Humanistiska Teatern

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FRANS MAGNUSSON DSEARCH

ARTFUL PARAMETERS

the architect as public art consultant

white

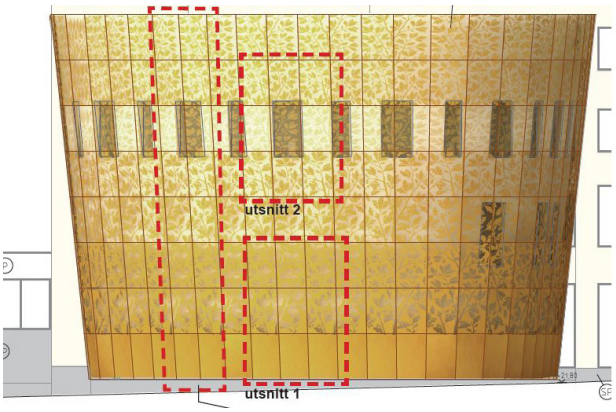
ARTFUL PARAMETERS

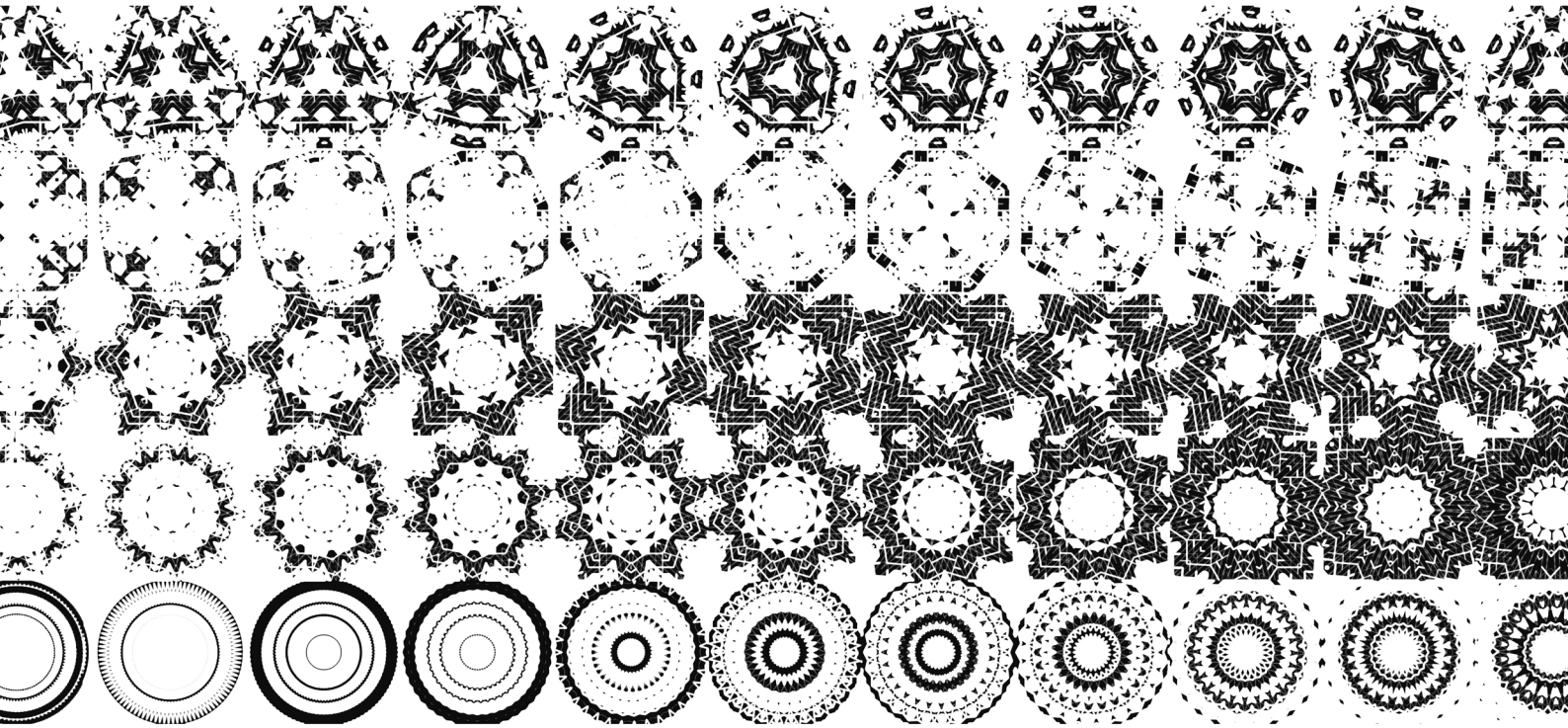
Humanistiska Teatern is a new flagship auditorium for the humanities at Uppsala University, aiming to support the humanist discourse. The bowl-shaped building was envisioned as a radiant and modern focal point, contrasting a historical milieu of brick, plaster and stone. Addressing this context, as well as daylight requirements and lighting, the design team at White Uppsala proposed a perforated façade screen as a singular, but variable, architectural element - lit from the inside at night and filtering daylight to the windows behind. A graphic pattern of hexagons, punched out of the aluminum panels, forms the main motif.

