Students in the Forest: The Role of Design-Build Pedagogies in Repairing Material Disconnections in Architecture Education

James Benedict Brown and Francesco Camilli

Abstract

This article explores an intellectual disconnection in architectural education about the conception of wood as a building material. It explores initiatives to develop in future architects a deeper consciousness of the complex ecology of timber, promoting its sustainable use in the building industry. It explores six case studies drawn from architectural education to explore the ways in which the properties that make timber sustainable are explored through research and design, and how this deep understanding is transferred to students through hands-on applications.

Keywords

architecture education, design-build, live projects, pedagogy, sustainability, wood

The role of wood in architecture

Wood is one of the most widely available and widely used building materials. Its relationship to the built environment is complex, not only as a building material but also as a fuel for thermal comfort and cooking food. In the densely populated temperate regions of the planet, the plentiful supply of both hardwood and soft-wood has provided societies with building materials that can provide shelter with excellent thermal properties through seasonal variations in temperature. From the

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most basic shelters to the most sacred places of worship, buildings have been constructed out of wood and organic materials for thousands of years. Northern narratives tend to privilege the development of architectural history from the perspective of access to hardwood. Across the tropical regions of the planet, reeds and grasses have also been used for millennia in the provision of shelter from the elements. In the *mudhif* (reed houses) of the Euphrates and Tigris Delta, the beehive-shaped *tukul* of the Sidama people in Ethiopia, or the coconut, palm, or bamboo walls and roofs of the *haus tambaran* (spirit houses) in Sepik, Papua New Guinea, we witness how hard- and softwood and other organic materials provide buildings with structure, insulation, and decoration.

Outside of the hottest regions, in places where clay could not be sun-dried to form usable bricks, wood and other organic materials were essential to fuel the kilns that would bake pieces of masonry. The characteristic joints and decorations of early Greek temples, originally constructed in wood, form the basis of the decoration and proportion of the classical orders, notably in the triglyph and guttae of a Doric entablature. The concrete dome of the Pantheon, the pointed arches of eighth-century mosques of the Abbasid Caliphate and European Gothic cathedrals four centuries later could only be constructed using timber formwork. Even Filippo Brunelleschi's dome of Santa María del Fiore in Florence, famously too large to be built on self-supporting timber formwork, references the wood that provided cantilevered scaffolding in its construction, secured using the circular holes of its tiled roof. With the energetic revolution brought about by the intensive use of fossil fuels, architectural production was dramatically changed by the availability and affordability of concrete and structural steel. Reinforced in-situ concrete was the characteristic material of the modern movement, but timber boards were always needed to create their formwork, often leaving an organic pattern on the surface of the setting concrete. An entire drawing office was employed for the construction of Denys Lasdun's National Theatre in London to select and arrange the wooden planks whose grain and relative offset would provide decoration to the finished surface.

A conceptual disconnection

We perceive a conceptual disconnection in the way that we think about wood as a building material. This has been driven, in no small part, by the way in which we as a profession have responded to the growing awareness of our culpability in creating buildings that are bad for the human environment. In response to the crisis of climate change, wood is now recognised as having a significant potential to address the need for the construction industry to reduce its carbon emissions. This conceptual disconnection relates not only to an awareness of the carbon emissions of the buildings we are making today but also to the cultural status of the architectural canon. In his recent synoptic history of the discipline, Calder (2021) presents a radical reinterpretation of architectural history, not according to empire, style, or material, but according to human access to energy. According to this narrative, architectural modernism was not a product of the industrial revolution, but a product of an energetic revolution, one in which sudden and plentiful access to vast amounts of fossil energy allowed architects to create buildings in ways that were taller, wider, bolder, and, ultimately, more carbon-emitting than ever before. Lucio Costa's urban plan and Oscar Niemeyer's landmark buildings for Brasília can no

longer be interpreted only as an intellectual evolution of the International Style, but as the deleterious manifestation of cheap oil. Iturbe (2019) describes the consequences of this moment as 'the death of carbon modernity'.

