Author: Robert Sheil of sixteen*(makers)

Research Output 2: *Kielder Residency*

Co-Authors: Phil Ayres, Nick Callicott, Chris Leung

Output Type: Design

Design and Production of Artefact: *Kielder Residency*

Media: Aluminium sheet, thermo activated sensor array and pistons, gas return springs, microprocessor, dedicated software

Dimensions: Variable

Locations: Kielder Park, Northumbria, UK

Curator: Peter Sharp, Kielder Partnership’s Art and Architecture Programme


Funding: Kielder Partnership’s Art and Architecture Programme
Questions/Aims/Objectives
The research focuses on how understandings of growth and adaptation may drive the design, manufacture and performance of built environments, involving the interdependent design practices of representation and making.

Contexts
The research occupies the increasingly connected worlds of digital and analogue design. The majority of related research in ‘evolutionary’ design processes (notably Fraser and Bentley) has concentrated on the role of computational representation; the Kielder Residency positions realization as equivalent to representation.

Methods/Description
Variably dimensioned work comprises aluminium sheet, thermo-activated sensor array and pistons, gas return springs, and microprocessor with dedicated software. Manifest as an assembly of sensory probes, micro-environmental data from selected plots was gathered and recorded over time while being simultaneously responsive to data fluctuation through passively activated mechanisms. As a method of validating the ‘real’ against the ‘ideal’, the actual behaviour of the assembly was captured and mapped upon the computational model programmed to simulate behaviour by inputting data numerically. Rigorous methodologies (Phil Ayres, ‘Getting Specific’, in Design Through Making, Robert Sheil (ed.), special issue of Architectural Design v. 75, n. 4) catalogue a circular process in assessing the design and performance of responsive artefacts while advancing the notion that adaptable architecture may become synthetic with its environment and energy-efficient.

Dissemination/Esteem
Funding: Art and Architecture Partnership at Kielder (commissioners of works by artist James Turrell and architects Softroom).
Talks: six international and four national.

Authorship
As part of the design/making practice sixteen * (makers), Ayres, Callicott, Leung, Sheil all contribute equally to the research.
In October 2003, sixteen*(makers) were awarded an architecture residency by The Art and Architecture Partnership at Kielder (AAPK) of Northumbria, UK. This organization is well known for commissioning works such as the ‘Belvedere’ by Softroom and the ‘Skyspace’ by James Turrell. Coordinated by Peter Sharp, AAPK consists of a number of large public bodies, including The Forestry Commission, Northumbrian Water and Tyndale District Council. Together they manage a land area of 62,000 ha centred on the UK’s largest reservoir and surrounded on all sides by one of Europe’s largest managed forests. (image 1)

In their appointment, AAPK were explicit that no architectural outcome was expected, but that a role for architecture in Kielder should be explored. Subsequently, the research began by exploring how an architectural design process could be challenged and informed by the site itself. Hence, our work focused on how understandings of growth and adaptation may drive the design, manufacture and performance of built environments. In this regard, the artefacts designed in the course of the project adopt passive energy and may be adapted to any location within temperate climates. The body of work as a whole involves the interdependent practices of design through representation and design through making, and occupies the increasingly connected worlds of digital and analogue design.

General Description
Research Questions/ Aims/ Objectives

The focus of the research is twofold:
(1) To explore difference in micro-environments across the territory of Kielder in order to inform strategies for future architectural interventions. (image 2)
(2) To develop a method of designing architecture within a context that is defined by a continual state of change. (image 3)
Design by Survey
With regard to these aims and objectives, bespoke surveying ‘probes’ were designed to act as dual monitors and responsive artefacts. (images 4–7) The probes were installed on an approved test site chosen for its remoteness, and for its variety. It was adjacent to a dense territory of trees, an area recently harvested and an area planted with saplings. (images 8–11) The probes were designed to measure difference over time rather than the static characteristics of any given instance. Powered by solar energy, the probes gathered and recorded ‘micro environmental data’ over time. The probes were simultaneously and physically responsive to these changes, opening out when warm and sunny, closing down when cold and dark. (images 12–15) Thus not only did the probes record environmental change, but they demonstrated how these changes might induce a responsive behaviour specific to a single location. This aspect of the work generated three critical issues for design in relation to surveying methods:

(1) How surveys become active tools in making design decisions
Surveys that capture information over time present the differing rather than the static conditions of any given instance. In this regard, responsive architecture may be designed to accommodate change with greater specificity.

