CourseNo: ARCHA4105_009_2013_3

Instructor Information: Michael J. Bell

NOTE: SEE FULL SYLLABUS IN PDF FORMAT IN FILES SECTION OF COURSEWORKS.

Materials-Based Design Studio IV

What is *Plastic* Architecture?

Michael Bell, Architect, Professor of Architecture

Zachary Kostura, Structural Engineer, Building Physics. ARUP

Brian Lee, Structural and Climate Modeling

Studio Support:

William Carroll, PhD, VP, Industry Issues, Occidental Chemical Corp

Hyon Woo Chung, Studio Critic for Structural Digital Modeling

An expanded team of studio critics will be in studio each week and projects will develop simultaneously along both structural and material engineering tracks. Technical support provided by the Vinyl Institute with the conference Permanent Change also supports the studio. Student work will be done as independent projects though a research period will be coordinated to provide an in depth analysis of the site. A studio trip to Cupertino, California will take place in early October. The studio will require a commitment to working with structural engineering and environmental analysis software and the critics will provide tutorials as needed.

Resiliency

Since the launch of the Architecture, Engineering and Materials conferences at Columbia University in 2007 followed by the introduction of *Materials-Based Design Studios (MDS),* the issues of infrastructure and housing and the technical potentials surrounding issues of energy, materials and urban design have all rapidly changed. During this time, it has become clear that the United States faces a critical need for new housing models and more so new forms of innovation in housing design, but also the material and industrial practices that are at the core of building methods. Calls for higher density and greater efficiency also have been linked to new forms of transportation and community as we look forward. But while financial reform has promised an improved market almost no where do we see a federal, that is, policy based, call for innovation in how we build and how we the immediacy of materials as a fundamental aspect of building and ideally of potential innovation.

Material Economies, Plastic Resiliency

A fall 2013 MDS would seek to address this by looking at building practices head-on; by looking at the market based house and its material make up, yet rather than seeing this through a "critical" lens, we'd seek to study the commodity aspect of building materials and better understand their often overlooked innovations. To do this we'd build on the four Columbia GSAPP publications on materials, (glass, concrete, metals, and plastics) but in particular we would work from the book *Permanent Change: Plastics in Architecture and Engineering*. We'd seek to imagine the architectural possibilities of the books 20 plus authors; the range of scholars, scientists, architects, engineers and chemists in *Permanent Change* form a basis for architectural study and we see this MDS as a testing of the books contents and an unfolding of the material into a graduate student culture.

Permanent Change marked a threshold in the four book series in placing chemical engineering at the pivot point of plastics. While other conferences addressing glass, concrete and metals all invoked issues of chemistry they more often focused on the structural aspects of materials and at time the physics of materials. While none of this is isolated when discussing material properties, *Permanent Change* did often demonstrate plastics as a particularly unique material and one that the critic and writer Sylvia Lavin described as a material that may have "preceded a concept.” That is, plastics because of their unique chemical engineering properties are still essentially a new material that architects and engineers could not posit against historical precedent. In this light they have often been characterized and at times disparaged as *artificial* and thereby less than other building materials, yet we nonetheless also realize the shear depth of their application and innovation in building as wiring, plumbing, siding, and water-proofing; as definitive in issues of hygiene and life span, ergonometric and function. What was uncovered in the conference and is explicated in the book is a kind of amnesia about plastics that enables the architect to both use them extensively (and intrinsically rely on them) while they also do not quite manage to allow their actual innovative qualities to drive design. This MDS would try to break that divide and place plastics at the center of design; part of this is acknowledging the resiliency of the materials and bringing to the surface of design—and in particular to seeing its effect. But the key issue would be trying to invoke plastics at a level well beyond the cultural connotations and expectations. Plastics are engineered to perform and yet we often limit their usage to what we imagine are mundane tasks. They are also deceptive at allowing an “easy read” – to really know plastics you need to know their chemistry and get past the cultural connotations.

Materials-Based Design Studio IV

What is *Plastic* Architecture today?

Material Economies, Plastic Resiliency

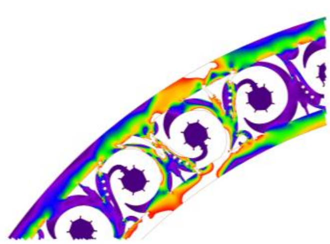
Plastic in Building

The GSAPP MDS will focus on meanings of the term *plastic* and the role of plastics in architecture. We will take the historical term plastics and its spatial themes and explore this in the context of plastics in commodity items but also as an economy themselves. The studio will explore plastics as a building element that needs to be un-covered and indeed re-seen as a zone of material innovation.

Architecture studios generally accept materials as givens or as organized by industry and by materials science: this is true for glass, concrete and metals as well as plastics. In seeking to improve the building industry we have generally focused on putting known elements together better; knowing that the commodity practices that underlie development and building in the United States have standardized building materials and means we generally have accepted materials as a given. Architects are often simply working with a roster of known materials and practices; this of course, allows us to manage risk and assure safety but it also often curtails innovation in ways that one could say the auto industry, or the electronics industry, for example, seem to be less limited by. In looking closely at materials and bringing students and indeed a top design talent to the mechanics and chemistry of materials projects like *Permanent Change* (the conference and book) hoped to break that threshold. To allow us to see architecture in the materials and innovate with the people who work at that level. In that zone, vinyl and other polymers, become uniquely fascinating because they are indeed so fully engineered but more so embedded in industry (that is, jobs, production and economy). The MDS has the benefit of working closely with its partners: in this case we would welcome a chance to engage with Dr. William Carroll of the V.I. but also to visit V.I. partner plants and see the industry up-close. Our studio work would then seek to address a case study of relatively small scale by exploring how a new model of housing for an American suburb could be more closely linked to the materials and industries it is made of.

Faculty
Michael Bell, Architect, Professor of Architecture
Zachary Kostura, Structural Engineer, Building Physics. ARUP
Brian Lee, Structural and Climate Modeling
Hyon Woo Chung, Modeling Associate

Industry and Academic Advisors
William Carroll, PhD, VP, Industry Issues, Chemist, Occidental Chemical Corp
George Middleton, architect



Left: Plastic Form: The history of architecture relies on the word plastic as a spatial and formal quality; something felt and apprehended as experience but also as embodied in form. But in the building industry we have instead seen plastics as something that is generally hidden if at all acknowledged. Plastic material imitates other materials and the plastic behavior of materials under structural loading is often sublimated to other visual or semiotic codes. The perfect calculus of Borromini's is rarely achieved but nonetheless the built world is rife with complex plastic forms and behaviors and with plastics that have barely been understood in architecture.

Center: Plastic Behavior: Finite Element Analysis, Henri Labrouste, Bibliothèque Sainte-Geneviève, plastic behavior of iron in conjunction with plastic shape of ornament forms a structural arch.

Right: Plastic Material: Polymers and Cars: the dashboard of a Mercedes Benz C Class. "The detail-oriented designers may spend years in development to ensure that an interior composed of about fifty different materials will be experienced as a unified composition. The A-Class is recyclable. Hartmut Sinkwitz" "Plastic Fantastic," in Permanent Change, Plastics in Architecture and Engineering, ed. Michael Bell and Craig Buckley.

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Permanent Change

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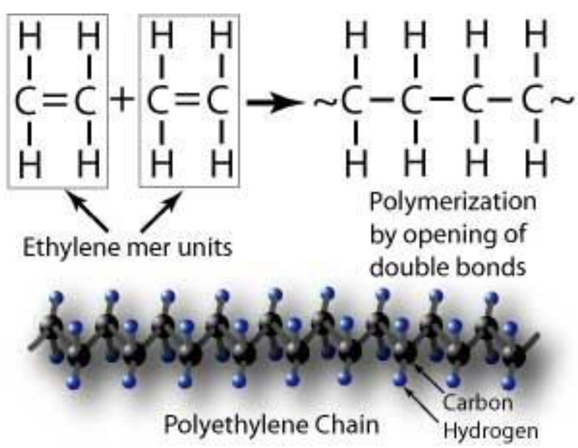


Part ONE

Plastic Form / Plastic Behavior / Plastic

In architecture and engineering the term *plastic* has historically referred to aspects of space and form--how building forms become virtually active, complex in shape and contour, or visually compelling and completed as form. In engineering *plastic* refers to a material's ability to sustain itself and recover at the limits of its elastic capability. Both aspects of the term are deeply historical if not ancient—they are fundamental aesthetic and technical aspects of architecture, engineering, and materials.

Yet during the second half of the nineteenth century, these broader artistic, cultural, and technical meanings of the term were essentially transformed if not fully replaced. *Plastic* literally came to mean a new and engineered synthetic material rather than the aesthetic or technical attributes of a material. Polymers dramatically affected the historic, i.e., "plastic" modeling of form, shape, and color but also garnered the technical capacity afforded by centralized research and development. They are simultaneously old and unprecedented: the hybridization of plastic as quality and as engineered material conflates experience and material science, leaving both terms inadequate to describe their social meaning and potential. The advent of polymers and the one hundred-year evolution of the chemical engineering of polymers prior to the 1950s met with a mid-twentieth-century strain of commercial mass media, mass production, and social upheaval that today is quasi-historical but also still evolving and shaping both culture and production. Polymers are everywhere in construction, but they are not yet evident in architecture in ways that were prophesized by critics and practitioners well into the 1950s.

What is the state of plastics as both a broader term and also as the more specific strains of polymers that are embedded in building today, and how do the current manifestations relate to the waves of promise that drove much of our last century's fascination with the material? Are plastics the first material for which it is possible to claim that material precedes concept?

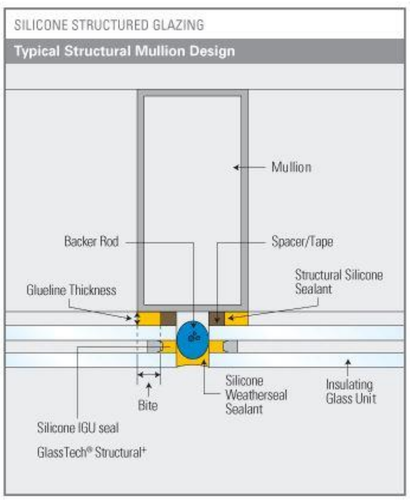
Architectural Plastic: All or Nothing

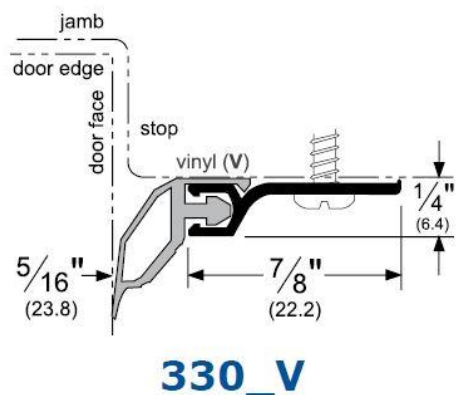
In the mid-1950s the promise of plastics took on a utopian guise but also often they assumed a full-fledged image of total design. Plastics heralded an era of synthetic and ultimately engineered design whose semiotic image and form at times seemed to betray the flexibility and dexterity that plastics represented at a chemical level. If the image of the fifties utopian house of the future at times became unilateral and effectively closed (literally as a hardened surface and social image) even as it was first envisioned to signify the torrents of heterogeneous practices that were beneath society, how do we today approach plastics? What newly engineered materials and forms of practice do we find operating in architecture of change, fusing differences or harvesting potentials? Plastics are agents in an era of harvesting energy or recovering lost energy, convening as a new means of cross-fertilization to conflate disciplines. Here plastics add a particular value—one of a range of newly liquid materials in the fields of design and engineering. The architectural value is still evident, yet the overall role of plastics as a semiotic icon—a signifier of change and simultaneously a comprehensive solution—has been replaced by a wider sense of plastics as the nomenclature of engineered environments, which today includes all building materials.

The Monsanto House of the Future, Disneyland (1967-67): Fiberglas House: MIT, Disney, and Monsanto.

Like the Monsanto House of the Future, other 1950s and 1960s iconic images of plastic architecture had a corollary in the far more pervasive yet also non-figural uses of plastics in plumbing, electrical wiring, and waterproofing. If this was a functional vs. aesthetic divide that some saw in advance, it seems to have also cast the project of a plastic architecture—a figural plastic/plasticity—into a kind of nostalgic kitsch approached as a signal of a nascent but unrealized former future: that is, we approach plastics in a way that is inhabited by the former vision of the material as a harbinger of the change and in doing so miss a closer look at what made the material radical in the first place. The House of the Future seems to be received today as a figural as well as material prophecy come undone before it even began—a trajectory that lost ground in light of other imperatives. In its place, we have realized a world of plastic versions of previous building components—vinyl-clad wood windows, vinyl wood siding, et cetera—now employed in ways that sustain former vernaculars (histories rather than futures), simultaneously casting our gaze forward *materially* and backward *formally*.

There seems to be little overt proclamations for a plastic architecture today even as the capacity of plastics is present in a wide body of practices. Polymers such as vinyl are increasingly called upon to abet an array of design strategies and are intrinsic to both experimental as well as commodity driven practices. The deep and pervasive use of polymers in building mechanics and discrete systems—from paint and coatings to wire casing, plumbing, windows, and siding—seems to continually reveal a divide where plastics migrate to pragmatic architectural functions rather than expressive proposals of form or shape. As opposed to being the manifest strategy of both meaning and form, as in the House of the Future, plastics often are called on to enclose uses and needs in airtight containers.





Permanent Change describes futures where the malleability of polymers allows one to alter their chemical structure after production; that is, to reengineer polymers by either returning them to their original atomic origins or remapping their molecular makeup and rerouting their postconsumer uses and thus environmental impact. Similarly the authors examine how polymers gain structural capacity—strength—and are shaped by way of initial thermal processes. Exhibiting properties of entropy prior to the application of heat, *thermoplastics* can be heated, shaped, and then melted again to be re-formed. Thermosetting of polymers induces molecular cross-linking; once formed the molecular structure becomes permanent, giving the material strength but it cannot be reshaped after its initial formation. The thermosetting and its inherent cross-linking effectively block the flow of one molecule past another, thwarting potential reuses or reengineering capabilities. Plastics have far more specific limits in terms of post-production re-shaping than broadly assumed and this has limited the theorization of the meaning and capacity in design. Plastics have promised a unique relationship to history, altering the life span of building components, but also engaging with other materials in ways that alter otherwise known architectural/engineering assemblies such as a curtain wall: polymer gaskets and silicone; pull insulated glazing units inward reversing years of curtain walls as mechanical assemblies. Today an IGU is chemically pulled inward rather than a mid-century assembly within which a plate of glass is mechanically pushed in. Likewise metals sustained by polymers in acrylic paints; or dramatically less parts in overall assemblies; polymers have altered the relationships of given materials and thereby re-engendered their properties and architectural meaning.

Materials Based Studio

A new direction in Architectural Material: Can we re-link infrastructure and architecture with material as a basis.

Columbia University's Graduate School of Architecture, Planning and Preservation (GSAPP) has been exploring the shifting boundaries between materials science, engineering and design in the realm of public dialogue through its annual *Columbia Conference on Architecture, Engineering and Materials*. In these conferences and associated publications the school has been exploring the contours of practice today. Building upon these conferences and their publications, we hope to move the conversation from the public realm into the design studio, directly engaging our partners and GSAPP faculty in a pilot program aimed at exploring the new structural and spatial aspects of otherwise known materials. The goal is to bring this work into the world in new ways.

Since the launch of the *Columbia Conference on Architecture, Engineering and Materials* at Columbia University in 2007 followed by the introduction of the *Materials-Based Design Studios*, the issues of infrastructure and housing and the technical potentials surrounding issues of energy, materials and urban design have all rapidly changed. During the past five years, it has become clear that the United States faces a critical need for new housing models that not only call for higher density and greater efficiency but also that are linked to new forms of transportation and community.

Infrastructural investment in United States cities has increased in the wake of the financial crisis of 2008, but these investments have not been seen as comprehensive; meaning, they have not been seen to instigate new forms of urban design or new forms of housing. In cities where mass transit is not readily available or planned, the future of housing means that cities must try to create newly dense zones of development that are to become urban in scale—that is, that provide an array of services and programming in some form of development that is both large enough to be diverse in programming but also of a scale that can be enacted by a small city with limited resources. Many United States cities face this scenario, and while mass transit is needed it is not always available in the near term. Advancing the work initiated in the conference, book and film project "Solid States," the Materials-Based Design Studio with support from the Lafarge Group will demonstrate how new investment in infrastructure can serve as the impetus and financial substrate for a new vision of the U.S. suburb.

Research supported by Lafarge Group and situated within the wider network of its partners who work in infrastructure materials will focus on the need in the United States for affordable housing and in particular the potential relation of housing to infrastructure where mass transit is lacking. The studio research and design focus will propose new alternative forms of housing that are integrated into new infrastructure investment in ways that fuse the financial and formal aspects of housing and infrastructure; they will propose a new form of urban living and transportation that takes infrastructure and the significant public investment and ownership of infrastructure as its basis.

Project Structure and Activities

The *MDS* breaks down the traditional model of studio education in which 12 students are guided by a single studio teacher for 12 weeks. The intense focus on materials calls for the expansion of the research and teaching team to include structural and mechanical engineers and materials scientists to bring the work to a higher level of technical achievement. The fall 2013 publication *Permanent Change* and the conference of the same name, sponsored by the Vinyl Institute, will serve as a key component of the studio research library.

Travel

MDS students and faculty will travel *to California where the massive investments in infrastructure have yielded little in terms of overall quality of the urban environment despite the immense sophistication of the engineering efforts.* The Vinyl Institute MDS travel will take us to the industrial and residential regions of California and focus on the Silicon Valley and its relation to urban planning and development. The site in this region serves as an indicator of how United States investment in infrastructure (from freeways to water supply) often is immense but is virtually un-coordinated and thus poorly situated to offer efficiency in new development. It essentially does very little to actually support housing. Mobility and housing account for a tremendous amount of household income today, and the California site is a key zone where new design is urgently needed. Housing in this case links to issues of transit, energy—to urban planning—but in our case to new forms of materials science and a close scrutiny of material innovations.

The Vinyl Institute will help frame research around material (piping, electrical supply, roofing, windows, etc.) but also uses of polymers as a wider substrate for building. The studio will be taught with the support of engineers that bring specific capability and also two advanced modeling experts who will assist with structural and material modeling.

Resilient Planning and Architecture relies on Material Innovation:

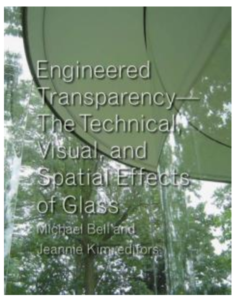
Led by Professor Michael Bell, with Zachary Kostura, Brian Lee, and Hyon Woo Chung, this work will tie in with Bell's research and design for the 2012 Museum of Modern Art exhibition "Foreclosed: Rehousing the American Dream." During this project, Bell has lead a research team of engineers, social scientists, and real estate developers in studying how Tampa and its small neighboring city of Temple Terrace can provide new housing models to a constituency that is still reliant on cars for travel and mobility at large but who increasingly realize the need for creating dense walking areas of the city to diminish the costs of mobility and of cooling private dwellings.

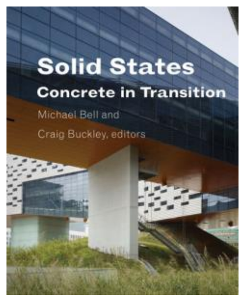
With access to this work by Bell and his team, the studio will initially focus its faculty and student research and design on sites proposed in the "Foreclosed" exhibition and then take on a site that adds to the breadth of the MoMA research by studying the Houston area and, specifically, the Houston shipping channel. Texas was not included in the MoMA study, and our work will add an important urban region to the scope of the museum's project.

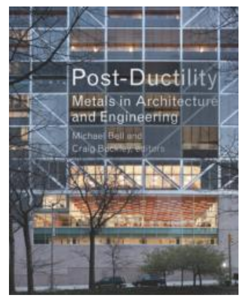
Critics: Parallel Engagement

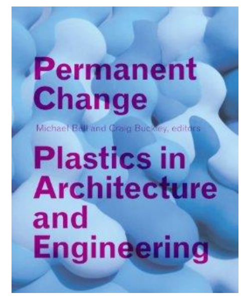
Historically, the architect and the engineer often worked in sequence, but today architects, engineers and a wide range of technical consultants often work with near simultaneous and immediate engagement and each affects the other at fundamental levels. More so, new levels of engagement in materials science and environmental engineering move the foundations of design and innovation to a technical level that dramatically changes the horizon for both practice and education, instigating a change in how industry, practice and academia engage each other.

