NPTEL

NPTEL ONLINE CERTIFICATION COURSE

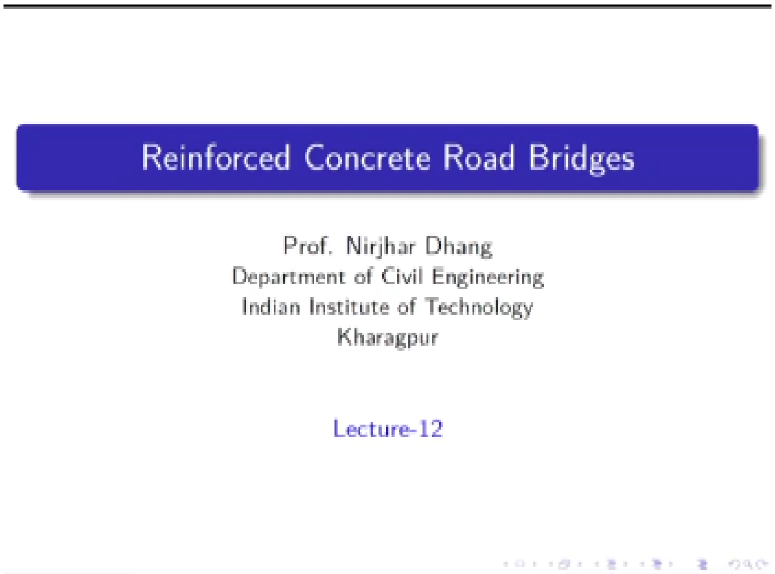
Course
on
Reinforced Concrete Road Bridges

by
Prof. Nirjhar Dhang
Department of Civil Engineering
Indian Institute of Technology Kharagpur

Lecture 12: Design of Slab Bridges (Part-IV)

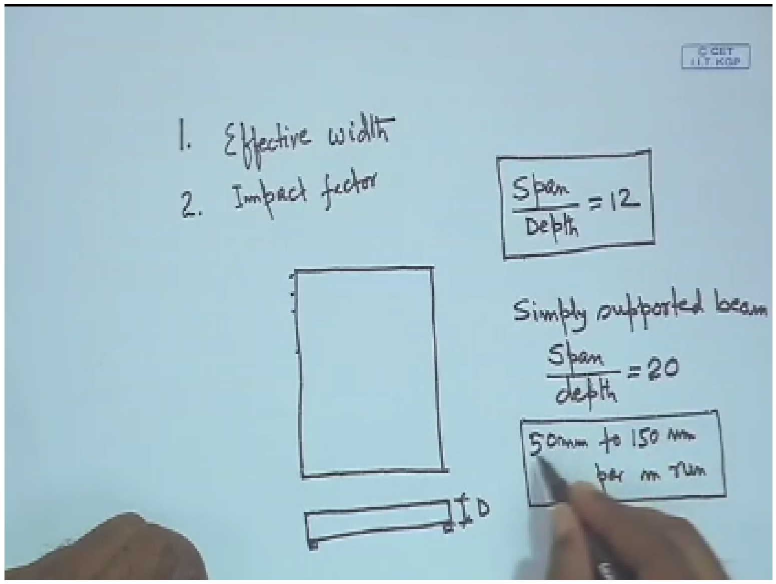
Hello everybody we have started with design of slab bridges and which we shall continue today also first of all let me tell you that for design of bridges we have take a very simple one that is slab bridge and which will be considered here almost like a beam.

(Refer Slide Time: 00:47)



And we shall see this particular one here that weather we shall provide that shear or not this lecture 12 of half an hour module so let us start with that whatever we have discussed that let us start let me just give you one.

(Refer Slide Time: 01:09)



One important part that is the 1 that you can say that effective width and the next one that one we shall get that is impact factor we have discussed that one and we started one problem a very simple problem because our objective is that if we can understand the basic class of deign how to start then you can do any problem you can solve one your own, here whenever you are though that one you would say effective death we have discussed we have taken a very simple problem of say 5.5 m span.

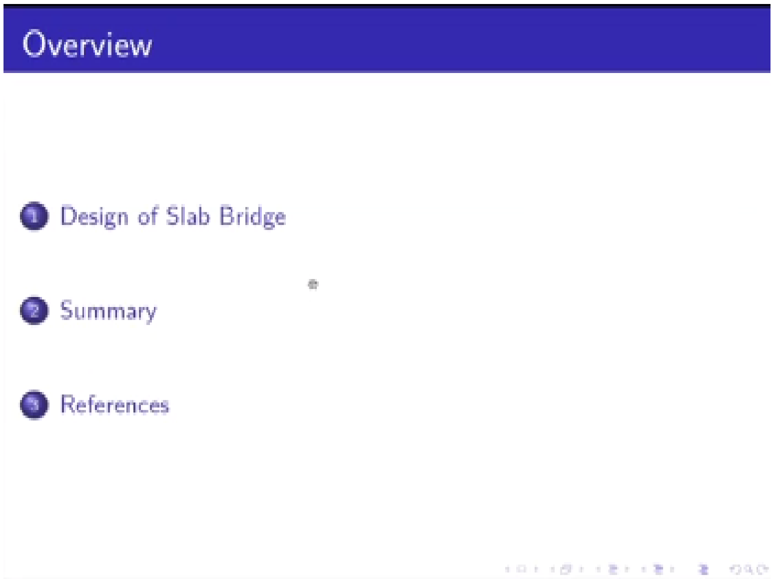
And then we are getting here the slab the support here this side I do not want to put that one that means if you see this one here that we can see the cross section which will come like this and where you are having certain bearing, so we have to provide these section D what we have decided that we have decided span / depth and we have considered this 12 you can find out in RCC IS 456 where we know simply supported beam or slab where we get span by depth equal to 20.

