

Then Try This • Algorithmic Pattern Salon

The dimensionality of cloth

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ABSTRACT

This visual essay explores the dimensional possibilities of woven cloth through multi-layer weaving, from the weave draft, to the thread interlacement, to a twelve-layer cloth. The text first introduces the basic components of woven structure - the warp and weft - and elucidates cloth's inherent dimensionality. Through images, drawings, and video animation, the essay then presents *Dodecaweave*, a twelve-layer weaving project completed by the author in 2018. It describes the multi-layer weave patterns and techniques used to create the cloth along with image details and explanation of the loom set-up and weaving process. The conclusion of the essay offers speculative thoughts about the transformational potential of woven cloth (metaphorical and actual) and the need for a reconsideration of known patterns in weaving and beyond. The essay also includes a video of the multi-layer weaving process.



Interlacing thread

The process of weaving is an active and translative one: it involves breaking materials down, examining disparate parts, and bringing them together in a new whole. A weaving is not merely a surface or a graphic representation but a material that takes form in space and time. In her book *On Weaving*, Anni Albers describes the basic construction of woven cloth as “the interlacing of two distinct groups of threads at right angles.”^[1] This surmised definition is important for distinguishing woven textiles from other textile constructions, like twining, knitting, and braiding. Taken as such, weaving seems like a simple gridded binary construction that makes a flat plane. But it is, and has the potential to be, much more expansive.

The two distinct groups of threads, mentioned by Albers, that make up a woven cloth are the warp and the weft. The warp forms the foundational structure of the textile; these threads are typically longer, stronger, and are set up first on the loom. They are the vertical, the y-axis, the longitude. They are more stable and stationary than the weft and, once set, their color, material, and position generally do not change throughout the weaving. The warp threads set the program for the cloth and determine its structure and pattern possibilities.

The weft threads are mobile. They are the horizon, the x-axis, the latitude. As warp threads are raised or lowered, the weft travels from one side of the cloth to the other, carried by the shuttle, in the space created in between the threads: the shed. As the warp closes around the weft after each pass, it locks the weft in place, interlacing the threads, building pattern, forming cloth. While the warp is fixed once set on the loom, the weft color, material, spacing, and patterning order can change at the weaver’s discretion throughout the weaving.

