



# SIXTEEN MAKERS

ODD STRUCTURES IN AN ALIEN ENVIRONMENT ARE HELPING A TEAM OF ARCHITECTS DESIGN WITH TIME, AS THEY EXPLORE THE FUTURE.  
**WILL JONES** REPORTS  
*PHOTOGRAPHY BY CHRIS LEUNG*







In the middle distance there are trees, tall conifers, but closer, the ground is barren and scarred. Tree stumps, shorn close to the earth, and dead branches litter the area. Only mosses grow, sucking moisture from ink-black puddles in the rutted earth.

This is Kielder Water and Forest Park in Northumberland, and an alien landscape

created after trees have been felled. Glinting in the sunlight stands a cluster of structures as strange as the surroundings: 'heads' of hinged metal fins with tube-like extensions, supported on single thin legs. There are five of them, motionless on the hillside.

These interlopers in a remote, ravaged landscape are not otherworldly invaders but

*'Cells' that use iterative data gathering software, are being used for a project aimed at adding information and time to the three dimensions that traditionally inform architectural design*

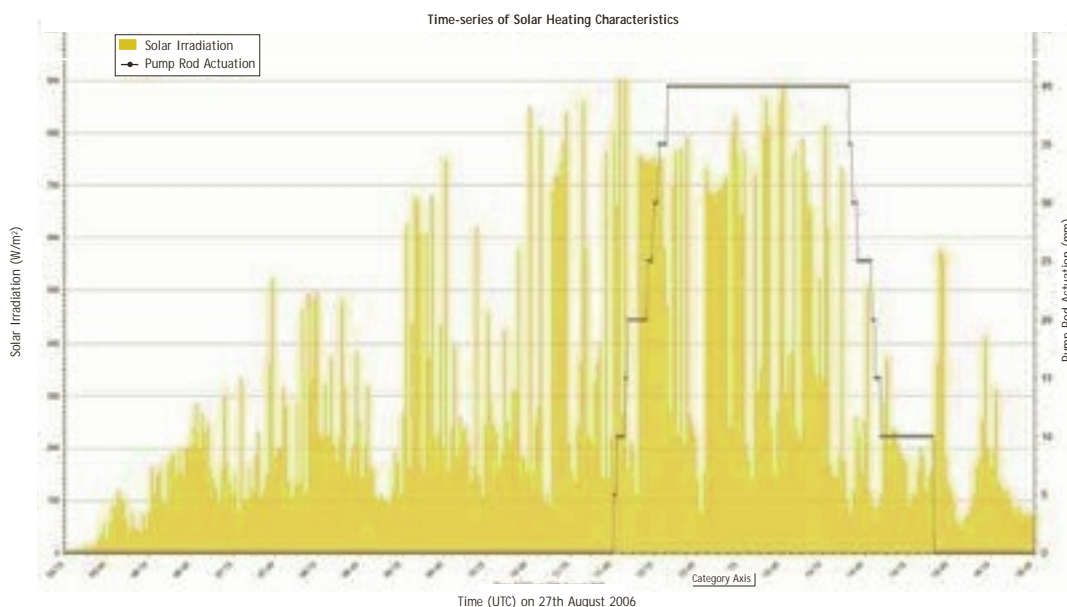
an experiment, intent on creating an architecture that evolves in response to its environment. The work is also the catalyst for a wider debate on what it is to be an architect in the 21st century; design innovator or component of the construction production line.

I am fascinated in the differences, >>>





WE SET OUT TO DEVELOP A RESPONSIVE ARCHITECTURE THAT CHANGES LIKE THE ELEMENTS WITHIN THE LANDSCAPE, ACCORDING TO MICRO INGREDIENTS – CLIMATIC, ENVIRONMENTAL AND PHYSICAL – AND WHICH CAN INFORM THOSE CHANGES AND EVOLVE



similarities and complementary issues that exist between the idealisation of representation and actualisation of fabrication,' says Bob Sheil of design research organisation Sixteen\*(makers). 'Even though the public may think of architecture as built structures, architects actually reside in the first territory. The actual making of the ideas over which they claim authorship is carried out by builders, people with a completely different skill set.