Wood has many characteristics that give it an outstanding potential for being a sustainable building material: it absorbs and stores the carbon that we are so desperate to remove from the atmosphere, and it has excellent thermal performance. Structural wood is produced with only a marginal reliance on fossil fuels, primarily in the logging and transportation of raw materials. The use of structural timber instead of steel and concrete is currently regarded as one of the most important means of decarbonizing the built environment and achieving national environmental goals and the UN Sustainable Development Goals. Consequently, there is a renewed global interest in the material, environmental, and social possibilities of wood as a building material. In 2020, the French government tabled new legislation to require all new public buildings to be built from at least 50% timber or other natural materials (Errard 2020). The capacity of wood to absorb and capture carbon in buildings (as opposed to releasing it into the atmosphere) is evidently an important opportunity. The completion of landmark tall timber buildings in Brumunddal, Norway (Mjøstårnet by Voll Arkitekter, 2019) and Skellefteå, Sweden (Figure 1, Sara kulturhus by White Arkitekter, 2021) has contributed to the perception of a so-called 'Scandinavian effect' (Bonner & Kara 2020), highlighting a new interest in the application of wood and engineered wood products in place of carbon-emitting materials such as reinforced concrete and structural steel.

Wood is often presented as being objectively better than reinforced concrete or structural steel, based largely on its ability to absorb and store carbon. The

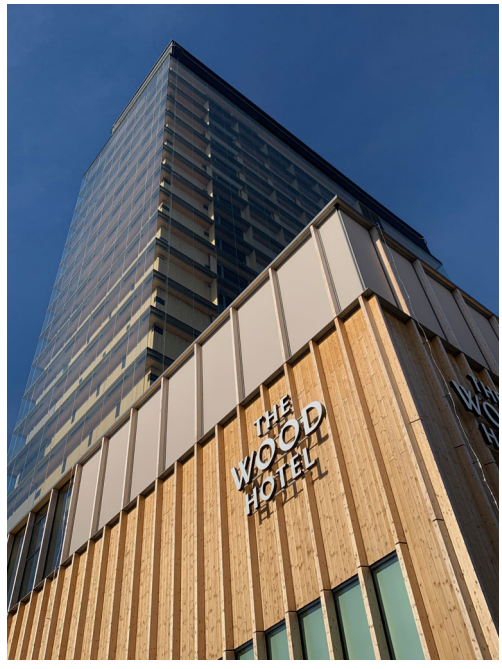

Figure 1
Sara Kulturhus, Skellefteå, Sweden, Designed by White Arkitekter, 2021. *Photo*: James Benedict Brown.

increased demand for wood products has been argued by advocates of the timber industry to be beneficial for the environment since increased felling leads to increased planting of new, younger trees which are argued to absorb more carbon than older, established forests. This is a reductive explanation of the processes involved in commercial forestry today: the complexity of the production of wood and engineered wood products makes it evident that some conditions must be met to achieve this sustainability. In densely forested but sparsely populated places, such as northern Sweden, this had led to a complex set of disputes between industrial and Indigenous stakeholders, where commercial forestry is now in conflict with traditional ways of life, such as Sámi reindeer husbandry. Sustainability—generally agreed to mean 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987)—is not only a matter of energetic balance but must also consider the impact of material extraction on forest habitats, animal life, fauna, human communities, economies and politics. The awareness of this is evidenced by a string of publications by Hutton (2018) and Moe (2017, 2021) and Ibañez *et al.* (2019), which characterise a new conceptual approach to the interconnectivity of materials, exploring how far-away landscapes are connected to those in which materials are used. They highlight the complexity involved in articulating the flows of energy embedded in the production process of a material, flows which we have so far tended to reduce to quantitative scores: *R* values or kilogram of carbon that may be conceived as being stored in a forest or mass of wood. What we are witnessing, in the case of wood, is the abstraction of timber from its ecological context, and an abstraction of the characteristics that make timber sustainable from the complex processes that generate them.

Our approaches to conceptualising the relative sustainability of different materials in construction are often oversimplified. We lack qualitative calculations to complement the more common quantitative calculations of a material's relative sustainability. In the words of Jane Hutton:

> *Wood is better understood as the woods: thousands of species, enmeshed in highly specific ecological configurations, of untold physical properties and propensities, with deep human dependencies and relations with other species. To maintain a generic understanding of wood, therefore, is to disregard its complex landscape entanglements and to forgo its most interesting design opportunities. To simply build with more wood is to reproduce and exacerbate existing conditions. To overlook the immense diversity of species, properties, and landscapes where trees grow is to ignore the material's greatest strengths and richest offerings.* (Hutton 2019, p. 20)

