The Global Bamboo Collective
11th WORLD BAMBOO CONGRESS
16th August 2018
THANKS

Carried by human to road side.

Martin + Guillermo

Carried by human to road side.

Carolina Salazar

Carried by human to road side.

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Dr David Trujillo

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Wang Wen Chih

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Troy Roberts

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Huong Thuc Hao

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Dr Diep My Hanh

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Dave Hodgkin

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Arief Rabik

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Dr Helen Norrie

Key Contributors

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Dr Helen Norrie
The Global Bamboo Collective.

Long vernacular history of bamboo construction
Recent emergence as contemporary building material
How does bamboo fit into a wider architectural narrative?
Does understanding bamboo’s role in the built environment also require an exploration of its social, cultural and environmental benefits?
Many different ways bamboo can be utilised
Round pole and engineered bamboo - two very different materials
Cohabitation rather than competition
Challenges

- Ready availability of non-renewable resources
- Rapid urbanisation transforming countries from agrarian to urban
- Increased population = increased consumption
- Building industry one of the major contributors to human induced climate change

“The constant search for uniqueness results in sameness + repetition”
-Juhani Pallasmaa
“the casual eradication of distinctive places and the making of standardized landscapes that results from insensitivity to the significance of place...”

-Edward Relph
Opportunity’s

- Fast growth rate
- Annual harvest
- High capacity for CO₂ mitigation when managed
- Restores degraded landscapes
- Shallow root binding system
- Multiple uses of the culm as building material, food, paper, textiles, fuel, furniture, etc
- Prevalent throughout the equatorial region of the world, majority developing countries
- Sympodial bamboo is non-invasive
- Unique structural properties
- Long history of craft
- Lightweight
- Round section
- Non-uniform shape
- Labour intensive
- Requires unique skill set (Artisan knowledge)
- Treatment critical to longevity
- Non-homogeneous structural properties
- Variation between species
- Variation within species (site + climate)
- Harvest requires specialised knowledge
- Monopodial bamboo is invasive
- Little research available relative to other building products
- Challenging to standardise
- Public perception

Contraint’s
The following presentation looks to establish a broad narrative of the different ways bamboo can be utilised in the built environment.
Case Study’s

Temporary  ←- - - - - - - - - - - → Transitional  ←- - - - - - - - - - - → Permanent

Art
Cave Urban

Shelter
HBC

Development
RAW Impact

Low Skill
1+1>2

High Skill
VTN

Engineered
Moso

Wang Wen Chih

UTAS

Mori

Simon Velez

EBF
Reputation as low value material with short lifespan
Pursuit of material permanence critical to changing perception
Embracing temporal qualities removes constraints of permanence
Tool for education, experimentation and expression
Green bamboo- cycle of growth, life and decay
Process of construction of equal importance as the built outcome
Image: Memmott, P. Gunyah Goondie + Wurley

Impermanence
Cave Urban

Carried by human to roadside.

Australian Context

Architecture

UTAS

Education

Art

RAW Impact

Development

EBF

Agroforestry

Research

HBC

Shelter

Agritecture

Agritecture

Research

UTAS
Bamboo in Public Domain
Three year cycle
"The line I trace with my feet walking to the museum is more important and more beautiful the lines I find hung up on the walls"

-Hundertwasser
“Design is just a moment within a continual state of material flow”

-Hiroshi Ota
Bamboo Forest
Woodfordia Bamboo Forest
Closed Loop
Woven Sky | Wang Wen Chih + Cave Urban

Image: Kai Wasikowski
Woven Sky | Wang Wen Chih + Cave Urban

Image: Kai Wasikowski
Woven Sky | Wang Wen Chih + Cave Urban

Image: Stephen Swayne
Woven Sky | Wang Wen Chih + Cave Urban

Image: Kai Wasikowski
Cyclical Architecture

Image: Ise Shrine
“Tradition is not static, it must be reinvented by every generation”

-T.S Elliot
“There is a secret bond between slowness and memory, between speed and forgetting.”

-Milan Kundera
Dream of Shodoshima

Image: Wang Wen Chih
Vast majority of bamboo construction is informal

Increasing urbanisation replacing vernacular architecture with aspirational materials.

Unsuitability to local climatic conditions

Conflict between humanitarian imperative and long term ecological and social consequences

Climate change disproportionately affecting developing countries
Resilience to Climate Change
“Shelter is a process not a product”

-Dave Hodgkin

Image: Humanitarian Benchmark Consulting
International Federation of the Red Cross

Early Recovery Program

75,000 Intermediate shelters built in 9 months

Built by local communities

Adapted traditional rope and dowel connection to resist earthquakes

$150 each
Shelter is not a testing ground

Fragility of local economy will magnify failure
Lifecycles

1. Plant

The lifecycle of the bamboo plant commences like any other plant, sprouting forth from a seed and sending up its first shoot to form a new culm 1, which sprouts leaves to commence photosynthesis 2-3. These first culms are limited in size by the photosynthetic capacity of the new clump resulting in smaller culms until sufficient culms exist for new culms to reach full height.

As the wet season approaches, new rhizome buds form underground 4. Then, as rains commence, the rhizomes form new shoots that sprout into that season’s culms 5. In their first year bamboo culms depend entirely on the health of the clump to reach their full height.

Inside the plant’s lifecycle, culm lifecycle occurs (next page).

The lifecycle of individual culms means that a new clump reaches full maturity and maximum production capacity at around 7-10 years 6. The plant then continues on until eventually flowering and then dying off 7. The full lifecycle of a clump varies greatly from species to species. Small ornamental species may flower and die annually whilst the larger woody species used in construction may have a lifespan from 60 to 160 years.

