Engineering Drawing and Computer Graphics

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MODULE 01

LECTURE 05: INTRODUCTION TO ENGINEERING DRAWING -V

Hello everyone. Welcome to our NPTEL online certification courses on Engineering Drawing and Computer Graphics. I am Rajaram from Mechanical Engineering, IIT Kharagpur. We are covering Module 1, in which we are on lecture number 5; Introduction to Engineering Drawing. Our course textbooks are engineering drawing by N. D. Bhatt and others.

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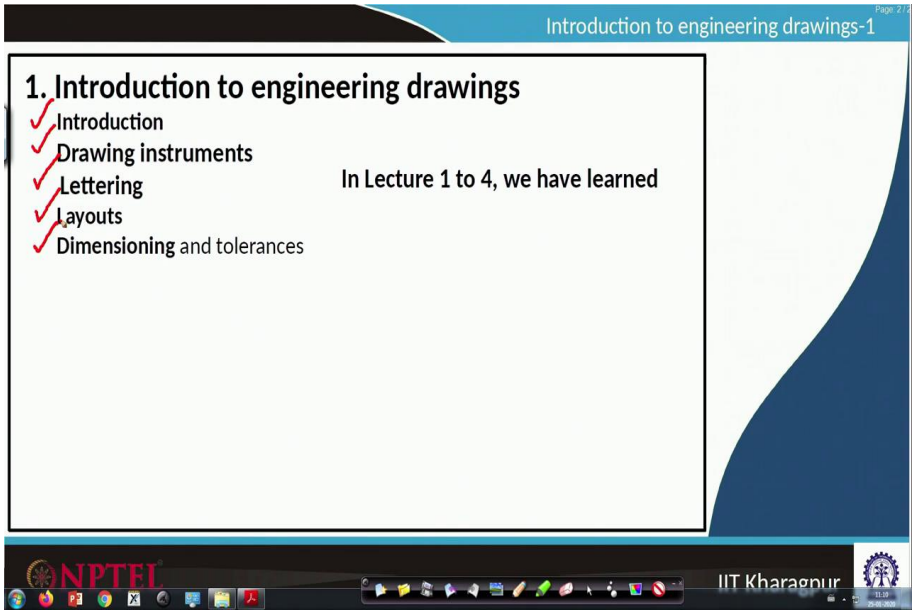

In lecture 1 to 4, we have learned about engineering drawing introduction, drawing instruments, the typical lettering style to be used; standard layouts of a drawing sheet, few issues on dimensioning.

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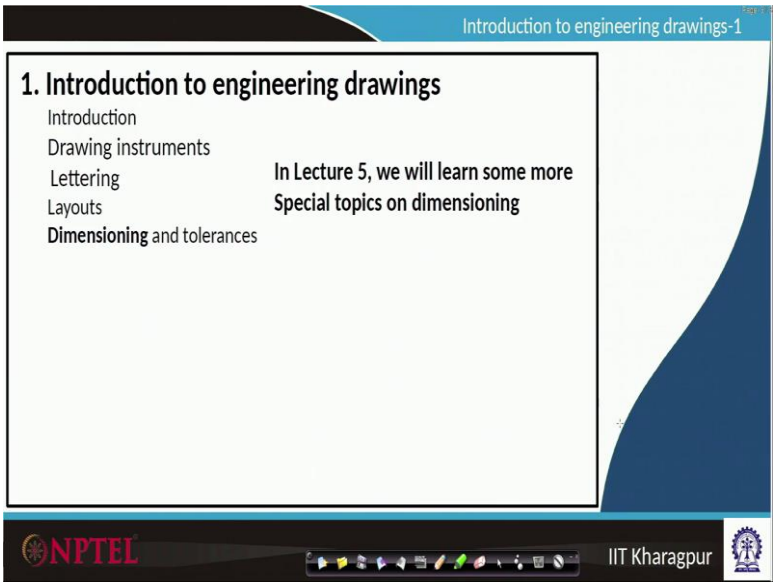

In today's lecture, we will learn some more things about dimensioning especially on particular topics, like, if these are arcs, circles, curves, how to give parallel kind of dimensions and many other things.

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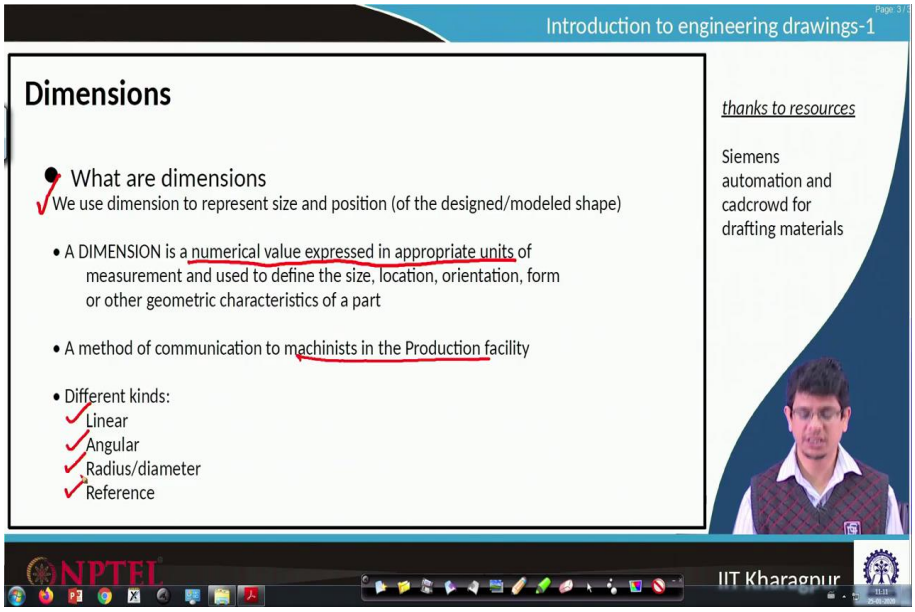

To briefly summarize you from the last classes, dimension is used to represent size and position. And, a dimension is a numerical value expressed in appropriate units. In our SI metric units, we use mm as a numerical value for the dimension, and this is the primary communication to machinists in the production facility.

We learned something about linear dimensions, how to give angular dimensions, if it is radius and what are reference dimensions.

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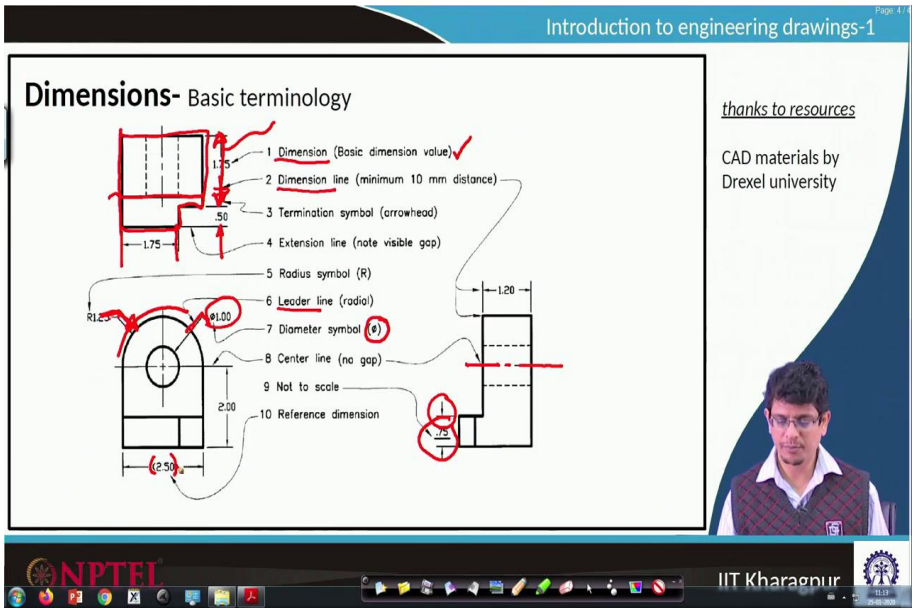

First one to summarize you again in terms of numerics; dimension. Here, for an object of this shape, this one what we have shown as 1.75 as the basic dimension, and there is a dimension line to represent the line. If it is minimum 10 mm then only we will show it on that side. If it is less than that we use another dimension from away, like that.

To represent any dimension, we require extension lines. And if there are any curves we represent it by a radius line. And the extension line for this radius to describe something like diameter or radius that line what we call leader lines. For any diameters, we use special symbol phi. To represent something like a centre, we use centre line by a dash, small dash and long dash lines. If those are not to up to scale then usually, we represent those dimensions. With respect to any reference, we use a reference dimension within parenthesis.

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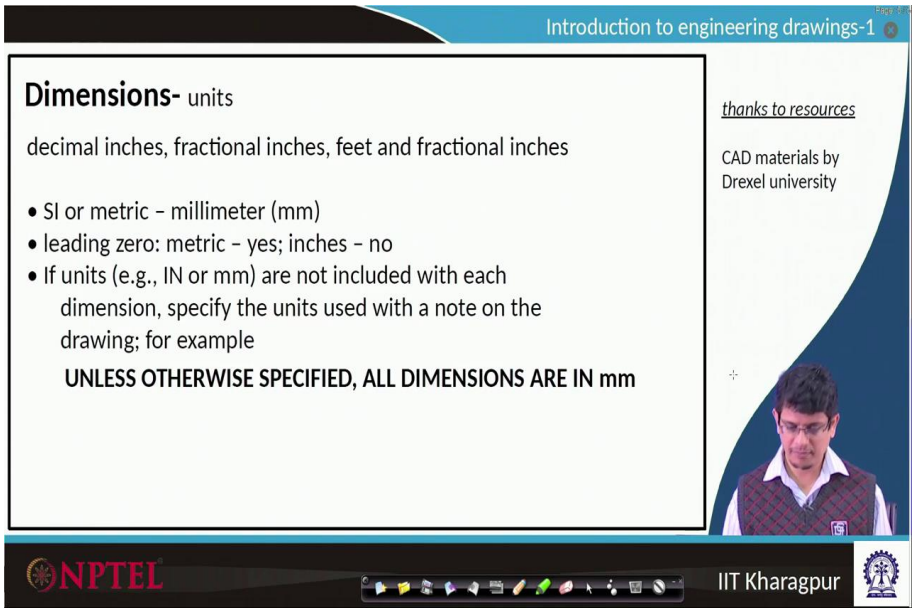

Usually, on our drawing sheets, we mention a word sentence, unless otherwise specified all dimensions are in mm. Instead of writing every time mm, we use all dimensions are in mm as a standard text.

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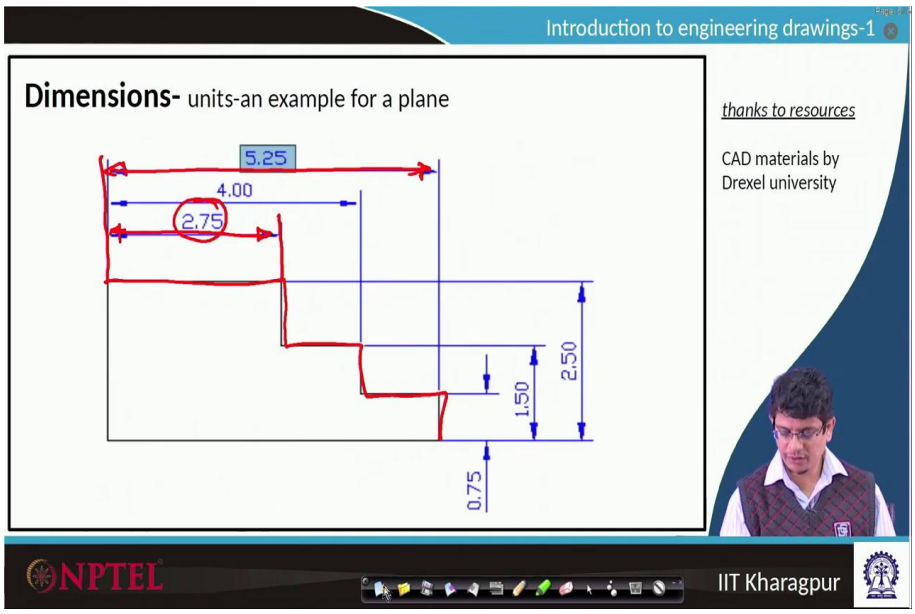

We went with a standard example where we have shown for an object to represent dimensions; we use the extension lines, smallest dimensions inside and largest dimensions outside. So, this is the smallest one that is a reason inside of that geometry near to that and the large one outside of that geometry.

