NPTEL ONLINE CERTIFICATION COURSES

Course
on
Reinforced Concrete Road Bridges

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Lecture 04: IRC Loading

Hello everybody so let us come to the fourth part fourth lecture and we are considering that as I told you earlier that we have come to the plan of the bridge only that means I can find out the span which is x axis and then with which we are considering isolated z axis, so now the thing is that we have to obviously have to find out the depth in a physical system that we should have a depth also so that one how shall you decide obviously we should know the loading how much loading is coming in the bridge.

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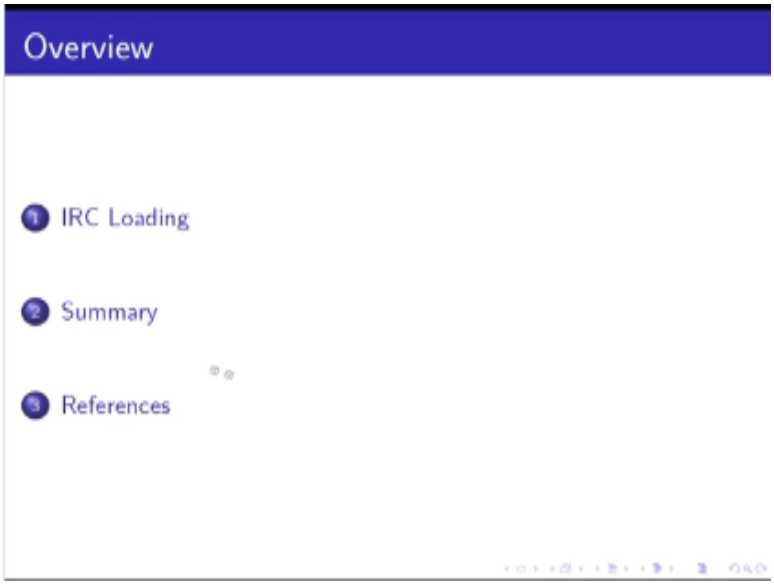

So coming to this one here reinforced concrete road biggest lecture for we shall mainly give this beaker one say IRC loading then summary and then your references and then we are considering that IRC loading that we shall consider here.

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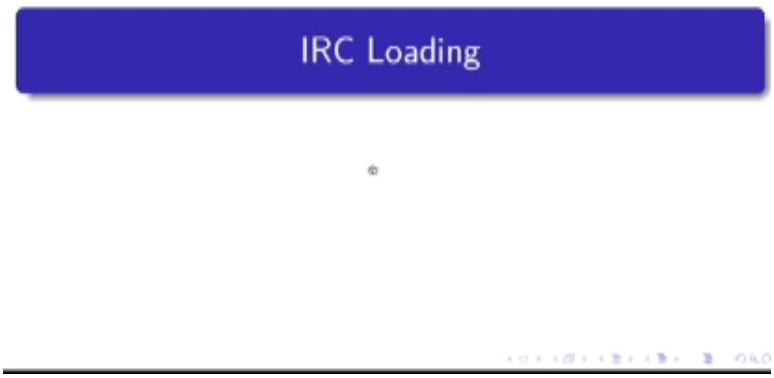

So let us come back to that for Quran here.

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So IRC loading and we shall consider this loading IRC6: 2014 and we are having class A loading wheeled vehicle IRC 70R loading tracked vehicle IRC 70R loading wheeled vehicle, so this is your consideration whenever we are considering say class A loading we have Class B also class A loading whenever you are considering that we are to find out.

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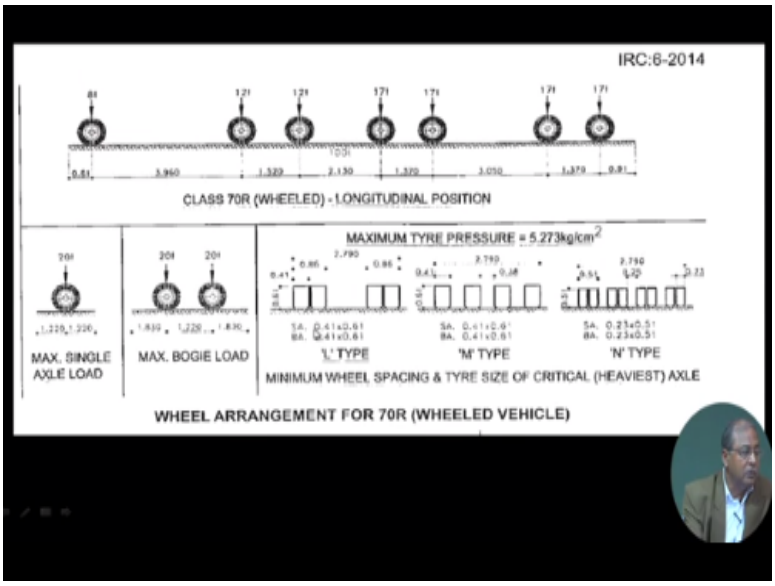

So this is first let me tell you that once we see the 70R loading whenever we have having 70L loading then we can consider this one you can say this is 8 electron, 12ton, 12ton, 17ton, 17ton, 17ton, 17tonne that means here we are having total 100 tonne load this is the one that we are having 100 tonne load we are having here.

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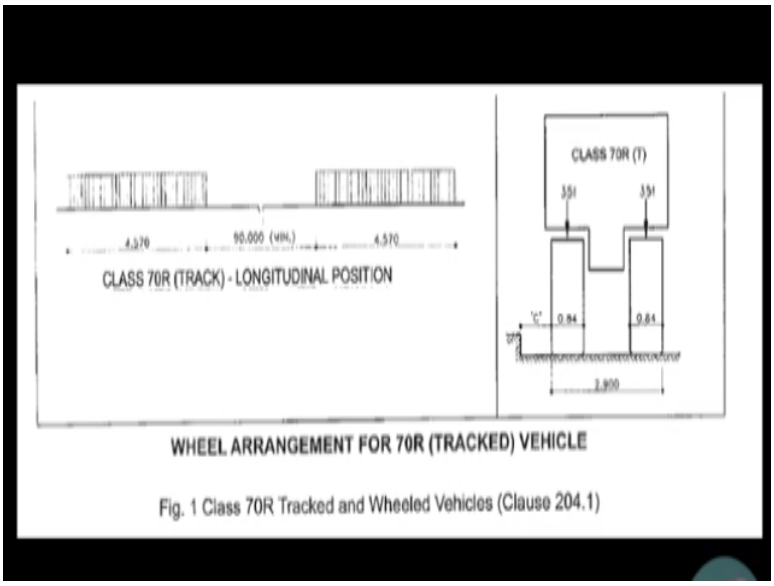

And then track vehicle we are having 70R or the 70-tonne loading which is equally divided in this visual that means this is 135 tonne this one will be 35 ton.

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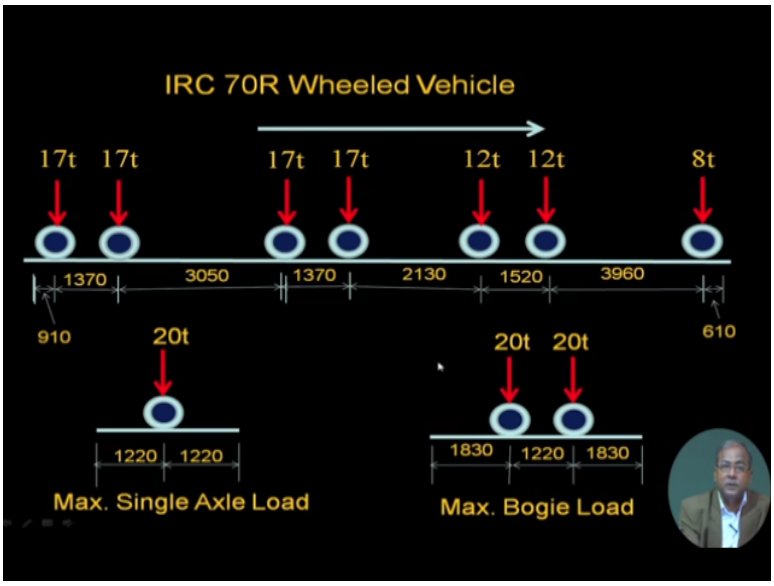

So the load here as I have taken the other direction because this is the direction of the vehicle that we can consider here, so we are consider this one as 8 tonne load, 12ton, 12tonne the 17ton, 17ton, 17ton, 17tonne and we are getting here 3960, 1520, 2130, 1370, 3050, 1370 that is in millimeter.

So you can see this factor one that is in millimeter that means here they are very close here there is no there is a gap of 3050millimeter there is a gap of this one together and then from the center of the front wheel to the edge of the vehicle that is coming 610 and here we are getting 910 that is the one we are getting it here and then we are getting the maximal single axle load 20 tonne maximum bogie load 20 tonne 20 tonne that particular one we are getting it here this is the one for IRC70 loading.

