The Hylomorphic Project

Open Source Architecture's participation at The GenHome Project
MAK Center, Los Angeles, 2006

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Open Source Architecture, Los Angeles › Chandler Ahrens, Aaron Sprecher, Dr. Eran Neuman

With:

Prof. Kristina Shea › structural engineer, Cambridge University, Great Britain
Dr. Marina Gourtovaia › EifForm software developer, Cambridge University, Great Britain
Prof. Clay Chaplin › Musician, California Institute of the Arts, Los Angeles
Heather Libonati › Lighting Designer, Los Angeles

Abstract:

In the Hylomorphic Project, Open Source Architecture (OSA) aims to research and develop new software and methodology for advanced computational design, which will be tested in an installation in the exhibition "The Gen[H]ome Project: Genetics and Domesticity" to be opened in the MAK Center for Art and Architecture in Los Angeles on March 2006. Together with structural engineer Prof. Kristina Shea of Cambridge University (UK), OSA develops genetic algorithms based in computational environments as a methodology for form finding in architecture. Referring to advanced technologies, OSA seeks ways to apply complex computational procedures in architecture in order to advance the discourse on computation beyond formalistic representations. As such, the project is part of a continuous academic research that draws great attention in contemporary architectural discourse and presented throughout the world in several exhibitions and conferences: the AIA Fabrication (2004), SoftSpace at Rice University (2004), and the Fonds Regional d'Art Contemporain (FRAC) Collection in France (2005, upcoming).

Proposal Context

- Context › The GenHome Project, MAK Center, Los Angeles

From the 1990s, avantgarde architectural discourse and production referred to new technologies in natural sciences to redefine new paradigms in architecture. Most notably among those addressed biological procedures were architects that referred to theoreticians such Rene Thom and D'arcy Thomson to enrich their discourses. Both theoreticians offered an alternative to the traditional scientific model, accounting qualitative rather than quantitative scientific datum. These accounts allowed artistic disciplines to apply ideas from science in the respective fields. Accordingly, architects implemented procedures from the biological research fields in architecture, attempting to develop a critical mode of operation in avant-garde architectural productions. Addressing, among others, issues of bio-mimeticism, examining molecular structuralism, or searching for ways to synthesize organic and inorganic tissues, the above mentioned architects mostly investigate the ways in which biology can operate and be generative in architecture. They attempt to create architecture as nature - architecture that is nature.

Referring to the genetic in architectural discourse, the exhibition Gen[H]ome Project wishes to broaden and specify several related issues. It proposes to review, theorize and present recent developments in biology and science applied in art and architecture. The visual and spatial arts have always turned to the life sciences in order to examine the mutual conceptual and operative relationships among the different fields. From the Modernist application of natural symbolism such as in Victor Horta's architecture, through Buckminster Fuller's appropriation of structural skeletons, to the Postmodernist replication of life imagery such as in Frank Gehry's Horse Head or Andy Warhol's iconic representation of human organs (Hearts series), art and architecture have used the life sciences to enrich their disciplinary scopes. Yet, the evolution of the life sciences in recent years brought about changes in the mutual influences among the different disciplines. The progression in the mapping of the human genome, the technological developments in medical and biological research and the genetic modification of plants, among others, changed the ways in which life sciences are appropriated in the arts.

The Gen[H]ome Project will present several recent works that reflect these changes in the perception of sciences in the arts. It will show that such changes are not only a result of evolution caused by the development in the different fields, but also that they signify a paradigmatic shift in the relationship among them. The infiltration of contemporary developments in biology into art and architecture triggered disciplinary transformations such as the redefinition of domesticity and notions of interactivity. Architectural and artistic objects no longer merely imitate and simulate natural structures and forms. They no longer purely apply natural structures in architecture, nor do they represent life in art (such as in the artificial creation of nature in Las Vegas). The infiltration of new concepts of life sciences into the arts has led to the collapse of old dichotomies. For example, the distinctions between object and subject, organic and inorganic matter, artificial and virtual existence, are increasingly blurred. The nature of architectural and artistic materiality cannot be defined lucidly, nor can the functionality of architectural systems. The artistic and architectural disciplines have changed their scope and nature of operations.

The exhibition will use the unique site of the Schindler house in conjunction with the MAK Center in order to demonstrate these changes. Thus, it will exemplify ongoing shifts in architecture that have transformed the discipline from a system of operations to an operational system, from representing scientific ideas to incorporating them, from treating matter as a system of information to using information as a generator of matter and from perceiving the human subject as a cyborg to integrating the organic and inorganic elements.

' Project > The Hylomorphic Project

When in 1932, Ludwig Wittgenstein called for a transformation of our language as a fundamental step to understand the human reality; artists - such as Moholy Nagy and Hannes Meyer - were producing works that aimed to investigate such new languages stemming from emerging techniques. Similarly, our current condition requires a redefinition of the architectural operational tools in order to create an adapted language to our ever-transforming reality.

Whilst Architecture has been constantly referring to the relation between subject and object, man and nature, sign and physical presence, the central architectural material remained intact from one period to another. In the light of its history and our present condition of mutation, The Hylomorphic Project aims to create a new form of language. Whereas most Computer Assisting Design software presumes a certain architectural assessment, they all contain latent styles and ideologies that powerfully condition each object constructed with them. These styles and ideologies do not necessarily modify or transform the discipline of architecture because they have little knowledge of such an idea. In this project, the computational codification represents an opportunity to create a language that transgresses the existing nature and codes of past architectures, blurring the dichotomy between subject and object, in favor of an unstable yet optimal architectural model.

The Hylomorphic Project aims to create a new procedure for an architectural endeavor that does not search for an ideal model - as a fixed condition - but rather a multiplicity of equally efficient yet morphologically different models. This project aspires to disassociate a number of common formal and structural techniques from the milieu of any particular field while enforcing the visual sensitivity emerging from techniques rather than figuration.

Proposal:

Our proposal is to research and develop new software and methodology for advanced computational design by developing an installation that visually, audibly and tactically examines new techniques of digitally conceived, generated and fabricated architecture. The installation is based on an addition to the Schindler house in the form of a temporary lightweight canopy in the main courtyard. The design of the canopy stems from the use of specific digital technologies, in particular a computational genetic algorithm known as EifForm, developed by Professor Kristina Shea at Cambridge University, Great Britain. EifForm is a stochastic optimization software that is based on a cost efficiency model analyzed through an iterative process. Once a base condition is established, the software runs multiple iterations and then analyzes them to determine a best scenario. The initial design of the canopy, based on the structural parameters of the existing house, will be computed in EifForm and an optimized solution will be determined.

