

Design of Reinforced Concrete Structures
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Lecture – 29
Design of RC Slender Columns

Well, so we have learnt how to design that short columns. Now, today we shall learn how to design slender columns or we call it long columns. And this is how the lecture number 29 design of RC reinforced concrete slender columns. But, before I start this lecture I shall give one correction last class what we have done.

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The area of shear reinforcement

$$A_{sv} = \frac{T_u s_u}{b_1 d_1 f_y} + \frac{V_u s_u}{2.5 d_1 f_y} \quad 0.87$$

$b_1 = 300 - 25 - 25 - \frac{20}{2} - \frac{20}{2}$
 $= 230 \text{ mm}$

$d_1 = 550 - 25 - \frac{20}{2} - 25 - \frac{16}{2}$
 $= 482 \text{ mm}$

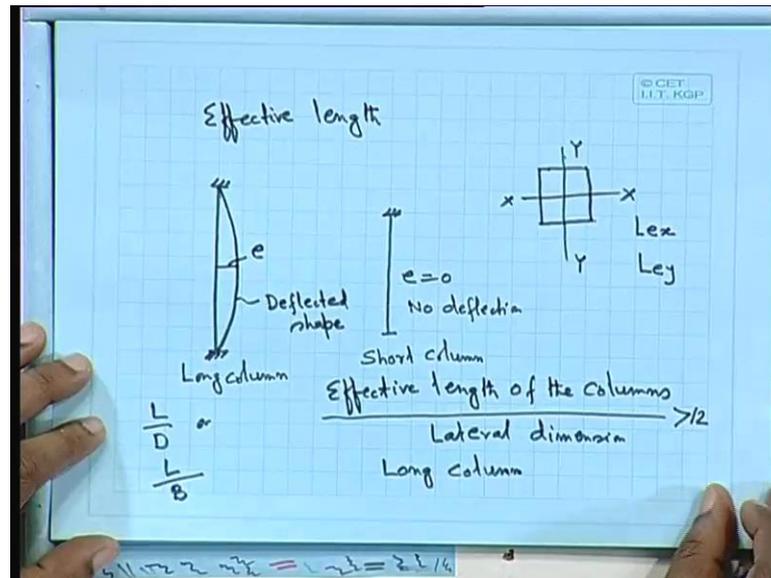
$$A_{sv} = \frac{37.5 \times 10^6 \times 200}{230 (482) 415} + \frac{109.218 \times 10^3 \times 200}{2.5 (482) 415}$$

$$= 163.01 + 43.68 = 206.69 \text{ mm}^2$$

We have done the design of that say due to torsion by mistake we have omitted that 0.87 in both cases here also it should be 0.87. Please take here this 0.87 and here also there should be 1 multiplication 0.87 that we have forgotten to take it. But, we have when we have given the sketch that design procedure there we have 0.87 0.87 but, well calculation of the problem there we have omitted this value 0.87. So, we are not doing calculation but, any way you check it your calculation with this 0.87. That means, here would shear stress sorry area of steel it will be more.

Here, that so you will get that more reinforcement so accordingly you change your calculation the rest of calculation of that problem what we have done in the last class.

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Now, come to the design of RC slender columns. Before that, we should know why we really need it that means we have to know the effective length or effective height whatever you call it. Effective length of column that is dependent we have if we take a plan of cross section this is the plan X and Y.

So, we have the 2 effective length L_{ex} and also L_{ey} because depending on the it is dependent on that L. And the condition of the boundary and the boundary condition at the top and boundary condition at the bottom. So, you will get 2 effective length and not the 1 effective length for the one column. Say like beam you will have only one effective length or effective span but, here you may get 2 different along X and along Y.

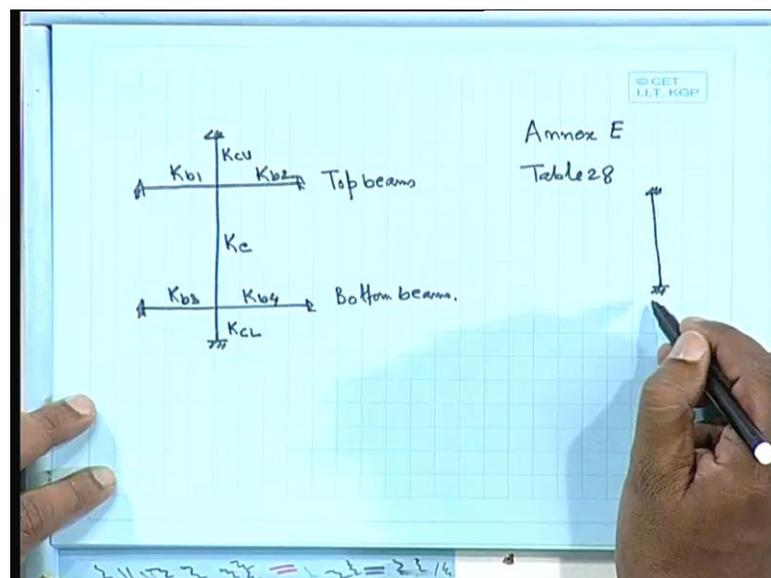
For a you have done so far that buckling columns that buckling or stability buckling of columns that you have done. Anything based on the same principle that means here what is happening. In this case, there is certain say deflection let us say e and this is your deflected shape. We are not talking in eccentricity at the top we are talking as if the from the centre line of the column that your loads are acting. Even then, there could be say some kind of deflection that buckling of the column.

