

# Display of Visual

## Part 1: Static Displays

# Introduction

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- ▶ Information displays are part of the background of everyday life.
- ▶ The most important principle to remember is that the display should convey the intended information in as simple and unambiguous.
- ▶ For more complex human-machine interfaces, such as the cockpit of an airplane or the control room of a nuclear power plant, well-designed displays insure the safe and effective operation of the system.
- ▶ We examine issues to consider in display design, with particular emphasis on relating design guidelines to the principles of human visual perception.

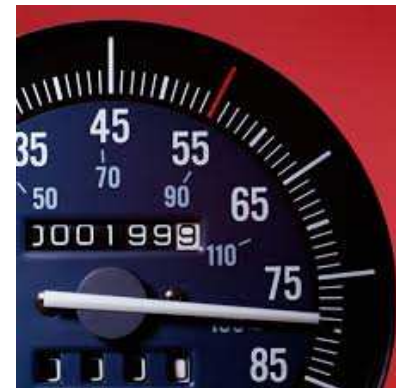
# Visual Displays

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- ▶ One of the first applications of human factors was in the design of aircraft display panels for the military.
- ▶ Engineers devoted substantial effort to determine the optimal arrangement of instruments on the display panel.
- ▶ The displays can separate to be 2 types of displays
  - ▶ *Static displays* such as road signs, signs marking exits in buildings or labels on equipment.
  - ▶ *Dynamic displays* change over time and include instruments such as speedometers, pressure gauges.



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# Status Displays

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## Status Displays

- The objective of a status display is to indicate the current state of the equipment (e.g., aircraft, car, etc.)
- Examples:
  - Speedometer
  - Fuel Gauge
  - Airspeed indicator
  - Altimeter
- Effectiveness of displays. Several factors must be considered when designing a good static display or sign.

# Static Displays

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- ▶ The principles that enhance the effectiveness of visual displays
  - ▶ Conspicuity
  - ▶ Visibility
  - ▶ Legibility
  - ▶ Intelligibility
  - ▶ Emphasis
  - ▶ Standardization
  - ▶ Maintainability

**TABLE 8.2**

**Principles That Enhance the Effectiveness of Visual Displays**

*Conspicuity*    **ရှင်စင်**

The sign should attract attention and be located where people will be looking. Three main factors determine the amount of attention people devote to a sign: prominence, novelty, and relevance.

*Visibility*

The sign or the label should be visible under all expected viewing conditions, including day and night viewing, bright sunlight, and so forth.

*Legibility*    **ရှင်ဖတ်ရလွယ်**

Legibility may be optimized by enhancing the contrast ratio of the characters against the background, and by using type fonts that are easy to read.

*Intelligibility*

Make clear what the hazard is and what may happen if the warning is ignored. Use as few words as possible, avoiding acronyms and abbreviations. Tell the operator exactly what to do.

*Emphasis*

The most important words should be emphasized. For example, a sign might emphasize the word “danger” by using larger characters and borderlines.

*Standardization*

Use standard words and symbols whenever they exist. Although many existing standards may not follow some recommendations, they are usually well established and it might be confusing to introduce new symbols.

*Maintainability*

Materials must be chosen that resist the aging and wear due to sunlight, rain, cleaning detergents, soil, vandalism, and so forth.

## Static Displays: Conspicuity and visibility

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- ▶ Conspicuity refers to how well the sign attracts attention.
- ▶ Visibility refers to how well the sign can be seen.
- ▶ Conspicuity and visibility will be determined by where a sign is placed, how well it attracts attention, and the environmental condition in which it is found.
- ▶ Ex, we know that visual acuity and color sensitivity decrease as a stimulus moves out further into the periphery of the visual field.
- ▶ Ex, a road sign should be visible during rain and fog, and at night, as well as on a sunny day.

## Static Displays: Conspicuity and visibility

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- ▶ Ex emergency vehicles such as fire trucks because they must move through traffic at high speed when answering alarms.
- ▶ The high accident rate is because of the fact that the color red, which is the color of the majority of fire trucks, is not very visible or conspicuous.
- ▶ Our visual systems are very insensitive to the long wavelength (red) at night; hence red cannot be detected very far into the periphery of the visual field.
- ▶ Moreover, color-blind people have difficulty identifying the color red.



# Static Displays: Conspicuity and visibility

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## Static Displays: Conspicuity and visibility

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- ▶ You may have seen the lime-yellow emergency vehicles.
- ▶ The human photopic sensitivity function shows that people are maximally sensitive to lime-yellow.
- ▶ This means that this color is distinguishable from most backgrounds even in rural areas.
- ▶ One successful human factors analysis involving visibility and conspicuity is that of the centered, high-mounted brake light required by law in US on car.
- ▶ The study shows that rear-end collisions were reduced significantly for vehicles that has the high, central brake light.
- ▶ The center-mounted brake light is more conspicuous because it is located directly in the line of sight.

