RICE UNIVERSITY

DISPLACEMENT ECOLOGIES

by

Brantley Frederick Highfill

A THESIS SUBMITTED
IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE

Master of Architecture

APPROVED, THESIS COMMITTEE:

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Architecture

Albert Pope, Gus Sessions Wortham Professor
Architecture

Fares el-Dahdah, Associate Professor
Architecture

HOUSTON, TEXAS
MAY 2011

ABSTRACT

DISPLACEMENT ECOLOGIES

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This thesis defines displacement as the occupation of infrastructural voids for collective use. By calibrating patterns of appropriation, I propose displacement as a formal strategy for leveraging issues of demand.

The discipline of architecture is becoming arguably subsumed by "sustainability" - an agenda which responds to demand with increased efficiency. Instead, this thesis ask how might systems of efficiency be leveraged for new modes of collectivity?

Specifically, this project re-appropriates growing energy needs by proposing a pumped storage facility in Las Palmas, Gran Canaria. Current technologies accommodate the storage of energy through the physical displacement of water: a spatial exchange that I leverage to increase the city's collective space.

Displacement reorganizes mass:void relationships. What if we design all voids? The Void:Void condition is a matrix of containers - some filled with people and others with water. Adjusting to changing energy and programmatic demands, displacement occurs as one void appropriates another.

ACKNOWLEDGEMENTS

To Neyran, for endless enthusiasm.

To LM // JA // AM // ZC // JB // MT // CA // CS.

To the professors and peers who challenged me.

To the wedge, for constant inspiration and support.

To Susan Smith, who knew I would write this before I did.

To my parents. To Keaton, Sawyer and Mckenzie. To Kay. And to Brantley Edwards.

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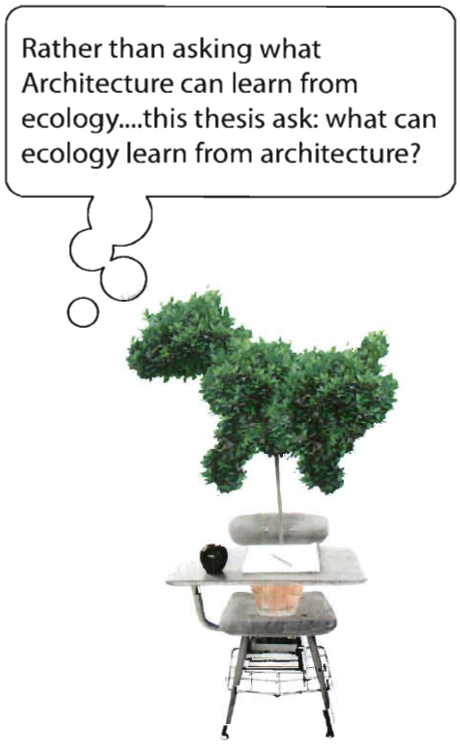
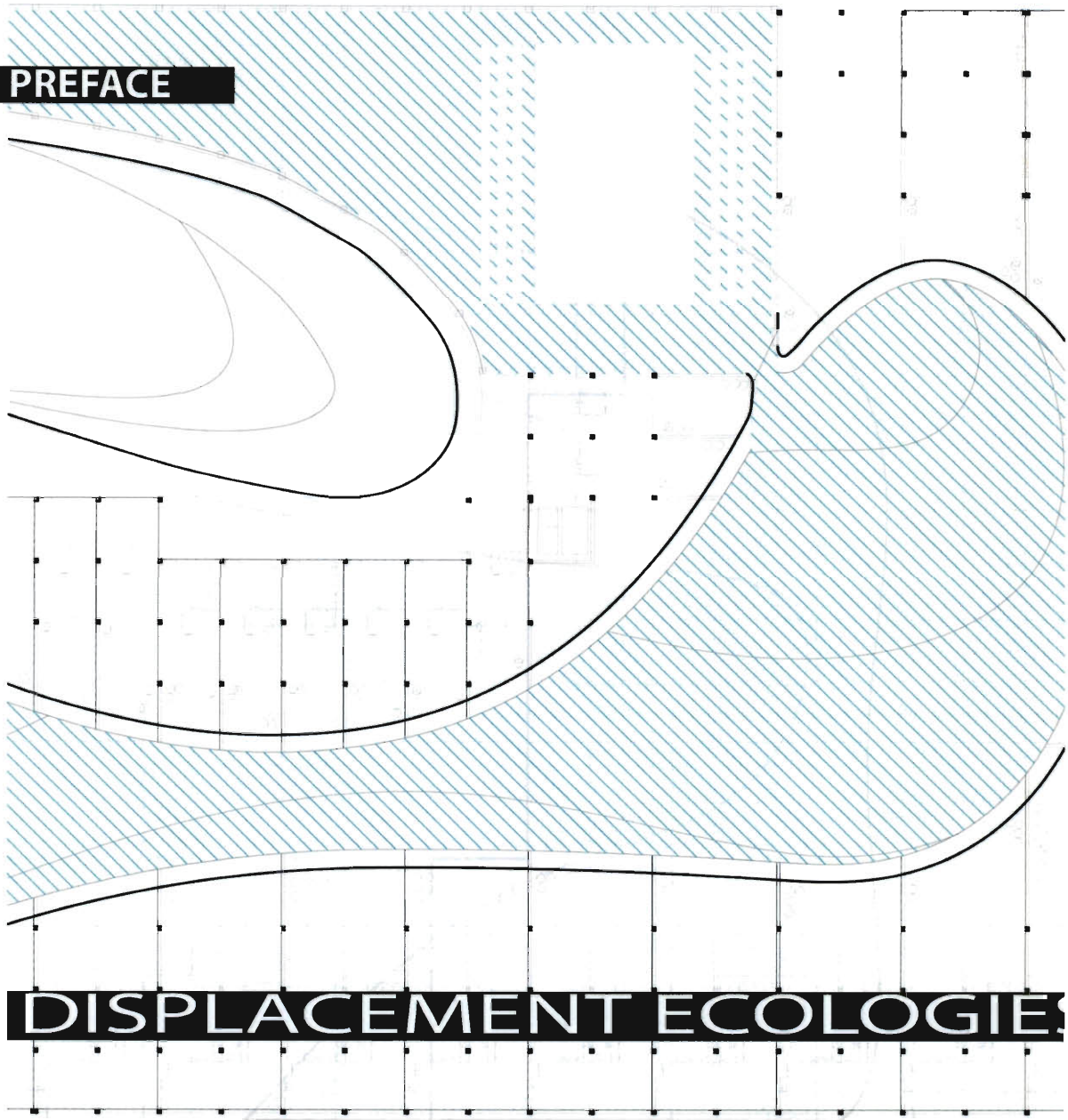


PREFACE



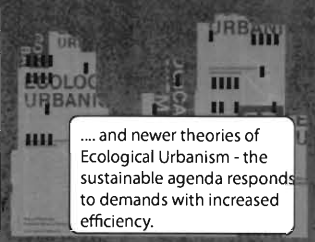
DISPLACEMENT ECOLOGIES

BRANTLEY highfill

This thesis defines displacement as the occupation of infrastructural voids for collective use. By calibrating patterns of appropriation, I propose displacement as a formal strategy for leveraging issues of demand.

For example, during the California (US) droughts of the 1970s, as pools were drained, the space was re-appropriated and skateboarding first popularized. Resource demands triggered new social dimensions.

The discipline of architecture is becoming (arguably) subsumed by sustainability. With standards of LEED...



.... and newer theories of Ecological Urbanism - the sustainable agenda responds to demands with increased efficiency.

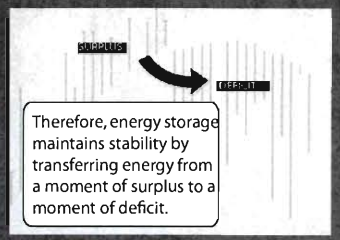
For instance, a "sustainable" building consumes less energy, carbon, water and produces less waste.

Instead, I ask "How might systems of efficiency...

be leveraged for new modes of collectivity?"

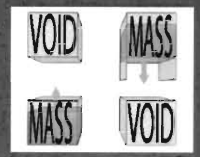
Specifically this project re-appropriates growing energy needs. Here we see an increasing shift to sources that require energy storage.

While energy use changes throughout the day, renewable supplies are also intermittent.



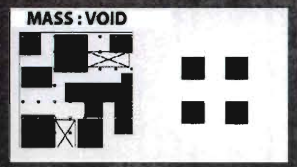
Therefore, energy storage maintains stability by transferring energy from a moment of surplus to a moment of deficit.

Existing technologies allow us to store energy with the displacement of water.



This process reorganizes relationships between mass and void.

And my proposal leverages this redistribution as a method for increasing the city's collective space.



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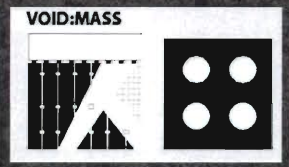
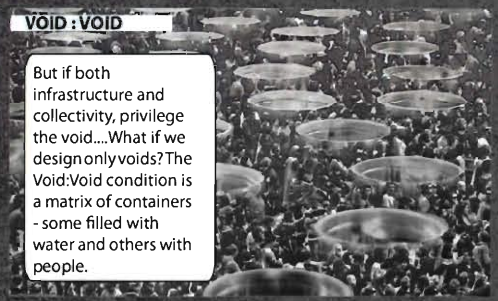
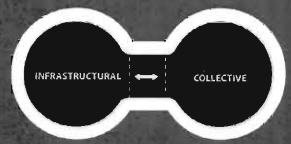


2) or the VOID: MASS Condition (Where we design a series of voids, encased by a solid).



But if both infrastructure and collectivity, privilege the void....What if we design only voids? The Void:Void condition is a matrix of containers - some filled with water and others with people.

In this way I create a gradient between the void as infrastructural or collective, with a flexible zone between.



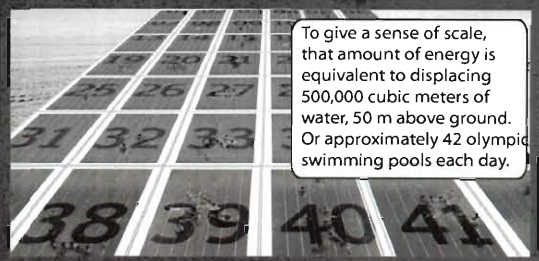
Displacement occurs: as one void appropriates the other - when either collective. or infrastructural demands are greater. Here the solid only exist as a thickened contour defining voids.

Testing this out, I cite my project in the city of Las Palmas: the capital of Gran Canaria.

With 2 million inhabitants... and a much larger tourist population of 12 million annually - the city's energy needs change frequently.

However, to meet mandates of the European Union, the city will need to drastically increase its wind generation (from approximately 10 to 45% of its total capacity).

This increased percentage of wind energy will create an unstable electrical grid - meaning a large amount of energy storage will soon be required.



To give a sense of scale, that amount of energy is equivalent to displacing 500,000 cubic meters of water, 50 m above ground. Or approximately 42 olympic swimming pools each day.

To do this, I select the largest void in the city's existing fabric: An abandoned soccer arena, and ask...

Can a void...be form?

Although the site was once a node of collectivity... I could flood it. Energy demands will determine the buildings overall mass.

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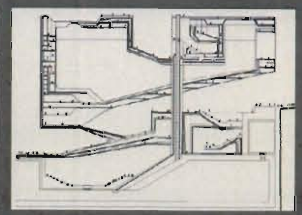
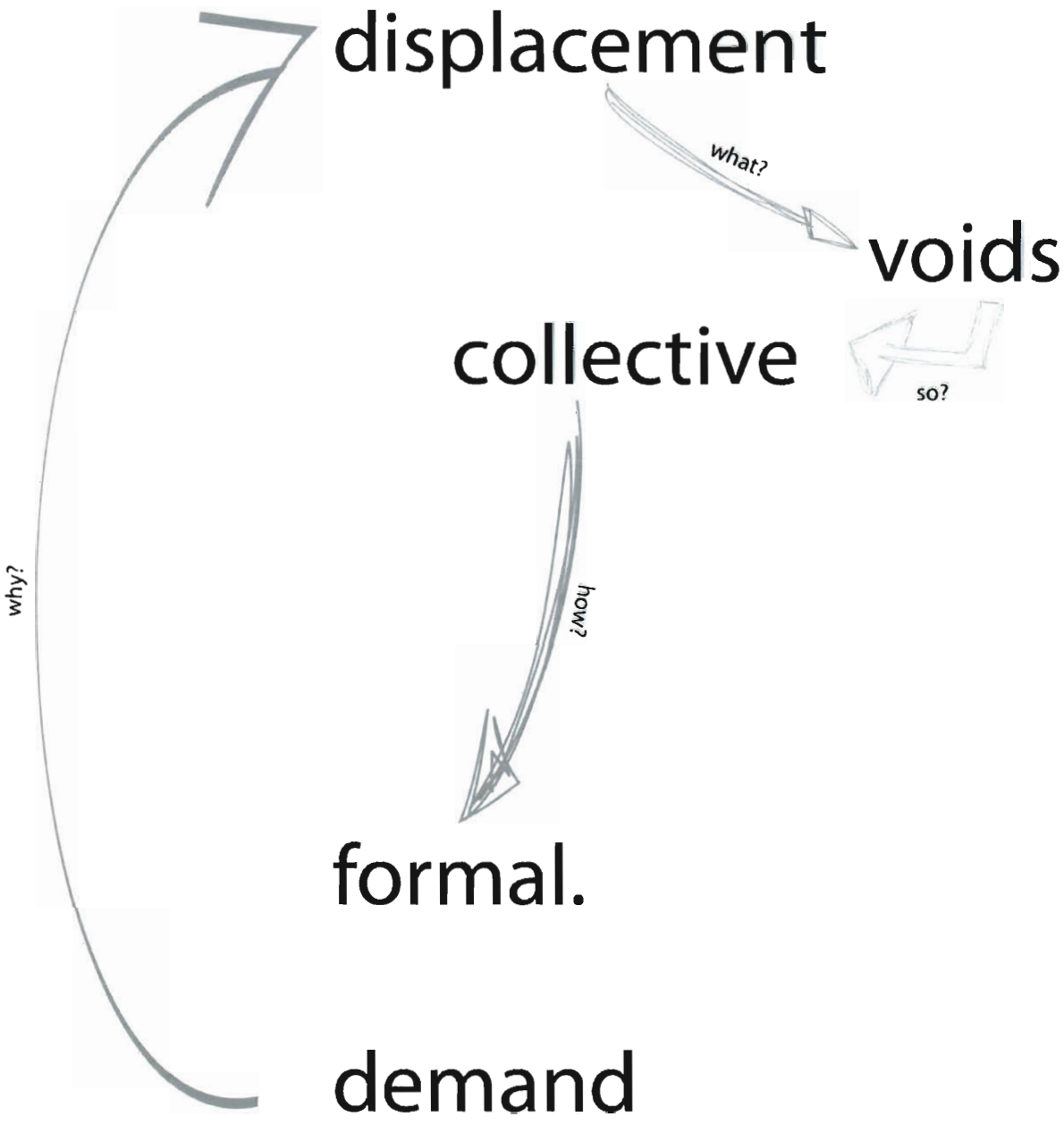
And at other times are flooded with water.



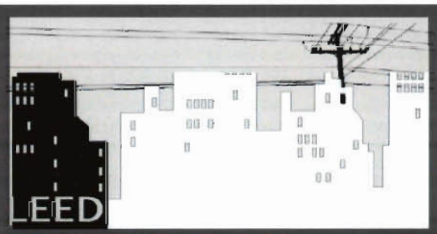
In this way, I define space by the thickness between voids....the VOID:VOID.

SUMMARY

This thesis defines displacement as the occupation of infrastructural voids for collective use. By calibrating patterns of appropriation, I propose displacement as a formal strategy for leveraging issues of demand.


displacement
what?
voids
so?
collective
how?
formal.
why?
demand

For example, during the California (US) droughts of the 1970s, as pools were drained, the space was re-appropriated and skateboarding first popularized. In this case, resource demands triggered new social dimensions.



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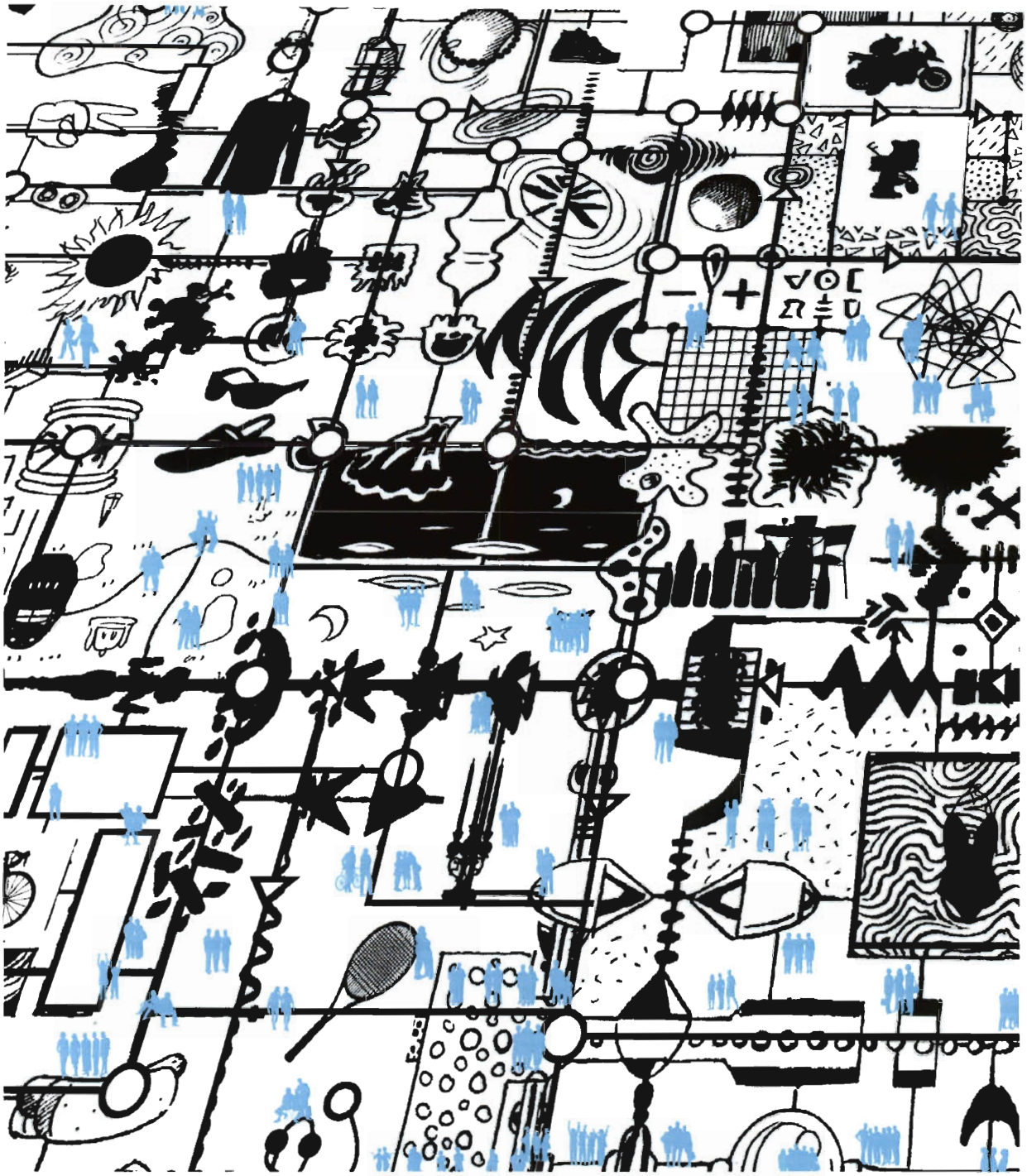

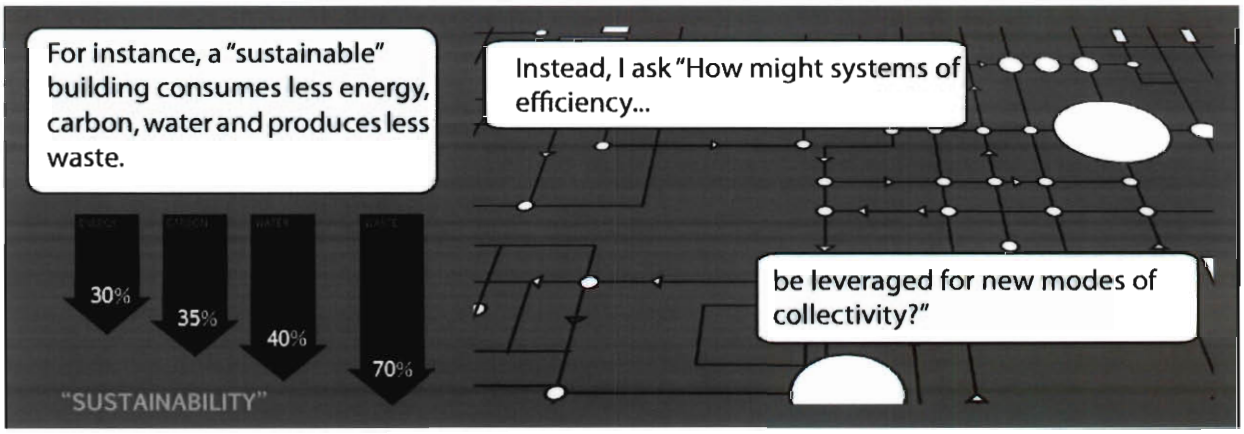
For instance, a "sustainable" building consumes less energy, carbon, water and produces less waste.
30%
35%
40%
70%
"SUSTAINABILITY"
Instead, I ask "How might systems of efficiency...
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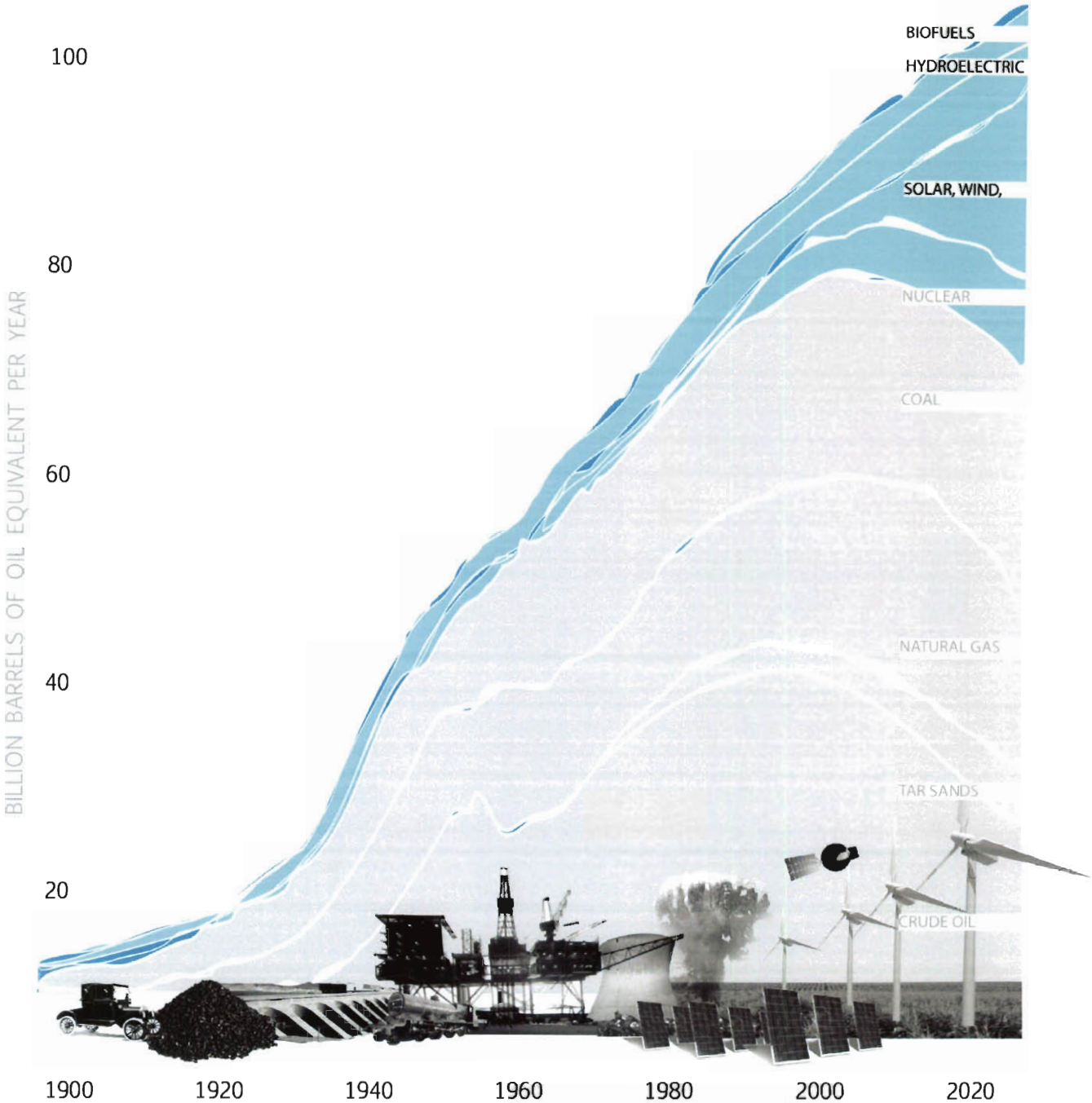
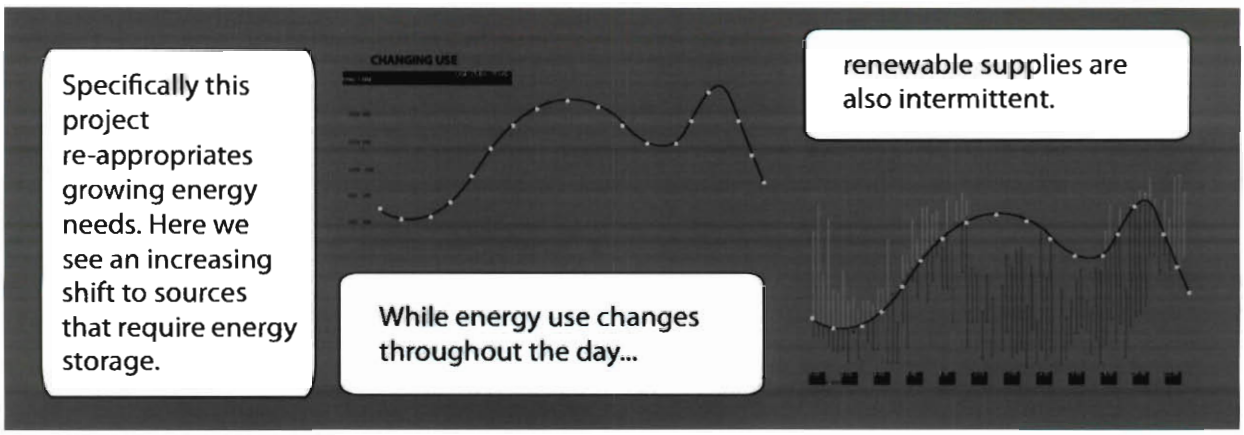
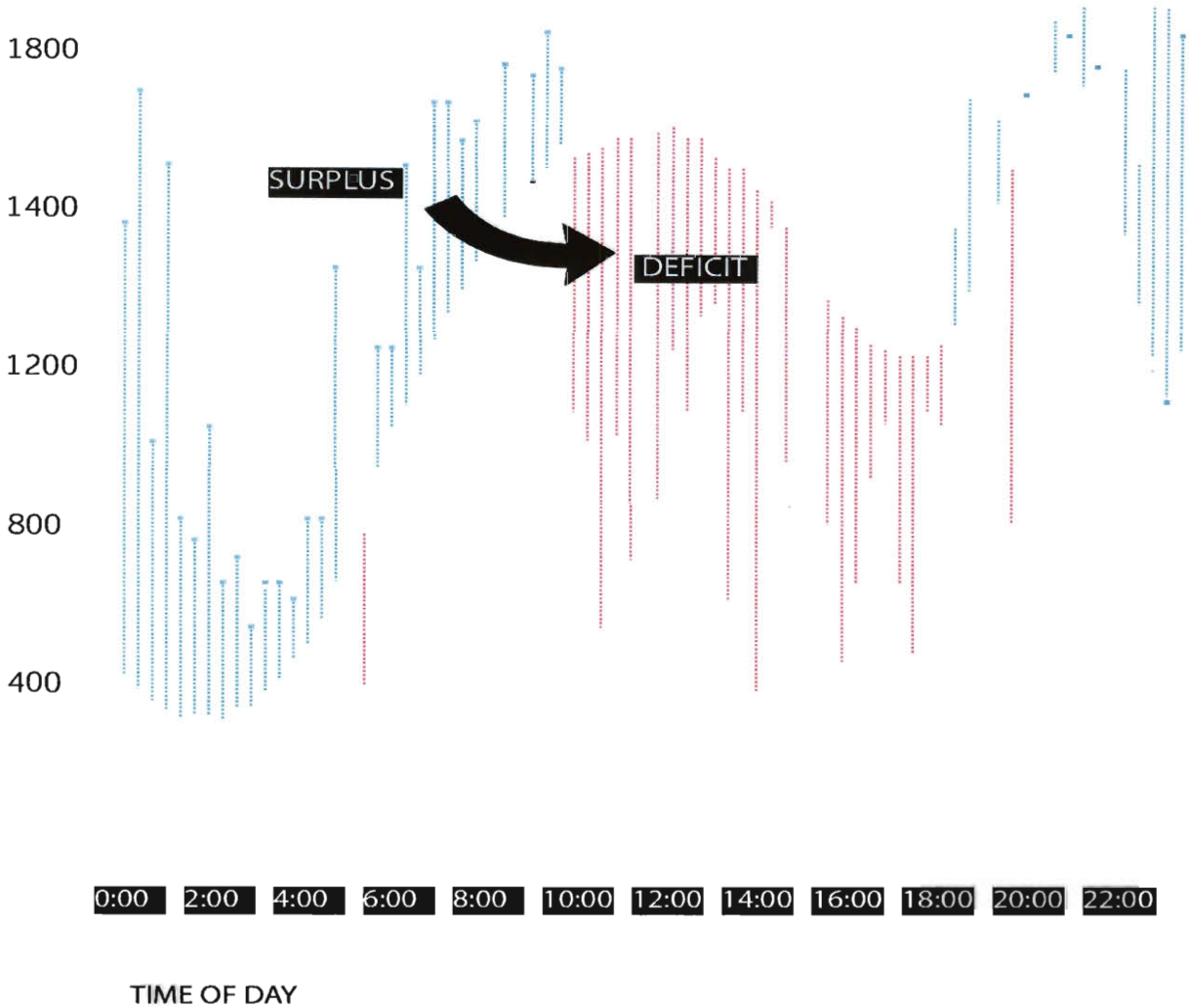


