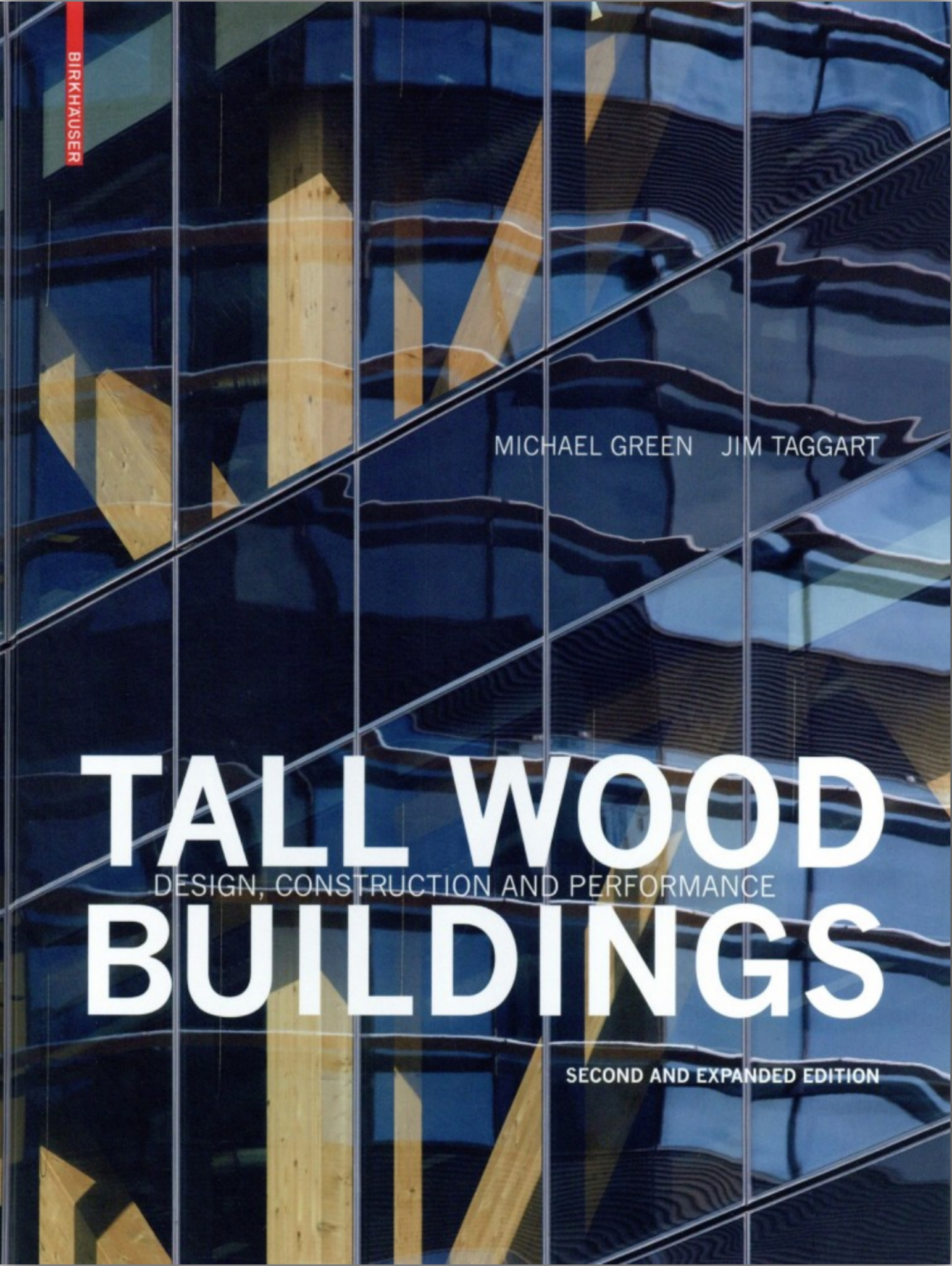
BIRKHÄUSER
MICHAEL GREEN JIM TAGGART
TALL WOOD
DESIGN, CONSTRUCTION AND PERFORMANCE
BUILDINGS
SECOND AND EXPANDED EDITION

# TALL WOOD BUILDINGS
## DESIGN, CONSTRUCTION AND PERFORMANCE

MICHAEL GREEN
JIM TAGGART

Second and expanded edition

Birkhäuser
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The first edition of this book came out in January 2017 in an English edition and a German translation (*Hoch bauen mit Holz*, 978-3-0356-0474-0). *Tall Wood Buildings* sold out so quickly that we had to reprint it as a corrected edition in July 2017. This 2020 expanded edition comprises five new case studies and all chapters have been carefully revised.