## Static Displays: Conspicuity and visibility

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- ▶ Motorcycles are not very conspicuous or visible under all driving condition at night.
- ▶ Increasing the conspicuity of these vehicles will decrease accident.
- ▶ For motorcycles, daytime conspicuity is better when the headlamp is on and when the cyclist wears a fluorescent vest and helmet cover.
- ▶ At night, the conspicuity of the motorcycles and bikes increased by the use of reflectorized materials and running lights.
- ▶ Reflectorized materials on shoes and clothing increase conspicuity of pedestrians under condition of poor visibility.

# Static Displays: Conspicuity and visibility

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# Static Displays: Conspicuity and visibility

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# Static Displays: legibility

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- ▶ On factor influencing legibility is the contrast ratio between figures on the display and their background.
- ▶ As a general rule, the higher the contrast ration, the better the legibility.
- ▶ Contrast is determined by the amount of light reflected by the figures on the display.
- ▶ The amount of light reflected by red, blue and green pigments is usually more than black and less than white, son the contrast ratio on of black on white is highest.
- ▶ This main that black characters against a white background will usually be more legible.



# Static Displays: legibility

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- ▶ We can increase the legibility of a display in daylight by using fluorescent colors and night by using reflective materials.
- ▶ For traffic signs and signals, legibility distance has to be great enough that a driver has enough time to read the signs and respond them.
- ▶ Fluorescent traffic signs are legible at farther distances in daylight than non-fluorescent signs of the same color.
- ▶ Fully reflectorized sign should have a figure/ground contrast ratio of 12:1 for legible highway signs.

# Static Displays: legibility



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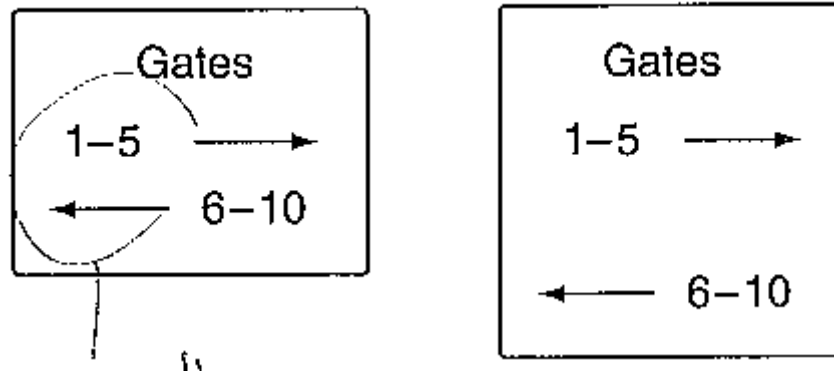
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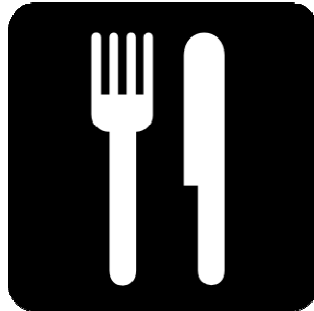
# Static Displays: Readability and intelligibility

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- ▶ A readable display allows people to quickly and accurately recognize information.
- ▶ The message on the display should be simple and direct.
- ▶ The display should use standardize symbols and words.
- ▶ The message should be unambiguous, a feature related to intelligibility.
- ▶ Signs must be constructed of materials that will withstand oil, mistreatment and weather, and maintain high levels of conspicuity, legibility and readability.



# Example



# Alphanumeric display

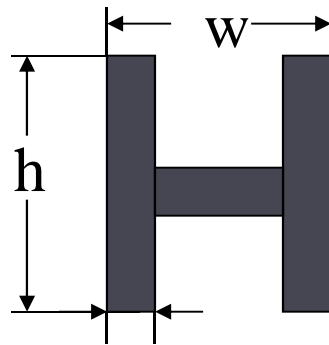
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- ▶ Alphanumeric displays are any display that used words, letters or number to convey information.
- ▶ Such displays are everywhere, from the buttons in the elevator to read signs and warning labels.
- ▶ Important roles for alphanumeric display
  - ▶ Stroke width
  - ▶ Size
  - ▶ Distance reading

# Stroke Width

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- ▶ Usually expressed as the ratio of the ratio of the stroke (width) to the height of the character.

