

## Structural Art

### Basis

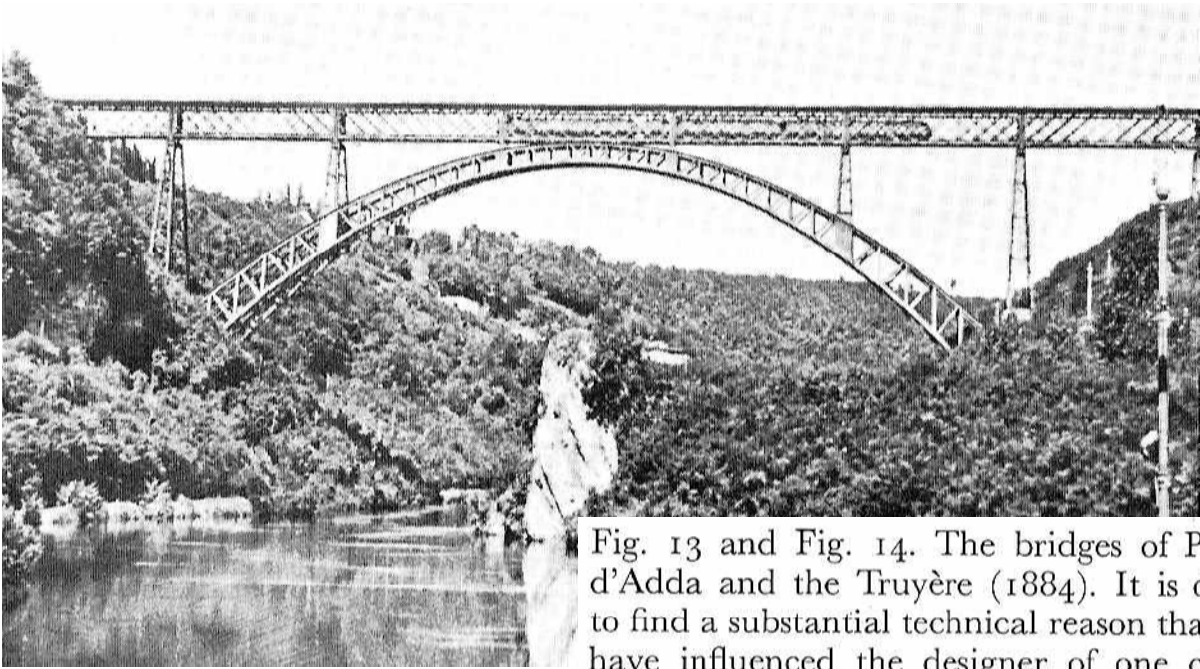
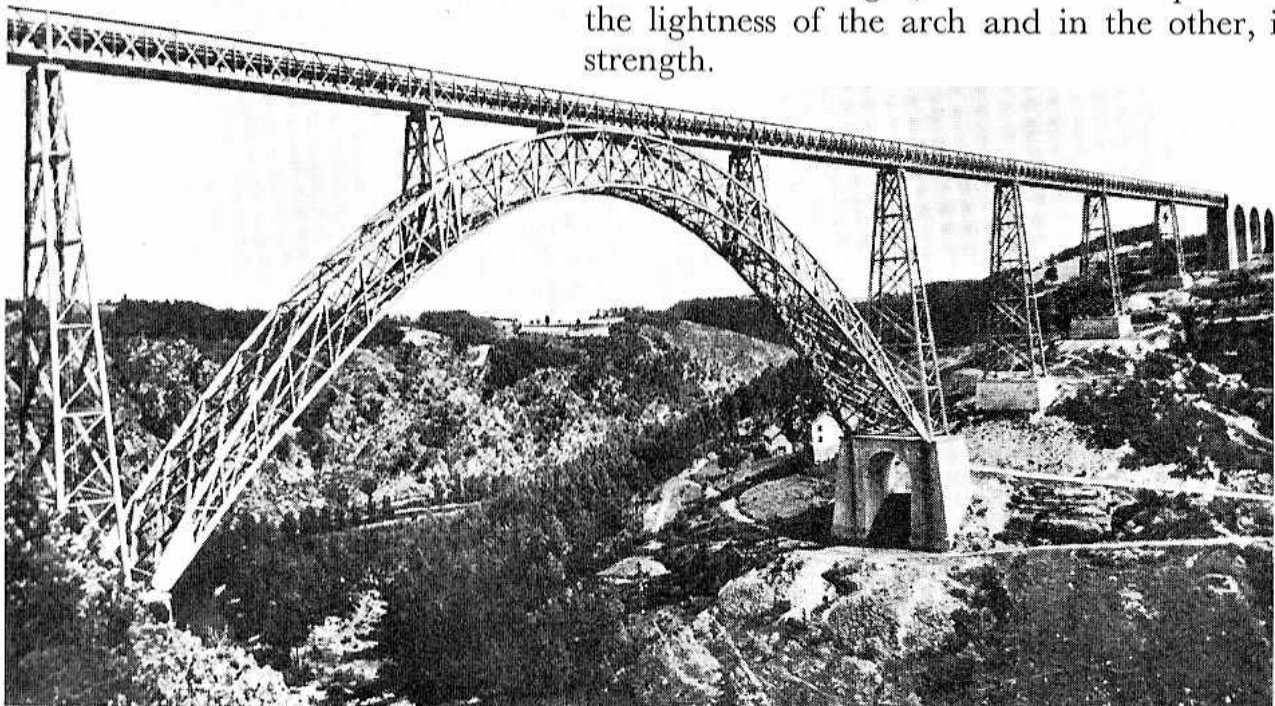


