Structure, Form, and Architecture: The Synergy
Prof. Shubhajit Sadhukhan
Department of Architecture and Planning
Indian Institute of Technology, Roorkee

Lecture - 03
Relationship of Structure to Architectural Buildings – Part II

Welcome all to the online course Structure, Form and Architecture: The Synergy. Now we move on to the lecture number 3, Relationship of Structure to the Architectural Building - Part II.

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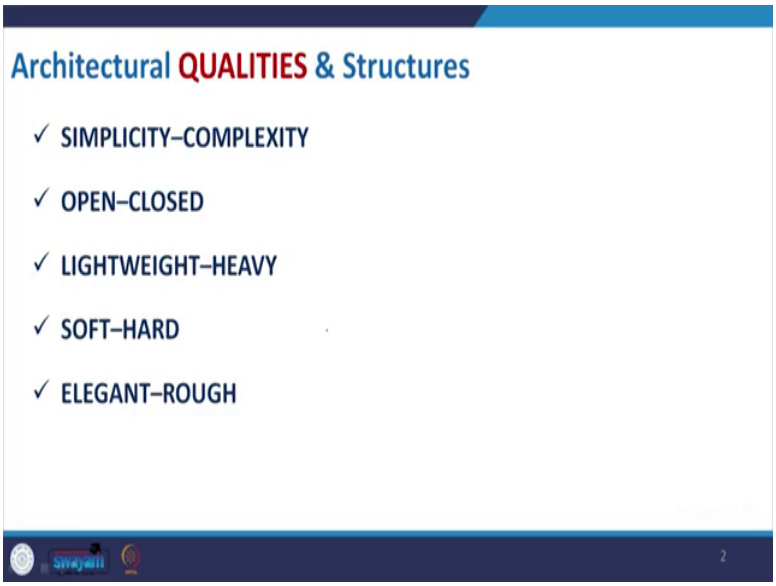

So, in the same topic, lecture number-2, we discussed about different structural you know example that actually full filled the concept of different architectural form. So, we discussed

in detail like different concept of say dynamic static or it may be like your you know chaos or in order form or architecture and how structure help to bring those concept into reality.

Now in this lecture, what we will learn that is the architectural qualities. Now, what exactly the qualities? We are not talking about the qualities of the material to be used for that. Basically we are talking about the overall experience that quality in this lecture and also we will see that how different structures that help to maintain that quality to achieve that quality.

Now, in this again we have some five pairs of that qualities architectural qualities where we talked we will talk about the simplicity and complexity, open and closed lightweight, heavy, soft versus heard, elegant versus rough. So, this terminologies sometimes is you know create confusion what about the light-weight and heavy. So, we will not really measure the weight of the building or the structure.

So, basically it is not directly leading to the you know physical weight of the building, but the arrangement of overall building how it look like, how we perceive that building. Again the soft and head is not like a building call soft is we touch and then we have some depression on it and having higher elasticity it is not. So, looking at that how soft and sometimes we say a building the formation and the structure used in that building giving a herd form or sense.

So, simplicity is basically very simplistic form of creating those you know architectural quality with some structural element. And now we move on to the first one simplicity versus complexity and we will try to understand this architectural qualities and structure relationship with some case study some examples.

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So, first we take this particular image of Villa Savoye Paris. Again it is beautiful architecture which having a perfect blend with the nature with these outset like it is being created with very simple form. Now, the way like looking at the building, we say it very simple. So, that convey the meaning of simplicity here.

So, in this if you see the elevation is very similar the font and rear. So, again they have a riven window. So, riven window and these openings are it is similar. Then the material the colour, texture everything is very similar. So, it is very straight composition of some rectangle and some cylindrical form some cuboid and cylindrical form. So, basically it create simplicity.

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Now, move to the next example. This is the example of one Boston place, here also it is a high rise building. So, the if you see the structure like Burj Al Arab and all again for the high rise. It is also having some complex structural system which actually making this structure strong along with the regular membership, structural member. They have some structural bracing ok.

