Building Materials and Compositess

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Lecture No - 24

Floor panels

So we are back to Module 5 and Lecture 4. So, in the previous three modules of prefabricated concrete construction, we had tried to cover after the introductory lecture then we moved to the recast items, which we usually use in developing countries. We had in first lecture discussed how, why we cannot adopt it so rapidly like other developed countries. And in Lecture 3, we had extensively discussed on the wall panel system, where we had understood that these are very intensive mechanized system, with lot of precision to be placed in position one after other.

And it is facing expansion so there should be proper sealing where it can actually take in some kind of water protection, there is a cushion which is possible through the ceiling system and we could design now we come to the floor panel part. Now when we are coming to the floor panel part we have to remember that these floor panels does not require any joining as such which has to be watertight, which was required for the wall panel system the masonry units or the aerated concrete units whichever. (refer time: 02:11)

Now coming to the floor panel system, which is today's discussion we see we have a system for the small spans, we have another set of system for the long spans. And this long span will also include the combined floor panel where beam and slab it is together coming as a composite. And also we need to know the assembling system which I was referring to in case of wall panel or in case of the units which are quite larger in size as compared to the brick the building units, they are set with mortars.

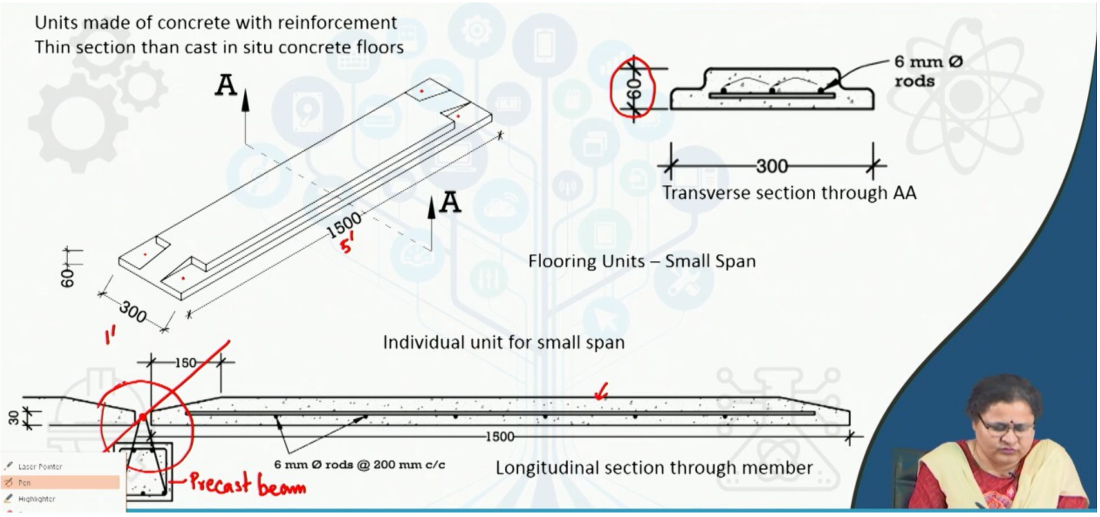
The wall panels are set with sealants. So, here also we need to know what should be the assembling system, when we are setting these panels one after the other. (refer time: 03:10)

Now coming to the small span system this is adapted in our country context. As you see a section of a small panel which is made of concrete, with reinforcement is inside it, which is a thin section compared to that of a cast in situ concrete floor. You can see the cross section here. So, if you cut a section through AA you will see that the section is something like this where the thickness you can find as 60 millimetre, which is smaller than that of a cast in situ system and you see the reinforcement bars are inside it when it is fabricated.

