



Gayathri



Tania

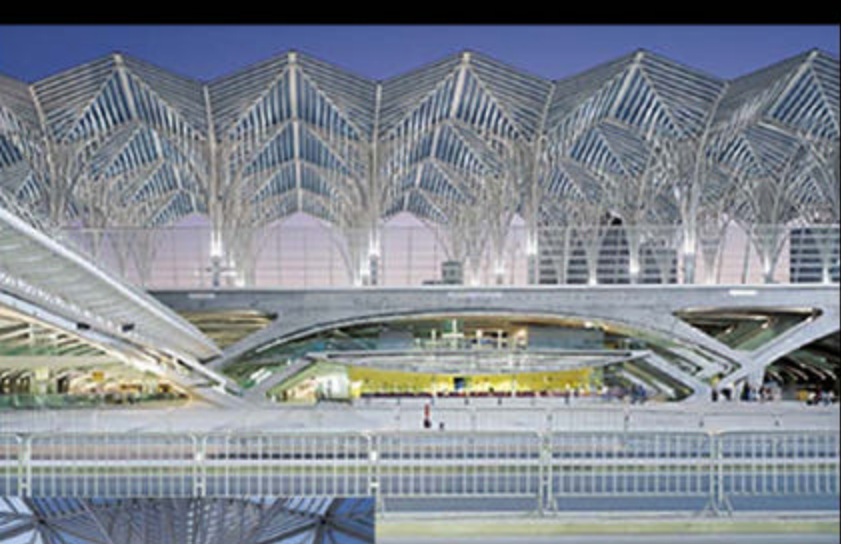


Shruti

**THE AWESOME
THREESOME
PRESENT**

Charlie??





ORIENT STATION

Lisbon, Portugal 1993-98

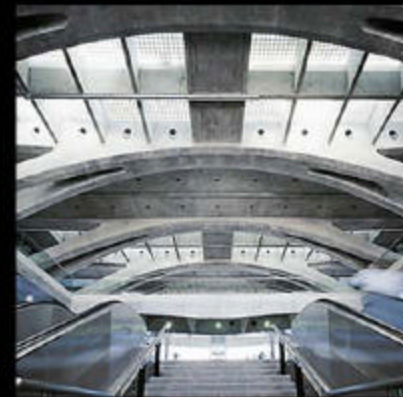
Transport hub for the North East district

- An important transport interchange for high speed inter-city trains, rapid regional transport, standard rail services, tram, metro networks, bus terminus with two level park and ride facilities for approx. 2000 cars.

- By Architect Santiago Calatrava, Zurich, Switzerland

- A complex Urban Insert that uses its structure to make a statement about its importance as a major Urban node.

- A part of the Urban Insert- the elevated train platform with the glass and steel trees is to be analysed in detail- both in terms of its contribution to the overall design and in terms of its structural behavior.

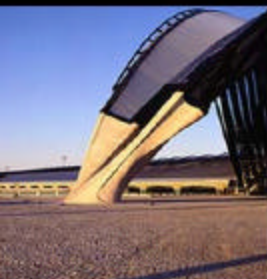


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SANTIAGO CALATRAVA



Lyon, airport station



Lyon, airport station



'I have built tree like structures and frequently, my designs recall the form of skeletons. Behind this is the principle of recurrence, whether in the case of trees or vertebrae, one finds the form dictated by the universal structural law that the base is thicker than the crown. The recurrence of this principle expresses economic efficiency, but it also rises from something beautiful, namely rhythm.'

- Approach to work is through understanding the architecture of the structure through geometry.

- Structure plays an important role in his architectural investigations and a means to study nature and extract out of nature's ways of giving appropriate forms to buildings.

