Design of Steel Structures
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Module - 3
Eccentric Connections
Lecture - 4
Analysis and design of joint with seat connection

Hello. Today, I am going to focus my lecture on analysis and design of joint with seat connections. So far, we have discussed in the last three lectures basically on bracketed connections. Basically, bracket connections we know that one joint has to be made through bracket where the load will be coming from girder to column. Now today we will be focusing on seat connections.

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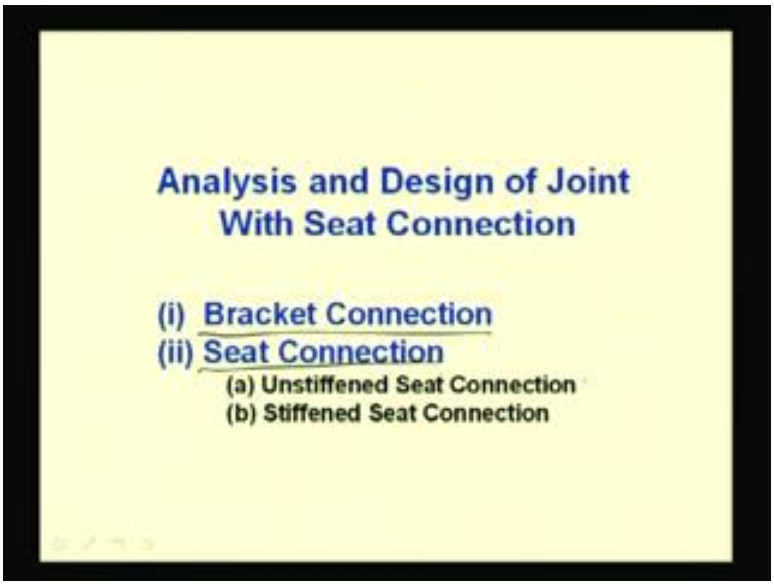

That means directly the load from girder will come to the column we will see, and in seat connection, there are two type of seat connection. One is unstiffened seat connection, another is stiffened seat connections. First, we will discuss details of unstiffened seat connections, then how to design we will see; we will go through one example through which we will be able to understand how to design a seated connection means seat connections with unstiffened means stiffened has not been given. Later, we will see if the load is high, then how to provide the seat connections with stiffener and how to design the stiffener. So, all these we will discuss.

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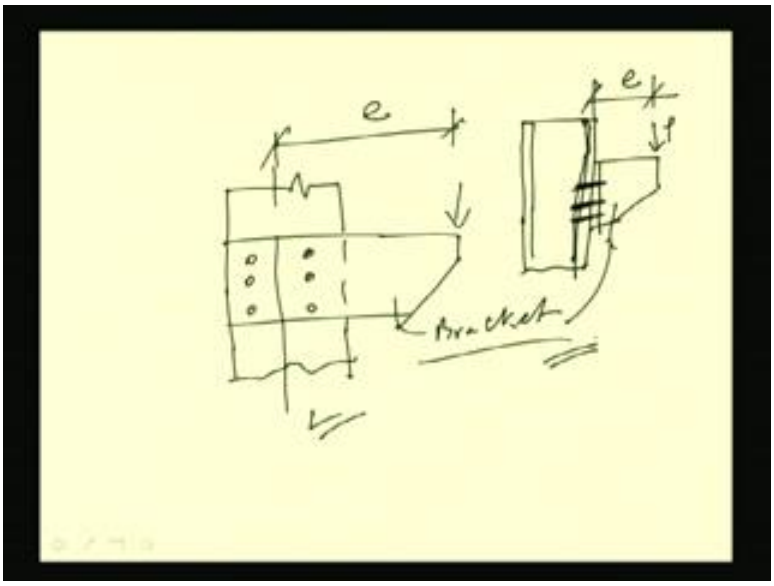

So, in case of bracketed connection it looks like this. We have seen that the load is coming from a girder or from somewhere else, and it is transferring to the column through this bracket; this is called bracket. And whether it depends on that bracket depends on whether load is lying on the plane of rivet joint or the load is lying perpendicular to the joint. If it is perpendicular to the joint, then we know how to means make it.

In the last class, we particularly discussed details about this joint. If we see and here we are providing the rivet, where it is a p. So, eccentricity will be basically here this much and here eccentricity will be this much. So, this is again bracket. So, one is load lying in the plane of rivet and one is load lying in the perpendicular to the plane of rivet. So, for these cases, either we can for this type of bracketed connections or we can go for seat connections.

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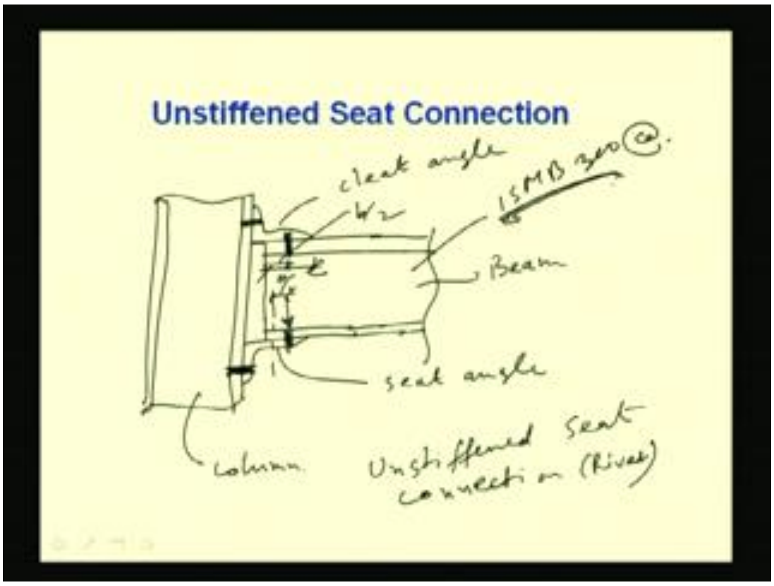

So, first we will discuss about the unstiffened seat connection. First, let us see how does it look, say one column is there. This is the column flange, say column, and this has some gap. This is beam, and this has been riveted or bolted, and this is called seat angle. Basically, this has to design. So, this has some connections with this column and with the beam and some nominal diameter of rivet had provided here with nominal angle which is called cleat angle. This cleat angle generally we make with nominal size.

Now basically this will be the force where acting and CG of the seat angle is this. So, this will become eccentricity e, and this we used to call as b, and this is basically as b by 2. So, this is the means typical connection of unstiffened seat, unstiffened seat connection with rivet impact, okay. So, in this way the connection we used to make. So, now we will go through the designs procedures. How to design one step by step we will see.

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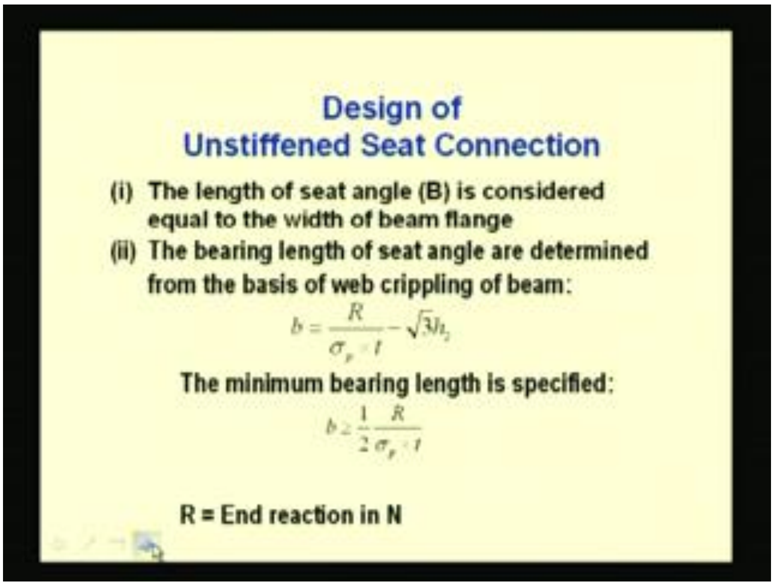

Say, first we will see that the length, length of seat angle. The length of seat angle which is denoted as B for our calculation is considered equal to the width of beam flange. So, we have a particular size of beam say ISMB, say 300 with some load. Now it has some particular flange width. So, we will consider the length of seat angle as same as the width of the flange of the beam. Then the bearing length of seat angle has to be calculated. The bearing length of seat angle can be determined from the basis of web crippling of beam.

