MORPHING STRUCTURES

An exploration of the fusion between marbled coating and triaxial weave

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Morphing Structures. An exploration of the fusion between marbled coating and triaxial weave

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Figure 1. Perceptual Pyramids

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1.2 Abstract

The purpose of this study is to investigate the effects of a marbled coating applied on a triaxial woven structure. Although both of these techniques are traditionally used for many years, they are nowadays utilized in innovative ways, the marbling being applied on a large variety of surfaces such as wooden floors or ceramics and the triaxial weave being used as a hi-tech material for sports or in the automotive industry and having applications in diverse fields, from art to architecture. Their fusion, however, is a topic that has yet to be thoroughly explored, which makes for the motive of this thesis work, as an opening has been observed for the exploration of the expressive power of their combination. The experimental approach that has been taken towards this exploration will determine how the marbling effect may contribute to the visual expression of the structure. Multiple cycles of experiments have been conducted in an attempt to understand the behaviour of the chosen materials and their combination, the effect that various colour combinations have and the best possible pairings between the elements. The organic marbling combined with the geometric triaxial weave proved to generate the most powerful visual expression and the clearest result out of all the experiments. Thus five experimental textiles were developed in order to illustrate different aspects of this complex relationship, where the marbling would affect the visual expression of the structure by either enhancing or concealing the structural aspect and the contrast between the graphic element and the organic one would be a constant presence throughout the work. This work pushes the boundaries of conventional textile design and through the application of a textile thinking to unconventional materials a different type of expression is born. By mixing a limited amount of variables in multiple ways, a large range of visual effects may be achieved.

1.3 Keywords

2.1 Introduction to the field

2.1.1 Background

Form and colour define our surroundings and shape the way we perceive reality. From the sinuous natural landscapes, to the angular cityscapes, the objects we surround ourselves with, the food we eat and the clothes we wear, form and colour are essential in understanding the world around us. In design, form and colour are tools for creating an endless variety of works; they determine one another, guiding the eye to focus on a detail or the whole ensemble, enhancing or concealing elements of each other, having the ability to transform one another. In the foreword of the book Dimensional colour it is stated that “a particular geometric configuration may appear very different when its colour, its context, or the colour of the light used for observation is varied.” (Swirnoff, 2003, p.X) In this project colour and form play an essential role, with focus on geometric structures combined with a marbling effect.

2.1.1.1 Paint as a medium to express

Marbling is a colouring technique which creates a pattern with an organic appearance, similar to marble, other stones or patterns in nature. It is traditionally used for paper and panels for furniture, but nowadays its application has expanded to a variety of surfaces. One marbling variety is thought to have originated in Japan around the XII-th century. Here ink is dripped on a water surface and then transferred onto paper; this technique is called suminagashi, as wonderfully illustrated in the works of Tadao Fukuda (1991). Ebru is another variation of marbling, first discovered in Turkey, India and Persia in the XV-th century, where the colours are dripped onto a viscous surface and then mixed with various tools such as combs and needles to create intricate designs. Many illustrated examples can be found in Nedim (Hyazinthe, 1986) and Yvonne Sonmez’s book, Türkisch Papier. Ebru. Turkish Marbled Paper (1987). Around the XVII-th century, marbling made its way to Europe, where only a few had knowledge about its manufacturing process. Nowadays very few, if any of its secrets are left undiscovered, while countless books and how-to web pages on the subject have appeared. While marbling is still used for creating beautiful paper surfaces, it has also expanded to other fields, such as textiles, interior design etc. and new understanding arises on its properties from a design, art and science point of view, in the latter related to fluid dynamics.

A distant relation with these traditional methods is observed in paint pouring, also known as fluid art. This is a technique of utilizing the paint without the use of traditional tools such as brushes or knives, but by pouring the paint directly on the canvas. An early expression of this technique was created by members of the abstract expressionist movement such as Jackson Pollock.
Black over Yellow, around 1950) with his ‘drip’ method and Helen Frankenthaler (Canal, 1963). Contemporary artists have brought multiple variations to this technique, creating a visual diversity in its possibilities of expression.

2.1.1.2 Structural expressions

Triaxial weaving is a technique traditionally used for basket weaving. Here “the weaving strands are in three directions in contrast to the more usual warp and weft structure” (Gailiunas, 2017). This type of weaving is now gaining new values as an element in art, design and technology, offering various possibilities both from a technical and aesthetical point of view. The technique has developed from its initial artisanal application into a fantasy of hypnotic colors and shapes, both as a means of producing strong graphic elements and as a way of shaping organic volumes.

2.1.2 State of the art

The field of textiles has expanded in recent years, introducing new materials and techniques and adopting innovative ways of approaching traditional crafts. Many contemporary works are interdisciplinary, bridging gaps between fields such as art, design and science and challenging the conventional understanding on what an art work or product may be.

Some artists pushing the boundaries of the medium of paint are Guillermo Mora and Leah Rosenberg. Mora (Mis pies, tu cabeza, 2014) uses the conventional medium of acrylic paint in an unconventional way in order to create three dimensional works with focus on color and shape. The artist throws a large quantity of paint onto a surface which, when it is dry, he peels off and folds together, supporting it only with rubber bands and leather belts. Another eye catching element of his work is the texture, from glossy to a cracked surface and the pastel color tones.

Similarly, Leah Rosenberg (Mille Feuilles, 2008) is using acrylic based paint as her primary medium. She creates sheets of acrylic paint and then stacks them on top of each other, moving the medium from two dimensional to three dimensional and by stacking and folding them she creates sculptural pieces. She also uses paint sheets to create objects that are somewhere at the border between painting and sculpting. A series of her work displays the acrylic paint as single sheets resembling hanged up pieces of fabric. Thus a fresh perspective is given to the matter through the transition from the conventional view on the paint medium to something else, a fabric or a sculpture in itself, removing the paint from the supporting canvas.

