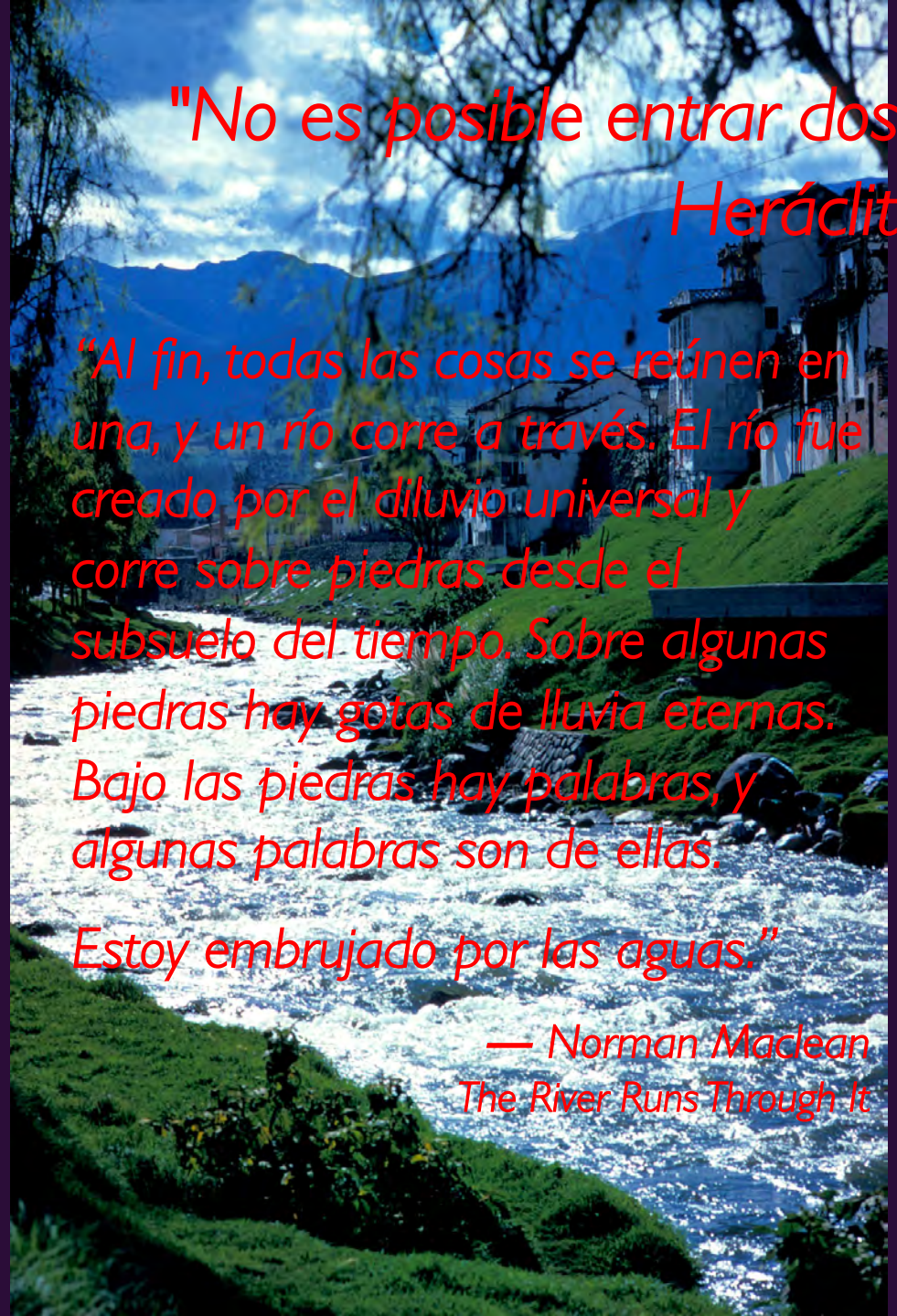
"No es posible entrar dos veces en el mismo río." — Heráclito, frag. 91

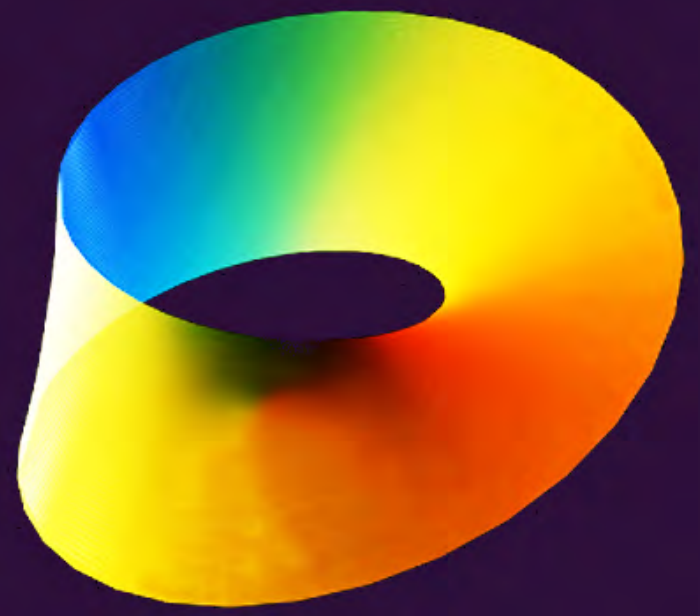


"Al fin, todas las cosas se reúnen en una, y un río corre a través. El río fue creado por el diluvio universal y corre sobre piedras desde el subsuelo del tiempo. Sobre algunas piedras hay gotas de lluvia eternas. Bajo las piedras hay palabras, y algunas palabras son de ellas.

Estoy embrujado por las aguas."

— Norman Maclean
The River Runs Through It

ecologías entrelazadas



- **bioenergética**: *economía de energía y materiales*
- **ecosofía**: *economía de ideas e información*

'Forma, sustancia y diferencia'

Pasos hacia una ecología de la mente

— Gregory Bateson

álvaro malo 06.2017

¿convergencia ó divergencia de naturaleza y propósito consciente?

economías entrelazadas:

1. **bioenergética,** economía de energía y materiales — un arrecife de coral, un bosque de pinos ó una ciudad — se trata de intercambios físicos, limitados al nivel termodinâmico …
   entropía, negentropía: presupuesto aditivo y substractivo (±)

2. **ecosofía**, economía de ideas, information y communication — se trata de redes y probabilidad, tiene límites fluídos que circumscriben pero no cierran el flujo…
   inteligencia, cibernética(IA): presupuesto fractal y multiplicativo (/x)

Gregory Bateson, *Pasos hacia una ecología de la mente,* "Forma, sustancia y diferencia"

¿convergencia ó divergencia de naturaleza y cibernética?

niveles de organización:

1. **trama**, estructura estática, armazón, 'rompecabezas'
2. **mecanismo de reloj**, movimiento predeterminado
3. **termostato**, circuito de retroalimentación, homeostasis
4. **célula**, vitalidad, transformación (conversión) de materiales y energía — metabolismo
5. **planta**, especialización, sociedad celular, sensación rudimentaria — tropismo
6. **animal**, sociedad de órganos, sensación refinada, locomoción, comunicación, aprendizaje, consciencia de sí mismo, emoción
7. **ser humano**, sensibilidad 'interior,' razón, lenguaje, ética, estética, libre albedrío
8. **sociedades**, roles jerárquicos, sistemas de comunicación/interactión, biomas
9. **sistemas trascendentes**, cosmos, ordenes inmanentes

Kenneth Boulding, *The Image: Knowledge in Life and Society* "Theory of Organization"

- **extensión** ∞ estar en el espacio
  - tener propiedades espaciales
  - objectos experimentados por el cuerpo @ colección de los sentidos

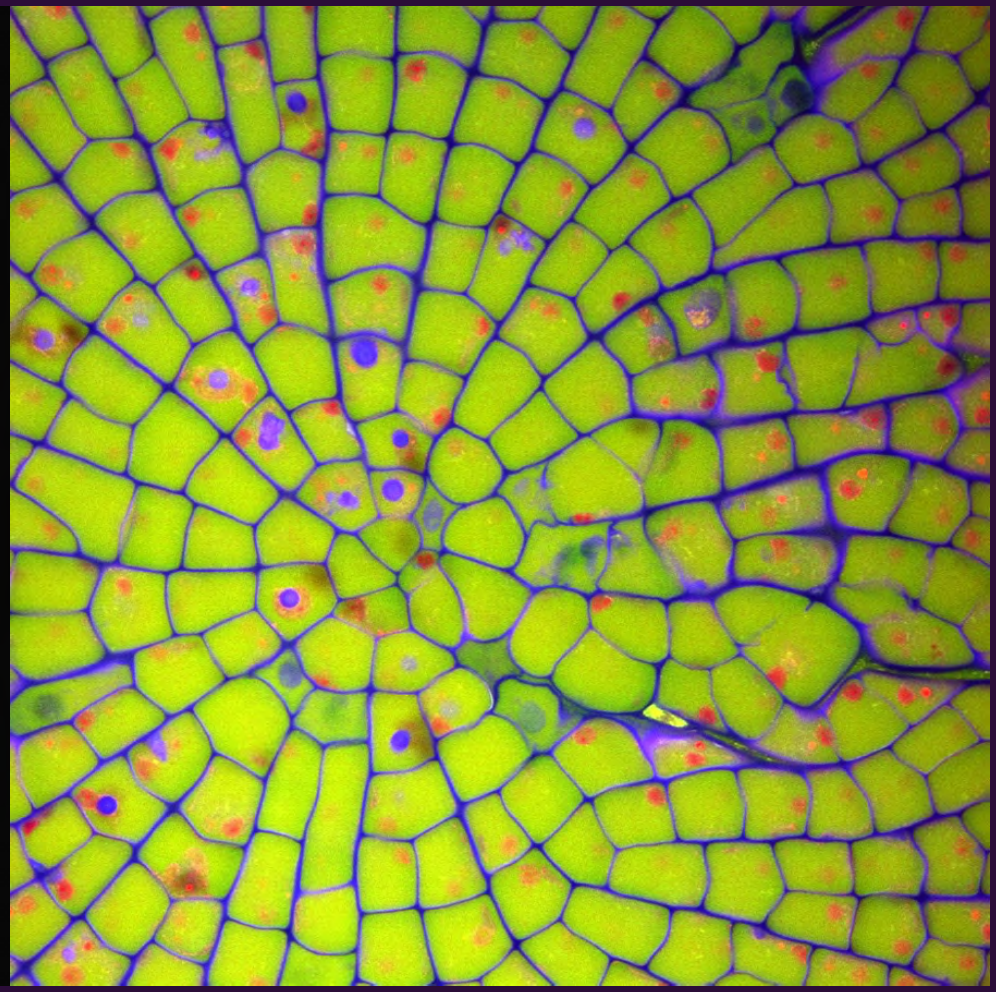
espacio ~ forma de sensibilidad externa [Kant CPR]

- **sensación** ⇉ registro de objects externos @ aperturas sensoriales
- **percepción** ⇉ interpretación y síntesis de sensaciones

- **intensión** ∞ ser en el tiempo
  - tener propiedades temporales
  - objectos experimentados por la mente @ estados afectivos internos

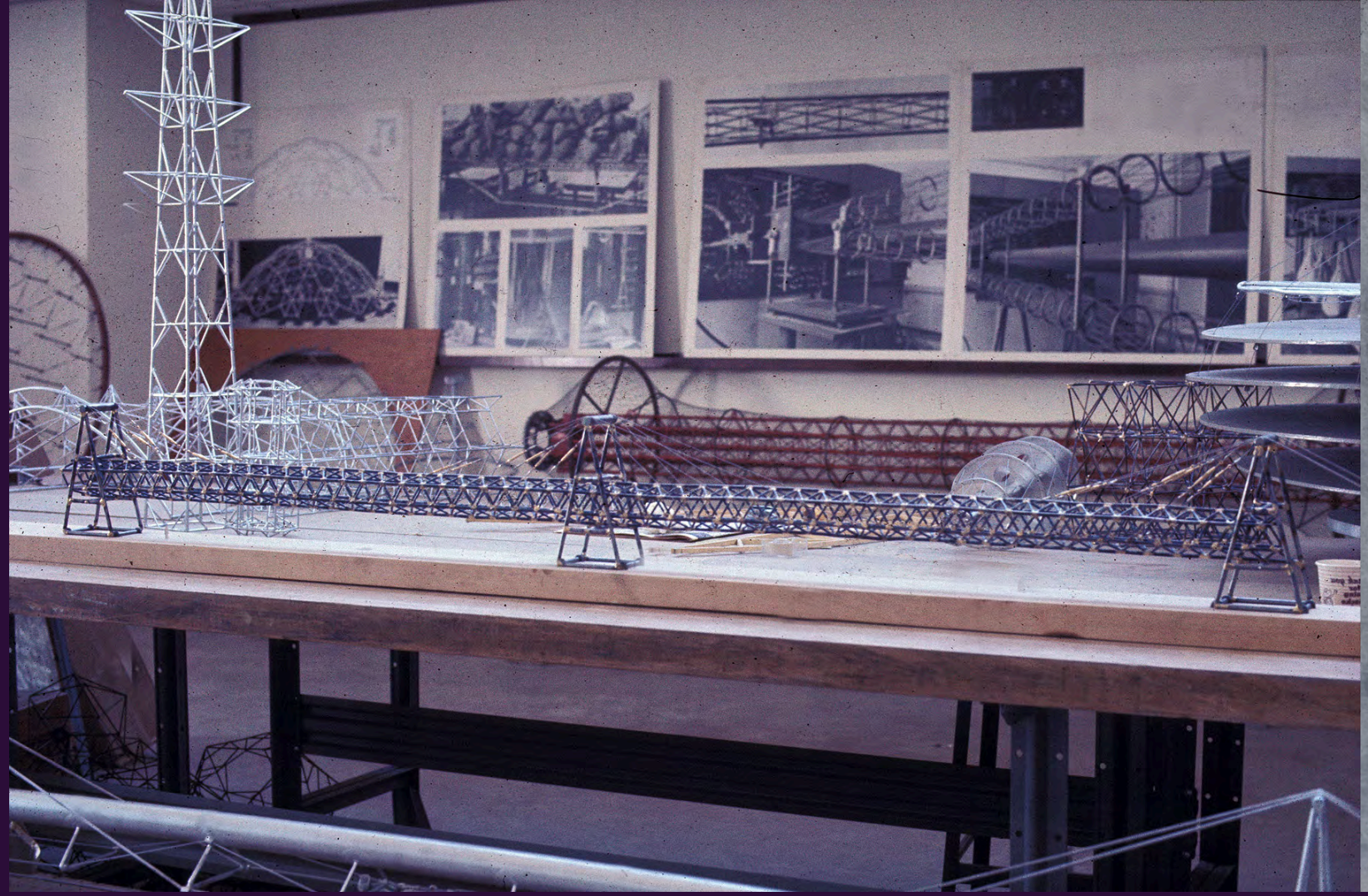
tiempo ~ forma de sensibilidad interna [Kant CPR]

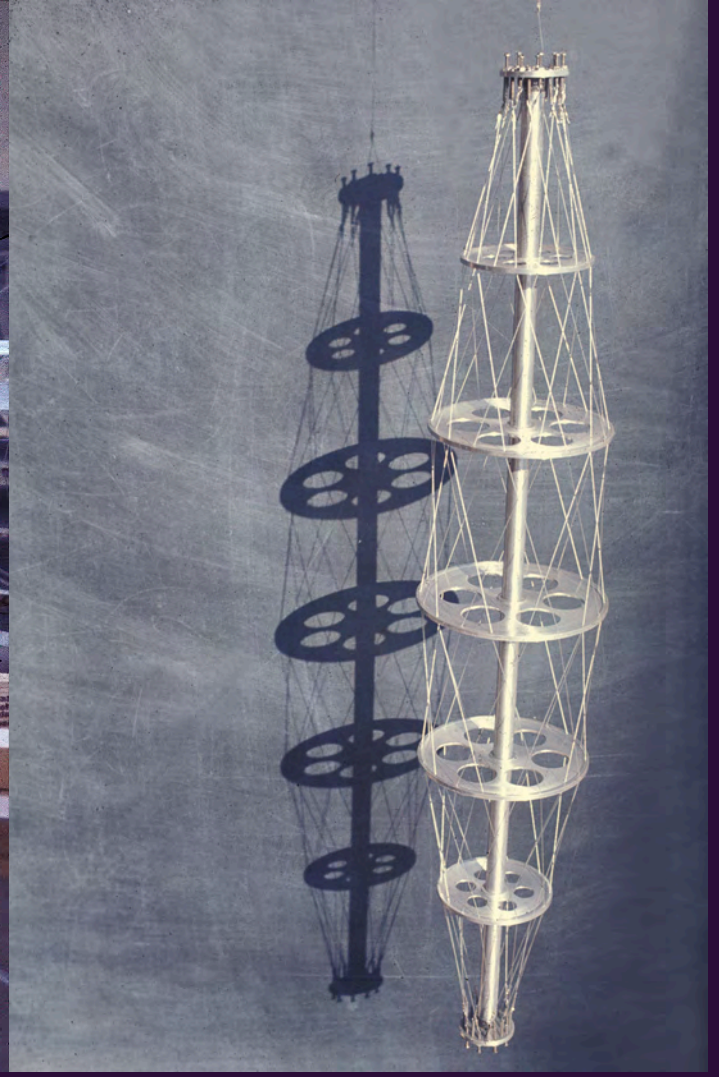
Immanuel Kant, *Crítica de la Razón Pura*, "Estética Trascendental"



ser humano en el ambiente…diseñar con la naturaleza

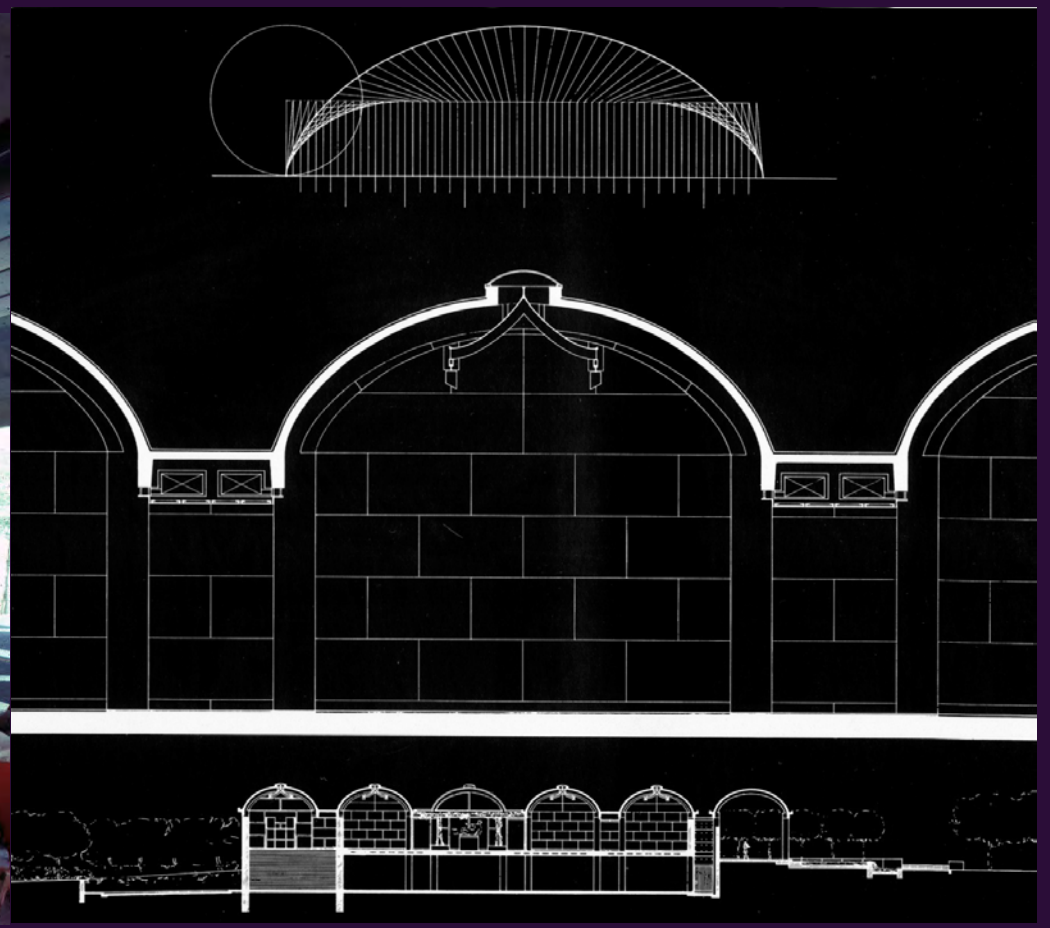
Ian McHarg, Design with Nature @ penn, 69-71





