

Gaussian Geometry
Double curvature surface defined by parallel lines at the spring point of the vault and an S curve at the apex. Each longitudinal section of the vault is a catenary curve

Structural Ceramic Gaussian Vault
Spanning 50 meters (164 ft), rising 6.5 meter (21 ft)

New Glass "Eyelid"
Joining edge of vault and top of wall

Existing Brick Masonry Wall
Only structure left after the fire

Steel Tendon and Lighting
Pretensioned element connecting the flat edges of each vault attached to concrete edge beam cast to cap existing masonry wall

Concrete Edge Beam
Cast-in-place beam and vault spring point, capping the top of the perimeter masonry wall and absorbing height variations in the wall.

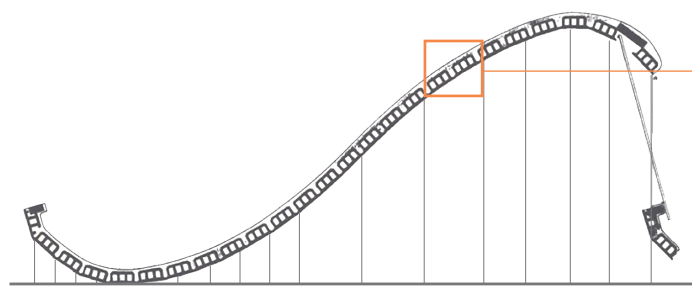
Building the Resistance Eladio Dieste's Digital Work in Cerámica Armada

Many archive photographs capture the construction of long-span reinforced masonry, double-curvature shell structures built by the practice of the late Uruguayan engineer Eladio Dieste. There are few photographs of Dieste hovering over models or drawings in his office. In most images, he is speaking with workers while inspecting and standing on formwork - construction materials always within his reach. Images show Dieste working with job captains dedicated to designing the complex choreography of materials and bodies on site. During the second half of the 20th century, his engineering and construction practice, Dieste and Montañez, invented four material innovations in Structural Ceramics or Cerámica Armada. Cerámica Armada combined the abundance of a local material, like clay brick, with the modern advent of steel reinforcement. Dieste's fascination with material was based in the structural resistance to gravity through the combination of material and form.

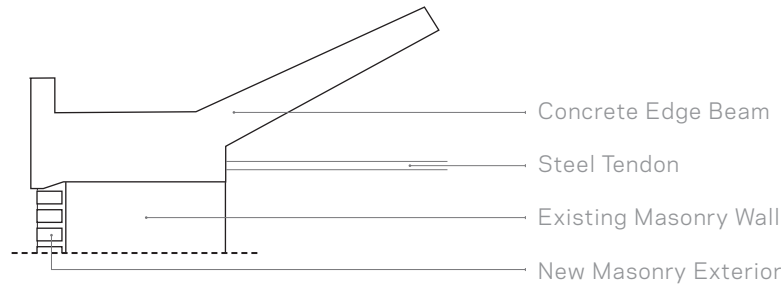
The virtuality of the digital in "Building the Resistance" is framed by the role of formwork systems designed to build Gaussian Vaults and other the double curvature geometries in Dieste's work. Studying the adjustable and reusable formwork systems designed and constructed by Dieste's practice highlights the implications of making digital work without computational technology or electronic media. Historical knowledge of these systems connects the invention of complex forms with the labor that produced them. Problematising the representation and construction scope of labor is critical to the ideas of economy proposed by Dieste. In "Architecture and Construction", Dieste suggested that Cosmic Economy was a way to reveal the order of the world by paying close attention to the people behind the construction of buildings (Dieste, 1992).