So, like structural bracing is something where you have to resist from the lateral force along with your members you go for you know supporting those elements with some cross base ok. So, depending on the floor and if you see that it is being connected to that and sometimes it is exposed to the you know externally or sometimes it is not.

So, here also it is very straightforward if we try to just draw the simple elevation. So, it is example of some vertical lines which is very you know straight form of architecture and then

horizontal line of this windows. So, even this structure is very huge, but it seems very simple. It can be the simplicity of architectural quality.

So, both the picture go back to the earlier one. So, this is one example its very you know not very high rise structure. This is very I will two story structure, there you maintain the simplicity in the quality with similar kind of elevational treatment from the front and the from the all the sides.

Now, here we what we have seen that this is a high rise building, but then also like with vertical and horizontal lines, it is creating a simple simplicity quality of the architecture. Now move to the complexity. How we can get it?

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So, this is one example. It is really wonder of the world and this is Eiffel tower. So, in this if you see if you click photo if you visit this place definitely, you will have some photographs, some selfie-groupie in here. So, this is very very beautiful structure where it is making a very symmetrical axis and this ornaments all this arrangement looks very beautiful from a distance.

But if you have a close look to those corners, the four lakes of this and see the arrangement so, different kind of prismatic truss different kind of steel arrangement the way, they are laid together their connections. So, it is not very simple looking at this, it is looking very complex. So, that is why this particular image is depicting the complexity of architectural quality.

So, this is also important thing sometimes we put this complexity to the structural element to create a like sometimes it we can refer back to the again the chaos concept that we discussed in the previous lecture, lecture number 2. So, it is one example of the complexity. Let us take another example of complexity. What is complex here?.

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Basically if you see the curvature so, it is giving a very smooth transition definitely we appreciate this, but the complexity is basically the roofing how the structure is being made and where from it is going up down. So, everything those arrangement of structure that actually you know help to bring this concept into reality and give the quality of this complexity.

So, sometimes complexity does not mean that will not like that building because of the structural you know you know haphazard or chaos in the system. So, this is example from Harbin Opera House in China where it is one example of the architectural quality convey the complexity. Move to the second architectural quality that is open and closed.

Before, I just go to few slides for taking some reference from different you know study, just let us guess what exactly will be there in the slide. So, what is open and what is close? So,

open quality architecture means where you experience some openness, it need not to be the open to sky, but the you know structure you make little light or you make the structure in such a manner that you create a transparency.

So, that you can connect with the you know external environment that is one openness we can say sometimes it may be that you create the space. So, spacious that we do not feel congested and feeling having some openness, we can connect ourself with the nature.

So, some examples if you see that you know most of the international airport good airports, they have the waiting bay facing the runway. So, while waiting you can connect with the you know runway the visually and then you can see the flight taking like landing and flights are taking off. So, this is somewhat sometimes we create this kind of architectural quality with open type of arrangement.

And closed is very you know you know confined where like you cannot to really you know see that quality like you feel very confined and you are forced to see what is to be you know shown by the design. So, you cannot connect with the external environment. So, both of them are having the requirement in the field of architecture.

Say for example, closed form architecture where this qualities to be maintained specially for the museum and some area where like there is no need to connect it with the external which may rather hamper the you know internal environment. So, there we go for this kind of things. So, now, let us see what is to be meant. So, this is one example of Suvarnabhumi International Airport, Bangkok.

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I personally experience this space and really it is something like where a long waiting can also not will not matter much because of this connection. So, there are many advantages to create this open type of qualities. First of all you can connect with the you know external environment. You can see this person facing outside you know enjoying the operation flight operations and other thing as well as maybe this you know corridor which is not much spacious for that, but then also it make it grand. So, that you do not feel congested to it.

This is another image of that how well it is being made and this structure. So, there are some you know steel members which are running through and these are some class material which is creating this openness with making transparency and where we can see through the outside environment. Now move to the next example of openness.

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Yes. So, this is another example of that kind which is Louvre museum in Paris. Here also like it is you know glass pyramid kind of thing where space frame is you know install that are acting as a structural member. So, all these structural members, they placed together in a form to create the pyramid and it is covered with some glass.