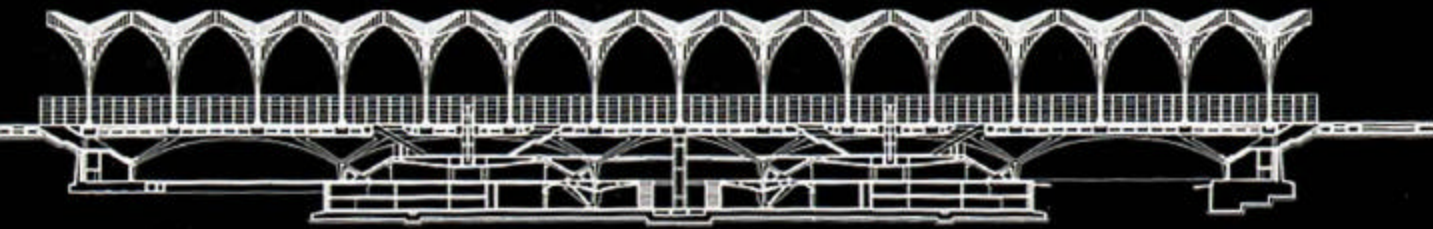
- Materials, their inherent properties and the way they are processed are understood and used for poetic expressions of forms.



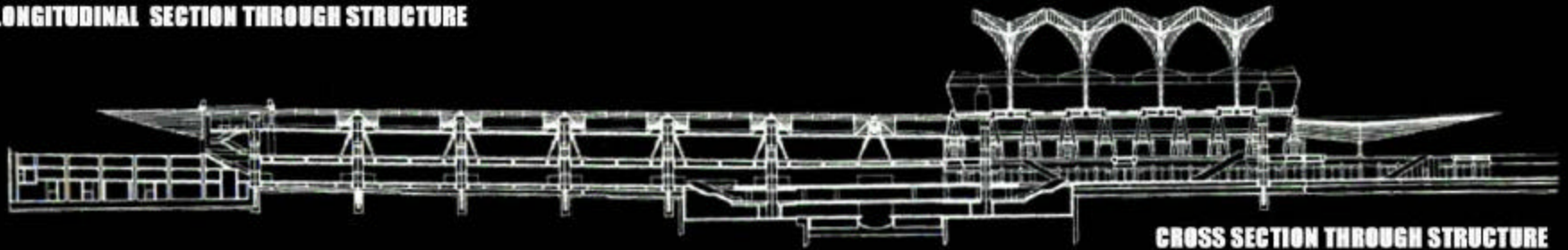
Orleans, Bridge of Europe



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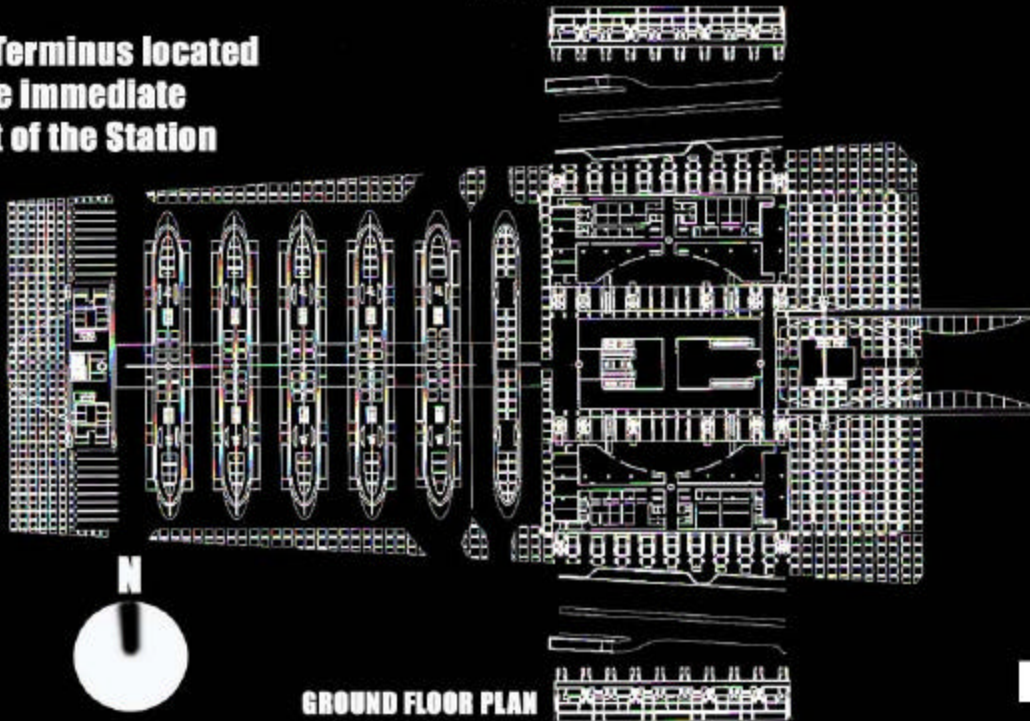
LONGITUDINAL SECTION THROUGH STRUCTURE