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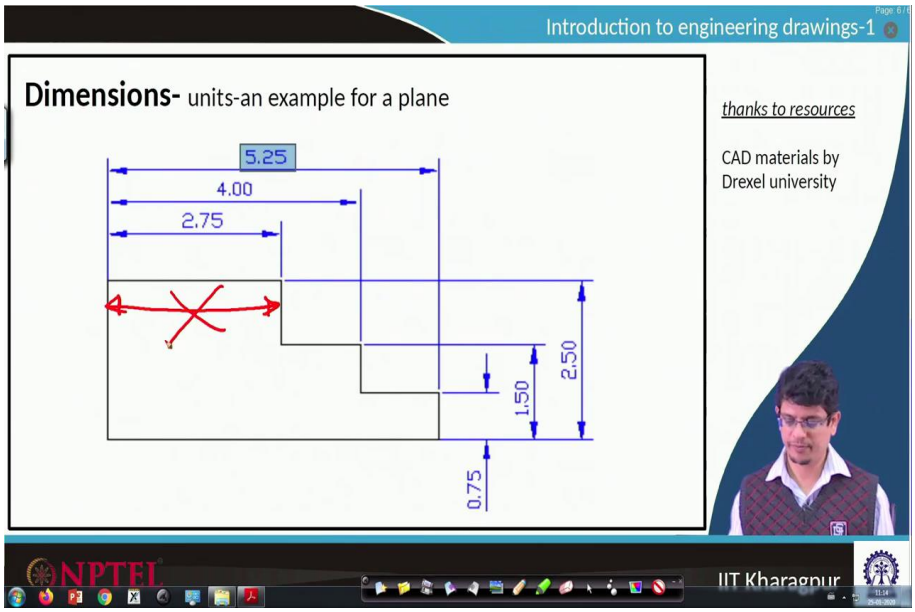

It is a standard practice not to show any dimension inside the object.

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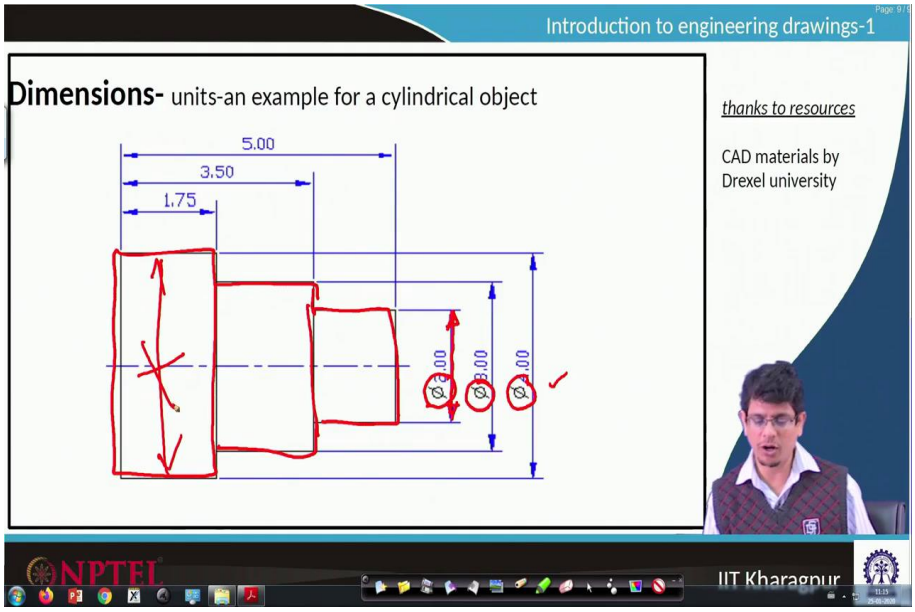

Similarly, if these are cylindrical objects, we went ahead and showed the major diameters outside of the object through the symbol phi. So, here it is one cylinder, a step 1 and again we have a step 1; So, the smallest dimensions inside and largest dimensions outside. We usually do not show anything inside of the object that is a wrong way of showing the dimensions.

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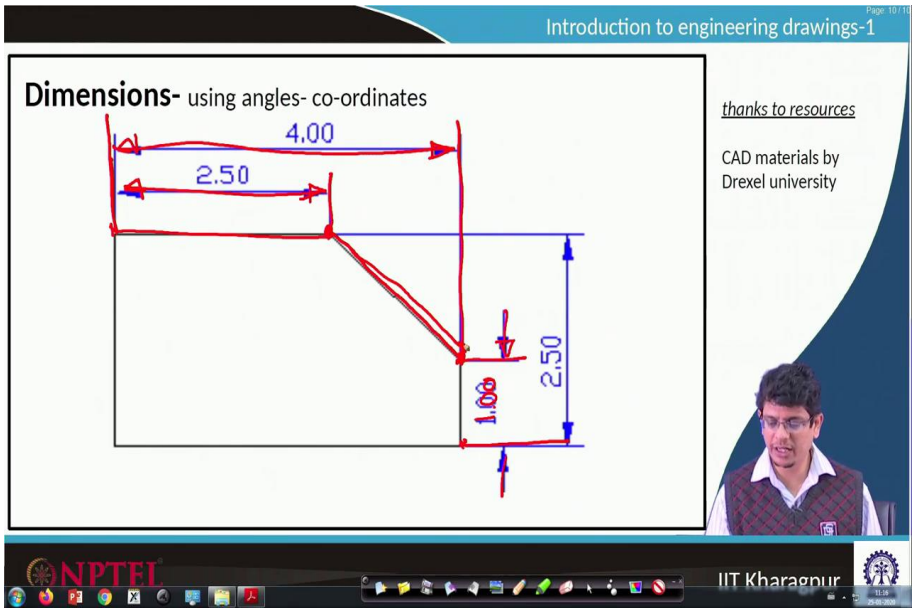

Using angles, coordinates also we have shown the dimensions, something like if there is an inclined object with respect to coordinate system this one 2.5 and this extreme point again through our extension lines at 4 units and similarly extension lines using that this point one can show it something like 1 unit. So, once we know these points in terms of lengths, we know where to where to join this line. This is the way one can construct these inclined lines.

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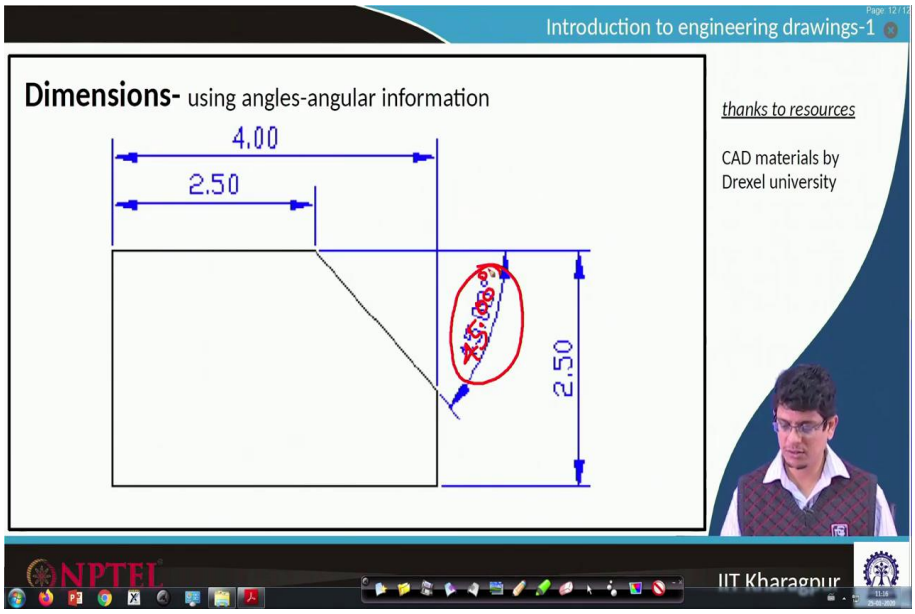

If it is angular information, we usually represent it in terms of angles.

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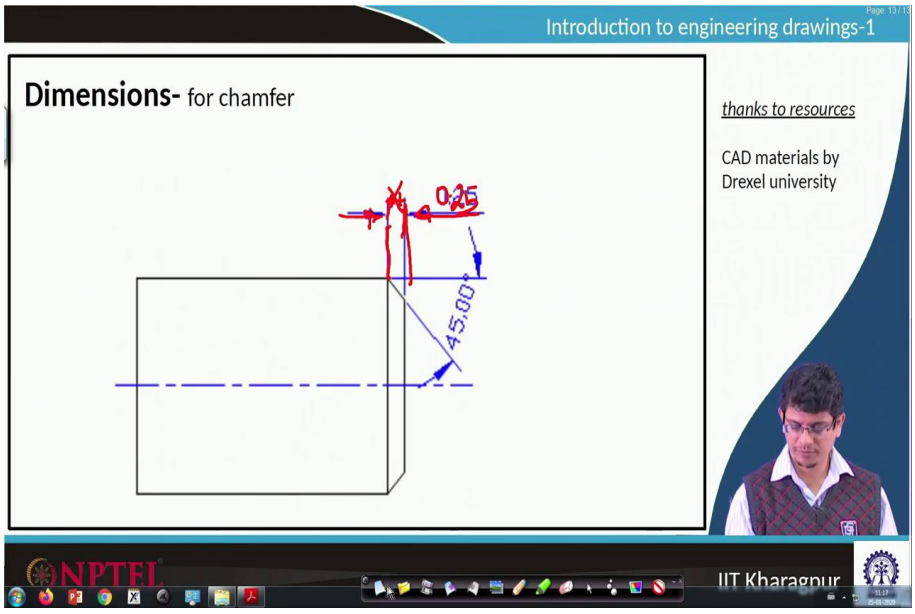

Any chamfers, we represent including that chamfering lens using these continuous lines. Note that the dimension is outside because the gap is too small. So, it is not a good idea to show it in this way.

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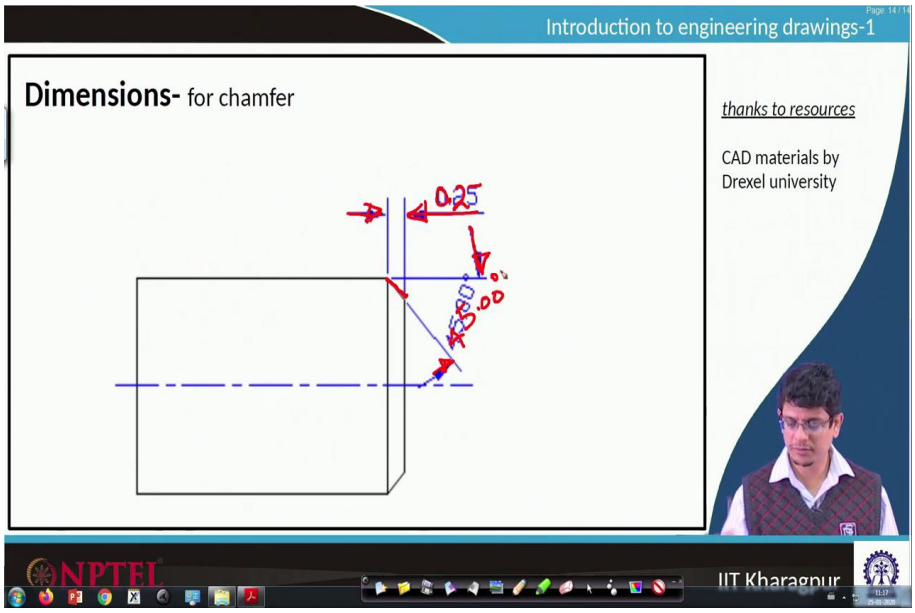

It facilitates us to show these small dimensions from outside, and also there is chamfering which will be at 45 degrees angle.