So, that you are protected at the same time when you are inside you can still get connected with the environment; with the outside environment. So, that is sometime encouraging you feel very much you know comfortable very much secure that you can connect with the external you know everything what is going outside, what is happening outside.

So, this is another architectural quality leading to openness, but to create it in both the example the previous one and this one. The common thing is that use of some steel members which create some void and we filled it up with some transparent material. So, which is

helping us to create this kind of open quality like quality wise the openness to the architecture and the supporting structure should be like that.

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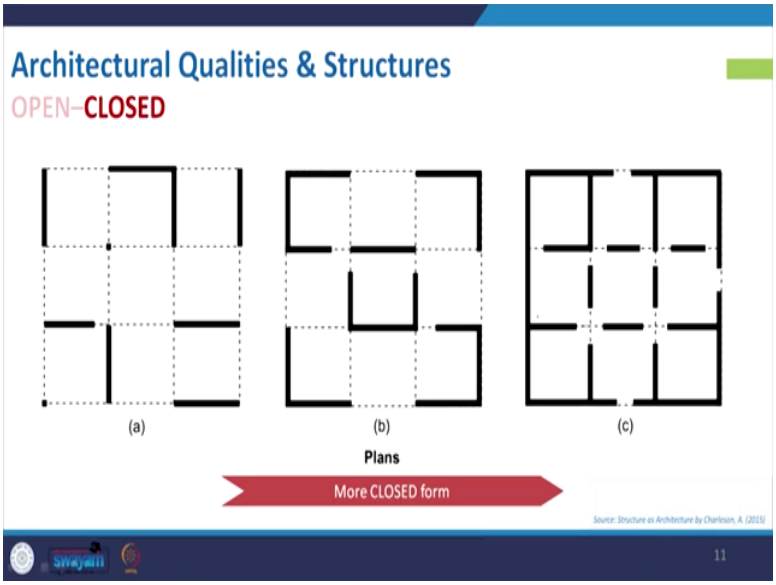

Now, move to the closed form. Now in this example, this is again taken from the same book structure as architecture written by Charleson and here if you see that though we do not have the wall you know all around, but the way they are placed you are in a closed form you cannot see this ok. Only this axis is having some openness.

So, in some arrangement, we get this kind of thing. So, this may be a door or something. So, this is creating a closed form and if you make it more in that manner in this only this opening, you can see otherwise it is very closed form. So, this is maybe some museum kind of thing and where this maybe some other form closer.

Now take example of our residential building, a bedroom a typical bedroom. So, we have this opening this side and maybe the door like for our region. So, maybe we have window for cross ventilation and all we have visual connection. Now, in some of the building you just maybe this is a dining area you make it full glass or make it very transparent so, that you can get connected.

So, for both the cases, the use of structural element will be different to create this you know to make it stable and create this environment to get connected with the environment and make it open or closed form. So, these are the concept plan. So, more closed form from a to c. Now, let us experience it.

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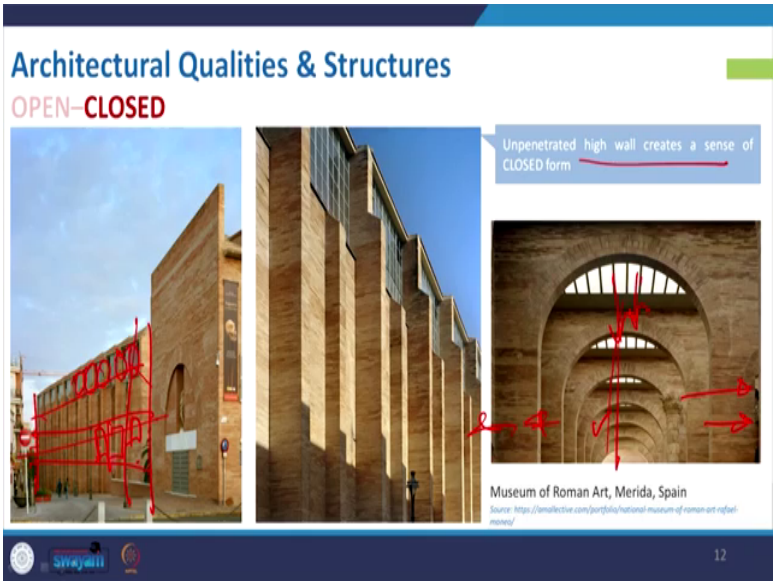

Now in this closed form, this is another example as I mentioned that mostly the closed form or closed you know say architectural quality being observed in most of the museum because

sometimes they do not need the you know daylight the sunlight because to protect the artifacts kept there from the light and they relay on the artificial lighting or with some different purposes.

