‘Finding Space That Does Not Exist’

Smart Geometry Conference, Barcelona 2010

Review by Dr Sandra O’Connell

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1. The conference took place at Barcelona’s Palau de la Musica
2. Mark Barry on the completion of the Sagrada Familia
3/4. Smart Geometry workshop at IAAC

From the recreation of Antoni Gaudi’s complex geometries for the completion of his monumental Sagrada Familia Cathedral in Barcelona to the 3D ‘printing’ of a structure on the lunar surface – the Smart Geometry Conference discussed pioneer applications of 3D software in Barcelona on 23-24 March. Conceived as a partnership between practice and academy, the conference brought together some of the ‘smartest’ researchers in 3D design in the schools of architecture at ETH Zurich, the University of Stuttgart; RMIT University Melbourne; CIT Copenhagen and Princeton University with the in-house digital technology units of architects Foster + Partners and engineering firms Adams Kara Taylor, Arup and Buro Happold.

“Usually we are competitors but during Smart Geometry, we collaborate and enjoy playing with digital design,” said conference organiser Xavier De Kestelier, a Professor at the University of Ghent and an Associate Partner with Foster + Partners.

Young engineers, Al Fisher and Sam Joyce of Buro Happold conducted particularly engaging experiments – ‘Design to Destruction’ – by testing (and crashing) the load-bearing capacity of 3D-designed plywood beams. The Buro Happold experiment was one of ten workshops (using Generative Components software) that took place during the conference at the Institute for Advanced Architecture of Catalonia, IAAC. Located in a former factory in Barcelona’s design and IT enclave Poblenou, IAAC is an international and interdisciplinary centre for research, education and experimentation. Its Masters programme in Advanced Architecture covers studies of territorial analysis and urban development as well as new digital processes. Director of Digital Tectonics, Marta Malé-Alemany develops with her students, for example, robots that can cut building components as well as new textile materials with structural capacity.

Throughout the five-day Smart Geometry workshops, IAAC’s vast production hall was filled with a frenzy of activity; researchers were engrossed in their laptops, while robots were fabricating, CNC machines cutting and architectural students sewing together pieces of fabric – the latter being a workshop by the University of Stuttgart (‘Deep Surfaces’) that produced prototypes of tensioned fabric to investigate complex spatial 3D systems. Also combining laptop with the sewing machine was Axel Killian of Princeton University who prototyped with his team ‘Inflatable Fabric Envelopes’ as a possible alternative to lightweight building structures. The automated manufacture of buildings from 3D models was investigated by ETH Zurich, who designed a circular structure of complex interlocking bricks. Their design ‘Explicit Bricks’ was manufactured by a KuKa robot used primarily in the automotive industry. Copenhagen’s CIT experimented with a CNC machine the ‘Manufacturing of Parametric

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Acoustic Surfaces' - essentially developing new architectural forms and materials to modify acoustic space. Workshops were also highly interdisciplinary as Princeton biology students collaborated with their peers in architecture, using 3D software and prototyping in an experiment to gain insight into the blood vessels structure of the human lung.

Ranging from the conceptual to the practical, the workshops invigorated the conference through work-in-progress presentations, while the Smart Geometry wrap-up party was held back at IAAC with a chance to visit and behold the completed experiments. "Tonight, the laptops are finally closed and the physical objects took over", said a relieved Xavier De Kestelier as the conference drew to a close. The teams had worked solidly for five days until midnight, when IAAC turned off the electricity that powdered laptops and robots.

While some conference presentations were highly theoretical – investigating the evolution of Parametrics since Ivan Sutherland developed the first 3D projections in 1963 in his PhD dissertation at MIT – there was also a fascinating practical dimension to 3D design. Hanif Kara of Adams Kara Taylor took delegates through recent engineering projects developed with 3D software – including a new project by Zaha Hadid in Azerbaijan and the Footbridge for the London Olympics designed by Irish firm Heneghen Peng. Italian engineer Enrico Dini is currently experimenting with 3D printing of large structures and has developed a 6mx6m printer that can produce large building parts. He has already realised a 3D-printed roundabout sculpture, inspired by Gaudi, for the Italian town of Pontedera near Pisa. "My dream is to make architecture", says Dini and current projects include a 3D-printed Villa in Sardinia as well as a research project with Foster+Partners for the first building on the moon surface.

The interface between highly conceptual 3D design and the traditional craft of making was perhaps most evident in the ongoing work to Antoni Gaudi's Sagrada Familia. Begun in 1882, Gaudi himself soon discarded traditional 2D design methods and assembled instead a team of model makers and sculptors that investigated and developed his ideas in 3D. However, during the Spanish Civil War, Gaudi's workshop was vandalized and most of his writings, drawings and 3D models were destroyed. "Due to the complexity of surfaces and forms, working with Gaudi's designs in 2D does not make a sense form an architectural point of view", says Chief Architect Jordi Coll of the present Church Technical Office.

To develop Gaudi's complex mathematics of "hyperbolic paraboloids", he collaborates with Mark Burry of RMIT in Sydney using 3D CAD software. "There is nothing casual about these geometries", says Burry. The 3D software allows Burry and his team to better understand the Sagrada's mathematics and proportions, slowly revealing the secrets that lie therein. With the aid of 3D printing – using Z Corporation Spectrum Z510 printers – Burry and the Technical Office can develop within a few hours and with unprecedented detail and accuracy, 3D scale models. "These are then handed to traditional stonemasons who are making 1:1prototypes , without which we would be left in the dark", explains Burry. All decisions on the Sagrada design are reached collaboratively between architects and stonemasons and the final pieces are cut from a quarry with a machine that can cut columns of up to 3-metre sections. The team is currently working on the Passion façade, which had been left only half complete. "The way we work is to find space that does not exist", explains Burry.

The 2010 Smart Geometry Conference took place in Barcelona from 19-24 March. Conference presentations will be available on
www.smartgeometry.org
www.bentley.com
www.iaac.net

Who is Who in 3D Design and Printing

3D Printing and Prototyping

Z Corporation
www.zcorp.com

Laser Prototypes Europe, Belfast
www.laserproto.com

Enrico Dini,
www.d-shape.com

Graphisoft
www.graphisoft.com

Materialise, Belgium
www.materialise.com

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