Structure, Form, and Architecture: The Synergy

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Lecture - 06
Connecting Structure and Architecture - Part I

Hello friends, welcome back to online NPTEL course on Structure, Form and Architecture: The Synergy. Today we are here with the Lecture number 6 that is Connecting Structure and Architecture. So, before we start today's lecture whatever we have cover so far, based on that we can say that now we have some idea like how structure is integrated with architecture and how structures support the architectural design to bring you know designed solution ok. Sometimes it will solve the function sometimes it will also help the design to make it aesthetically pleasant.

Now in this particular lecture what we will talk about again something similar to the previous one like the relationship, but earlier in two lectures we have seen that structural relationship with architecture in terms of architectural concept and sometimes in the other lecture, we have discussed about structural association which will maintain the quality, visual quality of architecture.

But, if you can recall the first lecture where we have asked you a question like which will come first the structure or architecture. So, basically there is no such distinct answer because they are acting together like when the design process starts at the same time, we have to also think about structures so that will have a proper synergy to bring that into real world.

Now sometimes in looking at some building, we will find that this building is something is nothing but structure. Say for example, we have taken this example of Eiffel tower. So, basically that is a structure, you can nicely build with you know symmetry and all. So, it is again architecture. So, we cannot put it in a single category, but depending on the dominance of something like either architectural dominance or the form dominance or sometimes structural dominance will classify those thing into different category.

So, in this lecture what we will do basically? We will explore the relationship between structure and architecture and here our focus will be based on the aspiration and intention of the designer.

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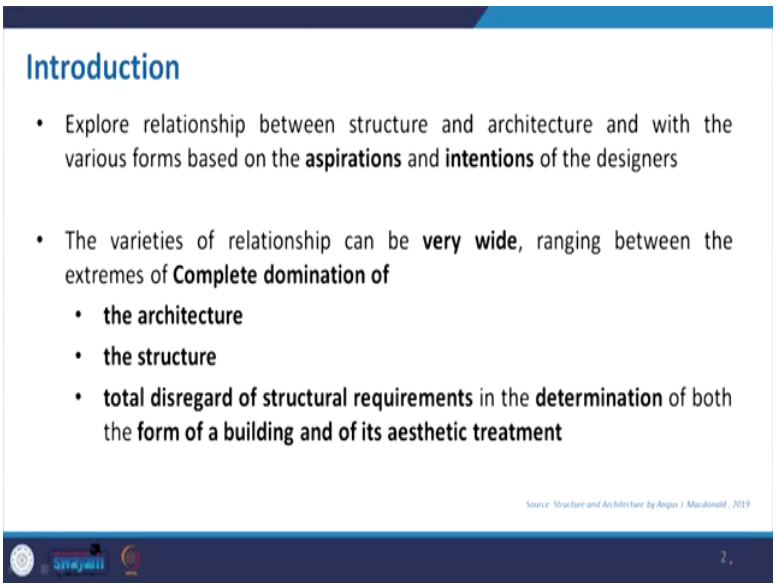

Say for example, as a designer we just design a building where I want to show some art form which will be definitely be supported with the structure, but will not really bother with the structural requirement or structural arrangement to optimize it.

So, sometimes we just ignore the structural constraint to make it sort of small. So, with the advancement of technology and different you know materials, nowadays it is possible to go beyond traditional, orthodox you know structural no fitted design; say we moved from frame structure to different sales structure and all.

So, there it depends on the designer or architect who will design the building and looking at that concept, quality or overall the form that to be created. So, whether there will be structured will take the predominance thing or sometimes it may not and sometimes with traditional orthodox beam column structure, we may feel bored. So, we go for making some twist on making that structure little bit interesting.

So, in this particular lecture, we will see those kind of thing. So, the varieties of relationship as already I mentioned that it ranging from complete domination of the architecture where architectural form then all these you know imagination creativity will come into reality. But again we should not really take these word in a wrong manner that when you go for that form creation will ignore the structural requirement because otherwise your design will be unstable.

So, there will be adequate structural support to make that form. But looking at the building what we will see the dominance of the architecture, not will see a beam column or something like that. Now other thing is a pure structure where the structure x itself representing a space ok. Already I mentioned like structure as architecture one example I felt our. So, we will see more on that also and then sometimes it may be like we totally you know ignore the you know structural requirement nor ignored in terms of the adequate load resistance and all, but to give the form.

