BOB PAVLIK

SELECTED EXAMPLES OF TEACHING AND DESIGN RESEARCH

In application for: Assistant Professor of Architecture

University of Hartford
College of Engineering, Technology, and Architecture
Department of Architecture

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ACADEMIC TEACHING

ACADEMIC DESIGN RESEARCH

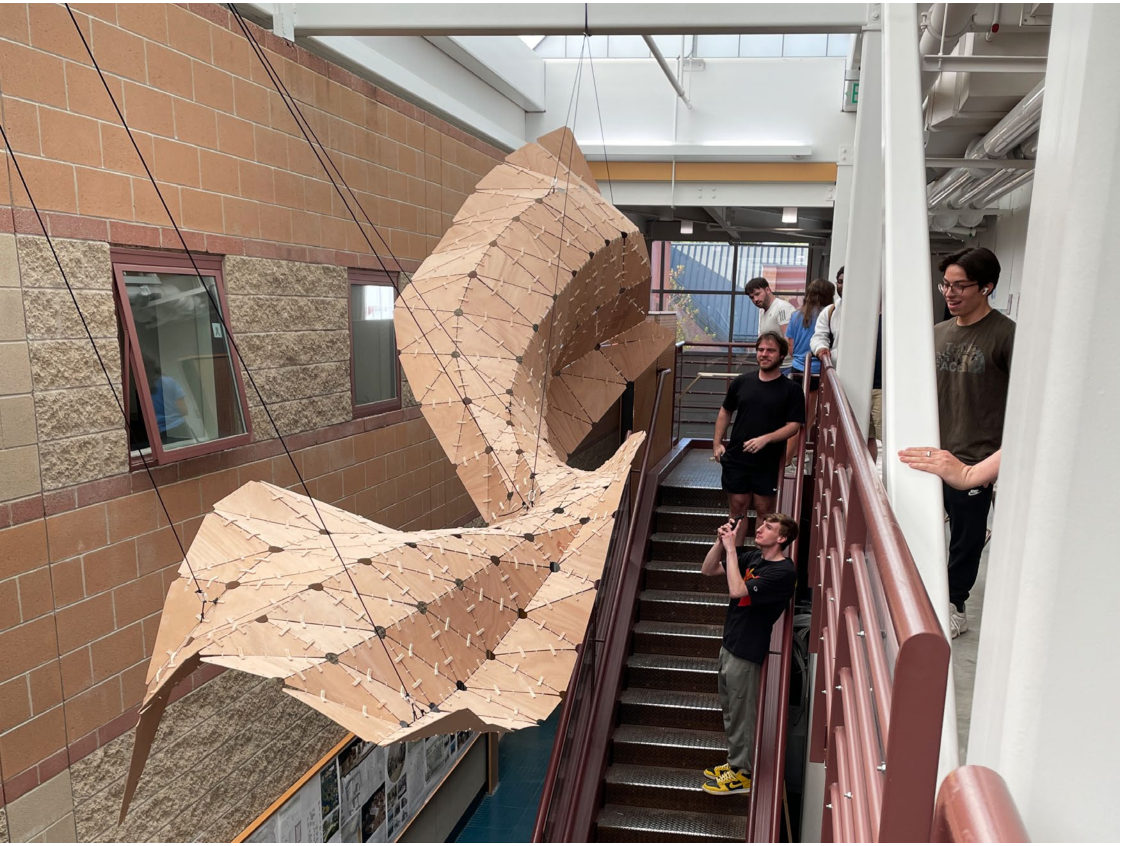
SCULPTURE PRACTICE

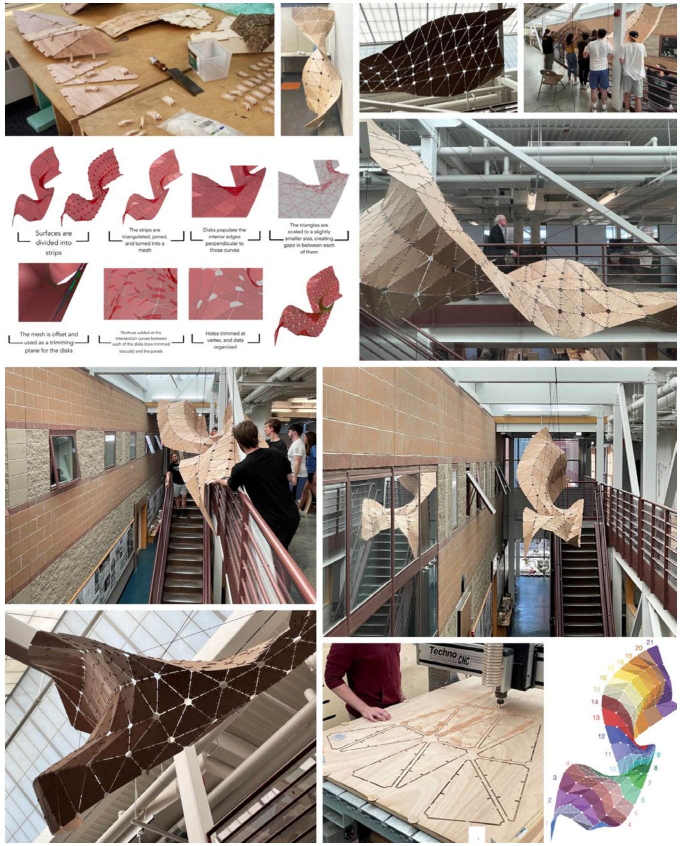
ACADEMIC TEACHING

Course: ARCH413 Advanced Design Studio: Tectonic Reinventions
Roger Williams University
Spring, 2023

tectonic reinventions

3mm okoume plywood
12mm Baltic birch plywood
Rhino3d
Grasshopper
Kangaroo for Grasshopper plug-in





This installation floats above an open stair, spatially enhancing and guiding the path of vertical movement. Built of 3mm thick okoume plywood, the 15-foot-long assembly weighs less than 20 pounds. Every triangular panel and connection component is unique in shape.

The orientation in which it hangs was predicted by locating the center of gravity in the digital 3d model and then creating a simulation using the Kangaroo physics engine in Rhino/Grasshopper. The results were then verified with a physical scale model.

The goal of the course was to investigate methods of generating surfaces that maximize double curvature, which increases structural stiffness. A “rationalization” process converted the smooth, monolithic design geometry into a constructable of parts that could be fabricated with available digital fabrication processes. The rationalized surface was then “unrolled” into flat, 2D patterns. In this case, the flat patterns are each a uniquely shaped triangle. These triangular panels are connected using a joinery method developed by the students though a process of full-scale prototyping. All components were digitally fabricated using a CNC (Computer Numerically Controlled) router.

This was a fourth-year undergraduate studio, with none of the students having prior experience with digital fabrication or Grasshopper software. A series of preliminary projects introduced and developed these skills, in preparation for this four-week project.

ACADEMIC TEACHING

Course: INTAR2367 Advanced Computing: Digital Fab
Rhode Island School of Design
Spring, 2022

polygon structures

Laser-cut corrugated cardboard
CNC cut plywood
Bristol board
Rhino3d
Grasshopper

In this seminar course, students investigated relationships between digital design processes, and methods of physical fabrication. Of primary concern were ways in which knowledge of fabrication processes and constructability serve to transform design geometry. This course made make extensive use of hybrid techniques, and those in which polarizations between "digital" and "manual" were blurred. This course relied heavily on the process of prototyping as a means of knowledge acquisition.

A series of projects introduced multiple methods of design rationalization. In Rhino, complex compound curvature surfaces were generated. However, most construction materials are flat, planar materials, which are inextensible (cannot be stretched). To construct a compound curved surface from flat sheet materials, which are inextensible (cannot be stretched), would either require localized stretching/shrinking of the material, or to approximate the original surface. Methods of doing the latter, such as generating curved developable strips, or triangulated meshing were investigated with Bristol board models.

