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Chapter 1

Introduction

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Abstract
The present work is a continuation of the ideas developed in previous projects during my Masters studies that explored the relation between pattern, form and space. Starting from the pattern multiplication for space construction the present project proposes textiles as an assortment of flexible expressions. The purpose of the project is to explore aesthetic and functional potential of textiles for outdoor temporary structures. This is to create a pattern interface which filters sunlight through a textile surface to offer instant sheltering solutions for outdoor activities. The project combines research and analyses of outdoor temporary structures and scope of textile in the area. The research is interpreted into a concept of a portable space for relaxation. The design process shapes this concept of relaxation into a sun shelter.

Aim
My aim was to explore aesthetics of geometric patterns to create flexible spaces with textile. To find relationship between aesthetics and function, pattern and form, expression and material, ambience and space is focused on environmental conscious design. My work lies between a beautiful expression of art and an object of functional design.
.............To Ammi & Abu...............
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During the project, experts from industry have been a valuable source, among them my sincere regards for Göran Ivarsson, Pernilla Harrysson, Lars Larsson. At the end, my deep gratitude for Tommy and Catrin Tammjärv.
1.1 Introduction to report
I have compiled this report as documentation of the journey from an idea to a product concept, and its execution. The report is divided into sections to give a complete profile of the project. The sequence of different sections is according to the sequence of work during process. I have compiled this report into four sections;
In background I have compiled my literature base study and reflection on it with some examples of inspirational designs. Herein lies aspects such as the flexible expression in textiles, form and space construction using soft materials and the possibilities in textiles to shape new trends in building materials for architecture. An approach to sustainable design is also added in this section.
Research describes my methods to understand design problem with in the application area through collecting and interpreting data. In this section I have described how I have developed my research, ideas and concepts from research to a design brief. Herein lies aspects such as what do I mean by outdoor environments? What is needed in such environment? How to enable relaxation? And what a textile fold can offer? This part also contains inspiration for artistic design expression.
In Design Process, I have described my creative journey from problem to a concept solution. Herein lies my methods for concept development, and description of one comprehensive concept in form of prototype. This chapter is all about building and shaping concept into reality. I have divided my design process into two sections, concept development and development of prototype. The practical aspects of design as material, structure, production, technique, scale and scope of product have been included in the second phase of this chapter, whereas refinement of concept is part of first section.
The result is final outcome of the project.
1.2 Introduction to project
I have taken this project as a chance to implement my opinion about design and design methods which I developed during two years of my study for Master. The motivation for this project was my personal experience of spending time close to nature for recreation. This project has been used to develop my skills for product development methods and to add to my knowledge of textile surfaces and patterns. This project is about investigating the phenomenon of folding a textile, and constructing form out of flat textile surfaces. My area of interest is to construct a temporary textile structure for outdoor relaxation in outdoor where textiles serves more like a shelter, and temporary home. This project is a continuation of exploratory work of using textile to add flexibility in space creation.
As soon as shape converts into form, it affects its space where it exists. The form is seen in relation to its 3 dimensional space and works as positive or negative element of space. Once a form is constructed, it becomes a space in itself. As the shape gets form it needs a surface or skin to exist in real space and here comes the textile part in this project. The selection of material and technique is focused within the area of textile so after concept development textile has been consulted as material choice to find the required design expression.
The beauty of a textile is the diversity of material characteristics and aesthetics; a textile is not necessarily a soft overlay for the body of some object, it is not considered as mere skin of armature rather technology in technical textiles and research has opened new horizons for this field. Now we see textiles part of flexible architecture, a replacement of wood or other solid material in furniture, a connection between design and science and much more. The realization of existing material world left this project with the choice of not making an effort for constructing a new material rather deepening my knowledge about product development methods and searching for right material for the selected application area. The sustainability issue has always been considered an important part of design process so the choices in design for previous projects resulted in building up thoughts for this project also. This led to an approach of using local material and technique to enhance design aesthetics and value of a product.
The design process investigates several experiments in pattern repetition, multiplication and juxtaposition for form generation, and then these experiments are evaluated under selected evaluation methods which results in forming up one concept outline for a product for outdoor relaxation. To find the idea of relaxation and its interpretation in design has been an important issue in this project.
Learning from folding techniques I wanted to investigate how the architectural thinking structures as armature and skin can be collapsed and expanded. Besides the exploration of shape and form functional aspects regarding portability, weight, easy installation, and durability have been considered as guidelines for selection of material and production technique.
1.3 Background

My project started with study of the phenomenon of folding a textile and observing how shape becomes a form when it is folded. I was interested in the flexibility and ability to convert a 2 dimensional surface in to 3 dimensional products by folding it. In this chapter I will discuss observations about changeability through adding flexibility in design, textile structures as soft architecture, and sustainability. The study in three subjects was used as a guide line through out design process.

1.3.1 Flexibility – Expression, Movement and Usability

In this chapter flexibility refers to aesthetic expression of textiles and the ability to add movement and time element in design. I have been looking into design examples to see how designers have approached flexibility in design by using modular structure, assembling and reassembling, continuity, or by changing form of the object. Flexibility and changeability can be used as a tool for user oriented options of a product. The search for such designs was meant to observe how different designers have approached this and what have they achieved.

Digital Dawn (fig 1.1) concept design Rachel Wingfield is a reactive window blind with a surface that is in constant flux, growing in luminosity in response to its surroundings. It digitally emulates the process of photosynthesis using printed electroluminescent technology. The darker a space becomes the brighter the blind will glow maintaining a balance in luminosity. A natural, botanical environment appears to grow and the behavior of a product can work as a tool for interaction with the user or environment. Changeability also adds movement and time element to a design which results in an exciting design.

Fig 1.1

Fig 1.2

Other than making design a living organism through movement, flexibility can actually enable adaptability and add more diversity to a product. Recliner sofa (fig 1.2) from Futura is an example of design in movement. It was exhibited in the Milan furniture fare 2009. The company has many designs which play with flexibility to change rather stiff and static appearance of heavy furniture. Bocushions of Le Vele sofa can swivel a full 360 degrees! They can also recline to form two single beds or one double, or a large chaise lounge
or two. Designed by Luigi Recalcati, this sofa addresses active social lives or urban life style lacking in floor space that demand furniture with adaptability of function.

