RESEARCH BY APPLICATION
REFRAMING TEXTILES INTO ARCHITECTURAL SYSTEMS

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ABSTRACT

This paper discusses a research in the qualities of reframing textiles into a framework of architectural systems. By reframing textiles into an architectural context, the potential for a new architectural coherence is evoked. (Shön, 1984)

A frame analysis of both the textile and architectural framework has been performed to create an awareness of the possibilities and values to which to give priority. At first the frame of textile techniques and tectonics is presented in a matrix to juxtapose the range and variety of textile in general. Next, construction shapes as described by Heino Engel in the book Structure Systems (Engel, 2007) are used as the architectural framework. By reframing or re-contextualizing the textile matrix into the architectural framework, architectural-textile combinations originate.

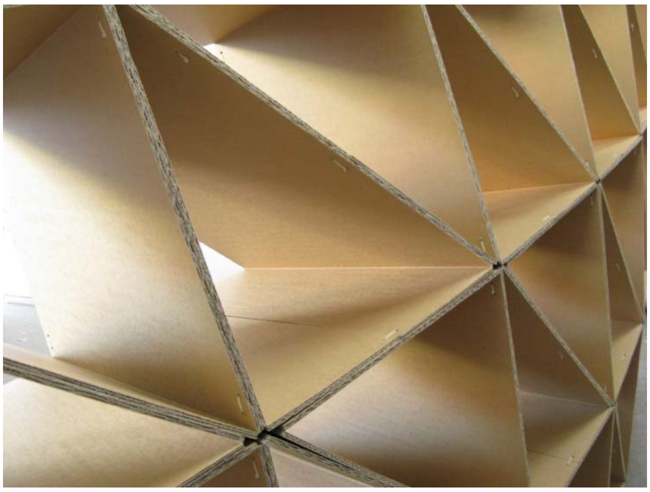

Figure 1. Salon de Karton, Design and Engineering: Ivo Vrouwe. An example of Reflection-in-Action. By building a structure by a digital model, physical feedback is generated.

By reflection-in-action (Schön, 1984), theoretical combinations are supported by physical case scenarios. Textile systems are implemented into designs of architectural sculptures and structures. By lifting the techniques from the digital context into a material environment new potential in textile design is generated by the researcher.

Keywords: Reframing, Textile, Tectonics

AIMS AND MOTIVATIONS

For several years I have worked as a designer and engineer for an office in lightweight and tensile structures. I specialized in designing and engineering foil and membrane structures in architectural application.

With regard to engineering, the use of textile in lightweight structures force an efficient use of material and an optimization in form to result in the desired structural behavior. Supported by formfinding software, double curved surface is designed. By defining boundary points or lines in a digital environment, the designer creates a geometry in which the form can be calculated. By the form-finding program, the surface is generated in between these parts and further processed into building components.

With regard to design, the dominance of form and force optimization of textile structure geometries, designs are mainly constructed by minimal-surface or form-active shapes. This effect limits these textile geometries to be materialized in tensioned and pneumatic pressurized structures. To extend the possibilities of textile design I started working on a broader view on textile techniques and tectonics in architecture.

Since textile is material independent, textile design is open for innovation and materialization in a wider range of materials and coherent techniques. By scaling up micro techniques as used in clothing and textile design to an architectural scale, specific textile qualities are innovated into an architectural variant. By stretching the textile architectural vocabulary, membrane is complemented with for instance weaving and folding geometries. Materialization can range from wood to metals and synthetic polymers.

Figure 2. Petrus and Paulus Church Maassluis, Architect: Haskoning Architects, Membrane engineering: Tentech B.V. An example of membrane design and engineering by the researcher.

RESEARCH APPROACH

This research concerns a semi-artistic design research, driven by an engineering interest to support artistic design. Semi-artistic is used because structural design is subjected to certain border conditions that limit the classical conception of an artistic approach. The research focuses on tools and products, rather than design theories to educate architects and architectural students. By describing design routines, tacit knowledge is supposed to become more explicit. (Östman, 2006) By introducing tools and methods in the form of procedures an digital scripts, routines can evolve into formalized methods.

The intelligent character of architectural textile engineering makes its techniques relatively hard to access by designers. The intelligent character can be looked upon in two ways. On the one hand a large quantity of knowledge and practice is necessary to design and engineer these systems. The unconventional way of designing is lectured in few places. This is why only a small group of, mostly self-educated specialists are able to design, engineer and process these structures. On the other hand, the complex geometries of these systems demand a large quantity of information to be described. When describing a cube for example, it takes eight points. Describing a double curved surface takes multiples of elements.

When textile geometries are implemented into architectural design, the architect is designated to a construction engineer, mostly educated with a non-artistic design background. Developments in custom made computer scripts and a limited amount of commercial software add to the accessibility to describe these systems and bridge the gap between architecture and engineering. Geometrically, great progress has been made to design and manipulate textiles in an architectural context. Unfortunately, most of the digital computation concerning textile geometry are material or structural independent. Materialization and structural dimensioning takes place at the end of the design process. For a progressive architectural concept to remain active, it takes an innovative and accommodating view of the engineering party.

Figure 3. Het Baken, Artist: Maarten de Reus, Structural Design and Engineering: Mark Feijen, Ivo Vrouwe. An example of design by textile systems. Volume patterning is used to describe the surface. Weaving is used to form a surface.

