Engineering Graphics and Design
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Week 3: Projection Basics
Lines

Welcome all. We are on week 3 of Engineering Graphics and Design, where we are looking at Projection Basics. Previous lecture we looked at drawing sheets, the different sizes, scales and the layout. In this lecture, we will be looking at different kinds of lines we use in a typial engineering drawing and how they vary and depending on the application and the need, we use different kinds of lines.

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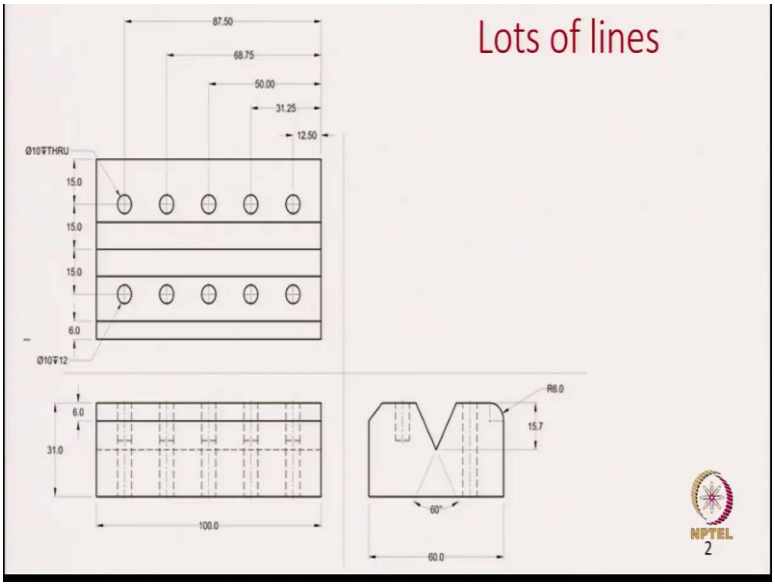

So, let us start looking into them. This is a typical engineering drawing and if you look closely, you see there are lots of lines. So, one you can see the object, so one which is very dark is the object. But in addition to the object, there are several kinds of lines. And what we will do in this lecture is we will go into most of these lines and see when to use these lines and what are the notations or the principles we need to follow when using these lines.

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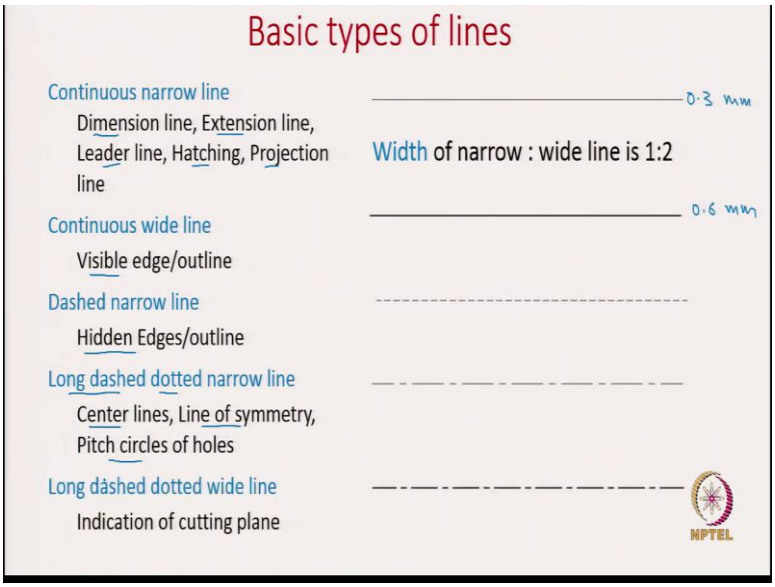

So, to start with there are some very few basic kinds of lines. So, to start with a continuous narrow line as you can see, it is continuous and it is narrow. To contrast it, we have the second line, which is the continuous wide line. So, the difference between these two is the first one is a narrow line which is thin and the second one is wider line, which is slightly thicker. And if you compare the width of these two lines, the ratio is 1 : 2.

Which is means the wider line is twice as wide as the narrow line. The typical width of these lines is about 0.3 millimeters and 0.6 millimeters. So, how do we do different kind of lines? Usually, we have different kinds of pencils like HB, 2H, 3H, 2B pencils. So, we need to pick a appropriate pencil for a wide line and a appropriate pencil for the narrow line. So even within this narrow line we see there are different applications.

For example, for dimensions, for extension lines, leader, hatching, projections, we use these narrow lines. And the wide lines we use for visible edge and outline. So the more details of it, we will have in the following slides where we will give it with examples. But what we are trying to capture in this slide is to say what are the different basic kinds of lines we use.