Changing the form to serve something else is another way of approaching flexibility in design. In this case assembling and reassembling of different components and the play of geometry has to be considered. Designed by William Warrent to make “stronger emotional relationships with our belongings,” Shelves for Life (fig 1.3) is a bookcase-slash-coffin that holds personal possessions in life and person—corpse—in death.

While thinking about flexibility for increased usability according to the changing behavior in surrounding environment, we find examples of adaptation as references from nature. How does adaptation works in nature? Adaptations offer the organism a better chance to survive in its surroundings. The concept for a product which adapts the form according to needs was initialized by looking into such examples in nature.

My plan was to work in the area of design for outdoors in natural landscapes, a space full of layers and patterns so my intentions were to understand what kind of shape and form will best suit for my design concept for natural environment. For this I started looking into forms and patterns from same landscape which was visualized as site of execution. This will be discussed further in design process chapter.

1.3.2 From shape to form: The relation between pattern, form and space

“The coexistence of substance and pattern, and exploring the point where the two meet, elicits a response from those who come into contact with it. It creates an element of surprise, a feeling of delight that cannot be defined, it can only be experienced.”

Cecil Balmond

The project was aiming at flexible textile spaces, for this to understand the relationship between form and space and the impact of surface in the created environment was a compulsory unit. To understand the relationship between form and space, examples from nature were referred as an ideal design form. How nature balances between shape, form and its space?

Nature is not symmetrical but it has a rhythm and uniformity in it. The randomness with harmony through repetition balances any form in nature. This was taken as basic principal.

Let's take example of a tree, consider leaves as one pattern, repeated many times resulting in a tree form, and many forms are then repeated resulting in another pattern in space, a beginning of a new form⁶.

I was interested in different stages of form construction by starting up from a flat surface, making pattern and then making a form through multiplication of patterns, this form would be conceived as a functional form which should fulfill the requirements within its space of usability.

During application project, in start of my masters program I took inspiration from Islamic patterns since they are multiplied and repeated to an infinite number, and forms blend in with patterns in architecture. They were revived to understand the connection between nature and geometry. This motivated under-

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⁶ For further reading; Barnsely, Michael F.(1993) Fractals Every Where: Pages 100-105 united states of America
standing of geometric orders of world and space. The study in the area was focused on our perception of forms and geometric patterns dueling in them. This was done by analyzing how philosophers, mathematicians and thinkers approach the relationship between shape and form. Inspired by the thoughts of Plato and Aristotle where every form in nature is derived from repetition and combination of geometric shapes. I started thinking of repeating basic geometric shapes for form construction. It was like walking backwards, form in shapes instead of shapes in form.

In discussion with Vensa Petresen, Cecil Balmond explains how he sees structure; “The thing is, what do I look at? On the surface colors and the shape greet me; but if I keep staring another picture enters, blurred, loosing details. Only certain features remain, which give character, like a certain cast to the face or gleam in the eye….seeing complex features we may draw a simple diagram. There is a sequence to look first and then speculate. Then the mirror journey starts off to discover, and to invent.”

I was inspired by the design methods of Balmond and the way he approaches structural design and structural logic. Through out sketching phase, approach to form and aesthetics was followed by his methods of approaching structure and façade of a building. In an interview with Jennifer Kabat published in metropolis magazine He talks about idea formation for any building starting with a shape or phenomenon in nature and then applies simple algorithm for repeating it and then converts it into a structure. His methods for approaching form and structure through simple geometry, and finding geometry in nature for perceiving structure have been followed in design process. Fig 1.4 shows his process of developing idea of Battersea Power Station inspired by spirals and twists. Form activates and defines space, while space activates and defines form. They relate to each other and effect each other. It works as defining exterior and interior or transition between them. The playing around between exterior and interior defines relationship of form and its space. The form can have space with in itself incase of a void structure, which means form can be a source of space with in space.

Stephen, Luecking Principals of three dimensional design: Objects, space and meaning: chapter for Space

1.3.3 Folded Textiles: Strength, Emotion, And Temporary: An approach to collapsible architecture

In my industrial project I was working with geometrical patterns and through folding them I was able to divide space and create space simultaneously. The project was aiming at creating personal space for workers in open plan offices with increased usability. The idea of playing with geometrical shapes and forms to create spaces was born during that project. In research project I continued concentrating on aesthetics of folding patterns for instant space making but the exploration was still away from function, technique and application area, this was carried on in degree project.
My initial sketches (fig 1.5) made me realize that a fold provides an instant form to a plane which could mean that this technique can be a good solution where instant form making and temporary structure will be needed to create spaces. At this stage the research on collapsible architecture and the scope of textiles in architecture motivated this project towards a study of space, form and structure.

Folding involves the play of geometry and needs structural logic for physical existence, this I realized when I was looking into various design projects of collapsible architecture. The M-velope (fig 1.6) was designed by Architect Michael Jantzen as a place to go for personal meditation. It can be moved and transformed into many different shapes by moving the hinged panels to an opened or closed position. The M-velope can be easily transported and does not require a foundation for it to be set up. If more space is desired, more than one M-velope can be connected together.

Tents and sun umbrellas, usual examples of collapsible structures were also part of survey. Looking through temporary and collapsible architectural geometry my question was where does textile fit and what can it add to a structure?

Emotions and Expressions: Developments in technical textiles has proved textile an ideal choice for light weight, portable, fabricated structures. The diversity in surface qualities and production techniques results in a wide choice of material quality providing opportunity to create various expressions and emotions. A textile can be a soft overlay but also it can replace stiff and heavy construction materials. Here the definition of textile merges into textile architecture. By finding various expressions in textile architecture, the scope of design in this area was very obvious and interesting for me.

Textile architecture can get expression as light as air and as hard as metal. The interplay of two extremes results even in more fascinating aesthetic expression with a mixture of emotions where flexibility and stiffness seems under war.

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7: See appendix 1
Clouds (fig 1.7) is a concept for textile tiles designed by Ronan and Erwan Bouroullec. These tiles can be attached together and used in many ways as coating and forming architecture in a fluid yet chaotic way.

Tea house (fig 1.8) by Kengo Kuma works with a ventilation system, it unfolds as an airborne ephemeral structure and swells into shape like a white textile blossom.

