Designing Environments for Low Vision: Tools & Techniques

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1 Learning Unit
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Acknowledgements

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Speakers List

• Edward Soenke, AIA, moderator
  Owner/Architect, The Design Partnership

• Dennis Siemsen, OD
  Low Vision Rehabilitation Specialist,
  Department of Ophthalmology, Mayo Clinic

• Nancy Clanton, PhD, PE
  President, Clanton & Associates, Inc.
Course / Learning Objectives

• Recognize types and components of low vision and how they affect perception of the built environment.

• Apply rules and tools to designing environments, including basic rules for lighting design and wayfinding.

• Compare new proposed standards that foster high-performance environments for people with low vision to general design codes and standards.

• Share and contribute knowledge toward the development of a national standard for low vision.
Supportive Environments for People with Low Vision

1. What is Low Vision?

Dennis Siemsen, OD, MHPE – Doctor of Optometry, Low Vision Service, Department of Ophthalmology, Mayo Clinic
What do we mean by “low vision”?

Vision that can’t be…

• corrected to 20/70 or better
• improved with standard glasses or contact lenses
• corrected with surgery or medicines
Source: National Eye Institute
What goes wrong with vision?

The Complete Guide to Eye Disease (abridged)

- Media Opacities
- Macular dystrophies and degenerations
- Peripheral retinal degenerations
- Optic nerve anomalies
- Visual cortex (brain) damage
Ocular Anatomy

Neuro-Anatomy
Normal Vision

Media Opacities

What

– Anything that prevents light from reaching the retina (receptor layer) of the eye
– Fuchs’ Corneal Endothelial Dystrophy
  • Clouding of the front-most layer of the eye
– Cataracts
  • Cloudy lens behind the pupil
  • Generally age-associated, but can be congenital, trauma, or medication related
Media Opacities

Effect (Pink Simulator)

– Generally a hazy view of the world
– “Dirty windshield” effect
– Light scattering
– Worse when viewing bright point sources of light
– Reflected light can by-pass filters and visors
Media Opacities
Age-Related Macular Degeneration

• Can be dry or wet
• Leading cause of blindness in the US among persons over 65
• 10 percent of the population over 52, 33 percent over 75
• Of those who are not legally blind, 90 percent have the dry variety
Age-Related Macular Degeneration

Effect (Orange Simulator)

- Loss of central vision
- Peripheral vision is intact
- Acuity loss in the range of near perfect to 5/125
- Difficulty reading, identifying faces, driving
Age-Related Macular Degeneration
Diabetic Retinopathy

What

- Number one cause of new blindness in the 20-74 year old age group
- Responsible for 10 percent of the blind population of the US
- Breakdown of retinal vessels leads to hemorrhage, edema and retinal detachments
Diabetic Retinopathy

Effect (Green Simulator)

- Multiple small blind spots from hemorrhage and laser treatment
- Macular edema distorts central vision
- Vitreous hemorrhage causes significant reduction in vision
- Retinal detachments can lead to total blindness
Diabetic Retinopathy
Retinitis Pigmentosa

What

– Hereditary condition which includes:
  • Progressive visual field loss
  • Night blindness
  • Abnormal electro-retinogram
– Characteristic pigmentary pattern
– Many syndromes associated with RP
Retinitis Pigmentosa

Effect (White Simulator)

– Gradual peripheral vision loss
– Cataracts
– Ultimate loss of central vision
Retinitis Pigmentosa
Optic Nerve Anomalies

Damage to the nerve fibers blocks signals to the visual center of the brain

– Glaucoma
– Vascular occlusions
– Multiple sclerosis
Glaucoma

What

– Optic nerve atrophy caused by intolerance to intraocular pressure

– Risk factors
  • Age
  • Family history
  • Race
  • Myopia
Glaucoma
Visual Cortex

What

– Cerebro-vascular events (strokes)
– Traumatic Brain Injury (TBI)
– Leads to infarct (damage) to brain tissue that processes the information it gets from the eyes
Visual Cortex

Effect

– Minor events
  • TIA’s
  • Headaches
  • Resolving field loss

– Major events
  • Significant visual field loss
  • Cortical blindness
  • Diplopia
Visual Cortex
Visual Cortex

Effect

– Minor events
  • TIAs
  • Headaches
  • Resolving field loss

– Major events
  • Significant visual field loss
  • Cortical blindness
  • Diplopia
Supportive Environments for People with Low Vision

2. Architectural Design

Edward L. Soenke, AIA, FCSI, NCARB – Owner, The Design Partnership, Architects
Low Vision Design Committee

Guideline Project:

Three Easy Steps:
Task 1: Guideline
Task 2: Standard
Task 3: Code Adoption
10 TIPS FROM THE GUIDELINES
1. Consider Exterior Walking Surface

Avoid confusing patterns,
Consider intensity of sunlight compared to night time

Walking surfaces should be medium to dark in value
2. Clearly define walkway obstructions

Pedestrians with low vision might not detect planters. Few people with low vision use long canes.

