

Fashioning New Structures

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Abstract

Fashion and architecture have historically been concerned with understanding the relationship between structure and skin (cloth and the body). With the developments and innovations occurring with materials science and technology this relationship is even more critical. Techniques traditionally associated with fashion and textiles are being used and transformed to create large scale lightweight sustainable structures in architecture. Fundamental to this advancement is collaboration and the need to take a multi disciplinary approach, as the project Composite Space involving fashion and textiles, architecture, business and aerospace engineering students at RMIT University demonstrates.

The disciplines of fashion and architecture are coming together through the use of textile design techniques, processes and materials. Like fashion, architecture primarily deals with form (coverage, protection and shelter) as a reflection of self. The fashion discipline has developed an extensive language to describe and explain the interaction between body (self) and cloth (form) recognising the need to balance self expression and function. Architecture is drawing on this language, not only as a means to express form, but to develop new ways of thinking about structures and to reconsider the relationship between structure and skin.

Essential to this is the use of textile composites with innovations occurring with materials sciences and technology. Textile composites, once exclusive to the aerospace industry are now being considered for the construction industry.

As composites are textile based, architecture is looking to fashion and textile design to help expand the possibilities of composite materials. Techniques and processes associated with fashion are being explored. Concepts such as pleating, tailoring, pattern making, drape, weave and knit are being used in architecture not just as a way to describe a spatial form but as an integral element of design and construction.

This reflects the shift in architecture towards more organic and fluid form.

Introduction

Fashion and architecture both deal with enclosing space around the human form (Bradley 2003, p2). In doing so, both are concerned with understanding the relationship between the body and

its covering, with their obvious points of differences being scale and choice of materials. While fashion is thought of as ephemeral and superficial, using soft, sometimes fragile, material, architecture is considered monumental and permanent, using rigid, highly durable materials (Hodge 2006, p11).

Fashion at the micro level focuses on an intimate and direct relationship of cloth to the body. The cloth provides protection as well as the aesthetic of being a means of self expression and identity. It must also work with the body and be flexible and lightweight enough to allow movement. In contrast, architecture deals with this relationship at the macro level, still providing protection and shelter, as well as expression and identity, but for the collective as well as the individual. Its relationship with material (traditionally steel and timber) is more indirect and rigid, as it surrounds the body or bodies at a distance.

With the advances in technology and materials within the textile industry this relationship of 'cloth' and the body is undergoing a re-examination. Textiles today are influencing how we respond to cloth and how cloth can respond to us at both the micro and macro level. For both fashion and architecture this is opening up new design possibilities. It is also increasing the complexities of the design process, making the need for collaboration and team work essential.

The influence of cloth

The relationship of cloth to the body is complex. At its essence, it is about providing basic protection and shelter from the elements (temperature, wind, rain). Once these basic needs are met, then it can provide "a means to express identity – whether personal, political, religious, or cultural" (Hodge 2006, p11).

For fashion this relationship is very direct. It operates at the micro level. There is an emphasis and need for the cloth to connect and interact with the individual. It needs to be tactile, soft and flexible. For the cloth to engage, various qualities must be taken into consideration. It is not only the look of the cloth (the visual design, colour and surface pattern), its durability (being structurally strong enough to withstand the wear and tear of being worn, to rubbing, to be stretched, distorted and of laundering), and its protective quality (safety such as resistance to chemicals and to heat) but also how the senses respond to it is important. That is, the tactile quality of the cloth (the touch and the feel of it) must be considered. Is the cloth soft, harsh, cool, warm, drape, smooth, or prickly, permeable or impermeable? It is a very personal

relationship as for the most part the cloth is in direct contact with the skin and the body. Hence the importances of terms like texture, handle, drape and comfort to describe a cloth.

