

## **AIA Practice Academy Grant Initiative**

# **Mentored Collaboration: The Connective Role of BIM Technology in Architectural Education**

Final Report

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## 1. Program Overview and Outline of Activities

The Boston Architectural College's Practice Academy project was entitled, "Mentored Collaboration: The Connective Role of BIM Technology in Architectural Education." Over the course of the grant's three year term, work focused on the impacts that building information modeling (BIM) software technology is having on design education. Most specifically, the BAC worked in partnership with select groups of architectural firms who were transitioning their practices to BIM and integrated design or integrated project delivery. The goal was to develop a series of representative curricular initiatives between the school of architecture and the profession to stimulate lifelong learning for practicing professionals – beginning with interns – through the partnership of academics and practitioners. This enterprise provided opportunities and challenges to: (1) develop a model for ongoing collaboration and partnership with practitioners; (2) study how the incorporation of new digital technology into a student's design education might lead to an increased understanding of building tectonics and potentially lead to his/her generating more thoughtful and well-crafted design solutions; (3) apply what was learned and create an incubator for new interdisciplinary courses; and (4) formulate and deliver as many lifelong learning opportunities for practicing architects and allied AEC professionals.

**NOTE: The accompanying winning NCARB Prize entry board complements BAC's final report to document and further illustrate the written summary that follows.**

### An Outline/Timeline of Project Activities during the 3-year grant period

#### a) September 2006 – January 2007

A series of semester-long case studies conducted by students and practitioners focused on the influence that building information modeling is having on the practice of architecture and the changing roles and responsibilities of student interns. The College aligned with 4 architectural offices transitioning to building information modeling, where BAC undergraduate and graduate students were employed. Together they composed a diverse group in that: a) they were at different stages of transitioning to BIM; b) they ranged in size from small to very large firms; and c) 3 different software applications were being used on a variety of building projects that were at different phases of development. Case study methodology was the same, with each of 4 firms adhering to a carefully structured case study template (Attachment A). The template tracked project activity, with both student interns and firm supervisors reflectively reporting on their experiences. Individual case study presentations were made to a group that included BAC administration and faculty.

Essential questions addressed during the case study process focused on two distinct issues: first, identifying how the use of BIM software was changing the practice of architecture and particularly the role of the student intern; and second, better understanding through a conversation with practitioners how and why BIM was becoming an effective and versatile design and project management tool.

The expectation was that by studying both subjects concurrently, the College would be qualified to understand curricular improvements stemming from changes in the practice of architecture that needed to be made. Simultaneously, practitioners would benefit by sharing experiences with each other as they transitioned to BIM and integrated project delivery. For practitioners the issues would quickly transcend those surrounding software alone and focus on such topics as best practices for effective training, carefully selecting initial projects, team selection, building consensus throughout the organization, even how to spatially restructure the office to maximize communication and team effectiveness.

b) January – May 2007

BAC formed an internal working group comprised of senior BAC administrators, faculty and practitioners. This committee was charged with the specific goal of positing and developing curricular change – new courses and revisions to existing classes – which apply BIM technology as well as foster the principles of integrated practice. There were 3 learning objectives for these courses: a) to enhance student understanding of basic construction; b) to test and assess didactic principles and theories involving interdisciplinary collaboration and teamwork; and c) to formulate new curricular materials and instruction which openly embrace and assimilate the use of computer technology into previously uncharted design studio settings

c) August, 2007

A demonstration BIM Charrette involving BAC students and partnering firms to highlight BIM and its potential application as a design tool. Students from the case study initiative worked in concert with several of their firm supervisors to utilize a set of hand drawn as-built drawings to generate a 3D Revit model. This demonstration provided a public venue for college faculty and administrators to witness firsthand collaborative methodology made possible in a BIM work environment. Several who had originally opposed incorporating BIM software into the curriculum began to understand more clearly how it could become an important teaching tool, particularly when it came to extending a student's understanding of 3-dimensional spatial design.

d) September – December 2007

An innovative, semester-long design workshop introducing BIM technology into a studio setting, with special emphasis on developing teamwork and group decision-making among students.

This 15-week workshop applied sustainable design strategies to achieve excellence in terms of energy use, aesthetics and construction. Using BIM (Revit) and building performance software (IES), students employed an iterative design process to create a “living building” that displayed a balanced relationship with its

environment. As a BAC design workshop versus an all-encompassing studio, emphasis was placed on exploring aspects of digital modeling, prefabrication, building materials and assemblies, with less emphasis on the completion of a cohesive building.

