NPTEL

NPTEL ONLINE CERTIFICATION COURSE

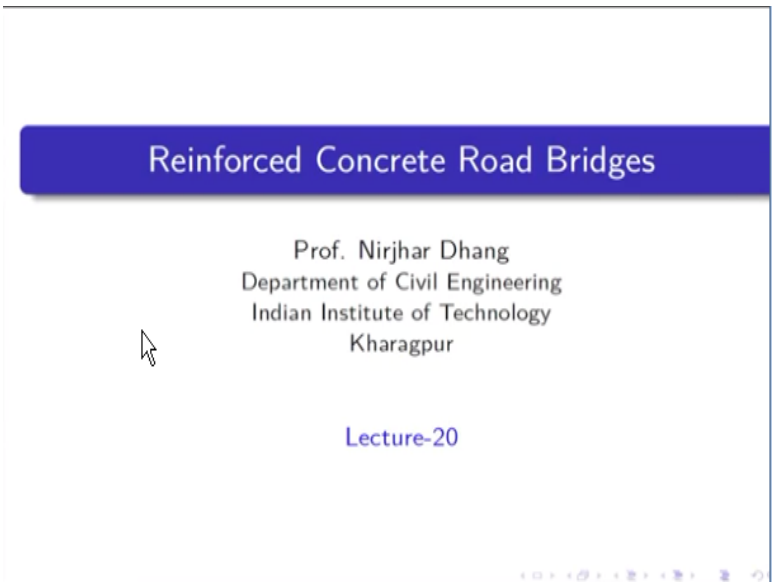
Course
On
Reinforced Concrete Road Bridges

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

Lecture 20: Summary and Closure

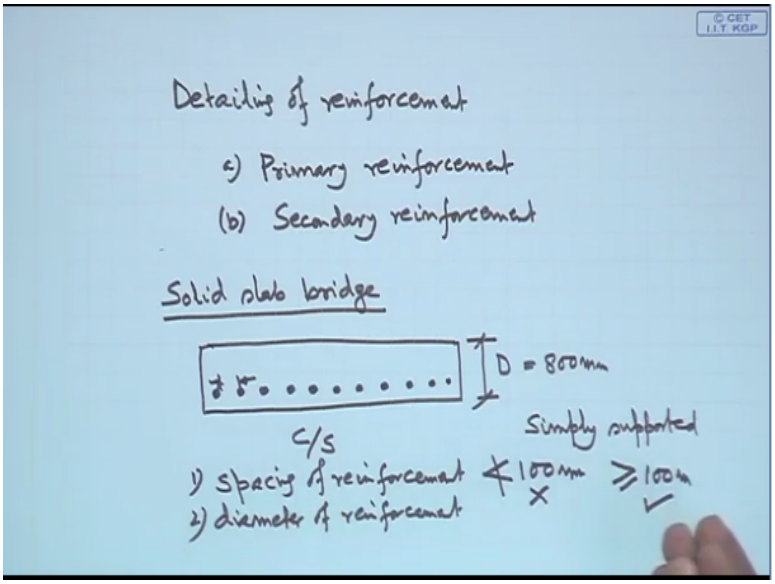
Hello everybody, so finally we have come to the end module lecture 20. So we are skilled with the design of RCC T beam bridge, what we would like to do here. I have told require mainly I have covered that one say design principles, though we thought actually short problem, but I shall supply that problem as I said for a pdf file, so that you can go through it and then we can discuss also.

(Refer Slide Time: 00:56)



Now coming to this one here in reinforced concrete this is lecture 20, coming to here that your reinforced concrete one is very, very important that is actually detailing of reinforcement.

(Refer Slide Time: 01:09)



There is one is important here that, I can say primary reinforcement, this is one. Another one I can say we call it distribution skill, let us say secondary. This is also equally important, but I mean to say this reinforcement is such that if you just have any problem unless it will collapse, it will fail. But this one there is a possible there will be cracks, other things will be developed, but it will not fail that way we are considering here.

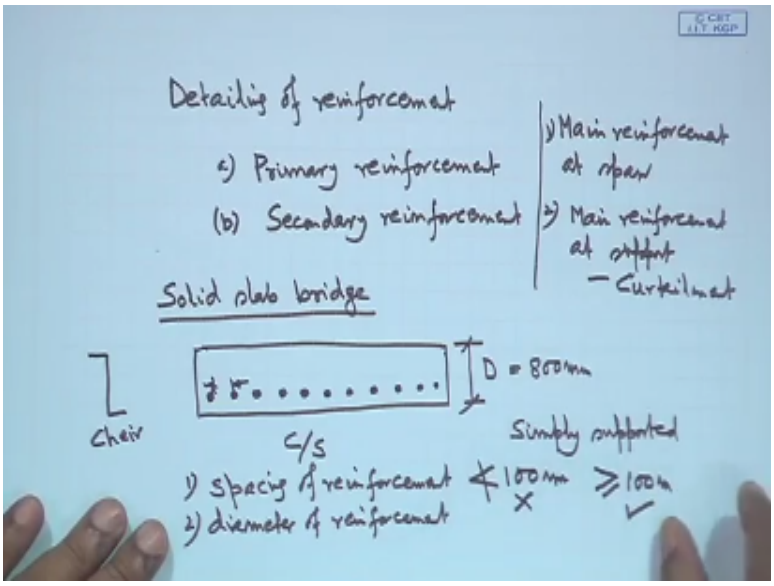
So coming to this one, whenever we are talking say solid slab bridge, then if you take the cross section, this is the depth may be say depth, sometimes may be say 800 millimeter say, something like that it may come for 10m I am talking. Then obviously this is simply supported so your objective that we have to provide the reinforcement and that reinforcement will be provided, you will have reinforcement the top also, at bottom and one.

