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To slip out of the geometric straitjacket
Using the tunnel method to promote irregularity in wallpaper patterns

ABSTRACT
The tunnel method is a technique employed in the design of wallpaper patterns to facilitate the hanging process while maintaining the integrity of the pattern. It can be utilised in both the reconstruction of historical patterns and the creation of new ones. I have explored the potential of this method since 2006, and in my latest project, I had the opportunity to document its application in Swedish wallpaper studios and endeavour to understand its historical background regarding cultural and printing conditions. By testing the effect of applying the method to wallpaper patterns, I explored its possibility of generating distinctive effects within the pattern when the wallpaper is installed. In this way, the user can actively participate in determining the degree of variation in the pattern during the installation process, either by embracing serendipity or by making deliberate choices. The purpose is to promote wallpaper patterns with greater variation and wallpapers made from sustainable materials. Although this investigation led to several different ways of utilising the tunnel method, there is still much to be explored in this field. By sharing my work, I aim to motivate more people to explore the potential of the tunnel method. Notably, the communication of its functionality to customers and its integration within the cultural context remain limited.

Keywords:
Craft research, pattern design, sustainability, wallpaper patterns, artistic research.

INTRODUCTION

One can view the repetition of a pattern's motif, known as the repeat, as a simplified explanatory model for something that is much more complex. It serves as a tool for the designer to capture the essence of what amazes them in the world. Many wallpaper patterns celebrate regularity, while others strive to break it down and trick us into believing that there is no system, only an organic flow.

Whatever the designer seeks to depict must fit within the limited framework of the pattern repeat, which for the wallpaper maker is confined to an area roughly the size of a quarter square metre.

The craft of wallpaper making is bound by rules, consisting of technical printing conditions and cultural conventions.

However, technical conditions can be stretched, and cultural conventions are questioned and changed over time. My research focuses on a method used to achieve greater pattern variation on a wallpapered surface. Often, the irregularity achieved through this method is just a whisper in the pattern, which the viewer unconsciously experiences but does not see. It is also possible to create distinct effects, making it an exciting area that can be further developed. I aim to contribute to its promotion through my work.

The title of this paper is a phrase borrowed from the book *Pepis Flora*, (Wängberg-Eriksson, 1998) where the author uses the phrase "to slip out of the geometric straitjacket" to describe designer Josef Frank's intricate systems for creating complex textile patterns with block printing, aiming to outsmart the technical constraints of printing to tell a more diverse story through his patterns.

Using pattern repeats in a sophisticated manner, such as through various tessellations and rotatable repeats, is not new. This utilisation is likely as ancient as the history of patterning itself. The "geometric straitjacket" refers to when the designer must adapt their creation to industrial processes. It is not "geometry" *per se* that presents the issue, but printing´s technical regulations, which, for wallpapers, are considerably more stringent than those applicable to other formats (e.g. block printing). And thus, the designer's ability to vary the pattern across a larger surface is limited (Figures 1 and 2).

FIGURES 1 AND 2. A pattern that has been adapted by Josef Frank to suit a more restrictive printing technique. On the left: Tulipan, block printed on linen by G.P & J Baker for Svenskt Tenn, from the 1930s. Designed by Josef Frank between 1925 and 1930. © Svenskt Tenn, Stockholm. On the right: Mille Fleur, designed for screen printing. The rotated repetition has been replaced with a linear repetition. Designed by Josef Frank in 1940. © Svenskt Tenn, Stockholm.

Terminology

This work concerns wallpaper designed for *rotary printing*. This printing technique has been used for continuous rolls of paper since (around) the mid-19th century and is the foundation for wallpaper becoming accessible as an interior material for the common man. It exists in techniques such as surface printing (Figures 3 and 4), flexographic printing, rotary screen printing and intaglio printing, all of which share the common characteristic of transferring the pattern onto the paper from a cylindrical printing roll (Broström, Stavenow-Hidemark, 2004; Hoskins, 2005; Kulling, Larsson, & Svensson, 1971). A contemporary alternative is digital printing, which has no repeat limitations.

FIGURES 3 AND 4. Left: old surface print machine with the print roll visible in the middle. Right: print rolls. At Lim&Handtryck.

A pattern for printing is a system of repeated motifs; *repeats.* The maximum repeat for wallpaper can be referred to as the *print repeat.* Its height corresponds to the circumference of the printing roller, and its width is the width of the wallpaper. These are the outer boundaries to which the pattern designer must adhere. In rotary printing, the pattern´s print repeats are vertically linked in the direction of the rotating printing roller, creating an infinite motif of a looping figure. Laterally, the print repeat must also be connected, *pattern matched*, and it is common for the wallpaper´s seams, the *repeat joints*, to link to each other *straight* (Figure 5), *staggered* (Figure 6) or *free.*

