



# **Integrated BIM**

A Post-Professional Curriculum  
for Design & Construction

AIA TAP BIM Awards submission, 2012





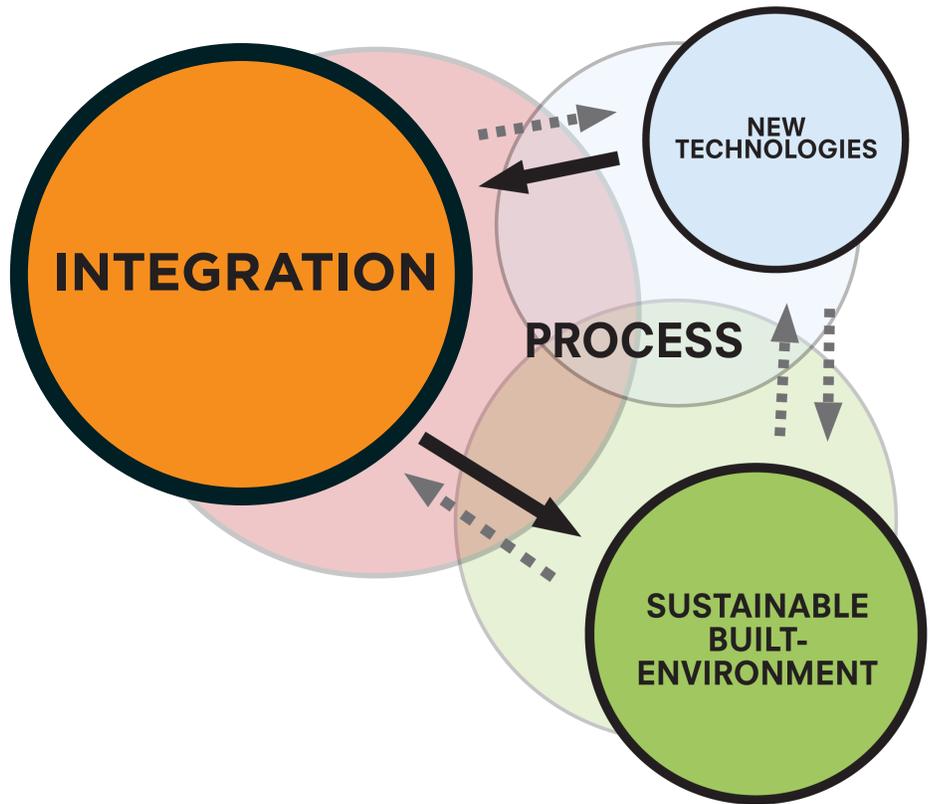
# Integrated BIM

A Post-Professional Curriculum for Design & Construction

## BACKGROUND

In 2009, an existing small-scale outreach program was redirected to create a three-semester, post-professional masters degree program focusing on the early integration and collaboration of design and construction disciplines on commercial scale projects. The purpose of such a significant curricular regeneration was to respond to the changing demands of industry, creating a “value-added,” post-professional graduate program. The changing demands of industry were to specifically be addressed in three key curricular aspects: the organizational or managerial components of integrated delivery, the requirements and constraints of “high performance” projects, and the evolving digital technologies enabling the process. To accomplish these aims, it was decided that a program based on interdisciplinary collaboration should also be collaboratively managed between schools of architecture and construction management, two distinct academic units housed in the same college within the university.

In addition to the parity of program administration, the program accepts a yearly cohort of students consisting of roughly equal numbers of individuals with architectural design and construction management backgrounds. The curriculum has evolved to be almost entirely “integrated,” featuring primarily team taught classes containing the entire cohort and “disciplinary”



## THREE PILLARS OF THE PROGRAM

The program takes the organizational and managerial principles of integrated design & construction, the impact of new digital technologies, and high-performance buildings as three key foci driving process.

classes focused on shared projects, with students working almost entirely on an interdisciplinary basis. In the 2011-2012 academic year, the program accepted 15 students from approximately 60 applicants. Because of the duration of the program (36 credits over 3 semesters) and the tightly orchestrated curriculum of courses and projects, the program remains small and increasingly selective, and will have graduated 46 students as of 2012.

