Some Vision Research Relevant to Built Environment Codes & Standards

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SKI Study Goals Included:

- To assess vision function comprehensively in an older population
- To explore relationships between vision function and visual task performance
The SKI Study Population

- Random sample of community-living elderly (N=900) in Marin County, California

- Average age 1st visit: 75.5 years (Range 58-102 years)
“Real World” Viewing Conditions

- All Testing Binocular
- Habitual Correction
Vision Function Measures

- Distance high contrast visual acuity (Bailey-Lovie Chart)
- Distance low contrast acuity (Bailey-Lovie)
- Near High Contrast Acuity (SKILL Light)
- Contrast sensitivity (Pelli-Robson Chart)
- Low contrast low luminance acuity (SKILL Card)
- Low contrast acuity in glare (Berkeley Glare Test)
- Stereopsis (Frisby test)
- Color vision (Farnsworth D-15)
- Visual field tests with and without attentional load
- Glare recovery time
- Temporal sensitivity (CFF)
SKILL CARD
(Smith-Kettlewell Institute
Low Luminance/Low Contrast)
Disability glare
(low contrast acuity in surrounding glare)

Berkeley Glare Test
Standard visual acuity

Times worse than young

20/20 (1.0) 20/30 (0.67) 20/48 (0.42)

Age
Low contrast acuity in glare

Times worse than young

20/40 (0.5) for young

20/152 (0.13)

20/710 (0.03)

Age
Times worse than young

- temporal resolution
- high contrast acuity
- low contrast acuity
- color vision
- contrast sensitivity
- SKILL dark acuity
- stereopsis
- attentional field size
- glare recovery time
- acuity in glare

Age
Percent of people failing to meet criterion.
Acuity: 20/200; log contrast sensitivity: 0.85
(1.0 log unit from young normal)
Percent of people failing to meet criterion. Acuity: 20/70; log contrast sensitivity: 1.30 (0.55 log unit from young normal)
Percent of those with 20/40 or better standard high contrast visual acuity who are “legally blind” (20/200 or 10 times worse) on non-standard measures.
<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Bright High Contrast</th>
<th>Bright Low Contrast</th>
<th>Dim Low Contrast</th>
<th>Glare Low Contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.5</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>87.5</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
</tbody>
</table>
Impact of Poor Low Contrast Vision on Task Performance
Face Recognition and Social Interaction In the Indoor Environment
Implications

- Low contrast vision losses will clearly affect lipreading
- Effects will be worse in the presence of glare
- Reading facial expressions, eye contact and other aspects of communication also affected for a large segment of society including many with “normal” vision and hearing.
Safety and Mobility
Role of Alternative Signage

- Braille signs can help but have to be found before they can be read
- Audible signs are another alternative for which standards already exist
Talking Signs
(Remote Infrared Audible Signage)
Lake Street. The shopping center is one block ahead. Press 1 for a store directory and current specials.
“Cone” of Transmission

Receiver *not* within signal transmission cone

Receiver within signal transmission cone

Receiver within signal transmission cone
Multiple RIAS Transmitters
Audible Sign on BART platform:

“Main boarding area for Daly City further down this platform”
703.8 Remote Infrared Audible Sign (RIAS) System

703.8.1 Transmitters. Where provided, Remote Infrared Signage Transmitters shall be designed to communicate with receivers complying with Section 703.8.2.

703.8.2 Remote Infrared Audible Sign Receivers.

703.8.2.1 Frequency. Basic speech messages shall be frequency modulated at 25 kHz (+/- 10% deviation), and shall have an infrared wavelength from 850 to 950 nanometer (nm).

703.8.2.2 Optical power density. Receiver shall produce a 12 decibel (dB) signal-plus-noise-to-noise ratio with a kHz modulation tone at +/- 2.5 kHz deviation of the 25 kHz subcarrier at an optical power density of 26 picowatts per square millimeter measured at the receiver photosensor aperture.
703.8.2.3 Audio output. The audio output from an internal speaker shall be at 75 dB(A) minimum at 18 inches with a maximum of 10% distortion.

703.8.2.4 Reception range. The receiver shall be designed for a high dynamic range and capable of operating in full-sun background illumination.

703.8.2.5 Multiple signals. Capture of the receiver by the stronger of two signals in the receiver field of view requires a received power ratio on the order of 20dB for negligible interference.
On Friday, July 23, 2010, Attorney General Eric Holder signed final regulations revising the Department’s ADA regulations, including its ADA Standards for Accessible Design. The official text was published in the Federal Register on September 15, 2010.
703 Signs

703.1 General.
Signs required to be accessible shall comply with 703.

703.2.1 Finish and Contrast.
Characters and their background shall have a non-glare finish.

Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background.
<table>
<thead>
<tr>
<th>Height from Floor to Character</th>
<th>Minimum View Distance</th>
<th>Min. Character Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 inches</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Notes: Not permitted except in elevators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 inches to &lt; 70 inches</td>
<td>&lt; 6 feet</td>
<td>5/8 inch</td>
</tr>
<tr>
<td></td>
<td>&gt; 6 feet</td>
<td>5/8 inch + 1/8” per ft. over 6’</td>
</tr>
<tr>
<td>&gt; 70 inches to &lt; 120 inches</td>
<td>&lt; 15 feet</td>
<td>2 inches</td>
</tr>
<tr>
<td></td>
<td>&gt; 15 feet</td>
<td>2 inch + 1/8” per ft. over 15’</td>
</tr>
<tr>
<td>&gt; 120 inches (3050 mm)</td>
<td>&lt; 21 feet</td>
<td>3 inches</td>
</tr>
<tr>
<td></td>
<td>&gt; 21 feet</td>
<td>3 inch + 1/8” per ft. over 21’</td>
</tr>
</tbody>
</table>
Peter Barker, Jon Barrick & Rod Wilson.

Building Sight: A handbook of building and interior design solutions to include the needs of visually impaired people. JMU Publication. 1995.
Bollards should be a minimum of 1 m high, and color contrasted with the background against which they will be viewed. They should also have a contrasting band near the top.

Street furniture should be color contrasted with background—and offset from the main pedestrian route where possible.

Distinguish doors and doorways with visual contrast.
Highlight glazed doors and side panels with prominent signs, logos or decorative features at eye level.

Provide 2" wide contrasting nosings on stairs.

Handrails should contrast visually with background surfaces.

Floor finishings should contrast with walls or a contrasting skirting should be provided.
Provide means of controlling natural and artificial light.

Aim for uniformity of illumination, avoiding strong shadows

Signs should be consistent, using prescribed typefaces, colors and graphics.
Overall Conclusions

- Vision under conditions of low contrast, glare and low light is impaired even in “normal” people as they age, and much more so in people with low vision.

- Contrast, Glare and Lighting are vital considerations for making the built environment more friendly to elders and people with low vision.
Conclusions (cont)

Simple environmental modifications (e.g., high contrast painting of edges, handrails, door jabs, etc.) can help a lot.

Knowing contrast levels of features & signs, we can estimate what proportion of the older population can see them.

Alternative signage can be part of the overall solution.
Thank you for your Attention!

Acknowledgements

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