studio Weinand 2023-24
Wood as a resource, from territory to material
ép. I : the round wood

The IBOIS laboratory, directed by Professor Yves Weinand, is dedicated to research into innovation in wood construction. Wood is both a renewable and recyclable resource, and today it plays a major role in the construction sector.
The research carried out by the IBOIS laboratory focuses on two main areas: wood-wood assembly, with minimal use of other materials, and digitization, applied throughout the production chain, from design to completion.
The aim of this research is to use digital tools to develop and deliver innovative and competitive timber construction solutions in the contemporary construction sector.

Wood as a resource, from land to material

By using a renewable and recyclable resource, timber construction has a better energy balance than other materials such as concrete or metal. However, a number of factors influence this calculation, casting doubt on the environmental virtues of contemporary timber construction.
The first issue is the geographical origin and the route taken by the primary resource in supplying the construction sector. In Switzerland today, only half of the wood used comes from within the country, and this proportion is tending to fall even further in the construction sector in particular[1]. With the development of the timber industry and the increase in demand, production and machining sites have been decentralized around large-scale, high-performance centers, to the benefit of small local sawmills. In addition to the distance between the place where the tree grows and the place where it is harvested, each transformation involves a displacement that further increases the carbon footprint of the finished product. Added to this is the considerable quantity of synthetic products added, such as glues and solvents used during manufacturing of glulam, or the external treatment of the wood. The entire production and processing chain therefore needs to be examined in order to reduce the environmental impact of timber construction.

The second issue is yield. The industrialization of the timber industry has also had the effect of imposing morphological criteria on timber supply. As a result, by favoring the straightest, largest-diameter trunks, a whole part of forest production whose geometry does not fit in with machining standards is not profitable, as it is often thinned to encourage the growth of the selected elements. What's more, in most felling processes, only a targeted part of the tree is required for the finished product, further increasing the proportion of non-valued wood. For example, to produce a standardized wooden beam, a volume of almost two and a half times that of the final volume is required[2]. In Switzerland today, most of this unused wood is used in the energy sector, but there is still no place for it in the construction industry. As well as raising the question of yield, wood processing also affects the quality of the material[3]: the protective layer formed by the outer part of the trunk is removed, making the wood more vulnerable, and cutting through the wood's natural cellular chains compromises its structural performance[4].

1: https://www.lignum.ch/

2: idem

3: Jeffrey Cook, "Explorations of Roundwood Technology in Buildings," In: Vance, Regina K et al. *Ponderosa pine ecosystems restoration and conservation: steps toward stewardship*; 2000 April 25-27. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 166-170. 22 (2001): 166–170.

4: Martin Self, "Hooke Park, Applications for Timber in Its Natural Form," in *Advancing Wood Architecture, A Computational Approach*, 1rst ed. (Routledge, 2016), 141–153.

Acting on these different factors requires us to question the geographical origin of the resource, the quality of forestry operations and also the character of the tree itself as an entity. Where does the wood used come from? How far has it travelled from being felled to being used on a building site? What transformations has it undergone?
Once this information has been identified, how can we intervene in the production chain? How can we reduce both the number of interventions and the number of kilometers travelled? What kind of architecture, and to what extent, could use a material that is as close as possible to its raw state?

the round wood

After several years working on the subject of timber plate structures (2005-23), the IBOIS laboratory headed by Professor Yves Weinand now aims to integrate these issues at the highest level by focusing on the specific subject of roundwood, from the extraction of the resource to its integration into the field of architecture.

