MAKING MACHINES: The Makerspace as the new Factory

CCNY Fall 2018 Studio Syllabus

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Increasingly over the past several decades, the manufacturing industry has shifted production to locations where labor costs are low. The Factory - where the norm is mass-production and a large supply chain and infrastructure exist between "thought", "production" and "use" - occupies a very different place in western society than half a century ago. In its place, however, is emerging the **Makerspace,** a different place for making. Makerspaces exist across the planet and offer anything from DIY biology wet bench facilities, through jewelry making and neon tube glass blowing, to advanced robotics and microelectronics and construction component prototyping and production.

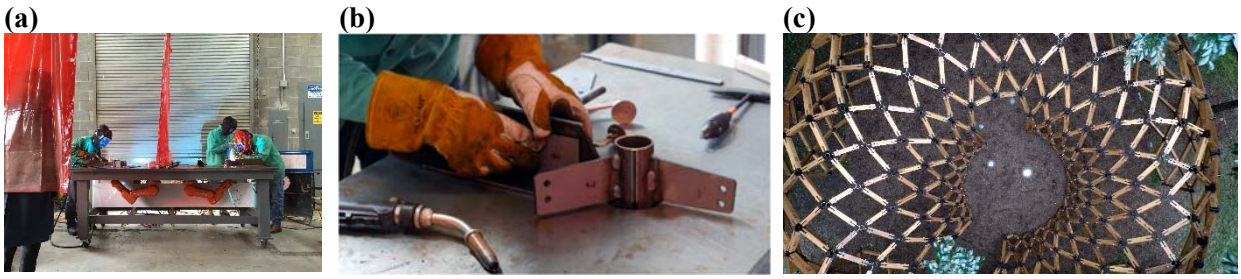
Left, abandoned blast furnace, Charleroi, Belgium. Right, the Autodesk BUILD Space, Boston, USA.

Three common themes permeate the Makerspace culture: (1) local community engagement, (2) a direct connection between thought (design) and action (making), and (3) an ability to produce at small as well as large scale. The two latter points are what distinctly sets the Makerspace apart from its predecessor, the Factory.

Context

The United Nations estimates that buildings are estimated to produce 40% of total global greenhouse gas emissions, distributed between construction activity and buildings in operation. Energy codes are becoming ever more stringent, largely driven by an increased public awareness of our built environment's direct impact on global climatic change. As an example, the New York City energy code currently has a proposal for an amendment in the 2021 code update [2], in which Passivhaus-like standards would be implemented for all new construction. If implemented, this would greatly increase the requirements on building envelopes with regards to air infiltration and thermal insulation, as well as on performance requirements of mechanical systems. Architects and designers who learn how to work within this new playbook will have tremendous advantage once these standards become codified.

In parallel, the advent of novel fabrication techniques is starting to change the construction playing field permanently. We can now curve oversized float glass and assemble into insulated glazing units (IGU:s), automate light gauge metal stud fabrication, and by using robotically assisted incremental metal forming create complex curvature from sheet metal with high accuracy and at low cost. Similarly, robots are moving beyond fabrication; robotically assisted assembly in construction is, while still at an experimental stage, thought to hold potential for major disruption of the field.



(a) Dual undermounted robotic work-cell used for the fabrication of the 376 welded steel nodes in the Lo-Fab Pavilion (b) Robotic positioning system allows the welder to repeat the same action no matter the node geometry (c) Final assembled pavilion on the Rose Kennedy Greenway in Boston. [Image credits: (a), (b) by Nathan King, Autodesk, (c) by Thatcher Bean, MASS Design Group]

Given the silo-ed nature of contemporary building culture, architects need to continually deepen their education on the wealth of materials, fabrication and assembly techniques available. We have tremendous resource and technological power at our fingertips, but also increasingly seeing the consequences of our way of life. At a time of depleting resources, increased pollution and global uncertainty it is more timely than ever to advance new forms of creativity and responsible innovation, in order to create the best possible buildings with the means we have at our disposal.

Left to right, extreme drought and extreme precipitation within the space of one year in California, USA.

