Theme: Society – Community and Economic Development

Agritecture: engaging with the environmental and ecological economy of bamboo in Vietnam

Dr Helen Norrie, Mr Jed Long and Ms Emma Hall
School of Technology, Environments and Design, University of Tasmania, Australia
Email: Helen.Norrie@utas.edu.au; jed@caveurban.com; ejhall@utas.edu.au

Abstract

Developing an understanding of the relationship between bamboo as a building material and as part of an ecological and economic supply chain is central to the 'agritecture' project being developed through collaboration between the University of Tasmania (UTAS) and Sydney-based architects and bamboo specialists Cave Urban. The cross-disciplinary field of agritecture explores the intersection between agriculture and architecture, investigating the relationship between buildings and places through collaborative design research projects. This project explores the cultivation of bamboo to assist with biodiversity, water filtration and soil remediation, and the parallel use of unprocessed bamboo in buildings that utilise low-tech construction techniques. It investigates the potential of temporary buildings to provide new infrastructure in villages where the economic ecology is shifting, focussing on regional and rural communities in Vietnam.

Introduction

Like many developing countries, Vietnam faces a diverse array of opportunities and challenges. The introduction of the Doi Moi policy in 1986 transformed the country from a centrally planned economy to a market-oriented one in a single generation. Rapid urbanisation has transformed the country's rural-based economy to an increasingly globalised economy, and in thirty years Vietnam shifted from one of the poorest countries in the world (1986 average income US $100) to a lower middle-class economy (2016 average income US $200 in rural areas and US $4000 in urban areas), (The World Bank; Fenson, 2016).

Although conditions in cities have been improving, two-thirds of Vietnam's population live in rural areas, where the poverty rate is 22% (Pham et al. 2017, p. 3). The disparity between the economic profile of urban and rural areas presents challenges, particularly as many rural settlements are remote and dislocated from other population centres. Some rural areas are being transformed by shifting agricultural practices, which are creating both positive and negative effects. On the one hand, there has been a concerted effort to reinstate primary forests decimated during the Vietnam War (or American War as it is known locally). In 2008, Vietnam became one of the first collaborators in the United Nation's PEDD+ program (Reducing Emissions from Deforestation and Forest Degradation in developing countries), restoring tree coverage to almost pre-war levels by 2011. Currently, more than 40% of land nationwide is categorised as either special use, protection or production forest. However, in some of the larger scale plantations the quality of growth is poor and native forests are being converted into cash crops, particularly rubber and cassava, which have a high export demand, particularly to China (Tatarski and Johnson, 2016). The increase in monocultural forestry and farming practices is leading to a lack of biodiversity, soil degradation and watershed issues, creating environmental stresses that will be exacerbated as climate change intensifies (Shaw 2006, p.5). The ramifications of large-scale, rapid change and economic value of development need to be understood in relation to the environmental cost of this growth.

An exploration of agritecture, the interrelationship between agriculture and architecture, offers ways of imagining alternative futures, particularly for regional and rural areas. Agritecture can be understood broadly as 'the art, science and practice of integrating agriculture into the built

environment' (Vertical Farming Academy). The term was first used in 1786, when Francois Cointeraux established the School of Agritecture in Grenoble, France, and a second school in 1788 in Paris. The School taught students how to work the land for food and shelter, using rammed earth to create buildings, however this practice waned as industrial capitalism replaced agrarian values. Contemporary agritecture has a broad focus from building-integrated agriculture, exploring rooftop and vertical farming and indoor planting, to environmental conservation and decontamination (Carlson, 2014).