So, we will think about the form and then adequately we give the support as and when required. So, in both the cases a building sometimes you know in order to make it something aesthetic something organic so, as already mentioned that we will go a little bit out of the traditional beam column and state forward structural design. So, on that basis this kind of you know connecting architecture and structure the form or the relationship, we can sub divide in five groups.

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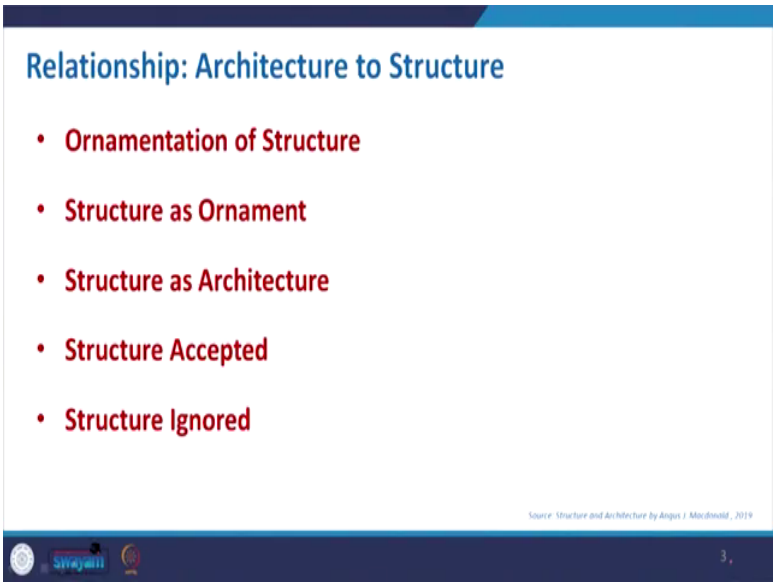

And here you will see that all these five groups are having similar what composition; that means, if you just put what left or right first and last. So, the group will change.

So, this is very important and that is why we should understand the difference and how we actually put a building in the category. After the end of this lecture, I what I will expect from you all like you will give provide more example to each of these categories so, that we will know that how we actually categorize the building in terms of your architecture and structure relationship. And in order to know all these 5 points and different examples in all the category, we actually will have two lectures. This is the part 1 where we will cover two of these five and then the next lecture will be continuation of that where we will discuss rest 3.

So, first two this ornamentation of structure and structured as ornament ok; they are little bit confusing, but I am sure that end of this presentation you will able to identify the difference

between these two category. And next lecture, we will discuss about structure as architecture, structure accepted and then structure ignored. Again I am saying that we should not take this structure ignored means we compromise the structural requirement it is not, but to create the form in form making we just you know go beyond the traditional structural system and all.

. So, we will go to you know look into all these examples. So, let us move on with the ornamentation of structure. So, what is ornamentation of structure?

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Before we go further detail with some other example, we all know this building right. So, this is Parthenon, Parthenon from Athens Greece. So, what exactly it is and why it is ornamentation of structure, what is a meaning of ornamentation? Means decoration more carving something like that. So, ornament is to making something beautiful in details and structure already. We have discussed with different definitions and time to time almost in all

lecture. So, far we have used the definition of the structure so, it is basically you know parts of a building in terms of building structure parts of a building which will resist all applied or impose load to that building ok.

So, here it is something like what we see that whatever the structure reunions, it is basically some combination of column and beam right. So, this your beam and column composition ok. So, with that this is very you know simple structural arrangement. So, we just make vertical columns and horizontal beam which will make the structure you know stable. But it is not the simple beam column, now it is we see for the high like your fame structure. Normally we use some you know rectangular cross section of that, sometimes it is circular. But what is additional to it? If you see the column so, there is some decoration and at the top portion of the column which is also referred as capital, it has some decoration ok.

So, we ornament this particular structure. So, basic structure is there, but in order to make it more ascetically present, we put some decoration to it and come up with some good solution. So, the upcoming slides will have some example under this category.

So, basically what is the fundamental in order to we look at a building and say that this is under this category. So, looking at the building, we should able to identify that overall the space creation is dictated by the structural form like structural arrangement rather. So, structural requirement dictated the form.

