Casting Light
The relation between space and light
Casting Light - The relation between space and light

Master Thesis Report
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Space and light are co-dependent. Without light we can not perceive space, white surfaces become black. Without surfaces we can not see light, it is immaterial. This symbiotic relation between light and space is what I am investigating. Because if we can not see surfaces without light, then light is part of what defines them. By sculpting a relation between inlets of light and surfaces I define space. Through this relation I can create a perception of change even though the space is static. How can I give form to and develop a technique to create a static space, that through light, expresses change?
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DEFINITIONS
My definition of words used regularly throughout this work.

SURFACE
The outer part of a structure.

STRUCTURE
An organization of parts creating a recognizable unity.

INLET
The obstacle that light meets before hitting a surface that restrains the light between the source and the surface.

LIGHTPICTURE
The light that you can perceive on the surface.
BACKGROUND

My investigation into light begun as a norm questioning way of measuring space. How can we measure space without numbers and hard values? I studied how light enters a space through models that let in light in different ways. I looked at how room sequences translated in these models, what angels light fell in from over a day and how surrounding objects reflected color. When studying in these models, I realized what they did different from the space. They separated the light and made it traceable from where it came and how it effected space. The light showed on the surface, creating various light pictures when the light changed. This became my starting point. With the aim to study light in space, I had studied light on the surfaces of a space.

How can I give form to and develop a technique to create a space, that perceptually interoperates change through light, and expresses motion though it has a static structure? Space and light are co-dependent and without light we cannot visually perceive space. Since we cannot perceive space without light, it is part of what defines it. I develop form that interoperates light. By directing light over inlets and surfaces, I define space. By directing different relations between inlets, surfaces and light, I redefine space. I create, static and specific architecture and through craft I explore techniques, materials and shape.
The space at the Konstfack Spring Exhibition.
The space in the process.
Clusters of casts and the linear construction.
THE SPACE

Approaching the space

A space with three-dimensional surfaces appear. A dark, large but thin, structure is visible. Many white pieces creates a spatiality inside the structure. It is messy and has a lot of distinct parts. When you get closer to it, the white pieces become castings that are hung from the dark construction. The construction is starting to be dissolved by the castings and by the perspective that creates a new narrative about the space. The dark structure is made from metal, it creates a skeleton that holds the space. A vertical structure is visible in between the castings. Like threads hanging down, holding the casted pieces in its place. Though they are thicker than threads and look like they could hold a bigger piece. The bent surfaces of the castings exaggerate the shadows that are casted on it. The grid that the pieces are hung from is linear and perpendicular, the shadow it casts are wave like. When light moves around the structure the grid billows over the castings and the three-dimensional surface. The edges of the castings has a soft curve that also leaves a shadow on the casting behind it, an even sharper shadow.

Changing the narrative

The space has two dominating expressions. The hard, dark, linear construction and the fragile, light, curved castings. The linear structure, that consists of three frames bearing vertically, and two grids bearing horizontally, is visible from a distance. It is dominating with its dark color, in the white space it is standing in. The flat surface behind it is not creating any shadows or gradients on the surface and the linear frame stands out in your sight field. When walking closer the narrative changes and the linear construction instead starts to frame your sight field and the focus point shifts to castings hanging from the horizontal grid. The castings cast shadows over each other. They also have a gradient on them because of its curved surface. The frame is now out of focus and you are close to the castings, you are in the space. The grid is broken up by the castings and you can no longer see all of it. What you see is instead the grid casting shadows in the castings, creating a wave like light picture on the surface that the castings are creating.

The expression of the space changes with the narrative.
Study of casts in relation to a flat surface.
Light Picture on a flat surface.
Detail of how the surface affects the Light Picture of a threaded rod.
What the surface does

The surface is a structure created from curved casts. The castings are assembled by being hung with threaded rod from the grid and placed in clusters. This creates a three-dimensional surface, letting the casts cast shadows on each other, meaning the casts creates both the surface and the inlet. When shadows are casted over more than one of the castings a fragmentation of the shadow is created. This happens because the casts are hung with varying distance from the inlet and in different angles. For instance the grid construction creates a shadow that is casted over more than one cast. This linear inlet becomes fragmented because of the casts positions. Each fragment also becomes curved depending on the cast’s curve and angle. In the drawings I illustrate how the surface translate one light condition and fragments the light picture created by the grid.

Drawing of how the casts are hung and how shadows are fragmented on the three-dimensional surface.

Drawing of fragments.

Illustration of the grid creating the inlet and the fragments.
Exploded drawings of fragments.