For fashion designers, textiles and textile fabrics are an ideal 'cloth' to work with. Textile fabrics are a relatively thin and flexible structure, with a considerable surface area (Denton & Daniels eds. 2002, p119). They can take on an infinite range of diverse characteristics and performance qualities. These can be determined or set through the selection of different fibre types, yarns, fabric constructions and decorative applications, as well as finishing processes and applications.

Traditionally, textile fabrics can be seen to fall into 2 distinct categories; decorative and structural. The decorative is about the surface of the fabric and the application of pattern to that surface, in a two dimensional form. Often it does not have structural integrity in itself. The decorative element (the skin) can not stand alone and it needs a substrate (the bones) on which to work. This can be achieved using an extensive range of textile techniques such as printing, embroidery or fabric manipulation. In contrast, structural textiles explore the 'bones' of a cloth. Starting with nothing, fibres and yarns are selected and the cloth is constructed, through techniques such as knitting, weaving and non-wovens. Even though these fabrics can take on a three-dimensional nature such as pleats, welts, texture, it is still ultimately about the surface; be it a three-dimensional surface.

Textile fabrics have historically worked well at the micro level, along side fashion. Traditionally both involve being worked by hand. The textile designer would craft the cloth, either by hand or with small hand operated machinery such as a loom or flat-screen printing. In doing so, the textile fabric (be it decorative or structural) would be designed with no absolute connection to what its eventual form will be. Indeed the textile designer would consider the creation of the fabric in two-dimensional form only. It was not until the fabric was placed into the hands of the fashion designer that the three-dimensional form of the cloth would begin to be explored and the relationship of the cloth to the body be realised. It could be considered to be linear in design process.

At this micro level, textiles can be both decorative and structural, as its performance requirements are relatively low, compared with the needs of architecture. And because of its flexibility and ability to easily mould to a form, it allows fashion designers to explore a vast array of design opportunities.

In contrast, for architecture the very qualities of textiles that appeal to fashion are considered a negative. Indeed, “architecture is equated with density and mass, while textiles have often been limited to lightweight decorative expressions” (Garcia ed. 2006, p23). Architecture’s relationship with the body is at the macro level, where structure and performance is of paramount concern. Compared to clothing, architecture must withstand and protect against harsh environmental conditions. Hence it’s ‘cloth’ of choice are highly durable materials such as timber, steel, metal, glass and concrete. They are made to be permanent, hard and rigid with structural integrity.

However, fashion and architecture have not always been so distant. It is argued both shared the same origins of textiles and developed out of the need to provide protection and shelter against the environment and the production of social space (Wigley 1995) (Bradley 2003) (Hodge 2006). “Clothing first provided the body with wearable shelter, with architecture manifesting as a framework to support the animal hides and panels of fabric that became roofs and walls” (Bradley 2003, p2). Gottfried Semper in the mid nineteenth century theoried this link, identifying “the textile essence of architecture, the dissimulating fabric, the fabrication of architecture, with the cloth of the body” (Wigley 1995, p12). Semper asserted “the evolution of architecture resulted from technological changes rather than from the pursuit of idealistic forms” (Bradley 2003, p136).

For architecture, the very first primitive forms of shelter were made using textile techniques, such as weaving, knotting and braiding. But this was when architecture was operating at the micro level. Shelters were small and intimate. The shelter was low rising and temporary in feel. It was when the functional requirements were low, allowing structure and surface to be one.

It was only, with the inception of modern architecture that the surface of the building became independent of its structure (Colchester 2007, p92). As the scale for architecture increased, there was a greater need for structural weight bearing, and textiles were not longer seen as appropriate and were replaced with materials such as wood, stone and steel.

Thus, textiles were confined to the interior, where they became a tool to humanise a building (Garcia ed. 2006, p45). Textiles were able to connect the architectural form with the body, providing coverage for the space that surrounded it. In doing so, textiles (as it does for garments) were a means to define social space (Wigley 1995 p11-15), between private spaces

and public arenas, both defining our identity and place in society (Bradley 2003, p6). It brought warmth, softness and comfort, through providing coverage such as bed linen, upholstered furnishing, screens, carpets and curtains. Textiles were able to define the space and give it identity at a micro level. Hence imagine a block of high-rise flats that at the macro level all appear the same and impersonal, but at the micro level is altered through the use of textiles to personalise the interior spaces.

