Fall 2016

Research Snapshot

Research Snapshot

Harvard University
Graduate School of Design

A Turning Point
in Research

From the Director of Research . . .

Welcome to the first issue of the **GSD Research Snapshot**. The purpose of the snapshot is to share with the GSD community the research accomplishments of our faculty. This issue provides just a sampling of the wide variety of research- and design-based investigations being undertaken at the school.

In recent years, research has become an essential component of design schools and design education. No longer limited to the humanities, theory, history, urban studies, and to selected topics in technology, it now encompasses a broad range of endeavors that mobilize a great diversity of disciplines. At the Harvard Graduate School of Design, we have moved beyond discipline-specific approaches to address a problem and have increasingly integrated sociology, geography, political science, mathematics, mechanics, thermodynamics, and computing, to name a few, in the research led by our faculty. Such diversity is both enthralling and challenging. Among the challenges, one finds the recurring question of what might be specific to research conducted in design schools.

The contributions gathered in this first issue of the Research Snapshot provide us with some useful clues. Design research is not only about understanding a world well on its way to becoming mostly urban but it is also about how to change this world for the better, using designers' and planners' tools. Design research wants to be both critical and operative. It aims to contribute to scientific knowledge through insights that can be gained only in close association with designers, and to provide concrete answers regarding buildings, cities, and landscapes.

As always, comments and suggestions are welcome and we look forward to hearing from you.

Antoine Picon
G. Ware Travelstead Professor of the History of Architecture and Technology
Director of Research

Contents

Material Processes and Systems (MaP+S) Group

Martin Bechthold, Kumagai Professor of Architectural Technology, Department of Architecture

Work by MaP+S expands the aesthetic and performative contributions of material systems for shaping better built environments. The goal is not to develop technologies as a final outcome, but to do so in order to expand design as an agent of change for a better future.

MaP+S research integrates robotics and digital fabrication processes, design computation, and scientific work on the micro-to-nano scale, producing prototypes, software, and new material solutions that have been patented and disseminated in the form of papers, books, and lectures. The group evolved from the previously established Design Robotics Group. Founded and led by Martin Bechthold, MaP+S has involved GSD faculty Panagiotis Michalatos, Mark Mulligan, and Leire Asensio Villoria. It employs four to seven research associates and integrates GSD's master's and doctoral students. Current work focuses on architectural ceramics, advanced composites, 3-D printing as a form of robotic fabrication, and the development of novel adaptive solutions for buildings. Outreach includes workshops offered worldwide as part of the RobArch and Smart Geometry conferences.

Presently, multi-year research on ceramics, sponsored by ASCER Tile of Spain, is reimagining the application space for mankind's oldest material system—ceramics. The culmination of MaP+S's annual research is typically presented in the form of a research installation at the CEVISAMA trade fair show in Valencia, Spain. Projects have included a mass-customized, 3-D-printed, sun-shading system; a structural ceramic/concrete shell; tectonic prototypes based on almost paper-thin ceramic sheets; and a digitally customized tessellated extrusion wall.

Ongoing work on advanced composites (sponsored by AD Group) is developing novel layering concepts that expand the performative qualities of carbon fiber composite structures. This includes form-active composite elements that change shape in response to external actuation. Other studies integrate optical and light controlling effects within a carbon layering system.

Work on 3-D printing started with a comprehensive technology analysis and associated process and cost model presented as a white paper to the sponsor Italcementi. Since then the group has developed several robotic 3-D printing workflows, built two different printers, and is currently working on questions of functionally graded materials and printing strategies optimized for thermal performance, with sponsors AutoDesk and ASCER Tile of Spain.

MaP+S also runs the Adaptive Living Environments (ALivE) project, a joint project with the GSD's REAL Lab led by Allen Sayegh, and a collaboration with the Adaptive Materials Platform led by Joanna Aizenberg at the Wyss Institute for Biologically Inspired Engineering (sponsor: Wyss Institute). ALivE develops novel applications for nano-scale materials in buildings with a focus on material-based adaptivity. The work has led to several patent filings, papers and exhibitions.

Geometry Lab

Cameron Wu, Associate Professor of Architecture, Department of Architecture

Andrew Witt, Assistant Professor in Practice of Architecture, Department of Architecture

Preston Scott Cohen, Gerald M McCue Professor in Architecture, Department of Architecture

The Computational Geometry Lab researches the intersection of design and science of shape and form, aided by computational tools and design intuition. The lab is unique at the School, combining computational, formal, architectural, and historical research into a heterogeneous yet synthetic agenda. The objective of the lab is to produce and disseminate new knowledge, to generate broad scalable solutions to big problems, and to explore the associated cultural and human implications. In addition to active research projects, the members of the lab pursue its research topics through seminars that use the facilities of the lab, including Mechatronic Optics, Conic and Developable Surfaces, and Structural Surfaces.

