Contemporary Architecture and Design
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Lecture - 22
Phases of Modern Architecture-
Tensile and Shell Structure
Part I

Hello students. Welcome to the NPTEL course Contemporary Architecture and Design. In the previous class, we started discussing we discussed about the Monolithic style of architecture. So, this monolithic style comes after internationalist movement. So, internationalist movement we have seen architects and designers where discussing about the purity of the form and then, the form was more rectilinear. And then, the it was light weight and it was driven from the machine aesthetics and we have seen the few material was shown. And mostly with the new materials like steel glass and concrete was shown and apart from that the colors of the material; there was black, white and the grey color which is the achromatic color palette was used.

And in the internationalist style we have seen that there was a decontextualization and the form overall form was not so heavy and it was like a light form and the form was more of rectilinear thing and when we moved from that to the next phase which was monolithic. Their form was started becoming the protagonist of the architecture. We have seen some examples and they were different based on different forms, it was divided into different clusters like it can be cuboids, it can be twin which can be two different cuboids or two different cylinders. It can be circular and it can be also like modular like grape bunch and it can also going into different kind of rhythm or it can augmenting that rhythm which was in metastasis.

Now, in the next phase, we will see that this is today we will discuss the third phase. The total second phase was the combination of internationalism and monolithic and now we are moving towards the third phase of modernity and we will see from now this time onwards, there lot of continuity to the post modern which we will discuss later. So, modern, high modern started going towards the transition. This is the transition phase of a post modern and modern. So, here, we will again see the form is given more importance and we will see deviation from the internationalist style while in the

internationalist style it was rectilinearity was predominantly there and apart from that there was pure form like circles and cylinders were there in the monolithic style. But here in this phase today, we will discuss the tensile and shell structures as well as the different other different buildings which was not really into the tensile and shell structure where the form was really important.

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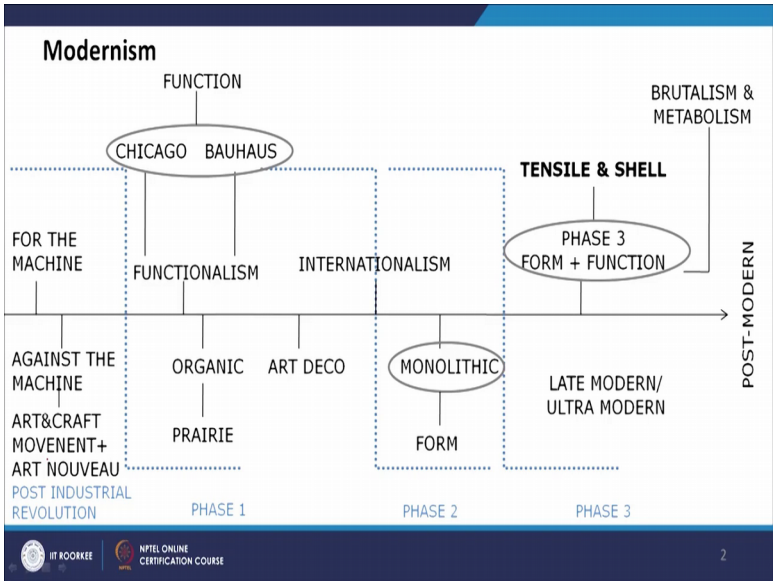

Now, if you look at the timeline; again, we will discuss will try to put this phase into the timeline. So, here we have discussed till the internationalist style and from the internationalist we started discussing monolithic we discussed monolithic style; where form was again coming in into the emphasis. And then from there was this movement which is tensile and shell was the majority of this movement; where form and function together was taken into consideration and the form was really very important in this movement.

So, in this late modern or ultra modern movement which is the last phase of modernism and also along with that there was Brutalist and Metabolist which we will discuss in the later stages these stages in this movements form was really important.

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So, if you look at the building internationalist building, it was definitely form was important; but form has a very simplistic approach and it was minimal and from there we have moved into the monolithic style where the form was seen as a container and the functions were feeded into that container. And from there, we will today discuss the where form was really very important for the architects.

And here, this is a building by Eero Saarinen which is this is the airport terminal TWA airport terminals of New York and here, we can see the structural members this columns and roofs are which is constructed as a shell structures are becoming the form of the building. So, structure is appearing as a form of the building and this is this is actually in contrast with the internationalist movements.

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So, from internationalism this Villa Savoye and Mise Van Der Rohes works and Le Corbusiers, we have seen. How monolithic have translated and given importance to the given more importance to the form and form was more iconic and easily perceivable.

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So, there was more geometrically defined forms in these designs and from there we can see this designs by Eero Saarinens and other shell and tensile structures design, form was becoming more dynamic. So, here we have we are seeing more geometric forms and here we are seeing more dynamic forms and more curvi linearity was added into the form. So,

here when we are making Saarinen is making the shell structure or the other tensile structure this is a Sidney Myer music bowl and this is a tensile structure; this is a shell structure and this is a tensile structure. Shell structure is designed by concrete and tensile structure is designed by the tensile property of steel was is used in this tensile structure.

So, when in both the examples, we have we are seeing that the structural elements are becoming as aesthetic element and with technological advancement, earlier it was like a roof and flat roofs and slabs were there. But with the structural advancement there was a shell structures and more curvilinear forms were discovered and they were they were performing better as a structure and as well as the tensile structure as a steel is used. So, they can take more span as a as steel as a new material was used during that time. So, we can see as a form these are more dynamic because different kind of curves were appearing because of this shell and tensile structures.

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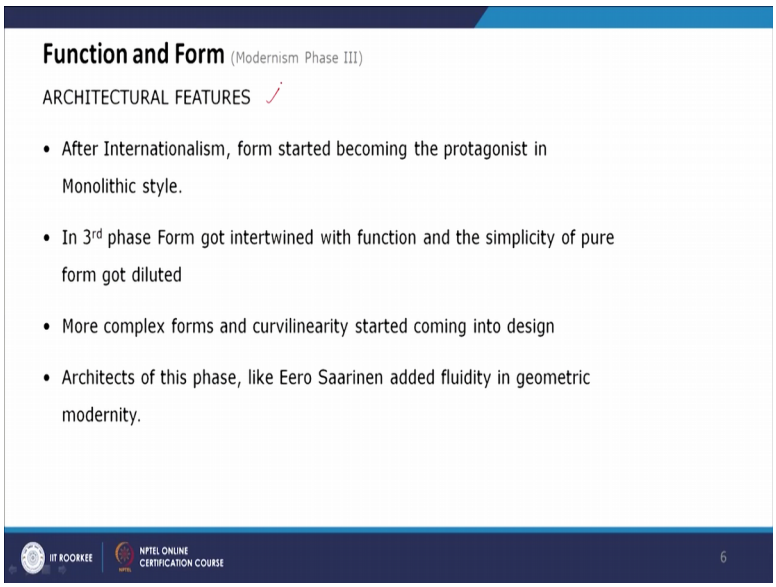

Now, if you look at the architectural features. So, after internationalism, form started becoming more and more important which we have seen in the monolithic style. And from the monolithic style and in the monolithic style they were mostly confined into the more geometric forms like semi circles, hemispheres, cylinders and cuboids. But later, in this phase, in this third phase there were more curvilinearity added into the modern minimalist approach.