But this is your name reinforcement like that. So I require spacing of reinforcement, then number two diameter of reinforcement. Whatever it is, that your maximize spacing other things we will make it here, that means here if you need this depth lays, there is a possible we will find out the reinforcement spacing is cannot close. I personally never give not less than 100 millimeter, it should be always greater than maximum 100 millimeter, never yes.

This is the one you should first follow, that 100 millimeter is not never less than that, that is the one first thing we should make that one, somebody can argue that why one 90 millimeter like that, why not because the things that you are having that as per code, codal provision you are

having say maximum, in the minimum spacing we will be say that maximum size of course is raised or maximum diameter bar whichever is maximum we all know that but at site you are having not a single bar like that there are so many bars there over lapping of bars like that we are having so in that case if you make less than these particular one.

(Refer Slide Time: 05:21)



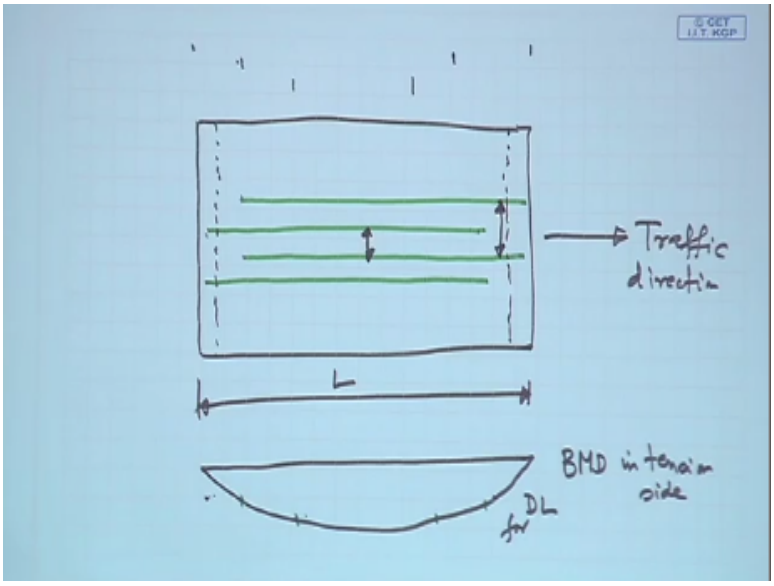
Then you will find it will be very difficult that it will be very jungle of reinforcement and finally whatever design you do finally what we will have in you will not be able to get it that proper that you say casting of your concert that you are and you will get void other things and so you will not get that required strength, so this is very important here that this is that is why I am tell this one primary one.

There are slab secondary reinforcement also with they are at side reinforcement will be at the top of also reinforcement will be there also those things to keep the top reinforcement we require certain kind of chair type of thing like this over that actually your reinforcement this is we call say chair so this one actually you are not designing actually this particular one is coming here now whenever you are giving this chair so it can put it here in a proper one that something you can provide the chair enforcement also.

Though in slab means actually call it actually loosely we can call that particular slab bridge without chair reinforcement that is the one but sometimes we provide chair enforcement in the solid slab also at least near the end then the next thing is there main enforcement at span and

main enforcement at support that mean this is the one two enforcement that means there will be curtail of enforcement here because why bending movement is less here, so you should have certain kind of idea that where you will curtail the enforcement.

(Refer Slide Time: 07:25)



You will find out that when we consider that one see your sold slab I am drawing the plane this is a traffic direction here you are having the support we find that reinforcement curtail in number of places one in the middle portion one can say I shall provide here to here then I shall provide certain portion here to here then I shall provide certain portion here to here all most lastly you can say if you draw the bending movement though because of live load it will be different but any way just let me tell you because of the dead load that I have draw BMD in tenant side so that is why I have draw in the bottom.

You will find out in different books that is drawn the upper direction but I pay for that one bending movement that it will directly give you idea that defection shape also this one for dead load only say but for livelihood you will have different one now what I mean to say I can have certain curtailment that means I can provide up to theses then up these another one we can provide and that way we can go ahead so that is the one we can provide alternatively you can make only one curtailment.

That means here whatever I can do very interesting thing that these again puts me I shall provide say up to this alternated reinforcement it will go other side that means both the bars having the

same length only thing it is tracked one is coming this way that means I having that one the next bar will go like that and the other bar it will go like that now whenever we are having that one more curtailment.

So that curtailment at what sequence you will give that one also to be very important that mean we can providing something like that here so that what interval your providing so that why that something's that your say the saving that one say reinforcement other things they go for one more cutter, so this is first one you are having one together then next like that like that here but here generally you can have say your make a cattlemen saturate that whatever spacing you are having here, D spacing and then these spacing the double of that then it is very easy to do it.

It is 100 then there is 200 like there is 125 then G2 150 so we can cuttle in the particular one that this is a section you will be check where that will be resist and that particular one we can find out here.

