Menu of Textures

Sketching and Modelling Texture to Direct Visual, Haptic and Tactile experiences

Lasse Hejll
Chalmers School of Architecture
Department of Architecture and civil engineering

Examiner: Jonas Lundberg
Supervisor: Kengo Skorick

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Spring 2020

Master´s Programme in Architecture and Urban Design
Material Turn Studio

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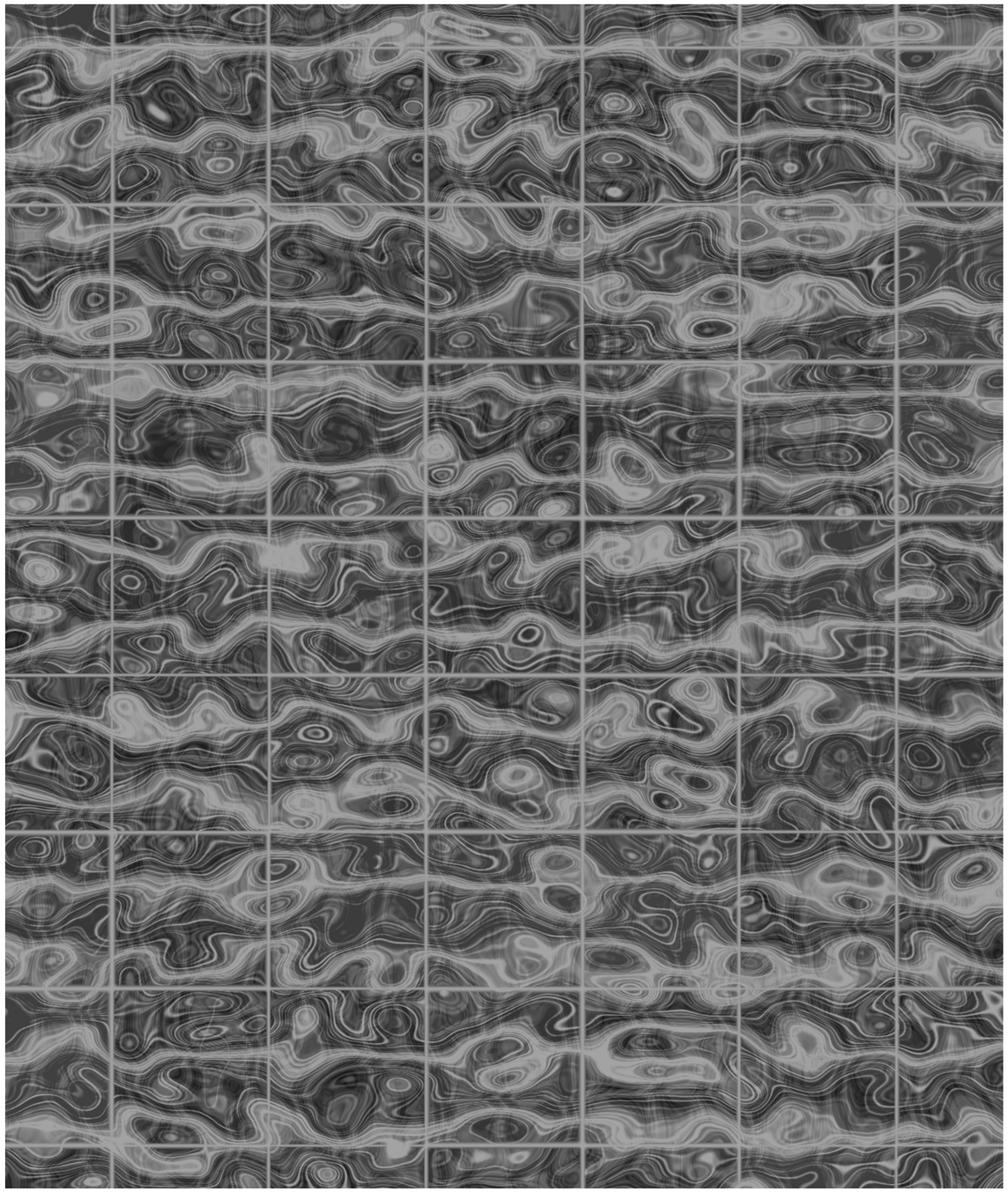


Abstract

Texture is properties of a material as we perceive it with our senses, by touch, sight, taste and to some extent hearing. Similar to how texture is used in cooking, as a tool for composition and a gage for identification and quality in raw or cooked material, texture could be used with materials for architecture. Experiencing architecture, just like eating food, is an experienced event that can be directed with texture as a narrating element.

The method developed within this thesis is a modelling tool that extends beyond modelling geometries to a detailed texture modelling scale. This thesis considers texture a variable equal, and similar, to form. Textures are made up by patterns that can be altered and describe different material properties. Applied on different geometries the combination of texture and form offers additional multisensory dimensions to a modelled form.

This thesis explores and creates textures, using digital parametric modelling tools and digital tools for texture creation. For texture building and editing, a software called Substance Designer is used. With this tool a texture is created using greyscale bitmaps and image editing tools to set up height-, normal-, roughness- and colormaps that describe a digital texture. Each map holds different attributes of a texture and by manipulating patterns and alternate its application in different maps, this method offers detailed control over texture properties and an alternative way of modelling digital representations of architecture.

The method is tested and materialized by experiments in a restaurant design testbed. A restaurant consists of different elements or settings that fill a role in a directed experience. Site and context, in part, offers reference materials as source for extractable properties to be used to create textures holding associative powers derived from multisensory experiences. Restaurant narratives and settings inform the layout of functions and spaces as well as forms and textures. The result of the experiment is architectural implementations of directing with form and texture, at scales ranging from building in a city scale to an intimate tactile scale.

Content

Introduction and Background

Student Background - Research Statements - Research Questions - Aims and Delimitations

Student Background

Cooking

Malmoe
Smak, Malmö Konsthall
TGI Fridays
Shakespeare (Höllviken)
Restaurang Möllan

Stockholm
Hotel Nortull
Artipelag
Silja symphony

France
Hotel Fort Royal (Deshaies, Guadeloupe)
Hotel Napolèon Bonaparte (Ile Rousse, Corse)

Building

Summer and extra jobs at my fathers carpentry shop since I was 12

My house in Åkarp
Restauration and reconstruction

Architecture Chalmers

Bachelor
MPARC Studios:
Material ans Detail
Architectural Competitions
Housing Inventions
Matter Space Structure 3

Research Statements

Texture in architecture is either a conscious choice that determines material, or a consequence of material choices and techniques for working with those materials. Either way texture is linked to, or constrained by, physical materials and practical implications of working with physical materials.

Many materials for construction that are mass produced have quite poor textural qualities in the sense that texture quality is in many ways perceived by its complexity and variation. Naturally, slowly grown, or site specifically produced materials have the economical odds stacked against them compared to standardized and mass-produced products of the building industry.

These practical implications limit the creativity of a design process focused on texture in that it requires knowledge of and experience with working with a specific material and the financial means to experiment with expensive materials and expertise.

Cooking is in many ways not limited by this as cooks are by profession experts in their materials. Preparing food is all about chemical experimentation with materials to achieve specific textural outcomes. Raw foods are a lot cheaper than materials for construction and the costs for failed experiments are miniscule and part of any cooks training.

Digital tools for creating material representations are developing quickly both for industry and amateur community, supporting game development, the film industry and architectural and other visualizations. These tools usually center around creating accurate representations of real-life materials. As the tools have developed, with more detailed control over texture qualities and application on 3D modelled geometry, they have become more viable earlier in the design process, as a sketching tool for exploring and modelling.

Working with detailed maps of patterns that make up a texture is a way of familiarizing oneself to a material, similar to how sketching a portrait reveals delicate lines and features that make up the character of that person's face. This intimate knowledge of material and texture is an integral part of any cook's experience and would probably be useful to architects as well.

Research Questions

- Can attitudes and methods for working with texture in cooking be translated to architecture?

- How can texture, applied to form, be used to direct architecture?

- Can detailed and abstract texture creation and exploration give a more conscious and intimate knowledge of material design?

Aims and Delimitations

This thesis presents a method developed for directing architecture by creating digital texture and applying that texture to form. The method is tested and visualized on a restaurant design. This method seeks to avoid the practical limits of working with physical materials as the design process is entirely digital to lower the bar for textural experimenting. While also creating a more intimate knowledge of the properties that a texture consists of.

The method intends to create narrating architectural elements; that is built forms with texture, relating to space or enveloping space. Narrative in this context implies associations evoked by multisensory experience of said element. By creating textures by layering and tampering with patterns and properties, and by applying those textures to forms, representations of multisensory architecture is produced. After a digital texture is produced one could proceed to try and find a suitable physical material and techniques to achieve the desired texture. This thesis does not take that step but remains at creating digital renderings and representations. This is to avoid constraints connected to available tools for working with different materials, material cost and cost in time.

The aim/purpose of the method is to find ways to direct architecture:
- by exploring and producing texture and form, working in tandem,
- by linking some forms to certain textures while contrasting to other forms and textures, and
- by layering detailed patterns in different maps of properties, achieve complexity that spans through multiple senses. These maps contain properties that make up shapes of haptic information, surface tactility, color information and reflection or absorption of light.

The method is then tested at a restaurant design. The design focuses on different scales and spatial settings to visualize the diversity of applications this method can be used for. Developing the restaurant itself, as a typology, or the narratives that comes with it, is not the goal for this thesis. The restaurant as a design project was chosen because it is a complex building with regards to spatial setting and a multitude of relations to humans that work, eat, meet and enjoy themselves in the same building. This offers a variety of architectural elements that are programmable by texture and form.

Multisensory experience, as is implied within this thesis, consists of visual and touch (haptic, or kinesthetic and tactile) experiences. Taste, smell and hearing has been left out. The method developed in the thesis involves modelling architectural elements and texture. Visual and touch experiences relate to three dimensional forms that can be modelled whereas taste and smell relates to completely different dimensions. Hearing does relate to form, space and texture as well, but it involves technical knowledge and aspects that does not fit within the context of this thesis.

Discourse

Perception of Form and Texture - Narrative - Cooking - Texture Directing
Meeting and Eating Narratives

Perception of Form and Texture

When architectural (or any) form is perceived by our senses the perception produces associations, emotions and thoughts. The emotions and thoughts evoked, differ from person to person as our reference base, to associate against, is different in all individuals, due to different upbringing, cultural background and other individual characteristics. Farshid Moussavi write in her book, The Function of Form, about how form evokes emotions and thoughts and she describes them by the philosopher Gilles Deleuzes defenitions of ***affect*** and ***affections***. Moussavi describes how individuals all build relationships to form in different ways. ***Affect*** is the characteristics of a form before individual interpretation, an objective description of form. While ***affections*** is the individual interpretations of the form. Each affect evokes a range, or a function, of affections that spans through all possible individual interpretations.

Affect / Affections: Does not imply a personal feeling but an ability to affect and be affected (Deleuze, Félix, 1987). Affect is a prepersonal intensity that represent one objects influence on a subject. Affections is how that subject perceive the influence of the object.

”Is architecture a form of mediation (an instrument of culture, criticism, etc.) and a product of culture, or is it a producer of culture?” - *Farshid Moussavi*

Given the premise that culture no longer is (and perhaps never has been) a static unitary entity, architecture, whether it is a product of culture or a producer of culture, operates in a diversity of cultures. A role of architecture is to produce relationships between built form and humans. As humans of a manifold culture have diverse reference bases to build their associative interpretations of form with, architecture need to produce multiple ***affective functions***, performing as a ***multiplicity***, to successfully mediate to a diverse public (Moussavi, 2009).

Affective Function – Multiplicity: The function of possible evoked affections of a form is referred to as an ***affective function*** (Moussavi, 2009). It describes how a form can perform as a ***multiplicity***, having manifold interpretations.

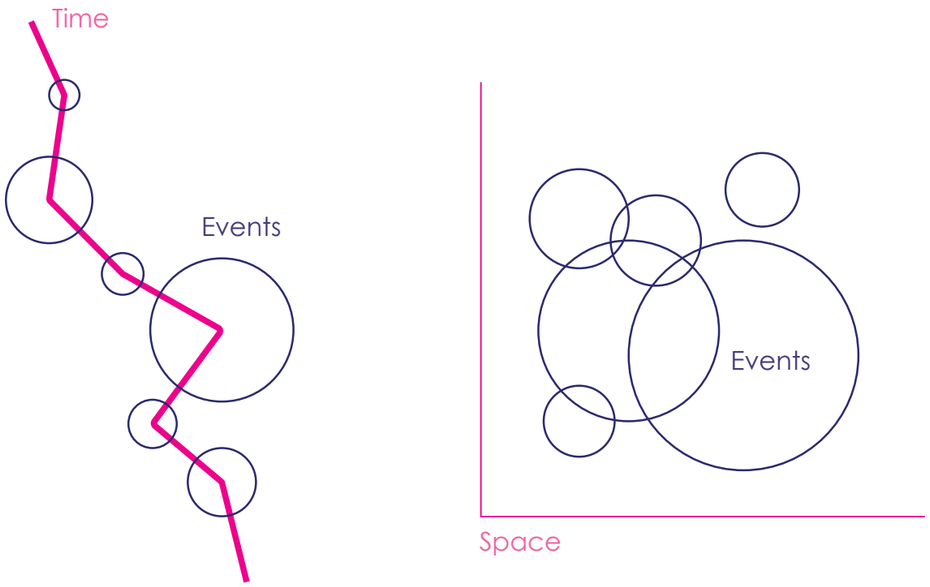
Form is the visible shape of a physical object while texture is the tactile forms and details felt by touch. The difference then, could be argued, is the mediating sense, vision or touch. But there is, first, a clear overlap of what is both visible and sensible by touch, and second, also no clear border between our senses as they are experienced simultaneously. All experience of architecture is multisensory (Pallasmaa, 2005). Percepts from all our senses merge to a fused experience of spatial and material qualities. Form and texture could be interpreted as the same percept quality but experienced at different scales. This two dimensional form-texture quality potentially offers exponentially larger ranges of affective functions than form or texture operating on its own.

Texture can either be the result of material and fabrication choices or a conscious goal that decides material and fabrication process. Either way, texture is an integral part of form in that it mediates visual, tactile and haptic experiences of matter. This thesis explores texture and form not as separate characteristics but as one multi-faceted trait or quality that spans from miniscule details, barely detectable by sensitive fingers, to large shapes enveloping spaces.

“The eyes want to collaborate with the other senses. All the senses, including vision, can be regarded as extensions of the sense of touch – as specializations of the skin.” – *Juhani Pallasmaa*

Image 1

Digital Grotesque, Grotto II (2017) is a project that highlights the overlap between texture and form. In their project Grotto I and II the wall elements were 3D-printed in sandstone. The shapes printed were created by algorithms forming faceted shapes at very high resolutions. This resulting in tiny details seamlessly merging with enveloping shapes, blurring the borders between tactile texture and visual form.



Narrative

1 a story or account of events, experiences, or the like, whether true or fictitious.

2 a book, literary work, etc., containing such a story.

3 the art, technique, or process of narrating, or of telling a story.

4 a story that connects and explains a carefully selected set of supposedly true events, experiences, or the like, intended to support a particular viewpoint or thesis.

(www.dictionary.com)

Narrative, or a story, usually implies several events happening in a timeline, one after another. These events can be connected by logic, reason or chance, happen at the same time or long apart. They can depend on each other or happen despite each other but there is something that connects them to a narrative. When talking about architecture and narrative, space can be a narrating medium (like a book in definition 2), or space can be part of the narrative like time. Just like events in time are connected for some narrative reason, events within a space can be connected by a narrative reason. The role of texture, in a narrative within space, is to convey perceivable experiences of materials where the materials or their texture fill a roll within a narrative. Within the context of this thesis, narrative is not defined as a specific story to be told by architecture, but an experience of haptic, tactile and visual percepts. Narrative texture is seen as an affective function that evokes individual affections in people experiencing matter. By the same logic, directing, when mentioned in the thesis, does not mean directing a narrative from a script, but rather programming texture and form for sensory experiences evoking multiple associations.

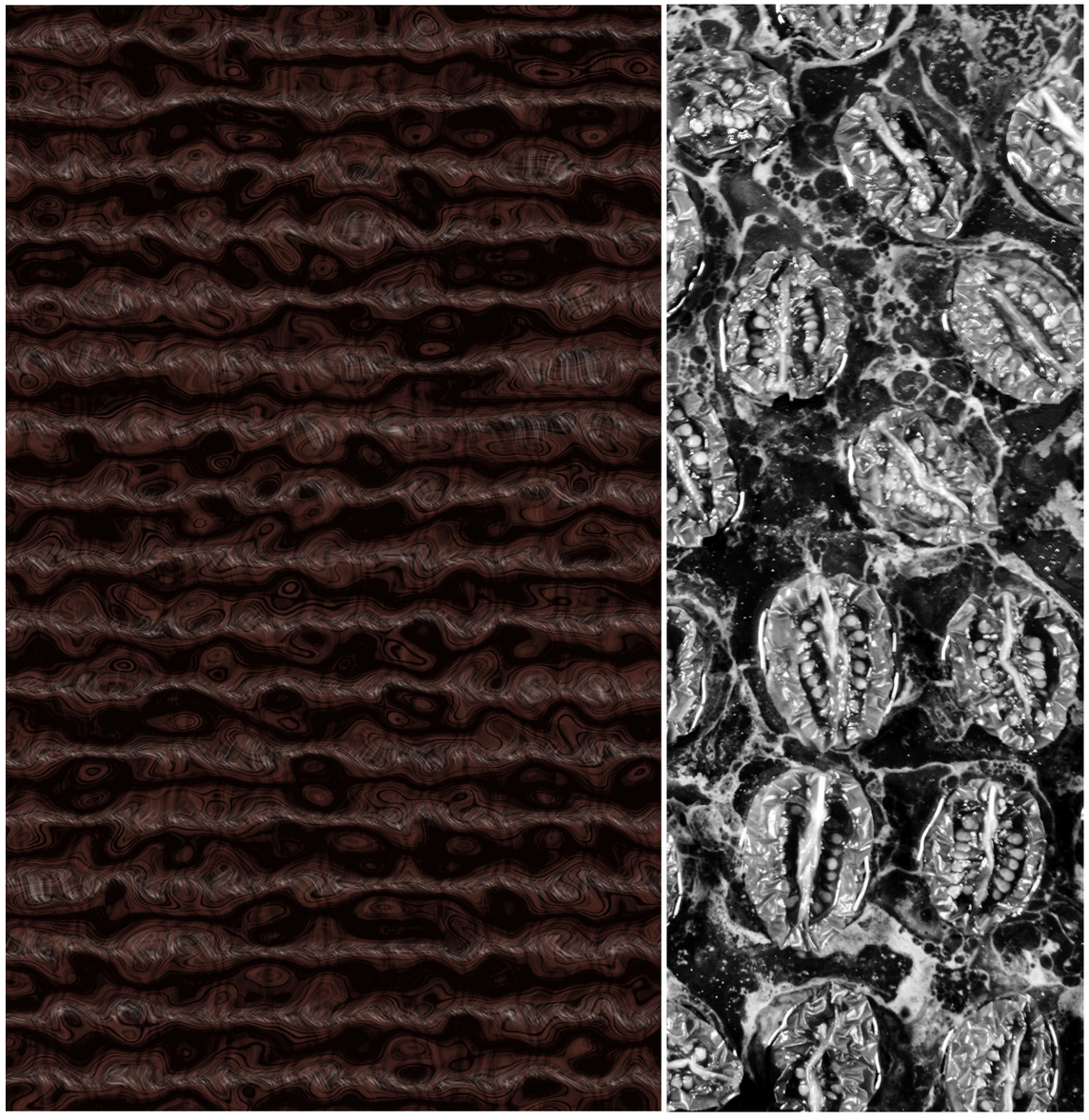


Image 2

Cooking - Texture Directing

Texture:

1 the visual and especially tactile quality of a surface:
rough texture.

2 the characteristic structure of the interwoven or intertwined threads, strands, or the like, that make up a textile fabric:
coarse texture.

3 the characteristic physical structure given to a material, an object, etc., by the size, shape, arrangement, and proportions of its parts:
soil of a sandy texture; a cake with a heavy texture.

(www.dictionary.com)

When we talk about texture in architecture or in cooking, we do not always have the same definition. In architecture, the first definition, tactile qualities of a surface, is usually what is implied. While in cooking it is probably the third definition, physical structure, shape, etc. This depends on a different relation to materials in architecture and cooking. In architecture materials are seen or felt and are described in texture by those impressions. The cooked materials on the other hand are touched by fingers, cutlery or chopsticks and are eaten. Texture in this case describes the feel or mouthfeel of the materials as they break apart.

Texture is the language for haptic and tactile perception. Juhani Pallasmaa argues that “All the senses, including vision, can be regarded as extensions of the sense of touch”. This suggests that texture, as carrier of haptic and tactile information, adds layers of sensations, visual as well as touch, imagined or associated, to all experiences of architecture.

Texture of raw materials is an important part of cooking. Texture tells us if the food is fresh or ripe if it is cooked long enough or if it has gone over. A well composed dish involves an interesting mix of different textures that says something about the quality of the raw materials. Contrast in different textures stimulates our mouth senses, haptic as well as taste. Cooking is about finding the signifying properties in food and to prepare them in a manner that preserves or enhances these properties. These properties can also be seen as a narrative of a meal, for example a seasonal narrative like crisp spring vegetables or sweet juicy fruits of late summer. A good dish is composed of flavors that work well together but being able to identify the different ingredients as you eat is also a sign of quality. For this texture is crucial.

Similar statements can be made of architecture and textures in building materials. Texture tells us something about the material and its intended use. In the same way a texture in food can highlight a certain ingredient or flavor, a texture in architecture can put focus on, or program an element, a space or a surface with a human multisensory relationship. Experience of texture, or the narrative of texture, gives an impression of a material, its intended use, but it also drives associations to culture, traditions and embodied memories in each individual that are experiencing the texture. The use and combination of different aspects of texture and forms to evoke multiple associations is what is implied when directing of textures is mentioned within this thesis.