Clearly marked obstruction.
3. Define changes of levels

Steps lack definition, plus, there’s a water hazard.

Strong contrast strip on each step.
4. Define curbs, ramps & steps

Contrast needed at ramps and curbs to alert for trip hazards.

Avoid tapered steps or add a handrail at the location.
5. Avoid Reflective & Transparent Vertical Surfaces

- Transparent panels lack definition, create hazards.
- Vertical mirrors at entryway create optical illusions, leading to accidents.
6. Provide consistent lighting in circulation spaces

- Our eyes adjust to the brightest spot in the visual field.
- Signage and obstacles disappear in the shadows
7. Avoid patterns on stairs; make lighting consistent on each tread.

**STAIRWAY LOOKING DOWN:**
Pattern is distracting.
Pattern conceals the edge of the steps.

**STAIRWAY LOOKING UP:**
Light placement is inconsistent.
8. Increase signage contrast

- Contrast between letters and ground
- Contrast between sign and wall
9. Bring signs to the user

• Use good contrast to repeat info at eye level
• Light from the side or internally to avoid shadows
10. Consider wayfinding

Use high contrast features and accent lighting to highlight destinations.
Awareness is Increasing

1. **IESNA 9th EDITION HANDBOOK** now considers age

2. **IESNA RP28-07 “Lighting and the Visual Environment for Senior Living”** uses same fc levels referenced in IAC Ch. 61 Table 4
Awareness is Increasing

IECC 2012 Energy Code Section C405.5.1 Total connected interior lighting power (LPD) contains this exception:

**Exception 1.4:** Lighting specifically designed for use by occupants with special lighting needs including the visually impaired and other medical and age-related issues shall not be used in calculating the total connected lighting power.
Design Examples (RDG Planning/Design)

Photo by Kun Ahang
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Supportive Environments for People with Low Vision

3. Low Vision and Lighting Design

Nancy E. Clanton, PE, FIALD, FIES, LEED Fellow
President, Clanton & Associates, Inc.
Consider:

- What to light
- How to light it
- What to light it with
Low Vision Concerns

- Loss of Flexibility = Harder to focus
- Sensitivity to glare (scattering)
- Diminished peripheral vision
- Require higher lighting levels (tasks)
- Pupil reacts slower (adaptation)

- Light is dimmed and blurred
- Change in color perception
Basic Lighting Design Concepts

- Minimize Glare (scatter and adaptation issue)
- Light surfaces (harder to focus)
- Layers of light (offers higher lighting levels)
- Controls, controls and more controls (adjusting light and color)

Tah Mah Lau Residence
HKS Architect
Glaring Concern vs. Glare Minimized

Unknown grocery store

Stop and Shop – Quincy, MA
Glaring Daylight
Controlling Daylight: Glare

Arapahoe County Building, Colorado
Lighting surfaces (tasks)
Provides higher lighting levels
Lighting surfaces—Less glare
Remember:

- Increased lighting **DOES NOT** equal better vision
- Use **layers** of light (choices)
- Use **lighting controls** (adjusting visual environment)

Layered lighting: pendants, cove, downlights, sconces
Layers of Light

University of Illinois, School of Business – Pelli
Clark Pelli Architect
Layers of Light
Provide consistent lighting in circulation spaces

• Our eyes adjust to the brightest spot in the visual field.
• Signage and obstacles disappear in the shadows
Inadequate Emergency Egress Lighting: NFPA Standard

• Inadequate for those with low vision
• Same for corridors and stairs (stairs are more hazardous)
• Current Regulations:
  -- Initial average of one footcandle, not less than one-tenth of a footcandle
  -- Minimum to maximum ratio not to exceed 40 to 1.
Light and Circadian Rhythms

- Patterns of Light and Dark are key to “Entrainment”

- Noon 12:00
  - High alertness 10:00
  - Highest testosterone secretion 09:00
  - Bowel movement likely 08:30
  - Melatonin secretion stops 07:30
  - Sharpest rise in blood pressure 06:45

- Light-Dark cycle
  - 04:30 - Lowest body temperature
  - 06:00 - Deepest sleep
  - 12:00 - Noon
  - 18:00
  - 19:00 - Highest body temperature

- 21:00 - Melatonin secretion starts
- 22:30 - Bowel movements suppressed
- 00:00 - Midnight
- 02:00
- 15:30 - Best coordination
- 17:00 - Greatest cardiovascular efficiency and muscle strength
- 18:00
- 18:30 - Highest blood pressure
- 19:00 - Highest body temperature
- 14:30 - Fastest reaction time

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http://www.nibs.org/?page=lvdc
Thank You