CBIP: AUTOMATION 2.0

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BUILDING INTELLIGENCE

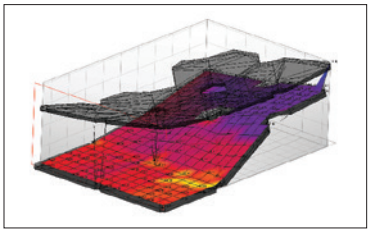
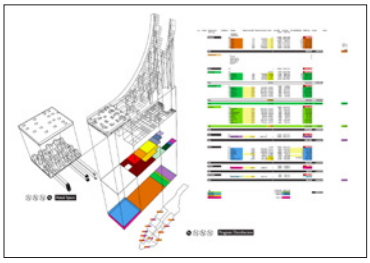
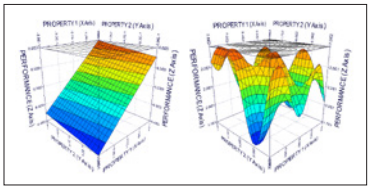
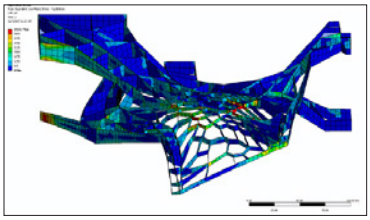
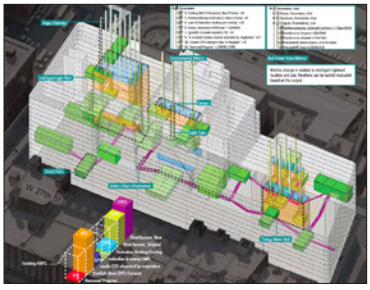
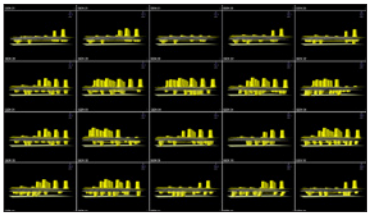
The Columbia Building Intelligence Project (CBIP) was developed to explore new technology-enabled design collaboration in architecture. Driven by the increasing amount of metric-driven data relevant to the design of the built environment, advances in digital design tools and communication technologies 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 cutting edge methodologies.

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.

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. (examples)

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

- What are the new models of collaboration in the context of increasing specialized 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 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.

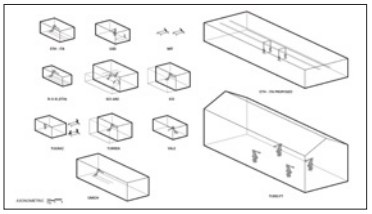
As in past years, the core of the design workflow will revolve around Dassault Systems CATIA, a powerful software package originally used for design and production in the aerospace industry and now increasingly used for designing and constructing todays most complex architecture projects. Over the course 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.

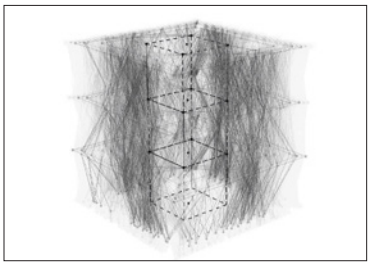
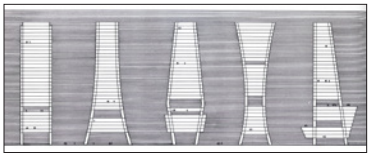
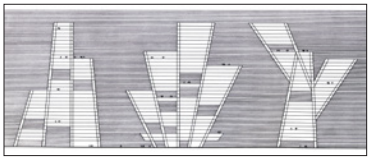
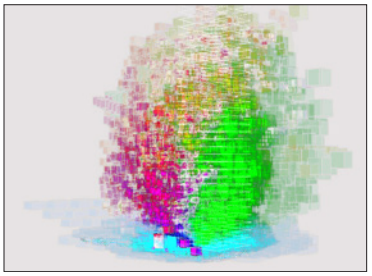
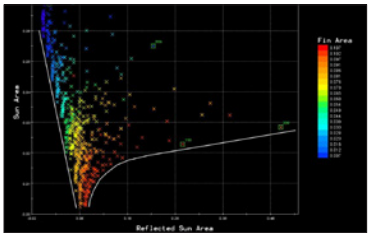
Unlike a typical studio in which students produce isolated stand-alone designs, the CBIP studio is based on a design-and-release model. The design task for each student will involve the creation of sophisticated components (Elements) that can be formulated, tested, compiled and released for others to 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.

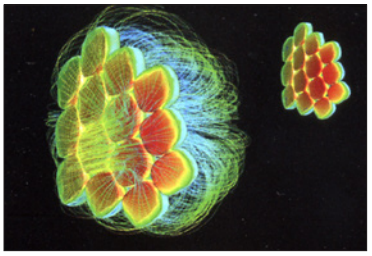
While the studio will be software-intensive, no prior experience with specific software is required. And while the studio will use sophisticated parametric design applications and other digital tools from engineering and computer science, CBIP is a first and foremost a design studio. Our objective is 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

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.