So, the third category is this dashed narrow line, so again it is a thin line, only thing is it has several dashes and we use these to represent hidden edges and outlines. Another variation is long dashed and dotted narrow line. So again, it is a thin line where you have a long dash followed by dotted, again long dash dotted which keeps repeating. We use these for central lines, line of symmetry, pitch circle of holes. We will look more into it later.

And the last category, I am showing is this long dashed dotted wide line. Again, we have this thick line. The difference is now we have this long dash, dot which are repeating using a thicker line. These are used for indicating cutting planes. So, to the rest of the lecture, we will be looking at different applications where we use these five different combinations.

Before I move, I need to mention that there are many other different kinds of lines, a combination of dash, dot, small dash, long dash, thick, narrow line and a wide line. But this being an introductory course, I picked only the ones which are most commonly used. Of course, we can go back to references or engineering standards to look into different kinds of lines because the use of these lines change from application to application.

So for example in the construction industry, their choice of lines are different from a mechanical industry where their choice of lines are slightly different. In this lecture, I will be following the conventions used in the mechanical components, but one can easily refer to any of this engineering standard to see what kind of lines you need to use for a particular application like construction, electronic or any other specific applications.

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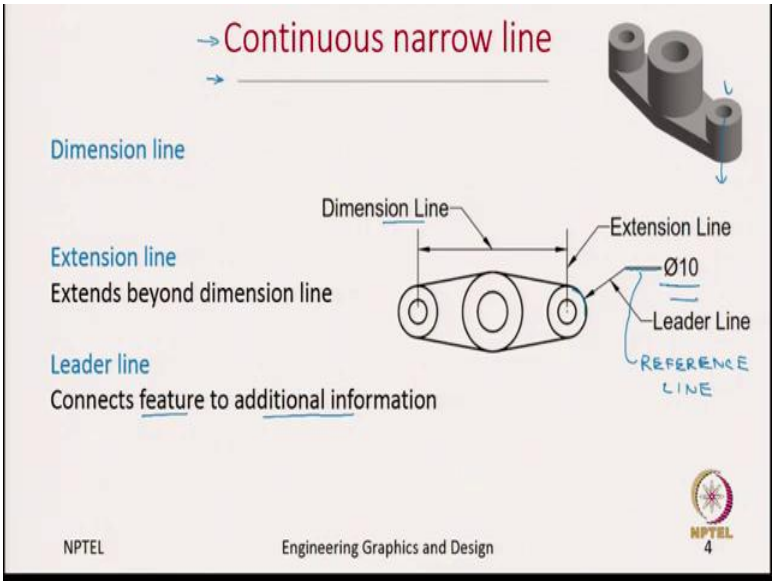

So let us go into the applications. So let us start with this continuous narrow line. Here is the line we have showed in the previous slide. Here is a pictorial or a 3D solid and what we have here is the top view of the solid. So, in this solid we are using three different kinds of lines which I will try to show. So first is the dimension line, which is used to show at least in this case how far these two small holes are placed.

So, the spacing between two holes is showed using this dimension line and to help with this dimensioning, we use a different line called an extension line. So, what this extension line does? It extends beyond the dimension line. So, it starts from the center of the hole feature with a small gap and then goes to the drawing line and extends slightly beyond the drawing line. So what is this extension line doing, it is helping us to come with these dimension lines.

And the other line we are showing is the leader line. So, what does the leader does? It connects the feature with additional information. For example, here what is it doing? So, it is showing this feature, this circular hole. And what is the information it is giving? The information it is giving is this phi is a simple use to mention diameter. So, it says the dimaeter of the circular feature is 10.

So, what we have is this leader line which is pointing out to the feature and this horizontal line though not mentioned here, this is the reference line. So, either on the top of this reference line or to the next of this reference line, we provide the information. In this example, we only provided that this diameter is 10 units.

But you can provide other information like let us say you can say that there is a hole, the depth of the hole is so and so units like 5 units or you can say that this hole is through hole, which means, this hole at the top goes all the way to the bottom, so which we cal it as a through hole. So, all that information can be given. So, if you have more information basically you need to mention it in multiple lines.

There are other slides where we will show that information. Here I am just trying to give you a brief introduction of these leader lines.

