Sectional Views and Conventions

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Describe the purpose of a <u>sectional</u> <u>view</u>.

Select the <u>appropriate type of sectional</u> <u>view</u> to show the <u>hidden feature</u>.



 Show <u>ribs</u>, <u>webs</u>, and <u>fasteners</u> when the cutting plane passes through them.

 Rotate certain features into the cutting plane.

 Describe and use conventional breaks and symbols



 Auxiliary section Broken-out section Conventional break Crosshatching Cutting plane Cutting-plane line Full section Half section Offset section Phantom section

Removed Section
Revolved Section
Ribs
Section lining
Webs

Sectional Views



Technical drawings must <u>show all parts</u> of an object, including

- Insides and
- Other parts not easily seen.

<u>Hidden lines</u> could be used to show hidden features.



 If hidden lines are used, the <u>part must</u> <u>be simple</u>.

 If the <u>shape is complicated</u>, dashed lines may show it poorly.



 Instead of hidden lines a special view called a section or sectional view should be drawn instead.

 A sectional view shows an object as if part of it were cut away to expose the insides.

Trawing Sectional Views

 To draw a <u>sectional view</u>, imagine that a wide-blade knife has cut through the object.

Call this knife a <u>cutting plane</u>.





Fig. 9-9 The cutting-plane line represents the edge view of the cutting plane.



The cutting-plane line represents the cutting plane as viewed from an edge.
 Refer to Figure 9-9, 9-10



Remove everything in front of the plane.

The <u>cut surface</u> and <u>interior parts</u> can be <u>seen</u>.

Trawing Sectional Views

 On a normal view, show where the cutting plane passes through the object by drawing a special line called a cutting-plane line.

Section Views/Cutting Plane Lines

- <u>Cutting Plane lines</u> have two forms:
 - A thick hidden (evenly spaced dashed) line.
 - A phantom line in accordance with ASME Y14.2M.



Section Views/Cutting Plane Lines

 The <u>arrows</u> on the cutting-plane line <u>indicate the direction of sight</u> when looking at the section view.







NOTE: ALL SIZES ARE ESTIMATED, NOT MEASURED.

Section Views/Cutting Plane Lines

 <u>The cutting-plane lines</u> are labeled with letters that relate to the proper section view.

 The section name, <u>SECTION A-A</u>, is placed <u>under</u> the view.











UNIFORMLY SPACED

Section View C

Section Views/Cutting Plane Lines

 The <u>arrows</u> on the cutting-plane line indicate <u>the line of sight</u> when looking at the section view.



Section Views/Cutting Plane Lines

 The <u>cutting-plane lines</u> are <u>labeled</u> with letters that relate to the proper section view.

◆ <u>SECTION A-A</u>, is placed under the view.





 When more than one section view is drawn, labels continue with <u>B-B</u> through <u>Z-Z</u>.

- Section Lines and Material Types

Drawing Sectional Views

 On the sectional view, show the cut surface by marking it with <u>evenly</u> <u>spaced thin lines</u>.

This is called <u>section lining</u> or <u>cross-hatching</u>.



 Section lines may be drawn using <u>different patterns</u> to represent the <u>specific type</u> of <u>material</u>.



 The American National Standards Institute (ANSI) provides many <u>standard symbols</u> to indicate different types of materials.

♦ Refer to Figure 9-2.



CAST IRON AND MALLE-ABLE IRON. ALSO FOR GENERAL USE FOR ALL MATERIALS



MAGNESIUM, ALUMINUM, AND ALUMINUM ALLOYS



STEEL



RUBBER, PLASTIC ELECTRICAL INSULA-TION





BRONZE, BRASS, COPPER, AND COMPOSITIONS



CORK, FELT, FABRIC, LEATHER, FIBER



WHITE METAL, ZINC, LEAD, BABBITT, AND ALLOYS



SOUND INSULATION





THERMAL INSULATION



FIREBRICK AND REFRACTORY MATERIAL



BRICK AND STONE MASONRY



MARBLE, SLATE, GLASS, PORCELAIN, ETC.





ELECTRIC WINDINGS, ELECTROMAGNETS, RESISTANCE, ETC.





