Luca Stephan Steiner

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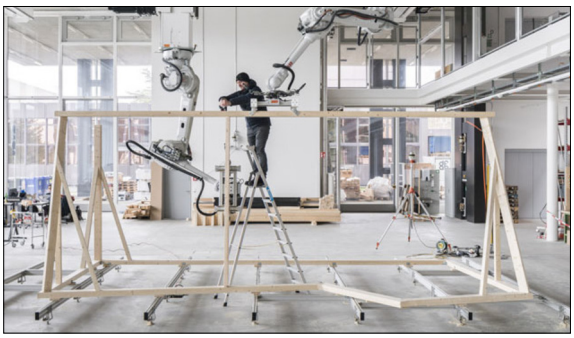
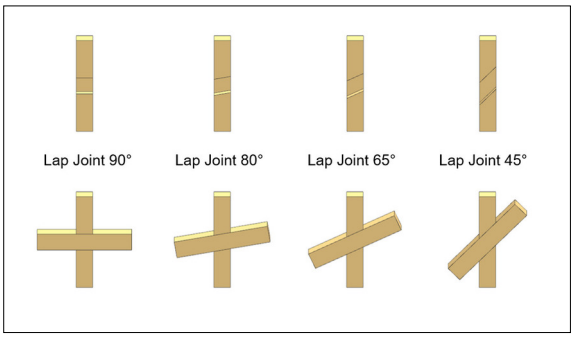
Subject Area	Mechatronics and Automation Technology
Project Partner	ETH Zürich, Department Architektur, Zürich, ZH

Timber Lap Joint Assembly Device

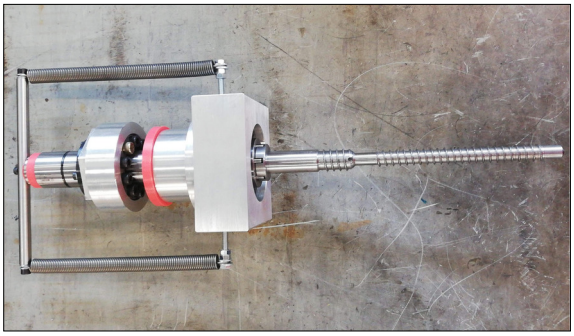
Development of a Novel Assembly Mechanism Utilising a Hole in the Joint



Spatial Timber Assemblies
Source: gramaziokohler.arch.ethz.ch



Beams with Lap Joints of Flexible Angles (unassembled/assembled)
Own presentment



Prototype with Novel Assembly Mechanism
Own presentment

Initial Situation: The Gramazio Kohler Research group of the ETH Zürich is doing research in the field of robot-assisted production and assembly of timber beam structures. In the Robotic Fabrication Laboratory, a research platform in the field of large-scale, robot-based fabrication in architecture and construction, timber beams can be prefabricated with the help of robots on a CNC milling machine and placed in the correct position in a timber beam construction. However, the assembly process of the timber beams still has to be carried out manually. Since lap joints are very often used in timber beam constructions, it is desirable to automate the assembly process of timber beams with lap joints. An existing assembly device for a robot enables the assembly of two timber beams with 90° lap joints by using a clamping mechanism.

Objective: The goal of this bachelor thesis is to develop and test another assembly device for assembling timber beams with lap joints. This device uses a different strategy for assembling the beams and makes use of a hole in the lap joint. In contrast to the existing assembly device, it should also be possible to joint timber beams with flexible angles between 45° and 90°.
Since timber to timber joints usually use tight joints to ensure rigidity, the assembly device must be able to apply a large assembly force. This is necessary to overcome the frictional force between the tight lap joints.

Result: Within this bachelor thesis, a complete timber lap joint assembly device has been developed. This device uses a hole in the lap joint for the beam assembly. Due to a budget restrictions only the assembly part of the device could be realized as a prototype. Based on functional tests with the manually operated prototype, it has been shown that the developed assembly mechanism works for beams with 45° lap joints. The device is expected to work for 90° lap joints since those require less assembly force.