Engineering Metrology

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Lecture – 22
Screw Thread Metrology

Welcome to the next lecture on Screw Thread Metrology.

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First we should understand, what is the necessity for these screws? Ok. Screw thread so, basically this thread which is used here in this bolt, this thread here, which is there this tries to give me a flexibility in making temporary assemblies. So, I wanted to assemble 2 piece, I will use this bolt and then either I can directly fasten it to the plate or I can put a nut on the other side and try to use for fastening.

So, this is used for temporary fastening or temporary assembly. So, this is required because wherever I wanted to create a very complex geometry, I will not be able to do it in a single piece. I do it in multiple pieces either I glue it or I do this fastening attachment and try to make a complex structure. This complex structure may be due to the limitation I do not have a large bed. So, then that is one. Second thing is I frequently have a wear and tear of parts.

So, I need to open the assembly replace it and then go ahead with the product. So, there also I use these temporary fastening techniques like screw threads. And, if you look at it this screw thread you should understand it is not like a standard flat shaft. So, a standard flat shaft it is easy to measure the diameter, here it is a thread which runs. So, you have a peak you have a valley.

So, now when you try to measure the distance, if you try to measure from here to the next pitch maybe there will be a variation. Or, if I try to put a flat plate on a line there might not be a perfect flatness in contact. So, the standard measuring devices cannot be used ok. And, here you see that I have put different types of screw threads M 6 M 4 M 5 M 8 and M 3. So, this tells me these are taps basically this clearly tells me that these are referring to some scale and this scale is a standard scale. So, this gives me the freedom of interchangeability. So, we studied in this course initially what is the need for interchangeability?

So, for maintaining the interchangeability concept we need to have a standard. So, M 3 M 4 M 5 M 6 and M 8, these are various types of taps which are available in the market today, by using these steps you create a thread. So, these thread follow a international standard ok.

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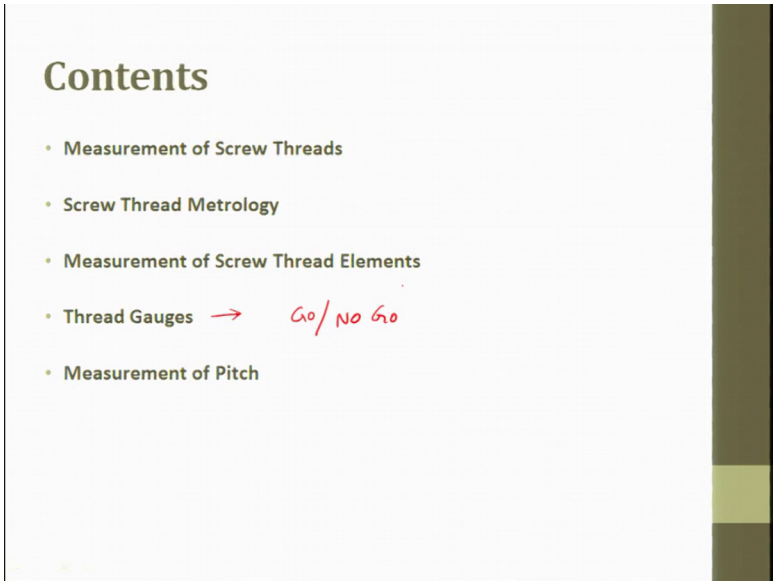

So, let us see what all are we going to cover in this lecture? So, we will try to cover what are the measurements for screw threads. Then, some of the terminologies screw thread

metrology terminologies we will see. Then, measurement of screw thread elements we will see then thread gauges we will see and then we will try to see how do we measure pictures? So, what is the need for understanding gauges?

So, these gauges, thread gauges means here it is something like a Go or No Go gauge we will try to use it. So, yes no. So, we can use this thread gauge, but if you want to do measurements then we will undergo various elements in measurement and finally pitch.

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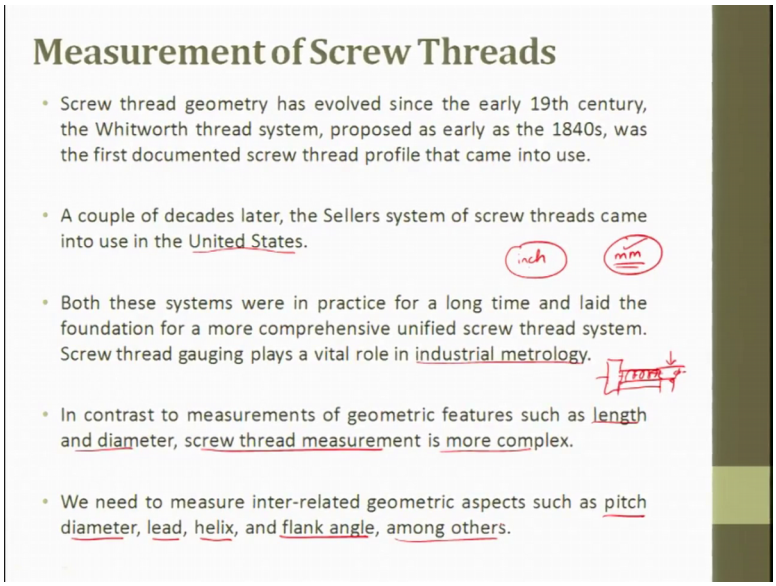

Measurement of Screw Threads; Screw thread geometry has evolved since the early 19th century, the Whitworth thread system, proposed as early as 1840, was the first documented screw thread profile that came into use. So, that was that time when industrial revolution started. So, big machines were started getting built. So, and lot of these machines had lot of mechanical moving parts which had wear and tear.

So, people were looking at some fastening techniques which can be used so, that they can have maintenance. A couple of decades later after this industrial revolution or during the time of industrial, the sellers system of screw threads came into use in United States. Both these systems were in practice for a very long time and laid the foundation for more comprehensive unified screw thread system. Because, in the world if you see there are certain countries which follow inches scale, there are certain countries which follow millimetre scale right. So, inches and millimetre there is always a difference.

So, if you want to have a standard and then across the world you have to start supplying your parts then people said that from inches let us move to millimetre. So, this is now a unified standard. So, we start using these millimetre standard, millimetre units for the screw thread. So, screw thread gauging plays a vital role in the industrial metrology. In contrast to measure the geometric features such as length, diameter, screw thread measurement is more complex.

So, if you take as such this is a shaft. So, if you want to measure the dimension of this shaft. So, what you do is we try to talk in terms of length and then we try to talk in terms of diameter, but when you try to have a screw thread on top of it the complexity increases, that is what we are trying to say.

We need so, what are the complexities? We need to measure the interrelated geometric aspect such as pitch diameter, lead, helix, flank angle and many other things amongst them. So, in the next slide we will see what are these things.

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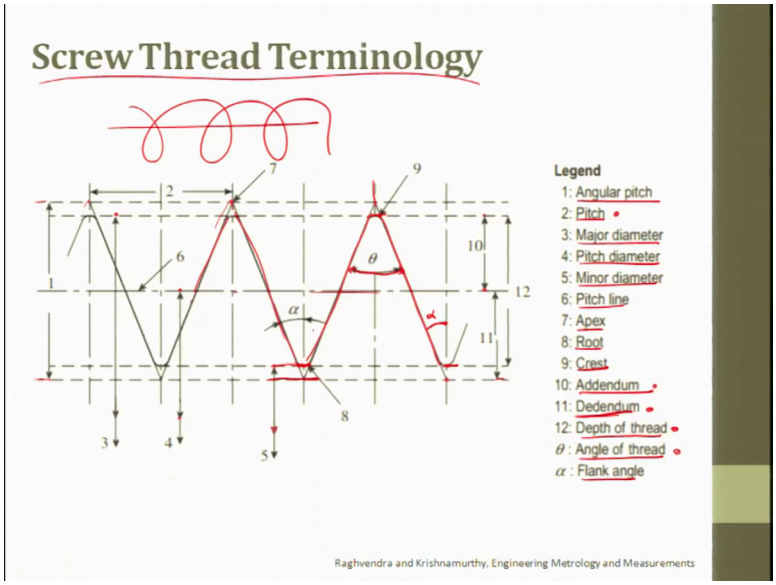

So, here I have listed the legends. So, from this you can try to read this figure. So, let us go step by step. First one we will try to take pitch. So, what is pitch? The if you try to measure the dimension between 2 peaks successive speaks in a screw thread this is called as pitch right, this is called as Pitch. So, pitch can change depending upon your requirement you can have a smaller pitch, you can have a larger pitch; that means, to say if the pitch is large so, then that number of threads are going to be less.

So, here the pitches decision is taken based upon the loads which come into effect and also the diameter ok. So, this is pitch. Next one is going to be major diameter. So, major diameter happens between this point and see if you see that there is a crest right here is a crest.

So, from the topmost point, if you try to take to the opposite side topmost point so, that is called as a major diameter so, major diameter. So, next one is going to be minor diameter; minor diameter is going to be major diameter minor diameter. Minor diameter is going to be from this point right from this point to the out to the outside.

So, from here it goes to here. So, this will be the minor diameter. And what is pitch diameter? Pitch diameter is from centre of the coaxial of the axis you will see through this point, we call it as the pitch diameter ok. What is a pitch line? The line passing it almost pitch line is nothing, but the axis line is called as the pitch line, the axis of the screw the centre portion of it. Then, we will try to see what is addendum and we will see what is dedendum? Addendum means from the central axis to the crest it is called as addendum, from here to here from the central axis to this is called as addendum.