At the heart of these critiques of architectural production is a recognition that our most common definitions of relative sustainability remain insufficiently narrow. It seems apposite to note how these emergent theories argue for a means of assessing environmental relations in ways that are neither exclusively quantitative nor qualitative, but which oscillate continuously between the two of them. Trees and the forests in which they grow are complex ecologies. Extracting a building material has consequences on these ecologies and the sustainability of this process lies in our capacity to conceive of the holistic nature of these ecologies. If understanding this dynamic is already a complex matter, transferring this understanding to architecture students is an even tougher challenge. How might architectural education be done differently to give this awareness to students?

A pedagogical disconnection

The structural properties of wood and other materials are typically addressed in architecture education in lectures, workshops and other modes of transmission-based teaching. Material science makes frequent, if covert, excursions into the design studio, through hands-on exercises in which students build scale models of bridges, towers and other structures.

Through original research into the hands-on use of wood in architectural education, we argue that certain initiatives in architectural education suggest that there is a disconnection in the pedagogical conception of wood in our discipline. In the English-speaking world, there are two traditions through which architecture educators have worked within the curricula framework to deliver hands-on opportunities to work with the processes of design and construction. The British tradition of live projects and the North American tradition of design-build projects are two different, but related examples of how architectural education responds to a lack of social and technical skills in its graduates (Brown 2012). Emerging from different traditions, these two kinds of alternative pedagogies are defined by their shared intentions to address the knowledge and skills gap between architectural education and practice (Brown & Russell 2022). Referring to Jane Hutton's critique of 'generic' understandings of wood (*op cit*), there is a disconnection in architectural education between the knowledge of working with materials and the complimentary but different knowledge of conceptualising its environmental origin and understanding of the diverse impacts generated by the choice of using timber in a building. Moe writes

> *Architects do not fully understand building in terms of the bonds and state that are constitutive of building. They are trained to construe a building only as an isolated object-instance, rather than building as a set of linked, systemic process of urbanization and civilization. As a result, they do not see that across a range of temporal and spatial scales, building is bonded to a range of factors and forces that extend well beyond any individual building and its plot of land. Furthermore, architects do not fully see the convection of material and energy across the surface of the earth, its assembly in a building for a limited duration, and therefore of design. Neither do they see the magnitudes of energy and meaning inherent in these flows of matter.* (Moe 2017, p. 19)

We argue that design-build projects present a particular opportunity for architecture students to engage with holistic quantitative and qualitative thinking about the 'emergetics' (Moe, *op cit*) of wood as a material. Design-build projects introduce matters of economy, budget and practicalities—but unlike 'raw' architectural practice, they permit students to work with some liberties, giving them the possibility to explore and critically reflect on the consequences of design choices, like that of using wood as a building material.

Methodology

Derived from a 2-year research project at [redacted] funded by the [redacted], we have set out to explore the hands-on use of wood in architectural education. This is most often but not exclusively in so-called design-build projects, familiar to many

readers as projects in which students of architecture engage in the design and construction of a building as part of their studies. Based on this original research, this article considers how wood is used by architectural educators and students in design-build projects as a means of correcting an implicit disconnection in the conception of wood as a material. This article analyses six case studies to understand how each of them explores the complexity of timber to better understand its positive environmental qualities. Many of these initiatives have both teaching and research goals.

Following an initial literature review, we identified several potential case studies from schools of architecture on three continents. Case studies were selected based on the opportunity that they provide students to engage with the actual realisation of a wooden building. The process of identifying case studies was not straightforward: The literature about such projects is not homogeneous: some initiatives have been the subject of books and publications, some are publicised with videos or other media online, whereas others barely have a website. Interviews with one or two of the identifiable leaders of each case study were held, with the goal of obtaining some degree of qualitative information not only about their methods and outcomes but also about the actual experiences, unexpected outcomes, social interactions and impacts of working with wood.