Because we have to see that the crippling in web of the beam should not happen. So, to take care of this, the code has provided this formula; that is b should be equal to r by sigma p into t minus root 3 into h 2, where b should be at least this much. That minimum bearing length should be half into r by sigma p into t. So, b should be greater than or equal to this value. So, first what we will do for designing? First, we will find out the length of seat angle which is equal to the flange width of the beam.

Then we will find out the bearing length; bearing length of the seat angle which can be found out from these equations. And in any case this bearing length should not be less than this; if it is less than this, we have to consider this value. Now here r is the end reaction in Newton; means end reaction means which the load is coming from the girder or from somewhere else that reaction.

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Now t is the web thickness of beam in millimeter. Here we are using t sigma p h 2 along with R. So, t is the thickness of the web of beam in millimeter. H 2 is the depth of root of fillet from extreme fiber of flange for beam in millimeter. This has been given in the code; in SP 6 all the details has been given. That means for a particular angle whichever we are going to consider seat angle whatever we are going to consider, for that particular angle we have all the details.

The thickness we know and h 2 which is given in the code in SP 16 that handbook and sigma p. Sigma p is the permissible bearing stress in MPa, which is generally taken as 0.75 f y depending upon the grade of steel, depending upon the type of steel, the f y value is given, and we can find out the permissible bearing stress as 0.75 f y. So, third step is then the connected length is adapted in such way that at least three horizontal rows of rivets can be accommodated remember.

The connected length is adapted in such a way that at least three horizontal rows of rivets can be accommodated. In general, it is 150 mm or more. So, this also has to be remembered that connected length generally becomes 150 or more to adapt three horizontal rows of rivets. Next is the seat angle; this thickness of the seat angle should be chosen such that the outstanding leg does not fail in bending on a section at toe of fillet. So, this has to also be remembered that the seat angle thickness should be chosen such that the outstanding leg does not fail in bending on a section at toe of fillet. So, how we will make it; let us see.

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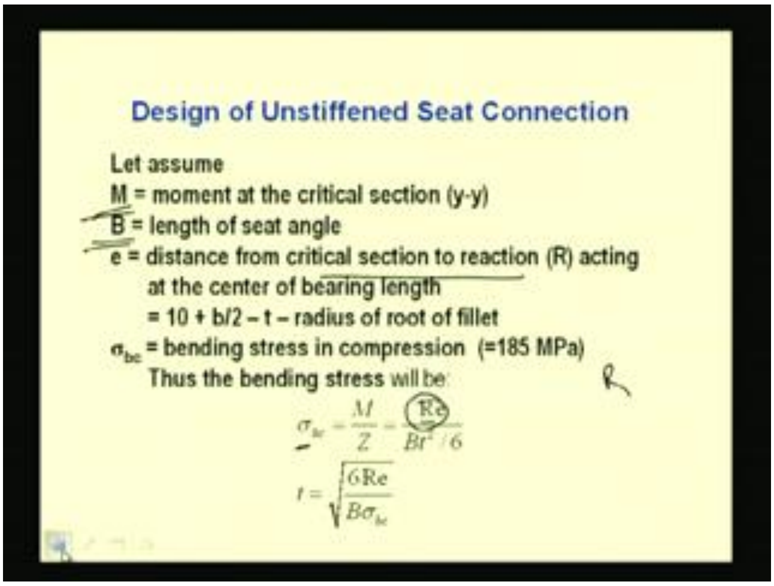

If the moment at the critical section is assumed as M and the length of seat angle is denoted as B. Then we can find out sigma b c as M by Z, where M is nothing but R into e; that means R is the reaction that is given, because of the load coming from the system coming through the beam or girder whatever you say. So, R e will be; that means e is the eccentricity that is distance from critical section to reaction acting at the center of bearing length.

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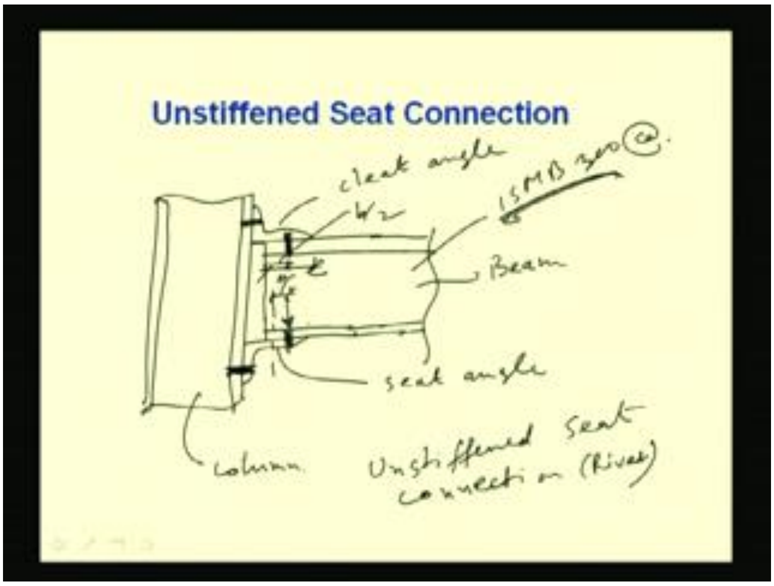

What is this? If we see the picture, this is e. That means this R is acting through this, and this is the CG of the angle. So, this will become e. So, this e value into R will become moment. And Z is nothing but the modulus of section, section modulus which is B t square by 6, where B is the length of seat angle, and t is the thickness. So, e can be calculated from this means as per this; that means this ten or fifteen whatever this is basically gap. Gap means if we see the picture, this is called gap.

So, this is ten; generally, we used to keep this as 10 mm. So, with this e will become 10 plus b by 2 minus t minus radius of fillet. So, accordingly e can be calculated. And sigma b c is the bending stress in compression which generally becomes 185 MPa. Sigma b c is the bending stress in compression which is 185 MPa. So, the bending stress can be calculated from this formula and through which I can find out the t as square root of 6 R e by B into sigma b c, right. T can be found out from this formula 6 R e by b into sigma b c and its square root. So, in this way we can find out the thickness.

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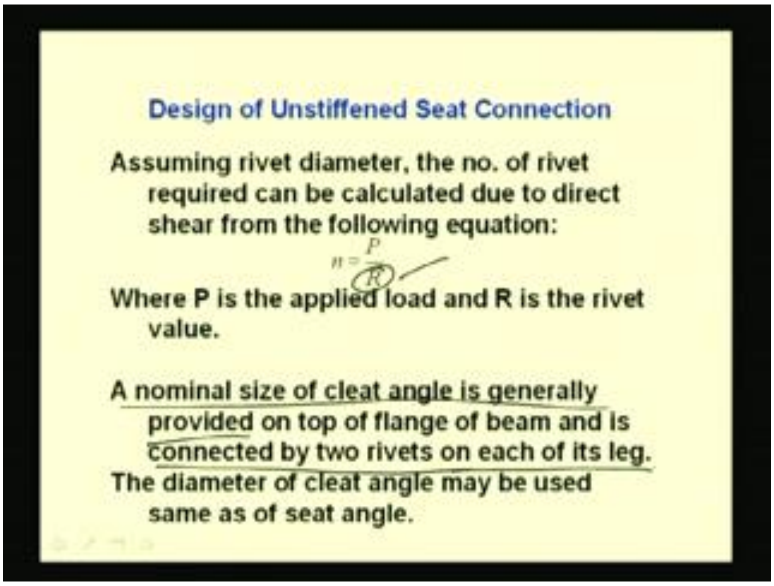

Now after finding out thickness, we have to assume some rivet diameter, and the number of rivet requires can be calculated from this. How? That we know the load acting on the joint and we know the rivet value. Rivet value can be calculated for a particular rivet diameter we can find out the rivet value. So, we can find out the number of rivets from this formula P by R, where P is the end reaction, and R is the rivet value, right. So, from this I can find out the number of rivet with assumptions of a particular diameter of the rivet.

Now a nominal size of fillet angle is generally provided at the top. So, after finding out the details of seat angle we will provide a nominal size of cleat angle which is provided at the top and top of the flange of beam, and it is connected generally by two rivets on each of its leg. So, we use two rivets on each of its leg to connect the cleat angle with the column and beam. And the dimension of the cleat angle may be used same as of seat angle. So, in case of seat angle whatever dimensional we have used the same dimension can be used for the cleat angle also.