This one we considered from the loading point of the other so that is why you have taken span / depth little less so that we can accommodate that depth now a days of course we go little higher also sometimes we 14 also like that we go, but I mean to say that I shall show you that why we are interested for that little higher depth that one that I shall show that because that your enforcement that one will come less but concert that one may be, come more bur reinforcement will come less.

That is the another objective here this 20 again further modified with compression steel the tension steel like that there are so many other parameters with that if you go back to the highest 4, 5, 6 you can find out that this is the bases I can say but this is a good start with this 12 and 1 can say argue that one it will little bit contribute it size that one but what I mean to say here instead of going for say 80mm/ m run or say sometimes you find out this one say 50mm to say may be say I can go up to say 150 mm/ m run.

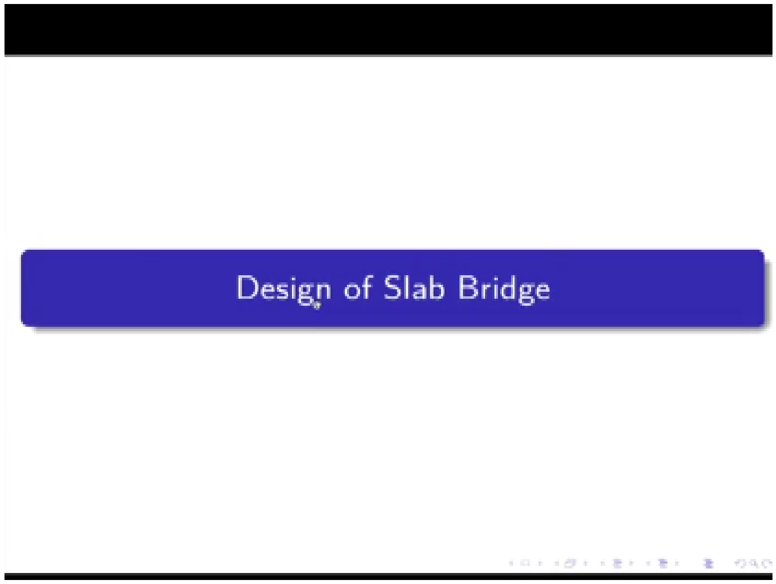
That millimeter span you can say this is one another way generally they considered here that means it can be in the lower side also this can be on the higher side of 150 mm that we considered because of per m run you can find out here that we can considered that means say if you consider 5m span it can be say 250m mm and 5m span it can be say your say 750 mm quite high but what I mean to say this particular range find out on the bases of that we can find out if you solve problem and then accordingly you can get your idea that how it comes but any way that is not the thing that.

(Refer Slide Time: 06:02)

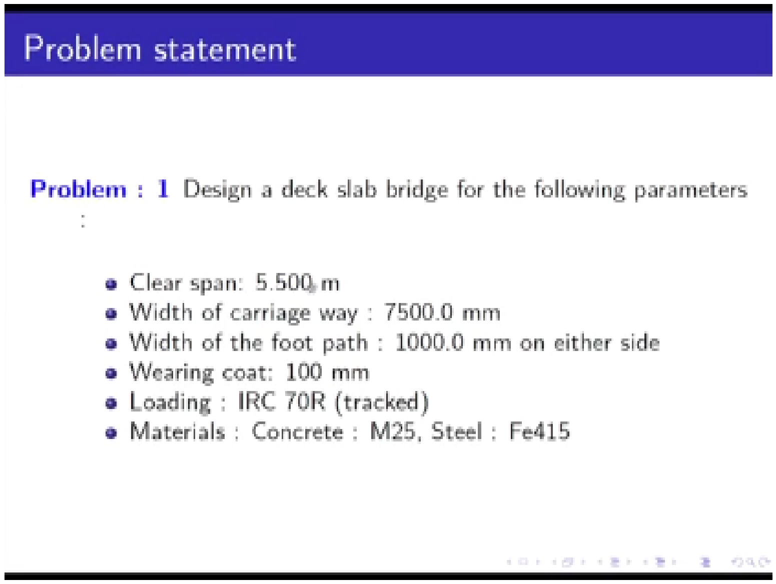


Let us see that how far we have gone there.

(Refer Slide Time: 06:04)

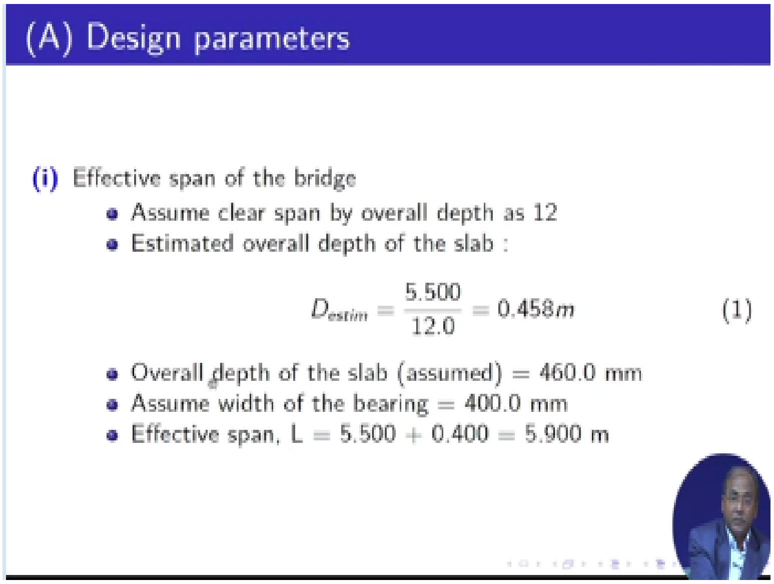


(Refer Slide Time: 06:07)