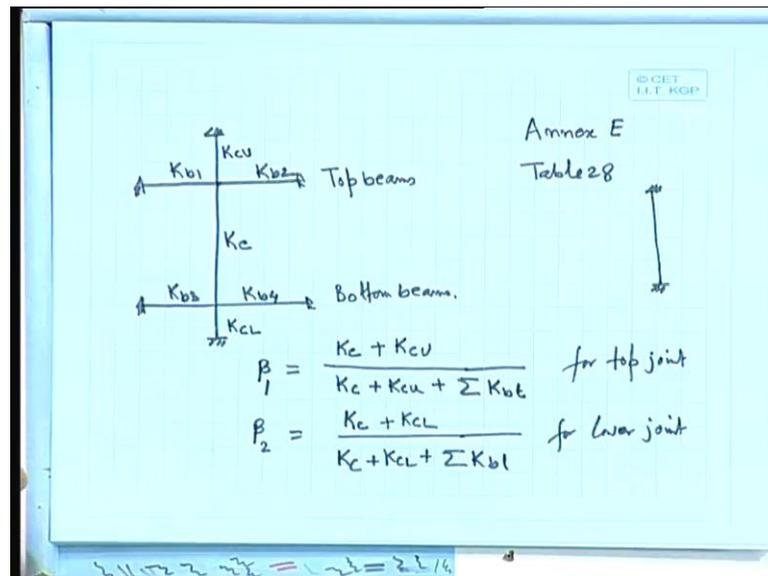
But, whereas, in the short column that whatever we have designed so far. We are assuming that there is no deflection due to the load that means there is no buckling of columns. So, whatever moments or whatever axial forces developed on that column that is due to applied load only but, here in addition to that load that ...

In addition to that, we have to take care certain load or certain moment due to this deflected shape. And so, we know that according to IS 456 that effective length of the columns divided by the lateral dimension. That means, L by d or L by b then if it is greater than $2 L$ if it is greater than $2 L$ then, we shall call it as a long column or slender column. So, this is our long column and this is our short column.

Now, what we have to find out we have already done that from the IS 456 that they will where it is given. But, different boundary condition that depends say fixed and there is no displacement there is no rotation and that is fixed or that is restraint say from against rotation against displacement. Like that there are so many conditions we have found in the table. And then, we can get that effective length factor that means the unsupported length multiplied by that factor will get that effective length.

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There is one more case and that I think we should know that is for the framed structure. Let us say let us take a specific problem or for framed structure we can consider. We are taking a frame and let us say that means this is a part of 1 building frame. We are taking a part of it and about only in 1 plane it could be other way also but, we are taking only 1 plane. So, if we take this one let us take the column stiffness of the top that is K_{cu} column stiffness of the lower one that is a K_{cl} . This is the actual column which we are considering that we have to find out the effective length of this column.

We are interested to find out the effective length of this column but, we are having certain portions on the top certain portions on the bottom because we have taken part of the building frame. And about one plane in one plane only the other plane also in perpendicular reaction that also there is another one. But, we are not taking care say right now. One example there is a beam K_{b1} another beam say K_{b2} here say K_{b3} another beam and here K_{b4} .

So, this is your top beams and this is your bottom beams what we do we have to find out the effective length. Here, this is not the case which we have done it which we have already done it that is according to your say that table I think that table. I think we can refer; we can give you. We have done it so far in annex E annex E that means your table 28. If you remember the table twenty 8 there are 1 2 3 4 5 6 7 cases. There are 7 cases and one of the case I think I should tell you you simply if you remember; just to remind you effectively held in position and restraint against rotation in both ends.

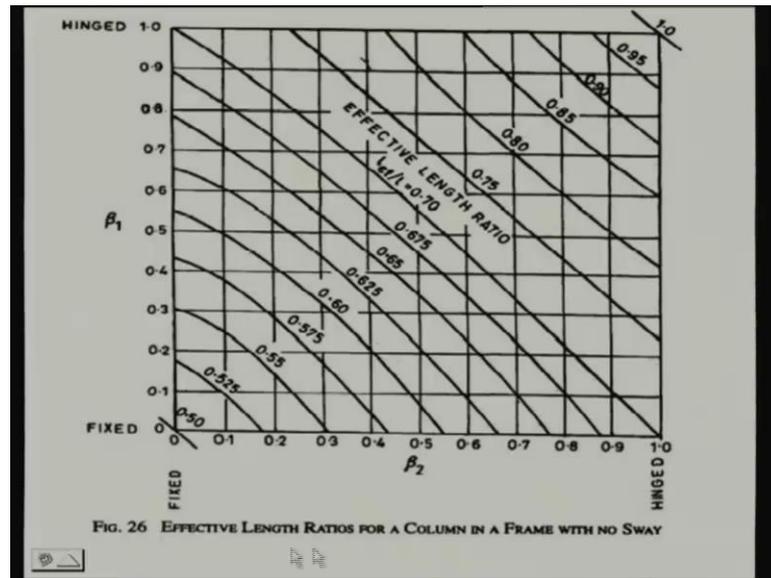
That means, the case where we have effectively held in position and restraint against rotation at the top as well as at the bottom that is one of the cases. So, what is case if we find out the effective length theoretically that is $0.5 L$ but, here the code says that you take it $0.65 L$. So, that is the case well it is clearly mentioned . But, when you are talking say building frame which you have to design. For that you have to find out the effective length and which will not fall out of those say 4 7 cases.

So, how shall we find out that one? We have to find out that according to this stiffness. So you have to find out the stiffness and accordingly we have to that calculate the effective length. So, there are two parameters you get it 1 is called beta 1 which will be equal to K_c K_c is the column stiffness plus k_{cu} that is the top one; this is the at this junction we are talking at the top. K_c by K_{cu} plus K_c plus K_{cu} plus for this case it should be summation of k here say k_{bt} . T means here 1 2.

So, summation of all the top beams so that means, here we are getting certain kind of say one parameter that factor. That one will give me the parameter what is the relative stiffness of this one that percentage of this one that we shall found out and that is we are talking some beta 1 for top joint. Similarly, we shall get beta 2 and that beta 2 will be equal to again K_c the column which we are considering, plus k_{cl} divided by K_c plus K_{cl} plus summation of K_{bl} that means for the bottom for the lower 1.

So, we shall get beta 1 beta 2. Now our code gives the 2 tables from where we can find out the effective length. So this beta 1 and beta 2 our code gives the 2 tables and that we shall get it here.