A milestone in the approach of the paint medium as a self standing material and in the change of perspective on it has been set by the artist Lynda Benglis (Totem, 1971). She creates sculptural pieces that mix different materials such as plaster, latex, pigments, aluminum, bronze and other metals. An extended
series of her works has the aspect of blobs and layers of paint suspended in the air or on the floor, seeming to still be flowing. Her art has a transformative quality, the material gains an unexpected factor after being manipulated, where liquid becomes solid and heavy becomes weightless. The works have an organic aspect and seem to have a life and movement of their own that is immortalized in a sculpture.

Another work pertaining to the appearance of paint is present in the graduate collection of Oksana Anilionyte, Fluid sense (2016). Oksana works together with scientists to create a polymer-based material that looks like liquid paint and interacts with the wearer’s body temperature, becoming a second skin. A defining characteristic for her work is its interactive quality, but regarding the visual aspect, the work has the appearance of organic wet paint that has just been applied on the body.

Troels Flensted (Poured Bowls, 2015) uses a water based acrylic polymer, resins and mineral pigments to create interior design objects that have a marbled appearance and capture a ‘frozen moment’, as stated by the designer about his poured bowls.

Triaxial weaving may be a traditional weaving technique for now but it has potential for innovation in carbon fiber composites for the automotive industry, musical instruments and is already being used for other various technical fabrics, as stated by The Textile Institute (R.H. Gong, 2011, p.160). It is also a useful tool in architecture, supporting the construction of stable structures due to its configuration based on equilateral triangles.

One architect, designer and inventor who adopted triaxial weaving in his work is Buckminster Fuller, (Nine chains to the moon, 1963) who developed geodesic domes as an alternative form of housing.

On a smaller scale, but equally as spectacular is Norie Hatakeyama (Energy Field Series, 2007). Proving an extended knowledge and control over the technique, the artist uses paper to create delicate organic shapes and volumes and to challenge the general perception on weaving and the triaxial technique itself.

Shore is a company working with woven rugs made out of silicone thread. They use a thick thread that determines the oversized aspect of the weave. The combination of a traditional technique, weaving and a hi-tech thread made out of silicone results in an innovative work. The colour palette is bright and playful and gradients add a visual bonus to the rugs. This is an example of color and structure interaction.

One way of approaching the interaction between the inherent structure of the fabric and coating may be observed in the work of Lucy Simpson (Silicone printed textiles, 2014) who, through material based experiments has discovered that the combination of silicone with puff print paste and aquasuede may generate a variety of textures which react differently depending on the underlaying fabric. Through different methods she creates materials coated with a pasty looking, brightly colored layer of silicone. Although silicone is a rather common coating material and textile treatment, the way it is used here
brings a different expression. Here the colors used are unitary and the accent is usually placed on the surface appearance of the material and coating.

Holton Rower (171229a, 2017) is an abstract artist working with sculpture, installation and assemblage whose primary medium is paint. By pouring different coloured layers of paint on three dimensional surfaces he creates mesmerising works that appear to be melting. His works are characterised by a mix of control and chance. He identifies his ‘pour paintings’ as sculptures. The hypnotic aspect of the multicoloured surfaces is determined by the uncontrolled quality of the poured paint. The artist prepares the surfaces, he chooses the colours, their quantity and the order they will be poured in but cannot control subtle details of the paint flow, leaving that aspect to gravity, aspect which dictates a lot of the appearance of the final product. The wooden three dimensional surfaces on which the paint is poured gain new volumes and are transformed by the stripes of dripping paint. The resulting works are situated at the intersection between painting and sculpture, with a highlight on the process. The work is finished when the paint stops spreading.

It is stated that “the most successful contemporary textile artists use the available new technologies alongside traditional techniques and materials, resulting in rich and powerful work.” (Braddock and O’Mahony, 1998). One designer combining the old and the new is Pernille Snedker Hansen (Refraction, 2013). Her Marbelous Wood project is reinventing the common wooden floor by the addition of a marbling treatment. The finished product looks organic, vibrant and colourful. Here an old technique – suminagashi – is used in a new context. The juxtaposition between the organic aspect of the marbling and the rigid geometry of the wooden tiles brings a balance through contrast, the geometry seems to be broken by the marbling effect and through it the pattern of the wood fibre appears to be enhanced. The result is fresh and spectacular and by apparently simple and straightforward means taken out of their common context a new view is born.

Each of the exemplified designers and artists have a different perspective and approach in their work, which leaves room for further exploration in colour and structure but more importantly in their interaction. The marbling is used both as a decorative and functional chromatic element in creating the design, either to create the illusion of volume in a flat surface, to disrupt the visual expression of the structure or to enhance the structural aspect, and brings a novel aspect to the exploration of colour and depth perception.
2.1.3 Motive and Idea discussion

The motive for this design project is the lack of exploration of design possibilities afforded by marbling and ways in which marbling may affect a textile structure. Although there are many designers and artists who work with colour and structure, these two specific techniques, marbling and triaxial weaving are not a common pairing in the field of design, thus a question arises as to what may happen when the two elements are placed together and an opening is created for further exploration and discovery. While most of the designers and artists described in the State of the art section deal either with paint as a material or triaxial weaving as a means of creating three dimensional shape, there are few who combine the two in creating valuable examples that also reflect on the work in this design program. The work of Lucy Simpson (Silicone printed textiles, 2014) beautifully illustrates the fusion of structure and coating. Similarly to her work, this design project seeks to create a dialogue between the structure and the coating, where the coating subtly follows the outline of the structure while also distorting its visual perception. Another example where structure and coating, this time as marbling coexist in the same work is represented in Pernille Snedker Hansen’s project, Marbelous Wood (2013). The balance between the geometric structure and the organic marbling is something that is also desired in this design project.