Michael Bell is a Professor of Architecture at Columbia University and chairs the Columbia Conference on Architecture, Engineering and Materials. Bell's design work has been exhibited at the Museum of Modern Art, New York; The Venice Biennale; The Yale School of Architecture; The University Art Museum, Berkeley; and at Arci-Lab, France. Bell has received four Progressive Architecture Awards, and work is also included in the collection of the San Francisco Museum of Modern Art. Books by Bell include Engineered Transparency; Solid States, Post Ductility (all volumes on the Columbia Conference on Architecture, Engineering and Materials); as well as 16 Houses: Designing the Public's Private House, Michael Bell: Space Replaces Us: Essays and Projects on the City, and Slow Space. Bell has taught at Berkeley, Rice, Michigan and Harvard. His 2008 Binocular House is included Kenneth Frampton's American Masterwork Houses.









Zachary Kostura is a practicing structural engineer with Arup, a global multidisciplinary engineering firm, and has worked on the design of high-rise buildings in Europe and the Middle East. He specializes in structures with unique geometry that involves detailed computational analysis. A graduate engineer of the department of Civil and Environmental Engineering at the Massachusetts Institute of Technology, Zak has broad experience with many aspects of building design including architecture, civil and structural engineering and sustainability. Kostura teaches at Columbia GSAPP and has taught with Michael Bell in founding the MDS.

Brian J. Lee is a graduate of Columbia GSAPP, Master of Architecture Program and the founder of Para Clocks

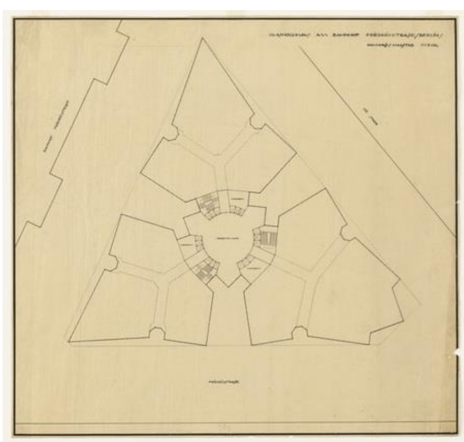
Hyon Woo Chung is a graduate of Columbia GSAPP, ADD program, and SCI-ARC.

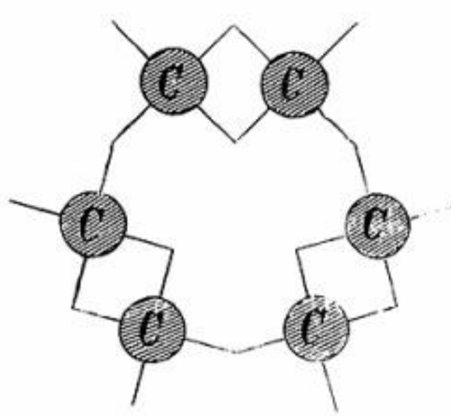
Is there a chemical era in architecture?

Below is an outline of the studio goals in regard to a specific site and United States economic region but in the widest sense we would seek to explore the resiliency of plastics and to unpack the vinyl, polymers and other engineered materials that are laced into contemporary building. We see this as a "chemical economy" and one that could add stability if allowed to flourish as more than an enabling sub-structure for architecture and thus for economy.

Theory: Is there a material era and does it have a chemical substrate that moves through the very economy and geography or a time: Sanford Kwinter has written of Mies as not only aware of the discovery of the Benzene Ring but also ultimately affected by the eras increasing capability in chemical engineering and its affects at all levels of society and political consequence. Mies use of steel and glass in this regard becomes coincident with the rise of ceramics and other engineered materials but also their application into infrastructure at all levels.

"With Kekulé chemistry became architecture, (or at the very least, applied geometry) and a whole new branch of science –stereochemistry – opened up. " Sanford Kwinter, "Mies and Movement: Military Logistics and Molecular Regimes," in *The Presence of Mies*, edited by Detlef Mertins, Princeton Architectural Press, page 89.





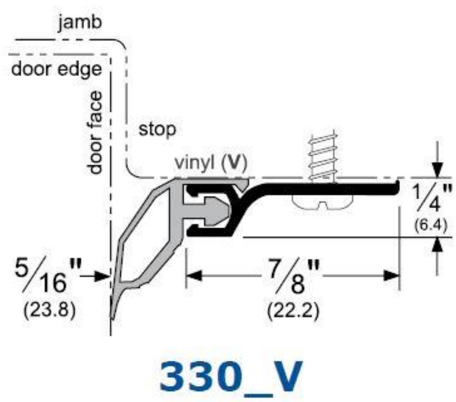
1921: Ludwig Mies van der Rohe

1921: Friedrichstrasse Skyscraper Project, Berlin-Mitte, Germany, Typical floor plan

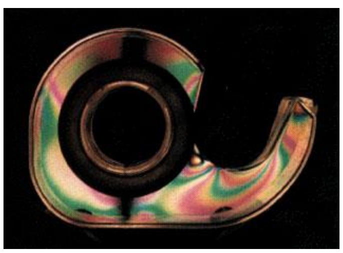
1857: A representation of the benzene ring from Kekulé's *Lehrbuch der organischen Chemie* (1861–1867). CHF Collections.

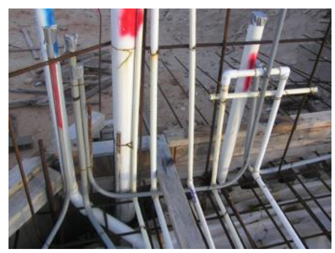
How do we re-invent these paths?

Plastic: Millions of gaskets cure poor construction



Plastic: Intricate Engineering hidden in commodity and trades





Utility, Structure, Material, Ergonometric = Non-Descript and Un-Noticed.
Metal vs. Polymer Bathroom Hardware: Mirroring
Hidden but ubiquitous vinyl, polymers, plastics

Plastic: Iconographic Commodities verified by history?

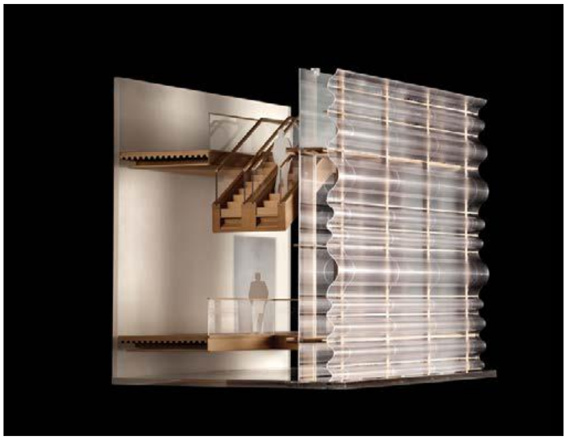
Gradient, Change and Flow? Geometry needs a material?

Today plastic has often been cast the material of flow; and indeed re-allocated as a material of choice in a generation who designed within the calculus of animation software; within splines that have the logics of flow;

But plastics were also the material choice for an era of linguistics and semiotics.

Above: Icon vs. Camouflage: Plastics invoke both semiotic and iconographic images but also technical aspects of flow and change. Michael Graves' telephone seems codified as Art Deco while Greg Lynn's Predator (with Fabian Marcacio) instead is dematerialized into field of camouflage. Lynn goes so far as to take iconographic toys and reveal in them the complex geometry of calculus—splines and abstract forms.

Plastic: Integral color, translucency and effects.



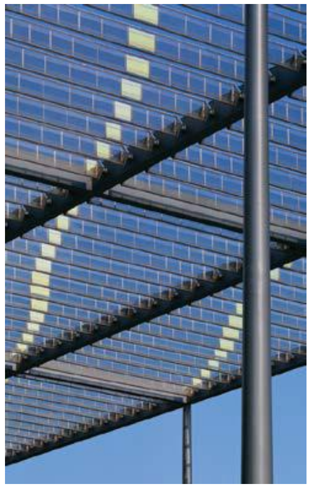

The designer makes use of a material quality and its capacity as line; one material as structure, surface, depth….

Left: The Light Pavilion

Right: Illuminated balconies, paths, and stairs, Light Pavilion by Lebbeus Woods with Christoph a. Kumpusch, in the Raffles City complex by Steven Holl Architects, Chengdu, China, 2012


LightShower by Yoshiko Sato and Michael Morris, Morris Sato Studio*LightShowers* extended these luminous, aquatic, and meditative themes from the Museum Gallery into the trade show hall environment through the design of a free standing Pavilion to envelope the interior platform installation. The forms, shapes, and colors of the Pavilion design were inspired by studies of water in various states—from solid ice to liquid to vapor. After extensive light and material studies, a CNC routed mold was created to thermoform individual sheets of stock-size Corian Illumination Series to their maximum physical limits as wall panels.

Plastic: Composites and new structural capacity.



"Contemporary engineering is constantly seeking to extend its palette beyond traditional materials, driven by a desire in architecture for irregular shapes, increased lightness and transparency, and surfaces with novel tactile qualities. There have certainly been technological advancements over the decades related to concrete, metal, and wood, but there are things that even those materials cannot do. Plastics—especially fiber-reinforced plastics—hold the promise of expanding the palette and pushing the envelope of material possibility."

Plastics as Structural Materials by Werner Sobek with Wolfgang Sundermann and Martin Synold

North Sails: expectant form will react to wind harvesting its energy.

"By carefully configuring the constitution of each layer, sail designers can prescribe the mechanical properties of the resulting composite. Since material is placed on an as-needed basis, it becomes possible to produce a lighter and more efficient structure for a given application." North Sails Three-Dimensional Laminates by Bill Pearson

Plastic: Plastic form from non-plastic materials

Plastic form and continuous change: Architectural manifestation formed by planar cuts. The energy to produce this work is expended and now suspended within the work.

"As we negotiate the current adaptation of the plastic arts within an age of now digital hyper-production, at issue once again is the base condition of the plastic arts in respect to technical change: plastik as a conceptual as well as physical materiality is the very process of its instantiation-into-being." Die Plastik by Mark Goulthorpe

Plastic: Plastic form from non-plastic materials

Beyond recycling is the re-engineering of molecules; breaking them back into their constituent atoms. What then of an economy that is not based on a massification of oil based products.

"Chemical recycling could be part of an overall resource management program if there was a desire to keep materials out of landfills or incinerators—a variation on the "cradle-to-cradle" concept espoused by the architect William McDonough. It could be used to recover materials landfilled previously, or, as mentioned earlier, to recover difficult-to-recycle materials such as mixed waste or thermosets."

"But recycling carbon in this way also points to a less obvious fact. For all the discussion of "running out of" petrochemical resources such as oil and gas, it should be recognized that carbon is an abundant chemical element in the Earth's environment. Use and reuse of carbon as a raw material, given an abundant non-fossil-based source of energy such as solar, nuclear, or geothermal, is a sustainable strategy for the twenty-first century. Consider that all the strategies involved in fuel cells or the hydrogen economy involve intensive use of very rare metals such as platinum. There may not be a sufficient abundance of platinum upon which an energy economy can be based. Even the so-called rare earth elements, while significantly more abundant than platinum-like metals, are substantially less abundant than carbon. Nature recycles carbon, and as a result, it is difficult to imagine running out of it. If we can make the energy investment make sense, we should think about it as well." Recycling to First Principles: Back to Atoms, by William F. Carroll, Jr.

"Synthetic nature appears to be in diametric opposition to the natural: economically, politically, ecologically, and capitalistically. In the twentieth century, the oil versus hemp battle resulted in a complete eradication of hemp and a domination of oil, including the control of the means of extraction, of the science at the base of the transformation, and of the global market, with the infrastructure of the United States serving as a vector of dissemination and massification" The Song of S(t)yrene, by Francois Roche

Materials-Based Design Studio IV

The studio will consist of an analysis and design phase. The first phase will unload the history, chemistry, and economies from the molecular scale of polymers to the urban scale of cities like Cupertino; and will include development of structural and climate analysis tools. The second phase will develop a design that identifies and realizes new potentials of these suspended ideas.

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1. Analysis Phase: Concepts and Economies of Plastics

"Plastic has generated more conversation and less precision than perhaps any other word used in architectural discourse to the extent that it now seems both tiresome and tired. Producing more than just the ennui caused by the constant repetition of buzzwords, plastic itself seems to be exhausted by the balancing act the word has been forced to perform since antiquity, when it was placed atop a crevasse between concept and material." Sylvia Lavin, "Neither: Plastic as Concept, Plastic as Material'" in *Permanent Change, Plastics in Architecture and Engineering*, ed. Michael Bell and Craig Buckley.

Structure and Energy

Choose a realm of plastics and its embodiment in a commodity item as listed below. With the resources of the writers in Permanent Change begin to both literally dissect the item and its material but also locate within its broader economic site and financial geography. Also review the lines of research in the studio syllabus as a starting point.

Choose one of the following as the basis for an analysis of plastic today:

- *Chemical House: outline the role of plastics in a Silicon Valley spec house.*
- *Cupertino Grocery Store: outline the role of polymers of a retail grocery store*
- *Mercedes Benz dashboard: outline the role of polymers in a high-end automobile.*
- *Mac II CI / Frog Design: describe the role of polymers in an early Mac as deigned by Frog Design*
- *Art Center: Any shape at all*
- *Toyota Celica: Circa 1973, the Celica used extensive plastic modeling to form a cock-pit environment for a low cost car.*
- *Back to Atoms: un-building molecules: show how a polymer can be de-engineered and returned to its original atoms*
- *Branch Bank: The ATM: show the use of polymers in a bank or ATM*
- *7-11 (Oh Thank Heaven): make evident the role of polymers in a convenience store*
- *Sony, Apple, Krups: how did these companies alter the use of plastics in industrial design*
- *Tupperware, Freshness: plastics in food preservation*
- *Anderson Windows: the commodity window made with vinyl casing*
- *Pemco: Gaskets: the ubiquitous gaskets and the role of polymers.*

2. Design Phase: Program and Realization

Transportation and Housing fusion: Developing a small fusion of architecture and infrastructure in which the role of plastics are not only essential but also create new potential from already present materials.

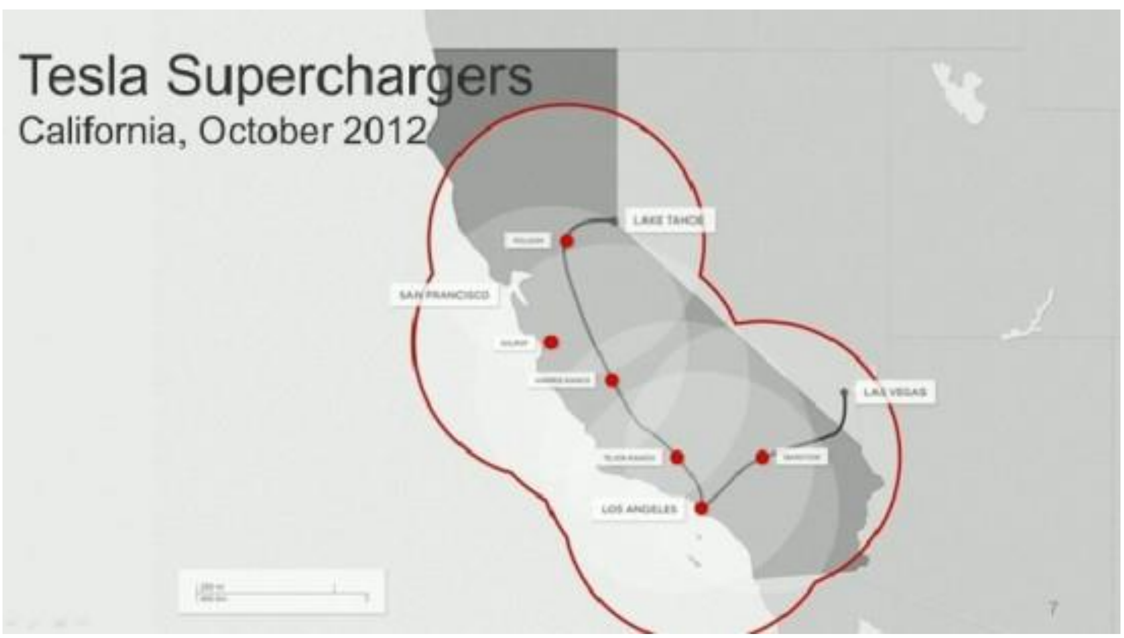
Your design work should focus on both a tectonic scale (structure and materials) in parallel with the scales implied by the concepts and economy of plastics.

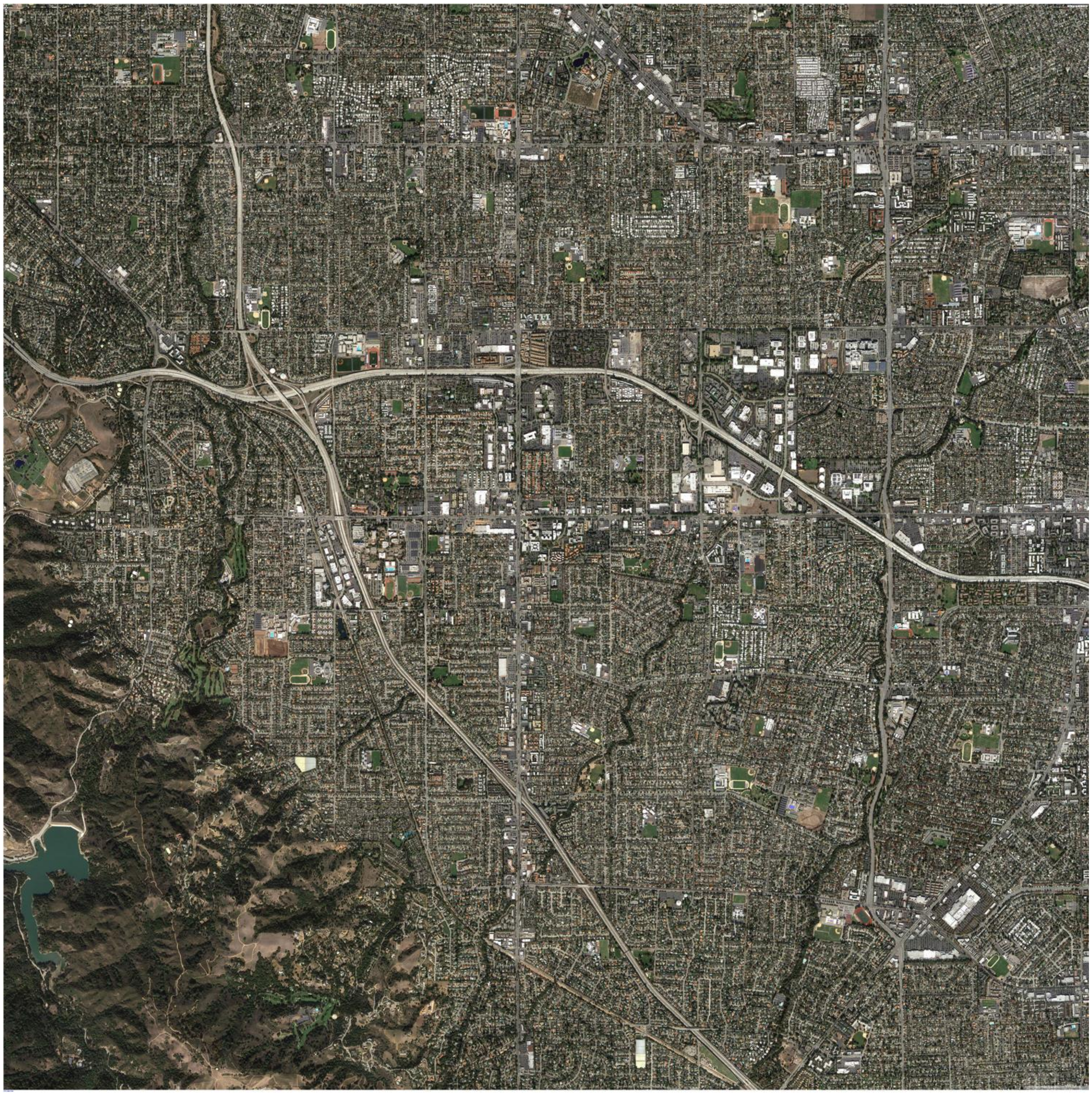
An example of the sought after scale:

A. **Tesla and the Electric Car: a Super Charger Station**.

B. **Replace the Valco Mall** with a series of new distributed forms of Amazon retail; instead of bricks and mortar plastic and chemicals.