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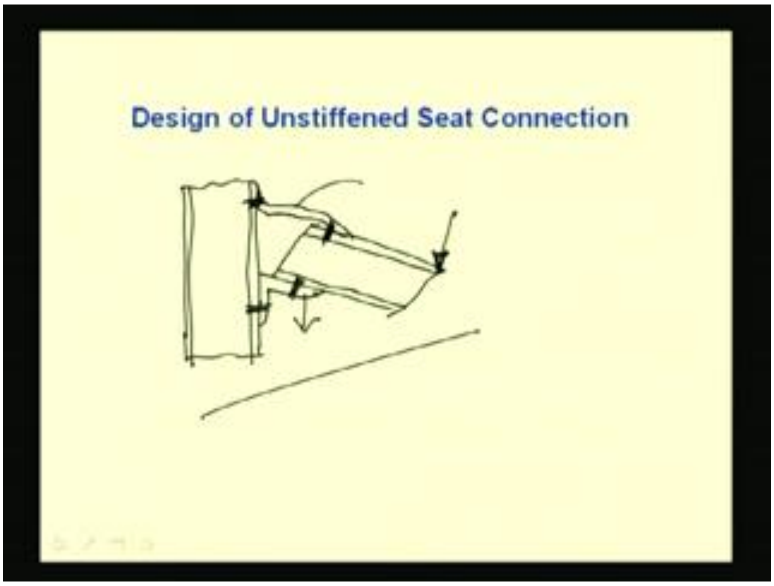

Now if we see how it fails means if we do not provide sufficient strong joint, then how it will fail let us see. So, this is a column, and if the load is high compared to the joint, then failure will be like this. So, the cleat angle whatever it was and the seat angle will be seeing like this. So, this will look like this. That means if the load is very high compared to the strength of the joint, then the failure will become like this. This means the seat angle will distort as well as the cleat angle behave like this. So, this is how the joint fails. Now let us go for the design.

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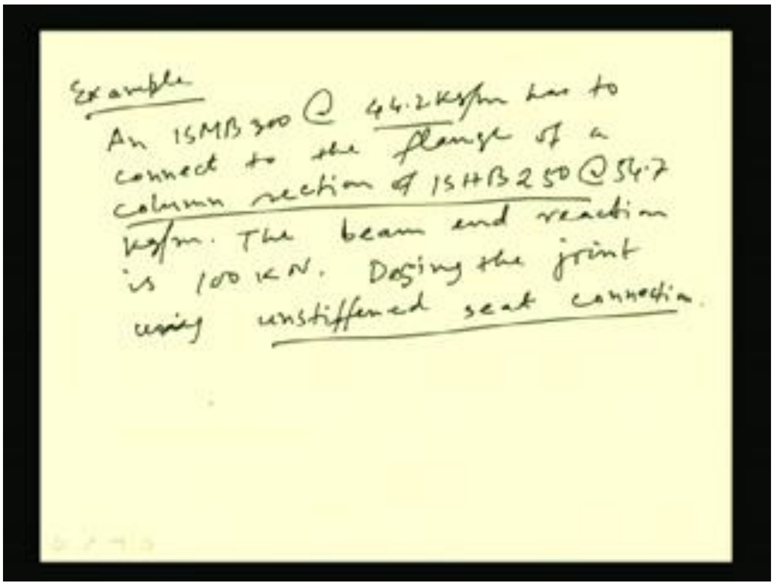

Design means if we go through one example with the provisions whatever we have given, then we will be able to understand how to design properly a seat connection; say An ISMB 300 at 44.2 kg per meter, because different weight of ISMB is available has to, say connect to the flange of a column section of, say ISHB 250 at 54.7 kg per meter. The beam end reaction is, say 100 kiloNewton. Design the joint using unstiffened seat connection. So, this is how the problem is. So, you have to design accordingly.

So, what is this? That an ISMB 300 at 44.2 kg per meter has to connect to the flange of a column section of ISHB 250 at 54.7 kg per meter; the beam end reaction is 100 kiloNewton. So, now we have to design with the unstiffened seat connection; that means the column if we see the column. Column size is this is column. This is ISHB 250. And this has been designed through the seat angle means with the seat connection we have to design. This is the beam of ISMB 300, right.

This is beam, and this is column. So, we have to find out the dimension of the seat angle and the cleat angle; that means nominal and the joint means what will be the number of rivets required to connect this joint; what will be the size of seat angle; what will be the thickness of seat angle and other details; how many rows of the rivets will be required; what is total number of rivets; what is the diameter of the rivets? All these things we have to find out.

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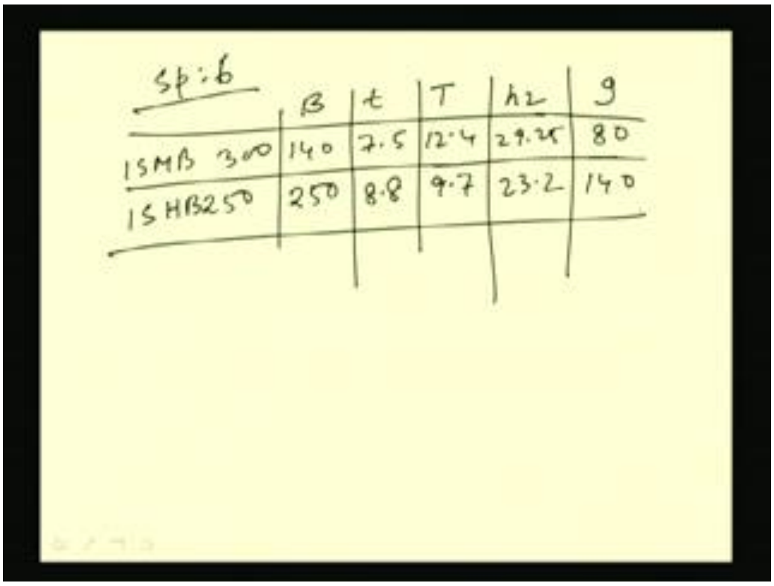

So, for finding out all these details, first we will see from the codal provisions means from the handbook of SP 6. From SP 6, we will get for, say ISMB 300. Say, the flange width is given 140. This is given in the tabular forms in SP 6, and thickness t is given, say 7.5 mm. This is the wave thickness, thickness of wave. And thickness of flange T has been given 12.4 mm. And h 2 has been given as 29.25. This is given in the code and the g which will be required again is given as 80.

And for the column ISHB 250, the width is given 250 mm and the web thickness for ISHB 250, it has been given as 8.8, and the flange thickness has been given 9.7; h 2 is 23.2, and g is 140. So, these are some parameters which will be required in case of designing the joint using seat angle. They are basically B means width of flange, write down and small t is the web thickness, and capital T we are assuming means considering as flange thickness, right. So, with all these data we have to now design the seat angle. So, what we will do? First we will find out the length of seat angle, okay.

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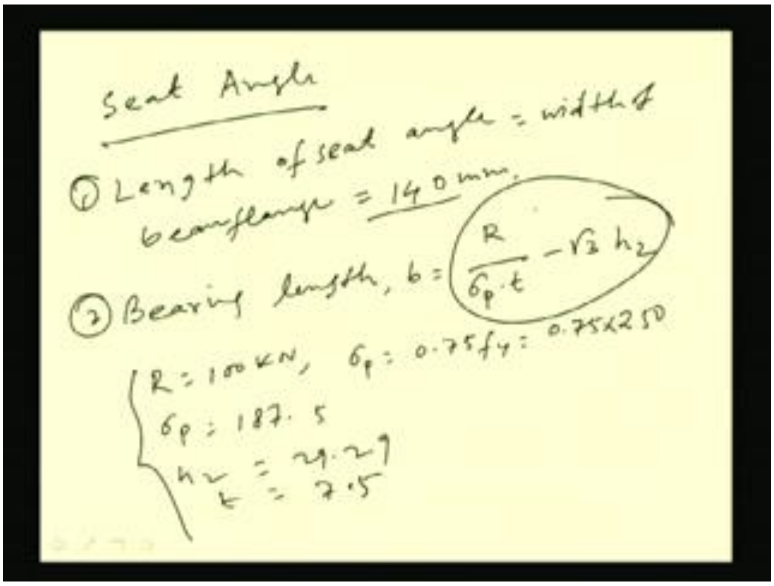

So, for seat angle length has to find out. So, length of seat angle this will be basically will be equal to the width of beam flange. So, that is given as 140. So, length of seat angle it has assumed as 140 mm. Now we have to calculate the bearing length next step. So, first step is this; say next step is bearing length which is called b; that is it can be found out from this formula R by sigma p into t minus root 3 into h 2.

So, if we provide the value here R is given as 100 KiloNewton, and sigma p is 0.75 f y. Say, for 250, if we consider f y as 250, then sigma p will become 0.75 into 250 that is coming 187.5. And other value is like h 2 is given, h 2 here as 29.25. So, h 2 will become 29.25, and thickness t is given as 7.5. So, t is 7.5. So, all these value if we put in this equation, we will get the values.

