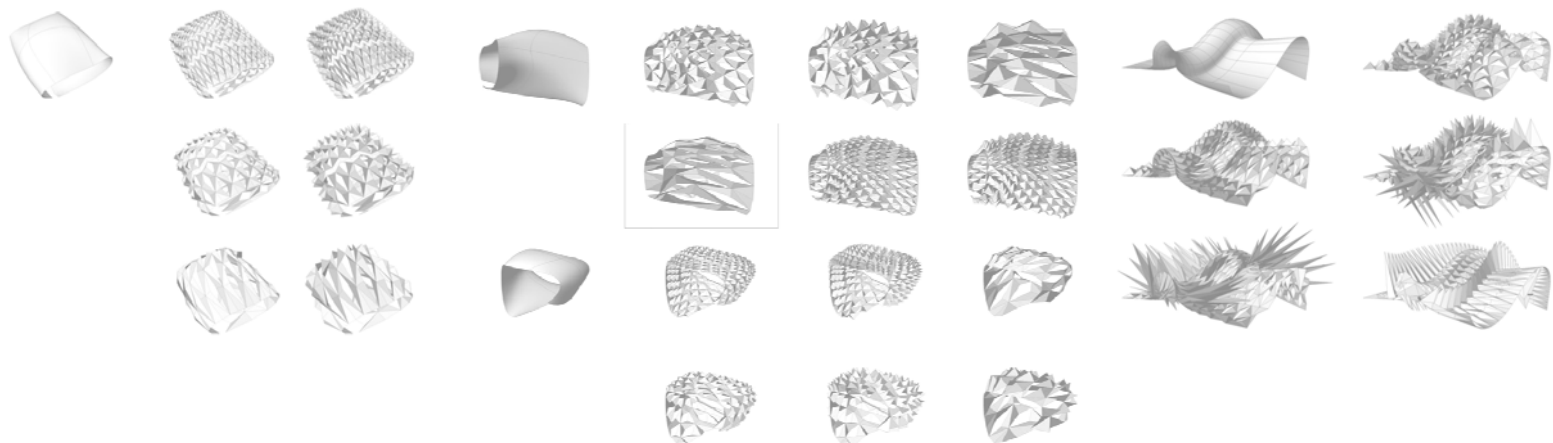


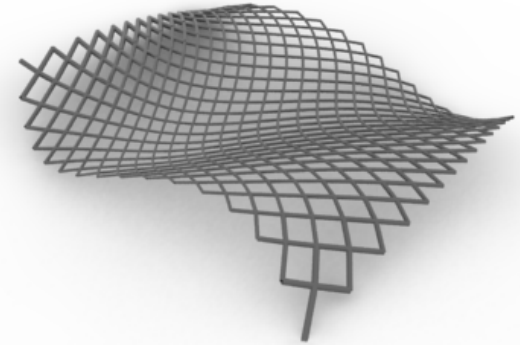
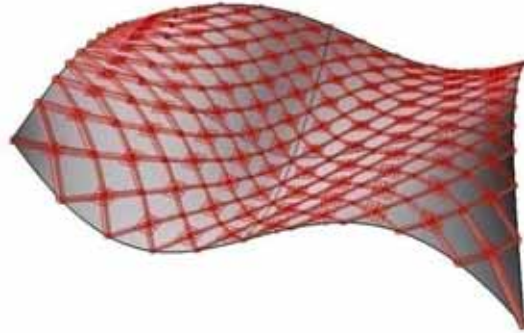
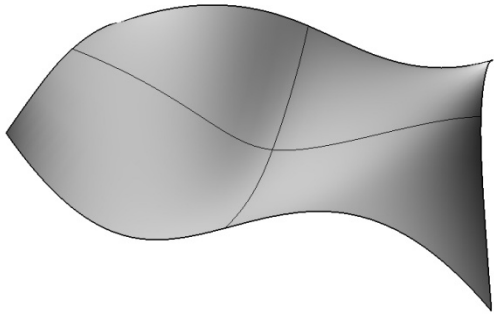
Parametric modeling:
grasshopper

“Parametric design is such that it is the parameters of a design that are declared, not the shape...

Equations are used to represent the relationships between objects. The ability to define, determine and reconfigure geometrical relationships is of particular value.”

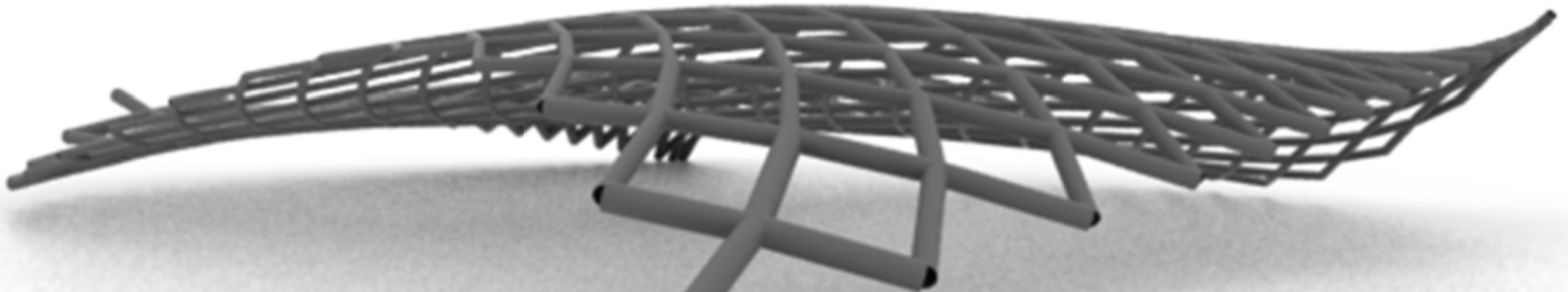
Mark Burry, ‘Paramorph’, 1999

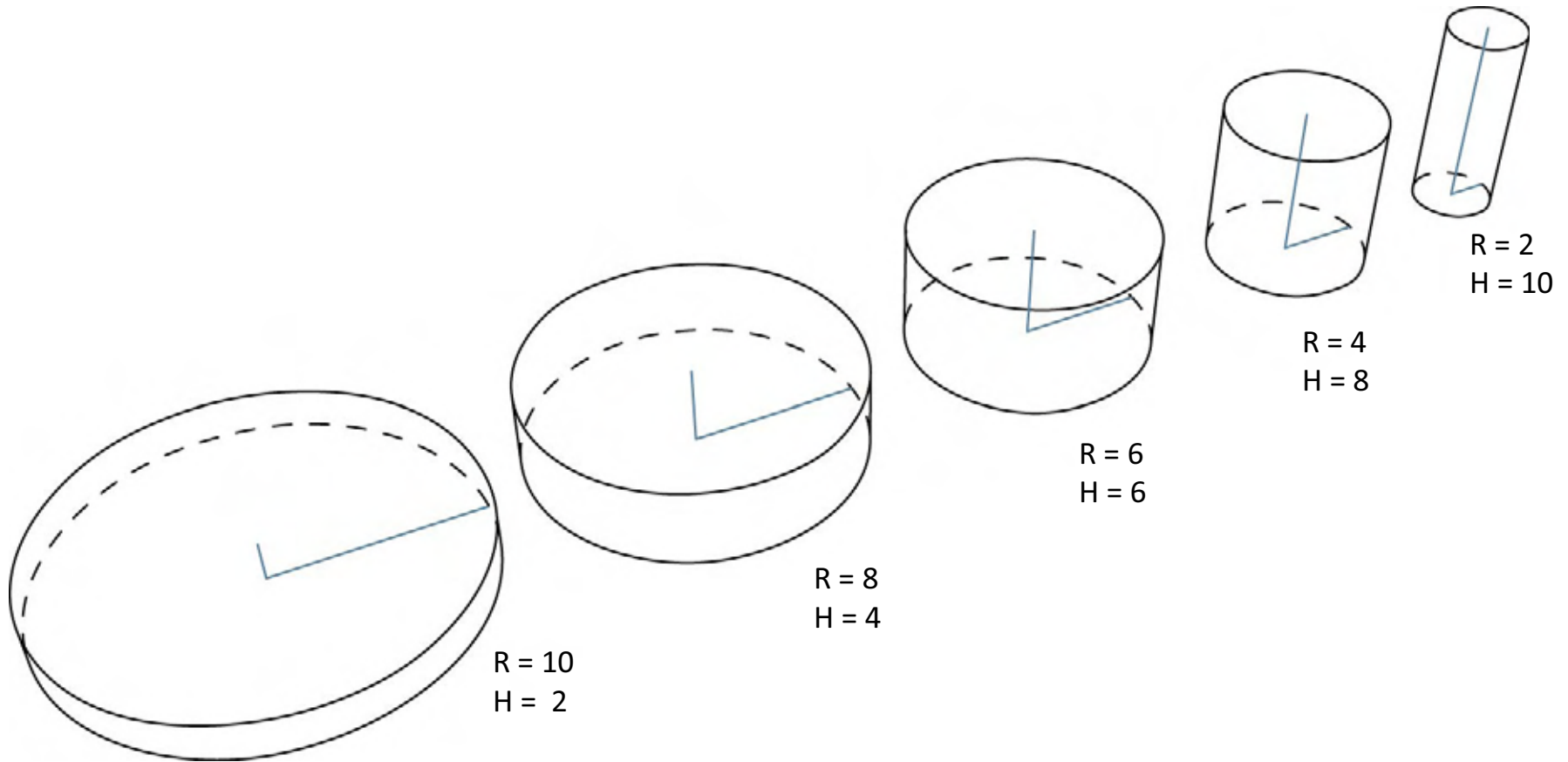




Design described as a set of variables (parameters) and expressions (relations between parameters)

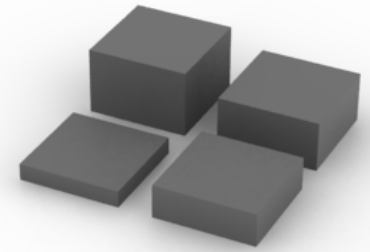
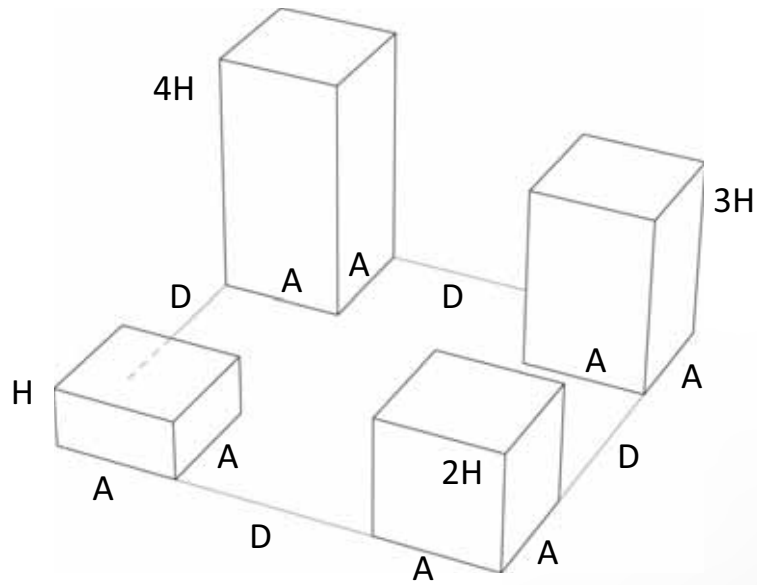
Constituent geometry that is mutually linked





Instead of being assigned fixed values, parameters that define 3d objects (such as height or radius) can also be stored as variables or formulas.

By assigning different values to the variables, different objects can be easily created.

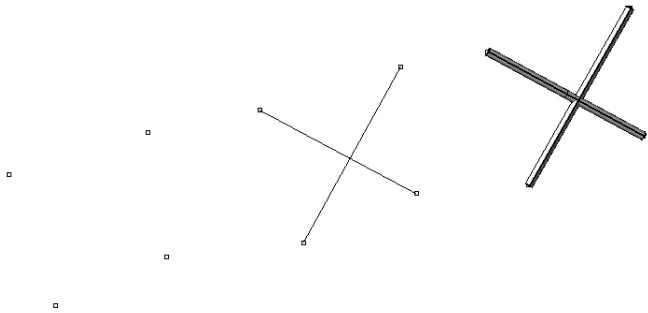


Formulaic description of relations

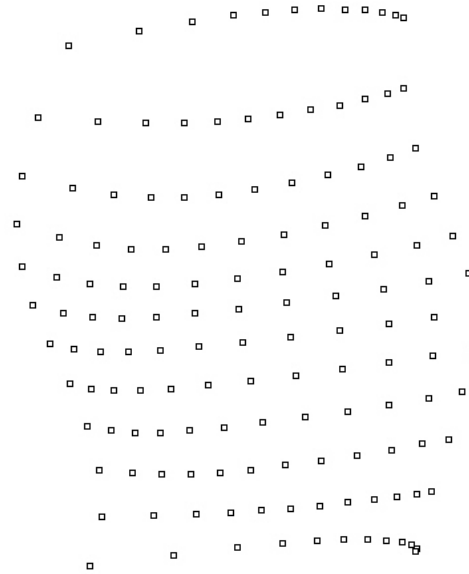
Parameters associated with the position and orientation of objects can also be defined as variables or formulas.

Interdependencies between objects can be created, and model's behavior under transformations defined.

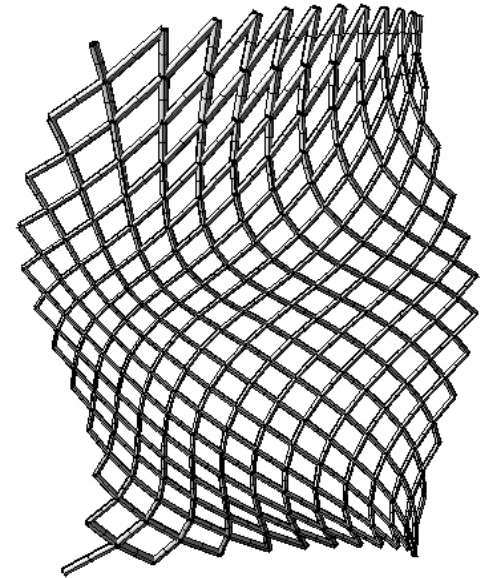
Different configurations can be explored by changing the values of variables.



Connect alternating points and pipe



Connect alternating points within an entire "list" of points and pipe the results



Objects can be collected in "lists"

Lists can be used to repeat rules and recipes across a set of similar items

TIME
+
TRANSFORMATIONS
+
PARAMETERS
=
DESIGN SPACE

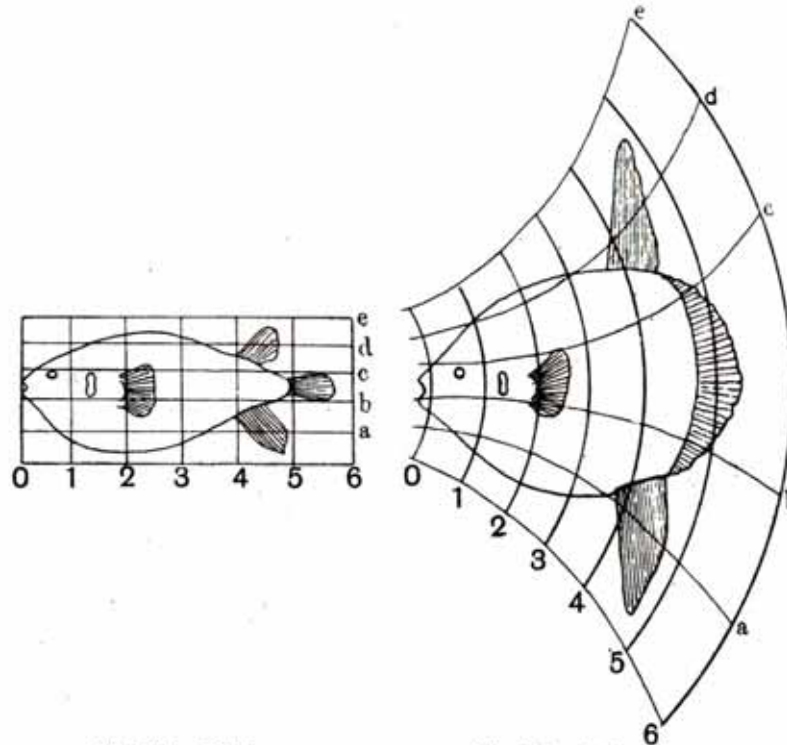


Fig. 525. *Diodon*.

Fig. 526. *Orthogoriscus*.

"The form of any particle of matter, whether it be living or dead, and the changes in form which are apparent in its movements and in its growth, may in all cases be described as due to the **action of force**.

In short, the form of an object is a **diagram of forces**..."

-D'Arcy Wentworth Thompson | *On Growth and Form* | 1917

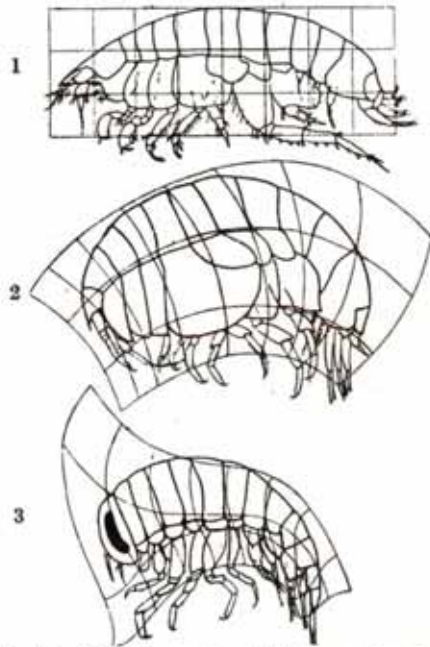


Fig. 514. 1, *Harpinia plumosa* Kr.; 2, *Stegocephalus inflatus* Kr.; 3, *Hyperia galba*.

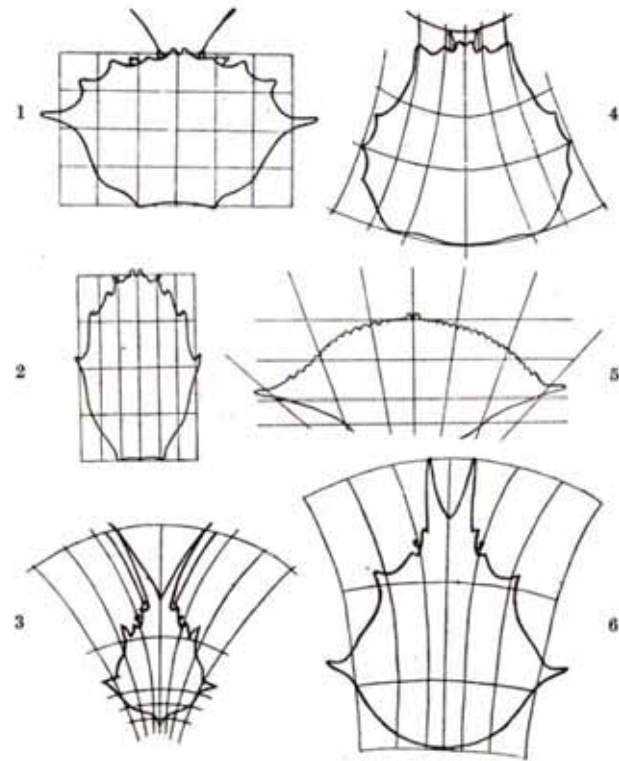
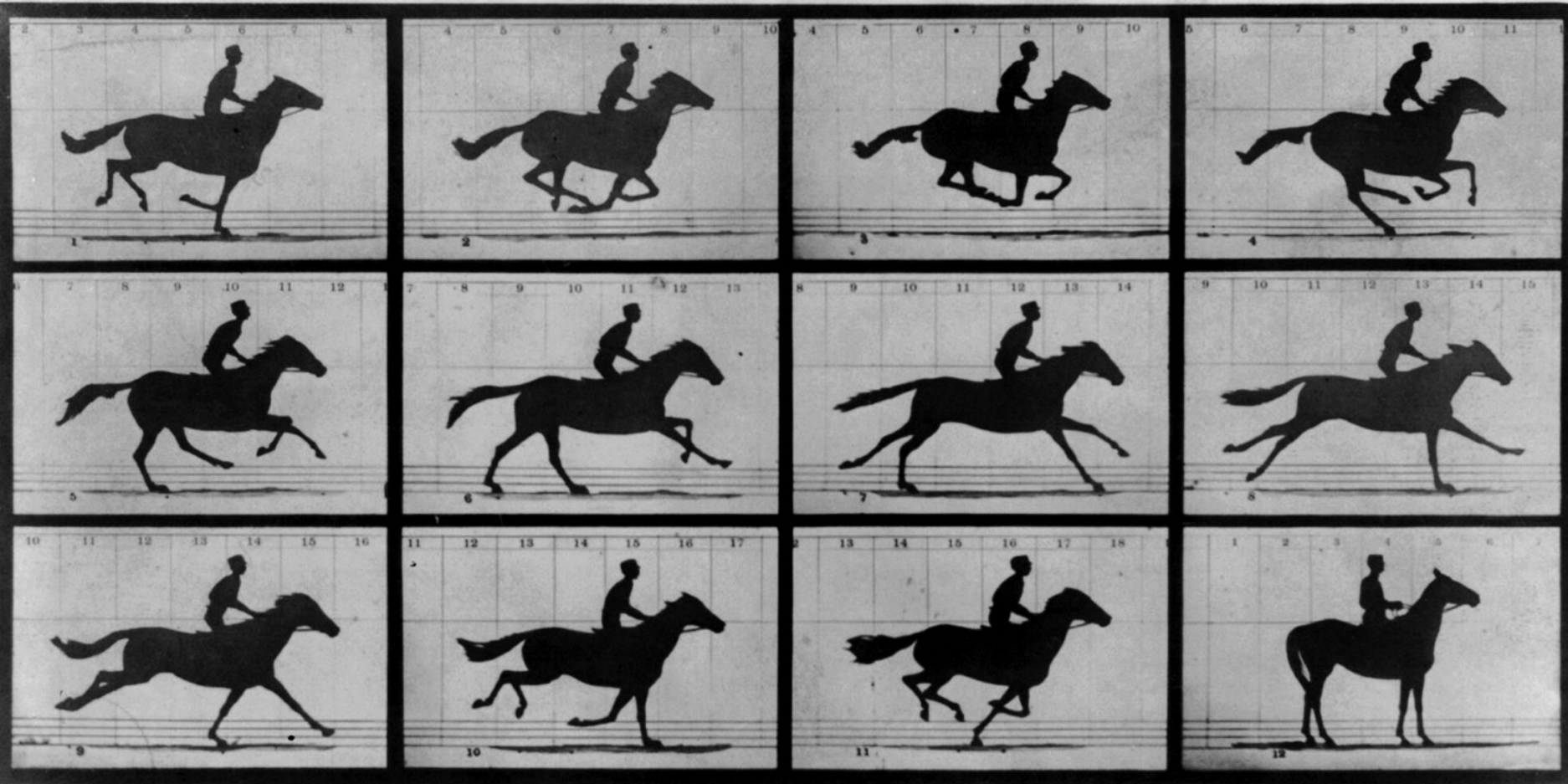


Fig. 513. Carapaces of various crabs. 1, *Geryon*; 2, *Corystes*; 3, *Scyramathia*; 4, *Paralomis*; 5, *Lupa*; 6, *Chorinus*.

“Physical form, according to D’Arcy Thompson, is the resolution at one instant of time of many forces that are governed by rates of change. In the urban context the complexity of these forces often surpasses human comprehension. A machine, meanwhile, could procreate forms that respond to many hereto un-manageable dynamics. **Such a colleague would not be an omen of professional retirement but rather a tickler of the architect’s imagination, presenting alternatives of form possibly not visualized or not visualizable by the human designer.**”

-Nichalos Negroponte | Architecture Machine | 1970



Copyright, 1878, by MUYBRIDGE.

MORSE'S Gallery, 417 Montgomery St., San Francisco.

THE HORSE IN MOTION.

Illustrated by
MUYBRIDGE.