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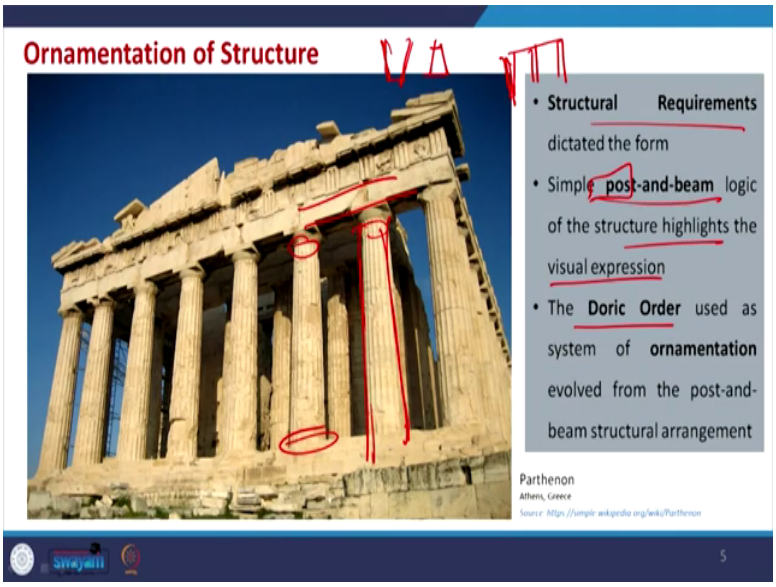

It is simple post and beam like structure that we have that will highlight the visual expression.

So, here looking at this if we just make a alternative to that, so, we should not really dare to compete with that. But if we want to simplify with a rectangular one so, we will have some you know post and then you have some you know beam like your beam structure. So, post refer to that vertical columns and beam already you know. So, this is the arrangement normally.

Now in order to beautify this so, we what they have done? They have used to this ornamentation. So, here it is Doric order used where you have you know the one property that this particular cross section will vary and at the top it is little bit tempered. And the reason is these all are made in some monumental scale. So, we know the perspective concept right.

So, whenever like we see a tall building so, basically that will act as a three point perspective. So, for a high rise building so, what we see from the bottom. So, it is something like that means it is merging to a point, but the point is it is not exactly the same even the rectangular one.

. So, this has been created to correct the visual error. So, the example if you make your structure little bit tampered downwards or something, you will have some things different. So, here they have made some correction in that in the history like these has been covered extensively so, sometimes we make those correction. Here in the Doric column what is the features that at the top or near the capital there will be some reduction in that and you have a capital like this.

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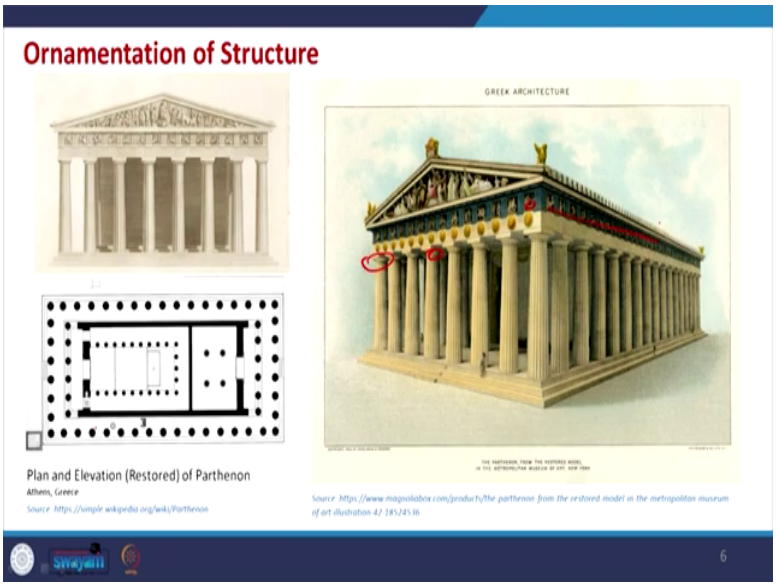

Now, this slide will clear this thing more you know accurately. So, if you see that this particular you know plan and elevation which is; obviously, restored after that that was no restored drawing. So, here you see the all these you know solid circles, small circles are the columns and it is arrangement of that a regular interval columns they make these building like that ok.