So, what is dedendum? From the central axis to you try to imaginarily make a crest right or make a truncation of the cone. So, till then it is called as dedendum ok. So, depth of the thread will be from the top most portion to the bottom most portion from one thread to the next so, one crest to the valley. So, that is called as the depth of the thread. And, here this angle between 2 flat planes at an angle. So, that is called as Angle of thread. This is this portion is called the angle of thread so, but you have flat plane. So, this flat plane is trying to make an angle. So, it is called as angle of thread.

So, what is flank angle with respect to the thread here, you try to take one between the plane and the central axis of the single thread it makes a flank angle ok. So, then we will try to see what is apex? So, if you try to draw and you try to extend the flat plane and if it meets at a point; so, that point is called as the apex right. In the same way in the bottom wherever it meets in it is called as the root.

So, this portion where it is touching the imaginary line it is called as the crest. So, crest happens on the top, root happens at the bottom. Crest on the top root at the bottom. So, what is left is the angular pitch. So, angular pitch is nothing, but which covers from the

imaginary down point of this extended thread to the topmost point is called as the angular pitch.

So, these are some of the terminologies, which are used when you have to measure these terminologies apart from the shaft diameter and the length when you talk about threads. So, thread screw thread terminology is slightly different, but generally what we more talked about is the pitch and then we talked about addendum, dedendum, depth of thread and angle of thread. So, angle of thread is when there is a single thread, the angle which is subtended is called as theta and when it is with respect to axis central axis this becomes alpha.

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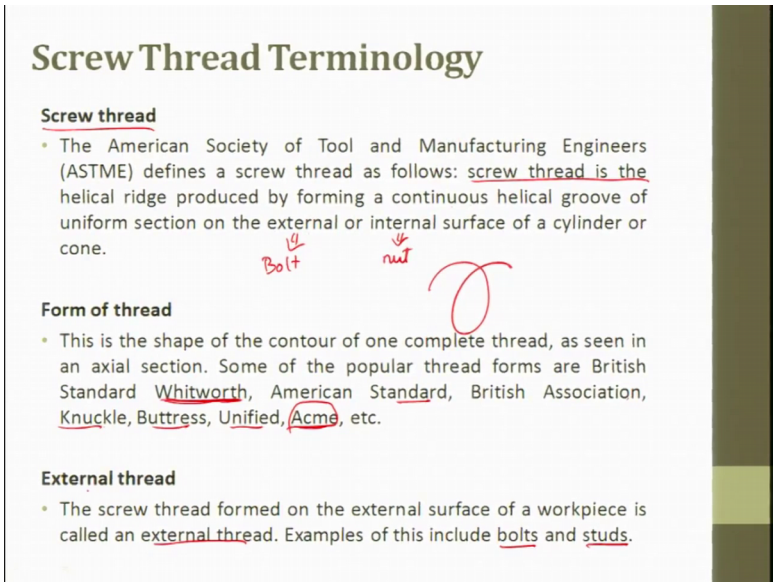

So, now, let us see the individual explanations; Screw thread. AS the American Society for Tool and Manufacturing Engineering; ASTME defined the screw thread as following. Screw thread is the helical ridge produced by forming a continuous helical groove of uniform section on the external or internal surface of a cylinder or a cone ok, is the helical ridge, helical ridge this is helical right.

So, when it is helix this is helix right. Helical ridge, helical ridge produced by forming a continuous helical groove, forming a continuous helical groove. So, this is a groove this is a groove. So, this is a groove, the depth which is given. Helical groove of uniform cross section on the external and internal, when you talk about bolt it is external; when

you talk about nut it is internal. Screws will have external nut is internal, surface of a cylinder or a cone, that is the screw thread.

Form of thread it is the shape of the contour of one complete thread, as seen in an axial section. Form of thread, it is the shape of the contour of one complete thread, one complete thread as seen in an axial section is the form of thread. Some of the popular threads forms are British Standard Whitworth. Whitworth is one standard, American Standard, then British Association, Knuckle, Buttress, and Unified, Acme.

So, Acme is the most common thread which is used today, but we still have Whitworth, American Standard, British Association, Knuckle and then, Buttress, Unified and Acme external thread. And, internal thread the screw thread formed on the external surface of a work piece is called as external thread for example, bolt stud these are external threads.

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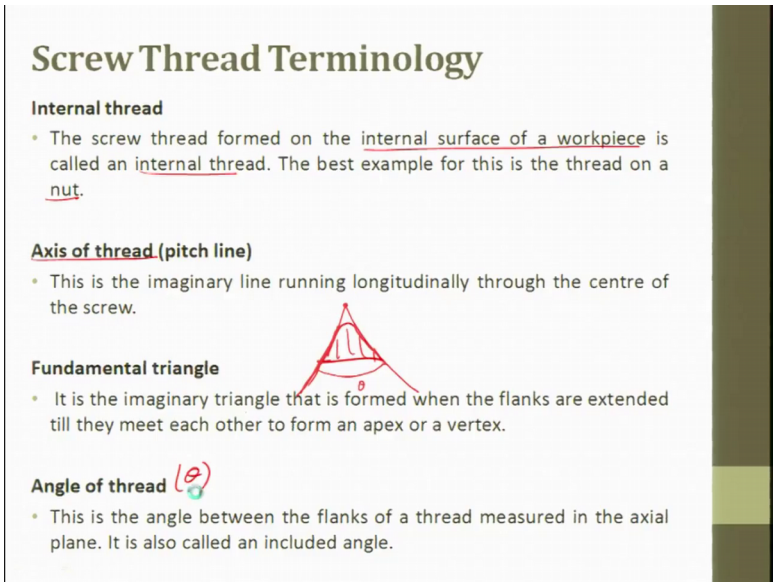

When you talk about internal threads, the screw thread formed on the internal surface of the work piece is called as internal thread. For example, in a nut ok. What is the axis of the thread, it is otherwise called as the pitch line, if you go back and see the definition pitch line. So, is 6 pitch line is nothing, but the axis of the thread is called as the pitch line.

So, axis of the thread, it is the imaginary line running of longitudinal throughout the centre of the thread is called as axis of thread, which is nothing but pitch line. Next one

is fundamental triangle this is the fundamental triangle.. So, it is the imaginary triangle that is formed when the flank are extended till they meet each other to form an apex or vertex. So, what will happen generally in a screw that it will be something like this. This will be a screw thread, but if you try to project at it forms a fundamental triangle, it is an image so, if you can go like this. This is your alpha, this is your theta. It is the imaginary triangle that is formed when the flank this is called as a flank ok.

Flank are extended till they meet each other to form an apex or a vertex. Angle of thread this is the angle between the plank of the thread measured in the axial plane, this is the angle between the flank theta, if you go back look at it theta, theta is nothing but angle of thread. This is a flank I said a plane, this is a flank, this is a flank between these 2 flanks the angle which is subtended is called theta, which is the angle of thread all these parameters have to be measured.

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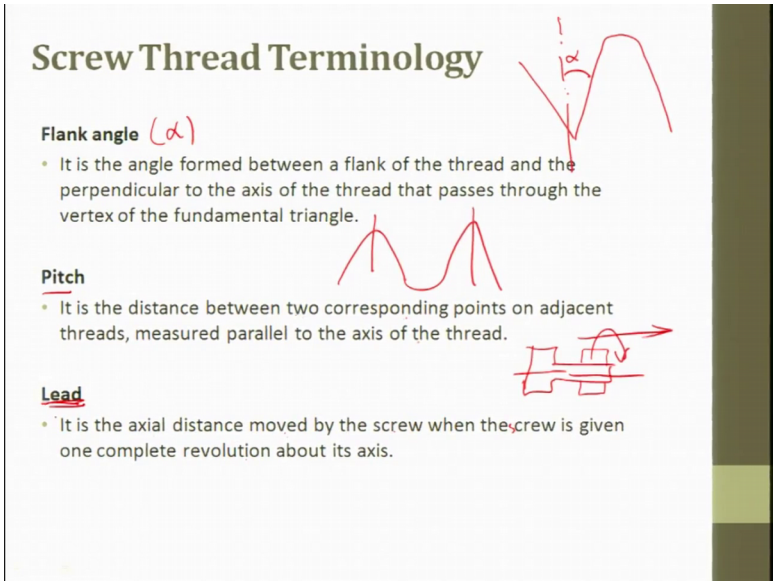

Next flank angle, it is the angle formed between a plank of a thread and the perpendicular to the axis. Suppose you have something like this right between the perpendicular line and the flank alpha it is nothing, but alpha. It is the angle formed between a plank of your thread and the perpendicular to the axis of the thread, that passes through the vertex of a fundamental triangle is called as flank angle, if you go back and see alpha is the flank angle. So, this is a triangle. So, this is the md fundamental triangle, this is the original surface. So, if you try to draw a imaginary perpendicular with respect

to this angle, it is called as flank angle. Then, what is pitch? Pitch is the distance between 2 corresponding points on adjacent threads measured parallel to the axis of thread.