The textile wall and tea house are different in expressions but both add soft expression to generalized image of stiff and hard architecture.

Collapsible and Temporary: The use of textiles as alternative to other traditional construction materials offers new dimensions to the potential and our perception of structure and space. These examples were to understand textile expression as new building material but it invaded another direction for me. Textile can add another quality to the collapsible structure, portability! Textiles can be strong and light weight at the same time so a structure even in big scale can be collapsed and transported easily.

The sketch in fig 1.9 is one of some quick sketches drawn to visualize multifunction possibilities with foldable and portable textile structures as an exercise for idea generation.

1.3.4 Sustainability: Think Global go local: Materials and techniques

“These days, the onus on us is even greater to promote and publicize the work of those architects and engineers, who have the knowledge to design not only pretty, trendy facades but, with their professional appreciation of the holistic approach, to design buildings that create quality solutions and to offer and ensure people places to live in that will provide the greatest pleasure in every way.”


We are designing in a time where design demands more than working with aesthetics.
What is then, to be considered while designing?

For me the answer has always been adding a meaning to design. By adding meaning to design means that it should offer a thought and concept behind certain aesthetics it carries. The interpretation of “meaning” can be subjective. What kind of meaning was this project searching for?

Among other goals, this project was also dedicated to find a way for its sustainability value.

Sustainability is a vast subject and can be interpreted in many direction. My intentions were to collect as much knowledge as I could on this topic which could help to opt for right choices. Through out project a continuous effort on research and design stages was undertaken to make it as sustainable as I could. Realizing the higher demands and complexity of the topic, my focus had been searching for local material and techniques as alternatives though other aspects like recycling, energy efficiency have also been considered. Besides I did not want to ignore the potential of my product as industrially produced. So the goal has been set to test the same product concept for both directions.

By this it should not be misunderstood as organic approach, the connection between craft and industry has been tested on various stages of production for example using the skill of craft persons for collaboration of craft and design, reviving aesthetics of some traditional technique for its promotion. The scope of using craft has many times been discussed with my tutors and fellow designers during project. On the discussion table the key question has been a collaboration between craft and design for promotion of small industry for a sustainable economy. To approach this concept the most influential advice was taken from “sustainable by design” where the writer talks about the need for developing a new material culture using local resources. The discussion with Prof. Carbonaro Simonetta has been a valuable source to implement this idea, which will be discussed in “Material” chapter.
Chapter 2

Research

2.1 Inspiration and ideals
  2.1.1 Light/shadow
  2.1.2 Space
  2.1.3 Structure
  2.1.4 Color

2.2 Out door relaxation

2.3 Design considerations; Defining situation
2.1 Inspiration and ideals
Following will be presented the works of nature, geometry and architecture which have inspired and worked as models in any manner, for creating a portable textile space.

2.1.1 Light/ shadow

1. Refreshing shadows. The layers of leaves which let the breeze come, and strain light into beautiful random shadows.

Fig 2.1

2. The beauty of textile to filter light and color. The colored shadow. The scaling of patterns to form rhythm, fluency and translucence in gradation
“The shadow structures” by Ball Nogues

Fig 2.2
2.1.2 Space

Fig 2.3

3. Something is there, but something is not. I feel hallow which encircles me with a gentle touch. An unseen wall which hides to reveal, an architecturally scaled environment that has a potent sculptural presence but is made of almost no material

“Unseen Current” by Ball Nogues, a space created, using Echoes Converge and InstaLator -- which automates the mind-numbing process of cutting thousands of unique lengths of string and enables the installation to function as architecture but also as a made-to-order product that can be rapidly deployed by the designer or owner.

2.1.3 Structure

Fig 2.4

4. Fractals in nature, asymmetry in Symmetry: Repetition with harmony, that’s how nature creates balance.

One single unit can create complicated structures just by multiplying its scale in an order.

Fig 2.5

5. Nature is an ideal source of inspiration, the more we understand the best we can create. How we perceive a perspective and how we can challenge perception through playing with structure, shape and pattern. Serpentine Gallery Pavilion, London UK by Cecil Balmond
2.1.4 Color

6. The ability to change color according to its surroundings. Chameleon uses their color-changing ability to blend in with their surroundings, as an effective form of camouflage, and for communication as a social indicator to other chameleons.

Fig 2.6

7. The temporary work of art by Christo and Jeanne-Claude’s: the free standing umbrellas executed in California and Japan. In Japan in the luxuriant vegetation enriched by water year round, The Umbrellas were blue. In California the brown hills are covered by blond grass, and in that dry landscape, The Umbrellas were yellow.

Fig 2.7

2.2 Outdoor relaxation

The application area of the project was set as portable textiles for outdoor in dry and sunny environments. Besides the scope of the product was set for dry weather, to be used for a short period of time with portability which means the product can be used anywhere whenever needed. To understand the situation more comprehensively I felt it necessary to analyze dry and sunny climate. Living in weather like Sweden and visualizing sunny and dry weather felt being away from target group, but during work progress in summers

Fig 2.8
experiencing some really warm days I was able to study the sitting behavior of people out side, the shift from enjoying under bare sun to look for shadow was observed at this stage (fig.2.8). I also went for camping to Rome during April when the weather was ideal for camping and for outdoor activities, the purpose was to experience and test the ideas, during camping I was able to discuss my thoughts with other people whom I met in camping village.

The warm and dry climate countries like Egypt, Pakistan, Saudi Arabia, Middle East, India, and South America were set as examples of sites. Deserts, Beaches, Rocky Mountains, grass lands, lakes, forests and safari parks were visualized as application area. The purpose to identify some of warm and dry resorts was to point out key issues for design problem.

- Isla Margarita (fig.2.9) is the biggest island of the Nueva Esparta State, and its capital is La Asuncion, which is located in a river valley that has the same name. It is formed by 2 peninsulas, and with its very dry and sunny climate, the main industry is tourism.

![Isla Margarita](image)

**Fig 2.9**

- Throughout Egypt, (fig.2.10) days are commonly warm or hot, and nights are cool. Egypt has only two seasons: a mild winter from November to April and a hot summer from May to October. The only differences between the seasons are variations in daytime temperatures and changes in prevailing winds.