The first research project, carried out by Petras Vestartas (arch., Phd. EPFL, 2017-2021) on the occasion of his thesis work "Design-to-Fabrication Workflow for Raw-Sawn-Timber using Joinery Solver"[5], explores the potential contribution of new digital design and manufacturing technologies in the use of raw timber for the production of complex structures.
Through this work, P. Vestartas examines the possibility of minimizing the transformation of wood through the use of 3D scanning and the capacity of robotics to produce joints in pieces of round wood of variable geometry. Drawing on assembly principles from traditional construction, he proposes and analyses innovative wood-wood assemblies machined from rough timber.
This first milestone marks the start of a larger-scale research project that will continue in 2023 with the work of Damien Gilliard (ing. arch., Phd. Candidate). His thesis, entitled "Scaling Up Timber", is part of the MainWood consortium[6] (ETH Zürich, EPFL, EMPA, WSL) and examines the relationship between forestry and timber production for the construction industry. Climate change is having an impact on the quantity and quality of the raw material, making it necessary both to anticipate these changes as effectively as possible by informing forestry practices, and to transform the relationship with the material by integrating the concepts of variable production and selective felling. D. Gilliard is going to set up a 3D forest scanning technique with the aim of establishing a new knowledge base of forest dynamics and exploitation scenarios.

While this research addresses certain technical aspects of the wood production circuit in the construction sector, trying to rationalize its use and reduce its environmental impact, it also outlines a change in design that should also be reflected in architecture. By offering an open field for experimentation, the studio can support such innovation. As a continuation of this research, the Weinand studio will be offering a series of workshops from the autumn 2023 semester on the theme of wood as a resource, making the link between territory and material. For this first episode, the subject will focus on exploring architecture in round wood.

The first axis on which this research is based is the relationship between low-tech and high-tech. Roundwood, which has been used for thousands of years in construction, is a material used in its raw state, with no further processing than cutting or simple assembly using hand tools. With the ambition of developing innovative assembly solutions for roundwood, it is now possible to take advantage of advanced digital technologies in a confrontation between low-tech and high-tech[7]. These technologies offer

5: Petras Vestartas, "Design-to-Fabrication Workflow for Raw-Sawn-Timber Using Joinery Solver" (PhD Dissertation, École Polytechnique Fédérale de Lausanne, 2021).

6: https://www.mainwood.ch/

a range of specialized support for analyzing the physical and structural qualities of a material, as well as for assisted design and high-precision manufacturing and construction.
The second axis of this research is the opposition between vernacular and experimental. Log architecture has inherited a homogeneous history that has seen few major changes since the ancestral construction models. The challenge of reinventing the image of such architecture is to give it a certain feasibility in the context of contemporary construction without falling into the opposite extreme of the experimental[8]. This can be achieved by placing materials and assembly techniques at the center of research, rather than building types linked to a specific context, while at the same time confronting the globalized design and production chain of contemporary architecture.

From precedents (...)

In idealized representations of primitive shelters, such as those by Marc-Antoine Laugier[9] or Claude Perrault in his translation of the Vitruvian treatises[10], log construction is omnipresent. Wood is represented by all these formal devices, knots and branches representing the natural character of the material. Roundwood, in the form of trunks or simple branches, has been a favorite building material since ancient times: present in many regions, it is a resource that is easy to work with simple hand tools and easy to transport, within certain size limits[11]. From the 19th century onwards, the industrialization of the timber industry and the advent of mechanized tools led to both standardization of the material and a wide diversification of derived products. These changes led to the development of the timber construction sector, but in fact reduced log construction to isolated cases. It is possible, however, to discern three distinct subjects that make up an initial overview of precedents for log architecture.

Traditionally, round timber has been used for framework construction in a variety of forms in all wooded latitudes. Its fiber composition gives it good tensile strength, its linear geometry makes it easy to assemble, and the material itself is easy to work with hand tools. Less commonly, roundwood is also used to create massive structures by stacking or juxtaposing. While the development of wood industrialization has seen these two types of construction evolve, replacing roundwood with increasingly standardized products, stacked log construction has survived through the ages and across continents, and is still practiced today. Originating in Scandinavia, but now found from North America to Russia, this type of construction, typically used to build small huts in forested areas, has been enjoying a resurgence of interest in Western Europe since the 1990s, following the publication of several books aimed at both the general public and professionals[12]. Renamed “fuste”, derived from an ancient term for a piece of wood or a grove of trees, the model is growing thanks to the training of craftsmen and the development of specialist construction companies. Other types of rough timber construction are re-emerging today, such as corded timber - a reference to the unit of measurement for firewood in Canada - but although interesting in terms of sustainable construction, they are still marginal in the timber construction landscape.

