Textile Technology in Architecture

In the past, architects' lack of interest in textiles and its disconnection from architecture was due to Modernists belief in anti-ornamentation,[1] along with famous architects such as Adolph Loos and Le Corbusier discouraging the use of textiles as they believed it lacked finesse. [2] In his book, Towards a New Architecture, Le Corbusier describes a decorated room with cushions, portieres, wallpaper and carpets as 'sentimental hysteria' [3], perceiving these objects as useless. [4] Loos regarded textiles as features that caught dirt whilst hindering the flow of light and air. [5] However, in recent years, textiles have intrigued architects, as will be explored in this article. Technological developments have improved the performance of textiles greatly, these include combining construction materials with fabrics, new printing techniques, manipulating surfaces and advanced computer modelling tools, among others. Technological changes in the textile industry have led to the creation of structures that would have been unbuildable without these developments, along with characteristics accompanying these changes.

The English engineer F.W. Lanchester registered a patent for 'An Improved Construction of Tent for Field Hospitals' in 1917 to create a design for a pole-free tent that would depend on a difference between internal and external pressure for support. [6] Unfortunately, this design was never accomplished due to the unavailability of suitable technology along with lack of interest in the use of textiles.

Textile technology today, paired with appreciation and awareness for developments, have experimented with PVC (polymer of vinyl chloride) coated polyester, glass fibres, and other new membranes to create umbrella structures, domes and tent-like forms that appear to be floating. [7] Advanced materials became attainable in the 1950's resulting in the progression of tensile membrane structures. The potentials and abilities of these membrane structures were not celebrated until the 1980's. [8] An example of this is the Nuage Léger Grande Arche in Paris, France (1984-89). [9] Hightex, a world leader in fabric architecture and tensile structures, [10] created this 'light cloud' [11] form using coated glass fibres connected to cable supports made into an appealing trait. This structure is intriguing in that from a distance it seems quite delicate; however, visitors are repeatedly amazed by its scale, strength and stability.[12]

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Types of fabric

Polytetrafluoroethylene (PTFE) is a resin that was developed in the 1970's by DuPont under the trade name Teflon. It consists of microscopic glass beads that can be applied onto a woven glass cloth, creating a strong and durable fabric. This resin has been used not only as a coating, but also as high strength fibres. [13]

Most fabric membranes employed in architectural structures are established on a glass fibre, polyester fabric, or fluorite membrane (a mineral). A coating is applied to maximise their performance and preserve the membranes from damage caused by pollution. [14] Their features are listed below:

Coated glass fibre membranes: [15,16]

- hydrophobic (water-repellent)
- non-combustible
- suited for permanent structures
- chemically inert
- flexible
- soil-repellent top coat
- available in any colour
- lifespan of over 25 years
- easy to clean
- no UV light damage
- up to 40% translucency
- glass fibre content causes kinking

PVC (polymer of vinyl chloride) coated polyester: [17,18]

- ideal for temporary structures due to low UV resistance
- good kink resistance making it – appropriate for repeated use in mobile structures
- less expensive than the glass fibre-therefore used in both temporary and permanent applications
- not durable - the plasticizers within the vinyl covering eventually ascend to the surface, creating a sticky exterior catching dirt
- negative environmental impact – toxic in manufacture
- non-biodegradable
- toxic dioxins released in a fire
- expansion behaviour temperature-dependant
- difficult to recycle

ETFE (ethylene tetrafluoroethylene) based on the fluorite mineral: [19]

- highly UV resistant
- no yellowing or fracturing
- flame-resistant
- self-cleaning
- light emission, translucency and thickness vary depending on requirements
- easily recycled
- lifespan of 25-30 years

Specialised fabrics examples

- Tenara – sun-screen fabrics
- Dyneon – fabrics that can be extruded and processed, generating concave and convex forms
- Alpha – fabricate a range of coated glass fibre membranes varying from blackout to highly translucent and coloured to colourless [20]

Uses

For the Unilever Series of commissions at London's Tate Modern, Anish Kapoor used PVC coated polyester to create an extraordinary sculpture that was architectural in scale, stretching across the length of the Turbine hall – a distance of 150m. The structure incorporated three steel rings linked by a single span of PVC coated polyester.[21]