This project explores the potential of bamboo agritecture in rural communities in Vietnam, examining the planting bamboo for environmental remediation and the use of unprocessed bamboo for buildings, particularly in communities in which the environmental and economic ecology is shifting. The project began as an exploration of the use of bamboo in both traditional and contemporary architecture in Vietnam, as part of an Australian Government New Colombo Plan (NCP) project, hosted by the University of Tasmania and architects and bamboo specialists, Cave Urban. The initial architectural focus of the project was expanded through an introduction to Dr Diep Thi My Hanh and the Phu An Bamboo Conservation Village. Phu An provides a model for understanding the diverse potential of bamboo from a food source to a building material and the wider applications for soil remediation and water filtration. Dr Diep's work as a taxonomist has involved the identification more than 130 species of bamboo in Vietnam, and the development of knowledge of the particular uses for different bamboo species. Phu An is both a bamboo arboretum, with a diverse collection of bamboo species for display and research, and an educational centre that builds knowledge for local communities (UNDP Equator Initiative, 2012).

Phu An provides a model for the potential of localised cultivation and use of bamboo, that contrasts with strategies of mass cultivation that have become a core economy strategy in some regions. It is driven by potential of bamboo to provide environmental remediation of damaged sites, and the concern that large-scale mono-culture planting of bamboo contributes to problems of bio-diversity and soil degradation. Research shows that bamboo grows well in localised areas, including gaps in forests, and matching bamboo species with the appropriate location may provide alternatives to mass cultivation. The introduction to this core knowledge of bamboo agriculture has led to the expansion of the initial bamboo architecture project to a broader field of bamboo agritecture, exploring the cultivation of bamboo as part of a tripartite system: as an agent of bio-diversity and environmental improvement; as a low maintenance and secure income-producing alternative to the high labour demands of conventional cash crops (such as cassava), producing bamboo shoots for food; and the use of raw material in contemporary buildings.

The Agritecture Vietnam Bamboo project draws on the agricultural knowledge developed by Phu An, and other projects including the 1000 Bamboo Villages in Indonesia and a project in Allahabad, India developed by the International Network for Bamboo and Rattan (INBAR) and Indian NGO Utthan. The Allahabad project, which commenced in 1996, focused on restoring soil quality, resulting in a decrease in the pH level of the soil and an increase in the carbon content, phosphorous levels and micronutrients in the soil. The water table has also risen and there has been an increase in the number and diversity of crops being produced in the region annually. Bamboo planting has also decreased the wind levels and the temperature, which has in turn increased birds and wildlife. Bamboo is used as a constant supply of fuel, powering refrigerators which store food and vaccines. This has assisted in a decrease in infectious diseases, leading to a reduction in child and maternal mortality rates. Training programmes have resulted in an increase in skills, allowing the construction of schools, which is in turn leading to an increase in educational attainment. (Benton 2014, 16-17)

The Agritecture Vietnam Bamboo project adds to the agricultural emphasis of other projects, focussing on developing prototypes for low-tech, hybrid construction systems that can be self-built by communities, and which draw on vernacular traditions. Developing projects with communities provides a real-world context in which to explore design research, providing ideas for temporary buildings that can assist with the changing economic ecology of regions.

Bamboo architecture in Vietnam

Traditionally in Vietnam, bamboo has had a diverse range of uses as an unprocessed building material. Bamboo poles were one of a number of materials in hybrid construction systems that included hardwood and thatch (made from water coconut palms or reeds). Increasingly, concrete and masonry were added to the material palette, with bamboo continuing to play a structural and decorative role, particularly as roof framing, flooring and wall cladding. Split bamboo was sometimes used as a substrate over which mud and/or animal dung was applied, in a wattle and daub-like wall construction (similar to Columbian *bahareque*). Bamboo was also used for furniture, cooking utensils, and baskets, either in its raw state or through minimal processing. More recently, the processing of bamboo has included using split bamboo as layers in plywood or 'mat board' or as a laminated product for structural members, flooring and wall panelling.

