Intermediate Engineering Graphics
5th and 5th Weeks Lecture Notes
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Topic: Sections, Revolutions and Auxiliary Views

1st Subject: Revolutions

Auxiliary view and revolution: as auxiliary view is obtained when the viewer views the object at an angle. Exactly the same view can be obtained by revolving (or the **revolution** of) the object until the side view shows the true size and shape of the object. The direction of such revolution can be **clockwise** or **counterclockwise**. The reversal of the revolution or to make it simple, the action of returning the revolved object to its original "normal" position, is called **counterrevolution**.

In revolution (or counterrevolution), an imaginary axis is assumed.

- **Revolution about axis perpendicular to front plane:** The view that is revolved is always the one where the axis is shown as a point, and this view is not changed in shape and size (in this case, the view in question is the front view). In the view where the axis shows as a line, the dimension parallel to the axis remains the same (The top and side views will change in shape and size but the depth dimension remains the same).
- **Revolution about axis perpendicular to top plane:** similar rules apply. In this case, the top view is revolved about an axis that appears as a point but its shape and size remain the same; the front and side views show the axis as a line parallel to the height dimension which remains the same.
- **Revolution about axis perpendicular to side plane:** similar rules apply. In this case, the side view is revolved about an axis that appears as a point but its shape and size remain the same; the front and top views show the axis as a line parallel to the height dimension which remains the same.

Successive revolutions and projection of views: the object can be revolved through as many stages as desired after the first revolution, and respective projection of view can be generated. In the creation of these views, an important rule must be remembered: Lines that are parallel on the object will be parallel in any view.

2nd Subject: Practical Application of Auxiliary View Verses Revolution

1. **Auxiliary views** are used to show the true shape and size of slanted surface. To correctly draw an auxiliary view, first imagine a "hinge" between a regular view and an auxiliary view in an imaginary glass "box"; then, draw construction lines perpendicular to the slanted edge to obtain the first set of true dimensions; then borrow another set of true dimensions from another regular view. In AutoCAD, this can be accomplished by using Osnaps (Endpoint, Intersection and Perpendicular) construction lines, and "dimension-transfer circles" or offset tool.

- **Three types of primary Auxiliary Views:** the three types of ordinary auxiliary view, the depth auxiliary view, height auxiliary view, and width auxiliary view, are so named according to the principle dimension of the object shown (See handout for details).
  For objects with a slanted surface that is shown as an edge view (EV) in any of a regular three views, a primary auxiliary view is enough to obtain the true shape of that surface.
- **Revolution of auxiliary view:** a drawing containing an auxiliary view can be revolved in such a way that the auxiliary view becomes a regular view and one of the regular views becomes an auxiliary view.
- **Partial and half auxiliary views:** since auxiliary view is primarily used to describe the slanted surface and shapes, a auxiliary view showing only the slanted parts with break lines, or a half view for symmetrical part with center line are good enough in most cases (The non-slanted parts of the object will be "foreshortened" in auxiliary views anyway, so why spend time drawing them? Remember, the purpose of drawing auxiliary views is to show true shapes and sizes!)
- **Auxiliary Sections:** used to show slanted parts with intricate interiors.
- **Secondary auxiliary views:** Secondary auxiliary views are those projected from a primary auxiliary view, and are needed when an object contains slanted not parallel to any regular viewing plane.
  For objects with a slanted surface that is NOT shown as an edge view (EV) in any of a regular three views, a primary auxiliary view is drawn first to obtain and edge view of that surface, then a secondary auxiliary view is drawn upon the edge view to obtain the true shape of that surface (See handout for detail).

2. **Revolutions** are used to:
   - Save time and simplify drawings (See handout for details).
   - Construct a true-length diagram (TL DIAG) for lines that are foreshortened on the regular orthographic views.

   - Show that a part is to be bent after machining (See handout for details).
     Clarify a drawing that would otherwise be confusing and difficult to draw (See handout for details).

3rd Subject: Sectional Views

1. Definition of sectional views: the sectional view, also called a cross section, or simply "section", is a cutaway view of the object, which shows the complicated interiors of the object that can not be shown clearly by means of hidden lines. The sectional view is drawn by assuming that an imaginary cutting plane has passed halfway or all the way through the object, and then removed a part of the object to expose its interior construction.

Sectional views shows the shape of the inside of some object not normally seen; sectional views are especially needed when the inside has some complicated shape which is difficult to show by hidden lines. An imaginary cutting plane is passed through the object to make a sectional view. One part of the object is "removed" in the drafter's mind so that the inside detail can be seen. A full section is one with the cutting plane passing through the entire object. The imaginary cutting plane is shown on the regular view by a thick broken line with long dashes between two short dashes and arrows indicating the viewing direction, plus coded letter above the arrows. The inside surface exposed by the cutting plane is indicated by thin, solid section line drawn at an angle (usually 45 degrees) and spaces between lines may vary from 1/32" for small sections to 1/8" or more for large sections; for average drawing, a spacing of 3/32" is about right. The spacing must be uniform throughout the same section.

2. Five types of sectional views:

a. Full section (the cutting plane is passed all the way through the object),

b. Half section (the cutting plane is passed only halfway through the object; used for objects with symmetrical shapes, combining both sectional and regular views on one single view),

c. Offset section (the cutting plane turns in order to cover several details located at different planes),

d. Broken-out section (part of the object is broken off to show the interior details; thick break line is used instead of regular cutting plane line),

e. Aligned section (used for circular objects; cutting plane turns to align itself with certain features so as to avoid foreshortening in the sectional view).

3. Three important things to remember:

1. Sectional lines should NOT be parallel to any edge line of the object;
2. If two or more parts are included within the same sectional view, then the angles of the sectional lines should be visually different;
3. Sectional views of castings with ribs should follow special conventions so as to avoid misleading (read p239 for details).

4th Subject: Drawing Auxiliary and Sectional Views in AutoCAD

Auxiliary views can be drawn in AutoCAD using a variety of tools and settings, including:
Offset, DDE, Parallel and Perpendicular Osnaps, rotation of the UCS (3P option), etc..

Remember: the TS (true size or true shape) auxiliary view of the surface drawn appear similar to its "foreshortened" counterparts in the regular orthographic views but differ from them in dimensions.

Sectional views are drawn in similar methods as regular orthographic views; but Hatch tool is used to draw sections, Spline tool may be used to draw break lines for broken-off sections, Poliline tool with Width option may be used to draw cutting-plane lines (another way for drawing cutting-plane line: draw a line, draw a dimension and break it apart, move the two arrows to the endpoints of the line and delete the unused elements of the dimension object.

Study Questions:

1. What is revolution and counterrevolution in engineering graphics?

2. When drawing views generated by revolutions, what is an important rule to remember?

3. What are the two major rules governing the revolution about axis perpendicular to planes (front, top and side)? What are their impact on the object's dimension? Please use a stick and a cardboard to play with this engineering graphic game at least ten times!

4. What are the two major categories of auxiliary views?

5. What is the relationship between auxiliary view and regular views? Can they switch roles?

6. Between complete auxiliary views on one side, and partial and half auxiliary view on the other side, which one will you choose under normal circumstances? What types of lines are needed in partial and half auxiliary view to indicate that the views are incomplete? Please explain the reasons.