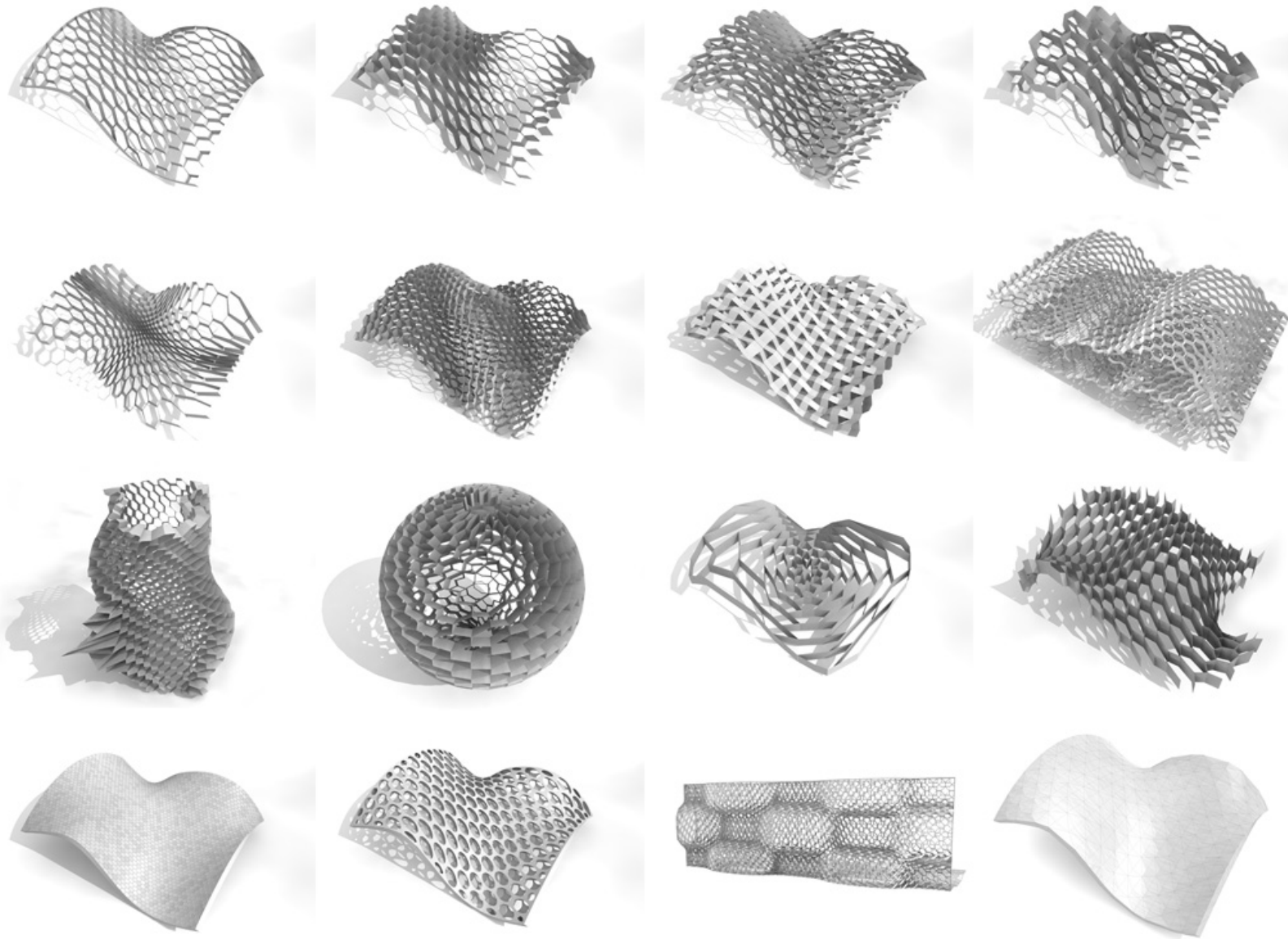
AUTOMATIC ELECTRO-PHOTOGRAPH.

"SALLIE GARDNER," owned by LELAND STANFORD; running at a 1.40 gait over the Palo Alto track, 19th June, 1878.

The negatives of these photographs were made at intervals of twenty-seven inches of distance, and about the twenty-fifth part of a second of time; they illustrate consecutive positions assumed in each twenty-seven inches of progress during a single stride of the mare. The vertical lines were twenty-seven inches apart; the horizontal lines represent elevations of four inches each. The exposure of each negative was less than the two-thousandth part of a second.

Eadweard Muybridge, 1878

Parametric modeling: grasshopper



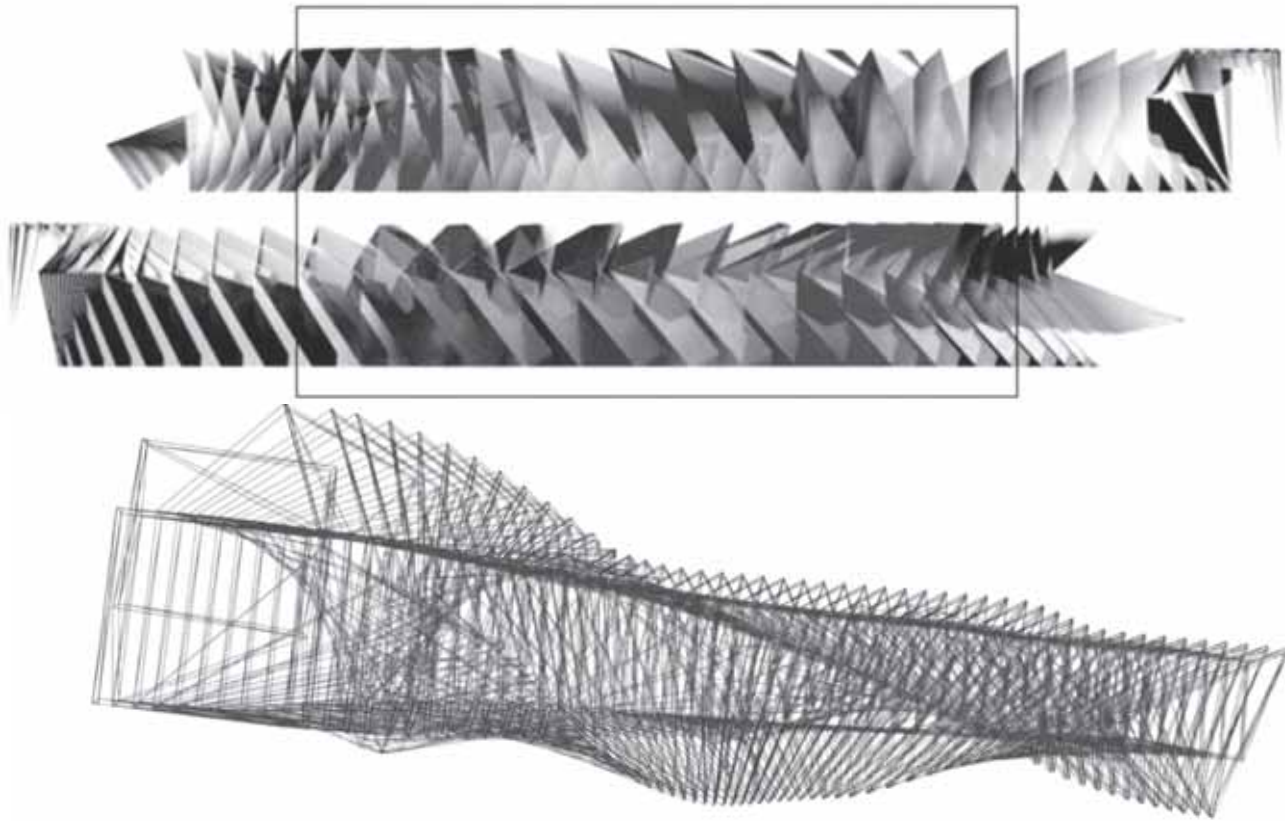
materialsystems.org | Andrew Kudless

Marcel Duchamp
1912



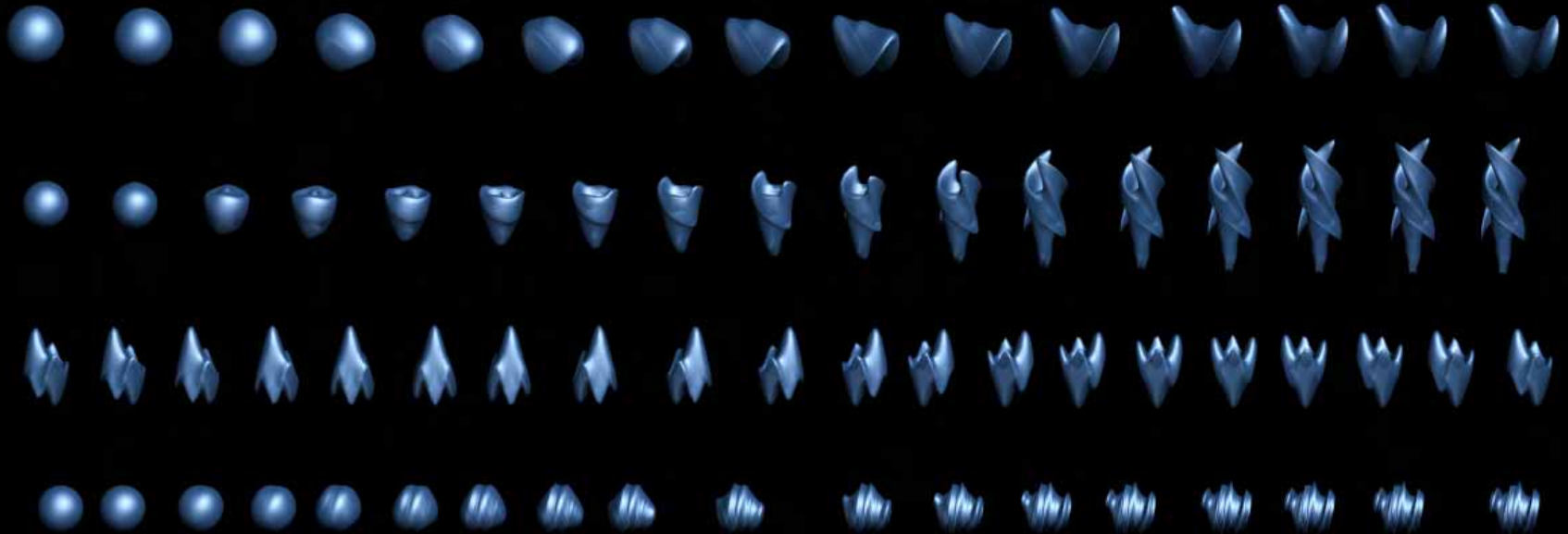
“...animate design is defined by the **co-presence of motion and force at the moment of formal conception**. Force is an initial condition, the cause of both motion and particular inflections of a form.”

-Greg Lynn | *Animate Form* | 1998



"...there is no essential difference between a more or less spherical formation and a blob. The sphere and its provisional symmetries are merely the index of a rather low level of interactions where the blob is an index of a high degree of information in the form of differentiation between components in time. **In this regard, even what seems to be a sphere is actually a blob without influence;** an inexact form that merely masquerades as an exact form because it is isolated from adjacent forces."

-Greg Lynn | *Folds, Bodies, & Blobs* | 1998



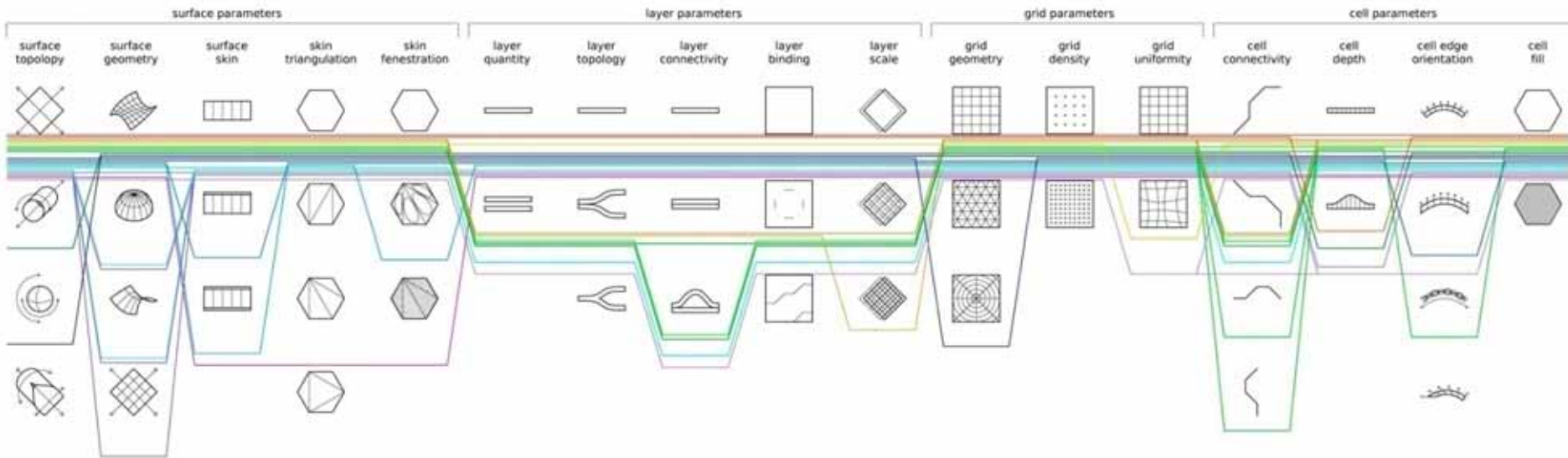
REPETITION and DIFFERENCE

PRECISE INDETERMINACY

ANEXACT yet RIGOROUS

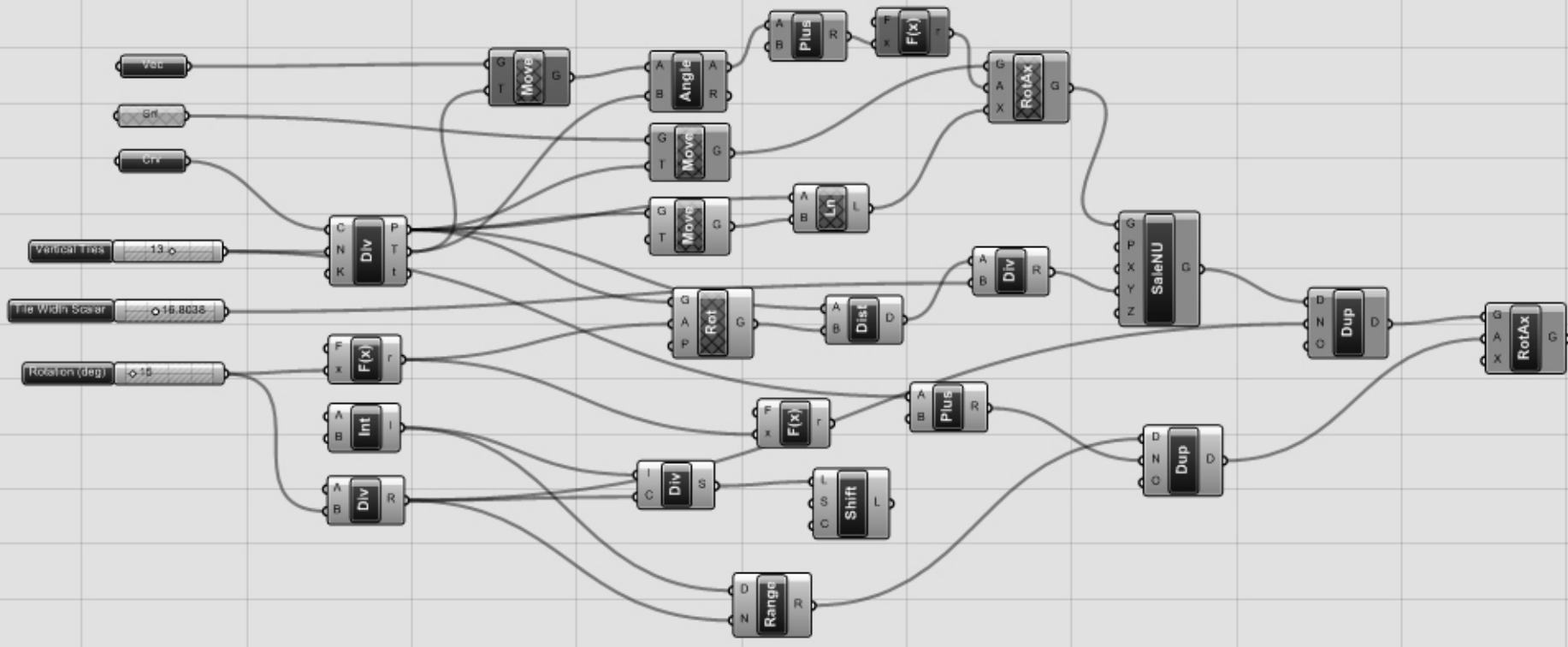
MULTIPLICITY

TOPOLOGICALLY IDENTICAL yet MORPHOLOGICALLY UNIQUE



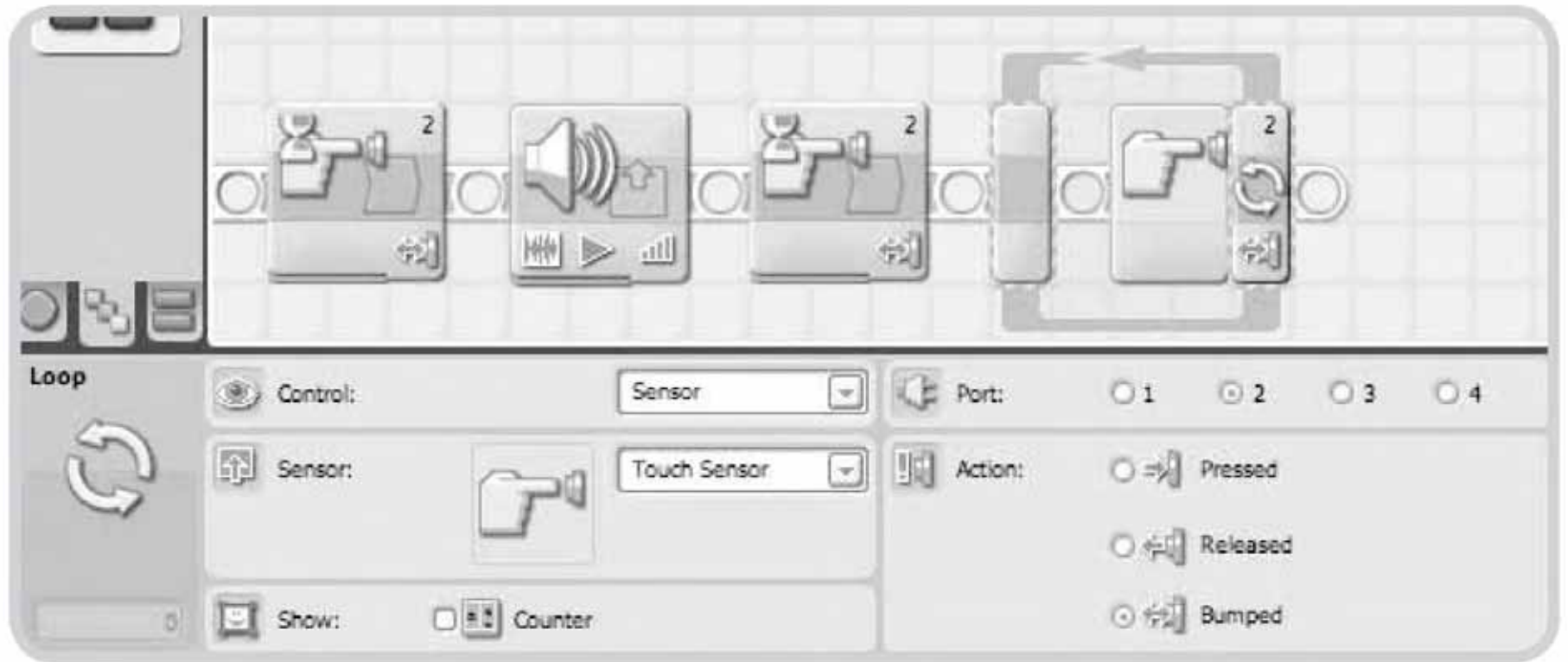
"...digital technologies really put at stake the architecture of information lying behind the buildings, and this architecture with digits also has to be designed."

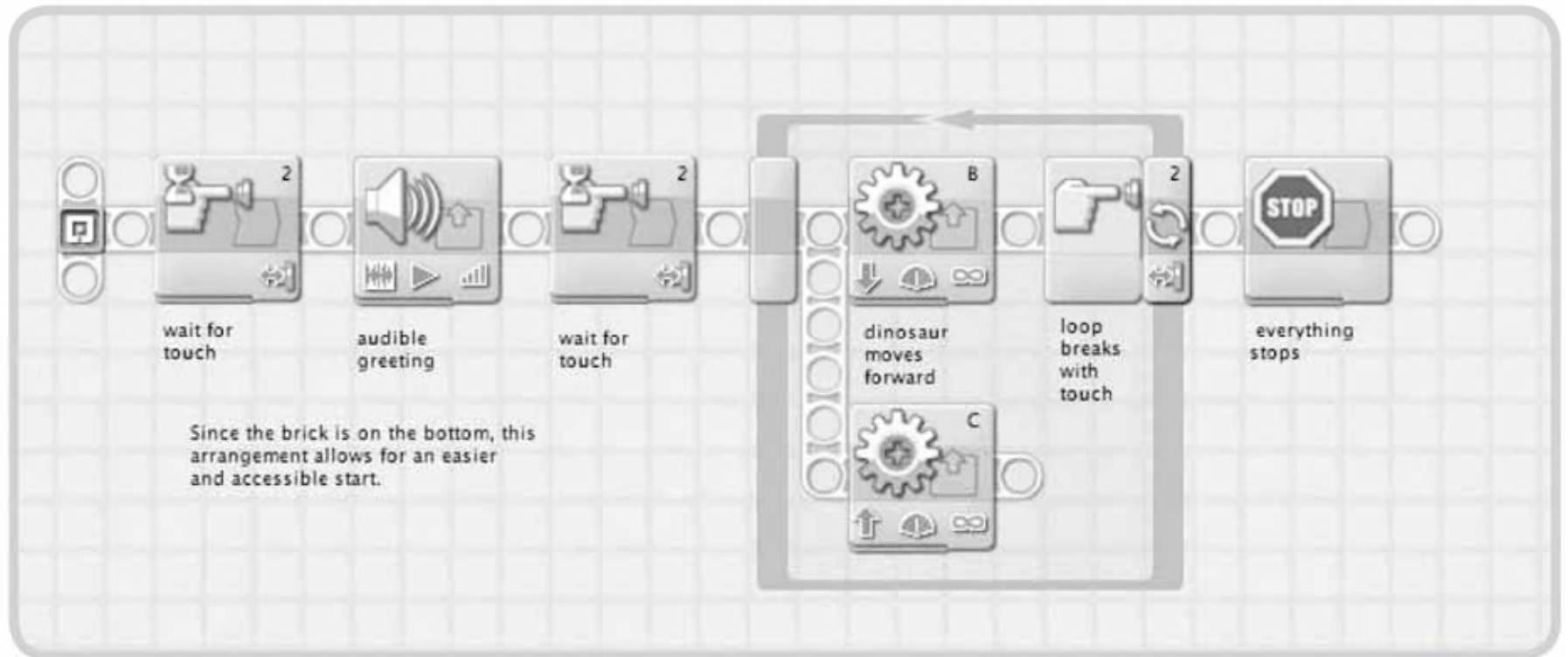
-Bernard Cache, *Architectural Design* 73, 2003



“...digital technologies really put at stake the architecture of information lying behind the buildings, and this architecture with digits also has to be designed.”

-Bernard Cache, *Architectural Design 73*, 2003



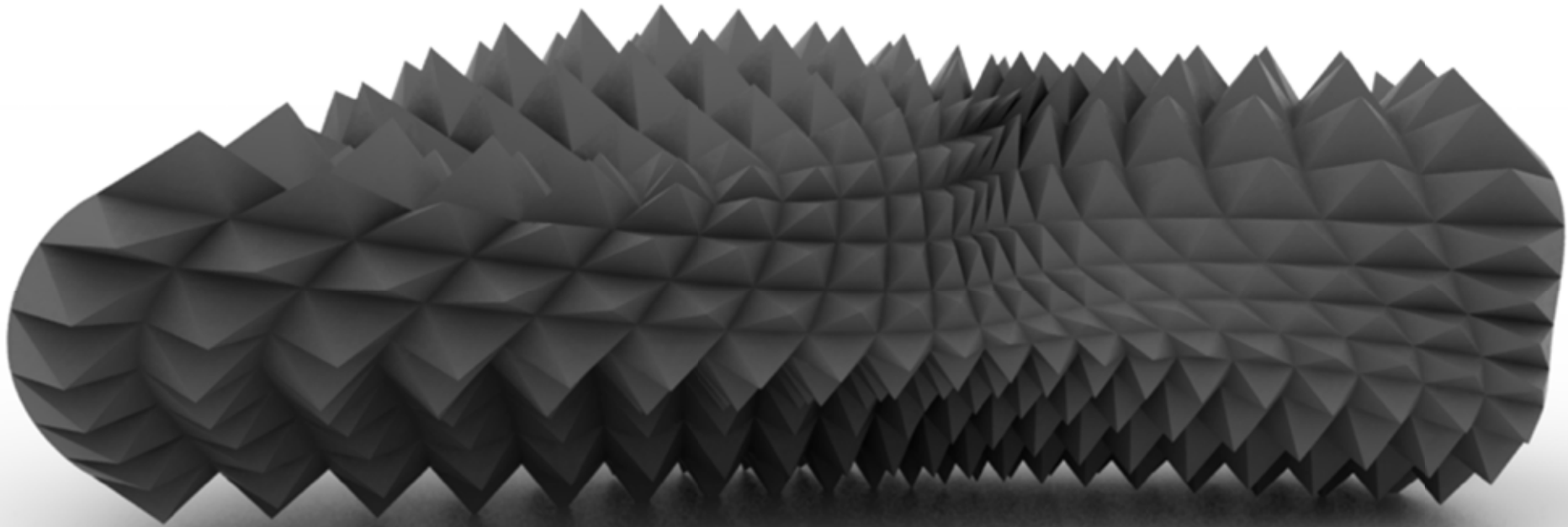


What are the implications when...

