B. Architecture

Structure and Architecture (AR6006)

History of Structural Design in the post Industrial Period

Lecture - 12

British Pavilion Expo, Seville, Spain

Now let us straight processed on to first case study, British Pavilion Expo, Seville, Spain, the British Pavilion was a temporary construction, standing from April-October of 1932. It was created for Expo'92 in Seville, Spain Grimshaw and associates were asked to design the pavilion by the Department of Trade industry who asked for maximum open-floor space a shaded outdoor area for people waiting to enter and a strong United Kingdom identification on the exterior. With these as the brief Grimshaw went on to design the building and this is how the building looks from the outside. Formidable building with beautiful structural expression with clever use of materials and lot of light again with grand feature wall at one side, which uses water as the main element as it tries to cool the lobby. These client requests influenced design decisions, but Grimshaw chose to use the pavilion to make a statement about energy flows, and to consciously make very specific design choices that resulted in a structure highly attuned both to climate and to the needs of an exhibition space. Each face of the Pavilion is reflective of a set of design choices that create a shaded, cool space in the midst of a sunny, hot city that has daily temperature variations of up to 20 degrees Fahrenheit. So the building that went on to the structure that was made of steel and canvas, here you can see the another picture of structural systems on the right hand side of the picture and of people walking to enter the building standing in the queues on the left hand side. Look at the way the architecture has introduced the light inside the building. Accounting for this dynamic climate in Seville we just saw the temperature difference is going to be $20^{o}F$ during the day.

As the Grimshaw Architects website states, the design is characterized by structural clarity, the external skin of the structure varies to respond to climate conditions. The pavilion creates a conditioned, comfortable interior that to shy away from the abundant energy resources available in a large city like Seville. In this building you can see the different walls of the building where there is clear difference in walls. In one wall you can see a water falls feature and on the other wall you can see lot of shading devices which acts as a temperature barrier and each wall is articulated in a similar way in such a way that it works for the climate. Instead of building with the assumption that those systems will support whatever design is created, Grimshaw and Associates created a structure that was attuned to the specific climate of Seville and responded to it in a unique and beautiful way. Both the North and south walls are created using Yacht technology Fabric is stretched between masts. Here you can see the masts of the building between which the fabric is stretched to form an arch like structure which creates the temperature barrier required. We also can take a look at the water wall which we describe certain while ago on this picture. The stretched fabric is shaded by alayer of additional fabric that keeps the hot southern sun from entering in directly, especially on the lower levels. This layer allows for more shading as well as a heat buffer, keeping heat from entering the pavilion. This double layer also served as the VIP entrance. The PVC coated fabric makes up the South and North walls, as well as steel mast rigging technology is used on the walls. The same technique is used on the South side is also used here, however the double layering technique is not used, so the more indirect Northern light cannot enter. This fabric creates a similar effect to a sheer curtain, and successfully create a gradual transition between indoor and outdoor variations in brightness. Outside of the North wall is a courtyard, which is shaded by the roof panels. Here you can see the building and outside of the building you can see how the panels are arranged, here you can see the water feature wall.

On top of which have masts which British we have described earlier through which the canvas is stretched to make it like a yacht like structure on the other side you see a big British flag which will be characteristic of the building which gives the strong UK character which the client wants. East side of the building is referred to as the “water wall”. It features the UK flag, which sits behind the layer of falling water that covers the wall. This water wall cools the Easter side of the building and is not heated by the Sun for most of the time people are using the pavilion. The people who are using the

pavilion from morning 9 to 6 that period the water cools the portion of the entire particular wall which the direct sun does not enters the portion of the day. This means the water stays cool, and the continual cycling of falling water cools the pavilion to approximately 82F, when the outside temperature was 102F.

