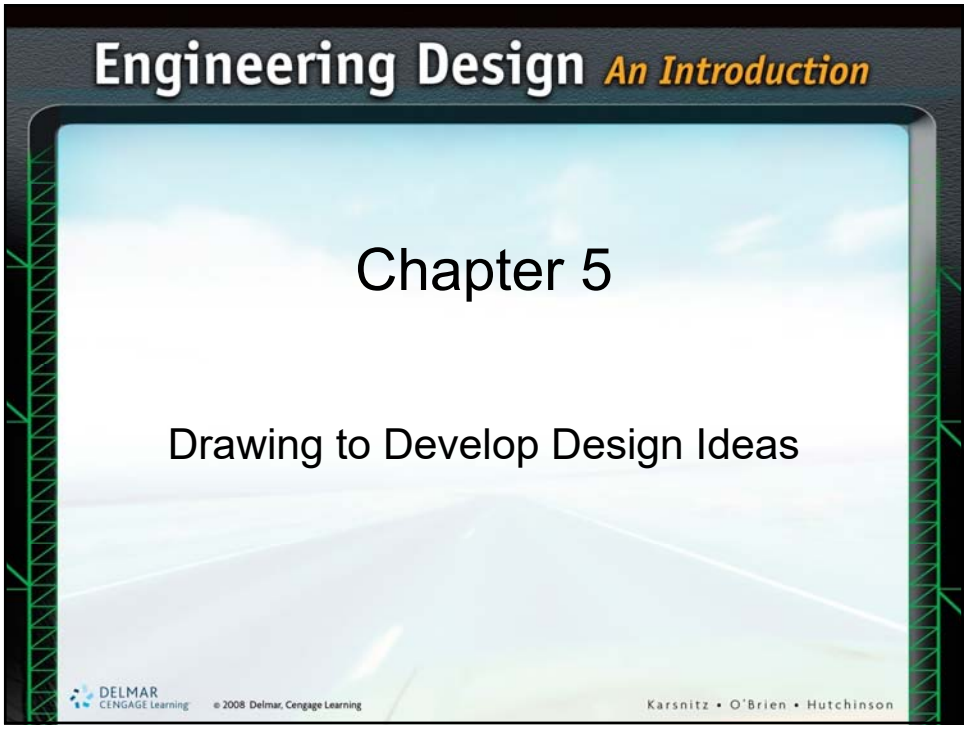
Engineering Design An Introduction
Chapter 5
Drawing to Develop Design Ideas
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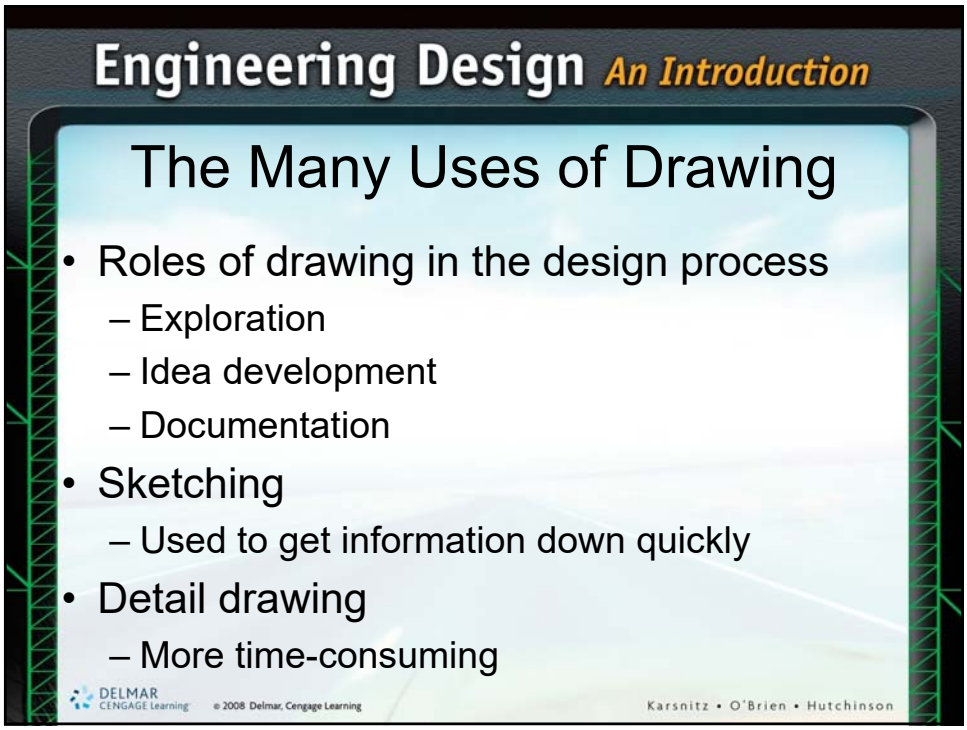
Engineering Design An Introduction
The Many Uses of Drawing
• Roles of drawing in the design process
– Exploration
– Idea development
– Documentation
• Sketching
– Used to get information down quickly
• Detail drawing
– More time-consuming
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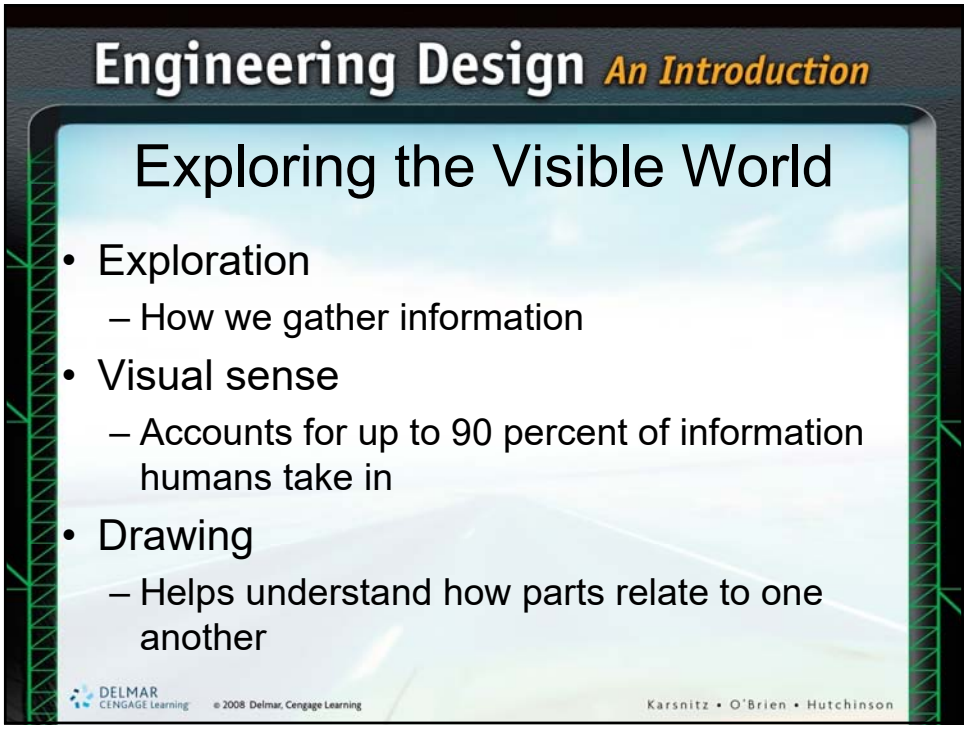
Engineering Design An Introduction
Exploring the Visible World
• Exploration
– How we gather information
• Visual sense
– Accounts for up to 90 percent of information humans take in
• Drawing
– Helps understand how parts relate to one another
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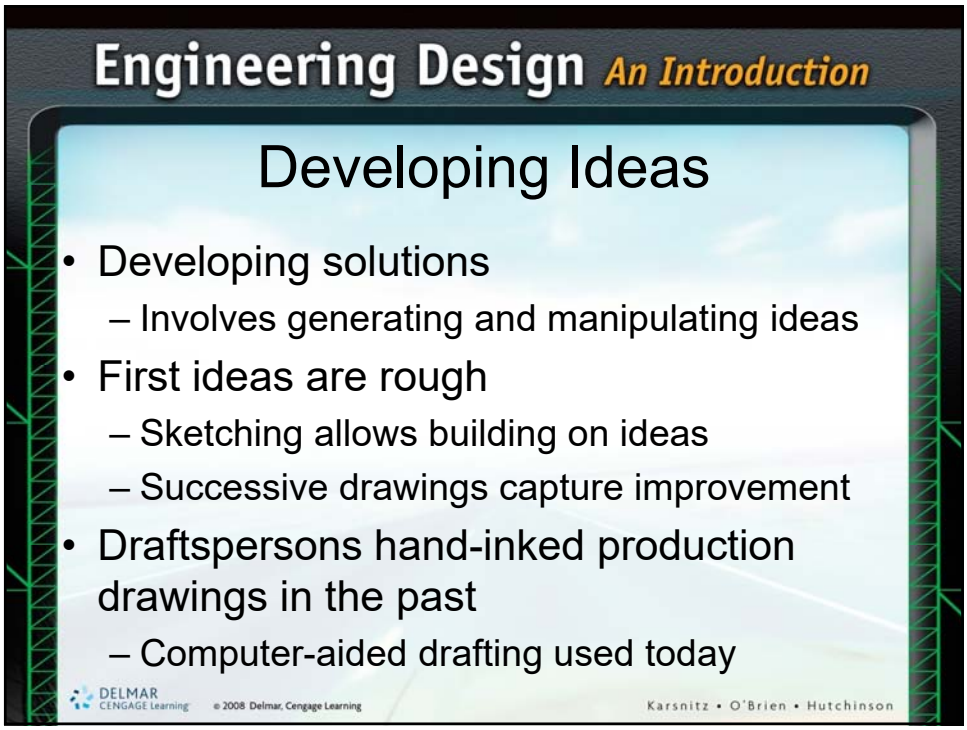
Engineering Design An Introduction
Developing Ideas
• Developing solutions
– Involves generating and manipulating ideas
• First ideas are rough
– Sketching allows building on ideas
– Successive drawings capture improvement
• Draftspersons hand-inked production drawings in the past
– Computer-aided drafting used today
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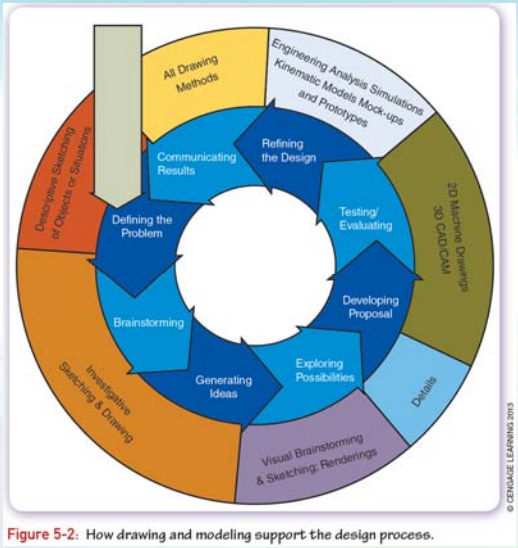