The print repeat can, in turn, be composed of several smaller repeats. They can range from tiny to encompassing the size of the entire print repeat, depending on the type of pattern, from *surface patterns* and *small-scale patterns* to *large patterns* (Figure 7).
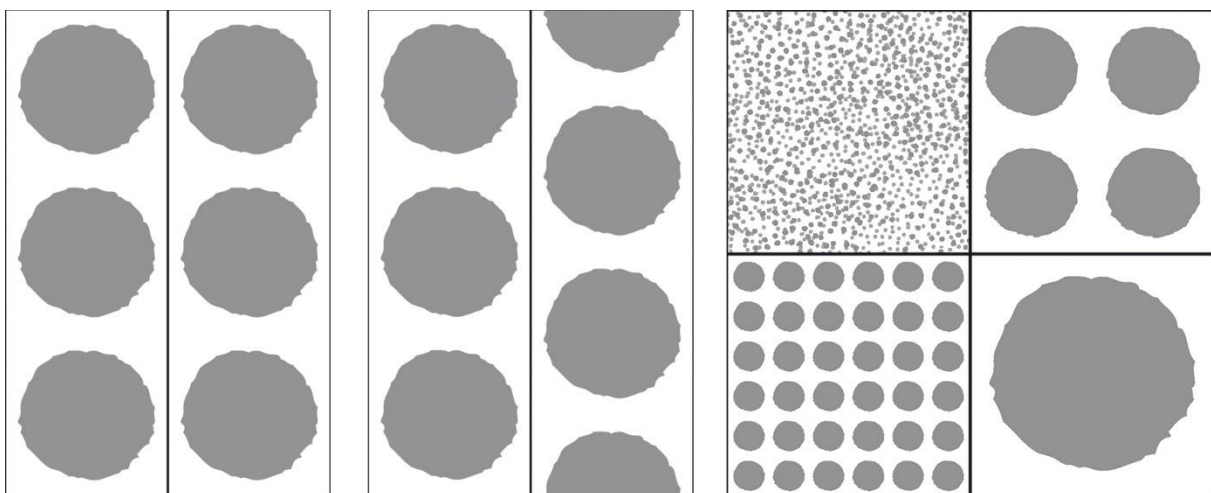
FIGURES 5, 6 AND 7. From left to right; straight alignment of two wallpaper strips and staggered alignment of two wallpaper strips. Last picture shows print repeat samples of a surface pattern, small-scale pattern, mid-size pattern and large pattern.

THE TUNNEL METHOD

When reconstructing a historical pattern or designing a new one, a *tunnel* can be used to facilitate hanging the finished wallpaper without compromising the pattern's qualities. In this way, a historical pattern can retain many of its small differences, thereby preserving its artisanal feel. A newly created pattern can, in turn, achieve greater variation when utilising a larger repeat. This method is commonly used for small-scale or surface patterns but can also be applied to larger patterns, such as a print repeat composed of four similar figures.

Example 1: (Figure 8) A small-scale wallpaper pattern can be composed of a single small motif repeated across the surface. In the design process, it is rational to digitally copy the same motif and distribute it evenly across the print repeat. This results in a statically repeated pattern with matching in each motif (A). If a pattern with slightly more varied motifs is desired, the entire surface of the print repeat can be utilised. However, this leads to higher pattern matching (B).

Example 2: (Figure 8) In a small-scale pattern printed with an old surface printing roller, the motifs are usually not completely identical. If it is to be reconstructed while preserving its original expression, preserving traces of the previous printing technique is an important aspect. Allowing each motif to retain its distinctiveness within a maximally large repeat when creating a new printing roller is one way to achieve this. However, this results in a high pattern matching requirement – for the wallpaper to fit as best as possible during installation, the correct motif must be paired with its match, making the repeat up to half a metre high, even if the motifs in the pattern may only be a few centimetres high (B).
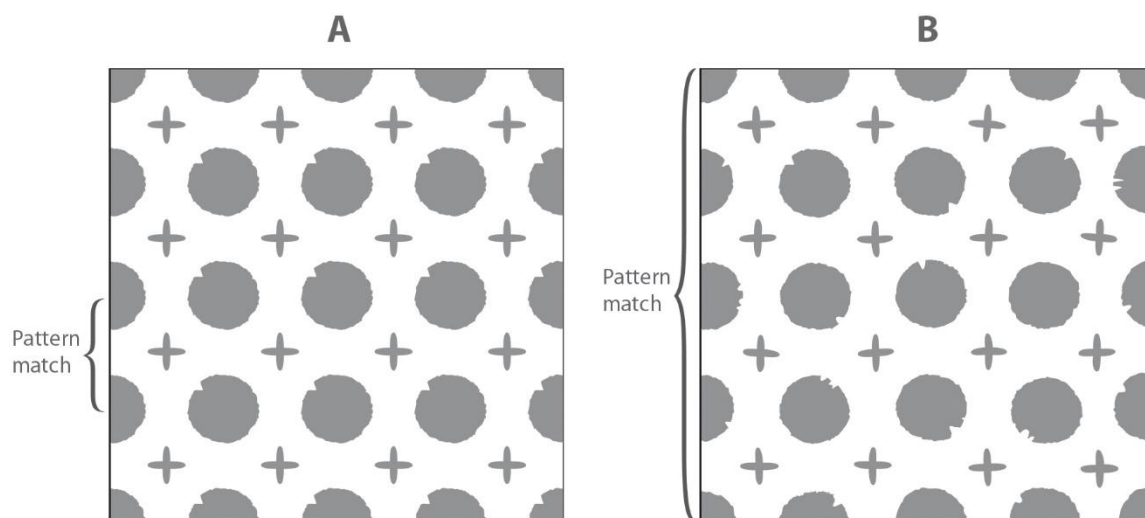

FIGURE 8. (A) and (B)

