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 pos-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 posttensioning 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.

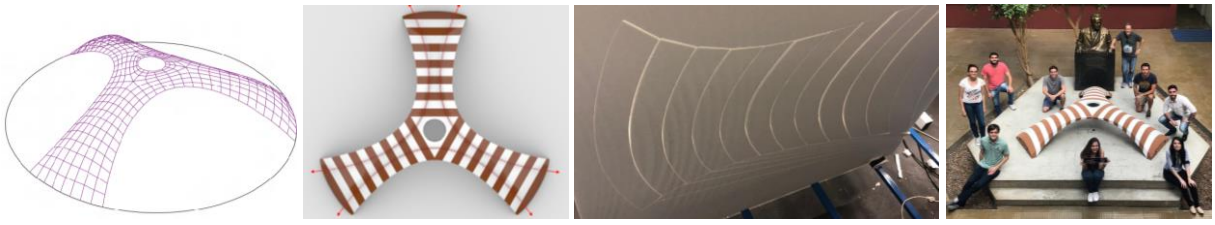

Figure 1 – Several steps of the process of design, production and assembling of *Stereodome I*

References

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