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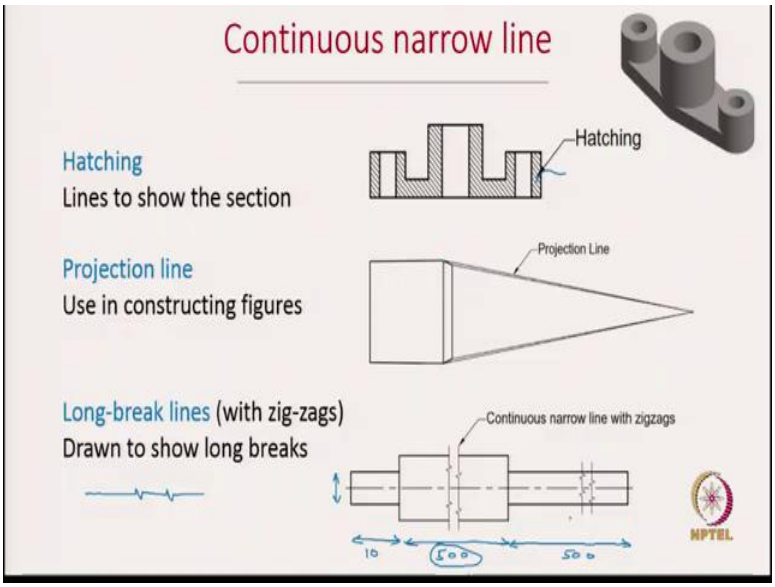

So, we use these continuous narrow lines for other applications too like for hatching. So, let us say we cut this object using a vertical plane, we cut this object and this sectioning, the cutting what we call is, in engineering we call it as sectioning; so, we section this object into 2 equal pieces and wherever that sectioning makes a cut with the material we show with this hatching.

So, this hatching, again we use this continuous narrow lines, as you can see these are a series of parallel lines, wherever you see this hatching you know that when there is a sectioning that sectioning or the cut really cuts a material piece. We also use it for projection lines. I think in week 2 we have talked about projectors. Projectors are the lines which connect your, a point on the object to the eye or observer through the projection plane.

So, even for these we are using these narrow or thin lines. And here we are discussing about long break lines. So, how do we define long break lines? These are like continuous narrow, line in between you have this zigzag. And why do we use this, to show long break. So, for example, let us say, this dimension is like 10 millimeters, but this dimension is very large, let us say like 500 millimeters.

So, if I really show all the 500 millimetes, then it will be too long, the object will be too long and probably it is not necessary because there is not much information, so you need to simply cut it down using this continuous narrow line with zigzags and then show. Basically,

essentially what it says is between these two zig-zag lines there is material and there is no big difference, so probably the same cross section continues.

So, by use of these lines, we are able to show this very long object in a reasonable dimesion, but then we are in the height direction, the dimensions do not change. So, wherever there is a cut, though here we write it as 500, in reality it might be just like 50. So, we are showing it as may be 50 millimeters, but the actal object is 500, that is what we write in the dimension. The same thing with the other feature here, so probably here again it is 500.

But here maybe I used only like 50 millimeters to show this feature. So, this helps when we are drawing large components which are very long in one dimension.

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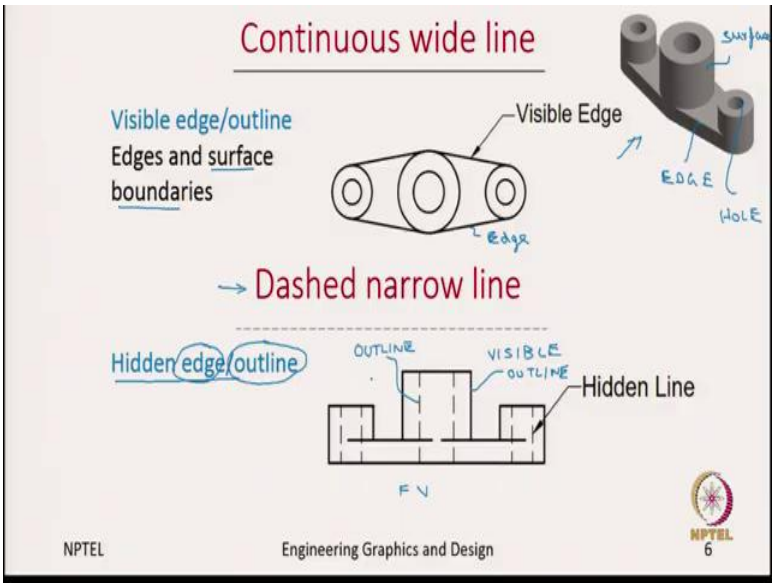

So now we are switching gears. Until now we are looking at narrow lines. Now we start looking at wide lines. Where do we use? So, we use them to show visible edges and outlines. So, when we look at any object, we first get an idea of that object by looking at the outline. So, for example, this 3D model here, if I am looking from the top what I look at is the edges. So, for example, this is an edge.