Illustration of inlet created by part of the grid, highlighting which part creates which shadow.
Studying casting in atelier.
A story about a cast

In the diffuse daylight in the atelier the casting look almost surreal. A gradient of gray is casted over the piece, with only a sharp break in color when the casting end and the surrounding space takes over. The edges are uneven, rough on parts and soft on others. On one side, the light hits the edges, the thin breaks of the edges, and reveals a border of the casting. The nub that is stuck in the middle of the mass, and the screw that penetrates it, are shiny. White from the light that is reflected on its right side, gray on the back side where the light does not reach. Below the casting a gap is created between the fragile edge of the casting and the floor. You could crawl under the casting, but you wouldn't because you can easily walk around it. It is hanging lonely, peacefully in the middle of the room. The only thing it is connected to, is another shiny long and thin piece, that reaches down from the sky to the backside of the casting. When I shift the focus of my eye I see a dark pillar reaching up, through my sight field. Along with the casting and the thin metal rod past the grid structure that connects the two. The pillars dark color is emitting the light and only the round faceted edges of the square pillars reflect a stripe of light. You can see details in the dark color, but it looks like smoke. When I shift focus again I see a silhouette of the surrounding space between the casting and the pillar. Boards tilted towards the wall in the back of the atelier and a trashcan in the middle leaves blocks of black, white, but a different white than the casting, olive green and beige yellow that fills the wedge between the casting and the construction.
LIGHT PRINCIPAL

Reflection on studies made of how inlets influences a surface

When letting light in to a space the relation between the inlet and the surface affects how we perceive the light picture on the surface. On a flat surface in relation to a rectangular inlet, the light picture becomes rectangular, it can have some skew if the inlet and surface are not parallel but more or less the same shape as the inlet. The same happens when a round or any shape of inlet stands in relation to a flat surface, the light picture and the inlet are very similar.

When the surface changes to a convex shape the relation changes. In the relation between a rectangular inlet and a one-way bent surface the light picture becomes bent. In a test, when light is let in through a rectangular inlet from the top and meets a convex surface the light picture becomes an arch. The sides of the surface are now further away from the inlet than the middle and when the light enters from the top light travels further down before hitting the surface on the sides than in the middle. The convex surface and the rectangular inlet creates an upward arch.
To create a straight light picture on a convex surface the inlet has to be bent in the same direction as the surfaces. Though the curve of the surface is not enough. Meaning the inlet has to have a deeper curve than the surface has to create a straight light picture. Here it also becomes difficult to control the light picture. The average of the curve is straight but a slight bend to it makes it look uncontrolled.

The one bent surface only manipulates the inlets in one direction. In the relation between a rectangular inlet and a convex surface that is bent in the other direction, will not be manipulated in the same way. Instead it will stretched over the surface depending on the angle it falls in from.

Movement

When light moves around an inlet the light picture on the surface moves. In the example with the flat surface and the rectangular inlet, the light picture moves but doesn't change. This is what happens in most architecture, when daylight moves around it. That is because the surfaces are often flat and the inlets two dimensional. If the inlet instead are three-dimensional, then when the light moves around it, the light picture will change as well as move. When both the inlet and the surfaces of a space are three-dimensional and light moves around it, the light picture changes. The movement becomes three-dimensional and something different from what we are used to see on the flat surface.
Photographs from study of how inlets influences a surface.
CASTING LIGHT

Material and shape

In the process of casting plaster, the material goes from being able to take any shape, to become static and unchangeable, unless you break it. The plaster has the properties that in the casting process take features from other materials, such as the shiny surface of the rubber. The plaster then gets a beautiful surface for catching light and the light matte color of it reveals light well. Plaster is a material that is common within housing and large scale architecture today in the shape of flats. Therefore it becomes relevant to explore the possibilities of the material in architecture and in relation to light. As mentioned the plaster is good at picking up the character of “a second material” where I can work with properties of other materials to create the expression I want. I am in control but the process and the craft leaves traces. I see this as a comment to the digital revolution where every moment is forecasted and the soul from the craft sometimes is lost. In computer modeled surfaces, which I tested in the beginning of this process, the expression of the surfaces became very controlled no matter what curves I worked with. I want to develop the casting technique so that it can be applied in a scale where the body can relate to and enter it and keep the character of the craft.

Developing elements

This work consists of two parts that come together into one space. I investigate light as a variable that changes static space and develop a technique to implement this theory in scale 1:1, which in this case consists of spatial elements and constructional structures in combination. When starting to cast elements I immediately started to cast large object with the intention that they are in scale 1:1. I wanted to create directions in a structure and did not want to relate it directly to a flat surface. I created hanging moulds with rubber. A threaded rod is weaving through the rubber with nubs stopping the rubber from moving along the rod when the plaster is poured in. I hung the moulds on iron pipes that is held up by wooden horses. In the first casting I used
nubs only on one side of the rubber which then evolved to having nubs on the inside as well. When casting in rubber, the plaster gains traces such as the rubber’s smooth surface. The nubs and threaded rod that I use to hold the mould in its place when casting, gets stuck in the mass. By deciding where the nubs are placed I control the size of the ridges and gullies within the object. The more rubber in between the nubs the bigger the ridges become, and the closer the nubs are placed together the higher they become. When hanging and attaching the rubber around the iron pipes I create the outer curves. The relationship between the position of the nubs around the threaded rod and the waves of the outer curves creates different directions and either lets the ridges travel all the way through the structure or cuts them of half way. The relationship between these and the weight of the material decides the shape of the ridges and gullies.