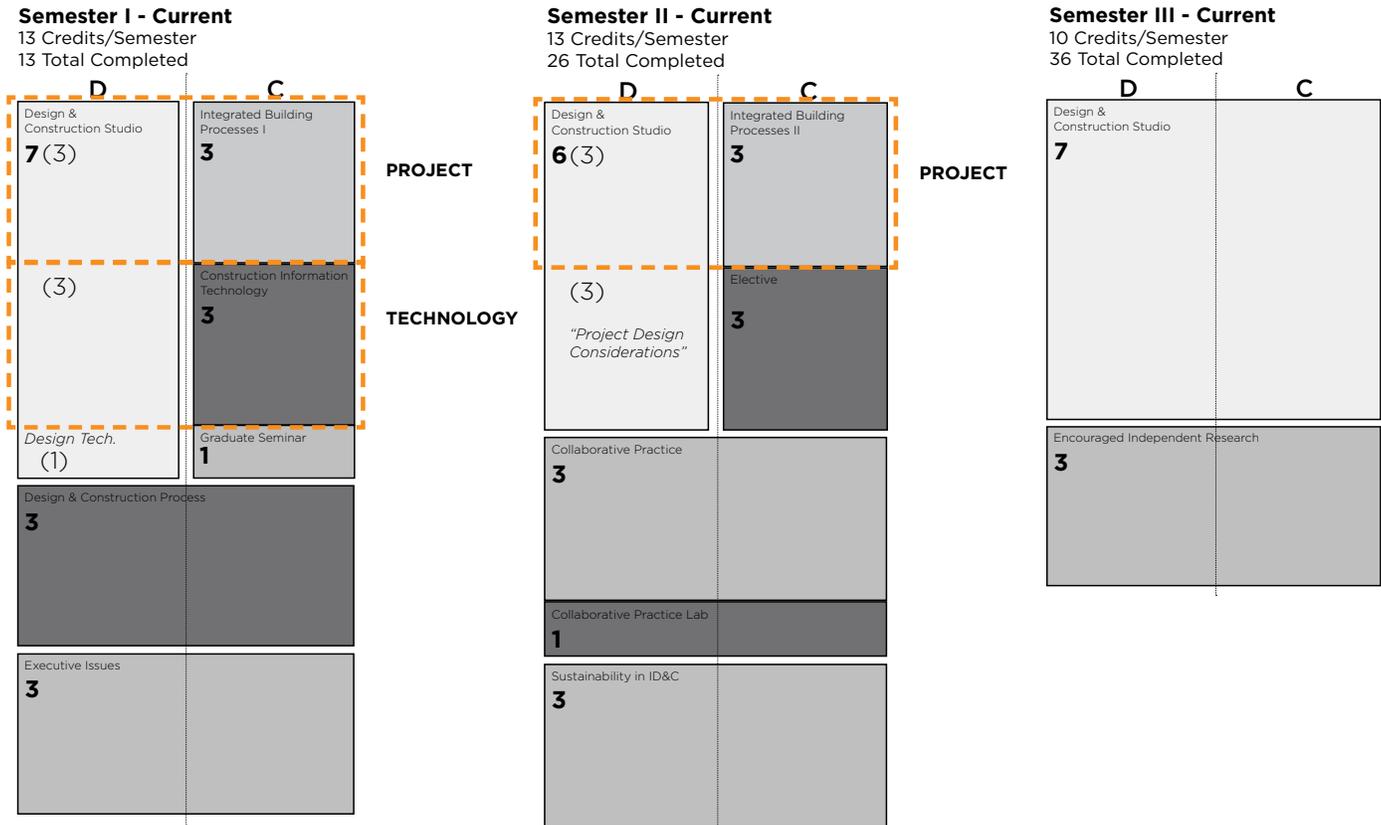
The program maintains a strong network of industry partners who support and help guide the curriculum, contributing in the studio

and classroom, as well as through strategic advisement. Beyond this group, industry response to the program has been overwhelmingly positive. Career placement among graduates has been near 100% in the challenging economy of the past three years, with a significant number of graduates occupying BIM leadership positions in major architecture and construction firms nationwide. Graduates have also indicated a greater ability to engage and communicate with collaborators and a greater understanding of the challenges and opportunities facing the firms in which they work. In



## CURRICULUM STRUCTURE

Coursework in the program is a combination of team-taught seminars and project-based studios. Project-based work and technology content delivery often spans several courses. BIM related is embedded in the program in multiple courses.



many cases, they have reported an acknowledgement of their skills and perspectives by their firm's management, leading to an accelerated track to decision-making roles.

