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Thinking Low-Tech: Promoting Local Practices in Design Studio
(*Thinking Low-Tech*: Mempromosikan Amalan Tempatan dalam Studio Reka Bentuk)

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ABSTRACT

This article interrogates low-tech material and construction as the basis of pedagogical strategies in the architectural design studio, enabling the development of innovative spatial interventions which foster dialogues between humans and their environment. The high-tech, contemporary architectural design movement generates limitless possibilities of architecture driven by technological advancement. Nevertheless, it is argued that the notion of low-tech enables the rediscovery of architecture that is rooted in its context, driven by the human-centred integration between natural resources and local material practices. Focusing on low-tech also provides the opportunity to develop meaningful innovation within the scope of the rural environment, a context often omitted within the urban-laden academic discourse. This article outlines lessons learned from the exploration of low-tech in a third-year architectural design studio at Universitas Indonesia. The studio begins by creating the collective compilation of vernacular knowledge in the techniques of gathering, treating, and crafting the material in their respective context. The design process follows by exploring the low-tech assembly of these materials in context, defining the needed passive manoeuvres to generate the appropriate spatial qualities. In conclusion, the compilation of material expands knowledge on materiality within a tropical context, where the material is found and transformed through connection with nature, appropriation of time, and intersection with communities' lifecycles. The low-tech assembly exploration expands ways of conscious reading towards the environment, both globally and from a more localised perspective. Such conscious reading enables students to programmatically develop the position and configuration of their project as a whole, thus enriching the pedagogical strategies of passive architectural design.

Keywords: Low-tech; local practice; architectural studio; material; nature

ABSTRAK

Artikel ini menyoal siasat bahan dan pembinaan berteknologi rendah sebagai asas strategi pedagogi dalam studio reka bentuk seni bina, membolehkan pembangunan campur tangan spatial inovatif yang memupuk dialog antara manusia dan persekitaran mereka. Pergerakan reka bentuk seni bina berteknologi tinggi dan kontemporari menjana kemungkinan seni bina tanpa had yang didorong oleh kemajuan teknologi. Namun begitu, dihujahkan bahawa tanggapan berteknologi rendah membolehkan penemuan semula seni bina yang berakar umbi dalam konteksnya, didorong oleh integrasi berpusatkan manusia antara sumber asli dan amalan bahan tempatan. Tumpuan kepada teknologi rendah juga memberi peluang untuk membangunkan inovasi yang bermakna dalam skop persekitaran luar bandar, konteks yang sering ditinggalkan dalam wacana akademik yang sarat dengan bandar. Artikel ini menggariskan pengajaran yang dipelajari daripada penerokaan teknologi rendah dalam studio reka bentuk seni bina tahun ketiga di Universitas Indonesia. Studio bermula dengan mencipta kompilasi kolektif pengetahuan vernakular dalam teknik mengumpul, merawat, dan membuat bahan dalam konteks masing-masing. Proses reka bentuk diikuti dengan meneroka pemasangan berteknologi rendah bahan-bahan ini dalam konteks, mentakrifkan manuver pasif yang diperlukan untuk menjana kualiti spatial yang sesuai. Kesimpulannya, penyusunan bahan meluaskan pengetahuan tentang kebendaan dalam konteks tropika, di mana bahan ditemui dan diubah melalui hubungan dengan alam semula jadi, pengagihan masa, dan persimpangan dengan kitaran

hayat komuniti. Penerokaan pemasangan berteknologi rendah memperluaskan cara membaca secara sedar terhadap alam sekitar, secara global dan dari perspektif yang lebih setempat. Pembacaan sedar sedemikian membolehkan pelajar membangunkan kedudukan dan konfigurasi projek mereka secara keseluruhan dengan pemprograman, sekaligus memperkayakan strategi pedagogi reka bentuk seni bina pasif.