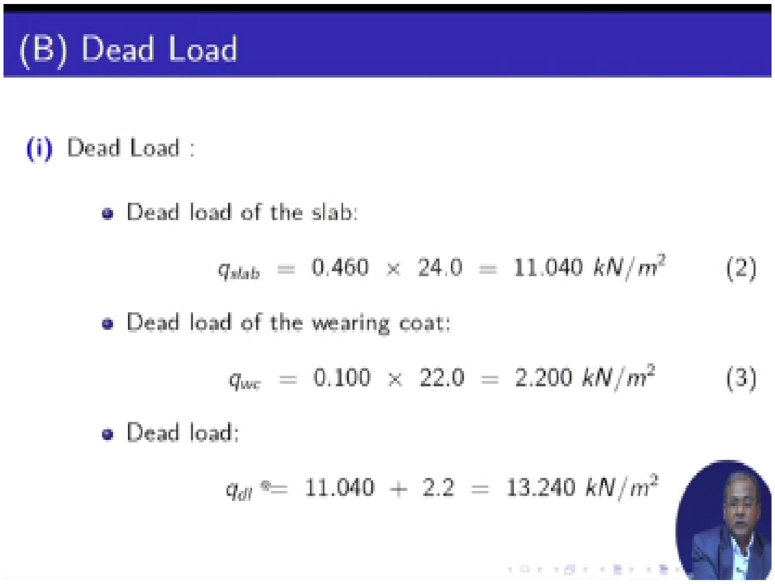
And we took this one 5.5m 7500mm that we have got it from the carriage way and then we are getting say 1000mm on either side foot path actually we shall see that shall be the problems on 1000 5mm footpath, then crash barrier like that we can give and we are in core reduce the bearing court that is in form 100mm to say 65mm, so that we have taken the load of say IRC 70R road so you can check that one weather with the IRC class A loading how it is coming concrete gate we are getting M25 now we would lie to reduce the death, so we can for same 30 so there are many more actually your options your say flexibility how you can take care your design.

(Refer Slide Time: 06:59)



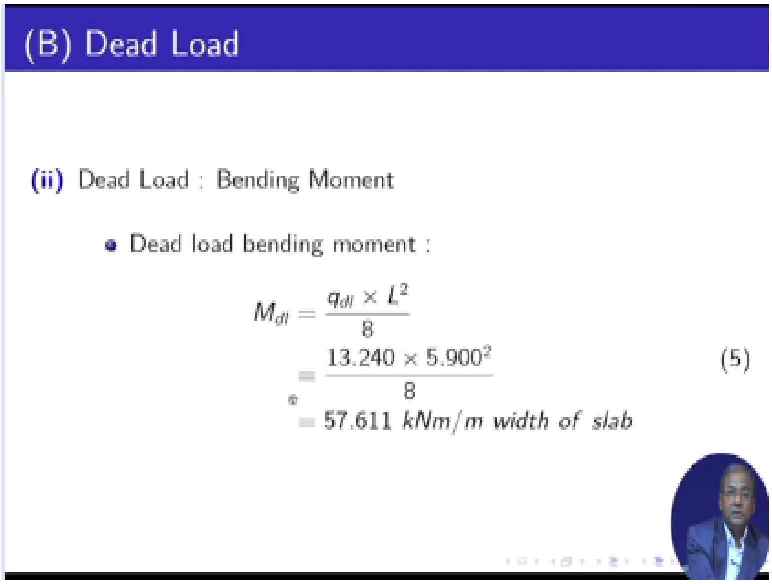
And I have told this particles one here because this is the first problem your are solving so obviously that we would like to be in the conjugative side one way we can start actually we can taken certain value then again we shall rerun, the whole thing that is another way of thinking but here we shall consider that, so here we have told the 460mm we have got it bearing length we have taken 400mm and effective span here we are getting 5.5 m + 0.400 either side and which is coming as 5.9 m that which we have already discussed that particular one.

(Refer Slide Time: 07:39)



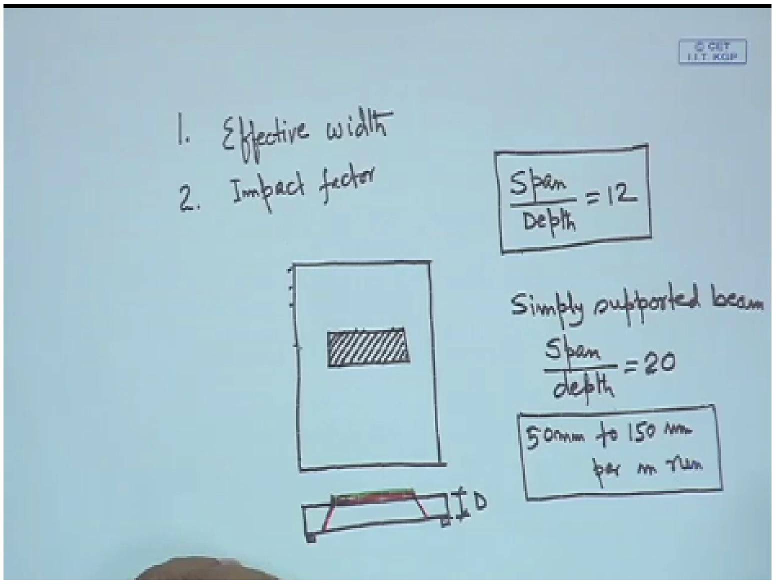
And also we have got this values that q_{slab} q the deck part 0.46 x 24 per square meter obviously and we are in coat that one you can get w see that particular 22 and q_{dl} that one we can get it say 11.04 + 2.2 that is so total we are getting summation of that 13.24.