...the static is replaced by the variable?

...homogeneity makes way for heterogeneity?

...modularization is enhanced with variegation?



Can the forces that make the object, both in the generation of the broad strokes and specific resolutions, combine with an intelligence of fabrication to become a '**process product**'?

Here the form, the forces that shape it, and the assemblage of materials in which we execute the ideology are part of the same gesture. This is not a call to replace the human act of design with algorithms, but **a critical search for a common language between design and execution.**

The resulting control of these processes empowers the architect to take on the role of the translator of unforeseen relationships simultaneously in imagined and real space."

-Sharples Holden + Pasquarelli | *Versioning* | 2002



FAT 2 FLAT : planar fabrication

FAT 2 FLAT : planar fabrication

Laser cutting + other CNC equipment

Planar fabrication strategies

- Contouring
- Tessellation
- Triangulation
- Radial approximation
- Ruled surfaces/unrolling
- Unfolding
- Interlocking assemblies (puzzle pieces, notching)

File prep

- Marking
- Nesting
- Assembly diagrams

FAT 2 FLAT : cnc equipment

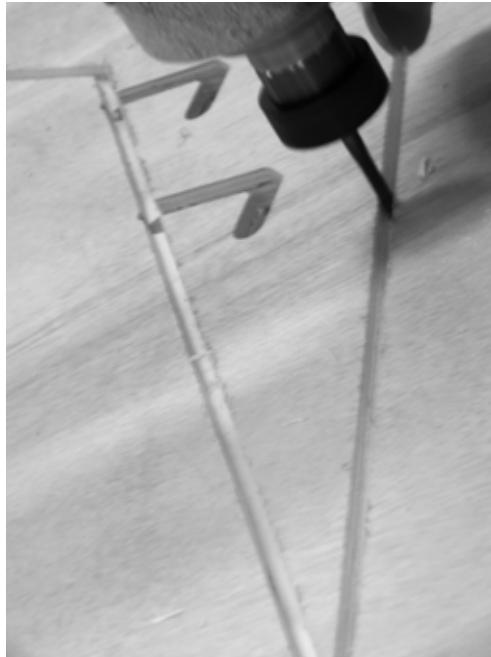
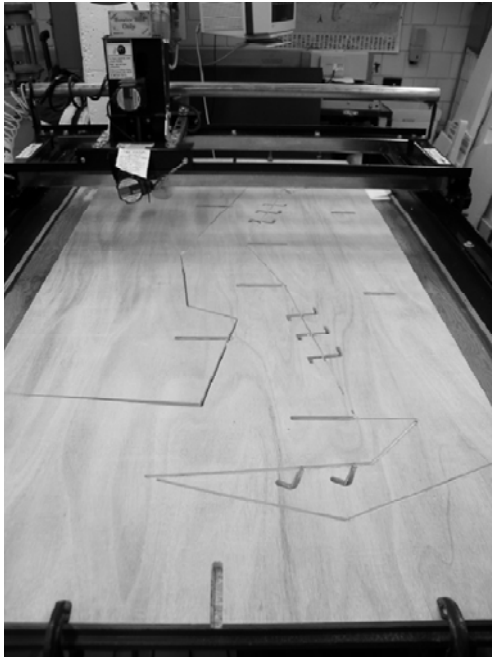


FAT 2 FLAT : cnc equipment



<http://flowcorp.com/waterjet-resources.cfm?id=644>

FAT 2 FLAT : cnc equipment



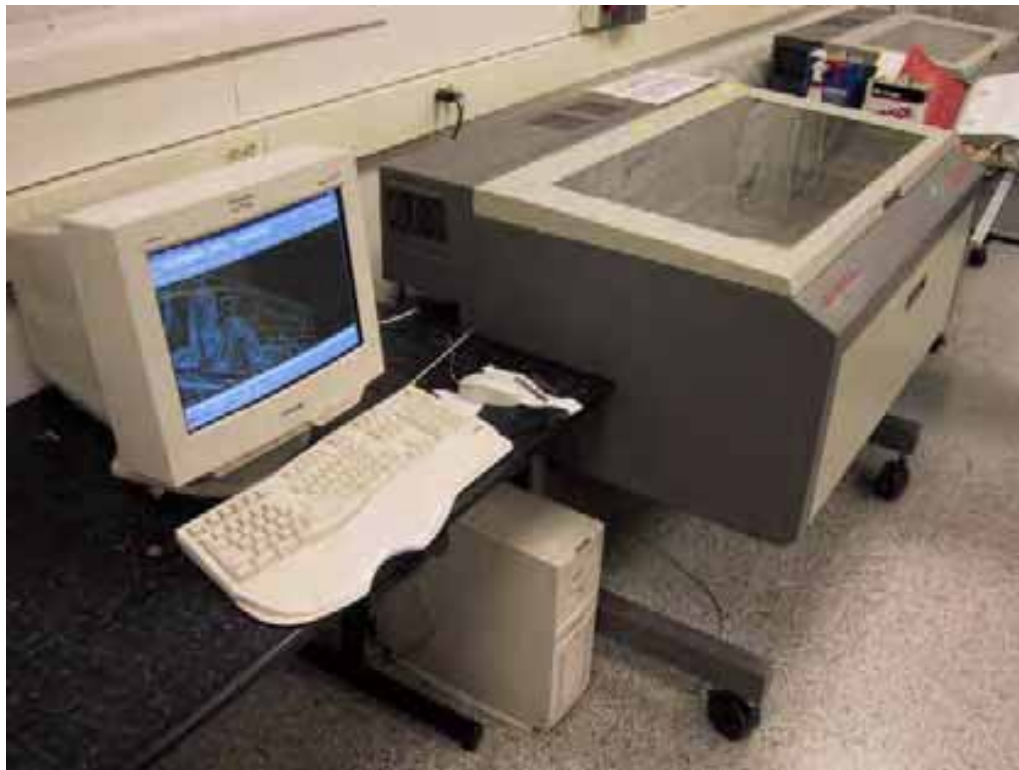
<http://video.google.com/videoplay?docid=364783456210779901&q=cnc+mill&total=344&start=70&num=10&so=0&type=search&plindex=4>

FAT 2 FLAT : laser cutting

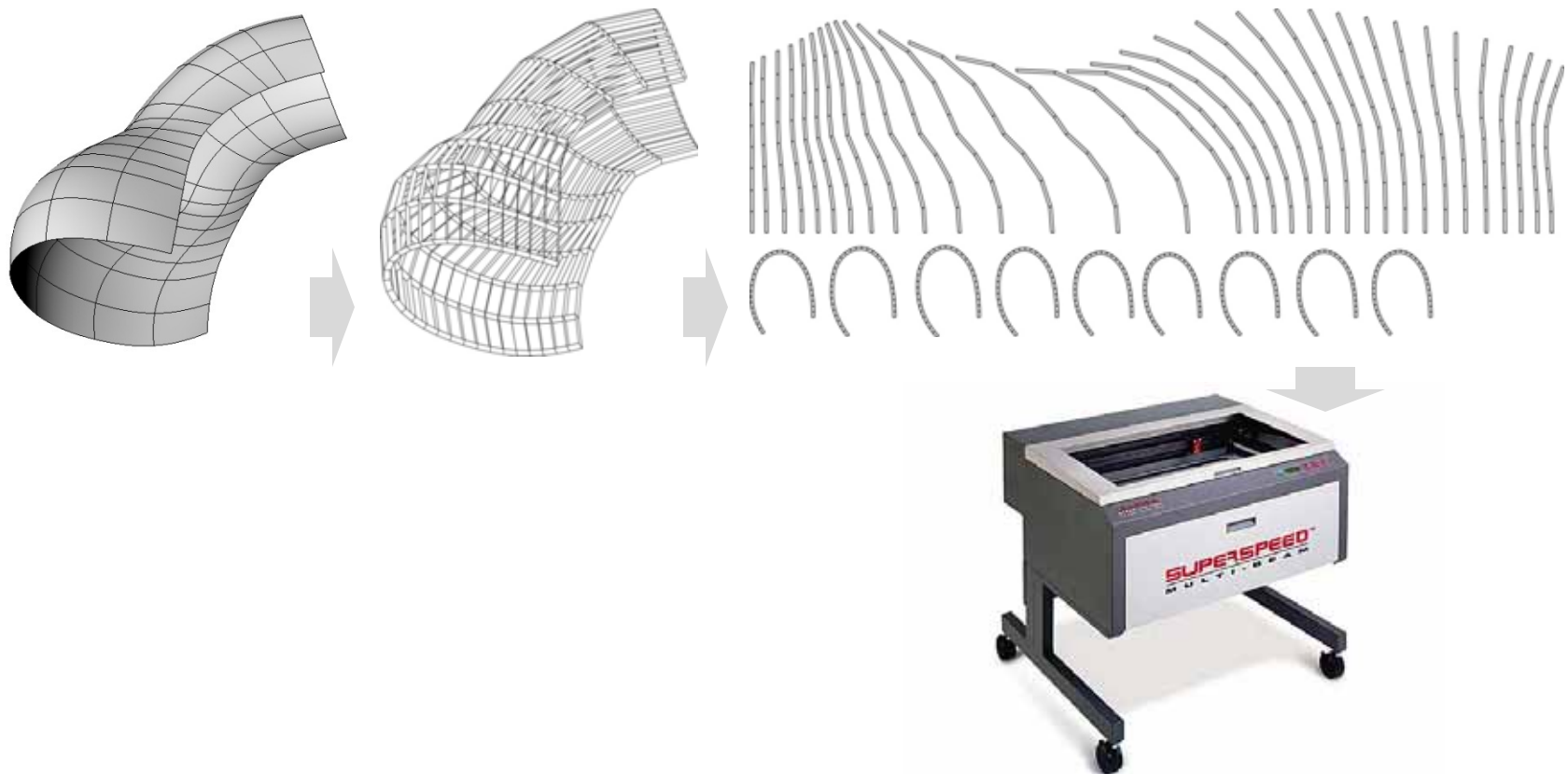


<http://video.google.com/videoplay?docid=-5217665377801481581&q=laser+cutter&total=745&start=0&num=10&so=0&type=search&plindex=1>

FAT 2 FLAT : laser cutting



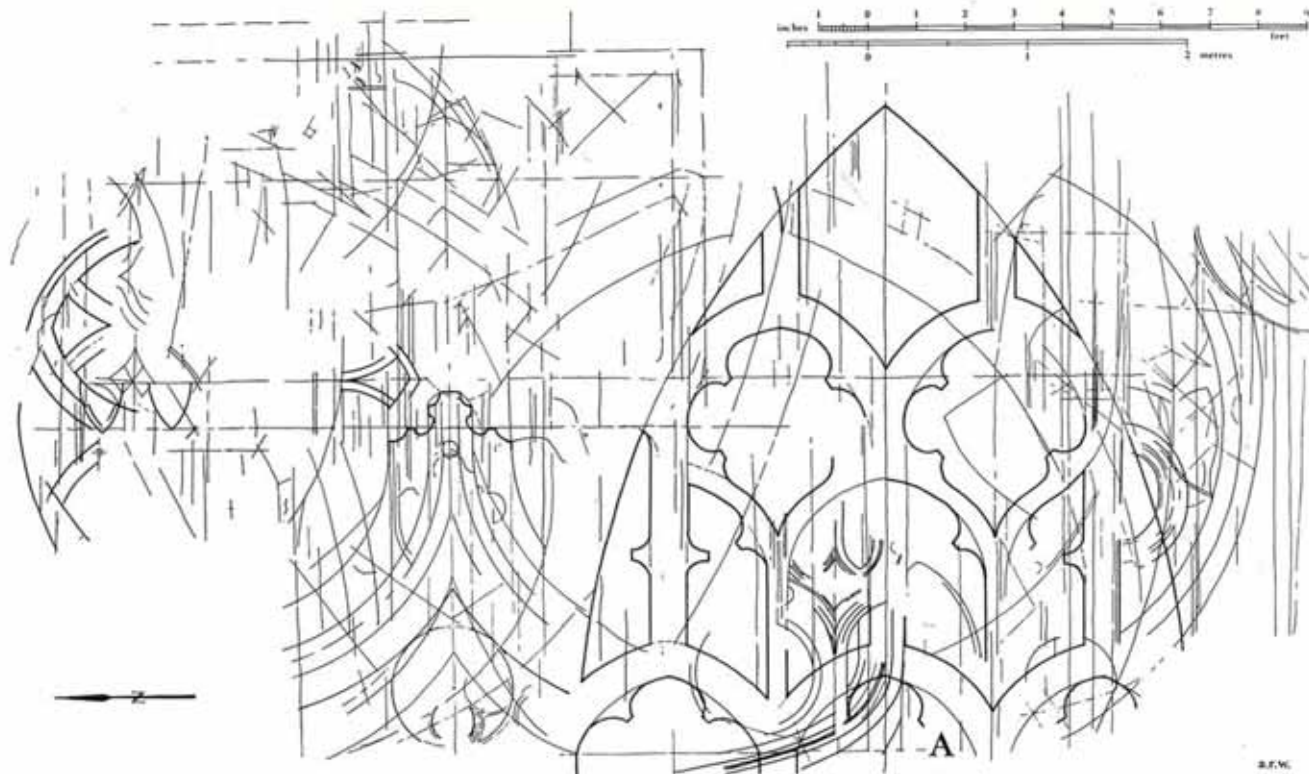
FAT 2 FLAT : laser cutting



Convergence of Representation and Production:

“...by using digital technologies it is now possible to generate complex forms in novel ways and also to construct them within reasonable budgets. In other words, the processes of describing and constructing a design can be now more direct and more complex because the information can be extracted, exchanged, and utilized with far greater facility and speed; in short, with the use of digital technologies, **the design information is the construction information**. This process-based change is far more significant than the formal change. It is the **digitally-based convergence of representation and production processes** that represents the most important opportunity for a profound transformation of the profession and, by extension, of the entire building industry.”

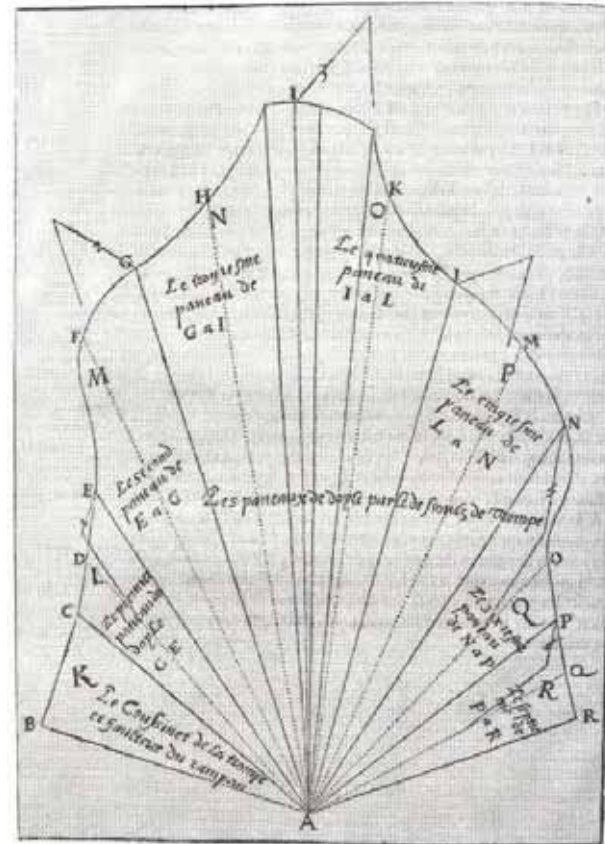
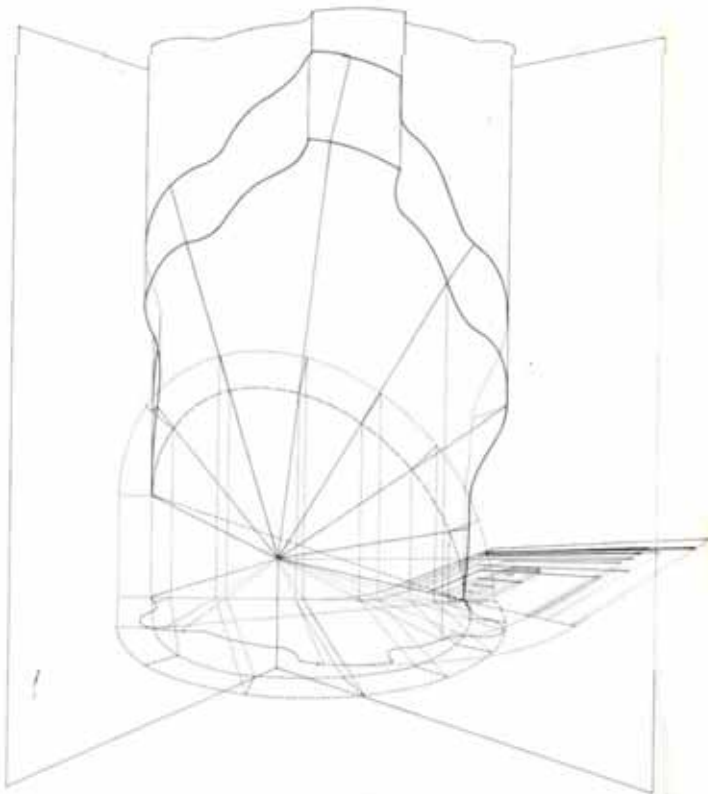
FAT 2 FLAT : design 2 production



Traits

“From here it [was] a short step to the mason’s yard, because each face, when drawn full size, would become a template furnished to the mason as paper, board, or zinc panels.”

