Design of Steel Structures
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Module - 4
Tension Member
Lecture - 1
Tension Member

Hello. Today, we will be going to discuss about design of tension member. In last few lectures, we have concentrated on design of connections. Basically after design of connections, we will see different type of members where in the industrial building or industrial structures it is appearing is, say tension member, compression member, tension member with bending, compression member with bending and also only bending means beam members. So, different type of members has to design for the industrial building as a whole. So, today we will focus our lecture today onwards that different type of members. First, we will start the tension members.

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We know tension members may develop in different type of industrial building structure when earthquake load or wind load is coming into a heavy structure, then column also sometimes faces tensile stresses. In fact, in truss, in roof, tension member develops.

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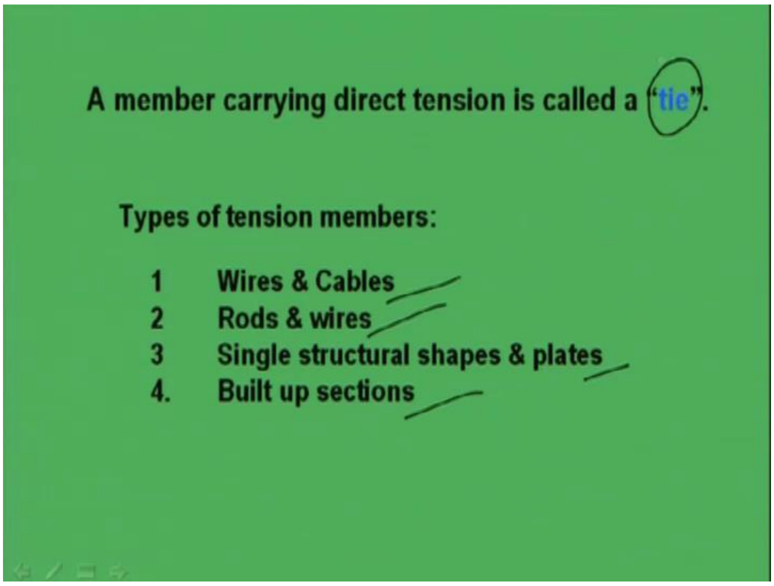

So, these are the type of tension member we can say. One is wires and cables; another is rods and wires and single structural shapes and plates and built up sections. In discussion of this tension member, we will see this term many times is coming which is called tie that which is carrying direct tension; means only direct tension is carrying that type of member is called also tie.

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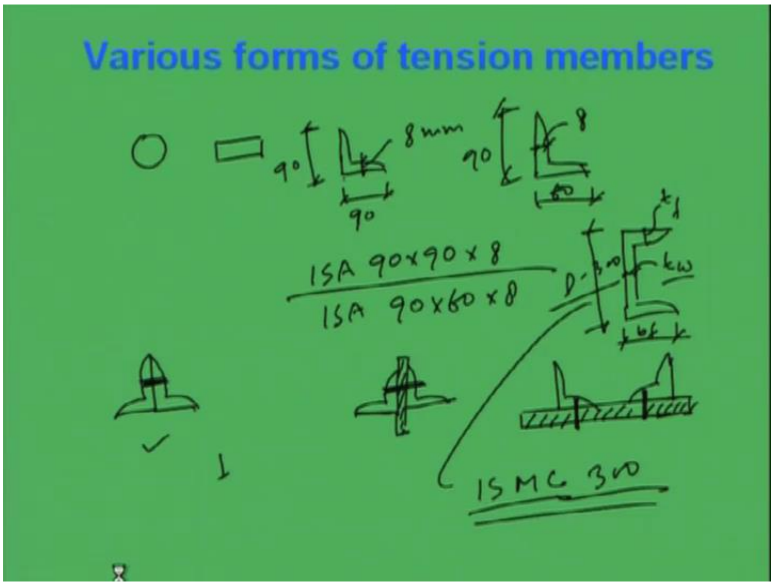

Now let us see what type of tension member we used to use in the industrial structure. Say, first is the simplest one is the circular section; this type of rod or wire can be used for tension member. Another is, say, a rectangular section. This is also one type of thing. But mostly used are we will see which is available in the code also; that is the angle section. This is called angle section. This angle section maybe with same length means this length maybe same, symmetric or maybe different.

This is different like ISA Indian Standard Angle, say, 90 by 90 by, say, 8. So, what does it mean? That means the length of the arms are 90, and the thickness this thickness is 8 mm. So, this way we can make, or it may be like this ISA 90 by 60 by 8; that means the larger length is 90 and, say, this is 60, this is 90, and thickness is 8 mm. So, various type of members are available; another members are that the angle maybe connected back to back and can be used, say, like this.

That means it depends on the requirement, what are the forces are coming and what are the requirement; accordingly, we can make it. Say, this angle has to be again connected through rivet or bolts; this is one type of member tension member can be. Another is we can provide a plate here, then it can be joined with angle, right. So, this is another type of where plates are given, and angles are placed back to back, and it has been connected through some rivet or bolt; this is one type.

So, angle can be made with different combination and we can find out some built-up sections. Another way can be made, say, this is a plate and angles are made like this. So, which type of shape will go? It depends on the requirement and designers can choose accordingly. Say, this is a plate which has been connected with two angles; two angles are connected through this plate. So, this is one type of built-up sections we can say.

Another is we know that apart from angle section, we know the channel section is also used for tension member, say, channel section, right. This is the flange width t f we used to call; this is the web thickness t w. Sorry, this is flange thickness; this is web thickness, and flange width is this one, right, b f, and this is the depth. So, when we call this, it is like the ISMC different type of things are there as we have discussed earlier in the very first class that ISMC is a 300. That means the depth is 300 and in SP 6, you will get the other dimension.

When we are defining ISMC 300 means that other dimensions like thickness of web and flange thickness of width of flange and other things can be found from the SP 6 from the handbook. And also other dimensions like I xx, I yy, R xx, R yy; all the required properties of the sections we can find out where if the center of gravity. And what is the R xx, R yy means radius of gyration, minimum radius of gyration, maximum radius of gyration. So, all these things we can be able to find from the handbook that is SP 61 1984.

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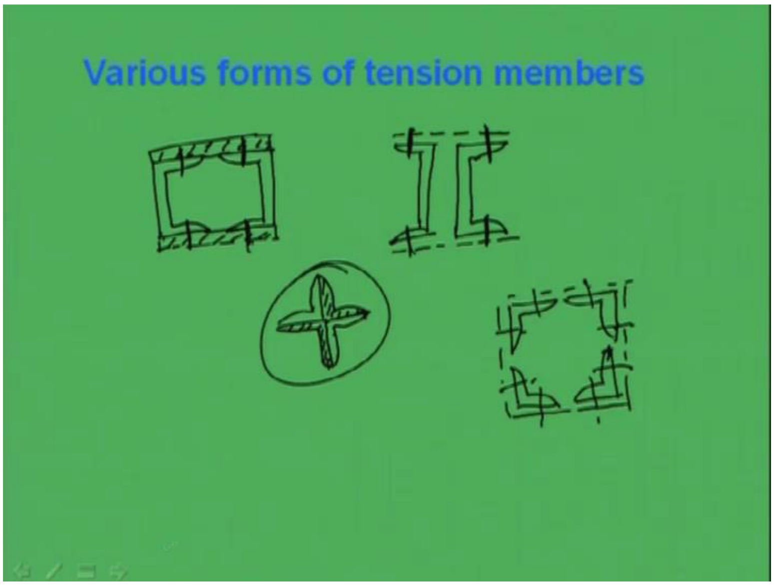

Now some other section we can see; say, suppose two channels can be placed like this to find a greater area and radius of gyration. So, that thus section can be made accordingly; so this is another way we can represent, right. So, two channels are placed and again we can provide some plate if it is required. Suppose, this section is not sufficient to carry the load, then we can provide some extra plate here; this also we can provide, and we can make some connections, right, and accordingly, the plates can be provided.