ENERGY DEMANDS

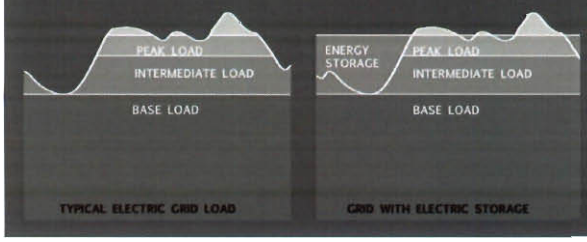


ENERGY STORAGE

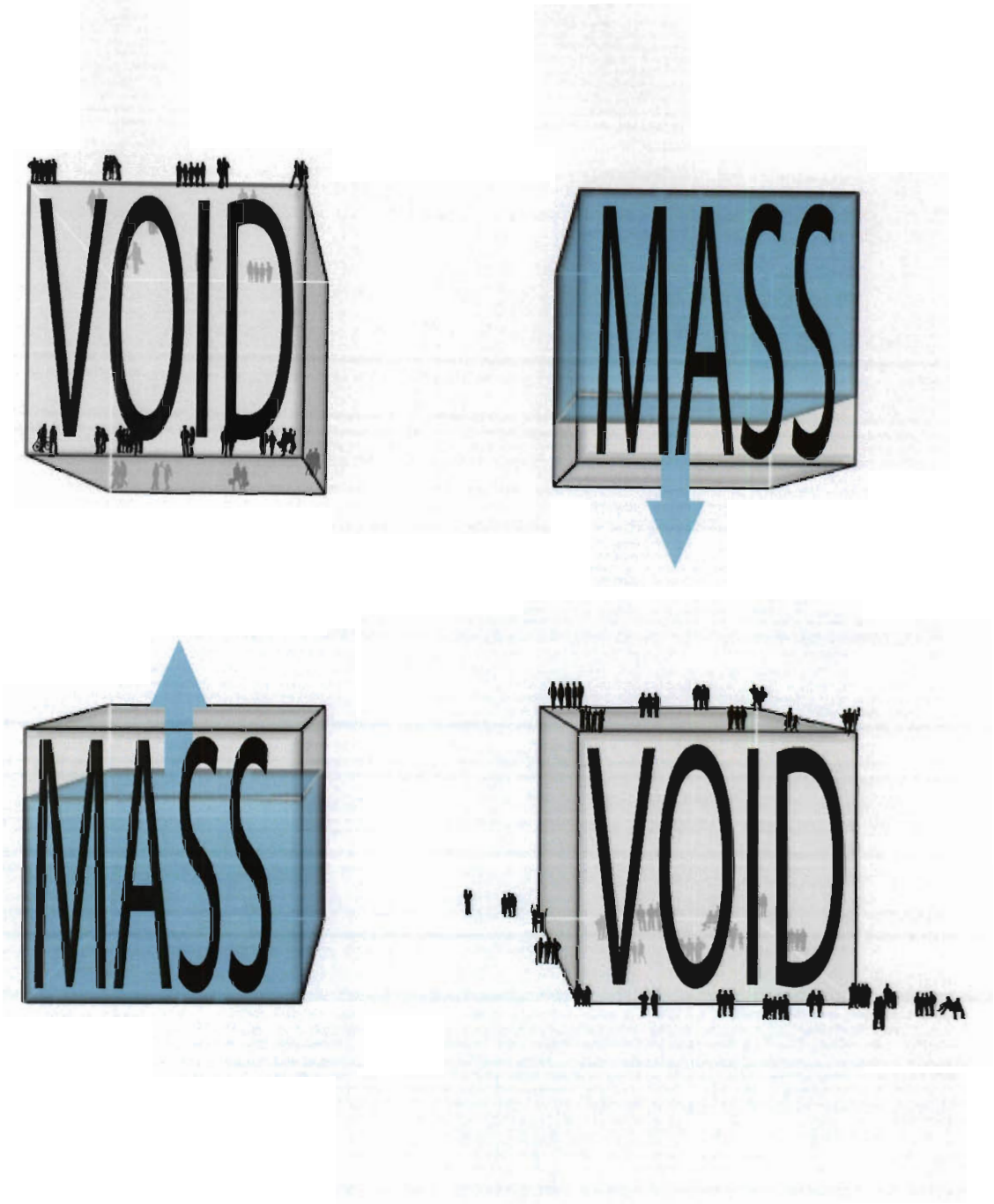
CASE STUDY//TEXAS WIND FARM

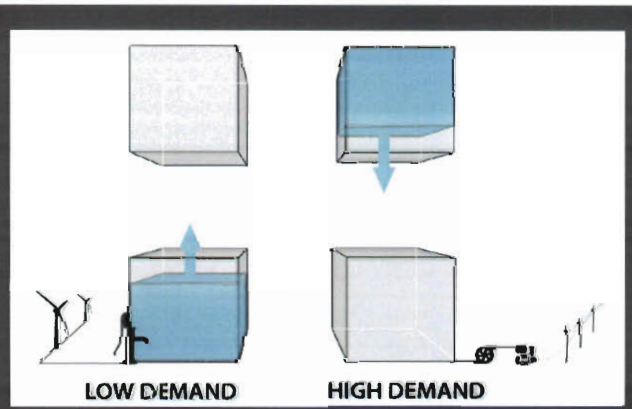


Therefore, energy storage maintains stability by transferring energy from a moment of surplus to a moment of deficit; allowing a changing supply to meet a changing demand.



Existing technologies allow us to store energy with the displacement of water. At night, when there is a surplus of energy, water is pumped to a higher elevation. Later, when demand is high, that energy is re-harvested by releasing water through turbines to run generators and balance the electrical grid.





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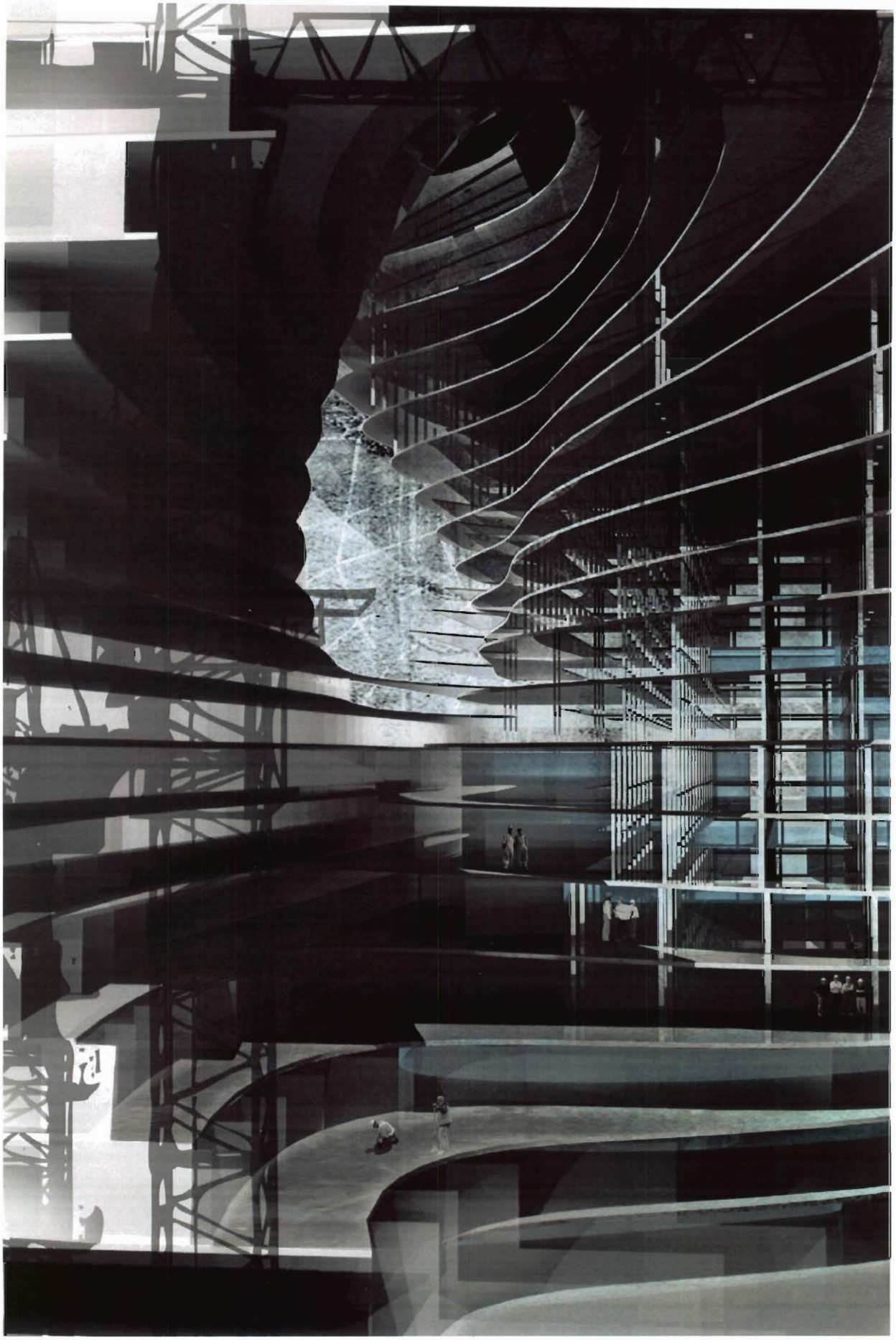
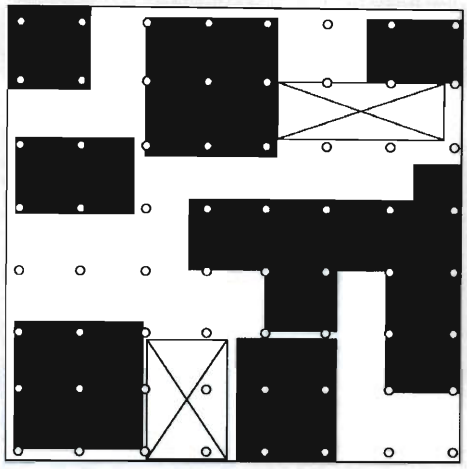


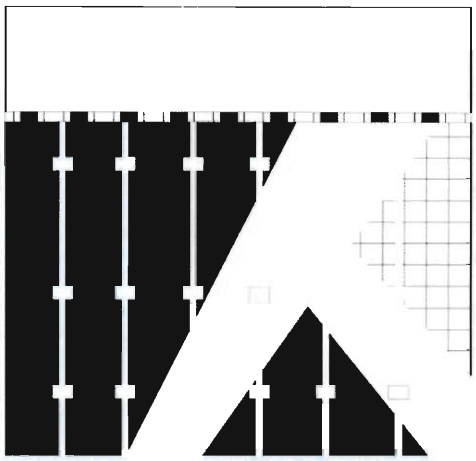
MASS:VOID

VILLA VPRO - MVRDV



VOID:MASS

BIBLIOTEQUE NATIONAL - OMA



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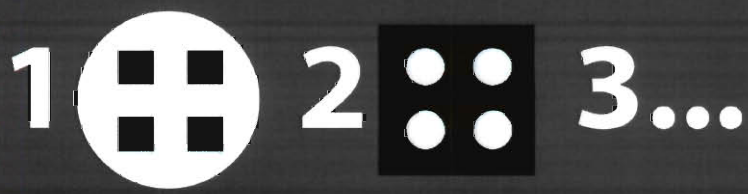

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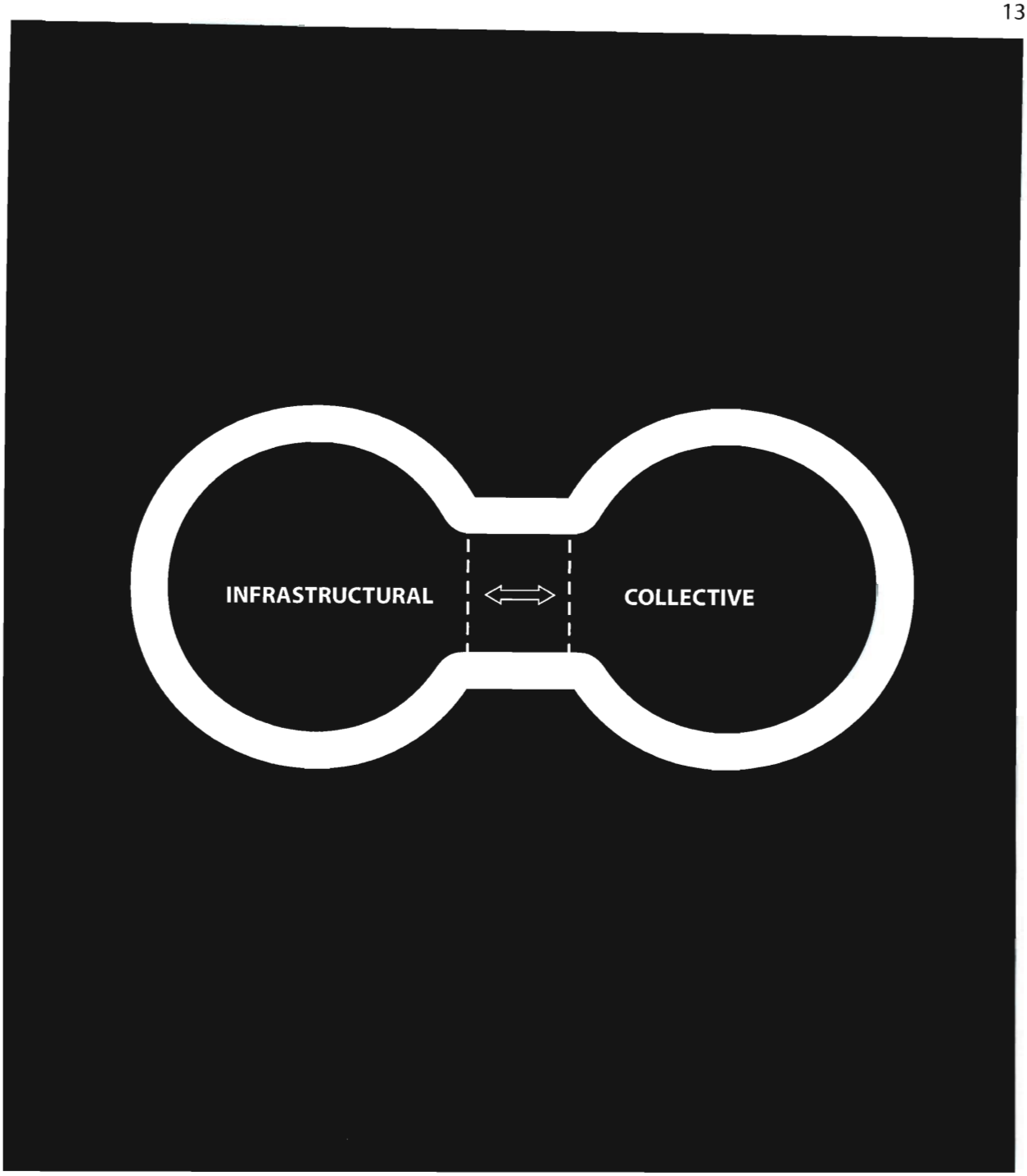

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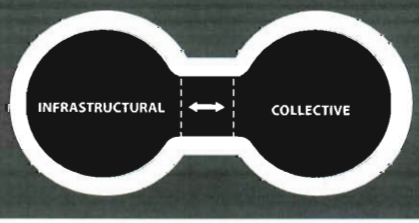

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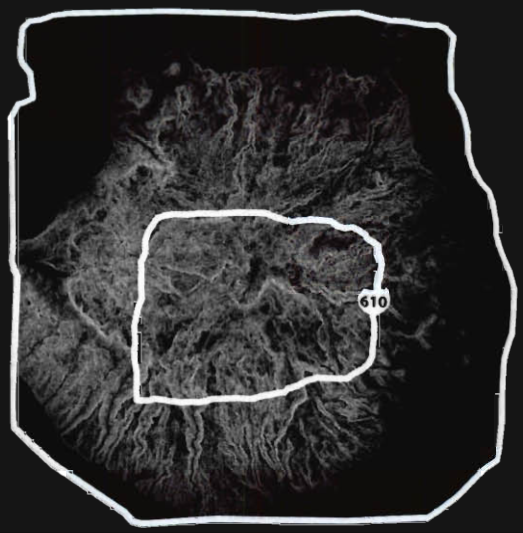
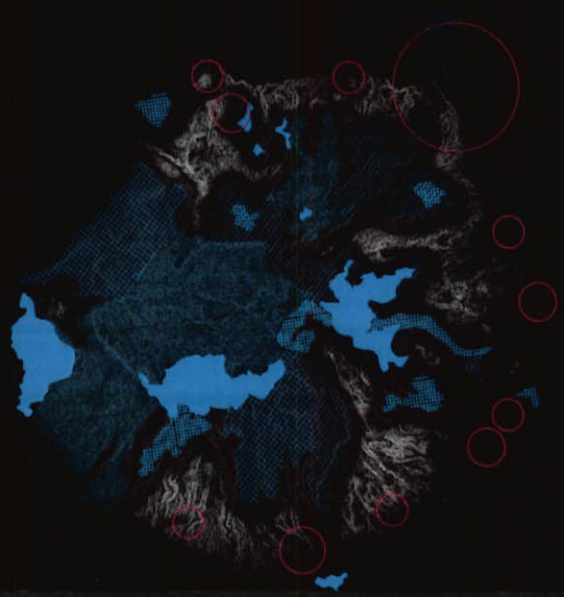


Gran Canaria relative to Houston



Protected Landscape versus Urban Nodes

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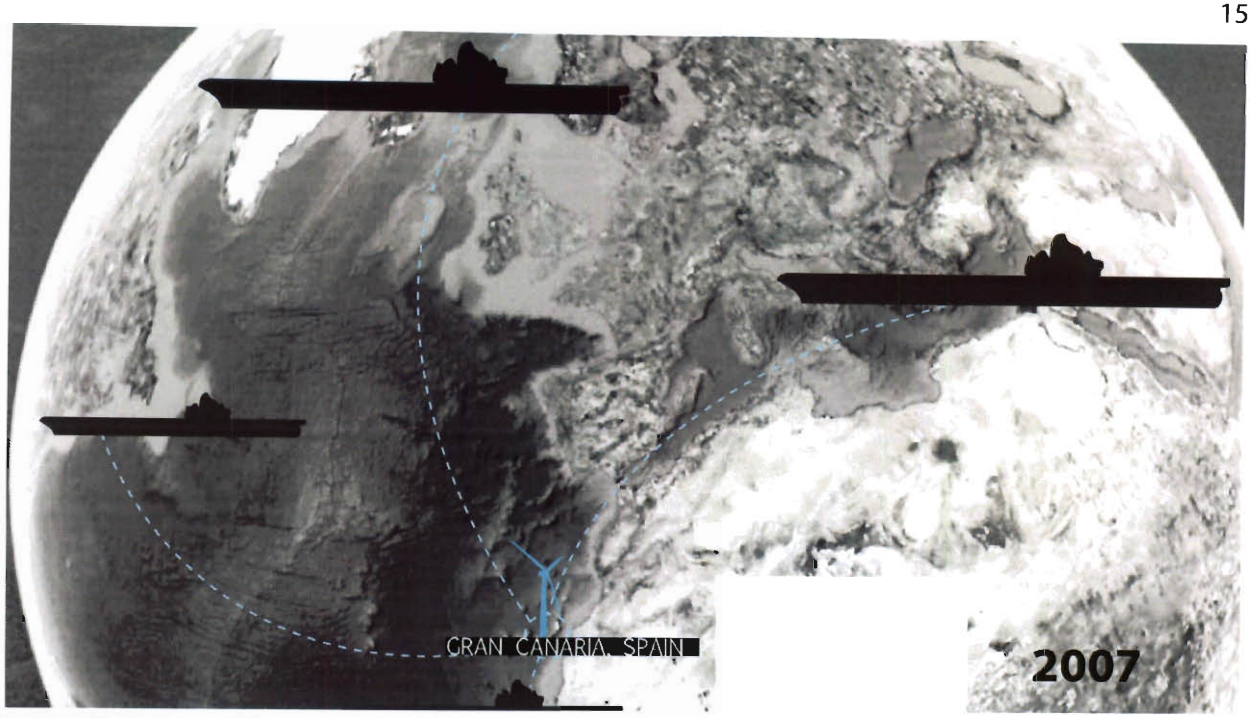
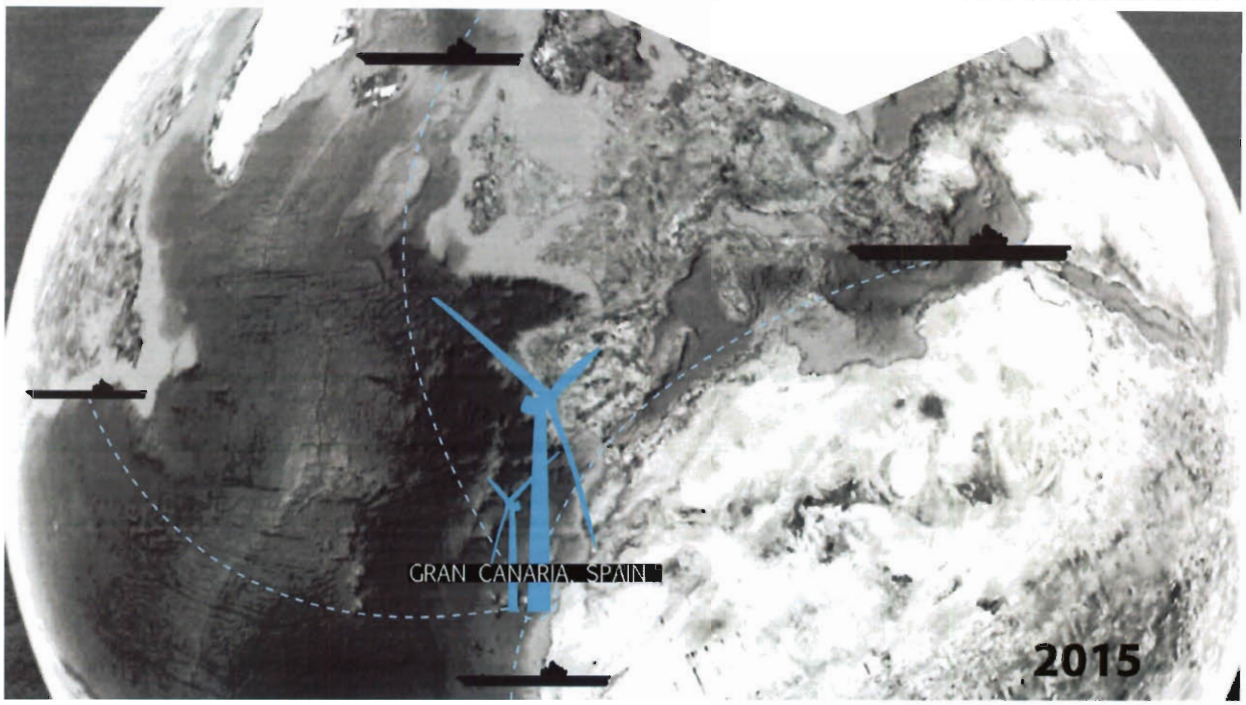
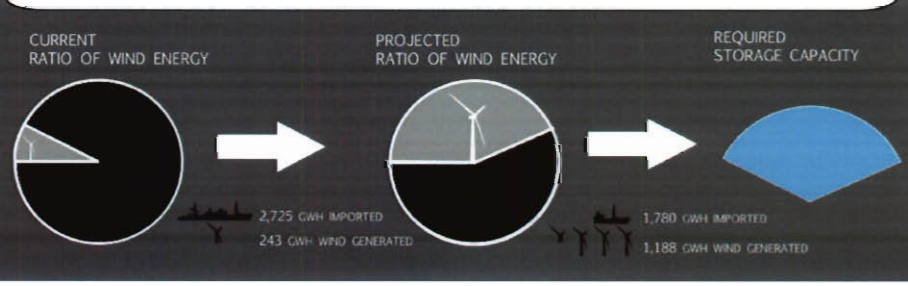
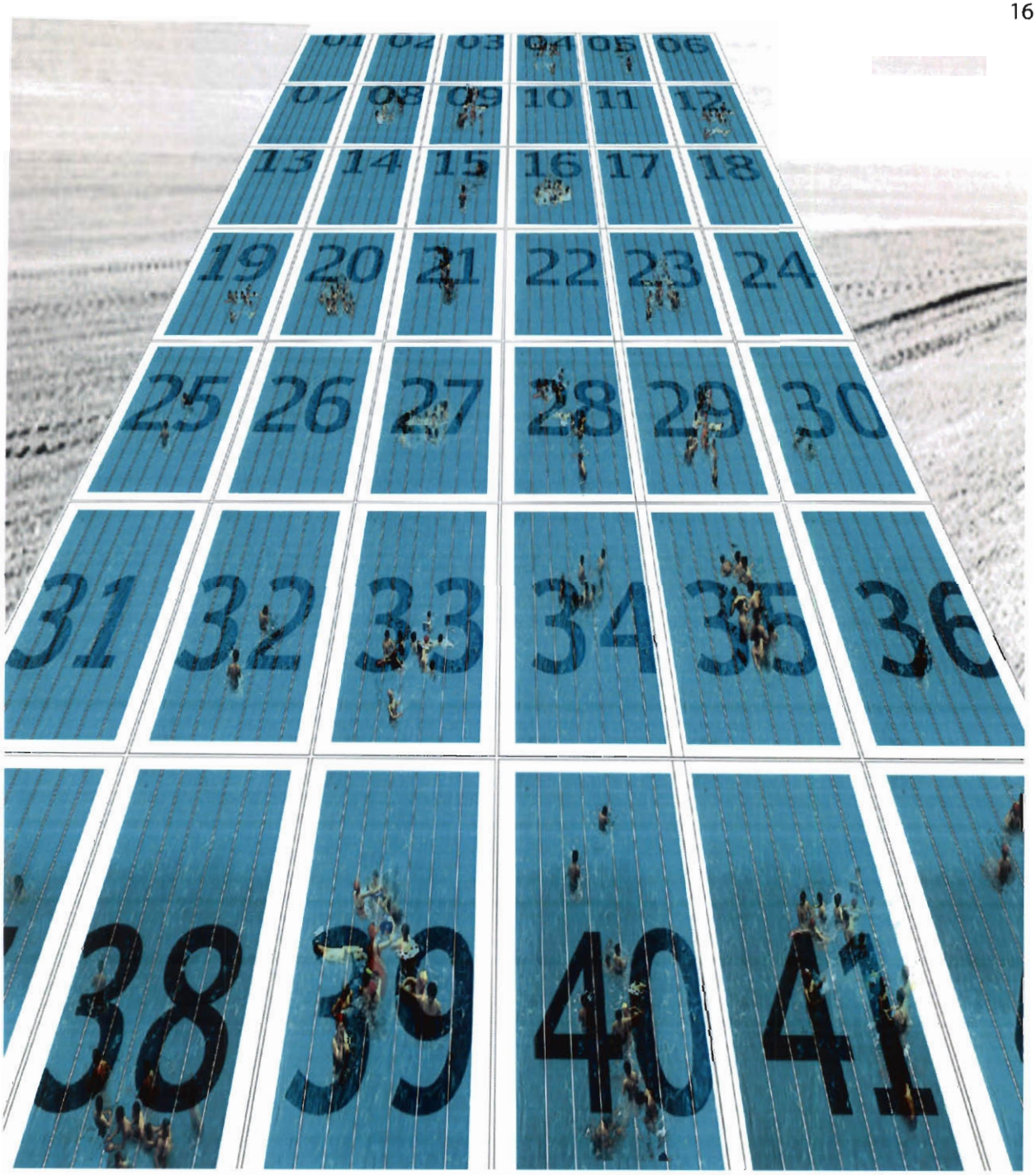