Nina Wittlöv Löfving at White Uppsala, initially applied for a White Research Lab project aiming "to explore and learn about *parametric design in architecture" and to that end contacted Dsearch, the WRL Development Network focused on *design computation.** To support the architect in the exploration of graphic expression of the façade, a design system was developed, automatically generating the punching pattern from the architect's sketch model.**

The conditions for the design project and the WRL study, was dramatically altered when the graphic motif of the façade was taken out of the architect's commission to be procured as a public artwork. With a profound experience of design computation and *automated fabrication** in an architectural professional context, Dsearch could secure White's continued influence over the façade. Dsearch would in the new constellation serve as consultants to the chosen artist Ann Lislegaard, acting as architectural advisors and translators between architectural commission, artistic process, construction project and façade fabrication.

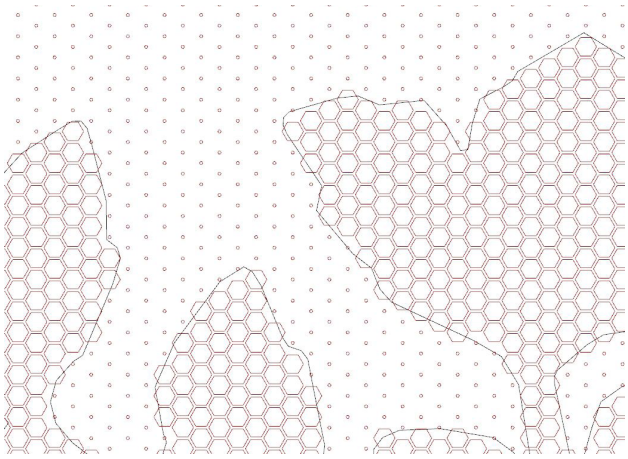
This change of conditions for the WRL project allows for a widening of scope to reflect on the implications of introducing design computation and automated fabrication to a conventional building project, as well as the difference that an artwork makes to the design process, construction project and the architectural qualities of the completed building.



