MS 281

Basic Geometry

A shell structure in HPRC

My design is the result of a design research into the implementation of a very thin concrete shell structure in High Performance Fiber Reinforced Concrete. The structure will function as a bicycle shed for the company Ebema, a supplier of building materials in Zutendaal.

High-pressure concrete is mainly used to take the pressure, the tensile forces and bending stresses are therefore limited as much as possible. The result of my design research showed that a half-cone structure is more stable and shows less deformation than the barrel vault. This is because the half cone is built up from a triangular base, which has more stability and retains its shape much better than a quadrangular base. The result consists of a deduplicated structure of concrete shell elements that rest on a column structure. The shell elements are created as two half-cone-shaped elements with a diggerent width and height, that can be connected to each other. Hereby two rhythms were created, that can be shifted by one ba into a poetic architecture. In addition, each shell element contains an arch at one end that ensures that the structure is loaded as much as possible with compressive forces. The forces on the structure are evenly transferred through the arch form to the underlying columns that support the structure.

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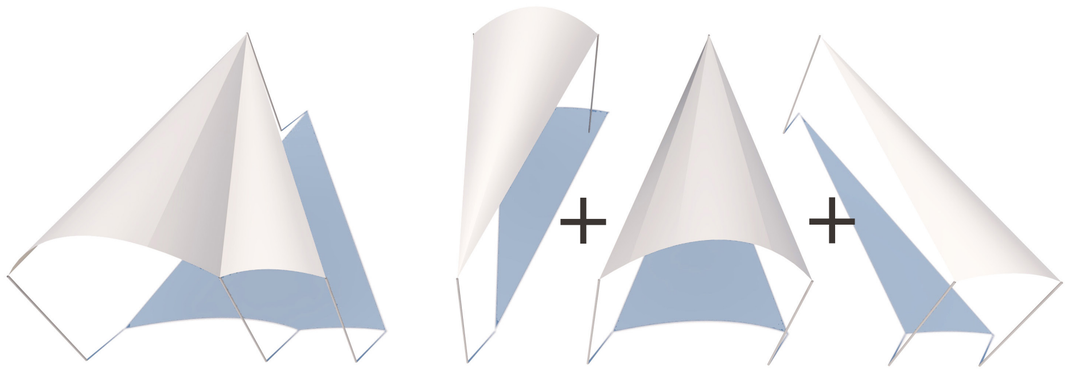
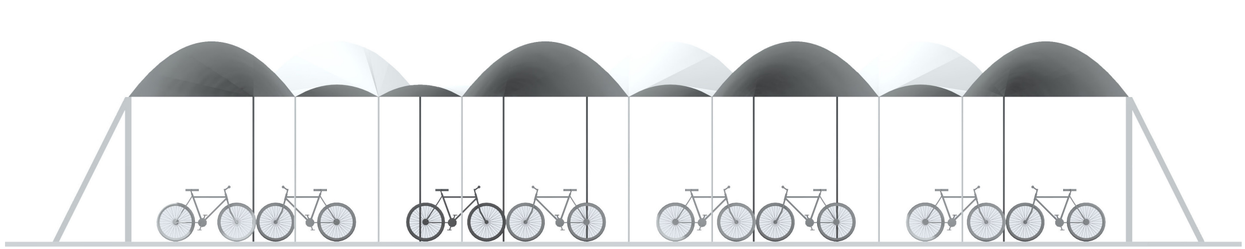
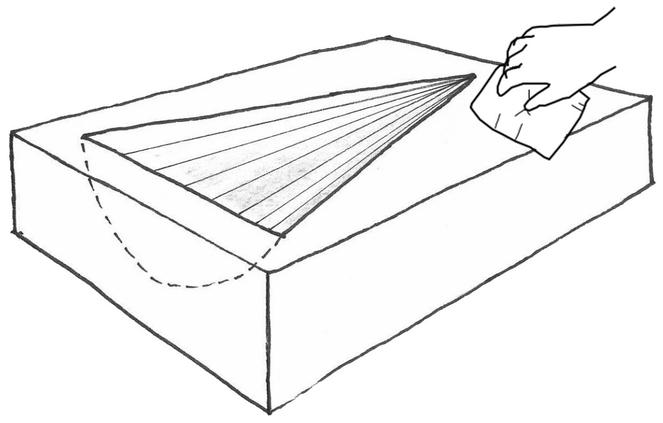