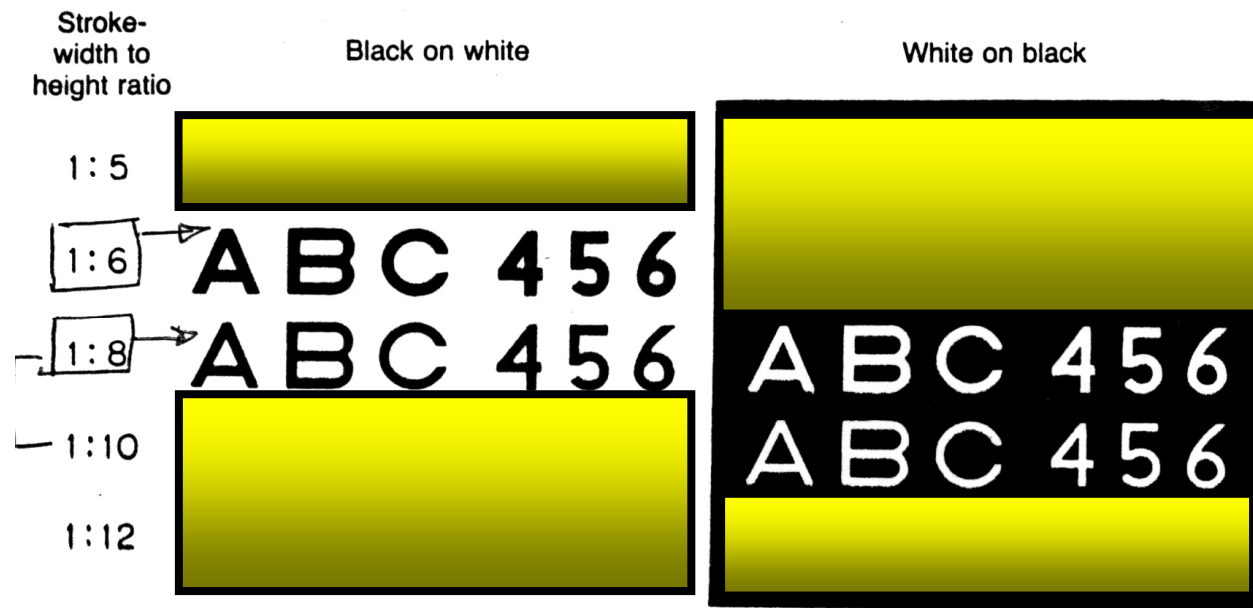


- ▶ White letters on black background - **irradiation** (letters appear to spread)
- ▶ Black on white letters should be thicker than white on black

# Stroke Width

- **Preferred thickness** (stroke width ) to height ratio:

- Black on White - 1:6 to 1:8
- White on Black - 1:8 to 1:10
- Luminous letters - 1:12 to 1:20



# Size

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- The size of the letter is measured in points.
  - One point (pt) = 0.25 mm.
  - Most commonly used font size for close reading varies 9 pt - 12 pt
- What would be the visual angle in minutes subtended by a letter of size 10 pt at the eye when viewing it from 50 cm.
  - $10 \text{ pt} = 10 * 0.25 = 2.5 \text{ mm}$
  - $H = 2.5 \text{ mm};$
  - $D = 500 \text{ mm};$
  - $VA = 3438 * H/D = 3438 * 2.5 / 500 = 17.19 \text{ minutes}$

# Distance Reading

- ▶ In order that the legibility of characters is retained as we move away from it. It is necessary to increase the size of the characters so that they subtend the same visual angle.
- ▶ NBS formula for stroke width of letters

$$WS = 1.45 * S * d * 10^{-5}$$

$$HL = WS / R$$

**TABLE 4-2**  
ONE SET OF RECOMMENDED HEIGHTS OF ALPHANUMERIC CHARACTERS FOR  
CRITICAL AND NONCRITICAL USES UNDER LOW AND HIGH ILLUMINATION AT 28 IN  
VIEWING DISTANCE

	Height of numerals and letters*	
	Low luminance (down to 0.03 fL)	High luminance (1.0 fL and above)
Critical use, position variable	0.20–0.30 in (5.1–7.6 mm)	0.12–0.20 in (3.0–5.1 mm)
Critical use, position fixed	0.15–0.30 in (3.8–7.5 mm)	0.10–0.20 in (2.5–5.1 mm)
Noncritical use	0.05–0.20 (1.27–5.1 mm)	0.05–0.20 (1.27–5.1 mm)

\* For other viewing distances (D), in inches, multiply tabled values by D/28.  
Source: Adapted from Heglin (1973) and Woodson (1963).

# Case and Layout

## Case

- ▶ IT IS NOT EASY TO READ EVERYTHING IN UPPERCASE !!!!
- ▶ It is not easy to read everything in uppercase.