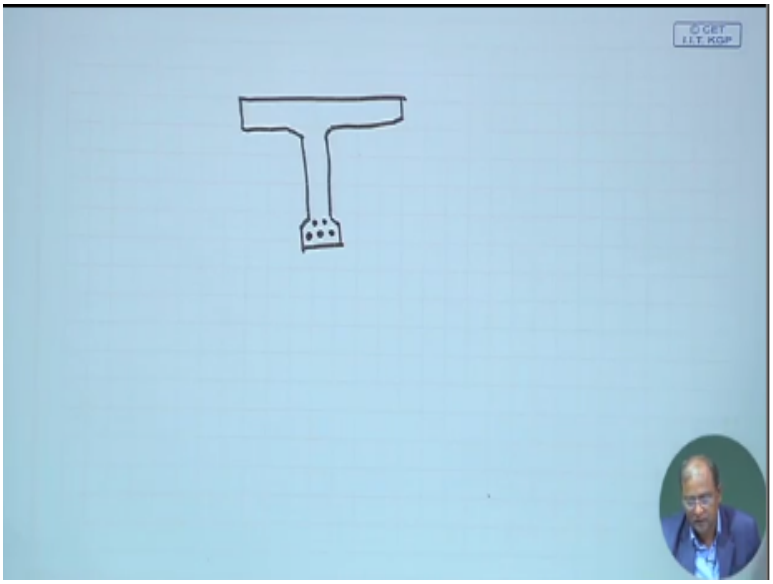
This is the thing that we do it and then we give sided for is mean the other things also we do it actually because it is 800m that one we say heavy that you are say that in section so we have to provide side reinforcement also then we have to provide that one that keep that your set of reinforcement in proper position that also there also the also we have to give a provide sheers that things and that is why I told you since you are providing, that keep that your set of reinforcement in proper position that also then also we have to provide shears other things and also.

I told you since we are providing shear so you can think that advantage so that we can provide the and the shear reinforcement that also you can consider here that is the thing regarding slab that way we can find out and then you are having that your bar marking under things we can do it so these comes under schedule of reinforcement we call it call it actually, here that these one is here schedule of reinforcement this note that particular one.

I am not talking actually bar bending schedule that is another term is there bar bending schedule that is the one length of the bars everything we have to mention because that is not the grider task here we mention that one is a schedule of reinforcement the what type of body you are giving and how it looks like but you are not giving the quantity bar bending schedule, actually means that you calculate the actual quantity of the bars also.

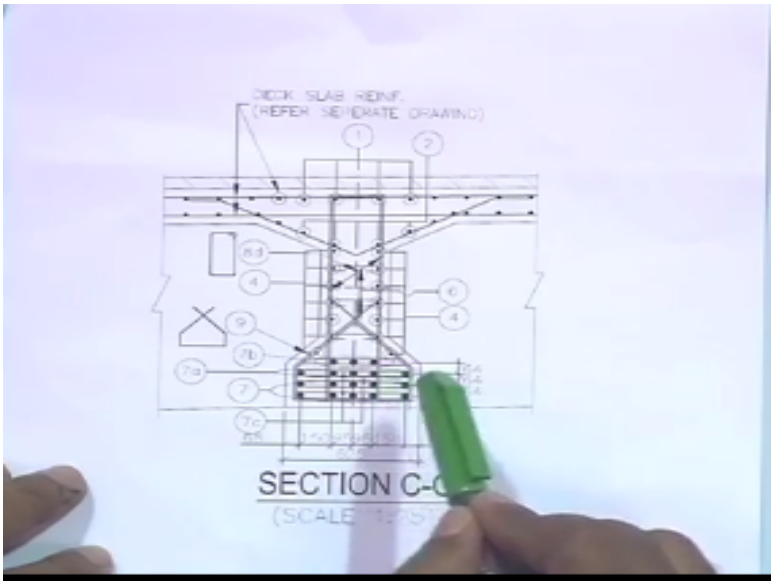
And which is not the task of designer so that is why we have to provide that schedule of reinforcement that we have to provide coming to the next one before going for summarize and closer of this course let me just explains sometime of that time you say or your what is called this.

(Refer Slide Time: 12:30)



RCC t beam that one we let me tell this is the span dimension like this and we provide here that named reinforcement again longitudinal reinforcement whatever it is we provide there is your some main reinforcement, now let me show you one figure then it will be clear that how it comes.

(Refer Slide Time: 13:10)



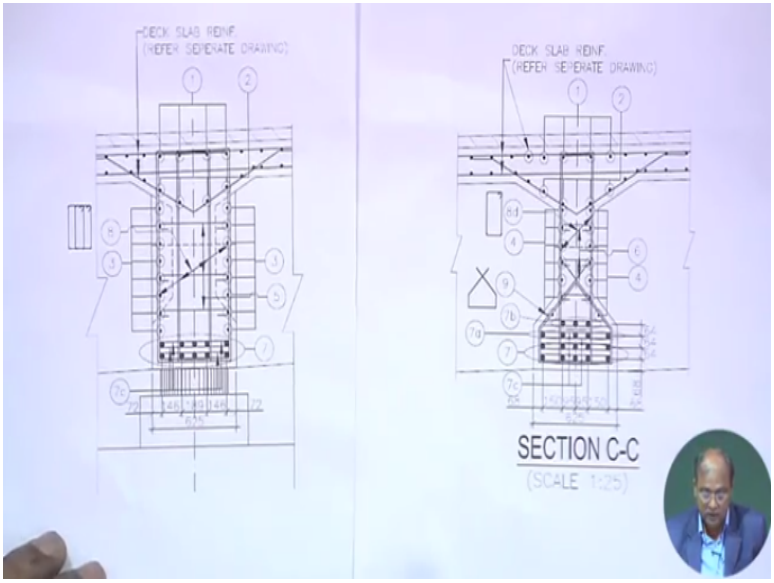
This one you can see that how it comes here this particular one to give you idea that this is the one that how the reinforcement comes and you are having different numbers for example this is one this is 2 this here we are having shape 4 6 whatever the bars are there 8d 7a 7b 7c all those things because if you mention the bar description showed here then the drawing will be too much crowded, and here also we just see this one here you can deck slab reinforcement refer shaper a drawing we actually separate.