So, here we can see the moderns high moderns minimalist the specially the internationalist styles minimalist approach was changed and diluted and more curvilinearity was started coming into the architecture. So, here the architects like Frei Otto and Eero Saarinen, they added fluidity and dynamism in this architectural style after internationalist movement. So, in third phase, form got intertwined with the function and the simplicity of the pure form got diluted and here it is not just not function; even the structure was important and everything around the and around the form was taken care of and the form was evolved into that.

So, function the movement within the space the structure everything generated the form and which form was not a simplistic a form like internationalist movement. It was a it was curvilinear; it was more dynamic and it was more it has more attraction value than the simplistic minimalist approach of internationalist movement. So, it was more complex and more curvilinearity started coming into the design. Architects of this phase like Eero Saarinen added fluidity and dynamism in the geometric form of modern the internationalist modernism.

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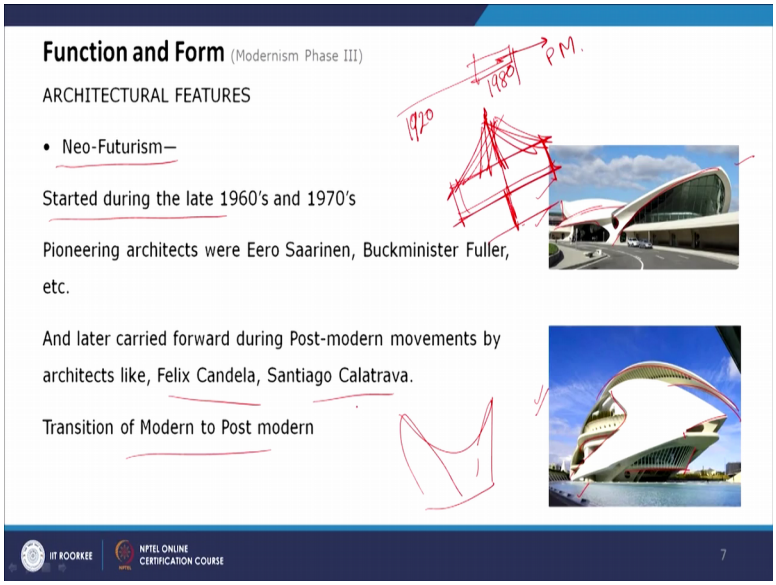

So, if you look at the building. So, these were the some examples of the building and this movement did not stop in the modern movement as we were seeing that this is the transition between modern and post modern. So, many post modern architects started taking this inspiration from this modern architects and they have translated this into

carried forward this into the post modern movement. Like this is the movement which this is the building which is designed by Eero Saarinen in modernist era in 1970's; but this is a design by Calatrava in Valencia. So, art and science park in Valencia which was designed much later, but has a similar philosophy of taking the shell structure into as a aesthetic element and the form of the building.

So, there is a term called Architectural movement called Neo-Futurism which evolved. So, before Neo-Futurism, definitely there was futurism; we will discuss that and in Neo-Futurism so this style of architecture of taking shell structure or a tensile structure and it is exploring the different curvilinear and different forms which is complex form and more dynamic. So, this style of architecture is called Neo-Futurism which looks futuristic. So, if you look this look at this building, this building does not look from the art; it looks from its it has a outlandish and extraterrestrial and also it this form is never it this form has lot of attraction value and this form was has lot of complex elements into this. So, these elements were added and this is definitely not a minimalist form.

So, lot of elements were there, lot of curves are flowing into this form as Calatravas design and Eero Saarinens design are there. So, these all these curves and are creating theme and it is it has a contextual connection with the phase. So, this form if you look at, this form looks like a bird which is trying to take off or trying which will just about to fly or just landed and this is a building as a airport building. So, this also goes with the theme of the airport where flights lands and flight take offs takes off. So, he compared that with a bird and the form was given as a form of a flying bird. So, it was not contextually disconnected. So, there was a theme and which connects with the airport building; so, as this science and art museum so there was lot of science and new advancement of science and art was there and Calatrava wanted this design to be futuristic.

So, in the new futuristism this started in the late 1960's and 1970's which is we can see which is around the late the ending phase of modern because modern started from 1920's which is the early modern and ended around 1980's. So, it is almost around the end of this modernism and this got continued in the post modern style. So, the pioneering architects were Eero Saarinen and Buckminister Fuller, who designed this Buckminister Fuller's house which was again a tensile structure and there was a mast and this main

volume of this architecture the space was hanging from this mast as a through the tensile members.

And then, later it this style got carried forward in the post modern movement by architects like Felix Candela and Santiago Calatrava. Felix Candela used lot of hyperbolic paraboloid shapes in his design and Santiago Calatrava uses shell structure as well as tensile structure in his design and which also looks and which is a continuity which was a continuation of the Eero Saarinen and Buckminister fullers and Frei Ottos design. So, this is the transition between modern and post modern, some part of post modern. Its post modern is also vast and there were different movements in post modern style and different philosophy in the post modern style. So, some part of post modern some architects of post modern style have taken this Neo-Futurism forward.

So, before discussing Neo-Futurism of course, there was a style which was futurism which later translated into the into the Neo-Futurism. Whenever we are using the term neo; that means, the revival of that earlier movements. So, there was a earlier movement which is futurism.

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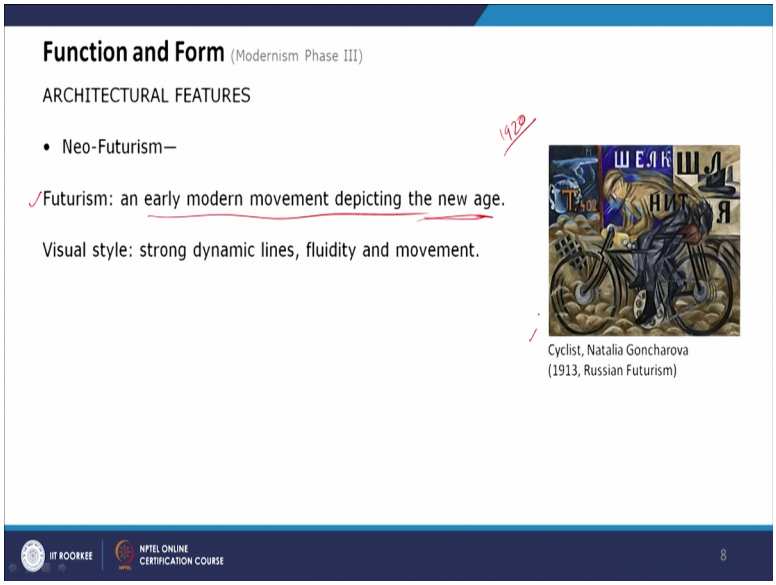

So, futurism was mainly started in Italy and Russia and early modern phases which is around 1920's which is in the beginning of this modern era and later it translated into many different other architecture and art movement and later in neo futurist style, this

got neo futurist style got evolved from this futurist movement. And in neo future, why we are discussing neo futurism?

