DESIGN OF A STRESS RIBBON GLULAM FOOTBRIDGE ACROSS A STEEP FOREST TORRENT

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Summary
For the Xitou area of National Taiwan University Experimental Forest, a nature conservation area in central Taiwan, our design team was tasked with developing a proposal for a wood footbridge, connecting pedestrian paths on either side of a steep torrent. Selected among various alternatives, our design consists of a stress ribbon glulam deck tensioned over two fan-shaped supports. These are themselves composed of curved glulam members and shaped like the leaves of a ginkgo tree. The pattern is prolonged in the wood lattice work of the guardrail. Combined foundations connect the bridge abutment and pier to each side, helping to balance out lateral forces. To permit the use of Japanese cedar sourced from the local forest, the glulam members are dimensioned to a relatively low allowable bending stress of 80 kgf/cm². Lessening their visual impact, most steel plate connectors are slotted into the glulam members. The bridge was finished in March and will be opened to the public in May. The resulting bridge is relatively high above the torrent, passing over the pedestrian path to one side. In addition to keeping the bridge clear of typhoon floods, this will let hikers experience crossing over and passing under the bridge, offering views from above and along the torrent. The paper will tell the story of how this design evolved, from early concept development to construction. The authors developed this design as part of their undergraduate course of study at the Department of Civil Engineering of National Taiwan University.

Keywords: glulam; stress ribbon; landscape integration; design to construction process
1. Introduction

In March 2017, the stress ribbon glulam footbridge designed by seven students from National Taiwan University was finished in Xitou, Taiwan. With the exposed wooden structure and the overcrossing pathways that we created, tourists can learn more about the beauty and feasibility of wooden structure and have more fun traveling in National Taiwan University Experimental Forest (NTU ExFo). During this project, whole design group worked through every part of the design process on our own, including site investigations, bridge concept design, structural design, detailed design drawings, and site supervision. Our design proposal was adopted by NTU ExFo and received a 6 million NTD sponsorship from the Pou Chen Group.

The design process of the stress ribbon glulam footbridge is very different from typical industry. First, most of the design processes are created by all seven design group members. Other than making all decisions by one or two designers, we proposed and shared our ideas with each other to develop the best solution. Second, the whole design process is a learning journey. Besides all the information we could get from textbooks, we enhanced learning practical specifications and industrial work methods to make our design reach the professional level. Under two instructors’ leaderships, from Belgium and Japan, from academia and industry, we started our distinctive design process with global perspectives. In the following of this article, we are going to tell the story of how the bridge was evolved.

2. Conclusion

Through all experiences we gained from the design process, the specialties of designing while learning as well as making decisions as a group made a great influence on this project and ourselves.

Learning by doing plays a significant role in our design process. We not only started to put what we have learned to good use but also began to face the gap between academics and industry. Although it took us longer to complete the project than the typical industry standard, our design reached a professional level with high quality. Moreover, it feels like we had been endowed with a new sense that allowed us to view things in a distinct perspective.

Different from typical industry, designing the stress ribbon glulam footbridge by discussing details as a design group is how we made our design better and more special. By comparing the strengths and weaknesses of different possibilities, we chose the best among all prospective options or even developed a more complete solution. The special structure system, combined foundations and overcrossing pathways are all generated by our brainstorming and discussions.

With all these specialties, this stress ribbon glulam footbridge will become a landmark of Xitou and the starting point of our unlimited potential journey. (Fig. 1)