“Where other than in the kitchen or at the dining table does family, social life crystalize most closely, thus contributing to the emotional and social establishment of a human home or center.”

Hagen Hodgson

”There are three things that cannot be tampered with in Italy: football, the pope and grandmother’s recipes. Nevertheless, in the kitchens of Osteria Francescana we pry, poke and question the authority of our culinary traditions. We take a step back, then come in closer, and make inquiries about texture, flavor and form. We see ingredients and recipes at a distance and through the magnifying glass, we throw out the recipe and start from scratch. Most important of all, we never stop questioning.”

Massimo Bottura

Meeting and Eating Narratives

Architecture and cooking have similar origins from gatherings around the hearth. Here two of our most basic needs, food and shelter, get satisfied. Home, to this day, is still usually our most precious architecture as well as the place where we share most of our meals with our families. The modern hearth, the kitchen and the dining table in our homes, is a powerful narrative that has some part in most peoples lives. A restaurant is a dining table in the public. The public is not our core family tribe, but it belongs to the dwelling of humans in a broader sense, communal, urban or at even larger scales. Eating normally takes place at the center of our homes but when we eat at a restaurant we eat in public. Eating is a social act and just as eating together with your family at home is important for family bonds, experiencing that act in public can help strengthen the sense of belonging to a tribe larger than that of the core family.

These narratives, of the hearth as the center of home and communities or aspects of them, are picked up as reference narratives in the presented restaurant design.

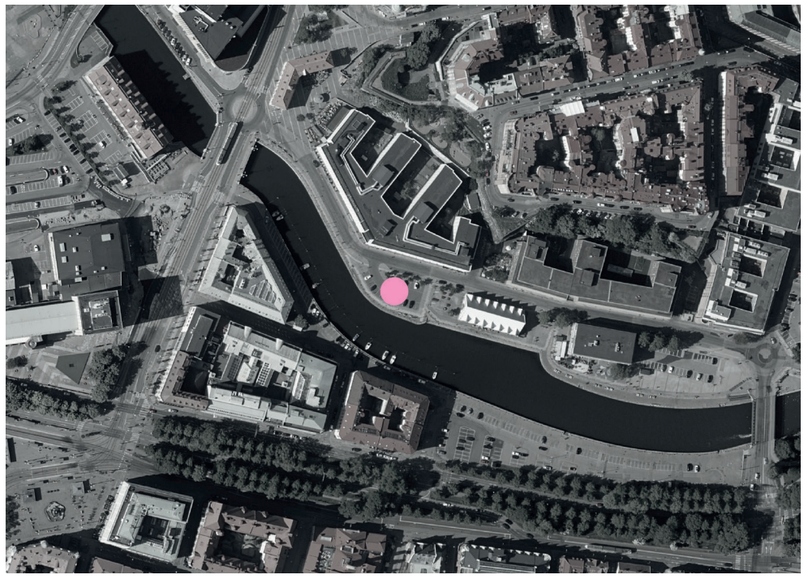
Traditions in restaurant architecture are many times linked to kitchen traditions. A sushi restaurant does not look the same as an Italian restaurant. This assumption is based on associations with the origin of the cuisine and traditions in cooking, agriculture or other food production, and architecture of that region.

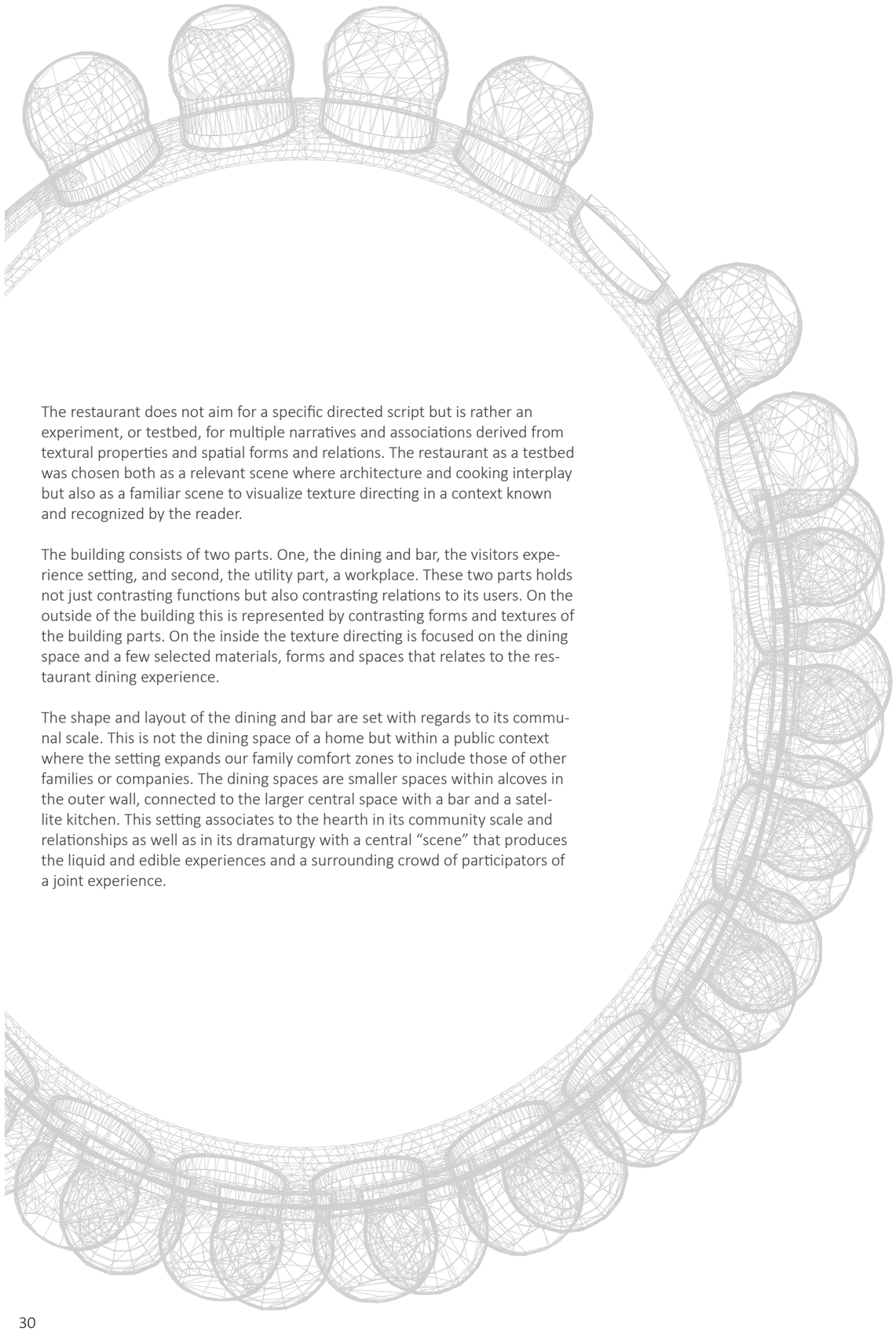
A chef that has taken the concept of food as an experience to heart is the founder of elBulli, Ferran Adria. He made the argument, that a dish is a conversation between the chef and the guest, where the chef`s knowledge of food, traditions and culture is condensed and told in a narrative that is a dish (Lopez, 2011). At elBulli new foods and dishes were designed in an iterative design process very similar to a design process within architecture. New techniques and methods developed at elBulli have had an enormous impact on the contemporary development of cuisines all over the world. Massimo Bottura, the chef of Osteria Francescana, also talks about traditions in cooking, he refers to it as playing with traditions or evolution in traditions (Bottura, 2014). His methods also involve dissecting dishes or ingredients to flavors and textures that can be recomposed into reinterpretations of cooking traditions. This concept, which is present in all kitchens that develops cooking, is the inspiration for the method developed within this thesis.

Restaurant Design Testbed

Site and City

The design testbed is a restaurant building visualized in detail at a few key points at varying scales. The site for the restaurant is located on a parking lot next to Feskekörka in central Gothenburg. The site was chosen for its central urban location, size and scale of surrounding buildings and spaces.

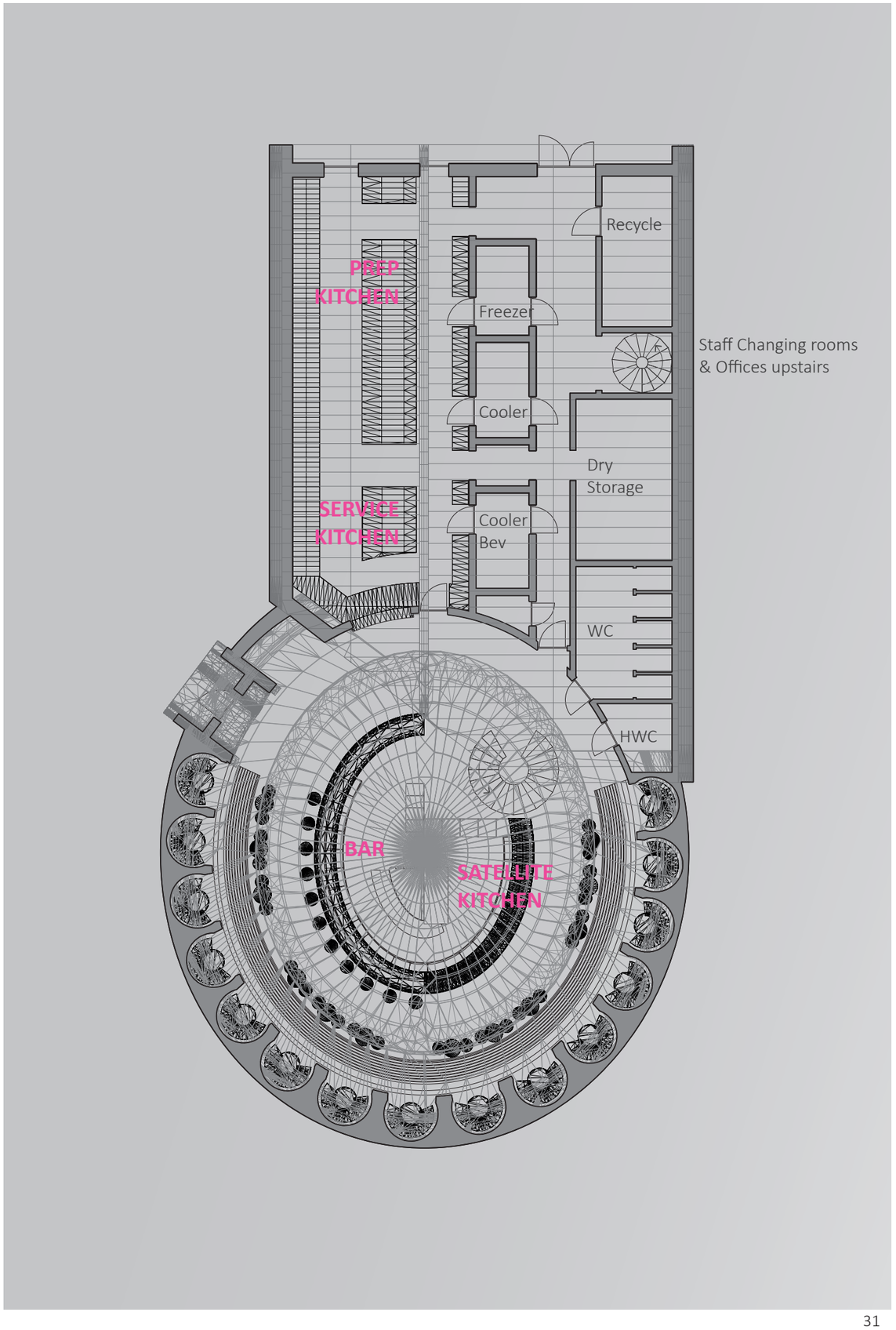


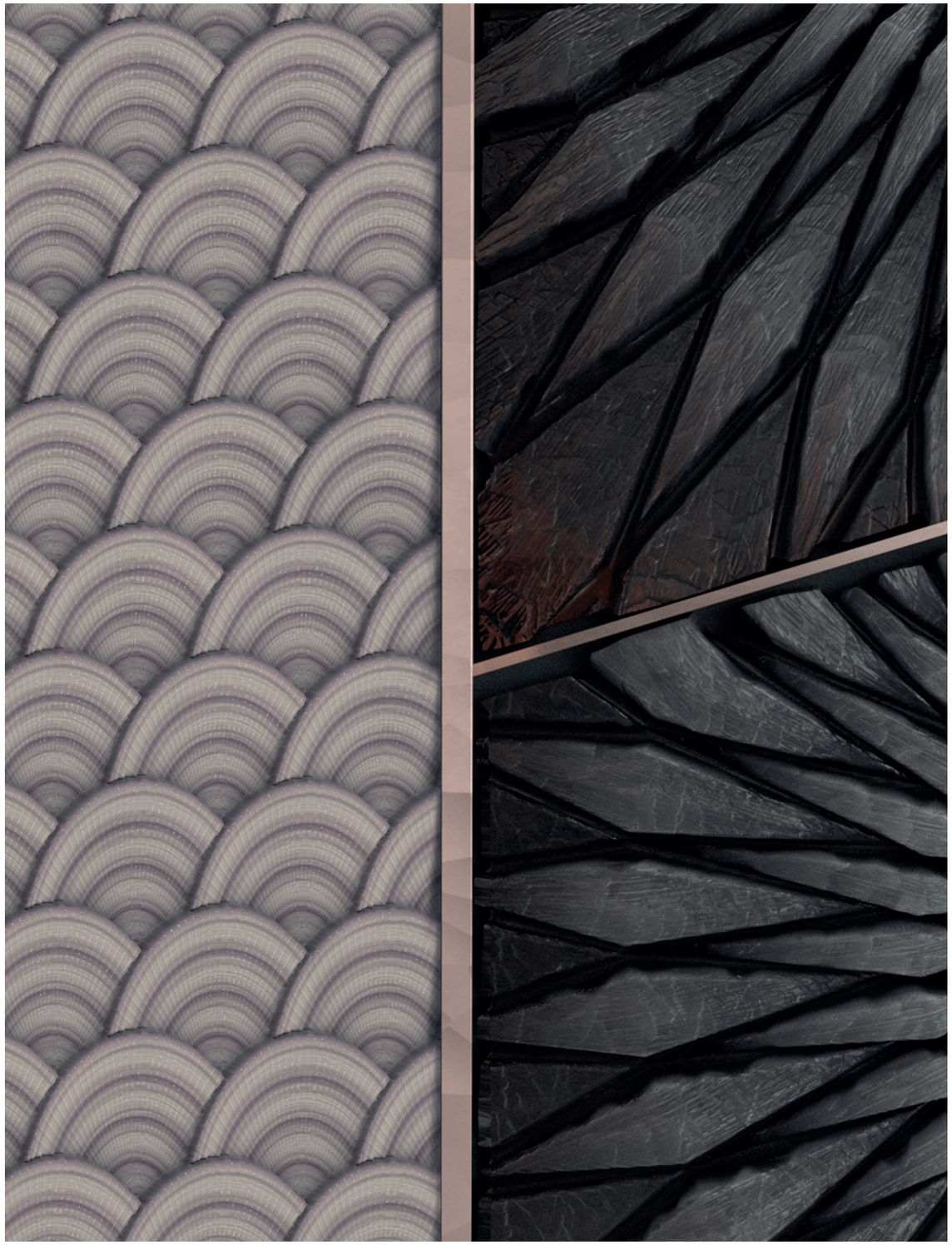


The restaurant does not aim for a specific directed script but is rather an experiment, or testbed, for multiple narratives and associations derived from textural properties and spatial forms and relations. The restaurant as a testbed was chosen both as a relevant scene where architecture and cooking interplay but also as a familiar scene to visualize texture directing in a context known and recognized by the reader.

The building consists of two parts. One, the dining and bar, the visitors experience setting, and second, the utility part, a workplace. These two parts holds not just contrasting functions but also contrasting relations to its users. On the outside of the building this is represented by contrasting forms and textures of the building parts. On the inside the texture directing is focused on the dining space and a few selected materials, forms and spaces that relates to the restaurant dining experience.

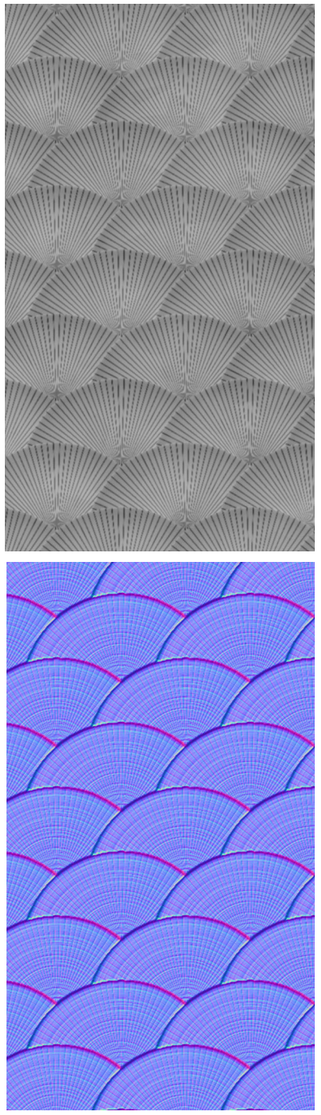
The shape and layout of the dining and bar are set with regards to its communal scale. This is not the dining space of a home but within a public context where the setting expands our family comfort zones to include those of other families or companies. The dining spaces are smaller spaces within alcoves in the outer wall, connected to the larger central space with a bar and a satellite kitchen. This setting associates to the hearth in its community scale and relationships as well as in its dramaturgy with a central “scene” that produces the liquid and edible experiences and a surrounding crowd of participators of a joint experience.