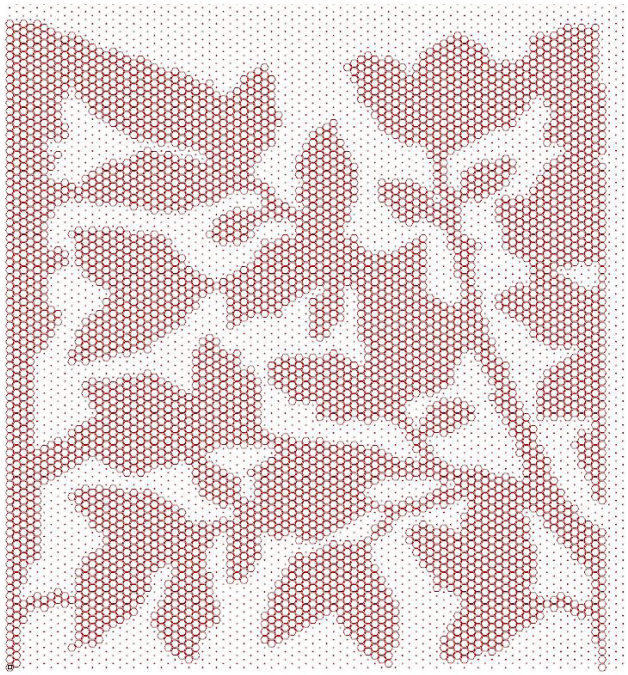


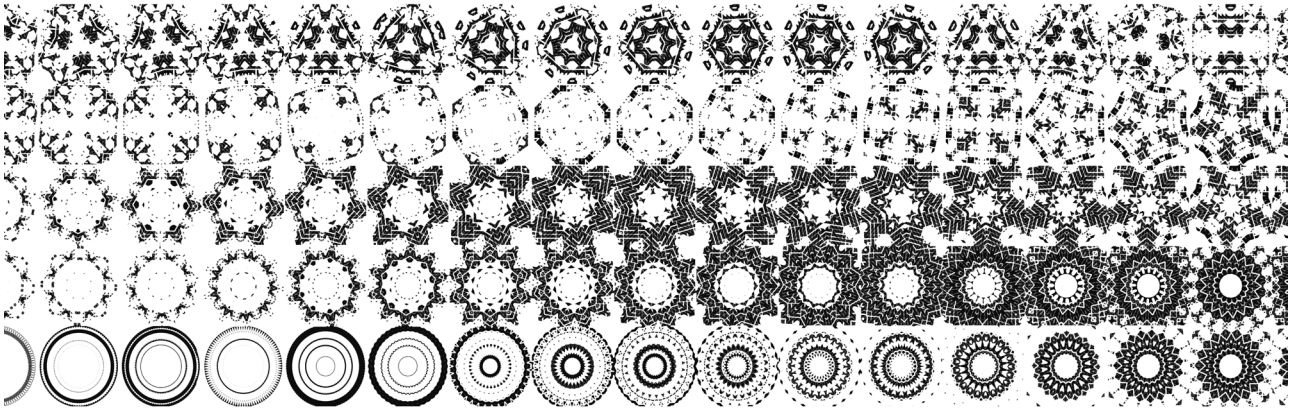
DEVELOPMENT

1 | Hexagonal perforations in a triangular grid was chosen as design principle for the screen. Its constant distance between openings is optimal since the structural integrity of the sheet – both during fabrication and mounted on the building – is determined by the minimum width of remaining material. This pattern thus maximizes the potential degree of openness in the screen. It also maximizes the number of perforations – a parameter corresponding to image fidelity. This can be compared with the number of pixels in a computer image.

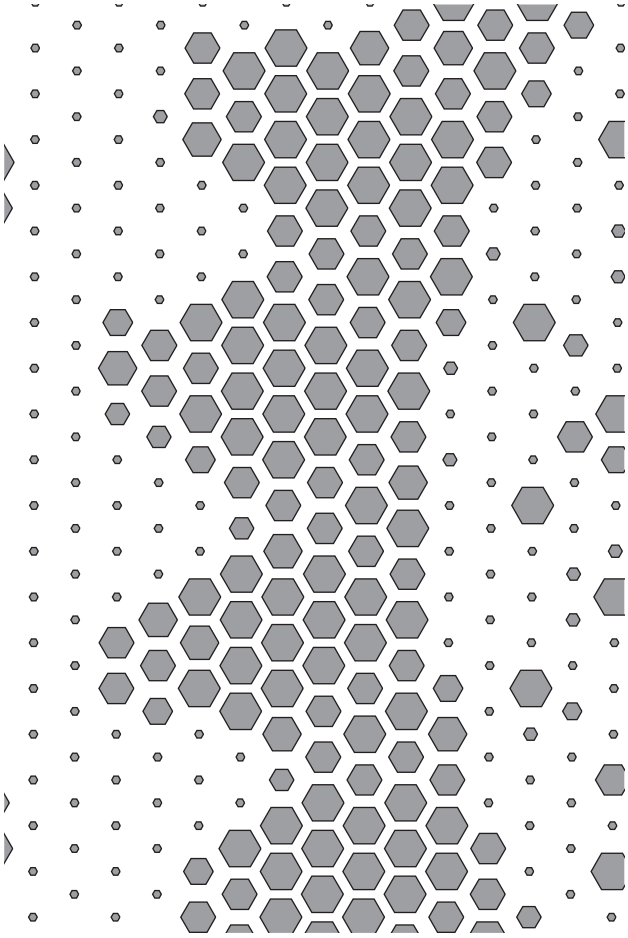


2 | The first version of the design system processed the input of a drawing comprising *polyline** curves in *Rhino*.* At this stage of the project, the motif for the screen was an oak leaf pattern, sampled from the ceiling of the auditorium at the University Main Building. The curves are laid over a grid where the nodes specify the center-points of the hexagonal perforations. The nodes within the curves yielded hexagons of a larger radius. In that fashion, the openness could be specified to control daylight conditions and form the graphic motif. Early sketches also explored the background as a gradient of varying hexagon sizes.