C. **A Silicon Valley transit system** that is both of the network and of specific place to be/live





Cupertino, California

Part TWO

Near - Infrastructural Architecture: *Silicon Valley: As Apple undertakes a new corporate campus of infrastructural scale what are the parallel implications for areas of Cupertino adjacent to the campus? Is there a compensatory vision for architectural work in the program of housing, retail, government and public space?*

With the design of the Apple Campus 2 can we say that Silicon Valley is undertaking the realization of an architectural identity? An anti-garage aesthetic that severs the Valley's access to the HP Garage and the legend of improvisational workspace architecture-less industry? Has one of the world's most entrepreneurial (and still technologically and financially evolving) regions resisted having an architectural identity or is this a natural evolution as an industry matures? The Campus is set in stark contrast to the city of Cupertino; while providing a wealth of services for employees it is apart from the Valley: a parking garage is planned to receive as many as 10,000 cars daily. Parking is still an overt threshold between work and domestic life yet the campus evokes a pastoral realm mixing an organic landscape and a high-tech R+D center. How does the separation of living and working space in most American cities, but in particular in Silicon Valley, help or deter the productivity and the overall capacities of an industry that is based on innovation and ever increasing modes of efficiency? Our studio will explore the future of housing and workspaces in Silicon Valley as its maturation as a city and economic powerhouse reaches a new level of promise. The Apple Campus 2 is a near-infrastructural work of architecture: it assumes a role that cities are expected to provide; parks, recreation, restaurants, day-care, gyms. Are their implications for new urban development adjacent to the new campus? What are its implications for the Valley and for architectural manifestation of near-infrastructural dimension on other aspects of urban programming?

Our work is specific to United States at a time when changes in energy costs have instigated an inevitable rise in housing density and its proximity to mass transportation, creating a critical moment to explore the potentials of smart boulevards but also how energy services are shared, and delivered The mass production and density issues of housing in the U.S. are being reassessed in light of energy for both transportation and building performance, which could change housing paradigms that have been in place for sixty years.

Staging Architecture's Disappearance:. Today major works of architecture and planning are often required to be virtually invisible; to be both visionary yet also disappear? Yet at midcentury in Europe there seemed to be little apprehension about the scalar qualities of architecture or its social ambitions: architecture seemed to become near infrastructure. The studio will study infrastructural scale works of architecture and urbanism in Germany at midcentury and explore what new options exist to again imagine works that fuse the two scales **Apple Campus 2**, Cupertino. Proposal: Foster Partners, Arup, Olin

Giving Form to a Still New Industry

Apple's new headquarters is virtually the same size as the Pentagon—in square footage and diameter. Surely there is a message. More surprising though is the sense that a company as globally influential as Apple could fit in such a small amount of space. The Pentagon has countless bases and controls half the airspace and desert in the United States. Apple assembles its products in China but regardless of how far you'd have to go to begin to understand the command and control aspects of the Pentagon (and how they materialize as space) or Apple, the overtness of the new Apple headquarters seems disconcerting.

There has been an anti-formalization of the Silicon Valley office park; the suburban origins of the Valley have been a-formal and much of what the Valley has produced from transistors, software and even computer hardware has been largely without figure (Apple is the notable exception). That lack of urban or architectural shape or coherent form has been in large part of what drove the valley: electronics and radio/satellites re-connected the evacuated spaces of the post 60's sprawl. To be <u>in</u> the Valley was to be a pioneer, amidst a modern day frontier.

Apple's iconic new offices have largely been presented without discussing Norman Foster as the architect (or Arup and the Olin Partnership as partners), and for a time many assumed Apple designed the building in-house—that it was a large form of industrial design. But somewhere in all of this it seems both right to engage an architect of Foster's stature but hard to imagine anyone's signature or identity being easily part of the Apple precinct. It seems to put a target on Apple and reveal their outsized influence against what is still a relatively small size—Foster gives them presence and makes them a visible.

Silicon Valley companies have long held enormous value against physical assets: General Motors' real estate holdings vs. Microsoft's were an example often taken as Microsoft rose. Microsoft held a tiny fraction of the real estate of G.M. and as such it was often stated that the new digital wealth and power of companies like Microsoft would not command the same revelations in architecture or real estate. The digital alleviated the burden of architectural expression and it left architecture perhaps chasing the wave of the network; forgoing its own self search for an identity and instead seeking a future in collaborations and forms of network management of construction; of design.

But Apple new Campus (one building really as a campus) does invoke the figure of the Pentagon in that it has made it headquarters so vividly iconic even as it reveals it to be almost petit—you cannot help but think about the new torus shaped offices in contraposition and scale to the Foxconn campus. It not a flattering image, but at the same time it's a signifier of the intellectual capital arguments that have often underlined how the faith that the U.S. would support itself without manufacturing—by controlling intellectual capital rather than manufacturing.

Putting any ethics of labor practices aside the Apple headquarters seems a harbinger of how unable the U.S. has been able to create the sorts of jobs Apple does embody. We do not have enough Apple's—compare this to the depth or research that reveal deep concern over a nation of retail jobs and low-level service wages. There is no doubt we need great new work spaces....but they inevitably cast a light on the other spaces outside the loop. What is outside of the network; what is outside the Valley and what is outside the high paid jobs at Apple.

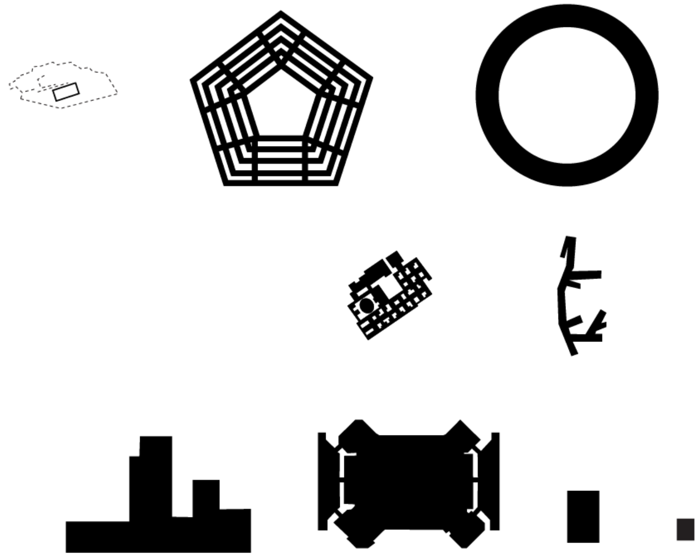
This site is right next door: The Valley is diverse economically and the Bay Area despite its wealth and success as an intellectual center is also rife with a crisis of affordability that places stress on households who struggle to afford housing in an area defined by the rapid rise of wealth.

Is there a parallel project that would give shape and a similar ambition to the Apple Campus 2 — for housing, for retail and government?

A realization in architectural and near-infrastructural terms that would as boldly project a new way to address old problems.

The Apple Campus is a place to work; its garages hold as many as 10,000 cars. The segregation of work and domestic space is intact and the role of the automobile and the commute has not been addressed here. Our studio will focus on the immediately adjacent site and seek a means to address what the Apple Campus leaves out: the rest of the worker's lives…..

Architecture Scale: When is a building larger then architecture?



Left to Right / Top to Bottom

The Acropolis	575,000 sq-ft	
The Pentagon	3.1M sq-ft	4 floors
Apple Campus 2	3.1M sq-ft	4 floors
Freie Universität	1.7M sq-ft	3-4 floors
Vanke Center	1.3M sq-ft	5 floors
Mall, Temple Terrace, FL	1.5M sq-ft	3-4 floors
Mall of America	4.2M sq-ft	4 floors
Centre Pompidou	1.1M sq-ft	7 Floors
Supermarket, Florida	50,000 sq-ft	1 floor

The Architecture-Less Origins of the Silicon Valley: the HP Garage

Text source: Wikipedia: "The HP Garage is a private museum where the company Hewlett-Packard (HP) was founded. It is located at 367 Addison Avenue in Palo Alto, California. It is considered to be the "Birthplace of Silicon Valley". It is a designated California historic landmark and is listed on the National Register of Historic Places. In 1939 Hewlett and Packard formed their partnership, with a coin toss creating the name Hewlett-Packard. Hewlett-Packard's first product, built in the garage, was an audio oscillator, the HP200A. One of Hewlett-Packard's first customers was Walt Disney Studios, which purchased eight oscillators to test and certify the sound systems in theaters that were going to run the first major film released in stereophonic sound, Fantasia."

Architecture or Infrastructure

The cleft between architecture and infrastructure in the United States has long meant that the deep resources of the public sector invested in infrastructure have rarely affected architectural design in any significant way. Housing, retail, commercial spaces—that is, building—is almost universally an adjunct of infrastructure and segregate from its means, methods or materials.

It is the financial segregation that seems today to be urgently in need of change: the public invests immense sums in its infrastructure, collectively owning roads, rights of way, materials and productive instruments that often bear little value on architecture and that are in essence under-utilized. Surely roads are full, and traffic congestion is the standing crisis of forty years, but there are also vast amounts of the built environment that were funded and constructed at immense sums that today are often dormant. Space beside, above or next to infrastructure often stands empty foregoing the ability of infrastructure to bear and sustain new architectural and development even as this capacity is immense.

Whole categories of architectural and urban theory have emerged to address these spaces in the past half century: from Ignasi de Solà-Morales theories on “terrain vague” to newly pragmatic forms of operational efficiency or performance we has seen these spaces as valuable because they are both less or more productive. Useless or useful.

Today, the large scale urban project faces a social and political (if not practical) divide: the segregation of public and private funds, spaces and protocols of architecture vs. infrastructure makes the large scale project almost impossible even as immense scales of investment are made. Forming a parallel city of everyday life that is latent with capacities but often devoid of development. It is a segregate world of two types of spending: trillions of dollars produces myriad infrastructures that in their simultaneous but divided means stand apart from architecture and its often urban ambitions. Infrastructure and architecture are separate legal and spatial entities.

What is possible if you begin to fuse the capacities of infrastructure and architecture?

Affordable Housing: Far Rockaway, NYC: Pre-Cast Concrete, 1972 / Steel Studs and Vinyl Siding, 2003

The Apple Campus 2 in many ways internalizes aspects of urban planning that were the precinct of government. For example: It will provide its own power sources, provide parks, exercise, and restaurants as well as a corporate theatre for product announcements. What happens to housing or living spaces as work spaces take on aspects of urban life? What happens to the legal or financial terms of housing but more importantly terms such as affordable housing and their specific local as well as national meaning? The campus itself promises to replace a maze of buildings with a unified new single building.

Part THREE
On Affordable Housing

In the United States affordable housing is increasingly capitalized as a hybrid of public and private monies; the studio will explore how these program have evolved and how architecture has been engaged in the process of designing and building housing. The Cupertino Area faces a difficult challenge in providing housing at reasonable prices, yet also has the enviable position of a deeply successful economy and a place in the emerging global economy. The Apple Campus 2 is a privately developed R+D lab and a corporate office for the world's most valuable company. Housing is rarely if ever developed with access to the financial resources and streamlined visioning process possible in a private company. Housing is instead almost universally achieved within economic and social goals that are incentivized by government. Our travel to Cupertino will seek advice and input on how the city works between the fiscal capabilities of private companies and government.

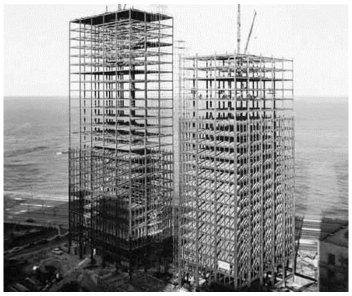
Section 42 of the United States Internal Revenue Service's tax code was designed at its outset in 1982 to be a source of innovation; an incentive to abet an entrepreneurial aspect of the affordable housing development industry. Low-Income Housing Tax Credits—the LIHTC program—quickly became the main source of capital for affordable housing; federal housing plans for affordability were not only constituted by deferred rather than direct revenue but also by incentives for developers that were intended to both spur housing creation but also free up capacity for creativity. Yet, since their inception we have seen architecture and design take on more traditional appearances. The construction of affordable housing, has taken on market rate techniques. Housing questions and in particular low income or Public Housing issues have been cast into hardened political positions since the inception of the public housing in the 1930's but today whether the one makes an argument from the left or the right, housing and the actual development means are largely adjudicated via market factors. That is, affordable or public housing is architecturally built in the same manner as market rate housing. Affordable housing as a derivative of tax credits, multi-tiered funding sources, and an architectural guise of "fitting in" with the quasi-vernacular of broader status quo developer housing models (and its constituency) has increasingly made it difficult to discuss the deeper meaning of either the political underpinnings of these policy shifts or the potential architectural and planning innovations they portend.

There are notable exceptions but in the widest sense architecture is simply not in the debate. Tax credits may subsidize capital investment in affordable housing but the final denominator is a normalizing housing development process; in short a process that has historically shown little incentive to innovation or experimentation. Affordable housing serves a constituency and addresses real need, but the social aspects of policy as economics are metered by a financial practice of real estate. The social aspects of economic policy are effectively narrowed by the financial aspects development. Architecture has pitched its goals against real estate a half a century; yet if it were to take part in realizing housing goals (of either a left or right agenda) it would need to gain some mode of access to the creative flow – the vitality- of what liberalized markets allow in virtually other capital intensive fields such as electronics, medicine, automobiles…and finance…

Affordable Housing for Seniors: What are the material and financial means to develop affordable housing today?

Part FOUR

Material or Labor


Mies Van Der Rohe: Lakeshore Drive, Chicago


Heinz Isler: Concrete Shell.

Steel or Concrete: Labor Efficiency vs. Material Efficiency

Our studio will work closely with environmental and structural engineering techniques. In seeking new potentials for architecture and infrastructure we will look closely at how labor, material and eventual form collaborate to produce the final work. Housing, roads, offices, parks will all be seen under a broader lens of materials, engineering and labor.

In the United States and in lower income work the segregation of trades, the pre-manufacture of material and components all seem to conspire to produce an architecture that reduces on-site labor and relies on mechanical assembly. Below Zachary Kostura suggests that despite the research and discovery of the means to more efficiently allocate materials we have instead turned towards a lower level of material so structural sophistication on favor of lower level and thereby less expensive labor.

[Text by Zachary Kostura]

A singular structural typology dominates our contemporary construction industry. In spite of the variety forms and programmatic uses that define our modern building stock, virtually all structures are, essentially, pure post-and-lintel systems. This system, like any other, is a composition of individual structural elements that work collectively to channel imposed environmental forces to the point of ultimate support. In a post-and-lintel system there are first posts, or columns, which act as major tributaries, or express lanes, for the transmission of this load. They are ideal for gravity loads as the most direct trajectory from such loads to the ground is a vertical line.

Lintels, or beams, allow for the ordered arrangement of posts by aggregating loads that are not coincident with these vertical elements and transferring them to the nearest straight shot to the ground. They do so in bending – a rotational resistance imposed by a horizontal element to a vertical force, yielding reactions at beam supports that are often though not necessarily vertical forces themselves.

The Uses of Tension

The broad use of post-and-lintel systems reveals a rather cavalier attitude to the use of tension – comprising half of the action of bending, and a force that could not be effectively developed by coincident elements within a structural system until the latter half of the 19th Century. Modern materials – particularly structural steel – permit the transfer of tension and, correspondingly bending, through and between lintels, posts, and other common structural elements.

The Minimal use of Material

The emergence of these new capabilities corresponded with a century-long sea change in building construction away from artisanal, bespoke fabrication toward industrial mass production and the exploitation of economies of scale. By developing a framework for unitized construction elements such as rolled wide-flange steel or reinforced concrete beams, the core characteristic of structural efficiency within the western world toggled from minimization of material use to ease of manifestation. This was further catalyzed by unionization of labor and substantially higher strength-to-weight ratios of structural materials.

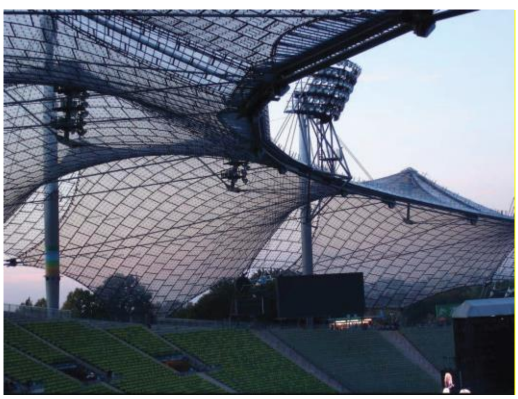
As a consequence, the pursuit of materialistically minimal structural forms, a pursuit begun before Abbott Suger and culminating during the lifetime of Antonio Gaudi, lost its fundamental drive. The development of structural forms with mathematically driven minimal material usage no longer corresponded with structural efficiency. Instead, the popular view of structural efficiency converged with the materially inefficient but process efficient Lego-block approach to construction embodied in the post-and-lintel system.

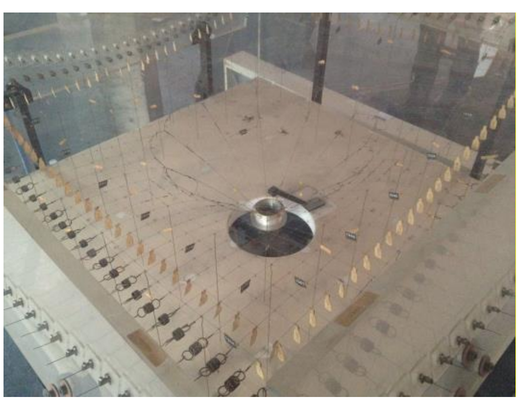
Today it is a necessary convenience to approach a structural element such as a beam as a singular, unitized object: a black-box within which the extent of our most detailed interest lies with the "big six" force types comprised of various types of axial, bending, and shear. However within each structural element is an intricate pattern of force flow on a scale analogous to the capillaries of a circulatory system, if the massive post elements represent an arterial scale.

Interrogated, this force flow reveals that the mathematically-driven minimalist forms developed before modern materials and processes are in fact alive and well at this microscopic scale. Within reinforced concrete beams we see tied arches.

The tools for interrogating this behavior include photo-elastic stress (analog) and finite element (digital) analysis. These techniques allow us to deconstruct driving force flow phenomena into principal tensile and compressive forces. The patterns they develop within a monolithic structure follow a narrow set of basic rules, and reveal geographic regions of true material efficiency (and inefficiency) within the monolith.

It is with this understanding of material efficiency that the structure can be further iterated upon. At the boundaries of our understanding of true structural efficiency, new digital construction and fabrication technologies offer the opportunity to again redefine this notion, as process efficiency can again be found within the development of bespoke components, if done intelligently and with a firm understanding of the process of fabricating and assembling structure.





Form Finding

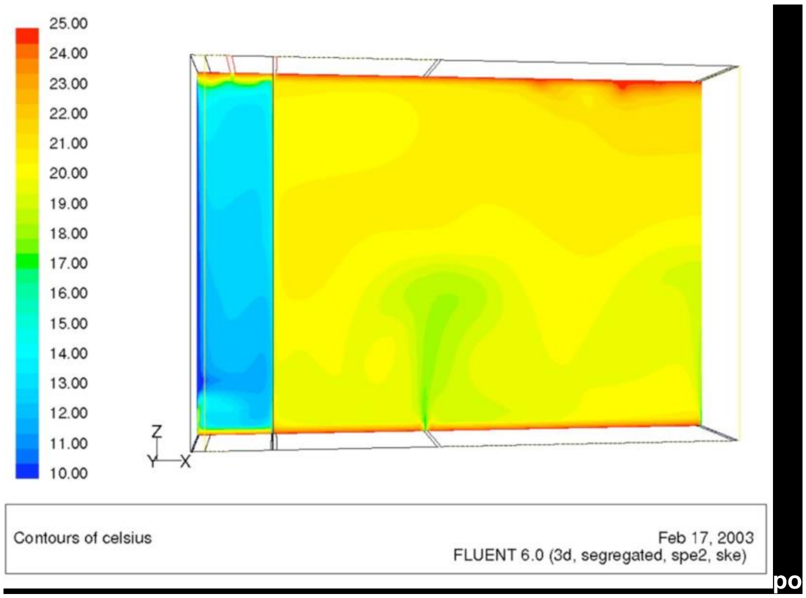
Frei Otto, Engineer, Munich Olympic Stadium (1972)

Fusion of architecture and infrastructure: efficiency and synthesis but also as an attempt to reconcile large scale social need with emerging ideals for design, materials and engineering. Fusion of engineering and architecture: driven by material and in particular uses of membranes, tension elements and then new means of coordination. Lightweight aspects of membrane polymers involving large tensile or grid-shell roofs over massive volumes were designed and constructed for one-off events – expos, Olympics, etc.. Our goal will be to consider the legacy of these projects on the surrounding areas they were designed for and see how they translate into new models for use in the US and our sites. They involve landscapes, utilities, environmental, circulation and are distinctly infrastructural.