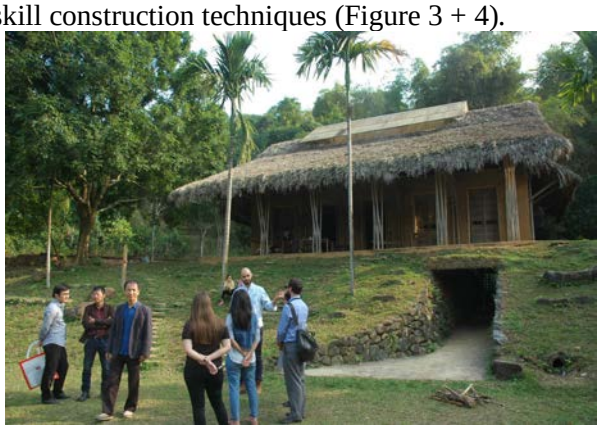
In the rapidly transforming contemporary society of Vietnam, bamboo has been regarded as a 'poor man's material.' Vernacular traditions have been replaced by new building methods, processes and materials. As a consequence, buildings and urban spaces are becoming increasingly more 'international' rather than identifiably local in character. However, within this ever-changing context, the importance of connections to cultural heritage are being increasingly recognised. Bamboo has emerged as a significant symbol of Vietnamese culture and often forms part of a narrative of nostalgia for traditional ways of life. This is presenting a shift in the role of bamboo in contemporary architecture, which spans the gamut from high-tech to low-skill in interesting ways that extend understandings of cultural identity. Bamboo is becoming a part of the new vernacular of contemporary architecture, following two contrasting trends.

The most well-known contemporary bamboo architecture from Vietnam is the iconic buildings by Vo Trong Nghia Architects (VTN). In contrast to the traditional practices, in which bamboo was always used in a flat plane, the architecture of VTN explores new forms through the use of bundled bamboo to create curved elements. In both the Sen Village Community House and the Diamond Island Community Centre (now demolished), VTN created expressive and iconic buildings that exploited the malleable characteristics of bamboo. These forms evoke a nostalgia for vernacular buildings, but employ high-tech construction techniques. In some instances bamboo is combined with steel, although this can be difficult to detect by the casual observer. Despite their name, these buildings are not constructed for community use, but serve as icons developers as part of a marketing narrative for both housing developments and resort architecture. Similarly, the highly expressive forms of the Naman Resort, the Wind and Water Café, and the Bamboo Wing and Roc Von restaurants have become key icons in the global 'iconomy,' the image based economy of marketing and architourism, that increasingly dominates the developed and developing world (Smith 2005, p.2-5). (Figure 1 + 2)

Figures 1 + 2

In contrast, Hoang Thuc Hao and the team at 1+1>2 Architects explore the use of hybrid bamboo and masonry structures, drawing on and extending vernacular traditions in a series of community buildings that engage directly with local cultures. The architecture of these buildings embraces modernist planning logics, focussing on the design of the sequential experience of spaces by the user, while also maintaining a sense of spatial character that evokes memories of traditionally places. The

Suoi Re Community House draws directly on vernacular techniques, with a stone base, mud brick walls, bamboo structure, processed bamboo floor, and a thatched roof, while the Cam Thanh Community House in Hoi An utilises a hybrid compressed brick and bamboo structure. Both use low skill construction techniques (Figure 3 + 4).



Figures 3 +4

Agritecture | engaging with communities

The Agritecture Vietnam Bamboo project has been developed through two NCP-funded travelling studios, with students and staff from the University of Tasmania working with colleagues and peers in architecture and agricultural science universities in Ho Chi Minh City, Hanoi and Huế. Studios include workshops with bamboo researchers and traditional bamboo masters to develop the team's understanding the environmental benefits of bamboo cultivation and to develop prototypes for bamboo for structures for cultural and agricultural community buildings.

In the first trip in June 2017, a team of 13 undergraduate architecture and agricultural science students and 4 staff from the University of Tasmania and Cave Urban worked with more than 40 Vietnamese students, academics, architects and bamboo masters to develop bamboo knowledge and skills. The project culminated with the construction of a full scale prototype for a temporary cattle shelter in a local farming community in Tay Giang, Binh Dinh, working with Tasmanian Institute of Agriculture (TIA) and Hue University of Agriculture and Forestry (HUAF). In January 2018 the project continued, with a similar size and scope of team, developing scaled prototypes for a Community House, on the campus of the National University of Civil Engineering (NUCE), in Hanoi. In June/July 2018 a third team will return to continue research, through the construction of prototypes for a cattle shelters and community buildings in other rural locations (Figure 5 + 6).