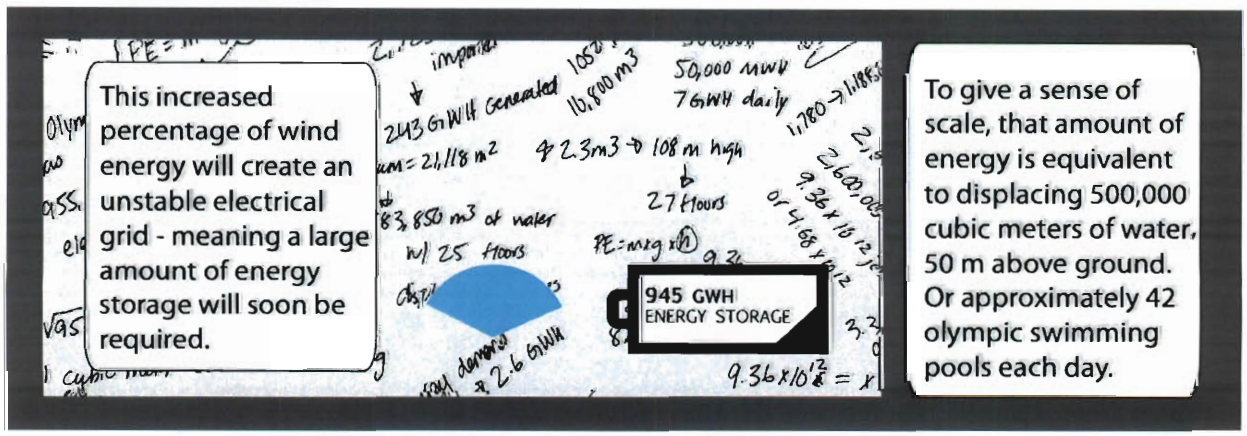


And because the island is geographically isolated, it relies almost exclusively on theimportation of petroleum.

However, to meet mandates of the European Union, the city will need to drastically increase its wind generation (from approximately 10-45% of its total capacity).







This increased percentage of wind energy will create an unstable electrical grid - meaning a large amount of energy storage will soon be required.

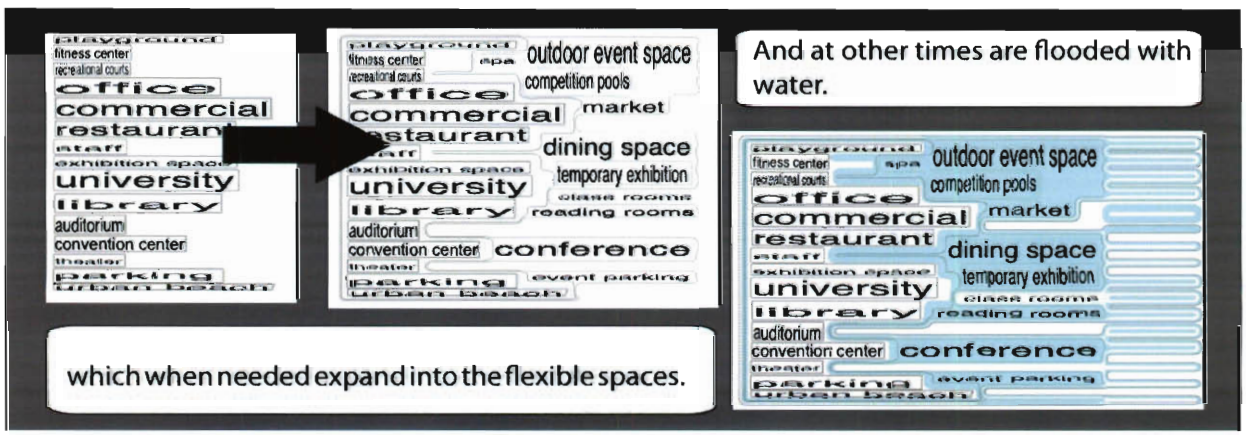
To give a sense of scale, that amount of energy is equivalent to displacing 500,000 cubic meters of water, 50 m above ground. Or approximately 42 olympic swimming pools each day.

ESTADIO INSULAR
ABANDONED SINCE 2003

To do this, I select the largest void in the city's existing fabric: An abandoned soccer arena, and ask: Can a void...
be form?

Although the site was once a node of collectivity... I could flood it. Energy demands will determine the buildings overall mass.

Then I insert additional voids as public program.



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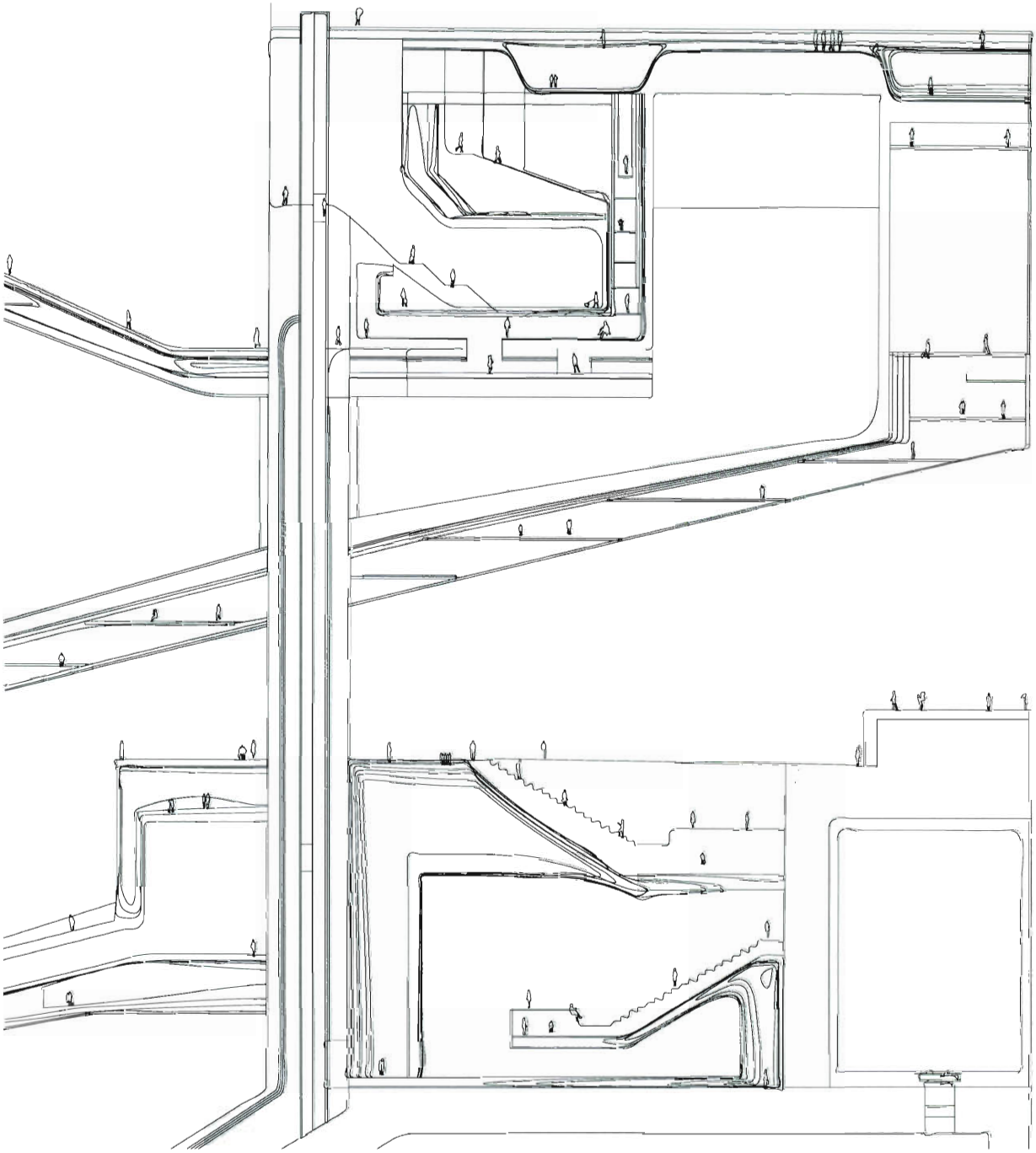

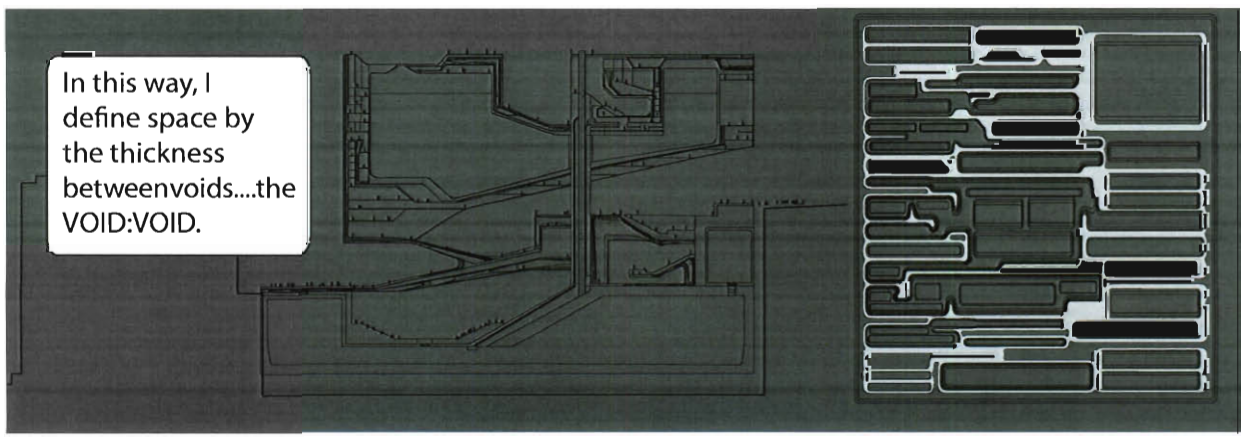
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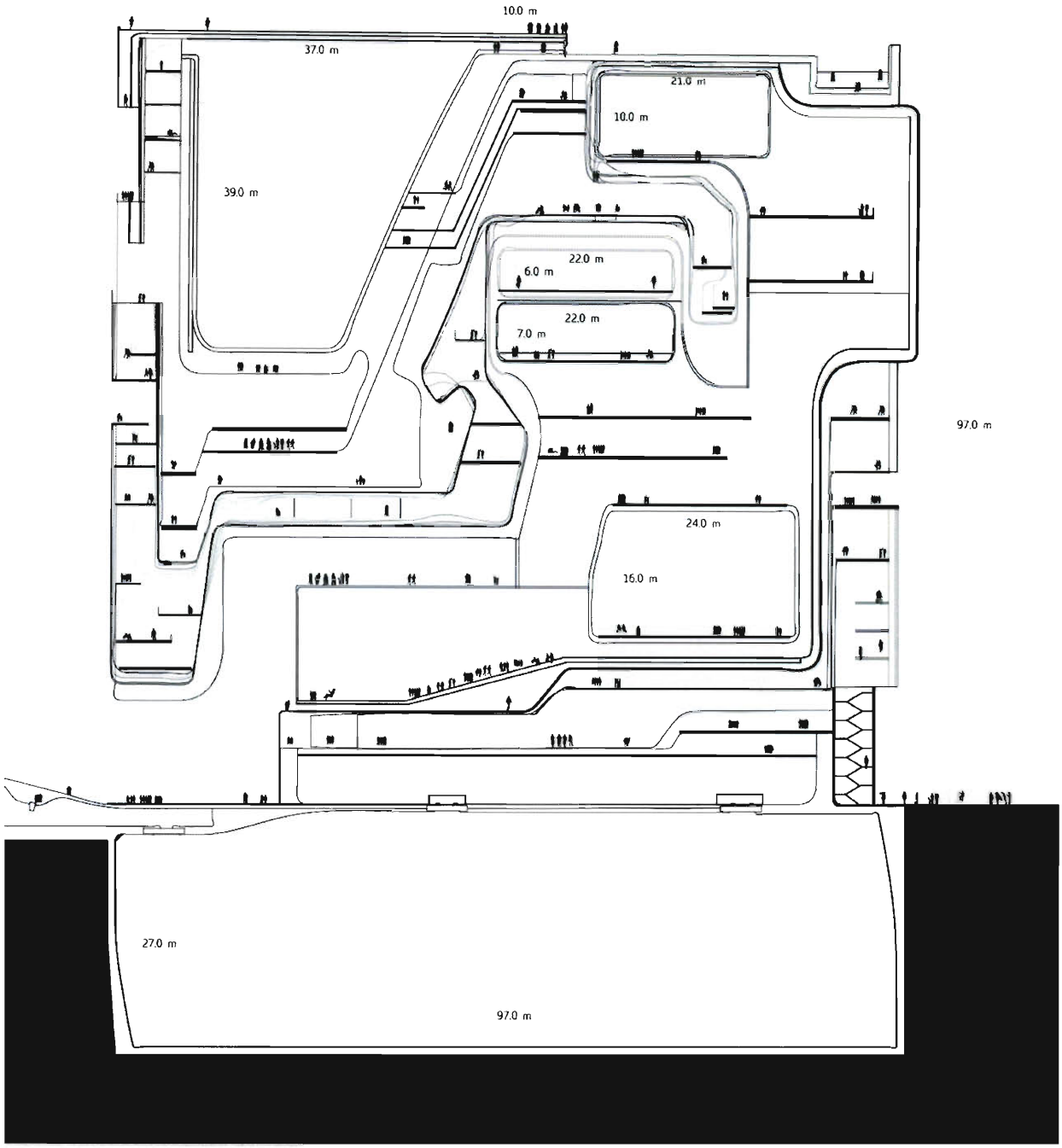
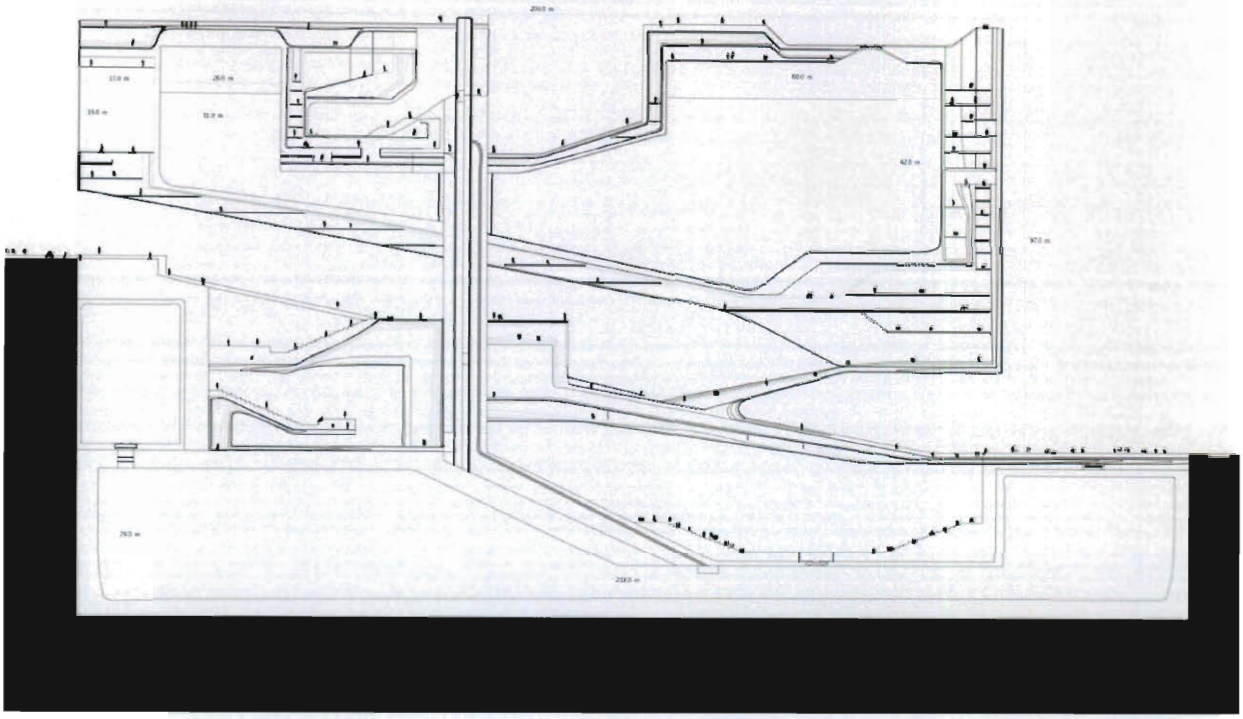
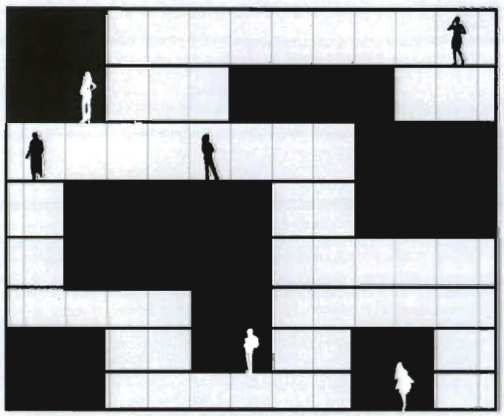


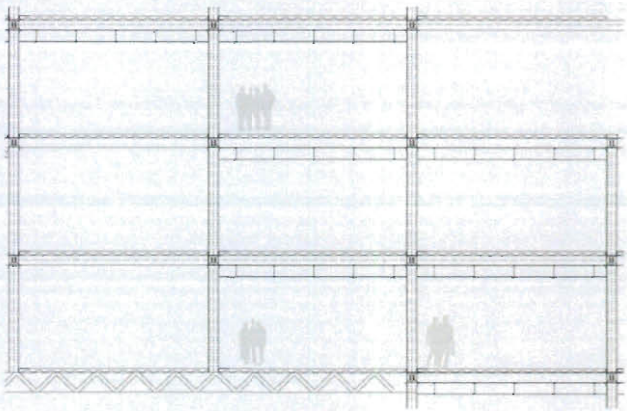
RESIDENTIAL UNITS HOTEL UNITS FLEXIBLE VOIDS

CITY INFRASTRUCTURAL COLLECTIVE CITY

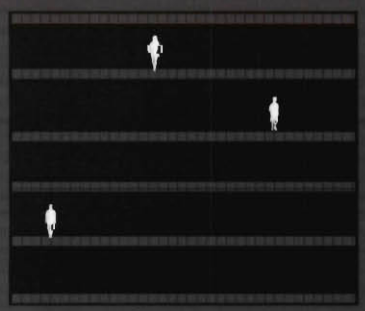
Three typologies of thickness are used depending on adjacencies. The thickness of units generates a structural grid.