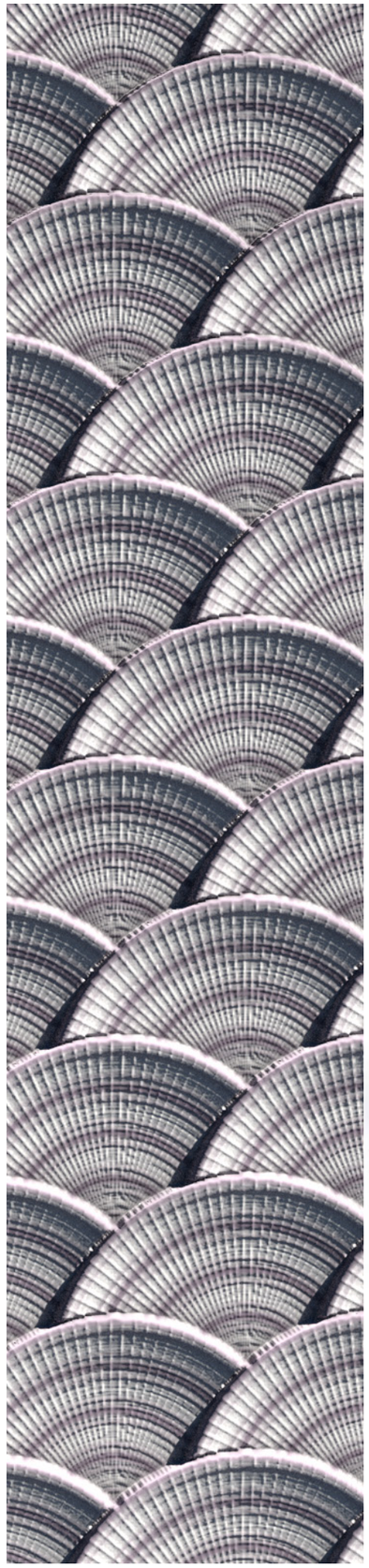




Utility- workplace part

Visiting- dining experience part

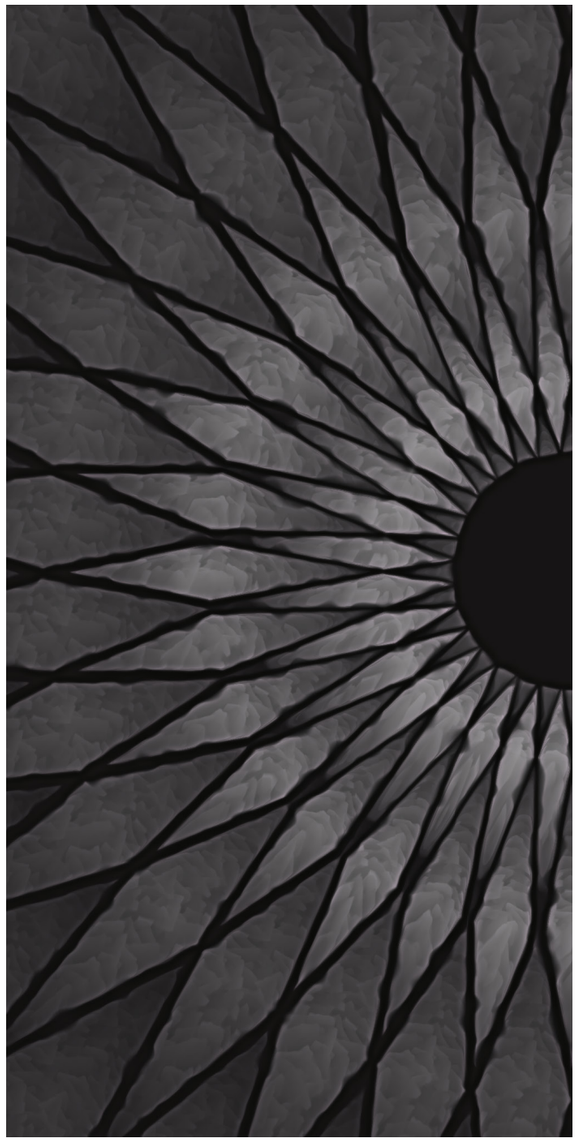




Reference material

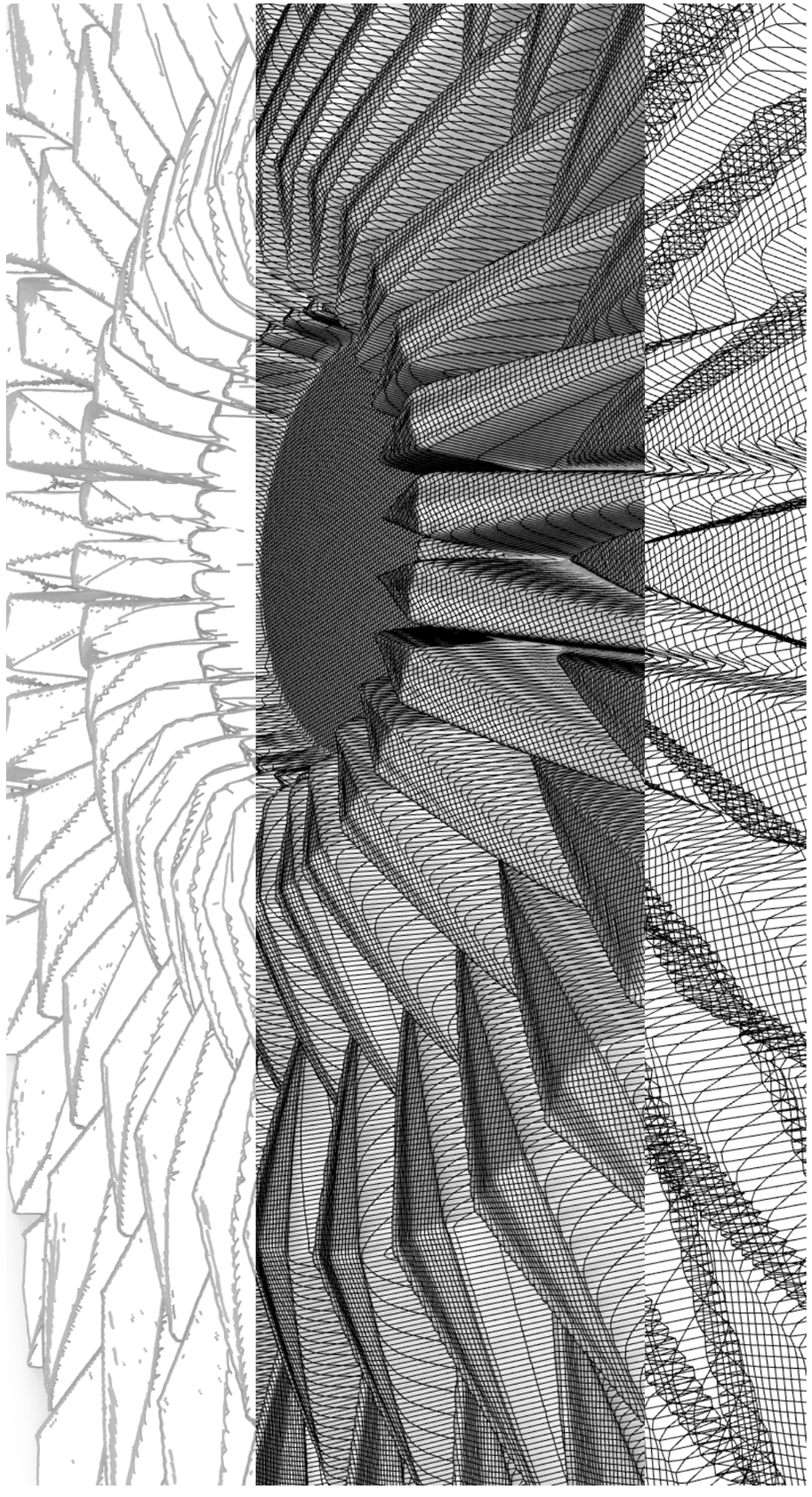
Reference material

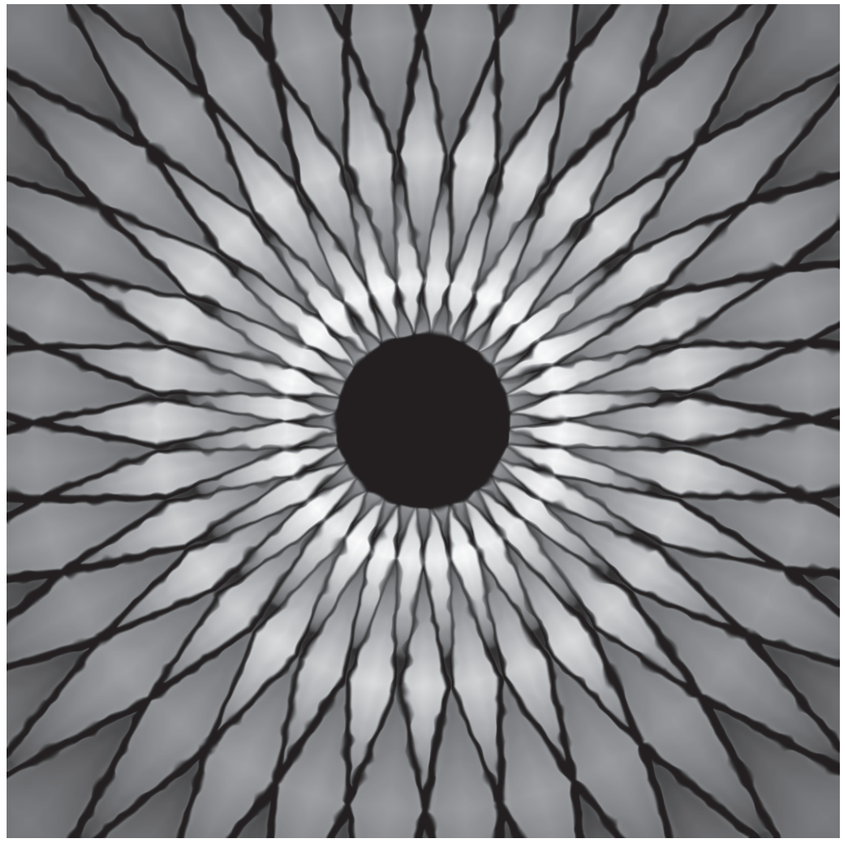
The utility building is covered by a light tiled material, referenced from porcelain and painted patterns of porcelain. The painted patterns have been recreated and combined with other created patterns and used in different layers of textural aspects, creating haptic forms of tiles, a tactile surface as well as patterns for reflections of light.

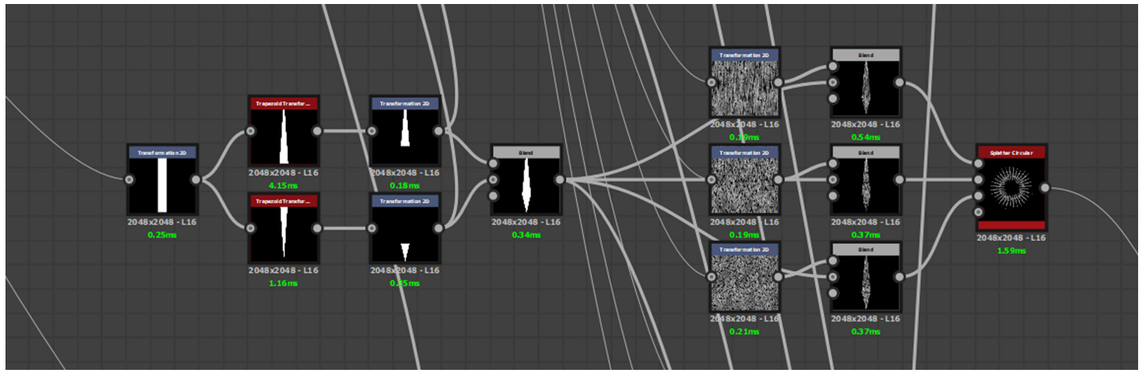


The dining building part is covered by larger tiles or elements that represents the dining spaces in the alcoves. The elements are formed by a voronoi pattern centered in the circular windows in each dining space. The radial pattern of the texture is centered in the same way. Texture properties are inspired by properties of burnt or aged wood and drift wood.

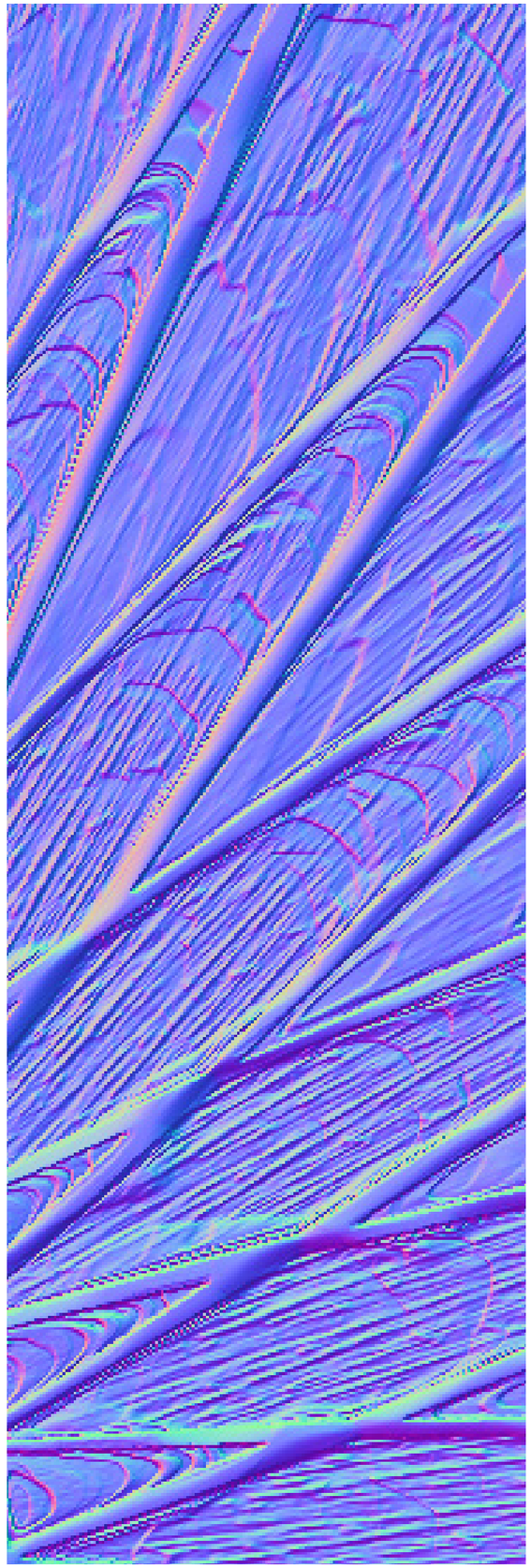
Image 4-6

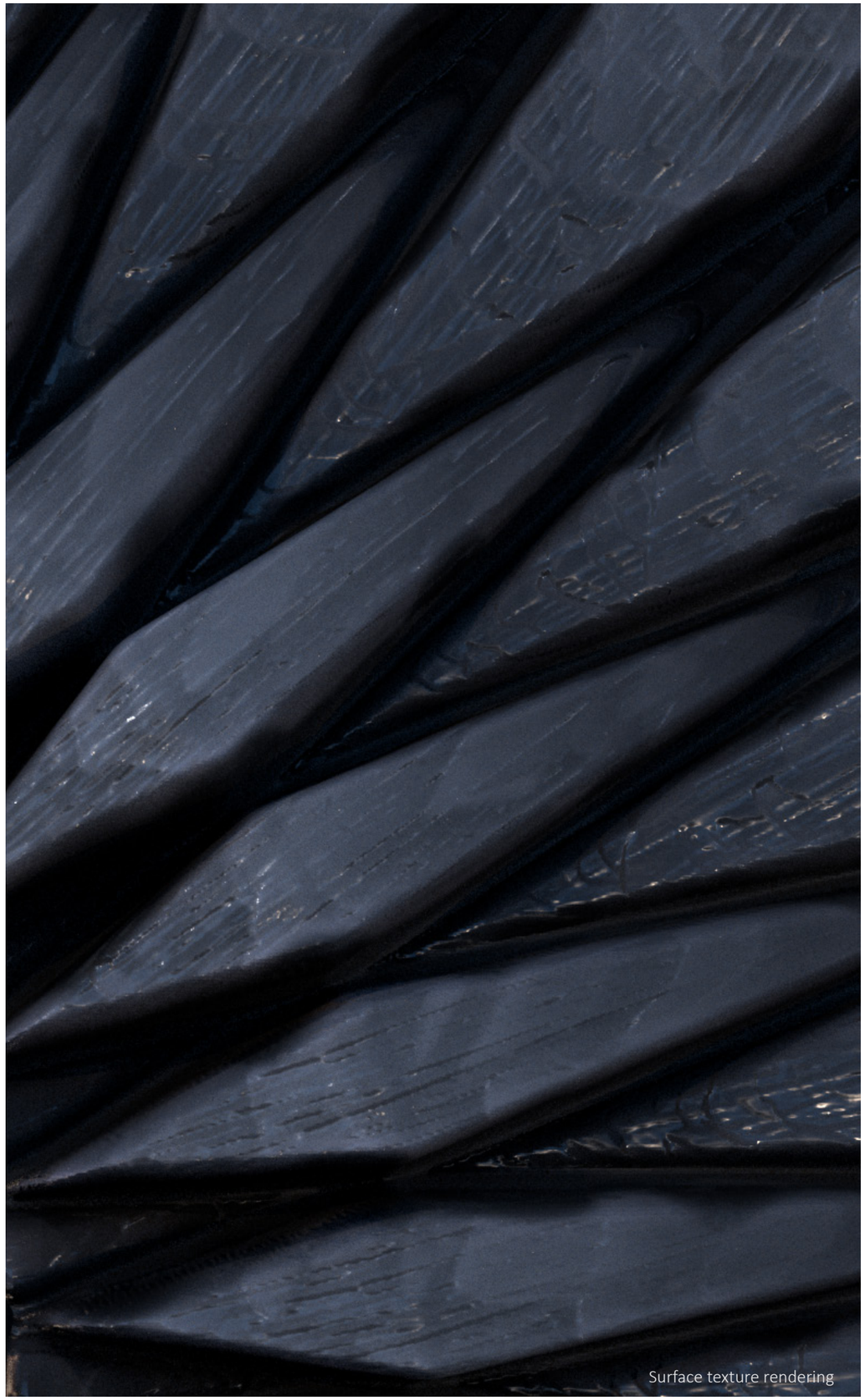






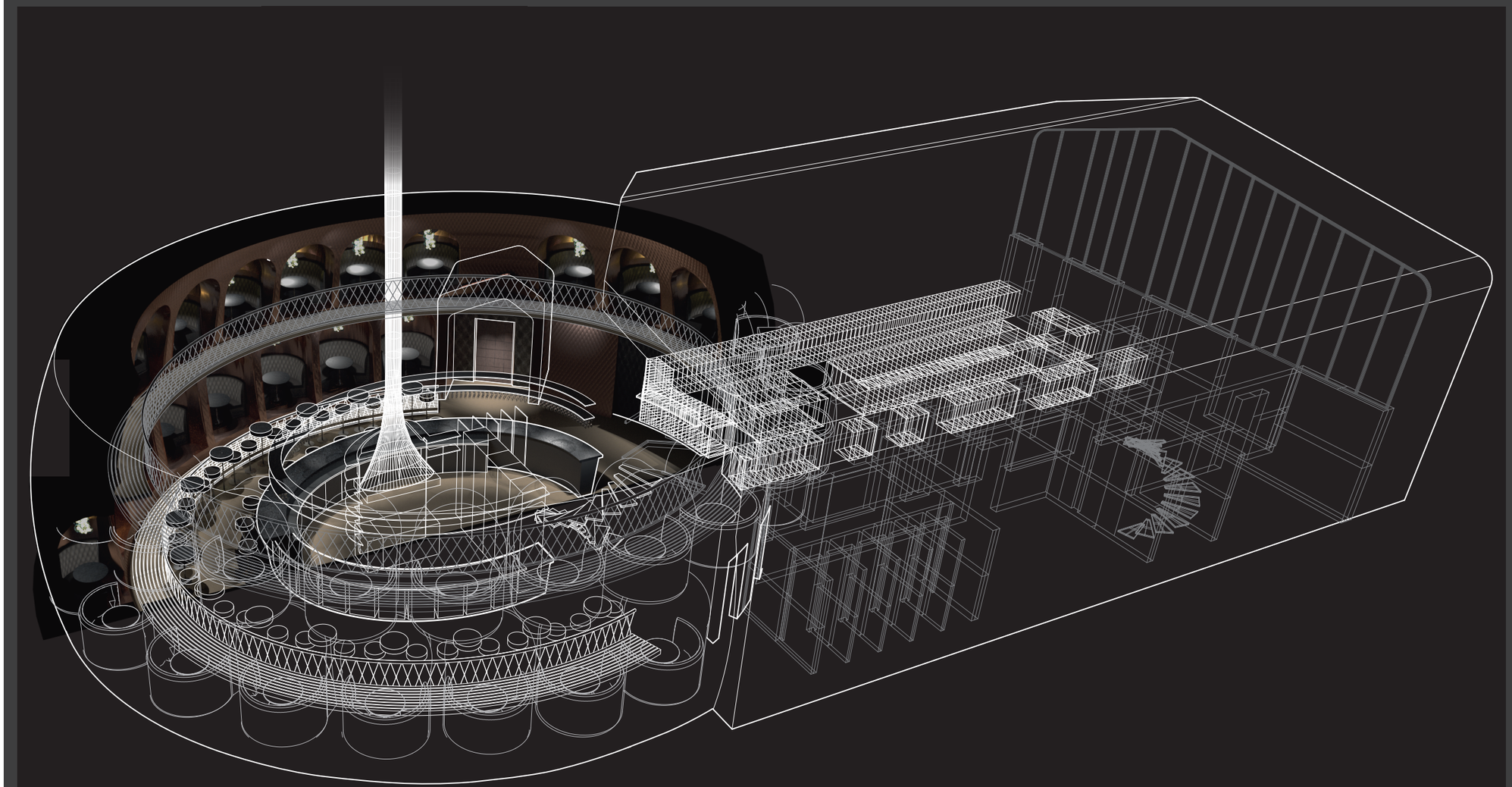
The radial pattern is set up by circular layers of tiles, shaped by displacement modelling.



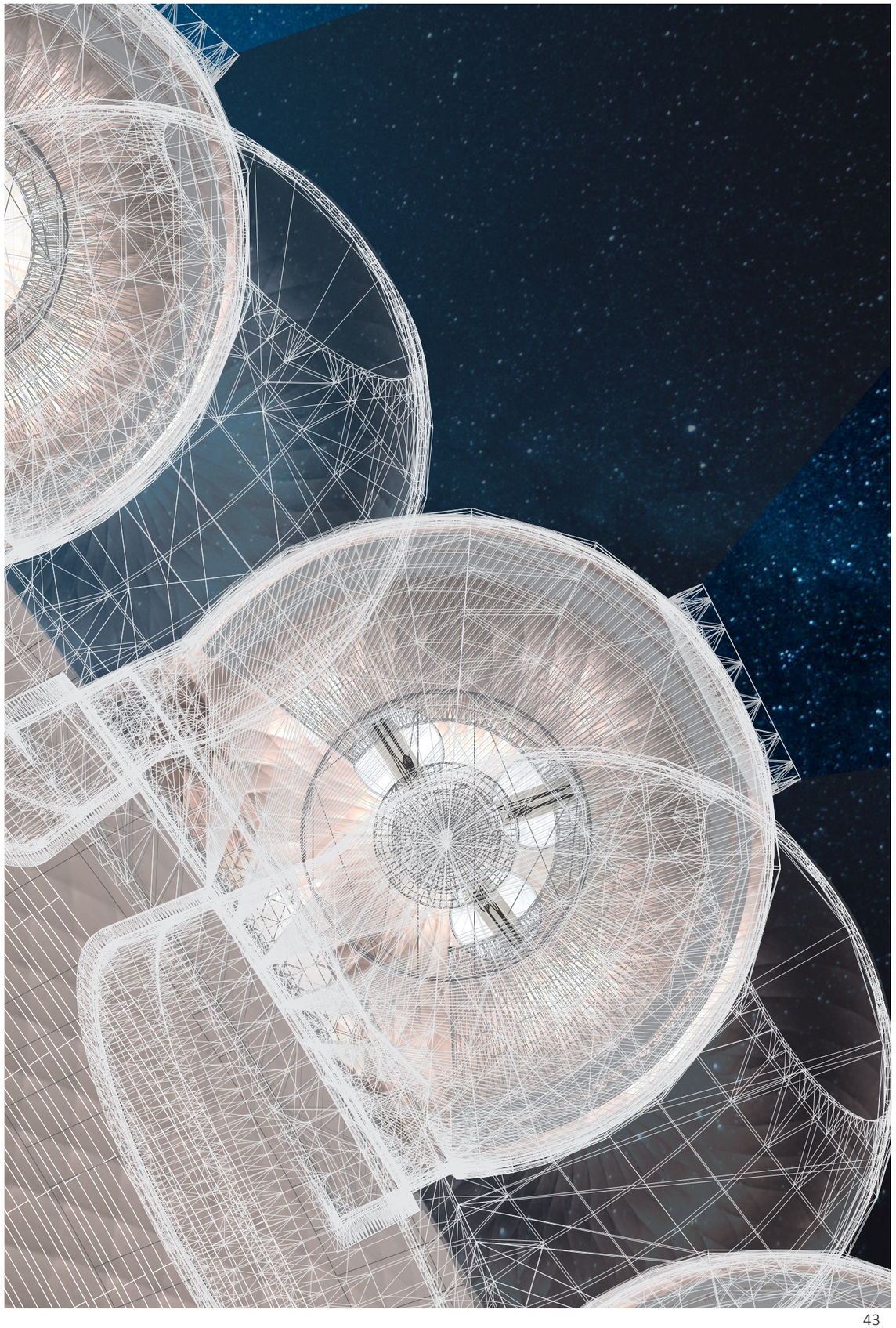


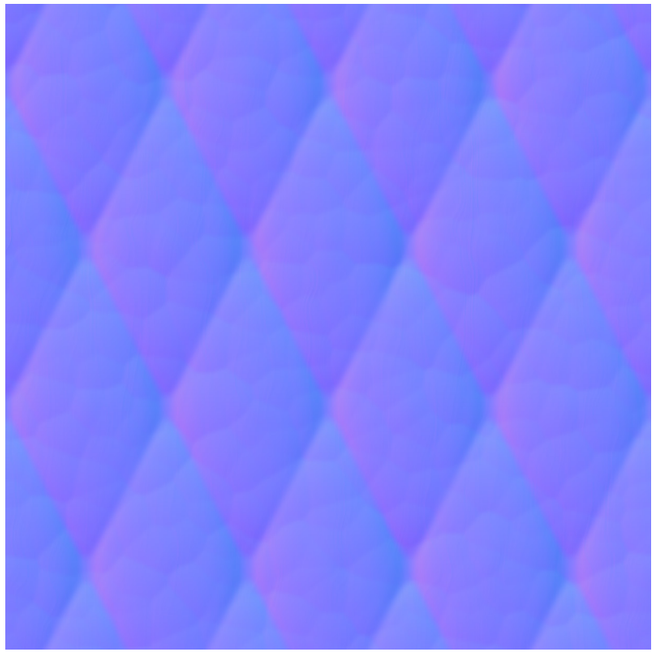
Surface texture rendering

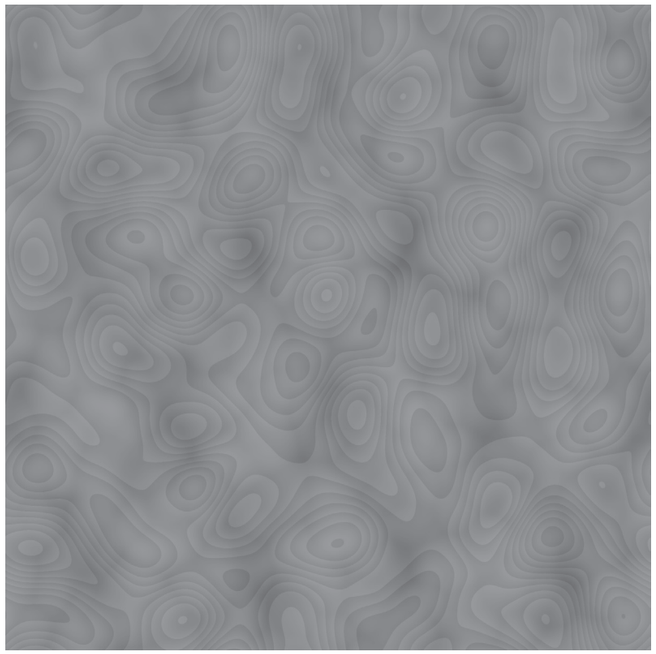
Dining Space



Dining spaces in two levels in alcoves in the solid outer wall. Surrounding the central bar and satellite kitchen.