Other way of orientation is the channels are placed back to back; that is, say, like this, right. Now these are connected through some gusset plate or some extra plate, and this are bolted here or riveted here by the rivet joint or bolt joint we are going to do; that is up to the designer’s choice. So, this is another way to make some built-up sections. Another way is that star angle; that means I can make like this. So, four angles are placed back to back and making as a star angle. So, this is one angle, and this is another angle; this is another, another.

So, these are making star angle we can say; means this is another type of built-up section. Another built-up section can be made like this. So, four angles are placed and made. So, this is another type of built-up section, where this can be connected through bolted and riveted like this, some extra plate has to provide; this is another way. So, in this way different type of built-up sections can be made as per the requirement of the sectional properties mean as per the requirement of the designers means on the basis of the load and other things and of course, as per the requirement of the architectural point of view. So, all these things we have to means take care while selecting the built-up sections.

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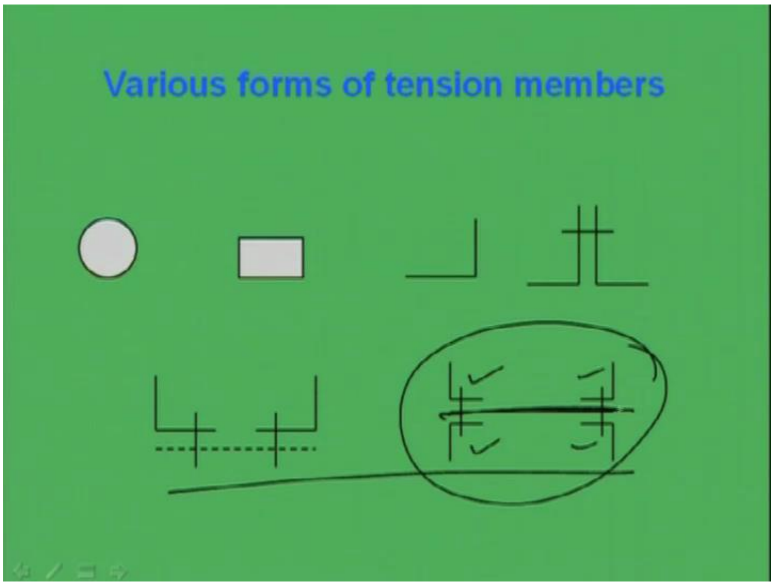

So, these are the built-up sections what I have discussed in this way; another way of making built up sections is like this. Those four angles are provided her with a gusset plate here. So, that is also in another way we can make it.

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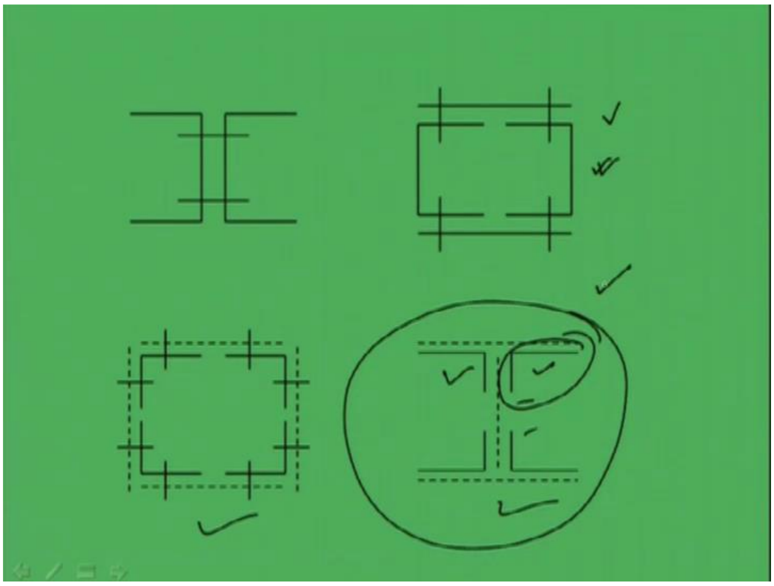

So, these are some way of making built up sections. Now we will see the properties of individual sections are available in the SP 6. But when we are going to make some built-up section, means it is difficult to find the properties of all these, because we have to find out the equivalent area, we have to find out equivalent moment of inertia in x direction, y direction, then radius of gyration, minimum radius of gyration, maximum radius of gyration, center of gravity. All this property many properties are there which we have to find out for the sake of design.

So, what can be done? In general, we used to make means we used to advise our students that they can make a small program means software they can make, then on that software they can just put this property this properties. So, means properties of these and the spacing, etcetera; all the things when they are giving, they can find out the sectional properties of the total built-up section.

So, if we can make software or we can make a program for accounting the properties of built-up section, then it will be better; it will be easier for a designer to choose a proper built-up section. Because if we do not have the programming means software, then what will happen? Designer will not find easy to find out the sectional properties. So, whatever they have tried with one sectional property if it comes okay, then they will not go for other sectional properties, because of the means laborious work.

So, if we have what you call this software like things, then what will happen? Designer will try, and through trial and error method, they can find out the best option which is coming and which will be economic; means in optimized way, they find out the best built-up section for that particular load. So, in that way the programming is very important.

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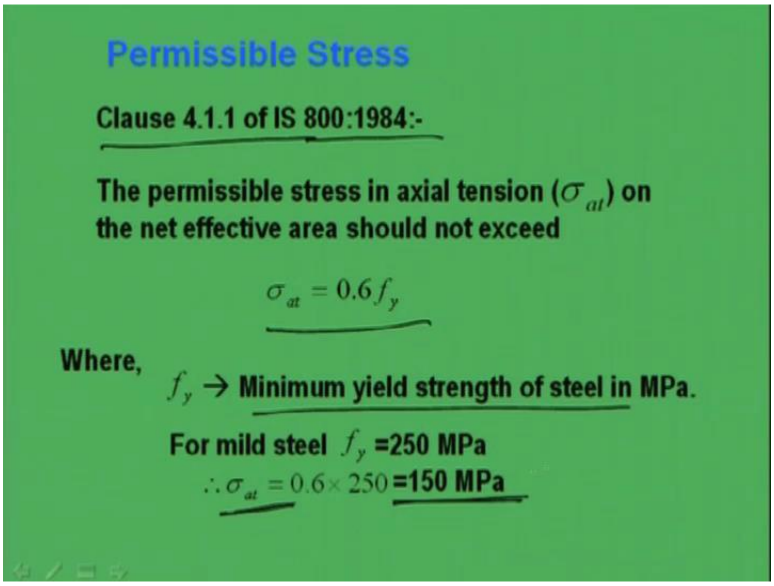

Next is we will discuss about the permissible stress. Now for the direct axial tension, code has suggested that permissible stress can be taken as 0.6 f y where f y is the minimum yield strength of steel in MPa. And for mild steel, this sigma a t the permissible stress in axial tension can be found out 0.6 into 250 as 150 MPa. So, as per the clause 4.1.1 of IS 800 1984, the permissible stress can be found out from this formula sigma at is equal to 0.6 f y. And on the basis of the type of steel, we can find out the sigma a t value. So, sigma a t value for, say, in case of mild steel will be coming as 150 MPa.