Figure 5-2: How drawing and modeling support the design process.

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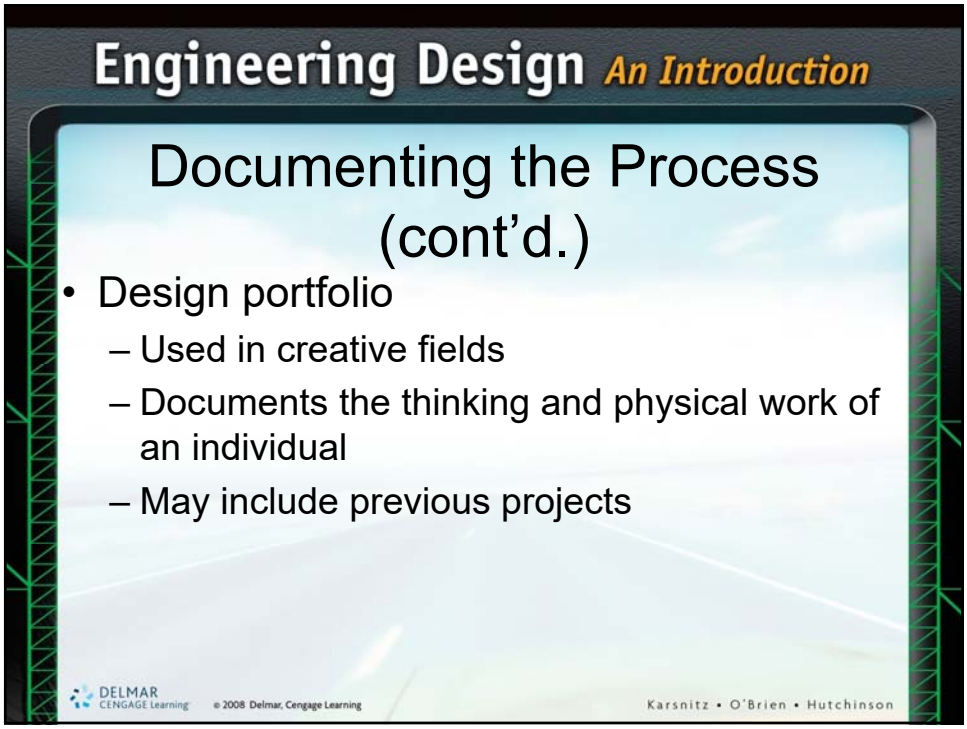
Documenting the Process

