Bootstrapping: a brief introduction

Marble Fairbanks

Bootstrapping is about generative growth. It is a process that utilizes a small amount of energy, or input, to trigger larger, successively more complex processes. In colloquial *social* terms, bootstrapping refers to the ability of the disenfranchised to rise up despite dominant power structures. In its more recent use as a *technological* term, it refers to hardwired circuits that enable organic *generative* growth (i.e., the small amount of software hardwired into computers that allows the installation of further software). For an architecture practice, bootstrapping suggests an approach that places renewed significance on the discrete and specific material and organizational decisions that are made within an expansive and increasingly connected global context – a globalism in which the dominant tendencies of large institutions overshadow the effect of the individual actions that collectively make up those institutions. Bootstrapping is the identification of strategic connections to the vast network of surrounding potentialities that allow an architectural project to be generative – for endpoints of a design process to continually evolve from, or completely transcend, their origins. Bootstrapping requires looking intensely at how architecture operates in the world after design (after the architect) so as to identify patterns of performance that then feed back into subsequent designs.

The work in this publication was presented as a series of lectures, given at several universities and conferences, that culminated in the Charles & Ray Eames Lecture at the University of Michigan. It represents the structure of our practice, which has evolved by continually shifting between larger urban projects and smaller interior work where we can operate as a laboratory, testing specific themes and ideas that then inform the urban-scaled work. Our interest in bootstrapping began with the Chicago School Competition, where we were faced with a new building type – schools within schools – that demanded a strategy that addressed physical growth and the relationship among increasing scales of use, combined with a program of intricate needs specific to an economically marginalized neighborhood possessing a significant population of disabled children on the south side of Chicago. This coincided with research we were doing on contemporary learning theories, on the codification of human knowledge in the field of artificial intelligence, and on learning organizations that look at ways in which collaborative work can yield greater results than hierarchically structured relationships. A consistent theme in this research was the identification of techniques to create generative patterns of growth, ones that can sustain themselves over time and in multiple contexts. Knowledge (both human and artificial) is more robust when it is learned and not taught, and when it is collective and not individual. Architecture is most effective when it transcends solving given programs and instead suggests alternative patterns of use. Two areas where we have focused on implementing principles of bootstrapping have been in the rethinking of program and in the use of digital communication to restructure practice.

Program

Critical discourse continually reveals that architecture is, at best, a detail in the operation of urban life, while architectural practice persists as a

delirious passion forced to navigate endless legal, economic, and political obstacles to arrive at something material in the world. The work presented here has resulted from observing and reflecting on not so much what architecture is as what architecture does, how it performs. More specifically, it focuses on patterns of human use under the myriad influences of political, social, and economic pressures, and the correspondingly thin line between architecture that reinforces organizational control and architecture that empowers growth. Bootstrapping is most useful in extending the definition of the architectural program. These projects are motivated by an effort to broaden conventional building program in relationship to the expansiveness of urban contexts increasing architecture's connection to the city. Caught historically between competing definitions – the literal inscription of function into form (functionalism), the free play of activities within a field (event), and the contemporary demand for maximum flexibility in a world driven by the logics of speed and liquidity (generica) – program, in its reduced architectural definition, has been stretched to its limit. It has lost its ability to effectively organize space. Bootstrapping redefines program as generative relationships between discrete human use patterns and the continually expanding network of influences that propel them into new relationships, succumbing neither to control, subversion, nor the vacuousness of generic flexibility. Housing Ecologies uses a specific yet supplemental program – the generative void – to intensify relationships among separate units and to direct a flexibility of unit growth over time: units can be combined or divided around the void to change the intensity of the relationships. Similarly, the generative spaces of each of the four small schools within the Chicago School introduced a space beyond the strictly defined program to allow students and teachers

to form a unique identity for their own school (a crucial aspect for the success of small schools). In the campus extension for the Fashion Institute of Technology in New York, the entrance from the street is surrounded by formal and informal program defined by the street façade wrapping under the building and turning outside-in. The matrix of relationships around the entry area create a perceptual knot between the building and the city constituting an expanded learning environment. Program is precise again, not as a problem to be solved, but rather it is an initiator of growth, of expanded relationships, renewed to *generate more program*… beyond design.

Communication

Sciuscia, the final project in the book, is one of several projects we have recently completed that explore the potential of digital technology to construct patterns of *communication* that lead from an immaterial concept to a material reality. From the outset of the digital transformation of architectural techniques, our primary interests have focused on the opportunities to reposition design as an integral part of the industries it relies on, from media to construction. The future significance of digital technology in architecture is first and foremost one of communication, not form. The opportunity for unprecedented forms of collaboration through ubiquitous communication systems allows architects to reorganize the very hierarchies of power that structure the relationship of design to society. Although this affects architecture most directly, by merging the representation of buildings (drawings) with their actual production through the common language of digital information, the broader implications of this new connectivity go beyond any specific industry. That Sciuscia

was designed and built in two months was primarily due to the close collaboration among owner, architect, fabricator, and contractor, as well as the ability to efficiently communicate ideas, instructions, questions, and changes in real time with instant response.

More than ever, design originates in actually organizing these new forms of collaboration before architecture even begins and continues long after architecture has ended. Bootstrapping is not a theory or a mode of production, but a practice that is intensely engaged with the contemporary milieu to analyze and structure what comes before, and to project what comes after, architecture.

Organizations, Program, Topology, and Pattern

Reinhold Martin, Karen Fairbanks, Scott Marble, and Luke Bulman

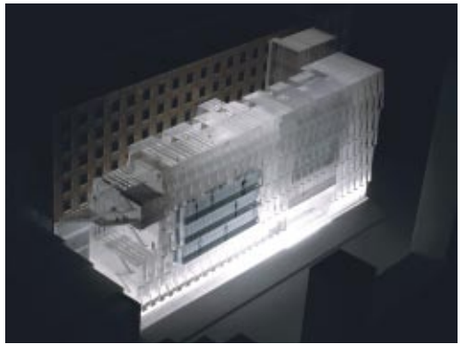
Held in August 2004, this conversation explores those interests and activities of Marble Fairbanks that resonate with the ideas presented in *The Organizational Complex* (2003, MIT Press) by Reinhold Martin. An examination of the post-World War II interplay of the military-industrial complex, cybernetics, and corporate aesthetics, this book draws on the work of Eero Saarinen, Georgy Kepes, Skidmore, Owings, and Merrill (SOM), and others to describe the then rapidly growing role of pattern, image, and the operational in spatial practices. Emerging from this period, architects increasingly recognized that a contemporary experience of space, be it material or otherwise, would be driven by soft techniques as much as by physical embodiment. Practices like Marble Fairbanks have chosen to adopt this expanded definition of architecture, while maintaining a commitment to the demands of its assembly. – LB

Organizations

Scott Marble: We continue to be fascinated with the many definitions of *organization* that, for us, productively fluctuate between its distinctly architectural use in terms like *plan organization*, *spatial organization*, and *material organization*, and its use to describe social, political, and cultural relationships that operate within and condition architecture. In much of our recent work, our efforts have focused on understanding these underlying relationships in order to design more strategically within this expanded context.