A unique characteristic of this project is precisely the unexpected fusion of two traditional techniques, the marbling which has been used for decades in order to create expressive prints on paper or as interior design accents and the weaving which is used both as an aesthetic and functional element in art, design and everyday life. Through this fusion an unexpected representation of what a textile may be arises. Both techniques have their own strong visual qualities, for marbling it is the organic look and for triaxial weaving it is the geometric expression, thus determining a tension in their meeting.

The paint, once liberated from its conventional canvas and due to its initial liquid state is free to take the shape of the background that it is poured on and also to influence the way that the background is visually perceived. The possibility of the material to alternate between two and three dimensions determined a visual play between real and perceptual volume by exploring the material in various forms, either as a flat surface or placed on a three-dimensional shape, play which is taken even further through the colour choice. Volumes appear where they were not, two dimensional shape seems to jump out of its flat plain, the expression of the structure becomes richer and structured shape becomes an organic organized chaos.

By applying a textile thinking to unconventional materials such as acrylic paint and industrial foam the conventional view on textiles is challenged and the border between textile design, painting and sculpture becomes blurred. The rich colourful expression is meant to make the viewer wonder about what one may see and to observe the contrast between the uncontrolled flow of the paint and the organized geometry of the structure and the changing of the visual aspect between flat and three-dimensional.
2.1.4 Design Program

This design program deals with the relation between structure and marbled coating. As stated by Downton (2005, p. 9), quoted by Koskinen (2011, p.27) research programs always have “a central, or core, idea that shapes and structures the research conducted.” In this case the core idea is the fusion of these two techniques. The visual expression of the triaxial woven structure is changed when it is coated with the organic marbling. A part of the process which evolved alongside the technique exploration is the visual and material transition from flat to three-dimensional and the search for colouring possibilities that would create the illusion of three-dimensionality in a flat surface.

The process evolved organically from exploring the flat paint layer in its pure state to bringing it into three-dimensionality by placing it over different structures. The structural exploration developed from testing conventional ready made textiles, to oversized hand made knits and settled on triaxial weaving, which offered a variety of possibilities for colouring, versatility in its expression when combined with the marbling and the possibility to make a gradual transformation from flat to volume, thus offering the potentiality to create a range of expressions.

Figure 6. Marbled acrylic skin
2.1.4.1 Marbled acrylic skins

The first steps into choosing this theme were taken in the Artistic Development course. The work here was based on an exercise in process art through the spontaneous use of paint on a large surfaced canvas. Process art is an artistic current where the process “is not hidden but remains a prominent aspect of the completed work, so that a part or even the whole of its subject is the making of the work “(Tate art term, n.y.). Through experimentation with paint and accidental paint splatters on the surrounding surfaces, the realization arose that a thin layer of wall paint, when dried on a plastic surface, may be peeled off and stand on its own as a material similar to leather rather than a medium on a canvas (Fig. 6). At the same time a marbling effect was explored through the mix of the colours prior to their pouring on the canvas. Koskinen explains that “Designers trained in the arts are capable of capturing fleeting moments and structures that others find ephemeral, imaginative, and unstable for serious research.” (2011, p.28) Based on subtle observation of somewhat accidental discoveries an idea for the design project was born.

2.1.4.2 Adding volume and shape

At the start of the Design Project these discoveries were further developed through an attempt to create a material and to place the marbled paint in a context. An innovation here was the separation of the paint from the canvas and thus the creation of an opportunity to move the surface from two dimensional to three dimensional. Once the paint is removed from its background it gains new definitions and no longer belongs in the ‘painting’ realm, having the potential of becoming anything, be it a coating, a textile or a sculpture. Another point of interest is the trace that the paint layers leave, the marbling effect which gives clues about how the pattern was created through the direction and size of the paint traces, as a motion frozen in time. Jones states that “Creativity is not so much having good ideas as being willing to attempt what is unfamiliar, being willing to change one’s mind.”(1979, p.34) This mindset and strategy were adopted in the work in this design project.

After a series of experiments it was observed that the paint sheets had a very flat appearance when dry, which is why the addition of an under layer was considered in order to take the exploration further and add volume to an otherwise flat surface. Levin(1966) states, as quoted by Cross in his article ‘Designerly ways of knowing’ (Cross, 1982) that “the designer knows that some ingredient must be added to the information that he already has in order that he may arrive at a unique solution. (...) What then is this extra ingredient? In many if not most cases it is an ordering principle.” In the case of this design program, the ‘extra ingredient’ was the choice to add a structure on which to pour the marbled coating on. Several options were tested, already existing woven and knitted textiles took the place of the structure and the decision for
the first part of this Design Project was to create a series of oversized knitted and knotted textiles that would have different yarn shapes and scales (Fig. 7).

In this design project the marbled coating plays a fundamental role in the overall expression of the textile. Coatings are often used for technical purposes. They may offer waterproof or fireproof qualities, fluorescence, stain resist, antimicrobial properties and so on. Other times, coating may be used for aesthetic purposes, either to add something to the initial material or to change its structure, as is the case for this work. The coated fabric “will have many properties which cannot be offered by either component individually” (Fung, 2002, p.24). The knitted structures from the first series of works were coated with the marbling effect only partially, in order to better understand the visual effect, to observe both the non-manipulated structure and the coated part and to enhance the illusion of the structural disruption. This effect also became a central element for the current work.

2.1.4.3 Structural exploration – triaxial weave

For the research project, the structure exploration was pushed further in order to discover how various structures interact with the coating. A variety of structures were tested, some with an organic appearance and others geometric. A triaxial woven structure was built in order to generate a contrast with the organic effect of the marbling. The technique was chosen due to its strong geometric aspect when woven within certain parameters. A similar thought process may be observed in the master thesis of Mi-Young Moon (1986, p.27), where she
recognizes the ‘natural affinity for grids’ of the woven structure and attempts to ‘destroy the rigid form by deliberately breaking the rhythm of the line through her interpretations with color and pattern’.