![Pyramids and Camels](image)

**Fig 2.10**

- The Climate of Pakistan is diverse (fig2.11). The country has three climate zones; in most of area the
climate is temperate with very hot and long summers and pleasant and short winters. During summers many people travel towards north of country to enjoy moderate weather. The spring and autumn is also celebrated with many outdoor activities.
From geographical condition of dry and sunny recreational lands the observations were;
• The idea of relaxation is dependant on climate
• Our need to be exposed in sun changes according to the climate change
• In hot and dry climate zones ventilation with in a space can be an issue also.
• Sun light, is an important element.
“I absolutely love the way a warm breeze feels on my skin. Shadows from the trees, for some reason I really dig the way a shadow made from a tree full of leaves looks. It is also nice to sit in the cool shadow on a hot day.”
http://whodoesshethinksheisanyway.wordpress.com/2008/05/27/ten-things-tuesday-15/#comments
To understand requirements the study in the area of outdoor relaxation consisted of family camping, holiday gatherings, activities for outdoor relaxation, and collecting people views about the idea of relaxation which resulted in building up a design scenario to make appropriate decisions during concept development.
From family camping and activities in outdoor relaxation;
• Relaxation is subjective to activities for recreation.
• Relaxation in outdoors can demand for private and personal spaces in a space with no boundaries
• The relaxation can be mental or physical or both.
• In terms of physical relaxation the body resting postures should be considered.
• The feeling of isolation, sheltered, silence, rest, ability to sense nature, openness can be sources to mental relaxation.
• The colors and shapes in nature can be a source for relaxation.
• The physical activity can be a source for relaxation for example playing a game, swimming or any other activity.

2.3 Design considerations; Defining situation

From site analyses, discussion with people, and spending time in such places I summed up observations stated above in form of a “observational picture board” to summarize analyses (Fig 2.12), these observations resulted in following considerations for design process;
1. Mark up space to provide a personal space to enable relaxation: by looking at recreational public sites, where many people share the same place with no borders. The need for private spaces was realized. Here the question was to investigate do people need a boundary when they want to experience openness, and closeness with nature? And can a space be created in an open environment with out disturbing the feeling of openness?
My first quest was answered in positive by looking into products which are available
and consumed in open environments for this purpose. The idea to mark up space to enable relaxation in open environment was closely related to the idea of personal space.  
“Where does the idea of you fit into what we call our collective space? What does the public realm mean without a glimpse into how one’s private realm may actually be perceived?”  
Donald Chong  
The inquiry in this area was pursued to understand how much space a person needs around him publicly which can enable relaxation when he is sitting alone and or with a group of familiar people. An exhibition in Queens Quay West, Toronto Canada presented various artists interpretations of personal space in public areas. (Y)ourspace of Donald Chong (fig2.13) and a team work of Mathiew Casavant, France Cormier, Josee Labelle, Melanie Mignault, Michel Langevin for “Please Swing” (fig 2.14) was inspiring.  
In “Please Swing” the team mentioned the idea of personal space as not escaping city realities yet they identified intimate products such as a park bench, a picnic blanket, a beach towel which offer proximity and fora moment “a pleasure bubble”.  
“All people are surrounded by a personal space. The borders of physical space are easily experienced when other people are perceived to get too close physically. The size and demarcation of personal space vary between different cultures, individuals and situations. Demarcations and control of one’s own personal space is crucial to people’s ability to relax and feel safe.”  
Edward T Hall  
The literature helped me to understand that comfortable interpersonal distances depend on culture, social situation, gender and individual preference. The cultural aspect was most interesting for me as I could compare the behavior of people in recreational sites between Europe and Asia. In Asian countries people will feel more comfortable if they are given an option for personal space in a public environment, even the settings in café’s and restaurants offer private blocks for families.  
Dealing with such a diverse subject, it was not easy to conclude for design concept. So I decided to do a small experiment to gather information specifically in context to situation, the purpose of the experiment was to visualize properties of a comfortable space.  
I drew three circles of different sizes in an open area to mark up space and asked people about which space feels comfortable to them in different relaxing postures if they are inside the space alone and also if they are with their friend?  
The observations were as follows;
• The idea of personal space refers to two levels strangers around the person and familiar people sitting together. The personal space expands when one person is alone surrounded by strangers and it shrinks while sitting with familiar people.
• Sitting with a group of familiar people makes a person feel comfortable in an open space
• Sitting alone needs more, sense of privacy in an open space.
• Depending on culture and area the demands for scale of boundary offering personal space will be different
• When someone else enters one’s personal space he/she will get disturbed
• In less populated area the boundary for a personal space will increase.
• Sitting with a friend demands for less space than sitting alone in an open space.
• Sitting in an enclosed space demands more space around the person than sitting under a shade, just covering on heads or sitting on a platform, this means that a structure with walls will be bigger in size than a structure without walls for the same number of people.
• Defining border promotes the feeling of ownership which results in calmness and relaxation

The research in this area revealed that I will look up for such solution in design which should provide personal space without disturbing the feeling of openness and closeness with nature. It also provided guidelines for scale of the product which will be discussed in the next chapter of development of prototype.

2. Daylight: The presence of sunlight in such environments and the need of shelter from warmth and light was noted as an important factor. Light and shadows can be a source of mental and physical relaxation and also can be used as design element. A study of day light was carried in quick sketching format, the purpose was to observe;
• How daylight can be used as a part of aesthetics through interplay of shadows to enable relaxation and offer soothing environment?
• How light filters through a surface? (fig.2.16)
• The dynamics of daylight! The changing effects of shadows during the day and splitting of light on a folded surface.(fig 2.17)

3. Sit and relax: Realizing the wideness of the subject I decided to carry the idea of relaxation in relation to resting and sitting and not considering any special activity. The purpose was to still keep a margin for concept development methods and avoiding naming at any particular product.
At this point a quick study of people sitting and relaxing behavior in open environment was carried by visiting some of such sites, a documentation through photographs was the result of this study which was evaluated during design process for functional analyses. The most interesting study in this area was, people sit on ground. It gives free choice of sitting postures and closeness to nature.