Because in neo futurism style some part of this all structural aesthetics which is there in the shell structure and tensile structures falls under the neo futurist movement. So, neo futurist movement is little vast and many other things are there. But we will just discuss the tensile and shell structure because we are mostly concentrating on the architecture and design. So, will not focus on the will not much discuss much about the art movements.

But we will in the futurism what happened this is an early modern movement which depicts the new age. Again, in the neo futurism they are depicting the new age; if you look at the Calatravas design as well as Eero Saarinens design, it was futuristic and it looks a like structural marvel and people will start thinking why and how this technological advancement was used. So, if you look at this huge overhang which does not have support which is a cantilever and then, you will try to realize that how structural capacity of a particular material was used into this design; So, in the futurism also it was the concept was that the new age or the new machine age has to be the protagonist and the lines and forms will definitely not be confined into the straight lines. So, it will be more dynamic, long dynamic fluid lines will be there and another concept in this neo futurist movement was motion.

So, if you look at this particular painting which is called Cyclist by Natalia Goncharova, who is a Russian painter; it was painted around 1913 which is quite in the similar phase of 1920's which is in the beginning stage of the modernism. So, if you look at so, this Cyclist has lot of added lines over there and if you look at the legs. So, this is one particular human being and there was three different curves were added. So, that there is there is a motion towards this side and if you look at the legs, there are many legs are there.

So, one human being will definitely have only 2 legs; but the we are seeing multiple legs at least 3 and many more shadows of other legs. So, it gives the feelings of motion. So, that this is not a capture of a particular time. So, it there is a timeline added into it and the cyclist is moving. So, this motion and dynamism is one of the key features of futurist style.

In the neo futurist style, if you look at the building. So, building has lot of dynamic element. It is not a static, rectilinear box. So, it has lot of fluid lines and whenever there is a fluid line. So, it adds towards the dynamic element of the building. So, if you look at this TWA terminal, it looks like the bird is about to fly. So, though it is a static architecture, but it gives a signs of dynamism. So, the bird will fly from this it gives the sensation that the bird will just fly from this land and some change in visual will happen.

Now, if you look at this Calatravas design because of this curves and all these curves are giving a dynamic direction towards this building and there is a there is a sense of direction and then, this huge overhang also catches peoples eye and the there will be a eye movement because of this dynamic line. So, user, the viewers will look at from a particular point and they will follow this curve and there will be a eye movement. So, if there is a static box like structure, there will be lesser eye movement and if there is a dynamic lines and specially the cantilevers they will grab eye and then there will be a movement in the building.

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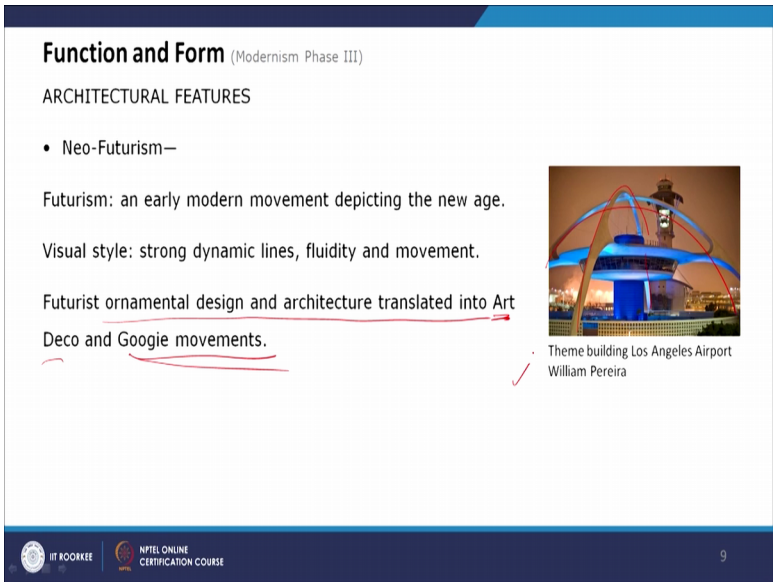

Now, from this style there was other from this futurist style there was other styles which got evolved from futurist movement. So, futurist movement ornamentation design and architecture translated into Art Deco and Googie movement. We have already discussed Art Deco.

Now, Art Deco definitely does not have much movement, but there was high on ornamentation in the machine generated style was there; it got blended with the craftsmanship and the floral design which came from arts nouveau. Now, Arts Deco also has a futurist approach because if you look at the painting of Tamara De Lempicka and there was a machine the all the all the surfaces look like a machine made. And the if you look at the tessellation, there was a emphasis on the color of metal which is gold and silver and steel on black. So, this there was a there was a approach to capture the futuristic style, even the sculptures of art deco was broken into more rectilinear form.

Now, later from art deco there was a Googie movement where there was more different colors and also the curvilinear forms were added. So, this is one example of Googie movement which is a theme building of Los Angeles international airport by William Pereira and this here also you can if you look at there is lot of similarity of this kind of structure with Calatravas and Eero Saarinens structure. So, it has fluidity, it has curvilinearity and if you look at these curves and these 2 parabolic structure which is pa[ssing]- crossing through each other has lot of fluidity and dynamism in this building. So, it does not fall into internationalist movement and the approach of Bauhaus and where the form was very cuboids and pure geometric form was there.