In both cases, the price one pays for a less static pattern is a high pattern matching requirement, leading to unnecessary paper consumption and customers finding the wallpaper hanging complicated. (Figure 9) The solution to this problem is a tunnel (Figures 10–12).
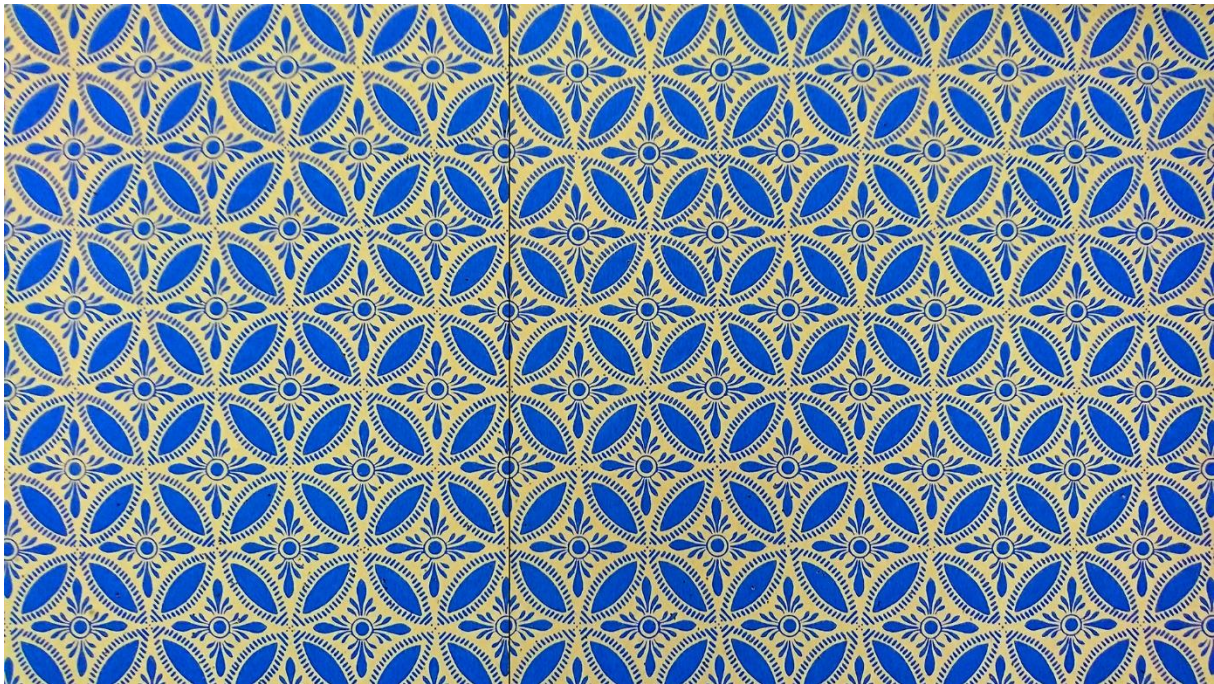
FIGURE 9. Example of a reconstructed small-patterned wallpaper lacking a tunnel. The repeat is four motifs high and fits every 26.5 cm. The wallpaper seam is marked out with a line. Wallpaper from Mölndals Museum, printed by Lim & Handtryck, both in Sweden.
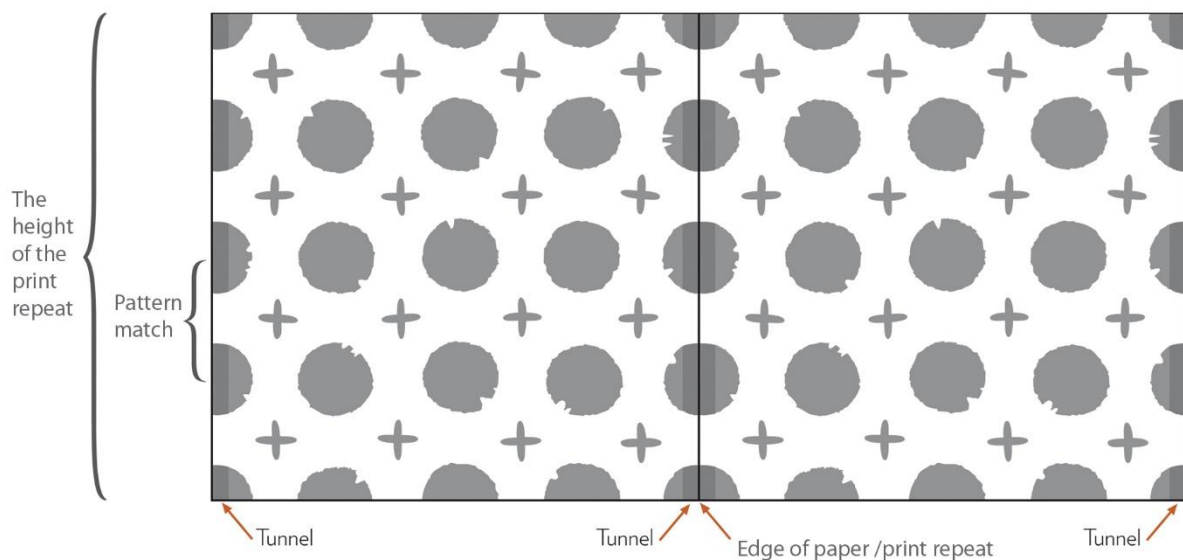