RECENT AND ONGOING PROJECTS

Spanning and Developable Surfaces. The lab continues to investigate large-scale construction systems for spanning and minimal surfaces—primarily unitized assembly systems or methods of material deformation which may accommodate these geometries. One example is the proof-of-concept installation from Fall 2015, which demonstrates the construction of a spanning surface through the use of an adaptable, flat-cut hexagonalization/triangulation.

Procedural Urban Modeling. With the support of a grant from ESRI, the lab has been researching methods and implications of procedural modeling in the city. While centering on the use of generative urban tools such as City Engine, the research attempts to go beyond prescriptive methods of design toward more open-ended and flexible uses of data-informed form-making. The current product of this work is a new software tool developed in the lab called PaintCE. Highly visual, it combines the power of procedural modeling with the simplicity of Photoshop.
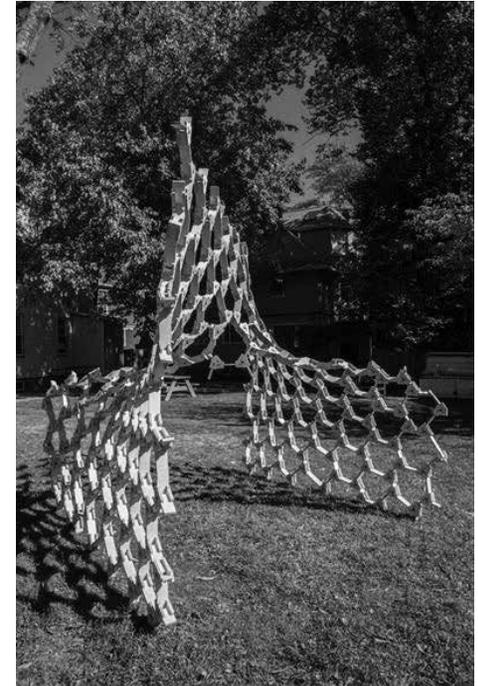
Haptic Robotic Interfaces. An ongoing challenge in design robotics is the latency that often occurs between design and robotic execution. The lab has acquired two Universal robots, the industry standard for co-working interactive technology. We have developed tools that allow the real-time feedback and response of the robots, which can lead to a range of applications, including augmented construction and real-time assembly interfaces. Recent student projects have demonstrated the power of these new tools, including the real-time holographic interface(s).

RECENT AND FORTHCOMING PUBLICATIONS

Andrew Witt, "Cartogramic Metamorphologies; or, Enter the RoweBot" (Log 36, Winter 2016) The paper summarizes Witt's recent work on seeing and classifying machines, specifically bots that scan urban form to generate metamorphological trees.

Andrew Witt, "Landscapes, Spaces, Meshes: A Cultural Narrative of Design Technics" (forthcoming, in anthology Architecture is All Over). This paper traces the historical development of meshes as both tools of landscape and spatial measurement.

Cameron Wu, "Plastic Idiomatic: Linguistic Concerns of the Baroque" (forthcoming, in anthology Finding San Carlino). Essay and formal analysis of Borromini's San Carlo alle Quattro Fontane.

Adaptive frame system for construction of knot spanning surfaces, 2015.

The Just City Lab

Toni L. Griffin, Professor in Practice of Urban Planning, Department of Urban Planning and Design

designforthejustcity.org

Can Design's Impact on Urban Justice be Measured?

Would we design better places if we put the values of empathy, protection, inclusion, or equity first? If a community voiced what it stood for and what it aspired to be, would it have a better chance of creating and sustaining a more healthy, vibrant place with positive, economic, health, civic, cultural, and environmental conditions? Imagine that the issues of race, income, education, and unemployment inequality, and the resulting segregation, isolation and fear, could be addressed by planning and designing for greater access, agency, ownership, beauty, diversity, and empowerment. Now imagine the Just City—the cities, neighborhoods, and public spaces that thrive using a value-based approach to urban stabilization, revitalization, and transformation. Imagine a set of values that would define a community's aspiration for the Just City, and imagine that we can assign metrics to measure design's impact on justice, and imagine that we can use these findings to design interventions that minimize the conditions of injustice.

The Just City Lab investigates the definition of urban justice and the just city, and examines how design and planning contribute to the conditions of justice and injustice in cities, neighborhoods, and the public realm. The research, originally launched at the J. Max Bond Center at the City College of New York's Spitzer School of Architecture, created the Just City Indicator Project, an indicator framework tool including an elaborate menu of urban values, indicators, and metrics, both spatial and social, designed to evaluate how design of the built environment contributes to health and economic, civic, cultural, aesthetic, and environmental-design wellbeing. The initial pilot project, *Public Life and Urban Justice in NYC's Public Plazas*, was completed in 2015 in partnership with Gehl Studios and Transportation Alternatives. Also in 2015, The *Just City Essays, Volume One* was published, a collection of essays from 26 prominent thinkers who define the just city in 22 different global cities. Both publications can be found at www.designforthejustcity.org.