Now, here also this is museum. So, this is a obviously, you know some story building. So, here they have some you know glass opening not opening it is a closed form. So, to in order to get some light from the top so, they create this. But apart from that if you see this elevation so, it is all closed no opening no window like a normal building that we put in. So, this is one example of the closed architectural quality that being designed.

Even in this inside, they also do not have you know any opening or any such window opening to connect the outside environment, they have something skylight from the top so, that this corridor will be illuminated for the activity. So, unpenetrated high wall creates a sense of closed form. So, if you get some window here or something so, definitely this will not be taken as this category. This is another example from India. This is newly built Bihar museum in Patna.

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Again another example in the museum category where you can see this is the from the entrance this is the mass this is very nicely created with some cotton steel which is whether steel and having some texture with that you know exposed concrete. So, it is creating a very contrasting architecture.

But overall if you see the quality category so, it is again a closed form although they have very nice environment inside, but from outside it is looking very closed. So, for museum the previous one from Spain and this example from India, Patna. So, here the structure is being made with this.

So, to make this closed form architecture the structural application will be different because of the span and all and when we have to create some punctures this, all these equation all these load calculation will differed because the moment you create some puncture in the you

know surface or the wall definitely the material you used to their glass or wood as window the calculation will change. So, we have to see what is required and what type of you know quality to you know come up with.

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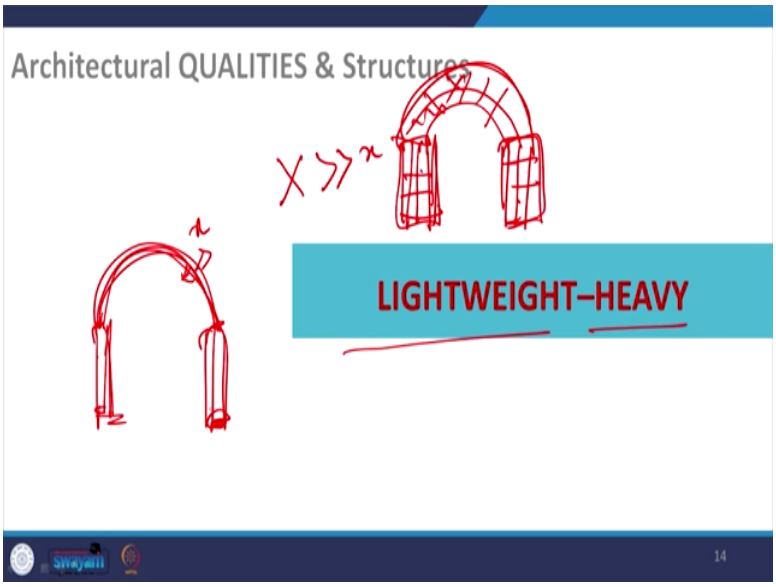

Now move to the light weight and heavy again, I am saying this light weight or heavy does not mean that it is a physical weight of the structure. Definitely when architectural look very lightweight overall like you know physical weight will be comparatively less, but definitely here it is a visual light weight or heaviness of the building.

So, say for example, if I just want to hm make a door so, I can just create some arch or break and I just make it support it. So, this is one with the very simple form. So, this is another the same, I just make with the huge you know support to that and then in order to give you know

considerably small thickness, I create it large to make it grand or I create some ornamentation where the thickness is much much higher than the small one.

So, this will make it literally heavy or if you create more detail into it at some elements so, that will make it very heavy visually heavy where at it is very simple sleek and consideratively lightweight.