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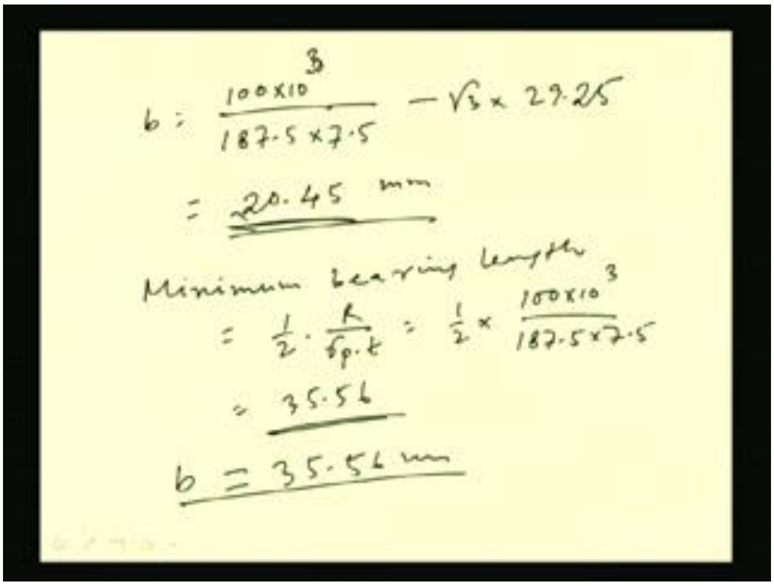

So, b will become in that way R means. So, 100 Kilonewton; that means 100 into 10 cube by sigma p is 187.5 as we have calculated, and thickness is 7.5 sigma p into t minus root 3 into h 2; h 2 is 29.25. So, after calculating this, we will get 20.45 millimeter. So, in this way I can find the bearing length 24.5 millimeter. Again we have to check whether it is more than the bearing length or not means minimum bearing length or not. Minimum bearing length, we know that is half into r by sigma p into t.

So, half into r means 100 into 10 cube. Sigma p means 187.5 into t means 7.5. So, this will become 35.56. So, minimum bearing length is 35.56, and we are calculating as 20.45. So, the bearing length we can provide minimum one; that means 35.56 millimeter. So, in this way we can find out the bearing length also.

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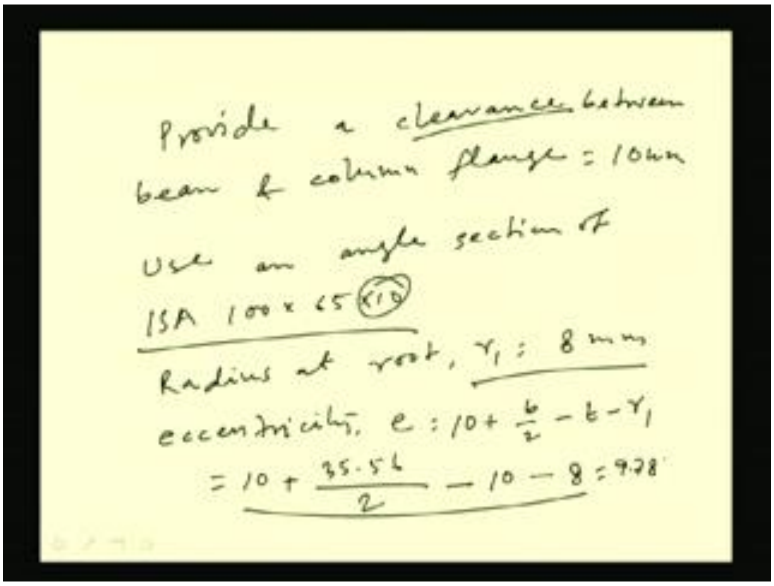

Next what we will do? We will provide some clearance; that means gap. We have to assume some clearance; say provide a clearance between beam and, say column flange, okay. So, 10 millimeter gap we are providing. Provided clearance between beam end column of a clearance, say this we are providing as 10 mm, okay. And let us use an angle section because we have to assume some angle and then we have to check angle section of, say ISA 100 by 65 by 10, okay.

So, we are using the seat angle as, say 100 by 65 by 10; that means the radius at root which will be required for calculation. Radius at root r 1 will become 8 mm. And this has been given in the code means in the handbook SP 6 from which we can find out the r 1 as 8 mm. So, the eccentricity e can be found out. Say, gap 10 mm plus b by 2 minus t thickness minus r 1 this root. So, if we calculate this will become 10 plus, say 35.56; the bearing length has been calculated as 35.56 minus thickness were given, say 10, thickness of the angle that is 10, and r 1 is found from SP 6 as 8. So, after getting calculation of this value, we are getting as 9.78 millimeter.

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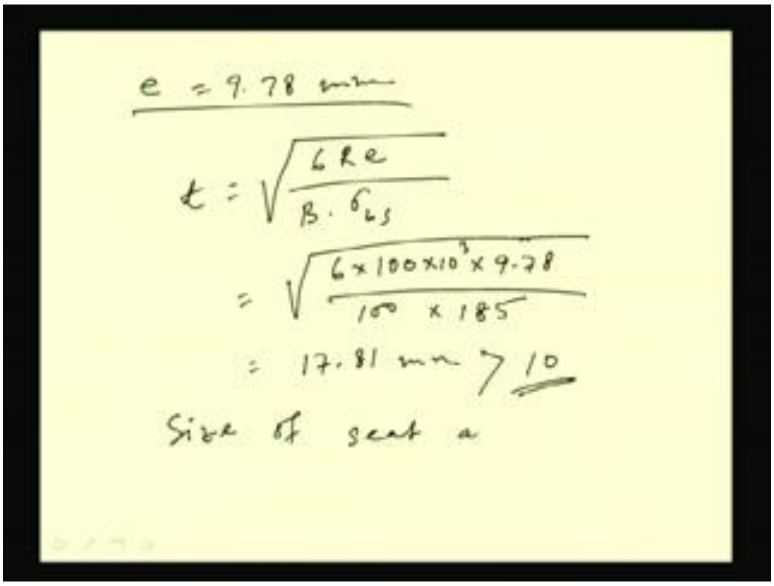

So, the eccentricity we are getting 9.78 millimeter, right. Now we will find out the thickness required to withstand that much load. So, thickness can be calculated from that formula that is 6 R e by b into sigma b s and the allowable stress sigma b s will be 185. So, 6 into r means 100 KiloNewton; that means 100 into 10 cube. E is 9.78 millimeter which has been calculated. And b is the width which is 100. And sigma b s is the permissible stress in bending that is 185, right.

So, after calculation this is becoming 17.81 millimeter. That means the thickness required for the seat angle is 17.81 millimeter, but we have provided 10 mm because ISS 100 by 65 by 10 we have used. So, it is greater than 10; that means the size of the seat angle is not sufficient to carry this much load. So, size of seat angle is not sufficient. So, what we have to do? We have to again go for redesigning; that means we have to increase the size of the seat angle. So, now we will see with the increase of size of seat angle, how we are going to make it safe. So, what we will do? Earlier we have considered 100 by 65 by 10.

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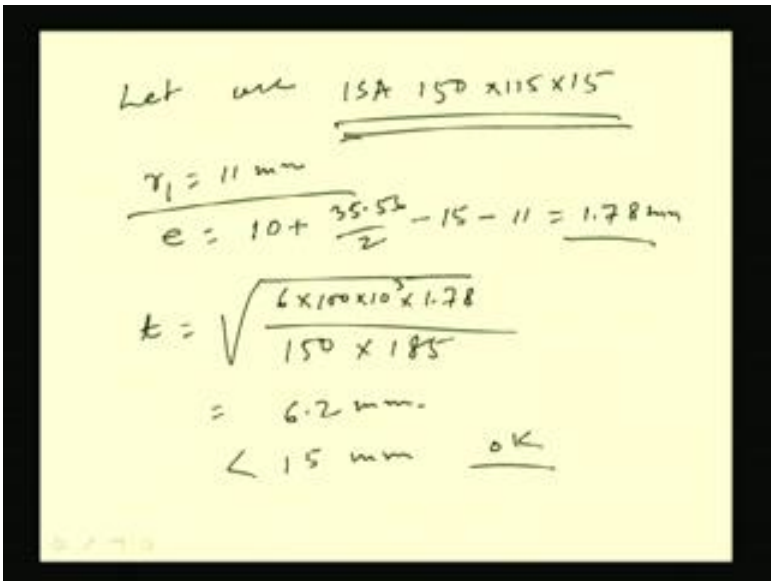

Now let us say ISA 150 by 115 by, say 15. Say, in place of 100 by 65 by 10, let us use ISA 150 by 115 by 15. Then from SP 6 r 1 can be found out which is given as 11 millimeter. So, eccentricity e can be found out 10 plus d by 2; that means 35.56 by 2 minus this thickness t. T is 15 here, and r is 11. So, after calculating this, we are getting 1.78 millimeter. So, eccentricity we are getting this much. So, now the required thickness again can be found out t is equal to 6 R e by sigma b s into b. That means 6 r was 100 KiloNewton.