The design process of computational optimization is recorded and an animation of the event will be projected onto the canopy surface and onto an adjacent wall. The playback of the generation process visually documents the design process. Simultaneous to the projection of the animation of EifForm at work, the design process is examined audibly. Clay Chaplin, a composer and professor of music at the California Institute of the Arts in Los Angeles, develops software that reads data and is able to assign notes and sounds. For the

Hylomorphic Project, he will develop software that transforms the streaming data generated from EifForm and reinterprets the data into music.

The visual projections and the audible analyzation of the design process are combined with the physical embodiment of the result of the process, the canopy itself, to create the installation. The installation is result of interdisciplinary procedures, creating in a multi-sensory environment that examines new methodologies for advanced computational design.

Final Product:

The final product consists of an installation that documents the design process, interprets the data produced during the genetic algorithm calculation, and culminating in a physical embodiment of the canopy. The exhibition will be open for 2 months. The design process will be documented by projecting animations of the EifForm software calculating the optimized structural iterations onto the canopy itself or on an adjacent wall. The software creates approximately 200 iterations of a design, which it analyses to determine the optimal structure. We are able to record a rendered image of each iteration in plan, elevation and axonometric view while also showing the generated data. We compile each view into an animation that literally shows the genetic algorithms in software generating an optimized solution. (Please see additional images at the end of the application).

Simultaneous to the projection of the animation, music that is composed relative to the data generated by the genetic algorithm software will play. Clay Chaplin, a professor of music at the California Institute of the Arts in Los Angeles, develops software that reads data and is able to assign notes and sounds to create a composition. The streaming data generated from EifForm will be processed through his software and the result will be the reinterpretation of data into music.

The design process culminates in the physical embodiment of the canopy itself. The optimized design of the canopy is generate by EifForm and the result is a topographically varied triangulated surface. The surface varies in height from 2ft above grade to 12 ft. The edge of each triangulated surface is one structural member made of wood. At the vertexes of the triangles, steel joints fasten the structure. In the design, there are 55 joints and each one is specific to the required geometry. The wood structure is then clad in fabric and photovoltaic thin film. Each triangular surface will be clad in either polyethylene fabric or photovoltaic thin film. The photovoltaic film will be wired so that the electricity gained will help to power the computers and projectors.

Work Plan and schedule:

July 2005 > initial design
August to October 2005 > fabricate prototypes/ test design feasibility
October 2005 > design finalized
November 2005 to February 2006 > music composed by Clay Chapman
November 2005 to February 2006 > fabrication of components
February 2006 > installation of exhibition
March 2006 > exhibition opening

Materials List:

The dimension of the canopy is 22 x 17 ft and the maximum height is 12 ft.

- Structure:

The structure consists of Douglas Fir straight members that connect at CNC fabricated wood joints. The wood structure relates the material and structure of the existing R.M. Schindler House.

Douglas Fir wood members, 500 linear feet
Steel joints, 55 joints

Wood Columns, 150 linear feet
Fasteners

- Fabric:

The wood structure is configured into a series of triangles, which will be clad in one of two different types of fabric. The materials are approximately evenly distributed on the surface of the structure.

The first material a polyethylene fabric produced by Dupont called Tyvek Housewrap and is commonly used in residential construction to wrap building and provide a weather barrier. The fabric is white in color and allows a degree of indirect light through.

The second material is a photovoltaic thin film, which is a flexible film with integrated photovoltaic cells that produce electricity that can be used to assist in powering computers and projectors. Solar Integrated Technologies is an international technology manufacturing company that has is US headquarters located in Los Angeles.

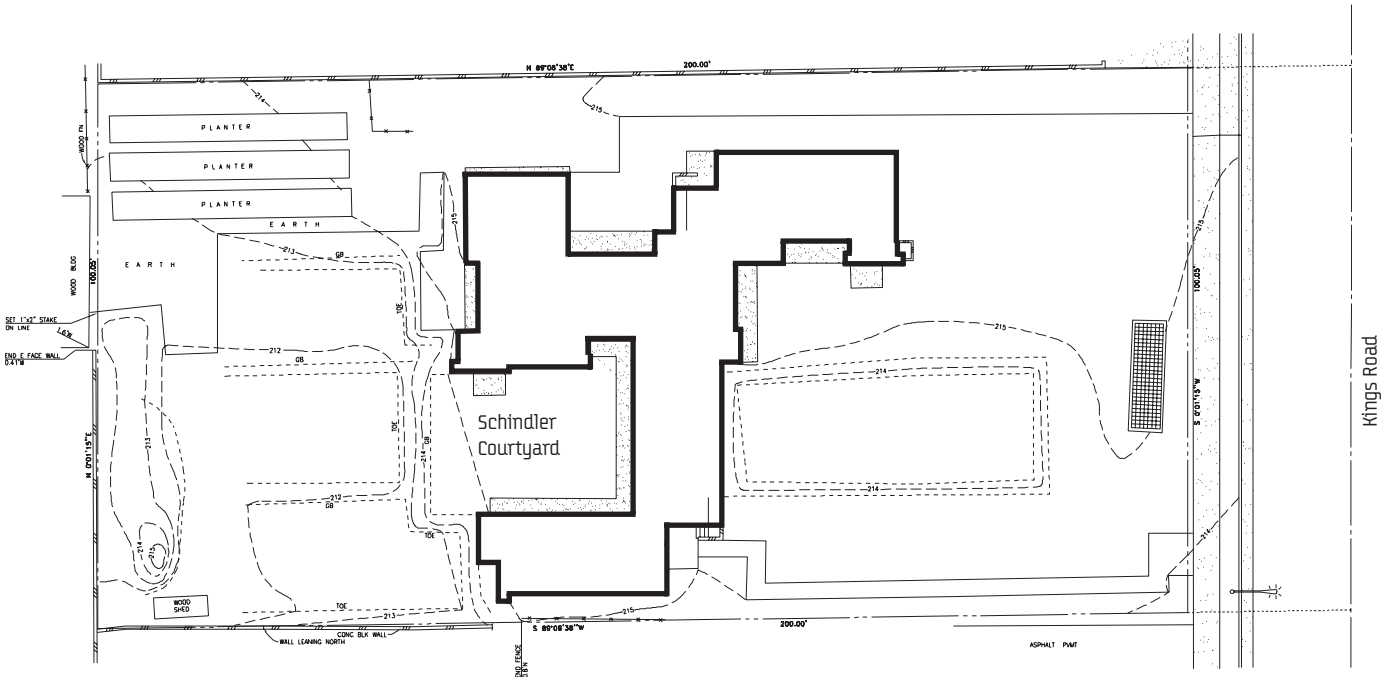
Tyvek Housewrap, 220 sq. ft.
Photovoltaic Thin film, 220 sq. ft.