VOID:VOID VIERENDEEL TRUSS

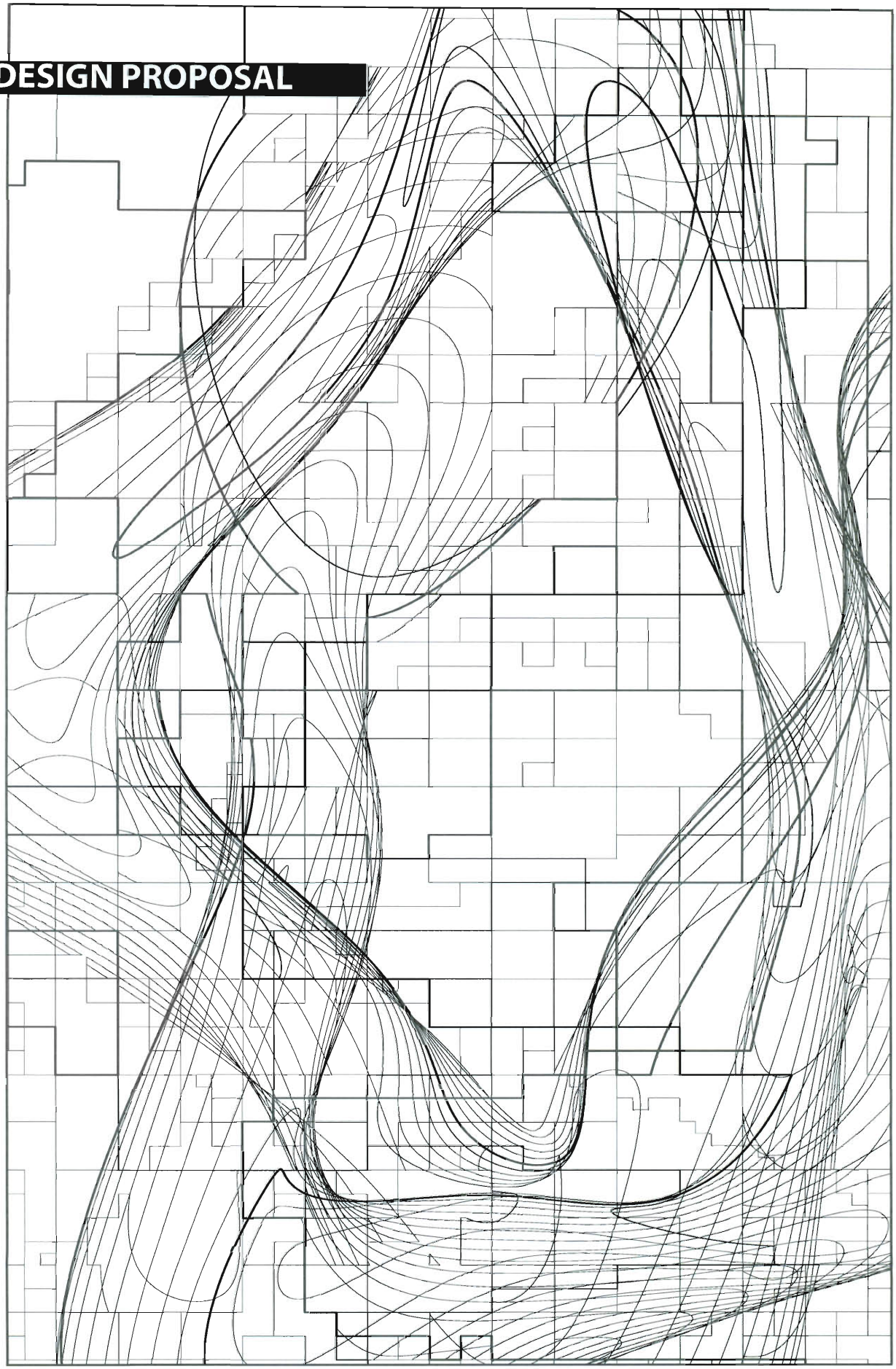


TYPICAL TRUSS

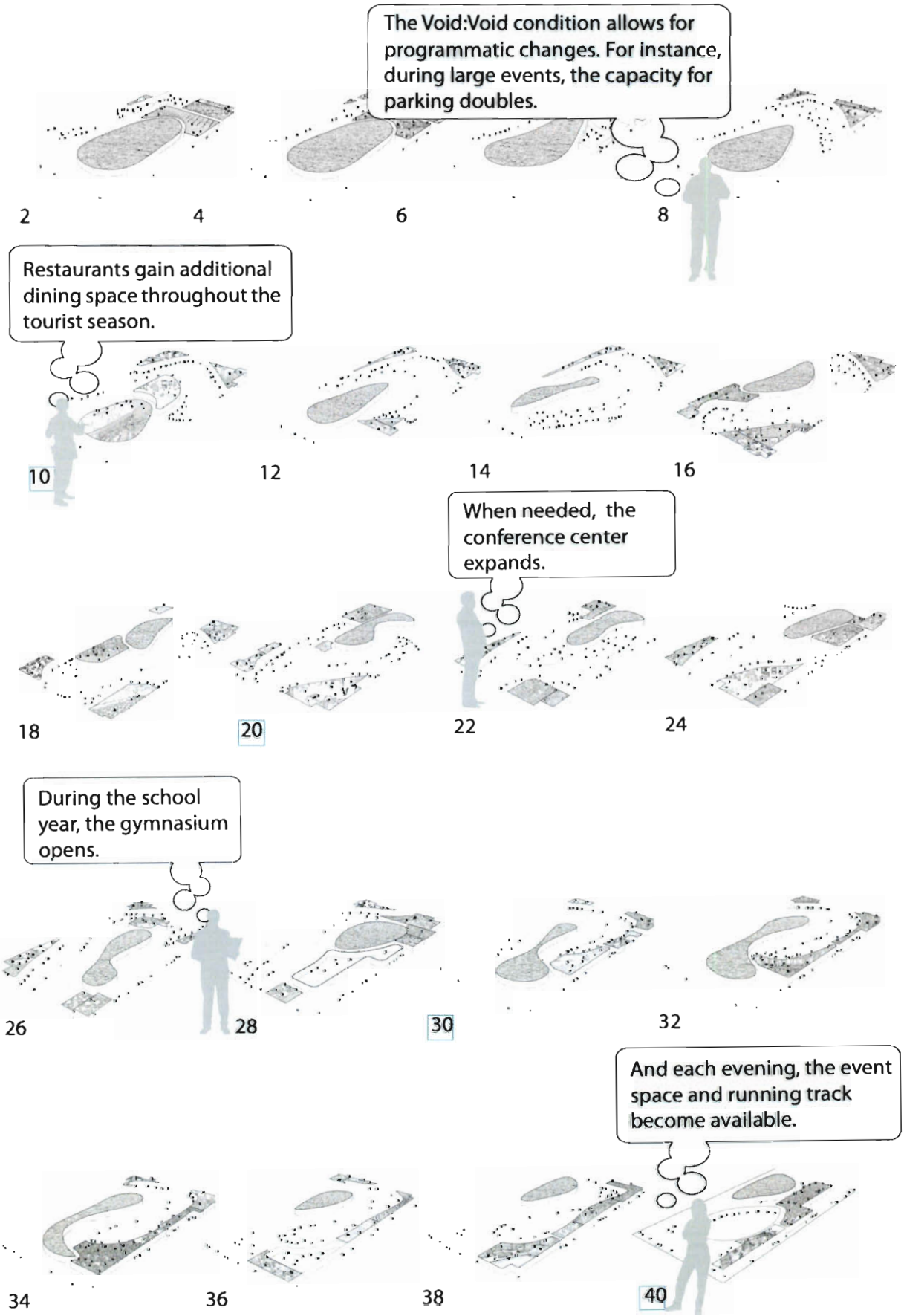
ZKM INHABITED TRUSS

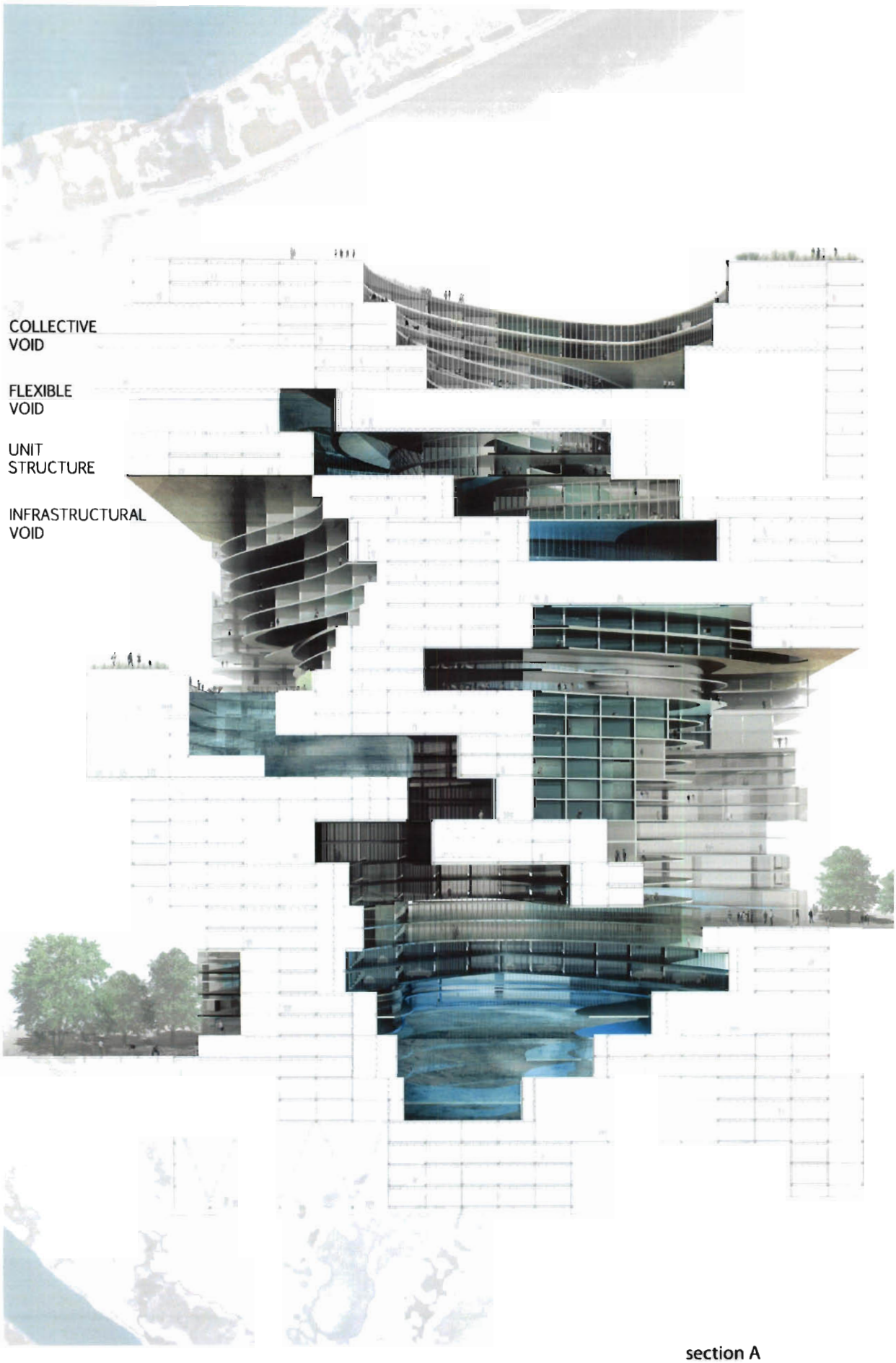
Other projects like OMA's ZKM inhabit the truss to allow for wider spans. However this creates a binary spatial condition. The Void:Void uses the thickness of units to establish a vierendell structural logic that allows for more dynamic and volumetric spaces.

DESIGN PROPOSAL

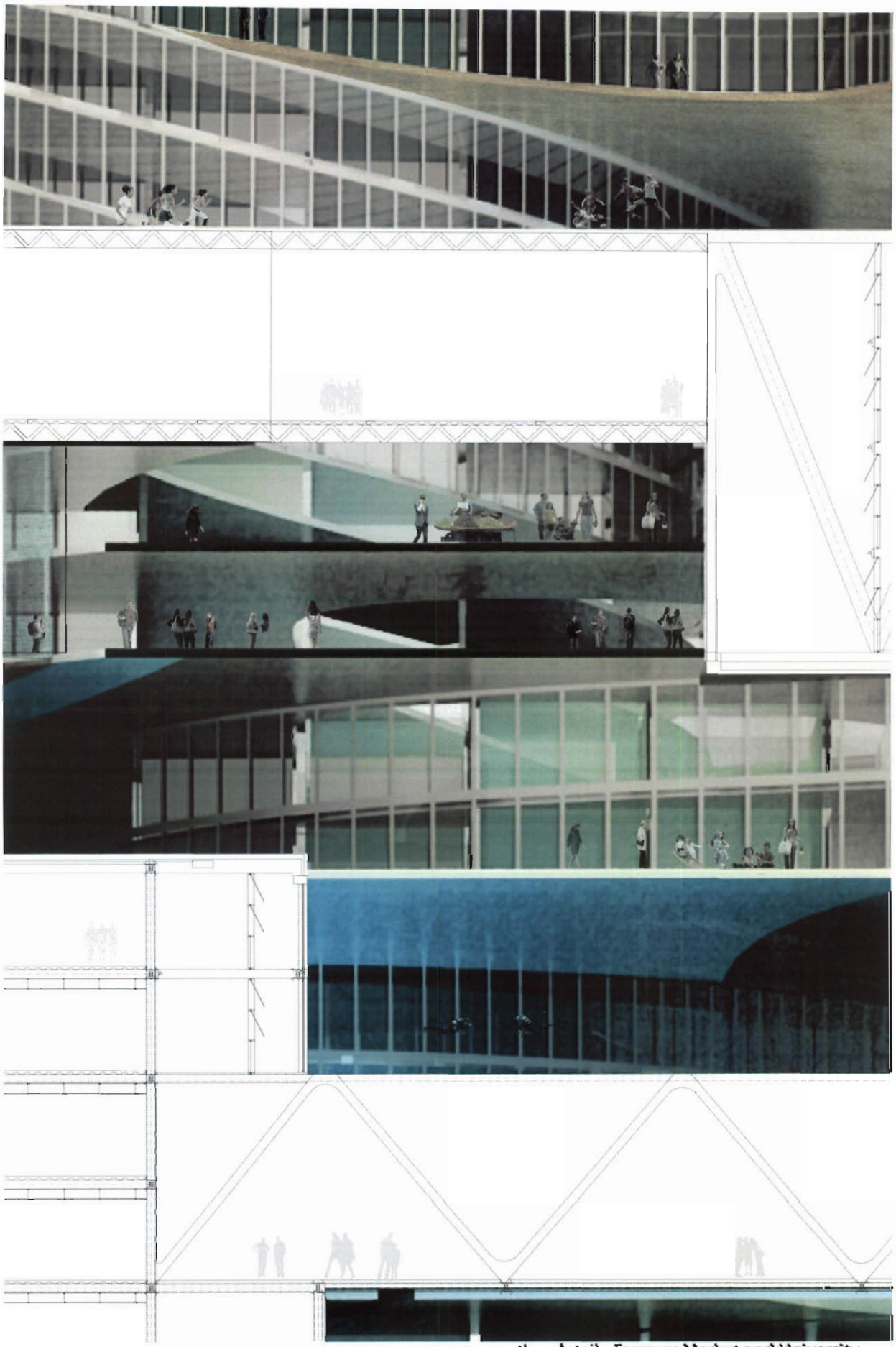


PLAN COMPOSITE

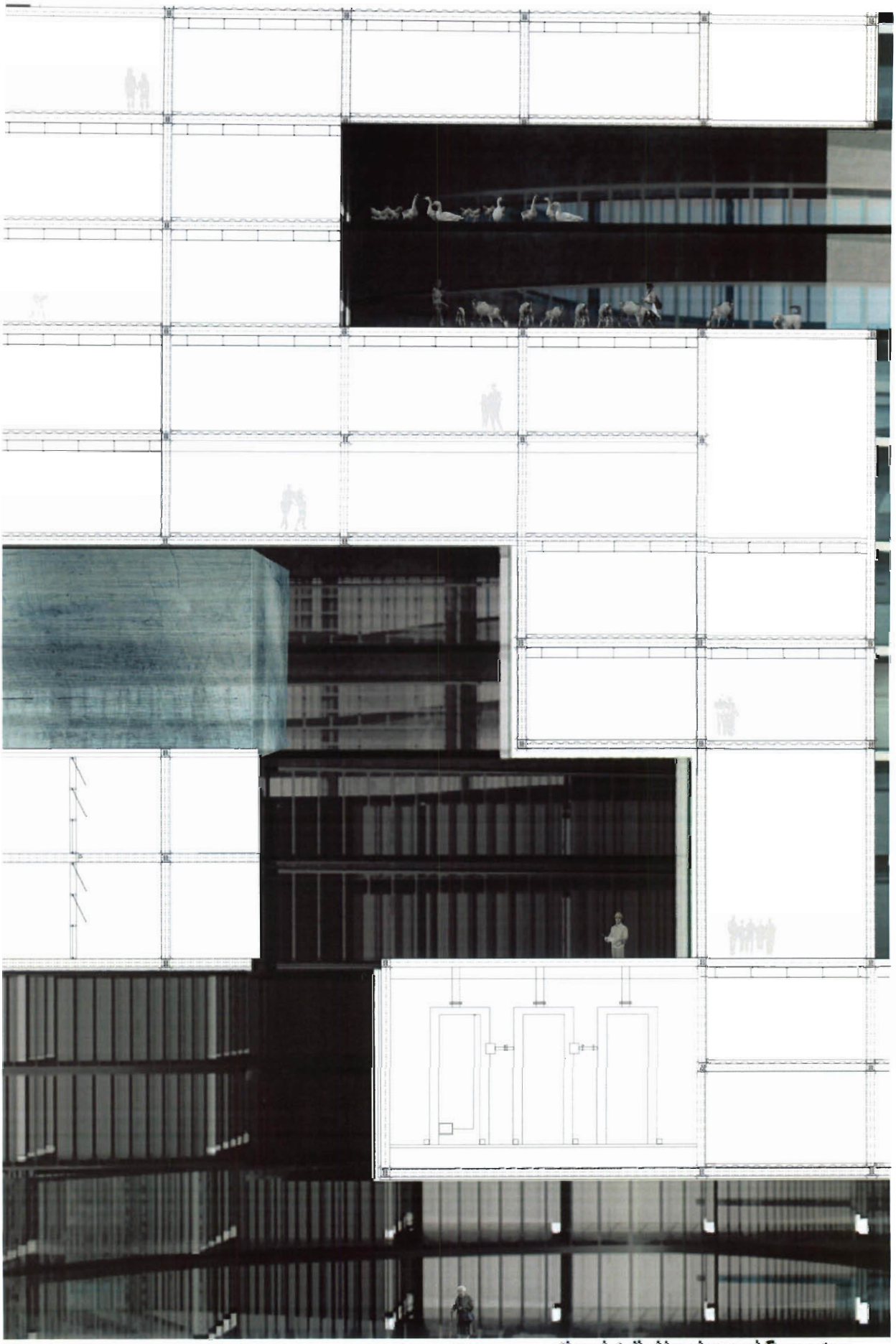

The Void:Void condition allows for programmatic changes. For instance, during large events, the capacity for parking doubles.
2
4
6
8
Restaurants gain additional dining space throughout the tourist season.
10
12
14
16
When needed, the conference center expands.
18
20
22
24
During the school year, the gymnasium opens.
26
28
30
32
And each evening, the event space and running track become available.
34
36
38
40


COLLECTIVE
VOID
FLEXIBLE
VOID
UNIT
STRUCTURE
INFRASTRUCTURAL
VOID

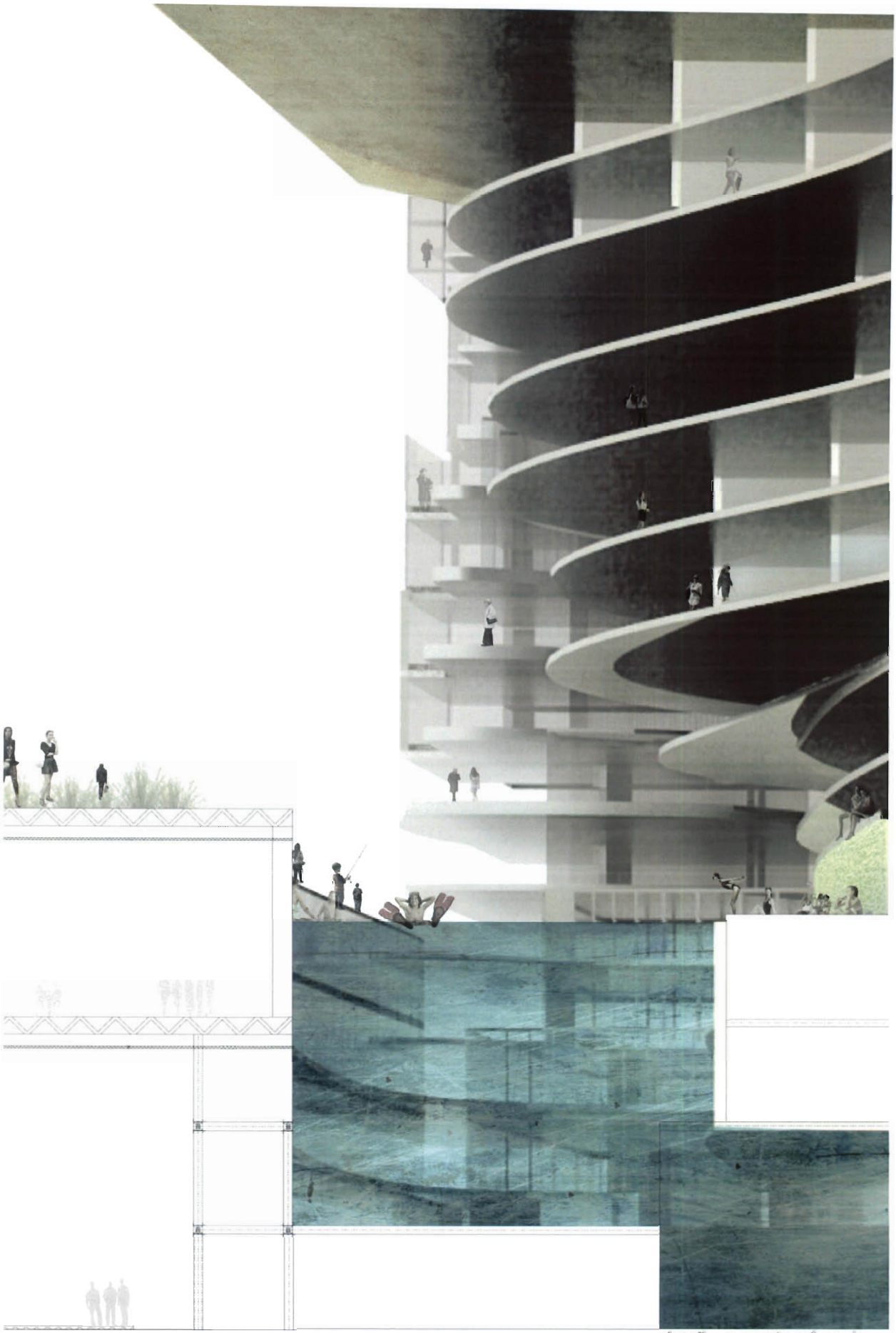
section A



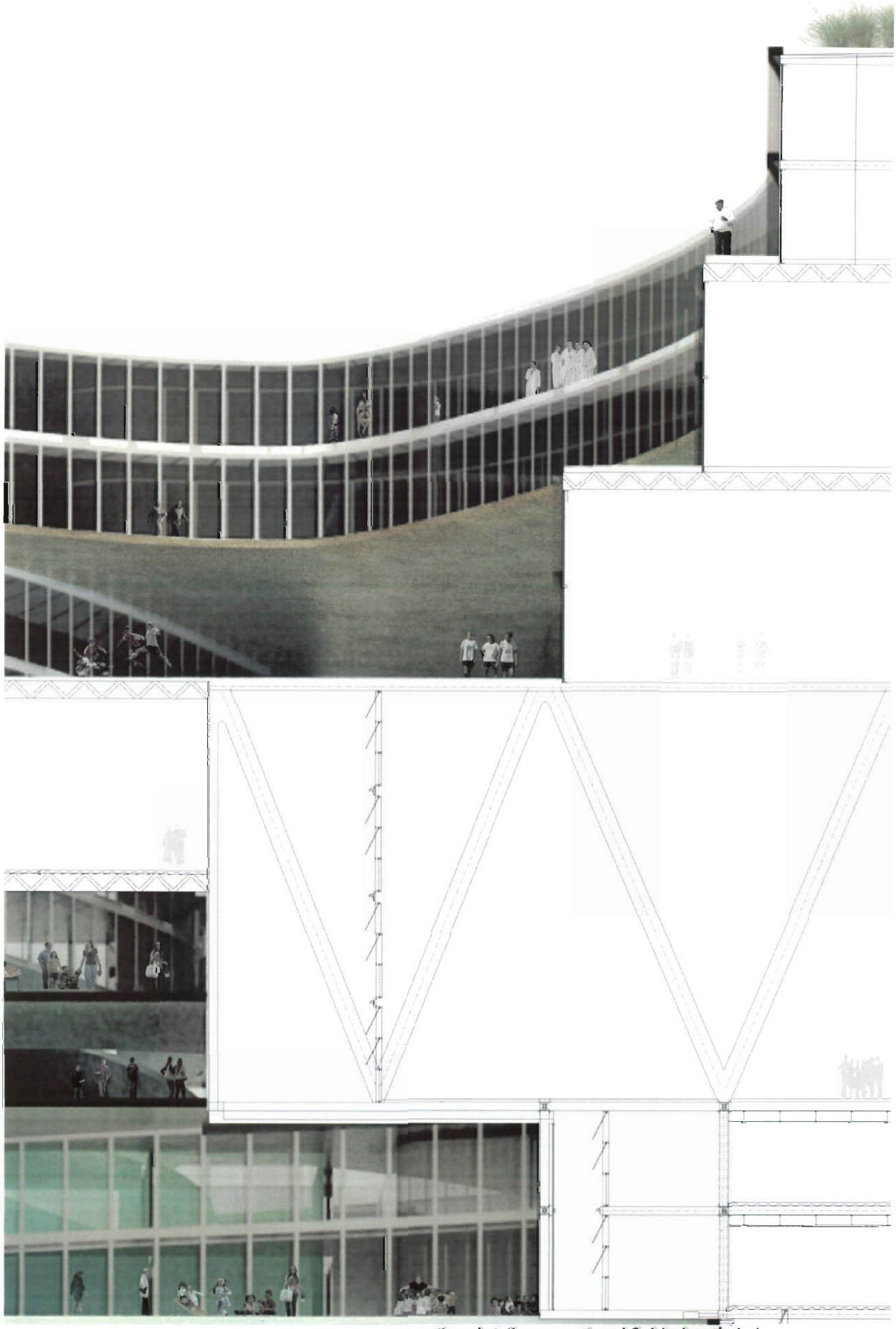
section detail - Farmers Market and University



