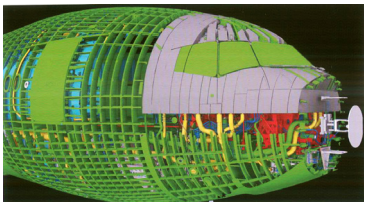
Columbia Building Intelligence Project
CBIP 2014 Studio

Columbia University GSAPP
Design Critics: David Benjamin, Laura Kurgan, Scott Marble (CBIP Studio Director)
Software Consultants: Adam Modesitt, John Cerone, Jason Roberts

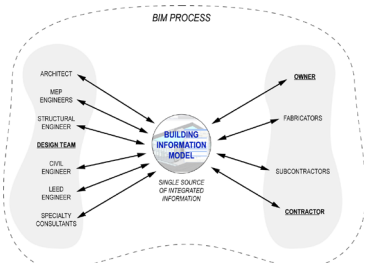
Student Software Assistant: Carlo Delano Bailey



Boeing 777 Because of the capabilities of Catia to simulate a virtual prototype, the 777 was the first passenger jet to be designed without a full scale mock up. 5000 Engineers in 26 countries collaborated on the design of the project.

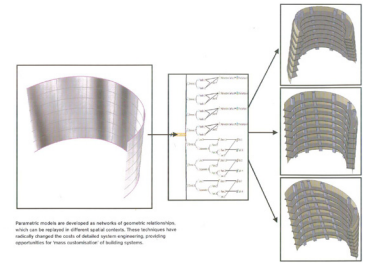
About CBIP

The Columbia Building Intelligence Project (CBIP) developed to explore new technology-enabled design collaboration in architecture. Driven by the increasing amount of metric-driven data relevant to the design of the built environment, advances in digital design tools and communication technologies and a new entrepreneurial spirit among a younger generation of designers, the goal is to foreground collaboration as a design issue for architects. The project also directly engages with current industry trends around new technologies and takes a critical response to the lack of creative options to Building Information Modeling and Integrated Project Delivery as viable methodologies.



BIM Model Diagram

CBIP began as a pilot research project in the fall, 2009 with a public Think Tank in New York that brought together leading experts from various sectors of academia and industry in an open dialogue about current and future trends in collaborative working methods. The first CBIP Studio followed this in the spring, 2010. Since then, we have had international Think Tanks in London, Tokyo, Stuttgart and Toronto along with yearly Think Tanks in New York that have served to inform and focus the Studio each year by bringing the insights of experts from around the world into the research of CBIP.

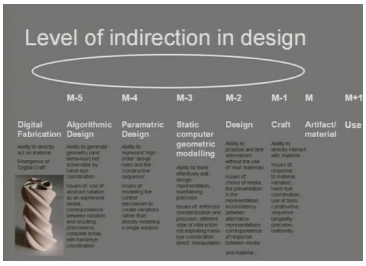


Parametric models are developed as networks of geometric relationships which can be replayed in different spatial contexts. (Dennis Shelden, Gehry Technologies)

Now in its fifth year, CBIP continues to evolve, building on the successes of the past years while continuing to focus the core questions of the research. Some of the more open-ended questions of the pilot phase have become more focused, while altogether new questions have arisen, which has pushed the studio to simultaneously become more rigorous and speculative.

Here are just some of the questions posited during the pilot phase that lead to the work produced by the students:

• What are the new models of collaboration in the context of increasing specialized design information?
• How can these new models expand the scope and capabilities of architects to embed the role of design in the total process of realizing a building?
• Is this leading to new forms of consultancies and practice and if so, do they take the form of large conglomerate organizations or small independent and agile nodes in a collaborative network?
• As individual projects and large aggregations of projects evolve to include more and more information, as well as more and more stakeholders, how might diverse and decentralized groups make intelligent design decisions?
• In architecture, is it possible to leverage “the wisdom of crowds,” as theorized by business writer James Surowiecki?
• Is there a way to take advantage of “crowd sourcing,” the contribution of many



by Robert Aish.
Digital processes in architecture have evolved from static computer drafting to dynamic parametric modeling that manages complex relationships between building parts. With digital fabrication, the connection to craft comes full circle as the work of architects now link directly to production.