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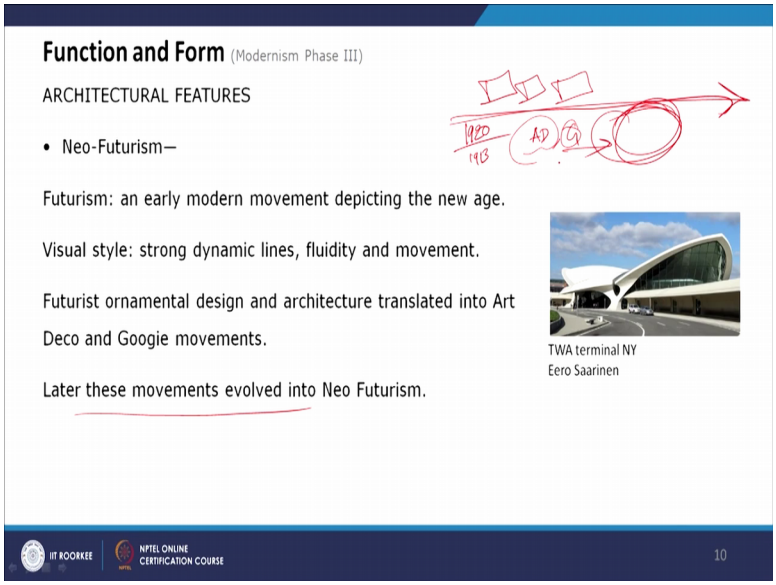

Now, in neo futurist style, there was later these movement evolved into the neo futurist style which was the highest form of these movements. And in all these movements, these

movements went parallelly to the modern movements. So, futurism started around 1930's. So, we have seen this painting cyclist which is painted around 1930 where movement and aesthetics was important and all these movement if you look at Art Deco and this Googie movement; their form was very important. There was a parallel movement which was going on during this modernist movement; where Bauhaus was there, Chicago style was there, Internationalist movement were there where the form was very simplistic and function was important.

So, these movements in Art Deco Googie movement was a parallel movement; Art Deco was a very predominant movement, but Googie movement was a small very small number of architects designed this. But in internationalist just after internationalist style, this neo futurist style many architects started carrying forward this particular thought process and changed the style and have taken have given this now different form. So, in this architectural feature, so here the sculptural expression driven from the functional exploration as well as the structure was very important.

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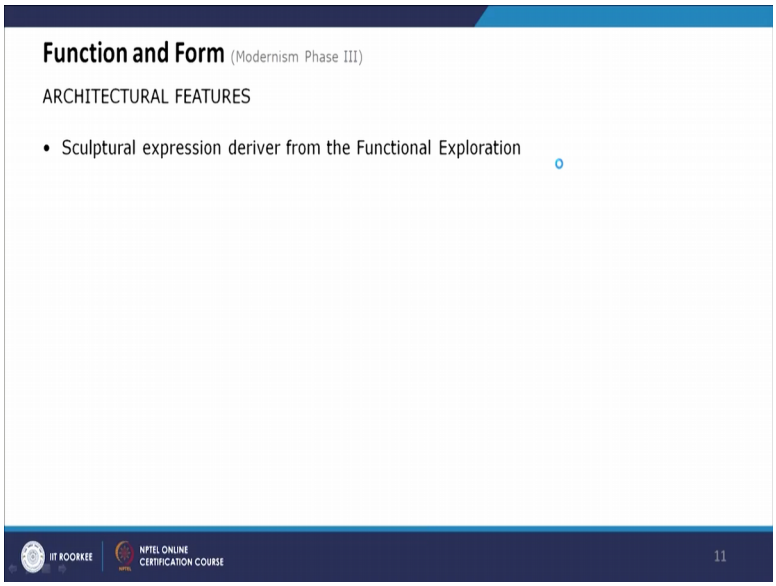

And many architects including Frank Lloyd Wright, le Corbusier, Eero Saarinen have designed some building which falls under where the structural structure, function and form together creates the sculptural quality of the architecture. So, we will see one of the very famous example which falls under this function and form and structure blends together. So, this is not a shell structure, not a tensile structure, but here form function

and everything creates the dynamic expression of the and architecture is a taken as a as consider as a sculpture.

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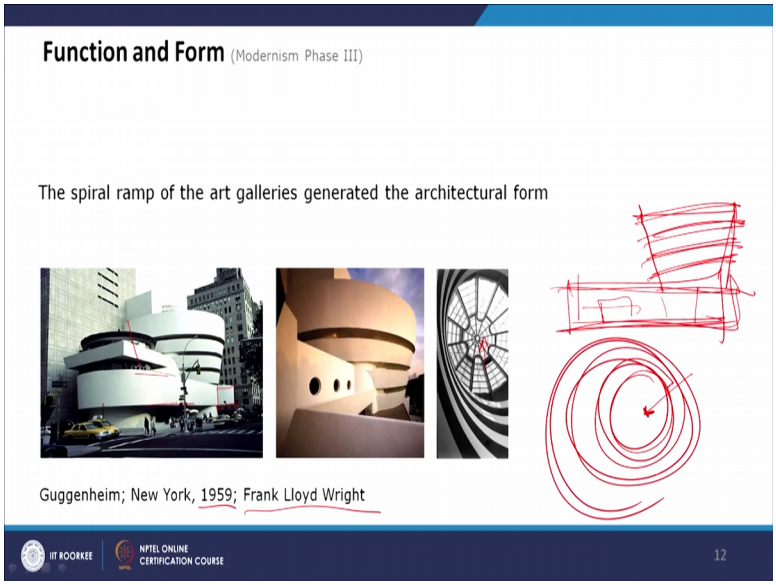

So, here in this example of Guggenheim museum, New York which is designed in 1959 which is almost 1960's before just before that. So, Frank Lloyd Wright whose most of the work was we have discussed under the organic movement, designed this masterpiece which is the Guggenheim museum of New York.

Here this museums form was evolved the this form has two components; one is the other functional part where there was a restaurant there was a art show. So, souvenirs shops and other auditoriums which is cuboid and curvilinear cuboid; even if you look at this, so this has a curve and there is a another kind of curve which was added over here. But on top of that this is the main focal point of this thing. So, this acts as a spiral inverted conical frustum on top of this base.

So, this form is generated from the function of this museum. While if you look at the plan, then you will see that there is a central atrium. This is the view from the atrium the top of this atrium is a skylight from where the light comes and around this atrium, this ram started going and if you look at so this ram started growing into the volume and that gives the form of this building.

And this is the very functional approach of design museum because whenever you are in the atrium, you see all these rams which is spirally going up in the on the top gallery. So, you take a lift and you go to the top floor and then, come down through the spiral and you see where you are and how many galleries are there and you get a view of the all the galleries.

So, that functional requirement gives the generates the form which is beautiful and which is not just simple cuboid and juxtaposition of few cuboids and there many different elements were added. So, circular windows, the sleet ribbon light windows were also there and there lot of ornamentation in the skylight of on top of the atrium. So, and even if you look at the different small elements into the in the in the inside the building there were lot of ornamentation is there which is simplistic; but each not absolutely minimal like internationalist movement. So, here the form and function has a absolute the beautiful blend of balance between form and function.