The introduction of triaxial weaving to this thesis work resulted in the opening of new possibilities of expression within the frame of the project. This technique shows versatility when small variables are introduced. Through variations such as thread thickness, width, or shape, colour and further treatments a large variety of structures may be achieved. This structure was first explored as a three dimensional volume (Fig. 8), since it offers the possibility of being woven as a cylinder and other three dimensional shapes. In this case, additional volumes were created by twisting and knotting certain yarns while constructing the pieces in order to push the three-dimensional effect even further. As a way of enhancing the interaction between structure and coating a variety of coating methods and assembling ways were tested. Small variables in the placement of the colours, the order of the actions and the scale create a dramatic change in result. The addition of twists and knots in the surface of the triaxial weave triggered the idea of pushing the three dimensionality, which would further be developed as the pyramids structure in the final pieces.

Figure 8. Circular triaxial weave
2.1.4.4 Colour matters

An essential element is the colouring, which may drastically influence the final outcome of the pieces. Colours are an important tool for the designer and when used properly they can determine a specific result. ‘How we experience colours is subjective, but designers are trained in chromatics to be able to design and choose colours in a more objective way. Also to use different colour and form combinations to achieve an expression to stand “out” or direct attention in different ways, i.e. to hide forms or highlight another etc.’ (Worbin, 2010, p.24). The colouring choices combined with the structure allowed to create the illusion of volume in a flat surface and to both disrupt or enhance the structural aspect, depending on the particular colouring effect applied. The combination between the triaxial structure and the marbled visual effect applied in this way is seen as new in the field of textiles and thus may be further explored in order to better understand its aesthetic and functional value.

2.1.5 Aim

The aim of this design project is to investigate the visual transformation of the structural expression of a triaxial weave through the use of marbling.

3.1 Method

The method applied in this design project is structured into an experimental exploration, the part of discovery, where the limits of the project are explored and extended in order to achieve a better understanding of the potential ways of approaching the topic followed by the part of reflection on the experiments that were carried out, which includes their analysis and evaluation and which guides the process to the final step, the decision making. This sequence is repeated multiple times in order to generate the results most suitable to the problem. After enough alternatives have been explored and their potential development and characteristics have been understood it is time to decide on the course of action that would best illustrate the aim of the design project and to carry it out. The initial state of the design project is unstable, which is why a large number of experiments were carried out in order to better understand the qualities of the materials, the way in which they interact and the alternatives that may be available, essentially any type of experiment that would offer more relevant information about the topic. These actions contributed to better defining the design program, the idea behind it and ways in which it may be manifested. The broader understanding of the subject determined critical thinking, which at times led to approaching a different solution to the one initially thought to be suitable. This is a further evidence of the initial uncertainty when approaching the design project. As stated by Jones (1992, p.XXV), to change one’s mind about the course of the project is something “likely to occur” when dealing with a complex design process.
After a careful evaluation of the resulting samples done by reflecting upon them, analyzing them visually and through touch and in some cases comparing the manipulated and non-manipulated samples, a limited number of results were considered to offer relevant information that would support the further development of the design project, thus they were selected and expanded again, but more focused on specific aspects of the project. The process is cyclical, meaning that some actions are partly repeated, the results are analyzed and refined, they are expanded, then refined again and the focus is placed on a more and more specific idea with each cycle until there is a coherent thread throughout the whole process. The selected results support the articulation of a precise idea and provide solutions for producing the material manifestation of the main idea. Guidelines for this sequence of actions are provided by Jones (1992, p.64), who describes the design process as being divided into three stages, which are divergence, transformation and convergence. In the case of this design project, the divergence stage was the one where the experiments expanded the design process in order to create enough possible directions to find a proper solution.

The transformation stage brought a better definition of the project, details were added in order to gain a clearer picture and limitations were starting to be set. Materials, techniques and tools were decided for further development. In the convergence stage there was an ultimate refinement of the subject. Details were set and precise actions were carried out in order to illustrate the aim of this design project.

The samples resulted from the experimental work were accompanied by a number of sketches and scale models that would support the clarification of the aim and expected result. Sketches are a reliable method for clarifying and extracting information throughout the design process, as stated by Schön (1983) quoted by Cross, describing sketching as a dialogue, where “[The designer] shapes the situation, in accordance with his initial appreciation of it; the situation ‘talks back’, and he responds to the backtalk” (Cross, 2006, p.19). In this design process sketches and models were used in order to form an overall view and also to set small details, such as shapes, structures, scales, colours, visual effects and ways in which they may work together.

By applying this set of actions, the experiments were refined until they produced a result that demonstrates the aim of this design project.
4.1 Development and Design rationale

During the design process the exploration involved different aspects of the project, such as materials, techniques and types of structures.

4.1.1 Marbling exploration

A series of experiments regarded the materials used to create the marbling. The following alternatives were explored:

- Acrylic based wall paint
- Pigment print paste and extender
- Regular acrylic paint
- Epoxy resin
- Silicone
- Cracking medium
- Gloss finish

The combination of acrylic based wall paint, pigment print paste and water (Fig. 12) was chosen due to the ease it can be controlled with and the variety in colour pallets that it may create, qualities which were lacking both in the epoxy resin and silicone. The resin takes an extended period of time to dry and becomes hard when it does, which makes it difficult to manipulate. Although expressive visual effects may be achieved by using the other materials, it was decided to opt for a more time effective alternative.

The wall paint and pigment print paste are both easily available materials that mix well together and may be manipulated without considerable difficulty. The regular acrylic paint created similar results and may be a good alternative in generating the same type of effects, the limitation here came with the difficulty in finding the large quantities necessary for experimentation and for the large scale pieces.