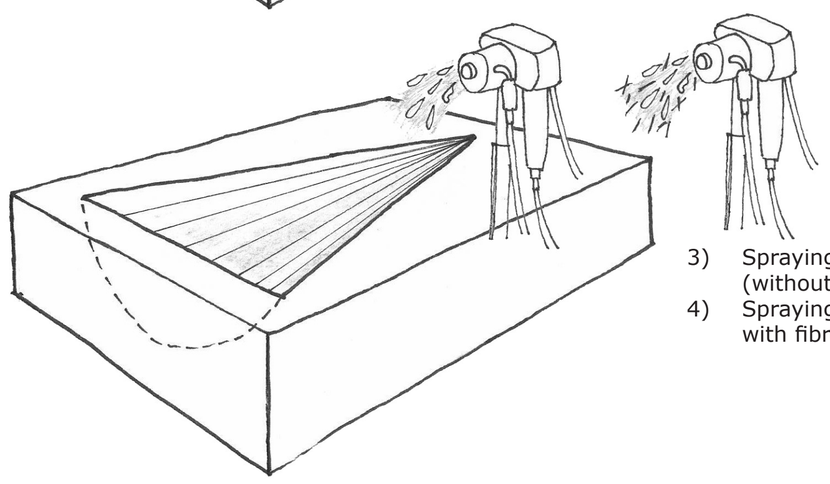
WORKING METHOD



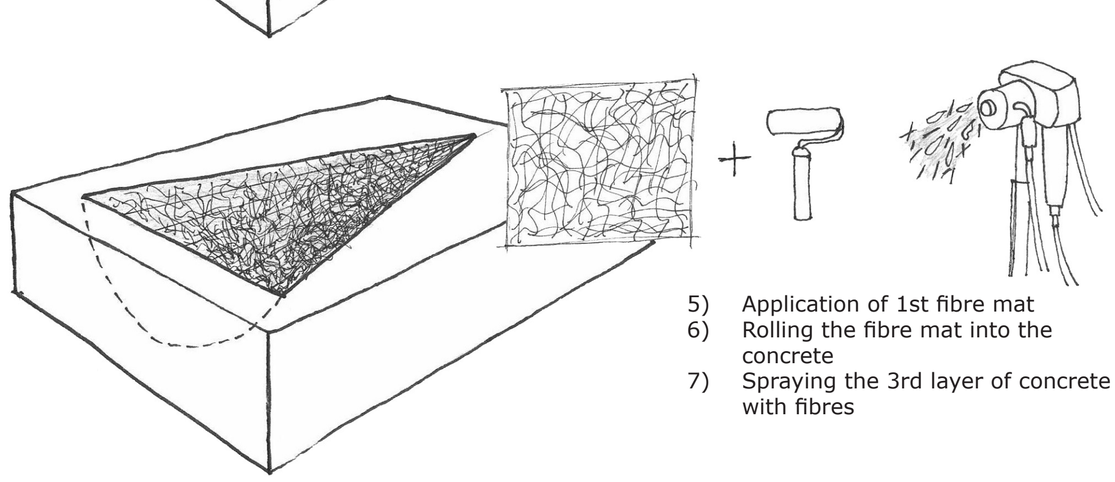


Constructing a shell structure with sprayed
High Performance Reinforced Concrete and Glassfiber Reinforced Concrete

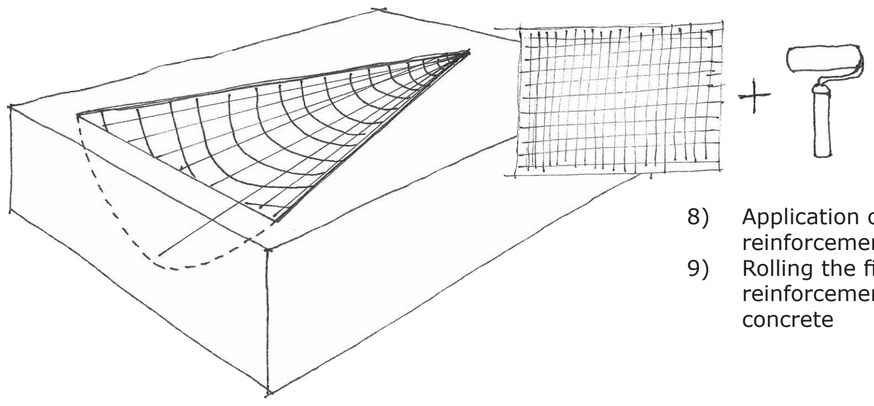
1) Customising the fibre mats
2) Apply demoulding oil to the mould