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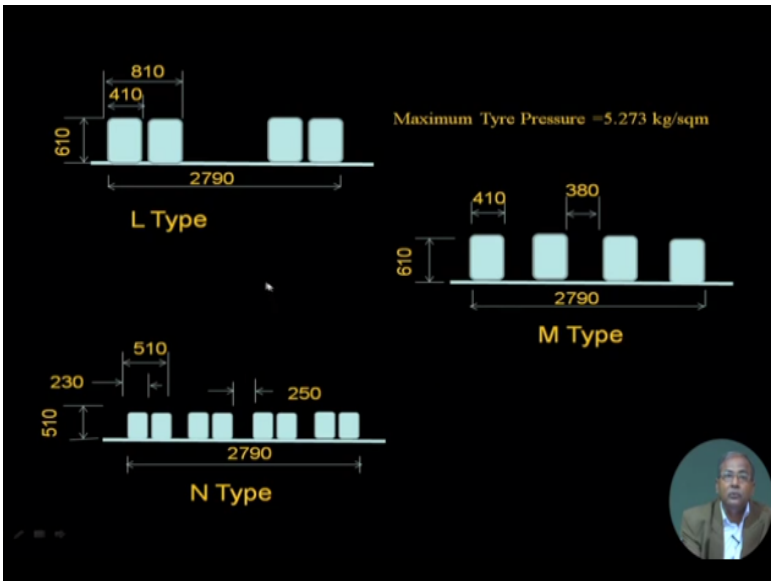

And then how this vehicles because what I mean to say.

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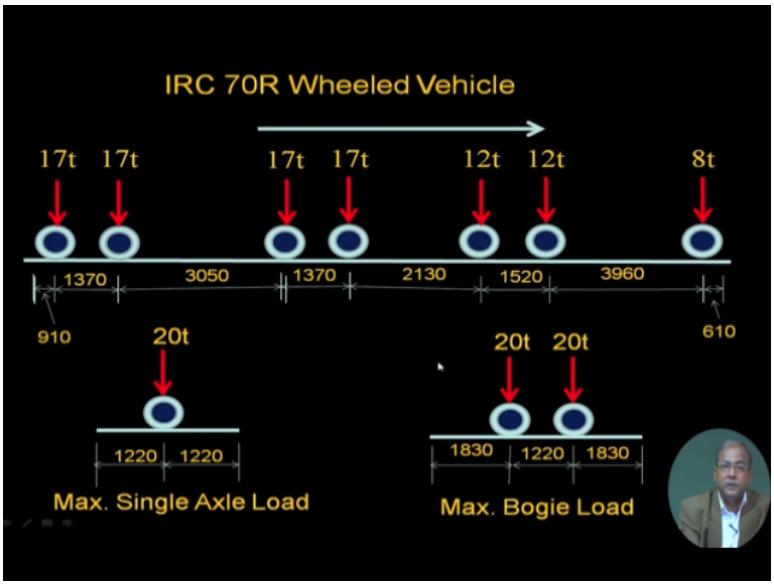

This one as if it looks like only one wheel it is not true that is not one wheel along this line that means normal to the board if you really consider that one there are number of wheels as you can see that at least you are having four wheels in a car two front wheels and two rear wheels that you are considering here.

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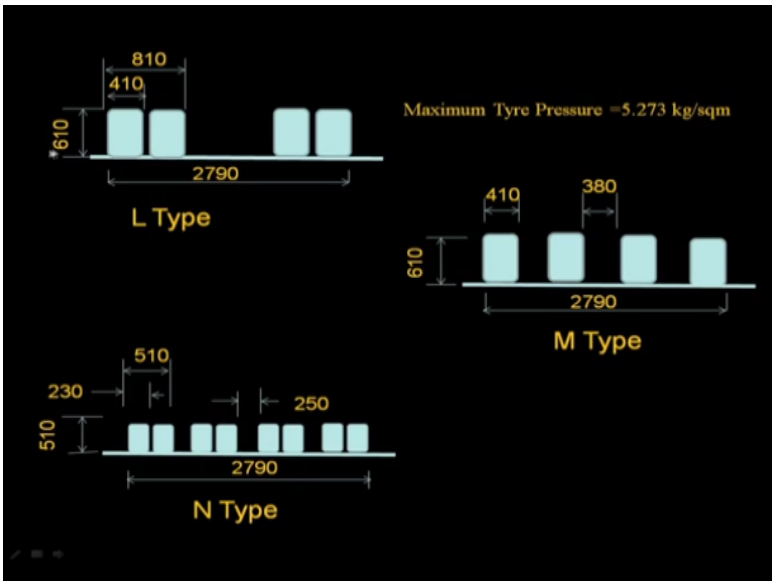

In this case we are considering this particular one here that 410 then 810 this is the total one we are having so that means this is one particular configuration we are getting it here that we call it L type this is equally spaced that is called M type and then we are having N type that means like this a pair of two like that will have four so imagine you see this one very interesting thing that this particular one we are having one type this is your another type and then further considering that aspect we are getting furthermore we are getting this one here.

And maximum tyre pressure that this is a 5.273 kg per square meter that particular one that is the one we shall allow, so this is the one that we consider and that is related to class 70 L loading. That will this loading if we consider that next one we are having so this is the one we are having that we consider whatever I have shown you this one here L type.

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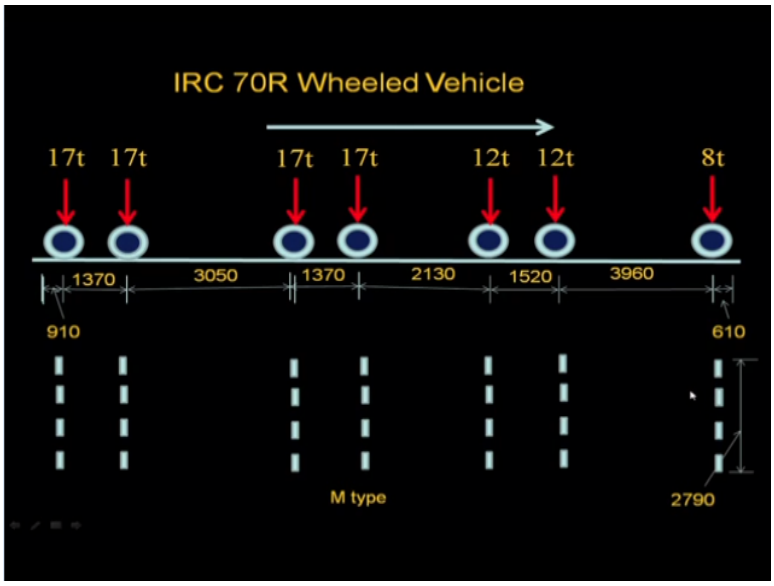

So L type it means actually like that you see that this is the plan, so this plan you are showing that these two wheels here there are two wheels here they are like that you will have this vector also how many we are having wheels here so we are having 7 so 7 into 4 that my total 28 wheels you will have so each line you are 4 and that is L type if it is M type then again you are having 4 that means 28 only but that is equally spaced.

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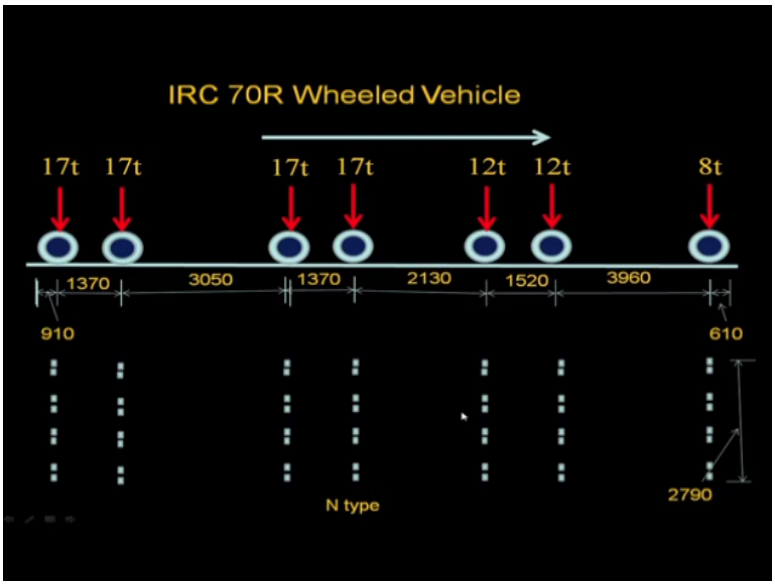

And N type you are having two each so 1, 2, 3, 4, 5, 6, 7 8 so 8 into 7 so there were 56 wheels you are having in the N type so you can understand that one that how the stress is how the these will be loaded depending on the wheel configuration.