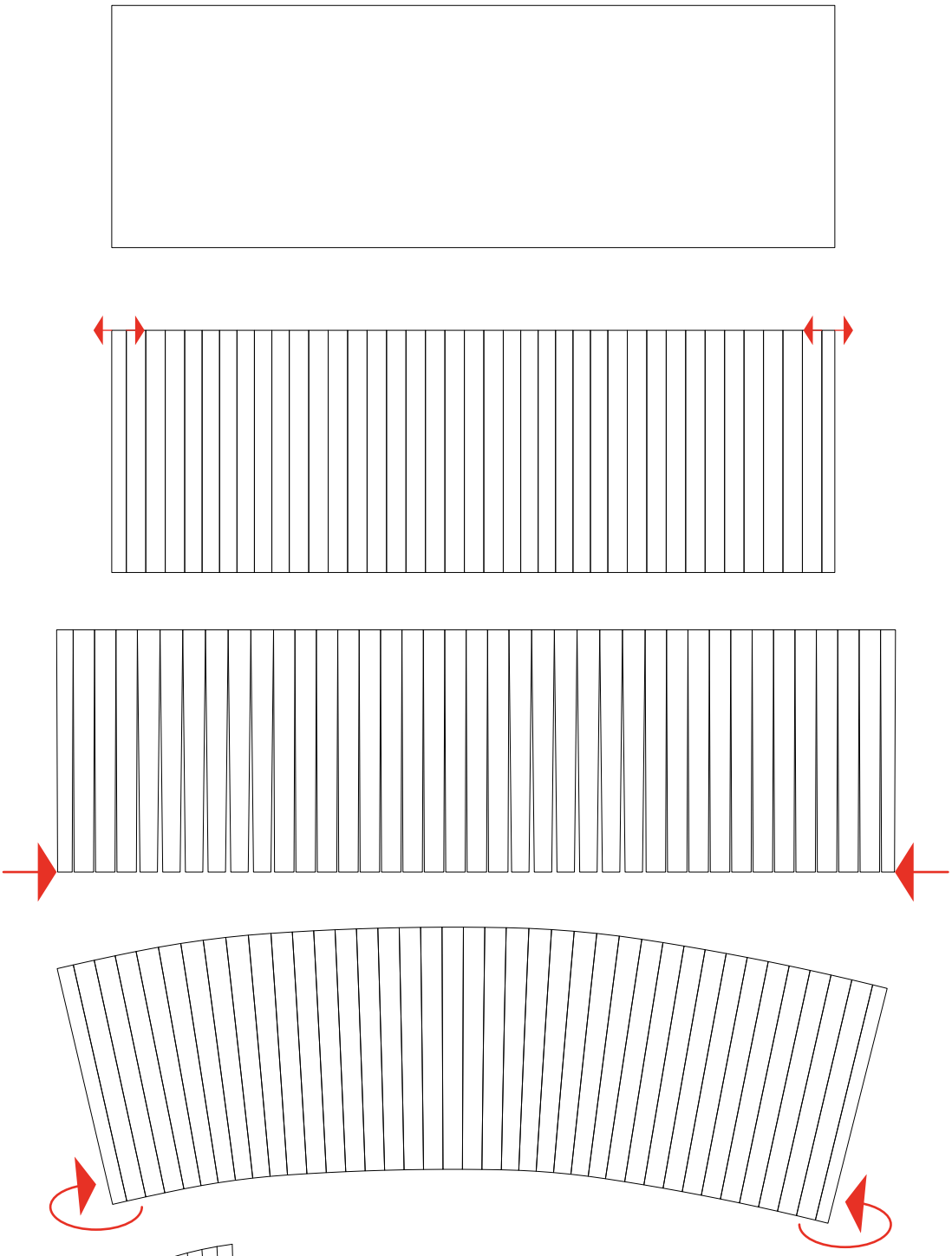
3 | The second version of the design system - developed in conversation with the artist - used a raster-based original as input. This motif, a series of stills from an animated film, comprised a series of circular figures in black and white. Architecturally, the black surfaces of the original were interpreted as areas of greater openness in the façade panels.