…peso cero, luz infinita

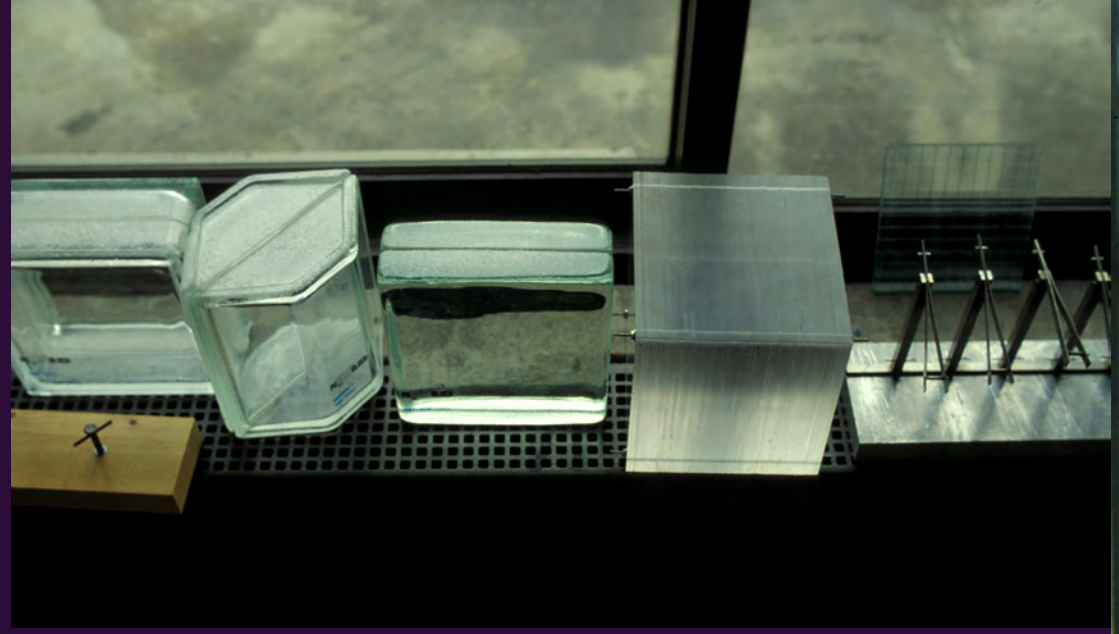
Robert Le Ricolais, Laboratory of Experimental Structures @ penn, 69-71

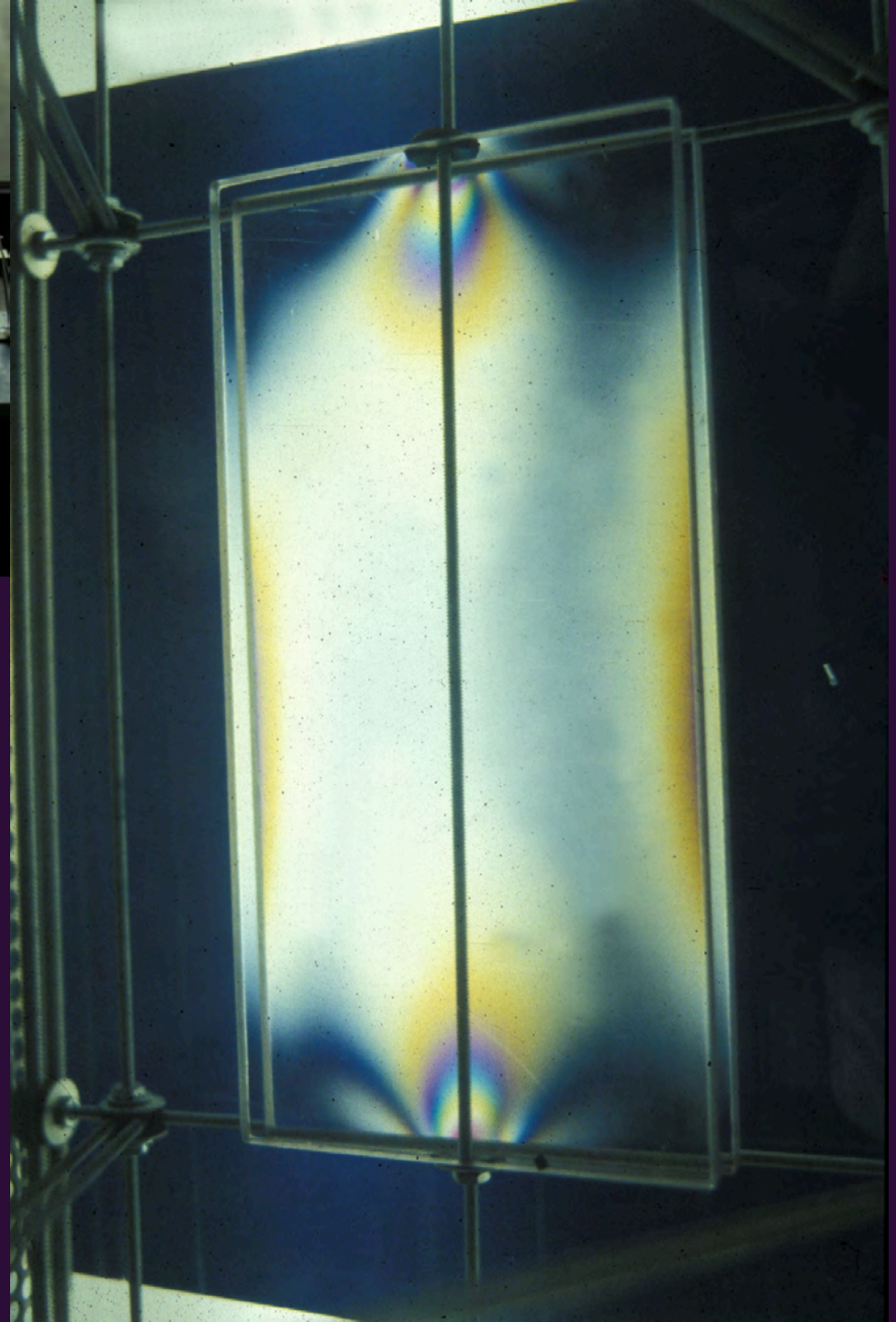


Kimbell Art Museum, Fort Worth, TX 1972

la estructura entrega la luz…el material es luz gastada

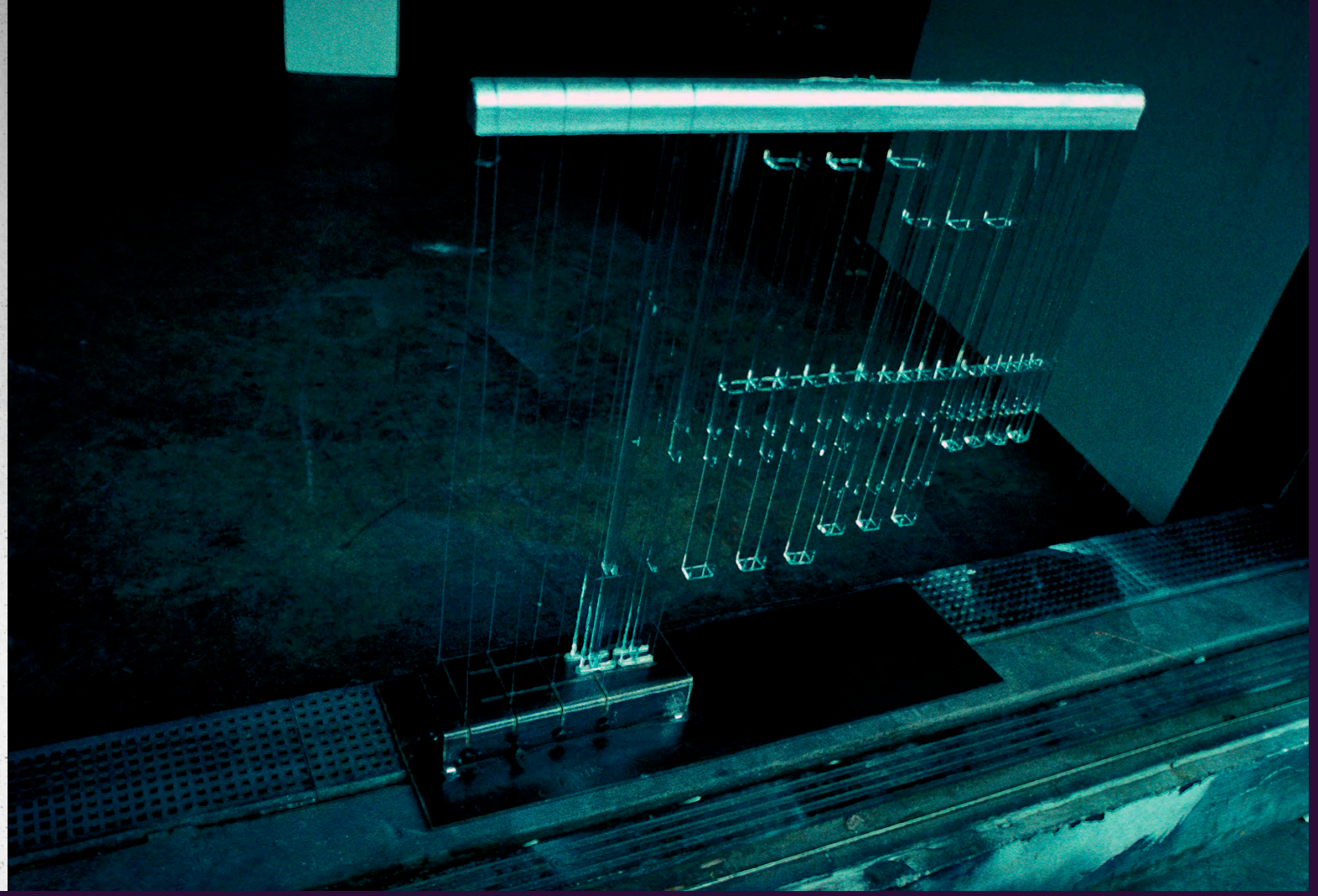
Louis I. Kahn, Masters Studio, @ penn, 69-71

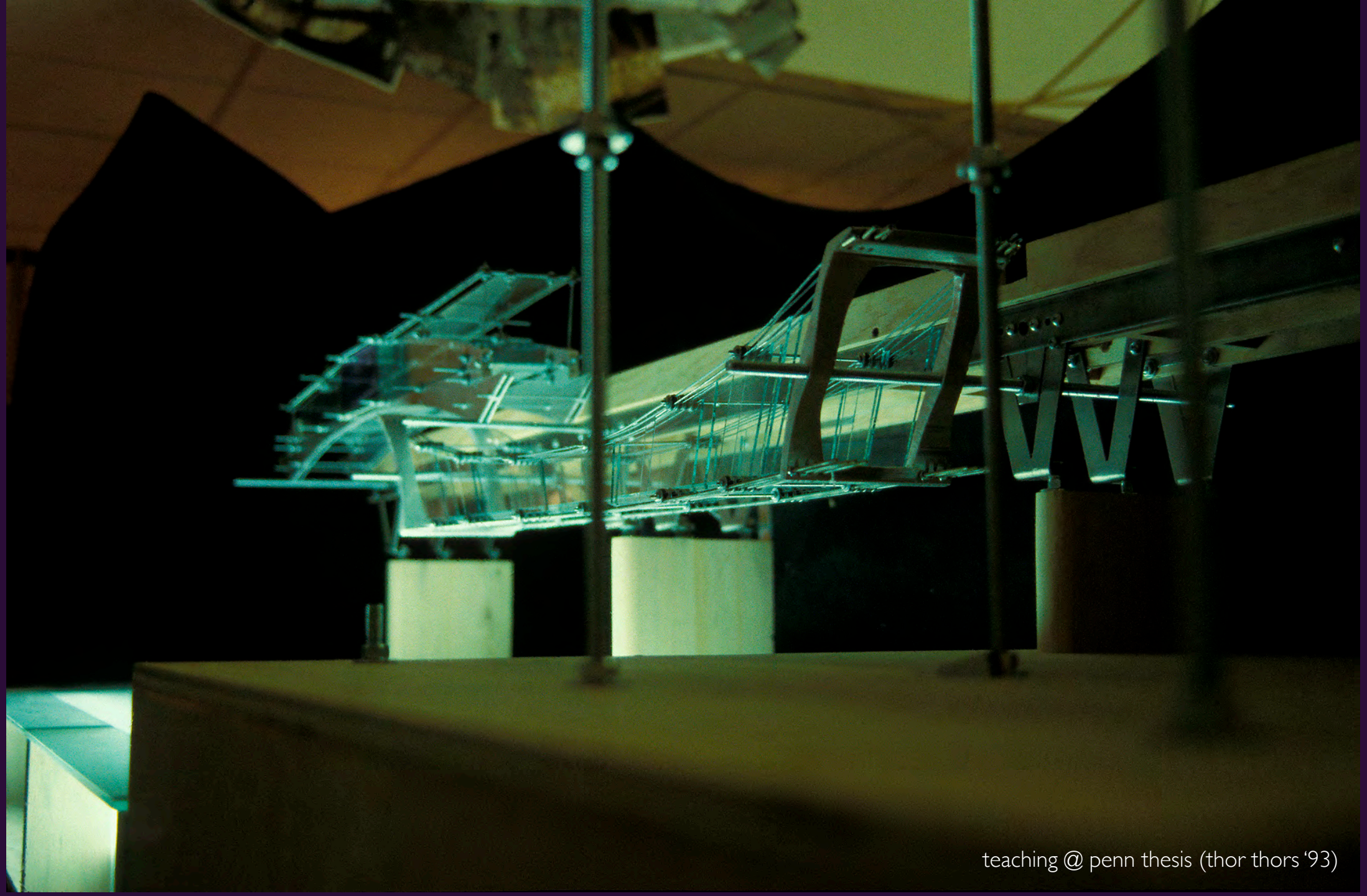




"Necesitamos nuevos conceptos y continuamente accedemos a la lengua objetiva de le física.".