(2) How micro-environmental conditions can inform site selection
Different sites will induce different responsive behaviours. For example, a site in constant shade will not present the same micro-environmental variability as one that dips in and out of shade. Thus micro-environmental data gathered from a time-based survey across a variety of potential locations will provide the designer with the information to preview their potential to activate a responsive construct.

(3) How by mapping seasonal scope and climate variability, passively activated responsive architecture may achieve synthesis with user needs
The peaks and troughs of visitor numbers in Kielder, as a recreational site, correspond with variation in weather and broad seasonal change. An architecture that is constructed to passively respond to environmental change, opening out when the weather is fine, closing down when the weather is poor, may thus achieve a synthesis with patterns of visitor frequency.
Images 5–7
Image 9
With respect to the second focal interest, new surveying methods that would enable the designer to recognize and work with change were developed. Using the same probes, ‘feedback’ mapping the difference between the ideal (digital model) and the real (manufactured artefact) was generated using time lapse image capture, photogrammetry, and a transgression of digital and analogue design media.

Like many architectural constructs the probes were initially designed by drawing, in this case as a 3D CAD model. As a property of the software in which it was designed, this ‘ideal’ model was capable of being dynamically animated to behave in response to data input. Before they were manufactured, the ‘ideal’ models were activated by an input of environmental data gathered on site. Thus before manufacture, a preview of how they might behave was ascertained. As a digital preview, this performance was a simulation, in other words an ‘idealized’ response that relied on the capability of the controlling software to interpret ‘real’ data. This is a familiar scenario in architectural design, whereby ‘reality’ is only experienced in the real world and design for manufacture is a projection of idealized expectations based on the best explicit and tacit knowledge available.

The assembly of probes at Kielder was installed with a further purpose. They were designed as props in the first phase of a process of evolutionary design. Once assembled and released on site, their dynamic behaviour, activated by the micro-environment, was captured by an array of high-resolution digital cameras programmed to record at regular intervals. The captured visual data was later developed to generate three-dimensional outline models via digital photogrammetry software. (images 16–20) The resulting 3D outline models were superimposed upon the time lapse footage of the probes, generating a digital analogue composite. (images 21–29)
The digital analogue composite could be compared with the ‘ideal’ model as it was loaded with the same data that has been used to drive the ‘real’ probes in the period in which they were captured. This established a method whereby deviations between ‘ideal’ and ‘real’ design models were observed and could inform strategies to modify the design for a second generation of artefacts.

This marks a significant shift in design for manufacture in responsive architecture that seeks to be site-specific. A new methodology has been developed that ties together ‘ideal’ intent with ‘real’ behaviour. It incorporates feedback that maps difference between ideal and real behaviour and thus offers the designer the opportunity to modify subsequent iterations based on that difference. Designed in this way, passively activated architecture may, as a consequence, evolve in accordance with its immediate context.

The majority of related research in ‘evolutionary’ design processes (notably Fraser and Bentley) has concentrated on the role of computational representation. The Kielder Residency places equivalent status upon realization and for this reason can be understood as a novel investigation within this field.
Images 24–26
Exhibitions
Media: Aluminium sheet, thermo activated sensor array and pistons, gas return springs, microprocessor, dedicated software, DVD, Flat artwork.
Sponsors: Kielder Art and Architecture Partnership, Building Centre Trust, Access Engineering, CADventure, OMNI printing, YRM, iButton, Photarc Surveys, Microchip.

Invited talks
Arizona State University, Chelsea College of Art, Delft University of Technology, Royal Academy Copenhagen, Savannah College of Art and Design, University College Dublin, University of Manitoba, University of Waterloo.
Appendix 1: Related Articles by Robert Sheil and other members of sixteen*(makers)


Conference Proceedings


Appendix 2: Critics’ Reviews

(2.1) W. Jones, 'sixteen*(makers)', *Blueprint* (November 2006), 248, pp. 86–90.