So, if I am looking from the top, I can look at this edge and I need to show that edge here. But there are other features which are not edges but outline. So, let us say, if you are looking the same object from the frontview. If you are looking it from the frontview, this is a cylindrical surface. But still you represent this cylindrical surface using vertical lines.

Those vertical lines are outlines because they have no edges because it is a smooth thing, but still you can see it in the frontview. So, this is what I am trying to show saying that this is a visible outline. So, because this line does not corrrespond to any sharp edge on the object but it represents the boundary – a surface boundary.

So, as you can see since you are using a wide line, compared to all other, most of the lines which are thin or narrow, this feature pops up. So, once you look at any drawing, you will be looking at the wide lines first which means you will be looking at the edges and the outline of the object first because we need to capture the object and then go into the details; that details can be like holes or hidden lines or dimension.

So, the next category is the dashed narrow lines which we use for hidden edges and outlines. So, for example if I am looking from the frontview, this is the frontview of this object, so this hole, the hole here, looking it from the front I cannot see it because I only look at the front face, but still, you know that there is a hole here, so how do we show that information. So instead of using continuous lines, we use this dashed narrow line.

So, once we have a dashed narrow line we know that there is some hidden feature, which you are trying to show with these hidden lines. And again there is edges and outlines. As I already mentioned edges are vents, you have a sharp edge on the object and outline mostly shows you the surface boundaries. So, for example, here can you guess what this is?

Is this an edge or an outline? So, this should be an outline – hidden outline because there we are only looking at this inner surface of this hole, there is no sharp edge but it represents the boundary of the curved surface

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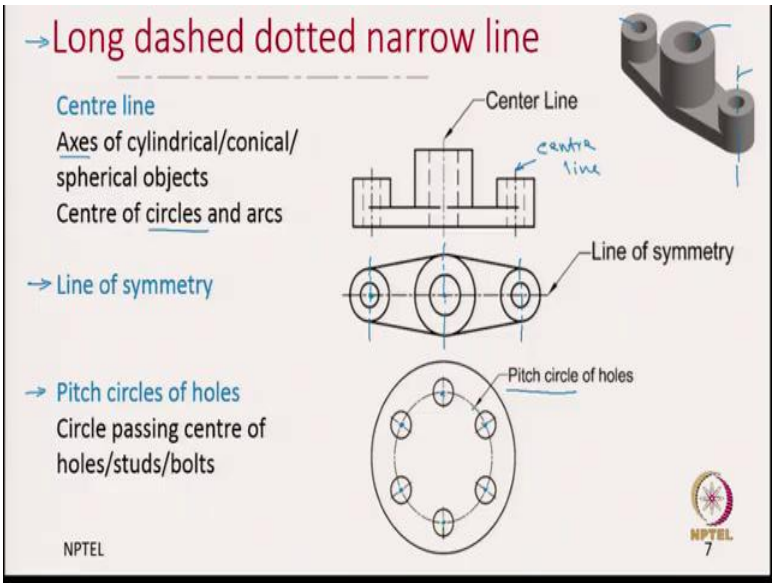

So, now we look at a different category called this long dashed dotted narrow lines. So, where do we use this? First, we look at central lines. So, what are central lines? These are axis of cylinder or a conical or a spherical object. At least in this case, what we have is a axis of these hollow hole. So, this axis is shown here as a central line. Similarly, you have one more axis, for this bigger hole and one more for the smaller hole.

So, we can also use this central lines to show the center of circles. So, for this previously, we had this top view, probably I have this picture. So, in the topview, how do I show that this is the center of this hole? Then what I need to do is I need to use this combination. So, this long dashed dotted lines. So, one if I have vertical and one if I have horizontal that intersection will tell me it is the center of this hole.

So, though I have not shown it here, one has to show them because that helps you to locate the center of the hole. The next category is this line of symmetry. So, in this object we can see there are many symmetries, but this is one line of symmetry, basically previously if you remember, this is the line of symmetry we used to section the object.

So again, we can use the same long dashed dotted narrow lines to show the line of symmetry. We can also use this line to show the pitch circle of holes. So, for example, here you see this is a different object where there are how many – 6 holes and what is interesting is all these holes, the center of the holes especially, the center of all the 6 holes they fall on a circle.

So that circle we call it as the pitch circle. So, it is the circle that passes through the center of these holes. It can be a hole, stud or a bolt. So, let us say for an engine block we use bolts. So, it can be center of those bolts. So, if you have a circle connecting those centers which we call is the pitch circle, again we can show it with this line.