The glossy appearance of both the cracking medium when it is not covered by a top paint layer and the epoxy resin triggered the idea of introducing another texture that would counterbalance the matte aspect of the dry paint. Thus, a gloss finish spray was added to some of the final pieces.

The pouring methods initially involved a variety of alternatives which were eventually reduced to the marbled patterns. Some of these were:

- Colours poured on the surface in a random drip pattern
- Colours poured one by one in a ‘faux’ nonwoven pattern
- Colours poured over a previously made and dried paint surface
- Colours poured over a wet paint surface
- Colours poured all together and then spread on the surface - marbling effect - when the colours are mixed together into one container and then poured
- Colours poured one by one - marbling effect II - when they are poured individually on the surface
- Combination between the last two alternatives
After a visual and tactile evaluation it was decided that the strongest expression is achieved through the marbling effect (Fig.13-16) thus this was the one that was taken further. The other alternatives (Fig. 9-11) lacked the unexpected factor and the coherence of the marbling. Although physically flat, this effect has an inherent appearance of volume and a strong organic character, qualities which generated the challenge to find a counterbalancing element which would add tension to the resulting work.
Figure 13. Marbling exploration
Colours poured drop by drop

Figure 14. Marbling exploration
Colours poured drop by drop

Figure 15. Marbling exploration
Colours poured drop by drop

Figure 16. Marbling exploration
Colours poured all together
4.1.2 Materials and structures exploration

The material exploration to be used for the structures involved experimenting with various conventional textiles and unconventional materials in order to understand their properties and the way in which they interact with the marbling effect. These materials were:

- Ready made knitted fabrics
- Ready made woven fabrics
- Textile net
- Tulle fabric
- Wool yarn
- Bubble wrap
- Plastic foil
- Flat industrial insulation foam
- Tubular industrial insulation foam
- Cable
- Polyester string
- Waterproof fabric and sponge custom made quilted thread
- Cardboard
- Styrofoam spheres and metal wire
- Wooden chairs
- Metal table
- Natural elements: tree branches and pine cones

Some of these materials, specifically the ones that were already assembled into a structure or an object, were directly coated with the marbled paint, others such as the cable, string, insulation foam, waterproof fabric and sponge and the styrofoam balls were first manipulated into a structure, usually a knit or weave and then coated.

The wooden chairs, metal table and natural elements, although visually attractive, directed the research away from its actual focus which left for little to no space for further development, thus they were discarded. The cardboard (Fig. 21) was too fragile, but this experiment led to the better understanding of the paint as coating, due to the fact that both the marbling effect and the outline of the structure underneath were visible. The cable and string were not as malleable as expected and the final outcome of the structures that were created was dull. The ready-made textiles(Fig.18-20) were discarded due to the limited amount of options they presented for future development. Although the texture of some of these fabrics remained visible after the coating, which added a textural element to the samples, most of them, due to the nature of the fabric, absorbed the paint thus making the marbling incomprehensible.

It became obvious that in order for the marbling to be visible, the surface it is poured on needs to be waterproof, so that the paint acts as a coating. This may
also be done by adding a prior coating before the paint layer, but it was decided that it may be more effective to create a structure from zero using waterproof materials. This would allow flexibility and a better control of the actual appearance of the structure, which would eventually open the frame of the project in order to find a suitable solution. A thread was produced from sponge covered with a waterproof material and then quilted together (Fig. 22, 23). Although it created an intriguing volume and due to the shape of the quilt in triangles it was able to generate various geometric shapes, it was discarded, evaluated as a time consuming alternative against other materials which would support a more continuous process. The industrial foam may have a large variety of shapes and it is also available in large sheets that may be cut in various shapes and widths. Due to its flexibility, light weight, malleability, availability, and waterproof quality it was chosen as the main material for the final structures.
A series of experiments were made based on the search for the best structure to be combined with the coating. The structures tested were:

- Oversized knits
- Oversized knotted structures
- Oversized weave
- Regular organic structures
- Irregular organic structures
- Spheres structure
- Variations on woven structures
- Triaxial weave – flat
- Triaxial weave - circular
- Variations on triaxial weave
- Pyramids structure
The initial set of knitted and knotted structures (Fig. 24-26) were a somewhat successful alternative for the structure and merged together harmoniously with the marbling effect. Here the marbling produced a disruption in the visual appearance of the structure, making it impossible to distinguish. Although the desired effect was created, after a series of samples were made it was decided that the range of possible expressions may be somewhat limited, thus the search continued. The organic structures (Fig. 27, 28) and the spheres (Fig. 29) produced ambiguous results, in the sense that although visually pleasing, there was not a significant tension between the structure and the marbling.
Figure 27. Structural exploration - organic structure
Materials: circular foam, acrylic paint
Technique: One colour coating, marbled coating

Figure 28. Structural exploration: organic structure
Materials: Circular foam, acrylic paint, epoxy resin
Technique: One colour coating, marbled coating, epoxy layer over marble

Figure 29. Structural exploration: Spheres structure
Materials: paper spheres, metal wire, acrylic paint marbled coating
The triaxial weaving was the answer to the search for contrast. Through its geometric appearance it was at the opposite end, expression wise, of the marbling, which is flowing and not structured. The cylinder weave (Fig. 30-32) was discarded due to the fact that it was not an absolute necessity in order to prove the point of the project. Its quality lied in the fact that it can be placed at eye level, which may easily be achieved with many other surfaces. When the pyramids structure is added as an under layer in the flat triaxial surface the expression is further enriched and the play between two and three dimensions becomes even more pronounced. Due to the geometric character of both the weave and the triangles they are able to merge together almost seamlessly and may be combined as a continuous changing surface where new forms emerge. Together with the various colouring techniques and thread shapes and thicknesses the triaxial weave is able to generate a large variety of visual effects that may be explored extensively. However, for the moment the exploration focuses on five alternatives and combinations between the weaving and the marbling that have been considered to give an insight into the main idea of this project and to support a clear picture of what is possible when the two elements are combined.
4.1.3 Development and Result - Final pieces