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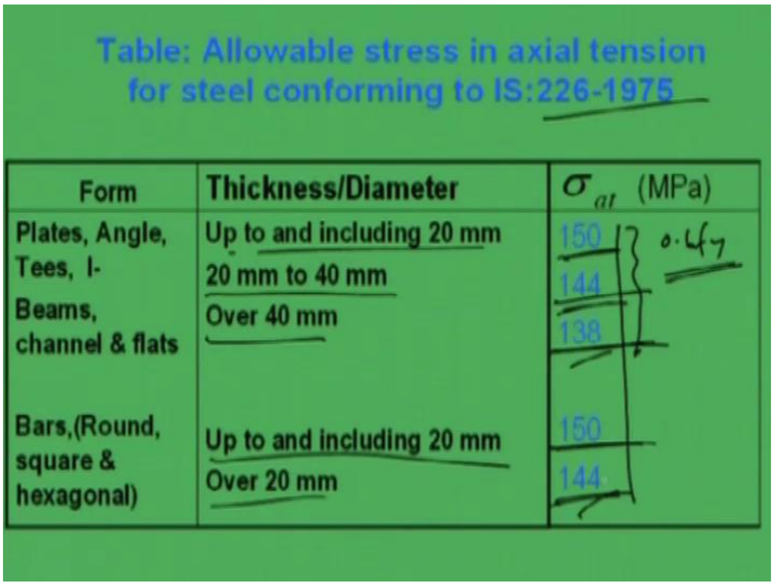

Table: Allowable stress in axial tension for steel conforming to IS:226-1975

Form	Thickness/Diameter	σ_{at} (MPa)
Plates, Angle, Tees, I-Beams, channel & flats	Up to and including 20 mm	150
	20 mm to 40 mm	144
	Over 40 mm	138
Bars,(Round, square & hexagonal)	Up to and including 20 mm	150
	Over 20 mm	144

Now allowable stress in axial tension for steel confirming to IS 226 1975 has been given in the table here. Say, for different type of section, the sigma a t values are coming different. That means, say, for plates, angles up to 20 millimeter, this will become 150 mm Newton per millimeter square. Say, plates, angle, tees I-beams, channels and flats. So, up to 20 mm diameter or thickness, this will be 150 mm. And if the diameter or thickness is in between 20 to 40 mm, then this sigma a t value is reduced to 144 MPa.

And if the thickness and diameter is over 40 mm, then this value is reduced to 138 MPa. That means it is not only that 0.6 f y; means as per the thickness or diameter of the section, this is going to reduce little bit. So, from 150 to 138 it has been reduced. And in case of bars means round, square or hexagonal up to 20 mm, this is 150 and over 20 mm, the code has suggested this as 144 MPa. So, while designing, we have to remember all these values; that means it is not exactly 0.6 f y. So, if the thickness is more or diameter is more means more than 20 mm, then it is going to reduce to 144 or 138 depending on the type of the section.

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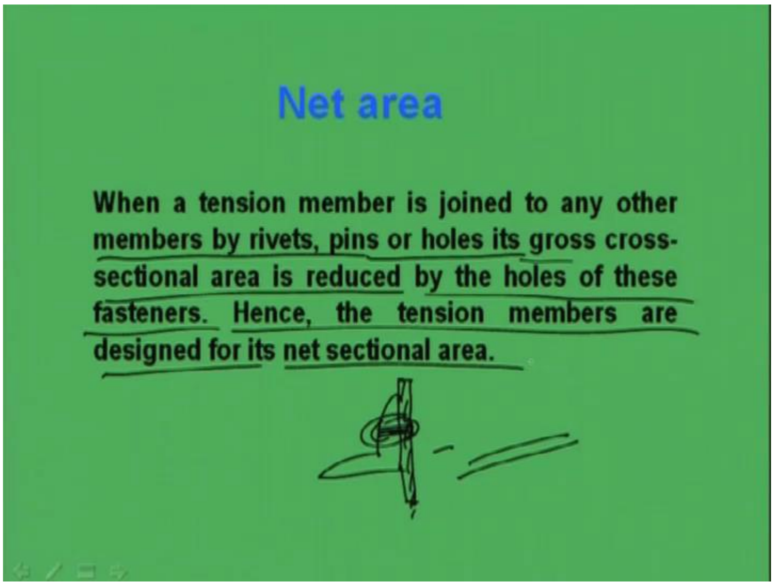

Now another thing is the net area; what is net area? Suppose, an angle section we have; say, this is an angle section. Now what will be then net area? Net area depends on how many holes have been made; that means how it has been connected to the other sections. Suppose, this is a plate and which is connected to the bolt or rivet, then what has happened? The net area will be the total gross area minus the rivet hole, and also it is not simply minus the rivets hole; we will discuss in later that how the net area has to be calculated.

It depends whether it is stagger or whether it is plain riveting, how it has been riveted, whether it is riveted or welded? And in which part it is being whether back to back or single. So, on that it depend the net area. Net area is going to carry the tensile force. So, when gross area is there. So, we have to find out the net area, then on that basis only we have to find out tensile strength of the member. So, we can say that when a tension member is joined to any other members by rivets, pins or holes, its gross cross-sectional area is reduced by holes of these fasteners. Hence, the tension members are designed for its net sectional area not the gross sectional area.

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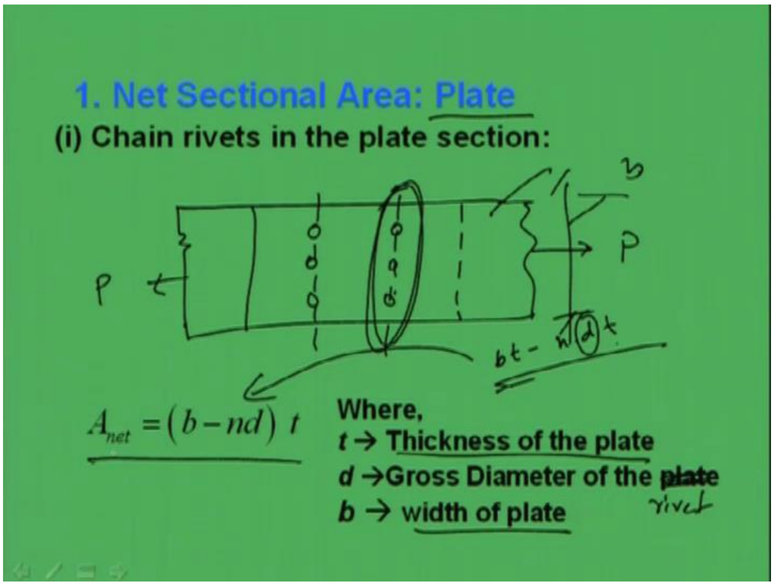

So, net sectional will let us calculate. First, let us see for the plate net sectional area for plate. Say, if it is chain rivets in the plate section. So, what will happen? Means if we see in the plan that one plate is like this. Now one plate is having force p and another plate say this one. So, if it is chain riveting, then the weaker section will be through this or through this because this is the maximum reduction of the hole will be. So, net area will be basically b into t; in this section if I see b into t minus n into d into t, okay. B into t is the gross area in this where b is this one width of the plate; this is b.

So, b into t, t is thickness of the plate. So, b into t minus n into d into t where d is the gross diameter of the rivet not plate; this is rivet, rivet or bolt, and b is the width of plate, and t is thickness of plate. Then we can find out area net; means net area of the section will be b minus n d into t which is coming from this equation. So, b minus n d into t; n is the number of rivets. So, in this way, we can find out the net area.