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# FOREWORD

We are living in an age which is increasingly dominated by our relationship with the planet. As the changes to our climate become ever more apparent, the way we live and inhabit the earth will, by necessity, be transformed.

A fundamental change in the way in which we build our cities is imperative, re-learning how to build in timber and how to build tall with the new engineered timbers that the 21st century technologies allow will be fundamental to our future. This new age of architecture takes us beyond the notions of modernism and concrete construction to a new timber age.

Timber is the only construction material that can be grown and as it grows it consumes carbon. Using timber not only reduces our impact on the planet but will also help to reverse some of the effects of 20th century industrialization. Timber construction is not only healthy for our planet but is also healthy for humans. Living and working in timber buildings is good for the soul and good for health. The time has come again to leave behind inhospitable concrete caves and embrace the timber age.

A new architecture emerges as we learn how to build in timber. We are at the beginning of this new and exciting era. This book marks this new age and will help to provide the inspiration and momentum for the outstanding architecture to come.

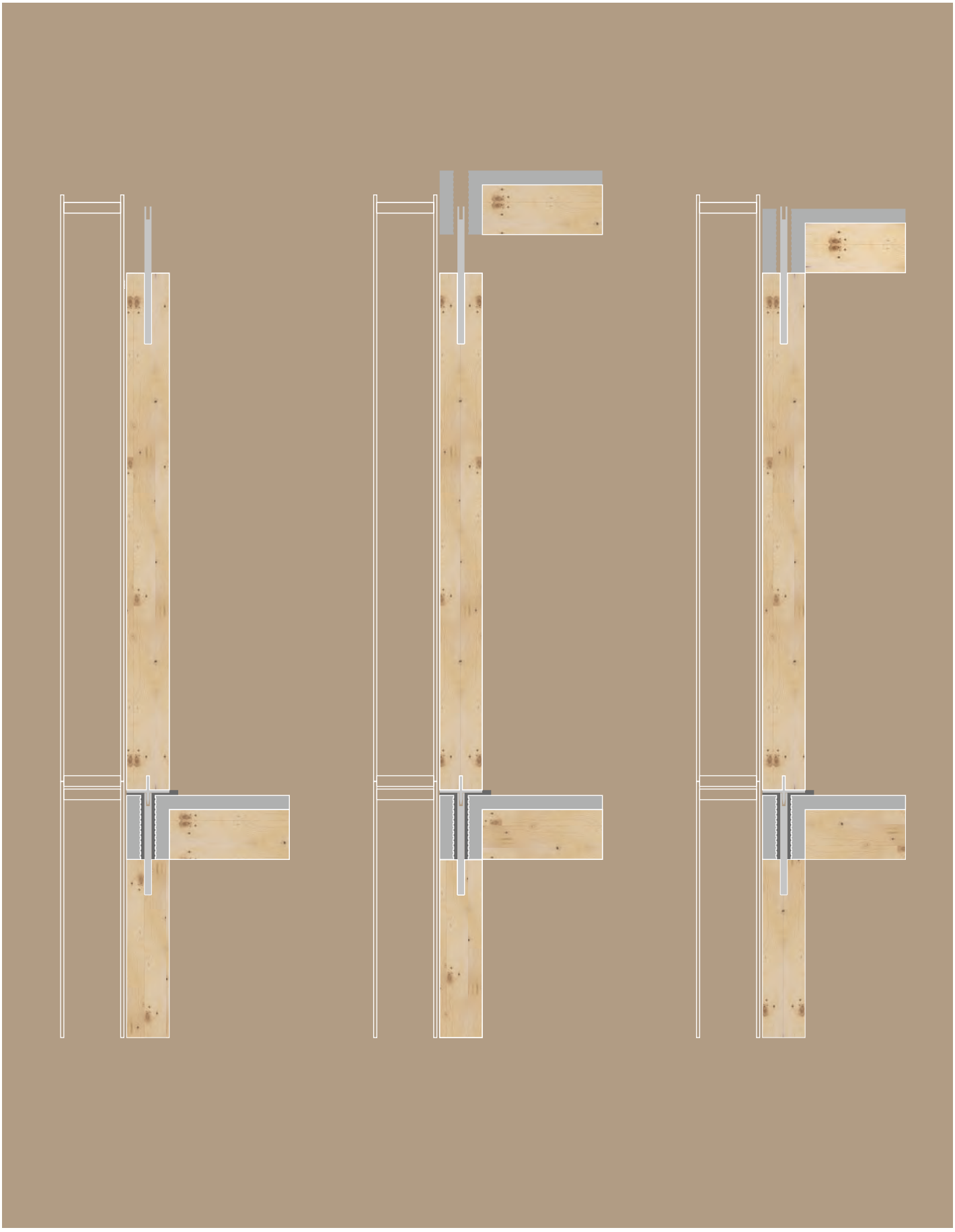
Andrew Waugh
Waugh Thistleton Architects, London
March 2020