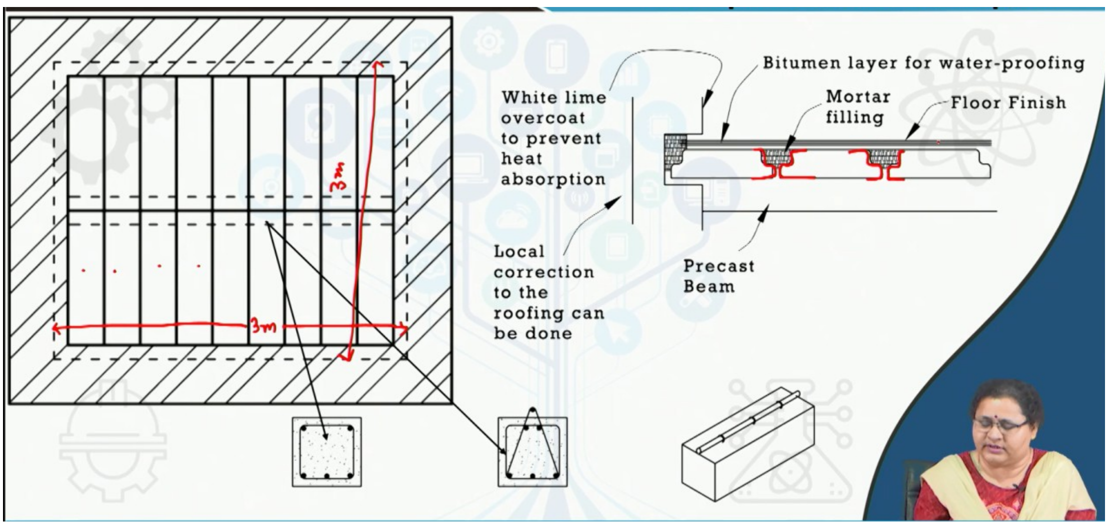
Now what are these gaps doing? these gaps here, as you can see, they can actually pull the system, help taking the system, to the place where it needs to be assembled. And if you look into the dimension it is something around 5 feet that is 1500 and on the other side it is only 1 foot. So, you can understand that this is humanly possible to be shifted to the place where it is to be placed. So, if you have such a small system and one after the other can be repeated then you can create a floor where you can actually give load.

So you can see this section on the transverse side similarly what you see on the other side, you see the longitudinal section. Now, here you will find that there is a detail when one section comes and is placed after the other, there should be some supporting member. It may be a wall it may be a beam. So, if it is a beam you will see the beam is raised in position with a reinforcement bar coming out.

So, this is again a precast beam where a reinforcement rod has been taken out. Why is it so? It is helping to lift the beam to position and as you had seen that there is a rod inside it. So, rod through and through passes through it to lift the beam entirely to the support system around it, I will come to that in the next slide. So, once this system beam is in position you can actually lift individual units and place it one after the other. (refer time: 06:47)

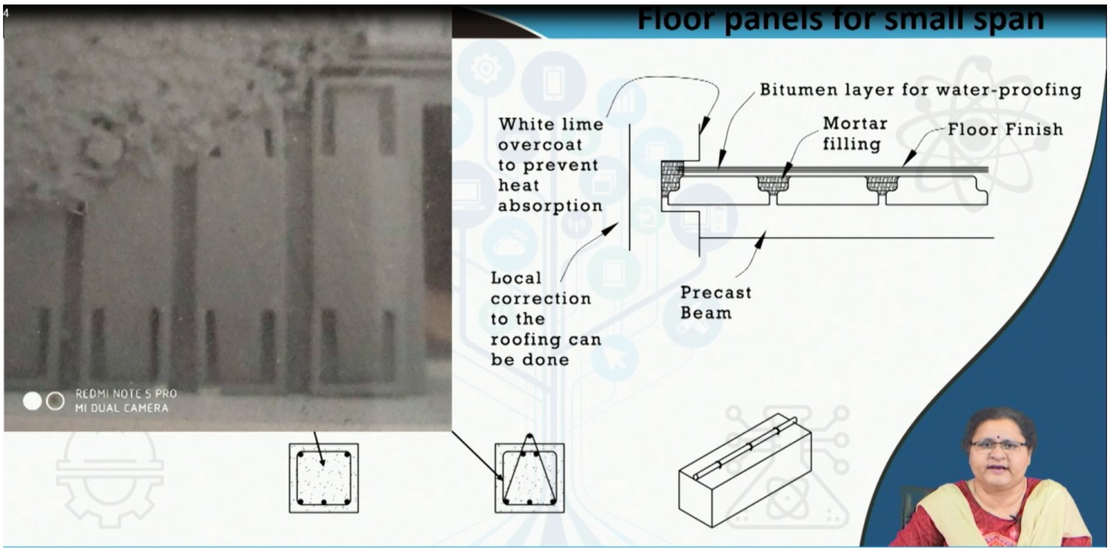


So, let us see it here, here you see if it is a small room of say 3 meters by 3 meters so if it is from here to here, it is 3 by 3 meters, 3 meters cross 3 meters. Then, actually you can place one, two, three, four units in this direction, 300 each and 1500 long, where this is the supporting beam. So, this supporting beam rests between the two walls and the cross, it is the floor slab, which is resting on one side on the wall Grove and the other end resting on the beam, as you had seen in the previous slide.