Architects Testa and Weiser gave much consideration to engineering issues, material development and fabrication technology during the design process of the carbon tower prototype. The unconstructed carbon tower (2001-04) consists of a skyscraper replacing steel structure with a 'structural network of forty twisted strands of carbon fibre' [22] - a material that is considerably lighter and more powerful than steel. This construction would be assembled using a 'purpose built robotic pultrusion'[23] (a method allowing the production of continuous debarment of composite materials), accompanied by braiding machines that 'knit vertical and horizontal strands together to form an exterior helix.' [24]

Testa and Weiser's experimentation with materials and technology has succeeded in revolutionising 'architectural textiles into lightweight reinforced membranes.' [25] Due to their strength, these membranes allow the removal of columns within buildings. Teresa Hoskyns explores this further, revealing that such synergy results in a building behaving as a single network, rather than 'a set of elements each performing a different task.' [26] Hence, it increases the potential for future investigation and improvements involving cooperative and responsive construction, freeing architecture from its fixed form. In this way, architecture may someday become like the interior of a building, like 'cushions and curtains, is constantly able to change and respond to different users.' [27]

Another example where textiles are applied to a construction material is the Eberswalde Technical University Library in Germany and the Storage Building in Mulhouse-Brunstatt in France by architects Herzog and De Meuron. Images representing the functions of the building were printed on the main exterior facades. This structure was praised for its "exaltation and celebration" [28] of the applied material. These architects have succeeded in breaking away from the formalist heritage of late-modernist architecture through the use of textiles as key elements in their popular architectural forms. [29]

Herzog and De Meuron's work is based on their personal interest in surface handling and pattern. This interest derives from Herzog's childhood, in which he grew up surrounded by the textiles of his mother's tailoring business, becoming 'interested in what people are wearing, what they like to wrap around their bodies…the aspect of artificial skin which becomes so much of an intimate part of people.' [30,31]

The Central Signal Box in Basel, Switzerland (1994-99) further emphasizes this engagement with architectural skins. This building was enveloped in thin copper strips that spiral and curve like fine pleats to admit daylight at exact locations.[32] Behaving as a lightning conductor, the copper shelters the sensitive equipment within the form. With the intention of softening this solid structure, Herzog and De Meuron have created an object with a striking artistic effect, 'a true evolution in structure.' [33] The copper's appearance transforms in different qualities of light whilst complimenting its surroundings.[34] This project demonstrates that textile technology has led to innovations that are not only beautiful in appearance, but equally functional and practical.

The 'Floral Street Bridge'[35] in Covent Garden, designed by Wilkinson Eyre Architects was constructed in order to link the Royal Ballet School and Royal Opera house, connecting the classrooms, stage and studios. This 'lightweight, semitransparent enclosed structure' [36], also known as the Bridge of Aspiration, 'appears to stretch like an expanding accordion' [37]mainly because the openings of both buildings are not directly aligned.

To accommodate this, a rotating aluminium spine sustains the 'sleevelike enclosure, pleated with twenty-three square aluminium portals'[38] and intervals, each portal able to rotate four degrees to achieve a 'twisting concertina-like form'[39] emphasizing the grace of dance. This design supports Hoskyns analysis on a 'fabric's ability as an external skin to take on different qualities of light' which can be manipulated even further when applied to building structures, for instance, a metal frame and stretched textiles 'over the frame to create the skin.' [40] In this manner, the relationship between outside and inside is broken down. In this case, the semi-transparent skin allows pedestrians to see those walking within the bridge and vice versa, while allowing sunlight to flow through.

I personally experienced this construction; I found it extremely intriguing and unique, with a powerful presence within the area. I witnessed the bridge after doing my research, doing so aided me in recognising techniques and the value of the decisions made concerning the bridge. I could clearly understand why a certain material was used, for instance, the skin enveloping the bridge is subtle yet the pleating detail is effective, influencing lighting and shadowing within the space while suggesting movement. It reminded me immediately of Issey Miyake's Pleats Please fashion line not only in appearance, but in its clever use of technology and delicate refinement.

Unifying fields: architecture, design and fashion

Technological advancements have allowed the textile industry to thrive, opening 'new possibilities for designers where restrictions of materials are no longer a limitation.' [41] Such improvements are 'making designs more exciting, with colour, wallpaper, textures, fabrics that could never have been created without the technology.' [42] This explains that such enhancements provide graduates of textile design with the ability to develop new practices of their own, whilst giving them the opportunity to work hand in hand with architects and interior designers. Evidence supporting this includes the technology 'Girli Concrete', co-founded by textile designer Trish Belford and architect Ruth Murrow. This method, also known as Tactility Factory, specialises in integrating textile materials into concrete in order to create soft, technical products for architects and interiors.