Fig 2.18
Design Process

3.1 Design Brief
3.2 Concept Development
3.2.1 Inspiration: Geometry in nature
3.2.2 Sketching phase I
3.2.3 Analogies
3.2.4 Sketching Phase II
3.2.5 Functional Analysis
3.2.6 Evaluation: Specification of requirements and user case
3.3 Development of Prototype
3.3.1 When shadows dance on the rhythm of sun
3.3.2 Form is my space
3.3.3 Color
3.3.4 Material; a quest for delight
“The way we get to a design isn’t through a linear process like optimization or refinement of preconceived form, it’s more about discovering a system” Daniel Bosia

My design process can be described as a constant and continuous process where research and analysis has been reflected in to product concept. Different methods were designed for idea development, evaluation and refinement towards a final concept. The methods were mostly used parallel due to the process being iterative. The aim with this phase was to visualize knowledge into aesthetic and functional form and then develop one concept out of it that evaluation indicated best suitable for further development.

3.1 Design Brief
The initial brief:
“A foldable textile structure for dry and sunny out door environments”
Was transformed into,
“To investigate aesthetics and function of temporary textile spaces in dry outdoor environments to facilitate relaxation.”

3.2 Concept Development

3.2.1 Inspiration: Geometry in nature
In the start of program I started with geometric forms in Islamic art, during progress my interest was shifted from the visual appearance to the logic behind them.

“The arabesque is an elaborate application of repeating geometric forms that often echo the forms of plants and animals. Arabesques are an element of Islamic art usually found decorating the walls of mosques. The choice of which geometric forms are to be used and how they are to be formatted is based upon the Islamic view of the world. To Muslims, these forms, taken together, constitute an infinite pattern that extends beyond the visible material world. To many in the Islamic world, they in fact symbolize the infinite, and therefore uncentralized, nature of the creation of the one God”6

If nature is the source of these geometric patterns then I should investigate them in nature for my design expression, was my decision. So the design expression was then inspired by geometry in nature. I wanted to construct a form through multiplying a shape. Looking into examples in nature where it forms its structure by repetition of one shape set as inspirational source. A collection of these examples in form of photographs and real objects was a reference to visualize expressions of form and surface.

6 Definition from Wikipedia: For study other literature on Islamic Design has been consulted.
3.2.2 Sketching phase I

“It does not matter if everything we do has already been discovered or invented, for discovery is an invention, a creative action. As part of a natural condition, being immersed in patterns, we navigate between surface layers and the codes hidden behind them. Seeing complex features we may draw a simple diagram. There is a sequence to look first then speculate. Then the mirror journey starts of to discover.”

Cecil Balmond, Frontiers of architecture I
My sketching had two phases. The first phase I would call random expression where sketching was not focused on any product idea. It was to understand the relationship between shape and form and to observe what kind of aesthetics and expressions do I get when I repeat a shape and then convert it into a form. The medium was mostly folding paper and fabric; quick pencil sketching and knitted samples were also part of the process.

![Fig 3.3](image)

3.2.3 Analogies
To find inspiration from other areas for principal solutions and to compare the product function with other products, some examples were analyzed from outdoor recreation. Some of them are provided in appendix 2. The aim was to note key functional issues and their already present solutions. Since the concept should result in a new type of product and offer new functions it was valuable to explore other fields related to application area. Many important issues like portability, weight, and packaging were identified at this stage, which were solved later during prototype development. This phase resulted in more clear view of functional requirements and new thoughts for sketching product ideas.

3.2.4 Sketching phase II
This phase concentrated on generating ideas. It was a continuation of first phase. Some forms from phase one were consulted and re sketched for further development. A list of functions from analogies was the source for sketching in this phase. Many random ideas were developed, and different forms were sketched for those ideas.
Some of the ideas were;
- A resting mat and a shaded chair
- A rug and a cushion
- A resting mat and sunshades
- A sunshade and a shelter with a play of shadow
3.2.5 Functional Analysis

This was done to establish priorities and to set up goals to refine concept (see following page). The sketches were evaluated through this chart. Priorities were established by assessing research on the grounds of functionality, usage requirements, and the ability to facilitate relaxation. A discussion with tutors and fellows was also considered a valuable source to avoid supposition.

The priorities were to approach relaxation through marking up space and screening off from sun light with portable structures.

So the final idea sketch;
A sunshade and a shelter with a shadow play
Functional Analysis

- Easy to install
- Temporary
- Strong against wind
- Highest priority

- To provide flexible solution
- Ability to change
- Multi-functional
- High priority

- To enable relaxation
- Source of rest
- A transition between exposed and unexposed
- Medium

- To develop Aesthetics
- Light and shadow
- Close to nature
- Mark up space

The main functions are set in four columns.
3.2.6 Evaluation; Specification of requirements and User case
The selected sketch was evaluated through comparing features with identified requirements. To execute evaluation of concept, a map of structural requirements with a small scale model was created. This model was then visualized in different fictional scenarios to test and verify concepts in user case.

Fig 3.6
The advantages and disadvantages were noticed for further filtration towards a mature product concept.
- The space is reduced when the shade is converted into shelter. Which means the same product accommodates different number of users. More when open and less when closed.(fig 3.6 and 3.7, also see appendix 3 for technical measurements)
- The flexibility / multi functionality offers a diverse range of sitting options.
- The two uses identify two different user situations which may not need to be combined.
- Both the structures require different structural geometry which should be combined.

The point that two products were targeting at two different user situations, despite the fact that the multi functionality was adding value to the concept, only summer shelter was followed for product development.

3.3 Development of Prototype
The concept was developed to enjoy nature under a sun shelter.
A space for relaxation in warm sun, a place redolent of refreshing breeze making its way through porous soft wall, a melody of wind on patterned surface, the feeling of hiding under cold shadow of an old tree, it surrounds me with a gentle touch, I can feel home under open sky.

Now it was time to visualize my concept of relaxation under this sun shelter,
3.3.1 When shadows dance on the rhythm of sun

Daylight has been a consideration both functionally and aesthetically. The excess in sun exposure can cause skin cancer and other derma problems. In dry and sunny environments people tend to sit under shades more than people living in cold climate zones where sun light is precious. For me, to study the amount of shadow produced by shelter was important, this was done by sketching different scale of cutting patterns and layers and making a study of shadows in various sun directions during day. The structure casts very strong shadows when the sun is on its full bloom (fig 3.8), since the slits are not visible from aerial view. That is exactly the time when dense shadows are required. With the dynamics of sun light the shadow travels under the shelter, it moves and creates dynamic patterns during day, a time element is added. (fig 3.12)

When the light passes through a surface, what difference does it make? My shelter is made out of one sheet of any material; its simple cuts are its beauty for surface and for space. How much light passes through the patterns, how much is it absorbed on the surface and how much does it reflect affects aesthetics. I wanted from light to complement the patterns on surface by not absorbing all and also not reflecting all, it should swim with the waves of patterns. So I tried different densities and layers of material to achieve a satisfactory result. Sketching with a 3M film revealed how I can use a surface to split light to add playfulness.