# HYBRID SYSTEMS

In addition to satisfying the requirements of program, structural design is also concerned with efficiency and economy of means. In some cases, a pure wood frame or panel structure may not provide the optimal solution.

Hybrid systems, in which different materials and structural solutions are used in combination, are common. The choice may be made for architectural, structural, environmental or economic reasons, or because of local construction practices or code requirements. The examples documented in this section opted for the following solutions:

- The floor system for the Badenerstrasse Mixed-Use Building consists of prefabricated LVL panels, whereas the walls use closely spaced green timber posts, a solution designed to minimize carbon footprint and ensure recyclability.
- LCT One uses a simple system of wood/concrete composite floor panels, and prefabricated wall panels incorporating glulam columns, a combination that speeds up the erection process and minimizes use of material.
- The Wenlock Mixed-Use Building has a concrete ground floor and circulation core, with a steel frame superstructure creating cantilevers that articulate the façade, and CLT panels for walls and floors.
- The Treet Apartment Building has a perimeter structure of glulam trusses, CLT stair and elevator cores and hybrid glulam and concrete 'power' floors that support stacked modular apartment units.
- With the exception of its fully encapsulated glulam post and CLT floor structure, the construction of Brock Commons Tallwood House follows the standard practices for high-rise construction in British Columbia.
- The glulam frame and composite wood and concrete floor construction of HoHo Wien resists lateral forces through the use of cast-in-place concrete stair and elevator cores and perimeter precast concrete ring beams at every floor.



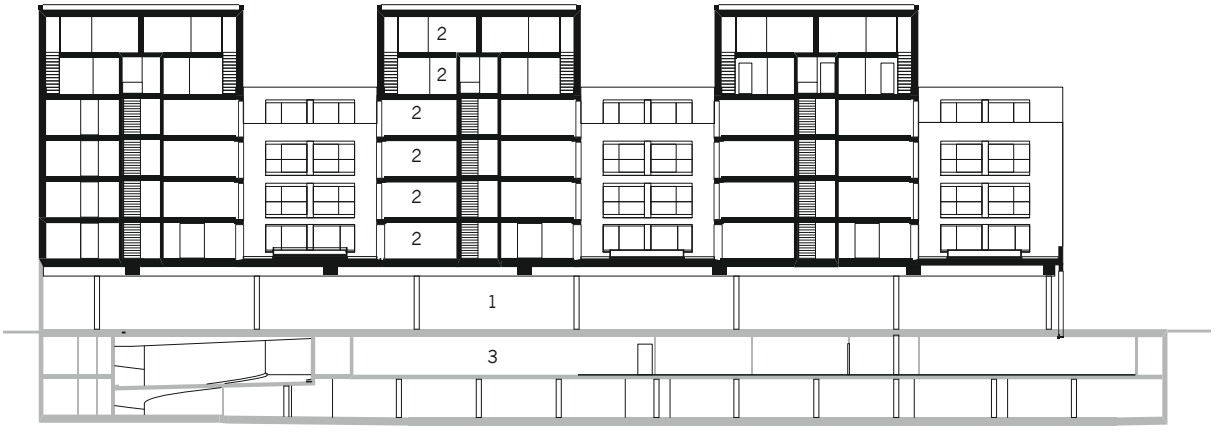
# BADENERSTRASSE MIXED-USE BUILDING

Zurich, Switzerland [Pool Architekten]

| | |
|---|---|
| 2010 | **Year** |
| Baugenossenschaft Zurlinden | **Client** |
| SJB Kempter Fitze AG | **Structural Engineer** |
| Zimmereigenossenschaft Zürich | **Engineered Wood Fabricator** |
| Caretta Weidmann AG | **Contractor** |
| Residential/Commercial | **Program** |

The Badenerstrasse project questions current assumptions about the use of wood in contemporary buildings, and offers a low-tech vision of a sustainable future.