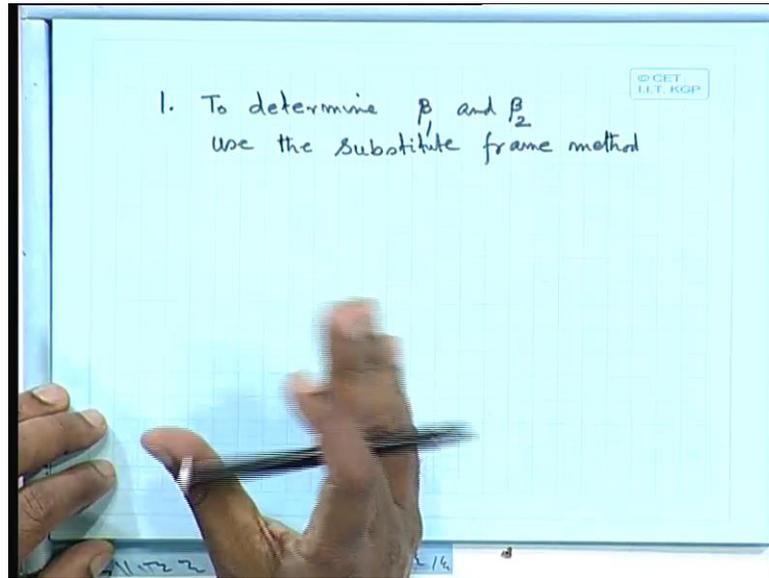
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So, this is your one table and you will get it in annex E annex E this table 26 effective length ratios for a column in a frame with no sway. If the frame has no sway in that case I shall take one parameter beta 1. Please note, here it is fixed this is your fixed position and in that case it is fixed both the ends fixed then we shall get 0.5. Then similarly, that beta 1 beta 1 starting from 0 to say hinge position that is 1. So, beta 1 and have the value from 0 to 1. Similarly, the other end also 0 to 1.

So, we have these two values already we have calculated 1 parameter beta 1 another beta 2 and according to that we shall find out value. So if it is say 0 0 that means 0.5 that is the case for fixed end condition. And the other condition when both ends fixed hinged that means, it will be the effective length will be same as the length of the column. So, that is one so we are getting it here one so, we shall get different values and we can find out that different values here say 5.575 or whatever it is we are getting we can find it out. So this is the one we shall get it.

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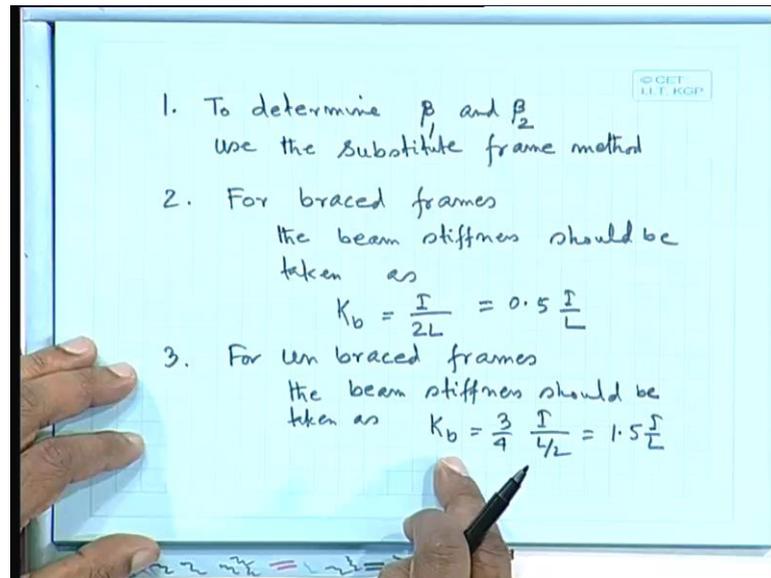


So, what we shall do it here then let me write down that few steps to find out. To determine beta 1 and beta 2 use the substitute frame method. What is that we have substitute frame method it means we have taken a part of the building frame we are not taking. We are taking a part of that that means you are taking a column and about its x axis. You take that plane and in that plane you go only top of 1 column and bottom 1 column similarly, right and left 1 beam its height. The way we have done it here that means this is a building frame.

We are interested to find out the effective length of this column. So, what we are doing here we are going one floor up and floor down and we are going one say plane in this side and another plane in this side. That means, 1 beam in the left and 1 beam in the right similarly, for the bottom also. So, that means when we are doing that that is when you say substitute frame.

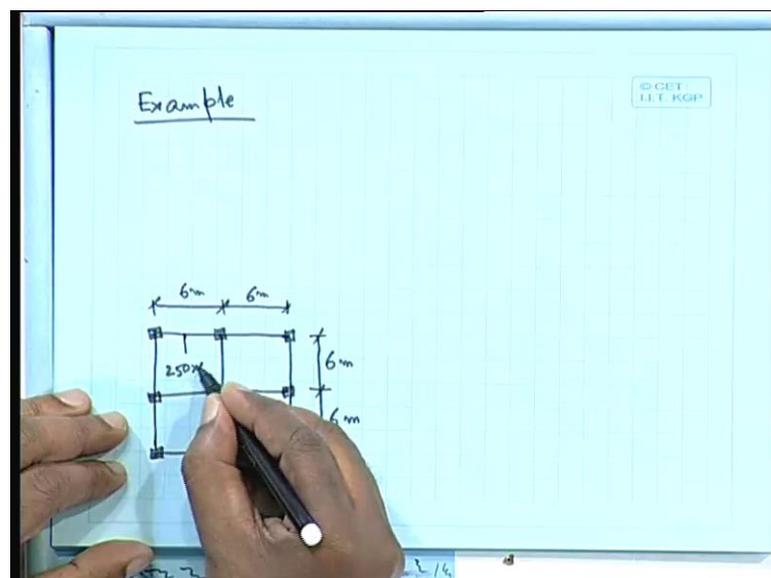
So, that case we take it that means we are having say either you do it say moment distribution method for your analysis we do it. Or say slope deflection method or say just simply say continuous beam for your analysis I am talking. Similarly, you can take a substitute frame method that means, there we take it say only say your beam only we shall take it and one floor up and one floor down for your columns. We are not taking the full building the one we do it in the computer analysis we do it but, I dont do that way instead manual calculation.