(Refer Slide Time: 08:02)



And on the basis of that you can get that you say dead load bending moment at the mid sapn we can find out which is coming here by 57.611km / m width of slab that means what we can do it here alreday we have discussed our objective is there.

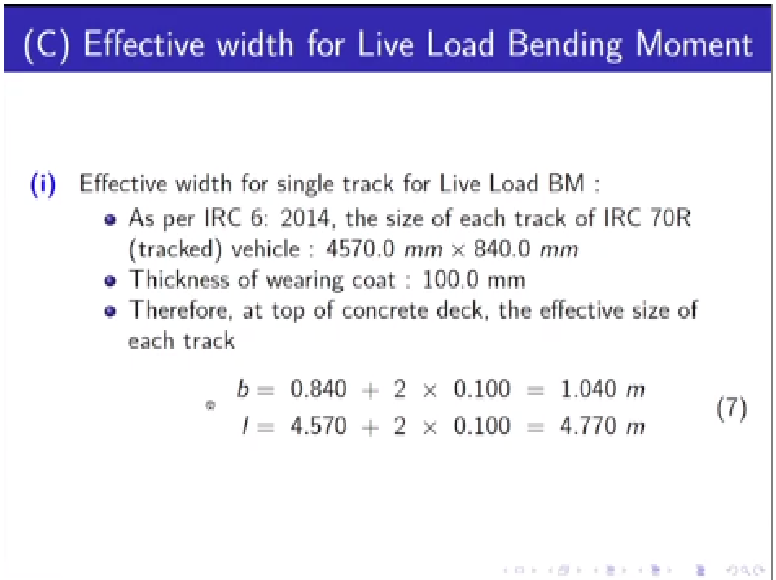
(Refer Slide Time: 08:25)



We shall take we are having this one here the impression, the impression of the track only one track you can consider here. And this one we are looking from this side so this is the one track that we have, this one we have the track and that one we will disperse and which we come here up to this first part we shall have due to wearing coat dispersion and second part here there is one I have told last time also that here how far shall we go that one very interesting thing and we shall say that particular one.

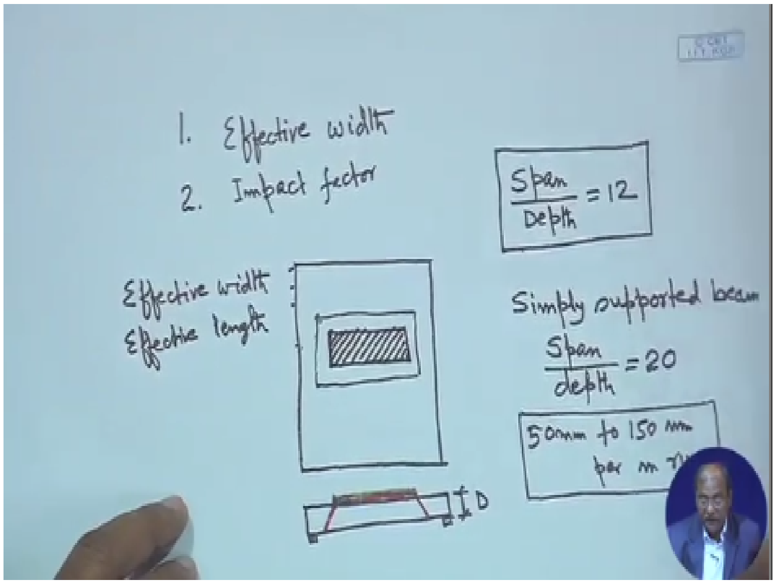
We can go at the bottom also we can go up to the effective depth that is because we can go up to the tension reinforcement that also we can think of it that way we can find out here, so coming to this one here we are getting this bending moment that we have got it similarly we can find out the shear force very simple that half of that will come because shear force will come half of that and which is coming as 39.058kn/ m width of shear. That means we can solve that particular one here for the dead load this particular one we can do it here that is very simple that we can take it.

(Refer Slide Time: 10:31)



My next question is coming as I have told you here next question is coming.

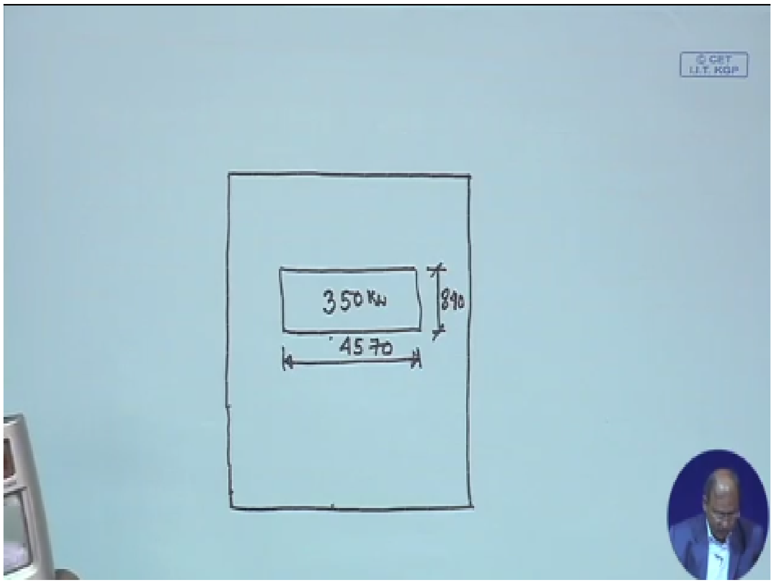
(Refer Slide Time: 10:37)



For the we are in coat and that you say that what will be the effective, so that means we have to find out the effective width, or effective width it will come like this which we have discussed in the last class also which will come like that and that we have to find out, this is your support so parallel to this support we have to find out and then longitudinal so we shall tell that one say here that is why we are calling actually effective width and effective length. So effective width and your effective length, length means along this.