Reinhold Martin: Organization can refer to logistics as well. For me, this kind of ambiguity is what's interesting about the constellation of issues around a word like *organization*. The resonances in this case are between spatial organization and logistics – which in your own work seems often to translate into diagrams of activity – and organization as a noun, usually referring to an entity or an institution. I think it is also important to consider the kind of institutions that one is working for and their interests, as a virtual context for what architects do. Your Fashion Institute of Technology (FIT) project literally participates in institution-building. Not just in the sense of building for institutions, but in renovating their image and reorganizing the way they teach as well as responding to their own fantasies about themselves. In a way, from the internal, architectural point of view vis-à-vis the spatial layout, the FIT project indexes these various forces. But of course anyone designing a project like this is challenged to interpret these forces and to respond to them critically and imaginatively, never taking anything for granted. Still, both spatial and institutional organizations are habitually reproduced in architecture. For example, one thing that's often taken for granted is that organizational systems or modes or logics simply are – they simply exist – and the architect's job is to respond to them, reproduce them, represent them, mobilize them. Such assumptions need, in a sense, to be deconstructed and denaturalized.

Inside the word *organization* of course is also the word *organism*, which implies that there's something natural going on. One of the main arguments in my book is that the organizational systems used in curtain walls and modular buildings in the 1950s and 1960s had a kind of "organicist" agenda even though the buildings themselves didn't look organic.



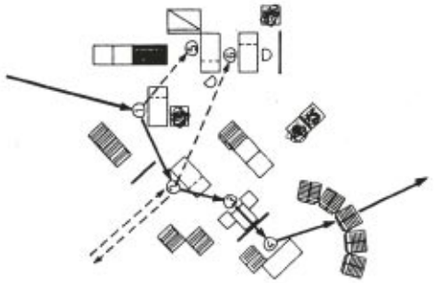
FIT Campus Extension aerial view

This agenda also operated in ideas about the corporation as a family; it made an organizational form like a corporate office seem inevitable, *natural*. There is a strategic opportunity for architects here if we do not take this as a given, but more as a field in which we operate. The nature of any given organization, be it the institution or its spatial patterns or the materials from which it's made, is always at stake – it's always contestable. And by implication the architect has more to say even than the client about the future of that aspect of the project. Of course we're also talking about clients such as developers; what you're proposing with your Housing Ecologies project, for example, is not just a building that looks different to a developer. You're proposing to reorganize, in a logistical sense, the way a developer builds.

Karen Fairbanks: Yes. Not only the way we form the envelope, but the way we want to allow the user subsequently to inhabit it. Housing Ecologies was designed to exploit a developer's interest in flexibility, but in a way that constructed an active and participatory form of living. Among other things, this was in response to the realization that the site would probably be developed under a New Urbanist agenda, with a lack of diversity in housing options, and most likely operate as a gated or homogeneous community. We were trying to question that, not only with the site organization but also with the housing unit distribution over time.

RM: So the typical organizational imperatives of the market as imagined by the developer are challenged by that assembly drawing. I should add that even though it may sound sometimes as if there is this big "organizational" conspiracy, of which the

Gregory Peck in *The Man In The Gray Flannel Suit*



Workgroup plan diagram, Quickborner Team

SM: While functionalism tried to directly express specific uses or programs, the ideas behind Quickborner were to physically organize relationships among individuals to improve communication and productivity. This kind of physical network, very influenced by cybernetics, created an even more rigid organization. Although the plans appeared very playful and almost chaotic, the logic driving them was one of control. It can be seen now as a last attempt to physically organize lines of communication before digital technology redefined the spatial and temporal potentials of networks. So Quickborner is beyond functionalism in a certain way.

RM: Yes, it's a kind of mad diagramming. It is behavioral in its approach to communication. And it is environmental, even ambient, rather than utilitarian, an example being the white noise generators they used to keep conversations private in an open office. So one of the challenges today, as virtual space becomes even more virtual, is that anybody who wants to carve something different out of this space must be able to recognize what's actually happening and reflect critically on that if they are going to push in a new direction, locally or globally. They must also have the tools, both historical and theoretical but also technical, to demystify virtual space – to know how it works and know how it's produced.

SM: As the practice of architecture becomes more aware of its reliance on, and position within, increasingly varied organizational systems, the role of the architect would seem to shift from a master creator of buildings and cities to more of a manager of political, economic, and industrial forces that then culminate in the form of buildings and cities. Any shift toward this realization would require architects to reposition themselves at this level. What you're talking about is a way of working today that is neither resistant to these forces, nor just an affirmation of the forces, but strategically in between. Is this something that you think has been established and is going on now?

RM: No, I don't think it's going on, though I would also add that resistance and projective action are not necessarily mutually exclusive. I wrote *The Organizational Complex* in response to many things going on in architectural discourse today. In the introduction there is an implicit critique of certain digital ideologies, especially the go-with-the-flow tendency. The research on cities that we're currently doing attempts to follow up on that critique in architectural terms. But in order to fight a battle, you need a map to lay out the territory and to make visible relationships and connections between things – patterns.

KF: You haven't mentioned pattern until now.

Pattern

RM: Well, yes, but that's only because it's everywhere. Patterns within patterns. Gyorgy Kepes called the kind of vision I'm advocating *pattern-seeing*. It was a mindset that was very important to him and to many others, including the Eameses and Buckminster Fuller. This is also something that's quite pervasive today, especially in the digital realm. Often architecture today is described in terms of patterns that change, like so-called "morphogenetic diagrams," though symptomatically these can also be seen as alternatives to the rigidities of the grid and particularly to functionalist hyperdetermination.

Office plan, Quickborner Team

What Is A Home?, Charles & Ray Eames

Of course the system is always one step ahead of you – it, too, is emergent. Organizations like the Rand Corporation understood this long ago, as did the military-industrial complex in general, which was already experimenting with computerized, emergent patterns and pattern recognition techniques. One of the initial tests of pattern recognition was trying to teach American computers to read Russian. (This had to do with the cold war, of course, where to recognize patterns was a strategic act.) Patterns present one possible answer to the question of how to work with systems: you use the same maps, but you learn to see the patterns as always developing and therefore always subject to change.

SM: It requires that you remain in a continual state of suspension, really.