-Robin Evans, *The Projective Cast*



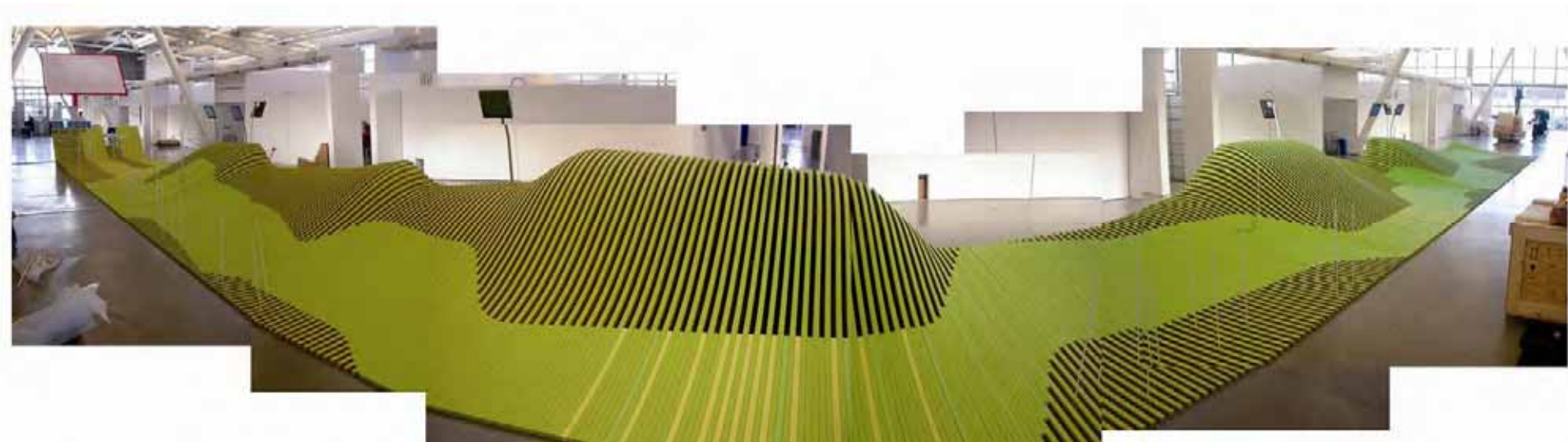


FAT 2 FLAT : fabrication strategies

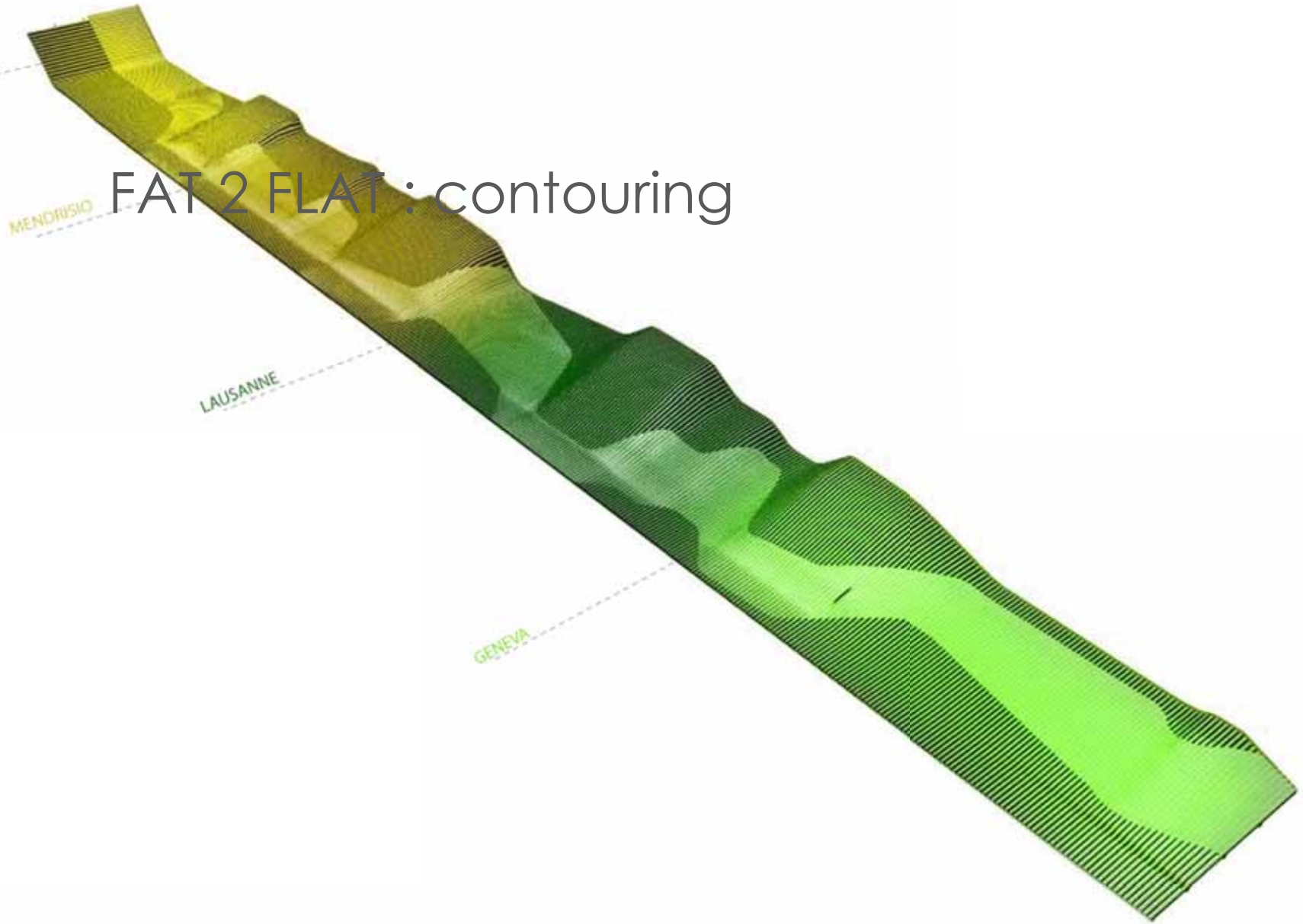
FAT 2 FLAT : contouring



FAT 2 FLAT : contouring



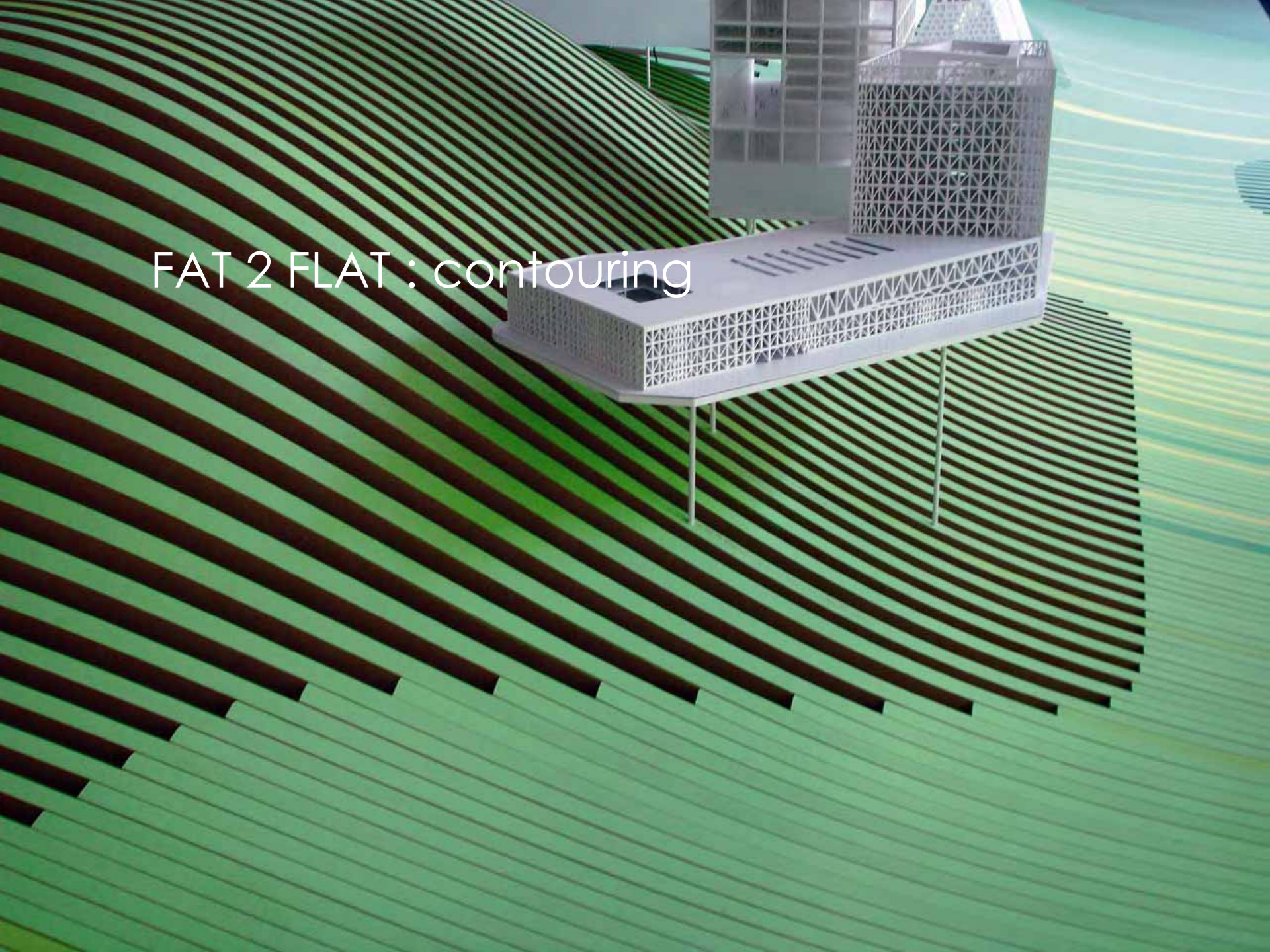
FAT 2 FLAT : contouring





FAT 2 FLAT : contouring

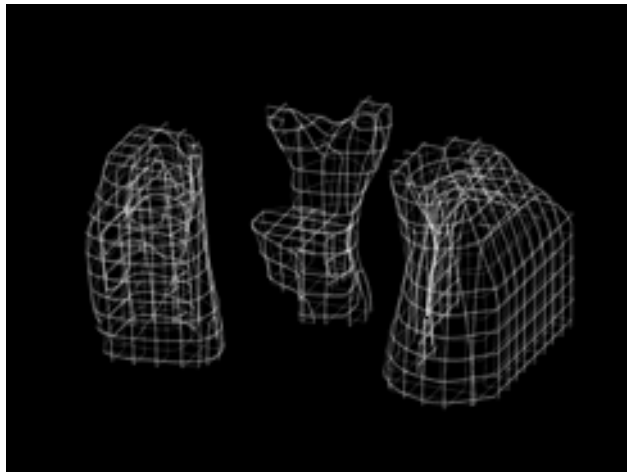
FAT 2 FLAT : contouring



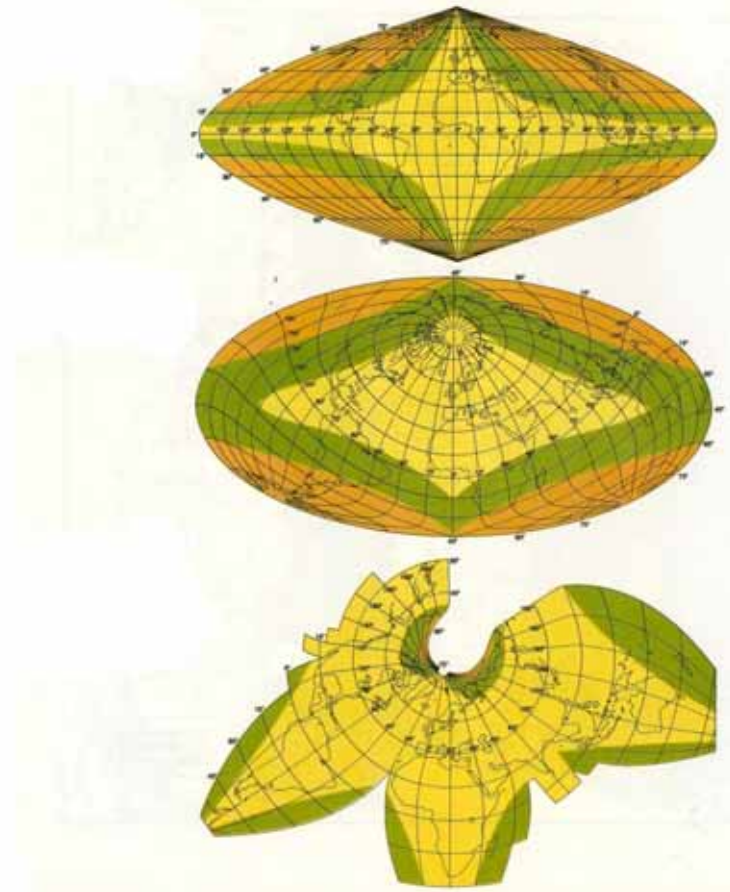
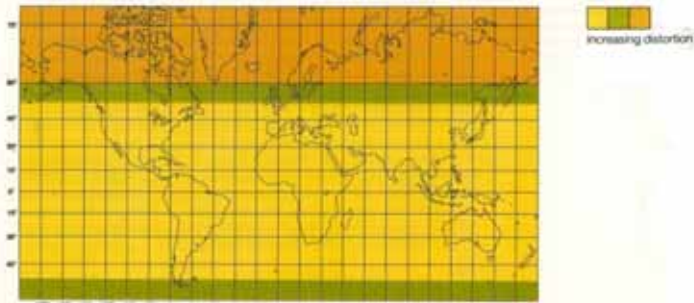
FAT 2 FLAT : contouring



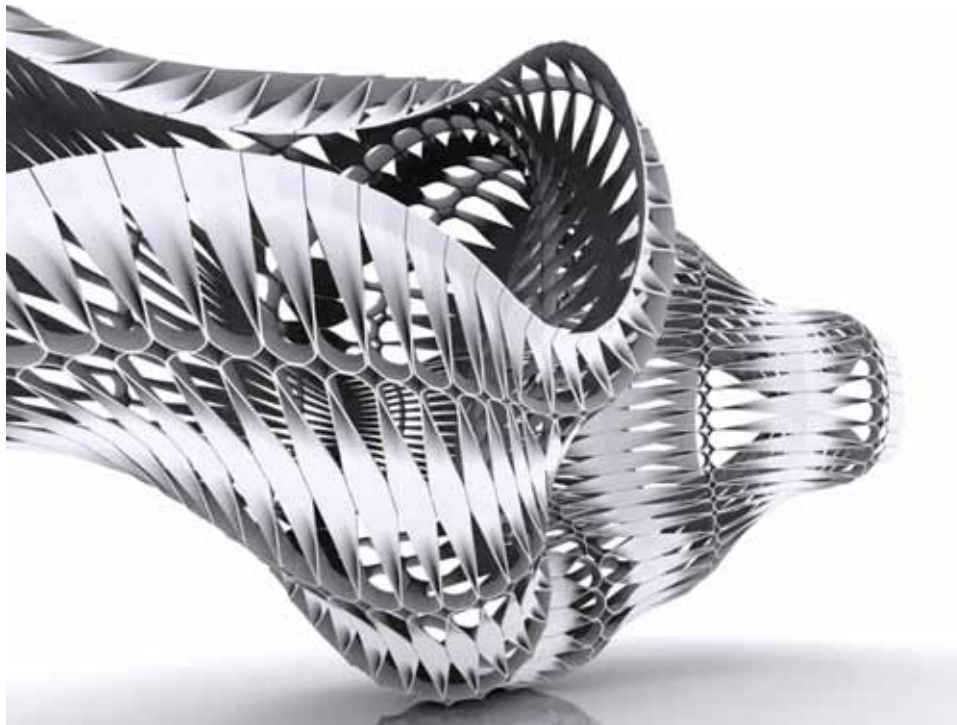
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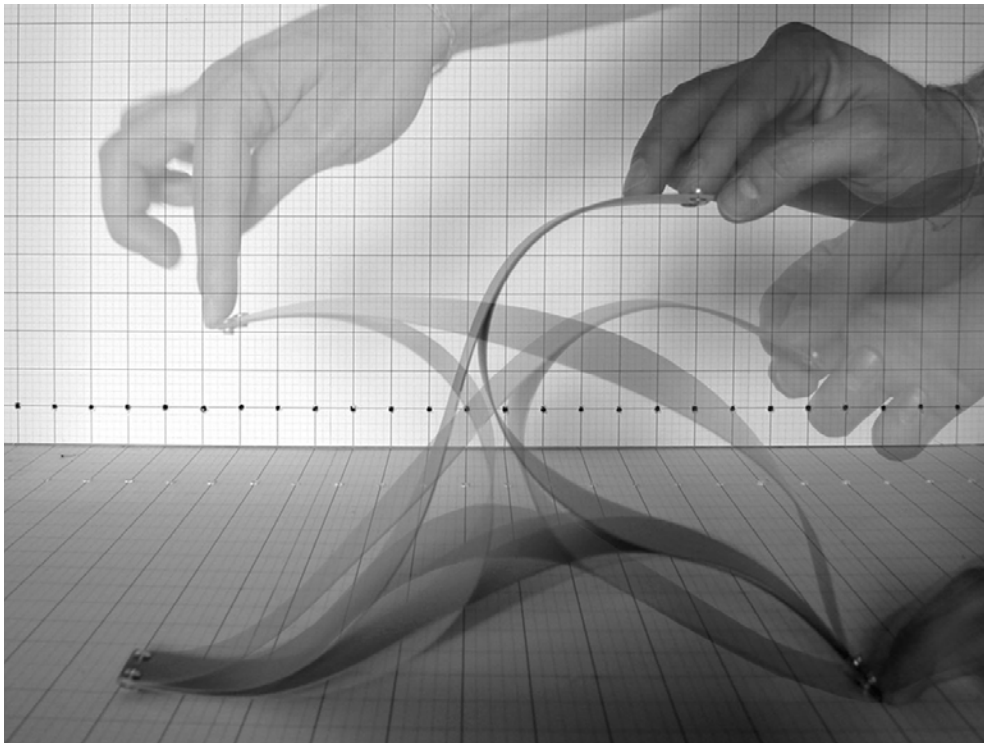
FAT 2 FLAT : unrolling



FAT 2 FLAT : unrolling



FAT 2 FLAT : unrolling



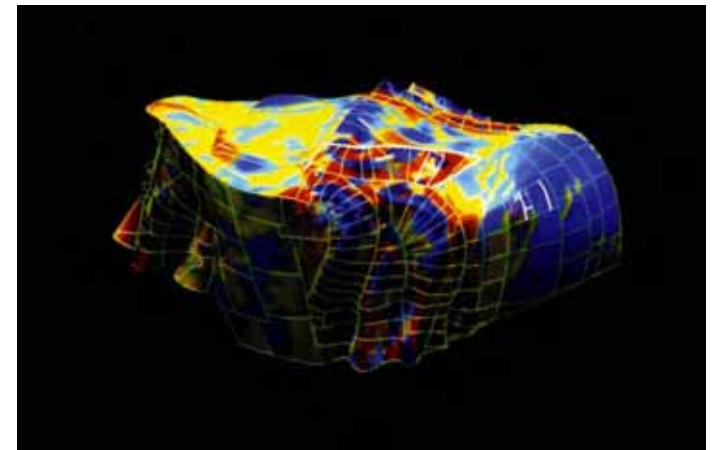
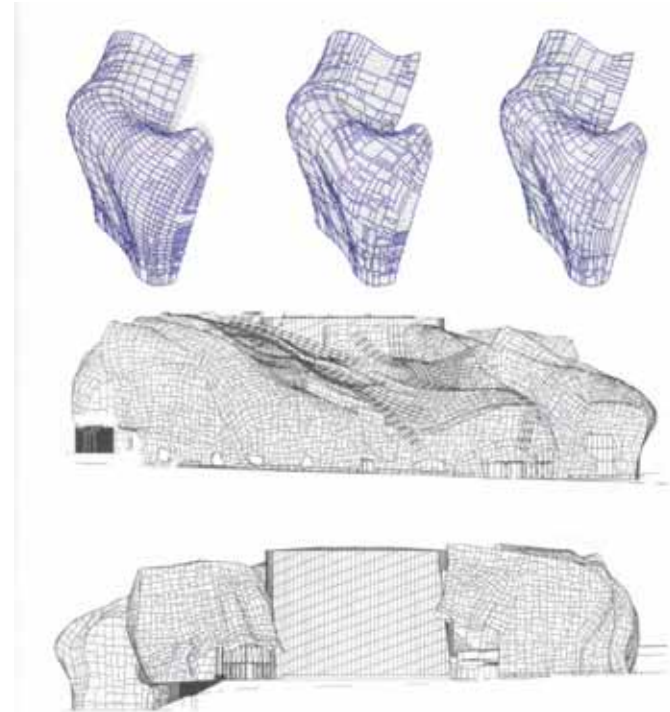
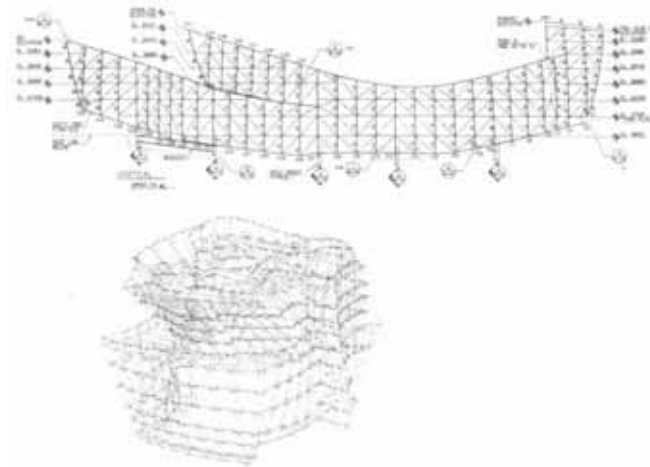
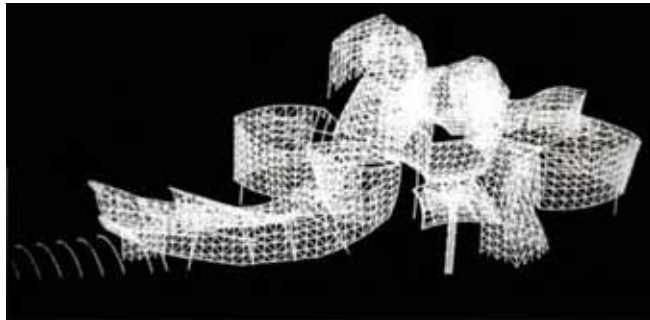
FAT 2 FLAT : unrolling