A freeform interview structure within these five topics allowed the interviewees to talk freely about their work while keeping an order that made the different conversations comparable. Following the piloting of a prototype interview schedule on an individual known to the researchers, the schedule was further refined and structured into five topics: timber as a material, design and architecture, education, ecology, and politics. The interviews were advantageous because they provided access to insights on the work of the different initiatives and institutions that might not otherwise be found in literature, especially that which is published by the institution itself for the purpose of marketing and publicity. This allowed us to understand in which way these initiatives relate to timber from an ecological point of view, meaning that we were able to grasp an idea of what kind of technical, social, or environmental relationships they try to explore. The interviews were conducted remotely, over a video link, and a recording was transcribed, proofed, and returned to the interviewee(s) for approval. A four-step process of coding was employed to allow a grounded theory to emerge from the interviews (Charmaz 2014). We regard interviews as neither wholly objective nor wholly subjective, rather as 'intersubjective' collaborative constructions of the interviewer and interviewee (Laing 1967). Research is ongoing and particular attention is being paid to the triangulation of results to achieve sufficient reliability.

Six case studies and three aspects

In the following discussion, we examine six case studies that, in some way, address an apparent disconnection between wood and its ecology. We examine them through three aspects identified during the analysis of the interviews.

The first aspect is to do with the production of timber, i.e. the industrial process through which the building material is extracted from the forest. This relates mainly to forestry management and to the methods and techniques used to grow, select and harvest wood. In this first aspect of our discussion, we want to underline how the industrial extractive approach towards forests can be an element of

the disconnection between timber and its ecology. Two British case studies address this aspect, one which has a loose inheritance from the other. Firstly, the Studio in the Woods, an independent weekend summer school initiated by the architect Piers Taylor, and secondly and the Hooke Park Design + Make program of the Architectural Association (AA), London at its rural campus in Dorset, England. Taylor worked at Hooke Park prior to establishing Studio in the Woods.

The second aspect is to do with manufacturing, intended as the ways in which the inherent physical properties of timber are studied and exploited to achieve the highest possible material efficiency in the use of timber as a building material. This aspect relates to how timber tends to be used as a substitute for other materials like steel or concrete, constituting a disconnection between timber and its vegetal nature. Two continental European case studies that illustrate this aspect are the Institute for Computational Design (ICD) at the University of Stuttgart, Germany and the Laboratory for Timber Construction (IBOIS) at the École Polytechnique Féderale de Lausanne (EPFL), Switzerland.

The third aspect is to do with the capacity of wood as a material of collective realisation, connecting faculty, students, clients, users and wider communities in the assembly of a building. As we explore, this kind of engagement opens up the possibility of a kind of sentimental bond with the material, thanks to its inherent accessibility to untrained builders. The two case studies explored in this aspect are the Design + Build studio of the University of Nottingham, England and the InSitu Project, Hong Kong.

Producing wood

In the United Kingdom, we identified two case studies that engage students of architecture in deepening their understanding of the production of wood from the forests in which it grows.

The Studio in the Woods is an annual summer school, held over one weekend in a forest landscape. The project was initiated in 2005 by British architect Piers Taylor (Invisible Studio) in collaboration with Kate Darby (Kate Darby Architects), Meredith Bowles (Mole) and Gianni Botsford (Gianni Botsford Architects). It was initially held within the working woodland where Invisible Studio is established but then moved to different locations throughout the United Kingdom, with plans for holding it in France in the future. The initiative is primarily intended for architecture students but is also open to carpenters, engineers, furniture makers, other academics and anyone interested in taking part. A number of individuals, usually architecture professionals, are invited to lead one of the five groups that will work within the studio. During the short timeframe of the studio, typically going from Thursday afternoon to Sunday, the groups would work during the day, while evenings are dedicated to lectures.

The use of locally available wood is embedded in the spirit of the initiative: being held in forests, it became natural to use the material available on site, and this triggered an interest in the organisers about the forests and woodland management, material waste and, above all, the ways in which design can respond to local contingencies. The buildings realised during the workshop are small, experimental pavilions that show spatial concepts obtained through different technical and formal approaches. What all the pavilions share is that the wood used to build them is fell on site and assembled with simple technologies that are compatible with the short timeframe of the studio. Students face the limits and opportunities of having to realise a building with raw materials, having to reflect critically on

what those materials allow them to do and how this reflects on the final design. They also have the possibility to witness the tension that generates between a building and the environment that produced its materials. This gives the students a small-scale demonstration of how it is possible to reflect on the relationship between the realisation of building and its environmental impacts.