### BIM IN THE CURRICULUM

As the program's primary medium for project development, documentation, collaboration, and communication, Building Information Modeling is a fundamental component of the curriculum, as well as a key educational management and delivery tool. BIM and information technology content is delivered in multiple courses: a 3-credit design and construction information technology seminar focused on

software skill development; an introductory, 3-credit seminar focusing on current issues and theories in architecture and construction practice; and in the studio sequence.

Team-taught, "project-based" studios occupy a central role in the curriculum, with content delivered through the provision of collaborative design and pre-construction services for actual clients, such as community development organizations, non-profit real-estate developers, small municipalities, as well as private enterprises. Projects have ranged in size from 10,000 sf to 150,000 sf, and have required design for high performance -- LEED Gold or better, where that system was used

as a metric. Target project budgets have ranged from hundreds of thousands to tens of millions of dollars. While seminar courses deliver the necessary introduction to BIM concepts in theory and practice, it is through embedded application in the interdisciplinary studio environment that the impact of BIM is most powerful, both in terms of advancement of the academic project, but also in terms of understanding BIM's impact in the world of actual practice.

Students learn to manage large amounts of project data among their interdisciplinary teams, as well as among client representatives, which often include design and construction professionals. Common project deliverables

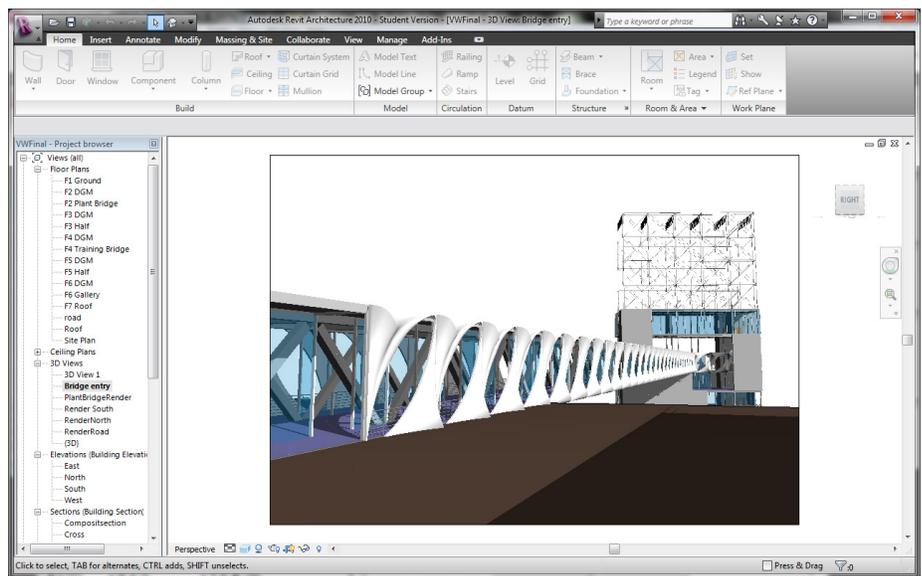
## COURSE BREAKDOWN AND BIM CONTENT

BIM related content is distributed throughout the curriculum in both integrated classes and discipline specific classes, in seminars and in studios. Project-based classes stress application of BIM skills, while seminars focus on theory and software instruction.

Track	Name	BIM Content	Credits
C	Integrated Building Processes I	Application: BIM Authoring, Interoperability	3
	Construction Information Technology	Software Instruction: Revit Suite, Navisworks, QTO	3
	Integrated Building Processes II	Application: Solid Modeling, Environmental Analysis	3
	Graduate Seminar	n/a	1
			<b>10</b>
D	Design & Construction Studio I	Application: BIM Authoring, Interoperability	7
	Design & Construction Studio II	Application: Solid Modeling, Environmental Analysis	6
			<b>13</b>
I	Design & Construction Process	n/a	3
	Sustainability for Integrated Design & Construction	Application: Environmental Analysis	3
	Collaborative Design & Construction Practice	n/a	3
	Collaborative Practice Lab	n/a	1
	Design & Construction Studio III	Application: Comprehensive	7
	Exec/Critical Issues in Design & Construction	Theories of BIM and Digital Technologies	3
			<b>20</b>