CROSS SECTION THROUGH STRUCTURE

N-S Railway Link

us Terminus located
the immediate
est of the Station

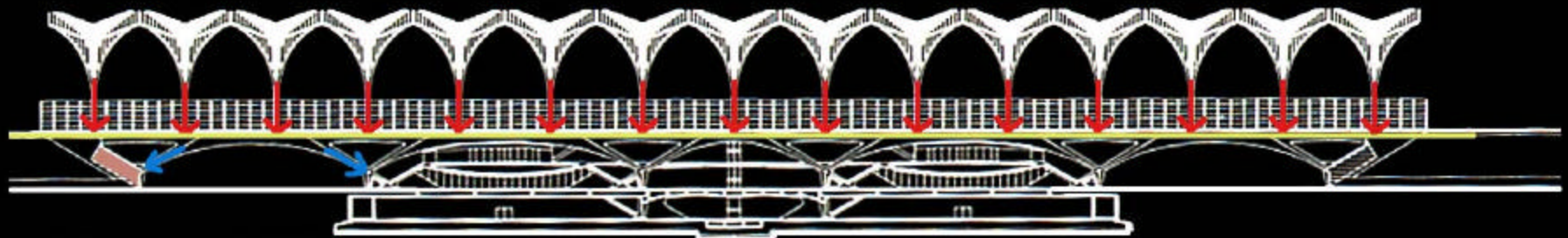


GROUND FLOOR PLAN

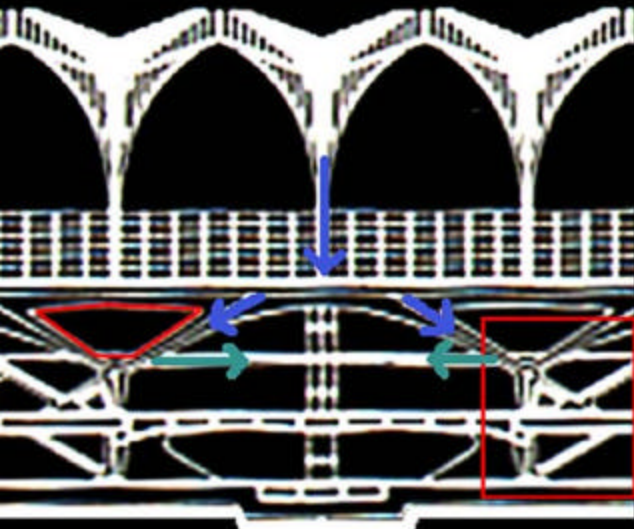
DESIGN ORDER

The tree structure on the topmost level, is constructed in a light weight material, steel. It makes the structure look light. The structure gets more dense on the lower levels, where reinforced concrete is used to take on all of the dead weight. The station platforms are placed on a bridge structure that comprises of 10 rows of arches. The total width of the bridge = 78 M The total span of the bridge = 260 M