Along the span direction and effective width means parallel to the support so these two we have do it alternatively if you are very much concern with we are very causes what we can do very simple oh yes we can do it, just simply we can take this one only that we do not want to go in dispersion so then obviously the stress we mode that one we can consider here, so this particular one that one particular one we can do it though that if you really consider the design from the design point of view.

(Refer Slide Time: 12:23)



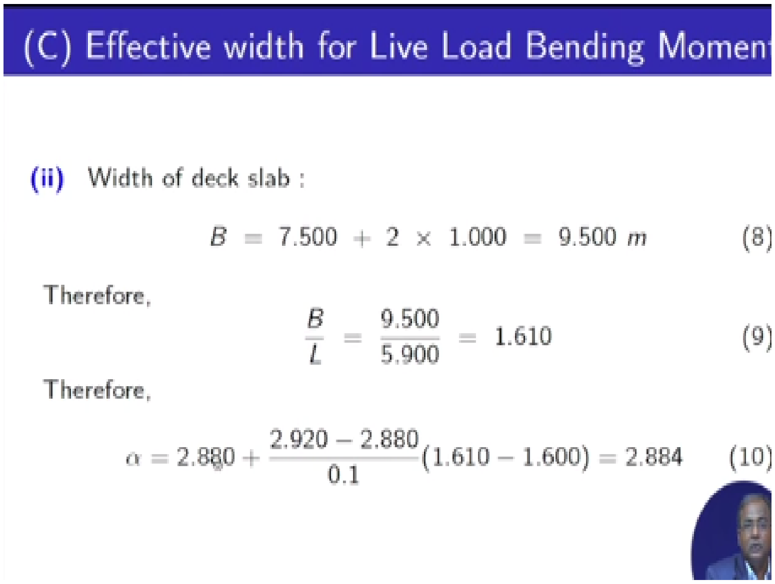
If we really see what we can do, so this is how much 840 this is how much 4570 and how much is here that load 350 kl in each track, so just to give you idea just let us find out 350/ 0.84 and divided by 45/ 0.84 and divided 4.57 which is coming as 91.17 if I say qL mode 91.17kw/m2. So this is the one we are getting here that particular one that much actually we are getting here that particular one if you really consider that we have just taken that impression, so as you can note down this is that how much we are getting this particular one.

And then would like to find out due to dispersion how much it comes that is the one how much actually it comes down that particular one you can find, so that means if you really do this way then when you are quite conservative and then the slab will on that your bridge will know but be a economic one though we want actually said to you one, but at the same time we have to see from the mechanics point of view whether we can make it economic also said to you obviously the first five no doubt about it.

But at the same time we have to see that one that unnecessarily we are becoming too much causes and we are spending lot of money, because as you know the bridge you can see that particular one that call that like that a small bridge like that say minor bridge measure is like almost every kilometer of the road at least you will get certain kind of actually concrete road work which they convert something like that even say 3m 4m like that it happens like that almost every kilometer in that width may happen.

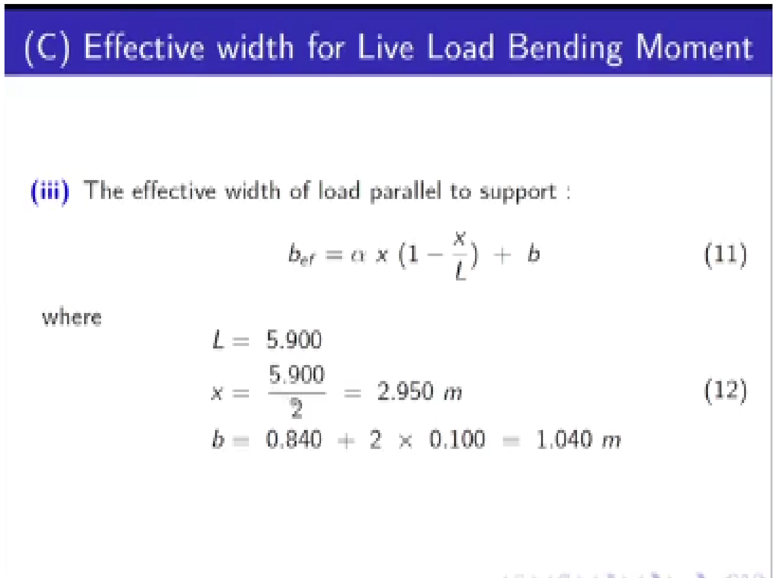
Coming to this one here whatever we have discuss this is the one 4570 x 840 which we have got it from the IRC6 this code thickness of wearing coat 100, so first level of dispersion this is the 1.84 into 2 both sides this one and length wise this much we are getting that is the one first one.

(Refer Slide Time: 15:40)



Next one we are having width of dead slab because we have taken that 2 x 1as shown that case within 1m so we can say B = 7.5m is the carriage way and 2 x 1 so 9.5 so B/ L 9.5 / 5.9 1.61, so α you can get it here 2.288, 2.92 – 2.880/ 0.1 so I have taken that from the table and from the table you can find out α which is coming as 2.884. So α for this D/l you can get it here 2.884 that you can find out.

