
Textile Logics in a Moving Architecture



Fig. 1 *Slow Furl architectural installation, Lighthouse Gallery June 08*

Abstract This paper discusses the architectural installation *Slow Furl*. Through the reporting on the conceptual framework, the design process, the technologies and its construction, this paper will discuss the thinking and making of a behaving architecture. The paper concludes with a critical appraisal of *Slow Furl* and the introduction of the conceptual thinking of a textile logic for thinking architectural construction. Introducing the project-in-progress *Woven Wood* we will present key ideas moving from an interest in the actuated to the structural.

Keywords architecture, interfacing, robotics, responsive environments, responsive structure

1 Introduction

This paper presents the thinking, design and making of *Slow Furl*. *Slow Furl* is an architectural installation investigating the making of a behaving architecture. Architecture is traditionally conceived within the static realm of its representations. The site of drawing, the plan and the section are devoid of temporal dimensionality, instead presenting space as a static expansion. Lived space is filled with the potential of movement. Leaning from E. Grosz and other contemporary thinkers inclusion of a Bergsonian thinking into architectural theory, space is fused with the motile and the enacted creating "...an unfolding space, defined, as time is, by the arc of movement" [1]. *Slow Furl* asks how to engage such the temporal dimensions of an architecture of movement querying how motility and action is brought about.

2 Developing design criteria for *Slow Furl*

Slow Furl is a robotic membrane. Its thick skin lines the interior of the Lighthouse Gallery. The aim for *Slow Furl* is to explore the idea of pace. Rather than fixing the digital in a responsive relationship to its user, where every call defines a reply, *Slow Furl* finds its temporality outside the

immediately animate. Learning from prior work such as Vivisection, Strange Metabolisms and Breathing Room [2,3] we had perceived that the defining the timeframes of these works had intuitively related to the size of the structure. Just like the quick breath of a small bird, the size of the organism relates its pace or breath. The aim for Slow Furl was to ask what the breath of a building might be. As such Slow Furl engages a geological time of imperceptible flow. Like a glazier or a frozen river, the installation imagines a space of continual change happening beyond the grasp of our perception.

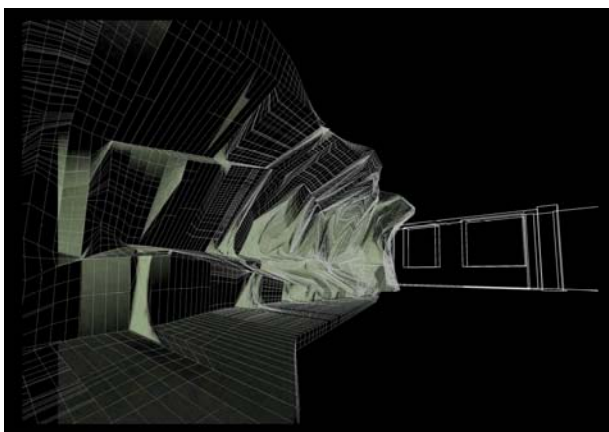


Fig. 2 Spatial diagramme of *Slow Furl* installation

This ambition defines interaction outside the primacy of the user. Here user control, or the perception of the same, is replaced by a focus on the architectural environment as an organism holding its own potential action or agency. The user is invited to engage in a physical sense, to touch or sit within its soft skins. As they do they feel the slow pulse of its movements. As a landscape, a cloud formation or an ice wall, Slow Furl forms and reforms around the body of its user. Where Slow Furl rejects a direct sense of interaction, the aim is to explore interaction as a metabolic act of self activation. As Slow Furl furls and unfurls its skins touch themselves thus creating a continual activation and re-activation of movement cycles.



Fig. 3 Full extension of *Slow Furl*

structure where independent low-order cells trigger a high-order patterning. As a network of distributed computational cells, Slow Furl seeks to draw movement as a negotiation of the multiple.

2.1 Skin and structure

Slow Furl is built as a skin cladding a dynamic armature. The skin is held by the armature that in turn imbues it with movement and action. The armature relates areas of action with areas of stasis, shifting between one and the other along its length. The armature is conceived as a skeletal substructure where moments of its striation have calcified. As such, its structure is relates the potential for movement actualised in its dynamic momentum.

The project learns from prior research through which we have developed methods for designing skin and structure from a single membrane [4]. As such the skin is sewn around the substructure like a glove, precisely shaped for its fit. The skin is made in an 8 mm thick spacer fabric sewn together as flat pattern cut sections. In the areas of stasis the skin fits tightly around the structure, whereas in the areas of movement the skin voluptuously folds to allow for movement. This spatial and temporal change create a differentiation of the relationship between structure and cladding.