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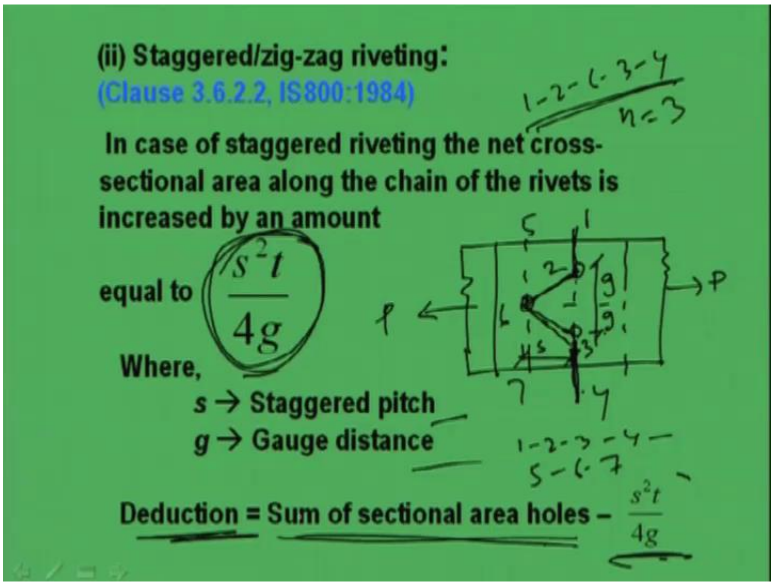

Now if it is staggered or zigzag riveting; that means if the plate is like this, say, suppose this is the plate; one plate is this; another plate is this with an axial tension. Say, now the rivets are placed in this way. So, what will happen? This is g gauge distance, and this is called s, the staggered pitch. So, if the staggered pitch is s and the gauge distance is g, then as we know the weaker section will be through this because maximum reduction will be this but because of this staggering. So, one failure can happen like this.

So, we have to calculate for this also. So, when it goes through this, what will happen? We will see that in case of staggered riveting, the net cross-sectional area will be increased by this s square t by 4 g, where s is the staggered pitch and g is the gauge distance. So, deduction will be sum of sectional area of holes minus s square t by 4 g. So, what we are seeing that this plate can fill through, say, if I number this one, two, three, four. So, through one, two, three, four, it can fill; this is chain riveting like or it can fill, say, five, six, seven, say, through five, six, seven, also it can fill. Another option is that one, two, six, three, four, when we are considering through this, we have to consider this one. In that case number of rivet will be three, but the deduction of area has to be deducted by s square t by 4 g also. That means sum of sectional area; that means here 3 into d into t minus s square t by 4 g. So, total deduction will be this. So, in this way we can calculate.

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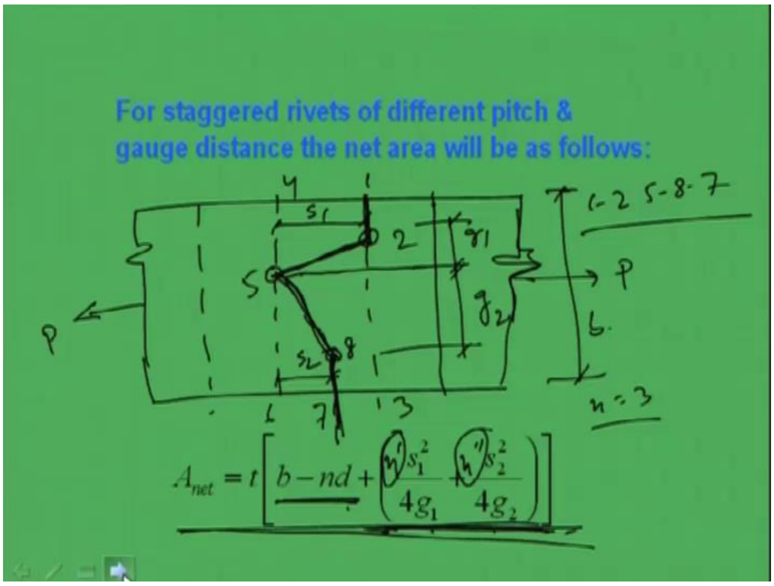

Now another thing is that if the gauge distance is different; that means suppose the plates are provided like this. Say, force is p. This is one plate; another plate is here. And we have say this is one. So, this is one and this is another, like this if it is. So, what will happen? So, chances of failure will be one. So, this is two and this is three; this is one.

Another thing is like this it may fail; that means one, two, say, this is four, five, six, seven. So, one, two, five, this is, say, suppose eight, eight, seven. So, one, two, five, eight, seven; in this way also it can fail; means this, this, this is coming this like this. So, for this we are seeing that things are different; this is, say, g 1, and this is g 2. So, gauge distance is different. And again this is, say, s 2, and this is, say, s 1. So, staggered pitch distance also different.

So, in that case net area can be calculated in this way. A net will be t into b minus n d plus s 1 square by 4 g 1 plus s 2 square by 4 g 2. That means here b is this width of plate; this is b and in this case, n will be three for this particular case, right. So, one chances of failure is like this it will go, like this and this. So, in that case, we are reducing by n d but because of stagger we have to add this much s 1 square by 4 g 1 plus s 2 square by 4 g 2.

Now, if it is n number of s 1 square if we see, then here again, say, n dash number is there, say, n double dash number is there. So, there also we can multiply this. It depends on how many numbers are reactivating; means same type of things are there, alright. So, net area in this way we can calculate from this formula; that is t into b minus n d plus s 1 square by 4 g 1 plus s 2 square by 4 g 2. So, in this way we can find out the net area.

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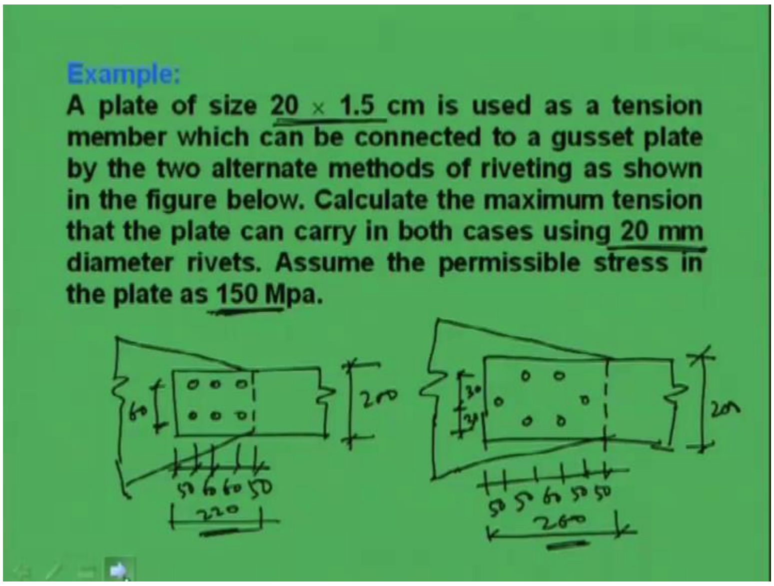

Now we will go through some example through which we will be clear how to find out the net area of the section. Say, suppose one example here we have that a plate of size of 20 by 1.5 centimeter is used as a tension member, which can be connected to a gusset plate by the two alternative methods of riveting as shown in the figure below. So, I am going to draw the figure now.

Now calculate the maximum tension that the plate can carry in both cases using 20 mm diameter of rivets, assuming the permissible stress in plate as 150 mm. So, this has been given that permissible stress is 150 MPa, and rivet diameter is 20 mm, and size of the plate is 200 by 15 millimeter or 20 by 1.5 centimeter. So, first two alternative way arrangement has been given; one alternative arrangement is like this, say, one plate is there. This is 200 mm, and thickness is 15 mm.

Now this has been connected with this gusset plate and riveting is done like this; that means chain riveting. This is given as 60 mm and these are 50 60 60 and 50; that means pitch is 60 mm, and edge distance is 50 mm. So, in this way it has been made; that means this will be 50 plus 50 100 220; its total length is 220. Another way of connections is given here that is zigzag riveting. So, in this case, this is also 200 mm now. So, same thing; one is connected through chain riveting, another is connected through zigzag riveting. So, this is made like this.

So, this distance has been given as 30 and 30, and this is given as this is 50; this is 50; this is 60 50 50. So, this pitch distance has been given like this 50 50 and 60. So, total is coming 260, here it is220, here it is 260 mm. So, this is the way the riveting has been done. So, in both the cases we have to find out the strength of the member. Now let us see what is the strength of the member?