CONCRETE



ROCK

EARTH



CAST IRON AND MALLE-ABLE IRON. ALSO FOR GENERAL USE FOR ALL MATERIALS



MAGNESIUM, ALUMINUM, AND ALUMINUM ALLOYS



STEEL



RUBBER, PLASTIC ELECTRICAL INSULA-TION









WATER AND OTHER LIQUIDS





WOOD ACROSS GRAIN WOOD WITH GRAIN

THIN PARTS



 <u>Cross-hatching lines</u> usually are spaced about 0.03 inches to 0.12 inches. (Think 1/8").

Space lines by eye, not by measuring
 Refer to Figures 9-3, 9-4.



Evenly space cross-hatching lines, usually at a 45° angle.

Graying or shading may also be used Refer to Figures 9-6, 9-7





Fig. 9-7 A cut surface may have a grayed outline.
Section Lining Rules



 1. Section lines are placed at 45° unless another angle is required to satisfy the next two rules.

 Avoid section lines placed at angles greater than 75° or less than 15° degrees from horizontal.



 2. Section lines should <u>not be</u> drawn <u>parallel</u> or <u>perpendicular</u> to any other adjacent lines on the drawing.

 Section lines are NEVER drawn <u>parallel</u> to or at right angles to visible lines.
Refer to Figure 9-8







Section lines should not cross object lines.

Centerline as Cutting Plane Line

 A cutting plane line is not needed when it is clear that the section is taken along an object's main centerline.

♦ Refer to Figure 9-11.





Sections Through Assemblies

 If the drawing shows more than one piece in section, draw the section lines at different angles.

♦ Refer to Figures 9-12, 9-13.



Fig. 9-12 Because this sectional view contains two different pieces in section, each piece is sectioned using lines at a different angle.



Fig. 9-13 This sectional view contains three assembled pieces in section, so the section lines are drawn in three different directions.

Outline Sectioning and Graying

V



When the area is large, you can use outline sectioning.

Refer to Figure 9-5



Fig. 9-3 Space section lines by eye. The distance between section lines varies according to the size of the space to be sectioned.





Fig. 9-4 You may blacken in the entire sectioned area instead of using section lines when areas are very small.





Fig. 9-5 Outline sectioning.





Fig. 9-6 A cut surface may be grayed.

Types of Sectional Views



Types of Sections: Full Sections. Offset Sections. ♦ Half Sections. Broken-Out Sections. Revolved Sections. Removed Sections. Auxiliary Sections. Phantom (Hidden) Sections.

Full Sections



 A <u>full section</u> is a sectional view that shows an object as if it were <u>cut</u> <u>completely apart</u> from <u>one end</u> or <u>side</u> to the other.
A <u>full section</u> is a sectional view that

These views are sometimes just called <u>sections.</u>









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The two most common types of <u>full</u> sections are <u>vertical</u> and <u>profile</u> sections.

Refer to Figures 9-17 and 9-18.



Fig. 9-17 Vertical section.



Fig. 9-18 Profile section.





Full sections remove <u>half</u> the object.

 In a <u>full section</u>, the cutting-plane line passes completely through the object along a center plane.



SECTION A-A

Section-view label

Section

lines



 Sectioning is also used in other drafting fields, such as <u>architectural</u> and <u>structural</u> drafting.

 <u>Cross sections</u> through <u>buildings</u> show the construction methods and materials.

24" MEDIUM CEDAR SHAKES (10" EXPOSURE) 30" FELT EA. COURSE 1 × 6 SPACED SHEATHING 2 × RAFTERS & CLG. JSTS. (OR TRUSSES- SEE ROOF PLAN) R-38 BLOWN-IN INSULATION % GYPSUM BD. CEILING

INSUL BAFFLE @ EAVE VENTS "SIMPSON" H2.5 SEISMIC CLIPS

2 × SOLID BLKG. W/ 2 × 12 SCREENED VENTS @ 6'-0" O.C.

- G.I. GUTTER ON 2 X 8 FASCIA

 $\frac{1}{2} \times 6$ BEVEL CEDAR SIDING 15" BLDG. PAPER (OR TYVEK) $\frac{1}{2}$ " CDX PLYWOOD SHEATHING 2 X 6 STUDS @ 16" O.C. R-19 BATT INSULATION $\frac{1}{2}$ " GYPSUM BD.