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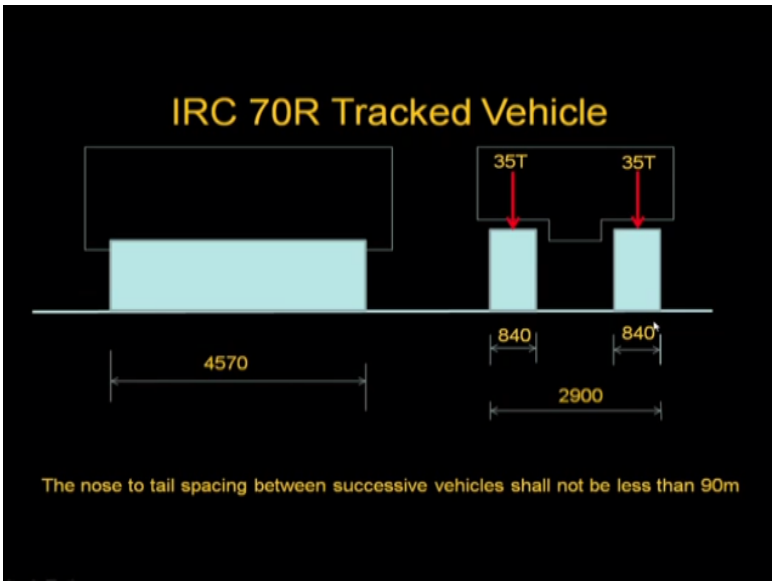

IRC 70L loading you are having the same way you are having and which you will have 35 tonne this particular here another one 35 tonne here and then you are having 840 millimeter thickness where width of that wheel you can find out and total the one we are having 2900 and this one you are having 4570 that means this is 4570 into 840 that is the one you will find out that your impression that impression on the bridge you will find out 4570 and 840 that particular in for one wheel and similarly this for the other wheel also.

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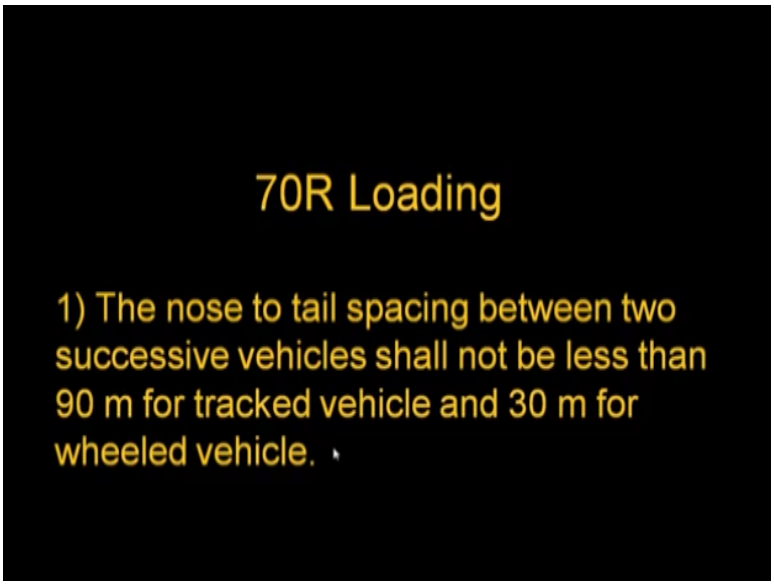

The issue is here as I have told you that 20 meters that I have told you earlier that to calculate that how many vehicles will come in a how many vehicles will you will allow in a lane because it should know if it is more than then obviously it will be crowded so that it happens that congestion other things that happens so here the 70L loading the nose-to-tail spacing between two successive vehicles shall not be less than 90 meter for tracked vehicle and 30 meter for-wheel vehicle.

So whenever it is a wheel that means your say 70 L loading having tracked vehicle and then you are having wheeled vehicle so whenever you are having tracked vehicle that time you have to consider that gap of say 90 meter and if it is wheeled one that one only we say 30 meter.

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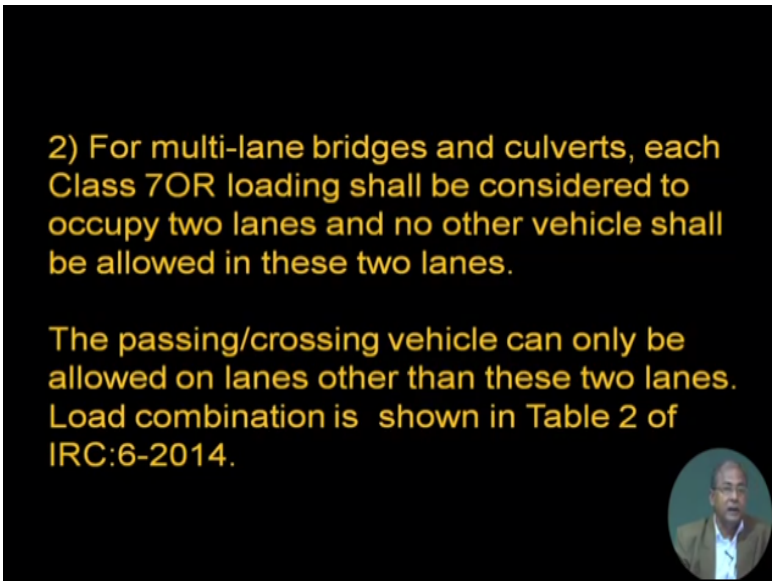

For multi land bridges and culverts each class 70 L loading shall be considered to occupy two lanes and no other vehicles shall be allowed in these two lands the passing crossing vehicle can only be allowed on lanes other than this two lands and load combination is shown in table 2 of IRC 6 so you can get the current load combination that means say for example here that you are having two lane so for two lane that means only one IRC 70 loading we shall consider before coming to that let us go to the other load.

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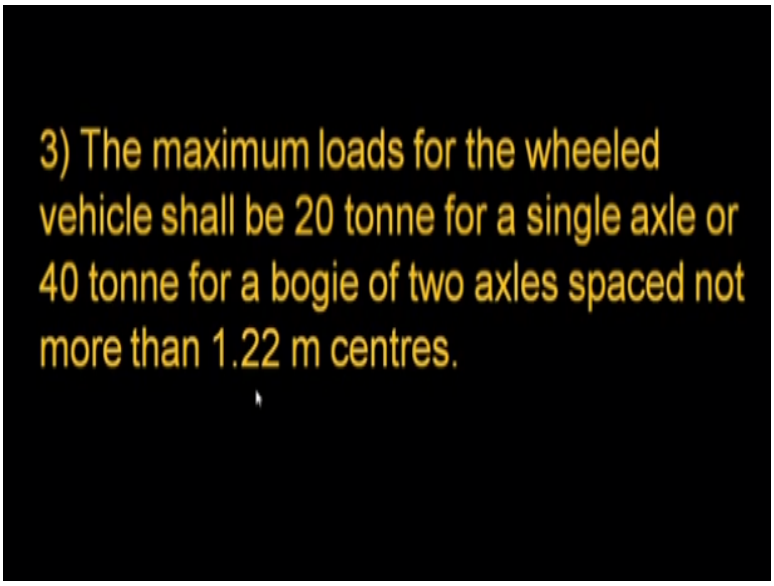

That we shall consider maximum loads for the wheel vehicles shall be 20 tonne for the single axle or 40 tonne for a bogie of two axles spaced not more than 1.22 m center that is the one we consider.

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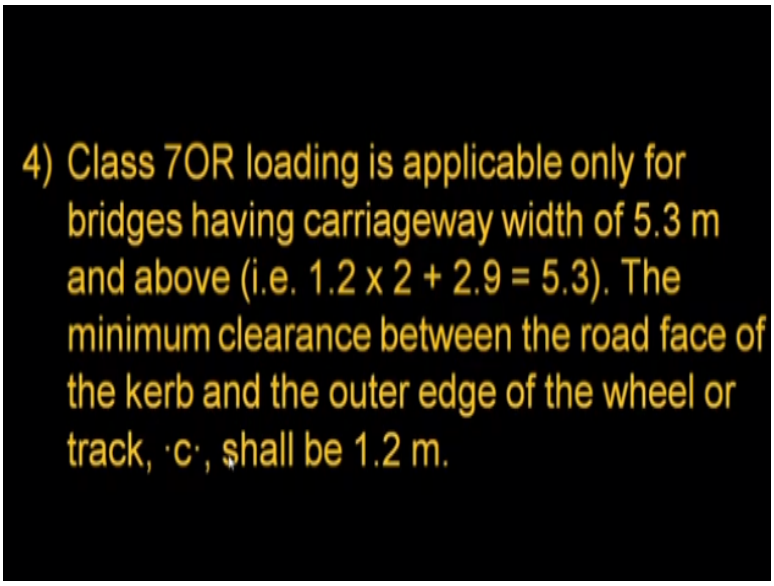

Class 7o R loading is applicable only for bridges having carriageway width of 5.3 meter and above so then only we can consider that one the minimum clearance between the road phase of the kerb and the outer edge of the wheel of track shall be 1.2 meter what is that one let me tell you then it will be clear.