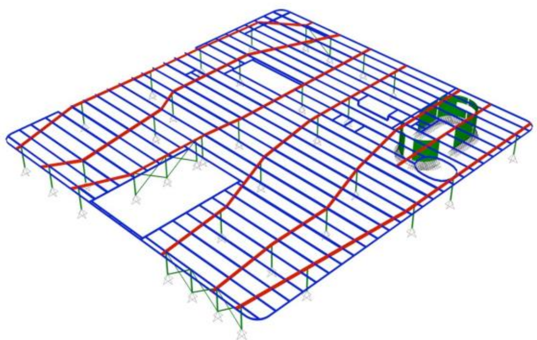
Part FIVE

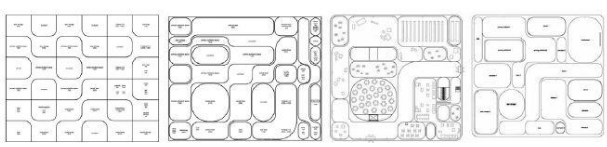
New Means of Form Finding and Coordination

Structural Engineering, Vision or Thermal Experience

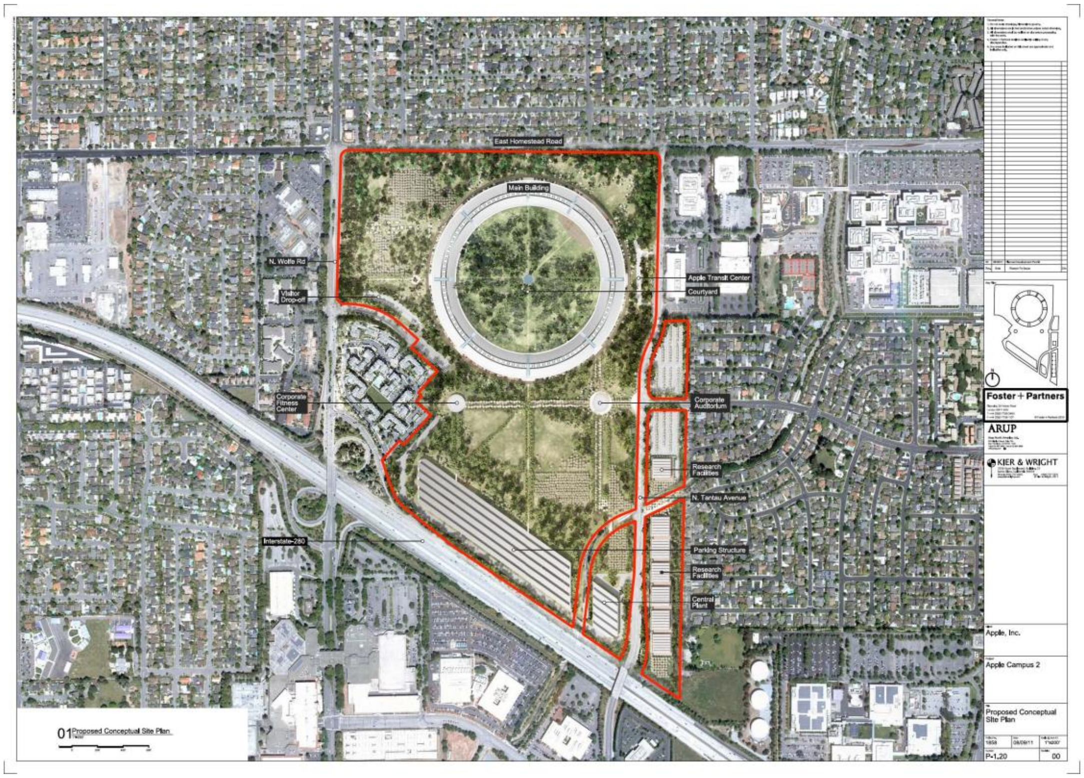


Environmental design/CFD Thermal Analysis (Provided by Transsolar, Stuttgart, Germany). Text by Transsolar edited by MB:
A solution with heat supply by radiation through the floor and ceiling surfaces, allows SANAA to temper the facade and buffer heat loss and gain without huge air flow rates. The heat supply by radiation heats the glass surfaces not by the air, but in a direct path. Therefore the air temperature in the cavity can be reduced to 12.5°C and with the only minimal reduced surface resistances, the heat losses through the facade drop to 180 W/m2 or by 40%. The inner surface temperatures facing the room keep the level of 15-25°C, out of the condensation range. Aside of the balance method the CFD evaluations confirmed the approach to reduce the air flow rate and instead use the radiant system. By factor four and with strong consequences for the size of the ducts, solving strong conflicts with the structural concept. As a side effect, the radiant heating system can be used in summer as a radiant cooling system, absorbing radiation before it heats the air and has to be removed by an air flow.

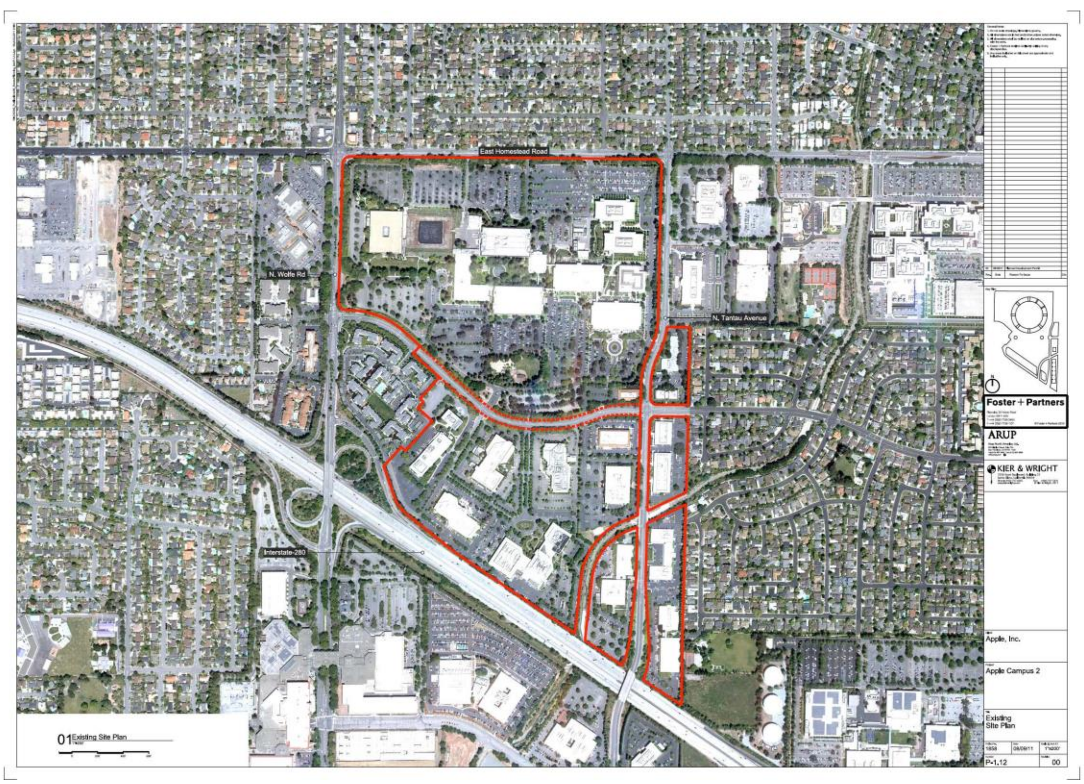


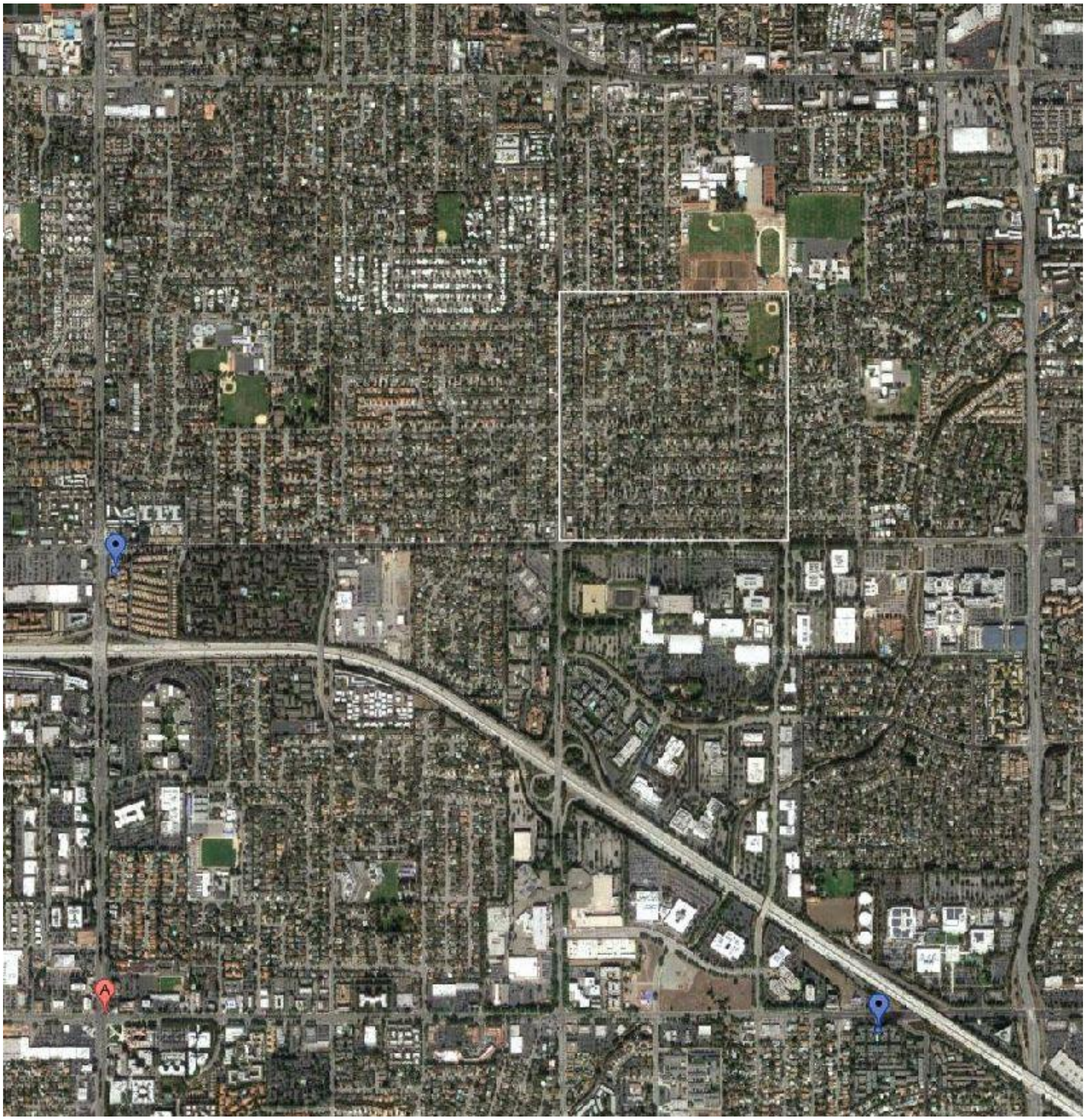


Brett Schneider; Guy Nordernson Associates: “The columns are located generally in the cavities between rooms (where possible) - locating the columns generally came after the design of the rooms (for the most effective functioning of those rooms). It was never clearly discussed, as such and early schemes show a much more regular arrangement, but the final location of the columns is not on any regular grid. This is important because there is no discernible pattern to their placement to be perceived, and thus they tend to disappear. I often refer to them as "hiding in plain sight." In addition, the columns have pins at their tops to allow rotation along the axis of the girders, so as to prevent the transmission of bending and allow the columns to be smaller, and the majority of the building’s lateral stiffness is in the exposed steel plate walls of the Lampworking Room (steel plate shear walls where flat and effective columns where the wall is curved) - another example of structure in plain sight that you might not easily recognize (even though you see its thickness clearly where the window is inset into it). The coordination of the systems was the most difficult part of the technical process and required extraordinary coordination and collaboration between designers. The roof framing at its deepest is 15" (375mm), and the structure shares depth with the mechanical systems below (air, roof drainage, and sprinklers) and the roof insulation above. The girders are 12-15" deep and extend up into the roof insulation when greater than 12", and the roof framing as a whole is penetrated and hunched to allow the passage of air, sloped drainage pipes, and sprinklers as necessary. The interaction is so complex that every beam was elevated to accurately document all of the penetrations.”



The Apple Campus replaces an existing set of buildings and parking lots originally built by Hewlett Packard. The new campus replaces the previous campus. Parking is still a threshold between city and office. A parking garage for up to 10,000 cars is sited at the property junction with I-280. Workers travel from their cars to the torus shaped building via a pastoral garden that reinvents the former orchards of the Valley.





Studio Site: The studio will begin with an analysis of the existing site and urban area between and surrounding the two Apple Campuses. The studio will ask that each designer propose a future for the area that seeks to increase density, fuse infrastructure and architecture in a new means to: Decrease energy usage for all facets of daily life: housing, work and office, commuting. Increase the scope and choice of housing and integrate with day-care, government, social and civic spaces and services. Bring a higher degree of efficiency to public investments and lower the carrying-costs of private spaces.

Part SIX

Total Planning

Becomes

A Fear of Planning

The New Campus Requires an Evaluation of History:

The Apple Campus can be related to academic as well as corporate campuses – the studio will focus on the work of Candilis, Josic and Woods and in particular an era when the merging of infrastructure and architecture was a major trajectory. Our focus will be on what has changed since and how these earlier models may be still useful.

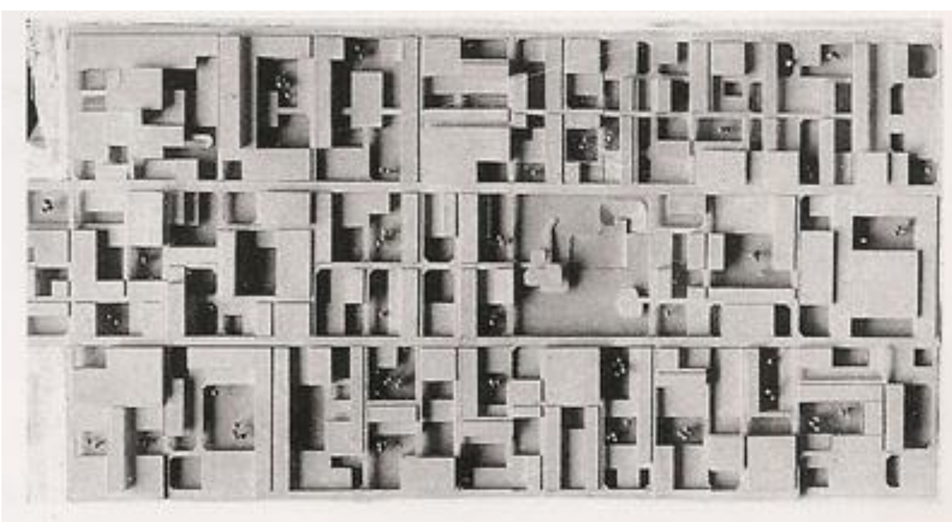
Apprehension: Fear of Total Planning?

At the time of its design and construction The Berlin Free University by the architects Candilis-Josic-Woods did not overtly reveal the vulnerability or doubt that the architects were facing about the scale and social ambition of their work. In the mid 1960's as the housing project at Toulouse le Mirail was under construction—halfway completed—Candilis expressed his doubts about how long the development for 20,000 people was taking and how centralized the control over its design was. Faced with criticism from both within and without the Team X group there was a sense that the work of the group's work was being realized with too much top down control. Realized by state organizations and of a scale that was often immense the project at Toulouse could be re-cast as counter to the ideals of the emergent and self-organizing social life that the architects imagined. In 1968 Aldo Van Eyck, an important member of Team X, and architect and professor at Delft University, was called a "lackey of capitalism" by student: Toulouse-Le Mirail was ten years into its design and execution: it now served 20,000 people—and according to Candilis could now be examined to gage how this experience had turned out and how their relationship to the political environment was effecting the work and people's lives.

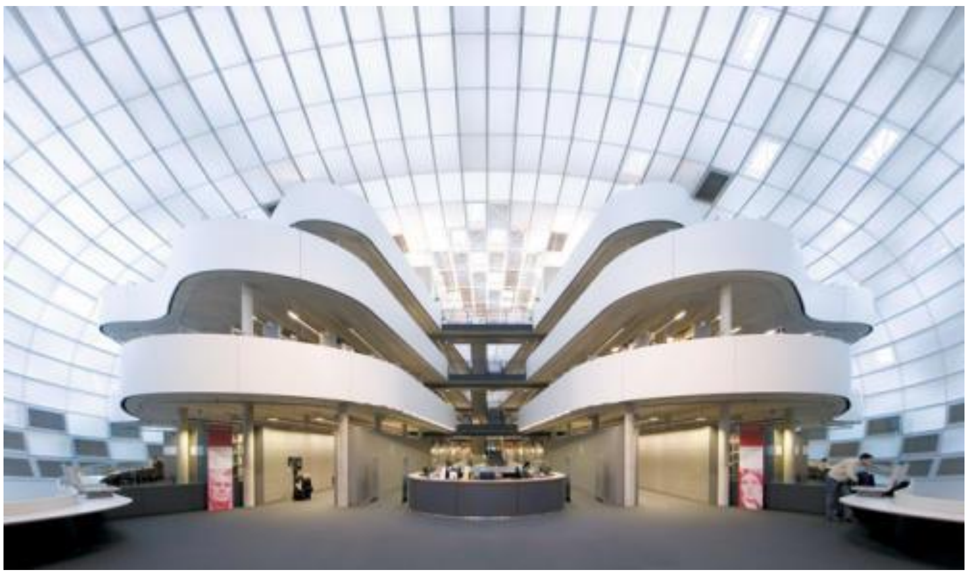
The histories of Team X are often re-analyzed, especially in the realm of housing, but the more private histories of how the architects saw their own work as it emerged reveals a self-imposed critique of scale, and especially control that pre-seeded later forms of post-modernism or renewed forms of existentialism: critical forces that dominated the intellectual milieu of schools in the 70's and 80's and that constructed how an architect viewed their own forms of control but also their engagement and ability to alter the forms of power that shaped their work.

Today, it is possible to claim a new generation has eagerly sought new modes of engagement with finance, with power, in part because we use computation to abet a more responsive and emergent means to work in immense scales while not demonstrating a top down form of control. That is architects seems to have come full circle in having recoiled from immense works and the social aspects of their scale but have returned to this arena again in part knowing we have no choice.

Housing in this light is poised to be renewed as an academic and professional project and its future financial security—its securitization—requires that it be new because the older forms are not stable enough to sustain investment. At least not sound investment.

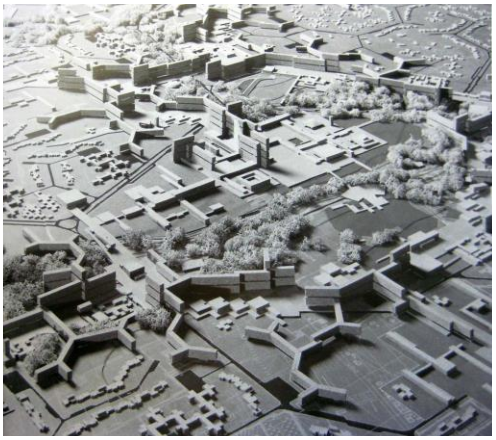


Candilis, Josic, Woods: The Berlin Free University: Planning Flexibility by planning everything.

