**Engineering Graphics and Design**
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**Week: 03**
**Lecture: 01**
**Drawing Sheet: Size, scale and layout**

Welcome to week 3, where we discuss about Projection Basics. In the previous week, we have looked into different kinds of projections, multi view projections, isometric projections, oblique projections and perspective projections. We concluded saying that we mostly use the multi view and the isometric view projections. We also discussed about sketching and visualization and few exercises about how to do freehand sketching, and how to enhance our visualization using few activities.

In this week, we will be going into a little formal aspects of this Engineering Drawing. We will be starting with the drawing sheet; we will look at what are the sizes available in the drawing sheet. And if you are drawing, what scale you will choose to depict your object, as well as the layout of the drawing sheet to know what are all the details you can find once you look at a drawing sheet.

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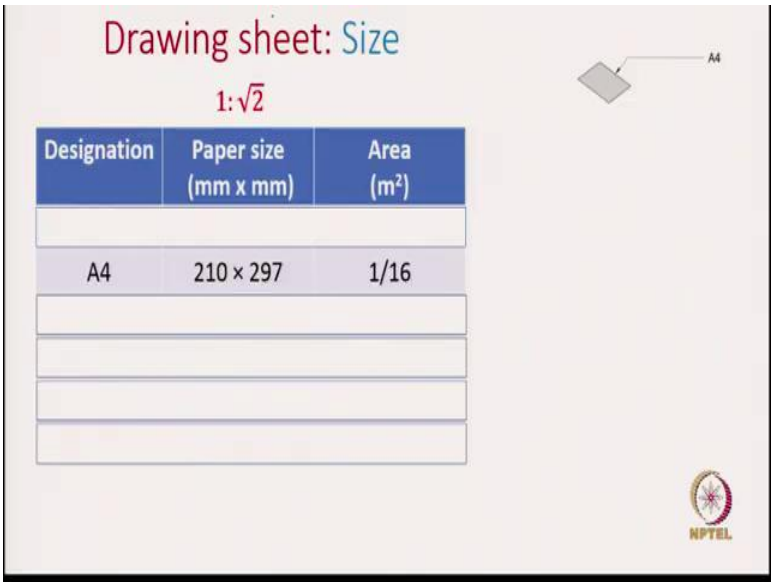

