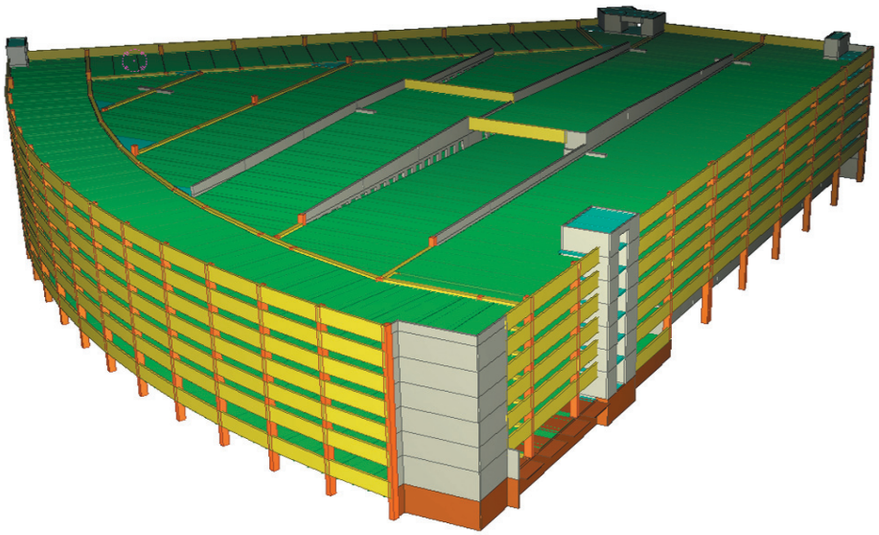
Increasing Precasting Productivity Through 3D Modeling

By: Tekla Corporation, Finland



In Malaysia, precast concrete is predominantly popular among large corporations, whereas small contractors may be unfamiliar with precast concrete's inherent advantages in quality, cost, flexibility and reliability. Nevertheless, the precast concrete industry in Malaysia is growing at a rapid rate despite its slow acceptance.

Charles M. Eastman is a man with a mission. Although he may play down all of his technical academic roles at Georgia Institute of Technology, he does not underestimate the value of technology and he is determined to revolutionise how the precast concrete industry does business.

Professor Eastman is Director of the PhD Program for the College of Architecture at Georgia Tech, one of the most respected polytechnic universities in the United States. He is also a veteran researcher whose field is in next generation computer-aided design, solids and parametric modeling, engineering databases and product modeling. Most recently, Professor Eastman has been active in design cognition and cognitive science research.

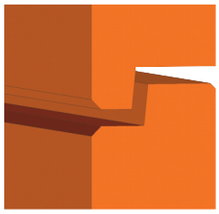
A NEW ERA FOR PRECAST

Two-dimensional drawings have always been the default method of the construction and architectural industry, dating as far back as 2,500 B.C. Several industries have made significant advances towards the adoption of new 3D software technology whereas others have lagged behind.

In April 2001, frontline North American precast concrete detailers and fabricators came together to form the Precast Concrete Software Consortium (PSCS). The original objective was to recreate what the steel industry did with 3D modeling and the integration of all operations through advanced IT. The consortium hired Eastman and his team from Georgia Tech, including Dr Rafael Sacks and Dr Ghang Lee, to evaluate a 3D top-down parametric modeling application to generate the engineering information used throughout the marketplace. Work on refining the software was tasked to Finnish building and construction modelling specialists, Tekla Corporation. Joint work began on a 3D beta development model, which included architectural and structural finishes. A 32-chapter specification list detailing the Tekla platform was published in Spring 2004.

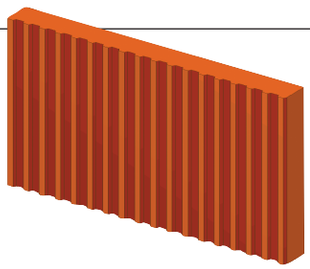
TRUE PRODUCTIVITY BENEFITS

In September 2005, the PSCS approved completion of the work and subsequently disbanded, and although the project officially ended, Tekla used this as an opportunity to redirect development. The Tekla Precast Users Group (TPUG) was established to sustain research on the software's fundamental 3D capabilities. Renowned Israeli researcher Dr Rafael Sacks assessed the actual tangible benefits the application would provide for precast concrete users. Based on current modes of operation, Dr Sacks and the Georgia Tech team found that there was an 80-84% reduction in drafting costs, a 35-51% reduction in engineering costs and the elimination of most design-related errors. Moving from 2D drafting towards 3D modeling could potentially save a company up to 5.5 percent of total project costs. Off the top, users can save up to 2% in errors. In short, 3D modeling has considerably improved accuracy and productivity, in addition to reducing project lead-time.



