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EDUCATION OF FUTURE BUILDERS THROUGH FOOTBRIDGE DESIGN TO CONSTRUCTION PROJECTS

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Summary

Blending structural, site, functional, and aesthetic challenges, footbridge projects can provide great training grounds to educate future builders. At the early design stage, the span requirement and program simplicity (letting pedestrians cross from A to B) encourage joint consideration of engineering, architectural and artistic issues, from structural form to integration with the landscape. While much can be explored via case studies, design drawings, scale models, and structural simulation exercises, we believe it is especially fruitful to let students materialize footbridge designs at 1:1 scale. This can help students gain early practical experience with structural materials, construction processes, project management, and user responses. In this paper, we describe three projects of this kind directed at undergraduate students of architecture and civil engineering. Although all three projects concern small footbridges of free spans between 5 and 20 m, the instructional approach was different and ranged from autonomous student exploration to sustained guidance by practicing designers and builders. The corresponding completed prototypes range from ephemeral bridges unsuitable for public access to a fully functional bridge intended for long term public use. When aiming for safe and serviceable student-authored designs, a balance must be found between expert guidance and student autonomy. Both ingredients seem needed to maximize student learning outcomes and the sense of achievement gained from such projects.

Keywords: design education; design to construction; collaboration between architects and engineers

In the education of architects and civil engineers, it is important to let students materialize their designs. Typically, this takes the form of scale models, used by architecture students to investigate form, space, and integration with a site (Fig. 1a) or by engineering students to carry out load testing at reduced scale. After graduation and some years of professional experience, students may then get the chance to realize their designs at full scale. Over the last few years, we have been trying to offer students earlier opportunities to design-build at 1:1 scale. For architects, prototyping at full scale can provide students with a better feel for spatial experience in relation to the human body. For civil engineers, it can help students get a better feel for material and structural behavior. For both, it can let users experience first-hand the opportunities and constraints associated with fabrication and construction processes. In this paper, we describe three such projects, conducted in Taiwan with architecture and civil engineering undergraduate students from Shih-Chien University and National Taiwan University.

For all three projects, students were challenged to design footbridges for actual construction. The three projects, however, explored different instructional approaches and design to construction processes. For the first project (Fig. 1b), targeting ephemeral bridges not intended for public access, teams of a dozen students designed and built bridges by themselves, with only loose feed-back and no logistic support, over periods of a few weeks. For the second project, students developed footbridge proposals intended for construction by professional contractors, and for long term public use. The constructed design (Fig. 1c) was evolved over two years by a group of seven students, with sustained guidance from a professional structural designer. For the third project (Fig. 1d), student teams designed and built small footbridges intended for temporary public access. They were given a limited choice of steel and wood sections, and worked with assistance from an experienced team of installation artists. By contrasting these projects, we hope to aliment debate on various issues of design education, including the relative importance of expert guidance versus student self-reliance.

Fig. 1. Footbridges designed by undergraduate students of architecture and civil engineering: a) scale model, b) ephemeral wood bridge not suitable for public access, c) glulam bridge intended for long term public use, d) steel-wood bridge intended for temporary public use