- Documentation
  - Collecting evidence of the thinking process
  - A record of ideas and development work
- Engineer's notebook
  - Used in industry
  - Careful record of ideas, calculations, thoughts, and plans
  - May be used to support a patent application


Engineering Design An Introduction
Documenting the Process (cont'd.)
• Design portfolio
– Used in creative fields
– Documents the thinking and physical work of an individual
– May include previous projects
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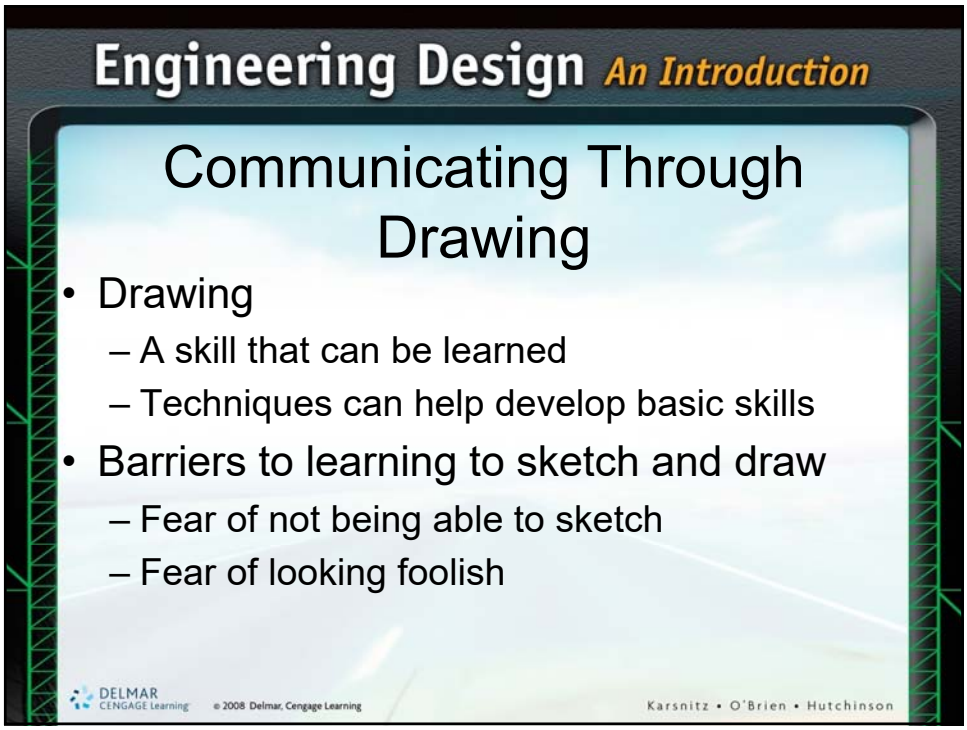
Engineering Design An Introduction
Communicating Through Drawing
• Drawing
– A skill that can be learned
– Techniques can help develop basic skills
• Barriers to learning to sketch and draw
– Fear of not being able to sketch
– Fear of looking foolish
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Whole-Brain Drawing

- Verbal thinking: left brain
- Visual thinking: right brain
  - Artists use when drawing, painting, sculpting
- Exercises and activities
  - Can help develop right brain
- Ultimate goal
  - Both halves of brain working together

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Warm-Up Exercises

- Exercise 1: Drawing mirror images
  - Helps mobilize the right brain

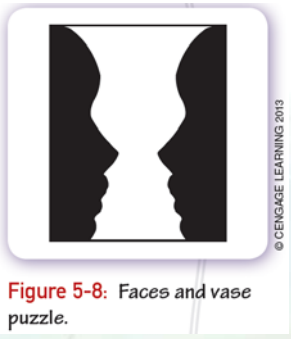

Figure 5-8: Faces and vase puzzle.

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Warm-Up Exercises (cont'd.)

- Exercise 1: (cont'd.)
  - Draw the profile of a witch at the right edge of a piece of paper
  - Draw a mirror image of the face along the left side of the paper

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Warm-Up Exercises (cont'd.)

- Exercise 2: Turn it upside down
  - Draw woman's face from Figure 5-11
  - Next, turn picture you were copying upside down
  - Try to copy the upside-down drawing
  - Compare the two drawings
- Second drawing uses more right brain
  - Judging distances and spatial relationships

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Warm-Up Exercises (cont'd.)

- Exercise 3: Blind contour drawing
  - Draw your hand holding a small object
  - Travel along the contour of the hand
    - First with eyes
    - Then using pencil on paper
    - Don't look at the paper
- Practicing contour drawing
  - Improves seeing details, judging distances, and controlling the drawing hand

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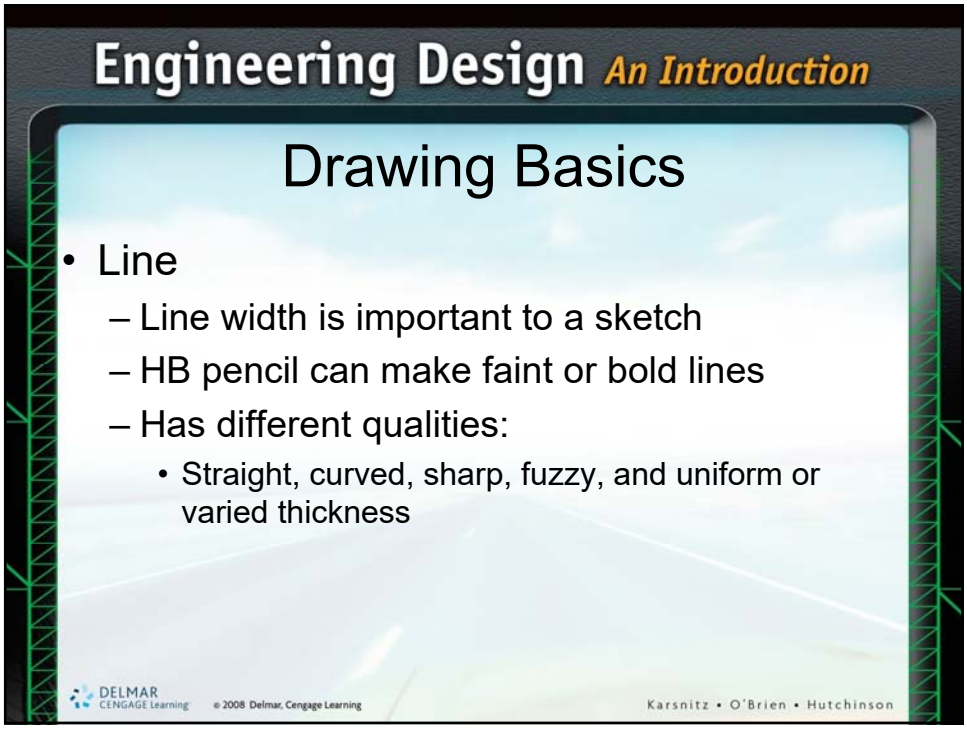
Warm-Up Exercises (cont'd.)