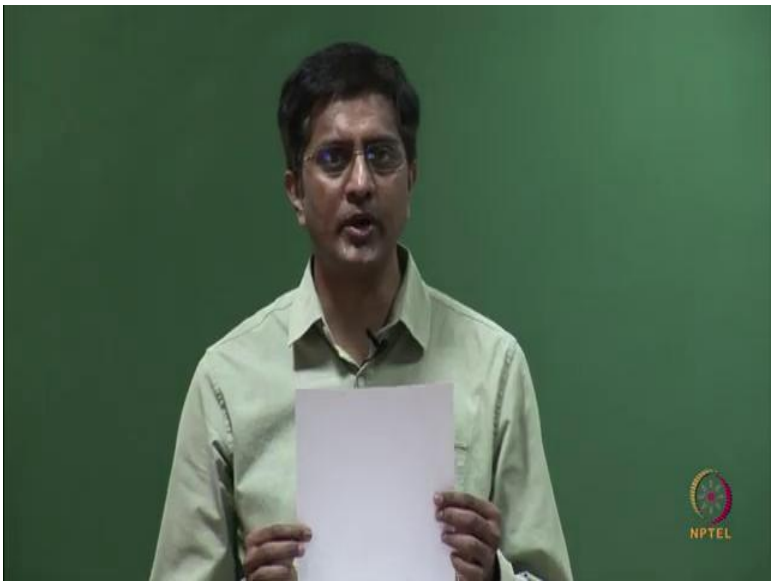
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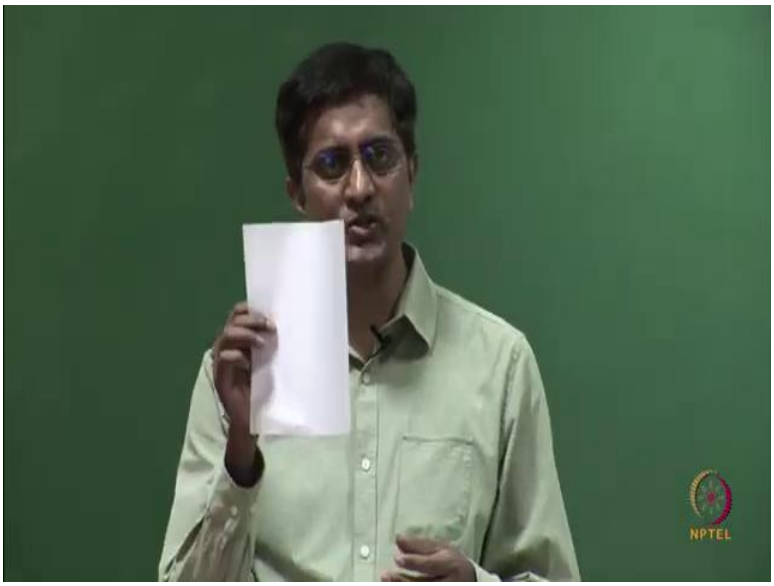
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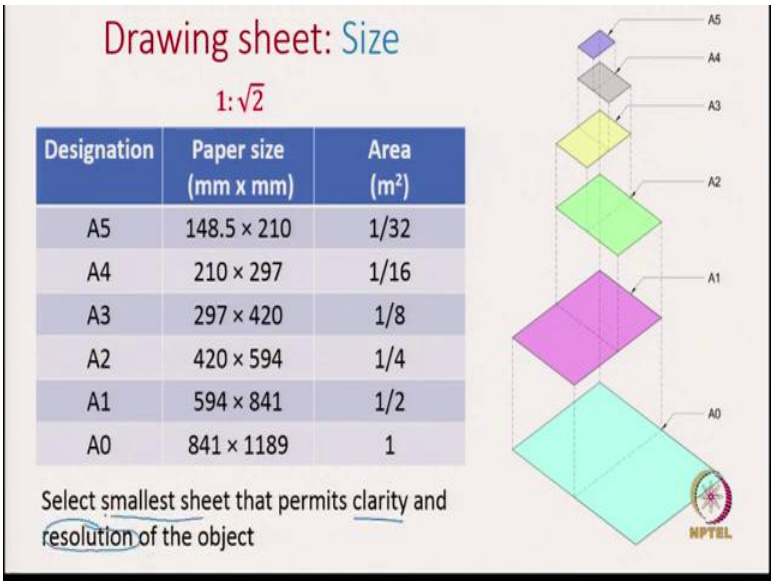


So, let us start with the size of a drawing sheet. I am sure all of you know A4 sheet. So, this is a typical sheet where we take photocopies so the dimensions of this sheet are 210 by 297 in millimeters, if you are wondering why these numbers are these random, or is there anything meaning into it, first thing to know is the ratio of these dimensions are 1 is to root 2. So, the shorter is 1 and the longer one is root 2, which is close to 1.4.

And the area as you can see here is 1/16 th of a meter square. Now let us see, this is A4 what the other sheets which are available. So, the first thing is, let us say if you want to go to a smaller sheet than A4 then what we have is A5. So, essentially, what we are doing is we are folding this A4 sheet into half the area. So, as you can see, I have folded it about the length. So, the length will be half, but the width will now become the length in A5. And therefore, the area as you can see is 1 /32, which is half of A4. Usually, we, in drawing we use sheet sizes which are larger than A4. So, let us look at what is the next larger than A4, as you can guess it is A3. So, in A3 what we are doing is essentially we are taking two A4 sheets and joining them along the longer edge.

So, since you are taking two A4 sheets, the area is twice and you will see that this dimension of 297 is common and we have the longer length is 420 now, twice the 210 width in the A4 and again the area keeps doubling. So, as you go to the A3 and then A2, A1 in every step it doubles the area doubles. So, now let us like look at A2. So, again, this green one show A2 which is double that of A3, the so on and so fourth.