4.1.3.1 Pattern Transforming

The first piece, Pattern Transforming (Fig. 45-48), combines the flat paint, flat triaxial weave and pyramids structure. There is a transition between two and three dimensionality and two different types of marbling are used. The colour palette is kept the same in almost the whole piece in order to let the viewer observe the structural transformation, from a flat organic pattern to a fragmented pattern and then going into a three dimensional volume. The pyramid volumes are initially visually distorted but become clear again when the light coloured thread is added. The colours chosen are a combination between light and dark values, specifically black accompanied by light turquoise, light grey and lilac (Fig. 36). The additional marbled sheet has a combination of warm and colder colours and an overall lighter shade (Fig. 35).
Figure S5. Marbled sheet before cutting, warm-cold

Figure S6. Marbled sheet before cutting, light-dark
This piece was produced by firstly coating the flat foam surface with the paint. Here the colours were poured one by one, drop by drop on the surface in a somewhat linear pattern, the light colours had the black in between them in order to generate a chromatic contrast. The marbled pattern is purposefully the same in almost the whole piece in order to let the viewer observe the structural change and how the structure and coating affect each other. Three large paint sheets were made to cover a part of the structure, one of them being the base, and an extra sheet was made (Fig. 37) to add lighter accents. This extra sheet was coloured in light, warm tones of salmon and pink with a diffuse contrast of light blue and lilac. After drying, the base sheet was partially cut into 6 cm wide strips, leaving a portion of the sheet uncut to become the flat part of the resulting piece, the area where the initial pattern may be observed in its unaltered state. The other sheets were cut into strips (Fig. 40-41) which created the other threads. The flat part transformed into the woven pattern when the other dark and light threads were interwoven with the base sheet (Fig. 42-43). This creates a pattern where the direction of the threads may be subtly understood due to the direction of the marbling but the cube pattern inherent in the weave is not obvious. Then the pyramids structure was added. This was initially made out of cardboard on top of which the threads continued to be woven (Fig. 42) in a similar manner as they previously were. Light coloured contrasting thread accents were added. In the pyramids part it may be observed that the part where the pyramids are only covered with the dark and light threads their visual appearance is distorted and the volume becomes incomprehensible. When the light coloured thread is added to the pyramids, their volume and shape become understandable again. What may be observed are shapes emerging from a flat surface, a play between two and three dimensions, clues about the direction of the paint and the weave, structures being distorted and then reconstructed. Thus, the methods used here are: for the marbling, the paint is poured both through all colours mixed together and the colours poured one at a time, they are added before weaving and there are three types of structures, the flat paint surface, the flat triaxial weave and the pyramids. The end threads are let loose in order to show the way the structure was produced and that a continuous sheet of foam was used – this is shown through the continuity of the marbled pattern on the individual threads. Thus the surface transforms from a flat two dimensional layer, into a flat weave characterized both by a disrupted marbled and structural pattern and then into a three dimensional pyramid layer.
Figure 37. Creating a marbled surface by pouring and spreading the paint
Figure 44. Pattern Transforming. Process

Figure 45. Pattern Transforming. Detail
Figure 48. Pattern Transforming - First piece
Detail
4.1.3.2 Melting Pyramids

The second piece, Melting Pyramids (Fig. 62-65), brings a variation in the structural aspect through the pyramids under layer. Although the structure is very strict and organized, the apparently random placement of the marble brings an organic quality to it, breaking the rigid pattern and making the rhythm of the volume harder to understand. This contrast is further enhanced by the colour choice, unitary in the structure and more complex for the marbling. A glossy transparent thread creates a textural contrast and again breaks the rhythm of the structure. When draped irregularly over a surface, the structure gains new shapes and volumes and completely transforms, allowing for its flexibility to be observed (Fig. 58,59).

The piece was made by first creating three large peach coloured foam sheets (Fig. 50,51). When dry, the sheets were cut into 10 cm wide threads. In parallel a pyramids structure was produced (Fig. 53). Here a waterproof structure was needed, due to the fact that the pyramids were supposed to be coated with the marbled paint after weaving. Thus, the initial cardboard was replaced with a transparent plastic sheet. After observing the qualities of the plastic of being transparent and glossy it was decided to introduce it not only as a structural element, but as an aesthetic one as well, so along with the matte coloured foam thread there was an additional plastic thread which broke the monotony of the structure by creating a glossy and transparent surface. The overall shape of the piece is a rhombus.
After the threads were woven (Fig. 52, 54-56) and secured on top of the pyramids structure, a marbled effect was added (Fig. 57, 60, 61) by pouring colours chosen according to a tetradic colour scheme, combining turquoise, lilac, pink and peach and adding black for a light-dark contrast. The structure was draped over a podium and then the colours were poured one by one on the central area of the structure, dripping from the top of each chosen pyramid in the same order at all times. The paint flow on the angle of the pyramids and gathering at the base of the structure generated an organic pattern that distorted the initial structure, making the shape difficult to understand. The gathering of the paint on the lower part enhances the contrast between rigid and flowing, standing as a proof of a once liquid material. Briefly, the sheets were covered in a unitary colour, cut, woven on top of the pyramid structure and then coated with the marbling, which was produced by pouring the colours one by one on the surface. When placed on an angled surface, this piece gives a better understanding about its flexibility and volume.
Figure 65. Melting Pyramids
4.1.3.3 Gradient Circle

