B. Architecture

Structure and Architecture (AR6006)

History of Structural Design in the post Industrial Period

Lecture - 15

Fleetguard

We straight away move on to fleetguard, Located in a newly designated industrial zone within a few kilometers of the town of Quimper in Brittany and adjacent to a major road, the site provides magnificent views across country towards Quimper and the south Brittany coast. The highly adaptable building, capable of responding to changing needs and functions and has established the company in mainland Europe. The Fleetguard was designed on 1981. First look at the building, the building itself is a white box but it doesn't look like a white box because of all the structural things at outside and the red color structural elements of the top and suspended roofs.

Fleetguard specializes in manufacturing heavy duty engine filters and the new plant at Quimper was to include production lines for air, fuel and oil filters, storage facilities and administrative headquarters totally 8,750 square meters but with a future growth potential of up to 40,000 square meters over 15 years. The design places great emphasis on minimizing intrusion on the landscape.

Surplus excavated soil has been used to create a carefully controlled landscaping scheme, relegating access roads to the perimeter of the site and segregating industrial from personnel traffic. The dynamic suspension structure reduces both roof span and structural depth, diminishing the overall mass of the building. The external structure frees the interior roof zone for flexible services distribution, unhindered by the excessive structural depth of a conventional frame of similar span.

The stairwell is enclosed in glass so that it becomes the focal point internally, linking both physically and visually the production and administrative areas. The main structure consists of elements which require very little fabrication and can be joined simply. Structure connections necessary for extending the building can be made without removing existing cladding, thereby avoiding disruption to the use of the building.

Total steel weight is 47kg/meter square, about 17% less than conventional structures of comparable bay size. The cladding is clearly articulated from the structural frame to facilitate bay by bay expansion without disruption to fleetguard's activities, and is separated from the roof zone by a continuous band of high-level glazing, bringing natural light into all parts of the building. Here this the interior of the building here you can see all the visible lines i.e., structural lines in brightly painted colors. The fleetguard building received famous awards such as,

Awards:

1986 – Premier Award for Exceptional steel structure, France.

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1982 – Concours de Plus Beaux Ouvrages de Construction Metallique.

1982 – Constructa-Preis for Overall Excellence in the Field of Architecture.

PA Technology Centre, Princeton

Immediately go on to next building, which is called PAT Center, the PAT center is in Princeton, USA. If you asked Richard Rogers about this building, he would say about this

"If we lose control of the process of building, we become merely decorators of sheds. If we are simply decorators of sheds, we shouldn't be called architects."

-Richard Rogers.

At first glance, it seems ironic that the architect of the PA Technology center (or PAT center) in Princeton NJ said this. The PAT center's 40,000 square foot single story volume is largely un-partitioned and quite shed-like inside. Its stayed roof structure, painted bright red and articulated by clevises and stainless steel pins, is certainly an exhibitionist form of ornamentation if not outright decoration. A more careful reading of the building reveals, however that Rogers' PAT center is more than "Simply" a decorated shed.

Many aspects of the building, including its structure and conditioning system, evolved in response to the client's needs, or to Rogers' ideas about efficient manufacture, construction and maintenance.

As a research and development company specializing in product design and telecommunications, PA Technology LTD wanted its Technology Center in Princeton, NJ to be flexible and expandable enough to meet its unpredictable space requirements. If also wanted a building that would be visually expressive of the highly technical operations inside. To solve the problem of spatial uncertainly, Rogers designed the building interior as a single large volume, modulated by a minimum of re-locatable partitions.

The stayed roof provides a largely column-free interior, which increases flexibility and with the exposed HVAC equipment and translucent façade panels, provides the buildings "high tech" expression. The buildings articulated structural components reflect their design as a "kit of parts", pre-manufactured from off the shelf products.

Roger's points out that mechanical conditioning equipment generally needs to be replaced long before the building shell it services. So to simplify refurbishing at the PAT center, the bulk of the HVAC system is set on bridges between the A-frame masts above the roof.

Concrete floor slab aside, the PAT Center's structure provides an armature from which the rest of the building's enclosure and servicing are hung. Set on thirty foot centers, it's a-frame masts rise forty five feet above twenty foot wide portal frames that define the building's central circulation spine; tension rods pinned to the tops of the frames branch out to pick up 75 foot long roof beams at four points.

Tension struts at the ends of these beams stabilize the lightweight roof against uplift loads. Secondary beams supporting the five inch deep roof deck span between the main roof beams on thirteen foot centers. The outermost facing beam is exposed on the building façade. Except for the local bending of the beams, gravity loads subject the structure to essentially to only axial forces.

Reflecting this and expressing the kit-of-parts concepts, most major structural connections are pinned through perforated gusset planes or clevises. With the addition of more A-frame masts and stays, the building is extensible on 30 foot modules.