E is 1.78 6 r e by sigma b s into b. B is 150, and sigma b s is 185. So, from this we are going to find the value of t as 6.2 millimeter which is less than 15 millimeter; that means it is okay. That means if we use ISA 150 by 115 by 15, then the angle is sufficient to carry the load. So, the dimension of the seat angle is perfectly okay, right. So, next what we will do? Next we will find out the rivet details.

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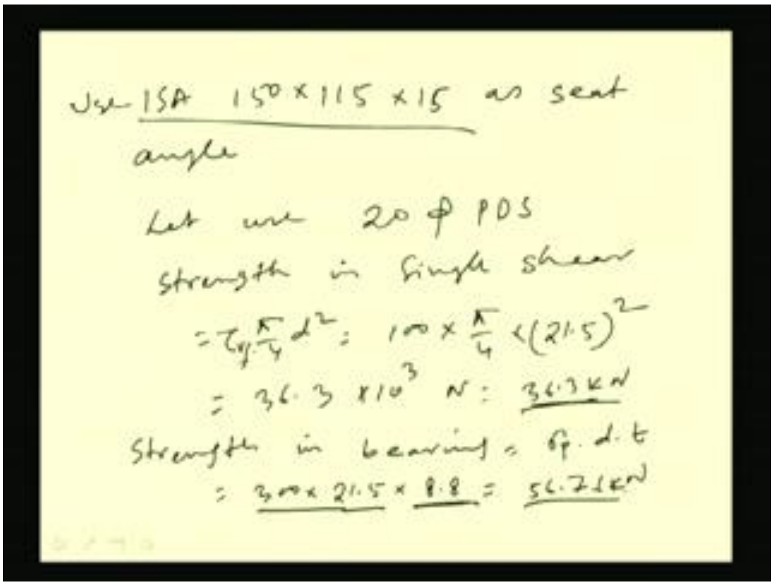

So, we are using ISA 150 by 115 by 15 as seat angle. Use ISA 150 by 115 by 15 as seat angle which is, say to bear 100 KiloNewton. Now, say let us use, say 20 mm diameter of power driven shop rivet. So, the strength in single shear will be because we have to find out the number of rivets. So, strength in single shear will become 5 by tau v f into 5 by 4 d square. That means for power driven shop rivet, tau v f will be becoming 100 MPa 5 by 4, and it is 20 mm diameter has been used. So, the gross diameter will become 21.5.

So, from this we are going to get 36.3 into 10 to the power 3 Newton or 36.3 KiloNewton. So, strength of rivet in single shear is 36.3 KiloNewton. Again in bearing we have to find out; that means strength in bearing strength of rivet in bearing; that will be sigma p into d into t. That means 300 into d. D means 21.5 into t. T is this one 8.8. So, this will become 56.76 KiloNewton. How do we get the t? If we see the earlier this t, the thickness web thickness is 8.8 for ISHB 250 for the column, the web thickness is 8.8. So, the strength in bearing will become 300 into 21.5 into 8.8 which is becoming 56.76 KiloNewton. Now the rivet value will become the list of these two.

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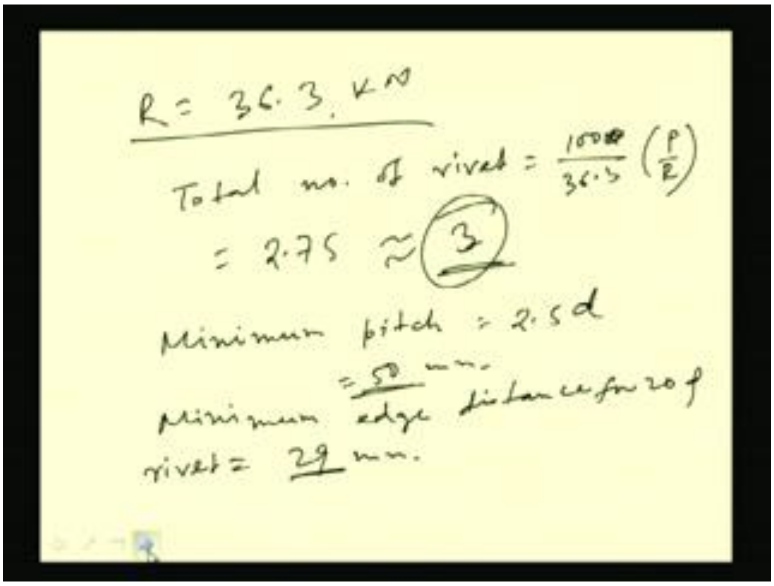

So, we can find out the rivet value as the list of these two; that means 36.3 KiloNewton. So, rivet value we got. Now total number of rivet we can find out. So, total number of rivet will become force was 100, 100 by rivet value 36.3 means P by R. So, this is coming 2.75; that means 3. So, we have to use three number of rivets, right. Now pitch; minimum pitch generally we use to make at least 2.5 d; that means 50 mm, right. And minimum edge distance as per the codal provision this will become for 25 rivet diameter, minimum edge distance will become 29 mm, okay. So, these are the value we have to keep in mind while designing the joint. Now let us use two rows. So, if we use two rows, we have to provide four rivets.

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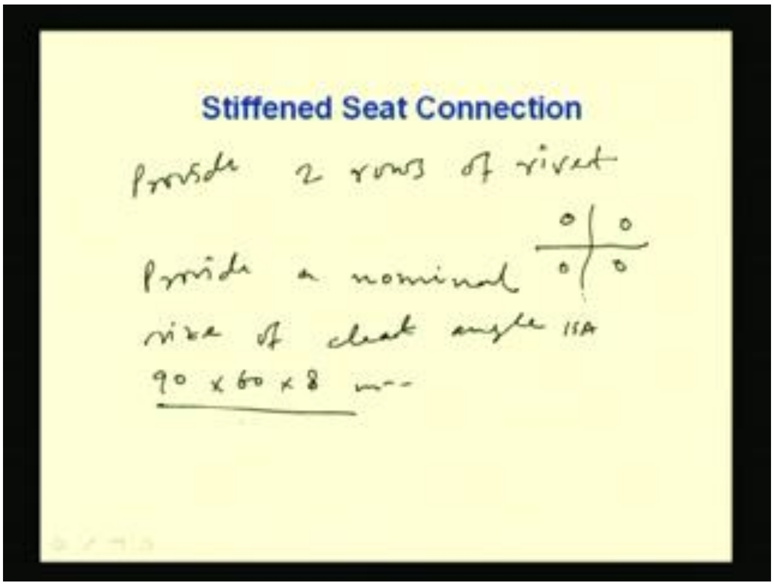

So, let us make that provide two rows of rivet. That means two rows means we are providing four, right; four rivets we are providing. So, total number of rivets is becoming four. This is all about the seat angle. Now cleat angle we have to make. So, provide a nominal size of cleat angle, say ISA 90 by 60 by 8, okay. So, cleat angle we are providing this 90 by 60 by 8. And we are providing some this rivet to join the cleat angle between column and the beam.