And now if you see this particular painting where it is definitely in overall sense it is just an arrangement a combination of your post beam or the column beam arrangement, but all others decorations special in the column or in the beam, those are additional ornament to it which add value to it and it will definitely it makes the structure different from a traditional beam column structure.

So, it has been in practice in the Greek architectures apart from this you know Parthenon, we have many such buildings there where they have used. Now for the decoration let look into the history. So, here are different type of columns or force being used.

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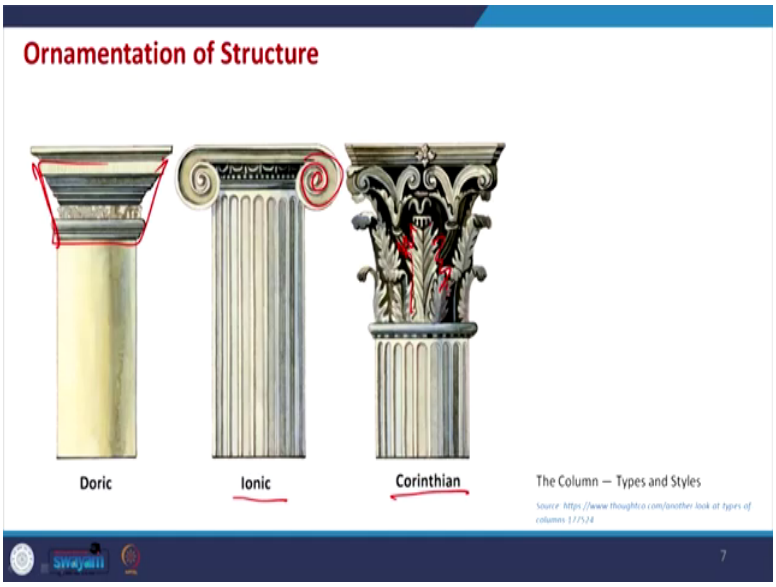

So, Doric order which was used in Parthenon you see the capital how it is being made. It is very simple staggered and there is some minimal ornamentation to that, where we come to Ionic, so, the capital will have some involute to create some way or something like that and when it is the Corinthians is more curving and all and overall it will give you know it with this picture, you can see do something like leaves and other thing give more organic look to the capital of the column.

So, with that we create different kinds of ornamentation of structure. So, basic structure is again post or column, but now with these carvings and all so, it is basically some ornamentation which add value to the structure. So, this is another example where Doric column is used that is Auckland War Memorial Museum. You can easily identify these things.

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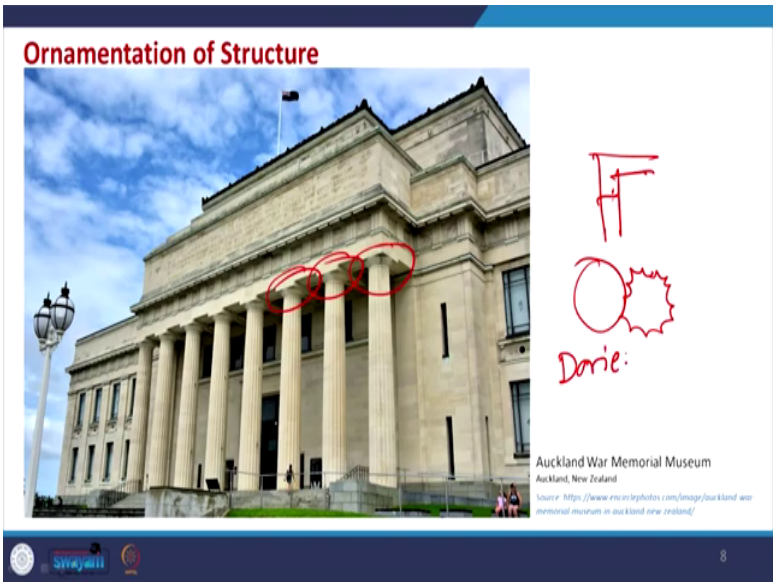

So, these are basically a cylindrical post pillar, but having those cross sections. So, basically it is not exactly the circle. So, instead of that basically if you draw it correctly so, you will have this kind of cross section and at the top also the capital is designed in a different manner. It is not a pointed beam column that we normally used for the frame structure.