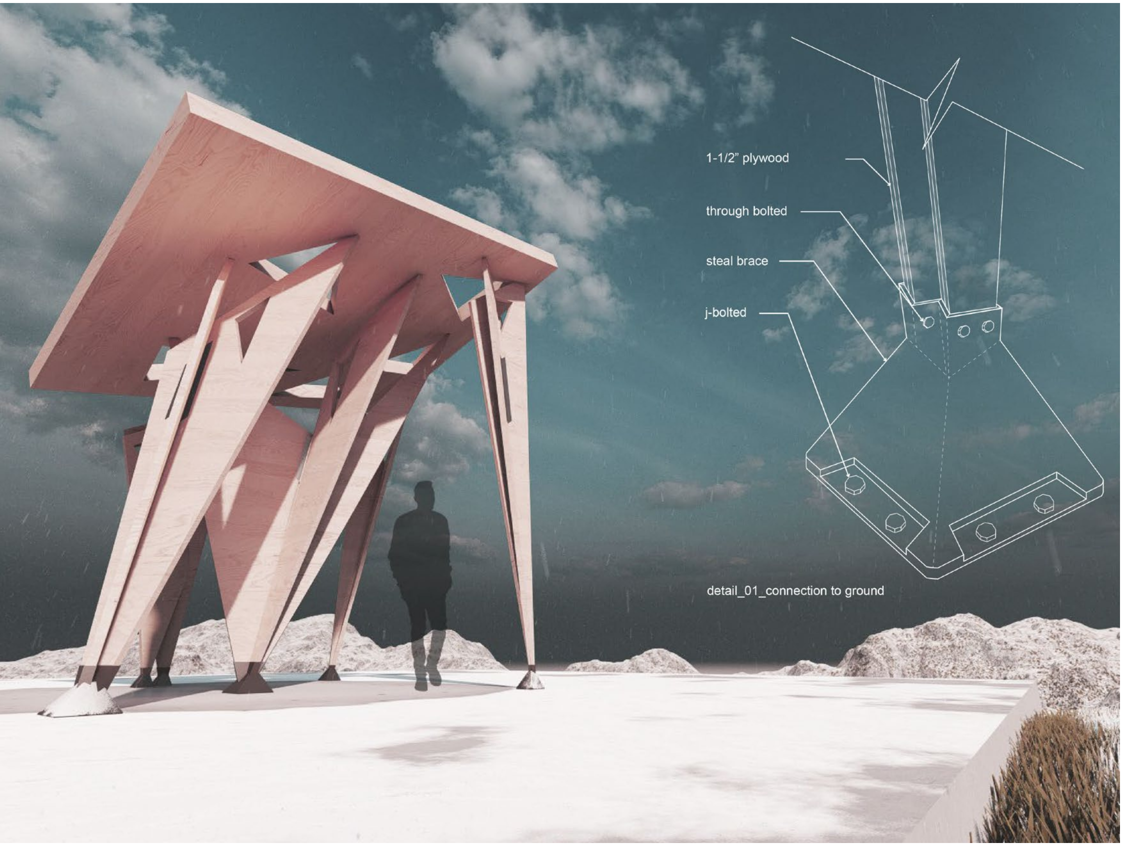
A concluding project resulted in a small inhabitable structure made from a surface of laser-cut corrugated cardboard and CNC milled plywood boundary edges.

ACADEMIC TEACHING

Course: ARCH530 Optimized Frameworks
Roger Williams University
Fall, 2020

optimized frameworks

Rhino3d
Grasshopper/Millipede
3D printer, PLA filament
Lumion



This course investigated use of topology optimization software for the generation of materially efficient architectural structures. This software arranges matter in space with the goal of minimizing material use and can arrive at complex geometrical solutions that were not possible by traditional design methods. Adoption of this software is common in product design disciplines which seek material reduction without loss of performance but is currently rare within the field of architecture.

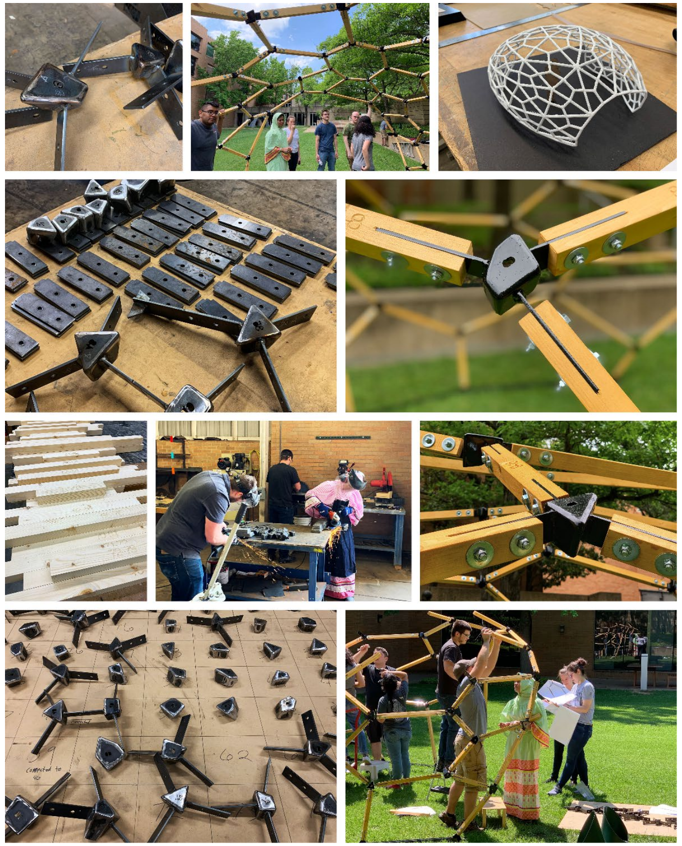
Current discourse around algorithmic design, optimization, form-finding, and design agency were examined through a series of readings and discussions. This course will question the potential roles that optimization may play during the design process.

This course investigated relationships between digital design processes, and methods of physical fabrication. Of primary concern were ways in which knowledge of fabrication processes and constructability serve to transform design geometry. The complexity of the geometries that we can generate requires digital fabrication equipment to realize them as physical artifacts.

A sequence of design projects provided a platform for investigating the expressive possibilities of optimized structures, as well as the challenges of rationalizing and translating idealized computational results into constructible assemblies.

ACADEMIC TEACHING

Course: ARCH5670 Advanced Design Studio: SpaceFRAMES
University of Texas at Arlington
Spring, 2019



CAPPA spaceFRAMES

1/4" plate steel
HSS steel tubing
Dimensional lumber
Rhino3d
Grasshopper
RhinoCAM

This structure was designed using a computational form-finding method, as a class project for a course that I taught that focused on shell structures, and the use of digital fabrication equipment to manufacture large numbers of unique components.

The first phase of this course concentrated on developing an overall surface form, using a range of digital form-finding techniques. From this form, multiple methods of subdividing the surface into straight line segments and intersecting point nodes were studied. A subdivision strategy that results in three struts coming into each node was chosen. As each of these 88 nodes is unique, a parametric design and fabrication system needed to be developed which could allow for the mass customization of these components. Not only does the included angle between wooden struts vary, but their axial rotation also differs as each strut enters a node. A series of prototype joints were constructed, to refine both the design and fabrication process. Fabrication of the wood struts and welded steel nodes took approximately two weeks, and the final assembly of the structure took less than two hours.

ACADEMIC TEACHING

Course: ARCH5670 Advanced Design Studio: Lightweight Deployable Structures
University of Texas at Arlington
Spring, 2018

CAPPA canopy

16 gauge cold rolled steel sheet
Rhino3d
Grasshopper
Kangaroo for Grasshopper
Karamba
RhinoCAM

This thin-gauge steel arch structure was designed using a computational form-finding method, in a course I taught focusing on shell structures. The design process used structural analysis software to simulate forces acting against an elastic material. The shapes that resulted from exaggerating the deflection of the material then became the form of the shell.

Shell structures are materially efficient due to their complex three-dimensional surfaces, in the way that an egg develops strength through its geometry. They are inherently efficient in their use of materials, as they transmit all structural loads through their thin surfaces and require no underlying framework.

Construction of this class of structure is difficult because these surfaces have double-curvature, which is difficult to realize with standardized building materials. This research project focused on methods of constructing complexly curved shells from flat two-dimensional patterns.

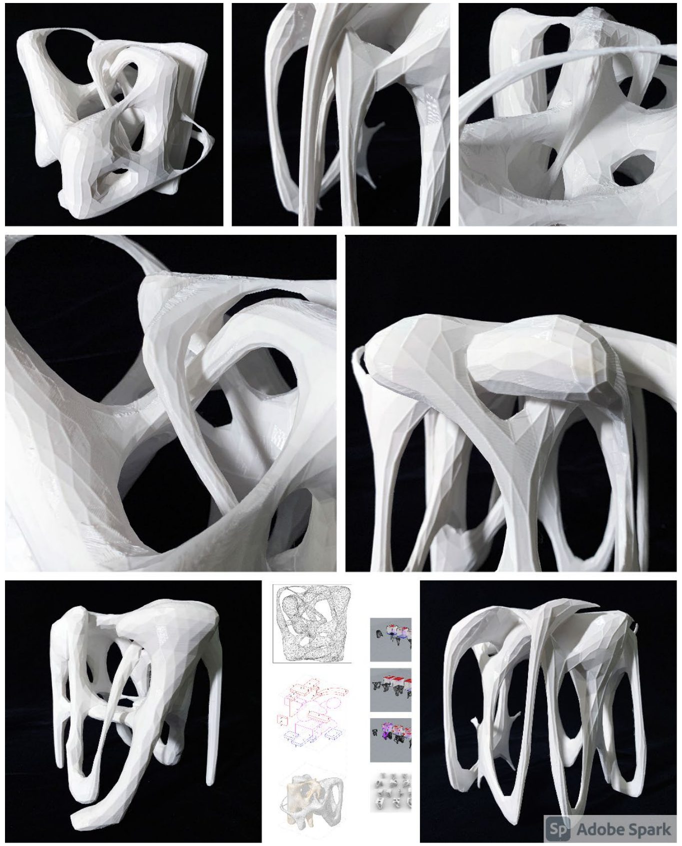
Students generated an iterative series of shell forms, each of which was structurally analyzed. A final design was chosen, and the surface subdivided into flat, triangular panels. When joined at their edges, these flat components are a functionally close approximation of the original three-dimensional form. Perforations were added to remove material weight where there is less stress in the shell. These panels were then cut on a CNC plasma cutter, manually folded and creased to the required joint angles, and assembled.