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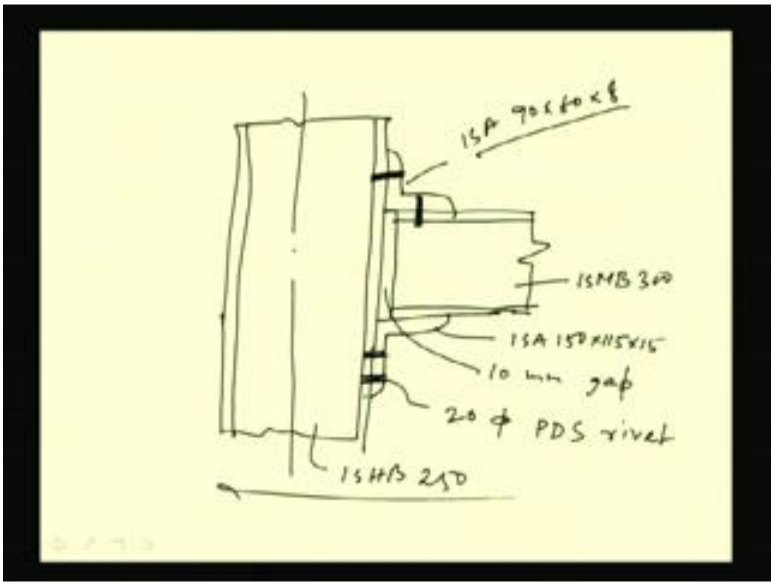

So, if we draw the diagram, it will become like this. Let us see the design details of the unstiffened seat angle; say this is the column. This is column flange ISHB 250, and this is the gap. This is ISMB 300, and this is 10 mm gap. And now we will provide seat angle and the cleat angle with some nominal dimension of cleat angle and the seat angle which has been found from the design. This is ISA 150 by 115 by 15. And here in each row, two rivets are there. So, 20 diameter of rivets of power driven shaft rivets. This have been used and this is ISA 90 by 60 by 8 which is the nominal has been used. So, these are the all details for this unstiffened seat connection. So, in this way we can make it.

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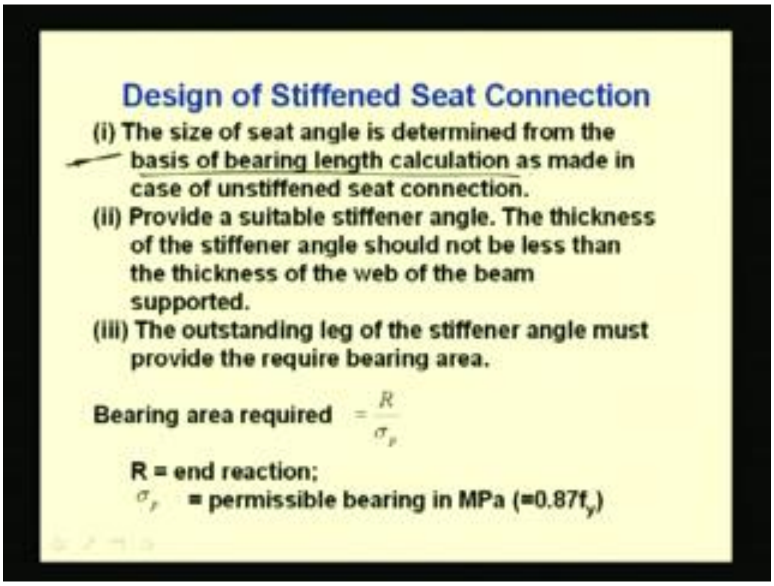

Now we will discuss about the design of stiffened connection. So, for design of stiffened connection means stiffened seat connection, almost similar way we will find out the design process except the design of stiffener. So, first step is that the size of seat angle which is determined from the basis of bearing length, okay, as made in case of unstiffened seat angle. So, the size of seat angle we will make as similar to the unstiffened seat connection; this is first.

Then we will provide which is new that is a suitable stiffener angle; we have to provide a suitable stiffener angle. The thickness of the stiffener angle should not be less than the thickness of the web of the beam supported which has to be kept in mind. What is this? The thickness of the stiffener angle should not be less than the thickness of the web of the beam supported, and the outstanding leg of the stiffener angle must provide the required bearing area.

So, outstanding leg of the stiffener should be chosen in such a way that its area should be sufficient. The bearing area required is basically R by sigma P, where R is the end reaction, and sigma P is the permissible bearing which is 0.87 f y. So, from this I can find out the area required for bearing and the stiffener which I am going to provide stiffener angle; the area of the stiffener angle must be more than this.

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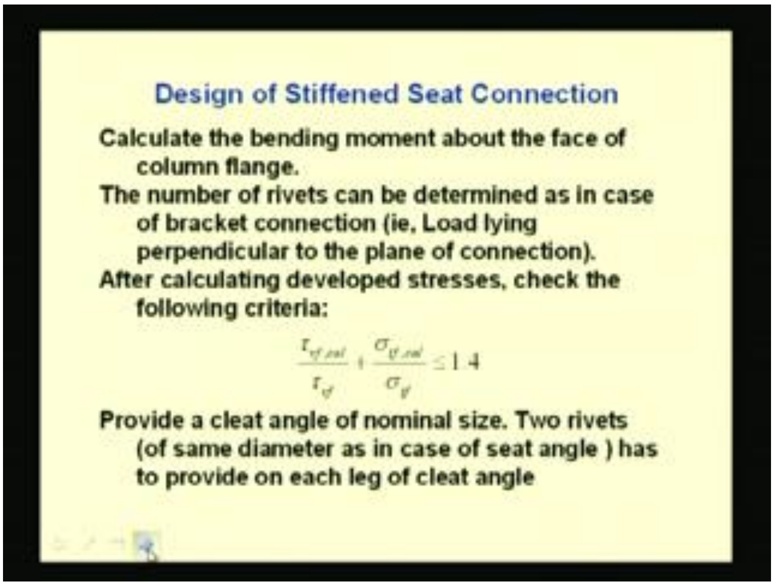

Then we will calculate the bending moment about the face of the column flange. Then the number of rivets can be determined as in case of bracket connection. That means similar to load lying perpendicular to the plane of connections. After calculating the developed stress, we have to check these criteria. The tau v f cal by tau v f plus sigma t f cal by sigma t f should be less than 1.4. And provide a cleat angle of nominal size two rivets has to provide on each leg of cleat angle. So, in summary what we have seen that design of seat angle is same as in case of unstiffened seat angle connections. Then the new thing is how to design the stiffener. So, for choosing the stiffener, we have to follow this process. And this will be clear if we go through some example.

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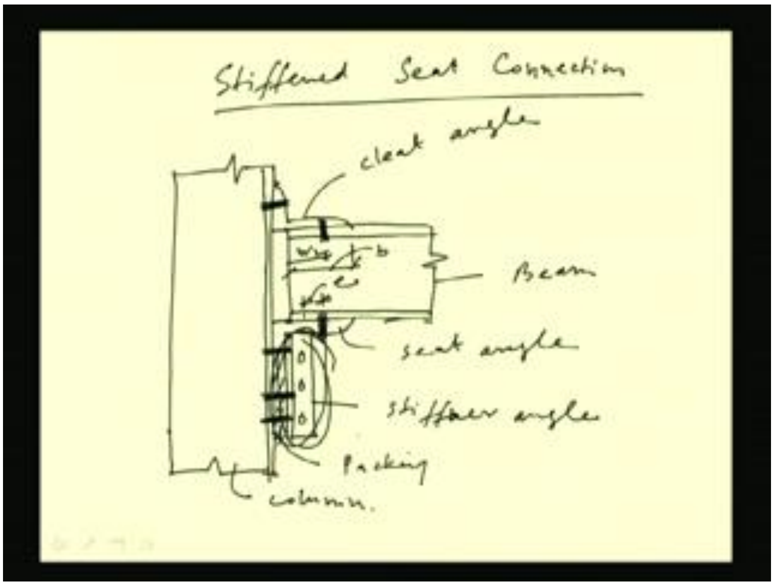

Before going to example, let me see how does it look like stiffened seat connection. So, this will be this is the column. Now this is gap. This is the beam. Now this is beam. This is column and now we will provide. So, let us provide first cleat angle. So, this is called cleat angle. Now this is b by 2, and this is b. Now this is the seat angle and after this, say we are going to provide some stiffener. Say, this is called say packing this gap, and this is the stiffener angle. This is what new things we have to make it stiffener angle.

And we have to now design; we have to connect the stiffener with the column as well as we have to connect the seat angle with the column seat angle. So, in this way we have to make, and this will be the e eccentricity, right. So, the new things what we are seeing here that this is the stiffener; so other design will be as done in case of unstiffened seat connection. In case of stiffened seat connections, only difference will be the design of stiffener, and for designing of stiffener, we will see how the load is coming due to eccentricity and load is coming due to the direct load and how to find out the equivalent load and how to check the resulting forces.

So, we will see this one. Design the previous joint using stiffened seat connection with a load of 150 KiloNewton. Say, when we go for stiffened seat connection, basically when load is more, load is high. So, in place of 100, let us make 150 KiloNewton. And let us see how we are going to design the things. So, what we will do now? So, first length of seat angle can be calculated as in earlier case which will be equal to the width of the flange, and it is 140 mm as the same size of beam and column has been used.

So, bearing length can be found out b is equal to R by sigma p into t minus root 3 h 2. So, from this if I put the value R as 150 in place of 100, and this is 187.5. So, all others are similar to the earlier cases 29.25. So, this data's are given in earlier problem. So, this is coming 56 millimeter.