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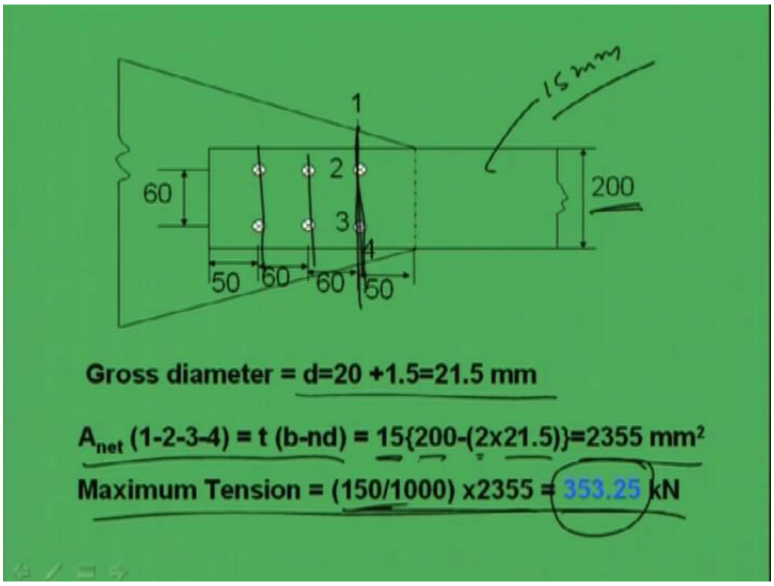

So, in first case, the weaker section will be, say, one, two, three, four, one, two, three, four because maximum reduction either one, two, three four or through this or through this, okay. But first will be this one; failure will be first this one, one, two, three, four. So, for this the formula is that t into b minus n d. Now d is the gross diameter of the rivet; that means 20 mm diameter has been used. So, 20 plus 1.5; this is the extra tolerance which is coming 21.5 millimeter.

So, net area is coming t into b minus n d. So, thickness is 5o mm which is of the plate thickness has been given this is 50 mm. So, thickness into b; b is 200, width of the plate minus n d; n is two number and d is this. So, after this we are getting 2355 millimeter square. So, maximum tension will be sigma a t into area; sigma a t is the 150 MPa. So, this into this is coming 353.25 kiloNewton. So, maximum tension we are going to get as 353.25 kiloNewton for chain riveting.

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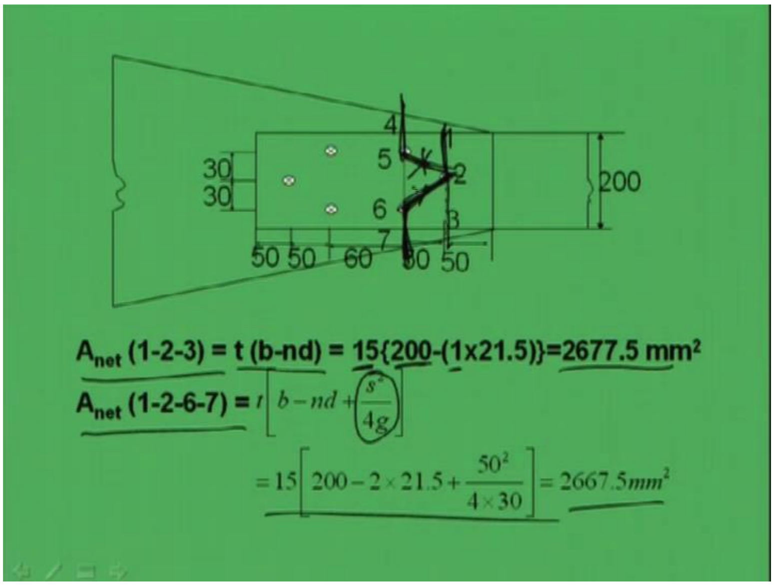

Now, let us see for this that is for zigzag riveting or staggered riveting. So, in this case what will happen? The net area first we have to see through one two three; this is one possible case of failure. So, for this t into b minus n d; that is thickness is 15, b is 200, n is one in this case. So, this will be coming two 2677.5 millimeter square. So, net area along one two three, say, will be 2677.5 millimeter square. And similarly, net area another way of failure is one two six seven; in this way also it can fail, right

So, net area along one two six seven will be t into b minus n d plus s square by 4 g. So, because of staggered riveting s square by 4 g is going to add. So, this will become 15 into this. So, this is coming 2667.5 millimeter square. So, this is another way we are going to calculate.

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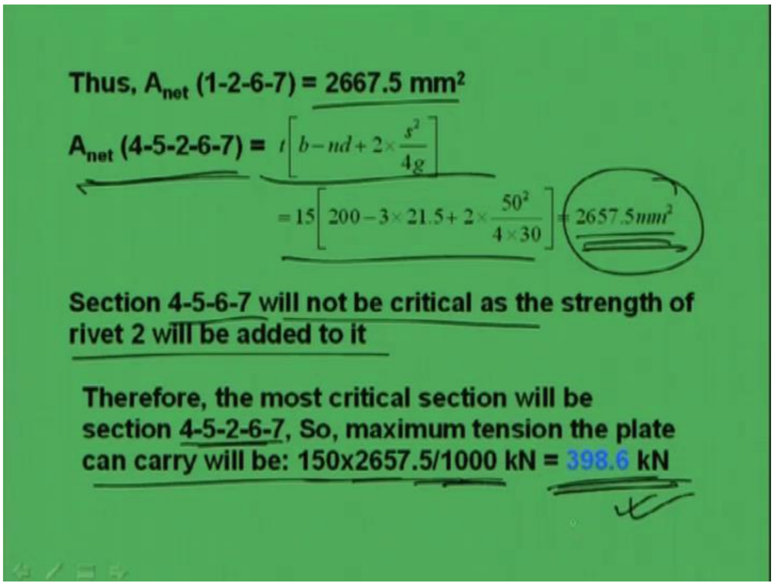

So, area net is going to be 2667.5 millimeter square, right. Another way of failure is four five two six seven; that is four five two six seven. So, this is another way it may fail four five two six seven. So, this will be coming like this t into b minus n d plus 2 into s square by 4 g because here two staggered rivet is there; this is one, this is another one. So, 2 into s square by 4 g. So, if we put the values, then we will get two 2657.5 millimeter square, right.

So, for three type of failure, we have seen that different type of net cross-section area we are going to get. So, the minimum one will be the strength of the plate which has to be calculate through that. Now another is section four five six seven. So, when we are seeing four five six seven, say, means it may failure like this also. So, in this case what will happen? If it has to fail, it has to fail through means we have to take care of this also this one also.

So, this will be not critical as the strength of rivet two will be added to it. So, rivet two will be added to the strength of that; that is why this will not be critical. So, the critical section will be four five two six seven which is the minimum. The most critical section will section four five two six seven; that means this one. So, this is minimum; it is coming two 2657.5 mm square, right.

So, maximum tension the plate can carry will be sigma a t into this by 1000 I am making for kiloNewton making kiloNewton. So, this is coming 398.6 kiloNewton. So, when the riveting has done in terms of staggered riveting, then we are going to get the strength of the plate as 398.6 kiloNewton. If you remember the earlier one, here we are going to get for the chain riveting, this is 353.25 kiloNewton. That means for with the same number of rivet if we go for staggered riveting, the strength plate will be more than the pitch riveting. In case of pitch riveting, what we have seeing in this case that strength is 353. And if you do the staggered riveting, this is coming 398.6. So, in this way we can see that how the riveting means riveting combination is going to increase the strength of the plate, right.

