STEREODOME I: design, production and installation of a Styrofoam masonry vault

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Abstract

This paper presents the steps of design, production and installation of a Styrofoam masonry vault, produced in 2018 at the Polytechnic School at the University of São Paulo (USP), in the context of a graduate course on Light Structures. The challenge of the project was to design and deliver an innovative structural prototype, in a relevant scale. After pondering on several candidate proposals, three of them have been carried out to the level of feasibility analysis, then students selected to design the funicular, three-legged masonry vault whose geometry is depicted in Figure 1(a). The base of the structure lays within a 3.0m diameter circle. The structure was produced with the assembling of 45 irregular bricks cut out from 10cm thick Styrofoam bulk blocks, with the aid of a CNC hot wire router machine. Cohesion between blocks was guaranteed by a set of internal post-tensioning twines, as well as shear locks made of wood sticks. Figure 1 shows several steps of the design and production: (a) shape finding using graphic statics, with the aid of RhinoVault Software [1-3]; (b) layout of the internal post-tensioning system; external twines connected the three bases, to provide the thrust required to a proper vault behavior; (c) efficient stereotomy techniques were applied to ensure that adjacent bricks could be cut out from bulk Styrofoam blocks with minimum waste of material [2], as well as high precision in the tessellation of the designed shape; (d) final assembling of the structure at the hall of the Civil Engineering building at USP. The structure was nicknamed ‘Stereodome I’, to reflect the production technique and the authors’ expectation that it might inspire the construction of some siblings, made from more durable materials, such as precast concrete or stone. Moreover, after a short exhibition period at the beginning of 2019, the Stereodome I prototype will be used as formwork for a thin vault made of sprayed, fiber reinforced UHPC.

Figure 1 – Several steps of the process of design, production and assembling of Stereodome I

References