During a 1990 interview with the architect Mariano Arana, Dieste stated that he rarely made models in his practice, "the model is slower and more expensive than computation - the smaller structures have been the models for the larger ones" (Dieste, 1992). In this passage, he was referring to the slowness of physical models and the speed of numerical calculations as a form of computation. Dieste's work challenged the geometrically planar hegemony of modernism by developing a repertoire of digitally produced forms. The process was digital because bits were used to anticipate and calculate the behavior of atoms - data predicted the behavior of physical matter (Negroponte, 1995). His practice trafficked in data before the ubiquity of computer servers displaced the understanding of physical matter as the product of intimate numerical knowledge. Many engineers, artists, and architects, like Antoni Gaudí, worked through digital means to find forms long before computational tools. Unlike other people investigating the relationship between materiality and virtuality, Dieste did not use any form-finding techniques other than the use of numerical calculations to anticipate material bending and load distribution.

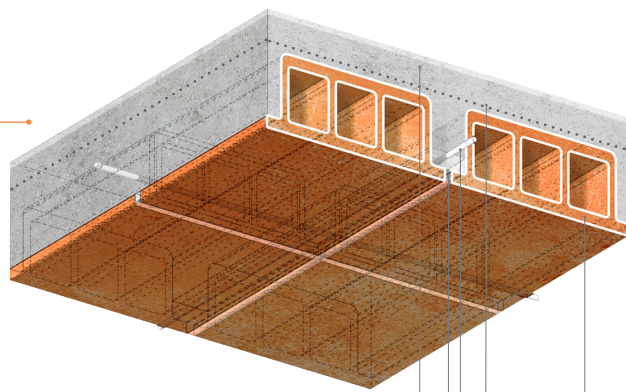
With a sense of Cosmic Economy in mind, how does examining formwork labor become a digital precondition for understanding the material effects of Cerámica Armada? Material lessons from Dieste's work highlight ways to resist gravity as well as the economic and political forces that shape the contemporary relationship between architecture and labor.