The skins created by Tactility Factory can be used on existing interior wall surfaces or combined with other precast concrete components. [43] However, only certain types of textiles are used. All the materials used are based on yarns that have been assessed to withstand the alkaline environment of concrete. [44] Glass Reinforced Concrete (GRC) is used since it is high in tensile strength, avoiding use of space. It also elevates its stability level in case of impact. Surfaces created using this technology include linen concrete, velvet concrete, stitched linen concrete and crystal concrete. [45]

In addition to this, both co-founders have been experimenting with the insulation and acoustic features of Girli Concrete, implying that textile embedded concrete may become heat regulators or sound barriers in the future. Due to this, Belford and Morrow have started testing the possibility of using this invention on exterior walls. [46]

Another noteworthy creation by these designers was 'catalytic clothing: a concrete and textile dress to demonstrate the concept that our clothes can potentially purify the air.' [47] To produce this dress, the design duo collaborated with Helen Storey, Professor of Fashion and Science at London College of Fashion, along with Tony Ryan, Professor of Polymer Science at the University of Sheffield. [48] Such partnership is evidence that textile technology advances have given individuals from diverse fields the opportunity to work hand-in-hand to produce unique products.

Tactility Factory use locally sourced materials, decreasing carbon emissions during transportation. The fabrication of their inventions produces as little waste as possible. [49]

Issey Miyake is an ideal example of a fashion designer demonstrating the overlay linking textile technology, architecture and interiors. Miyake is known and praised for innovation in clothing, textile and interior design. His famous 'Pleats Please' [50,51] line was the result of relying on textile development technologies and 'architectonic shapes' [52] that float and bounce depending in the wearer's movement, 'like kinetic artworks that expend and contract.' [53]

I have visited the Pleats Please store in London, and tried on his clothes in order to get a personal feel of the texture of the pleats. The clothes were wonderfully light and comfortable, flowing beautifully with movement in air whilst gently hugging the body. It is quite intriguing how the pleats completely transform the polyester, creating a structured fabric with character and life.

Moreover, Issey Miyake's contribution to interiors is evident through his partnership with Ron Arad, creating products that work with both clothing and furniture. This work was featured in the 2006 Milan Furniture Fair. Miyake has also coproduced with architects Frank Gehry and Jean Nouvel. [54] Miyake's New York headquarters was designed in collaboration with Frank Gehry. [55]

<u>Challenges</u>

However, like every field, the textile industry faces various challenges. In the context of its utility in architecture, the environmental and economic implications are prominent. The manufacture of some of these fabrics, such as PVC coated polyester is harmful to the environment and the public. This fabric is difficult to recycle and releases harmful toxins in a fire situation. [56]

Another crucial matter is that many individuals will oppose the interconnection between the architecture and textile design. Hoskyns touches on this issue, arguing for 'an end to the divisions between interior architecture, interior design and interior decoration and for combining them under one title: interiors.' Many professionals and students will be unhappy with the idea of having their careers and expertise this closely associated with another. In an unpublished survey I carried out with architecture and interior architecture students, 97% of students disagreed with Hoskyn's as many believed architecture studies the technical side in greater depth, therefore it is harder and requires more work and effort. Students did not see the relevance and did not appreciate that textile design requires much effort.

Moreover, in an age of increasing sub-specialisation one could argue that the concept of amalgamating extensive fields defies the purpose of a specialist being an expert in his practice. Alternatively, as the case with this nexus, such implementation may require extensive teamwork- not only is this expensive, but it is teamwork with specialists from diverse backgrounds, which can be seen as both negative and positive in the daily practice. For this reason, it could be argued that this could be a subspecialist field in itself due to the high level of proficiency required. However, one could also debate that since many firms have architects, interior designers, engineers and so on, it encourages fellowship and underlies their success.

Through technological advancements and interests in manipulating fabrics and surfaces, fashion designers, architects and those in the field of interiors have unanimously gained appreciation and awareness to the infinite possibilities partnered with future developments.

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