Recounting an early iteration of the Studio in the Woods, Taylor recalls

> *I remember when we first fell timber and have it milled, it was mind-blowing that you take a tree that architects historically would just cut into regularised pieces and throw two-fifth of it away, to see the waste, see the actual material. You know, a tree, of course, is never straight. It's always kind of wonky. And it may sound obvious just to say it, but suddenly being aware that our own presumptions around material weren't abstract things but rather real things. We had a scarce amount of material and we had to understand how to use it intelligently.* (Taylor 2021)

In the use of elective thematic groups, The Studio in the Woods operates like an architecture school in miniature but relocated to a forest environment and without the constraints of a normative institutional curriculum. Taylor explains that 'what I want to show is that not only can you accrue a project, but that contingencies of real world, engagement with real people, real material, and a real place are things that can really inform a project' (ibid).

Hooke Park in Dorset is the rural campus of the Architectural Association School of Architecture in London. The 143-ha country estate was purchased by the Parnham Trust in 1983 and used for the establishment of a School of Woodland Industries. Taken over by the AA in 2002, it now hosts an experimental facility for the use of wood in its natural form as a building material. The campus integrates a managed forest with 17 different tree species, from which wood is harvested to be used both for research projects and for the expansion of the campus. The buildings and facilities of the campus, designed with the contribution of Frei Otto, Buro Happold, Edward Cullinan, are themselves applications of the technologies developed there.

Emmanuel Vercruysse, director of the MArch/MSc Design + Make graduate program at Hooke Park, has identified the reduction of waste in wood manufacturing prime concern: 'we could say that maybe 30% of a tree will actually make it as a building material and 50%–60% gets discarded along the way. We are really interested in looking at that process and finding alternative usage of what is perceived as zero-value material such as thinnings' [1] (Vercruysse 2021). In addition to hands-on graduate education in wood construction, the campus is also the site of research into the optimisation of wood production through robotisation and other technologies, particularly wood products that are usually considered unusable and disposed of as waste or fuel.

Implicit in this vision lies a critique of standardisation in industrial wood production, which normalises the dimensions, characteristics and behaviours of timber products in much the same way as other industrial building materials are produced. Vercruysse explains that this engenders in architects the obligation to invert the understanding of materials: 'don't make a demand on the forest … we actually turn it around and see what is available in the forest for us to build with' (ibid). The pedagogical approach of the Design + Make program at Hooke Park is, therefore, defined by a change in the architect's attitude to material: not demanding or

expecting a standardised product that can be described according to a predetermined set of dimensions of guaranteed structural properties, but learning to work with and develop a symbiotic relationship with the forest and those who have the expertise to harvest wood from it. Through this, the architect can hope to understand and respond to the material properties of everything that the forest produces, finding a specific use for every different piece of wood. So-called small-diameter timber, including coppiced wood and thinnings that might ordinarily be cut and allowed to decompose on the forest floor, is finding architectural applications. Previously, such an approach might be characterised as representing opposition to modernity. Modern technologies, including photogrammetry and digital scanning, give architects the opportunity to survey the available wood rapidly and efficiently. By inhabiting the forest, students of the AA Design + Make program have an opportunity to witness and participate not only in the construction of a building but also in the production of wood and the management of the forest from which it is harvested. The complexity of wood as a material is thus made evident.

Manufacturing wood

The University of Stuttgart, Germany is home to two adjacent, but distinct research centres identified during our literature review. The Institute for Computational Design (ICD) is a research centre that focuses on computational design and the development of computer-aided manufacturing processes in architecture. The neighbouring Institute of Building Structures and Structural Design (ITKE) is concerned with structural engineering and its integration with architecture. Together, the two institutes participate in the Cluster of Excellence Integrative Computational Design and Construction for Architecture (intCDC). Through a joint interview with Luis Orozco (ICD) and Anna Kritschl (ITKE), we were able to explore the research undertaken by both.

While wood is not the exclusive research focus of either centre, the Institutes are situated in a region where forestry is well-established and industrial production is substantial. Consequently, research into the wood as a building material is mostly oriented towards minimising material and expansion of performance through the exploitation of its inherent physical capacities. Counter-intuitively, given the dominant paradigm of discourse around wood as an environmentally sensitive material, Orozco and Krtschil characterise this as 'not choosing to take the approach of some timber research … where the more wood you use, the more carbon you have sequestered, and therefore the better is your life cycle analysis' (2021). The goal is the efficiency of material use, and the consequence is buildings that are characteristically lightweight.