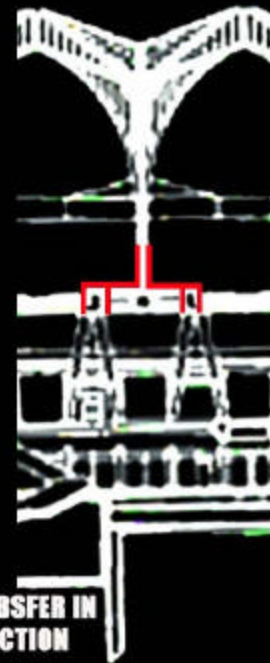
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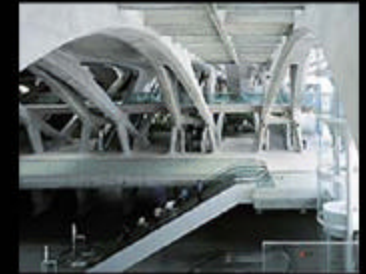
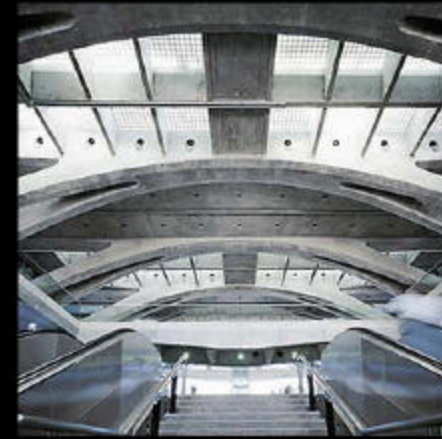
LONGITUDINAL SECTION SHOWING LOAD TRANSFER THROUGH THE STRUCTURE



LOAD TRANSFERS IN A TYPICAL BAY



LOAD TRANSFER IN CROSS SECTION



The flooring of the overhead railway system is made up of transparent material to light the area below in order that there would be some ventilation through the long-span arches.

Floor acts as a tie for arches
 Skeletal structure brought out through detailing of elements.
 The joints of the arches detailed out to take care of the point load and to maintain a clear space in the circulation bay.
 Point load from the trees have been distributed uniformly through the arches.

Overall structure

THE BUS STOP..



STRESS DISTRIBUTION THROUGH LONGITUDINAL SECTION

The system is a simple composition of an arch and two members on either sides that take care of the compressive forces in the arch.

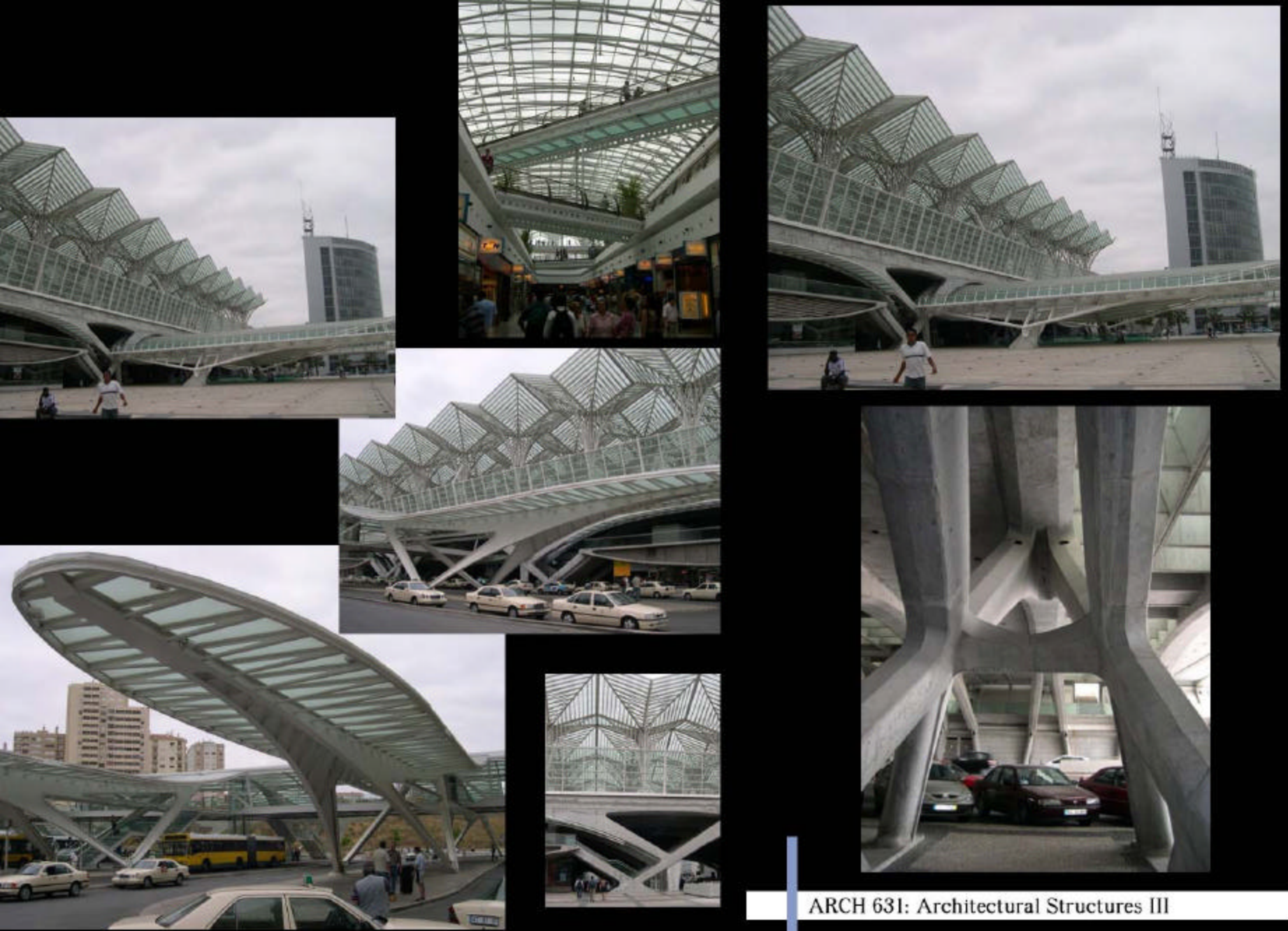
A tie member connecting all the elements takes care of the tensile stresses in the structure.