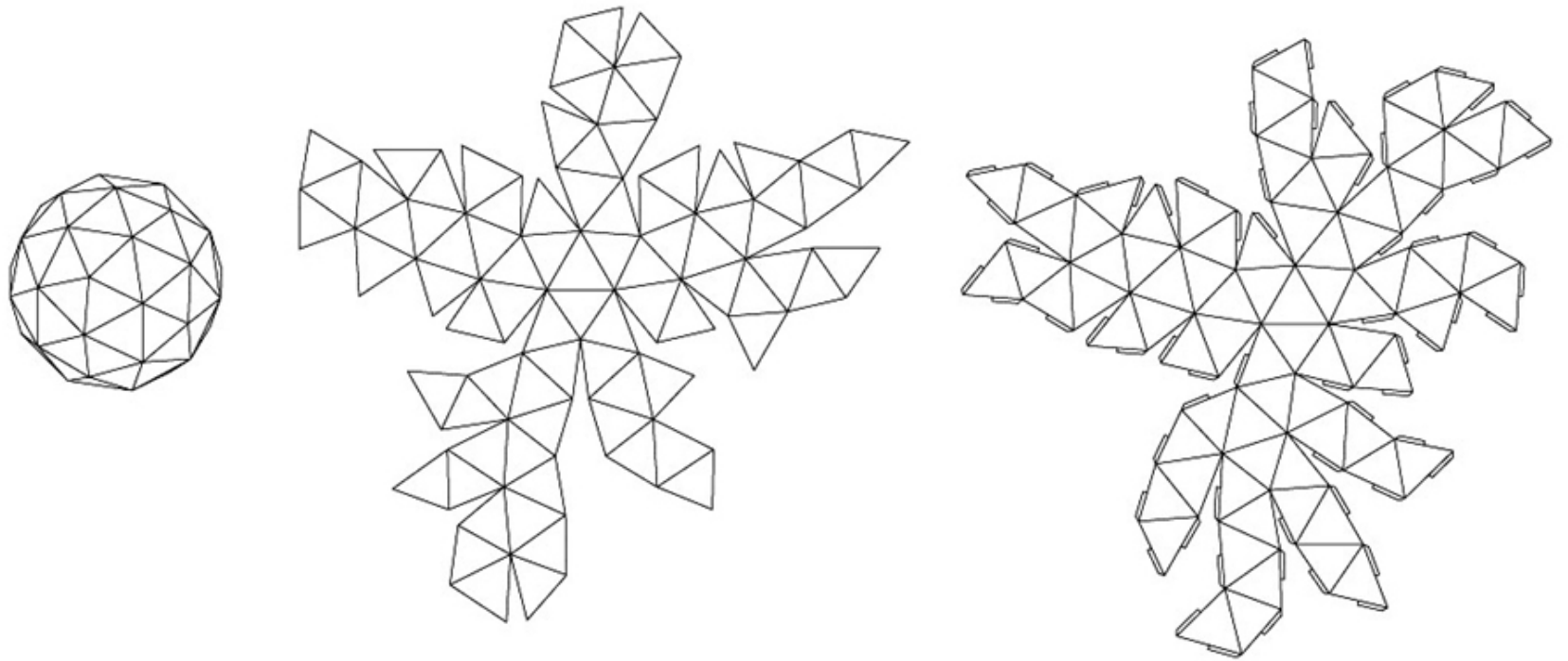
FAT 2 FLAT : unrolling



FAT 2 FLAT : unrolling



FAT 2 FLAT : unfolding



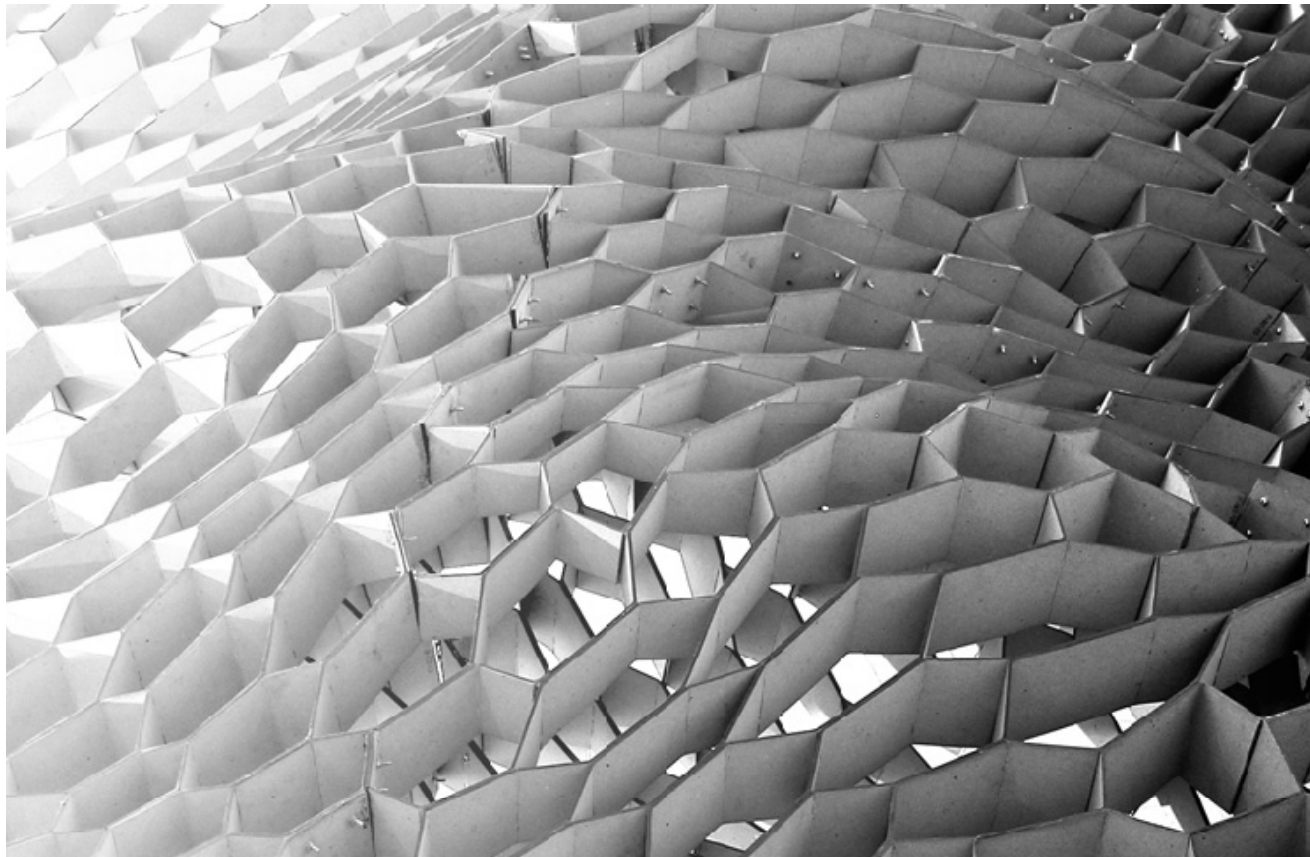
FAT 2 FLAT : unfolding



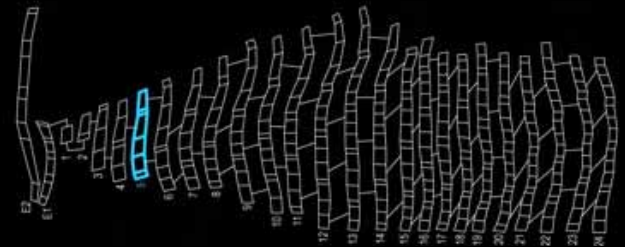
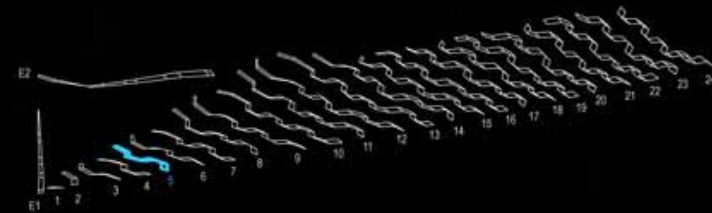
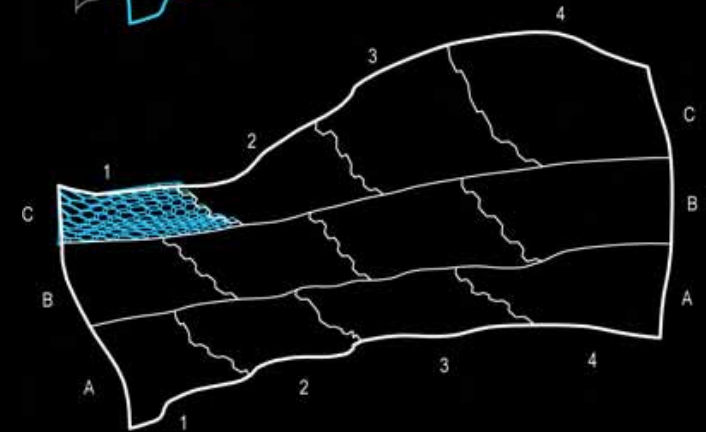
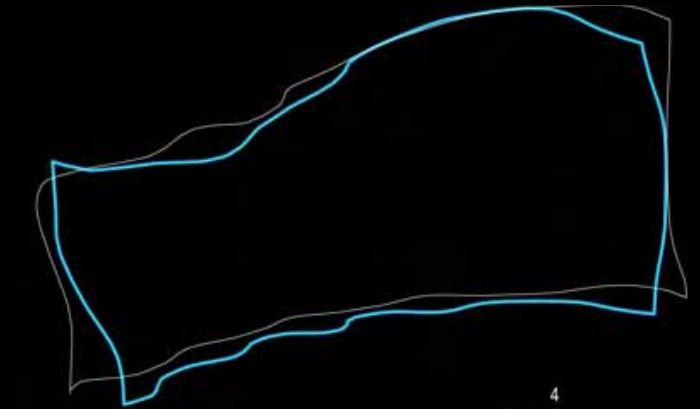
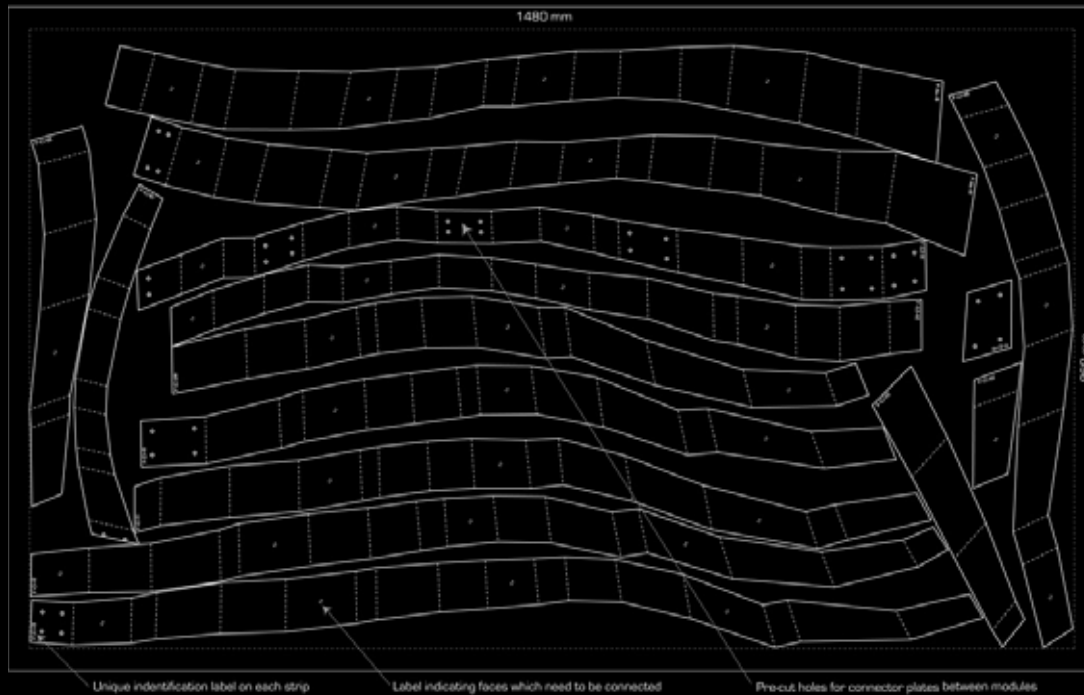
FAT 2 FLAT : unfolding



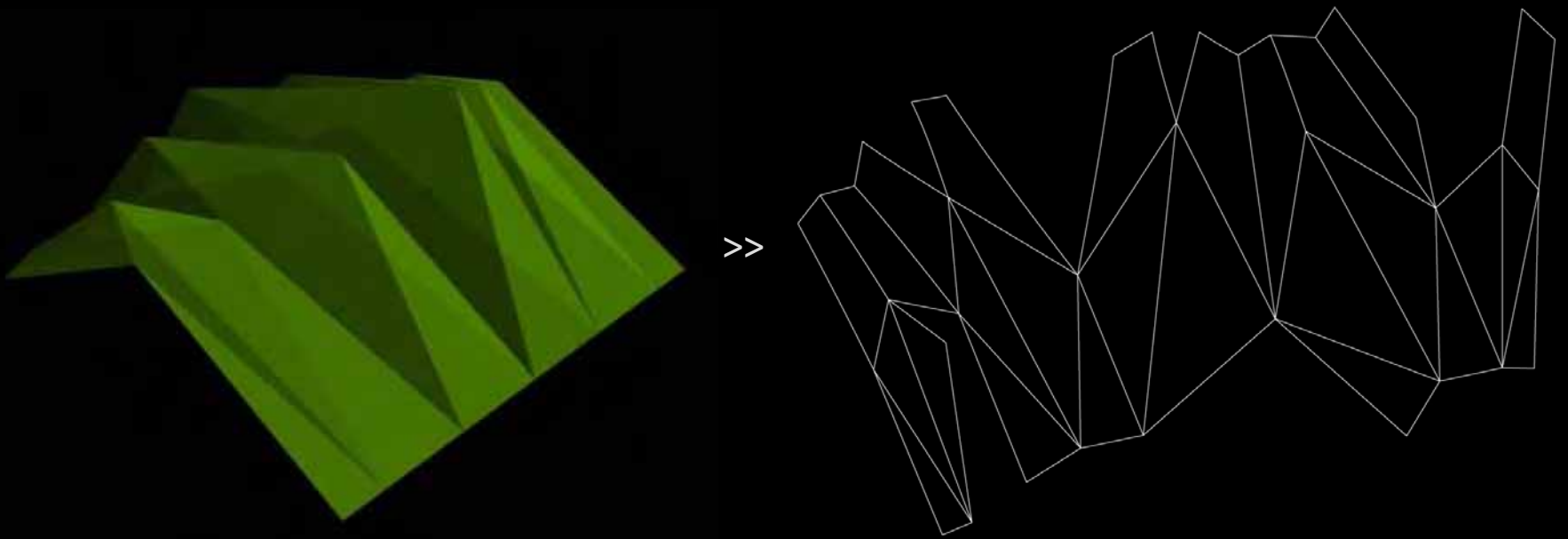
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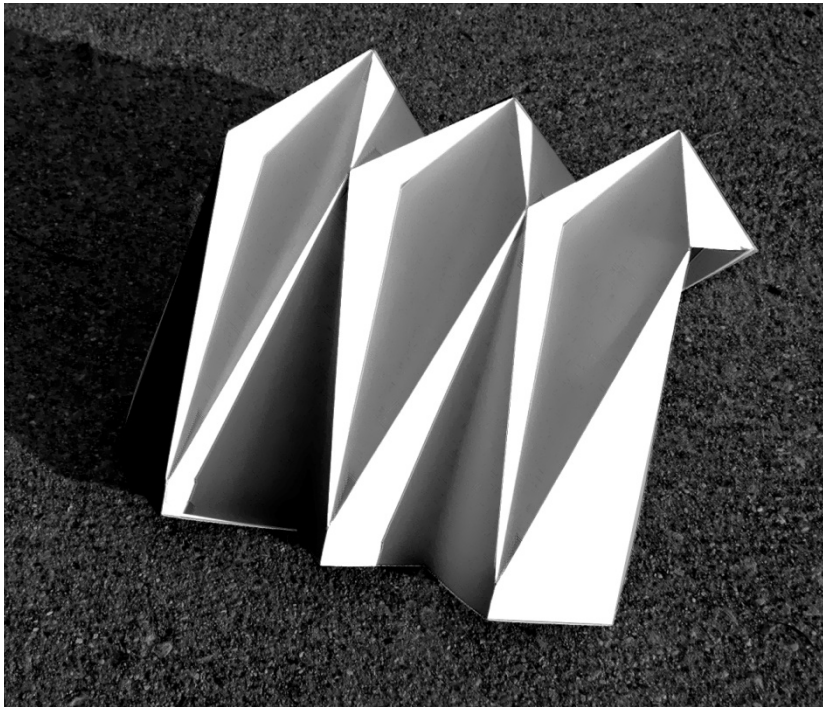
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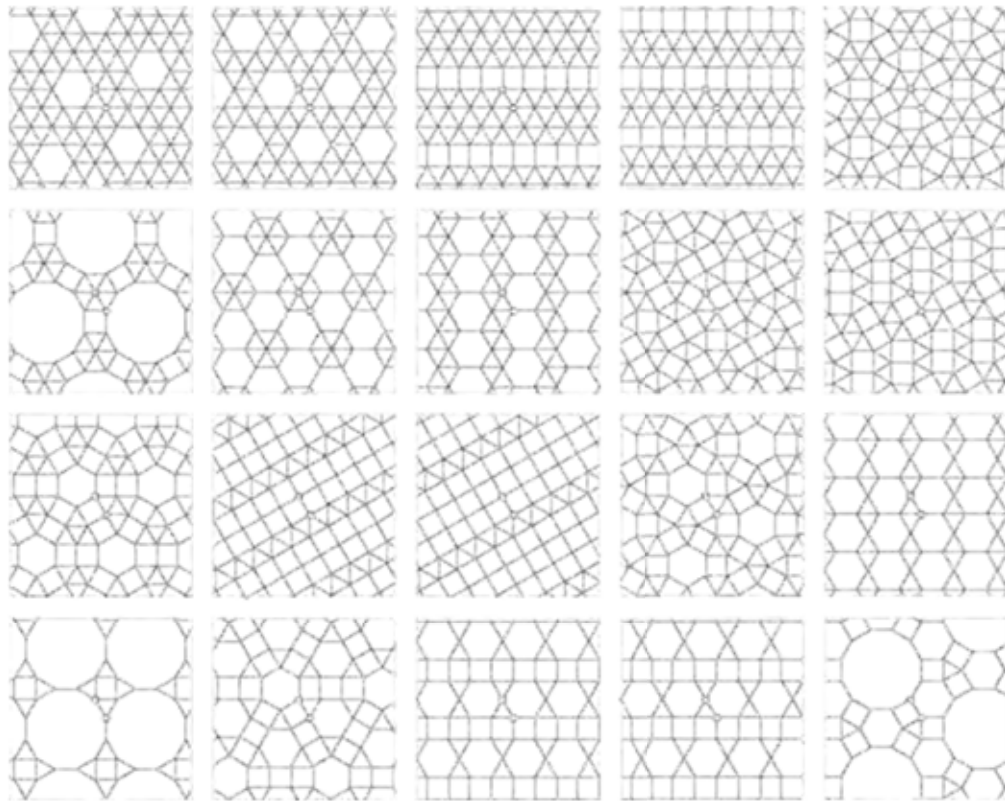
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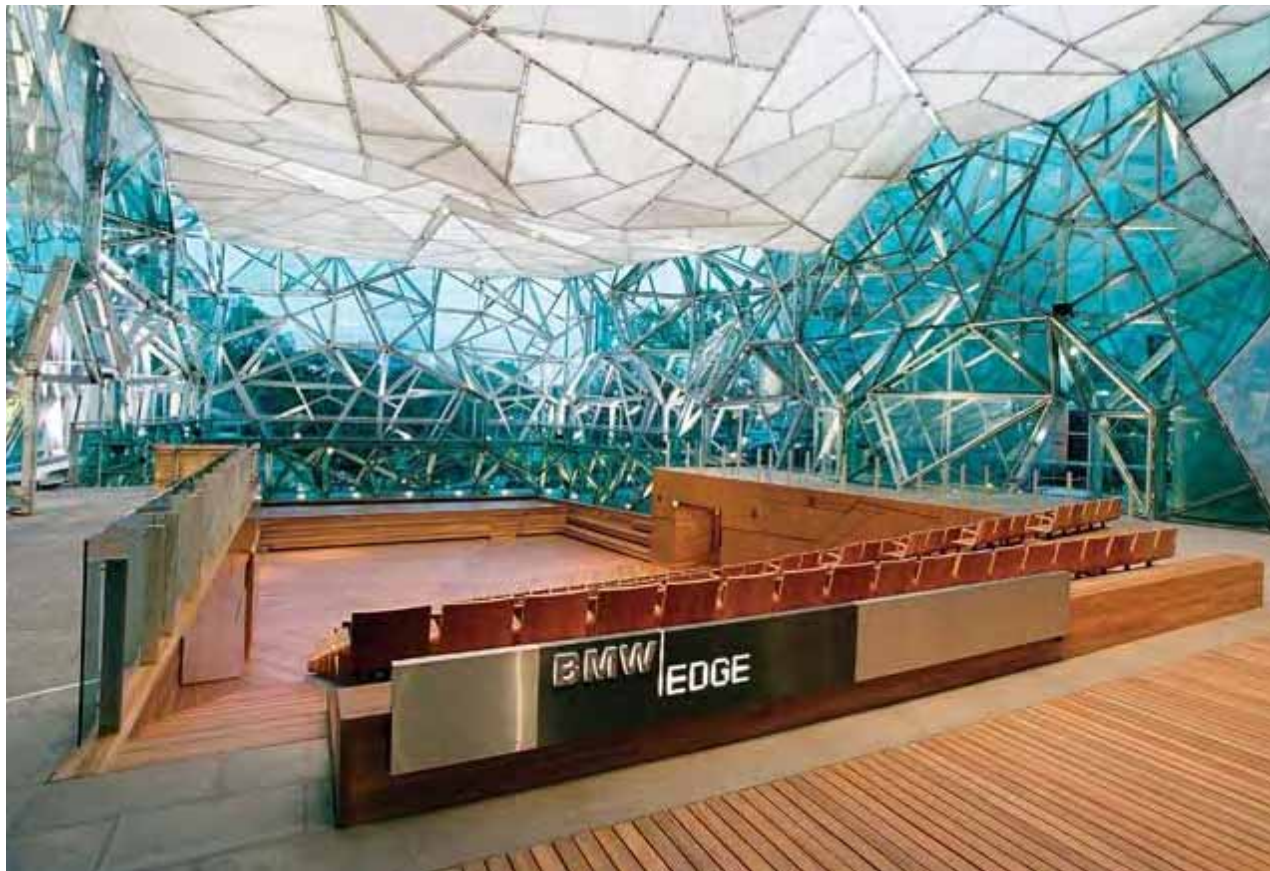
FAT 2 FLAT : unfolding



FAT 2 FLAT : tessellation



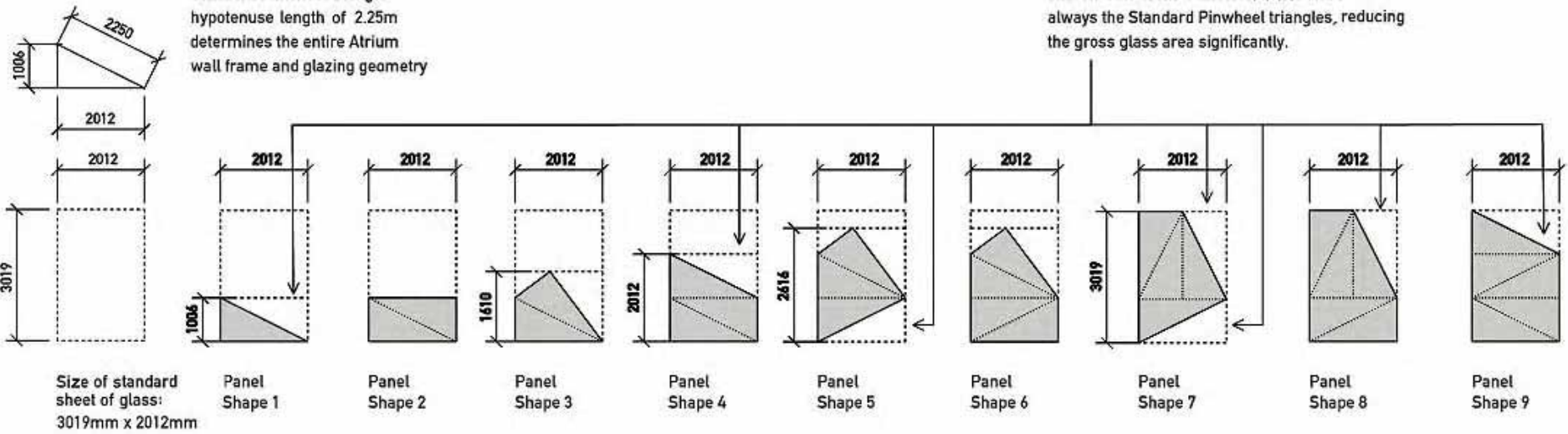
FAT 2 FLAT : tessellation



FAT 2 FLAT : tessellation

Standard Pinwheel triangle:
 hypotenuse length of 2.25m
 determines the entire Atrium
 wall frame and glazing geometry

The off-cuts from Panels 1,4,5,7,8 and 9 are
 always the Standard Pinwheel triangles, reducing
 the gross glass area significantly.