For the interior space, textiles are very much about the decorative, being flexible, fragile, soft and tactile, while the outer shell is permanent and rigid, with structural integrity. There was a distinction between the inside and the outside, the structural and the surface.

However, more recently the role of textiles as cloth is changing for architecture. Innovations and advances in textile fibres and technology are influencing how textiles are being used for architecture, as well as fashion. Tradition and technology, the decorative and structural, and the micro and macro are blurring. Traditional textile techniques, such as weaving and knitting that were once only suitable for fashion are being transformed to a macro scale. And likewise architectural concepts are being adopted by fashion designers.

This is leading to re-examination of the relationship of cloth to the body. In the future, the surface and structure, as well as the form the cloth takes may need to be considered as one.

For fashion, this can be seen as important in relation to the development of new fibres (such as with nanotechnology, micro-fibres, new synthetics that appear natural, and fibres that are lighter, softer and stronger), shape memory textiles, smart textiles and wearable electronics (Xiaoming ed. 2001). Textiles are being designed to be technical and 'intelligent' fabrics, with new functions being engineered into the cloth making them more responsive to the individual and to the surrounding environment (Jayaraman, Kiekens & Grancaric eds. 2006). Textiles are changing fashion's cloth to be more structural. This is allowing fashion to look to architecture to innovate with new forms, exploring the space and volume between the body and cloth, the structural and sculptural nature of fabric. A fabric may appear rigid and hold its shape, but in fact be soft and flexible, allowing for easy movement.

Fashion is also looking towards architecture, re-examining the concept of shelter and clothing with innovative projects such as Lucy Orta's *Habitent* and *Nexus Architecture* and Moreno

Ferrari's *Transformables Collections* (Colchester 2007, p74-83). These conceptual designs explore ideas such as nomadic shelter, future societies, cities and multi-purpose textile objects, using the most advanced new textiles.

Likewise for architecture, textiles innovations are impacting on its relationship of cloth to the body. Architecture is looking towards fashion and textiles to innovate, through the use of textile techniques, such as weaving and knitting. In particular, developments in the area of high performance fibres, technical textiles and high-tech machinery are enabling traditional hand crafted techniques to be transformed, scaled up and made through automotive means. "Fabric architecture has reasserted itself at the start of the 21st century" (Colchester 2007, p92).

This can be seen in the development and construction of tensile structures and air-support structures, such as the Millennium Dome, London 2001 (Braddock Clarke & O'Mahony 2005, p150-162). Likewise the development of textile composite structures is another area of significant advance. Traditional nature fibres, such as jute and wool (both once used in primitive housing construction) have been progressively superseded by synthetics such as nylon and polyester fibres, and by high performance advanced fibres such as glass, dyneema, arimids, carbon, and metals, as well as the emergence of hybrid fibres, textile composites and textile membranes. These are resulting in high strength, low weight materials that potentially perform better than conventional materials (Horrocks & Anand eds. 2000, p24-39), and thus are offering architects a new way to explore form that is more fluid and organic. It may be possible to do this so that the structure and surface skin are combined within the building.

With the changing relationship of cloth for architecture the surface of a building is now being discussed using the language associated with fashion and sportswear. A building can be "perceived as a technical analogue for human skin that regulates the transmission of light, heat, moisture and other environmental pollutants" (Colchester 2007, p92). The very intimate and direct relationship fashion has with cloth is being adapted by architecture to describe how a building might respond to the individual and its surrounding environment.

