

From the Bazaar to Space Architecture: Fabrics Reshape the Human Habitat

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Abstract: This paper is a study of new possibilities for creating and transforming the human habitat made feasible by recent materials research characterized especially by lightweight and hybrid textiles. The purpose is to discuss the use of *soft* cladding materials as significant, integral components of built spaces and to challenge typical assumptions that textiles only serve as decorative or as add-on elements to the hard or solid surfaces of architectural spaces. The paper discusses examples of interdisciplinary research in art, interior design, and architecture within an historical and theoretical context of the significance of textiles in built environments.

1. Introduction

All operations in the textile arts seek to transform raw materials with the appropriate properties into products, whose common features are great pliancy and considerable absolute strength, sometimes serving in threaded and banded forms as bindings and fastenings, sometimes used as pliant surfaces to cover, to hold, to dress, to enclose, and so forth (Semper, 1989, p. 215).

The form and language of architecture is constantly in flux, reflecting cultural change and contemporary technological innovation. Architectural materiality in the nineteenth century was characterized by massive, heavy construction that derived primarily from the use of solid materials like stone, brick and wood. Technical innovations in the production of concrete, steel and glass eventually contributed to the development of larger, lighter buildings in the twentieth century (Addington & Schodek, 2005, p.3; Manzini, 1989, p.107). Light, airy structures and glass-clad buildings, symbolic of modern architecture as a whole, dominate today's built environment. Recent innovations in many highly specialized fields of materials technology are setting new standards of material strength, lightness, and flexibility for better performance. New, engineered textiles have brought fabrics to the forefront of lightweight architectural applications as replacements for heavier construction materials such as stone, wood, metal and glass (Klassen, 2004). New material innovations have spurred curiosity and stimulated an increasing number of investigations into a wide range of architectural and product design applications that have the potential to further reshape the material and spatial qualities of the built environment.

In this paper, I discuss recent research into what I have termed *malleable matter* (Klassen, 2004) and its range of innovative interdisciplinary applications in the built environment. With the term *malleable matter* I refer to an entire class of hybrid, *soft* materials composed in part of flexible textiles and in part of non-textile materials such as glass, metals, carbon or ceramics (Braddock & O'Mahony, 1999, p.55). This class of materials combines strength with lightness and flexibility in contrast to traditional materials that are inflexible, solid, or hard. The purpose of this discussion is to investigate the use of soft cladding materials as significant, integral components of built spaces and to challenge typical assumptions that textiles only serve as decorative or as add-on elements to the hard or solid elements of architectural spaces. In addition to material applications, it is my intention to discuss transformations in our

perceptions of personal space and ideas of physical boundaries in built environments (Braddock & O'Mahony, 1999, p.6-7) that are intrinsic to the concept of malleable matter. Therefore, the range of examples presented - including historical and contemporary projects - are seen as experiments in *malleable space*: projects that create their forms, spatial concepts and expression from the physical and metaphorical qualities - e.g. pliancy, elasticity, expansion, retractability, etc. - of textiles.

2. Overview

The art of dressing the body's nakedness... is probably a later invention than the use of coverings for encampments and spatial enclosures... It may be that climactic influences and other circumstances are sufficient to explain this cultural-historical phenomenon, and that the normal, universally valid process of civilization cannot absolutely be reduced from it; nevertheless, it remains certain *that the beginning of buildings coincides with the beginning of textiles* (Semper, 1989 p.254).

Fabrics and textiles are the most common form of what I call malleable matter and have been a part of the built environment in the form of nomadic tents, awnings, or temporary structures used for shade as long as mankind has built shelters. The nineteenth century architectural theorist Gottfried Semper (1803-1879), whose ideas transformed the theory and practice of modern architecture, significantly gave priority to textiles in his historical account of architecture. "Woven fabrics almost everywhere and especially in the southern and warm countries carry out their ancient, original function as conspicuous spatial dividers; even where solid walls become necessary they remain only the inner and unseen structure for the true and legitimate representations for the spatial idea: namely, the more or less artificially woven and seamed-together, textile walls" (Semper, 1989, p.255).

Textiles still provide a common flexible construction element that complements fixed facades and walls of buildings. For example, cotton awnings, known as *toldos*, still cover the spaces between two buildings throughout the streets of Spain. In many Middle Eastern countries, temporary bazaars in an urban context, reminiscent of nomadic tents, are created by stretching fabric in between buildings or by the simple use of post and ropes (figure 1).



Figure 1. 1. Toldos, Spain & Bazaar, Turkey

In the history of modern architecture, art and design, textiles have continued to play their 'original function' of primary material expression and spatial division. In the early 20th century, textiles have been transformed by a constructivist design attitude in the textile and clothing designs by Aleksandr Rodchenko and Varvara Stepanova. More recently, as in the soft

sculptures of Claes Oldenburg, Dennis Oppenheim and Louise Bourgeois, artists have looked to fabric and other similar materials to fundamentally transform the materiality of the artistic object.