So, A1 again is double of A2 and A0 is again double of A1. So, as you can see A0 is the drawing sheet which has the area of 1 meter square. And then as you go smaller, it becomes half, one half, one fourth and so on and so forth. So, what we are shown here are the typical drawing sheets used. It is not that these are the only sheets which are used in practice. Sometimes you may want a longer sheet because probably the object you are trying to depict maybe of longer dimensions.

So, in those special cases you look into different special drawing sheets, but what we are looking here is the very commonly used drawing sheets. So, you might be having a question. So, if we have too many options to pick up which drawing sheet should you choose? So, a guideline is you should pick the smallest sheet that permits clarity and resolution. The key words here are clarity and resolution.

The point is not to minimize the area and all. But to focus on clarity, am I able to show all the features of my object in a particular drawing. And is the resolution of these features good enough so that one can understand by reading the drawing. So, depending on that, and depending on the object you pick. We tend to choose different drawing sheets.

Typically, in engineering colleges, we tend to use A2. But as A4 is quite common, we can also do for A4, but it all depends on the kind of object you are practicing. Typically, in this course, we suggest using A3. But of course, as I say, there is no hard and fast rule, depending on the object you are depicting, and the purpose of why you are drawing these objects that should dictate which drawing sheet you will choose for a particular drawing task.

So, for example, let us say I need to depict a large object such as a car, an aero plane or a ship. Of course, we cannot draw to full scale, which means I cannot show the same scale on a paper. At that time, what I need to do is I need to make a drawing which is smaller than the original object.

So, for that, what happens is we need to discuss not just about the drawing sheet size, but also about the scale.

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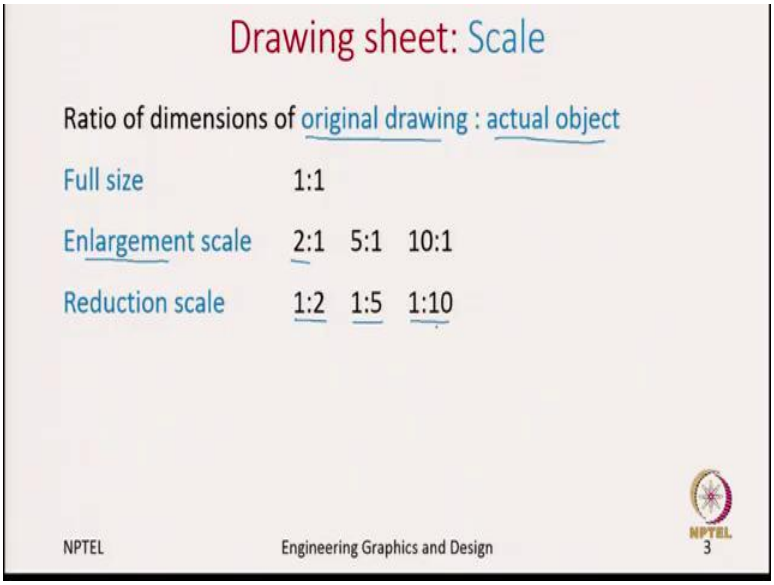


So, what do we define by scale, we say it is the ratio of the linear dimensions between the original drawing and the actual object. So, here we have three options. So, either we can do full size scale, which means 1 : 1.

Let us say I am drawing to depict this pen on an A4 sheet. So, the dimensions are quite convenient for me to pick a full size, which means let us say the length of this pen is 15 centimeters. I will show the exact dimension of 15 centimeters on the drawing sheet also. So, then, we call this as full size.

But there are other scenarios. So, first let us look at enlargement. Here, what we are trying to do is the drawing is made at a bigger scale. So, let us think about a electronic chip. So, let us say usually the dimensions are about 20 by 20 plus or minus 20 by 20 millimeters. But then there are plenty of information to show if you want to show the electrical circuits or the electronic circuits, then you may want to choose to enlarge the chip.

So, that you can show those details more clearly. So, then, the question is to say. Now, I know that I need to draw a bigger drawing, but how big should I draw? Again, you should go by the principle we discussed previously saying that, what is the purpose of you drawing this and then can you convey this information using your particular sheet, depending on that you choose which enlargement scale you will choose?