Drawing that particular one here we have to do that mean that particular one we will give in a separate one this is your particular section which is given as say in section CC which is at medium or link section and these are you can your reinforcement here that you are considering your reinforcement here 1 2 3 4 5 5 and the 3 that means here 15 + 3= 18 that means you are providing this 18 that you are providing here reinforcement that you are providing this is your main reinforcement.

Which will get it from the bending moment whatever we are computed from bed load line load all this things whatever we computed for a particular grider and the main span or mid span you will find out that, that is the one that is one telling this is your primary that means first one you

are having that overall depth, that we use to get it will help you to know the moment of resistance due to concrete and second part is that you say still the reinforcement that you have to provide so that the structure will not failed theses are called side reinforcement since there is six and two weak so obviously you have to provide certain side reinforcement part that you are having steel observed also so this particular one you are having here just to show you here this is the medspan.

(Refer Slide time: 15:33)

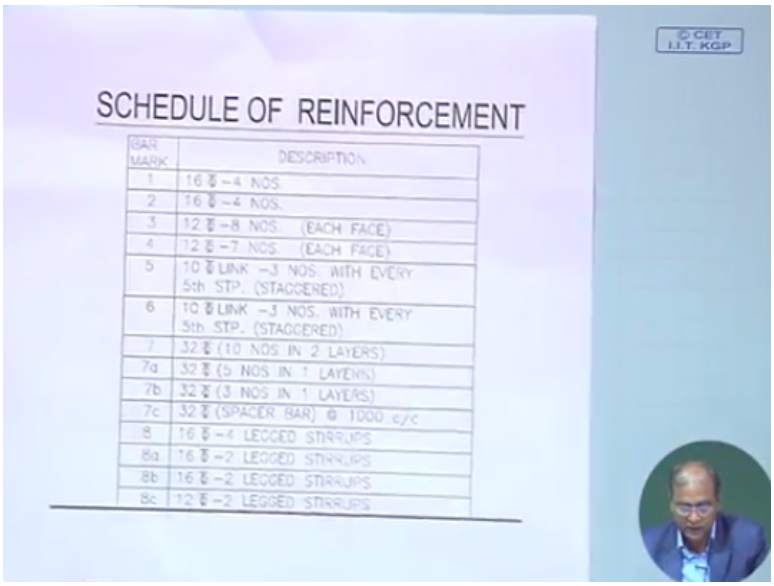


And this one we are getting here it is becoming white so that's why that it may not be isolate but anyway just to bear with this situation for this particular one this is at the support so whatever you can see here there are two particle lines and here you are having one vertical line this is another vertical line this is other vertical line this is about trigger line so that line also shown here that means this is whole set trigger why does it is shown this is two legate.

Similarly these bar how it looks like the bar loops like this the bar loop like this so those information also you have to lead now whenever you are having this information now here that here was missing that is here one, two, three then pipes seven C you see that one that reinforcement is cut here.

So that means here we are having only thing here you are having take thin there means there si a cut along reinforcement here now where shall I get this information so where shall I get this information that what is number 1 number 2 number 3 those things.

(Refer Slide Time: 17:00)



We get it here that is called actually schedule of reinforcement so we can take it here this schedule of reinforcement that you can get it here for each of them there is one gate of reinforcement and that's why you can find out please a little bit careful and be attentive so that you can find out 7 a) 32 10 nos and 7 b) 32 5 nos and 7 c)32 at space bar that means now whenever you are providing a layers different layers of bar so it will fall .

So that's why you have to provide in between you have to provide a space bar so that the bar will not come down and that on is what specifying to provide that one you have providing at 1000 so that means 1 meter you have to providing that then you are providing whole legged stirrups 16 for whole legged stirrups 16 for two legged stirrups you are providing.

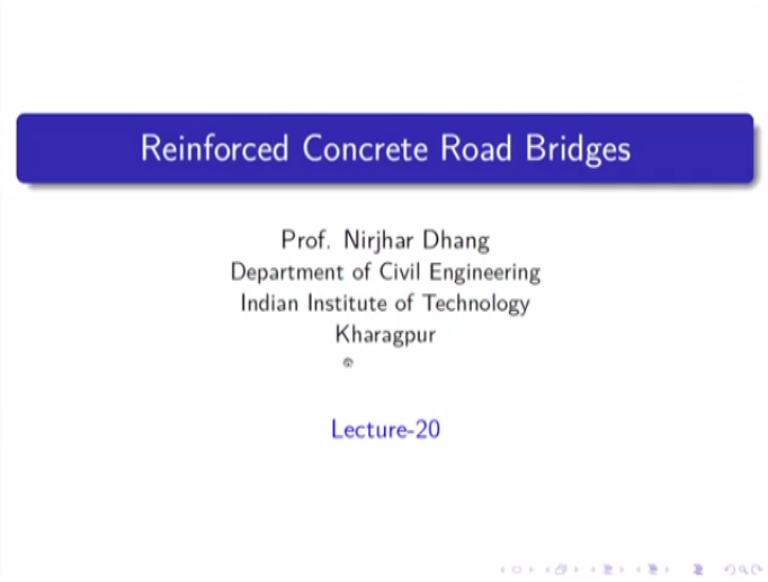
So like that all the information you have to keep it here and this is called at schedule of reinforcement that's why I told you that these information you are giving that one because that bar mark whatever you are providing it there that one I don't want it to crowded because if you make it crowded it will very difficult to understand that if you keep on writing so many things then it will be very actually you can see that how difficult it is that particular figure.