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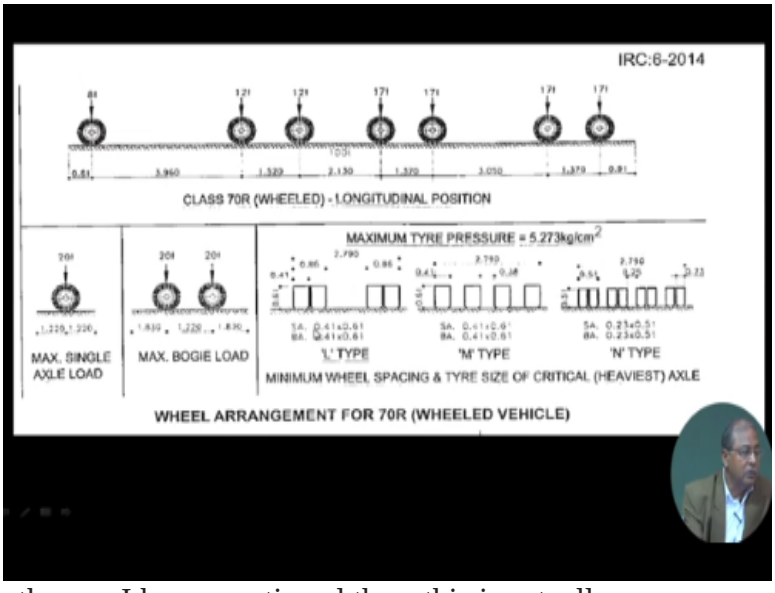

So this is you the c the one I have mentioned the c this is actually you c means that they total by 1 and that how much will you get gap on the end so that is we call it c.

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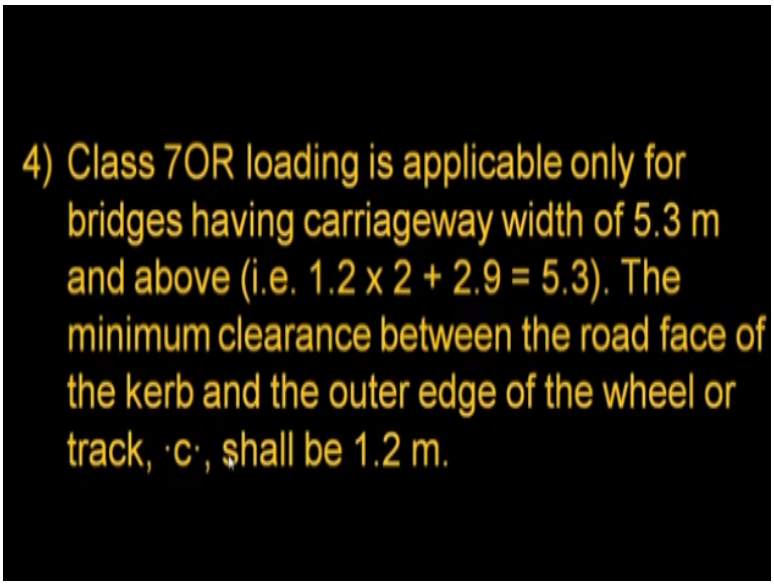

So whatever I have told you here that c that is 1.0 meter so from the end of the kerb that one will be say 1.2 m and also one more important here that if it is a single NB is 4.25 meter then obviously that your that you need not consider for the usual join 70L loading that means 70 L loading will not pass through that particular bridge so minimum 3 meter or we can consider that one you can say your government bridge that we can consider.

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5) The minimum clearance between the outer edge of wheel or track of passing or crossing vehicles for multilane bridge shall be 1.2 m. Vehicles passing or crossing can be either same class or different class, Tracked or Wheeled.

So this c that we have considered here the minimum clearance between the outer edge of the wheel or track of passing or crossing vehicle so multilane bridge shall be 1.2 meter vehicle passing or crossing can be either same class or different classes whether whatever it is so it should be minimum 1.2 meter.

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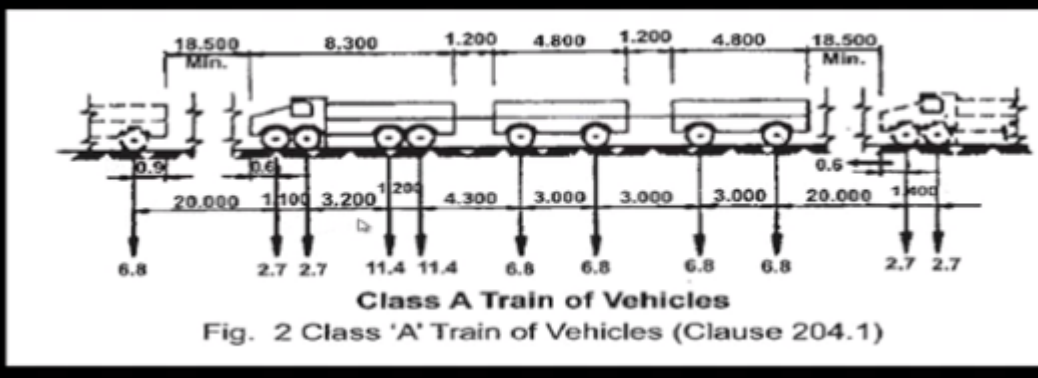

Fig. 2 Class 'A' Train of Vehicles (Clause 204.1)

The next loading is actually your call it actually your say class A so first one I have told you 70 L loading and this loading we are considering your say class A loading.

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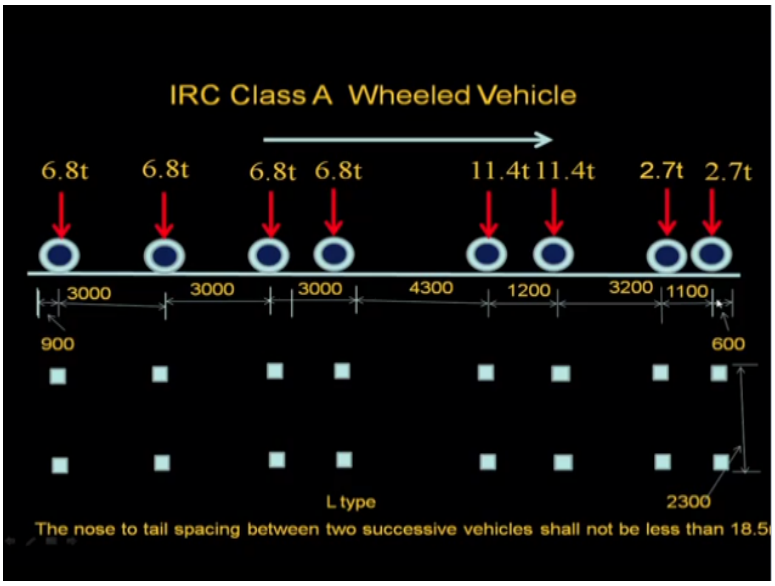

So and that is the one we can see that how it looks like and the loading I have taken from this side that means it is moving in this direction, so this is 2.7 this is 2.7 then 11.4 then we are getting 11.4 then 6.8, 6.8 , 6.8 and 6.8 so total we are getting here 8 there we got actually the distribution along the 7 lines of your say wheels but here we are getting 8 so 2.7 2.7 2 with a spacing of 1100 then 3200 three gap then 11.4, 11.4 the 1200 the 43000 then 3000 each so like that we can consider and we can find out that one.

And this is the one that you will say that impression of the tyre how it comes from nose to tail spacing between two successive bagels shall not be less than equal 5m that way can consider here so or other way you can say 20 meter I can say from the I am telling from heel to heel so therefore cone one we can consider so here so that means we are from centerline of this wheel to other one which comes as say 20 meter.

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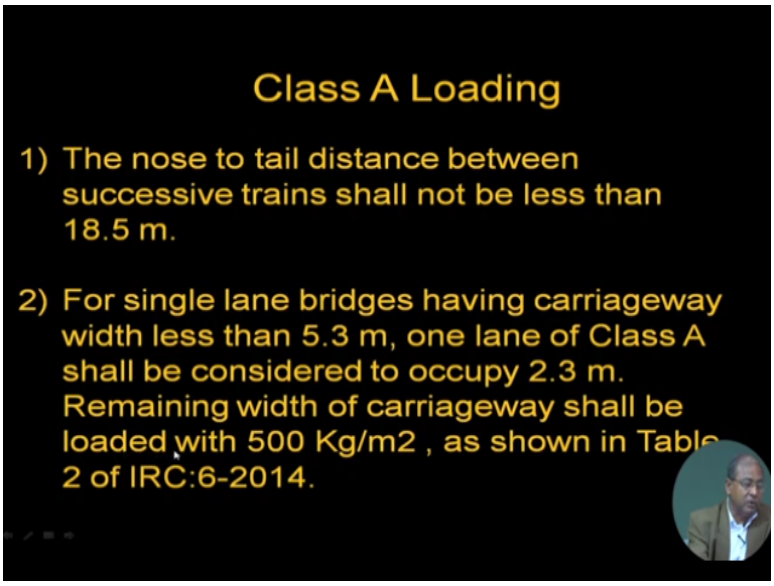

Nose to tail distance between successive trains shall not be less than 18.5m for single lane bridges having carriageway we with less than 5.3 meter one lane of classes shall be considered to occupy 2.3 meter remaining with the carriageway shall be loaded with 500 kg per square meter so and which is actually can see from table 2 of IRC 6 so that particular one we can consider there.

