Electronics Equipment Integration and Prototype Building
Dr. N. V. Chalapathi Rao
Department of Electronics Systems Engineering
Indian Institute of Science, Bengaluru

Lecture - 26
Electronics equipment integration and Prototype building

Hello, let me continue from where I left off in the last session. This lecture is the continuation about how to make dimensioning representations on parts which we need. As I said there are two distinct phases of operation; one of them is the conceive a part depending on its functionality and various things. Secondly, put it down on a piece of document, which in this case is it is easily understood by the fabricator. And something which is continued with the; why I mentioned it as 2 phases is, what I make? I make a solid model, take it to the fabrication shop and discuss with them.

And instead of taking to the fabrication shop, if they are directly available online or you can bring them over, you can always find out something about how to slightly modify the various features in that such that, your part can finally be fabricated, which is slightly different from production drawings. In the case of production drawings, a very complicated, dimensioning, tolerancing, fit and surface finish; afterwards the actual other production operation saying.

If you remember yesterday, I left one thing hanging saying; in case you do a non ferrous casting how do you remove the flash that is wherever the moulds close. For that they usually use sandblasting or shot blasting, it is a very last job, they use shot blasting; if it is a little finer job, they use sandblasting.

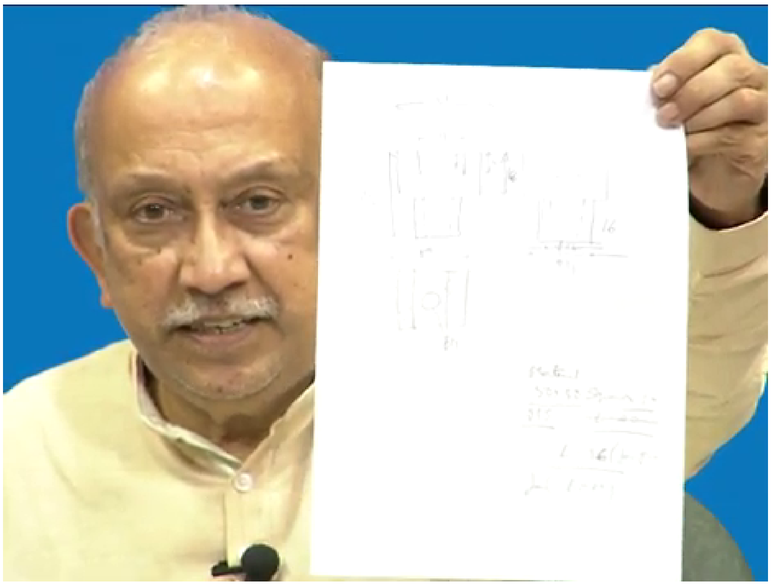
Otherwise, for very fine parts there is something called liquid honing or vapour blast; that is you have pumice powder directly injected at, I am sorry impinging on a surface which will improve various things which is extensively used in tooling. When you are making tooling this so called vapour blast or liquid honing is used, we will ignore that; the idea is saying, you need to mention what is the surface finish of the part.

So, one is the basic dimensions we require, second the amount of tolerances that are possible and you also make a fit; a limits and fits such that we know the matching part how well it assembles to each other and finally, the sort of surface roughness and any other protective finish we give.

Usually we apply either zinc or nickel plating to most parts; earlier they used to make cadmium, but because of the environmental hazard, except in very critical applications most of the times we use zinc or occasionally nickel and of course, all other finishes are possible.

So, the drawing contains all these other than the basic dimensions and later on the stock material from which we make the drawing are all mentioned here. The starting point of all this is something which you need to conceive in your mind.

(Refer Slide Time: 04:03)



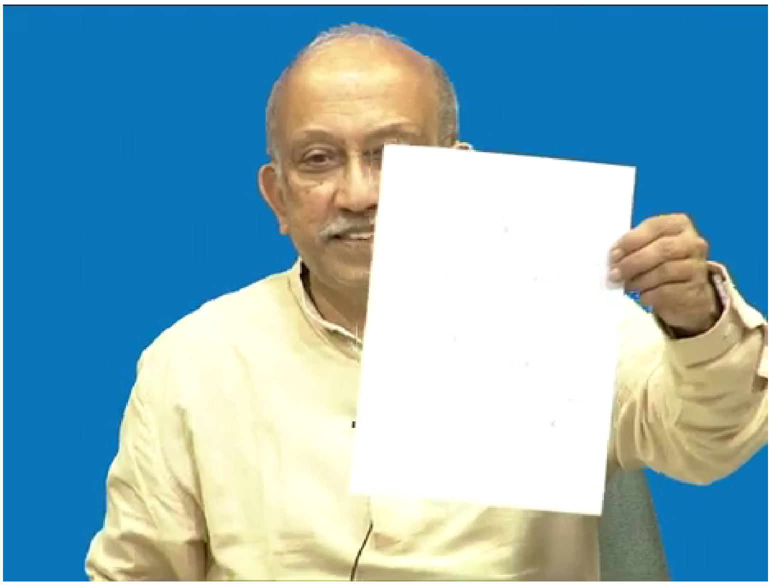
I belong to the old trained school, so I can only do things like that. So, if you see here, I have three features; and the top left is one way of the part which I shall call elevation, at the it is about the middle left, you see the plan we have fit. Similarly, at top right, you see the another side we have fit; that is the left view is projected on top.

And most important is at the bottom, things related to the material are written there saying, it says I need to take a 50 mm into 50 mm mild steel square of length of 36 millimeters; though the object length is only 34 that 36 mm is supposed to be specified, so that they can order stock based on this.

This important right side bottom information is very much important for the bill of materials preparation. So, bill of materials has sometimes it is auto generated saying; if in my electric vehicle we have four jacks in four corners and then we require four of these bushes. So, person who is preparing the process sheet and person who is preparing the different types of this orders for the stores; he will multiply all these things and usually if it is made in a proper format, all this is kept somewhere it is archived and kept there.

And the next person who is ordering all these, the logistics people will know what material is required and all that and a huge amount of database is maintained about what materials are available, how much is used, how much is issued, is it a surplus material and how to dispose it off and all that.