'Pre-Renaissance architects fully understood the construction process through their constant interaction with craftsmen. By definition, they were master builders. However, since the introduction of standardisation and mass production in the 19th century, the architect's need for knowledge in artisanship has waned, to be replaced by a need for ingenuity in the utilisation and adaptation of ready-to-use components. The architect's contact with craftsmen and builders became less and less and the exchange between drawing and making was drastically altered. Now, with new digital technologies we could be seen as simple pattern makers.'

The cells are the culmination of four years as 'architects in residence' by Sixteen\*(makers). Kielder Park has previously invited architects and artists including Softroom and James Turrell but this is the first long-term project to be undertaken by an architect.

Sheil says: 'There was no brief, no particular site, no real timescale for the project when we started. It was the complete opposite of all that an architect is used to and so we set out to explore our relationship to the site, the actual design process and the architect's connection with it.

Sixteen\*(makers)'s canvas was some 62,000 ha of managed forest and 150 million trees. Each year, 1,200 ha are felled and replanted in a highly designed cycle based on soil condition and site topography, historic and projected weather data, and visual impact on the landscape.

The intensity with which this tree felling cycle is approached and how the landscape is planned, constructed, developed and managed formed the basis for the architects' residency. 'We were drawn to the forest as a whole; its customisation and

reaction to change; and on change as an environmental presence and force,' says Sheil. 'We set out to develop a responsive architecture that changes, like elements within the landscape, according to micro-ingredients – climatic, environmental and physical – and which can inform those changes and evolve over time.'

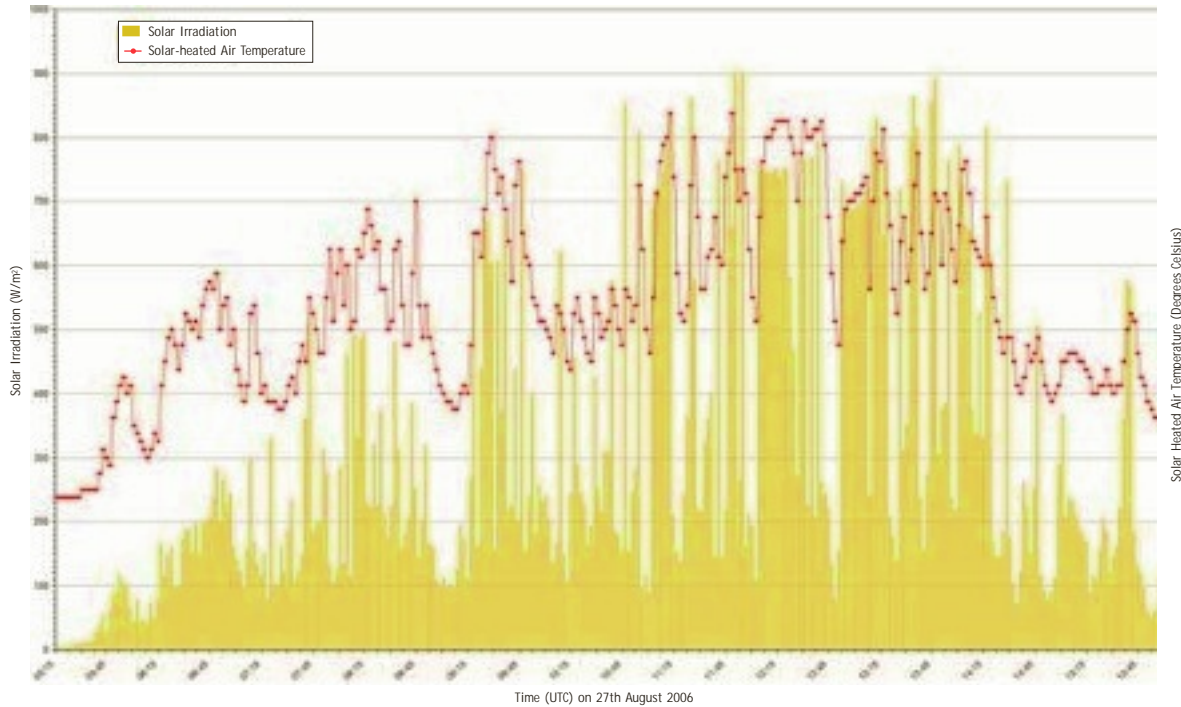
The team found a site in a newly-felled area near mature trees. Recording stations were set up to capture temperature data every 30 minutes for a year, within and the forest canopy and outside it. Back at the practice's base in The Bartlett, London, the form of the architectural intervention took shape. Bespoke elements, designed and made using CAD/CAM technology, form clusters of 3mm-thick cell leaves, supports, ground anchors and feet pads. The leaves open and close according to macro and microtemperature changes sensed by wax-filled pumps acting as passive actuators.