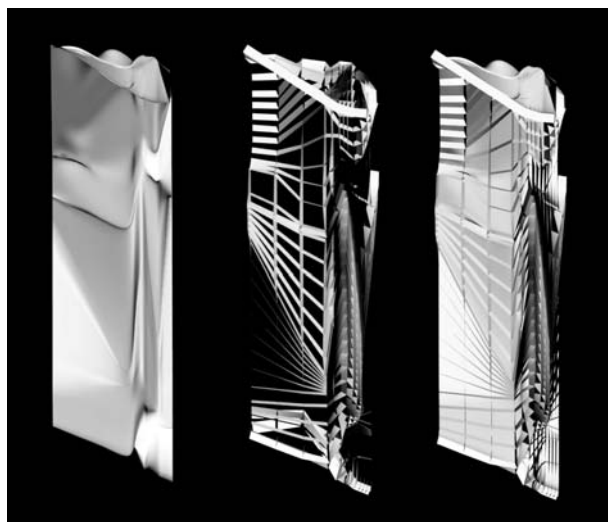


Fig. 3 Developing skin and structure from single membrane

2.2 Embroidery and soft switching

The skins are in turn embroidered with conductive thread allowing for soft switches [5] to control the continual action of its armature. As the structure moves the skins touch thereby creating a switching and unswitching of its circuitry. This continual switching actuates slight differentiations in the movement cycles. The embroideries further create a sense of surface description and shaping of the textiles membrane.

Finally it was the aim to create Slow Furl as a cybernetic



Fig.4 *Thick skin of Slow Furl*

2.3 Imperceptible flow

In the setting of the conceptual framework and design criteria for Slow Furl the imagination of the slowness of its pace has been defining. The choice of motors and gearing was deliberately done so as to accentuate the notion of pace. The gageing of its tempo has been fundamental to the design process. During the making of Slow Furl motors and movement scores, actuation cycles and differentiations within these were designed directly using the motors in question. The surprising result of the installation is therefore double. During the design process we looked at the substructure without its cladding skin. The pace of the installation was designed to be at the given speed of the geared motors and is slow but clearly perceptible. As the skin was attached the movement seemed to vanish. Through stop frame animation the actuality of its movement was tested and seen to move, not only slightly but radically.

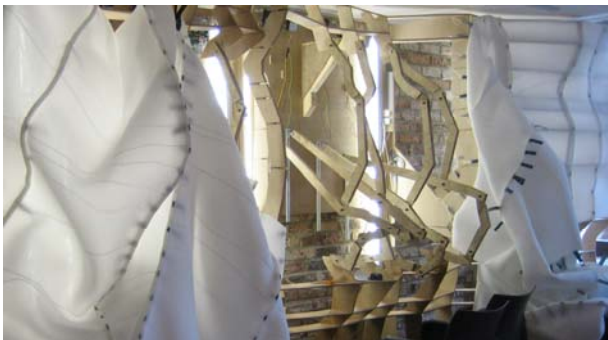


Fig. 5 *Structure and skin: 4 of the 16 moving members*



Fig. 6 *Peering into apertures of the skin*

This creates an interesting finding which points not at the organism which is the installation but rather at our own self as a sensing organism. The soft curvatures of the skin create a strange dilution of the movement, making it imperceptible to the eyes of the user. In the exhibition users were able to peak behind the structure at given apertures and slits thereby allowing them an understanding of the straightforwardness of the movement score, while simultaneously presenting a static presence.

3 Discussion of design

The structural logic of Slow Furl seeks deliberate low tech solutions. The technology of its programming and actuation are simple structures of movement loops repeating as the skin touches and un-touches itself. In the realisation that the refined complexities of reactive cycles between action and interaction are imperceptible we have kept programming of the armature to a most simple switching between differentiations in tempo. The sensing through soft switches and the actuation of the structure using simple linear motors with multi-hinged armatures repeats the ambition of low tech solutions enabling complex movement scores.

In assessing Slow Furl it is the relationship between skin and structure which is most critical. In Slow Furl the skin has a performance in respect to the actuation of the installation becoming a unifying membrane that holds the patterning of the multiple arms. However it has no structural performance instead becoming dependent on the substructure.