As you can see in the drawings, the first casting (Fig. 1) has ridges traveling across the whole surface. In the third (Fig. 3) they are broken by the threaded rod half way. Since most of the spaces around us are constructed from the flat surface I investigate what happens when I create space that interprets daylights movement in a different way with the focus on directions within the surface structure. In this case it crates a wave like surface that shapes the light picture. In relation the the three-dimensional surface that originates from this casting method, these surfaces does not fragment the light picture, they shape it.
The elements

With the larger casts with me, I tested casting plaster in other shapes to see where I could find directions. I casted smaller pieces that were related do the flat surface, but that also related to each other, creating abstract joints. I also casted with the same technique as the larger pieces but with only weaving the tressed rod through the rubber once, creating only one ridge and a little bit different proportions of the ridge because of its volume and weight. I casted in bags to try to get a double sided piece. After many tests and another try to create a large casting in a slightly different way, trying to put screws in on different places than in a row, I went back to the one ridged castings. I develop this technique by using rubber sheets on both sides of the cast. The screw weaved through both sheets creating a void in between that I filled with plaster.

How to thread a mould

When I thread the mould, I need to be thorough. I have two sheets of rubber. One that is 942mm long and 223 mm wide. One that is 1102 mm long and 223 mm wide. They are placed on top of each other when I cast with the longer sheet on the bottom. I cast in between the sheets. They are arranged together by a 60 mm long screw, type M8, that weaves through the rubber sheets. There are two wholes in both of the rubber sheets placed in the middle of the sheet, parted in width. On the bottom sheet the wholes are placed with a distance of 75 mm cc apart. On the top sheet the wholes are placed with a distance of 47 mm cc apart. When the wholes are place with different length apart it creates a void when I thread the screw through them. I start with screwing a nub, type M8, onto the screw as far in as possible, I place a small rubber ring after the nub before I thread it in the first hole of the bottom sheet, going from the bottom - up. Then I screw a new nub onto the screw tight against the bottom rubber sheet. I thread the first hole of the top sheet on to the screw, bottom - up. I place another rubber ring on the screw and a nub, tight, to fasten the first layer. I screw a new nub onto the same screw but I leave a 15 mm long gap on the screw. Then I place a rubber ring and thread on the other hole of the top sheet on to the screw, now going top - down. Again, one nub, tight. After this I thread the second hole of the bottom sheet, top - down, and I end with a rubber ring and a nub to secure the mould. I hang the short side of the bottom sheet around one iron pipe each. I fasten it in itself with 3 small screws and nubs. I place the ends of the iron pipes on two wooden horses and fasten them with clams so that the weight of the plaster won't drag the moulds out of its place when casting. It is important to tens the mould with the clams and angle the clams so that the edge of the inside of the clam will stop it self from shifting when the plaster is poured on. Now I use 3 smaller clams to secure the edges of the top sheet that is loose. I place one in the middle of the sheet, above the screw. Here I clam the middle of the top sheets two long sides together so that they don't fall into the casting. The other two clams I place on the short sides of the top sheet. I fold one third in from the right side and then one third in from the left and place the clam over the three layers that are created. Now the mould is ready to cast in.
Pieces of rubber, nubbs, screws and clams.
A casting in process.
A cast.
A cast.
A cast with attachment.
CREATING CONSTRUCTION

To carry and to be carried

Space can not exist without construction. Either it is integrate in the spatial elements, such as load bearing walls, or it is extracted from spatial elements only connecting through joints that hold them. Construction can exist without spatial elements, it might then create spatiality but doesn't have to, and in this work the construction has no purpose without the interior.