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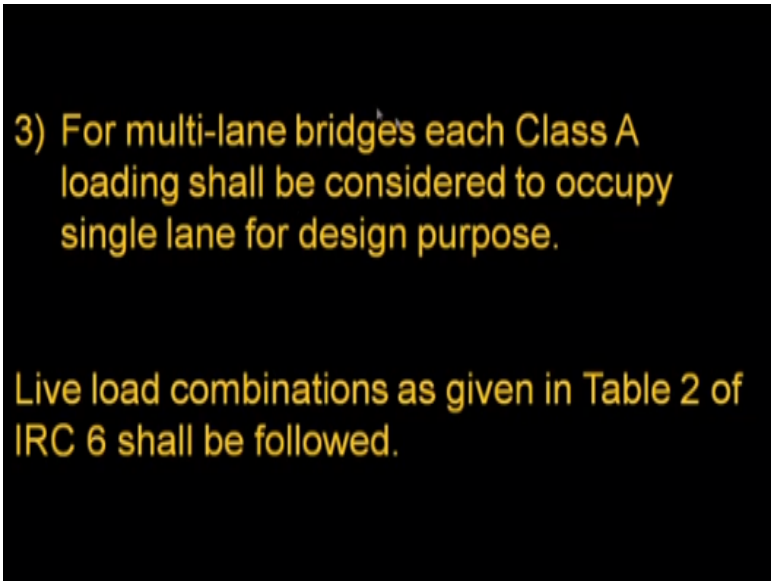

For multi languages each class a loading shall be considered to occupy single length for design purpose I live load combinational dodging so that means so we shall follow that table so Table two is very important in our case and that one we can we can consider that particular one here so let me since I am showing that one saying table- I am referring so many times so let me just show you that what exactly it means that particular overload that particular one I can tell you here.

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IRC:6-2014

STANDARD SPECIFICATIONS AND CODE OF PRACTICE FOR ROAD BRIDGES

SECTION : II
LOADS AND STRESSES
(Revised Edition)

(Incorporating All Amendments and Errata published upto December, 2013)

So this is the one standard specifications and code of practice for load bridges section two.

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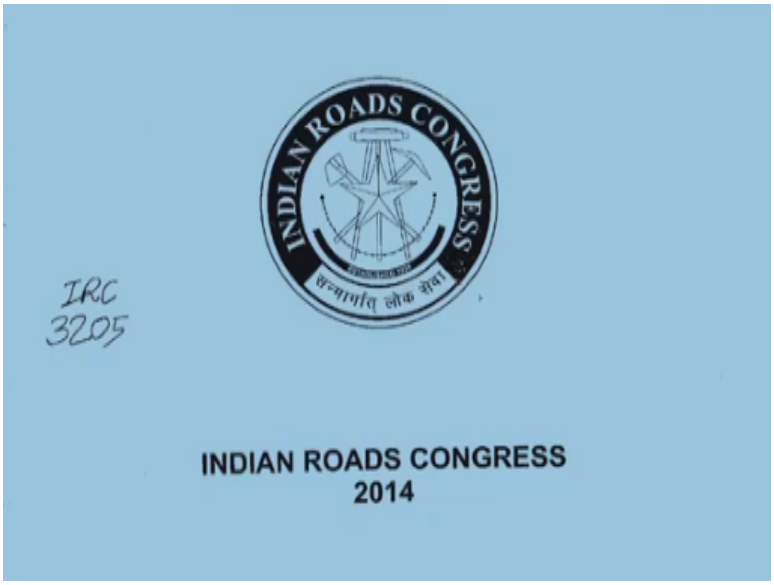

So just to just let me please allow me to go to that particular one I have taken from this one so then it will be clear.
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The dispersion of loads through the fills above the arch shall be assumed at 45 degrees both along and perpendicular to the span in the case of arch bridges.

204.3 Combination of Live Load

This clause shall be read in conjunction with Clause **112.1** of IRC:5.The carriageway live load combination shall be considered for the design as shown in **Table 2**.

Table 2 Live Load Combination

Sl. No.	Carriageway Width (CW)	Number of Lanes for Design Purposes	Load Combination
1)	Less than 5.3	1	One lane of Class A considered to occupy 2.3 m. The remaining width of carriageway shall be loaded with 500 kg/m²
2)	5.3 m and above but less than 9.6 m	2	One lane of Class 70R OR two lanes for Class A
3)	9.6 m and above but less than 13.1	3	One lane of Class 70R for every two lanes with one lanes of Class A on the remaining lane OR 3 lanes of Class A
4)	13.1 m and above but less than 16.6 m	4	One lane of Class 70R for every two lanes with one lane of Class A for the remaining lanes, if any, OR one lane of Class A for each lane.
5)	16.6 m and above but less than 20.1	5	
6)	20.1 m and above but less than 23.6	6	

So this is your the table to table 2 you can consider this one so we can find out this one as table two that less than 5.3, 5.3 meter above but that one so we can go to that particular code.

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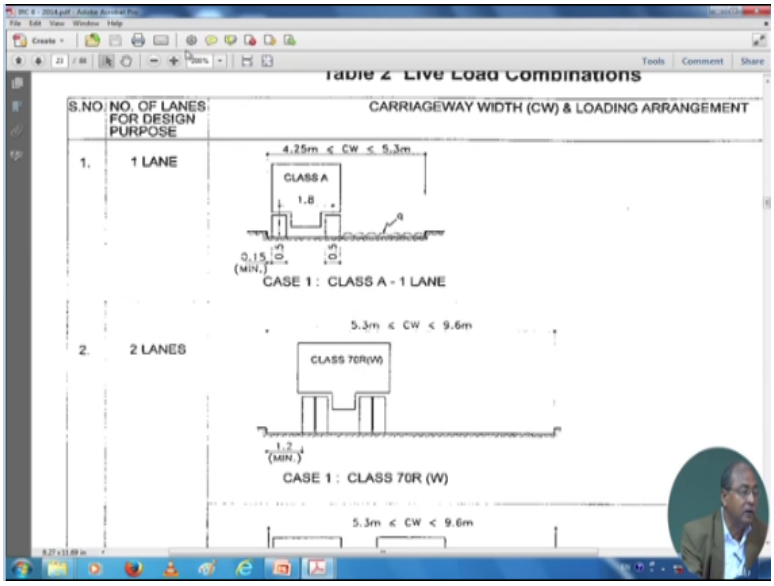

And load combination also you can see what I would like to show the this particular one you can see so this is 4.5 meter 70 5.3meter and then we have to apply this load additional load we have to apply to lanes 5.3 m to 9.6 so only you will apply that once a class 70R loading so we shall consider only 70 R loading that we shall consider here.

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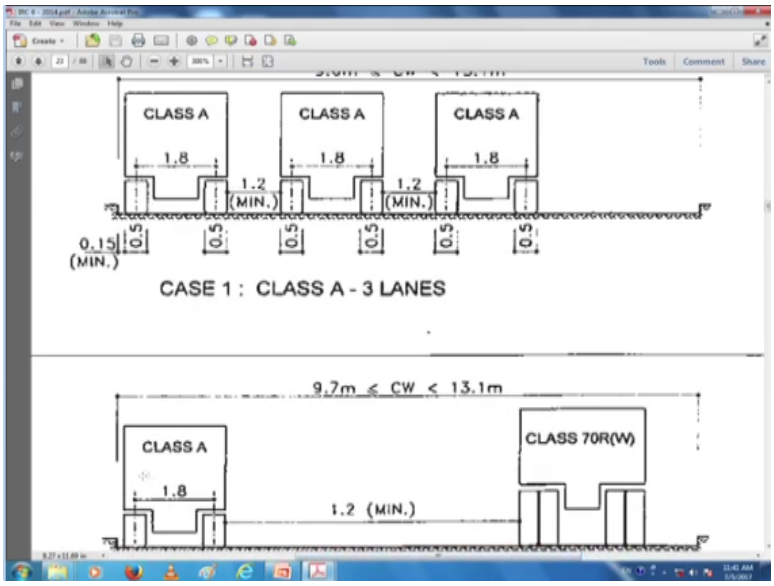

Then for class A two loading we have to allow to class A loading for 3 lengths so for single lane we are having only one choice number one that you apply the load one vehicle and then you give remaining one that load uniformly distributed load for two-lane we are having two choices one is that class 70R loading and then you are giving Class A loading that means 70R loading only will be one which is at a distance of 1.2 meter from the left 1.2m from the left if we consider that another case will be there where you are getting that 0.15 meter that one and then we are having two loading that we shall consider.

Class A loading that we shall go there if say 3 lanes then what we are having choices first one that we are having three class A loading then one class a loading one 70L loading so like that we can consider here three class loading so that way so I am not going to detail up all that particular one I request you to therefore this particular code and you can get it for different one because as I have told you that one mainly we restrict ourselves most of the cases we find out that single lane, double lane and triple lane that is the one we most of the cases we generally follow this one.