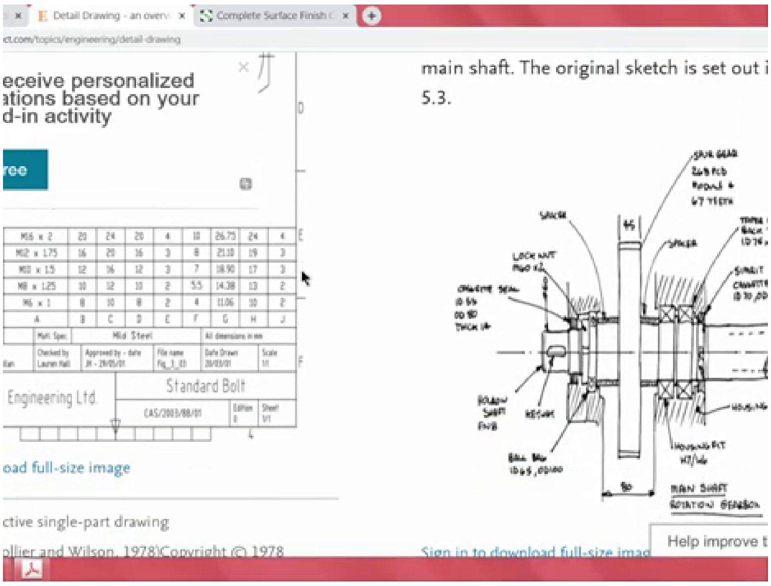
(Refer Slide Time: 05:55)



So, all the information is coded into this, it looks simple on the outside; but reality is, the part I want and how it is to be manufactured, to what tolerances it is to be manufactured, how well it has to be inspected finally. Things are not which are mentioned here is saying, typically what is the weight of the part and what is the minimum various types of quality inspections on that; that is an acceptable quality level.

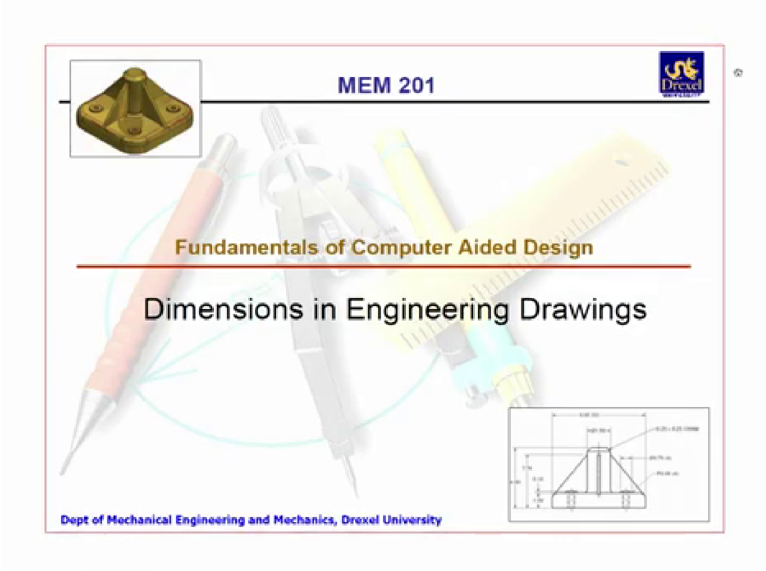
In case of this large gross crude part, things are not very, it is not a big issue; but imagine you have to make small pins which are part of a connector or imagine you have small riveted standoffs and all which are part of your equipment. There in that case, this becomes very very important, you must use things are which are already available and alternate supplies and all are there.

(Refer Slide Time: 07:00)



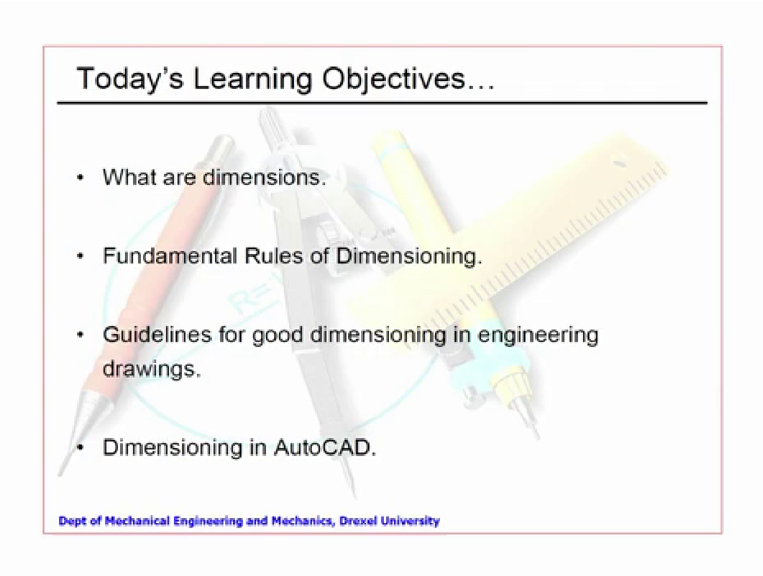
Now, see here, just like me they have indicated everything on their own; and here something related to the title block in which the type of materials that are required and everything is also mentioned here. And this probably forms part of the various assembler drawings and so on.

(Refer Slide Time: 07:27)



Now, let me continue with this which is taken from the Drexel University in the United States. There this is one of the probably the oldest colleges and we were all influenced by such presentations. Now, this being on the what do you call, I hereby acknowledge that this is not a my effort and it belongs to this Drexel University, the department of mechanical engineering and everybody has to undergo yes; it is nothing to do with whether it is meant for the only for your examination.

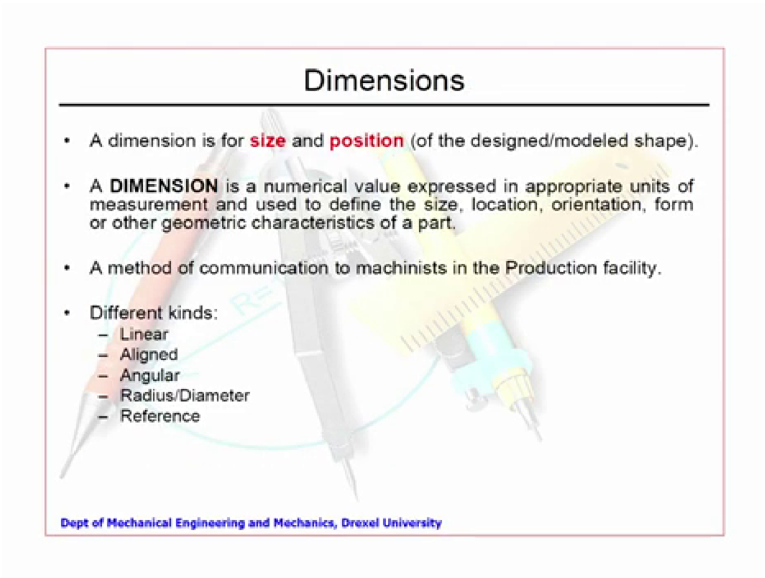
(Refer Slide Time: 08:12)