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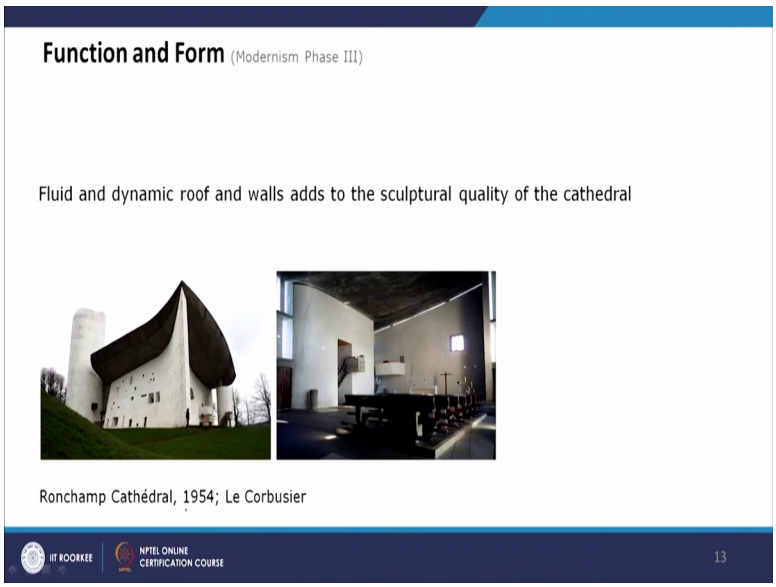

Now, another example of within these phase is Ronchamp Cathedral by Le Corbusier and which is again designed at the similar phase which is 1954; So, here if you look at the fluidity in the in the wall and the roof. So, all the walls and roofs are not rectangle. So, this is this has curves from all the direction. So, it has curve in this direction and this roof has curve in these direction as well as these direction.

So, everything is derived from the curve curved dynamic movement of this of different plates. And, so Ronchamp Cathedral and if you if you if you look at the fenestration is paltered around this solid wall. So, and within the building also there is small sleets and then so it is like juxtaposition of different curvilinear facades and form planes are creating this building.

So, this is the cathedral design by Le Corbusier and if you look at so this building is also has a this Brutalist approach of exposed concrete and this also can be fallen under the brutalism. So, we will discuss brutalism later, but this also has a because of this sculptural quality and the curvilinearity this comes under the similar phase.

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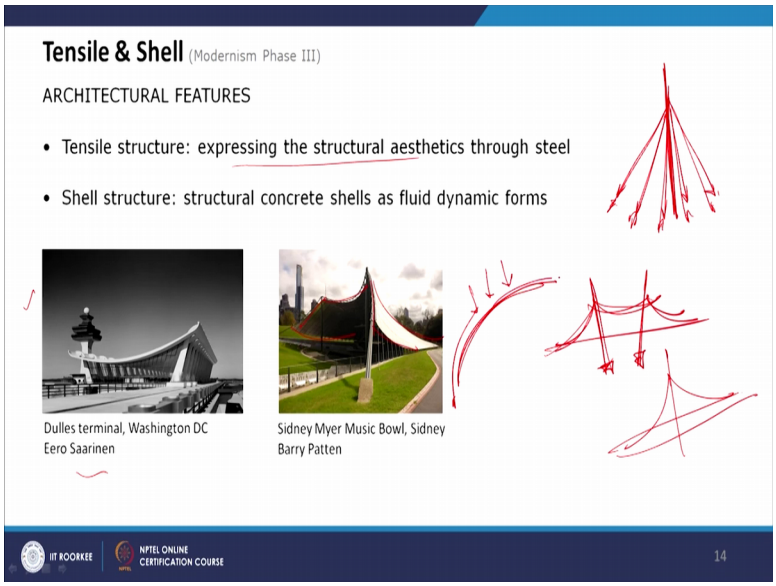

Now, again the Eero Saarinens many works are there. So, within the this sculptural and within the space, where sculptural qualities the form and the function and the structure was equally important which got evolved from monolithic style; there was one of the major component was tensile and shell structure. So, before that we have discussed this New York's Guggenheim museum and Ronchamp Cathedral. Ronchamp Cathedral is a shell structure, but Guggenheim is not. But there many of the other examples falls under this form and function which is not shell structure, but majority of the component is shell structure and tensile structure.

Now, tensile structure as we were discussing is expression structural aesthetics through steel. So, steel is the main element and as steel has the very good capacity of taking

tensile load. So, this tensile structure will generally have a steel mast which will hold and there will be lot of steel strings which will hold the structure and this how this is how the form of this tensile structure will be created. So, there can be two steel pose and then the canopy of the tensile structure and there can be one and then the canopy of the tensile structure. So, this is how the tensile structure also has a dynamic form because of this canopy or the fabric which is there around the tensile structure; it can be fabric, it can be some other material which gives this dynamic form. But the main structure element is this is the tensile steel members.

Now, in the shell structure the structural members is the shell of the concrete shell which is structurally very stable because the concrete shells has a particular curve which flows the load into the from the top to the bottom. So, that is how the shell structures form is designed and it is a very stable form and lesser material of lesser concrete material is required because it is the form is optimized during from the structural calculations.

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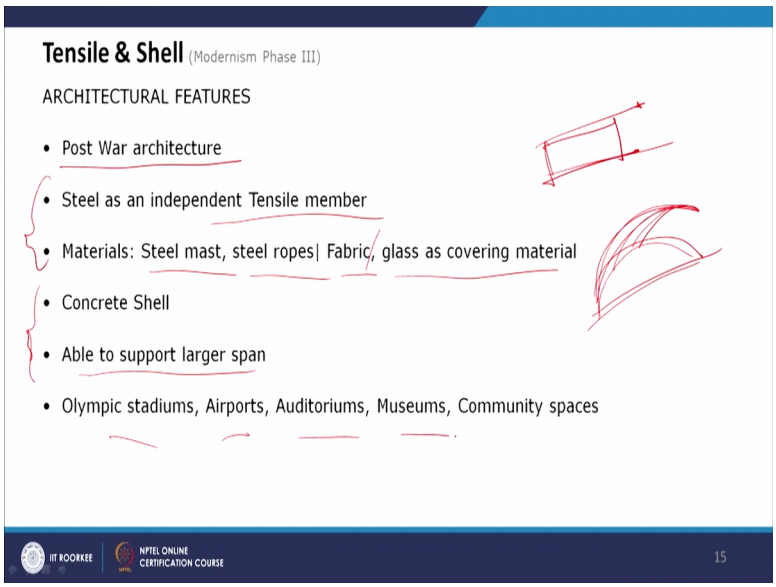

So, the architectural features where it is post war architectures. So, all this war situations like a World War 1 and World War 2 already happened. So, during the World War 1 and World War 2; so, most of the designs were focused on the functional quality of the architecture. Because during the world war, the money was very there was a crisis situation and the most of the buildings has to perform and the aesthetic was not as

important as the functional qualities because the most of the moneys are going to the war.

And because most the all the countries around the world were involved in the war in the both the wars in the First World War as well as the Second World War. Second World War was much more in had much more impact on the economy; but first word war was also quite devastating. So, that time architecture was mostly concentrated on the functional qualities. Now, after the war again, architecture started flourishing into the aesthetic values and aesthetic aesthetic elements. So, whenever there is we are deviating from a cuboid and we are adding lot of cantilevers and if you look at the Calatravas design and Eero Saarinens design. So, the cost increases.