- Environment:

The environment of the installation is created by projections of the animations describing the design process, music composed relative the data produced during the design process, and general lighting.

LCD projectors, 4 units
CPU, 5 computers to run animations and music
Lighting

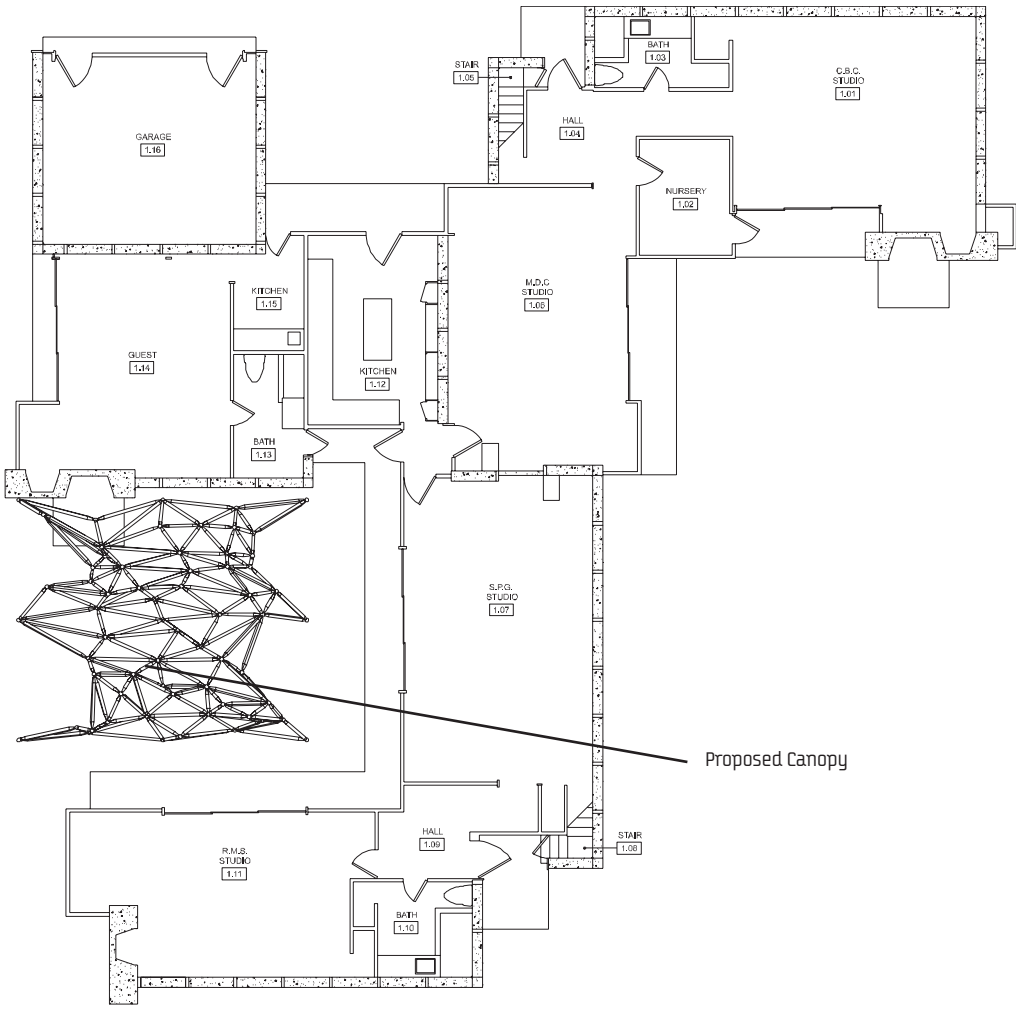
Images from animation - quadrant view: plan, elevation, axonometric, and data



Site Plan

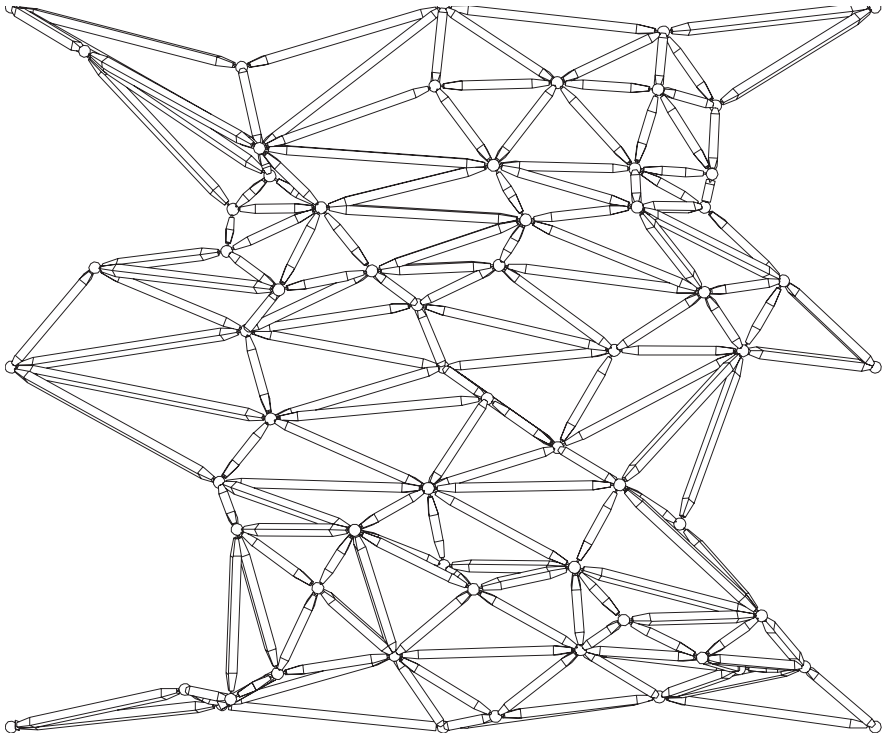
MAK Center for Art and Architecture
R. M. Schindler House
835 North Kings Road
Los Angeles, CA 90069