Ludwig Wittgenstein, *Philosophical Remarks*

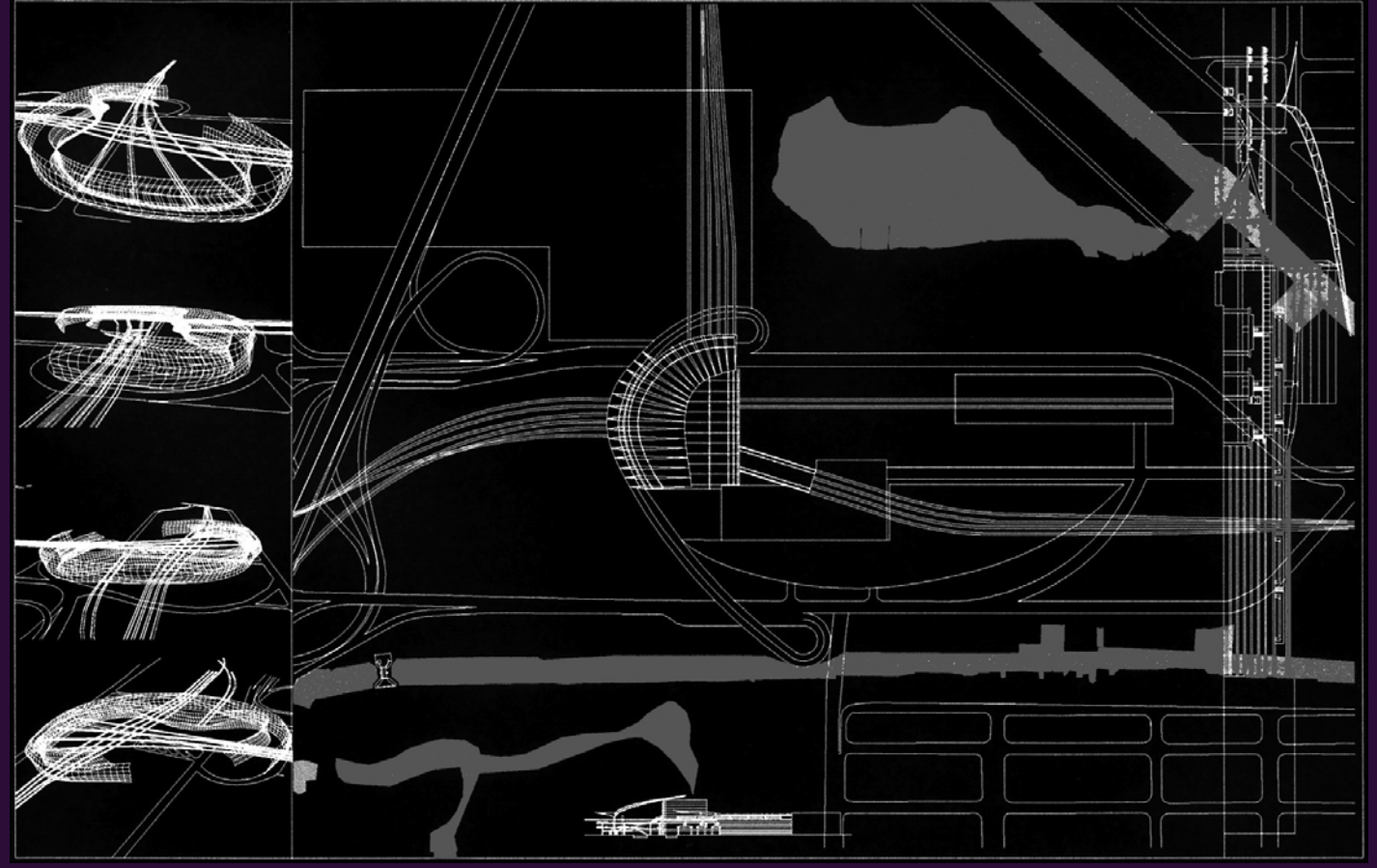


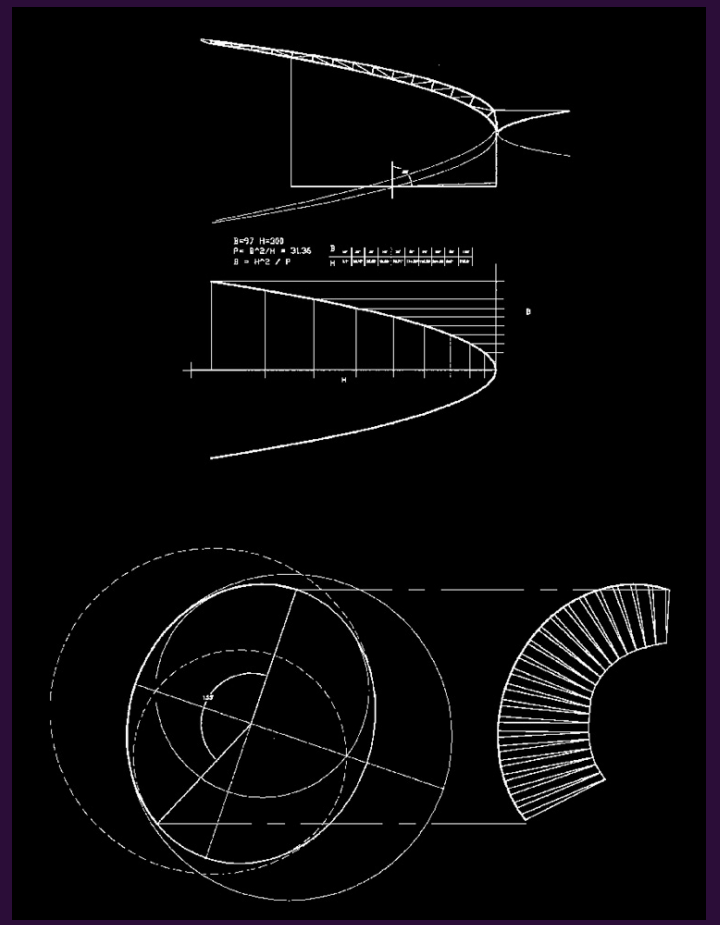


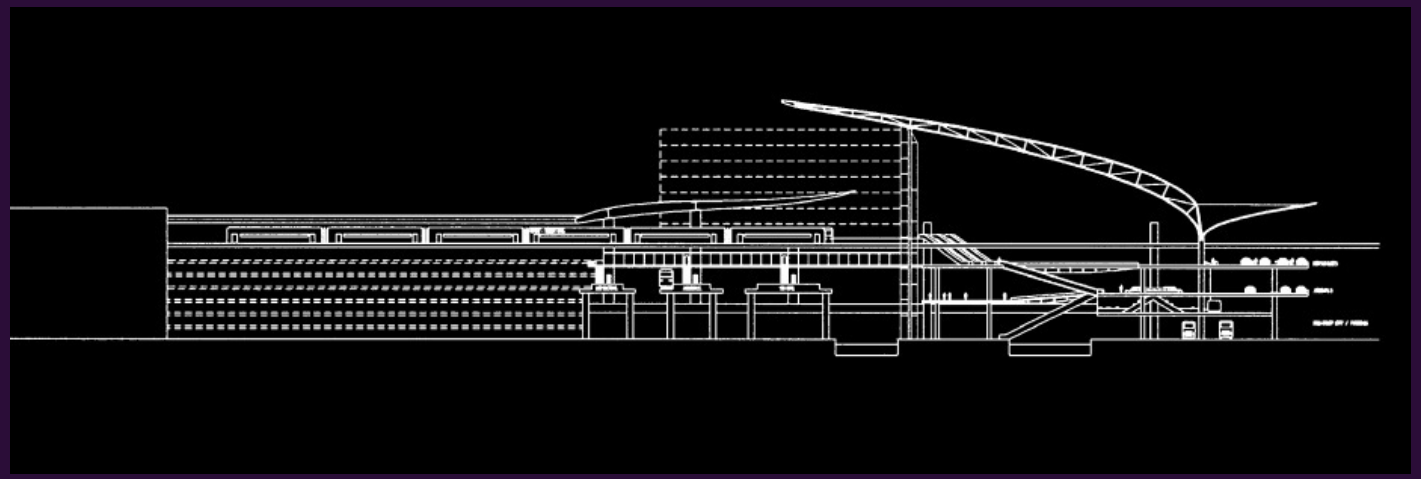
teaching @ penn thesis (thor thors '93)

"El milagro de la luz derramada sobre el horizonte verde y gris de césped y agua, brillante y fluyente bajo la superficie — césped y agua constituyen el sentido y fenómeno primario de los Everglades de Florida."

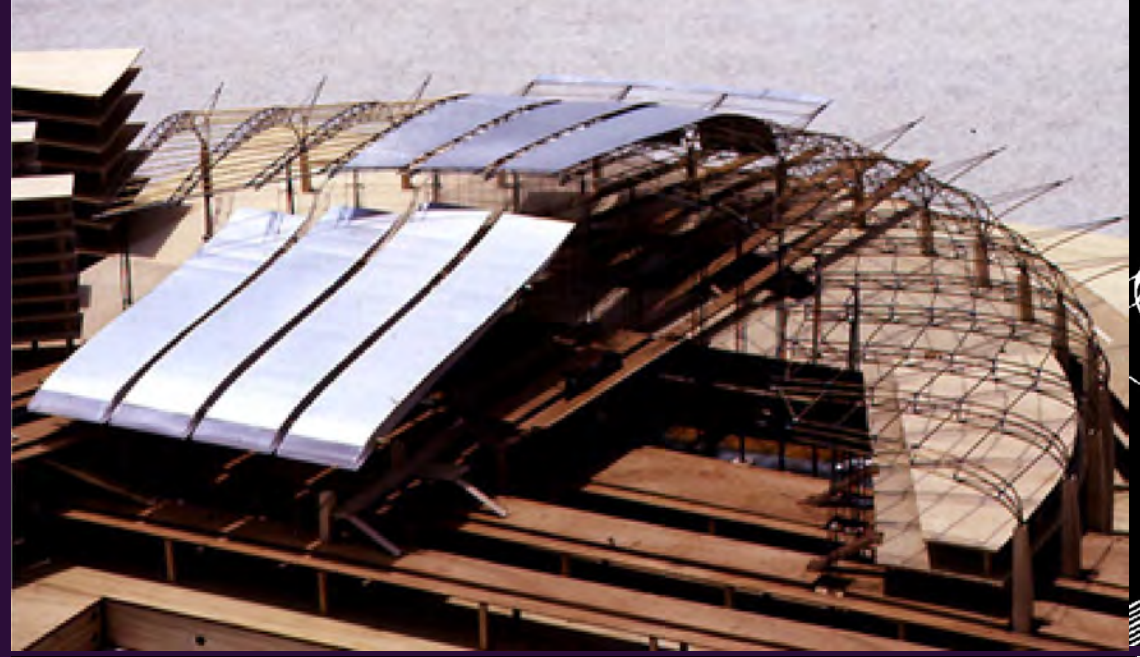
Marjory Stoneman Douglas, *The Everglades: River of Grass*

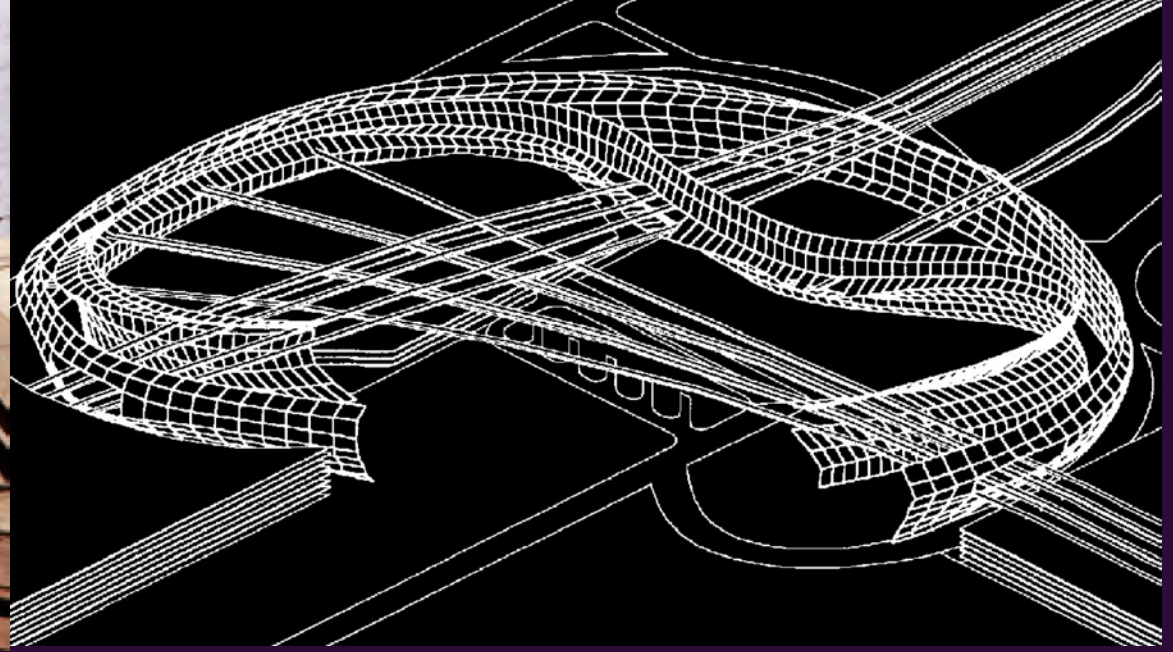


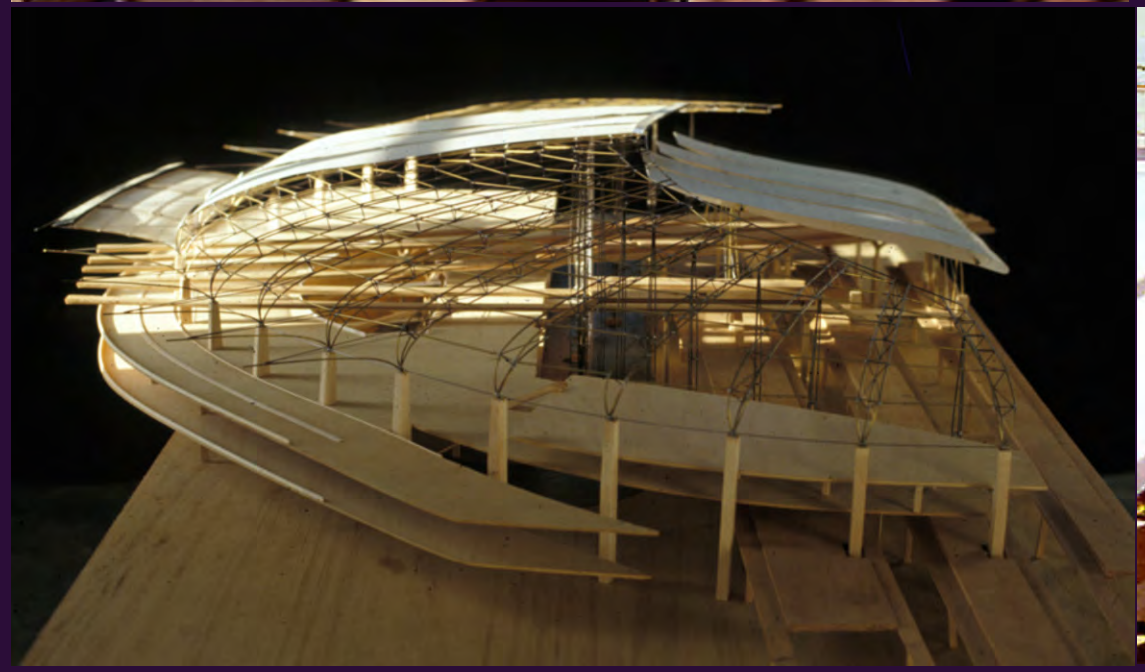


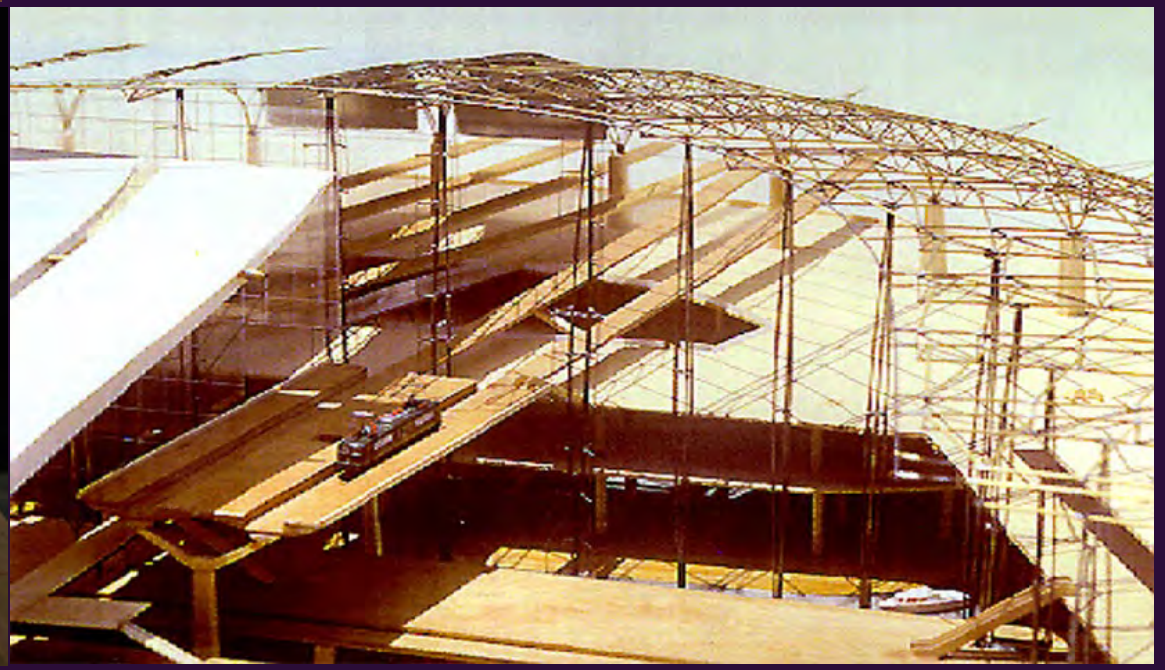


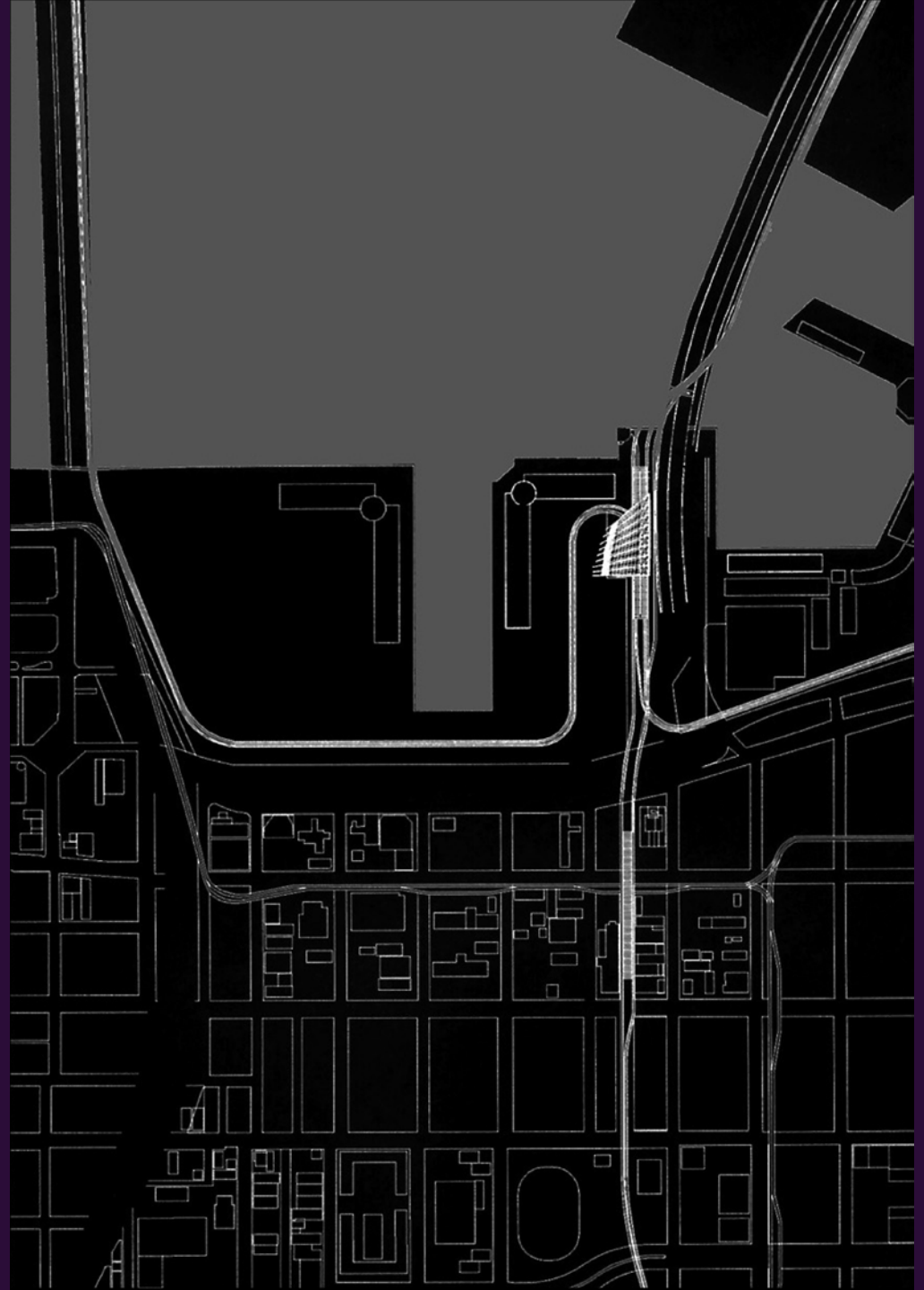
teaching/research @ florida/marc (juan linares '96)