So, it is a distance between ok. It is a distance between 2 corresponding points on adjacent threads ok, measured parallel to the axis of the thread is called the pitch. What is lead, it is the axial distance moved by the screw when the screw is given one complete rotation about it is axis is called as the lead. For example, you have a shaft or you have a screw, then you have some a nut, this nut is rotated. So, it is the axial distance moved it is the actual distance moved by the screw, when the screw is given one complete revolution about it is axis is called the lead.

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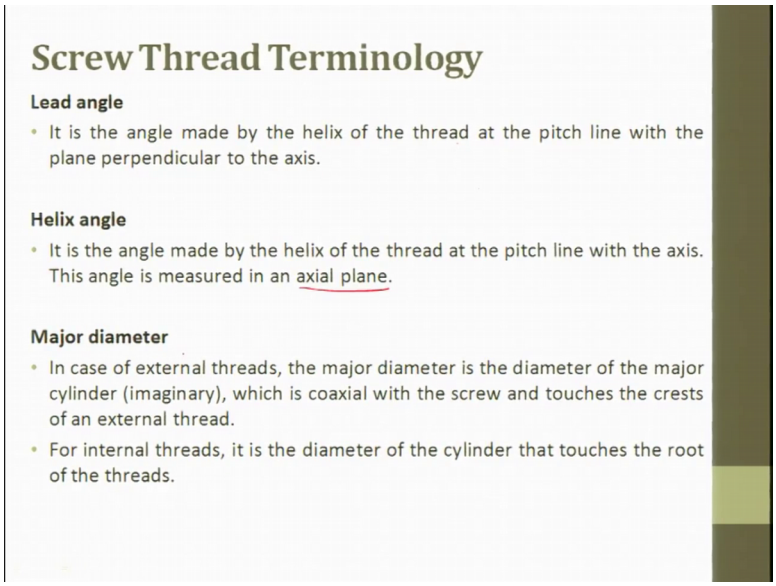

Then, lead angle. It is the angle made by the helix of the thread, at the pitch length with the plane perpendicular to the axis. Helix angle, we have already seen it is the angle made by the helix of the thread at the pitch line with the axis this is and it is measured in an axial plane. Then, we will try to see what is major diameter and minor diameter? Major diameter in case of external thread, the major diameter is a diameter of the major cylinder, which is coaxial with the screw and touches the crests of an external thread. So, if you go back. So, major diameter is 3 this is 3.

So, an imaginary let us see the definition, it is the major diameter the diameter of the image of a major cylinder, which imaginary, which is coaxial to the screw; coaxial to the

screw and touches that crest, coaxial to the screw and which touches the crust. So, this is the coaxial to the screw and touches all the crest is called as major diameter.

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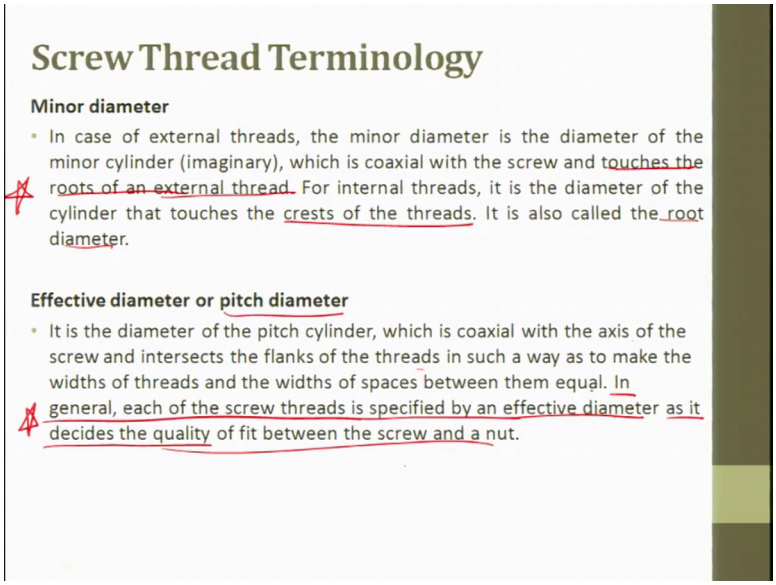

When we talk about minor diameter in case of external thread, minor diameter is the diameter of the minor cylinder, which is coaxial with the screw and touches the root of an external thread, which touches the roots of an external thread is called as minor diameter. So, for internal threads, it is the diameter of the cylinder that touches the crest of the crest of the thread this is for internal and that is for external. Please and this is very important, when you when the definition is asked in the examination you can always say the major diameter I can ask in terms of with internal threads, touches the crest of the thread. So, this is called the roots diameter, effective diameter or the pitch diameter.

It is the diameter of a pitch cylinder, which is coaxial with the axis of the screw and in and inserts the flank of a thread, in such a way as to make the width of the thread and the width of the space between them equal. In general, each screw thread is specified by an effective diameter or if it is diameter as it decides the quality of the fit between the screw and a nut. So, this is also very important. In general, each of the screw thread is specified by an effective diameter as it decides the quality of the fit between the screw and a nut. So, this is also a very very important point. So, please keep this in mind when it is major diameter or minor diameter it will be both when it is external thread internal thread it will be lit roots and crest that is the difference. And, here if we want to talk about the fit,

which has to happen between the screw and nut then pitch diameter plays a very very import role.

So, all these things are defined in this geometry pitch diameter is also defined pitch diameter pitch diameter is 4. So, this is the pitch diameter ok. Minor diameter this is the minor diameter between the crest and the through.

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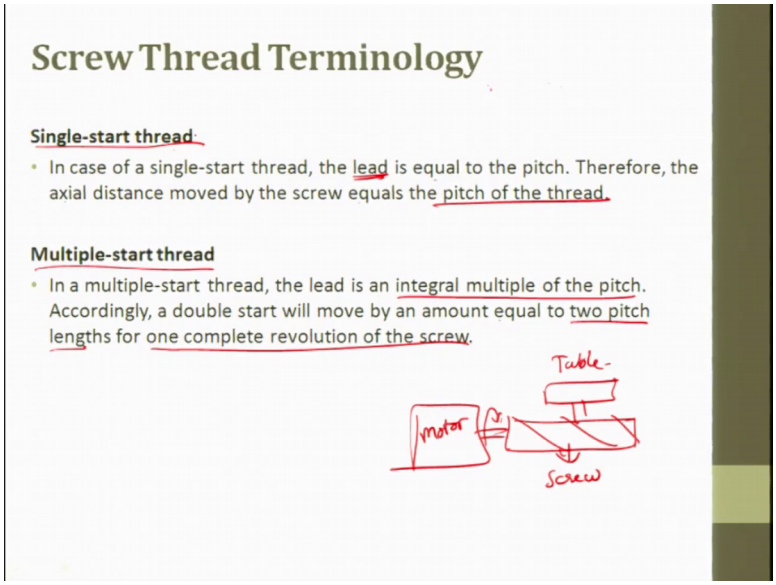

So, there can be single start thread and multiple start threads, in case of a single start thread the lead is equal to pitch. What is the lead? Lead is I rotate the screw or I rotate the nut, what is advancement it has is the lead is equal to the pitch, what is pitch the distance between 2 consecutive threads is the 2 consecutive peaks or 2 consecutive valleys in a screw is called a pitch. So, if it is a single thread then the lead will be equal to pitch so; that means, to say I know if I rotate it by one pitch the lead will be equal. For example, if you attach a motor right and then you attach a screw to it. So, the motor rotates right this is this is a motor this motor rotates and this is the screw and on top of it if you have a table which is attached. Now for what rotation of this table will the screw advance or the table move if

So, this is the lead what for one rotation, what is the lead it has equal to the pitch that is what we are saying. Therefore, the actual distance moved by the screw is equal to the pitch of the thread. So, this is an important parameter. So, we have it. There are also multiple start threads. So, multiple start thread are the lead is an integral multiple of the

pitch. Accordingly you can have double start, triple start, depending upon your requirement, a double start will move by an amount equal to 2 pitch length for one complete rotation of the screw. So, you can also have double start. And, generally what you have on top lead and then you have a bottle, they will always have a multiple start.

So, you can try to fasten just the rotating half you can try to lock the bottle. So, we will always have a multiple start thread in a bottle plastic bottle with the lid we will have multiple. And single start is generally in a nut bolt we always have a single start. Multiple start for special application you can also have multiple start thread please understand there is a difference between single start and multiple starts.

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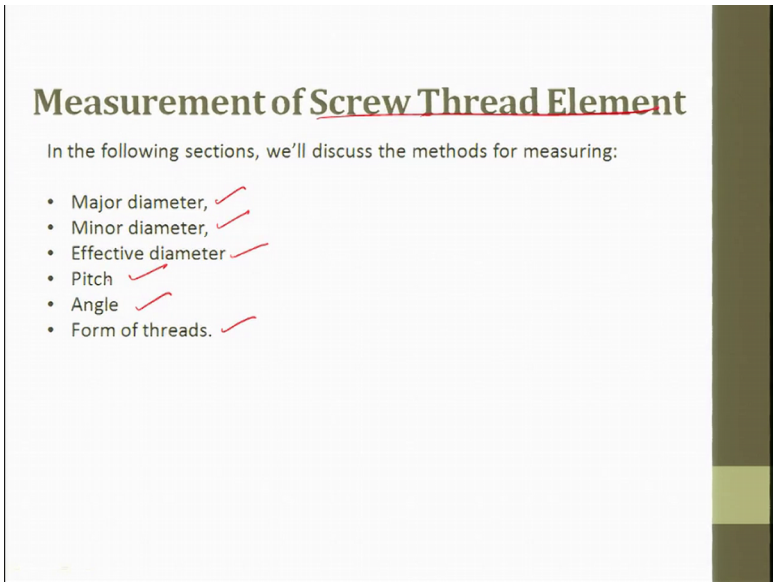

So, what are the elements? Screw thread elements which are to be measured or which is easy to measure; major diameter, minor diameter effective pitch angle and form of threads are very important. Form of threads, Whitworth, thread acme thread, these are different forms of threads. So, these are the 5 elements or 6 elements, which are there in a screw, which has to be measured. So, that we evaluate the performance of screw and nut when they are in waiting; so internal surface, external surface.