FIGURE 10. Two adjacent repeats of pattern (B) (Figure 8), with a tunnel. The tunnel area is marked with a darker color in the motifs. The repeat retains its full height but achieves the same tight matching as pattern (A) (Figure 8), through adjusting the pattern within the tunnel area to ensure all motifs match each other. The width of the tunnel varies depending on the type of wallpaper (overlapping installation or edge-to-edge) and printing method. The narrower the tunnel, the lower the risk of it being visible. The area does not need to have a straight edge; it should be invisible so that the tunnel blends into the pattern.
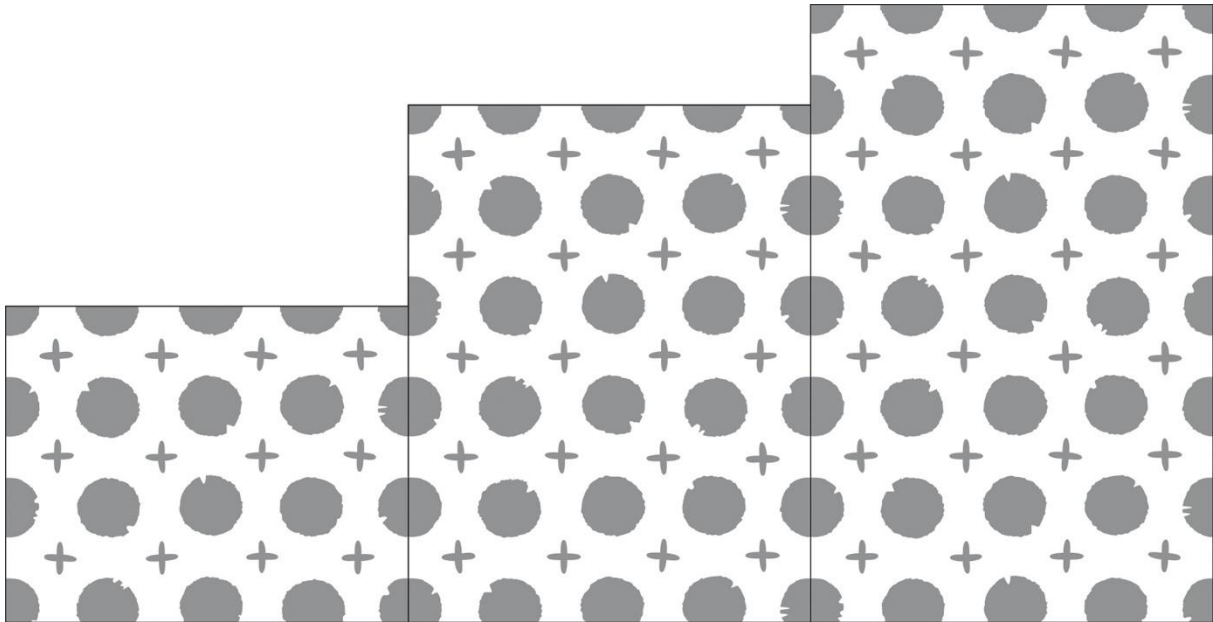
FIGURE 11. Now, the strips of (B) (Figure 8) can be tightly pattern aligned, with all motifs in the seam matching each other.

FIGURE 12. Blue Cornflower, a fragment from 1943, reconstructed in 2021. A Danish wallpaper that has been reconstructed by Ann-Charlott Strandberg at Lim & Handtryck, Sweden, with the addition of a tunnel. Note that the outer edge of the stars within the tunnel are not entirely uniform; their width does not need to require complete inclusion to function.

My exploration of this method commenced in 2006, when I created Magnolia, (www.mirjamkorn.se), a wallpaper pattern for Boråstapeter. At that time, I was unaware of any practitioners or an established term for it, which posed challenges in effectively communicating its attributes to others. I always kept an eye out for designers working on similar issues, but they were difficult to find. In 2010, to my great joy, Boråstapeter produced a wallpaper collection with the Spanish designer Jaime Hayón, (www.hayonstudio.com), including diverse installation methods for some of the wallpapers. Acromaki, at 27 cm width, achieved intricate graphical patterns through alignment shifts and inversion, and Tiles was designed as square pieces that could be combined and rotated freely in relation to one another during installation (Figure 16).

In 2016, I had the opportunity to explore the possibilities of the tunnel method further in the project Patterns and Diversity (Mönster och Diversitet). Previously, I had been using the tunnel method for seamless patterns and patterns that had a double pattern match. In the project in question, I explored repeats that could be pattern matched in multiple places within the seam. I drew creative inspiration from the alpine landscape of Finse in Norway. Some patterns were complete, while others were drafts that needed more work. In 2021, I continued my research, in the project Oregelbundna tapetmönster (Irregular wallpaper patterns), as a Visiting Craft Researcher at The Craft Laboratory, University of Gothenburg, (Korn, 2023) with the intention of:

- identifying wallpaper makers and designers who were familiar with the method and interview them about how they practise it,
- if possible, tracing the historical usage of the method and wallpapers where it is used to create a visible effect (within a limited scope, primarily Swedish pattern designers during the 20th century and construction wallpapers from the same period),
- describing the method and its possibilities, to spread knowledge,
- continuing working on the patterns I had started in Patterns and Diversity.

The context of the study was Sweden, given the limited amount of time combined with the vastness of the field. However, finding historic samples of distinctive tunnel usage turned out to be more challenging than I expected. Svante Helmbaek Tirén, an art historian specializing in ornamentation, recommended that I also look abroad. *Exploring digital archives, particularly those from the British 1960s era, along with pop art and related sources, might assist me in my search*, he said. I searched in Cooper Hewitt, Smithsonian Design Museum, (www.collection.cooperhewitt.org), Deutsches Tapetenmuseum (www.tapeten.museum-kassel.de), Musée du Papier Peint (www.museepapierpeint.org), and the Victoria and Albert Museum (www.vam.ac.uk/collections).