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Now, move to the example this is from the airport mostly and you will also get many example mostly for the airport and all as because like the airport deal with so many passengers. So, movement of passengers is the basic principle how they can move passengers, they can facilitate passengers and make them and environment which will be very comfortable to them.

So, they create the space and that should be obstruction free one can connect with other, everything should be visible. So, for that we should go for basically a column free space where these are the transitional space where we get it and we only use those heavy structure or the piers to support it where it is required, otherwise we have to make the roofing very much light.

So, for that truss can be used, space frame can be used so, these are the structural element which you know small dimension or small the score section of the iron members can hold this. And along with the advantage of that you can create some translucent you know environment which will allow light to pass on so, that you can also maximize the day light use.

So, make these structured very light even you see this huge span and look into the roof, it is very you know looking very transparent and only few members are just holding the load the space frame and all similar to this one also. So, you just have a feel of the structure is very light visually light may not be the light the way we think.

If you add all are load and all it will be a substantial, but visually we can say that it is light and it is only possible when you create this kind of roofing with the truss and you do not have any further use of it. Because the moment if you want to make it more story and all so, probably this kind of structural roofing will not be possible and that is time you I have to face that very hard type you know ceiling on top of you. So, this is possible for this and normally for the airport, these are been used. So, this is one example for the light weight quality and obvious.

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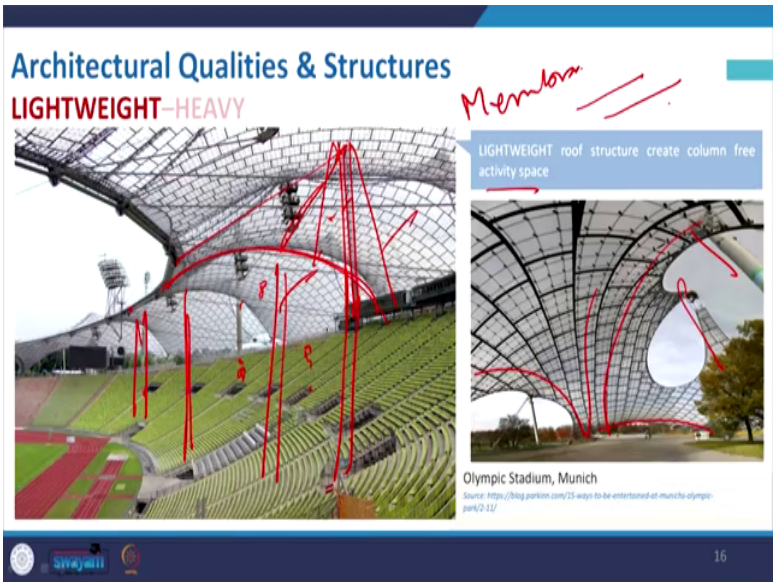

So, now this is a very important for a stadium the huge area to be covered a for the spectator to protect them for the unwanted with the situation, it may be a scorching heat or it may be a rain. So, for that they has to be protect and for that definitely the main principle that any spectator sitting anywhere in that stadium should enjoy the match going on or any sports going on in the field clearly.

So, we cannot have you know the heavy column structure to support the roof so that is the constant. In order to work on that constant so, we should think of some of the light structure. So, it is possible with some membrane structure.

So, what is membrane structure? So, basically membrane is a very thin you know seat it may be made of rubber, it may be a plot and it is to be supported with the minimal structural

element and here you can see if you can see that, there are some piers outside just you know attach to the stadium where like this members are cabled.

So, this is a tensile cable structure and we will also discuss what exactly it is and its hold it and they put some material which will allow light to come, but it will also protect from this things. So, looking at this definitely, it is feeling very light structure. So, transparency also play crucial role to feel this, the visual perception of lightness.

So, lightweight roof structure create column free activity space which is essentially not only in the stadium the same Olympic stadium in Munich, they have created similar kind of arrangement entrance gate for that. Again it is under the same category of lightweight. So, both the example if you see that this is a you know example from the airport and next one is the stadium. So, if you go to any stadium and then you can get it.

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Now, come to heavy. This is St. John University Library. So, here if you see what is heaviness in this, there is no such obstruction regular obstruction because again it is being created, but this is basically a structure which is look very heavy. So, this is like a branches of a tree which is holding the roof.