So, definitely if you make building which is like Bauhaus building the cost it will be much more cost effective, but the Calatravas design and later phases, we will see in the post modern design lot of aesthetic elements were added. The facade treatment, facade was treated with a lot of materials. So, definitely cost will increase. So, it was possible because it was post war movements and after the war again, all the countries had started gaining the economic stability that is why money was again there. And then, in architecture lot of added elements and aesthetic elements were added which was not acting as a functional element. For example, if you look at this Calatravas building which I was showing earlier. So, this element does not solve any functional purpose. So, it was possible to design this because there was a in it was designed in the post modern style after the war was finished.

So, steel as a independent tensile member was used. This is the as a material perspective and the material was steel mast, steel ropes, fabric or glass covering as a material of the steel. So, this was for the tensile structure and this is for the con shell structure concrete shell was used and it was able to support a larger span. Mainly the type of building was again different.

So, we have seen the change of the typology of the building in during the industrial revolution. So, in the in the after the industrial revolution lot of different kind of buildings like railways, office buildings started evolving started coming out in the cities and different places and lot of influx was there in towards the city because there was a industrial revolution and that was the need. And now, after the world war there were

Airport, Olympic stadiums, Auditoriums, Museums and Community spaces started coming. So, after the world war; so there was a agreement between the different countries of the world that they will be there will be peace; they will try to maintain the peace. And through that they started making this Olympics; more and more Olympic stadium.

During the war, there was Olympic was stopped in few years and after that more and more Olympic stadium started coming in different countries and all people from all over the world started coming into the different countries. So, there was a more healthy communication between the different countries. And airport started coming so that there was a communication between two different countries and that was airport was the main point and become the gateway of countries entry point. And then, auditoriums, museums and community spaces; So, these are the spaces where this is not the basic need of people; it is a desire and when a country or a society becomes economically stable, these kind of functional building start coming into thus as a this spaces.

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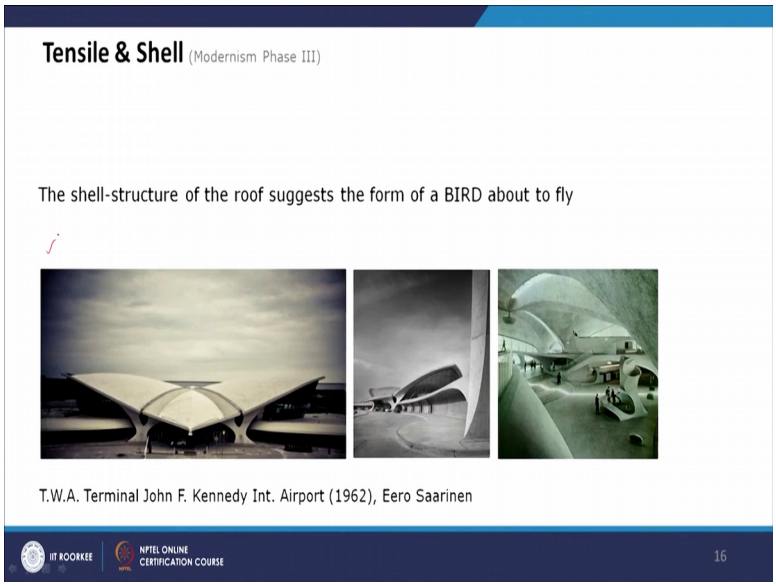

Now, coming into the examples of the tensile and shell structure; So, this is a shell-structure design by Eero Saarinen which is around 19 which is in 1962 this is in New York. So, as we are discussing the shell structure gives the form which suggests that there is a BIRD which is about to fly or just landed and if you look at the building.

So, building has lot of aesthetic quality and within the building also if you look at look at so this is the staircase and this staircase has lot of curvilinear form curvilinear lines coming into the around this and this facades none of the facades are straight rectilinear facades. So, all the facades within the building and outside the building are all curvilinear and also it solves the function. Because if you look at the building.

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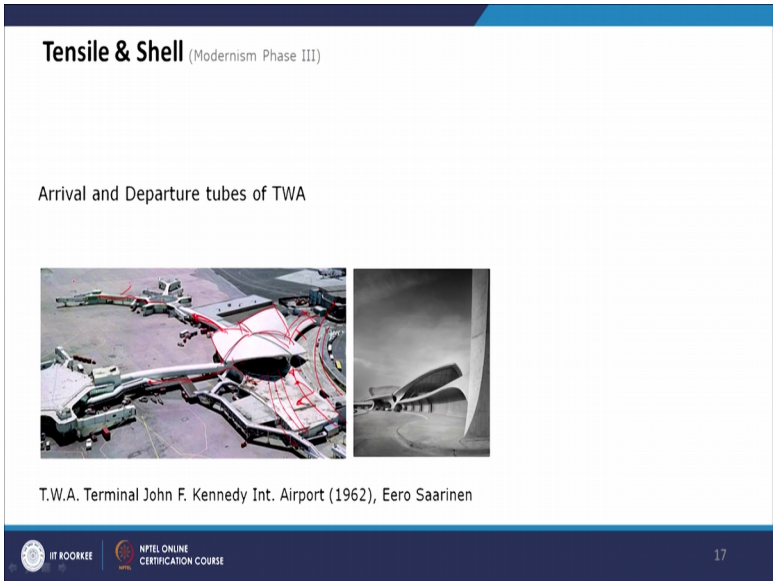

So, this is the bird's eye view of this building which looks like a bird and from here this is the arrival and the people will arrive from here. So, this is the road and (Refer Time: 35:12) stop and people will enter the building from here and then, all these functional things like board, taking boarding pass and baggage into the check in all this will happen here. And this form is the lounge from where 2 tubes will go and one is the arrival tube and another is the departure tube.

So, this 2 wings of this bird is actually dividing the function of this building into two different spectrum which is one is arrival and another is departure which is the major two different functions of an airport. So, there is a arrival lounge and departure lounge are getting divided into this 2 wings of this bird and from there 2 tubes comes out and where there is this aerobridges and gates were there to the flight and this there are the taxiways of airport and the runways are there. So, if you look at this building. So, together it gives a very sculptural a form and which is absolutely dynamic and all the curve lines are

curvilinear. Now, within the interior also it blends it incorporates the sculptural quality and all these elements which is designed as a as within the architecture.