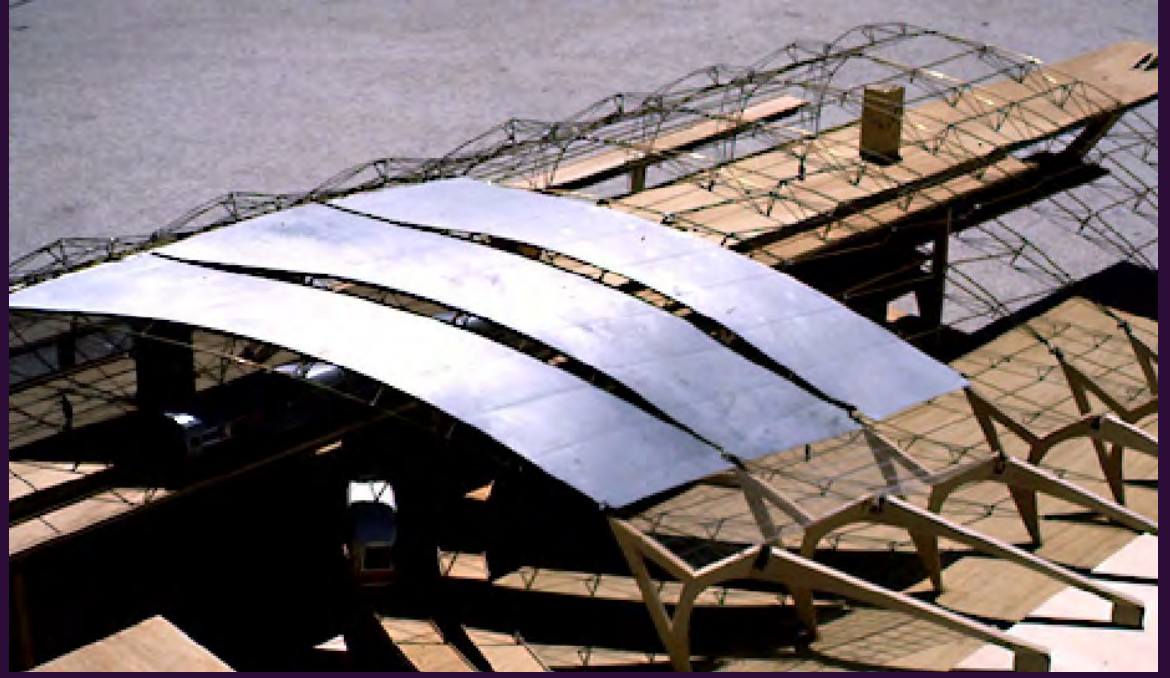




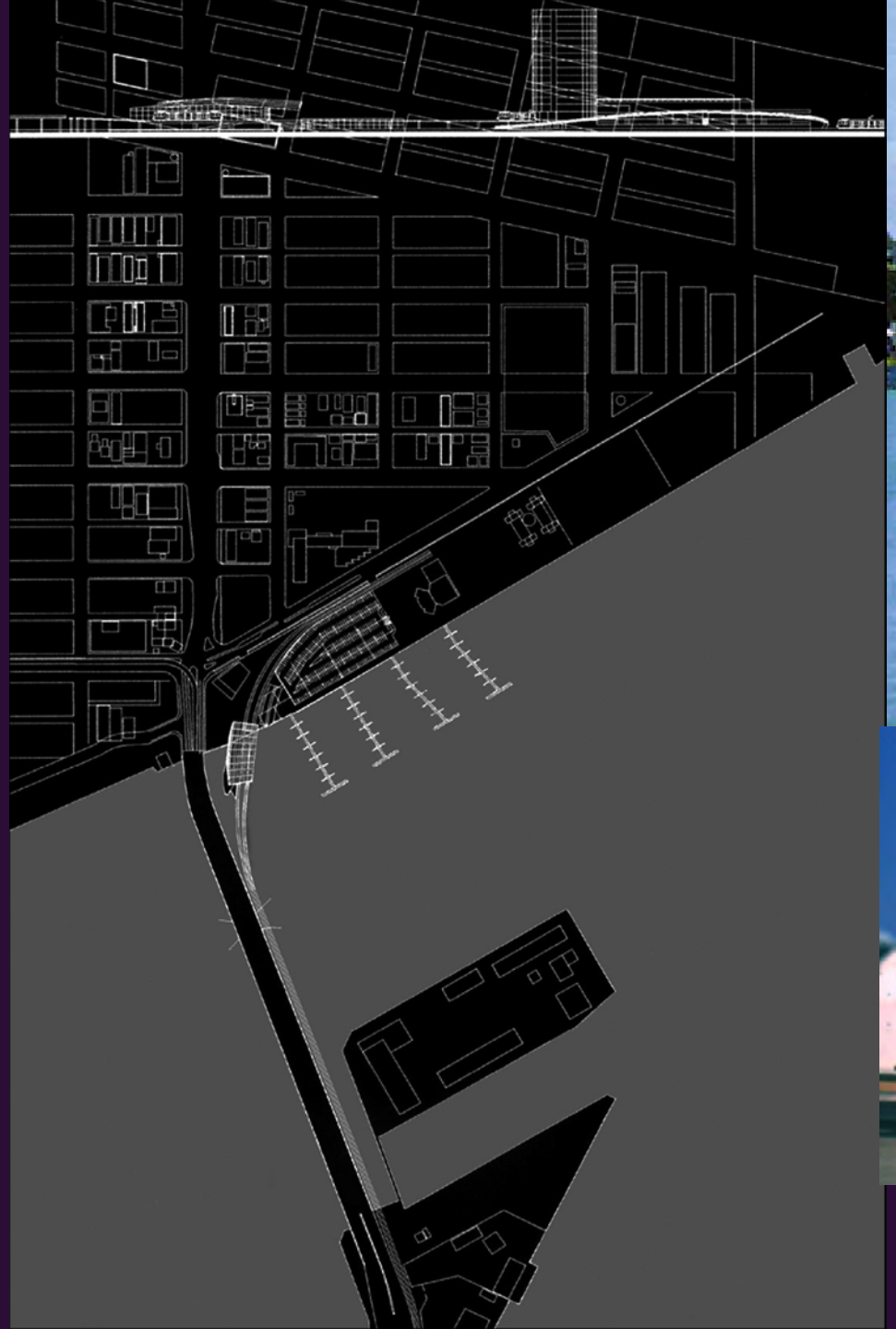




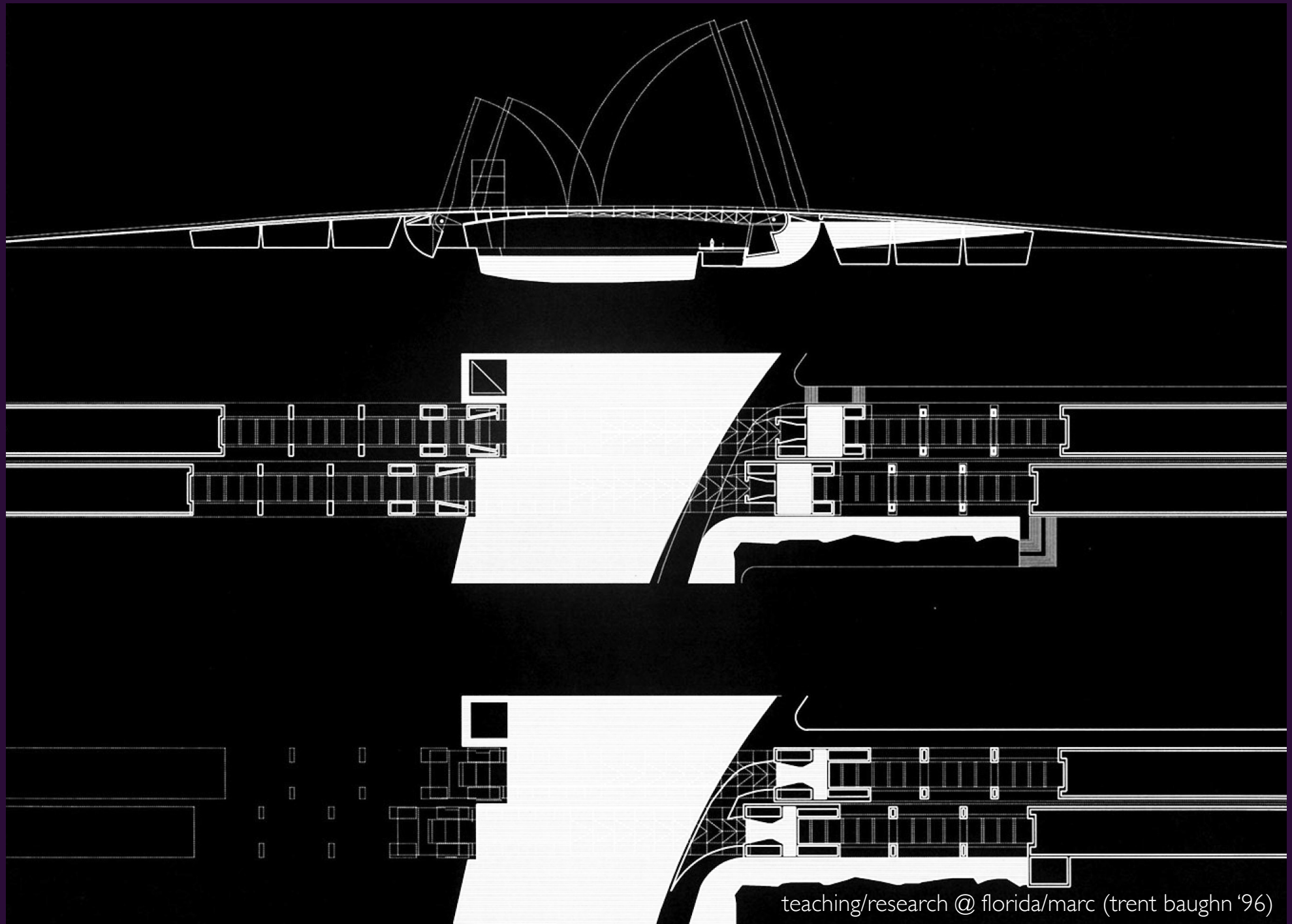




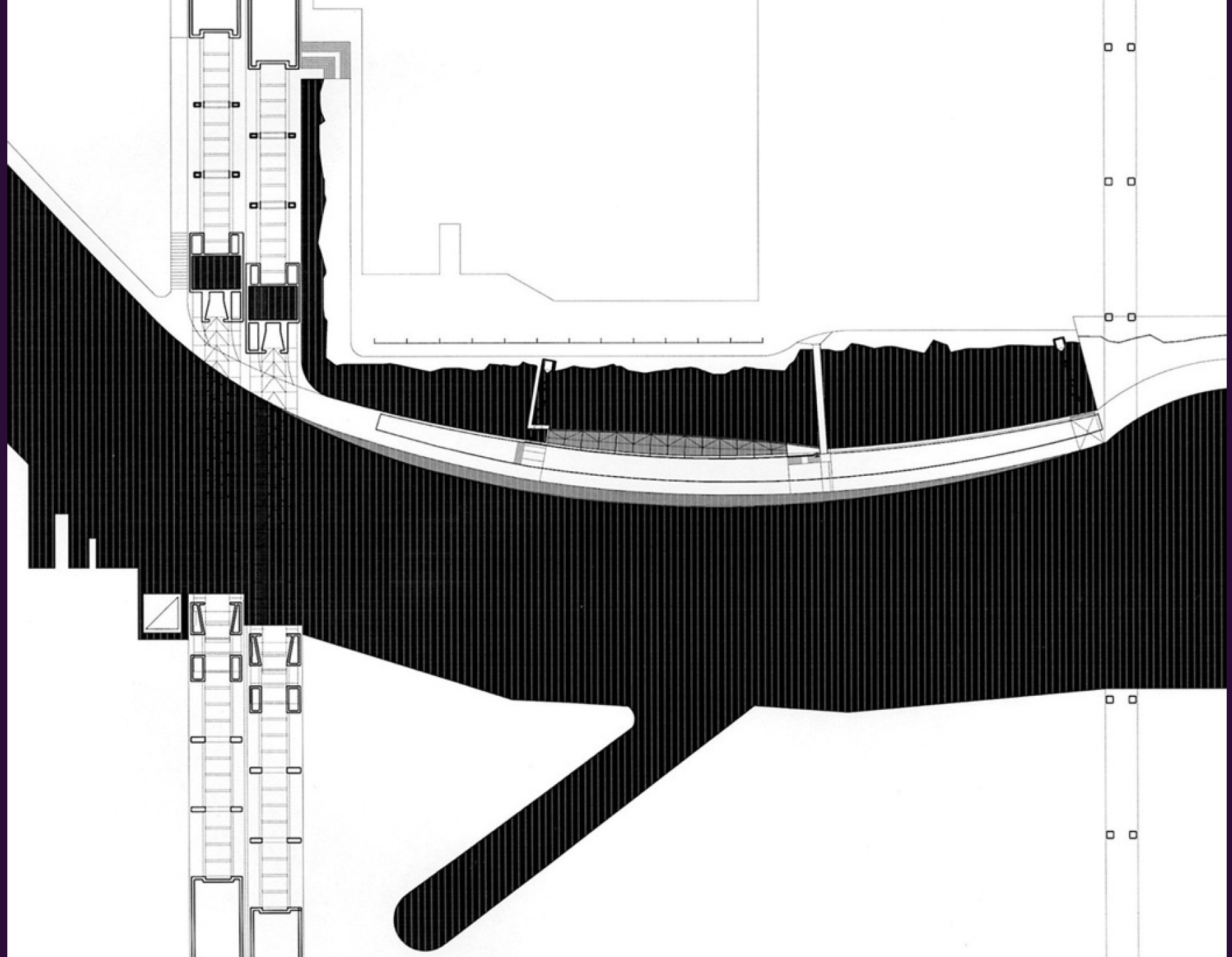
teaching/research @ florida/marc (eric blumberg '96)

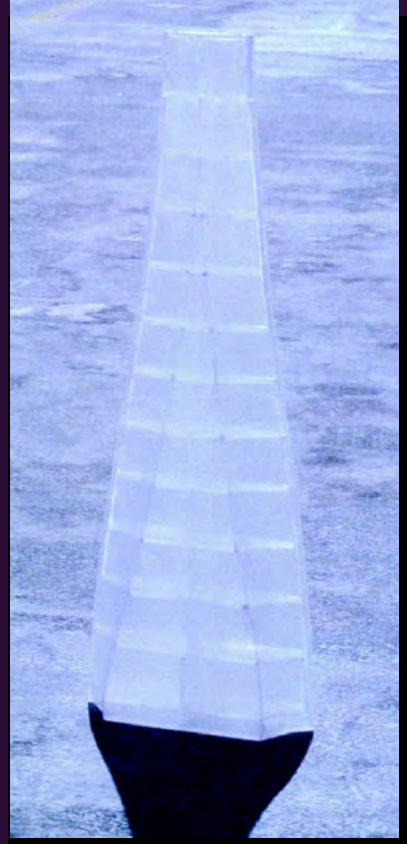


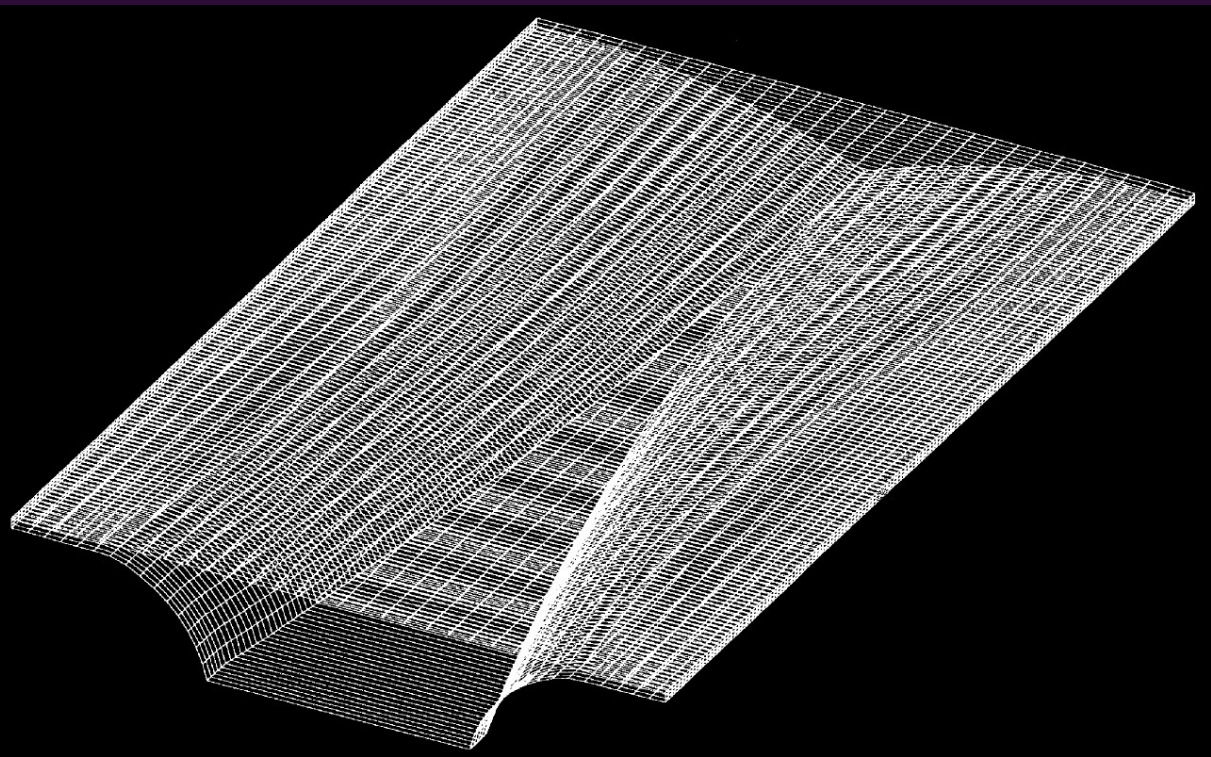
teaching/research @ florida/marc (hamed rodriguez '96)