Figures 5+6

Central to these studios is the engagement with local communities, drawing on both traditional skills and contemporary research into bamboo. Phu An Bamboo Conservation Village provides an ideal introduction to learn about many aspects of bamboo,particularly the different features of species, how

bamboo grows, and the use of bamboo for soil remediation and water filtration. Design workshops provide hands-on experience for the team to learn how to build with bamboo, with short model-making exercises encouraging experimentation with the expressive qualities of bamboo. This provides a familiarisation with the use of bamboo in construction and develops teamwork skills, working with local Vietnamese students and community.

Visiting contemporary bamboo buildings provides an understanding of different construction systems and techniques, as explained about. Another key element of the bamboo orientation involves learning bamboo construction techniques, particularly different ways of connecting round poles and constructing building elements, like coconut palm roof panels. Working with bamboo masters, the team develops building skills, understanding jointing techniques, making bamboo pins and practicing rope tying techniques. This includes demonstrations and hands-on practice in the construction of prototypes of building components, using both traditional techniques and experimenting with developing new structural systems (Figure 7, 8, 9, 10).

Figures 7+8

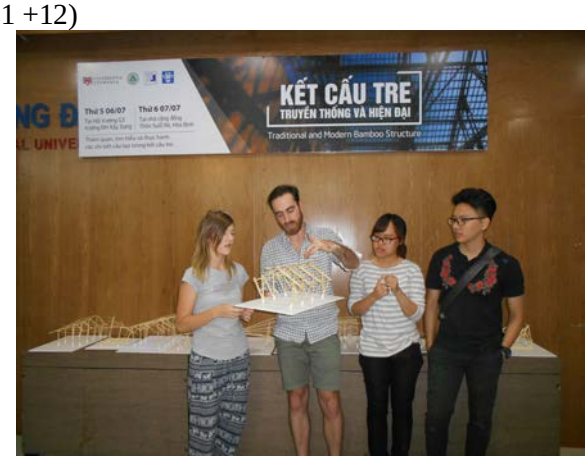
Figures 9+10

Another essential element of the project involves working regional communities to develop projects directly, engaging with diverse contexts and exploring design research into bamboo buildings that draw on vernacular traditions and also develop new construction techniques and forms to suit contemporary conditions. Two key projects have been carried out: the prototype for small scale buildings for agriculture uses; and a prototype for a larger-scale building for community uses.

Project 01 - Cattle Shelters. Tay Giang, Binh Dinh

Drawing on connections with the Tasmanian Institute of Agriculture (TIA), a project was developed with the Huế University of Agriculture and Forestry (HUAF) to design and build a prototype for bamboo cattle shelters. TIA and HUAF are working with communities to develop sustainable cattle farming practices that allow greater productivity, through a project funding by the Australian Centre for International Agricultural Research (ACIAR). Currently the 'cattle keeper' leads the cow each day to find food, but this process involves the cows expending the equivalent energy walking as it acquires through eating. New farming practices involve a more stationary life for cattle, and cattle shelters are needed to provide protection from both the sun and the rain.

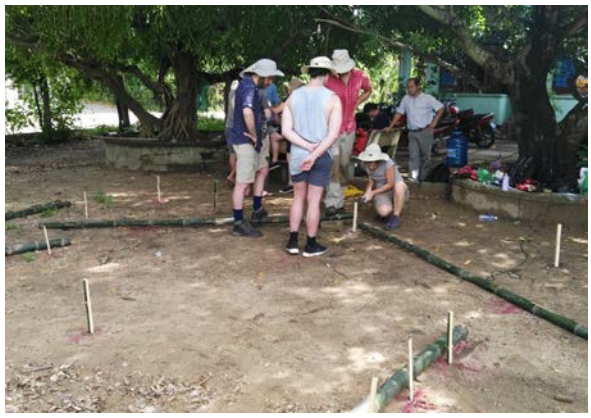
Working with the students at the National University of Civil Engineering (NUCE) and the Hanoi University of Architecture (HAU) the UTAS team developed ideas for small scale buildings that could be used for cattle shelters, and potentially also a range of other community activities. Designs were developed with construction in mind, as a prototype was to be built in Tay Giang, Binh Dinh as a culmination of the study tour. Twelve teams developed schemes, and then assessed each to determine a selected scheme. This was further developed, refining the structural system through an analysis and exploration of buildability. (Figures 11 +12)