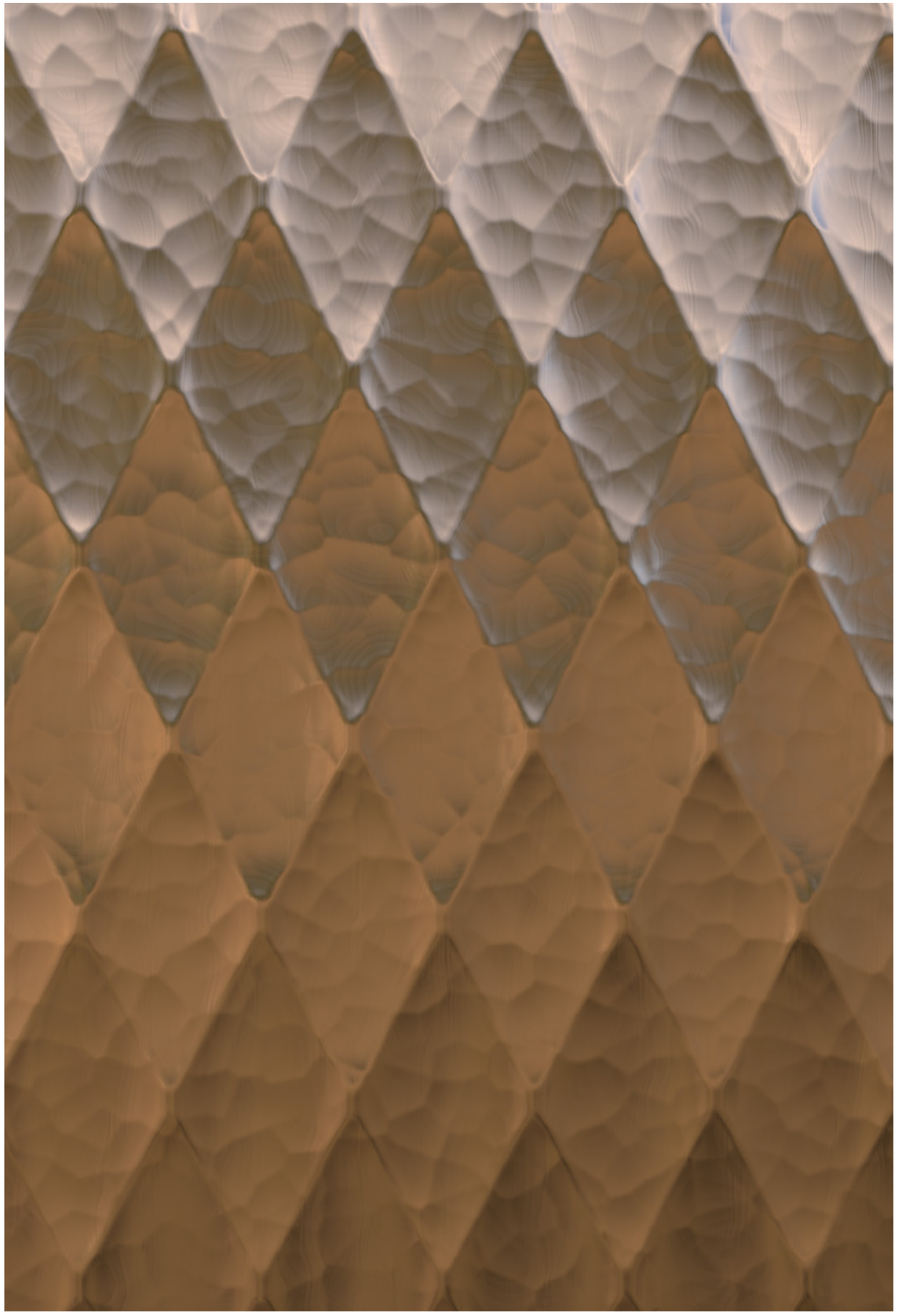


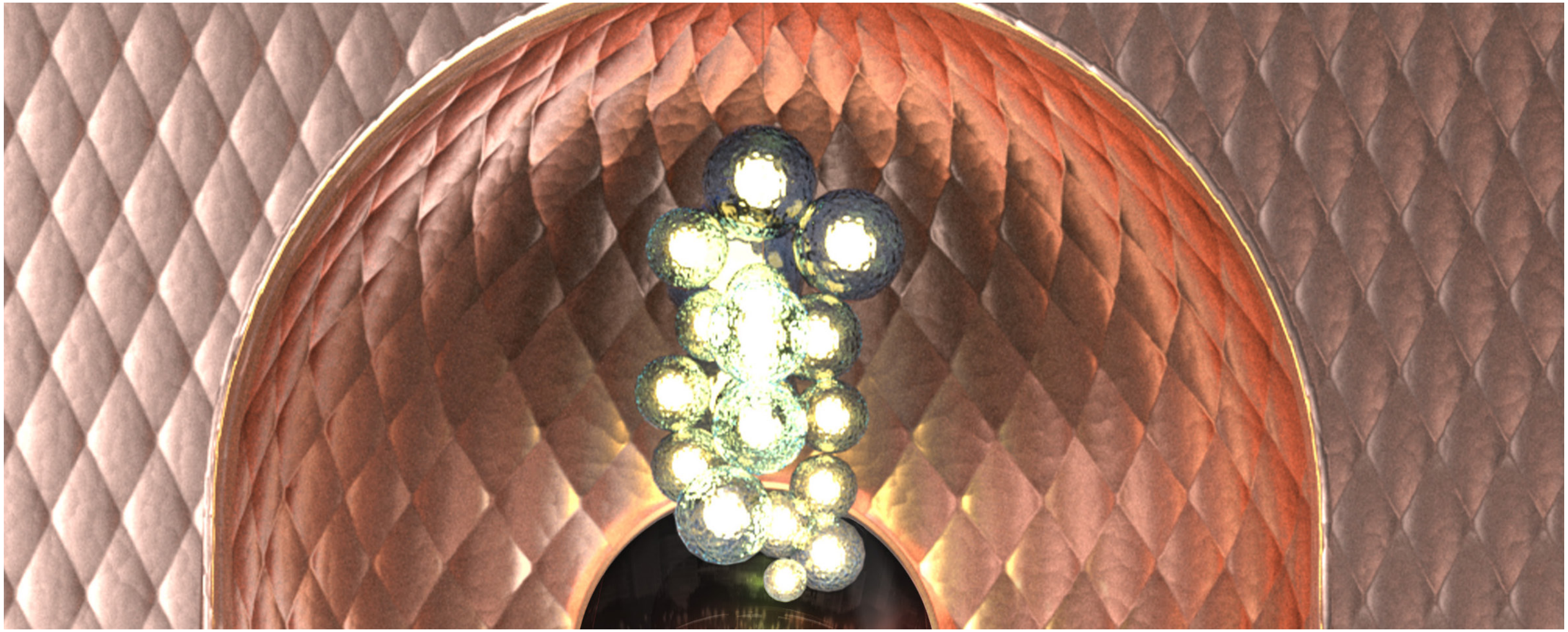




Reference copper kitchen ware material.

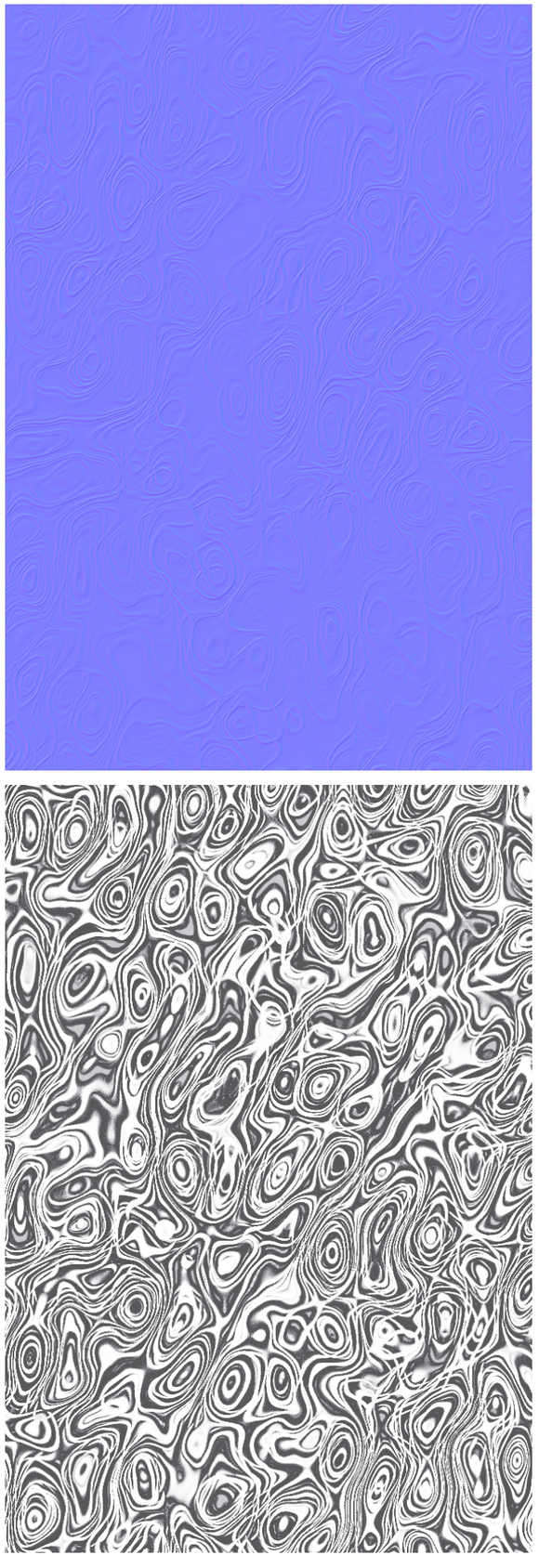
Image 7

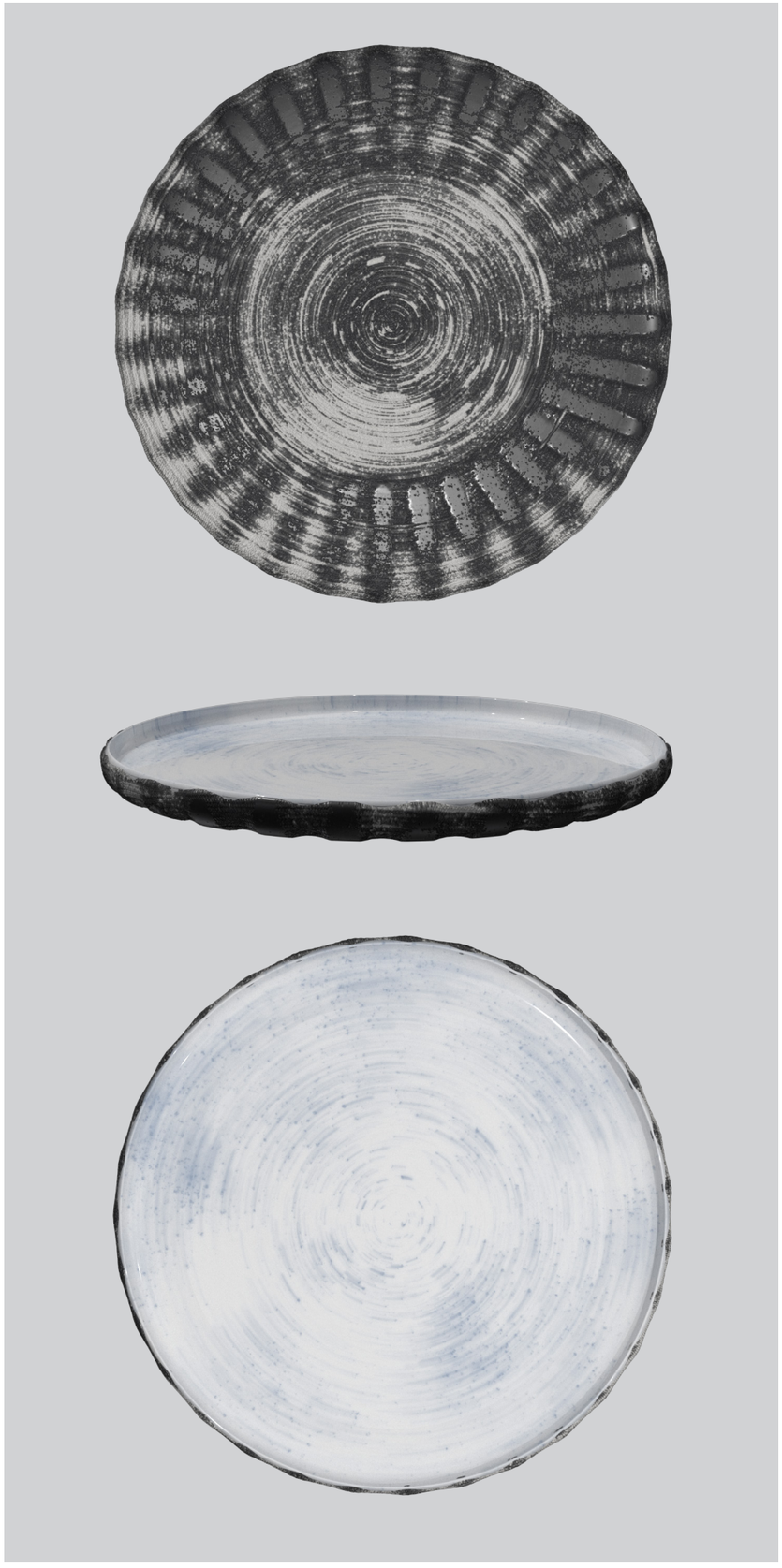




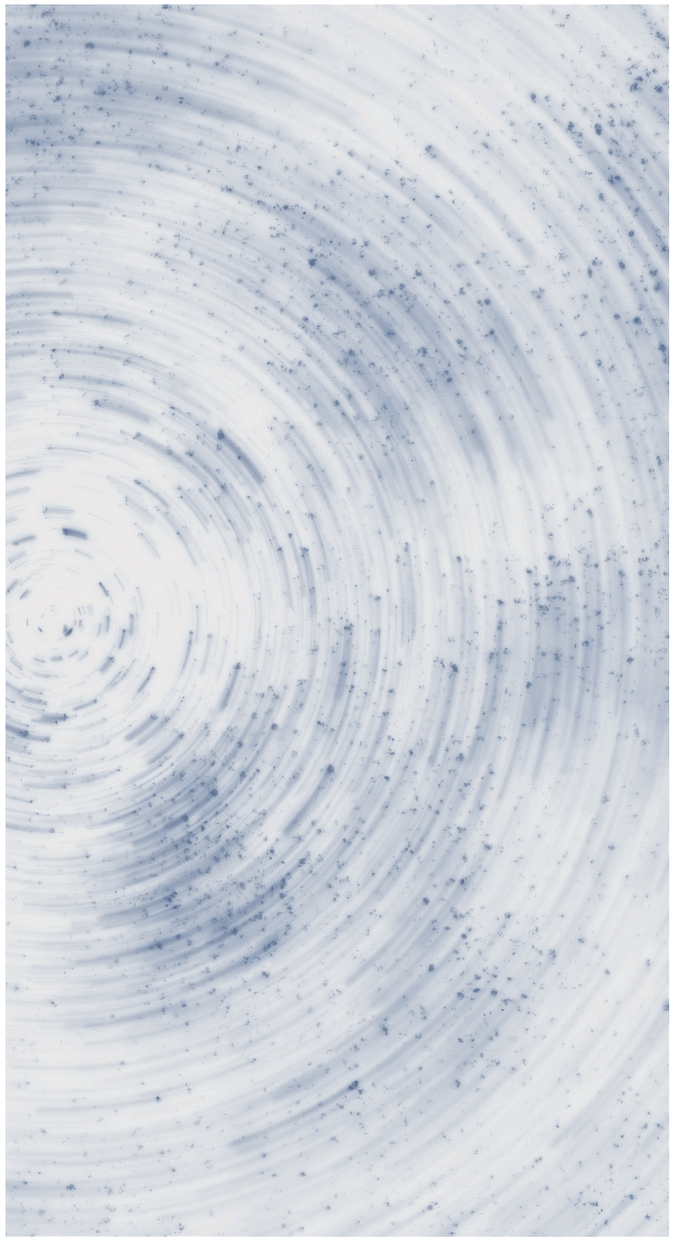
The copper texture created for the outer wall envelopes both dining areas in the alcoves as well as the larger space in the center of the building. The different shape, or curvature of the texture, creates different light and color ambiances in the different spaces. The facetted surface also creates multitude of reflections, that scatters light sources, creating a light ambiance more related to natural settings, like light filtered through trees or reflected of a water surface, than a constructed setting.

Table surface and plate. Tactile scale, surfaces explored by touch.



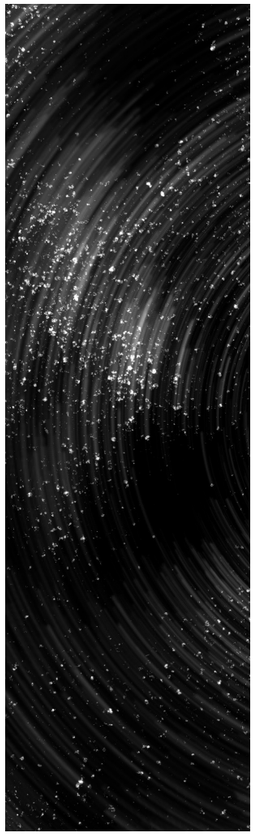


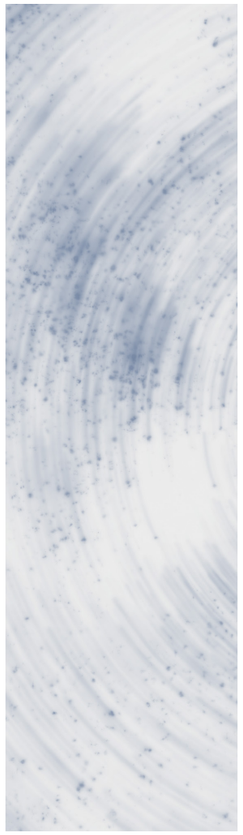
Reference material

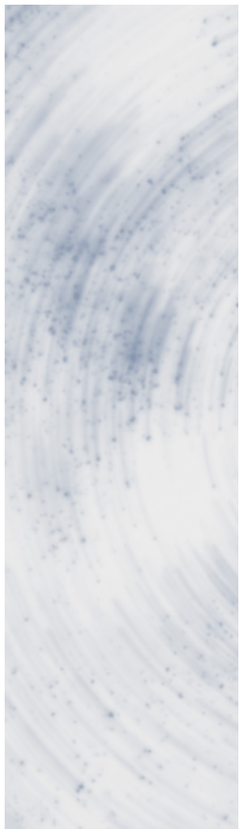


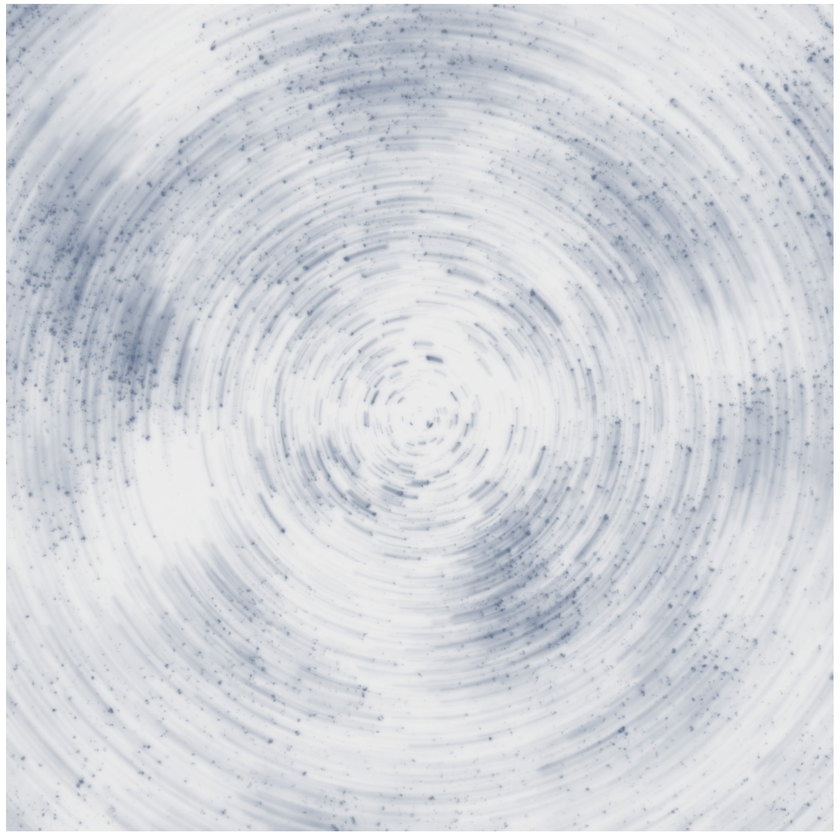
A plate directed with opposing sides, the top is programed with very subtle tactile information and a pattern in color. The bottom or the outside have a rougher texture as the pattern have been used in different layers in the texture.