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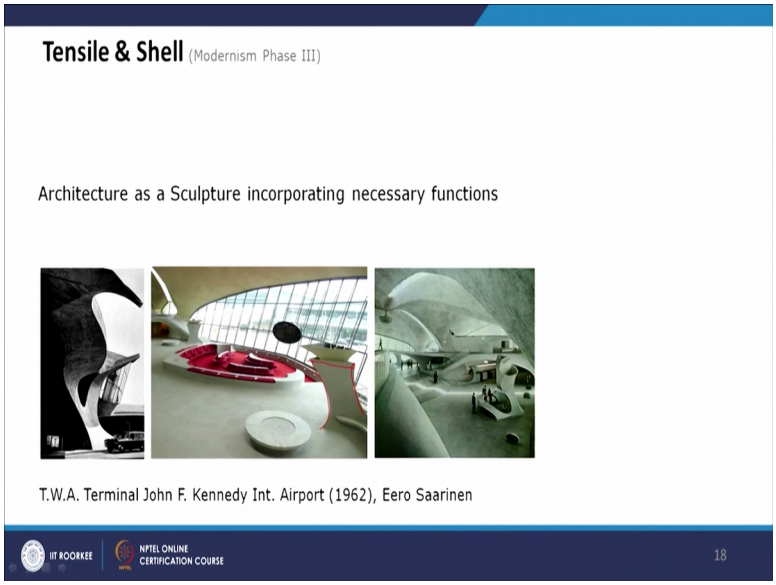

And as concrete shell structure are intertwined with the interior. So, there is a drop down sitting which is designed within the architecture. It is not just interior design element. So, it is blended with the architecture and so we can we can see from this pedestal and the drop down sitting of this space.

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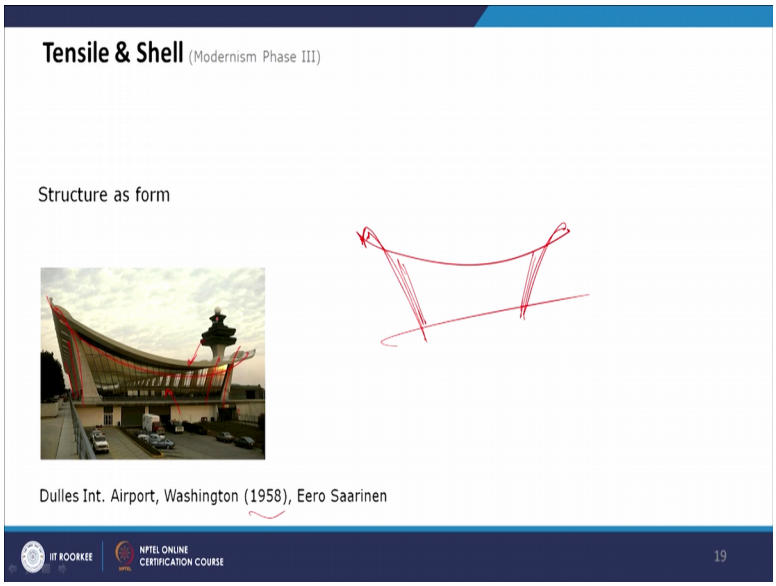

Now, another example of the same architecture Eero Saarinen in Washington, Dulles airport which is design in 1958; So, if you look at this inverted vault which is also shell structure and this columns series of columns and this vault and the columns on that side is creating the form. And so, this columns are holding this vault and on the other side also this column is holding in this vault and here this glass curtain wall again the new material was shown. The new material steel and glass for the glass curtain wall and the concrete was the shown as the element of this the texture of this building and the structural manifestation is taking the form. Now, other architects example during this phase was also has the they took the similar approach.

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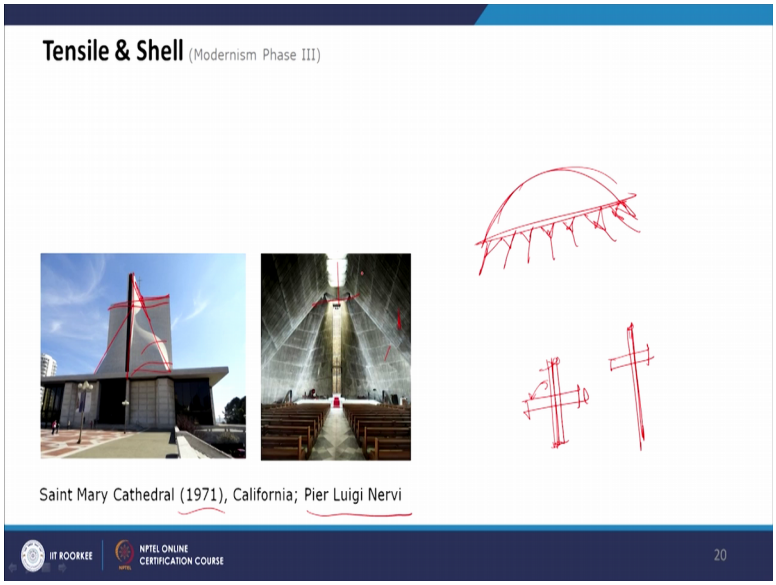

So, Pier Luigi Nervi, we have already shows one example of Luigi Nervi Olympic stadium in Italy. So, which was also you can fit into that monolithic style. So, monolithic circular style was also under this Luigi Nervi's Olympic stadium of Italy. So, and also this is the shell structure. So, monolithic architecture style was just before the shell structure.

So, lot of influence and some of the examples can be feeded into the both of the styles. So, Luigi Nervi's, other examples was this Saint Mary Cathedral which is in 1971 in California and here, if you look at this cathedral this gives from the top. So, this gives the cross which is a Greek cross which is equal in both the side. This is a Latin cross, where one vertical element will be bigger than the horizontal element, but Greek cross has 2

elements will be similar. So, from the plan if you look at so this is the Greek cross and from here, if you look at this like a folded paper and which the base is becoming more circular and the top is becoming just 2 cross and the if you look at this wall, this is again a shell structure and the concrete was exposed concrete and on top if you look at so this acts as a cross as a skylight.

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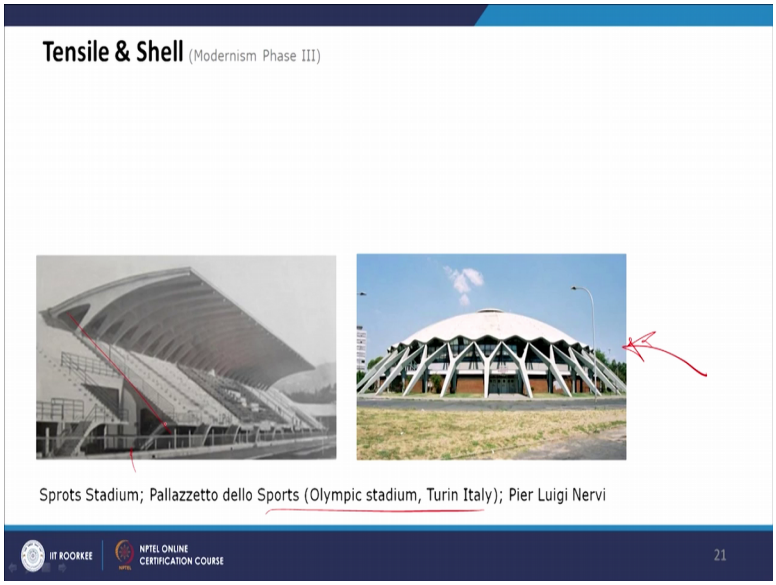

Now, Nervi's other design in this Olympic stadium can also come within this shell structure. So, we have discussed this in monolithic style as well. This is intriguing Italy and other sports stadiums which is shell structure again was explode by Pier Luigi Nervi.