Now if you further there you make it. it will further difficult that's why you keep the bar mark here with these bar marking and with this bar mark we just make it here and this one we called schedule of reinforcement you have the additional information quantity other things which will

come which is not a job of designer that one will be done by the contractor they will do it or the he will be telling of the that you have seen schedule of reinforcement that one.

One more thing i would like to say this here that poor sectors that will be done by may be done by a separately things see the substractor and foundation will be done by separately you can see I have told perceive earlier that bearing will be done by the separately things see and not only that the reinforcement also done by separately then see that casting of that you reinforcement concrete that concreting will be done by the another regencies but reinforcement that will extracts those particular one according to drawing you do it.

(Refer Slide Time: 19:35)



So these are the things actually we make it here so coming to the now last part of this particular lecture as well as for this course let us come to the particular one here summary and closure that

we4 can let us see that whatever we are discussed so far in this class the thing is that initially possibly with a started would that we shall saw the different progress but I have thought of that one that problems will be giving separately so that you can go head and go through it and you can have questions other things also no like that and next thing is that but the basic things basic principle, basic philosophy, basic idea that I actually tried to make it.

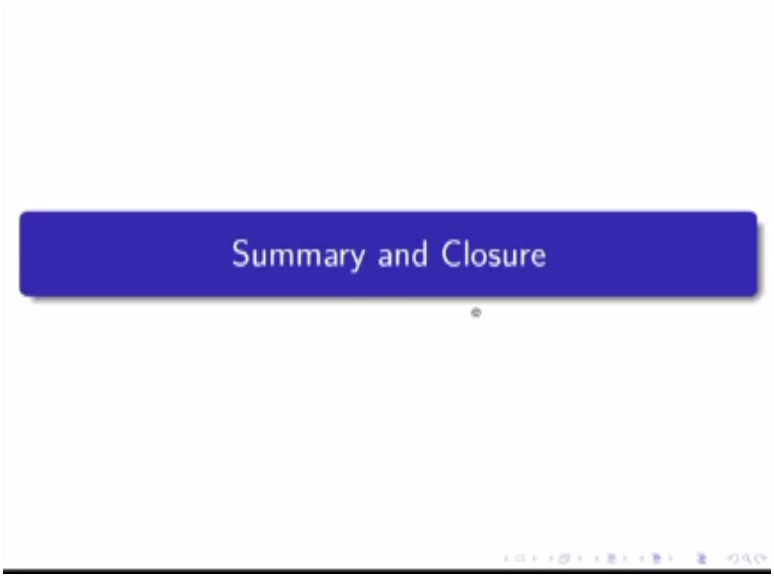
The bridge engineering very interesting course no doubt and it is a separate, it is very important also and then it has dealt in different, because I have told you that the bridge are actually neck of the transport system, as all the information is going through that one. If there is any problem or any kind of deficiency the whole system will destroyed, that is the whole idea regarding the bridge engineering.

So coming to that one let us see whatever we have discussed so far, because since this is the first course on the bridge engineering, that one is subset of that one which are most common, so that is why thought that I have given such a introduction because the simply starting from a middle it will not help you and it will not an idea. I have given one video for the references and that I have given for the whole course for bridge engineering, so that you can understand that one, how you can actually go ahead, you can actually think.

If you do not get a opportunity for another course like that because the thing is that, this is the one starting point in enforce concrete and then we can have actually sub structure and foundation separately, then you can have stress concrete, then we can have steel bridges and then we can have steel concrete composite bridges. Then cable supported bridges like say, Cable Bridge or sustained bridge and finally bridge maintained. So I consider the bridge engineering part, actually I am at Kodakpur I am taking class on bridge engineering in one semester course and I have distributed the course in that fashion.

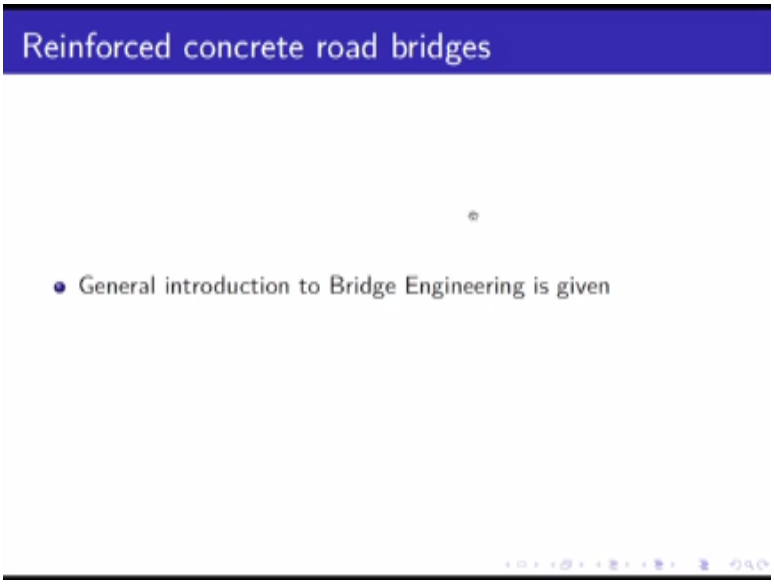
Which comes around say 60 hours, out of 60 hours 48 hours lecture and 12 hours your tutorial we consider here, so coming to this particular one let us see before going ahead.