Beyond the areas of fashion and the art object, early designers also brought soft materials into the spatial realm of architecture. Lily Reich, an important pioneer of modern design in Germany during the 1920s and 30s, created her professional design career in the cross-disciplinary context of exhibition design, clothing and furniture design, and architecture. In collaboration with Mies van der Rohe, she designed the Velvet and Silk Café in 1927. In this exhibition space created for display of women's fashions, she created a group of small spaces that flow into one another by use of black and yellow silk draperies suspended from curved metal rods. In this display space (figure 2), the floating fabric walls expressed new qualities of spatial flexibility, flow, and interpenetration. The qualities developed through experimentation with textiles were later reproduced in the creation of solid architectural spaces of many modern architects such as those of Mies van der Rohe (McQuade, 1996, p.25).



Figure 2. Velvet and Silk Café (1927)

An innovative, contemporary expression of lightweight textile construction, as a divider, enclosure, and shade provider in a domestic context is Shigeru Ban's Curtain-Wall House (1997). Ban's project uses a large curtain as one layer of the exterior building envelope, either inside or outside of a sliding wall (figure 3). By this strategy, he creates an architectural wall-like presence with paradoxical qualities of enclosure and permeability, separation and openness, opacity and movement that connects interior of the house with the urban exterior through complex, changing experiences of form and space. With this design gesture, the Curtain-Wall House gives design credibility as a construction material to what otherwise is considered a decorative interior element. In another example of contemporary textile construction, artist Do-Ho Suh draws upon the idea of 'clothing as space.' For Suh, inhabitable installations made of textiles are an expansion of the idea of clothing on the body. In his Perfect House II project, he uses tailoring techniques that are native to fashion design to recreate the architectural space, enclosures and furniture of a typical New York apartment from translucent nylon, transforming hard architecture into soft space.



Figure 3. Curtain-Wall House, Shigeru Ban & Perfect House II, Do-Ho Suh

At the scale of large building complexes, Frei Otto has been a pioneer in the creation of tensile fabric structures, most notably the Munich Olympic Stadium of 1972. Since the mid-sixties, Otto has set new standards in textile architecture with tent, net, pneumatic and suspended constructions. He has created structures of extreme lightness combined with high performance by making optimum use of thin membranes of synthetic fabrics and cables of high-strength steel. A follower and apprentice of Frei Otto, Bodo Rasch continues to develop retractable or convertible roofs made of textiles for large-scale public buildings, such as the large umbrellas providing shade for the courtyards of the Masque of Madinah, and other event spaces. His projects have contributed to advancements in development of lightweight fabric constructions and highly efficient movement systems (figure 4) (Schanz, 1995, pp.192-201).



Figure 4. Large Umbrellas, courtyard of the Masque of Madinah .

Influenced by Frei Otto's work, FTL Design Engineering Studio of New York has innovatively used textiles in architecture for the past twenty-five years (Kronenburg, 1997, p.20). In many recent projects, such as 'Power Shade' and 'Room for Spacewalks for the New Space Shuttle' they have explored the use of new forms of hybrid textiles in the creation of architectural spaces to extend the use of textiles beyond conventional building applications (T. Dolland, personal communication, November 5, 2004).

'Power Shade' is based on the development of a mesh fabric that directly incorporates flexible solar panels (Iowa Thin Films PowerFilm™) into its construction and can either be deployed over an existing tent or built as a stand-alone structure. It is a lightweight, energy conscious design application as a sunshade and power generator tent for temporary shelters in diverse contexts; for example, urban parking lots, rural recreation areas or open fields, and portable structures for military and for disaster relief efforts (T. Dolland, personal communication, November 5, 2004). In addition to new applications of textiles on earth, new

applications to house live/work environments for space exploration and travel have been investigated (Herwig, 2003, p. 146-155). ‘Room for Spacewalks’, conceptualized also by FTL, is a research and development project in support of NASA’s Space Launch Initiative. This structure is a temporary pressurized airlock that functions to allow astronauts to leave the space vehicle and perform space walks (figure 5). The ‘TransHab Module’, a proposal by NASA for the International Space Station, is foreseen as a deployable, inflated habitat that will orbit the earth. Both space projects, utilizing a combination of composite fabric shells that include advanced fabrics such as Kevlar webbing, Nextel ceramic fabric, and scuff resistant Nomex cloth, are expected to be deployable and at the same time withstand the extremes of temperature and resist the impact from space debris and meteorites (Kronenburg, 2000, p. 154-9; Hart, 2002; Klassen, 2004). Though these concepts are developed for the extreme conditions of space, the innovative technological application of textiles exhibited in these projects is certain to prompt innovations in terrestrial building applications.