So, it can be 2 : 1, 5 : 1 or 10 : 1, these are the recommended sizes. But of course, you can go in the multiples of 10, like 20 : 1, 50:1 or 100 :1 and even bigger, depending on the application. For example, if I am talking about men's devices, where the dimensions are in the order of microns tempo minus 6 meters, then you need probably hundred, thousand of these kind of enlargement skills.

The same with nano devices. And the opposite extreme is the reduction scale. So, the examples of depicting a car an aero plane or a shape on an engineering drawing. It is very hard to have a big sheet drawing sheet which will capture the whole object. So, usually what we do is we draw a small drawing. What we are trying to do is we are trying to shrink the object onto the drawing sheet.

So, the common notation is to use 1 : 2, 1 : 5, and 1 : 10. Of course, depending on even 1 : 10 may not be sufficient because let us say for a sheet probably it is like 100 meters long, even 1 : 10 it will make it the drawing should be 10 meters long. So, even that is not sufficient. Maybe then you can go to 1 : 100 or maybe more than that.

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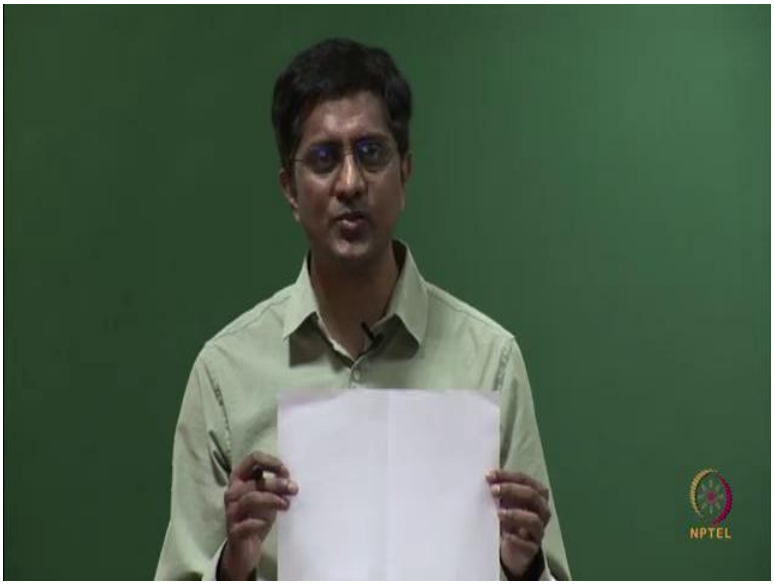