So, instead of having this in order to remove this regular obstruction, one has created this kind of structure, but inside it if you look into this it look very heavy and very congested. So, congestion, feeling of heaviness they are closely related. So, in this structure is one example of the heaviness and the material use the concrete and all where we have a large cross section and all, we actually perceive it is very heavy.

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Move to the next example. Here also if you see this example from Brazil ah, this is again you know area of the art form and all. So, huge concrete structure look very simple right. If you

say that you put this example into the simplicity, yes, it is not very complex. But having this mass heavy wall of the concrete, it creates and create the sense of heaviness.

So, in these two example one is from the library where the supporting piers, having different branches, holding the roof, creating a sense of heaviness and this is one itself those elements. It is creating the architectural quality under the category heaviness. Now, move to the soft and hard. Already, I mention soft does not mean that material used in that building is very soft in nature or hard is a very hard materials. So, let us see this.

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So, in this is one example of Tama Art University, Japan. So, in this if you see the plan, the plan is something like this where plan is in curve and in the elevation also, it is in curve. So, double curvature creates a softness as because you know whenever we draw any curve line, it is representing the softness.

It symbolize the wave the flow and all and whenever we go for a straight forward straight line, it is representing hard in that concept. So, in this it is very smooth and soft and this arches even the interior of this space is having those multiple curvature, the plan even the you know arrangement of those furniture's.

So, all together it is showing a soft flow. So, curve the structure both in plan elevation with suitable geometry irregularity flowing of softness both in exterior and interior space.

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Let us. So, I think in this I do not need to really say about this. It is a nice example of a flow wave. So, this is a apartment building in Denmark where the roof is being created in such a manner, it is looking very soft. So, again I am mentioning this soft is not about the material quality, it is the visual softness.

So, here we can easily make this and it happens you know sometimes when we are you know just unintentionally or in subconscious mind when we play with the pen instead of making straight line always, we just make something like this right. So, this is the softness and when you make a line, it is a bold statement bold line, it is represent the hardness.

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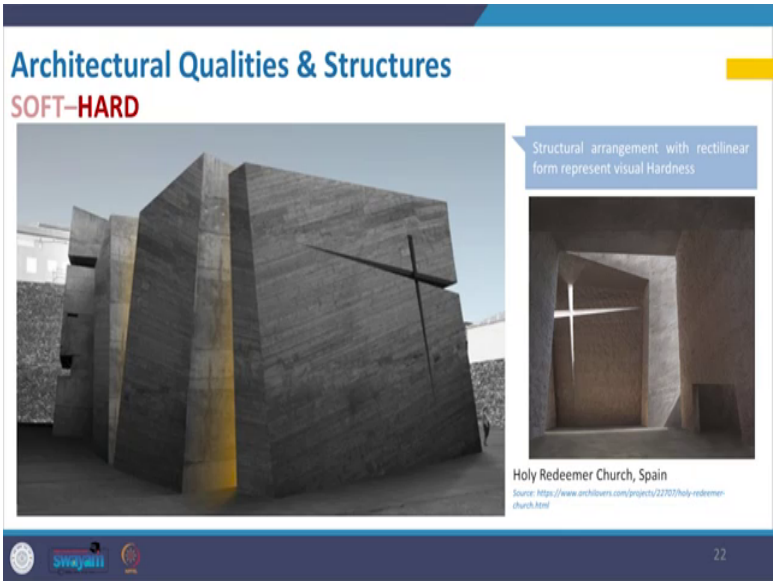

So, move to the hardness from the softness; so, back to back. This is a flow and here it is something like it is a very bold like say for arrangement of some stone placed together with the minimalistic form and the heavy thickness and the material that used stone type. So, it is giving the example of the hardness in the architecture.

So, this is also important this is nice example of Holy Redeemer Church in Spain and people they do appreciate it is in you know when a good review in architectural forum and then this is really you know one example of the hard quality.

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That is so true. This is another art foundation. Here also if you see like as already mentioned very straight line and then use of this concrete structure a placed in form, it is giving a visual sense of hardness and no opening also no openings or no such visual connection with the outside in this surface is one example of the hardness.