West Elevation

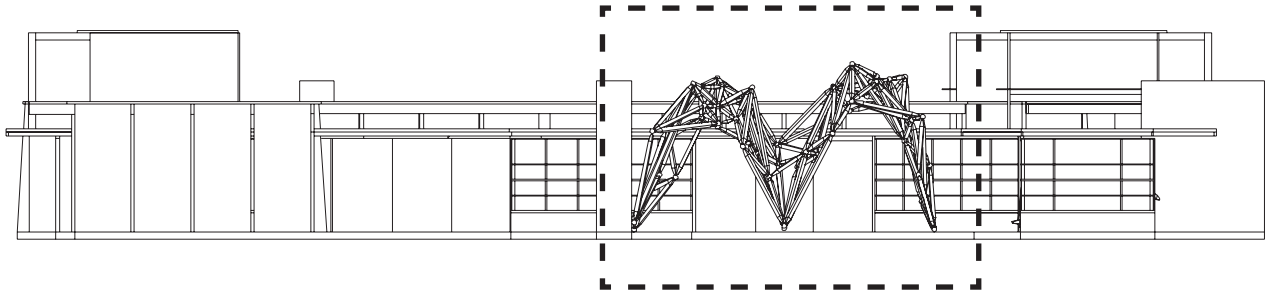


1 2 5 10

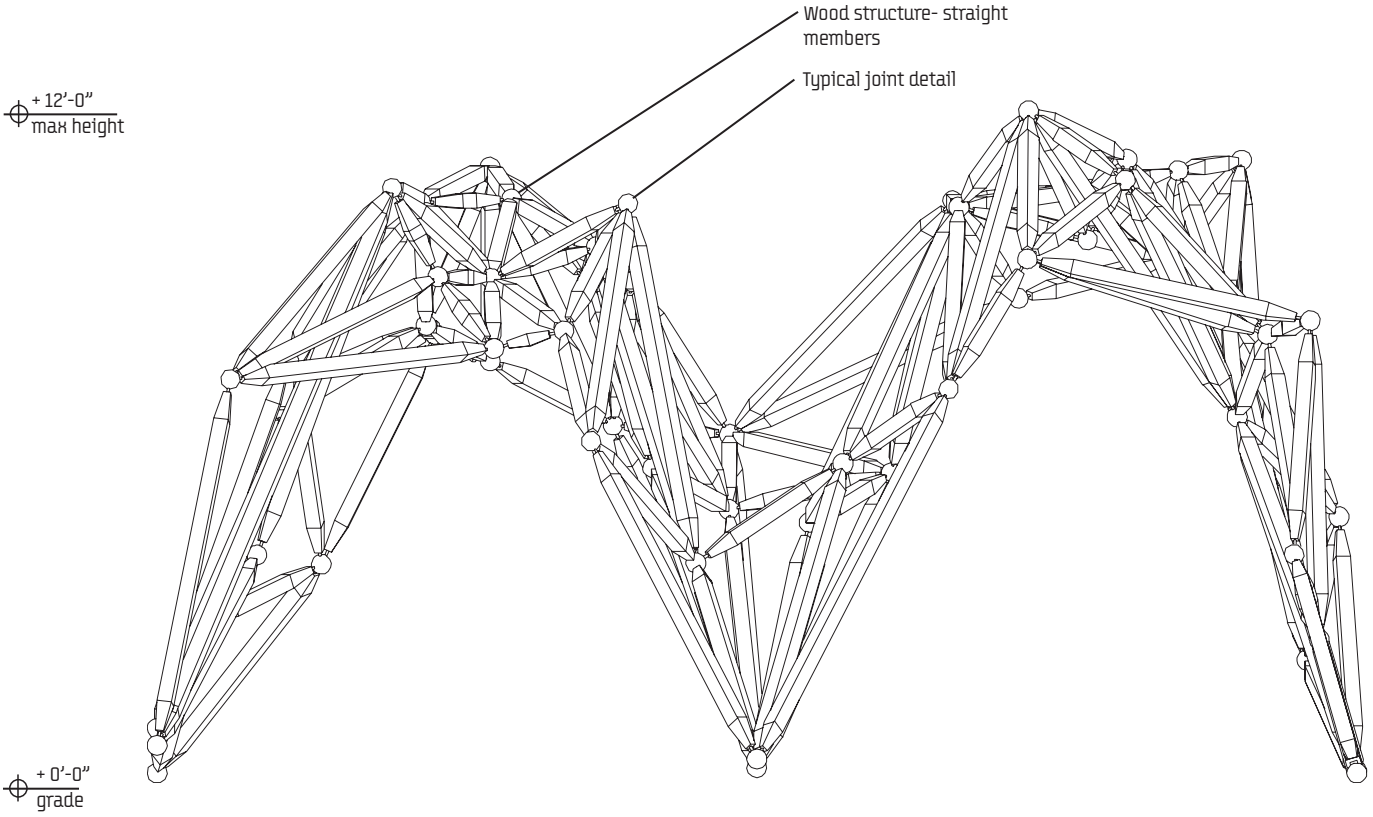
Floor Plan