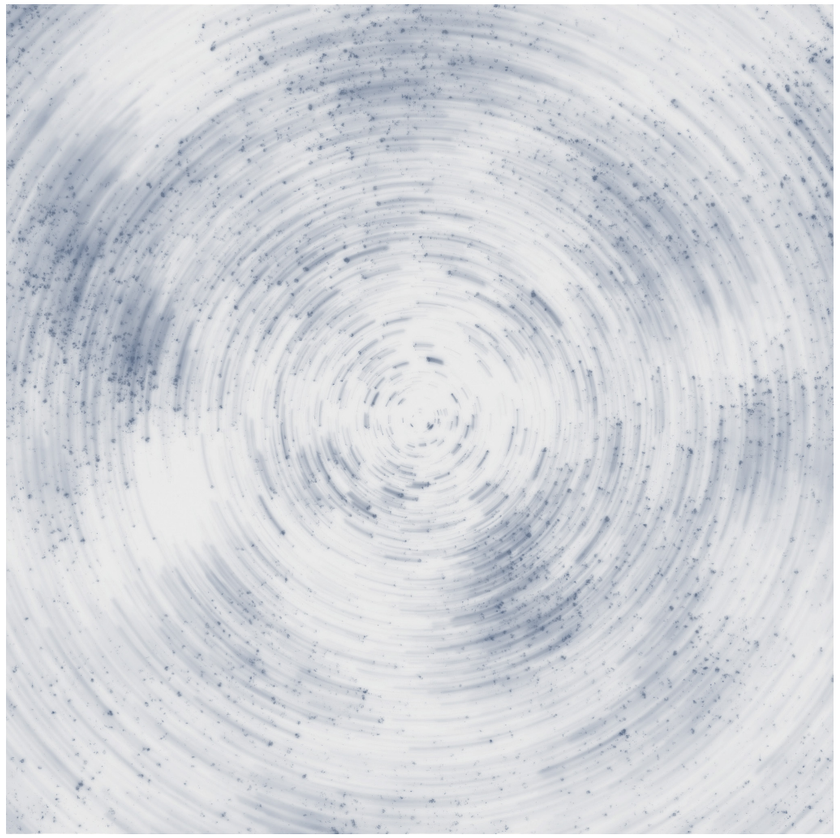
Image 8



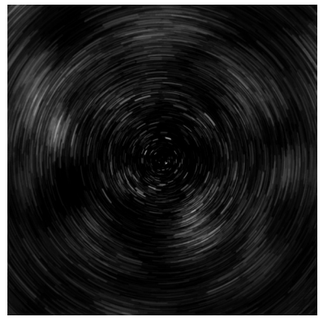




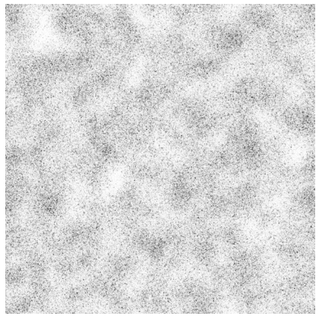


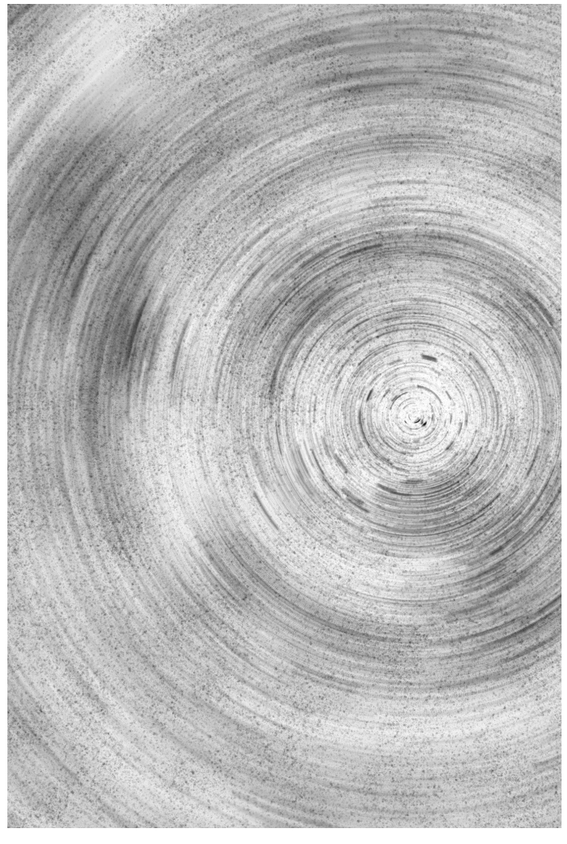


Color pattern of the plate top

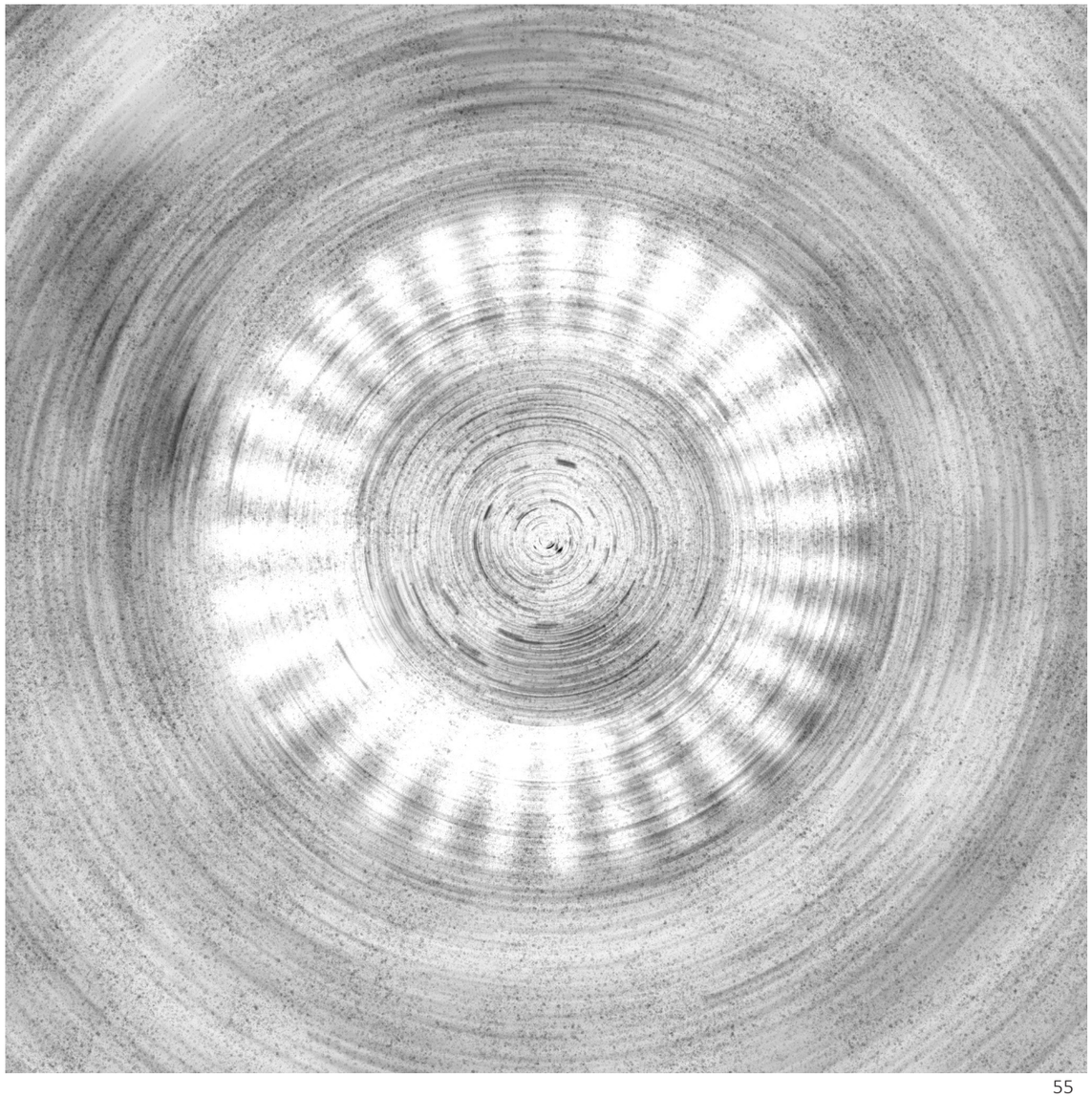


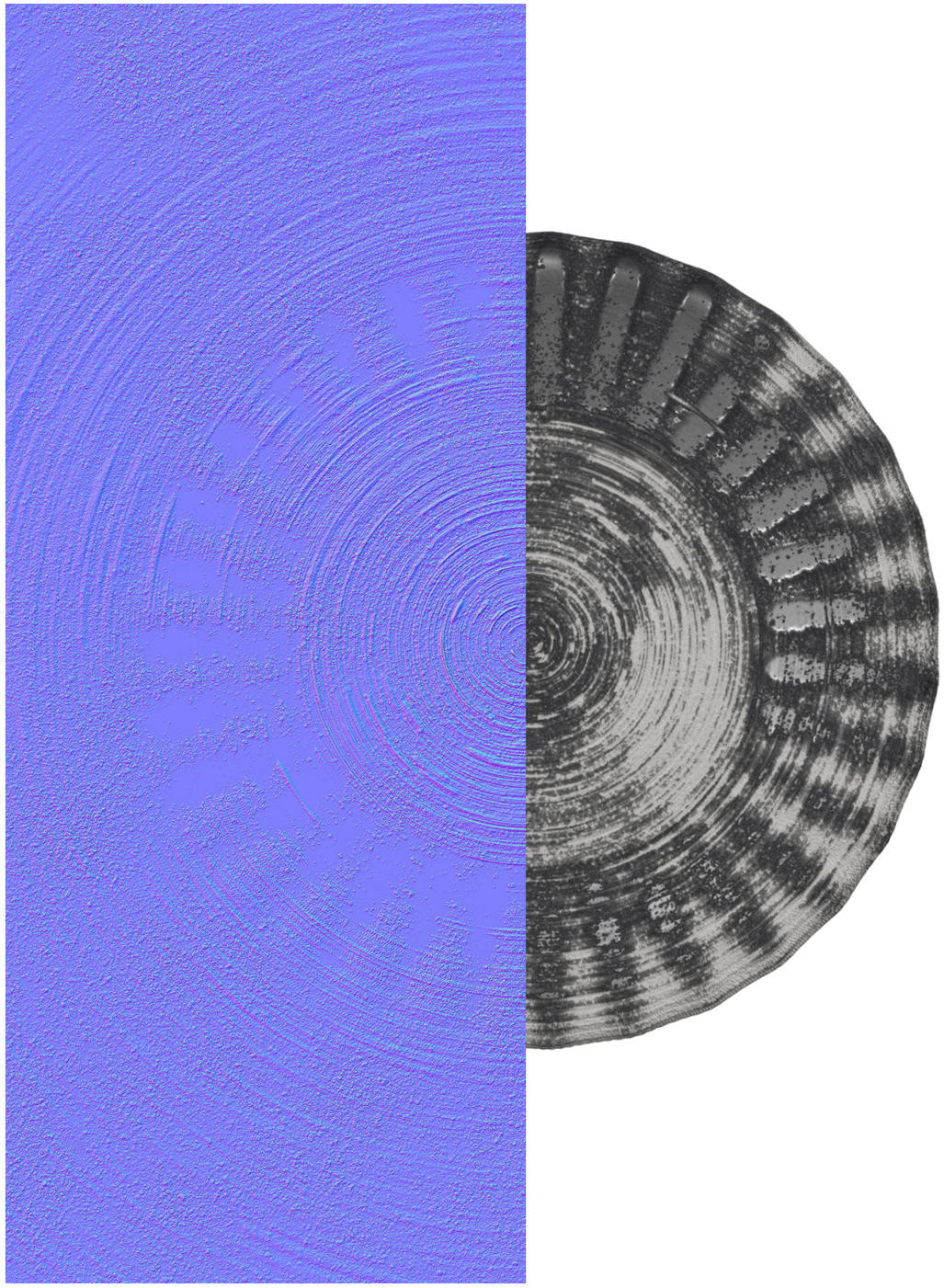
Patterns used for tactile properties of the bottom texture

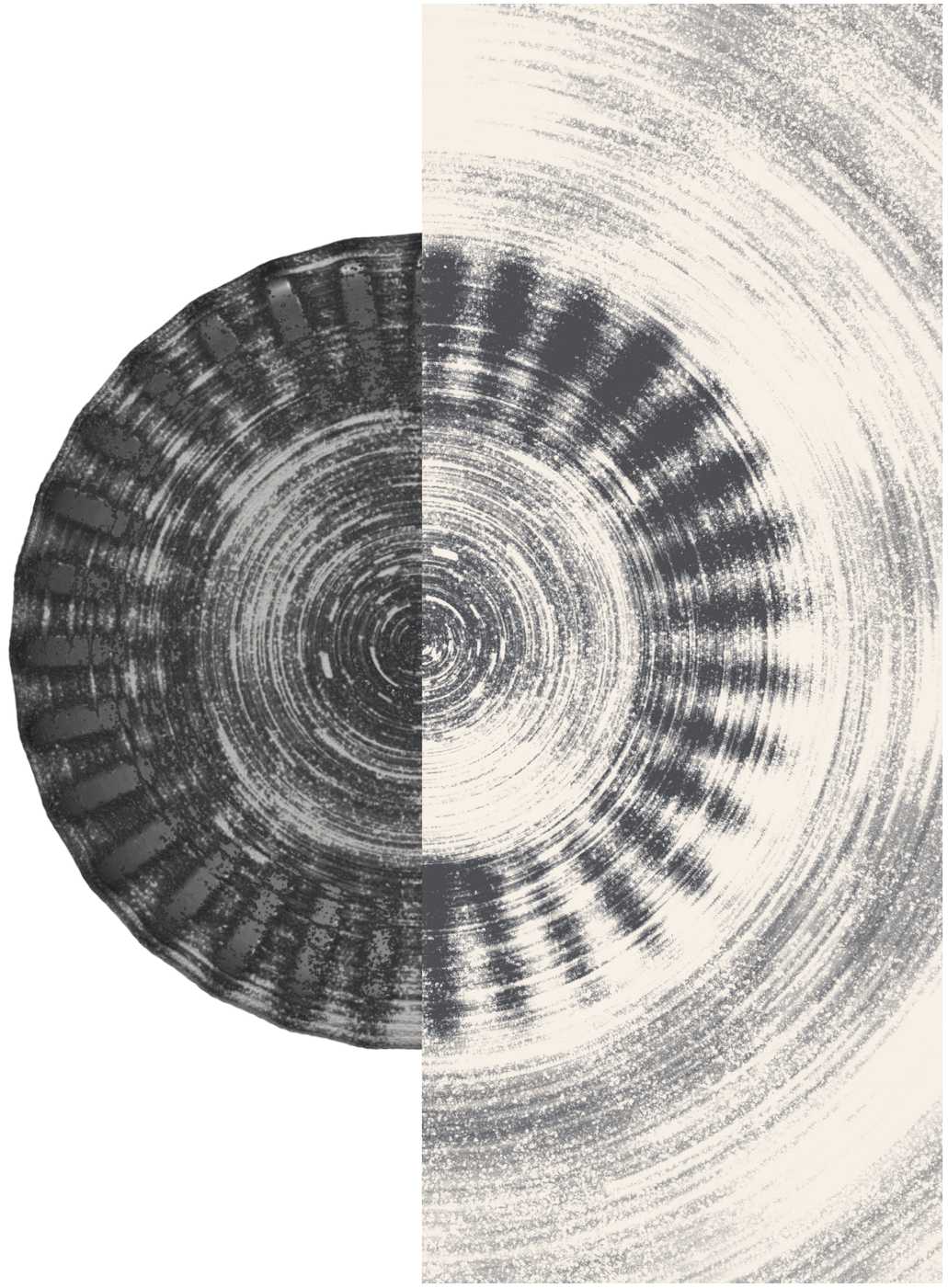




Displacement pattern







Method

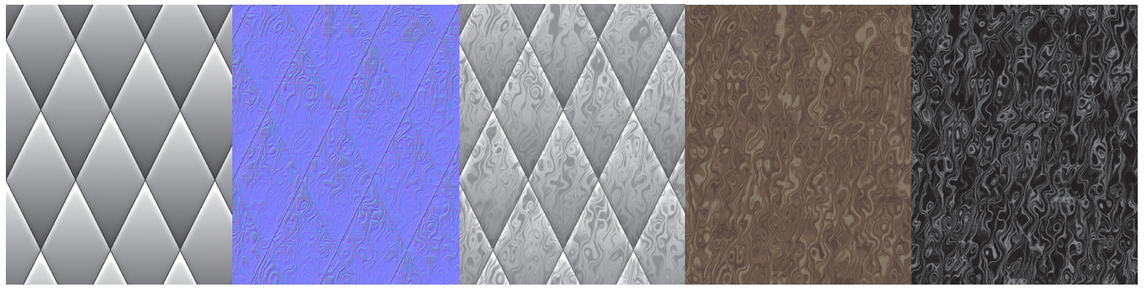
Creating Digital Texture and Tactile Representations
Pattern Workflow Example

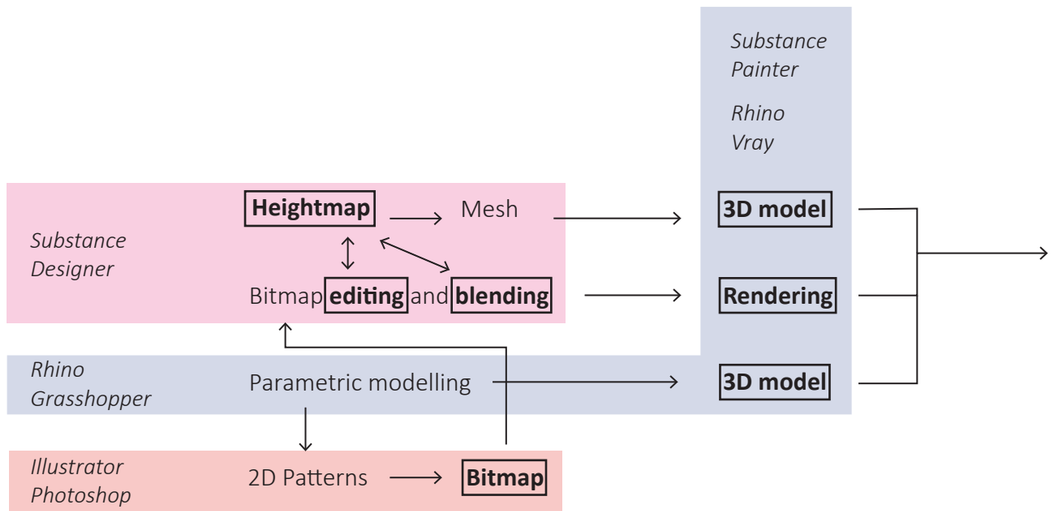
Creating Digital Texture and Tactile Representations

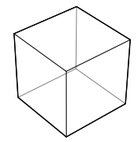
A digital material is an abstract visual representation of a material or texture. It can either strive to accurately represent a physical material or as is done within this method, remain abstract when it comes to the material as a whole but strive for physical accuracy in each property of itself. For this method a digital software called Substance Designer is used. It uses greyscale bitmap images of shapes and patterns that are combined and blended using different image editing tools into a texture function, that then can be altered with different inputs in a similar way as a Grasshopper function. The output from Substance is different bitmaps that can be used by for example a rendering engine.

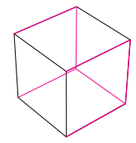
This method for working with texture involves building up texture in layers of separate patterns or properties. The different maps contain different aspect of a texture that is used by a rendering engine to create an image of a texture. The method looks at the different aspects of a texture not just as a visualization tool but as representations of experiences of texture, both tactile and haptic as well as visual. This approach gives an intimate knowledge of the detailed patterns that make up a texture and direct control over each property with the possibility to change, copy and blend to make many iterations of the same or different textures. These iterations of texture can then be used to direct experiences of texture, in a very intimate and subtle scale.