**1** Supermarket
**2** Private residence
**3** Parking garage




**Section AA**

Located in central Zurich, this project is the first in Switzerland to meet the requirements of new energy regulations based on the criteria of the 2000 Watt Society.[1] The building extends the full depth of the property between Badenerstrasse and the new Hardau city park. The mixed-use program includes retail space occupying a single-storey concrete podium, above which are 54 apartments spread over six storeys, and constructed using field-assembled massive timber panels.

## CONCEPT

Above the podium, the residential accommodation is divided into six contiguous rectangles, alternately pushed forward toward the park, or back toward Badenerstrasse. The result is that both main façades are strongly articulated as a series of vertical volumes separated by courtyards.

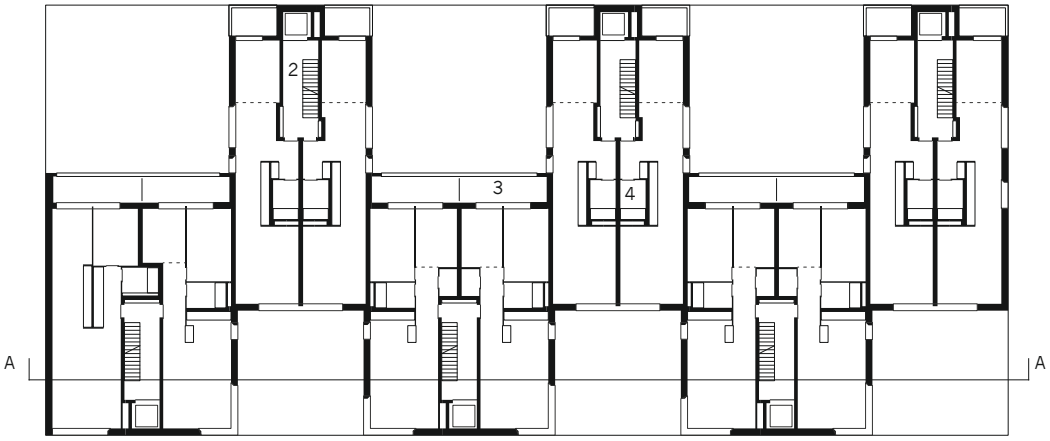
All units are arranged in linear fashion and extend the full depth of the building. This allows for through ventilation, natural light from multiple directions and the opportunity to create a more 'closed' elevation toward the busy street, and a more open one toward the park. Balconies on the park side further articulate the vertical massing and connect the building and its occupants visually to the surroundings. Building entrances are located on both sides, strengthening connections to the immediate neighbourhood and animating the public realm.

The façade is clad in fibre cement panels, which give the building an impression of massiveness appropriate to its city centre setting. As such, it sits comfortably among its historic neighbours, most of which have stucco or stone façades.

## CONSTRUCTION

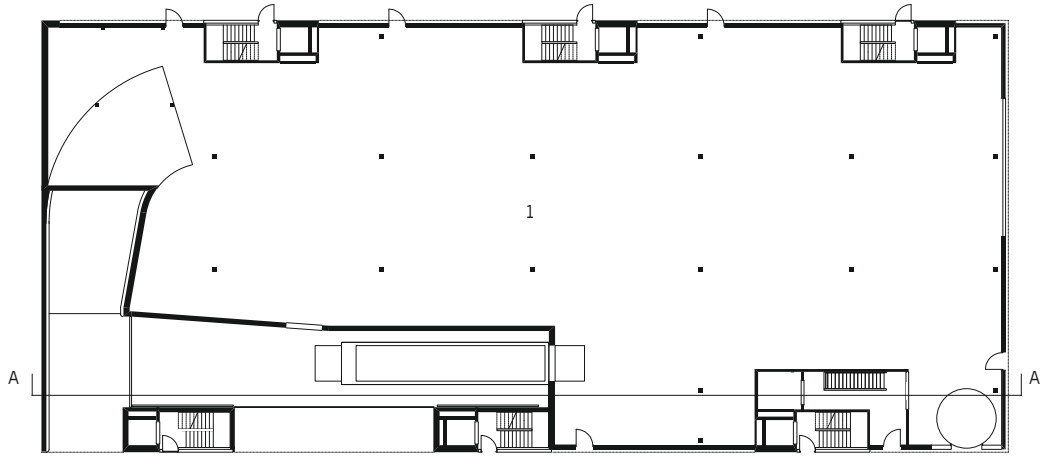
The six apartment storeys are constructed using a simple cross wall structure that remains consistent throughout the height of the building. Wood construction offered numerous advantages. In addition to the shortened construction schedule that results from the use of prefabricated and modular elements, wood offered reduced weight and environmental attributes consistent with the project goals.