I also sought traces of the use of tunnels in Swedish and Danish surface-patterned wallpapers with free match, dating from the 1930s to the 1960s, but found none (possibly one) (Andersson Møller, 2013). Other methods have been applied to achieve similar results, such as printing with unsynchronized rollers, sometimes of different circumferences, and sometimes combined with embossing. Alternatively, skilfully designed patterns with pragmatic alignment have been employed (Andersson Møller, 2013; Tapetorama (www.tapetorama.se/vintagetapeter); Broström & Stavenow-Hidemark, 2004).

Four out of six Swedish wallpaper makers/pattern designers queried (Korn, 2023) use the tunnel method. They had learned the method either on their own or from a colleague. There was no common and established name for the method outside of their own workplace/sphere, perhaps because this seems to be a relatively young method that has been developed in parallel according to individual needs. At Boråstapeter, the terms *gata* (street) and *tunnel* are used. Gata is a term that can also refer to an unwanted visible line when working with wallpaper patterns. Tunnel describes quite well what the method does; it is a *passage*. It works as a permissive no-man's land within the repeat joints, enabling closer encounters between the pattern's motifs than the surrounding area allows. I decided to use the term tunnel further on.

Creating a pattern with a tunnel is a slow craft, involving multiple rounds of drawing, computer adjustments, test printing, and review. Sissa Sundling, Head of Design at Boråstapeter, mentioned (Korn, 2023) that they have even had to redo the printing rollers when unforeseen errors, which were not detected in the pattern during the work, emerged after the initial test print (Figure 13).

The advantage of using a tunnel as a tool in the design of small-patterned and surface-patterned wallpapers is that it significantly reduces waste during installation. In the segment of wallpapers which are installed by professionals – who often work on a piecework basis and prefer patterns that are as easy to match as possible – this is highly appreciated. It saves time and reduces environmental impact.

FIGURE 13. Detail of two strips of Jaipur Linen, with the seam in the center. The repeat height is 53 cm, and the wallpaper aligns every third cm, i.e., within each motif. From Oriental Dreams collection by Boråstapeter, design Sissa Sundling.

EXPLORING THE TUNNEL

Creating my own patterns has helped me understand how the method can be utilised. Each pattern presents new challenges – *how can I depict what I want using the tunnel as a tool?* The tool acts as a gate opener, playing the trick that it's possible (for me) to step into the adjacent pasture (the repeat) and utilise it as well. By utilising multiple points of alignment and/or turning wallpaper strips upside down, there's a chance to fool the eye for a longer moment than a straight repeat usually allows (Figures 14–15).

When the interviewees (Korn, 2023) use the tunnel, its purpose is to operate without being visible. The aim is to combine maximum variation in the pattern with corresponding ease of installation. Presumably, the need for this method is linked to increased computerization and demands for precision. An assumption based on the information I have accessed thus far (Korn, 2023) is that the method has gradually emerged alongside the technological shifts that have occurred in wallpaper production during the latter part of the 20th century. I would like to believe that as long as even the simplest wallpaper patterns were hand-painted without post-processing in a computer, the tolerance for less perfect pattern matching was greater – there was no demand for a tunnel (Figure 9).

In my own exploration, I am testing how the tunnel can be intentionally used to create a distinct effect in the pattern when the wallpaper is installed. The purpose of this is the same as mentioned above, but I also want to invite the installer to actively participate in determining the degree of variation, either by leaving it to chance or by personally controlling the level of pattern diversity. By not keeping the function of the tunnel hidden from the user, it can also be given greater potential.

FIGURES 14 AND 15. Two examples which illustrate the distinction between traditional pattern matching and varied pattern matching. In both installations, six strips of the same wallpaper are used. Above, the wallpaper lacks a tunnel and is installed uniformly across the surface. Below, the wallpaper features a tunnel that allows for pattern matching at two vertical positions, and even more combinations are achieved if a strip is hung upside down. The seam runs through the central region of the orange motif. (Finse Sten, From Patterns & Diversity. Combination of drawing and watercolor processed digitally. Layout of six imaginary strips.)

Except for Hayóns´ work (Figure 16), I have found two examples of contemporary wallpapers where a visible tunnel is used, serving different purposes. The British wallpaper Hybrid, designed by Sofie Eli-asson and Matt Ducket in 2005 (Hanaor, 2006), consists of three wallpapers featuring animal silhouettes that can be installed individually or combined. Using a tunnel as a tool, various versions of the same animal or hybrid creatures are created, depending on how the wallpaper(s) is/are mounted. The Swe-dish designer Lisa Bengtsson has created two wallpapers, Coco Tiger (Figure 17) and Tillsammans, which can be installed both in a straight alignment or offset. A change in the details occurs based on the method of installation.

A wallpaper with a pronounced tunnel effect, like Acromaki or Hybrid, presupposes an engaged or pragmatic installer. Studio Lisa Bengtsson takes a more practical approach with its wallpapers – the customer can choose the installation method based on what best suits the ceiling height and paper consumption.

FIGURES 16 AND 17. Acromaki, Jaime Hayón, Boråstapeter. Coco Tiger, Studio Lisa Bengtsson. Photo Boråstapeter and Studio Lisa Bengtsson.