The properties of the textures are manipulated digitally and saved in different bitmap images. These images represent a map of a surface that can be tiled on a 3D geometry.



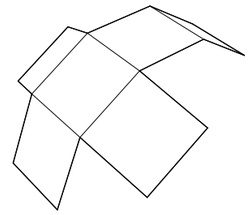


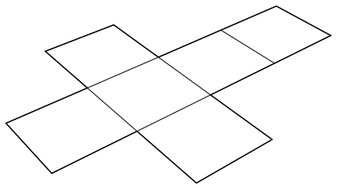




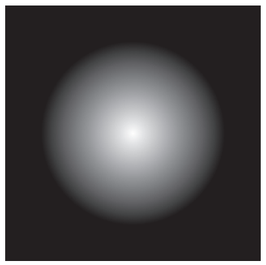
To fit a 2D image on a 3D geometry, the geometry is “unwrapped”. This operation works like backward origami, the geometry is cut in specific places so it can be unfolded to become flat. The unwrapping of a geometry can be done either strategically to minimize visibility of texture seams or as a conscious tool for creating edges or meetings between materials.

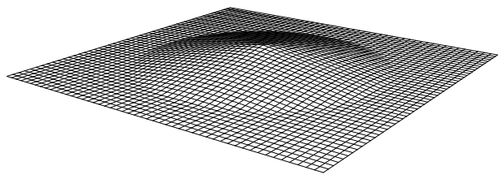
The texture is then rendered on the geometry or visualized in other ways to try to represent the different visual, haptic and tactile properties.



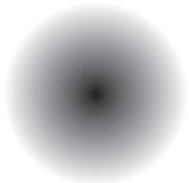


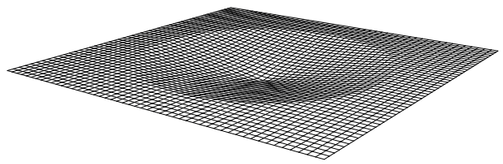
Heightmap shape





Darkness values inverted





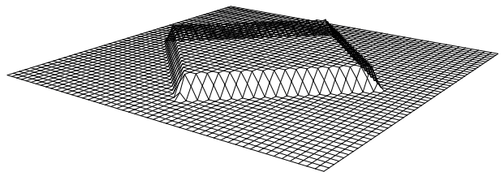
Heightmaps

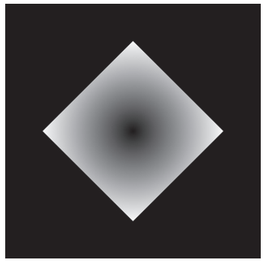
Displacement - Surface 3D modelling

A heightmap is a greyscale image that describes the shape of a surface. Each pixel in the image corresponds to a point on the surface where the darkness value represents the height. The height is determined within a range where white is the highest and black is the lowest point. When creating a digital texture, a heightmap changes the actual geometry of the surface as opposed to other maps that merely creates an illusion of depth.

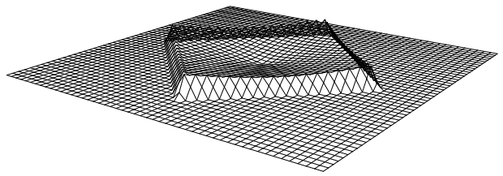
Workflow

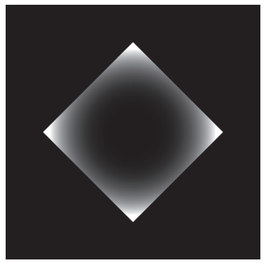
Heightmap shape



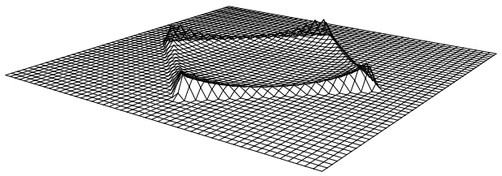


Blended images work like Boolean operations

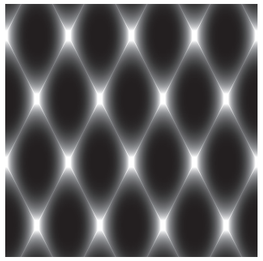


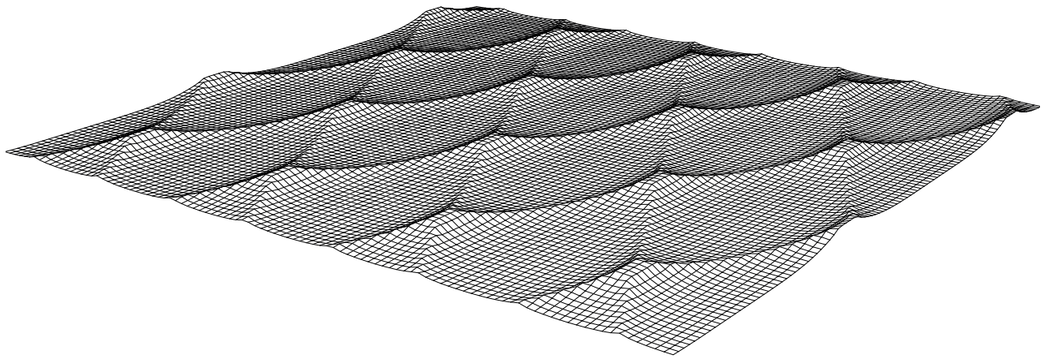


Adjusted darkness values changes the shape

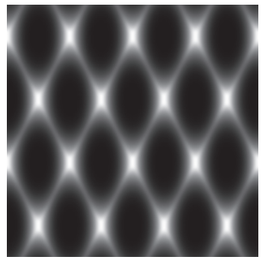


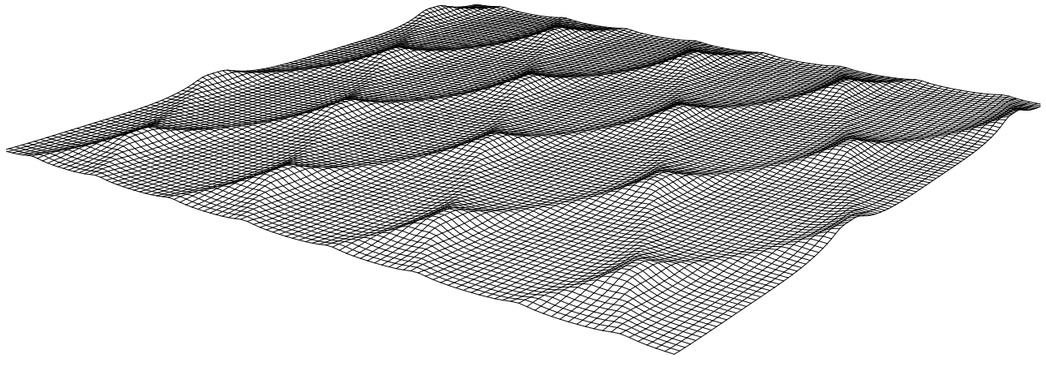
Tile generator. Array, offset and dimensions of tiles





Blured image softens the edges

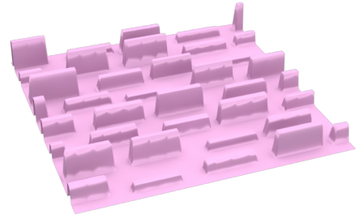




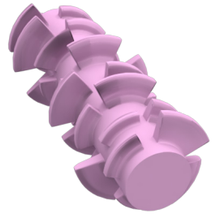
Narrative Applications

Heightmap displacement works as an extrusion directed by the surface normal. This kind of extrusion can visualize expansion or growth. The extrusion is guided by the surface shape and the directional expansion can help pronounce the shape. Directing this type of properties can be done by pronouncing curvature or by contrasts, keeping it in place within a frame or attached to a more rigid texture. Heightmap information can be used at any scale from landscape to barely detectable details. Within the context of this thesis heightmaps mostly handle information at a haptic human scale, describing forms and shapes relatable to the human body. The smaller details are usually not rendered as displacement but put in a normalmap. The normalmap information is more specifically tactile and describes how a surface feels to touch.

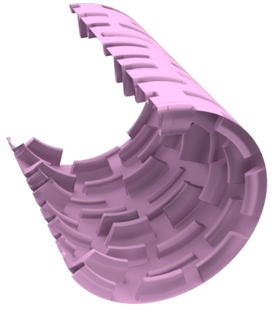
Basic heightmap



Flat geometry



Positive curvature
Stretch the displacement extrusion



Negative curvature
Compress the displacement extrusion

Normalmaps

Normalmaps also describe the geometry of the surface but the pixel colors represent the normal angle. This is not a greyscale image, instead it has two color gradients where one represents angles in a “north-south” direction and the other an “east-west” direction or the U and V direction on a digital surface. Since a combination of two-color gradients is not as intuitive to work with as a greyscale representing height, the patterns that are applied to the normalmap are first created as greyscale images and then translated by the program to the normal color gradients. The only adjustments done directly in the normalmap is an intensity gage that increases or decreases the sharpness of curvature where the normal angles change. Normalmap information can be used to create curvaturemaps (like ambient occlusion) that are used for applying color, light or darkness to areas specified by curvature. Since the normalmap does not change the geometry it can have a higher resolution than the heightmap which makes it suitable for smaller details and patterns.

Narrative applications

Normalmaps contain patterns that usually evoke associations to what material it is and its tactile qualities. By sticking to layering properties of the same material a representation of that material is produced, but by cherrypicking desired properties of different materials the result is more abstract. This abstraction bypasses associations connected to specific materials wich offers possibilities to explore tactile qualities more freely.

Reference images of details typically described by a normalmap

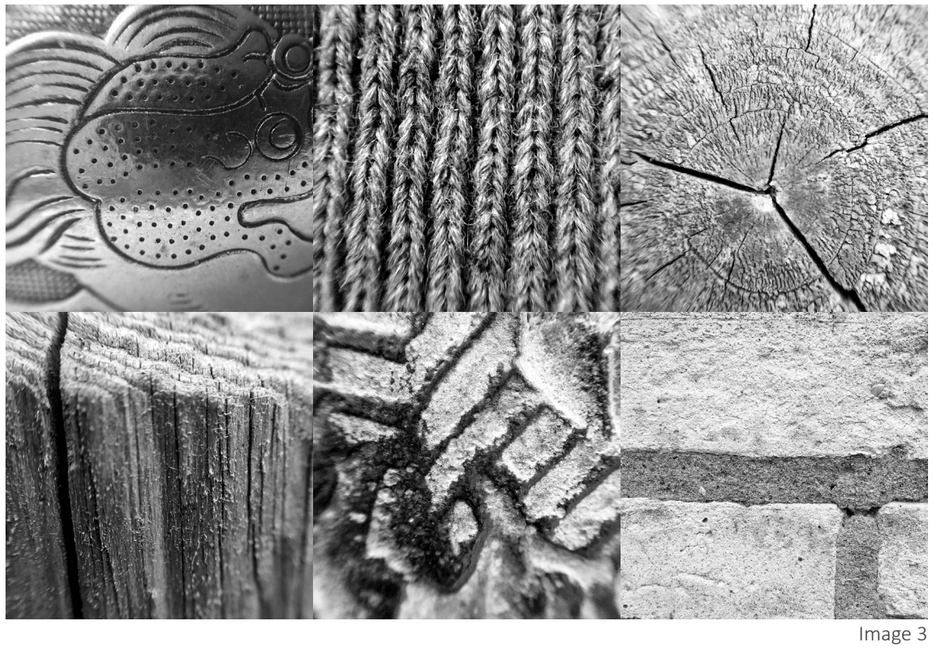
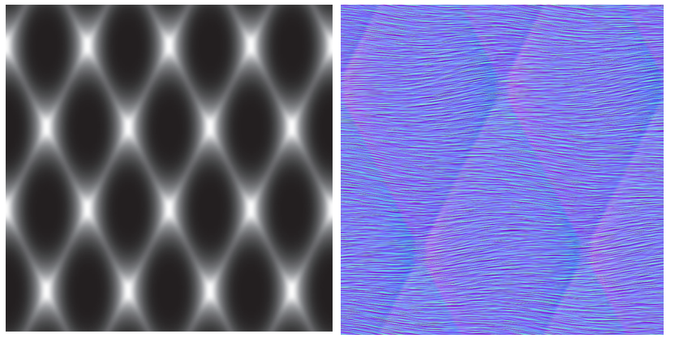
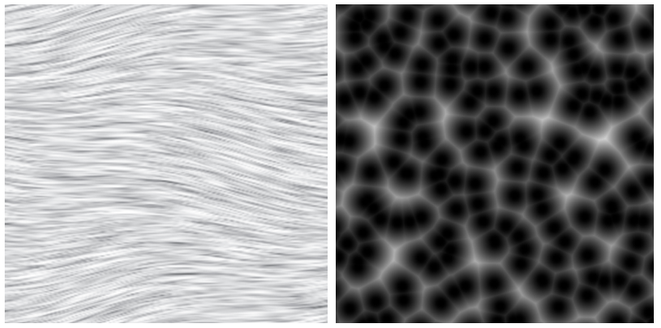


Image 3

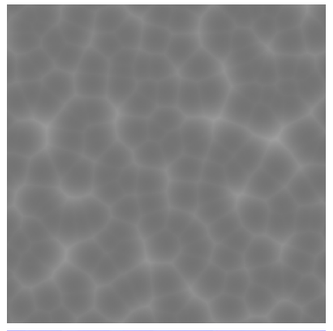


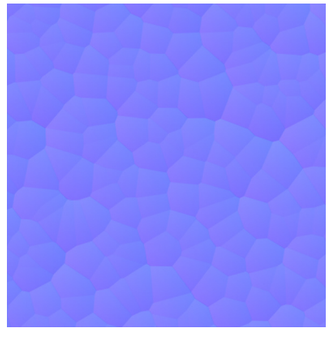
Patterns of smaller and denser details feeds into normalmap



Workflow

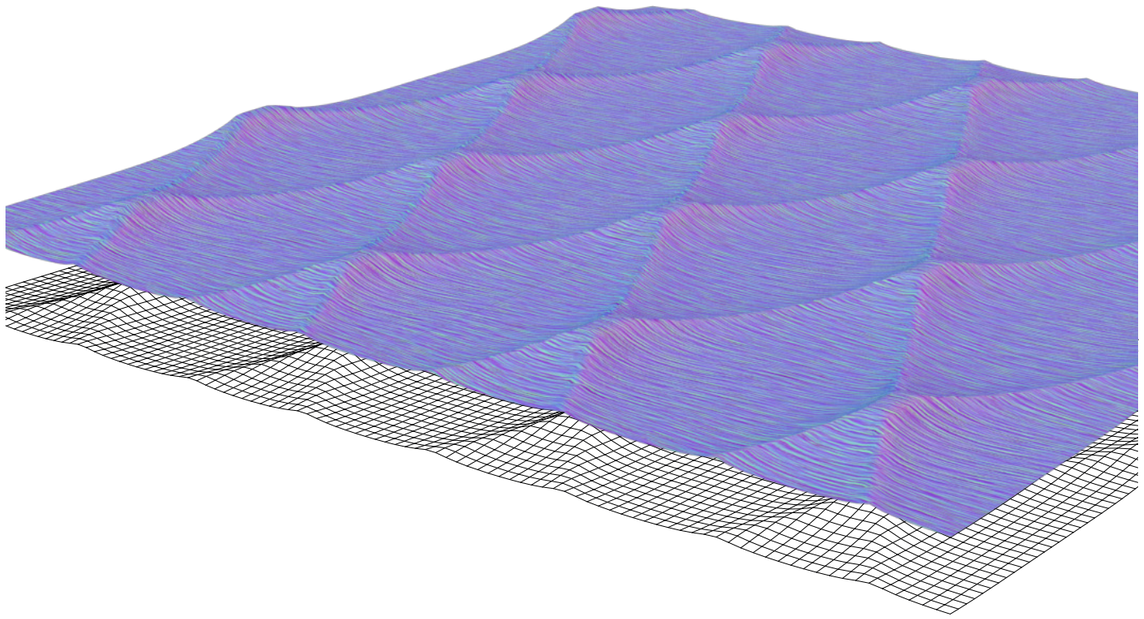
The workflow in Substance designer usually follows scale. Larger shapes and patterns are modelled first in greyscale bitmaps and are exported as the finished heightmap used for displacement in for example renderings. Then more layers of smaller and smaller details are added to the same heightmap. This detailed heightmap, or some iteration of it, is used for the normalmap. Certain patterns or properties can also be extracted to the roughnessmap, basecolormap, ambient occlusion or other types of maps. The greyscale bitmaps are manipulated with different image editing tools where one can extract and tamper with specific ranges of grey values. Each command or operation is connected as a node to create a texture function where the nodes can be altered afterwards to create different iterations of a similar texture.

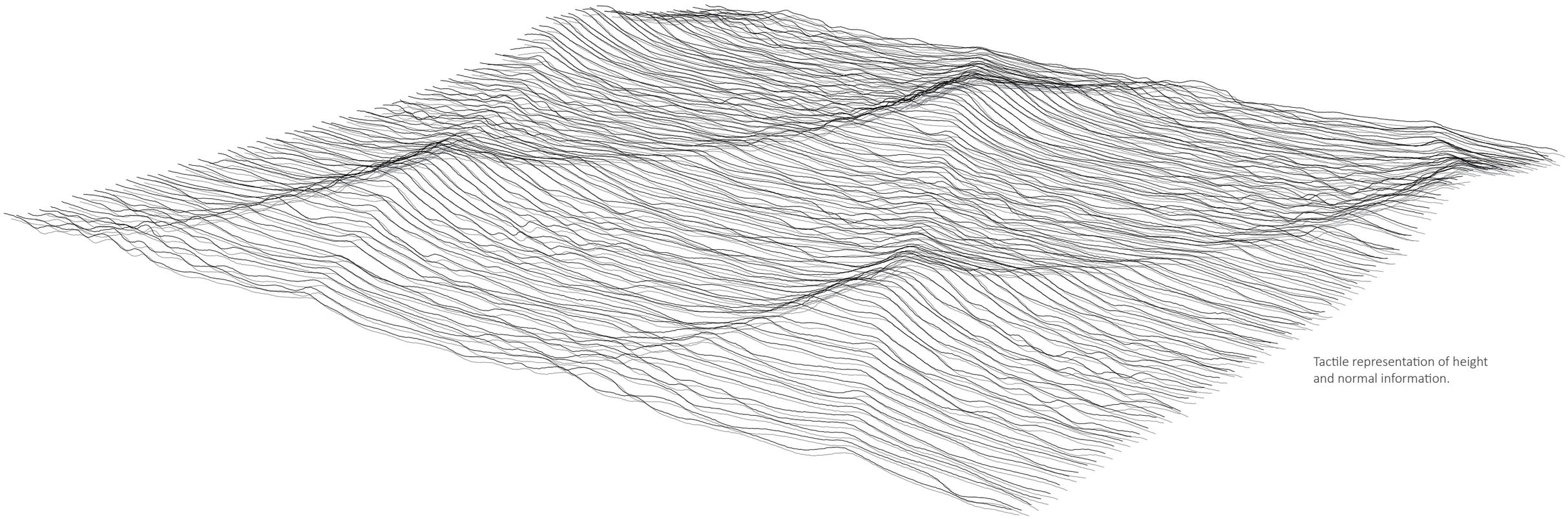




Representations

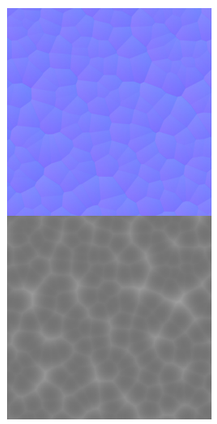
Normalmap information describes texture at a tactile scale. Creating representations of normalmap information needs to be more abstract than the heightmap since the high resolution of details makes it difficult to just represent it as a mesh. As the sense of touch, especially at the fingertips, has a higher saturation than the vision, details at this level need to be enlarged or exaggerated to visually represent how they would feel to touch. The normalmap itself also has a 3D quality to its appearance and can also serve as a visualization of tactile forms.