With the industrialization of wood, production moved towards standardization of finished products. To increase yields, certain morphologies are privileged in favor of smaller elements or elements with variable geometries. In parallel with the development of these forestry practices, a number of studies carried out in the late 1990s looked at the possible uses of this thinning wood, which is removed to encourage the growth of the most promising profiles[13]. The Hooke Park project in the UK is

7: Michael Dickson and Dave Parker, “The Opportunity of Roundwood Construction,” in *Sustainable Timber Design*, 1 rst. (Routledge, 2014), 37–50.

8: G. Carlos and V. Chen, “Hooke Park: Locality and Landscape” (M. Arch Graduate Dissertation, Architectural Association, 2014).

9: Marc-Antoine Laugier, Essai sur l’architecture. *Nouvelle édition revue, corrigée, & augmentée ; avec un dictionnaire des termes, et des planches qui en facilitent l’explication.* (Paris : Duchesne, 1755).

10: Vitruve, *Les dix livres d’architecture de Vitruve, corrigez et traduits nouvellement en françois avec des notes et des figures*, trans. Claude Perrault. (Paris : J.-B. Coignard, 1673).

11: Alpo Ranta-Maunus, ed., *Round Small-Diameter Timber for Construction: Final Report of Project FAIR CT 95-0091*, VTT publications 383 (Espoo: Technical Research Centre of Finland, 1999).

12: Marie-France Houdart and Thierry Houdart, *L’art de la fuste : techniques de construction en bois bruts.*, 3ème édition., vol. Cahier n° 1, Découvrir la construction en bois bruts (Lamazière-Basse : MaÏade éditions, 2004).

one of the few examples of this kind of experiment. Originally the property of a timber joinery manufacturer, and now an experimental site for London's AA School of Architecture, this woodland estate now boasts several generations of innovative log buildings, the first of which were designed by Frei Otto back in 1987[14]. The originality of the Hooke Park project lies in the combination of a raw material, advanced assembly technologies and innovative materials[15]. By developing this activity directly on the site where the trees are produced, the project also offers a model for diversifying the local economy: by using a local resource and skills, it makes it possible to develop self-management of the forest estate[16].

13: Alpo Ranta-Maunus, ibid.

14: Martin Self, ibid.

15: Mark Prizeman, "Hooke Park as a New AA Initiative in Education," *Architectural Design 75*, no. 4 (2005): 54–57.

16: Michael Dickson and Dave Parker, ibid.

More recently, as issues relating to environmental footprint and energy consumption have become crucial, various examples of projects built entirely or in part from logs have appeared on the architectural landscape. By using a material in its raw state, each of these projects offers a response to the problem of integrating a non-standard material into architecture, in terms of both structure and aesthetics. Each trunk has particular geometric characteristics, which means that its structural properties - as well as its appearance - vary. Some of these projects also combine logs with standard elements or other materials. Although less radical than Frei Otto's structural prototypes at Hooke Park, this research nevertheless multiplies the possibilities for integration, while toning down the predominant image of raw timber. This is the case for isolated projects, such as that of the architect John Pawson in Germany[17] or the Yamashita Sekkei office in Japan, but it is also becoming a specific market, as demonstrated by the work of the American company WhooleTrees Structures[18].

17: https://7kapellen.de/

18: https://wholetrees.com/

These three categories of projects - vernacular architecture and traditional construction; the case of Hooke Park; structural experimentation and plastic research - provide lessons that can be analyzed and compiled in the form of a case study. The compilation of this documentation is based on the definition of analysis criteria that cut across all the cases in the corpus, making it possible first to analyze different aspects of each of the projects and then to make comparisons. In the case of a corpus of architectural projects, this analysis involves creating graphic and quantitative documents that are similar from one case to another, and then compiling a comparative directory.