The genius of this idea is to keep the water wall and make the water itself cool the interior building. But the problem with the water wall is that when the water gets heated up by the atmospheric heat or by the direct sun, if the water gets heated up, it cannot cool the interiors. It is impossible that hot water curtain to cool the interiors. So what Grimshaw said he designed the building such a way that it does not get heated while the people where occupying the building, it cools the building by 20^{o} when the temperature is about 102^{o} the inside temperature will be 82F. Here you can see the sketches of the water walls by Grimshaw. Here is what the outside temperature is about 102^{o}F and this is the water feature and the inside of the water feature, when it goes inside it becomes 82^{o} and there is an AC and other things are operating it comes to an average temperature. This design choice creates a more passive cooling system, which also uses a small amount of electricity for the water pumps that cycle the water. This electricity is powered by the photovoltaic on the roof. The cooling effects of the water wall also mean that the air conditioning system utilize in some places in the pavilion only has tom cool the air another 10 degrees, as the air conditioned space was kept at 72F. That is what we saw in the earlier picture here. The air condition space was kept at 72^{o}F the water wall could achieve only 82^{o} so the remaining 10F will be cooled by the AC system. The other side of the building where it is completely shaded to keep the sun away from the inside of the building to prevent the building to getting heated up. The fabrics reflect most of the visible light, only small amount of the heat and light gets transferred in the fabric layer and the wall layer. Even though there is the filtered light getting passed through the building the heat is definitely reduced. This is another view of the water feature at the front of the building. As the west wall gets the afternoon sun, Grimshaw chose to make it a barrier condition, lining it with heavy water tanks filled with sand. This design choice keeps the Western afternoon sun from heating the interior of the pavilion. The roof has a set of solar panels that are suspended above the roof plane, which provide shading from direct sunlight as well as power from the photovoltaic cells. The power from these cells fuel the minimum amount of Air conditioning needed as well as the water pump

that draws the water back up to the top on the East wall. The solar cells face south to catch maximum sunlight.

This is one of the famous building designed by Grimshaw, the brief only stated that the building is to have very strong UK character and the brief only give him minimal directions such a way that the space needs to be maximum and they needs to be have external transition space and very minimal requirements of shorts. But what the Nichols Grimshaw decided to do was he wanted to create the parameter called environment inside the building and the introduction of the parameter of the building creates the environment inside of the building such a strong character of the building itself so that the use of steels and masts, yacht like fabric materials on the walls and fazards and the use of water walls and use of sand filled water tank on one side and using evaporative cooling is one of the primary is one of the method to deduce the interior temperature 102^{o} on the outside of about 82F in the inside whereas the comfortable degree's is at 72F so load on the air conditioning is very less. Imagine that if a building can give you very many solutions to very many problems instead of just the main problems which was stated by the clients themselves. The main problem was to create the image of an UK in the exhibition in 92 in Seville but Grimshaw did that in addition to that he also challenged the whole system of designing in pavilion and also he make sure that the environment that is to be taken care lightly. This is the British Pavilion Expo, Seville, Spain with quick look on the buildings Short.

International Terminal, Waterloo

This is very very interesting building designed by Nicholas Grimshaw again, this was called the International Terminal, Waterloo. The International Terminal Waterloo is a multi-faceted transport interchange that was designed to facilitate the journeys of 15 million international rail passengers per year. Grimshaw's brief for the project was to build a streamlined terminal, and because of the international service, it had all the requirements of an airport including full security screening, immigration and customs border control. The international terminal is not the airport building against what we saw in the previous section of Stansted airport terminal by Norman Foster.

Today we are going to look at railway terminal. This railway terminal has very one important feature which was strikingly similar to an airport.

Because this terminal is international terminal, which means that there are trains which were takeoff from this place to France to Netherlands to Belgium to other countries which means the terminal has lots of things like immigration, security control, border control, passport check, visa check and every single thing which an airport has. Now let's see how Nicholas Grimshaw tackle this kind of problem by a traditional setting like waterloo.

When the brief has given to him, Grimshaw produced the building with massive columns and steels which has used and to create a very large massive space on the inside which is very beneficial for the people to transfer from one place to another. Because the airport itself has shed which can compared to large shed and the international terminal railways has very similar in that parameter which can be compared to a large shed. This is an another view of platforms with the cleans curves which Grimshaw tried to make here contrast between the Opaque panels on one side and transparent panels on the other side. He clearly marks the difference at the center of the building and he clearly states that on one side and it like to come inside on the terminal on one side and light is diffused to enter the terminals. A clear clever premeditated choice of how much light which wants to let inside of the building.

All within a constrained central London site, through which passengers could pass quickly and efficiently. It was a big challenge, because waterloo, it is one of the primary and important portion of the London and it has very historic background also. And to provide a building in just a congested way to provide a vast expanse of space that has the terminal feeling, the constrained space of waterloo was very difficult. The resulting landmark design is a monument to the new railway age heralded by the advent of cross-channel rail travel in Britain. The roof responds to the dictates of the site, specifically to the west where it must rise more steeply in order to accommodate the height of the trains. Here the steep of the thing is shallow and here it is predestined the slope of the roof, because it accommodate the height trains here. The raise of this side of the portion is steeper than this side. This side is shallower. Look at the massive steel columns; look at the way the panels have been created and to create passage for the light. And the same thing is happening here the way the panels are smoothly transition from one place to another, the same way that is happening over here. And these are the complex structural connections that are needed to keep the structure stable. The building design of the western side is clad in glass,