- Exercise 4: Positive and negative shapes

Figure 5-18: Seeing and drawing negative shapes around the scissors.


Engineering Design An Introduction
Drawing Basics
• Line
– Line width is important to a sketch
– HB pencil can make faint or bold lines
– Has different qualities:
• Straight, curved, sharp, fuzzy, and uniform or varied thickness
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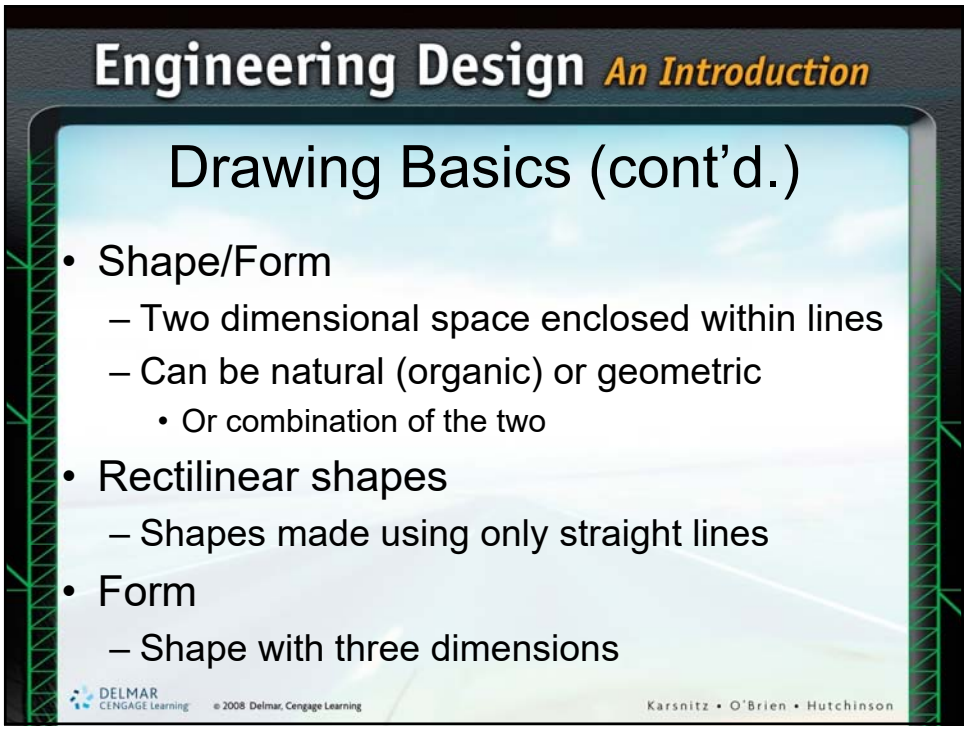
Engineering Design An Introduction
Drawing Basics (cont'd.)
• Shape/Form
– Two dimensional space enclosed within lines
– Can be natural (organic) or geometric
• Or combination of the two
• Rectilinear shapes
– Shapes made using only straight lines
• Form
– Shape with three dimensions
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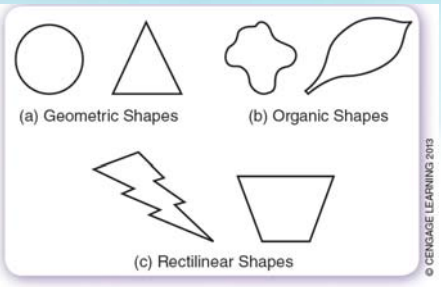

Figure 5-20: Types of shapes.

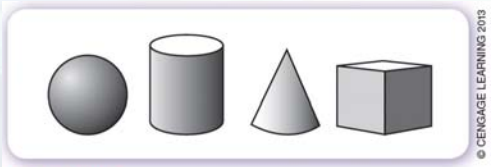

Figure 5-21: Basic forms: sphere, cylinder, cone, cube.

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Drawing Basics (cont'd.)

- Shading
  - Result of light falling on the object's surfaces
- Value
  - Range of shades
  - Blackest black of your pencil is darkest value
  - White of the paper is lightest value

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Drawing Basics (cont'd.)

- Light source and shading
  - Light most often comes from one main source
- Think of light source as coming over left shoulder
- Shade forms along their long axis

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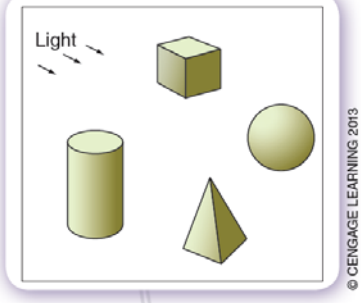

Figure 5-27: The direction of the light coming from the source and the distance from the source to the object affect how light or dark a surface will appear.

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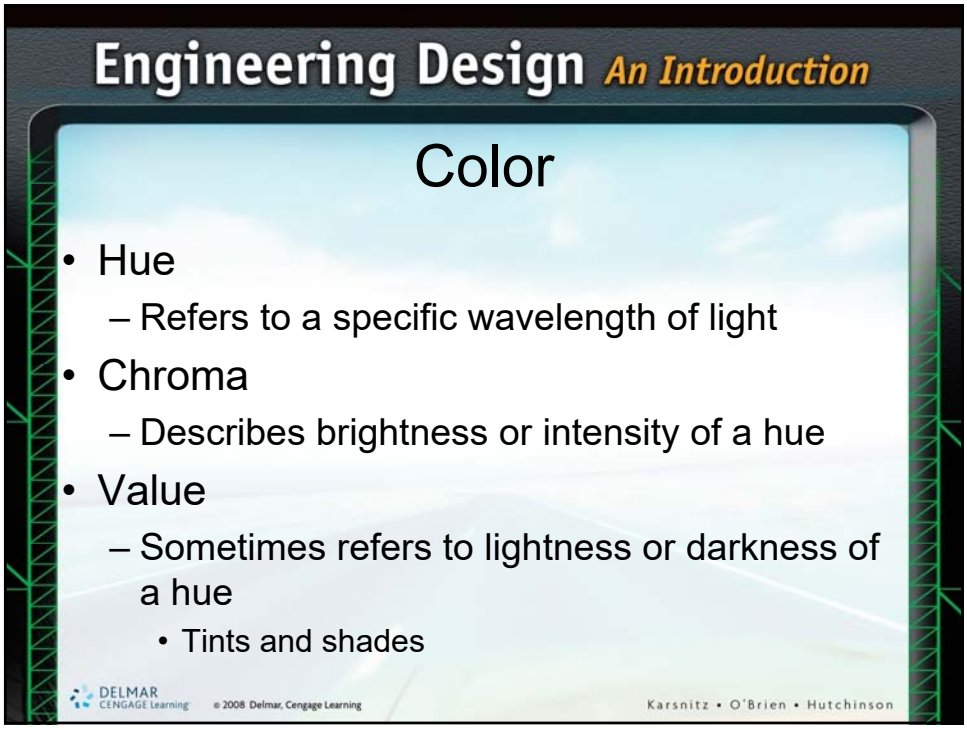
Figure 5-28: Using a pencil to get a blended shade on a cylinder.