Fall 2016 begins The Just City Lab's first year at the GSD, during which it will aim to expand the Just City Indicator Project. Over the last decade, indicator frameworks around sustainability, livability, and resiliency have been incorporated into many municipal governance structures as a way to monitor progress on achieving healthier environments, growing economies, and improving operating efficiencies. These frameworks also aim to address the provision of "equity." The Just City Lab operates from the opinion that many of these frameworks fall short on truly measuring the presence of equity and often lose sight of other critical social justice values. In fact, the lab questions whether striving for equity alone is enough to address the challenges of exclusion, disrespect, intolerance, and the spaces of marginalization in the city. Professor in Practice of Urban Planning Toni L. Griffin, along with research assistants Caroline Lauer (MUP '18), Milan Outlaw (SMArchS '17 at MIT), and Meghan Venable-Thomas (DrPH '18) are developing an illustrated index of just city values and evaluation metrics for assessing urban justice and injustice at the neighborhood scale.

Visit our website www.designforthejustcity.org for updates on our work, previous publications, and the Just City manifesto videos, a collection of student videos defining the Just City.

Social Agency Lab

Michael Hooper, Associate Professor of Urban Planning, Department of Urban Planning and Design

gsdsocialagencylab.tumblr.com

The Social Agency Lab studies the ways in which individuals, institutions, and organizations shape social outcomes in cities. The lab leads a number of funded research projects related to this theme. These projects currently focus on social dimensions of urban change in sub-Saharan Africa, Haiti, Mongolia, Montserrat, and aboriginal communities in Canada. With a strong focus on empirical research, based on extensive primary data collection, the lab is committed to getting GSD students involved in field research. All lab projects involve GSD students as research assistants, trained to work in the field and to collect and analyze diverse forms of primary data.

A representative current project, *The Politics of Urban Densification in Ulaanbaatar, Mongolia*, examines the dynamics of Ulaanbaatar's rapid growth and the tensions between the different approaches proposed to manage this transformation. To address the city's expansion, international organizations, such as Japanese and American aid agencies, have developed plans for urban densification. Through detailed interviews, the project examines the perspectives of three groups of individuals on these plans: international planners, Mongolian officials, and local residents. Based on these interviews, the project is revealing the tensions that exist between standard, global models of "compact city" development—favored by international development officials and funders—and more context-specific and culturally-nuanced models of urbanization advocated by many Mongolian planners and local residents.

The lab is also working on several new projects. One is located in Montserrat, in the Eastern Caribbean. This project investigates the long-term impacts of disasters on shelter needs and resident well-being. The project will ramp up in Spring 2017, as a team of six GSD students conduct interviews with local residents and planners about how lives and livelihoods have been transformed by the volcanic eruptions that displaced many of the country's residents between 1995 and 2010.

In terms of recent outputs, the lab recently published two peer-reviewed articles on the politics of urban densification. The articles focus on Ulaaanbaatar, Mongolia, and were written by Michael Hooper along with two MUP graduates, Aldarsaikhan Tuvshinbat (MUP '15) and Raven Anderson (MUP '14). The lab also completed a study of the role of international shelter standards in post-disaster reconstruction. The report was co-authored by Michael Hooper and MUP graduate Martha Pym (MUP '15). Full details on all lab publications can be found on the lab's website, http://gsdsocialagencylab.tumblr.com/.

Research team conducting interviews in Ulaanbaatar, Mongolia (Photo: R. Anderson)

Energy, Environments, and Design Research Lab

Kiel Moe, Associate Professor of Architecture and Energy, Department of Architecture

research.gsd.harvard.edu/eed

The EED Lab continues to further articulate the full hierarchy of energy associated with architecture and urbanization. As the 2015 book *The Hierarchy of Energy in Architecture: Emergy Analysis* demonstrated, an ecosystem science assessment of the hierarchy of energy in building a typical North American institutional building suggests that about 80 percent of the energy is associated with material and construction, while only 20 percent is associated with the operations (heating, lighting, etc.) of the building. Meanwhile, energy analysis in building science excludes and externalizes the energetics of bio-geophysical inputs and outputs of the system. Given the epistemological and methodological limitations of energy analysis in building science, the use of ecosystem science that was developed for the multi-dimensional accounting of energetics in large, open systems is a necessary advancement of architecture and energy today. *The Hierarchy of Energy in Architecture: Emergy Analysis* provides a concise introduction to this method.

Given the emphasis of the energetics of material production and construction in this evaluation of building, a much more comprehensive architectural evaluation of building over long periods is necessary. To reckon with this observation, *Empire, State & Building* will be published in late 2016. *Empire, State & Building* tracks the building ecology of one building site—that of the Empire State Building—over the last 200 years of construction. Chapters on the respective topics of empire, state, and building offer a broader view of building as a central historical process

of urbanization. This enables meaningful architectural and ecological comparisons between the construction methods, building typologies, and durations that have occurred on this site: from farm and row houses, to the Waldorf Astoria Hotel, and finally to the Empire State Building itself.