Figures 11+12

Arriving in Tay Giang, the team met with the local cattle club, and researchers from HUAF, led by Professor Nguyen Xuan Ba, and Dr Rowan Smith from TIA. They visited existing cattle shelters to understand the practical requirements for feeding and cattle separation. The team worked with local farmers to harvest bamboo, and then embarked on a focused three-day building workshop to construct a full-scale prototype.

A building site was set up at the front of the Tay Giang Commune office, where the Cattle Club meets. This allowed the locals to observe the process, and to assist with construction techniques. The portal structure allowed the frames to be set out to a template and constructed on the ground, and then raised into place. The frames formed their own scaffold, creating an ease of construction. It also allowed a streamlined process, with one team setting out the structure while another manufactured bamboo pins, which would be used as fixings. By the end of the first day, the two frames were erected and the cattle shelter had begun to take shape (Figure 13 + 14).

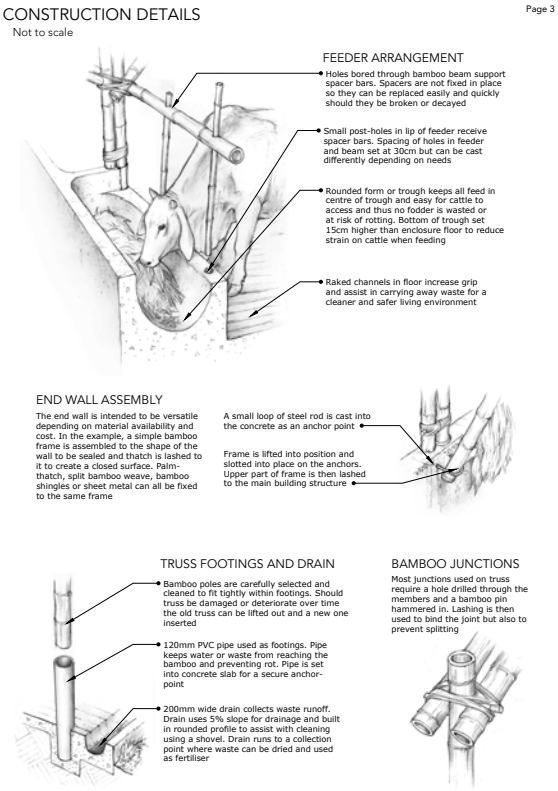



Figures 13+14

As this was an experiment in building processes and was not intended as a permanent building, fresh bamboo was used to build the prototype. Although the freshly harvested bamboo would produce longer term issues with shrinkage as the bamboo dried out, it allowed the building to be constructed on a very tight budget. The bamboo was harvested by the team from a nearby farm, demonstrating the field-to-building efficiency of the design. A roof of black plastic and bamboo splits provided a very cheap but efficient covering for the structure (Figure 15 + 16).


Figures 15+16

After construction, the design was refined to incorporate the requirements for feeding and cattle separation, and a pamphlet was prepared that outlined instructions for the construction of the cattle shed, using local materials. This is intended to provide directions for the local farmers to construct their own shed. It is envisaged that the concrete slab would be laid, and the bamboo cattle shed built as a temporary structure for 3-5 years. This allows for the farmer to invest in more cattle, and then constructing a more permanent building to be constructed as their economic position is improved through new farming practices. Future development of this design will include ways that this building system can be adapted for a range of other uses, including temporary housing (Figure 17 + 18).