Kata kunci: Berteknologi rendah; amalan tempatan; studio seni bina; bahan; alam semula jadi

INTRODUCTION

This paper investigates the understanding of low-tech material and construction, and how it can be used as the basis of design learning in an architectural design studio. Contemporary discussion of architectural pedagogy has developed a wide focus on the high-tech presence of architecture, with fabricated material and complex assembly (Kolarevic 2014; Salihbegovic & Salihbegovic 2020). Such focus on high-tech presence stems from the boundless technological advancement that leads to the growth of architectural practice that seems to be able to do everything, generating complex architecture with "undulating, contorted, writhing masses of glass and steel and concrete" (Fowles 2021: 37). Yet with climate change and biodiversity emergency, further re-thinking is required, to address whether design challenges can be met the other way, with a low or no-tech approach (Fowles 2021; Kolarevic 2014). Low-tech discussions offer possibilities to "re-balance the relationship between buildings and technology" (Fowles 2021: 37).

Current architectural pedagogy that focuses on the utilisation of low-tech is limited, despite the growing discourse that explores design learning based on a focus on the materiality of architecture (Pelman & Zoran 2022). Such focus leads to the importance of hands-on engagement with materials and the fabrication process, where the cultural process of material is valued, and the connection between learning and making is emphasised (Pelman & Zoran 2022; Thomas 2007). It also enables an understanding of the material and all of its properties actively, which becomes important to formulate architectural space (Riskiyanto et al. 2021; Schröpfer 2012). Creativity is an important soft skill for architecture students (Yusoff et al. 2022), yet it is argued such skill is seldom driven by the understanding of materiality. A further discussion on the pedagogical strategies driven by low-tech understanding is therefore necessary.

This paper started with a literature exploration of low-tech in architectural design discourse, and a discussion of low-tech in architectural pedagogy. The study then follows by examining the processes and output of the design process of a third-year architectural design studio in the Department of Architecture, Faculty of Engineering Universitas Indonesia. This studio focused on technological aspects of architecture, creating small public facilities in rural environments using low-tech approaches. The students were required to utilise a significant form of natural materials, from bamboo, earth, wood, hays, stone, and so on, and apply them for the construction of their architectural projects. They were also allowed to explore other types of low-tech material in the form of recycled material that can be easily acquired in rural environments and demonstrate a particular spatial or structural importance.

Based on such requirements, this article outlines the important aspects of low-tech architecture and its creative application in the construction of an architectural project. The study then concludes by discussing lessons learned from the overall design process, highlighting possibilities for further improvement.

LEARNING LOW-TECH: MATERIAL, TECHNOLOGY, AND CONTEXT

This paper explores the notion of low-tech material and construction and its emergence in the architectural design process. Low-tech architecture highlights the need to demonstrate a lean architecture created from fewer components, with the use of natural, renewable materials, with less requirement of embodied energy (Fowles 2021; Salihbegovic & Salihbegovic 2020). Along with the current environmental and economic concerns, the process of low-tech construction refers to the resurgence of "handmade building", which is the built environment that utilises "methods of construction that are more responsive to local conditions" (Golden 2017: 1).

In addition, a low-tech approach to design provides twofold objectives, not only as responsive and responsible construction but also to support social and cultural engagement with society. The idea of low-tech promotes contextual values, supporting and stimulating local craftsmanship (Fowles 2021). The use of vernacular values is also particularly apparent, demonstrating the importance of site-specific techniques to obtain harmony with the environment and synchrony with the local natural system (Salihbegovic & Salihbegovic 2020). The contextual emphasis of such an approach thus potentially generates "social engagement, sustainable development, and cultural continuity" (Golden 2017: 1).

While the significance of low-tech architecture is abundant, there is a need for further inquiry into how low-tech approaches can be expanded and scaled (Fowles 2021). In addition, there are also challenges in navigating

its creative process, which is created by the perception of opposition between traditional and contemporary development (Golden 2017). Contemporary development often aims for the material to be manufactured for its sole purpose, optimising buildability, yet creating a neutral, often no-frills account towards the whole space (Stratford 2007). On the other hand, consideration of tradition often leads to a perception of a conservative and backward outlook of the overall design process, which tends to strive for immutability (Golden 2017). There is an attempt at reconciliation towards this discrepancy, for example, through integration between natural and modern material (Osmi et al. 2021). This paper argues that exploring pedagogical practices driven by low-tech design provide possibilities to respond further towards these challenges.