## Layout

- ▶ Two factors to be considered: **Inter-letter Spacing** and **Inter-line Spacing**

**TABLE 4-3**

RECOMMENDED LETTER HEIGHTS (IN INCHES) FOR VARIOUS STROKE  
WIDTH-TO-HEIGHT RATIOS AT VARIOUS DISTANCES\*

Stroke width- to-height ratio	Distance				
	28 in	10 ft	20 ft	100 ft	1000 ft
1:6	0.097	0.418	0.835	4.175	41.75
1:8	0.130	0.557	1.114	5.570	55.70
1:10	0.162	0.696	1.392	6.960	69.60

\* Letter heights computed using formulas presented in the text and assuming a Snellen acuity score of 20/40.



# Symbolic displays

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- ▶ Sometime called pictographs, are often effective for conveying information.
- ▶ It is more difficult to develop an effective symbol for abstract or complex concepts.
- ▶ Ex, think about how you might design a symbol indicating “exit” without using the word exit or any other text.
- ▶ Hence, symbolic displays are used extensively in facilities such as airports and train stations, where many travelers may not be familiar with the local language.
- ▶ A Canadian study on highway, the pictographs on the sign increased the number of errors people made because there were several pictographs that they could not understand.
- ▶ Hospital, there is no guarantee that he or she will be able to comprehend the display’s message.






# Symbolic displays



# Symbolic displays: Orthopedics clinic and Dentistry clinic

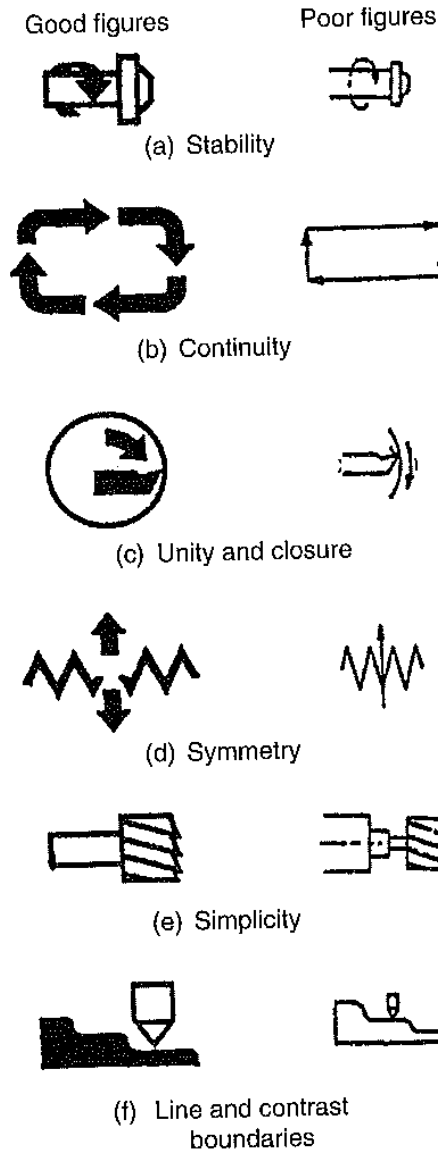
- ▶ Although the symbol can be recognized as a leg in a plaster cast, most people misinterpreted the referent to be the “plaster room”
- ▶ Everyone recognized and comprehended the tooth symbol for dentistry.

			
Recog. 88	Recog. 90	Recog. 90	Recog. 90
Compr. 98	Compr. 96	Compr. 98	Compr. 98

	Recognition score	Comprehension score
	80	2
	40	12
	60	8
	50	6
	60	8

# Symbolic displays



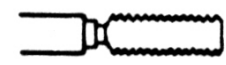

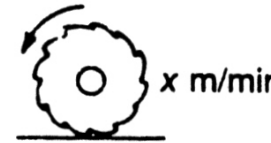

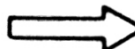


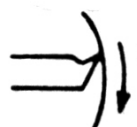
- ▶ How symbolic coded can be made more easily interpretable by designing them to be consistent with general organizational principles:
  - ▶ Figure-ground
  - ▶ Symmetry
  - ▶ Closure and continuity
- ▶ Closed, solid figures are easier to interpret than more complex open figures.
- ▶ Figure contours should be smooth and continuous, unless discontinuity contributes to the information that is to be conveyed.



# Symbols

## Perceptual Principles of Symbolic Design

- Derived from Gestalt Psychology

<b>(a) Figure/ground</b>  Good, stable figure      Poor, unstable figure		<b>(d) Simplicity</b>  A simple shape is really perceived   Too much detail makes a weak symbol	<b>(e) Unity</b>  All parts of this symbol lie within a single boundary making a good symbol   Detail outside makes a poor symbol
<b>(b) Figure boundary</b>  Good   Poor   Poor	<b>(c) Closure</b>  Closed figure readily perceived   Open figure has less impact		