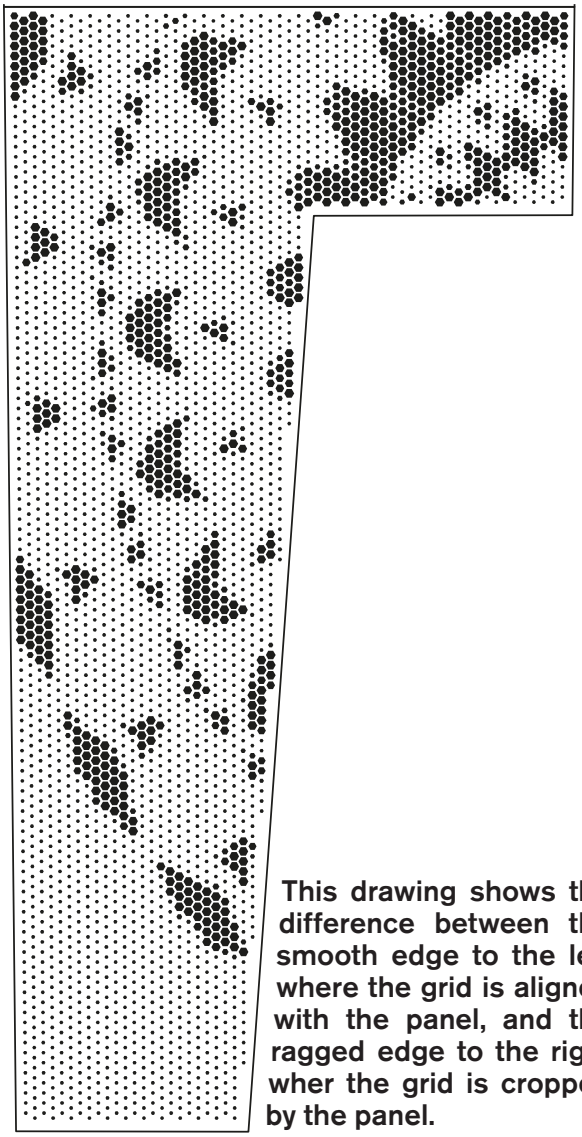
4 | The original image file was sampled and analyzed in *Grasshopper.** The lightness value of the pixels corresponding to nodes in the punching grid was queried and categorized into a pseudo-greyscale, where each colour represented a hexagonal punch/die of a specific radius. In addition to the colours used for the figure and background of the pattern, intermediate sizes where used to smooth the pattern edges. This technique is referred to as anti-aliasing in computer graphics.

PROJECTION

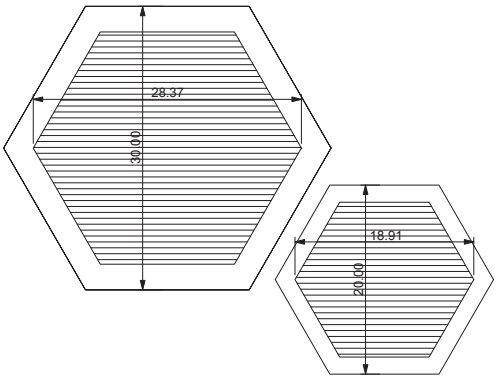
Emergency exit door is covered with a panel, which is part of the motif.



5 | The bowl-shaped building exhibits a non-rectangular façade surface. One fundamental exercise was thus to project the façade grid on the image in order sample it, as well as flatten it to produce fabrication drawings. The building shape is revealed in the façade elevation where the panels form trapezoid columns with triangular wedges in order to capture each surface in parallel projection.