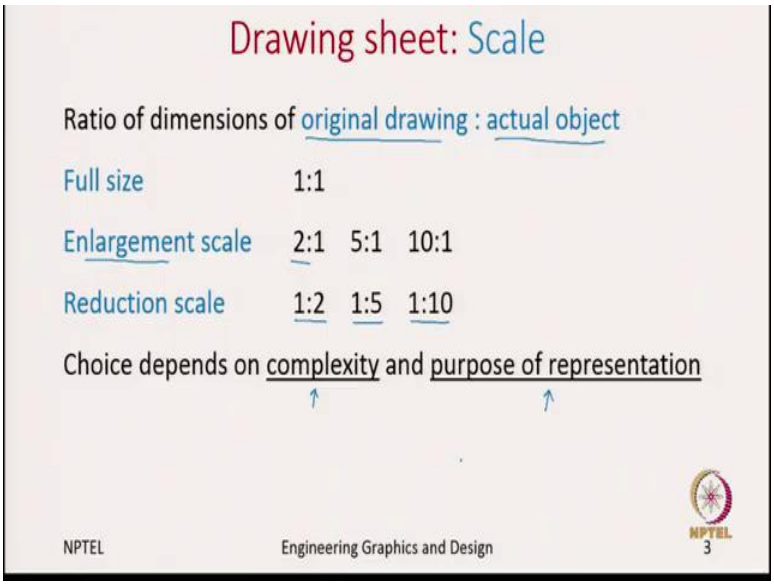


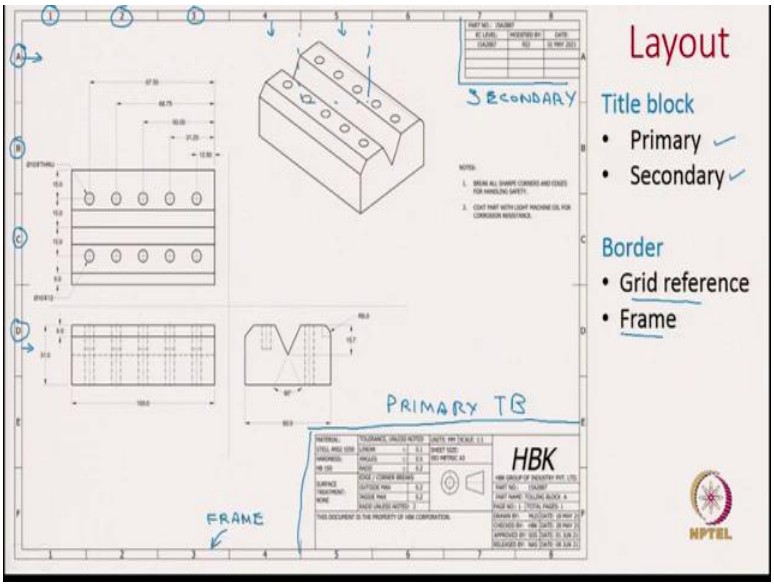


So, the idea is to say you can the actual object dimensions might be very big or very small, but to bring it meaningfully onto a paper your engineering drawing, you can either use the enlargement scale for very small objects or the reduction scale for very large objects. So, again, this is the choice the person who is drawing should make and when he is making this choice, the points to remember he needs to look into the complexity of the object.

Which he is trying to depict, and the purpose of representation. Because, the purpose of representation will tell you how much detail you want to convey. Sometimes, probably, it is like a advertisement or sales related, you may not need the complete details of this aero plane or a car, you are mostly looking at the outer edges of the surfaces.

But let us say if you are looking to convey the mechanical working of these things, then you need to go into more details of the object and try to depict as much details as possible. So, we had looked at different kinds of drawing sheets and the scale you will choose to depict your object. Now, let us look at layout. So, what we see on this slide is a typical engineering drawing.

As you can see, there is plenty of information. So, let us dig into it and see one at a time and see what are the various information that this engineering drawing consists. So, let us start with title block. So, what you see in the bottom right corner, this is the primary title block. So, this contains most of the information related to the company where this drawing is being prepared.

It will also contain information about various information about the object engineering drawing, like what kind of projection is used, what are the scales, which is used, and units used in the engineering drawing. It will also consist information, which is useful to fabricate these objects. So, maybe details of the materials, the kind of materials to be used, and the allowable tolerances.

We will look into each of these in the next slide. But let us focus on the other details we have on this sheet. So, after primary title block, we also have this secondary title block. So, let us say last year this object was designed. And again, this year, we are relooking into it and modify this drawing.

So, even this information needs to go on the drawing sheet because then we know what is the trail? So, what is the origin of this engineering drawing, and what is the new version of this engineering drawing, we should also know who made it earlier and who modified it now. So, those information can go into this top right corner.

Where we can place the secondary title block. So, let us see what else we have in this drawing. So, we also have border. So, if you notice there is these two parallel lines which are going on all boundaries of this drawing sheet. So, what we see here are two aspects. One is called the grid reference.

So, if you notice clearly, we have these grid reference in numbers, 1, 2, 3, and so forth, in the horizontal direction, and in the vertical direction, we have it in alphabets A, B, C, D. How does? Why are these placed? The reason is, this helps you to look into a specific location of this

drawing sheets by a combinations. So, let us say I am saying we are looking at this pictorial I say you can find the pictorial about A5.

So, A is this direction, and 5 is this direction. So, I just need to look into this corner to find this pictorial view. Similarly, let us say I am looking at this side view. I simply say it is D and maybe 4, D4. So, this way, you are able to pinpoint one specific location in a drawing.

Why is this necessary? Probably if you are doing A4 and A3. It may not be needed because these are not big drawings. The size is small. But let us say you are working with A0 or A1. These drawings are big and they might be having lots of information and then it will be easy for you to pinpoint saying that you can find this particular feature at one particular location.