3.3.2 Form is my space

“A space is like an empty material that can be cut and defined by the “blade” of a planar shape”

Stephen Luecking

Form was controlled by space requirements and pattern construction. I concentrated on creating space for stronger shadows and an encircling space to enhance the feeling of being sheltered like inside of a transparent shell. I wanted to experiment with basic geometric forms like circle, square, hexagon and octagon, believing that these forms are the basics of complicated structures and the less can create more. To form structure patterns were repeated towards the center
point which gives architectonic form to my fabric.

3.3.3 Color

Color gives expression to a form, that’s how choice of color can be very personal so as its aesthetics. To choose color for my shelter which should complement with the idea of relaxation which in itself is individual. How do I proceed?

I see my concept as a product in nature from nature and for nature lovers; (will be described in detail when the material enters the project); the color should then be adapted from nature also. Examples of color adaptation in different species gave birth to the concept of a product which adapts color from its environment, could be interpreted in different ways.

- A color changing surface sensitive to its surrounding
- A surface in coordination to its environment taking the most dominant color

Fig 3.13

Fig 3.14

- A surface in contrast to its environment presenting the color absence in its surrounding
- The color of nature, a surface with its natural finish.

To find expression for this “outdoor pleasure” color was approached through these four channels. A color changing surface could be an interesting approach to add flexibility in aesthetics this demanded to search for a material which can translate it into reality. There are some materials in market like MOR-PHOTEX® and Guinold® and Cromoflex® but I could not find the same expression in any. Thermo chromic dyes could be introduced but due to the fact that they are still on research level, the scope of this project was far from their usability as sustainability and functionality were the important part of this project.

The next three approaches were explored by reviewing the research in outdoor situations and reanalyz-
ing them for color reference. Two types of landscapes green lands and barren lands were selected as two extremes which let me work with a family of green and brown.

The green family was inspired by new born leaves, a symbol of freshness. A two layer color concept was developed at this stage.

For the brown family the natural as earth and wood was selected with a trim of red underneath as sunset in the desert or far away drowning in the sea. Search for a material in its natural color tone without any artificial coloring was developed at this stage.

3.3.4 Material; a quest for delight

“Conceptual component gives shape to a form. Material component gives richness, color and texture.”

Cecil Balmond, Frontiers of Architecture

This was the toughest part during design process. The problem with textiles is that material can change its properties at any stage of production. If you are looking for an expression it offers you thousands in the same family, same is for technical aspects. The development and research in the field of technical textiles, especially where it embraces construction and architecture it is possible to meet any given challenge. To look for material which combines aesthetic expression and technical demands with consideration on sustainable issues was the challenge for this project.

Outdoors was an important area to be considered;

“Textiles for architecture and construction should be resistant to deformation and extension under tension and to wind and water. The fabric must be waterproof, impermeable to air and wind, and resistant to abrasion and mechanical damage. It should also to be resistant to degradation from long-term exposure to sunlight and acid rain. Depending on the application, the fabric may need to transmit or reflect different levels of light. These requirements can be met by applying special coating to base fabrics......The most widely used fabrics for tent walls are polyesters and vinyl.”

Advantages of Using a Textile Structure in Architecture and Construction
The Masterbuilder: Published Sunday, July 19, 2009

Literature was evaluated by product situation for example considering that the product is for temporary use in outdoors when it is dry and sunny, the requirement for water proofing were not on priority but some level of moisture resistance must be there. For material search the requirements were mentioned as;

Function requirements:
1. Protective properties, weather Protection
2. High strength
3. Light weight

Design requirements:
1. Foldable
2. Sustainable, recyclable or biodegradable
3. Not to stiff but not too soft.

PVC coated polyester
To meet the demands of weather proofing and high strength, a research was made with the company F.O.V. The company specializes in outdoor textiles and is the only one which is allowed to work with
PVC coating in Sweden. The PVC coated polyester was a material which could be used to make free standing structures. In discussion for PVC sustainability issues with Pernilla Harrysson, she told me that FOV is using PVC with out any harmful agents in it. Further investigations about material revealed that PVC on polyester can be recycled through a texyloop process where both fiber and coating can be recycled by selective dissolving. To test the design requirements a segment of sketch was enlarged. When cut the fabric was not able to hold the rhythm of patterns with uniformity. Disappointed with the results, I started thinking of some material with more stiffness but still thin and light.

**Industrial Felt by Industri textile**

The patterns should be cut to form a structure; no technique other than laser cutting was in consideration then. To understand technique the contact company was Industri Textile Job. Technique in relation to material was under discussion with Mr. Göran Ivarsson and Mr. Peter Edensvård. A solution of polyester felt was found. Used for filtration and made out of single polymer was good for functional requirements and recycling, but there was not enough material in stock. I could not continue with it.

**Tyvek**

Having paper like quality with a good tear strength, water resistant, UV protection, good insulation, thin, light weight, strong, available in various qualities, printable, and recyclable, all my demands were carried out. The material was heat pressed to find expression of textured surface.

Tyvek® is a brand of spun bonded olefin, a synthetic material made of high-density polyethylene fibers; the name is a registered trademark of the DuPont Company. Made of high density polyethylene which is 100% recyclable. Tyvek® can also be safely incinerated, and because it yields water and carbon dioxide, it essentially leaves no residue for disposal. And, if recycling or incinerations are not options, Tyvek® can be safely land filled. Because it is chemically inert and contains no binders, Tyvek® will not leach into groundwater.


Tests for laser cutting were also successful. The fabric is available in big length, which meant that the structure can be cut in one sheet, reducing assembling and joining for cost effective production.