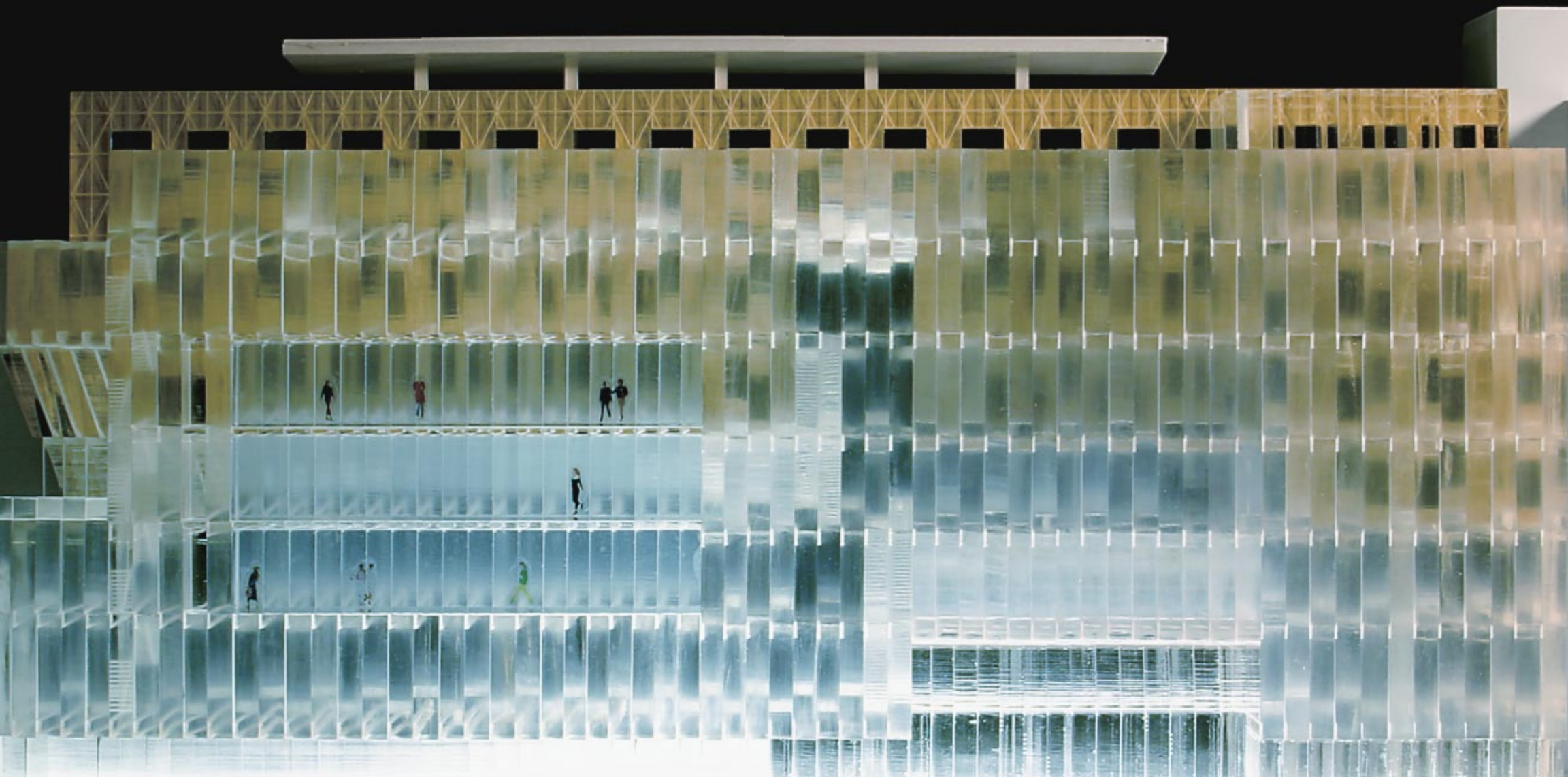
RM: Yes. You can't identify with anything – you must keep one step ahead of fixed, rigid order. At the same time, the organizational complex is telling you, "Emerge. Change." That's what advertising is telling you all the time, to change, because if you're always the same, you don't buy anything. "Think different," as they say at Apple, and buy a different color iPod every year. It doesn't mean that there's no escape. But that's another reason why topology is a very important tool for architects. There is no outside to this system in the classical sense that allows you to stand apart and resist the thing externally. But however complex the system is, it's also full of holes. And so, in a sense, the outside is on the inside.

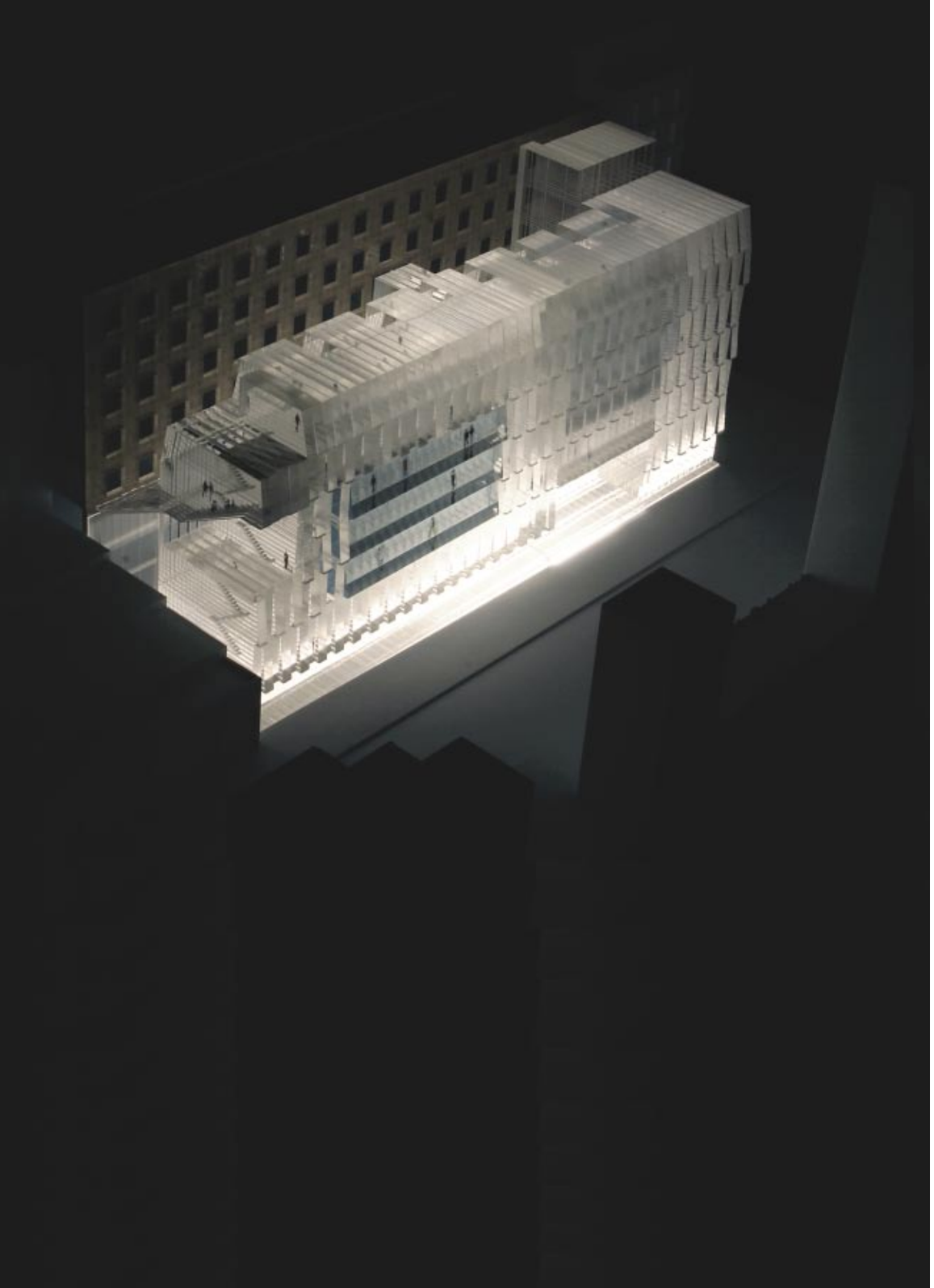
That's where images come in. An *image* of seamlessness is one of the things that the organizational complex and its progeny have been very successful at maintaining. Think of the curtain wall. It is an image, a sort of phantasm, of seamlessness. You're trapped in the grid; maybe now it keeps on changing, but there's no outside. So architects like Rem Koolhaas have developed strategies of surfing that are based on the premise that there is no outside. You can trace these efforts and others to the 1960s and to groups like Superstudio that in a way represented one last attempt to imagine a revolutionary architecture – to escape. But now we go with the flow, which nevertheless assumes that there is in fact a flow, and that this flow is seamless. I'm not pretending that there's an easy way out. But there are loopholes and wormholes in this seamless fabric. Still, since images are real, the image of seamlessness works, oddly enough, to reinforce the *fact* of seamlessness, which is why the curtain wall is not just a decorated shed or billboard. It's not just advertising. Images organize. They organize by maintaining the phantasm of internal coherence, of organic integration, which in turn helps "build" both subjects and institutions in a feedback loop. The fantasy of identification with the monolithic, integrated network of the corporation as a family is made possible concretely through images.