For that you can use this grid reference. Usually, we start from the diagonally opposite to the title block. So, in this case, we start from the top left corner, and then use numbers in the horizontal and alphabets in the vertical. And the other thing to look out in this border is the frame. Frame is this inside edge.

So, this frame defines the drawing area of this drawing sheet. So, if you follow this all this will be the drawing area. So, and what is the other information we can find? So, as we said, the frame defines the drawing space and in the drawing space, you can help the drawings. So, you can have the pictorial drawing usually pictorial drawing is done using isometric drawings and as you can notice, we do not put any dimensions to the pictorial drawings.

So, I never mentioned what are the lens or locations of any features. Because that information is better represented in the multi views, like the front view, top view and the side view. So, in the drawing space, we have the pictorial, the multi views and the notes. So, here is you can one can give the information, see the idea is when someone is drawing, you want to convey all the engineering information and capture it on the drawing sheet.

So, that when I transfer this drawing sheet to somebody to a third party? Let us say he is fabricating this particular object. He need not again contact back to me, all that information, which is necessary to fabricate it can be given. So, these notes can be like what are the precautions they may have to take when preparing this object or something related. So, as you

can see, there is plenty of information available on an engineering drawing, we just need to know like where to look for a specific information.

So, now let us look into the primary title block and see what information we have there.

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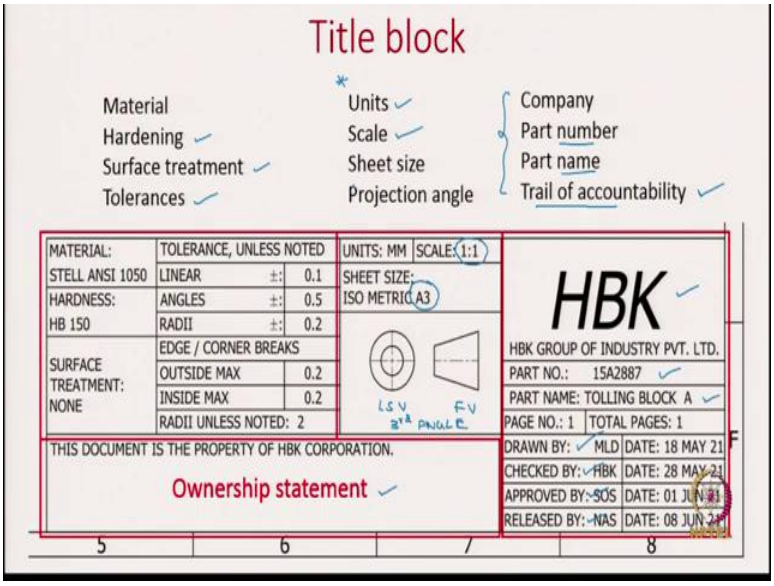


Here is the enlarged view from the previous slide. So, here to there are plenty of information we will look one at a time. So, first, let us look at this block which has the units. So, you may use millimeters, inches depending on the location you are working in. So, for example, Europe probably they use a different units and the North America might be using a different units.

Since now, we are in the global market where the design originates at one company the fabrication happens in other country and the sales happen in other country to make sure the communication is flawless. This information needs to be captured. So, that there is no misinterpretation.

So, you need to mention which units your dimensions are done and scale. So, for example, here you can see we mentioned the scale is 1 : 1 which means a full size and we also note. What is this drawing sheet we are using. So, we mentioned that we are using A3 and this is the projection angle from previous lectures we know since this trapezoidal is the front view and this is the side view, left side view this is drawn in third angle projection.

So, this is the kind of information you can find here. So, in addition to this you can also find the ownership statement. So, usually these engineering drawings are proprietary material or these are almost like legal documents. Because there is a lot of design process which went into it and then there is a lot of accountability or the proprietorship of these design drawings.

So, that information is given here saying that so and so company owns this drawing or what should be done for someone to get these drawings for use. In this right corner, we have information about the company. The details about the part, like the part number, name and trail of accountability.