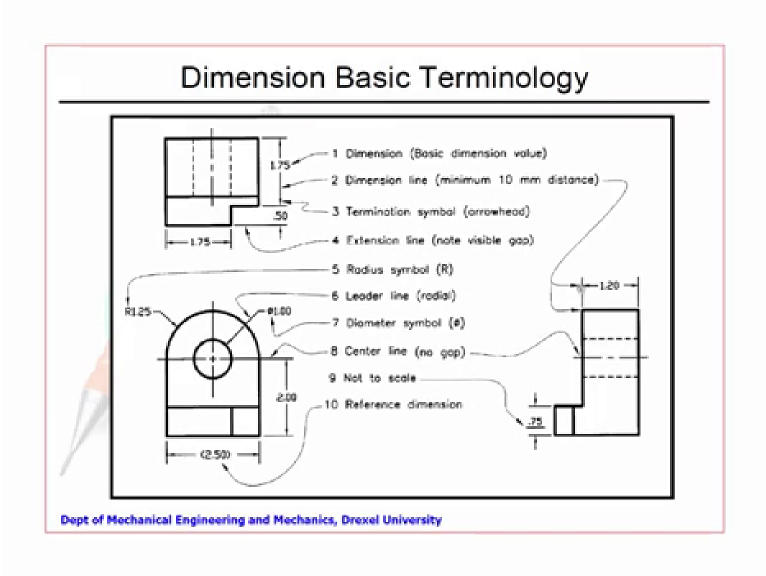
So, let me quickly go through things which are presented here. Can you see here; first of all it is about guidelines for good dimensioning and engineering drawings which you need to learn. That last point dimensioning and AutoCAD was, because previously, this Autodesk's main program used to be the de facto standard in converting 2 D drafting into files.

And in fact, they are one of the earliest people, Autodesk were probably one of the earlier people who started with the IGES Initial Graphic Exchange Format. Later on the DWG format as adapted by AutoCAD became a de facto standard, and later on something related to that has become the in and out; how do you export and how do you import those things. So, several other DXF drawing interchange formats and all were standardized later.

(Refer Slide Time: 09:20)



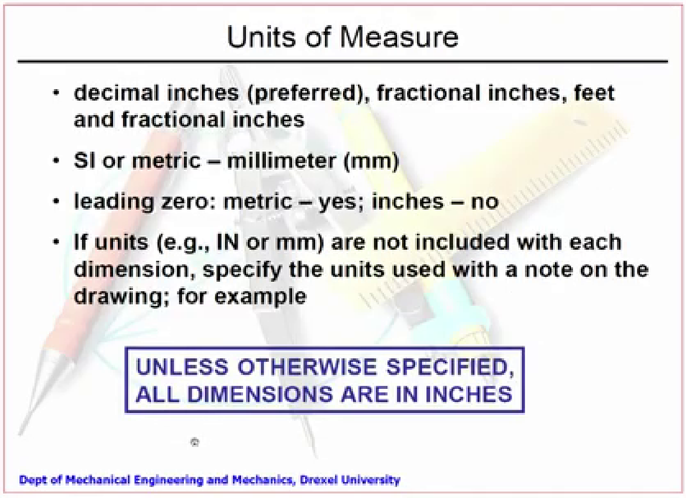
(Refer Slide Time: 09:23)



So, if you remember we saw some of these yesterday saying, what is a basic dimension value, what is the dimension; various things are how do you describe a particular line, in this case we have a center line which is the dash dotted line. And on the other slide know we have things like these line lengths, then we have; you see here some very important thing one 2.5 is put in brackets saying, it is only a reference dimension.

The idea of a reference dimension is no further machining needs to be carried out to maintain the dimension; probably it is brought from the stock material. And after you, if you maintain this R 1.25 all around and you make these things asymptotic; by definition this will become 2.5 and one should not constraint this as well as this, unless it is very very critical.

(Refer Slide Time: 10:30)



Next one talks about the basic units of measure; this is where the difference between any CAD drawing and physical prints make a lot of differences. One of the difficulty is until a print is made or job continues to be in some drawing units which in the end we need to convert it to a printable form. And in print form, the dimensions are picked from there and they are measured.

So, when this was made for the United States and we now elsewhere in the world except the US, most of them we have all become systems international or the metric related sorry metric dimensions. Where a small problem happens here, especially in the case of our students who enter our colleges in this part of end; the scientific community has used MKS or CGS system; in that M stand for length, length is in metres or you have centimeters.

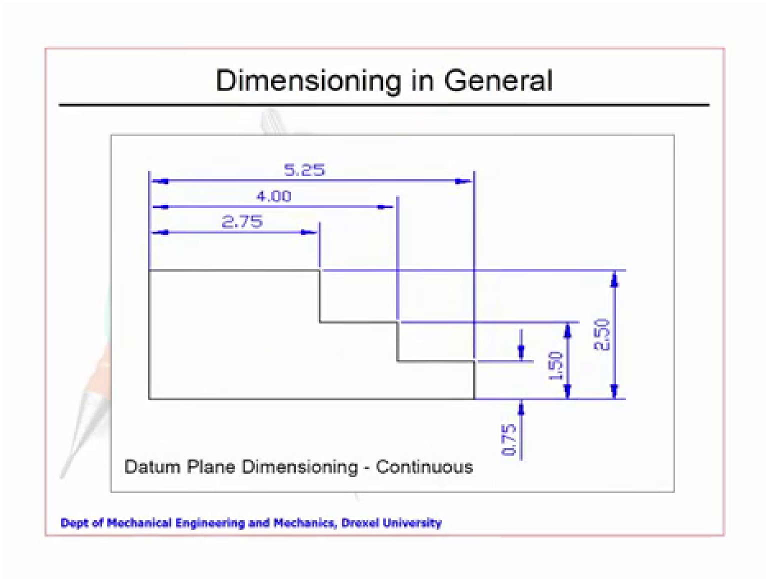
So, extensively centimeters is used in the case of our normal drawing which we use up to the high school level, you follow centimeters. Unfortunately, when it has come to engineering, the standard which is used is millimeters. So, it needs to we know a little bit of conscious effort to remember that everything should be in millimeters not in centimeter; occasionally it leads to confusion, but then we have to get used to it.