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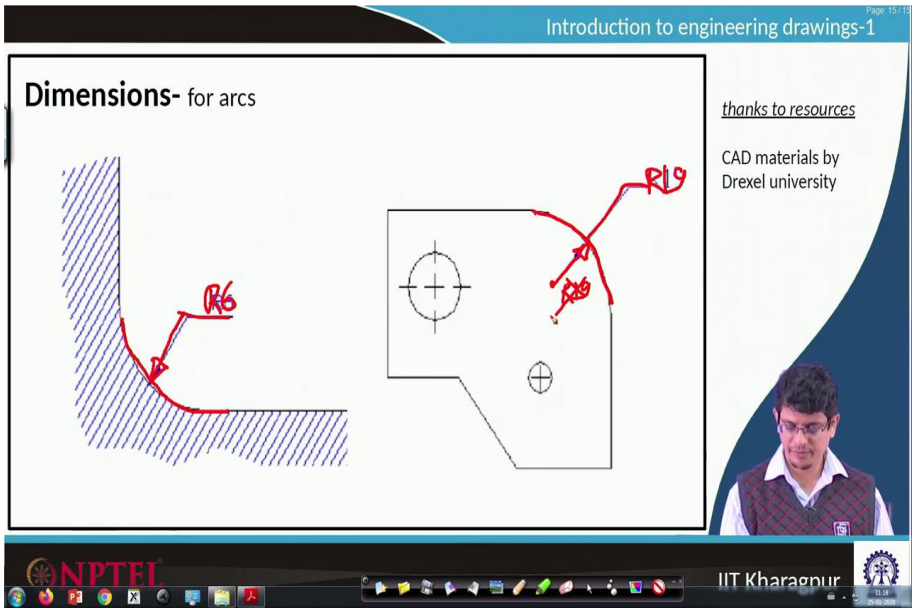

If those are arcs at single positions, we usually this is the arc and using dimension line, leader line we will be in a position to represent the units; R for radius 6 units of that.

Similarly, something like this arc is there and from here we are going to measure that arc, but using leader lines, we will be in a position to represent the small units. We usually do not show it here inside the object.

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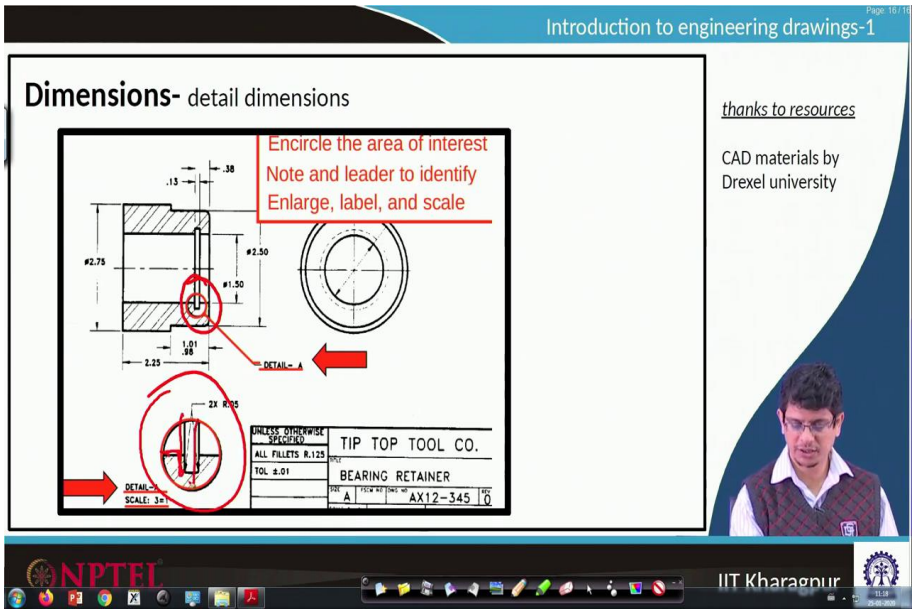

Similarly, if there are any intricate shapes, we encircle the area of interest and then show it as enlarged views with precise cut dimensions.

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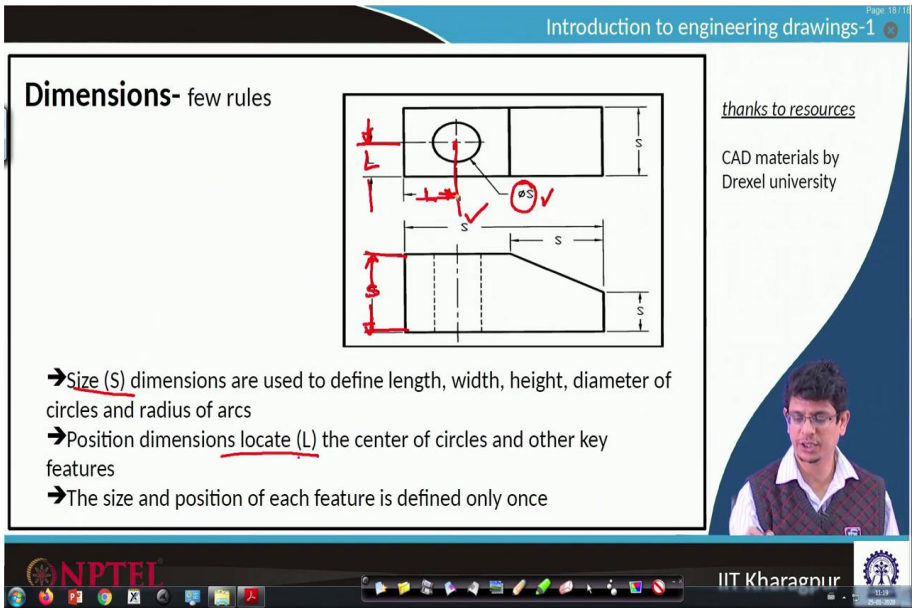

Then we have tried to look at different rules for this drawing lines. Some of them about the size, position, how to represent them and for example, if there are any diameters on how to represent them. So, here size represents S symbol and positions location. So, we represent it by Ls. This is the size, and this is location, the hole is at that particular location.

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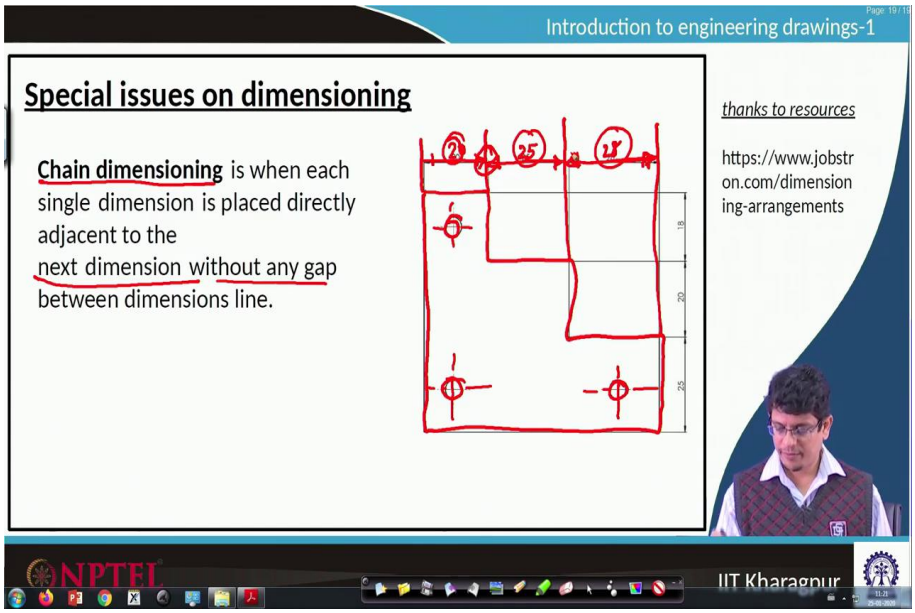

Now, we will come to particular issues on dimensioning. There are different ways of dimensioning these lines. One of them is called chain dimensioning. It is used when every single dimension is placed directly adjacent to the next dimension without any gap. For example, let us take this object. There is a step block.

It has a few holes also. So, whenever there are holes, circles and so on, we usually represent by these dash-dot lines.

Now, we would like to use chain dimensioning. If you notice, here is an extension line, there is one more extension line, there is one more extension line; in between that we are going to show dimension 20. Again, this one is 25 and again this one 28. There is no gap between these extension lines, next to each other, we are showing dimensions through these dimension lines arrows.

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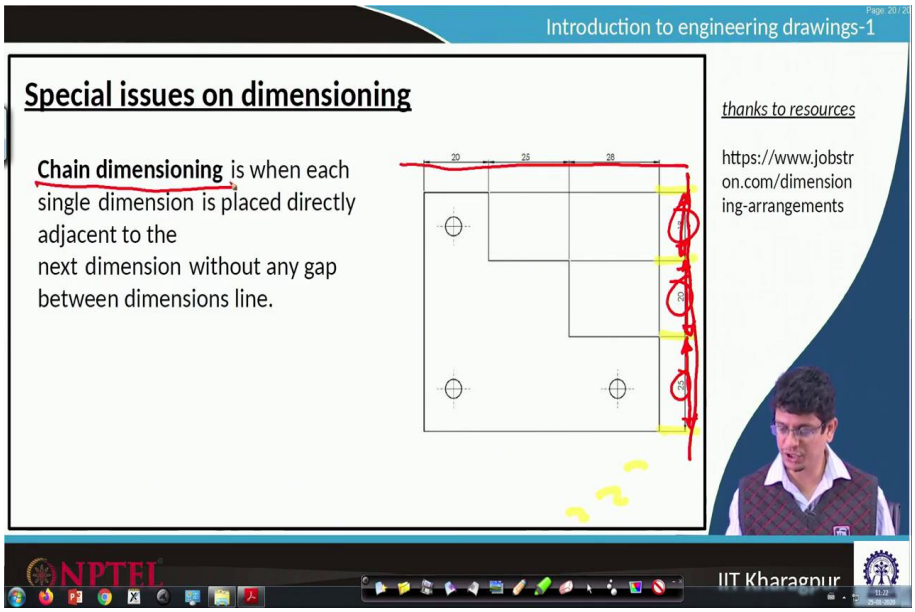

Similarly, for the vertical direction, let us use another colour. These are the extension lines, and in that, we use dimension line, again dimension line here and also here dimension line. So, there is no gap between them. This kind of next to each other if we are showing at the same level such kind of things what we call chain dimensioning.