Experimental pavilions built with the support of students showcase the research undertaken at the two institutes and the new possibilities of these innovative building methods. The BUGA Wood Pavilion, built in Heilbronn in 2019, used a segmented shell superstructure. It applied the structural principle found in the shells of sea urchins but executed with experimental joints, adhesives, and robotised manufacturing. The Urbach Tower, built in Urbach in 2019, is made of self-shaped curved timber panels, realised by exploiting and programming the natural capacity of timber to change its shape when its internal moisture content decreases. This avoids energy-intensive transformation techniques, producing high-performing, sustainable building elements. Students involved in these projects are exposed to the possibility of continuing in a research career in the field of

computational design. During their studies, they are confronted with the inherent structural qualities of wood and experiment with new technologies to exploit them. In this way, they can understand that the complexity of timber, rather than something to be normalised, is an opportunity to use it more effectively and, therefore, sustainably. While other materials are used, Orozco and Krtschil (2021) explain that 'the reason we choose to use timber for both these rather different research trajectories is because it is an easy material to machine and to work with'.

In Switzerland, meanwhile, at IBOIS at EPFL Lausanne, a similar concern for material efficiency is manifested in practical research into construction methods that seek to minimise or avoid complete biomass waste and the use of adhesives in joinery. Like the research institutes in Stuttgart, stakeholders in IBOIS place great importance on a close connection to industry. In the words of Yves Weinand, director of the institute: 'we still believe that construction methods and logistics are part of the architectural design and that we need to change the architectural design [process] … by reinventing or inventing new construction methods' (Weinand 2021). This approach to architectural research is concerned explicitly with a greater understanding of the logistics of production, manufacturing, and fabrication, thanks to a close collaboration with industry. Like many initiatives in architectural education which engage students with real clients and real projects, the Institute also operates as an architecture practice, accepting commissions where technologies can be researched in collaboration with industry. The Institute pursues an integration of the logistics of wood, its fabrication and construction methods, and the design process.

The research activity of IBOIS goes in parallel with the teaching at the Weinand Design Studio. Here students learn to experiment with parametric design and to test the ease of fabrication of their concepts with the help of 5 axis CNC machines. The underlying idea is that architecture, structure, form and material should be looked at in a holistic manner to achieve sustainable innovation. Through this approach, students are educated to think that a project is not only the result of a creative effort but rather the creative synthesis of a complex series of environmental and human factors: the available resources, the available technical capabilities, the constraints of fabrication should be put together to produce innovative and sustainable spaces.

Assembling wood

The greatest opportunity for students of architecture to come face to face with wood as a building material is in a design–build project. Familiar to many North American faculty and students, two case studies elsewhere are significant because of their deliberate but very different approaches to engaging students with wood in the assembly of buildings.

The Insitu Project is a research-by-design platform established by the architect and academic Peter Hasdell and Kuo Jze Yi. Drawing on disciplinary contributions from design and the social sciences, the project has led to the design and construction of several buildings by students in different rural provinces of China since 2015 (Figure 2). The project is constituted as a non-profit registered association based at the School of Design at Hong Kong Polytechnic University and Shenzhen University. It has collaborated with other academic institutions, non-governmental organisations, and community groups. The focus of the InSitu Project is more towards participatory design research than the two case studies discussed above. Sustainability is interpreted in its broadest possible context here, considering not

Figure 2
Miaoxia Community Guesthouse (Background), 2018, and Community Kitchen (Foreground), 2016. Part of the Miaoxia Community Projects, Designed and Built by InSitu Project. *Photo*: InSitu Project.

only materials and the environment but also the social and economic sustainability of the buildings completed. Lessons about the material economy are learned through communication with local stakeholders, understanding the culture and skills in a particular place, and handling not only hardwood but also bamboo and other organic materials. Hasdell (2021) explains: 'this is part of the sustainable cycle in my view because it is how the human or cultural skills actually develop at the same time as the harvesting of this renewable resource'.