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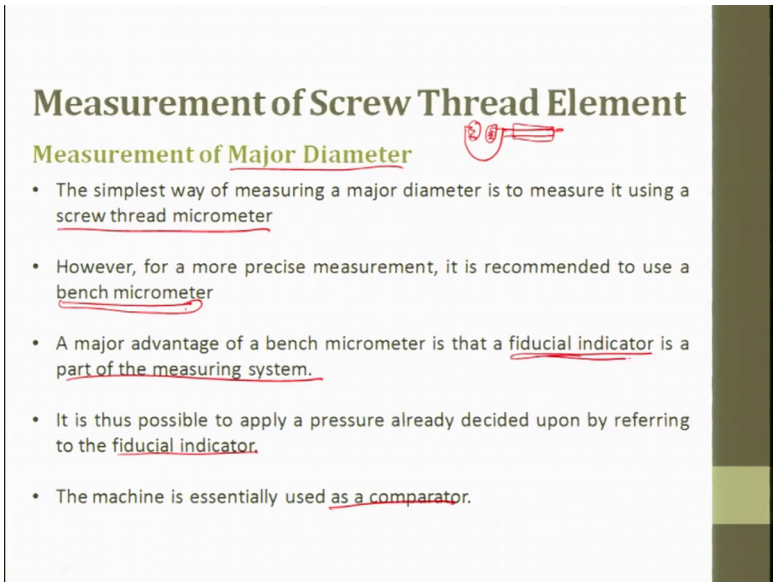

First let us see, how do we measure the major diameter? The simplest way of measuring a major diameter is to measure it using a screw thread micrometer. Screw thread micrometer generally what we do is we take a screw thread micrometer and here we have a fixed one and here we have a moving one. So, we try to change the contacting point, we try to change the contacting point. So, that the screw threads exactly mate with the annual threads. So, that you can try to measure the diameter; however, for a more precise measurement it is recommended to use a bench micrometer, which we saw what is a bench micrometer. The major advantage of bench micrometer is that yeah your fiducial indicator is part of the measuring system.

It is thus possible to apply a pressure already decided upon by referring it to the indicator, fiducial indicator. The machine is essentially used as a comparator. We covered this topic under the comparator in comparator, when we finished vernier calliper screw gauge we also studied about the bench micrometer which is very important. Bench micrometer is predominantly used to measure the major diameter of screw threads. So, you have this fiducial indicator which is there.

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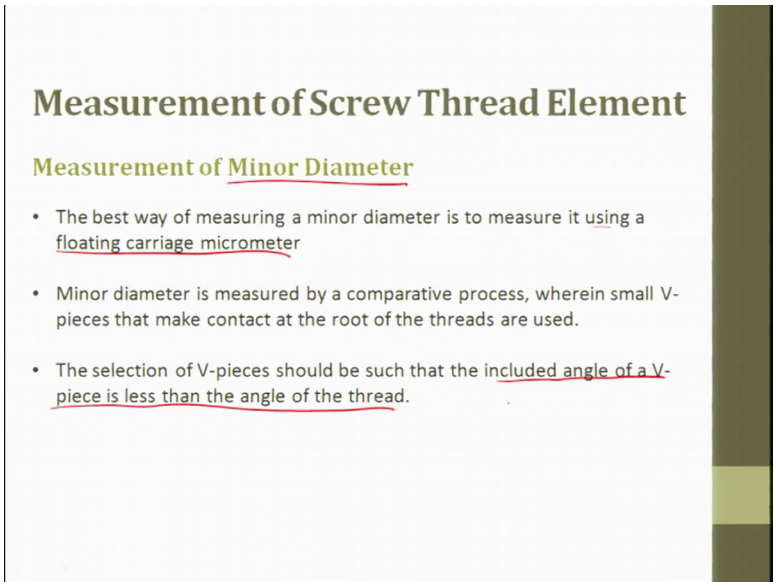

Then how do we measure the minor diameter? The best way to measure the minor diameter is to measure its using floating carriage micrometer. This also we saw when we studied about the comparator. The minor diameter is a measure by a comparative process; where in small V-pieces that make contact to the root of the threads are used. The selection of V-pieces should be such that if the included angle of the V-piece is less than the angle of the thread.

So, major diameter, minor diameter can be measured by floating carriage micrometer and the bench micrometer, these 2 are comparating devices with this you can try to measure the major and minor diameter.

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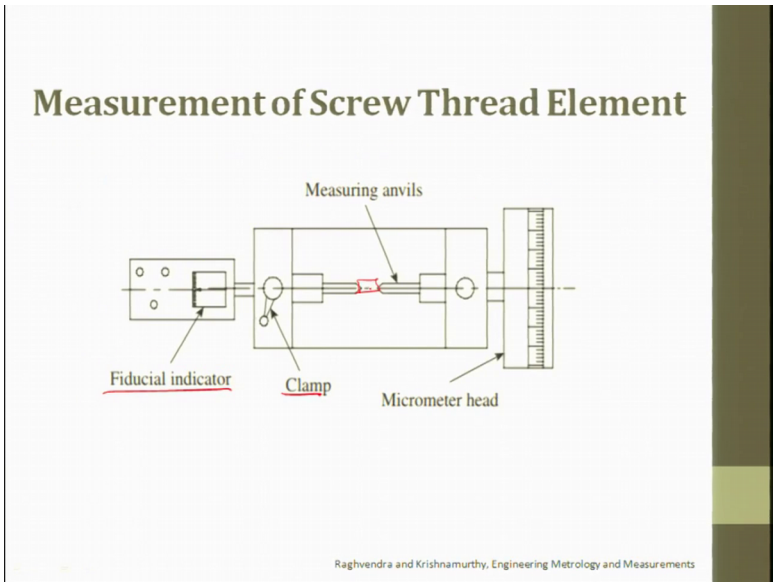

So, if you go back and look at this, this is the fiducial indicator you have a clamp. So, here is a clamp which is maybe one we can take it as dead centre, the other one we can take it as a live centre. We move this put the screw thread here and then between these 2 clamps we hold it, at that this is seen by a micrometer reading, what is the thread major diameter reading of it? Major diameter and minor diameter can be measured.

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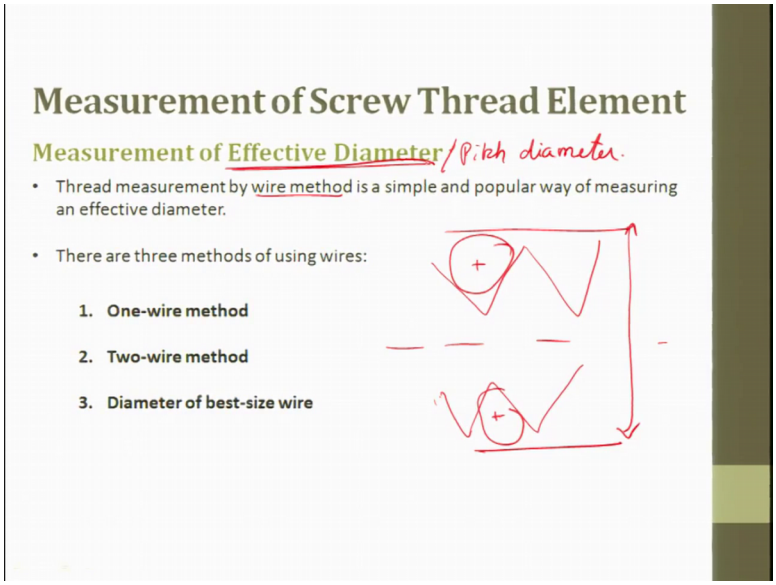

The effective diameter, which is otherwise called as the pitch diameter is very important and this has to be measured. So, a thread measurement is always conducted by a wire

method, which is very simple and popular. What is a wire method? Between 2 threads you just put a wire and then start so, if you have a thread. So, now, what you do is you have a suppose you have something like this. So, you put one more wire. So, now, you know the diameter of the wire and you so, now, you measure that the diameter here.

And, then you know thus the wire diameter from this by trigonometrical calculations we can try to figure out, what is the effect pitch diameter? So, if you go back and see what is the effective diameter? In this diagram the 4 is the pitch diameter, which we are interested to measure or the effective diameter. So, there are three methods one is called as one wire method, two is called as two wire method and the third one is called as the diameter of the best size wire.