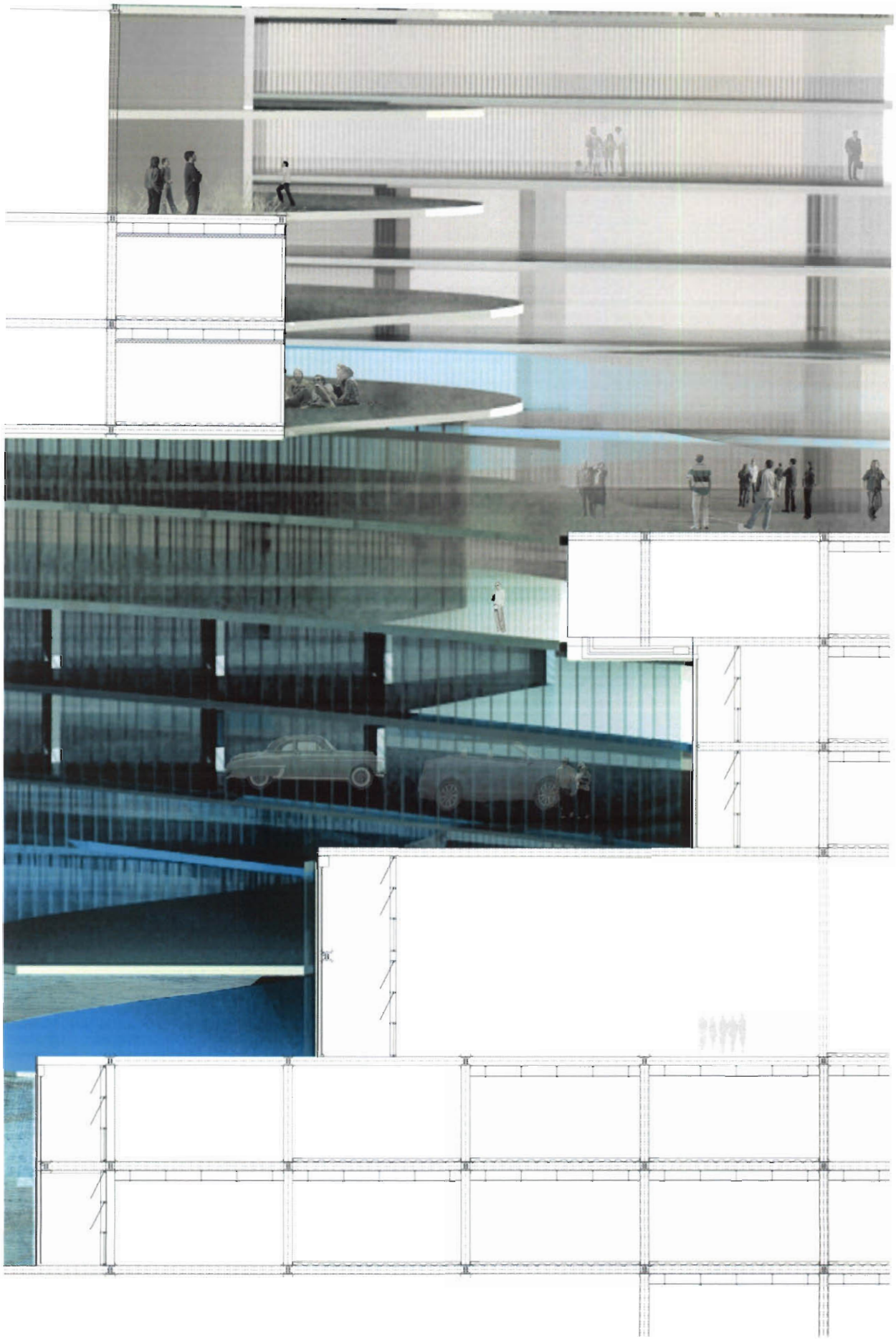
section detail - Housing and Generators



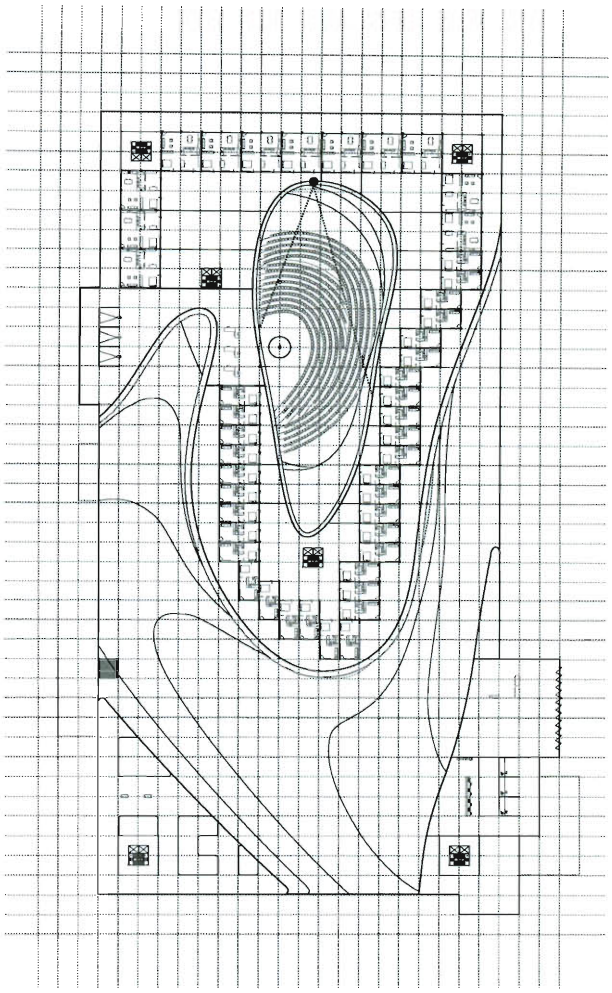
section detail - recreational pools



section detail - recreational fields, brothel, day care

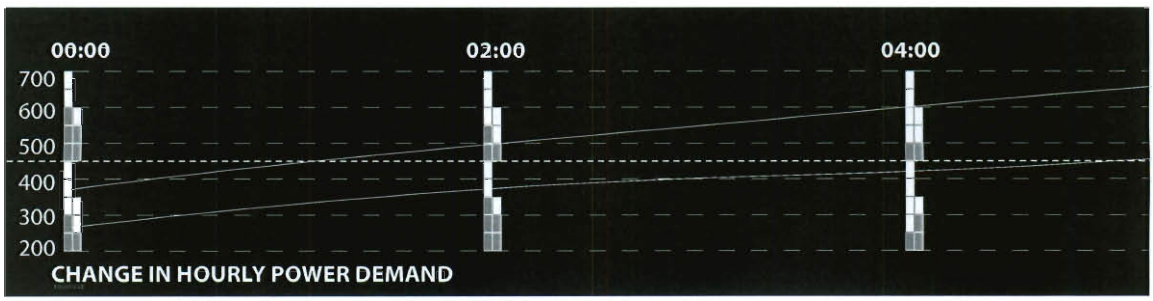


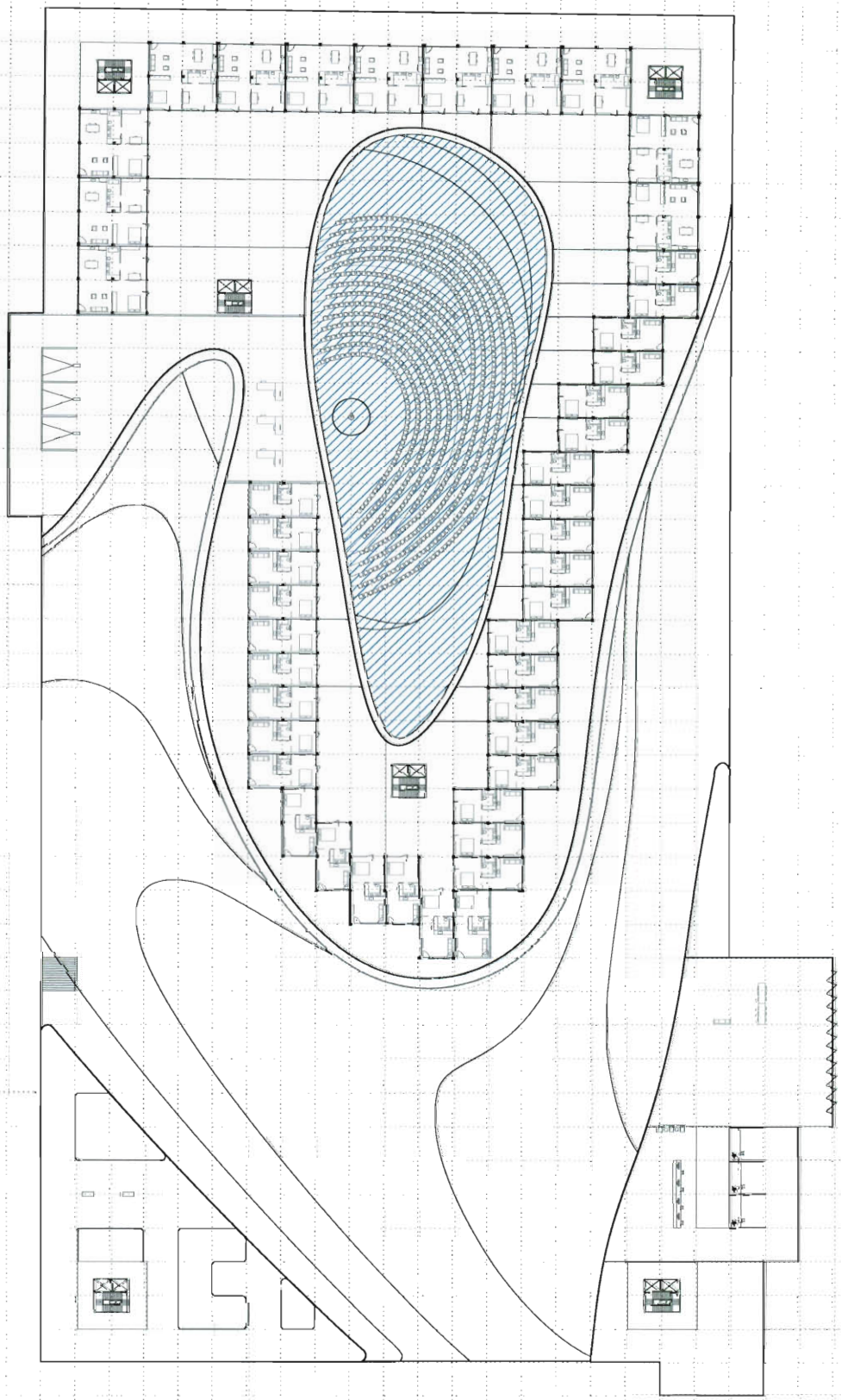
section detail - parking and convention center



00:00

As energy demands change throughout the day, the appropriation of voids by either water or people is calibrated. For Instance, as water is pumped into storage tanks at night, the opacity of the building changes and residential units gain have temporary privacy.





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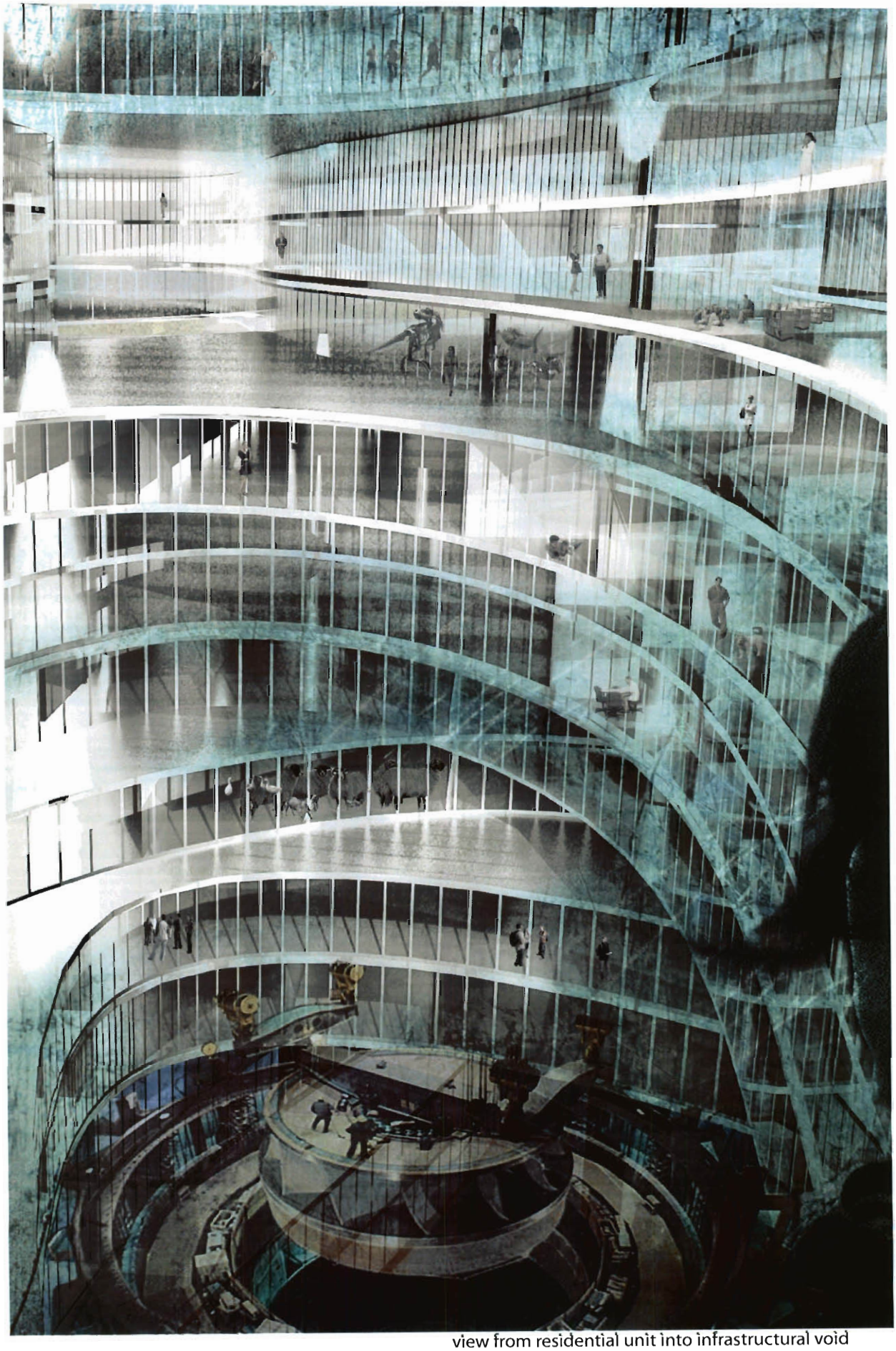
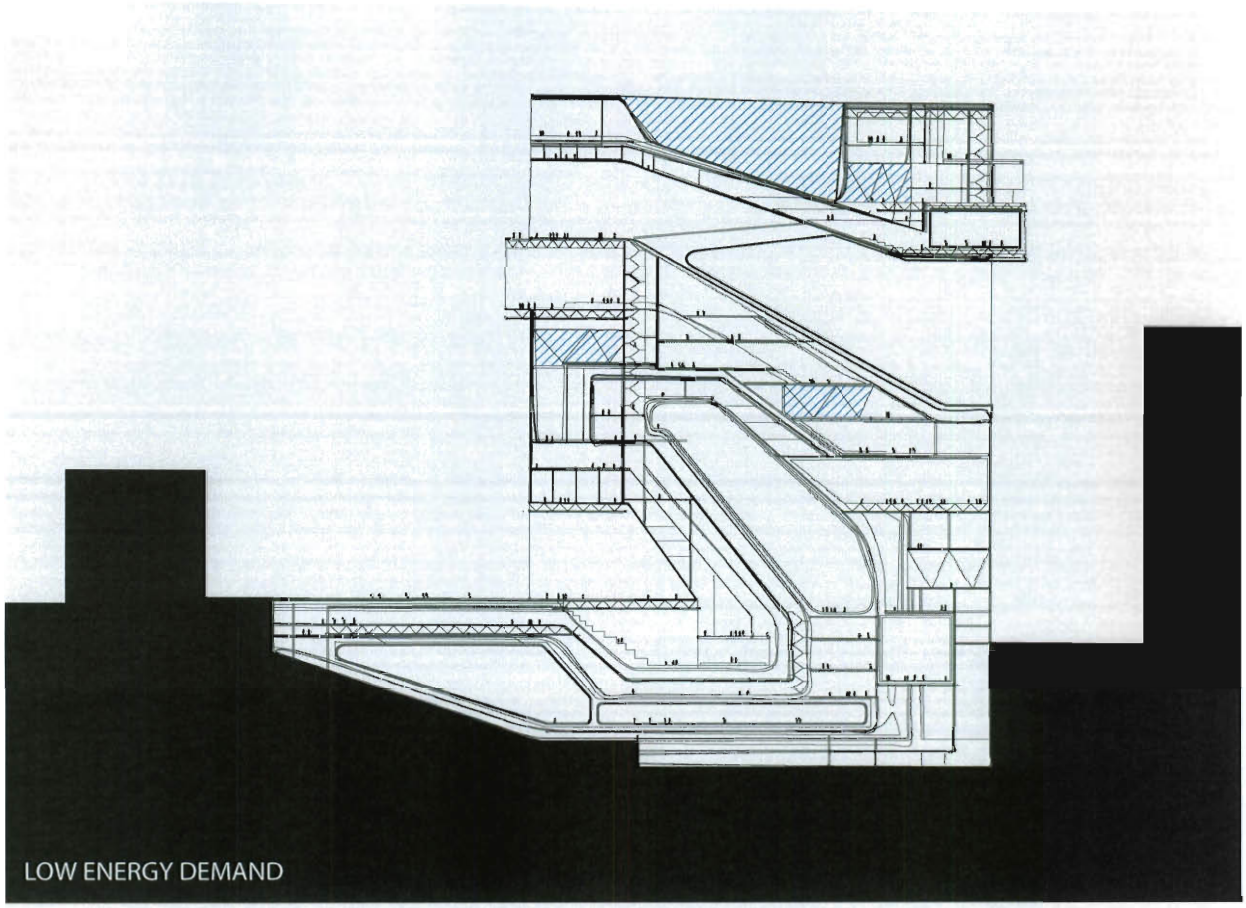
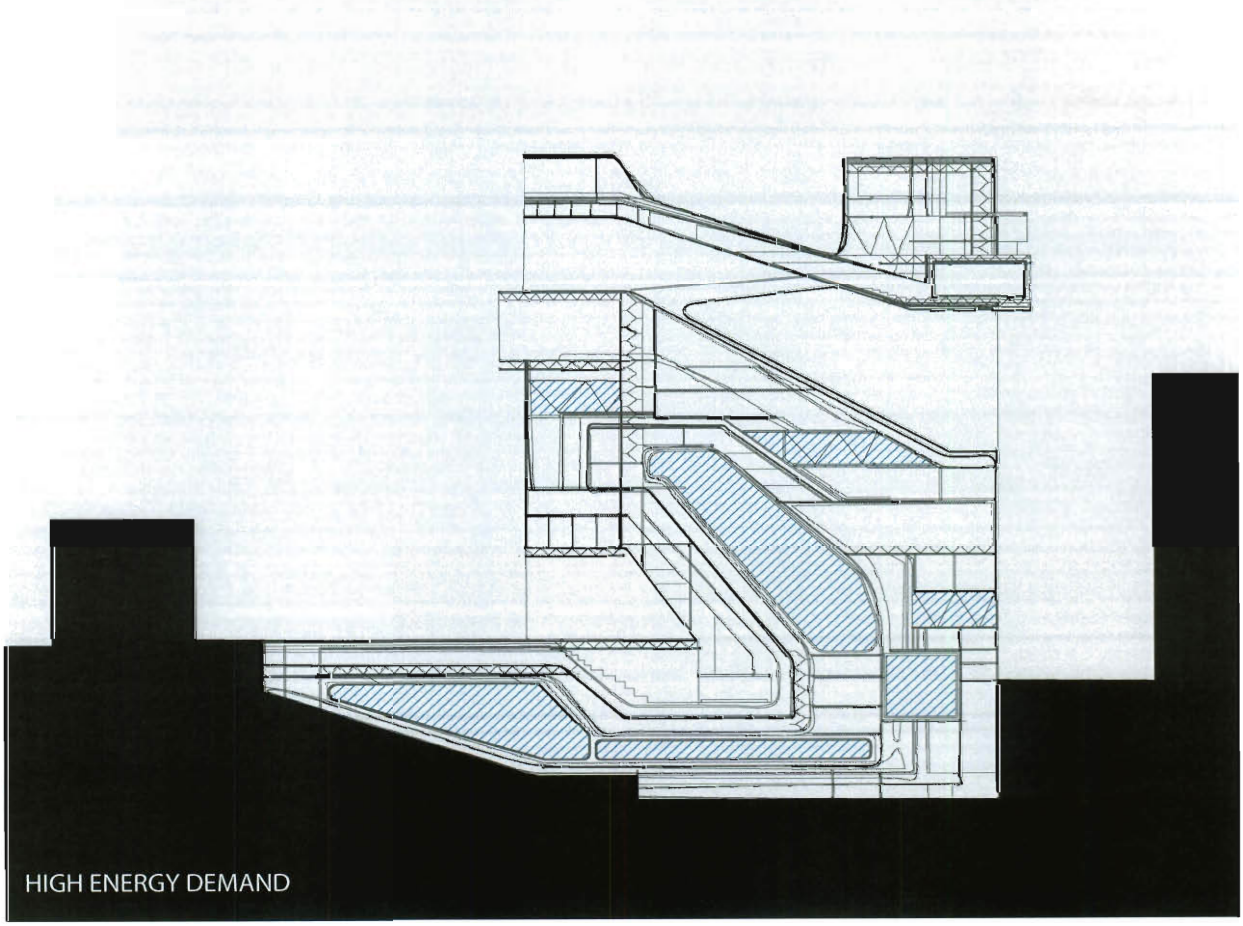
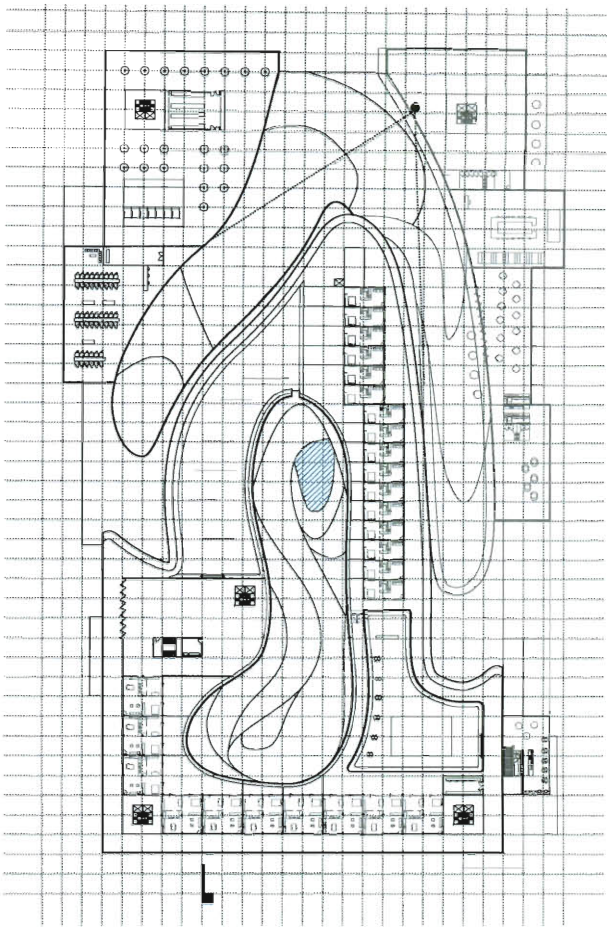


view from residential unit into infrastructural void



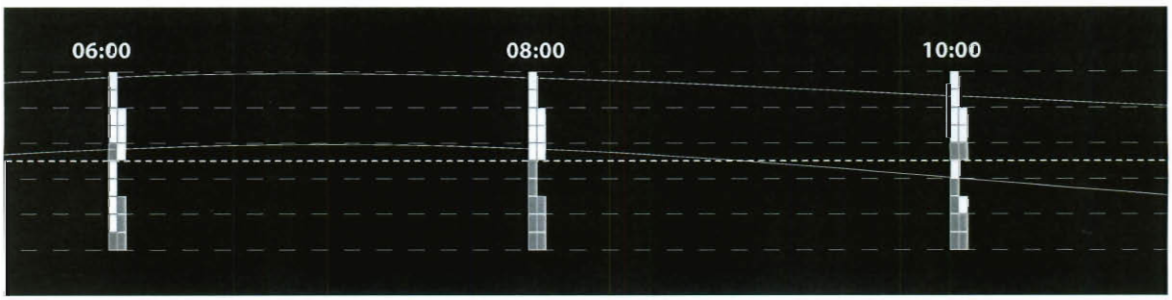


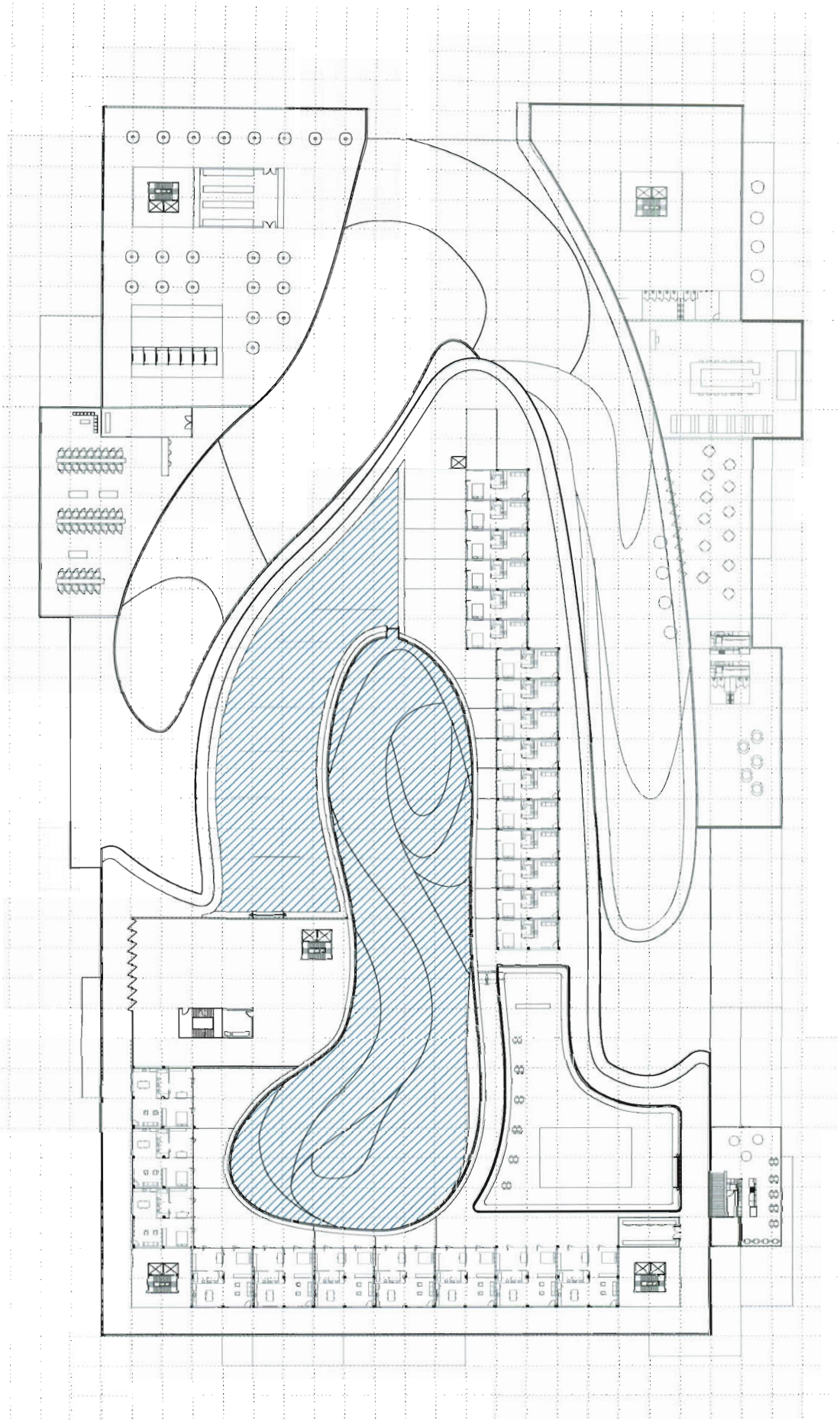
residential units



08:00

Rather than soild/void, the VOID: VOID defines space by thickness. Whereas infrastructure and collectivity privilege the void, thickness is reserved for hotel and residential units. Therefore close adjacencies exist between private and public space.