Engineering Design An Introduction
Color
• Hue
– Refers to a specific wavelength of light
• Chroma
– Describes brightness or intensity of a hue
• Value
– Sometimes refers to lightness or darkness of a hue
• Tints and shades
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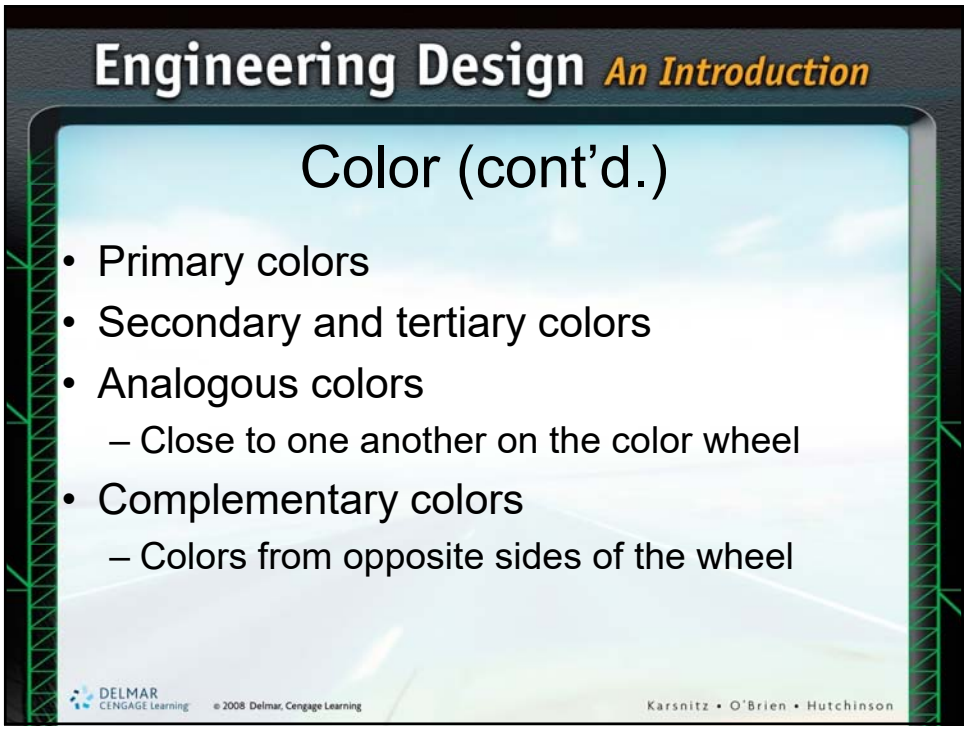
Engineering Design An Introduction
Color (cont'd.)
• Primary colors
• Secondary and tertiary colors
• Analogous colors
– Close to one another on the color wheel
• Complementary colors
– Colors from opposite sides of the wheel
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Texture

- Can be nature of material itself
  - Or result of a production process
- Artists' tricks for simulating texture
  - Make rubbings over an actual texture
  - Scans of real textures

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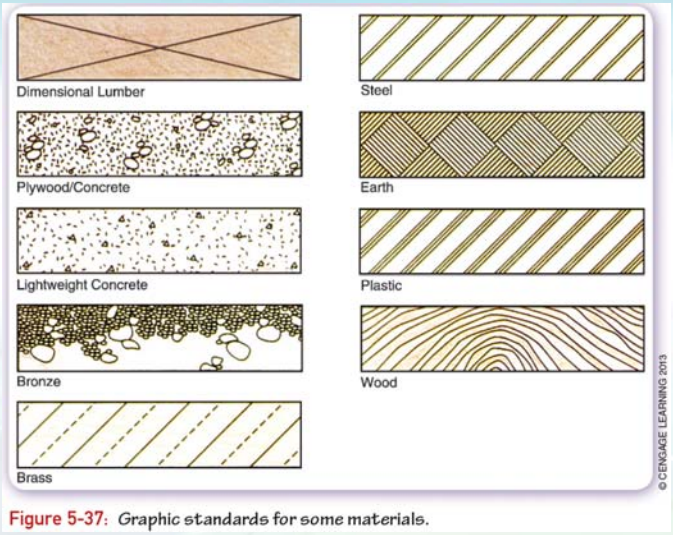

Figure 5-37: Graphic standards for some materials.