So, once this is done, you can now find out that this is how the section looks. So, you can see this is the transverse section, as you can check, this is the transverse section edge of each of the slab. What is happening? For lifting purpose you had used this you had made this knot and there you are now filling some weak mortar to bring the entire floor in one particular level. So, you are filling some mortar and bringing it completing it or making it at one level so that it can be used as a floor.

If you remember, I had shown you an image so this was from a model this picture was taken from a model developed by BMTPC building material technology promotion Centre. (refer time: 09:09)



Those have developed for our low-cost housings. It is a fast mechanism you can create three meter by 3 meter rooms one adjacent to the other and you can make the roofing very quickly even if the support is a brick wall. So, now here in this image you can see the mortar is being filled and the gaps are completed. What happens in case of the roof? In case of roof, water may enter through the gaps narrow gaps here and there.

So Bitumen layer or an EPDM sheet particularly used for damp proofing may be inserted on the roof level. So, once that is done, the moisture entry or water entry can be controlled. So, this is extensively being used. Here you must remember in a developing country like ours, we can use this system for low cost housing, small span structures. (refer time: 10:40)

But on the other end, if we look into large industrial constructions, factories, there the span is not so small like 3.6 meters or say 3 meters, where we can adapt such small span system. Here we need to think how we need to cover longer, larger spans. Now these again are made of concrete as I have told you in my introductory lecture most of these units are made of concrete with reinforcement as they are taking tension there should be reinforcement inside to take the tense inside load.

So they are again made of early strength gain cement, that is quick-setting cement, low slump concrete, these terms you know, low slump concrete means it is stiff concrete, less of water in it, steam curing for 24 hours, these are all factory made pre tensioned steel wires can be used for higher efficiency, larger spans etc. So, pre tensioned is the wires or the reinforcement is put under tension before the casting is done so they can take higher amount of load tensile strength.

Now under this long span we have two types one is the slab only and other is combined or composite of slab and beam together. So, coming to the slab which is itself stand-alone slab, they are again of two types. Flat slab, hollow core so, flat slab is 100 percent concrete with reinforcement inside it. Hollow slab is having course spread along the entire where it is reducing the weight, at the same time, going for larger spans.

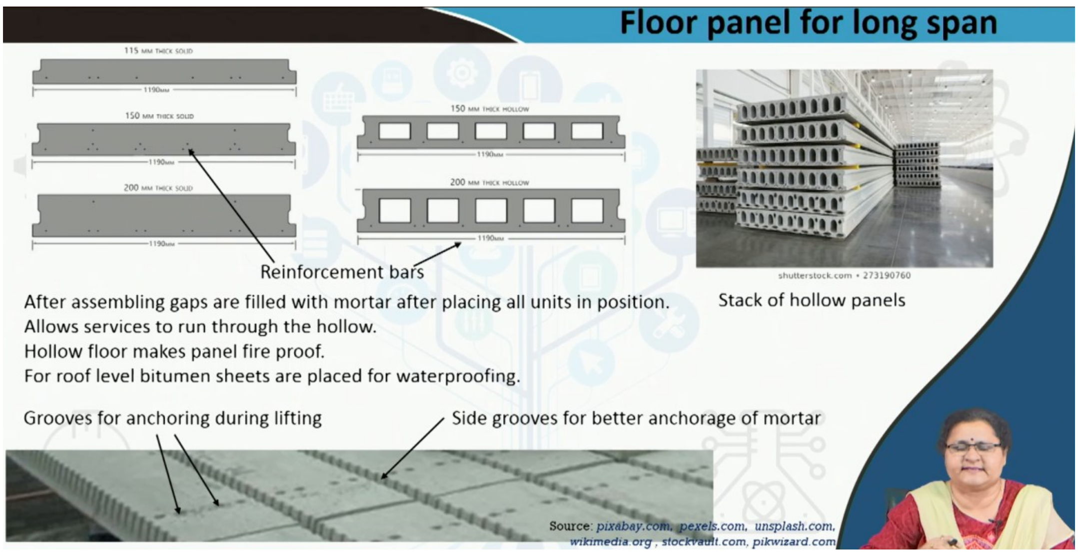
Now you see how it is represented, if FS4 flat slab F stands for flat and slab is slab of which again you see, four is the four feet of its width. So, if you go by code, you will find if FS4 that means it is four feet width flat slab. So, it will not have any hollow core inside it. It is solid slab. Length can be as large as 25 feet. So, you can now understand that we were talking of small spans referring to something around five feet.