Finally, to consider the more projective and design implications of this expanded account of architecture and energy, a third major project is *Wood Urbanism: From the Molecular to the Territorial*, expected to be published in the winter of 2017. This volume assembles a range of research and design work related to massive wood building today. The system boundary of wood necessarily includes everything from forestry practices, manufacturing and transportation processes, and construction, as well as very small-scale thermal, humidity, and physiological responses to wood. As such, wood provides a broad but tangible set of factors that can be linked and amplified by design.

Responsive Environments and Artifacts Lab

Allen Sayegh, Associate Professor in Practice of Architectural Technology, Department of Architecture

research.gsd.harvard.edu/real

The Responsive Environments and Artifacts Lab (REAL) pursues the design of digital, virtual, and physical worlds as an indivisible whole. It recognizes the all-pervasive nature of digital information and interaction in the realms of architectural, urban, and landscape design. The lab takes an interdisciplinary look at the design of the built environment from the lens of technologically augmented experiences, with a strong focus on the sustainability and longevity of technology. Putting the human being at the center and forefront, researchers at REAL examine the emerging ways in which technology fuses into the ways we live, work, and play—from the micro (bodily sensors, smart product design, augmented interfaces) to the macro (interactive buildings, information infrastructures, communication frameworks).

Key research questions addressed by the lab include:

- What is the impact of digital technology on the experience of the built environment?
- What are the transformations that the emerging spatial intelligence of cities will foster?
- How can responsive environments facilitate the creation of new forms of relationships with the city?
- What experiences are truly physical, and what are truly digital today?
- How does mediated matter permeate our environments, our surroundings, and our personal space?
- How can the functioning mechanisms and dynamics of existing urban contexts promptly respond to the user needs and contextual occurrences?
- How can we design for an audience that is rapidly adopting new technologies and what approaches can we take to embody responsiveness in our design decisions?

The research pursued by the lab tackles pressing problems of urban contexts by assuming that the inner intelligence of a city starts from its individuals and its built environment, and technology, tools and digital infrastructure augment what the specific community and a place have to offer. This research addresses the challenges related to the integration of digital technologies in cities, exploring both opportunities and repercussions on the spatial structure of the built environment as well as on the experience of citizens in both physical and virtual realms.

Studies at REAL also investigate the role of new augmenting and responsive technologies in articulating, mapping, and exploiting the specificities of places through a multisensory approach. Combining objective analysis and subjective experience, projects research urban qualities that are measurable that help us understand cities in new and perhaps previously unexplored ways.

By researching, designing, and prototyping responsive environments and artifacts that take advantage of the increasing number of opportunities that innovative technologies offer today, the main objective of these studies is to better inform design decisions for the creation of enhanced urban experiences and ultimately for the improvement of the daily lives of citizens—beyond the efficiency—and optimization-driven approaches widely employed today by technology's advocates.

City Form Lab

Andres Sevtsuk, Assistant Professor of Urban Planning, Department of Urban Planning and Design

cityform.gsd.harvard.edu

The City Form Lab is investigating how urban form affects the quality of life in 21st-century cities. It develops new analytic software tools for urban designers and planners and researches the effects of city design decisions on social, economic, and environmental wellbeing.

The City Form Lab has been developing and freely sharing the Urban Network Analysis plugins for Rhinoceros 3D and ArcGIS software platforms, which enable researchers to analyze relationships between people and places along spatial networks. The UNA Rhino toolbox, released in 2015, has been downloaded by over 3,000 users worldwide. The UNA GIS plugin, released in 2011, has been downloaded by over 100,000 users worldwide. The lab is also using spatial analysis tools to investigate business location choices, property values, and walkability in cities.

Counter to conventional wisdom among urban designers and transportation planners, one of our recent papers, published by *Urban Morphology*, demonstrates that smaller city blocks are not always better for pedestrian accessibility. Using spatial network analysis and simulation, we show that depending on parcel and street dimensions, larger blocks can provide pedestrians with better access to surrounding destinations than smaller blocks.

In another paper, published by *JPER*, we investigate which detailed location attributes explain retail and food service establishments' location patterns in dense urban environments. Distinguishing between agglomeration and location effects, the paper discusses built environment factors that affect retail and food business location choices as a group and explores the differences between individual store types individually.

Every built environment contains a spatial order, marked by relationships of proximity and adjacency between different buildings, public spaces, and routes that connect them. The UNA toolbox helps planners and architects analyze these relationships and quantify how intensely different routes are likely to be utilized, how visible or connected public spaces are, or how conveniently one can get from one space to another. This, in turn, helps us understand what locations in the city suit better or worse for particular land uses, how many and what types of users of public space are likely to benefit, or how the activities in one location might influence another.