By the end of the semester, students had been exposed to a unique studio experience involving the introduction of new software technology as an integral element in their design approach, as well as an introduction to a collaborative learning process.

e) January – May 2008

An advanced integrated design studio with Worcester Polytechnic Institute students blending BIM software and a strong emphasis on the development of an interdisciplinary, collaborative learning environment

The Spring 2008 studio, largely guided by discussions and suggested curricular improvements originating with the practice academy grant, focused on issues of integrated design. The class featured the participation of students and faculty from the Civil Engineering Department at the Worcester Polytechnic Institute (WPI). The course reinforced ongoing research on sustainability and building information modeling and their impact on design education and practice. Students worked in interdisciplinary teams comprised of both BAC and WPI students who held joint sessions/reviews encompassing site and typological analysis, schematic design and integrated design development of the various building assembly components. Revit models were shared and jointly expanded by both sets of students for the first 12 weeks of the course. BAC students then worked individually for the final 4 weeks of the course to develop and refine their individual design solutions.

f) October 2007 – May 2008

A series of 12 professional outreach symposia and conference presentations to diverse audiences comprised of AEC professionals. Topics covered the adoption of BIM and necessary changes in design education.

Examples include the following:

1. 2-day BIM Symposium at Build Boston

The BAC and Practice Academy Phase I architectural firms assumed a lead role in organizing and delivering a 2-day BIM Symposium at Build Boston in November of 2007. Nearly 700 conference attendees registered for the 7 workshops; the team assembled 35 speakers from coast-to-coast and concentrated on hands-on issues to assist firms struggling with whether and how to transition their practices to BIM and integrated practice. The individual workshop sessions were: 1) A BIM Overview: What It Is and What

It Isn't; 2) BIM and Project Delivery; 3) Beyond the Tools; The Business of BIM; 4) BIM and the Small Practitioner; 5) BIM, Integrated Practice and the Education of Students and Young Professionals; 6) BIM and the Enlightened Owner; and 7) Where are Things Headed with BIM and Integrated Practice?

2. A series of conference and workshop presentations featured collaborative efforts between the BAC and firms participating in the practice academy grant were presented.
  - These included a Large Firm Roundtable discussion among principals and educators held in Boston in October, 2007;
  - a plenary address at "The Future of Professional Practice" conference held in Washington in December 2007;
  - The 2008 BAC Winter Board Retreat in January 2008 included discussion that focused on the role that building information modeling and integrated design is having on reshaping architecture.
  - A workshop at the national AIA convention in Boston in May 2008
  - A Continuing Education Workshop in Building Information Modeling and Integrated Practice in June 2008. The workshop featured a panel discussion with firms from the practice academy project plus contractors and structural engineers transitioning their own practices to BIM and integrated project delivery. The emphasis was on best practices and questions that practitioners need to address when they transition to BIM.

Major points raised and discussed in each of these presentations were:

- i. BIM results in a different way of thinking about design and design practice.
- ii. BIM encourages integrated thinking about design and building technology.
- iii. BIM promotes collaboration between internal and extended project teams.
- iv. BIM results in a different way of working.
- v. BIM promotes 2-way mentoring between interns and experienced professionals.
- vi. BIM facilitates a changing internship experience.
- vii. Understanding the critical lessons and challenges that we as academics are learning as we study BIM and integrated practice which inform and challenge what and how we teach.
- viii. BIM and Integrated Practice are not about technology. This is an opportunity to foster design leadership; educators have the power to influence change

g) June 2008 – May 2009

The dedication of the 3<sup>rd</sup> year of the grant encompassing the field of collaborative inquiry research within the context of changes in architectural practice

precipitated by BIM technology and integrated project delivery. The main goal has been to address individual questions/problems and challenges 5 major firms in Boston are facing as they adopt building information modeling and integrated project delivery. (See poster for more information.)

### **Most Successful Aspects of the Program**

Notably successful aspects of the program are grouped 2 ways: first – internal, long term benefits to the BAC; and second – the development of a coordinated research team comprised of the 3 sponsored programs and AIA advisory board.