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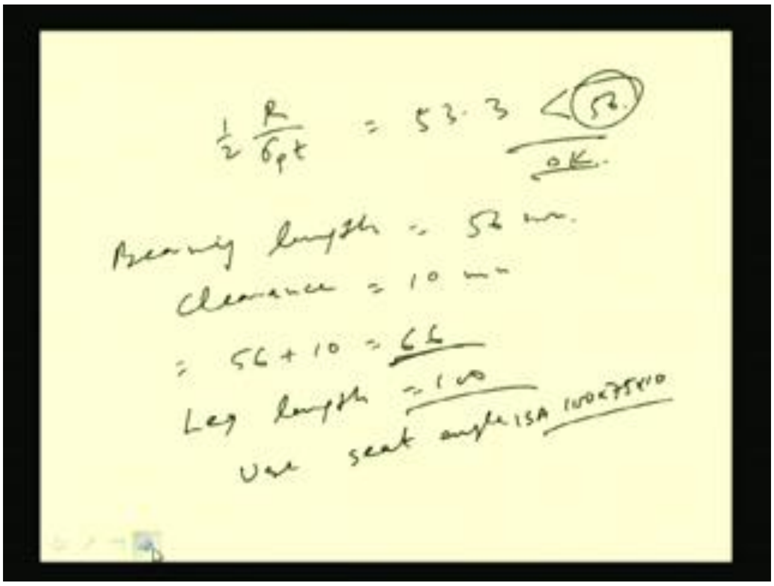

And minimum bearing length which is half into R by sigma p t; this is coming 53.3 which is less than the calculated bearing length 56. So, this is okay; okay means 56 we can consider. So, bearing length in this case will be 56 mm. And provided clearance of, say clearance you provide, say 10 mm gap of use. So, length of outstanding leg will be how much? So, that will be 56 plus 10; length of outstanding length will become 66. So, let us provide leg length as 100 because required is 66. So, we can use the seat angle of, say ISA 100 into 75 into 10. So, in this case let us provide the seat angle as this. Now the details of the seat angle I am not going into details; we will see the stiffener angle.

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So, how to calculate and design the stiffener angle? So, as we told that bearing area, what is the bearing area required? Bearing area required will be the total load 150 by allowable stress 187.5; this is coming 800 millimeter square. So, bearing area we are going to find; according to that let us use say two number of ISA 60 by 40 by 8. These sections let us use. So, area provided will be that will be 2 into 60 into 8. So, this is coming 960. So, we need 800, and we are providing 960 mm square length. Now another thing is length of the outstanding leg will become 60 minus 10; that will be 50. And here thickness of the angle is 8, and length of the outstanding leg will become 50.

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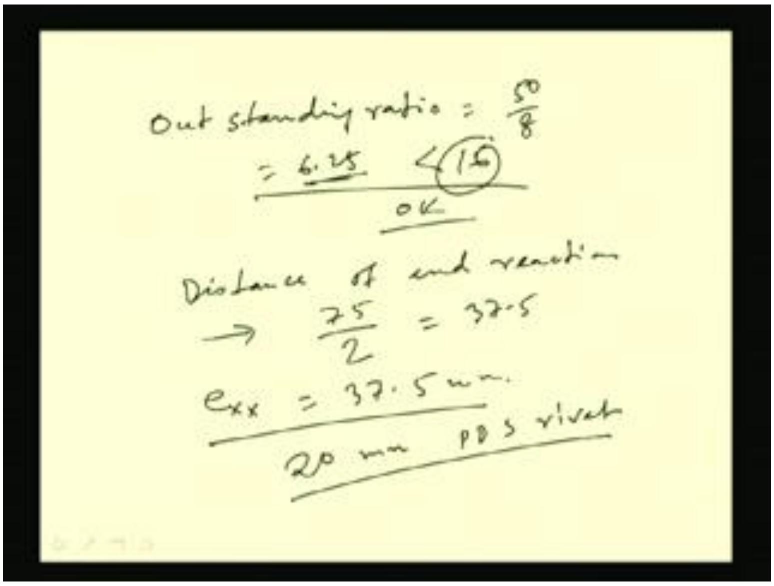

So, from this I can find out the outstanding ratio. Outstanding ratio will be 50 by 8 is equal to 6.25. As per codal provision, it has to be less than 16. So, this is okay. As per codal provision, this outstanding ratio has to be less than 16. So, we are getting 6.25. So, it is safe. Now distance of end reaction from column flange will be how much? Distance of end reaction from column flange will become 75; 75 was the length. So, this will become 37.5 So, that means the eccentricity e xx we can make as 37.5 millimeter. Now we have to assume some rivet diameter to find out the rivet value. So, as in earlier case we have considered the rivet diameter 20 mm power driven shaft rivet.

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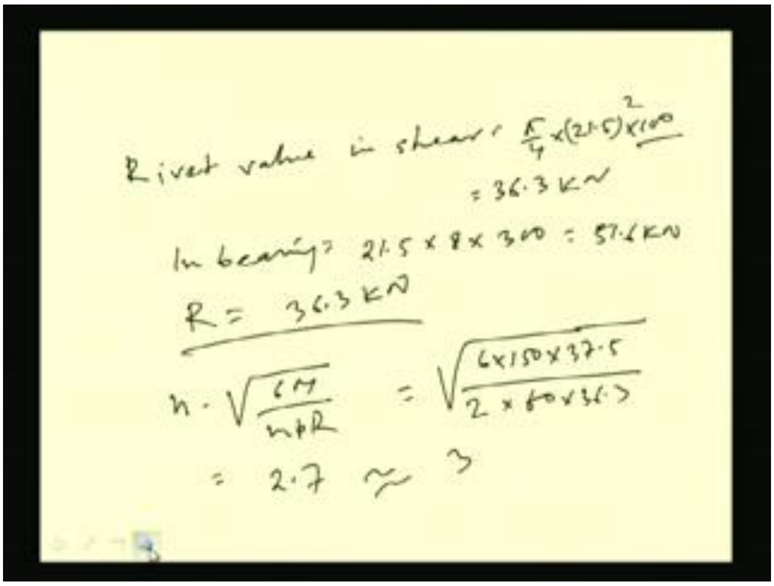

So, using this we can find out the rivet value as in shear; that will be 5 by 4 21.5 square into 100 will be the tau v f; that is 36.3 KiloNewton. And rivet value in bearing will be sigma p f into d into t; this is d, t is 8, and sigma pa is 300. So, this is becoming 51.6 KiloNewton. So, I can make the rivet value as 36.3 kiloNewton. So, rivet value we have. Now we have to find out the number of rivets. So, number of rivets can be found out n as 6 M by mpR. So, using two rows of rivet, we can find out 6 into 150 was the load, and this is the eccentricity; M two rows we are using. Say, let us use pitch as 60 and rivet value as 36.3. So, from this I am getting 2.7. So, three numbers of rivets we can use.

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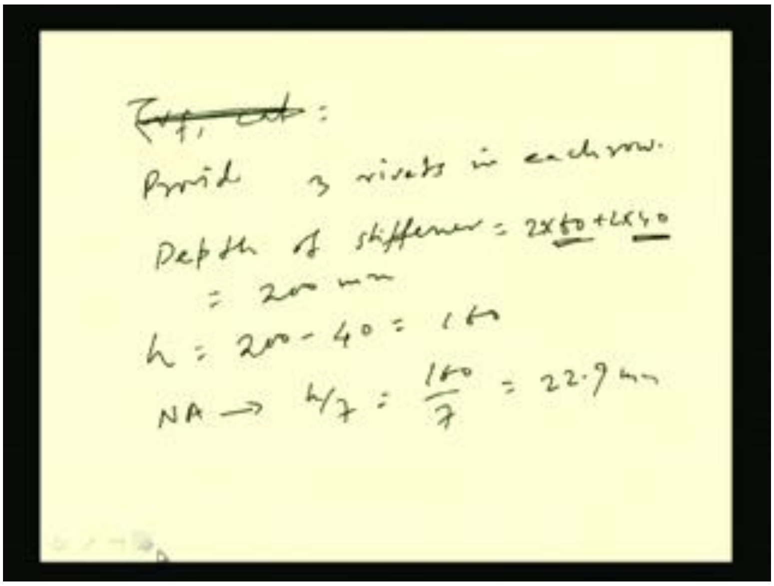

So, with this I can find out tall v f cal. Sorry, provide three rivets in each row. So, what will happen? So, depth of stiffener can be found out. That will be 2 into 60 plus 2 into 40. Edge distance we are considering 40 and pitch is considered 60. So, with this we are getting 200 mm. So, h will become 200 minus 40; that means 160, right. So, neutral axis will be lying at h by 7; that means 160 by 7; that means at 22.9 mm from the bottom, right. So, how does it look like?