Given the impact of textile materials innovations on both fashion and architecture, it is becoming more important to look to each other not only for inspiration but to innovate. Already the two disciplines do look to each other and there are examples of their similar design processes

(Hodge, B 2006) (Garcia ed. 2006), but this needs to go further to include a broader range of design and technical disciplines.

As a cloth's complexity increases, so too is its relationship with the body. This is leading to greater complexities in the design process and need for a wide knowledge base. Collaboration and a multi-disciplinary approach are necessary. How might architects and fashion designers need to approach design?

“Advanced tools and materials are making the designer's task ever more complex. As a consequence, we are starting to see some changes in design practice. People from a wide range of disciplines are being included in design teams. Design is no longer regarded as the task of just one person” (Braddock Clarke & O'Mahony 2005, p136-137).

Because of the intimate nature of how fashion and textile designers approach their craft, both have to a certain extent collaborated. While collaboration may have been either direct or indirect it could often be considered linear. The fashion designer selected the fabric after it was made. In doing so, they would not really have a lot of input into the fabric itself. Sometimes in large fashion houses, fashion designers may have textile designers to develop fabrics for them. They would have some input, such as the overall thematic direction and colour palette for the season. But ultimately the cloth was developed separately to the eventual form.

So too for architecture, the development of materials has been separate to the development of the architectural form. Materials are selected from a pre-existing range and the architect must then work with them. Again, it is generally a linear process.

It could be considered that textile innovations are making it necessary for designers to work more in teams and to adopt a non-linear approach with design. There will be a greater importance on collaboration and for different expert persons to have input at various stages of the design process. It also gives rise to the likelihood of roles to cross over or even blur. If a fabric is the form, and the form the fabric, then where does one role end and other begin?

For fashion and architecture to deal with surface, structure and form as one entity opens up great possibilities, but also increases the complexity of the design process. Therefore there is a

need for a multi-disciplinary approach. In particular architects, fashion and textile designers, textile technicians and engineers will need to work together. In collaborating it will be critical to advance a shared language in order to communicate ideas and each area's knowledge.

For fashion this is not necessarily new idea, particularly in the area of knitwear design. For example consider the emergence of three-dimensional garment technology (such as Wholegarment by Shima Seiki). Textile designers, textile technicians and engineers must work together with fashion designers from the start to develop garments. It is not be a linear process, but a multi- faceted approach.

Three-dimensional garment technology allows for a garment to be integrally knitted, minimising the need for post make-up labour. With this you can not conceive a garment (the form) without considering the fabric. They are one in the same. The garment's fabric and form must be planned, designed and knitted in one. Whereas, traditional knitwear was based on the principal of 'cut and sew'. First the fabric was considered as a two-dimensional piece, with stitch structures, colour, fibres and yarns considered. The fabric was knitted, then the garment pattern pieces were laid over it and cut, then panels were sewn and trims and details attached. Now with three-dimensional knitting, all of these steps in the design and product development need to be considered at the same time. The preparation and development is complex and combined with the highly technical nature of the machine technology and programming requirements a team of designers and technicians is required.

The advantages of this technology is that once designed, the item can be mass produced and at lower cost. As well, an infinite number of variations of the design can be generated quickly, allowing for mass-customisation, and with minimal waste of raw materials.

This is made even more complex, when technical textiles such as the incorporation of electronics for sportswear and active wear are considered. More specialists are needed to be called upon to advance the design process. For example, with electronics being incorporated into a garment, the traditional cut and sew method of a garment is made redundant, as cutting into a circuit, would destroy the electronics. Therefore as the electronics and fabric are developed, the placement of them in relation to the body must be considered and the garment pattern must be determined. There is a need to work closely with the body and in three-dimensional form from the start of the design process.

This has led to innovative designs in fashion. And the question arises as to whether a similar approach can be expanded to architectural applications at the macro level. If it is possible, then architecture needs to look to fashion and its connection with textiles to find clues as to how to do this.

For architecture this is an exciting development. This is well demonstrated in the example of a collaborative design studio 'Composite Space' run at RMIT University between architecture, textile design, aerospace engineering and business students in semester 2, 2007.