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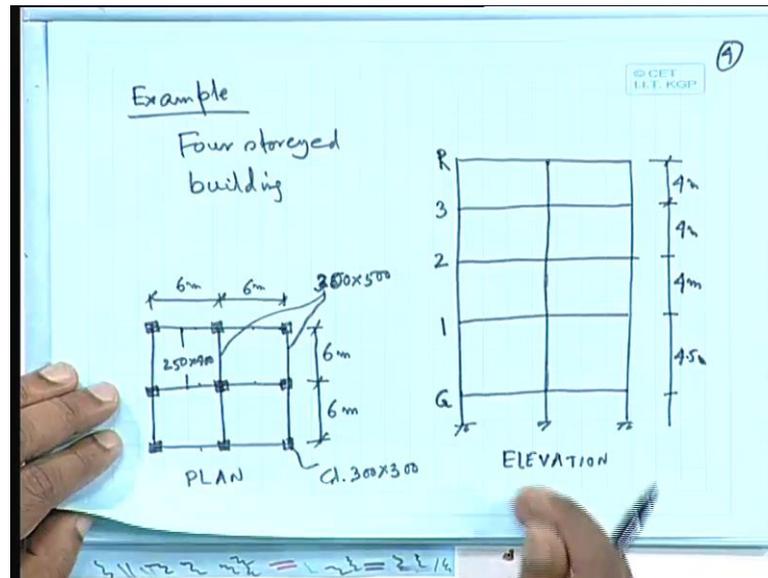


Number 2: for braced frames no sway the beam stiffness should be taken as K_b equal to I by $2L$. For base frame that means there is no sway we shall take it $0.5 I$ by L . Number 3: for unbraced frames the beam stiffness should be taken as k_b equal to 3 by $4 I$ by L by 2 equal to $1.5 I$ by L . So, this is your case we take it. So, these are the cases we shall take it say whatever the beam stiffness K_b and this one for the unbraced one that we shall take it this value $0.5 I$ by L and $1.5 I$ by L that we shall take it. I think it is better that we solve one problem then it will be clear.

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So, let us take one example. So, let us take first this is the plan of a building say just a simple one plan. And let us take the dimensions are 6 meter, 6 meter this side this is also say 6 meter, 6 meter. And we have these beams let us say 250 by 400; these beams this this all these beams are 250 by 400. Whereas, the other sides let us take due to loading may be that is coming as say 300 by 500 other side. And columns 300 by 300.

Let us say the building frame. So, let us take this building frame this is 4 meter height this is the elevation this is also 4 meter, 4 meter, 4.5 meter and whatever it is that your foundation. Let us say, we are interested to find out the we shall having that all all other case let us take say only this case that means this column say. We are interested to find out the effective length of the this column. That means, each one that we have to find out it will be something 4 meter multiplied by some that factor that we have to find out.

So, this is a 4 storied building so we have to find out that this one that means not other cases. That means, here whatever we have we have this beam and this beam and the column. So, we shall find out the effective length of each column.

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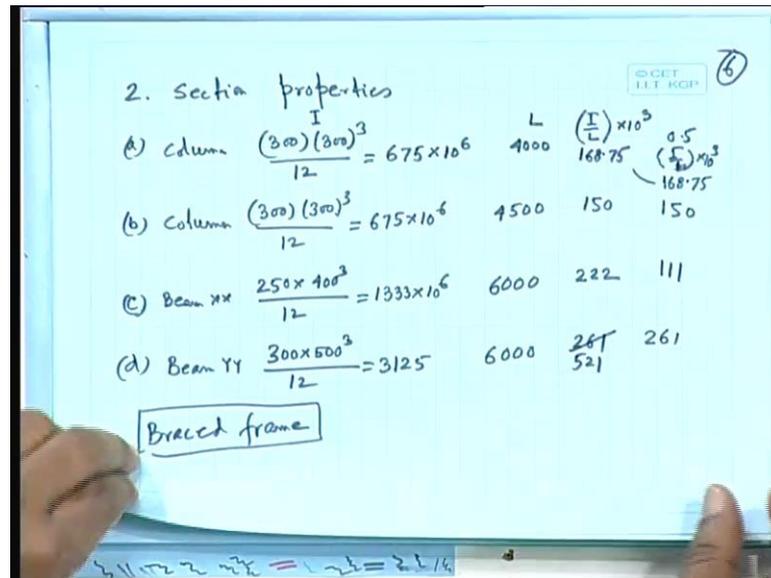
	xx	yy
Roof to 3 rd Floor	$4000 - 400 = 3600$	$4000 - 500 = 3500$
3-2	$4000 - 400 = 3600$	$4000 - 500 = 3500$
2-1	$4000 - 400 = 3600$	$4000 - 500 = 3500$
1-G	$4500 - 400 = 4100$	$4500 - 500 = 4000$

First you find out unsupported length that is equal to full length minus beam depth. So, we shall get it roof to first floor; third floor roof third second first ground. So, we are having these floors. So, roof to third floor means this one, third floor to second floor means this one, second floor to first floor means this one and first floor to ground floor means this one. So, we having those 1 2 3 4, 4 columns and effective length will be different.

So we can have say xx that 1 will be here 4000 minus the beam depth that is we are given 400 and which comes as 3600. In yy it will be 4000 minus we have taken it will be 3500 and this 1 will be 500. So, 3500. Then we are having say between third and second the same 1 so 3600 and here we have 4000 minus 500 again the same 3500.