ACADEMIC TEACHING

Course: ARCH4395/5395 Optimized Frameworks for Architecture
University of Texas at Arlington
Spring, 2019

spatial matrix

Rhino3d
Grasshopper3d
Millipede
3D printer, PLA filament

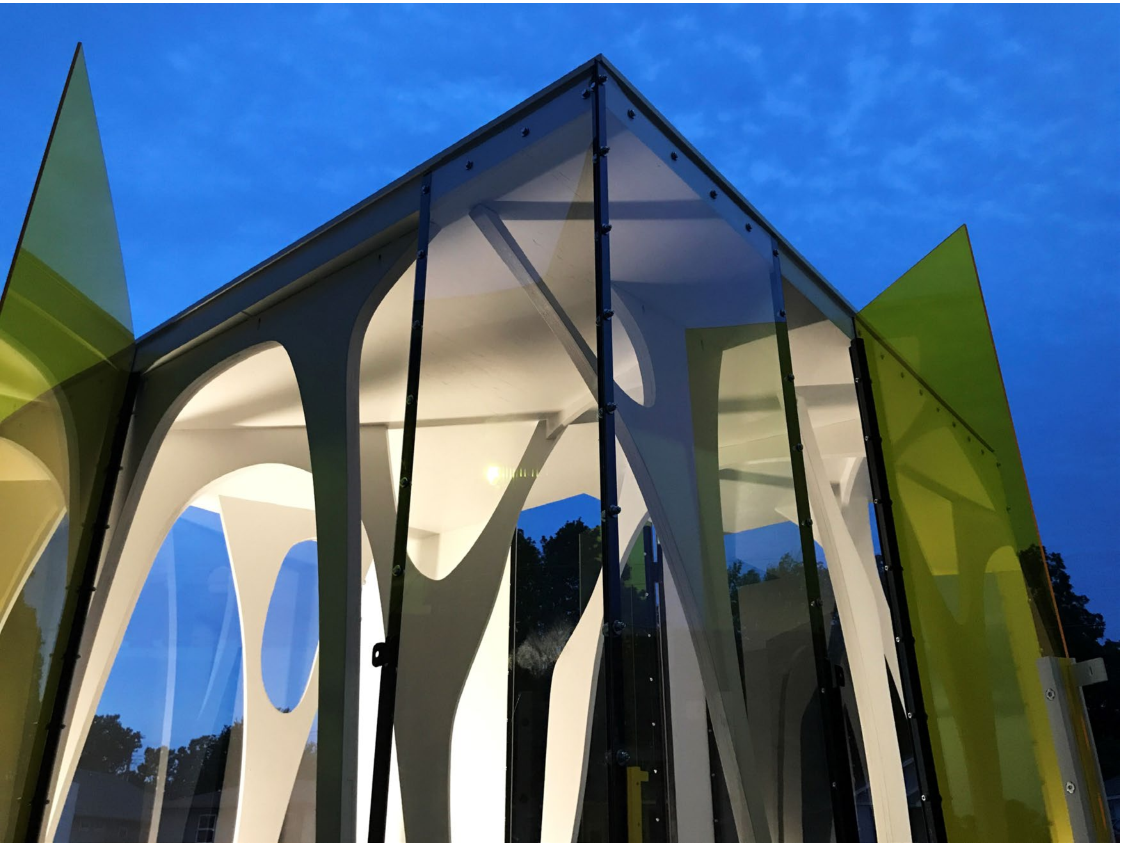


These artifacts were produced during a course I taught that investigated use of topology optimization software for the generation of materially efficient architectural structures. This software arranges matter in space with the goal of minimizing material use and can arrive at complex geometrical solutions. Adoption of this software is common in product design disciplines which seek material reduction without loss of performance but is rare within the field of architecture.

Current discourse around algorithmic design, optimization, form-finding, and design agency were examined through a series of readings and discussions, and the course questioned the potential roles that optimization may play during the design process. Beyond simple goals of efficiency, this design software was used here for its expressive aesthetic potential

ACADEMIC TEACHING

Course: ARCH5970 Optimized Frameworks for Digital Fabrication
University of Oklahoma
Summer, 2017



diaphysis

12mm Baltic birch plywood
1/2" CDX plywood
Acrylic ,HDPE, Polycarbonate sheet
Rhino3d
Grasshopper/Millipede
RhinoCAM

This small inhabitable structure was designed and constructed during a 4-week workshop that I led. This course investigated use of topology optimization software for the generation of structurally efficient building frames. This software, increasingly used in other design fields, arranges matter in space with the goal of minimizing material use by placing it where it is structurally most efficient.

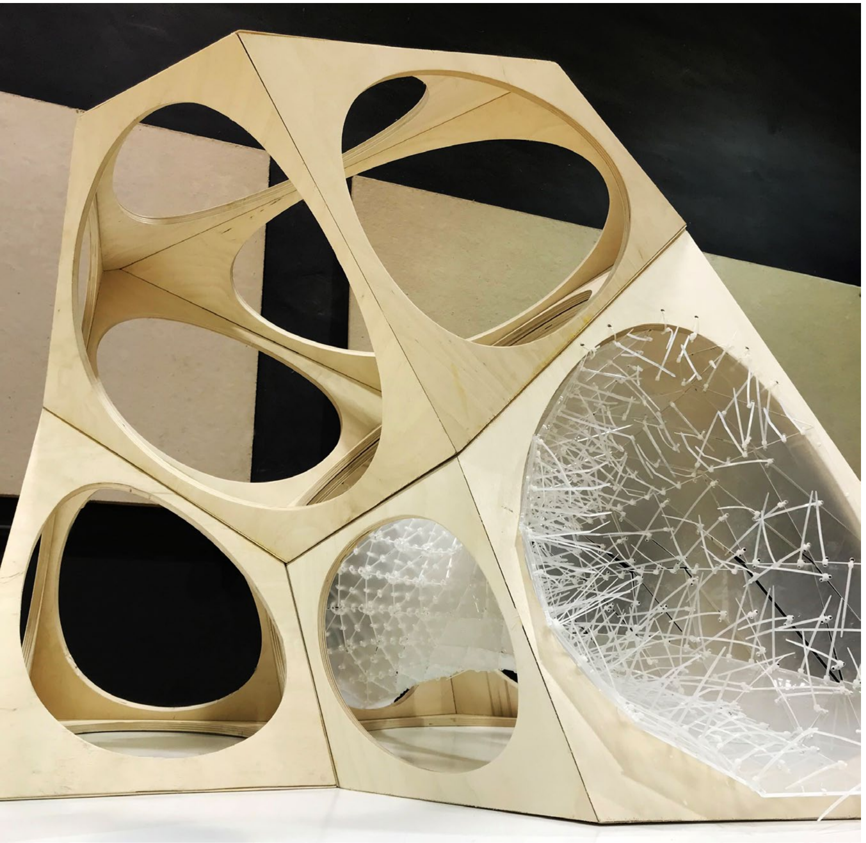
Another goal of the course was to investigate the expressive potentials of using this software for form generation. The result was a forest of internal bone-like columns, wrapped at the perimeter with a non-structural envelope of thin plastic panels. All components were digitally fabricated using a CNC (Computer Numerically Controlled) router and laser cutter. Upon completion it became only one of a handful of buildings in the world that was designed with structural topology optimization methods.

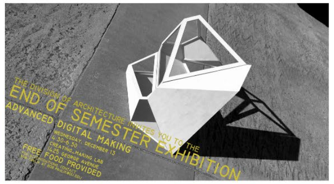
ACADEMIC TEACHING

Course: ARCH5970 Advanced Digital Making
University of Oklahoma
Fall, 2017

advanced digital making

Mixed media
Rhino3d
RhinoCAM
Grasshopper3d





This digital fabrication course was structured similarly to the one I taught the prior year (previous portfolio page). This semester had four projects that again each focused on the geometric principles of a particular artist or architect.