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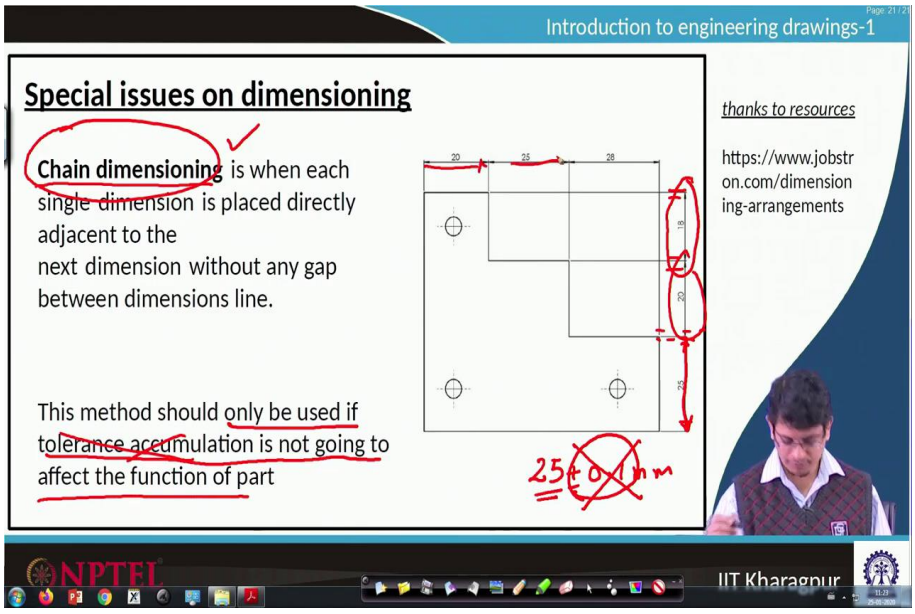

This method we can use it only if tolerance accumulation is not going to affect the function of the part. These tolerance issues in the next class we will learn about it.

Instead of 25 mm, if we have plus or minus 0.51 mm kind of units this extra thing what we call tolerances. That means when you are machining or perhaps making a part of producing this kind of parts, it is not easy to produce precisely at 25 mm there always be plus or minus kind of corrections involved; such type of things are called tolerances. More details we will learn it in the next class. When we do not have such kind of tolerances then only, we will be in a position to show chain dimensioning. Otherwise, what will happen? This supposed to be 25 plus or minus; that means, there always with some kind of gap. So, a continuous chain dimensioning is not possible when such kind of layers exist between the parts. It unnecessarily confuses the machinist. So, we use chain dimensioning only when such tolerances accumulation is not possible. If that is not there then only, we should go with chain dimensioning; this kind of continuous thing.

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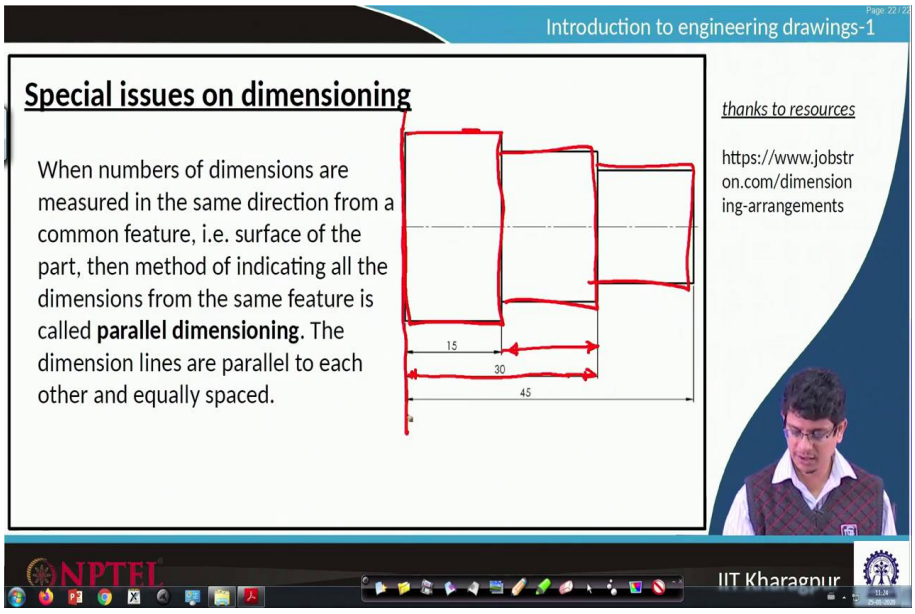

Let us take a cylindrical object, this one. Here, representing chain dimension instead of that, we go with parallel dimensioning. So, that there always be a reference base.

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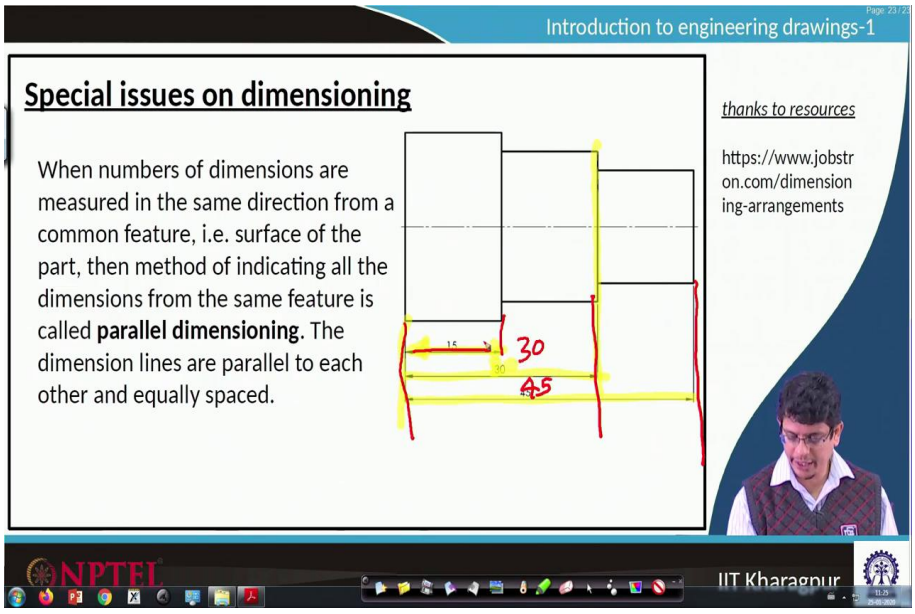

Let us look through a highlighter. This is the reference base. From that reference base, we are going to have such kind of dimension, 15 units.

Similarly, from that reference base, this one is at 30 units. Likewise, from this reference base, we have it 45 units. So, with this reference, it is quite easy to represent up to which length.

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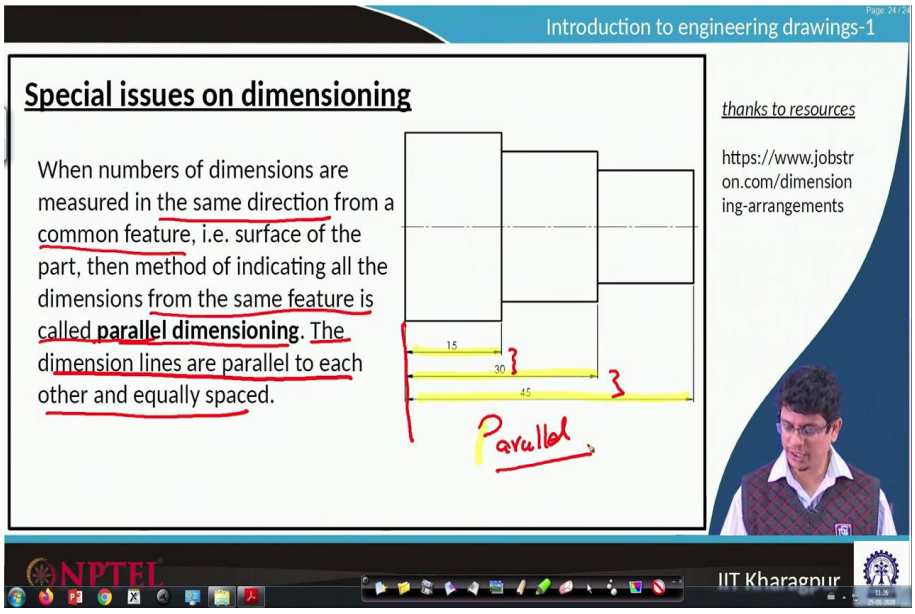

That kind of thing especially if we are showing it if we are showing this one, look at this these are parallel with each other; such kind of dimensions what we call parallel dimensioning. When numbers of dimensions are measured in the same direction from a common feature; here the common feature is this, that is surface of the part then method of indicating all the dimensions from the same feature is called parallel dimensioning.

Note that the dimension lines are parallel to each other and equally spaced. This gap will be one on the same. Such kind of dimensioning is called parallel dimensioning.

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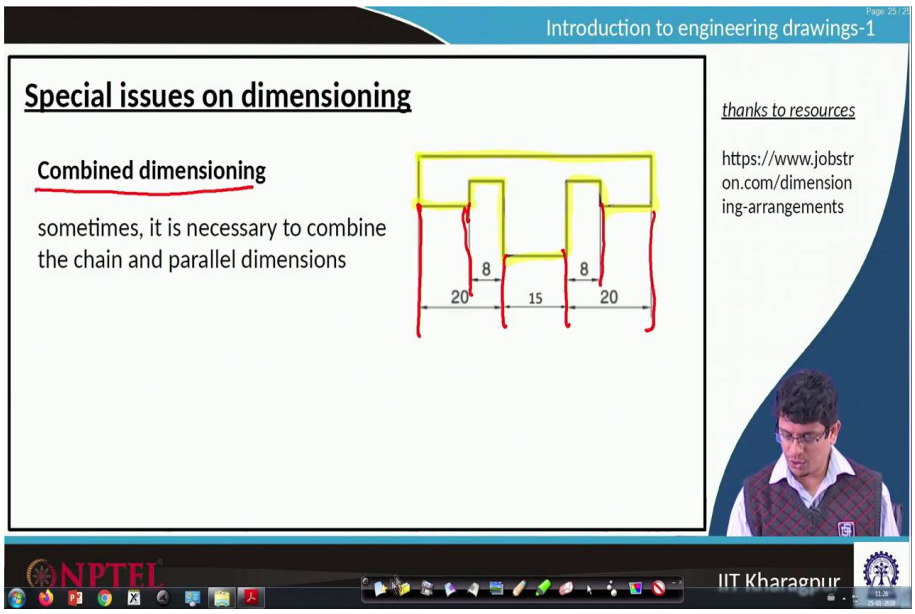

There is one more way of dimensioning these things called combined dimensioning. Let us pick this object. This is the object, and these are the extension lines.

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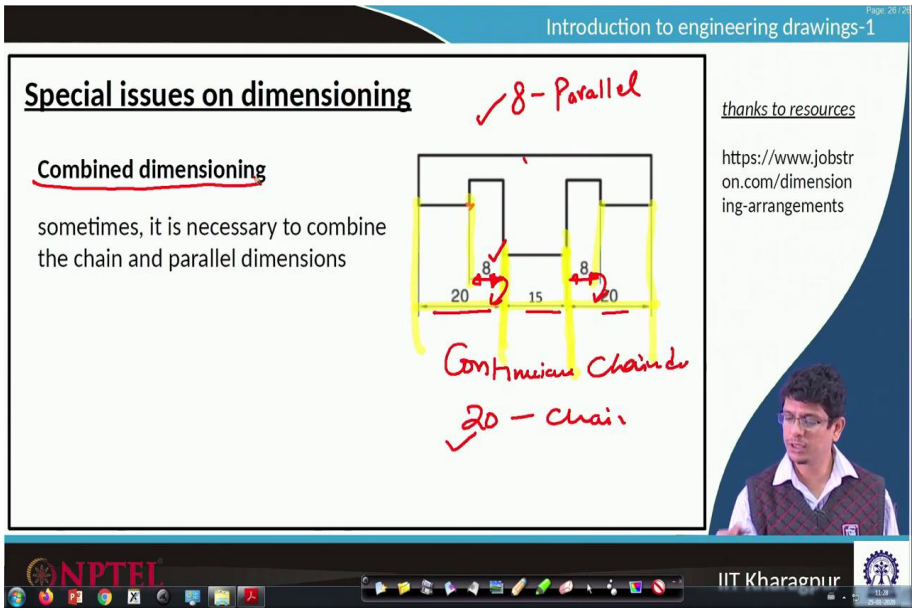

So, these are a kind of continuous chain dimensioning. If you note 20, 15, 20 next to each other and it is a continuous chain dimensioning.