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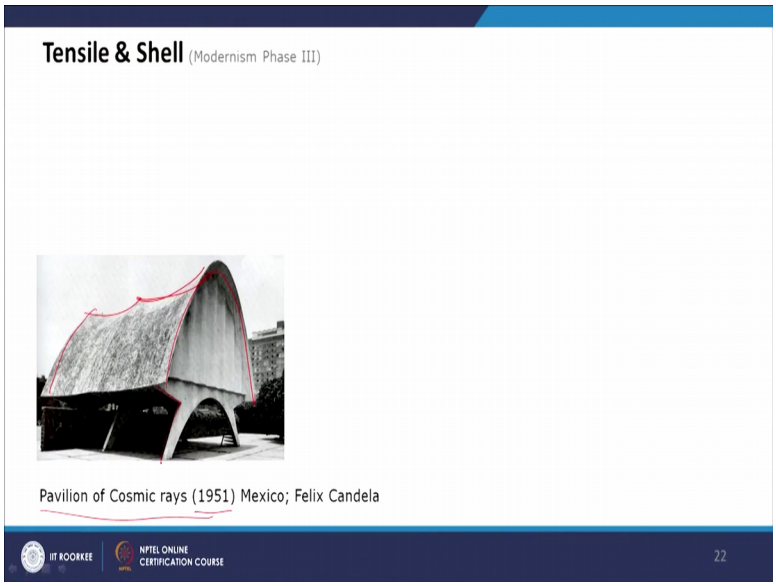

Now, Felix Candela was another architect who used lot hyperbolic parabola. So, this is a Pavilion of Cosmic Ray in designed in 1951. So, this is parabola and then, there is a slight curve and which gives the sense of hyperbolic parabola into this.

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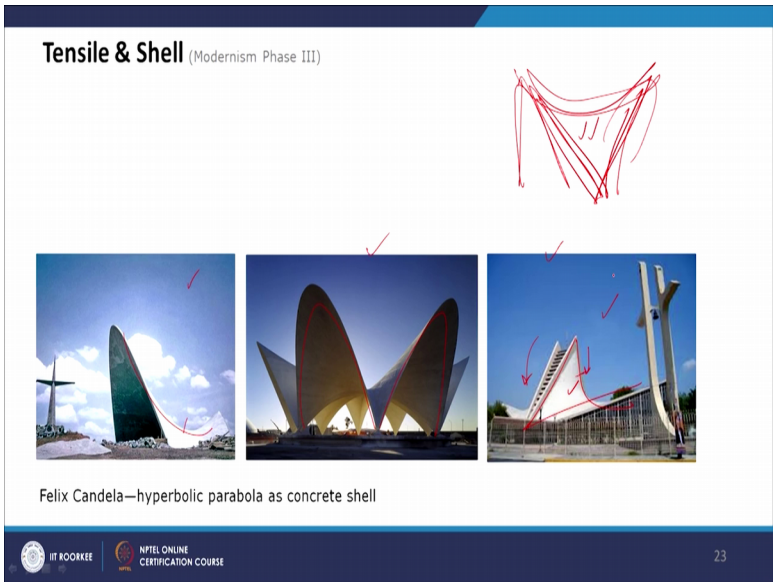

So, this is in most of his design of Felix Candela hyperbolic parabola is seen. These are few examples of Felix Candela's other works, where you can see hyperbolic parabola was used in to generate the form. So, this hyperbolic parabola, all these hyperbolic parabolas are shell structured. These are concrete shells. There is one hyperbolic

parabola, this is the series of hyperbolic parabola intersecting each other. There is one hyperbolic parabola, this is this is if you take this hyperbolic parabola and then, cut 1 section from here and only take this part you will get this hyperbolic parabola and then, there was two different hyper identical things of this form is creating the shape of this building.

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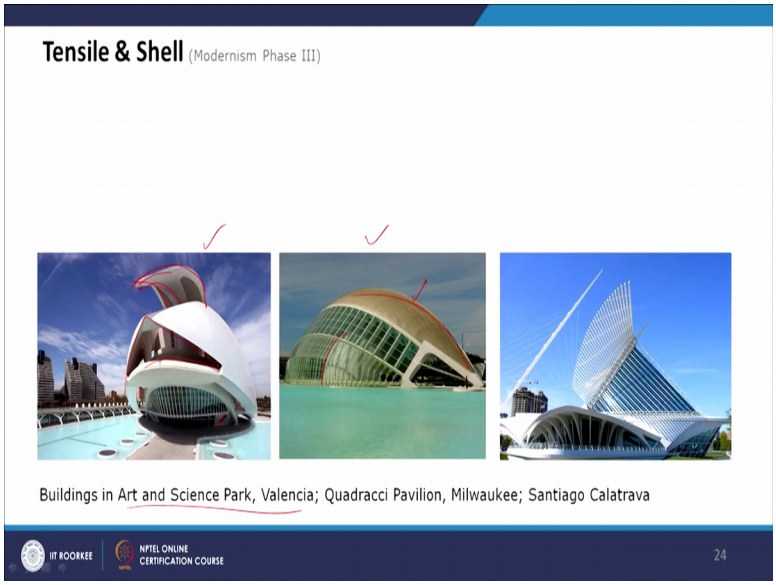

Now, another architect who have taken this neo futurist form into also in the post modern style was Santiago Calatrava. In Santiago Calatrava, this is the Art and Science Park of Valencia. These 2 buildings are there, this is the IMAX of Art and Science Park of Valencia; this is one of the museum building. So, if you look at so there is a lot of shell structure was used and the dynamic forms and different curves were and this is definitely not minimalist lot of elements are coming in within the structure are there and some elements just as an aesthetic element and also taking the structure load. But not, does not have any functional direct functional thing; so, this is the lot of exaggerated forms are there.

So, within the Imax also if you look at. So, this vault is a shell structure and this is the art museum art gallery of Milwaukee and this Quadracci art Pavilion of Milwaukee which is in USA. So, if you look at so there is a combination of shell structure as well as the tensile structures are there; so, this steel mast is taking the tensile load and also this is the tensile form designed out of steel. So, this is the combination of shell and tensile is there,

but these designs are done in much later stages which is almost in the similar timeframe of the post modern style, the post modern era.

Thank you. In the next class we will discuss more with this examples of the tensile structure and examples of from industrial design and other architectural movements on the which focuses on the similar design principle.