The purpose of my work is also to promote a sustainability perspective on wallpapers. One could argue that it would be easier for me to realize my ideas of greater variation in a wallpaper pattern by utilising digital printing instead of traditional methods. However, there are several arguments supporting my choice not to do so. Rotary printing enables the utilisation of paper-based wallpaper, in contrast to the increasingly prevalent non-woven materials in wallpaper production. Non-woven wallpapers, which are also printed using rotary printing, are products that generally have partially petroleum-based raw materials in both the paper and the printing ink. In addition, the adhesive required for their installation often contains anti-mould agents and other questionable raw materials.

In turn, I contend that it is unfortunate that a product like paper-based wallpapers, which can be manufactured using sustainable materials such as partially recycled paper and colour based on cellulose, linseed oil, and natural pigments, and furthermore installed using cellulose-based glue, is gradually disappearing from the market.

Below is a description of two patterns I have worked with, and two concepts I have chosen to categorize them under. The patterns are intended to be printed using surface printing and traditional cellulose-based glue print. (Figures 18–25)

Finse Fjäll (Finse Mountains)
This pattern (Figures 18–20) aligns in 22 places; all mountains fit with each other in the seam, creating different formations depending on how the wallpaper is pattern matched when mounted. The pattern represents a *Wandering Tunnel* (see Figure 21).

FIGURE 18. Finse Fjäll. Revised version from 2023. Part of the print repeat cropped vertically. The tunnel at left and right side.
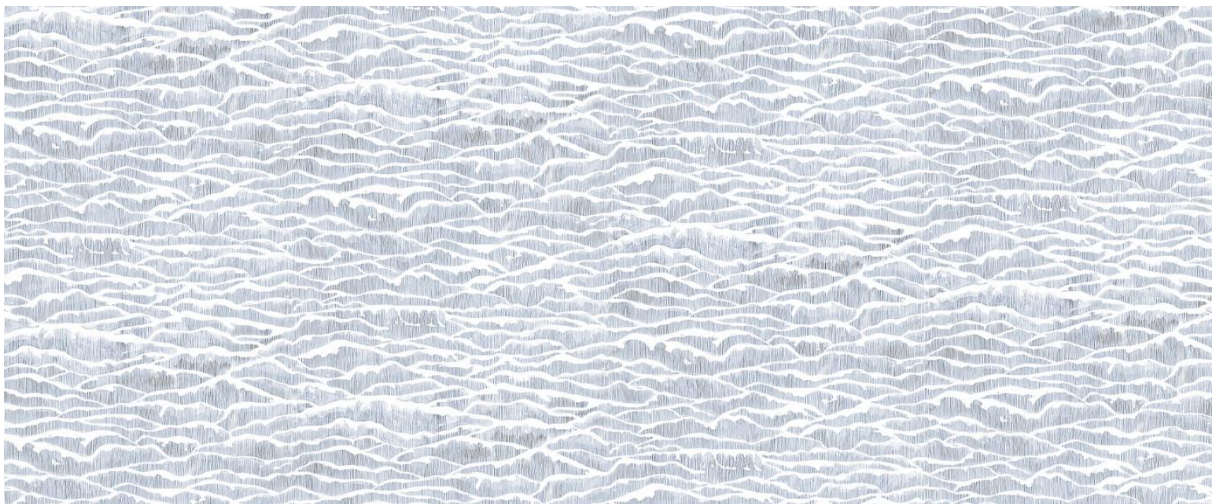

FIGURE 19. Finse Fjäll. Layout with four (imaginary) strips. From Patterns and Diversity. The original pattern, a combination of drawing and watercolor, processed digitally. Revised for surface printing in 2023. (Figure 18 and 20).

FIGURE 20. Finse Fjäll. From the work of adapting the pattern for surface printing. To the left, testing if the tunnel will work in all 22 places. The seam seen in the middle. To the right, close-up on the pattern, the tunnel in its making on the left side, where all mountains have the same height.

The application of the method in this pattern (Figure 18–20) I have named the *Wandering Tunnel*. The challenges associated with this variant resemble those encountered in creating surface patterns with free matching. If the repeat is too discernible, it appears to jump around the installed surface, necessitating a visual resolution of the repeat through the use of similar-looking figures. The matching can be made tight, and within the meeting points of the repeats, more or less pronounced changes in the pattern can emerge. Thus far, I have found that it works best for patterns lacking clear symmetry. When applied to patterns with a linear image – horizontal or diagonal – the repeat can appear to span multiple widths of wallpaper.
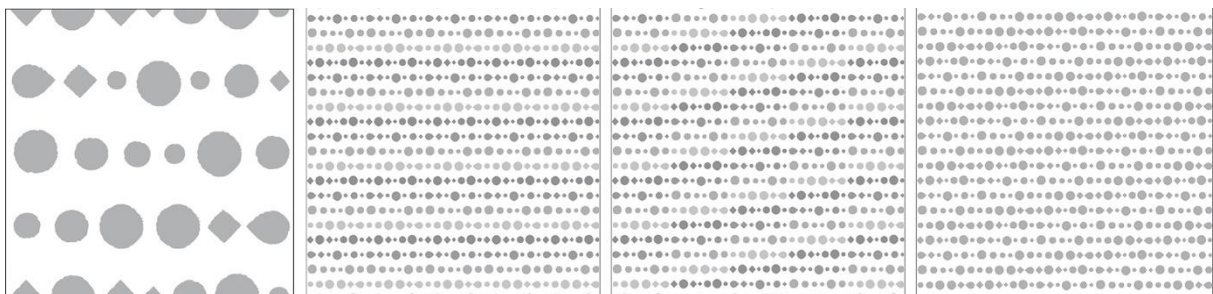

FIGURE 21. Wandering tunnel. From left to right: 1. Example of a print repeat with a wandering tunnel. All rows fit together and create an "infinite" line when installed. 2. Wallpaper strips installed with straight match. The rows in the pattern are marked in different colors to illustrate what happens in the pattern design. 3. Wallpaper strips installed with running match. The rows in the print repeat are marked in different colors to illustrate what happens in the pattern design. 4. Same image as the previous one but in uniform color.