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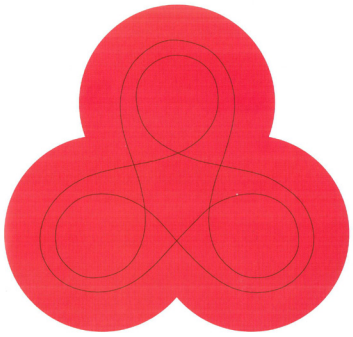

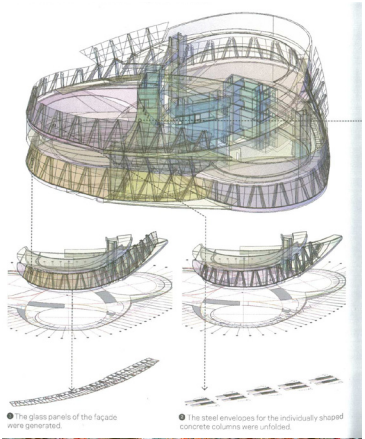

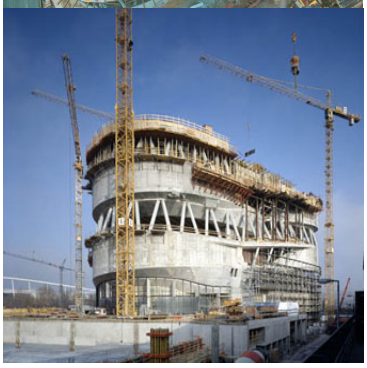

Mercedes Benz Museum, UN Studio.
The parametric model for this project not only described the geometry of the design but also was used to produced fabrication information for many parts of the building. It was also used during construction to manage and update associative parts when changes were made to help coordinate the work of all trades.

distributed users toward a collective product?
• Can open source design methods pioneered for software development be applied to or reformulated for architectural design?
• Might an open source model start to change the one-off nature of buildings and reduce inefficiencies in the design and construction industry?
• How might multiple independent parties build successive versions toward the goal of a single deliverable?
• Could modules of buildings and 3D files be “checked out,” revised, and “checked in” by different architects, fabricators, and contractors over time durations that exceed a single project?
• If complex building components could be designed, documented, and released into a broad architectural community, how would intellectual property be handled?

CBIP Workflow

In this studio, we will experiment with the same sophisticated modeling and project management software currently used in industry for its most advanced projects. We will explore new forms of Building Information Modeling (BIM) and parametric modeling techniques that challenge conventional applications that are becoming industry standards.

As in past years, the core of the design workflow will revolve around *Dassault Systems* CATIA, a powerful software package originally used for design and production in the aerospace industry and now increasingly used for designing and constructing todays most complex architecture projects. Over the course of the semester, students will become fluent in CATIA as well as in other applications for simulating building performance and managing design information. Students will learn to create robust and reusable parametric models.

Unlike a typical studio in which students produce isolated stand-alone designs, the CBIP studio is based on a *design-and-release* model. The design task for each student will involve the creation of sophisticated parametric components (Elements) that can be formulated, tested, compiled and released for others to use. Each design Element will be created in CATIA, documented with an instruction manual, and then made available as a tangible research product that others can download, re-configure, and utilize. The Elements will be used in single instances, but their primary role is to be integrated with other Elements into comprehensive design proposals (Strategies). By the end of the semester, students will have designed dozens of individual Building Elements, as well as several Building Strategies, that will become part of the CBIP Library, which currently has over 90 Elements and 20 Strategies from previous studios.

While the studio will be software-intensive, no prior experience with specific software is required. And while the studio will use sophisticated parametric design applications

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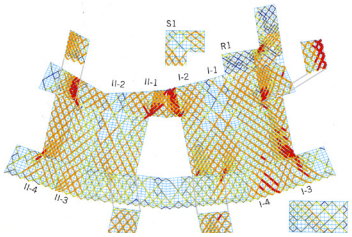
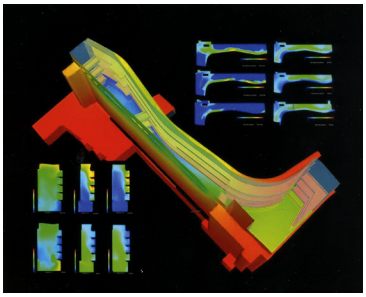