Let us look at other ones, this to this and this to this. When we are looking at this 8 mm and this 8 mm are in parallel with this parallel with that. So, we have both the parallel for these 8 parts; parallel dimensioning and for this 20, chain kind of part. Both are included in the same drawing. Such kind of things is called combined dimensioning.

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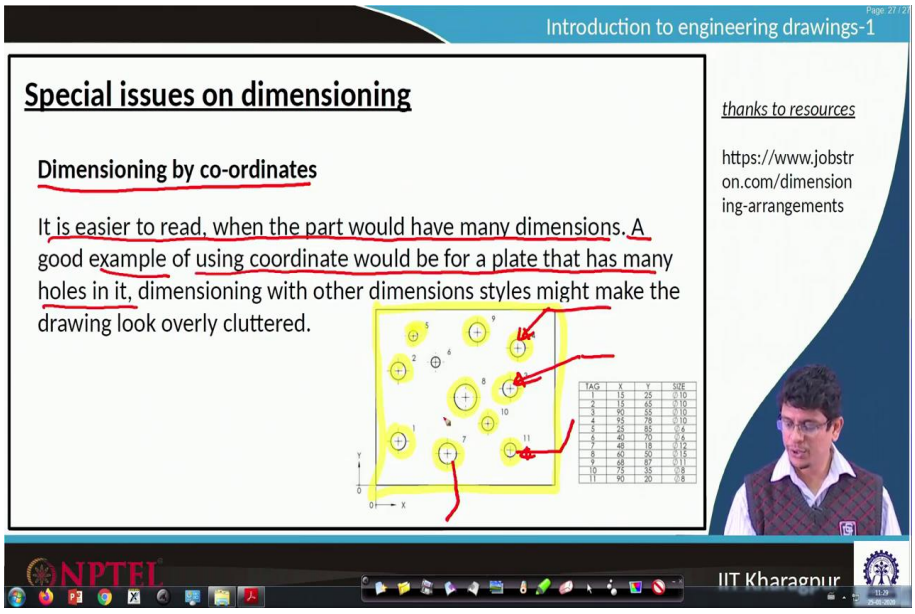

Sometimes it is necessary to combine the chain and parallel dimensions for that purpose we use it. Sometimes, we might require to use dimensioning by coordinates also. It is easier to read when the part would have many dimensions. Let us consider an example of using coordinates would be for a plate that has many holes in it. Let us look at that plate. This is the plate. There are many holes of different sizes. Now, if someone would like to start showing the dimensions it becomes a bit clumsy, it becomes very clumsy. So, it is not a good idea to really show all these dimensions around that object. Instead of that, it is a common practice to tabulate things.

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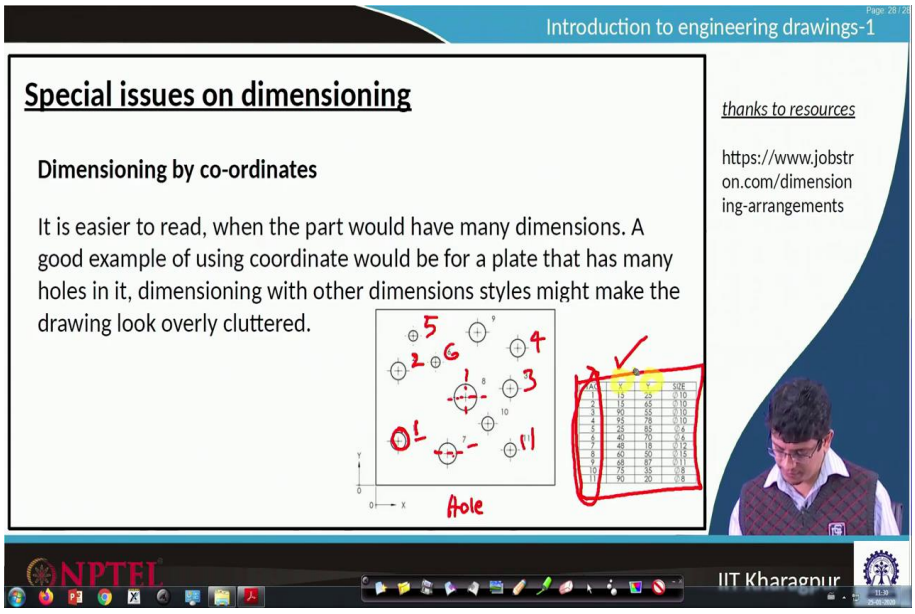

Whenever a hole is there, we always have this dash the odd kind of lines. It is more like drilling a hole through a rectangular plate. Here we have different holes; 1, 2, 3, 4, to 11. In total, 11 holes are there for this box.

So, when we are not interested in representing this rectangular plate, but holes and their location, usually we go with this kind of tagging. You just give the name 1, 2, 3 kind of names, tag what we call and its X coordinates its Y coordinates.

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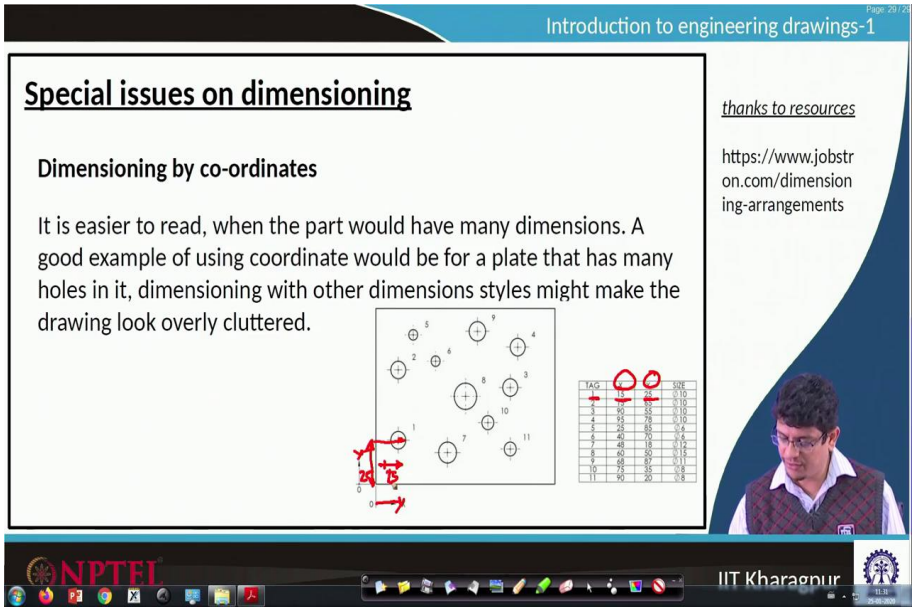

So, for X for Y for 1, 1 it is at 15 units, and it is at 25 units. Perhaps in the X direction, here we know X direction it is the Y direction; in the X direction 15 units. So, if we see this one is 15 units and if we are looking at that, this one is 25 units this is the way we understand this 15 and 25. The centre of that hole is at that 15 and 25 units and the size basically diameter we usually represent.

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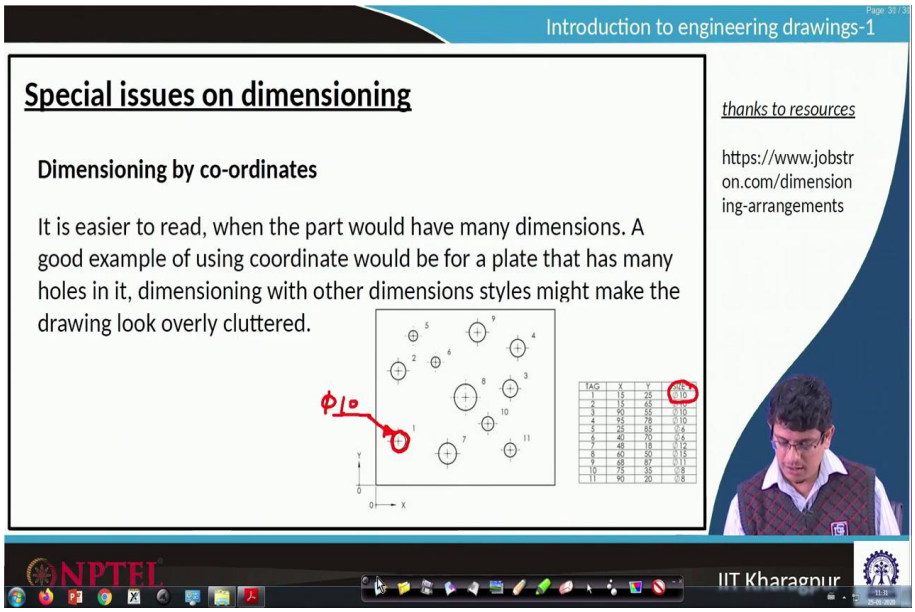

So, this entire diameter if we are going to show it by leader line 5 10 units.

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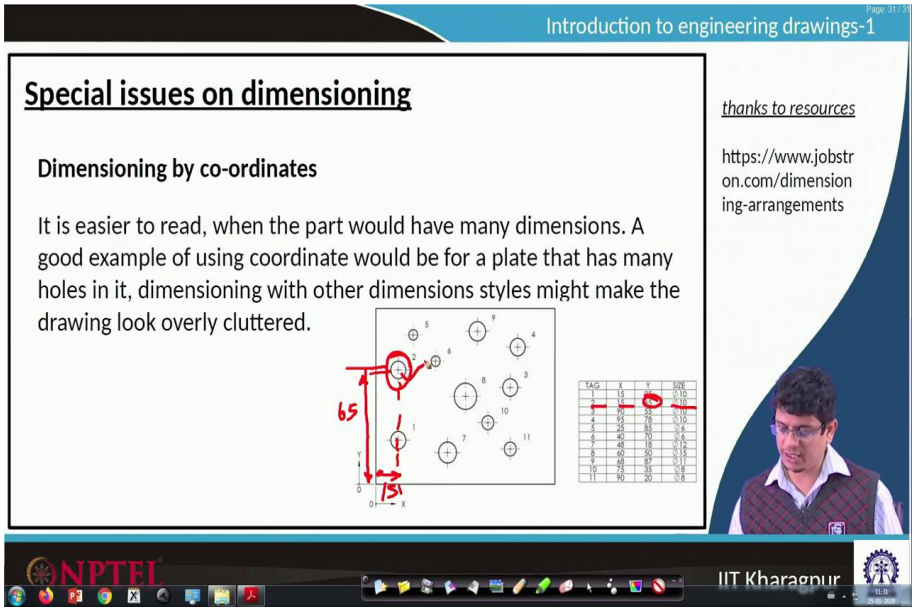

Similarly, for the other holes like 2, 2 is this one; again 15 units that is the reason we have this X dimension 15, and it is at a longer distance in the Y direction. So, that is 65 for the second hole, and the diameter is 10 for that.

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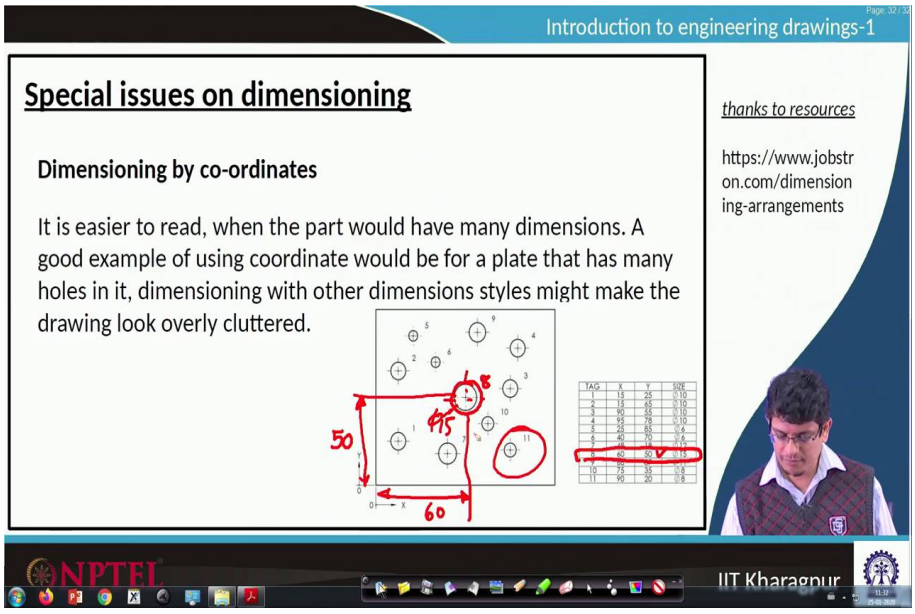

Let us look at the bigger one (8). So, let us look at this hole, the dimensions and understand that. This part is 8; this is the hole with dash-dot lines. It is located at 60 units in the X direction, 50 units in the vertical direction; and it has a diameter of 15 units.