(Refer Slide Time: 22:15)



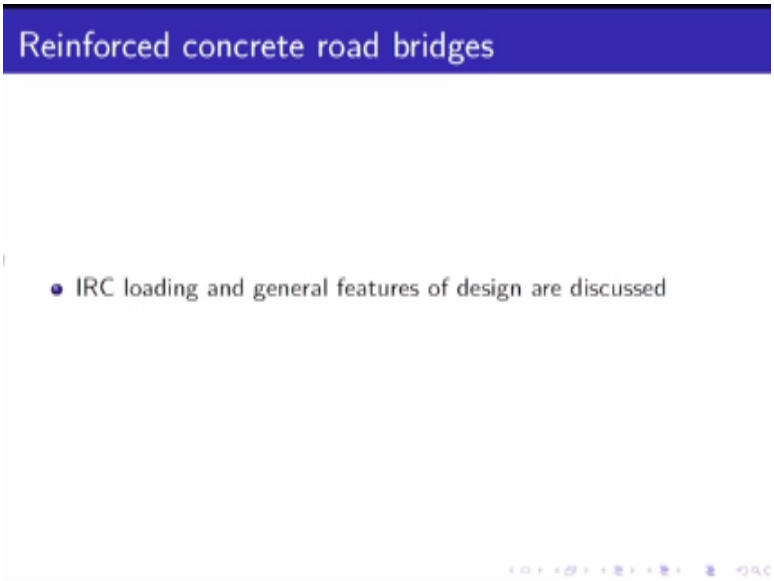
What are the things that we have covered?

(Refer Slide Time: 22:21)



So as I have told you earlier I have given general introduction to bridge engineering, given that particular one here with different aspects of that particular one I have given and these particular one you can take it actually the first part of the lecture with that first lecture itself, allow you the references that already we have uploaded, you can consider that one. These two can quote together, so that you can get an idea about the bridge engineering, what it means? That one you can consider over here.

(Refer Slide Time: 22:57)



Second one we can consider over here, I have told actually the IRC loading generally, initially I thought of give you the euro code also, but anyway it will be too much may be because I have tried to make a slow space that you can understand because the thing is that, it is not only the numerical problem solving, is the one that I would like to test for my idea, my experience, my feelings about this particular course that on bridge engineering.

That is the idea, because the thing is to understand the approach then you can go ahead with the problem on your own but the thing that, my objective that one that I would like to show you the venue, there are so many paths, which path you have to follow? That is the main objective of that a particular course in this 10 hours that I have to make it.

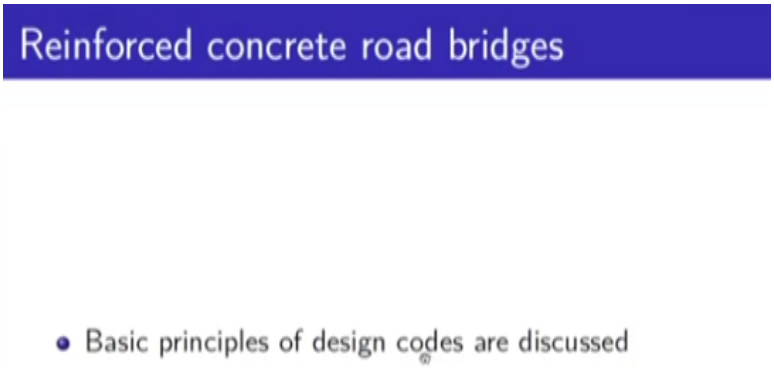
So IRC loading and general features of design which is mainly covered under the IRC 6 and IRC 5, general features of design regarding your foot path and your course say casberia and rallying

those auto geometry that is given in IRC that particular one which is called section one and then IRC 6 loading which is given in, impact loading and other things that is given in IRC 6 that is called section 2 and these section 2 you are having here that your combination of loading also they are you can find out here.

And that is a very good book another the IRC 6 now we are having 2014 latest one and you can find out the different combinations and other you can find out and which is close to euro code and if you get the opportunity you go through the euro code also, so that you can find out, how the IRC is actually taken up these things you can find out.

I shall take and give one problem which I have not covered here that I have not told but at least I shall solve show you one problem solving that one by that I shall supply, so that it, can go through that problem you can find out that so you should give the next two weeks that we can give that one when you will find out that, so coming to this particular one here.