Despite the significantly growing architectural discourse of material-driven pedagogical approaches, the potential of learning design based on material is often overlooked (Pelman & Zoran 2022). In the design process, design can be done independently of material, nevertheless material can also be the driver of design, be it as the basis of the spatial formulation, or as the objective of the design where the project exist to develop and build the material (Hegger et al. 2020; Schröpfer 2012). In this sense, the low-tech design process is significantly rooted by the material, be it as the driver or as the outcome of design– instead of being independent from it.

The focus of material in current architectural learning then led to a massive digital fabrication endeavour, yet such endeavour may lead to significant detachment from the matter itself, disregarding the real conditions it may experience in everyday life (Poole 2007). Low-tech making, on the other hand, enables a unique learning process in accordance with such detachment. Exploration of design based on material started by understanding the material quality, be it how material is perceived, how material is prepared and assembled according to its properties (Hegger et al. 2020). Through making and engaging with material that is more natural or site-specific, there is a possibility that another form of knowledge is acquired, namely the action knowledge, which is a set of knowledge which stems from the dialogues of materiality that occurred during the making operation, integrating between the matter at hand and the creative process itself (Riskiyanto et al. 2021). Action knowledge illustrates the values placed within the human interaction itself with the material. It demonstrates the distinct qualities of low-tech architecture such as imprecision, not as a limiting quality, but as the evidence of an intimate handling of the material which values the material, the process, and the potential contingency that arise between them (Shotton 2007). Such contingency may emerge in the form of unexpectedness in the making process, or in the form of the diverse qualities of the material that requires various manoeuvres (Riskiyanto et al. 2021; Shotton 2007).

The material exploration in the design process often demonstrates a simple interplay between two things: the material qualities which is what the material will convey to the spatial experience; as well as the material requirements, which is what the material need to do to support the livelihood of the user of the space (Hegger et al. 2020). However, the overall tectonic qualities arising from the direct handling of its material in low-tech architecture potentially demonstrate a more organic presence produced by the dynamic action among the human body, materials, and construction (Riskiyanto et al. 2021). This organic presence of low-tech creates an interconnection between the spatial and material processes. The way the material is collected and prepared, for example, often demonstrates a complex environmental and social process happening in society (Golden 2017). Examples are the process of acquiring materials based on seasons and site conditions (Atmodiwirjo et al. 2018), or the use of social connections between women to collectively gather and craft the material for further use (Golden 2017). This existence of resources and actors becomes an important basis of action knowledge, which later shapes the organic interplay between the material qualities and the material requirements in low-tech architecture.

The spatial and material process of low-tech architecture is also significantly situated in its environmental context demonstrating a larger scope of natural systems. Some use of material, such as straw or brick, requires a sun-drying process at a particular temperature and time (Harahap et al. 2020; Salihbegovic & Salihbegovic 2020). In its assembly, these contextual situations are also important to form and connect materials to bring the immediate relationship between the space and its surrounding environment (Golden 2017). Instead of a monolithic presence of the materials, a more layered outlook towards its material assembly (Hegger et al. 2020) may be more imminent in low-tech architecture. While the idea of material layering is common in contemporary architecture to achieve its optimum material requirements (Hegger et al. 2020), in low-tech architecture, there is a potential demonstration of the body's interaction with the wider natural systems (Suryantini et al. 2022). Such in-depth interaction indicates an integrated dialogue between humans and their environment that may not exist in a more high-tech presence of architecture.

The following section aims to explore the design learning process driven by the notion of low-tech architecture. It aims to convey important strategies in constructing students' action knowledge in understanding the process of understanding and assembling the material in an architectural studio, towards an architecture rooted in its context.

METHODOLOGY

The third-year design studio on which this study is based was conducted in 2021 and the class consisted of a combination of 151 students. The low-tech project was one of the two projects explored throughout the semester, focusing on understanding joints and material. The low-tech project spanned five weeks from material investigation to design finalisation. Whilst the focus on technology itself was part of the studio's primary agenda for the third-year student in the Department of Architecture Universitas Indonesia, the low-tech theme was first introduced during that year.

In the studio, students were required to collectively acquire a sufficient knowledge of vernacular architecture in their respective tropical contexts. The emphasis on rural environments provides programmatic importance for the overall design process, creating a community focus of the design from which the material knowledge can be derived. However, as the studio was still conducted online due to COVID restrictions, the exploration of vernacular material knowledge in various traditional communities in Indonesia was done entirely through online research.