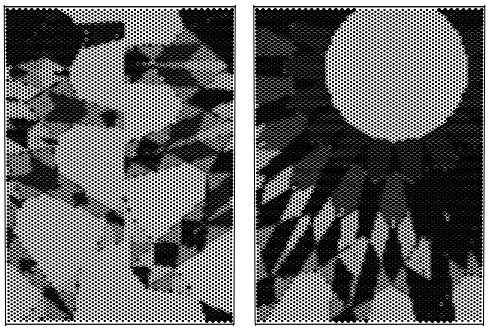


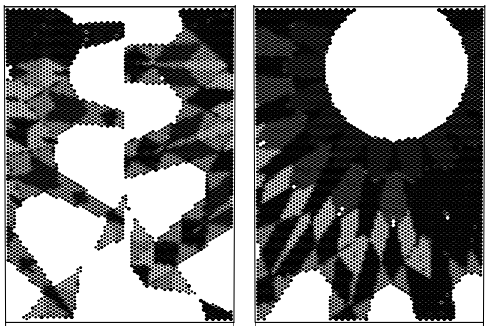
This drawing shows the difference between the smooth edge to the left where the grid is aligned with the panel, and the ragged edge to the right wher the grid is cropped by the panel.



6 | A key decision was to conform the grid to the panel edges, as opposed to cropping a grid of uniform dimensions. The raggedness of the latter alternative was deemed too disruptive to the overall impression of the motif. This choice deeply impacted fabrication in that a non-uniform grid precluded the use of multi-tip punches, capable of speeding up fabrication by multiplying the number of perforations per punching action. With the limited variety of punches and the relatively large area, the setup cost was small compared to the run-time of the punching machine. The non-uniform grid was consequently costly, but the ability to quickly visualize the alternatives helped support the artists case.

7 | Due to the limited capacity of the coarse punching grid to capture the sharp line-based original image with fidelity, great effort was made to translate the underlying artistic intent to the new architectural medium of building-scale punched aluminum panels. To accomplish this, a dialogue between the artist and Dsearch was established that complemented the visual materials with verbal questions, explanations and interpretations relating the artistic and the architectural intent. The task was to capture the details emphasized by the artist as well as relevant overall characteristics, such as brightness and contrast. Punch radii and grid dimensions was studiously determined over several iterations to find the right trade-off between fidelity and cost.