Cross "S" section
Curved apex, flat spring points



Concrete Edge Beam
Vault spring point and steel tendon

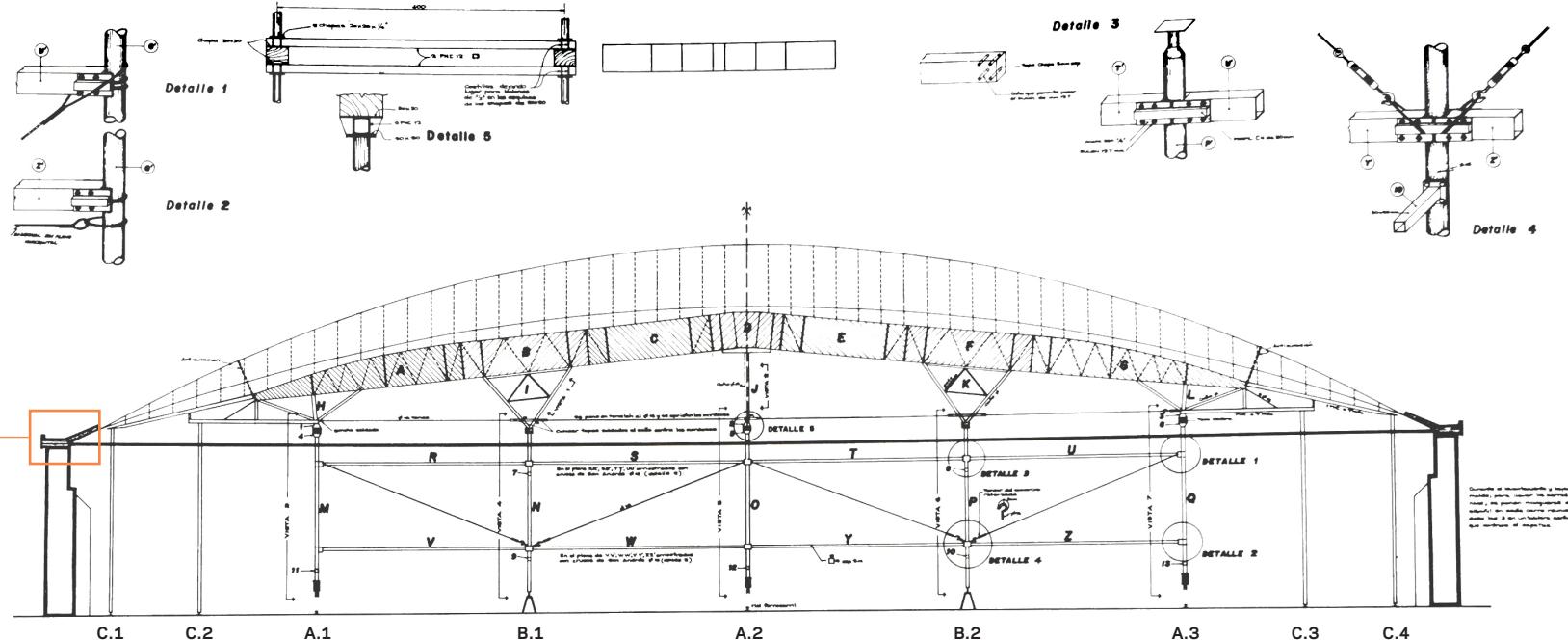
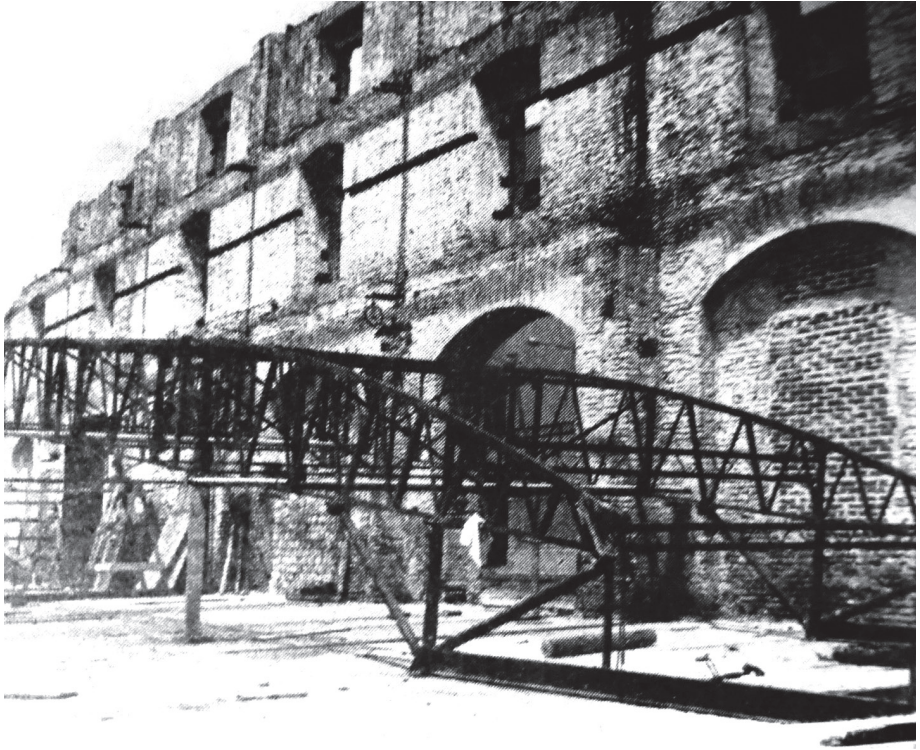


Cement
Mortar Joint
Steel Reinforcement Grid (100mm)
Metal Mesh
Hollow-core Bricks (Bovedillas) (25cm x 25cm x 10cm)

Material Assembly
Cerámica Armada (Structural Ceramics)



Julio Herrera and Obes Warehouse (1970-73), Montevideo, Uruguay.
Construction Images: Dieste and Montañez Archive



Julio Herrera and Obes Warehouse (1970-73), Montevideo, Uruguay.
Formwork and Scaffolding Drawings: Dieste and Montañez Archive

Timber Formwork
Gaussian Double Curvature Geometry

Steel Truss
Support for Formwork and connected to height adjustment mechanism

Steel Frame
Height adjustment mechanism and rolling base support

High Position (8.00m)
Ready to assemble vault; wait for drying time before lowering.

Low Position (6.50m)
Ready to disengage from vault; roll to adjacent vault position.