Consequently, there is an opportunity for a mutual learning exchange. Students and local stakeholders alike can learn from one another. Working with stakeholders who are not familiar with drawings, 1:10 and 1:50 models are a signature methodology of discussing and developing designs collaboratively. Students are exposed to and encouraged to learn from crafts and skills that are not taught in the academy. A careful understanding of all these local conditions, materials and skills is valued to identify and promote sustainable practices. Drawing on local material knowledge is reported as being important: 'these things have been disrupted over the past sixty or seventy years of Communist rule and rural policy changes … we are not claiming to put [them] back in place but just to understand some of these aspects and understand where the material cycle fits in … the local environment' (ibid).

The Design + Build Studio of the Department of Architecture and Built Environment at the University of Nottingham, England is offered as a second-year undergraduate elective, although on at least one occasion the studio has extended vertically to engage students in both undergraduate and graduate programs. Over a period of about a decade, the studio has realised several crèches in rural South Africa, involving students in the complete process of design and on-site realisation (Figure 3). Within the course, students participate in the development of the design in the fall semester, are trained in building techniques, and then travel to sites located in northern South Africa to build the crèche during the Easter vacation.

While the first iterations of the project involved a variety of materials and structural systems, over the past 5 years, the studio has moved more deliberately

Figure 3
Lesedi Creche, Limpopo Province, South Africa. Designed and Built by the University of Nottingham Design + Build Studio, 2018. *Photo*: James Benedict Brown.

towards working exclusively in wood. Peter Russell, Assistant Professor and current director of the Studio argues that the choice of timber for these projects has several different advantages over previous experiments with steel, masonry and earth. There is a shorter learning curve, greater ease of moving and lifting building components, good tolerance of errors, and widespread local availability of standardised dimensions and lengths. The material choice of standardised building components is part of this and reflects an expanded understanding of life-cycle sustainability. Russel (2021) explains: 'if sustainability requires that we address inequality, then we must embrace building systems that are approachable, that can be taught and learned rapidly'. While students are only on-site for a total of 4 weeks, the intention is to deliver a building that is constructed with easily comprehensible and adaptable building systems. Students are encouraged to recognise their part in an ongoing process that goes on beyond the duration of their time on site. The material convenience of timber is therefore an element of a strategy for effectively realising high-quality semi-public buildings which can then be extended or adapted by clients in the future.

Having overseen a shift in material choice during his tenure, Russell explains the studio's preference for wood:

> *We use timber for lots of different reasons … it's very democratic. We can skill up basic timber skills to build a stud wall or a structural wall out of timber, especially if you've got an engineer or a lecturer or a builder guiding you. You know we can teach young people who've never done anything how to put nails together correctly very quickly. We can teach them how to do sheeting very quickly, and they can lift and move this stuff very quickly. It's very efficient in terms of its material properties for working with young people … The learning curve is shorter than with a lot of other materials.* (Russel 2021)

The University of Nottingham's Design + Build Studio is not defined exclusively by its hands-on construction: the project spans the two traditions of the North American design–build and the British live project, and the social engagement is highly prized by both faculty and students alike. Russell observes that 'students seem to be able to spot meaningful work a mile away. They know when they are being given a piece of project work that their tutor has invented and is going to assess based on whatever he or she likes, and they can see that our project isn't that: that there's impact … this is going to make the lives of a lot of people measurably better' (ibid). While it is beyond the scope of this paper to explore the socio-cultural consequences of transnational design-build projects, it is significant that this opportunity to work hands-on in a less-privileged environment gives students a sense of *meaning* that is missing in normative architectural education.

Discussion

The six case studies described in this article all offer hands-on engagement with wood for students of architecture that goes over and above the normative experience of their education. No single example addresses all the aspects explored and no one model is easily replicable. Taken together, however, they offer valuable insights into how teachers, researchers and architects have gone out of their way to respond to an apparent deficiency in normative architectural education.

In the University of Nottingham's Design + Build Studio, we see most clearly the expression of an idea that, over and above other materials, versatility and ease of use make wood the ideal material through which novice students can confront the complexity and materiality of the building process. Irrespective of whether a student is handling irregular forest thinnings at the Design + Make program at Hooke Park or the internationally standardised dimensions of industrially produced wood products in Nottingham's Design + Build Studio, there emerges a sense that hands-on experience with wood can repair a disconnection in our understanding of the material. For a project with an additional dimension of social engagement such as Nottingham's, wood is used not only because of its versatility and practicality but because it can help students become aware of their responsibilities towards the end user. They learn to provide inexpensive, yet decent and high-quality accommodation that can easily be adapted with little training or equipment.