Now second and first the same one this is in millimeter. So, 3500 and first to ground floor will have 4500 that is the one we have taken. Please note 4500 the first one that is little higher so 4500 minus 400. So, which comes as 4100 500 minus 500 which comes as 4000. This is your unsupported length.

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What about your mmh that say I second moment of area section properties? So, there are we can take this case we can find out that 1 column that is 300 by 300 cube by 12. That is the 1 that moment of inertia second moment of area and this 1 comes as ... So, we can write down this 1 say 675 into 10 to the power 6. What about your L? The L we shall get it here so, L we have 4000 and I by L this one 1 let us say I by L we can multiply with say 10 to the power 3. That I am taking it out 10 to the power 3 that if we take it out we shall get it here this is your I; L is this much that 4 000.

So, I by L that 1 is coming as 168.75 so 168.75 into 10 to the power 3 that we shall get it. Now, there is 1 more column according to say your length that section is same but, length is different. So, we shall get it 300 equal to 675 into 10 to the power 6 L is here 4500 and we get it here 150. That means, 150 into 10 to the power 3 that we shall get it. C that is your beam beam say xx the xx line and that 1 250 into 400 cube by 12. That is your along 1 axis that is 250 into 400 250 the width 400 the overall depth. And this 1 comes as 1333 into 10 to the power 6.

Length is here 6000 6 meter and we get it here 222 222 into 10 power 3. Beam yy that means along yy that is 300 into 500 cube by 12 equal to 3125 and length same 6000 and we get it 261. So, 261 into 10 to the power 3. If we take this one that is frame the frame is braced we are taking that one. So, braced frame then what should be our correction the

correction will be here that 0.5 times I by L into say 10 to the power 3 say. The same 1 I by L 10 to the power 3 this is L.

So, for columns there is no change it will be same as 168 let me write down here 168.75 for columns there is no change but, this column also there is no change. Here, it will be 111. That means, half of this 1 that will be 111 I think I have done a mistake here let me check it here. So, 3125 divided by 6000. So, which comes as 521, this 1 is 521. So, half of that 521 into 0.5 261 say yes this 261 will come here.

So this is your that values we shall take it that Kb 111 kb here 261 the column that one there is no change 150; for column that another column 168.75. So, this is your section properties.

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3. Ratio of stiffnesses

R $\frac{168.75}{168.75 + 2 \times 111} = 0.43$

3 $\frac{2 \times 168.75}{2(168.75 + 111)} = 0.60$

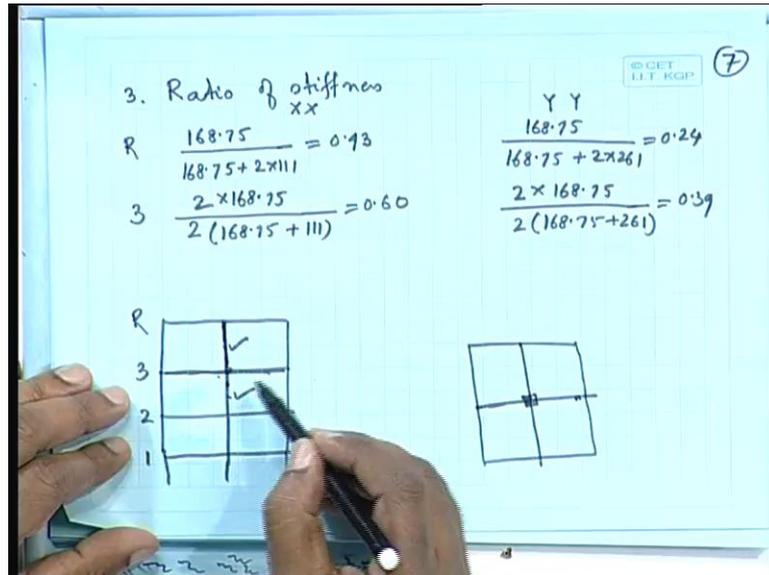
Y Y $\frac{168.75}{168.75 + 2 \times 261} = 0.24$

$\frac{2 \times 168.75}{2(168.75 + 261)} = 0.39$

R

3		
2		
1		

$2 \times 111 = 222$ $2 \times 261 = 522$



Now, we can find out the stiffness ratio of the stiffness we can find out that different joints. That means ratio of stiffness means the column stiffness and the overall stiffness of that particular junctions. So, top 1 is roof 168.75 divided by 168.75 plus 2 into 111 that is the beam which comes as 0.43 that is xx. Please note, we have taken that 1 here 168.75, 168.75 and and that beam we are having here along x we are talking 2 into 111.

So, one case we are considering here I think I should write down here that one frame that will be clear. So, we are interested here we are interested here to find out say this 1. When you are talking this one, then this is your roof this is your third second first similarly, down ground. So, at this level we are having only this column but, when we shall take this 1 then we are having this column as well as this column.

So for roof in xx we are having and we are taking this one only these 2. Similarly, for yy for yy we shall take it as 168.75 divided by 168.75 plus 2 into 261 which comes as 0.24. So, that it will be other way. The normal to that 1 that means we are taking that let me draw the plan I think then it will be clear. So, we are talking the column position at this level so when you are talking the roof one then, we shall take along xx that means this one only this frame. We shall take this frame but, when we shall take say along yy then we shall take the other frame so that is what we are taking.

So number 3: it will be but, when you are talking this one, this column as well as this column so 2 into 168.75 divided by 2 times I think I can write down both plus 111. That means, we are having the beam 2 beams and top and bottom columns which is coming as

a 0.60. Similarly, here also 2 into 168.75 divided by 168.75 plus 261 which comes as 0.39. So similarly, we can come down say 2 also 2 1 all of them we can do it the similar fashion we can do it so let us find out for 2. At this level at this level like that let us find out.

Yes, so we are taking say 2 into 168.5 means this is 168.75 this is 168.75 for what about for beams because we are taking along xx we are taking along for xx. Similarly, for yy or yy the other way so for xx means here 168.75 we have taken this one, this one and bottom 111, 111. That means, for this means that we have got it so thats why we are multiplying by 2 and that we are getting 0. 60. And similarly, here also, same fashion we can complete the other one also.