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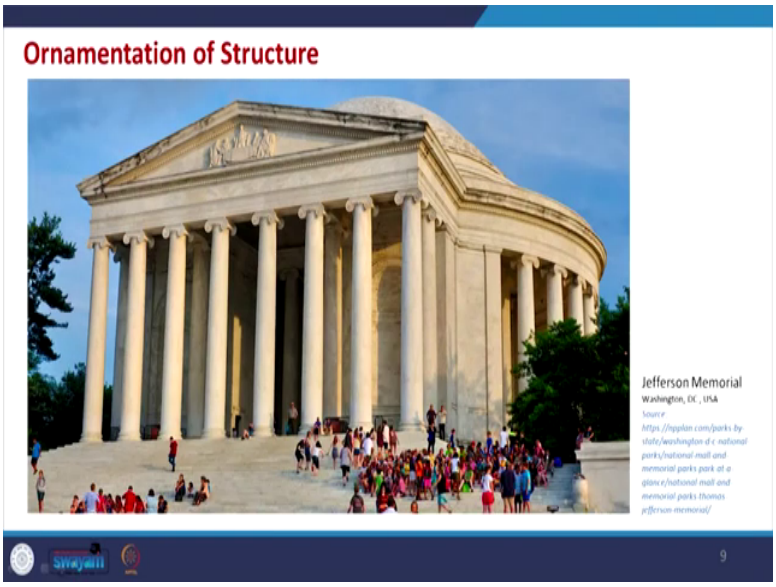

Now this is from example of Doric and now move to the next one this is Jefferson Memorial in Washington DC. So, here also if you see the intense where the column is used and this is exactly the same and that we have seen for the ionic column. So, at the capital you have some you know some involve or something to make it beautiful.

So, this is another example of ornamentation of structure and that is following the ionic column. Move to the next one, this is the New York Stock Exchange and here if you see the capital.

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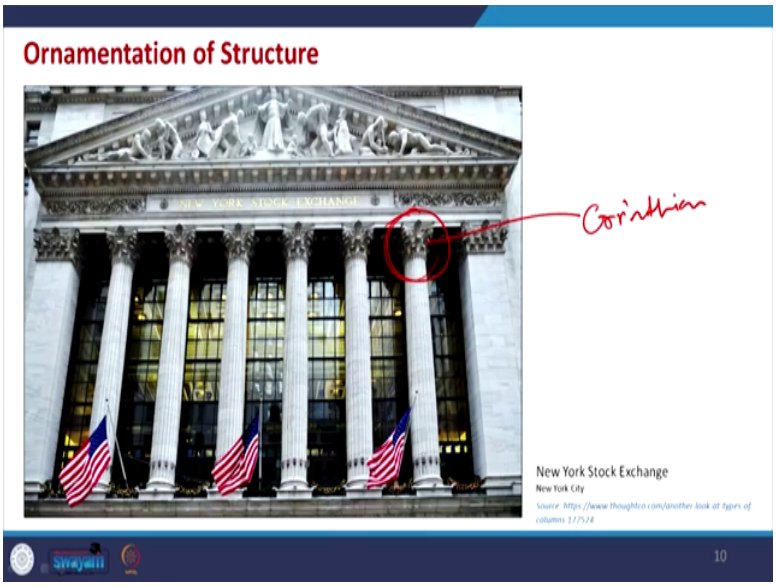

Again it is pretty similar now, I think it is clear. If you compare the slide where I have shown different three types of the column style at the capital, so, here it is definitely for the Corinthian where it is giving more organic leaves and other floral will kind of you know final outcome. So, this is something really interesting.

So, it could be a state beam column, but to give that classical look to maintain that you know important history or something. So, we can still use it even in the modern building we can and after that you know there are other types Tuscan and other you know combination and the later stage after you know in the gothic gots after that also.

So, decoration this particular you know tradition is being practice to ornament the simple structure. So, here we have seen three examples, three buildings were like one followed the

Doric the other one is your Ionic and this is Corinthian. Move on to this building portal building in New York, here also it is something where this beautiful curvature we made.