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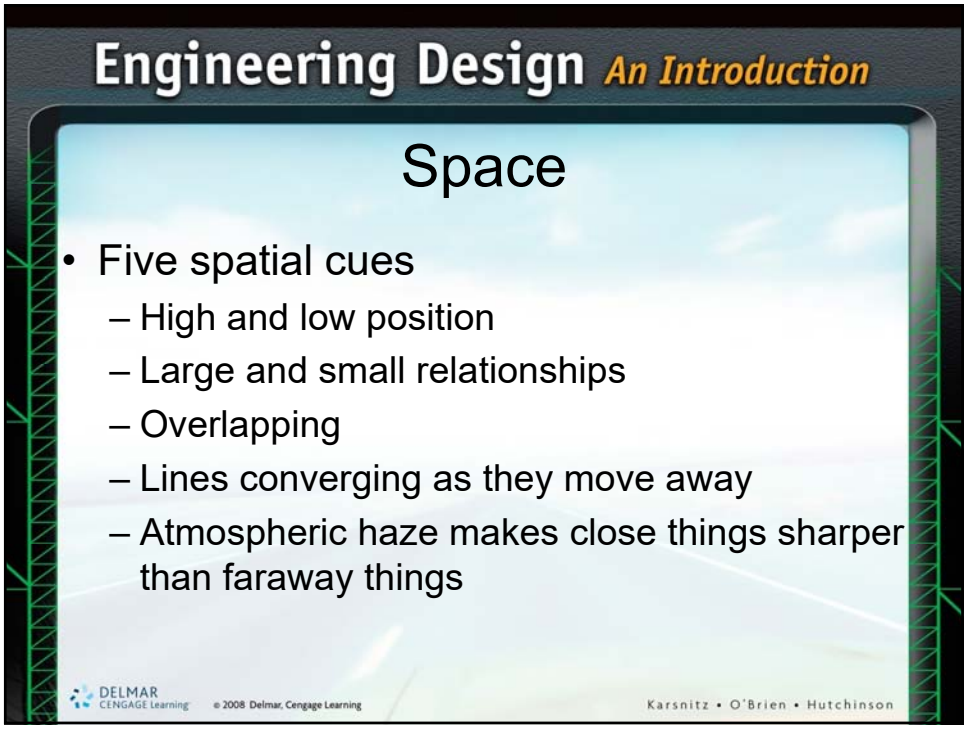
Engineering Design An Introduction
Space
• Five spatial cues
– High and low position
– Large and small relationships
– Overlapping
– Lines converging as they move away
– Atmospheric haze makes close things sharper than faraway things
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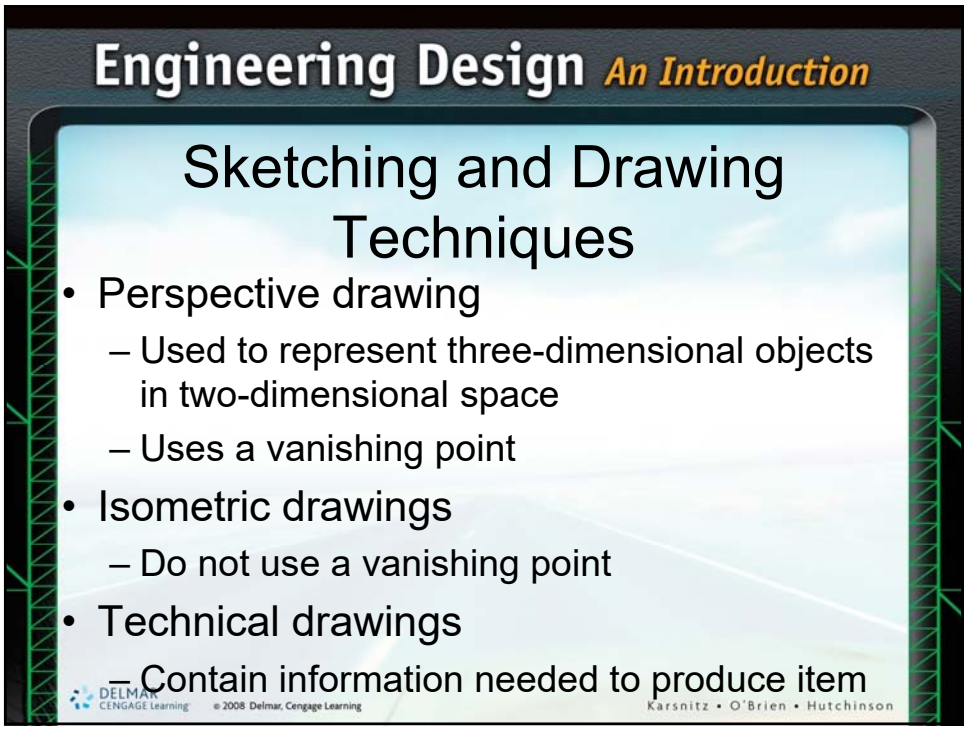
Engineering Design An Introduction
Sketching and Drawing Techniques
• Perspective drawing
– Used to represent three-dimensional objects in two-dimensional space
– Uses a vanishing point
• Isometric drawings
– Do not use a vanishing point
• Technical drawings
– Contain information needed to produce item
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Perspective Drawing

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Figure 5-41: Follow the roof, windows, ends of column, and fence posts to find the vanishing point.

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Perspective Drawing (cont'd.)

- Exercise 5: Cube in one-point perspective

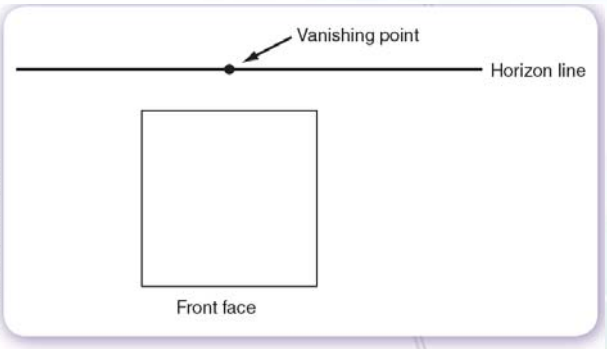

Figure 5-43: Step One

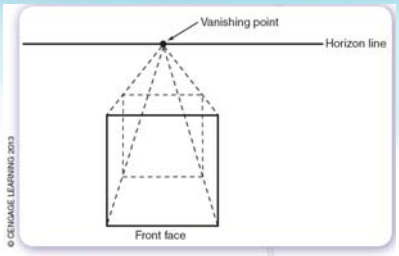

Figure 5-44: Step Two

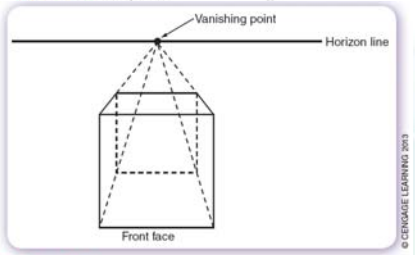

Figure 5-45: Step Three

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Perspective Drawing (cont'd.)

- Interior views
  - Horizon line placed slightly above center
  - Vanishing point centered on this line
- Two-point perspective
  - Viewing at an angle to the object
    - Closest part of object is an edge not a face
  - Placement of horizon line depends on eye level you want to represent

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Perspective Drawing (cont'd.)