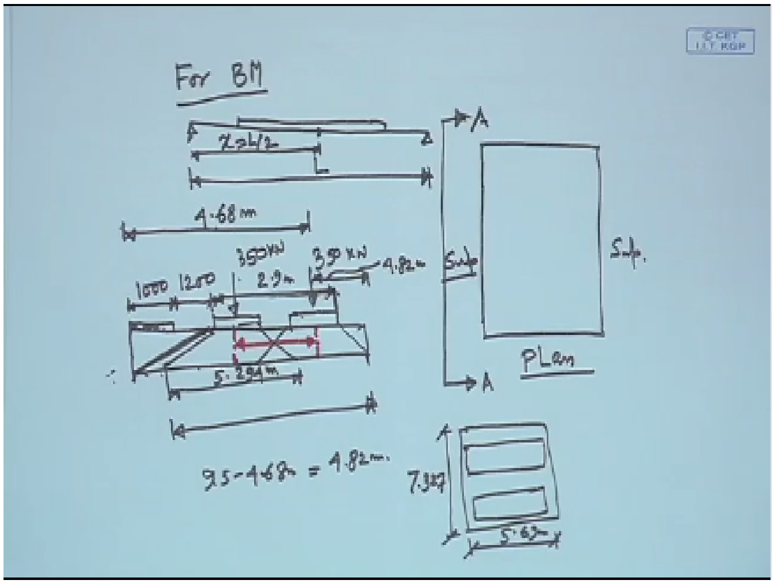
(Refer Slide Time: 16:24)



The effective width of load parallel so that means one will be the depictive width and other one as I have told you effective length this is most important one effective width and other one we have told you that is call actually effective length. So in this case which we have discussed actually the effective to α and x I – x / l + b, so B is parallel to this one so 0.84 + 2 x 0.1 that is the one point, that means at the top of concrete so we are actually the vehicle over the varying coat.

So from varying coat we are coming down to the top of concrete which will be 100mm in this case but the thing is that again 100mm is quite high we can take it 65mm, now it is the actually they make it because eight is a certain kind of regular process such a certain interval maybe we have to actually we are in the coat. So that as you understand we are in coat what does not mean actually here that you are giving coating so that you are mean structure will not have that much of problem that much of dispersion.

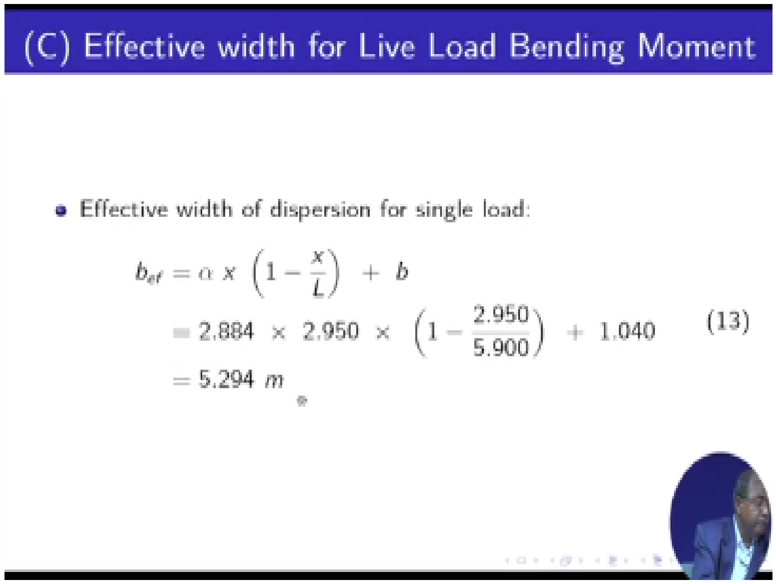
So L = effective span 5.9 x = 5.9 because we are considering this one for the bending movement so effective width that particular one width for the bending moment and other one for the C air force. Now what is the objective let us see this one this two things let us consider here.
(Refer Slide Time: 17:55)



What we are doing basically if this is your beam so since bending eventually maximum at the del so we are considering the load equally space so this is the one you can consider that is why if this is your L then x will be equal to L/2, so this is the one x this is for bending moment. So we can take it here L X B that we can find out which will equal to 1.04 that we can take it here whatever we have gotten already we have done it.

So B effective = α x 1- x / l + b so 2.884 already we have got that particular one from the table which we are shown that over here just for give idea this particular one we have got that α.

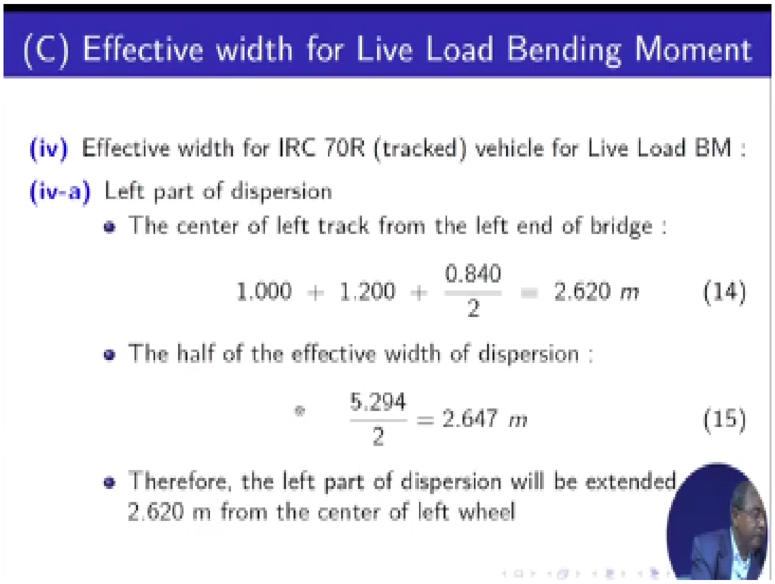
(Refer Slide Time: 19:11)



And then x 2.95 which is at the middle which we have already got it at the middle and 1- x / l so this is the 12.55 parallel so plus B 1.04 the parallel have to support to that particular width so which is coming as 5.29, so that means the this person will come this much that if you this one here I am looking this problem this is the plane of the bridge this is support this is also another support. Now you are looking from this side let us say I mean to say A view A.