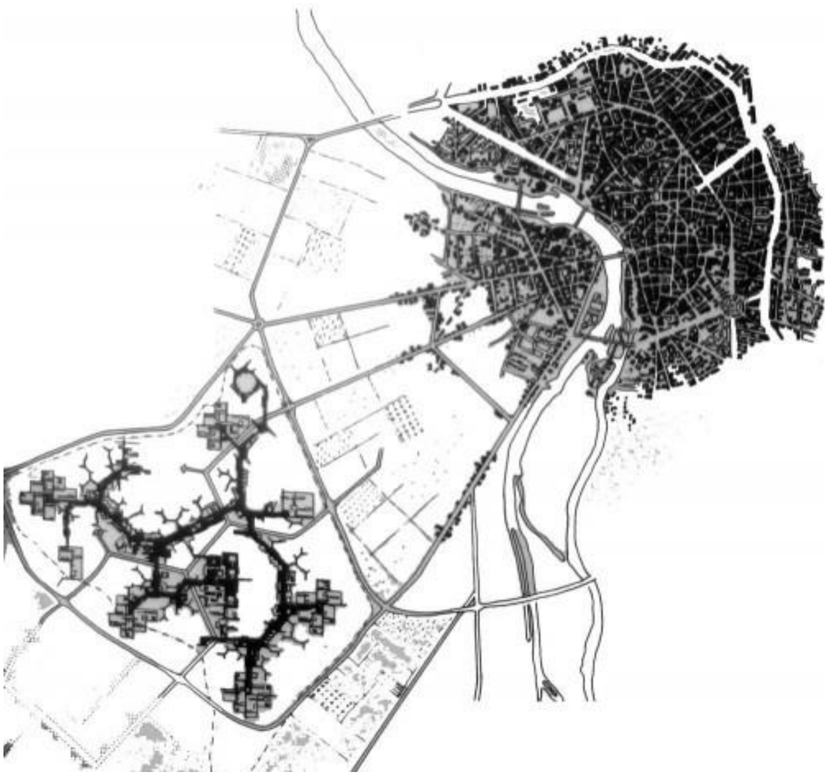


Candilis, Josic, Woods: The Berlin Free University: Hierarchy provided by Norman Foster

A last gasp of confidence in the large-scale infrastructural as architectural project.



Toulouse Le Mirail: A near City realized at Once: Where are we today:



Candilis, Josic, Woods: new city at Toulouse-*Le Mirail*, *France*
The new city was adjacent to the old city; a parallel new world.

Part SEVEN

The Focused Production of a Fragmented Landscape

A. The fragmented landscape was made with careful attention to money.

At the Detroit Economic Club in 1944 the Secretary of the Treasury described a need for ten billion dollars a year in exported goods if the U.S. expected full employment after the war. During the 1940's, after the signing of the Bretton Woods Treaty a new United States landscape that was driven with a new level of integration of the duel mechanisms of production and finance. Production was understood through a lens of efficiency; while finance advanced towards the forms of structured leverage that are now common (and in crisis). Yet both finance and production still operated at local levels despite the international trade. Nations were largely segregate economically even if connected and the relationship of materials, goods, products and labor were partitioned into relatively local zones. They would of course become increasingly connected—and connected. You could call this the ductile era: the spectacle of cities, commerce, development, and jobs revealed itself in a tensioned constellation of cities—in the lights at night photograph above.

While a common attribute of this new landscape was a United States that could no longer provide full employment without exporting what it produced it was still a United States based in material and labor. The country was deterritorialized by labor and economic issues but still a producer of hard goods—material economics.

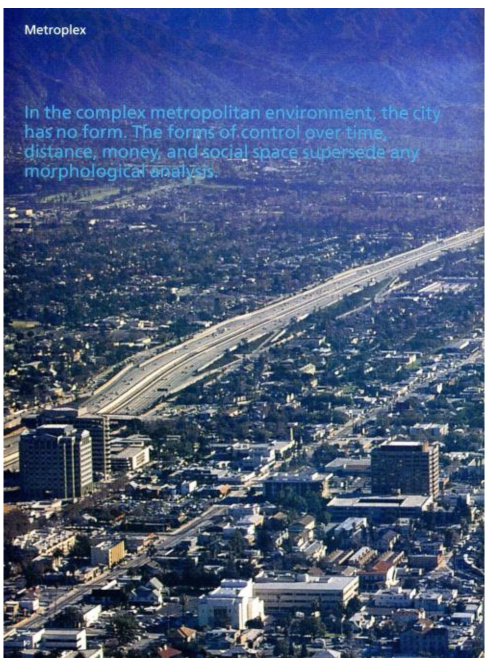
Today this equation is virtually reversed—it is finance that seems to have driven production and while material is still the final equation of presence — material itself is sited at the final of many tiered steps—tranches— (far away from the real motivation which is virtually finance itself). Material is inevitable but if it can be isolated from the production of surplus all the better. So too actual labor or a paying customer. Is there an architectural result that would not critique this at its philosophical level: that is, not criticize?

Specialist Richard Plum, center, rubs his eyes as he conducts trading in shares of Bristol-Myers Squibb on the floor of the New York Stock Exchange, Aug. 8, 2006. Shares of Bristol-Myers Squibb Co. sank more than 6 percent that day as a generic drug maker Apotex Corp. Disclosed it has begun selling a cheaper version of the big pharmaceutical company's best-selling drug Plavix. That's the deal with capitalism: constant competition, constant change. **Photo credit:** Richard Drew, AP

B. Building the tool to traverse the metropolis requires focus and an Endless Interior

Tiffany Cortez, from Toledo works on a stabilizer on a Jeep coming down an assembly line at the Chrysler Jeep plant in Toledo, Ohio, August 28, 2006. Women have long been a critical component of the American factory. Remember Rosie the Riveter? Photo credit: Madalyn Ruggiero, AP

General Motors Corp. assembly line worker Chuck Hallendy assembles transmissions using robotics at the GM Powertrain plant in Warren, Michigan June 1, 2006. Photo credit: Rebecca Cook, Reuters



“In the complex metropolitan environment, the city has no form. The forms of control over time, distance and money, and social space supersede any morphological analysis.” California: Excerpt: Neil Denari, Gyroscopic Horizons, 1999, Princeton Architectural Press

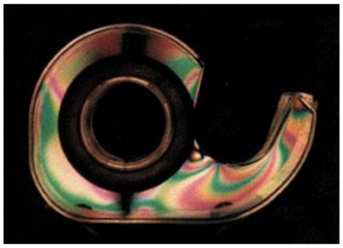
What then for architecture, which attempts to organize material—to shape space, to organize social life and to enter into the highest levels of civic/political, thought? Can it persist in such a realm, can it compete with modes of efficiency in finance. Or does it have options to become less persistent meaning less materially bound—or less tied to plastic or tectonic organizations of space as derived from organized material—from modes of form.

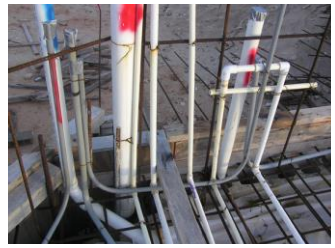
Is there a technical project to recover from both the seeming detritus of everyday late 20th Century Urbanism (and all its minor and major infrastructures)? Is there a spatial theorem in the post 1960's art and architecture, to recover, and then extend, i.e. leverage, which might help give coherence to the extended landscape and often evacuated spaces of American cities? Can we reverse engineer the way artists and architects addressed and often retreated from the facts of the everyday sprawling city?

Infrastructure and Architecture: The result: American developmental practices failed to understand negative space: space is here a residual, a cast off. Endured by many and often thrilling in how it produces modes of vacancy it is nonetheless seen as something to remedy. (Instrumental use of structure, light and material: remove branding and examine spatial qualities.)

Empty Space: Paris, Texas: The existential dimensions of the American west; parallel lines to infinity and the endless expanse of a limitless but barren desert. The dimensionless expanse is no longer endlessly ready for development. The future now faces an internal horizon as the ethos of expansion turns inwards to density and cities are made more compact and clearly defined. Wim Wenders directed the film that was released in 1984. The screenplay written by Sam Shepherd. The music was by Ry Cooder.

C. Structural Engineering and Material Science is everywhere



Utility, Structure, Material, Ergonometric = Non-Descript and Un-Noticed.
Metal vs. Polymer Bathroom Hardware: Mirroring
Hidden but ubiquitous vinyl, polymers, plastics

This studio will focus on themes of architectural structure and advanced potentials in structural analysis using finite element analysis to instigate new concepts of architectural space and meanings of the term emptiness. Our work will aspire to correlate with and be inspired by the emptiness that surrounds, imbues and seems rife in American cities. How and why is the empty space of the city produced and what are its values within architecture?

We will rely on a series of technical and artistic means to explore what this seeming banal and negative aspect of the late 20th edge city can yield in terms of positive architectural/structural experience. What is the philosophical status of emptiness in architecture, art and urbanism today and how structural design and its capacity to produce volume affect this?

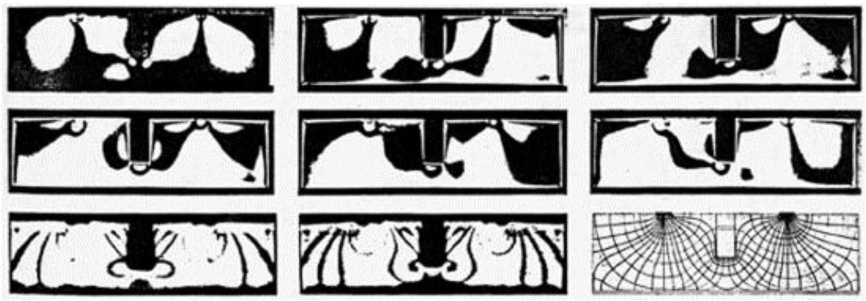
Our work will trace a series of architectural case studies between the 1960's and today to examine how architectural means have responded to or ignored the spatial conditions cities. The studio will work with Zak Kostura in a series of tutorials in **Fixed Element Design** and **Finite Element Analysis**. The resulting work will be focused on the nature of the spaces possible by way of structural design but also the activity and dynamism of the material and its deployment as framing itself. By frame we are not referring to a limited nature of the structural system as lineal frame only, but instead, of the range of possible structural potentials and the degree to which one can design the distribution of stress and strain in a structural system.

An example of what is meant by frame is shown below: Photo-elastic stress analysis has often focused on the behavior of the material and its performance structurally. In the examples below finite element analysis done by photo-elastic stress testing with polarized light shows the internal dynamic of force within an object (in this case a plastic tape dispenser). The ergonometric design and functionality of the dispenser relies on the structural integrity of the design and the end result is an item placed within the field of tools. In other words little attention is paid to the aesthetic aspects of the dispenser as an object beyond its performance yet also there is little if any attention paid to the finite element analysis and the functional capacity it imparts either. A cleft between how something is made and how it secures its performance divides appearance and use from material and design.

In this studio we are concerned with this behavior and the elastic limits it is concerned with managing—we will see frames as both dynamic and internal and also as the bearing agent for the negative space and its qualities.

D. Photo-Elastic Stress Analysis in the work of Giuseppe Terragni

During the 1930's Giuseppe Terragni and Pietro Lingeri produced a set of photo-elastic stress analysis models while designing the Palazzo Littorio. The photo-elastic process literally presents a materialist mode of vision—if you have access to its means or were capable of imagining the work that precedes construction: as optic experiments these tests translate material stress into a mode of visual/material duration. The eyes of the engineer witness the heat that is sustained by the structural loading: a humanist project of vision is survives as a technique of industrial and material science.



Palazzo Littorio, Giuseppe Terragni and Pietro Lingeri, 1934, Rome, Italy (unbuilt). Photo-elastic study. Designed as a spectacular vantage from which Mussolini would address an audience, the Palazzo Littorio has confounded critics who have sought to understand the symbolic purpose of the photo-elastic structural diagrams shown on the building's cantilevered elevations. Terragni and Lingeri were pioneers in the use of photo-elastic process the major method of experimental stress analysis in the 1930s. As a form of element analysis, the photo-elastic process reveals patterns of stress distribution in the patterns generated by polarized light passing through an assembled model. The photo-elastic process transformed Terragni's architectural and visual subject from one drawn within perspective and volume to one drawn within perspective and volume to one drawn within the optics of chemistry and material science.

Part EIGHT

1966 – 77

Architecture and Art: A Loss of Plastic Space

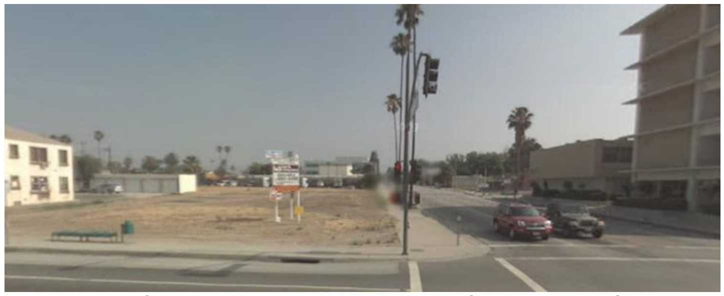
1960's Architectural Formalism and its relation to the late 20th Century Extended American Metropolis

Architects have had a troubled relationship to the later day metropolis: its fragmented and real-estate driven development have created a field that is routinely characterized as fragmented but also seemingly intractable. Tied to land use laws, zoning and speculative real estate development as well as divisive politics…in this realm architects often retrenched even as they sought to give their work a role in the extended field beyond the formal and literal scope of their work.

As architects the tools we have inherited from foundational post-war critics, and practices struggle to provide direction in the milieu of the contemporary city. The city of at midcentury—more surely divided between urban and rural—more fully compact or emptied of commerce—is today nothing short of a fractured and inchoate hybrid. Both dense and arid; compacted and drained—a provocation to attention and concentration and yet an abandonment of much of what we are capable of. This city streamlined and produced with relentless efficiency as a vectoral process and exacting procedure has for many prominent urban theorists been presumed to supersede the local acts of architects and architecture. As a product of controlled attention—and opportune organizations of human action its leaves the professional practices relegated to the discrete and potentially one off buildings would adrift.

Building the 1960's and 70's: Single Family Houses immediately opposite the Apple Campus site. Apple Campus (Infinite Loop) shown at upper right.

Swimming in the lost space of infrastructure

The area if full of pools: but when you get out of the viscous water, where are you? The arid west?

The Swimmer struggles to get out of the Pool: Navigating the inchoate fabric and the after effects of economic promiscuity. In the contemporary metropolis it seems we oscillate on the cusp of two spaces: while fully connected, plugged in, subjugated, over-coded, and prearranged by the mechanisms of urbanism, we are also adrift loose and flailing in the malformed, unshaped spaces that the templates of commoditization fail to cohere. In these spaces adjacent to the freeway, beside the house, behind the retail strip the trajectory of economic vectors that maintain and invent the shape of the city find nothing to carry or transmit them, let alone give them plastic presence. These spaces slip off of us as water slinks in sheets off a swimmer emerging from a pool wafting, cohering, flexing to and unfolding from the body. Though the codes of the contemporary city are mediated by the intellect, it is hard to believe that we don't swim in and out of the vaporous, a-plastic spaces they construct; that we don t register their haptic presence as they slip on and off.

Seeking a Commensurate Architecture: The spectacular light show conceals the in between spaces held within the light: Example: El Paso, Texas and Juarez, Mexico: El Paso has approximately 650,000 persons and is projected to increase to 1,000,000 in less than 10 years. What happens when cities become denser in terms of uses and population and when the primary building methods must change as well? El Paso will face both newly increased population densities and will simultaneously need to embark on new methods of construction and innovation in energy use and consumption. Our studio will explore these limits with specific focus on the role of new forms of material structure as both an environmental component in urban design and architecture. Our studio program is open in terms of use and instead focuses on structural and environmental issues in design. Our goal is to explore how the space between—the emptiness of the American extended landscape can be made new by way of new concepts in structure and its capacity to reframe negative space.

Drive-in movie—Detroit, 1955: Taking the inside spectacle outside. The movies offered the car as a new seat; the outdoor nap seems destitute by comparison or perhaps mildly disorienting. Robert Frank. The Americans

American try to maintain old rituals but the proximity of the machine has both liberated them and made their space uncomfortable. The American's are displaced, lost adjacent to their own means of liberation. They don't yet miss the city. Robert Frank. The Americans

Expanding the Space of Architecture: Case Study: A

—Charles Gwathmey: The Gwathmey House and Studio; Amagansett, NY; 1967.
—A Semiotic Uses of Geometry secures plastic Space.

The formalist language of the Gwathmey House and Studio in Amagansett, New York, resonated across a series of media capitals and centers of architectural publishing as soon as it was completed in 1967. The codified language of the work, minimal sentences of geometric components, was transmitted to a wide-ranging population of architects ready to initiate their own experiments. But in the ensuing years, between the houses emergence as a near canonical work of architecture and our time, the rapid changes in how cities are constructed, how money is moved, how constituencies are made and un-made…. all of this deeply challenged the capability of the architect to remain so seemingly insular, so apart from a wider spectrum of urban concern. But if this is the case, then one must ask how architecture can gain its legitimacy anew, if the scope of what it is demanded of it is so vast that it indeed is unknowingly overwhelmed at its outset. Is there a new local, immediate, even insular practice of architecture available today—would it be legitimate to seek aspects of space, of material and of immediate dimension apart from so much of what has preoccupied us; apart from overt forms of communication, economics, finance, markets—of shifting demographics, social mechanisms, of new forms of computer aided control. What is the status of a more discrete architecture? Is it possible or meaningful today?

This studio will frame a series of experiments based in the very immediate and local aspects of structural engineering and of material capabilities; the client is *unknown*, the site is the expanse from Los Angeles to San Bernardino (a prototypical expanse of American Terrain Vague). The budget does not exist; this is blue-sky work funded with themes of future scalability; you are working a lab and in the face of only your own imagination and key material capabilities. We are as far from Amagansett and the Gwathmey house as possible today, but we are seeking it ancestors: an architecture that is firmly under our control, discrete its realization but capable of immense complexity and uncharted aspects of space and capable of sustaining new experience.



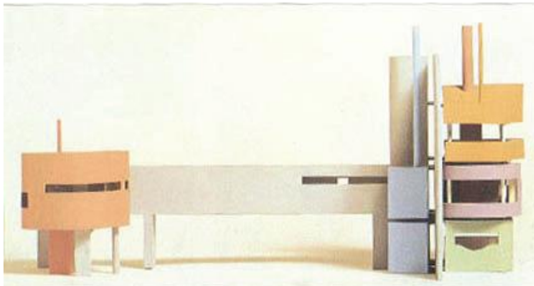
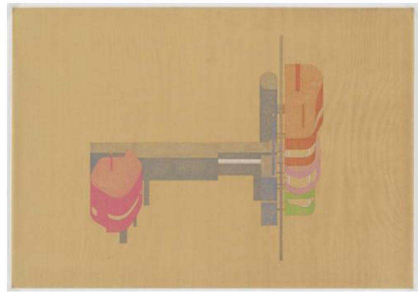
Charles Gwathmey: Gwathmey House, Amagansett, New York: Model Shown at the Museum of Modern Art
Richard Meier, Further Lane, East Hampton, New York

Both structures are composed of primary, minimal geometric forms that appear to be carved from a solid volume rather than constructed as an additive, planar assemblage. As they are manipulated in response to site, orientation, program and structure, the intersections of these forms are defined by

Not Lost: a Modern Villa in East Hampton, New York. The neo-Cubist spatial devices located the body with assuredness. Confidence is inspired and the architect knows where he stands.

Expanding the Space of Architecture: Case Study: B

—John Hejduk: Wall House 2 (A.E. Bye House); Project; Ridgefield, Connecticut; 1972
—Plastic Space is dissolved after a Passing of Plastic Limits:


Bye House, Model and Isometric Drawing

Life has to do with walls; we are continuously going in and out back and forth and through them; a wall is the quickest, the thinnest, the thing we're always transgressing, and that is why I see it as the present, the most surface condition. -John Hejduk

Wall House 2 reinterprets the traditional configuration of a house: instead of being enclosed within one shell, rooms and circulation systems are physically isolated from each other. Kitchen, dining area, bedroom, and living room are stacked curvilinear volumes, linked vertically by an independent circular stair and connected to a study by a corridor. The wall—which Hejduk sets between the rooms and the circulation systems, so that one has to pass through it to move from one room to another—becomes a line of passage, a boundary.