A bridge running perpendicular to the structure connects all the bus stops providing lateral stability.



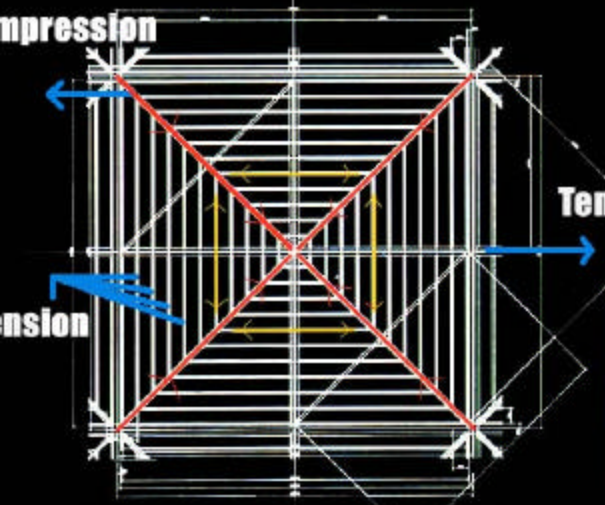
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Source : Calatrava- Public Buildings,
www.structurae.de

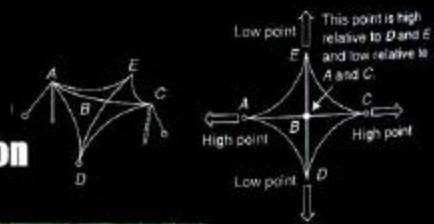


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DIFFERENT VIEWS OF THE ORIENT STATION



Anticlastic structure...



like a tree...

Types of loads

The structure formed of individual trees mainly has to deal with two types of loads

- Self weight (gravity load)
- Wind loads (lateral load)

-The third type of load is the suction caused by the high speed trains as they pass through the platform.

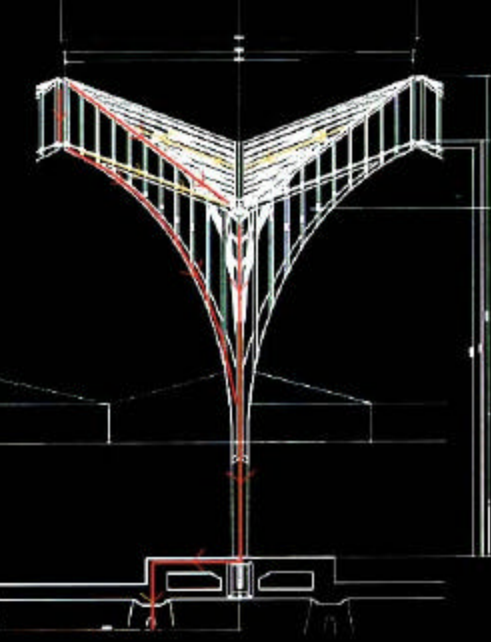
Whole structure formed by **4 trees along one direction and 15 trees in the other.**