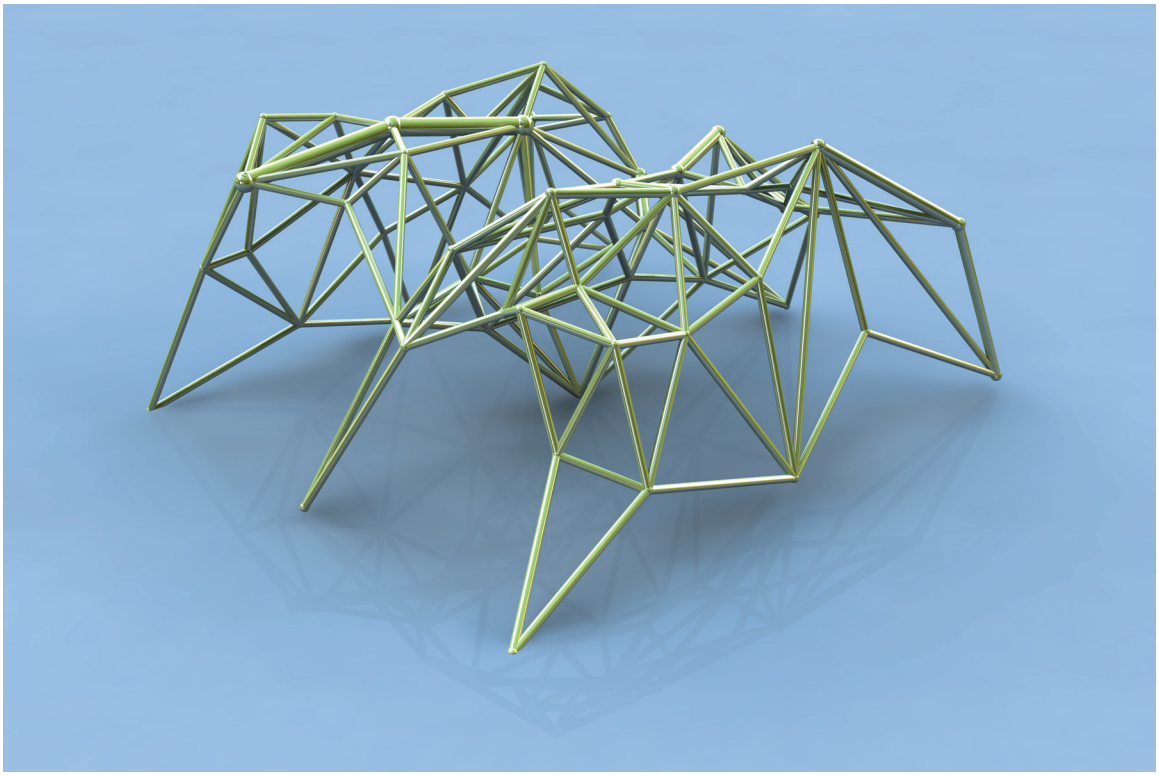
Enlarged Plan

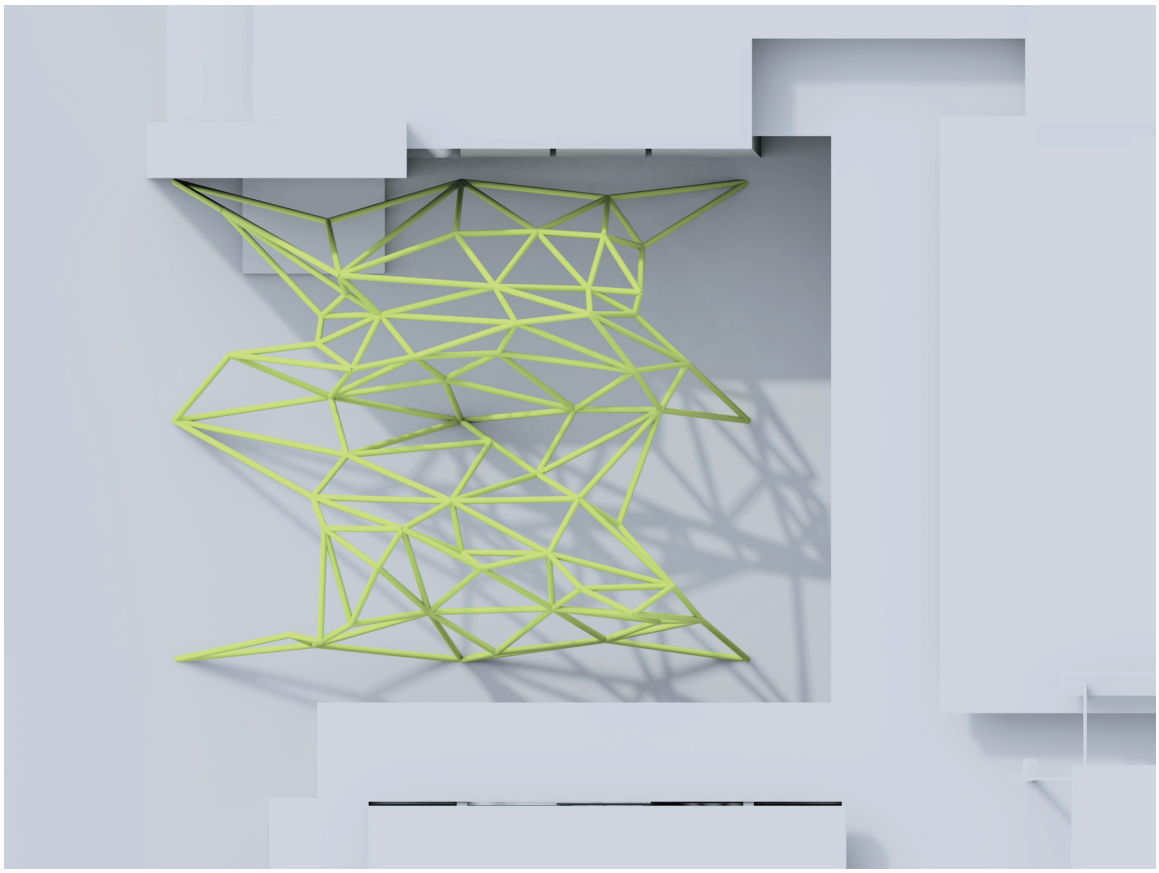


West Elevation

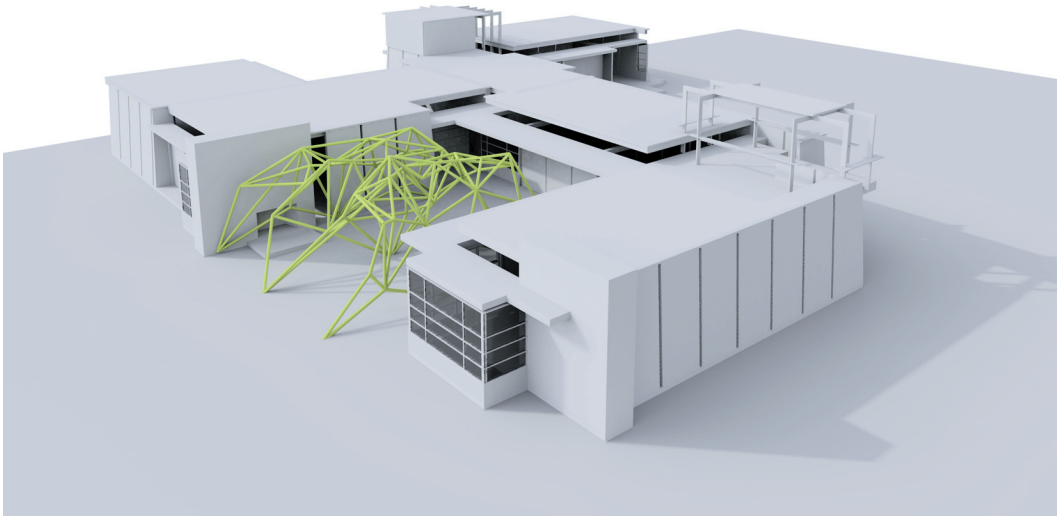