And now it is we can see the system is itself taking twenty five feet in one go. Coming to the hollow core it is represented by 4 HC6 where actually 4 refers to the width and 6 refers to the six inches in depth. So, if you are referring to such code, you must remember that in flat slab, it is ending with its width, whereas the hollow core slabs are beginning with its width and ending with its depth.

So, these are now available up to length of 40 feet and can vary up to a thickness of 200 millimetre. How are these course made? You can have pipes inside very closed set in the mould and then the casting is made. So, it is a continuously cast in the industry and they are made hollow. Now, these hollow can have another advantage can be the carrier of various service lines. So, some service lines may pass through these hollow cores.

Next coming to the combined beam column these are having the beam associated with it. So, this is similar to flat slab with ribs. So, these ribs act as the beam and they are usually looking like the figure T. (refer time: 16:55)

So, these will have large flanges or projections which will act a slab one after the other. And these T's these ribs will act as the beam now there are different types. Double T, single T and waffle slab where T is on both the directions and it becomes a waffle like structure. So, we will come to each of them one by one. These are sections through the solid core that is flat slab and the hollow core slab.

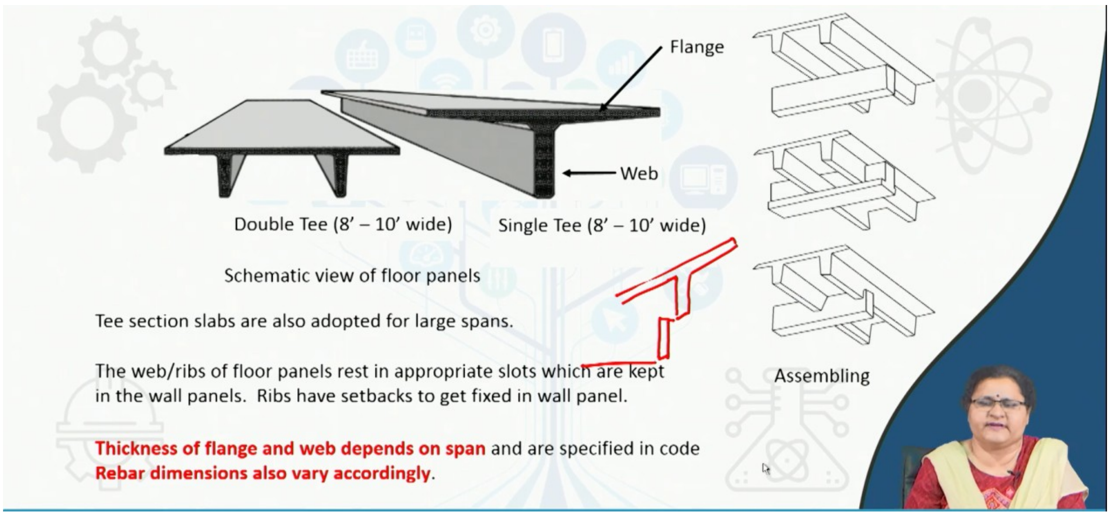


Now what you can see here, similar to the small spans, here also there are grooves to have Anchorage and they are also helping in setting the concrete or mortar which will be added later to make it a single surface. So, here also you can see such groves you can see the reinforcement bar which are shown by black dots. So, they are all designed accordingly and are placed. So, after assembling the gaps are filled with mortar after placing the units in position.