Fig. 13 and Fig. 14. The bridges of Paderno d'Adda and the Truyère (1884). It is difficult to find a substantial technical reason that could have influenced the designer of one of these bridges to choose a fixed-end arch and of the other, a two-hinged arch. Both fall within the realm of indeterminate structures and require immovable supports, though to a varying degree of tolerance with respect to possible differential settling of the foundations. Therefore one might imagine that the choice of structural system was due to the difference in aesthetic or architectural result sought, in one case emphasis of the lightness of the arch and in the other, its strength.

Nervi writes to explain these bridges:



## **Where does Structural Art Come From?**

Engineers operate on three core principles, in order of importance:

### **1. Safety**

The prime motivation for all of engineering is safety. The public expect it; we must deliver. Engineering disasters disproportionately attract both attention and criticism, duly because of their rarity and perceived 'preventability'.

### **2. Efficiency and Economy**

*Efficiency – The conservation of natural resources:*

Engineers strive to create structure that uses a minimum of material to do the greatest work. It is said that an engineer can do for \$1 what anyone can do for \$10.

*Economy – The conservation of public resources:*

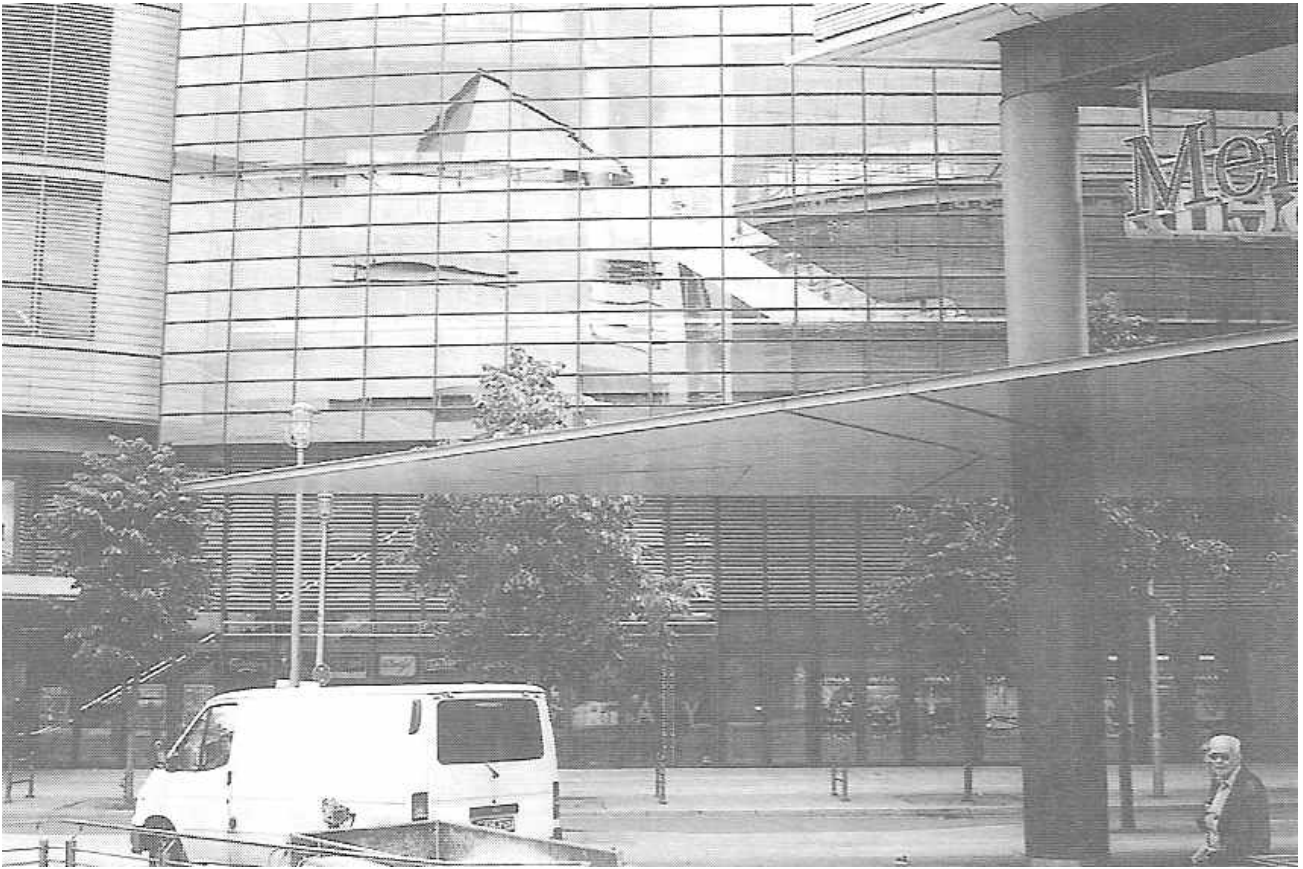
Engineers always must work under the discipline of economy consistent with usefulness; the public demand a more utility for less money. Successful designers are those that know how to build their structures for less money.

### **3. Elegance**

The above, more important requirements are to be seen as motivators, rather than inhibitors for elegance. Minimal materials and building costs may help, but they are not sufficient to render aesthetic structures. As Nervi describes, engineers have great freedom *after* meeting the first two requirements. Their only other consideration therefore is the conscious aesthetic motivation – Le Corbusier's 'engineer's aesthetic'.