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XX

$$2 \frac{2 \times 168.75}{2(168.75 + 111)} = 0.60$$

$$1 \frac{168.75 + 150}{168.75 + 150 + 2 \times 111} = 0.59$$

B $\beta = 1$

YY

$$2 \frac{2 \times 168.75}{2(168.75 + 261)} = 0.39$$

$$1 \frac{168.75 + 150}{168.75 + 150 + 2 \times 261} = 0.38$$

B $\beta = 1$

So, number 2: 2 into 168.75 divided by 2 168.75 plus 111 it will be same 0.60 that is xx. Similarly, for yy 2 into 168.75 divided by 168.75 plus 261 equal to 0.39. Now, that 168.75 plus 150 because the ground floor to first floor that column height is different. So, that why you are getting different one so 168.75 plus 150 top and bottom different plus 2 into 111 which comes as very less change but, you have 0.59.

The other 1 168.75 plus 150 along yy we are talking so 168.75 plus 150 plus 2 into 261 which comes as 0.38. For the basement or the ground basement we have told the bottom beta equal to 1, here also beta equal to 1 because we are not why we are taking this 1 because that foundation not designed for bending. That means it is hinged 1 so that

is why we are taking beta equal to 1. So, if we take this cases that means for all the cases we have got it that different values we have got it. And we can find out now the effective length ratio.

Yes, we have taken the for the bottom we have taken oh yes basement let us say yes call it ground say yes. So, we can take that particular.because we are not transferring any load to the foundation. Then not for building only for the axial load hinged condition and that is why we are taking beta equal to 1.

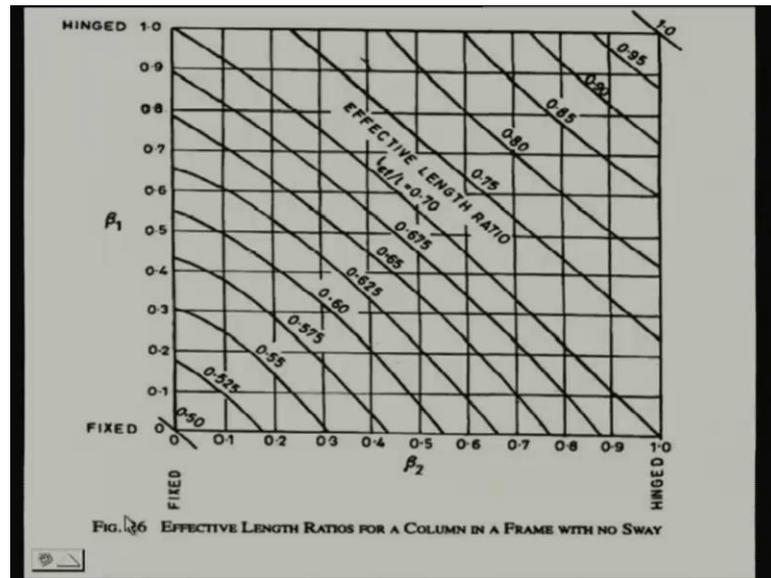
If you if you are interested and if you design for that one. For you have to calculate that beta for taking say foundation depth say 1.2 or 1 meter or whatever you are provided on the basis you have to find out that. But, most of the cases we take beta equal to 1.

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Storey	x x		Ratio
	β_1	β_2	
R-3	0.43	0.60	
3-2	0.60	0.60	
2-1	0.60	0.59	
1-G	0.59	1.0	

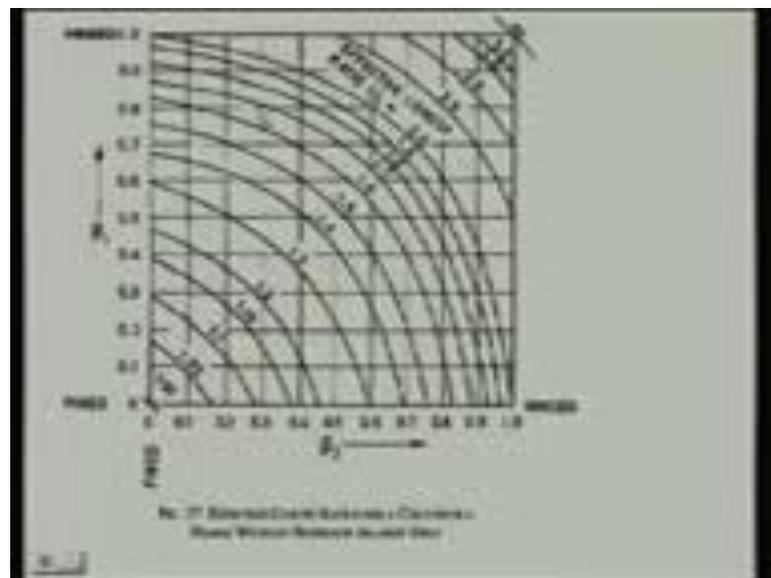
So, for different storey say R-3 beta 1 and beta 2 we are talking say only xx. So, we can get beta 1 and beta 2 R-3. That is given say 0.43 given we got it for 1 case and another 0.60 then 3 2 both 0.60 0.60. 2 1 again 0.60 0.59 and 1 ground that is your say 0.59 1.0. These are the different values for top and bottom. So, beta 1 beta 2 we have got it for top and bottom we have got it say these values we have got it. So, what about the ratio then? Then the factor we have to find out find out that factor that ratio we have to find out what we shall get it.

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We have 2 cases 1 is that 1 say no sway L which is the case of no sway I think I can so atleast the next 1.

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We are having another one that figure 27 where we are having that one say without restraint against that means we are having sway. For that case we find out, the ratio is getting that more than 1 that 1 and it is going up to say infinite. So, from 0 to say 1. But, anyway this is another case when we are having the sway. But, here the case we have considered here that is your say without sway there is no sway.