This allows services, pass through these holes, or sometimes the services are embedded in these gaps also. So, whenever two such members are sitting one after the other, you can actually have the service lines passing through on top of which you can actually pour in the concrete. So, let us see how it looks when it is made in factory. So, this is a picture collected from the Shutterstock, you can see this is made in factory how they are separated and kept in position they are to be carried to the site and each of them you can understand it is a huge length.

Here you see another picture, where you can see these grooves within the top part or the face which help in lifting. These in position now you can see the grooves are in the side for better Anchorage of the motor and these are lifted at both ends by means of a crane and kept over beams below. We will come to that later so they are not resting on because what which we had seen in case of a small span floor slab. Here we are saying it is sitting on a precast beam which is already in position. (refer time: 20:25)

Now, let us come to the combined kind of floor slab. What we see here? It is a double T as I was telling this is a single T you see with the double T the rib size depth has gone down, here it is a larger. Single T having a larger rib. So that is the web that is the flange and it is around 8 to 10 feet wide. Now these can sit over a system in the way it is shown here. There may be special notches at the end of the T. There may be special notice in the web to get into a walling system.



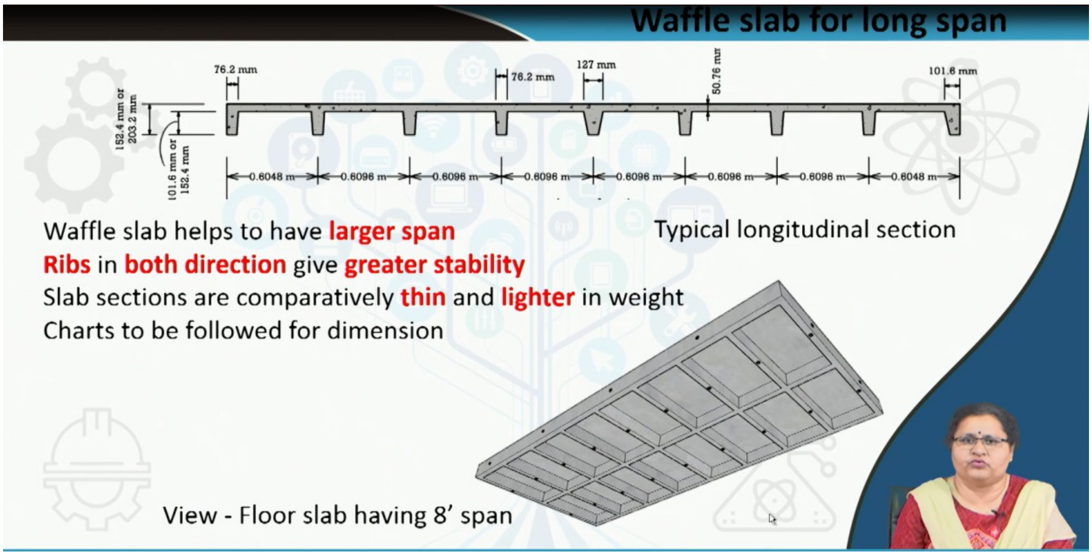
So this is the continuous T which needs to get assembled in a walling system where this will exactly go and match with the wall system. So, one has to be very careful while these are being placed. These are all to be set within its groove if the drawing is perfectly done. So, every instruction should be there when it is being fabricated, when it is being made and when you are coming to site, it is only the job of assembling it in order where the way it was actually placed.

So these webs or ribs of the floor plans rest in appropriate slots which are kept in the wall panel. Ribs have set backs to get fixed in the wall, thickness of the flange and the web depending on how big the span is and are specified in the code. Even the reinforcements, direct dimensions are specified in code. So, we as architects, we need to know the system, how it needs to get into place and then accordingly we have to design for the say the industrial structure or say a large span office structure office space which will use these panels.

So we need to get prepared knowing these systems, instead of only knowing the conventional methods. So, we are plunging into the prefabricated world, we have to follow specific rules, specific nomenclatures, we have to know the codes, what is the specification and we just cannot make a wishful dimension. We have to look into how much how big these can go up to and what is my requirement and which is the closest in dimension and we have to design accordingly.