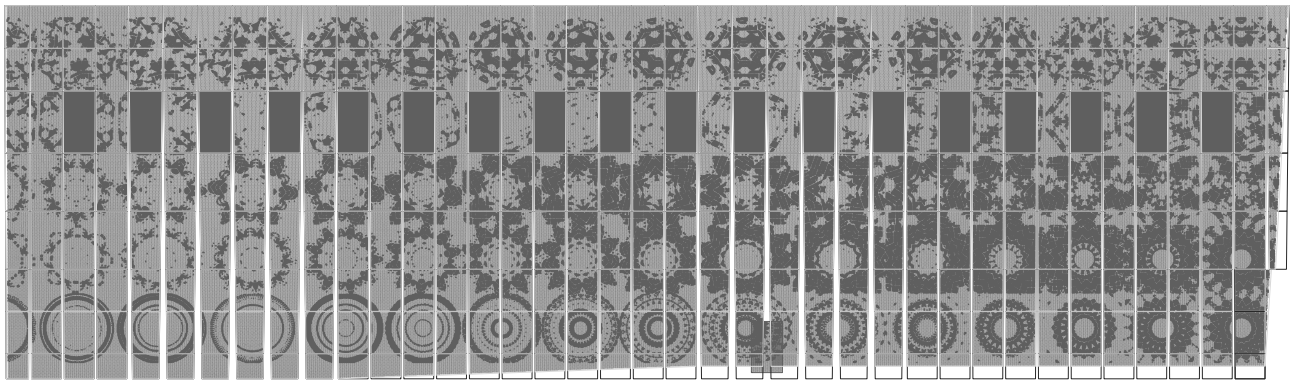
CONTEXT

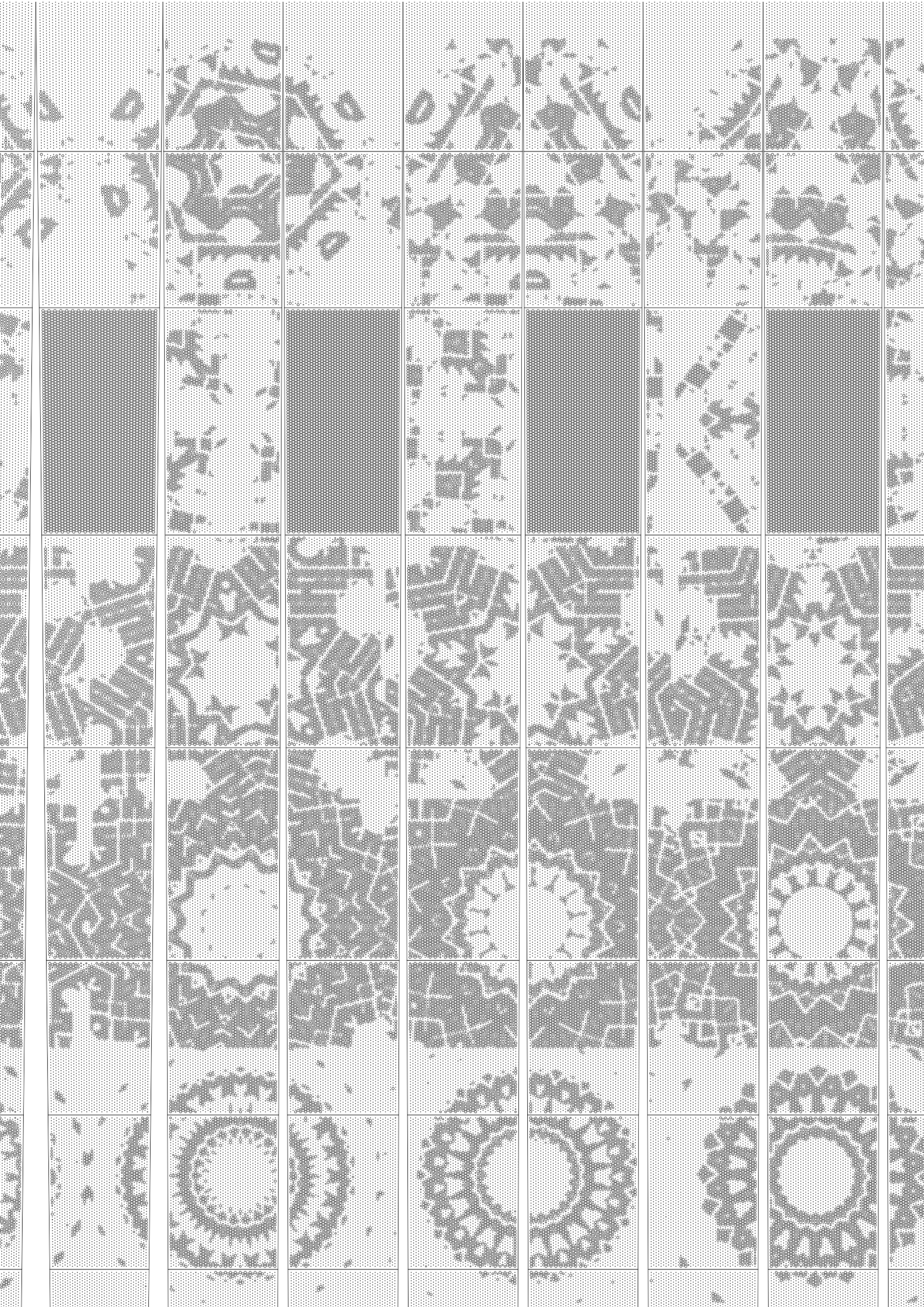
The rectangular original motif is cropped by adjoining building.

8 | One challenge was to visualize the overall impression of a pattern consisting of a massive number of miniscule elements. Adding to the difficulty was the fact that the impression of a perforated surface varies greatly depending on lighting conditions. Drawings in various scales was thus complemented by a full-scale mockup, laser-cut at White Stockholm.

9 | To satisfy the daylight requirements for the reading spaces on the top floor, a 65% openness was needed in the panels covering those windows. Here, perforations larger than those making up the figures were needed. These sizes were only possible in the upper part of the façade, where the non-uniform grid made for greater distances between nodes due to the taper of the building volume.

10 | Grasshopper was used to automate the pattern information for all 323 panel fabrication drawings. Delivery was carried out in separate dwg-files, all individually named and organized so as to be referenced into a collected drawing.