Team member Chris Leung says: 'The proposition is sensitive to changes in the physical environment. Cells will move in response to the site conditions and also microclimates created by the objects

*Above: The cells collect and process short and longer term data such as the solar information generated in this chart, that became part of the wider design process, so while architects are no longer 'master builders', neither need they become the deskilled 'pattern makers' digital technology could turn them into*



Time-series of Solar Heating Characteristics



Solar Heated Air Temperature (Degrees Celsius)

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Top: Solar heating data

Right: The Bartlett team set up the cells with their own power sources and solid state recording technology so that they would run much like a probe to another part of the solar system



themselves. Hence, as a leaf opens in response to a rise in temperature due to the sun shining on the actuator, it may start to shade that pump and so cool it again.'

Installed in Kielder, the cells' movements are recorded using 3D photogrammetry – five networked time-lapse cameras – at one minute intervals. Pyrometers measure solar irradiation and a differential sunlight sensor tracks hours of sunlight using the same time increment, over a five day period.

This information is recorded on solid state technology enclosed within a site-based weather station. 'The remote station is self-sufficient, like space probe technology,' says Leung. 'It has its own power source and a degree of intelligence in the software to drive the cameras, initiating photography only when there is enough light to start recording.'

Sixteen\*(makers) believes that with the wholesale encroachment of multimedia technologies, the need for architects to understand the intricacies of both construction and manufacturing processes is now imperative. Digital fabrication,

CADCAM, computer numerically controlled (CNC) machinery and additive processes such as stereo-lithography and selective laser sintering now allow the production of objects thought impossible in the recent past. The architect's designs are being drawn directly into the construction process as never before. And, if architects don't fully understand and transcend the process, they will be consigned to being a simple link in the production line.

The data collected – both long-term temperature fluctuations and the intense five-day recordings – have now been mapped on to a digital 3D model of the cell using software written by team member Phil Ayres. The cyclical nature of the recorded weather patterns, allows data to be extrapolated to create a digital picture of conditions for the Kielder cells from the date they were installed until a time 40 years in the future when they become completely overgrown by mature trees.

This, in turn, is transformed using computer modelling into a digital growing architecture. 'The physical movements of our cell are used to inform the development

of a larger architecture in the three dimensional environment. The design evolves, learning from itself as it generates,' says Ayres. 'We have developed software that will add or subtract cells depending on set criteria according to the real recorded conditions. The 3D design is part of a circular, iterative process.'

This is designing using the three dimensions of space, plus an environmental data set and time, 5D. 'People have talked about it for a long time, but we are now designing with time,' says Sheil. 'Things are often assumed to be resolved in the drawing but there is a whole set of other parameters in the real world. This project responds to that larger set of criteria to allow designers to create on a deeper level.'

The apocalyptic appearance of the site at Kielder and its rigidly detailed management proved the inspiration for Sixteen\*(makers) to present the physical representation of a theoretical argument. Ultimately, the cells are bound into a learning process; evolving as a digital project, and enabling the knowledge of their creators to develop ■