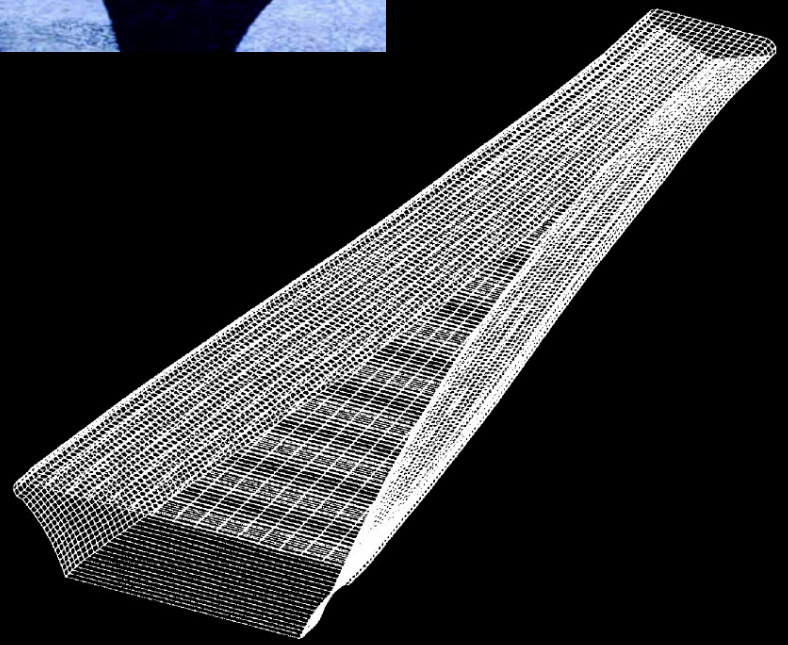


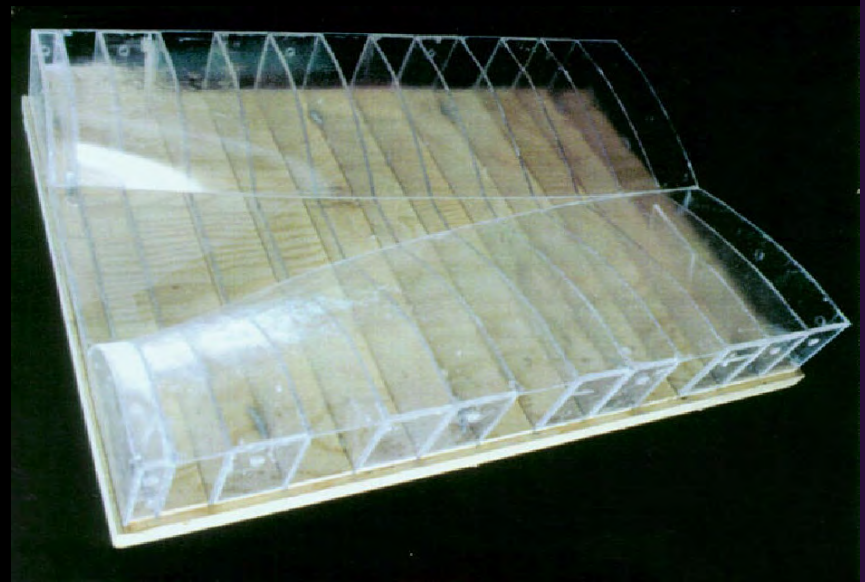
teaching/research @ florida/marc (trent baughn '96)









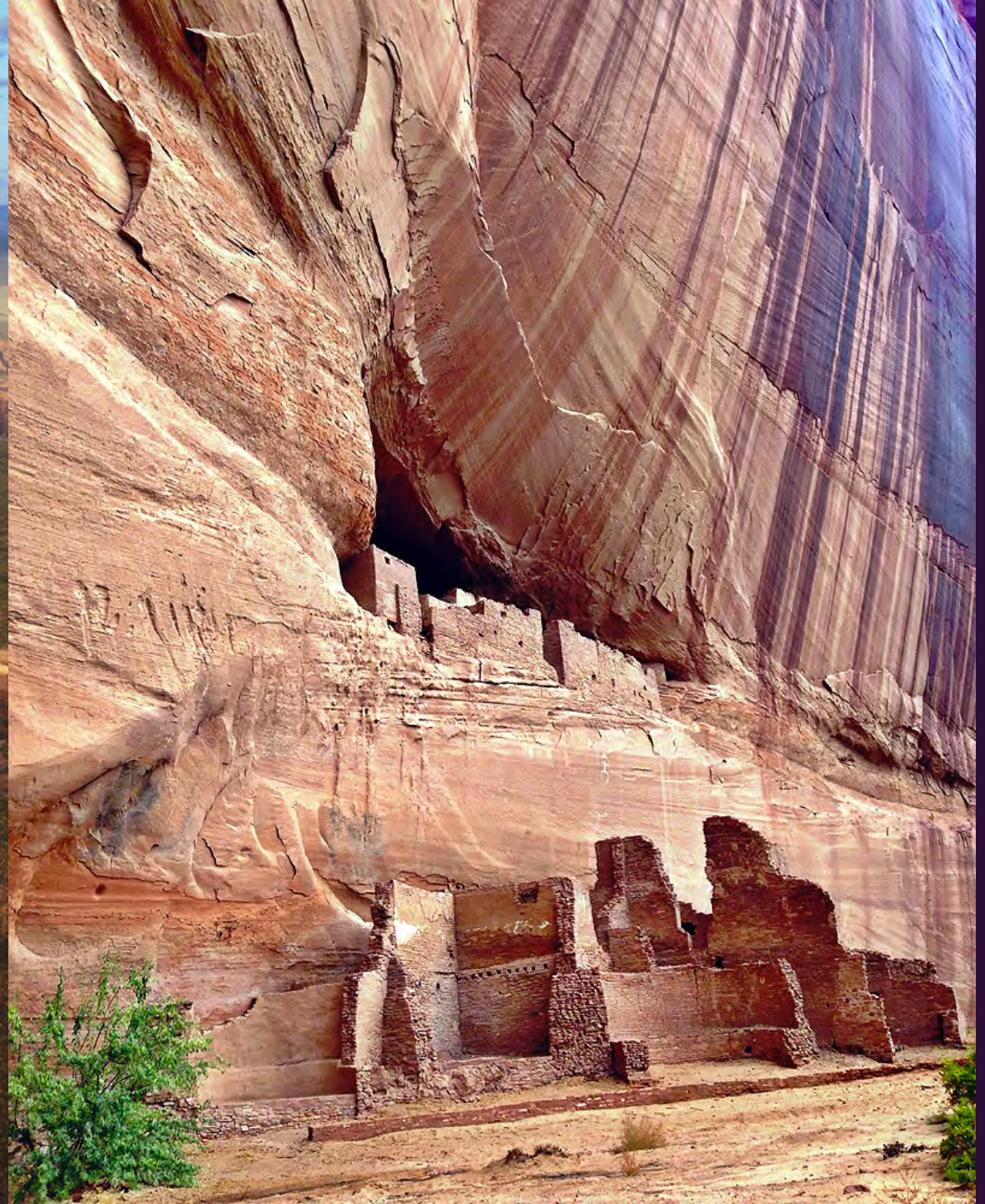


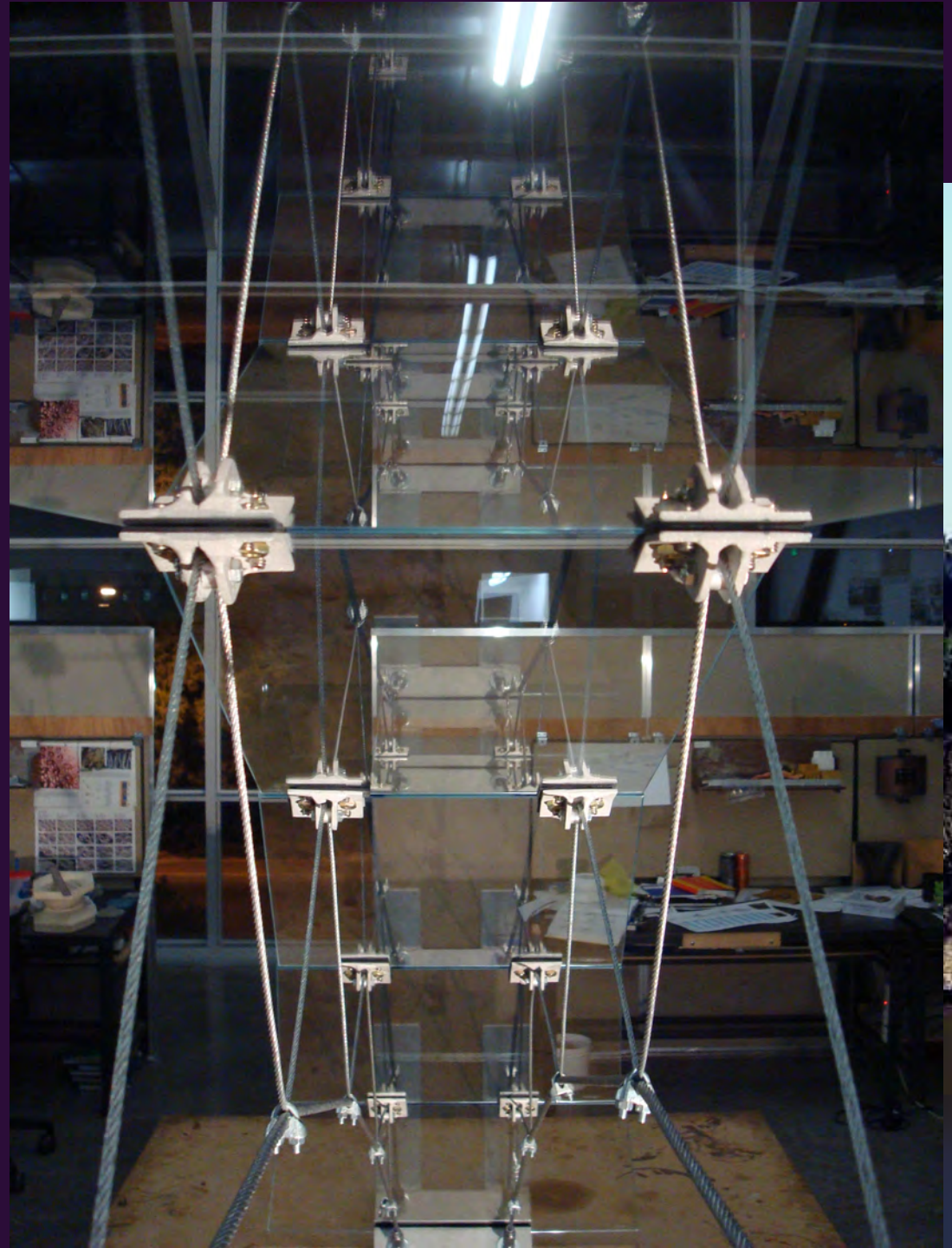

CSR
CSR

naturaleza como laboratorio: ética de la tierra ~ investigación estética

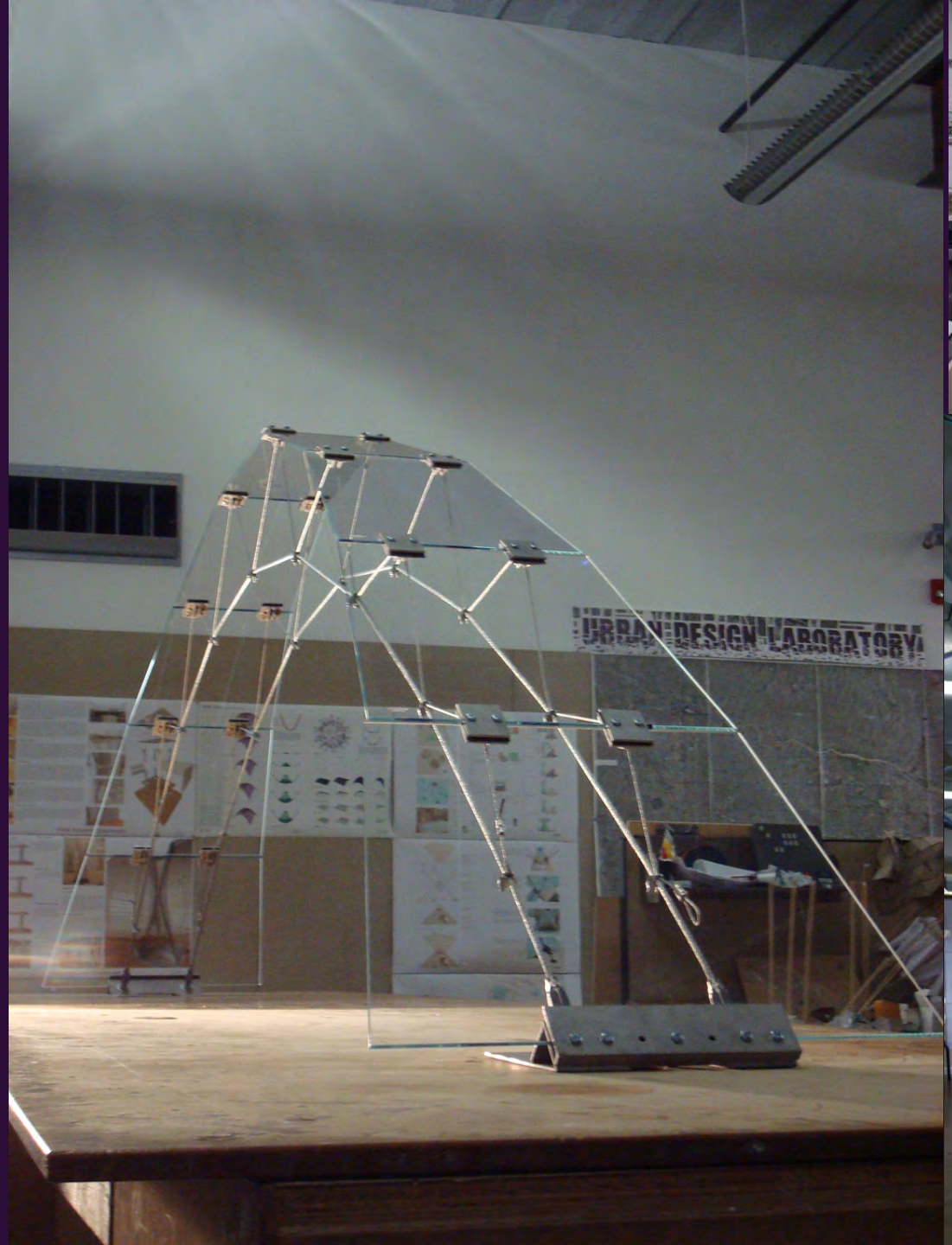
"La vida del desierto vive adaptándose ensimisma a las condiciones del desierto…Así ocurre que aquellas cosas que sobreviven en el desierto son marcads en el tiempo con un carácter peculiar desértico…Parece que el esfuerzo les otorga aspectos únicos y las hace no diferentes de su clase, pero más positivas, más insistentes."

John C. Van Dyke, *The Desert: Further Studies in Natural Appearances*





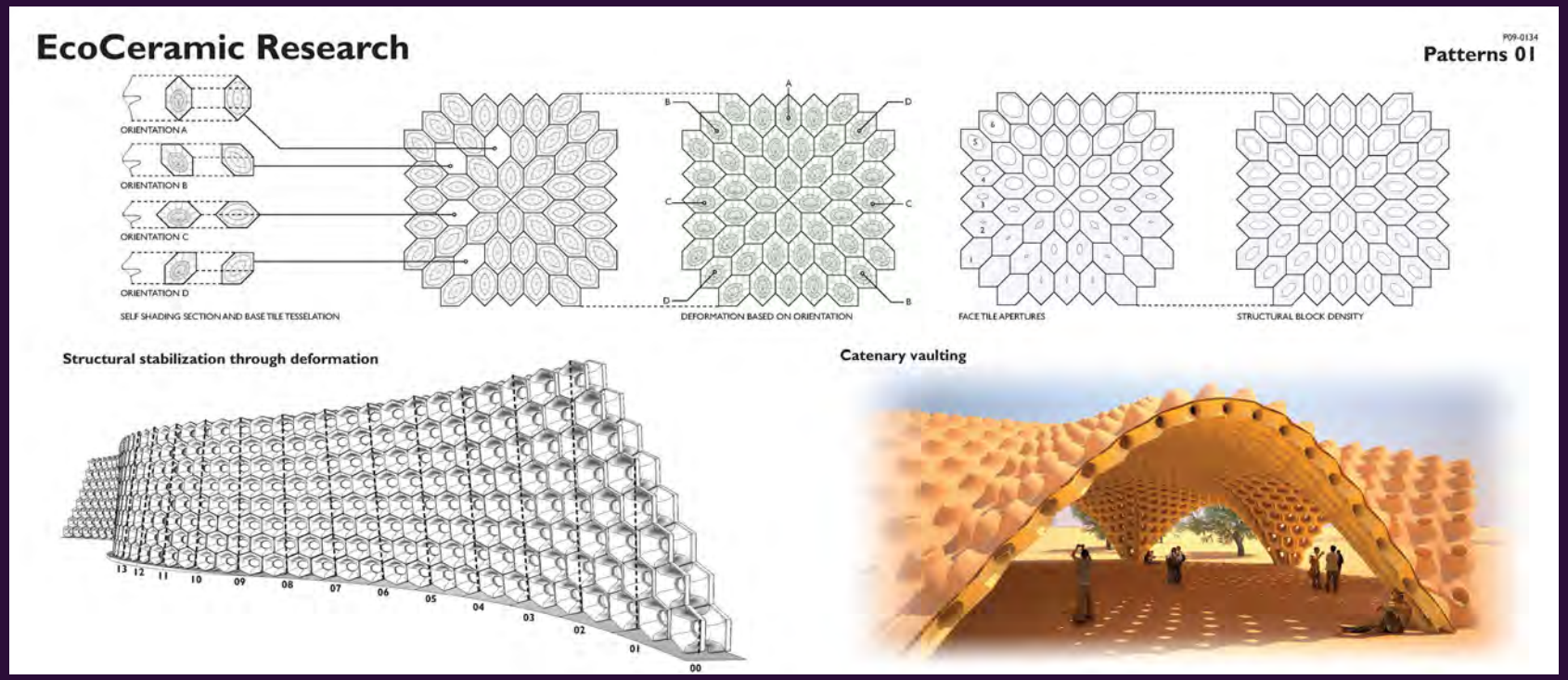
fuerza ~ material


URBAN DESIGN LABORATORY

Investigación EcoCerámica™

Al principio del siglo 20, 15 empresas fabricaban ceramica modular en moldes diseñados por arquitectos; hoy hay sólo tres, dos de ellas enfocadas en preservación histórica. La cerámica tiene muchas propiedaes positivas como material de constructión: aislamiento térmico (eficiencia energética), control de humedad (bienestar ambiental), plasticidad (estabilidad estructural), acabados vidriados (durabilidad).

Esta investigación estaba enfocada en métodos innovativos, integrando materiales cerámicos tradicionales con procesos de diseño y fabricación digitales. Usando como laboratorio el clima árido y extremo de Tucson, Arizona, los módulos cerámicos fueron diseñados y fabricados diagramando y desenvolviendo superficies geométricas que mitigan las fuerzas ambientales del desierto.