Since textile geometry's intelligent character relate to geometrical as well as structural and material aspects, concerning design a more integral approach is favored. By introducing structural concepts and material aspects in an early state of the design process, a more coherent result is the outcome. To generate this coherence a reframing strategy is used.

In this strategy, textile qualities of geometries are combined with structure and materialization. By reframing architectural geometry into a textile framework, another meaning or sense is assigned, the situation is viewed upon in another context. Freed from former prejudices, a different view and different rules apply. With this reframing approach original possibilities occur. (Schön, 1984)

FRAME ANALYSIS

In this research frame analysis is used to create awareness of the tacit frameworks used in the reframing strategy. With the frame awareness, possible dilemmas in the reframing strategy are avoided to the utmost extent. (Schön, 1984) By focusing on frame qualities in relation to the scope of the research topic, certain benefits within the framework surface above others. Outcome of this discussion, favors decisions in relation to alternatives within the solution space of the applied frames. With a stable problem definition, subjective observations are embedded in a solid theoretical background which can result in a more objective procedure. (Dorst, Dijkhuis, 1995)

To situate the applied frames, classical material science is taken as a starting point. In material science a distinction into three groups is often made;

- Material production
- Material processing or manufacturing
- Material application or design

With textile being material independent, a framework for material production and material processing is less obvious. One can say that the thread or wire is the material production and the manufacturing through crafts like weaving or knitting the material process. In this way of grouping, techniques like folding, patterning and ruffling are ignored or to be assigned to a different group.

In this research material production is understood as the group of tectonics with which textiles are produced. This group is further mentioned as textile tectonics. The description tectonics is used to refer to the way material parts are assembled to a stable whole. (Semper, 2004) Crafts like weaving and knitting belong to this group.

Material manufacturing is understood as the framework of techniques to process the textile tectonics into a textile application. Techniques like folding, pleating and patterning belong to this frame. This group is further mentioned as textile techniques.

All used subjects within the group of textile techniques and tectonics are obtained with a description of its geometrical constraints. The constrains describe the solution space within the technique can behave.

Since the textile framework contain several qualities, many subjects in the framework can form a base for the reframing strategy. The geometry of techniques, ways of fabrication and structural behavior can for instance be used as a subject to implement into the architectural framework. With the ambition to construct and materialize architectural textile geometries, the framework is narrowed down by limiting its input. Structural systems like used in the book Structure Systems by Heino Engel, are used as the third group of Material Application.

The book Structure Systems describes six systems. Only four of these systems apply for this research. The four systems contain Form-Active, Surface-Active, Section-Active and Vector-Active structures. In the context of this paper, further characteristics and qualities of these systems won't be mentioned.

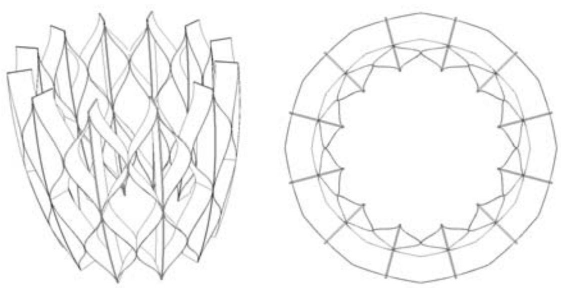

Figure 4. Stageability 4D, Design and Engineering: Ivo Vrouwe. Design research combining Surface Active Systems and Ruffling Textile Techniques.

By reframing the geometrical constrains of textile techniques and tectonics into the framework of structural systems, the results behaves like a hybrid of both. Reframing architectural techniques into a more lightweight, more dynamic environment, results should have incorporated some of these qualities.

EMPYRICAL METHOD

To unlock the qualities of a transdisciplinary research, physical reflection within the research is generated. Physical reflection is generated by case scenarios in two phases. The first phase is a project approached “from within” to be able to support a project in the second phase “from outside”. (Dunin-Woyseth, Nilsson, 2007)

The first phase consists of case scenarios designed and manufactured by the researcher. These projects are used to understand the crafts, techniques and materials applied to the design. The projects have a relatively small scale and depart from a bottom-up approach. Starting with a material, a technique or tectonic together with a structural system, the design is made to support reflection-in-action. (Schön, 1984)

Techniques derived from the first phase are applied on a bigger scale within the context of a project in the second phase. With the first phase completed, a better understanding of the language of the disciplines involved is generated. (Dunin-Woyseth, Nielssen, eds., 2004)

Figure 5. Shelves, Design and Engineering: Ivo Vrouwe. An example of Phase 1; Volume patterning reframed into a surface-active system by the use of wood.

With the use of case scenarios from both phase one and phase two, knowledge is generated about the design and integration of these systems into the final structure or architecture. The focus is on a bottom up research approach instead of communicating an end product. Starting with a textile technique or tectonic, methods to incorporate these techniques into a diversity of designs are described. With this approach, a single design routine can support a diversity of geometries and applications.

Figure 6. Pergola, Artist: Arjan Karssen, Structural Design and Engineering: Mark Feijen, Ivo Vrouwe. An example of Phase 2; Volume patterning reframed into a section-active system by the use of steel.

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