And as we come down next important thing is, you see here very very important, leading zero; that is if something measures 5 millimeters, it is considered perfectly all right if you write 05 millimeters. Because when you want to someway mention it and the way the centering and all it takes place and the way things are represented and added to that is, how occasionally they are all sorted that zero is required on the left side.

Earlier the imperial system did not permit anything; if something is 1 inch, you call it to 1 inch; if it is a one and quarter inch, you will call it one and quarter inch. And US did use the decimal system, but they have got into decimal inch system. So, something will become one and a half, 1.5 and fractional inches are slowly getting what you call replaced.

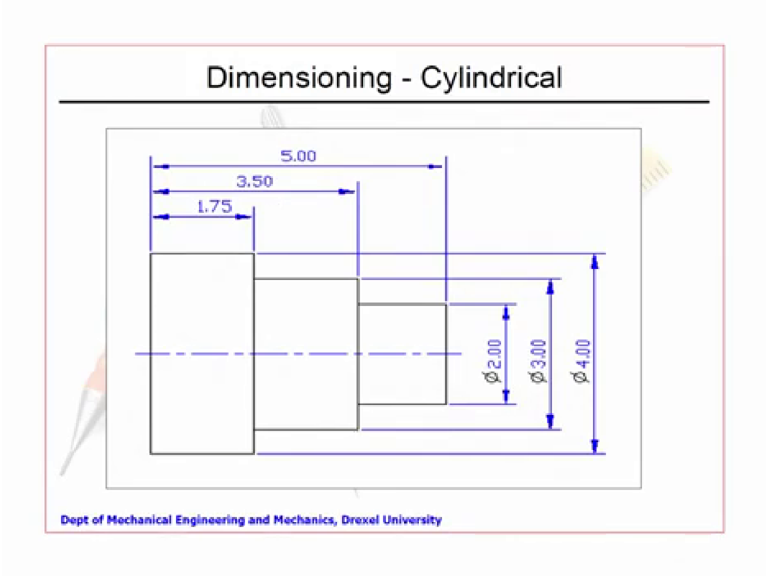
And by definition if you do not include anything, you would need to include this in the title block, saying all the dimensions are in millimeters unless otherwise specified.

(Refer Slide Time: 13:50)



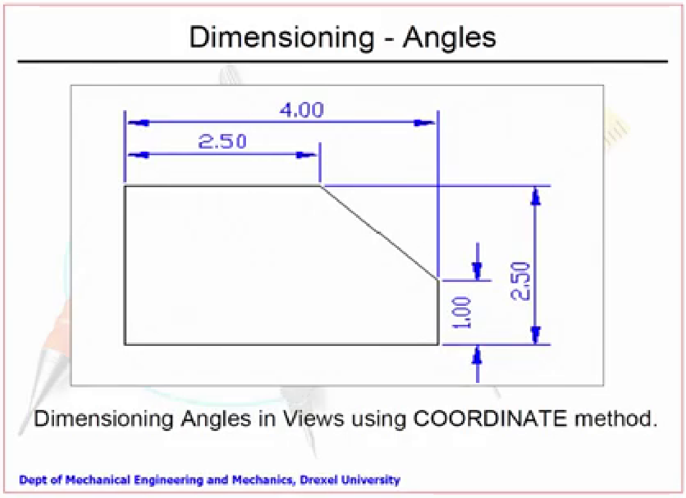
This if you remember, how we have various option; these options can be set easily in your CAD or by hand when you do it, you can do these things.

(Refer Slide Time: 14:03)



And when it comes to cylindrical dimensions you see a small difference is there; while this could be a sectioned view, half sectioned view and all this. Invariably these cylindrical parts are all mentioned with the diameter symbol, only in rare cases the word dia is written; otherwise depending on the precision you require two digits are all shown there. This looks like auto generated in some CAD packets; it is just mentioned it is AutoCAD in the beginning, probably it is done like this.

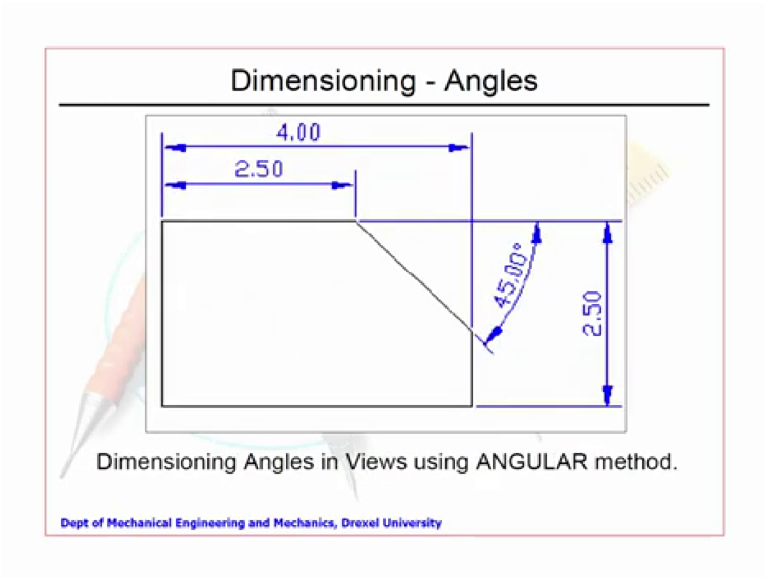
(Refer Slide Time: 14:44)



Next we come to how to mention angular dimensions. These angular dimensions are required depend on the particular type of job that we require. Sometimes for example, this looks like a chamfer in a corner or it could be a mating part. Say what they have written is, the remaining portion; after you remove that, the remaining portion is mentioned here, this is actually it is inches, but let me continue to just call it two and half millimeter.