Enlarged Elevation

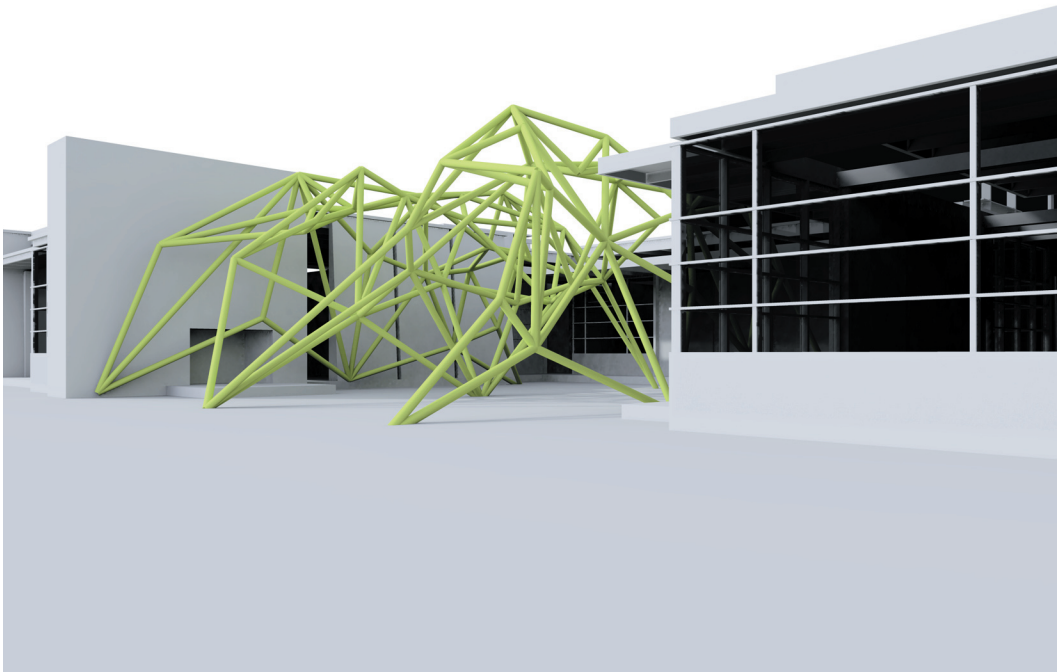




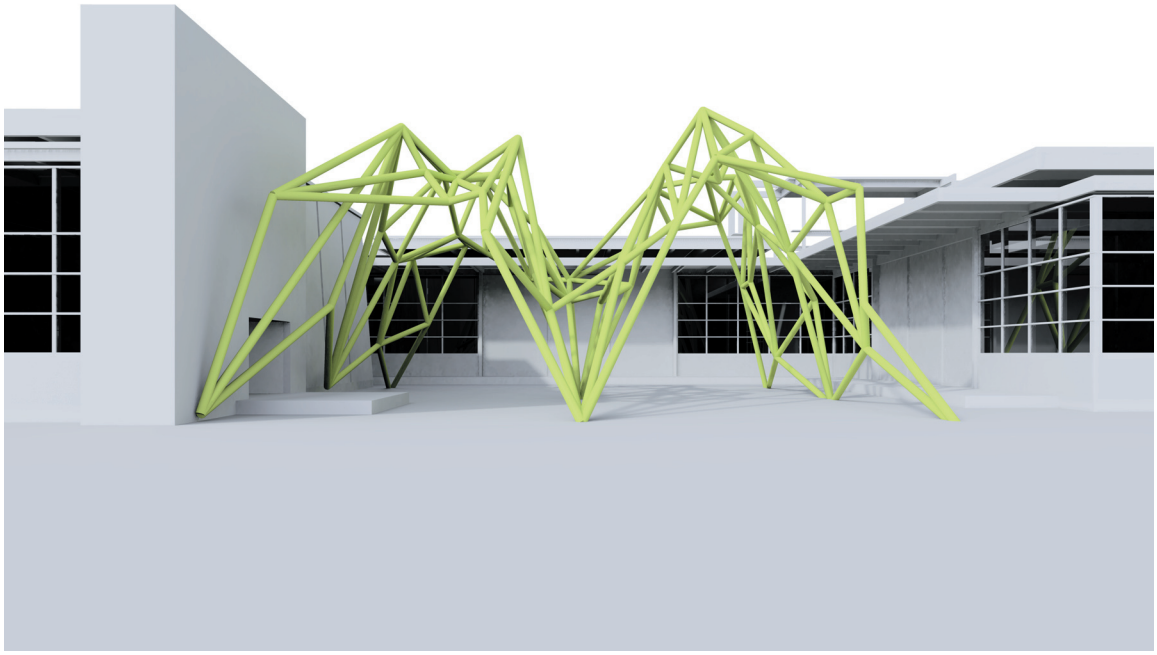
Roof Plan rendering
canopy structure only