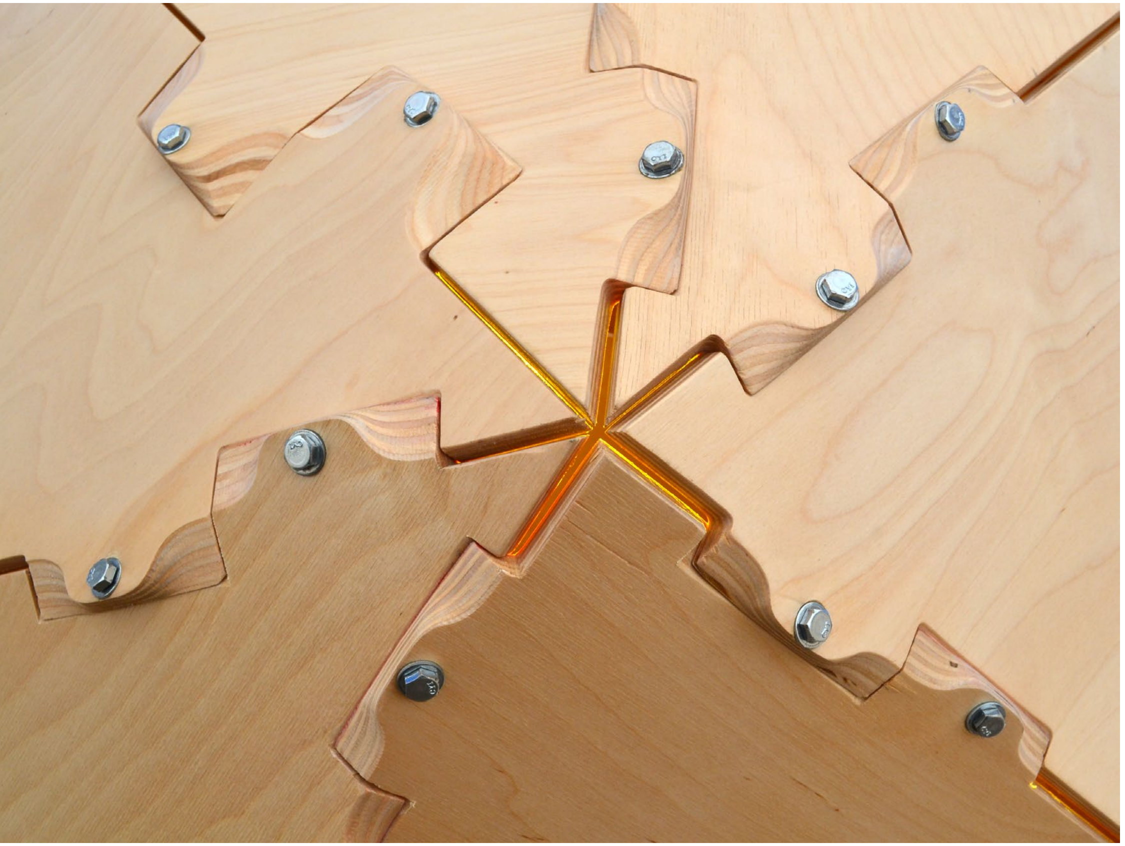
This course relied heavily on the process of prototyping as a means of knowledge acquisition. There was an expectation of continual experimentation within the digital fabrication lab. The process of making physical artifacts through an iterative process was the primary working method within this course.

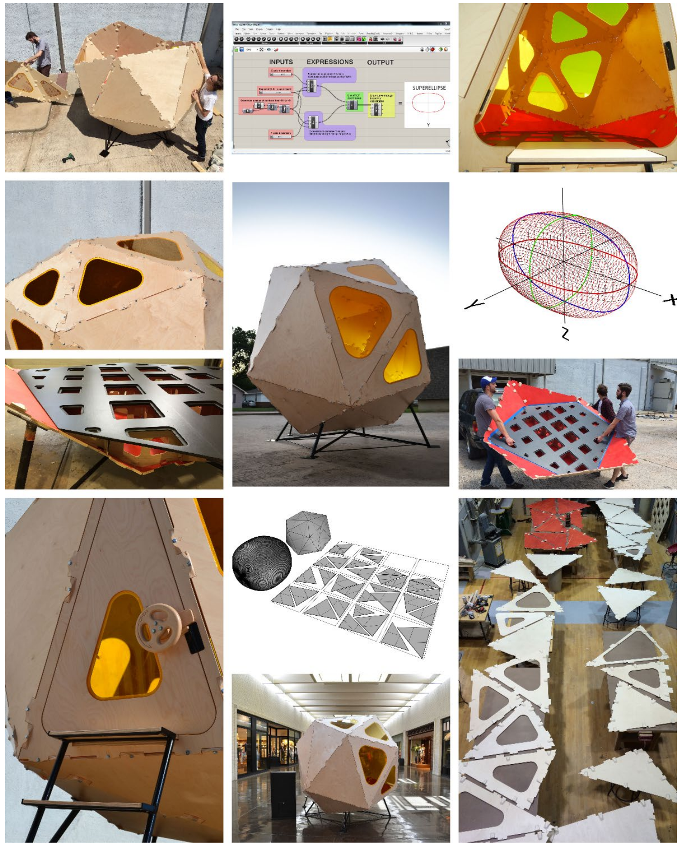
-Rachel Whiteread and Sol LeWitt- Proto-parametric, set theory, serialized objects
-Isamu Naguchi and Barbara Hepworth- Complex 3D objects, CNC milling 3D objects by indexing them in multiple machining positions.
-Richard Deacon and Tomas Saraceno- Aggregations and networks of fabricated, tectonic irregular polygons.
-Zaha Hadid and Anish Kapoor- Developing compound curved surfaces into 2D patterns.

The semester also concluded with a gallery exhibition that was open to the public.

ACADEMIC TEACHING

Course: ARCH5970 Advanced Digital Making
University of Oklahoma
Spring, 2016





superegg

12mm Baltic birch plywood
Steel tube
Acrylic sheet
Rhino3d
Grasshopper
RhinoCAM

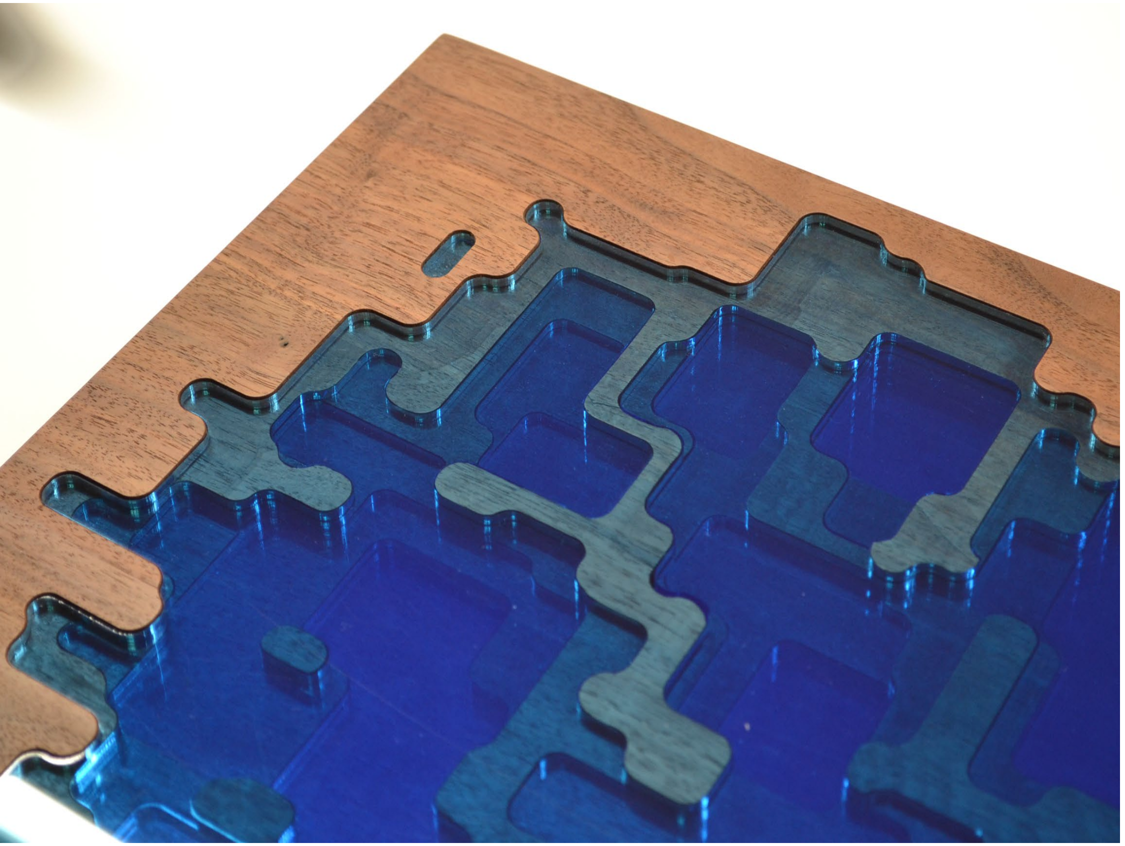
This irregular polyhedron structure was constructed as a final project during a Digital Making seminar course that I taught. The students were challenged to design a structure which enclosed space with the most minimal and efficient use of materials, while maintaining exceptional overall strength.

Research into structural surface geometries eventually led students to a parametric equation that generates a 2D shape called a “superellipse,” and its 3D version, which is known as a “superegg.” This was generated as a digital 3D model by using a graphical programming environment called Grasshopper3D. The students chose this geometry as a starting point as its curved surfaces lend it structural strength, while being more volumetrically efficient than a perfect sphere or ellipsoid.

From this superegg, the students developed a novel process of approximating its form with triangular panels, which can be cut from flat sheets of material. They also developed a novel edge-joining technique, which was made possible by computer-controlled fabrication equipment (a CNC router and laser cutter), which they had learned to program during this course. Each of the 32 unique panels was then cut with this digital equipment and hand finished prior to assembly.

ACADEMIC TEACHING

Course: ARCH5970 Advanced Digital Making
University of Oklahoma
Fall, 2016



advanced digital making

Mixed media
Rhino3d
RhinoCAM
Grasshopper3d
Processing

This digital fabrication course that I taught investigated relationships between digital design processes, and methods of physical fabrication. Of primary concern were ways in which knowledge of fabrication processes and constructability serve to transform design geometry. This course will made extensive use of hybrid techniques, and those in which polarizations between “digital” and “manual” were blurred.