I am creating a space where I work with light through the relation between inlets and surface and will do this with the castings that I have developed. In this part I will talk about the elements as "to be carried" and the construction as "to carry". To carry and to be carried are words are strongly connected. Like the construction and spatial elements, carried can not exist whiteout carry and carry could exist without carried but, for what reason? Like with light and surfaces, they coexist. In some architecture, to carry and to be carried, are imbedded in each other but in this work I see them as two separate parts. So what hierarchy does the the relation between to carry and to be carried constitute? What influences the perception of the hierarchy? What becomes dominant and what is subordinate? In this case the hierarchy of to carry and to be carried are visual or structural. When you visit the space, the visual is dominant. The space I am creating is meant to be perceived visually through light and form. In different moments, different parts will be in focus. Like a story revealing itself as you read it. Contrast is always where my eyes are drawn first and the contrast between the carrying and the carried lies in the material and shape. For the space to be contrasting it needs to have dominant parts. It needs variation. I want to create this by having both the carrying and carried structures to be visually dominant within the same space. This means that the story of the space will develop, different parts will be dominant in different parts. The visual hierarchy influences the structural hierarchy but if the carrying and the carried both are dominant visually, how does it affect the structural hierarchy? To be carried is, in this work, the core. It makes all the demands and the carrying obeys. That is the hierarchy from which I derive my design decisions but still the carrying sets a larger frame to which I need to adapt.

Developing Construction

When I started developing the construction I looked at the technique I used to cast, to see if I could find a good connection. I had a beginning that translated the casting technique into the construction, threaded rod, screws and nubs. I begun to structure a construction of frames, with a crossbar. Two parallel and one perpendicular, the basic construction principal within architecture. I sketched constructions with threaded rod sticking of from it and holding the casted pieces but since steel is structurally good in tension, hanging soon became interesting. Because even though the construction obeys the light, I did not want to fight structural principals. As I previously mentioned the construction obeys the
light principal, but it still sets the larger frame. Inspired by Sverre Fehn’s Nordic Pavilion, I found I could within the grid open up for light with the same structural principal as Fehn uses in the Nordic Pavilion. The inlet that I wanted to create from the castings, are also in relation to the construction, the grid and the hanging tereaded rod. Together they create a strong character and sharp inlet. This creates a relation between round and linear shapes. The surface that is structured from curved castings with a round outer shape and the construction that creates an inlet.

*Sketch model of construction with wood.*
Volume study
ASSEMBALING SPACE

Contrast and balance

I am looking for contrast in the space. I do not dislike the flat surfaces but I dislike the generic. It is contrast that my eyes are drawn to. Contrast and balance are strongly connected. To find something balanced, I need contrast. When assembling a space that has a clear carrying system and pieces that are carried, the visual impression of the two in relation becomes distinct. The material expression of the two parts are both raw. The plaster and metal expresses different characters. The materials also translate light very different from each other. The castings, in plaster, I decided to use because of its good light interpreting properties. The very light gray interoperates light well and in my opinion becomes very beautiful in the way it shows contrast. The surface that has a fine grain and copies properties from the material it is casted in making it possible to control the look of it. Dark materials, such as the metal that I’m using to build the structure, does not interoperates light in the same way as the plaster. The tactility I find plaster to translate, I do not find in metal. Small changes are lost. The steel is dark and light absorbing and has totally different light emitting properties than what I have been looking for in my investigations. Therefor I find it to be an interesting complement that has a strong character and a dark color, contrasting the castings. I find contrast to be crucial to catch my interest. It is contrast that my eyes are drawn to. I do not let either the castings nor the construction take over totally. That would create an unbalance. Instead I let the story of the space unfold the contrast and the castings and the construction take turn being dominant. The construction sets the larger frame and when you are approaching the space it is dominant. When you enter the space, the castings dominate visually. And when you look closer the meetings, between castings and construction is dominant. This reflects the story of the process. The castings are dominating the decision making in process but the construction sets the larger frame.

Material expression

Steel is a strong material that are historically used in large constructions with thin proportions. Bridges and spaces carrying with a large span. The material are specifically useful in tension and other materials are often reinforced with steel. When casting I started to reinforce the moulds with steel in form of screws and nubs to hold the rubber in place while casting. The contrast between the standard measurements of the nubs and screws and the freeform castings was appealing and that gave the inspiration the construction. It was important that the construction would obey for the light but at the same time have a character in itself.
DISCUSSION

The flat surface interoperates light in a different way than the three-dimensional surface I have developed. Initially this investigation was a comment to the flat norm that devours us. The flat surface that is everywhere. The table that my laptop is right now on, the floor that the table stands on, the surfaces of the legs that lift the tabletop from the floor and the walls of the space I'm right now in. Starting this project, I saw the flat surface as a visual pollution in architecture but after this research project I have changed my mind. My space interoperates light in a different way than the flat surface but I do not dislike the flat surface. I dislike the generic, when it is repeated everywhere, and my space becomes a contrast to that. The flat norm is what makes my space interesting. In this work the interior is the driving factor for the design decisions. Though the construction sets the larger frame.

How does the hierarchy between the construction and the interior influence the space? Looking at the process of this work in relation to the outcome, it becomes clear that by letting the interior and in this case light be the driving force, I can create architecture that is different from the norm.

Me in the space.
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Tadao Ando  
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Sverre Fehn  
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Junya Ishigami
Japanese Pavilion

Heather Roberge
En Piante