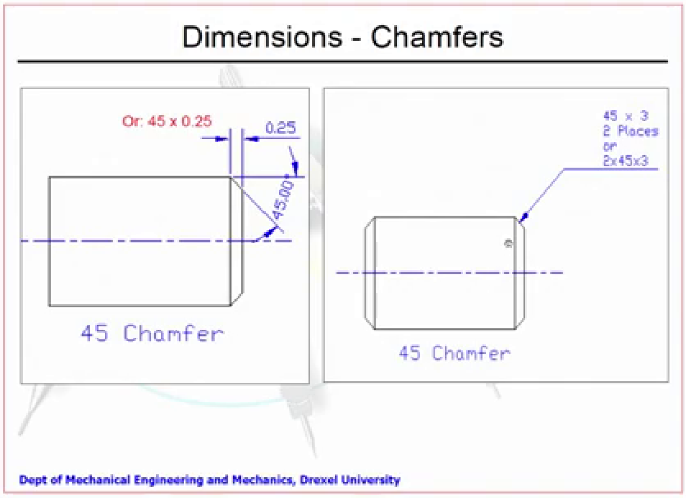
So, I have 2.5 millimeters, 1 millimeter; this is mentioned in not the other way, you should not write the saying this is one and half and this is one and half. Though while specifying chamfering, we probably specify those dimensions, so dimensions, the remaining part it is easier to measure, to check and all that; setting is something else.

(Refer Slide Time: 15:48)



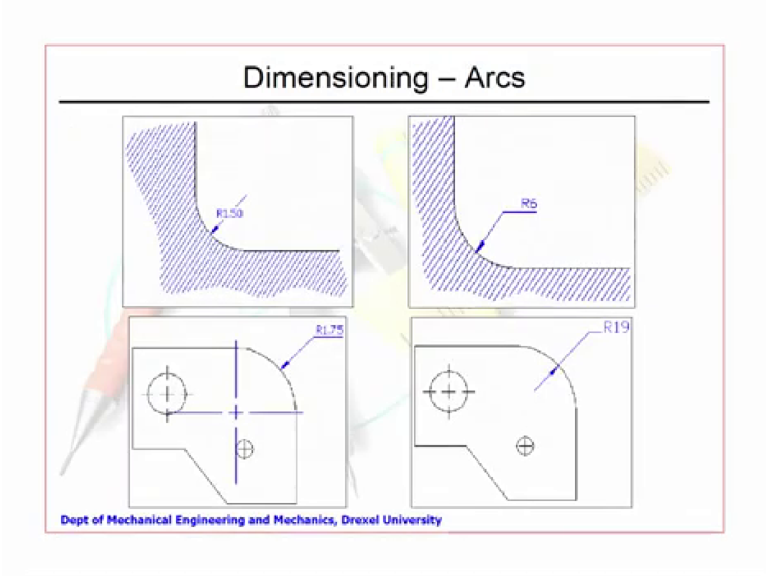
Then in some conditions angular dimension is preferred. And in some even other rare cases, if it is a taper, both the taper angle or the taper step is mentioned here saying; in this case both is one and half by one and half. Instead it will say 1 is to 1 with the other dimension saying, how many millimeters down it is for a given length, which is another way of representing those things.

(Refer Slide Time: 16:21)



So, you see here coming back to the chamfers, it clearly says 45 degree chamfer; 45 into 3 at two places, 45 at this, this is a convention which is followed. Fortunately for us that is, those of us are moving out to the new CAD and we make a solid model; probably even if you were to miss the drawing can be read and the process people will be able to understand those things.

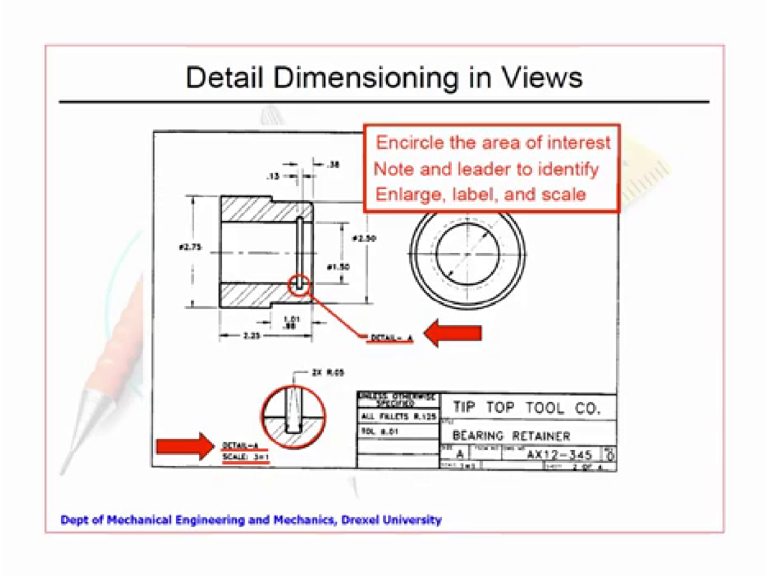
(Refer Slide Time: 17:00)



Now, here two other things here, there are two fillets here; this one is a fillet. Fillet is typically what you do for making sure that stress concentration does not occur. So, this could be part of a casting or it should be a part of some other thing, an internal bore. So, see where the thing is shown.

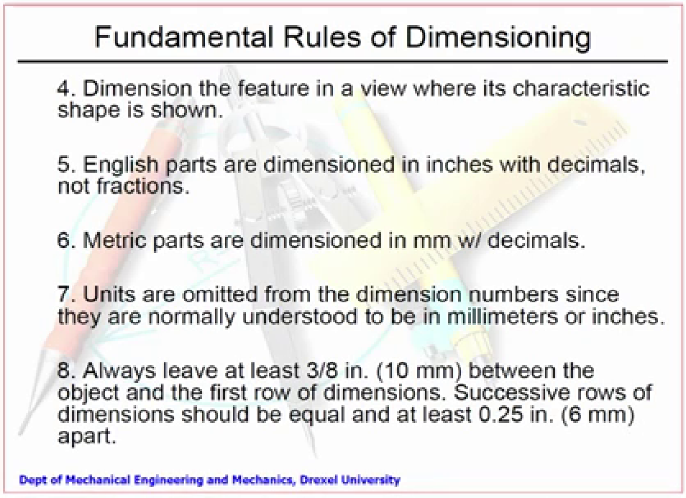
So, you have one thing where inside the dimension line; here it is brought out horizontally and it is shown outside. This is a matter of both convention in the company when you are working or the drafting office, and the country where it is used. And similarly, it is also a convention related to where finally the trade in which these things are used. So, people who are in the construction field; they have different people who are in the fabrication or chemical engineering fields that different conventions they follow.