The study guides in treating, crafting, composing, and joining the material. Based on such knowledge, students are tasked to investigate the creative assembly possibilities of these materials, from their construction as skin, and supporting structure, to the space of small public facilities in rural contexts. The selection of small public facilities as the scale of the project was intended as an opportunity for the student to first develop their awareness of the intimate detail of construction, before continuing to the second project with a larger scale and longer time for the remainder of the semester.

The study investigates the process of knowledge acquisition through students' exploration of vernacular knowledge and their overall making process of low-tech architecture. The study explores pedagogical strategies that take place to enable such inquiry of knowledge, as well as to support the organic development of the material assembly in accordance with its surrounding context.

FINDINGS AND RESULTS: LOW-TECH LEARNING IN THE ARCHITECTURAL DESIGN STUDIO

COMPILATION OF MATERIAL KNOWLEDGE: DIALOGUES WITH COMMUNITY

The design process started with a creative compilation of the material, specification, source, treatment, and assembly techniques collectively by the students (See Figure 1). Each material within this compilation needs to be based on a particular traditional community in Indonesia, creating a form of dialogue between the students and the community that he or she investigates. The information regarding such material was sourced from existing books, journal articles, magazine articles and videos that explain the specific material treatment that is being used distinctively in a particular context. Students are required to each select ten different materials and they are then tasked to identify the dimension, collection strategies by the community, and the initial treatment of the material in context. This strategy enables students to understand that the specification of materials and how they are sourced and prepared can create different qualities of the material. For example, bamboo materials from different contexts can be collected and treated differently by each community, thus creating different qualities of the material, often for different requirements.

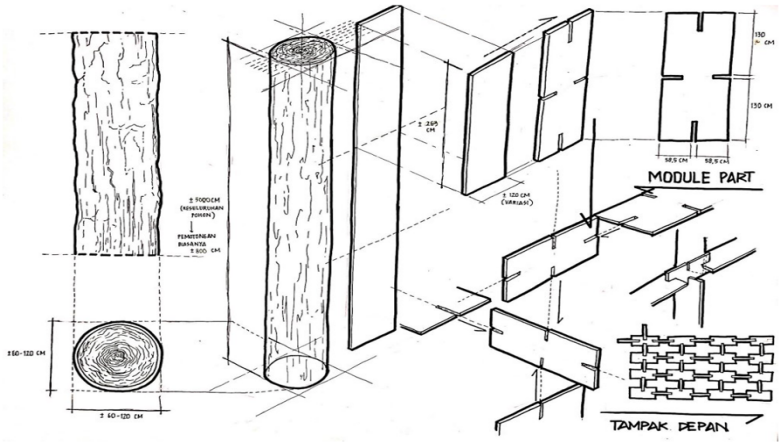

FIGURE 1. Creative redrawing example of specification and preparation of the material from raw condition to become a building component

Exploration of natural and recycled materials brings forth challenges on the unclear dimension of the material, as often the calculation of the material is done through unstandardised tools of measurements, such as the use of hands or other body parts. Students may redraw and retrace the materials and the sequence of body movements in calculating the width and the depth of the material, enabling an understanding of how the body initially interacts with the material. Furthermore, the process of redrawing and retracing also applies in mapping the process of preparing the material into a form that can be easily assembled for the construction process.

An example is the palm leaves that can be used for roof purposes. The students draw the process of cutting and weaving the leaves and tie the multiple leaves in a long stick to create roof components. Through drawing these preparation processes, the students can be informed about the continued flow of transformation between the material's raw state into something that can be applied constructively. This redrawing process also possesses a significant documentation value as there is a lack of comprehensive visual information regarding the different ways communities shape their living spaces in detail.