ROOFING SYSTEM

Steel framed and FRP cladded structure that branch out like 'trees' are interlocked to form a continuous system of transparent roofs which are arranged on a **17 M grid.**



DETAIL PLAN OF TYPICAL TREE STRUCTURE



SECTION THROUGH TYPICAL TREE STRUCTURE

DETAIL ANALYSIS OF TREE STRUCTURE

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Source : Calatrava- Public Buildings, www.structurae.de



SELF WEIGHT TRANSFER

The members (**orange**) along the synclastic surface are in tension.

Members (**blue**) connecting the arches and the **main members** of the synclastic surface are in compression.

The arches (**red**) are the branches of the tree that carry the load of the foliage to the trunk.

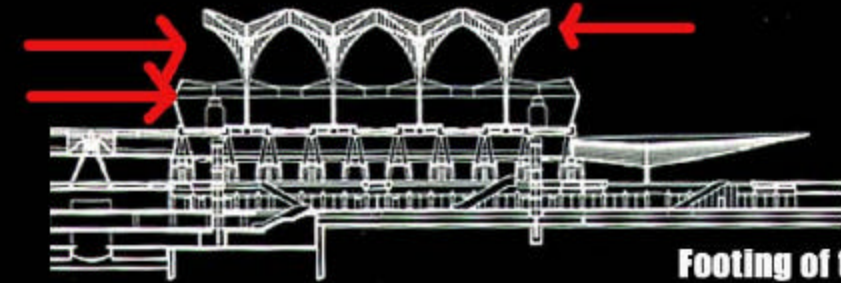
The arches are connected together using a pin connection.

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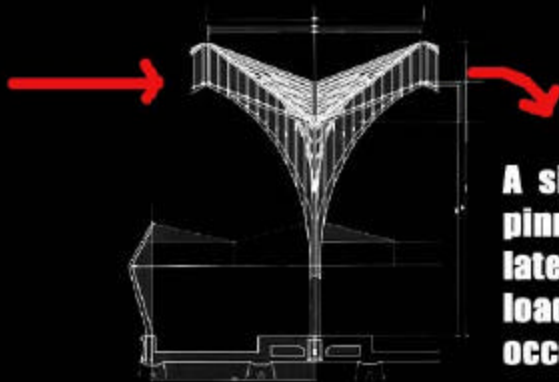
LATERAL LOAD- WIND LOAD



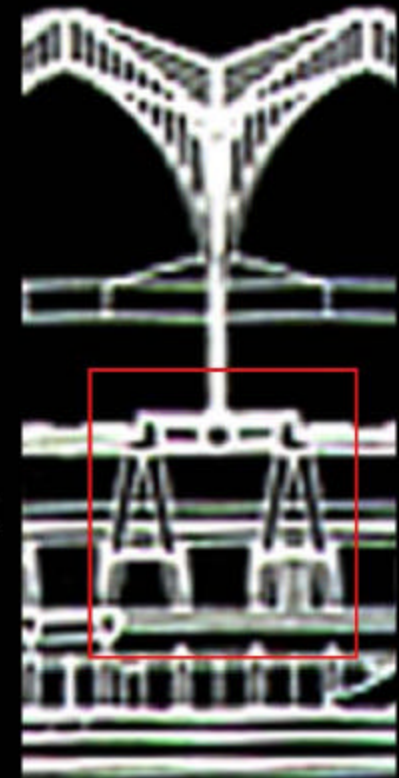
Stacking of the trees in either directions makes them stable against lateral loads. Since the trees are stacked 4 along across the tracks and 15 along the platform, the roof as a whole is laterally stable.



Footings of the tree structure is thickened to uniformly distribute the load over two arches to avoid puncture due to point load.



A single tree structure with a pinned joint at the base is not laterally stable when a lateral load is applied- overturning occurs.



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