(Refer Slide Time: 18:12)

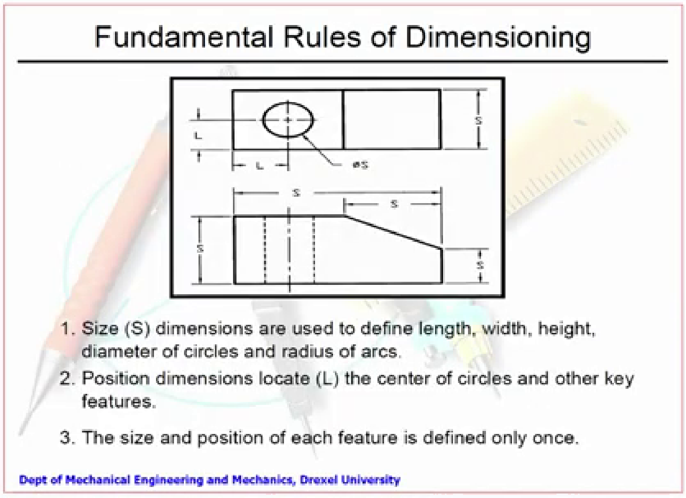


You see which is, if you have a print; because you need a print when you are actually offering it in the fabrication shop. In the fabrication shop see what they have shown saying; if there is a closed detail we need to follow, we need to show it separately. Right now for matter of convenience, only at that place the some critical dimensions have been shown here; otherwise the fit also is to be shown here, because this could be a circlip is placed inside, what is called an internal circlip. So, internal circlip has certain dimensions that information also is required here. So, somebody needs to find out for every job; how things fit together easily.

(Refer Slide Time: 19:27)

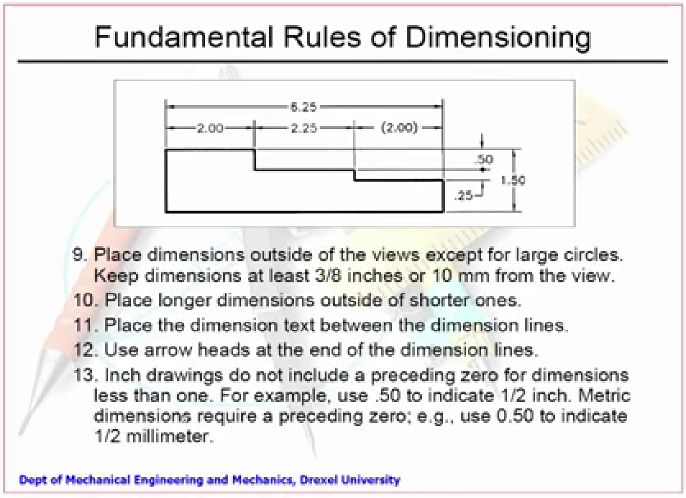


(Refer Slide Time: 19:29)



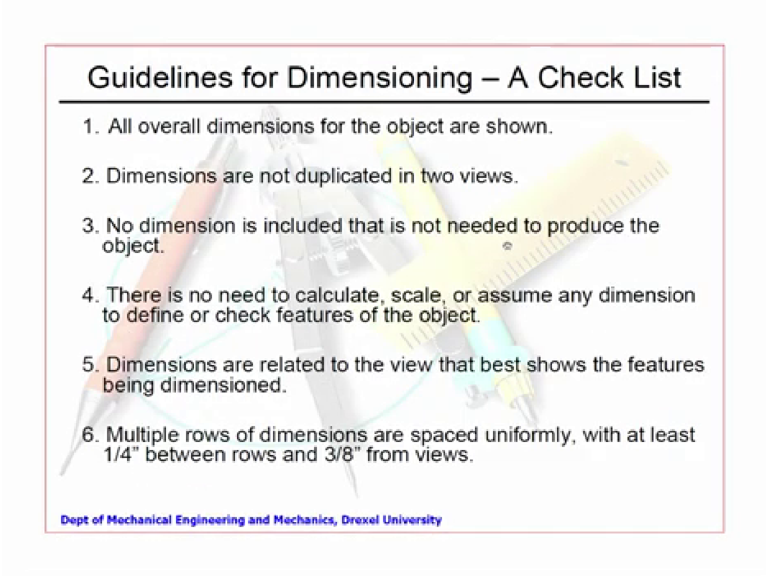
Now, if you go back to the my slides again; length, width, height, position, dimension, size and position of each feature is defined only once. Very critical thing is, why it is showing only once? If I change it in one place automatically people have to refer to this and nowhere else and two contradict ratings should happen; because often know whether you like it or not. And then this is a matter of convention saying, leave about this much dimension while printing and all that.

(Refer Slide Time: 20:03)

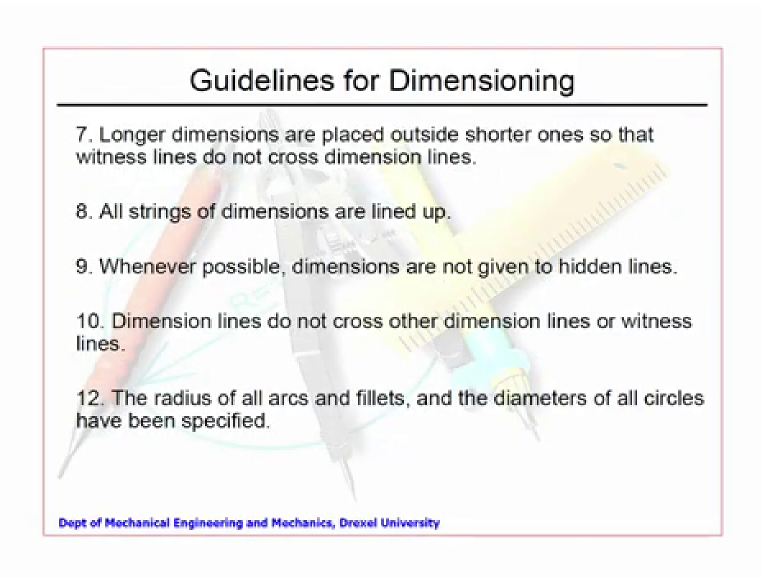


So, you see here one very interesting thing, 2 millimeter is critical, 2.25 is critical and 6.25 is critical; these two is what is the remaining dimension, so that it will not lead to any unnecessary confusion. Now, if you look at the right side, I have 1.5; then you see there is a small dot here, that dot represents from here to here. Now, are we violating it? Strictly not, but it is unavoidable here, you must show this; you cannot leave this, otherwise it does not make sense. If you see here, this last portion, from here to here is not mentioned; see near this last portion, from here to here is not mentioned, 1.5 is mentioned, total 3 is mentioned, so by default it will become 1 millimeter.