(Refer Slide Time: 25:21)



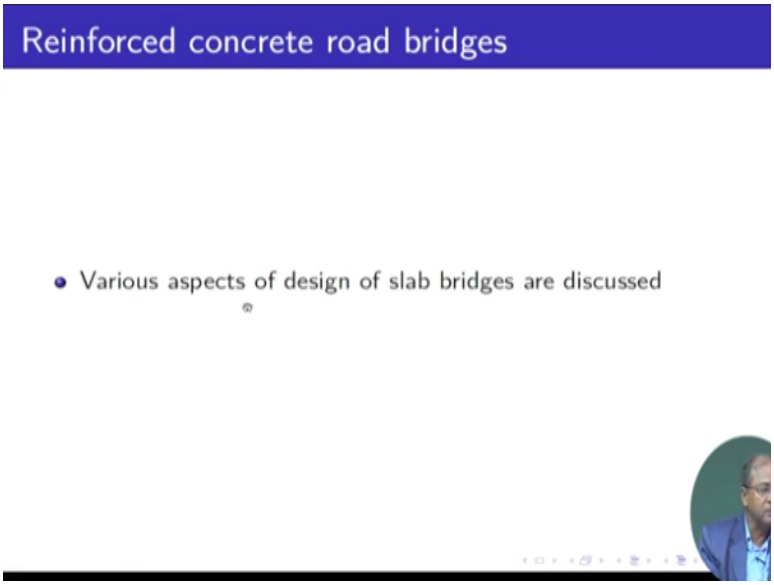
That basic principles of design codes are also discussed why we have discussed actually that most of the cases actually that will not get any opportunity to do that elaborately analysis but modern codes with that load resistance factor design that is the code actually you followed that is based on certain principle of that your simply elaborating that elaborating index that target elaborating those things.

That is why I have taken exclusive that particular one here though it was two tight within an half an hour what I thought that it should be there so that you can understand that how that code actually make that gamma or different factor how they calibrate how they are coming to that 1.5 or 1.15, 1.2 those values how they are coming that is the one and that is why I have referred one book also.

So that you can go that particular one if feel because I have told you earlier this is the one that show you that how that codes are actually thought that there since having experience on your say reinforce concrete or the steel design ,so let me refer those two books and ,but the thing that I have found in that miserable because the things that the here they some of that they could not correlate in the bridge between the bridge inhering and then the structure then that why I tried to leave the spectrum one here ,as I have told you in the last class also .

So that the wattsney method and the limestone method that the considering that the rectangular section and on the rectangular section in the limestone method which is follow in I R C 200 both the method are there rectangular method that we space block actually used in the I R C 100 ,and that I have shown you and the how it is used full for the these are the neutral axis of the rectangular block that the parabola block because it keeps confusion are problem in the computers and that it actually overcome this rectangular block.

(Refer Slide Time: 27:56)



And we have discuss with the reinforce slab bridges and we also solve the problem that we have given hen we aspect with the design of the design the slab bridges we have discussed here then we have how to calculate the exceptive width that the things we have calculate and then on the dissection that we have calculate we have calculate the C R force and then we can check that one though we have shown with the Walter.

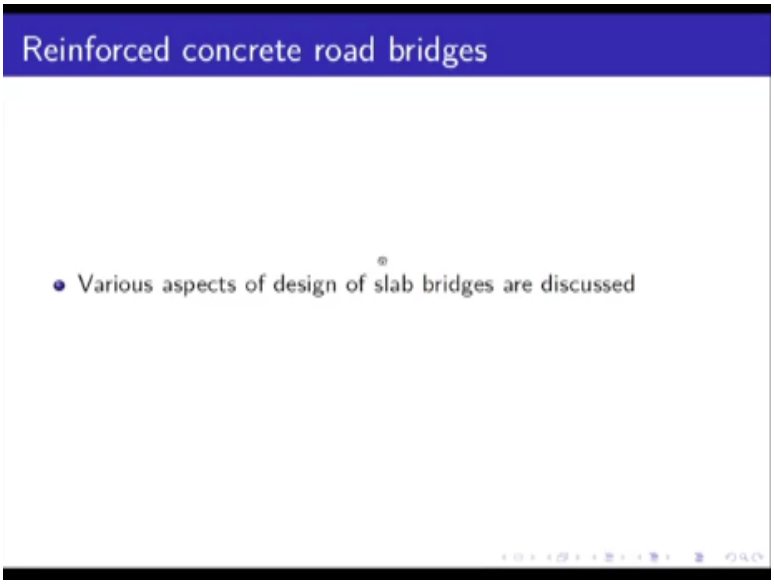
So method and then again supplied in the other one in the method main objective is that it will find you that in next in that between the parameter changes that will get the different values but te basic principle will design even the same in the waltneys stay method and limestone methods and whatever weather which stick block you are considering weather parabolic rectangular or the rectangular the matter the principle is that the confusing force is = to tensile force the first one.

And the moment of residence due to steel mounted register and due to concrete will = to composite force times liver or tensile force times liver that is the one that will give you the moment or for super binding moment. Similarly for shear force also, shear case that will take B and divide by the bd that particular one we will consider. The support in the RCCT that support we provide most of the cases we provide four leg and the mean span and certain the beyond length after the say 1m, 1.2 m or 2.4 m like that we can consider provide actually 2 legs at support.

That is the one we provide that one, generally we provide 12m dia, provides 60m dia, 150 cm or 100 cm depending on the situation you can find out. Why I am telling this number because you

should at least the time of design what it will generally provide because in the standard bridges what we generally provide that also you should know.