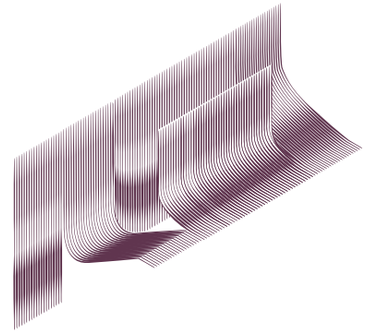
KF: Images are just one of the patterns, literally like a plan, a pattern that is recognizable. Patterns, as a form of organization, can be played out in the plan, in the façade, in the image(s) of the institution.

RM: Image is, exactly, one of the patterns. Looking at your FIT project, it exposes an interesting problem in the relation between pattern and plan, image and organization. In many modernist glass curtain wall buildings, image and organization, or pattern and plan, are more or less isomorphic. The Union Carbide Building is even more – much more – sys-

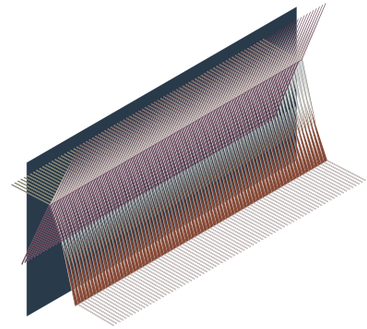
Fashion Institute of Technology Campus Extension



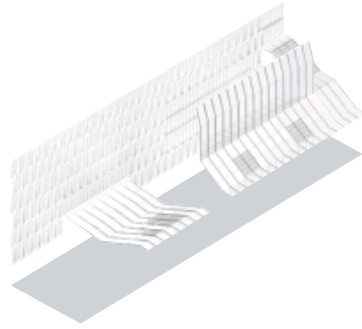




1. Looping of inside and outside



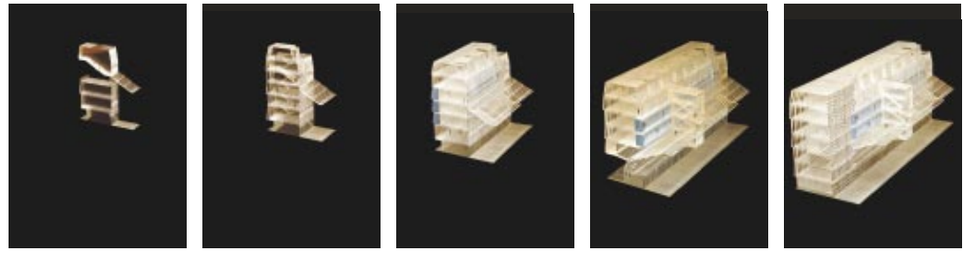
2. Spatialization of surface



3. Thickening of surface

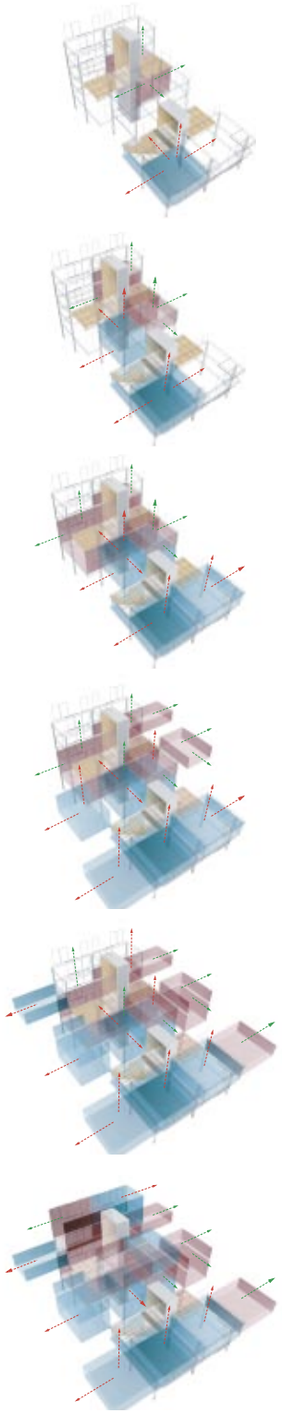
Surface weave

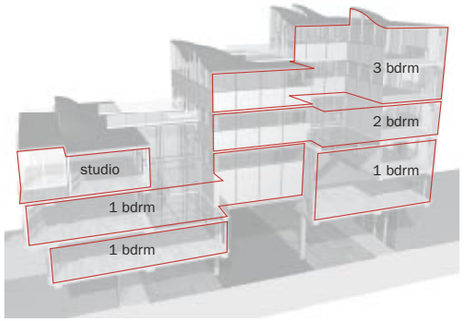
The front and rear façades wrap back to link into the 4th floor of Building C forming an exterior balcony off existing studios. The new building is conceived as a thickened façade that is threaded together with a combination of material surfaces, views and movement.