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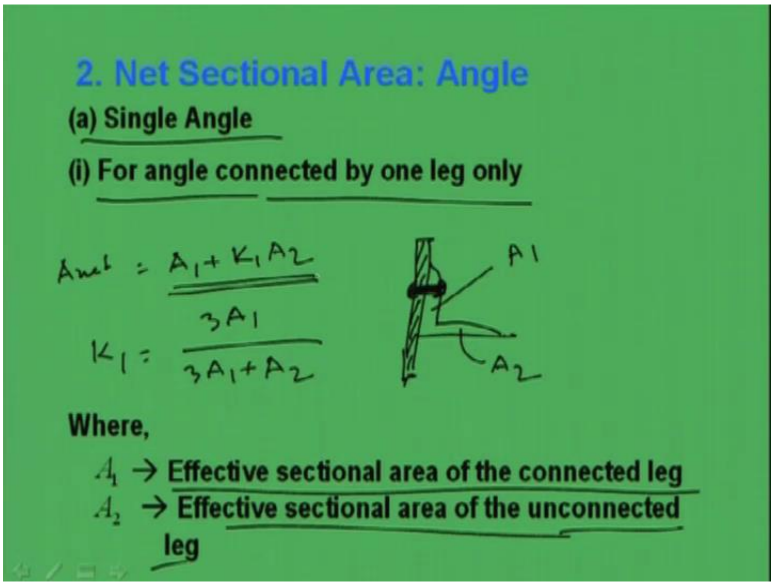

Now another way is that. So, far we have discussed about the plate strength of plate. Now if it is angle, what will be the net sectional area? Net sectional area can be made for single angle, for angle connected by one leg only, right. First, we will discuss about the single angle of the angle connected by one leg only; that means, say, this is the angle which is connected by one leg, right, within the riveting. So, what will happen? As per the codal provision, the area net has been calculated as A 1 plus K 1 A 2, right, where A 1 is the area of the angle which means arm which is connected to the plate and this is A 2 the unconnected leg.

So, A 1 is the effective sectional area of the connected leg, and A 2 is the effective sectional area of the unconnected leg, right. So, net area can be calculated if it is joined like this, then A 1 plus K 1 into A 2, where K 1 can be found out from this ratio 3 A 1 by 3 A 1 plus A 2, right. So, when we are going to calculate the net sectional area of the angle, we have to see which type of angle we are going to make means whether it is single angle or double angle.

Now in case of single angle, whether it is connected by one leg only or two leg only. So, if it is connected by one leg only in case of single angle, the net area will be A 1 plus K 1 A 2, where K 1 is equal to 3 A 1 by 3 A 1 plus A 2. So, in this way you can measure.

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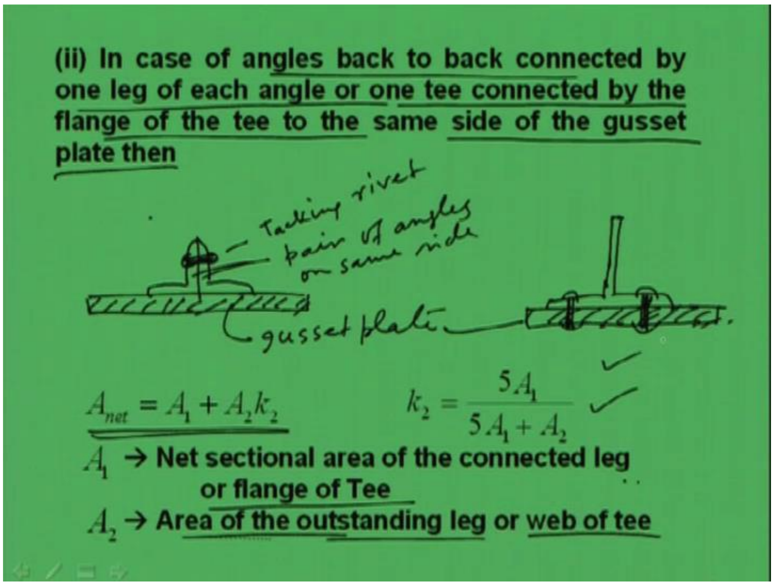

Now in case of angles back to back connected by one leg of each angle or one tee connected by the flange of the tee to the same side of the gusset plate, then how to calculate the net area? Let us see first how it is connected that if two angles, say, this is one angle like this, another angle is like this, right. Now these are connected back to back, right, okay. Now this is gusset plate. If so then I can find out area net; net area is equal to A 1 plus K 2 into A 2, where K 2 will be 5 A 1 by 5 A 1 plus A 2; this is called tacking rivet.

And these are the pair of angles, right, on same side. So, if the angles are connected like this, then the net area of the section will be like this. A net is equal to A 1 plus K 2 into A 2, where A 1 is the net sectional area of the connected leg of or flange of tee. In case of tee, how it would look like? So, this is the gusset plate and tee is connected, right. So, this is the tee which is connected through its flange; this is riveted, and this is riveted.

So, if it look like this also, then the area net can be made through same formula; that is A 1 plus K 2 into A 2, where K 2 is 5 A 1 by 5 A 1 plus A 2, where A 1 is the net sectional area of the connected leg or flange of tee. And A 2 is the area of the outstanding leg or web of tee. So, in this way we can find out the net area.

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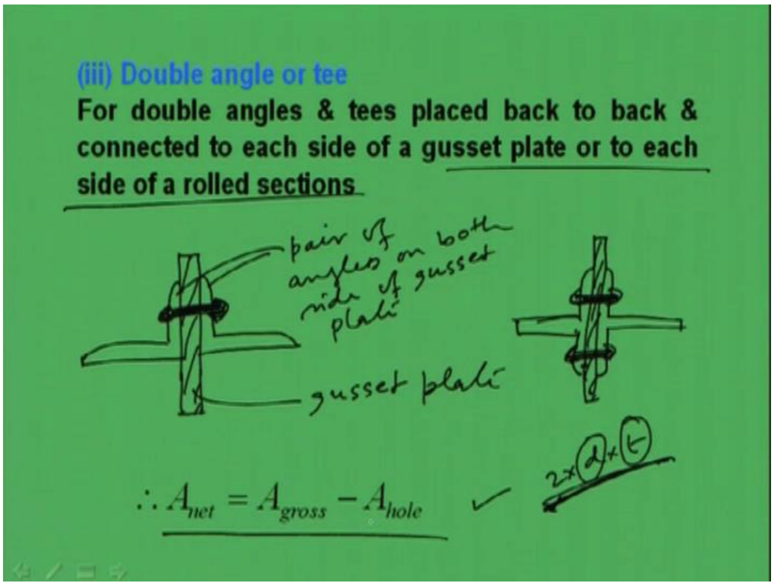

Another option is that double angle or tee. In case of double angle or tee means for double angles and tees placed back to back and connected to each side of gusset plate or to each side of rolled sections, how it look like? Say, if it is like this, say, suppose this is the gusset plate, and this is connected like this, right. So, now if it is connected back to back and this is the rivet, right.

Now this is gusset plate, and these are pair of angles on both side of gusset plate. So, these two angles if it is connected through gusset plate on both sides, then the net area can be made simply by A gross minus A hole; A hole means area of the rivet means area of the hole due to rivet, okay. Another is tee, if tee joints are placed like this; that means one tee is placed in this way, another tee is placed like this, and it is riveted.

So, for this also, the net area can be calculated from this formula that is A gross minus A hole. So, in this case A hole means 2 into d into t because two rivets are there two diameter of rivets are d, and t is the thickness of the flange. So, if we have, then I can find out net area. So, this is the way to calculate the net area for different type of sections if it is placed in different way. So, with this let us see let us go through some example.