1. **Creating a Genuine Dialog with Faculty:** First and foremost the grant provided an instructional framework that allowed the BAC to begin to realize earlier, all-too-theoretical internal conversations about developing a seamless connection between practice and classroom-based education. The resulting alliance has been specific and project-based, with clear, deliverable outcomes with significant opportunities for refinement and incremental improvement.
2. **Collegiality Becoming Collaboration with the Firms:** Similarly, it provided a specific venue for the BAC to interact and align more effectively with practicing professionals, creating a model program for both practitioners and educators to realize/appreciate mutual benefits. The Practice Academy grant provided a viable platform for the BAC to become a valued partner, initiating primary research that would identify key concerns and issues, effectively disseminate information through its well-developed network of practitioners and educators to inform and play a significant role in the national conversation about changes within the architectural profession advanced because of BIM technology.
3. **The Role of the Advisory Committee:** Important lessons and progress was made due to superb guidance coupled with administrative freedom by the advisory committee to evolve and shift directions.

### **An Alignment with BAC's Philosophy of Concurrent Learning**

BAC is nationally recognized as a leading practice-based institution, with its strong connection to practicing architects who both supervise our students in offices during the day as well as instruct them at night in the classroom.

That said, the value proposition for firms to participate in the education of BAC students has largely been founded on their vested interest to prepare the next generation of design professionals by teaching them both during the day as well as at night. With the work we have done through the Practice Academy, there is a notable shift – firms involved are clearly coming to understand that the BAC can play an important role by helping them to navigate transformative change by bringing them together and enabling them to learn from each other.”

**Document the outcomes or results of the program. Include quantitative results, such as, how many students participated and how many workshops were held, as well as qualitative results. Provide a description of student work with examples.**

Number of students who participated in various program elements:

Fall 2006 Case Studies – 7

August 2007 Design Charrette – 8

Fall 2007 Design Workshop – 7

Spring 2008 Advanced Design Studio – 8

Collaborative Inquiry Initiative – 2 current graduate students, 4 BAC alumni

Information Workshops

2-day BIM Symposium – November 2007

4 public presentations including LFRT Boston Meeting, 2 AIA conferences including national conference, Boston 2008

1 Continuing Education Weekend presentation

Please refer to attached NCARB Prize Entry Board for narrative and graphic details of student work

### **Document Use of Funds**

Student Stipends	\$5,000.00
Professional Services for Case Studies	\$2,500.00
Design Workshop Instructors	\$4,750.00
Collaborative Inquiry Consultant	\$5,950.00
Graduate Research Stipend	\$2,000.00
Administrative and Special Printing Costs	\$2,856.00
Food and Beverage	\$2,215.00
<b>Balance</b>	<b>\$4,729.00</b>

Refer to attached NCARB Prize Entry Board for information regarding lessons learned, challenges, and the evolution of the program.

BAC's major recommendation is to reconsider changing the Practice Academy grant back to a 3-year process. It takes that long to implement a process that is flexible enough to learn from and make requisite changes. What is more, a meaningful connection and sense of common purpose developed not only among the 3 schools selected, but with the AIA advisory committee, a varied group of practitioners and educators drawn from around the country. What better testament of the effectiveness of the 3-year term can there be than to point to the fact that 2 of the 3 institutions selected, Iowa State and Boston Architectural College, were awarded 2009 NCARB prizes?

### **Applying Valuable Outcomes from the Practice Academy Program in the Future**

There is no doubt among any of the participants in the PA grant program that this was an extremely worthwhile venture. First and foremost it added a level of legitimacy and credibility that made BAC faculty, administration and practitioners outside the BAC willing and interested in participating and contributing to a nationally recognized program. In addition, it provided invaluable "seed" funding to:

- i. attract a selection of BAC students to dedicate time and energy to the case studies
- ii. compensate quality instructors and teaching assistants to teach design workshops and studios
- iii. support 2 key outside consultants to initiate and guide the case study and collaborative inquiry phases of the project
- iv. provide stipends for panelists participating in selected workshops
- v. underwrite costs for critical special equipment, printing and publishing

With regard to the legacy of the grant and its lasting impact, there are 2 areas worth noting:

- The first is the evolving BAC design curriculum and this is evidenced in the semester-long courses described earlier in this report: the design workshop integrating Revit and building performance software, as well the interdisciplinary studio with other engineering and construction education programs in greater Boston. Both have been permanently added to the curriculum; they have been widely accepted by the faculty and positively endorsed by students who have enrolled in these classes over the last 2 years.
- Second, as described on page 6 in the section, "Collegiality Becoming Collaboration with the Firms," the Practice Academy grant has focused and fortified the BAC's relationship with practitioners who partner in the education of our students. The thoughtful alignment initiated by the College has demonstrated that Academia can indeed play a significant role in shaping the conversation within the AEC industry about transformative changes brought about by building information modeling. Moreover, the grant has clearly demonstrated that both practice and classroom settings can serve as effective laboratories within which to experiment and reflectively observe how specific relational patterns of behavior need to be inculcated in order to maximize the role of the architect.