The first part of the semester will be devoted to the study of precedents. A body of work, documented as exhaustively as possible, will be the subject of an architectural, constructive and quantitative analysis specific to log construction. For the presentation of this first part, which will be organized in the form of a critique and an exhibition of the work, the following documents will be expected: a complete 3D Rhino model produced according to a predefined model; a physical model of a fragment at 1/10 scale; an exploded isometric representation (scale to be defined); a quantitative analysis according to a given table. The creation of these documents will also provide an opportunity, in the studio, to familiarize oneself with the representation of a material that is not commonly handled. Research and experimentation in 2D, 3D and scale models will be part of this first phase of study on the theme of round wood.

19.09	(1)	Presentation of IBOIS research **Introduction > precedents**	Round table presentation Choice of case studies; formation of groups
25.09 26.09	(2)	Tour de table of selected case studies Review of analysis hypotheses	Primary analysis (context, operating diagram) 3D sketches, drawings and models
02.10 03.10	(3)	*Unlearning Center* **Review of work with prof. Y. Weinand**	In-depth analysis (construction and details) 3D sketches, drawings and models
09.10 10.10	(4)	Pre-presentation and validation of productions Introduction to quantitative analysis documents	Development of presentation material Completing analysis documents
16.10	(5)	**Critique > precedents (prof. Y. Weinand + guest)**	Document archiving > precedents

Workshop: Trees points cloud

Using a natural material in its raw state means challenging the notion of standard. Each tree has its own geometric characteristics - such as the cross-section and diameter variations of the trunk, the proportions and dimensions of the branches, etc. - as well as structural and aesthetic characteristics. The ambition to rethink log architecture therefore requires these parameters to be taken into account right from the design phase. Today, 3D scanning technology makes it possible to capture the physical reality of a site by recording a cloud of points referenced according to their position in space. Particularly well-suited to surveying old buildings or the morphological layout of an area, it is now being used in forestry research to obtain precise libraries of existing tree profiles. One of the aims of creating these libraries is to create a database for architectural projects.

Prior to the project phase (> mock-up), a four-day group workshop will be held between 17 and 31 October. Supervised by Damien Gilliard and Andrea Settimi, researchers at the IBOIS laboratory, the workshop will involve creating digital models of trees using 3D scans of a plot of forest land. From capturing point clouds on site to sequencing the data using Rhinoceros 3D software and the Cockroach plug-in (developed by the IBOIS laboratory, Petras Vestartas and Andrea Settimi), this workshop will provide an opportunity to familiarize oneself with 3D scanning technology and the processing of this type of information with a view to implementing it in a design process.

17.10	(5)	**Introduction > points cloud workshop**	-
23.10 24.10	(6)	(program in progress)	- -
30.10	(7)	**Review of work with prof. Y. Weinand**	Creation of the database

(…) to *mock-up*

> "Buildings are artificial constructions. They consist of single parts which must be joined together. To a large degree, the quality of the finished object is determined by the quality of the joins."[19]

19: Peter Zumthor, *Thinking architecture*, Third, expanded edition. (Bâle : Birkhäuser, 2010).

Resolving construction at the scale of detail is an integral part of the architectural project equation. The exercise involves the precise arrangement of materials in relation to each other, to the general structure of the building, its program, its volumetry, and so on. This material and constructive identity has a direct impact on the sensory perception of architecture, by interacting with our most basic senses:

> "When you touch the black-stained wooden handrail, it is not cold steel. It is not back to the natural; it is back to yourself. You stand, you sit, you touch, you look you smell."[20]

20: Nina Rappaport, "Power Station, Nina Rappaport Talks with Jacques Herzog about His Firm's Transformation of an Abandoned London Power Station into the Tate Modern, While Sara Hart Gets under the Building's Seamless Surfaces.," *Architecture 05.00* (2000): 146–155.