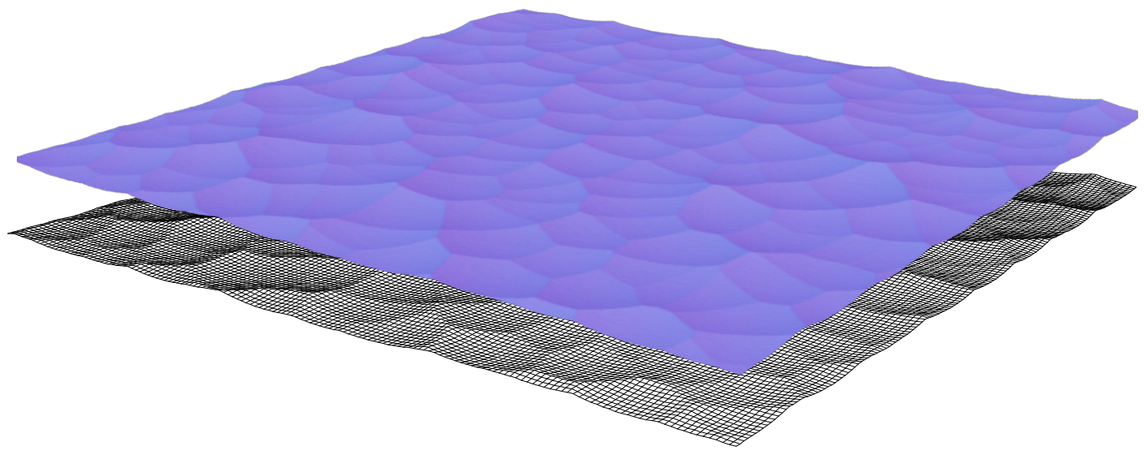


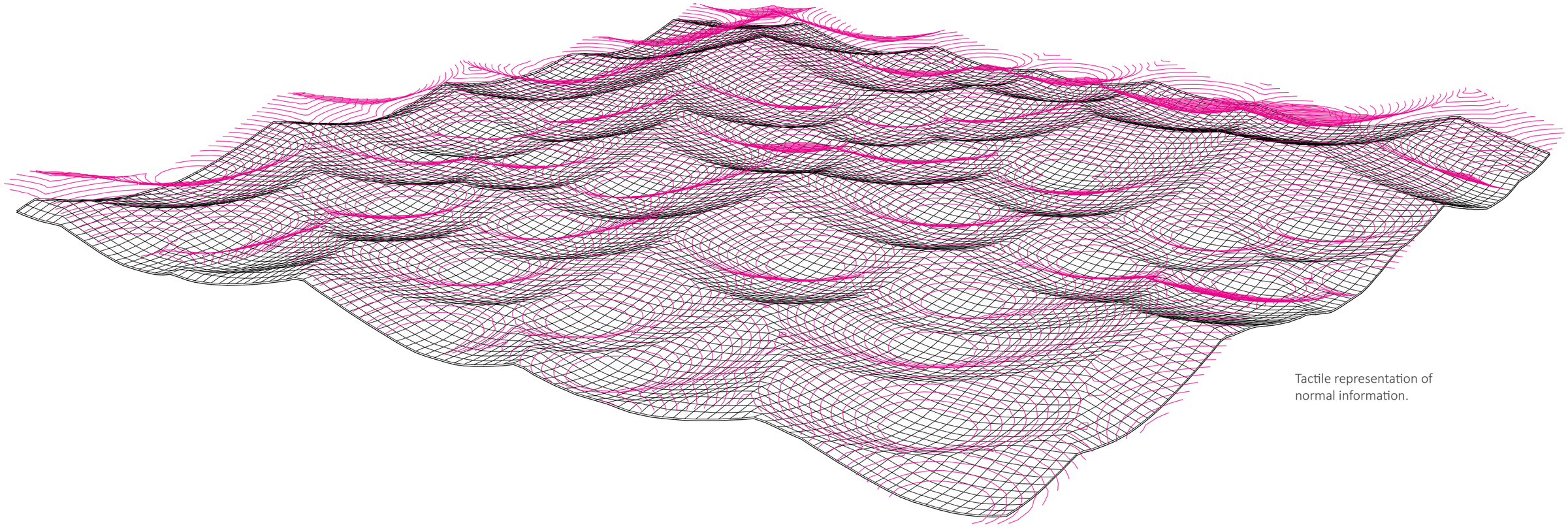


Tactile representation of height and normal information.

The normalmap is modelled in a similar way as the heightmap but in greater detail. Then the greyscale heightmap is translated to the two two-color gradient normalmap.







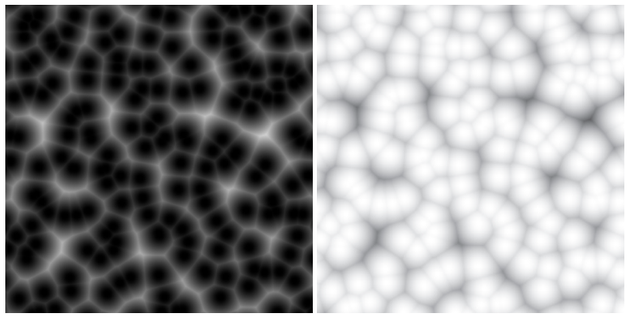
Tactile representation of normal information.

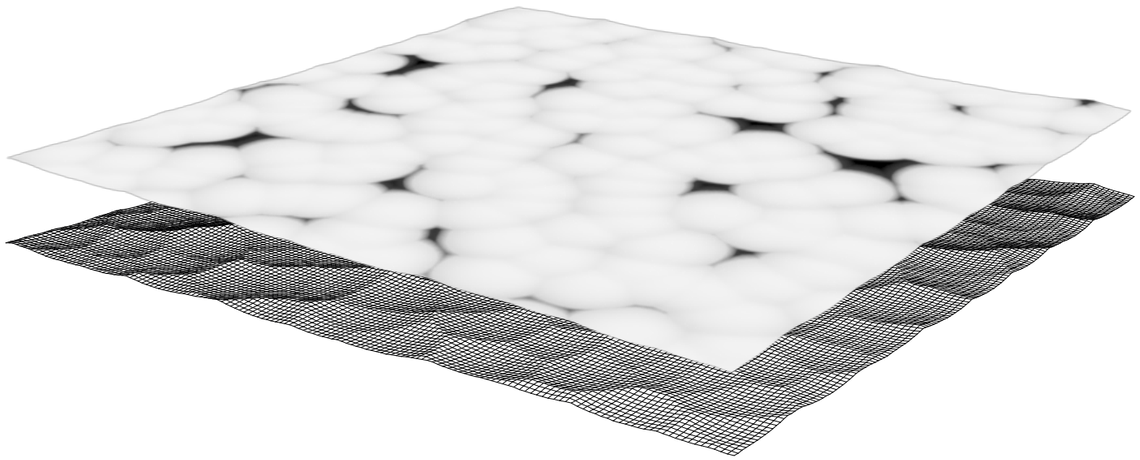
Roughnessmap

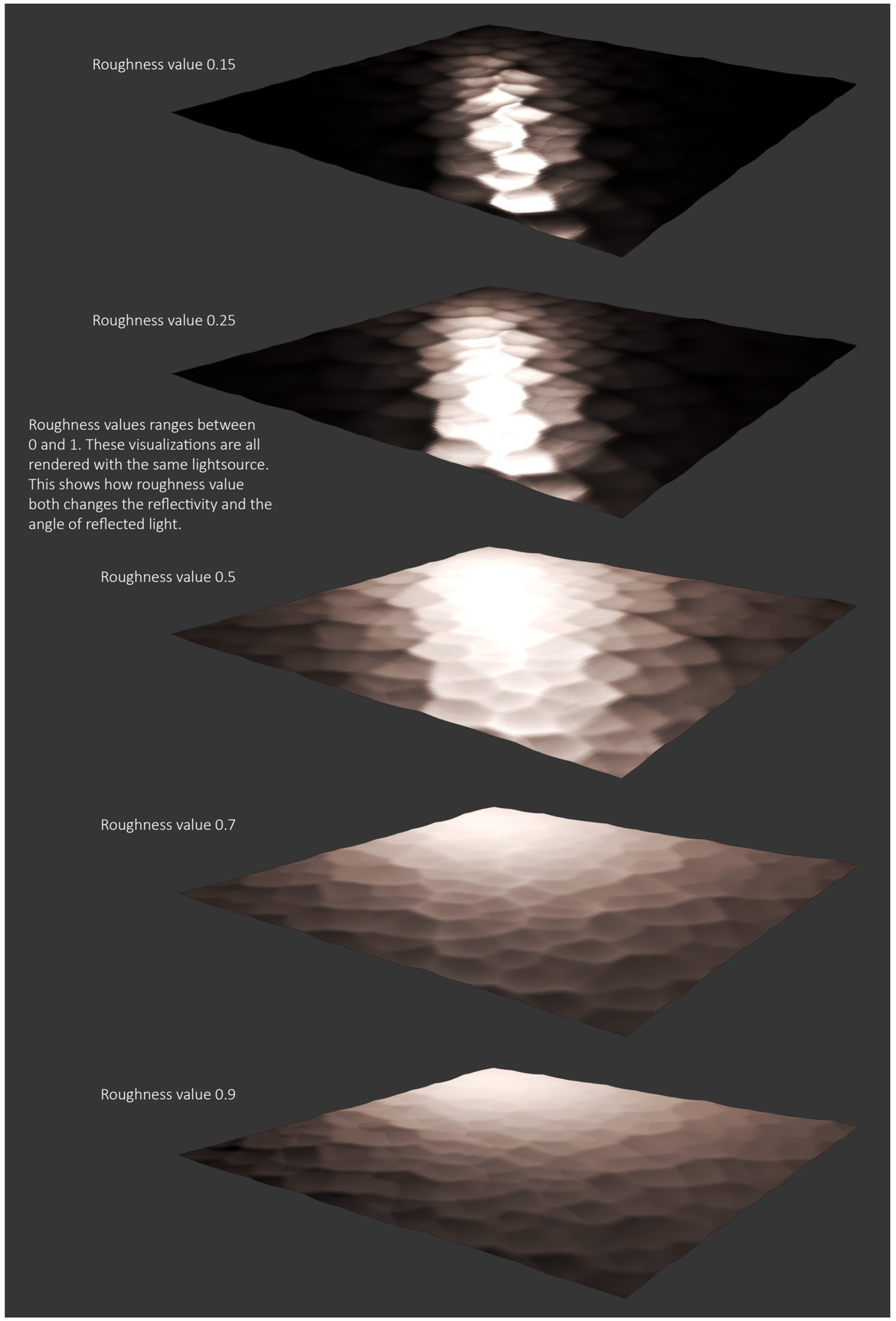
A roughnessmap describes how light reflects off the surface. High roughness values signify a fractured facetted surface that diffuses and spreads out the reflection while low roughness gives a flat surface with a clear reflection. Patterns that makes up height-, normal- or basecolormaps can be extracted and used in the roughnessmap.

Workflow and Narrative Applications

Roughnessmap values are inverted compared to the heightmap as black equals low roughness values that equals high reflectivity which usually corresponds well with heights on the geometry. Shapes and patterns are edited within greyscale images just as with the heightmap. Here curvature information is useful as it can reveal height edges or crevasses that are worn differently and have a different surface structure.



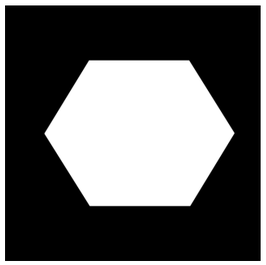




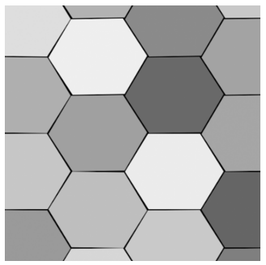
Pattern Workflow Example

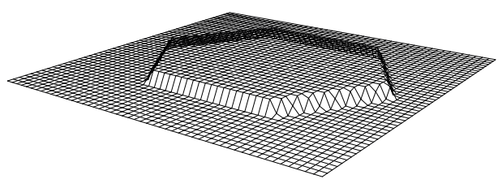
Two examples of textures and their respective workflows. Both originates with a hexagon tile pattern in the heightmap. The first example is inspired by patterns found in different wood materials while the other works with more abstract, or reference less, patterns.

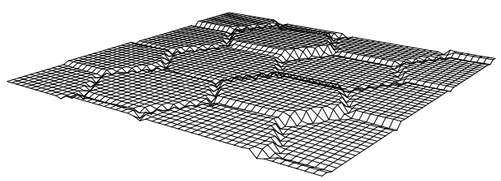
Heightmap shape

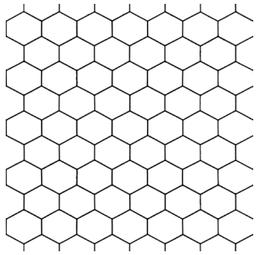


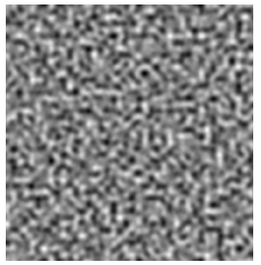
Tile generator

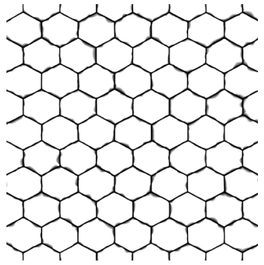




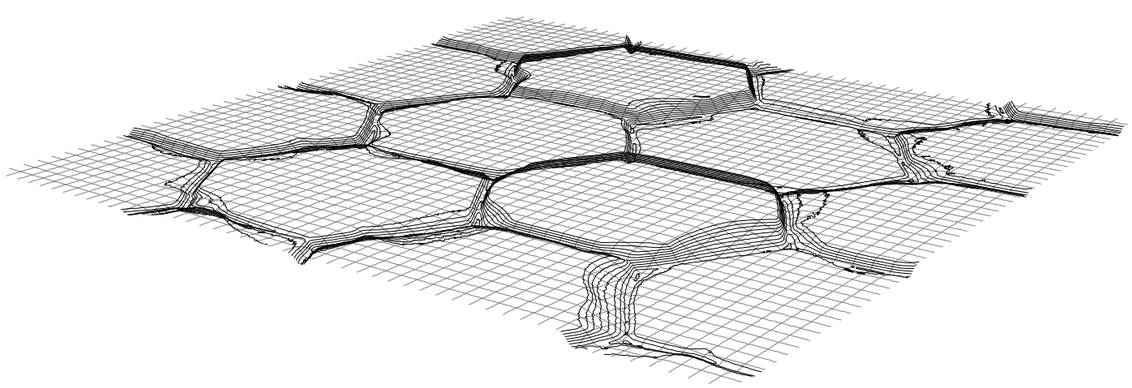




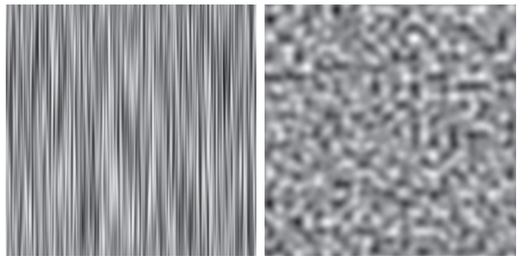




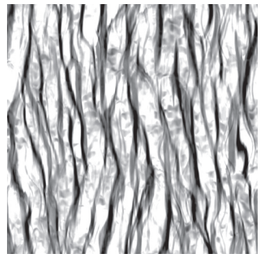
”Slope blur” uses a noise pattern to smudge out sharp edges



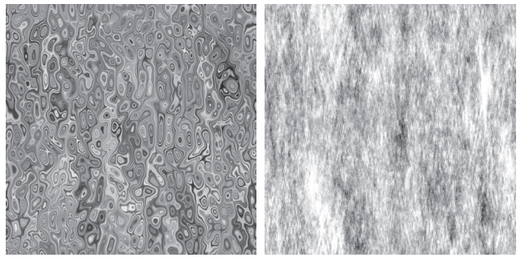
This ”slope-blur” command is concentrated at the darker values of the image which smudges out the sharp edges and creates the effect of chipped-off tiles.



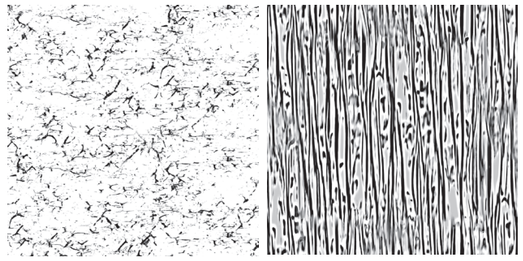
Blend



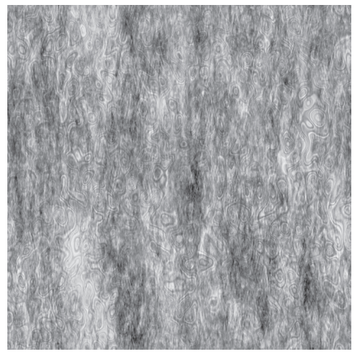
Transform



Blend



Blend



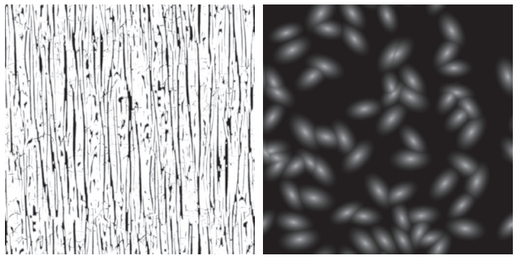
Crack pattern

Blend

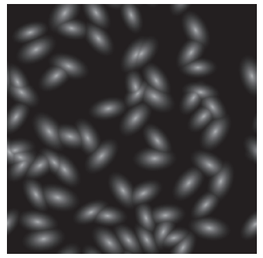
Wood surface texture

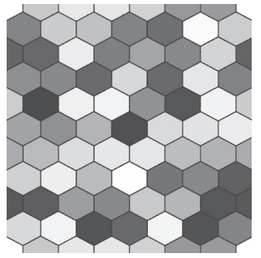
Random scatter pattern

Crack pattern

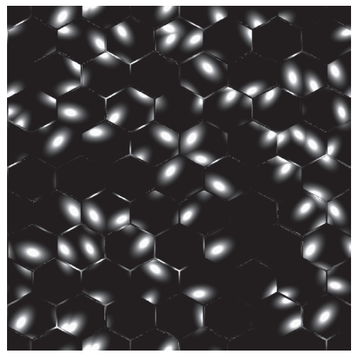


Warp

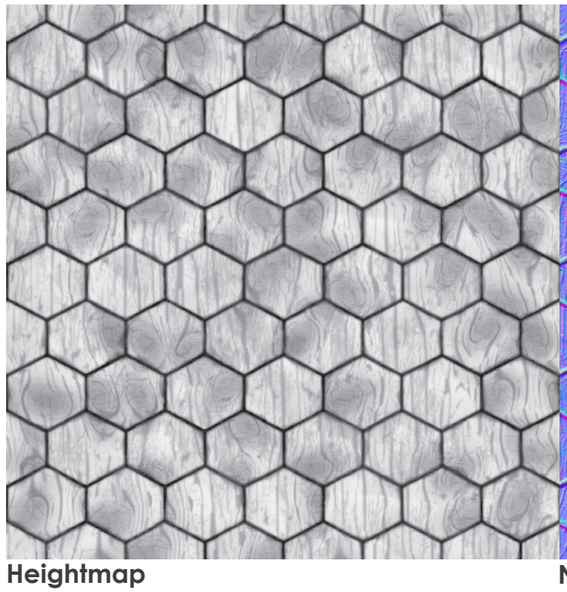




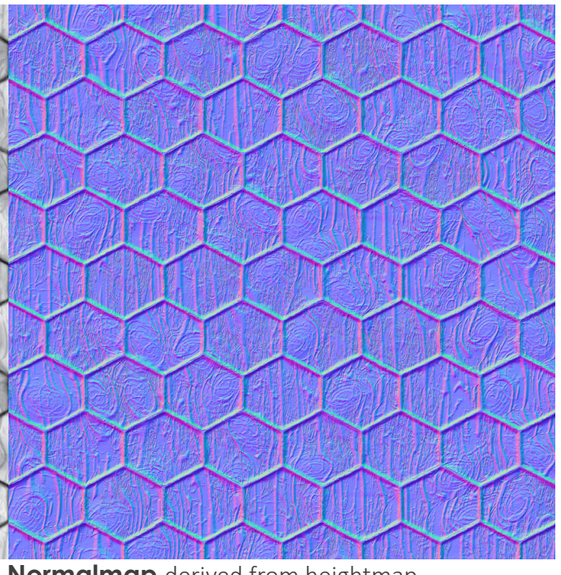
Directional warp by tile color



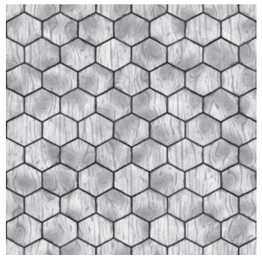
Blend



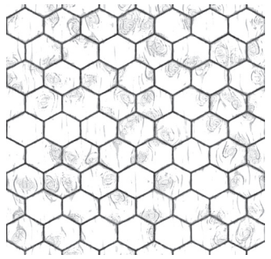
Heightmap



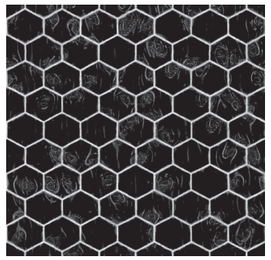
Normalmap derived from heightmap



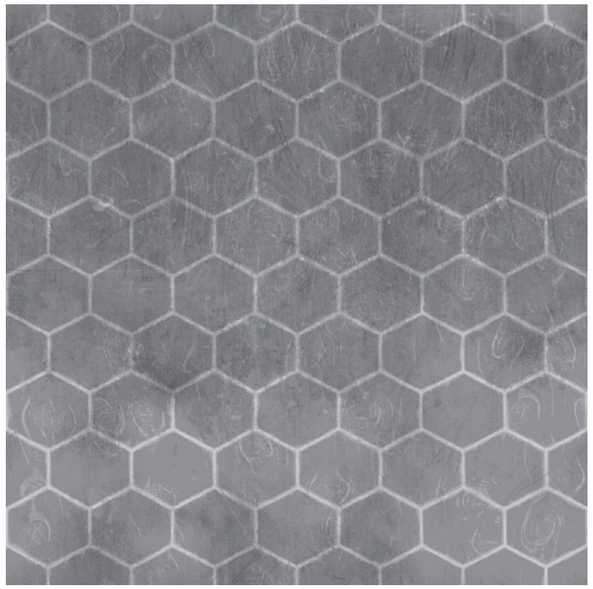
Heightmap



Heightmap levels adjusted
Ambient Occlusionmap



Ambient occlusionmap
inverted



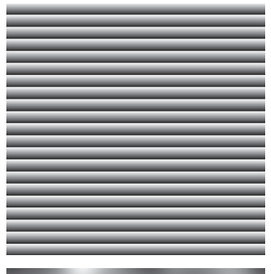
Inverted ambient occlusionmap levels adjusted
Roughnessmap

Picked color gradient

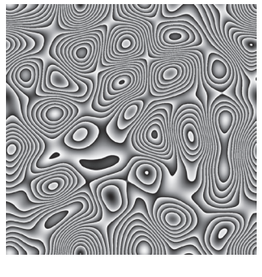
Heightmap

Wood surface texture

Greyscale
gradient

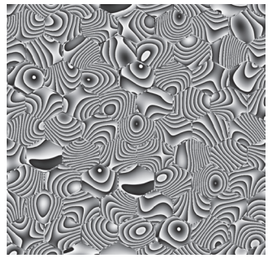


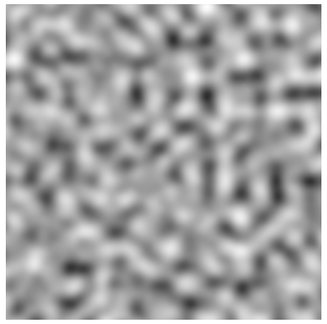
Noise

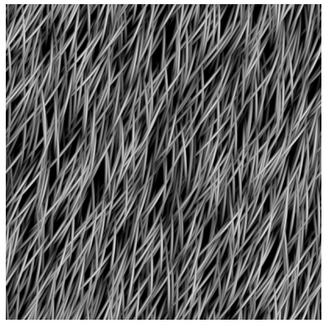


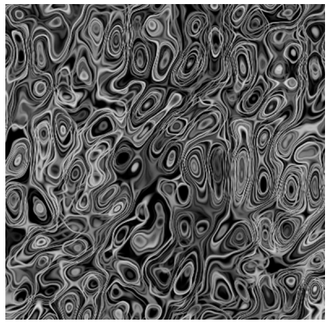
Greyscale
gradient
noise

Directional warp

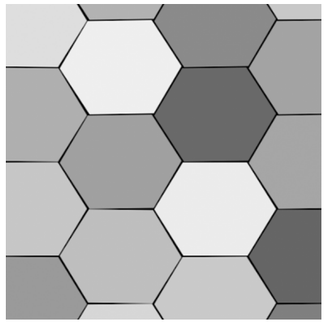


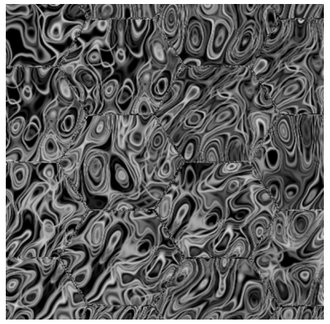




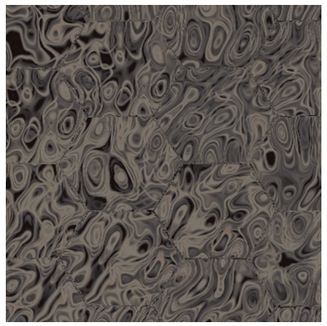


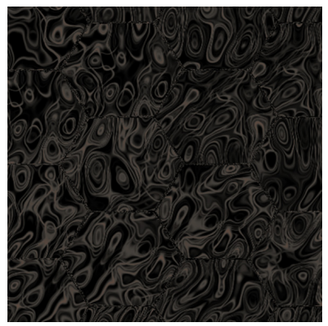
A “warp” command twists a pattern around grains in a noise map.