Students made use of digital fabrication equipment through a series of six design projects. Each project looked at the work of a well-known visual artist: sculptor, conceptual artist, installation artist, etc., and translated either their geometries or design processes into a digital workflow. Each project resulted in a fabricated artifact. The goal was gallery-quality craft, of both the object and its documentation.

The six artists that provided the inspiration for the projects in this course were:
-Naum Gabo- Ruling lines (introduction to Grasshopper)
-Anish Kapoor- Developing compound curved surfaces into 2D patterns.
-Sol LeWitt- algorithmic/computational drawings, proto-parametric
-Joel Shapiro- mitered irregular polygons, CNC router
-Barbara Hepworth- Indexed surfaces, CNC milling full 3D objects by indexing them in multiple machining positions.

The semester concluded with a gallery exhibition that was open to the public.

ACADEMIC TEACHING

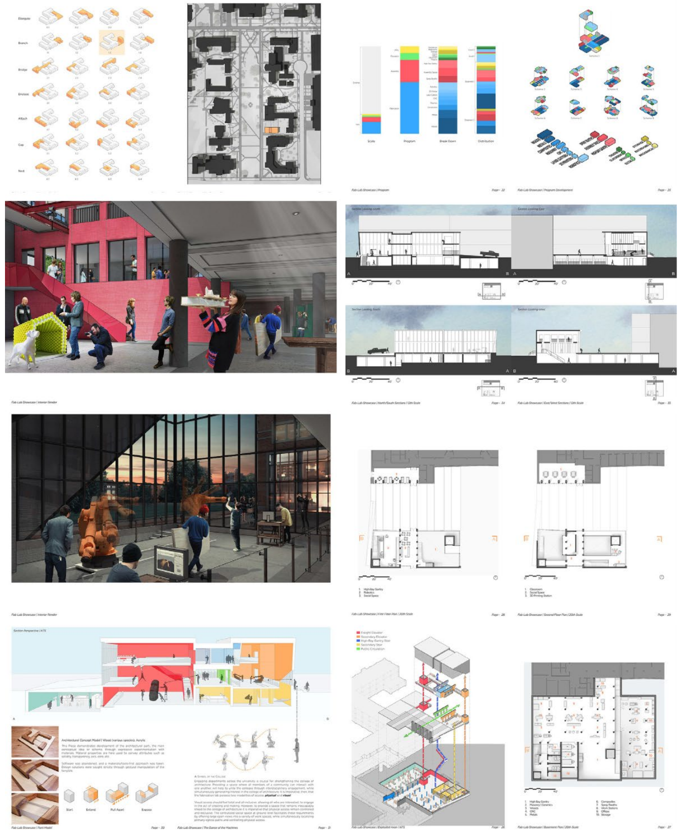
Course: ARCH5955 Design IX
University of Oklahoma
Fall, 2016

ReMaking Gould

Fab-Lab Showcase

University of Oklahoma, Design Studio, Fall 2016 | Prof. Robert Pavlik
Individual Project | Design: Victor Trautmann

The purpose of a Fabrication Lab at Gould Hall is to enhance creating and making within the college of architecture. Subsequently, the Fabrication Lab must function as a space that facilitates the chaos and spontaneity that accompanies the making of things. The act of making can be sharp and intentional or meandering and experimental. To facilitate this range of action, movement through the space must be free, fluid and dynamic; an open plan, providing an ambiguity of function that can conform to the needs of multiple individuals. Consequently, the program is not constrained by physical dividers within the building layout, but rather by circulation corridors that weave between spaces and act as open partitions.



This fifth-year undergraduate design studio focused on designing an addition to the University of Oklahoma College of Architecture building. This building is an aggregation of multiple meandering and maze-like wings, with no cohesive organization. This studio investigated strategies for adding an additional massing, which would house the growing fabrication facilities, which were currently housed at an off-site location. It also encouraged a radical reorganization and modifications to the existing programming.

The goal of this addition was to better integrate the making of physical artifacts, both through analog and digital methods, into the design culture at the College of Architecture. It was to also serve as an iconic expression of Gould Hall, which will visibly display the work produced within the College of Architecture to the rest of the OU community.

To better understand the workflows within a contemporary "maker space," this course began with an introduction to basic digital fabrication technologies. A brief hands-on project focused on the use of the CNC router.

To more fully investigate ways in which a fabrication facility may be integrated into a design or research setting, I led a group of students on a field trip to Boston and Cambridge. We visited the Harvard GSD, MIT Department of Architecture, the Autodesk BUILD Space, and the Artisan's Asylum makerspace/artist community.

ACADEMIC RESEARCH

University of Oklahoma
2017

superleggera

Carbon fiber fabric
Carbon fiber tow
Expanded polystyrene foam
Rhino3d
Grasshopper/Millipede
RhinoCAM

This ultra-lightweight table (under 48oz.) was the result of experimenting with the development of structural topology optimization methods using Grasshopper3D software. This method uses a process of structurally analyzing a block of material that is placed between structural loads and support points. Through a series of iterative steps, it incrementally removes the least efficient material. This process of decay results in leaving material only where it is most efficient at transmitting loads to supports.

In this case a small table was chosen as a project to test this algorithmic design process. An animation below illustrates this method of material removal. The form of the three arched legs was CNC milled in stacking segments, to create a rigid foam core, over which carbon fiber cloth was laminated. A vacuum bag process was used to consolidate the carbon fiber and minimize excess resin. The tabletop surface was generated separately with the same design process and fabricated with the same technique. The legs and top were then bonded together.

ACADEMIC RESEARCH

University of Oklahoma
Fall, 2017

optimizations + fabrications

Parallam PSL (Parallel Strand Lumber)
Waterjet-cut steel plate
Rhino3d
Grasshopper
Millipede
RhinoCAM

This expressive timber-framed structure was designed using a computational topology optimization routine, with the goal of orienting a series of struts to for maximum structural efficiency. The result of this design process is that the timber struts are non-orthogonal, joining at complex angles other than 90 degrees. This required the development of a joinery system that could accommodate these angles as well as allow each connection to be geometrically unique.

Steel plate components were cut with an abrasive waterjet and welded into joint assemblies. By always having at least three plate surfaces coming together at every vertex, and keeping the edges of the components perfectly aligned during welding, the proper joint angles are guaranteed.

ACADEMIC RESEARCH

University of Oklahoma
2016

carbon fiber joints

Carbon fiber twill-weave cloth
Carbon fiber tow
Epoxy resin
Baltic birch plywood
Rhino3d
RhinoCAM

This sculptural assembly was the outcome of experimentations using topology optimization software to generate structural frames. This software combines structural analysis with genetic algorithms to orient material in space so that it is structurally efficient. This results in complex angles at the nodes where individual struts intersect, and each node is unique. In traditional frame systems, angles are standardized, and the number of unique types of joints is minimized.

This sculpture focused on the development of a joinery system that allows for this wide range of geometric intersections that optimization generates, as well as expressing the overlapping visual flows between the multiple struts that enter each joint.

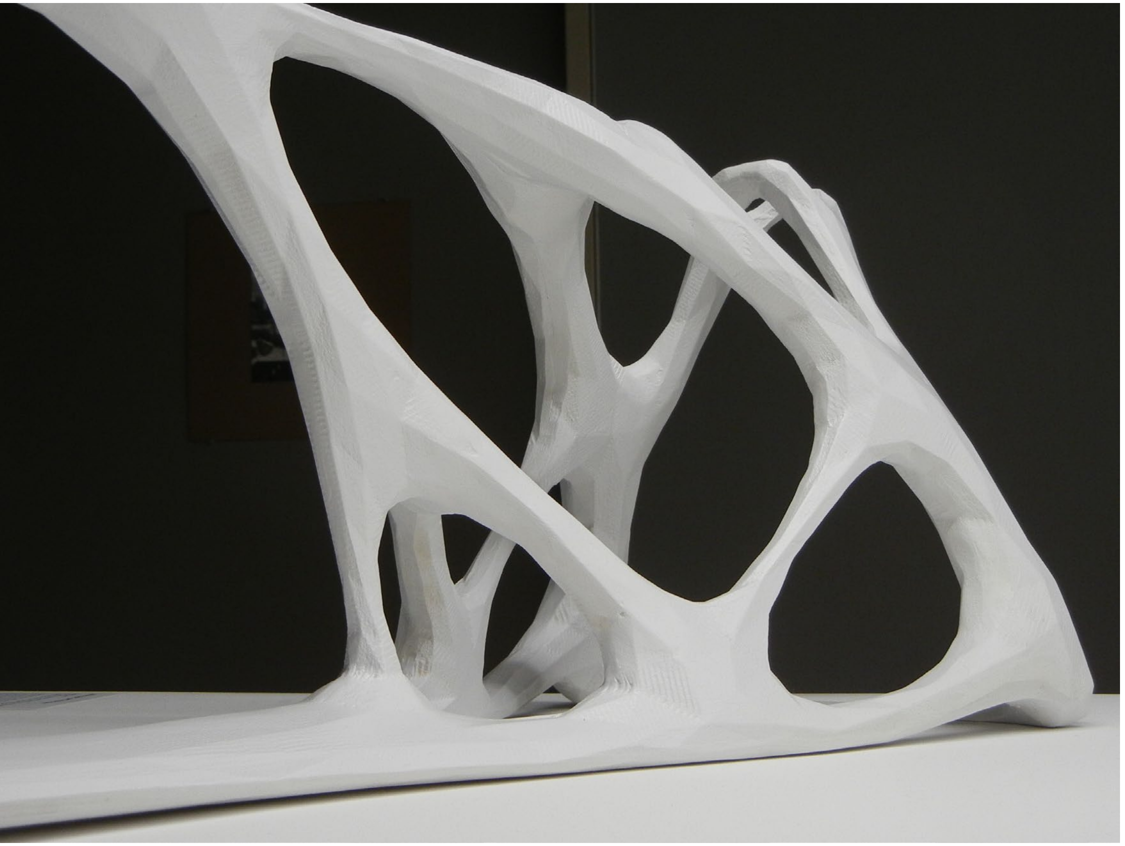
The design is a network of standardized wood strut members, each with a simple rectangular cross-section, but requires each of the ten intersection nodes to be unique. A process was developed to fabricate socketed joints from high strength carbon-fiber, laminated over CNC machined wood cores. These nodes can transmit compression, tensile, and moment forces between the wood struts