So after looking into different types of floor panels, both short span or small span, as well as long span, let us try to also see the other one which is the waffle slab. (refer time: 24:03)

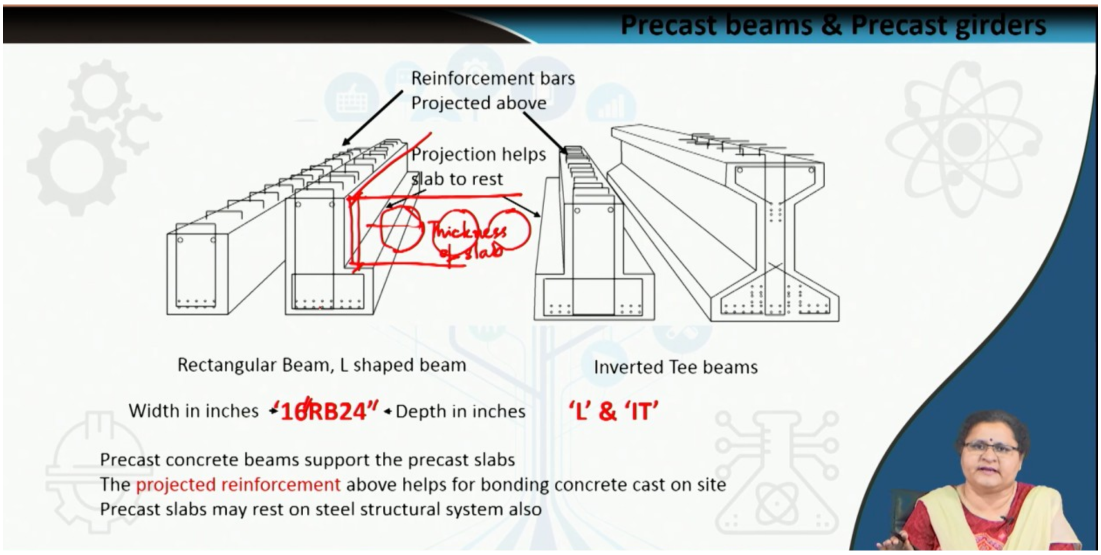
These are also meant for long spans where you see it is one slab, it is not a flat slab neither a T slab neither a combined one, rather a combination of both. So, these can go for large spans but they can take in tension in both the directions. So, they have ribs in both the directions and they have much better stability. They can be managed with much thin cross section. Here you see around 50 millimetre of slab thickness you can actually achieve. Here is 50 millimetre slab thickness and you can have the ribs or the webs of much lesser dimension.



So, charts are there, accordingly the mould is now getting complex, complicated. The reinforcement system inside it is also getting complicated which was not that much difficult in case of the others. So, if such kind of slab is also adopted you can go for such kind of slabs for long span. Let us now go to how these are to be assembled. (refer time: 25:35)

Precast beams and precast girders, so we use the girders when it is a large span. We can use this precast beams which we were talking about, when we were also doing the small spans. Here these are to be of the lengths, between the support system. So, here you can see this may be huge

long rectangular beam or it may be at the edge it may be in L shaped beam. Now this L-shaped is having the projection where you can actually rest the slab.