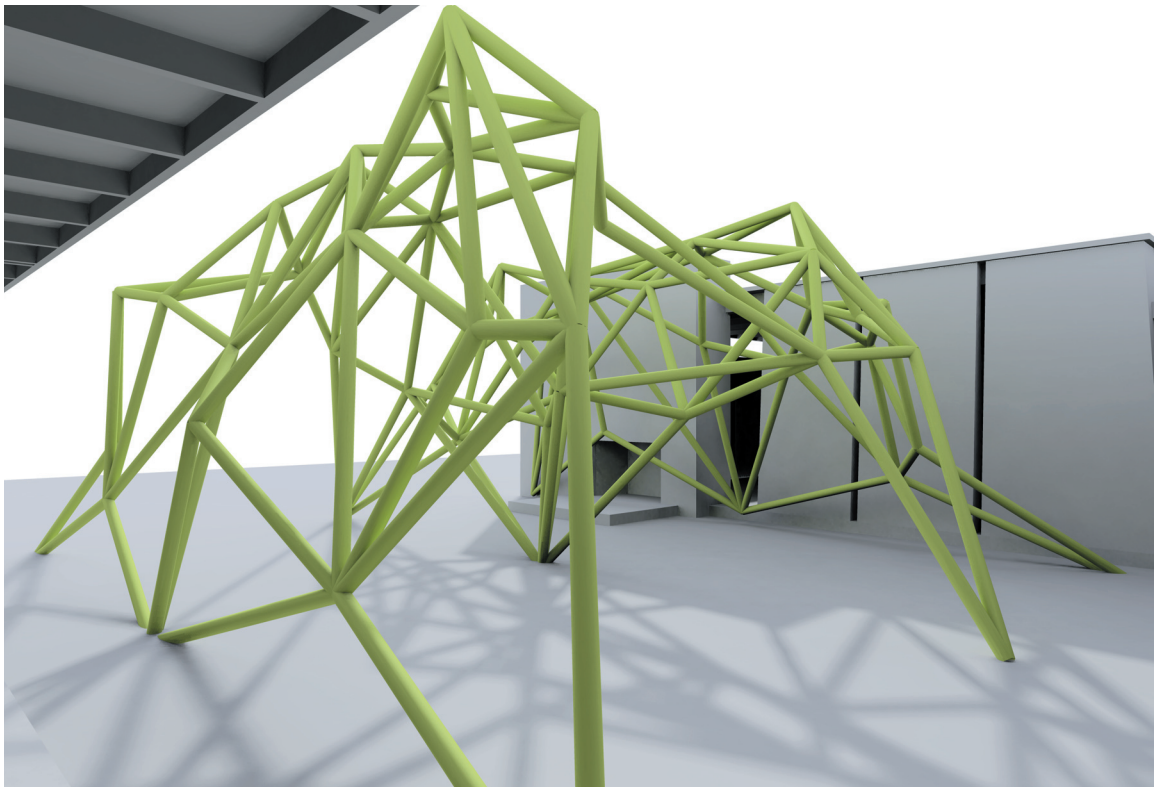
Aerial Perspective



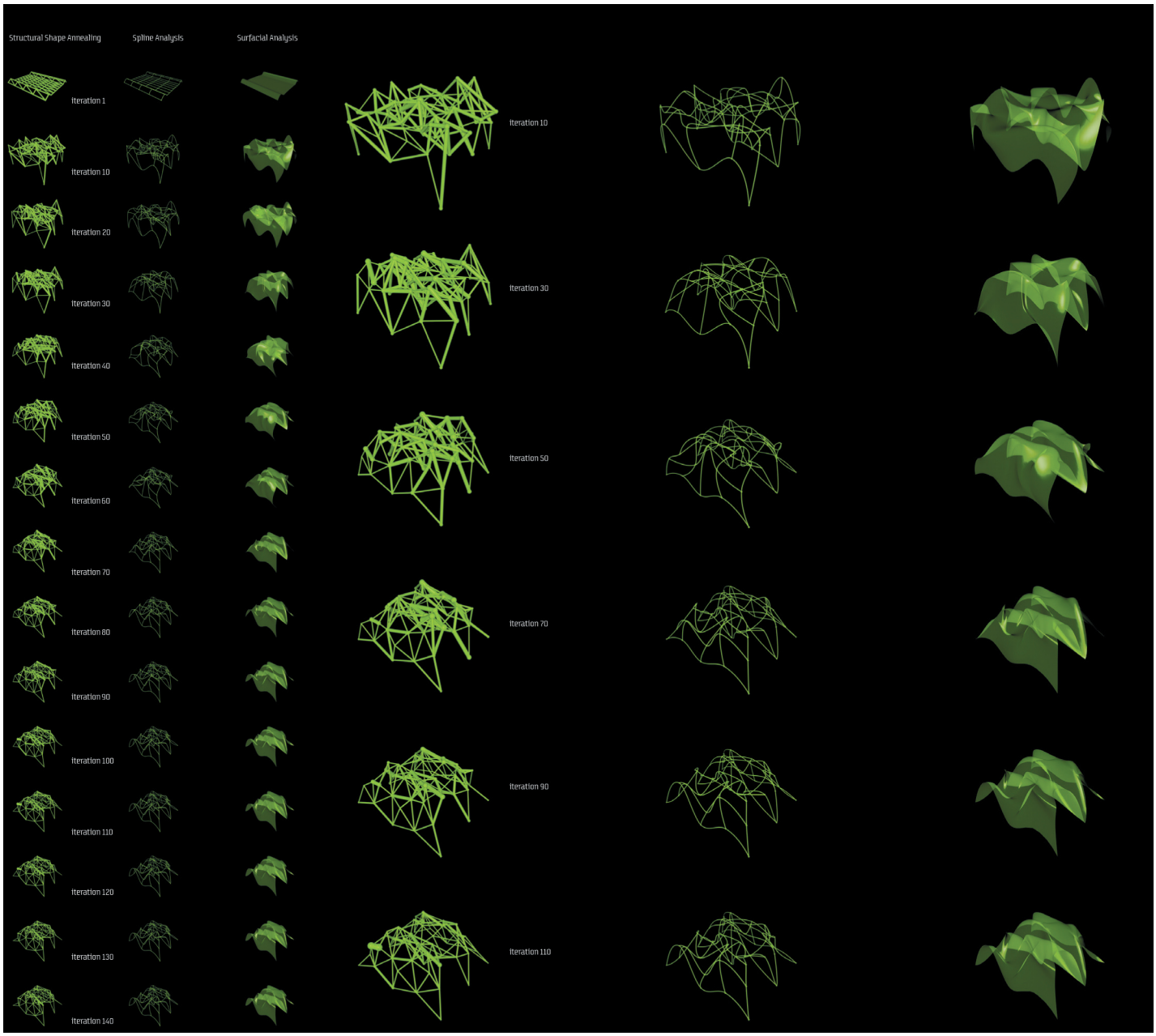
Perspective from southwest
canopy structure only



