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.

Parametric modeling: grasshopper
Objects can be collected in “lists”

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

Connect alternating points and pipe

Connect alternating points within an entire “list” of points and pipe the results
TIME
+ TRANSFORMATIONS
+ PARAMETERS
= DESIGN SPACE
"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
“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
Parametric modeling: grasshopper
“...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
MULTIPICITY
TOPOLOGICALLY IDENTICAL yet MORPHOLOGICALLY UNIQUE

Parametric modeling: grasshopper
“...digital technologies really put at stake the architecture of information lying behind the buildings, and this architecture with digits also has to be designed.”
“...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
Parametric modeling: grasshopper
Since the brick is on the bottom, this arrangement allows for an easier and accessible start.
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.”

-Branko Kolarevic | *Architecture in the Digital Age: Design + Manufacturing* | 2003
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
FAT 2 FLAT : contouring
FAT 2 FLAT : unrolling

Images from Peter Wildbur | Information Graphics | 1989
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
FAT 2 FLAT : unfolding
FAT 2 FLAT : unfolding
FAT 2 FLAT : unfolding
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.

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

Panels:
- Shape 1
- Shape 2
- Shape 3
- Shape 4
- Shape 5
- Shape 6
- Shape 7
- Shape 8
- Shape 9

The off-cuts from Panels 1, 4, 5, 7, 8 and 9 are always the Standard Pinwheel triangles, reducing the gross glass area significantly.
FAT 2 FLAT : tessellation
FAT 2 FLAT : tessellation
FAT 2 FLAT: tessellation
FAT 2 FLAT : tessellation
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

http://www.fosterandpartners.com/content/projects/0984/0984_03.mov
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
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FAT 2 FLAT : interlocking assemblies
FAT 2 FLAT : interlocking assemblies
FAT 2 FLAT : nesting
FAT 2 FLAT: nesting
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
FAT 2 FLAT : assembly
FAT 2 FLAT : assembly
FAT 2 FLAT: assembly
FAT 2 FLAT : assembly
FAT 2 FLAT : marking
FAT 2 FLAT: marking
FAT 2 FLAT : marking
“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
Parametric modeling: grasshopper

What informs this search?...
What informs this search?...
maybe...