Offset Sections



- In <u>full sections</u>, the cutting plane is usually taken <u>straight</u> through the object.
- Offset sections are almost the <u>same</u> as <u>full sections</u>,
 - Difference: the cutting-plane line is staggered.

The line cuts through features that are not in a straight line.



The cutting plane can also be <u>offset</u> or <u>shifted</u> at one or more places <u>to show a</u> <u>detail</u> or <u>to miss a part.</u>
Refer to Figure 9-19.
The cutting plane is offset to pass through

the two bolt holes.

***** Offset Section - Figure 9-19




Half Sections



A <u>half section</u> is <u>one half of a full</u> <u>section</u>.

 A <u>full section</u> makes an object look as if <u>half</u> if it has been cut away.
 Refer to Figure 9-20.

 A <u>half section</u> looks as if one <u>quarter</u> of the original object has been cut away.



The term <u>half section</u> is used because <u>Half</u> of the view appears in <u>section</u>. The other <u>half</u> is shown as an <u>exterior</u> <u>view</u>.





The half section shows one half of the front view in section. Refer to 9-20 E.



Half sections are commonly used on symmetrical objects.

Both the <u>inside</u> and <u>outside</u> can be <u>shown in one view</u>.



 A <u>centerline</u> is used to separate the <u>sectioned part</u> of the view from the <u>un-</u> <u>sectioned part</u>.

 <u>Hidden lines</u> are normally omitted from the un-sectioned side.

Half Sections - Figure 9-20

 Use a centerline where the exterior and half-sectional views meet since the object is not actually cut.





 In the top view, <u>show the complete</u> <u>object</u>, since no part is actually removed.

Use <u>one arrow</u> for the direction of viewing.

Half Sections - Figure 9-20





Half sections show one-quarter of the object removed.

The term <u>half section</u> is used because
Half of the view appears in section.
The other half is shown as an exterior view.

Broken Sections



 A broken-out section shows an object as it would look if a portion of it were cut partly away from the rest by a cutting-plane and then "broken off" to reveal the cut surface and insides.
 Refer to Figure 9-21





Broken Sections - Figure 9-21





A broken-out section show some inside detail without drawing a full or halfsection.



The broken-out section is bounded by a <u>short-break line</u> drawn freehand the same thickness as visible lines.
 Refer to Figure 9-22



 <u>Broken-out sections</u> show only a small portion of the object removed.

Broken-out sections clarify hidden features.

Broken-out Sections



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Broken-out Sections



FRONT VIEW WITH BROKEN-OUT SECTION





Fig. 9-22 Two additional examples of broken-out sections.





Aligned Sections



 <u>Aligned sections</u> are used when a <u>feature is out of alignment</u> with the center plane.

An offset section would distort the image.



 The cutting-plane line cuts through the feature to be sectioned.

 The feature is then rotated to align with the center plane before projecting into the section view.



Revolved Sections



 <u>Revolved sections</u> clarify the contour of objects that have the same shape throughout their length.

 The section is <u>revolved in place</u> within the object, or part of the view may be broken away.



 A <u>revolved section</u> has a cutting plane passing through a part, and then <u>revolved</u> 90° so that its <u>shape</u> can be seen clearly.



Use a revolved section:
When the part is long and thin.
When its shape in cross section is the same throughout.
Refer to Figure 9-25



Revolved Section - Figure 9-24







The view may be shortened.

<u>Give</u> the <u>full-length</u> of the part <u>by</u> a <u>dimension</u>.

This lets you <u>draw a large part</u> with a revolved section <u>in a short space</u>.






Fig. 9-25 Revolved sections in long parts.



Removed Sections



 <u>Removed sections</u> serve much the same function as revolved sections.

The section view is removed from the regular view.



 A <u>removed section</u> is taken from its normal place on the view and <u>moved</u> <u>somewhere else</u> on the drawing sheet.

 A <u>cutting-plane line</u> shows where the section was taken.



 The removed section must be positioned to look as if it were in its normal place on the view.

The removed section cannot be rotated in just any direction !

Refer to Figure 9-26 for examples



 When <u>multiple removed sections</u> are taken, the cutting planes and related views are labeled.

 Drawing only the ends of the cuttingplane lines simplifies the views.





Section A-A



Section C-C















Removed Sections Figure 9-26











Use <u>bold letters</u> to <u>identify</u> a <u>removed</u> section and its corresponding cutting plane.



