

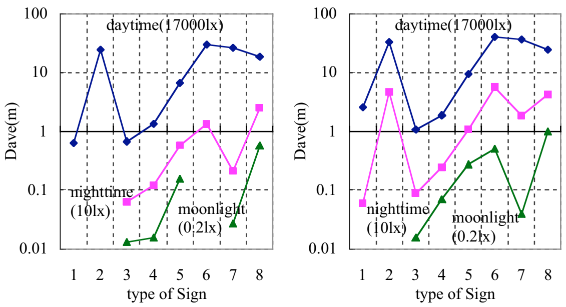


Figure12-1 the Aged Figure12-2 the Young
Figure12 Average Visible Distance: $D_{ave}$

People recognize what the kind of a sign is by reading main characters first. The main characters are written in not only Japanese but also foreign language such as English, Chinese, and Korean. These main characters in foreign languages have similar size, contrast and reflectance and so on. We calculate the visible distance of the main characters $D_{main}$ in Japanese and English, and show the results in Figure13. $D_{main}$ of English character is shorter than that of Japanese. Sign1's $D_{main}$ in English cannot be calculated in nighttime because of low visibility. Sign8 (sign for temporary refuge) is written in Japanese only, which may cause problem for foreigners.

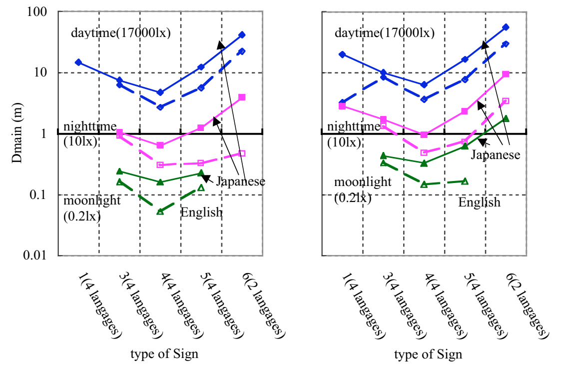


Figure13-1 the Aged Figure13-2 the Young
Figure13 Visible Distance of main words: $D_{main}$

Figure14 shows the relationship between $D_{ave}$ and $D_{main}$, And we calculate the Visible Distance $D$ of the important words; "You are here." (this message can be found in Sign1, Sign3, Sign4 and Sign5) and a pictogram for the refuge (in Sign1, Sign2 and Sign3).

This figure shows that longer $D_{main}$ does not automatically mean long enough $D_{ave}$ for Sign 1, Sign3, and Sign4. $D$ of "You are here." is significantly shorter than $D_{maini}$, indicating difficulty of recognizing where the person is in the city. Particularly for Sign1 of which visibility is so low, we cannot compute Sign1's $D$ of "You are here." despite the low risk level (young and daylight).

In the meantime, $D$ of the pictogram for the refuge is sufficiently long especially Sign1 and Sign3 of which the values of $D_{ave}$ are shorter. That is to say, the pictogram is effective in functioning as text information to guide evacuees.

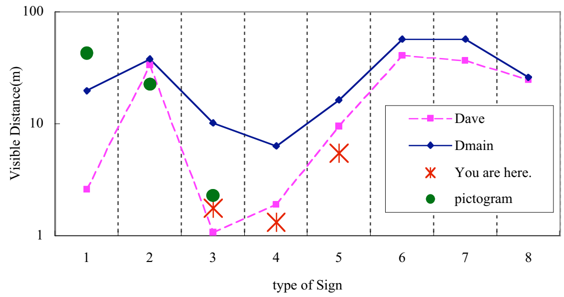


Figure14 Comparison among $D_{ave}$, $D_{main}$ and $D$ of the important words under the risk level of young and daytime.

## 4. Conclusion

### 4.1 Problems

From the findings of our survey, we can point out several shortcomings of current signs for disaster prevention.

(1) Placement of leading signs needs close examination. Signs with longer visible distance (Sign2) are limited to certain sites. While the maps are located evenly throughout their area surveyed, the visibilities tend to be low.

(2) The visibility of signs in nighttime or moonlight situation is not high enough especially for foreigners and the aged. Senior citizens cannot recognize Sign1 and Sign2 at all, and other types also do not always have sufficient visible distance.

(3) Visibility of the signs to indicate present location is not good enough. Even in daytime situation where plenty of light provided and for the young with good visual acuity, the visible distance is shorter than 1.8 m.

### 4.2 Proposal

In order to remedy the current problems, our proposal is to implement the following policies;

(1) To remodel signs in terms of character size, because the size is relatively immune to the natural deterioration compared with contrast and reflectance. In particular, characters indicating present location and other crucial information are to be enlarged. (E.g. with background reflectance ratio 0.79, luminance contrast 0.67, height 1.9m and distance 10m, the aged need the character size of 8cm in daytime, 43cm in nighttime, and 104cm in moonlight.)

(2) Pictogram leading to the refuge should be more extensively posted with sufficient character size.

(3) Planning and Management of the signs should be trans-departmental. For example, road-related signs

located densely along the major roads are potentially useful, but not utilized for disaster preventive purposes.

The object of this study is limited to permanent signs, but Text Information is particularly important under non-routine situation like disaster and reconstruction. Therefore, we should consider visibility even for temporary signs.

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## 災害時の避難誘導に関する行政管轄下の標識の視認性
## －京都市東山区を対象とした実態調査－

秋月有紀*、田中哮義・岩田三千子**

*京都大学防災研究所21世紀COE研究員
**摂南大学工学部

### 要　旨

観光客などの帰宅困難者にとって避難経路の把握に有効に機能する、行政管轄下の標識の視認性の実態について、京都市東山区を対象に調査を行った。その結果、避難場所を誘導する標識の配置が不十分であり、夜間や無灯時の視認性が（特に高齢者や外国人にとって）低いため、風化の影響を受けにくい文字寸法を重点的に標識のデザインを見直し、部局を超えた標識管理を行い、点でなく面での配置計画を実施する必要性を挙げた。

キーワード:　文字情報，行政管轄下の標識，視認モデル，避難経路、帰宅困難者、高齢者