

Advanced timber framing from non-standard timber parts

Final Report

Activities during the project

The project was structured into main three stages:

1. Workshop at TU Graz 20.3.2018 – 23.3.2018

During this workshop the teachers explored with the students the possibilities and limitations of cold wood bending by making physical models with wooden stripes. The mathematical and geometrical theory was explained to the students. Afterwards, small simple structures were created by the students. After the review of these creations, each student worked independently under the teachers' supervision to create a more elaborated architectural structure that would at least partially enclose the space. At the end of the workshop these models were reviewed and critiqued.

2. Design exploration and finalization

During this time the students worked further on their designs of bended structures. In parallel, the VUTBR and TUG teachers jointly explored the digital tools of simulating the geodesic lines on curved surfaces. These approaches included:

- a) finding a geodesic line from an initial starting point on a surface and a directional vector
- b) finding a geodesic line between two points

These tools were provided to the students in order to recreate their physical models digitally. The created digital models were produced parametrically and used for analysis of the structural loads. After reviewing all projects the whole team picked one project to build in the final workshop in 1:1 scale. From this point on, the team continued working only on this project. The design was finalized, the material and the fabrication tools were outsourced and the cost was calculated.

The building location was part of the public camping site next to village Krhovice on the bank of river Dyje (Thaya), which in this region more or less follows the Czech/Austrian border.

Through a local sawmill we managed to obtain wooden planks from freshly cut ash tree with great bending characteristics.

3. Workshop in Czech Republic 10.5. - 13.5.

The workshop took place on the building site. Prior to the workshop, parts for the framework were fabricated by CNC milling from OSB boards. The framework was constructed on the site on the first day. According to the prepared plans, the wooden planks were bent over the framework and connected together by weaving and riveting the connections. The framework was taken apart after the structure gained enough structural integrity. The structure was completed by gradually adding more planks. On

the last day the finished self-supported structure was lifted above the ground and connected to the tree. The structure is being visited by the wide public since it has been on the site. We will continue to monitor the structure in terms of wood behaviour in the future.

The outcomes of the project

In this project we explored timber structures constructed from so called "geodesic lines" on a curved surface. A geodesic can be simply explained as the shortest line between two points on a surface. This enables to find the position of a wooden plank on a curved surface, with minimum bending/twist forces of the material. In the project we tested the geometrical possibilities of this approach both on physical as well as on virtual models. At the end of the project a 1:1 self-supported structure was successfully built. The TUG teachers (Stavric, Wiltsche) and the VUTBR teacher (Kaftan) benefited from the collaboration on the project in terms of exchanging expertise in terms of geometry, construction and fabrication. The students in the project had the opportunity to experiment with novel types of construction and they undertook the whole process from design to construction. It is planned to present the outcomes of the project in a scientific paper in one of the upcoming geometry conferences in 2019.

A reportage from the final workshop was filmed by the Czech national TV and this can be seen here:
<https://www.ceskatelevize.cz/ivysilani/1097206490-udalosti-v-kulture/218411000120514/obsah/619992-utociste-pro-vodaky-od-studentu-architektury>



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