LEGO FREE-FORM?
Towards a Modularized Free-Form Construction

YIN-CHENG HSU
NCTU, Taiwan

KEYWORDS: CAD/CAM, free-form construction, modularization

Design Media is the tool designers use for concept realization (Schon and Wiggins, 1992; Liu, 1996). Design thinking of designers is deeply effected by the media they tend to use (Zevi, 1981; Liu, 1996; Lim, 2003). Historically, architecture is influenced by the design media that were available within that era (Liu, 1996; Porter and Neale, 2000; Smith, 2004). From the 2D plans first used in ancient egypt, to the 3D physical models that came about during the Renaissance period, architecture reflects the media used for design. When breakthroughs in CAD/CAM technologies were brought to the world in the twentieth century, new possibilities opened up for architects.

For ages, visionary architects have always pursue after new special concepts and possibilities. With big leaps in information technology, CAD (Computer Aided Design) emerged as well as CAM (Computer Aided Manufacture). With these two technologies along side each other, possibilities for the pursue for free-form have exposed. Various architects like Frank Gehry, Greg Lynn and NOX each push for free-form architecture in their own separate ways.

FIGURE 1, 2. *TRADITION FREE-FORM CONSTRUCTION METHODS.*


T. Tidafi and T. Dorta (eds)
Joining Languages, Cultures and Visions: CAADFutures 2009

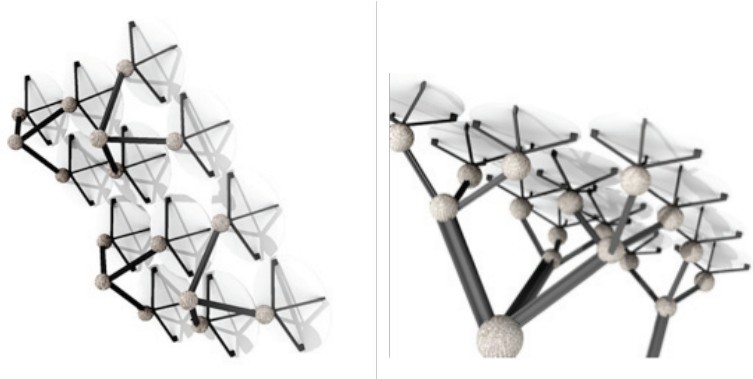
However, free form construction has always lead to various problems. Mounted-expenses, complicated marking, and difficult transportation for components were inevitable and undeniable. The aim of this research is to develop a new framework to solve such difficulties by using modularization methods.

Traditionally, free-form structures are constructed with two main elements: a. the skeleton and b. the skin. Former architects and designers have used similar methods in the making of each of these elements. With the designed or generated free-form, designers slice these forms vertically and horizontally to obtain a structural frame. The frame is then deconstructed in to 2D components that will then be CNC milled or laser-cut and marked with an individual code forming the overall skeleton. The skin components are to be manufactured to fit this skeleton with 3D manufacturing methods and are also each marked with an individual code. To sum up, this is an enormous task.

FIGURE 3. *FREE-FORM CONSTRUCTION USING A FREE-FORM CORE ELEMENT.*

This research tends to view 3D construction with a new concept which the researcher would like to call the "Free-Form Burden". While traditional free-form structure are casted on a pure free-shaped space and at the same time it's exterior, this is a heavy burden for the making of the elements. If "freedom" of the elements were to lay in something else for example a core element (a lot smaller then the whole structure) with plug holes with fixed angles and fixed depth for modularized components, this may lead to great cut-downs in expenses. In addition, if the "Free-Form Burden" were to be transferred to smaller components such as joints (freedom in joining angels) and rods (freedom in length), that may lead to greater surprises. This research tends to reach a conclusion by setting a new framework for construction.

FIGURE 4,5. *FREE-FORM WITH "FREE-FORM BURDEN" ON JOINTS AND RODS.*



REFERENCES

Liu, Y.-T.: 1996, Understanding of Architecture in the Computer Era. Taipei: Hu's.

Lim, C.-K: 2003, An insight into the freedom of using a pen: pen-based system and pen-andpaper.

In Proceedings of the 22nd Conference on Association for Computer Aided Design

in Architecture 2003. Indianapolis, Indiana. pp. 382-391.

Porter, T. and Neale, J.: 2000, Architectural supermodels. Oxford: Architectural Press.

Schon, D. A. and Wiggins, G.: 1992, Kinds of seeing and their function in designing, Design-Studies, Vol. 13, pp. 135-156.

Smith, A. C.: 2004, Architectural model as machine: A new view of models from antiquity to the present day. Oxford: Architectural Press.

Zevi, B.: 1981, The modern language of architecture: Van Nostrand Reinhold.