So I can draw and we are having footpath certain gape the loading then another loading will be there like this, what we shall do so we can find out for this one whatever we have got it this is actually that 5.294, so 5.294m this particular one. So finally we shall have the wall aping and then we shall have to find out that total this length and that length will have the load 350 kn and 350 kn.

This load will be set so compare to that one earlier whatever we have told you that one say 840 so it will go as highest this particular one here that we have to find out. So far we have to found for one track we have found, so now there is a for the both of them we have to find out how much that means we shall get it here, so we shall get the center to center distance and then we shall get this side also then we shall get this side also that means we shall have three parts.
(Refer Slide Time: 22:13)

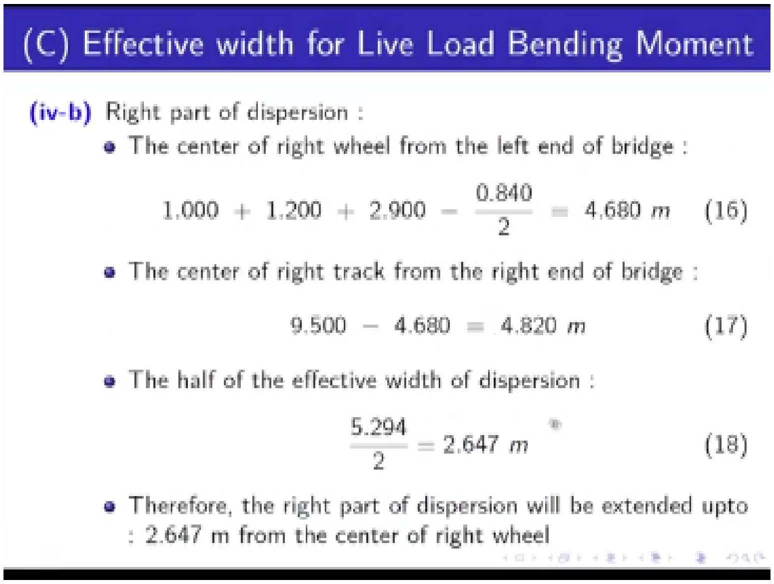


So left part of dispersion obviously I left part we mean to say do you shown from this side to this side left part it can go beyond that you are say width of the bridge that is also possible beyond the width of the bridge that is possible. So center of left track from the left end of bridge left side one there is a footpath 1.2 that is the one from the carp the distance of the wheel or track outer side plus center line for 0.84/ 2 that 0.84 the track width support which is coming as 2.62.

But the half of the effective width of dispersion because 5.294 is a dispersion for one track so 5.294/ 2 that particular one we are getting here 2.647m which is greater than 2.63m that means I can go maximum 2.62 because I cannot go with some imaginary certain width. So that particular one so therefore the left part of dispersion will be extended up to 2.62 we cannot go though we know that is 6.647 but we shall not be able to go that means here in this one is coming up to this we can go though it looks like it is possible to go out but only we can go up to this is the one left part of dispersion as for this figure you can say.

So left part of dispersion we have got it and that particular here. Similarly we have to check for the right part of the dispersion also.

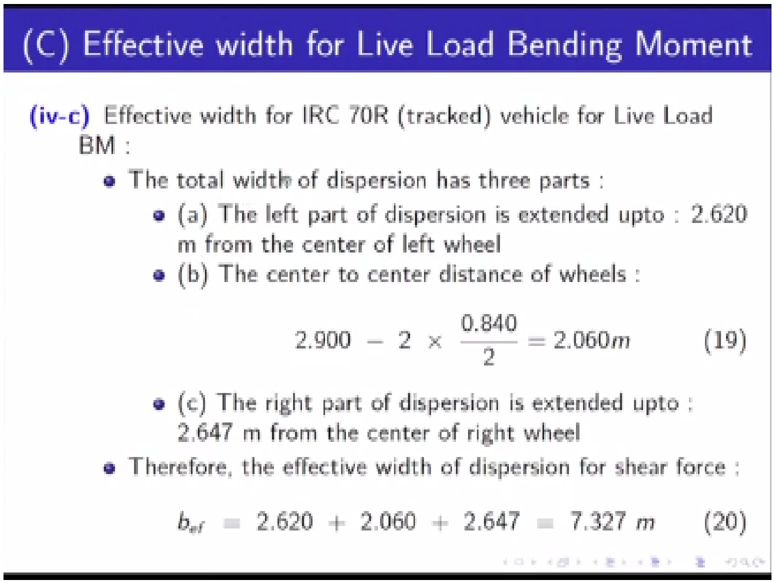
(Refer Slide Time: 23:55)



So this is the one center of right wheel from the left end of the bridge so how much is this one, that we have to find out, which as coming over here 4.68m. How are we getting the 4.68m? 1m foot path and 1.2 cargo way and last 2.9 because as per the way provision, from this end to this end that is 2.9 m. so I can write down here this one is 2.9m, so – 0.840/2, so I am going out again so this is getting 4.680m. so this is the one centre of track from the right end of bridge, so let us find out this from this end.