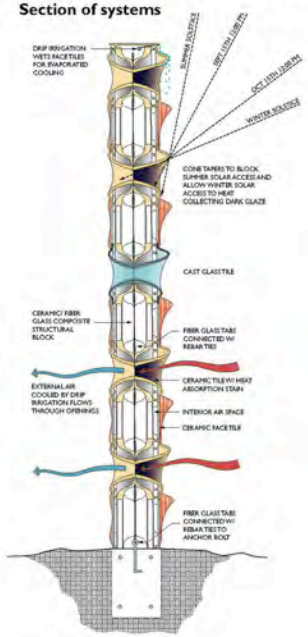
teaching/research @ arizona 2008 (jed laver | kelly winn '08)

Submitted to ARCHIPRIX International Prize Rotterdam/Montevideo '09 http://www.archiprix.org/2009/?project=2577

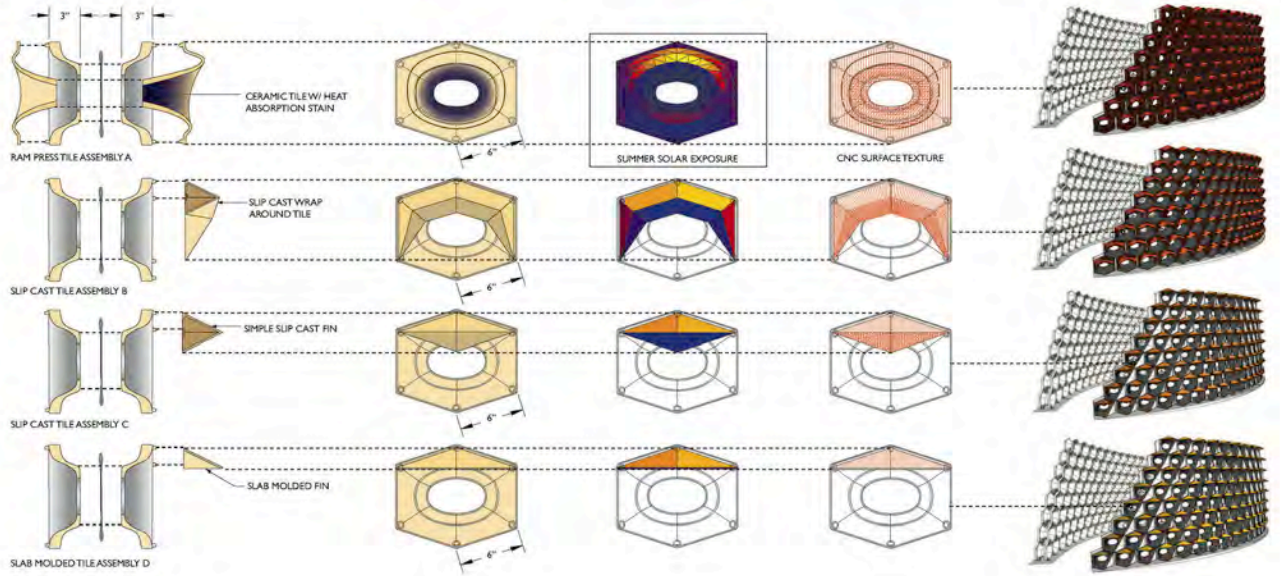
EcoCeramic Research

P09-0134
02

Section of systems



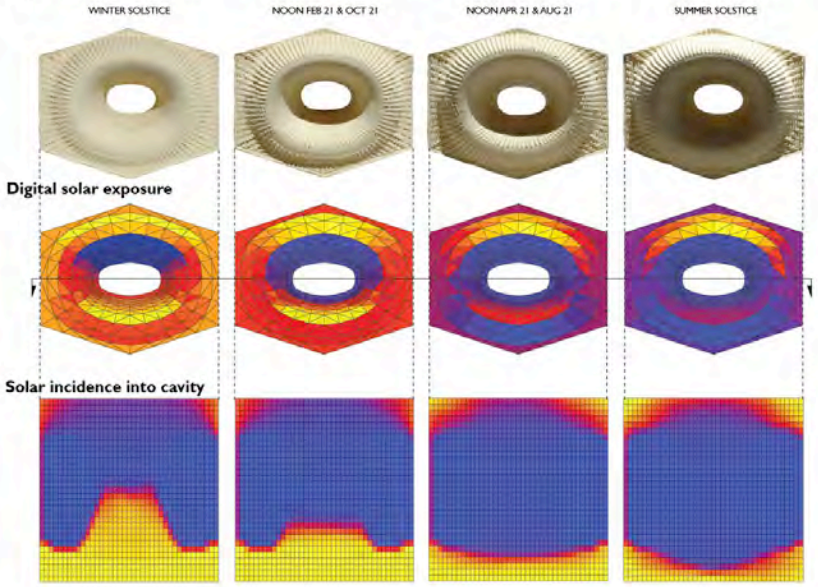
Alternative face tiles



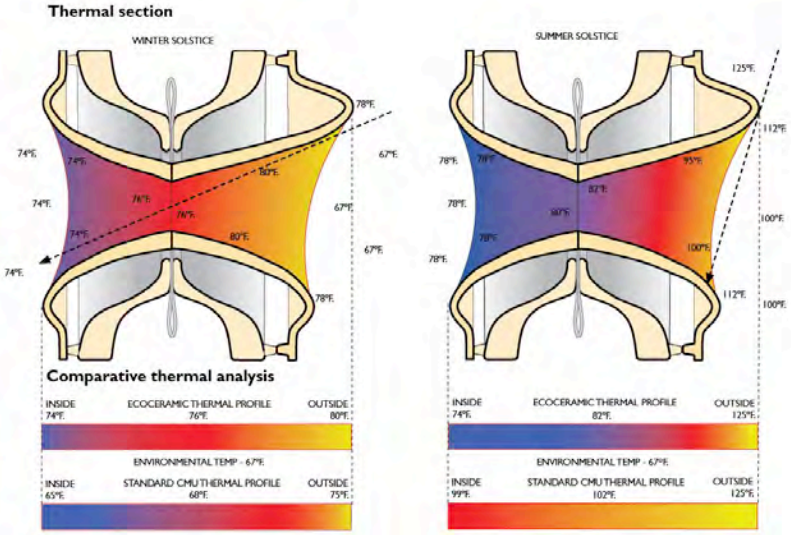
EcoCeramic Research

P09-0134
Thermodynamics 03

Physical shading analyses



Thermal section

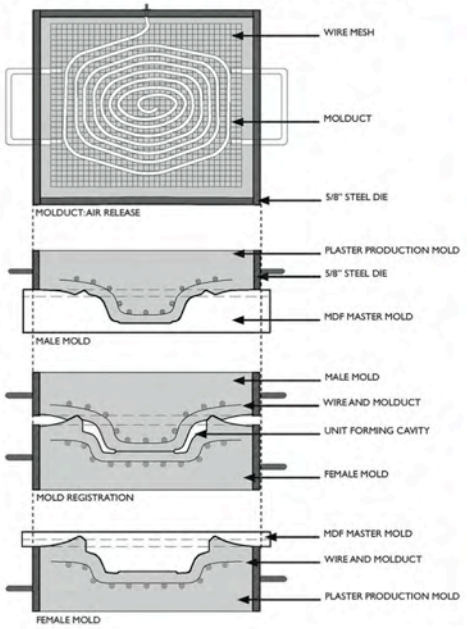


Comparative thermal analysis

EcoCeramic Research

P09-0134

Fabrication 04



Pressurizing the plaster production mold

CLAY CHARGE READY

PRESSING OF CLAY IN MOLD

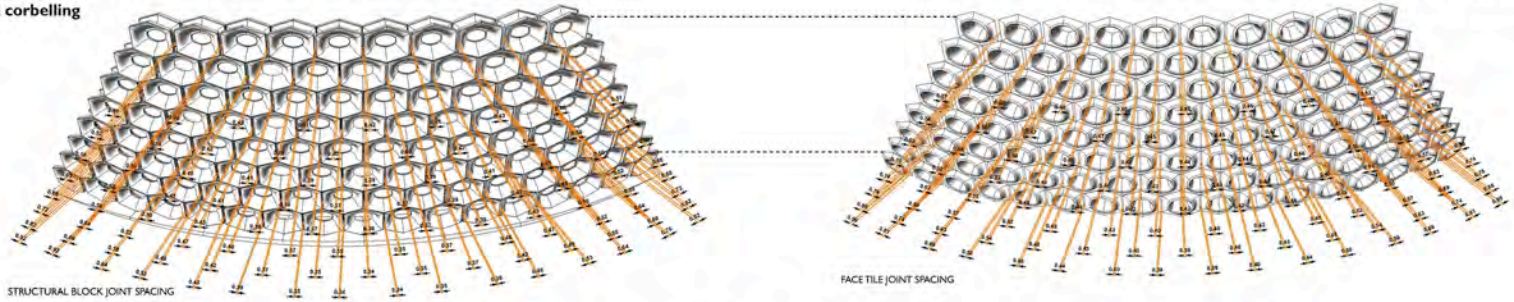
UNIT FORMED

EcoCeramic Research

P09-0134

Construction 05

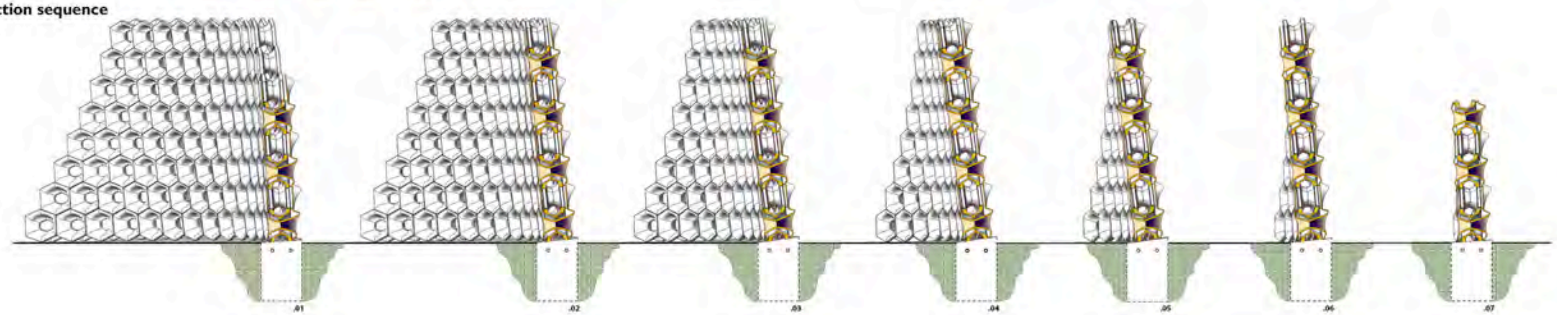
Digital corbelling



STRUCTURAL BLOCK JOINT SPACING

FACE TILE JOINT SPACING

Section sequence

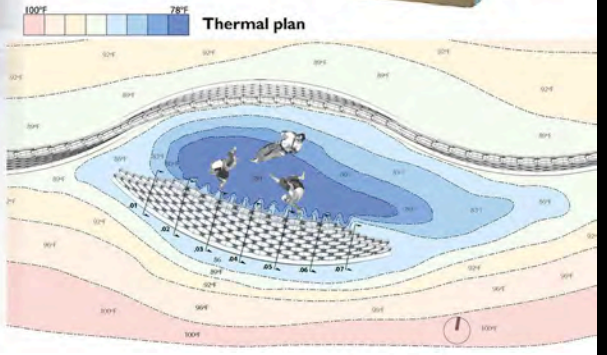


EcoCeramic Research

P09-0134
Ecology 06

In situ

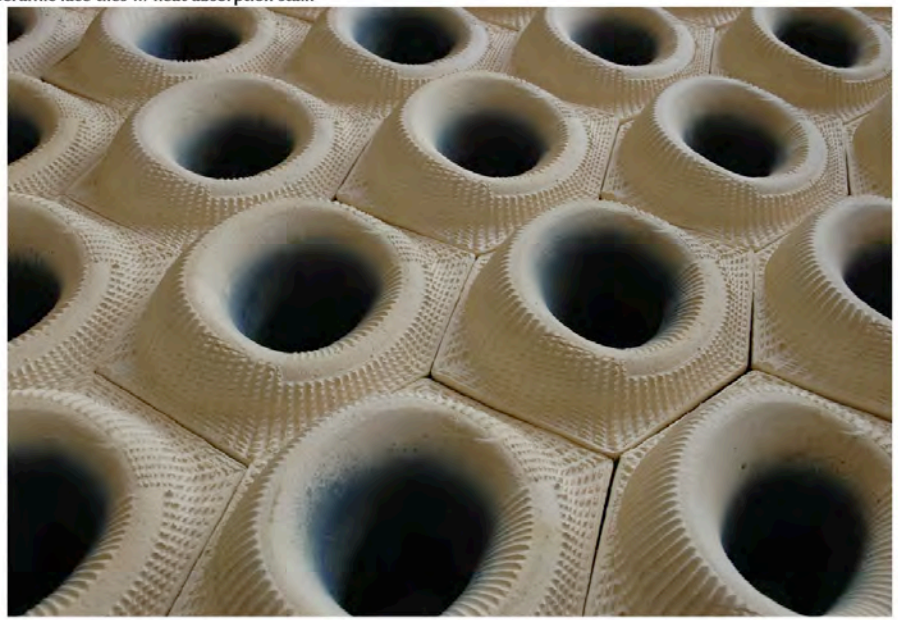
Physical prototype



EcoCeramic Research

P09-0134
Mass Production 08

Ceramic face tiles w/ heat absorption stain



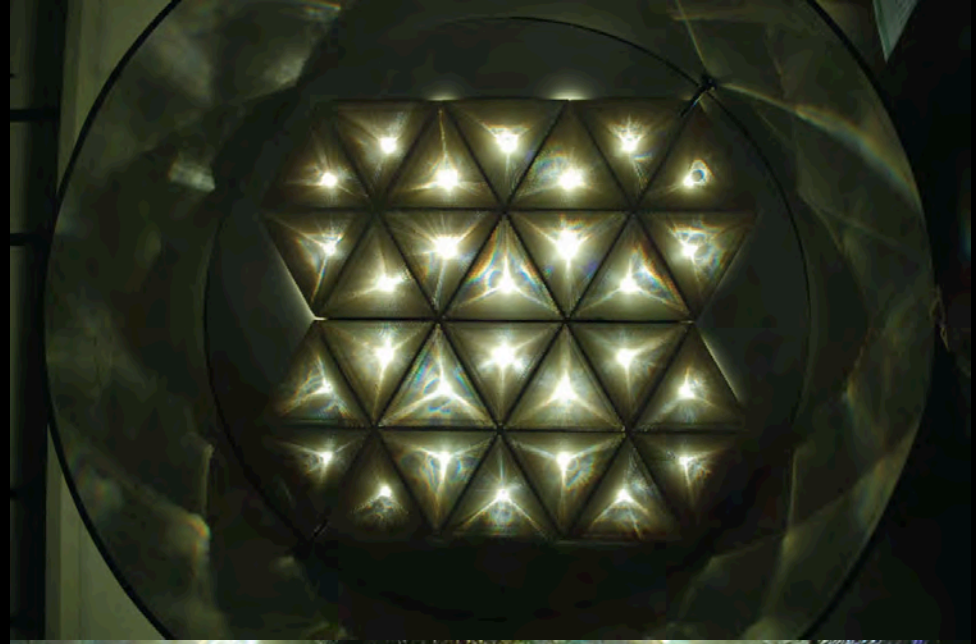
Ceramic tile production

Aperturas sensitivas

Hipótesis

…dos veces al día, amanecer y atardecer, los fotoreceptores en nuestros ojos atraviesan un portal de igual eficiencia en respuesta a la luz natural. En esos momentos de baja iluminación (1 cd/m2), los conos que detectan color y detalle tienen la misma sensibilidad (visión fotópica) que los bastones que detectan contrastes de luminancia y movimiento (visión escotópica). Este fenómeno se llama vision mesópica, un punto de partida para una possible búsqueda de una luz especial…

…en vez de disminuír opacidad en materiales translucentes, vidrio o acrílico, esta investigación busca posibles soluciones usando materiales opacos penetrados por precisas aperturas refractivas que admiten y distibuyen luz limitada al espacio interior. Cuando la posición del sol y la geometría de los receptáculos lumínicos están alineados, la luz llenará los espacios de modo uniforme. En cualquier otro momento la apertura admitiría luz de modo cronométrico, insinuando el paso del tiempo…

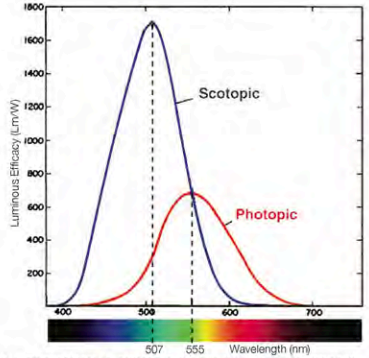


teaching/research @ arizona 2008 (ben ari mcdonald '08)

Within the range of detectable wavelengths (380nm - 780nm), so closely tied to the sun's energy, our vision has varying sensitivity. Generally speaking, sensation peaks in the middle of this range (around 555nm) and is very week toward the ultraviolet and infrared boundaries.

Spectral Sensitivity

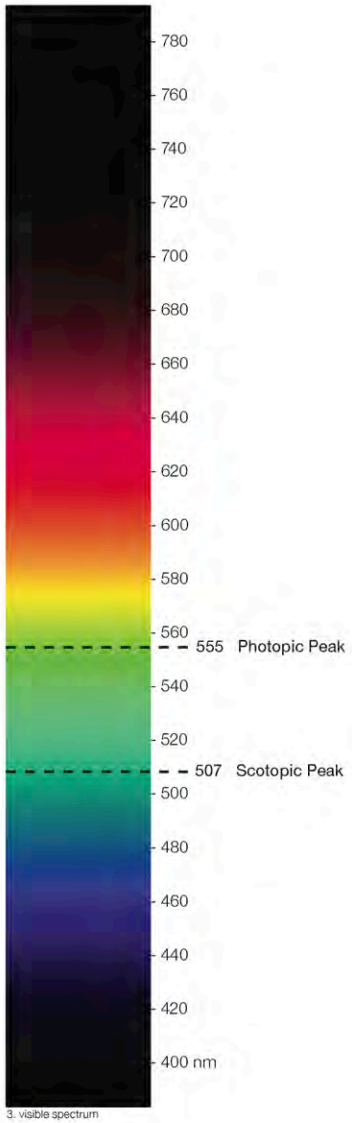
A more subtle fact is that this spectral sensitivity curve changes relative to the amount of light present in our visual field. Our vision goes through three major wavelength sensitivity changes. These are called the photopic, scotopic, and mesopic visual ranges.



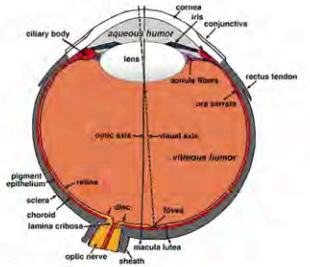
2. Luminous Efficacy Functions (Source: http://webvision.med.utah.edu/)

Most of our daily visual experience occurs within the photopic range (> 3 cd/m²). This is our light-adapted vision. At these levels, cone cells are the most active. Strong signals from the three types of cone receptors allow us to maximize our color and detail sensing ability. The great majority of cone cells are packed in the fovea of the eye (Figures 6,7) which corresponds to the center of our vision.

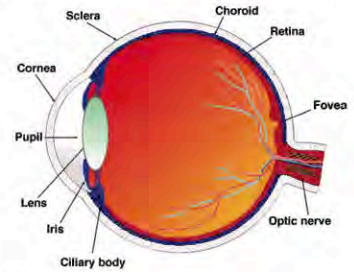
Vision in the scotopic (< .001 cd/m²) range requires dark adaptation. At these light levels, rod cells are the dominant receptors and cone response is nearly non-existent. Because there is only one type of rod cell, scotopic vision is color blind. What rods lack in color detection, however, is made up for by an increased ability to sense peripheral vision, detect movement, and detect subtle changes in shape and contrast. A classic example of this is from stargazing when an object in the sky is invisible to the center of vision but is revealed when we avert our eyes slightly to allow more rod cells to pick up a response.