So, here you see the company name, part number, these numbers are needed because as you can imagine, in a large company, there will be plenty of engineering drawings. And there is someone who needs to do this bookkeeping. So, for them to retrieve these drawings, they follow a different numbering system.

But for us to once you find the drawing, and you want to understand what object this is. The part name helps you to give some indication about what is this part? Let us say it can say it is an engine block or a windshield or an axle. And more importantly, we also have the trail of accountability.

So, here it says, who prepared these drawings and who checked these drawings, who have approved these drawings and who has released these drawings along with the dates. So, you have the trail of accountability. So, in future when you see that this particular object needs to be redesigned or if you see that there is a flaw in their design, you can go back to that specific person to check what is the rationale and maybe if there is any course of correction to be done.

And the last information we have in this title block is the details of the material. So, these details of the material you need when someone is fabricating it. So, they need to know what material they should use to prepare this object and any specific treatments they need to do. So, something like surface treatment.

What is the hardness of the material and the tolerances? So, this being an introductory course, we will not be going too much detail into all this. But I think this is more important where we specify that what are the units we use, scale, sheet size and projection. But once you go to a

specific place to work, depending on the place of work even this layout of these title blocks will change.

And depending on the purpose, some of these information might be removed and some can be retained. So, what I am trying to say is there are depending on the kind of company one is working like an automotive, aerospace, electronic or other companies. The kind of information which is available might be a little more or less than this and the style at which you present this information will also change, the layout of the engineering drawing is not always the same it changes from place depending on the nature of the job.

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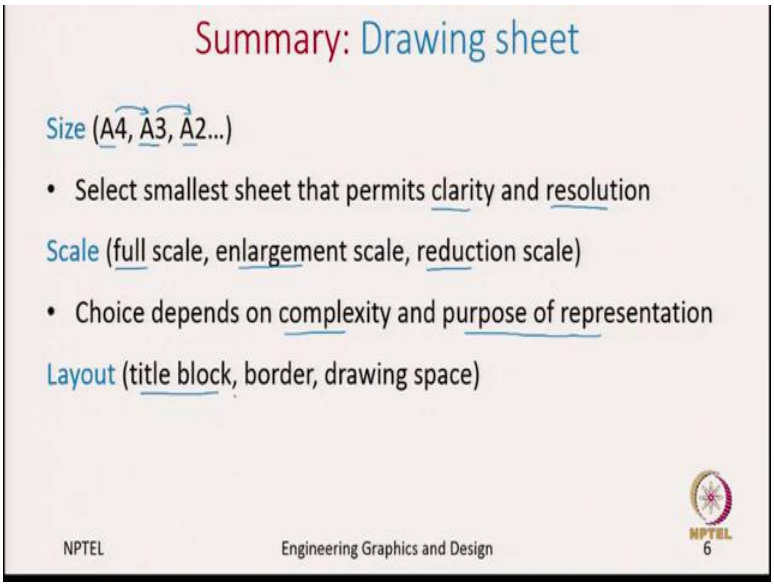


So, in summary, what we looked about the drawing sheets is we started looking with size of the sheets saying that sizes of A4, A3, A2 as you go in this direction the size of the sheet doubles. So, going from A4 to A3 we double it, again A3 to A2 we double the size. But the choice of the size, we make sure that the clarity and the resolution of the object decides which size of the drawing sheet you will choose.

So, depending on whether it is a large object or a small object, and depending on the amount of information about the object, you want to depict. The size of the sheet can be. Similarly, for the scale, we looked at three different scales saying that a full scale which means 1 : 1 enlargement scale, where the drawing size is much larger than the object and the reduction scale where the object is much bigger.

But your drawing paper is small. And again, this choice of the size depends on purpose of representation and the complexity of the object. So, finally, we also looked into the layout saying that in a particular engineering drawing, you can look into title blocks, which could be primary and secondary.

And there is a border, we follow, the size of the border again depends on whether you are looking at a bigger drawing sheet like A0 and A1 probably the borders are close to 20 millimeters. Whereas in the smaller sheets like A4 and A3 probably 10 millimeters size borders are sufficient. And lastly, we said in the drawing space, you can have many details like the pictorial view, multi views and few notes. So, with this, we come to the end of this lecture.