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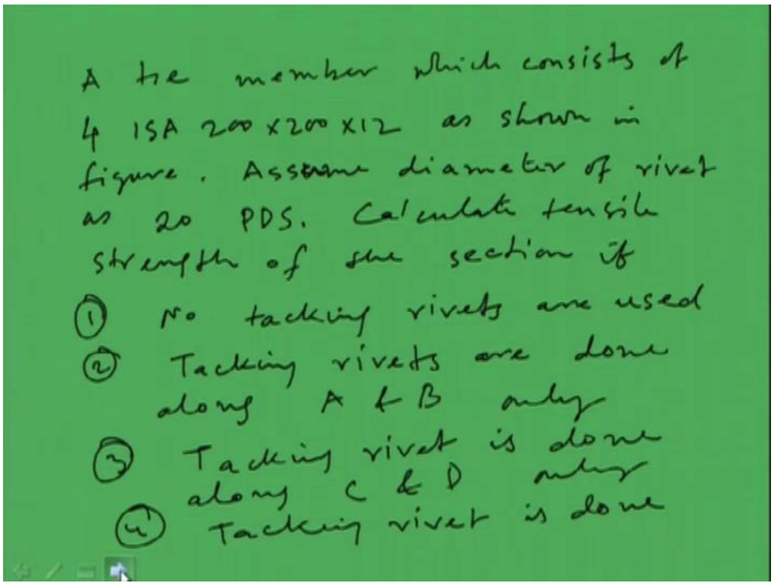

So, this example is a tie member which consists of 4 ISA 200 by 200 by 12. So, 4 angle of 200 by 200 by 12 has been made as a built-up section as shown in figure. I am going to draw that figure. Assume diameter of rivet as 20 power driven shaft rivet. Calculate tensile strength of the section if for different conditions, you have to find out the tensile strength. No tacking rivet are used; tacking rivets are done along A and B only. Three tacking rivet is done along C and D only.

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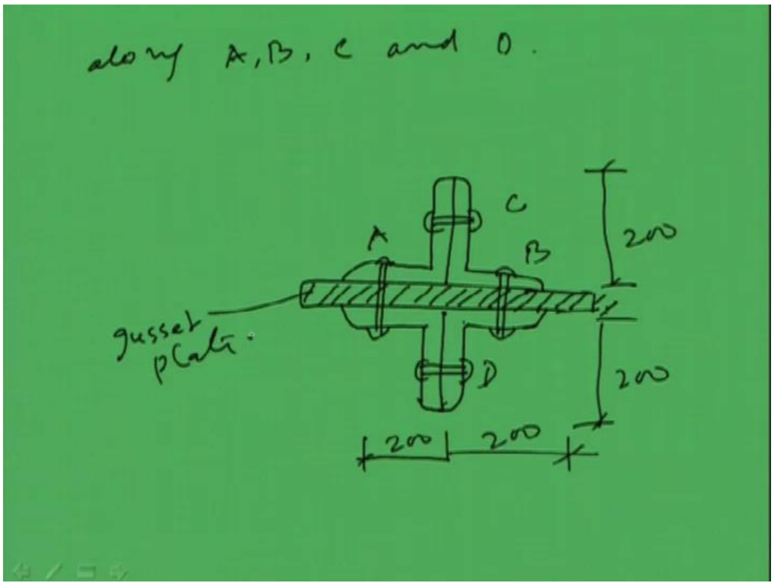

And next case is tacking rivet is done along A, B, C and D. So, these are the four cases we have. Now first let me draw the orientation of the sections, say, this is the gusset plate. Now four angles are with same leg length. So, these are the four angles. Now riveting has been done one is here, this is here. Now this is, say, A B C D. So, this is basically 200; this is also 200; similarly, this is 200; this is also 200 mm. And this is gusset plate, okay. So, now we have to find out the values.

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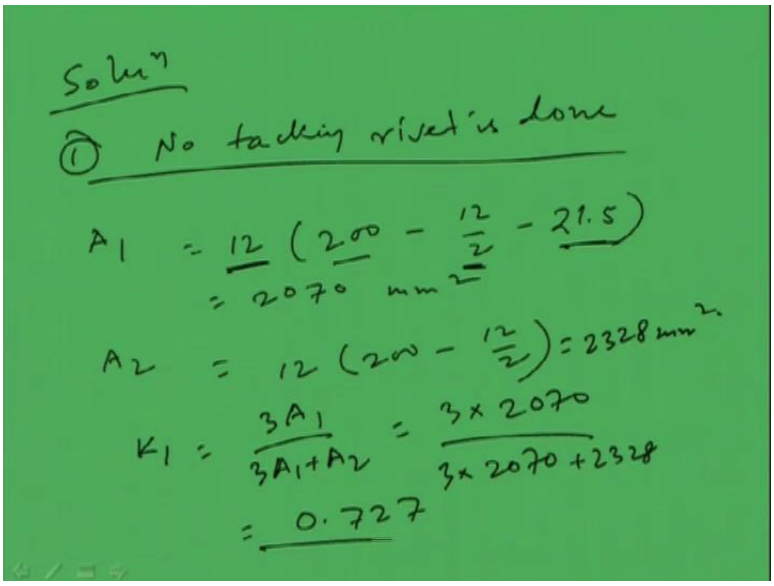

So, in case of solution, first is if no tracking rivet is done, all angles will act individually. So, A 1 will be area of connected of length; that will be 12 into 200 minus 12 by 2 minus 21.5. Because the thickness of the angle, this angle section is basically this is ISA 200 by 200 by 12. So, thickness is 12. So, 12 this is thickness 200 minus 12 by 2, and one rivet is there. So, deduction due to hole will be 21.5. So, A 1 will become this 2070 millimeter square.

Similarly, A 2 is the area of outstanding leg. So, this will become 12 into 200 minus 12 by 2; there is no connections because of no tacking rivet is done. So, A 2 will be this. So, this is coming 2328 millimeter square. So, now I can find out K 1. K 1 will be 3 A 1 by 3 A 1 plus A 2. So, this will become 3 into A 1 is 2070 by 3 into 2070 plus 2328. So, value of K 1 will become 0.727. So, now we can find out the net area.

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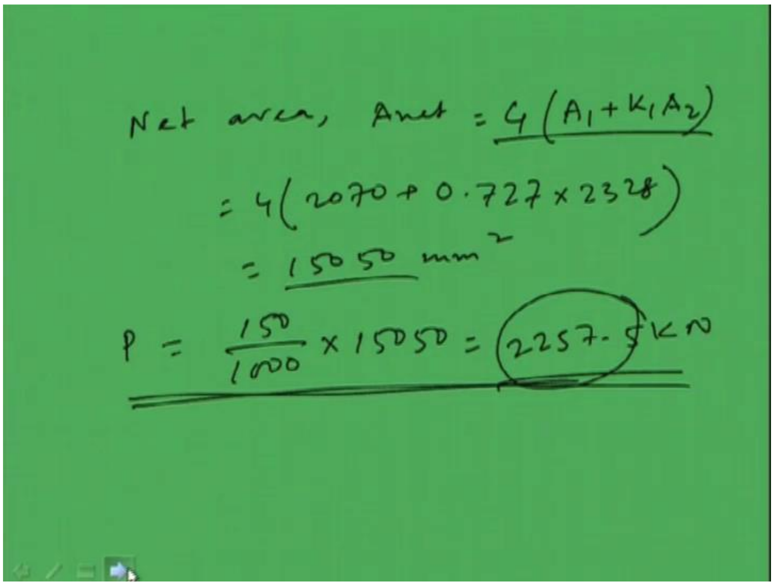

Net area will be A net which we define generally will be 4 into A 1 plus K 1 A 2; four angles are placed. So, that is a 4 has been multiplied. So, 4 into A 1 plus K 1 A 2. So, 4 into A 1 is 2070 plus K 1 is 0.727 into 2328 is A 2. So, these values are coming 15050 millimeter square. So, net effective area is going to have this. So, permissible tensile force P will be sigma a t which is 150 MPa. So, to make in kiloNewton I am dividing 1000 15050. So, this will be the force. So, 2257.5 kiloNewton. So, this is the permissible tensile force which we are going to get in case of no tacking rivet are used. In case of no tacking rivet are used, we are going to get the permissible load as 2257.5 kiloNewton.