(Refer Slide Time: 30:01)

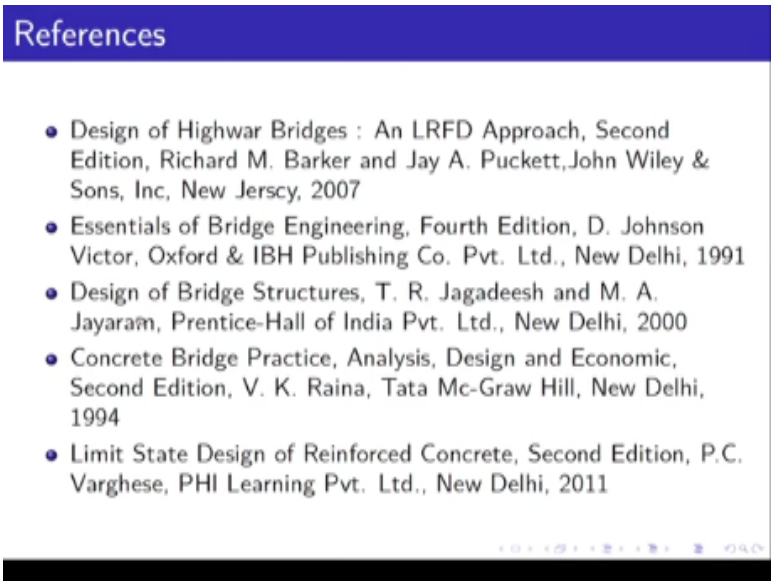


Next finally we come to this particular one here may be various aspects of design of RCC beam are we have discuss in the few class. Though you could not solve the problem in detail but I have given the basic incite of basic principles what we will give you that submit you the complete solution of at least the one you can understand that different aspects how to design that once a slab. How to design your say gently we have brought ho\w to design the garden.

How to calculate that simply method you can try with the stead with shape or CSI bridge or media or whatever it is available to you in your other aspects like abacus and sees other things also there are so many sectors available. With that also we can find out the in the moment CR force providing the connectivity geometry coordinates section information and loading we can find out that you are is a dandy moments CR force you can design it also.

Finally though I have given the separate video on that but I should put it on record which books I have followed that there are plain to have other books available but mainly whatever books I have followed that occur the one. That I have considered.

(Refer Slide Time: 31:27)

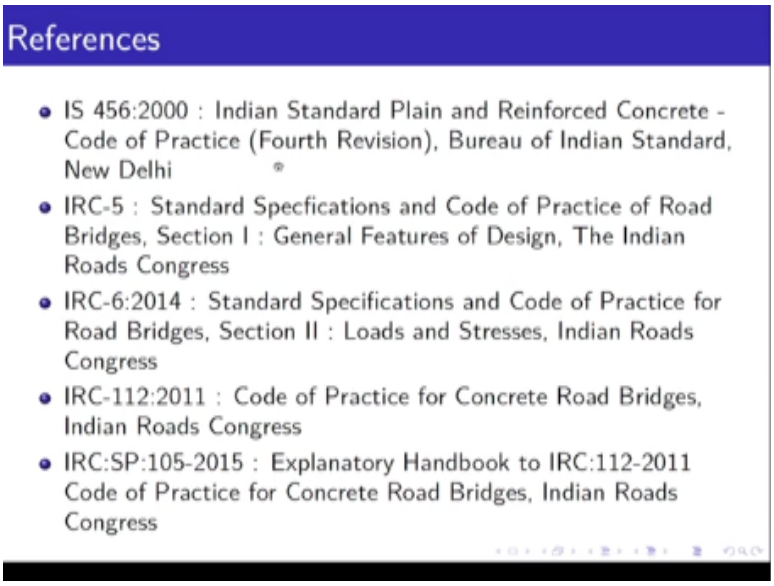


These particular on is here sorry past Mr. these one the design of highway bridges this one the mistake of highway bridges. LRFD that second edition essential of bridge engineering portal design by Johnson Victor this is very, very old book and very good book also. This book also very good that design of bridges T.R. Jagadeesh and A. Jayaram these are the spectrum here. I am sorry that the first mistake is that is why excuse me that is why here is highway and then concrete bridge practice analysis design.

And economic one the second edition V. K. Raina this is also we required book it is very thick book possibly in the second stage whenever you go for your say pectricene engineer you can do it. I thought that I should give you one book on the enforce concrete that I should give it here. And this book I actually I extensive to use it now it is easy for this, so that book can use it, so that is why I thought enforce concrete also you can follow.

There are many more books are available in the market, you can find out and all books are definitely good. But whatever I have followed only those books I have given I am not bust but I release I have got with the gook which I have not going to read which is not wise to different. That is why I give you the tower of books are available and extensible and to use it.

(Refer Slide Time: 33:02)



Next part we are having here that IS 456:2000 that is fourth revision. IRC – 5 that code which is IRC – 6 :2014 IRC – 112 :2011 for concrete road bridge of particular one we can consider. So these are the codes and IRC:SP:105-2015 that explanatory handbook these Also we have find. Which is comes that one the explain the different aspect of IRC: 112 Petron here so these are the codes actually we have to used. So this is, oh I think that I have tried my best to give you my idea regarding bridge engineering.

That possibly we could solve few more produce but if you go to this books other things I have hope that you will able to understand bridge engineering will be able to design bridges particularly enforce concrete. Road bridges solid slab and your RCC TBM bridges you will be able to do it on your own and with this i finally conclude this particular course thank you very much.

(Refer Slide Time: 34:14)


Thank you