The third piece, Gradient Circle (Fig. 76-80) presents an alternative way of creating the structure by using a circle as the base. The structure is partially coated with a gradient effect that flows outwards and creates the illusion of volume and depth. The difference between the coated and uncoated parts and the subtle glossy effect added to the basic structure enhance the contrast between the elements.
In this case three circle shaped sheets were coated with a turquoise coloured paint, then a gloss spray was added (Fig. 72) on each of them in order to create a textural contrast with the marbling. Two of the sheets were then cut into curved strips and one into radial strips and then woven together (Fig. 73,74). After the structure was assembled the marbling was poured on top in a gradient colouring (Fig. 75), going from the same shade of turquoise into violet and then dark blue. The paint was partly left to flow outside the limits of the structure, to further enhance the visual effect and to guide the visual interest towards it. Although the structure is somewhat flat, the illusion of volume and depth appears in the marbled area and the structure is concealed, allowing only for subtle hints of its outline to be visible, which may only be observed when viewed attentively. The regularity of the geometric structure is obvious in the parts that do not have the marbling which makes for a strong contrast when this is added. The colour scheme was kept basic, in cold tones in order to allow the visual effect to shine.
Figure 74. Weaving - first two layers

Figure 75. Creating the gradient
Figure 80. Gradient Circle
4.1.3.4 Perceptual Pyramids

The fourth piece, Perceptual Pyramids (Fig. 99-101) creates a play on visual perception. This is the most complex piece colour-wise, combining three different coloured sheets, each done with another marbling technique. The perceptual pyramids created through the addition of the grayscale triangles are followed by real pyramids to further enhance the visual effect, going from perceptual three dimensionality into the real one. The solid colour is brought on top of the marbling, inverting the action order.
Firstly the three sheets of marbled foam were produced. In one of them there were used tones of purple, pink and peach (Fig. 89). The colours were first poured one by one and then spread on the surface (Fig. 91), which created a clearer delimitation between colours in some areas and a more diffuse one in others. Another sheet was coated with a yellow-green-turquoise colour scheme (Fig. 90), where the colours were first all poured into one container and then poured together on the surface, which generated a soft transition from one colour to the other. The last sheet was coloured in black and white (Fig. 88) poured on the surface one drop at a time (Fig. 85-87) in order to create a hard contrast between light and dark and an area with a clear pattern to contrast with the soft ones. Although very different, the three colour schemes merge together to create a vivid visual effect. A small number of pyramids was added and the sheets were cut into strips (Fig. 95). The strips were painted in a solid dark grey in specific areas that when woven together, would form triangles on the surface (Fig. 94). The structure was created, the majority of the surface woven in the dense cube pattern and a small part woven over the pyramids structure. Some threads were left loose outside the limits of the weave in order to add a dynamic feeling and to offer clues about the way that the structure was produced. The resulting piece has areas where the cubes pattern is clearly visible, areas where the dark grey triangles are formed, through which the eye is tricked into perceiving the remaining coloured triangles as three dimensional pyramids, and an area of actual pyramids, also partly painted with the dark grey colour in order to further enhance the 2D/3D effect and to create a continuity with the two dimensional pattern. Thus in this piece the optical effect is created by bringing the solid color on top of the marbling, as opposed to the previous pieces.
Figure 89. Marbled sheet before cutting - pink and purple

Figure 90. Marbled sheet before cutting - green and yellow
Figure 101. Perceptual Pyramids
4.1.3.5 Dripping Octahedron

The fifth piece, Dripping Octahedron(Fig.108-113) places the weave on a three dimensional shape. The colour palette is limited to grayscale in order for the visual effect to shine. The cubes pattern is visually distorted by the angles of the shape but the marbling placed on top, although destroying the pattern, helps the eye to perceive the overall volume and adds an illusion of melting through its outward drips.

Here it may be stated that the pyramids are oversized and glued together and the woven surface is done on top of them. Firstly, the overall shape was created out of cardboard. Then four foam sheets were covered each with one colour: white, light grey, dark grey and black. It was decided to let the effect be visible without being disrupted by the colour and as a counterbalance to the other colourful pieces, thus the choice of non colours followed. The sheets were cut into strips (Fig.104) and then assembled in a complex three dimensional triaxial woven pattern(Fig.105-107). In order for this three dimensional weave to work it is necessary to have an even number of threads of each colour; in this case it was six and that the geometric figure is based on equilateral triangles which make the surfaces meet at 60 degrees angles, thus supporting the assembling. After the structure was produced, the marbling came by pouring black and white paint, one at a time on one side of the construction. Here the otherwise clear structure is disrupted and the marbling continues flowing outside of the shape. A similarity may be observed between this and the Gradient Circle piece, but some fundamental differences are that the circle piece is flat whereas this piece is three dimensional and the marbling effect is different, here being a strong black and white contrast and in the other piece a gradient. Here the perception of the structure is changed because of the angles inherent in the overall shape, so they seem to be slightly bent, but the marbling surprisingly gives the eye a means of balance and supports the observation of the angled surfaces through the drip of the paint. The overall result is somewhat confusing for the sight, where shapes that seem clear have unexpected perspectives and the marbling conceals the structure but accentuates the angles.
Figure 104. Threads before weaving

Figure 105. Weaving the first two layers

Figure 106. Weaving the first two layers - various angles

Figure 107. Woven structure - various angles
Figure 108. Dripping Octahedron - Fifth piece. Detail
Figure 109. Dripping Octahedron - different angles

Figure 110. Dripping Octahedron - different angles
5.1 Result and discussion

The resulting collection of five pieces illustrates variations on the fusion between triaxial weaving and the marbling effect. Variations in colour combination, pouring method, thread shape and size and action order generated a diverse group of works that stay well within the decided frame of the project but all have unexpected details and offer a different facet of this fusion between techniques. Different ways of applying the paint generate different visual effects, and through the addition of the marbling, a geometric structure gains a fluid quality. The marbling effect creates the appearance of unexpected volume and depth and depending whether it was poured before or after weaving and on the colouring it can either support the structure visually, making it easier to observe or it can conceal it, leaving only a fine trace of the structural outline. Of course, in some cases the actions may be turned around completely in order to create a similar result through different means, as is the case for the Perceptual Pyramids piece, where the structure has the greyscale triangles and pyramids, which enhance the remaining area of the coloured threads and produce a three dimensional effect in a flat surface, due to the manner in which the eye perceives this colour difference. Thus the perceptual volume may also be produced by placing the solid color on top, not only the marbling.