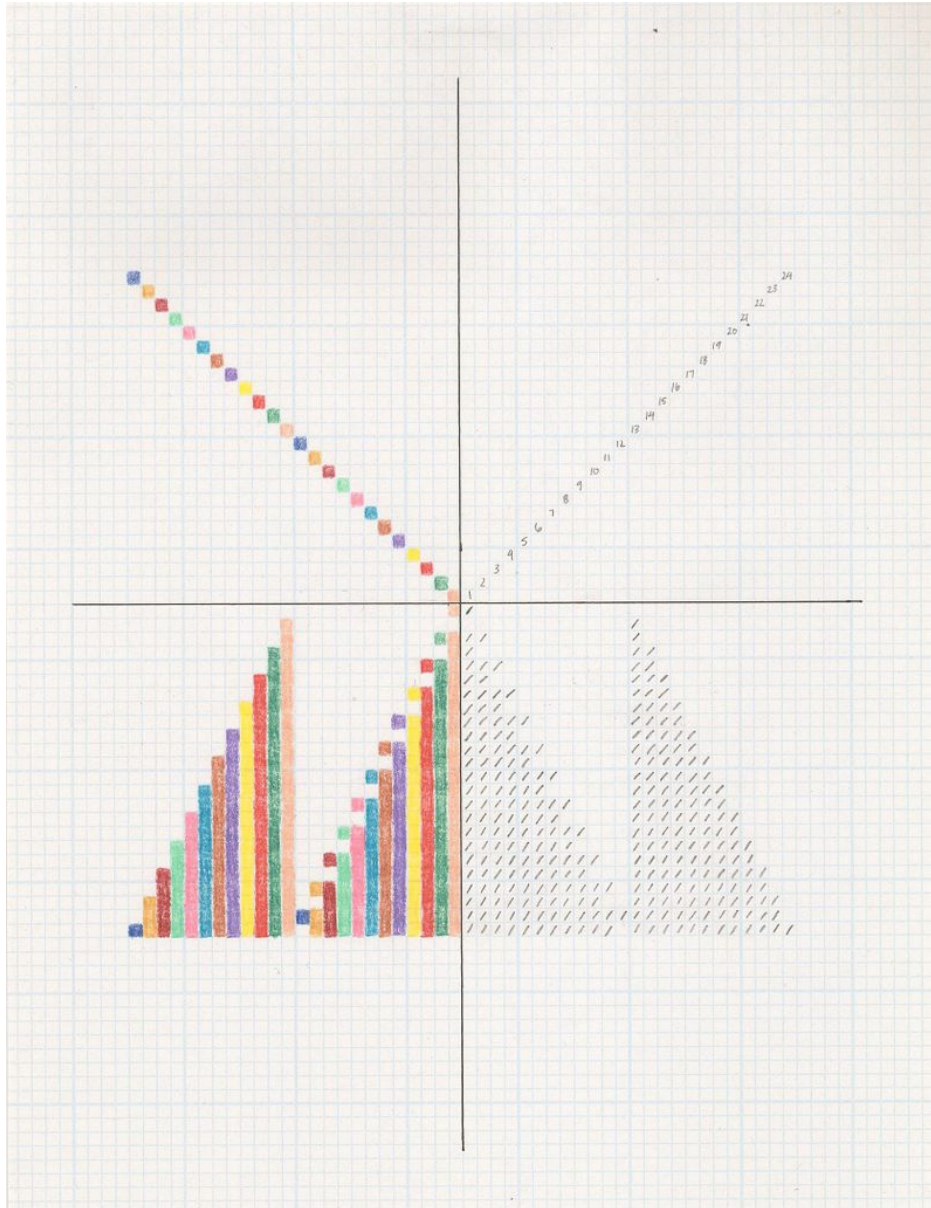


Figure 1
Hand-drawn weave draft of twelve-layer woven structure

Looked at graphically in draft notation – the binary planning map of a woven textile (Figure 1) – or viewed face-on, woven cloth is indeed a coming together of two groups of threads at right angles and creates a gridded structure. If we look at the edge of the cloth and view it from the side, however, we see that the warp and weft threads break the plane to curve and wind over and under each other. In a letter written by Buckminster Fuller in tribute to Anni Albers, he describes this deceptive contrast between the seemingly flat face of a fabric and its physical dimensionality:

From aeronautical altitudes, the crisscross grids of earth's cities seem to be two-dimensional planar arrangements, as do woven fabrics, seen from a distance. Seen from inside cities or within the loom, both

cities and fabrics disclose, multidimensional structure of great complexity.[2]

The cloth's dimensionality begins in the threads – or perhaps in the draft – and expands as it is woven. When removed from the tension of the loom, the woven fabric drapes, it lays, it folds, it droops, it wrinkles, it bunches, it wraps, it covers, it falls, it hangs. It moves on the z-axis. It exists in three-dimensional space, responding to touch, gravity, and manipulation. The folds in the cloth make pockets, make layers, make waves.

Dodecaweave: Unfolding the grid

Dodecaweave (Figure 3) is a twelve-layer woven work, completed in 2018, investigating the material possibility of something that is simultaneously multiplicitous and structurally binary through



Figure 2
Cloth after being removed from loom



Figure 3
Dodecaweave 2018

drafting and weaving multi-layer cloth. The weaving is eighteen feet long; eight inches wide on one end and nine feet wide on the other end. The resulting form of the weaving was determined by its design and woven construction. Each layer in the cloth is a distinct bold color, visually emphasizing the transition between the layers.



Figure 4

Detail of center of weaving, showing the transition between woven sections and techniques

Woven entirely from one warp, the cloth has two sections that each utilize a different technique for creating a multi-layer weaving by using multiple or continuous wefts. The first section (Figure 5) was woven with twelve separate wefts (Figure 6) to create a series of twelve individual layers that stack on top of each other, with openings on either side of the cloth allowing access to the layers (Figure 7).



Figure 5
Detail of first section of cloth showing stacked layers



Figure 6
Twelve shuttles for weaving twelve layers



Figure 7
Weaving stacked layers with multiple-weft technique

The second section of the weaving used a single continuous weft at a time, a technique that joined the layers at alternating edges (Figure 9) to produce a cloth that unfolds to twelve-times its width, like a giant pleat or fan (Figure 8).