- Understanding perspective visually
  - Simple aid: place transparent grid over the scene
  - Helps organize what we see
- Isometric drawing
  - Drafting convention
  - Covered in detail in Chapter 10

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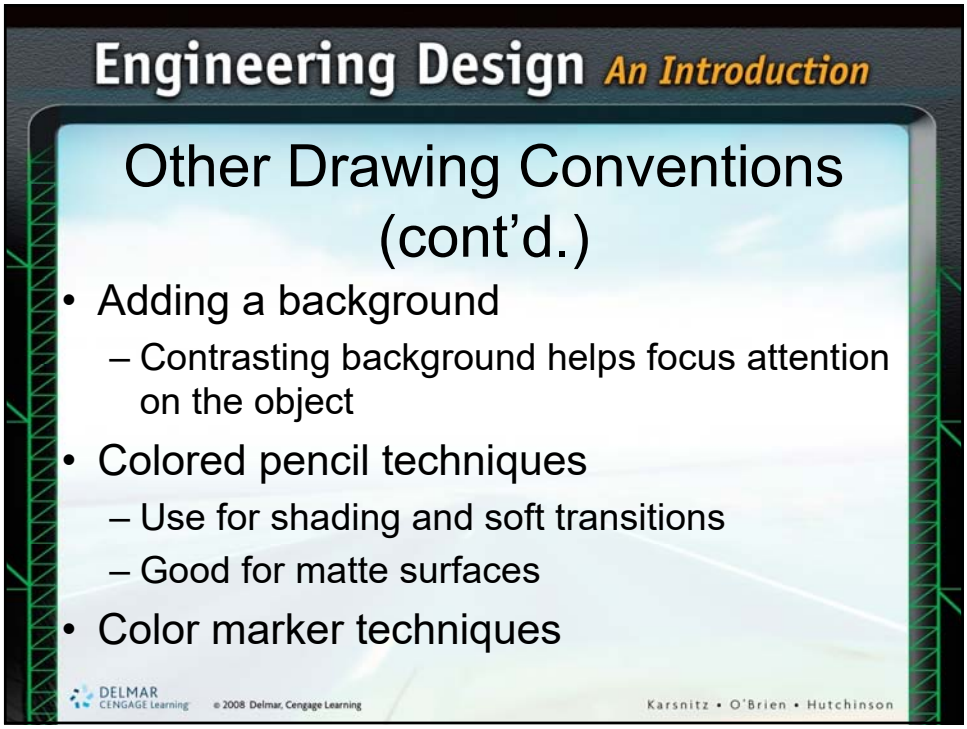
Other Drawing Conventions

- Crating
  - Process of visualizing the object you want to draw inside a box or crate
- Sighting for proportion
  - Visual measurement
  - Helps determine relative points in a drawing
- Outlining
  - Stands out against the background


Engineering Design An Introduction
Other Drawing Conventions (cont'd.)
• Adding a background
– Contrasting background helps focus attention on the object
• Colored pencil techniques
– Use for shading and soft transitions
– Good for matte surfaces
• Color marker techniques
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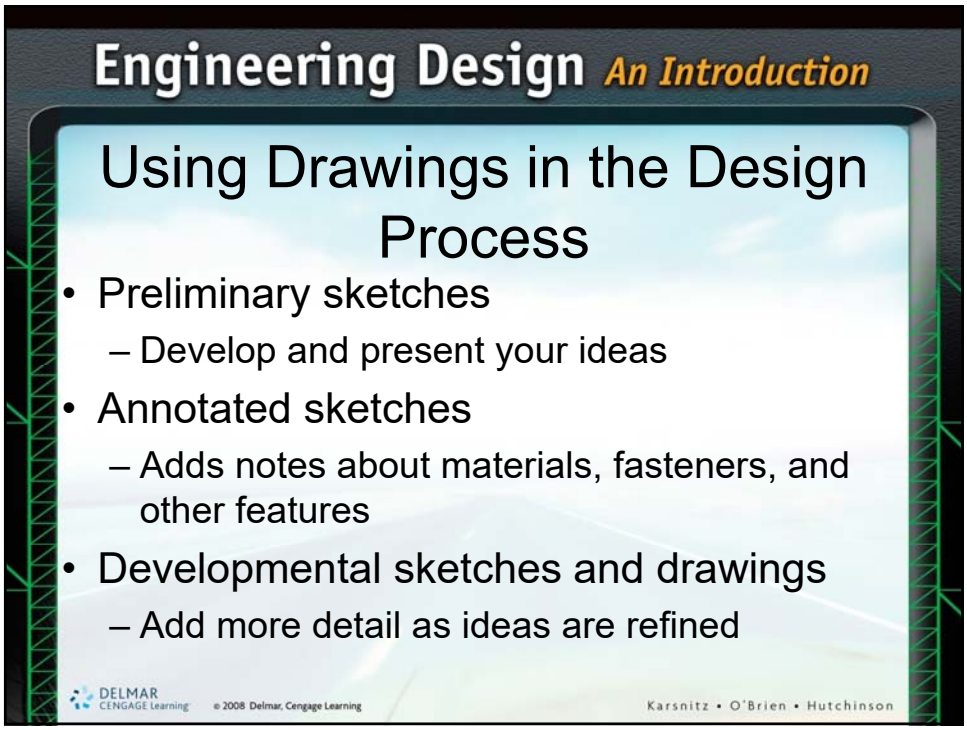
Engineering Design An Introduction
Using Drawings in the Design Process
• Preliminary sketches
– Develop and present your ideas
• Annotated sketches
– Adds notes about materials, fasteners, and other features
• Developmental sketches and drawings
– Add more detail as ideas are refined
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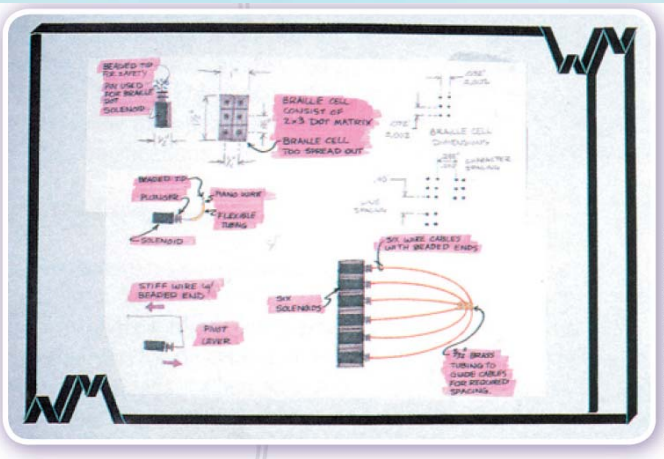

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Figure 5-84: Annotated sketch of computer Braille reader components.

