Designing Changeable Message Signs for Visually Impaired Travelers

Transportation Research Board's 88th Annual Meeting

January 12, 2009

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PENNSTATE

Visual Impairment Demographics

There are many ways of describing or categorizing visual impairment.

Loss of central field visual acuity is the one most closely correlated with sign reading deficit.

Visual Impairment Demographics

The WHO estimates that in 2002 more than 161 million people worldwide were visually impaired, of whom 124 million people had low vision (20/60 – 20/400) and 37 million were blind.

2006 National Health Interview Survey found that over 21 million U.S. citizens 18 years of age and over reported having trouble seeing, even when wearing glasses or contact lenses.

Designing CMS for Visually Impaired Travelers

While there is nothing that can be done with the visual characteristics of CMS that will help the blind, there is a lot that can be done to improve CMS visibility of people with low vision.

Designing CMS for Visually Impaired Travelers

Private Transportation – Private vehicle

Public Transportation (aka Transit or Mass Transit):

- **Air - Airlines**
- **Road - Bus**
- **Rail - Train, Subway, Light Rail**
- **Water - Ferry**

Special Events – Stadiums

Other – Hotels, Malls, Amusement Parks, Belt buckles

Private Transportation Visual Requirements

The majority of states require 20/40 or better visual acuity in one eye with best correction.

34 states permit the use of bioptic telescopes for drivers who cannot pass the 20/40 criterion.

Private Transportation Visual Requirements

Only require a vision test at initial licensing. Florida is one exception that retests drivers over 80.

Even so, the majority of private vehicle drivers have better than 20/60 (generally accepted criterion for low vision) visual acuity when corrected.

Designing CMS for the Visually Impaired

In 2007 the American National Standards Institute's (ANSI's) A117 Task Group on VMS led by Beezy Bentzen was established to ensure CMS readability by the visually impaired.

High resolution CMS (because they are visually very similar to print signs) are already covered by the requirements of ANSI Standard A117 - Accessible and Usable Buildings and Facilities.

High versus Low Resolution CMS

High resolution VMS characters have vertical pixel counts of 16 rows or greater.

High versus Low Resolution CMS

Low resolution VMS characters have vertical pixel counts of 7 to 15 rows.

Specific Recommendations

- Letter Height
- Character Width
- Stroke Width
- Case
- Font
- Character Spacing
- Line Spacing
- Finish
- Contrast Orientation
- Brightness
- Motion Characteristics

Letter Height

Minimum of 2.0 inches plus 0.20 inches for each foot of minimum viewing distance. Or, a Legibility Index of 5 ft/in of letter height.

Highway CMS have a recommended LI of 30 ft/in or $1/6^{th}$ the height recommended.

Assuming highway CMS accommodate drivers with 20/40 visual acuity, then the recommended letter height would accommodate viewers with 20/240 vision

Shape

Character Width – 70 to 90 percent of height

Stroke Width – 15 to 20 percent of height

Character Height	Character Width	Stroke Width
7	5-6	1
8	6-7	1-2
9	6-8	1-2
10	7-9	2
11	8-10	2
12	8-11	2
13	9-12	2-3
14	10-13	2-3
15	11-14	2-3

Shape

Case - Uppercase

Font - Characters should be conventional in form, be san serif, and not italic, oblique, script, highly decorative, or of other unusual forms.

Spacing

Character Spacing - 22 to 35 percent of the character height (i.e., 2 to 5 pixels depending on number of vertical pixels).

Line Spacing - Spacing between the baselines of separate lines of characters should be between 135 and 170 percent of the character height.

Miscellaneous

Finish - Non-glare

Contrast Orientation - Light characters on a dark background

Brightness - In exterior locations they should automatically adjust in response to changes in ambient light levels.

Motion

CMS often present more information than will fit on a single display. The messages must therefore be displayed in a dynamic format.

Paging - text is static, but a number of pages of information are shown sequentially to convey the entire message.

Scrolling - text that moves down the sign from top to bottom.

Streaming - text that moves across the sign from right to left.

Motion (Paging)

When a CMS message can be displayed in its entirety on a single screen it should do so statically.

- **A minimum three seconds or**
- **One second for every seven characters**

Motion (Streaming)

How fast a message should stream across the sign is mainly a function of the target audience's reading rate.

Reading rates (WPM) for the visually impaired are slow and depend on the functional type of impairment (e.g., macular degeneration vs. glaucoma vs. diabetic retinopathy).

Some research has shown that larger window size (more letters visible at a time) might be beneficial for individuals with visual impairment.

Motion (Streaming)

Most research shows that the visually impaired find it easier to read static than moving text.

Other research has shown that moving text can actually help people with central field loss because tracking the text might help to stabilize their eye movements.

Future Research

Paging Duration

Streaming Rate

Color