include design documentation and visualization, project scheduling, site utilization, constructability, environmental analysis, and financial analysis, including overall capital budgets, pro forma, and life-cycle cost analysis. Students employ a range of applications, including BIM authoring applications (typically Autodesk Revit), model aggregators, other 3d and parametric modeling tools, several environmental analysis applications, scheduling applications, project management applications, graphic design applications, as well as the standard suite of word processing, spreadsheet, presentation, and digital communication applications. The information that drives analyses performed outside of the primary BIM authoring application is derived from the building information model wherever possible and practical. To this end, data interoperability, as well as an understanding of information management strategies, becomes a key component of the program's technology focus.

BIM platforms provide a single



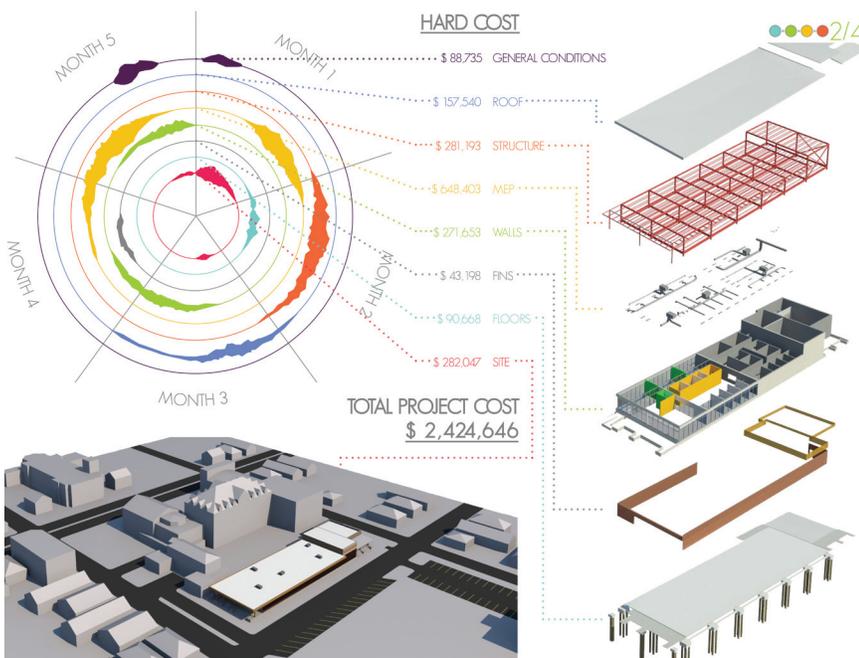
Building information model for Volkswagen Bridge project from fall 2009, containing linked architectural and structural models, as well as facade panels imported from a parametric solid-modeling application.

virtual environment in which students interact with both the virtual design model and with each other, as well as a central repository from which data can be extracted and utilized in other processes.

## REPRESENTATIVE PROJECT CASE STUDY AND MODEL

Between 2009 and present, the program has undertaken projects for Volkswagen's production plant in eastern Tennessee; for several community based non-profit