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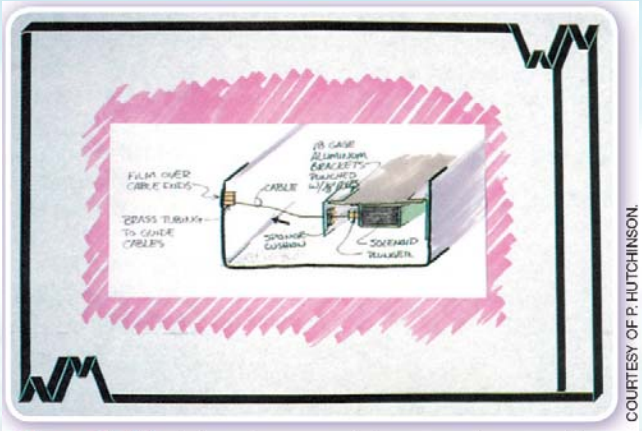

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Figure 5-85: A developmental drawing showing the solenoid control in the final Braille reader system.

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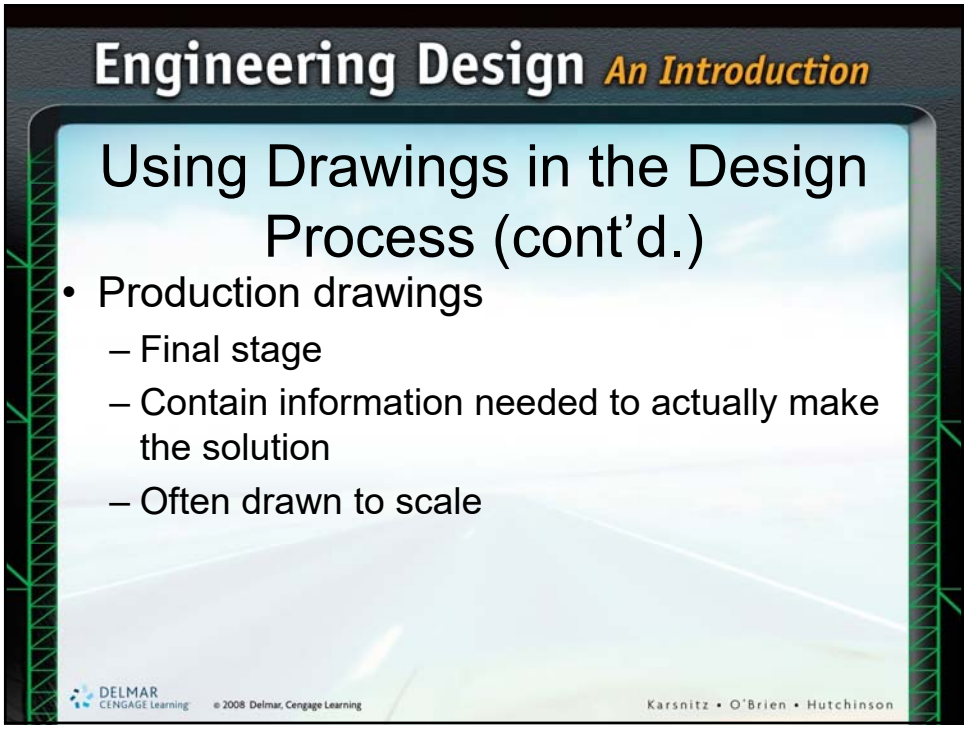
Engineering Design An Introduction
Using Drawings in the Design Process (cont'd.)
• Production drawings
– Final stage
– Contain information needed to actually make the solution
– Often drawn to scale
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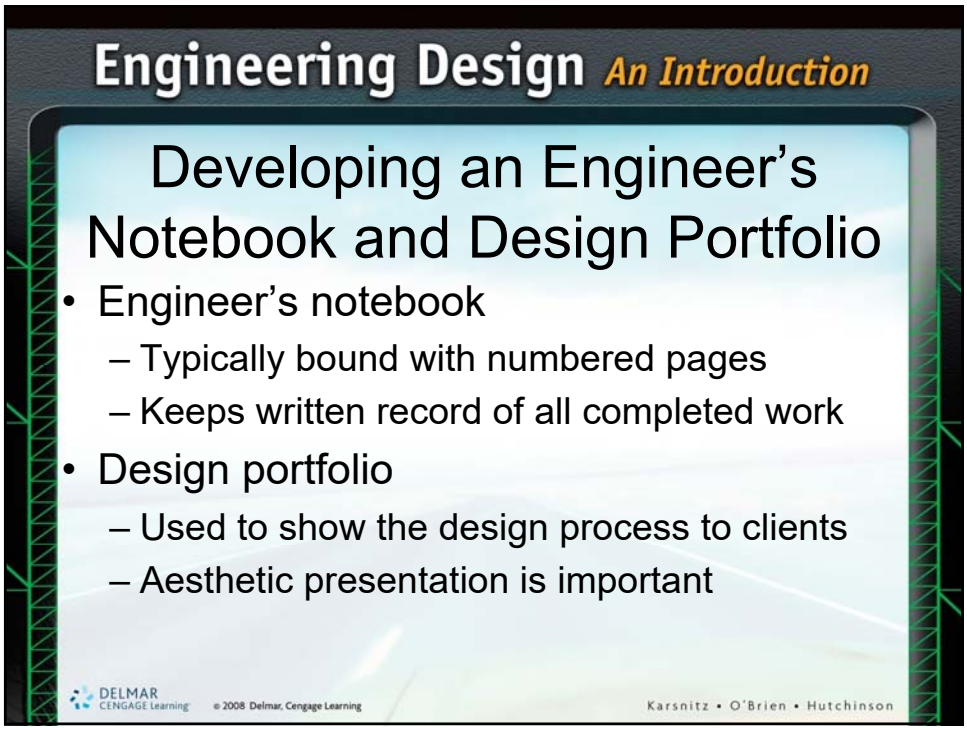
Engineering Design An Introduction
Developing an Engineer's Notebook and Design Portfolio
• Engineer's notebook
– Typically bound with numbered pages
– Keeps written record of all completed work
• Design portfolio
– Used to show the design process to clients
– Aesthetic presentation is important
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Portfolio

- Components of a portfolio
  - Title page
  - Page numbering
  - Table of contents
  - Often landscape orientation
  - Logo
  - Binding on the left side or the top
  - Page content

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Portfolio Page Layout

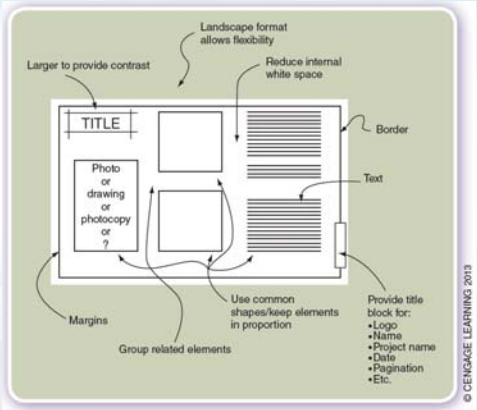

Figure 5-90: A well-organized page is easy to read and understand. It follows rules of alignment.

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