Now, we are moving to the last pair of qualities that is the elegant and rough. Elegant the word its defined is very you know very perfect very smooth or very sophisticated and when rough is something like its very brute. So, somethings we create.

So, say for example, like if you see any such gothic architecture or something so, there is small-small creation small-small ornamentation to the structure is piece of elegant and roughness where it lead to the deconstruction concept to the architecture. So, let us clear our this concept, little bit clear with example.

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So, this is one of my favorite example design by Felix Candela L'Oceanografic building. So, here what happens, why it is important in the elegant category? Suppose this is a very good you know you know curve curvilinear form of architecture where you know parabolic hyperbolic, hyperbolic paraboloid these kind of form being used and Felix Candela is good in that.

So, in this is perfectly executed, the thickness the petal form or something the seal form. So, it is been created very you know accurately from inside also, the this is giving elegance to the

example of this elegance experience to the users in this. So, rhythmic flow created through curves makes the structure very much elegant.

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Now this is another example a terminal building again from India. This is Mumbai International Airport. This is the entrance and the beauty in this particular transition. So, smooth transition of column and you know roof with different elements, it is create very elegant, its very beautifully done with a small you know solid white shade and light.

So, basically the overall ambience is giving a sense of elegant quality of architecture and it is possible through the structure. So, the purpose as I mentioned for the airport, this is a huge span if you can get some idea. This is a car, it may be of on less than 2 meter and then you can place it. So, this is a huge span that is being supported with this and this particular

smooth transaction transition sorry and they are like creating this particular piece very elegant.

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Now, come to the rough. So, rough structure can be created like the way we put it may not be something like the result of ignorance during the construction that somebody just left the job in half done and that is why the outcome is that. Intentionally it may be created to create some contrast.

So, this is one example of Skissernas Museum in Sweden where this extension is made. So, if you have a close look. So, it is something rust steel, but it is not. This is being created with the cotton expo like steel which is weather steel and which is seasoned with some chemical you know into it which will protect this from the external environment and this similar material being used in the Patna museum.

You can get the detail if you search more on that and this is basically the exposed concrete. So, with this rough finish with your steel and then this is the concrete is giving something not really you know bad architecture, I guess. It is making a composition and creating the contrast these two particular colour creating contrast that sometimes we are talking about in architecture and create this rough quality in maintaining it without compromising the stability and durability of the structure.

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Let us take the last example in the rough category where it is again the seashore library where it is again a concrete structure if you see the roof and it is finished very rough and also the cladding has been done giving a you know exposed finish. So, when you put structuring with the wooden it you know put some impression on the concrete without plastering if you go with that so, it is giving a rough finish.

So, we appreciate this kind of thing in some of the cases definitely it is not maintaining or compromise in quality or it is not to be made for the cost cutting to have the beautiful finish sometimes with the rough quality can be maintained. But to get it, we have to be choosy about the structural material that we will use it to create it. We cannot create it with all the materials available to us, but definitely so, we have to be choosy when to use it to make it rough or elegant or smooth.

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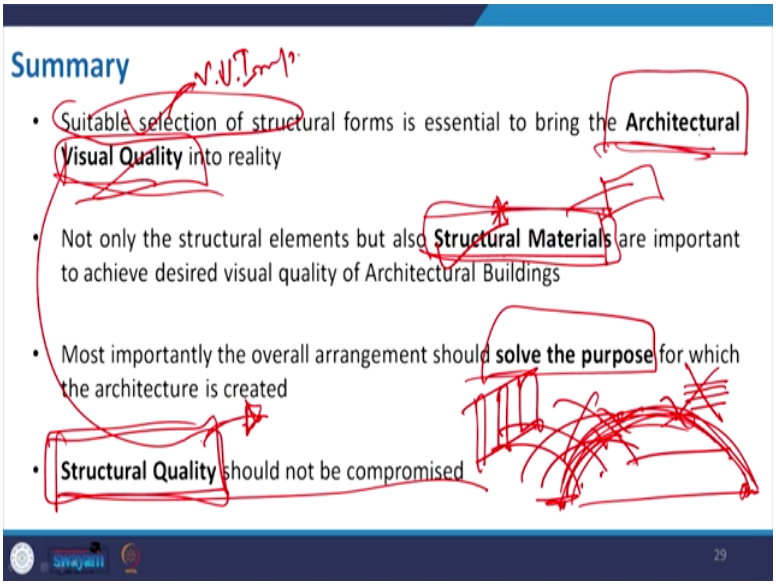