**Solar Woven by AB LUDVIG SVENSSON**

Besides Tyvek, another suitable material for the shelter I found was a woven fabric of polyethylene. It blocks 90% of the sun’s UV radiation and saves energy when used inside. Withstanding hail, downpour and wind, the material is strong and tear resistant – with a longer life.

After a tedious search two materials were found which were appropriate for the concept. What was missing though? Did I find what I wished for?

“Prosperity is a strong word, a word that makes us happy because there is a treasure in its mouth which is not just about wealth, but also about heading in the right direction. Like “Design” which literally means “Project”, Prosperity has
its prefix “Pro” a kind of knight of the future who stands guard before us. And we should not forget that prosperity harbors the ancient work “Spara” which means “Saving”. Designing prosperity entails not only imagining and creating the design conditions for progress, but also thinking about a kind of design economy in terms of saving resources.”

Prof. Carbonaro, Simonetta

Throughout my project I was searching for a concept which could transform my design into a prosperous design. How I could do it, I had many ideas through approaching sustainability on social and economic grounds. One of the ideas was to use traditional techniques and materials to add emotional value to design which results in long life span of product since it will be kept for long time with a sense of belongingness, like we save a piece of jewel with us.

Discussing my idea with Prof. Simonetta Carbonaro, it was further refined,

“Antiquity does not come from a past designed to fetter the future. Antiquity is our primary source and renewable resource, for looking at the world today. It harbours the experience of its creatures, like a century-old beach tree that has hosted generations of chaffinches. Antiquity has an aesthetic and educational purpose because the values with which it is imbued manifest themselves to us even today. It is a treasury of values that we can understand, reinterpret, and share but not possess.”

I took this task as searching for a material could be used as an alternative to my proposed material which takes inspiration from traditions and looks for a renewable resource, an intimate design.

Palm tree Leaves

My childhood memory, my parents home town, in warm summer we traveled to meet my grandparents to this small town. We were playing on a woven mat of some leaves under dense shadows of many years old tree, in one summer afternoon. What was that leaves which I saw village people preparing baskets for bread, floor mats, and the roof of the hut. How rough they seemed, how cold they behaved!

Palm trees leaves! A renewable source! A revival of craft!
I started working with them for
my product concept. Strips of leaves can be woven and stitched together for alignment of patterns and structure. It needs no finishes since already used since ages for outdoors, and can be colored in any color. Due to good flexibility they can be shaped into required aesthetics while complementing with the natural feel. In Thailand palm leaves are used for sun umbrellas also. They have good insulation against UV and heat absorption.

My concerns were about the short life span of material, which can be worked in future work. There are examples of very old manuscripts written on palm leaves in Sri Lanka but then they are preserved indoors. For outdoor use the mats are usually used for two to three years and then they start breaking, but since they are locally produced and are not very expensive they can be easily replaced. The old ones are land filled, which is no harm with this biodegradable natural material.

If the structure is made out of palm leaves, the panels will be hand stitched together, which may not make a small fold for easy portability. The scenario for this product is set for people bringing a portable shelter with them to nature sites; with less flexibility it may not be suitable for this situation. But I could imagine a great potential in this idea if the scope (will be discussed later) is defined for summer café’s or small shelter on house terrace. The product can serve two functions also, a floor mat and a sun shelter! Because of short life span of leaves, the fabric sheets can be offered separately with a color range.

**Bark Cloth**

During my search for local materials to save resources another interesting material I found and worked with is Bark Cloth. Craft of making non woven cloth from bark of tree comes from Africa, especially the fabrics from Uganda. A company in Germany is producing bark cloth in Uganda. Since it is coming from plant the qualities of fabric for further treatment were similar to cotton. To make it suitable for outdoor, I used acrylic coating since it is possible to use acrylic coating with 97% biodegradability. The material gets a good insulation and heat absorption. It comes as sheets of fabric in different sizes from 2 to 3 square meters; each sheet is different in color and texture, just like tree trunks have individuality in them. It can be stitched together. The natural feel of material in coordination with my sketch aesthetics made it a choice for sun shelter.
4.1 Result
4.1.1 Advantages/Scope of Product
4.1.2 Production
4.1.3 Shamyana Scale drawing for one person
4.1.4 From Shape to Form: Installation Visualisation
4.2 Discussion
4.2.1 Design Process
4.2.2 Limitations
4.3 Words for the end
4.1 Result
Shamyana: The outdoor pleasure

The result of my research and design process is my concept of a sun shelter “Shamyana”, which reflects my developed aesthetics in coordination with function. I have presented my concept in different material suggestions, two of which are industrial materials and two are traditional materials representative of their respective regions. The concept of “Shamyana” has been visualized as a product, for which I have suggested its structure, Scale and packaging details with technical drawings for one person. Selected are shown in this chapter and the other parts can be referred in appendix 4.

Fig 4.1
4.1.1 Advantages/ Scope of Product
• “Shamyana” is a concept for outdoor relaxation and celebration. It has a wide scope in other scenarios for the same application area for example a beach café with many shelters, a structure for kids to play on house terrace or in garden or temporary room for outdoor gatherings and celebrations.
• The structure is a free standing form which makes it possible to be executed any where on a rock, in sand, on the grass, every where.
• The slits of patterns let the air flow, which allows more stable structure even in windy conditions.
• With accessories like insect net, floor mat this free standing structure can be used for evening sittings or a resting room in house garden also.
• The structure can be scaled up to offer a place for parties and get-togethers in open environments.

4.1.2 Production
Production involves fabric and armature. For fabric, I tested four of my suggested materials. Mr. Göran Ivansson and Mr. Peter from Industri Textile Job helped me finding solution for pattern cutting. Bark cloth, Tyvek and Solar Woven can be laser cut, laser cutting burns the edges which blocks fraying or tearing, the materials are strong enough, they don’t need any further finish. Palm leaves will be hand woven and stitched.

For supporting structure, the discussion with Prof. Ulrike Rahe, Product developer was useful. She suggested me to analyze my proposed suggestion: if the structure is not offering any new technology and uses techniques that are already produced then I should refer to them.

Therefore the solution for structure comprises of glass fiber poles with shock cords, tent pegs, sand bags, and pole pockets. The fabric and poles will be attached with pole pockets, to increase weight, for a stable structure sand bags or tent pegs will be used.