Size of standard
 sheet of glass:
 3019mm x 2012mm

Panel
 Shape 1

Panel
 Shape 2

Panel
 Shape 3

Panel
 Shape 4

Panel
 Shape 5

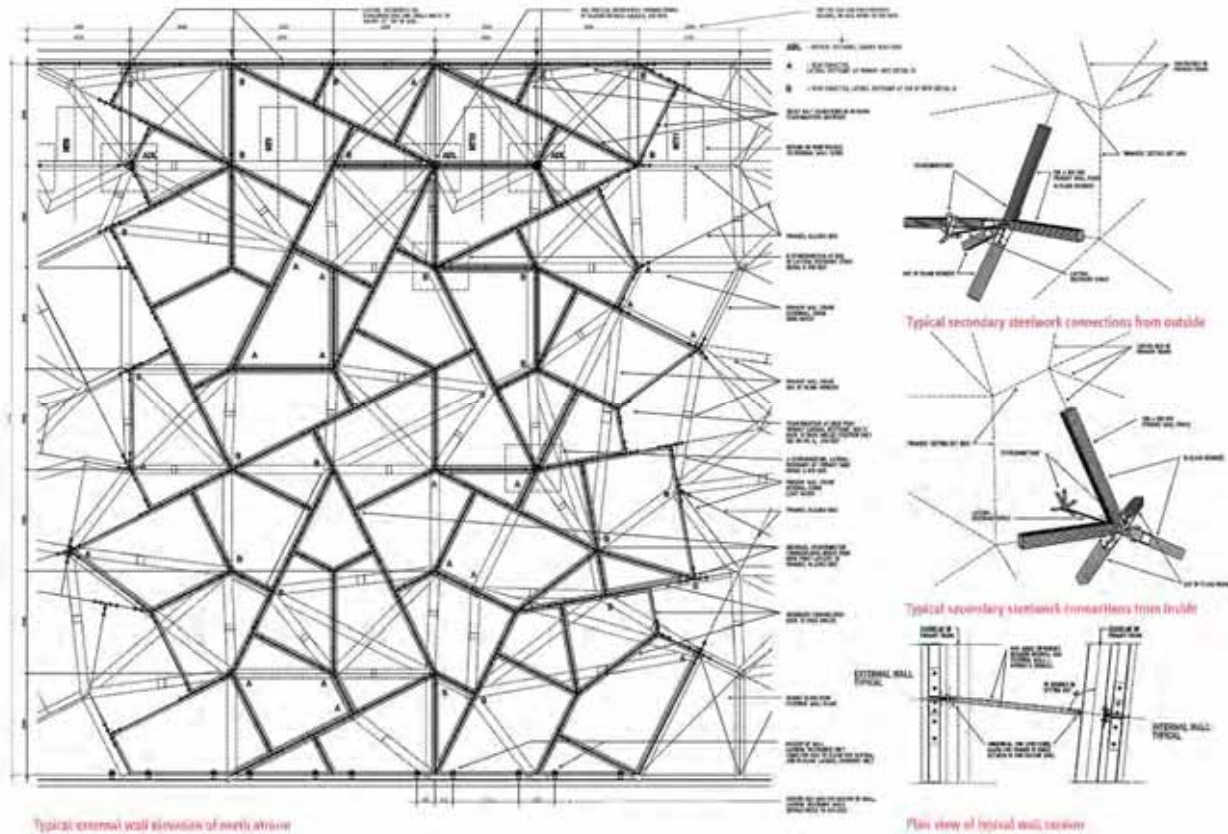
Panel
 Shape 6

Panel
 Shape 7

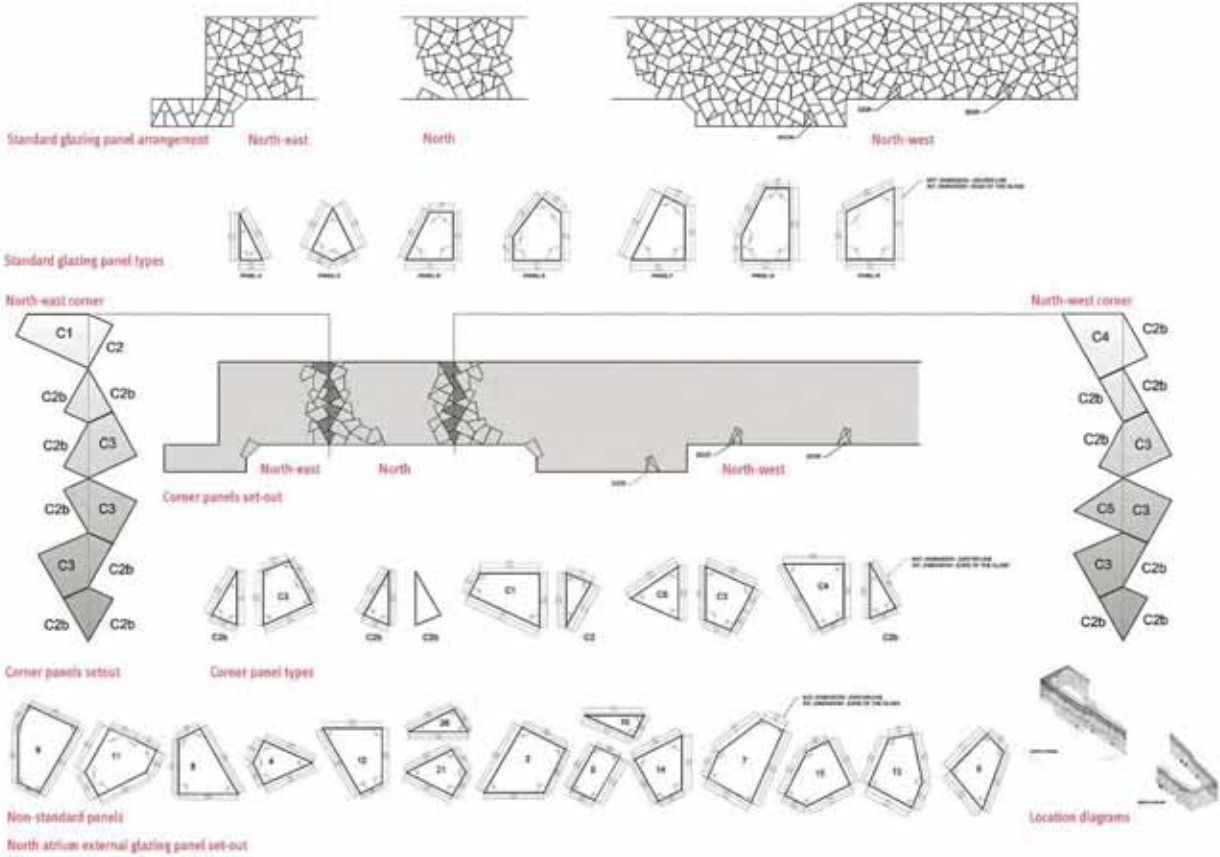
Panel
 Shape 8

Panel
 Shape 9

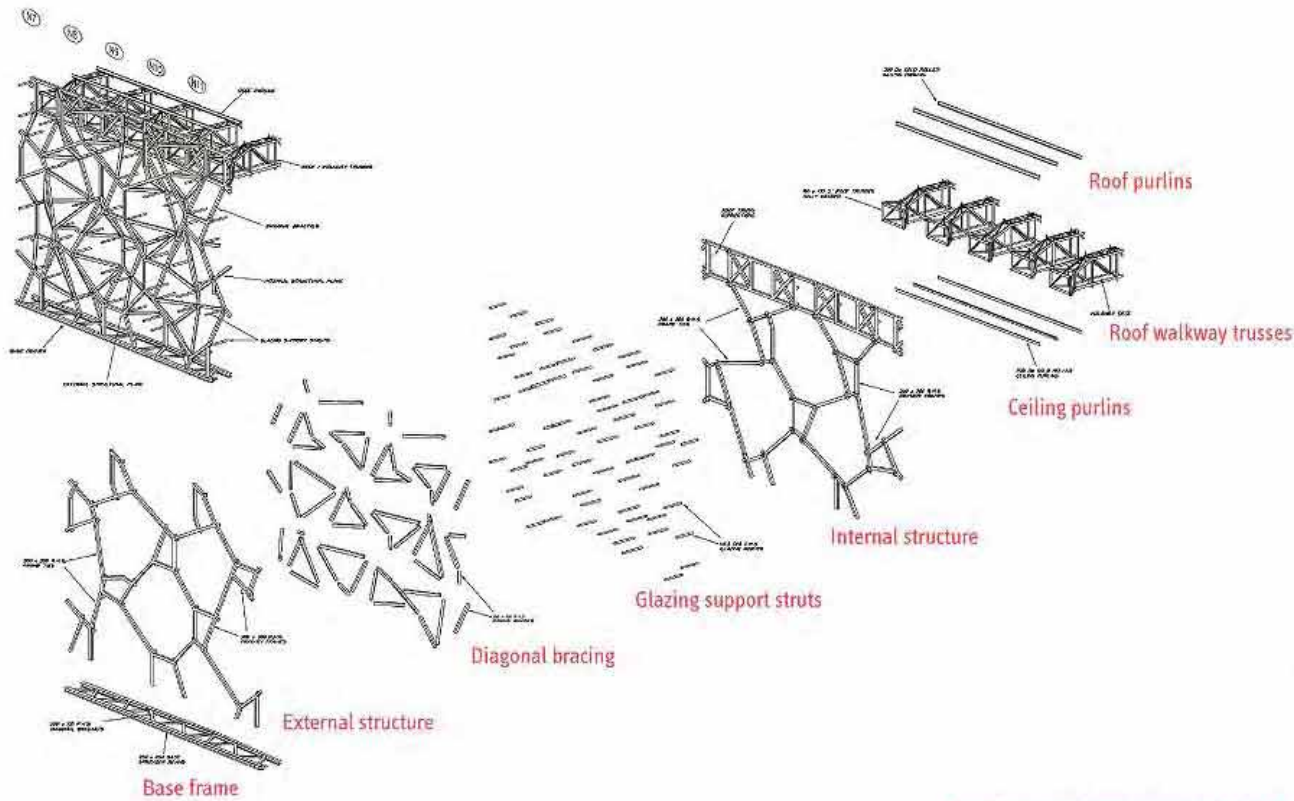
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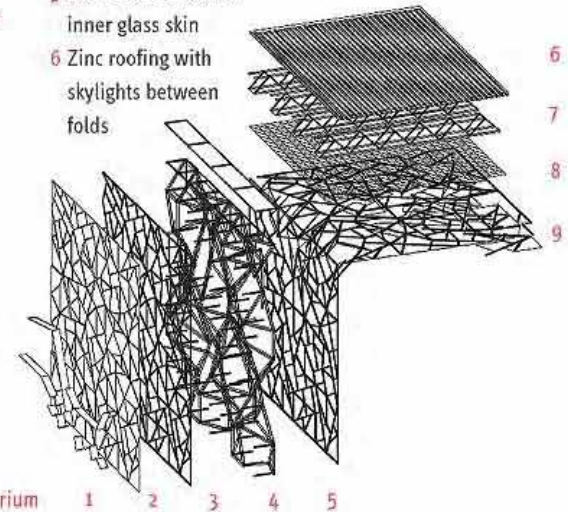
FAT 2 FLAT : tessellation



FAT 2 FLAT : tessellation



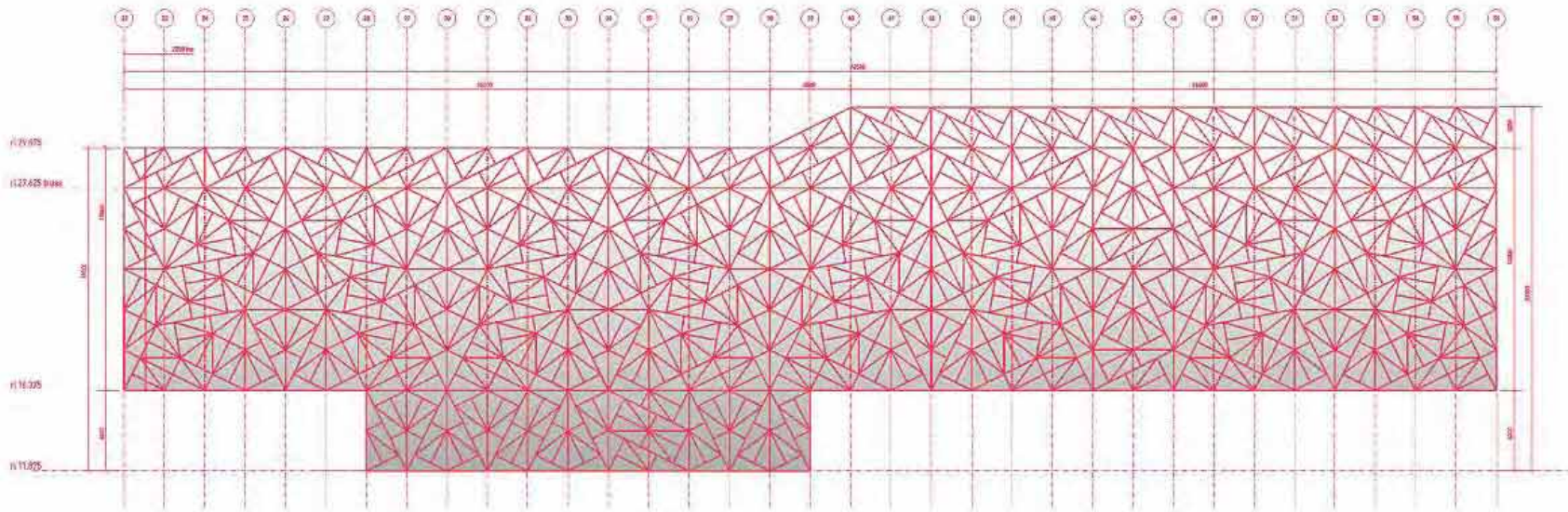
- | | |
|---------------------------------------------|-----------------------------------------------|
| 1 Diachroic glass solar fins | 7 Primary roof structure |
| 2 Open-jointed glazing (rain screen) | 8 Ceiling suspension mesh |
| 3 Secondary framing (supports rain screen) | 9 Suspended framed translucent ceiling panels |
| 4 Primary structure | |
| 5 Steel-framed sealed inner glass skin | |
| 6 Zinc roofing with skylights between folds | |



Typical wall/roof construction of north atrium

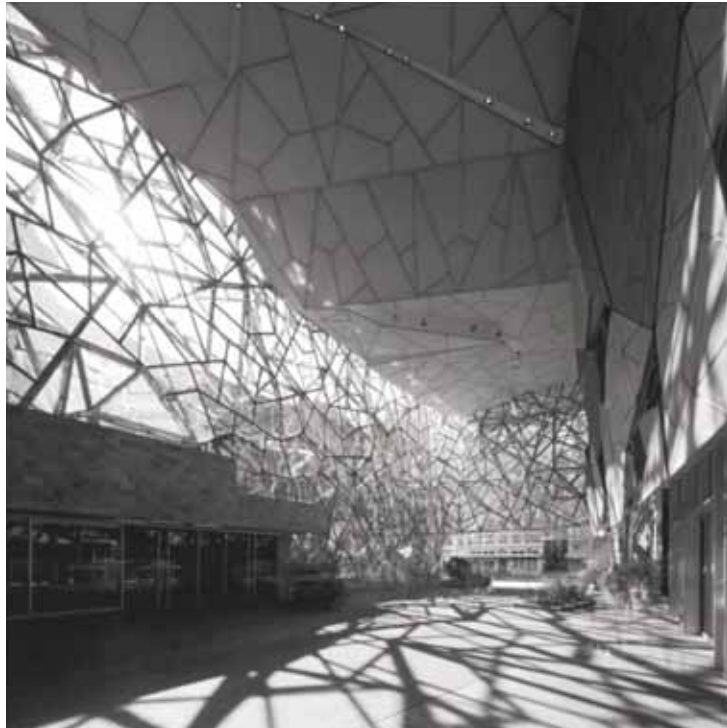
1 2 3 4 5

FAT 2 FLAT : tessellation



West wall of north atrium showing glazing panel set-out

FAT 2 FLAT : tessellation



FAT 2 FLAT : triangulation



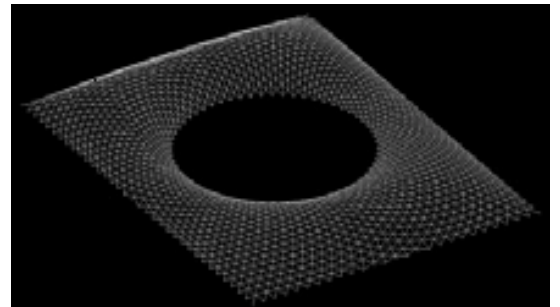
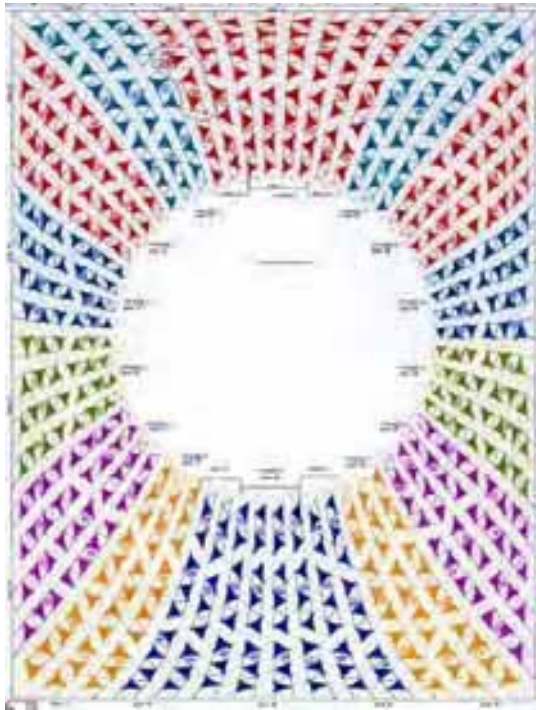
FAT 2 FLAT : triangulation



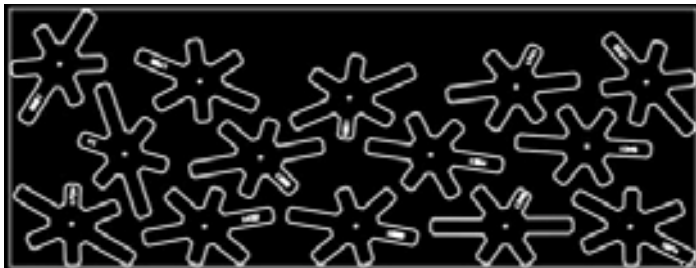
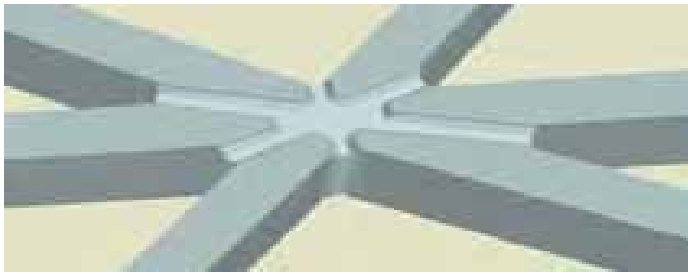
FAT 2 FLAT : triangulation



FAT 2 FLAT : triangulation



FAT 2 FLAT : triangulation



FAT 2 FLAT : triangulation



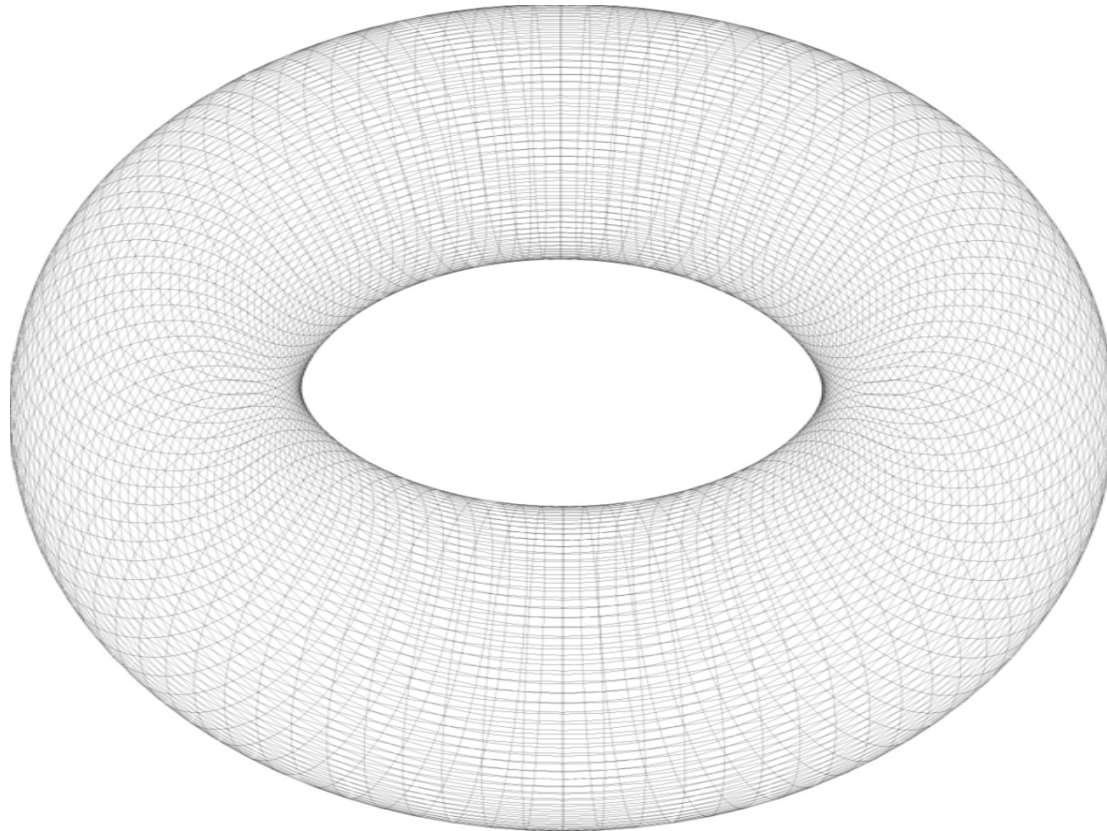
FAT 2 FLAT : tessellation



FAT 2 FLAT : tessellation



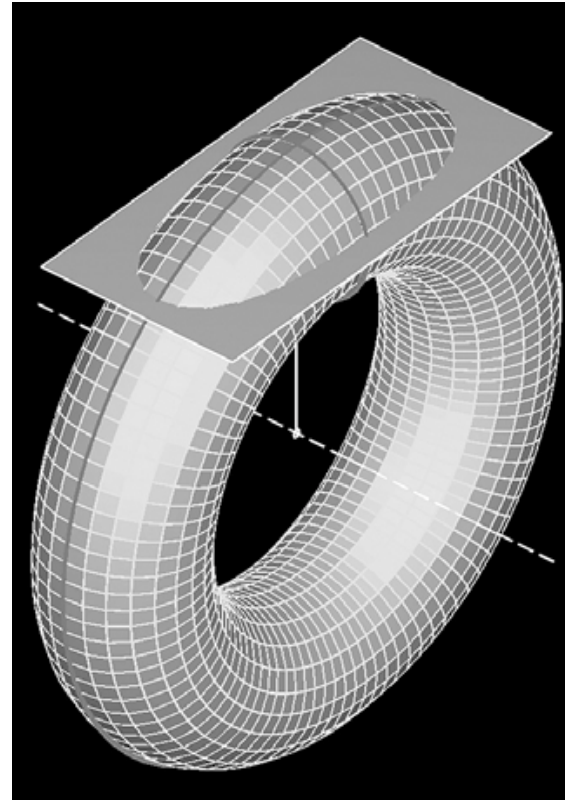
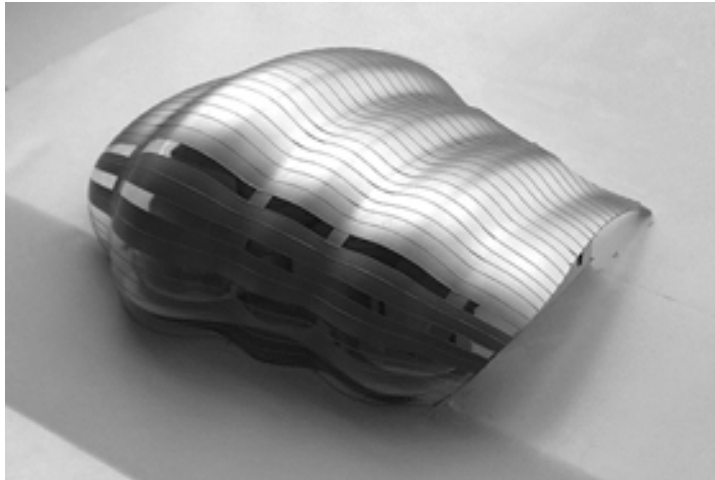
FAT 2 FLAT : radial approximation



FAT 2 FLAT : radial approximation



FAT 2 FLAT : radial approximation



FAT 2 FLAT : radial approximation



FAT 2 FLAT : interlocking assemblies



FAT 2 FLAT : interlocking assemblies



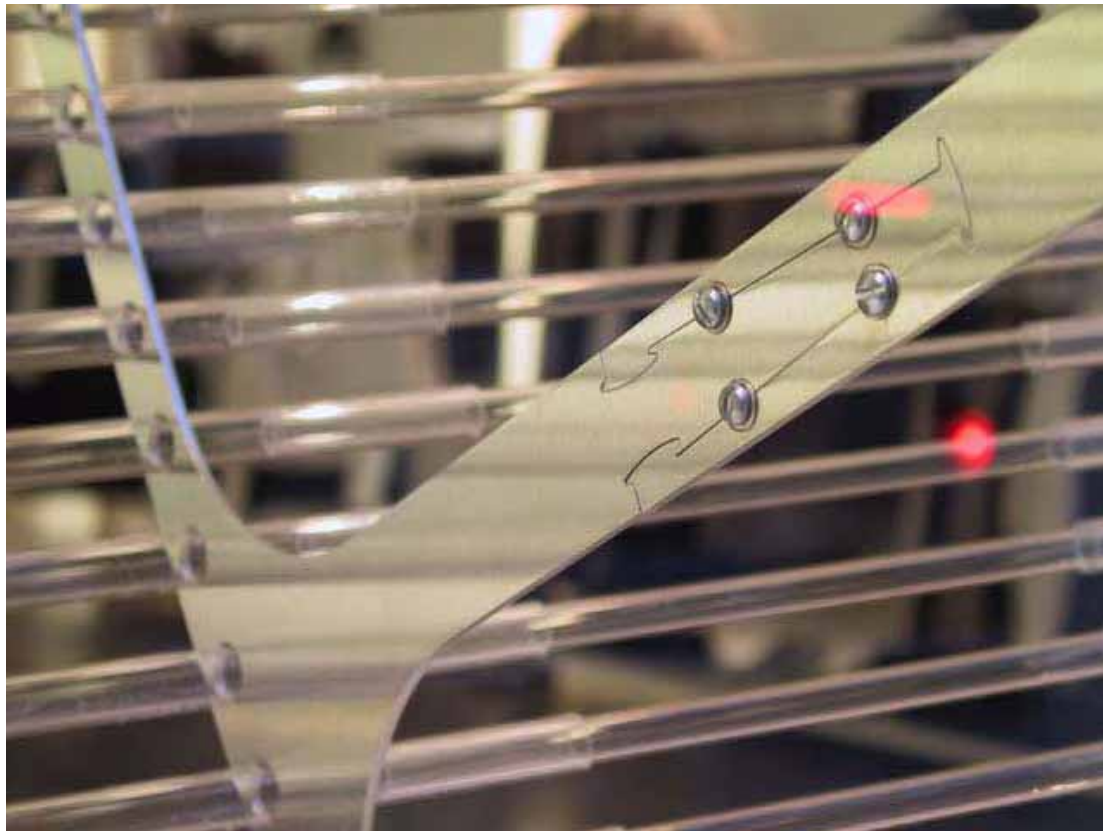
FAT 2 FLAT : interlocking assemblies



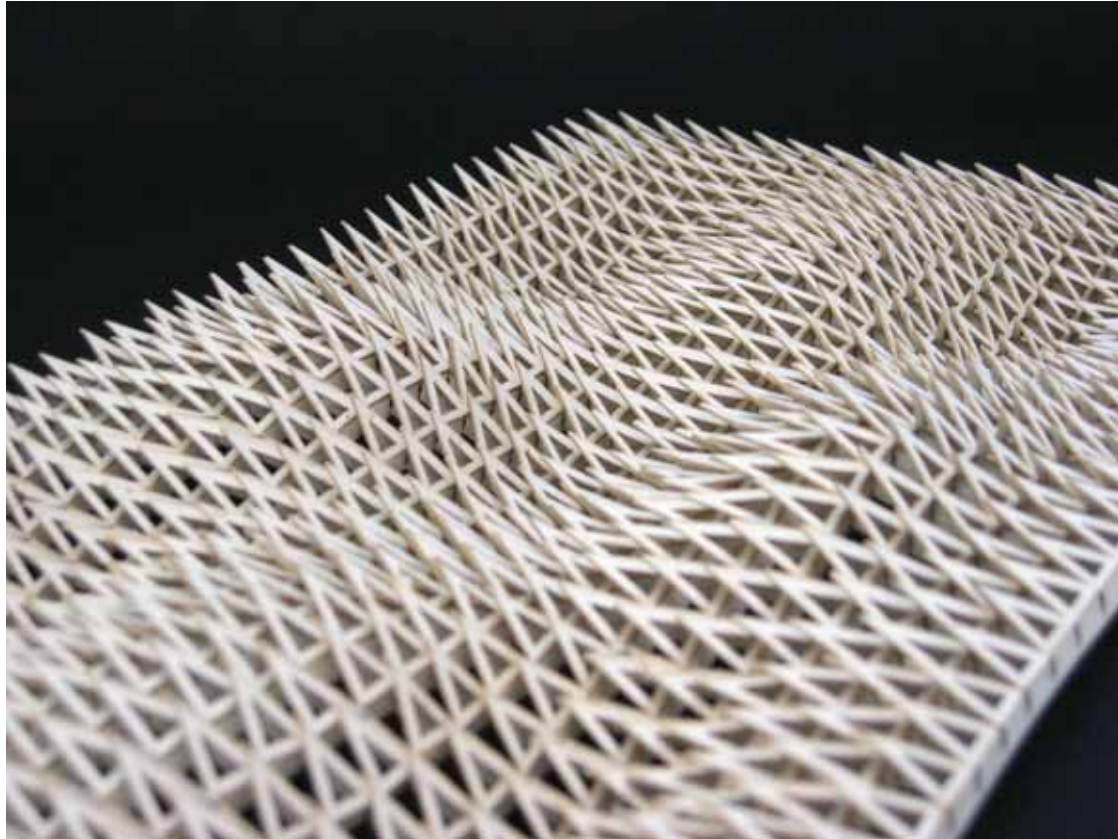
FAT 2 FLAT : interlocking assemblies



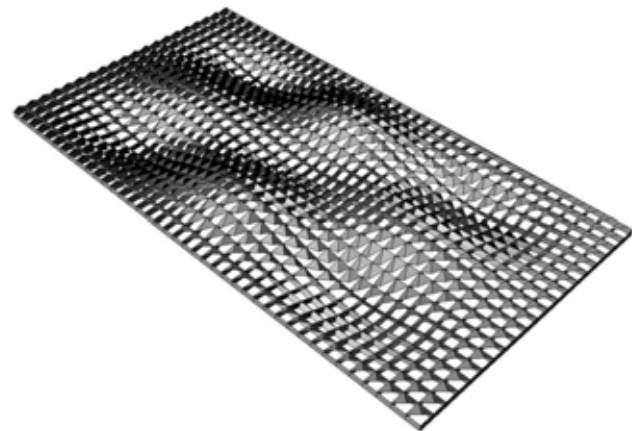
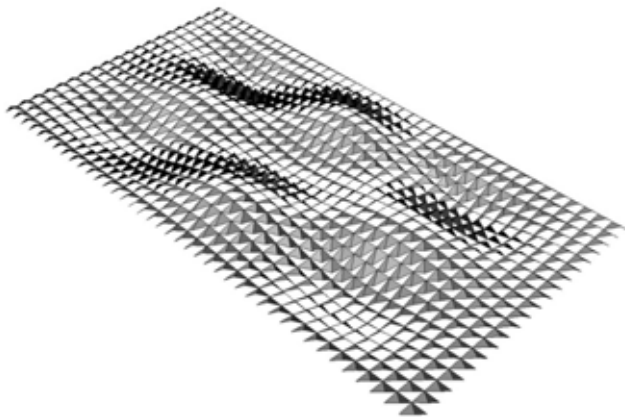
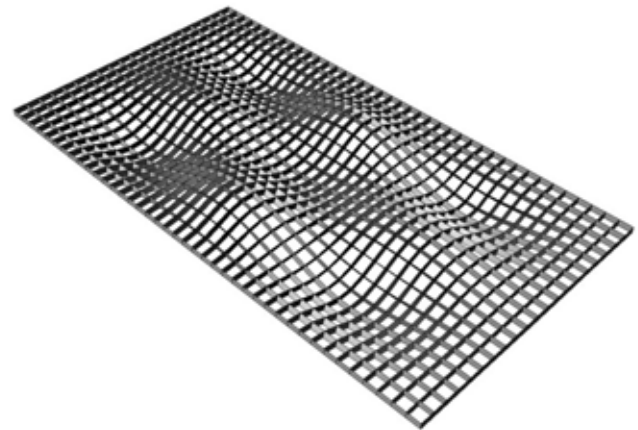
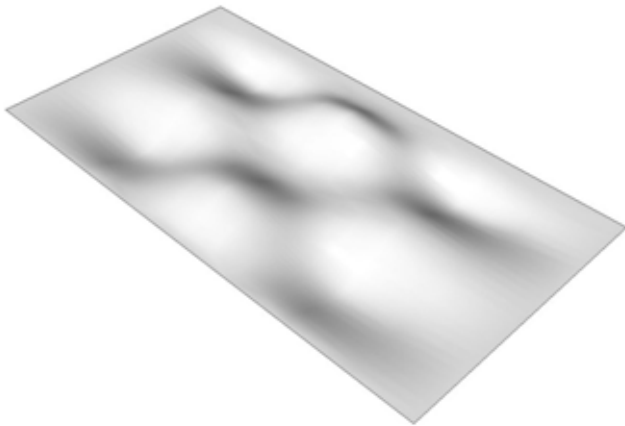
FAT 2 FLAT : interlocking assemblies