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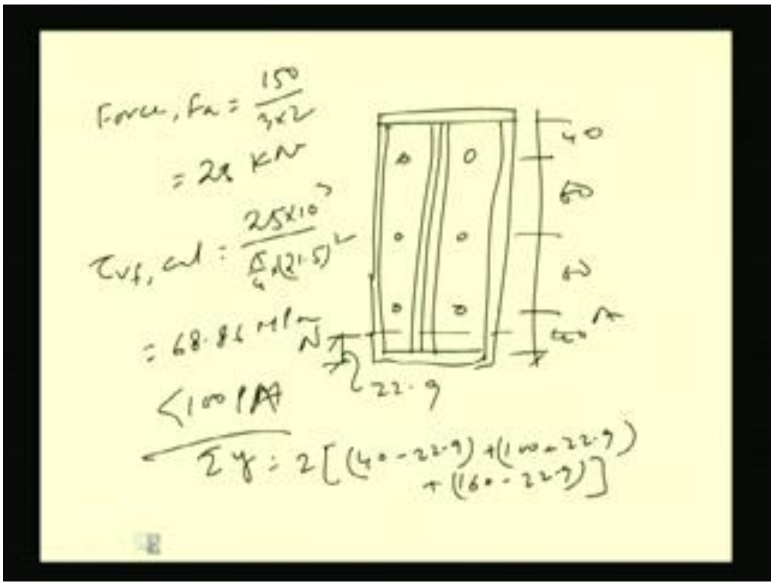

So, if we see we will see. So, we are using three rivets, right, and these are 40, 60, 60 and 40, and neutral axis is lying here, neutral axis which is 22.9, right. So, now force in each rivet due to direct force, force in each rivet f a will be total load by total number 150 by 3 into 2. That will become 25 KiloNewton. So, now tau v f cal can be found out 25 KiloNewton by area of the rivet pi by 4 into 21.5 square.

So, this is becoming 68.86 MPa which is less than 100 MPa. So, this is okay from shear stress point of view, right. Now we will provide the means we will find out the stress due to bending, and this is similar to that case of load lying perpendicular to the plane of joint. So, we can find out the critical section. So, critical means we have to find out sigma y will become 2 into 40 minus 22.9 plus 100 minus 22.9 plus 160 minus 22.9. So, this will be the summation y.

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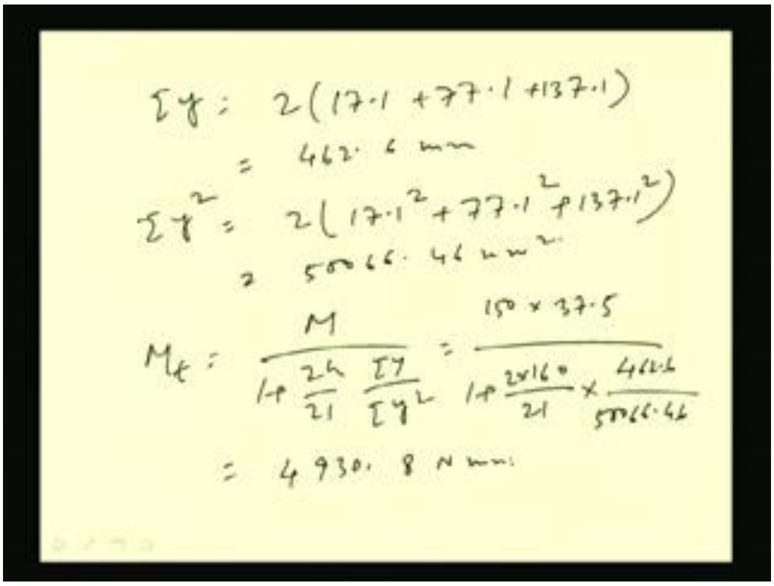

So, summation y is becoming 2 into 17.1 plus 77.1 plus 137.1. So, this is becoming 462.6. Similarly, summation y square can be found out as like this 17.1 square 137.1 square. So, this will become 50066.46 millimeter square. So, now I can find out the total movement M t from the equation M by 1 plus 2 h by 21 into summation y by summation y square. So, from this I can find out moment will be 150 into 37.5 by 1 plus 2 into h is 160 by 21; summation y is 462.6 by 50066.46. So, from this I can find out M t as 4930.8 Newton millimeter.

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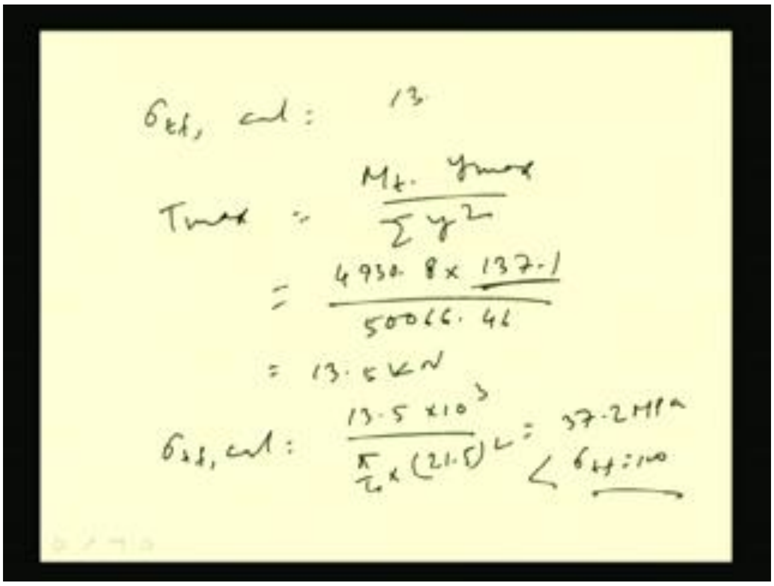

So, I can find out now sigma t f cal which is sorry. So, M t I am going to find out this. So, now T max will become M t into y max by summation y square, and y max will be the outermost rivet. So, that will be 4930.8 into 137.1 by 50066.46, because y max is this outer most. So, from this I am getting 13.5 KiloNewton. Now sigma t f cal can be found out now 13.5 by area t by a 5 by 4 into 21.5 square. So, this is coming 37.2 MPa which is less than sigma t f which is 100. So, it is okay.

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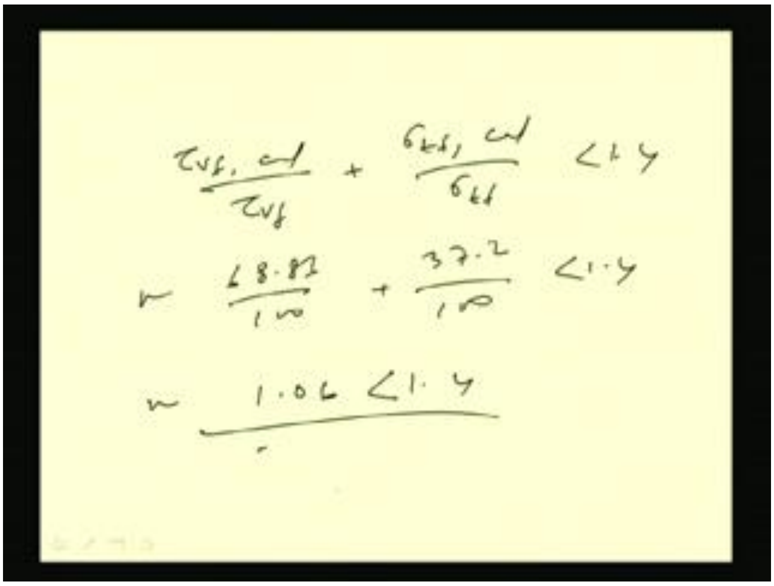

Now we have to check that tau v f cal by tau v f plus sigma t f cal by sigma t f which has to be less than 1.4. So, if I put the value 68.86 by 100 plus 37.2 by 100; this is 1.4. So, this is coming 1.06 which is less than 1.4. So, I can say this is say. So, in this way we can make the things, okay. So, with this I like to conclude today's lecture that what we have done today that we have focused on analysis and design of seat connection whether it is stiffened or unstiffened. So, in next day, we will discuss about the eccentric connection with welding joint. How we will be doing the eccentric connections with the use of welding; those things we will discuss in the next class.