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 studio will be supported by software consultants who will conduct an initial "bootcamp" session on CATIA to expedite the use of this powerful software platform. 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.

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

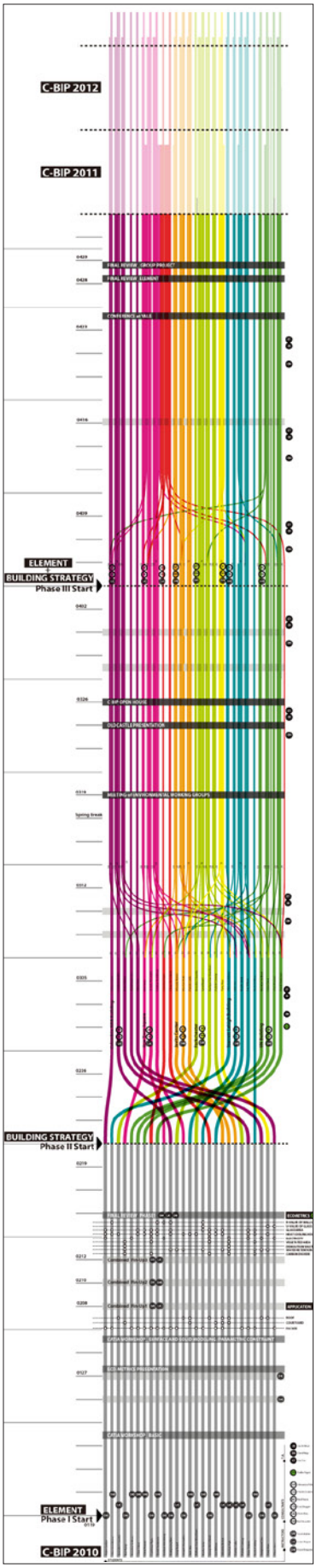
- Library of over 90 CATIA CBIP Building Elements from previous years
- Library of over 20 CATIA CBIP Building Strategies from previous years
- Video archive of over 50 short "pecha kucha" style presentations by industry leaders from the past CBIP Think Tanks
- CBIP Webpage with select material from the CBIP pilot project
- CBIP Tech Help webpage with dozens of software tutorials and technical resources

AUTOMATION 2.0

In this section of the CBIP studio, we will consider how architecture might be defined by an ecology of numbers—an ebb and flood of input numbers and output numbers. To start, we will engage input numbers as a technique to grow geometry. We will use parametric modeling software to create adaptive three-dimensional models that are defined by precise inputs. Then we will write scripts that generate complex forms based on changes in the inputs. This general approach reflects a relatively new paradigm in artificial intelligence: rather than program machines to follow fixed and known rules, set up an emergent system to evolve new and unexpected results.

But applying scripting to generate geometry is only the beginning. The heart of our research will involve the study of how specific input numbers correspond to specific output numbers. After a set of inputs generates a precise form, how do we measure its performance?

For performance analysis, we will a variety of digital simulation packages to test the performance of possible designs under various conditions. We will also consider



how to quantify objectives such as program and aesthetics in order to measure each design.

Then, we will pioneer the application of multi-objective optimization software to architectural design. This software will allow us to automate the process of generating, evaluating, and evolving thousands of possible designs through the use of evolutionary computation and genetic algorithms. For our purposes, optimization will not be about simple and cold-blooded efficiency—but rather it will be about complex trade-offs and the art of negotiation between competing architectural values.

In addition to strategically applying a variety of software applications, we will investigate a series of advanced topics related to contemporary use of algorithms, including authorship, wireframing, interoperability, and optimization.

We will use software to investigate data, to explore a very wide potential design space, to minimize our preconceptions, to avoid relying on old rules of thumb, to derive unexpected high-performing results, and to enhance our creativity. Most importantly, we will use software to collaborate and to develop designs that are not fixed singular, but instead are adaptive and re-usable.

Automation 2.0 is one unit of the CBIP collaborative studio and we will share a common workflow with the other 2 units as described in the attached general syllabus.

LABORATORY FOR EMBODIED COMPUTATION

In this section of the CBIP studio, we will apply our building intelligence to the design of a next-generation university laboratory for research on automation in architecture. This laboratory will enable faculty and students to experiment with robots, sensors and other interfaces between computation and the physical environment. This facility should also allow build and testing of models, building systems and technologies.

The program is expected to include new specialized laboratories that are crucial to studying general model theory and experimenting with robots, sensors, and other interfaces between computers and the physical environment. This facility should also allow the building and testing of models, building systems and technologies. The work related to building systems and construction will support the testing and analysis of materials and structural models—work that helps develop a deeper understanding of the tectonic aspects of building. Through this facility, faculty and students will be able expand the horizons of their work by designing and constructing new models that take advantage of cutting-edge instrumentation.

Questions to be explored include: What are the research topics and automation equipment of today's most interesting questions about embodied computation? And what might be the research topics and automation equipment of tomorrow?

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***Dassault Systems** is an industry partner with CBIP.*