The pieces were made to work together, both visually and conceptually, but also to be able to stand on their own. Thus the colour scheme is limited to a certain range of colours, generally a play between warm and cold pastel tones combined with black and white. The color palette has been chosen in order to produce either colour harmonies or soft or harder contrasts - cold and warm, light and dark. The visual effects depended heavily on the method in which the paint was applied but also on the after treatments. A combination between pouring techniques creates a vivid visual play in some pieces, as is the case for Perceptual Pyramids, created with very contrasting coloured yarns. A more subtle effect may be observed in the Gradient Circle piece, where a gloss finish is added to the structure before the marbling is applied. This creates a glossy effect which comes in contrast with the texture of the matte marbling. In ‘Pattern Transforming’, although the marbled pattern is the same in almost all the surface, it is shown how this can take many faces and transform through its use in the structure, becoming from regular to fragmented and, in the area with the pyramids, chaotic. An unexpected way of achieving a different type of surface was the addition of the plastic thread in ‘Melting Pyramids’ which added the glossy and transparent texture. The transparent areas may be a perfect vehicle for light to travel, which generated the idea of seeing the structure as a possible light installation. This aspect may become part of a future exploration. ‘Dripping Octahedron’ also gives a clearer insight of potential applications for these objects. Since it may be woven three dimensionally it gives a reference towards actual utilitarian interior objects, such as furniture or light installations.

The concept has a clear potential for further commercial use through a variety of approaches. Depending on where the focus is placed, some products can be created which have as a central element either the structure combined with the pattern or the pattern alone. The marbling effect may easily be translated into expressive prints for garments or interior, for wallpaper, curtains or upholstery, either as it is or in a collage of different types of marbling. The weaving may also be introduced as a flat, geometric element which may support the creation of optical illusion based effects (Fig. 114,115).

The focus can also be placed on creating an object. By refining the material choice for the background a more stable alternative may appear that can be used for interior, for example if the industrial foam would be replaced with a wooden ‘thread’, possibly bamboo, the structure would gain stability and a more
environment-friendly quality so that it may be reproduced at a broader scale. The hardness but also flexibility of this new material would allow to create more three dimensional structures that can be used to create various objects, from lampshades to tables. The triaxial weaving offers the possibility of creating a more dispersed structure where the surface has holes throughout, which can be effective when creating a lampshade. Some of the threads may also be replaced with a transparent surface in order for the light to pass through, which may generate other complex visual effects.

A way of developing the project from a visual and conceptual point of view would be to push the visual effects even further. The colouring may become even more complex and a more three dimensional approach may be taken towards the structures, to create angles which also modify the perception of a structure or to create more organic structures. Different sizes and thread shapes and different materials may also be introduced and the structures may also have more types of threads in the same structure. Although there are countless ways in which the idea may be developed from a wideness perspective, the project might benefit from an in-depth development, where one particular visual effect is explored in order to be better understood and to further reveal its possibilities.

The works combine a spontaneous, artistic point of view with a well thought through design process. A textile thinking is applied to non traditional textile materials, thus the work that is generated challenges the traditional perception on textiles, being placed in an interdisciplinary realm where textiles, painting and sculpture meet. This bonds together areas that are not usually approached by textile design and bridges a gap between fields, questioning the norm and contributing to the opening of the field for a new generation of textile related works, where there is room for both textile and non textile materials, speculative works whose boarders are not rigidly defined as one thing, but which leave room for interpretation, imagination and further exploration. This union between fields gives an insight into a possibility for the future of textile art and design as an expanding field where ideas from multiple areas meet to create a richer expression which can relate to more people and question the actual meaning of textiles and allow for more room for their development. Textile art is no longer seen as a closed space in which only conventional ideas can manifest themselves, but as an open field where a view from the outside, no matter of the background, is welcome as a way of giving a refreshing look on tradition and of broadening the design understanding of both the creator and the viewer.

All in all, this project demonstrates the expressive power of the mix between these two techniques. They influence each other, merge together and generate contrast and tension, creating unique and spontaneous expressions that would not be possible without their fusion. Their dialogue refers to a mix of control and spontaneity, the geometric and organic, rigid and fluid, construction and motion. This apparent contradiction creates expressive visual effects that deserve a closer look in order to be fully grasped and understood, and the fusion of these elements may offer diverse possibilities for further exploration for many years to come.
6.1 References


Fuller, R.B. (1963), Nine chains to the moon, Carbondale: Southern Illinois Univ. Pr.; [online] Available from https://openlibrary.org/books/OL5879733M/Nine_chains_to_the_moon (accessed 2018.03.2)


Moon, M. (1986), Creative textile design inspired by interactions of color, Master of the Arts Thesis, Iowa State University, Ames, Iowa


Snedker Hansen, P. (2013), Refraction #1, [online] available from http://www.snedkerstudio.dk/ accessed 2018.03.2)


Photographs:

Berg, J. (2018), Figure 1-5, Figure 46-48, Figure 58, Figure 62-65, Figure 80, Figure 99-101, Figure 108-113;

Benea, C. (2017-2018), Figure 6-45, Figure 49-57, Figure 59-61, Figure 66-79, Figure 81-98, Figure 102-107, Figure 114-115.