This assessment of Slow Furl has led to the envisioning of a textile logic for thinking structure. Thinking textiles as technology rather than a material, a textile logic for architecture creates more complex relationships between the compressive and the tensile. Using the logic of the stitch, where each cell structurally links to the next, textile thinking merges the thinking of skin and structure.

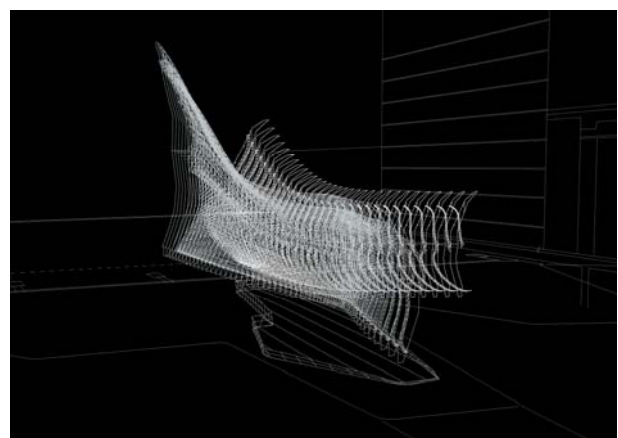


Fig. 7 *Woven wood structure using bent wood*

Here, the complex motilities of Slow Furl are here replaced by a structural ordering. This opportunity for architecture to learn from a textile thinking is enabling a profound shift in tectonic culture as noted by P. Beesley and S. Hanna in their text "A Transformed Architecture". Here

a fundamental differentiation is made between ordered systems where primary structural systems support secondary and integrated systems where "... every fibre has an integral role in maintaining structure, each as important its neighbour" [6].

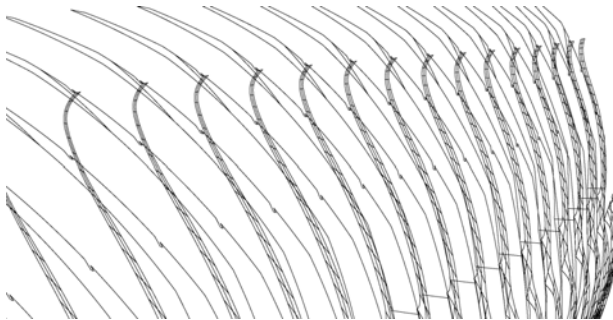


Fig. 8 *Interlacing of wood members*

Where *Slow Furl* operates within the ordered structures of traditional structural thinking we are in parallel projects investigating the potential for more complex relationships between skin and structure. In the project *Woven Wood* we are looking at a tensile structuring of the wood substructure. *Woven Wood* investigates the making of a structural wall where each member of the striated substructure is tied to its neighbouring members through the bending of wood inter-sectors. Here, the members are co-dependent creating a structure where load bearing becomes a continual shift between the compressive and the tensile.

Woven Wood considers the structural performance of the membrane rather than its actuation. As a transitive material it considers its internal structural integrity. By expanding the performance of a transitive material to include the statics of materials, and referencing the notion of pace and slowness gained from *Slow Furl*, we can gain a wider understanding of how these material can be designed and find application.

Slow Furl won the interactive architecture commission INTERArChTIVE and was exhibited at The Lighthouse Gallery in Brighton, England, as part of the Architecture 08 Festival, June 08. *Slow Furl* is developed with support from CITA and University of Brighton.

Woven Wood is a project-in-development created in response to design call for an exhibition space and is to be erected August 09.

References

1. Grosz, E., *Architecture from the Outside*, Massachusetts Institute of Technology, 2001
2. Ramsgard Thomsen, M "Building liveness, imagining architecture as a robotic membrane", *Proceedings of Ubi-Comp Conference, Innsbruck 2007*
3. Ramsgard Thomsen, M "Metabolistic architectures" i *Metabolistic Networks*, ed. S. Bonnemaïson, University of Dalhousie, Sept 2007
4. Ramsgard Thomsen, M "To build a Knitted Wall", conference presentation, *Ambience 08, Smart Textiles, Conference Proceeding*, April 2008.
5. Berzowska, J. 2005. *Memory Rich Clothing: Second Skins that Communicate Physical Memory*, *Proceedings of the 5th conference on Creativity & Cognition*, ACM Press, New York (2005) 32 – 40.
6. Beesley, P. and Hanna, S. *A Transformed Architecture in "Extreme Textiles Designing for High Performance"* ed Matilda McQuaid, Thames and Hudson 05