However strong architecture may be on a spatial or even urban scale, its identity can be contained in the precise, ordered implementation of elements on a detailed scale. However, this expression can manifest itself in a number of different ways. In his book The architectural detail, Robert R. Ford attempts to define these different categories, focusing on two models in particular: detail as articulation and detail as subversive activity[21].

21: Edward R. Ford, *The Architectural Detail*, 1st ed. (New York: Princeton Architectural Press, 2011).

The first model defines the idea of the joint as a relationship between the parts of a building, but also how it can become a metaphor for a broader idea, going beyond structural construction. This concept of project through detail is illustrated in the case of the houses built by architect Peter Zumthor in Jenaz (CH) for the Luzi-Brunner family and in Leis (CH) for his wife

Annalisa and himself. From the outset of the Leis project, the use of log construction was as much a reflection of the local vernacular architecture as of the very feeling of living in a house built from solid wood:

> "Annalisa had always dreamed of living in a house built of wood. (…) Was she talking about the way Swiss mountain pine smells, about a crackling fire in the living room stove, about the special warmth of wood as a shell for the human body, the way she did recently? I don't recall exactly what she said but I still have the impression that there was something special emanating from the house that she described, something that applies only to houses made of solid timber, and not out of slats and boards and not out of plywood or veneers."[22]

This type of construction has certain rules, in terms of the size of the elements and the logic of stacking, which P. Zumthor circumvents by organizing the plan around small structural volumes[23]. But at the scale of detail, the log expresses all its strength through the precise, controlled design of its assembly. Each piece, prefabricated and labelled, is assembled on site in a timed ballet. From the first drawings to the interior finishes, the expression of the material shapes the very identity of the project.

22: "The Leis Houses," in Peter Zumthor, *Thinking Architecture*., Third, expanded edition. (Bâle : Birkhäuser, 2010).
23: idem.

The more recent project by the Ted'A architectural practice in Orsonnens (CH) takes a different approach to this question of detail and its influence on the design and interpretation of the project. The building's construction is based on the more traditional combination of a timber frame and cladding, but a number of constructional details, like so many special cases or anomalies, forge the character and uniqueness of the structure. Although these elements have an inherent function in the whole, they act autonomously, exaggerating this position through the strength of their design.
The entrance is via a covered courtyard created by creating a void in the volume of the building. The envelope disappears at this corner, leaving the passageway clear, and reveals the load-bearing framework in the form of two insulated posts. Directly in contact with the ground and the elements, they are created in the form of a stack of three mineral volumes of different dimensions. Playing on the image of a random assembly, they seem to have been added together in the same way as successive wedges would be used to redress the balance of the overall structure. With no equivalent in the rest of the building - even the treatment of the concrete is different - these posts act as an autonomous element that is at the same time irremediably linked to the project.
Like other projects by Ted'A, part of the strength of the Orsonnens school project lies in the building's skillful interplay with these isolated, iconic details. To cite just one example, the plan is organized around a central void lit by an opening in the roof and occupied by a single post that runs the full height of the building. Supported by a concrete base, it is made up of four square sections joined together, which then separate at the top to join the four corners of the glass roof. At the center of the plan, it sets out the organization of the ground floor, highlighting both the luminous void and the singular object that occupies it.

Using different systems, these two projects illustrate the importance the use of materials on a detailed scale can play by building the image of a project. Mastering this exercise depends first and foremost on a good knowledge of the materials themselves and the associated skills, but also on an ability to exchange and communicate in order to develop the project in collaboration with qualified craftsmen.
While drawings remain the most direct and universal medium, a mock-up - a partial 1:1 scale model - can be a very useful validation tool. The difference

in scale with the mock-up means that the material or materials and the way they are used have to be transposed to reality, as well as being an exercise in composition:

> "A form of proxy architecture, the mock-up is frequently comprised of disparate elements from a single building project. Windows, curtain wall systems or material samples often find themselves coupled together in an assemblage that bears more resemblance to public art installations than to architecture."[24]

The definition of the object as such acts like a totem[25], bringing together in an imaginary composition the various details of a project in order to understand its articulation and appreciate its material reality. Like an abbreviation of the project, the mock-up constitutes a chimerical artefact, presenting the new construction to come via a skewed, symbolic reality.