Practice Academy Final Report – June, 15, 2009

## ATTACHMENT A

# AIA Practice Academy Initiative Phase One: Case Study Analysis Template and Deliverables

### The Table of Contents for the Report of the Case Study Semester:

- I. Student's Architectural Description of the project on which the Case Study will focus, to include
  - a. Program, site, construction budget
  - b. PDF's of project drawings to include representative plan, elevation, section, 3-d images using BIM; also illustrative BIM data in schedule or tabular form.
  
- II. Student's Description of (i) the roles and (ii) prior BIM experience/education/training to include
  - a. BAC student role on project
  - b. Other Architectural team roles
  - c. Others as relevant to the project, such as the Client, other Consultants, the Builder (if known)
  - d. Project goals to be achieved by using BIM
  
- III. Firm's description of key tasks of the project during the Study period, to include
  - a. A statement, written at the outset, of the project tasks for the month
  - b. A list, prepared at the completion of the architectural hours per week put into the project by Job Title.
  
- IV. Student's Assessment of this BIM project and how it has contributed to my architectural education, to include:
  - a. At least a dozen "Ipod Journal entries" dictated at separate times during each of the four weeks in the midst of the work day while the thoughts are fresh; each is to follow a pattern of (i) describing, factually, a specific event/task and (ii) describing your personal stream-of-consciousness reactions, feelings, and understandings gained by reflecting on the event/task .
  - b. At least four more reflective Ipod Journal entries done at quieter times, one during each week focusing on BIM and its role in work and in education.
  
- V. Firm's Assessment of how the use of BIM (compared to pre-BIM process) affected the design and construction of this project, to include
  - a. An Assessment, written at the end of the month, summarizing the ways in which the tasks were accomplished, or not, or were modified as the work progressed
  - b. An opinion as to the long-term value of BIM, anticipating BIM's effect on Construction Time, Change Orders; Errors; and how well the Architect's design goals and the Client's intent is met?

- VI. Student's Peer Review (by one BAC student looking at work of another participating student/firm): Has the use of BIM in this project advanced the design process towards Integrated Design and Construction? How can this application of BIM advance the BAC's understanding of how to teach an integrated design approach to architecture?
- VII. Student's Comparative Lessons from the other Case Studies (by each student after hearing the reports on all the cases): In reviewing and comparing the four case studies, what is learned about practice and education?

#### Term Due Dates

All four firm project teams should be launched as of this date. The effective start date for the four week period is this past Monday October 2. All materials should be turned into Len Charney in electronic form by the dates specified below.

During the Week October 9-13: Individual meetings are to occur between Len Charney and each of the firm teams to ensure that the project teams are launched and any questions are answered.

By Friday October 13

Students turn in Items Ia, all of II, two weeks worth of IV.  
Firms turn in Items Ib, IIIa.

By Friday October 27

Students turn in last two weeks of IV

By Friday November 3

Firms turn in Items IIIb

By Friday November 10

Students turn in Item VI  
Firms turn in Item V

Week of November 13-17: Major Review with All Participants—to be scheduled as soon as practical

By Friday December 1

Students turn in Item VII

#### Long-term Goals of Sharing/Publishing the Lessons Learned

This project is presenting a significant opportunity to learn about a nationally and internationally significant change in the way design and construction documents are produced and parallel change in architectural education. The goal is to have publishable quality materials at a future point in this 3 year project. This first semester can in some ways be considered a “data-gathering” activity that will be part of a longer-term project that will eventually be written up by some of the same as well as new participants.

Towards that end, it is very desirable to have usable documentation of all the above material. However, in all cases the emphasis is on raw data content, not polished sentence structure or political correctness. All participants are asked to be as frank, accurate, or (in some sections) as opinionated, as possible.

Near-term Confidentiality of Materials

All materials will be treated as confidential with the understanding that future critics and writers within the BAC study process will have access to the very useful material we are collecting in this semester. However, there will not be a published sharing of source material without giving the original providers of the material a reasonable chance to review content to insure that appropriate confidentiality i