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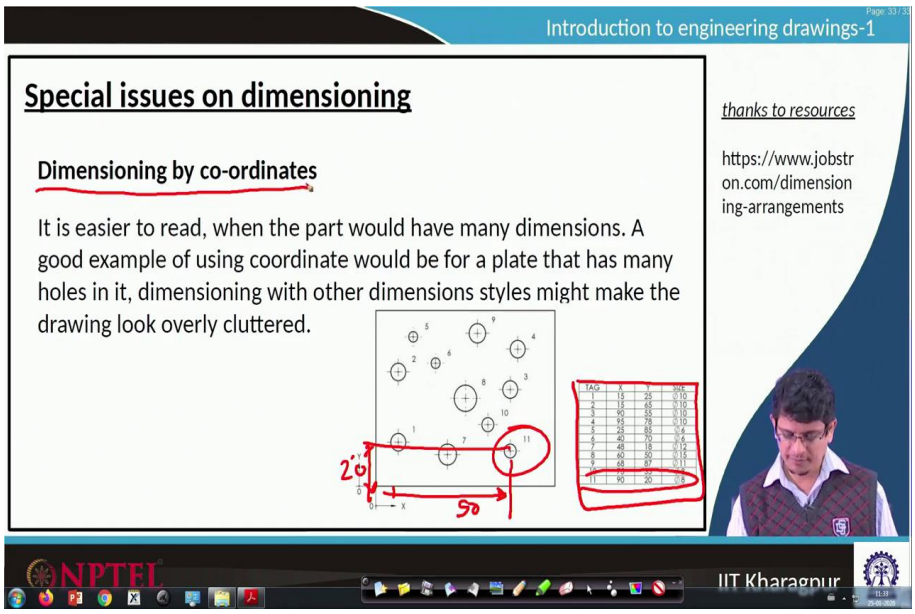

Similarly, let us pick 11th part here. In the horizontal direction, it is at 90 units, and this is at 20 units. So, instead of showing all these dimensions which becomes a bit clumsy, usually, we go with a tag table. This kind of thing is called dimensioning by coordinates.

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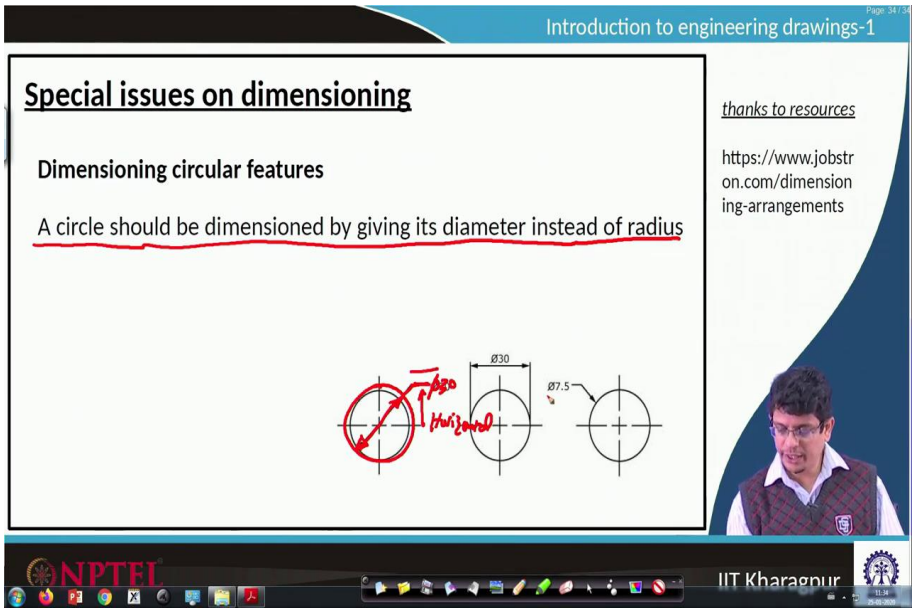

Similarly, whenever circular features are there, there are different ways of showing diameter. Let us pick an example, say a circle. If it is a circle, it should be dimensioned by giving its diameter instead of radius. Only for arcs, we use radius for any kind of circles we have to go with diameter dimensioning.

Let us pick this circle because this gap is large one can show it in terms of an arrow, a leader line with phi 30. Usually, these leader lines we keep it horizontal; this is the way.

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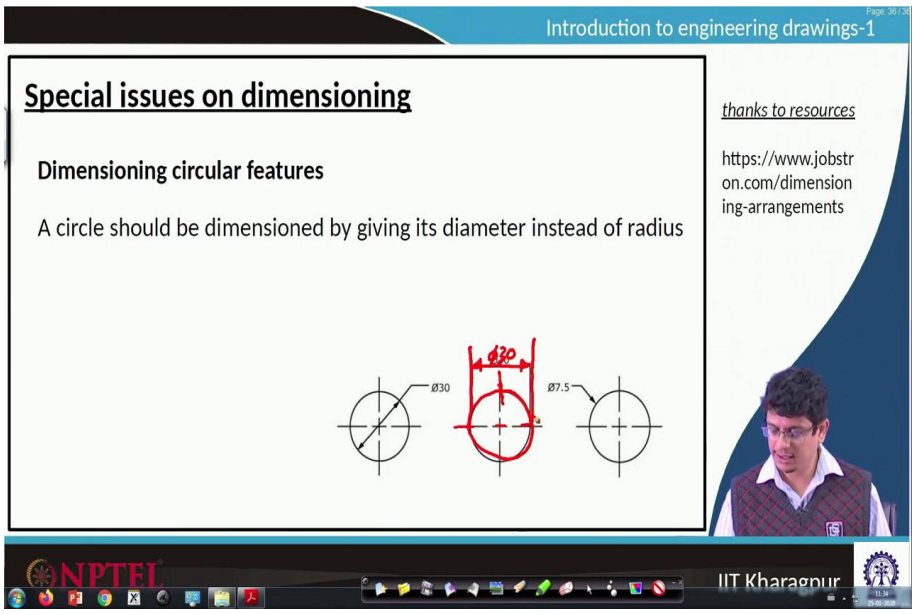

And next to it, we show the phi symbol diameter represents and the dimensioning that is one way of showing the things.

Let us look at other dimensioning. For example, this is another circle. For this circle, these are the extension lines. One can also show it in terms of phi 30 units; this is another way. If we have a hole and other things, we usually go with this dash-dot kind of things or a circle with holes also we will be in a portion to show these dash-dot lines. There is another way of showing this dimension.

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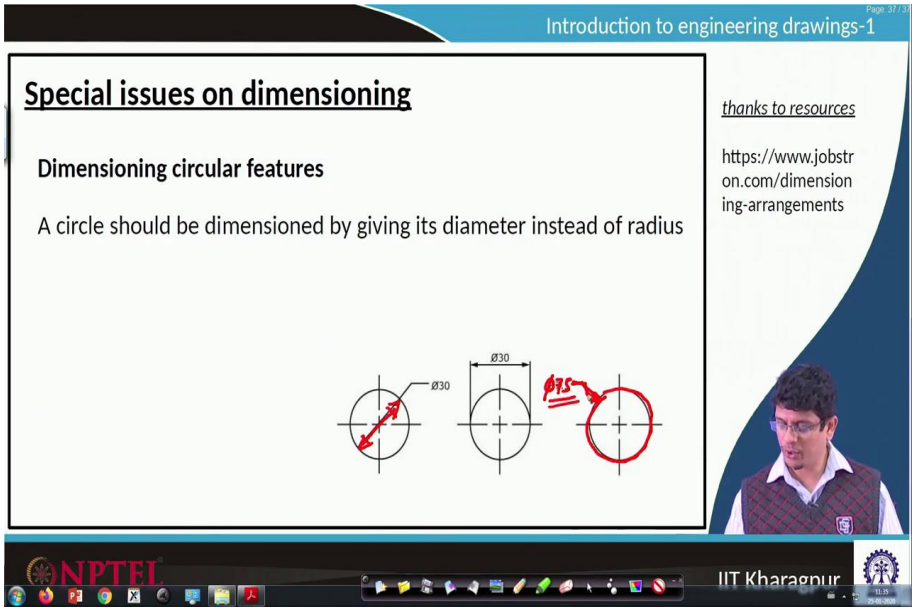

Instead of showing this dimension line double arrows thing one can also show it by a single arrow, a leader line with phi 7.5. So, this way also represents that there is a circle, and the diameter is 7.5 units.

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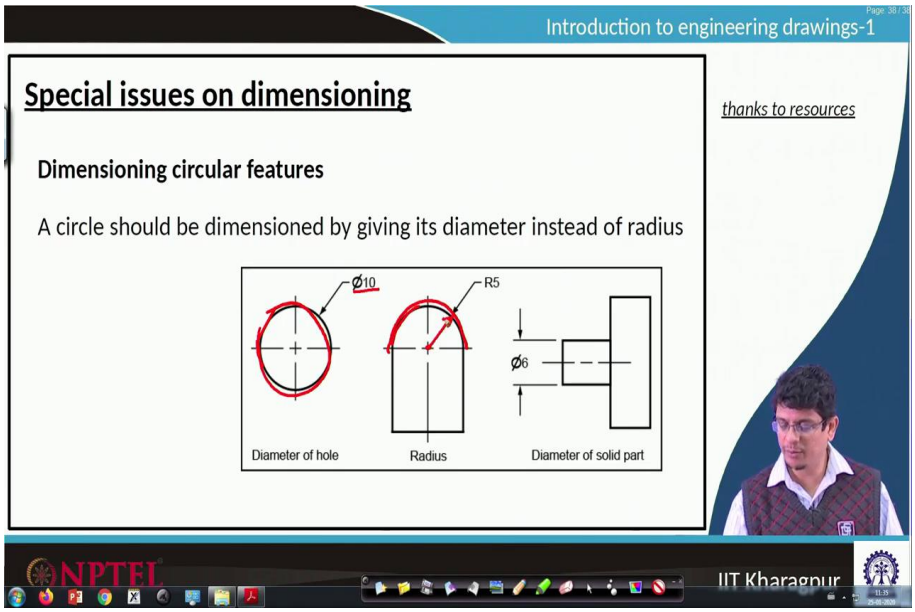

There are a variety of circular features we usually see it. If it is something like a planar circle thing, we represent by diameter phi. Sometimes we see hump kind of shapes, curves circular radius curves that kind of thing we only represent because it is not a circle, it is just a hump, and it has a radius. So, perhaps this is the centre from there it might be at R5 units.