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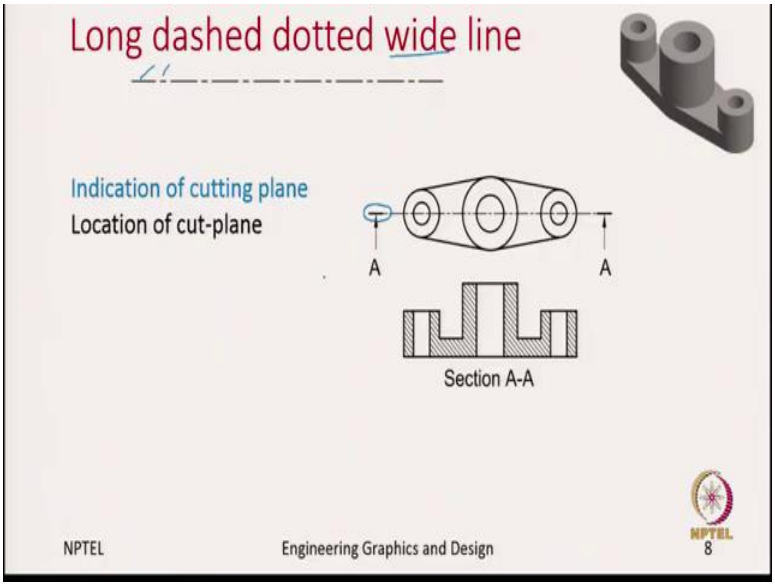

So lastly, we have this long dashed dotted wide line. So again, wide line meaning thick lines we are using and we have this long dash, short dash, which are repeating again. So, we use these to indicate the cutting planes. So, previously we said we are sectioning this object. How do we mention that we are sectioning this object? – By drawing a line.

So, as you can see at the edges of these lines, we have this wide line and again these lines have these long dashed, dotted, long dash which are repeating. So, this represents the line about which we are cutting this object into 2 pieces.

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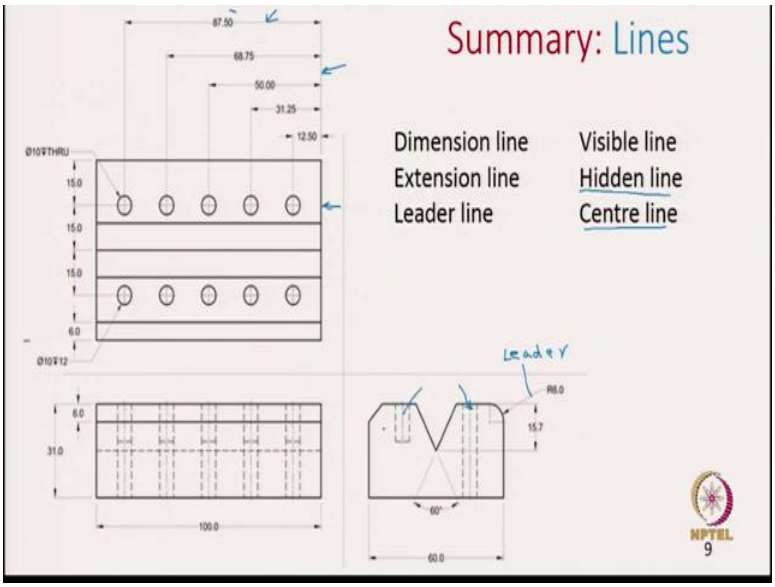

So, let us see in summary what we have learnt. So again, we are looking back at this engineering drawing where we have, we said there are lots of lines. Now after going through the commonly used lines, we can make some sense of what each of these lines are and how they are different from each other. So, for example, we know this is a dimension line. We know this as an extension line. Do we have a leader here? Yes. This is the Leader line.

And similarly, we have these visible lines which are dark. So, the boundaries of the object which we call it as visible lines by edges or outlines, which we have it dark because if you look at the engineering drawing from a hands distance, your eye should follow the object first and then to the background information about dimensions and all other stuff.

So, we have these visible lines and we say that there are some hidden features which you may not be able to directly see but you know that there is some feature behind it which you want to convey. For that we use these dashed lines in narrow lines – dashed narrow lines and finally we said, we also need to show the center of the line.

So, for example, here is a cente line showing the axis of this hole, similarly, there are plenty of other centre lines we have. So, I think what we have learned in this lecture is looking at an engineering drawing, we know we can identify what are the different lines used in it and we also know the meaning of each of these lines.

So, when we read these drawings, we exactly visualize this object as was perceived by the person who was initially drawing these drawings. So, with this we come to the end of this lecture. In the next lecture, we will be looking at dimensons.