But if it is more than that then obviously you can consult this particular code or detail of that now coming to this one here whatever we have discussed that word colon here.
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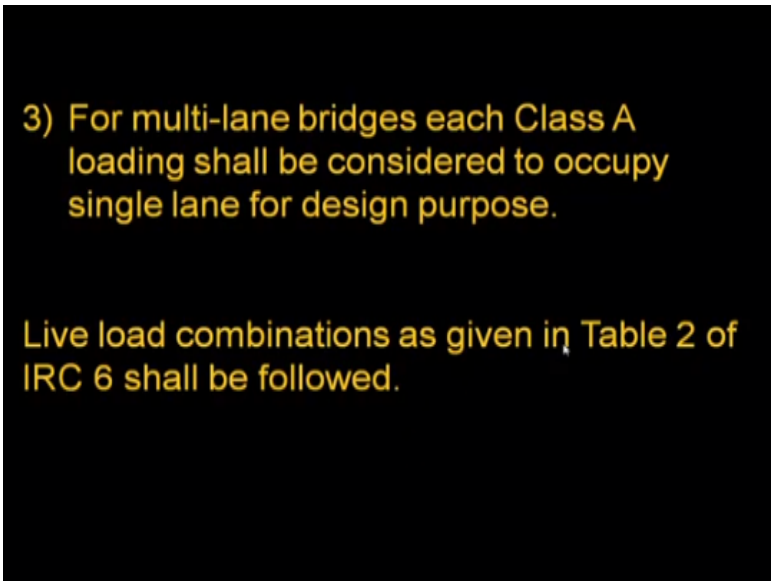

So this is the one table two whatever I have told you here.

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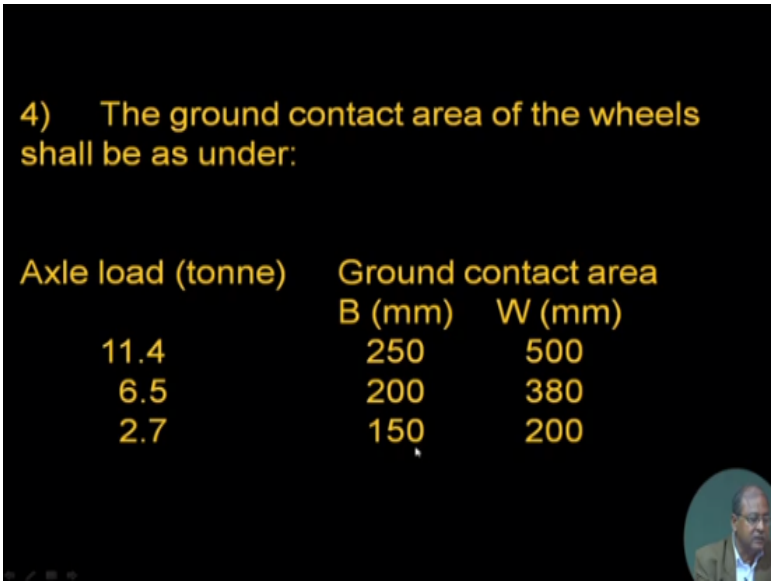

The next one you are having the ground contact area that how much will be the ground contact area because that one actually very important here the ground contact area that whenever you are having that wheel then how much load it will take that impression that from there it shall get the stress and then from there we can find out because if we consider that say only a concentrate load then obviously bending wind shear force will come more.

So for this case 11.4 meter we consider this 250 / 500 if it is say 6.5 then 200/300 80 2.7 obviously very less so 150 by 200 so that is a one may your plan of that where that particular viewing is coming into picture that one.

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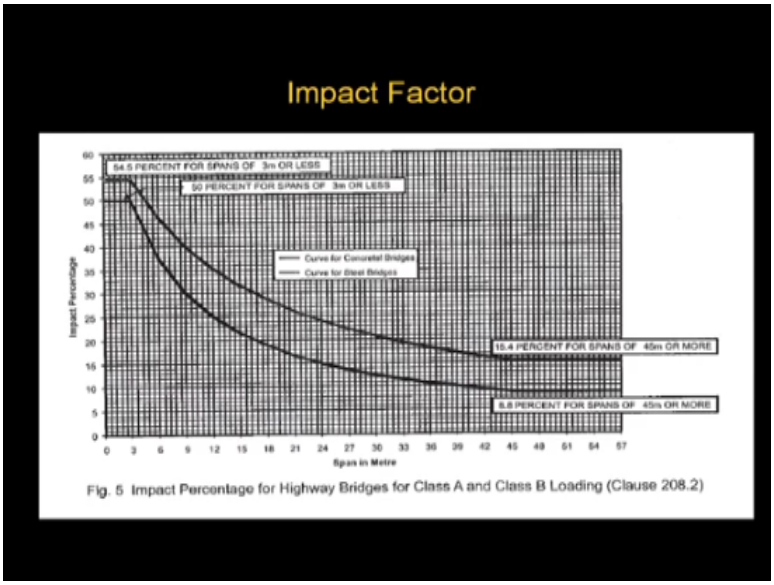

One more important part is that that we call it actually you say that impact factor since the vehicles are moving the dynamic one so whatever we can consider the vehicles are moving so we should get certain kind of additional load in addition you will see beyond a static load and that one here it depends on the vehicles that you said beach spell in this case you can consider this one here that you're having two lines here I have taken four figures high above IRC6.

So we are having this one and then you are having this particular one here what we calculate actually here that load that let me tell you this particular load and this one I am given for class A loading.

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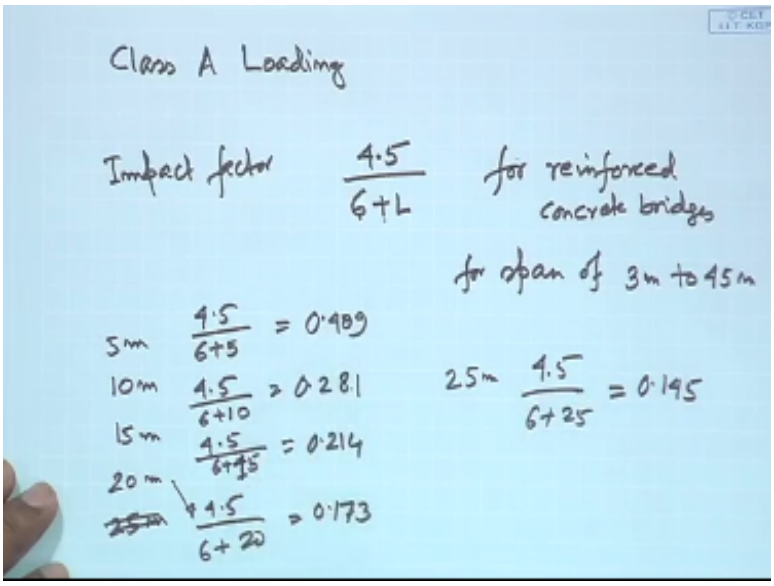

So we can consider that one, so class A loading so impact factor which will be your equal to say 4.5/ 6 + L this is for reinforced concrete be this also this is valid for span of 3m to 45 meter so if we consider this one here 6m + 3 m 9m so 4.5/9 that is50% so if we come back here.

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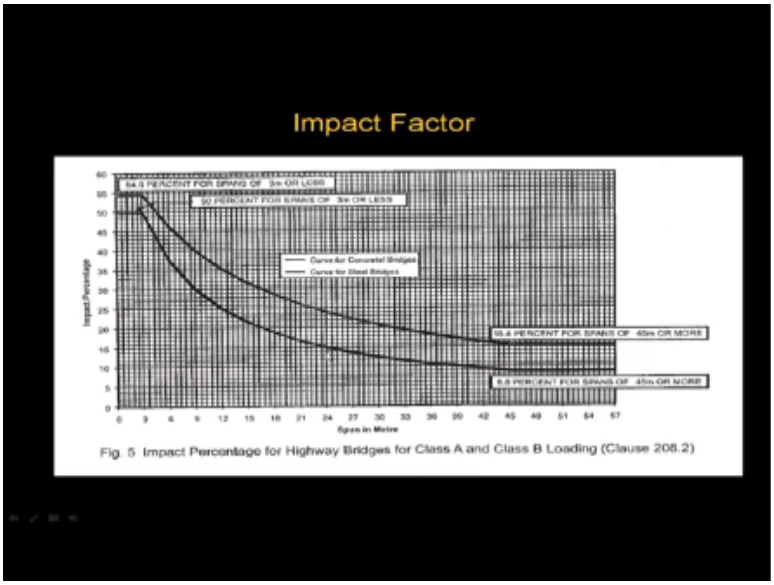

Fig. 5 Impact Percentage for Highway Bridges for Class A and Class B Loading (Clause 208.2)

Because the curve is not clear that which one so that means here this 50% the bottom one means that is for the reinforced concrete bridges so this particular one we consider here that one we call it actually would say reinforce concrete bridges that we consider here that is the we can show that means here whatever value we shall consider here in addition we have to get that you have to multiply that so that I can get additional bending moment so and also it depends on the span of the bridge so whatever we shall consider here that span that work alone can consider so if we consider say 20 meter so you can calculate that.