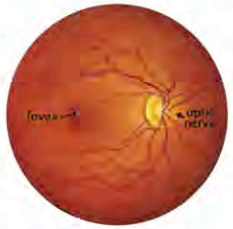
3. visible spectrum



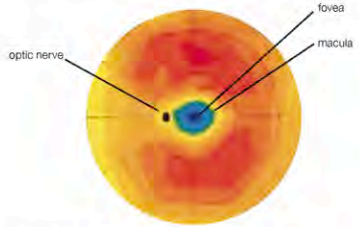
4. horizontal section of eye



5. vertical section of eye



6. ophthalmoscope view of human retina



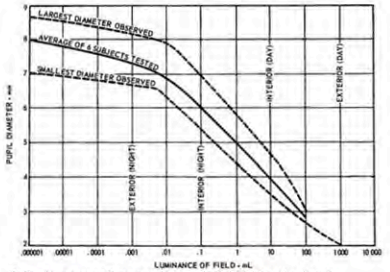
7. retina rod/cone distribution

Finally, mesopic vision range (.001cd/m² - 3 cd/m²) occurs in between light and dark. Within this range, rod and cone response is shared. As of yet, there is no standard luminous efficacy function for mesopic vision. It appears that vision in this range undergoes rapid changes that are a result of a complex set of factors including illumination level, spectral content of the image, and adaptation time. Owing to a lack of scientific knowledge relating to the mesopic range, it might be best described experientially as a combination of photopic and scotopic vision. Color and detail are simultaneously detectable with peripheral vision, motion detection, and light sensitivity.

This thesis sets out to explore the perceptual intrigue of the mesopic range through observational studies which are then intended to be used as inspiration for creating an architectural enclosure.

Pupil Aperture

Adaptive pupil size helps the eye to accommodate the broad range of light levels spanning photopic and scotopic vision. Beyond the basic principle of letting more or less light into the eye, the size of the pupil (Figure 8) also determines the region of the retina that receives light and helps to explain the perceptual changes of dark versus bright environments. In bright light, the pupil contracts and limits incoming light to falling in the center of vision containing most of the cone cells. In the absence of light, muscles in the iris relax, resulting in an enlarged pupil that admits light to a much larger portion of the retina, thus allowing rod cells more opportunity for response.



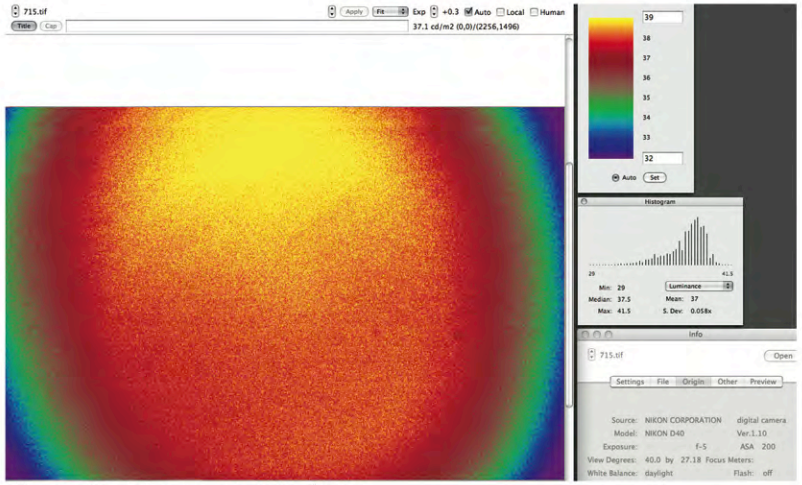
8. Pupil Luminance Response (Source: IESNA Lighting Handbook)

9. Pupil dilation (actual size)

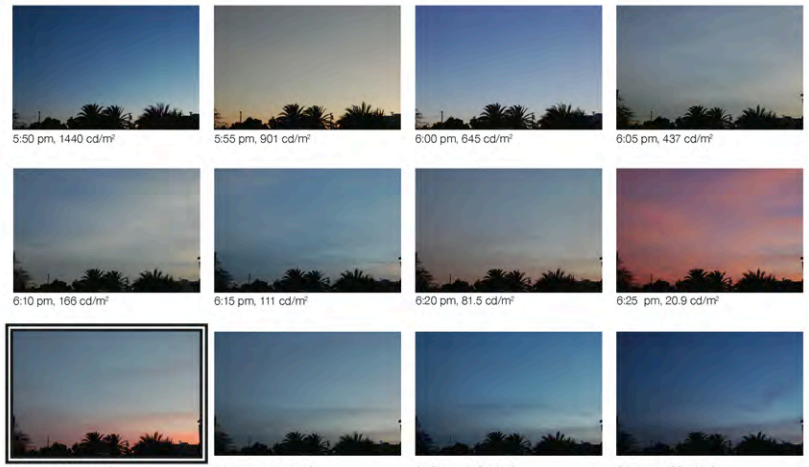
…luz, visión y percepción han sido temas constantes de la arquitectura desde su origen…este proyecto es uno investigación fenomenológica en búsqueda de inspiración lumínica en la construction espacial….

Typical Image Luminance Analysis

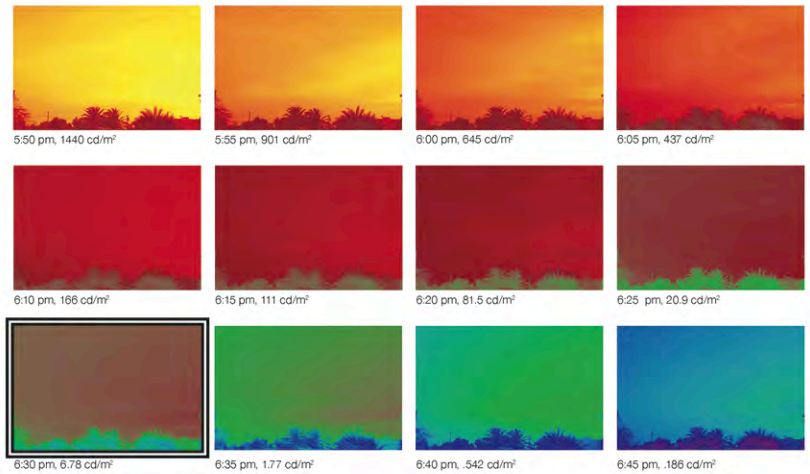
Figure 4 shows a typical example of an HDR image displayed in Photosphere as a false color luminance map. This particular image is from the overhead sky at 7:35 on May 9th (West is up). Even though the brightness of the sky was relatively consistent across the image to the naked eye, the luminance map clearly shows more brightness, as it should, toward the western-setting sun. Because the range of luminance values is so narrow (32-39 cd/m2), the luminance value recorded for this time is an average of the entire image.
Proceeding this way, average luminance values corresponding to observed areas of sky were recorded for each image. Figure 6 shows another way to visualize luminance values across an entire twilight session by setting a custom range for the false color map based on the brightest values from the early photo.



4. Photosphere false color luminance map of zenithal sky at twilight



5. HDR twilight image sequence



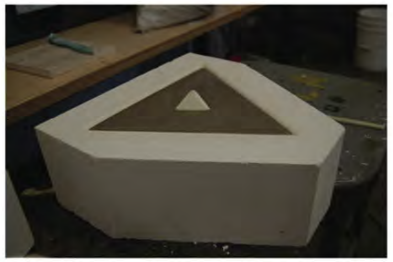
6. False color HDR twilight image sequence

…el trabajo se enfoca en una metodología de responder a esta pregunta, ¿cuál es una luz especial?' Una pregunta con variables, difícil de responder con certeza, pero pienso que la respuesta está en la lógica de preguntar…

43. Slip casting setup

44. Slip casting production line

45. Pottery plaster molds for slip casting



46. Slip

47. Greenware

Slip Casting

Two-part pottery plaster casts made from the machined Corian molds enclosed a cavity which was then be filled with the liquid slip. (Figures 45,46) The pottery plaster is highly absorbent and pulls moisture from the slip at all interfaces, causing the slip to harden. After a period of about 15 minutes, the thickness of the hardened slip was optimal and the remaining liquid was poured out, producing the hollow cavity for insulation as see in Figure 55. The clay body then remained undisturbed in the plaster for a period of at least 8 hours which gave them time to harden enough to be released from the molds to air dry. To increase production capacity, four sets of the plaster sets were made so that up to 12 pieces could be made daily. (Figure 44)

48. Glaze coating detail

49. Glazing production

50. Ceramic kiln

51. Glazing application

Glazing

The finish surface of the light containers greatly affected the quality of light. To reinforce the intention of an evenly scattered interior light, a matte white glaze was chosen to minimize any specular behavior. After an initial bisque fire (Figure 50), the light containers were glazed using a spray applicator. (Figure 51)

¿Una luz especial para qué?' Para estar en silencio y consciente. Para pensar y meditar. No para trabajar en alguna labor. Pienso en una calidad de luz en la cual puedo proyectar mi mente…como en el fuego o la penumbra…

Aperture Fabrication: Acrylic

Glass was chosen as the ideal material because of its durability and high index of refraction. However because the glass fabrication process took a long to time to begin, cast acrylic was also explored.

A series of 'best guess' aperture geometries were digitally designed so each could be tested empirically for best performance. At first, the CNC router was used to machine the geometries out of MDF (Figures 4-6). Liquid silicone was then cast into these as a final step before being able to cast acrylic. Because the apertures were so small, it was a challenge to get enough machining resolution to make the apertures as smooth and clear as possible. 3d printing was tested for precision but it too had more texture than desired. Finally, Dupont's Corian countertop material was tested for its machinability with the router and the results were far better than the MDF or 3D print. (Figure 7)

4. CNC routing of MDF

Aperture Fabrication: Glass

Casting the small glass apertures required a thorough process of seeking advice on and off campus, asking for material donations, and being able use lab space and furnaces in the Material Science Department.

A strict requirement of the apertures was that they had to be optically clear - the surface of the glass had to be smooth and specular. Any light scattering at the surface would have defeated the refractive intentions for the glass. After talking with glass fabricator Charly Amling, in the Chemistry Department, it became clear that graphite might be a perfect mold material for casting glass. Thankfully, a few blocks of graphite were generously donated for this research by Leon Good of Weaver Industries. The graphite block was then carefully machined using the CNC router (Figure 8). Special care needed to be taken for this machining because graphite, though relatively soft and easy to machine, also produces dangerous shavings which are both abrasive and conductive.

Even though graphite is an ideal material for casting glass into, it is prone to oxidation when exposed at temperatures above 480°C.

This required glass to be melted in a crucible first which could then be poured into the graphite which could then be placed in a separate oven for annealing. (Thankfully, graphite's oxidation threshold was also the annealing temperature of the lead crystal glass used for the casting)

The first casting experiment with graphite was done using two ovens in the Architecture materials laboratory. The glass product of this cumbersome procedure (Figures 9-12) was beautifully clear - but also deformed because the glass did not reach a high enough temperature to become liquid enough to fill the small shapes in the graphite.

8. Machined graphite mold block

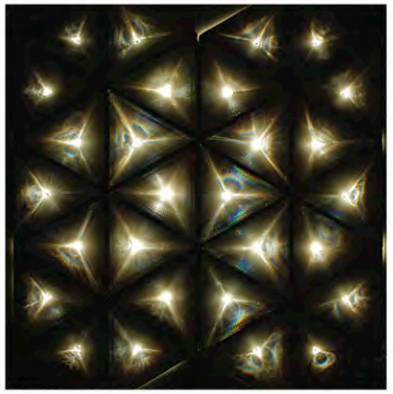
9. 850°C furnace

10. Casting sequence

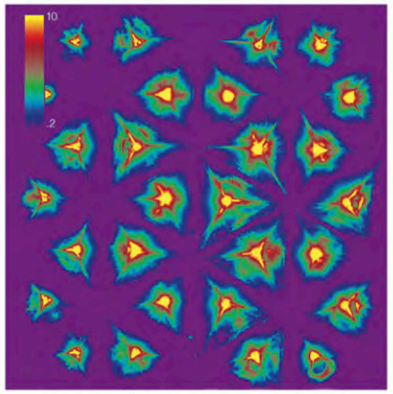
11. Heat reflective armor

12. Annealing oven

Luego de muchas sesiones de observación en el crepúsculo, en mi experiencia personal empecé a percibir el espacio sintiendo la luz con mis ojos de manera similar al sentido del tacto — tocando con la vista.

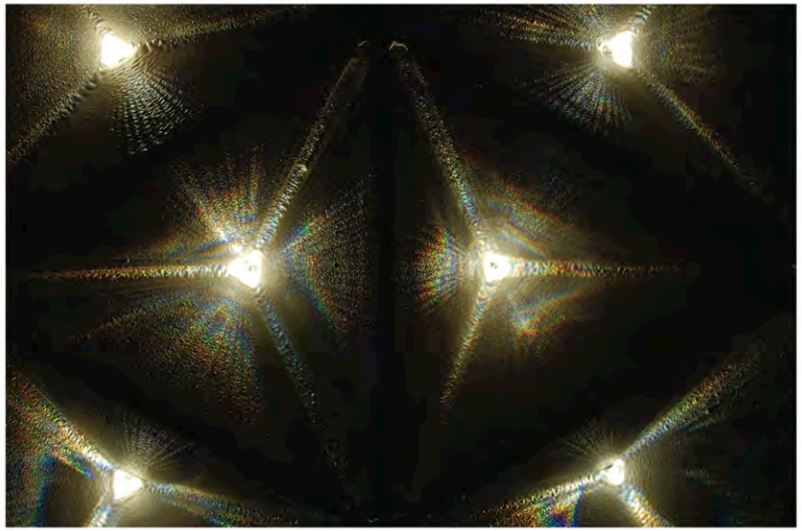


69. HDR composite photograph

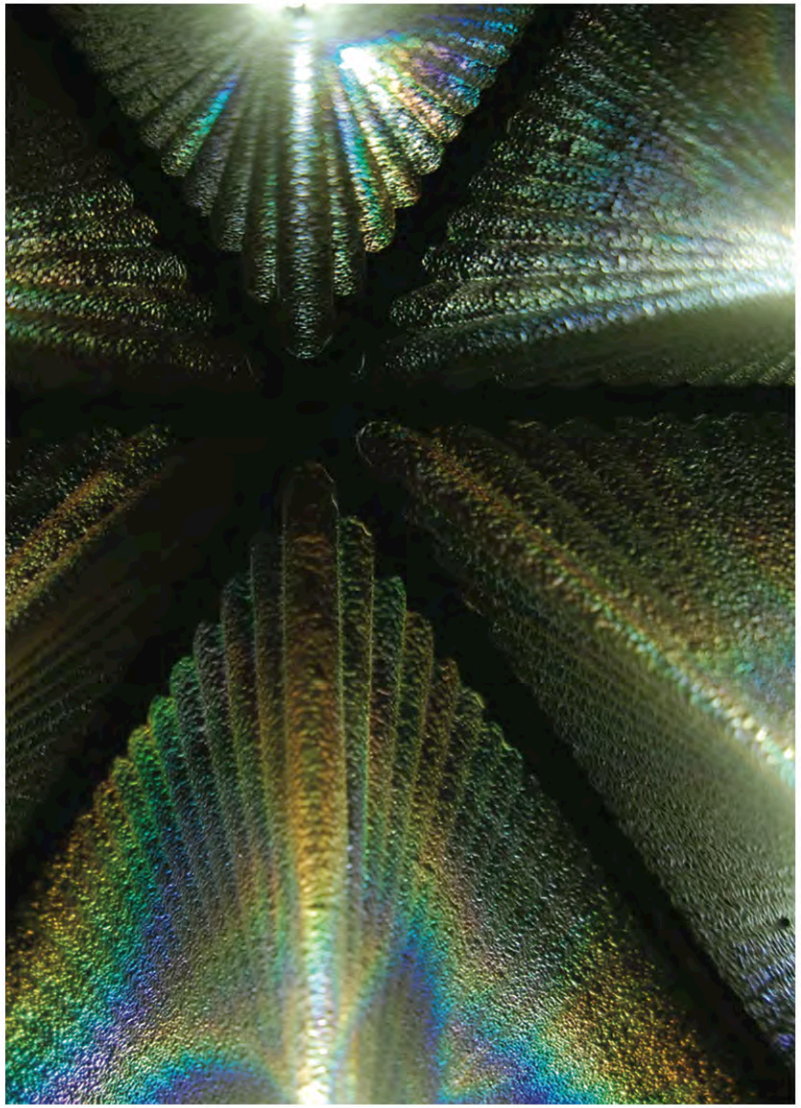


70. False color luminance image for values between 10 and .2 cd/m2)

Finally, an HDR image of the enclosure was made to demonstrate the proposed method for analyzing the resultant luminance values. Despite the arbitrary luminous intensity of the projected light source, Figure 70 shows significant presence of light levels falling near the target luminance values at the upper boundary of the mesopic vision range.