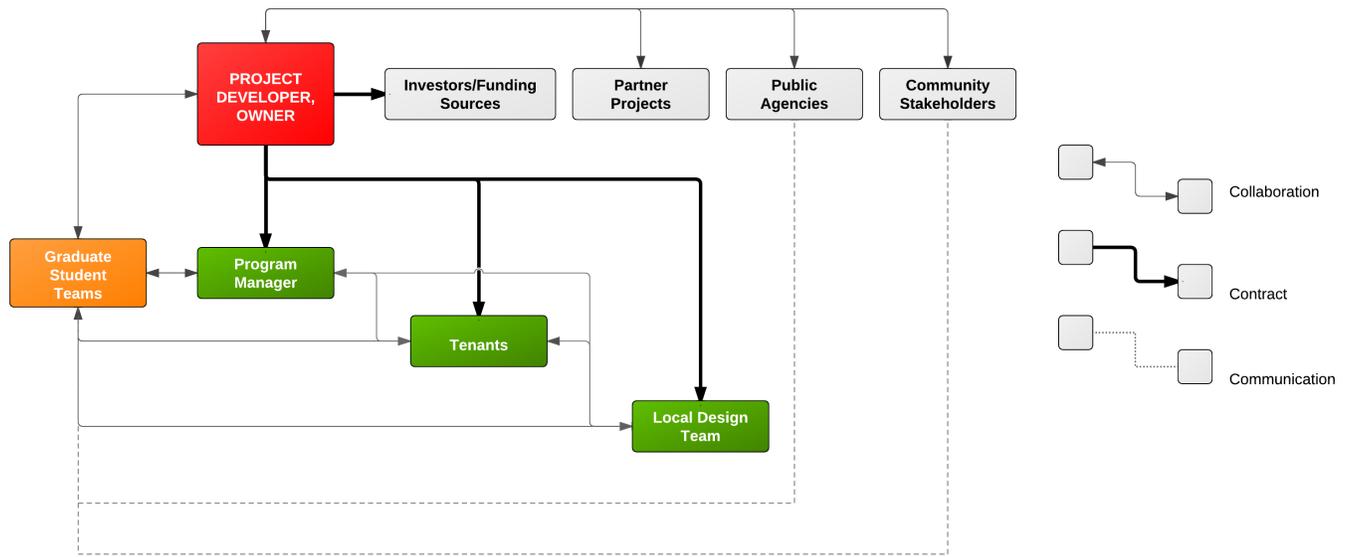
entities in New Orleans; and for a Minnesota-based not-for-profit real estate developer (among several others.) Each project utilized BIM as the central collaborative design and development tool, and academically each subsequent project built upon those prior. In the spring of 2011, program directors were introduced to Artspace, a not-for-profit real estate developer from Minneapolis who was in the initial feasibility study phase of an



### BIM MINING

The building information models produced by students for New Orleans artist's community and public access television station became the basic repository for project information. Material and systems information for visualization (ABOVE), cost analysis, schedule, and constructability (LEFT) are extracted from central project models.

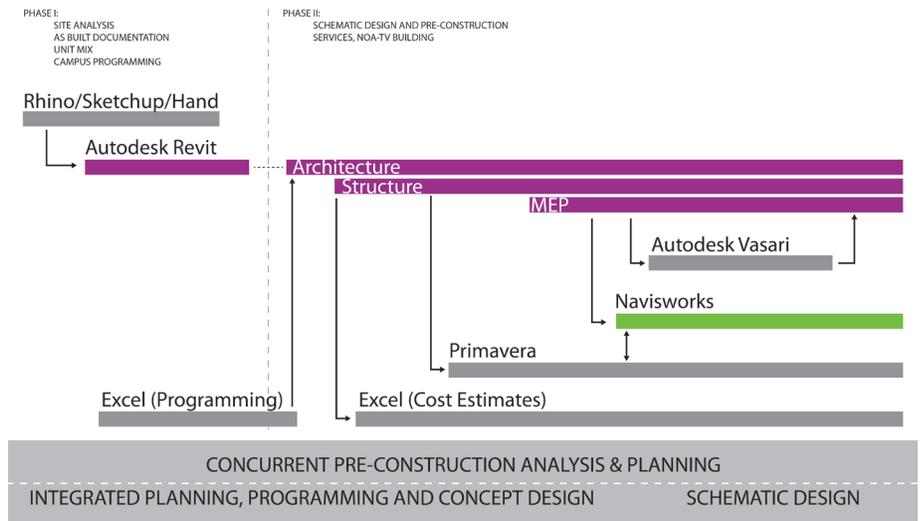
**NOLA COMMUNITY CENTER PROJECT TEAM**



adaptive re-use project in New Orleans. Artspace has nearly 40 such properties in the U.S., their mission is: "...to create, foster, and preserve affordable space for artists and arts organizations." Following the radical restructuring of the Orleans Parish school system following hurricane Katrina in 2005, a number of former public school buildings throughout the city remained empty or underutilized. In 2011, Artspace entered discussions with the local Board of Education to redevelop the Andrew J. Bell Junior High School campus in the historic Treme' neighborhood of New Orleans. The Bell School campus, consisting of six building on two city blocks was in an advanced state of disrepair, having been largely unmaintained and exposed to the elements for five and a half years.