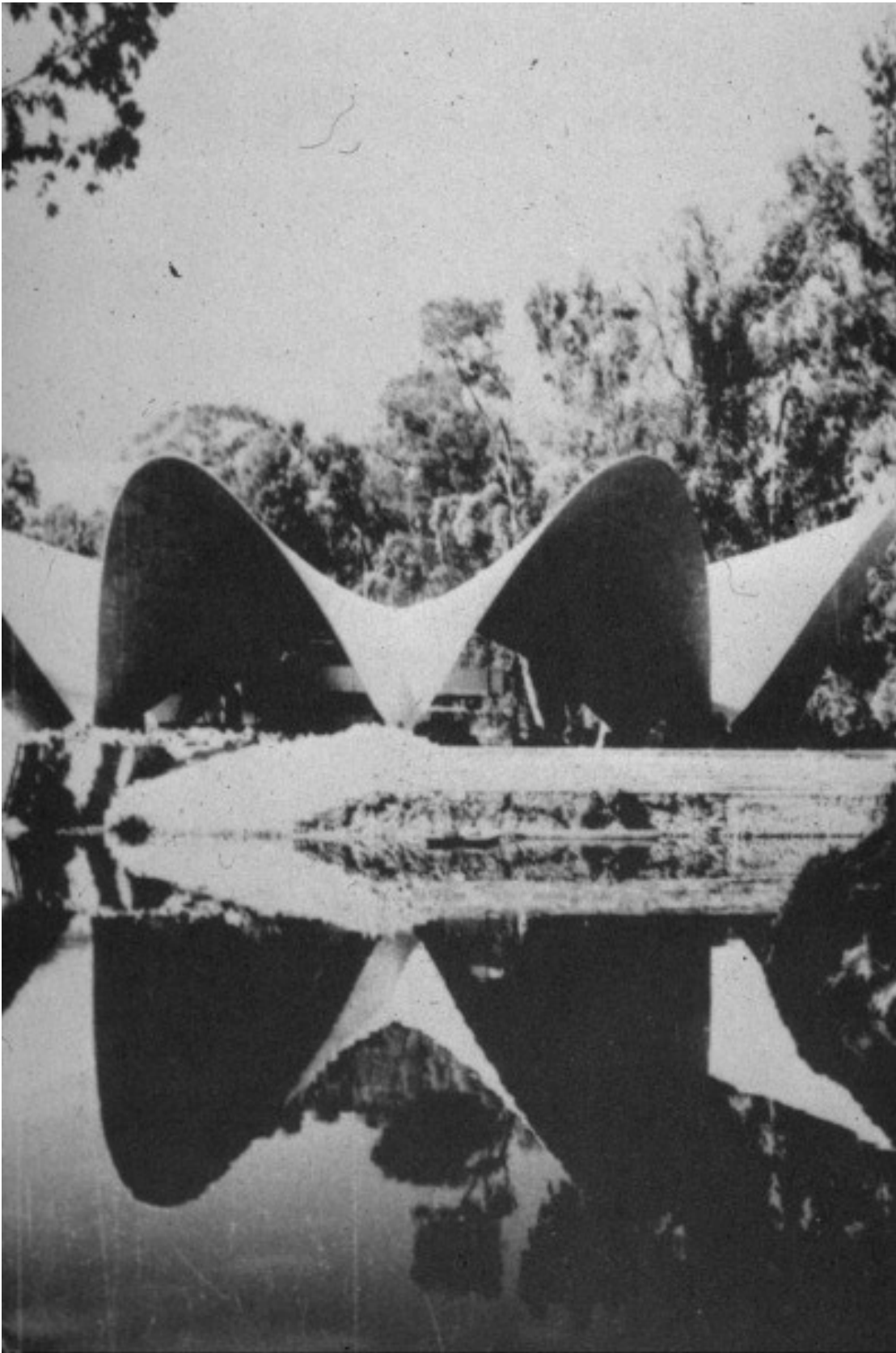
The works of the great structural artists to be described was carried out under free competition and their works therefore represent the ideal balance of these principles.

**Unknown Everyday Example**



The span-depth ratio of this cantilever defies structural logic: how does it work?