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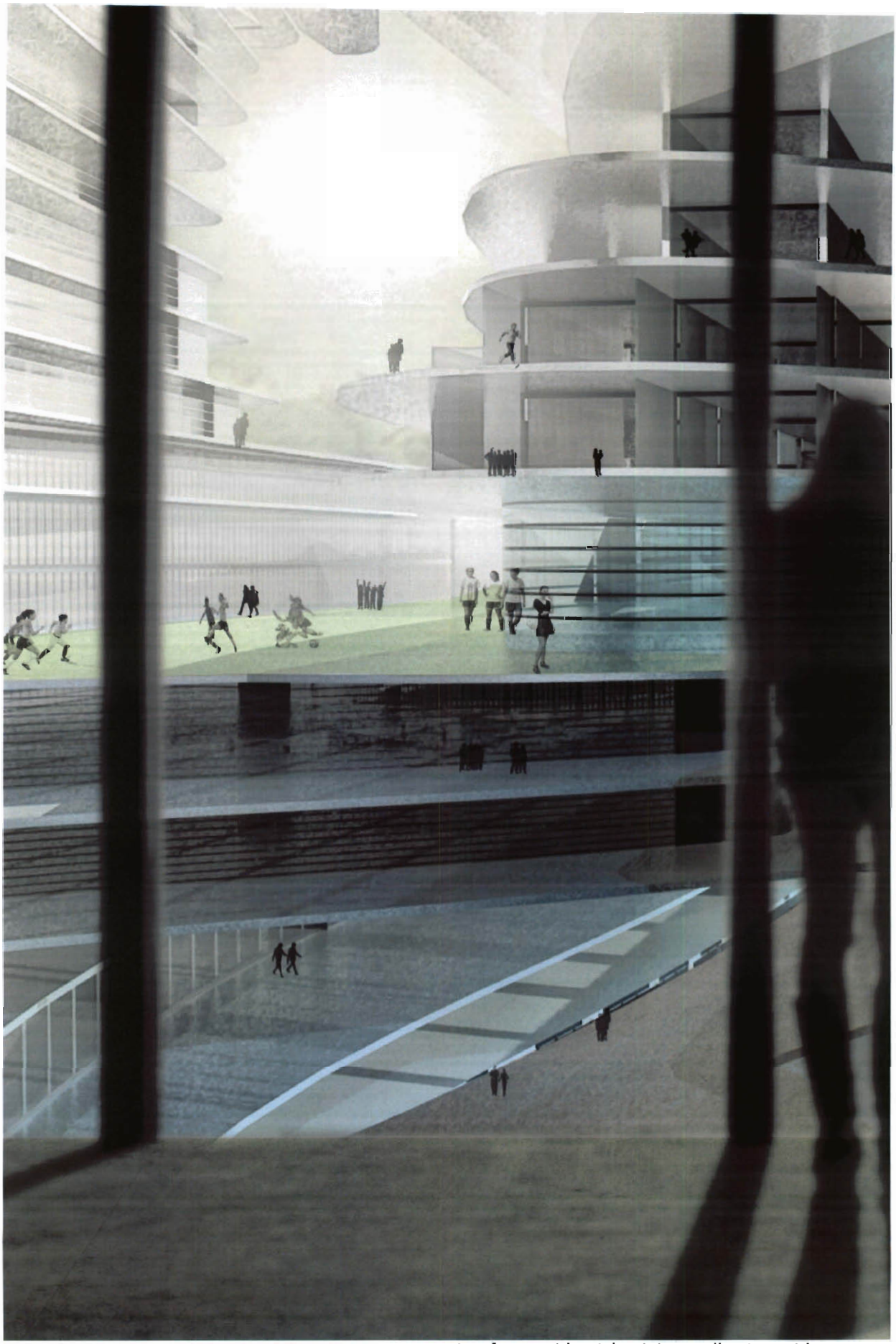
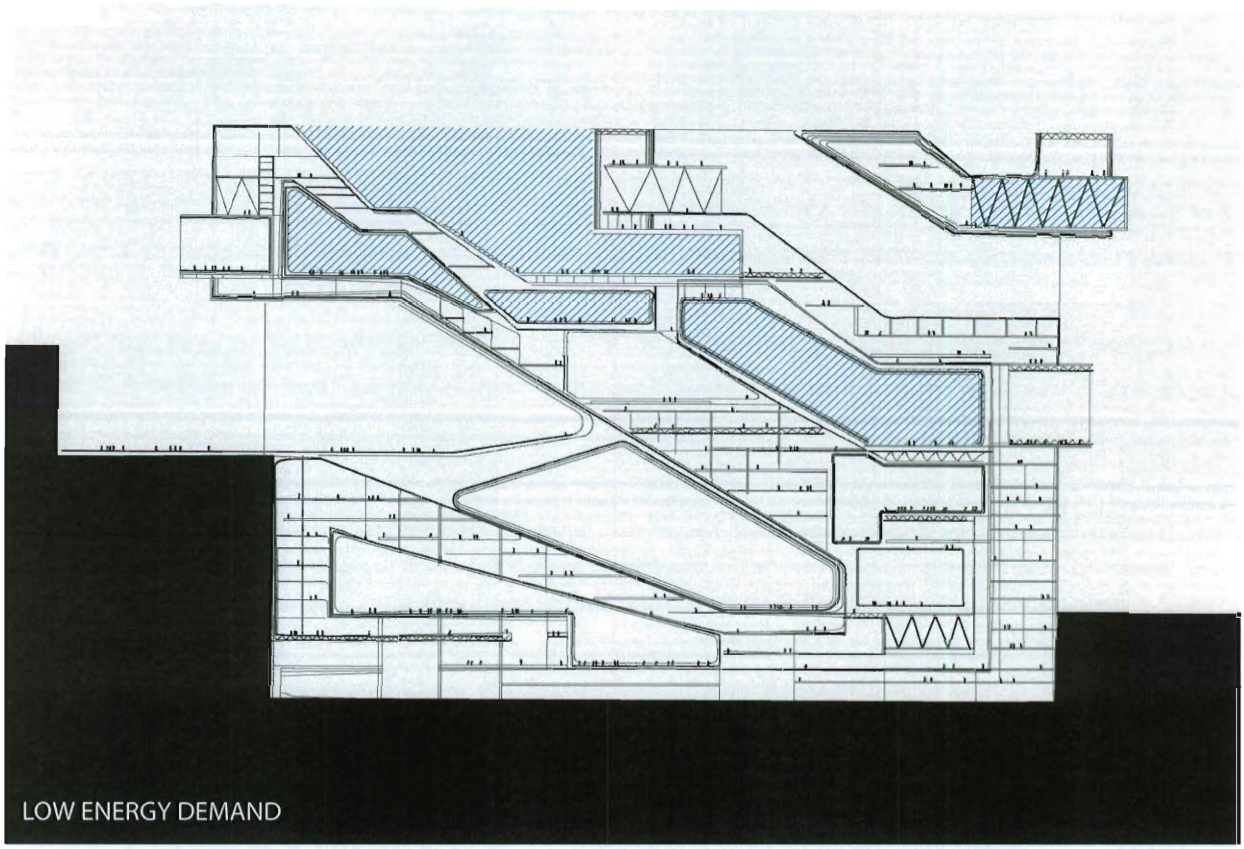
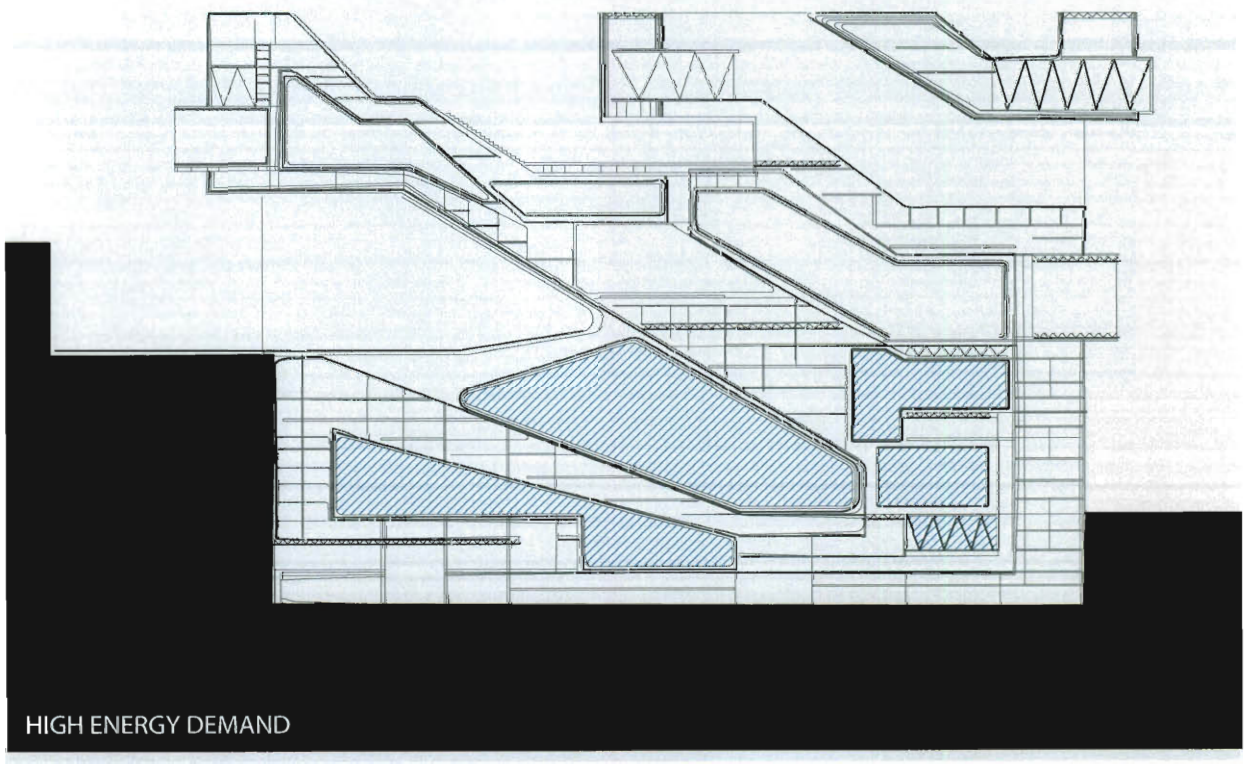
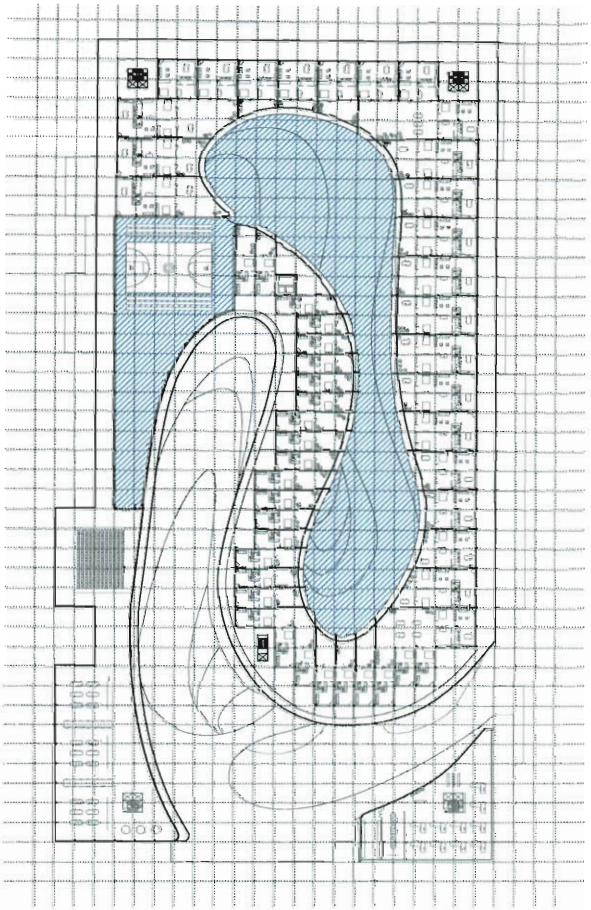


view from residential unit into collective void



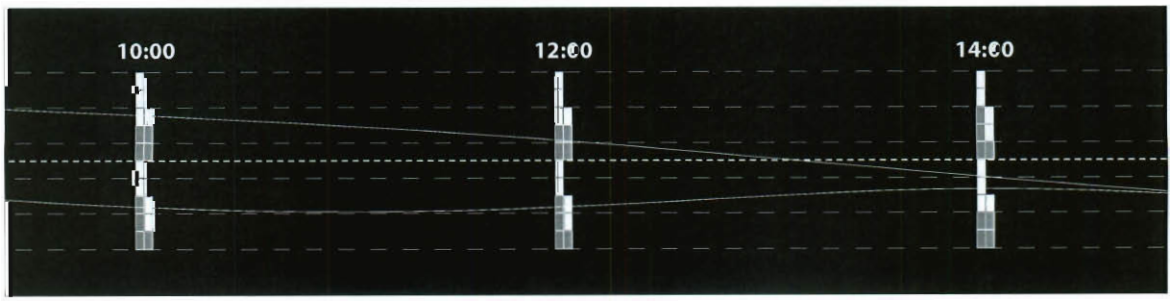


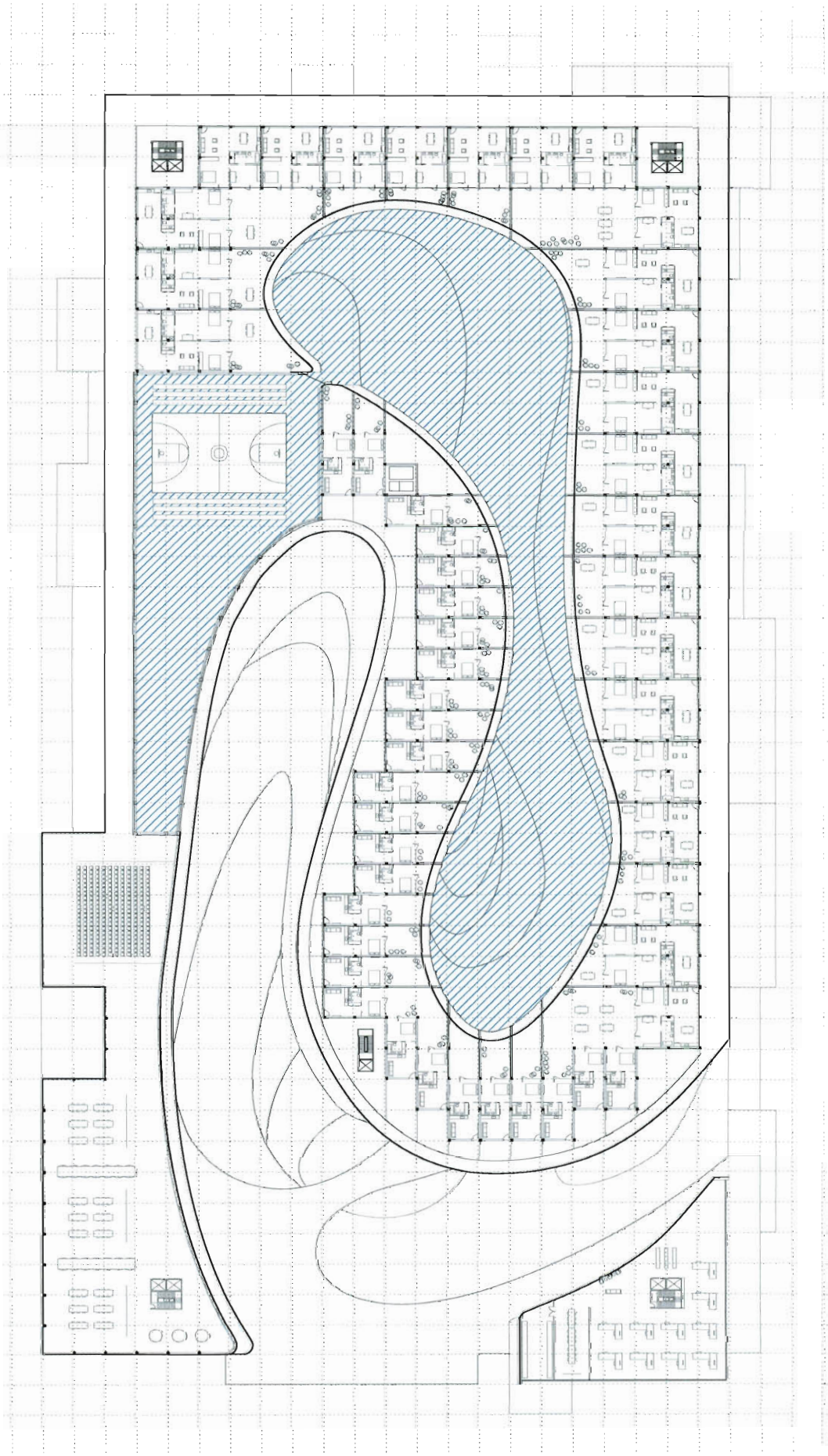
thermal heating exchange



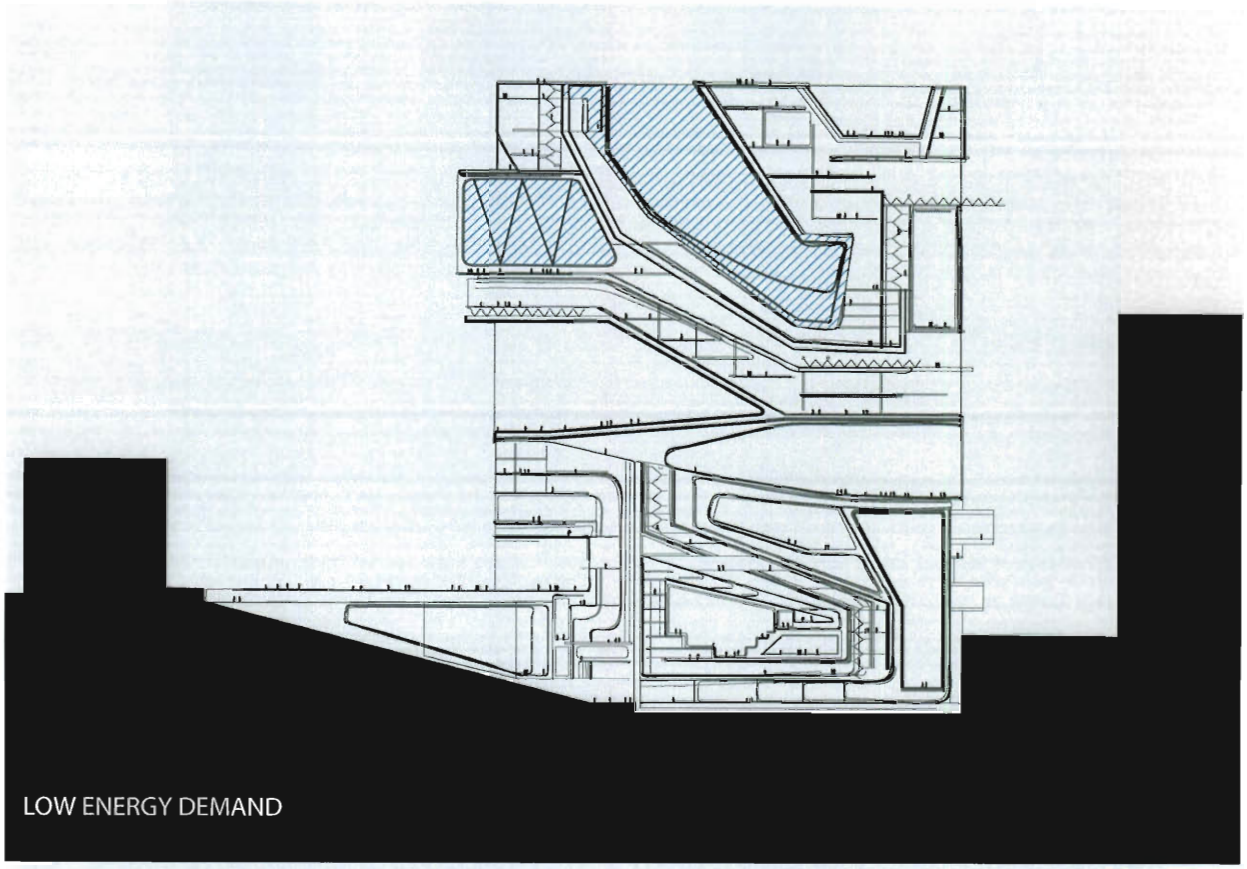
16:00

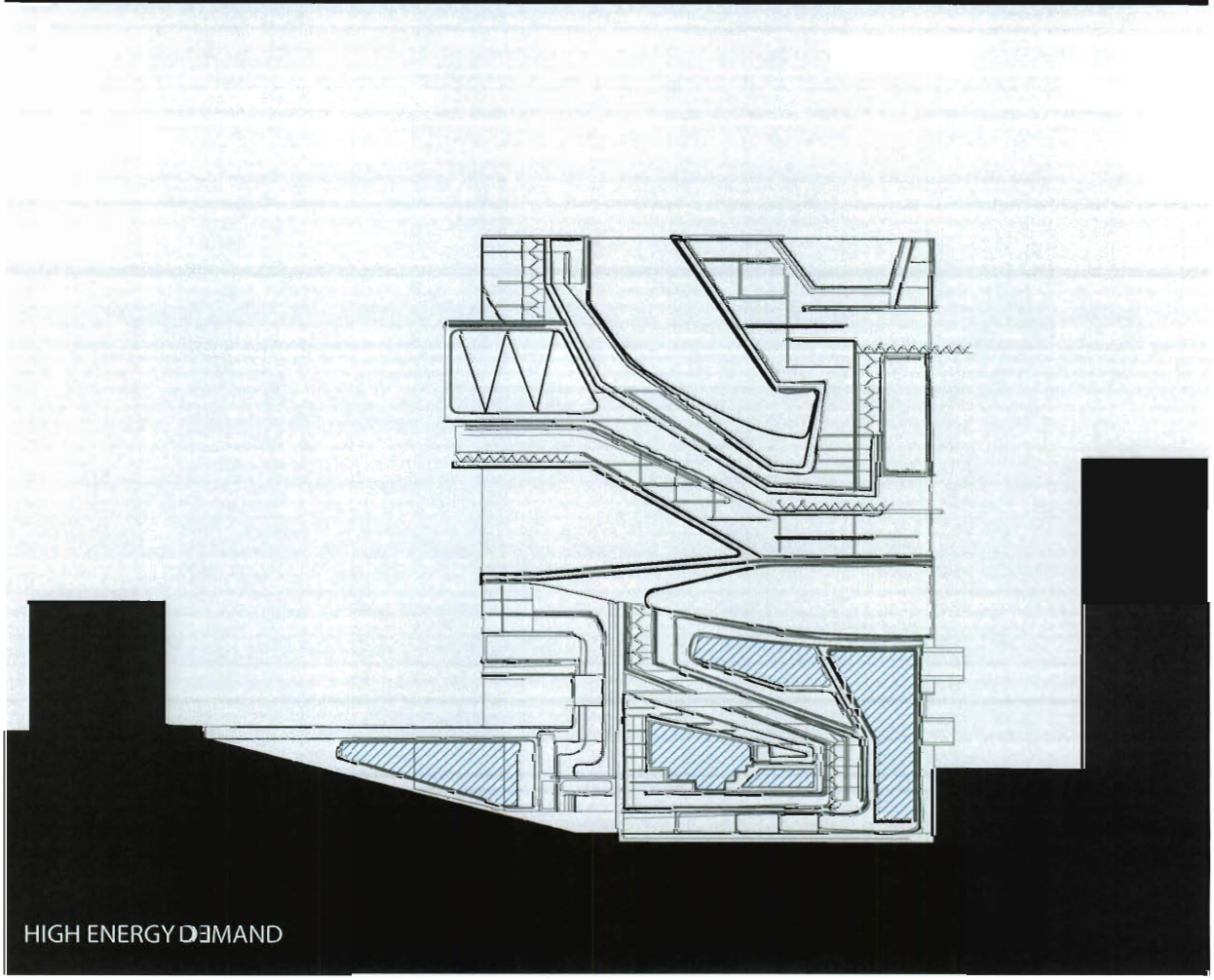
The displacement of water responds to an infrastructural demand. However, this project leverages that demand to create ephemeral and atmospheric conditions within the building. In the evening, when energy demands are highest, water is collected in the Southern plaza to create a reflection pool and supply recreational fountains.



