The Tehran Swimming Pool Canopy: Integrating Structural and Computational Design

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Abstract

This paper is a case study describing the structural design and construction of the Tehran Swimming Pool Canopy realised during a two weeks' workshop on computational design and structures. The canopy covers a four by ten-meter area of an unused swimming pool, converting it to a vivid exhibition area. The canopy's free form surface was optimised through several steps, four of which included structural performance. The result was a design driven by information output from each step; analysing the structural potentiality of geometry and patterns, combined with implicit structural concepts that resulted in a highly optimized 4mm aluminium tensegrity shell. The aesthetics were derived from calculations and structural needs, and entirely formed through algorithms based on geometry and structural behaviour but designed by humans. At each stage of the design process different modelling and analysis techniques were used to exploit the potential in the form, optimise the structure and enhance communicating.

Keywords: Computational design, structural optimisation, digital fabrication, laser cutting, CNC bending.

1 Introduction

ComStruct was a two-week workshop combining computational design with structural analysis. The workshop took place at the Contemporary Architects Association in August 2015. 25 participants - all with a background as either architectural students or professionals – was taught Rhino/Grasshopper and the structural analysis plugin Karamba [1] by five tutors, for in the end to design a canopy structure covering an empty 10.0 x 4.0 m swimming pool situated in the venue.

Nature has always been a big source of inspiration for architects, and structural behaviour is invariably connected to nature. The clear separation of structural engineer and architect that happened with the industrial revolution, brought with it examples of how inspiration was moving from purely nature towards a more scientific and structural approach. Early examples as the Eiffel Tower in Paris was inspired by a bone structure, and Anthony Gaudi's La Sagrada Familia in Barcelona took Robert Hooke's inverted hanging chain principle two steps further; using three-dimensional sheets instead of chains and loading them with sand bags to simulate real-life

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