How much will be from this end then? It will be proportional, so this end here we are getting 4.82. As you know this particular one here, then the total is we can get 9.5m, so 9.5 – 4.68 = 4.82m, so the half of the effective width of dispersion is 2.647m here. Therefore the right part of 2.647 and this is 4.82 so this value is less than this value that means quite far away that to right hand side. So you can say that it will go up to the full extent, because inversely I can go only up to 2.62, but here I can go up to 2.647m, that means here I can go here, that particular one here we can find out here, so that is the one we are getting it here that particular one we can do it.

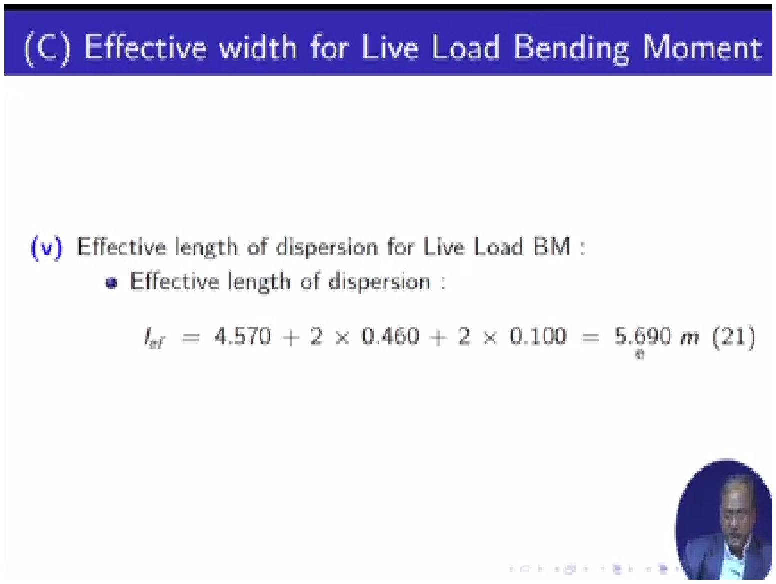
(Refer Slide Time: 26:14)



Coming to the next one, so effective width for IRC 70 R are loading for vehicles load, we have actually three parts. One is the left part of the left track, right part of the right track and in between to center of the center track. These are the three parts and we have found also that extent of the left part of the dispersion is up to 2.620m from the center of the left wheel. The center to center distance of wheels 2.060m, because 2.9 is the outer track -2 x 0.480/2. The right part of the dispersion is extended up to 2.647m it will work up to the full extent of the problem.

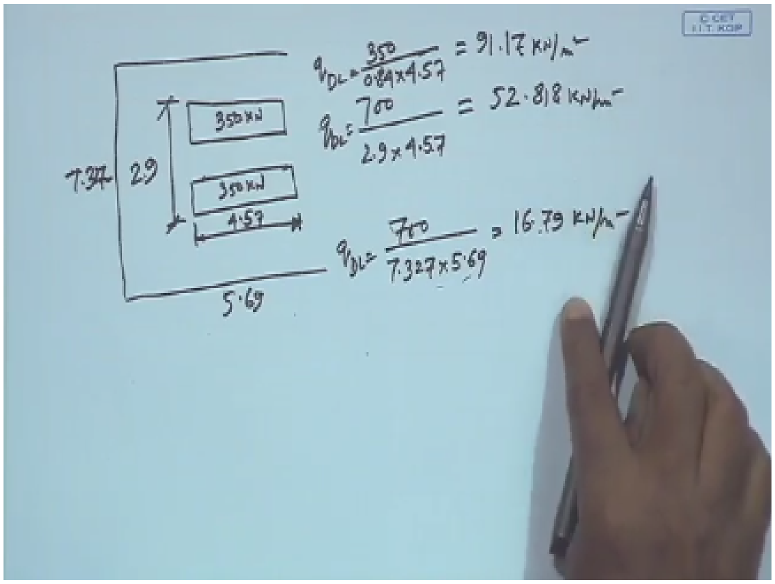
So 2.647m that means 2.62 + 2.06+2.647 so 7.327 that particular one, that means I can say, truly speaking 2.9 m that is disposed to 7.327m. So you can see this one here, so I am getting here 7.327m, so 2.9m the outer top outer track that is 2.9 which is going to 7.327m, that way. That means it is quite high, that particular one we can consider here.

(Refer Slide Time: 27:45)



Now the effective length of dispersion for live load BM that will be effective length of dispersion that is 4.570 is the track length, last 2 x 0.460 that is the depth 2 x 0.100 that is volume, which is coming as 5.690m. So we can say the total equation considering the 2 tracks, which is coming as here, this is 5.69m and the previous one I am getting is 7.327, so 7.327 we have got it here, that particular one we can find out, 7.327m x 5.62m, so this is the one we have got it, so coming to this one here just to make it.

(Refer Slide Time: 29:02)



We are having two tracks so 350 kilo neutron, so let us take both of them to get an idea, so I can say here 700 q_{dl} without any dispersion. So we can find out 700 /2.9 divided by 4.57, which is coming as here 52.81. Earlier you got it here q_{dl} 350 / 0.84 x 4.57, so we can say 350 / 0.84 x 4.57 which is coming as 91, 17 KN/m^2. Now if you really see now this total how much we have got it here? This side I have got it 7.327m and this side I have got it 5.69m. so you can write down here 700/7.327 x 5.69, that one it comes as 700/7.327 x 5.69, so you can say this one 16.79 KN/m^2.

So you can imagine that how much we are getting it here, so from 91.17 to 52.818 without any dispersion, just consider that and then you can go for 16.79. That means you can imagine from there how economical it will be this particular one? So that is one important one, only thing we can say that it could be little bit more than you can check it, whether it will come up to effective depth, it will not go up to full extent it will go to the effective depth. So let us conclude this one with this particular one and then we will go to say binding moment, that you should find out and check that way, the session we have taken alright or not thank you very much.