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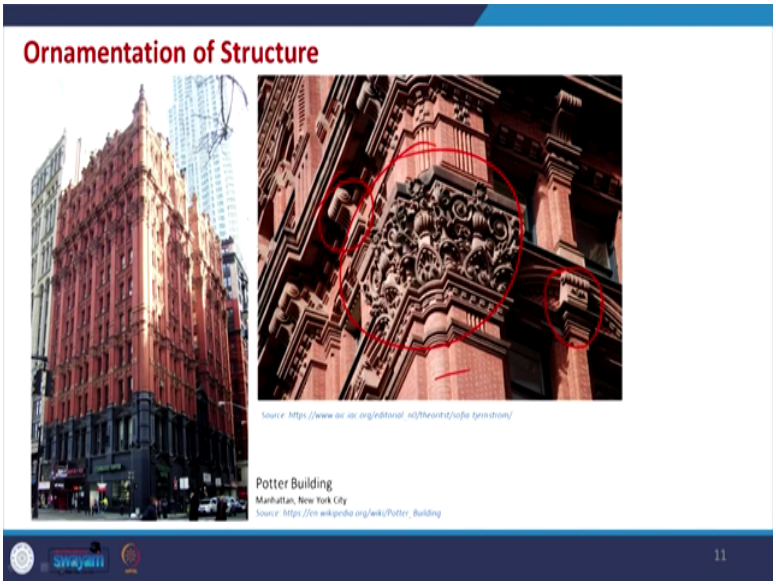

So, this ornamentation it is mixed up many. So, this is a corner portion and even the arches everything is having some extra ornamentation and that is why make this building little bit different. So, this is giving a terracotta look to the whole structure and again you see the combination its basically adding some ornament to the basic structure. So, this is another example of this category ornament of structure.

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A previous lecture also I have shown you where the span is you know covered with this mass room column. So, this is basically the mass room column. So, we know the mass room. So, with that concept we developed it. So, the slab and the column their connection ok, the simple geometry is connecting at this you know normal or at nighttime right angle, but here it is something where they have a smooth transition.

So, it could be a simple cylindrical column normally which can see in flyovers or some of the elevated roads to the metro, elevated metro corridor where normally you have the cylindrical or like cuboidal pious and on top of that you have this particular you know corridor or maybe the flyover.

, But this section can be improved like this where we can ornamented, it maintained the proper geometry and all, but finally, outcome it looking at that it is not a simple column slap

combination rather than it is some additional you know ornamentation to that combination. So, this is a modern example of that and it is from Mumbai International Airport that already we have discussed in some of the earlier presentations.

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So, before we move to this particular next category so, let us clear this out. So, what is the basic concept to put a building in this category that? Looking at the building will simplify it with this is just like stock shares Typical beam post or beam column structure and if the space is being created with the arrangement of these beam and columns this is the fundamental ok.

Now addition to that we add some ornament following some style sometimes it may be a combination. So, we used in earlier case in Greek and Roman architecture, there we used different you know Doric and we can later on your Corinthian and then after that you know a mixed of that. So, that meet the you know very simplistic beam and column to really a piece

of ornament. So, that is basically the ornamentation. So, along with some past like historic example, I have also shown some modern examples. So, that it will be clear that nowadays also it is in fact, these are very few ornamentation that I have shown, but definitely you can explore more and I also want you to do that.

So, you go through different you know piece of building and then try to analyze that what exactly it is that, how much ornamentation being done and can we put that building in this. So, then we will discuss in time to come.

Now move to the next topic for this lecture that is structured as ornament. Now here we have to very much careful. Earlier it was ornamentation of structure; now structure as ornament; that means, in this category will get to know about the buildings where we used basically a structure that act as the ornament to the space creation.

Now how it is different from the last one that ornamentation of structure [vocalized-noise?] in ornamentation of structure basic is your structural requirement fulfillment and then we add some decoration to it. Here the basic function is being made with some basic structure and then some structural arrangement put into that building which will act as ornament. So, structure itself act as ornament.

. So, in this building was if you see this is basically showing all the services, there are you know cross basing there are some you know tube structures. So, this is having this escalator, having cantilever. So, everything all together it is making some impression of the structural arrangement. So, here it is something like structure act as ornament to this building which is very simple rectangular building, but this adds value to this. So, here it acts as a ornament.