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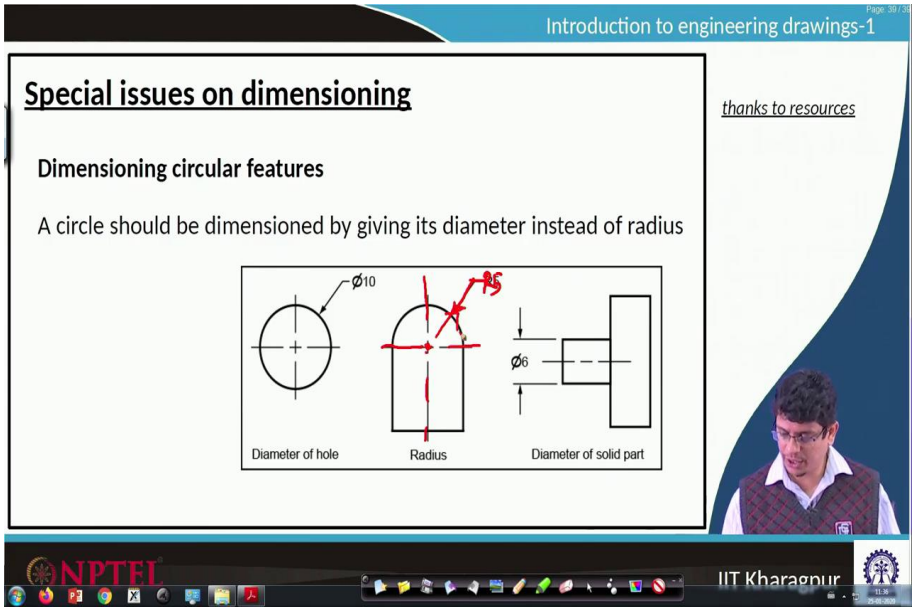

So, instead of showing within the dimensions within the object, we usually show it in that way. For this kind of curves arcs, it is necessary to show that centre also. From that centre, if we measure the radius, we usually go with that.

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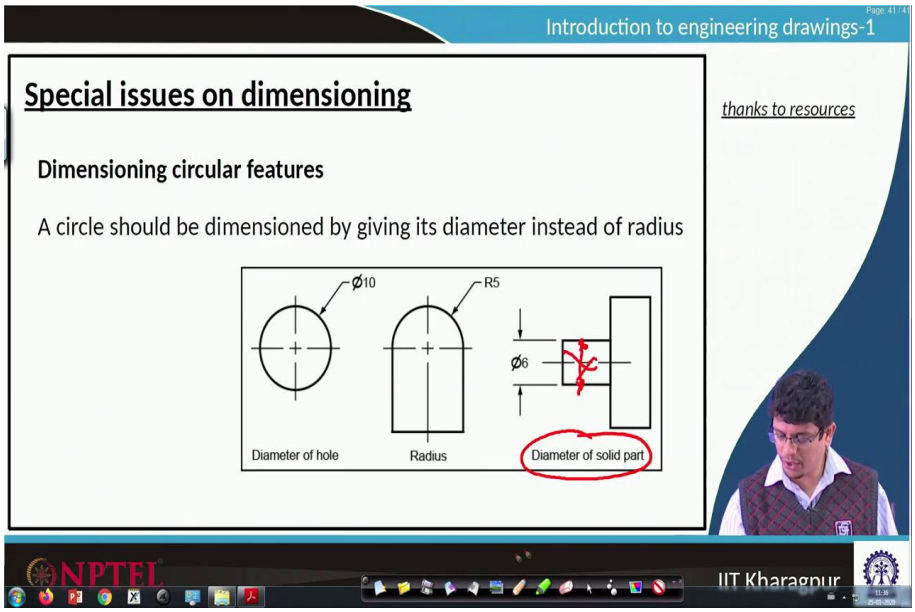

If it is something like cylindrical objects and diameter, we would like to show instead of showing within the object this is a wrong practice.

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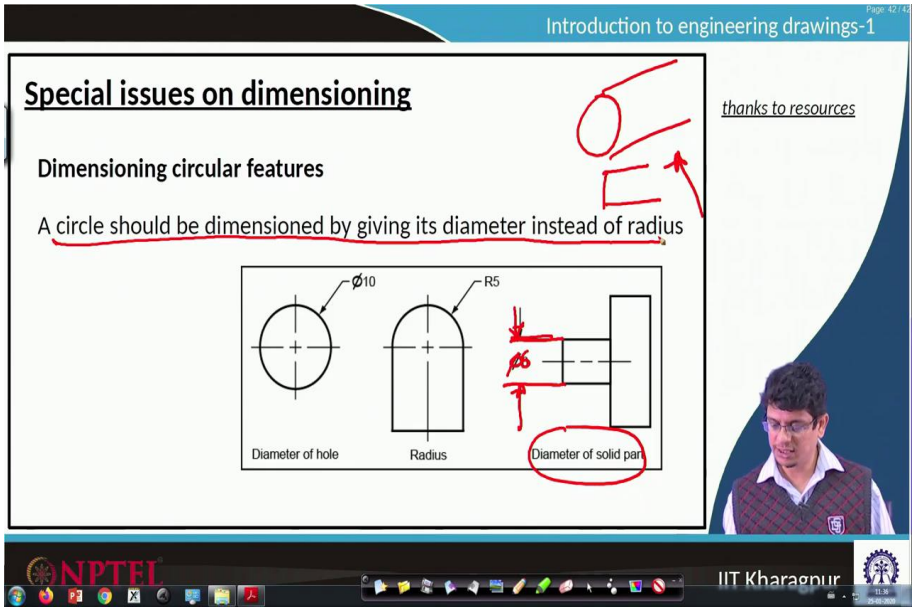

So, what we do is we go-ahead from the object where rectangular dimensions are visible or view because a cylinder if we are looking from one of the views like this side, it behaves like or it looks like a rectangle. These views we will learn in the later lectures. For those dimensions, we have to show, it is phi is 6 millimetres of dimension.

So, a circle should be dimension by giving its diameter instead of the radius is a must.

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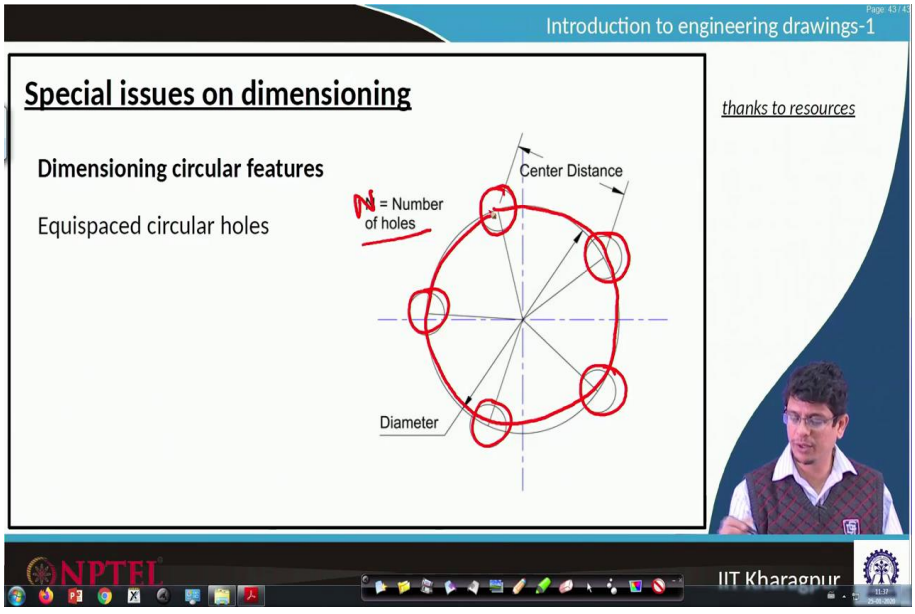

There are many holes they are aligned in circles. There is a circle there is another circle and so, on. There are N number of circles. In that case, we mention how many circles are present along the main circle.

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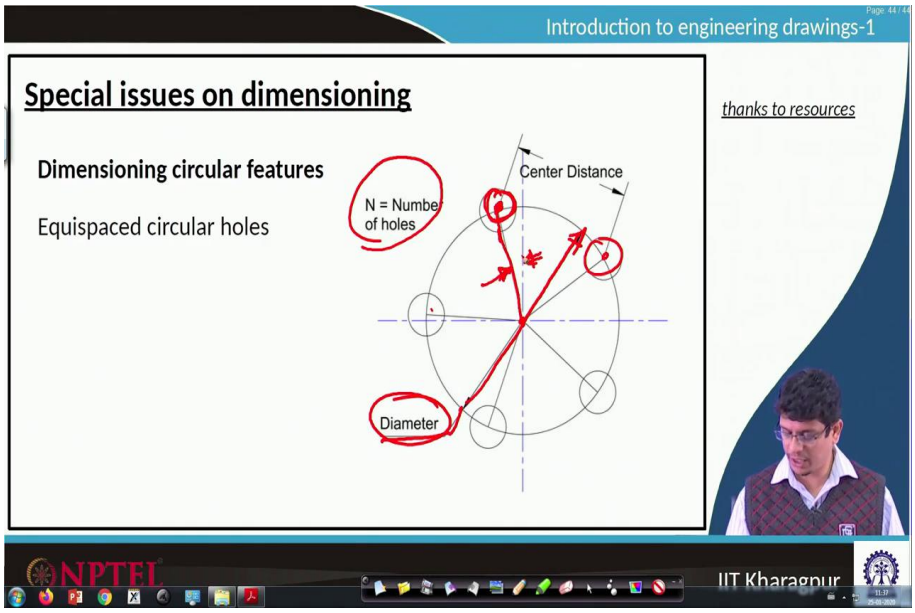

So, usually, we represent that main circle diameter through leader line and also centre to centre distance between these circles because they are uniformly spaced, in such case, we just represent the number of holes. Otherwise, one can really show angle made by that circle, the radius connecting the centre of that circle to other peripheral circles, what is that angle also we usually mention.

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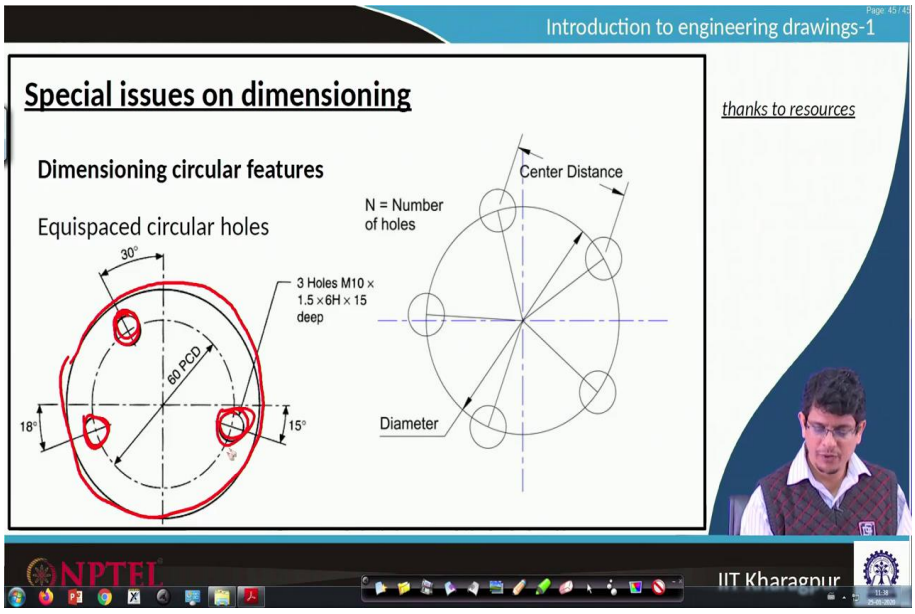

For example, let us look at this drawing. Here there are circles. The main object is this on which these circular holes are created.