Badenerstrasse is the first project to use the 'Top Wall' system developed by the Swiss engineer and carpenter Hermann Blumer as the main structural support system. The system is based on standardized 100mm × 200mm spruce wood vertical supports that do not need to be kiln-dried to perform effectively. The elements are not factory-prefabricated into wall panel units (as is usual in contemporary massive timber construction), but instead positioned and fixed in




**1** Supermarket
**2** Stairwell
**3** Balcony
**4** Elevator shaft

**Typical floor plan**




**Ground floor plan**

place on sleepers, using 20mm diameter beech wood dowels or plug anchors inserted into pre-drilled holes. The floors are a prefabricated panelized construction, consisting of 40mm upper and lower skins of laminated veneer lumber with 160mm deep joists, the voids being filled with a 50mm layer of gravel. Above the panel is a 30mm layer of sound insulation, covered with 70mm of concrete screed (including in-floor radiant heating), and a finish floor. Below the panel resilient channels are mounted, with a gypsum fibreboard finish.

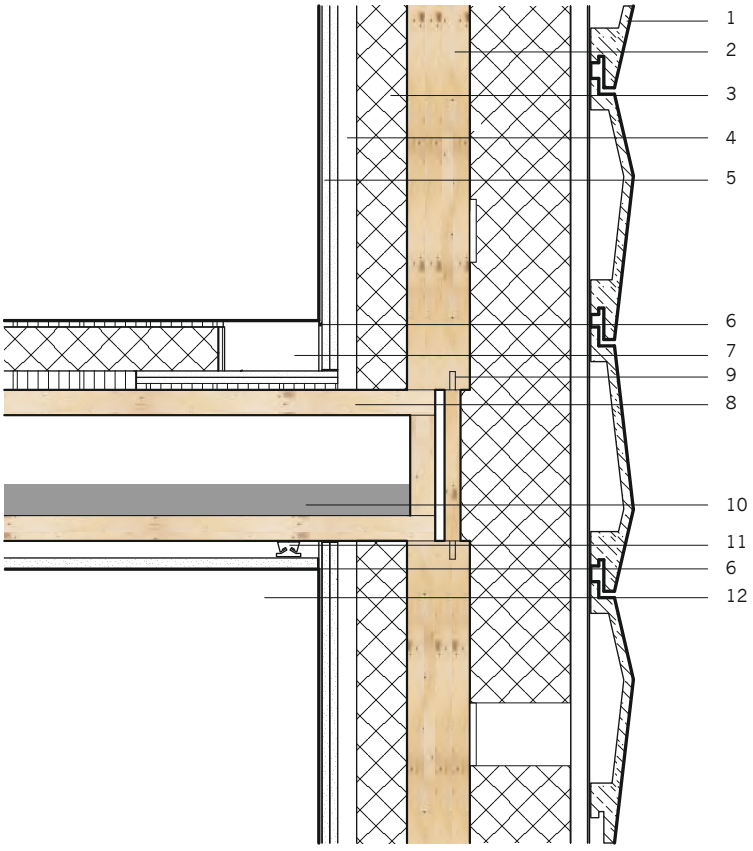
With the introduction of digital fabrication, building with massive timber has become a high-tech, high-precision method of construction. In contrast, the approach taken in this project (particularly with respect to the walls) is intentionally low-tech. Here, the natural properties and variability of wood as an organic material are accepted and incorporated into the system. Two aspects are of particular interest.

Firstly, the vertical elements are configured with a 10mm gap between them, which allows the wood to shrink, swell or warp perpendicular to grain. While the elements are precise in the vertical dimension, this configuration allows for a 5% change in the size of the cross section. It is not necessary to process the material to avoid knots and splits, as these do not affect the overall performance of the system.