3) Spraying the 1st layer of concrete (without fibres)
4) Spraying the 2nd layer of concrete with fibres

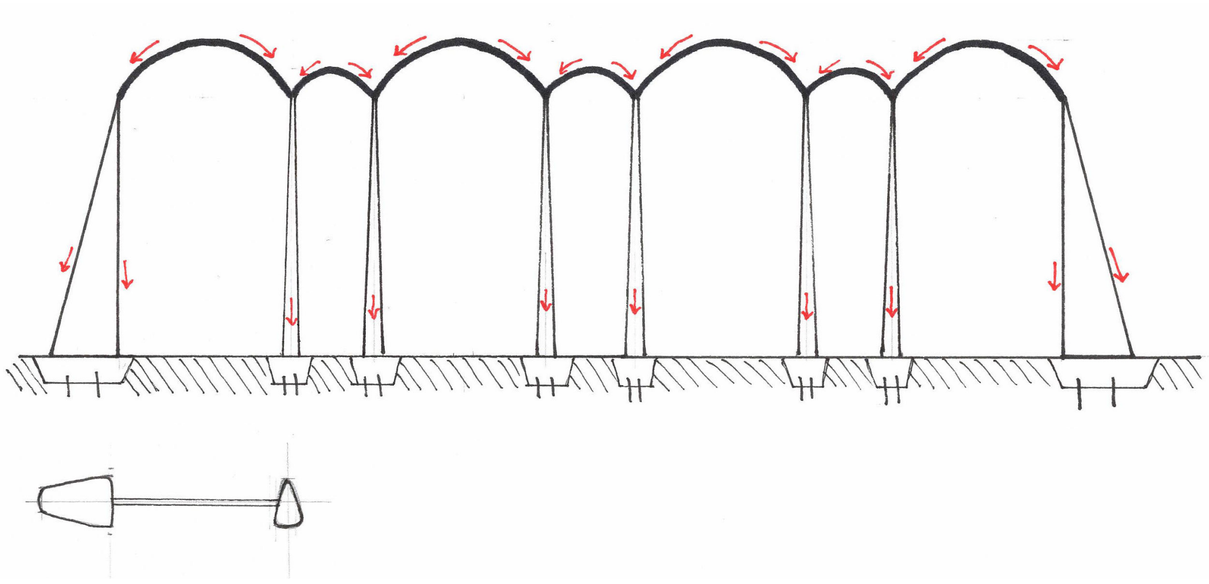


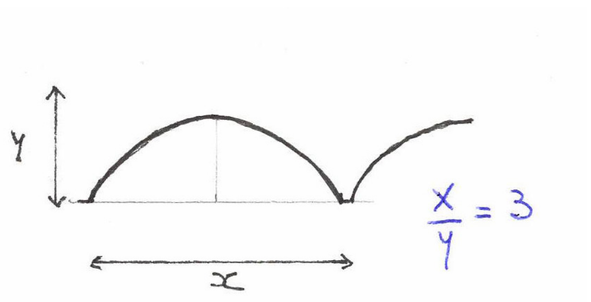
5) Application of 1st fibre mat
6) Rolling the fibre mat into the concrete
7) Spraying the 3rd layer of concrete with fibres



8) Application of the effective fibre reinforcement mat (XY)
9) Rolling the fibre reinforcement mat (XY) into the concrete

BEARING CAPACITY



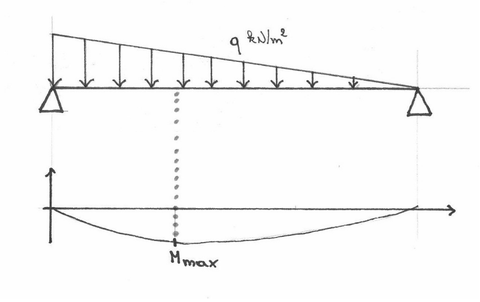


Proportion span-rising = max. 4

A ratio between the span and rise of max. 4 gives a maximum compressive stress of 0.3MPa.

This proportion was used by Eladio Dieste in his designs for the free-standing barrel vaults.

Triangular force distribution



The moment shifts and becomes smaller
(compared to the barrel vault)