# B. Architecture

# Structure and Architecture (AR6006)

# History of Structural Design in the post Industrial Period

# Lecture - 16

**Kansai International Airport**

Kansai International airport is an international airport located on an artificial island in the middle if Osaka Bay. It has a single four-storey terminal designed by Renzo Piano Building Workshop (Renzo Piano and Noriaki Okabe). It is the longest airport terminal in the world at a total length of 1.7 km from the end to end. A sophisticated people mover system called Wing Shuttle moves passengers from one end of the pier to the other. The see-out of bay is created in the Island and this is the map of the Osaka bay. Here you can see the entire bay is the Osaka.

The Osaka Airport was constructed on 1960's and what's now was they are looking for a new place to build airport because the Osaka Airport was located near to the city of Osaka and the airport is getting minimized. We need area of at least 3km area to build international airport.

The terminal is 1.7 km long with 42 boarding gates, designed to handle 100,000 passengers a day. Its long and light structure was designed to withstand the violent earthquakes which often affect this region of Japan. Below this there was the conceptual sketch of the Airport.

Kansai airport rests upon the island like a glider seen in plan. The main body of the airport forming its fuselage and the boarding gates positioned in its wings. A notable feature and one of primary importance in the organization of the airport is the unobstructed visibility of the planes themselves thanks to the uninterrupted lines of vision through the open departures level main Terminal building.

The departure level is covered by a large clear-span undulating roof of asymmetrical form. It is perhaps this shape that is the projects main innovation. The form of the roof came from extensive study of structure and ventilation requirements undertaken with Peter Rice and Tom barker, Ove Arup's structural and services engineers respectively.

It was decided that the air could simply be projected across the space from the rear of the building towards the front runways side. It is this predicted trajectory of the air that is mimicked in the form of the roof we see today. Having thus avoided enclosed air distribution ducts suspended from the ceiling the vast structure is left exposed. Beneath, blade-like deflectors serve not only to guide the airflow but also to reflect the light coming in through skylights in the roof. What happens here is usually there are huge air diffusers and air distribution does which abstract the view of the entire terminals. In this case the draft itself will be from the one end to another end.

Let us take a look at the structural design of the system and we say large elements and large number of suspension of the buildings in the earlier episodes. So look at the solid steel structure, airport buildings now a days use solid steel structures. In the main terminal Building the geometry of the roof's undulating cross-section is formed of a series of arcs of different radii connected at tangent points.

Three-dimensional beams spanning 80m follow the cross-sectional asymmetrical form of the roof, supported at their extremities by pairs of inclined columns. The 42 boarding gates are housed within the 'wings'' of the glider.

Their glazed facades address the runway while their opaque curved roof sweeps down to turn its back on the distant coastline. The height of the "wings" decreases to the buildings' extremities with the roofs following an almost imperceptible curve just sufficient to ensure the control tower's lateral line of vision. Geometrical studies led to the development of a mathematical model that would guarantee the maximum standardization of components for the building.

In any airport the control tower is one place which we can observed any portions to the entire airport. So from the control tower we must be able to look at all the part of the Airport. In some cases the building itself can

abstract some space which is unobserved by the control tower. It is just a one portion of the toroid which makes the structure. What it means is at the ends of the building the height of the building is low and at the middle section the height of the building is huge which gives the control tower enough view across all the places.

The maximum standardization of component is required since it is an off shore project and we have to necessarily make the components elsewhere in a factory fabricated. The final result is that all of Kansai Airport is 82.000 stainless steel panels if the roof is absolutely identical (this is also thanks to the building's overall size, which allowed the curves to be absorbed with low tolerances. Even a curve is look likes straight line in that scale because the panels in that curves are so big does not looks like a curve.

Kansai International Airport (KIX) is the world's first ocean airport. Four months after opening, the airport was severely tested by the magnitude 6.7 Kobe earthquake and it survived with only minor damage and provided continuous operation during the relief efforts. The latest challenge in this project is to build a input terminal. We human beings evolved the study of architecture, constructing building on land. But this building proves entirely a different course in the career of human architecture because in this we started build a building on water. Still now we haven't encountered that kind of force system which the water thrust on the land.

## Structural System of Building

Look at this structural system of the building tubertables which we are talking about. In this we can see the curve which bent from the one end of the airport to another. This is the toroid which we are talking about the entire airport cover is in the form if very big toroid with the diameter of 42 km. Here they were not used the entire structure they used only 1.7km which is just a top of the portion. We saw the sketch of the building earlier of the roof.

Here he got everything he want we can see the escalators, and he want two support over there and he placed two supports where practically he has placed everything what he want. This is the detailed section of the Kansai International Airport and here you can see the place where the air is sucked from one end of the terminals and it gets transformed to another end of the terminal and get deposited over there in a place.

This is the overall plan of the terminals. In this picture we can see the place where there is parking, and where we enter the building, the different gates totally 42 gates over there and the road which the planes take place. There is a transition system for the people to travel from one end to another. There is a escalators which take them from that place. Here in this picture you can see the land of rising sun, the eastern most country in the world. This is the triangular three dimensional thrust it is basically arched like a cover in a roof top which the thrust travel from one end of the building to another. There are totally 18 thrusts which are placed exactly 14.4 m apart. So the total meter of the thrust is 82.8m. There are also continuous secondary thrusts.

This are designed to observe lateral forces which is generated by earthquakes. There are very many different types of forces which place in Airport building. The primary force is the actually force generated by the load on the top of it.  Wind load, we never know in which direction from which the wind going to attack, so wind a lateral force. The building is to be strong to control large forces. Since the building is 1.7 km long and every material that we know of expands when we heated up and contracts when we cool down. So the expansion is allowed 450 – 600 mm thickness in the design of the building for every 150 to 200 meters. This gap is filled by rubberized elements to provide weather proofing such that water will not enter inside.