Composite sections

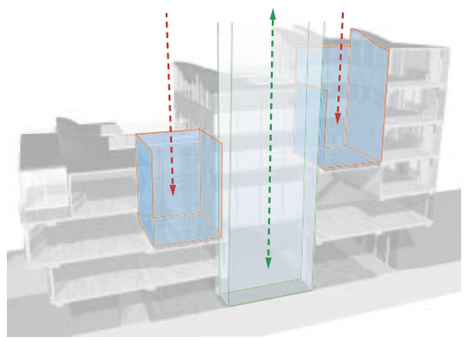
Composite section model describes the relationship between the surface weave module and internal organization. Adherence to internal/external equivalence is loosened to achieve moments of syncopation between the building skin's modularity and the disposition of spaces. Consequently, it becomes possible to locate areas where micro-adjustments could be made between envelope design and local conditions.





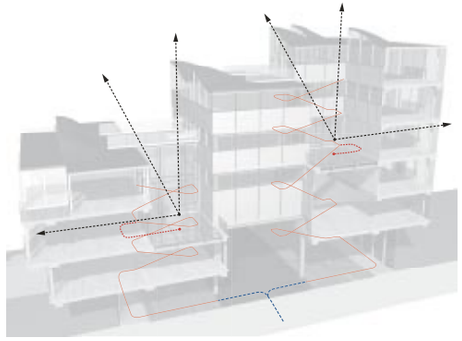
Unit flexibility

The base number of units within a 26-foot wide bay ranges from four units in the ocean side building to six units in the furthest land side building and ranges from studios to two bedroom units. The prefabricated concrete frame structure and wall panel system allow unit expansion both vertically and horizontally. The stair core, which serves two bays, also contains vertical shafts for all utility risers with short distribution runs to bathrooms and kitchens.



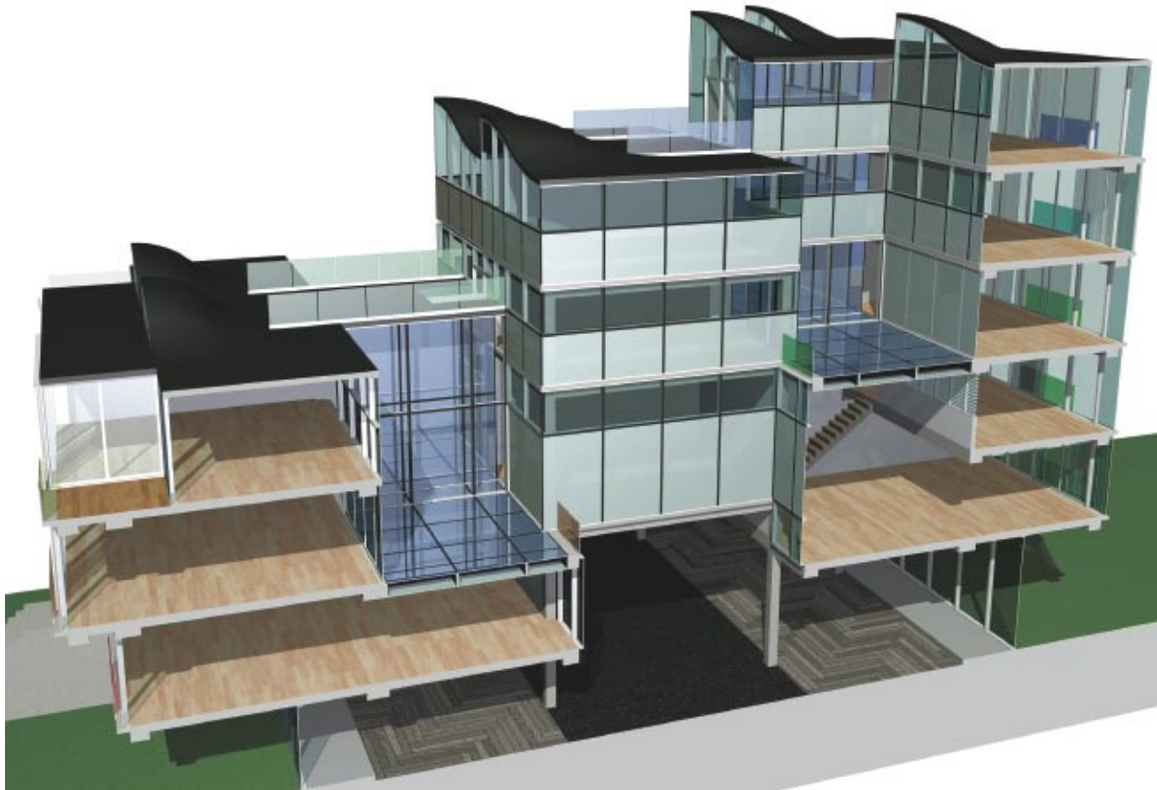
Generative voids

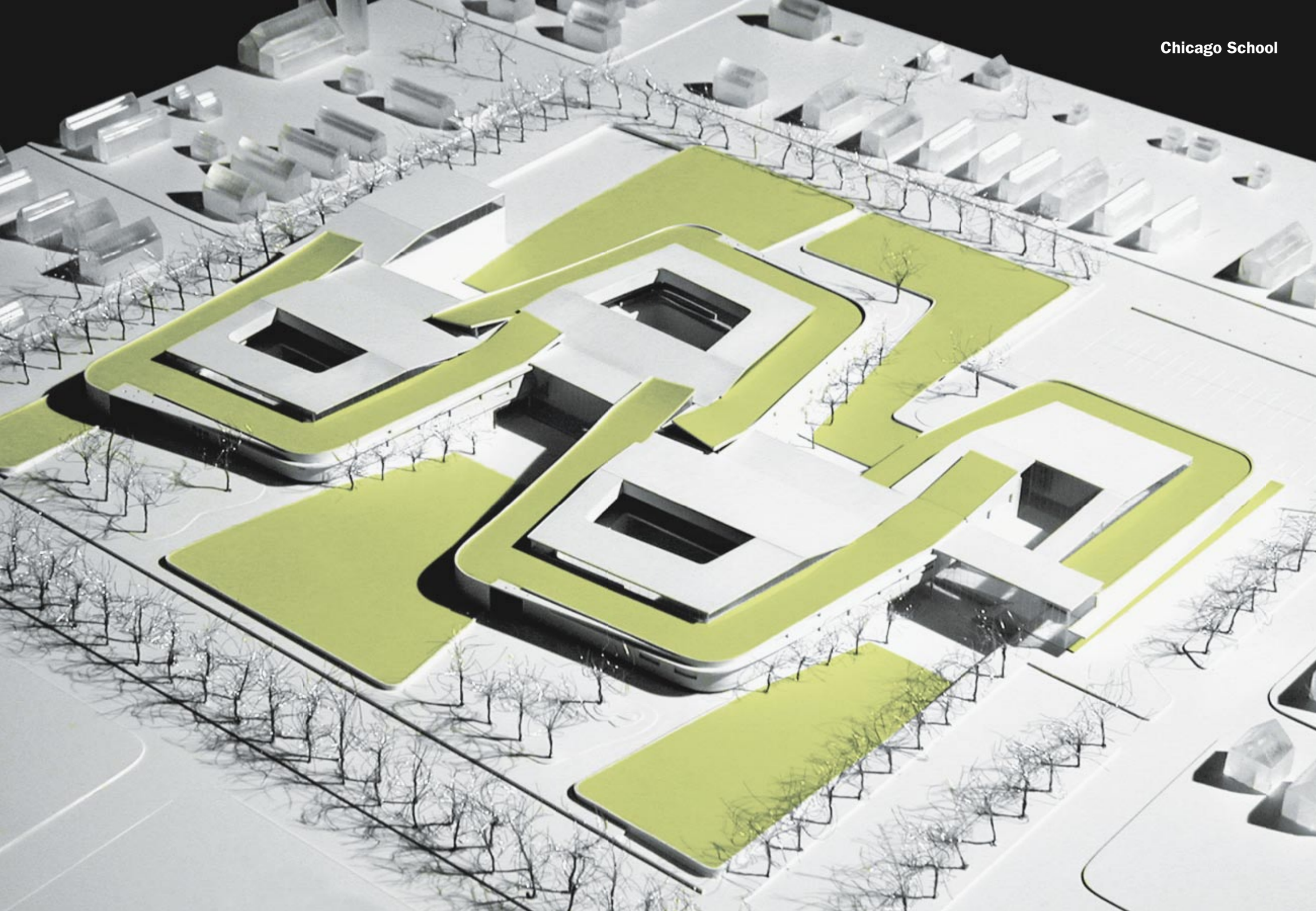
Given the base distribution of units which are oriented either ocean side or land side, cross ventilation and light to each room is achieved by voids within the mass of each housing band. The floor of the voids are owned and occupied by the adjacent unit while the space above is common to allow light and air into upper units. The voids are a space of negotiation between neighbors. For larger configurations, the voids can become the sole domain of a single homeowner.