During introductory conversations with Artspace, the potential for the project and the partnership to fit in well with the

**nola artists community / public access tv 200 hrs**



**ORGANIZATION AND WORKFLOW**

ABOVE: Diagram showing project team relationships. Artspace, the project developer/owner, worked with graduate students who performed a campus assessment and schematic design for a key building prior to final site acquisition. The Building Information Model proved to be a valuable communication tool in bi-weekly client meetings, and was part of the final hand-off to the local design team. BELOW: Workflow diagram showing project phases and software applications employed.

goals of the academic program were recognized, particularly those to utilize BIM as the central vehicle for capturing and modeling existing conditions, as well as for the development of new construction components on the campus.

Original documentation was sparse, and strategies for building reuse, demolition, historic preservation, or new construction had not been fully developed. Because much of Artspace's work on the project at the time was focused on site



acquisition and project financial planning, they were not yet in a position to hire a local professional design and construction team -- an aspect of Artspace's work that is critical to their mission of community betterment. For the graduate program, this meant that the students could engage in real programming, schematic design, structure and MEP analysis, constructability, site utilization, sustainable strategies, cost estimates, and schedules, all of which was centrally coordinated through the interdisciplinary-produced BIM model and would help develop the owner's capital budget. This work would inform and supplement the owner's efforts, and would eventually be handed off to the local design and construction team when brought on board.

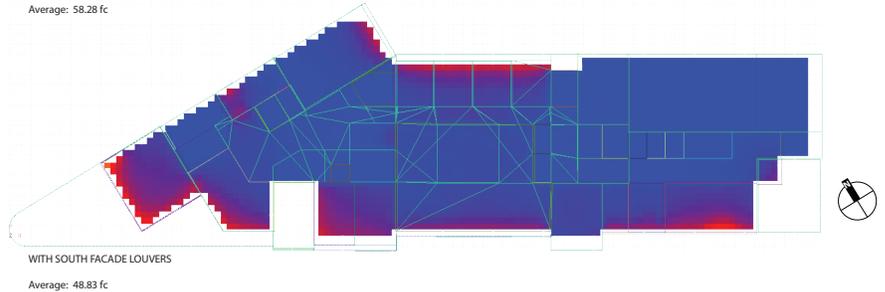
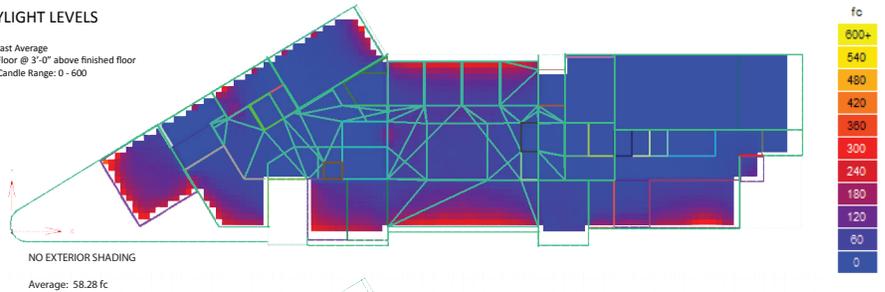
In structuring the scope, it was decided that a portion of the study would focus on analysis of the campus as a whole, to include a zoning study, a parking study, an as-built survey of site and buildings, a strategy for systems integration, and the production of a base building information model. In addition, students would undertake a focused design and pre-construction analysis of a key newly-constructed building on the campus -- a new facility for public access television station New Orleans Access Television (NOA-TV) that would also include space that would complement both the residential artist's community and an adjacent multi-tenant non-profit center. Student work at the campus level directly contributed to ongoing Artspace efforts such

## DAYLIGHTING

Daylighting analysis using Ecotect to determine artificial lighting load reduction.

