Rapid Prototyping for architecture

Rapid Prototyping technology, typically used in product development circles, is slowly building a strong foundation within the architectural profession.

Architectural model making has undergone a revolution in the past few years. The ability to create scale free form models directly from 3D CAD data in a matter of hours is a reality and the technology is currently being used by key architectural practices for the creation of proposed and as-built designs. One of the pioneers of this technology in Australia and throughout the world is Formero.

The prototyping technologies

Formero employs three key Rapid Prototyping (RP) technologies for the production of its architectural models. These are Selective Laser Sintering (SLS), Stereolithography (SLA) and Objet 3D printing. The actual model production process is different between the technologies, but the key concept that unites them is that models are built up layer by layer.

The model building process

For a formal quote (and of course in order to build the physical model) 3D CAD data is required. This can be sent to Formero in a number of formats but the industry standard Rapid Prototyping format is STL. However, it should be noted that not all 3D CAD systems produce good STL output.

To help with the process of data production, Formero consults closely with clients to teach them the best way to export data from a wide range of 3D CAD applications. These sessions also include tips on the most effective way to build 3D CAD models specifically for Rapid Prototype model production.
“We teach our clients the importance of creating separate models for building design and rapid prototyping,” explains James Sanders, Rapid Prototyping Manager, Formero. “A classic example is the client who designed a 100m high office block and wanted to create a 1m high scale RP model. They simply scaled their model down in their CAD program which resulted in the walls having a physical thickness of one micron, which is too small for RP models (this is currently limited to 0.5mm). Naturally we were able to rectify this, but if the customer’s data is right first time, it will streamline the whole process, reducing turnaround time and of course cost.”

Once the data is received Formero project managers assist the client in choosing the process best fitting their requirements.

SLS is ideal when interior details are required within a structure, however because it uses powder its surface finish is a little rough. While SLA, can provide excellent surface definition and see through models. Objet’s new Connex500 3D printing systems allows the print of models with multiple materials offering an unprecedented level of design emulation.

For model production a degree of hand finishing is often necessary after the build, particularly for SLA models to smooth the surface or to hide marks made by layering or supports. In the case of SLA and Objet 3D printing, models are printed using a support material that needs to be removed by hand. Some clients also require additional finishing on their models such as paint jobs or specific textures.

In terms of single build volumes, Formero currently has a capacity of 500 x 500 x 250mm for single SLA models, 400 x 340 x 270mm for single SLS models and 490 x 390 x 200mm for single Objet 3D printing models. In many cases multiple models are joined together to form a larger model.

**Time and cost benefits**

Of course one of the major attractions of this technology is the extremely quick turnaround time which is a major selling point for Formero when offering up Rapid Prototyping as an alternative to traditional model making.

“While traditional model makers may take weeks, the average turnaround for projects, once resolved CAD is available, is two to four days,” says Peter Canfield, Technical Sales & Development Manager, Formero.

In addition to turnaround time the relatively low cost of models is a major draw for many clients. Models can cost anywhere from hundreds of dollars to thousand of dollars depending on size, which is the primary driver as this dictates the amount of machine time. Other factors that can affect cost include amount of surface finishing, and any required textures or painting. These post processes are all done by hand in house by extremely skilled labour, which is in contrast to the automated RP technologies used for actual model production.

Formero also offers Polyurethane (PU) for the creation of short batch runs for actual architectural fittings such as specialised door handles.

**Having conceived the unique structure for the Water Cube, we knew that we needed to make a physical model in order to properly convey the ideas to the Jury of International experts. With 22,000 elements and 12,000 joints, there was no way that we could make one manually, so we turned to the rapid prototyping skills of Formero. Despite the fact that nothing of this magnitude had been made using an SLA machine before, the team at Formero were determined to make it work and were exceptionally helpful. The result was spectacular! In July 2003, our team was announced the winner of the competition and was awarded the design commission for the 2008 Olympic Aquatic Center.” Tristram Carfrae, Arup Fellow.

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