Predicted peak hour foot-traffic on streets around Davis Square metro station in Somerville, MA, including walks from homes to the subway and from subway to employment locations within an 800m walkshed.

The Body of Evidence: The Palace of Westminster's Trial by Fire

Edward Eigen, Associate Professor of Architecture and Landscape Architecture, Department of Architecture and Landscape Architecture

Eigen's research began with a "body of evidence"—the report of the royal commission appointed in 1837 for the selection of stone to be used in the new Houses of Parliament. The commissioners, including the architect Charles Barry along with economic and structural geologists and stratigraphers, visited more than 100 quarries and as many buildings to assess the quality and durability of selected specimens. Their findings provided insight into not only the dense interiority of matter, but also the prevailing climate. The effects of the chemical and mechanical causes of the decomposition, they observed, are greatly modified according as buildings be situated in "smoky towns" or rather "in those places in open country, where many of the aëriform products which arise from such towns, and are injurious to buildings, are not to be found." The most telling litmus were those emblems of the Romantic imagination: "buildings in a state of ruin, from being deprived of their ordinary protection . . . constitute an equally severe test of the durability of the stone employed in them."

When considering the current rate and scale of atmospheric change and urbanization, it might not be possible nor even useful to sustain the time-honored categories of city and country. But there is still much to be learned from the commission's findings and the evident failure of its practical application. The choice of Anston limestone proved to be monumentally unsound. Before it was even complete, the new Houses of Parliament began showing signs of decay. A morbid body of evidence, this national emblem in stone became an open-air laboratory of endurability.

Originally conceived as a pendant to Eigen's earlier published research on the destruction by fire of the Houses of Parliament, the opportunities furnished by the Dean's Junior Faculty Research Grant to conduct a new round of archival excavation and site visits have provided the foundation and ground floor of a broader, collaborative project on the legibility and liabilities of stone as a building material and cultural matrix. The evolving table of contents for *Lithographies*, as the planned volume of research- and design-based investigations is to be called, includes contributions from GSD alumna Anna Neimark and current and former faculty members Zaneta Hong and Jane Hutton. What is proposed is a sort of Rosetta Stone to interpret and interpolate the potentially non-congruent uses and meanings of an immemorial building material and its present-day analogs and synthetic substitutes.

Planting Coastal Infrastructure

Rosetta S. Elkin, Assistant Professor of Landscape Architecture, Department of Landscape Architecture and Associate, Harvard Arnold Arboretum

The research proposes a model whereby the biological arrangement of plants above and below ground can lead to a new paradigm in the modification of coastal environments. By offering a consideration of plants in which woody material becomes the primary wave attenuating agent, the proposal exploits disturbance regimes to cultivate rhizomes––plant species with extended and interconnected root mass––as structural components. Roots are rarely offered as a measure of resilience, despite their biological capacity to structure soil.

The ideas offered as part of this research synthesize around the necessity for new paradigms in practice, in order to move away from the commonly held ideas that the materials of grey infrastructure (concrete, steel) are resilient to storm events, and that the role of green infrastructure is not one of protection or defense, but of ecosystem services. Therefore, the research contributes to established concepts in the development of nature-based features, arguing that the influence of the root zone ought to be measured and considered alongside other built features. Roots have the capacity to adapt uniquely over time, growing back stronger following disturbance. Faced with uncertainty as a result of a changing climate, *Planting Coastal Infrastructure* proposes that self-organizing processes can be harnessed to generate ecological transitions and alternative scenarios that do not replicate a past equilibrium or offer a false promise of stability. Species are selected to collapse above ground, increasing their productivity below ground. The project aims to gather data on the concealed foundations of species development, in order to amend the typical coastal berm construction detail.

The study of roots is complicated by their concealed position underground. Therefore, satisfactory data must be generated in order to move the project forward. In collaboration with US Army Corps of Engineers, and those involved in the Living Shoreline program, we are currently deliberating upon the possibility of adapting existing riparian models to include root zones and embed saline levels. Concurrently, the Natural Resources Conservation Service of USDA (NRCS) is invested in real-time data and measurement at their physical site located along the New Jersey coast. Exposing plants of varying ages to a series of disturbances would enable a different dataset to develop from in-situ monitoring. At this stage, the project is funded in order to convene expertise from within the GSD community in dialogue with both federal agencies, in order to advance the digital and analogue models under consideration.
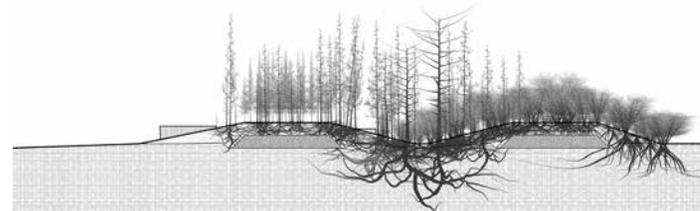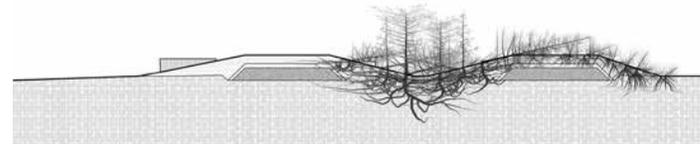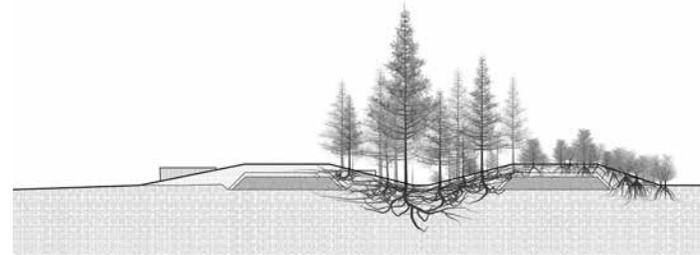
Surplus Housing: Models for Domestic Space and Urban Life in South America