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So, here basically what normally when we see any building, we will see if the building the structure is given visual prominence ok. So, that may fall into this category. Say for example, this is Loyal Headquarters Building. So, here if you see that this building form and other space are very simple functional rectangular shape. But if you see all these you know duct that like it is exposed all these you know vertical services and other thing which is made of steel which act as ornament to that. Otherwise, it could be a simple multi story building rectangular building we will see this beam column, but this you know exposed or externally placed all these services at some value to it as ornament.

So as through if you see the inside interior of that building where again it has a prominent. So, all these you know structural bracing is visible, they are you know raptors Booleans, then you have this particular you know structural arrangement for the roof. So, its altogether if you look at the building, you will first see that all everything wherever you look; this is our

structure. And in order to make it little bit beautiful; if you see if you can search more on this building.

So, this is not straight forward there are also some you know we know ornamentation kind of thing being made. So, that this can add at add some value as ornament ok. So, building was very simple, but all this structure add some value as ornament.

So, design process is driven by visual rather than technical consideration in this category. So, we have to understand it what exactly. So, technical consideration it could be; see if I redesign the building maybe take a similar kind of example. So, in order to just fulfill the functions, we can simply make it with your some you know slab and then beam column, but here structure should be visually upcoming ok. Visually pleasing and on that the emphasis given on that visual rather than technical and that is why if you see all those structural elements, they act as like some you know to make this building more beautiful. So, these are being pleased as a beautification you know elements or as ornament.

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So, with that move to the interior view of the same building, here you can see ok. Here all these you know circular column, then the beam say everything act as ornament and this is another picture where it can be easily seen like all these you know services. So, all the you know pipes are externally pleased which adds some value to is as ornament.

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Move to this one so, that was the title slide also. So, here if you see that the building is again a rectangular one and it is form centre Pompidou in Paris of museum. So, here in this case if you look into the overall arrangement, so, basically this is again a vertical curb is being placed outside and it is being decorated and covered with some transparent material.

So, these are all portions are supported with some cantilever and other things. So, these are visible. It is not for that one cannot hide could not hide it from thus you know viewer, but rather the architect wanted these to be exposed and act as like people can easily understand the type of structure being used and it is so beautifully placed in order with some rhythm. So, that it acts the structure itself act as ornament.

But the study says instead of making these cantilever, all these you know structures; so, if you could have used it with a simple one, you can even save like more than 25 percent of the

structural you know elements; that means, here that was not the constants. So, meet these building like something a piece of structural arrangement and add beautifications for each and every corner. So, all these joints are very beautifully placed maintaining some rhythm and all. So, that this building come up as a you know one example under this structure as ornament category.

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This is another example that do we discussed earlier presentation also under the category of reef structure, but here also if you see this is the exterior and these two are form interior. So, here if you see the detail is nothing, but the structural arrangement and here it is all exposed and very beautifully done.

Say for example, if you see this you know inside so, the you know regular spacing of this vertical member and then close spacing of this horizontal members that create some kind of you know interesting features to the interior.

And along with this reefs and other thing along with the glass and other composition so, basically that add some value to this spiracle you know architecture. So, here if you see that it could be designed with some other technique with some you know sales structure or something, but here it is basically designed in that category. And if you look into this so, structure here being used and very predominant. So, dominance of structure is there and act as ornament. So, that it adds some value. So, it could be very straight way design or something, but here in order to make it aesthetically pleasant. So, some of the neat finishes and you know the combination of different structure being made.

So, this is very important to know this kind of you know relationship where we can connect the structure to the building as ornament. So, connecting structure with the architecture this is the second category.