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See appendix 4
4.1.3 Shamyana, Scale Drawing for one person

Arial View:

Front View:
4.1.4 Installation Visualisation in sketch

Step One: Unwrap Fabric

Step Two: Attach shock corded poles with fabric

4.2 Discussion
This project was discernment of the need for outdoor recreation. Living a busy urban life in populated areas, where life is at speed to be close to nature or some time for relaxation is inevitable. The design in this field, due to high demands expresses technical aspect more then artistic quality. This project was an effort to pave all those outdoor technicalities with a soft, rhythmic artistic expression.

4.2.1 Design process
 Intentions of the project were to create flexible space of soft expression, instant form construction, and to explore textile for its physical and psychological protective properties. This was accomplished in form of a shelter which protects from strong sunlight and also is a source to enjoy nature with a feeling of being close and open simultaneously. The findings and their aesthetic translation followed some selected methods, if some other methods would be selected the result could be different, for me this project has been a design project both for designing a concept but also designing my design methods. The sunlight has been taken as part of design, which in collaboration with material forms patterns with in a space, this add excitement element in the design. During different day time the shadow cast on the ground varies, the shadows can be colored also depending on material. The play between light and shadow through a surface can be used to enhance interior spaces. A potential for such aesthetics of light and shadows can be observed where textile works as a screen, many flexible spaces can be created by placing patterns in half drop repeat and cutting them as it was done in “Shamayana” also see fig() in appendix. I see a great potential of creating flexible solutions with this technique.

The strong aesthetics are achieved by discovering the relation between pattern and form, where pattern works like a cell the basic unit of any form. Working with geometry, everything splits into algorithms; it was all about testing and finding right ratios between scale of pattern, scale of form, form of space and material behavior. Logics and aesthetics were going parallel, and that is what makes a geometric pattern and structure so balanced, visually and structurally. This game of algorithms has made me realize that there is a lot that has to be discovered yet. It is a start of a huge field; the depth of ocean has to be explored yet.

4.2.2 Limitations:
Time is the limit; some has been discovered much has to be explored. During development of prototype many ideas were developed to see the possibility of structure in knitting and molded textiles and a textile surface which works like a prism. Discussion with my tutors the ideas were not followed due to the time limitation and scope of project. “Shamayana” invited me to the study of daylight which resulted in multi directional ideas – such as using the construction to absorb and transmit solar energy – ideas that could not be continued due to time constrains.

4.3 Words for the end
The more my design experience grows, the more design problems I identify and solve. What I have achieved in this design project is: refinement of my design methods, a strategy to proceed from a question to an answer, another expression for my artistic skill, more knowledge of textile materials and more design experience!
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5.3 Appendices
5.1 Bibliography

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1. The Oztrail Cabana Beach Dome is a simple, free standing quick erect dome style beach shelter.
- Simple to erect
- 3 pole design
- Free standing
- Fixed floor that folds up over the entrance
- Sand pegs and sand pockets
- Carry bag for easy storage
- 270 x 120 x 160H cm
- 3kgs
- BCF PLU 166826


2. In 1971, Bo Hilleberg, a professional forester, founded his own company, Hilleberg AB. An avid, life-long outdoorsman, Bo was terminally frustrated with tents that required pitching the inner tent first and then covering it with a loose rain fly that usually displayed the same properties as a kite in the wind. He envisioned a tent that had an outer and inner tent that pitched together, simultaneously—but he didn’t have the necessary sewing skills. With Bo and Renate’s marriage, Renate took charge of these wing while Bo handled design and ales, a division of labor that has served the couple—and company—admirably ever since.

3. **STAIKA – DETAILS**

- Adjustable roof vents can be closed with snow-proof panels, and are accessible from inside the tent.
- Separate vent cover protects open vents from snow and rain.
- Full no-see-um mesh on doors covered by equal sized, zipper adjustable, fabric panels for all season comfort.
- Free standing design provides excellent stability, generous head height, and integrated vestibules.
- Linked inner and outer tent for simultaneous pitching. Each can also be used alone.
- Short pole sleeve and clip system provides quick set up.
- Large fly protects zippers from the rain.
- High bathtub floor keeps out ground water.
- Dual entrances and vestibules for easy access and storage.
Appendix 2
http://dornob.com/category/more/

http://www.campingworld.com


www.yatzer.com/assets/Image/5.may08/takeshi/fractal
Appendix 3
Reduction value 1: 0.7 from sun umbrella to sun shelter.
Appendix 4

Structure Detail of Shamyana:
The structure consist of two major units i.e. Poles & Fabric.
1. POLES
The poles are made of glass fibre tubes. Each pole is in six foldable segments. Shock cord is built in in the poles to join all of pieces together. Four full length shock corded poles are required to make desired octagonal structure.
Figure on right shows examples of shock corded poles available in market.

(Each pole made from joining of 6 pieces, shown in drawing)

Total Length of one pole = 335cm
Total number of poles = 4
Weight of a Fiberglass pole = 160 g
Total Weight of poles = 640 g
FABRIC
Regardless of material of fabric, it will be attached to poles with the help of loops/hooks. Fabric will be tied with center of poles to stabilise form. Loops/Hooks will be stitched during fabrication & poles will have a center mark for easy assembly.

Examples of available items
http://www.campingstore.co.uk/includes/print2.
TENT PEGS
Made from titanium, the pegs can be used for fixing shelter, an alternative of sand/stones/soil bags.
Weight: 0.4 ounce per stake
Size: 6" / 15cm
http://www.backpacking.net

SAND BAGS
The sand bags are connected with pole pockets at 2 poles on four ends. The bags are used as alternatives of tent pegs. They can be filled in with stones, sand or soil depending on the material available. They will be available in same colours as colour of the structure.
Sand Capacity = 2.5 kg per bag
Material= Polyester
http://www.calumetphoto.com/item/MW2405/

FLOOR MAT
Soft thick mats with non slip, hard wearing ribbed surface. Anti bacterial, hygienic and easy to clean. NBR foam, CFC free. These are available in various colour combinations.
1.5cm Thick
http://www.matdepot.com

INSECT NET
Flynet to secure from insects and flies. A very useful accessory for places where insects intefare while you are relaxing. This stretchable net is attached at inner side of the poles.
http://www.mamaandpapas.co.uk