Felipe Correa, Associate Professor of Urban Design, Department of Urban Planning and Design

Sponsored by LandInvest

sap-network.org

Surplus Housing: Models for Domestic Space and Urban Life in South America examines how a comprehensive overview of the affordable housing delivery process can help redefine the provision of mass housing in Brazil and the region at large. Furthermore, the work examines how new public/private models of urban development, paired with a careful re-examination of the spatial identities that shape them, can provide an alternative to the ubiquitous landscape of repetitive dormitory cells by introducing more vibrant mixed-income and mixed-use urban districts. Looking across a variety of scales—from the interior of the unit to the scale of the district and the city—the project proposes a new physical, social, and economic template for housing delivery. While prototypical, the concepts and strategies explored in this project are geared toward intermediate-scale South American cities—urban agglomerations with a population ranging between 500,000 and 1,500,000 inhabitants—that are expected to have the greatest urban growth in the decades to come.

Central to this applied research project are the following three questions:

How can the diversification of housing typologies help encourage mixed-income development while providing variance in the configuration of interior spaces?

Can housing development, anchored within an expansive notion of domesticity and urban life, serve as the backbone for a more comprehensive urban project bringing mixed-use programs into the financial template?
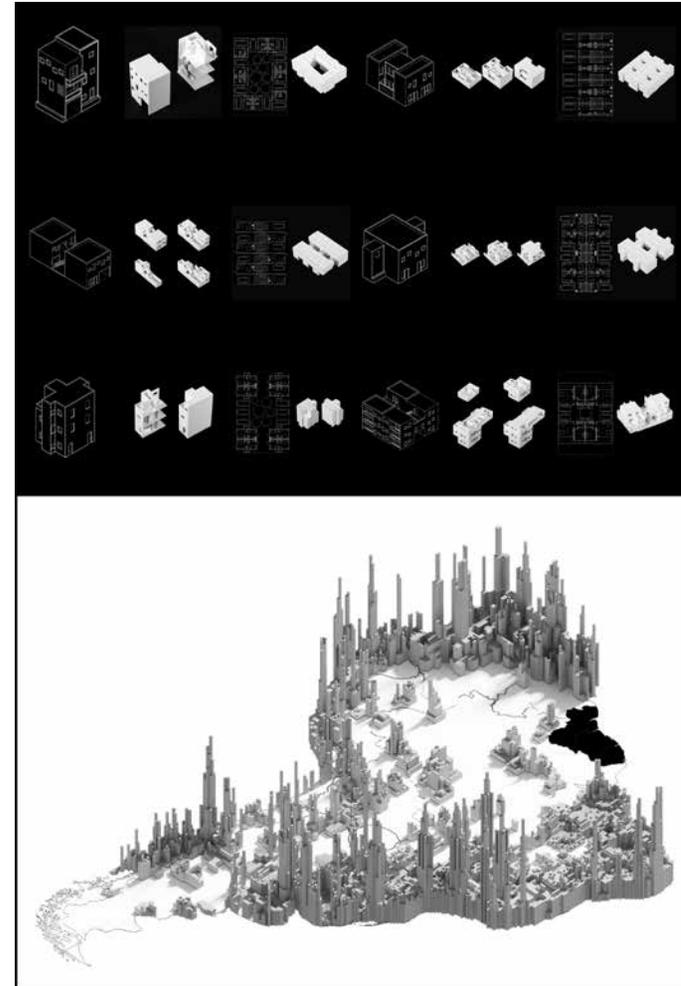
Can a housing project incorporate hard and soft infrastructures (education facilities, cultural centers, basic services) as an integral part of the housing delivery system? In doing so, can it provide surplus value to the house beyond the value of the unit itself?