providing arriving passengers with views of Westminster. There is an another reason why Grimshaw shows to leave the western wall open not just to get the light inside and also he wanted the passenger to look at the west minster, it was visible on one side, because in often architecture what we have to do is when you have a interesting site or when you have a very good view of something from the site is what we do is we neglect that view, we tried to include that view inside the building. In such a way that the buildings itself would create like a passage way. Here the terminal is just a passage way that one has to enter or they are transferring from one country to another country, the moment they step inside London, the only thing which they will see through this glass walls here is the Westminster building which is the most famous land marks in the UK. Imagine if you are in the railway station and one side full of open glass and through which you can get enormous amount of sunlight which is the beautiful view of Westminster on that side. So that is the idea behind the usage of opaque panels on one side and transparent panels on the other side such is the genius of the architecture.

Underground, a two-storey viaduct supports the platforms and incorporates two floors of passenger facilities: Departures and arrivals, a basement car park and the brick vaults underneath the mainline station. Departures and Arrivals are assigned a level each to encourage a single direction of passenger movement on each floor. In any kind of the building the first and the foremost thing that we should consider is circulation the movement of the people. We cannot have contradicting movement of people, people moving here and there and the people moving one place to another and another bunch of people to other place, they wouldn't know which way to go., some people will walk on the left side of the payment, some people will walk on the right side of the payment. So there is no clear demarcation when there is traffic in two way. So what Grimshaw has done is, all the arrivals at one level and all the departures at another level which means that the traffic flow of the passenger is only unidirectional. So the only passenger arrival and step out to the railway station and then they walk out to the city. The passenger comes out from the city and directly goes to the train. Which means there is only unidirectional pedestrian flow of traffic. So what you see here is railway station, look at the same use of lights and panels and AC, the same panels are repeating. Best known for its 400-meter-long curved glass roof, Grimshaw's International Terminal at Waterloo Station provides airport-quality accommodation for the London end of the Eurostar trains

services through the Channel Tunnel to Paris and Brussels. The length of the trains and the curve of the five new tracks dedicated to the Eurostar service at the side of the existing station determined the geometry of the new building, including the distinctive roof. The distinctive roof here is the main feature. Because nowhere in any of the previous train terminals had this kind of roof being administered. Because of the curvature itself the amount of glass and the amount of materials itself required to build this kind of roofs. So that is probably this kind of the roof is abundant not used in this kind of buildings. They keep saying Eurostar, the Eurostar stopped its services at waterloo and commenced at St. Pancras railway station a few years ago. This is an another look at the same thing showing the distinctive roofs here which opens up on the one side and shallow on the another side. Other elements of the building include a reinforced concrete box to accommodate an underground car park and provide a foundation over the Underground train lines, and a two-story viaduct supporting the Eurostar platforms, which are reached by escalator from a subterranean 'departure loungue'. The roof accounted for 10 percent of the overall budget. This is the same picture of the same terminal but from the other end.

In contrast to more recent complex curved glass roofs, such as Grimshaw's own Eden Project or Norman Foster's British Museum courtyard, the Waterloo roof was designed to use standard- size glass sheets, which overlap and use a concertina joint to accommodate the dual curve of the roof-arch and the track. The international terminal is at the west end of the station concourse at Waterloo Station. Most of the interior and platforms can be seen only with a ticket for travel. You cannot directly go into the platforms and take a look at the building. This is how the overall terminal looks, the way the building curves on this side and the curve plan on here.

The Twentieth Century Society has applied for the urgent spot-listing of the terminal which is under imminent threat from a €400 million redevelopment. There is a redevelopment going on and the 20th Century Society is calling for the spotting listing building at grade 2. They wanted this building to listed as grade 2 so that it can be protected from massive redevelopment which is happening. It was one of the highest profile buildings in the world at the time of its completion in 1993, winning a number of prestigious awards including the RIBA President's building of the year. Look at the standard sheet glass pattern which creates the different views. Less visible to passers-by, but just as impressive, is the vast concrete substructure underneath,

which contains dedicated arrival and departure levels and a car-park. Waterloo is a definitive work in the oeuvre of Sir Nicholas Grimshaw and a key example of British high tech design. This is how the buildings look from the top. Here you can see the actual curvature of the building and the building is little more transparent on this side and little more opaque on this side. You can clearly see all those things in the plan itself. Some of the Sketches were Grimshaw drew for this building, it is the section of the building created and this is another section which we can clearly see the five tracks on the five platforms and all also we can see the difference in the roofs. Here we can see the shallow roof and here we can see the steep roof and this is completely the open glass part and this is partly open opaque part.