Source: Tina di Carlo; *Envisioning Architecture: Drawings from The Museum of Modern Art,* New York: The Museum of Modern Art, 2002, p. 176

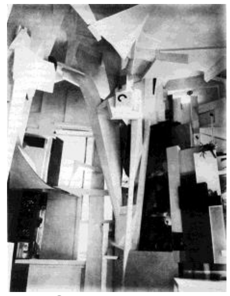
Tension and Compression Exceed Limits. The Post Plastic was actually thought to be plastic: Hejduk claimed that the wall was "time" and that he had in effect separated space from time—that elastic limits had been passed. An essay written at the time by Hejduk titled "Out of Time and into Space" analyzed Le Corbusier's Carpenter Center within similar paradigms of diagonal tensions, central and peripheral energies—Cubist spatial techniques—and ended with this incantation of a potential new space that could emerge as kind of post cubist space—to quote Hejduk: "The tension and compression, the push- pull may have therapeutic value to the docile; the question remains, at what point do the harmonic fluctuations crack causing dissolution and failure of the spatial organism." My understanding of this work began with the rendering—while it is possible to describe this work as a cubist composition, a still-life against a neutralized plane—a plane that in Hejduk's terms is virtually made of color: on Mondrian's color Hejduk wrote—"Mondrian puts a metaphysic into the density of his pigmentation." I found myself continually looking at the periphery and at the surreal drawing of the trees and the landscape. I think this transformation set the stage for the discovery of the Masque in Hejduk's work for it released our perception of space from the single building and into an expanded field of building while it simultaneously placed the spatial organism of each person in a singular and identifiable work—each part is identified and held separated: a final still life that has been unframed.

This is post-Cubist and post-Plastic architecture. Ironically this seems to be a post Cubist stillness and narrative that Picasso also returned too in the early 1920's: in these paintings of the Harlequin done during and after Cubism the narrative returns, the linearity and the sequential nature of time yet in the stillness of the post cubist work one sense the weight of each subject as a potential energy: an immanent force. The character appears before or in front of the picture plane and their roles are defined as segregate: these painting are like a masque.

Expanding the Space of Architecture: Case Study: C

—Frank Gehry: Gehry House, Santa Monica, Ca. 1977-78
—Inside-Out House Reveals City in New Ways.


Frank Gehry, House, Santa Monica, 1977-78


Kurt Schwitters, Merzbau, 1933

Within the attempts to critique and understand the house Frank Gehry remodeled and renovated for he and his family in Santa Monica, California, there were often mentions of the new kitchen that was now a sidebar to the existing structure. The new kitchen was inside a torus shaped zone that wrapped the old house and that was closer to grade then the house's existing floors. Gehry evacuated the original ground floor of the house and displaced its functional kitchen to the new perimeter. The anthropology, the sociology that might follow such a formal move, we instead eclipsed by the seeming fragmentation of the now famous corner window and the collage of metals, stucco, chain link and raw lumber or plywood that was the new palette. The house was called a Schwitters' collage, a signifier of the earthquake zone and social fragility of Los Angeles (and by extrapolation, the United States), or a Lissitsky-esque Proun. It was probably all anyone claimed it was—it was remarkably resilient to interpretation and still is, but what was often missed was that Gehry had moved the domestic ritual of cooking to the perimeter—to a the torus space. And in doing so he also had managed to make a space that seemed remarkably comfortable. Far from being an exercise in erasing subjectivity—de-humanizing the Dutch Colonial vernacular—it was instead an experiment that showed we were somehow fine to live next to the house and that the debates about fragmentation were not effective in describing why something so intimate and primordial as cooking and eating was somehow better on the margins. Whatever the critique, the outcome, was far more complex as a lived experience then as a lesson in art history or critical studies. Our studio starts here: in the Gehry kitchen—from there we trace outwards to explore how people live in the margins of space, on the perimeter of produced artifacts and nearly automatic spaces and how the control or production of the edge manifest the emptiness that is lived in.

.
Mies Van Der Rohe, Farnsworth House, a perimeter galley kitchen.

The Gehry house framing, the windows and the use of safety glass on the skylights, unfolded the space of the kitchen into the yard, into the sky above and formed a residual more than shaped space to actually live in. The unfolding was afforded by spatial techniques that were indeed related to Lissitsky or Schwitters but it was their way of folding and unfolding the exterior void—the space outside—into architecture and back out again that set the stage for a career of work that was as concerned with the negative space of the city as it was with the functioning, private and anthropological space of the house. What follow are images by Robert Frank, photographs, from his work titled The Americans. Frank found American's struggling to acclimate to the new world of automobiles and automobile scaled worlds—but more so his photographs showed a resilient if weighted sense of empathy and immediacy even in the scalar distances of the modern world. People survived and even seemed to try on the new world with an intuitive knowledge of its potential but also a suffering of its consequences.

Expanding the Space of Art: Case Study: D
Outside the Manhattan Gallery

Robert Smithson & Richard Serra, art in the western landscape: on Spiral Jetty, Utah
Donald Judd; art in a gallery, New York

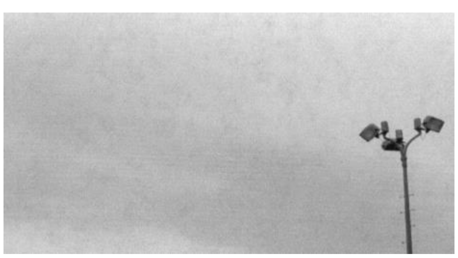
Our work will rely in part on the early work of Rosalind Krauss and in particular her writing on the transformations in sculpture in the essay Sculpture in the Expanded Field. Krauss explores the degree to which the “expanded field” of operations, the site, of sculptors in the 1960’s affected the degree to which the work could indeed still be called sculpture:

The critical operations that have accompanied postwar American art have largely worked in the service of this manipulation. In the hands of this criticism categories like sculpture and painting have been kneaded and stretched and twisted in an extraordinary demonstration of elasticity, a display of the way a cultural term can be extended to include just about anything. And though this pulling and stretching of a term such as sculpture is overtly performed in the name of vanguard aesthetics-the ideology of the new-its covert message is that of historicism. The new is made comfortable by being made familiar, since it is seen as having gradually evolved from the forms of the past.

No sooner had minimal sculpture appeared on the horizon of the aesthetic experience of the 1960s, than criticism began to construct a paternity for this work, a set of constructivist fathers who could legitimize and thereby authenticate the strangeness of these objects. Plastic? Inert geometries? Factory production? - none of this was really strange, as the ghosts of Gabo and Tatlin and Lissitsky could be called in to testify. Never mind that the content of the one had nothing to do with—was in fact the exact opposite of—the content of the other. Never mind that Gabo's celluloid was the sign of lucidity and intellection, while Judd's plastic-tinged with Day-Glo spoke the hip patois of California.

It seems fairly clear that this permission (or pressure) to think the expanded field was felt by a number of artists at about the same time, roughly between the years 1968 and 1970. For, one after another Robert Morris, Robert Smithson, Michael Hazier, Richard Serra, Walter De Maria, Robert Irwin, Sol LeWitt, Bruce Nauman . . . had entered a situation the logical conditions of which can no longer be described as modernist.

Sculpture in the Expanded Field, Rosalind Krauss, October, Vol. 8. (Spring, 1979), pp. 30-44.



Parking Lot, Sodium Vapor Lamp, and non-art is everywhere and anywhere.

Non-Structural Space provided by Structural Means: Urban Space, Art and Architecture

Urban Space: Streetscape: Electric Wires
"Albuquerque, New Mexico, 1972," by Lee Friedlander. He said he deliberately includes "those poles and trees and stuff" that other photographers avoid.

Photo one:
The frame activates the space or is residual to the latent space

Photo two:
The frame is also active. It conducts

This means: there can be more complex relationships between the frame and space and that the frame may be active in its own right without that activity affecting the space it appears to enclose. It may not appear to enclose anything. Yet the frame behaves with accord to its own weight: the electric cable exhibits a centenary carver.

Art: Richard Serra, Core Ten plates, posts… The bellows enables Ms. Verburg to tilt the lens and the film away from each other to alternate the focus within an exposure or, as she said, to extend “space within the image. Philip Gefter

Photo three:
The **frame** is highly active and not actually a frame but a set of elements that act as a frame: force holds them together and thus their equilibrium does not affect the quality or the shape of the space..

Photo four:
The frame does not affect social space, or function of space. It is in space with its subject.

The frame may result in the creation of a static space and maintenance of an uneasy balance: social critics or philosophers speak of where great amounts of activity have been created or entered into but change does not happen and was not supposed to happen. A status quo is sustained.

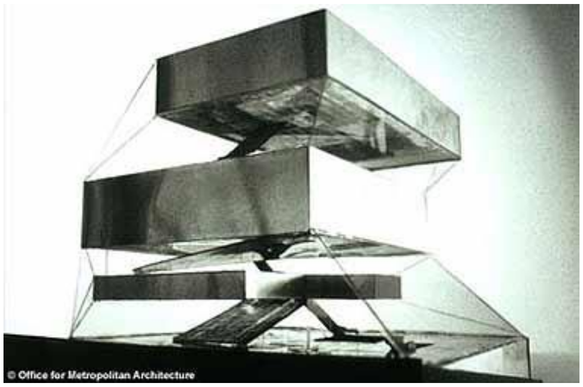


Photo Five / Six

The in-between is provided by the structural engineer and the void is understood to provide an alibi to the architect who hopes to relieve themselves of programming everything..

Architecture: Werner Sobek: To protect the remains of the crematorium of the Sachsenhausen concentration camp, a protective shelter was erected in the form of a translucent envelope structure with a homogeneous surface. The roof was designed and built as a membrane structure stabilized by a partial vacuum.
Architecture: OMA: Seattle Public Library Proposal

Expanding the Space of Architecture: Case Study: E
Misunderstood: Abstraction, In-Action and Social Goals?

The Case of Frank Gehry as Dirty Harry or a Building Appears to Turn its Back in the City and Human Need.

1. Architecture and Structural Mechanics and the Ethics of Engagement
Misunderstanding the uses of Efficiency and the Optimization

Our protagonist is Frank Gehry. Our hypothesis: that the potential of his work since Bilbao has been misunderstood and that the advent of CATIA in his work and its later re-purposed incarnation as Gehry Technologies Software has been commissioned as the signifier of enhanced architectural capacity and its future promise as a new bearer of professional authority. In other words: the existential aspects of Frank Gehry's production are over. To the contrary our goal is to explore where Gehry, working with CATIA and GT software often chose non-optimal means, non-efficient and non-linear paths and where his work's potential for inconsistency or failure became the source of potential architectural public innovation: here spatial euphoria, insight and ecstasy delight yet bear no clear answer or overt professional path to social legitimacy for the profession. A return to Gehry's own early allusions to his interest in art, in the work of artists more than architects (who perhaps drew too harsh and yet dull a line between social and formal goals for architecture.

2. Misunderstanding a Seeming but Endorsement of Anomie:

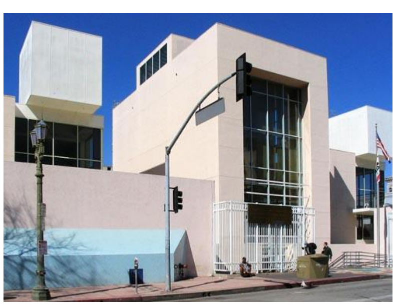
Made to seem legitimate as the new master architect, or made to seem illegitimate as "Dirty Harry" or ironic later day post-modern architect Gehry became the privately left publicly right architect: working for the rich private client and institution Gehry was accused by Mike Davis of becoming the Dirty Harry of architecture. His Frances Howard Goldwyn Regional Branch Library was seen by Davis as providing:

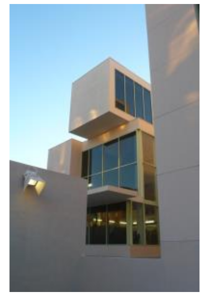
"15-foot security walls of stucco-covered concrete block… anti-graffiti barricades covered in ceramic tile… sunken entrance protected by ten-foot steel stacks… stylized sentry boxes perched precariously on each side."

What Davis did not see in the work was the eccentric loading of the "precariously" stacked "sentry" boxes—or the tendency for rotation, torque and toppling that was common in his work of the time. In this regard Gehry was easily seen as un-interested in producing an open work of public architecture—of acquiescing to the security demands of the client. Is it possible to offer a counter-reading: that the architect was exploring the potential of a perceptual work of architecture that used the very apparatus of ties own security demands as structural devices—devices that are balanced in equipoise of new dismantlement. Of failure. The Goldwyn Library will be one of our key focus and case studies: what are the internal loading aspects of the building and how do they verify and act on the otherwise seeming stalemate that Davis saw in the work?

Gehry has never allowed himself to be easily boxed in by critics on either side of the equation: But what has failed to find critical footing or easy discussion has been that it is Gehry's use of technology that has allowed him to become more humane by being more efficient; to become more humane by modeling the static impasses of equilibrium and even entropy that are enacted with architecture. Gerry is the most advanced architect to work in 40 years if one examines his uses of both technology of negative space; with OMA, Siza and Holl he is forever old fashioned in the drive towards experience, forever modem in his reliance on architectural technologies but forever anti-modern in his anti-efficiency and seeming lack of social resolve. Gehry solves social questions by not solving them: by instead creating a poise that is the edge condition between action and in-action.

Misunderstanding the Precarious nature of Center of Gravity and Center of Mass



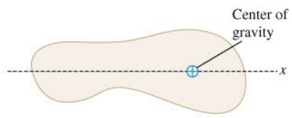


Does the balance, complex centers of mass and gravity and the layering of light upon light speak to anything other than a structural tautology or did Gehry bring attention to the near critical balance of the institution—in this case a city library—and instill it with an un-easy presence, a barely secure yet immediate structural integrity hidden beneath layers of stucco, drywall and off-the-shelf window walls. In short: was it a remedial seeming but instead highly complex new monument: an evacuated shell that refers one back to the evacuated city. A device to seem comfortable even as you slowly realize you are in the midst of a silent storm,

3. Misunderstanding the motivation towards Fragmentation and Ornament

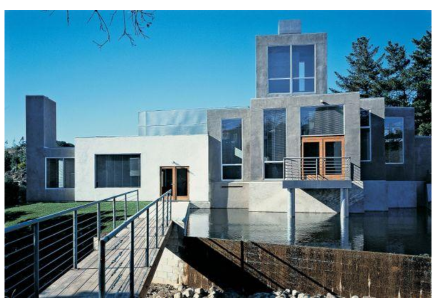
"I became interested in chain link fencing not because I like it but because I don't. The culture seems to produce it and absorb it in a mindless way, and when I proposed to use it in a way that was decorative or sculptural, people became very upset. There was a discrepancy: people may have had it around their tennis courts, around their swimming pools, or around their backyards, where it was only chain link. But if I proposed to use it as a screen in front of their house, they were annoyed and confused."

4. Studio Case Study in Stacking, Instability, Moment Connections and Volume



Outside

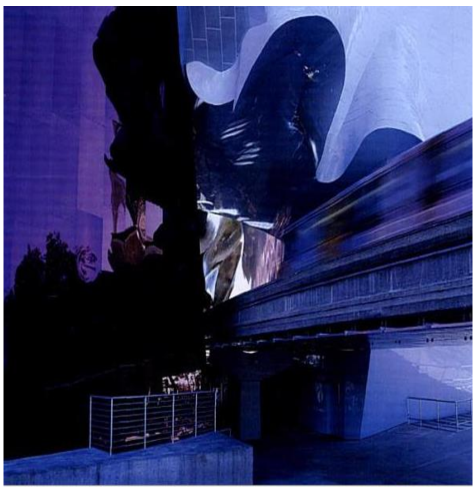
Inside_Double and Triple Emptiness



5. Spline and Surface


Inside Corner Absent


Spline Connection alters fragmentation




Inside: Spline controls surface

Part NINE

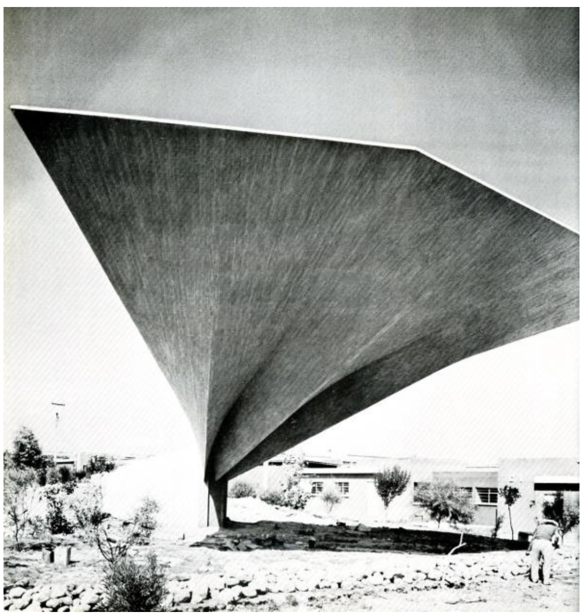
A Plastic Material of another Era?

Concrete: A Reintroduction

Concrete: Measurement and Coordinated Action

Concrete is understood to be the building materials that virtually assured and verified the rise of modern engineered cities. Reinforced concrete, the quasi-alloy that fused and perfected a dual material structure of concrete and steel instigated more than a hundred years of invention in building form and structure. The fusion of course relies on both concrete and steel, but it is arguably concrete that gains the accolades for the plastic shaping of building and space even as this shaping would not be possible without reinforcement. What then is concrete itself and what are the futures of concrete in terms of reinforcement, but also in terms of its own chemical engineering, its own capitalization, its own geographic production and installation and its role in energy and environmental impact?

In the matrix of reinforced concrete it is concrete that seems to be the colloquial focus—the role of steel even as reinforcement is of course essential and fully integral yet this have little value in the popular discussion of building. The confidence to imagine new forms of plastic work, however, was sourced and manifest in this hybrid of steel and concrete. The rationalization of structure lies with the fusion of two materials—the paired ductility of the two materials. But the critical discussion was in part tilted towards concrete itself and today as the techniques of both reinforcement and concrete change what future roles do we see for both aspects of this hybrid structure. Will it remain hybrid or can it increasingly tilt towards singulars aspects of concrete?



Seguro Social Housing Development, Band Shell, Santa Fé, D.F., Mexico, 1956. Felix Candela.
The structural reinforcement and plastic forming of concrete often met the most ambitious of social purpose; the rough forming often seemed to lend itself to pragmatic need—sun shading and structure. Concrete has always brought the engineer and the architect towards lofted goals.

Parallel Action

In the past decade the concept of an alloy or what would constitute concerted but segregate behavior as parallel, fused or coordinated action between materials has all come under a new lens of evaluation and opportunity. Can we still talk about reinforced concrete with the operative word reinforced—or is a more complex interaction now the key to our thinking about material coordination. What constitutes coordinated materials today? How are we re-inventing the control of coordinated structural assemblies both before and after construction and what are the limits of the modeling of complex or coordinated behavior of structural form. Aspects of time and duration—the nature of material in time and application, but also under effects such as thermal action or long term deterioration. Engineers, architects, and materials scientists are more able to predict and anticipate interaction and dynamic relationships between materials with a level of accuracy that was not possible even ten years ago. These examinations of material behavior arguably more fully constitute the cutting edge in architecture and engineering than the material itself—that is the techniques of measurement and prediction might be seen as equal too and in part constitute a mode of material itself. In this regard do we begin to see materials as approaching or differentiating themselves from each other as forms of behavior rather then as intrinsic differences? Are species of material modeling attributes of material itself: do they form a circumstance that is by nature material and intrinsic?

New Locations, Same Material

Material does of course persist in isolation even as it cannot be as easily segregated as it once might have been; material offers innovation at its own inherent levels and within it own chemical engineering. Industries are still segregate as well and their locations, means of capitalization and relation to labor, economies are key. With this in mind, what then, can we say about concrete in architecture or engineering that we don't already know—that is, after a conversation about its historical role as instigator or indicator of mass, weight, presence and solidity—of seeming permanence? New species of concrete as well as reinforced concrete are entering the world's markets—and rapid urbanization creates as much as 80% of the worldwide market for concrete and this will instigate a wave of new works drawn from new circumstance. The persistence of concrete as both new material and as new application is more urgent then ever if we gage its current implementation—the scope of its uses. What are its critical dimensions in terms of plasticity, urbanity or architectural space and structure? What are the futures of concrete in regard to contracting and implementation—of coordination of economies as much as labor or material?