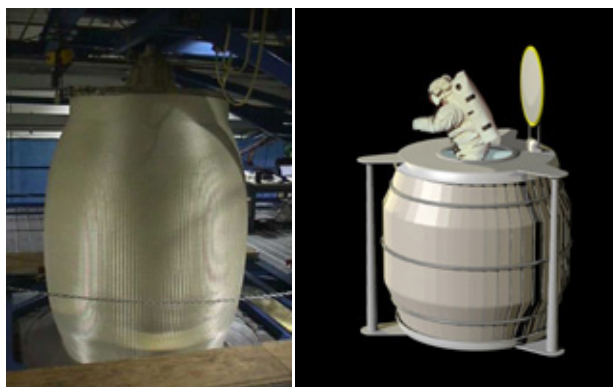


Figure 5. Room for Spacewalks, FTL Design Engineering Studio

3. Research Field

Current research in textiles reveals the thought-provoking creative potential of material developments. So-called ‘smart materials’ are often considered to be a logical extension of the trajectory in materials development toward more selective and specialized performance. While the conventional materials are considered to be static, smart materials are ‘dynamic’ and can respond to energy fields due to their enhanced physical and chemical properties (Addington & Schodek, 2005, p. 3-5). Engineered textiles now combine fabric with glass, ceramics, metal, or carbon to produce lightweight hybrids with extraordinary properties that enhance performance in specialized applications such as energy exchange or distribution, establishing communication networks or phase-change in response to environmental conditions. Sophisticated finishes such as silicone coatings and holographic laminates transform color, texture, and even the form of textiles (Braddock, 1998, p. 48-97). ‘Intelligent’ properties of advanced fabrics are now also being planned and built into their atomic structure.

New textile technology is bringing together art, design, engineering, and science. What is required is a spirit of interdisciplinary design experimentation and innovative collaborative frameworks for research and development, within which appropriate transfer of recent innovative technologies into architectural applications can be encouraged.

Institutions such as the Fabric Workshop and Museum in Philadelphia have been encouraging material advancements and sponsoring creation of new works in fabric or other unconventional materials by leading artists and designers. For this purpose, artists such as Anish

Kapoor, Rachel Whiteread, Doug Aitken, Hella Jongerius, Mel Chin, Jorge Pardo and Bill Viola have produced works that cross the boundaries between art, architecture and materials science (Stroud, 2002). An example of this kind of work is Canadian artist Jana Sterbak's 'Oasis' project, which proposes a media/technology shelter built from a technologically advanced steel fiber. Innovative experimentation with materials for this project included hand-woven copper, nickel-plated Kevlar, and silver-plated knit nylon. Further, it demonstrates the potential fruits of innovative collaborative approaches to research and design with the carrying out of computer generated form-finding exercises for this project by FTL Design Engineering Studio (Stroud, 2002, p.272),

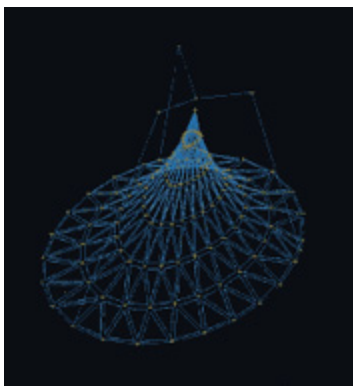


Figure 6. Oasis project, Jana Sterbak

In the context of professional practice, Kennedy and Violich Associates (KVA) have been involved with research and development of advanced fabrics for architectural and industrial design applications. Expanding on the tradition of portable screens in architecture, their 'give back curtain' integrates photo-luminescent pigments with synthetic or natural fibers to create a curtain/privacy screen that absorbs or emits light. This creates a dynamic medium that responds to the luminosity conditions in a space over time (Lupton, 2002, p.154).



Figure 7. Give Back Curtain, Kennedy and Violich Associates

4. Conclusion

Despite the many examples of innovative use of fabrics in architecture, fashion and design, their use in conventional built environments remains largely limited to decorative additions to space after the construction process is complete. I believe that use of malleable

materials, especially in small scale, domestic environments can provide adaptable, flexible, environmentally sustainable design solutions. This premise derives from my main research program that asks whether designers, in their creative work, can reduce the ecological footprint of built environments by partial or full use of malleable materials. Environmental concerns and technological advancements related to the production of materials and construction of built environments are continually forcing designers to reevaluate their current design approach. In the next few years, my aim is to build prototypes of alternative building design components that address problems arising from the life span of built and fixed spaces. Through built prototypes, I want to exploit the evolving potential of malleable materials to produce new forms of design adaptability (to different and changing functions), complexity and responsiveness.

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