Come to the summery we summarize this particular lecture. So, in this so, we actually learnt about the quality architectural quality. So, suitable selection is very important. It is essential to bring the architectural visual quality into reality. So, if you want the quality of open form, then definitely that thing should be your (Refer Time: 36:20) and that should be support it.

Not only the structural element, but also structural material as I mentioned in last two slides that were like the cotton steel that material being used which is strong in the you know in order to make it stable as well as this is creating some rough finish. So, material structure material is another important parts to create the visual quality whether it is making rough and all.

So, we have to know about the materials and definitely we will cover that aspect in some of the lectures and most importantly the overall arrangement should solve the purpose. So, like when we maintain think of the quality, quality definitely will come, but before that it should solve the purpose. If requirement is to create the column free area, then that is the constrain to us and the available options which options are not to be used we have to discard that.

Then we have to select the best option for this whether it is a truss or it is a like your space frame or sometimes you need something to be very bold and very closely place then maybe these are not being used. So, with that we have to understand the structural material, the suitable selection of structured maintaining quality and the purpose to be solve without compromising it. Then structural quality should not be compromised.

So, even we talked about the visual quality of architecture to select the structure, but then also we have to say like take care of the structural quality. It should be strong enough stable enough and durable enough because it incurred not only the cost of construction, but also it is dealing with the life. And so, life of people or any living you know creatures so, it is very important to make it very safe.

So, structural quality and visual quality, they should be you know act together to have a desired result. So, this is overall understanding. So, with lecture 2 and 3, we know about the different concept architectural concept and different architectural quality and this association with the structure type of structure that support this concept and quality which is having a relation. So, the relationship to the architectural building is being justified with that and in time to time we will also discuss some of the more examples when different context.

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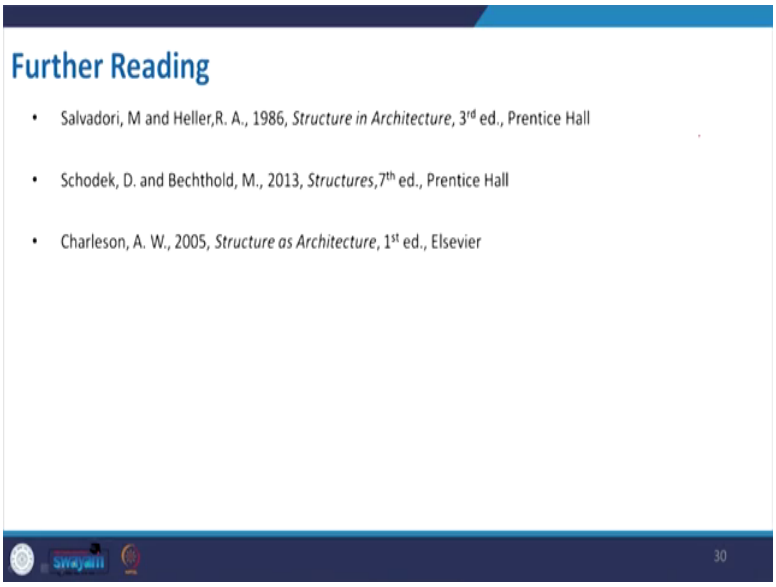

So, these are the same reading material. Some books you can refer and all the pictures and other they are actually reference, you can go through and read more about the structure to know about their function. You can also get some more information about the history or maybe the material used.

So, next we will be discussed in lecture number 4, the different kind of loads on structure, I just somewhere discreetly mentioned about different kind of loads. So, we will discuss in detail in that lecture. Thank you all to take part in this.

Thank you.