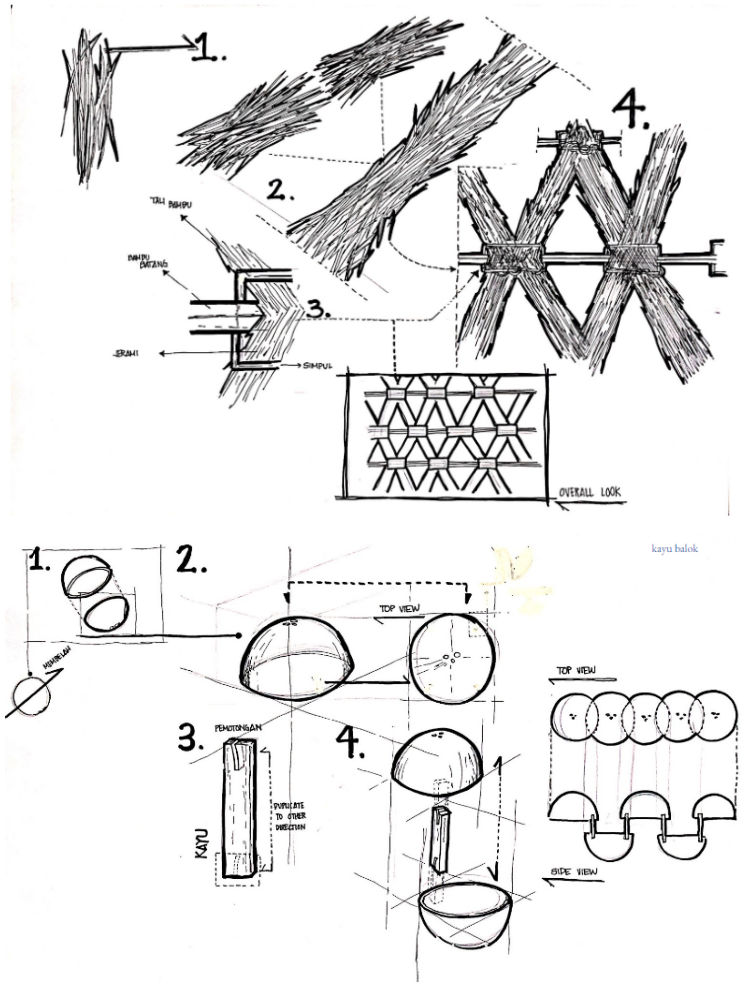

FIGURE 2. Creative redrawing example of the assembly of hays and coconut shell

The students do not only identify the specification of the materials but also their assembly techniques, be it between similar or different materials. This process of identifying the assembly techniques enables further learning processes regarding the connection of each material for different qualities or requirements in space. It also demonstrates the further treatment of the materials to enable the joining of components in a particular position and roles. The low-tech assembly techniques also enforce less use of resources, and therefore there are various approaches to how joints can be made with limited to no need for connective components. Understanding of such approaches demonstrates various assembling actions, from stacking, intersecting, combining, inserting and a lot of other more which is rarely discussed in contemporary architectural design. Instead of simply applying the

structure and the material separately, these assembling actions promote a more active and integrated view of the overall construction.

ENVIRONMENTAL POSITIONING: DIALOGUES WITH THE NATURAL SYSTEM

After the creation of material compilation, the students are further tasked to choose their rural context and create a reading of the environment. This reading requires the student to determine the macro and micro situations of their project through dialogues with the natural system. The macro reading of the context is done by positioning the context within its global position and addressing the trajectory and angle of the sun throughout the day. In addition, the macro reading also addresses the flow of wind in the area in accordance to the relative position of the context with the nearest sea. This understanding of the global position then follows with the micro reading of the site, which then creates a contextual limit of the area. For example, based on Figure 3, the sun's trajectory creates the need for a certain position in site, orientation, or proportion and dimension to be met to generate optimum access to light and air specific to their particular context.