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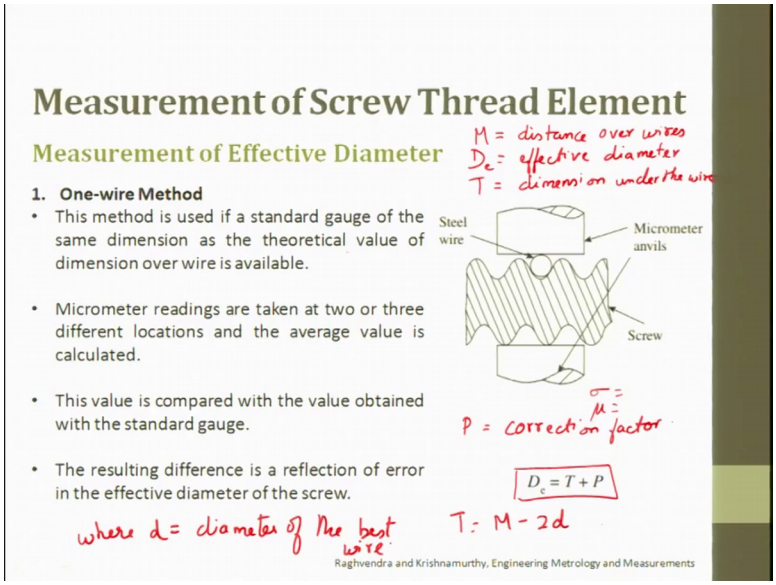

Then, the next topic of discussion is going to be measurements of screw thread elements. So, here there are 3 types of methods; one is one wire, 2 wire and the best size wire. So, one wire method; this method is used if a standard gauges of the same dimension as a theoretical value of the dimension over wire is available, then we go for this measurement. So, here the micrometer is readings are taken at 2 or 3 different locations and the average value is taken. So, generally in metrology or in even measurements any measurements what we do is we asked him to repeat the process and when you repeat the process we get 3 or 4 set of datas. Then, what we do we try to find out the standard is

sigma, standard deviation and the mean try to figure out what is the process variation and then try to choose the method what we want.

So, here also what we do is we try to take 3 readings and then we try to take the average value of it. So, this value is compared with the value obtained with the standard gauge. The resulting difference is a reflection of the error in the effective diameter of the screw. So, how do we figure out? This is the effective diameter of the screw. So, here there are 2 3 parameters which I have to describe; first one is called as M, M is nothing, but the distance over wires. The effective diameter D E is the effective diameter. And, T is the dimension under the wire and P is the correction factor ok. So, we have to find out this P for various methods.

So, if we wanted to measure T, T is the dimension under the wire T is nothing, but M minus 2 d where d is equal to diameter of the best wire right. So, when we use 2 wire method, when we use 2 wire method, this will be more easily understood.

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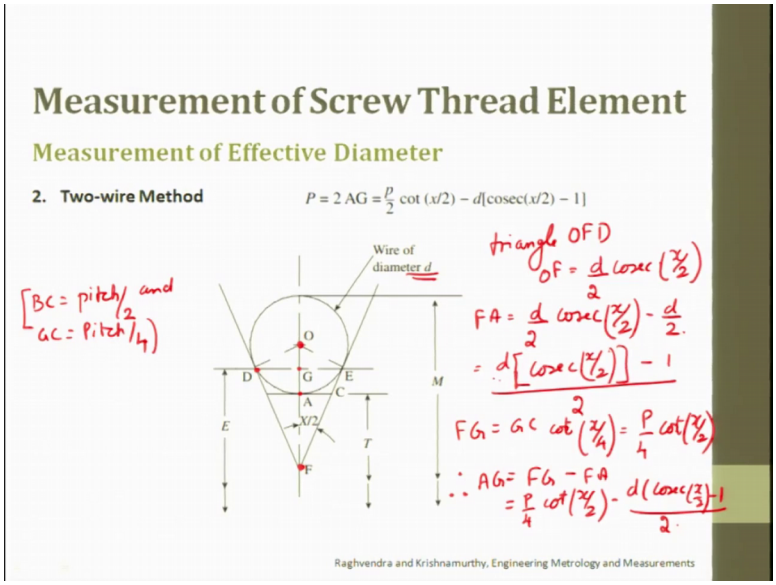

So, what we are trying to say is in the 2 wire method ok.

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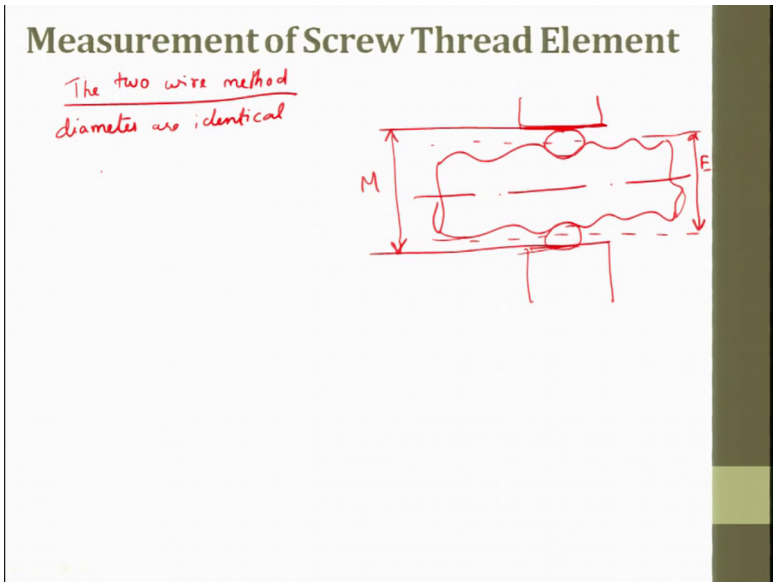

So, basically this was single wire, when we try to take a 2 wire method ok. So, here you tried to keep one wire. And, in the opposite side you keep one wire and then what we do is we try to put the screw gauge, and here it is a perfect contact ok. So, the distance between this to this is called as M ok.

The distance between the centre of this and centre of this is called as E ok. In a 2 wire method this is a 2 wire the 2 wire method. The diameter are identical you cannot take varying diameter and then what we do is these 2 diameter identical diameters are placed and they have to be in contact with the screw thread. So, if we wanted to find out the P. So, what we do is ok. So, I will go to this diagram. So, then here I will try to derive the entire thing. So, if you want to find out the equation. So, here what we do is we try to take a triangle OFD triangle O F and D, this triangle is nothing, but O F is equal to d by 2 cosecant secant x by 2.

Triangle O D F this can be represented as d by 2 ok. What is d, d is the wire diameter x by 2. So, if you want to find out F A, F A is nothing, but d by 2 cosecant x by 2 minus d by 2. So, what is F A? F A is nothing, but d by 2 d by 2 cosecant x by 2 minus small d by 2. So, this intern we represented it as d bracket cosecant x by 2 minus 1 divided by 2. I think here it is d. So, it is this and then F G, if you want to find out F G. What is FG? F G is F and you get G right. If you want to find out F G, it is nothing, but G C G C cot x by 2 which is nothing, but p by 4 cot x by 2 ok.

So, here we should understand; B C is equal to pitch by 2 and G C is equal to pitch by 4. Therefore, A G equal to F G minus F A, which will come to P by 4 cot x by 2 minus d cosecant x by 2 minus 1 divided by 2 ok

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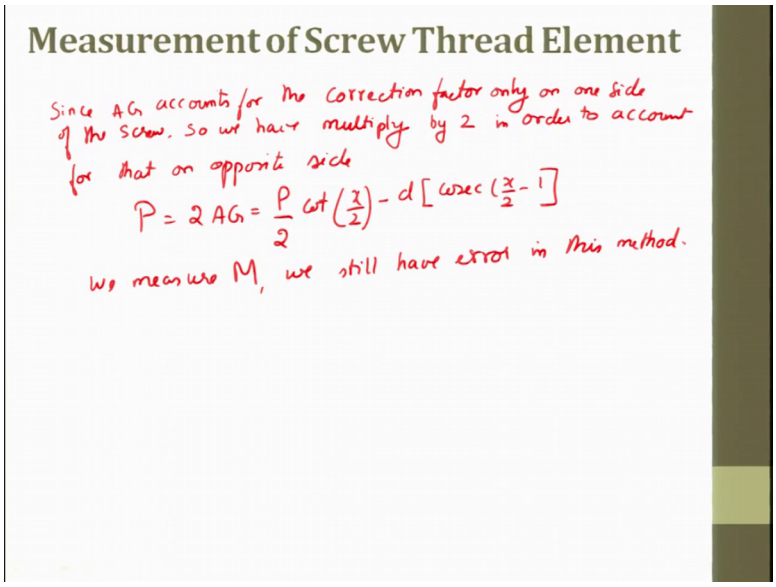

So, after this after this since, since A G accounts for correction, accounts for the correction factor only on one side of the screw. So, we have to multiply 2 times multiply by 2 in order to in order to account for that on opposite side. So, now, P is equal to 2 times A G, which is nothing, but P by 2 cot of x by 2 minus d cosecant x by 2 minus 1 will be there. So, although it is possible to measure; measure the value of M, we measure M the distance between the wires using micrometre, this method is for error.

So, although we measure it we still have errors we still have error in this method in this method ok. So, here let me go back and it is d by 2 minus 1. So, this is for a 2 wire method, we are trying to find out this P. So, the P is nothing, but the correction factor.