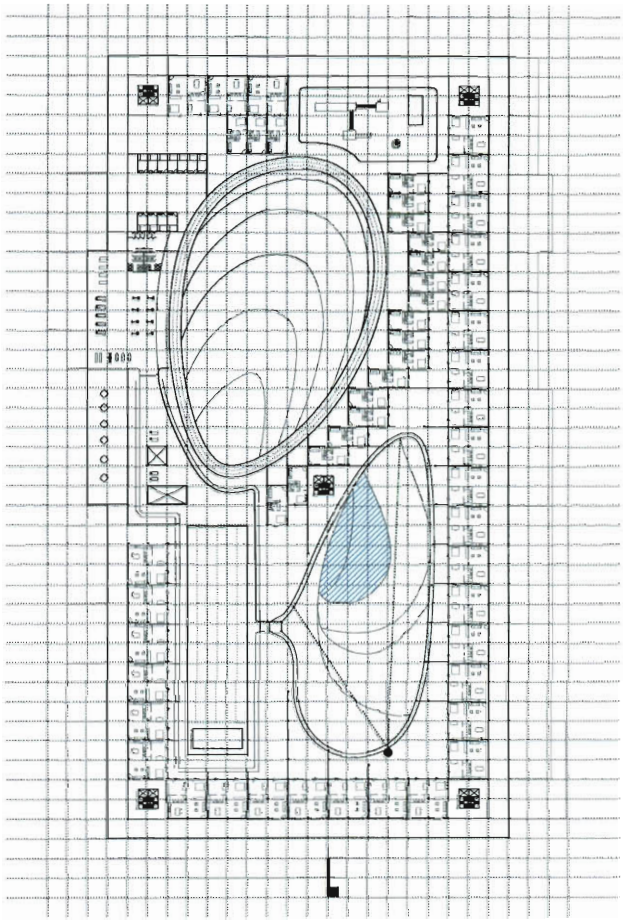


reflection pool - south plaza



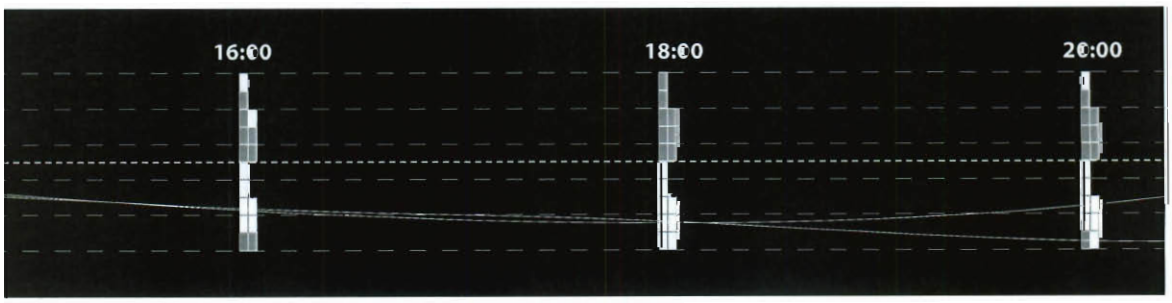


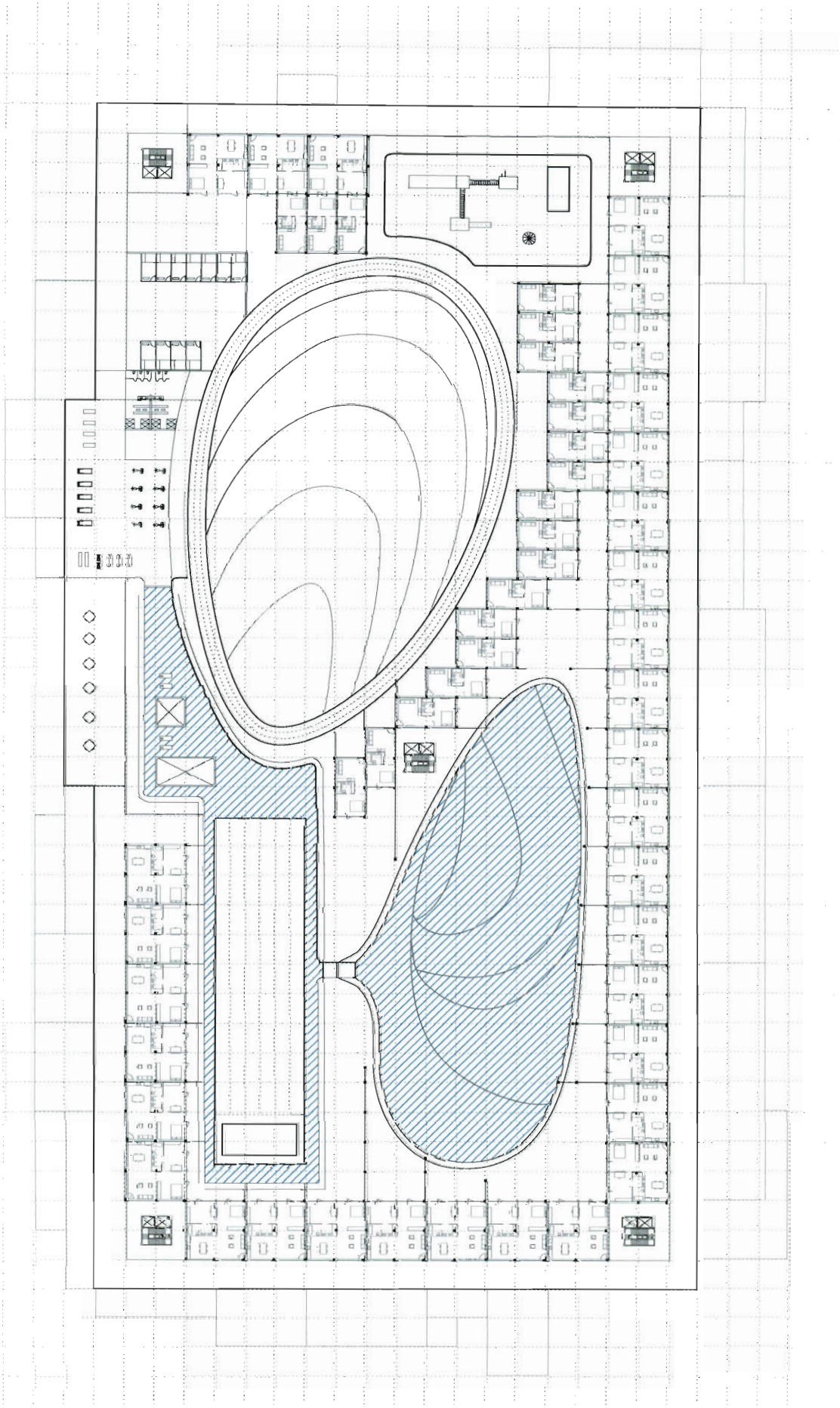
south plaza - reflection pools

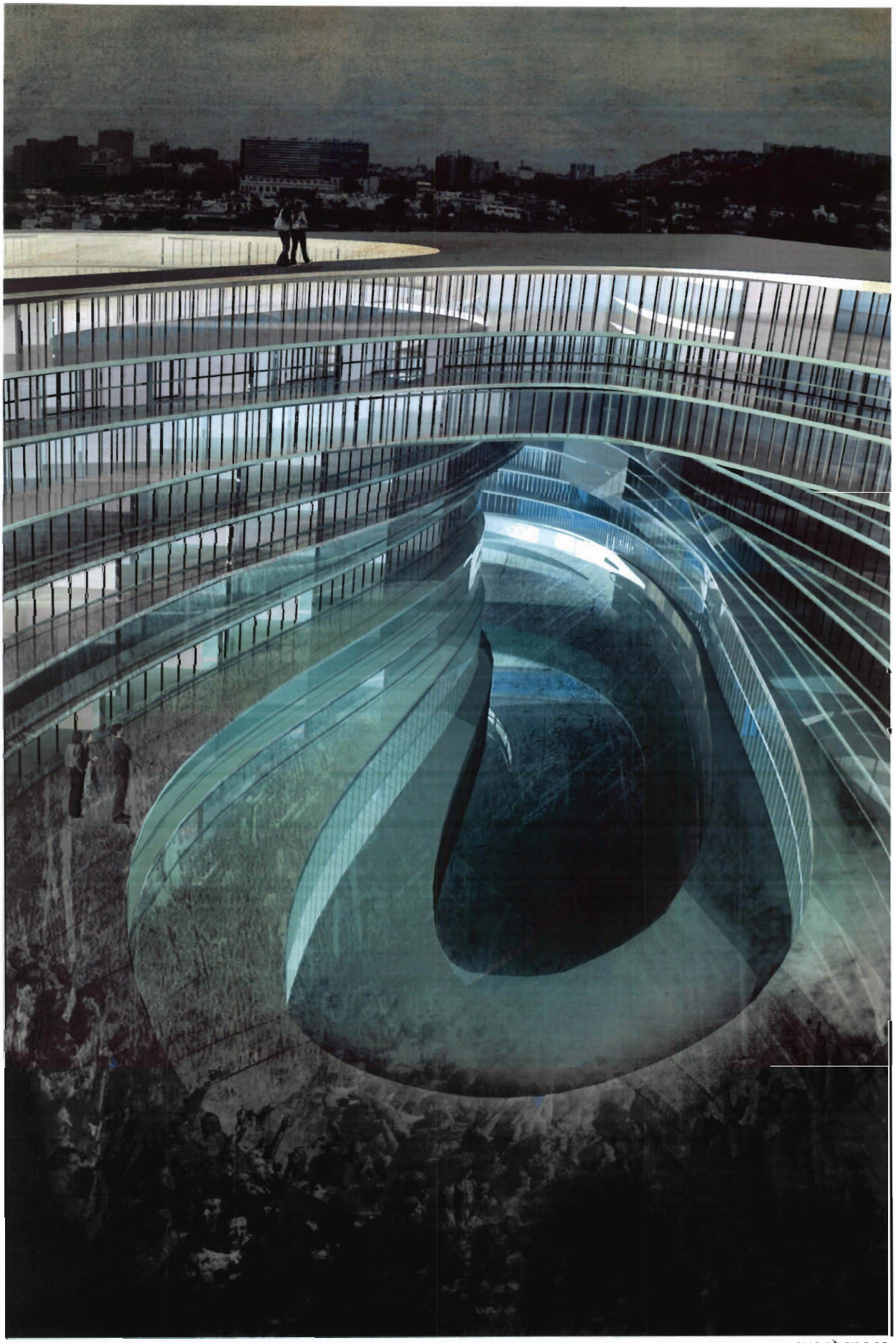


20:00

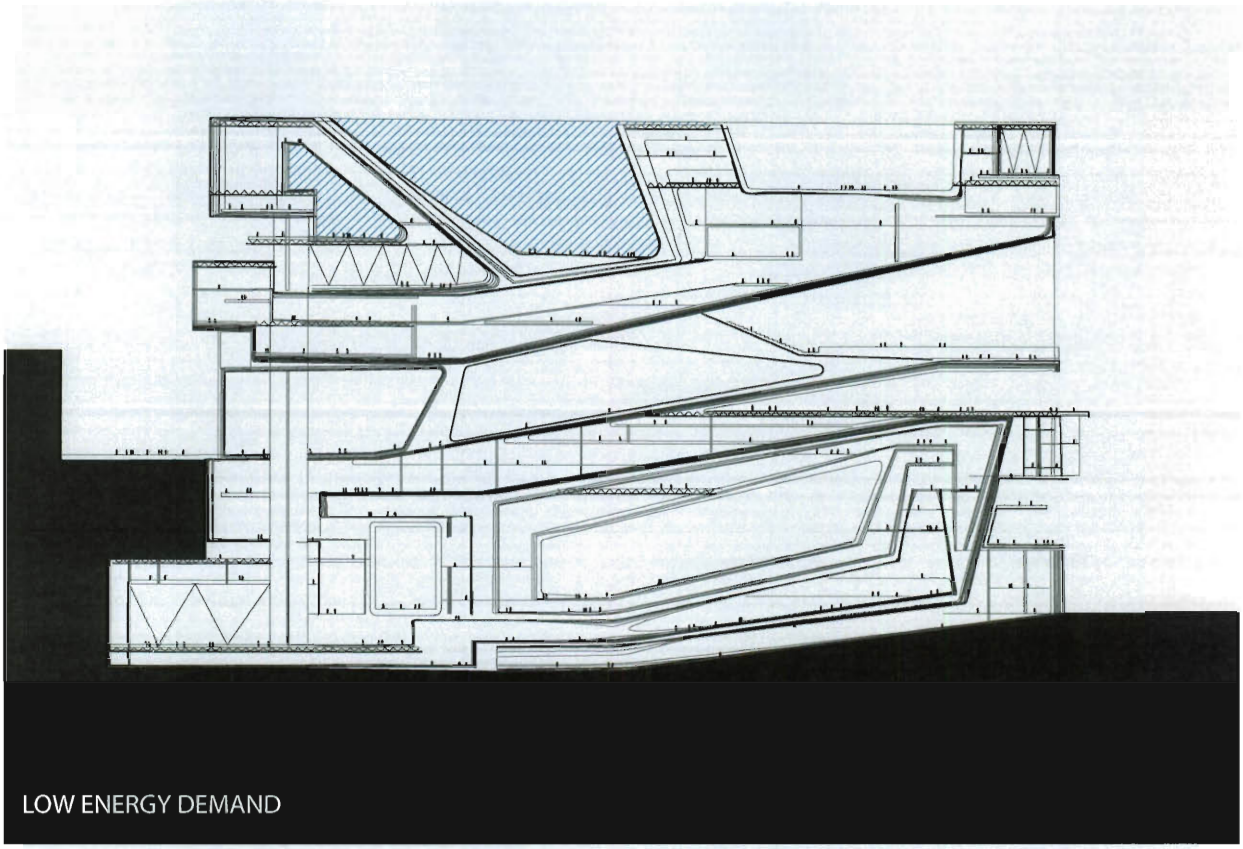
The VOID:VOID condition allows for the daily and seasonal flexibility of spaces. In the evenings, the rooftop event space opens for concerts and performances.

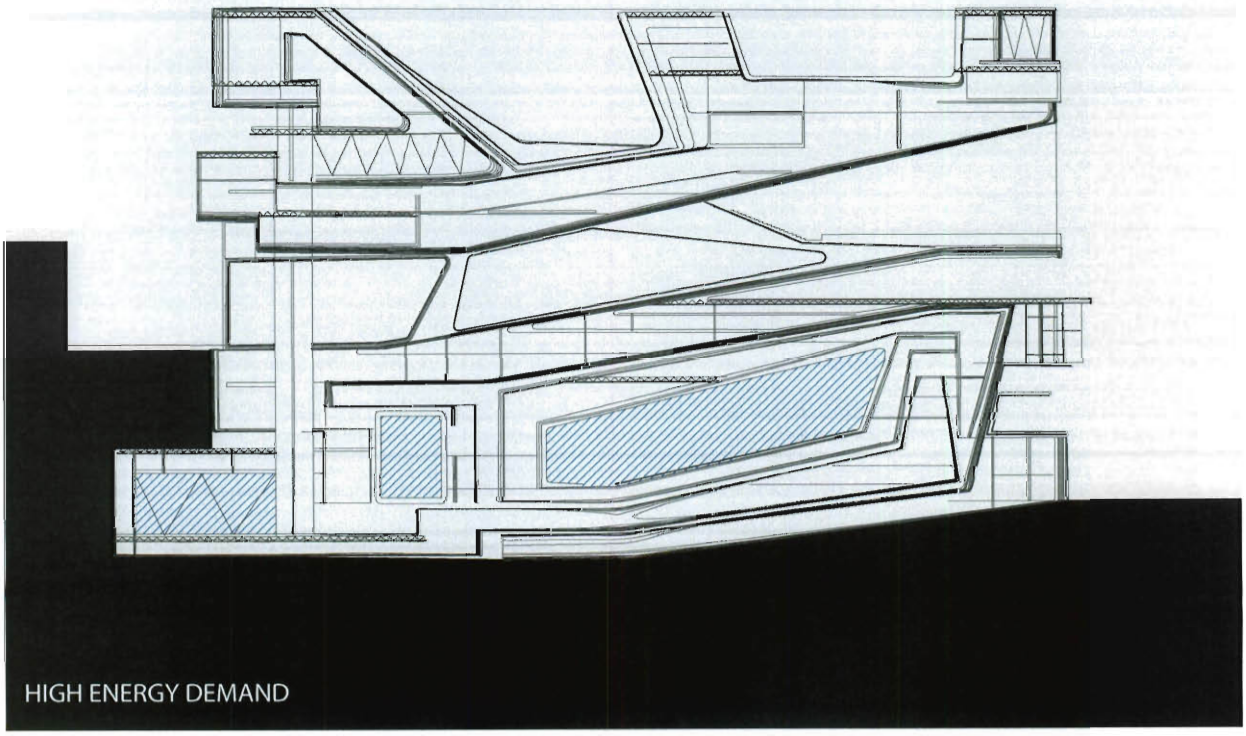


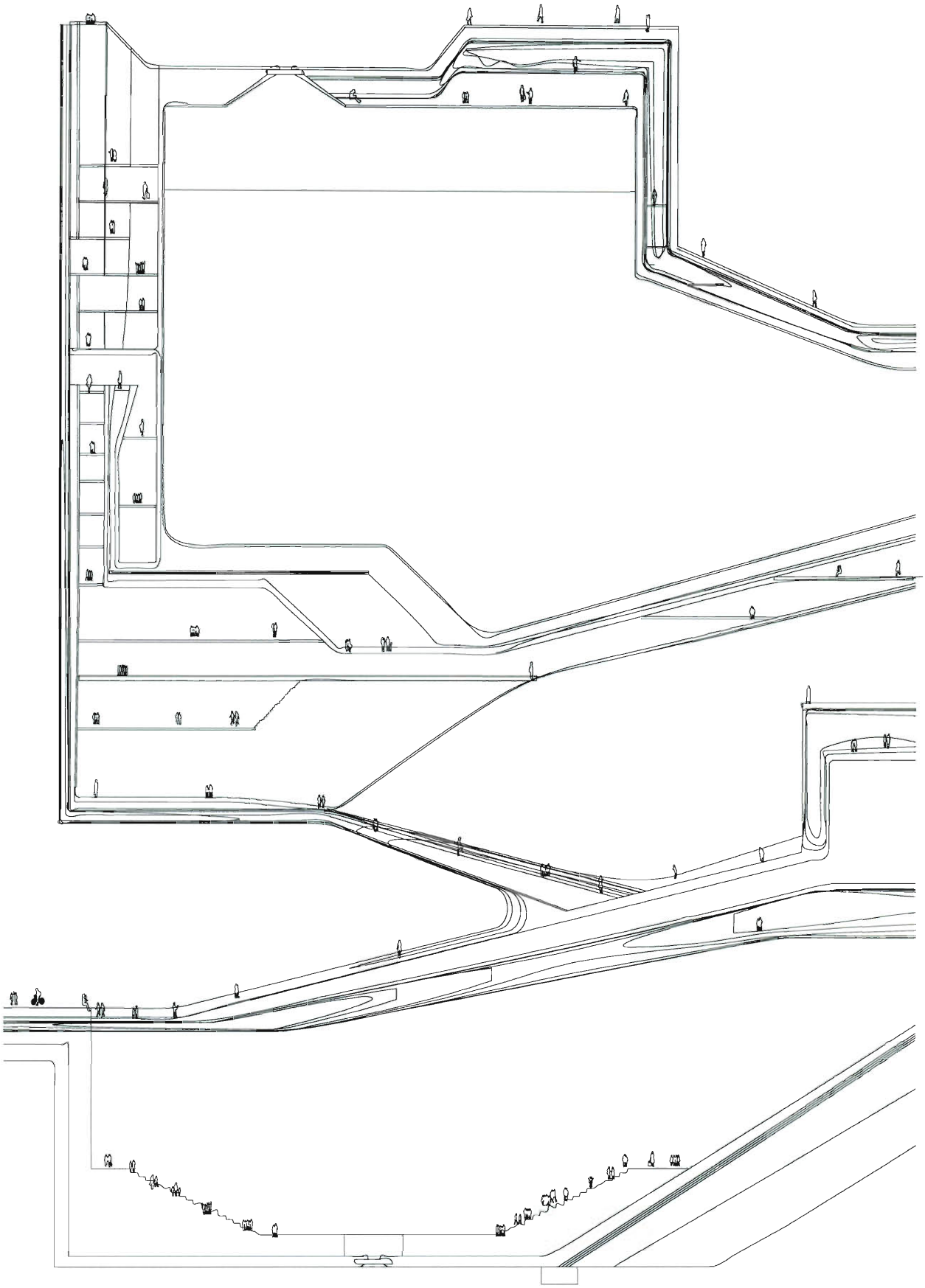




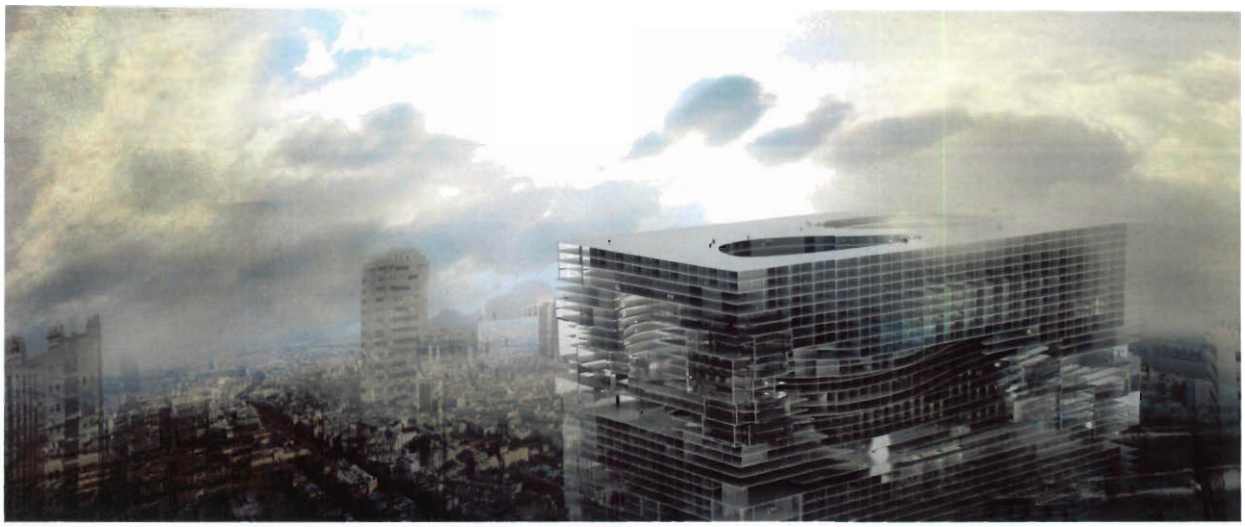
event space


LOW ENERGY DEMAND


HIGH ENERGY DEMAND



section diagram detail

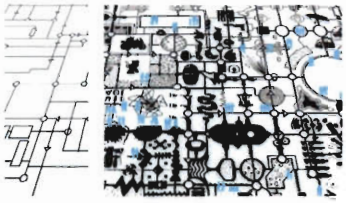


void as object

PRESENTATION

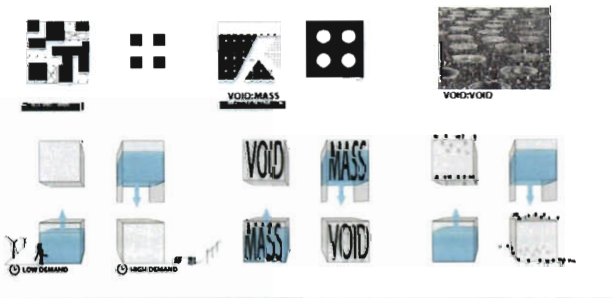
DISPLACEMENT ECOLOGIES

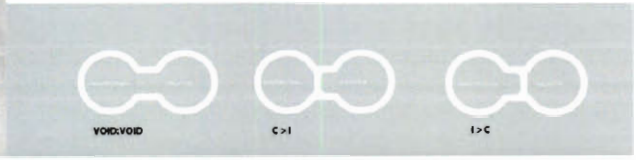
BRANTLEY HIGHFILL

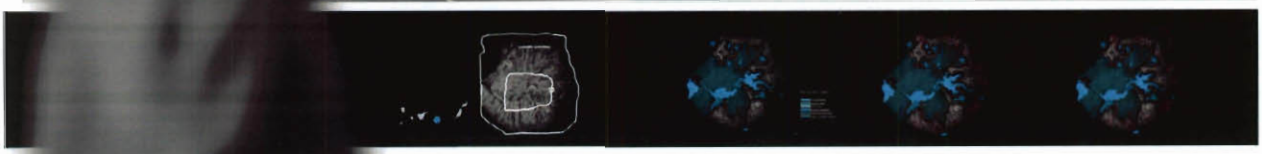


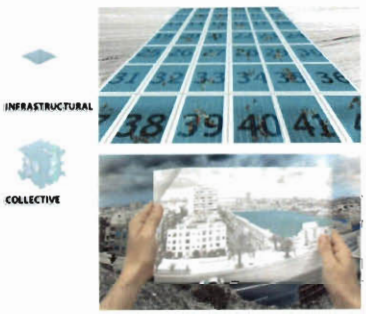
This thesis defines displacement as the occupation of infrastructural voids for collective use. By calibrating these patterns of appropriation, I propose displacement as a formal strategy for leveraging issues of demand. The discipline of architecture is becoming arguably subsumed by "sustainability" - an agenda which responds to demand with increased efficiency. This thesis suggest that systems of efficiency can instead be leveraged to generate new modes of collectivity.

