Re-thinking Local Timber

Atelier Weinand 2021 Autumn
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Teaching assistant
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carpenter
Technical advisor
and security coordinator
Site – Saw-mill Campus

Project Site – A
Program

The program shows the current saw-mill organization that has to be extended 10 meters to accommodate an industrial robot arm on a 5 meter rail. The timbers that are delivered to this saw-mill are sized to mountain trucks that are the maximum of 5 meters in length. The timber production follows mountain forest harvesting process resulting in regular beam and timber boards products. The robotic facility will bring a 3rd product – raw timber fabrication. This minor extension requires rethinking the whole building. Meaning the current structure must be dismantled and a new building has to be constructed. The relative small program turns the focus to a structural system you are going to design in order to accommodate the needed facilities. Be aware that the current building is constructed as one continuous rail system, when freshly cut trees are deposited first in the outside storage area, processed in the saw-mill and taken from the delivery part. The overall program and organization can be changed depending on your design decisions and larger size analysis or remain as is.

- Outdoor Storage – 154.75 m²
- Saw-mill – 100.69 m²
- Office – 40 m²
- Robotic Facility with 10 m track – 100 m²
- Delivery – 37.96 m²
- Utilities – 26.09 m²
<table>
<thead>
<tr>
<th>Week</th>
<th>Day 1</th>
<th>Plan 1</th>
<th>Day 2</th>
<th>Plan 2</th>
<th>Student's deliverables</th>
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<tbody>
<tr>
<td>W1</td>
<td>Tu 21/09</td>
<td>[9:00] Intro + Lecture on timber construction</td>
<td>[13:00] Workshop on inquiry skills</td>
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<td></td>
<td>Mo 27/09</td>
<td>Site visit + visit of local sawmill and timber construction company</td>
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<td></td>
<td>Tu 28/09</td>
<td>Autonomous work: concept proposal</td>
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<td>W2</td>
<td>Mo 04/10</td>
<td>[9:00] Students review</td>
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<td>Tu 05/10</td>
<td>Autonomous work: program integration</td>
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<td>[13:00] Roundtable personal investigation</td>
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<td>[9:00] Autonomous work: developing an efficient construction system</td>
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<td>W3</td>
<td>Mo 11/10</td>
<td>[9:00] Professor review: concept proposal and program integration</td>
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<td>Tu 19/10</td>
<td>Autonomous work: assessing project performance</td>
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<td>Mo 25/10</td>
<td>[9:00] Students review</td>
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<td>W6</td>
<td>Mo 01/11</td>
<td>[9:00] Intermediary Critic</td>
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<td>Tu 02/11</td>
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<td>[9:00] Workshop Digital Integrated Design (Rhino-Grasshopper workflows)</td>
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<td>Autonomous work: application of parametric tools</td>
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<td>[9:00] Assembly sequence and construction principles</td>
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<td>W9</td>
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<td>Tu 30/11</td>
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<td>[9:00] Students review</td>
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<td>Tu 07/12</td>
<td>Autonomous work: refining architectural plans</td>
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<td>Mo 13/12</td>
<td>[9:00] Autonomous work: presentation preparation</td>
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<td>Tu 14/12</td>
<td>Structure of the presentation and the discourse</td>
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<td>Mo 20/12</td>
<td>[9:00] Oral preparation</td>
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<td>Tu 21/12</td>
<td>Final Critic</td>
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<td>[9:00] Final Critic</td>
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**Group activity** · Autonomous activity · Master students activity

*Program subject to modifications*
1

Site Analysis + Economic Model

Both come together
Swiss context

Swiss Timber Use
10.54 million m³/year

Construction
3.04 mil m³/y
37% Local
63% Import

Paper
4.13 mil m³/y
67% Local
33% Import

Energy
3.37 mil m³/y
98% Local
2% Import

Swiss Wood
51%
Swiss context

INTRODUCTION

Rossiniere
Lausanne
Chavornay

Softwood

Spruce 37%
Fir 11%
Larch 5%
Pine 3%
Arolle 3%

Hardwood

Beech 18%
Maple 5%
Ash 5%
Oak 2%
Chesnut 2%

Double-curved only starts from here 2000-9000 CHF
Single-curved Spruce Beam
Spruce 3-Ply Panel
No curvature glulam from Spruce

After Sawmill + Processing Without Fabrication

Robot Cutting For Joinery

Raw

CHF
Swiss context

Local Trees
Local Application

Source: «24 heures»

«Si l'on n'innove pas en prenant des risques, on n'aura plus que les yeux pour pleurer»

"If we do not innovate by taking risks, we will only have the eyes to cry on"
Swiss context

Grosses Sägewerke
Grandes scieries (11)

Mittlere Sägewerke
Scieries moyennes (47)

Kleine Sägewerke
Scieries petites (500 – 5 000 m³) (199)

Kleinlädigen
Petites scieries (<400 m³) (90)

Classe de grandeur des scieries selon débitage par année en m³
Grandes scieries > 2 000 000 m³
Scieries moyennes 5 000 – 25 000 m³
Petites scieries 400 – 5 000 m³
Petites scieries < 400 m³
Swiss context