DISCUSSION

The design system developed for Humanistiska Teatern is capable to automatically adjust a complete façade elevation with new dimensions – even if it comprises tens of thousands of perforations. The main difficulty in this kind of development is to determine what parameters are fundamentally important for the design logic of a specific project. Parameters replace absolute dimensions. Finding these parameters and specifying their associations to each other is a design activity in its own right. This network of associations interweaves quantitative and qualitative aspects of the project – arising from project management, construction, and fabrication - as well as client, users, architect and engineers. In this, case also a very unusual set of parameters coming from the artwork was highly influential in the outcome.

To make full use of the information management potential of design computation in order to harness the precision of automated fabrication, communication channels need to be established between early stage design and the final stage fabrication and assembly; something which due to the chronological segmentation of conventional design- and construction processes, rarely happens. The recurring issue of complex communication was in this case compounded by the entangled project relations, where White was commissioned as architects to deliver the design-, but not construction drawings for the façade and later on also engaged consultants to the artist through Dsearch. The interface between artist and façade construction project was unconventional and understandably vague, since the commission was to integrate the artwork onto the very material of the façade system – the art is quite literally punched through the façade screen.

A concrete example, highlighting this complexity, was a situation where the façade engineer wanted to base the construction drawings on the material delivered by Dsearch. As consultant to the artist we argued that this was akin to finishing the painting before mounting the canvas. We were not commissioned to take responsibility for the final dimensioning of the whole façade. Here it was crucial to point out for the whole project organization that although the artistic process was completed, we were still waiting to finalize the resulting geometry - based on the final fabrication drawings. One argument was that the punching process was described in tenths of millimeters and any discrepancy due to incorrect input geometry would have severe implications.

On the one hand, the role as artist consultant entailed a guarding of artistic intent in the translation from video stills to punched metal - making sure that the impression of the motif was not disrupted by technical issues such as fittings and panelization, or formal issues such as distortion due to the shape of the building. On the other hand, the role as architectural consultant also entailed the responsibility to communicate and clarify the architectural conditions of the building, in order to provide the artist with a relevant context. The artistic medium was already established to a high degree, both in terms of architectural context and geometry, and in terms of expression and fabrication.

Dsearch therefore sought an opportunity to start a dialogue as early as possible with the commissioned artist; the argument being that Dsearch, as experts in aesthetics, conceptual design, as well as building construction and fabrication could inform and support the artistic process. Due to the strong position of the Public Arts Council Sweden that the artistic process must stand fully autonomous from the construction project, this ambition unfortunately failed - a fact later lamented also by the artist. For the project this was a missed opportunity to explore the expressive potential of metal punching. A visual language based on textures or gradients would for instance lend itself more readily to the pixel-like punching technique. Another potential lies in the possibility to develop bespoke punches with unique shapes, together with a non-grid placement of the perforations.

In the end, the artwork finds its expression through this convoluted process - as a raster that balances its emphasis between its origin as video and its actualization as building façade. It also balances its identity as separate from the building and integral to it. One explanation for this is its inclusive attitude to the building where various openings are either draped over by the motif, as in the case of the emergency exit – or integrated, as the rectangular swathes of openings that let in daylight to the rooms behind the motif.

Such interplay between architecture and art heightens the value of both, and provides qualities to the public realm that cannot be achieved by any of these means of expression alone. The case of Humanistiska Teatern shows the potential for further exploration of this interface and the capacity of design computation to manage the complexities arising from integrating artistic and architectural intent with advanced building-scale fabrication.

DICTIONARY

Automated Fabrication
Fabrication processes with a high reliance on information management and a low reliance on manual labour.

Design Computation
The use of computational tools, methods and techniques to augment the cognitive and intellectual capacities of the designer.

Design System
Project specific assemblage of workflows, design concepts, individuals and infrastructures.

Grasshopper
Visual scripting environment enabling design computation development in Rhino (see below).

Parametric Design
Set of methods within design computation where geometric dimensions and compositions can be managed as parameters. Geometric aspects can be associated to each other, forming a design logic maintaining a coherent formal language throughout variation of the parameters.

Polyline
Complex curve comprising a subset of straight lines or circle segments.

Rhino
A standard application for 3d-modeling at White.

WHITE TEAMS

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Dsearch: Frans Magnusson, Jonas Runberger & Vladimir Ondejcik

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Artist: Ann Lislegaard
Public Art Agency Sweden: Peter Hagdahl
Facade Contractor: LWAB
Perforation: RMIG

KEYWORDS

Design Computation, Art, Automated Fabrication, Tender

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