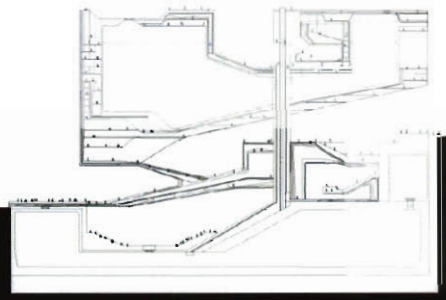
VOID : VOID





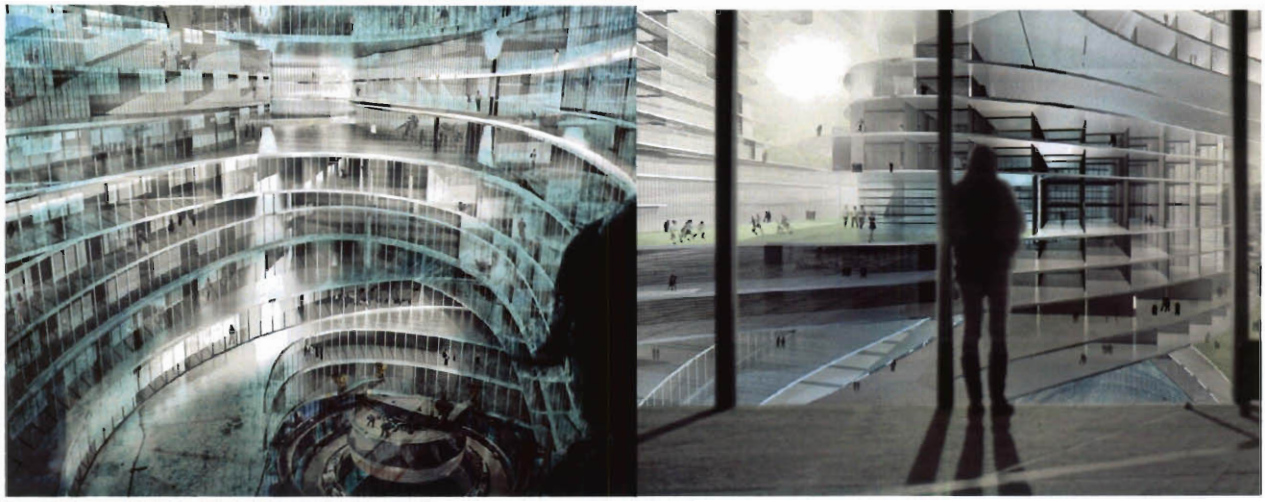


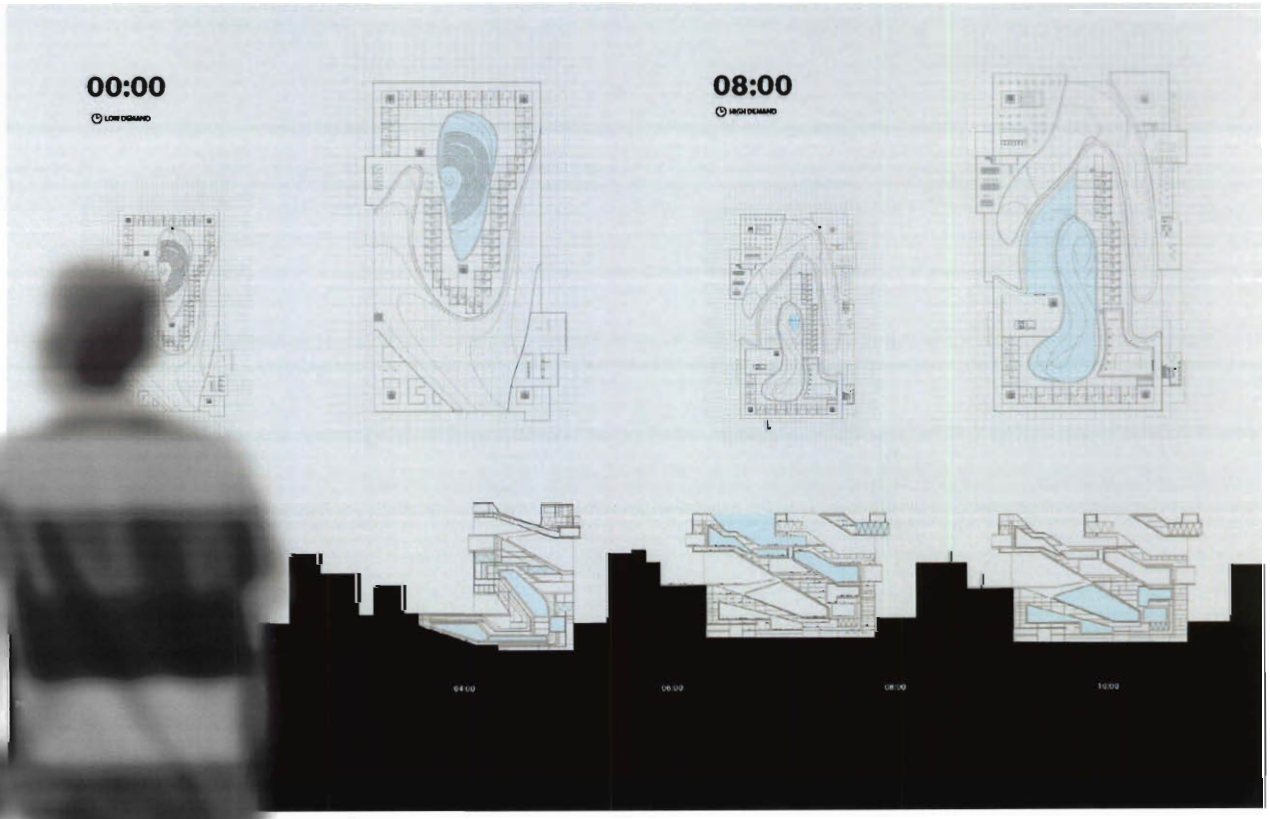




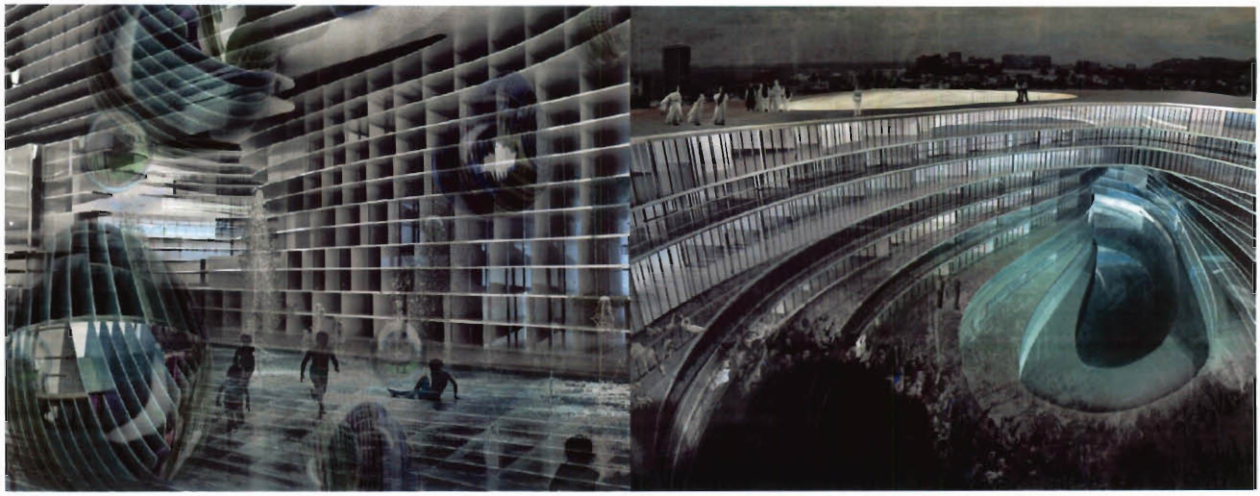
PRESENTATION BOARDS 3-4

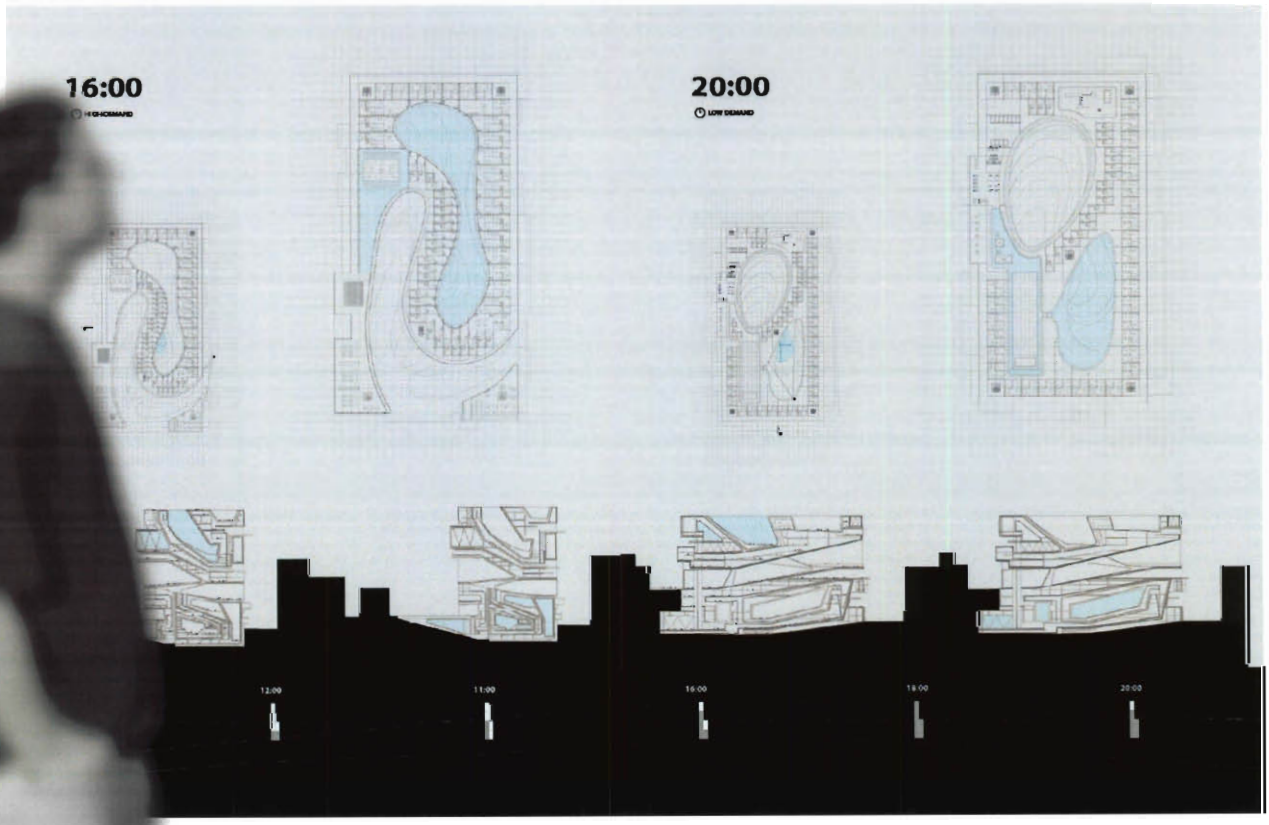
PRESENTATION BOARDS 5-6





PRESENTATION BOARDS 7-8



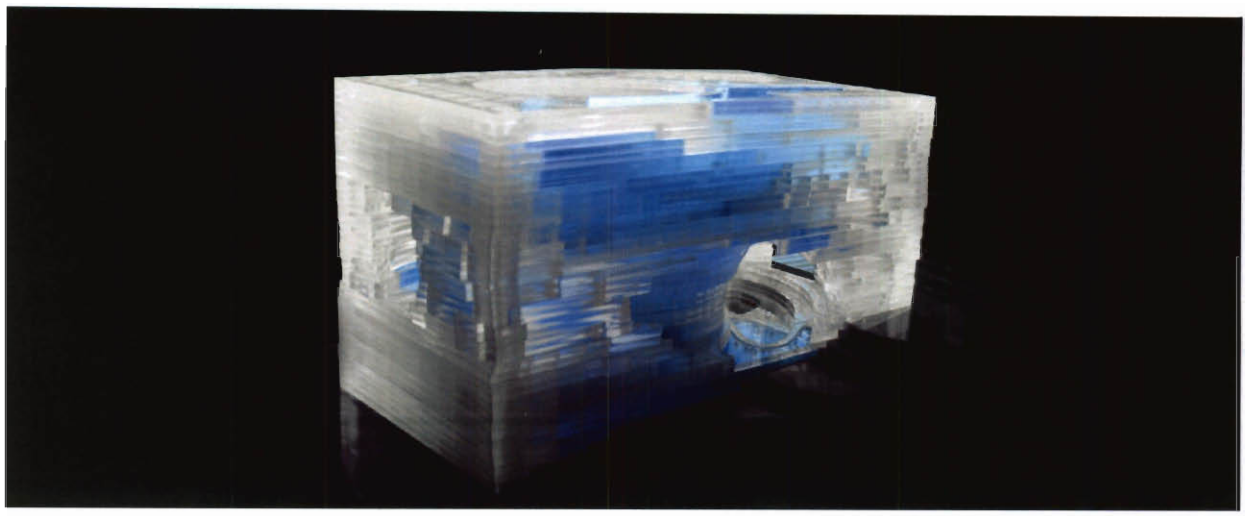


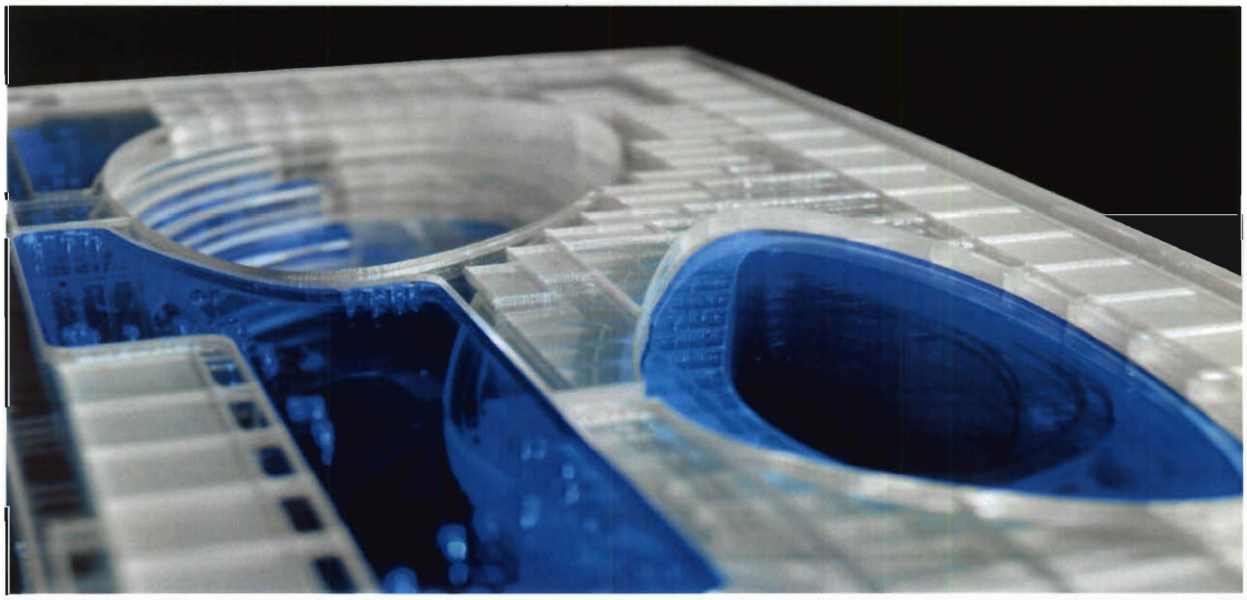
PRESENTATION BOARDS 9-10

ORAL DEFENSE PHOTOGRAPHS

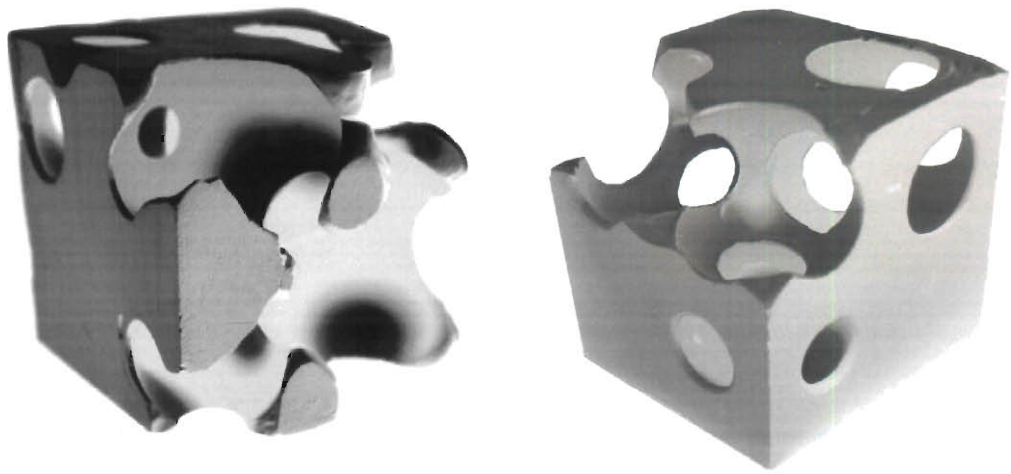
PHYSICAL MODELS

DETAILS - PLEXI MODEL

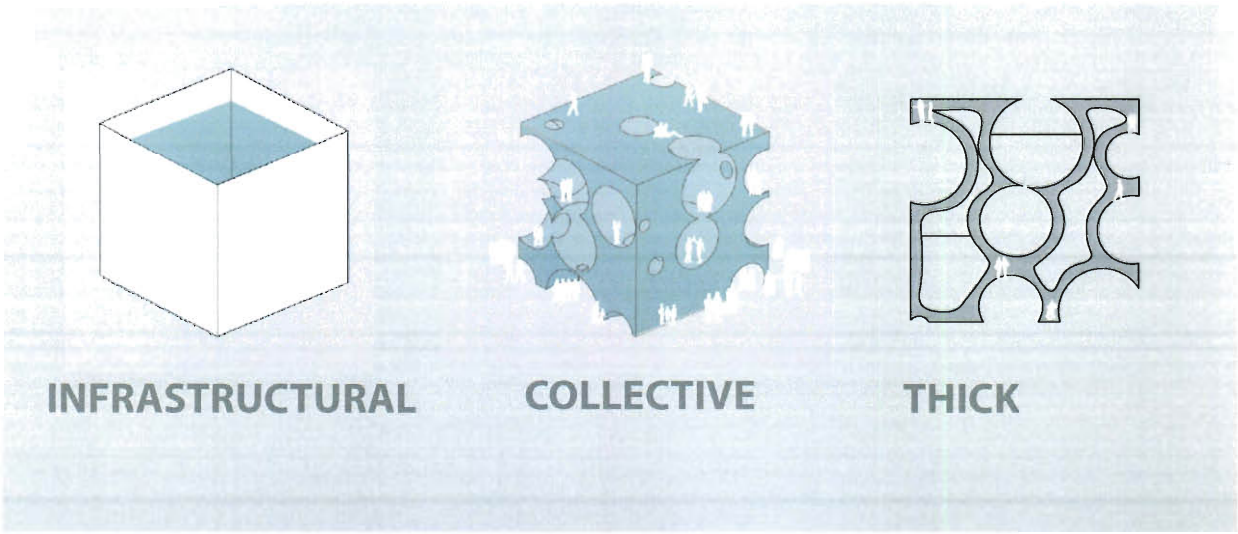


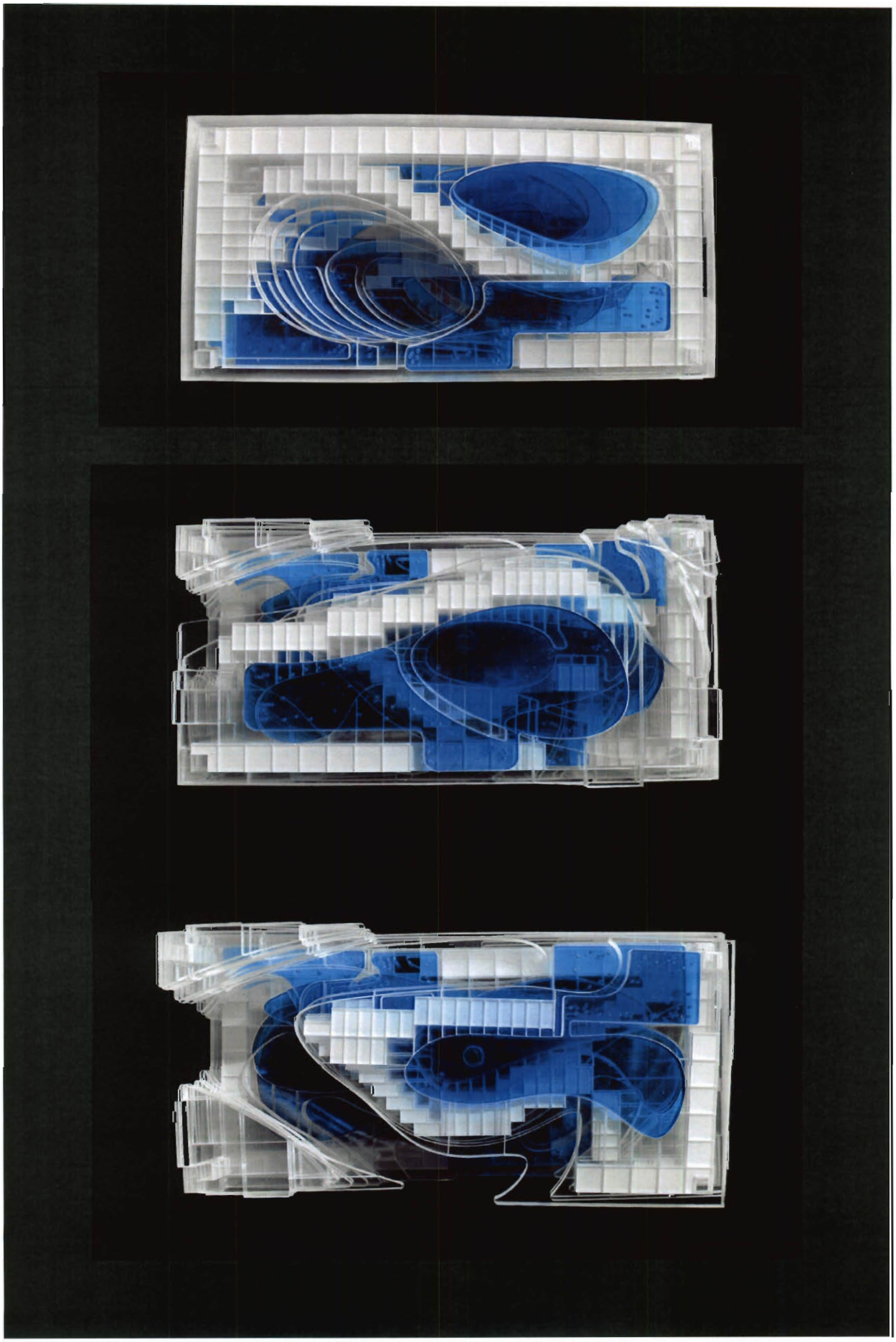


PLEXI MODEL



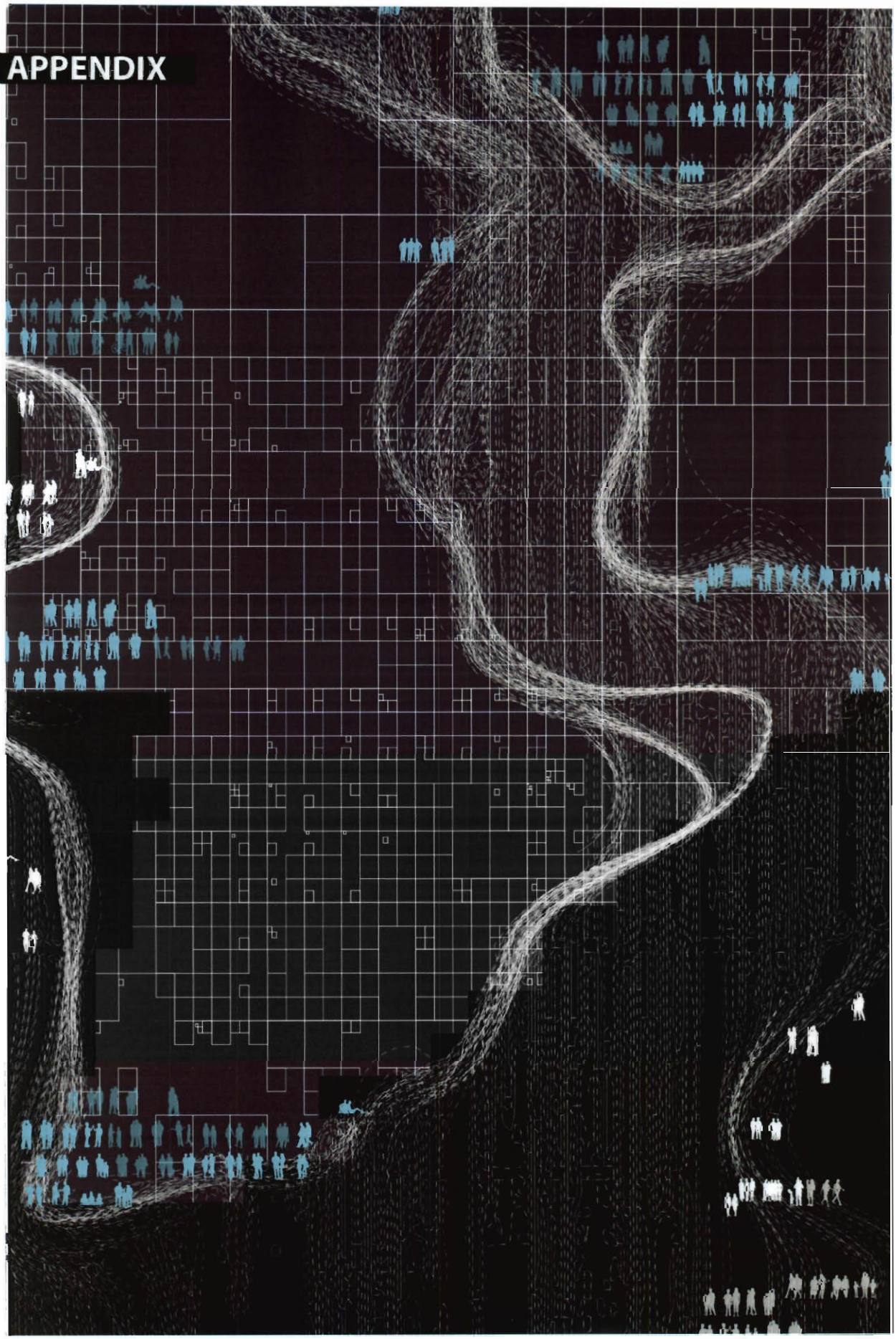
PLASTER CONCEPT MODELS - VOID:VOID





PLEXI MODEL - PLANS

APPENDIX

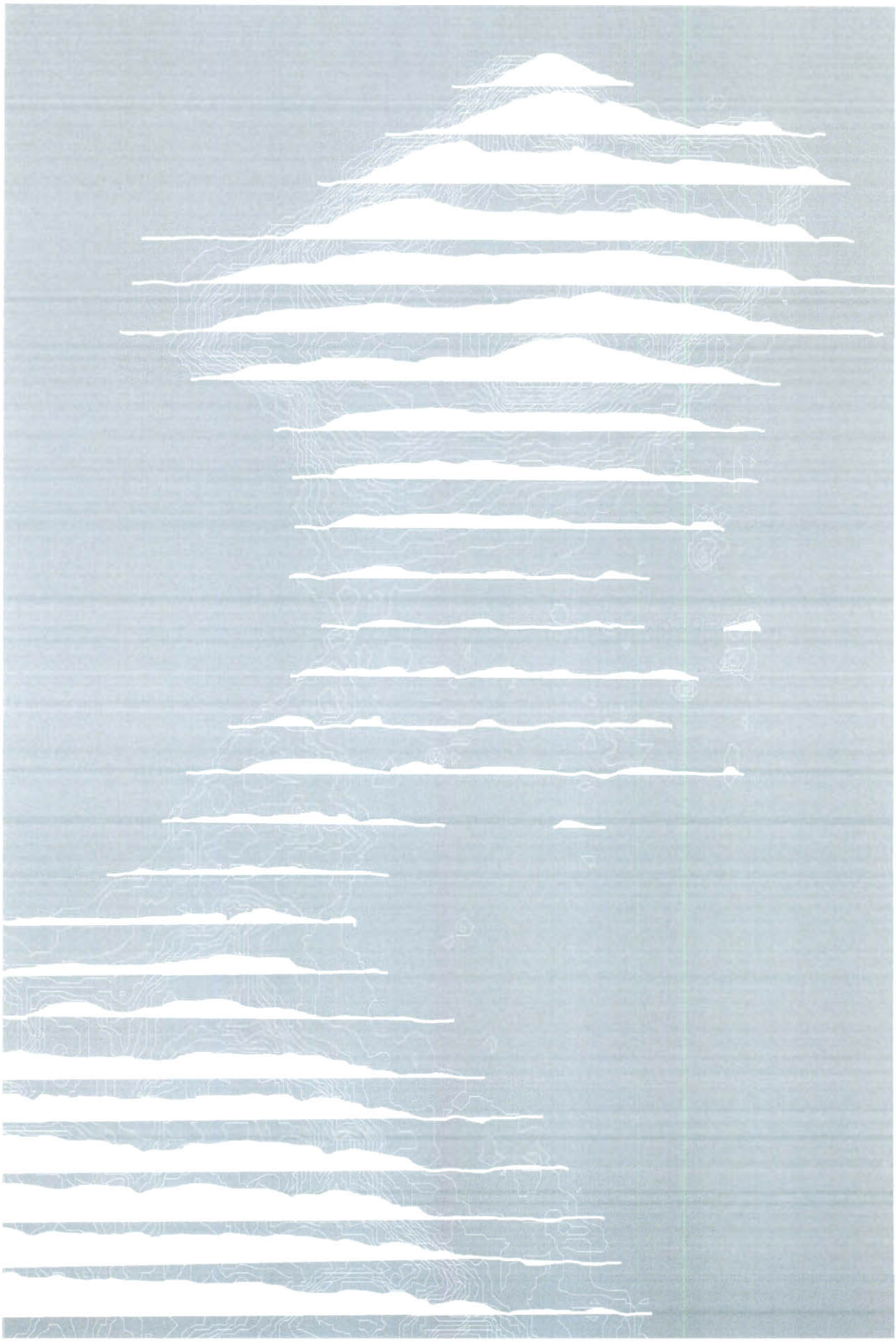


THICKNESS ILLUSTRATION

PHOTOGRAPHS - GRAN CANARIA SITE VISIT

SITE PHOTOGRAPHS

DISPLACEMENT MAPPING



LAS PALMAS - TOPOGRAPHY MAPPING

BIBLIOGRAPHY

Allen, Stan. Points + Lines Diagrams and Projects for the City. New York, NY: Princeton Architectural, [20]. Print.

Blight, Geoffrey. Assessing Loads on Silos and Other Bulk Storage Structures: Research Applied to Practice. London: Taylor & Francis., 2006. Print
.

Bright, Deborah. "The Machine in the Garden Revisited". in Art Journal Summer (vol. 52, 1992.) Env. Design N81 .C6

Burns, J. Carol. "High-Performance Sites" in Burns, Carol, J., Kahn Andrea" Site Matters. Design Concepts, Histories and Strategies. New York: Routledge (2005)297-310

Carta, J.A and Bueno C, "Wind powered pumped hydro storage systems, a means of increasing the penetration of renewable energy in the Canary Islands" Renewable and Sustainable Energy Reviews, 2004

CASE: Toyo Ito : Sendai Mediatheque. United States: HARVARD GRAD SCH DESIGN, 2002. Print.

Corner, James. " Terra Fluxus" in The Landscape Urbanism Reader Charles Waldheim, editor. in The Landscape Urbanism Reader. Princeton Architectural Press(2006) 21-33.

Eyres, D. J. Ship Construction / Eyres, D J. 1988. Oxford: Butterworth-Heinemann, 1988. Print.
Frampton, K. "Toward an Urban Landscape" Columbia Documents Volume 4 Columbia Documents of Architecture and Theory: D(1995) 83-93.

Khaligh, Alireza, and Omer C. . Onar. Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems. Boca Raton, FL: CRC, 2010. Print.

Koolhaas, Rem. "Whatever Happened to Urbanism" in S, M, L, XL: O.M.A., Rem Koolhaas, Bruce Mau, 1995

Kwinter, Sanford and Umberto Boccioni. Landscapes of Change: Boccioni's "Stati d'animo" as a General

"... architecture and landscape can appropriate the utility and serviceability of infrastructure. One could imagine landscape/ architectural projects conceived as functional infrastructures, ecological machines that process and perform, public spaces that literally 'work'."

Reed, 'Public Works Infrastructures, Ecologies, Practices,' in The Landscape Urbanism Reader.

Theory of Models. Assemblage, No. 19 (Dec., 1992), pp. 50-65

Leupen, Bernard, René Heijne, and Jasper Van. Zwol. Time-based Architecture. Rotterdam: 010, 2005. Print.

Mostafavi, Mohsen, and Gareth Doherty. Ecological Urbanism. Baden, Switzerland: Lars Müller, 2010. Print.

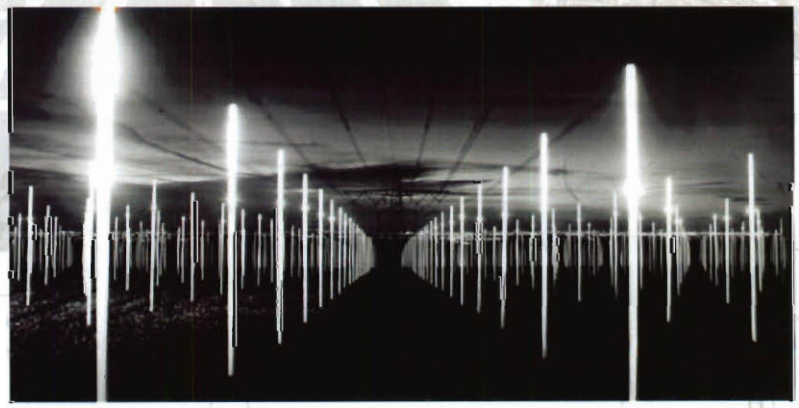
Sanks, Robert L. Pumping Station Design. Boston: Butterworth-Heinemann, 1998. Print.

Somol, R.E. "Urbanism without Architects" in Allen, Stan Points + Lines, Diagrams and Projects for the City. New York: Princeton Architectural Press(1999)137-143 Env. Design

Strang, Gary. " Infrastructure as Landscape." in Simon Swaffield. Theory in Landscape Architecture. Philadelphia: University of Pennsylvania Press.(2002) 220-226.

Water Transmission and Distribution. Denver, CO: American Water Works Association, 2003. Print.

Zaera, Alejandro, Farshid Moussavi, and Albert Ferré. The Yokohama Project. Barcelona: Actar, 2002. Print.



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