Organized in seven research lines, the project examines the following topics:

1. The Landscape of Affordable Housing in South America
2. Affordable Housing and the Intermediate-Scale City
3. An Inventory of Best Practices in Affordable Housing
4. The Affordable Housing Unit and the Composite Cell
5. From Housing Fields to Mixed-Use Districts
6. Concepts for a New Prototypical Town
7. Recommendations for a New Era of Affordable Housing

top: study of diversified housing typologies
bottom: urban densities throughout South America

Transforming Urban Transport: The Role of Political Leadership (TUT-POL)

Diane E. Davis, Charles Dyer Norton Professor of Regional Planning and Urbanism, and Chair, Department of Urban Planning and Design

research.gsd.harvard.edu/tut

TUT-POL seeks to advance actionable knowledge of how, when, and where political leadership has proven critical to the successful implementation of transformative transportation policies. It does so through case study research of eight localities— Los Angeles, Mexico City, New York City, Paris, San Francisco, Seoul, Stockholm, and Vienna—all central cities of major urban regions around the world, embedded in contexts of democratic governance, and bearing marked change in transport system characteristics within the last 20 years or so against, *ex ante*, what might be considered overwhelming odds.

In focusing on the *how's* of implementation, the research investigates the place-based relationships and conditions that enable or constrain the introduction of transport policies intended to challenge car-centrism and change mode-share while also fostering mobility and environmental aims. A starting point for the research is the institutional context of governance—for instance, degrees of centralization, decentralization, and overlap among local, regional, and national authorities. Yet equal attention is also paid to involvement of political parties, civil society, the private sector, and other potential stakeholders in transport policy decision-making as well as the interactions between technical experts, political actors, and civil society. A larger aim of the research is to theorize the conditions and processes, political and otherwise, that have most successfully moved transport policy initiatives from the drawing board to the real world.

Finally, in seeking to better understand why a given transport policy might be considered "transformative," we examine the extent to which it contributes to changes in the spatial form, socio-economic composition, and governance of cities. Although we start from the assumption that some of the most effective and long-lasting changes in modern cities come from innovations that alter the way citizens and vehicles move (or not) through physical space, we also recognize that truly transformative change is not merely a product of new mobility practices. It also is a function of the ways that adoption of certain transportation policies might drive governing actors and institutions to transform their own mandates and responsibilities, not just in terms of regulations and accountability but also with respect to their longer-term capacities to produce alternative urban futures, transportation-related or otherwise.

In combining both scholarly and practical aims, TUT-POL is producing a wide range of deliverables including an edited volume (bringing together short versions of eight cases) and scholarly journal articles, long versions of cases on the project website for free download along with supplementary pedagogic material, summary briefs and reports of findings for practitioner audiences, and blog articles and popular-media pieces. Dissemination activities and events include webinars, seminars, summits, and conferences in the US, Europe, Asia, and Latin America with audiences of planners, elected officials, and policy researchers, as well as university-based scholars and students.

The restored Cheonggyecheon stream in the TUT-POL case study city Seoul, South Korea.

(Re)planned Obsolescence: Rethinking the Architecture of Waste, 2015–2017

Hanif Kara, Professor in Practice of Architectural Technology, Department of Architecture

While industrial architecture and, to a certain extent, the infrastructure for modern urbanism share a common set of materials, methods, and techniques, only recently have we been able to separate the dynamics of industrial architecture from the currents of modern architecture. One reason for this is that the transformation of interdisciplinary discourse brought by the information age has generated its own architecture with concomitant effects on industry and industrial architecture in which the architects remain largely absent. The Waste project at the GSD was set up to undertake three years of sponsored research using waste-to-energy plants in Sweden and the USA to elicit a repositioning of the role of design and architecture in infrastructural projects.

Our research is based on a number of key objectives, all designed to work toward our main goal of creating a framework that cultivates a pedagogical curiosity about, and reconsideration of, the role of waste in society. We want to better promote design while developing educational material in this area. We aim to strengthen the understanding of what is known and not known about the role of design in waste-to-energy facilities, looking to find why there are outstanding gaps in this area, identify what they are, and how they can be addressed with design. The research develops working methods and processes that enable collaboration between designers, architects, clients, policymakers, and other stakeholders, and makes recommendations for future research, education, and industry.

This all came from our research hypothesis—that while architecture and design are absent (if not completely neglected) in waste-to-energy projects, these disciplines can contribute significant value through programmatic hybridization, performance enhancements, contextual assimilation, and increased societal acceptance. The interdisciplinary approach we take therefore draws on the technical, societal, and cultural interactions that recognize that the demand for waste-to-energy facilities is likely to increase worldwide due to waste production and the demand for alternative sources of local energy.

We took a hybrid approach to research, consisting of three methods: quantitative, qualitative, and design. Quantitative methods enabled us to forecast demand, understand input/output mechanics of waste-to-energy facilities, and recognize performance parameters in the facility as is and in potential programmatic hybrids. Qualitative methods allowed us to identify key socioeconomic enablers for waste-to-energy facilities and understand key stakeholder drivers through semi-structured interviews. Finally, design methods have helped us develop and test the proof of concept for prototypical design solutions and programmatic hybrids.