Split horizon

The horizon has a powerful presence at Arverne. The stepped section of the housing bands allows the upper units to view over the roofs of adjacent units toward the expansiveness of the ocean and simultaneously into the immediacy of the voids. From within the void, the sky is framed by the units above.





Landscape and building exterior

The design is based on providing sufficient autonomy to each of the four small schools while maximizing shared resources such as library, cafeteria, science and art areas and health services.

Organizational junctures within the building function as bootstraps providing a structure to encourage self generation at multiple scales: from the student in the classroom to the community of a small school, to the larger school community housed in the entire building, and finally to the neighborhood community.

The classrooms (A) provides the platform for the generation of a group dynamic between the students and their teachers, and is their link to their small school. The generative space of each small school (B) acts as a bootstrap for that school to generate its own identity and link to the school at large.

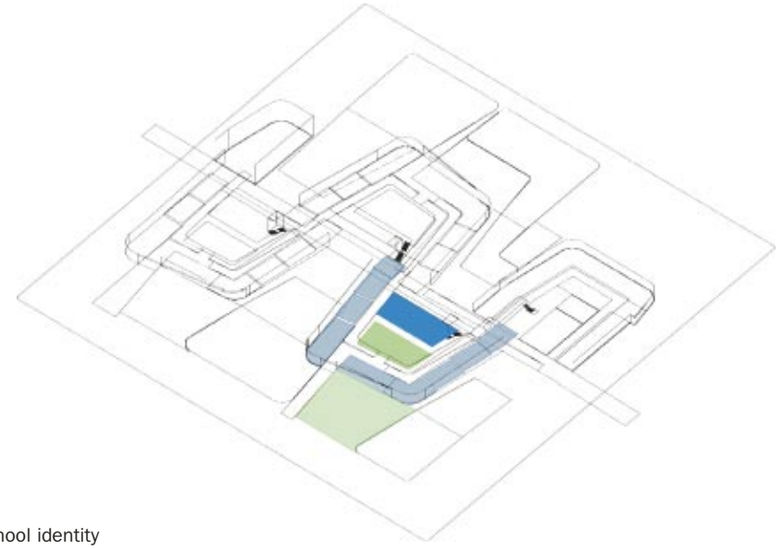
The parent/teacher rooms and classrooms that bridge across the interior street (C) link adjacent small schools, providing a shift in scale from the small school to the larger one. The interior street (D) is a bootstrap to the community.

Landscape and building interior

The building is continuous with the landscape, sloping up out of the landscape towards the entry to each small school (E), while the grassy play areas slope down towards the interior street (D).

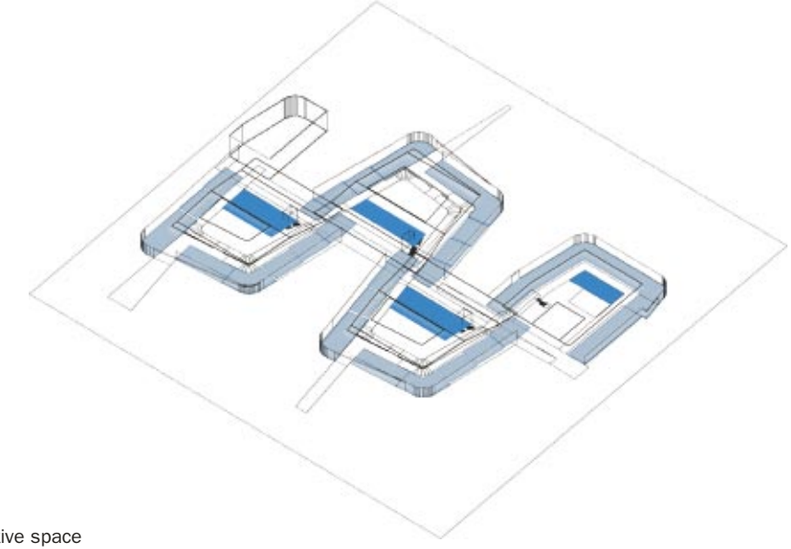
The continuity is perceptually reinforced through the use of grass on the classroom roofs. The landscape of the site interweaves large soft grass areas (1) and hard surfaces (2) to play on with interspersed islands of resilient playground surfaces, plantings, and exploratory gardens of water, sand, and wind (3). The landscape also extends to the edges of the site with a zone of community gardens (4) to engage the neighborhood.

The primary movement of students and teachers is facilitated by a system of 1:20 ramps that allow all students of varying abilities to access all programs. The ramps allow for a two story arrangement of programs that facilitate interaction between the small schools, the shared programs and the community circulation space of the interior street. The school building is compact and efficiently arranged such that travel time is minimized and the identity of the small schools remains clear. As students travel on the ramps to their classrooms they encircle the space of their school, creating and defining its atmosphere through their daily interactions.