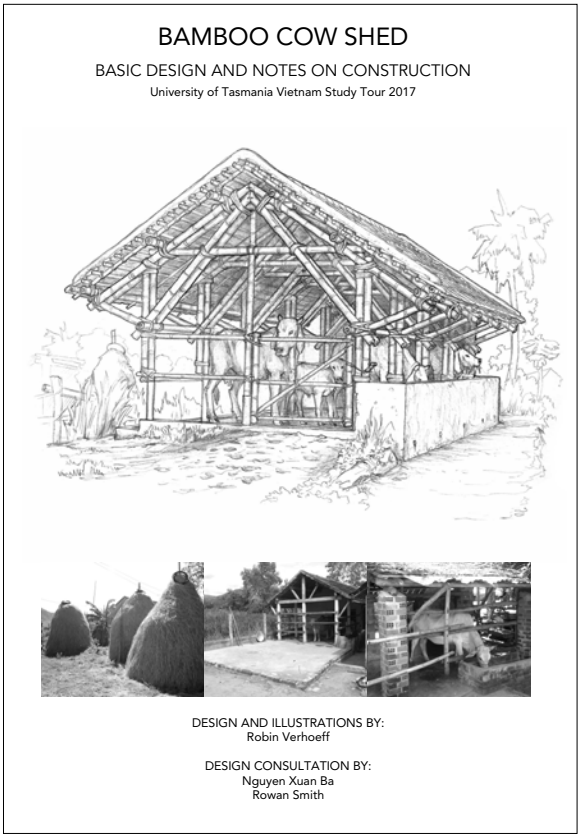
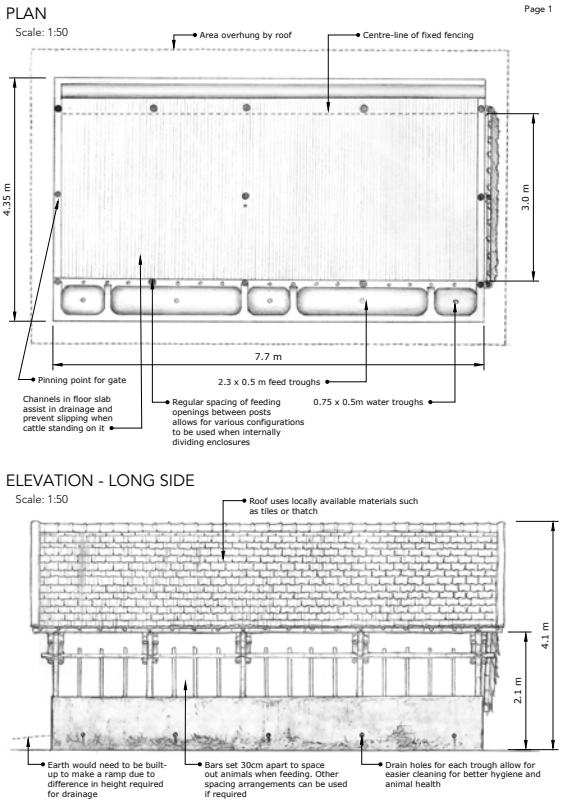