Following the development and maturity of our findings, the research is disseminated through graduate seminars and design studios, which have released primary findings to small groups of students and faculty. A manual is currently being drafted for publication in January 2017, and it is intended for a small exhibition and seminar to take place in Sweden or the GSD in 2017/2018.

One intention is to ally design with the waste-to-energy industry through igniting a renewed interest among architects to engage with what we have labelled *Architecture and Waste*, encouraging an earlier and closer collaboration with those involved in this contemporary building type. We hope to get those directly involved in waste incineration—governments, large specialized private industrial organizations, city authorities, and the public—to see the value of design.

Looking to the horizon, economic models that decouple global economic development and finite consumption, first developed by major schools of thought in the 1990s, have recently gained more traction and hint at recasting the historical principles of obsolescence as we know them today under the rubric of the circular economy. A key principle of this approach is that waste itself is designed to become obsolete. As a society, we are some way from this becoming a reality, but as we edge toward that goal there is a demand for many more facilities to be designed and built throughout the world. We hope this manual adds value to and improves the design approach toward these waste-to-energy plants.

A Sustainable Future for Exuma: Environmental Management, Design, and Planning

Mohsen Mostafavi, Dean and Alexander and Victoria Wiley Professor of Design

Gareth Doherty, Assistant Professor of Landscape Architecture, and Sr. Research Associate, Department of Landscape Architecture

Sponsored by His Highness the Aga Khan

sustainableexuma.org

This multi-year ecological planning project was a collaboration among the Government of The Bahamas, the Bahamas National Trust, and the GSD. The goal was to facilitate the design and management of a more sustainable future for Exuma, an archipelago of 365 islands and cays, and The Bahamas more generally.
'
We sought to answer four main questions:

1. How to learn about the realities of daily life on the islands?
2. How to develop an ongoing interaction, rather than a document that sits on a shelf?
3. How to build more sustainably on the islands?
4. How to more effectively communicate within Exuma's oral tradition?

The first phase of the project focused on fieldwork and engagement including participation in daily routines that created a better understanding of local issues particularly across Exuma and more generally across The Bahamas. We sought to understand local issues through various forms of public engagement. Public forums, workshops, and conferences were part of the process, in addition to fieldwork that facilitated the connection of researchers with residents. The second phase of the project focused on proposal making, where we designed and imagined projects that have the potential for a long-term spatial and economic impact, while the third phase focused on a plan for action and implementation. The project has two

parallel and mutually informing components: research and education.

Research

The project's research branched into four main parts: resource management, economic development, governance, and sociocultural issues. These four components break into more specific subcomponents, including analysis of geology, economy, waste, energy, food, water, mobility, tourism, visual pollution, and mechanisms for implementation. The project also identified a series of case studies from around the world that offer potential lessons for the future of Exuma.

Education

The educational component was divided into six main components, including conferences, forums, and workshops. Each year of the three-year project, full scholarships were offered for Bahamians to take part in any of the degree programs at the GSD and we now have two Bahamian students supported by the Exuma Fund. We also awarded sixteen scholarships for Bahamians to take part in the Career Discovery Program. The Executive Education component included courses offered in The Bahamas, designed for government officials and educators, as well as selected openings for Bahamians to take part in the various programs at the GSD. Harvard faculty were available for educational outreach in The Bahamas and the FAS-GSD cross-listed course on Design Anthropology had a focus on the Exuma project during the

project, collaborating also with the College of The Bahamas.

The project resulted in a "toolbox," each tool aimed at a different constituency for activation, including various government ministries, the Bahamas National Trust, the College of The Bahamas, individuals, and the Exuma Alliance, an NGO formed specifically to implement the projects' recommendations.

The final phase of the project focused on communication. While several essays are in process for peer-review, we wanted to reach a broader audience than the academy. We held exhibitions at the GSD and the College of The Bahamas, and currently the exhibition is open at the National Art Gallery of The Bahamas until the end of October 2016. Underlying the dynamics of the exhibition, and future publication, are four propositions:

1. Engage widely
2. Work across scales
3. Share knowledge
4. Imagine futures

The Exuma Toolbox—which is part book and part traveling exhibition for the smaller islands—will be published by Actar in 2017.

Administration

Mohsen Mostafavi
Dean and Alexander and Victoria Wiley
Professor of Design

Patricia Roberts
Executive Dean

Antoine Picon
G. Ware Travelstead Professor of the History
of Architecture and Technology
& Director of Research

Anne Mathew
Director, Research Administration

Nony Rai
Coordinator, Research Administration

For additional information on the GSD Design
Labs and other research programs, please
refer to www.gsd.harvard.edu/research

For GSD faculty profiles, please visit
www.gsd.harvard.edu/faculty

Harvard University
Graduate School of Design
48 Quincy Street
Cambridge, MA 02138

www.gsd.harvard.edu