Urbanism and Infrastructure: Concrete +

In its known roles concrete has never been far from urbanism or from being vested as a form of civil life itself. From its essential chemical engineering to it place in formal aesthetics and the plastic arts, concrete has often been seen as the source of a kind of pragmatic *brilliance*: as basic and essential, yet also lofting the indices of social life and public progress and carrying the weight of perceived urban success and urban failures. Concrete has also been expected to provide aspects of the ineffable. Its properties provide a sense of permanence, but it also has been the very material to provide everything but permanence: concrete is intrinsically based in concepts of time and of movement—of flow and the formalization of flow and here it can perhaps be renewed as a temporal medium—as something that is both actual and a model. Both fixed and in transition—solid but only as a stage that indicated attributes of solidity. Recall the use of concrete in the banked test tracks at the 1927 Turin Fiat factory—concrete as the sub-strata upon which acceleration and centrifugal force were played out above a factory where column span was a component of labor efficiency. Compare this to the stilled and expansive spans—the fragile interiors of August Perret 's Notre Dame de Raincy completed five years earlier or the concave modeling of the surfaces of Le Corbusier's Ronchamp. Concrete as we have historically received it has always been concrete + form—but also concrete + speed, + aesthetics, + abstraction. But what is concrete itself or what is added to concrete today?

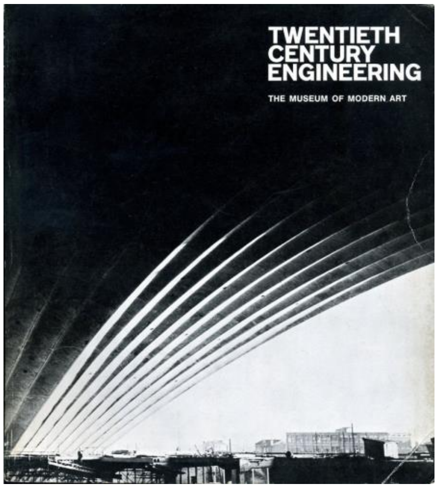
What don't we know about concrete going forward—to the day after tomorrow? To next year? Ten years from now?

These histories can of course be projected into future states: to uses of concrete in infrastructure, in water works, in airports, in military installations and predominantly within rapid development of cities today.

This studio brings a world of leading architects to the Columbia University to discuss the implications of new technologies in concrete at the scale of building, within architecture and engineering and at the scale of infrastructure.

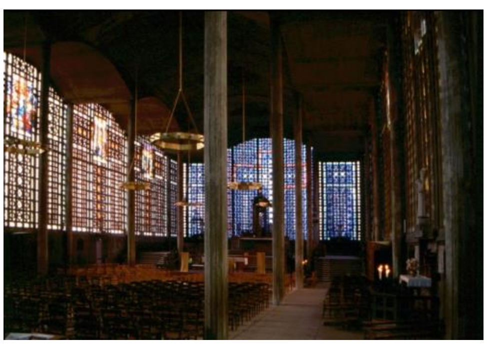
And within new forms of measurement, coordination and production.

The Plastic Arts and a Plastic Material



The Museum of Modern Art, 1964, Arthur Drexler

Aside from plastic qualities other new questions are key for concrete today: for example, how do concrete and construction materials integrate with other systems today and those from the outset of the 20th century? How are concrete works dismantled—is there innovation in the expected life span of materials that affect design? Do we still expect material properties to affect architectural space in architecture and engineering; how is material understood as plastic and expressive? Perret revealed two worlds; he offered the most delicate balance between them—an equipoise of tenuous spatial extension achieved in rational construction. By the end of the of the 20th Century Perret's version of reinforced concrete had gained countless new capabilities and had increasingly become a different kind of spatial engine as well as structural system. It also became an entirely new economic commodity and fact of urbanization. Concrete is often nonetheless seen as similar if not identical to the earlier forms, either in terms of its plastic capabilities, its techniques of reinforcement, or its role in environmental crisis. The cleft between the techniques and the imagined capacities of concrete grew wider over the past one hundred years and architecture has not yet explored these changes.




For all its weight, concrete has almost always been simultaneously an indicator of empty space—by way of surface and volume, and at times of lightness. These ideas are renewed as we reexamine concrete not only as surface and form but also as integral to and coordinated with other materials; as composites that are not so much assemblies but alloys—new materials in total with new potentials.

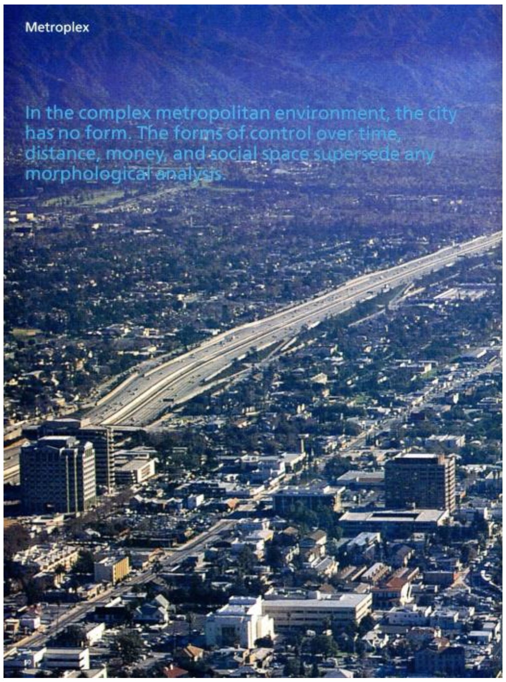
Perret showed a deeply restrained relation to the visceral and plastic aspects of concrete that are commonly known in the work of Le Corbusier, or even Oscar Nieymayer, or Paul Rudolph. Plasticity of form and the rationalization of construction dominate architectural thought in the 20th century and Le Corbusier's architecture made both cases emphatically. Perret may be more of a touchstone in today's work, however, as more tenuous works bear renewed examination in light of advances in concrete that show it to be a material of capable of more technical refinement and thereby more delicate deployment.

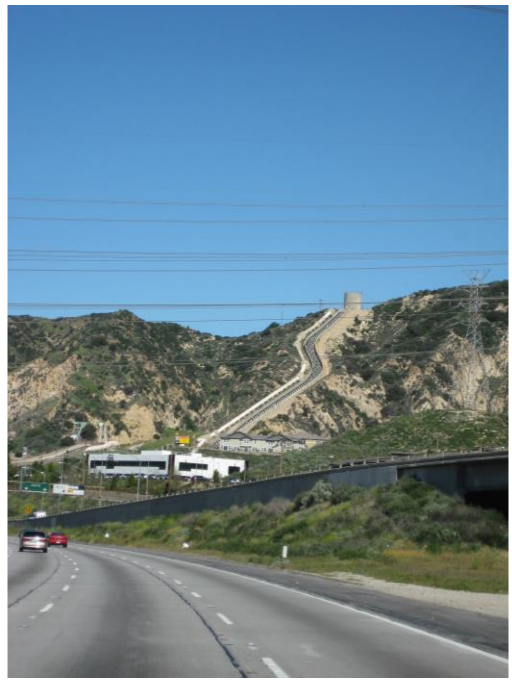
Antecedents for this work could be pointed in Giuseppe Terragni's work in concrete: Terragni replaced an expected robustness with a thinned surface quality—a planarity and a-plastic lack of material thickness. Richard Neutra's Lovell Health House (indeed his entire career) often fused light steel framing technologies with similarly planar reading that made concrete seem as planar and as liquid as glass in his work. His Lovell Health House was a hybrid structure of steel stiffened by the diaphragm action of concrete—the ductility of steel increased by the compressive strength of concrete. Today concrete is increasingly ductile in its properties and in particular by way of fiber reinforcement, super plasticizers, and innovations in nanotechnology and the chemistry of material science. Concrete is seen in less overtly robust terms and its potential applications are now far subtler in terms of scale and proportion.

Text by Neil Denari—When concrete is asked to support the painted hieroglyphs of airport logistics, the airport tarmac, not unlike the facade at the Bank of London and South America, might be seen as an emblem of concrete's role within the graphic project. As a literal ground to the more informative and indeed operative language of information architecture (or graphic design), concrete is nothing more than a slab, a sort of mineral desktop supporting the lines, logos, icons, and texts that are necessarily the most important and contingent programs of airport functionality. In the process of becoming first plastic and then graphic, concrete's directness as a material is no longer a quality in and of itself, but it appears only in collaboration with the media content inscribed into a blank, grey background.

Pre-Concrete: Former Futures

Bound by materials and their spatial organization, architects and engineers are beholden to the intricate layers of commodity and investment practices that, today, are global in nature. The nature of our professions is more tightly woven into and responsive to investment than it has ever been; yet, frequently, it is less inclined toward characteristics of place and instead bound to translocations and interconnected matrixes of development, as well as the input of consultants and partner practices. During the past twenty years, professional practice often seemed to be indexed by way of a constellation of world cities and their particular relations—the city, in this sense, superseded the nation as the nexus of exchange.





left: Neil Denari, Gyroscopic Horizons, 1999, Princeton Architectural Press
right: The Grapevine Aqueduct, California, I-5: Freeways, Architecture, Infrastructure

Nonetheless, trade barriers between emerging economies are changing dramatically, at times reinforcing the role of national relations in development and design. In this realm, the anticipated roles of architects and engineers are often fused, in terms of both the planning of cities and general themes of urban life; that is, each forms a unified practice that takes on similar characteristics of the other. These practices, at times, produce work that can be characterized as quasi-infrastructural, more than architectural.

What new forms of practice have emerged in today's economic arena? How have concepts of architectural space and technique been reorganized to allow us to operate at levels that were previously the domain of international contractors or state organizations? What is the role of the architectural concept in an era of deeply engineered materials and equally instrumental economic demands on design?

Generations of architects since the 1930s have helped redefine the scope of international and then global practice; the latter, as a socially critical instrument, is still relatively young. Avant-garde firms such as Archigram (in London) or Superstudio (in Florence) in the 1960s depicted infrastructural worlds that borrowed industrial metaphors from history while promoting new modes of social life, but what can we say of today's critical practices? What role does the image of infrastructure and its material techniques now play? What is the role of space, of event, or of nonmaterial design in an era of such deeply coordinated value?

Practitioners of the generation of architects that began their careers in the 1970s and '80s—often working on disinvested and neglected urban sites—are now emerging as global participants in the rise of a new city. The new means of capitalization and distribution of resources and building materials are affecting design practice, including the global exchange of real estate, high-tech forms of construction and material management (both relatively new)—so, too, is the need to once again examine the city as a central frontier of social life.

The city and its sprawling context is like an out-of-control economic and material engine that threatens the discrete terms of architectural and engineering practice; the city, in itself, constitutes a new form of material practice—a condition that is a source of new material conceptions, in which a new form of urban life will emerge in the gaps between the imagined and the real.

Out of Control? New Control?

Expansive Low Rise / Low Density Development: Concrete infrastructure and the adjacent architectural housing in Houston, and Tijuana, Mexico shows the technologies of concrete in transportation but not in architecture. Today work on infrastructure changes in light of what we know of evolving economies or evolving demand—the civil aspects of concrete and of infrastructure are contravened and supported by an arena of expanded technologies—a more prevalent awareness of new means and methods from leveraging economic potentials, control parameters for off-site work, embedded digital technologies that monitor life span and repair, and smart materials. In other words, what is added to concrete today changes the very nature of concrete and reconvenes its qualities in every sense. How does this affect its inherent qualities and application?

Civil Life

In its known roles, concrete has always remained at the heart of theories of urbanism, as a form of civil life itself. From its chemical engineering to its formal aesthetics and plastic art, concrete has often been the source of ingenuity and pragmatic beauty; basic and essential, it has improved social life and served as an indicator of public progress, carrying the perceived weight of urban success (or failure). Concrete is also expected to provide a sense of the ineffable, while its properties convey permanence.

It is also the very material that provides anything but permanence. Intrinsically based in concepts of time and movement, of flow and the formalization of flow, it a temporal medium and its use can perhaps be renewed as such. It is both fixed and in transition—solid, but only as a stage that indicates attributes of solidity. In this realm, concrete has been historically understood as a substrate and a material of the antique city, but it has also been understood as an inevitable, robust, and vigorous agent of the modern urbanization of metropolitan life. Capable of providing historical foundations, concrete can also be molded into the newest of instruments. The differences and the divide between then and now are immense, yet concrete nevertheless sustains a hold not just on architecture and infrastructure but on the very imaginations of the architects and engineers, and their aspirations for a stake in the construction of civil society. Concrete, it seems, is understood as the building material that virtually assures the rise of modern, engineered cities. Reinforced concrete (a composite of concrete and steel) instigated more than one hundred years of invention in building form and structure over the course of twentieth century, during which the technology was greatly refined, and it remains the predominant system in use today. It defined architecture anew as a deeply plastic art, yet techniques of reinforcement continually changed during this period and the mechanics and capitalization of its design and implementation changed in regular cycles.

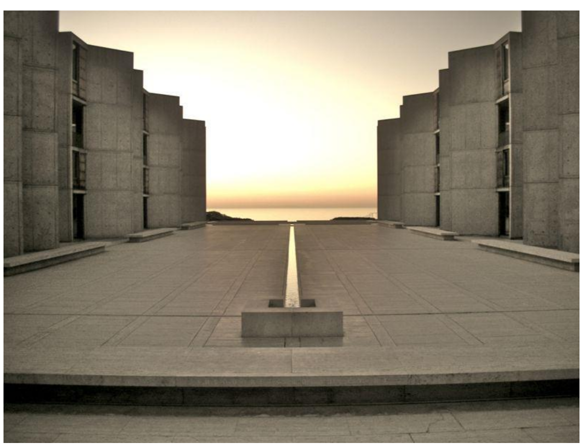
Concrete has a diverse history that forms the "preconcrete nature" of much of the built world today. This past can be projected into its future states: toward uses of concrete in infrastructure, waterworks, airports, military installations, and, predominantly, within the rapid development of established and emerging cities today. Solid States: Concrete in Transition brings together a group of leading architects, scholars, and engineers to discuss the implications of new technologies in concrete within architecture and engineering, at the scales of building and infrastructure, within the contexts of new forms of measurement, coordination, and production.

What forms of practice have emerged today in this arena— how have concepts of architectural space and technique been reorganized within practices of engineering and architecture to allow us to operate at levels that may have been previously the domain of international contractors or state organizations? What is the role of the architectural concept in an era of deeply engineered materials and equally instrumental economic demands on design?

Generations of architects since the 1930s have helped write a story of international and then global practice, yet the global practice, as a socially critical instrument are still relatively young. If the practices of Archigram or Superstudio and others depicted infrastructural worlds that borrowed industrial metaphors as well as outright techniques from history while promoting new modes of social life, what can we say of today's critical practices? What is the role of the image of infrastructure and its material techniques—what is the role of space, of event, or of nonmaterial design in an era of deeply coordinated material value?

Have practitioners of the generation that began work in the 1970s and '80s on what were often disinvested and neglected urban sites now emerged as global participants in the rise of a new city? How do building materials and their new means of capitalization and distribution affect design practice: within the global exchange of real estate, high-tech forms of construction and materials management are relatively new—so, too, is the need to again examine cities as a central frontier of social life? Is material a significant attribute of this condition or can we examine it still as an attribute of design rather than a determining factor?

Is the city and its sprawling context an out-of-control economic (yet still material) engine that threatens the discrete terms of architectural and engineering practices, or does the city constitute a new form of material practice itself— a condition that is the source of new conceptions of material in which the gaps between the imagined and the real are the zones where a new form of urban life will emerge?

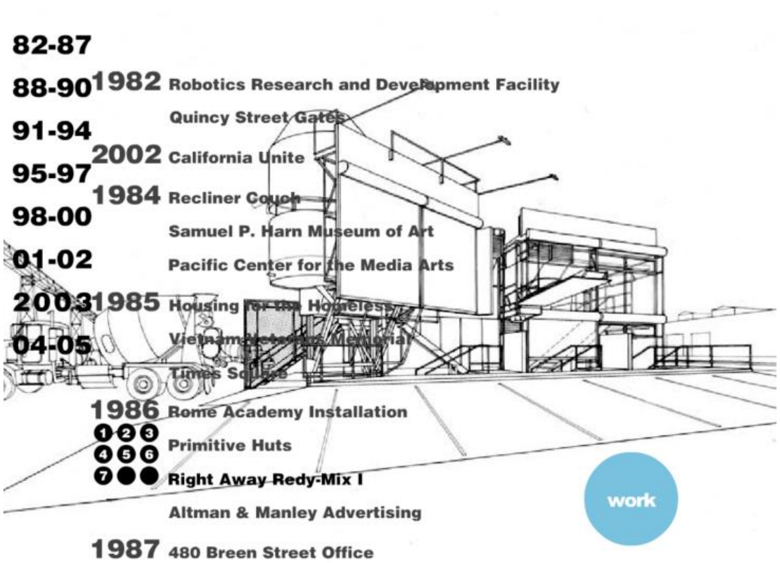


What was supposed to be: The Humanist Monument: Timeless Architecture
Louis Kahn, the Salk Institute, La Jolla, California.

In its known roles concrete has never been far from urbanism or from being vested as a form of civil life itself. From its essential chemical engineering to its place in formal aesthetics and the plastic arts, concrete has often been seen as the source of a kind of pragmatic brilliance: as basic and essential, yet also lofting the indices of social life and public progress and carrying the weight of perceived urban success and urban failures. Concrete has also been expected to provide aspects of the ineffable. Its properties provide a sense of permanence, but it also has been the very material to provide everything but permanence: concrete is intrinsically based in concepts of time and of movement—of flow and the formalization of flow, and here it can perhaps be renewed as a temporal medium—as something that is both actual and a model. It is both fixed and in transition—solid, but only as a stage that indicates attributes of solidity. In this realm, concrete historically understood as the substrate and material history of the antique city is also understood as an inevitable, robust, and vigorous agent of modern urbanization and metropolitan life. It is capable of providing historic foundations while it's also molded into the newest instruments. The historical differences and the divide between then and now are immense yet concrete nonetheless sustains a hold over not just architecture and infrastructure but over the very imagination of the architects and engineers and their aspirations for a stake in construction of civil society. Concrete it seems is understood to be the building material that virtually assured and verified the rise of modern engineered cities. Reinforced concrete, the composite of concrete and steel refined at during the century, instigated more than one hundred years of invention in building form and structure and still is the predominant system in use today. It defined architecture anew as a deeply plastic art yet techniques of reinforcement continually changed during this period of time and the mechanics and capitalization of its design and implementation changed in regular cycles.

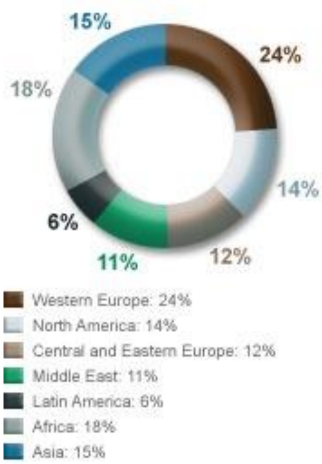
Concrete is a new material again. What don't we know about concrete going forward—to the day after tomorrow? To next year? Ten years from now?

What is the architecture of fiber reinforced concrete? What spatial qualities result when concrete approaches the strength to weight ratios of steel? What is the role of concrete in urban architecture, infrastructure in this era when



Above: Concrete Batching Plan, Oakland, California, Wes Jones, Peter Pfau, 1987, "Building Machines," Pamphlet Architecture No. 12. The Batching Plant drawings relied on a machine metaphor; a signifier of concrete manufacturing in which the truck's mixer was turned upright to form a conic section and a local billboard for the Right Away Redi-Mix batching plant.

Below: Lafarge sales profiles for cement: Concrete is today a decidedly global project and segment of development and finance.



Geographical breakdown of Cement Business sales (12/31/2008) Source: Lafarge Group (www.lafarge.com)

Part Two: The Techniques

The studio will focus on a series of fundamental issues and goals in regard to the state of the art in concrete.