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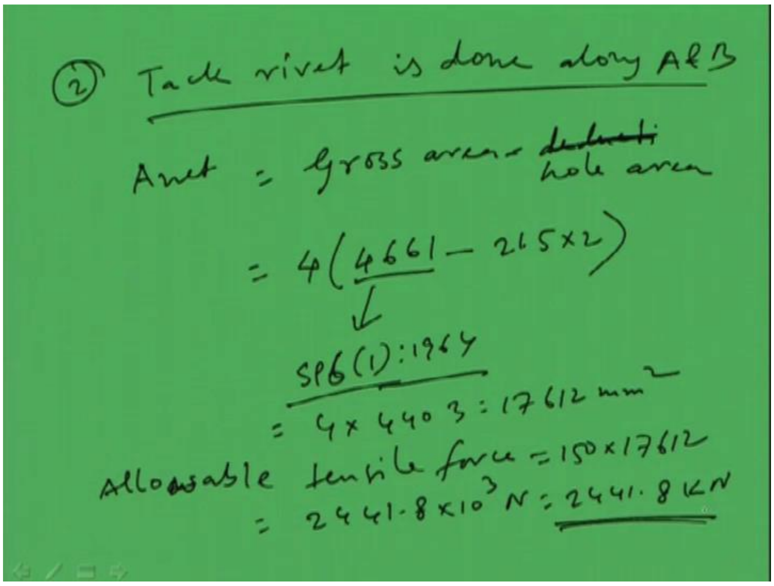

Next, we will go that if tack rivet is done along A and B, second case; tack rivet is done along A and B. So, second condition let us see. So, what will happen? In this case, angle will be acting in pairs on both sides of gusset plate. So, in this case if you see, the angle will be acting pairs on both side of the gusset plate. So, this will be one, and this will be another one. So, in this way we can find out.

So, the area net will be net effective area will be gross area minus deduction of hole means minus whole area. So, this will be 4 into gross area is we know that is f4661. This we are going to get from SP 6 SP 1 1964. From the handbook of SP 6, we will get the area of the angle ISA 200 by 200 by 12 is 4661, right. So, minus hole area, hole is 21.5 into 2, okay. So, from this I can find out the total area is 4 into 4403. That is 17612 millimeter square.

So, allowable load tensile force will be 150 into 17612; that means 2441.8 point eight into 10 cube Newton. That means 2441.8 kiloNewton, okay. So, if tack rivet is done along A and B, we will get allowable tensile force as 2441.8 kiloNewton. So, this is another orientation through which we are going to get the allowable load.

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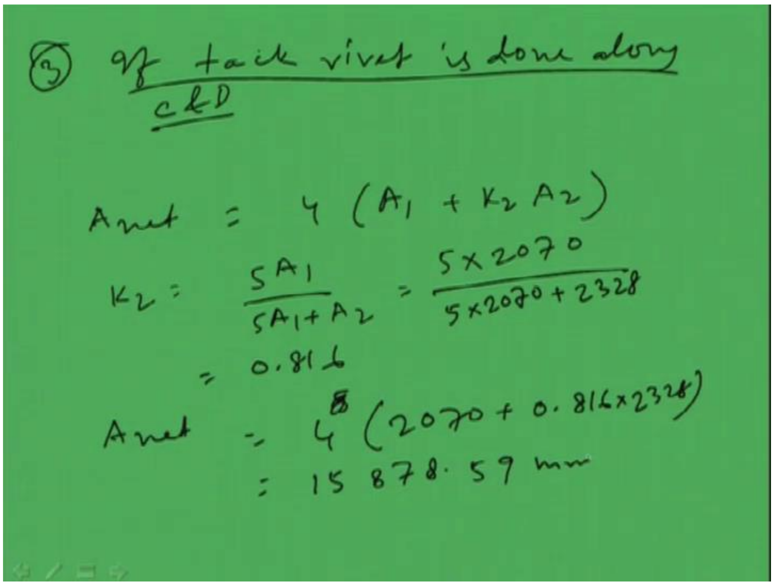

Another condition is given means condition three that if tack riveting is done along C and D. So, for this what will happen? Area net because angles on the same side of gusset will act in pair here angles on the same side of gusset will act in pairs. So, area net will be 4 into A 1 plus K 2 into A 2, right, where K 2 I can find out as 5 A 1 by 5 A 1 plus A 2. So, 5 into we have the area earlier we have calculated 2070. This area we have calculated earlier; this is the area A 1 and A 2 we have calculated this.

So, these two will be required here for calculating. So, 5 into 2070 plus 2328; so this is becoming 0.816. Thus net area will become 4 into 2070 plus K 2 is 0.816 into A 2; A 2 is 2328. So, from this we can find out the net area as 15878.59 millimeter square.

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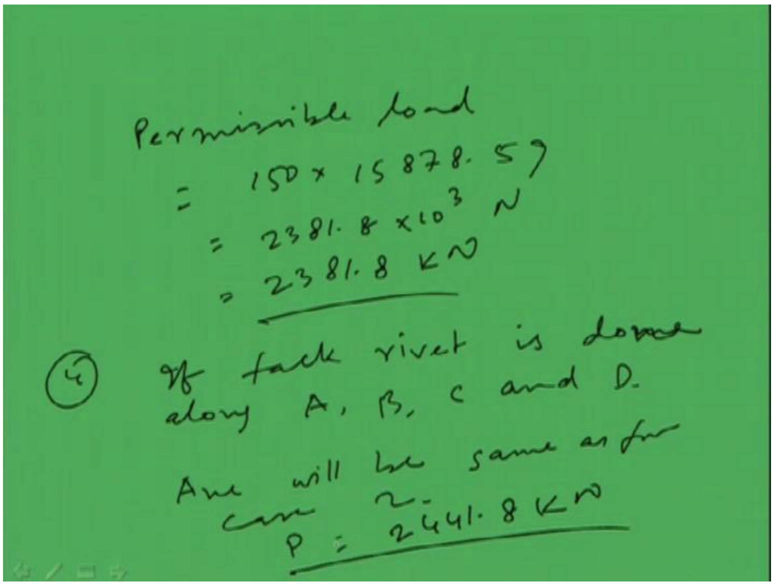

So, similarly the permissible load, load will become 150 into the area 15878.59. So, this is coming 2381.8 ten cube Newton. That means 2381.8 kiloNewton. So, if tacking rivet is done along C and D, then the permissible load will become 2381.8 kiloNewton. Then last condition is if tack rivet is done along A, B, C and D, then what will happen? So, here what will happen? It will be exactly same as in case of case two. A net will be same as for case two.

So, permissible load will be in case two, what was the permissible load 2441.8 kiloNewton. So, this will also be 2441.8 kiloNewton. So, if the tack rivet is done along A, B, C and D, it will be similar case to the case two. So, the load will be also similar; that means P will become 2441.8 kiloNewton. So, in this way we can find out the strength of the member considering the net area.

In this lecture, what we have seen now that how to calculate the net area for finding out the tensile strength of the member. The net area is depending on the type of connections, how it has been oriented, how it has been connected, whether it is through gusset plate or simply it has been connected back to back, whether the longer leg is connected or the shorter leg is connected. So, depending on the different orientation, the code has given some formula through which we have calculated the net area. And once we get the net area, we can find out the permissible strength of that member due to tension, right. So, with this I like to conclude to today's lecture. In next lecture, we will see how to design the tension member.

Thank you.