The tunnel method can also be used to achieve a distinct and spectacular effect. I refer to it as the *Visible Tunnel*, although it is not the tunnel itself that is visible but rather the outcome it creates. It seems to work best with clearly distinguishable elements, allowing the viewer to easily identify the components of the repeat, even when combined in different ways across the wallpapered surface.
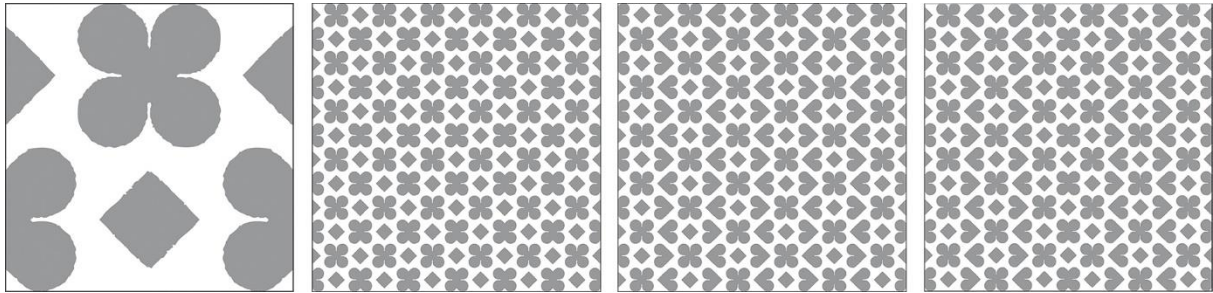

FIGURE 22. Visible Tunnel. From left to right: 1. Explanatory model for a print repeat with a clear tunnel. 2. Wallpaper strips installed with straight match. 3. Wallpaper strips installed with offset match. 4. Wallpaper strips installed with *multi-matching*.

Broderi [Embroidery]
An example of a repeat featuring a Visible Tunnel (Figure 23–25). In this case, the tunnel is a narrow passage without elements, which allows for a free pattern match. However, three matching options are suggested, which can be combined in various ways, enabling many possibilities for different wallpaper installations depending on how the strips are aligned to each other on the wall.
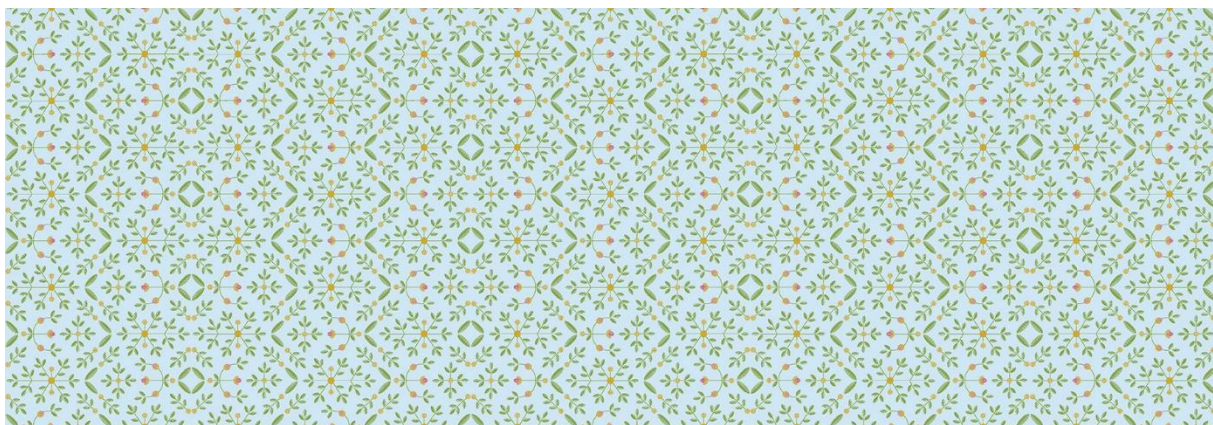

FIGURE 23. Broderi. Different combinations together. The perceived pattern variation extends across 6 strips of wallpaper.