0. Strength to Weight:

from Wikipedia (unfortunately*):* The specific strength is a material's strength (force per unit area at failure) divided by its density. It is also known as the strength-to-weight ratio or strength/weight ratio. Materials with high specific strengths are widely used in aerospace applications where weight savings are worth the higher material cost. Materials such as titanium, aluminum, magnesium and high strength steel alloys, as well as carbon fiber-epoxy or other composites are widely used in these applications for this reason.

Specific tensile strength of various materials

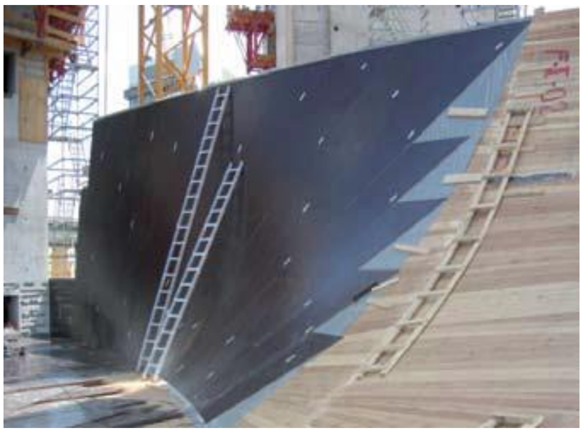
Material	Strength (MPa)	Density (g/cm³)	Specific Strength (kN·m/kg)	Breaking length (km)	source
Scifer steel wire	5,500	7,87	?	71.2	[1]
Bainite	2,500	7,87	?	32.4	[1]
1 µm iron whiskers	14,000	7.87	?	183	[1]
Concrete	10	2.30	4.35	0.44	
Rubber	15	0.92	16.3	1.66	
Brass	580	8.55	67.8	6.91	[2]
Oak	60	0.69	86.95	8.86	[3]
Balsa (axial load)	73	0.14	521	53.2	[4]
Polypropylene	80	0.90	88.88	9.06	[5]
Nylon	78	1.13	69.0	7.04	[6]
Magnesium	275	1.74	158	16.11	[7]
Aluminium (alloy)	600	2.70	222	22.65	[8]
Steel	2,000	7.86	254	25.93	[8]
Titanium (alloy)	1,300	4.51	288	29.38	[8]
Silicon carbide	3,440	3.16	1,088	110	[9]
Glass fiber	3,400	2.60	1,307	133	[8]
Vectran	2,900	1.40	2,071	211	[8]
Carbon fiber (AS4)	4,300	1.75	2,457	250	[8]
Kevlar	3,620	1.44	2,514	256	[10]
Spectra fiber	3,510	0.97	3,619	369	[11]
Colossal carbon tube	6,900	.116	59,483	6,066	[12]
Carbon nanotube (see note below)	62,000	.037-1.34	46,268-N/A	4,716-N/A	[13][14]

1. Formwork:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

Advanced work in admixtures and plasticizers allows new methods of formwork and newly extensive pours. Yet to build in concrete is still to build twice: one builds the formwork prior to the pour and the resulting work holds residual if not explicit references to the absent formwork. What aspects of formwork change in light of new concrete mixtures and how is formwork itself conceptualized and made effective today? (Michael Bell)

Exposed Concrete: Design, Engineering, and Performance by Werner Sobek + Heiko Trumpf



Mercedes-Benz Museum, shutter patterns and formwork for the double curved surface, Stuttgart, Germany.

2. Reinforcement:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

From Wire Mesh to 3-D Textiles by Antoine E. Naaman

Text by Antoine E. Naaman—

3-D Reinforcement Systems Using Polymer Fibers

It is only in the late 1990s and early 2000s that 3-D meshes—also described as 3-D fabrics or textiles—derived from the technology of textiles and fabrics became available for research studies in Ferro cement-type products. In particular, the Institute of Textile Technology (ITA) at RWTH, Aachen University in collaboration with the Technical University of Dresden (TUD) Germany, pioneered a number of 3-D textiles for applications in cement and concrete composites, which they have termed *textile-reinforced, concrete* (TRC)

Advanced FRP Meshes, Textiles, or Fabrics—2-D Systems

During the mid-1980s and early ’90s, polymer meshes, textiles, or fabrics made with high-performance fibers such as carbon, glass, Kevlar, or Spectra were tested for Ferro cement applications. | fig. 4 Since they exhibited high tensile strength in comparison to the conventional low yield strength of steel-wire meshes on the market, they were immediately viewed as a way to increase the performance of Ferro cement composites.

Both analytical and experimental studies, however, show that adding FRP meshes, textiles, or fabrics in excess to the two extreme layers, with the goal of improving bending resistance, does not lead to a sufficient improvement to justify the additional cost of the intermediate layers. This is because, unlike steel meshes, FRP meshes using high-performance fibers such as carbon, Kevlar, or glass show a linear elastic stress-strain response in tension up to failure, with no yielding. Thus the addition of intermediate layers of mesh for bending may lead to successive failures of the mesh layers at ultimate resistance, instead of allowing for the simultaneous combination of forces from different layers of mesh, as is the case with yielding steel-wire mesh.

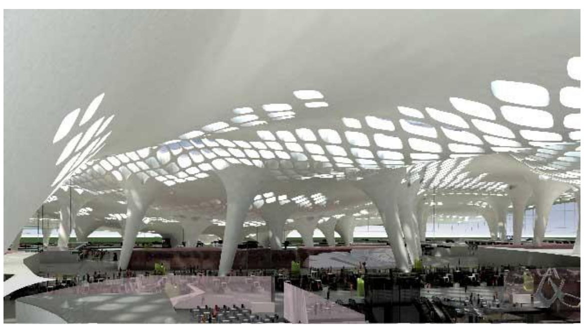
3. Concrete and Flow:

Architecture as a small-scale legal component of the city is posited here as an agent of retroactive coherence. As a small-scale participant in the great milieu of managerial systems, it provides a lens and intuiting device for comprehending illusive and temporary processes that precipitate the construction of the city. Architecture's political and social agency—its ability to participate in the construction of an urban subject—finds its potency in an enzymatic role. The otherness of the late modern city and its self-regulation subsists in a conflation of perceptual and technical mathematics. Architectural work recovers immanent movements in the stillness of distance; latent procedural histories of legislative policy, capital investment, and speed are reinhabited by an architecture that slows these processes to a threshold of comprehension.

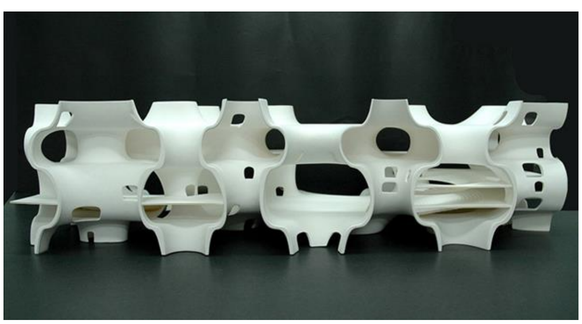
Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.
Concrete: Dead or Alive by Sanford Kwinter

Text by Sanford Kwinter—It is true that concrete, from its inception, was principally conceived as a kind of ductile and programmable stone, but its labile chemical nature soon lent it to the operations, control, and specification of civil and chemical engineers. In recent years, a further set of determinations has taken hold of it. An important one is the extension of its latent properties by incorporating electronic and electromechanical components, so that the ripe transmissive activity taking place invisibly inside of it has increasingly come to be expressed in feedback loops and communicative channels; concrete is not only a highly active material but it is becoming rudimentarily sensate. Another development to which I would like to briefly call attention to in more detail is the new determination, whose accompanying transformations of uses and formal languages are drawn from the biological sphere.

It is arguable that new design motifs are emerging from the evolving marriage between modifiable materials and numerical techniques and control. I will limit my consideration to what could be called osteomimicry, which entails an espousal of the unusual logic of the biological structural members we call bones. Two examples are the coming Taichung Metropolitan Opera by Toyo Ito and the Shenzhen Bao'an International Airport by the Reiser + Umemoto.—



Reiser + Umemoto



Toyo Ito

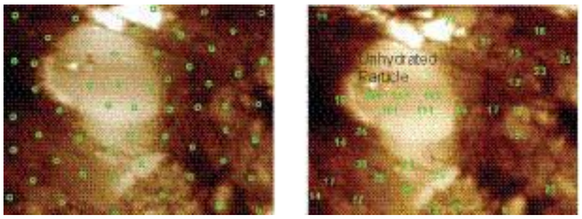
4. Chemistry of Concrete:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

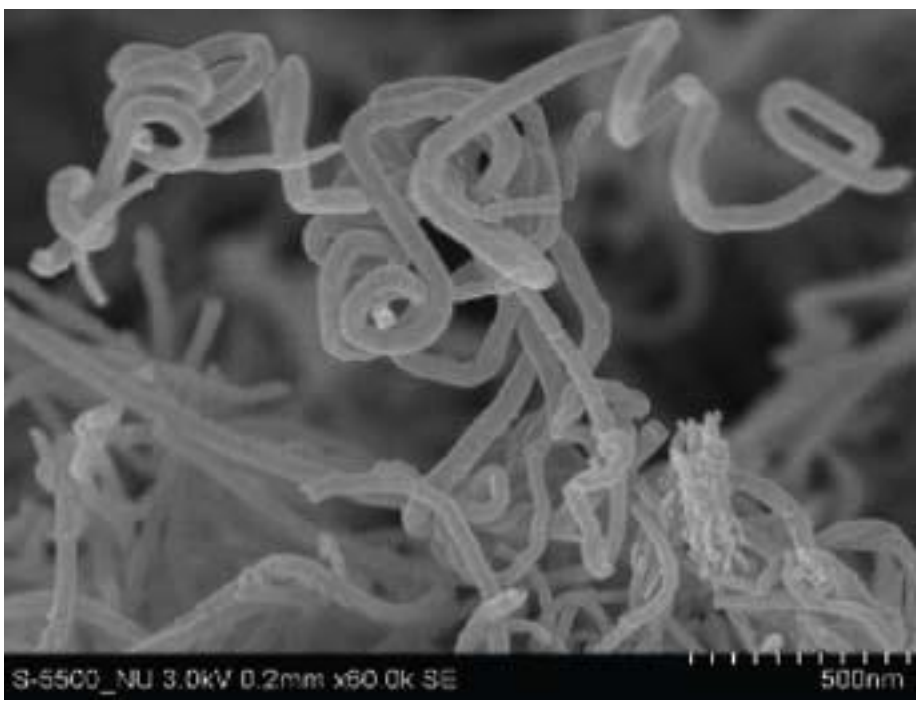
Nanotechnology in Concrete by Surendra P. Shah

Nano-indentation on six-month-old cement paste: w/c 0.5; image size:

60 × 60 micrometers. Left: indent locations; right: Young's Modulus in gigapascals



Text by Surrnedra P. Shah—the next obvious step is to go a scale further and use nanofibers so that the cement itself, which is the most brittle component of concrete (and contains nanocracks), becomes ductile. My group has just started working on this; the fibers we are using are called *carbon nanotubes*. There are two issues with carbon nanotubes. First, they are very difficult to disperse; and second, they are very expensive. In an effort to solve both problems, we have found a method that combines surfactants and ultrasonic energy to disperse the fibers.



SEM images of poorly dispersed carbon nanotubes forming bundles in eighteen-hours-old cement paste

5. Porosity and Mass

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

Form Over Mass: Light-Concrete Structures by Hans Schober

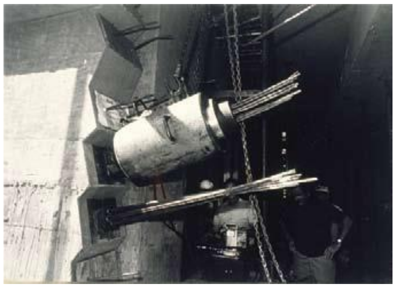
Factory cafeteria with identical light columns. Photo taken during construction; structural design by Schlaich Bergermann und Partner, Boehringer Ingelheim, 2000

Text by Michael Bell—for all its weight, concrete has almost always been simultaneously an indicator of empty space—by way of surface and volume, and at times of lightness. These ideas are renewed as we reexamine concrete not only as surface and form but also as integral to and coordinated with other materials; as composites that are not so much assemblies but alloys—new materials in total with new potentials.—

6. Post Tensioning: Applied Force:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

Engineering in Cuba by Ysrael Seinuk
Cable ends, LIRR, Forest Hills, New York



Text by Ysrael Seinuk—In an early project realized for the Long Island Rail Road in Forest Hills, we created a deck over the railway tracks, with a span of sixty feet (18.3 meters) that was to carry a sixteen-story building. | fig. 10 To build the deck, we used prestressed, precast box beams. To anchor it, we used a wall laced with multiple post-tension strands, with each jack pulling fifteen strands. The project was the first time in New York that multiple post-tension strands were used in a building. The technique was far from new; it had been used already by Magnel, as well as by Fritz Leonhardt in Germany around twenty-five years earlier. Much later, we also used post-tension at the Trump Tower (1982) in New York. In order to accommodate the shopping mall in the base of the tower, we used large columns that opened up like an A-frame, which eventually had to carry fifty stories.

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.
Horizontal Skyscraper: Continuous City / Continuous Garden; Vanke Center; Shenzhen, China
Text by Steven Holl Architects

—Appearing as if it had once been floating on a sea that has suddenly subsided; the structure of the Vanke Center levitates as a new horizon. Seen from beneath, the building invokes a raised horizon that leaves the earth-bound visitor firmly situated by nonetheless at a distance from a suspended urban world.

Held on eight concrete cores (measuring approximately 10 meters by 10 meters each), the extended, and floating horizontal spans average 50 meters in length. These distances, allowed by a never-before implemented hybrid structural system, makes the expanse possible, but also gives the final mass an uncanny visual presence The structure, set at a height of 35-meters conforms to the zoning envelope; a heterogeneous series of programs set within this single volume is fused in a single loop: the concept was proposed as an alternative to of the anticipated placing of several smaller structures at distant intervals on the site. Instead of discrete buildings programmed for specific uses that subdivide the site the elevated horizontality of the Vanke Center generates a large and continuous green space at grade and a continuously changing social program above. An innovative structural system was needed to implement the concept.

The structural engineering and the building's open ground level provide a new quality of protection against tsunamis, while the porous micro-climate created below serves as a landscape for changing public use and everyday life. The structural systems combines steel and concrete: combining the inertia and mass of a concrete frame with lightweight cable-stay technology drawn from bridge engineering, the Vanke Center is able to span tremendous distance without the anchorage typical of suspension bridges or the tension and compression of cantilevers. The building uses its own in-born weight; the concrete frame serves as a ballast and resistance to compression, enacting and maintaining the bearing and spanning capacities. An immobile yet dynamic structure, it creates and enables a laminar form of urban space: the world above and the world below become embedded in each other, and mutually supportive as they are also apart and parallel.—

7. Ductile Limits and Visual Presence:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

As Thin as Possible: Barely There. Magical Structuralism by Guy Nordenson

—The tyrant and great architecture patron Sigismondo Malatesta had as his motto, “tempus loquendi, tempus tacendi,” which translates as “a time to speak, a time to be silent.” A related Quaker saying advises that we “say as much as necessary and as little as possible.” Technology does not drive history; rather it is the entanglements of human desire for power, for beauty, and for immortality, and the opportunities and obstacles of reality, that give true magic to our work. Technology in the service of desire is, at its best, doing as much as necessary and as little as possible.—

World Trade Center Tower 1, model, by Guy Nordenson and Associates, 2003

8. Energy Management and Sustainability.

All Text Excerpted from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

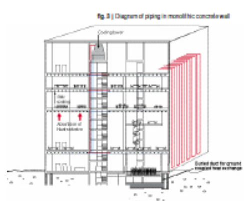
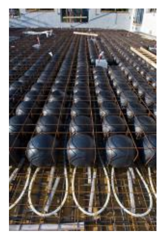
a. An Integrated Energy and Comfort Concept: Zollverein School of Management and Design, Essen, Germany

Matthias Schuler

Text by Matthias Schuler—Boundary Conditions: As a base for the integrated energy and comfort concept for any project, we research local boundary conditions such as macro- and microclimates, noise, and air quality, as well as soil conditions and available energy sources. The climate in the city of Essen is very moderate, seldom reaching temperatures below freezing and rarely exceeding maximum temperatures of 30 degrees Celsius (86 degrees Fahrenheit). Near the school, the former coal mine Zeche Zollverein stopped actively digging in 1986, but the existing mine shafts and tunnels, measuring some 1,000 meters (3,280 feet) deep, have been kept accessible for possible future uses. As a consequence, the public owner of the mines, Deutsche Steinkohle AG (DSK), has to permanently pump mine water up from this depth in order to keep the mines from flooding.

Energy Concept

In order to make use of the mine water as a natural heat source, a heating system was required that would be capable of accepting an inlet temperature in the range of 27 to 30 degrees Celsius (80 to 86 degrees Fahrenheit). Therefore a radiant heating system within the exposed concrete ceilings was chosen, which can be reversed during the summer for nighttime activation of the thermal mass by an evaporative cooling tower. The mine water can also be used for preheating the intake air.

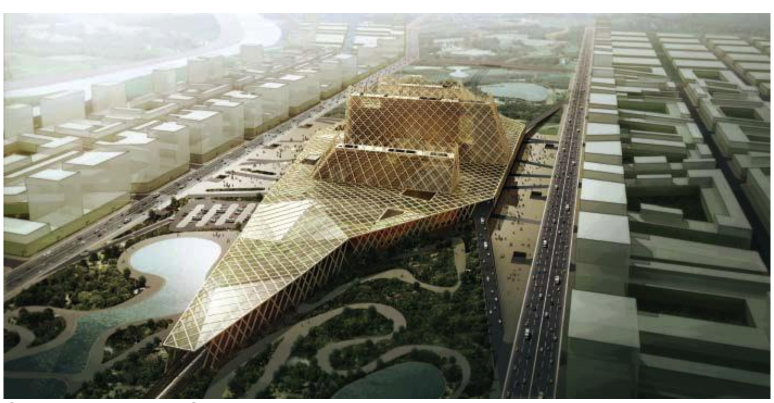




SANAA, Zollverein School, Active Insulation and

b. The Hypergreen Path

Jacques Ferrier

Text by Jacques Ferrier—We used this concept of dissociating the climatic structure from the envelope itself for the Changsha Station project in China. Here, the concrete grid permits the fusion of station, shopping center, public amenities, and office buildings, which are grouped together to form an urban megaobject. The density of the Changsha complex varies according to the amount of sunlight it receives, and it provides a support for photovoltaic cells that also act as sunbreakers.



Changsha Railway Station competition, by Jacques Ferrier Architectures, Beijing, China, 2006
Jacques Ferrier, Architect

c. Green Concrete and Sustainable Construction: A Multiscale Approach
Paulo Monteiro

Text by Paulo Monteiro—Typical concrete contains about 12 percent cement, 8 percent mixing water, and 80 percent aggregate by mass. This means that worldwide 1.5 billion tons of cement is required yearly for the production of concrete. Currently, the production of Portland cement is responsible for 7 percent of the carbon dioxide emissions globally. In addition to cement, the concrete industry annually consumes 9 billion tons of sand and rock as aggregate. The consumption of materials by the world's population at this rate is only exceeded by our use of water. In addition to the 1.5 billion tons of cement and the 9 billion tons of sand and rock consumed, the production of concrete requires one billion tons of mixing water. To provide some comparison, the use of one billion tons of potable water corresponds to 110,000 times the volume of water in the San Francisco Bay. Such a rate of consumption obviously creates huge strains in regions where fresh water is scarce.

Text by Paulo Monteiro—In the Department of Civil and Environmental Engineering at the University of California Berkeley, we are developing the following lines of research in order to develop green construction. The first is to improve the nanostructure of the hydration products used in concrete production; the second is to develop dedicated membranes that allow for the use of both recycled water and sea water in the production of concrete; the third is the development of geopolymers from waste products, with the goal of replacing the use of Portland cement; and the fourth is integrated research on the mechanisms of concrete deterioration in order to develop innovative repair strategies.

9. Ruins and Regeneration:

Excerpt from: Solid States: Concrete in Transition; edited by Michael Bell and Craig Buckley.

Artificial Natures / New Geographies by Kate Orff

Text by Kate Orff—One could speculate, for example, that entire mountaintops have been exploded for aggregate, carted to the flatlands, and reconstituted into new, high-rises (or artificial mountains) as a sort of large-scale redeployment of nature and the construction of a new geography.—