Scieries
- Grosse Sägewerke
- Grandes scieries (11)
- Mittlere Sägewerke
- Scieries moyennes (47)
- Kleine Sägewerke
- Petites scieries (400 - 5000 m³) (199)
- Kleinstsägen
- Petites scieries (<400 m³)
Swiss context
Swiss context
In 1996, as part of the project "Forest differentiation using digital satellite imagery", two datasets covering the whole of Switzerland were created on the basis of Landsat TM satellite images, which divide the forests into coniferous, mixed coniferous, mixed deciduous and deciduous categories. The aim of this project was, on the one hand, to help to develop reliable experience and knowledge of digital remote sensing and of using satellite data for statistical purposes and, on the other hand, to add a statistically verified and geographically differentiated distinction between deciduous, mixed and coniferous forests to the Swiss land use statistics. After the satellite images used had been geographically and radiometrically corrected, the first step involved distinguishing between forest and non-forest areas. After this the forest was divided into four mixture ratios.
Swiss context

Forestry + Low-tech saw mills

This is what limits local construction or you import timber products from abroad or large centralized sawmills.
# Raw-wood Properties

## Introduction

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Raw</th>
<th>Mechanical Rounding</th>
<th>Raw Boards</th>
<th>Planks for Laminated Timber</th>
<th>Planned Boards</th>
<th>Rectangle Beams</th>
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<tbody>
<tr>
<td>1 - 1.3</td>
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<td>1</td>
<td>0.75</td>
<td>0.57</td>
<td>0.57</td>
<td>0.5</td>
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<td>1</td>
<td>1.20</td>
<td>1.6</td>
<td>2.13</td>
<td>2.18</td>
<td>2.40</td>
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</table>

Efficiency $E = \text{Mechanically Rounded Timber}$

Wood needed to produce 1 $m^3$ of Timber
Swiss context  Alpage de la Cierne

INTRODUCTION
Experiments in strong natural surroundings
I have had a teacher, famous German wooden engineer, who always asked his students: What is the biggest enemy of wood? And he wanted the students to answer: The saw.

It is always good that you are using round-wood that is not cut by a saw. But there is a difficulty to use round-wood without a saw.

Frei Otto 2015 - AA Hooke Park
Design Methods

The New Non Standard
Jonathan Enns
Princeton University
2010

Bandsawn Curved Lumber
Ryan Luke Johns,
Nicholas Foley
IaaC
2012-14

Robotic SawMill Timber Joinery
IaaC
2013

7xstool and 7xcabin
Tom Pavlovsky
ETHZ
2013-14

New Structural Systems
In Small-Diameter Round Timber
Aurimas Bukauskas
2015

Biomass Boiler House
Sahu & Wang
AA Design & Make
2015

Wood Chip Barn
Zachary Mollica
AA Design & Make
2016

Developing a Fabrication Workflow for Irregular Sawlogs
Niels Martin Larsen,
Anders Knudsen
Aarhus School of Architecture
2017

Combining Parametric Form Generation and Design Exploration to Produce Wooden Reticulated Shell using Natural Tree Crotches
2018

A New Approach to Free-form Wooden Shell Structures using Helical Cuts,
Peer Haider,
Marzia Calvarrese,
ImaxPro,
TU Dresden
IASS
2019

Prototype Cabin
Wyatt Armstrong
AA Design & Make
2019

David Marshall Unmaking Architecture
2019

Human-in-the-loop Fabrication of 3D Surfaces with Natural Tree Branches
2019

Whole Timber Construction: A State of the Art Review
2019

Conceptual Joining
Lucas Allner, Daniela Krollner,
collaboration with Philipp Homung
Angewandte
2019

Making Form-work Experiments Along the Grain of Concrete and Timber,
Sasa Zivkovic,
Leslie Lek
Cornell University
Fabricate
2020
2
Software support (CAD + Fabrication)
Function – Saw-mill Cooperative

Analyse Existing Timber Supply Chain

- Timber Seasoning Shelter
- Shed for Timber Assembly
- Canteen
- Wood-chip Barn
- Sawmill Shelter

Propose a New Building for Research and Development

- Digital Fabrication
- Workshop room with manual tools, Lecture rooms) Canteen

*Requirements will be given to each group before start of the semester.
Software support (CAD + Fabrication)
Methodology

**Physical**

Micro:
- Scanning & Fabrication
  - State-of-the-Art Review

Meso:
- Joinery Solver
  - Design Target

Macro:
- Study Cases
  - Assignment of Linear Elements From a Stock

**Digital**

- Point-cloud Processing

**Introduction**

$W = 0.1$

$W = 0.6$

$W = 0.3$
Joinery – From Regular to Irregular

CurveAxis + Two Outlines

Computed Joint

Plates

Beams

Reference

Raw-wood

A  Side-Side  B  Top-Side  C  Cross  D  Top-Top  E  Custom
Library - Tree Topology*

* Prefabricated Elements Can be Used too.
Swiss Context – Forest Visit

INTRODUCTION

Conic

Reaction

Height

A

B

C
Swiss Context – Multiple Scan Studies

INTRODUCTION

Scan Visit 1

Scan Visit 2

Forest Scan
Mostly straight Spruce
Thank you