

Segmented Spiral using Inter-Connected Timber Elements

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Abstract

This paper describes the design, fabrication, and construction process of a scenography structure representing a five-meter height spiral made out of 3-ply cross laminated panels. The structure includes 29 timber boxes, shown in (see Figure. 1). Typical through-tenon wood-wood joints [1] are used in parallel to screws. The structure is attached to the main supporting system through multiple cables. A scanning system was applied to facilitate the further measurements. The paper also presents digital workflow of 3D modeling, Finite Element (FE) simulation, fabrication, assembly, and the experimental tests. The principal objective of structural calculation was to understand the load-bearing capacity of the system and the interactions between the timber boxes. The numerical FE model was built in ABAQUS™ to simulate the structural behavior of the spiral [2]. Further details are given about the different steps involved in modelling and fabrication of this structure, such as parametric tools, G-Code [3] tool-path generation for the 5-axis CNC machine, and on-site installation. Finally, the loading tests are highlighted to draw possible structural optimization using laser scanning and displacement sensors.

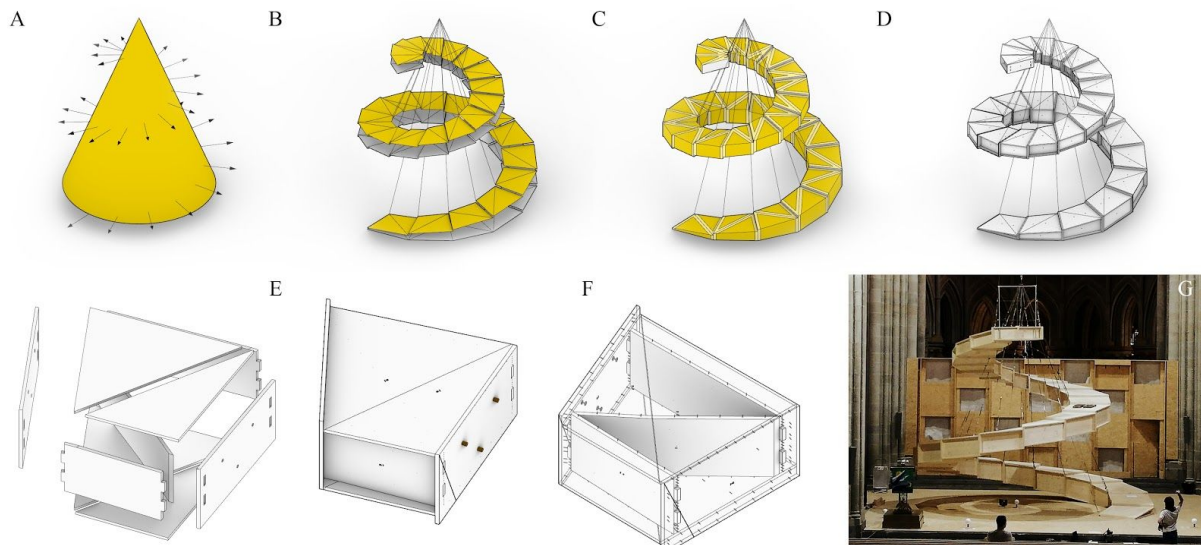


Figure 1. Geometry development of segment timber shell: A - vectors equidistant to central axis of cone B - top and bottom layer of steps C - fem model D - final model with fabrication data E - assembly of one box F - assembly of two boxes G - built structure.

[1] Achim Menges, Tobias Schwinn, Oliver David Krieg, *Advancing Wood Architecture – A Computational Approach*, Routledge, Oxford, pp. 199-210. (ISBN: 9781138932982). 2016

[2] Dassault Systemes (2019). Abaqus V6.12. Retrieve from (Accessed on January 31 2019).

[3] ISO 6983-1:2009. *Automation systems and integration — Numerical control of machines — Program format and definitions of address words*, 2009.