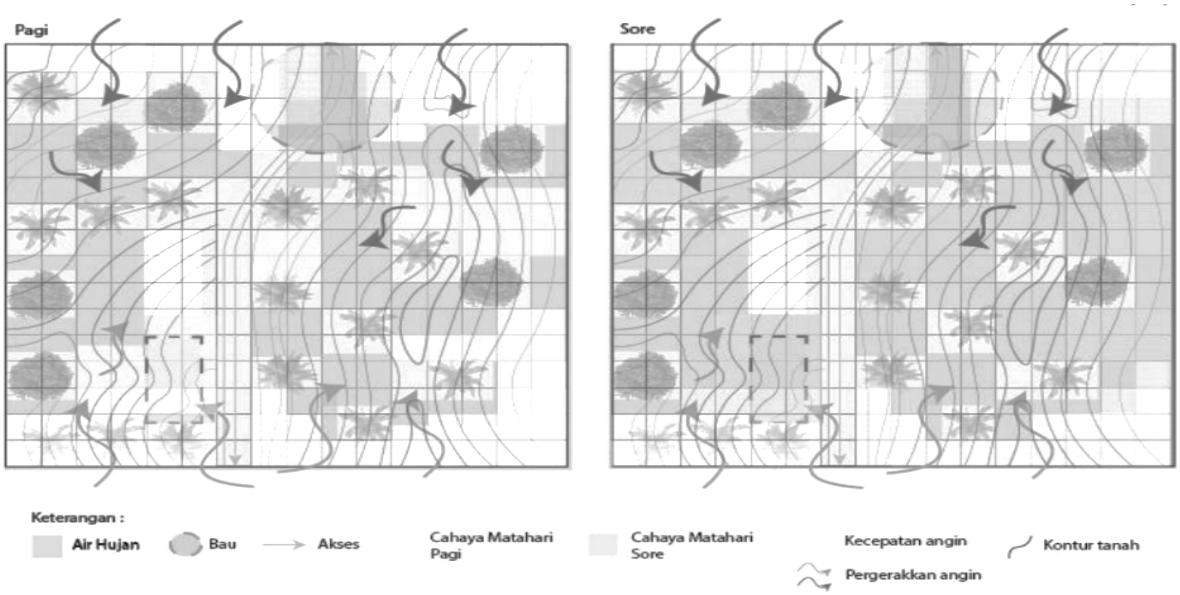

FIGURE 3. Example of micro mapping the context as a dialogue with the natural system

The dialogue with the natural system is part of the need to apply important principles of low-tech, which is the need for less embodied energy. Without comprehensive use of machinery, the project requires passive design strategies to create comfortable living qualities for the users. The macro and micro reading of the context requires the student to have an integrated view towards the context instead of simply a partial outlook. This reading method arguably expands previous tropical design strategies, which are often limited to the suggestion for a fixed component of architecture, such as a sloping roof to fend off rainwater splash and create shades, or a high ceiling to promote airflow. Instead, understanding the overall fundamental principles of environmental reading potentially opens a wider possibility for the creative assembly of the material by the students, as will be discussed in the following section.

ASSEMBLY CONFIGURATION OF MATERIAL: MAKING CREATIVE RELATIONS

The learning process continued by proposing a form of technological ideas based on the students' compilation of material knowledge. These technological ideas were demonstrated using a collection of keywords that will be performed in their model-making. The proposition of the technological idea enables creative interpretation of material qualities and material requirements for the project, based on the previous dialogues with vernacular knowledge of the community and the natural system. Students are invited to creatively reconfigure assembly techniques from the community, in response to the natural system reading in their context.

The assembly techniques were used to produce a small public facility in their selected rural context. The programmatic uses of the facility were aimed to be as simple as possible, not only due to the limitation of time

in their five-week project but also as their focus of learning was intended for the application of technology, particularly materiality and low-tech construction. The public facility has various aims in relation to the community's context, which may span from the cultural centre, arts centre, food harvesting and storage, and so on. The programming itself should also provide possibilities for technological creativity, discussed as the layered response in the following paragraph.

The contextual limit created by the micro reading of the site should not be seen as a restraining presence towards the design proposition, but instead, as a way to guide potential innovation. This process of reconfiguration demonstrates the process of making creative relations that follows low-tech design principles but also expands its vocabulary. This vocabulary also demonstrates the process of building the connection between the site and the existing knowledge of assembly techniques. The students may choose their response towards a particular site-specific aspect of nature that they would like to creatively celebrate and shape the performance of their architecture. The selection of responses by the students demonstrates decision-making abilities and also creates the focus of intervention. Identification and connection between spatial elements can be conducted more organically and openly. Instead of fixating on a specific configuration of the technological components, students may create a layered response of the material qualities and material requirements in response to the programming of the project.