(Refer Slide Time: 21:03)

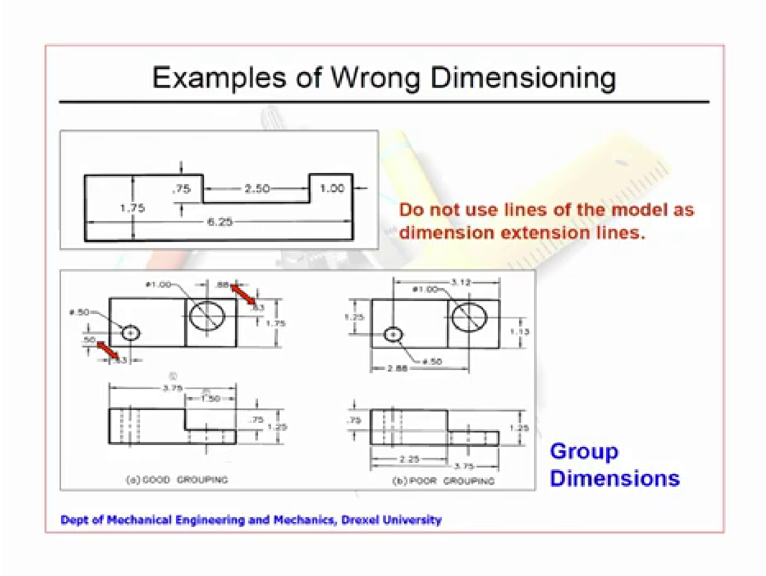


(Refer Slide Time: 21:16)



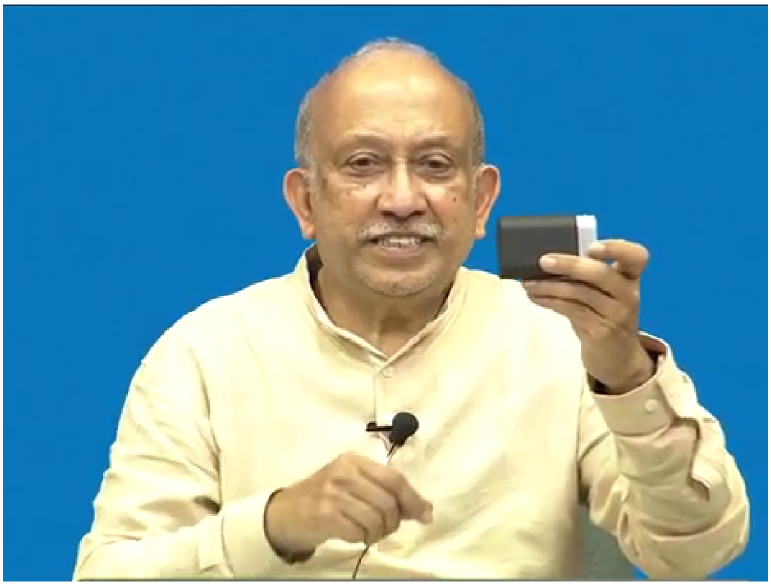
I suggest you go through this from the department of mechanic ME; I think 2 0 1 from Drexel, it is something which all of us and we will be able to understand what these things are.

(Refer Slide Time: 21:29)



So, these are all matter of convention, only when you come to a little.

(Refer Slide Time: 21:42)

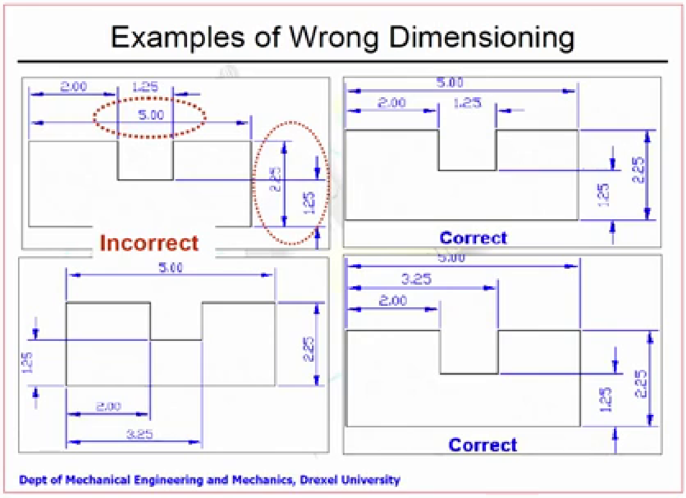


You have seen this very important thing, what has been shown there is, we have a, let say I am representing this; when I am representing this, I may have dimension something which I needs to be put from here to here; put from here to here. It is accept in very exceptional cases, we cannot use these two lines to show the dimension; it is say always logical to bring it out and show it like that.

And then you see here, there is a small step here; now there is every chance of the small step being forgotten or ignored in case we try to follow these things here. Now, you see here at the various things about how dimensions are good grouping. You see here, we are trying to dimension the center point of this. So, things are related to the 0.63 and 0.88 have been shown which are related to that; though technically it is possible that you know we can put it somewhere else, logically it is not correct.

Similarly, if you see from the edge, this takes some 0.5 and 0.63 and there is a 0.5 inch hole, this is a very logical way. The same information is presented here; but if you see, it is a little wag. If somebody wants to know where I drill this, logically 3.12 is shown here, similarly 1.25 is shown here and it needs a little bit of thing saying I read 1.75 here; and then after that I do all this to just to locate this point, this leads to a lot of confusion and not easier way of doing it.