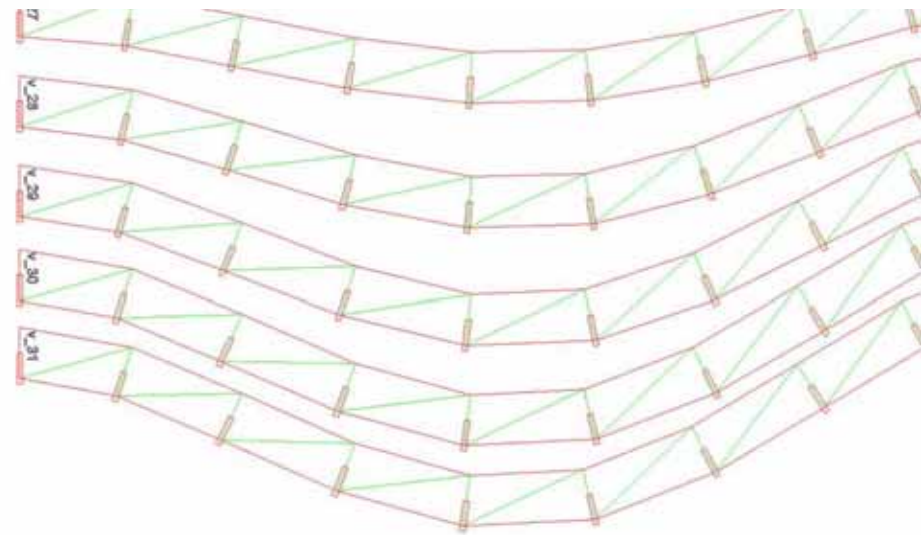
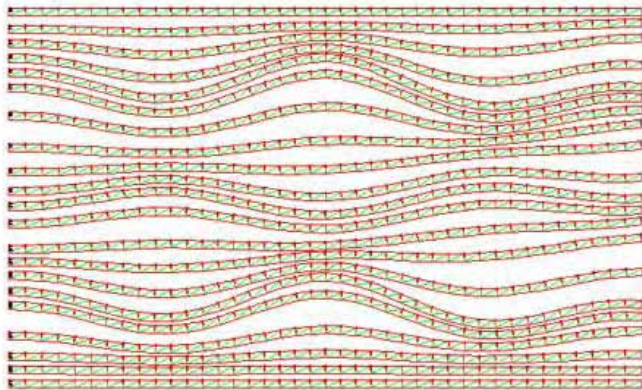
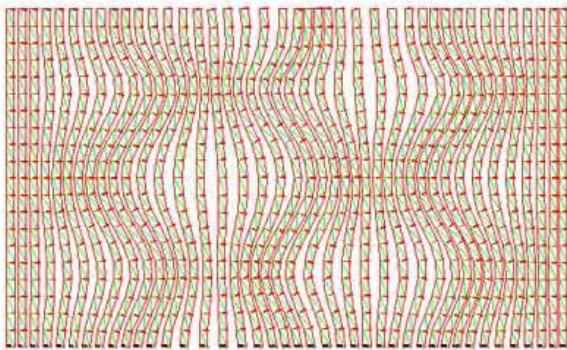
FAT 2 FLAT : interlocking assemblies



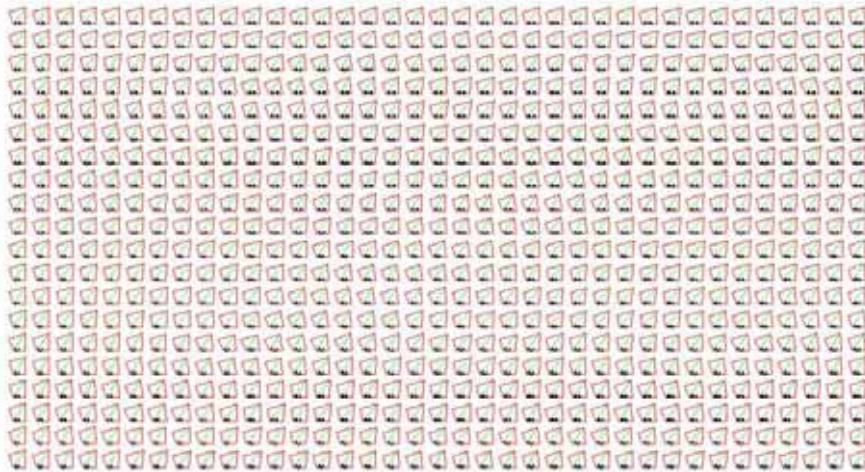
FAT 2 FLAT : interlocking assemblies



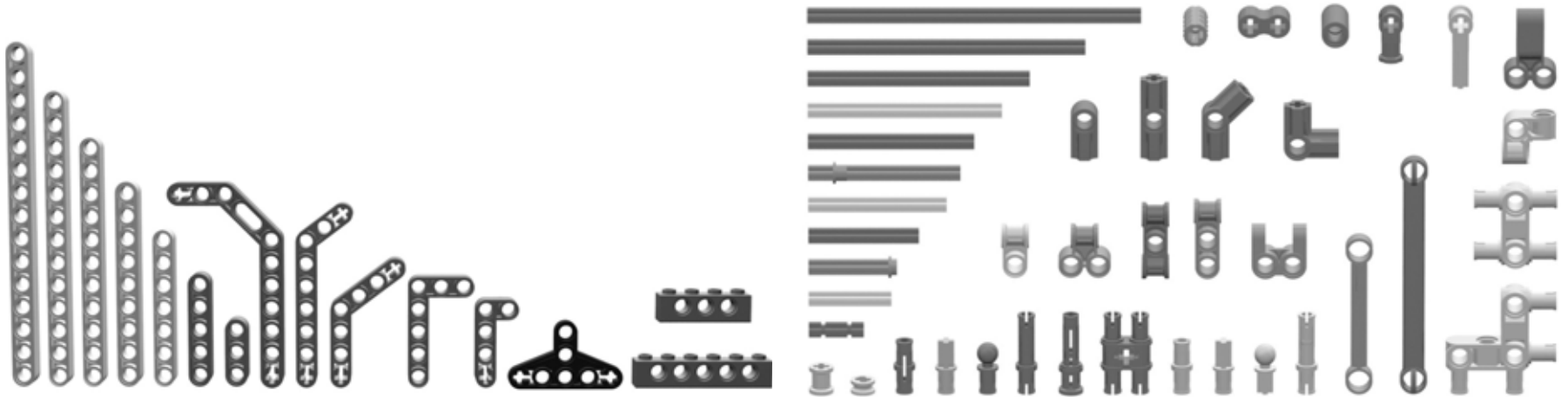
FAT 2 FLAT : interlocking assemblies



FAT 2 FLAT : interlocking assemblies



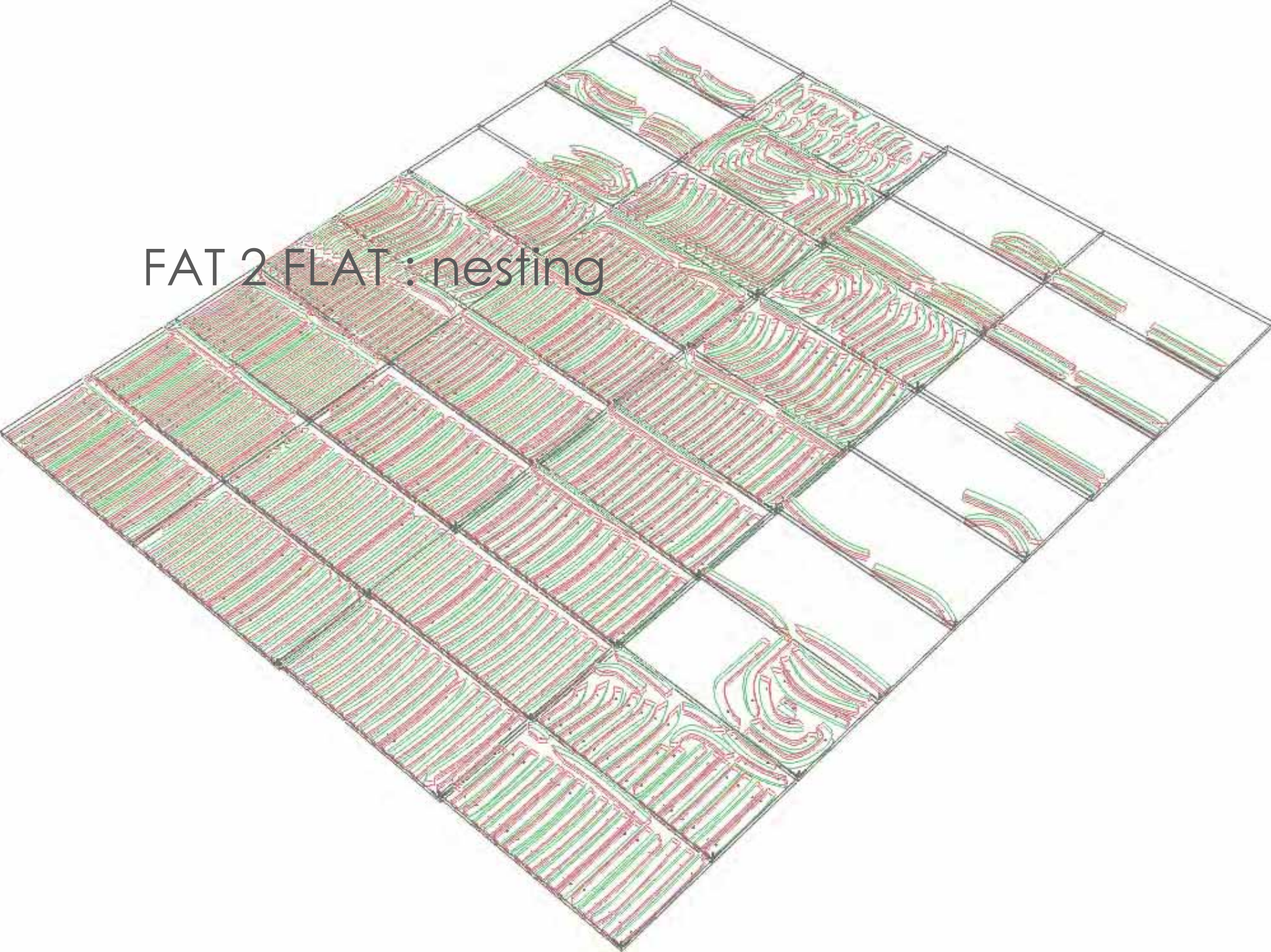
FAT 2 FLAT : interlocking assemblies





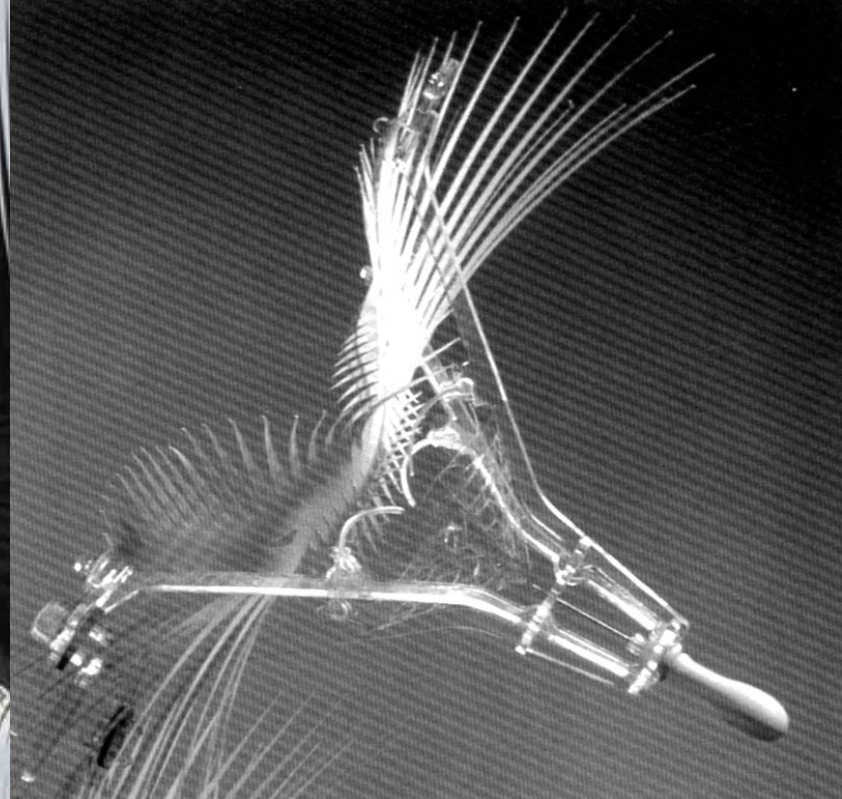
FAT 2 FLAT: fab preparation

FAT 2 FLAT : nesting





FAT 2 FLAT: nesting



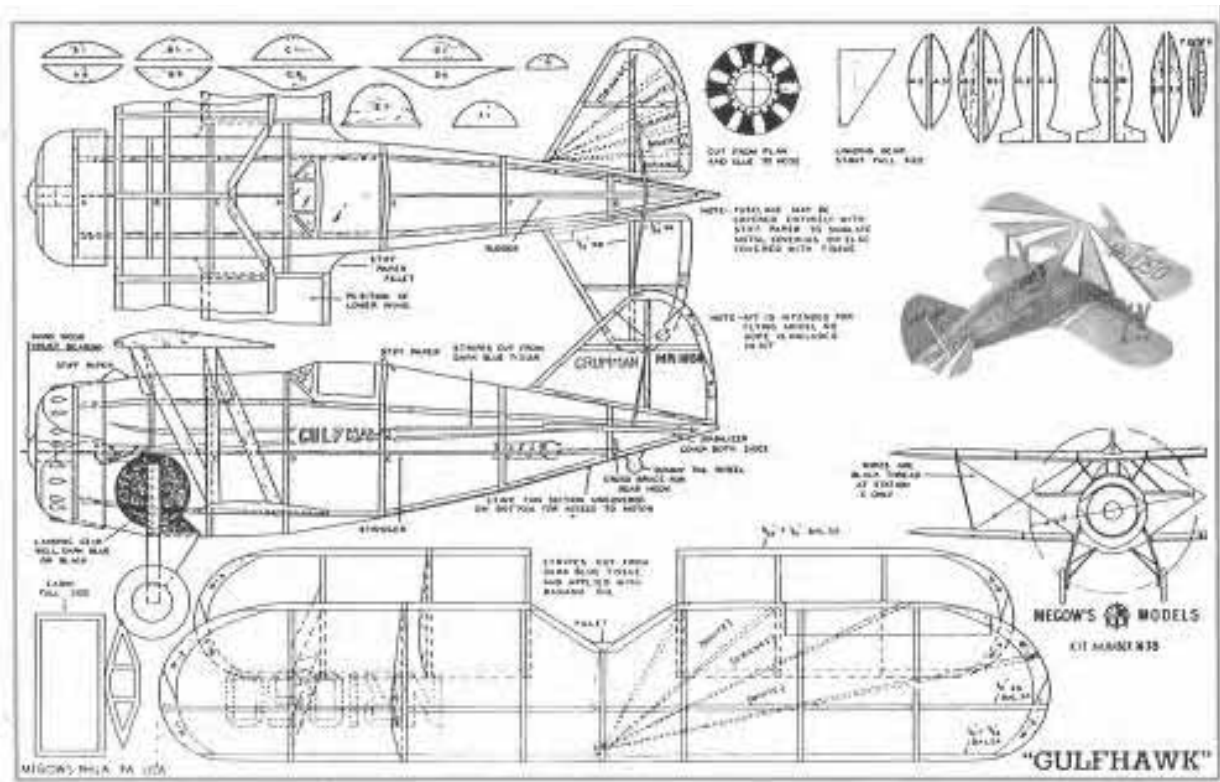
A large, dense, white, fibrous structure resembling a nest or a complex web, illuminated against a dark background. The structure is composed of numerous fine, radiating fibers that form a complex, interconnected network. The overall appearance is that of a highly textured, three-dimensional object. The text "FAT 2 FLAT : nesting" is overlaid on the left side of the image.

FAT 2 FLAT : nesting

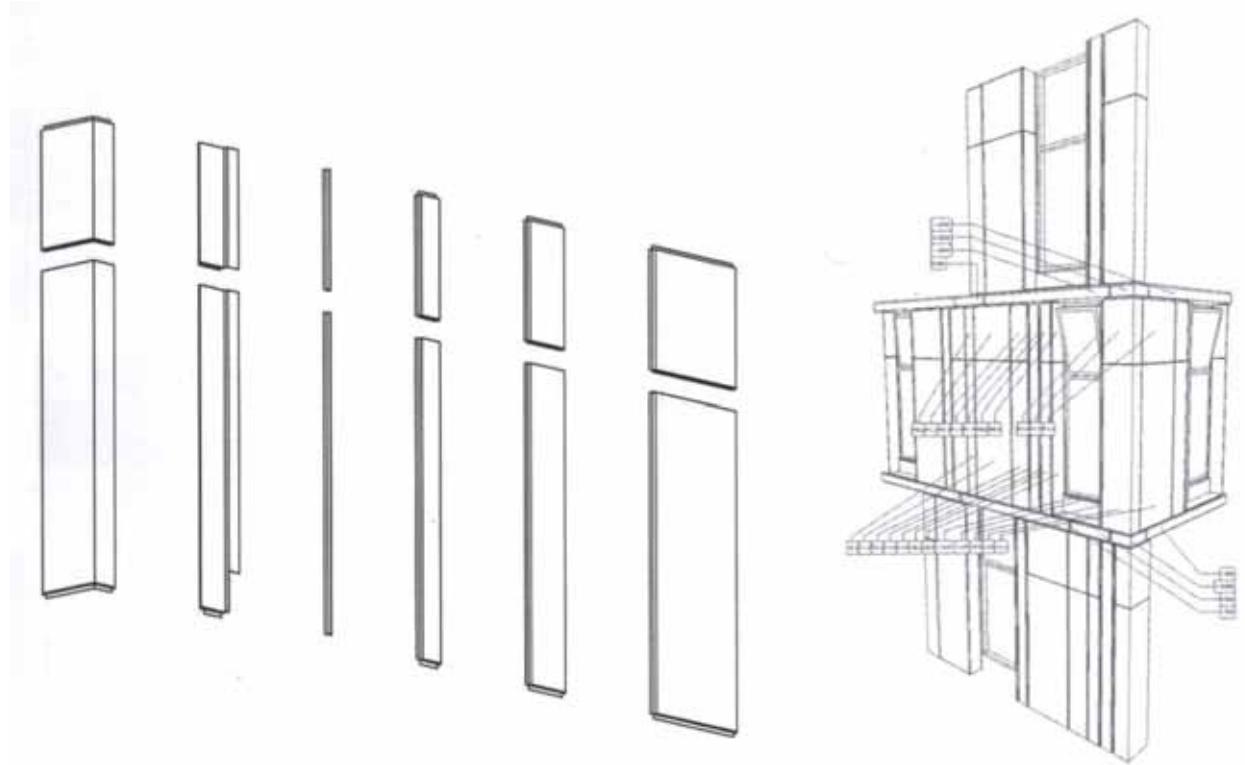


FAT 2 FLAT : nesting

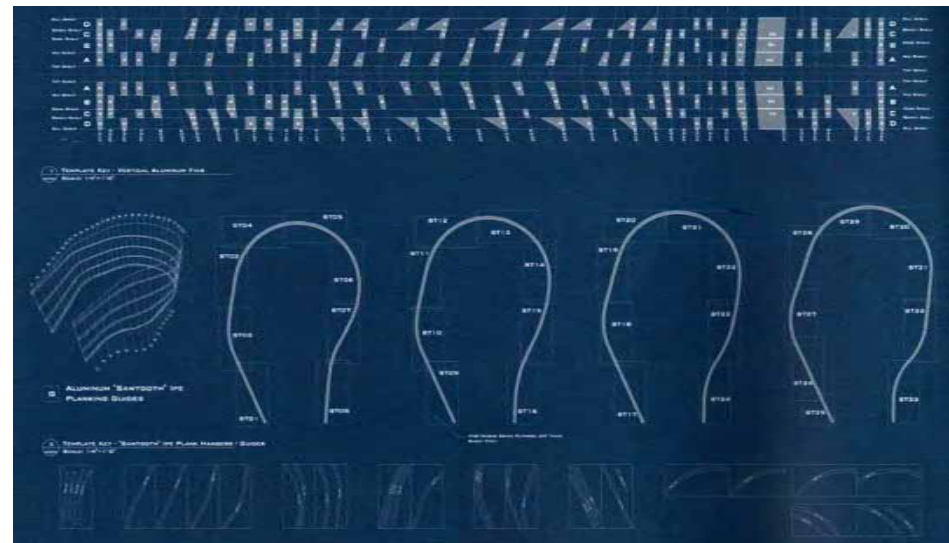
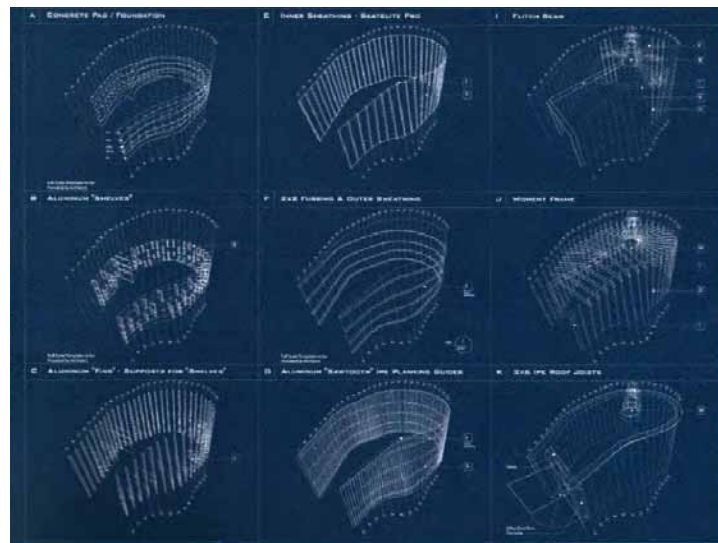
FAT 2 FLAT : assembly