**Felix Candela**



**Robert Maillart**





**Heinz Isler**

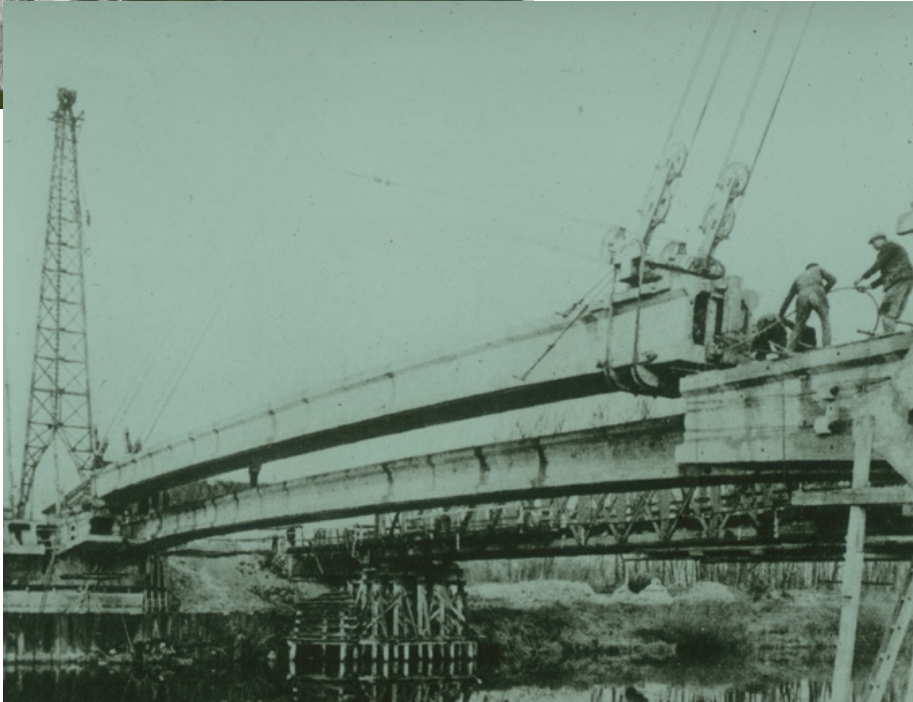