So, we shall go to the previous 1 (Refer Slide Time: 37:53) that is your figure 26. So, what we do it here? We have got that top 1 say beta 1.43 beta 2 say 0.6. So, what we can do so beta 1 say 0.43 it will be somewhere here please note, it will be somewhere here along this line. And beta 2 that is 0.6 so it is somewhere here. So, wherever it will cut then we shall get there are different lines so from there we can get the ratio.

So, that figure from this figure 26. So, we have to select the figure which case you are considering whether you are considering say without sway or with sway. If it is without sway then we shall take figure 26. If it is with sway then figure 27. So, in our case we are considering this 1 say without sway. So, in that case that you will find out all the values are coming less than 1.

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Storey	x x		Ratio	L ₀	L _e
	β_1	β_2			
R-3	0.43	0.60	0.6875	3600	2475
3-2	0.60	0.60	0.733	3600	2639
2-1	0.60	0.59	0.73	3600	2628
1-G	0.59	1.0	0.85	4100	3485

Fig 26
 IS 456: 2000

$$\frac{L_e}{D} = \frac{L_e}{B}$$

$$D = 300$$

$$\frac{3485}{300} = 11.61 < 14$$

So 0.43 and 0.46 for that the ratio from the table figure 26 IS 456 2000 that is our reference. In that case, taking this beta 1 beta 2 different values we shall get this is your say 0.6875 then 0.733 next 1 say 0.73 and this 1 say 0.85. So, we have got these values. What about the L 0? So L 0 that we have got it let us write down. So 3600 this is also 3600 and 4100. So, these are the values we have got it here. And now we can find out the effective length. So, le equal to so 2475.733 into 36, so 2639 0.73 into 3600. 26284100 0.85 so 3485.

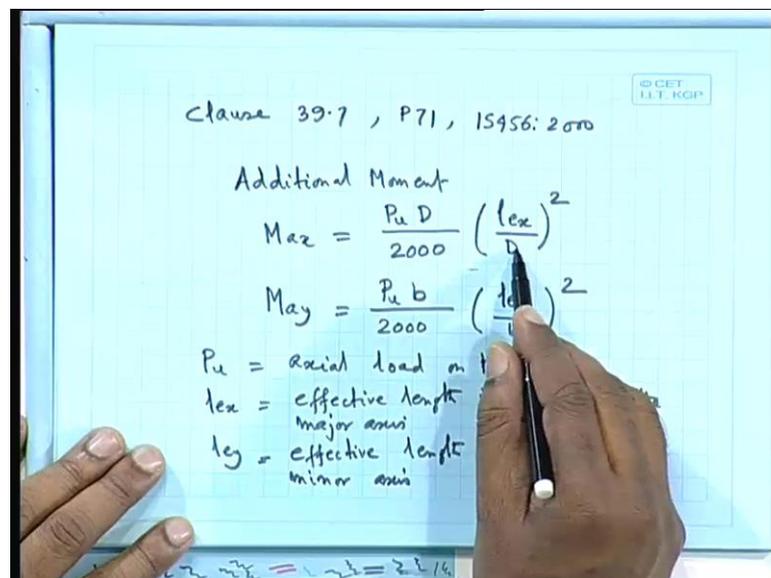
So, we can find out the this effective length and we can find out divided by the lateral dimension. We can find out the that factor which is coming as say value that L by D or

Le by D or Le by say b we can find out that values. Whether it is coming less than if it comes less than 12 then we have to design it as say as I say short column. And if it is greater than then it will be treated as a long column. But, whatever way we consider here all the cases it seems it has come that because D equal to say we have 300.

So, we can find out here so 1 of the cases I can say 3485 that is the maximum 1 and divided by 300 which is coming as say 11.61 so less than 12. But, if it is say 250 3485 divided by 250 in that case it is coming 13.94. But, if we take that same case say your say 2 fifty then it will come say greater than in that case you have to design let us say that long column.

So, here also you can take the dimension that is important whether we have to design a long column or a short column that we have to find out according to this. So, this is your for framed structures braced or unbraced for that case we do it and we find out the we calculate the your say effective length and then the rest of the procedure same. If you can find out the effective length then find out for long column or short column design we can do it.

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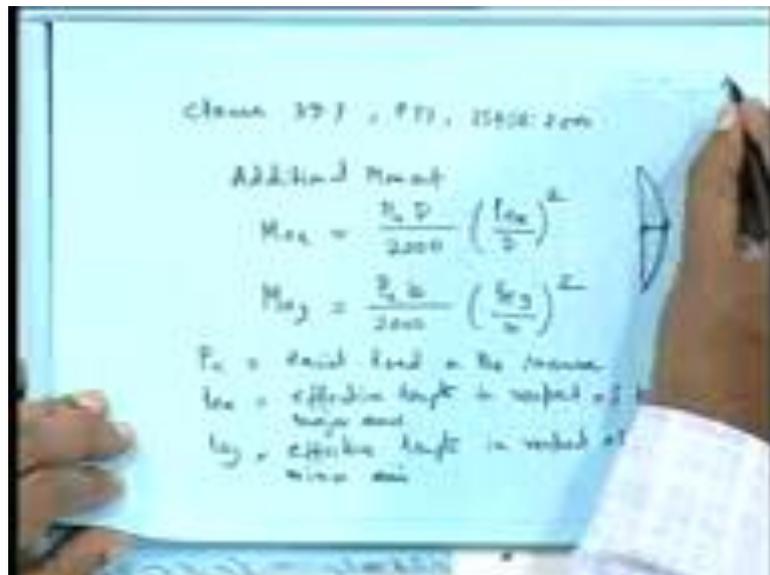
Now what is the difference that in the long column design? So, far we have done that effective length only now what about the long column that design how how does it affect. Here also what we do I think I should go to the reference of the code. So, that is

given in clause 39.7 page 71 IS 456 2000. So, in this case what will happen here IS 456 2000 in this case what we shall do that it says that there is a additional moment.