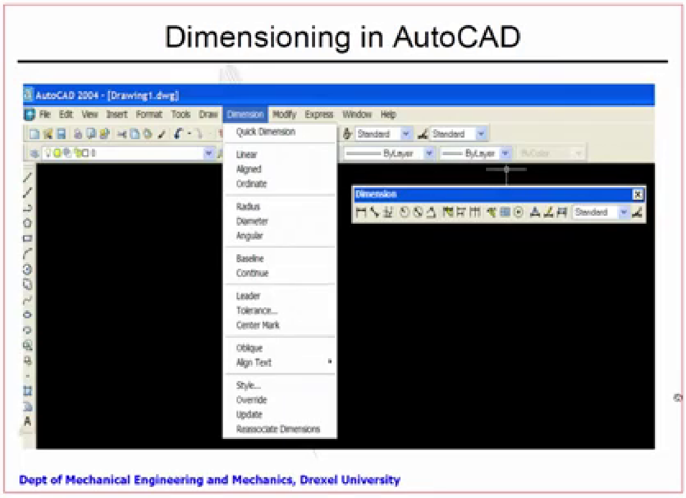
(Refer Slide Time: 23:30)



Same thing here saying, all sorts of you know mix up of things which are shown here. So, if you look at a part like this, we do not know what it is; you see here there is a 5 here, obviously this 5 refers to this, seen this. It is logical, because somehow it leads to a wrong thing as if this is the 5 millimeter belongs to this. If you now place it on top of it and make it logically, easier for us to read all these things; two variants here, the grove depth is groove width is given here and the starting point is given. In this case from a datum line the things are shown here. So, both are correct.

And logically if you place everything one after the other, it will be easier to understand. In this case 2.25 has been given here and 1.25 has been taken there.

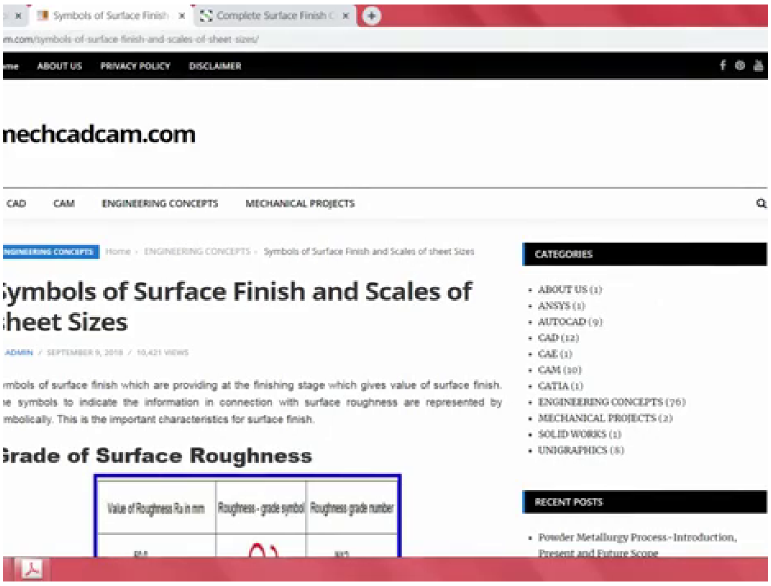
(Refer Slide Time: 24:34)



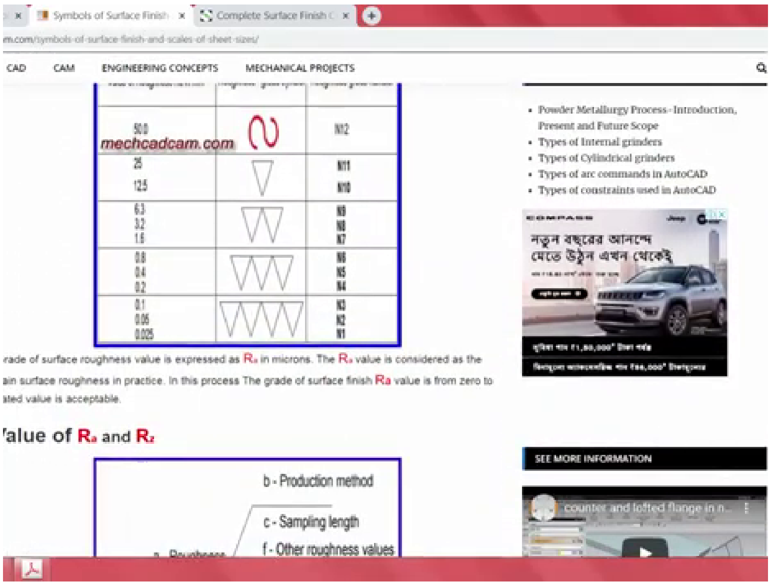
While in principle this is correct, it leads to confusion; same part if you are to be dimension like this, it will be very very convenient for us to do these things. Do not worry too much about it; whichever package you have, usually these are common in this.

So, I will stop this at this and continue with the next thing. These questions that slide was intended for the people who were taking the drafting course in Drexel University, which is one known very old extremely.

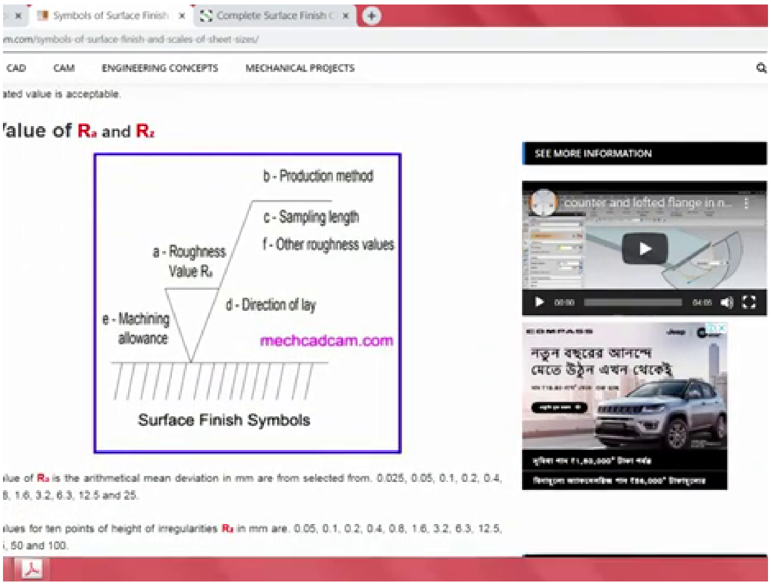
(Refer Slide Time: 25:11)



(Refer Slide Time: 25:16)



(Refer Slide Time: 25:20)



Now, we have this important thing about surface roughness, so far which I have tried to avoid; which I will take separately, because somehow it is very closely related to the type of fit that we are talking about. If something is smooth, the fits will be different; if something is, you need an interference fit, then the type of surface roughness we specify will all be very different.

So, I will take a break here, and we will get back to this later.