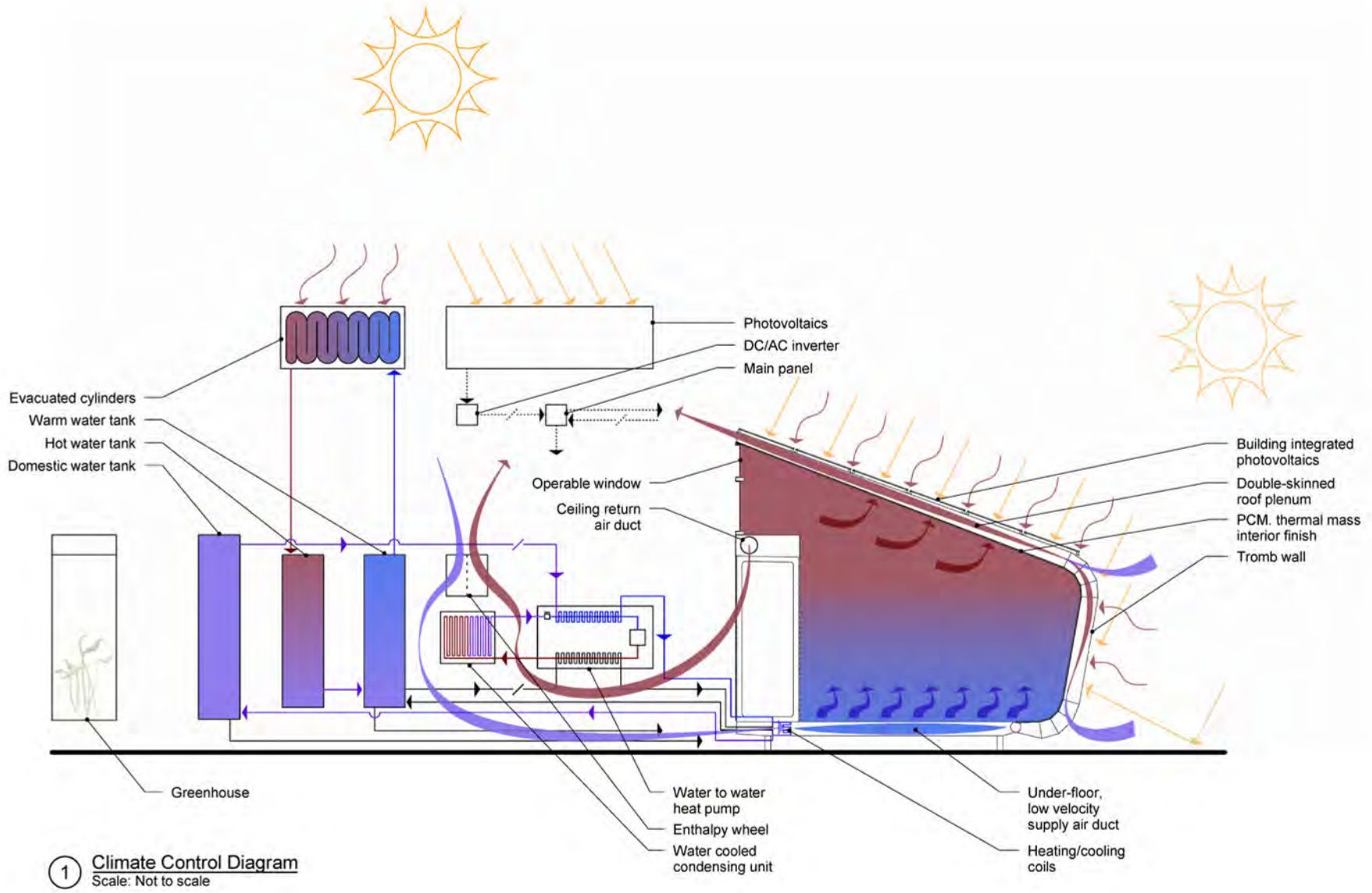
71. Light containers

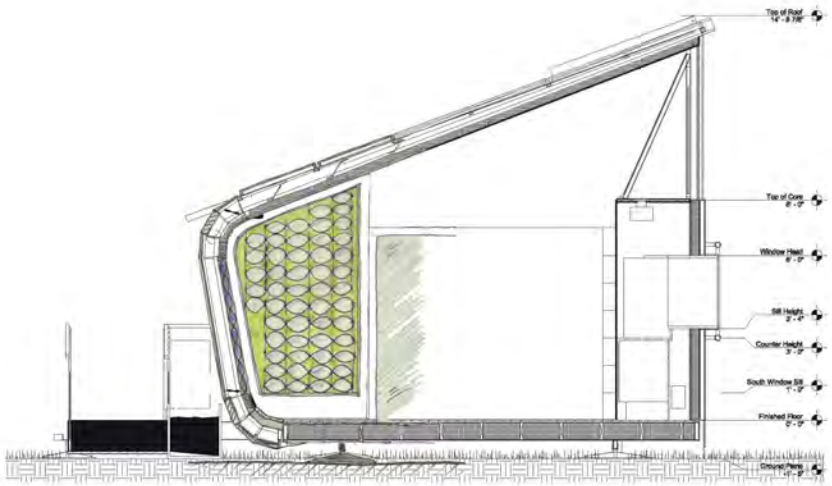


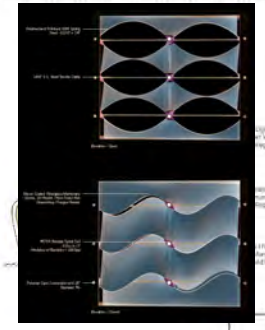
72. Light Container intersection

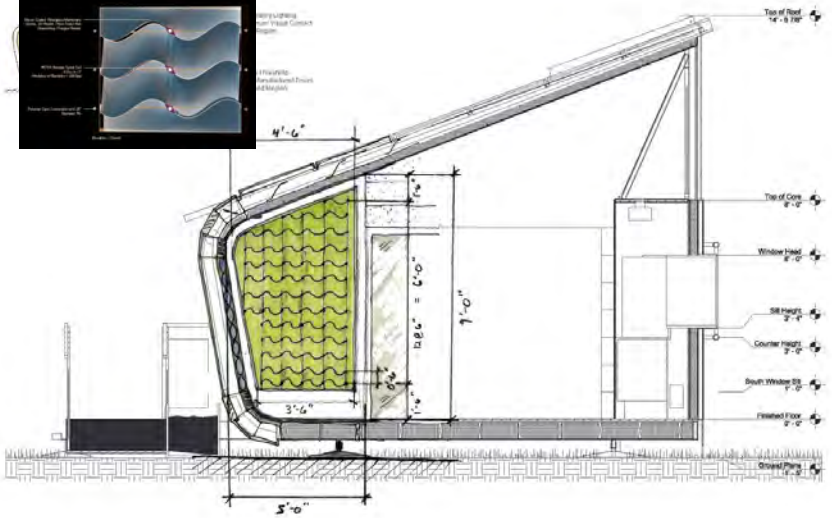
"Siempre intentas. Siempre fallas. No importa. Intenta otra vez. Falla otra vez. Falla mejor."

—Samuel Beckett

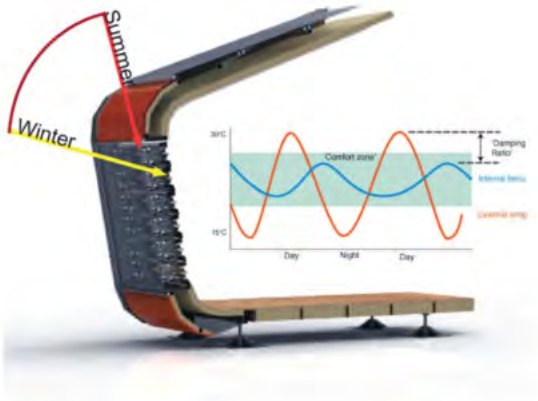

Photovoltaics
DC/AC inverter
Main panel
Evacuated cylinders
Warm water tank
Hot water tank
Domestic water tank
Operable window
Ceiling return air duct
Building integrated photovoltaics
Double-skinned roof plenum
PCM. thermal mass interior finish
Tromb wall
Greenhouse
Water to water heat pump
Enthalpy wheel
Water cooled condensing unit
Under-floor, low velocity supply air duct
Heating/cooling coils
1 Climate Control Diagram
Scale: Not to scale

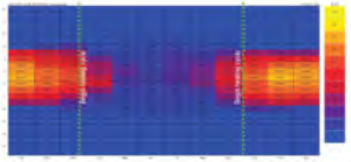


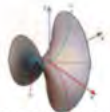




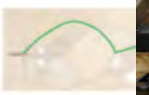
compliant thermal regulation skin (vander werf '09)
EMT M.Arch. Thesis '09

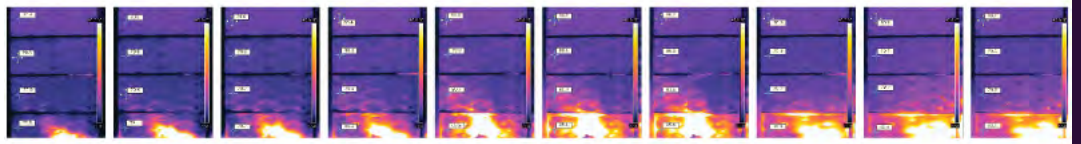


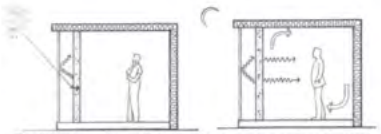




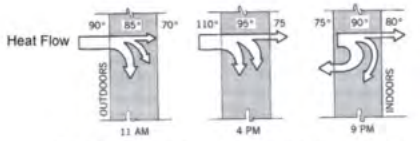
Scherk's Minimal Surface







Traditional trombe-wall application using concrete as thermal mass. Water has nearly three times the heat capacity of concrete and can also serve as a day lighting source



As daylight penetrates the tanks, the thermal mass is "charged", and can be directed into the house over an extended period of time.=

polymer trombe wall (eddie hall '09)
Capstone '09

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 09-29

NSF 09-606 11/13/09

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☐ SMALL BUSINESS ☐ MINORITY BUSINESS
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☒ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **EFRI-SEED Preliminary Proposal: Adaptive Autonomous Performance in a Sensitive and Integrative System (AAPSIS) for Telemedicine Building**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 2,068,430	48 months	07/01/10	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

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☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ EAGER* (GPG II.D.2) ☐ RAPID** (GPG II.D.1)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
_____
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT
Dept of Materials Science & Engineering

PI/PD POSTAL ADDRESS
P.O. Box 210072
Tucson, AZ 85721
United States

PI/PD FAX NUMBER
520-621-8059

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME Pierre A Deymier	PhD	1985	520-621-6080	deymier@u.arizona.edu
CO-PI/PD Eniko T Enikov	PhD	1998	520-621-4506	enikov@engr.arizona.edu
CO-PI/PD Ana María López	MD	1988	520-626-6000	alopez@azcc.arizona.edu
CO-PI/PD Álvaro Malo	MArch	1970	520-621-6752	malo@u.arizona.edu
CO-PI/PD Mary Peterson	PhD	1984	520-621-5365	mapeters@u.arizona.edu

Electronic Signature

Materials Science

Aerospace

Medicine

Architecture

Cognitive Science

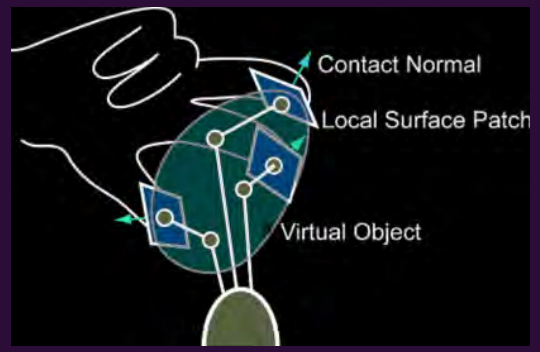
NSF/EFRI-SEED

Adaptive Autonomous Performance in a Sensitive Integrative System for Telemedicine Unit

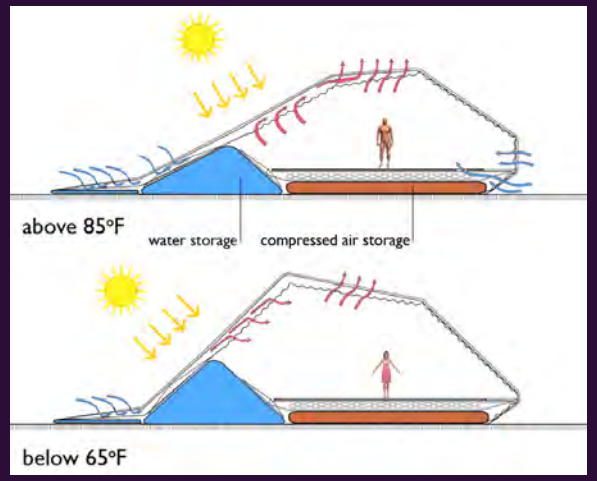
MATERIALS TECHNOLOGIES
Materials & Sensing
Multifunctional envelope
Polymer membrane/fabric
Automorphic Pneumatic structure
Solar-powered CAES
Micro/Macro Sensing Network
Integrative Aesthetics

NEED
Autonomy & Interdependence
Adaptive
Autonomous Performance
Sensitive
Integrative
Sustainable
Telemedicine Unit

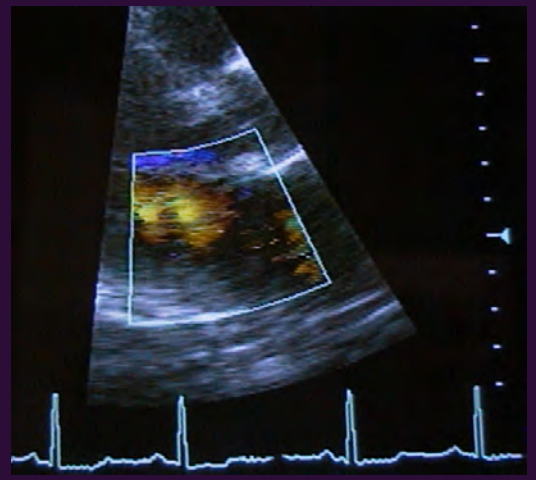
TASKS
Modeling & Simulation
Integrated hardware/software system
Model-based computer control
Dynamic predictive resource manager
Integrated sensor/actuator network
Energy storage/recovery system
Multi-paradigm simulations



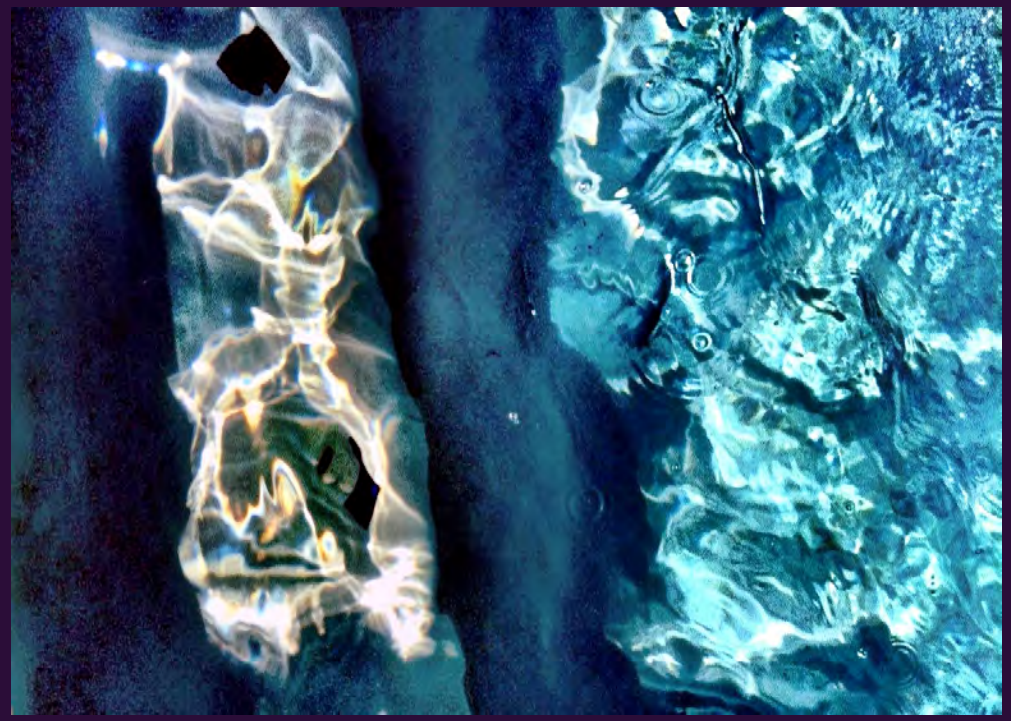
Haptic technologies



Hypothetical pneumatic structure

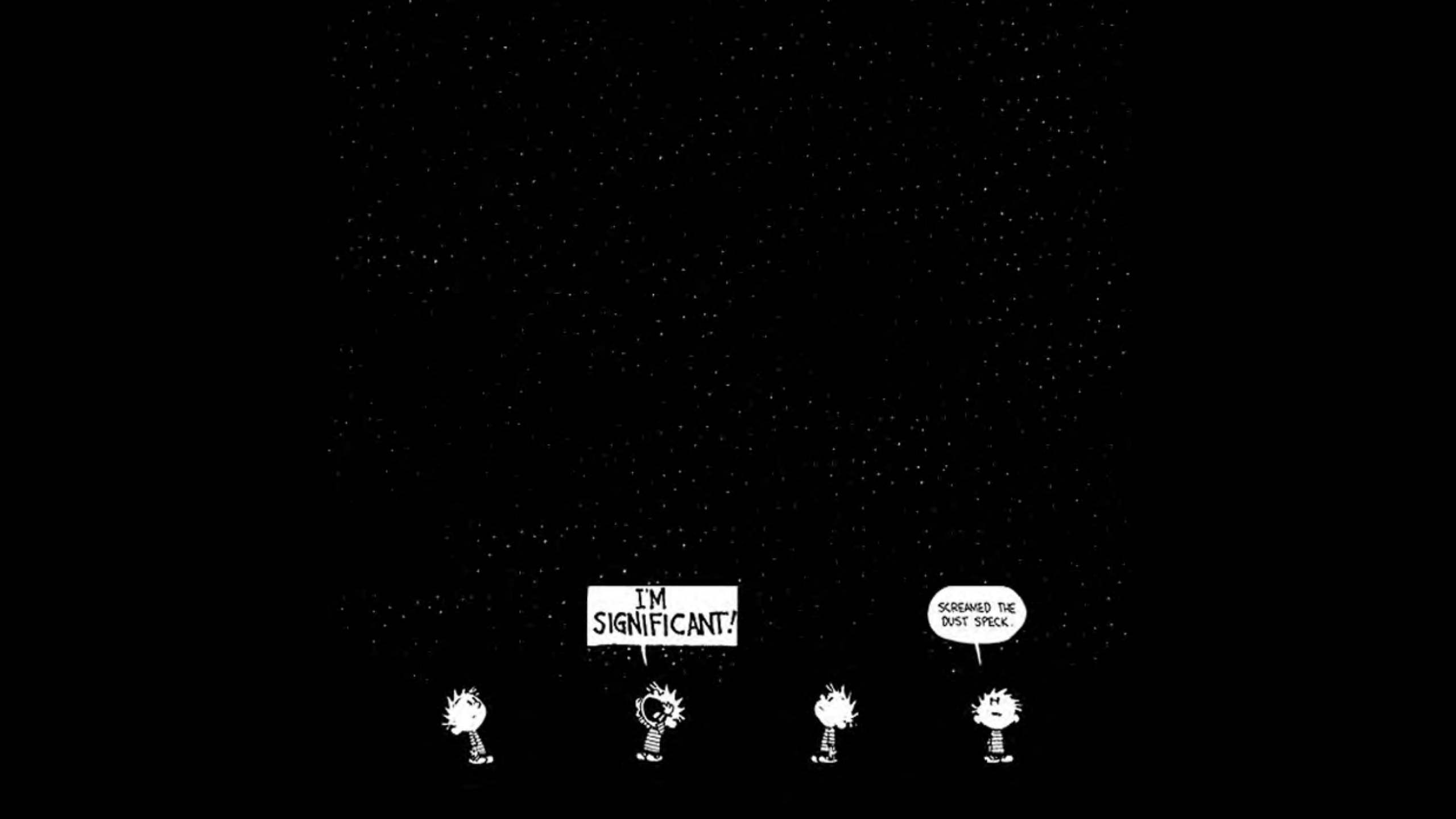


Diagnostic modeling



” Hay cosas que sólo la inteligencia es capaz de buscar, pero que, por sí misma, no encontrará jamás. Estas cosas sólo las encontraría el instinto, pero no las buscará jamás.”

Henri Bergson, *Evolución creadora*


I'M SIGNIFICANT!
SCREAMED THE DUST SPECK.