**Christian Menn**

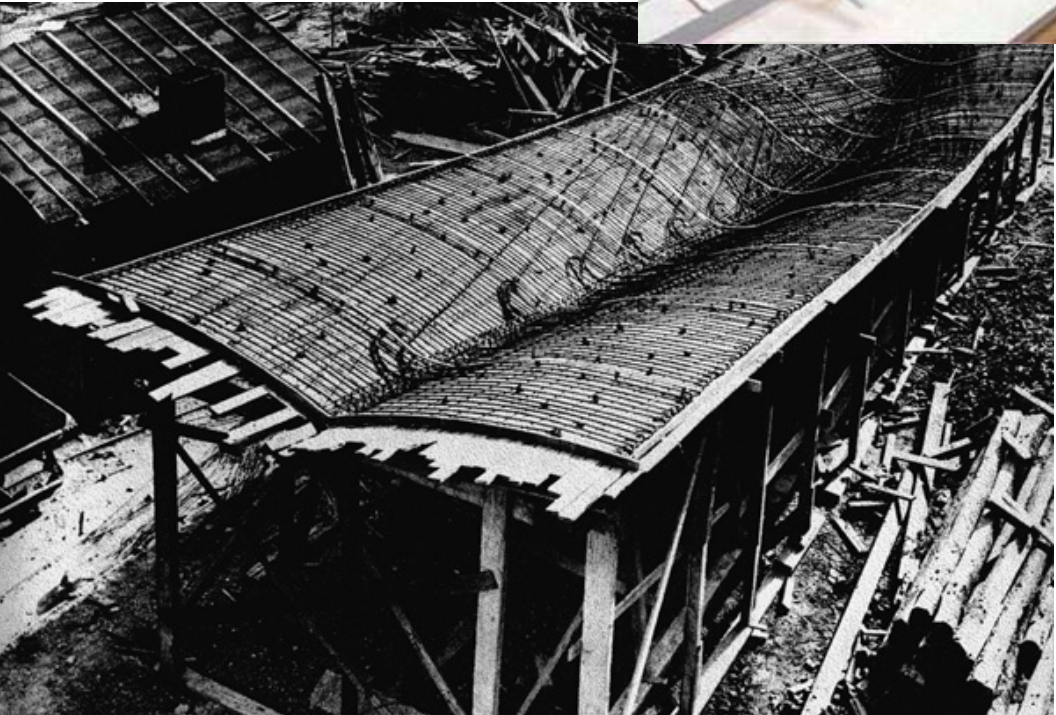
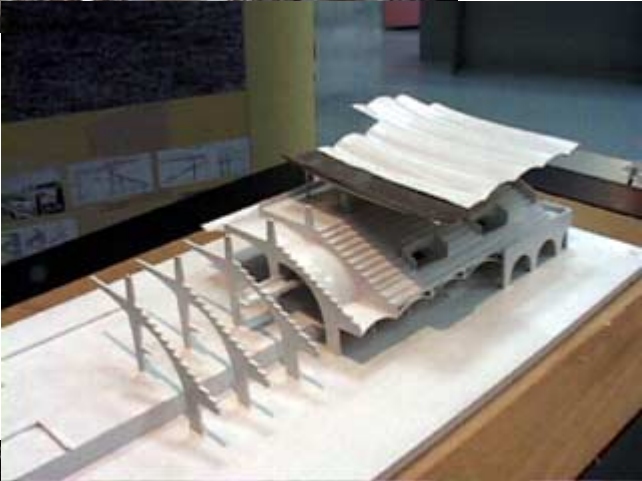