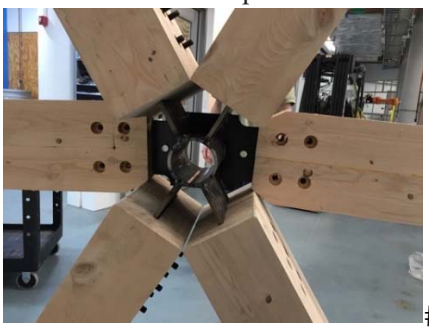
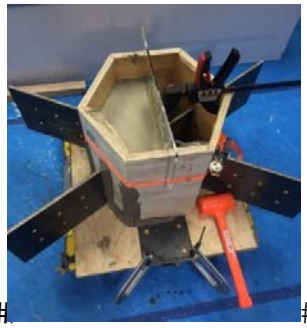
Studio Mission statement

Our studio is interested in investigating strategies of design, fabrication and construction which hold the above statements in central, critical view. Our studio builds on a series of research themes that have been pursued across several years and between practice, industry and academia through instructors' present and past formal and informal affiliations. While we are appreciative of aesthetics, we do not see it as an end in itself, but rather as a possible and even likely outcome of efficiently performing, well designed buildings. We value performance over form and efficiency over everything. We draw inspiration from old masters like Brunelleschi and Gaudi as well as from contemporary ones like Norman Foster, Moshe Safdie, Thomas Heatherwick and Bjarke Ingels. We draw it from engineers like Buckminster Fuller, Frei Otto, Peter Rice and Ted Happold. We draw it from sculptors like Isamu Noguchi, Konstantin Brancusi and Jean DuBuffet. What all of these have in common, and what truly inspires us, is discipline-transcending thinking and a refusal to remain in a silo-ed reality. Each in their own way they always tend to gravitate towards crossover approaches, whether it be science, technology, art, media studies or social science. Finally, we draw inspiration from nature itself, and from her curiously efficient systems which silently labor away all around us all the time at the invisible scale. The studio, in summary, has an agenda which is not formal but performative. Drawing on instructors' industry experience within architecture, engineering, construction

and making we aim to build what we design at full scale, which requires us to understand our designs to a detailed level.

Site

Our site will be in New York City and will deal with several of the factors of building in a highly dense urban environment with a rich historic fabric. During the semester we will undertake an optional but highly recommended study trip to New England with Boston as it center. There we will look at architectural objects of interest and contemplate a city with similar history to NYC, but with a very distinctly different present regard to scale, character and urban condition. While in Boston we will engage with the Autodesk BuildSpace, a state of the art maker space and fabrication facility located in the historical Seaport District, which is currently undergoing significant urban transformation. There we will undertake a short but intense collective full-scale prototyping exercise based on select designs from the introductory design charrettes. We will also visit several experimental facilities at MIT, Tufts and Harvard where new developments in fabrication techniques and material science are driving architectural discourse forward.


Left and center: Partially completed structural node prototype created by team Perkins + Will in the Autodesk BUILD Space to serve as a proof of concept for the structural system for the proposed River Beach Tower. [Image by Autodesk BUILD Space]

Right: 3d-printed visualization from the BUILD Space's Stratasys PLA machines of molecular structures' aggregation and intra-molecular binding [Image by Giorgia Cannici]

Program

Inspired by our experience at the BuildSpace, we will set out to create a new Makerspace for NYC. Community engagement has a long and proud tradition in NYC, so one crucial component in the conceptualization will be to understand key factors of how communities can be activated and feel involved in – rather than alienated by - local architectural development and its digital/virtual and physical presence.

When the Makerspace is thought of as a place where the pieces are made to build the space itself, interesting questions arise. What if, for instance, an embryonic version of the Makerspace is placed in a community, whose members are activated inside the space in order to expand on it; add to it using the space and the objects made in situ? How can novel techniques and technologies – such as functional parts 3d-printing [link] and robotic assembly – help us move away from the representational and the prototypical, and toward the final product? When the Makerspace can truly replicate itself, will we then have hit a "singularity of making" – to paraphrase Ray Kurzweil – and closed the loop on design to production?

These are all questions we aim to affront during the first third (approximately six weeks) of the semester, which will kick off with a series of fast design charrettes and workshops and culminate with our study trip. Following our return to NYC, the remainder of the semester will be spent developing projects in depth in groups of two to three students through desk critiques and invited workshops and lectures.

Preliminary schedule:

Week 1-6: Group research and Fab Intro

Week 7-8: Prototyping

Week 9-11: Consultant Co-Lab

Week 12-16: Proposal Development

Bibliography and suggested readings:

[1] Un Habitat, "Planning Sustainable Cities: Global Report on Human Settlements", 2009

[2] Urban Green Council: "Blueprint For Efficiency: An 80x50 Buildings Partnership Report", 2018 (https://www.urbangreencouncil.org/content/projects/blueprint-efficiency-80x50-buildings-partnership-report)

[3] Food And Agriculture Organization Of The United Nations, State Of The World's Forests, 2009.

[4] Kurzweil, Ray, "The Singularity is near", 2005

Brynjolfsson, Erik and McAffee, Andrew: The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies

Sadao, Shoji: Buckminster Fuller and Isamu Noguchi: Best of Friends

Rice, Peter: An Engineer Imagines

Crisinel, Michael: Glass & Interactive Building Envelopes

McLeod, Virginia: Detail in Contemporary Timber Architecture

Sennett, Richard: The Craftsman