So, now where is this correction factor used? So, this is the effective diameter is equal to theoretical dimension of the or the dimension of the wire and P is the correction factor with this. So, T plus correction factor we get the effective diameter. So, this method also has an error. So, let us look at the best wire method which is this method, which is called as the best wire method.

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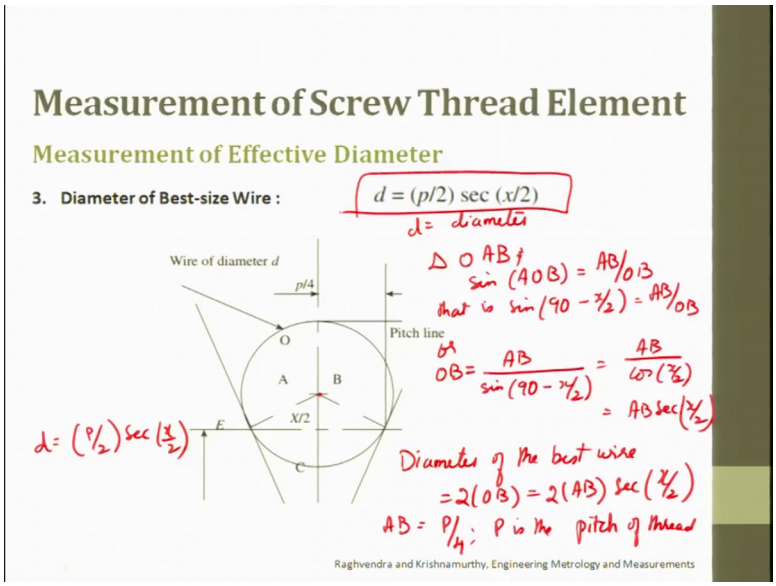

So, in best wire method what we do is we try to find out this d. So, what is this d d is nothing, but the diameter, diameter is d of the wire and then what we do is we try to take, we try to put the wire such that it comes in contact with the flank along the pitch line. So, when we try to take the triangle O A B, we get it as triangle O A B we get it as sign A O B is equal to A B by O B, that is sine 90 minus x by 2 will be equal to A B by O B or O B equal to A B sine of 90 minus x by 2.

So, which is nothing, but A B by cos x by 2 and this is nothing, but A B secant x by 2 ok. So, the diameter, diameter of the best wire is equal to 2 times O B 2 times O B. So, that is nothing, but 2 times A B secant x by 2 ok. So, from this can be find out A B is nothing, but A B is nothing, but A B is nothing, but P by 4 where P is the pitch P is the pitch ok. So, pitch of the thread. So, finally, what we get is d which is nothing, but P by 2 into secant x by 2. This is the relationship we have written it earlier ok. This is the diameter of the best wire method you tried to get the diameter fine. So, this is what x by 2 ok.

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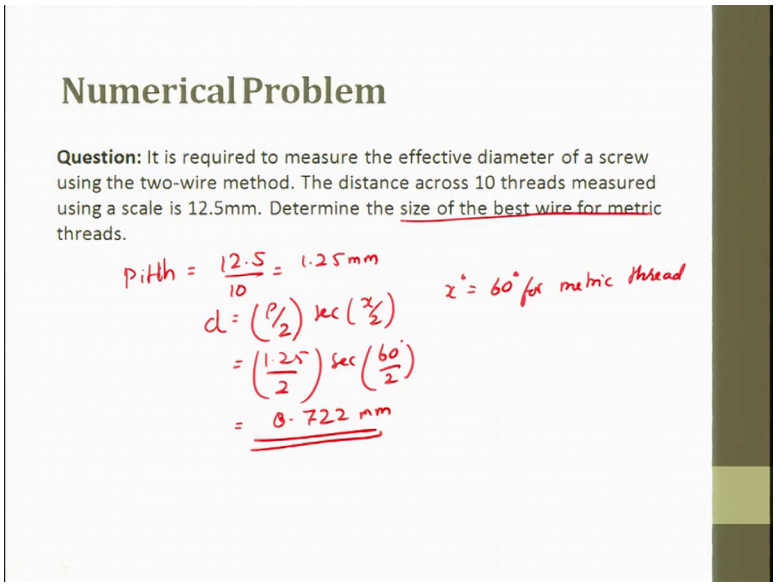

So, we will try to do a problem and then we will try to proceed. So, it is required to measure the effective diameter of a screw using a two-wire method. The distance across 10 threads measured using a scale is 12.5 millimetre. Determine the size of the best wire for metric threads. So, here what is given is a pitch, pitch equal to 12.5 millimetre for 10 threads. So, that is nothing, but 1.25 millimetre will be the pitch.

So, what is the effect to diam best wire method diameter, diameter is nothing, but P by 2 into secant x by 2 which is nothing, but where x where x is equal to 60 degrees, 60 degrees for metric thread. Thread it is different, but for metric thread it is 60 degrees. So, what we do is we try to take P is nothing, but 1.25 by 2 into secant 60 by 2 ok. So, this is equal to 0.722 millimetre. This will be the size of the best wire of a metric thread used ok. So, this is done by 2 wire method. So, the best diameter wire is taken and then we are also trying to take the 2 wire method what is the pitch.

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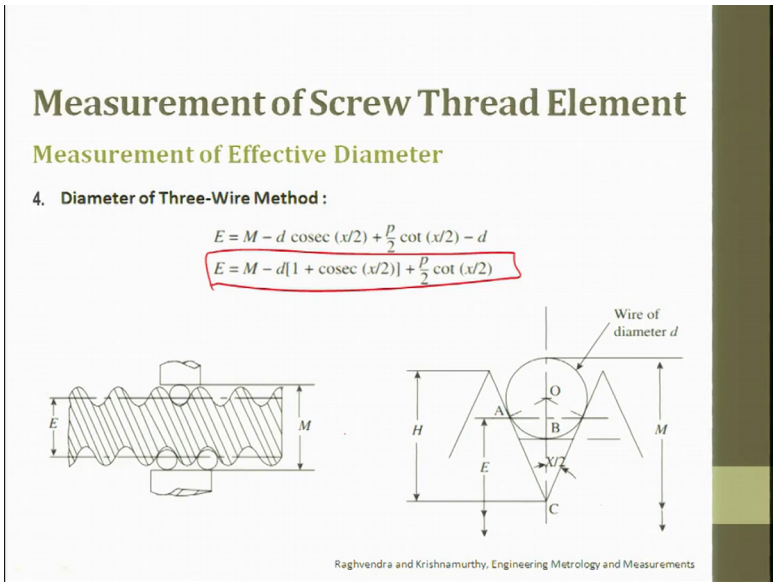

So, next is 3 wire method. So, in the 3 wire method, we have this is E and this is you are measured 1. So, you have 2 wires on one side and one wire on the other side we try to measure it. So, if you want to calculate E, E is intern E is nothing, but M minus d, d is the diameter of the wire cosecant x by 2 plus P by 2 cot x by 2 minus d. So, this derivation you can derive it from this equation we will try to give this complete derived equation in the study material.

But, I would request you guys to solve this and see. So, we can try to find out E equal to d. So, this will be the E E is nothing, but the effective diameter ok. So, here is a figure we have used 3 wire method to calculate this.

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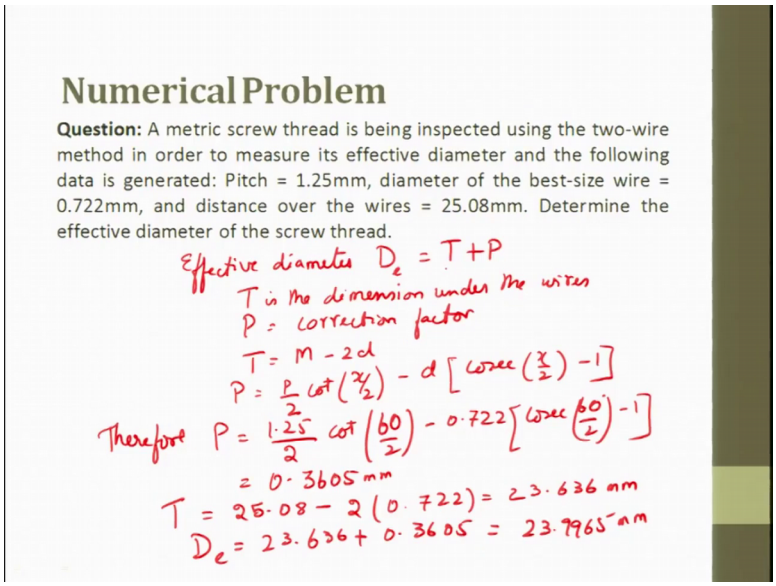

So, let us try one problem and see here. A metric screw thread is being inspected using a two-wire method in order to measure its effective diameter and the following data is generated; Pitch equal to 1.25, diameter of the best wire equal to this much, and the distance over the wire is this much. Determine the effective diameter of the screw thread. So, effective diameter is nothing, but is nothing, but D e equal to T plus P.