The two research institutes ICD and ITKE at the University of Stuttgart are significant for their research-driven approach to working with timber. While not directly equivalent to the North American tradition of design–build or the British tradition of the live project, the involvement of students in the hands-on construction of pavilions and buildings that emerge from research projects is important. Students benefit from an opportunity to engage with wood and cutting-edge technologies with a particular concern for the optimisation of material used. Their work addresses the disconnection in a coherent understanding of wood as a sustainable material by more deeply exploring its structural and material characteristics. Orozco & Krtschil (2021) explain how the environmental properties of wood as a building material are important, but only the basis for a wider architectural agenda: 'we have quite an interest in timber as a material because of its environmental qualities of carbon capture … [but] if we are looking at a larger research goal, a larger altruistic goal, it is the idea of looking at increased urbanisation'.

In the work the Studio in the Woods and the InSitu Project, we see attempts to re-establish the connection between students and two different conceptions of the environment. In the former, it is a concern with understanding the inspiration that wood offers when it is comprehended alongside expert collaborators in its natural environment; in the latter, it is a concern with engagement with communities and individuals that hold traditional skills.

What emerges from the six case studies and the three aspects of working with wood is that the pursuit of sustainability is linked to the deep understanding of ecology, be it environmental, material or social, and of the ways through which this ecology can integrate human activity while being preserved. This suggests that the role of holistic architectural research that investigates the connections between design and materials through concrete experimentation is crucial to elaborate effective approaches to sustainability. Involving future architects in these experiments can therefore be a way to diffuse sustainability in architectural practice.

Conclusion

The ecological breakdown of mankind's environment is, without a doubt, the most urgent issue of our times. The lack of awareness or an unwillingness to accept the ecological impacts of our actions on the environment threatens us and future generations. We argue that this problem is evident in architecture, where the material dimension of a building tends to be abstracted from the ecologies that produce it. We typically specify materials based on quantitative representations of their performance and price. While having immense potential to mitigate the negative environmental impact of construction and building operations, wood is itself subject to this conceptual disconnection in architecture education between the design and construction of buildings.

Through ongoing research into the use of wood in architectural education, we have witnessed various attempts to address the abstraction of timber from its ecological context. So-called 'design-build' projects that use wood are just one way in which educators address this disconnection. On the margins of mainstream architectural education are compelling examples of how students can be given expanded opportunities to conceive and understand the origins, life cycle and diverse ways of working with wood. Design–build can, if framed correctly, give students a direct sense of the complex implications of these material dimensions. Architectural education and research, whether it is in collaboration with industry or resisting market requests, can be the place where this disconnection between materiality and ecology is recomposed through the exploration and deeper understanding of materials and the transmission of this knowledge to future architects.

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James Benedict Brown is Associate Professor of Architecture at the Umeå School of Architecture, Umeå University Sweden. He coordinates and teaches undergraduate history courses and has a particular interest in critical pedagogy, decolonizing the curriculum and the role of design-build and live projects in architectural education. James studied

Architecture at the University of Sheffield (BA Honours 2004 and Master of Architecture 2008) and Queen's University Belfast (2012). He has held academic positions at De Montfort University, Norwich University of the Arts, the Royal College of Art and the University of Nottingham. *Postal address*: Umeå Universitet, SE-901 87 Umeå, Sweden. Email: james.brown@umu.se

Francesco Camilli is an architect and Postdoctoral Research Fellow at Norges teknisk-naturvitenskapelige universitet (NTNU) in Trondheim, Norway. Between 2020 and 2022, he was a Research Fellow at the Umeå School of Architecture, Umeå University, Sweden, where he conducted research funded by the Kempe Foundations on the role of timber in architectural education, with a particular focus on its ecological impacts. Francesco graduated in 2016 at the Faculty of Architecture of Sapienza University in Rome, Italy, where he also obtained his PhD in 2020 at the Department of Architecture and Design, with a thesis on contemporary participatory practices in architectural design. Francesco's early career research studied the role of effect and atmospheres in architectural design and space. *Postal address*: NTNU, Postboks 8900, Torgarden, NO-7491 Trondheim, Norway. Email: francesco.camilli@ntnu.no

Endnote

1. Young trees were removed to improve the growth of those that remain.

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