FIGURE 24. Broderi. Print repeat with Visible Tunnel. A sketch from my Visiting Craft Researcher project Oregelbundna tapetmönster (Korn 2022). Hand drawing, digital processing. Free alignment with certain given elements. At least 9 combinations, which can be further combined with each other. Possible to be flipped upside down.
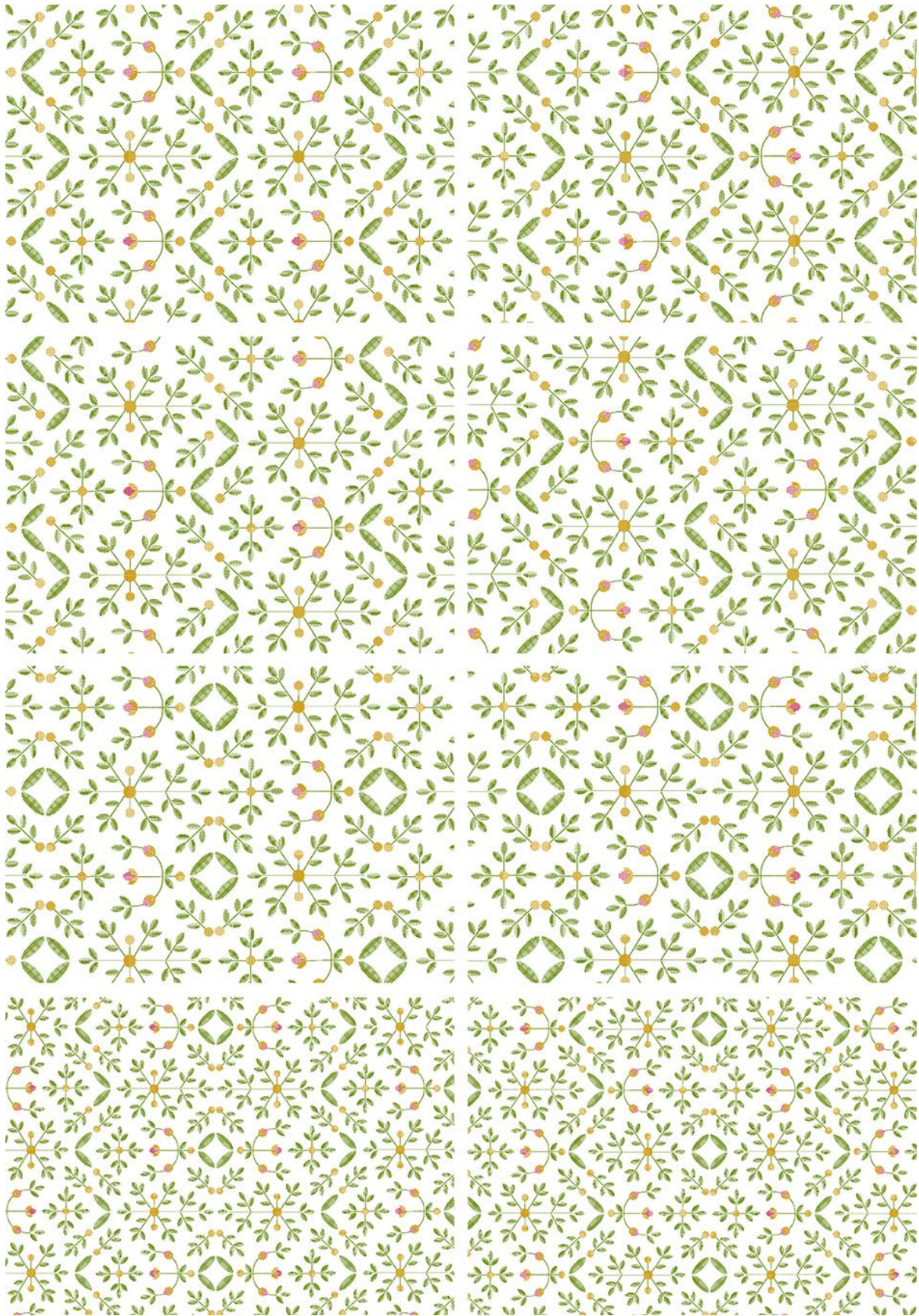
FIGURE 25. Broderi. From top to bottom, left to right: 1. Strips installed with straight alignment. 2. Installed with straight alignment and every other length inverted. 3. Installed with staggered alignment, variant A. 4. Installed with staggered alignment, variant A, and every other length inverted. 5. Installed with staggered alignment, variant B. 6. Installed with staggered alignment, variant B, and every other length inverted. 7 and 8. Different versions of installation with *multi-matching*.

CONCLUSION

The common utilisation of the tunnel, where it operates invisibly to facilitate smoother installation, is well integrated into the design of several wallpaper manufacturers and provides economic and environmentally sustainable benefits.

Regarding the utilisation of the tunnel to achieve distinct effects in the pattern, the embedding of wallpaper patterns like these in the cultural context in which I operate is very limited. Referring to the interview with Sissa Sundling, Head of Design, Boråstapeter, (Korn, 2023) regarding wallpapers with visible tunnel effects, like Hayón (Figure 16), Magnolia (Korn, 2023), and Hybrid (Hanaor, 2006), most customers do not want multiple alignment options to choose from; they already find wallpaper installation challenging enough as it is.

The boundaries of the different names under which I have categorized the tunnel method are fluid, and fundamentally, it is the same method that is used consistently, with essentially the same questions and pitfalls that arise during its creation. Sorting them has helped me to understand and distinguish their applications, characteristics, and possibilities. Perhaps the terms I propose can be useful in wallpaper making and education.

The question of how wallpapers with distinct tunnel effects and their alignment should be communicated to customers and painters remains. Perhaps *multi-matching* could be a useful term. A wallpaper like Broderi could be sold with a manual featuring different installation suggestions.

In large areas, such as public environments, the characteristics of irregular patterns might have greater potential.

One can question whether tunnel adaptation is truly justified when recreating a historical pattern to be installed in a historical/museum environment. In such cases, a contemporary, more perfectionist filter is imposed upon the old. The dilemma arises from the fact that a recreated wallpaper often has a larger market than the original historical interior.

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