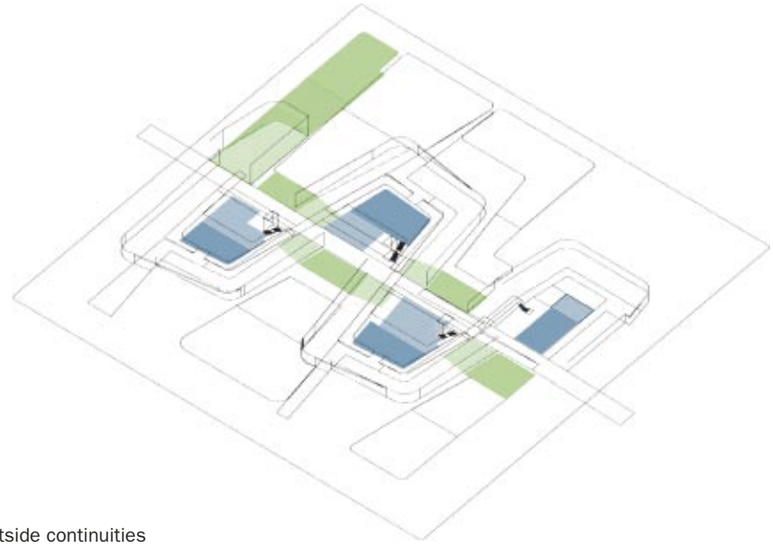
Small school identity

The generative space, the courtyard adjacent to it, and the outdoor play space of each small school provide the platform for the school's identity to evolve.



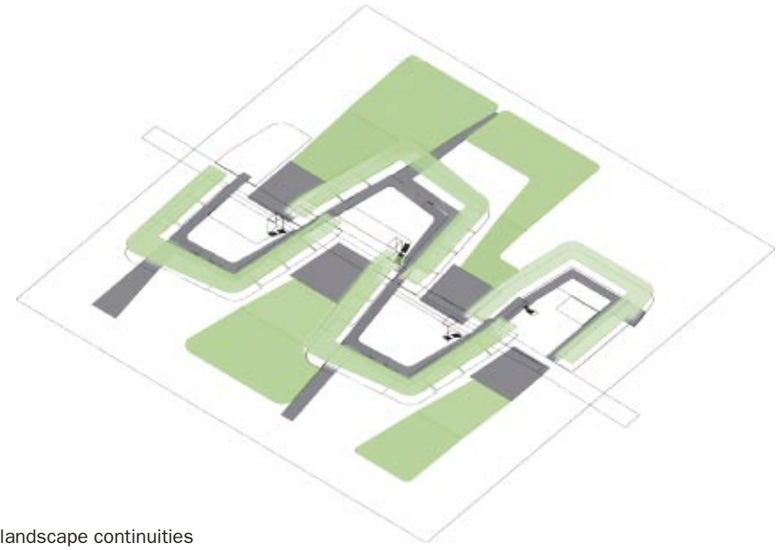
Generative space

Each small school is provided with a generative space intended to evolve and grow as part of the self-constructed identity necessary for the success of schools.



Inside/outside continuities

Each shared program has an adjacent outdoor space with views and direct access so that school activities can occur both inside and outside.



Building/landscape continuities

The building is set into the landscape such that the two levels perform as a continuous path of movement.

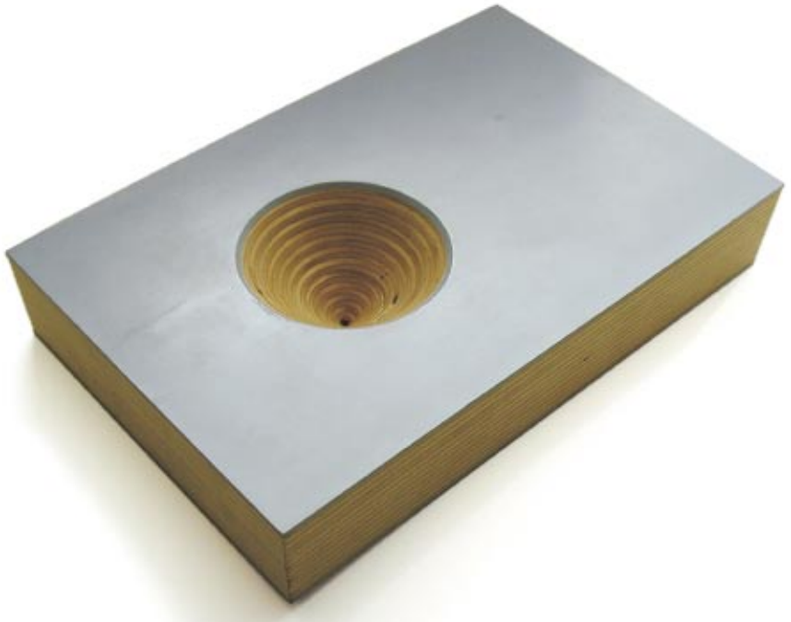
Seven prototypes

These seven prototypes from Marble Fairbanks represent a portion of the assemblies they have designed and tested. Full-scale mock-ups are part of every architecture office's practice; their evaluation is arguably the most direct way that design can be assessed. In this way, prototypes are evidence of a practice's thinking about the relation of materials, production economies, performance, and aesthetic effects. Architecture's development is dynamically linked to methods of construction; as the effects of fluid economies and information management are absorbed by the practice, opportunities arise in the space between the traditional categories of documentation and construction: fabrication, in which the link between design process and final product can be made most direct. While there are many examples of an architecture of customization through the master builder tradition (Carlo Scarpa's work comes to mind) it is only recently that a widespread application of customized fabrication under the architect's influence becomes possible. Isn't an opportunity just a rupture where new things can enter? Yet, the opportunity to use advanced fabrication techniques is not automatic. It arises from an understanding of a project's full operational schema. If we accept that architecture coordinates both material and immaterial phenomena, then effectiveness will be based upon a combination of situational awareness and dexterity. The degree to which a practice is able to understand and communicate the implications and potentials of fabrication is the degree to which it can transcend simple efficacy to become an instrument of thinking. – LB