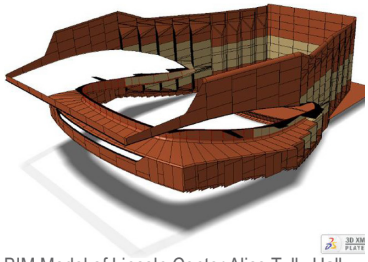
Diagram of axial stresses in modified perimeter structure (CCTV building in Beijing)

and other digital tools from engineering and computer science, *CBIP is a first and foremost a design studio*. Our objective is to combine the most creative thinking with the most advanced digital tools in an effort to push design to a new plateau. The studio will also incorporate more intuitive sketching software such as Rhino, as well as non-software-based design techniques. And it will take on the complex challenge of incorporating issues around culture, program, history, and aesthetics – issues that resist easy quantification – into the design workflow. Ideas, concepts, and imagination will drive the entire process


Multiple computational fluid dynamics (CFD) models for environmental performance in winter and summer. (University of Michigan Research Building)

New CBIP Partnership

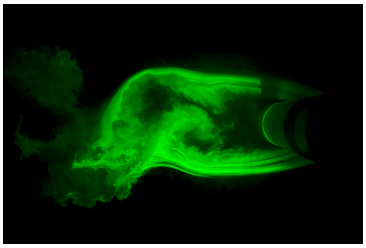
For the first time, CBIP is also partnering with *Dassault Systems* (the maker of CATIA) to roll out its new 3DEXPERIENCE collaborative platform. *Dassault* has been developing this platform for several years as part of a concerted effort to transform the design and construction industry. After seeing the student work from past CBIP studios, they immediately saw new design potentials for their software as well as a shared ambition to completely rethink current conventions. With this new partnership, CBIP students will be the first users of this powerful new platform and the full suite of associated design tools.


BIM Model of Lincoln Center Alice Tully Hall, Gehry Technologies. Diller, Scofidio & Renfro, Architects.

Studio Structure

CBIP 2014 will take a new approach to student and critic collaboration. The studio will be divided into three research units taught by Scott Marble, Laura Kurgan and David Benjamin and while each unit will have a unique focus, they will be closely integrated in content and method. In addition, CBIP will be a vertical studio comprised of both 2nd and 3rd year students. Each critic will provide a supplement to this general syllabus outlining the focus of their research unit in more detail.

Students will be based with one critic through all phases of the studio but will also have direct interaction with the other critics, as well as the expanded CBIP team. Students will work individually to design their Elements and will have the option to work alone or in groups of up to 3 to design their Strategies.


The use of parametric modeling and performance simulation software is often complemented by physical testing. Here, the massing for a tall building design is tested in a wind tunnel for the effects of vortex shedding. (Benjamin Advanced Studio 4)

The studio will be supported by software consultants who will conduct an initial “bootcamp” session on CATIA. There will also be weekly CATIA workshops throughout the semester that take place outside of studio time that will prepare each student with the necessary skills to develop design solutions and collaborate with others through methods of integrated modeling. During a typical week, each student will have two desk critiques with her GSAPP critic and one pin up with another research unit.

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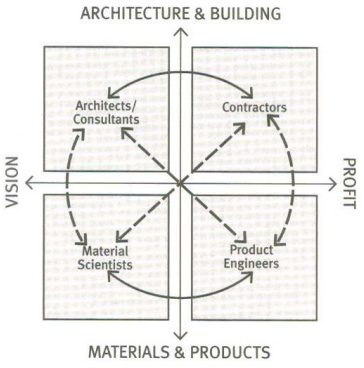
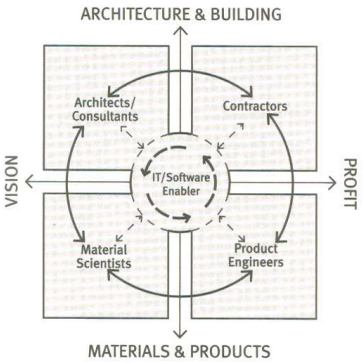


Traditional Industry Relationships The four major disciplines need to cross the boundaries established by their traditional roles.