Examples of this layered response can be seen in the way the floor area is interchangeably elevated and lowered to allow cooling and drying of the fish in this fish processing project (Figure 4). Another example is the creation of permeable walls and elevated platforms to divide and protect a particular habitat of plants. A varied configuration of shading structures that are integrated or instead standalone becomes necessary to enable appropriate lighting access to different kinds of plants (Figure 5).

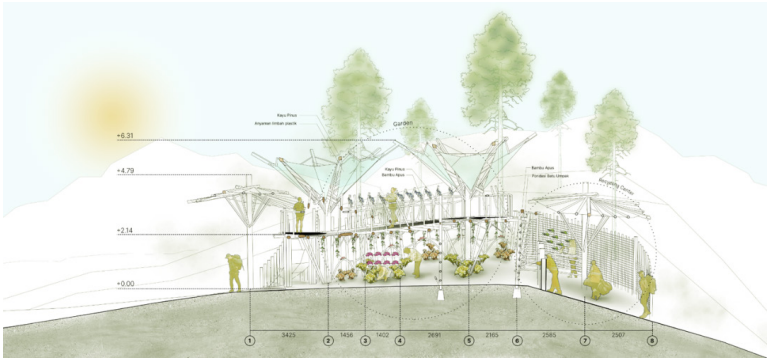

FIGURE 4. Example of low-tech design work with composed permeable walls and varied shading structure

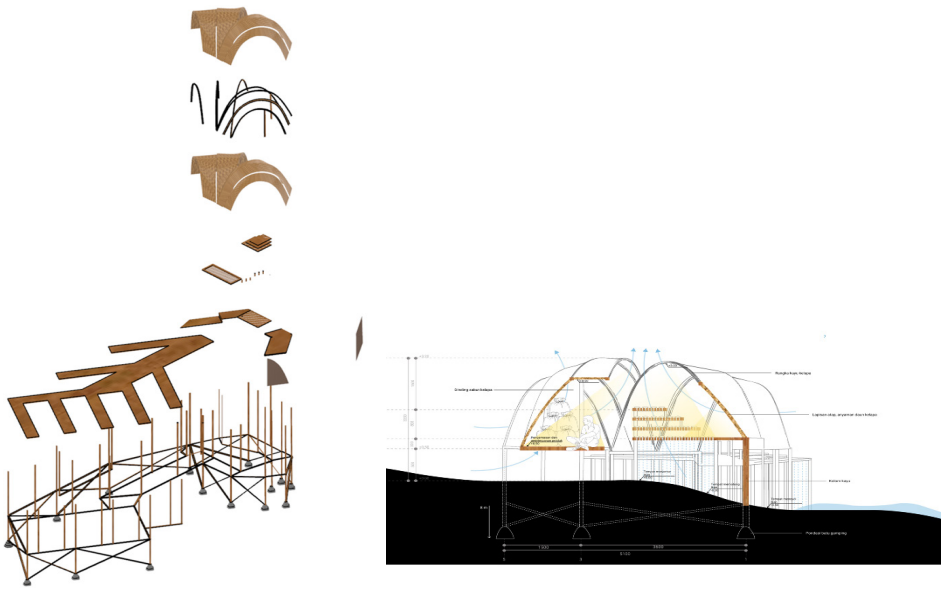

FIGURE 5. Example of low-tech design work with elevated and lowered floor composition

CONCLUSION

This paper aims to outline the pedagogical strategies in an architectural design studio based on the notion of low-tech architecture. Low-tech design learning becomes important as a way to rediscover architecture that emphasises the connection between humans and the surrounding environment. This form of learning is now more urgent than ever with the worsening climate change and biodiversity emergency that calls for the use of fewer resources and less embodied energy, with values towards local craftsmanship and other socio-cultural processes of material. The process of material-driven design learning is often limited to the direct application of the material qualities and material requirements of the project independent of its context. Low-tech discussion enables dialogues of material operation that inform the creative development of architecture, thus connecting actors, materials, and the surrounding environment.