Where T is the dimension under the wire and P is the correction factor ok. T equal to M minus 2 d and P is equal to P by 2 this correction factor P by 2 into cot x by 2 minus d cosecant x by 2 minus 1 ok. So, therefore when you solve put all the equations P equal to 1.25 divided by 2 cot 60 by 2 minus d, d is 0.7 0.722 cosecant 60 by 2, because it is metric minus 1 ok. This is nothing, but 0.3605 millimetre. So, T the theoretical value is nothing, but 25.08 the distance of the wire minus 2 times d 0.722, which is equal to 23.636 millimetre.

So, finally, D e is nothing, but T 23.636 plus 0.3605, which is nothing, but 23.9965 millimetre. So, in this what we have done is we know the effective diameter is nothing, but dimension under the wire plus correction factor ok. And, this small p let me now put it like this. So, that you will not get confused this is P and this is the correction factor. So, let me correct it this is a small p. So, then this will be the small p pitch by 2 this is pitch, small p when here again pitch of the thread P, P is d by 2 is P ok. So, this small p is the pitch and big P is this is the error ok.

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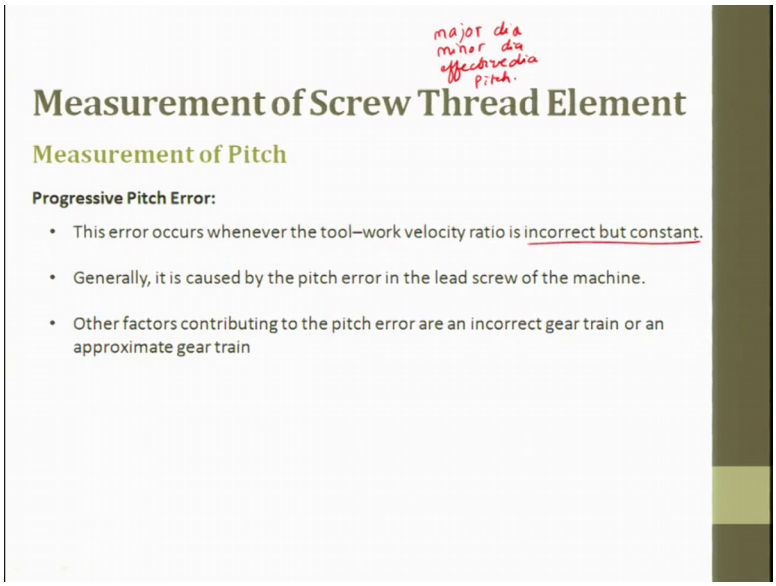

Next is measurement of pitch. So, till now what we saw major diameter, major diameter measurement, then minor diameter measurement, then we saw effective diameter measurement, effective diameter measurement. Then we are going to see the pitch measurement techniques, pitch measure of pitch is done by progressive pitch error. This error occurs when the tool work velocity ratio is incorrect, but constant. So, this is progressive pitch ok.

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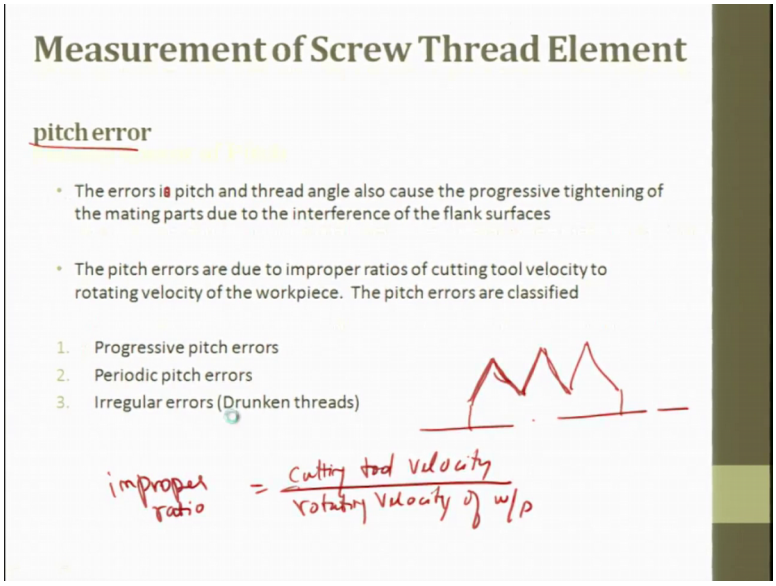

After measuring the major diameter minor diameter and the effective diameter; the next topic of discussion is going to be the pitch error. The error is pitch and the thread angle error in the error is pitch and the thread angle also cause the progressive tightening of the mating surface, due to the interference of the flank surface so; that means, to say between these 2 surfaces if there is an error. So, then these are the flank surfaces right. So, when there is an error. So, this error is called as pitch error.

The pitch error are due to improper ratios of cutting tool velocity to the rotating velocity of the work piece. So, it is improper ratio of cutting tool velocity, cutting tool velocity to rotating velocity of work piece. This is the improper ratio ok. The pitch error can be classified into 3; one is called as progressive pitch error, next is called as periodic pitch error. And the third one is called as irregular errors which is called as drunken thread error.

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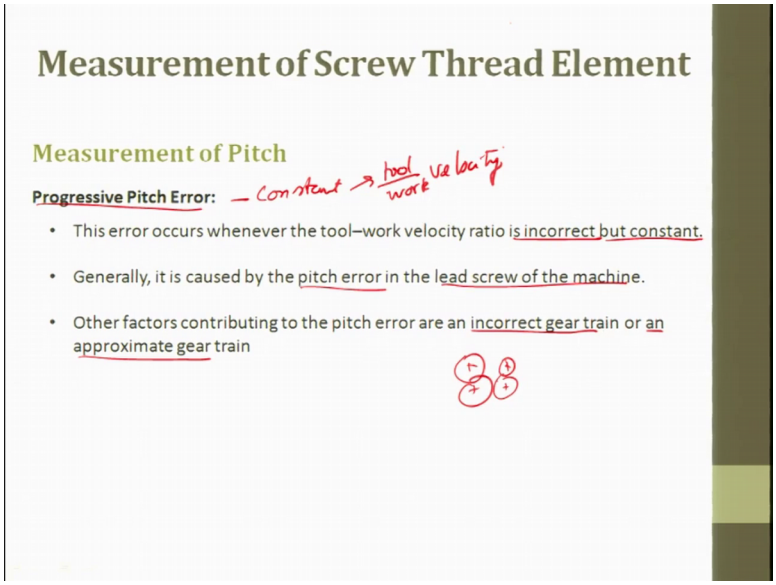

So, progressive pitch error this error occurs, whenever the tool work velocity ratio is incorrect, but constant it will be incorrect what do you want, but it will be constant. Generally, it is caused by the pitch error in the lead screw of the machine this is called as progressive pitch error. Other factors contributing to the pitch error are an inaccurate gear train or an approximate gear train.

So, if there is the gear train; gear train is nothing, but the 2 gears then this intern transmits to this, this intern transmits to this, a series of gears, which are in mess with each other either for reduction or increase in torque we call it as gear train.

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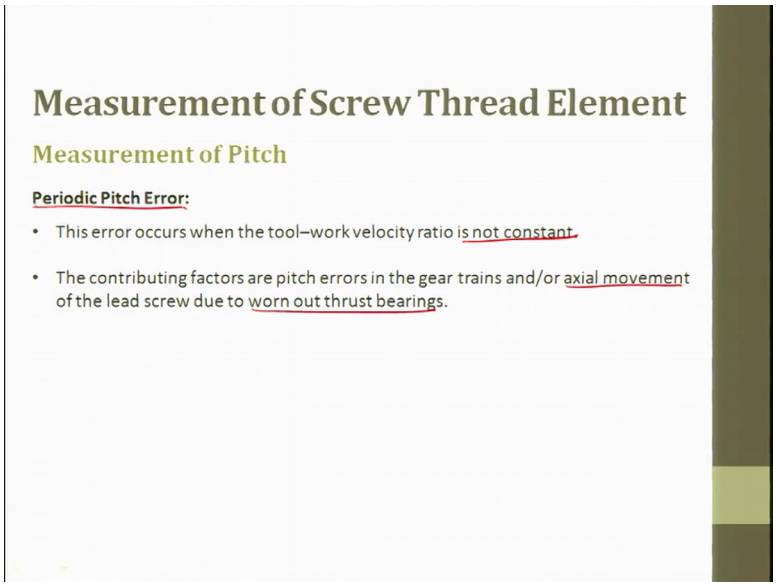

So, next one is called as periodic pitch error. This error occurs when the tool work velocity ratio is not constant. In the previous one it is constant, but it is incorrect progressive pitch error is constant, but incorrect. So, what is constant tool work velocity, rate constant for progressive in periodic it is not constant. The contributing factors are pitch error in the gear trains and or axial movement of the lead screw due to the worn out through the thrust bearings, we always will have periodic pitch error.