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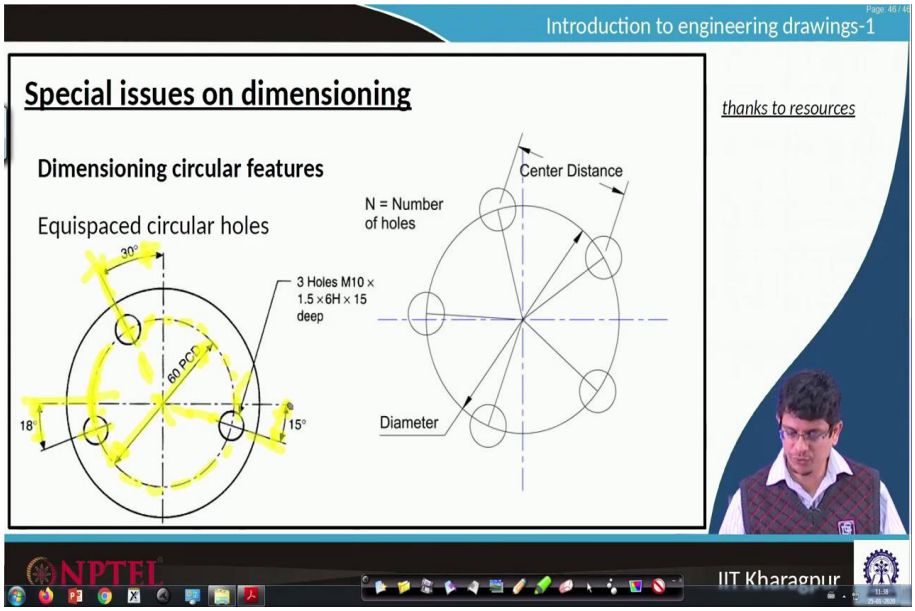

Whenever these holes are present, it is common practice for us to show it by dash-dot kind of lines, and they are placed around this circle. So, again the dash-dot kind of curve we have shown. This ah these smaller holes 1, 2, 3 are placed around that.

So, naturally, we are going to show that dimension. It is some 60 units, and this circle with horizontal is placed at 18 degrees. Perhaps this circle the radial location that is placed at 30 degrees. Perhaps this radial location is placed at 15 degrees; such kind of things we usually show.

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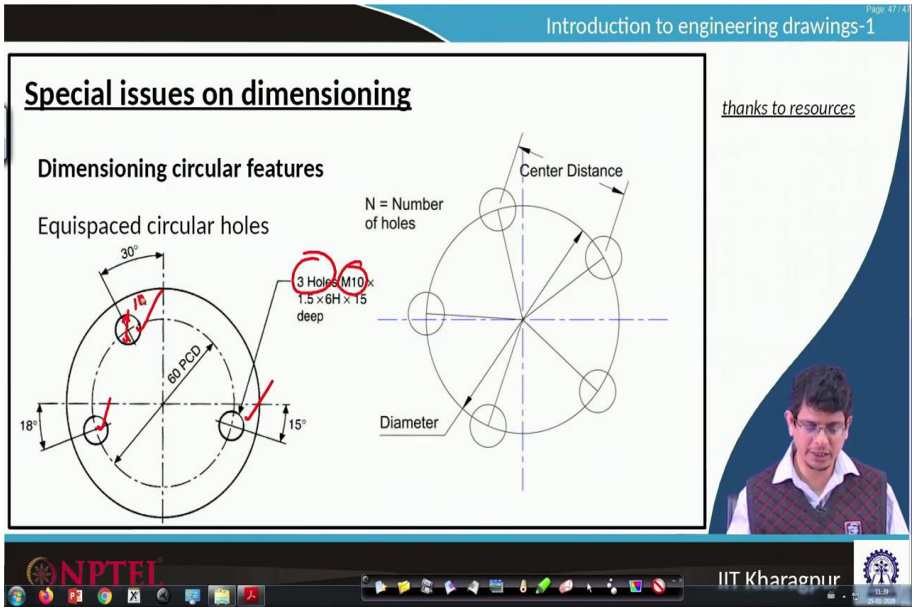

And one more thing one has to notice three holes; 1, 2, 3, holes we are showing. Something about the diameter of that hole perhaps this one is that 10 units. Remaining things we will learn when we are going to learn about other dimensioning.

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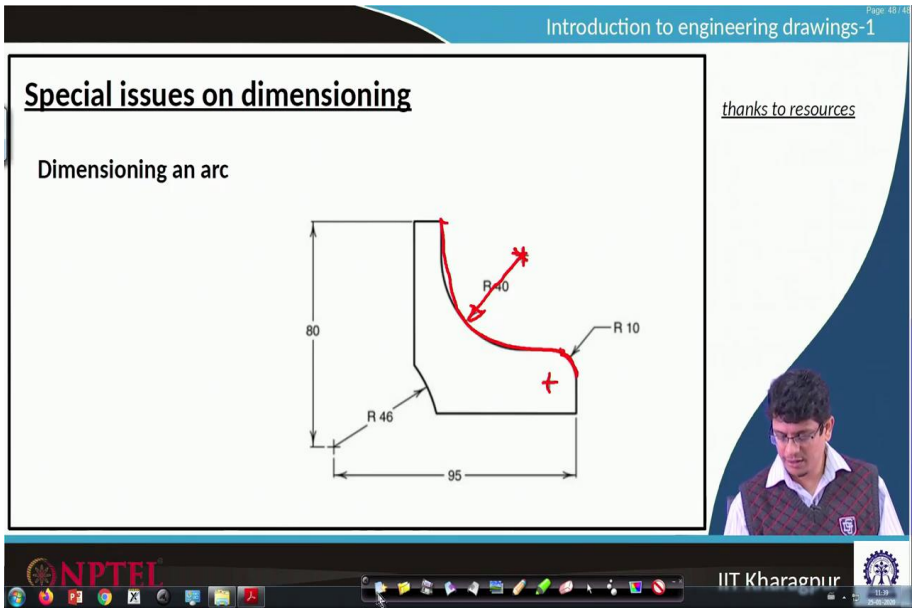

Similarly, whenever there are arcs for this arc, we usually represent it by radius and centre of that. Similarly, there is the centre of this circle.

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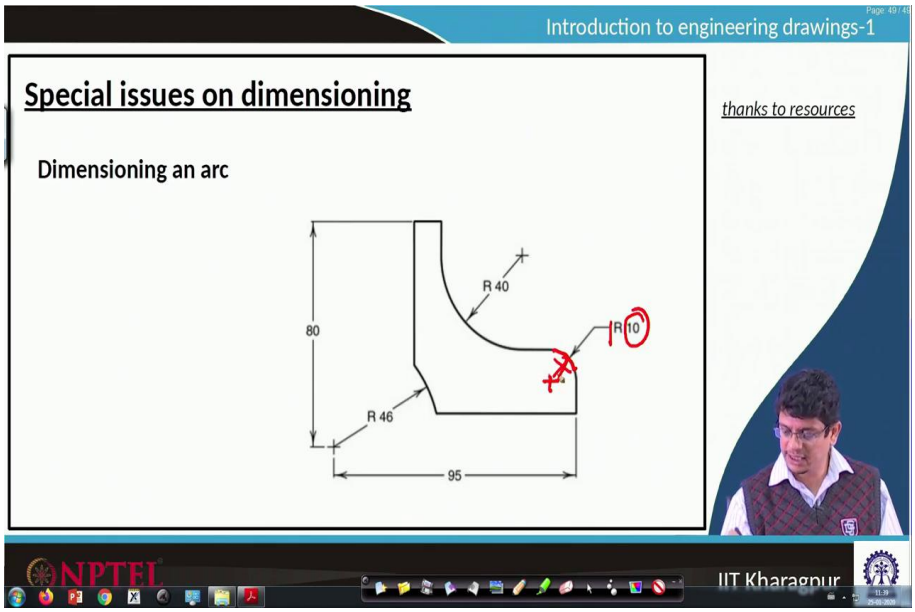

For example, this is another arc. From this centre, if we measure that it is of 10 units and symbol is R because we do not use inside of the object.

So, we usually show that radius from outside through leader line with 10 units and the centre of that arc is this 10 plus sign.

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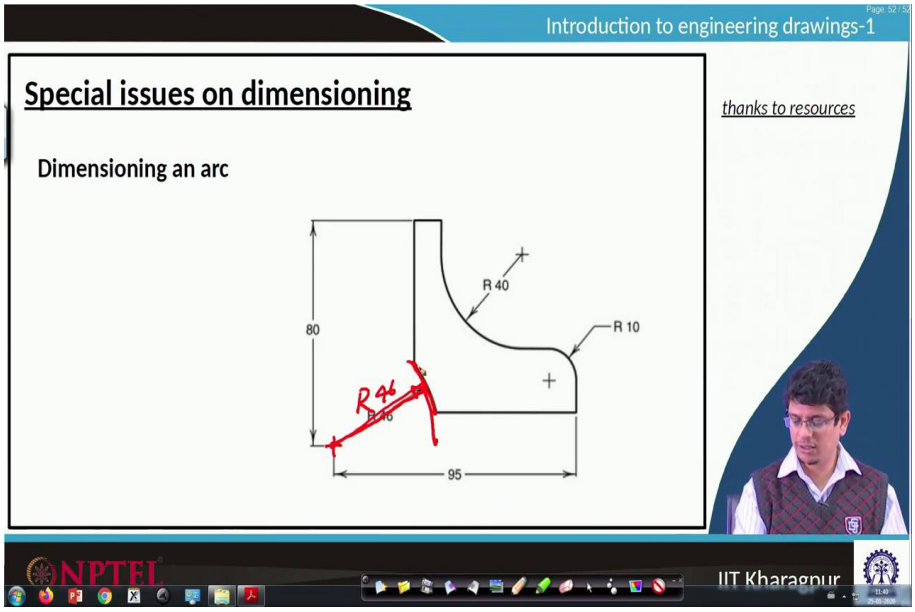

Similarly, there is exterior kind of curves from here. The centre of the arc is not inside the object but outside of it. So, with respect to that, we show 46 units. This radius is made from this centre.

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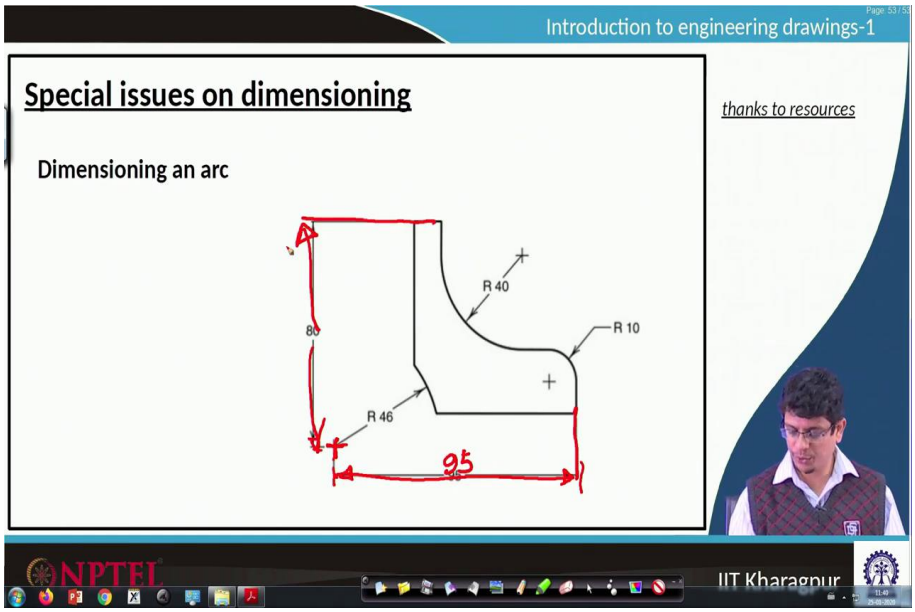

Similarly, one has to be careful here because we have this exterior object. There should be a reference dimension; something like this is 95 units from the object from this centre to this one is 95. Similarly, the reference is this centre is at 80 mm from this. This is the way we show it.

In today's class, we have learnt about these special dimensions for dimensioning of objects. In the next class, we will learn more about tolerances.

Thank you very much.