Figure 17



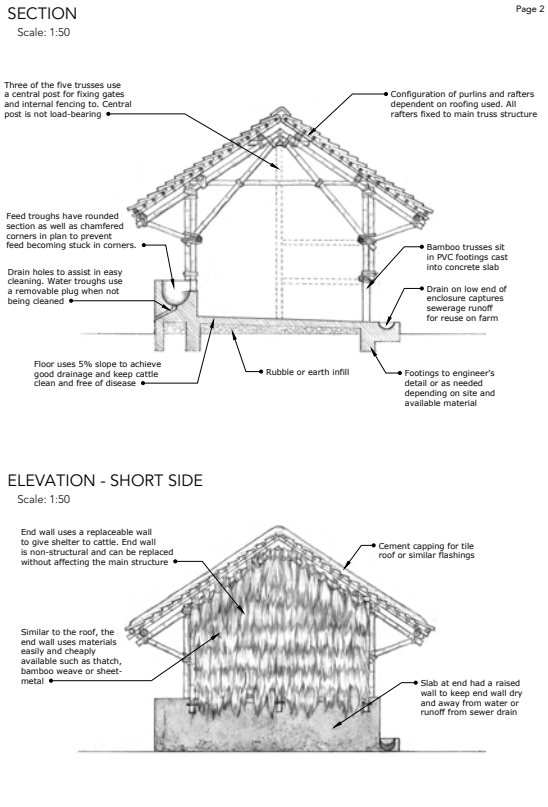


Figure 18

Project 02 - Community Building, Ro Koi, Kon Tum

The community of Ro Koi has been given land to build a new community building, through an arrangement with the Vietnamese government and the catholic church. A partnership between the Ro Koi Community and the Phu An Bamboo Conservation Village is developing ideas for bamboo agritecture, which includes the planting of bamboo in each of the local housese and the design for a multi-purpose building that would provide both a spiritual and gathering place. This draws on the Phu An Village model, developing the cultivation of bamboo as part of an ongoing process of biodiversity and natural resource management, which also provides a new crop of food and raw materials for construction and handicraft products. The community building is envisioned as the centrepiece of this project, providing ways of promoting the use of bamboo in contemporary buildings, and developing skills in bamboo building and product handicrafts.

As part of an initial site visit and introduction to the community, the team brought bamboo that had been cultivated at Phu An and planted it in each of the houses in the village. A visit to the local "rong," a large vernacular building used for meetings, celebrations and rituals, provided inspiration for the UTAS team's designs of the new cultural building. The rong uses a hybrid construction system, with a timber structure and either a thatched or corrugated iron roof. The elongated form provides a strong contrast to the landscape and the neighbouring village. Ideas for the community building were developed through a quick model making exercise using bamboo splits, which allowed for the development of expressive ideas for the building form. Five ideas were presented to the community for inspiration. Although each model was very abstract, it provided a diverse range of ideas for the community to consider, raising the aspiration of the project (Figure 19 + 20).

Figure 19 + 20

The next stage of the project involves developing ideas for the site, and the UTAS team is interested in the possibility of constructing a temporary building, which can be used as a prototype for the development of a future permanent building, and also provide a vehicle to develop bamboo design and construction techniques of both the research team and the community. Following the June visit, ideas for the design of this temporary building were developed by Cave Urban and the UTAS team and tested through the construction of a pavilion christened, the "Hammock Hut," on the site of an annual music festival Woodford in Queensland, Australia Figure 21 + 22).

Figure 21 + 22

In January 2018, the second NCP studio explored the refinement of the Hammock Hut, working with students from NUCE to transform the original design for a structure that could provide a more enclosed shelter and accommodate a range of community uses. The development of prototypes at various scales allowed for the exploration of different issues. Working at 1:10 provided an exploration of form: a 1:5 scale prototype explored the resolution of columns and footings; and a 1:3 scale mock-up of two bays of the structure simulated the construction process (Figure 23, 24, 25, 26).

Figure 23 + 24

Figure 25 + 26

Like the cattle shelter, the idea for a temporary building as a ‘place holder’ is a response to the complexities of localised bamboo treatment. While the untreated bamboo can be easily harvested and utilised for buildings, without treatment to protect from insects the structural integrity of the bamboo is limited to a few years. However, the use of untreated bamboo allows the assembly of hybrid structures to provide immediate solutions to local shelter issues, facilitating capacity-building of local construction knowledge and techniques. The temporary structure can be used to test out formal and spatial ideas, and inspire the fund-raising for a more permanent structure, and localized bamboo treatment facilities. The prototypes for both the cattle shelter and the community building will be explored in future studios, incorporating other materials, including compressed brick. Future projects will also focus on the spatial planning of farms, with bamboo planting for wind-breaks and to assist with erosion and soil remediation. This will involve a broad range of technical expertise from the disciplines of agriculture, landscape design and architecture, working with local bamboo masters and communities.

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