ACADEMIC RESEARCH

University of Oklahoma
Summer, 2015

topology truss

MDF
TopOpt
Autodesk Inventor
solidThinking
Rhino3d
RhinoCAM



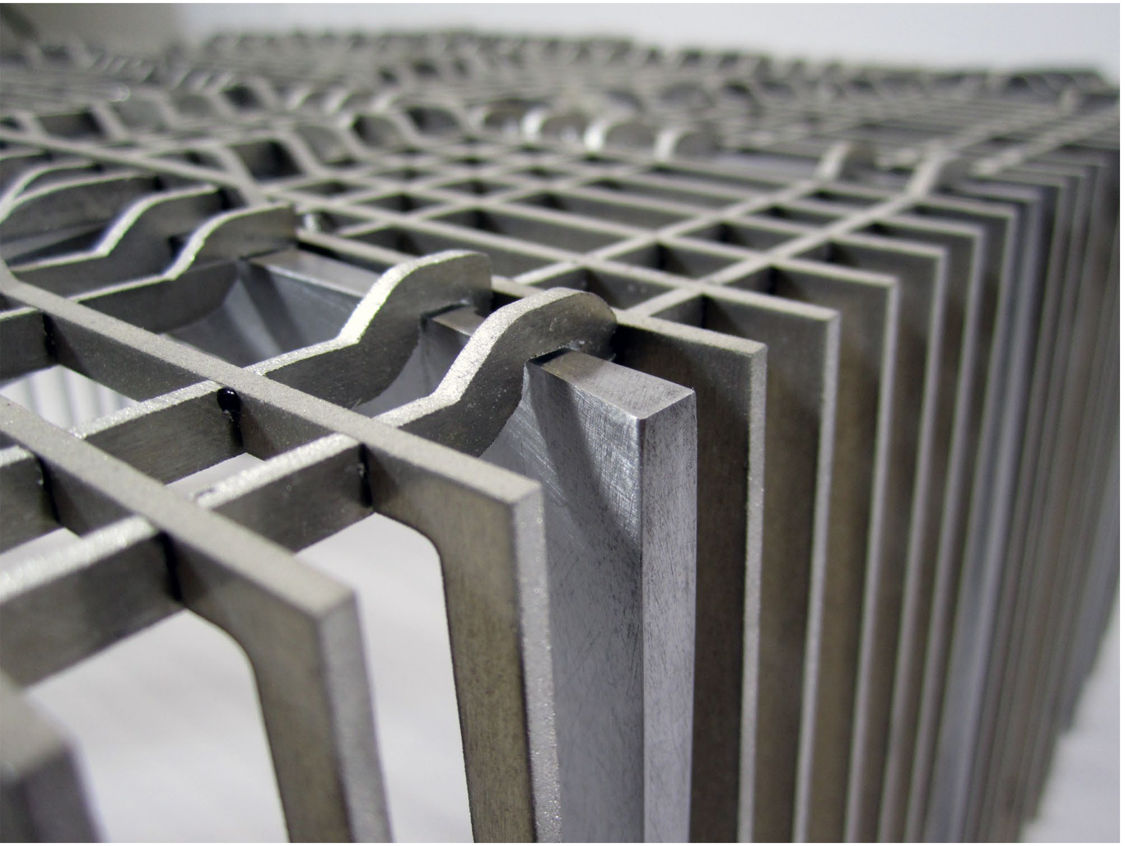
Topology is a set of surface characteristics and relationships that remain intact, regardless of deformation. The combination of topology and geometry can be optimized for maximum structural efficiency through computational methods. These are based on the finite element method of analysis, incorporating an evolutionary solver to iteratively remove inefficient material.

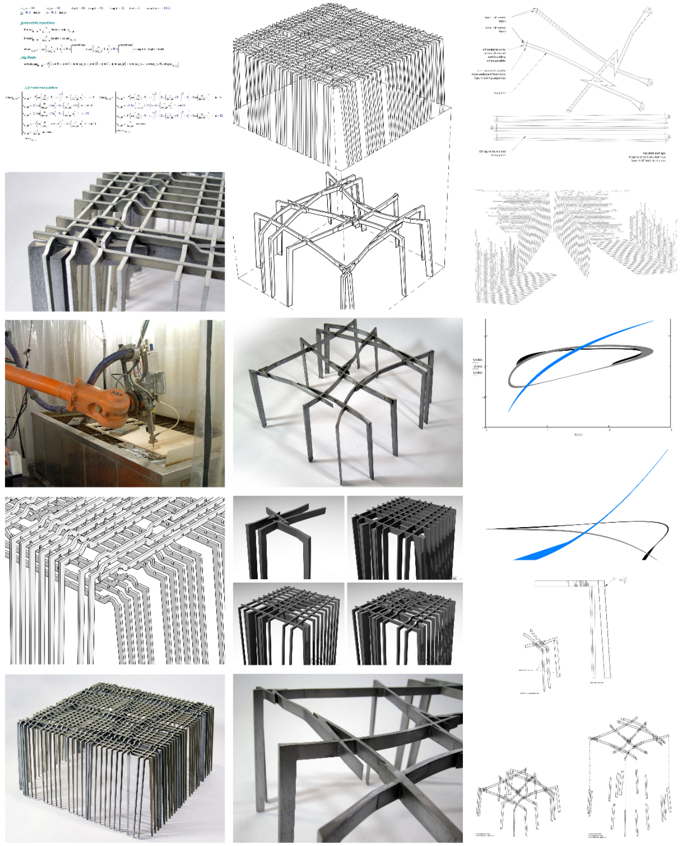
Topology optimization software can arrive at solutions that were not possible by traditional methods. This software is common in product design disciplines which seek material reduction without loss of performance, but are uncommon within the field of architecture. This is partially due to the nature of architectural structures, which are complex, large in scale, require transmission of forces across joints, and often utilize composite materials such as reinforced concrete.

The perception of relinquishing design agency to the computer may be another factor in the slow adoption of this technology. It may be believed that an optimization routine will return a singular idealized solution that leaves no room for architectural expression. This project investigated the current techniques of topology optimization and the role that they may play within the creative design process. It questioned whether optimization could be a flexible tool that plays a partnership role during early generation of design concepts.

ACADEMIC RESEARCH

Harvard GSD (graduate student)
Spring, 2011





computational tectonics

waterjet-cut steel plate
waterjet-cut aluminum sheet
MathCAD
Rhino3d
MasterCAM

Constructed of steel and aluminum, this project investigated the translation of a purely computational design method into a physical tectonic object. Working within a software environment that is intended for solving technical calculations, the design process was based on the graphing of a three-dimensional equation.

The mathematical phase of this project began with a known equation that graphs Cartesian X-Y “threads” into a box-like form. Additional lines of code were added to the equation, which manipulated these threads through the programming logic of a series of conditional “if-then” statements. This allowed for a precision in choosing which parts of the equation were modified and controlled. However, the ways in which the individual manipulations would interact was unpredictable. Limited control was gained through a heuristic series of design iterations that brought an intuitive feel.

Translation from computational line to material object was based on a decision to assign the manipulated threads the role of primary structure. The remaining grid of the intact non-manipulated threads is expressed as if draped over this frame.