Cantilevered stair tread, Vertical Townhouse

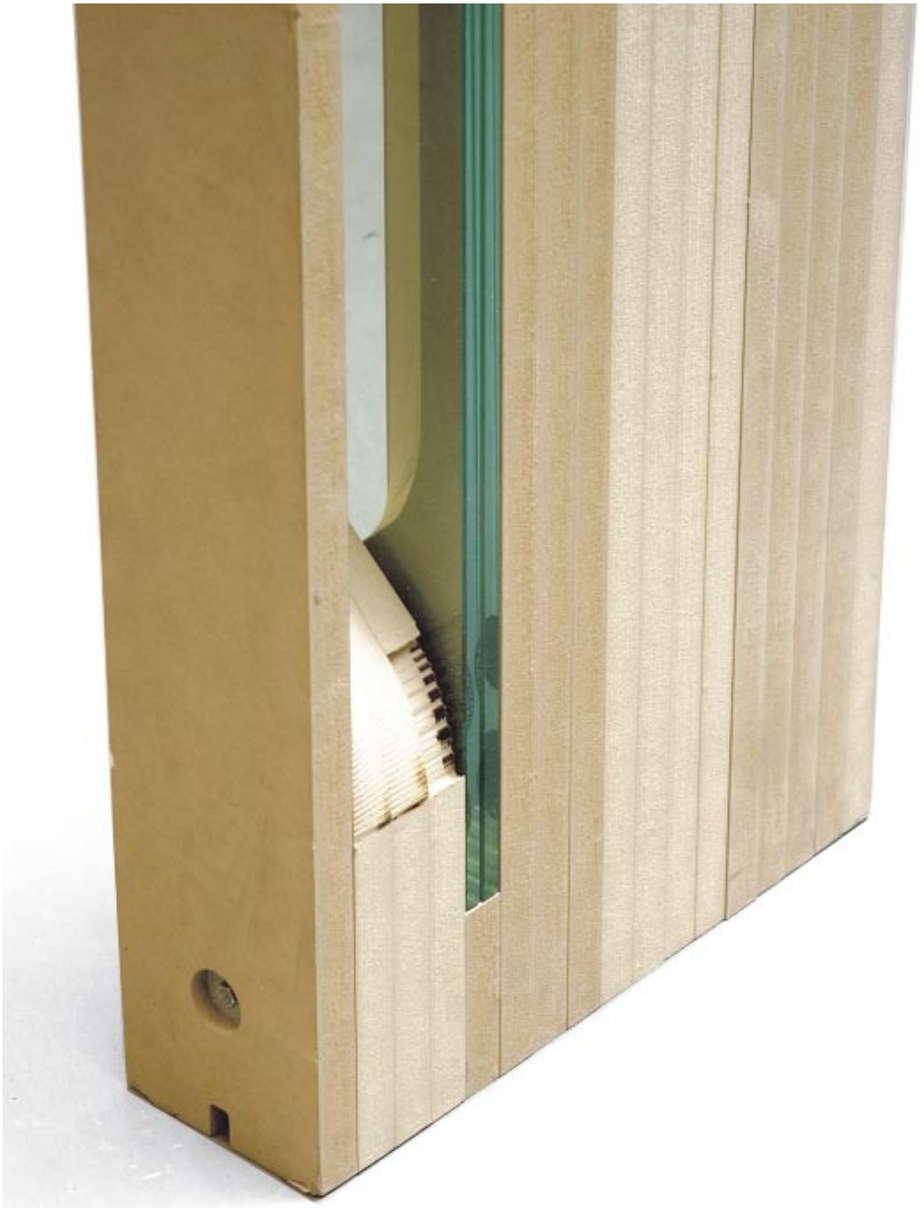
Radii studies for handrails, Vertical Townhouse

Radiator cover, Thirteenth Street Townhouse



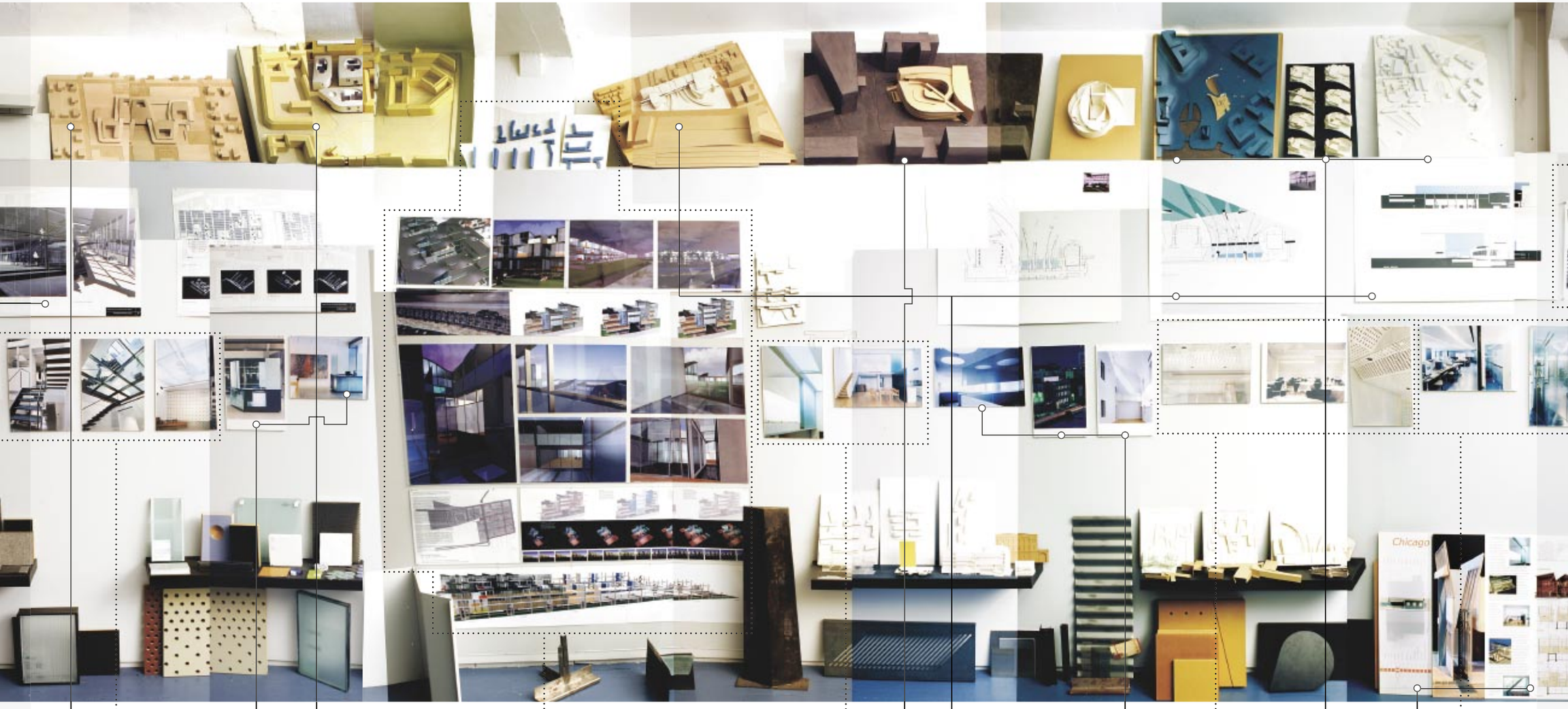
Milling study for folding wall, Vertical Townhouse

Steel frame for glass intersection, Cooper Union Engineering Design Lab



Wall, Slide Library, Columbia University

Perforation panel, Sciuscia



Chicago Public School

MoMA Ticket Booths

St. Petersburg Business Center

Evanston Library

Nara Convention Center

Our Children's Foundation

Cardiff Opera House

Chicago Suburban House

Vertical Townhouse
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Housing Ecologies
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