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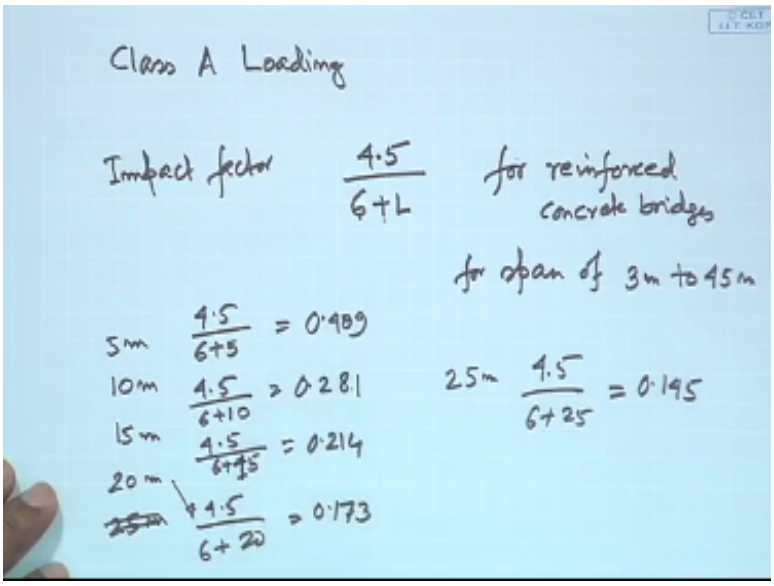

So if we consider say for example 5m five let us take say 10m then 15m then let us take say 20m and let us say 25m because our range for our case it will be only within this particular range only so we can find out that so let us calculate that but code 1and we shall use this formula 4.5 / 6 + 4. 5 6 + 5 4.5 6 + 10 4 .5 6 + sorry 6 + 15 4.5 20 this one and another one let me write down here for 25m let us cut it here 25m 4.5 6 + 25. So I can get it here just to give you idea 4.5 / 11 so 0.409 4.5/ 60 0. 4. 5 / 21 these caves 0.214 4.5 / 26.

0.173 4.5/31 so point 0. 145 so our case for our case that means you are getting 20meter which will go up to say 15 meter so that means almost approximately you can consider say 21% increase that we are whatever vending ones here force you shall get it for the empirical load that we shall have to increase with this one service you can say that once a 25% like that you can say that is 25 so that is if I consider a 30% like that then that is a good enough here we are getting 17% so that means here that means 30% and I can appreciate 20% for 20 meter per sec 1 so this is the one my objective is that to tell you another one sometimes.

We go as for that codal provision all those things but also you should understand that this is the span then how much it is coming so that means here say 5 meter span means 40% 10 meter span you can set the 30% I can say the rounded of I am talking 50 meters span okay 20% I can consider this but this one also 20% 50, 20 I can say this one I can consider 15%.

So like that actually you should keep it in your mind that how much is that load nothing is that basic objective linearly that we have to feel those values is not like that you are getting certain

values and there are so many software's available and on the basis of that you are calculating and you are finding those values when there but you want to know that how much actually it comes how much load it comes our objective here just to show you that okay this is the span.

So bending moment should not be more than that or bending one should not be less than that at least you should have those feelings whenever you are going to design that particular one.

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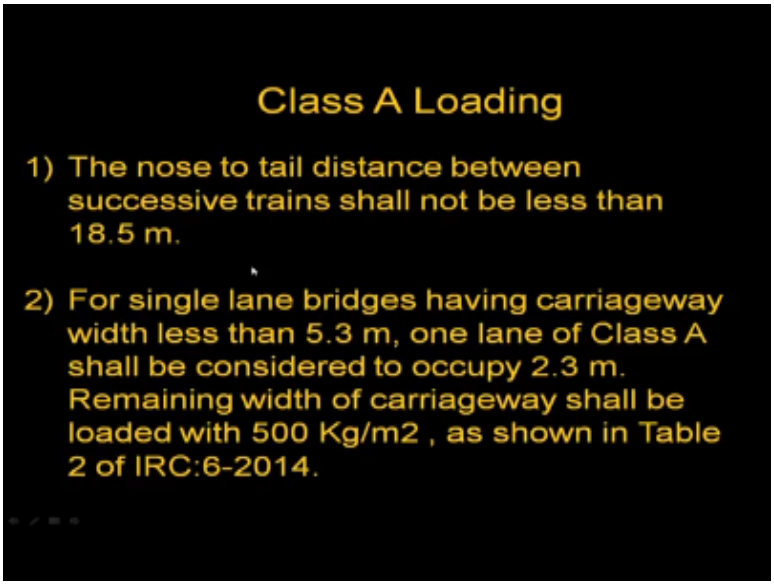

So coming to this one here before I go to that your say summary let me come back to this particular here that IRC loading.

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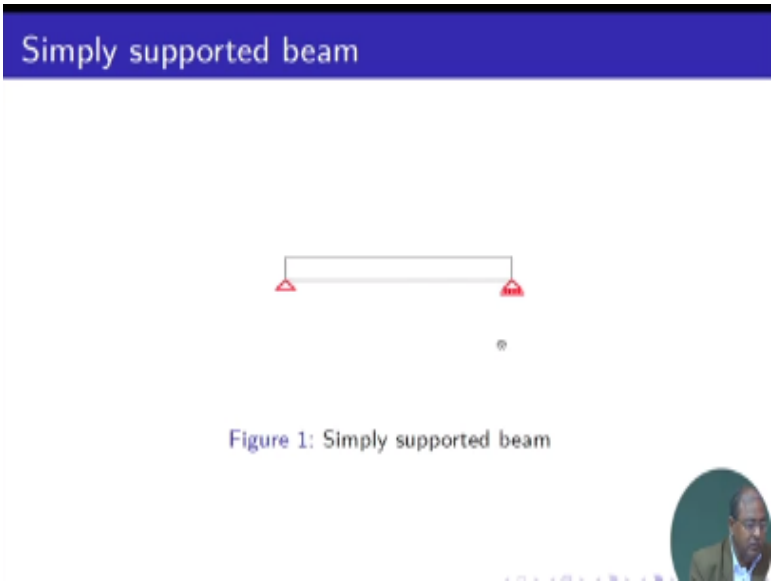

So that one I can say in IRC loading so this one's simply supported beam.

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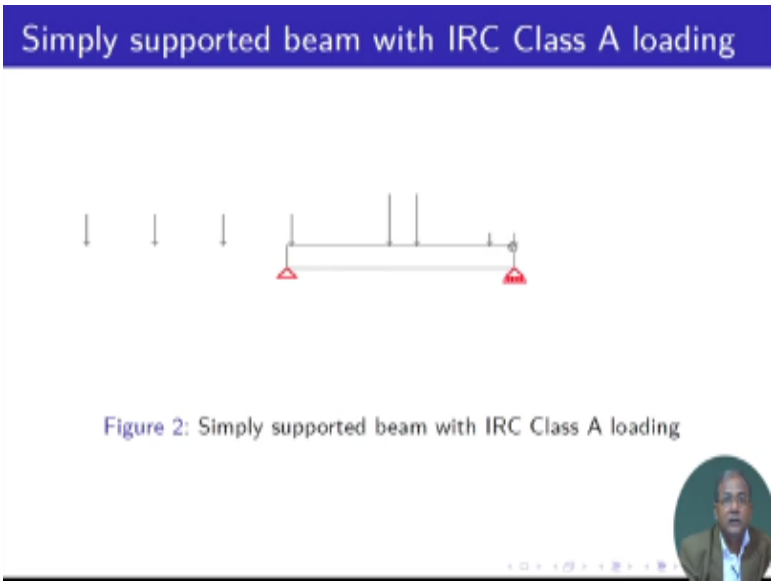

Figure 2: Simply supported beam with IRC Class A loading

And the loadings are moving in this direction this is the one we are considering that class A loading then we are having say sorry.