Horizontal wind load is distributed by the building's façade panels (acting as one-way slabs) to the roof and ground planes. Wind is resisted at the upper level by the steel roof deck acting compositely with the beams beneath it as a diaphragm. Resting directly on the steel roof deck, two layers of rigid insulation covered with a built-up-roofing membrane and gravel comprise the rooftop enclosure system. The upper layer of insulation is tapered for drainage.

The façade is made of pre-fabricated pre-glazed, 2-3/4 inch thick "kalwall" panels set in aluminum frames. Twenty percent of the total panel area is clear glazed. The remainder is made of a sandwich of translucent fiberglass insulation set between sheets of rigid fiberglass. Besides a chiller, gas fired boiler and drain pipes, all the building's condition equipment and services are provided from above.

Air handling units and primary supply and return ducts are cradled between the A-frame masts above the central spine's sky lights; hot and cold water is supplied just below roof level. To keep air moving to and from the air handling units at the proper temperature, the main ducts outside the building enclosure are insulated.

Branch supply and return ducts penetrate the roof in each 30 foot bay between masts and serve the 75 foot wide building sections to either side of the central spine with variable air volume fan-assisted ducts. A perimeter Hydronic heating system supplements the forced-air supply in the winter (which makes sense, given the façade's rather small 4.5 R value). Separate foul, wash and lab drain lines are provided under the concrete floor slab. This is how PA Technology center looks like, this is scale model which is made through understand the building works.

Olympic Athletic Center of Athens

We shall directly we moved on to Olympic athletic center of Athens are next case studies for the day. This building was not designed by Richard Rogers as previous two building designed by Richard Rogers. This building was designed by the famous persons called Santiago Calatrava. This architect is famous for this structural expression and any place across the globe if you see any different building, there is very good chance that the building is designed by Santiago calatrava.

Olympic Athletic center of Athens (OAKA), is a sport facilities complex built in 1982 and refurbished for the Athens 2004 Olympic Games under a design produced by the Spanish architect Santiago Calatrava.

The complex is an articulated building system inserted into the context of an existing sports center built in the eighties. It was extensively renovated in time for the 2004 Summer Olympics, including a roof designed by Santiago Calatrava, and innovatively positioned with Enerpac hydraulics. The roof was added a top the sidelines and completed just in time for the opening of the Games. The two giant arcs have a total span of 304m and a maximum height of 72m.

Also, it has a total weight of 19,000 tons with 5,000 polycarbonate panels, covering area of 25,000 sq m. The west arc was assembled 72m from its final position and the east 65m – both later slid into place. The roof is designed to withstand winds up to 120 km/h. The stadium was then officially re-opened on 30 July 2004.

Olympic Sports Complex intended provide a permanent center for athletic and cultural events within an ecologically sustainable park-like setting, served by an upgraded transportation system. The principal architectural interventions included a new roof for the Olympic Stadium, a new roof and refurbishing of the Velodrome, entrance plazas and entrance canopies for the complex as a whole, a central plaza of the Nations, tree-lined bounlevards, a pair of arcade structures reminiscent of the ancient agora.

This is a design of a central Olympic Icon and a sculptural Nation’s wall. The Olympic stadium is covered with a roof of laminated glass, composed of a pair of bent “leaves”, capable of reflecting up to 90% of the sunlight. The Velodrome roof structure is composed of two 45 meter high arches, weighting 4,000 tons, from which the glass and steel roof is hanging. Four entrance plazas provides ceremonial access to the complex. Each entrance gate is roofed with a vaulted steel canopy, which provides the public with a clear identifying element for the complex.

When illuminated at night, these canopies serve both as orientation devices and as attractions in themselves. Two of the plazas are located at opposite ends if a central circulation spine, which runs between the Olympic Stadium and the Velodrome.

Another two, on the north side of the complex, lead from the Irinis Electric Railway Station and the Neratziotissa pedestrian bridge to one of the two covered Agoras. The Nations Wall is a tubular steel wall sculpture, designed to move in a wavelike motion, creating a pleasing effect of light and shadow over the center circulation spine and the Plaza of the Nations. The Nations Wall can also serve as a giant video screen. In additions there are new warm-up areas for athletes, improvement of pedestrian bridges, connections to public transportation, parking areas and bus terminals as well as the design of the installations and infrastructure for all elements.

All structures have been designed so that they can be prefabricated off-piste in large measure, reducing the need for onsite personnel and equipment and minimizing interference with other construction work on the existing buildings. The stadium roof covers a surface of some 25,000 square meters (269,098 square feet). The bearing structure of each leaf is comprised of double-tied arches made of tubular steel, which span 304 meters (997 feet) and rise to a height of 60 meters (197 feet).