 A removed section can be a <u>sliced</u> <u>section</u> or it can show additional detail visible beyond the cutting lane.



 When multiple removed sections are taken, the cutting planes and related views are labeled.

 Drawing <u>only</u> the <u>ends</u> of the <u>cutting</u>plane lines <u>simplifies</u> the views.

Special Cases



Certain <u>exceptions</u> are made to the general sectioning rules for:
Ribs and Webs in Section.
Hidden and Visible Lines.
Alternate Section Lining.
Certain Parts usually not sectioned.
Rotated Features in Section.

Special Cases - Ribs in Section



Show <u>ribs</u> as if the cutting plane passed in <u>front</u> of the <u>rib</u>. Refer to Figure 9-29.

Ribs and Webs in Section









 If a cutting plane passes through a rib, a web or other thin, flat part, at right angles to the flat side,

Show the section lines for that part.

♦ Refer to Figure 9-30.





INCORRECT

Fig. 9-30 Web in section.

Sections and Hidden and Visible Lines

Hidden and Visible Lines

Do not draw hidden lines on sectional views unless they are needed for dimensioning or for clearly describing the shape.
 Refer to Figure 9-31A
 A hub is described clearly using no

hidden lines.

Hidden and Visible Lines



Α



PREFERRED HIDDEN LINES NOT SHOWN

Fig. 9-31 Omit hidden lines when not needed for clarity.

Hidden and Visible Lines

 On sectional assembly drawing hidden lines are generally omitted.
 Refer to Figure 9-32.

 Include all lines that would be visible on or beyond the plane of the section.



Fig. 9-32 Omit hidden lines to keep the drawing from becoming confusing.



 In a section view, include all lines that would be visible on or beyond the plane of the section.

Refer to Figure 9-33 and 9-34.





Hidden/Visible Lines Fig 9-33





Fig. 9-33 Show all visible lines beyond the sectioned surface.





Alternate Section Lining



 Alternate section lining is a pattern made by leaving out every other section line.
 Refer to Figure 9-35A & B.

 Alternate section lines are useful to show ribs and other thin, flat pieces in one-view drawings.


LINE

Other Parts NOT Sectioned



 Do not draw section lines on spokes and gear teeth when the cutting plane passes through them.

♦ Refer to Figure 9-36.



Other Parts Not Sectioned

 Do not draw section lines on these objects when the cutting plane passes <u>lengthwise</u> through the object.

- Spokes
- Gears teeth
- Shafts
- Bolts
- Pins
- Rivets

Draw section lines when cut <u>across</u> the axis Sectional Views and Conventions







Fig. 9-38 Section bolts, screws, rivets, and similar parts when the cutting plane cuts the across the axis.



Figure 9-39 shows items that should not be sectioned.



Fig. 9-39 Examples of features not sectioned.

A section or an elevation can be hard to read if drawn in true projection.
It can also be hard to draw.
Refer to Figure 9-40.

 Compare the true projection to the good practice drawings.



Note that only the parts that extend <u>all</u> the way around the vertical axis are drawn with section lining.
Refer to Figure 9-41.
Lugs are <u>rotated</u> to show true shape.



 When a section passes through spokes, do not draw section lines on the spokes.
 Refer to Figure 9-42 A and B





 When drawing a section or elevation of a part with holes arranged in a circle, follow example shown in Figure 9-43.



 The holes have been <u>rotated</u> until two of them lie squarely on the cutting plane.

 This shows the <u>true distance</u> of the holes from the center.







Fig. 9-43 Good and poor practice for showing holes.

Conventional Breaks and Symbols

Conventional Breaks/Symbols

 Conventional <u>breaks</u> and <u>symbols</u> are used to <u>show</u> that a <u>uniform part</u> of a <u>very long object</u> has been <u>cut</u> out of the drawing.

 This makes drawing easier to draw and easier to understand
 Refer to Figure 9-45



Fig. 9-45 Conventional breaks and symbols.



Fig. 9-46 Drawing the break symbols for cylinders and pipes.



 Using breaks lets you draw a view to a larger scale.

Give the length by dimension.

 Symbols for breaks are usually drawn <u>freehand</u>.



 Section line symbols are placed in the section view to show where material has been cut away.