Secondly, because the wood used is not processed, glued or nailed, it can be easily dismantled and reclaimed at full structural value, when it reaches the end of its initial service life. Thus the material can be incorporated into other high-quality wooden products, as was common practice with reclaimed timbers well into the first half of the 20th century.

**The breathable cement cladding is the outermost layer of a highly insulated vapour-permeable wall construction.**

**A worker installs the horizontal pegs that connect the posts into a continous wall.**




**Detail section**

**1** Breathable cement cladding
**2** Solid spruce 'Top Wall' system
**3** Insulation cavity on both sides of the solid wood posts
**4** Ventilated cavity
**5** Double layer of gypsum fibreboard
**6** Acoustic spacer
**7** Utility cavity
**8** LVL panel
**9** Beech wood plug
**10** Acoustic insulation
**11** Acoustic ceiling hanger
**12** Gypsum ceiling

**Non-load-bearing walls within the building consist of wood and metal elements depending on the service systems running through them.**

**Wall prior to application of gypsum board. Notice the metal brackets used to stabilize and connect sections of the wall to the floor beneath.**

With the wood posts at its core, the exterior wall construction includes 80mm of mineral fibre insulation, 30mm strapping, felt and gypsum fibreboard to the inside; and house wrap, 160mm mineral fibre insulation, 30mm battens and 70mm fibre cement rainscreen cladding to the outside.

With respect to Zurich's new energy performance requirements, the norms stipulated by SIA Effizienzpfad Energie (Path toward Energy Efficiency)[2] were the basis for the calculation of the operational and embodied energy to optimize both the construction methods and the performance of the building. The choice of a construction system based on solid sawn lumber significantly reduced the embodied energy of the building. Energy for building operation is supplied by a heat pump, solar panels and the recycling of heat produced by the supermarket on the ground floor.