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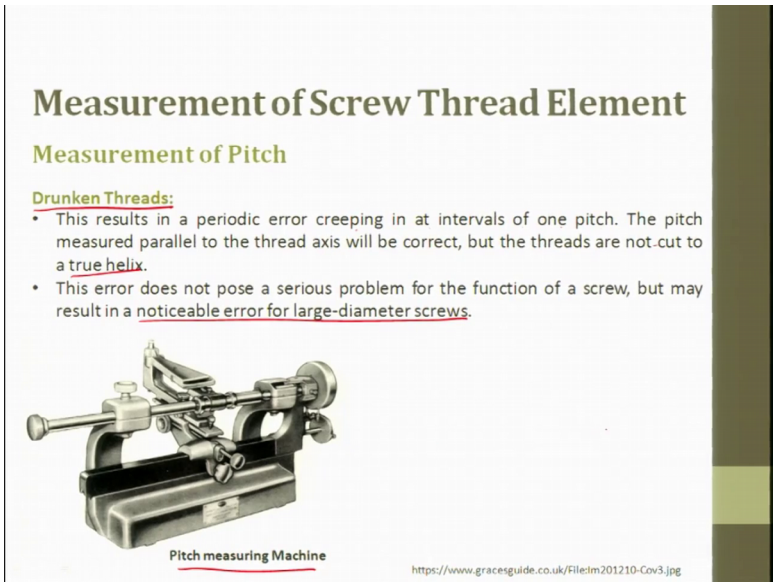

The drunken error, drunken error this results periodic error creeping in at intervals of one pitch. The pitch measured parallel to the thread axis will be correct, but the thread are not cut to the true helix angle, then you have a drunken thread error or it is otherwise called as irregular error. This error does not pose a serious problem for the functioning of a screw, but may result in a noticeable error, when we will be using large diameters; this is a pitch measuring machine. So, here what we are trying to do is we are trying to measure the pitch and we are trying to quantify the error.

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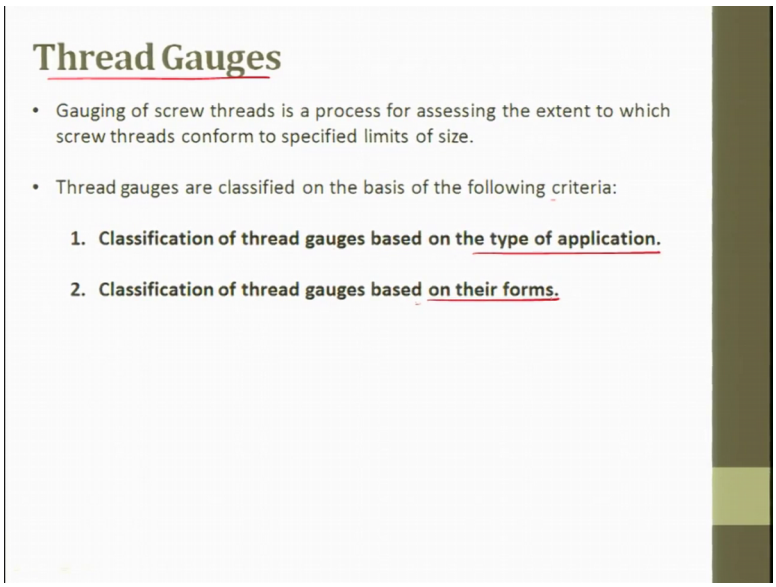

So, the next one will be thread gauge. Thread gauge or of screw threads is a process for assessing the extent to which the screw thread confirms to a specific limit of the size. So, you already have a gauge. So, this gauge is allowed to see you just place this on top of the screw and then see screw threads and see how much it is perfectly setting. The thread gauge are classified on the basis of following criteria, classification of thread gauge based on type of application, classification of thread gauge based on their forms.

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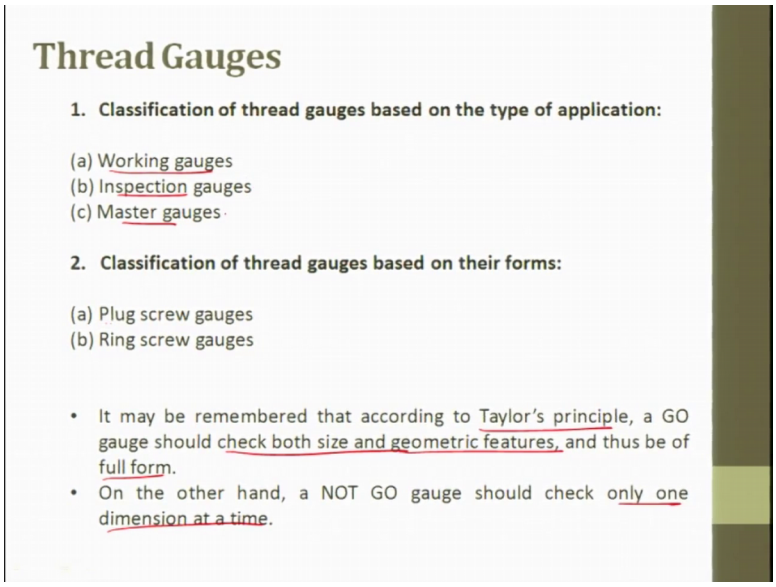

Classification of thread gauge based on type of application, working gauge, inspection gauge, master gauge. So, this we studied in the beginning what are these working inspection and then masters. Then the classification of thread gauge based on form you will have a plug screw gauge or a ring screw gauge to find out.

So, again here these gauges we will try to have we will try to follow Taylor's principle for GO gauge and no GO gauge. A GO gauge should check both sides and the geometric features and that must be in full form and no GO gauge should check only one dimension at a time and it will be short.

So, that is how by looking at the GO gauge no GO gauge you can try to figure it out. So, you can have working gauge, inspection gauge, master gauge based on the application and when the classification is based on the form, it can be plug type and ring type. Plug type means if there is a nut it is plug type, if there is both can be used plug and ring can be used here.

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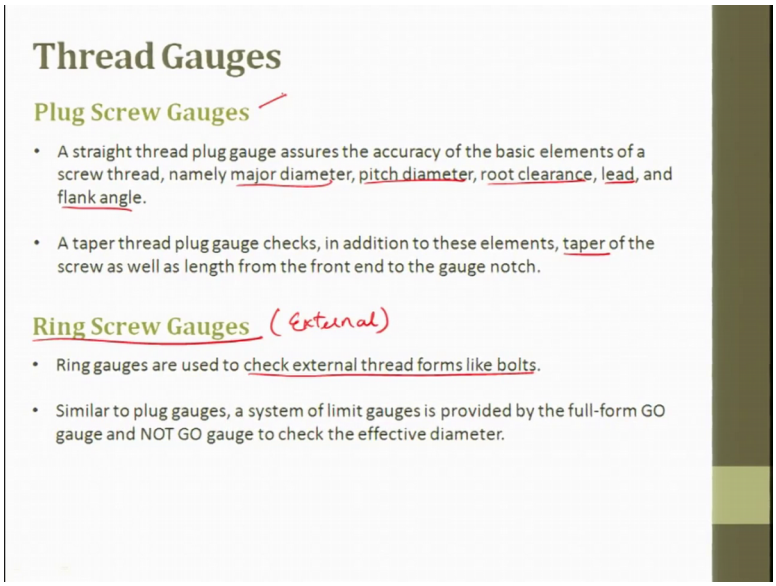

Plugs screw gauge a straight thread plug gauge assures the accuracy of the basic element of a screw thread, namely major diameter, pitch diameter, root clearance, lead and the flank angle. A taper thread plug gauge checks, in addition to all these elements, taper also as well as the length of the front and to the front end to the gauge notch. So, it checks all these dimensions in the taper and when you tuck a plug it talks about major diameter, pitch diameter, root clearance lead and flank angle.

The rings screw gauge they are used to check the external thread form like bolt ring external ok, like bolt. Similar to plug gauge a system of limit gauge is provided by the full form of GO gauge and NOT GO gauge to check the effective diameter. So, we will have plus gauge screw gauge as well as ring screw gauge for measuring.

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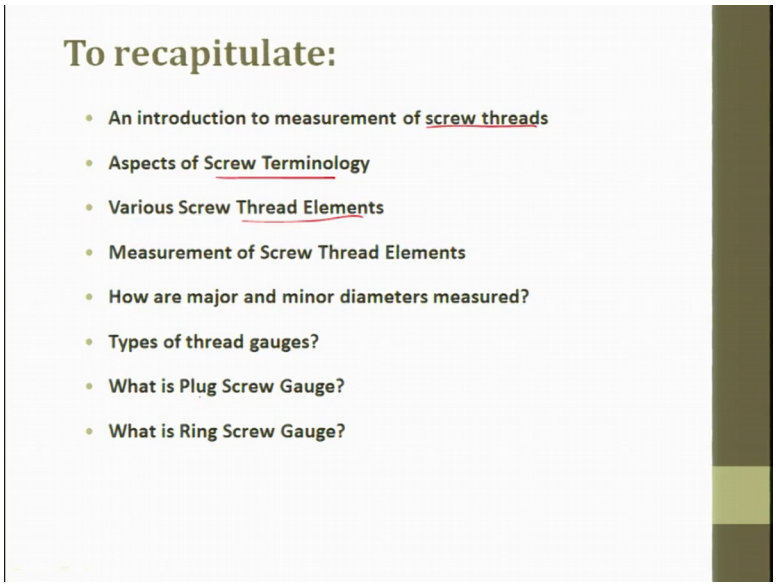

So, when we try to recap we have the following points, we first saw the introduction of measuring screw thread, then we saw terminologies, then we saw various thread elements, then measurement of screw thread elements, major axis minor axis measurement, type of gauges, then plug screw gauge and ring screw gauge.

With this we come to an end for this chapter.

Thank you.