Enabling Collective Intelligence An entire new industry that produces communication / collaboration software has made it possible for the various parties involved in a project to have real time sharing of information. *from Refabricating Architecture, Kieran & Timberlake*

In addition to the expanded studio team, students will have access to a vast library of resources generated over the past four years including:

• Library of over 90 CATIA CBIP Building Elements from previous years < http://c-bip.gsappcloud.org/library/elements>
• Library of over 20 CATIA CBIP Building Strategies from previous years < http://c-bip.gsappcloud.org/library/elements>
• Video archive of over 50 short “pecha kucha” style presentations by industry leaders from the past CBIP Think Tanks
• CBIP Webpage with select material from the CBIP pilot project < http://c-bip.gsappcloud.org/>
• CBIP Tech Help webpage with dozens of software tutorials and technical resources <http://cbiptech.ning.com/>

The Columbia Building Intelligence Project is generously supported by Oldcastle BuildingEnvelope
Dassault Systems is an industry partner with CBIP

DATA 2.0
Critic Laura Kurgan

Over the course of just one generation there has been a radical shift in the ways in which we inhabit, navigate, communicate and build urban spaces. While we used to replicate the physical world within computational space, now we use computational space to guide us through physical space – GPS, smart phones, social media, smart buildings and so-called smart cities, are just a few technologies which have altered everyday life and work in our cities.

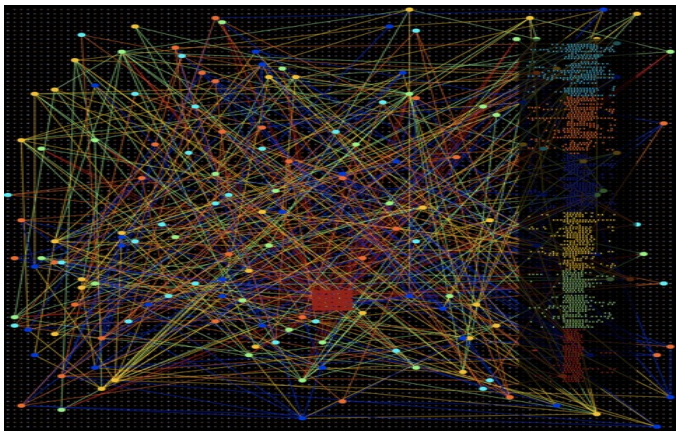
While Manufacturing 2.0 , and Automation 2.0 will take build space as it's priority and infuse it with and 'ecology of numbers', or organizational models and new methods of building, Data 2.0 will take computational space as its priority to inform and infuse physical space and built models. Thought this way, there are a multitude of ways in which the structure of the C-BIP studio will structure collaboration between these three design environments for architecture.

In particular our group we will learn from design around the concept of an Artificial Neural Networks(ANN) as a way to have physical space in fact **LEARN** from data space and vice versa. Today, Neuroscience is at the cutting edge of new institutions of science at many universities today. Columbia's first building on the Manhattanville campus is the Mind, Brain Behavior Institute, (MBBI) which plans to break down many of the silos that exist between Art, Science, Engineering, Social Sciences and the Humanities.

We will have two options for our work. First we are going to look carefully at some of the programs for the urban layer of the MBBI building which will communicate and exhibit science to a broader public. We will use this as a prototype for building an exhibit about new brain science and neural networks which might adapt itself to many other neuroscience buildings which are springing up on campuses around the country – San Diego, Princeton, and Harvard all have such programs, for example; as well as other appropriate locations for such an exhibit.

Second, and simultaneously, we will research what the potential of a neural network might be in any building. As an algorithm of sorts, an Artificial Neural Network, is a method of taking many sources of data inputs which pass through a series of nodes which allow the network to learn from itself by producing outputs which are fed back into the system. We are going to think of how buildings can learn from themselves; we will research data systems in a building which inform physical space, and watch how physical space adapts to it and such that the data is altered. How can systems like this radically alter the ways in which we inhabit and work in buildings, which incorporate systems like this, beyond the smart city?

Data 2.0 is one unit of the CBIP collaborative studio and we will share a common workflow with the other two units as described in the attached general syllabus.



Learning Model: Larry Abbot, Columbia University