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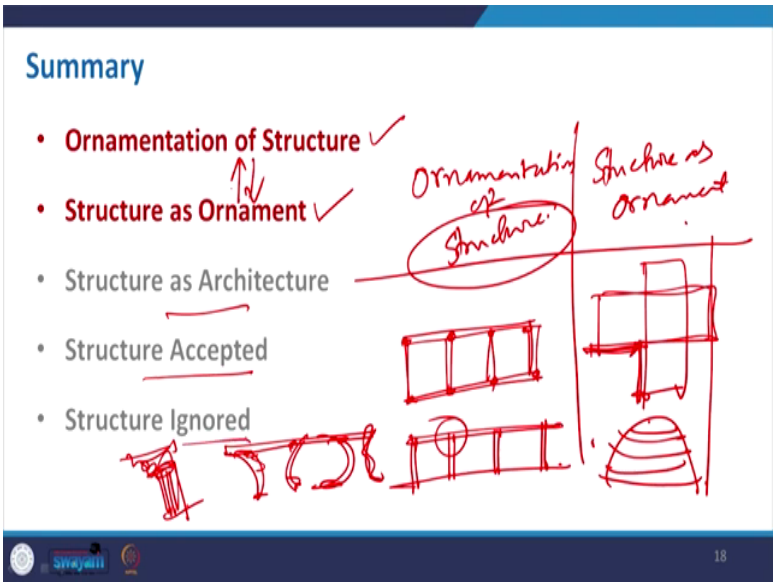

So, now, we come to the you know end of this particular presentation. So, here we have discussed about ornamentation of structure and structure as ornament though both are having similar words just here and there the combination, but definitely we got to know some of the thing we can distinguish.

So, again to quick recap. So, the first category ornamentation of structure and the other is structure as ornament. So, what exactly? So, ornamentation of structure means structure is the basis that dictate everything. So, a typical say I just try to make one building. So, these are beam and these dots are like your columns and we make the elevation that is the beam and then you know you have these structure maybe a shelter or something.

But this is very simple; structure driven, there is nothing to play with some other form and all. But now instead of this I just replaced this arrangement with the beam is there and then we

just ornament it with some you know different structural element. I just leave some other loop or maybe we just decorate like the other columns and other things. So, give a classical loop to it. So, depending on the need, we can do it. So, basic fundamental is the structural dictation to the form and we ornament it with some you know decoration. Here it is something that new structure is being supported with something and very easy form may go. But here the use of structure is very predominance and perfect execution of all the structural element together add some value to the building.

So, here the structure itself act as ornament and we have seen two buildings one is a museum then other one that you know spherical one with the reef structure that we have seen. So, these all are example under this structure as ornament and that the Lloyd Headquarter, we have seen the services which normally you know in the building we just hide it with the dot and all. But here it was shown and with the structural like steel application of steel and other metals. So, that act as a structure itself as a ornament to the building. So, then we will discuss this three structure as architecture accepted and ignored in the next lecture.

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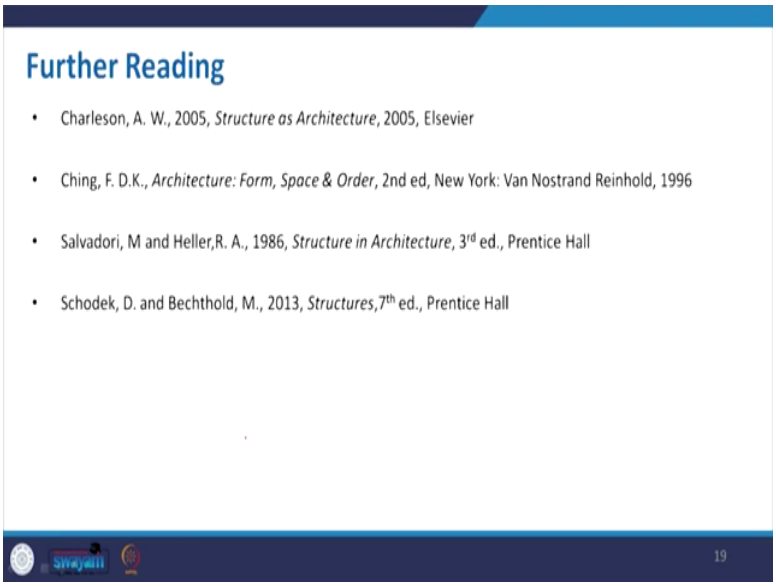

And these are the reading materials, I keep on updating it whenever I add some you know new source to it and here also some of the informations are taken from the book you know structure and architecture. So, you can also refer to those books and also go through those links that being provided under each of these picture I have taken so, that you can go to get more information about that. And as already mentioned we will be discussing the rest free category in part 2 and like for this time being like, bye take care.

Thank you.