The Pure Tension Pavilion is a lightweight, rapidly deployable, tensioned membrane structure and portable charging station commissioned to showcase a new hybrid electric car.

The Pure Tension Pavilion is an experimental structure that, similar to a concept car, is a working prototype that speculates on the future of personal mobility and alternative energy sources, while also exploring digital design methodologies and innovative structural solutions. The pavilion pushes boundaries at all levels, from structural performance to sustainability and portability.
Officially launched in Milan, Italy in October 2013, this experimental structure was developed through a process of rigorous research and development that investigated methods of associative modelling, dynamic mesh relaxation, geometric rationalization, solar incidence analysis, membrane panelling, and material performance.

Conceived as an extension of the legacy of Frei Otto’s seminal lightweight tensioned membrane structures where Otto looked to precedents in Nature to describe principles of stable minimal energy surfaces that could inform and ultimately find the equilibrium between unique form and form-found material, enabling efficient and effective structural performance. The continuous form of the pavilion was developed with a parallel process of analogue form-finding (physical models) and digital form-finding (dynamic mesh-relaxation techniques) to explore the pure tension of the interior membrane skin against the external flexurally-active boundary frame. A carbon fibre perimeter ring was to be bent into shape by the tailoring of the skin which bound it. In response, the frame would push out while the skin pulled in, creating a form-force equilibrium that would result in a structure that was lightweight, cost-efficient, and easy to assemble and disassemble.

At the competition phase, the uniquely sensual and continuous form was to consist of a tensioned HDPE Mesh skin with embedded PV panels and a perimeter carbon fibre rod. The effect of the structure’s organic form, perforated mesh, and PV transparent panels provide a striking graphic identity which would encourage visual and spatial interaction while simultaneously enabling different configurations to accommodate a variety of activities including vendors, demonstrations, car trade shows. The proposal added another level of innovation by utilizing the pavilion as a portable solar-powered charging station.
Frame optimization diagrams

Pavilion drawings

With car back open, the car moves out more to adjust to the height.
ALVIN HUANG, AIA is the Founder and Design Principal of Synthesis Design + Architecture and a Tenure-track Professor at the USC School of Architecture in Los Angeles. He is an award-winning architect, designer, and educator specializing in the integrated application of material performance, emergent design technologies and digital fabrication in contemporary architectural practice. This exploration of “digital craft” is identified as the territory where the exchange between the technology of the digitally conceived and the artisanry of the handmade is explored. His wide-ranging international experience includes significant projects of all scales ranging from hi-rise towers and mixed-use developments to bespoke furnishings.

IMAGE CREDITS
Figure 1: Mosca Partners, 2014
Figure 2: Lani Garfield, 2014
Figures 3, 4, 5, 8, 9, 11: SDA, 2013
Figure 6: Fabric Images, 2013
Figure 7: LDB advertising, Volvo Car Italy, 2013
Figure 10: Buro Happold, 2013

PRACTICE PROJECTS