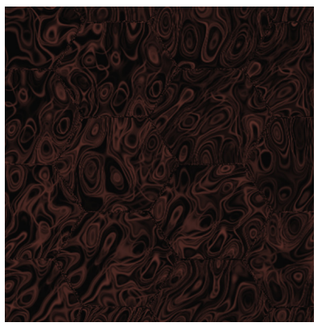


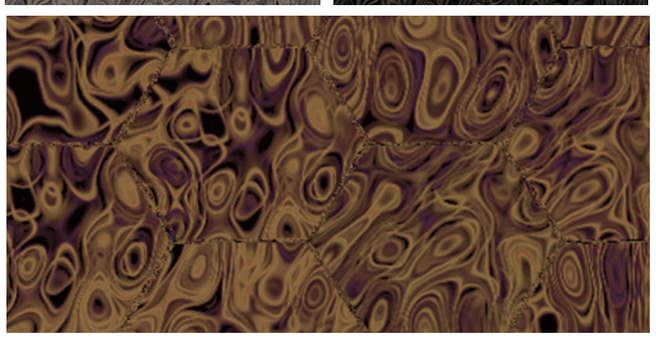


”Directional warp” breaks up a pattern in generated tiles and rotates each tile according to the darkness value in respective tile.



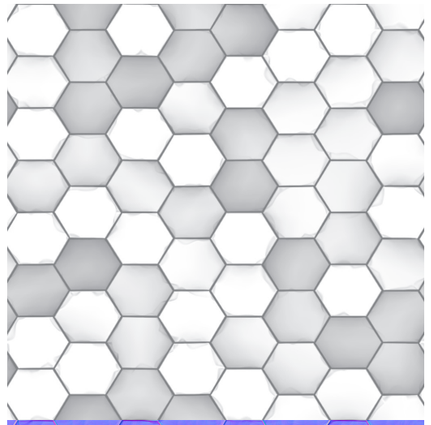




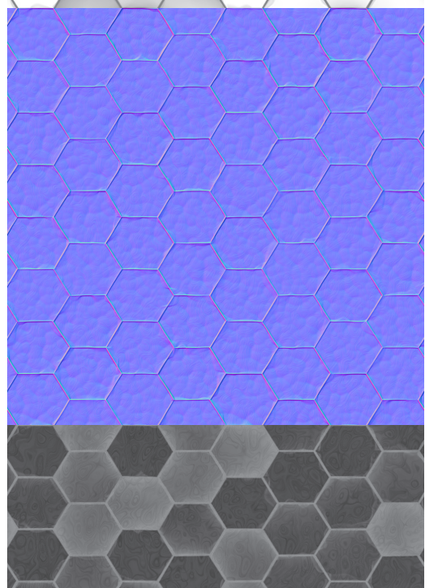


The greyscale can be substituted for any color gradients, and several gradients can be combined to one pattern with color gradients varying in depth.

Heightmap

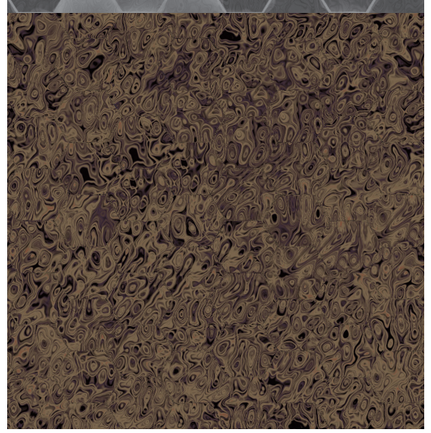


Normalmap

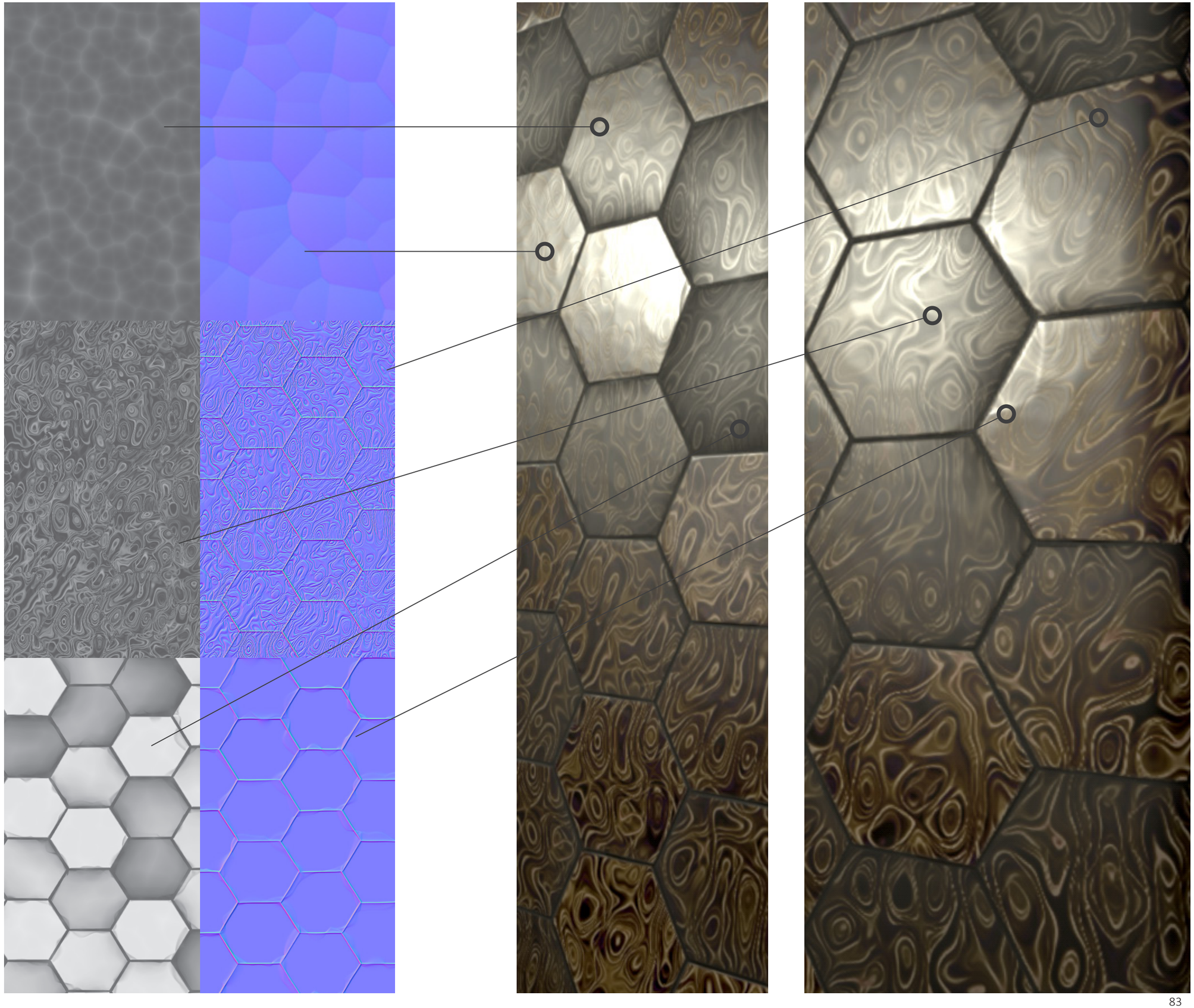


Roughnessmap

Basecolormap



Both roughness and normal information effects the light reflections. The normalmap contains surface normal angle information, which determines light reflection angle. The roughnessmap contains information about how light is reflected or absorbed in each point.



During the Matter, Space, Structure master thesis pre studies course, design for haptic and tactile qualities were explored through physical prototypes. Here follows a description of two prototypes designed for sensual experiences of a grip of the hand with discoveries relevant for directing texture and form.

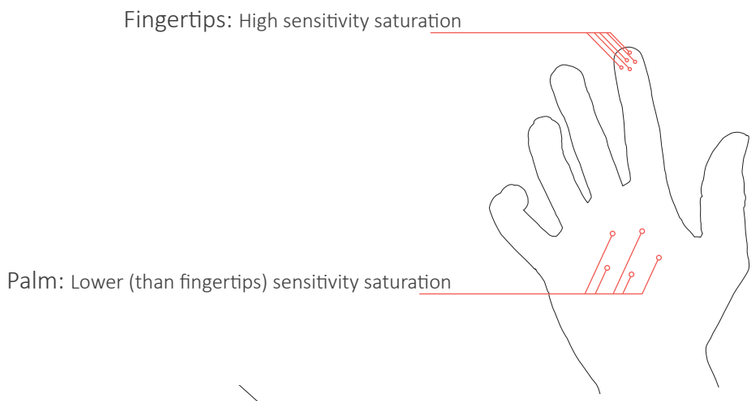
Prototype Grip 1

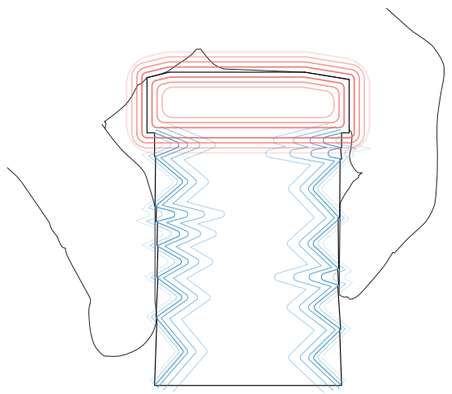
Directing of shape and surface texture for a specific haptic experience.

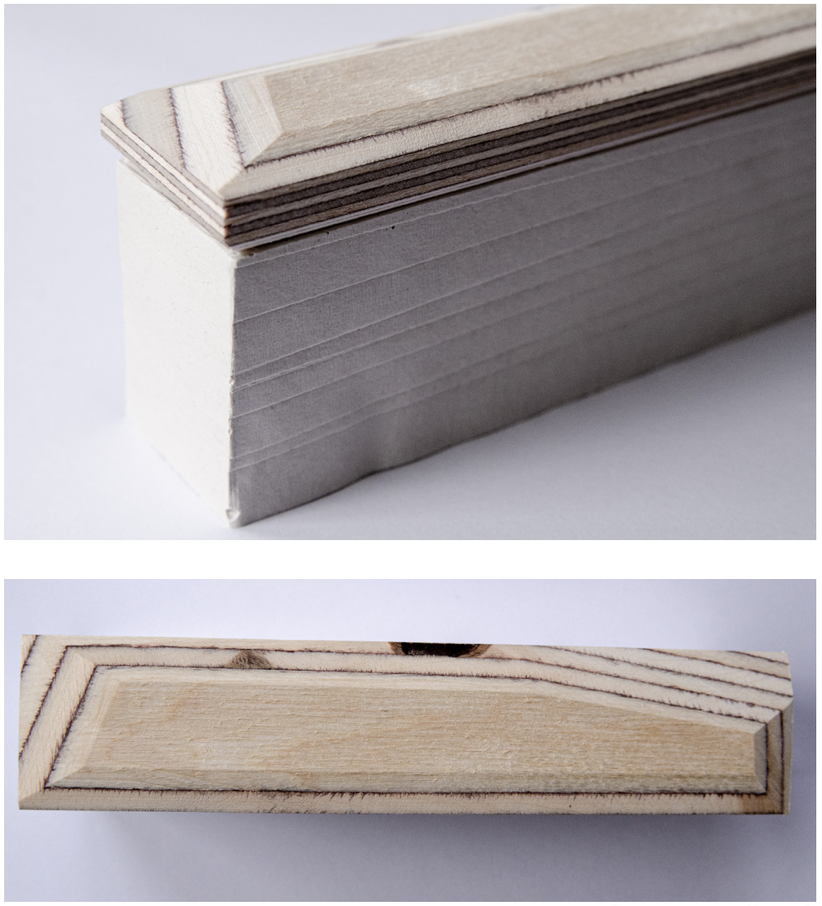
Idea/Expectations: Idea about texture design to fit a grip. Different haptic sensations in the palm of the hand and at the fingertips. Higher saturation in sensitivity at the fingertips can detect finer details.

Method: Analog fabrication. Cast plaster with tape layers on the mold to make subtle edges, plywood sanded down at arbitrary angles to make a comfortable grip.

Result/Reflection: Turned out similar to what I expected. The edges in the plaster turned out less subtle than I predicted, I underestimated the sensitivity at the fingertips. Pattern of the sanded plywood gives a visual map of the height difference. As the edges on the plywood are not detectable in the palm of the hand (by my hand) the plywood is perceived as a soft, slightly rounded shape a bit warmer than the plaster. The edges on the plywood can be felt with the fingertips which demonstrates the difference in saturation. The face of the plywood that is glued to the plaster has its edges sanded in to create a thin gap at the edge. The edge is not felt as you grip the prototype, due to the shape of the hand, but the gap makes a shadow that visually pronounces the edge between different materials.







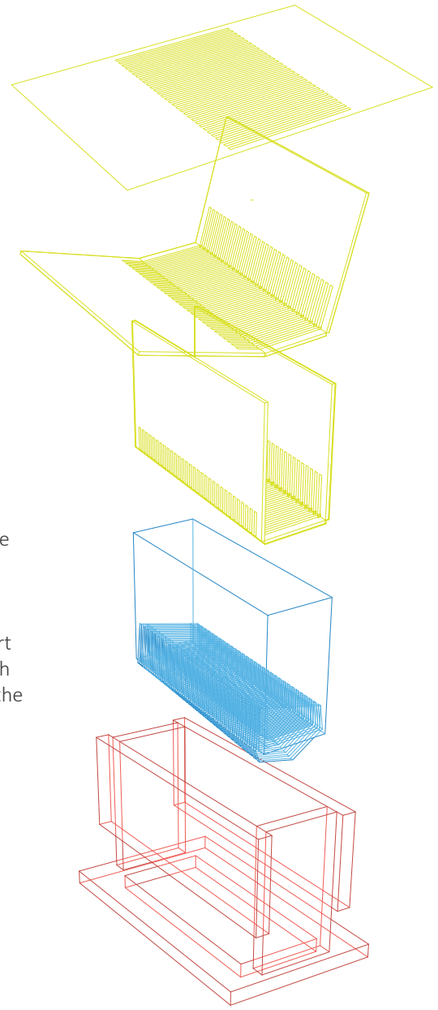
Prototype Grip 1

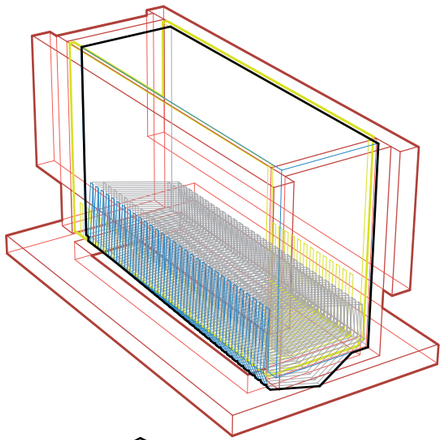
Prototype Grip 2

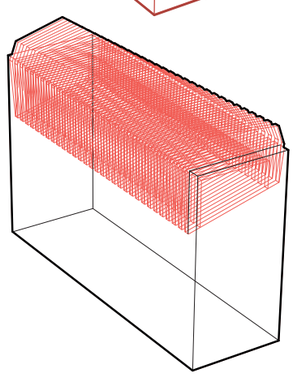
Texture composition. Surface of lamellas.
Edges of textures visualize structure.

Idea/Expectations: Further testing on the grip idea. Flat surface changed to lamellas. Lamellas sunk into the plaster cast to make an edge surface rather than an edge line.

Method: Digital modelling with analog manipulation. Lamellas were made from tweened curves in Rhino and laser cut in 2 mm plywood. The edges were sanded down to make a surface of edges rather than smaller flat surfaces with gaps. The sanded down angles also help holding the lamellas in place after the plaster has set. Mold were modelled in Rhino with inner part in cardboard and outer parts in mdf. The cardboard piece was laser cut with slots for the lamellas to fit in and edges to fold it to fit in the outer part of the mold. The inside of the cardboard was covered with fine grain salt to try a different surface texture.







Result/Reflection: The grip shape is similar to the first prototype. It seems to me that the overall feel of the grip is in larger part defined by what is felt at the fingertips. The first prototype gives a very smooth impression with clearly defined edges in the plaster while the second grip is more defined by the crumbly or grained texture of its plaster. Though the wood feels different as well. The lamella surface feels pointy sometimes, if you touch the edges with the harder parts of your palm, and smooth other times. The lamellas also feel warmer than the flat wooden surface in the first prototype, maybe because of less density. The edge surface, where the lamellas makes a raster over the plaster, shows a different relationship between the textures than the clear line in the first prototype. Lamellas sunken into the plaster visualizes how it was made. While also giving the impression of a more permanent union of the textures, as opposed to the first prototype where the plywood is almost like a lid that can come off.

Prototype Grip 2

Summary

Reflection

In the thesis method the aim was to direct architecture using texture and form. Directing as was implied here entailed evoking different associations through sensory experiences. Sensory experiences though, using a digital media for representation, are at first hand communicated visually. The intention of adding texture to form is to evoke haptic and tactile associations by extension, through embodied memories of recognizable patterns. The result of the method was high resolution renderings of textured form, and bitmaps that structures or categorizes the textural properties. To what extent these renderings or maps evoke associations are subjective, but the process of sculpting the patterns make visible, at intimate resolution, the different aspects or properties that makeup a texture pattern. This makes it possible to multiply, blend or combine texture properties, or in extension associations, in other words direct experiences of texture. Renderings is a way to visualize the result of the process, the bitmaps in themself is another, but the actual process, to consciously develop new iterations of texture is a tool that is the main achievement of this thesis.

So, the method developed can be described as a modelling sketching tool which focuses on texture as a catalyst for evoking sensory associations. Texture experiences are subjective and rather than trying to use texture to tell a specific story the evoked associations are meant to highlight contrasts, tensions and edges as well as links and similarities in both forms and spaces. This concept, to use texture as an additional composable dimension to form, was inspired by attitudes in restaurant kitchens where cooking tradition is evolving. To see texture as a variable rather than a material given constant opens opportunities for reinterpretation of traditions and methods. The ability to pick up specific properties or nuances of textures and reuse or reinterpret those in new materials or with new techniques makes it possible to create new architecture that reiterates existing concepts, whether those are built, are traditions, or are patterns in nature, while still maintaining a visible or tangible relation to that existing concept. Further development of this tool could be other ways of visualizing or materialize the created texture, digital or in real life.

In the pre studies texture were explored through physical prototypes. There texture directing were tackled by shaping tactile and haptic surfaces and shapes, while also combining different materialities with those surface shapes. With the digital method for texture directing, developed in the thesis, similar modelling and directing were done this time by digital modelling in Rhino and by displacement modelling in Substance Designer. But rather than programming materialities from physical materials to the modelled form, the thesis explored and used created abstract materialities described by bitmaps with different layers of haptic, tactile and visual information of texture. The pre studies prototypes were made in plywood and plaster as those materials are cheap and have a wide range of techniques, methods, machines and tools to work with. However the texture creating always originated in one or many of those tools or techniques. By changing to a digital texture, the mindset of the designer changes from- what is possible to do, to,- what should I do.

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Images

Image 1 Digital Grotesque, Grotto II. (2017) http://digital-grotesque.com/concept.html

2 My Photo

3 My Photos

4 https://www.publicdomainpictures.net/se/view-image.php?image=24099&picture=brant-tra-textur

5 https://www.peakpx.com/574560/gray-drift-wood

6 https://www.publicdomainpictures.net/se/view-image.php?image=95762&picture=old-wooden-background

7 https://www.pxfuel.com/en/free-photo-jplbl

8 My Photo