Lap Joint

Panel to panel



Profile finish

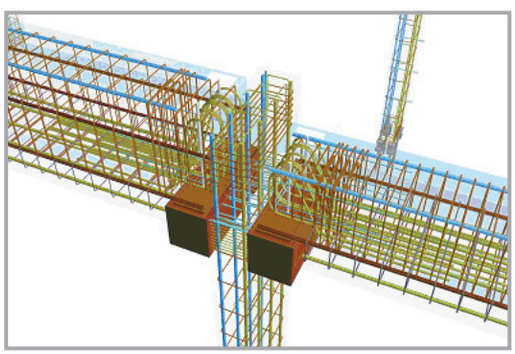
Column

CONCRETE USABILITY

Precast concrete is significantly more complex than other materials. Perhaps this is the reason the industry has not fully progressed beyond the realm of 2D. Eastman sees 3D becoming a worldwide phenomenon. He also projects that the entire construction trade will gradually shift to 3D modeling not just for rendering, but for production purposes as well.

The innovative architecture of today cannot be possible without 3D capabilities. Curved and complex surfaces requires fundamental 3D modeling. Another big dilemma is that a designer often has to consider the element in two shapes; as the manufactured shape, and as the resurrected shape. These concerns further support the need for automation.

Eastman notes that user benefits would, without a doubt, outweigh the disadvantages. "The basic transformation is that every element is machine readable and interpretable. All project information for estimating, manufacturing, erecting and finishing components are stored in a centralised 3D model. Change management is automatic. Spatial conflicts in design coordination get resolved. Using such a 3D model guarantees resolution of most consistency issues."



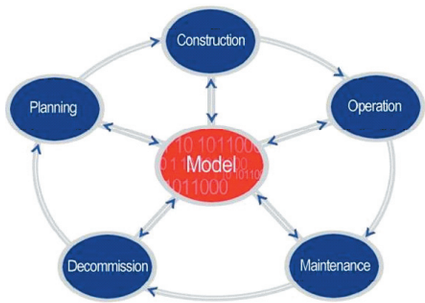
This translates well for facilities management. Eastman sees 3D model software as the future in operating data. The model is systematic, thus providing a platform for enhanced communication between all parties.

MAKING 3D A STANDARD FOR PRECASTERS

Eastman professes that 3D is so much easier to understand and likens 3D to some sort of a magic coding system. "The design process has traditionally been organised around drawings and it is deeply rooted in facets beyond construction. I envision the approach of a paradigm shift. The types of principal abstractions have remained constant, but there will be a change. And this will require a shift of thinking. It is just a matter of time before the industry and its tertiary organisations modify the way of doing business."

"Fortunately, the industry is inching forward. And schools are slowly implementing 3D courses into the curriculum. Players such as Tekla have a strong foundation in the game and are exploring new practices to reach a threshold. Tekla's commitment to the industry and specifically the North American market is being addressed with increased funding, 3D technology promotion via workshops and with hitting the educational route by supplying universities appropriate software to learn from."

Eastman is proactive when it comes to furthering 3D capabilities. His current project is very much influenced by cognitive science and is applicable to the future of Tekla software. "There are plenty of real cognitive perplexities and cognitive loading issues when using complex software like Tekla Structures. Such software requires transparency. A user must be able to sit down and use the system for whatever time needed – be it one hour or six hours at one stretch – and be productive. There are huge advantages to Tekla Structures. All segments of the industry can genuinely benefit from its superior quality control and engineering and drawing cost reduction. Companies can actually lower in-house overhead costs by up to 50%. This is not hypothetical software, this is a real application."



THE FUTURE

Precast concrete is an extremely attractive material to construct with. The material is low in cost, and it is produced worldwide. There is an intrinsic advantage in terms of cost when compared to steel or other materials. It can be finished to provide an amazing range of appearances.

When asked about the long-term prognosis for the precast industry, Eastman chuckles, clarifying that he is not a psychic. "We will see a major transformation in all precast vertical markets. 3D is a way for precast as a whole to compete and become more productive. Building Information Modeling (BIM) will be part of that growth. There is enough cultural and social awareness about BIM that it will eventually become part of our daily work process." ■