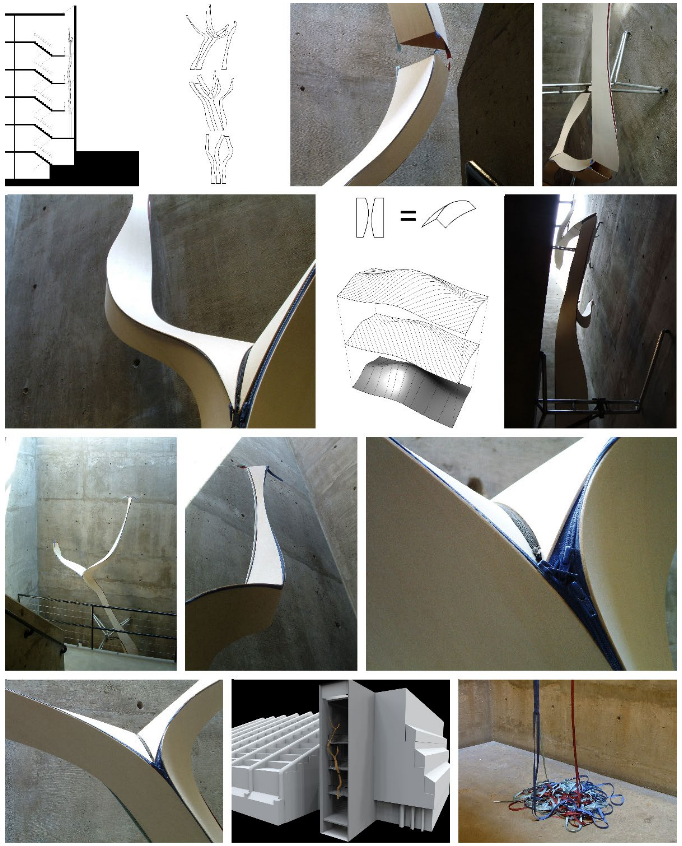
Metal parts were cut with an abrasive waterjet, controlled by a 6 axis industrial robot. The primary frame is cut from steel plate, with the vertical elements cut separately, welded, and ground smooth. The secondary grid is realized in aluminum and assembled with simple notching. The integration of hand-craft techniques required careful strategies to maintain precision alignment during the welding process.

ACADEMIC RESEARCH

Harvard GSD (graduate student)
Spring, 2010

zero-k

3mm Italian poplar plywood
zippers
steel tubing
Rhino3d
RhinoScript



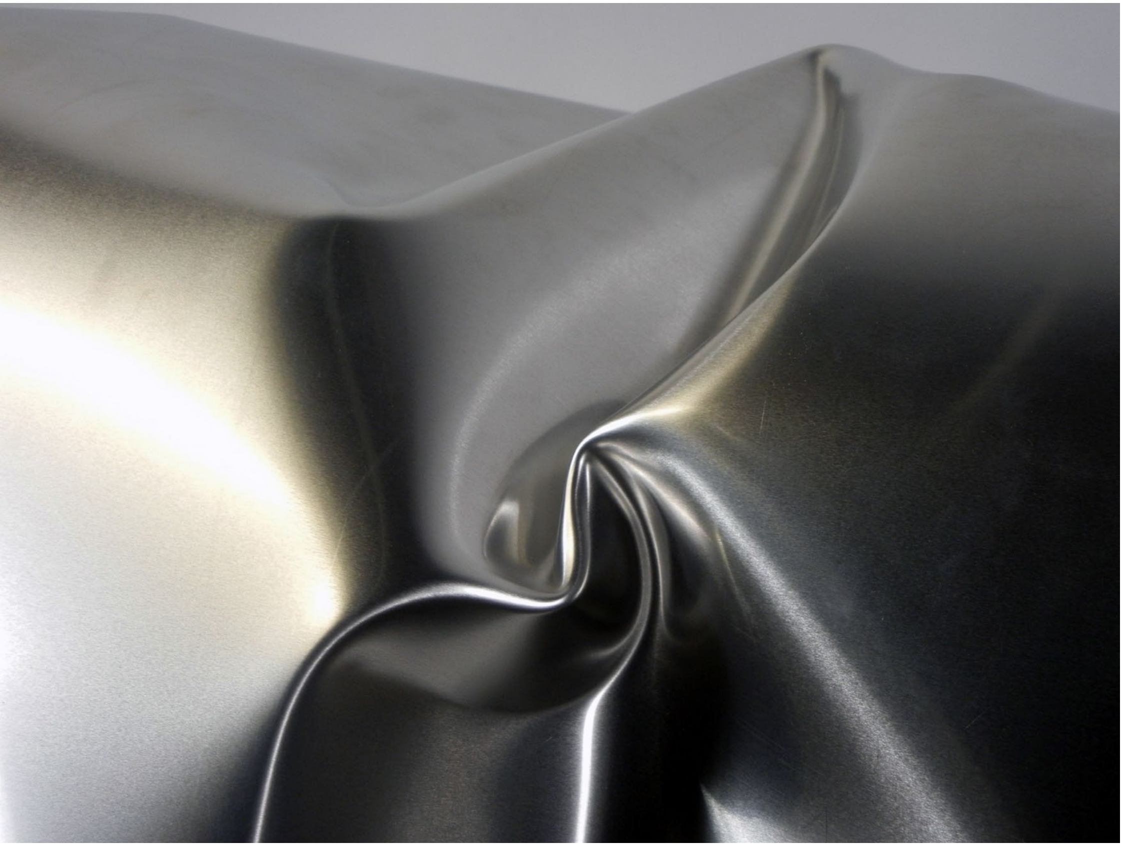
This four-story tall installation was the result of research that investigated two issues. The first was a search for methods of geometrically constructing curved surfaces that can be unrolled into flat 2d patterns without distortion. These surfaces have only simple curvature, with no compound curvature, and have what is known as zero Gaussian curvature. The second focused on an assembly principle. Dissimilarly curved edges of flat shapes are joined along their lengths, pulling the components into a spatial assembly.

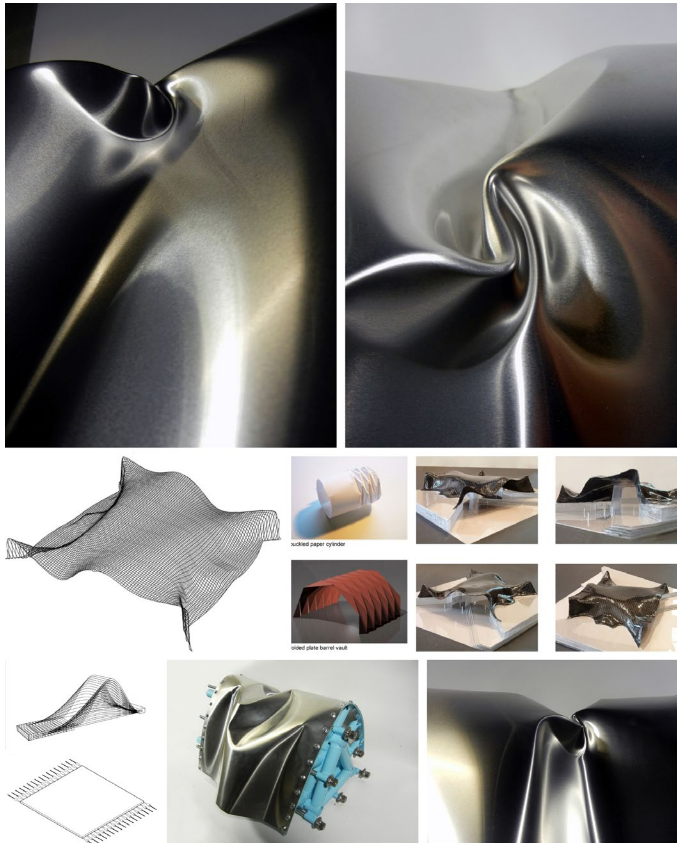
Generating zero Gaussian surfaces is inherently problematic. The solution found for this project required an unorthodox design process. Zero Gaussian surfaces could not be constructed from a desired set of edge curves. Rather, a library of curved surfaces was generated using a different technique and these surfaces were then overlapped and trimmed, resulting in the final form of the piece. The design process is consequently unpredictable in nature and requires an intuitive feel for directing the overall form.

Continuous zippers join the edges of the 3mm thick plywood, which was cut with a CNC router. The assembly method allowed for rapid deployment from flat 2d components to 3d form. The installation was divided into three vertical segments, with the form having a perceptual continuity across gaps at the divisions.

PERSONAL DESIGN RESEARCH

Location: Providence, RI
2011





buckled surfaces

6061 aluminum sheet
welded steel tubing
carbon fiber cloth
epoxy resin
Rhino3d
CADRE Pro

This project was a form-finding exercise arising from an observation that a buckled tube creases into a folded-plate barrel vault arrangement, and that a buckled strut approximates an arch. The resulting question: can buckling force generate a form that is structural when loaded in a perpendicular direction to the original force? However, buckling behavior is inherently unpredictable and defies computational simulation.

A technique was devised to use Finite Element Method structural analysis to simulate buckling behavior, and to generate forms. As this behavior is unpredictable, each successful analysis would produce differing results, and more often produced a software crash. Following these computational experiments, several models were constructed in carbon fiber.

Paper models were used to experiment with physical forces as a form-finding method. Following these, a mechanical device was then constructed to produce results in an isotropic material. Sheets of .070” thick x 36” long aluminum were slowly buckled to witness the propagation of deformations.

