

# BioMat Pavilion 2018: Development, Fabrication and Erection of a Double Curved Segmented Shell from Biocomposite Elements

Hanaa DAHY<sup>\*a,c</sup>, Jan PETRS<sup>a</sup>, Derk H. BOS<sup>b</sup>, Piotr BASZYNSKI<sup>a</sup>, Arjan P.H.W. HABRAKEN<sup>b</sup>, Patrick M. TEUFFEL<sup>b</sup>

<sup>a</sup> Department of Bio-based Materials and Materials Cycles in Architecture (BioMat) at Institute of Building Structures and Structural Design (ITKE), University of Stuttgart, Keplerstrasse 11, 70174 Stuttgart  
\* [h.dahy@itke.uni-stuttgart.de](mailto:h.dahy@itke.uni-stuttgart.de)

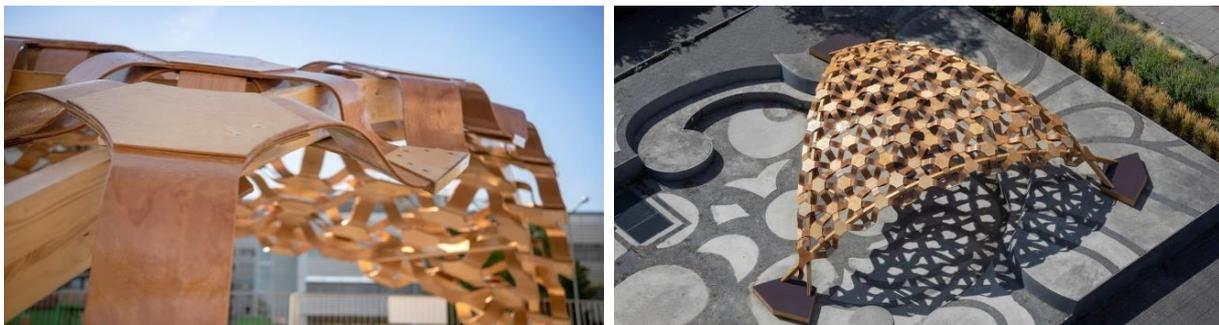
<sup>b</sup> Department of the Built Environment, Eindhoven University of Technology, De Rondom 70, 5612, Eindhoven

<sup>c</sup> Faculty of Engineering, Department of Architecture (FEDA), Ain Shams University, 11517 Cairo, Egypt

## Abstract

Bio-based composite materials in architecture have gained various new applications due to their availability, renewability, and environmentally-friendly characteristics. This paper demonstrates the use of bio-based building materials for load-bearing structures and its structural analysis through a 1:1 realized segmented shell pavilion, referred to as *BioMat Pavilion 2018*. The pavilion consisted of 121 parametrically optimized curved elements prepared by a vacuum-assisted veneer-reinforcement lamination process. The biocomposite panels were fabricated from elastic or flexible fibreboards that were applied as sandwich cores then glued together with veneer from both sides to create a biocomposite with elevated stiffness. Digitally prefabricated elements were bolted together on site into four shell segments which were later screwed to three curved timber intersecting arches, fixed to three footing foundations.

In this paper, thorough discussion will take place of the structural analysis method, form-finding hierarchy and construction stages of the 3.6 m height, 9.5 m span research pavilion made from biocomposite panels, covering an area of around 55m<sup>2</sup>.



**Figure 1.** (a) The erected BioMat pavilion at the campus of University of Stuttgart; (b) Connections of modular biocomposite sandwich panels in combination with the structural beams. © BioMat/ ITKE-University of Stuttgart. Republished from [1]

## References

- [1] H. Dahy, “Natural Fibre-Reinforced Polymer Composites (NFRP) Fabricated from Lignocellulosic Fibres for Future Sustainable Architectural Applications, Case Studies: Segmented-Shell Construction, Acoustic Panels, and Furniture“, *Sensors*, vol. 19(3), 738, 2019.
- [2] H. Dahy, “Biocomposite materials based on annual natural fibres and biopolymers—Design, fabrication and customized applications in architecture“, *Construction and Building Materials*, vol. 147, 212-220, 2017.