So, we shall take the additional moment and those are let us say M_{ax} will be equal to $P_u D$ divided by 2000 multiplied by L_{ex} by D whole square. So, we shall get it we know P_u , P_u is the applied load. So, that means here this value whatever we are getting here D by 2000 this value that is nothing but, the E or the eccentricity I can say. Indirectly we are calculating the eccentricity along x . And similarly, we are calculating eccentricity along y which means P_u times b divided by 2000 multiplied by L_{ey} by b .

So, well P_u that axial load on the member, L_{ex} effective length in respect of the major axis, L_{ey} effective length in respect of the minor axis. And D is the depth D is the depth and that b say consider and the other b is the width of the members. So, these are the all the cases here we can say d by 2000 times L_{ex} by D whole square that is nothing but, the eccentricity.

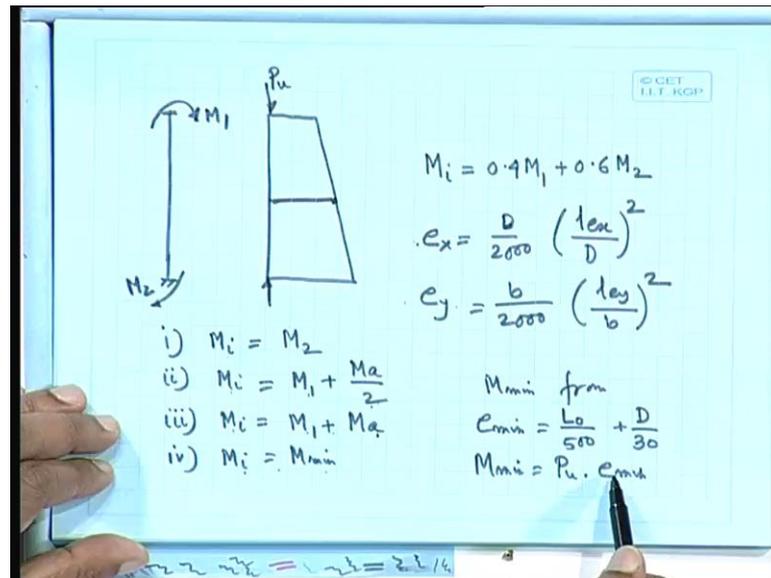
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And take in other way we can say if that we are getting this value. This value we are getting there that buckling of view we are getting. And if you consider that critical load if you take the critical load what is the buckling first second of buckling like that. From there you can find out the eccentricity and accordingly we can calculate.

But, our code says that for a particular case you can say that your value whether if it is hinged condition that your value will be different. If it is say one end fixed other end hinged the value will be different but, here code gives in this fashion. So that, we can take say almost say equal value in all the cases that maximum possible cases that the consider this 1 say same design. That we shall take it.

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Now, what we shall do it here just to give you the design procedure. I think we shall make a design procedure. Here is a column say which is for both the axis 1 case say we are having here say \$M_1\$ another 1 here say \$M_2\$ \$M_1\$ \$M_2\$ that means say here ... Say moments at the top and moments at the bottom. So, in moment at the top and moment at the bottom and it it will happen like this it may happen say in this fashion also it may happen.

So, we have to find out the intermediate building moment. We shall find out that intermediate building moment here and that intermediate building moment what we take it that is say \$M_i\$ will be equal to \$0.4 M_1\$ plus \$0.6 M_2\$. This is the value we have to take it. That means, at this we shall take it say 40 percent of this and 60 percent of the we shall find out that one. After getting this and in addition to that we get that additional moment.

So, that means this one we are getting from analysis and now if it is a long column or slender column. So, you will get the additional moment whatever that \$P_u\$ is acting here

pu that is that si 1. So, from that pu you will find out I can say eccentricity E eccentricity will be equal to d by 2000 times say Lex by D 1 case or Le by D I can consider 1. So, this I can get it. Let us say, ex similarly, say ey will be equal to b by 2000 multiplied by L ey by b whole square.

So, we shall get ex and ey the different values and after getting this similarly, I can get it m 1 means x about along x along y along x. So similarly, from the other axis also we can get it. So, after getting this 1 few cases we consider number 1: let us say Mi equal to M 2 if we consider the maximum. So, Mi equal to say M 2 this is 1 case. Number 2: Mi equal to M 1 plus Ma by 2 M 1 means the top say that minimum 1 out of M 1 and M 2 this Ma by 2 Ma by 2 we are getting out of this eccentricity.

Number 3: Mi equal to M 1 plus Ma and number 4 Mi equal to M minimum. So what is M minimum? M minimum we can get it from that e minimum which is equal to L 0 by 500 plus d by 30. That please note that already we have used it. So, L 0 by 500 plus d by thirty from the I shall get e minimum. So, M min will be equal to Pu times e min that means we are getting 4 cases; that means, if we know M 1 M 2.

So, I can find out mi the intermediate moment that 1 say just simply take maximum moment Mi equal to M 1 plus Ma by 2 the additional moment or whatever you are getting due to this say your slenderness. That multiplied by e x when you talking say along x getting say M Pu times ex or Pu times y. The other 1 Mi equal to M 1 plus M a and the fourth 1 Mi equal to minimum which you are eccentricity point of view. Yes, that this the 1 we are getting it here.

That means, if we know mone here and that that m 2 here find out the values that we can get it here. Now, the thing is out of that we greatest one. Greatest out of this 4 and that is moment we shall take it. That means we are taking moment what is the moment we are getting here the maximum moment out of these 4 we are taking. And then, rest of thing we shall do it according to the 1 design whatever we have done it I just say within say that.

We can find out the design but, only thing that in slenderness column slender column what we have to do moment, how much it is coming. So applied load and the additional moment due to this eccentricity. So, our code gives only this formula from we get that additional moment. That additional moment has to be applied like this so out of that we

shall get the greatest 1 and along x similarly, along y we shall do the design. And that is all.