Figure 8

Detail of second section of cloth woven with continuous weft technique, unfolded



Figure 9
Edge detail of continuous weft technique on loom

The cloth was woven on a 24-harness AVL Compu-Dobby loom (Figure 11) in 3/2 mercerized cotton. This material was chosen with the aim of making the weaving as bulky as possible to emphasize the form and dimensionality that I was seeking in the multi-layer structure. Each individual woven layer was woven in plain-weave and had a balanced weaving sett of ten ends-per-inch, which made for a total 120 ends-per-inch (10epi*12layers) when dressed on the loom (Figure 10). The starting warp was eight yards long and ten inches wide.



Figure 10

Dodecaweave threading pattern and the warp dressed on loom, before weaving

Multi-layer weaving may seem complex – and it can be! – but its basic rules are quite simple: each woven layer acts as its own warp and weft structure system. When weaving on an individual layer, all the warp threads of the layers above must be lifted out of the way and the warp threads of the layers below are left in a resting state, so they don't interlace with the target layer's structure. In *Dodecaweave*, each plain-weave layer was woven using two of the doobby loom's twenty-four harnesses. The light pink warp was threaded on harnesses 1&13, the dark green warp on harnesses 2&14, the red warp on harnesses 3&15, etc. Whenever I was weaving the red warp layer, I first raised harness 3 along with any harnesses carrying threads for the layers above the red layer (i.e. if red was the third layer from the top beneath light pink and dark green, I raised harness 3 plus harnesses 1, 2, 13, and 14). To complete the plain weave structure on the red layer, I then lifted harness 15 along with any harnesses for the above layers on the following weft pic.