FAT 2 FLAT : assembly



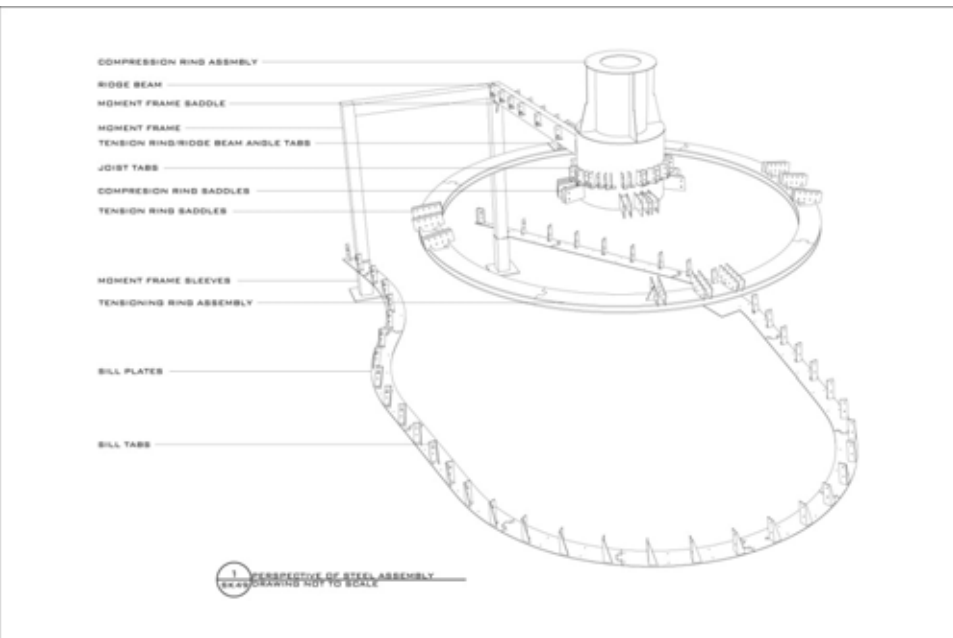
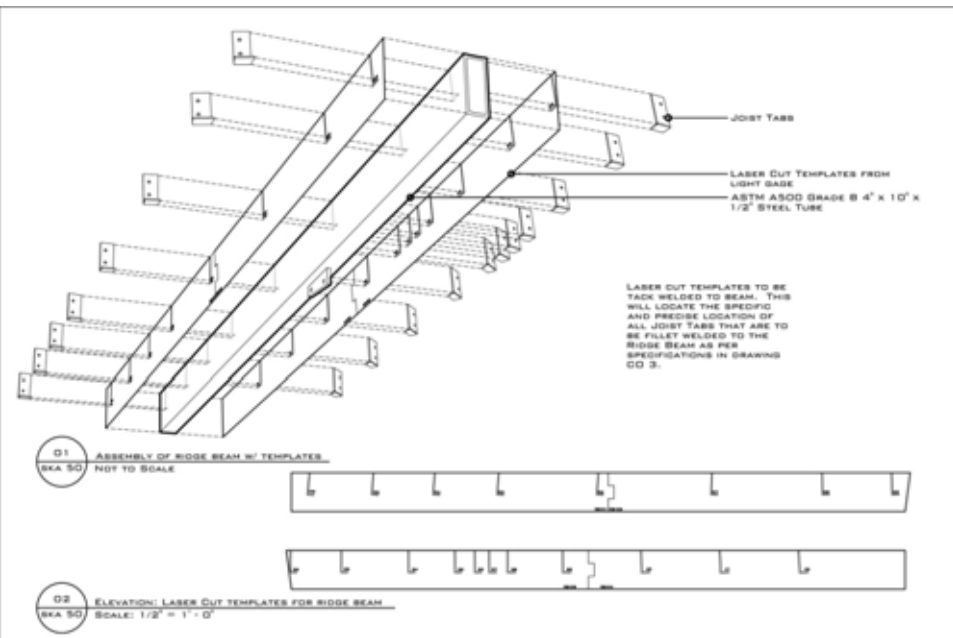
FAT 2 FLAT : assembly



FAT 2 FLAT : assembly

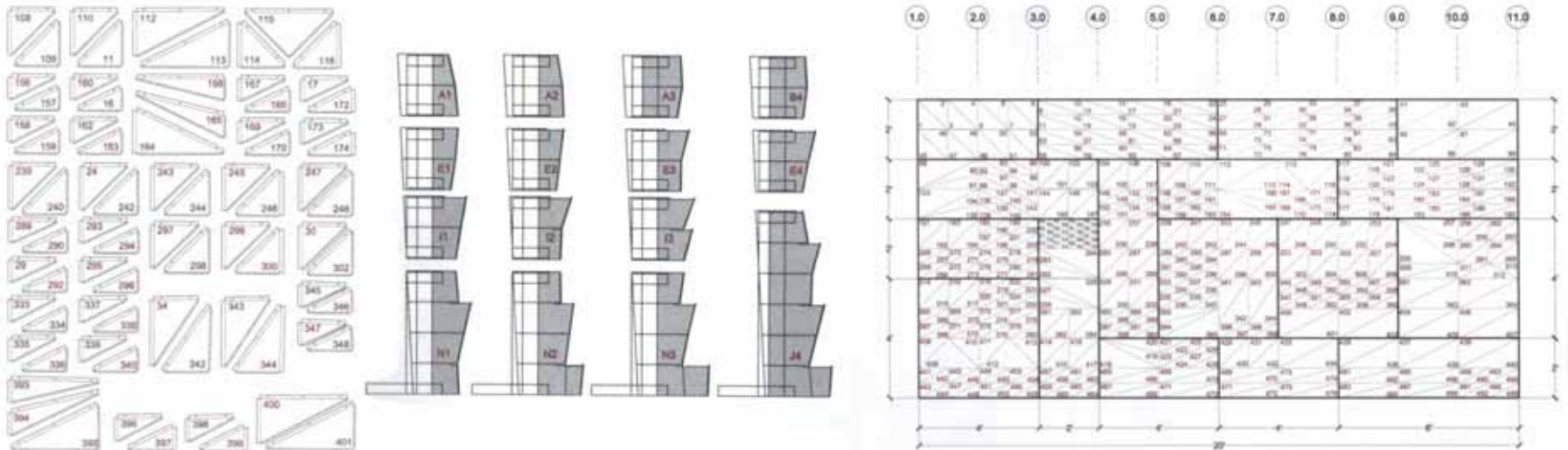


FAT 2 FLAT : assembly

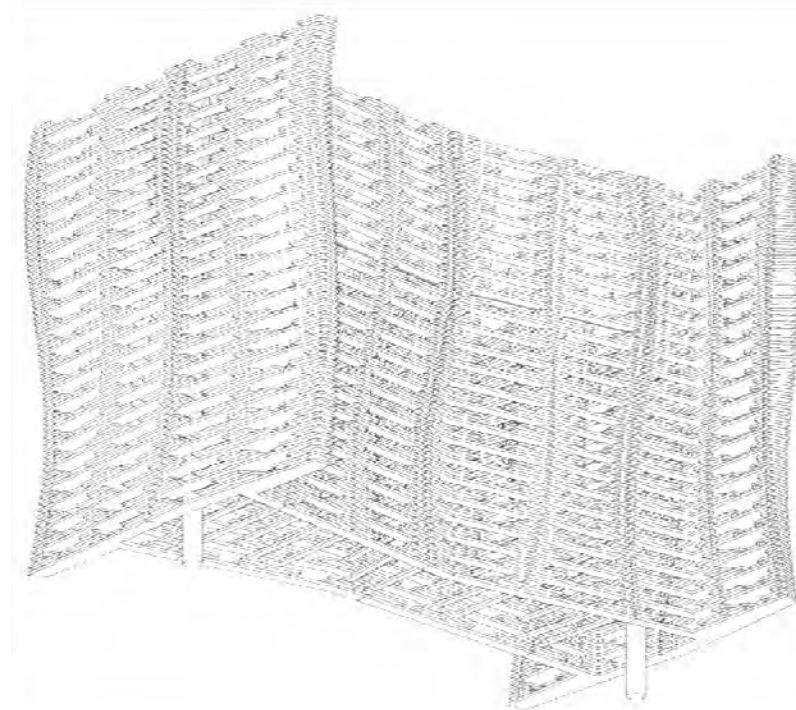
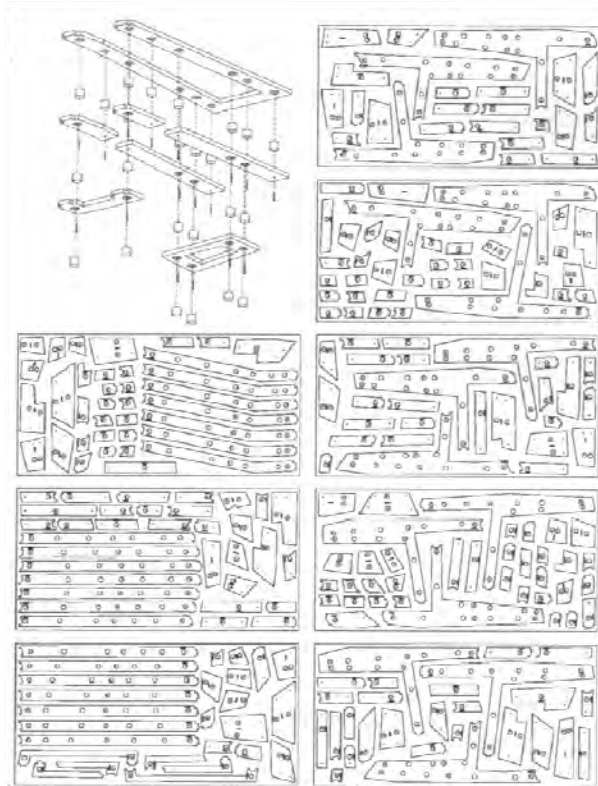


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FAT 2 FLAT : assembly

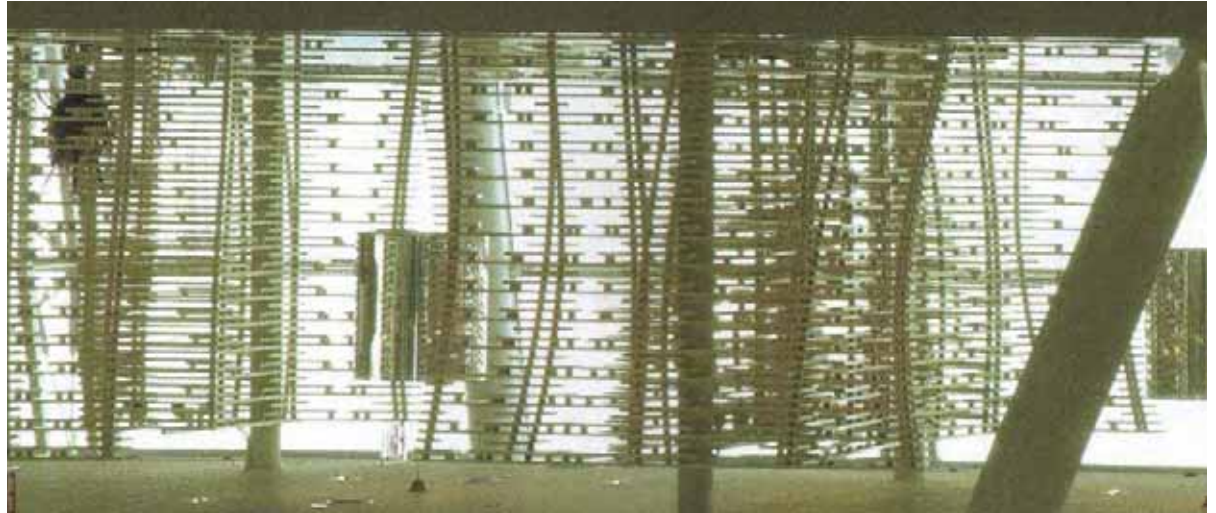
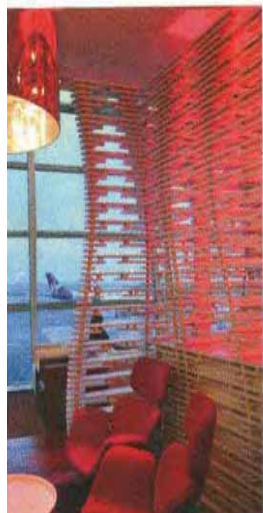


FAT 2 FLAT : assembly

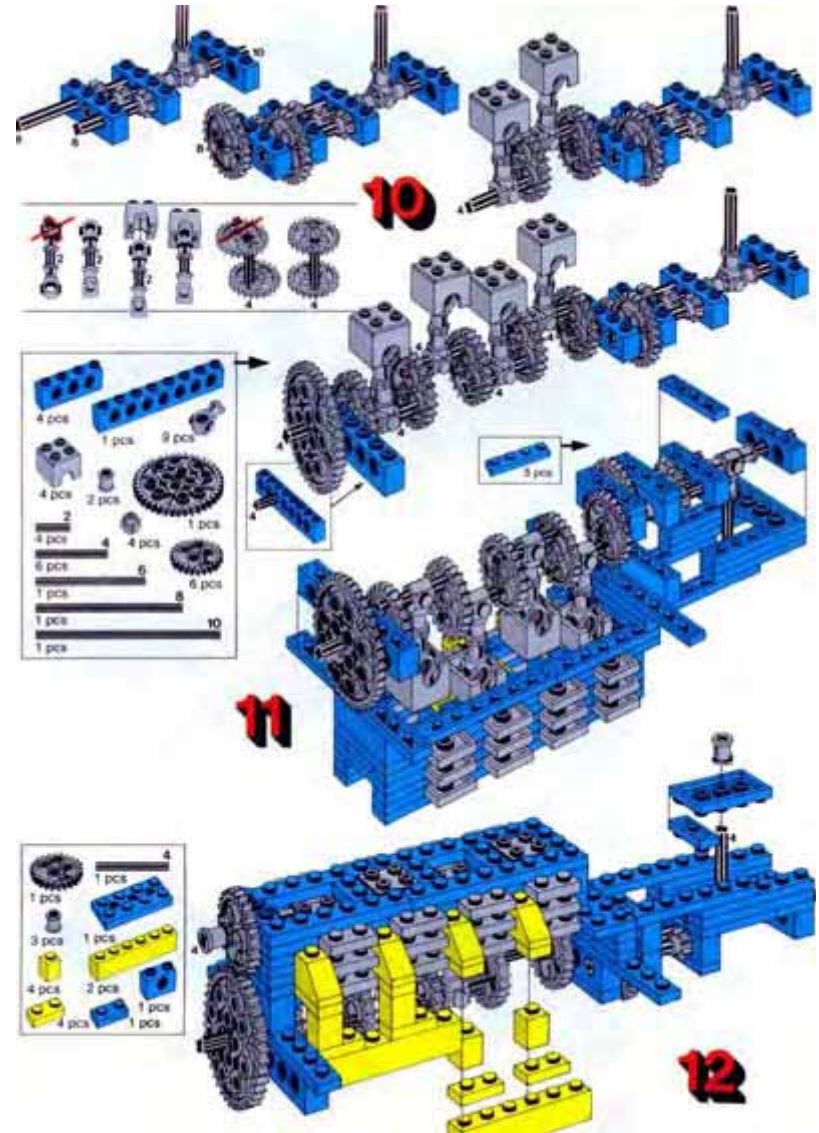




FAT 2 FLAT assembly

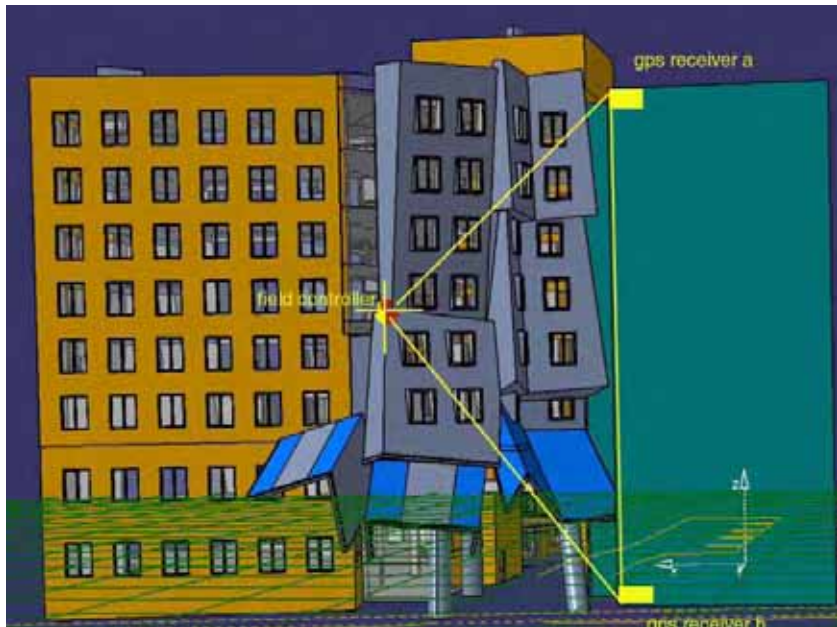


FAT 2 FLAT : assembly



FAT 2 FLAT : marking

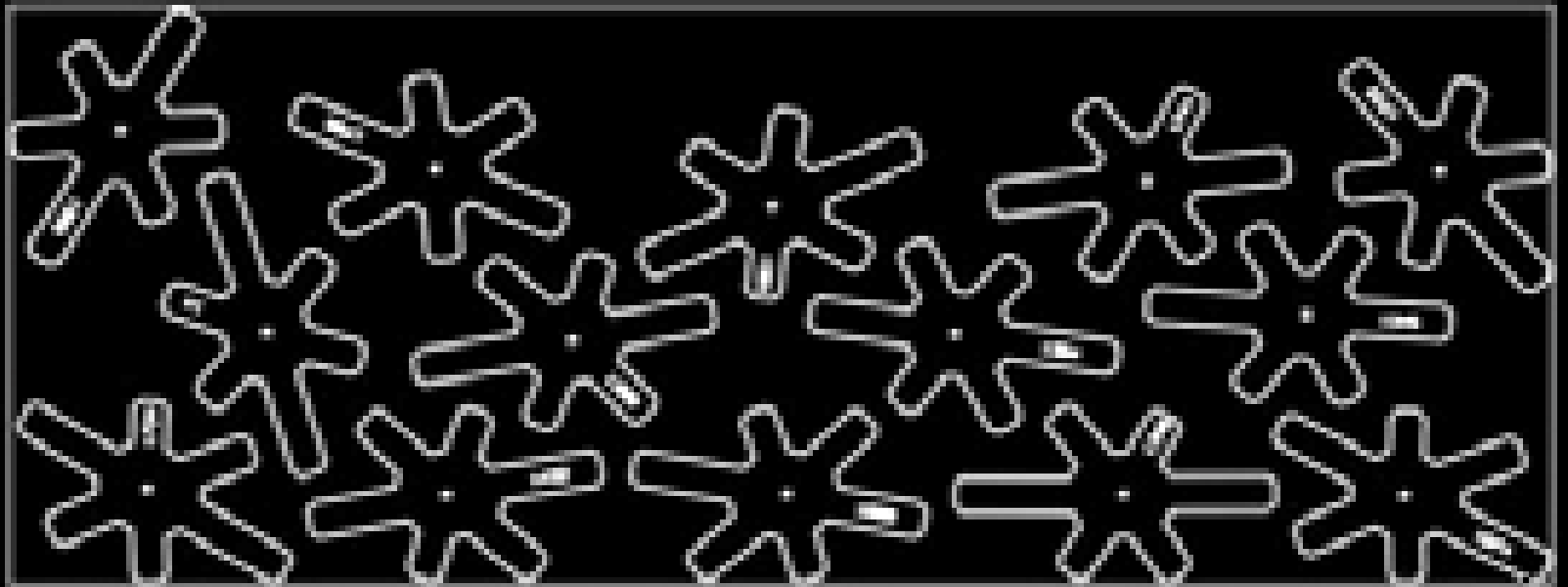




FAT2 FLAT : marking

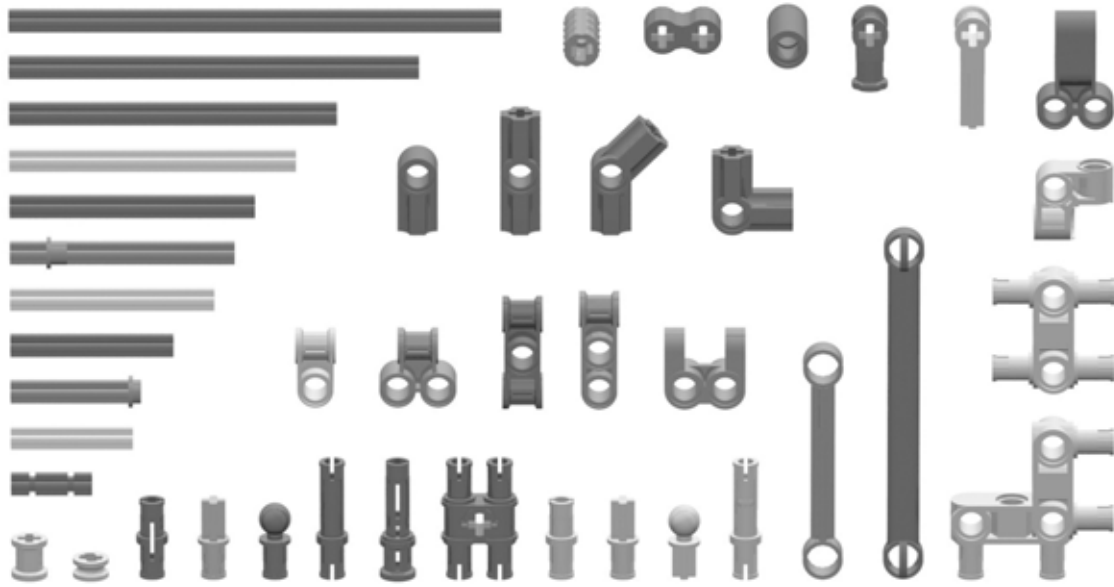


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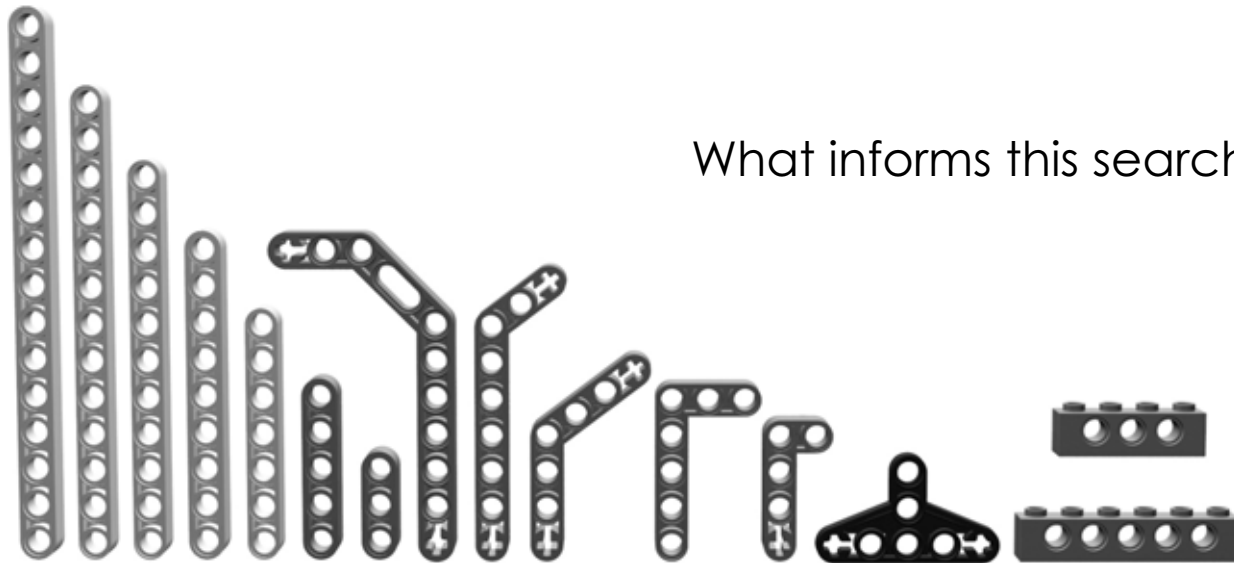


“There is a paradigm shift from the making of form, to **the finding of form.**”

-Branko Kolarevic | *Architecture in the Digital Age: Design + Manufacturing* | 2004



What informs this search?...





What informs this search?...



maybe...