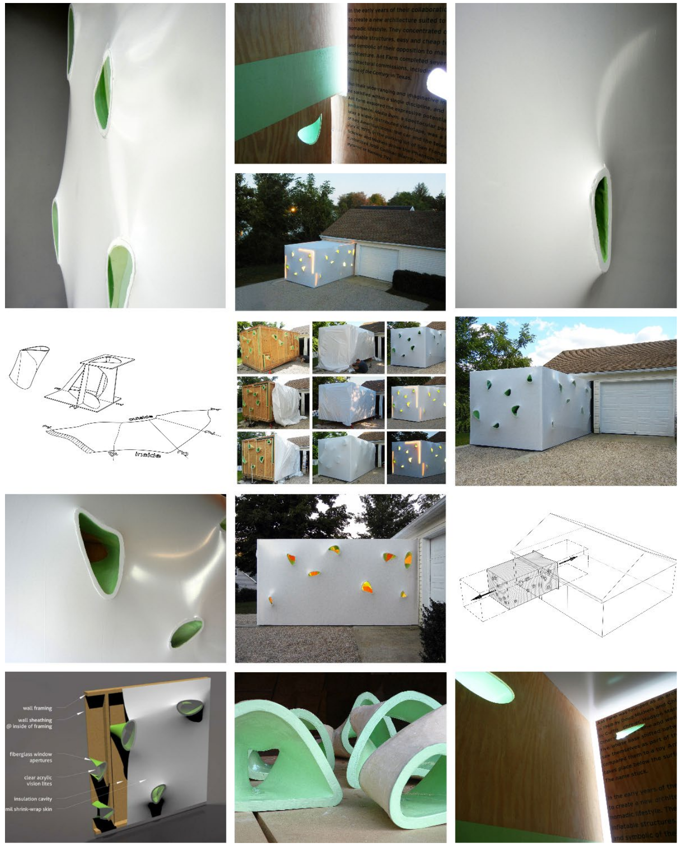
See https://bobpavlik.com/buckled_surfaces/ for video animations.

PERSONAL DESIGN RESEARCH

Location: Torrington, CT
2008, 2013

HQ

Industrial shrink wrap
fiberglass
CDX plywood, reclaimed
KD studs
Rhino3d
RhinoScript



This rolling structure nests within a host building and contains “clean-room” office space for computer hardware. When rolled to the exterior position it guarantees open floor area in a fabrication workshop. This project served as a platform for exploring how the logic of the ubiquitous suburban vinyl-sided, light wood frame structure could be reinterpreted for increased material efficiency.

This structure relocates the sheathing to the inside of the studs, where it also acts as finish surface. This requires a new type of corner configuration to achieve continuity of shear resistance. The weathering surface is reduced to a single film of heat-shrink membrane. Apertures press outward on the membrane to hold it clear of wall insulation. The plywood material used in the project was reclaimed from a gallery exhibit of the work of the Ant Farm artist’s collective, which influenced the forms of the apertures and the membrane skin is evocative of their work with inflatable structures.

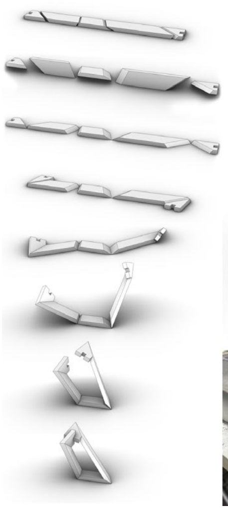
Computational methods were employed to generate the aperture forms, as well predict the surface geometry of the membrane. A script was written to generate the aperture forms and to distribute their locations across the wall surfaces. This script also output 2d patterns that were used in the fabrication process. A second script, using a computational dynamic relaxation routine, was used to predict the surface geometry of the membrane for accurate design renderings.

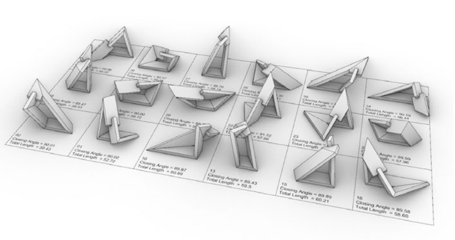
SCULPTURE PRACTICE

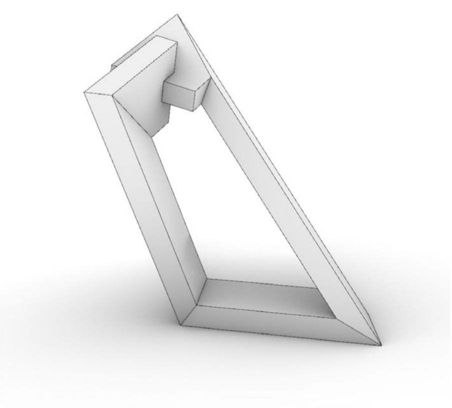
Location: Torrington, CT
2023

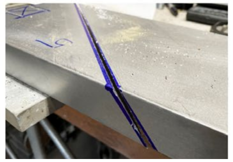
folded tube

welded aluminum tubing
Rhino3d
Grasshopper3d
Galapagos evolutionary solver
Octopus multi-objective genetic solver









Many of the sculptures that I create are the outcome of playing a particular geometrical game. This piece began with a simple premise: working with one fixed length of rectangular tubing, would it be possible to make a series of bends that would result in the material wrapping back to itself, with the ends intersecting at exactly 90 degrees to each other? And would it be possible to do this with zero material waste?

To solve this problem, I wrote an algorithm that will geometrically construct the sculpture from four points in space. These become the center points for compound miter cuts. A length of tubing is cut, alternating parts are rotated 180 degrees, and then reassembled to bring the ends back together. The end components slightly overlap, for the strongest visual reading of the 90-degree relative rotation.

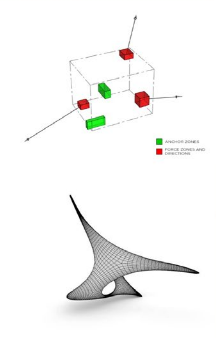
I designed the algorithm to allow me to measure the overall length of the tubing, the relative rotation angle between the end positions, and whether the center of gravity of the piece falls directly over the base, which will allow it to be stable and stand. Very small changes in the locations of any of the four points will significantly change these outcomes.

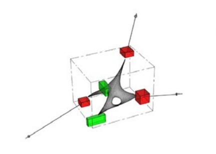
This design is only one solution out of an infinite number of other configurations that would also satisfy the design goals. Rather than search for them through a time-consuming trial and error process of manually moving points, I use a genetic solver to automate the search for other solutions.

See https://bobpavlik.com/folded-aluminum-wip/
for video animations.

SCULPTURE PRACTICE

Location: Torrington, CT
2023





de-optimizations

carbon fiber cloth/epoxy resin
phenolic microspheres
extruded polystyrene foam (EPS)
Rhino3d
Grasshopper3d
Millipede 3d
RhinoCAM

This carbon fiber piece was designed using software that is intended for structural optimization. This software determines the most minimal way to orient material in space, to transmit a given set of forces to support points. It is used in high performance applications, where minimal material use is critical, typically for weight savings. Here I am using it as a purely aesthetic tool, using it to generate three-dimensional forms. I refer to this as “de-optimization,” as I am using a system intended for maximizing efficiency and using it in an inherently inefficient manner.

The three-dimensional form was sliced into layers in the computer model, each of which was then CNC milled from EPS foam and stacked/glued into the overall form. This foam core was then coated in a thin epoxy filler layer, to sand out any low or high spots. It is now in the process of having carbon fiber cloth laminated to its surface with a vacuum bagging process. The final sculpture is extremely lightweight.

SCULPTURE PRACTICE

Location: Torrington, CT
2023

fast fuse

welded steel tubing
steel plate
concrete
Rhino3d
Grasshopper3d

This steel sculpture is composed of four independent poly-lines, each three segments long, that trace through space. They converge in a parallel bundle at the core, being in perfect alignment and spacing, before their end segments diverge off into distinct directions. Several of those end segments are in perfect alignment in space, even though they are not physically connected. Others are perfectly parallel but exist along separate spatial vectors.

The composition has a dual reading. From some angles the tubes appear densely grouped, looking like they may even be stacked face to face. From other angles, the spaces between them are revealed, and each of the four lines seems to hover independently in space, with no visible connections between them. The bright red color and high gloss finish help with both of these readings. The high reflectivity can play visual games with depth perception distinguishing one segment from another. The vibrant hue stands in stark contrast to any backdrop, allowing the poly-lines to crisply register.

The sculpture is constructed of welded steel tubing. The joints are complex compound miter cuts, which were determined through a computational digital design method that allows for control of simultaneous alignments and spatial twists. The weld connections were ground smooth, and the sculpture finished in automotive urethane paint.

SCULPTURE PRACTICE

Location: Torrington, CT
2022

vapor line

welded steel tubing
Rhino3d
Grasshopper3d

In this sculpture, a continuous line of steel winds through space. At each joint, the rectangular steel tubing intersects at a unique, complex angle. Each joint is a compound miter, which requires a complex and accurate cut in two angled directions simultaneously. The pieces that directly attach to the flat base are all perpendicular, parallel, or in straight alignments with each other. As the pieces expand upward into space, they freely angle outward, each in its own independent direction. The center-most piece that's up in the air is also in perfect straight alignment with the longitudinal pieces that are down at the base. In two locations the vertical members narrowly avoid a collision, with a very small space between them. Achieving these compositional effects required using a parametric computer model, to carefully plan the path that the steel traces through space and to generate the precise angular cutting dimensions.

The line is painted light blue, to mimic the color of air. When viewed against the sky, it melts into the background and dematerializes. The automotive paint on its surfaces is polished to a high gloss, which adds to that effect. When viewed against a wooded background, that reflectivity brings a trace of the sky down into this scene. While the piece is highly angular and geometric, maybe almost aggressively, its color and its finish contradict and soften that reading. As you move around the sculpture, especially back a slight distance, you might notice where some of these vertical pieces briefly appear to become parallel to each other, even though they are not.