Within the design process, this study outlines pedagogical strategies in the way students generate dialogues with the vernacular community knowledge and the natural system, as well as the process of making creative relations by reinterpreting and connecting between the two dialogues. The visualization of the material as a form of community dialogue serves as the learning vehicle for the students regarding the sequential flow of the material from its position in context to its application as building components, and the connection between different materials that ensure optimum use of the material. The reading of the natural system through macro and micro reading of context ensures an integrated outlook of the context and expands tropical design strategies to reach the passive performance of the project. Creative interpretation and reconfiguration of assembly techniques based on both specific contextual limits and programmatic ideas expand the vocabulary of low-tech design assembly with layered quality.

As a form of a material-driven learning process, low-tech pedagogical strategies demonstrate the focus on the capacities of students to optimise the given power of the environment and local resources. The study outlines that such capacities need to be learnt by the students before moving on to the overpowering excessive use of technology in the production of space. It is also an urgent and important design approach that is particularly relevant to the tropical rural environment, thus requiring further exploration of such methodologies for wider architectural practice.

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REFERENCES

Atmodiwirjo, P., Johanes, M., Saginatari, D. P., & Yatmo, Y. A. 2018. Ecological aspects of the traditional brick making process in Pedurungan Kidul, Central Java: 3rd International Tropical Renewable Energy Conference 'Sustainable Development of Tropical Renewable Energy', i-TREC 2018. E3S Web of Conferences, 67(04034). https://doi.org/10.1051/e3sconf/20186704034

Fowles, E. 2021. Make low-tech our mantra. *Riba Journal*, August, 36–40.

Golden, E. M. 2017. *Building from Tradition: Local Materials and Methods in Contemporary Architecture*. 1st edition. Routledge.

Harahap, M. M. Y., Suryantini, R., Paramita, K. D., & Yatmo, Y. A. 2020. Sun-drying in traditional brickmaking: Strategies for achieving efficiency. I*nternational Journal of Technology* 11(7): 1414. https://doi.org/10.14716/ijtech.v11i7.4458

Hegger, M., Drexler, H., & Zeumer, M. 2020. Basics Materials. 2nd edition. Birkhäuser.

Kolarevic, B. 2014. Adaptive architecture: Low-tech, high-tech, or both? In *Alive*, edited by M. Kretzer & L. Hovestadt. Birkhäuser.

Osmi, S. K. C., Ngadenin, A., Nor, N. M., Husen, H., Yahya, M. A., & Daud, N. M. 2021. Bonding strength of bamboo reinforcement in concrete – A Systematic Literature Review (SLR). *Jurnal Kejuruteraan, Special Issue* 4(1): 1–11. https://doi.org/10.17576/jkukm-2021-si4(1)-01

Pelman, B., & Zoran, A. R. 2022. Material-driven architectural pedagogy: A sociomaterial perspective. *FormAkademisk* 15(1). https://doi.org/10.7577/formakademiskmisk.4787

Poole, S. 2007. Pumping up: Digital steroids and the design studio. In *Material Matters: Architecture and Material Practice*, edited by K. L. Thomas. Routledge.

Riskiyanto, R., Yatmo, Y. A., & Atmodiwirjo, P. 2021. Reading (hidden) dialogue of organic tectonics. *The Plan Journal* 6(2).

Salihbegovic, A., & Salihbegovic, A. 2020. Natural Materials in Contemporary Low-Tech Architecture. IOP Conference Series. *Materials Science and Engineering* 960(4): 42012-. https://doi.org/10.1088/1757-899X/960/4/042012

Schröpfer, T., ed. 2012. *Material Design: Informing Architecture by Materiality.* (1st edition). Birkhäuser.

Shotton, E. 2007. Material imprecision. In *Material matters: Architecture and Material Practice*, edited by K. L. Thomas. Routledge.

Suryantini, R., Saginatari, D. P., & Yatmo, Y. A. 2022. Deep interior: Sensorial encounters of orang suku laut with the sea. *Interiority* 5(2). https://doi.org/10.7454/in.v5i2.232

Thomas, K. L., ed. 2007. *Material Matters: Architecture and Material Practice*. Routledge.

Yusoff, W. F. M., Ja'afar, N. H., & Mohammad, N. 2022. Preliminary investigation on architecture students' perceptions of developing hard and soft skills via project-based learning. *Jurnal Kejuruteraan* 34(4): 629–637. https://doi.org/10.17576/jkukm-2022-34(4)-11.