

Flat foldable structure in Glued Laminated Bamboo based on origami and kirigami design

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Abstract

Beyond the constant research for innovation, one of the main functions is to design focused in sustainability of their products. With the reduction of wood supply and the current need for sustainable products, bamboo appears as an alternative eco-efficient material. Among the most promising options for bamboo panels for new product design is Glued Laminated Bamboo (GLB), a high-quality material with excellent visual aesthetics and physical/mechanical characteristics similar to medium density wood. As it is not well known by industry and not yet fully explored in Brazil, this work presents a research that seeks a new strategy to give different functionality to these material, increasing its possibilities of use. From the end of last century, scientists have turned their attention to the old traditional techniques of folding and cutting called as origami and *kirigami*, and discovered their interrelations with geometry and mathematics and their potential in development of innovative products in Engineering and Architecture fields, revolutionizing the resolution of real and current problems such as space and material economy, flexibility of use and transportation. Thus, this research seeks to combine the use of Glued Laminated Bamboo with folding and cutting techniques of origami and *kirigami* in development of articulated flat foldable structures, which are able to flatten completely during the opening or closing movement, organizing a design process to validate application strategies and determining its possibilities and its limits. For this, an experimental and practical research was carried out, whose first stage consisted in creation of initial physical paper models of three selected folding and cutting techniques (Masahiro Chatani's "Screen" origamic architecture model, Yoshimura Pattern and Miura-Ori), in order to analyze its geometry. Then, virtual models were generated in the SolidWorks program with thicknesses of 10 mm and 38 mm, to evaluate its influence. Meanwhile, GLB plates were processed and produced in laboratory, to be treated in CNC Router and in Rolland, two milling machines, in order to obtain the physical parts of the structure. Finally, we proceeded with the assembly of the hinged models in order to observe the viability of design process of flat foldable structures in GLB with origami and kirigami principles.

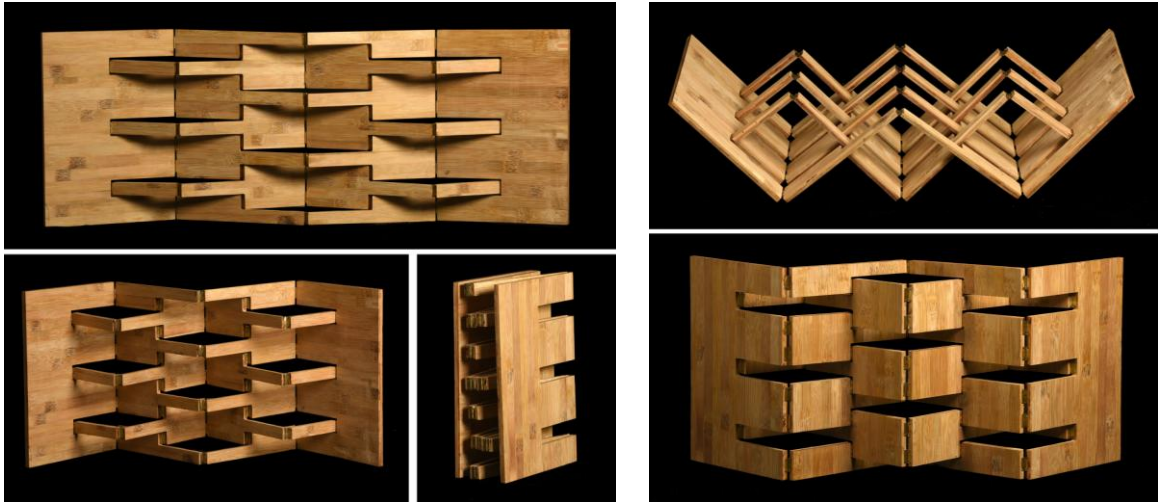


Figure 1: Symmetric Byobu. 2015. Inspired by Masahiro Chatani's "Screen".



Figure 2: Rigid Flat Foldable Arc. 2015. Based on Yoshimura Pattern.



Figure 3: Miura-Ori-Take. 2016. Based on Miura-Ori.