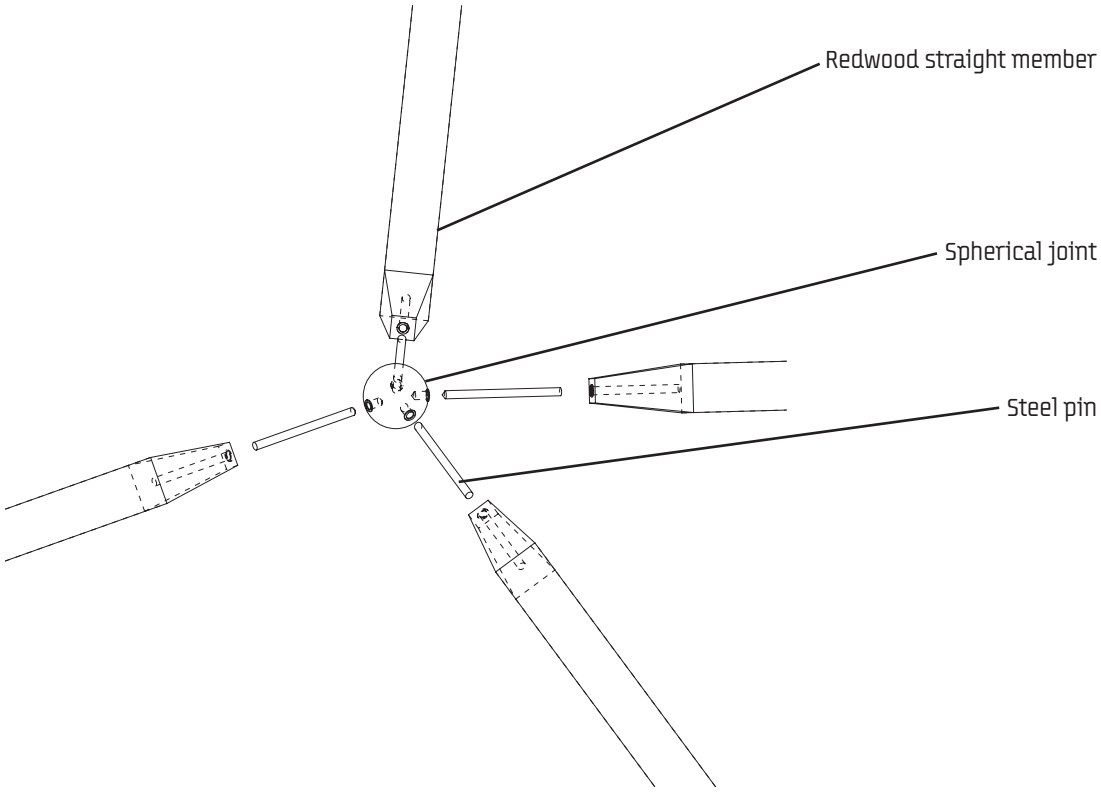
Perspective into courtyard
canopy structure only



Perspective from courtyard
canopy structure only



view ofEifForm iterations



Axonometric of typical joint

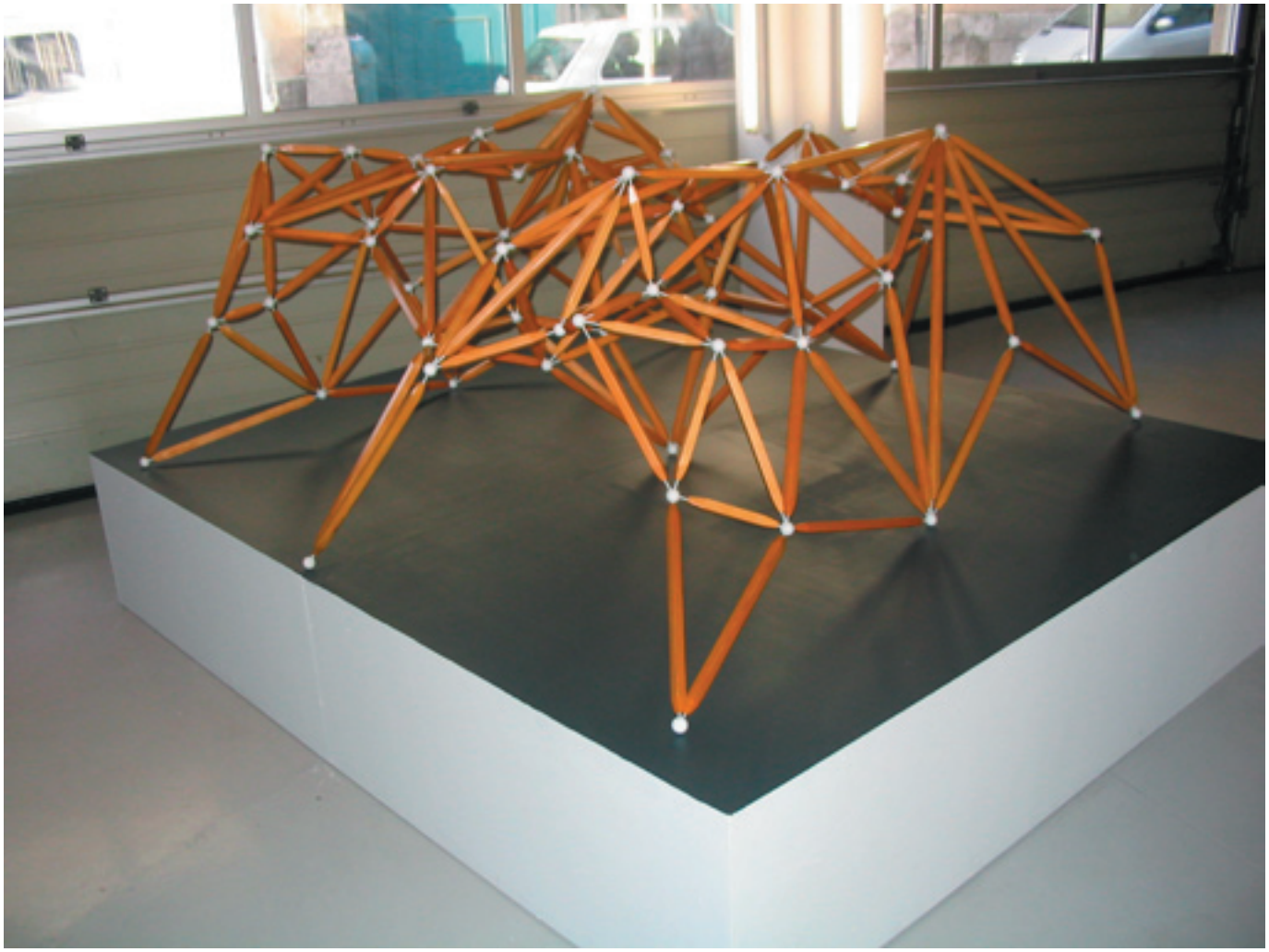


PHoto of prototype at the
FRAC Centre