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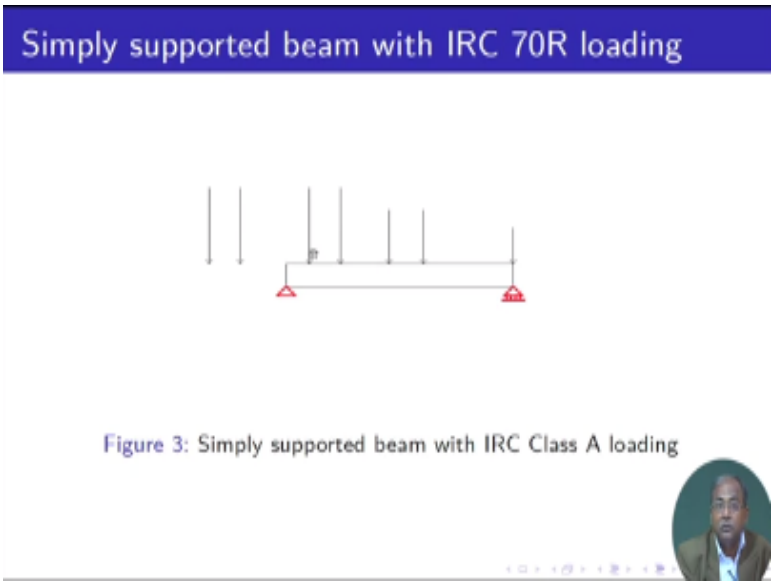

7th we are loading like that we are getting those information we are getting it here, so if we really consider that load how to calculate that at least you should understand this particular problem that you should understand that. So here what we will do that for Curran here just to give you idea.

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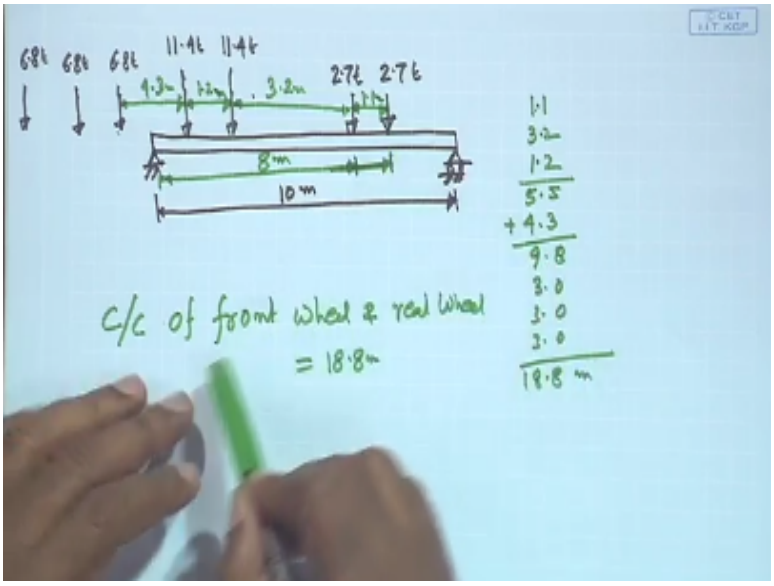

Let us consider that you are considering a beam simply supported beam because in our case such slab as well as your say other one it will be your simply support only let us considered that we are having the loading here and then and we are having these loads outside like that one more is there outside of there it has considered this one 10meter this one 2.7t generally we should using low Newton and here we shall solve the problem whenever we shall design that one we shall consider a little later but anyway since it is given in IRC in ton so let us use that one in ton.

And then 11.4 11.4t ton then we are having 6.81 like that one more sorry I think this is going out 6.81 will go actually that the curve one just to tell you this factor 1 and let us consider sorry this one the front wheel the total one we are having say 8meter this one 1.1meter next one we are having 3.2meter 1.2meter, so from one end we are having 1.1, 3.2, 1.2.

So 5.5 meter we are getting here now if you add 4.3, so which is coming 9.8 that means these from this end to this end 9.8 meter so from this end to this end I am getting 8 meter, so that way so that means only I am getting these four wheels I am getting it here. Now the thing is that here our objective does occur on here there are two aspects because this is before going to the design let me let us discuss this one that is more important actually here for this load we have to find out the maximum bending moment.

Now you have to find out the maximum minimum moment and since this vehicle is moving in this direction all of them are not coming so how many wheels are coming inside and on the basis of that you to find out and similarly we have to find out that if this side moves and come this

direction whether I shall get the maximum element or not because the span cannot accommodate all the wheels the vehicle with that full vehicle will never come into this particular bridge either in the front side that if you use the font side there then you will get certain load if you review the other one then you will get.

So we have to find out this particular one here one way obviously we can get it that one that we should start from this end and move forward one by one move forward and then it will come to this direction that way it will come and then we can find out where the maximum arrangement where it is coming those calculations actually we can do it we shall show you that particular problem we shall show you that how to do it.

So this is very, very important here that particular one we shall consider here because you are having say 9.8meter and then you are having 3.0 meter3.0 meter and 3.0 meter, so total you are having 18.8 meter. So vehicle length is your say 18.8 meter so on the centre to centre of the who is front wheel so centre to centre of front wheels and real wheel that is18.8 meter, so that means to accommodate the full vehicle we require18.8 meter span then all I can say that all the vehicles are coming within.

So that means whenever you shall go for our CCTV 20 meter that means go all the way through system but even then also I cannot give you guarantee whether full load is coming that is the one that maximum element is coming or not or it may happen that what your want that certain other portion going out that way it is coming more so that we have to find out so this is very, very important for the Benham and point of view. Another one from the C force point of view.

So these two aspects we shall consider we shall solve this problem and then I shall show you that there are many more different aspects because here we are considering only concentrated load we are very much familiar so far hotter body absorb Lamia solving structural analysis we have taken concentrate load but here in this case the vehicles are we will sell on the same line there are so many wheels, so loads are distributed and on the basis of that how much your bending moment will come and shear forces will come that we have to consider. So we are doing this fucker on here.

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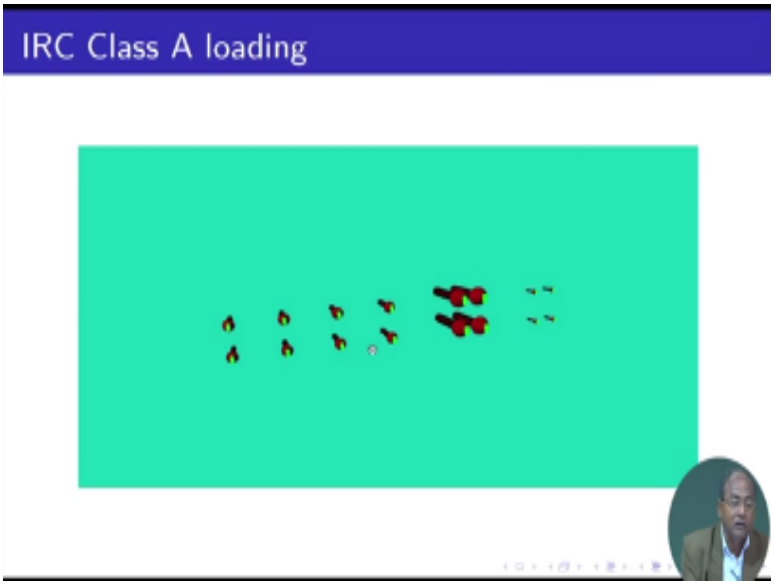

And the one I can say this is the one that your say plan this is your that wheel that one coming the one you can consider this wheels you can consider here that major one I have to get one knee class a loading the other side you can see that one that green portion you can think the medium that is the impression of the wheel.

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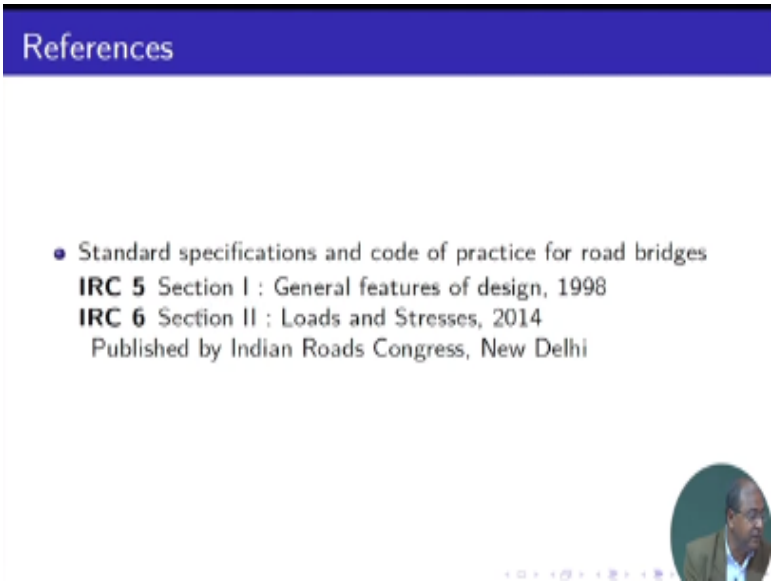

So we did I sing I shall consider that and then I have just mainly covered say introduced your today that IRC five and IRC six so that particular aspect we have considered so general first so let me summarize that in this week whatever we are considered we have considered that your that general bridge engineering and out of that why we have taken there is only reinforced concrete load which is that we have considered because this one very popular economic also and for a small span you can consider that one we can go maximum up to 25 meter span.

We have given that how to decide that width of the bridge that also we have discussed and then the IRC the class A loading and seven clear loading that also we have discussed okay with this we conclude the session here but before concluding this week one the fifth lecture we shall consider that one that basic design principle that how we go for the displacement that we shall consider in the next half an hour thank you very much.