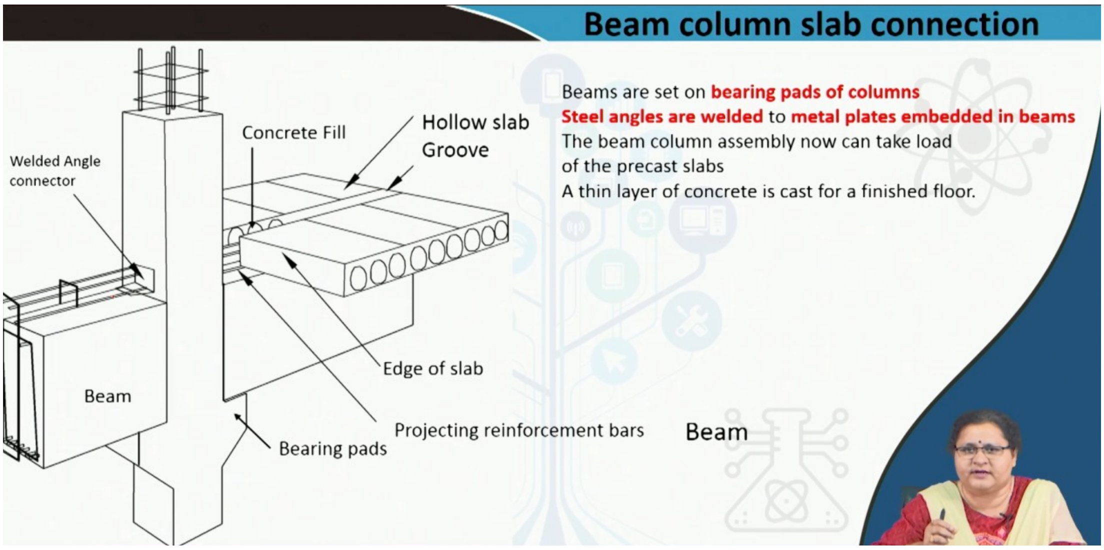
So, you can understand that this dimension, should be matching with the thickness of the slab. Now, in the case of the short span, you had seen the reinforcement is projecting out. Here also you see the reinforcements are projecting out in all the cases. What are they doing? When the slab is placed, here, at the end, these are to be locked, these are to be sealed.

So, this area again another slab will come on the other side. So, these are to be sealed with mortar. And the same level will be reached and the load sharing will take place. If it is a rectangular beam you see it is RB 16 inch refers to the width, 24 inch refers to the depth, so, there should be 16 inch 24 inch. Similarly, you have L refers to the L-shaped beam IT refers to the inverted T beam.

So, same way the charts are to be followed to get specific dimension for the particular thickness of slab. Now, these slabs maybe a flat slab this slab maybe a hollow-core slab. So, depending on what the specification is, what is mentioned, the items are to be chosen the depths and dimensions are to be chosen. So, these projected reinforcements help them to place in position, at the same time, they help to make it a unified structure when the mortar is put on as the final layer. (refer time: 28:53)

Now, coming to the beam column slab connection, here, when we are setting these hollow code slabs or the flat slab, you see we were placing it on top of this rectangular beam say or L-shaped beam. So, on rectangular beam you can see how it is set, it is set on two sides of the reinforcement. So, this is the reinforcement and you are setting your member hollow slab here, on the other side hollow slab there.

So, the reinforcement is in between and when you are coating it with the concrete some concrete is getting filled here and the top is getting a fine layer. Here, you see the beam has been welded to the column. What did we see? When we were looking into the wall panel system, they were set one after the other with dowels, one inserted within the other, on the vertical direction. On the horizontal Direction, there were gaps were sealants were pushed into, there were backer rods to absorb the expansion if any.



But here the load has to be transferred through the beam into the column. So, that is why the beam cannot be unstable. It has to be set rightly with the column. So, the beam you may check it is sitting on the bearing pad which is a projection in the column. That is also to be designed so that this projection is always left on that particular position. The beam is resting on it further the beam is having welded connection with the column making it a very strong joint.

Thus whatever load some 30 feet 25 feet 40 feet entire load is being borne by this and is transferred through the column to the foundation. If that is not done, the structure or the system will crumble. In case of cast in situ system, we do not have such options. There beam column slab are all together cast in one day and then it is left for curing. So, there is continuity between the entire structures. It becomes monolithic.

Here that is not possible because you are assembling or integrating piece by piece. So, this has to be kept in mind. So, these bearing pads, steel angles, and metal plates, all are to be there to take the load of the precast lab. And finally once everything is done, you are laying the concrete film on top to give it a very neat finish, which one cannot identify even what is the system below it. (refer time: 32:54)

So, we may conclude that depending on the span, the type of the flooring system has to be selected. Beam and column should be in place to receive the flooring member. So you just cannot start placing the floors without your beam column system in position. Beam column system may be precast, it may be steel section, it may be brick wall, it may be anything other than precast system also.

Floor slabs are to be accommodated in the walling system also if it is a combined system. If it is not a combined system it may be lying independently on the structural system. And then the walling may be done with even brick wall or concrete masonry units or aerated autoclaved concrete blocks. So, with these we finish this lecture 4.