Figure 11
Weaving on 24-harness dobbie loom

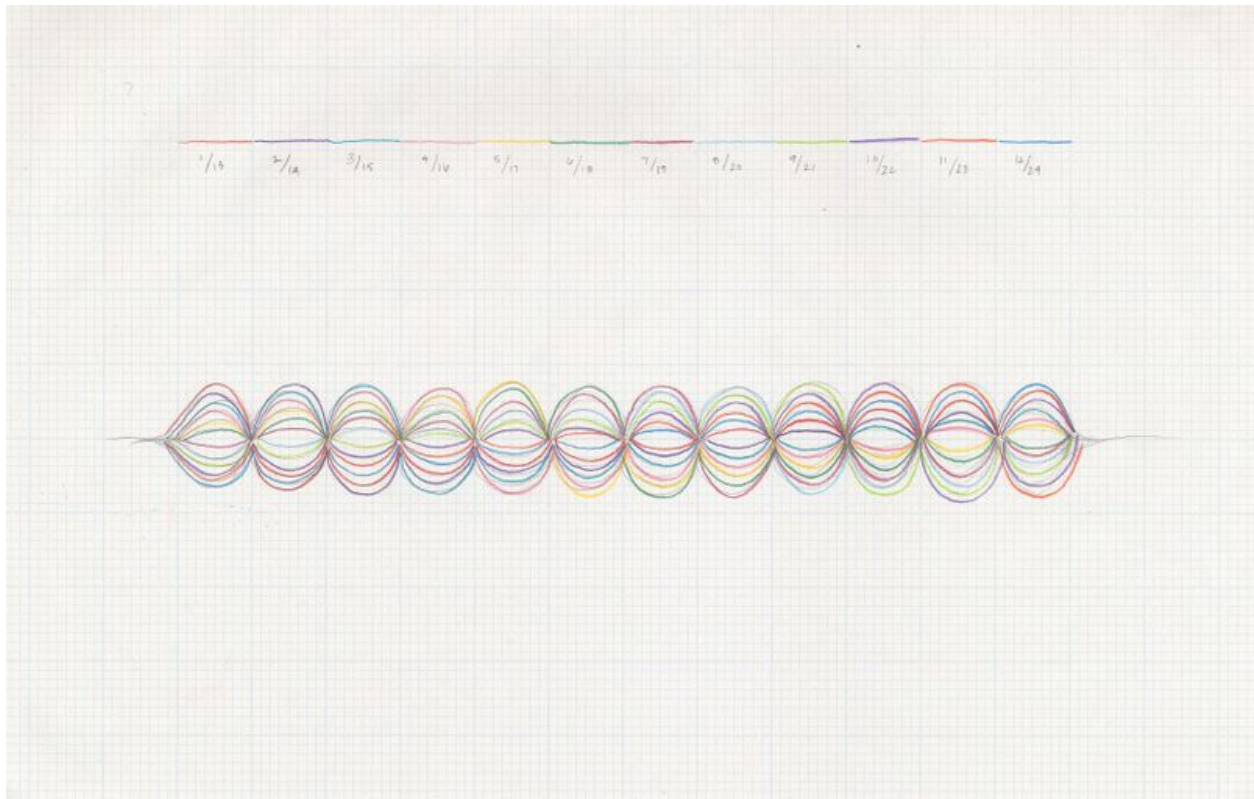


Figure 12
Sketch of side view of twelve-layer cloth

This weaving and design process began with sketches and drawings that conceptualized the two methods of multi-layer weaving described above, visualizing them as if looking from the edge of the cloth (Figure 12), or from the top of the unfolded twelve-wide section. To understand and plan the woven structure for the twelve-layer cloth, I hand-drew a series of thirteen colored-pencil drawings that are both technical drafts of the weave structures used to create the cloth as well as abstract drawings exploring pattern, repetition, and form (Figure 13). As a contiguous set, they transmit a sense of the transformation between the flat binary of the drafts and the stacks, pleats, pockets, and folds of the cloth. We see a shift in the construction of the fabric as the woven layers, represented by a corresponding colored cell, change position in the cloth. The draft and the weaving each communicate the same information but occur on different planes, two material expressions of the same structure.

**Figure 13**

Twelve layers, thirteen ways, a set of twelve hand-drawn weave drafts

To arrive at the final woven cloth, these drawings were translated into a digital weave-drafting software, Fiberworks, that interfaced with the compu-dobby loom, communicating to the loom which harnesses to raise for each weft pic (Video 1).



Video 1

Animated gif of the digital Fiberworks draft for each weave layer

Woven cloth as an emergent material

Weaving is a technically binary structure: a warp thread can be either raised or lowered. When drafted, woven structure is depicted as a binary pixel grid. From within this seemingly fixed structure, endless possibilities emerge. Woven in multiple layers, weaving maintains its inherent binary nature but takes on a new physical dimensionality that troubles the binary and reveals the false promise of two seemingly fixed states: on/off, up/down, black/white, full/empty. From the flat draft to the woven cloth, there is a transformative shift that occurs in multi-layer weaving. The resulting cloth becomes a model for creatively reimagining our presents and futures.

Audre Lorde used the language of structure and pattern to speak to the need to reimagine these futures in her speech “Age, Race, Class, and Sex: Women Redefining Difference”:

The old definitions have not served us, nor the earth that supports us. The old patterns, no matter how cleverly rearranged to imitate progress, still condemn us to cosmetically altered repetitions of the same old exchanges, the same old guilt, hatred recrimination, lamentation, and suspicion.

For we have, built into all of us, old blueprints of expectation and response, old structures of oppression, and these must be altered at the same time as we alter the living conditions which are a result of those structures.^[3]

In this speech, Lorde calls for new patterns, new structures to build a more just world. The woven cloth is a known pattern, a familiar structure, built from the gridded plane with threads interlaced at right angles.

Through this work with multi-layer weaving, I am searching for the z and Δ axes in an x/y world. With this work, I speculatively draft new structures and weave new forms as a way to consider how to destabilize and rebuild broader structural social and political patterns.

Multi-layer weaving shifts the understanding of the grid to something that is multiple, dimensional, and in flux rather than fixed and restricted. “The multiple is not merely that which has many parts but that which is folded many ways,” elucidates Gilles Deleuze[4] By challenging the planar grid, the multi-layer cloth becomes a metaphor and model[5] for building new worlds from a seemingly fixed system: folds within folds. Beyond metaphor, weaving and other materials have the potential for metamorphosis – a shifting of form or transformation from material to action. From a single warp, parallel worlds and possibilities emerge simultaneously, held together within the structure. The cloth invites in meaning, affect, discovery, change, possibility. It opens up to the bizarro world on the other side of the graph, the unknowable space in between the woven layers. They exist in tandem. Entangled. Perhaps irreconcilable. Multiplicitous. Possibilities ever unfolding.



Video 2
Weaving Dodecaweave

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About the author

Etta Sandry is an artist, researcher, educator, and facilitator from the midwestern United States, currently based in Boulder, CO. Her material-focused research is rooted in fiber and weaving and spans media through sculpture, writing, and installation. Etta completed her MFA in the Fibre & Material Practices program at Concordia University in 2021. She has exhibited her work in the United States and Canada and was the 2022 Experimental Weaver in Residence at the Unstable Design Lab in Boulder, Colorado.

More of Etta's work can be found at ettasandry.com.

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