At the start of the semester, teams were formed with a mix of all disciplines. The brief asked for each discipline to look to the other for not only for conceptual inspiration but more importantly to work together to share their skills and knowledge base. It was through this process of exchange, ideas moved from being influenced or inspired by each other, to projects being about true collaboration.

As part of this process, textile design students had to consider form as they developed fabric ideas and to consider their fabric would become fixed and rigid. Micro level textile techniques such as knitting, weaving and fabric manipulation techniques like pleating were considered and applied to the macro level. The fabrics were not to be in direct contact with the body, it was not about micro level fabric issues such as movement or drape. Instead the textile design students had to consider their work at a much larger scale.

At the same time, architecture students had to consider the cloth at a more intimate level and in its flexible state. They had to grapple with understanding a new dimension to how materials behave; of the fibres, yarns, fabrics and how these could inform and inspire. They had to consider the relationship of form, structure and skin, and to consider this at both the macro and micro level of how the cloth would perform.

Business students researched existing textile composite markets and products to inform their team as to the feasibility of ideas. Engineering students gave input as to how to address structural issues that these new materials and techniques brought up.

This highlights the need to take a multi-disciplinary approach to design in order to respond to the increasingly complex performance and construction related issues. As material technology innovates, more complex responses are needed. In particular, architects need to look at both the micro and macro level of materials and look to fashion in order to innovate.

Conclusion

Textile innovations are bringing about a re-examination of the relationship of cloth to the body and how designers can innovative with this relationship to create new forms.

Advances with textile materials and technology are making it possible for architects to scale up textile techniques and concepts that have long been associated with fashion and begin to apply them to a vast scale of a building. For architects, textiles are offering enormous potential. It is also allowing architects to look towards designing more responsive buildings that may engage and interact with the body in a more personal and intimate way.

Similarly for fashion, the new textile innovations are making it possible for ideas more closely associated to architecture such as volume, sculpture and structure to be explored and developed at a micro level. As well, fabrics are becoming more responsive to the individual with new functions being engineered into the cloth.

In the future, the cloth and the form it takes in surrounding the body will need to be considered not as separated elements, but as one entity. This will increase the complexities of the design process. Therefore a multi-disciplinary approach is needed. Further close collaboration between fashion designers, textile designers, and architects has the potential to produce new and innovative solutions.

References

Braddock Clarke, S & O'Mahony, M 2005, *Techno textile 2*, Thames and Hudson, London.

Bradley, Q 2003, *The Fashion of Architecture*, Berg, Oxford.

Colchester, C 2007, *Textiles Today*, Thames & Hudson, London.

Colin Gale & Jasbir Kaur, 2002, *the Textile book*, Berg, London.

Denton, M J & Daniels, P N (editors) 2002 *Textile terms and definitions, eleventh edition*, the Textile Institute, Manchester

Garcia, M (ed.) 2006, *Architextiles*, Architectural Design, Nov/Dec 2006, Wiley-Academy, London.

Hodge, B 2006, *Skin + Bones: Parallel Practices in Fashion and Architecture*, Thames and Hudson, MOCA Los Angeles.

Horrocks, AR & Anand, SC (eds.) 2000, *Handbook of technical textiles*, The Textile Institute, Woodhead Publishing Limited, Cambridge.

Jayaraman, S, Kiekens, P & Grancaric, A M (editors) 2006 *Intelligent Textiles for Personal Protection and Safety*, IOS Press, Amsterdam.

McQuaid, M 2005, *Extreme Textiles, Designing for high performance*, Thames and Hudson, London.

Xiaoming Tao (ed.) 2001, *Smart fibres, fabrics and clothing*, The Textile Institute, Woodhead Publishing Limited, Cambridge.

Wigley, M 1995, *White Walls, Designer Dresses*, MIT Press, Cambridge.