Eugene Freysinnet



**Eduardo Torroja**



**Pier Luigi Nervi**



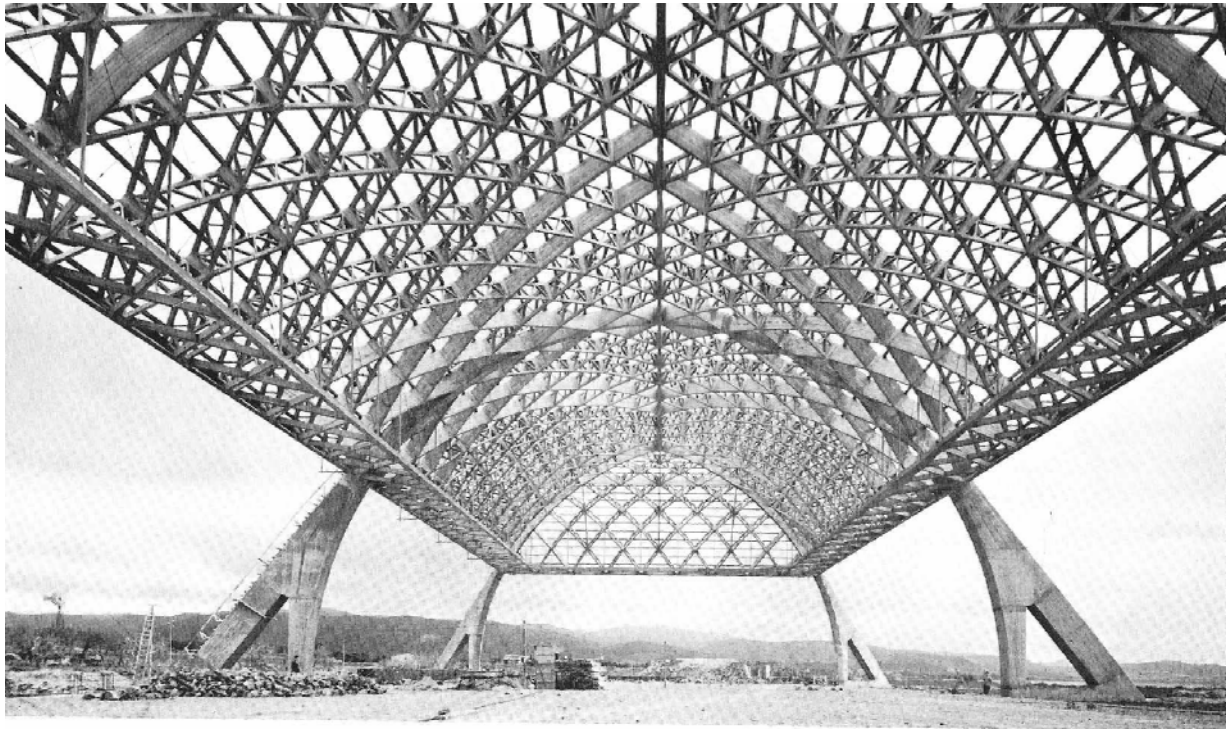


Fig. 82. Airplane hangar. The statically most important ribs were cast in place because of the difficulty of transmitting the internal stresses through the joints.



Fig. 49. Gatti Wool Factory, Rome: plan (left) and view of floor slabs with ribs following the isostatic lines of the principal bending moments.