The choice to work with a raw material that has an infinite number of different structural and aesthetic qualities influences the project process. This is because log construction does not have a catalogue of standardized norms, elements and implementations that can be arranged to meet a spatial or programmatic ambition; it still has to be composed. By rethinking the design cycle with the aim of integrating the intrinsic parameters of the material from the outset, the Weinand studio is proposing for the 2023 semester to explore the project on the smallest scale, that of detail, via the theoretical concept of the mock-up as a symbolic representation of the project. On the basis of previous studies and the results of the workshop, the studio project consists of creating a technical mock-up of a log architecture. In the manner of a mock-up, which, in the form of an imaginary artefact, brings together the disparate elements of a project, the project consists of a set of details of a hypothetical building. With no more program than "making a home" - providing a floor, a roof, a facade - the mock-up constitutes, in symbolic form, the material and constructive identity of the project.

24: David K. Ross et al., *Archetypes - David K. Ross, A Standpunkte publication* (Zurich: Park Books, 2021). Reto Geiser, "Between Representation and Reality," in Archetypes - David K. Ross (Zurich: Park Books, 2021).

25: Reto Geiser, "Between Representation and Reality," in *Archetypes - David K. Ross* (Zurich: Park Books, 2021).

The final phase of the semester will be devoted to a project exercise. By comparing one of the fragments analyzed in the case study with the 3D trees obtained during the workshop, the aim of the exercise will be to compose, in the theoretical form of a mock-up, a section of log architecture using innovative details. This composition will be the result of an in-depth study of the different assemblies, but also of a mastery of the overall constitution of the whole created. The assessment criteria will therefore cover both the technical development and the understanding of the symbolic significance of the project. The second part of the project will be presented in the form of a critique and exhibition of all the work produced during the semester. The exhibits will consist of 2D and 3D representations, scale models and, where appropriate, 1/1 scale prototypes.

31.10	(7)	**Introduction > mock-up**	3D sketches, drawings and models
06.11 07.11	(8)	Lecture / conference Studio work / individual critique	Project development 3D sketches, drawings and models
13.11 14.11	(9)	Studio work / individual critique **Review of work with prof. Y. Weinand**	Project development 3D sketches, drawings and models
20.11 21.11	(10)	Lecture / conference Studio work / individual critique	Project development 3D sketches, drawings and models
27.11 28.11	(11)	Studio work / individual critique **Review of work with prof. Y. Weinand**	Project development 3D sketches, drawings and models
04.12 05.12	(12)	Lecture / conference Studio work / individual critique	Project finalization 3D sketches, drawings and models
11-15.12	(13)	Pre-presentation and validation of productions	Development of presentation material
18-22.12	(14)	**Critique > mock-up (prof. Y. Weinand + guest)**	Document archiving > mock-up

Method: studio - courses/meetings/visits

Studio work is a major part of the semester program, so attendance is required on the days of the week dedicated to this teaching. Professor Yves Weinand and the laboratory team - Damien Gilliard (ing. arch., Phd. Candidate), Agathe Mignon (arch., Phd., scientific collaborator), Andra Settimi (arch., Phd. Candidate) and Joseph Tannous (arch., Phd. Candidate) - will provide support throughout the semester to ensure the smooth development of the projects.

Occasionally, meetings will be arranged for interim presentations. Research in the timber construction sector, and even more so in the field of technical and digital innovation, also requires an interest in particular aspects of architecture and building. The semester program aims to provide a dynamic and applied introduction to these issues through a range of talks given by researchers, specialists and professionals. These events will be divided between ex-cathedra lectures, invitations or visits to sites or companies.

Evaluation: continuous assessment and critical appraisal

Evaluation is divided into continuous evaluation (attendance and participation throughout the semester, workshop work) and occasional evaluation during critiques.

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