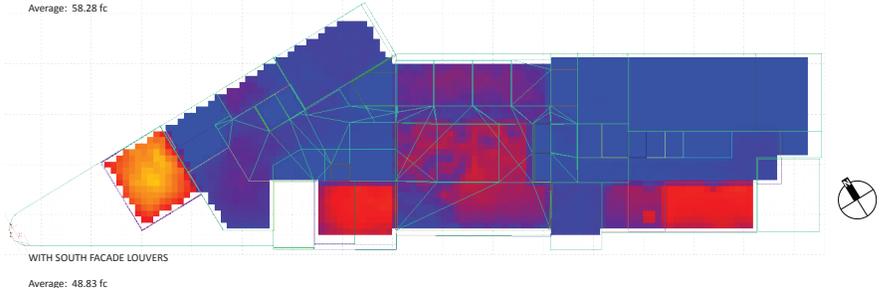
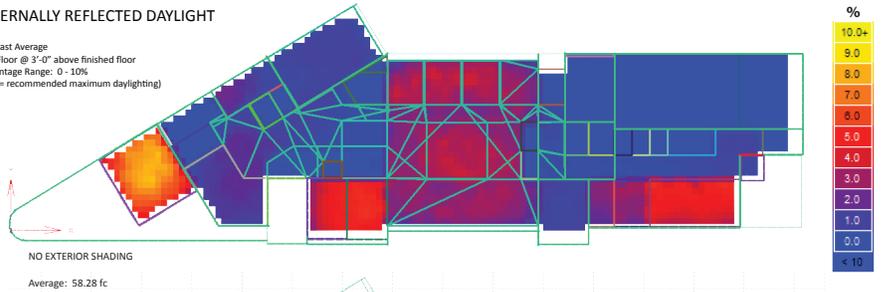
### DAYLIGHT LEVELS

Overcast Average  
First Floor @ 3'-0" above finished floor  
Foot Candle Range: 0 - 600



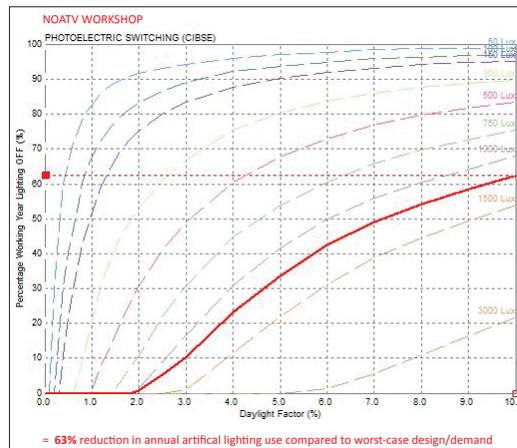
### INTERNALLY REFLECTED DAYLIGHT

Overcast Average  
First Floor @ 3'-0" above finished floor  
Percentage Range: 0 - 10%  
(10% = recommended maximum daylighting)



### DAYLIGHTING FACTOR FOR ARTIFICIAL LIGHTING REDUCTION

Annual Percentage of OFF time for artificial lighting based on daylight exposure during hours of operation



Zone	Artificial Lighting Load Reduction based on Daylighting (%)
SPUN Café	93%
Lobby West	64%
Stair West	91%
NOATV Training	87%
NOATV Main Space (cubicles + offices)	51%
Stair East	90%
NOATV Workshop	63%
Workshop Storage	98%
Master Control	58%
Lounge	90%
Conference Rm 2	18%
Non-Profit Main Space (cubicles + offices)	86%
Classroom 1	68%
Classroom 2	76%
Classroom 3	86%
Non-Profit Training Room	69%



## INTEGRATED BIM

officials, and eventually, a zoning change application, of paramount importance in cities with political climates such as New Orleans.

The project was carried out over approximately 14 weeks, spanning spring and summer semesters in 2011. Student teams conducted analysis on site and met with clients and stakeholders over the course of approximately five days of work on the ground in New Orleans. In addition, one co-located charrette was held at the program's university facilities. Bi-weekly project briefings were held between Artspace and the students via both phone and video conference. Artspace and its representatives were very committed to the relationship and saw the value that the student work could bring to their process, as such there was more informal weekly (and often daily) email and telephone interaction.

Ultimately, this project provided an ideal arrangement of client and project timing on which to leverage BIM and to further refine a curriculum that utilizes BIM to achieve its primary goals both in relation to curricular content, client value, and industry relevance.

### SITE SURVEY

Students and faculty gather geospatial data to inform BIM-based as-built drawings of existing former middle school campus buildings.