2. Culm

The new culm sprouts A during the rainy season. The culm can reach full height and width in just 3-4 months B. During the first season, culms are so busy shooting up that it is not until the next year that they start to send out branches and begin to photosynthesize C.

Over the next 2-3 years, culms dry out and toughen up, reaching their full strength and maturity at around 4-5 years D. By 6-7 years, fungal attack appears, rot and age begin to set in. The culms finally succumb, falling to the ground to rott and provide food and protection for newly forming shoots E.
Different jointing systems offer differing relative merits (see comparison below). The choice of jointing system should be based on the relative importance of these characteristics to the project at hand, as well as taking into consideration local skills, construction knowledge and available materials.

1. **Bolts**
   - Crushing of the bamboo must be avoided. Bolts are only as strong as the bamboo they pass through.

2. **Plywood & bolts**
   - Commonly for trusses or structural load. Bolt locations should still align to nodes.

3. **Fill & bolts**
   - Creates a very rigid joint. Particularly well suited to footing connections and industrial loads.

4. **Nails**
   - Prone to splitting, particularly in running species. Pre-drilling or chiselling will reduce tendency to split. Best suited to temporary structures and clumping species.

5. **Pegs**
   - Commonly may be timber or bamboo. Requires pre-drilling. Strength is dependent on node to joint placement.

6. **Rope or rattan**
   - Often well known at village level. A range of materials can be used; seek local advice for traditional materials.

7. **Wire**
   - Prone to splitting, requires pre-drilling. Best suited to joining bamboo to timber.

8. **Rubber strap**
   - A range of re-used rubber (such as old inner tubes) can be used, but beware that they may break down under UV exposure. Heavily dependent on how it is attached to the bamboo (often poorly nailed). Hard to find consistent supply.

9. **Pegs & rope**
   - See separate notes under pegs and ropes. Labour intensive, strong and low tech.
Dissemination of best practice guidelines to local population that builds upon existing local architecture rather than replacing it with novel solutions.
Bamboo is only relevant if there is a readily available local source.
Shelter.


Resilience - Degraded Landscape
Khmer Rouge

Agrarian dependence upon natural resources

Population

1980 - 6.5 million
2018 - 15 million
36% below poverty line
Flooding | RAW Impact

Resilience

Neighbouring community destroyed
Grow Bamboo
Build Bamboo
Export Manufactured Bamboo Products

Produce bamboo products for Cambodian application
Average annual income

1986 - US$100
2016 - US$1000 | Urban
- US$200 | Rural

Population 96 million
2/3 live in rural setting
Rural poverty rate 22%

Rapid development has positive and negative outcomes

Needs to be understood in relation to environmental and social costs of transformation.
Phu An Conservation Village | Dr My Hanh Diep
Vietnam has long history of bamboo use

Traditionally utilised as part of hybrid system

Traditional techniques being replaced by concrete and brick construction

Rapid change is causing distinct change to urban landscape

Loss of cultural character has led to bamboo being identified as a symbol of Vietnamese culture

Nostalgia for traditional way of life

Iconography in high end application
Rong House | Ro Koi

Hybrid Construction System
Suoi Re Community House

Use bamboo to make Columns, rafters

Use the soil to ram the wall

Use palm leaves for roofing

Use stones in the stream to make stone-wall

Use the soil to make yard

Local Material and Local Workers
Suoi Re Community House

1+1>2
Activation and Programming
Wind and Water Cafe | Vo Trong Nghia Architects
Panyaden School | Chiang Mai Life Construction

Build on 24H
All Bamboo
Engineered

Round pole construction is relevant in countries where bamboo is locally sourced and there is a tradition of vernacular construction.

Urbanisation requires new construction methodologies for bamboo to maintain relevance.

Engineered bamboo products (EBP) provide a pathway into regulated building markets.

EBP often compete with timber products.

Why are they better than timber?
ISO Technical Committee 165, Working Group 12

- ISO 19624 - Grading
- ISO 22157 - Physical + Mechanical Properties
- ISO 22156 - Structural Design
- ISO 23478 - Engineered Bamboo

Building on existing timber codes rather than reinventing the wheel

Full culm construction lacks standardisation in connection and jointing techniques

Engineered bamboo creates a product recognizable by the market
Standardising Bamboo

Standardisation and innovation provides access to new markets

Not in opposition to full culm bamboo

Resilient industry utilises both forms of bamboo construction

Informal and formal of equal importance
Bamboo Forest

Harvest + Treatment

Round Pole Construction

Vernacular
Low Tech
High Tech

Engineered Bamboo

Reconstituted Densified Bamboo
Laminated Bamboo
Bamboo Boards

1. Rhizome
2. Chaume (culm)
3. Noeud (nodes)
4. Internodes
5. Culm sheath
6. Sheath blades
7. Sheath ligule
8. Culm auricles
9. Shoot
10. Branches
11. Leaves
12. Flowers

Bamboo Forest

Barrio Los Andres, Manizales
Suoi Re Community Centre, 1+1=2 Architects
ZERI Pavilion, Simon Velez
Why is bamboo the right material
Wood is Good
Balancing Supply and Demand

Loss of material quality
Context + Social Narrative
Material Transport
1000 Bamboo Villages | Environmental Bamboo Foundation

Process Bamboo

Cultivate Bamboo

Harvest Bamboo

Manufacture Bamboo

Export Manufactured Bamboo Products
Agritecture- A mechanism to understand Bamboo as a building material and as part of an ecological and economic supply chain
How does bamboo maintain relevance?
There is no single solution, rather...

The appropriate architectural response is achieved through responding to the client, site, social and cultural context.
“Tradition is not static, it must be reinvented by every generation”

-T.S. Eliot