Bamboo-based Biocomposite

Application for a sustainable naval architecture

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11th World Bamboo Congress, Xalapa, Mexico
Floating solutions for underprivileged people
Shores and rivers.

Bamboo project

- Large resources in Asia
- Outstanding strength and growth rate
- Pro-poor
- Compatible with modern composite techniques

A way to preserve traditional carpentry and ensure safety at sea.

From Bangladesh to Vietnam.
A composite inside a composite

Vascular bundles carry the fibres.

Highest density at the periphery.

Valentijn de Vos May, 2010, Bamboo for exterior joinery

We want the bamboo structure... but flat.
Boards with poles

Luong
*Dendrocalamus barbatus*

- 5 m middle sections
- ~10 cm base diameter
- 5 to 10 mm thick wall

Splitting
2 halves

& Flattening
Mechanically
Boards with poles

Planing from inside
minimum 2,5 mm
Boards with poles

Shaping, gluing and pressing

Cross-cut of a 4 layers board
Mechanical properties – Conclusions

- **More** layers: higher resistance to **shear**, higher **rigidity**.

- **Thinner** layers: higher **bending strength**.

- **Impact strength**: uniform whatever the configuration.

- **Low pressures** (2 Mpa / 10 Mpa) give better results (epoxy).

- **Heating**: no significant advantage, except for the Modulus of Elasticity.
Evolution of the weight of samples soaked in fresh water

- **No coating**: 46% weight change
- **1 layer epoxy paint**: 25% weight change
- **2 layers epoxy paint**: 10% weight change
Assembly of a traditional Vietnamese boat

- Collaboration with a Vietnamese carpenter
  *Binh Duong province*

- 32 bamboo culms, 27kg epoxy, 2L paint

- 2 weeks of work
• Carpentry tools, saws, blades and nails

• Hull: 9 molded planks (4 layers of 3 mm) nailed together
26 reinforcement bars, (9 layers of 4 mm) individually shaped out of bamboo beams and nailed on the hull.
Hull caulked with jute rope and tree oil.

(dipterocarpus)
Conclusion

• Easy process to implement, anywhere near bamboo and by anyone.

• Material: promising mechanical properties fairly easy to protect from water.

• First successful association with carpentry techniques & successful collaboration with local workers.

• High potential of optimisation.
Future development

- Cross layers (0°/90°/0°/90°/0°...) ➔ reinforcements.
- Extend ageing testing in marine environment.
- Optimisation and industrialisation to reduce cost.
- Evolution of the building techniques: moulded parts, modern carpentry and composite.
  Adapt to this new kind of material
- Find greener solutions (resin and paints).
Acknowledgement

Làng Tre Village
(Phu An, Binh Duong, Vietnam)

Mr Tam our associate carpenter

Bamboo Hardwood (Bamboo Living)

Bach Khoa University
You want to participate? Learn more?

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Meet us and see the boat in La Rochelle, France: 26 Sept. to 1st Oct