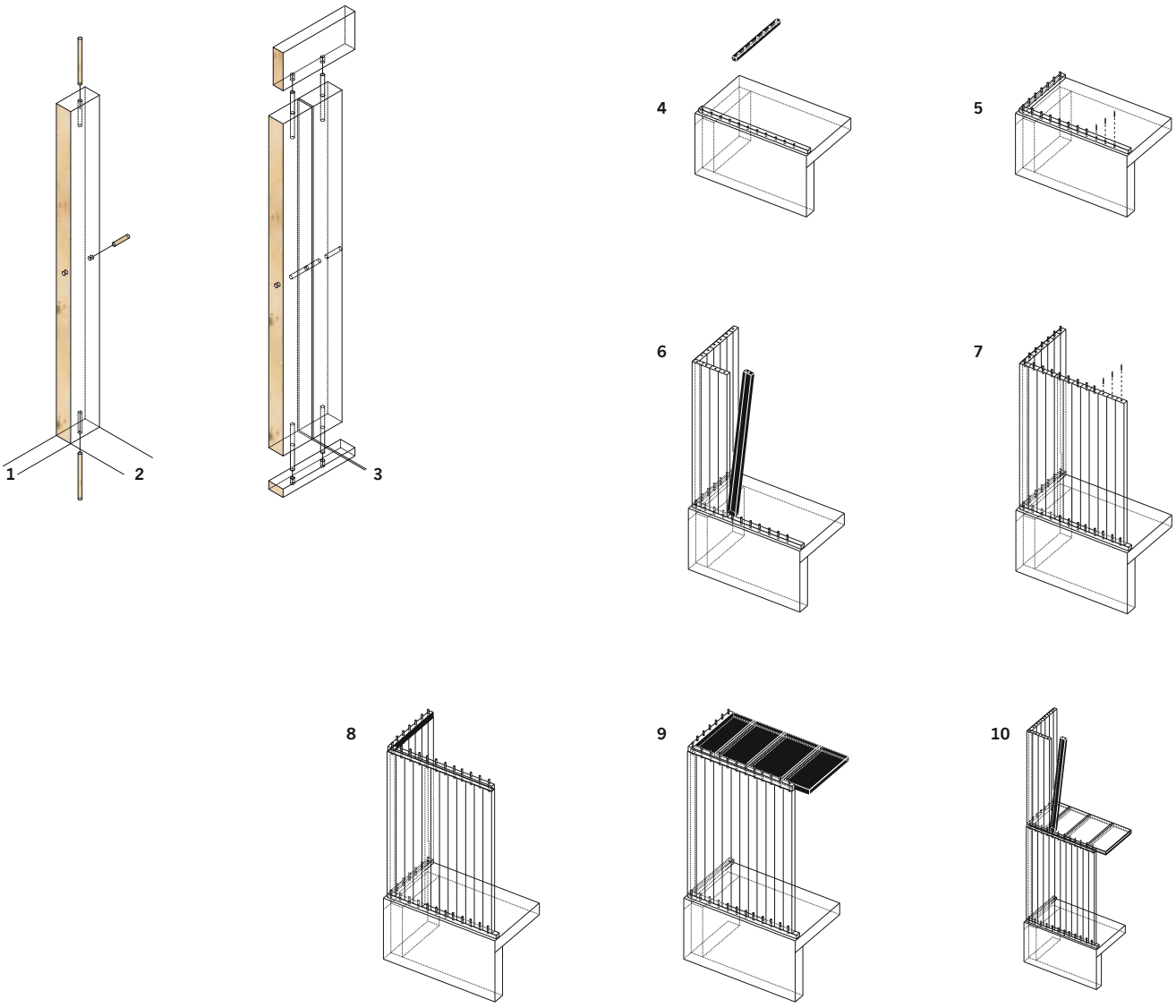
## CONCLUSION

The Badenerstrasse project not only expands our understanding of contemporary approaches to sustainable building, questioning some current assumptions and preconceptions, but also anticipates a future in which resource shortages will make the recycling and reuse of buildings and building materials an industry imperative.

## REFERENCES


1 The 2000 Watt Society is a model, first developed by ETH Zurich, that aims to reduce energy consumption to a continuous 2000 Watts per capita, the level it believes is necessary to achieve long-term stabilization of the Earth's climate.

2 Merkblatt SIA Effizienzpfad Energi' (SIA 2040), 2011. Retrieved from: http://www.sia.ch/de/themen/energie/effizienzpfad-energie/




**Drawing of 'Top Wall' system**
**1** 100mm solid green spruce posts **2** 200mm width **3** Wall posts are separated by 10mm to allow for shifting and swelling within the wall. **4** Wood supports with regular holes provide the base for the wall system. **5** Wooden dowels are inserted into the holes and secure each post in the wall. **6** Each post is placed onto its own peg and horizontal pegs connect the posts. **7** Dowels are inserted into the top of the posts and hold the next wooden support layer. **8** The support layer holds the next wall layer and frames the floor. **9** Wooden floor panels are placed on the wooden posts. **10** The process starts again to build the next floor.

**The 'Top Wall' system before and during construction. The pegs are already inserted and the posts are about to be installed.**

# ABOUT THE AUTHORS

**MICHAEL GREEN**
Michael founded his architecture firm MGA | Michael Green Architecture, not for profit school DBR | Design Build Research and research platform TOE | Timber Online Education, to focus on progressive architecture, research, education and innovation. From Vancouver, British Columbia, he and his team work on international projects that are diverse in their scale, building type and location.

A Fellow of the Royal Architectural Institute of Canada, Michael is vested in helping build healthier communities through innovative architecture, interiors, landscape and urban design. He is particularly known for his research, leadership and advocacy in promoting the use of wood in the built environment with extensive international talks on the subject, including his 2013 TED talk which has been translated into 31 different languages and viewed over 1.3 million times.

**ANDREW WAUGH**
Andrew is a founding director of Waugh Thistleton Architects, London. Andrew has led the practice on award-winning schemes from cinemas to synagogues; social housing to offices and was responsible for the design and delivery of Murray Grove, 2009, the project which spearheaded the international movement in tall timber construction, and Bushey Cemetery which was shortlisted for the prestigious Stirling Prize in 2018.

**JIM TAGGART**
Since leaving architectural practice in 1992, Jim has written and lectured extensively on the use of wood in contemporary architecture to audiences throughout North America and across the world. He is also the author of the award-winning books *Toward a Culture of Wood Architecture* (2011) and *The Architecture of Engagement* (2019).

Jim has taught architecture at the British Columbia Institute of Technology in Vancouver since 2004, and has been editor of *Sustainable Architecture and Building Magazine* (SABMag) since its inception in 2006. He is a Fellow of the Royal Architectural Institute of Canada, Executive Director of the Royal Architectural Institute of Canada Foundation and was the recipient of the 2012 Premier of British Columbia's 'Wood Champion' award.

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